WORKING GROUP ON THE BIOLOGY AND ASSESSMENT OF DEEP-SEA FISHERIES RESOURCES (WGDEEP)

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International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Editors

Elvar Halldor Hallfredsson • Pascal Lorance

Authors

Erik Berg • Helle Torp Christensen • Guzmán Diez • Inês Farias • Ivone Figueiredo • Elvar Halldor Hallfredsson • Hege Øverbø Hansen • Lise Heggebakken • Kristin Helle • Juan Gil Herrera • Pascal Lorance • Teresa Moura • Julius Nielsen • Lise Helen Ofstad • Martin Pastoors • Bruno Almón Pazos • Mário Rui Rilho de Pinho • Magnus Thorlacius • Rui Vieira • Pamela Woods

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i Executive summary

WGDEEP gives advice according to an advice schedule where, in short, half of the stocks advice is given in year y and the other half has advice in year y+1. The exception from this schedule is stocks from ICES Division 5.a (Iceland) that have advice annually. Available time-series for international landings and discards, fishing effort, survey indices and biological information were updated and for all stocks and are presented in Sections 4–15 of the report.

In response to a special request from the EU on the added value of having small TAC for greater silver smelt in subarea 7 the meeting evaluated available information. The EU TAC, currently covering subareas 5, 6 and 7, does not correspond to the stock unit evaluated by ICES which is greater silver smelt in subareas 7, 10, 12 and Division 6b. The current ICES advice recommends to limit catch to a low level. Possible seasonal aggregations of greater silver smelt in the North of Subarea 7 should be considered as extension of the more abundant stock from divisions 5b and 6a. In the absence of a TAC of greater silver smelt in Subarea 7, the potential risk is the development of target fishing on possible aggregations. To prevent this the fisheries should be monitored carefully so that TAC, or similar management action, can be reintroduced on short notice in case of very rapid increase in catches as has been observed in other greater silver smelt fisheries. Bycatch of GSS in other fisheries should be kept at absolute minimum. A mechanism based on a maximum proportion of bycatch of greater silver smelt per fishing operation and in the total catch could be considered.

Some other important topics were discussed in the meeting and require further scientific studies, being sorted out through appropriate ICES protocols or a combination of both. The first of these topics was how advice could be designed as precautionary in the event of an extended recruitment failure, as seen for blue ling in sections 5.a and 14, 2. The second topic was how to treat regional differences in biomass/catch/survey trends in regions of a large stocks unit as seen for ling in Subareas 6–9, 12, and 14, and Divisions 3.a and 4.a (lin.27.3a4a6-91214). For this assessment unit, the bulk of landings are from divisions 4.a and 6.a where commercial CPUE show an increasing biomass trend while in Subarea 7, catch have declined over the past 3 decades and one survey covering a significant part of Subarea 7 shows a strongly decline index of biomass of ling. The group discussed that there may be some population structure that differs from the assessment unit, and that changes in environment factors may impact ling differently in different parts of its distribution.

Contrasting trends were observed for stock with a biomass index from surveys, stock with clear variation in indices were:

- Greater silver smelt in area 1, 2, 3a and 4: based upon the acoustic index, the biomass of has slightly decreased, but an issue that needs addressing is marked increased bycatches in other fisheries in area 4. These are registered in the Norwegian catches as lesser silver smelt. The lesser silver smelt has a more southern distribution than greater silver smelt and the distribution areas overlap in the North Sea. Distribution may change as a response to changes in environment. Still, available information suggests that this bycatch is predominantly greater silver smelt, and they have been treated as such in the assessment. This issue is planed to be addressed further in the upcoming Benchmark for the stock in 2020
- Greater silver smelt in Divisions 5.b and 6.a: the biomass index also decreased for leading to a reduction in advised catch using the DLS 3.2 rule as usual. The advised landings decreased by 20% according to a decrease in the Faroese summer groundfish survey index, which is used as the index for the stock development. It has to be noted that this

survey have very few stations (<5) deeper than 500 m and are therefore only likely to cover the juveniles adequately. The adult part of the population is not fully covered by these surveys and they may not necessarily reflect correctly the temporal variation of the biomass of the stock. This stock unit is planned to be benchmarked in February 2020.

- Ling in Division 5.b: a decrease in the Faroese summer groundfish survey index, which is used as the index for the stock development occurred in 2017-18 and lead to advising 20% reduction of catch. Even if all signs from commercial catches indicate that ling in Division 5.b at present is in a good state, and this is confirmed in the exploratory age based assessment and length-based indicator method. This stock unit is suggested to be benchmarked in 2021.
- Blackspot seabream in Subarea 10: for this stock the biomass index increased to high level in recent years. Possibly as a results of several management measures introduced in recent years.

The stocks of greater silver smelt in the NE-Atlantic are planned for ICES Benchmark in February 2020.

ii Expert group information

Expert group name	Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)
Expert group cycle	Annual
Year cycle started	2019
Reporting year in cycle	1/1
Chair(s)	Pascal Lorance, France
	Elvar Halldor Hallfredsson, Norway
Meeting venue(s) and dates	ICES Headquarters, Copenhagen, Denmark

1 Ecosystem productivity and ecosystem approach in WGDEEP stocks

1.1 Ecosystem productivity and ecosystem approach for deep-water stock

Deep-water stocks have overall lower biological productivity than continental shelf and coastal stocks. For ICES category 1 stocks this is conveyed in the assessment, forecast and advice by using the stock specific life history traits. Average natural mortality (M) is lower is deep-water stock, age-at-maturity is older and growth is slower. In other words, the lower productivity of deep-water ecosystem, which is well documented and was subject to a recent review for the west of the British Isles (Vieira et al, 2018), is *de facto* accounted for in population dynamics models of these stocks.

For the numerous Category 3 stock assessed by WGDEEP, a population indicator (usually a biomass index from a scientific survey) is used to estimating the stock trend in recent years. By its very nature, such indicator is expected to change with both the exploitation rate and the biological productivity of the stock, these factors are confounded in the indicator. In none of the WGDEEP Category 3 stocks these two factors can be quantitatively disentangled. However, for some stocks some ecosystems factors have been identified or hypothesised to influencing observed trends.

Note that decreasing productivity and increasing exploitation would have the same effect of decreasing a biomass indicator.

1.2 Account for some stocks

1.2.1 Blackspot sea bream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)

The strait of Gibraltar has been the main area where this stock has been fished since the 1980s. Based on a biomass indicator in the Strait of Gibraltar, the stock biomass decreased in the last decade as a consequence of increasing exploitation. The EU TAC covers Subarea 27.9 but the Strait of Gibraltar is the path between the Atlantic ocean and the Mediterranean sea and it is also cut at 36°N by limit between the CECAF and the ICES area. Blackspot seabream migrates across the three areas, where management regimes differ, in particular with the TAC only applying to the ICES area.

In ICES Division 9.a, in addition to catches from the targeted fishery in the Strait of Gibraltar, there are catches from coastal areas of Northern Spain (Galicia) and Portugal. The stock structure is unclear and the level of mixing of population from Gulf of Cadiz with those at the occidental Iberian coast is unknown. The overexploited status of the stock is derived from data from the Spanish fishery in the Strait of Gibraltar where in addition the high fishing mortality resulting from the high valued of the species and the absence of catch limits in the Mediterranean and CECAF areas, natural mortality may have increased as a consequence of the predation from the recovering blue fin tuna stocks. The Spanish project VORATUN (CTM2017-8b2808-R: Study of blackspot seabream-bluefin tuna interactions in the food web of the Strait of Gibraltar with analysis of stomach contents and stable isotopes: Impact on fisheries) is on-going to analyse this question.

1.2.2 Blackspot seabream (*Pagellus bogaraveo*) in subareas 6, 7, and 8 (Celtic Seas and the English Channel, Bay of Biscay)

This stock collapsed in the 1980s and is remains at a low level compared to historical level. The stock annex reports that environment has changed in the Bay of Biscay, in particular with a documented warming of the upper layer of water. This warming was considered unlikely to be unfavourable to blackspot seabream, as other stocks of the species are distributed in warmer areas in the Gulf of Cadiz and the Mediterranean Sea. There is no assessment for this stock, ICES has been recommending no catch, minimum landings size and regulation of recreational fisheries.

1.2.3 Blue ling (*Molva dypterygia*) in Subarea 14 and Division 5.a (East Greenland and Iceland grounds)

In 2019, the expert group considered to include further ecological consideration in the assessment used for this stock.

Since 2012, the advice of blue ling in 5.a and 14.b has been based on F_{proxy} (Cat 3.3). In 2018, the biomass indicator was at high level and the application of the F_{proxy} implies an increase of the catch advice for 2020 with respect to 2019. However, as the index of small fishes, indicates that the recruitment over the past 7 years has been very low, an increase of adult stock catches seems inappropriate. The driving factor for the low recruitment might be environmental as the adult biomass continues to be high. In terms of environmental changes, warming of sea temperature and expansion of distribution area of warm-water species such as anglerfish has been observed in Icelandic waters (see stock annex). The effect of these on blue ling recruitment is unknown. Nevertheless, the low recruitment was taken into account in the assessment and advice for the stock

1.2.4 Roundnose grenadier (*Coryphaenoides rupestris*) in Division 3.a (Skagerrak and Kattegat)

The stock was depleted by a directed fishery that lasted from 2000-05. This stock, compared to other deep-water stock, is distributed in a restricted area. Recruitment was observed to be intermittent (Bergstad et al., 2014). Recovery from the depleted status is unlikely to occur until a new strong recruitment event, which is unpredictable. The previous one dates back from the early 1990s

1.2.5 Ling (*Molva molva*) in Subareas 6-9, 12, and 14, and Divisions 3.a and 4.a (Northeast Atlantic and Arctic Ocean)

CPUE indices from areas where the main fisheries occur are used to assess the stock. These show an increasing trend since the early 2000s. The application of the ICES Category 3 rule leads to an advice catch for 2020-2021 slightly higher than the previous advice. However, the Spanish survey on the Porcupine bank (SPPGFS-WIBTS-Q3) covering ICES divisions 7c,k shows a strong declining trend on abundance and on biomass. The advice was not changed because 90% of the catch from this stock come from Subareas 4 and 6. However, it was considered likely that there are different trends by area. Landings in subarea 7 have decreased since the late 1980s where they were comparable to landings in each of subareas 4 and 6. The groups considered likely that environmental changes have make subarea 7 less suitable to ling.

1.2.6 Black scabbardfish (*Aphanopus carbo*) in the Northeast Atlantic and Artic Ocean

The stock structure in the whole Northeast Atlantic is still uncertain. Although available information does not unequivocally support the assumption of a single stock, most available evidences support it. Juveniles are mesopelagic and adults are benthopelagic. The species does not complete its life cycle is in one area and either small- or large-scale migrations occur, with primarily spawning occurring in southern areas (Madeiran and Canary Islands waters) and juveniles recruiting in Northern areas. These particularities are taken into consideration by ICES model adopted to monitor the stock dynamics.

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2 Stocks and Fisheries of the Oceanic Northeast Atlantic

2.1 Area overviews

Stocks and fisheries of the Oceanic Northeast Atlantic (Mid-Atlantic Ridge and oceanic seamounts and the Azores archipelago). 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. The subareas with hard substrata are characterized by a rough bottom topography comprising summits and upper slopes of seamounts and seamount complexes, the central rift valley slopes, and several fracture zones with steep slopes. However, the MAR is mainly sediment-covered and has generally gentle sloping bathymetry, and only about 5% of the lower bathyal area is hard substratum (Niedzielski *et al.* 2013).

The oceanic Northeast Atlantic also has off-ridge seamounts and seamount complexes with summits reaching into fishable depths, e.g. the Altair and Antialtair, and the Josephine Seamount.

The Azorean archipelago of nine islands and many seamounts is a major geomorphological feature spanning the MAR in the southern end of the ICES area.

2.2 Fisheries overview

Two different types of deep-water fisheries occur in the area, i.e. 1) oceanic fisheries with large midwater and bottom trawlers and longliners fishing in the central region and northern parts of the MAR, and 2) longline and handline fisheries inside the Azorean EEZ where trawling is prohibited. The latter fishery is targeted at stocks which may extend south of the ICES area.

This section deals with fisheries on the MAR and in the Azores.

2.2.1 Azores EEZ

The Azores deep-water fishery is a multispecies and multigear fishery. The dynamics of the fishery appears primarily determined by the main target species *Pagellus bogaraveo*. However, others commercially important species are also caught and the target species change seasonally according abundance, species availability, and market demand.

The fishery is relatively small scale in which 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 and island slope type with fishing operations occurring in all available areas, from the islands coasts to the multiple 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.

2.2.2 Mid-Atlantic Ridge

The Northern MAR is a very extensive area located between Iceland and Azores, and comprises features such as the comparatively shallow Reykjanes Ridge extending from southern Iceland to the Charlie-Gibbs Fracture Zone, as well as prominent seamount complexes such as the Faraday Seamounts just south of that fracture zone. Trawl fisheries started on the MAR in 1973, and more than 40 seamounts have subsequently been explored, fished for shorter or longer periods, and regarded as commercially important in Soviet/Russian assessments (Table 2.7.1). Figure 2.7.1 illustrates subareas of the area beyond national jurisdiction (where the Northeast Atlantic Fisheries Commission regulates fisheries) with depths shallower than 2000 m. These are the subareas within the approximate maximum depth of deep-water fisheries in the ICES area (in reality few fisheries extend deeper than 1500 m).

The basis of the pioneer Soviet deep-water fishery was the discovery of concentrations of roundnose grenadier (*Coryphaenoides rupestris)* on multiple hills along the MAR. 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 during multi-nation exploratory and commercial operations in the 1970s–1990s. Trawl and longline fisheries were conducted in Subareas 10, 12, 14 and 5 (Figure 2.7.2) by Russian, Icelandic, Faroese, Polish, Latvian, Spanish and Norwegian vessels. However, few of these (often subsidized) efforts led to lasting regular fisheries. It has also been suspected that IUU fishing occurred by vessels from other areas, but the scale of such activity is unknown.

The fishing activity has declined substantially during the last decade and in recent years (i.e. after 2010) the fisheries on the MAR comprised primarily a minor Faroese fishery targeting orange roughy on a few seamounts, and a recently developed Spanish trawl fishery (with bentho-pelagic trawls) targeting grenadiers (*Macrouridae*). Both fisheries fished in very limited areas compared with historical operations.

The major fishery in waters on and adjacent to the MAR is, however, currently the midwater trawl fishery along the western slope of the Reykjanes Ridge and in the Irminger Sea targeting *Sebastes mentella.* Annual landings in international waters ranged between 23 and 41 thousand tonnes in 2012–2014 (ICES, 2015).

2.3 Details on the history and trends in fisheries

2.3.1 Azores EEZ

Since the mid-1990s the landings of deep-water species show a decreasing tendency (Figure 2.7.3 and Table 2.7.2), reflecting the change in the fleet behaviour towards targeting blackspot sea bream.

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

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

2.3.2 Mid-Atlantic Ridge

Grenadier (Macrouridae) fisheries: The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 and 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 19 years, there has only been a sporadic fishery (Figure 2.7.2) 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). During the entire fishing period to 2009, the catch of roundnose grenadier from the northern MAR amounted to more than 236 000 t, mostly from ICES Subarea 12.

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 14.b) there has been a decline in interest.

A new Spanish fishery for grenadiers has developed in Division 14.b since 2010. Official Spanish landings of roundnose grenadier have ranged between 242 and 2075 t. In the same period annual catches of 4–2687 tonnes of roughhead grenadier as well as 3–448 tonnes of roughsnout grenadier were reported to the working group. During 2015 and 2016 Spain reported landings of roundnose grenadier from subdivision 14.b1 of 533 t (and 330 t from 12.a1) and 371 t (and 289 from 12.a1) respectively. In 2017 the official Spanish landings were reported as 84 t (16 from 12.a1 and 68 t from 14.b1).

Blue ling fisheries: The deep-water fisheries off Iceland tend to be on the continental slopes although in 1979 a short-lived fishery on spawning blue ling (*Molva dypterygia*) was initiated on a "small steep hill" at the base of the slope near the Westman Islands. The fishery peaked at 8000 t in 1980 and subsequently declined rapidly. Later, in 1993, French trawlers found a small seamount in southerly areas of the Reykjanes Ridge at the border of the Icelandic EEZ and were fishing for blue ling there 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 2.7.2). A fishery on the seamount was resumed by Spanish trawlers in the 2000s with biggest catch about 1000 t, but this has ceased.

Orange roughy fisheries: In 1992 the Faroe Islands began a series of exploratory cruises for orange roughy beginning in their own waters and later extending into international waters. Exploitable concentrations were found in late 1994 and early 1995. Several vessels began a commercial fishery but only one vessel managed to maintain a viable fishery. Most of the fishery took place on five banks. In the northern area (ICES Subarea 12) catches peaked in 1995–1998 (570–802 t), and since then have generally been less than 300 t (Figure 2.7.2). Catches from 6 to 470 t per annum were also made in ICES Subarea 10 in 1996–1998, 2000–2001, 2004–2011, 2012, 2014, 2015 and 2016. The black scabbardfish was the main bycatch species and in recent years' catches were 45–313 t for both Subareas (2009–2014).

Longline fisheries for redfish: 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 vertical longlines were used in the fishery in rugged terrain. The fishery continued in 1997, but experienced an 84% decrease in cpue. Norway carried out two exploratory longline surveys in 1996 and 1997. A Russian longline fishery was conducted in the same area in 2005–2007 and 2009.

Alfonsino fisheries: The first commercial catches of alfonsino in this area were taken by pelagic trawling on the Spectre seamount in 1977 and this and other seamounts were exploited in 1978 and 1979. No commercial fishing took place during the 1980s but nine exploratory and research cruises yielded about 1000 t of mixed deep-water species, mostly alfonsino, but also commercial catches of cardinal fish, orange roughy, black scabbardfish and silver roughy (*Hoplostethus mediterrraneus)*. A joint Norwegian-Russian survey in 1993 used a bottom trawl to survey three seamounts and a catch of 280 t, mainly alfonsino and cardinal fish, was taken from two of them. Orange roughy, black scabbard fish and wreckfish *(Polyprion americanus)* were also of potential commercial significance. Commercial fishing yielded more than 2800 t over the next seven years (Figure 2.7.2). In recent years there have been no indications of a target 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. Faroe Islands reported landings of 141 t of alfonsinos and 82 t of orange roughy from area 10 (and 1.7 t from area 12) during 2015. During 2016 Faroes reported landings, from area 10, of 48 t of alfonsinos, 86 t of orange roughy (and 7 t from area 12) and 50 t of black scabbardfish (and 0.2 t from area 12).

Current status*:* Deep-water fisheries in the MAR have declined to very low levels in the recent years in Subareas 10 and 12, due to many reasons, including the economic reason and the implementation of a range of management measures.

2.4 Technical interactions

2.4.1 Azores EEZs

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

2.4.2 Mid-Atlantic Ridge

Seamount aggregating species such alfonsinos and orange roughy are sensitive to sequential local depletion. However, no data were available to assess such effects in these areas. Little is understood about the stock structure of these species and it is not known whether the trawler fleets that fished in international waters of the MAR fish the same stocks that are exploited inside the EEZ by the Azorean fishery.

2.5 Ecosystem considerations

2.5.1 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.

2.5.2 Mid-Atlantic Ridge

Most of Divisions 12.a, 12.c, 10.b, 14.b1 and 5.a are abyssal plain habitats with an average depth of around 4000 m which remains unexploited. The major topographic feature is the northern part of the MAR, located between Iceland and the Azores. The geomorphological characteristics of seamounts and ridges and the hydrographic conditions associated with them form the basis for densely populated filter-feeding epifaunal communities comprising sponges, bivalves, brittlestars, sea lilies and a variety of corals (gorgonians, scleractinians a.o.), including the cold-water coral *Lophelia pertusa* and *Solenosmilia* (Mortensen *et al.*, 2008). This benthic habitat, probably also benefitting from impinging biomass of mesopelagic organisms (fish, zooplankton) (Sutton *et al.*, 2008), supports elevated levels of biomass in the form of aggregations of fish such as roundnose grenadier, orange roughy, alfonsinos, etc. The sessile benthic communities on hard substrata (i.e. regarded as 'vulnerable marine ecosystems' *sensu* FAO (2009) are highly susceptible to damage by bottom fishing gear, and the fish stocks can be rapidly depleted due to the life-history traits and behaviour of the species. The demersal fish fauna of the MAR has been well described based on data from exploratory fishing and scientific investigations (e.g. Hareide and Garnes, 2001; Bergstad *et al.*, 2008; Fossen *et al.*, 2008). Several of the seamount fish have long lifespans, low production rates and form easily targeted aggregations.

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. There is a substantial literature on biogeography of seamounts and the MAR, and also some recent studies of population genetics. Demersal fish assemblages on the MAR resemble those on adjacent slope areas on either side (Bergstad *et al.*, 2012), and for some important commercial species, e.g. roundnose grenadier, genetic studies suggest homogeneity across wide areas across the ocean basin (Knutsen *et al.*, 2012).

2.6 Management of fisheries

2.6.1 Azores EEZ

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

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

2.6.2 Mid-Atlantic Ridge

There is a NEAFC regulation of fishing effort in the fisheries for deep-sea species (species on the NEAFC Annex 1b) list of regulated resources). This generalized measure is intended to prevent expansion in fisheries, including by third parties. The use of gillnets is prohibited beyond 200 m depth.

Specific measures including the TAC were introduced for grenadiers, orange roughy, blue ling and deep-water sharks (http://neafc.org/managing_fisheries/measures/current). In 2015, the fishery for orange roughy was closed, and directed fishery for deep-water sharks has been prohibited.

Current NEAFC measures also include regulations on bottom fishing aimed to protect VMEs. Regular fishing with bottom-touching fishing gear is only allowed in restricted subareas of the NEAFC Regulatory Area designated as 'existing fishing areas' (Figure 2.7.4). Other areas are either closed to bottom fishing or considered subareas only open to pre-assessed exploratory fisheries evaluated and accepted by the commission. In the event a possible VME is encountered in 'existing fishing areas' or during exploratory fishing, move-on rules apply and temporary closures established until it has been determined that a VME exists or not.

European Union TACs for deep-sea species apply to licensed EU vessels fishing on the MAR.

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2.8 Tables

Table 2.7.2. Overview of landings in Subareas 10 (a.1,a.2,b),12I (c, a.1) (does not include information from 12.b, Western Hatton Bank) and 14.b1).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*	2018*
ALFONSINOS (*Beryx* spp.)	731	1510	384	229	725	484	199	243	172	139	161	192	211	252	312	245	232	222	168	131	292	156	149	157
ARGENTINES (*Argentina silus*)		1			2					4													0	0
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1			72	0	16	9		0		0	27.81
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	253	224	357	134	1062	502	384	198	73		80	162	240	163	16	206	85	7	86	63	14
BLUEMOUTH (*Helicolenus dactylopterus*)	589	483	410	381	340	452	301	280	338	282	190	209	275	281	267	213	231	190	235	200	256	306	333	283
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		14	16	21	4	10	7	7	7	5	5	4	4	2	4		5	4
GREATER FORKBEARD (*Phycis blennoides*)	75	47	32	39	41	100	91	63	56	46	22	134	201	18	26	14	11	6	8	9	10	10	15	35
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1			0	0		1		0	0
MORIDAE						1	88	113	140	91	69	127	86	53	68	54	55						169	
ORANGE ROUGHY (*Hoplostethus atlanticus*)	676	1289	814	806	441	447	839	28	201	711	324	104	20	108	26	74	112	139		47	84	93	<1	0
RABBITFISHES (*Chimaerids*)			32	42	115	48	79	98	81	128	193				22	0		2	6				0	0
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6	0	0	2726	868	448			0	0
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5	1691	3366	2724	1907	2075	862	659.95	84	27
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	1115	1052	1012	1119	1222	947	1034	1193	1068	1075	1383	958	1070	1089	1042	687	624	613	692	663	701	515	499	445
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	35	25	6	14	104	63	12	1	7	5	31	70				75	
SILVER SCABBARDFISH (*Lepidopus caudatus*)	789	826	1115	1187	86	28	14	10	25	29	31	35	55	63	64	68	148	282	0	713	429	87	101	73
SMOOTHHEADS (*Alepocephalidae*)		230	3692	4643	6549	4146	3592	12538	6883	4368	6872							160	17				0	0
Trachipterus sp																		54					0	0
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66	64	19		2	107	0	29			1		0	506
WRECKFISH (*Polyprion americanus*)	244	243	177	140	133	268	232	283	270	189	279	497	664	513	382	238	266	226	209	121	116	101	128	89
TOTAL	7222	10113	17861	22323	20993	17578	16533	17272	10950	8161	10364	2666	2674	2489	2393	3715	5218	7441	4398	4493	2,764	2,014	*1,621*	*1,662*

***- provisional data**

Table 2.7.1. Summary data on seamount fisheries on the MAR.

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

2.9 Figures

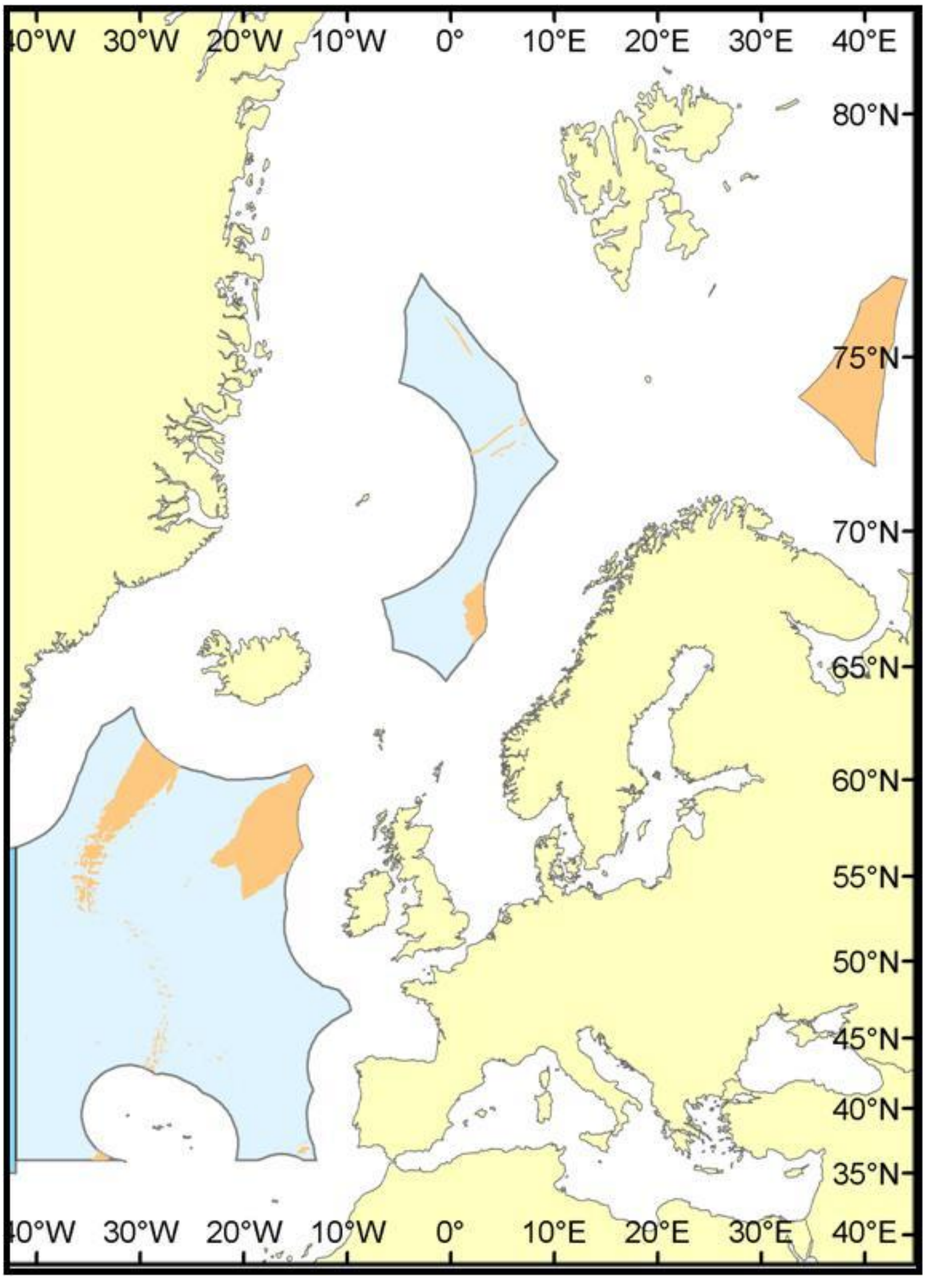


Figure 2.7.1. The NEAFC Regulatory Area (area beyond national jurisdiction) in the Northeast Atlantic (light blue polygons) with superimposed subareas shallower than 2000 m (light brown patches). Note that the NEAFC RA in the Barents Sea is entirely shallower than 2000 m, and that a high Arctic NEAFC RA (beyond 80◦N) is not shown on the map.

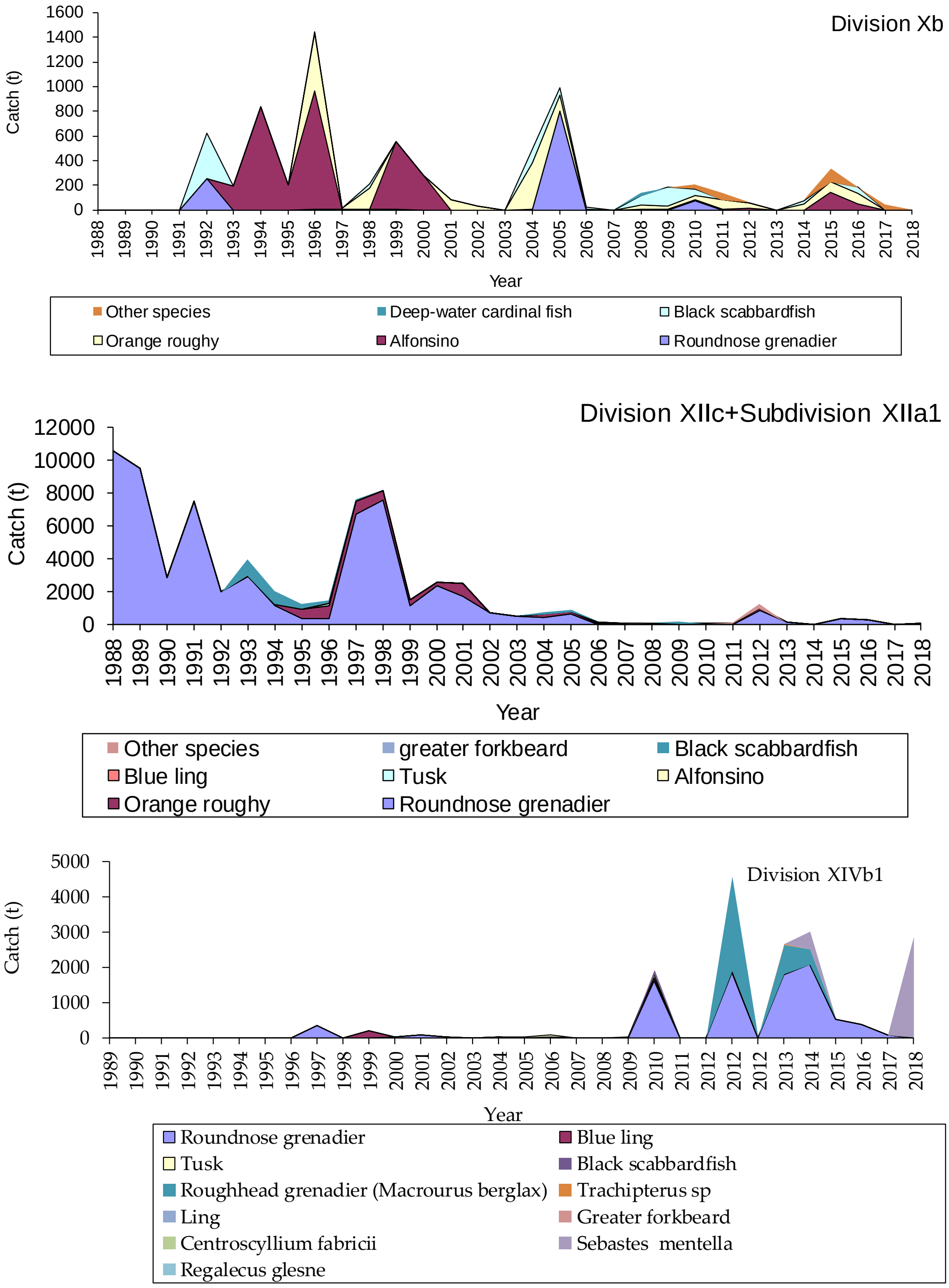


Figure 2.7.2. Annual catch of major deep-water species on MAR in 1988–2017.

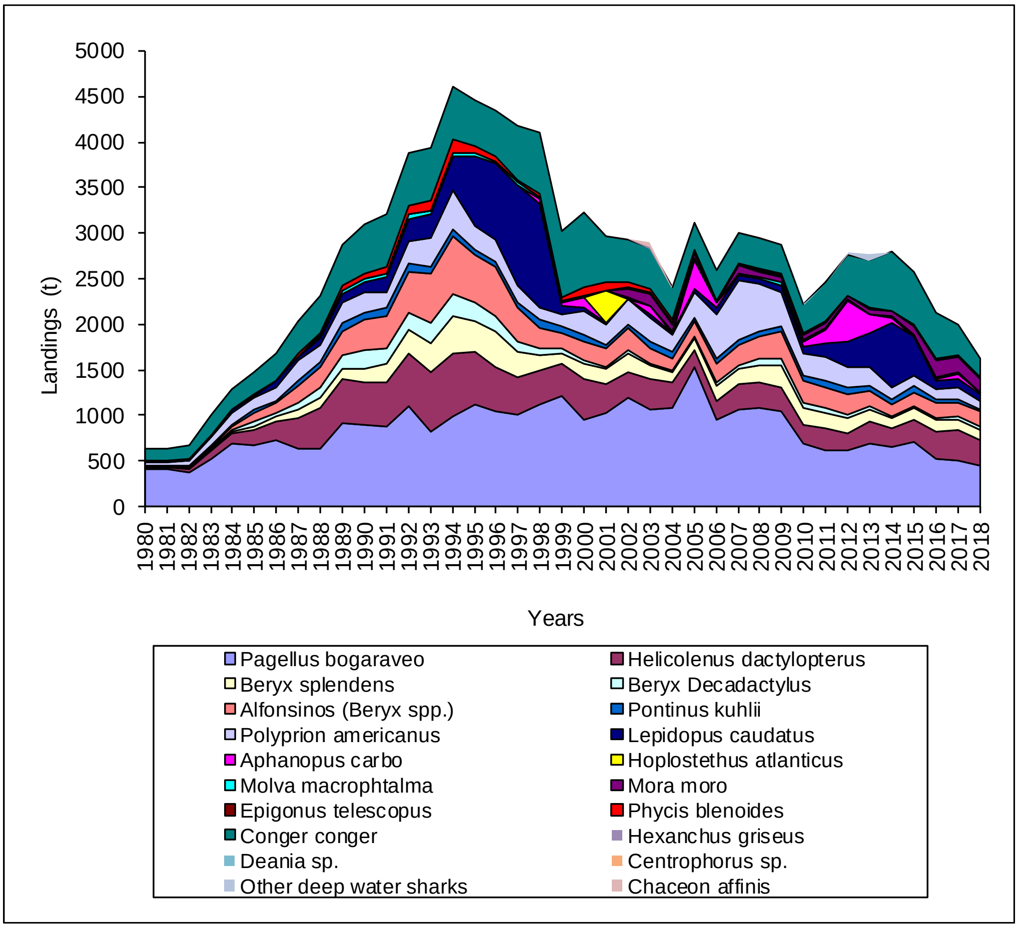


Figure 2.7.3. Annual landings of major deep-water species in Azores from hook and line fishery (1980–2017).

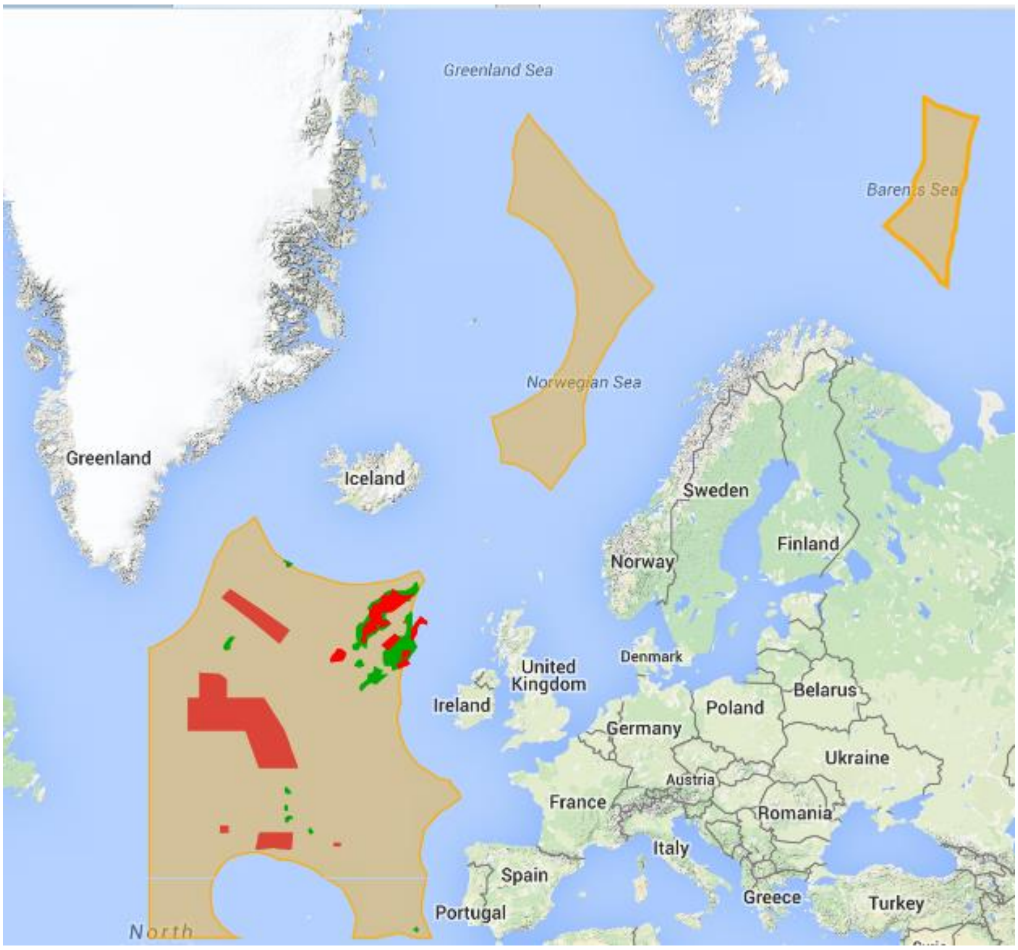


Figure 2.7.4. The regulatory area of NEAFC (light brown) and subareas of the Mid-Atlantic Ridge, seamounts and the Rockall-Hatton areas designated as bottom fishing closures (red), and 'existing fishing areas (green). Areas outside closures and 'existing fishing areas' are only open to pre-assessed exploratory bottom fishing. Source: www.neafc.org .

3 Ling (*Molva Molva*)

3.1 Stock description and management units

WGDEEP 2006 indicated: ‘There is currently no evidence of genetically distinct populations within the ICES area. However, ling at widely separated fishing grounds may still be sufficiently isolated to be considered management units, i.e. stocks, between which exchange of individuals is limited and has little effect on the structure and dynamics of each unit. It was suggested that Iceland (Division 5.a), the Norwegian Coast (Subarea 2), and the Faroes and Faroe Bank (Division 5.b) 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 4, 6, 7 and 8) 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.

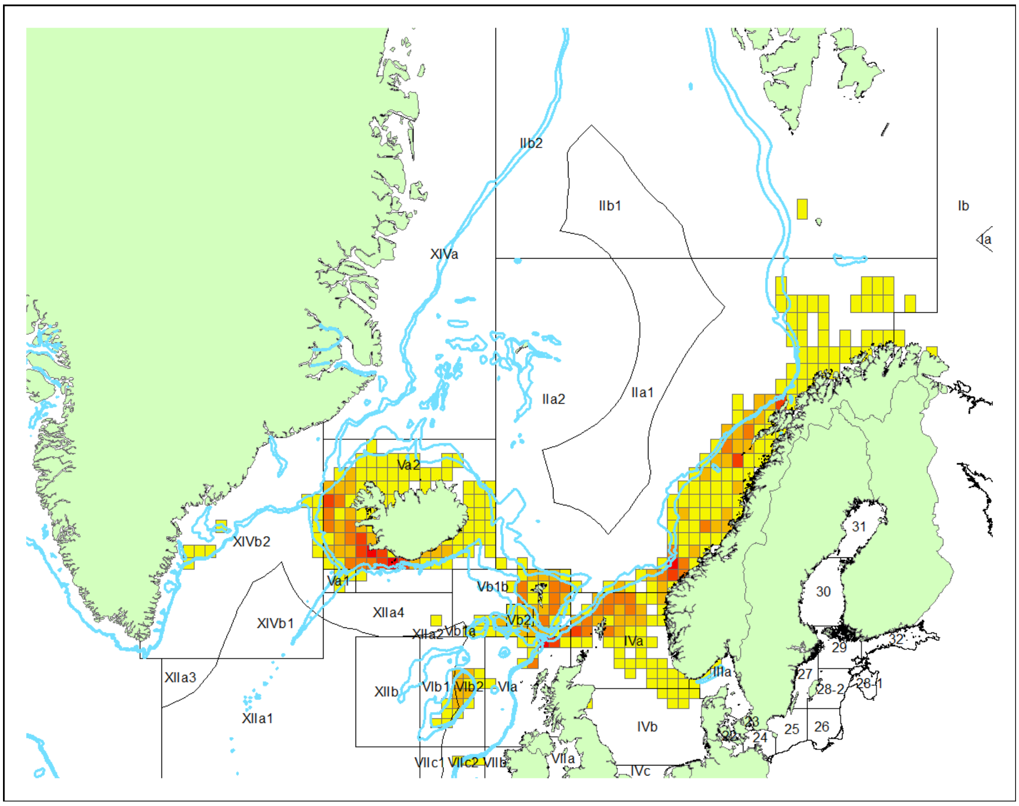


Figure 3.1. Map of fishery distribution (catches) in 2013 (data from Iceland, Faroes and Norway).

In a working document presented at WGDEEP-2014, the first study of population genetic structure of ling by genotyping six geographically distinct samples with eleven microsatellite DNA markers. The results rejected the hypothesis of a single ling stock in the Northeast Atlantic, and rather suggest the existence of two or more groups, with the main grouping represented by a western (Rockall and Iceland) and an eastern group (Faroe Bank, Norway). Significant genetic differences coincide with an expanse of deep water that probably limits connectivity facilitated by migration. Retention in gyres and directional oceanic circulation may also prevent drift and admixture during planktonic life stages. On the other hand, the apparent absence of genetic differentiation within the eastern part of the distribution range indicates gene flow, perhaps by larval drift and migration, over considerable distances.

A small-scale exchange of 50 ling otolith images was done in 2013 (WKAMDEEP, 2013). The results of this exchange showed that the mean CV of all the 9 age readers of ling was 10.3% and the conclusion was that the precision is probably high enough to support age-structured analytical assessments (WGDEEP, 2013). The results from the annotations of this exchange highlighted that the problem (in most cases) was to do with edge growth. It is necessary to train an age reader and inform them when to count the first translucent zone (first year) (WKAMDEEP, 2013). Also earlier ling otolith exchanges concluded that there was some inconsistencies between age readers but the differences were not very substantial and could easily be adjusted (Bergstad *et al.*, 1998; Øverbø Hansen, 2012). An analysis of edge growth of ling otoliths is recommended to help on this problem with edge growth.

3.2 Ling (*Molva Molva*) in Division 5.b

3.2.1 The fishery

The longline fisheries in Faroese waters were mainly on the slope on the Faroe Plateau and a small amount of it was on the bank areas and Wyville-Thomson Ridge (Figure 3.2.1). Ling was also caught as bycatch by trawlers fishing saithe on the Faroe Plateau (Figure 3.2.2). In the latest years, foreign catches was mainly by the Norwegian longliners.

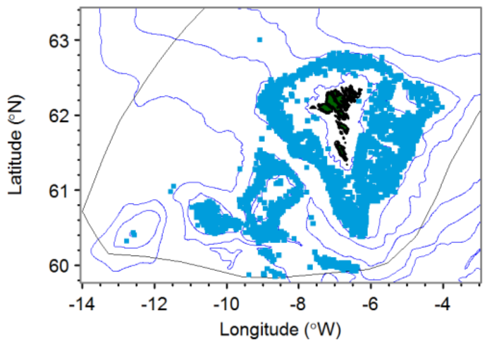


Figure 3.2.1. Ling in 5.b. Spatial distribution of the longline fishery 1985 to present, where ling was >30% of the total catches in the sets. These are the data behind the longliners cpue series of ling.

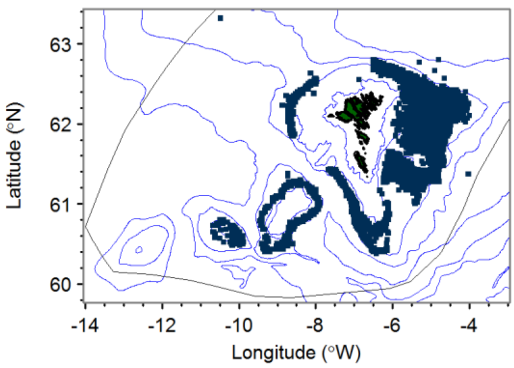


Figure 3.2.2. Ling in 5.b. Spatial distribution of pair trawler fishery 1994 to present, where ling was in the catch and saithe >60% of the total catch per haul. These are the data behind the pair trawler bycatch cpue series of ling.

3.2.2 Landings trends

Landings data for this stock are available from 1904 onwards (Figure 3.2.3). Landing statistics for ling by nation for the period 1988–2018 are given in Tables 3.2.1–3.2.3 and total landings data from 1904 onwards are shown in Figure 3.2.3.

Total landings in Division 5.b have in general been very stable since the 1970s varying between around 4000 and 7000 tonnes. In the period from 1990–2005 around 20% of the catch was fished in area 5.b2, and in the period 2006–2018 this has decreased to around 10%. The preliminary landings of ling in 2018 were 5185 tons, of which the Faroes caught 82%. The reason for the low foreign catches in 2011–2013 was because of no bilateral agreement on fishing rights between the Faroes, Norway and EU.

Around 50–70% of the ling in 5.b was caught by longliners and the rest mainly by trawlers (30–40%). Only a minor part of the landings was by other gear.

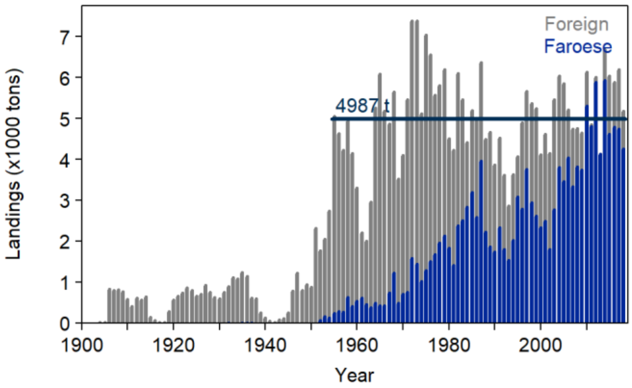


Figure 3.2.3. Ling in 5.b. Total international landings since 1904. The mean catches from 1955 to present were around 5000 tons.

3.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, effort should be adjusted such that catches should be no more than 4157 tonnes in each of the years 2020 and 2021. All catches are assumed to be landed.

3.2.4 Management

For the Faroese fleets, there is no species-specific management of ling in 5.b, although there is a licensing scheme and effort limitations. 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 for ling is 60 cm, but that is not enforced because of the discard ban. Mostly 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm. Other nations are regulated by TACs.

There is a bilateral agreed quota between Norway and Faroe Islands, but there was no such agreement in 2011–2013. In 2019, Norway can catch 2300 tons ling/blue ling, 1921 tons tusk, 100 tons saithe and 800 tons other species as by-catch in bottom fishery in Faroese waters.

In 2019, the Faroese Government will allow 5 Russian vessels to undertake experimental fishing in the Faroese Fishing Zone at depths deeper than 700 meters, provided that a Russian scientific observer is onboard. No more than 3 vessels can be operating simultaneously. Two of these vessels can undertake experimental fishery in deep waters around Outer Bailey and Bill Baileys Banks, at depth between 500 and 700 meters. Catches in this area are not allowed to exceed 500 tonnes of deep-sea species.

Quotas of blue ling/ling* and other species for European Union vessels fishing in the Faroese zone in 2019 is 1885 tonnes and 700 tonnes, respectively. *By-catch of maximum 665 tonnes of roundnose grenadier and black scabbardfish are to be counted against this quota.

3.2.5 Data available

Data on length, gutted weight and age are available for ling from the Faroese landings and Table 3.2.4 gives an overview of the level of sampling since 1996.

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 (mainly length and round weight, Table 3.2.4) as well as catch and effort data are available. Data of ling larvae from the annual 0-group survey on the Faroe Plateau was also investigated.

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

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

3.2.5.2 Length compositions

Length composition data are available from the Faroese commercial longliners, the trawler fleet that captures ling as bycatch and from the two groundfish surveys (Figures 3.2.4–3.2.7).

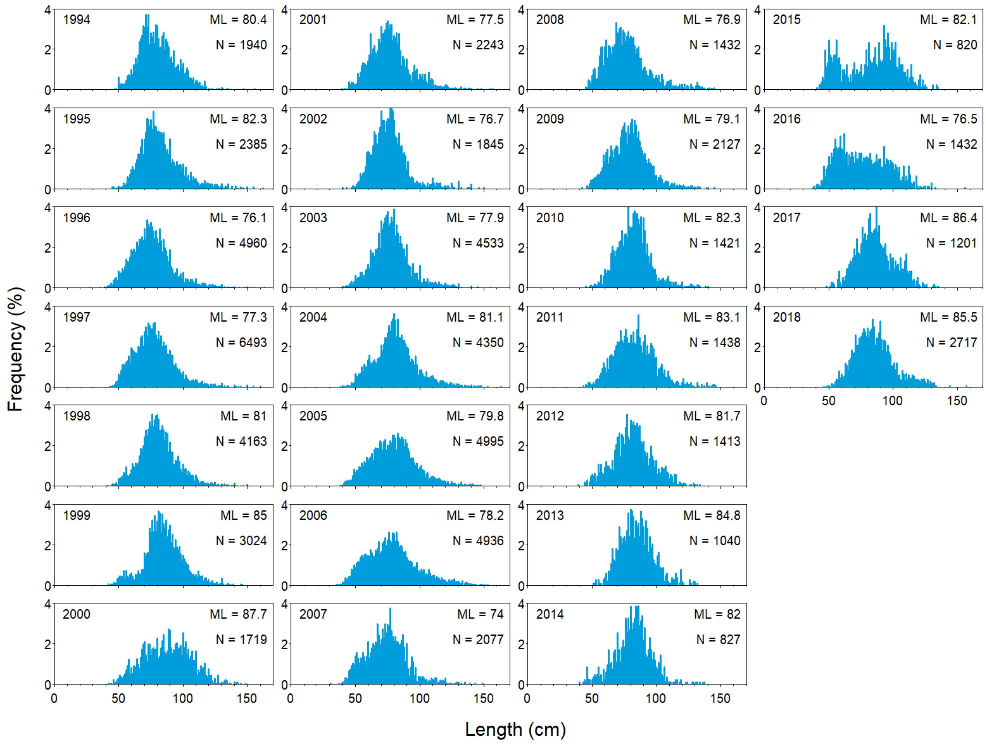


Figure 3.2.4. Ling in 5.b. Length frequencies from the landings of ling from Faroese longliners (>110 GRT). ML-mean length and N-number of length measures.

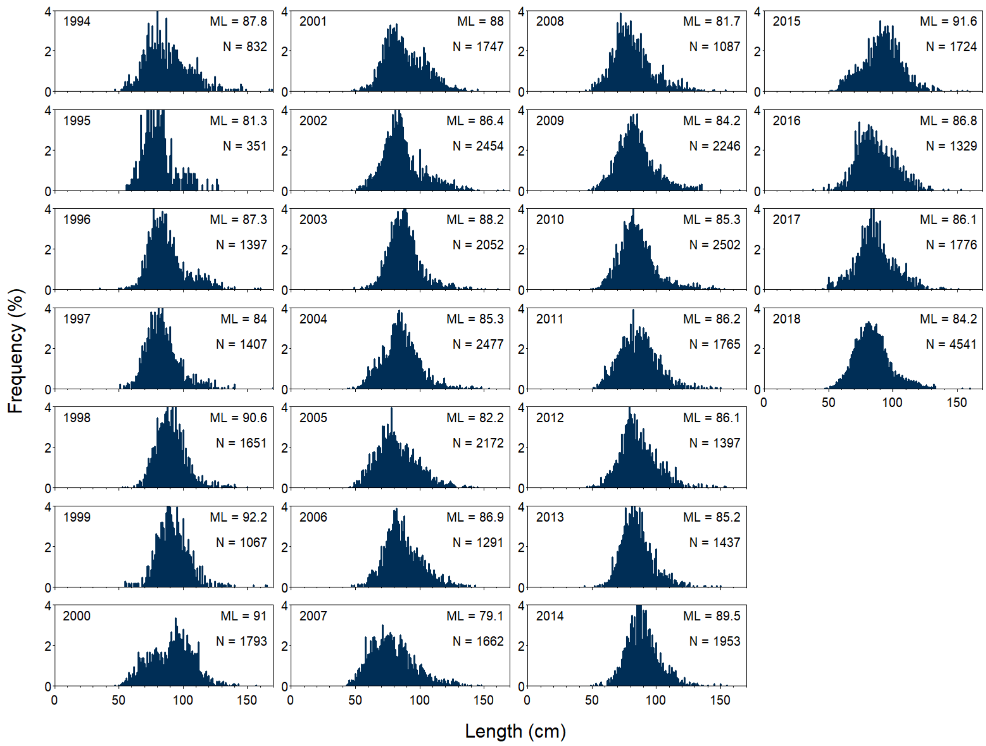


Figure 3.2.5. Ling in 5.b. Length frequencies from the landings of ling from Faroese trawlers (>1000 HP). ML-mean length and N-number of length measures.

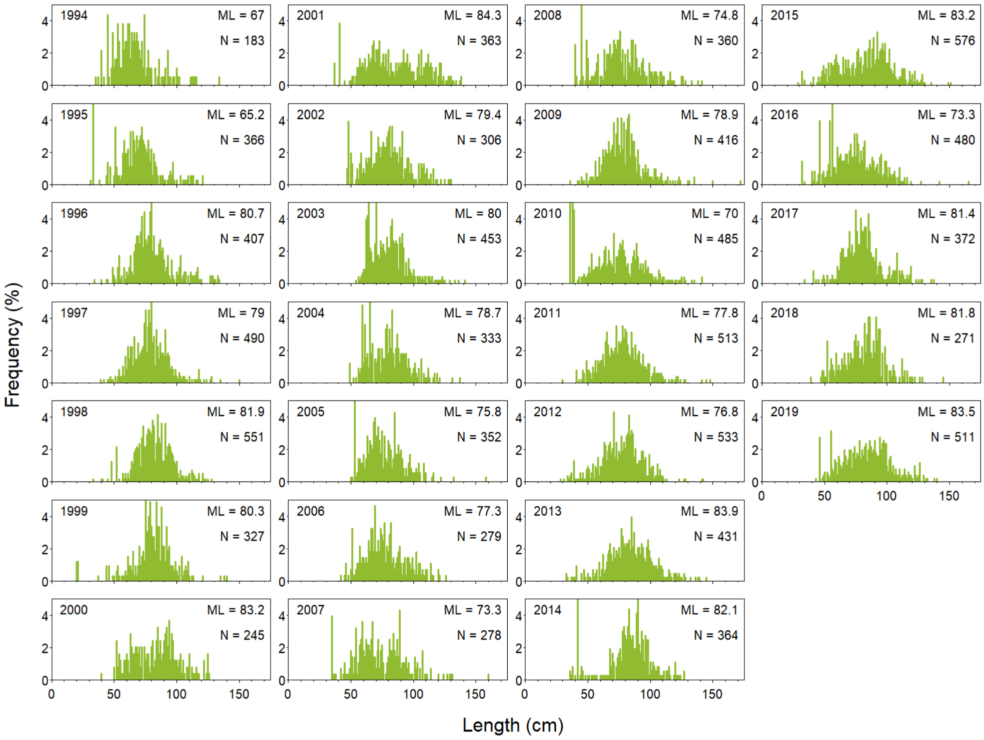


Figure 3.2.6. Ling in 5.b. Length frequencies from the spring groundfish survey. ML- mean length, N–number of calculated length measures. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

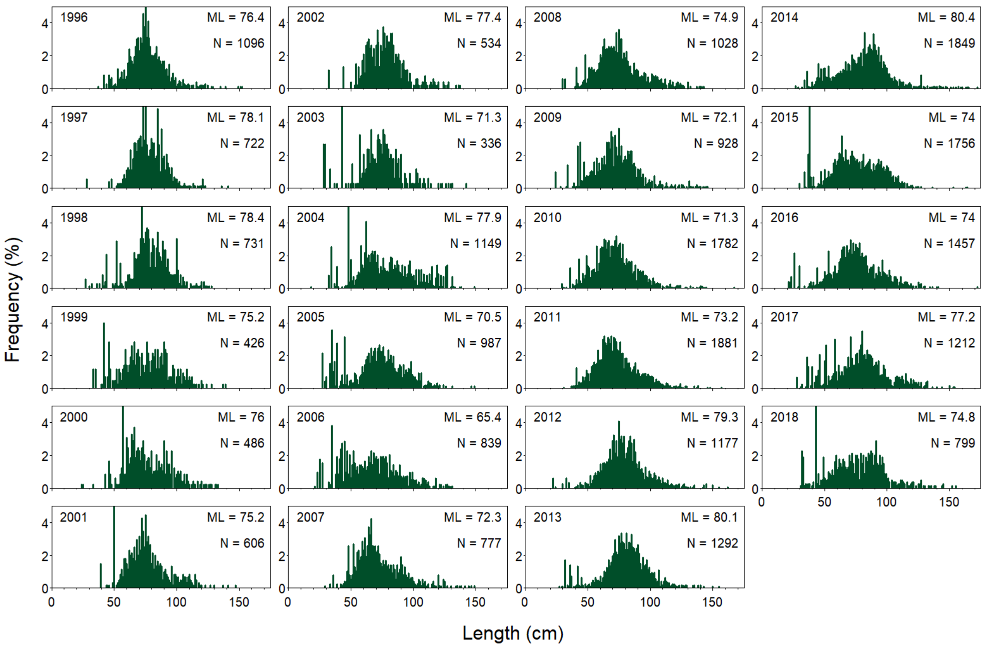


Figure 3.2.7. Ling in 5.b. Length frequencies from the summer groundfish survey. ML- mean length, N–number of calculated length measures. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

3.2.5.3 Catch-at-age

Catch-at-age data were provided for Faroese landings in 5.b for the period 1996 to present. Due to few age data in the recent period were all age data from 1996 to present combined (the same age–length key for all these years in the exploratory assessment). Thereafter the age–length data was distributed on the lengths for the distinct years and fleets (longliners and trawlers) (Figure 3.2.8). The most common ages in the landings are from five to nine years and the mean age is around 7–8 years.

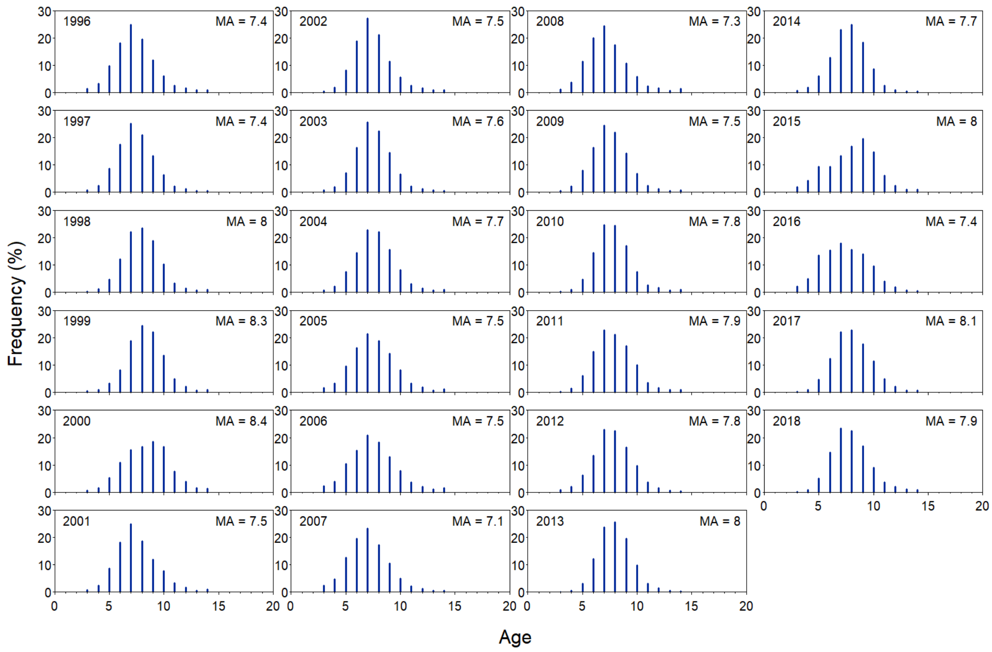


Figure 3.2.8. Ling 5.b. Catch-at-age frequencies used in the exploratory assessment. MA- mean age.

3.2.5.4 Weight-at-age

Mean weight-at-age data from the landings in 5.b was modelled using all the age samples from the landings (1996 to present) combined before they were distributed on the length distribution for the distinct year and fleet (longliners and trawlers). There is no particular trends in the mean weights over the period (Figure 3.2.9).

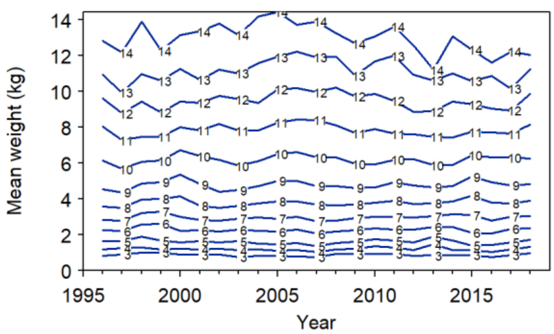


Figure 3.2.9. Ling in 5.b. Mean weight-at-age in the catches.

3.2.5.5 Maturity and natural mortality

Maturity ogives of ling are presented in a table below. The results fit well with the statement that ling become mature at ages 5–7 (60–75 cm lengths) in most areas, with males maturing at a slightly lower age than females (Magnusson *et al.*, 1997).

Maturity parameters:

Area	Sex	A_{50}	N	L_{50}	N	RW_{50}	N	GW_{50}	N
Faroese waters	Combined	5.89	1677	68.86	1737	2069.5	1308	1435.2	295
Faroese waters	Female	6.21	846	71.81	871				
Faroese waters	Male	5.60	831	66.54	865				

The same maturity-at-age calculated from all data was used for all years in the assessment for sexes combined.

No information is available on natural mortality of ling in 5.b. Natural mortality of 0.15 was assumed for all ages in the exploratory assessment.

3.2.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch per unit of effort (cpue) data available from three commercial series, the Faroese longliners, the Faroese pair trawlers (bycatch) and Norwegian longliners fishing in Division 5.b. The Faroese cpue data are mainly from five longliners (GRT>110) and 6–10 pair trawlers (HP>1000). The effort obtained from the logbooks was estimated as 1000 hooks from the longliners, number of fishing (trawling) hours from the trawlers and the catch as kg stated in the logbooks. The selection of data and standardization are described in the stock annex for ling in 5.b. The data selected in the longliner series was only from sets where ling was more than 30% of the total catch to be able to compare with the Norwegian longliner series.

The standardized cpue data from Norwegian longliners fishing in Division 5.b are described in the stock annex for ling in 2.a (Section ling in 1 and 2). The sets where ling >30% of the total catch were used. The Norwegian and Faroese longliners are comparable and both have ling (and tusk) as target species.

Fisheries-independent cpue series

Cpue estimates (kg/hour) for ling are available from two annual groundfish trawl surveys on the Faroe Plateau designed for cod, haddock and saithe. The annual survey on the Faroe Plateau covers the main fishing areas and mainly a large part of the spatial distribution area. Information on the surveys and standardization of the data are described in the stock annex.

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

3.2.6 Data analyses

Mean length in the length composition from commercial catches from Faroese longliners and trawlers showed an increase in mean length from 74–79 cm in 2007 to around 83–86 cm after 2010 (Figure 3.2.4–3.2.5). The mean length from the Norwegian longliners fishing in Faroese waters, in the period 2003–2009 were around 87 cm. The Faroese trawlers have a slightly higher mean length compared with the Faroese longliners.

Length composition from the two groundfish surveys on the Faroe Plateau showed high interannual variation in mean length, from 65 to 85 cm, which may partly be explained by occasional high abundance of individuals smaller than 60 cm (Figures 3.2.6–3.2.7).

Fluctuations in abundance

Information on abundance trends can be derived from the cpue data from the Faroese longliners (Figure 3.2.10), Norwegian longliners fishing in 5.b (Figure 3.2.11), bycatch from the Faroese pair trawlers fishing saithe (Figure 3.2.10) and from the Faroese groundfish surveys (Figure 3.2.12). Data from these series are presented in Table 3.2.5–3.2.6.

The Faroese longline cpue series and the Faroese trawl bycatch cpue series show an increasing trend since around 2001 (Figure 3.2.10). The Norwegian longline series show an increase after 2004 (Figure 3.2.11). In 2018, there was a decrease in cpue from the Norwegian longliners. It has to be noted that there are less than 100 fishing days from Norwegian longliners in Faroese waters in 2009–2014 (Table 3.2.6).

The two survey cpue series indicate a stable situation from the late 1990s and an increase in recent years (Figure 3.2.12). There was a small decrease in latest years, but the values were still well above the mean value. In 2018, the survey value decreased below the mean value, but the spring survey in 2019 showed an increase well above the mean value again.

A potential recruitment index was calculated from the two surveys as the number of ling smaller than 40 cm (Figure 3.2.13). The index indicates increasing recruitment in recent years. In addition, a potential recruitment index was calculated of ling (2–3 cm in length) from the annual 0-group survey on the Faroe Plateau 1983 to present, which also showed indications of high recruitment (Figure 3.2.14). These recruitment indices support an indication of increasing recruitment in distinct years.

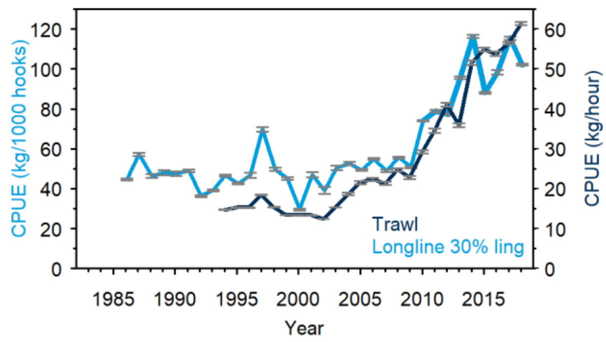


Figure 3.2.10. Ling in 5.b. Standardized cpue from Faroese longliners (turquoise line) and pair trawlers (bycatch, dark blue line) fishing in Faroese waters. Data from longliners (>110 GRT) are from sets where ling >30% of the total catch. Data from trawlers are from hauls where ling was caught and saithe >60% of the total catch. The error bars are SE.

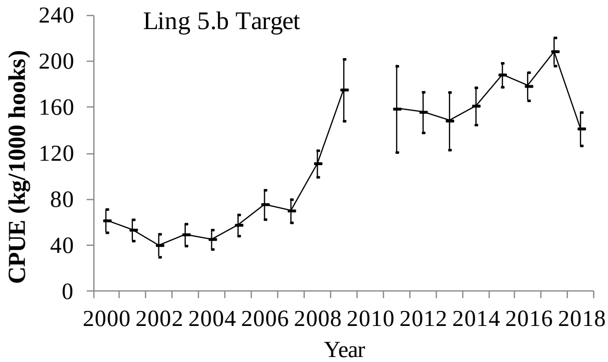


Figure 3.2.11. Ling in 5.b. Standardized cpue (kg/ 1000 hooks) of ling from Norwegian longliners fishing in 5.b. The bars denote the 95% confidence intervals (Helle and Pennington, WD 2019).

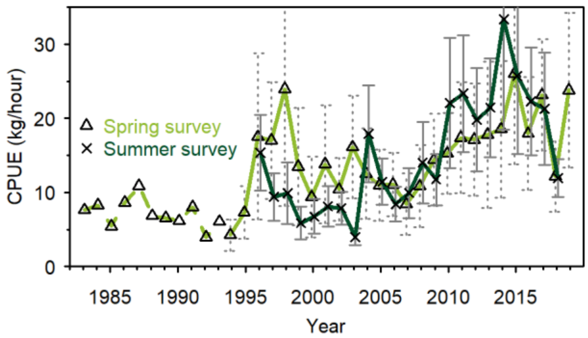


Figure 3.2.12. Ling in 5.b. Standardized cpue (kg/h) from the two annual Faroese groundfish surveys on the Faroe Plateau. The error bars are SE. The data for 1983–1993 were not standardized.

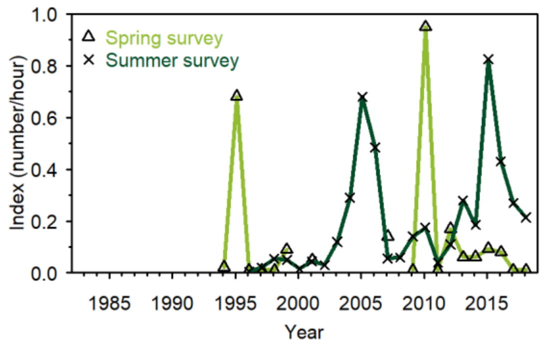


Figure 3.2.13. Ling in 5.b. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

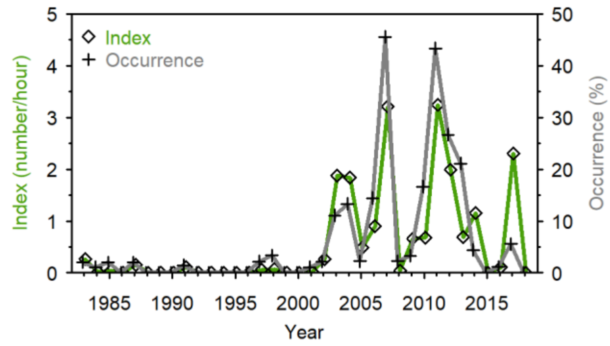


Figure 3.2.14. Ling in 5.b. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

Analytical assessment

An exploratory assessment of ling in Division 5.b was done by using the age-based model SAM. The summer survey series was used as tuning series. Ages from 2137 otoliths were used in the combined age–length key, and then distributed out on length distribution of each distinct year (1996 to present). The summer surveys on the Faroe Plateau cover most of the spatial distribution area and the fishery areas.

The SAM model fitted the cpue-data well, but the log q residuals showed some seasonal problems in following the cohorts.

The results from the SAM model supported that ling in Faroese waters is at a high level as both the recruitment and SSB were above long-term mean in the latest five years (Figure 3.2.15). The retrospective pattern showed that fishing mortality tended to be underestimated, whereas the recruitment and SSB tended to be overestimated.

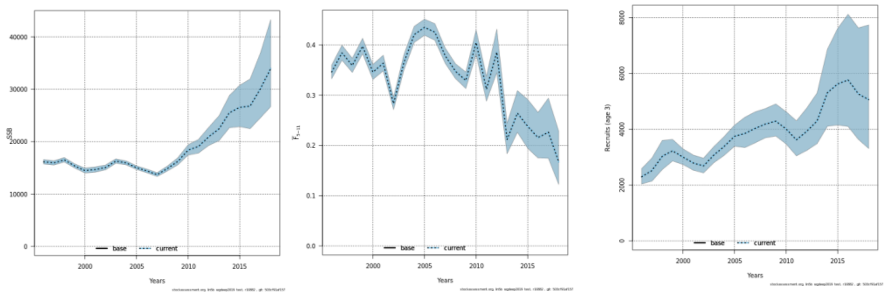


Figure 3.2.15. Ling in 5.b. Output from the age based assessment using SAM.

3.2.6.1 Reference points

There are no accepted reference points for this stock. The Length Based Indicator (LBI) is used as F_{MSY} indicator. The adult abundance measured by surveys is above the average of the time-series, so expert judgement considered it likely that SSB is above any candidate values for MSY $B_{trigger}$.

Yield per recruit analysis in SAM from the exploratory assessment gave F_{MAX} = 0.20, $F_{0.1}$ =0.11 and $F_{0.35SPR}$ = 0.14.

3.2.7 Comments on assessment

All signs from commercial catches and surveys indicate that ling in Division 5.b at present is in a good state, and this is confirmed in the exploratory assessment.

There is a clear seasonal pattern in log q residuals and there need to be a closer look at the diagnostic to find the best settings. It is also necessary to look closer at the ALK for the whole period to solve the strong log q residual patterns. Still, the assessment is assumed to show there is an increase in recruitment, stock biomass and spawning–stock biomass during the latest years.

For this stock unit, advice is given every second year, so the advice for 2020 also applies for 2021. The advice is based on trends in the cpue (kg/hour) from the Faroese summer survey on the Faroe Plateau (DLS method 3.2).

There are possibilities to increase ling in 5.b to a category 1 stock with the excising data.

3.2.8 Management consideration

Stability in landings and trends in abundance indices suggest that ling in Division 5.b has been stable since the middle of the 1980s, with an increasing trend in the last seven years. The available data series does not cover the entire period of the fishery (back to the early 1900s; see Figure 3.2.3) and no information is available on stock levels prior to 1986. There is evidence of increased recruitment in the last seven years compared to earlier levels.

The only species-specific management for Faroese fisheries of ling in Division 5.b is the recommended minimum landing size (60 cm), but this does not appear to be enforced because of the discard ban. Mostly 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm.

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

3.2.9 Application of MSY proxy reference points

Length-based indicator method (LBI)
The input parameters and the catch length composition for the period 1995–2018 are presented in the table below and in Figure 3.2.16. The length data used in the LBI model are data from the Faroese longliner and trawler fleets. The length data are not raised to total catch.
Input parameters for LBI.

Data type	Years/Value	Source	Notes
length–frequency distribution	1995–2018	Faroese long-liners and trawlers	
Length–weight relation	0.0033* length $^{3.1311}$	Faroese survey data	combined sex
L_{MAT}	69 cm	Faroese survey data	
L_{inf}	185 cm	Faroese survey data	

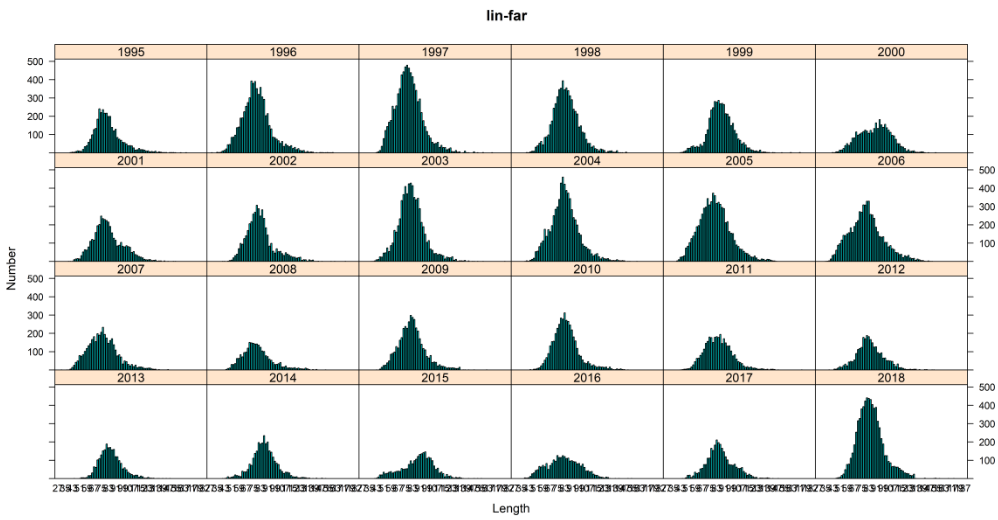


Figure 3.2.16. Ling in Faroese waters (5.b). Catch length distributions for the period 2001–2018 with 2 cm length bins (sex combined).

Output from the screening of length indicator ratios for combined sexes was conducted under three scenarios: (a) Conservation; (b) Optimal yield, and (c) maximum sustainable yield (Table below and Figure 3.2.17).

Analysing the results showed that the conservation of immature ling indicator, L_c/L_{mat}, was usually less than one, while $L_{25\%}/L_{mat}$ was usually around 1 (Figure 3.2.17). In 2014-2018, $L_{25\%}/L_{mat}$, has been greater than 0.96 (Table below).
The conservation of large ling indicator, $L_{max5\%}/L_{inf}$, was around 0.65 for the entire period (Figure 3.2.17), and between 0.64 and 0.67 in 2014-2018 (Table below). The indicator was less than 0.8, which suggests that there were few mega-spawners in the catch. Since the VBF produced an unusually high L_{inf}, the value used in the model was L_{max}. This could be the reason that the indicator ratio was less than 0.8. If we would have used a lower L_{inf} value, the indicator ratio would have been higher! The catch was lower than the length of optimal yield.

The MSY indicator ($L_{mean}/L_{F=M}$) was greater than 1 for almost the whole period (Figure 3.2.17), which indicates that ling in Faroese waters are fished sustainably. Only in 2018, the MSY indicator was 0.89.

Conclusion of LBI is that the overall perception of the stock during the period 2014–2017 is that ling in Faroese waters seems to be fished sustainably, except in 2018 (Table below). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

	Conservation				Optimizing Yield	MSY
Ling 5.b	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	$L_{mean}/L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2015	0.65	1.08	0.67	0%	0.72	1.09
2016	0.54	0.96	0.64	0%	0.66	1.08
2017	0.71	1.07	0.65	0%	0.70	1.02
2018	0.96	1.04	0.66	0%	0.70	0.89

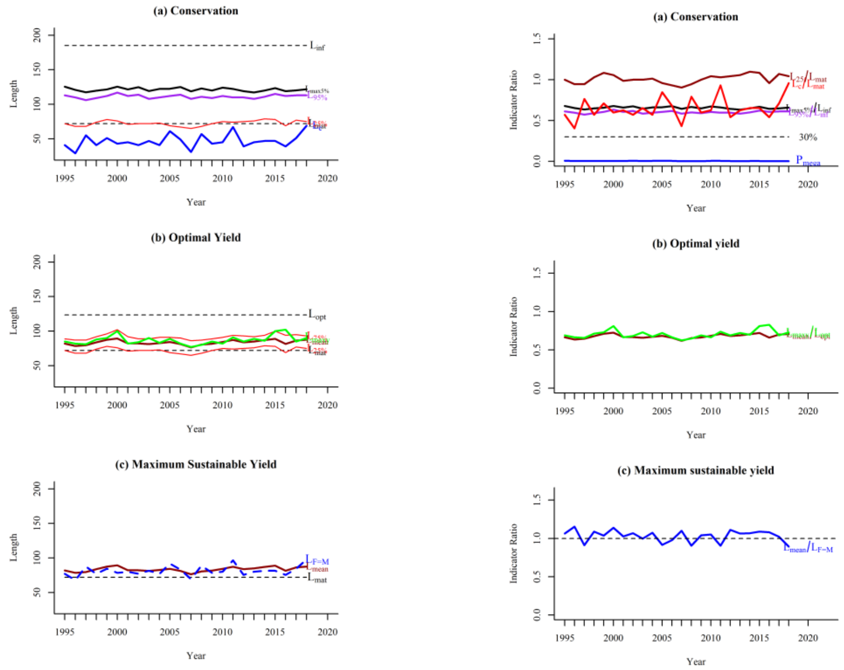


Figure 3.2.17. Ling in Faroese waters (5.b). Screening of length indicators ratios for sex combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

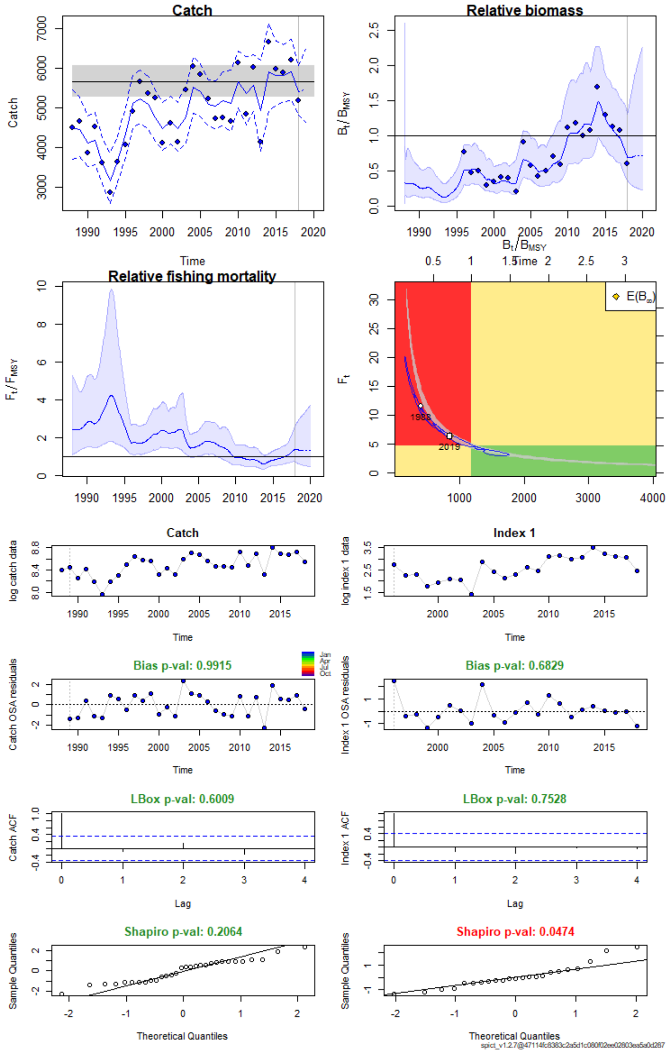
Stochastic Production model in Continuous Time (SPiCT)

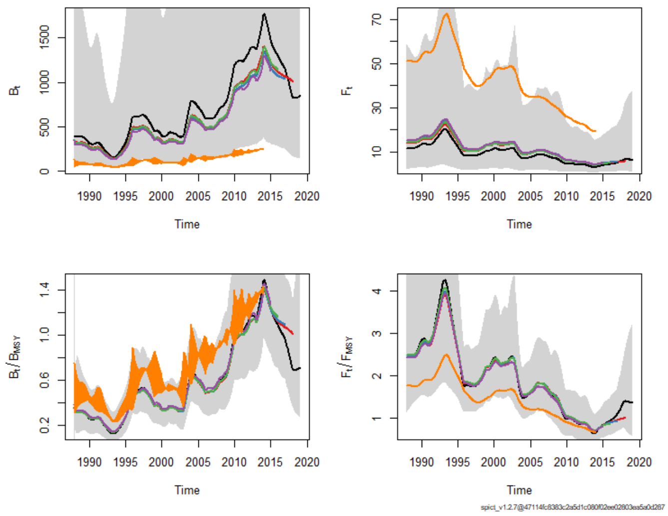
The input data for catch was a time-series of landings for area 27.5.b from 1988–2018. The abundance index was from the Faroese annual trawl summer survey (1996–2018).

The model did not give any reliable results. A default run gave the warning message: "Model did not obtain proper convergence! Estimates and uncertainties are most likely invalid and cannot be trusted". Several different settings were tried (as suggested in the WKProxy review, WGDEEP report 2017). With setting of α=1, β=1 and n=2 the model did converge with warnings and the confidence limits are very wide. Example of the output tables and figures is showed below.

The conclusion was that this model cannot be used for lin-27.5b assessment unit.

```
Stochastic reference points (Srp)
          estimate       cilow     ciupp  log.est rel.diff.Drp
 Bmsys 1187.856826  257.024479 5489.7644 7.079906  0.004221596
 Fmsys    4.771605    1.043542   21.8182 1.562683 -0.002840615
 MSYs  5668.051584 5302.090646 6059.2719 8.642601  0.001404956
Predictions w 95% CI (inp$msytype: s)
                  prediction        cilow       ciupp    log.est
 B_2019.00       845.1418556  139.4215739 5123.057619  6.7395045
 F_2019.00         6.4374576    1.1046182   37.516005  1.8621337
 B_2019.00/Bmsy    0.7114846    0.2731469    1.853253 -0.3404015
 F_2019.00/Fmsy    1.3491179    0.5667802    3.211331  0.2994509
 Catch_2019.00  5476.6067864 4626.0489971 6483.550415  8.6082410
 E(B_inf)        851.2873790           NA          NA  6.7467498
```


Catch
Relative biomass
Relative fishing mortality
E(B∞)
1985
2019
Index 1
Bias p-val: 0.9915
Bias p-val: 0.6829
LBox p-val: 0.6009
LBox p-val: 0.7528
Shapiro p-val: 0.2064
Shapiro p-val: 0.0474
Time
Lag
Theoretical Quantiles
Sample Quantiles


Time

3.2.10 Tables

Table 3.2.1. Ling in 5.b1. Nominal landings (1988–present).

Year	Denmark[2]	Faroes	France	Germany	Norway	E&W[1]	Scotland [1]	Russia	Total
1988	42	1383	53	4	884	1	5		2372
1989		1498	44	2	1415		3		2962
1990		1575	36	1	1441		9		3062
1991		1828	37	2	1594		4		3465
1992		1218	3		1153	15	11		2400
1993		1242	5	1	921	62	11		2242
1994		1541	6	13	1047	30	20		2657
1995		2789	4	13	446	2	32		3286
1996		2672			1284	12	28		3996
1997		3224	7		1428	34	40		4733
1998		2422	6		1452	4	145		4029
1999		2446	17	3	2034	0	71		4571
2000		2103	7	1	1305	2	61		3479
2001		2069	14	3	1496	5	99		3686
2002		1638	6	2	1640	3	239		3528
2003		2139	12	2	1526	3	215		3897
2004		2733	15	1	1799	3	178	2	4731
2005		2886	3		1553	3	175		4620
2006	3	3563	6		850		136		4558
2007	2	3004	9		1071		6		4092
2008		3354	4		740	32	25	11	4166
2009	13	3471	2		419		270		4174
2010	28	4906	2		442		121		5500
2011	49	4270	2		0		0		4321
2012	117	5452	7		0		0		5576
2013	3	3734	7		0		0		3744
2014		5653	10		308		0	13	5983

Year	Denmark[(2)]	Faroes	France	Germany	Norway	E&W[(1)]	Scotland [(1)]	Russia	Total
2015		4375	16		993	1	0	6	5391
2016		4214	8		855	0	103		5180
2017		4371	4		864		54		5294
2018*		3836	2		793		42		4673

*Preliminary.

(1) Includes 5.b2.

(2) Greenland 2006–2013.

Table 3.2.2. Ling in 5.b2. Nominal landings (1988–present).

Year	Faroes	France	Norway	Scotland	Total
1988	832		1284		2116
1989	362		1328		1690
1990	162		633		795
1991	492		555		1047
1992	577		637		1214
1993	282		332		614
1994	479		486		965
1995	281		503		784
1996	102		798		900
1997	526		398		924
1998	511		819		1330
1999	164	4	498		666
2000	229	1	399		629
2001	420	6	497		923
2002	150	4	457		611
2003	624	4	927		1555
2004	1058	3	247		1308
2005	575	7	647		1229
2006	472	6	177		655
2007	327	4	309		640
2008	458	3	120		580
2009	270	1	198		469
2010	393	1	236		630
2011	522	0	0		522
2012	434	1	0		435
2013	387	1	0		388
2014	276		389	7	672
2015	244	1	337	3	585
2016	569	4	126	11	710

Year	Faroes	France	Norway	Scotland	Total
2017	359		542		901
2018*	428		78	6	512

***Preliminary.**

Table 3.2.3. Ling in 5.b. Nominal landings (1988–present).

Year	5.b1	5.b2	5.b
1988	2372	2116	4488
1989	2962	1690	4652
1990	3062	795	3857
1991	3465	1047	4512
1992	2400	1214	3614
1993	2242	614	2856
1994	2657	965	3622
1995	3286	784	4070
1996	3996	900	4896
1997	4733	924	5657
1998	4029	1330	5359
1999	4571	666	5238
2000	3479	629	4109
2001	3686	923	4609
2002	3528	611	4139
2003	3897	1555	5453
2004	4731	1308	6039
2005	4620	1229	5849
2006	4558	655	5213
2007	4092	640	4731
2008	4166	580	4747
2009	4174	469	4643
2010	5500	630	6129
2011	4321	522	4843
2012	5576	435	6011
2013	3744	388	4132
2014	5983	672	6655
2015	5391	585	5976
2016	5180	710	5890

Year	5.b1	5.b2	5.b
2017	5294	901	6195
2018*	4673	512	5185

***Preliminary.**

Table 3.2.4. Ling in 5.b. Overview of the sampling from commercial landings and different surveys since 1996.

	Commercial sampling			Survey sampling		
Year	Length	Gutted Weight	Age	Length	Round weight	Age
1996	6399	410	1084	1748	366	11
1997	7900	541	1526	1478	326	0
1998	5912	538	1081	1580	820	0
1999	4536	360	480	805	665	0
2000	3512	360	360	1237	684	14
2001	3805	420	420	1573	889	0
2002	4299	180	300	1492	817	0
2003	6585	360	661	1608	887	0
2004	6827	1169	659	1968	1131	0
2005	7167	3217	540	1511	1050	0
2006	6503	4038	276	1338	937	0
2007	4031	1713	120	1166	969	0
2008	2521	1945	60	1454	1052	10
2009	4373	4348	232	1499	1039	0
2010	4345	4279	180	2392	1395	0
2011	3405	2828	0	2562	1949	0
2012	2810	2447	50	1855	1771	0
2013	2477	2076	0	1873	1652	274
2014	2985	2274	20	2923	2268	556
2015	2544	2171	210	3453	2502	418
2016	2761	2360	360	2490	2227	435
2017	2977	2426	480	1890	1469	437
2018*	7443	7443	1492	2300	1634	641

Table 3.2.5. Ling in 5.b. Data on the cpue series from Faroese commercial fleets and groundfish surveys. Only the spring survey data from 1986–1993 was not standardized. N- number of sets/hauls behind the commercial cpues.

	Longline			Trawl (bycatch)			Spring survey		Summer survey	
Year	Mean	se	N	Mean	se	N	Mean	se	Mean	se
1986	44.6	0.6	47				8.6			
1987	57.2	0.8	91				10.9			
1988	46.4	1.1	26				6.9			
1989	48.0	1.2	28				6.6			
1990	47.6	1.1	39				6.2			
1991	48.9	0.6	110				8.0			
1992	36.3	0.4	139				4.0			
1993	39.2	0.5	130				6.1			
1994	46.6	0.4	182	14.8	0.2	69	4.3	2.1		
1995	42.6	0.4	150	15.3	0.1	244	7.3	3.6		
1996	46.7	1.3	22	15.3	0.1	216	17.5	11.2	15.3	5.1
1997	69.7	1.0	91	18.4	0.1	586	16.9	7.9	9.4	3.2
1998	49.7	0.7	77	15.4	0.1	597	23.9	15.8	9.9	4.1
1999	45.1	0.6	80	13.4	0.0	926	13.6	8.0	5.8	2.2
2000	29.6	0.5	68	13.3	0.0	851	9.4	5.4	6.8	2.3
2001	47.1	1.2	31	13.4	0.0	905	13.8	8.0	8.1	2.7
2002	39.2	1.8	9	12.5	0.0	792	10.4	4.2	7.9	2.2
2003	50.5	1.0	26	15.3	0.1	701	16.1	6.9	4.0	1.1
2004	52.6	0.7	73	18.9	0.3	591	12.5	6.1	17.9	6.5
2005	49.3	0.4	120	21.8	0.4	783	11.0	4.8	11.4	3.1
2006	54.8	0.5	135	22.6	0.5	666	11.1	4.3	8.4	2.4
2007	48.9	0.5	72	21.6	0.4	692	8.4	4.2	9.9	3.4
2008	55.6	0.4	175	25.1	0.5	612	10.8	5.6	14.0	5.5
2009	50.8	0.4	181	23.1	0.4	759	14.4	6.2	11.7	3.4
2010	74.3	0.4	823	29.7	0.4	968	15.2	5.4	22.1	8.8
2011	78.6	0.5	796	35.2	0.6	714	17.4	7.5	23.3	7.9
2012	77.5	0.5	679	41.7	0.6	1118	17.1	7.6	19.8	7.0
2013	96.1	0.8	368	35.9	0.5	928	17.8	9.9	21.4	6.7
2014	116.3	0.7	645	51.5	0.6	1275	18.5	9.2	33.4	14.9
2015	88.1	0.5	447	54.8	0.5	1614	26.0	12.3	25.7	10.5
2016	98.2	1.1	341	53.7	0.5	1256	17.9	7.6	22.3	7.3
2017	115.5	0.8	265	56.5	0.4	990	23.1	7.5	21.2	7.6
2018	102.1	0.5	450	61.4	0.3	1263	12.2	4.8	11.9	2.6

Table 3.2.6. Ling in 5.b. Data from the Norwegian longliners cpue series. Mean cpue is from longliners with more than 30% ling in the sets. SE- standard error * 1.96 = CI, N- number of days that the Norwegian longliners operated in an ICES subarea/division (Helle and Pennington, WD 2019).

Year	Mean cpue	SE*1.96	N
2000	61.7	10.1	288
2001	53.6	9.3	371
2002	40.2	10.0	355
2003	49.5	9.5	391
2004	45.5	8.4	571
2005	57.9	9.2	335
2006	75.8	12.8	125
2007	70.3	10.1	294
2008	111.4	11.6	167
2009	175.5	26.9	39
2010			
2011	158.9	37.5	11
2012	156.1	17.7	50
2013	148.5	25.1	24
2014	161.5	16.2	83
2015	188.6	10.4	205
2016	178.6	12.2	163
2017	208.9	12.2	152
2018	141.7	14.5	124

3.3 Ling (*Molva Molva*) in Subareas 1 and 2

3.3.1 The fishery

Ling has been fished in Subareas 1 and 2 for centuries, and the historical development is described in Bergstad and Hareide (1996). In particular, the post-World War II increase in catch caused by a series of technical advances, is well documented. Currently the major fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries, but bycatches of ling are taken by other gears, such as trawls and handlines. Around 50% of the Norwegian landings are taken by longlines and 45% by gillnets, partly in the directed ling fisheries and in part as bycatch in fisheries for other ground fish. Other nations catch ling as bycatch in their trawl fisheries. Figure 3.3.1 shows the spatial distributions of the total catches for the Norwegian longline fishery from 2013 to 2017.

The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number stabilized at 26. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas 1 and 2 has declined since its peak in 2011. During the period 2000 to 2014 the main technological change in Subareas 1 and 2 was that the average number of hooks per day increased from 31 000 hooks to 35 000 hooks. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (for more information see Helle and Pennington, WD 2019).

The total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2018 is 43% less than the average effort during the years 2000–2003. It should be noted that the annual fishery covers the entire distribution of ling in Subareas 1 and 2 (see Figure 3.3.1), so that the catch produced by the applied effort is likely proportional to the actual population.

The cod stock in the Barents Sea has been very abundant for several years but now there is a downward trend in the cod stock which results in lower quotas. Because of lower quotas for cod the fishing pressure on ling is expected to increase.

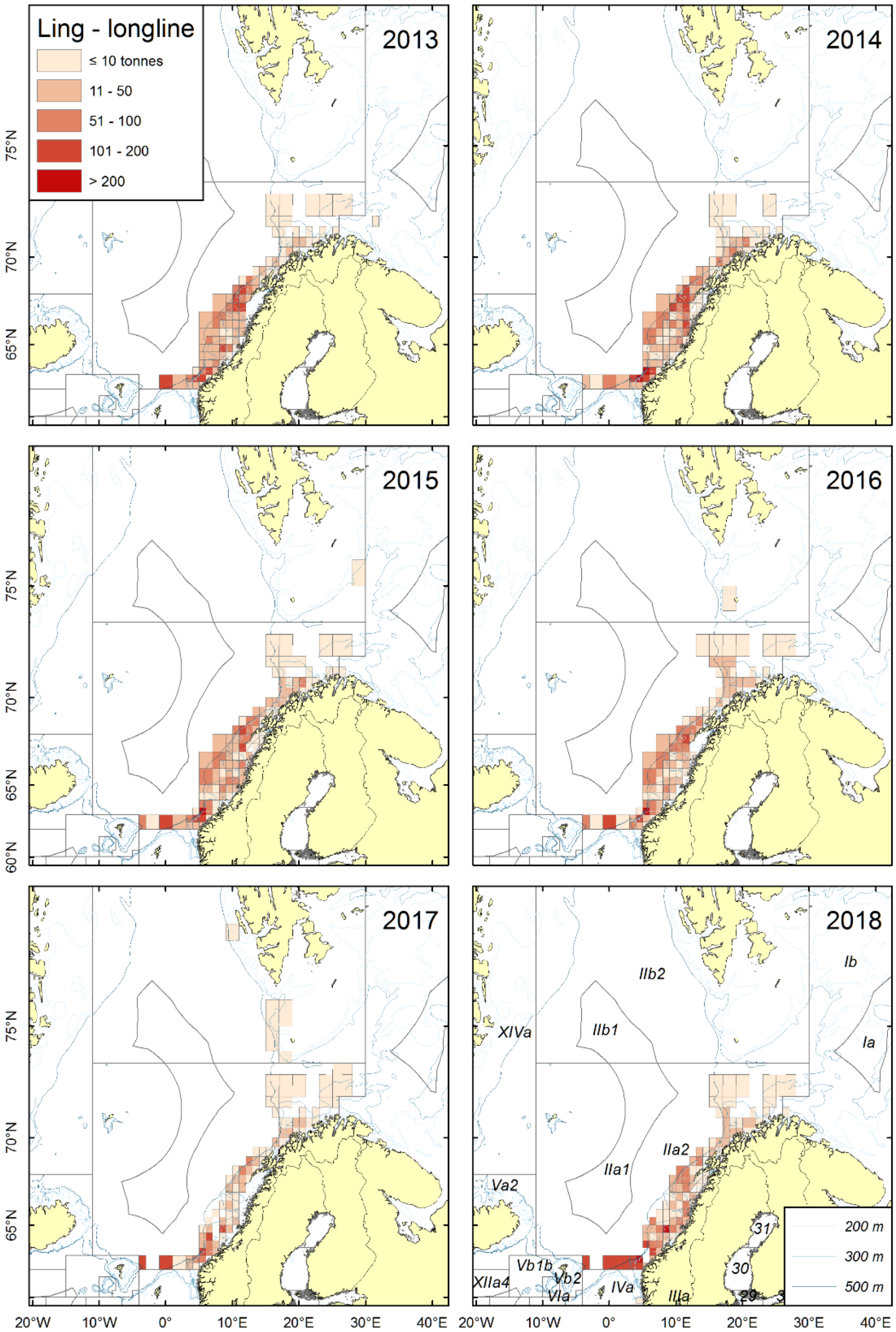


Figure 3.3.1. Distribution of the total catch of ling in Subareas 1 and 2 taken by the Norwegian longline fishery in 2013–2018.

3.3.2 Landings trends

Landing statistics by nation in the period 1988–2018 are in Tables 3.3.1a–d. During 2000–2005, the landings varied between 5000 and 7000 t, which was slightly lower than the landings in the preceding decade. In 2007, 2008 and 2010 the landings increased to over 10 000 t. The preliminary landings for 2018 is 11, 609 t, a significant increase compared to the previous years. Total international landings in Areas 1 and 2 are given in Figure 3.3.2.

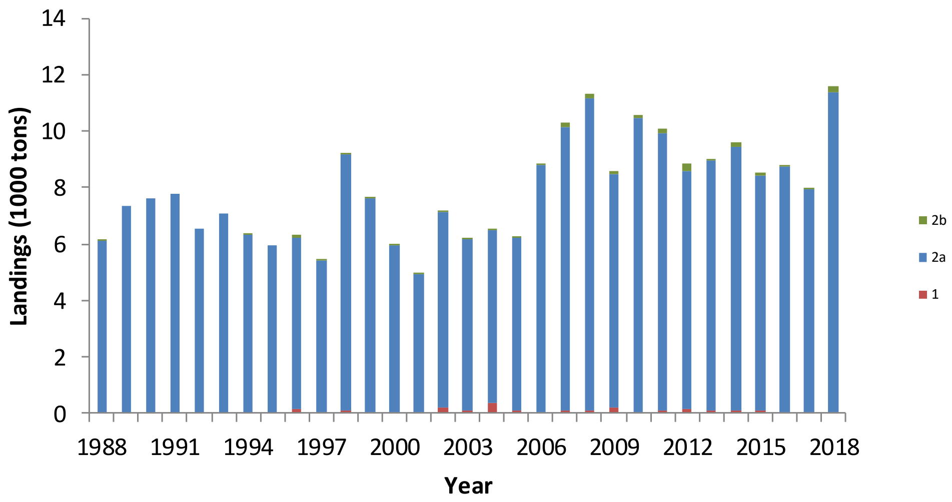


Figure 3.3.2. Total international landings of ling in Subareas 1 and 2.

3.3.3 ICES Advice

Advice for 2018 and 2019: ICES advises that when the precautionary approach is applied, catches should be no more than 13 103 tonnes for 2018 and 2019. All catches are assumed to be landed.

Management

There is no quota for the Norwegian fishery for ling, but the vessels participating in the directed fishery for ling and tusk in Subareas 1 and 2 are required to have a specific licence. There is no minimum landing size for the Norwegian EEZ.

The quota for ling in EU and international waters was set at 36 t for 2019.

3.3.4 Data available

3.3.4.1 Landings and discards

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

3.3.4.2 Length compositions

Length composition data are available for the longliners and gillnetters from the Norwegian Reference fleet. Figures 3.3.3 and 3.3.4 show the length distribution of ling in Areas 1 and 2 for the period 2001 to 2018. The mean length in Area 1 has varied slightly, while the mean length in Area 2a has been very stable. The weight–length graphs are in Figure 3.3.5.

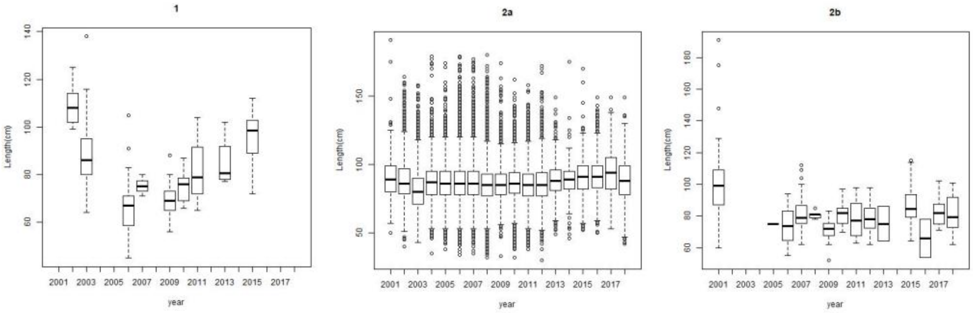


Figure 3.3.3. Box and whiskers plots for the length of ling in Areas 1, 2a and 2b for the period 2001 to 2018 from the Norwegian Reference fleet.

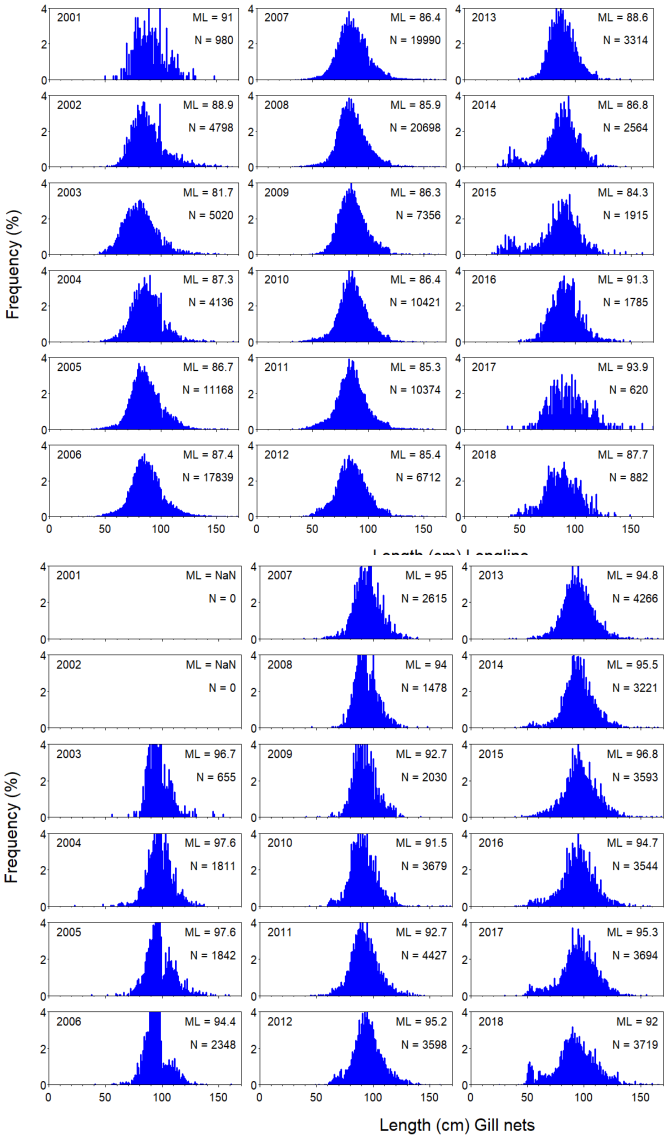


Figure 3.3.4. Plots of the length distributions of ling in Subareas 1 and 2 combined for the period 2001 to 2018 from the Norwegian Reference fleet.

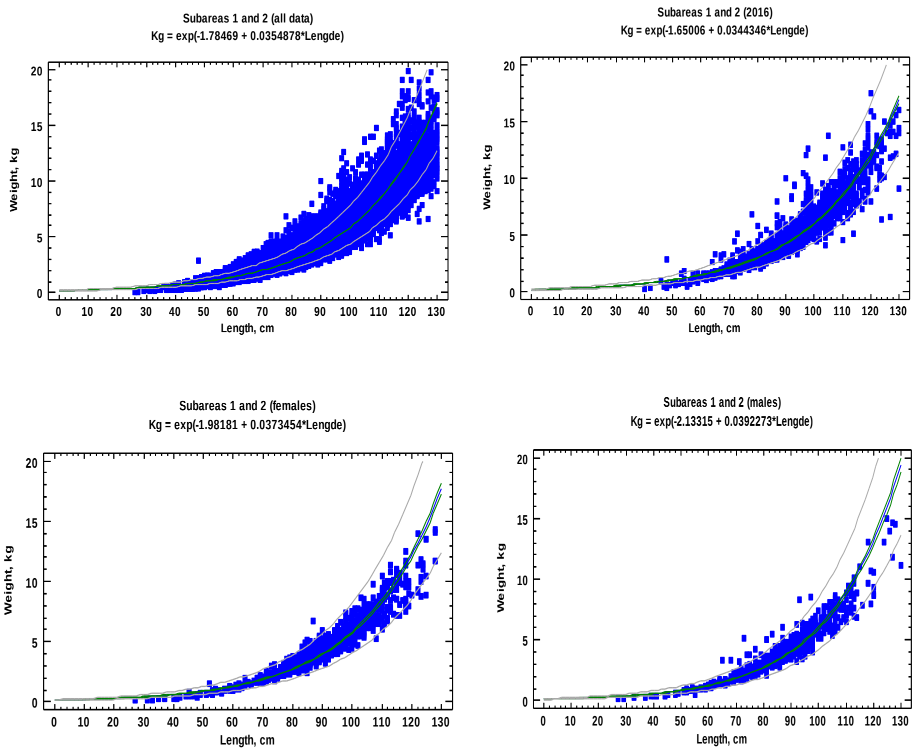


Figure 3.3.5. Weight–length relationship for the period 2008–2018, and only for 2018 (upper panel) and for females and for males, separately (lower panel). Data were collected by the Norwegian Reference Fleet.

3.3.4.3 Age compositions

The Catch-at-age composition for each year is in figure 3.3.6, and box and whiskers plots for the estimated age distribution of catch for: the total catch; and separately for the longline fishery and for the gillnet fishery for 2010–2017 (Figure 3.3.7).

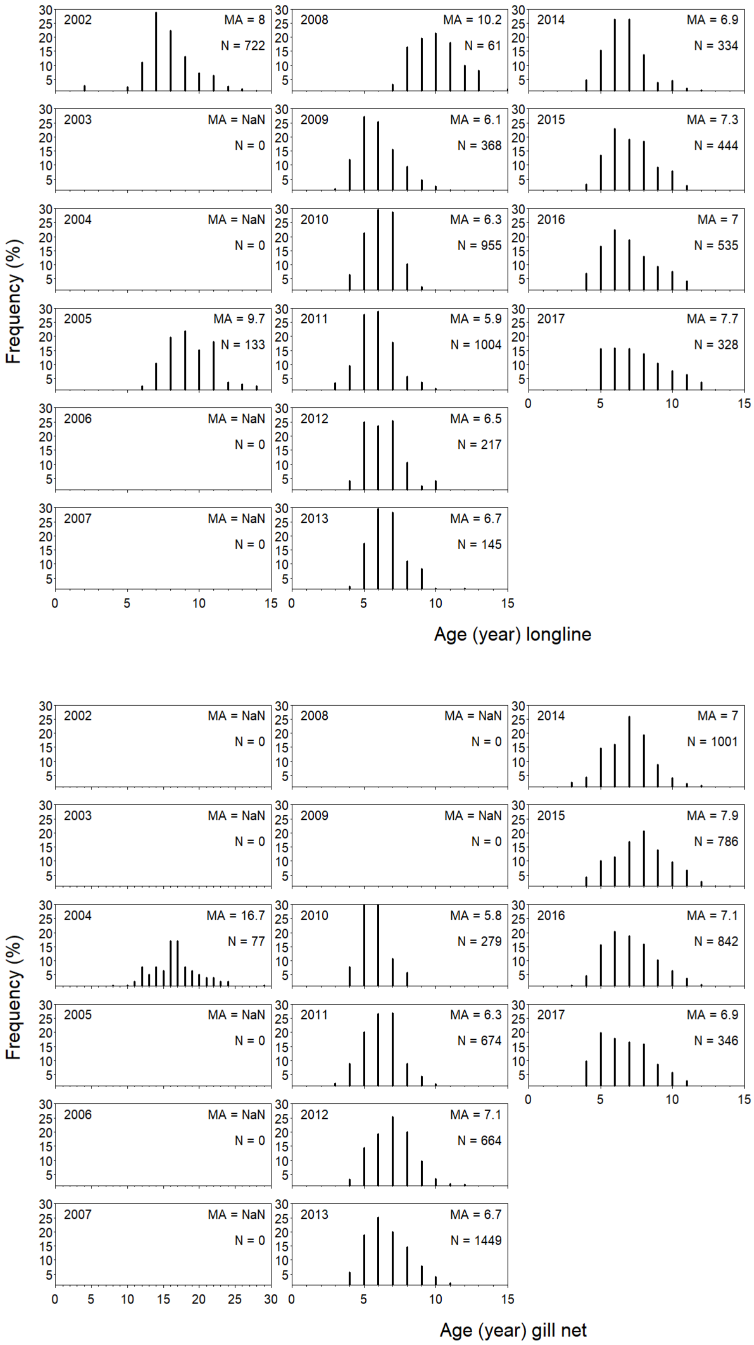


Figure 3.3.6. Ling in Areas 1 and 2, Catch-at-age composition. MA denotes mean age.

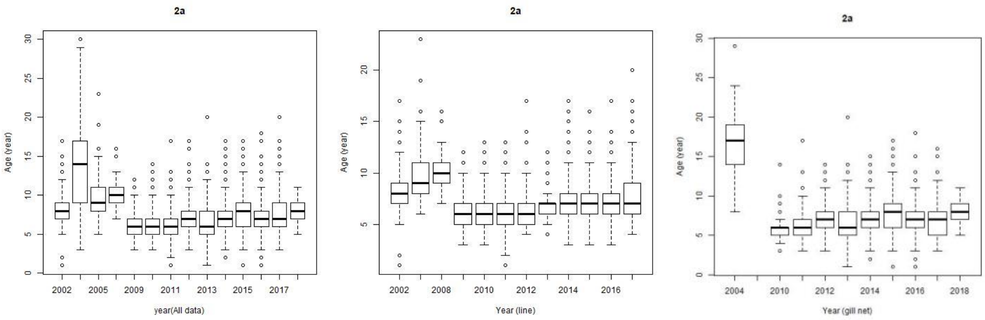


Figure 3.3.7. Age composition of the fish caught by longliners and gillnetters during the period 2002–2018.

3.3.4.4 Length and weight-at-age

Figure 3.3.8 shows the average mean length and mean weight-at-age for the years 2009–2018.

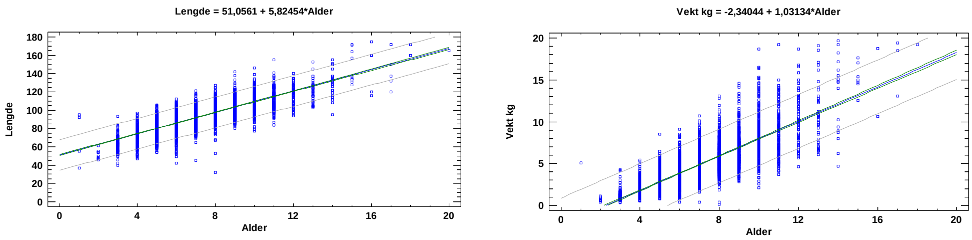


Figure. 3.3.8. Average mean length and mean weight versus age for the period 2010–2018.

3.3.4.5 Maturity and natural mortality

Maturity ogives for ling are in Figure 3.3.9 and in the following table. The results fit well with previous observations that ling reach maturity between ages 5–7 (60–75 cm) in most areas, while males reach maturity at a slightly younger age than females (Magnusson *et al.*, 1997).

Maturity parameters:

Stock	L50	N	A50	N	Source
Lin-arct	73.0	1540	7.0	769	Norwegian long liners (Reference fleet) and survey data

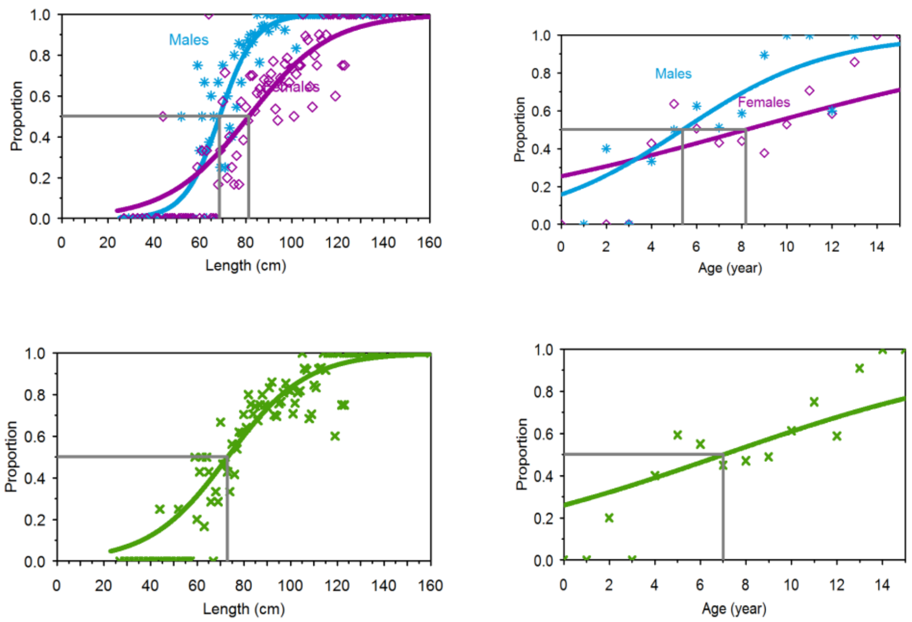


Figure 3.3.9. Maturity ogives for ling in Areas 1 and 2: males and females (upper panel) and for males and females combined (lower panel).

3.3.4.6 Catch and effort data

Two standardized cpue series for 2000–2018 for Norwegian longliners are in Figure 3.3.10. One series was based on all the catch data, and the other cpue series used only catches of ling that made up more than 30% of the total catch by weight, that is it is assumed that these were targeted catches. No research vessel data are available.

3.3.5 Data analyses

Length distribution

In Figures 3.3.3 and 3.3.4 are plots of the length distributions in Area 1 and 2 for 2001 to 2018. It appears that the mean length in Area 1 has varied slightly, while the mean length in Area 2a and 2b has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery.

Cpue

Graphs of two standardized GLM-based cpue series estimated based on all the data and based on data for which ling made up more than 30% of the catch are shown in Figure 3.3.10. Both cpue series indicate an upward trend for the entire period. The method is described in Helle *et al.*, 2015.

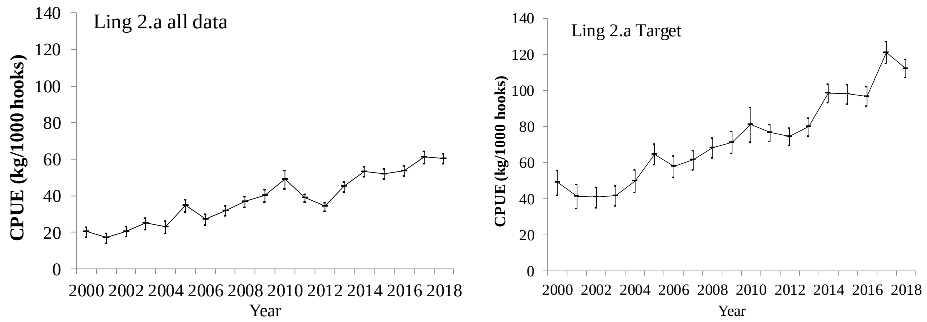


Figure 3.3.10. Estimate of cpue (kg/1000 hooks) for ling in Area 2a based; on all available data, and on catches when ling was considered the target species for 2000–2018. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

3.3.6 Comments on the assessment data analyses

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

3.3.7 Management considerations

The annual catch of ling since 2006 do not appear to have had a detrimental effect on the stock given that cpue continued to increase steadily, and therefore, the current catch levels are considered appropriate.

However, the cod stock in the Barents Sea has been very abundant for several years but now there is a downward trend in the cod stock which results in lower quotas. Because of lower quotas for cod the fishing pressure on ling is expected to increase.

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the ling cpue series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope and pray that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g., Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

3.3.8 Application of MSY proxy reference points

Two different methods were tested for ling in areas 1 and 2: The Length-based indicator method (LBI) and SPiCT.

Length-based indicator method (LBI)
The input parameters and the length distributions of the catches for the period 2001–2018 are in Table 3.3.2 and Figure 3.3.11. The length data used in the LBI model are from the Norwegian gill netter and longline fleet.

Table 3.3.2. Ling in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length–frequency distribution	2001–2018	Norwegian gill netters (Reference fleet) fishing in divisions 1,2a,2b	
Length–weight relation	$0.0055 * length^{3.0175}$	Norwegian Reference fleet and survey data	
L_{MAT}	73 cm	Norwegian Reference fleet and survey data	Sexes combined
L_{inf}	172 cm (L_{max})	Norwegian Reference fleet and survey data	

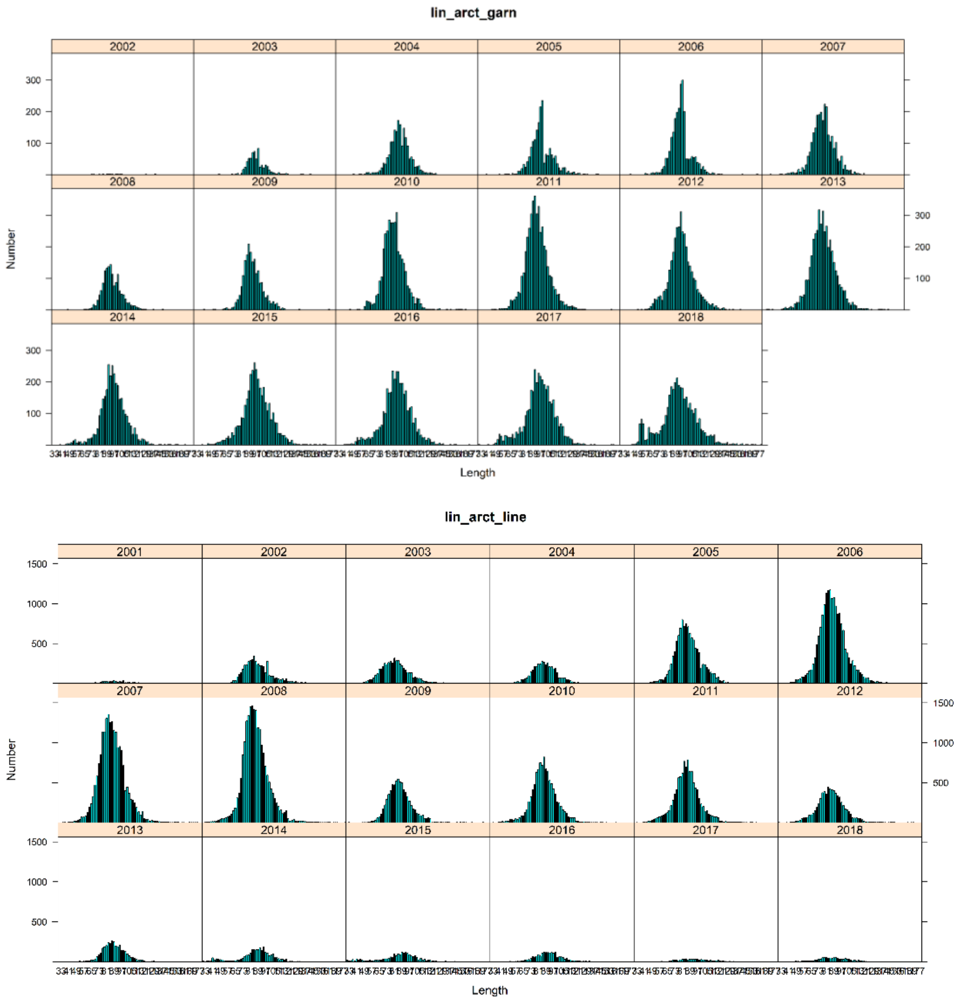


Figure 3.3.11. Ling in arctic waters (1, 2.a, 2.b), upper palel is length data from gillnetters, lower is from longliners. Catch length distributions, 2 cm length classes, for the period 2001–2018 (sex combined).

Outputs from the screening of length indicator ratios for combined sexes under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield, for ling from the gillnet and longline fishery are in Figures 3.3.12a and b.

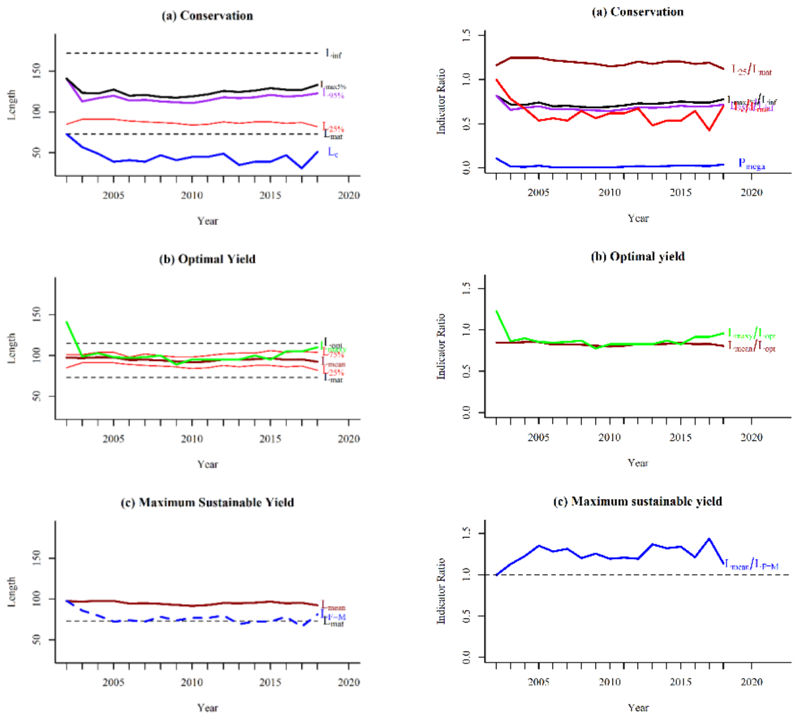


Figure 3.3.12a. Ling from gillnetters in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

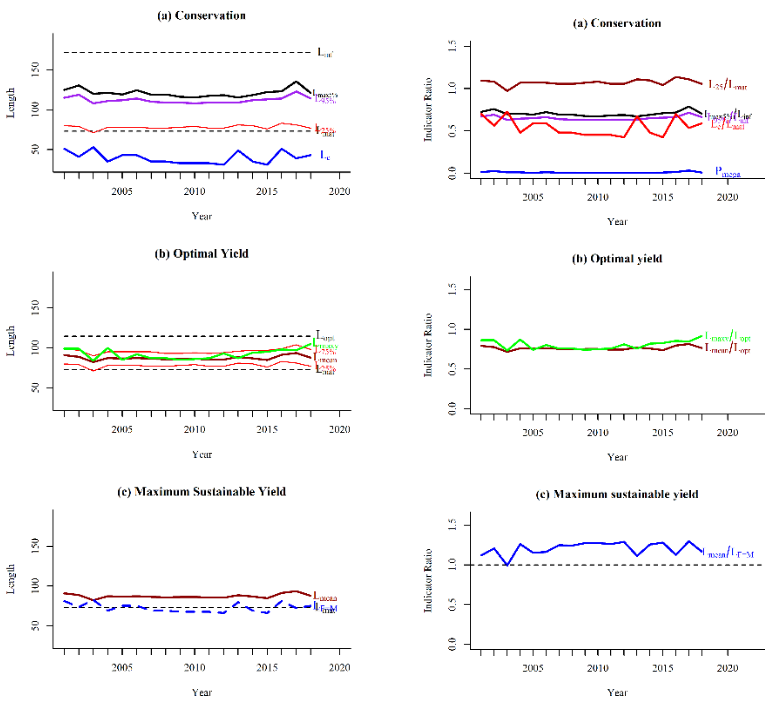


Figure 3.3.12b. Ling from longliners in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

Analysis of results

The results using length data from gillnet and longline fishery showed the same trend. The model for the conservation of immature ling shows that L_c/L_{mat} is usually less than one, but $L_{25\%}/L_{mat}$ is usually greater than 1 (Figure 3.3.12). In 2014–2018, $L_{25\%}/L_{mat}$ was also greater than 1 (Table 3.3.3), therefore there is no indication that immature ling are being overfished.

For the status for large ling, the model shows that the indicator ratio of $L_{max5\%}/L_{inf}$ is around 0.7 for the whole period (Figure 3.3.12) and between 0.74 and 0.78 in 2016–2018 (Table 3.3.3), which is less than the limit of 0.8 suggesting that there is a lack of mega-spawners in the catch, which indicates that there is a truncation point in the length distribution. The mean length of ling in the catch is lower than the mean length for optimizing yield.

The MSY indicator ($L_{mean}/L_{F=M}$) is greater than 1 for almost the whole period (Figure 3.3.12), which indicates that ling in arctic waters are fished sustainably. Regarding model sensitivity, the MSY value was always greater than 0.90.

Conclusion: The overall perception of the stock during the period 2016–2018 is that ling in arctic waters seems to be fished sustainably (Table 3.3.3a and b). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 3.3.3a. Ling (gillnetters)in arctic waters (1, 2.a, 2.b). The final results from the LBI method.

Traffic light indicators

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	$L_{mean}/L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2016	0,64	1,18	0,74	2 %	0,83	1,21
2017	0,42	1,19	0,74	2 %	0,83	1,44
2018	0,70	1,12	0,78	4 %	0,81	1,14

Table 3.3.3a. Ling (longliners)in arctic waters (1, 2.a, 2.b). The final results from the LBI method.

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	$L_{mean}/L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2016	0,70	1,14	0,72	2 %	0,80	1,12
2017	0,53	1,11	0,79	3 %	0,82	1,30
2018	0,59	1,05	0,70	1 %	0,77	1,17

Table 3.3.4 Ling in arctic waters (1, 2.a, 2.b). Stock status inferred from LBI for MSY. Green tick marks for MSY are provided because the $L_{mean}/L_{F=M}$ > 1 in each year. Stock size is unknown as this method only provides exploitation status.

	Fishing pressure			
	2016	2017	2018	
MSY (F/F_{MSY})	✓	✓	✓	Fished sustainably

	Stock size			
	2016	2017	2018	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

<u>Results for the SPiCT model</u>:

The first run was carried out with standard settings in SPICT, and with catch data and CPUE for all available years. The model converged, and the plots from the diagnostics looked good, but there were large confidence intervals in the estimates (BMSY, MSY, FMSY, and K) (Tables 3.3.4 and 3.3.5).

There were 8 runs where the parameters n, α and β were varied and the landings period varied (Table 3.3.4). Overall, run number 2 was considered the best since the confidence intervals were smallest (Table 3.3.4). This run was made without priors.

The model estimates MSY of 13998 tons. The advice for 2018 and 2019 was 13 103 tons, so slightly above the advice. Associated estimated BMSY was 80 538 tons, and FMSY was 0.174. The estimated carrying capacity (K) was about 132 000 tons.

The model indicates that the stock abundance is greater than BMSY and the fishing mortality is less than FMSY and will remain less than FMSY if future catches continue to be kept at the same level as in the previous years. The traffic light figure shows that the stock started in the red zone and are now in the green zone (Figure 3.3.13). This corresponds to the current perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality. The retrospective plot showed that the test is not very robust.

Table 3.3.5. Ling in Subareas 1 and 2

Run	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	***9***
Landings period	1988-2018							2000-2018	
CPUE	2000-2018							2000-2018	
Parameter settings									
n	mod.est	no priors	2	mod.est	2	2	2	mod.est	no priors
Alfa	mod.est	no priors	1	1	mod.est	1	4	mod.est	no priors
Beta	mod.est	no priors	1	1	mod.est	mod.est	1	mod.est	no priors
Convergence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parameter estimates									
Bmsy	48542	80538	64042	48620	98957	331	118405	198287	298082
cilow	2365	2631	3710	1494	3140	245	7912	549	742
cihigh	996345	2465206	1105588	1582100	3118945	449	1772027	71560310	119692700
MSY	12294	13998	12923	12227	14917	9607	15881	19473	23913
cilow	6370	4985	5768	5813	4606	8668	5599	1376	1047
cihigh	23727	39304	28954	25718	48309	10647	45044	275564	545968
Fmsy	0,253	0,174	0,202	0,248	0,151	28	0,134	0,098	0,080

Run	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	***9***
cilow	0,024	0,015	0,024	0,015	0,015	21	0,025	0,004	0,004
cihigh	2,724	1,913	1,662	3,978	1,504	41	0,732	2,543	1,460
K	80769	131971	129006	87262	198103	663	237052	350183	530407
cilow	3753	3822	7391	1103	6290	490	15816	1379	607
cihigh	1738135	4556695	2251880	6901823	623968	898	3553104	275807	463175100
Diagnostics	OK- (shapiro)	OK	OK- (shapiro)	OK-(shapiro)	OK-(shapiro)	OK	OK-(shapiro)	OK	OK
Retrospective	negative	negative	OK	OK-	negative	negative	OK	negative	negative

Table 3.3.5. Ling in Subareas 1 and 2

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: -6.5146433
Euler time step (years):  1/16 or 0.0625
Nobs C: 30,  Nobs I1: 19

No priors are used

Model parameter estimates w 95% CI
       estimate       cilow       ciupp    log.est
 alpha  1.946440e+01    0.0084974 4.458573e+04  2.9685873
 beta   1.088478e+00    0.3942173 3.005409e+00  0.0847804
 r      6.233445e-01    0.0261604 1.485289e+01 -0.4726560
 rc     3.476386e-01    0.0315744 3.827548e+00 -1.0565919
 rold   2.410305e-01    0.0229820 2.527876e+00 -1.4228317
 m      1.399969e+04 4986.4968706 3.930441e+04  9.5467904
 K      1.319718e+05 3822.1873644 4.556695e+06 11.7903432
 q      1.219800e-03    0.0000530 2.806500e-02 -6.7090983
 n      3.586164e+00    0.6997288 1.837937e+01  1.2770831
 sdb    4.617200e-03    0.0000021 1.021726e+01 -5.3779644
 sdf    1.014038e-01    0.0474830 2.165558e-01 -2.2886449
 sdi    8.987130e-02    0.0633502 1.274951e-01 -2.4093772
 sdc    1.103758e-01    0.0738236 1.650260e-01 -2.2038645

Deterministic reference points (Drp)
       estimate       cilow       ciupp    log.est
 Bmsyd 8.054163e+04 2631.4654115 2.465149e+06 11.296530
 Fmsyd 1.738193e-01    0.0157872 1.913774e+00 -1.749739
 MSYd  1.399969e+04 4986.4968706 3.930441e+04  9.546790
Stochastic reference points (Srp)
       estimate       cilow       ciupp    log.est  rel.diff.Drp
 Bmsys 8.053826e+04 2631.1850571 2.465206e+06 11.296488 -4.184835e-05
 Fmsys 1.738056e-01    0.0157874 1.913452e+00 -1.749818 -7.876586e-05
 MSYs  1.399800e+04 4985.2225680 3.930499e+04  9.546670 -1.204398e-04

States w 95% CI (inp$msytype: s)
                    estimate       cilow       ciupp    log.est
 B_2018.00      9.361188e+04 3920.5509349 2.235192e+06 11.4469126
 F_2018.00      1.048495e-01    0.0043894 2.504540e+00 -2.2552296
 B_2018.00/Bmsy 1.162328e+00    0.7533638 1.793299e+00  0.1504249
 F_2018.00/Fmsy 6.032570e-01    0.2515450 1.446736e+00 -0.5054119

Predictions w 95% CI (inp$msytype: s)
                  prediction       cilow       ciupp    log.est
 B_2019.00        9.644965e+04 3778.1278761 2.462207e+06 11.4767763
 F_2019.00        1.099475e-01    0.0047744 2.531909e+00 -2.2077520
 B_2019.00/Bmsy   1.197563e+00    0.8477587 1.691704e+00  0.1802887
 F_2019.00/Fmsy   6.325890e-01    0.2716378 1.473171e+00 -0.4579343
 Catch_2019.00    1.071500e+04 8026.5032832 1.430402e+04  9.2794002
 E(B_inf)         1.042643e+05           NA           NA 11.5546846
```

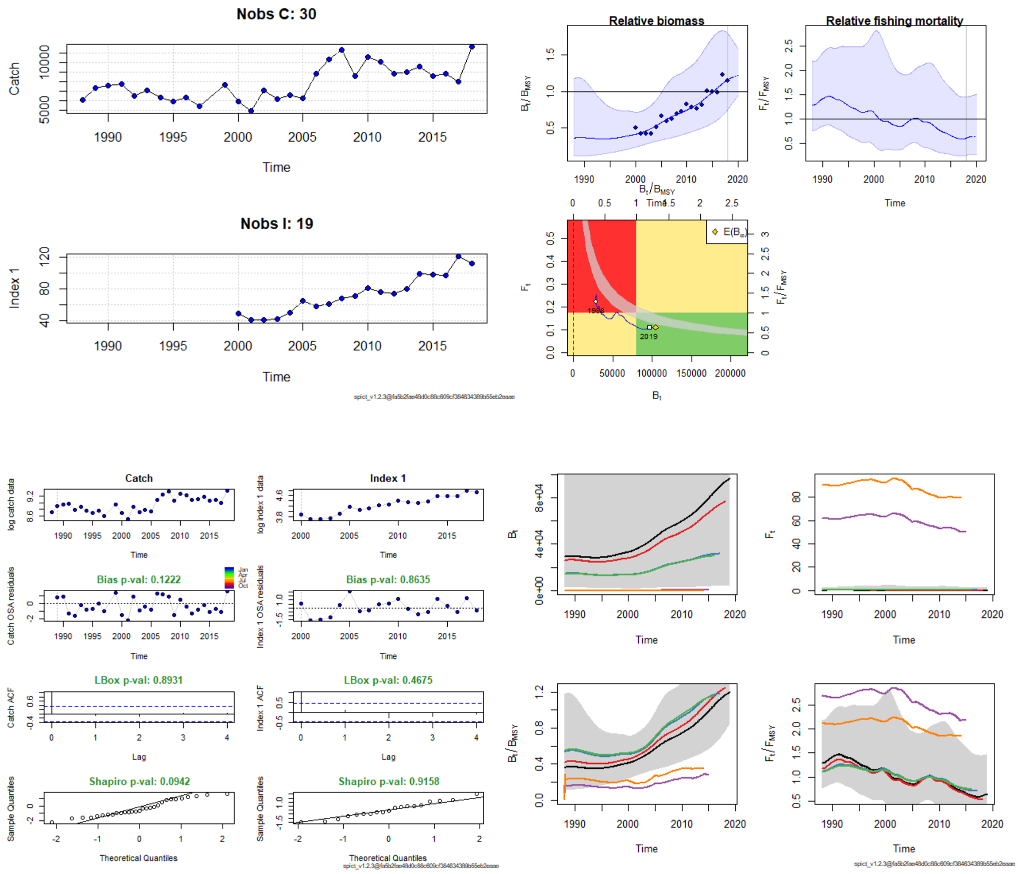


Figure 3.3.13. Ling in Subareas 1 and 2. Upper left corner shows the input data for the model, upper right corner the model output, lower left corner the model diagnostics and the lower right corner the retrospective analysis.

3.3.9 Tables

Table 3.3.1a. Ling 1.a and b. WG estimates of landings.

Year	Norway	Iceland	Scotland	Faroes	France	Total
1996	136					136
1997	31					31
1998	123					123
1999	64					64
2000	68	1				69
2001	65	1				66
2002	182		24			206
2003	89					89
2004	323			22		345
2005	107					107
2006	58					58
2007	96					96
2008	55					55
2009	236					236
2010	57					57
2011	129					129
2012	158					158
2013	126					126
2014	122				1	123
2015	93					93
2016	65					65
2017	43					43
2018*	34					34

Preliminary. Table 3.3.1b. Ling 2a. WG estimates of landings.

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Spain	Greenland	Poland	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

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Spain	Greenland	Poland	Total
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	1	2	7	8189	0	19	17						8244
2010	10	0	18	10 318	0	2	47						10 395
2011	4	6	6	9763			19						9798
2012	21	6	9	8334		7	45		3				8425
2013	7	9	7	8677		1	114		4				8819
2014	3	13	3	9245			73						9337
2015	10	5	4	8220		3	115		5				8362
2016	18	6	11	8523	2	3	112		8	2	9	6	8700
2017	17	13	8	7684		3	150		15		4	6	7900
2018*	13	12	17	11160			129		4		1	5	11341

*** *Preliminary. Table 3.3.1c. Ling 2b. WG estimates of landings.**

Year	Norway	E & W	Faroes	France	Total
1988		7			7
1989		-			
1990		-			
1991		-			
1992		-			
1993		-			
1994		13			13
1995		-			
1996	127	-			127
1997	5	-			5
1998	5	+			5
1999	6				6
2000	4	-			4
2001	33	0			33
2002	9	0			9
2003	6	0			6
2004	77				77
2005	93				93
2006	64				64
2007	180		0		180
2008	162	0	0		162
2009	84				84
2010	128				128
2011	164			7	171
2012	266				266
2013	76				76
2014	85	52			137
2015	95				95

Year	Norway	E & W	Faroes	France	Total
2016	53				1
2017	28				28
2018*	238				238

*Preliminary.

Table 3.3.1d. Ling 1 and 2. Total landings by subarea or division.

Year	1	2.a	2.b	All areas
1988		6119	7	6126
1989		7368		7368
1990		7628		7628
1991		7793		7793
1992		6521		6521
1993		7093		7093
1994		6309	13	6322
1995		5954		5954
1996	136	6083	127	6346
1997	31	5373	5	5409
1998	123	9072	5	9200
1999	64	7581	6	7651
2000	69	5891	4	5964
2001	66	4858	33	4957
2002	206	6917	9	7132
2003	89	6062	6	6157
2004	345	6138	77	6560
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	161	11 346
2009	236	8244	84	8564
2010	57	10395	128	10580
2011	129	9798	171	10098
2012	158	8425	266	8849
2013	126	8819	76	9021
2014	123	9337	137	9606
2015	93	8362	95	8550
2016	65	8700	54	8819

Year	1	2.a	2.b	All areas
2017	43	7900	28	7971
2018*	34	11341	238	11613

***Preliminary.**

3.4 Ling (*Molva Molva*) in Division 5.a

3.4.1 The fishery

The fishery for ling in 5.a 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 5.a is caught on longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2009–2018. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2007 to around 6% in 2017. Catches in trawls have varied less and have been at around 20% of Icelandic catches of ling in 5.a (Table 3.4.1).

Table 3.4.1. Ling in 5.a. Number of Icelandic boats and catches by fleet segment participating in the ling fishery in 5.a.

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	10 143
2011	151	58	59	5595	241	1677	1279	9060
2012	156	48	58	7477	264	1398	1551	10 952
2013	163	45	57	6781	354	2805	254	10 194
2014	128	30	60	10 342	673	2722	228	13 965
2015	159	44	58	7765	655	1913	1218	11 551
2016	137	46	60	5242	689	1833	820.6	8581
2017	132	40	61	4901	560	1541	700.4	7703
2018	123	38	62	4006	387	1606	701	6700

Most of the ling caught in 5.a by Icelandic longliners is caught at depths less than 300m and by trawlers, less than 400 m (Figure 3.4.1). The main fishing grounds for ling in 5.a as observed from logbooks are in the south, southwestern and western part of the Icelandic shelf (Figure 3.4.2). The main trend in the spatial distribution of ling catches in 5.a 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 3.4.3). In recent years the main fishing pressure has shifted towards shallower waters (Figure 3.4.1).

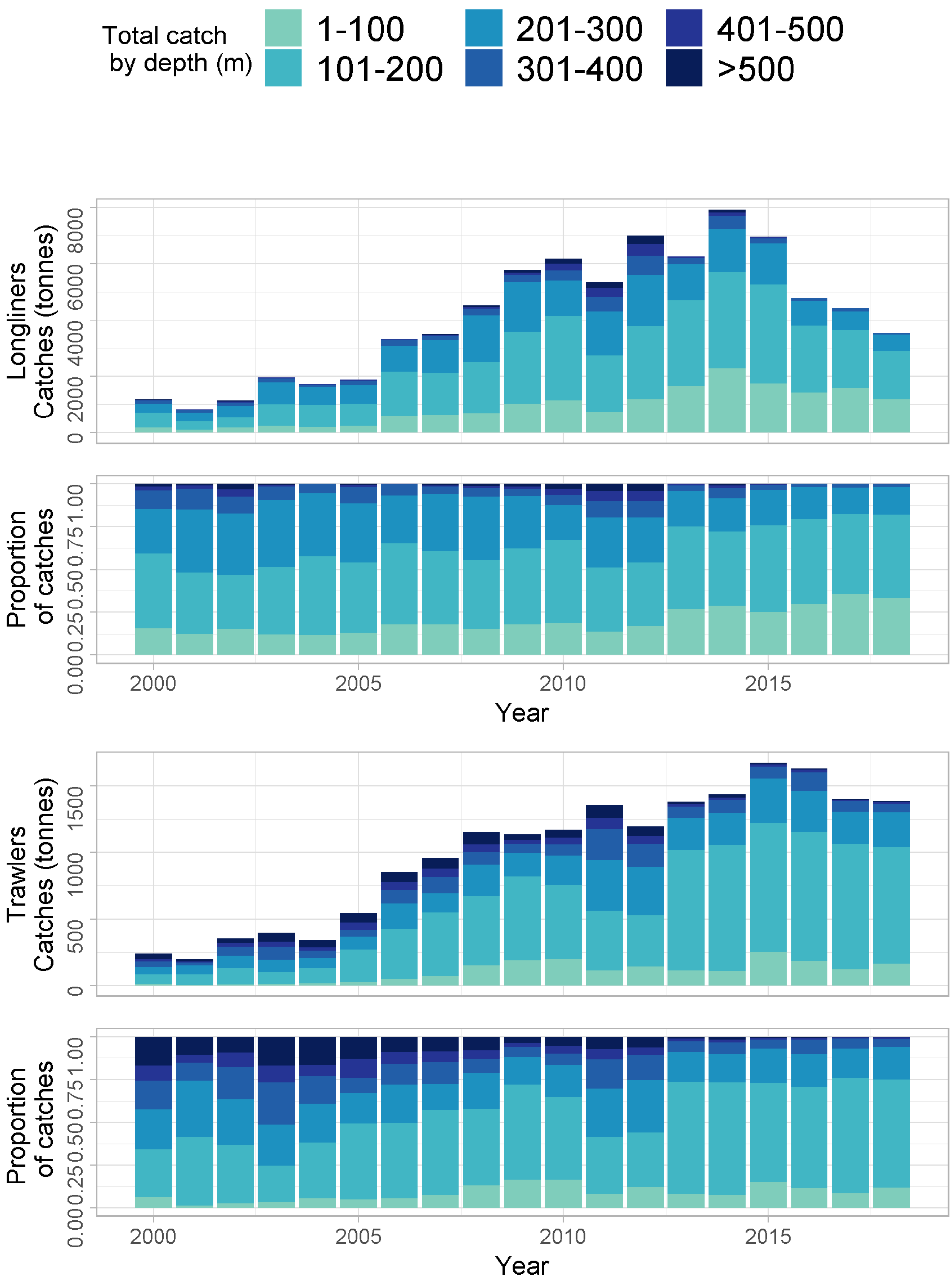


Figure 3.4.1. Ling in 5.a. Depth distribution of ling catches from longlines, trawls and gillnets from Icelandic logbooks.

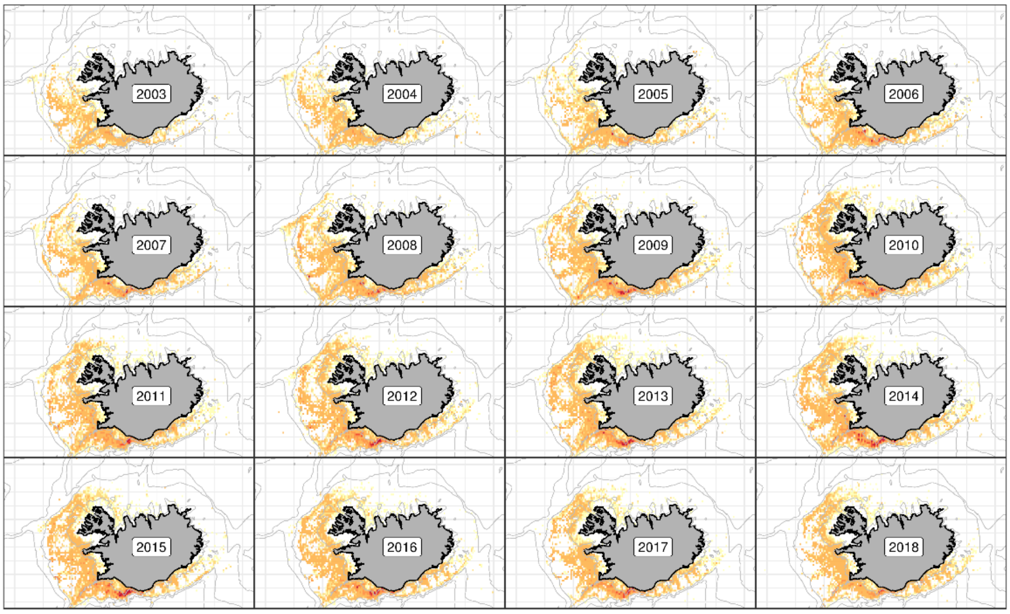


Figure 3.4.2. Ling in 5.a. Geographical distribution (tonnes/square mile) of the Icelandic longline ling fishery since 2003 as reported in logbooks by the Icelandic fleet.

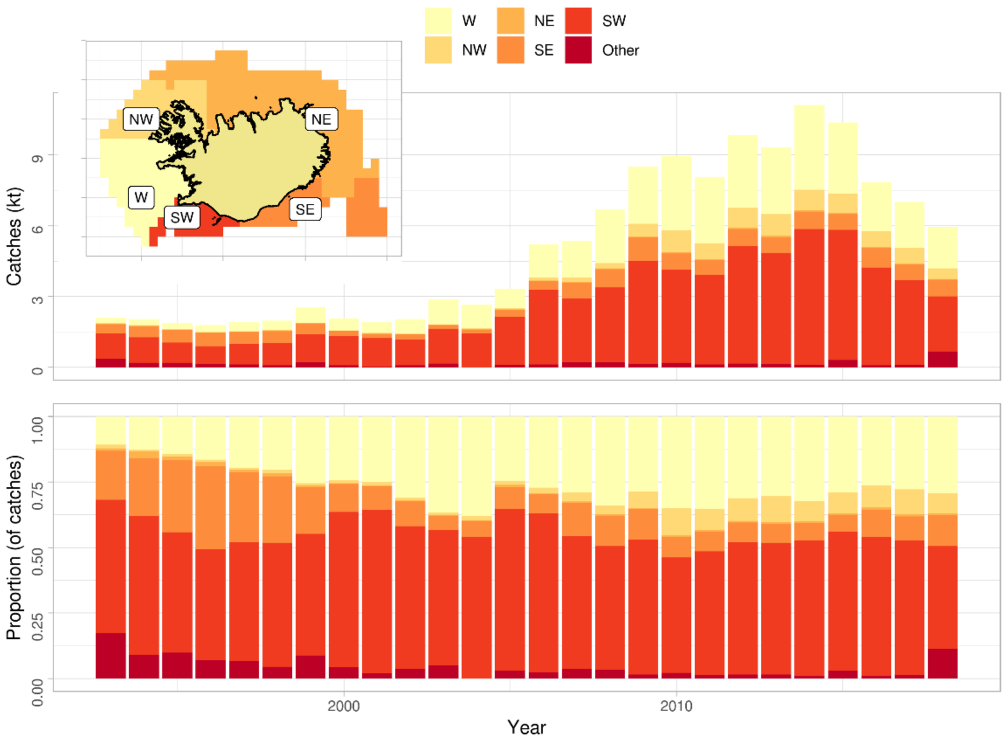


Figure 3.4.3. Ling in 5.a. Changes in spatial distribution of ling catches as recorded in Icelandic logbooks.

3.4.2 Landings trends

In 1950–1971 landings of ling in 5.a 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 by year and reached 11 kt in 2010 and remained at that level until 2014, apart from 2011 catches of 9.6 kt, when the catches increased to 16 kt. This catch level has not been reached since the early seventies. (Table 3.4.6 and Figure 3.4.4).

3.4.3 ICES Advice

The ICES advice for 2019 states: ICES advises on the basis of an MSY approach that catches should be no more than 6 255 t. All catches are assumed to be landed.

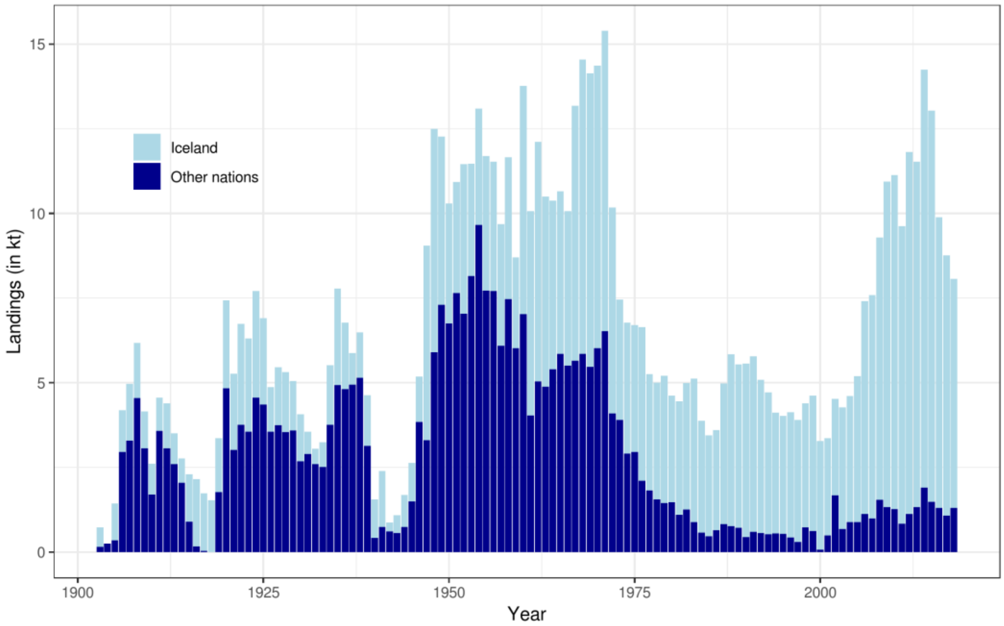


Figure 3.4.4. Ling in 5.a. Nominal landings.

3.4.4 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 5.a has been managed by TAC since the 2001/2002 fishing year.

Landings have exceeded both the advice given by MRI and the set TAC from 2002/2003 to 2012/2013 but amounted to less than two thirds in 2015/2016 (Table 3.4.2). Overshoot in landings in relation to advice/TAC has been decreasing steadily since the 2009/2010 fishing year, with an overshoot of 53% to 35% in 2010/2011, 24% in 2011/2012 and 4% in 2012/2013. 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 5.a.

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

Table 3.4.2. Advice given by MRI, set national TAC by the Ministry of Fisheries and Agriculture and landings by fishing year (1st of September–31st of August).

Fishing year	MRI-advice	National-TAC	Landings
1999/2000			3961
2000/2001			3451
2001/2002	3000	3000	2968
2002/2003	3000	3000	3715
2003/2004	3000	3000	4608
2004/2005	4000	4000	5238
2005/2006	4500	5000	6961
2006/2007	5000	5000	7617
2007/2008	6000	7000	8560
2008/2009	6000	7000	10 489
2009/2010	6000	7000	10 713
2010/2011	7500	7500	10 095
2011/2012	8800	9000	11 133
2012/2013	12 000	11 500	12 445
2013/2014	14 000	13 500	14 983
2014/2015	14 300	13 800	13 166
2015/2016	16 200	15 000	9769
2016/2017	9343	8143	8336
2017/2018	8598	8598	8573
2018/2019	6255		

3.4.5 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).

3.4.5.1 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.

3.4.5.2 Length compositions

An overview of available length measurements is given in Table 3.4.4. Most of the measurements are from longlines. The number of available length measurements increased until 2014 in line with increased landings, followed by an annual decrease for the same reason. Length distributions from the Icelandic longline and trawling fleet are presented in Figure 3.4.5.

Table 3.4.4. Ling in 5.a. Number of available length measurements from Icelandic commercial catches.

Year	Longlines	Gillnets	D. Seine	Trawls	Sum
2000	1624	566	0	383	2573
2001	1661	493	0	37	2191
2002	1504	366	0	221	2091
2003	2404	300	0	280	2984
2004	2640	348	46	141	3175
2005	2323	31	101	499	2954
2006	3354	645	0	1558	5557
2007	3661	0	76	400	4137
2008	5847	357	15	969	7188
2009	9014	410	0	966	10 390
2010	7322	57	0	2345	9724
2011	7248	0	150	1995	9393
2012	12 770	85	150	2748	15 753
2013	10 771	267	122	2337	13 497
2014	6448	1286	120	5053	13 610
2015	3315	1563	0	5667	10 545
2016	2483	2039	0	3673	8195
2017	1636	485	0	3189	5310
2018	1424	559	0	2315	4298

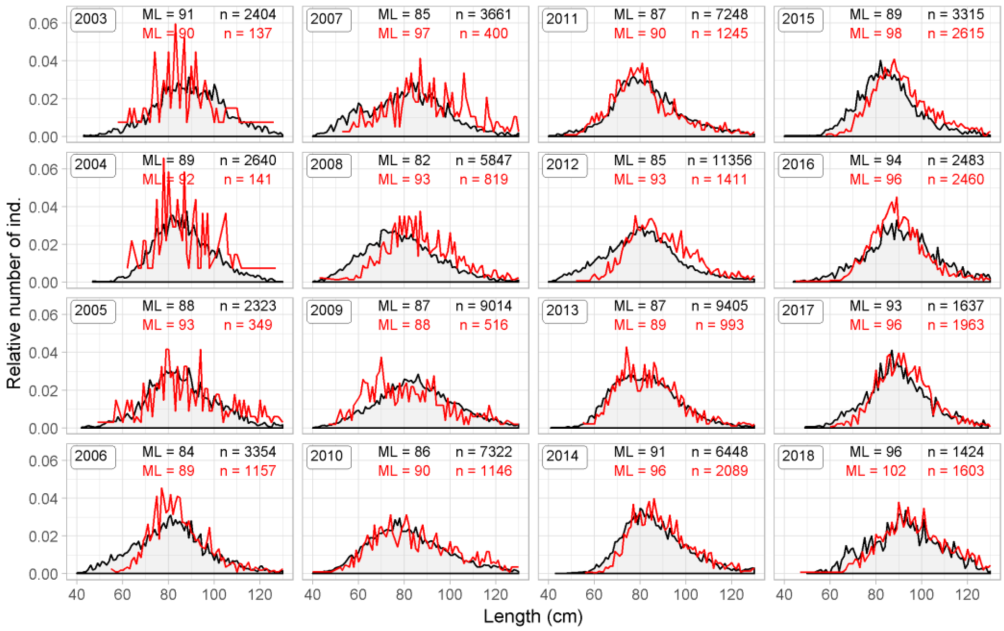


Figure 3.4.5. Ling in 5.a. Length distributions from the Icelandic longline fleet (black line with shaded area) and trawls (red lines).

3.4.5.3 Age compositions

A limited number of otoliths collected in 2010 were aged and a considerable difference in growth rates was observed between the older data and the 2010 data (WGDEEP, 2011:WD07). Substantial progress has been made since 2010. Now aged otoliths are available from the 2000 onwards (Table 3.4.5). Most of the ling caught in the Icelandic spring survey is between age 5 and 8 but from longlines the age is between 6 and 9.

Table. 3.4.5. Ling in 5.a. Number of available aged otoliths from the commercial catches.

YEAR	LONGLINES	GILLNETS	D. SEINE	TRAWLS	TOTAL
2000	650	200	0	150	1000
2001	550	193	0	37	780
2002	519	166	0	150	835
2003	900	100	0	150	1150
2004	750	100	46	100	996
2005	750	0	0	231	981
2006	1137	288	0	550	1975
2007	1300	0	50	100	1450
2008	1950	150	0	365	2465
2009	2550	150	0	400	3100
2010	2498	50	0	850	3398
2011	2546	0	50	700	3296
2012	4031	50	50	941	5072
2013	2863	100	50	800	3813
2014	743	225	20	913	1901
2015	595	300	0	1003	1898
2016	440	345	0	680	1465
2017	310	85	0	595	990
2018	244	100	0	409	453

3.4.5.4 Weight-at-age

No data available.

3.4.5.5 Maturity and natural mortality

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

No information is available on natural mortality of ling in 5.a, set to 0.15 in the analytical assessment.

3.4.5.6 Catch, effort and research vessel data

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

The cpue estimates of ling in 5.a have not been considered representative of stock abundance.

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 groundfish surveys is given in the stock annex.

Figure 3.4.5 shows both a recruitment index and the trends in biomass from both surveys. Length distributions from the spring survey are shown in Figure 3.4.6 (abundance) and changes in spatial distribution the spring survey are presented in Figure 3.4.7.

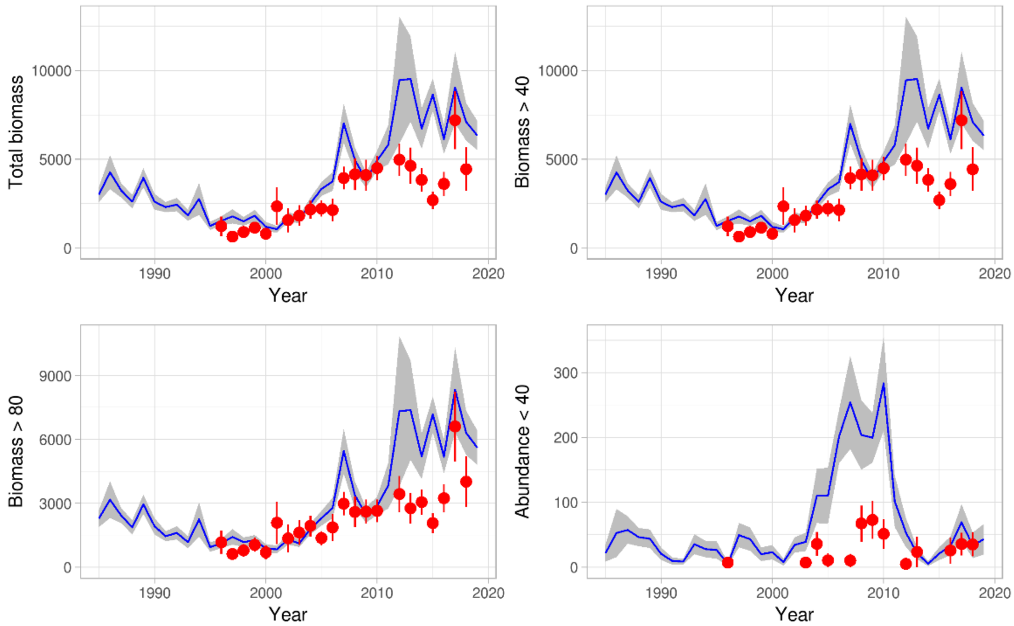


Figure 3.4.5. Ling in 5.a. Shown are a) Total biomass indices, b) biomass indices larger than 40 cm, c) biomass indices larger than 80 cm and d) abundance indices smaller than 40 cm. The lines with shades show the spring survey index from

1985 and the points with the vertical lines show the autumn survey from 1997. The shades and vertical lines indicate +/- standard error.

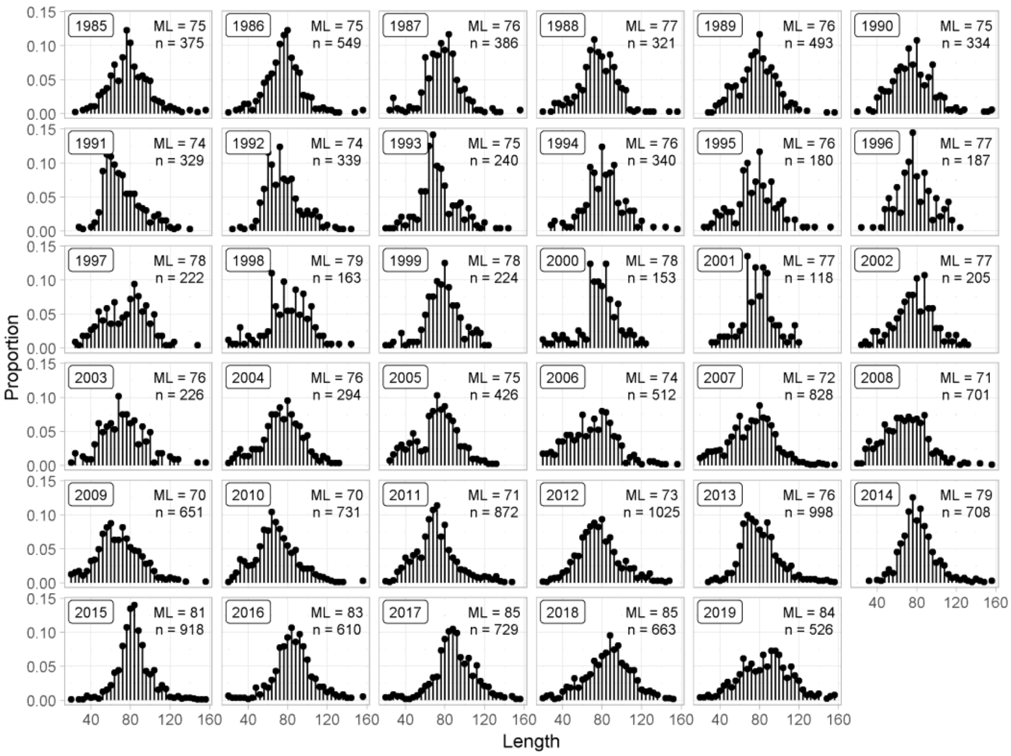


Figure 3.4.6. Ling in 5.a. Abundance indices by length (3 cm grouping) from the spring survey since 1985.

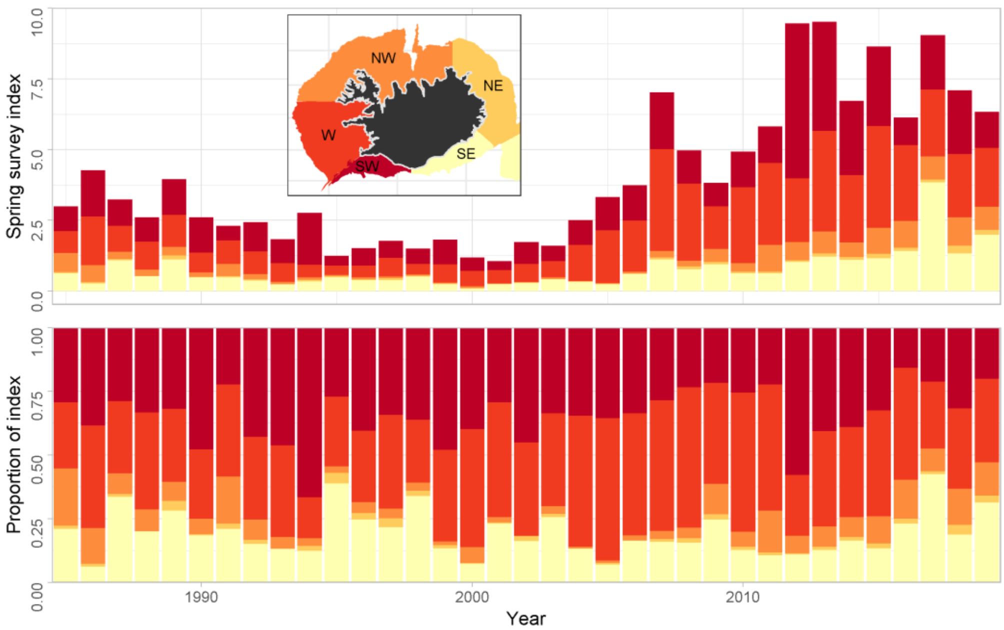


Figure 3.4.7. Ling in 5.a. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

3.4.6 Data analysis

There have been no marked changes in the number of boats participating in the ling fishery in 5.a. Most of ling catches are taken at depths less than 300 meters (Figure 3.4.1). 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 3.4.2 and 3.4.3).

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 3.4.5). This may be the result of increased recruitment in recent years rather than increased fishing effort. Mean length has varied in the period 2009 to 2018 between 82–96 cm with no clear trend. 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 9; but from longlines the age is between the ages of 6 to 10.

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 3.4.5). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices increased and have been for the last five years the highest in the time-series. The index of the large ling (80 cm and larger) shows similar trend as the total biomass index (Figure 3.4.5). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003–2007 and but then decreased by around 25% and remained at that level until 2010. Then the juvenile index fell to a very low level in 2014 but has since then started showing signs of an upward trend (Figure 3.4.5). However, the increase in the juvenile index is very uncertain as it is simply some variation in the length distribution of the survey but not a distinct peak (Figure 3.4.6).

The shorter autumn survey shows that biomass indices were low from 1996 to 2000 but have increased since then (Figures 3.4.5). There is a consistency between the two survey series; the autumn survey biomass indices are however derived from substantially fewer ling caught. Also, there is an inconsistency in the recruitment indices (<40 cm), where the autumn survey shows much lower recruitment, in absolute terms compared with the spring survey (Figure 3.4.5). 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.

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, with the exception of 2016 and 2018 when a substantial increase was observed in the southeast area. However, most of the index in terms of biomass comes from the south-western (around 40%) and the south-eastern (around 40%) area. Between 2003 and 2011 most of the index came from the south-west or around 30%. A similar pattern is observed in the autumn survey in terms of increased proportion in the south-east but with the majority of the biomass caught around the western part of the country.

Analytical assessment on Ling using Gadget

In 2014 a model of Ling in 5.a developed in the Gadget framework (see http://www.hafro.is/gadget for further details) was benchmarked for the use in assessment. As part of a Harvest Control Evaluation requested by Iceland this stock was benchmarked in 2017 (WKICEMSE 2017). Several changes were made to the model setup and settings which are described in the Stock Annex.

Data used and model settings

Data used for tuning are given in the stock annex.

Model settings used in the Gadget model for ling in 5.a are described in more detail in the stock annex.

Diagnostics

Observed and predicted proportions by fleet

Overall fit to the predicted proportional length and age–length distributions is close to the observed distributions. (Figures 3.4.7 to 3.4.12). In the initial years of the spring the observed length proportions appear have greater noise in, however as the number of samples caught the noise level decreases. Similarly for gears where only a small portion of the ling catch is caught, such as the gillnet, the overall noise is greater than for those gears with greater number of samples.

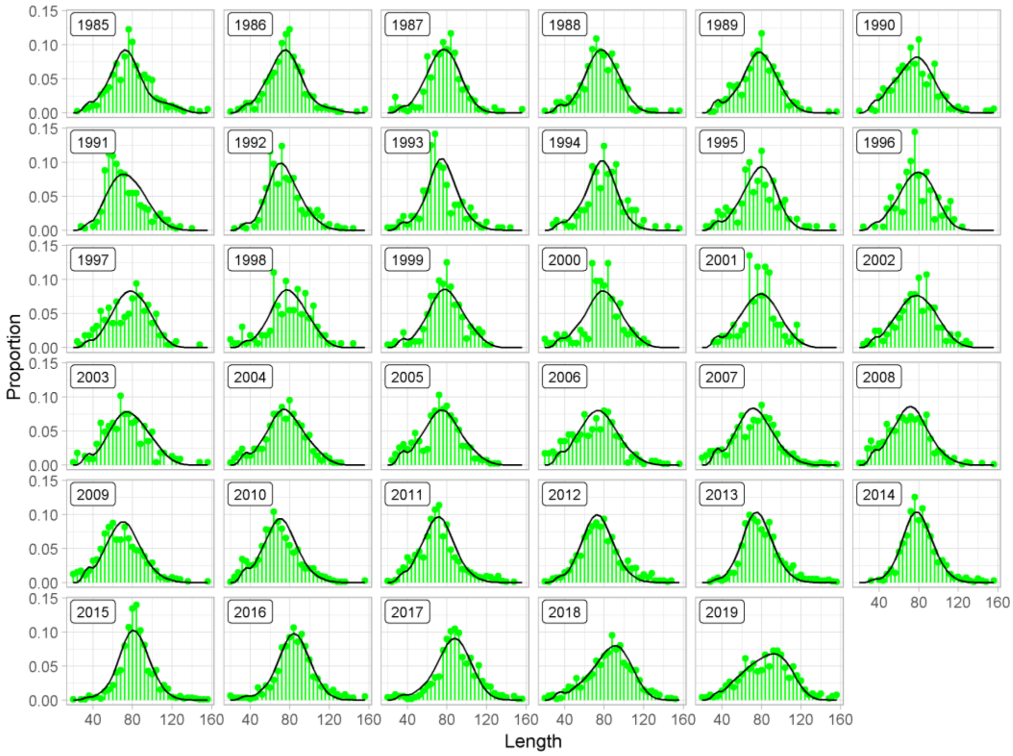


Figure 3.4.7. Ling in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions in the spring survey (green lines and points).

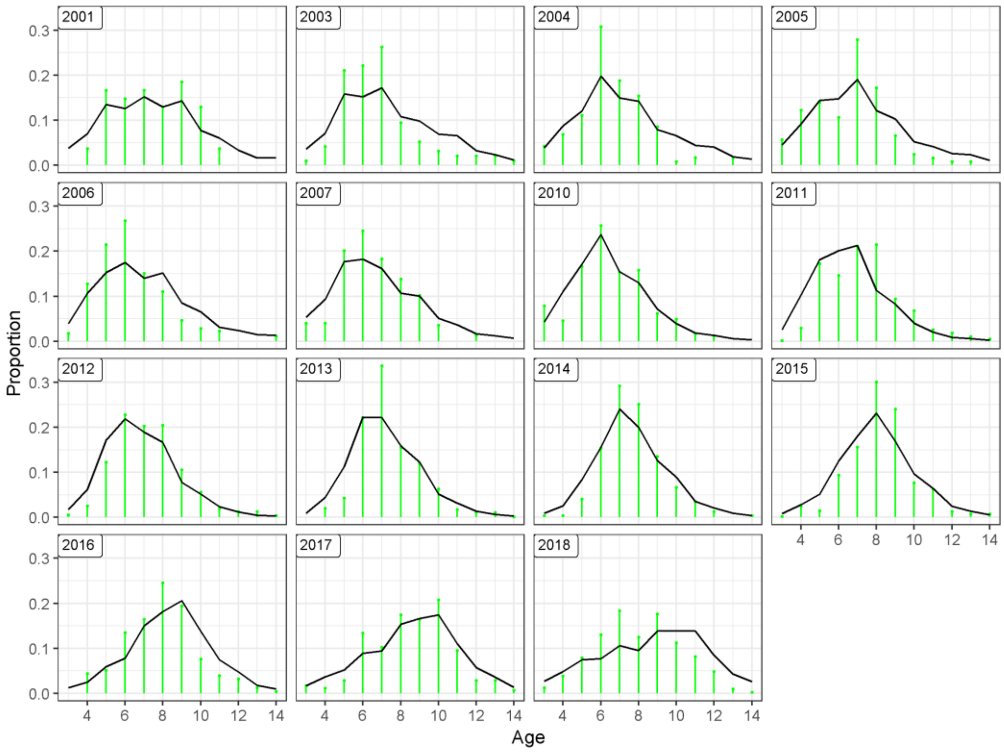


Figure 3.4.8. Ling in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in the spring survey catches (green lines and points).

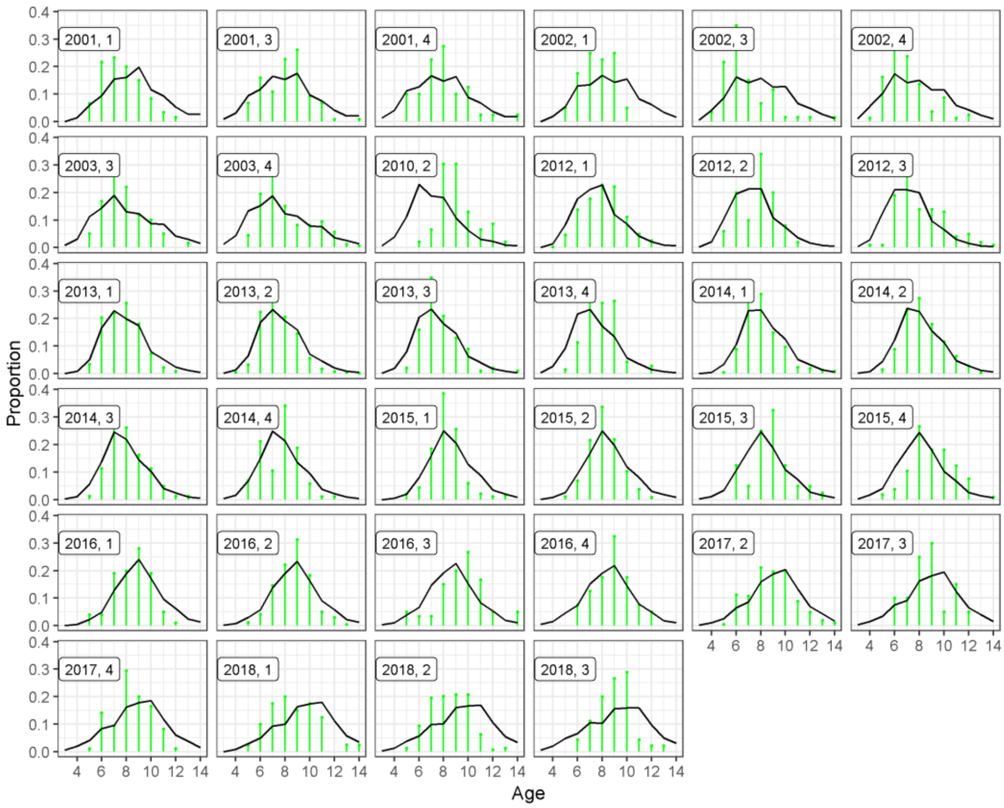


Figure 3.4.9. Ling in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in longlines catches (green lines and points). Each year is split into quarters.

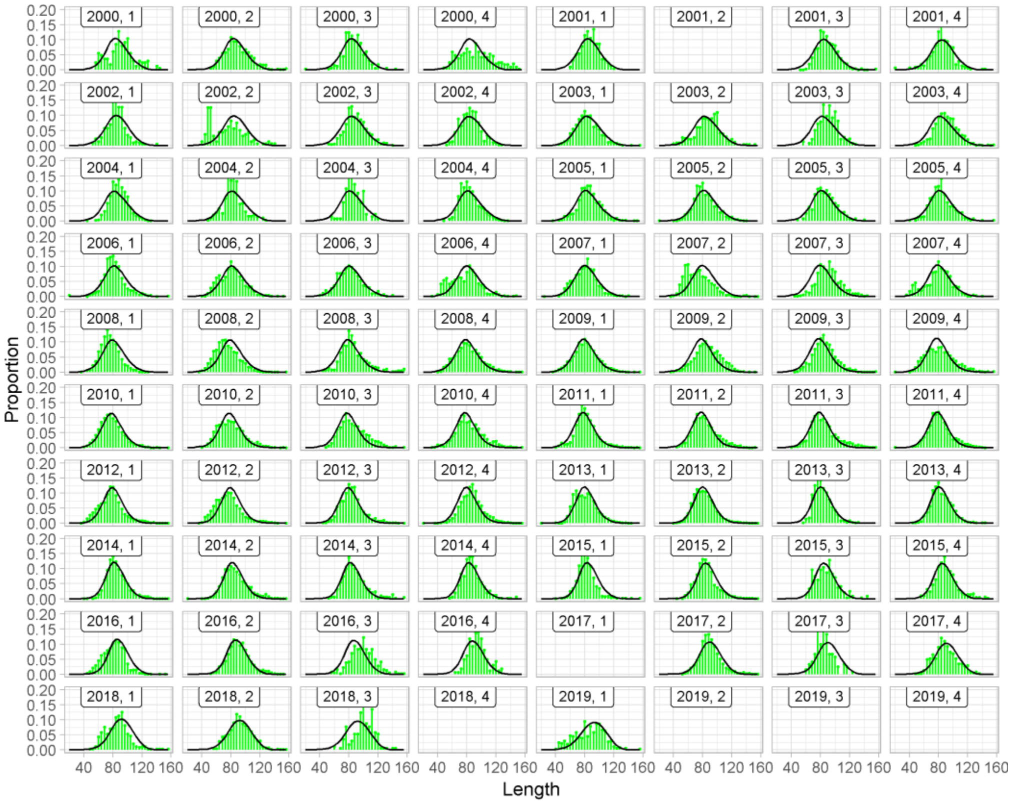


Figure 3.4.10. Ling in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions from longline catches (green lines and dots).

Model fit

Figure 3.4.13 shows the overall fit to the survey indices described in the stock annex. In general, the model appears to follow the stock trends historically. Furthermore, the terminal estimate is not seen to deviate substantially from the observed value for most length groups, with model overestimating the abundance in the two largest length groups. Looking at the first three length groups (20–50, 50–60, 60–70) the model appears to discount the recruitment peak observed between 2005 and 2010 as the increase is not observed in the bigger length classes to the same degree. Summed up over survey biomass the model overestimates the biomass in the terminal years.

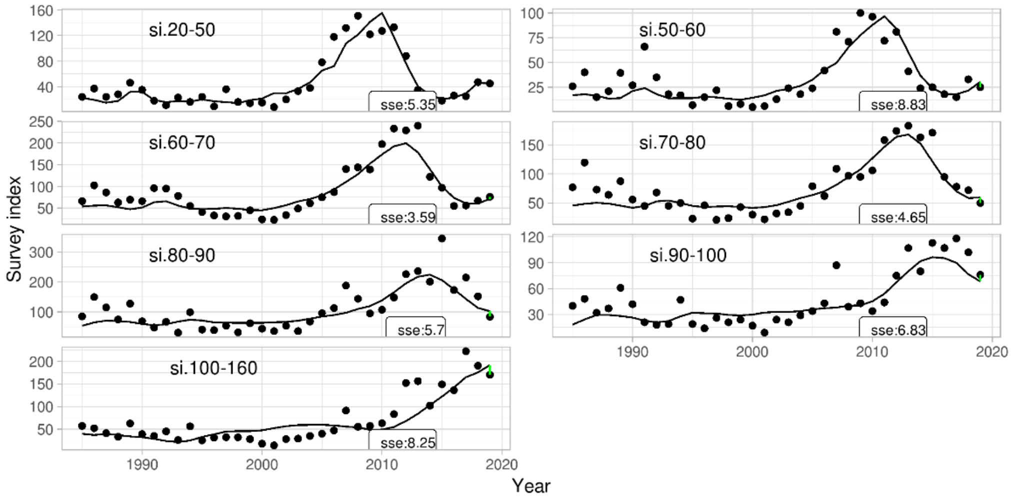


Figure 3.4.13. Fitted spring survey index by length group from the Gadget model (black line) and the observed number of ling caught in the survey (dotted line). The green line indicates the difference between the terminal fit and the observations.

Results

The results are presented in Table 3.4.7 and Figures 3.4.14 and 3.4.16. Recruitment peaked in 2009 to 2010 but has decreased and was estimated in 2013 to 2015 to be at low level. Since then recruitment has increased somewhat. Spawning–stock biomass has increased since 2000 and was in 2014 estimated the highest SSB estimate in the time-series with a slight decrease since then. Similarly, harvestable biomass was in 2014 estimated at its highest level in the time-series. Fishing mortality for fully selected ling (age 14–19) has decreased from 0.66 in 2009 to about 0.20 in 2019.

This year's assessment shows a downward revision of SSB and an upward revision of fishing mortality compared to the 2014 and 2015 assessments (Figure 3.4.15). The reason for this revision is the 'one-way trip' in the data and as the model is now getting closer to the terminal total survey index there is a downward revision of biomass. Therefore, when running an analytical retrospective analysis, a very similar pattern is observed (Figure 3.4.16). Nevertheless, some slight inconsistencies were found in input data and catches used in the model. The catches in the model have been updated with official ICES catches as presented in Table 3.4.6.

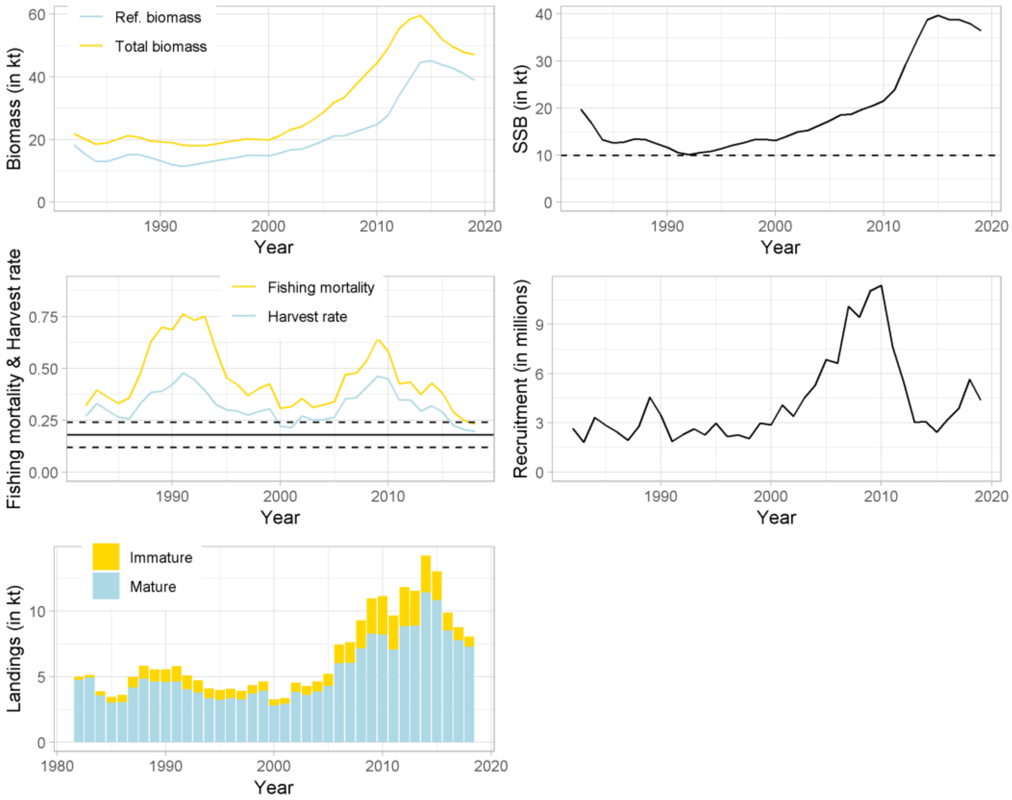


Figure 3.4.14. Ling in 5.a. Estimated biomass, fishing mortality, recruitment and total catches.

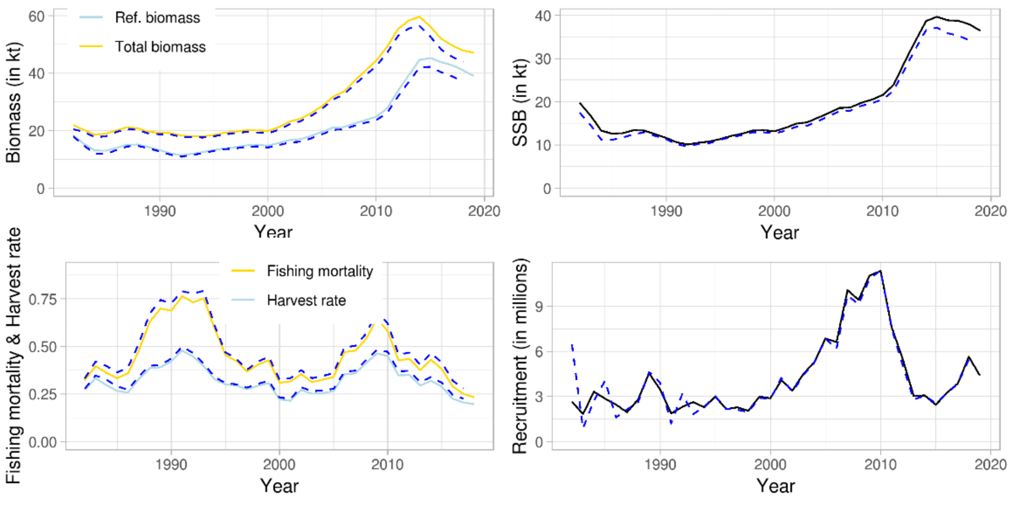


Figure 3.4.15. Ling in 5.a. Estimated biomass, fishing mortality, recruitment and total catches this year compared with the previous assessment (dotted line).

Reference points

At the WKDEEP-2014 benchmark meeting for ling in 5.a the following reference points were adopted.

REFERENCE POINT	VALUE	TECHNICAL BASIS
MSY $B_{trigger}$	9.5	Based on B_{pa}
F_{MSY}	0.24	Based on stochastic simulations
B_{lim}	8.6	Median of the lowest SSB
B_{pa}	9.5	Based on the 97.5% quantile of the lowest SSB

As part of the WKICEMSE 2017 HCR evaluations the following reference points were defined for the stock.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	9.93 kt	B_{pa}
	H_{msy}	0.24	The harvest rate that maximises the median long-term catch in stochastic simulations with recruitment drawn from a block bootstrap of historical recruitment scaled according to a hockey stick recruitment function with B_{loss} as defined below.
	F_{msy}	0.284	The median fishing mortality when an harvest rate of H_{msy} is applied.
Precautionary approach	B_{lim}	7.09 kt	$B_{pa}/e^{1.645\sigma}$ where $\sigma = 0.2$
	B_{pa}	9.93 kt	SSB(1992), corresponding to B_{loss}
	H_{lim}	0.56	H corresponding to 50% long-term probability of SSB $> B_{lim}$
	F_{lim}	0.70	F corresponding to H_{lim}
	F_{pa}	0.41	$F_{lim}/e^{1.645\sigma}$ where $\sigma = 0.33$
	H_{pa}	0.35	H corresponding to F_{pa}
Management plan	H_{mp}	0.18	H from the MP.

The management plan proposed by Iceland is:

> The spawning–stock biomass trigger (MGT $B_{trigger}$) is defined as 9.93 kt, the reference biomass is defined as the biomass of ling 75+ cm and the target harvest rate (HR_{MGT}) is set to 0.18. In the assessment year (Y) the TAC for the next fishing year (September 1 of year Y to August 31 of year Y+1) is calculated as follows:
>
> When SSB_Y is equal or above MGT $B_{trigger}$:
> $TAC_{Y/y+1} = HR_{MGT} * B_{Ref,y}$
>
> When SSB_Y is below MGT $B_{trigger}$:
> $TAC_{Y/y+1} = HR_{MGT} * (SSB_y / MGT\ B_{trigger}) * B_{ref,y}$

WKICEMSE 2017 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

3.4.7 Comments on the assessment

At WKICEMSE 2017 the assessment was benchmarked. Various settings were changed from the previous assessment. Therefore, the assessment in 2017 is not directly comparable to previous assessments of this stock.

3.4.7.1 Management considerations

All the signs from commercial catch data and surveys indicate that ling in 5.a is at present in a good state. This is confirmed in the Gadget assessment. However, the drop in recruitment since 2010 will result in decrease in sustainable catches in the near future.

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

3.4.8 Tables

Table 3.4.6. Ling in 5.a. Catches by country (Source STATLANT).

Year	Belgium	Faroe	Germany	Iceland	Norway	UK	Total
1980	445	607	0	3149	423	0	4624
1981	196	489	0	3348	415	0	4448
1982	116	524	0	3733	612	0	4985
1983	128	644	0	4256	115	0	5143
1984	103	450	0	3304	21	0	3878
1985	59	384	0	2980	17	0	3440
1986	88	556	0	2946	4	0	3594
1987	157	657	0	4161	6	0	4981
1988	134	619	0	5098	10	0	5861
1989	95	614	0	4896	5	0	5610
1990	42	399	0	5153	0	0	5594
1991	69	530	0	5206	0	0	5805
1992	34	526	0	4556	0	0	5116
1993	20	501	0	4333	0	0	4854
1994	3	548	0	4049	0	0	4600
1995	0	463	0	3729	0	0	4192
1996	0	358	0	3670	20	0	4048
1997	0	299	0	3634	0	0	3933
1998	0	699	0	3603	0	0	4302
1999	0	500	0	3973	120	1	4594
2000	0	0	0	3196	67	3	3266
2001	0	362	2	2852	116	1	3333
2002	0	1629	0	2779	45	0	4453
2003	0	565	2	3855	108	5	4535
2004	0	739	1	3721	139	0	4600
2005	0	682	1	4311	180	20	5194
2006	0	960	1	6283	158	0	7402

Year	Belgium	Faroe	Germany	Iceland	Norway	UK	Total
2007	0	807	0	6592	185	0	7584
2008	0	1366	0	7736	176	0	9278
2009	0	1157	0	9610	172	0	10939
2010	0	1095	0	9867	168	0	11130
2011	0	588	0	8743	249	0	9580
2012	0	875	0	10706	248	0	11829
2013	0	1030	0	10212	294	0	11536
2014	0	1738	0	12450	158	0	14346
2015	0	1233	0	11553	250	0	13036
2016	0	1072	0	8582	230	0	9884
2017	0	829	0	7692	244	0	8765
2018*	0	1103	0	6756	203	0	8062

***Preliminary.**

Table 3.4.7. Ling in 5.a. Results from the Gadget assessment.

YEAR	BIOMASS	B75	SSB	REC3	CATCH	HR	F
1982	21,91	17,90	19,76	4,59	4,99	0,30	0,32
1983	20,23	14,71	16,79	1,83	5,12	0,38	0,40
1984	18,56	12,16	13,30	3,32	3,88	0,33	0,36
1985	18,93	11,76	12,59	2,86	3,45	0,29	0,33
1986	20,08	12,61	12,73	2,45	3,60	0,28	0,36
1987	21,20	13,70	13,42	1,95	4,97	0,36	0,48
1988	20,77	13,76	13,30	2,79	5,85	0,44	0,63
1989	19,53	12,90	12,45	4,55	5,55	0,44	0,70
1990	19,28	11,99	11,62	3,46	5,56	0,48	0,69
1991	19,11	10,88	10,56	1,87	5,79	0,56	0,76
1992	18,27	9,97	10,11	2,30	5,09	0,51	0,73
1993	17,99	10,33	10,49	2,63	4,71	0,45	0,75
1994	18,01	11,08	10,79	2,27	4,11	0,36	0,59
1995	18,47	11,94	11,37	2,99	3,97	0,32	0,45
1996	19,23	12,59	12,07	2,16	4,07	0,32	0,42
1997	19,65	12,99	12,60	2,28	3,91	0,30	0,37
1998	20,18	13,60	13,32	2,04	4,35	0,32	0,40
1999	20,06	13,81	13,40	2,99	4,62	0,34	0,43
2000	19,88	13,60	13,15	2,88	3,28	0,24	0,31
2001	21,19	14,50	13,94	4,09	3,36	0,23	0,32
2002	23,13	15,44	14,91	3,40	4,53	0,29	0,35
2003	24,14	15,64	15,22	4,50	4,28	0,27	0,31
2004	26,11	16,61	16,28	5,30	4,63	0,28	0,33
2005	28,56	17,84	17,37	6,86	5,20	0,29	0,34
2006	31,73	19,10	18,55	6,62	7,43	0,40	0,47
2007	33,56	19,03	18,66	10,08	7,62	0,41	0,48
2008	37,35	19,90	19,74	9,43	9,28	0,47	0,54
2009	40,83	20,64	20,49	11,05	10,95	0,54	0,65
2010	44,37	21,33	21,56	11,36	11,15	0,51	0,58

YEAR	BIOMASS	B75	SSB	REC3	CATCH	HR	F
2011	49,17	23,71	23,92	7,62	9,65	0,39	0,43
2012	55,31	29,21	29,08	5,50	11,83	0,39	0,43
2013	58,33	34,35	34,03	3,02	11,54	0,33	0,38
2014	59,59	39,96	38,71	3,07	14,25	0,36	0,43
2015	56,20	41,40	39,67	2,44	13,04	0,32	0,38
2016	51,96	40,97	38,86	3,23	9,88	0,24	0,29
2017	49,66	40,65	38,73	3,86	8,77	0,22	0,25
2018	47,88	39,31	37,92	3,18	8,06	0,21	0,23
2019	46,12	37,39	36,45	3,18			

3.5 Ling (*Molva Molva*) in Areas 3.a, 4, 6, 7, 8, 9, 10, 12, 14

3.5.1 The fishery

Significant fisheries for ling have been conducted in Subareas 3 and 4 at least since the 1870s, pioneered by Swedish longliners. Since the mid-1900s the major targeted ling fishery in Area 4.a is by Norwegian longliners conducted around Shetland and in the Norwegian Deep. There is little activity in Area 3.a. Of the total Norwegian 2018 landings in Subareas 3 and 4, 83% were taken by longlines, 9% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from central and southern North Sea (4.b,c) are bycatches from various other fisheries.

The major directed ling fishery in Area 6 is the Norwegian longline fishery. Catches of ling by trawl fisheries from the UK (Scotland) and from France are primarily bycatches.

When Areas 3–4 and 6–14 are summed over 1988–2018, 42% of the total landings were in Area 4, 30% in Area 6, and 24% in Area 7.

In Subarea 7, the Divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some Irish and Spanish landings are from targeted longline fisheries, whereas other landings are primarily bycatches in trawl fisheries. Data split by gear type were not available for all countries, but the bulk of the total landings (at least 60–70%) were taken by trawls in these areas.

In Subareas 8 and 9, 12 and 14 all landings are bycatches from various fisheries.

The Norwegian fishery

The Norwegian longline fleet increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number of vessels decreased and then stabilized at -26 in 2015 to 2018. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that each Norwegian longliner operated in an ICES division was highly variable for 4.a, stable for 6.b and declining for 6.a. The average number of hooks has remained relatively stable in 4.a and 6.a. During the period 1974 to 2018 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2018).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2018 is 43% less than the average effort during the years 2000–2003.

The French fishery

French fleets operating in 6, 7.bck are mainly otter trawlers, gillnetters and longliners.

The number of otter trawlers operating in the region has decreased from around 70 in the beginning of 2000 to 28 in 2018. Gillnetters have varied from 24 vessels in 2005 to 5 in 2016. In 2018 the number of vessels increased to 14. The number of longliners has increased from 1 in 2000 to 17 in 2017 and 2018 (Table 3.5.3).

Since 2000, otter trawlers effort has decreased by a factor of 2. Gillnetters had a peak effort in mid-2000 followed by a steep decrease by a factor of 5 since 2010 with an increase in 2017 and 2018. The recorded fishing efforts by longliners has been imprecise due to lack of information in the first part of the 2000s. The activity seems to have peaked in 2007 followed by a sharp decrease to 2009. Since 2009, the effort has been steadily increasing (Figure 3.5.13).

Landings of ling by otter trawlers increased from 2004 to 2014, and since declined. For gillnetters and longliners, landings are closely related to changes in efforts.

The Spanish fishery

The Spanish fleet catches ling in ICES Subarea 7, mostly in Divisions b, c and g–k, and the catch is mainly taken by longliners. However, there are also important bycatches of ling by trawlers operating in the Subarea 7. Porcupine Bank is an important fishing area for the Spanish trawlers, therefore the data from the Porcupine Bank Spanish ground fish survey could be useful as an indicator of abundance and status of ling in the area.

3.5.2 Landings trends

Landing statistics for ling by nation in the period 1988–2018 are in Tables 3.5.1 and 3.5.2 and Figures 3.5.1 and 3.5.2.

There was a decline in landings from 1988 to 2003, since then the amount landed has been stable and slightly increasing. When Areas 3–14 are pooled, the total landings averaged around 32 000 t in the period 1988–1998 and afterwards the average catch varied between 16 000 and 20 000 tons per year. The preliminary landings for 2018 is 20 688 t.

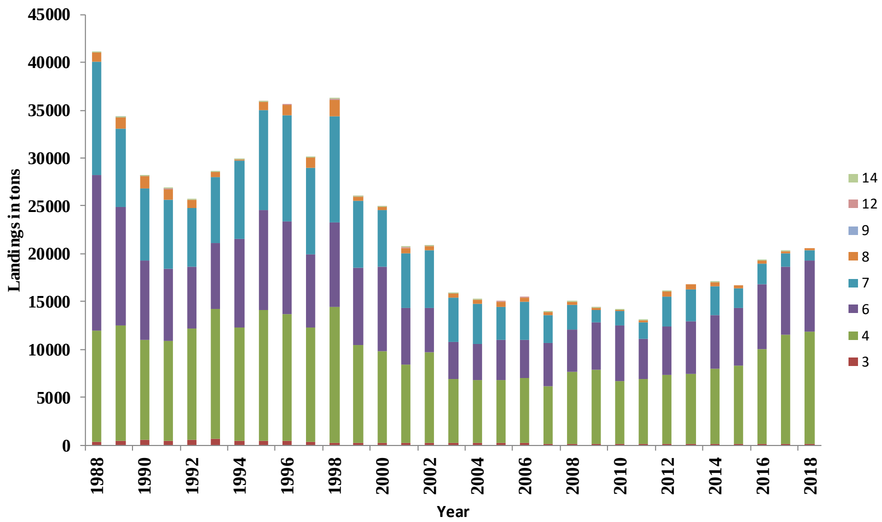


Figure 3.5.1. International landings of ling in areas 3.a, 4, 6, 7, 8, 9, 10, 12, 14.

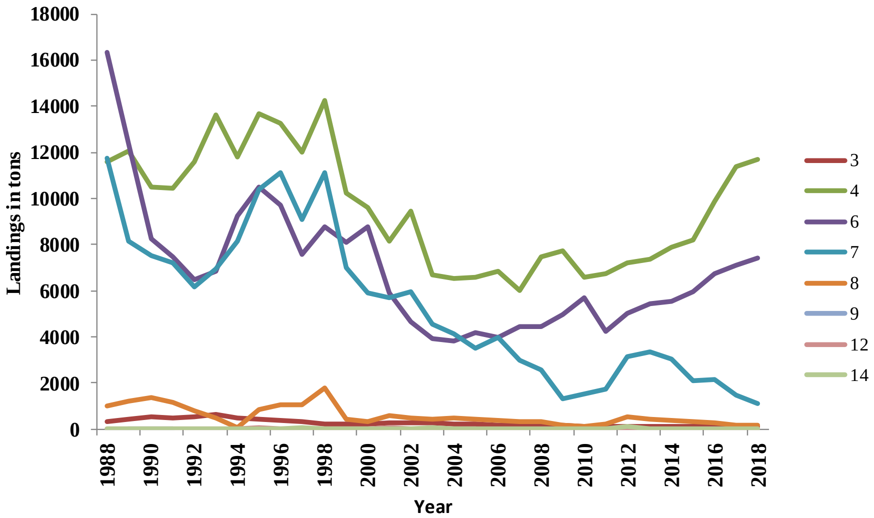


Figure 3.5.2. International landings of ling in areas 3.a, 4, 6, 7, 8, 9, 10, 12, 14.

3.5.3 ICES Advice

Advice for 2018 to 2019: "ICES advises that when the precautionary approach is applied, yearly catches should be no more than 17 695 tonnes in 2018 and 2019. If discard rates do not change from the average of the last three years (2014–2016) this implies landings of no more than 16 793 tonnes.".

3.5.4 Management

Norway has a licensing scheme in EU waters, and in 2019 the Norwegian quota in the EC zone is 8000 t. The Faroe Islands has a quota of 200t in 6.a and 6.b. The quota for the EU in the Norwegian zone (Area 4) is set at 1 350 t.

EU TACs for areas partially covered in this section are for 2016–2019

	2016	2017	2018	2019
Subarea 3	87 t	87	87	170
Subarea 4	2912 t	3494	3843	4035
Subarea 6, 7 (EU and international waters)	10 297 t.	13 696	12 696	12 196

3.5.5 Data available

3.5.5.1 Landings and discards

Landings were available for all relevant fleets. Within the Norwegian EEZ and for Norwegian vessels fishing elsewhere discarding is prohibited and therefore there is no information if there were discards. Discards by countries are given In Table 3.5.4. for the years 2012 to 2018 , and by area and countries for 2018 (Table 3.5.5). Discarding has been increasing over this period; 1012 tons of ling were discarded in 2018.

Table 3.5.4. Total discards of ling by country for the years 2012 to 2018.

	Denmark	Spain	Ireland	France	Sweden	UK (Scotland)	UK (England)	Total discard	Total catches	%discard
2012		46	176					222	16435	1.35
2013		101	160	29				290	17063	1.70
2014		54	435	15				504	17518	2.88
2015		0	0	131	4	704		839	17596	4.77
2016		1	220	72		1302	22	1598	20900	7.74
2017	1	10	105	71	2	959		1147	21427	5.36
2018	1		43	89		876	3	1012	21700	4.66

Table 3.5.5 Reported discards of ling by area and country for ling in tons.

Area	Country	Discards
27.4	Denmark	1
27.4.a	France	51
27.4.a	UK(Scotland)	718
27.6.a	France	13
27.6.a	UK(Scotland)	85
27.6.b	Ireland	6
27.6.b.1	UK(Scotland)	2
27.6.b.2	UK(Scotland)	71
27.7.g	France	2
27.7.g	Ireland	36
27.7.g	UK (England)	3
27.7.h	France	4
27.7.j	France	2
27.7.j	Ireland	1
27.8.a	France	14
27.8.d	France	2
Total		1012

3.5.5.2 Length composition

Data from the Norwegian reference fleet

Average fish length, weight–length relationships and the length distribution for the Norwegian longline and gillnet fishery in Areas 4a, 6a, 6b for ling are shown in Figure 3.5.3–3.5.5, respectively.. Data are from the Norwegian longline reference fleet.

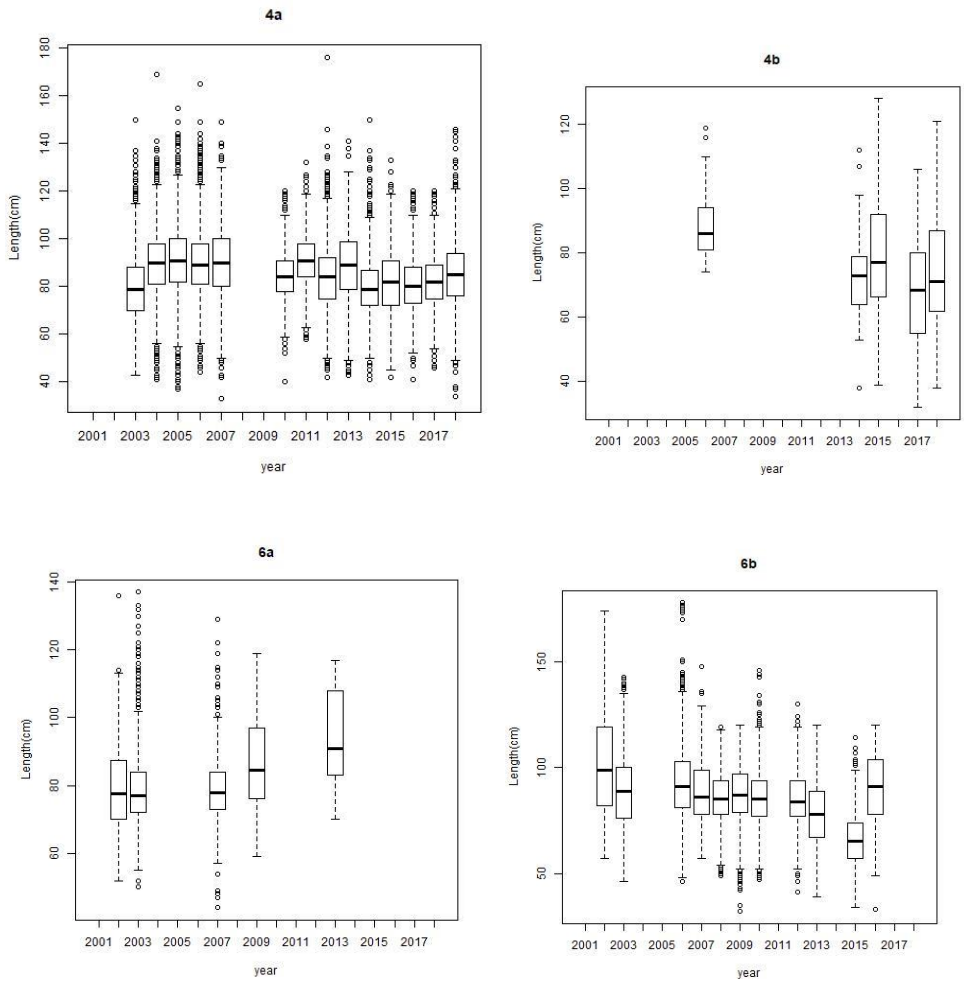


Figure 3.5.3. Box and whisker plots of the annual length distributions of ling based on data from the Norwegian longline reference fleet in Areas 4.a, 4.b, 6.a and 6.b.

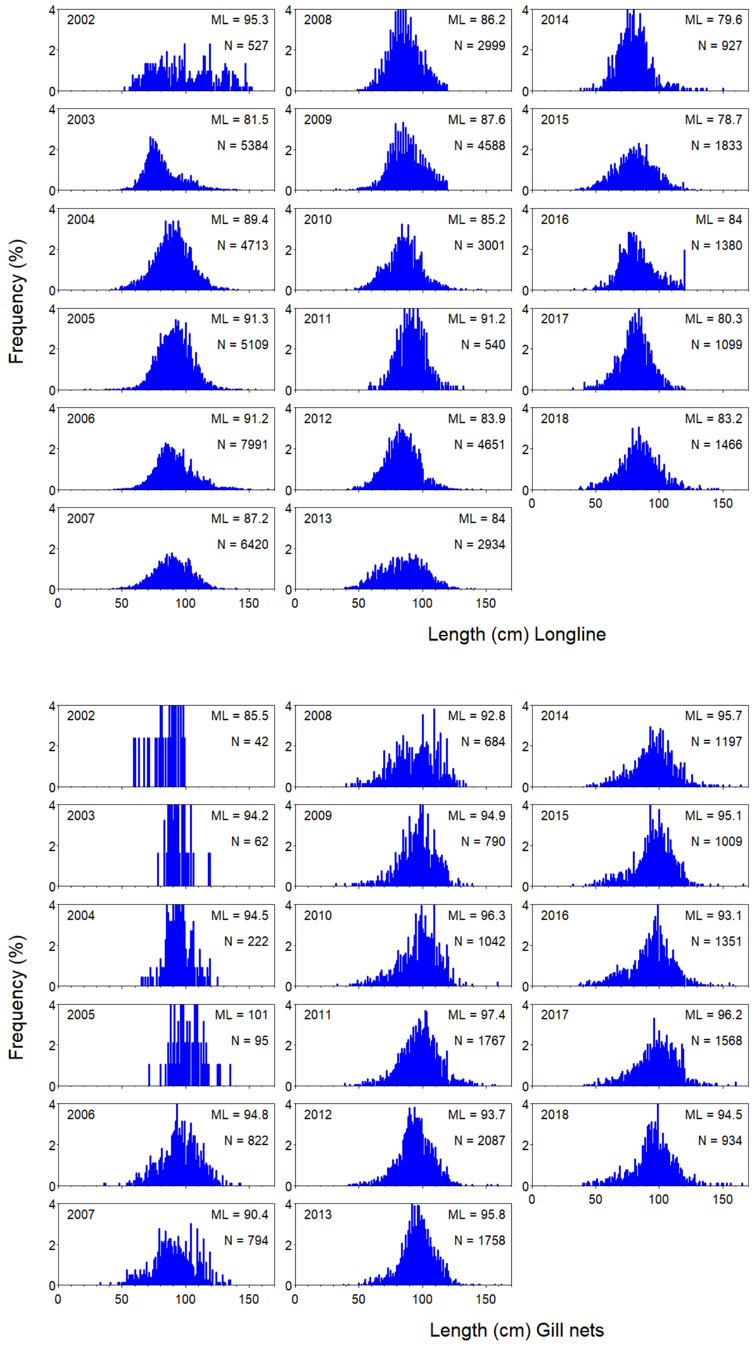


Figure 3.5.4. Length distributions of ling in Areas 3a, 4.a, 6.a and 6.b based on data from the Norwegian reference fleet.

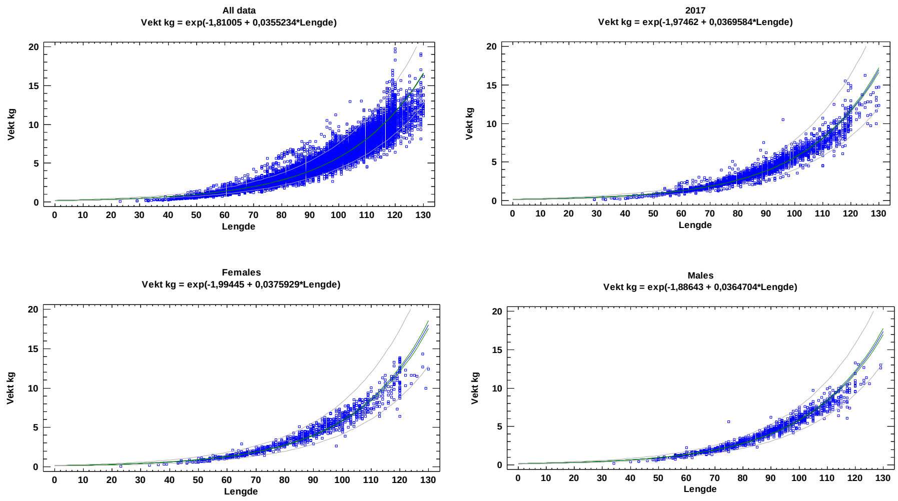


Figure 3.5.5. Weight as afunction of length for ling based on all available Norwegian data.

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

In Figure 3.5.6 are the estimated length distributions of ling for the years 2001–2018. (For more information see Ruiz-Pico *et al.*, WD 2019).

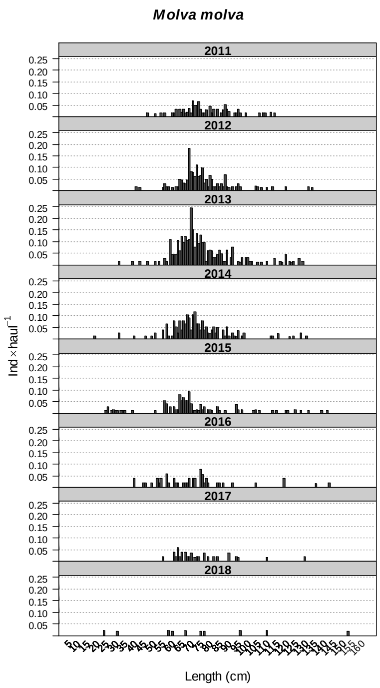


Figure 3.5.6. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey in the period 2001–2018.

3.5.5.3 Age compositions

Estimated age distributions for the years 2009–2017 based on data from the Norwegian Reference fleet for all areas combined (Figures 3.5.7) and box and whisker plots for the age composition of the fish taken by longliners and gillnetters in Area 4.a (Figure 3.5.8).

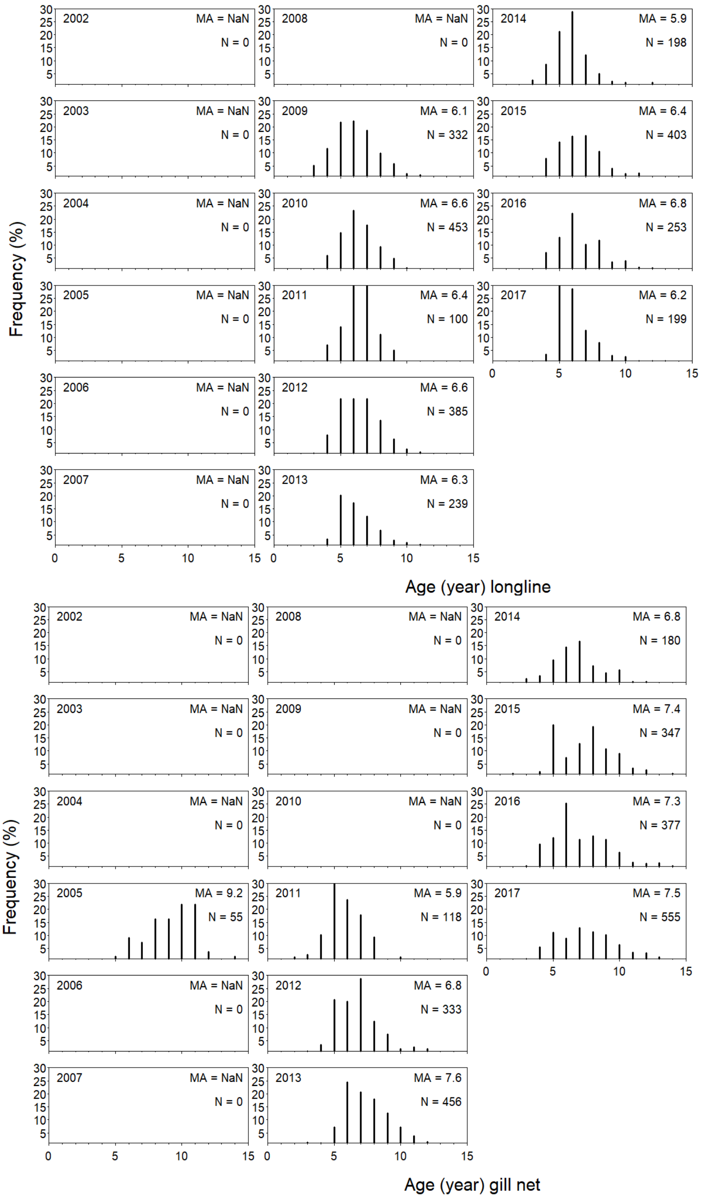


Figure 3.5.7. Age distributions for ling areas combined for all catches taken by longliners and by gill netters.

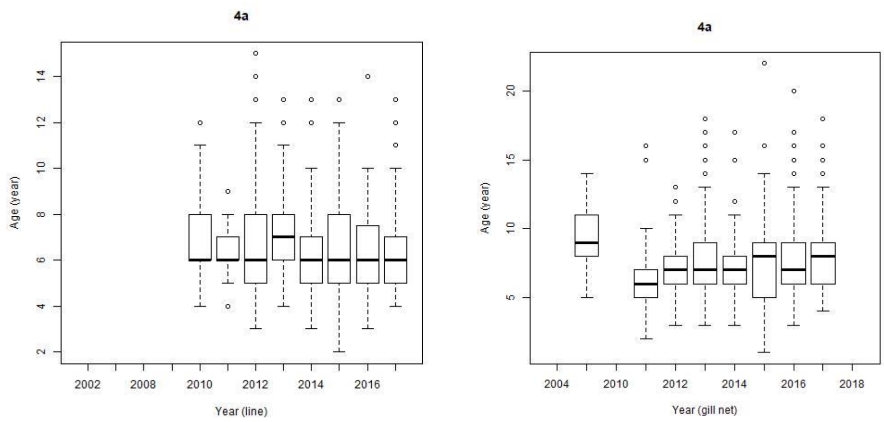


Figure 3.5.8. Age composition of the fish in area 4a taken by longliners and gillnetters.

3.5.5.4 Weight-at-age

Weight and length versus age for combined data from 2009 to 2017 for Areas 4.a and 6.a based on data from the longliners in the Norwegian reference fleet (Figure 3.5.9).

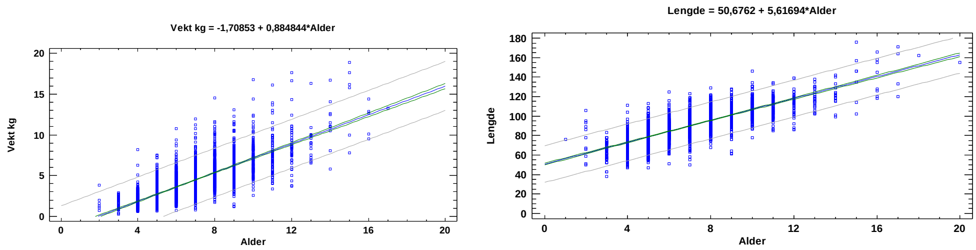


Figure 3.5.9. Weight versus age and length versus age for ling (combined data from 2009 to 2017) for Areas 4.a and 6.a based on the Norwegian longliner reference fleet.

3.5.5.5 Maturity and natural mortality

Maturity ogives for ling are in Figure 3.5.10. The maturity parameters were:

Stock	L_{50}	N	A_{50}	N	Source
Lin-lin.27.3.a4.a6-91214	63.6	1472	4.8	336	Norwegian long liners (Reference fleet) and survey data

The results fit well with that ling becomes 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).

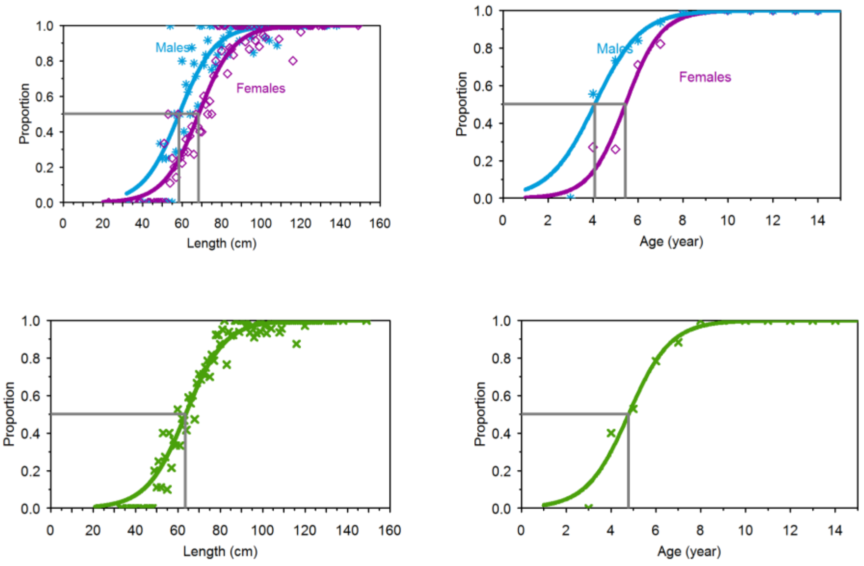


Figure 3.5.10. Ling (lin.27.3a4a6-91214), maturity ogives for age and length for males and females (top panel) and sexes combined (lower panel).

3.5.5.6 Catch, effort and research vessel data

Spanish Porcupine Bank survey

The Spanish bottom trawl survey on the Porcupine Bank (ICES divisions 7.c and 7.k) has been carried out annually since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in these areas (ICES, 2010a; 2010b). The survey provides estimates of biomass and abundance indices. Area covered by the survey is shown in Figure 3.5.11.

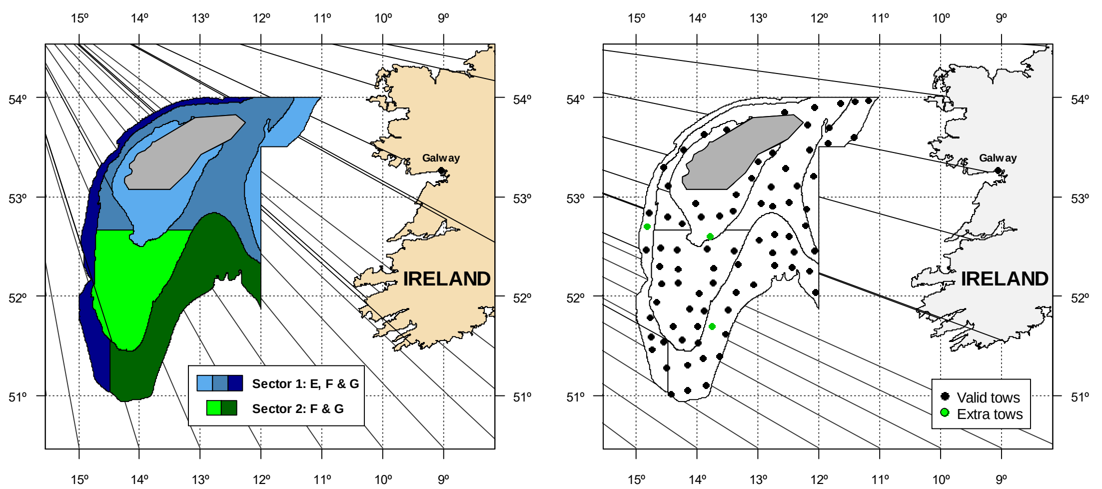


Figure 3.5.11. Left: Stratification design used in the Porcupine surveys starting in 2003: Previous years were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank denotes a large non-trawl able area. Right: distribution of hauls in 2018

French IBTS survey

Ling are caught in small numbers in the French western-IBTS area, also referred to as EVHOE. Population indices (based on swept area for biomass, mean length, etc.) for the Bay and Biscay and Celtic Sea (ICES Divisions 7g,hjk and 8a,b,d) combined were provided for years 1997–2018 (Figure 3.5.15). The survey covers depths from 30 to 600 m and is stratified by depth and latitude. The percentiles are based on a very small number of ling per year and that is the reason for the small error bar in the percentile graph.

Commercial cpues

French lpue

Landing effort, measured in hours at sea, and landings per unit of effort (lpue) are provided by the French otter trawl, longline and gillnet fishery for areas 6 and 7.bck for the years 2000–2018.

Norwegian longline 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 2000–2018. 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 for 2010 due to changes from paper to electronic logbooks. Since 2011 data quality has improved considerably and data from the entire fleet were available.

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

A standardised commercial cpue series using data from the Norwegian longline reference fleet was based on methods described in Helle *et al.*, 2015.

3.5.6 Data analyses

Length data analysis

Mean length of the commercial catches by the Norwegian longlining reference fleet fluctuate and is approximately 90 cm for Areas 4 and 6.b and around 80 cm for Area 6.a. The series does not indicate any apparent time trends (Figure 3.5.3). When all data for these areas are combined for longline and for gill netters the average length is about 10 cm higher for gill netters compared with the longliners (Figure 3.5.4)

On Porcupine Bank based on Spanish surveys the estimated length distributions appear to be quite stable with a length range of approximately 30–130 cm. The mode of the distributions tends to be around 70 cm, and there are no clear recruitment signals, which implies that Porcupine Bank is not a recruitment area for young ling (Figure 3.5.14). For more information, see Ruiz-Pico *et al.*, WD 2019.

The French IBTS survey (EVHOE)

Ling is caught in small numbers (average of 14 individuals per year since 1997) in the French W-IBTS-Q4 (EVHOE) survey covering ICES divisions 7.g,hjk and 8.a,b,d. populations indices are however presented (Figure 3.5.12). but are not considered representative of stock trends in the area.

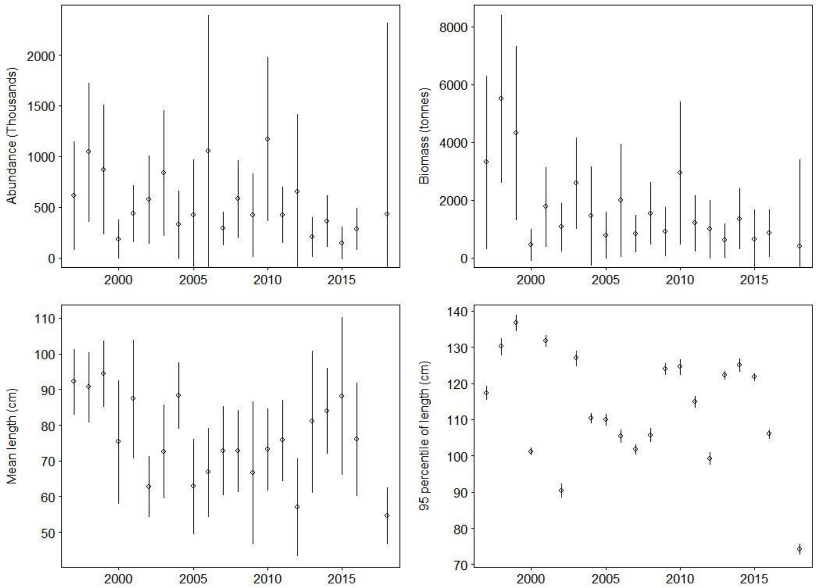


Figure 3.5.12. Population indices (swept area raised abundance and biomass, mean length and 95 percentile of the length distribution) of ling in the Bay and Biscay and Celtic Sea (ICES divisions 7.g,hjk and 8a,b,d) from the French EVHOE survey (W-IBTS-Q4), 1997–2018

French landings per unit effort (lpue)

The landings of ling by otter trawlers increased from 2004–2014. During the last three years there was a decrease in landings. For gillnetters and longliners, changes in landings are closely related to changes in effort (Figure 3.5.13).

Overall, while total fishing effort has decreased in the areas fished by the three major French fleets, there is a clear increasing trend in lpue for otter trawlers and a decrease since 2014 for the gillnetters. The lpue seems to be low but stable for longliners

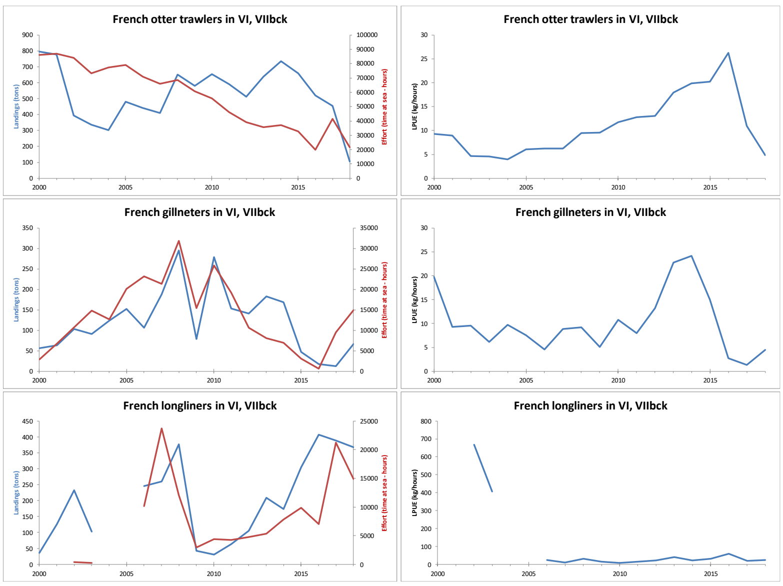


Figure 3.5.13. Ling lpue series for the main French fleet operating in 6, 7.b, c and k.

Spanish ling 2016 Porcupine Bank (NE Atlantic) survey

Estimated biomass and abundance indices based on data from the Porcupine Survey for the years 2001–2018 are in Figure 3.5.14. The abundance indices for ling based on the survey were quite stable from 2001–2012. Taking into account the 80% confidence limits, except for the peak in 2013, the abundance indices for ling have been quite stable, for the years 2001–2018, however there is a downward trend after the peak in 2013.

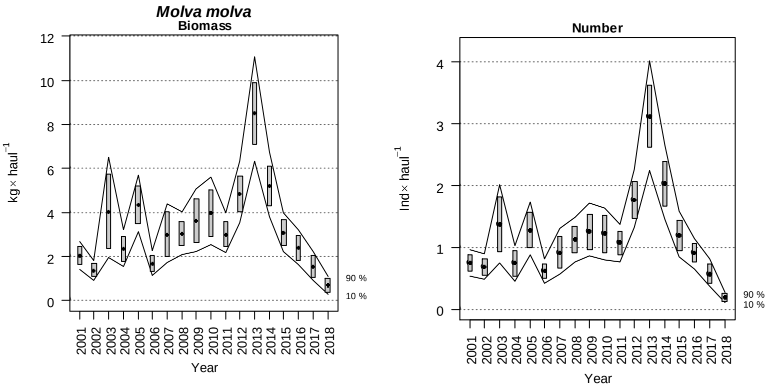


Figure 3.5.14. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2018. Boxes mark the parametric, based standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

Cpue series based on the Norwegian longline fleet

Figure 3.5.15 show the Norwegian CPUE series from 2000 to 2018. In areas 4a and 6a there were a steady increase in CPUE from 2002 until 2016. There was a negative trend for both areas in 2017 and 2018 (4.a and 6.a). This trend can be seen both when all data was used and when ling was targeted. In 6b there was a positive trend, but with a stable level for the last four years.

For ling, cpue has generally increased for all areas until 2018 when there was a decrease in all areas. A large part of Rockall (Area 6.b) was closed for fishing in the beginning of 2007. After 2007, the cpue for ling increased steadily until 2015, after this there have been a declining trend.

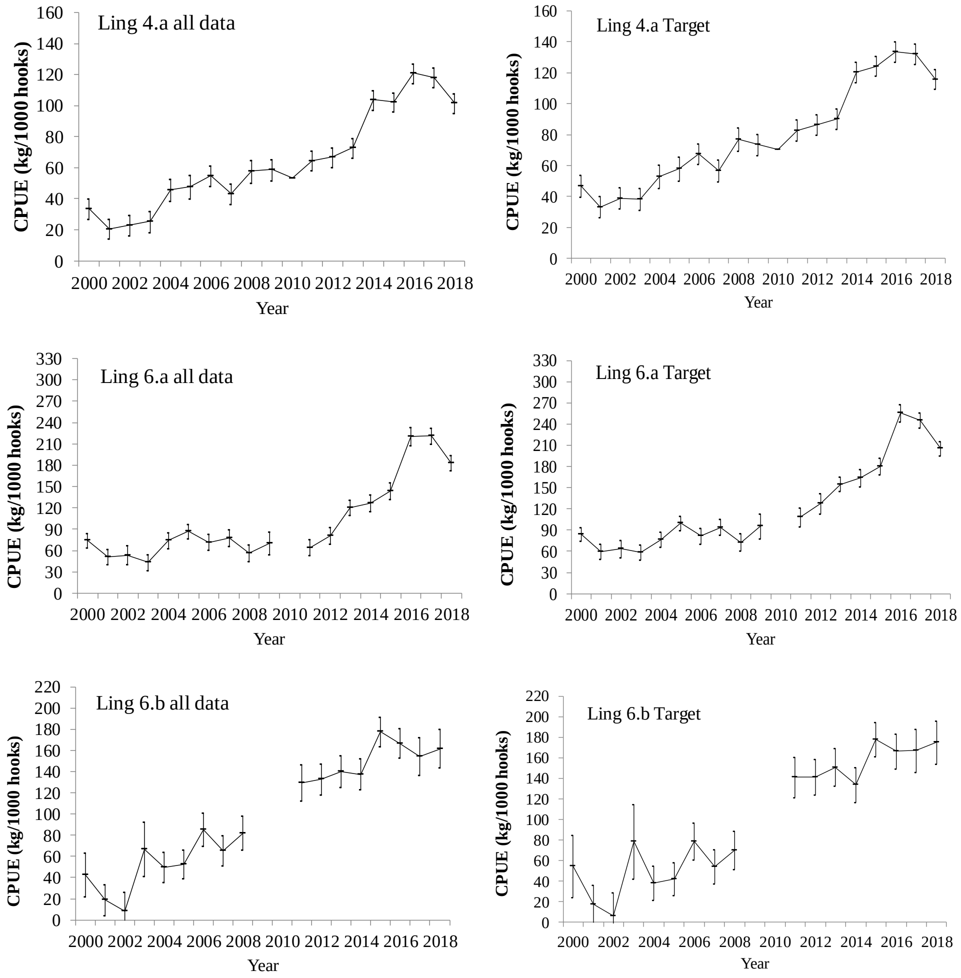


Figure 3.5.15. Cpue series for ling for the period 2000–2018 based on all available data and when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

The ling stocks in Areas (3.a, 4, 6, 7, 8, 9, 10, 12, 14) were best covered by the Norwegian longline fleet. It was therefore decided in plenary that a combined cpue series should be made in order to give advice for the entire area, and that the data from the targeted fishery should be used. The combined series were based on all available data and when ling was targeted is shown in Figure 3.5.16.

When all data for Areas 3.a, 4, 6, 7, 8, 9, 10, 12, 14 are combined, the cpue series when all data is used and when ling was targeted indicates a steady increase since 2003 to 2017 and then decline in 2018.

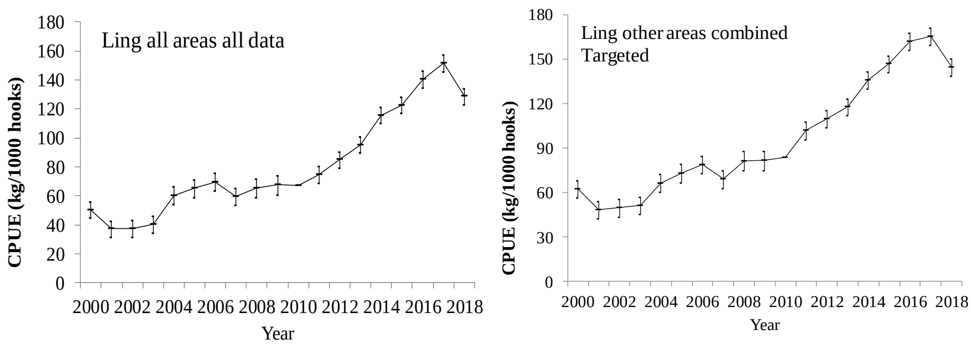


Figure 3.5.16. Cpue series for ling, areas 4a, 4b, 6a and 6b combined, for the period 2000–2018 for all data available and based on data when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

Biological reference points

See Section 3.5.9.

3.5.7 Comments on the assessment

The standardised cpue time-series for the Norwegian longliners shows similar trends as the superpopulation model presented in 2012 and the unstandardised time-series presented in 2011. The trend is either stable (4.a and 6.a) or increasing (6.b) during the last decade (Figure 3.5.16).

All data in Areas 4.a, 6.a and 6.b were combined to make one index for the entire area. These series show the same positive trend with a decline during the last one to two years as shown for each area separately. This trend is also reflected in the French lpue series based on the otter trawlers but not in the Spanish biomass and abundance indices.

3.5.8 Management considerations

The cpue series based on commercial data either indicate a stable or an increasing trend, since the catches have been stable and the indicator series shows an increasing trend. There has been an increase in discarding of ling, in 2016 there was a peak when 7.65% was discarded, 5.35% in 2017 of the catches were discarded and 4.66% in 2018 were discarded (See Table 3.5.4).

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the ling cpue series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope and pray that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g. Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

3.5.9 Application of MSY proxy reference points

Two different methods were tested for Ling, the Length based indicator method (LBI) and SPiCT.

Length–based indicator method (LBI)

Information used in LBI for ling in Division 3.a, 4.a, 4.b, 6.a, 6.b, 7.

Information and data

The input parameters and the catch length composition for the period 2002-2018 are in the following tables and figures. The length data used in the LBI model are data from the Norwegian longline fleet. The length data are not weighted and therefore do not represent the length distribution of the entire catch.

Table 3.5.6 Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Input parameters for LBI.

Data type	Source	Years/Value	Notes
Length frequency distribution	Norwegian long-liners (Reference fleet)	2002-2018	
Length-weight relation	Norwegian Reference fleet and survey data	0.0055* length $^{3.0120}$	
L_{MAT}	Norwegian Reference fleet and survey data	64 cm	Combined sexes
L_{inf}	Norwegian Reference fleet and survey data	183 cm	

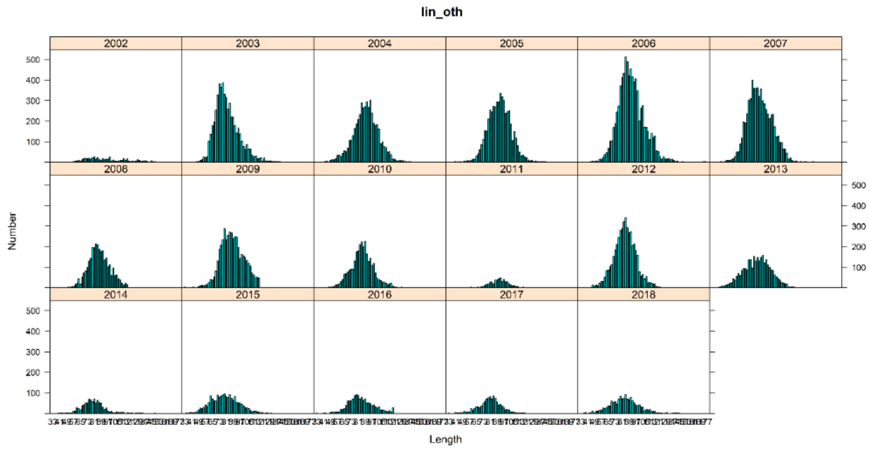


Figure 3.5.17 Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Catch length composition for the period 2001–2016 at 2 cm length classes (sex combined).

Outputs

The screening of length indicator ratios for combined sexes was conducted under three scenarios: (a) Conservation;.(b) Optimal yield, and (c) maximum sustainable yield. The results are presented in the following figures.

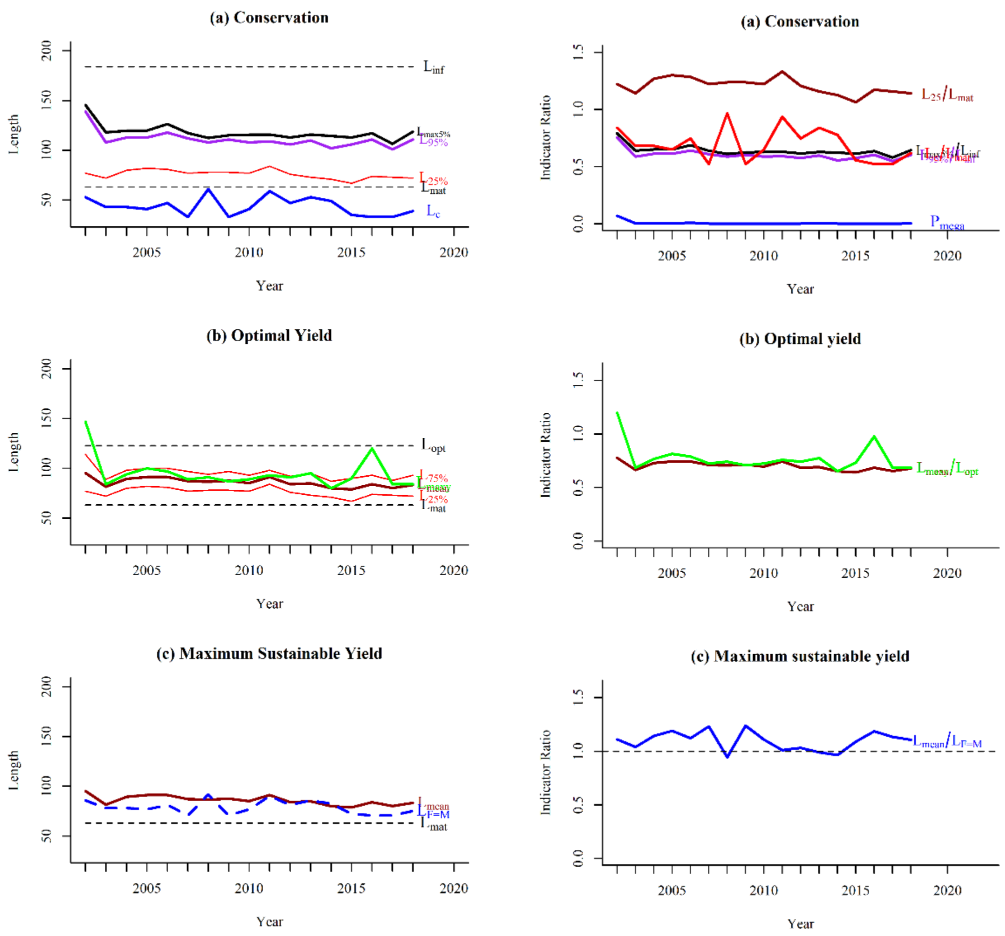


Figure 3.5.18. Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Screening of length indicators ratios for sex combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysis of results

For the conservation of immature ling the model shows that L_c/L_{mat} is usually less than one, but $L_{25\%}/L_{mat}$ is usually greater than 1 (Figure 3.5.18). In 2016-2018, $L_{25\%}/L_{mat}$ has been greater than 1 (Table 3.6.7). The sensitivity measure, L_{mat}, suggests that there is no overfishing of immature ling.

The conservation measure for large ling shows that the indicator ratio of $L_{max5\%}/L_{inf}$ is around 0.6 for the whole period (Figure 3.5.18.) and between 0.58 and 0.66 in 2016-2018 (Table 3.6.7). Therefore, since the conservation indicator is less than 0.8, this implies that there are few of mega-spawners in the catch which indicates that there is a truncation point in the length distribution of the catch, i.e., the present catch levels are not optimal.

The MSY indicator ($L_{mean}/L_{F=M}$) is greater than 1 for almost the whole period (Figure 3.5.18.), which indicates that ling in other areas were fished sustainably. The sensitivity measure, L_{inf} , indicates that MSY is always higher than 0.94.

Table 3.5.7. **Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). The final results from the LBI method.**

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2016	0,52	1,17	0,64	0 %	0,68	1,19
2017	0,52	1,16	0,58	0 %	0,65	1,14
2018	0,62	1,14	0,65	0 %	0,68	1,11

Conclusions

The overall perception of the stock during the period 2014-2018 is that ling in other areas seems to be fished sustainably (Table 3.5.8). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}..

Table 3.5.8 **Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Stock status was based on LBI for MSY. The green marks for MSY were given because $L_{mean}/L_{F=M}$ > 1 in 2016 to 2018. Stock size is unknown since this method only provides exploitation status.**

	Fishing pressure			
	2016	2017	2018	
MSY (F/FMSY)	✓	✓	✓	Appropriate

	Stock size			
	2016	2017	2018	
MSY Btrigger.(B/BMSY)	?	?	?	Unknown

SPiCT

Ling in Areas 3.a, 4, 6, 7, 8, 9, 10, 12 and 14

The first run was carried out with standard settings in SPICT, and with catch data and CPUE for all available years. The model converged, and the plots from the diagnostics looked good, but there were wide confidence intervals for the parameter estimates (BMSY, MSY, FMSY, and K) (Tables 3.5.9 and 3.5.10).

There were 6 runs where the parameters n, α and β were varied (Table 3.5.9). Overall, run number 4 was considered the best since the confinement intervals were smallest (Table 3.5.9). For this run, the parameter n was estimated by the model, while α and β were set to 1.

The model estimated MSY of 24781 tons. The advice for 2018 and 2019 was 17 695, which is considerably lower than any of the runs of the model. Associated BMSY was calculated to be 116 092 tons, and FMSY to 0.211. The estimated carrying capacity (K) is about 294 000 tons (Tables 3.5.9 and 3.5.10).

The model indicates that the stock abundance is above BMSY. The fishing mortality rate is less than FMS and will remain less than FMS if the catches continue to be kept at the same level as in previous years. The traffic light figure shows that the stock started in the yellow zone, went into the red zone and are now in the green zone (Figure 3.5.19). This corresponds to the present perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias or normality; the test for autocorrelation was significant. The retrospective plot showed that the test is relatively robust.

Table 3.5.9. Ling in Areas 3.a, 4, 6, 7, 8, 9, 10, 12 and 14.

Run	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Landings period	1988-2018						
CPUE	2000-2018						
Parameter settings							
n	mod.est	No priors	2	mod.est	2	2	2
Alfa	mod.est	No priors	1	1	mod.est	1	4
Beta	mod.est	No priors	1	1	mod.est	mod.est	1
Convergence	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parameter estimates							
Bmsy	115756	974259	114754	116092	95255	97854	177395
cilow	14363	157	52275	49684	51158	51413	70315
cihigh	932911	6024765000	251909	271258	177364	186247	447542
MSY	23642	37030	25298	24481	24424	24252	28447
cilow	16817	4314	20231	19489	21163	20495	20266
cihigh	33235	317812	31634	30751	28117	28697	39929
Fmsy	0,204	0,038	0,220	0,211	0,256	0,248	0,160
cilow	0,034	0,000	0,119	0,103	0,147	0,145	0,088
cihigh	1,239	29	0,409	0,432	0,446	0,422	0,293
K	368151	472751	230915	294213	190511	196843	355138
cilow	19121	303	104966	71903	102316	103316	140720
cihigh	7088471	73700140000	507992	1203868	354728	375034	896269
Diagnostics	OK- (Box)	OK- (Box)	Bias og Box	OK-(Box)	OK-(Box)	OK- (Box)	Bias and box
Retrospective	OK	negative	OK	OK	negative	OK	OK

Table 3.5.10. Ling in Areas 3.a, 4, 6, 7, 8, 9, 10, 12 and 14

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: -29.8297462
Euler time step (years):  1/16 or 0.0625
Nobs C: 31,  Nobs I1: 19

Priors
    logn  ~  dnorm[log(2), 2^2]
 logalpha  ~  dnorm[log(1), 0.001^2] (fixed)
  logbeta  ~  dnorm[log(1), 0.001^2] (fixed)

Model parameter estimates w 95% CI
          estimate        cilow        ciupp    log.est
 alpha  1.000001e+00 9.980424e-01 1.001962e+00  0.0000005
 beta   9.999909e-01 9.980328e-01 1.001953e+00 -0.0000091
 r      2.465330e-01 2.336290e-02 2.601495e+00 -1.4002593
 rc     4.220905e-01 2.053948e-01 8.674043e-01 -0.8625356
 rold   1.466128e+00 1.610000e-05 1.338424e+05  0.3826247
 m      2.463878e+04 1.948859e+04 3.114998e+04 10.1120767
 K      2.942132e+05 7.190277e+04 1.203868e+06 12.5920600
 q      9.321000e-04 4.894000e-04 1.775100e-03 -6.9781124
 n      1.168152e+00 1.633691e-01 8.352742e+00  0.1554234
 sdb    6.443380e-02 4.584010e-02 9.056970e-02 -2.7421162
 sdf    1.003486e-01 7.559490e-02 1.332080e-01 -2.2991050
 sdi    6.443390e-02 4.584010e-02 9.056970e-02 -2.7421157
 sdc    1.003477e-01 7.559400e-02 1.332071e-01 -2.2991141

Deterministic reference points (Drp)
          estimate        cilow        ciupp   log.est
 Bmsyd 1.167464e+05 4.983079e+04 2.735202e+05 11.667760
 Fmsyd 2.110452e-01 1.026974e-01 4.337022e-01 -1.555683
 MSYd  2.463878e+04 1.948859e+04 3.114998e+04 10.112077
Stochastic reference points (Srp)
          estimate        cilow        ciupp   log.est  rel.diff.Drp
 Bmsys 1.160918e+05 4.968438e+04 2.712584e+05 11.662136 -0.0056389228
 Fmsys 2.108731e-01 1.030213e-01 4.316337e-01 -1.556499 -0.0008163026
 MSYs  2.448053e+04 1.948880e+04 3.075081e+04 10.105633 -0.0064642948

States w 95% CI (inp$msytype: s)
                  estimate        cilow        ciupp    log.est
 B_2018.00       1.643320e+05 8.502719e+04 3.176042e+05 12.0096438
 F_2018.00       1.212633e-01 6.171820e-02 2.382569e-01 -2.1097911
 B_2018.00/Bmsy 1.415535e+00 8.792317e-01 2.278965e+00  0.3475074
 F_2018.00/Fmsy 5.750533e-01 3.539313e-01 9.343236e-01 -0.5532925

Predictions w 95% CI (inp$msytype: s)
                prediction        cilow        ciupp    log.est
 B_2019.00       1.667248e+05 8.397487e+04 3.310176e+05 12.0240998
 F_2019.00       1.223017e-01 6.117150e-02 2.445211e-01 -2.1012641
 B_2019.00/Bmsy 1.436146e+00 9.259402e-01 2.227483e+00  0.3619634
 F_2019.00/Fmsy 5.799778e-01 3.522949e-01 9.548086e-01 -0.5447655
 Catch_2019.00  2.047309e+04 1.602548e+04 2.615506e+04  9.9268668
 E(B_inf)       1.733058e+05           NA           NA 12.0628129
```

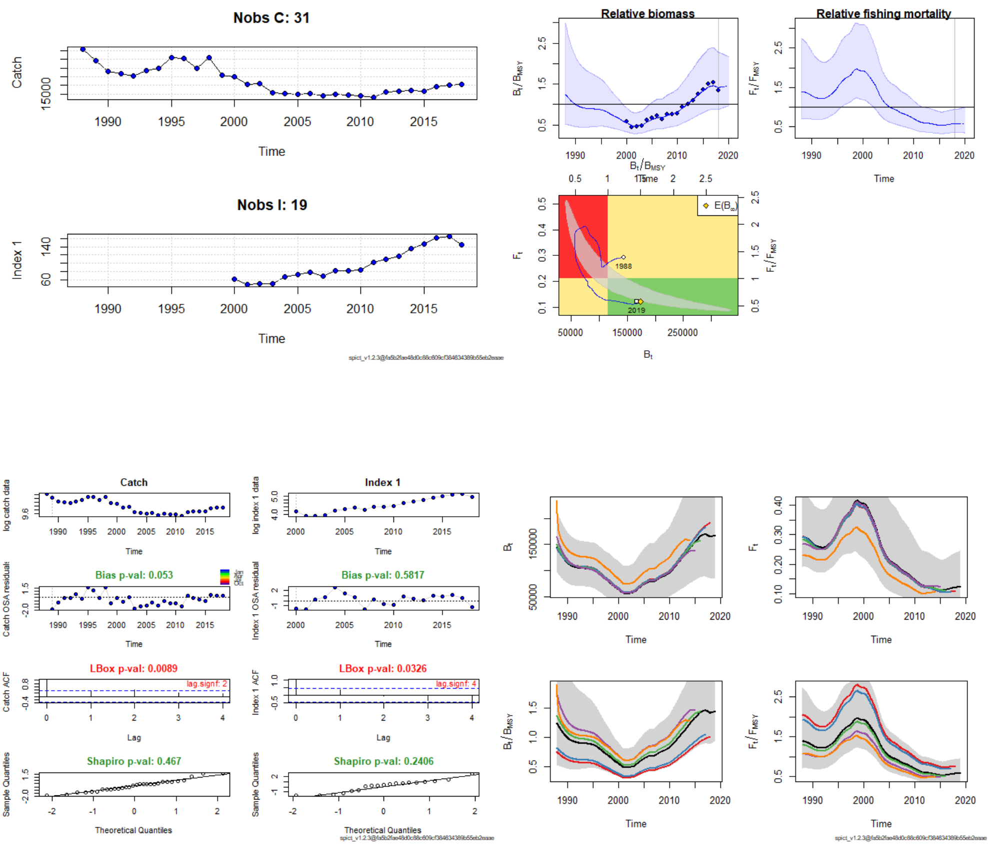


Figure 3.5.19. Ling in Areas 3.a, 4, 6, 7, 8, 9, 10, 12 and 14. Upper left corner shows the input data for the model, upper right corner the model output, lower left corner the model diagnostics and the lower right corner the retrospective analysis.

3.5.10 Tables

Table 3.5.1. Ling 3a, 4a, 6, 7, 8, 9, 12 and 14. WG estimates of landings.

Ling 3

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

Year	Belgium	Denmark	Germany	Norway	Sweden	E & W	Total
2014		51	1	54	14		120
2015		58	1	50	16		125
2016		77	1	57	17		152
2017		58	1	57	22		138
2018*		95	1	57	25		178

***Preliminary.**

Table 3.5.1. (continued).

Ling 4.a

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

2014	404	182	53		5038	3	23	2046	7749
2015	424	127	53		5369	6	90	2018	8069
2016	797	304	71		6021	5	65	2477	9740
2017	1036	300	111		6925	11	78	2761	11222
2018 *	1030	854	114	2	6318	15	65	3222	11620

***Preliminary.**

(1) Includes 4b 1988–1993.

Table 3.5.1. (continued).

Ling 4.bc.

Year	Belgium	Denmark	France	Sweden	Norway	E & W	Scotland	Germany	Netherlands	Total
1988					100	173	106	-		379
1989					43	236	108	-		387
1990					59	268	128	-		455
1991					51	274	165	-		490
1992		261			56	392	133	-		842
1993		263			26	412	96	-		797
1994		177			42	40	64	-		323
1995		161			39	301	135	23		659
1996		131			100	187	106	45		569
1997	33	166	1	9	57	215	170	48		699
1998	47	164	5		129	128	136	18		627
1999	35	138	-		51	106	106	10		446
2000	59	101	0	8	45	77	90	4		384
2001	46	81	1	3	23	62	60	6	2	284
2002	38	91		4	61	58	43	12	2	309
2003	28	0		3	83	40	65	14	1	234
2004	48	71		1	54	23	24	19	1	241
2005	28	56		5	20	17	10	13		149
2006	26	53		8	16	20	8	13		144
2007	28	42	1	5	48	20	5	10		159
2008	15	40	2	5	87	25	15	11		200
2009	19	38	2	13	58	29	137	17	1	314
2010	23	55	1	13	56	26	10	17		201
2011	15	59	0		85	24	11	17		211
2012	12	45	1	10	84	25	7	8		192
2013	15	47	1	5	71	0	21	12	4	176
2014	16	46	0	6	34	7	14	15	3	141
2015	11	36		6	54	10	16	14		147

Year	Belgium	Denmark	France	Sweden	Norway	E & W	Scotland	Germany	Netherlands	Total
2016	14	42		6	50	7	9	21	1	150
2017	9	36		9	74	4	9		2	143
2018*	9	38		8	62	2		36	1	**156**

***Preliminary.**

Table 3.5.1. (continued).

Ling 6.a update for Spain.

Year	Bel-gium	Den-mark	Fa-roes	France (1)	Ger-many	Ire-land	Nor-way	Spain(2)	E&W	IOM	N.I.	Scot.	To-tal
1988	4	+	-	5381	6	196	3392	3575	1075	-	53	874	14 556
1989	6	1	6	3417	11	138	3858		307	+	6	881	8631
1990	-	+	8	2568	1	41	3263		111	-	2	736	6730
1991	3	+	3	1777	2	57	2029		260	-	10	654	4795
1992	-	1	-	1297	2	38	2305		259	+	6	680	4588
1993	+	+	-	1513	92	171	1937		442	-	13	1133	5301
1994	1	1		1713	134	133	2034	1027	551	-	10	1126	6730
1995	-	2	0	1970	130	108	3156	927	560	n/a		1994	8847
1996			0	1762	370	106	2809	1064	269			2197	8577
1997			0	1631	135	113	2229	37	151			2450	6746
1998				1531	9	72	2910	292	154			2394	7362
1999				941	4	73	2997	468	152			2264	6899
2000	+	+		737	3	75	2956	708	143			2287	6909
2001				774	3	70	1869	142	106			2179	5143
2002				402	1	44	973	190	65			2452	4127
2003				315	1	88	1477	0	108			1257	3246
2004				252	1	96	791	2	8			1619	2769
2005			18	423		89	1389	0	1			1108	3028
2006			5	499	2	121	998	0	137			811	2573
2007			88	626	2	45	1544	0	33			782	3120
2008			21	1004	2	49	1265	0	1			608	2950
2009			30	418		85	828	116	1			846	2324
2010			23	475		164	989	3	0			1377	3031
2011			102	428		95	683	8				1683	2999
2012			30	585		47	542	862				1589	3655
2013			50	718		54	1429	899	10			1500	4660
2014			0	937		39	1006	1005	6			1768	4761

Year	Bel-gium	Den-mark	Fa-roes	France (1)	Ger-many	Ire-land	Nor-way	Spain(2)	E&W	IOM	N.I.	Scot.	To-tal
2015				891		65	1214	961	4			1629	4764
2016			92	1005		156	1313	1109	9			1975	5659
2017			5	868		156	1530	1500	3			2244	6306
2018*				878		93	2185	1560	4			1922	6677

***Preliminary. (1) Includes 6.b until 1996 (2) Includes minor landings from 6.b.**

Table 3.5.1. (continued).

Ling 6.b.

Year	Faroes	France [2]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Russia	Total
1988	196		-	-	1253		93	-	223		1765
1989	17		-	-	3616		26	-	84		3743
1990	3		-	26	1315		10	+	151		1505
1991	-		-	31	2489		29	2	111		2662
1992	35		+	23	1713		28	2	90		1891
1993	4		+	60	1179		43	4	232		1522
1994	104		-	44	2116		52	4	220		2540
1995	66		+	57	1308		84		123		1638
1996	0		124	70	679		150		101		1124
1997	0		46	29	504		103		132		814
1998		1	10	44	944		71		324		1394
1999		26	25	41	498		86		499		1175
2000	+	18	31	19	1172		157		475	7	1879
2001	+	16	3	18	328		116		307		788
2002		2	2	2	289		65		173		533
2003		2	3	25	485		34		111		660
2004	+	9	3	6	717		6		141	182	1064
2005		31	4	17	628		9		97	356	1142
2006	30	4	3	48	1171		19		130	6	1411
2007	4	10	35	54	971		7		183	50	1314
2008*	69	6	20	47	1021		1		135	214	1513
2009	249	5	6	39	1859		3		439	35	2635
2010	215	2		34	2042		0		394		2687
2011	12	5		16	957		1		268		1259
2012	60	7		13	1089	3			218		1390
2013		19		8	532	6			229	1	795
2014	60	7		10	435	2			258	2	774
2015	5	10	1	16	952	11	6		211	3	1215

Year	Faroes	France [2]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Russia	Total
2016	56			35	821	2	4		170		1088
2017	5		2	59	498	7	2		219	1	793
2018*			2	84	408	6	3		252		**755**

***Preliminary. [1] Includes XII. [2] Until 1966 included in 6.a. [3] Included in Ling 6.a.**

Ling 7

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 3.5.1. (continued).

Ling 7.a.

Year	Belgium	France	Ireland	E & W	IOM	N.I.	Scotland	Total
1988	14	-1	100	49	-	38	10	211
1989	10	-1	138	112	1	43	7	311
1990	11	-1	8	63	1	59	27	169
1991	4	-1	10	31	2	60	18	125
1992	4	-1	7	43	1	40	10	105
1993	10	-1	51	81	2	60	15	219
1994	8	-1	136	46	2	76	16	284
1995	12	9	143	106	1	-2	34	305
1996	11	6	147	29	-	-2	17	210
1997	8	6	179	59	2	-2	10	264
1998	7	7	89	69	1	-2	25	198
1999	7	3	32	29		-2	13	84
2000	3	2	18	25			25	73
2001	6	3	33	20			31	87
2002	7	6	91	15			7	119
2003	4	4	75	18			11	112
2004	3	2	47	11			34	97
2005	4	2	28	12			15	61
2006	2	1	50	8			27	88
2007	2	0	32	1			8	43
2008	1	0	13	1			0	15
2009	1	36	9	2			0	48
2010		28	15	1			0	44
2011	1	2	23	1			1	28
2012	2		11	1			0	14
2013	1		6				23	30
2014	2	0	11				16	29
2015	1		8				10	19

Year	Belgium	France	Ireland	E & W	IOM	N.I.	Scotland	Total
2016	1		10				13	24
2017			9				15	24
2018*		1	9					10

Preliminary. (1) French catches in 7 not split into divisions, see Ling 7. (2) Included with UK (EW).

Table 3.5.1. (continued).

Ling 7.b, c.

Year	France [1]	Germany	Ireland	Norway	Spain [3]	E & W	N.I.	Scotland	Total
1988	-1	-	50	57		750	-	8	865
1989	-1	+	43	368		161	-	5	577
1990	-1	-	51	463		133	-	31	678
1991	-1	-	62	326		294	8	59	749
1992	-1	-	44	610		485	4	143	1286
1993	-1	97	224	145		550	9	409	1434
1994	-1	98	225	306		530	2	434	1595
1995	78	161	465	295		630	-2	315	1944
1996	57	234	283	168		1117	-2	342	2201
1997	65	252	184	418		635	-2	226	1780
1998	32	1	190	89		393		329	1034
1999	51	4	377	288		488		159	1366
2000	123	21	401	170		327		140	1182
2001	80	2	413	515		94		122	1226
2002	132	0	315	207		151		159	964
2003	128	0	270			74		52	524
2004	133	12	255	163		27		50	640
2005	145	11	208			17		48	429
2006	173	1	311	147		13		23	668
2007	173	5	62	27		71		20	358
2008	122	16	44	0		14		63	259
2009	42		71	0		17		1	131
2010	34		82	0		6		131	253
2011	29		58			28		93	208
2012	126	1	39	230	370	1		246	1013
2013	267	2	46		379	136		180	1010
2014	118		57		279	19		59	532
2015	101		53		184	144		78	560

Year	France [(1)]	Germany	Ireland	Norway	Spain [(3)]	E & W	N.I.	Scotland	Total
2016	93		46	6	172	46		207	570
2017	90		32		133	34		26	315
2018	57		39		138	32			266

***Preliminary. [(1)] See Ling 7. [(2)] Included with UK (EW). [(3)] Included with 7.g–k until 2011.**

Table 3.5.1. (continued).

Ling 7.d, e.

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

Year	Belgium	Denmark	France [1]	Ireland	E & W	Scotland	Ch. Islands	Nether-lands	Spain	Total
2015	5		204		137			1		347
2016	3		141		149					293
2017	4		105		94					203
2018*	3		85		84			1		173

*Preliminary.

Table 3.5.1. (continued).

Ling 7.f.

Year	Belgium	France [1]	Ireland	E & W	Scotland	Total
1988	77	-1	-	367	-	444
1989	42	-1	-	265	3	310
1990	23	-1	3	207	-	233
1991	34	-1	5	259	4	302
1992	9	-1	1	127	-	137
1993	8	-1	-	215	+	223
1994	21	-1	-	379	-	400
1995	36	110	-	456	0	602
1996	40	121	-	238	0	399
1997	30	204	-	313		547
1998	29	204	-	328		561
1999	16	108	-	188		312
2000	15	91	1	111		218
2001	14	114	-	92		220
2002	16	139	3	295		453
2003	15	79	1	81		176
2004	18	73	5	65		161
2005	36	59	7	82		184
2006	10	42	14	64		130
2007	16	52	2	55		125
2008	32	88	4	63		187
2009	10	69	1	26		106
2010	10	42	0	17	0	69
2011	20	39	2	94		155
2012	28	80	<1	59	<1	167
2013	22	68	1	93	40	224
2014	61	182	0	91		334
2015	15	54	2	17		88

Year	Belgium	France [1]	Ireland	E & W	Scotland	Total
2016	25	51	1	34	3	114
2017	7	21	1	19		48
2018*	5	18	1	19		43

***Preliminary. [1] See Ling 7.**

Table 3.5.1. (continued).

Ling 7.g–k.

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [2]	E&W	IOM	N.I.	Scot.	Total
1988	35	1	-1	-	286	-	2652	1439	-	-	2	4415
1989	23	-	-1	-	301	163		518	-	+	7	1012
1990	20	+	-1	-	356	260		434	+	-	7	1077
1991	10	+	-1	-	454	-		830	-	-	100	1394
1992	10	-	-1	-	323	-		1130	-	+	130	1593
1993	9	+	-1	35	374			1551	-	1	364	2334
1994	19	-	-1	10	620		184	2143	-	1	277	3254
1995	33	-	1597	40	766	-	195	3046		-3	454	6131
1996	45	-	1626	169	771		583	3209			447	6850
1997	37	-	1574	156	674		33	2112			459	5045
1998	18	-	1362	88	877		1669	3465			335	7814
1999	-	-	1220	49	554		455	1619			292	4189
2000	17		1062	12	624		639	921			303	3578
2001	16		1154	4	727	24	559	591			285	3360
2002	16		1025	2	951		568	862			102	3526
2003	12		1240	5	808		455	382			38	2940
2004	14		982		686		405	335			5	2427
2005	15		771	12	539		399	313			4	2053
2006	10		676		935		504	264			18	2407
2007	11		661	1	430		423	217			6	1749
2008	11		622	8	352		391	130			27	1541
2009	7		183	6	270		51	142			14	673
2010	10		108	1	279		301	135			14	848
2011	15		260		465		16	157			23	936
2012	23		584	2	516		201	138			56	1520
2013	24		622		495		190	74			203	1608
2014	13		535		445		177	185			202	1557
2015	11		391		366		153	131			13	1065

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [2]	E&W	IOM	N.I.	Scot.	Total
2016	10		383		549		107	114			9	1172
2017	10		291		392		85	91			12	881
2018*	6		171		312		76	52			5	622

***Preliminary. [1] See Ling 7. [2] Includes 7.b, c until 2011. [3] Included in UK (EW).**

Table 3.5.1. (continued).

Ling 8.

Year	Belgium	France	Germany	Spain	E & W	Scot.	Total
1988		1018			10		1028
1989		1214			7		1221
1990		1371			1		1372
1991		1127			12		1139
1992		801			1		802
1993		508			2		510
1994		n/a		77	8		85
1995		693		106	46		845
1996		825	23	170	23		1041
1997	1	705	+	290	38		1034
1998	5	1220	-	543	29		1797
1999	22	234	-	188	8		452
2000	1	227		106	5		339
2001		245		341	6	2	594
2002		316		141	10	0	467
2003		333		67	36		436
2004		385		54	53		492
2005		339		92	19		450
2006		324		29	45		398
2007		282		20	10		312
2008		294		36	15	3	345
2009		150		29	7		186
2010		92		31	11		134
2011		148		47	6		201
2012		349		201	2		552
2013		281		139	35	4	459
2014		280		110	4	1	395
2015*		269		63	5		337

Year	Belgium	France	Germany	Spain	E & W	Scot.	Total
2016		207		77	3		287
2017		154		43	2		199
2018*		145		34	4		183

Ling 9.

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 3.5.1. (continued).

Ling 12.

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
1988				-				0
1989				-				0
1990				3				3
1991				10				10
1992				-				0
1993				-				0
1994				5				5
1995	5			45				50
1996	-		2					2
1997	-		+	9				9
1998	-	1	-	1				2
1999	-	0	-	-	+	2		2
2000		1	-		6			7
2001		0	29	2	24		4	59
2002		0	4	4	0			8
2003			17	2	0			19
2004								
2005				1				1
2006	1							1
2007								0
2008								0
2009		0	1					1
2010								0
2011		1						1
2012	3						1	4
2013								0
2014								0
2015								0

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
2016								0
2017								0
2018*								0

Table 3.5.1. (continued).

Ling 14.

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	Russia	GREENLAND	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				8	9
2000			26	-				0	26
2001	1			35				1	37
2002	3			20				0	23
2003				83				0	83
2004				10				9	19
2005								18	18
2006								19	19
2007				5				2	7
2008					1		1	19	20
2009	+	3						5	8
2010		3						3	6
2011	2			1				5	8
2012	1		105					5	111
2013								2	2
2014	1	1	6	1	1			8	17
2015								21	21

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	Russia	GREENLAND	Total
2016	9	1		10			1	15	35
2017	1			1			2	5	7
2018*								5	5

***Preliminary.**

Table 3.5.2 Ling. Total landings by subarea or division.

Year	3	4.a	4.bc	6.a	6.b	7	7.a	7.bc	7.de	7.f	7.g–k	8	9	12	14	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	9	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	37	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	19	15 240

Year	3	4.a	4.bc	6.a	6.b	7	7.a	7.bc	7.de	7.f	7.g–k	8	9	12	14	All areas
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	18	14 942
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	19	15 414
2007	174	5858	159	3119	1314		43	358	710	125	1749	312		0	7	13 927
2008	168	7259	200	2950	1551		15	259	569	187	1541	345		0	20	15 045
2009	149	7408	314	2324	2635		48	131	363	106	673	186		1	8	14 341
2010	142	6398	201	3031	2687		44	253	294	69	848	134		0	6	14 104
2011	140	6508	211	2999	1259		28	208	425	155	936	201		0	8	13 073
2012	145	7018	192	3655	1390		14	1013	436	167	1520	552		0	111	16 208
2013	130	7197	176	4660	795		30	1010	482	224	1608	459		0	2	16 771
2014	120	7749	141	4761	774		29	532	605	334	1557	395		0	17	17 075
2015	125	8069	147	4764	1215		19	560	347	88	1065	337		0	21	16 736
2016	152	9739	150	5659	1088		24	570	293	114	1172	287			**35**	19269
2017	138	11222	143	6306	793		24	315	203	48	881	199		0	**7**	20276
2018*	178	11620	156	6677	755		10	266	173	43	622	183		0	**5**	20683

***Preliminary.**

Table 3.5.3. Number of French fishing vessels (otter trawlers, gillnetters and longliners) during the period 2000–2016.

NUMBERS OF SHIPS	OTTER TRAWLERS	GILLNETTERS	LONGLINERS
2000	65	12	1
2001	77	13	2
2002	66	15	3
2003	61	19	2
2004	52	22	0
2005	46	24	1
2006	44	20	6
2007	42	20	7
2008	37	20	7
2009	38	20	6
2010	29	21	2
2011	32	18	3
2012	36	15	4
2013	33	14	8
2014	33	13	9
2015	31	9	11
2016	28	5	12
2017	32	11	17
2018	28	14	17

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

4.1 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 14 and Division 5.a with a small component in 5.b, and a southern stock in Subarea 6 and adjacent waters in Division 5.b. This was supported by differences in length and age structures between areas as well as in growth and maturity. Egg and larvae data from early studies also suggested the existence of many spawning grounds in each of areas of the northern and southern stocks and this was considered as indications of 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 of blue ling in the ICES area is uncertain.

As in previous years, in addition to one stock in Division 5.b and Subareas 6 and 7 and one in Division 5.a and 14. All remaining areas are grouped together as “other areas". This latter unit includes Subareas 1 and 2 and Division 4.a and 3.a were historical landing have been significant and subareas, 8 and 9, where the species does not occur. Landings reported in 8 and 9 are ascribed to the related Spanish ling (*Molva macrophtalma*). The situation in Subarea 12 is different as this subarea includes part of the Mid-Atlantic Ridge (12.a1, 12.a2, 12.a4 and 12.c) and the western slope of the Hatton Bank (12.b). 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 (6.b). Therefore, including ICES Division 12.b in the assessment unit for 5.b, 6 and 7 could be considered. Because of the much lesser abundance of blue ling on the Hatton Bank, this should not impact significantly on the assessed stock biomass and dynamics.

Historical total international landings show that blue ling have been exploited for long. Before the start of the time-series used by WGDEEP, Norway landed 1000–2000t per year in the 1950s and 1960s. These landings might have been mainly from Subareas1 and 2. German landings starting in the 1950s were mainly reported in Statlant from ICES Division 5.a and 5.b. Since 1966, the main fishing countries have been the Faroe Islands, France, Germany, Iceland and Norway (Figure 4.1.1). Except in a few recent years where large amount where caught in Division 5.a, the stock unit of Division 5.b and Subareas 6 and 7 have had the main contribution to total landings (Figure 4.1.2).

Blue ling is known to form spawning aggregations. From 1970 to 1990, the bulk of the fishery for blue ling was seasonal fisheries targeting these aggregations which were subject to sequential depletion. Known spawning areas are shown in Figure 4.1.3. In Iceland, the depletion of the spawning aggregation in a few years was documented (Magnússon, 1995) and blue ling is an aggregating species at spawning time. To prevent depletion of adult populations temporal closures have been set in the Icelandic and EU EEZs as well as in the NEAFC RA.

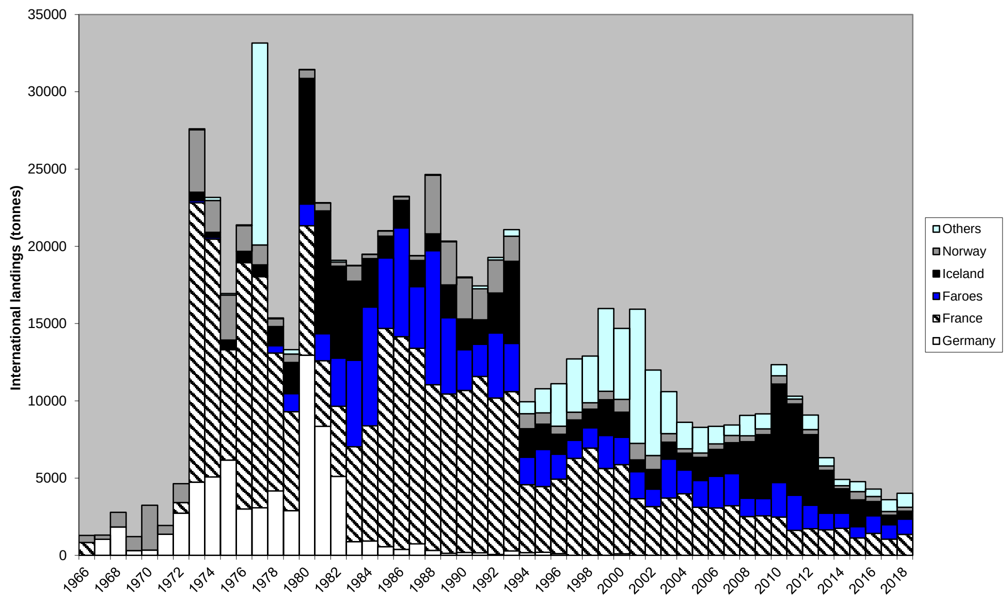


Figure 4.1.1. Total international landings of blue ling in the Northeast Atlantic, by country, 1966–2018.

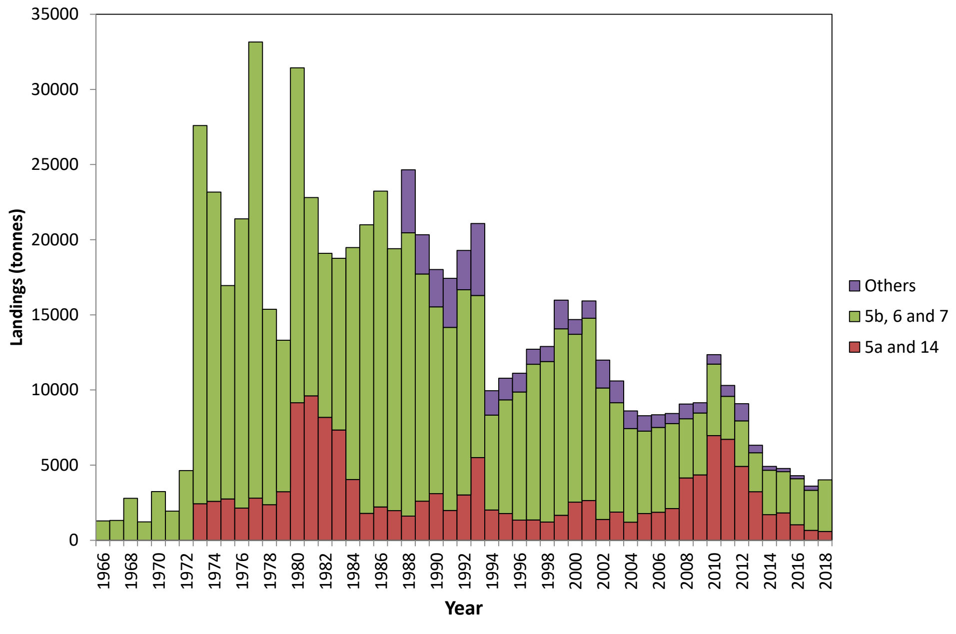


Figure 4.1.2. Total international landings of blue ling in the Northeast Atlantic, by stock unit, 1966–2018.

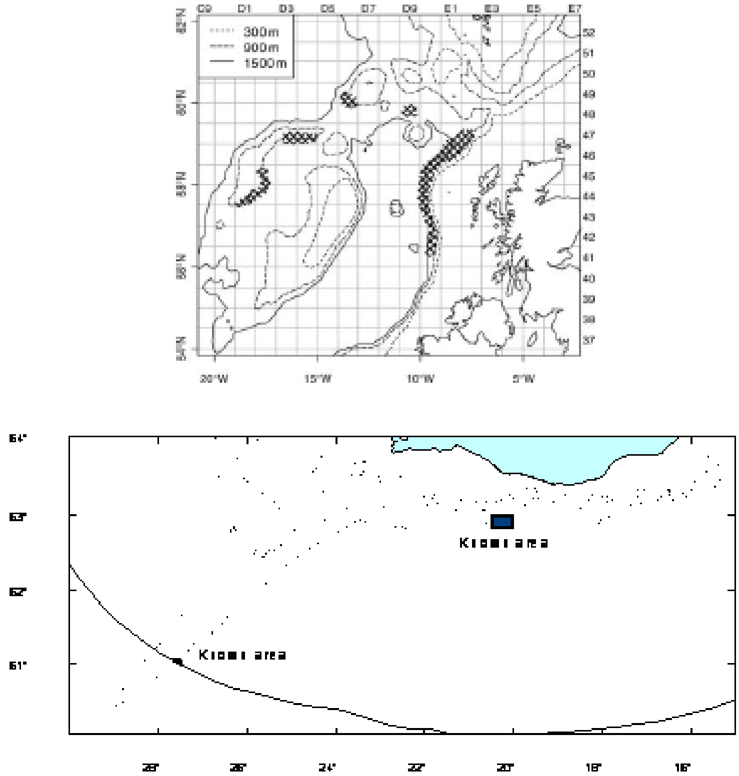


Figure 4.1.3. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b, from Large *et al*., 2010).

4.2 Blue Ling (*Molva dypterygia*) In Division 5.a and Subarea 14

4.2.1 The fishery

The change in geographical distribution of the Icelandic blue ling fisheries from 2003, to 2018 (Figures 4.2.1 and 4.2.2) indicates that there has been an expansion of the fishery of blue ling to northwestern waters. This increase may partly be the result of increased availability of blue ling in the north western area.

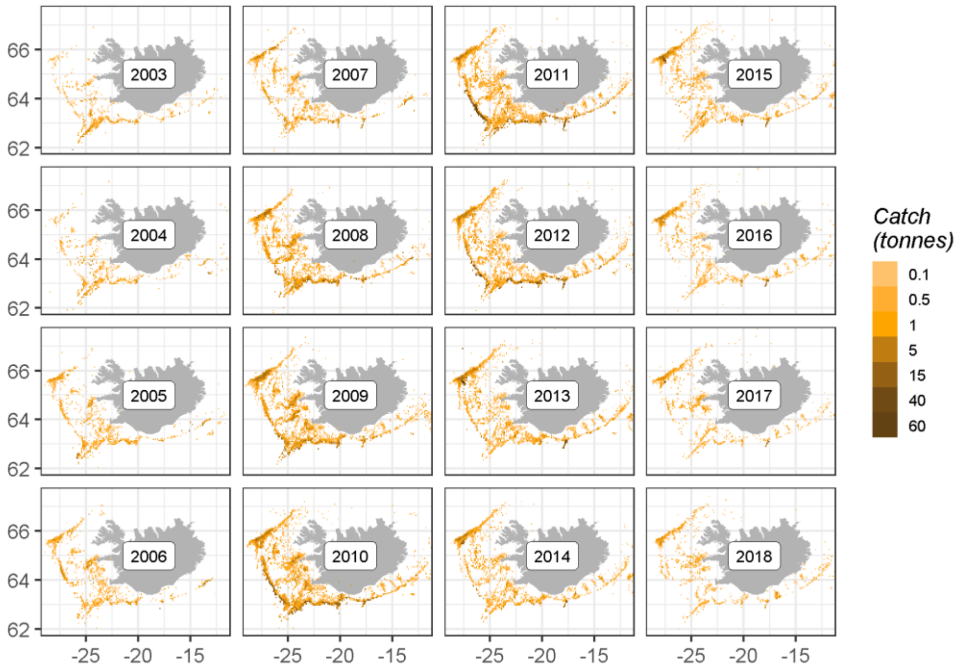


Figure 4.2.1. Blue ling in 5.a and 14. Geographical distribution of the Icelandic blue line fishery since 1999 as reported in logbooks. All gear types combined.

Before 2008 the majority of the catches of blue ling in 5.a were by trawlers, as bycatch in fisheries targeting Greenland halibut, redfish, cod and other demersal species (Table 4.2.3). Most of the catches by trawlers are taken in waters shallower than 700 m and by longliners until 2008 mostly at depths shallower than 600 m.

After 2007 there was a substantial change in the fishery for blue ling in 5.a (Table 4.2.3). The proportion of catches taken by longliners increased from 7–20% in 2001–2007 to around 70% in 2011 as longliners started targeting blue ling. The trend has reversed and in 2015–2018 the proportion of longline catches decreased to 20–30%. At the same time longliners have started fishing in deeper waters than before 2008 and until 2012 the bulk of the longline catches have been taken at depths greater than 400 m (Figure 4.2.3).

Historically the fisheries in Subarea 14 have been relatively small but highly variable.

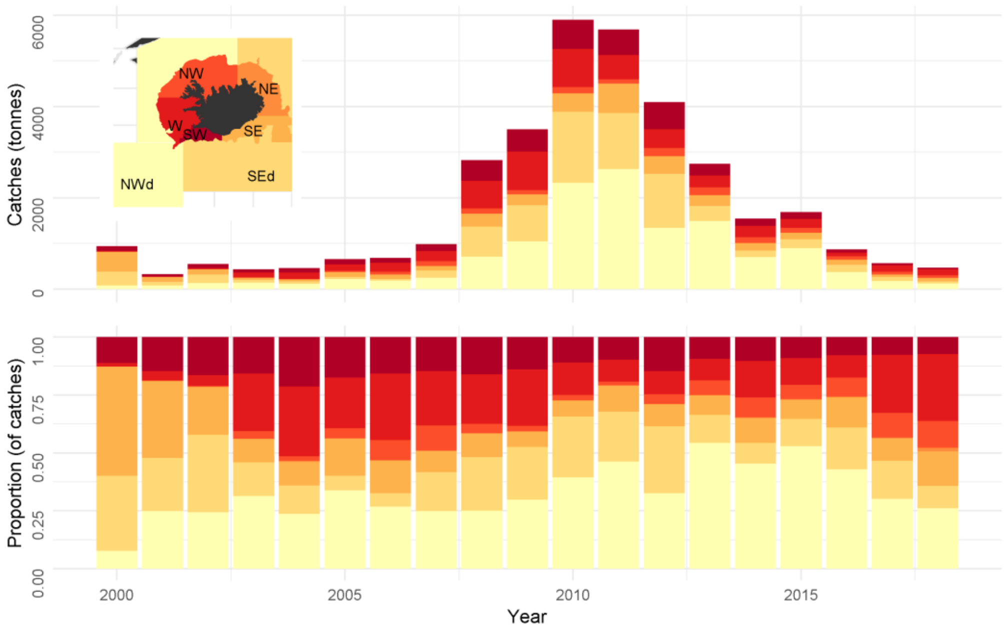


Figure 4.2.2. Blue ling in 5.a and 14. Spatial distribution of reported catches in 5.a in tonnes (upper) and as annual proportions (lower). The inserted map shows the area division and location of operations in 2013 (hauls and lines) as white points.

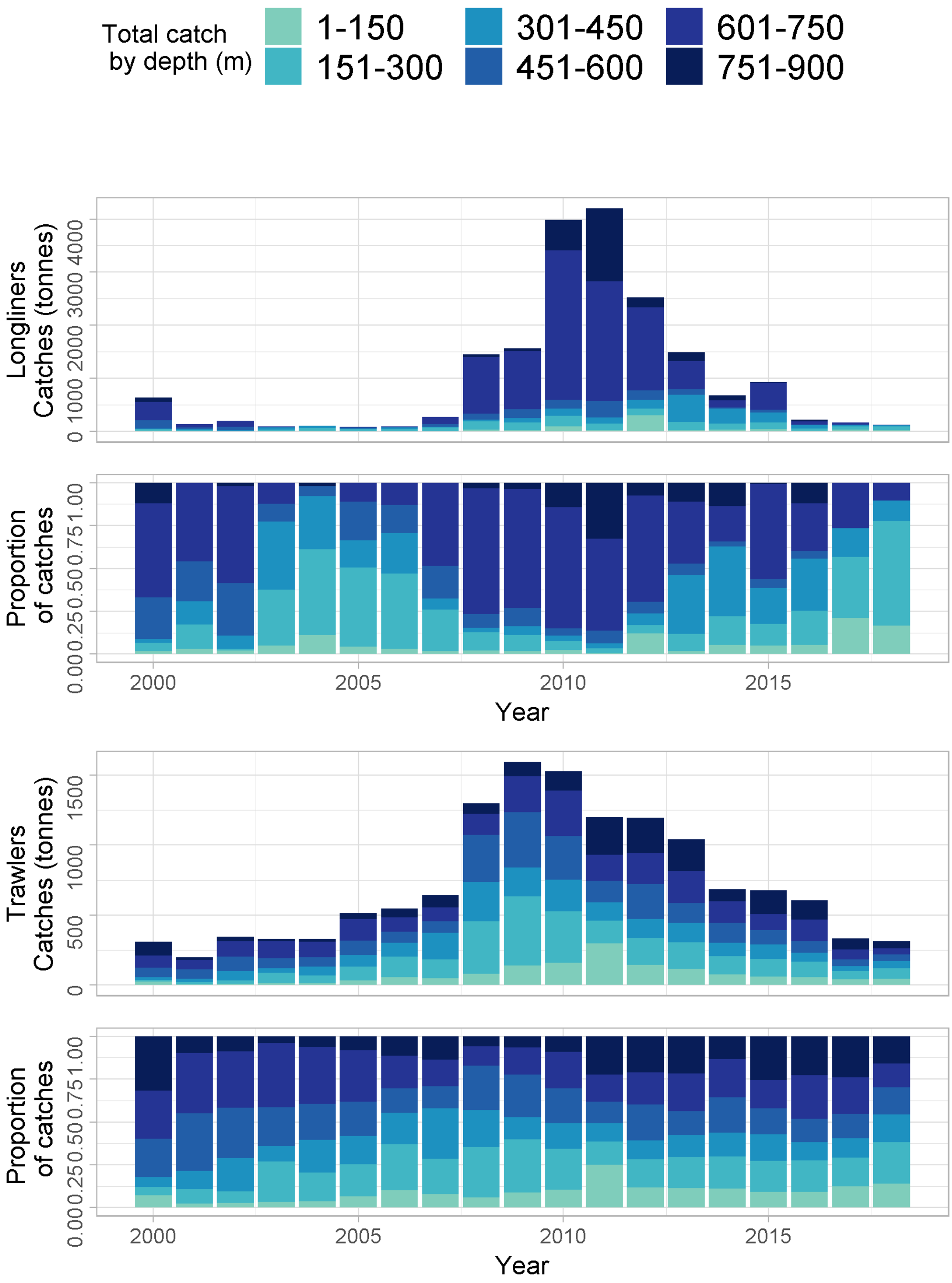


Figure 4.2.3. Blue ling in 5.a and 14. Depth distribution of longline catches and proportion of catches (upper half) and the same for trawls (lower half) in 5.a according to logbook entries.

4.2.2 Landings trends

The preliminary total landings in 5.a in 2018 were 530 t of which the Icelandic fleet caught 502 t. (Table 4.2.2 and Figure 4.2.4). Catches of blue ling in 5.a increased by more than 370% between 2006 and 2010, the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet. Since then catches in 5.a decreased compared to 2010 or by around 6400 tonnes (Table 4.2.3).

Total international landings from 14 (Table 4.2.2) 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 2018 were 51 t.

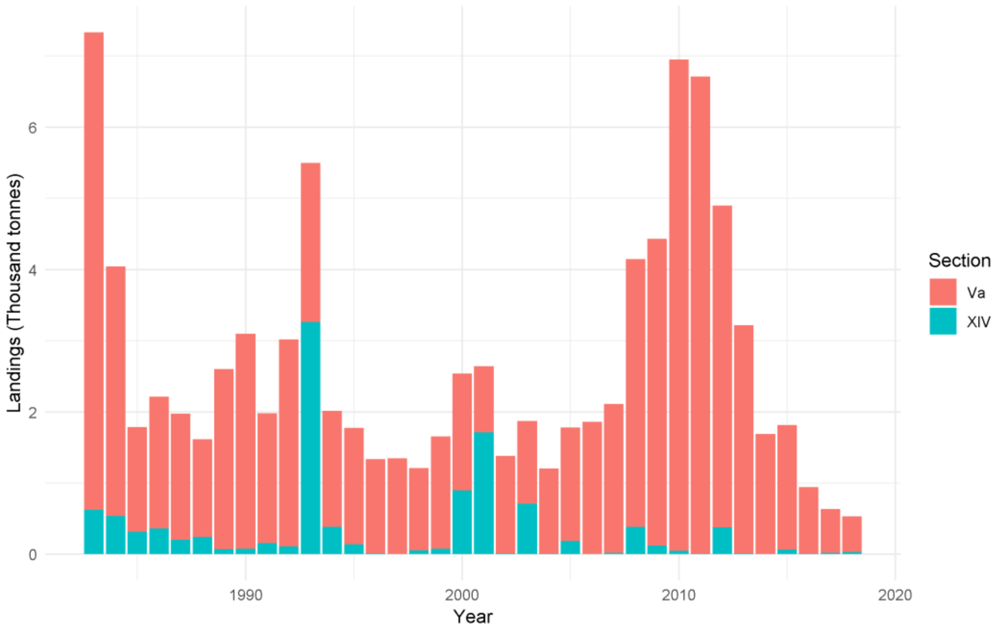


Figure 4.2.4. Blue ling in 5.a and 14. Nominal landings.

4.2.3 ICES Advice

The ICES advice for 2018 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1520 tonnes. Area closures to protect spawning aggregations should be maintained and expanded as appropriate.

The basis for the advice was the following: The ICES framework for category 3 stocks was applied (ICES, 2012). The Icelandic autumn trawl survey was used together with the catch to calculate a harvest rate index. Based on this an F_{proxy} has been chosen from a reference period, 2002–2009, when the fishing pressure was relatively constant and the SSB increased steadily, which implies that the harvest was considered sustainable.

The advice is based first on a comparison of the latest index value (index A) with the preceding value (index B), combined with the F_{proxy} target (catch/survey biomass). The index is estimated to have decreased by less than 20% which means that the uncertainty cap was not applied. So, in estimating the catch advice the F_{proxy} is used directly with the survey observation (index A).

The advice changed in 2019 (see section 4.1.7).

4.2.4 Management

Before the 2013/2014 fishing year the Icelandic fishery was not regulated by a national TAC or ITQs. The only restrictions on the Icelandic fleet regarding the blue ling fishery were the introduction of closed areas in 2003 to protect known spawning locations of blue ling, which are in effect. As of the 2013/2014 fishing year, blue ling is regulated by the ITQ system (regulation 662/2013) used for many other Icelandic stocks such as cod, haddock, tusk and ling. The TAC for the 2018/2019 fishing year was set at 1520 based on the recommendations of MRI using the same advisory procedure as in 4.2.3.

Table 4.2.5. Blue ling in 5.a and 14. TAC recommended for tusk in 5.a by the Marine Research Institute, national TAC and total landings from the quota year 2013/2014.

FISHING YEAR	ICES/MRI ADVICE	NATIONAL TAC	ICELAND	OTHERS	LANDINGS
2013/2014	2400	2400	1653	101	1754
2014/2015	3100	3100	1898	41	1939
2015/2016	2550	2550	1734	90	1824
2016/2017	2032	2032	932	7	932
2017/2018	1956	1956	554	6	560
2018/2019	1520	1520	333		

4.2.5 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).

4.2.5.1 Landings and discards

Landings data are given in Tables 4.2.1 and 4.2.2. Discarding is banned in the Icelandic fishery. There is no available information on discarding of blue ling in 5.a and 14. Being a relatively valuable species and not being subjected to TAC constraints before 2013/2014 fishing year nor minimum landing size there should be little incentive to discard blue ling in 5.a.

4.2.5.2 Length compositions

Length distributions from the Icelandic trawl and longline catches for the period 2003–2018 are shown in Figure 4.2.5. Due to a mistake, no length measures were called for from commercial catches in 2017. Mean length from trawls increased from 86 cm in 2012 to 108 cm in 2018. On average mean length from longlines is higher than from trawls.

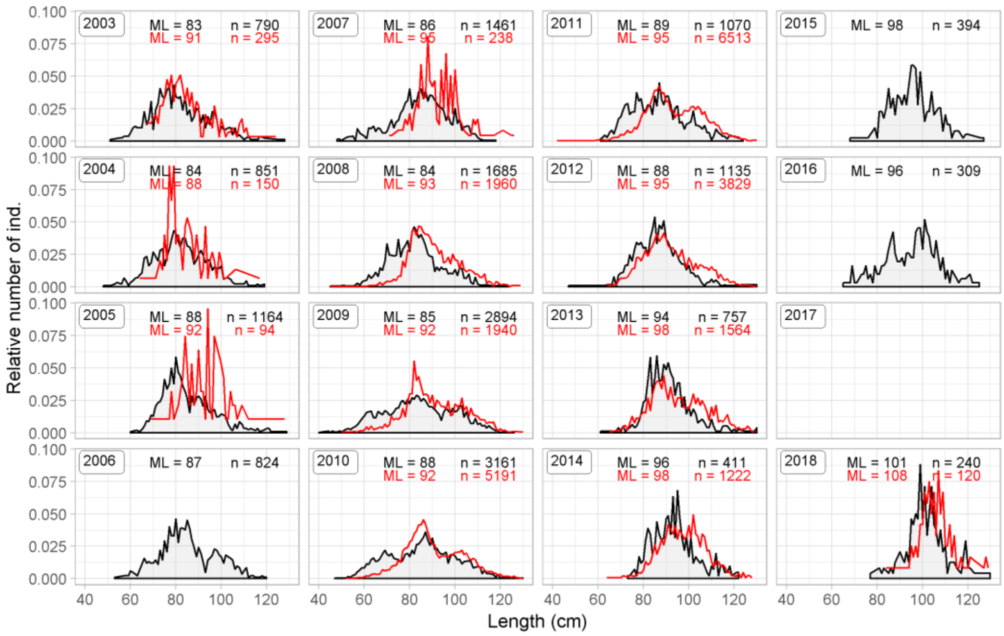


Figure 4.2.5. Blue ling in 5.a and 14. Length distribution of blue ling from trawls (black lines with shaded area) and long-lines (red lines) of the Icelandic fleet in 5.a since 2003, though 2017 is missing due to lack of data. The number of measured fish (N) and mean length (ML) is also given.

4.2.5.3 Age compositions

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

4.2.5.4 Weight-at-age

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

4.2.5.5 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*).

4.2.5.6 Catch, effort and survey data

Effort and nominal cpue data from the Icelandic trawl and longline fleet are given in Figure 4.2.6. 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 5.a and therefore no attempt has been made to standardize the series. However, looking at fluctuations in cpue and effort may be informative regarding the development of the fishery. Cpue from longlines increased from 2005 to 2010 but has since then decreased to their previous values. No marked changes are observed from trawls since 2000.

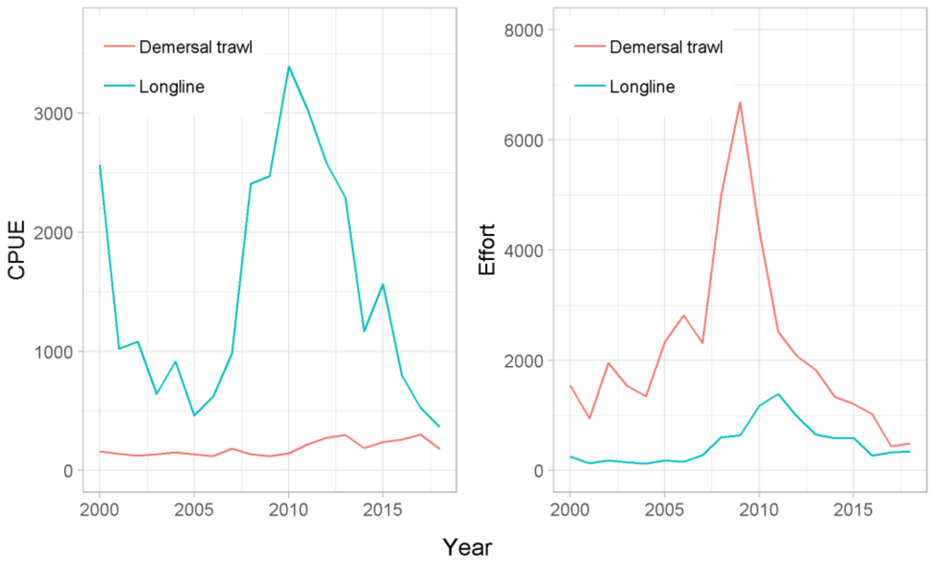


Figure 4.2.6. Blue ling in 5.a and 14. Nominal cpue and effort from longlines (blue line) and trawls (red line) in 5.a based on logbook data where blue ling was either recorded in catches or above certain level.

Time-series stratified abundance and biomass indices from the spring and autumn trawl surveys are shown in Figure 4.2.7 and length distributions from the autumn survey and its spatial distribution in Figures 4.2.8 and 4.2.9. 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.

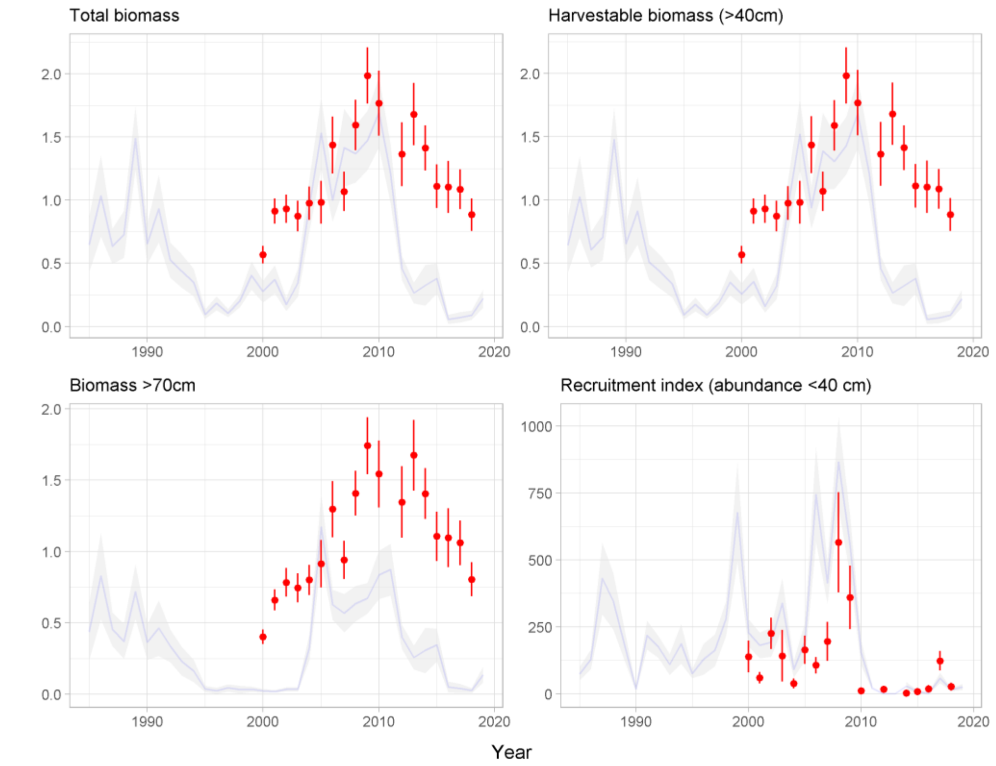


Figure 4.2.7. Blue ling in 5.a and 14. Abundance indices for blue ling in the Icelandic autumn survey since 2000 (red points and vertical lines) and the Icelandic spring survey since 1985 (faded blue line and shaded area). Total biomass index (top left), biomass of 40 cm and larger (top right), biomass of 70 cm and larger (bottom left) and abundance index of <40 cm (bottom right). The shaded area and the vertical bars show +/- standard error of the estimate.

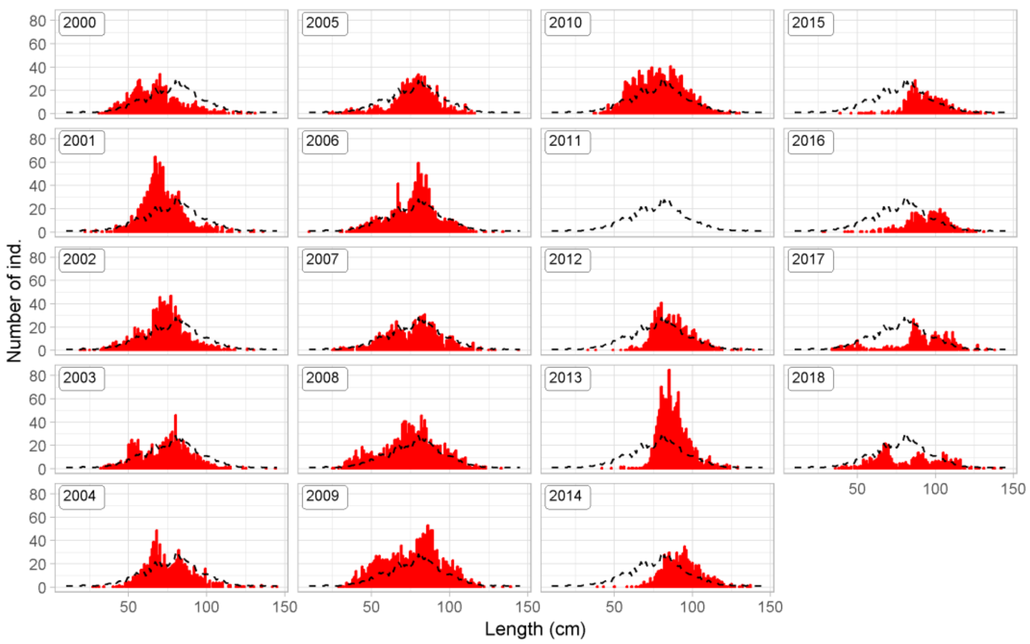


Figure 4.2.8. Blue ling in 5.a and 14. Length distributions from the Icelandic autumn survey since 2000. Black line is the average by length over the whole survey period.

Figure 4.2.9. Blue ling in 5.a and 14. Spatial distribution from the Icelandic autumn survey.

4.2.6 Data analyses

Landings and sampling

Catches from the Icelandic longline fleet increased rapidly from 2007–2010 resulting in a rapid expansion of the fishing area and change in the selectivity of the fishery although there are now strong indications since 2012 that this may have reversed. This can be seen when looking at Table 4.2.3. In 2005 longliners caught 102 tonnes of blue ling when trawlers caught 1260 tonnes or 84% of the total catches (1505 tonnes). In 2011 trawlers caught 1618 tonnes, out of 5900 tonnes or 27%, but longliners 4138 tonnes or 70%. Since then the proportion taken by longliners has decreased and in 2018 longliners caught 26% of the catches, trawls 73% and other gear 1%.

As longliners take on average larger blue ling (Figure 4.2.5) this will have resulted in an overall change in the selection pattern in 2006–2018. Total catches by the Icelandic fleet decreased between 2010 and 2013 and this decrease is mainly the result of decrease in trawls in 2011 but in longlines in 2012 and 2013. The expansion of the longline fleet to deeper waters between 2008 and 2012 (Figure 4.2.3) may be the result of decreased catch rates in shallower areas.

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 from 2005 to 2010 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 4.2.6). In 2011 to 2018 cpue from longline has decreased rapidly apart from a slight increase 2013-2015. Cpue from trawling has remained at low levels while effort increased until about 2009 after which it has decreased (Figure 4.2.6).

Surveys

The spring survey covers only the shallower part of the depth distributional range of blue ling and shows high interannual variance (Figure 4.2.7). It is thus unknown to what extent the spring indices reflect actual changes in total blue ling biomass, given that it does not cover the depths were largest abundance of blue ling occur. It is however not driven by isolated large catches at a few survey stations.

The shorter autumn survey, which goes to greater depths and is therefore more likely to reflect the true biomass dynamics than the spring survey does indicate that there was an increase in blue ling biomass since from 2003 to 2009 (Figure 4.2.7). Since 2010 the biomass index has decreased to similar levels as observed in 2002–2005. A large increase of more than 200% in the recruitment index was observed in 2008 but in the 2010 it had decreased again to its lowest observed value and has not increased markedly again (Figures 4.2.7 and 4.2.8). Due to industrial action, only part of the autumn survey was conducted in 2011.

F_{proxy}

Relative fishing mortality (F_{proxy} = Yield/Survey biomass) derived from the autumn survey (+40 cm) and the combined catches from 5.a and 14 indicates that fishing mortality may have increased by more than 150% between 2007–2010 (Figure 4.2.10 and Table 4.2.4). Since then there are indications that it has decreased by similar percentage between 2012 and 2014, to the same levels as observed in 2002 and 2009 but has decreased even further between 2015 and 2018. The reason for the decrease is because of proportionally greater decrease in landings than in the survey index.

Figure 4.2.10. Blue ling in 5.a and 14. Changes in relative fishing mortality (Yield/Survey biomass >39 cm). The yellow box highlights the reference period used by ICES as basis for the 2012 advice and the blue dotted line is the target F_{proxy} of 1.75 (Mean of 2002–2009).

Analytical assessment

Exploratory stock assessment on Blue ling in 5.a and 14.b using Gadget

An exploratory stock assessment of blue ling in 5.a using the Gadget model was presented at WGDEEP 2012. Updated results of the model were not presented at WGDEEP 2019.

4.2.7 Comments on the assessment

Following the close of the working group meeting and during the preparation of the draft advice, there were discussions about the appropriateness of using the F_{proxy} in deriving the advice. It was concluded that the recruitment estimates of recent years were much lower than those observed during the period used for the calculation of the F_{proxy} and that the F_{proxy} is likely no longer appropriate. Consequently, the ICES framework for category 3 stocks using survey trends was applied. The Icelandic autumn trawl survey (IS-SMH) was used as the index for the stock development. The advice is based on the ratio of the mean of the last two index values (index A) and the mean of the three preceding values (index B) multiplied by the mean catches in the last three years. The index/ratio is estimated to have decreased by 20% and thus the uncertainty cap was not applied. The stock status relative to candidate reference points is unknown and the precautionary buffer was applied. The result is TAC for 2020 set at 483 (987/1226)*755*0.8), which is a 68% decrease from last year's advice.

4.2.8 Management considerations

Landings have decreased considerably in the last year and as blue ling in 5.a is now part of the ITQ system such a rapid increase in landings as observed between 2006 and 2011 is unlikely. Blue ling is caught in mixed fisheries by the trawler fleet, mainly targeting redfish and Greenland halibut. After the inclusion of blue ling in the ITQ system the longliners have shifted from a directed fishery to a more mixed fishery for the species. Because of the restrictions of the TAC the implications of low blue ling TAC for the trawlers can be considerable, although the species is a low percentage in their catches.

Recruitment index from the autumn survey indicates very little recruitment to the stock since 2010, resulting in a truncated length distribution from both the survey and commercial catches.

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

4.2.9 Tables

Table 4.2.1. Blue ling: Landing in ICES Division 5.a.

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

Year	Faroe	Germany	Iceland	Norway	UK	Total
2000	0	7	1605	25	8	1645
2001	95	12	752	49	23	931
2002	28	4	1256	74	10	1372
2003	16	16	1098	6	24	1160
2004	38	9	1083	49	20	1199
2005	24	25	1497	20	26	1592
2006	63	22	1734	27	9	1855
2007	78	0	1999	4	10	2091
2008	88	0	3653	21	0	3762
2009	178	0	4132	5	0	4315
2010	515	0	6377	13	0	6905
2011	797	0	5903	2	0	6702
2012	312	0	4207	2	0	4521
2013	435	0	2769	2	0	3206
2014	71	0	1588	30	0	1689
2015	10	0	1734	4	0	1748
2016	6	0	925	84	0	1015
2017	4	0	618	0	0	622
2018[1)]	28	0	513	0	0	541

[1)] **Provisional figures.**

Table 4.2.2. Blue ling: Landing in ICES Division 14. Source: STATLANT database.

Year	Faroe	Germany	Greenland	Iceland	Norway	Russia	Spain	UK	Denmark	Total
1983	0	621	0	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	0	79
1991	0	105	5	0	0	0	0	45	0	155
1992	0	27	2	0	50	0	0	32	0	111
1993	0	16	0	3124	103	0	0	22	0	3265
1994	1	15	0	300	11	0	0	57	0	384
1995	0	5	0	117	0	0	0	19	0	141
1996	0	12	0	0	0	0	0	2	0	14
1997	1	1	0	0	0	0	0	2	0	4
1998	48	1	0	0	1	0	0	6	0	56
1999	0	0	0	0	1	0	66	7	0	74
2000	0	1	2	4	0	0	889	2	0	898
2001	1	0	1	11	61	0	1631	6	0	1711
2002	0	0	0	11	1	0	0	0	0	12
2003	0	0	3	0	36	0	670	5	0	714
2004	0	0	7	0	1	0	0	7	0	15
2005	2	0	6	0	1	0	176	8	0	193
2006	0	0	6	0	3	1	0	0	0	10
2007	19	0	1	0	1	0	0	0	0	21
2008	1	0	5	0	2	0	381	0	1	390
2009	1	0	5	0	3	0	111	4	0	124
2010	1	0	8	0	9	0	34	0	3	55
2011	0	0	8	0	2	0	0	1	6	17

Year	Faroe	Germany	Greenland	Iceland	Norway	Russia	Spain	UK	Denmark	Total
2012	0	0	13	367	9	0	0	0	3	392
2013	0	0	16	0	0	0	0	3	9	28
2014	0	0	14	0	3	0	0	0	0	17
2015	0	0	66	0	1	0	0	0	5	72
2016	0	0	9	0	0	0	0	0	7	16
2017	0	0	12	0	4	0	0	0	3	19
2018[1)]	0	0	34	0	12	0	0	0	5	51

[1)] Provisional figures.

Table 4.2.3. Blue ling. Catches by gear type and numbers of boats participating in the blue ling fishery in 5.a.

Year	Longline	Trawl	Other gear	Total landings	Longliners		Trawlers	
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	No boats	Hooks (mill.)	No. boats	Hrs (thous)
2000	804	797	25	1626	15	5.6	23	2.1
2001	129	576	51	756	15	2.3	26	1.6
2002	255	980	22	1257	12	2.8	30	3.1
2003	197	879	22	1098	9	1.4	37	2.7
2004	145	891	44	1080	10	2.1	39	2.8
2005	102	1260	143	1505	8	0.9	52	4.3
2006	151	1461	121	1733	12	1.5	53	4.9
2007	373	1537	81	1991	12	2.8	51	4.2
2008	1453	2111	88	3652	23	10.2	67	9.6
2009	1678	2245	208	4131	25	10.6	64	13.1
2010	3977	2184	213	6374	37	20.0	61	10.0
2011	4138	1618	144	5900	35	21.2	57	5.9
2012	2425	1306	476	4207	24	15.1	53	5.2
2013	1421	1293	53	2767	28	6.6	49	4.0
2014	622	911	54	1588	23	4.4	47	3.8
2015	868	841	25	1734	29	4.9	46	2.9
2016	213	681	30	925	16	1.5	50	2.6
2017	169	436	14	619	23	2.1	46	1.2
2018	134	372	7	513	13	2.0	43	1.2

Table 4.2.4. Blue ling in 5.a and 14. Catches in 5.a and 14 along with survey biomass index (larger than 40 cm) from the Icelandic Autumn survey and the calculated F_{proxy} (($C_{5.a}$ + C_{14})/I).

Year	5.a	14	Index	Fproxy
2000	1645	898	574.5	4.43
2001	931	1711	950.2	2.78
2002	1372	12	988.3	1.40
2003	1160	714	930.1	2.01
2004	1199	15	1039.7	1.17
2005	1592	193	1051.4	1.70
2006	1855	10	1492.9	1.25
2007	2091	21	1128.1	1.87
2008	3758	390	1645.2	2.52
2009	4233	124	2073.8	2.10
2010	6905	55	1836.8	3.79
2011	6702	17	*No survey*	
2012	4521	392	1411.5	3.48
2013	3082	28	1762.3	1.76
2014	1588	17	1455.8	1.10
2015	1734	72	1161.1	1.56
2016	925	16	1118.0	0.84
2017	623	19	1086.0	0.59
2018	530	51	884	0.66

4.3 Blue Ling (*Molva dypterygia*) in Division 5.b and Subareas 6 and 7

4.3.1 The fishery

The main fisheries are those by Faroese trawlers in 5.b and French trawlers in 6.a and, to a lesser extent, 5.b. In recent years landings from Scottish fisheries in Division 6.a have increased and represented one quarter of the total catch from the stock in 2017. Total international landings from Subarea 7 are small and are mostly bycatches in other fisheries. There used to be more fishing in divisions 7.b–c, but these also reduced to very small bycatch in recent years.

Landings by Faroese trawlers are mostly taken in the spawning season. Historically, this was also the case for French trawlers fishing in 5.b and 6.a. However, since the 2000s blue ling has been taken round the year together with roundnose grenadier and black scabbardfish as well as deep-water sharks until 2009.

4.3.2 Landings trends

Total international landings from Division 5.b (Tables 4.3.1a–f, Figure 4.3.1 and revised stock annex) peaked in the late 1970s at around 21 000 t and then decline until 2010. Thereafter landings have oscillated between 1000 and 1500 tonnes per year. Note that landings for years prior to 2000 were moved to the stock annex, in order to shorten report tables.

The landings from Subarea 27.6 peaked at about 18 000 t in 1973 and fluctuated throughout the 1980s within the range of 5000–10 000 t and have since gradually declined. In the 2000s reducing EU TACs have been the main driver of the catch level. In the last five years, landings have been stable at 1200–1500 tonnes in 6.a and minor in 27.6.b.

Landings from Subarea 7 are comparatively small, mostly less than 500 t per annum in the whole time-series and less than 100 t during the last ten years.

In 2018 landings increased by 28% compared to 2017. The increase was spread across all fishing countries and all areas. This increase was therefore not the consequence of an emerging fishery but that of higher catch in all fisheries. The total landings in 2018 are the highest since 2011. However, landings remain well below the TAC and maximum level recommended in the ICES advice. Some EU fleet, in particular the French fleet of large trawlers, appear to be in a situation of under capacity. Although higher fishing opportunities for blue ling became available in 2015, vessels kept fishing mostly for saithe. This under capacity is the results of the reduction of the number of French trawlers >=30 m, based in harbours where deep-waters species are landed from 35 in 2005 to 16 in 2016 (Common Fleet Register data). Further the restriction of fishing at spawning time no longer allows for major target catch at the spawning season as in the 1980s and 1990s.

In 2016-2018, landings data by country and ICES Division were extracted from InterCatch for all countries, expect for the Faroe Islands where ICES preliminary landings were used. In 2018 as some landings from Spain were slightly higher in preliminary landings than in InterCatch, values from preliminary landings were used.

4.3.3 ICES Advice

The ICES advice for 2019 and 2020 is "when the MSY approach is applied, catches should be no more than 11778 tonnes in 2019 and no more than 11150 tonnes in 2020."

Following reference points development carried out in 2015 for stocks of ICES category 1, F_{MSY} for the stock was set to 0.12 in 2016, and this resulted in an increase of the catch advice from 2017 compared to previous years. The last advice before 2016, delivered in 2014, was based on an F_{proxy} defined as $F_{50\%SPR}$=0.07.

4.3.4 Management

Prior to 2009, EU deep-water TACs were set on a biennial basis; however from 2009 onwards, annual TACs were applied for the components of this stock in EU waters of 5.b, 6 and 7. TACs are fixed according to bilateral agreements between EU and Faroe Islands and EU and Norway. There was no agreement between the Faroe Island and the EU in 2011–2013 but these were resumed in 2014. The EU TAC includes quotas for Norway and the Faroe Islands. The EU has a quota for ling and blue ling in Faroese waters. This EU quota is divided in national quotas between Germany, France and UK. In 2015 and 2016, this EU quota in Faroese waters was 1500 t and a bycatch of roundnose grenadier and black scabbardfish of up to 500 t was allowed to be reported under the same quota (EU council regulation 2015/104). In 2017, the EU quota was 2000 t, the allowance for a bycatch of roundnose grenadier and black scabbardfish was still included but up to a limit of 0 t (EU council regulation 2017/127 and Faroese regulation). For 2018, the EU quota of ling and blue ling in Faroese waters is 2000 t and a bycatch of roundnose grenadier and black scabbardfish may be counted up to the limit of 665 t. (EU council regulation 2018/20).

The table below provides the EU TAC the quota 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 FAROESE WATERS OF 5.b(1)	INTERNATIONAL
Year	Area	ICES advice	EU TAC	EU	Norway	Faroe		landings
2006	67	Biennial		3037	200	400	3065	5650
2007	67	No direct fisheries		2510	160	200	3065	5648
2008	67	Biennial		2009	150	200	3065	3940
2009	5b67	No direct fisheries	2309	2009	150	150	3065	4121
2010	5b67	Biennial	2032	1732	150	150	2700	4759
2011	5b67	No direct fisheries	2032	1717	150	0	0	2861
2012	5b67	Same as 2011	2031	1882	150	0	0	3031
2013	5b67	3900	2540	23905	150	0	0	2588
2014	5b67	3900	2540	2210	150(2)	150(3)	1500	2949
2015	5b67	5046	5046	4746	150(2)	150(3)	1500(4)	2793
2016	5b67	5046	5046	4746	150(2)	150(3)	2100	3059
2017	5b67	11314	11314	11014	150(2)	150(3)	2000	2669
2018	5b67	10763	10763	11463	150(2)	150(3)	2000	

(1) TAC for ling and blue ling, against which a bycatch roundnose grenadier and black scabbard fish may be counted, up to a limit of 665 t in 2018.

(2) To be fished in Union waters of 27.2.a and 27.4-7 (BLI/*24X7C).

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

(4) including a quota of 419 t to Germany, which was caught as ling without blue ling landings

In Faroese waters, Faroese vessels are encouraged to land all fish, which is thought to be done for blue ling, owing to the species value and the absence of fish of unmarketable size. Faroese vessels in Faroese waters are regulated by licences and fishing days but no quota.

Since 2015, the EU TAC in EU and international waters has been set to the level of the ICES catch advice. As all catches are not from EU countries (which caught 60 to 75% of the total catch in the last 15 years) this EU TAC at the level of the advice could result in total catch in excess of the advice.

In 2009, the EU introduced protection areas of spawning aggregations of blue ling on the edge of the Scottish continental shelf and at the edge of Rosemary Bank (6.a). 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. In 2013, NEAFC introduced a protection of the spawning area located near the southwest boundary of the Icelandic EEZ, this area is banned to bottom fishing gears from 15 February to 15 April (rec 7:2017, https://www.neafc.org/managing_fisheries/measures/current).

In ICES Division 27.6.b, areas closed to bottom fishing gears have been extended and these include some of the spawning areas identified by Large *et al*. (2009), see Figure 4.1.3b.

4.3.5 Data availability

4.3.5.1 Landings and discards

The time-series of landings was updated (Tables 4.3.1a-f).

Based upon data provided to ICES through InterCatch, international discards in 2016-17 were less than 1% of landings for country reporting through InterCatch. Faroese data were provided separately and Faroese vessels are considered making no discards. The proportion of blue ling discarded by year in the French deep-water trawl fishery in 2010–2015 based upon French onboard observations carried out under the DCF was estimated to 0.01–0.3%, well below the maximum 5% level where discards are considered negligible in ICES advice. This low discarding proportion comes from the absence of catch of small fish.

Similarly, Spanish observer on board trawlers fishing in 6.b reported that discards for this species are negligible, in the range of 0–0.5% of the catch.

4.3.5.2 Length compositions

Annual length distribution of blue ling landings from Faroese trawlers was available from 1981 to 2018 (Figure 4.3.2).

Length distribution of blue ling in Faroese spring and summer groundfish surveys are shown in Figures 4.3.3 and 4.3.4. A deep-water survey was initiated in 2014 in Faroese waters, the length of blue ling in this deeper survey is larger than in the two other surveys (Figure 4.3.5).

Time-series of number and occurrence (percent of haul) of blue ling smaller than 80 cm in Faroese surveys was provided (Figure 4.3.6).

4.3.5.3 Age compositions

Age estimations were not used in 2019 as the assessment is carried out at a biennial frequency.

4.3.5.4 Weight-at-age

Blue ling is landed gutted in France, the only EU country where age estimation of this species is carried out. Weight-at-age is calculated using the length-at-age and length–weight relationship.

4.3.5.5 Maturity and natural mortality

Analyses of Faroese survey data were presented in 2018 (Ofstad, 2018, WD). Analysed data include a Faroese blue ling survey from 1995 to 2003 and the larvae data from the Faroese 0-group survey 1995-2017. These analyses reveal the occurrence of some spawning areas in Faroese waters and very small numbers of larvae were observed pelagically in the 0-group survey in June/July (see stock annex).

4.3.5.6 Catch, effort and RV data

Catch data were updated, discards data reported to intercatch were negligible. The standardized cpue time-series from the Faroese trawler fleet was updated.

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

The Scottish deep-water research survey has been set to be biennial, the last survey was carried out in 2017; the available time-series is presented in Figure 4.3.7).

The standardized time-series from the Faroese spring and summer surveys were updated (Table 4.3.2).

4.3.6 Data analyses

Length distribution of catches of Faroese fleets show that fish caught are mostly in the length range 70–120 cm (Figures 4.3.2). Recruitment inputs are visible in survey catches in some years, e.g. 2007–2009 and again in 2017-18 (Figure 4.3.3). Smaller and more variable numbers are caught in the Faroese spring survey (Figure 4.3.4). The time series from the Faroese deepwater survey in still short (5 years) and no standardised index is calculated yet.

Surveys

The Faroese surveys show varying biomass since 1994 with high values in 2004, 2005 and since 2009 (Table 4.3.2). The depth range (<500 m) does not extend down to the core depth distribution of blue ling. The provided indices used all hauls and are stratified indices.

Multiyear catch curve (MYCC) model

The model was not fitted in 2019.

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

The model was not fitted in 2019.

Reference points

Reference points the stock were defined by WKMSYref 4 as F_{MSY}=0.12, MSY F_{lower}=0.08 and MSY F_{upper}=0.17. MSY B Trigger was set as B_{pa}=1.4*B_{lim} (table below), because the variability of the stock dynamics was not fully captured by the WKMSYref4 analysis. This is because the only input available to WKMSYref4 was SRA as the MYCC does not cover a sufficient time-series to estimate a stock–recruitment relationship. SRA does not allow for significant variability of recruitment. In these circumstances a MSY $B_{trigger}$ based on 5% of B_{MSY} is not meaningful and was not recommended by WKMSYref4. B_{lim} was set as B_{loss}, the lowest biomass estimate in the time-series (here the time-series of biomass from the SRA estimate in 2014).

Reference points for bli-5b67 estimated by WKMSYref4.

MSY F_{lower}	F_{MSY}	MSY Fupper with AR	MSY $B_{trigger}$ (tonnes)	MSY Fupper with no AR
0.08	0.12	0.17	75 000	0.14

Further, F_{lim} was estimated to 0.17 by WKMSYref4 Based on simulated fishing mortality to B_{lim} and F_{pa} was estimated to 0.12 as F_{lim}*exp(-1.645*0.2). Therefore, F_{pa} is estimated to be equal to F_{MSY} and F_{lim} to MSY F_{upper}. This comes from setting B_{lim} at B_{loss}≈20% of the unexploited biomass, which is in all circumstances much more than 5% B_{MSY}, again, a level not used here because the long-term of mean of B_{MSY} could not be projected in a projection taking account of recruitment variability.

4.3.7 Comments on assessment

No assessment was made in 2019.

4.3.8 Management considerations

No new aspect of management was considered.

4.3.9 References

Large, P. A., G. Diez, J. Drewery, M. Laurans, G. M. Pilling, D. G. Reid, J. Reinert, A. B. South, and V. I. Vinnichenko. 2010. Spatial and temporal distribution of spawning aggregations of blue ling (*Molva dypterygia*) west and northwest of the British Isles. ICES Journal of Marine Science 67:494–501.

4.3.10 Tables

Table 4.3.1a. Landings of blue ling in Subdivision 5.b.1 (see stock annex for years before 2000).

YEAR	FAROES	FRANCE(1)	GERMANY(1)	NORWAY	UK (E & W) (1)	UK (Scot.)	IRELAND	RUSSIA(1)	TOTAL
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
2009	523	325						0	848
2010	840	464		49			0	0	1353
2011	838	312		0			0	0	1150
2012	799	424		8			0	5	1236
2013	440	423		0			0	3	866
2014	730	609		29					1368
2015	621	142	0	140	0		0	0	9503
2016	1100	555	0	74	0		0	0	1730
2017	766	267	0	21	0	3	0	0	1057
2018	813	225	0	150	0	0	0	0	1188

(1) Includes 5.b.2.

Table 4.3.1b. Landings of Blue ling in Subdivision 5.b.2 (see stock annex for years before 2000).

YEAR	FAROES	NORWAY	SCOTLAND	France	TOTAL
2000	0	37	37		74
2001	212	69	63		344
2002	318	21	140		479
2003	1386	84	120		1590
2004	710	6	68		784
2005	609	14	68		691
2006	647	34	16		697
2007	632	6	16		654
2008	317	0	91		408
2009	444	8	161		613
2010	656	10	225		891
2011	319	0	0		319
2012	211	0			211
2013	133	0	2		135
2014	150	6	2		158
2015	82	97		46	225
2016	13	0	7		20
2017	88	9	0	0	97
2018	150				150

Table 4.3.1c. Landings of blue ling in Division 6.a (see stock annex for years before 2000).

YEAR	FAROES	FRANCE	GERMANY	IRELAND	NORWAY	SPAIN(1)	E & W	SCOTLAND	LITHUANIA	TOTAL
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	1178			86	6		47		1322
2013	2	1168			132	11		203		1516
2014		1094			18			278		1390
2015	0	920	0	0	127	83	8	371	0	1509
2016	0	831			37	125	0	273	0	1266
2017	0	772	0	0	29	44	0	641	0	1486
2018		1128			87	72		735		2022

Table 4.3.1d. Landings of blue ling in Division 6.b (see stock annex for years before 2000).

YEAR	POLAND	RUSSIA	FAROES	FRANCE	GERMANY	NORWAY	E & W	SCOTLAND	ICELAND	IRELAND	ESTONIA	SPAIN	TOTAL
2000				514		184	500	966		7			2171
2001			238	210	1	256	337	1803		4	85		2934
2002		3	79	345		273	141	497		1			1339
2003	4	2		510		102	14	113			5		750
2004	1	5	4	514		2	10	96			3		635
2005		15	1	235		1	9	80					341
2006			3	313		2	4	29					351
2007		1	15	112		4	7	30					169
2008		12	2	29		2	2	9		0			56
2009		1		10		1		7		0			19
2010		0	0	39		15		1		0			55
2011		0	0	9		11		0					20
2012				3		3						1	217(1)
2013				5				0				3	39(1)
2014								3					4(1)
2015	0	0	0	0	0	2	0	0	0	0	0	31	33
2016	0	0	0	0	0	0	0	0	0	0	0	18	18
2017	0			0	0	1						21	22
2018				0				1				6	7

(1) **Includes unallocated catch.**

Table 4.3.1e. Landings of blue ling in Subarea 7 (see stock annex for years before 2000).

YEAR	FRANCE	GERMANY	SPAIN	NORWAY	E & W	SCOTLAND	IRELAND	TOTAL
2000	91	2	65	5	31	17	73	284
2001	84	2	64	5	29	17	634	835
2002	45	4	42	0	77	55	453	676
2003	27	1	42	0	8	16	28	122
2004	23	1	15	0	4	1	19	63
2005	37	0	25	0	1	0	11	74
2006	30	0	31	0	2	0	4	67
2007	121	0	38	0	2	1	2	164
2008	28	0	6	0	0	0	0	34
2009	10	0	1	0	0	0	0	11
2010	13	0	24	0	0	0	0	37
2011	23	0	26	0	0	0	0	49
2012	19	0	21	5	0	0	0	45
2013	32	0	0	0	0	0	0	32
2014	24				3	2		29
2015	11	0	63	0	3	1	0	78
2016	23	0	0	0	0	1	1	25
2017	5	1	0	0	1	0	0	7
2018	4	0	58	0	0	1	0	63

Table 4.3.1f. Blue ling landings in Division 5.b and subareas 6 and 7 (see stock annex for years before 2000).

YEAR	5.b	6	7	TOTAL
2000	2524	8352	284	11 160
2001	2114	9178	835	12 127
2002	2024	6053	676	8753
2003	3815	3338	122	7275
2004	2700	3459	63	6222
2005	2516	2891	74	5481
2006	2850	2733	67	5650
2007	3296	2188	164	5648
2008	2060	1846	34	3940
2009	1461	2649	11	4121
2010	2244	2478	37	4759
2011	1469	1343	49	2861
2012	1447	1539	45	3031
2013	1001	1555	32	2588
2014	1526	1394	29	2949
2015	1128	1542	78	2748
2016	1750	1284	25	3059
2017	1154	1508	7	2669
2018	1338	2029	63	3431

Table 4.3.2. Standardized biomass indices (kg/h) of blue ling in the annual demersal trawl spring and summer survey on the Faroe Plateau.

YEAR	SPRING SURVEY		SUMMER SURVEY	
	Index	SE	Index	SE
1994	1.66	0.98		
1995	1.38	0.95		
1996	1.39	0.78	4.93	2.03
1997	3.46	2.10	1.31	0.67
1998	1.60	0.97	3.26	1.34
1999	0.10	0.06	1.85	0.81
2000	0.63	0.58	1.28	0.57
2001	1.38	0.83	1.87	0.96
2002	0.68	0.58	0.80	0.40
2003	2.31	1.76	0.90	0.57
2004	1.51	1.12	5.46	2.47
2005	1.13	0.90	4.87	1.84
2006	2.18	1.68	2.06	0.80
2007	2.30	1.74	1.64	0.76
2008	0.90	0.55	1.11	0.48
2009	4.39	2.35	3.04	1.48
2010	4.27	2.58	4.01	1.80
2011	2.92	1.79	3.41	1.55
2012	4.52	3.05	4.04	1.41
2013	2.99	2.04	3.84	1.61
2014	1.36	1.01	3.63	1.97
2015	1.63	1.38	5.00	2.14
2016	1.28	1.1	6.78	4.50
2017	0.35	0.3	5.38	2.36
2018	1.08	0.72	4.73	2.14
2019	3.03	1.47		

Table 4.3.3. Standardized cpue index (kg/1000 hooks) from the Norwegian longliners in ICES Division 6.a.

YEAR	LOWER LIMIT	MEAN INDEX	UPPER LIMIT
2000	5.14522	8.45856	11.7719
2001	0.57171	4.51638	8.46105
2002	4.55438	9.18872	13.8231
2003	0.802716	4.00281	7.20291
2004	-2.12752	1.49584	5.1192
2005	0.976371	4.07241	7.16846
2006	7.14419	10.0979	13.0516
2007	3.16964	6.66199	10.1543
2008	12.3322	16.057	19.7818
2009	8.74638	13.0669	17.3873
2010			
2011	11.0952	13.6633	16.2314
2012	15.026	17.8324	20.6389
2013	16.6513	19.1335	21.6156
2014	6.7922	9.87746	12.9627
2015	19.7497	22.5361	25.3225
2016	6.39335	9.4825	12.5716
2017	6.10182	8.8683	11.6348

Table 4.3.6. Estimated SSB and yield in the long term (after stabilization) of the stock bli-5b67 under a range of fishing mortality. Projection initiated from the stock number-at-age in 2014 and run for 200 years, with a range of F value from the current F to ten times more.

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

4.3.11 Figures

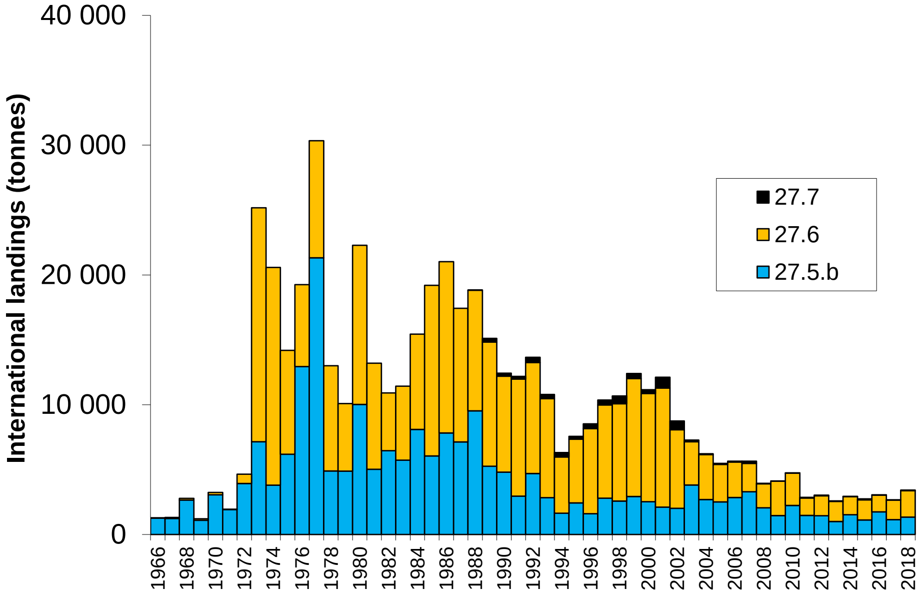


Figure 4.3.1. International landings for bli.27.5b67 in ICES subareas 6 and 7 and Division 5b.

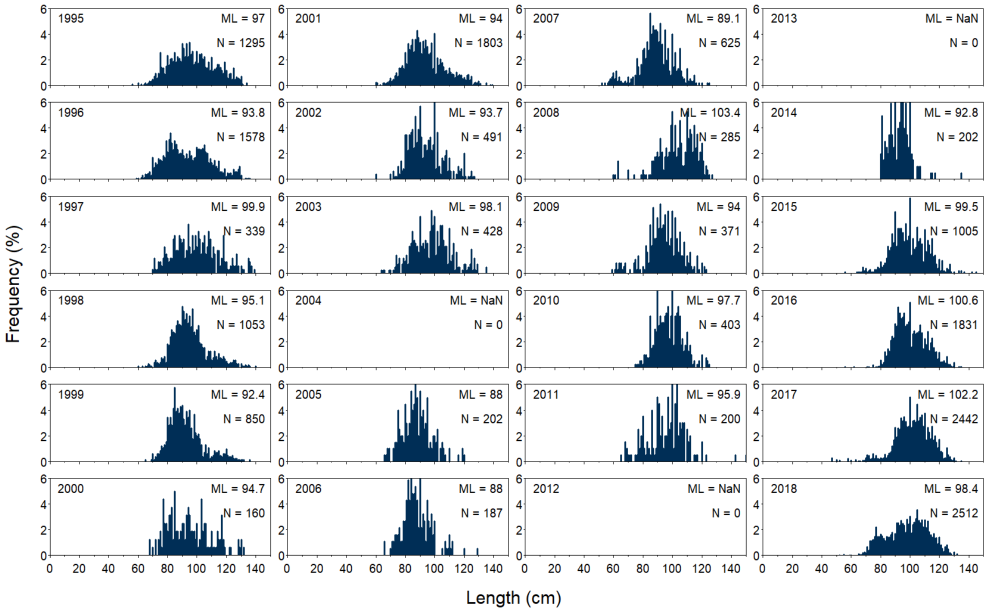


Figure 4.3.2. Length distribution of blue ling landings from Faroese otter-board trawlers >1000 HP in ICES 5.b.

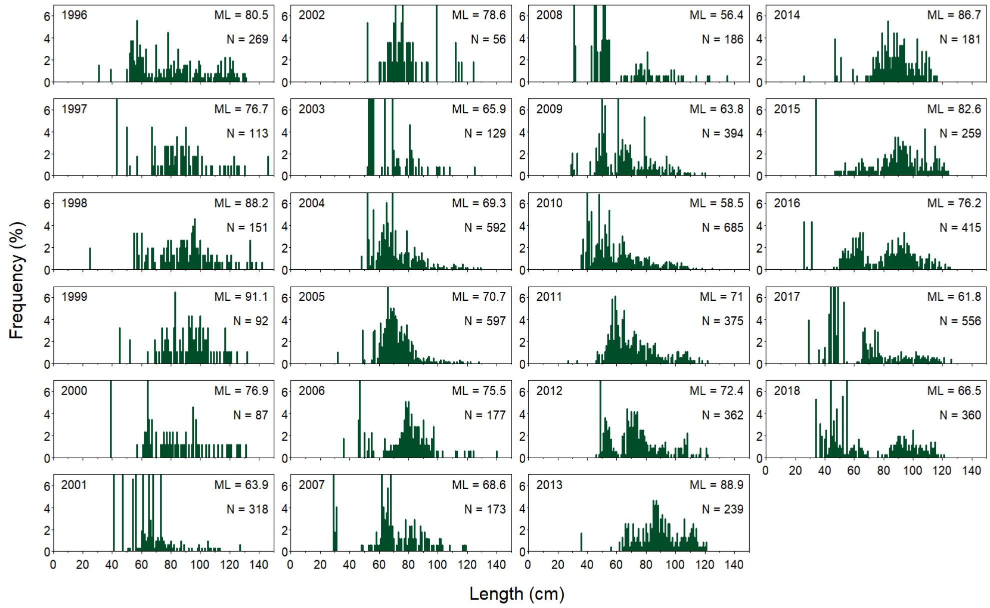


Figure 4.3.3. Length distribution of blue ling in the summer groundfish Faroese survey on the Faroe Plateau.

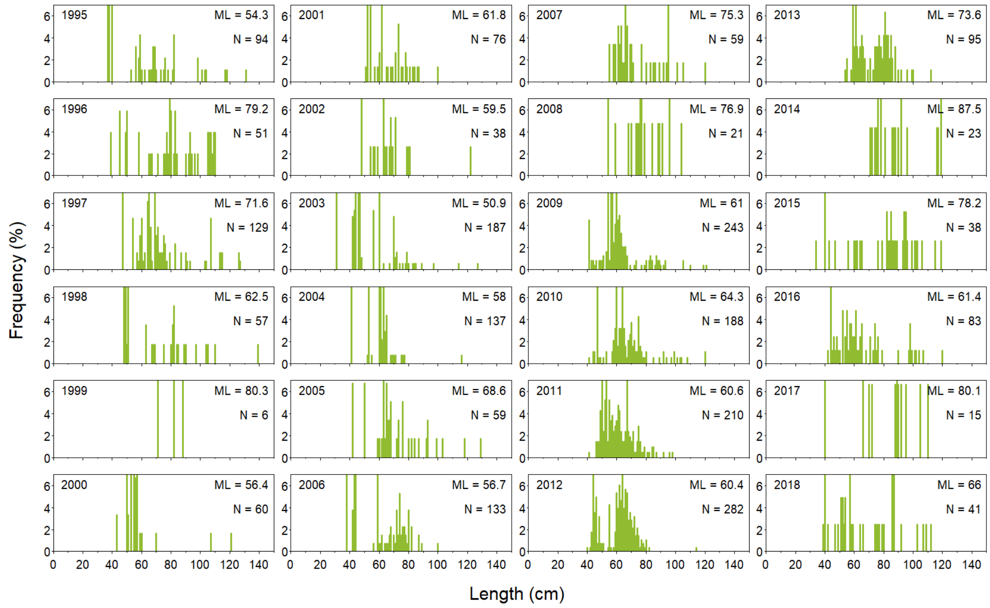


Figure 4.3.4. Length distribution of blue ling in the spring groundfish Faroese survey on the Faroe Plateau.

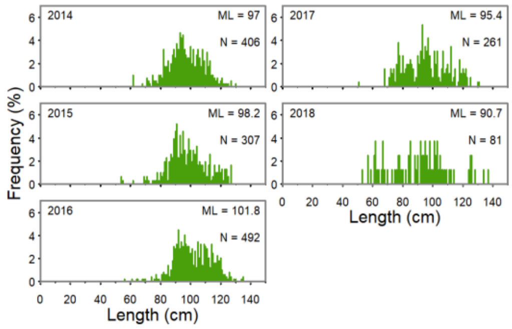


Figure 4.3.5. Length distribution of blue ling in the deep-water survey in Faroese waters.

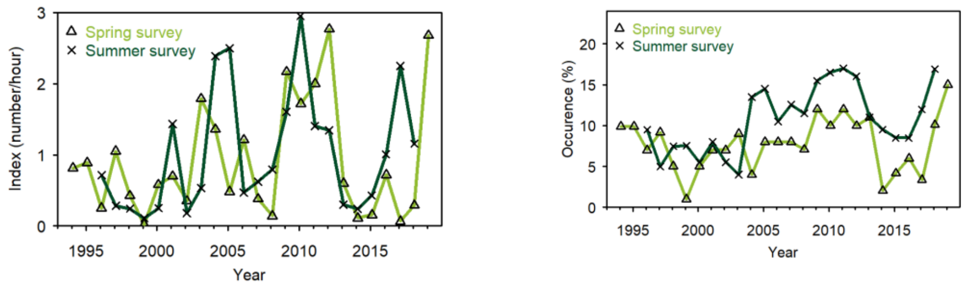


Figure 4.3.6. Juvenile (<80 cm) blue ling caught in groundfish surveys on the Faroe Plateau (left) number per hour and (right) occurrence.

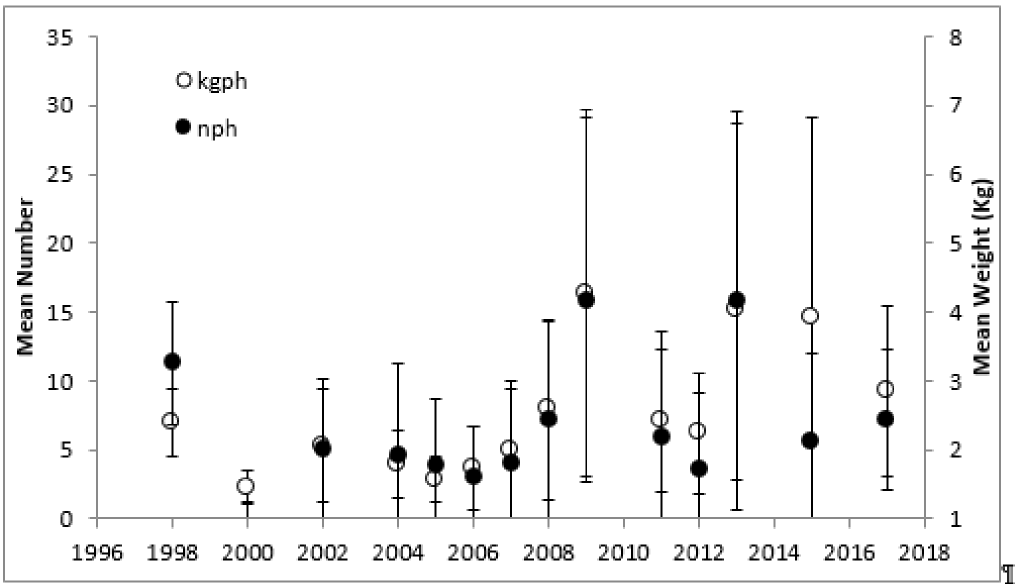


Figure 4. 3.7. Biomass index in the Scottish deep-water survey, based on haul carried out from 400 to 1600 m along the Scottish slope.

4.4 Blue ling (*Molva dypterygia*) in 1, 2, 3.a, 4, and 12

4.4.1 The fishery

The directed fisheries on spawning aggregations for blue ling on Hatton Bank (Division 12.b) and Division 2.a (Storegga) are no longer conducted. Blue ling is now only taken as bycatch of other fisheries taking place in these areas.

In Hatton Bank (Division 12.b) blue ling represents a significant bycatch of trawl fisheries for mixed deep-water species; especially from Spanish freezer trawlers. In Division 2.a there is a bycatch from the longline and gillnet fisheries on ling, tusk and saithe.

In other ICES subareas blue ling is taken in minor quantities. Small reported landings in Subareas 8 and 9 are now ascribed to the closely related Spanish ling (*Molva macropthalma*) since the species is not known to occur in any significant numbers in these subareas.

4.4.2 Landing trends

Landing data are presented in Tables 4.4.0a–f. There are also historical landings from the Norwegian fishery, mainly from Division 2.a, back from 1896 (Figure 4.4.1). During the whole time-series, around 90% or more of the total landings were taken in Subareas 2, 4 and 12 combined. Landings from other areas are currently at a low level. In 2018, 86% of the landings came from Subarea 2 and 4.

For all areas, a continuous decline on landings has been observed after the higher landing levels in the 1988–1993 period and total landings are now only 11% of that level. However, the total landings have increased since 2016 which was the lowest level recorded since 1988.

4.4.3 ICES Advice

The ICES advice for 2018 and 2019 is:

"*ICES advise that when precautionary approach is applied, there should be zero catches in each of the years 2018 and 2019. This advice is unlikely to change until the scientific information is sufficient to assess the status of the stock. Closed areas to protect spawning should be maintained*."

4.4.4 Management

A 2019 precautionary TAC for EU vessels in international waters of 12 was set to 229 tonnes and value for bycatches only; no directed fishery for blue ling is allowed in this area. TACs for vessels in EU waters and international waters of 5.b, 6 and 7 were set to 11 778 tons; of this a quota for Norwegian and Faroese vessels was set to 150 tonnes each to be fished in Union waters of 2.a, 4, 5.b, 6 and 7. In Union and international waters of 2 and 4, a precautionary TAC for EU vessels was set to 53 tonnes. In Union and international waters of 3.a, a precautionary TAC for EU vessels was set to 8 tonnes.

4.4.5 Data availability

4.4.5.1 Landings and discards

Landings data are presented in Table 4.4.0a–f. Denmark and UK(Scotland) reported discards; Denmark reported 0,3 t and UK(Scotland) only very minor discards.

4.4.5.2 Length compositions

No new length compositions are available. There are length compositions from the Spanish fishery from 2017.

4.4.5.3 Age compositions

No age data are available.

4.4.5.4 Weight-at-age

No weight-at-age data are available.

4.4.5.5 Maturity and natural mortality

No data were available.

4.4.5.6 Catch, effort and research vessel data

For the Norwegian catches there was presented a cpue from Subarea 1, 2, 3.a and 4 combined (Figure 4.4.5.). The cpue series is calculated from 2000–2018 and is based on longline data from the Norwegian fishery.

4.4.6 Data analyses

The assessment for this stock is based on landing trends. This is followed by some uncertainties because the trends in landings can be a consequence of changes in effort rather than changes in the stock. However, it is regarded that the situation for the stock is reflected by the landings and it is also thought that discards are minimal for this species since the fishery is exclusively done on larger individuals.

The landings have declined for all areas and the mean landings are now less than 15% of the mean landings from the years 1988–1993 (the period with stable landings). There has been however, some fluctuations in landings for some areas.

Landings from Subarea 1 has always been low (less than 5 t for the whole time series). However, for 2018 Greenland landed 16 t from this area and resulted in a large increase from 2017 level.

The historical Norwegian landings, mainly in 2.a show that landings reached almost 6000 tonnes in 1980. Since then landings have decreased. In 2010, there was an increase in landings from Subarea 2 as a result of an increase in Faroese landings. From 2013 onwards, landings are at the same low levels as seen in the early 2000s. Landings in 2016 were lowest on record but have increased in 2017 and 2018.

The increase of landings in Division 3a in 2005 (2.5 times increase from 2004–2005) is likely to be associated to the increase of the Danish roundnose grenadier fishery. This fishery stopped in 2006 and the landings of blue ling have since been insignificant.

In Subarea 4 an increase on French and Norwegian landings were registered in 2010 and 2011. The increase in landings seen for Subarea 4 in 2015 was a result of increased Norwegian landings. The landings have again decreased since 2016 and 2018 landings are still at the low level seen in the mid-2000s.

In Subarea 12 and after relative high levels for the period 2001–2005 landings have declined. There have been reductions in Spanish fishing activity in this area which for now is the only country reporting landings from this area. The reported landings from this Subarea are all from Division 12b.

The length compositions from Spanish landings from 2017 show lengths from 69-129 cm (Figure 4.4.6). This is in the same range as seen in length compositions from Faroese catches from areas 5.b, 6 and 7.

The Norwegian cpue series shows a low level and varies without any trend for the years 2000–2018. Although there is no directed fishery from this area there seems to be no recovery for this part of the stock.

4.4.6.1 Biological reference points

There are not yet suggested methods to estimate biological reference points for category 5 and 6 stocks.

4.4.7 Comments on assessment

Not applicable.

4.4.8 Management considerations

Trends in landings suggest serious depletion in Subarea 2 and perhaps also for the other Subareas. Landings have also declined strongly in Subarea 12 from 2002 onwards. Landings in other subareas and divisions are minor but there is some evidence of a persistent decline.

The advice given in 2017 remains appropriate.

Blue ling specimens caught in Subarea 12.b probably belong to the same stock that is exploited in Subarea 6. Management of Subarea 12.b should be consistent with the Advice for ICES Subarea 5.b and for Divisions 6 and 7.

The bulk of current bycatches of blue ling from subareas and divisions treated in this section are taken within EE (Table 4.4.1).

4.4.9 Tables

Table 4.4.0a. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea 1. (* preliminary).

Year	Iceland	Norway	France	Faroes	Greenland	Total
1988		10				10
1989		8				8
1990		4				4
1991		3				3
1992		5				5
1993		1				1
1994		3				3
1995		5				5
1996		2				2
1997		1				1
1998		1				1
1999		1				1
2000		3				3
2001		1				1
2002		1				1
2003						0
2004		1				1
2005		1				1
2006						0
2007						0
2008						0
2009		1				1
2010		1				1
2011			3			3
2012			1			1
2013						0
2014				4		4

Year	Iceland	Norway	France	Faroes	Greenland	Total
2015						0
2016		1				1
2017						0
2018*	6				16	22

Table 4.4.0b. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Divisions 2.a, 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			333
2009	56	1			219		9			285
2010	183	1			234		4			422
2011	312	7			167					486
2012	188	7			142		1			338
2013	79	16			107					202
2014	29	16			73		9			127
2015	16	6			91					113

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	Russia	Total
2016	22	7	0.059		57		1			87
2017	57	5			112		3			177
2018*	112	4			124	0,105	0,69			241

Table 4.4.0c. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea 3. (* preliminary).

Year	Denmark	Norway	Sweden	FRANCE	Total
1988	10	11	1		22
1989	7	15	1		23
1990	8	12	1		21
1991	9	9	3		21
1992	29	8	1		38
1993	16	6	1		23
1994	14	4			18
1995	16	4			20
1996	9	3			12
1997	14	5	2		21
1998	4	2			6
1999	5	1			6
2000	13	1			14
2001	20	4			24
2002	8	1			9
2003	18	1			19
2004	18	1			19
2005	48	1			49
2006	42				42
2007					0
2008		2			2
2009		+			0
2010		+			0
2011					0
2012					0
2013		1			1
2014		+	+		0
2015	+	+			0
2016	0.154	0.64	0.005	0.307	1

Year	Denmark	Norway	Sweden	FRANCE	Total
2017		0,775			1
2018*	0,286	0,97	0,085		1

Table 4.4.0d. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Division 4.a. (* preliminary).

Year	Denmark	Faroes	France (4ab)	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		46		1		176
2012			96		70				166
2013			5		38				43
2014			4		34		12		50
2015	+		6		74	+	3		83
2016	0,48		6	0,041	74		6		87

Year	Denmark	Faroes	France (4ab)	Germany	Norway	E & W	Scotland	Ireland	Total
2017	0,499		3		65	0,012	5		73
2018*	3,209		3,3	0,018	50,3	0,025	3,4		60

Table 4.4.0e. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea 12. (* preliminary).

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	unallocated	Total
1988		263											263
1989		70											70
1990		5					547						552
1991		1147											1147
1992		971											971
1993	654	2591	90			1							3336
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	48	9						1318
2003		7		1096			40		12	37			1192
2004		27		861		10					7		905
2005		10		657		35				8			710
2006		61		436							4		501
2007	1			353									354
2008				564									564
2009		+		312							+		312
2010				50									50
2011				55									55
2012				205								427	632
2013				178								76	254
2014				80									80

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Rusia	unallocated	Total
2015				12									12
2016				29									29
2017				28									28
2018				24									24

Table 4.4.0f. Blue ling (*Molva dypterygia*). Total landings by Subarea (past reported landings from subareas 8 and 9 are ascribed to *Molva macropthalma* and not included). (* preliminary data).

Year	1	2	3	4	12	Total
1988	10	3537	22	363	263	4195
1989	8	2058	23	457	70	2616
1990	4	1412	21	495	552	2484
1991	3	1479	21	620	1147	3270
1992	5	1039	38	553	971	2606
1993	1	1020	23	412	3336	4792
1994	3	419	18	421	752	1613
1995	5	359	20	477	573	1434
1996	2	267	12	179	788	1248
1997	1	291	21	269	417	999
1998	1	278	6	280	438	1003
1999	1	291	6	264	1353	1915
2000	3	249	14	129	594	989
2001	1	208	24	252	675	1160
2002	1	149	9	376	1318	1853
2003	0	147	19	92	1192	1450
2004	1	174	19	83	905	1182
2005	1	197	49	66	710	1023
2006	0	202	42	94	501	839
2007	0	262	0	62	354	678
2008	0	333	2	74	564	973
2009	1	285	0	89	312	687
2010	1	422	0	155	50	628
2011	3	486	0	176	55	720
2012	1	338	0	166	632	1137
2013	0	202	1	43	254	500
2014	4	127	0	50	80	261
2015	0	113	0	83	12	208

Year	1	2	3	4	12	Total
2016	0,84	87	1	87	29	205
2017	0	177	1	73	28	279
2018*	22	241	1	60	24	348

Table 4.4.1 Blue ling in Subarea 27.nea. Landings inside and outside the NEAFC Regulatory Area (RA). Weights are in tonnes.

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total landings
2014	0	181	261
2015	0	196	208
2016	0	176	205
2017	0	251	279
2018	0	324	348

4.4.10 Figures

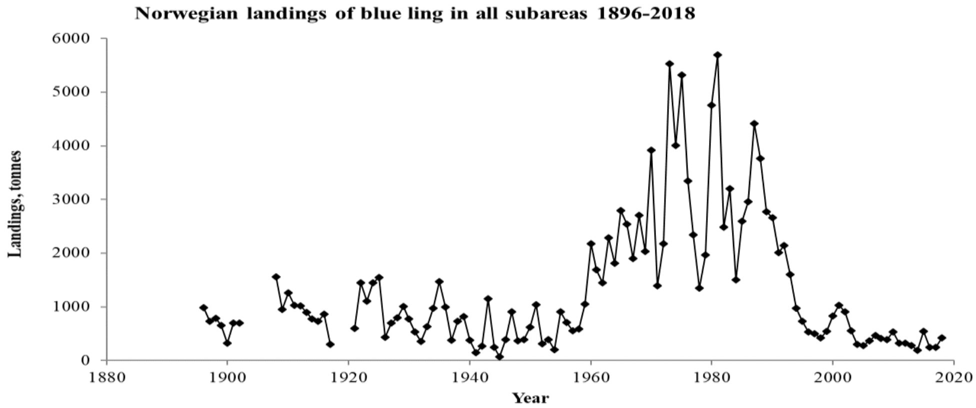


Figure 4.4.1. Reported Norwegian landings on blue ling from 1896–2018.

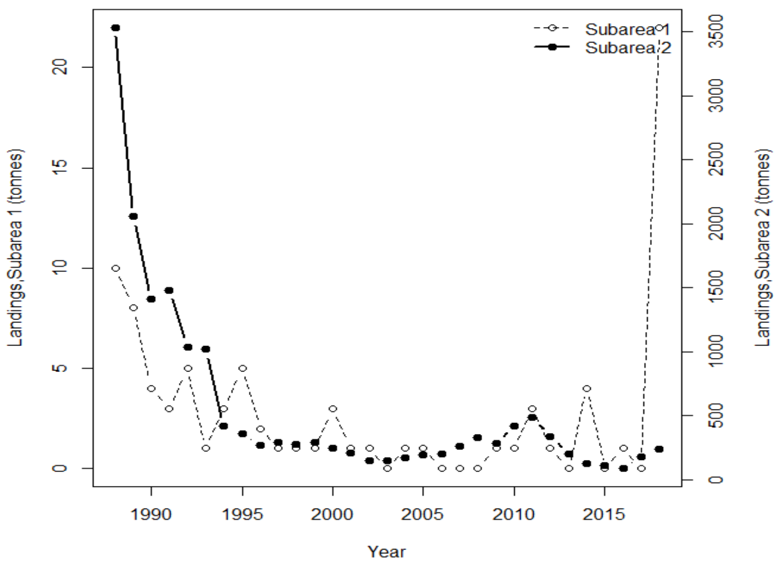


Figure 4.4.2. Landings of blue ling in Subareas 1 and 2. Subarea 1: open circles, left axis. Subarea 2: filled circles, right axis.

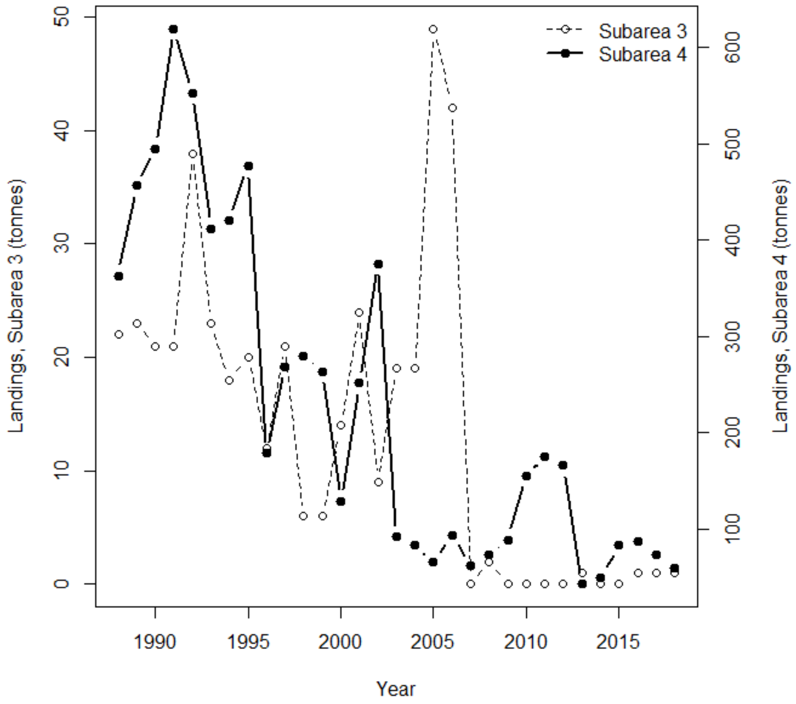


Figure 4.4.3. Landings of blue ling in Subareas 3 and 4. Subarea 3: open circles, left axis. Subarea 4: filled circles, right axis.

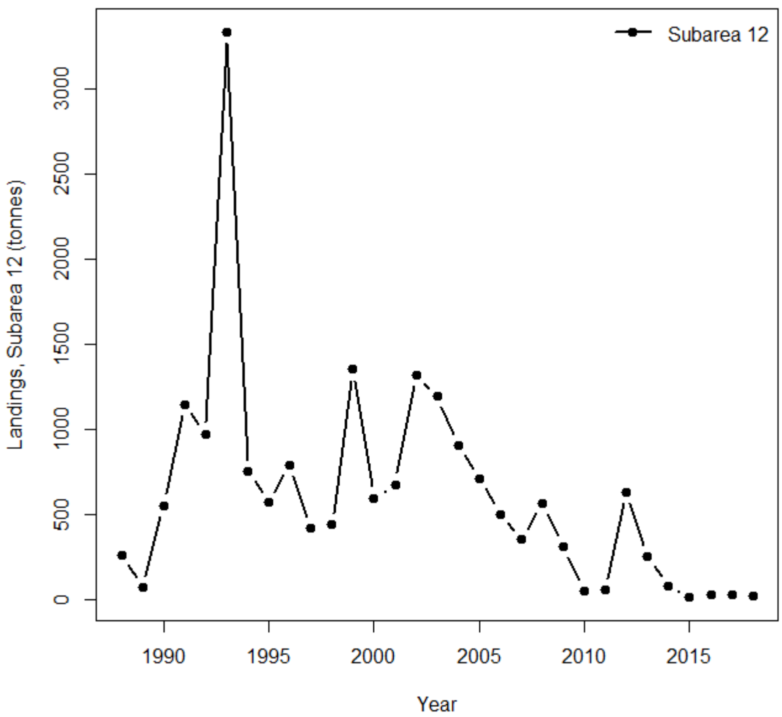


Figure 4.4.4. Landings of blue ling in Subarea 12.

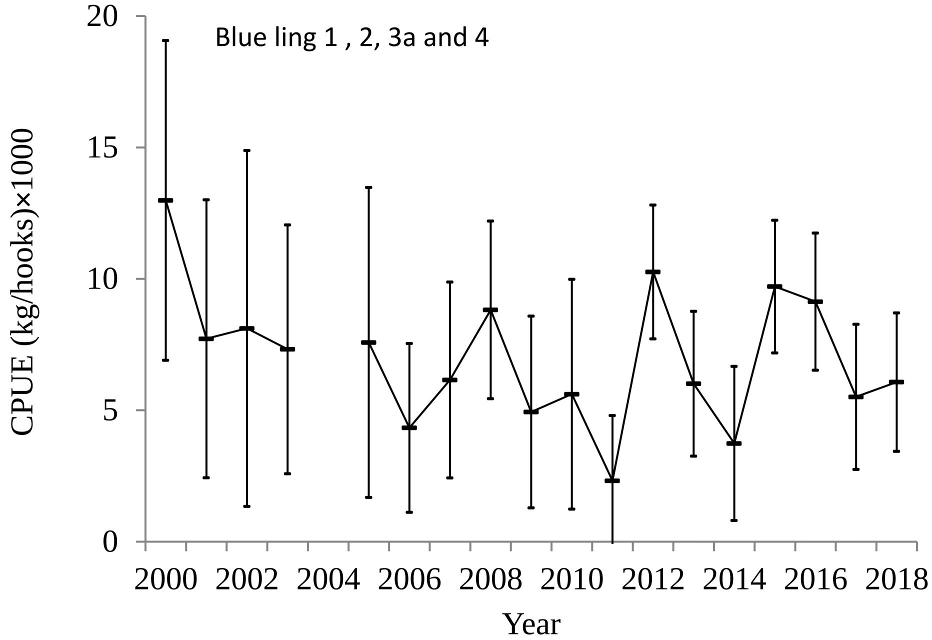


Figure 4.4.5. Norwegian cpue (kg/1000 hooks) from longlines catches in areas 1, 2, 3.a and 4 from 2000–2018.

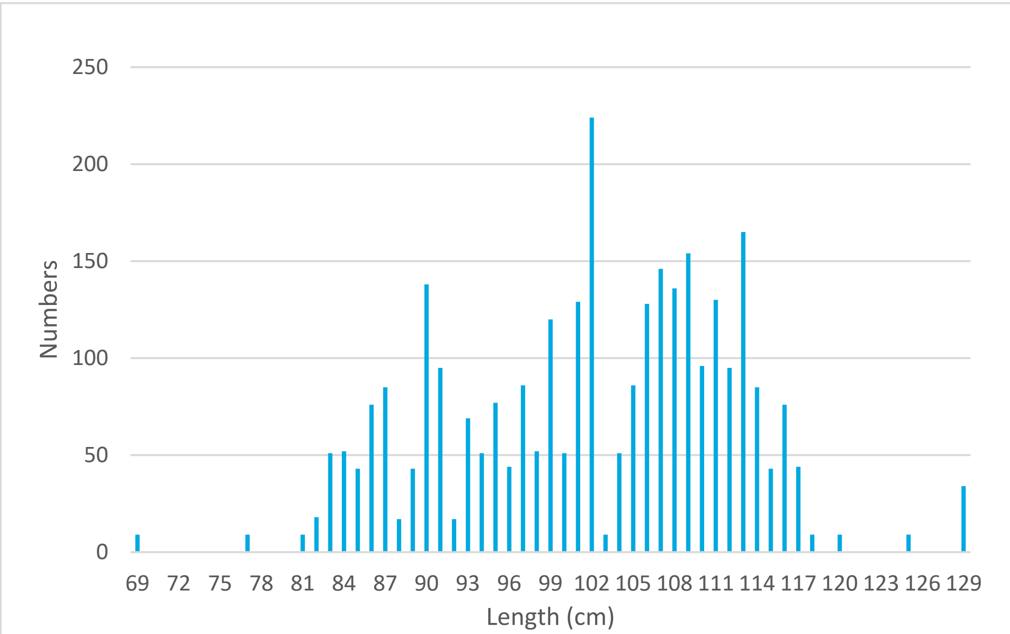


Figure 4.4.6. Length composition from Spanish landings from area 12b in 2017

5 Tusk (*Brosme brosme*).

5.1 Stock description and management units

In 2007, WGDEEP examined the available evidence for separate tusk stocks in the ICES region. Based on genetic investigations, the group suggested the following stock units for tusk:

- Area 5.a and 14;
- Mid-Atlantic Ridge;
- Rockall (6.b);
- Areas 1, 2.

All other areas (4.a,5.b, 6.a, 7,…) should be assessed as one stock unit until further evidence of multiple stocks become available.

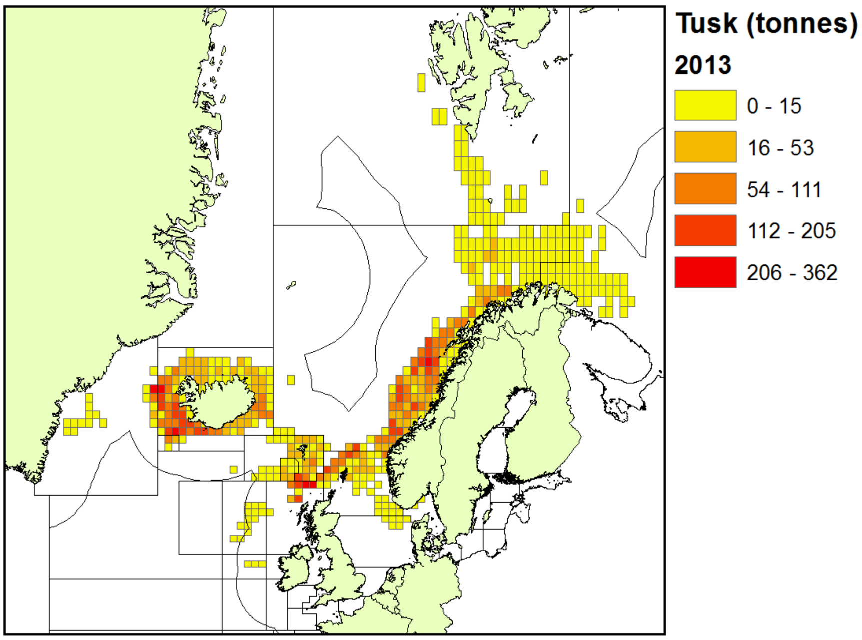


Figure 5.1. Reported landings of tusk in the ICES area by statistical rectangle in 2013. Data are from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in account for 99% of all reported landings in the ICES area.

5.2 Tusk in 5.a and 14 (*Brosme brosme*)

5.2.1 The fishery

Tusk in 5.a is caught in a mixed longline fishery, conducted in order of importance by Icelandic, Faroese and Norwegian boats. Between 150 and 240 Icelandic longliners report catches of tusk > 100 kg, but ~100 more vessels have small amounts of bycatch landings (Table 5.2.1). Far fewer gillnetters and trawlers participate in the fishery. The number of longliners reporting tusk catches in 2016 decreased to 138 from 163 the previous year (Table 5.2.1) and has continued to decrease since. Most of tusk in 5.a, around 97% of catches in tonnes, is caught on longlines, and this had been relatively stable proportion since 1992 (Table 5.2.1).

Table 5.2.1. Tusk in 5.a. Number of Icelandic boats with tusk landings and their total landings.

Year	Number of boats			Catches (Tonnes)			
	Trawlers	Gillnetters	Longliners	Trawlers	Longliners	Other	Sum
2000	106	175	370	93	4564	37	4738
2001	83	224	350	73	3248	38	3422
2002	80	174	304	75	3722	30	3920
2003	78	148	305	56	3941	21	4059
2004	74	130	303	85	3007	15	3135
2005	77	101	324	108	3398	14	3540
2006	72	82	338	91	4912	16	5059
2007	64	65	308	95	5834	20	5987
2008	63	59	255	114	6762	19	6937
2009	66	65	239	107	6757	16	6953
2010	59	62	228	92	6761	14	6919
2011	51	54	221	69	5742	12	5847
2012	53	68	228	60	6255	16	6344
2013	53	43	233	74	4911	17	5016
2014	52	43	249	86	6045	14	6163
2015	47	32	228	69	4745	14	4835
2016	54	32	206	61	3420	8	3494
2017	50	31	180	48	2481	6	2540
2018	55	27	158	83	2840	17	2940

Most of the tusk caught in 5.a by Icelandic longliners is caught at depths less than 300 meters (Figure 5.2.1). The main fishing grounds for tusk in 5.a as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf (Figures 5.2.2 and 5.2.3).

The main trend in the spatial distribution of tusk catches in 5.a 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 50–60% of tusk is caught on the southern and western parts of the shelf (Figure 5.2.3).

Tusk in 14 is caught mainly as a bycatch by longliners and trawlers. The main area where tusk is caught in 14 is 63°–66°N and 32°–40°W, well away from the Icelandic EEZ (Figure 5.2.4).

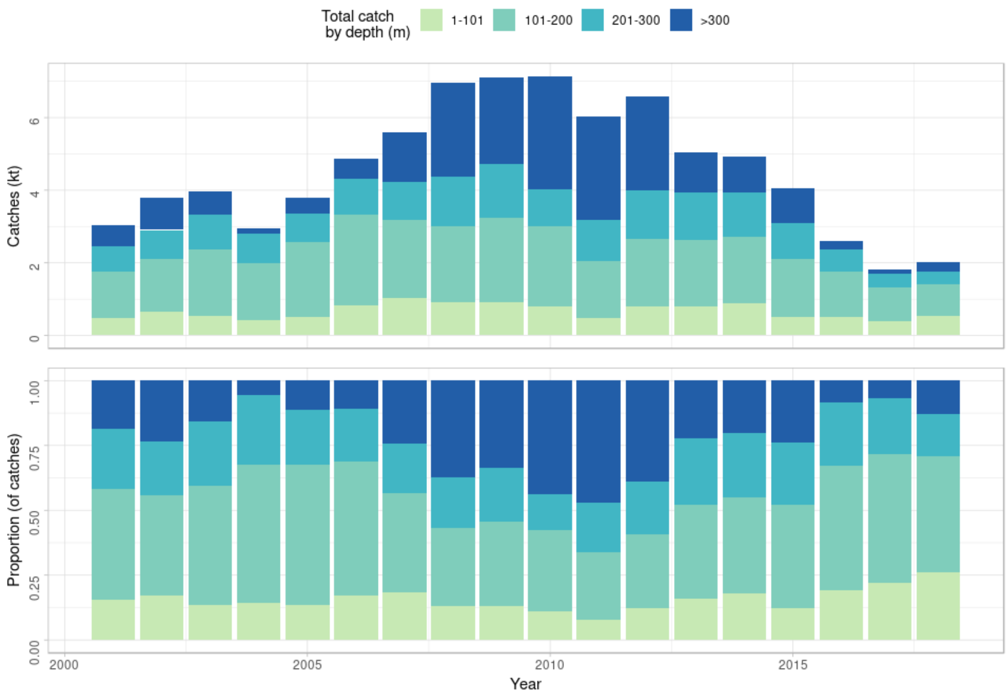


Figure 5.2.1 Tusk in 5.a and 14. Depth distribution of catches in 5.a according to logbooks. All gears combined.

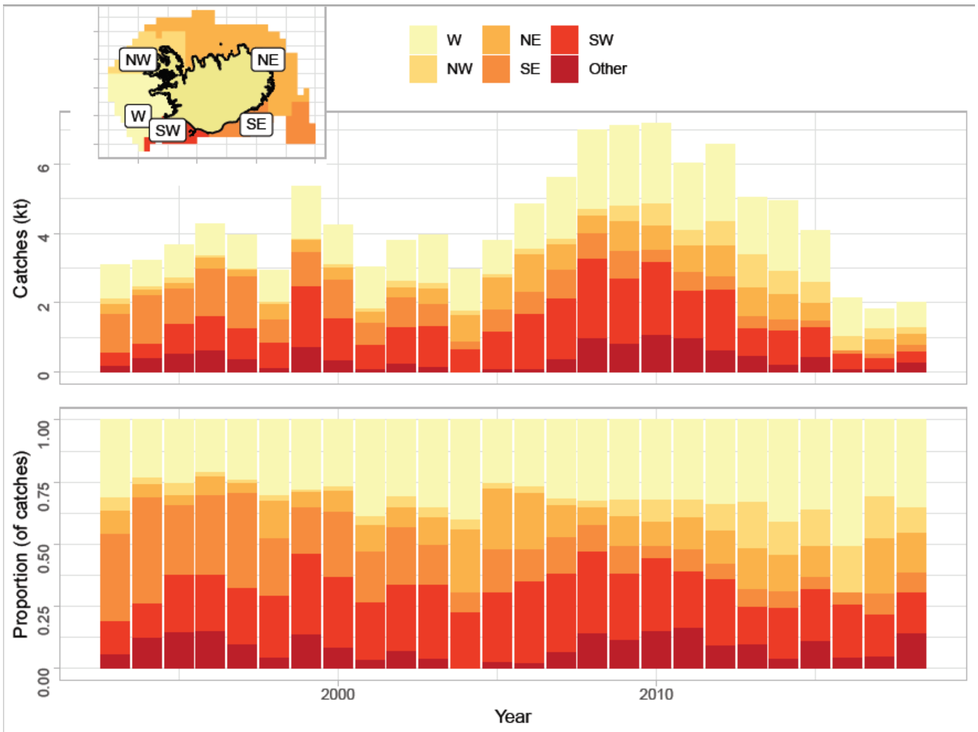


Figure 5.2.2 Tusk in 5.a and 14. Changes in spatial distribution of the Icelandic fishery as reported in logbooks. All gears combined.

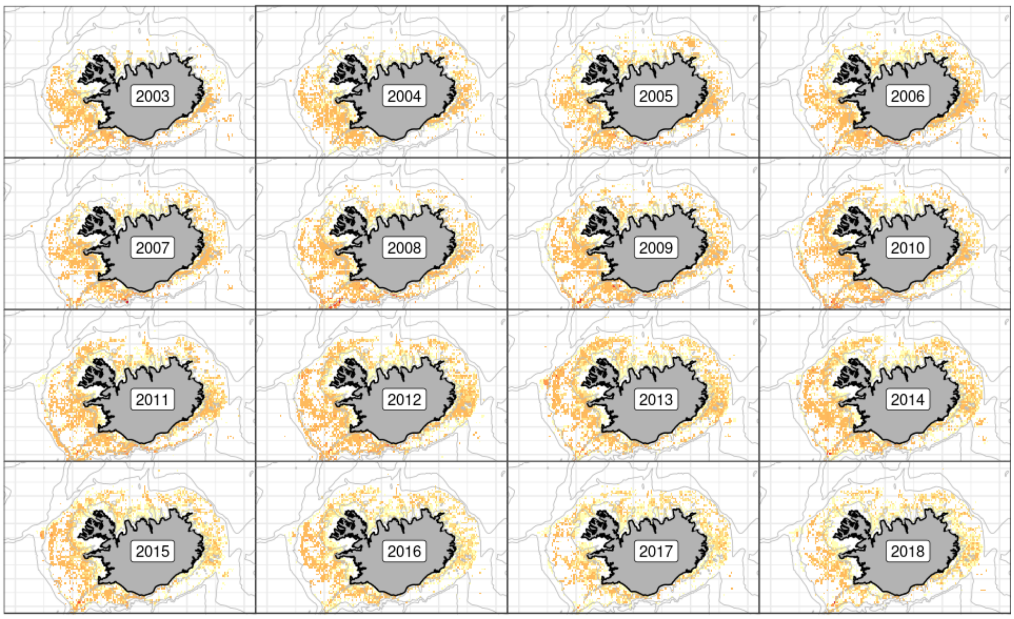


Figure 5.2.3 Tusk in 5.a and 14. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

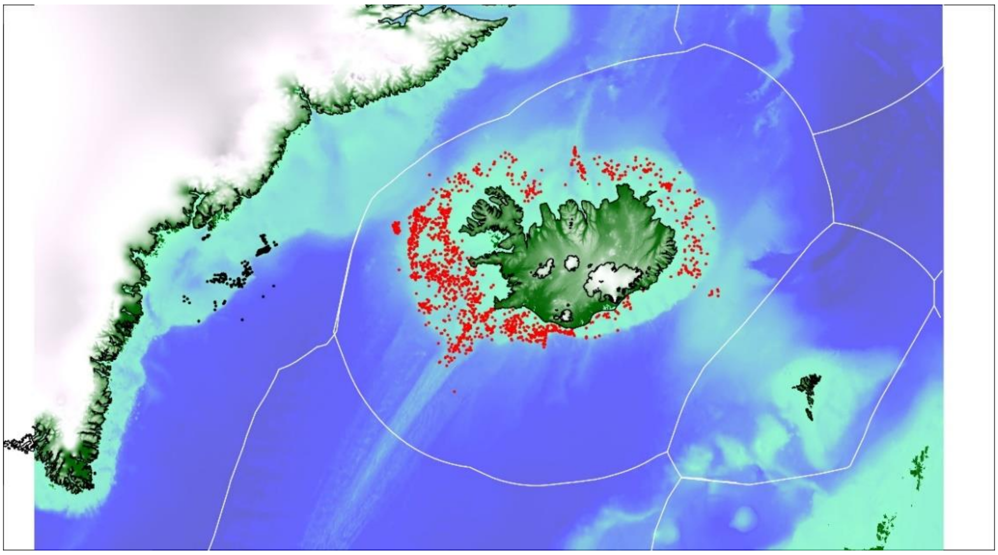


Figure 5.2.4 Tusk in 5.a and 14. Position of longline operations in 14.b and 5.a where tusk was recorded in 2015.

5.2.1.1 Landing trends

The total annual landings from ICES Division 5.a were around 2940 tonnes in 2018 (Table 5.2.7), signifying a continuous decrease in landings from 2010. This is contrary to the trend in landings from 2000 in which the annual landings gradually increased in 5.a to around 9000 tonnes in 2010 (Figure 5.2.5).

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 5.a was caught by foreign vessels, mainly vessels from the Faroe Islands. This proportion reduced to 15–25% until the most recent years in which it increased to closer to 50% due to a reduction in Icelandic catches (Table 5.2.7).

Landings in 14.b have always been low compared to 5.a, rarely exceeding 100 t. However, around 900 tonnes were caught in 2015, after which catches have been consistently substantial. Catch data from section 14 reported by the Greenland Institute of Natural Resources (WD06, Annex of this report) also reflect this trend. Around 682 tonnes in 2018 were caught in the 14.b mainly by Faroese and Greenlandic vessels (Table 5.2.8).

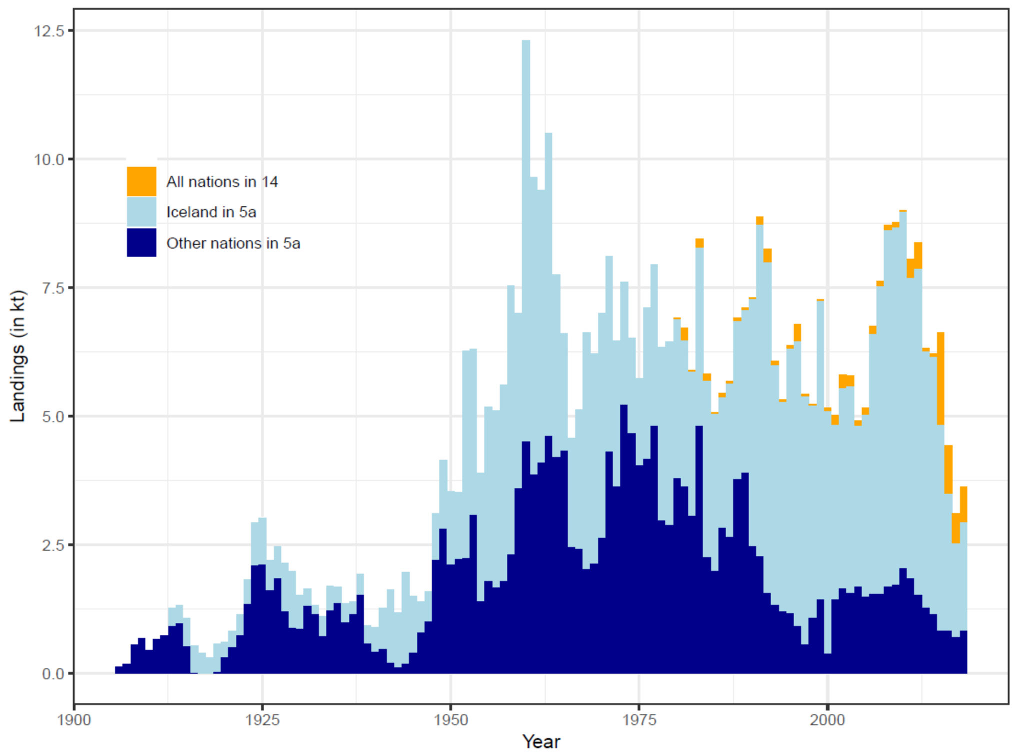


Figure 5.2.5 Tusk in 5.a and 14. Landings in 5.a and 14 (source for 14: STATLANT).

5.2.1.2 ICES advice

The latest Advice from ICES in May 2018 states: ICES advises that, based on the MSY approach, catches should be no more than 3,776 tonnes.

5.2.1.3 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. At the beginning, the TAC was set as recommended by MFRI but thereafter had often been set higher than the advice. One reason is that no formal harvest advisory rule existed for this stock. Up until the fishing year 2011/2012, the landings, by quota year, had always exceeded the advised and set TAC by 30-40%. However, since then the overshoot in landings has decreased substantially, apart from 2014/2015 when the overshoot was 34%. In recent years the TAC has not been filled. (Table 5.2.2).

The reasons for the large difference between annual landings and both advised and set TACs are threefold: 1) It is possible to transfer unfished quota between fishing years; 2) It is possible to convert quota shares in one species to another; 3) The national TAC is only allocated to Icelandic vessels. All foreign catches are therefore outside the quota system. [However, in recent years managers have to some extent taken into account the foreign catches when setting the national TAC (see below)].

There are bilateral agreements between Iceland, Norway and the Faroe Islands related to fishing activity of foreign 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 a 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. The tusk advice given by MFRI and ICES for each quota year is, however, for all catches, including foreign catches. Further description of the Icelandic management system can be found in the stock annex.

Figure 5.2.6 shows the net transfers in the Icelandic ITQ-system. During the 2005/2006–2010/2011 fishing years there was a net transfer of other species quota being converted to tusk quota, this however reversed during the following three fishing years. In the 2015/2016 and 2016/2017 fishing years there was again a small net transfer of other species being changed to tusk quota.

Table 5.2.2. Tusk in 5.a and 14. TAC recommended for tusk in 5.a by the Marine Research Institute, national TAC and total landings from the quota year 2001/2002.

Fishing year	MRI advice	National TAC	Landings
2001/02		4500	4876
2002/03	3500	3500	5046
2003/04	3500	3500	4958
2004/05	3500	3500	4901
2005/06	3500	3500	5928
2006/07	5000	5000	7942
2007/08	5000	5500	7279
2008/09	5000	5500	8162
2009/10	5000	5500	8382
2010/11	6000	6000	7777
2011/12	6900	7000	7401
2012/13	6700	6400	6833
2013/14	6200	5900	5881
2014/15	4000	3700	4958
2015/16	3440	3000	3494
2016/17	3780	3380	2407
2017/18	4370	3770	3139
2018/19	3776	3100	

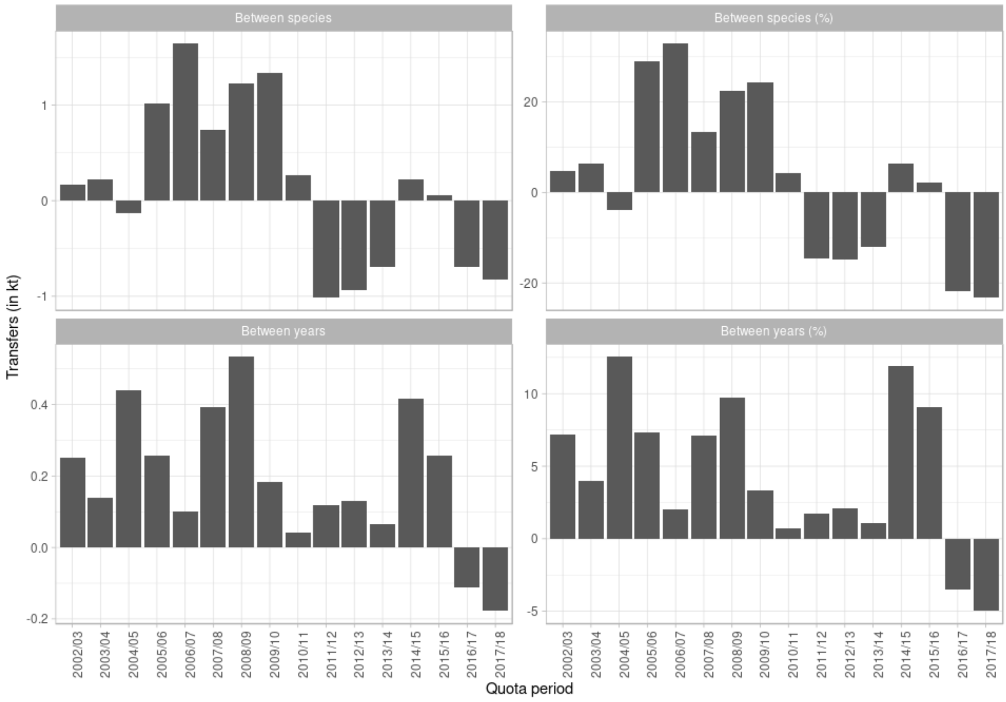


Figure 5.2.6 Tusk in 5.a and 14. Net transfers of tusk quota to other species in the Icelandic ITQ system by fishing year. Positive values indicate that other species are being changed to tusk but negative mean that tusk quota is being converted to other species.

5.2.2 Data available

In general sampling is considered appropriate 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). The sampling coverage by gear in 2018 is shown in Figure 5.2.7.

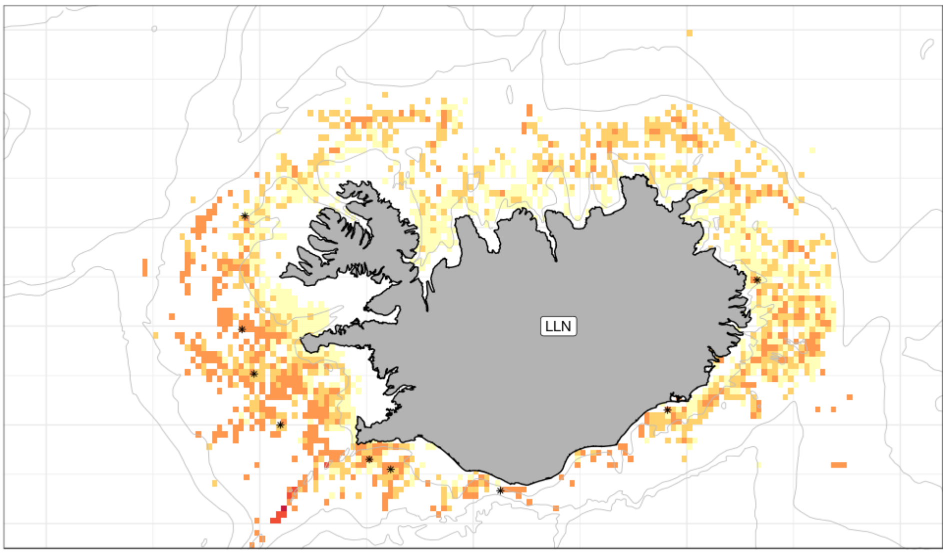


Figure5.2.7 Tusk in 5.a and 14. Fishing grounds in 2018 as reported by catch in logbooks (tiles) and positions of samples taken from landings (asterisks) by longliners.

5.2.2.1 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, as well as in Norway. Based on limited data, discard rates in the Icelandic longline fishery for tusk are estimated very low (<1% in either numbers or weight) (WGDEEP, 2011:WD02). Measures in the Icelandic management system such as converting quota share from one species to another are used by the Icelandic 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 5.a and 14.

Landings for tusk in 14 are obtained from the STATLANT database. Figures reported by the Greenland Institute of Natural Resources (WD06, Annex of this report) are in agreement. No information is available on discards in 14.

5.2.2.2 Length compositions

An overview of available length measurements from 5.a is given in Table 5.2.3. Most of the measurements are from longlines; number of available length measurements increased in 2007 from around 2500 to around 4000 and were close to that until 2016 when they decreased to around 1700 and have remained roughly at that level.

Length distributions from the spring survey data and longline fishery are shown in Figures 5.2.8 and 5.2.9 respectively. In the figures, numbers-at-length are multiplied by the expected proportion mature at that length to split catch numbers into mature and immature components.

No length composition data from commercial catches in 14 are available.

Table 5.2.3. Tusk in 5.a and 14. Number of available length measurements from Icelandic (5.a) commercial catches.

Year	Longline		Gillnets		Trawls	
	Samples	Measured	Samples	Measured	Samples	Measured
2005	34	5820	0	0	1	21
2006	30	4861	0	0	4	472
2007	68	11936	2	167	1	150
2008	110	20963	0	0	0	0
2009	108	21451	0	0	0	0
2010	58	9084	0	0	0	0
2011	43	8158	0	0	0	0
2012	70	11867	0	0	1	150
2013	35	6469	0	0	0	0
2014	62	11748	0	0	0	0
2015	35	4821	0	0	0	0
2016	28	4844	0	0	0	0
2017	14	1710	0	0	0	0

Year	Longline		Gillnets		Trawls	
2018	23	2781	0	0	0	0

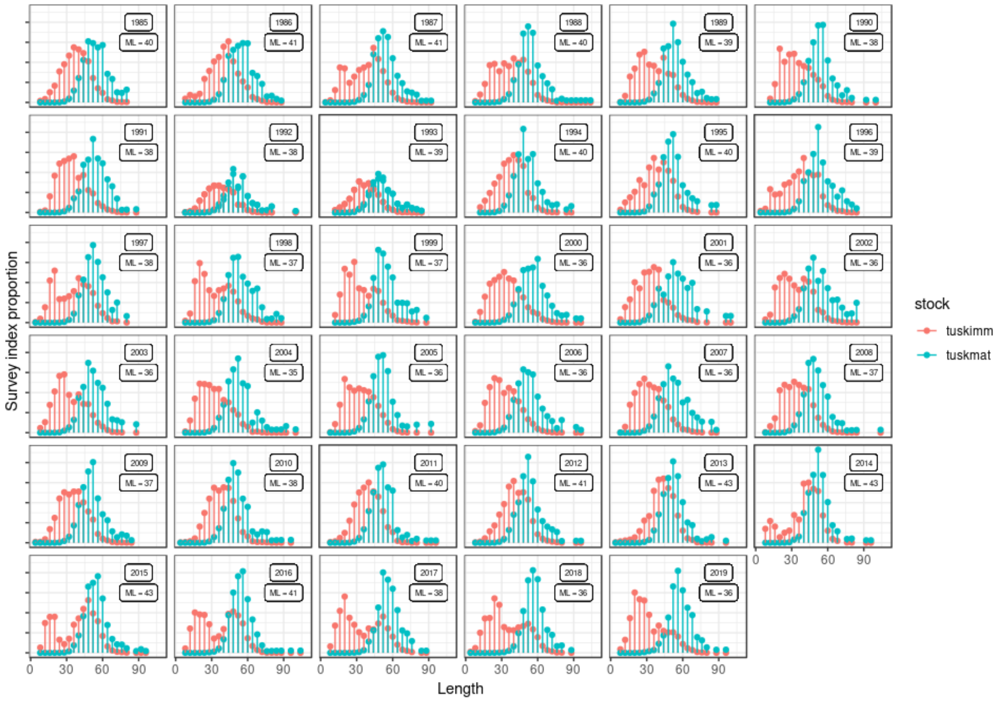


Figure 5.2.8 Tusk in 5.a and 14. Length distributions from Icelandic spring survey catches. Red areas are immature tusk and green represent mature tusk. Small numbers to the right refer to mean length (ML).

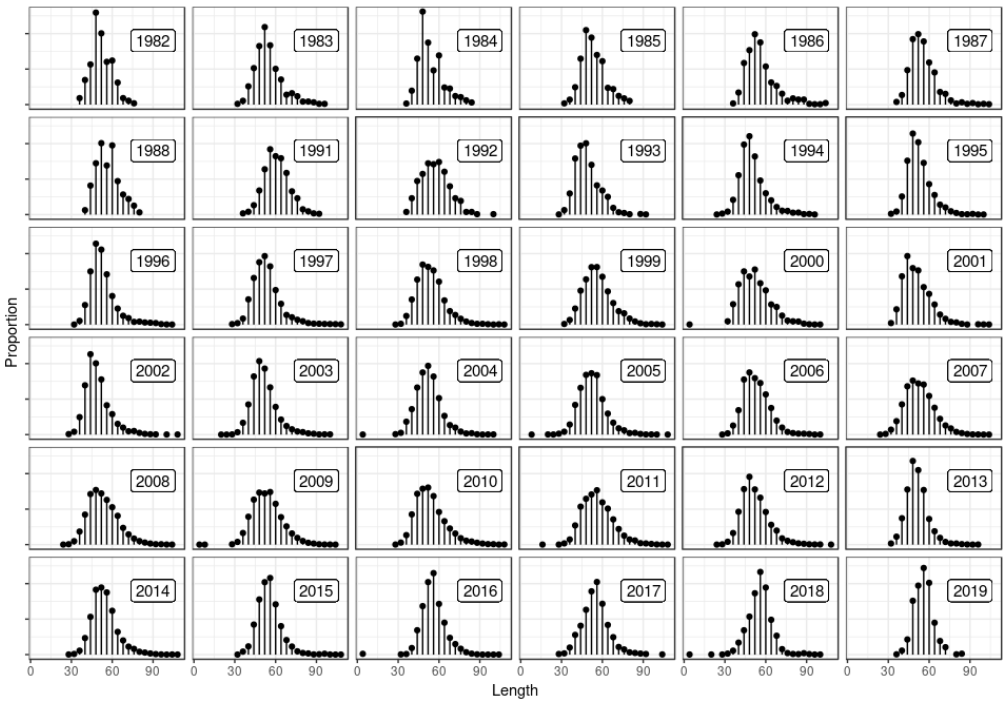


Figure 5.2.9 Tusk in 5.a and 14. Length distributions from Icelandic commercial longline catches.

5.2.2.3 Age compositions

Table 5.2.4 gives an overview of otolith sampling intensity by gear types from 2000 to 2018 in 5.a. Since 2010, considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2008–2017. The age data are used as input for the Gadget assessment. It is expected that the effort in ageing of tusk will continue. Age distributions are shown from the spring survey and commercial longline samples in Figures 5.2.10 and 5.2.11 respectively.

No data are available from 14.

Table 5.2.4. Tusk in 5.a and 14. Number of available otoliths from Icelandic (5.a) commercial catches and the Icelandic Spring survey and the number of aged otoliths.

Year	Longline			Survey		
	Samples	Otoliths	Aged	Samples	Otoliths	Aged
2000	17	849	0	229	321	0
2001	17	849	0	208	282	0
2002	17	851	0	207	303	0
2003	18	900	0	229	343	0
2004	10	500	0	225	422	399
2005	12	600	0	263	488	148
2006	15	750	0	281	499	457
2007	22	1100	0	290	483	381
2008	32	1600	600	282	489	475
2009	27	1350	1090	277	453	434
2010	29	1449	1373	241	378	363
2011	28	1400	1306	270	738	728
2012	34	1700	1112	285	771	750
2013	22	1100	490	275	744	517
2014	28	620	587	241	585	560
2015	26	555	505	260	614	573
2016	14	290	290	259	689	676
2017	8	160	160	245	579	570
2018	9	180	179	247	560	549

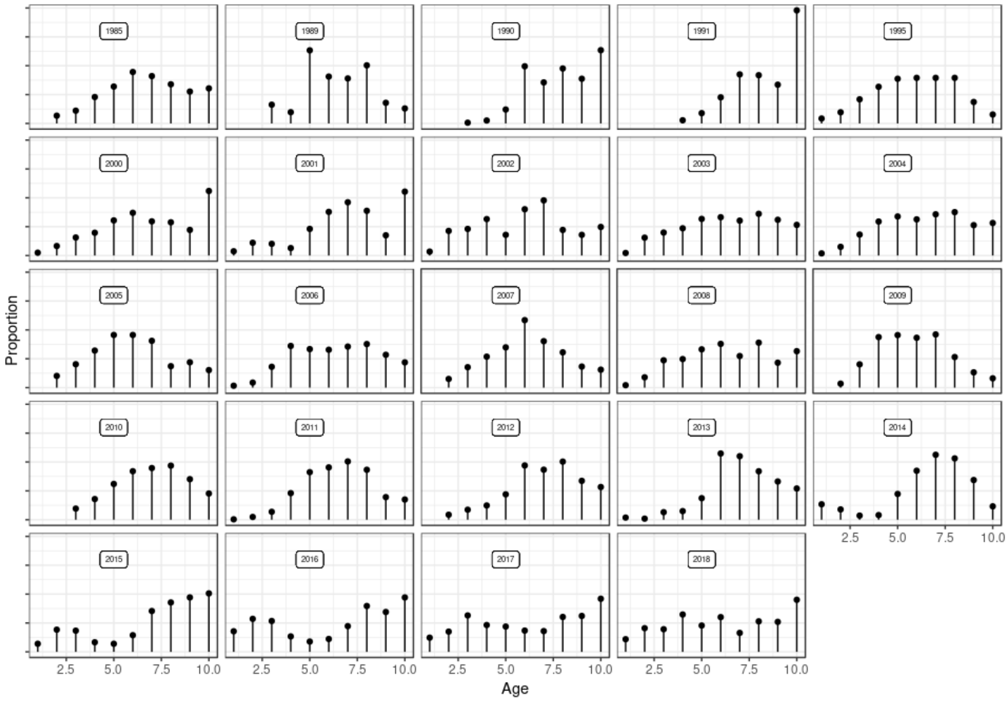


Figure 5.2.10 Tusk in 5.a and 14. Age distributions in proportions in 5.a from the Iceland spring survey.

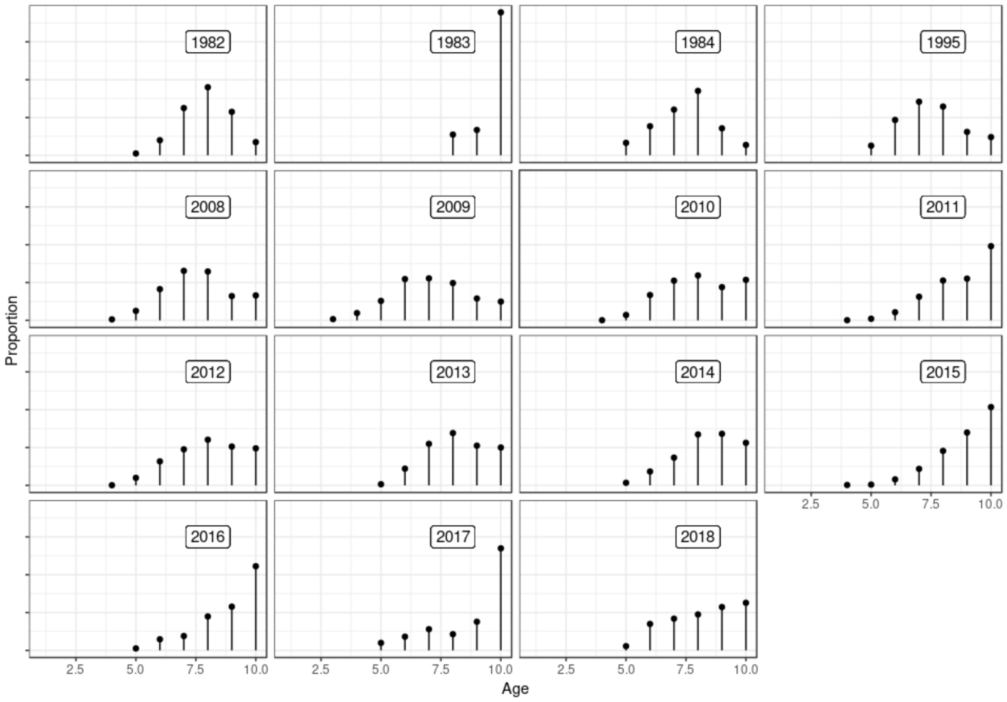


Figure 5.2.11 Tusk in 5.a and 14. Age distributions in proportions in 5.a (from longlines). Samples for 2019 are only from January–March.

5.2.2.4 Weight at age

Weight-at-age data from 5.a are limited to 2008–2019. No data are available from 14.

5.2.2.5 Maturity at age

At 54 cm around 25% of tusk in 5.a is mature, at 62 cm 50% of tusk is mature and at 70 cm 75% of tusk is mature based on the spring survey data.

No data are available for 14.

5.2.2.6 Natural mortality

No information is available on natural mortality of tusk in 5.a or 14. For assessment and advisory purpose the natural mortality is set to 0.1 for all age groups.

5.2.2.7 Catch, effort and research vessel data

Catch per unit of effort and effort data from commercial fisheries

The CPUE estimates of tusk in 5.a are not considered representative of stock abundance.

CPUE estimations have not been attempted on available data from 14.

Icelandic survey data (ICES Division 27.5.a)

Information on abundance and biological parameters from Haddock in 5a is available from two surveys, the Icelandic groundfish survey in the spring and the Icelandic autumn survey. 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 5.a. In 2011 the 'Faroe Ridge' survey area was included into the estimation of survey indices. In addition, the autumn survey was commenced in 1996 and expanded in 2000; however, a full autumn survey was not conducted in 2011 due to labour strikes and therefore the results for 2011 are not presented. A detailed description of the Icelandic spring and autumn groundfish surveys is given in the Stock Annex. Figure 5.2.12 shows both a recruitment index and the trends in various biomass indices. No substantial changes in spatial distribution are seen in general although there are spatial gradients in size distributions (Figure 5.2.13).

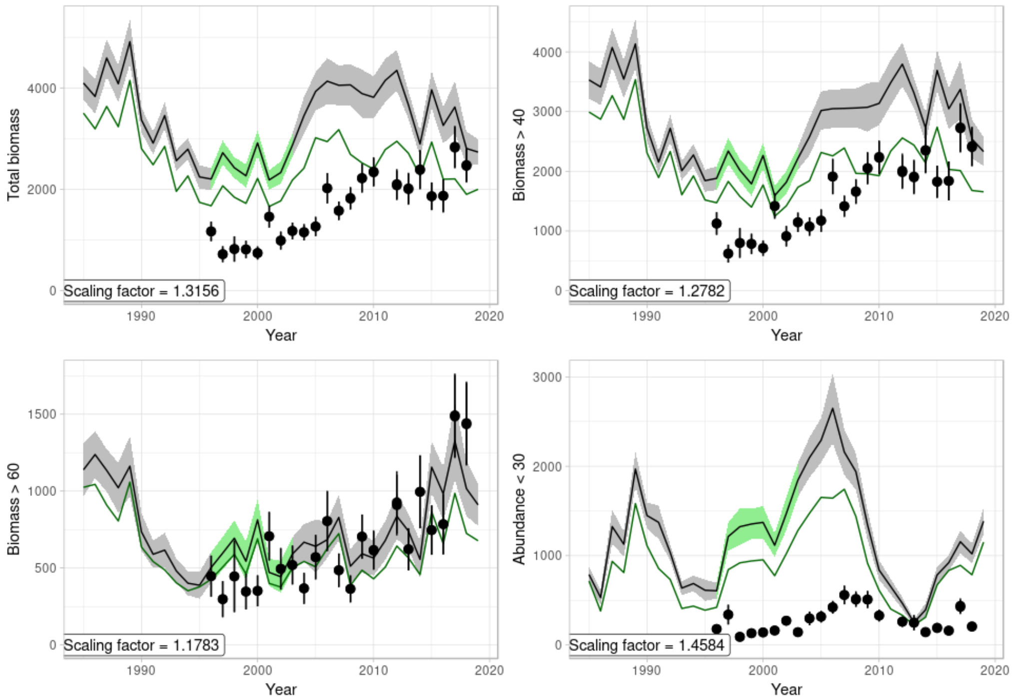


Figure 5.2.12. Tusk in 5.a and 14. Indices in the Spring Survey (March) 1985 and onwards (line shaded area) and the autumn survey (October) 1996 and onwards (No autumn survey in 2011). Green line is the index excluding the Faroe-Iceland Ridge.

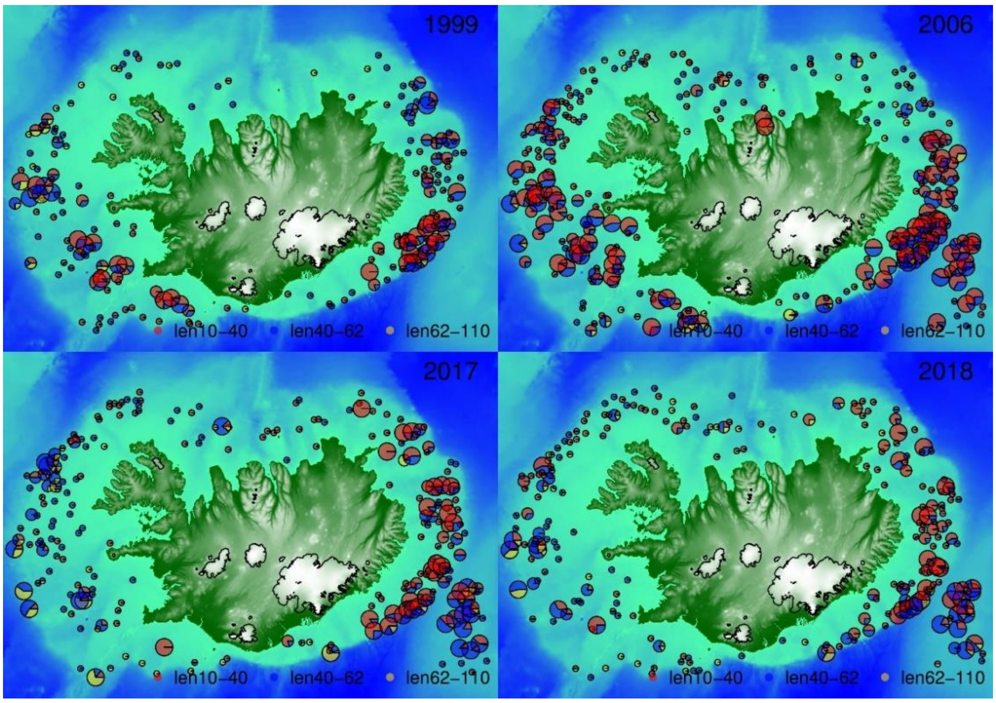


Figure 5.2.13 Tusk in 5.a and 14. Changes in spatial distribution divided by size. Size of pie is indicative of numbers of specimens caught at the tow station.

German survey data (ICES Subarea 27.14)

The German groundfish survey was started in 1982 and is conducted in 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 was 30 minutes at 4.5 kn. (Ratz, 1999). Data from the German survey in 14 were available at the meeting up to 2015. The trend in the German survey catches is similar to those observed in surveys in 5.a. It should, however, be noted that the data presented in Figure 5.2.14 is based on total number caught each year so it can't be used directly as an index from East Greenland. Length distributions from the survey in recent years are shown in Figure 5.2.15.

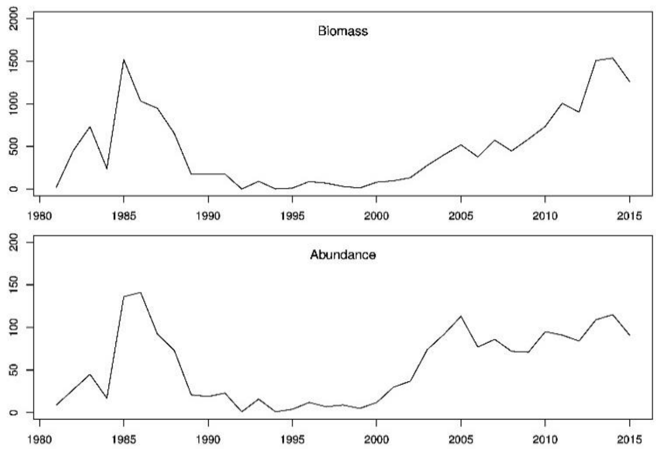


Figure 5.2.14 Biomass and abundance estimates from the Walter Herwig survey in 14. The data are just the total number caught and then converted to weight.

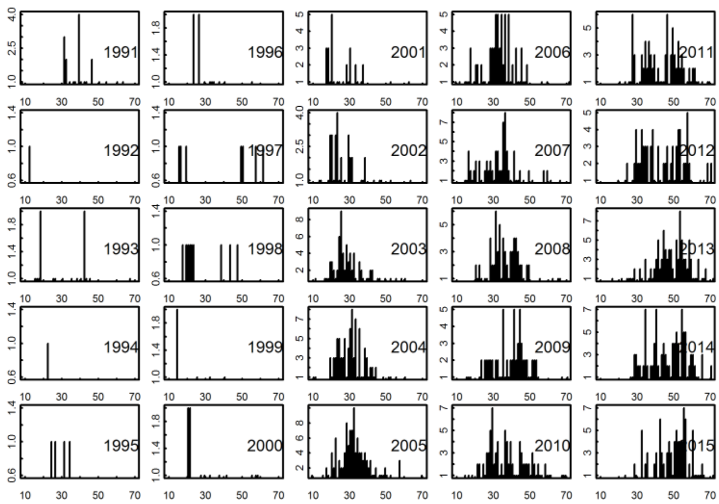


Figure 5.2.15 Length distributions from the Walter Herwig survey in 14.

Greenland survey data (ICES Subarea 27.14)

The Greenland Institute of Natural Resources conducted a stratified bottom trawl survey in East Greenland (ICES 14b) from 1998 to 2016 at depths between 400 to 1500 m (WD05, Annex of this report). Survey results for tusk show a highly variable but increasing trend over recent years, so results from this survey will be monitored after it resumes in the future as a potential biomass index to be included in the tusk assessment.

5.2.3 Data analyses

There have been no marked changes in the number of boats nor the composition of the fleet participating in the tusk fishery in 5.a (Table 5.2.1). Catches decreased from around 9000 tonnes in 2010 to 2940 tonnes in 2018. This decrease is mainly because of reductions in landings by the Icelandic longline (Tables 5.2.6 and 5.2.7). This has resulted in less overshoot of landings relative to set TAC (Table 5.2.2). Species conversions in the ITQ system show that other species were converted to tusk last year rather than vice versa.

There are no marked changes in the length compositions since 2004, mean length in the catches ranges between 52.7 and 54.1 (Figures 5.2.8 and 5.2.9). According to the available length distributions and information on maturity only around 29% of catches in abundance and 44% in biomass are mature. There does seem to be a gradual increase in mean age of the age distribution from commercial catches from roughly 7 to 9. The reason for this is unknown, but given the lack of distinctive cohort structure in the data the first explanation might be a lack of consistency in ageing. Also, tusk have experienced a reduction in fishing mortality over the latter half of this range. Reasons such as difference in sampling, temporal or spatial are highly unlikely.

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 5.a. The total biomass index and the biomass index for tusk larger than 40 cm (reference biomass) has remained at similar level as in since 2011 at a relatively high level (Figure 5.2.12). The same holds for the index of tusk larger than 60 cm (spawning–stock biomass index) but that index didn't increase by similar factors as the other two biomass indices. The index of juvenile abundance (<30 cm) decreased by a factor of six between the 2005 survey when it peaked and the 2013 survey when it was at its lowest observed value. Since 2013 juvenile index has increased year on year in the 2014–2017 surveys. 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 labour strikes in the fishing industry, 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. However only around 20 to 25% of the catches are caught in this area (Figures 5.2.2 and 5.2.3). The change in juvenile abundance between 2006 and recent years can be clearly seen in Figures 5.2.12 and 5.2.13 where in 2006 juveniles (<40 cm) were all over the southern part of the shelf but can hardly be seen in recent years.

5.2.3.1 Stock assessment on Tusk in 5.a using Gadget

Since 2010 the Gadget model (Globally applicable Area Disaggregated General Ecosystem Toolbox, see www.hafro.is/gadget) has been used for the assessment of tusk in 5.a (See stock annex for details). As part of a Harvest Control Evaluation requested by Iceland this stock was benchmarked in 2017 (WKICEMSE 2017). Several changes were made to the model setup and settings which are described in the stock annex.

5.2.3.2 Data used by the assessment and model settings

Data used for tuning are given in the stock annex. Model settings used in the Gadget model for tusk in 5.a are described in more detail in the stock annex.

5.2.3.3 Diagnostics

Observed and predicted proportions by fleets: Overall the fit of the predicted proportional length distributions is close to the observed distributions (Figures 5.2.16 and 5.2.17). In general, for the commercial catch distributions the fit is better at the end of the time-series (Figure 5.2.16). The reason for this is there are few data at the beginning of the time-series and the model may be constrained by the initial values.

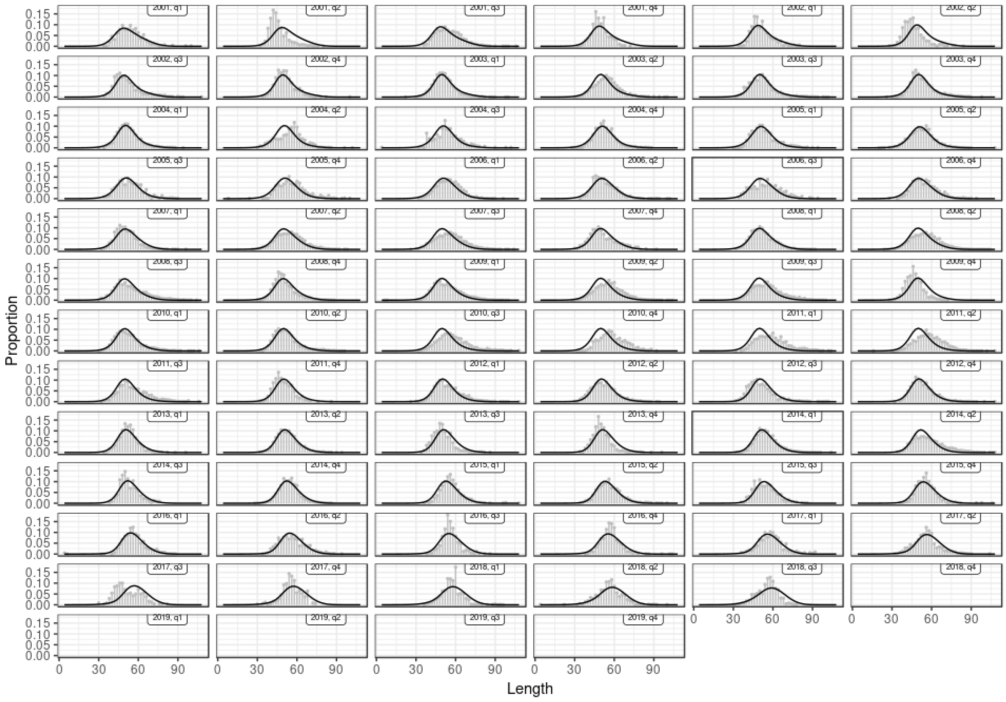


Figure 5.2.16 Tusk in 5.a and 14. Proportional fit (black line) to observed length distributions (grey points and bars) from commercial catches (longlines) by year and quarter from Gadget.

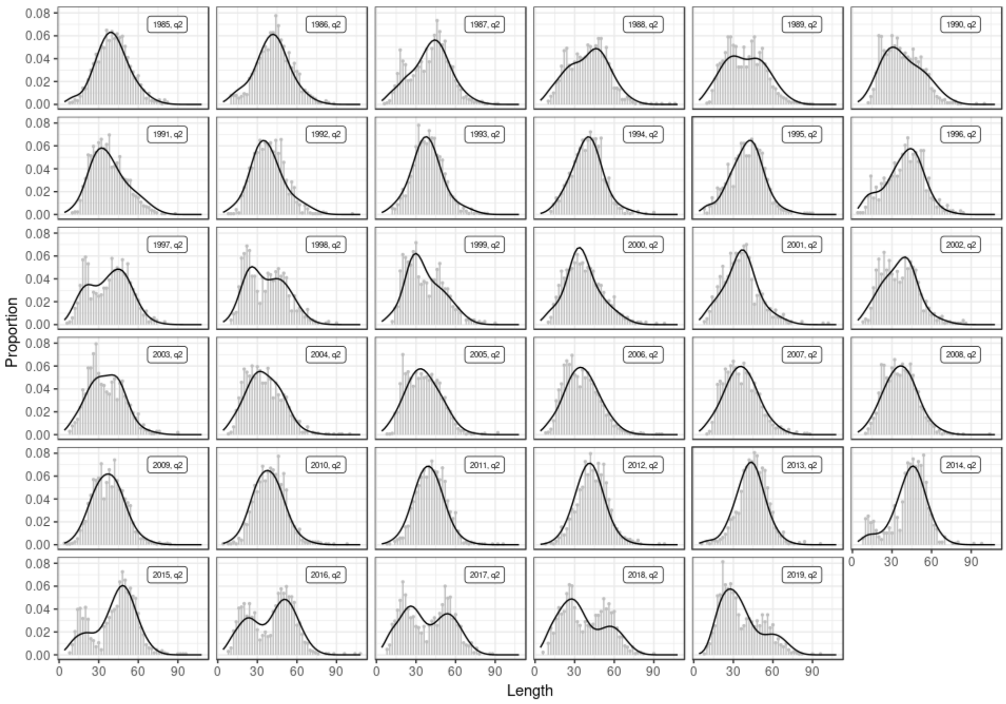


Figure 5.2.17 Tusk in 5.a and 14. Proportional fit (black line) to observed length distributions (points and blue bars) from the Icelandic spring survey by year from Gadget.

Model fit: In Figure 5.2.18 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 (10–19, 20–29, 30–39, 40–49, 50–59 and 60–69), of 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.

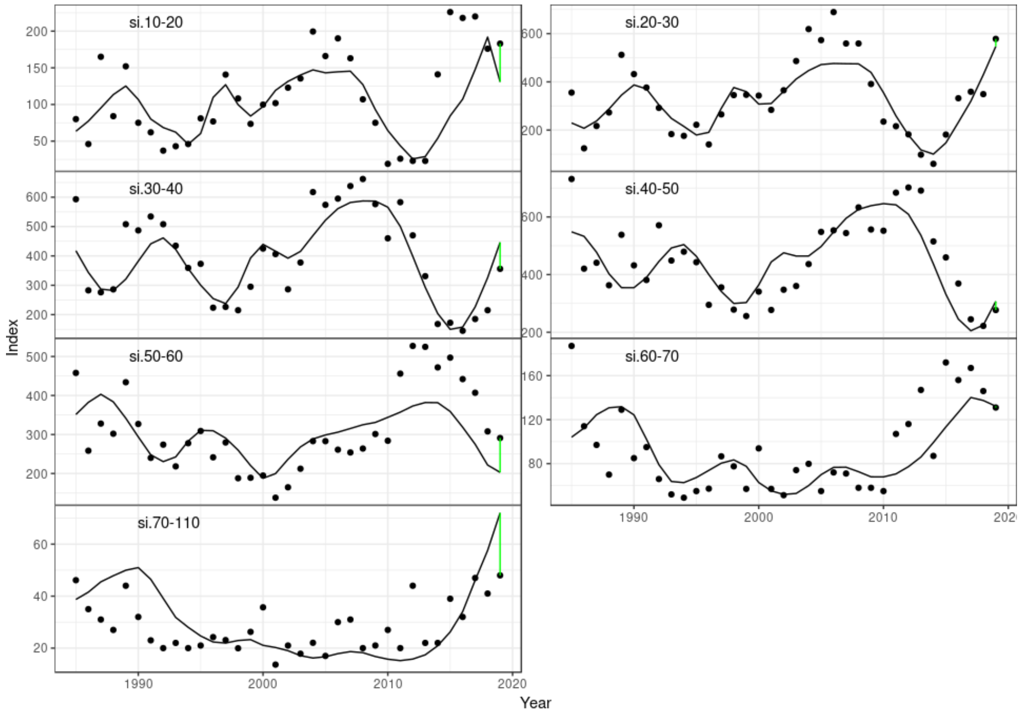


Figure 5.2.18 Tusk in 5.a and 14. Gadget fit to indices from disaggregated abundance by length indices from the spring survey.

5.2.3.4 Model results

The results are presented in Table 5.2.8 and Figure 5.2.19. In comparison with last year, there has been a slight downward revision of biomass levels. Recruitment peaked in 2005 to 2006 but has decreased and is estimated in 2013 to have been the lowest observed. Recruitment in 2014–2018 is estimated to be considerably higher than in 2013. Spawning–stock biomass has increased slowly since 2005. Harvestable biomass is estimated at a fairly high level compared to the rest of the time-series. Harvest rate has decreased from 0.29 in 2008 to 0.12 in 2016 and remains close to the target 0.13. Estimates of reference biomass (B40+) have also been stable for the last several years.

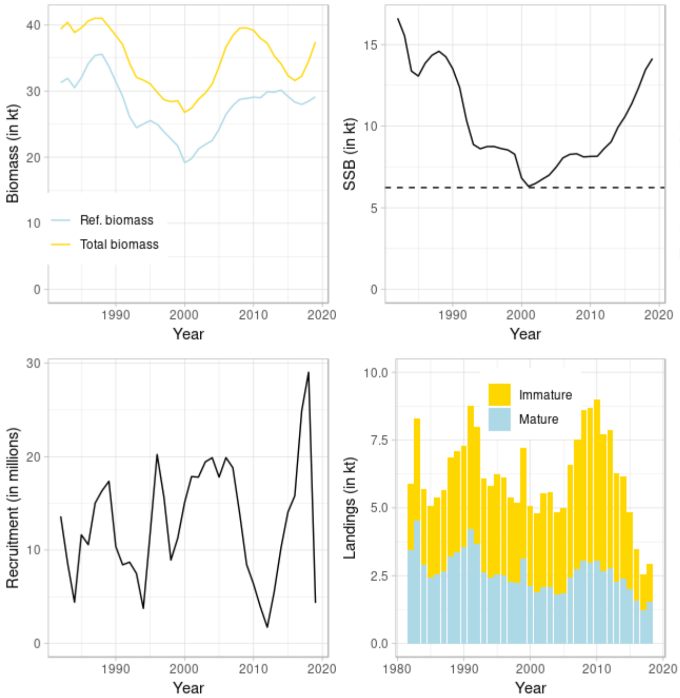
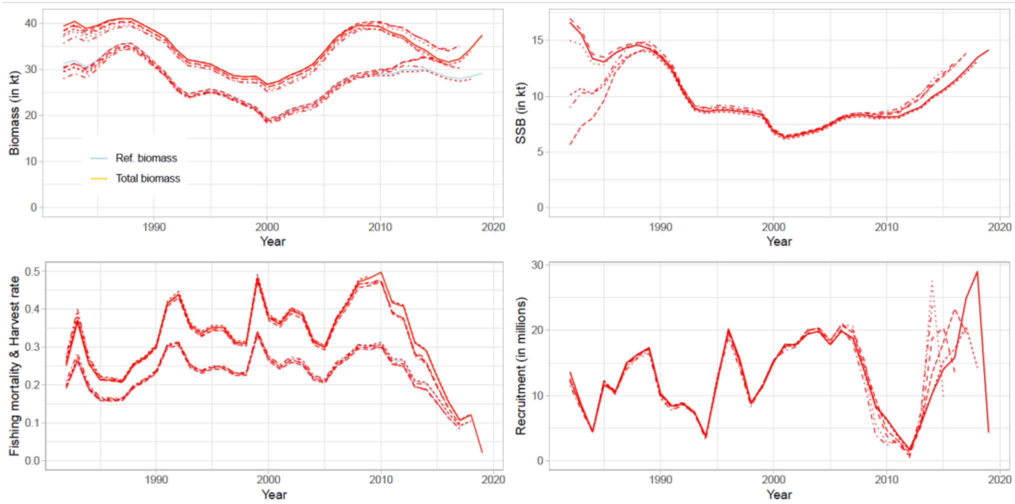


Figure 5.2.19 Tusk in 5.a and 14. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for tusk for the age groups most important in the fishery i.e. ages 7 to 10 (solid line).

5.2.3.5 Analytical retrospective analysis

An analytical retrospective analysis was completed with a 5-year peel, which shows some a gradual downward revision as biomass decreased but has stabilised as biomass started to increase again. It does not exhibit bias (Fig. 5.2.10), as Mohn's rho was calculated as -0.077283327 for F, 0.029 for recruitment, 0.109 for spawning stock biomass and 0.036 for total biomass.



5.2.3.6 Reference points

In the past, yield-per-recruit-based reference points, estimated as described in the stock annex, were used as proxies for F_{MSY}. F_{MSY} from a Y/R analysis is 0.24 and F0.1 is 0.15. WGDEEP 2014 recommended using F_{MSY}=0.2 as the target fishing mortality rather than F_{max}. This was subsequently used as the basis for the advice in 2014 by ICES. (See stock annex for details). As part of the WKICEMSE 2017, HCR evaluations requested by Iceland the following reference points were defined for the stock.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	6.24 kt	B_{pa}
	H_{msy}	0.17	The harvest rate that maximises the median long-term catch in stochastic simulations with recruitment drawn from a block bootstrap of historical recruitment scaled according to a hockey stick recruitment function with B_{lim} as defined below.
	F_{msy}	0.226	The median fishing mortality when an harvest rate of H_{msy} is applied.
	$H_{p.05}$	0.371	The harvest rate that has an annual probability of 5% of SSB $< B_lim$.
	$F_{p.05}$	0.356	The median fishing mortality when an harvest rate of $H_{p.05}$ is applied.
Precautionary approach	B_{lim}	4.46 kt	$B_{pa}/e^{1.645\sigma}$ where $\sigma = 0.2$
	B_{pa}	6.24 kt	SSB(2001), corresponding to B_{loss}
	H_{lim}	0.27	H corresponding to 50% long-term probability of SSB $> B_{lim}$
	F_{lim}	0.41	F corresponding to H_{lim}
	F_{pa}	0.27	$F_{lim}/e^{1.645\sigma}$ where $\sigma = 0.25$
	H_{pa}	0.20	H corresponding to F_{pa}
Management plan	H_{mp}	0.13	

The management plan accepted by Iceland is:

The spawning–stock biomass trigger (MGT $B_{trigger}$) is defined as 6.24 kt, the reference biomass is defined as the biomass of tusk 40+ cm and the target harvest rate (HRmgt) is set to 0.13. In the assessment year (Y) the TAC for the next fishing year (September 1 of year Y to August 31 of year Y+1) is calculated as follows:

When SSBy is equal or above MGT $B_{trigger}$:

TACy/y+1 = HRmgt*BRef,y

When SSBY is below MGT $B_{trigger:}$

TACy/y+1 = HRmgt* (SSBy/MGT $B_{trigger}$) * Bref,y

WKICEMSE 2017 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

5.2.4 Comments on the assessment

A benchmark was completed in 2017, which was done as part of the Harvest Control Rule evaluation request to ICES from Iceland. WKICEMSE 2017 noted: “Catches of tusk in Greenland, within ICES Subarea 14, were discussed. Minor catches (representing <5% of the total catch of tusk in 5.a+14) have always occurred in the Greenland area and were never included in the stock assessment of tusk. However, these catches increased in 2015 and 2016, representing around 10%–15% of the total catches in those years. None of the work presented to WKICEMSE included these catches, which seem to occur well away from the area where the catches included in the stock assessment take place (i.e. in or around ICES Division 5.a). Information about these catches in the Greenland area is somewhat limited and no biological samples are available; doubts related to population structure, movement and connectivity were also noted during the discussion. It was then decided to conduct a stock assessment run incorporating those catches (just the tonnage), to gain understanding on their potential impact on stock assessment results. Their inclusion in the assessment resulted in minor revisions upwards of the estimated stock biomass (around 1%–4% revision, on average throughout the years in the stock assessment) and downwards of the estimated harvest rate (around 0%–3% revision, on average throughout the years in the stock assessment, although with an increase of the harvest rates estimated for 2015 and 2016); the results of this run are available at the end of Section 2.2. As there are some doubts in relation to these catch data and population structure of tusk in the area, WKICEMSE did not feel that a decision to include these catches in the stock assessment at this point was appropriate before conducting additional explorations and having a better understanding. It is recommended that appropriate stock experts in WGDEEP should explore this issue further." This was discussed at WGDEEP-2017 and the following points were raised:

- Stock structure is generally unclear when it comes to deep-water stocks and many of the stock units assessed by WGDEEP are defined based on very limited scientific knowledge.
- The current advice units of tusk are not based on genetic studies except for tusk in Rockall and on the Mid Atlantic Ridge.
- The fishing areas for tusk in 5.a and 14 are widely separated. However survey data do show continuous distribution between Greenland, Iceland and the Faroe Islands.
- Genetic studies do not detect difference in tusk populations from the Barents Sea down to the Faroe Islands and over to Iceland and Greenland (Knutsen *et al*., 2009).
- Knutsen *et al*. (2009) proposed that the bathymetry over the NE-Atlantic could form a "bridge" between Norway and Greenland. However, they point out that tusk is not believed make extensive migrations and actually to be a sedentary species. Larval dispersal could account for the lack of genetic difference in tusk.
- It is highly plausible that the increased abundance of tusk seen in the Walter Herwig survey is of Icelandic origin that might have been dispersed as larvae to Greenland, similar as has been reported for cod in 5.a. However, unlike cod it is unlikely that tusk would migrate back to Iceland.
- The tusk population in Greenland is likely to be a "sink" from the Icelandic population and as such should not affect the productivity of tusk in Iceland.

Based on this, WGDEEP 2017 concluded that the catches in 14 should not be included in the assessment of tusk in 5.a. Additionally, the EG concluded that the division of tusk into different advice units should be reviewed, not only in 5.a and 14, but for all the tusk stocks.

5.2.5 Management considerations

Increased catches in 14.b from less than 100 tonnes in previous years to 900 tonnes in 2015, and about 682 tonnes in 2018 are of concern. However, the signs from commercial catch data and surveys indicate that the total biomass of tusk in 5.a is stable. This is confirmed in the Gadget assessment. Recruitment in 5.a is on the increase again after a low in 2013. A reduction in fishing mortality has also led to harvestable biomass and SSB that seem to be either stable or slowly increasing. Due to the selectivity of the longline fleet catching tusk in 5.a and the species relatively slow maturation rate, 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 5.a 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 also be maintained and expanded if needed.

5.2.5.1 Ecosystem considerations

Tusk has recently exhibited spatial changes in length distributions (Figure 5.2.13), however, there have been no obvious changes in maturity patterns or growth through time. Demographic patterns of tusk should be monitored as other Icelandic demersal species have exhibited recent changes (e.g., haddock). However, as tusk biomass levels and indices appears stable or increasing, environmental factors and multispecies interactions are not currently considered to be a concern for the assessment.

Table 5.2.6. Tusk in 5.a and 14. Nominal landings by nations in 5.a.

Year	Faroe	Denmark	Germany	Iceland	Norway	UK	Total
1980	2873	0	0	3089	928	0	6890
1981	2624	0	0	2827	1025	0	6476
1982	2410	0	0	2804	666	0	5880
1983	4046	0	0	3469	772	0	8287
1984	2008	0	0	3430	254	0	5692
1985	1885	0	0	3068	111	0	5064
1986	2811	0	0	2549	21	0	5381
1987	2638	0	0	2984	19	0	5641
1988	3757	0	0	3078	20	0	6855
1989	3908	0	0	3131	10	0	7049
1990	2475	0	0	4813	0	0	7288
1991	2286	0	0	6439	0	0	8725
1992	1567	0	0	6437	0	0	8004
1993	1329	0	0	4746	0	0	6075
1994	1212	0	0	4612	0	0	5824
1995	979	0	1	5245	0	0	6225
1996	872	0	1	5226	3	0	6102
1997	575	0	0	4819	0	0	5394
1998	1052	0	1	4118	0	0	5171
1999	1035	0	2	5794	391	2	7224
2000	1154	0	0	4714	374	2	6244
2001	1125	0	1	3392	285	5	4808

Year	Faroe	Denmark	Germany	Iceland	Norway	UK	Total
2002	1269	0	0	3840	372	2	5483
2003	1163	0	1	4028	373	2	5567
2004	1478	0	1	3126	214	2	4821
2005	1157	0	3	3539	303	41	5043
2006	1239	0	2	5054	299	2	6596
2007	1250	0	0	5984	300	1	7535
2008	959	0	0	6932	284	0	8175
2009	997	0	0	6955	300	0	8252
2010	1794	0	0	6919	263	0	8976
2011	1347	0	0	5845	198	0	7390
2012	1203	0	0	6341	217	0	7761
2013	1092	0.12	0	4973	192	0	6257
2014	728	0	0	4995	306	0	6029
2015	625	0	0	4000	198	0	4823
2016	543	0	0	2649	302	0	3494
2017	492	0	0	1833	216	0	2540
2018	517	0	0	2097	326	0	2940

Table 5.2.7. Tusk in 5.a and 14. Nominal landings by nations in 14.

Year	Faroe	Denmark	Greenland	Germany	Iceland	Norway	Russia	Spain	UK	Total
1980	0	0	0	13	0	0	0	0	0	13
1981	110	0	0	10	0	0	0	0	0	120
1982	0	0	0	10	0	0	0	0	0	10
1983	74	0	0	11	0	0	0	0	0	85
1984	0	0	0	5	0	58	0	0	0	63
1985	0	0	0	4	0	0	0	0	0	4
1986	33	0	0	2	0	0	0	0	0	35
1987	13	0	0	2	0	0	0	0	0	15
1988	19	0	0	2	0	0	0	0	0	21
1989	13	0	0	1	0	0	0	0	0	14
1990	0	0	0	2	0	7	0	0	0	9
1991	0	0	0	2	0	68	0	0	1	71
1992	0	0	0	0	3	120	0	0	0	123
1993	0	0	0	0	1	39	0	0	0	40
1994	0	0	0	0	0	16	0	0	0	16
1995	0	0	0	0	0	30	0	0	0	30
1996	0	0	0	0	0	157	0	0	0	157
1997	0	0	0	0	10	9	0	0	0	19
1998	0	0	0	0	0	12	0	0	0	12
1999	0	0	0	0	0	8	0	0	0	8
2000	0	0	0	0	11	11	0	3	0	25
2001	3	0	0	0	20	69	0	0	0	92
2002	4	0	0	0	86	30	0	0	0	120
2003	0	0	0	0	2	88	0	0	0	90
2004	0	0	0	0	0	40	0	0	0	40
2005	7	0	0	0	0	41	8	0	0	56
2006	3	0	0	0	0	19	51	0	0	73
2007	0	0	0	0	0	40	6	0	0	46
2008	0	0	33	0	0	7	0	0	0	40

Year	Faroe	Denmark	Greenland	Germany	Iceland	Norway	Russia	Spain	UK	Total
2009	12	0	15	0	0	5	11	0	0	43
2010	7	0	0	0	0	5	0	0	0	12
2011	20	0	0	0	131	24	0	0	0	175
2012	33	0	0	0	174	46	0	0	0	253
2013	1.9	0.3	0	0	0	23.8	0	0	0	26
2014	2	0	0	0	0	26	0	0	0	28
2015	670	0.1	166	0	0	62	0	0	0	898
2016	111	0	182	0	0	178	0	0	0	471
2017	83	0.38	335	0	0	141	0	0	0	559
2018	345	0	108	0	0	228	0	0	0	689

Table 5.2.8. Tusk in 5.a and 14. Estimates of biomass, biomass 40+ cm, spawning–stock biomass (SSB) in thousands of tonnes and recruitment (millions), harvest rate (HR) and fishing mortality from Gadget.

Year	Biomass	B_{40+}	SSB	Rec3	Catch	HR	F
1982	39372	31264	16612	9839	5877	0.188	0.251
1983	40399	31916	15542	9520	8286	0.260	0.366
1984	38847	30512	13374	10133	5692	0.187	0.256
1985	39532	32021	13072	6368	5060	0.158	0.214
1986	40595	34146	13860	3271	5381	0.158	0.212
1987	41000	35407	14351	8609	5644	0.159	0.209
1988	40978	35547	14590	7833	6864	0.193	0.254
1989	39699	33703	14252	11128	7076	0.210	0.272
1990	38394	31413	13518	12108	7296	0.232	0.302
1991	37008	29190	12374	12853	8762	0.300	0.415
1992	34186	26111	10364	7676	7999	0.306	0.439
1993	32054	24456	8879	6236	6074	0.248	0.36
1994	31642	25008	8618	6445	5828	0.233	0.336
1995	31087	25531	8753	5544	6227	0.244	0.353
1996	29828	24987	8755	2781	6103	0.244	0.352
1997	28676	23833	8633	8807	5399	0.227	0.314
1998	28400	22768	8547	14980	5173	0.227	0.31
1999	28522	21713	8281	11565	7227	0.333	0.483
2000	26764	19167	6825	6609	6241	0.265	0.378
2001	27422	19765	6315	8352	4806	0.243	0.361
2002	28736	21230	6488	11182	5549	0.261	0.397
2003	29696	21917	6748	13228	5571	0.254	0.384
2004	31069	22510	7004	13183	4822	0.214	0.313
2005	33708	24233	7483	14392	5006	0.207	0.299
2006	36644	26478	8056	14721	6600	0.249	0.372
2007	38407	27816	8274	13188	7539	0.271	0.416
2008	39503	28735	8313	14728	8626	0.300	0.472
2009	39534	28879	8118	13925	8680	0.301	0.483

Year	Biomass	B_{40+}	SSB	Rec3	Catch	HR	F
2010	39189	29073	8148	10265	8978	0.309	0.498
2011	37969	28981	8156	6252	7701	0.266	0.418
2012	37223	29884	8631	4715	7873	0.263	0.408
2013	35320	29821	9039	2892	6264	0.210	0.312
2014	34107	30129	9935	1287	6163	0.205	0.291
2015	32329	29188	10576	4076	4836	0.166	0.22
2016	31580	28329	11382	7598	3494	0.123	0.155
2017	32244	27972	12363	10413	2541	0.091	0.106
2018	34506	28457	13460	11715	2940	0.103	0.121
2019	37093	29130	14143	18434			

5.3 Tusk (*Brosme brosme*) on the Mid-Atlantic Ridge (Subdivisions 12.a1 and 14.b1)

5.3.1 The fishery

Tusk is bycatch in the gillnet and longline fisheries in Subdivisions 12.a1 and 14.b1. During 1996 and 1997 Norway also had a fishery in this area.

5.3.2 Landings trends

Landing statistics by nation in the years 1988 to 2018 are shown in Table 5.3.1.

The reported landings are generally very low in these areas. Russia reported some landings of tusk in 2005, 2006, 2007 and 2009 and no landings were reported by the Russians for 2010 and 2011. In 2012 Norway reported 17 tonnes in Area 14.b1 and the Faroe Islands, 1 ton. No landings have been reported in 2013, 2014, 2016 to 2018, while in 2015 Greenland reported 2 tons.

5.3.3 ICES Advice

Advice for 2018 and 2019: ICES advises that when the precautionary approach is applied, there should be zero catches in each of the years 2018 and 2019 unless there is evidence that this is sustainable. Measures should be taken to limit occasional high levels of bycatch.

Management

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

5.3.4 Data available

5.3.4.1 Landings and discards

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

5.3.4.2 Length compositions

No length compositions were available.

5.3.4.3 Age compositions

No age compositions were available.

5.3.4.4 Weight-at-age

No data were available.

5.3.4.5 Maturity and natural mortality

No data were available.

5.3.4.6 Catch, effort and research vessel data

No data were available.

5.3.5 Data analyses

There are insufficient data to assess this stock.

5.3.5.1 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.

5.3.6 Comments on the assessment

No assessment was carried out this year.

5.3.7 Management considerations

Tusk is a bycatch in all fisheries. Advice should take into account the advice for the targeted species. Life-history traits for tusk do not suggest it is particularly vulnerable.

5.3.8 Tables

Table 5.3.1. Tusk 12. WG estimate of landings.

Tusk 12

Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
1988		1					1
1989		1					1
1990		0					0
1991							0
1992							0
1993	29	1	+				30
1994	27	1	+				28
1995	12	-	10				18
1996	7	-	9	142			158
1997	11	-	+	19			30
1998				-			1
1999				+	1		1
2000				5	+		5
2001		1		51	+		52
2002				27			27
2003				83			83
2004		2		7		5	14
2005	2	1					3
2006						64	64
2007						19	19
2008						0	0
2009						2	2
2010							0
2011							0
2012	1						1
2013							0

Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
2014							0
2015							0
2016							0
2017							0
2018*							0

*Preliminary.

Tusk 14.b1

Year	Faroes	Iceland	Norway	E & W	Russia	GREENLAND	Total
2012			17				17
2013							0
2014							0
2015						2	2
2016							0
2017							0
2018*							0

Table 5.3.1. (Continued). Tusk, total landings by subareas or division.

Year	12	14.b1	All areas
1988	1		1
1989	1		1
1990	0		0
1991	0		0
1992	0		0
1993	30		30
1994	28		28
1995	18		18
1996	158		158
1997	30		30
1998	1		1
1999	1		1
2000	5		5
2001	52		52
2002	27		27
2003	83		83
2004	14		14
2005	3		3
2006	64		64
2007	19		19
2008	0		0
2009	2		2
2010	0		0
2011	0		0
2012	1	17	18
2013	0		0
2014	0		0
2015	0	2	2

Year	12	14.b1	All areas
2016	0		0
2017			0
2018*			0

*Preliminary.

5.4 Tusk (*Brosme brosme*) in 6.b

5.4.1 The fishery

Tusk is only bycatch and not targeted in the trawl, gillnet and longline fisheries in Subarea 6.b. Norway has traditionally landed the largest catch of tusk in area 6.b. In particular, during the period 1988–2018 Norwegian vessels have reported over 80% of the total landings. Small by-catches of tusk were also taken in 6.b by trawlers in the haddock fishery. Since January 2007 parts of the Rockall Bank has been closed to fishing which were the traditional areas fished by the Norwegian longline fleet.

The Norwegian longline fishery

The Norwegian longline fleet increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased and then stabilized around 25 since 2014. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The decrease in the size of the fleet was because of closed areas, increasing fuel costs and larger quotas of Arcto Norwegian cod. The total number of days the fleet has been fishing in area 6.b per year was a maximun of 464 fishing days in 2002 to 78 days in 2018 (Figure 5.4.1). The number of hooks set per day increased from an average of 30 000 in 2000 to 35 000 in 2018.

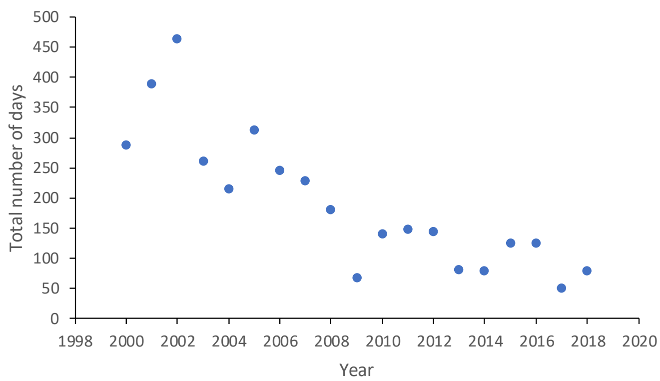


Figure 5.4.1. Estimated total number of days the Norwegian longline fleet fished for tusk during the period 2000 to 2018 based on logbooks.

5.4.2 Landings trends

Landing statistics by nation in the period 1988–2018 are in Table 5.4.1.

Landings varied considerably between 1988 and 2000; peaked at 2344 t in 2000, and since 2000 were low with a declining trend. In 2014 the catch was 38 tons, an all-time low during this period, while in 2015 the total catch increased to 226 tons but in 2018 the landings decreased to 46 tons (Figure 5.4.1).

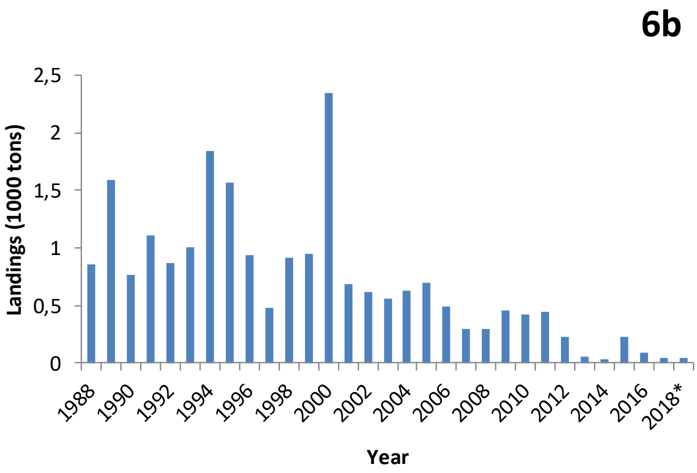


Figure 5.4.1. The international total landings of tusk from Subarea 6.b.

5.4.3 ICES Advice

Advice for 2019 to 2020: ICES advises that when the precautionary approach is applied, catches should be no more than 280 tonnes in each of the years 2019 and 2020. If discard rates do not change from 2017, this implies landings of no more than 216 tonnes.

5.4.4 Management

Apart from the closed areas, there are no management measures that apply exclusively to 6.b.

Norway, which also has a licensing scheme, had a catch allocation in EU waters (Subareas 5, 6 and 8). In 2018, the Norwegian quota in the EU zone was 2923 t (up to 2000 t are interchangeable with ling quota).

EU TACs cover Subareas 5, 6, 7 (EU and international waters) and in 2019 is set at 1207 t.

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

5.4.5 Data available

5.4.5.1 Landings and discards

Landings were available for all relevant countries. In 2016 there was reported 7 tons of discarded tusk, 14 tons in 2017, while in 2018 the catch increased to 21 tons.

5.4.5.2 Length compositions

The length distributions of tusk based on data provided by the Norwegian reference fleet for the period 2002–2017 are in Figures 5.4.3 and 5.4.4. The average length during this period fluctuated without any obvious trends (no data were available for 2004, 2011, 2014, 2017, and 2018).

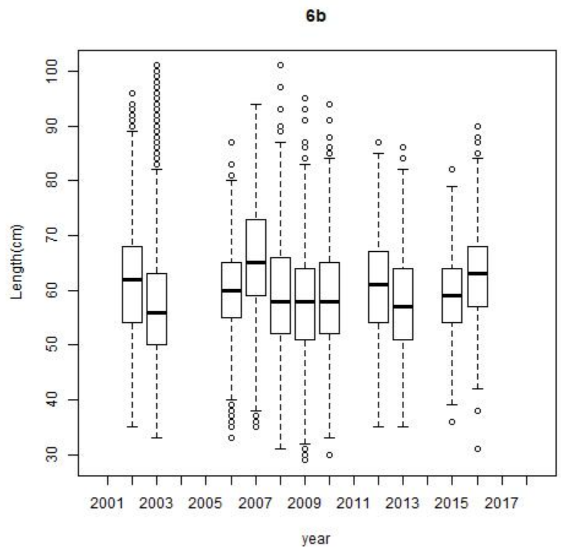


Figure 5.4.3. The length distribution of tusk based on data provided by the Norwegian reference fleet for 2002–2016 (no data were available for 2004, 2011, 2014 and 2017).

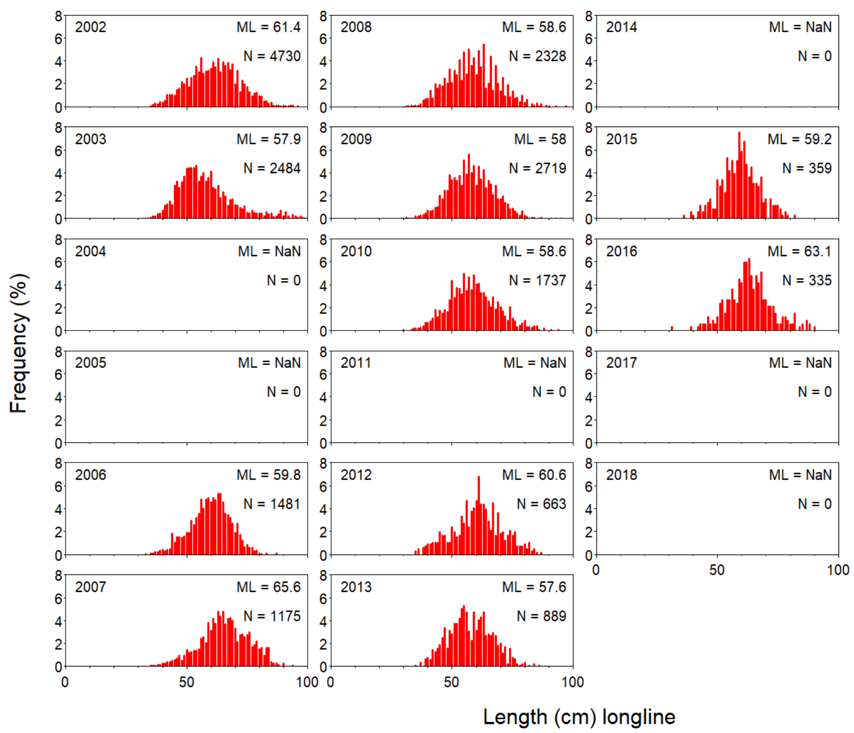


Figure 5.4.4. The length distribution of tusk based on data provided by the Norwegian reference fleet for 2002–2016 (no data were available for 2004, 2005, 2011, 2014, 2017 and 2018).

5.4.5.3 Age compositions

No new age composition data were available.

5.4.5.4 Weight-at-age

No new data were presented.

5.4.5.5 Maturity and natural mortality

No new data were presented.

5.4.5.6 Catch, effort and research vessel data

Norway began in 2003 collecting and entering data from official logbooks into an electronic database, and data are now available for 2000–2018. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in each year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

5.4.6 Data analyses

No analytical assessments were carried out.

Norwegian longline cpue

When using all available data, the standardized cpue series showed a declining trend from 2000–2007, after 2007 the cpue has been at a stable but a low level. When only data from the targeted fishery are, used, the cpue appears to be stable, although there were no new data for 2016 and 2017 (Figure 5.4.5).

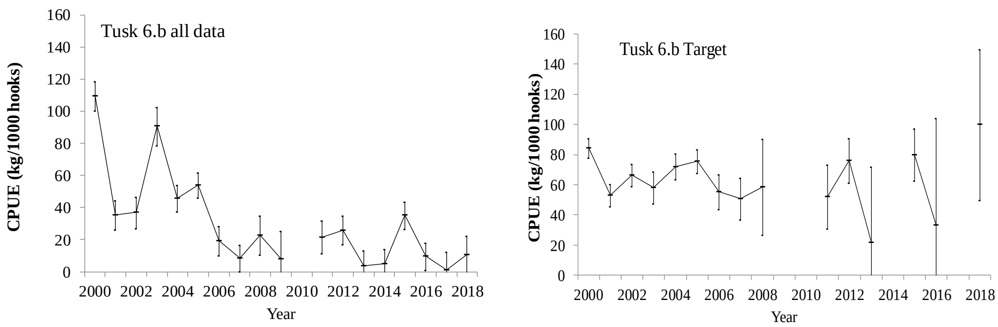


Figure 5.4.5. Estimated cpue (kg/1000 hooks) series for tusk in Subarea 6.b based on skipper's logbooks (during the period 2000–2018). The bars denote the 95% confidence intervals.

5.4.6.1 Biological reference points

See Section 5.4.9.

5.4.7 Comments on the assessment

5.4.8 Management considerations

The landings since 2001 have been low with a decreasing trend. With the exception of 2015, the landings have been very low since 2013. The decreasing size of the fleet was caused by several factors including; closed areas, increasing fuel costs and larger quotas of Arcto Norwegian cod. The total number of days the fleet were fishing in area 6.b per year has decreased from a maximun of 464 fishing days in 2002 to 78 days in 2018 (Figure 5.4.1). When all available data are combined, the cpue series also shows a decreasing trend until 2007 after this it has been at a stable but low level. The cpue series for the targeted fishery for tusk also shows a stable level.

The main fishing grounds traditionally exploited by the Norwegian fleet in 6.b were closed to bottom contacting gears in 2007 and this may have influenced recent estimates of cpue.

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the tusk cpue series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope and pray that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g. Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

5.4.9 Application of MSY proxy reference points

Length-based indicator method (LBI)

LBI was applied in 2017 with the input parameters and the length distribution of the catch for some years during the period 2002–2016 (WGDEEP 2017). The length data used in the LBI model were from the Norwegian longline fleet; L_{mat} was "borrowed" from the Faroese data. No new length data or other biological data were available for 2017.

The conclusion from last year's report was that the overall perception of the stock during in 2015 and 2016 were that tusk on Rockall seem to be in good shape, specifically tusk stock is fished sustainably, and the stock is not fished greater than the length-based indicator of MSY. However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}. Background data for L_{mat} are not available for the Rockall area and were "borrowed" from the Faroese data. The tusk on Rockall are genetically different from the tusk in neighbouring areas (Knutsen *et al*. 2009), and it is very likely that values like L_{mat} also are different from other areas. Until these values have been established for this area, the method and results must be evaluated accordingly

Table 5.4.1. Tusk 6.b. WG estimate of landings.

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	Total
1988	217		-	-		601	8	-	34		860
1989	41	1	-	-		1537	2	-	12		1593
1990	6	3	-	-		738	2	+	19		768
1991	-	7	+	5		1068	3	-	25		1108
1992	63	2	+	5		763	3	1	30		867
1993	12	3	+	32		899	3	+	54		1003
1994	70	1	+	30		1673	6	-	66		1846
1995	79	1	+	33		1415	1		35		1564
1996	0	1		30		836	3		69		939
1997	1	1		23		359	2		90		476
1998		1		24	18	630	9		233		915
1999				26	-	591	5		331		953
2000		2		22		1933	14		372	1	2344
2001	1	1		31		476	10		157	6	681
2002		8		3		515	8		88		622
2003		7		18		452	11		72	1	561
2004		9		1		508	4		45	60	627
2005		5		9		503	5		33	137	692
2006	10	1		16		431	2		25	2	487
2007	4	0		8		231	1		30	25	299
2008	41	0		2		190	0		16	44	293
2009	70			4		358			17	3	452
2010	57			1		348			13		419
2011	3					433			14		450
2012	15					209			9		233
2013		1				46			11		57
2014	6					26			6		38
2015	1					218	7		7		226
2016				1		80			9		90

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	Total
2017				2		37			8		47
2018				2		35			10		47

***Preliminary.**

Table 5.4.1. (Continued).

Tusk, total landings in Subarea 6.b.

Year	6.b	All areas
1988	860	860
1989	1593	1593
1990	768	768
1991	1108	1108
1992	867	867
1993	1003	1003
1994	1846	1846
1995	1564	1564
1996	939	939
1997	476	476
1998	915	915
1999	953	953
2000	2344	2344
2001	681	681
2002	622	622
2003	561	561
2004	627	627
2005	692	692
2006	487	487
2007	299	299
2008	293	293
2009	452	469
2010	419	419
2011	450	450
2012	233	233
2013	57	57
2014	38	38
2015	226	226

Year	6.b	All areas
2016	90	90
2017	47	47
2018*	47	47

***Preliminary.**

5.5 Tusk (*Brosme brosme*) in Subareas 1 and 2

5.5.1 The fishery

Tusk is primarily bycatch in the ling and cod fisheries in Subareas 1 and 2. Currently the major fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, e.g. trawls and handlines. The total Norwegian landings are usually around 85% from longlines, 10% from gillnets and the remainder by a variety of other gears. For other nations, tusk is bycatch in their trawl and longline fisheries.

Figure 5.5.1 shows the spatial distribution of the total catch by the Norwegian longline fishery from 2013 to 2018. The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased to 26 in 2018. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas 1 and 2 has declined since the peak in 2011. During the period 1974 to 2016 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2018).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2018 is 43% less than the average effort during the years 2000–2003. It should be noted that the annual fishery covers the entire distribution of tusk in Subareas 1 and 2 (see Figure 5.5.1), so that the catch produced by the applied effort is likely proportional to the actual population.

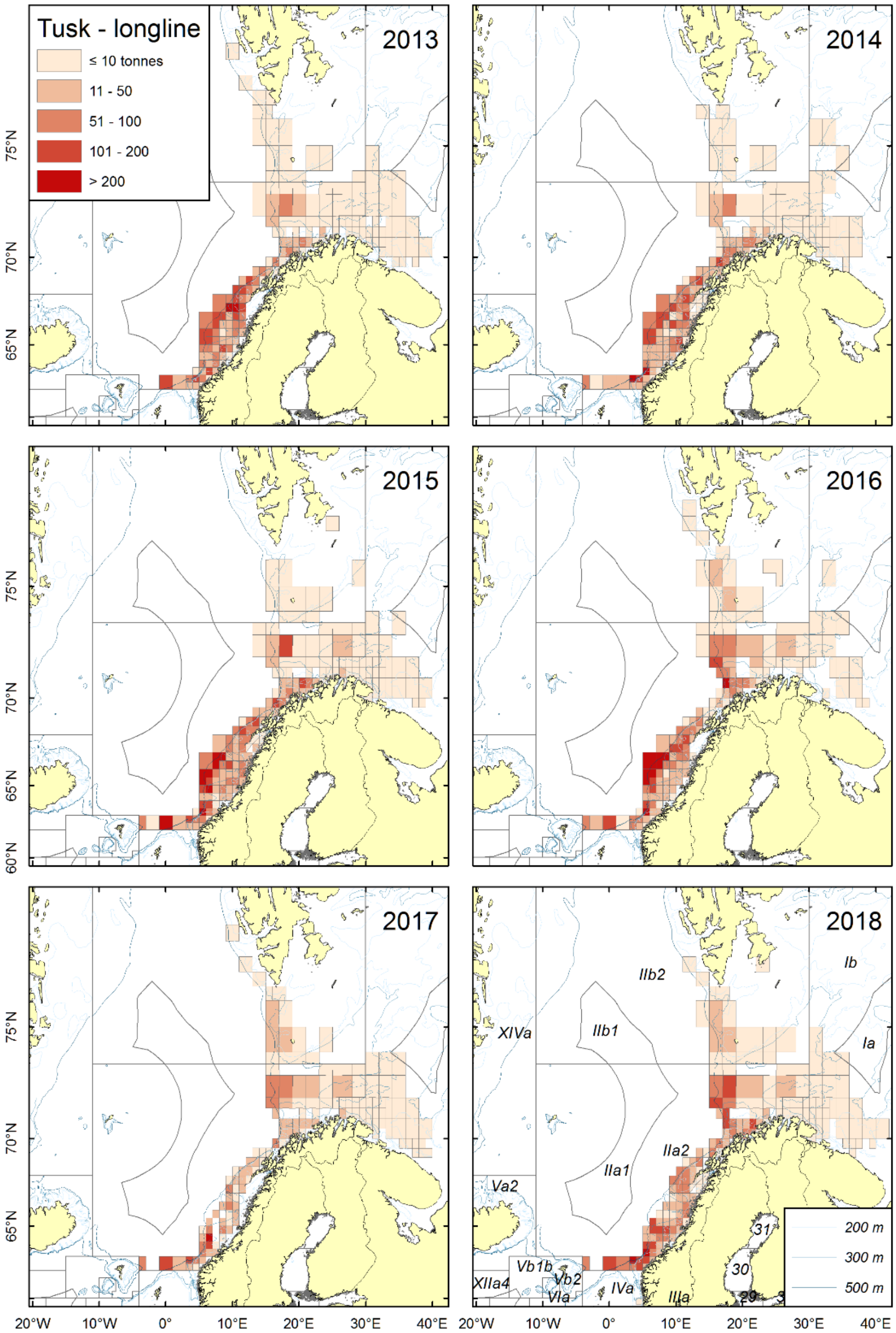


Figure 5. 5.1. Distribution of catches for the Norwegian longline fishery in Subareas 1 and 2 in 2013 to 2018.

5.5.2 Landings trends

Landing statistics by nation from 1988 to2018 are given in Table 5.5.1a–d. Landings declined from 1989 to 2005, afterwards the landings increased some years and have since varied around 10.000 t. (Figures 5.5.2 and 5.5.3). The preliminary landings for 2018 are 10 487 t.

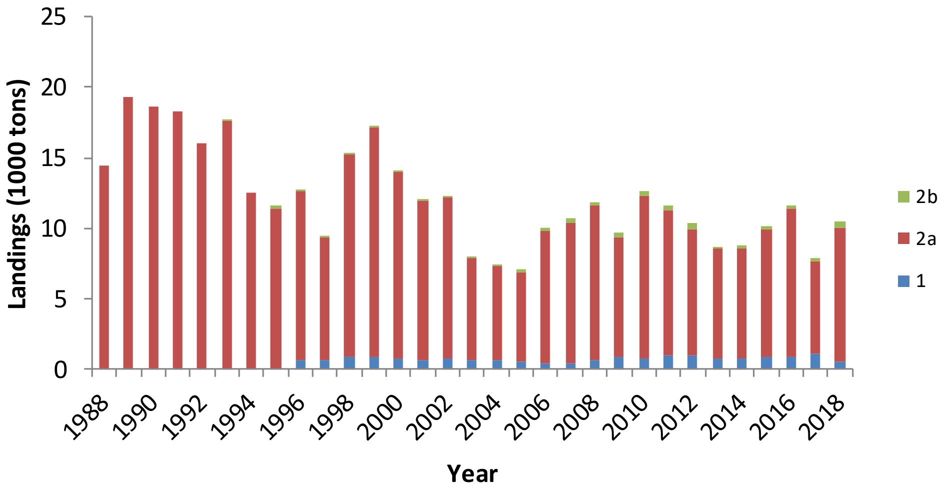


Figure 5.5.2. Total yearly landings of tusk in Areas 1 and 2 for 1988–2018.

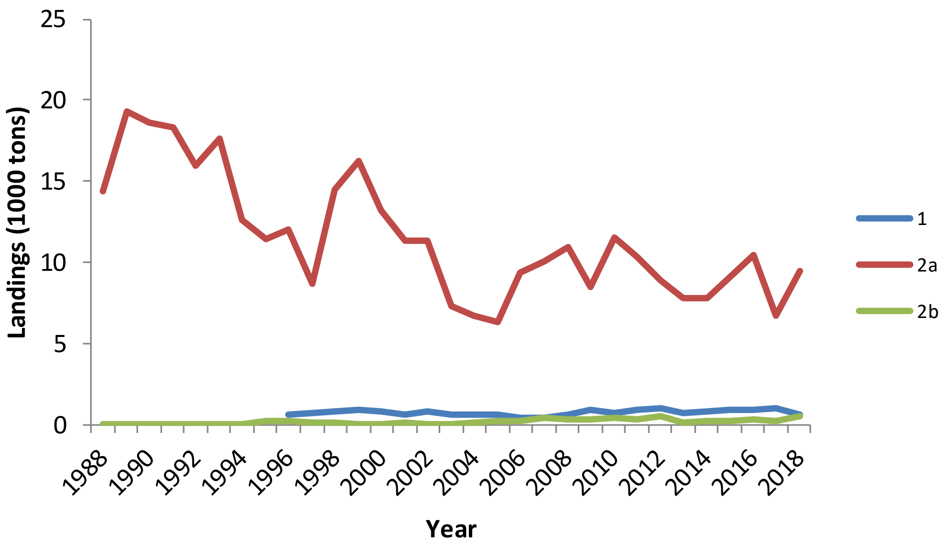


Figure 5.5.3. Total yearly landings of tusk in Areas 1 and 2 for 1988–2018.

5.5.3 ICES Advice

Advice for 2018 and 2019: ICES advises that if the precautionary approach is applied, then the yearly catch should be no more than 10,451 tonnes for 2018 and 2019. All catches are assumed to be landed.

Management:

There is no quota for the Norwegian fishery for tusk, but the vessels participating in the directed fishery for ling and tusk in Subareas 1 and 2 are required to have a licence for tusk. There is no minimum landing length 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 1, 2 and 14) was set to 21 t in 2019.

5.5.4 Data available

5.5.4.1 Landings and discards

The amount landed was available for all the relevant fleets. The Norwegian fleets are not regulated by TACs, and there is a ban on discarding. The incentive for illegal discarding is believed to be small. Germany reported 3 tons of discarded tusk in 2017. The landings statistics are regarded as being adequate for assessment purposes.

5.5.4.2 Length compositions

Figures 5.5.4 and 5.5.5 show the length distributions and Figure 5.5.6 shows the length–weight relationship for tusk based on data provided by the Norwegian reference fleet for the period 2001–2018.

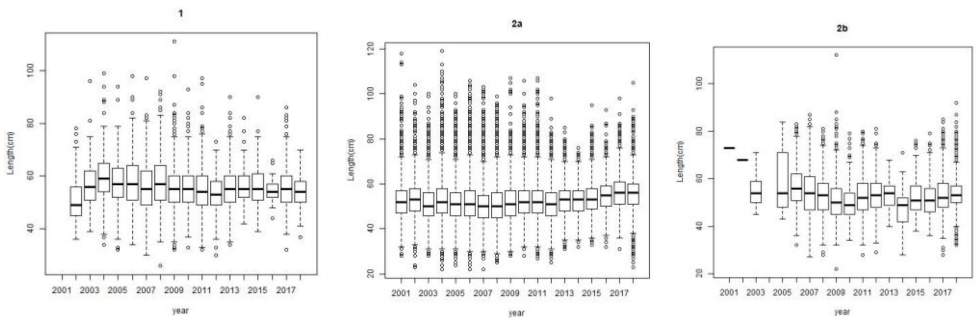


Figure 5.5.4. Box and whisker plots showing the length distribution of tusk. The data were provided by the Norwegian reference fleet for the period 2001–2018.

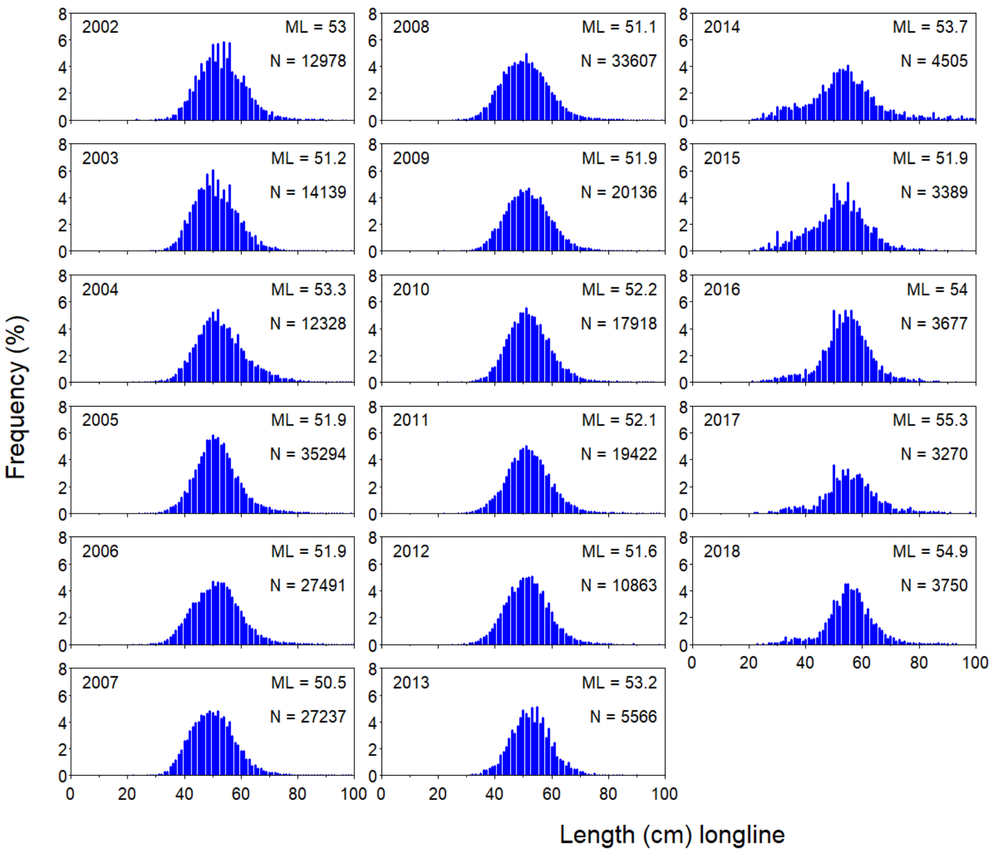


Figure 5.5.5. The estimated length distributions of the catch of tusk by Norwegian longliners combined for the Areas 1, 2.a and 2.b.

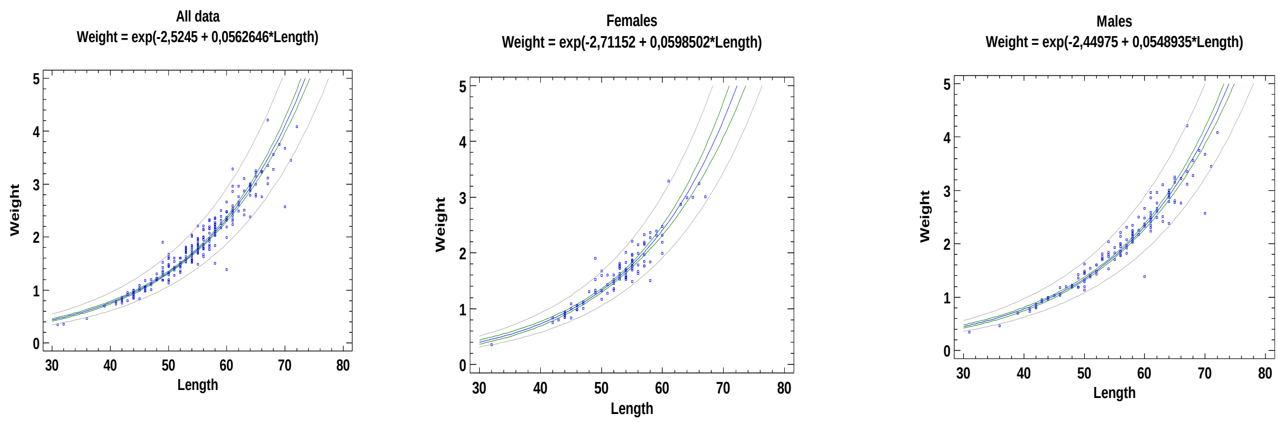


Figure 5.5.6. Length–weight relationship for tusk.

5.5.4.3 Age compositions

The average length and weight-at-age for males and females based on the combined data for the years 2000–2002, 2004, 2005, 2010, 2011, 2013-2016 are shown in Figure 5.5.7 and the catch-at- age compositions from the longline fishery in areas 1 and 2 are shown in Figure 5.5.8.

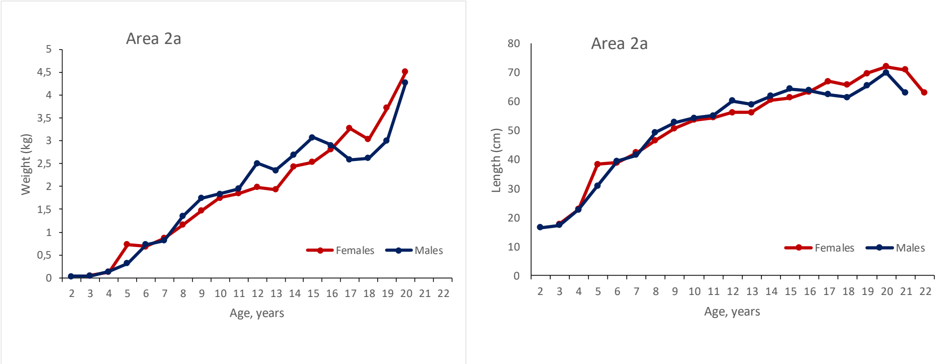


Figure 5.5.7. Average length and weight-at-age for all available data for the years 2000–2002, 2004, 2005, 2010, 2011, 2013-2016.

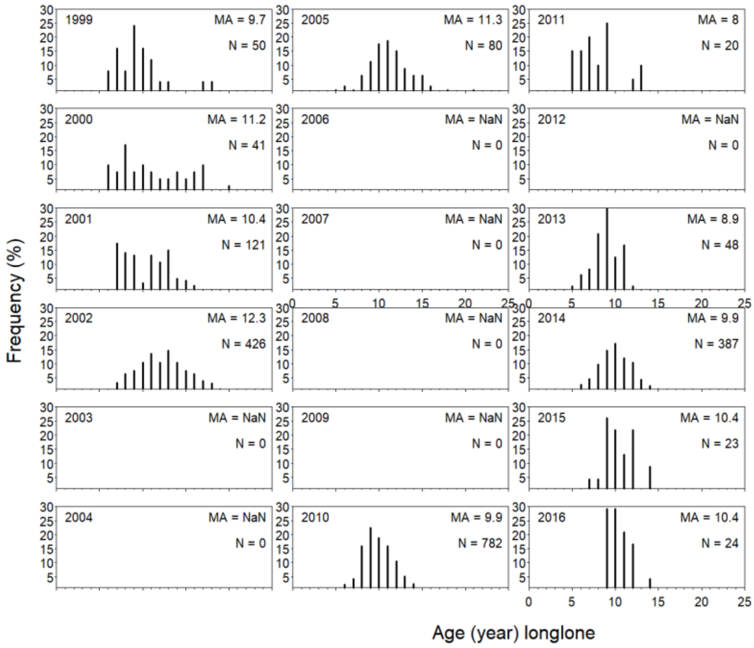


Figure 5.5.8. Catch-at- age composition from the longline fishery in areas 1 and 2.

5.5.4.4 Maturity and natural mortality

Maturity ogives for tusk are in Figure 5.5.9 and in the Table below. There were insufficient age data to determine A_{50}.

Maturity parameters:

Stock	L_{50}	N	A_{50}	N	Source
Usk-arct	56.3	2616			Norwegian long liners (Reference fleet) and survey data

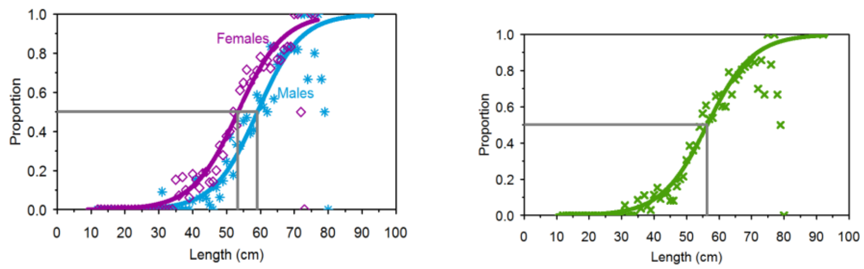


Figure 5.5.9. Tusk 1 and 2, Maturity ogive on length for males and females, and all data combined.

5.5.4.5 Catch, effort and research vessel data

Norway began in 2003 to collect and enter data from official logbooks into an electronic database, and these data are now available for the period 2000–2018. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

The method for estimating cpue for tusk is given in Helle *et al*., 2015. An analysis based on these data is in the WD Helle and Pennington, 2018. Two cpue series, one based on all data and one when tusk was targeted were presented (Figure 5.5.9). No research vessel data are available.

5.5.5 Data analyses

Length distribution

The mean length fluctuated without any obvious trends (Figure 5.5.4)

Assessment

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

CPUE

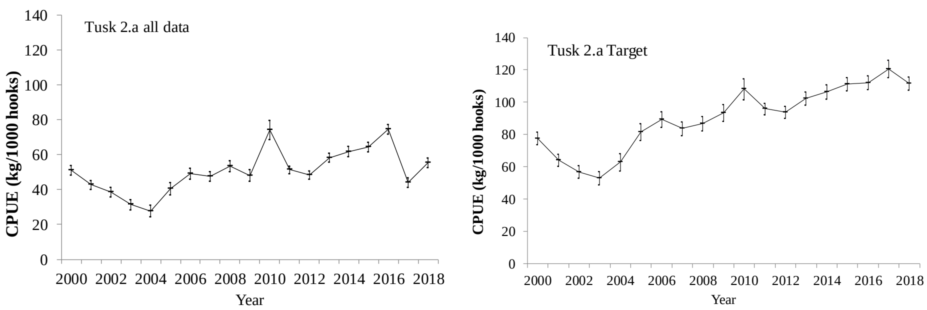


Figure 5.5.9. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbook data for 2000–2018. The bars denote the 95% confidence interval.

Two standardized GLM-based cpue series using all the data and based only when tusk made up more than 30% of the catches are in Figure 5.5.9. Both cpue series show an upward trend from 2004 until 2016, while for 2017 and 2018, the estimates diverge (Figure 5.5.9).

Biological reference points

No traditional biological reference points are established for tusk. Life history parameters are in Table 5.5.2.

5.5.6 Comments on the assessment

It appears more likely that the cpue series for tusk based only on data from the targeted fishery reflects the population trends than does the series based on all the catch data.

5.5.7 Management considerations

Catch levels since 2004 do not appear to have had a detrimental effect on the abundance of tusk given that the cpue continued to increase steadily. Current catch levels are considered to be appropriate. The fishing pressure on tusk has decreased considerably because the size of the longline fleet fishing for tusk has decreased by about 65 percent since 2000 and because of greater access to quotas for Arcto-Norwegian cod. Since the catches have been stable and the indicator series show an increasing trend, it is suggested not to apply the 20% buffer.

The cod stock in the Barents Sea has been very abundant for several years but now there is a downward trend in the cod stock which results in lower quotas. Because of lower quotas for cod the fishing pressure on tusk is expected to increase.

As always, it should be emphasized that commercial catch data are observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the tusk cpue series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope and pray that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g. Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

5.5.8 Application of MSY proxy reference points

Two different methods were tested for tusk in 2017 for the areas 1 and 2: the Length-based indicator method (LBI) and SPiCT.

Results for the LBI

Information and data

The input parameters and the catch's length distribution for the period 2001-2018 are in the following tables and figures. The length data used in the LBI model are from the Norwegian longliner fleet. The length data are not raised to total catch.

Table 5.5.2 Tusk in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length frequency distribution	2001-2018	Norwegian long-liners (Reference fleet)	
Length-weight relationship	$0.0106 * \text{length}^{3.0168}$	Norwegian long-liners (Reference fleet) and survey data.	combined sex
L_{MAT}	56 cm	Norwegian long-liners (Reference fleet) and survey data.	
L_{inf}	119 cm (L_{max})	Norwegian long-liners (Reference fleet) and survey data.	

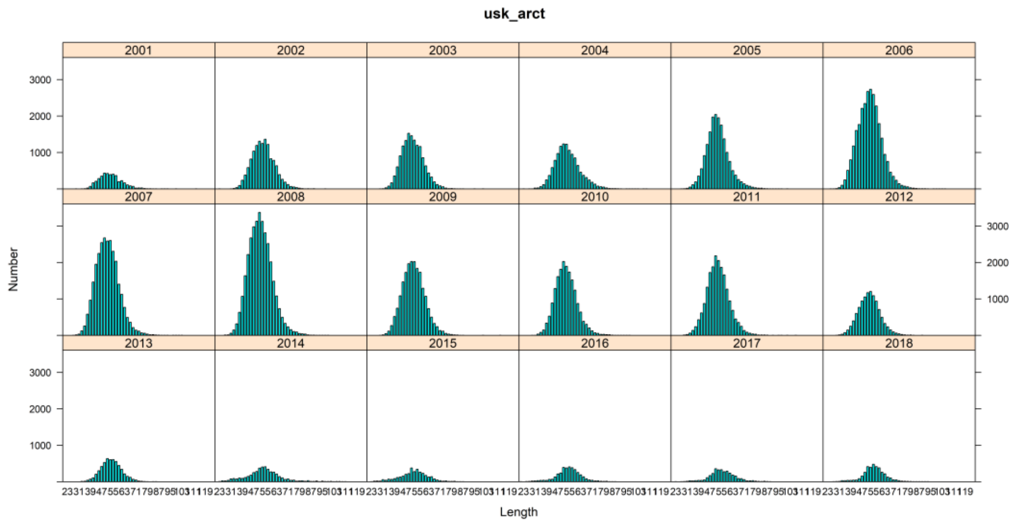


Figure 5.5.10 Tusk in arctic waters (1, 2a, 2b). The length distribution (2 cm length bins) based on data from the Norwegian longline fleet for the period 2001–2018 (sex combined).

Outputs

The length indicator ratios for combined sexes were examined for three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield are presented in the following figures.

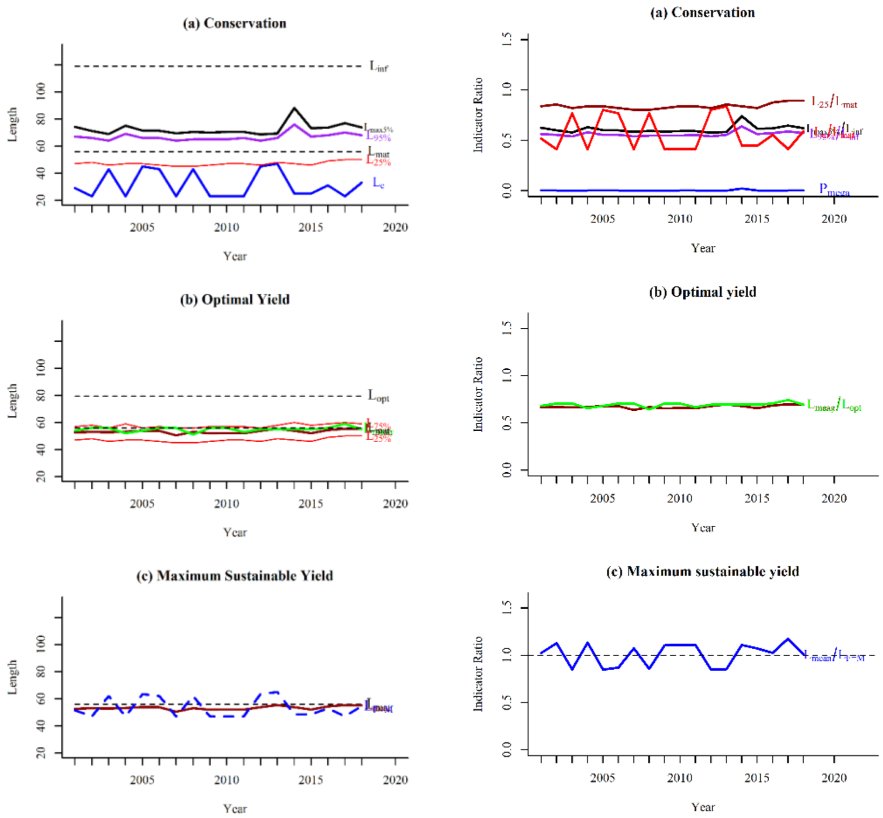


Figure 5.5.11 Tusk in arctic waters (1, 2.a, 2.b). Using length indicators ratios for sex combined to examine three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysis of results

The conservation model for immature tusk shows that both L_c/L_{mat} and $L_{25\%}/L_{mat}$ are less than one, but $L_{25\%}/L_{mat}$ is still usually greater than 0.8 (Figure 6.5.11, Table 6.5.3). Regarding the sensitivity of L_{mat}, there appears to be little or no overfishing of immature individuals.

The conservation model for large individuals estimates that the indicator ratio, $L_{max5\%}/L_{inf}$ is between 0.62 and 0.65 in 2016-2018 (Table 6.5.11), which is less than the cut-off point.0.8. Since the VBF results gave an unusual low L_{inf}, the value used in the model was L_{max}. This could be the reason that the indicator ratio is less than 0.8. If we had used a smaller L_{inf} - the indicator ratio would be higher! Since tusk is a slow growing, deep-water species, the P_{mega} and L_{mean}/L_{opt} values are unreliably.

The MSY indicator ($L_{mean}/L_{F=M}$) is greater than 1 for almost the whole period (Figure 4.3.11), which indicates that tusk in arctic waters are fished sustainably. Regarding model sensitivity, the MSY value was always greater than 0.90.

Conclusion: The overall perception of the stock during the period 2016–2018 is that tusk in arctic waters seems to be fished sustainably (Table 6.5.3). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 5.5.3 Tusk in arctic waters (1, 2.a, 2.b). The results from the LBI method

	Traffic light indicators					
	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2016	0,55	0,88	0,62	0 %	0,69	1,03
2017	0,41	0,89	0,65	0 %	0,70	1,18
2018	0,59	0,89	0,62	0 %	0,70	1,01

Conclusion: The overall perception of the stock during the period 2016–2018 is that tusk in arctic waters seems to be fished sustainably (Table 5.5.3 and 5.5.4). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 5.5.4 Tusk in arctic waters (1, 2.a, 2.b). Stock status inferred from LBI for MSY. Green tick marks for MSY are provided because the $L_{mean}/L_{F=M}$ > 1 in each year. Stock size is unknown as this method only provides exploitation status.

	Fishing pressure			
	2016	2017	2018	
MSY (F/F_{MSY})	✓	✓	✓	Fished unsustainably

	Stock size			
	2016	2017	2018	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

<u>Results for the SPiCT model:</u>

The first run was carried out with standard settings in SPICT, and with catch data and CPUE for all available years. The model converged, and the plots from the diagnostics looked good, and there were relatively small confidence intervals in the parameter estimates (BMSY, MSY, FMSY, and K) (Tables 5.5.3 and 5.5.4).

Since the first run showed very positive results only one other run was tested. In this run, the parameter n was set to 2, while α and β were set to 1. Comparing the two runs, number one appeared to give the best result.

The model estimated MSY was 11,311 tons. The advice for 2018 and 2019 was 10,451 tons, so the estimated MSY was slightly above the recommended level. Associated BMSY was 27,265 tons, and FMSY was 0.415. The estimated carrying capacity (K) was about 91,000 tons.

The model indicates that stock abundance was greater than BMSY and the fishing mortality less than FMSY and will continue to be lower if the catches continue remain at the same level as in the previous years. The traffic light shows that the stock was in the red zone and is now in the green zone. This corresponds to the present perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality. The retrospective plot shows that the test is robust.

Table 5.5.5. Tusk in Subareas 1 and 2. Output from SPICT

Run	1	2
Landings period	1988-2018	
CPUE	2000-2018	
Parameter settings		
n	mod.est	2
Alfa	mod.est	1
Beta	mod.est	1
Convergence	Yes	Yes
Parameter estimates		
BMSY	27265	33355
cilow	16655	20850
cihigh	44636	53361
MSY	11311	12286
cilow	10475	11115
cihigh	12214	13582
FMSY	0,415	0,368
cilow	0,263	0,226
cihigh	0,655	0,601
K	91497	66862
cilow	48332	41767
cihigh	173213	105087
Diagnostic	OK	OK- (box)
Retrospective	OK	OK

Table 5.5.6 Tusk in Subareas 1 and 2. Output from SPICT

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: -13.2155375
Euler time step (years):  1/16 or 0.0625
Nobs C: 31,  Nobs I1: 19

Priors
     logn  ~  dnorm[log(2), 2^2]
 logalpha  ~  dnorm[log(1), 2^2]
  logbeta  ~  dnorm[log(1), 2^2]

Model parameter estimates w 95% CI
           estimate        cilow        ciupp    log.est
 alpha  3.376395e+00 3.206255e-01 3.555563e+01  1.2168085
 beta   3.859358e-01 1.518768e-01 9.807059e-01 -0.9520842
 r      2.794229e-01 8.052790e-02 9.695662e-01 -1.2750290
 rc     8.296429e-01 5.254505e-01 1.309937e+00 -0.1867599
 rold   8.560695e-01 1.305180e-02 5.614981e+01 -0.1554038
 m      1.131196e+04 1.047507e+04 1.221570e+04  9.3336155
 K      9.149686e+04 4.833167e+04 1.732130e+05 11.4240599
 q      3.110200e-03 2.088900e-03 4.631000e-03 -5.7730560
 n      6.735979e-01 1.589048e-01 2.855383e+00 -0.3951219
 sdb    1.493310e-02 1.644600e-03 1.355910e-01 -4.2041782
 sdf    2.377642e-01 1.547809e-01 3.652378e-01 -1.4364759
 sdi    5.041990e-02 3.180920e-02 7.991900e-02 -2.9873698
 sdc    9.176170e-02 4.831420e-02 1.742804e-01 -2.3885600

Deterministic reference points (Drp)
          estimate        cilow        ciupp    log.est
 Bmsyd 2.726946e+04 1.665743e+04 4.464215e+04 10.2135226
 Fmsyd 4.148215e-01 2.627253e-01 6.549687e-01 -0.8799071
 MSYd  1.131196e+04 1.047507e+04 1.221570e+04  9.3336155
Stochastic reference points (Srp)
          estimate        cilow        ciupp    log.est  rel.diff.Drp
 Bmsys 2.726523e+04 1.665464e+04 4.463578e+04 10.2133675 -1.551026e-04
 Fmsys 4.148384e-01 2.627172e-01 6.550425e-01 -0.8798662  4.085641e-05
 MSYs  1.131066e+04 1.047456e+04 1.221350e+04  9.3335013 -1.142295e-04

States w 95% CI (inp$msytype: s)
                   estimate        cilow        ciupp    log.est
 B_2018.00      3.824361e+04 2.548154e+04 5.739738e+04 10.5517317
 F_2018.00      2.453653e-01 1.495041e-01 4.026921e-01 -1.4050072
 B_2018.00/Bmsy 1.402651e+00 1.042672e+00 1.886913e+00  0.3383642
 F_2018.00/Fmsy 5.914720e-01 3.917363e-01 8.930475e-01 -0.5251409

Predictions w 95% CI (inp$msytype: s)
                 prediction        cilow        ciupp    log.est
 B_2019.00      3.887012e+04 2.588760e+04 5.836332e+04 10.5679812
 F_2019.00      2.719306e-01 1.606366e-01 4.603324e-01 -1.3022084
 B_2019.00/Bmsy 1.425630e+00 1.072167e+00 1.895619e+00  0.3546137
 F_2019.00/Fmsy 6.555097e-01 4.132389e-01 1.039817e+00 -0.4223422
 Catch_2019.00  1.058752e+04 7.321394e+03 1.531068e+04  9.2674310
 E(B_inf)       3.929146e+04           NA           NA 10.5787625
```

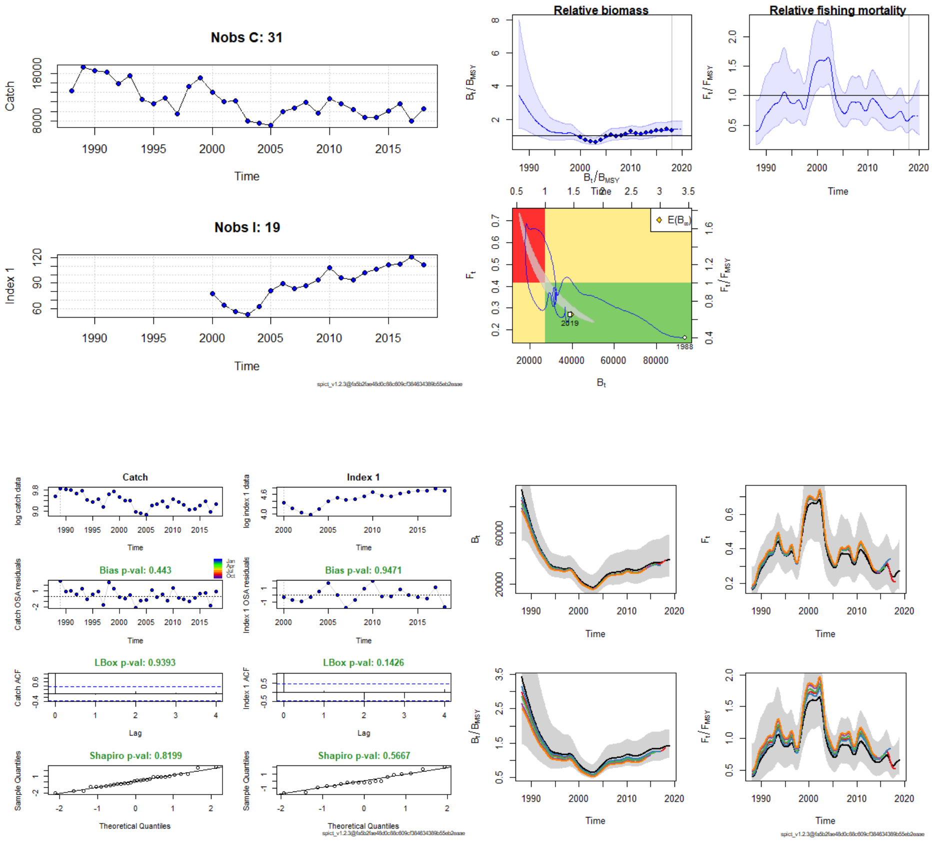


Figure 5.5.12. Tusk in Subareas 1 and 2. Upper left corner shows the input data for the model, upper right corner the model output, lower left corner the model diagnostics and the lower right corner the retrospective analysis.

5.5.9 Tables

Table 5.5.7 a. Tusk in subarea 1. Official landings.

Year	Norway	Russia	Faroes	Iceland	Ireland	France	Total
1996	587						587
1997	665						665
1998	805						805
1999	907						907
2000	738	43	1	16			798
2001	595	6		13			614
2002	791	8	n/a	0			799
2003	571	5			5		581
2004	620	2			1		623
2005	562						562
2006	442	4					446
2007	355	2					357
2008	627	7					634
2009	869	1					870
2010	725	1				1	727
2011	941						941
2012	1024						1024
2013	692						692
2014	766	5					771
2015	904						904
2016	890	2					892
2017	1036	1					1037
2018*	555	2					557

*Preliminary.

Table 5.5.8 b. Tusk in Division 2.a. Official landings.

Year	Faroes	France	Germany	Greenland	Nor-way	E & W	Scotland	Russia	Ireland	Iceland	Total
1988	115	32	13	-	14 241	2	-				14 403
1989	75	55	10	-	19 206	4	-				19 350
1990	153	63	13	-	18 387	12	+				18 628
1991	38	32	6	-	18 227	3	+				18 306
1992	33	21	2	-	15 908	10	-				15 974
1993	-	23	2	11	17 545	3	+				17 584
1994	281	14	2	-	12 266	3	-				12 566
1995	77	16	3	20	11 271	1					11 388
1996	0	12	5		12 029	1					12 047
1997	1	21	1		8642	2	+				8667
1998		9	1		14 463	1	1	-			14 475
1999		7	+		16 213		2	28			16 250
2000		8	1		13 120	3	2	58			13 192
2001	11	15	+		11 200	1	3	66	5		11 301
2002		3			11 303	1	4	39	5		11 355
2003	6	2			7284		3	21			7316
2004	12	2			6607		1	61	1		6684
2005	29	6			6249			37	3		6324
2006	33	9			9246	1		51	11		9351
2007	54	7			9856	0	5	85	12		10 019
2008	52	6			10 848	1	3	56	0		10 966
2009	59	3			8354		1	82			8499
2010	39	6			11 445		1	49			11 540
2011	59	5			10 290		1	41			10 405
2012	54	7	1		8764	2		48		1	8877
2013	24	13	3		7729		7	52		2	7830
2014	10	9	1		7682		7	38			7743
2015	19	5			8906	1		90			9021

Year	Faroes	France	Germany	Greenland	Nor-way	E & W	Scotland	Russia	Ireland	Iceland	Total
2016	61	2	1	2	10332		1	57		3	10459
2017	14	4	2	3	6521		2	106		3	6655
2018*	12	2	5	1	8651		1	63		731	9466

***Preliminary.**

(1) Includes 2.b.

Table 5.5.9 c. Tusk in Division 2.b. Official landings.

Year	Norway	E & W	Russia	Ireland	France	Total
1988		-				0
1989		-				0
1990		-				0
1991		-				0
1992		-				0
1993		1				1
1994		-				0
1995	229	-				229
1996	161					161
1997	92	2				94
1998	73	+	-			73
1999	26		4			26
2000	15	-	3			18
2001	141	-	5			146
2002	30	-	7			37
2003	43					43
2004	114		5			119
2005	148		16			164
2006	168		23			191
2007	350		17	1		368
2008	271		11	0		282
2009	249		39			288
2010	334		57			391
2011	299		20		5	324
2012	453		40			493
2013	121	3	16			140
2014	185		41			226
2015	97		69			166
2016	165		144			309

Year	Norway	E & W	Russia	Ireland	France	Total
2017	153		81			234
2018*	427		37			464

Table 5.5.10 d. Tusk in subareas 1 and 2. Official landings by Subarea and divisions.

Year	1	2a	2b	All areas
1988		14 403	0	14 403
1989		19 350	0	19 350
1990		18 628	0	18 628
1991		18 306	0	18 306
1992		15 974	0	15 974
1993		17 584	1	17 585
1994		12 566	0	12 566
1995		11 388	229	11 617
1996	587	12 047	161	12 795
1997	665	8667	94	9426
1998	805	14 475	73	15 353
1999	907	16 250	26	17 183
2000	798	13 192	18	14 008
2001	614	11 301	146	12 061
2002	799	11 355	37	12 191
2003	581	7316	43	7940
2004	623	6684	119	7426
2005	562	6324	164	7050
2006	446	9351	191	9988
2007	357	10 019	368	10 744
2008	634	10 966	282	11 882
2009	870	8499	288	9657
2010	727	11 540	391	12 658
2011	941	10 386	319	11 646
2012	1024	8862	493	10 394
2013	692	7830	140	8662
2014	771	7745	226	8742
2015	904	9021	166	10 091
2016	892	10459	309	11660

Year	1	2a	2b	All areas
2017	1037	6655	234	7926
2018*	557	9466	464	10487

***Preliminary.**

5.6 Tusk (*Brosme brosme*) in areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9 and other areas of 12

5.6.1 The fishery

Summaries of the fisheries are in the Overview Sections: 3.3., 3.4, 3.5 and 3.6.

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

When landings from Areas 3–4 and 6.a–12 are pooled over the period 1988–2018, 35% of the landings have been in Area 4, 47% in Area 5.b, and 17% in Area 6.a.

In Area 5.b, tusk was mainly fished by longliners (about 90% of the catch), and the rest of the catch of tusk was taken by large trawlers. The main fishing ground for tusk is on the slope around the Faroes Plateau and on the Faroe Bank in areas deeper than approximately 200 m. The Norwegian longliners were not allowed to fish inside the Faroese EEZ in 2011–2013, and now the Faroese longliners fish in the area where the Norwegian longliners used to fish. Since 2014 Norwegian longliners have quotas in 5.b.

5.6.2 Landings trends

Landing statistics by nation in 1988–2018 are in Table 5.6.1 and are shown by year in Figure 5.6.1.

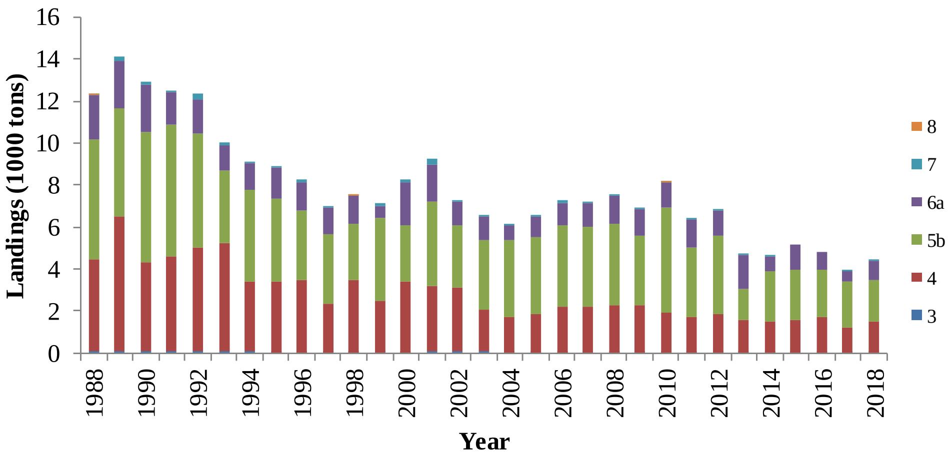


Figure 5.6.1. Landings of tusk per year for 1988–2018.

For all subareas/divisions, the catches were relatively stable from 2002 to 2012, afterwards the total catch declined and stabilized at about 4 500 tons. The total catch was 4 411 tons in 2018 (Figures 5.6.1 and 5.6.2).

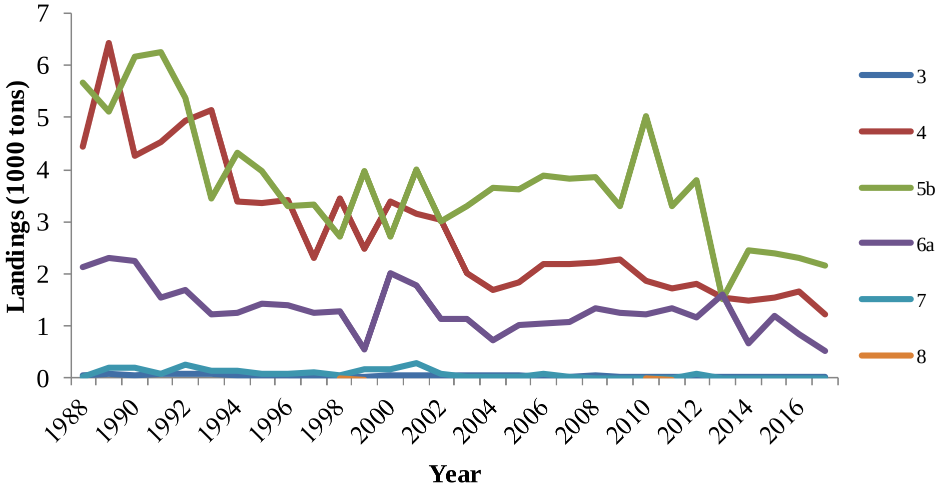


Figure 5.6.2. Landings of tusk by area for 1988–2018.

5.6.3 ICES Advice

Advice for 2018 and 2019: *ICES advises that when the precautionary approach is applied, catches should be no more than 8984 tonnes in both 2018 and 2019. Discarding is considered to be negligible.*

5.6.4 Management

There is a licensing scheme and also effort limitation in area 5.b. The minimum landing length for tusk in Division 5.b is 40 cm. Norway has a bilateral agreed quota with the Faeroes in 5.b, which is 1,921 t for 2019. Norway also has a licensing scheme in EU waters, and in 2019 the Norwegian quota in the EC is 2,923 tons.

In 2019, the Faroese Government will allow five Russian vessels to undertake experimental fishing in the Faroese Fishing Zone at depths deeper than 700 meters, provided that a Russian scientific observer is onboard. No more than three vessels can simultaneously be operating. Two of these vessels can undertake experimental fishery in deep waters around Outer Bailey and Bill Baileys Banks, at depth between 500 and 700 meters, provided that catches in this area do not exceed 500 tonnes of deep-sea species.

The quota for the EU in the Norwegian zone (Area 4) is set at 170 t, but only three vessels can be operating simultaneously.

EU TACs for areas partially covered in this section are in 2019:

Subarea 3: 31 t

Subarea 4: 251 t

Subarea 5, 6, 7 (EU and international waters): 1 207 t

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

5.6.5 Data available

5.6.5.1 Landings and discards

The total landings and discards of tusk were available for all the relevant fleets. The Norwegian and Faroese fleet are not allowed to discard tusk, and incentives for illegal discarding are believed to be low. The landing statistics and logbooks are therefore regarded as being adequate for assessment purposes.

Discards by countries for the years 2013–2018 (Table 5.6.2), and by area and country for 2018 (Table 5.6.3).

Table 5.6.2 Total discards of tusk by country for 2013 to 2018.

	Spain	Ireland	France	UK (Scotland)	Denmark	Germany	Total landings	Total discards	Total catches	% discards
2013	40	12					4673	52	4725	1.1
2014	0	0					4585	0	4585	0.0
2015			6	12			5155	18	5173	0.3
2016			1	152			4820	153	4973	3.1
2017			8	130	5		3916	143	4059	3.5
2018	1	6	4	80		6	4411	96	4507	2.1

Table 5.6.3. Discards of tusk in 2018 by area on country.

Area	Country	Discards
27.4	Germany	6
27.4	UK(Scotland)	79
27.4.a	France	4
27.6.a	Spain	1
27.6.a	UK(Scotland)	1
27.7.c	Ireland	6
Total		96

5.6.5.2 Length compositions

Figure 5.6.3 show the estimated length distributions of tusk in Areas 4.b, 5.b and 6.a based on data provided by the Norwegian reference fleet for 2001–2018, and Figure 5.6.4 shows the estimated length distributions of the catch of tusk by Norwegian longliners, combined, for Areas 4.a, 5.b and 6.a.

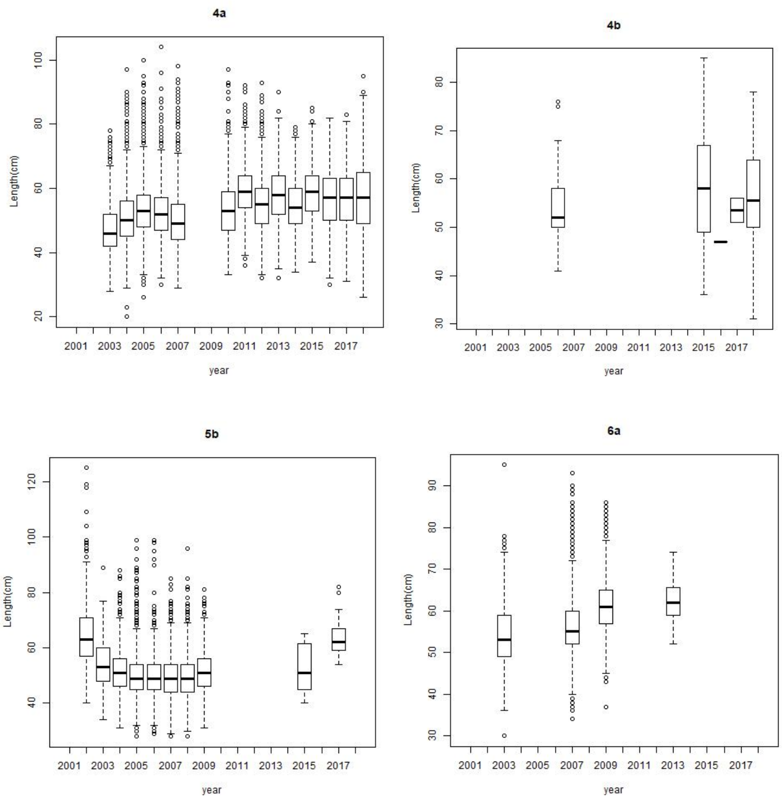


Figure 5.6.3. Length distributions of tusk in Areas 4.a, 4.b, 5.b and 6.a for 2001–2018, based on length data from the Norwegian reference fleet.

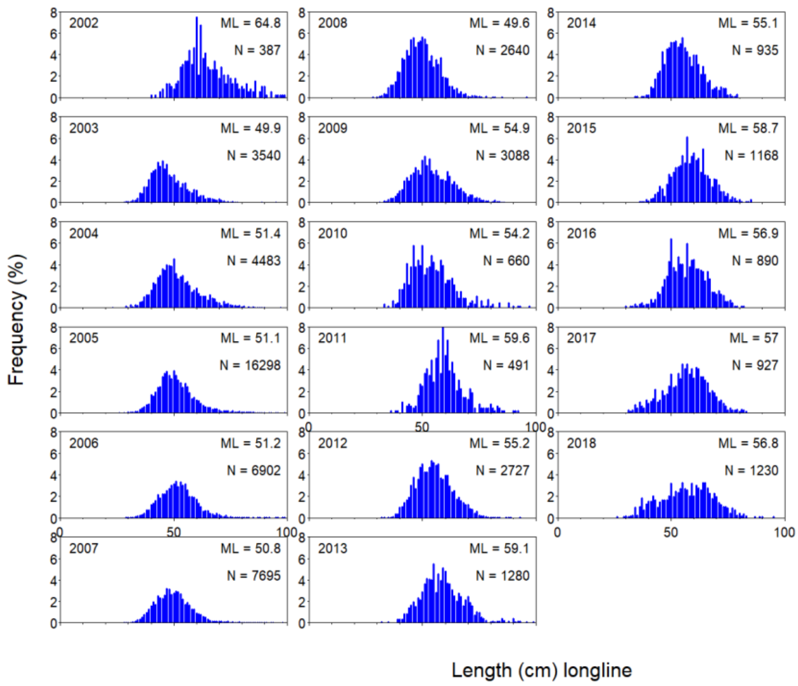


Figure 5.6.4. The estimated length distributions of the catch of tusk by Norwegian longliners, combined, for Areas 4.a, 5.b and 6.a.

The length distributions of tusk based on the commercial catches by Faroese longliners since 1994 are in Figure 5.6.5.

The length data are from several trawl surveys conducted in Faroese waters: the annual Faroese spring (1994-present, Figure 5.6.6) and summer surveys (1996-present, Figure 5.6.7), deep-water surveys (2014–2016, Figure 5.6.8), the annual Greenland halibut surveys (1995-present, Figure 5.6.9), redfish trawl surveys (2003–2011, Figure 5.6.10) and the blue ling surveys (2000-2003, Figure 5.6.11).

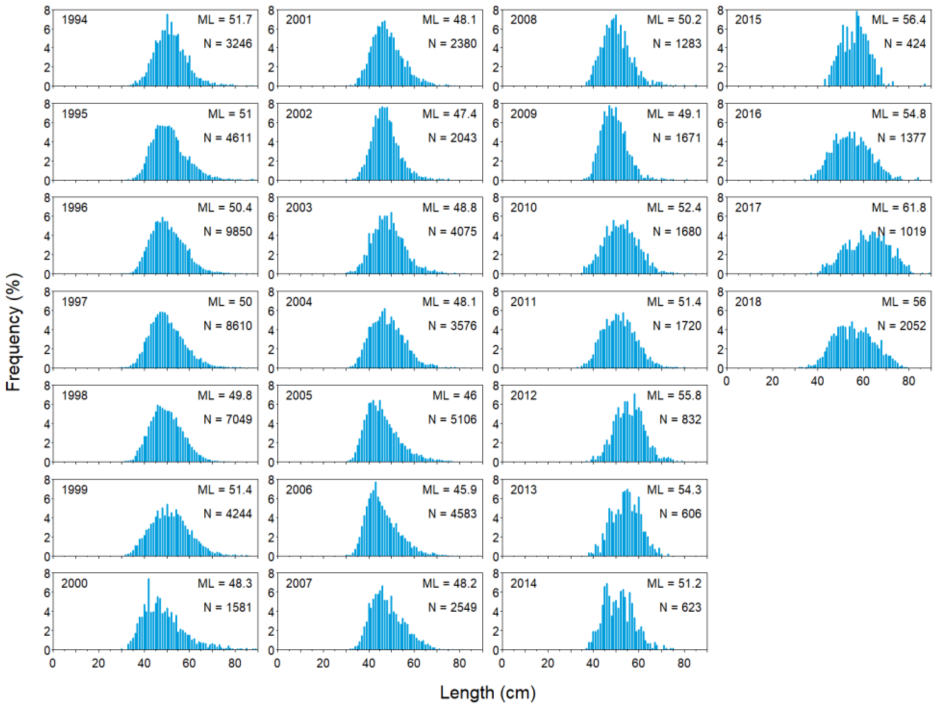


Figure 5.6.5. The estimated length distributions of the catch of tusk by Faroese longliners (>100 BRT) in Area 5.b.

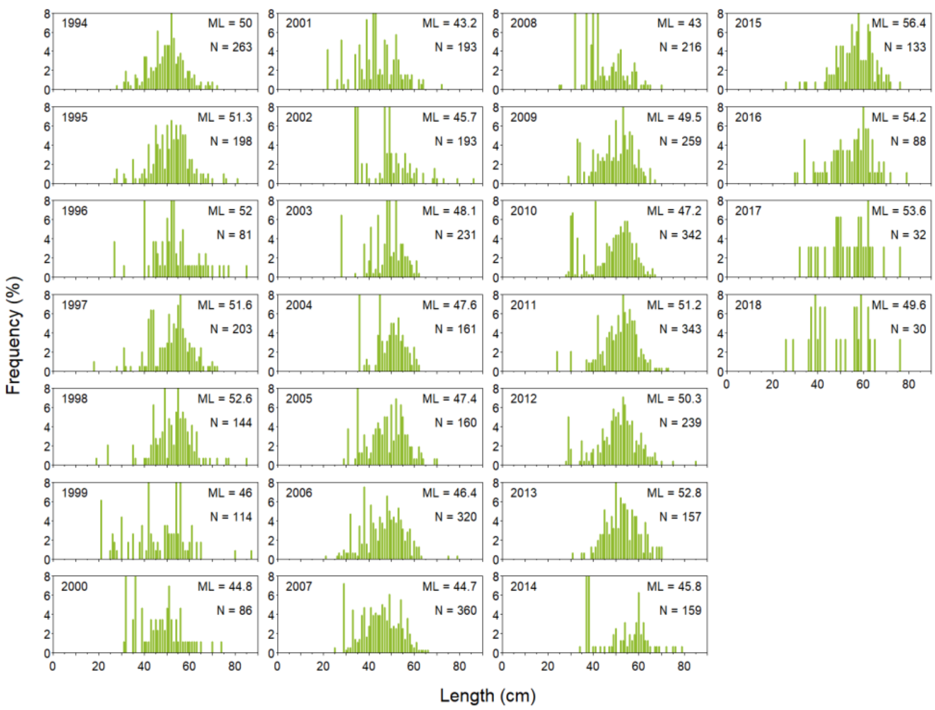


Figure 5.6.6. Estimated length distributions of tusk in Area 5.b based on data from the Faroese spring groundfish surveys.

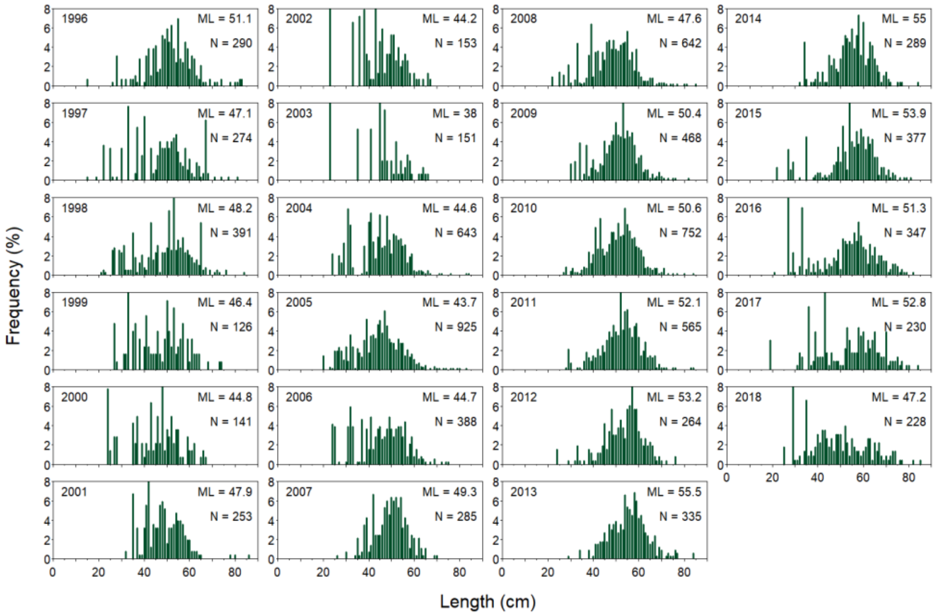


Figure 5.6.7. Estimated length distributions of tusk in Area 5.b based on data from the Faroese summer groundfish surveys.

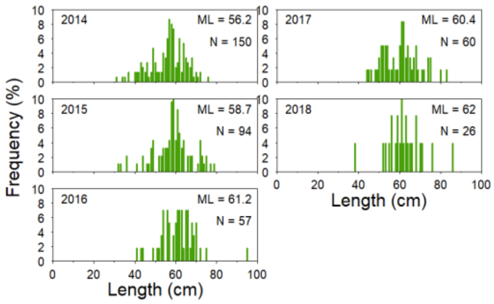


Figure 5.6.8. Length distributions of tusk in area 5.b. Data from the deep-water surveys in 2014–2018.

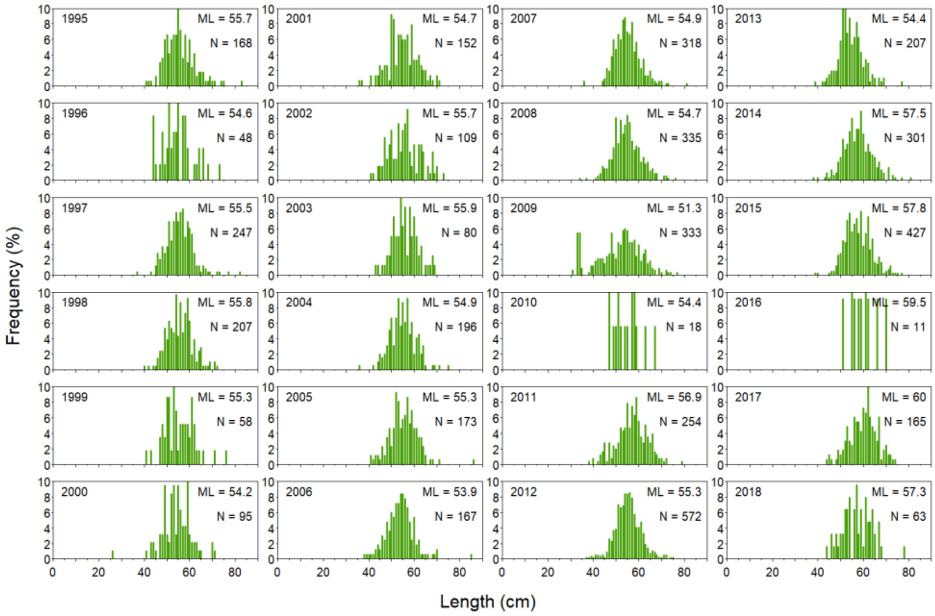


Figure 5.6.9. Length distributions of tusk in area 5.b based on the annual Faroese Greenland halibut trawl surveys.

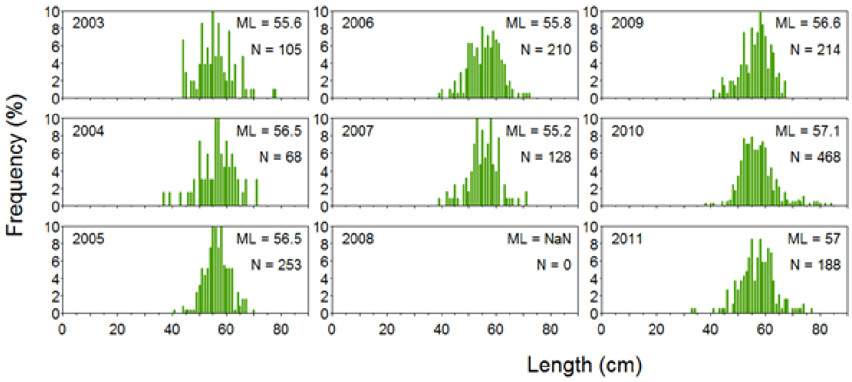


Figure 5.6.10. Length distributions of tusk in area 5.b based on the redfish trawl surveys 2003–2007, 2009–2011.

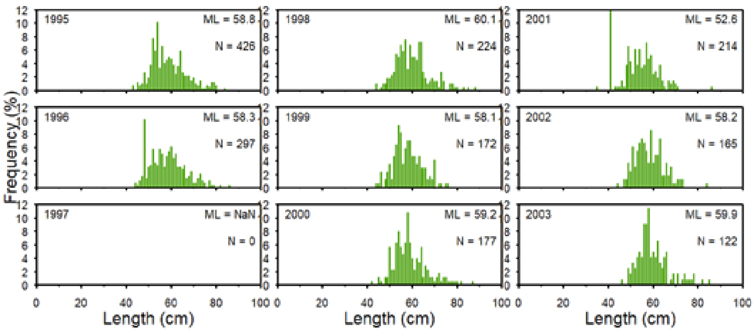


Figure 5.6.11. Length distributions of tusk based on the blue ling surveys in 2000–2003.

5.6.5.3 Age and growth compositions

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

5.6.5.4 Weight-at-age

No new data are available.

5.6.5.5 Maturity and natural mortality

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

5.6.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch-per-unit of effort (cpue) series for tusk based on two commercial fleets: the Faroese longliners, and the Norwegian longliners. The Faroese cpue data are from longliners (GRT >110) and the effort units are based on logbook data. The selection of data and estimation of cpue series are described in the stock annex for tusk in areas 3.a, 4.a, 5.b, 6.a and 7. The data selected in the longliner cpue series were sets where tusk was more than 30% of the catch, which is the same criteria as used for the Norwegian longliner series.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database, and data are now available for 2000–2018. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in every 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 the switch from paper to electronic logbooks. Since 2011 data quality has improved considerably and data from the entire fleet were available.

The cpue data for tusk from Norwegian longliners fishing in Division 5.b are described in the stock annex for tusk in 2.a (Section tusk in 1 and 2) and in Helle *et al*., 2015. The cpue series was based on sets where tusk was greater than 30% of the total catch. The Norwegian and Faroese longliners both have ling and tusk as target species.

Fisheries independent cpue series

Estimates of the cpue series (kg/hour) for tusk are available from two annual Faroese groundfish trawl surveys on the Faroe Plateau that were designed for cod, haddock and saithe. The annual survey on the Faroe Plateau covers the main fishing areas and mainly the larger part of the spatial distribution area (Ofstad, WD WGDEEP 2017). Information on the surveys and standardization of the data are described in the stock annex.

5.6.6 Data analyses

Length distributions

Norwegian length distributions, based on data provided by the longline reference fleet from Areas 4.a, 5.b and 6.a, have varied slightly with no obvious trends (Figures 5.6.3 and 5.6.4). The average length of tusk caught by Norwegian longliners in the combined areas 4.a, 5.b and 6.a was 57 cm in 2018.

Faroese length distributions, based on data from Faroese longliners fishing in Area 5.b, varied mainly between 48 and 56 cm (average 51 cm), and there was no downward trend. In 2018, the mean length was 56 cm and the maximum was 80 cm and most of the landings were between 40 and 60 cm (Figure 5.6.5).

The mean length of tusk sampled in the Faroese spring and summer groundfish surveys varied between 43 and 55 cm (Figures 5.6.6 and 5.6.7). The length distributions are noisy and some mean lengths seem too high. The reason behind the overestimation is probably that small tusk, below commercial landing size, are a subsample from the catch and thereafter multiplied up to the total catch weight. Few tusk smaller than 30 cm are caught in these surveys. The mean length of tusk caught in the Faroese deep-water survey was around 56–58 cm (Figure 5.6.8). The mean length of tusk in the Faroese Greenland halibut-, redfish- and blue ling surveys, which used a commercial trawl, varied around 55 cm (Figure 5.6.9–5.6.11).

Cpue trends

4.a

Two cpue series for tusk in Area 4.a based on Norwegian longline data were; one based on all the catches, and one based on when tusk appeared to be the target species. The series based on all the catches indicates at first a stable cpue and then a slightly decreasing trend for the last four years, while the series based on the targeted fishery shows a clear and positive upward trend from 2002 until 2013, and then a declining trend with a slight increase in 2018 (Figure 5.6.12).

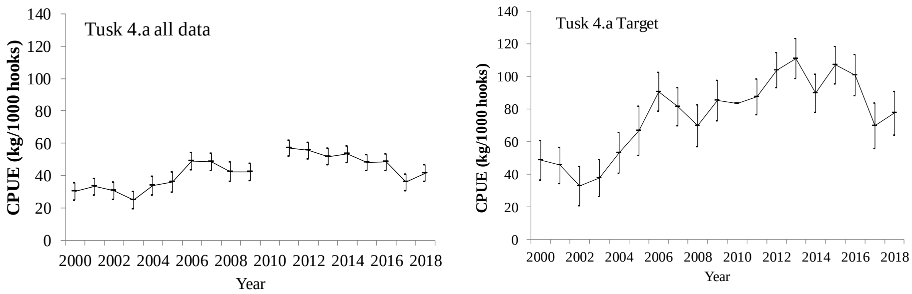


Figure 5.6.12. Tusk cpue series in 4.a for 2000–2018 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

5.b

A standardized commercial cpue series for longliners fishing in Faroese waters is in Table 5.6.4, and Figure 5.6.13. In 2018 the cpue was 65 kg/1000 hooks and the mean cpue from 2008 to 2018 was 83.4 kg/1000 hooks.

The standardized cpue from the annual Faroese groundfish surveys in spring (1994-present) and summer (1996-present) are in Figure 5.6.14. In addition, a CPUE series for the spring survey, 1983-1993, based on non-stratified data, are in Figure 5.6.14. The cpue series for the annual groundfish surveys show a downward trend during the last years. These surveys are only conducted in waters less than 530 m, so these estimates are not covering the whole distribution area of tusk.

Abundance indices for tusk caught by the Faroese 0-group survey on the Plateau were at a low level from 1983-2011, whereas the indices have increased in 2012–2013, but decreased in 2014 (Figure 5.6.13). In 2015-2018, no tusk was caught in the 0-group survey on the Faroe Plateau.

Abundance indices for tusk < 40 cm, generated by the Faroese groundfish survey on the Plateau, have been low in several years (Figure 5.6.23).

Table 5.6.4. Tusk 5.b. Standardized cpue for Faroese longliners in Faroese waters.

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CPUE	**83.6**	**84.8**	65.2	60.7	**70.4**	**59.1**	**48.5**	**48.0**	**53.0**	**52.3**	46.1	79.6	55.6	48.8	40.4	56.8	49.6
SE	0.27	0.25	0.42	0.29	0.22	0.17	0.12	0.16	0.13	0.15	0.37	0.23	0.25	0.18	0.26	0.23	0.58
N	112	125	58	67	147	274	301	246	305	214	26	54	57	77	71	77	22

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CPUE	70.8	47.2	61.4	**69.3**	61.9	**67.3**	**68.8**	**90.9**	**93.0**	**94.8**	**78.6**	**81.1**	**73.5**	**100.6**	87.8	**64.9**
SE	0.46	0.99	0.74	0.51	0.88	0.81	0.83	0.50	0.66	0.67	0.82	0.65	0.84	2.11	1.77	1.08
N	23	26	53	103	76	145	135	651	634	509	169	194	119	119	73	97

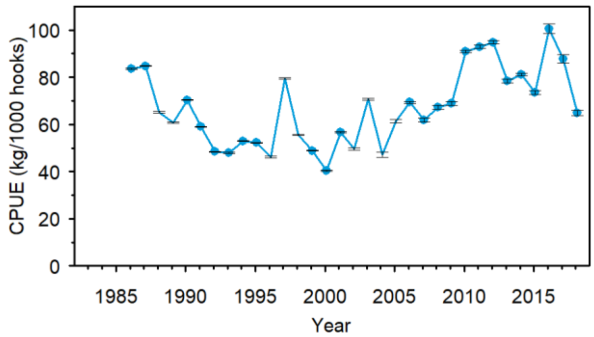


Figure 5.6.13. Tusk 5.b. Standardized cpue for longliners (<110 GRT) fishing in Faroese waters. The diamond points show when the estimated cpue is based on more than 100 sets.

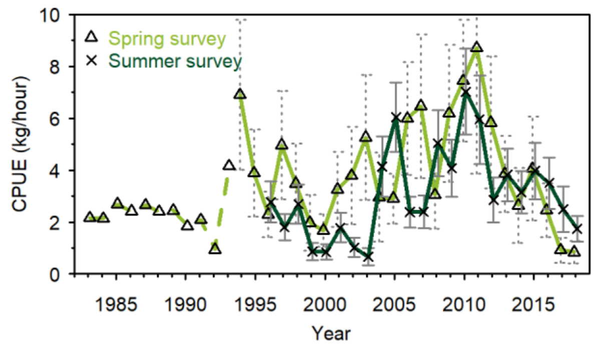


Figure 5.6.14. Tusk 5.b. Standardized cpue from the annual trawl groundfish surveys. The spring survey data from 1983–1993 are not stratified.

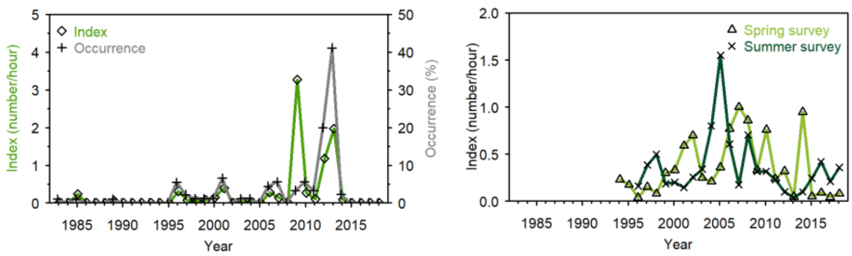


Figure 5.6.15. Tusk 5.b. Abundance index for tusk (2–3 cm in length in number/hour) on the Faroe Plateau based on the 0-group survey (upper figure) and abundance index for tusk <40 cm from the annual spring and summer trawl survey on the Faroe Plateau (lower figure).

The cpue series based on the Norwegian longline data shows a stable trend from 2000 to 2008, afterwards it increased until 2012, then decreased until 2017 and a relatively large increase in 2018 (Figure 5.6.16).

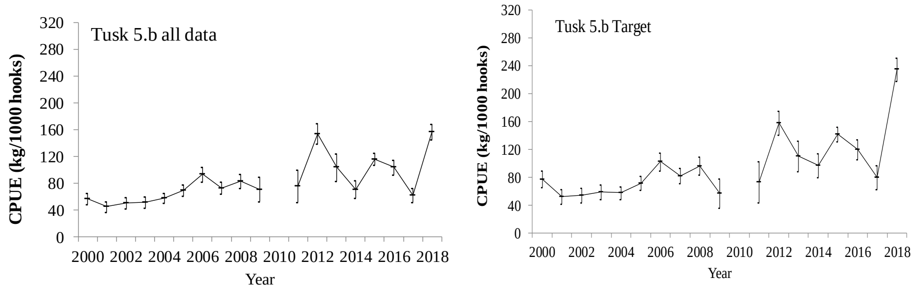


Figure 5.6.16. Tusk cpue series in 5.b for 2000–2016 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

6.a

In area 6.a a cpue series based on the Norwegian longline data shows an increase in cpue from 2004 to 2008, afterwards it has remained at a high, but slightly declining level (Figure 5.6.17).

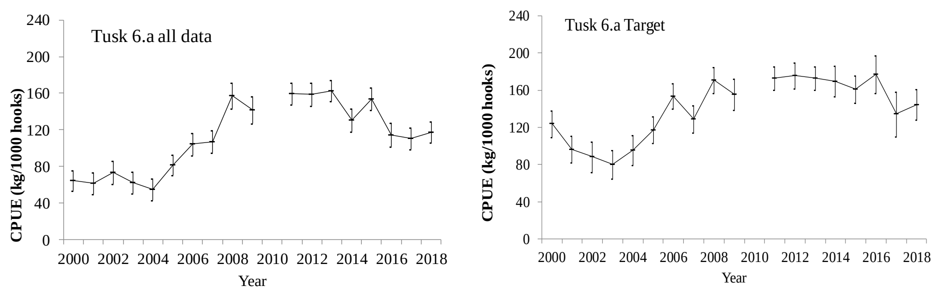


Figure 5.6.17. Two cpue series for tusk in area 6.a from 2000–2016 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

Combined cpue series for "Tusk areas 4, 5b and 6a"

To derive a cpue series for merging all areas, the data from the Norwegian longline fleet was combined (Areas 4.a, 4.b, 5.b and 6.a). CPUE was estimated using all available data and when tusk were targeted (daily catches when tusk made up more than 30% of the total catch, Figure 5.6.18).

The combined Norwegian longline cpue series shows an increasing trend from 2000 to 2010, after 2010 cpue was at a high and stable level, declined in 2017 but increased again in 2018 (Figure 5.6.18).

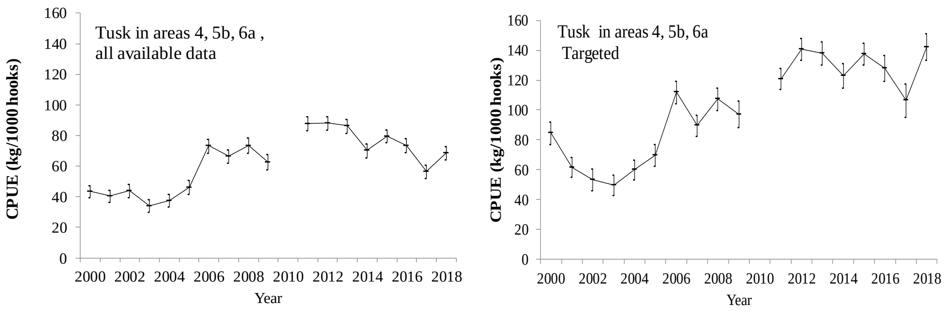


Figure 5.6.18. A combined cpue series for all "other tusk" areas for 2000–2018 based on data from the Norwegian longline fleet when tusk was targeted (>30% of total catch). The bars denote the 95% confidence intervals.

5.6.6.1 Biological reference points

See Section 5.6.9.

5.6.7 Comments on the assessment

The tusk stocks in Areas (3.a, 4, 5b, 6a, 7, 8, 9, 10, 12, 14) were best covered by the Norwegian longline fleet. It was therefore decided in plenary that a combined cpue series should be made in order to give advice for the entire area, and that the data from the targeted fishery should be used

5.6.8 Management considerations

Landings of tusk in all subareas have been declining since 2002. The cpue series, for the Faroes longline fishery in 5.b and for the Norwegian longline fisheries show a stable or positive trend since 2003 with a decrease during the last few years until 2018. In 4.a and 6.b the cpue series indicate a positive development of the stocks until the last year.

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the tusk cpue series tracks the actual population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g. Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

5.6.9 Application of MSY proxy reference points

Two different methods were tested for tusk in other areas, the Length-based indicator method (LBI) and SPiCT.

Length-based indicator method (LBI)

Information used in LBI for tusk in division 3.a, 5.b, 6.a, and subarea 4, 6, 8, 9, and 12.

Information and data

The input parameters and the catch length composition for the period 2002-2018 are presented in the following tables and figures. The length data used in the LBI model are data from the Faroese- and Norwegian longliners. The length data are not raised to total catch.

Table 5.6.5. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length frequency distribution	2002–2016	Faroese long-liners fishing in Division 5.b	Data combined from both sources
	2002-2016	Norwegian long-liners fishing in divisions 4.a, 4.b, 5.b, 6.a	Lengths grouped into 2 cm bins
Length-weight relationship	0.0161* length $^{2.9101}$	Norwegian long-liners (Reference fleet) and survey data.	combined sexes
L_{MAT}	51 cm	Faroese survey data	
L_{inf}	125 cm (L_{max})	Norwegian long-liners (Reference fleet)	

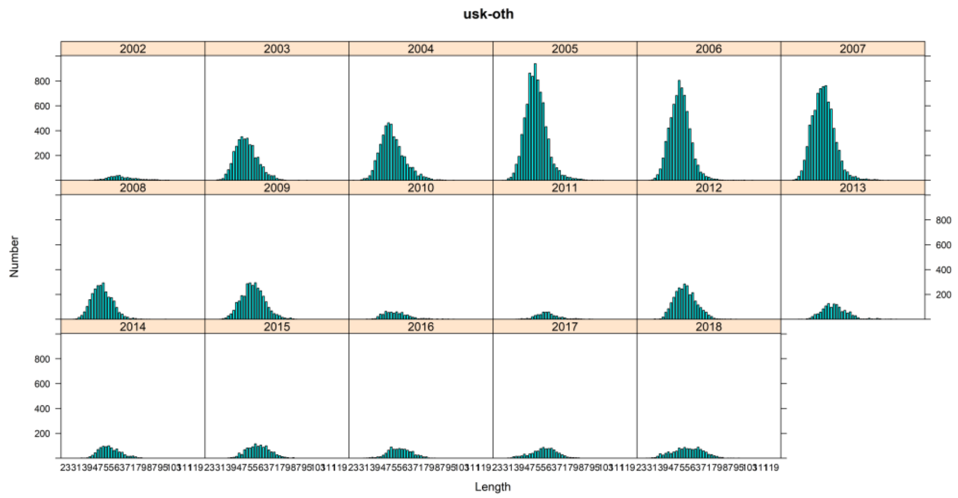


Figure 5.6.19. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Catch length distributions (2 cm bins) have not been raised to total catch for the period 2002–2018 (combined sexes).

Outputs

The length indicator ratios for combined sexes were examined for three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield are presented in the following Figure 5.6.20.

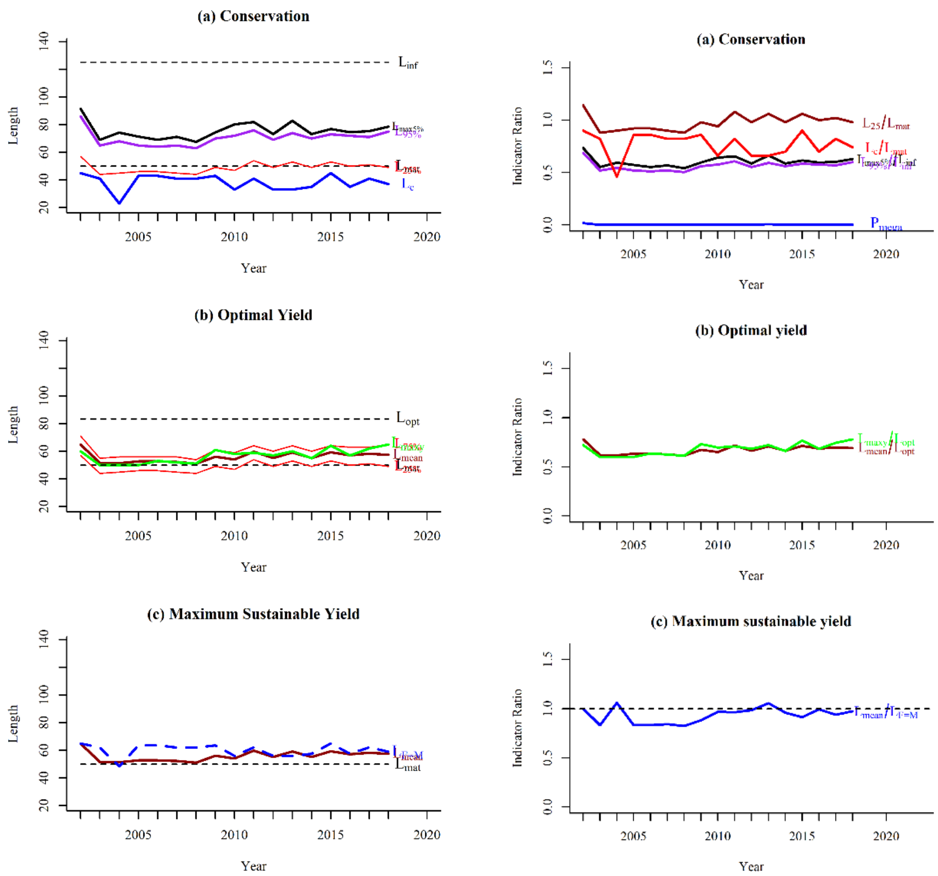


Figure 5.6.20 Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Screening of length indicators ratios for sexes combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysis of results

The conservation model for immature tusk shows that both L_c/L_{mat} and $L_{25\%}/L_{mat}$ is around or above 1 (Figure 5.6.20). In 2016-2018, the ratios were between 0.98 and 1,02 (Table 5.6.6). Regarding the sensitivity of L_{mat}, there appears to be little or no overfishing of immature individuals. The estimate of L_{mat} is based on data from Division 5.b, so L_{mat} may differ in the other areas.

The conservation model for large individuals shows that the indicator ratio of $L_{max5\%}/L_{inf}$ was around 0.6 for the whole period (Figure 5.6.20), and between 0.6 and 0.63 during the period 2016-2018 (Table 5.6.20), which is less than the baseline, 0.8. The reason that the VBF results gave unusually low values of L_{inf}, was because the value used in the model was L_{max}. If we had used a smaller value of L_{inf}, then the indicator ratio would be higher. Since tusk is a deep-water and slow-growing species, the P_{mega} and L_{mean}/L_{opt} values used were probably incorrect.

The MSY indicator, $L_{mean}/L_{F=M}$, was less than 1 for almost the entire period (Figure 5.6.20), which indicates that tusk in other areas were fished unsustainably, however for the last three years it was very close to 1, between 0.94 and 0.99. It should be noted that if L_{inf} were set equal to L_{max}, then MSY would always have been greater than 0.8.

Table 5.6.6. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). The final results based on the LBI method.

Traffic light indicators

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2016	0.70	1.01	0.60	0 %	0.68	0.99
2017	0.82	1.02	0.60	0 %	0.70	0.94
2018	0.74	0.98	0.63	0 %	0.69	0.97

Conclusions

The overall perception of the tusk stock in these areas during the period 2016–2018, based on the LBI results, is that tusk seems to be overexploited and fished unsustainably (Table 5.6.7.). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 5.6.7. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Stock status inferred from LBI for MSY. Red tick marks for MSY are provided because the $L_{mean}/L_{F=M}$ < 1 in each year. The MSY ($L_{mean}/L_{F=M}$). Stock size is unknown as this method only provides the exploitation status.

	Fishing pressure			
	2016	2017		**2018**
MSY (F/F_{MSY})	✗	✗	✗	Fished unsustainably

	Stock size			
	2016	2017		**2018**
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

SPiCT

The input data were landings in 1988–2018, and the cpue index for the targeted fishery from 2000–2018 (Figure 5.6.21).

The first run was carried out with standard settings for SPICT, and with catch data and CPUE for all years. The model converged, and the plots from the diagnostics looked good, but there were relatively large confidence intervals for the parameter estimates (BMSY, MSY, FMSY, and K) (Tables 5.6.8 and 5.6.9).

There were 3 runs where n, α and β were varied (Table 5.6.8). All these runs were relatively like the first run. Overall, run number 3 was considered the best. In this run, the parameter n was set to 2, while α and β were set to 1.

The model estimated a MSY of 8933 tons. The advice for 2018 and 2019 was 8984 tons, almost identical to the model result. Associated BMSY was 22,527 tons, and FMSY was 0.397. The estimated carrying capacity (K) was about 46,000 tons.

The model indicates that stock abundance is greater than BMSY and the fishing mortality rate is less than FMSY and will continue if the catches continue to be kept at the same level as in the previous years.

The traffic light figure shows that the stock started in the yellow zone, went into the red zone and are now in the green zone. This corresponds to the present perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality. The retrospective plot indicated that the test was robust.

Table 5.6.8. Tusk in areas 3.a, 4.a, 5.b, 6.a and 7

Run	**1**	**2**	**3**	**4**
Landings period	1988-2018			
CPUE	2000-2018			
Parameter settings				
n	mod.est	No priors	2	2
Alfa	mod.est	No priors	1	4
Beta	mod.est	No priors	1	1
Convergence	Yes	Yes	Yes	Yes
Parameter estimates.				
B_{MSY}	25477	25760	22527	25922
cilow	17276	18318	10975	13845
cihigh	37573	36225	46239	48535
MSY	10352	10470	8933	9014
cilow	8987	9151	7673	8010
cihigh	11925	11980	10400	10143
F_{MSY}	0,407	0,406	0,397	0,348
cilow	0,274	0,282	0,194	0,190
cihigh	0,605	0,585	0,809	0,637
K	37170	36712	45676	51938
cilow	24938	25436	22159	27711
cihigh	55401	52986	94153	97346
Diagnostic	OK	OK	OK	OK
Retrospective	negative	negative	OK	OK

Table 5.6.9. Tusk in areas 3.a, 4.a, 5.b, 6.a and 7.

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: -26.1231599
Euler time step (years):  1/16 or 0.0625
Nobs C: 31,  Nobs I1: 19

Priors
    logn  ~  dnorm[log(2), 0.001^2] (fixed)
 logalpha  ~  dnorm[log(1), 0.001^2] (fixed)
  logbeta  ~  dnorm[log(1), 0.001^2] (fixed)

Model parameter estimates w 95% CI
          estimate       cilow       ciupp    log.est
 alpha  1.000001e+00 9.980435e-01 1.001964e+00  0.0000015
 beta   9.999931e-01 9.980351e-01 1.001955e+00 -0.0000069
 r      7.997287e-01 3.945536e-01 1.620986e+00 -0.2234828
 rc     7.997280e-01 3.945546e-01 1.620979e+00 -0.2234836
 rold   7.997273e-01 3.945534e-01 1.620981e+00 -0.2234845
 m      9.132152e+03 7.833895e+03 1.064556e+04  9.1195567
 K      4.567628e+04 2.215890e+04 9.415279e+04 10.7293344
 q      3.670700e-03 1.741100e-03 7.738500e-03 -5.6073817
 n      2.000002e+00 1.996086e+00 2.003926e+00  0.6931480
 sdb    1.181636e-01 8.595330e-02 1.624444e-01 -2.1356852
 sdf    1.026990e-01 7.493610e-02 1.407476e-01 -2.2759533
 sdi    1.181638e-01 8.595360e-02 1.624445e-01 -2.1356836
 sdc    1.026983e-01 7.493550e-02 1.407468e-01 -2.2759601

Deterministic reference points (Drp)
         estimate       cilow       ciupp    log.est
 Bmsyd 22838.146655 1.107946e+04 4.707639e+04 10.0361875
 Fmsyd     0.399864 1.972773e-01 8.104897e-01 -0.9166308
 MSYd   9132.152473 7.833895e+03 1.064556e+04  9.1195567
Stochastic reference points (Srp)
         estimate       cilow       ciupp    log.est rel.diff.Drp
 Bmsys 2.252669e+04 1.097458e+04 4.623884e+04 10.022456  -0.01382627
 Fmsys 3.965913e-01 1.944279e-01 8.089615e-01 -0.924849  -0.00825205
 MSYs  8.932869e+03 7.672815e+03 1.039985e+04  9.097493  -0.02230904

States w 95% CI (inp$msytype: s)
                   estimate       cilow       ciupp    log.est
 B_2018.00      3.586626e+04 1.745776e+04 7.368575e+04 10.4875523
 F_2018.00      1.223448e-01 5.880010e-02 2.545615e-01 -2.1009122
 B_2018.00/Bmsy 1.592167e+00 1.288133e+00 1.967963e+00  0.4650963
 F_2018.00/Fmsy 3.084908e-01 2.252140e-01 4.225606e-01 -1.1760633

Predictions w 95% CI (inp$msytype: s)
                 prediction       cilow       ciupp    log.est
 B_2019.00      3.693141e+04 1.797455e+04 7.588112e+04 10.5168176
 F_2019.00      1.218926e-01 5.787130e-02 2.567388e-01 -2.1046152
 B_2019.00/Bmsy 1.639451e+00 1.312227e+00 2.048274e+00  0.4943616
 F_2019.00/Fmsy 3.073506e-01 2.176436e-01 4.340325e-01 -1.1797662
 Catch_2019.00  4.544547e+03 3.471596e+03 5.949110e+03  8.4216833
 E(B_inf)       3.785290e+04           NA           NA 10.5414630
```

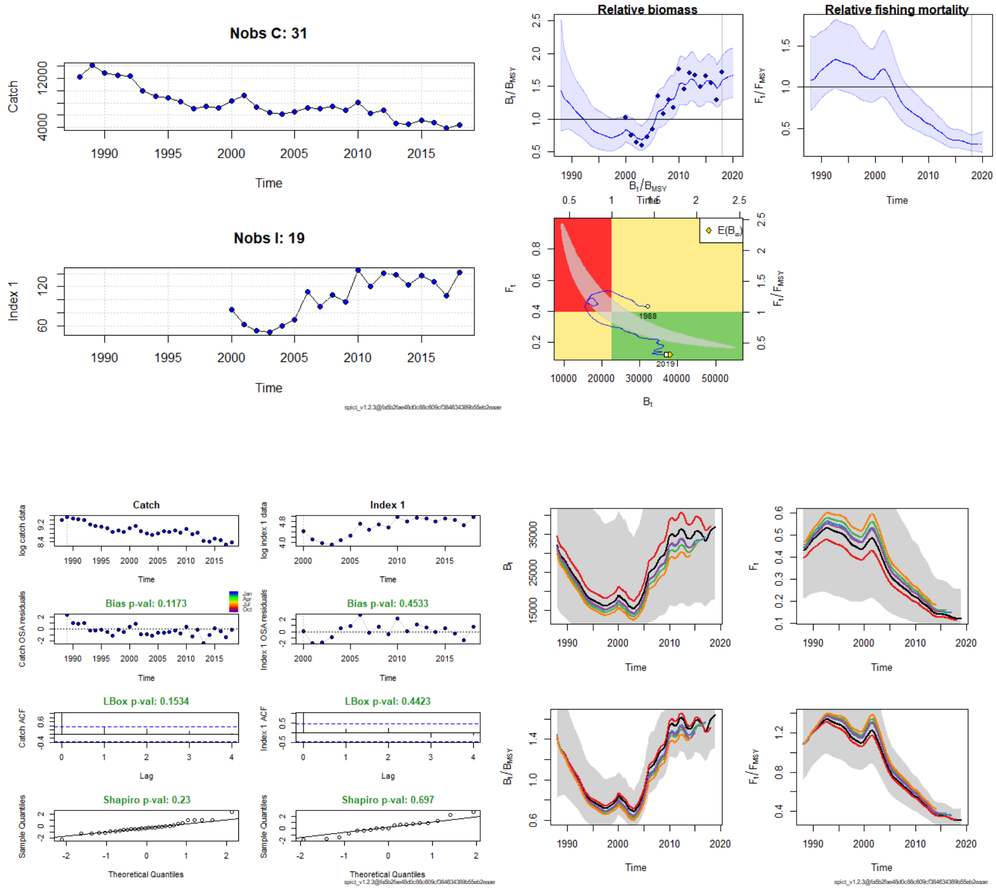


Figure 5.6.21. Tusk in areas 3.a, 4.a, 5.b, 6.a and 7. Upper left corner shows the input data for the model, upper right corner the model output, lower left corner the model diagnostics and the lower right corner the retrospective analysis.

5.6.10 Tables

Table 5.6.1. Tusk 3.a, 4, 5.b, 6, 7, 8, 9. WG estimates of amount landed.

Tusk 3.a

Year	Denmark	Norway	Sweden	Total
1988	8	51	2	61
1989	18	71	4	93
1990	9	45	6	60
1991	14	43	27	84
1992	24	46	15	85
1993	19	48	12	79
1994	6	33	12	51
1995	4	33	5	42
1996	6	32	6	44
1997	3	25	3	31
1998	2	19		21
1999	4	25		29
2000	8	23	5	36
2001	10	41	6	57
2002	17	29	4	50
2003	15	32	4	51
2004	18	21	6	45
2005	9	30	5	44
2006	4	21	4	29
2007	1	19	1	21
2008	0	43	3	46
2009	1	17	1	19
2010	1	17	3	21
2011	1	14	3	17
2012	1	17	2	20
2013	1	20	1	22

Year	Denmark	Norway	Sweden	Total
2014	1	7	1	9
2015	1	7	1	9
2016	1	12	1	14
2017	1	8	1	10
2018*	2	5	1	8

***Preliminary.**

Tusk 4.a

Year	Denmark	Faroes	France	Germany	Norway	Sweden[(1)]	E & W	N.I.	Scotland	Ireland	Total
1988	83	1	201	62	3998	-	12	-	72		4429
1989	86	1	148	53	6050	+	18	+	62		6418
1990	136	1	144	48	3838	1	29	-	57		4254
1991	142	12	212	47	4008	1	26	-	89		4537
1992	169	-	119	42	4435	2	34	-	131		4932
1993	102	4	82	29	4768	+	9	-	147		5141
1994	82	4	86	27	3001	+	24	-	151		3375
1995	81	6	68	24	2988		10		171		3348
1996	120	8	49	47	2970		11		164		3369
1997	189	0	47	19	1763	+	16		238	-	2272
1998	114	3	38	12	2943		11		266	-	3387
1999	165	7	44	10	1983		12		213	1	2435
2000	208	+	32	10	2651	2	12		343	1	3259
2001	258		30	8	2443	1	11		343	1	3095
2002	199		21		2438	1	8		294		2961
2003	217		19	6	1560		4		191		1997
2004	137	+	14	3	1370	+	2		140		1666
2005	123	17	11	4	1561	1	2		107		1826
2006	155	8	14	3	1854		5		120		2159
2007	95	0	22	4	1975	1	6		74	3	2180
2008	57	0	16	2	1975		3		85	1	2139
2009	48		8	1	2108	7	3		93		2268
2010	36		10	2	1734		8		71		1861
2011	52		24		1482	1	6		72		1636
2012	28		14	1	1635	1	3		67		1749
2013	42		11	3	1375		3		76		1510
2014	21		13	3	1365		3		58		1463
2015	24		6	2	1448	1	5		44		1530
2016	33		5	3	1565	1	4		39		1650

Year	Denmark	Faroes	France	Germany	Norway	Sweden[1]	E & W	N.I.	Scotland	Ireland	Total
2017	37		5	2	1121				41		1206
2018*	37		6	1	1341	1			53		1439

[1]) Includes 4.b 1988–1993.

***Preliminary.**

Table 5.6.1. (Continued).

Tusk 4.b

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	Sweden	Total
1988		n.a.		-	-				
1989		3		-	1				4
1990		5		-	-				5
1991		2		-	-				2
1992	10	1		-	1				12
1993	13	1		-	-				14
1994	4	1		-	2				7
1995	4	-	5	1	3	2			15
1996	4	-	21	4	3	1			33
1997	6	1	24	2	2	3			38
1998	4	0	55	1	3	3			66
1999	8	-	21	1	1	3			34
2000	8		106	+	-	2			116
2001	6		45(1)	1	1	3			56
2002	6		61	1	1	2			71
2003	2		5	1					8
2004	2		19	1		1			23
2005	2		4	1					7
2006	2		30						32
2007	1		6				8		15
2008	0		69			0	2		71
2009	1		3			0	0	13	17
2010	1		13						15
2011	1		95						96
2012	2		43					2	47
2013	3		28						31
2014	2		9						11
2015	3		14	1					18

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	Sweden	Total
2016	2		5		2				9
2017	1		16					1	18
2018*	1		15	1					17

(1) Includes 4.c.

***Preliminary.**

Tusk 5.b1

Year	Denmark	Faroes(4)	France	Germany	Norway	E & W	Scotland (1)	Russia	Total
1988	+	2827	81	8	1143	-			4059
1989	-	1828	64	2	1828	-			3722
1990	-	3065	66	26	2045	-			5202
1991	-	3829	19	1	1321	-			5170
1992	-	2796	11	2	1590	-			4399
1993	-	1647	9	2	1202	2			2862
1994	-	2649	8	1 (2)	747	2			3407
1995		3059	16	1 (2)	270	1			3347
1996		1636	8	1	1083				2728
1997		1849	11	+	869		13		2742
1998		1272	20	-	753	1	27		2073
1999		1956	27	1	1522		11(3)		3517
2000		1150	12	1	1191	1	11(3)		2367
2001		1916	16	1	1572	1	20		3526
2002		1033	10		1642	1	36		2722
2003		1200	11		1504	1	17		2733
2004		1705	13		1798	1	19		3536
2005		1838	12		1398		24		3272
2006		2736	21		778		24	1	3559
2007		2291	28		1108	2	2	37	3431
2008		2824	18		816	18	13	109	3689
2009		2553	14		499	4	31	34	3135
2010		3949	16		866		58		4889
2011		3288	3		1		1		3293
2012		3668	23		102				3793
2013		1464	36		0				1500
2014		1764	32		511		3		2310
2015		1338	26		717				2081
2016		1494	17		747		3		2261

Year	Denmark	Faroes[4]	France	Germany	Norway	E & W	Scotland [1]	Russia	Total
2017		1472	18		544		1		2035
2018*		1119	14		849		1		1983

1) Included in 5.b2 until 1996.

(2) Includes 5.b2.

(3) Reported as 5.b.

(4) 2000–2003 5.b1 and 5.b2 combined.

*** Preliminary.**

Table 5.6.1. (Continued).

Tusk 5.b2

Year	Faroe	Norway	E & W	Scotland (1)	France	Total
1988	545	1061	-	+		1606
1989	163	1237	-	+		1400
1990	128	851	-	+		979
1991	375	721	-	+		1096
1992	541	450	-	1		992
1993	292	285	-	+		577
1994	445	462	+	2		909
1995	225	404	-2	2		631
1996	46	536				582
1997	157	420				577
1998	107	530				637
1999	132	315				447
2000		333				333
2001		469				469
2002		281				281
2003		559				559
2004		107				107
2005		360				360
2006		317				317
2007		344				344
2008		61				61
2009		164				164
2010		127				127
2011		0				0
2012		0				0
2013					12	12
2014		123			6	129
2015		323			1	324

Year	Faroe	Norway	E & W	Scotland (1)	France	Total
2016		42				42
2017		135				135
2018*		21				21

(1)Includes 5.b1.

(2)See 5.b1.

(3)Included in 5.b1.

*Preliminary.

Tusk 6a

Year	Denmark	Faroes	France [(1)]	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain	Nether-lands	Total
1988	-	-	766	1	-	1310	30	-	13			2120
1989	+	6	694	3	2	1583	3	-	6			2297
1990	-	9	723	+	-	1506	7	+	11			2256
1991	-	5	514	+	-	998	9	+	17			1543
1992	-	-	532	+	-	1124	5	-	21			1682
1993	-	-	400	4	3	783	2	+	31			1223
1994	+		345	6	1	865	5	-	40			1262
1995		0	332	+	33	990	1		79			1435
1996		0	368	1	5	890	1		126			1391
1997		0	359	+	3	750	1		137	11		1261
1998			395	+		715	-		163	8		1281
1999			193	+	3	113	1		182	47		539
2000			267	+	20	1327	8		231	158		2011
2001			211	+	31	1201	8		279	37		1767
2002			137		8	636	5		274	64		1124
2003			112		4	905	3		104	0		1128
2004		1	140		22	470			93	0		726
2005		10	204		7	702			96	0		1019
2006		5	239		10	674	16		115	0		1059
2007		39	261		3	703	9		70	0		1085
2008		30	307		1	964	0		44	0		1346
2009		33	217		4	898	0		88	2		1242
2010		41	183		5	939			48			1216
2011		87	173		1	1060			25			1337
2012		106	166		1	860			41			1174
2013		46	191		1	1204			66	86		1594
2014		0	193			393			60	16		662
2015			200			866	1		63	62	1	1193

Year	Denmark	Faroes	France [1]	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain	Nether-lands	Total
2016		41	178		1	499			42	82	1	844
2017		5	136			274			59	37		511
2018*		144		0	658			81	57	0	940	144

Not allocated by divisions before 1993.

*** Preliminary.**

Table 5.6.1. (Continued).

Tusk 7.a

Year	France	E & W	Scotland	Total
1988	n.a.	-	+	+
1989	2	-	+	2
1990	4	+	+	4
1991	1	-	1	2
1992	1	+	2	3
1993	-	+	+	+
1994	-	-	+	+
1995	-	-	1	1
1996	-	-		
1997	-	-	1	1
1998	-	-	1	1
1999	-	-	+	+
2000		-	+	+
2001		-	1	1
2002	n/a	-	-	-
2003		-	-	-
2004				
2005				
2006				
2007				
2008				
2009				
2010				
2011				
2012				
2013				
2014				
2015				

Year	France	E & W	Scotland	Total
2016				
2017				0
2018*				

***Preliminary.**

Tusk 7.b,c

Year	France	Ireland	Norway	E & W	N.I.	Scotland	Total
1988	n.a.	-	12	5	-	+	17
1989	17	-	91	-	-	-	108
1990	11	3	138	1	-	2	155
1991	11	7	30	2	1	1	52
1992	6	8	167	33	1	3	218
1993	6	15	70	17	+	12	120
1994	5	9	63	9	-	8	94
1995	3	20	18	6		1	48
1996	4	11	38	4		1	58
1997	4	8	61	1		1	75
1998	3		28	-		2	33
1999	-	16	130	-		1	147
2000	3	58	88	12		3	164
2001	4	54	177	4		25	263
2002	1	31	30	1		3	66
2003	1	19		1			21
2004	2	19					21
2005	4	18				1	23
2006	4	23	63			0	90
2007	2	4	7				13
2008	2	2	0				4
2009	0	4	0				4
2010		5					5
2011		1					1
2012			63				63
2013	3	1					4
2014		1					1
2015							0
2016							0

Year	France	Ireland	Norway	E & W	N.I.	Scotland	Total
2017						1	1
2018*						3	3

*Preliminary.

Table 5.6.1. (Continued).

Tusk 7.g–k

Year	France	Germany	Ireland	Norway	E & W	Scotland	Spain	Total
1988	n.a.		-	-	5	-		5
1989	3		-	82	1	-		86
1990	6		-	27	0	+		33
1991	4		-	-	8	2		14
1992	9		-	-	38	-		47
1993	5		17	-	7	3		32
1994	4		12	-	12	3		31
1995	3		8	-	18	8		37
1996	3		20	-	3	3		29
1997	4	4	11	-		+	0	19
1998	2	3	4	-		1	0	10
1999	2	1	-	-		+	6	8
2000	2		5	-	-	+	6	13
2001	3		-	9	-	+	2	14
2002	1				1		3	5
2003	1		1				1	3
2004	1						0	1
2005	1						1	2
2006	1		1				1	3
2007	1						1	1
2008	0						0	0
2009	0		0		0	0	0	0
2010	0							0
2011	0							0
2012	0					2		2
2013	0							0
2014								0
2015								0

Year	France	Germany	Ireland	Norway	E & W	Scotland	Spain	Total
2016								0
2017								0
2018*								0

***Preliminary.**

Tusk 8.a

Year	E & W	France	Total
1988	1	n.a.	1
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	-	-
1997	+	+	+
1998	-	1	1
1999	-	-	0
2000	-		-
2001	-		-
2002	-	+	+
2003	-	-	-
2004		1	
2005			
2006			
2007			
2008			
2009			
2010		4	4
2011		0	0
2012			0
2013			0
2014			0
2015			0
2016			0

Year	E & W	France	Total
2017			0
2018			0

***Preliminary.**

Table 5.6.1. (Continued).

Tusk, total landings by subareas or division.

Year	3	4.a	4.b	5.b1	5.b2	6.a	7.a	7.b,c	7.g-k	8.a	All areas
1988	61	4429		4059	1606	2120		17	5	1	12 298
1989	93	6418	4	3722	1400	2297	2	108	86		14 130
1990	60	4254	5	5202	979	2256	4	155	33		12 948
1991	84	4537	2	5170	1096	1543	2	52	14		12 500
1992	85	4932	12	4399	992	1682	3	218	47		12 370
1993	79	5141	14	2862	577	1223		120	32		10 048
1994	51	3375	7	3407	909	1262		94	31		9136
1995	42	3348	15	3347	631	1435	1	48	37		8904
1996	44	3369	33	2728	582	1391		58	29		8234
1997	31	2272	38	2742	577	1261	1	75	19		7016
1998	21	3387	66	2073	637	1281	1	33	10	1	7510
1999	29	2435	34	3517	447	539		147	8	0	7156
2000	36	3260	116	2367	333	2011		164	13		8300
2001	57	3095	56	3526	469	1767	1	263	14		9248
2002	50	2961	71	2722	281	1124		66	5		7280
2003	51	1997	8	2733	559	1128		21	3		6500
2004	45	1666	23	3536	107	726		21	1		6125
2005	44	1826	7	3272	360	1019		23	2		6553
2006	29	2159	32	3560	317	1059		90	3		7249
2007	21	2180	15	3468	344	1077		13	1		7119
2008	46	2139	71	3798	61	1347		4	0		7466
2009	19	2268	17	3135	164	1242		4	0		6849
2010	21	1861	15	4889	127	1216		3	0	4	8136
2011	17	1623	96	3287	0	1337		5	0	0	6361
2012	20	1749	47	3793	0	1174		63	2		6848
2013	22	1510	31	1500	12	1594		4	0		4673
2014	9	1463	11	2310	129	662		1			4585
2015	9	1530	18	2081	324	1193		0			5155

Year	3	4.a	4.b	5.b1	5.b2	6.a	7.a	7.b,c	7.g-k	8.a	All areas
2016	14	1650	9	2261	42	844		0			4820
2017	10	1206	18	2035	135	511		1			3916
2018*	8	1439	17	1983	21	940		3			4411

***Preliminary.**

6 Greater silver smelt (*Argentina silus*)

6.1 Stock description and management units

At the WGDEEP 2014 it was suggested that unit arg-oth should be further split into advisory units as fishing grounds are sufficiently isolated (WD, WGDEEP2014, figure 6.1.1). This change was implemented at the WGDEEP meeting in 2015. Greater silver smelt is now divided into four management units by ICES areas;

- aru.27.123a4 in ICES areas 1, 2, 3a and 4;
- aru.27.5a14 in ICES areas 5a and 14;
- aru.27.5b6a in ICES areas 5b and 6a;
- aru.27.6b7–1012 in ICES areas 6b, 7-10 and 12.

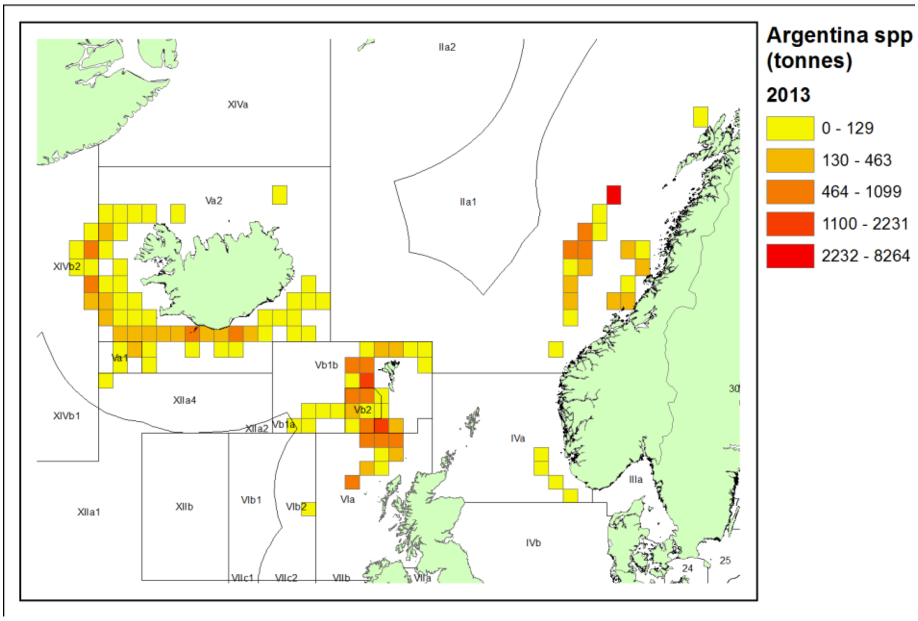


Figure 6.1.1. Catches of greater silver smelt by Iceland, Norway, Faroes and the Netherlands in 2013. Some catches of *A. sphyraena* and *Argentina* unidentified may be included in the Norwegian and Dutch landings.

6.2 Greater silver smelt (*Argentina silus*) in 1, 2, 3.a and 4

6.2.1 The fishery

The targeted fishery is primarily conducted by Norwegian midwater and bottom trawlers in Division 2.a, and the fishery was initiated in the early 1980s. From the 1970s until the mid-1990s a smaller target fishery existed in Division 3.a (Skagerrak), but landings from that area have since been only minor bycatch.

In addition to the target fisheries in 2.a, trawl fisheries for other species along the Norwegian Deep in Division 4.a (northern North Sea) result in variable but sometimes significant landed bycatch of greater silver smelt. These landings can also contain, presumably minor, quantities of the lesser silver smelt (*Argentina sphyraena*) which has a more southern and shallower distribution then greater silver smelt. Since 2012 the landings have increased from 350t to 5500t in 2016 and 2017 and in 2018 reaching the highest landings so far with 7786t.

6.2.2 Landing trends

International landings are summarised in Tables 6.2.1–6.2.4. The variation through the time-series primarily reflects the developments in the Norwegian target fisheries in Subarea 2. The landings from 4.a were estimated based on sampling of mixed-species catches at the fishmeal factories, and the quality of the process may have varied somewhat through the time-series.

From peak levels of 10000 t to 11000 t in the 1980s when the targeted fishery developed, the landings (primarily by Norway) from Subareas (1 and) 2 declined in the 1990s. Except for in 2001, when landings were 14369 t, the landings remained relatively stable at 6–8000 t until 2003. In 2004 to 2006 landings increased sharply to reach 21685t in 2006. The monitoring of abundance was not satisfactory in that period, but the increase in landings did probably not reflect increased abundance. Since the fishery was not restricted by a TAC, it is thought that temporal variation in landings primarily reflected variation in the market demand. In 2007–2017 the Norwegian catches in targeted fisheries were around 12000t per year in accordance with annual TAC regulations reintroduced in 2007. In 2018 the landings increased to 15800t.

Since 2014 marked increase is observed in catches in area 3 and 4, and these have in 2018 risen to substantial 7786t. Mostly they are bycatch taken at the southern slope of Norwegian trench, and the bulk of them are reported as lesser silver smelt. There are uncertainties on how well these landings are estimated and about species identification, and this should be addressed with better sampling in cooperation with the industry (Table 6.2.5). In the end of 2018, 267 samples of Argentines from the industry was identified to either *Argentina silus* or *Argentina sphyraena* using different criteria given in the identification key of Argentines; number of muscle segments, number of pectoral fin rays, number of gill rakes on the lower part of the first gill bow and the size of the eye diameter compared to the snout length (Table 6.2.6, Figure 6.2.16-6.2.19) (ICES WGDEEP 2019 WD7). Preliminary results show that up to 10% of the individuals sampled might be *A. sphyraena*. In this report, all registered landings are assumed to be greater silver smelt.

In 2018 total landings were 23859 t (Table 6.2.1–6.2.3). Landings from Subarea 2 were 15823 t and the remainder were reported from 4 and 3.a. The total landings were substantially higher than the ICES advice for 2018.

6.2.3 ICES Advice

In 2017 ICES advised that, when the precautionary approach is applied, catches should be no more than 15 656 tonnes in each of the years 2018 and 2019. All catches are assumed to be landed.

6.2.4 Management

For a period after 198 3 a Norwegian precautionary unilateral annual TAC applied in 2.a which was always the main fishing area. The landings never exceeded the quota and this regulation was abandoned in 1992. As landings increased substantially in the mid-2000s, a 12 000 t unilateral Norwegian TAC was introduced in 2007 and this TAC was maintained until 2015 when for 2016 it was increased to 13 047 t, which also was the TAC for 2016. In 2018 the TAC is 13770 t. The Norwegian target fishery is further regulated by a licensing system that limits the number of trawlers that can take part and specifies gear restrictions, bycatch restrictions, and an area- and time restriction. In 2018 there were 27 licences, and around 25 boats took part in the fishery.

In 2016 a RTC-regime (Real Time Closures) was implemented to the direct fisheries in area 2, aimed to limit bycatch of redfish, saithe and haddock. Closing criteria was sat to 1000 kg in combined weight of redfish, saithe and haddock in single catches.

In 2017 a minimum landing size (MLS) in the direct fisheries of 27 cm was implemented in the direct fisheries, with access to 20% mixture of greater silver smelt in numbers under the MLS in single catches. Also, ban on landing greater silver smelt to be processed to fishmeal was repealed in 2017.

In Norway vessels that are not licensed to greeter silver smelt fisheries can have up to 10% in weight bycatch of greater silver smelt in single catches and landings. This also applies to vessels that are licenced, but those must subtract the bycatch from their quota.

If the total TAC in the direct fishery is not fished during the year, up to 10% of the total TAC can be transferred to the following year.

There is no Norwegian TAC for fisheries in 4.a and 3.a where targeted fisheries are prohibited, but bycatch restrictions apply. The EU introduced TAC management in 2003 applying to EU vessels fishing in the EU EEZ and international waters. For 2019 the EU TAC for 1+2 =90 t, and for 4 + 3 the TAC was 1234 t.

This management unit is not distributed in international waters, hence the 2019 TACs described above totalling 13 770 t (Norway) and 90 (EU; area 1 and 2) +1234 t (EU; 3 and 4) apply to Norwegian and EU waters, respectively.

6.2.5 Data available

6.2.5.1 Landings and discards

Landings data are presented by ICES Subareas and Divisions and countries (Tables 6.2.1–6.2.4, Figure 6.2.1–6.2.3). (Data from 2014–2018 were obtained from national official statistics (Norway) and InterCatch. From earlier years data are WG estimates based on national submissions to ICES which are not fully included in InterCatch.)

Discarding is banned in Norway and all catches are assumed to be landed. There is information in InterCatch on very minor discards from non-Norwegian fisheries on this management unit, but bycatches are assumed generally to be landed.

6.2.5.2 Length compositions

Length distributions are presented for target fishery catches from 2.a for the period 2009–2018 and for bycatches by Norwegian vessels in 4.a for the years 2011, 2013, 2014 and 2016-2018 (Figure 6.2.4–6.2.6). For each year these distributions are derived by pooling multiple samples from landing sites and samples provided by commercial vessels (WD by Hallfredsson *et al.*, WGDEEP 2016).

Length information is available from the Norwegian slope survey in 2.a in March biennially 2009–2016 (Figure 6.2.7) (WD by Hallfredsson *et al.*, WGDEEP 2017).

Length information is available from the annual Norwegian shrimp survey in 3.a–4.a, 1984–2016 (Figure 6.2.8).

6.2.5.3 Age compositions

Age compositions from Norwegian catches 2013-2018 are presented in Figure 6.2.9.

Age distributions by depth from the Norwegian slope survey in March 2018 are shown in Figure 6.2.10.

6.2.5.4 Weight-at-age

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

6.2.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

6.2.5.6 Catch, effort and research vessel data

A trawl acoustic survey has been conducted in 2009, 2012 and biennially since then, along the continental slope in Norwegian EEZ from 62–74°N (area 1 and 2). Additionally, trawl surveys were conducted in 2.a in 2003–2005.

For area 4 and 3a information is available from the Norwegian shrimp survey in years 1984–2016. Stations are in the depth range of 80-660 meters, with around 25% of the stations deeper than 300 meters.

6.2.6 Data analyses

Length and age distributions

In Division 2.a size and age distributions from target fisheries (Figures 6.2.5 and 6.2.9) continue to consist of rather smaller and younger fish than catches in the 1980s during the initial years of the target fisheries (Bergstad, 1993; Monstad and Johannessen, 2003; Johannessen and Monstad, 2003). There are, however, no changes in the size and age composition in the recent eight years when the target fishery has been regulated with TACs and other measures. Length and age distributions in the Norwegian survey sampling the entire geographical and depth range show higher length and age ranges, however, with deeper than 400 m samples having proportion of old fish closer to those observed in the 1980s (Figure 6.2.10). The fishery is mainly conducted shallower than 400 m (Figure 6.2.13).

In Division 3.a there has been a declining trend in the length distributions throughout the 1984–2016 shrimp survey time-series, but with some reappearance of large fish in the most recent years (Figure 6.2.8).

In Division 4.a size distributions from the bycatch (Figure 6.2.6) suggest that the catches comprise rather variable but smaller fish than those in the target fishery landings in 2.a. This probably reflects that the slope of the Norwegian Deep in 4.a is comparatively shallow and is mainly a juvenile area and feeding area for dispersed large fish out with the winter-spring aggregatory phase (Bergstad, 1993).

Commercial and survey cpue series

In area 2 biomass estimates based on the acoustic observations and trawl swept area estimates show increasing trend from 2012-2016 (Table 6.2.7, Figure 6.2.12). The latest survey shows however a declining trend, down to around the 2014 values. Greater silver smelt has been distributed rather evenly from 300–500 m depth in the surveys according to acoustics, which is in contrast to the catches that are mostly conducted at depths around 300–400 m (Figure 6.2.11-6.2.13). There is a rather high CV in the trawl estimates, and the acoustic biomass estimates are considerably higher than the trawl indices. It is possible that this reflects that the trawl indices don't show the more pelagic part of the vertical distribution of this bento-pelagic fish. One should however be careful in the interpretation of absolute biomass values from different methods, and the comparison might thus not be fully appropriate. It is reassuring that both methods show similar trends. Greater silver smelt seemed to be more northerly distributed in 2018 compared to previous years. Registrations were strikingly low at the slope south from around 67°N (Figure 6.2.11).

Incidence and abundance indices for greater silver smelt from the annual Norwegian shrimp survey in 3.a and southeastern parts of 4.a are shown in Figure 6.2.14. The CPUE in biomass and numbers was recalculated for the shrimp survey (Figure 6.2.15) and these are the ones presented in the advice.

The catch rates in terms of numbers and weight from the survey in 3.a and 4.a suggest pronounced variation and trends (Figure 6.2.15). The survey catches rates first declined steadily and then rather abruptly to unprecedented low levels in 2005. After 2010, indices showed abrupt increase until around 2015 and have been at a relatively high level since then.

Exploratory assessment

Exploratory assessment surveying different DLM assessments (SPiCT, LBI, DLMtools) was presented at the 2018 meeting (Hallfredsson, WD WGDEEP 2018). The stock is suggested for Benchmark in 2020.

Existing abundance, length and age dataseries for this stock are rather short in time. However, if the time-series are maintained they may support more analytical assessment in near future.

6.2.7 Comments on the assessment

The ICES framework for category 3 stocks was applied (ICES, 2012) in 2019, for a two years advice (2020 and 2021). For draft advice, the Norwegian acoustic survey in Subarea 2 was applied as an index for the stock development. The advice is based on a comparison of the two latest index values with the three preceding values, combined with latest advice. For years where index values are not available the values are obtained by interpolation. The index is estimated to have decreased by 18% and the uncertainty cap was not applied to calculate the catch advice. The stock status relative to candidate reference points is unknown. An LBI length-based analysis was presented at the 2018 meeting (Hallfredsson, WD WGDEEP 2018). This analysis was updated and the index ratio $L_{mean}/L_{F=M}$ is higher than 1 which indicates that the exploitation status is within precautionary levels (Figure 6.2.20). Thus, the precautionary buffer was not applied in 2019. Excepted mean length of catch above L_{mean} when F=M is 33.25cm. The LBI-analysis was based on length-distributions in the direct fisheries in area 1 and 2 for 2009-2018. Discarding is considered negligible.

6.2.8 Management considerations

Advice is given every second year for this stock and the 2019 advice applies for 2020 and 2021.

The size and age distributions of landings in the major fishery, i.e. the target fishery in the Norwegian EEZ, remains stable, suggesting that the prior decline in the proportions of large fish in the catches observed during the first decades of the fishery has halted. Furthermore, corresponding data from Norwegian surveys show that larger and older fish occur in adjacent and deeper areas than the areas being used by the fishery (Figure 6.2.10). The fishing areas (both for the target fishery and bycatch fisheries) have remained the same since the early 1980s. The exception is the 3.a where a target fishery was conducted until the mid-1990s but not since.

Acoustical biomass estimates for Division 2.a in 2012 showed some reduction compared to 2009, but from 2012-2016 a marked upward trend has showed, as does the trawl index. However, from 2016-2018 the acoustical biomass estimates and the trawl index has declined. Before the benchmark in 2020 the acoustical biomass and the trawl index will be reconsidered.

The Norwegian shrimp survey data from Division 3.a suggest that the abundance in that area has increased in recent years after an abrupt decline in 2004–2005. The apparently rather rapid increase in the abundance index in recent years may suggest that immigration from northern areas (in 4.a or 2.a) may have happened. The abrupt decline in 2005 may partly have resulted from high incidental mortality due to greater silver smelt being a bycatch in the roundnose grenadier fishery which peaked in 2003–2005.

The bycatch in area 4 has increased rapidly since 2012 and was 7786 tonnes in 2018. This is an alarming level. There are uncertainties in how this bycatch is estimated in this fishery, as it is an industry fishery for reduction. Additionally, most of these catches are registered as lesser silver smelt, but there are strong reasons to assume that these for the most are greater silver smelt catches (Figure 6.2.16-6.2.19). These matters will be further investigated before the benchmark in 2020.

6.2.9 References

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6.2.10 Tables

Table 6.2.1. Greater Silver Smelt in 1, 2, 3.a and 4 by countries. WG estimates of landings in tonnes. ICES official statistics. Landings from 1966-2018 are shown in Stock Annex.

year	Denmark	Sweden	Ireland	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	SUM
1988	1062	0	0	1	0	13014	5	14	0	0	0	0	14096
1989	1322	0	0	0	335	10495	0	23	1	0	0	0	12176
1990	737	0	0	13	5	10686	0	0	0	0	0	0	11441
1991	1421	0	0	0	3	8864	0	0	6	1	0	0	10295
1992	3564	0	0	1	70	8932	0	0	101	0	0	0	12668
1993	2353	0	0	0	298	8481	0	0	56	0	0	0	11188
1994	1118	0	0	0	0	6221	0	0	614	0	0	0	7953
1995	1061	0	0	357	0	6419	0	0	20	0	0	0	7857
1996	1446	0	0	0	0	6817	0	0	0	0	0	0	8263
1997	1455	542	0	1	0	5167	0	0	0	0	0	0	7165
1998	748	428	0	169	277	8655	0	0	0	0	0	0	10277
1999	1420	0	0	0	7	7151	0	0	18	0	0	0	8596
2000	1039	273	10	0	3	6107	0	195	18	9	0	0	7654
2001	907	1011	3	0	0	14360	0	7	233	28	0	0	16549
2002	614	484	4	0	0	7406	0	0	164	0	0	0	8672
2003	918	42	0	4	617	8351	0	7	22	4	4	0	9969

year	Denmark	Sweden	Ireland	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	SUM
2004	910	0	36	4	4277	11574	0	4	12	0	0	0	16817
2005	470	0	0	1	28	17066	0	16	0	0	14	0	17595
2006	335	0	0	6	0	25149	0	4	2	0	0	0	25496
2007	0	0	0	0	0	16373	0	1	0	0	0	0	16374
2008	0	0	0	0	0	13424	0	0	0	0	0	0	13424
2009	0	0	0	0	0	13495	0	0	0	0	0	0	13495
2010	0	0	0	0	0	12865	0	0	33	0	0	0	12898
2011	0	0	0	0	0	12060	0	0	0.4	4	0	0	12064
2012	0	0	0	0	0	12352	0	0	0	1.2	114	18	12485
2013	0	0	0	0	0	13227	0	0	0	2.3	0	0	13229
2014	40	1	0	204	345	14471	0	0	0	1	0	0	15062
2015	0	1	0	0	0	15235	0	0	0	0	0	0	15236
2016	0	1	0	38	11	18835	0	7	0	1.4	0	0	18893
2017	0	1	0	0	10	17788	0	35	0	0	0	0	17835
2018*	18	4		67	152	23609		9					23859

Table 6.2.2. Greater Silver Smelt in 1 and 2. WG estimates of landings in tonnes.

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
1988			11332	5	14					11351
1989			8367		23					8390
1990		5	9115							9120
1991			7741							7741
1992			8234							8234
1993			7913							7913
1994			6217			590				6807
1995	357		6418							6775
1996			6604							6604
1997			4463							4463
1998	40		8221							8261
1999			7145			18				7163
2000		3	6075		195	18	2			6293
2001			14357		7	5				14369
2002			7405			2				7407
2003		575	8345		7	2	4	4		8937
2004		4235	11557		4					15796
2005			17063		16			14		17093

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
2006			21681		4					21685
2007			13272		1					13273
2008			11876							11876
2009			11929							11929
2010			11831			23				11854
2011			11476			0.4				11476
2012			12002				0.2	114	18	12134
2013			11978				0.3			11979
2014			11752							11752
2015			12049							12049
2016			13115		7		0.4			13122
2017		10	12277		35					12322
2018*	0.2	0.4	15823		8.5					15832

Table 6.2.3. Greater Silver Smelt in 3. WG estimates of landings in tonnes. Figures in parentheses are discards as recorded in InterCatch. Landings from 1966-2018 are shown in Stock Annex.

Year	Denmark	Germany	Norway	Sweden	TOTAL
1988	1062		27		1089
1989	938		236		1174
1990	732		1150		1882
1991	1421		800		2221
1992	3564		634		4198
1993	2343		487		2830
1994	1108				1108
1995	1061				1061
1996	1389		159		1548
1997	1455		703	542	2700
1998	748		413	428	1589
1999	1420		2		1422
2000	1039		4	273	1316
2001	907			1011	1918
2002	614			484	1098
2003	918			42	960
2004	910		1		911
2005	470				470
2006	324				324
2007					0
2008					0
2009					0
2010					0
2011					0
2012					0
2013					0
2014			2	1	3

Year	Denmark	Germany	Norway	Sweden	TOTAL
2015			22	1	23
2016			101	1	102
2017			3	(1)	3(1)
2018*				(3.6)	(3.6)

***Preliminary landings**

Table 6.2.4. Greater Silver Smelt in 4. WG estimates of landings in tonnes. Figures in parentheses are discards as recorded in InterCatch. Landings from 1970-2018 are shown in Stock Annex.

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	Russia	TOTAL
1988			1		1655				1656
1989	384			335	1892	1			2612
1990	5		13		421				439
1991		1		3	323	6			333
1992			1	70	64	101			236
1993	10			298	81	56			445
1994	10				4	24			38
1995					1	20			21
1996	57				54				111
1997			1		1				2
1998			129	277	21				427
1999				7	4				11
2000		7			28		10		45
2001		28			3	228	3		262
2002					1	162	4		167
2003			4	42	6	20			72
2004			4	42	16	12	36		110
2005			1	28	3				32
2006	11		6		3468	2			3487
2007					3101				3101
2008					1548				1548
2009					1566				1566
2010					1034	10			1044
2011		4			584				588
2012		1			350				351
2013		2			1249				1251
2014	40 (7)	1	204	345	2717				3307(7)
2015					3164				3164

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	Russia	TOTAL
2016		1	38	11	5619				5669
2017					5508	(388)			5508(388)
2018*	17(1)		67	152	7786	(38)		6	8028(39)

*Preliminary landings

Table 6.2.5. Catches (t) registered as greater silver smelt (GSS), lesser silver smelt (LSS) and mix of both species (LSS/GSS) in Norwegian fisheries as registered port landings (upper table) and logbooks (lower table) .

ICES area	LSS	LSS/GSS	GSS	Total
IIa2	0	15823	0	15823
IVa	7782	3	1	7786
VIa	5	0	0	5
Total	7787	15826	1	23614

ICES area	LSS	LSS/GSS	GSS	Total
IIa2	80	1866	15498	17445
IVa	1357	1351		2708
Total	1437	3217	15498	20152

Table 6.2.6: Percent lesser- and greater silver smelt according to the different taxonomic measures (see text). Borderline see fig.6.2.16-6.2.19.

%	Eye diam. vs. snout length	Muscle segments	Gill rakes	Pectoral fin rays
Borderline	8	6		13
Lesser silver smelt	10	0	3	6
Greater silver smelt	82	94	97	81

Table 6.2.7. GSS in 2.a. Biomass estimates (t) for greater silver smelt in Norwegian slope surveys conducted in March 2009, 2012, 2014, 2016 and 2018. For acousic methods see Harbitz, WD ICES, WKDEEP 2010.

		SWEPT-AREA, BOTTOM TRAWL								ACOUSTICS		
Area	**SW**	**SE**	**NW**	**NE**	**Total**	**std**	**CV**	**SW**	**SE**	**NW**	**NE**	**Total**
2004					43978	20366	0.46					
2005					114644	39648	0.35					
2009	24171	44961	484	997	70613	18952	0.27	122026	91901	1069	1787	216783
2012	4505	28778	1053	155	34491	12996	0.38	66961	96643	10941	3352	177897
2014	104726	18818	2769	0	126313	98011	0.78	209771	111156	7216		328143
2016	53868	118059	4256	47	176230	81894	0.46	113942	456046		1573	571561
2018	6375	22878	4703	2282	36238	7744	0.21	51226	238676	10719	990	301611

SW = Latitude < 70°N, depth 500–750 m.

SE = Latitude < 70°N, depth 300–500 m.

NW = Latitude > 70°N, depth 500–750 m.

NE = Latitude > 70°N, depth 300–500.

***In 2014 the survey was conducted without the use of a midwater trawl. This might reduce accuracy and precision of the estimates because the allocation of backscattering strength to species categories in the pelagic zone could not be supported by catch information from targeted trawl tows.**

6.2.11 Figures

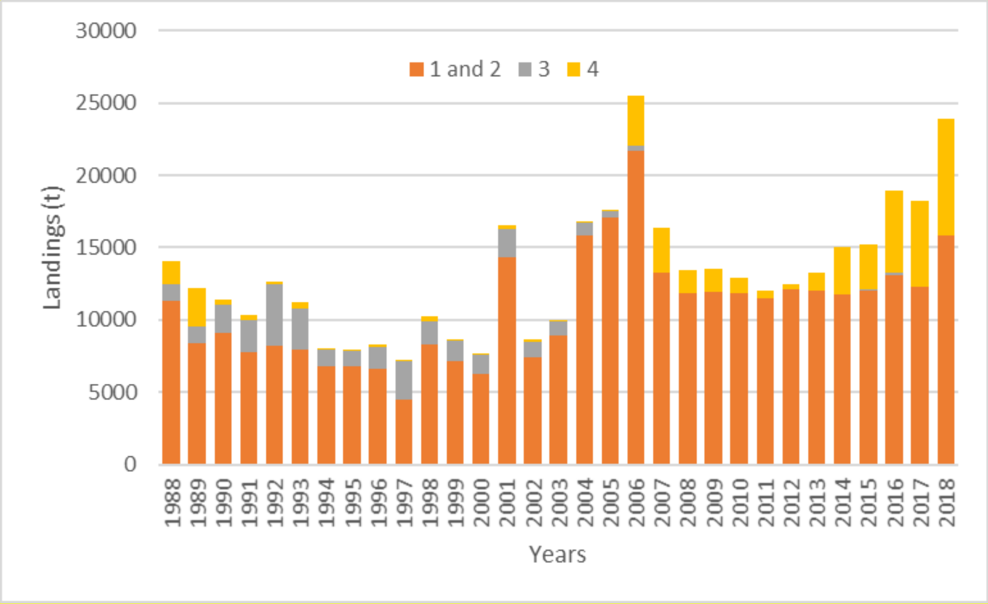


Figure 6.2.1. Total landings of greater silver smelt in Subareas 1, 2, 3 and 4.

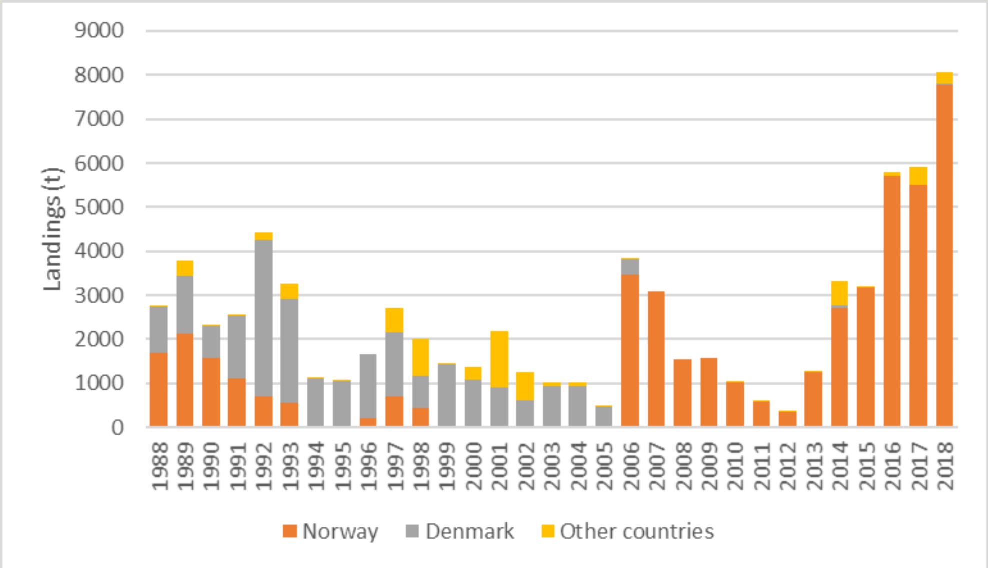
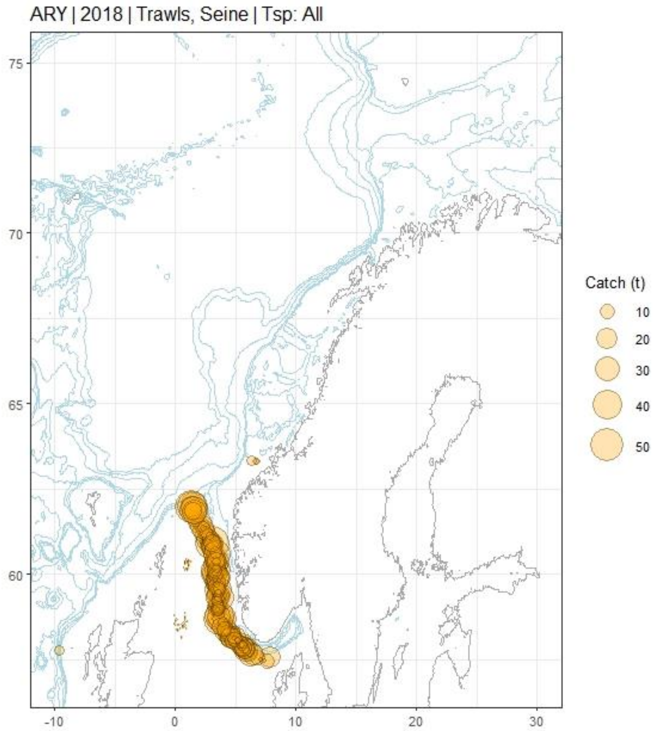
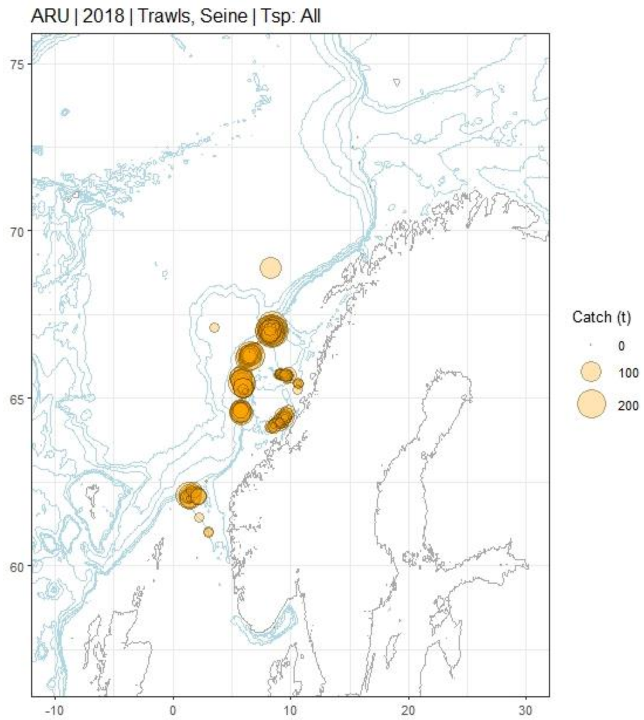


Figure 6.2.2. Total landings of greater silver smelt in Subareas 3 and 4, by countries.


ARY | 2018 | Trawls, Seine | Tsp: All
75
70
65
60
-10
0
10
20
30
Catch (t)
10
20
30
40
50


ARU | 2018 | Trawls, Seine | Tsp: All
75
70
65
60
-10
0
10
20
30
Catch (t)
0
100
200

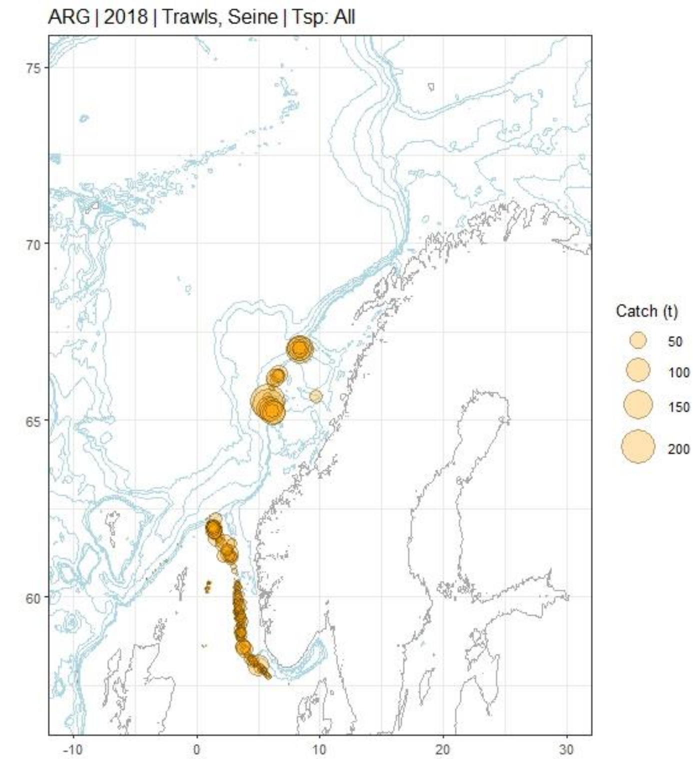


Figure 6.2.3. Norwegian catches in 2018 based on logbooks, included bycatch. Uppermost, middle and lowermost panels show catches registered as lesser silver smelt, greater silver smelt and mix of both species, respectively. Bubble sizes reflect sizes of single catches. NB: Catch representing max bubble size varies between panels.

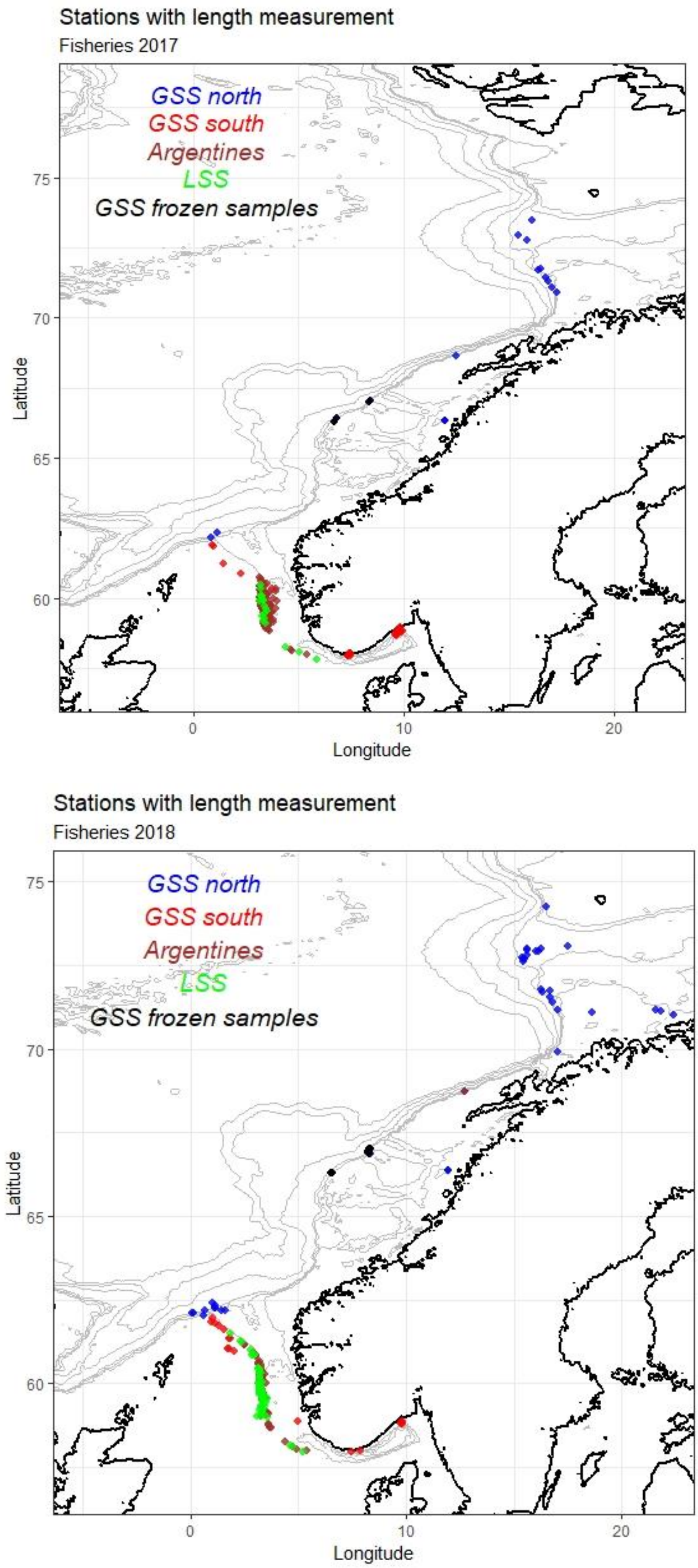


Figure 6.2.4. Positions from the fisheries for 2017 (upper panel) and 2018 (lower panel) with length measurement landed as GSS, LSS, GSS/LSS and frozen samples.

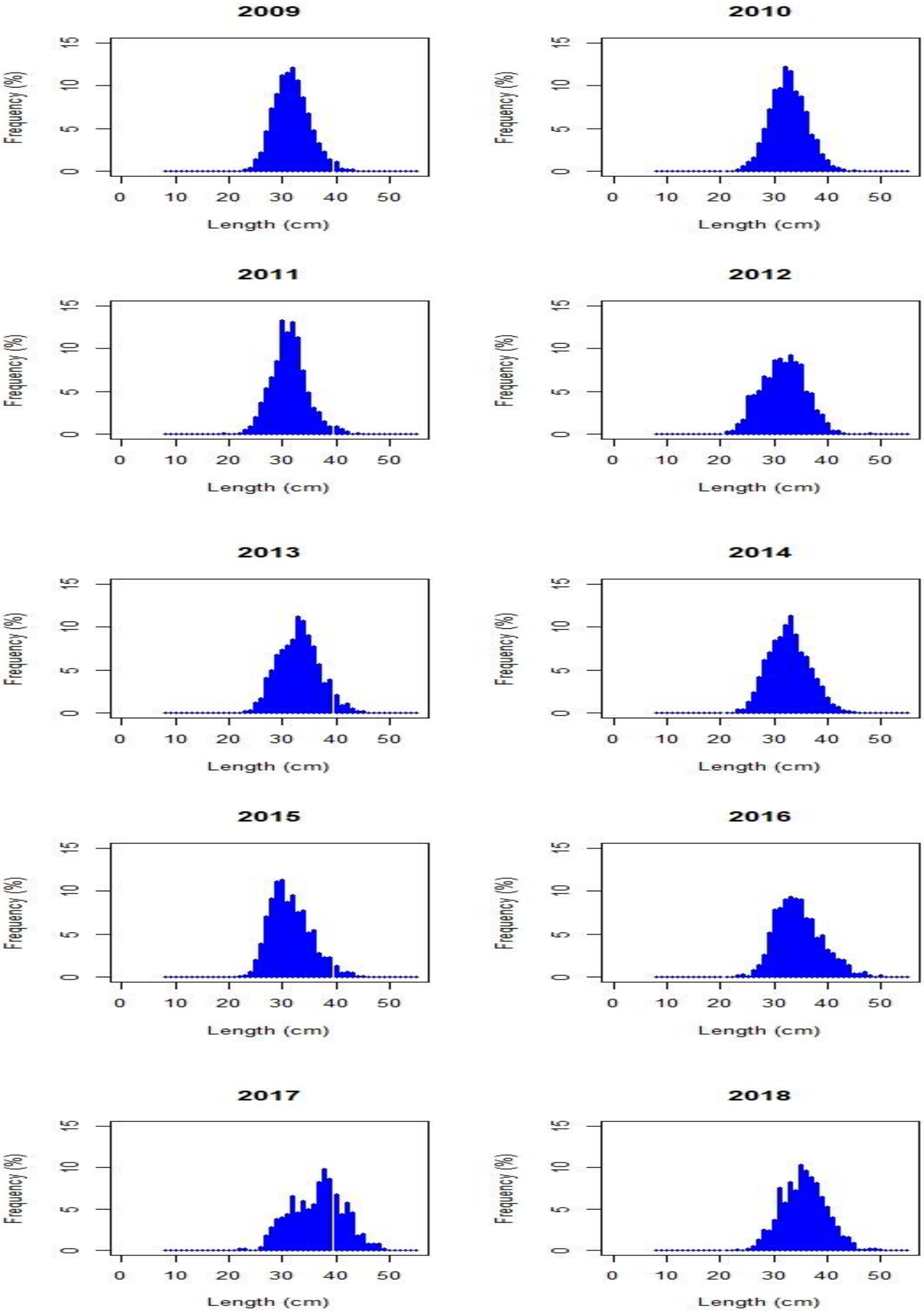


Figure 6.2.5. Greater silver smelt in 1, 2, 4 and 3.a. Length distributions from the target fisheries in 2009–2018 north of 62°N (approximately area 1 and 2).

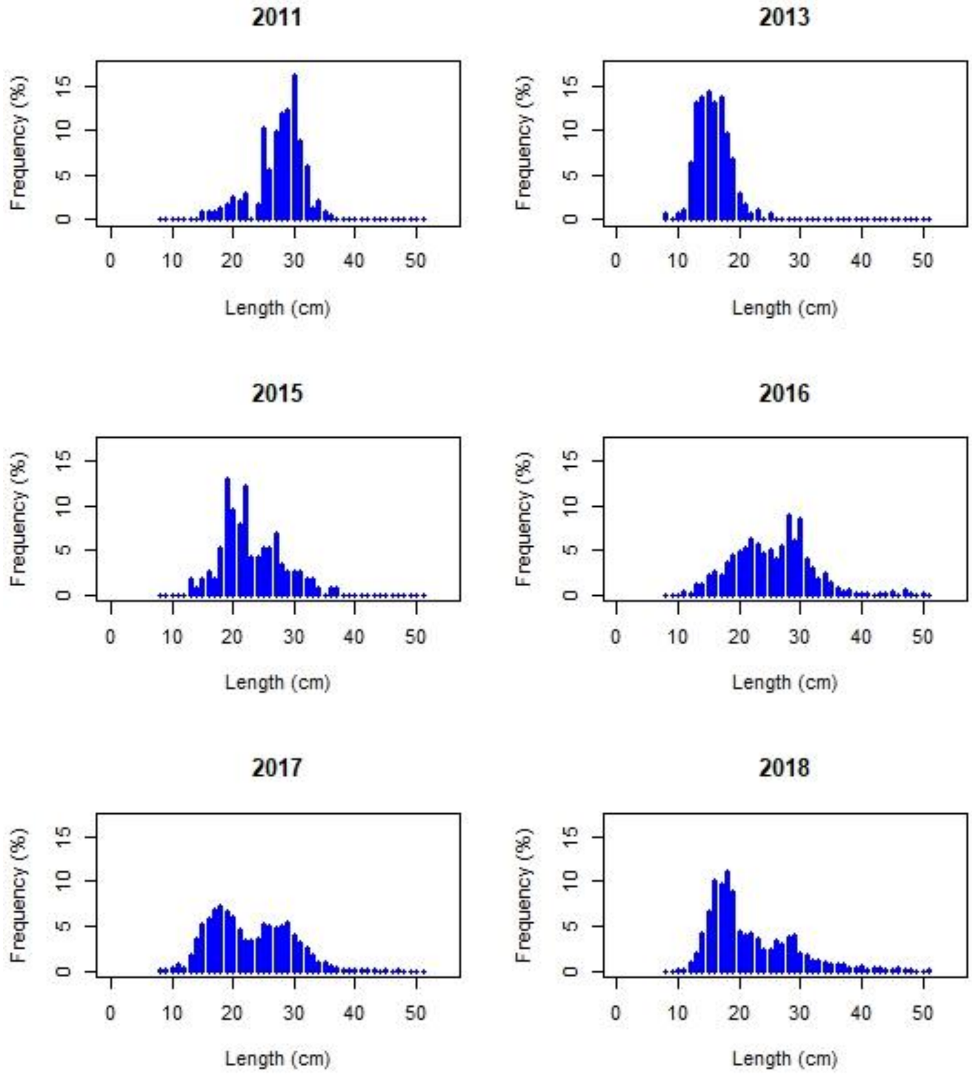


Figure 6.2.6. Greater silver smelt in 1, 2, 3.a and 4. Length distributions in annual samples from Norwegian bycatches south of 62°N (approximately area 3 and 4.).

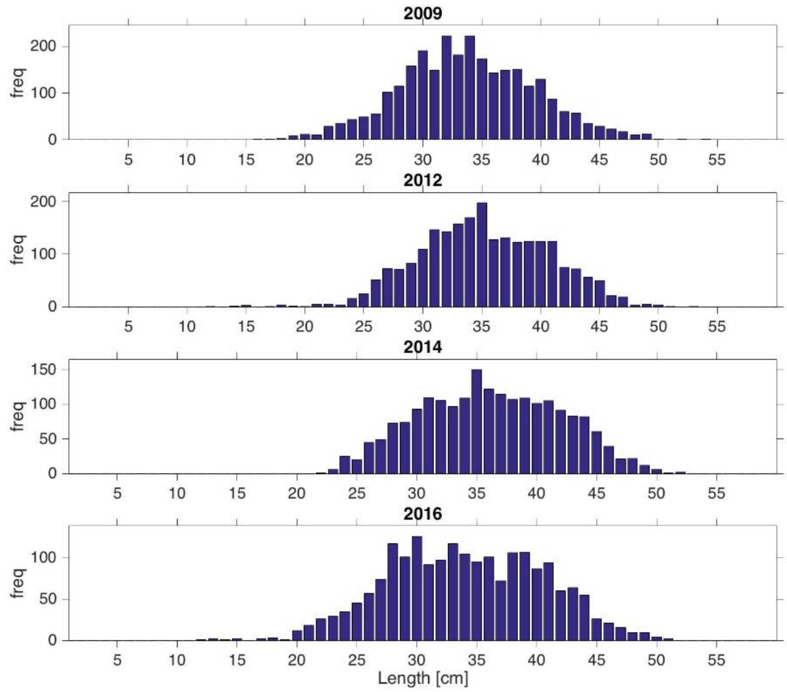


Figure 6.2.7. Length frequencies for Argentine in Norwegian slope survey in 2009, 2012, 2014 and 2016. No apparent substantial difference between years is seen, and few individuals have lengths outside the range 20–50 cm. Will be updated before benchmark 2020.

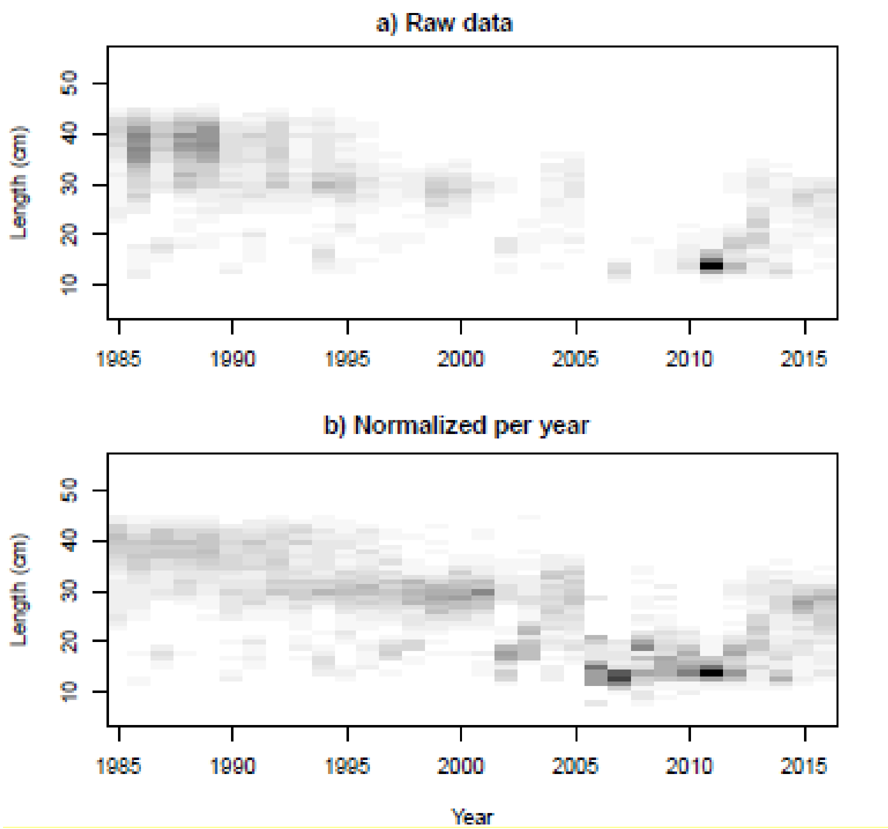


Figure 6.2.8. Greater silver smelt in 1, 2, 3, and 4. Length distributions from the annual Norwegian shrimp survey in 3.a and eastern parts of 4.a, 1985–2016 (from Hallfredsson *et al.*, 2016, WD for WGDEEP). This length distribution series will be updated before benchmark 2020.

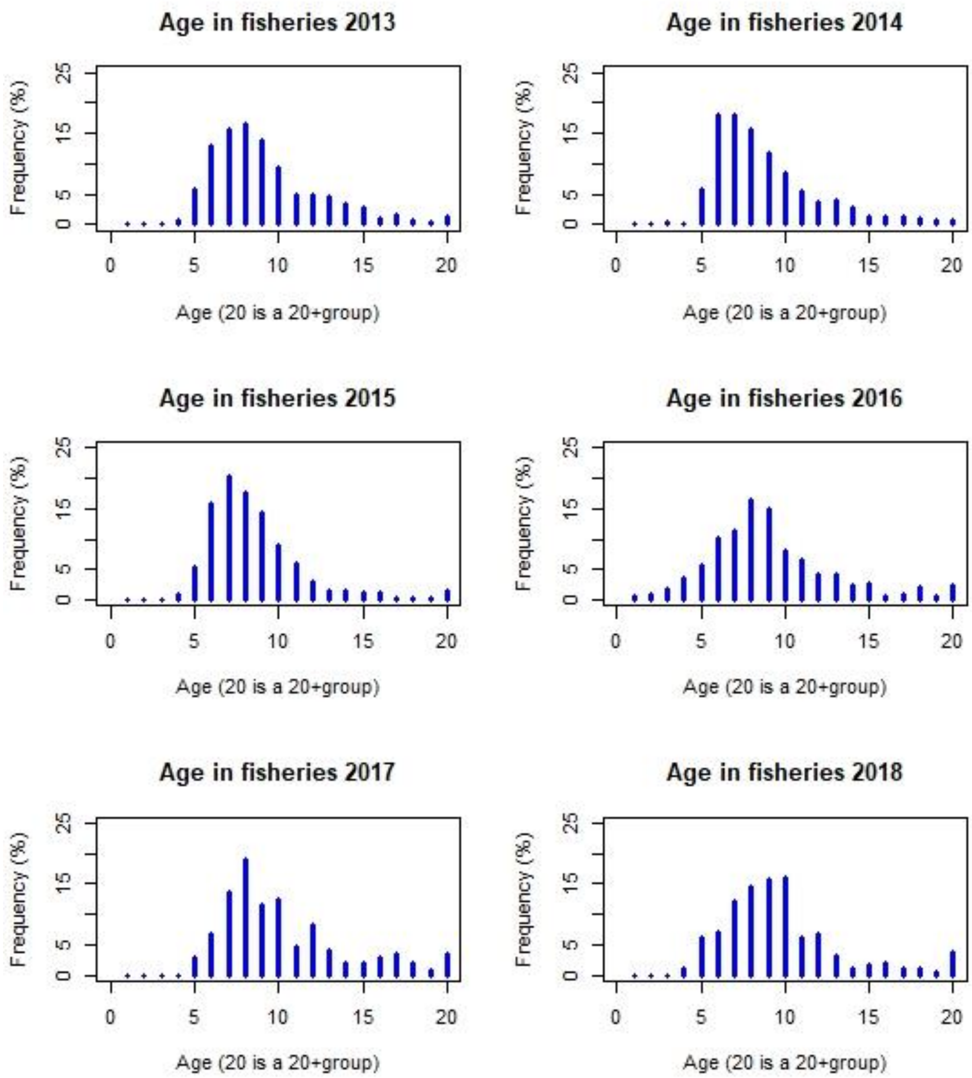


Figure 6.2.9. Greater silver smelt in 1, 2, 3, and 4. Age composition of Norwegian landings samples, 2013-2018.

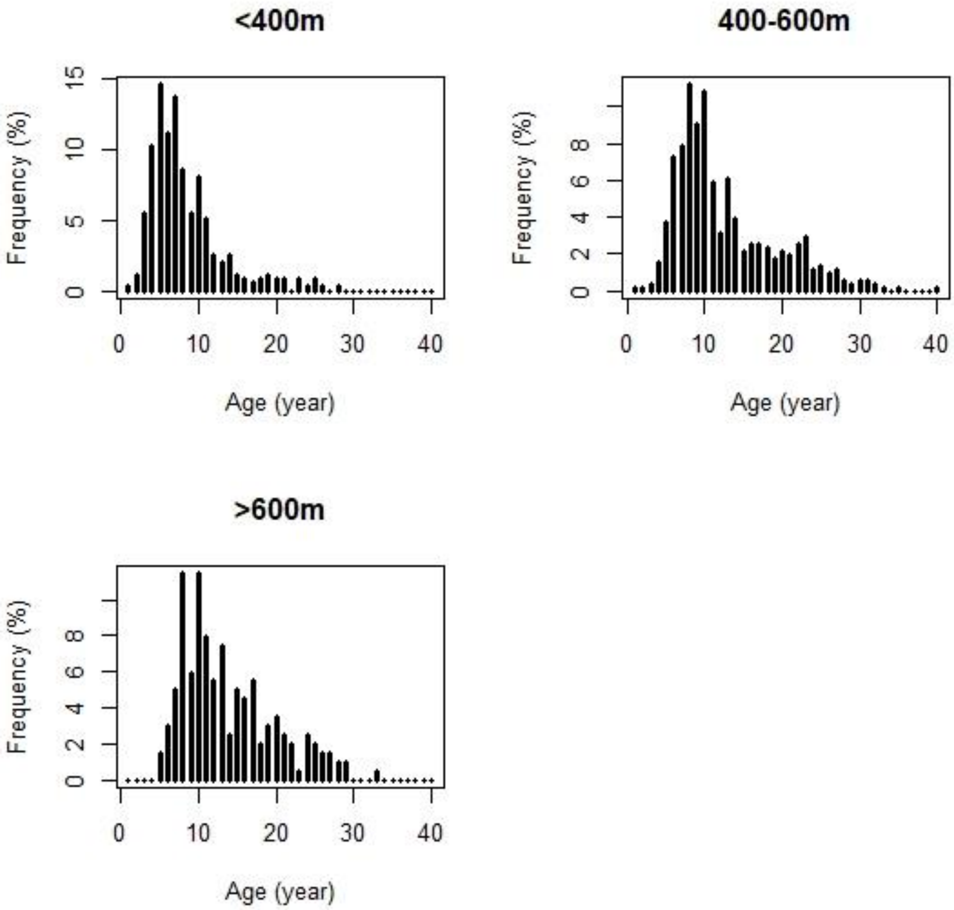


Figure 6.2.10. Greater silver smelt in 1, 2, 3, and 4. Age compositions by depth zones in the Norwegian slope survey in March–April 2018.

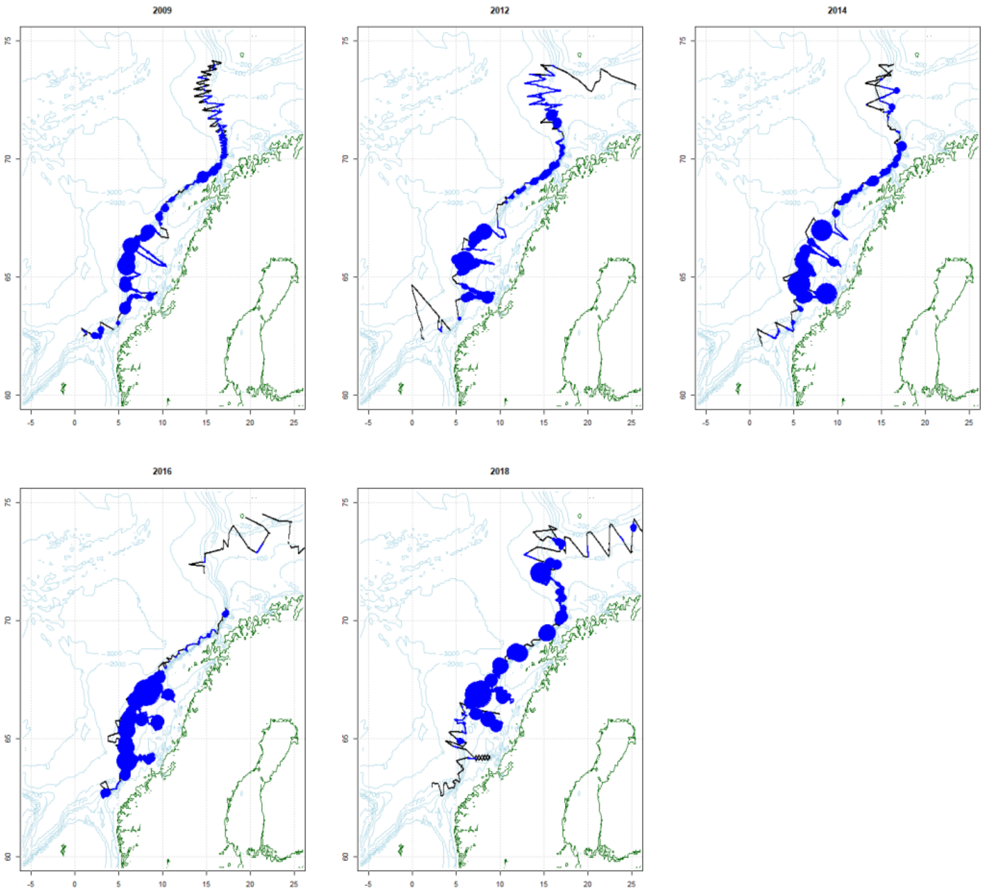


Figure 6.2.11. Greater silver smelt in 2.a. Acoustic backscattering strength estimates SA-values) in Norwegian continental shelf and slope surveys March–April 2009, 2012, 2014, 2016 and 2018.

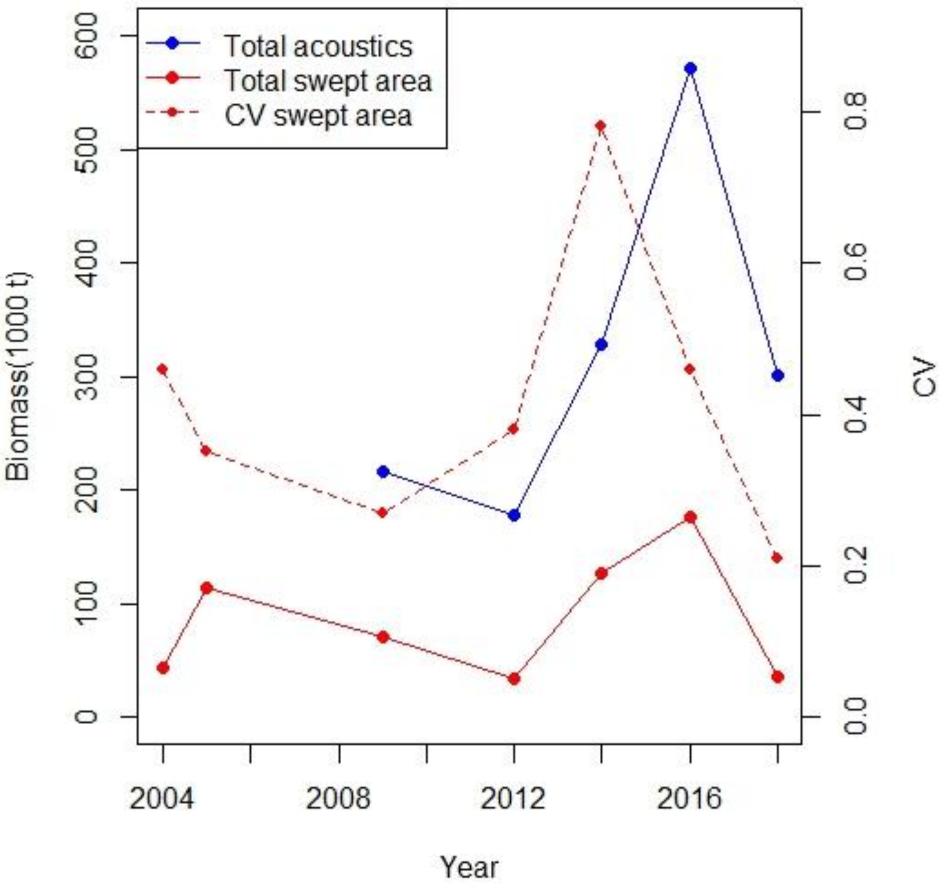


Figure 6.2.12. Estimated biomass for greater silver smelt for acoustic surveys in March–April 2009, 2012, 2014, 2016 and 2018 (for method see Harbitz, 2010), and bottom trawl swept area estimates from the same surveys and 2004 and 2005 in addition. Also shown is CV for the trawl estimates.

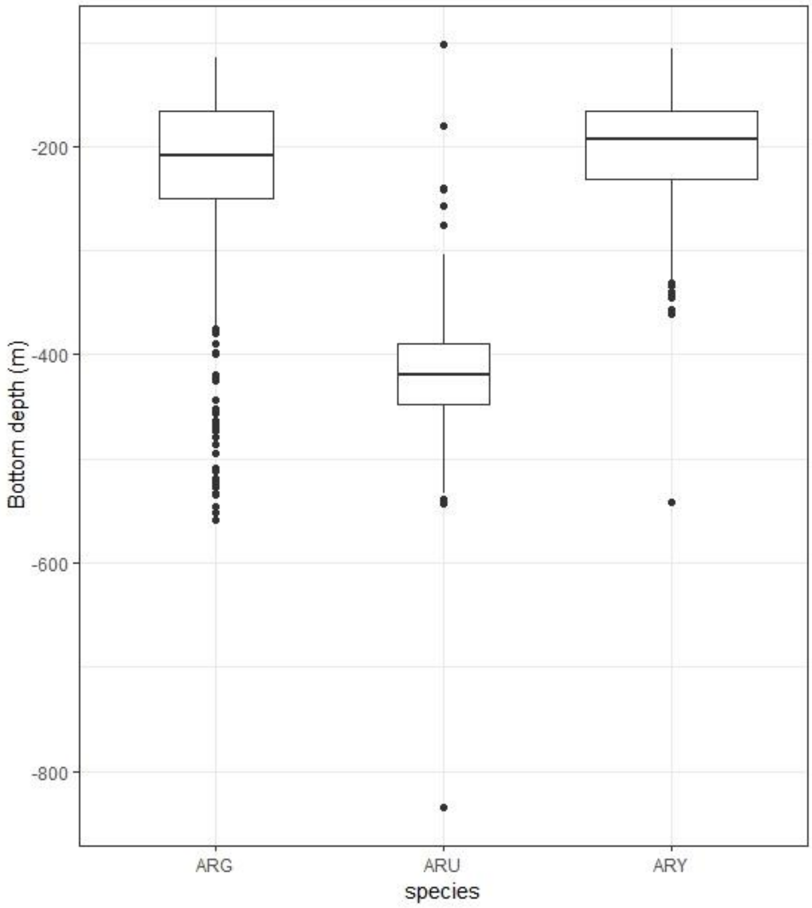


Figure 6.2.13. Boxplot showing depth where catches were registered in 2018 according to logbooks as respectively ARG (mixed greater silver smelt and lesser silver smelt), ARU (greater silver smelt) and ARY (lesser silver smelt).

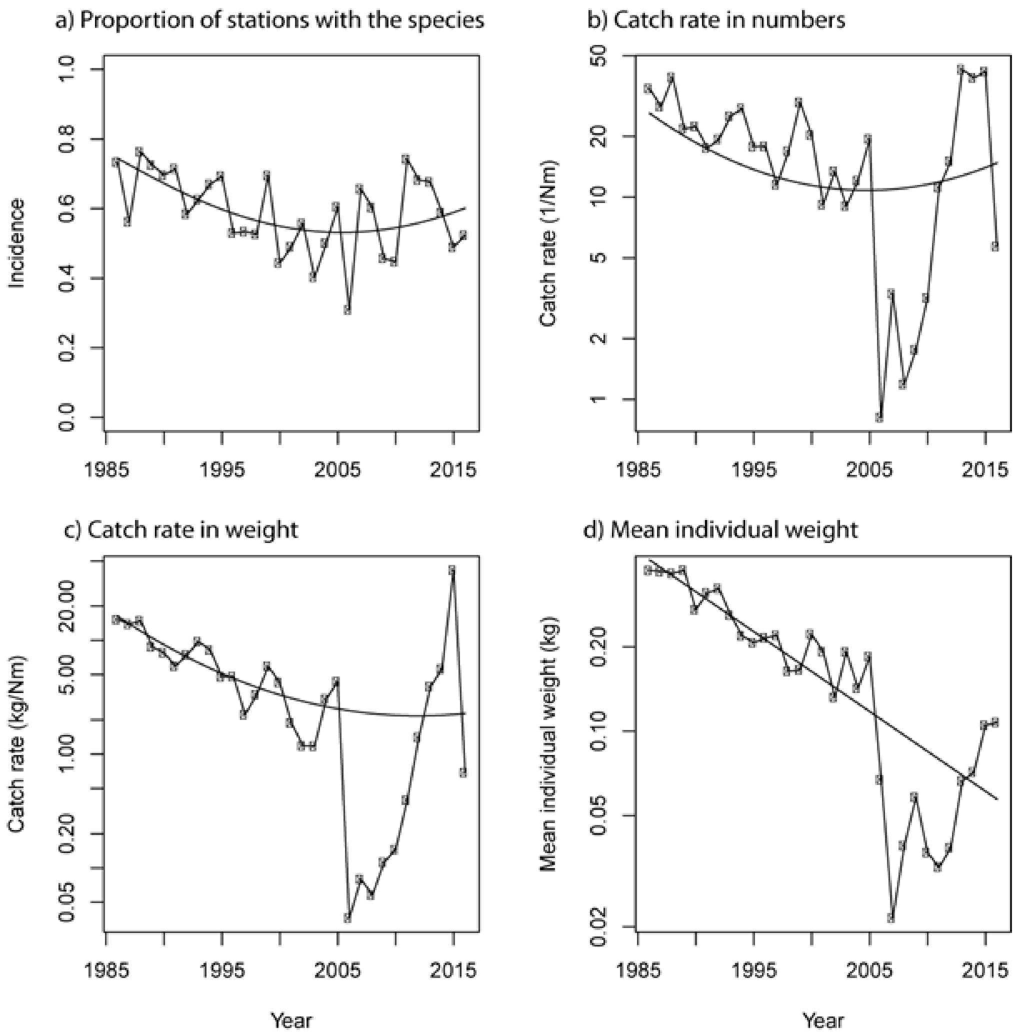


Figure 6.2.14. Greater silver smelt in 1, 2, 3 and 4. Annual estimates of incidence, mean catches in numbers and weight, and mean lengths derived from the annual Norwegian shrimp survey in 3.a and eastern parts of 4.a, 1985–2016 (note-logarithmic scales). Superimposed on the means are fitted trend lines, allowing for linear and quadratic effects, using quasi-Poisson regression. (from Hallfredsson *et al*., 2017, WD16 WGDEEP).

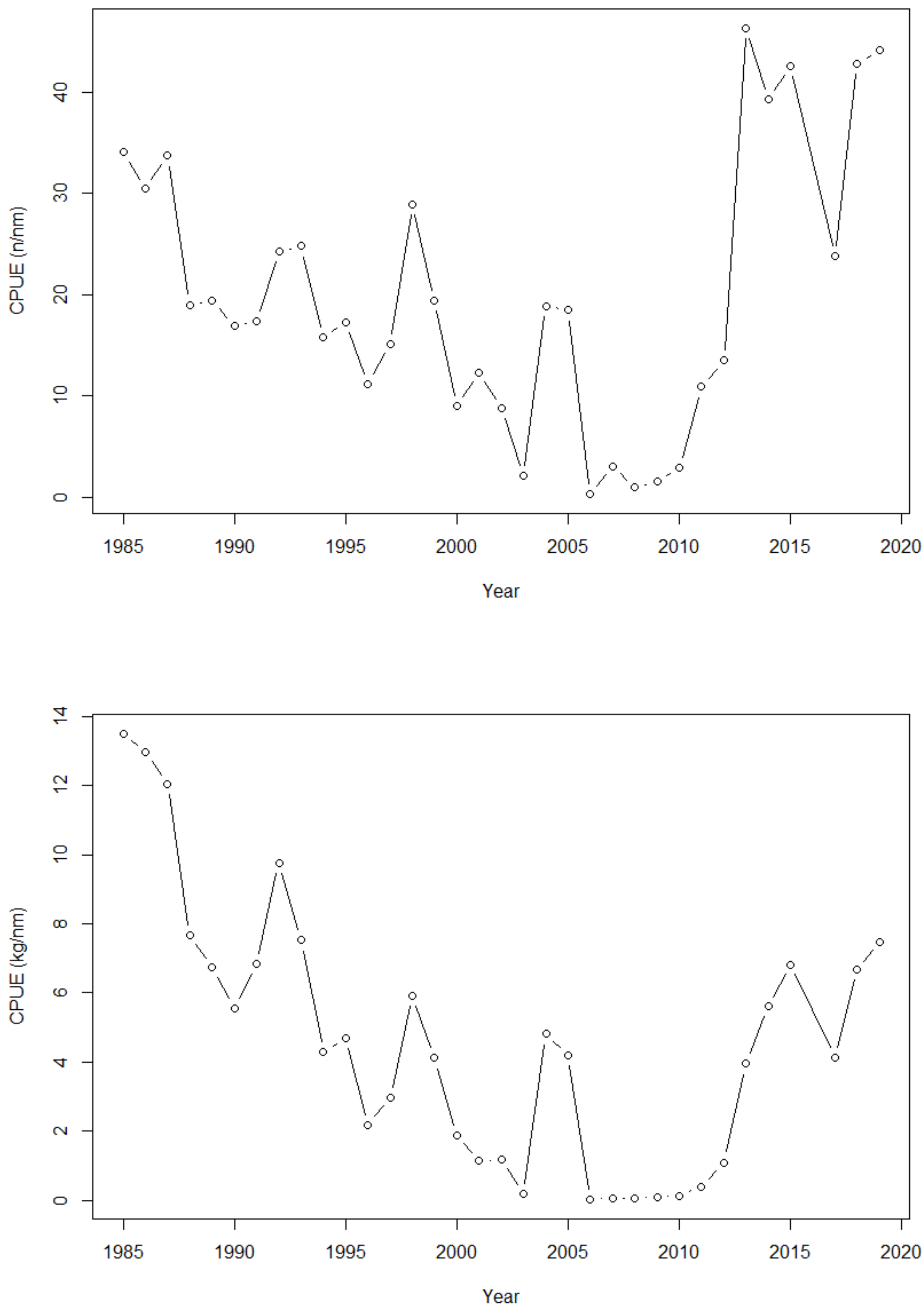


Figure 6.2.15. CPUE in numbers (upper figure) and biomass (lower figure) of greater silver smelt in 1,2,3 and 4 recalculated for the annual Norwegian shrimp survey (1986-2019).

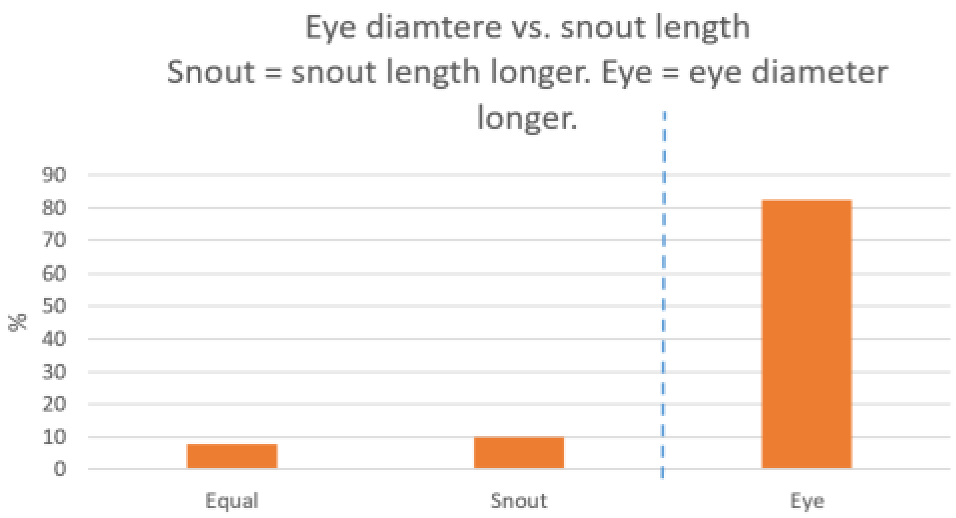


Figure 6.2.16. Eye-snout ratio percent appearance in samples from the fishery. If the snout length is longer than the eye diameter (Snout) the fish is lesser silver smelt, while vice versa if eye diameter is longer then snout length (Eye) the fish is considered greater silver smelt.

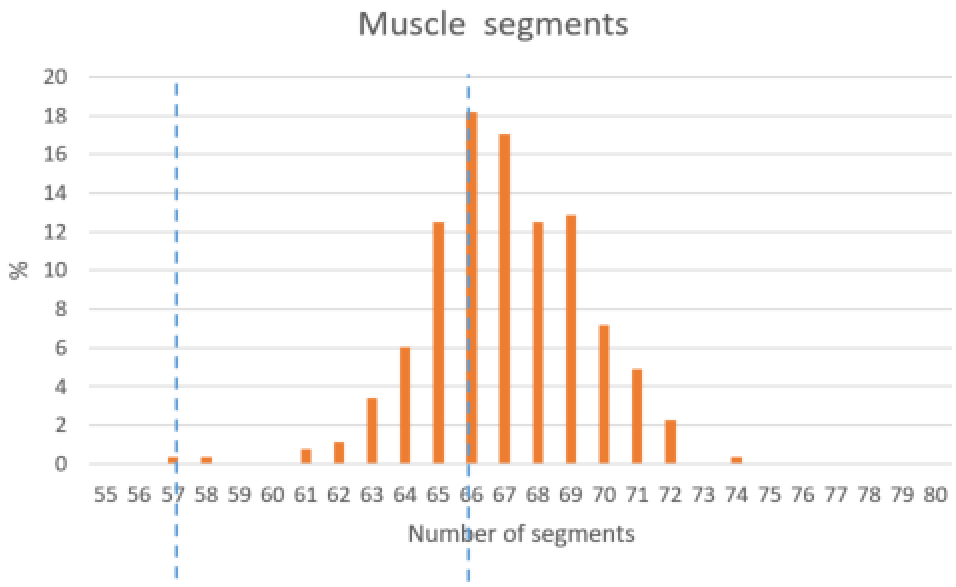


Figure 6.2.17: Number of muscle segments the samples from the fishery . Blue dotted lines show boundaries for the taxonomic measure. Less than 57 are lesser silver smelt while 64 or more are greater silver smelt.

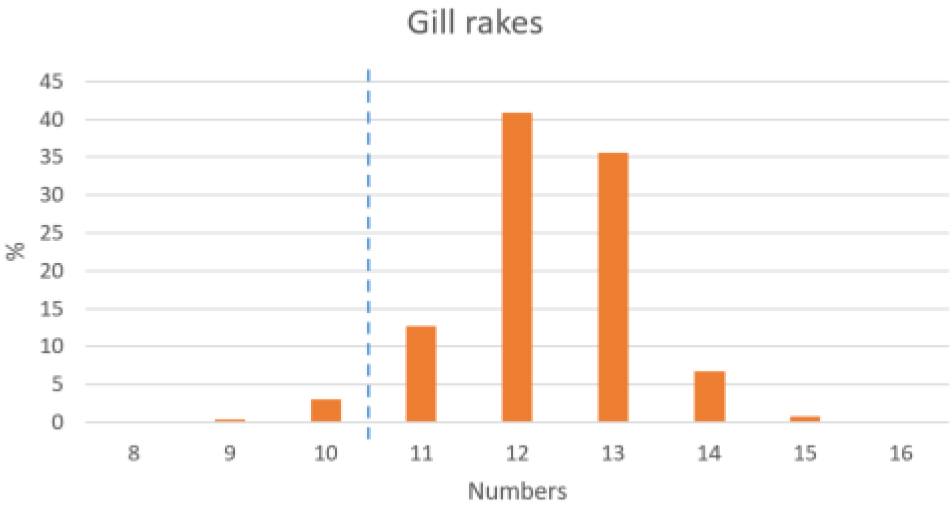


Figure 6.2.18. Number of gill rakes in the samples from the fishery. More than 10 are greater silver smelt.

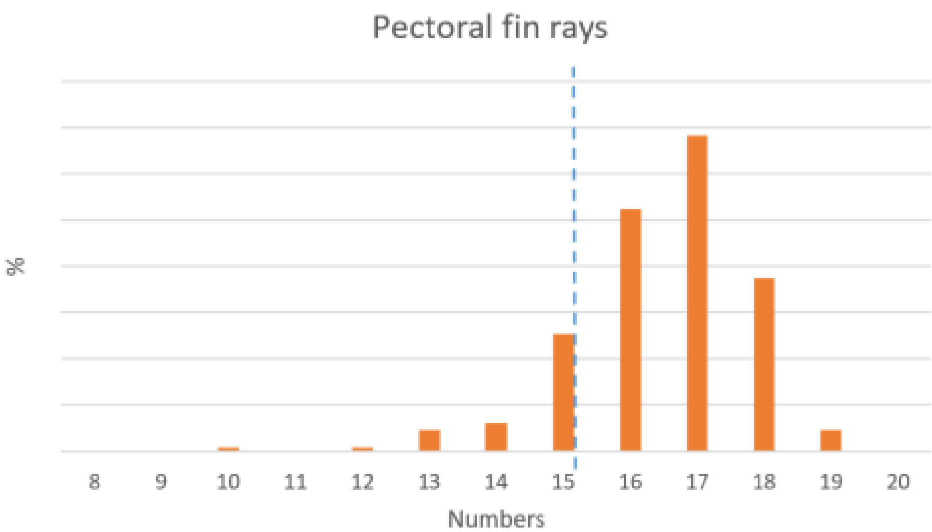


Figure 6.2.19 Number of pectoral fin rays in the samples from the fishery. More than 15 are greater silver smelt.

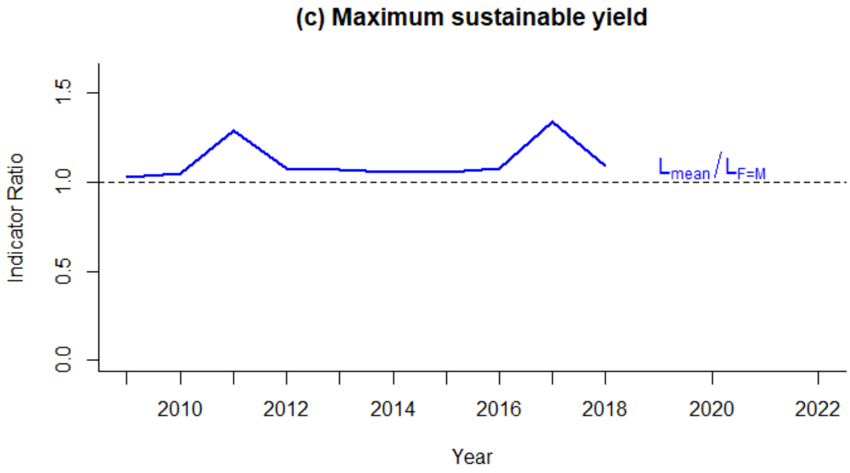


Figure 6.2.20. Greater silver smelt in subareas 1,2 and 4, and in division 3a. Index ratio $L_{mean}/L_{F=M}$ from the length-based indicator method used for the evaluation of the exploitation status in subarea 1 and 2. The exploitation status is below $F_{MSYproxy}$ when the index ratio value is higher than 1.

6.3 Greater silver smelt (*Argentinus silus*) in 5.a and 14

6.3.1 Fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m, as targeted fishing is only allowed at depths greater than 400 m (Figure 6.1.1). 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 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 in the past (Table 6.1.1).

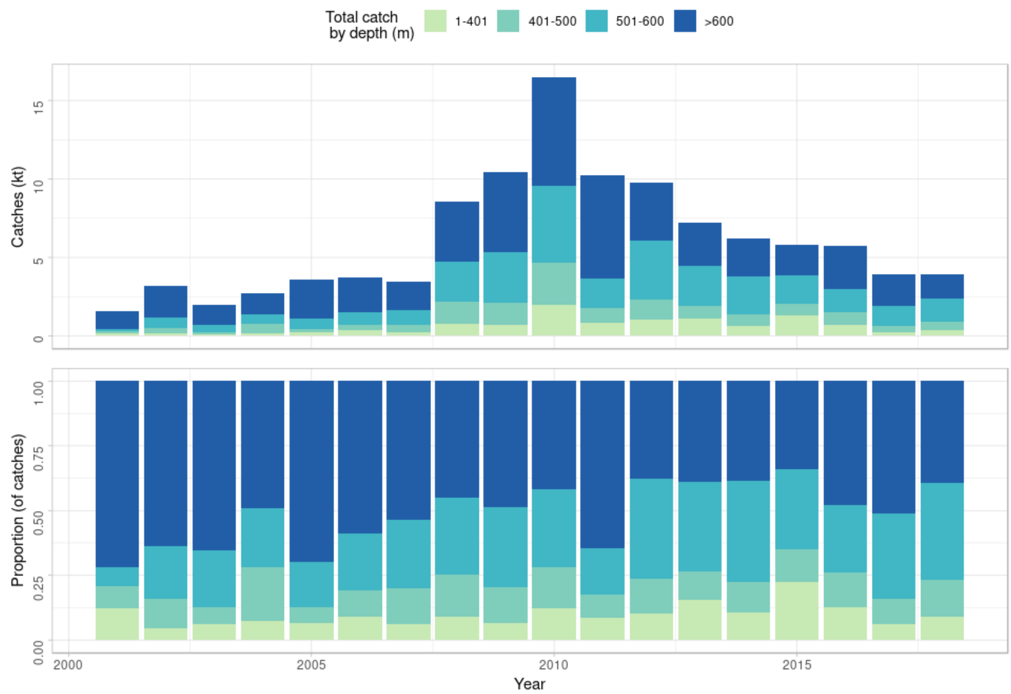


Figure 6.1.1 Greater silver smelt in 5.a and 14. Depth distribution of catches in 5.a according to logbooks. All gears combined.

6.3.1.1 Fleets

Since 1996 between 20 and 39 trawlers have annually reported catches of greater silver smelt in 5.a (Table 6.1.1). The trawlers participating in the greater silver smelt fishery also target redfish (*Sebastes marinus* and *S. mentella*) and to lesser extent Greenland halibut and blue ling. Number of hauls peaked in 2010, but the number of hauls have decreased since then in line with lower total catches. In most years over 50% of the greater silver smelt catches are taken in hauls were the species is more than 50% of the catch (Table 6.1.1).

Table 6.1.1. Greater silver smelt in 5.a. Information on the fleet reporting catches of greater silver smelt.

YEAR	NUMBER TRAWLERS	NUMBER HAULS	REPORTED CATCH	NO. HAULS WHICH GSS >50% OF CATCH	PROPORTION OF REPORTED CATCH IN HAULS WERE GSS >50%
1997	26	854	2257	384	0,846
1998	39	2587	11132	1968	0,955
1999	24	1451	4456	824	0,865
2000	23	1263	3491	643	0,827
2001	26	767	1577	255	0,715
2002	32	1134	3127	504	0,777
2003	30	1127	1965	253	0,538
2004	27	1017	2688	340	0,705
2005	30	1368	3520	361	0,732
2006	31	1542	3725	395	0,715
2007	26	1259	3440	461	0,759
2008	31	3143	8428	863	0,663
2009	34	3434	10233	1010	0,694
2010	36	4724	16280	1836	0,740
2011	34	3244	10155	973	0,723
2012	31	3334	9732	985	0,713
2013	31	2704	7192	618	0,651
2014	24	2336	6157	487	0,614
2015	24	1836	5312	334	0,600
2016	26	2090	5708	387	0,596
2017	21	1347	3878	241	0,593
2018	20	1424	3876	216	0,481

6.3.1.2 Targeting and mixed fisheries issues in the Greater Silver Smelt fishery in 5.a

Mixed fisheries issues: species composition in the fishery

Redfish spp. (*Sebastus marinus* and *S. mentella*) are the main bycatch species in the mixed fishery encompassing 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 5.a (Table 6.1.2).

Table 6.1.2. Greater silver smelt in 5.a. Proportional bycatch species composition where greater silver smelt was more than 50% of the total catch in a haul.

Year	Redfish		Greenland halibut	Ling	Blue ling	Other
	S. marinus	*S. mentella*				
1997	1,4	79	0,0	6,9	7,2	5,5
1998	5,3	77,9	0,0	3,6	6,4	6,8
1999	4	79,9	0,0	2,5	5,9	7,6
2000	4,8	71	0,2	0,3	9,7	14,1
2001	22,4	55,4	4,5	0,5	0,9	16,3
2002	16,9	74,2	0,4	1,2	4,0	3,2
2003	37,7	52	0,4	0,1	5,1	4,7
2004	25,1	68,4	0,7	0,1	0,9	4,8
2005	15,6	69,5	4,3	1,4	3,0	6,2
2006	28,8	59,8	1,4	0,9	1,0	8,1
2007	12,1	70,9	5,9	0,3	6,1	4,6
2008	26,7	60,8	2,8	1,2	5,0	3,4
2009	20,9	63,7	3,3	0,2	7,9	4,1
2010	16	63,7	2,0	0,9	6,4	11,1
2011	13,4	66,3	2,2	0,4	4,8	12,9
2012	8,9	67,5	1,3	0,2	7,5	14,5
2013	9,6	63,8	4,7	0,2	9	12,8
2014	2,4	78,3	2,8	0,3	5,5	10,7
2015	13,8	67,1	3,1	0,3	4,2	11,7
2016	10,9	73,5	5,5	0,2	2,8	7,1
2017	2,9	85,6	1,6	0,2	2,9	6,8
2018	4,7	87,7	2,1	0,1	1,6	4

Spatial distribution of catches through time

Spatial distribution of catches in 1996–2018 is presented in Figures 6.1.2 and 6.1.3. 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 likely reason for this is that the fleet focusing on redfish and Greenland halibut in more northern regions also takes a few hauls of greater silver smelt in the area (Figures 6.1.2 and 6.1.3).

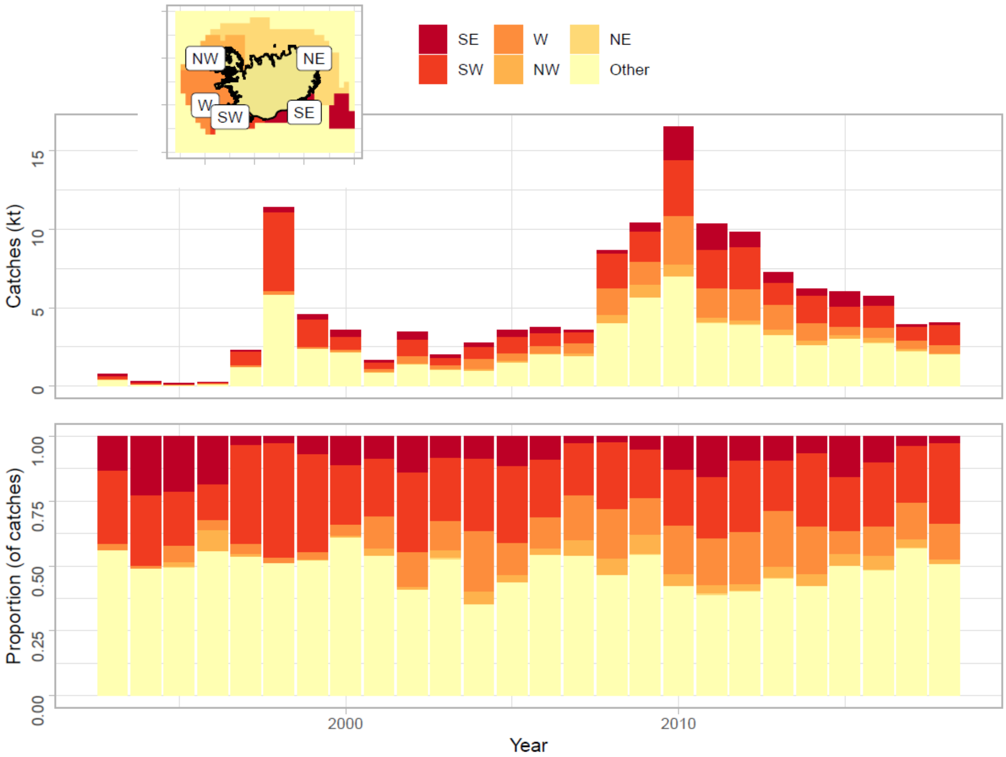


Figure 6.1.2 Greater silver smelt in 5.a and 14. Spatial distribution of catches defined by regions deeper than 400 m by year (See stock annex for details). Above are the catches on absolute scale and below in proportions. All gears combined.

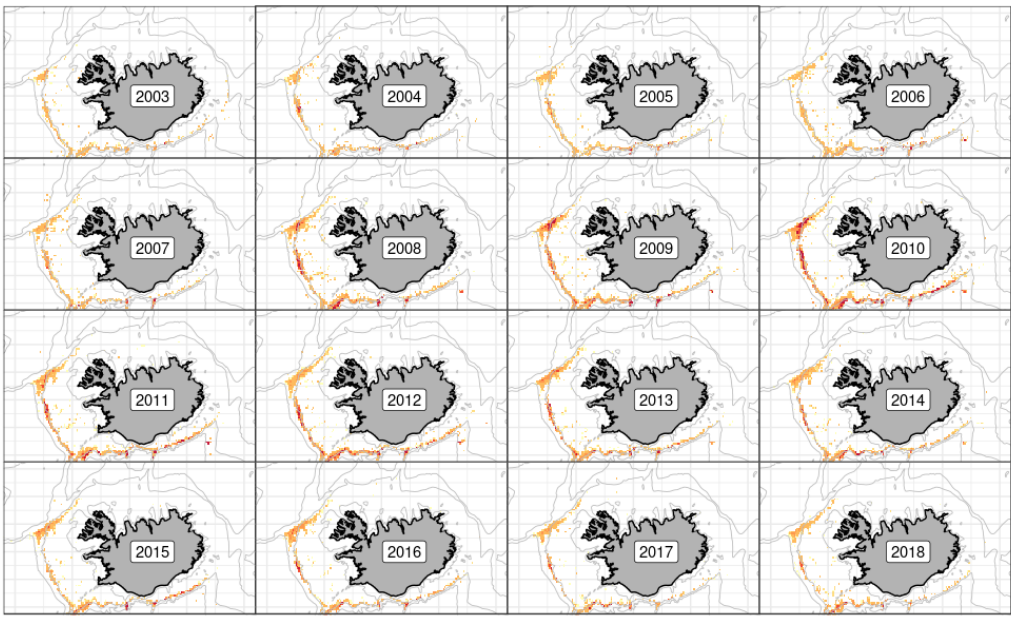


Figure 6.1.3 Greater silver smelt in 5.a and 14. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

6.3.1.3 Landing trends

Landings of Greater Silver Smelt are presented in Table 6.1.3 and Figure 6.1.4. 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 2 600 to 6 700 t. Since 2008 landings have increased substantially, from 4 200 t in 2007 to almost 16 500 t in 2010. In 2011 landings started to decrease due to increased management actions, and landings in 2018 amounted close to 4 500 tonnes in 14 and 5.a.

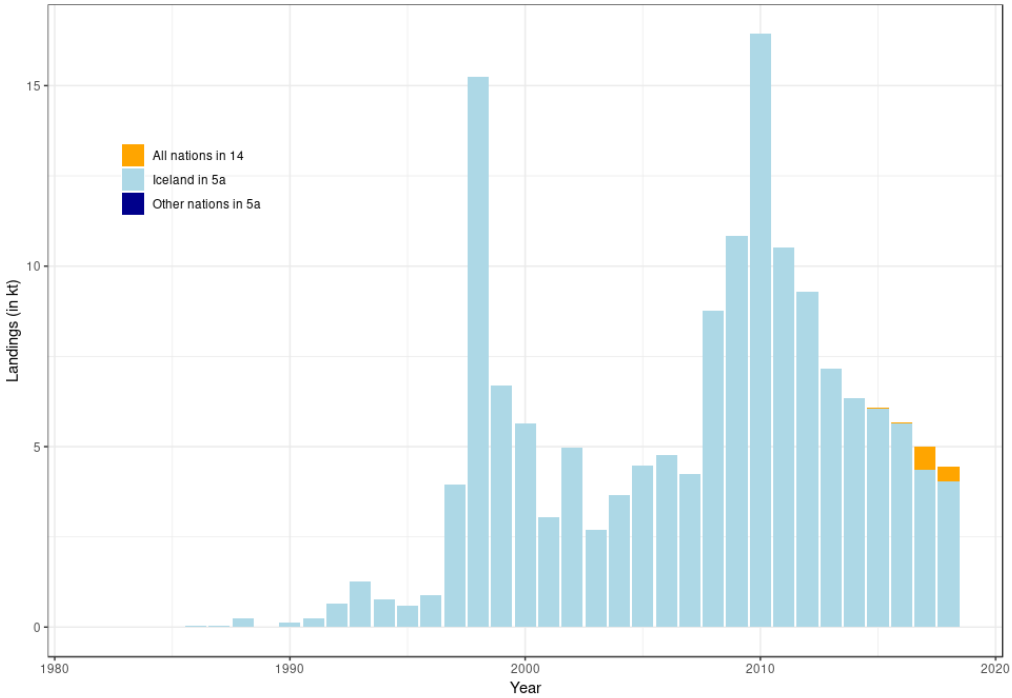


Figure 6.1.4 Greater silver smelt in 5.a and 14. Nominal landings. 23 tonnes were landed by foreign vessels (England and Wales) in 1999, which is the only year of catches reported by foreign vessels.

Table. 6.1.3. Greater silver smelt in 5.a and 14. Landings records from the Icelandic directorate of Fisheries and Greenland (WD05, annexed to this report).

Year	Inside the NEAFC RA	Outside the NEAFC RA		Catches
		Section 5.a	Section 14.b	
1988				206
1989				8
1990				112
1991				247
1992				657
1993				1255
1994				613
1995				492
1996				808
1997				3367
1998				13387
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
2013	0	7154		7154
2014	0	7241	4	7245

Year	Inside the NEAFC RA	Outside the NEAFC RA		Catches
2015	0	6056	12	6068
2016	0	5646	16	5662
2017	0	3946	666	4612
2018	0	4035	425	4460

6.3.1.4 ICES advice

The ICES advice for 2018 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 7 603 tonnes. The basis for the advice was the following: For data-limited stocks with reliable abundance information from fisheries-independent data and a target F_{proxy}, where abundance is considered above MSY $B_{trigger}$, ICES uses a harvest control rule that calculates catches based on the F_{proxy} target multiplied by the most recent survey biomass estimates. For this stock the F_{proxy} of 0.171 is applied (with no uncertainty cap) as a factor to the 2018 survey index biomass estimate of 55 693, resulting in catch advice of no more than 9 124 t. ICES does not implement the default rule as used for other data-limited stocks because the fishing mortality has changed significantly in the last two years.

6.3.1.5 Management

Before the 2013/2014 fishing year the Icelandic fishery was managed as an exploratory fishery subject to licensing since 1997. A detailed description of regulations on the fishery of greater silver smelt in 5.a is given in the stock annex.

The TAC for the 2013/2014 fishing year was set at 8 000 based on the recommendations of MRI using a preliminary Gadget model and the 2014/2015 fishing year the recommendation was to maintain the catches at 8 000 t. For the fishing year 2015/2016 it was also maintained at 8 000 t, but was 7 885 t for 2016/2017, 9 310 t for 2017/2018 and 7 603 t for 2018/2019.

Figure 6.1.5 illustrates the difference between national TAC and landed catch in 5a. The difference can be attributed to species transformation (in both directions, Figure 6.1.5). For the 1999/2000 fishing year the government of Iceland increased TAC mid-season.

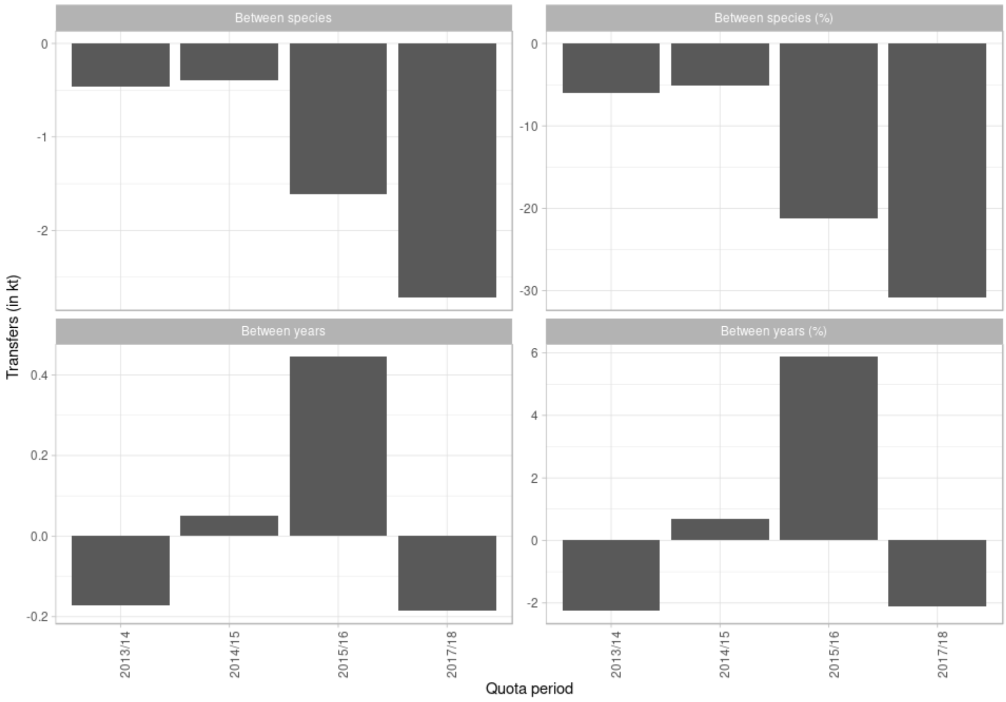


Figure 6.1.5 Greater silver smelt in 5.a and 14. An overview of the net transfers of quota between years and species transformations in the fishery in 5.a.

6.3.2 Data available

In general sampling is considered good from commercial catches, as one of the requirements of owning a fishing license for greater silver smelt is the retention of scientific samples (Table 6.1.4). The sampling does seem to cover the spatial distribution of catches. Similarly, sampling does seem to follow the temporal distribution of catches (see MRI 2012). The sampling coverage by gear in 2018 is shown in Figure 6.

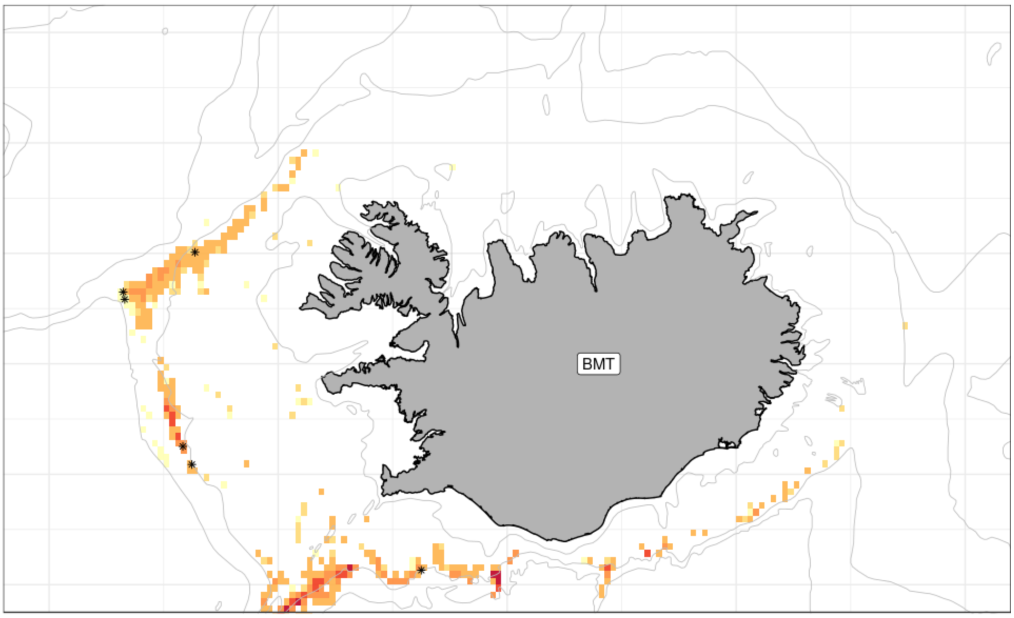


Figure 6.1.6 Greater silver smelt in 5.a and 14. Fishing grounds in 2018 as catches reported in logbooks (tiles) and positions of samples taken from landings (asterisks) by main gear types.

6.3.2.1 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.

6.3.2.2 Length compositions

(Table 6.1.4) gives the number of samples and measurements available for calculations of catch in numbers of Greater Silver Smelt in 5.a. Length distributions from autumn survey and commercial samples are presented in Figures 6.1.7 and 6.1.8 respectively.

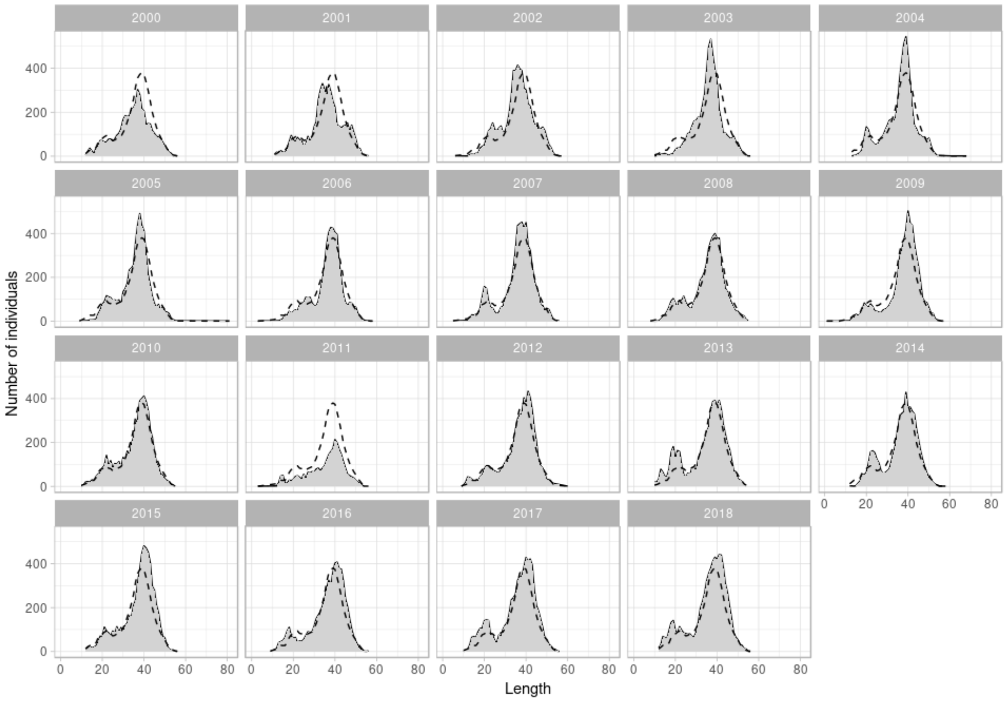


Figure 6.1.7 Greater silver smelt in 5.a and 14. Length distributions from Icelandic autumn survey catches. Small numbers to the right refer to mean length (ML).

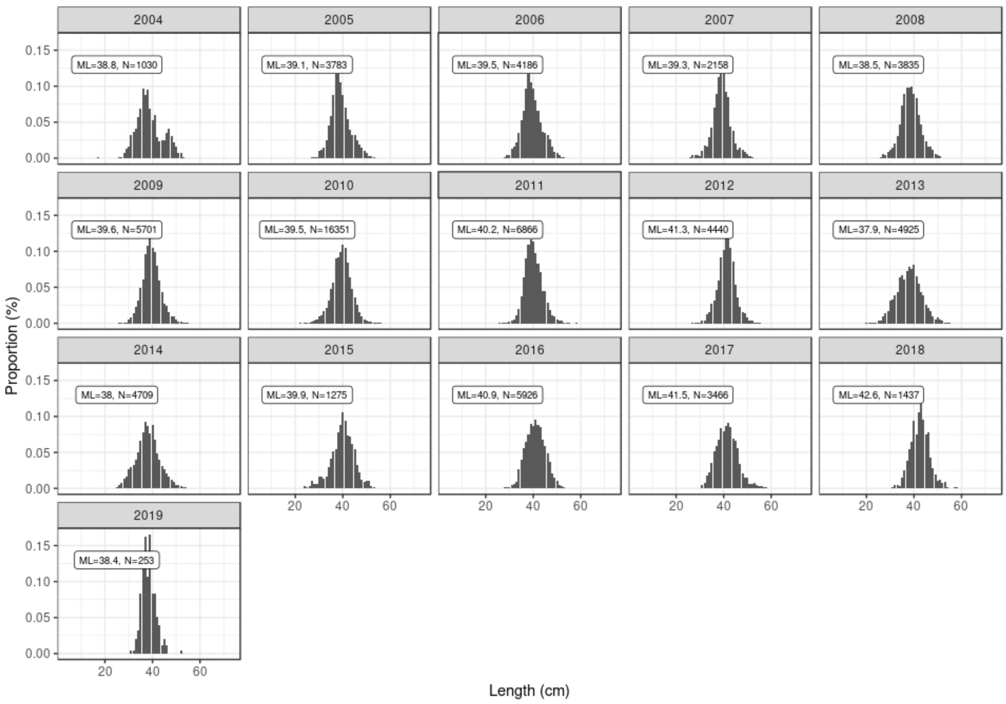


Figure 6.1.8 Greater silver smelt in 5.a and 14. Length distributions from commercial catches.

6.3.2.3 Age compositions

(Table 6.1.5) gives the number of samples and measurements available for calculations of catch in numbers of greater silver smelt in 5.a. Age distributions estimated from as catch in numbers are given in Figure 6.1.9.

Table 6.1.5. Greater silver smelt in 5.a. Summary of sampling intensity and overview of available data.

Year	No. length samples	No. length measurements	No. otolith samples	No. otoliths	No. aged otoliths
1997	45	4863	28	1319	985
1998	141	14911	102	6018	890
1999	58	4163	44	2180	82
2000	27	2967	18	1011	113
2001	10	489	6	245	17
2002	21	2270	10	360	127
2003	63	5095	13	425	0
2004	34	996	7	225	84
2005	49	3708	14	772	0
2006	29	4186	13	616	465
2007	14	2158	8	285	272
2008	44	3726	39	1768	1387
2009	53	5701	36	1746	1387
2010	134	16351	68	3370	3120
2011	63	6866	40	1953	1774
2012	35	3891	23	1094	405
2013	47	4925	34	710	704
2014	32	4709	16	350	340
2015	11	1275	8	221	217
2016	45	5880	13	285	184
2017	20	2927	12	250	206
2018	12	1437	9	185	181

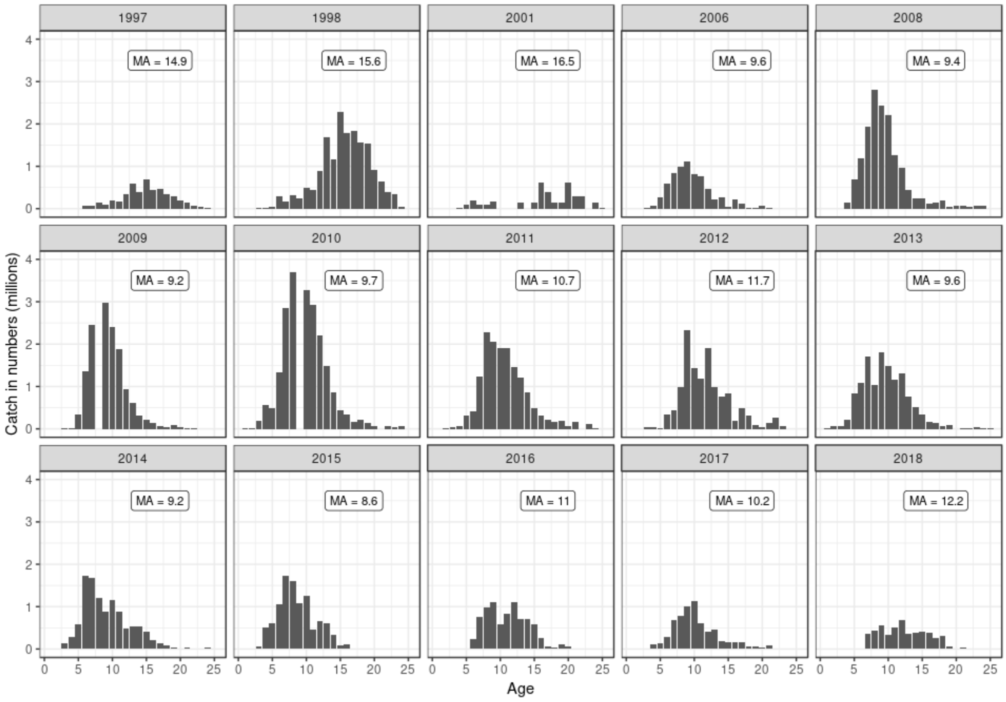


Figure 6.1.9 Greater silver smelt in 5.a and 14. Catch in numbers at age. Estimates for 2002 are based on limited number of aged otoliths.

6.3.2.4 Weight at age

No marked changes can be observed in mean weight-at-age from commercial catches between 1997–1998 and 2006–2013.

6.3.2.5 Maturity at age and natural mortality

Estimates of maturity ogives of greater silver smelt in 5.a 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 5.a are mature.

No information exists on natural mortality of greater silver smelt in 5.a.

6.3.2.6 Catch, effort and research vessel data

Catch per unit of effort and effort data from commercial fisheries

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

The Icelandic spring groundfish 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 5.a and is therefore not considered representative of stock biomass. The survey may be indicative of recruitment; however, the data have not been explored in sufficient detail to be used for this purpose. In addition, the autumn survey was commenced in 1996 and expanded in 2000. A detailed description of the autumn groundfish survey is given in the stock annex for greater silver smelt in 5.a. The survey is considered representative of stock biomass of greater silver smelt since it was expanded in 2000. Figure 6.1.10 gives trends in biomass density and juvenile density (numbers) for the spring survey in 1985 to 2019 and for the autumn survey in 2000 to 2018. These values represent simple mean densities over stations; no stratification was used in these as the standard spring and autumn stratification schemes are inappropriate. Due to industrial action in 2011 the autumn survey was cancelled after about one week of survey time. Greater Silver Smelt is among the most difficult demersal fish stocks to get reliable information on from bottom-trawl surveys. This is in large part due to the fact that most of the greater silver smelt caught in the survey is taken in few but relatively large hauls. This can result in very high indices with large variances particularly if the tow-station in question happens to be in a large stratum with relatively few tow-stations. Therefore, a special stratification scheme was developed and the index is winsorized when used in the advisory procedure (See stock annex for details). A comparison of indices, with or without winsorization are shown in Figure 6.1.11. No substantial changes in spatial distribution are seen in general 6.1.12.

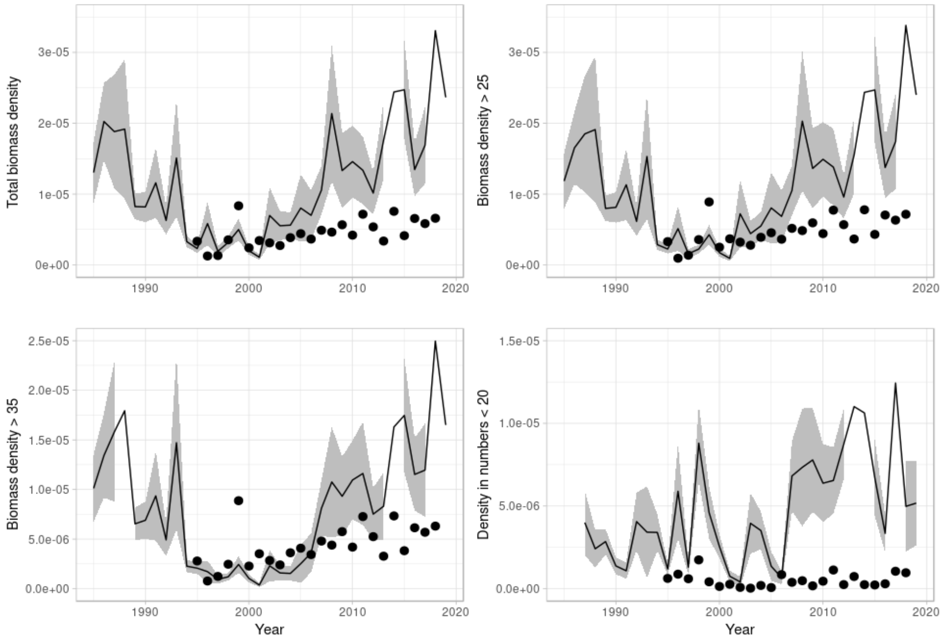


Figure 6.1.10 Greater silver smelt in 5.a and 14. Indices calculated without stratification (mean density) from the Icelandic spring survey (black lines and shaded area) and from the autumn survey (dots and vertical lines). Vertical lines and shaded area represent +/- 1 standard error.

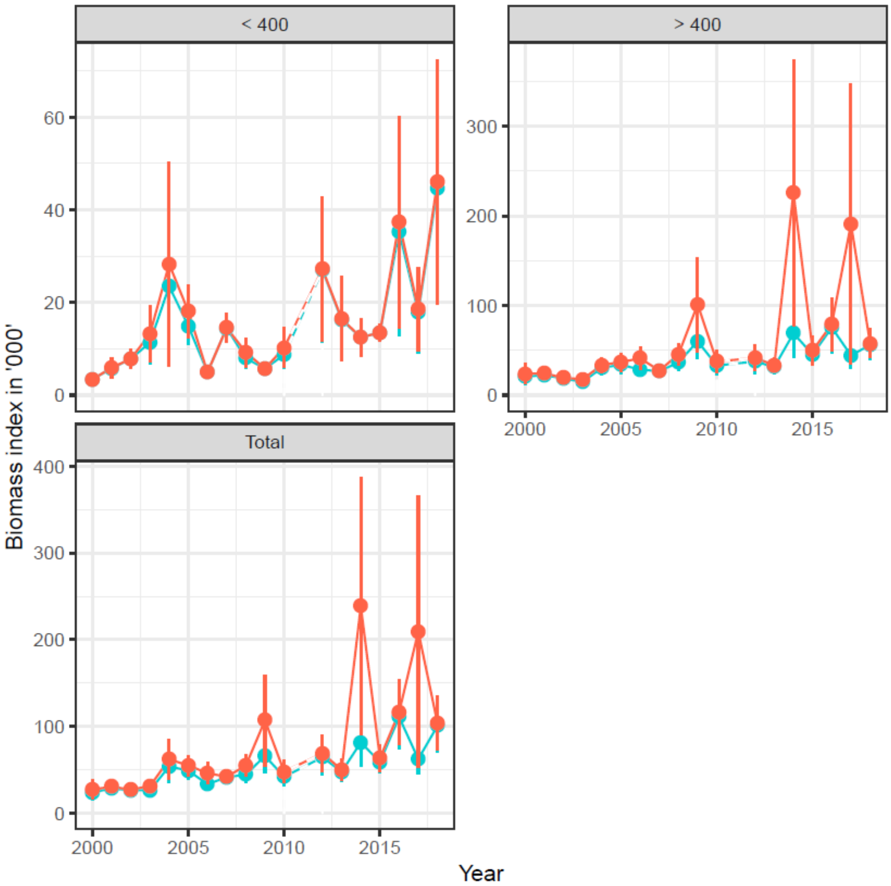


Figure 6.1.11 Greater silver smelt in 5.a and 14. Index from the Icelandic autumn survey, including stratification and separated by depth. The line colour indicates the biomass index used, either un-altered (red) or Winsorized (blue).

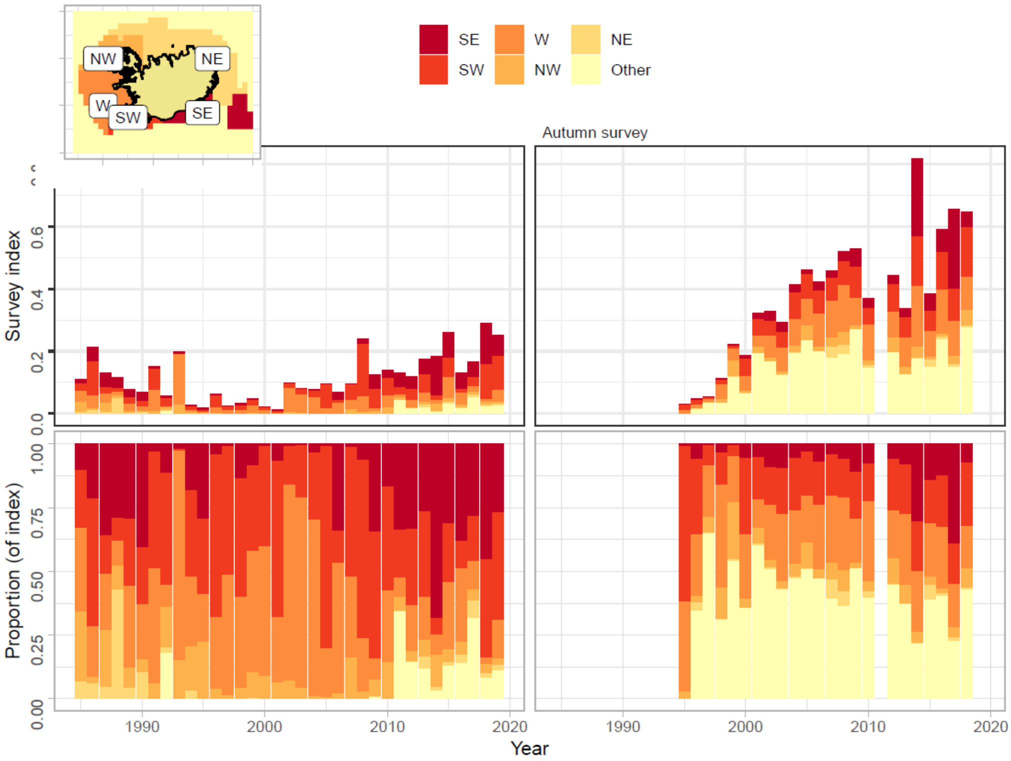


Figure 6.1.12 Greater silver smelt in 5.a and 14. Estimated survey biomass in the autumn survey by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

6.3.3 Data analyses

6.3.3.1 Landings and sampling

Spatial distribution of catches in 5.a did not change markedly between 2015 and 2016 and fishing for greater silver smelt in the NW area seems to have stopped (Figures 6.1.2 and 6.1.3). Landings of greater silver smelt increased in 5.a rapidly from 2007 to 2010 when they peaked at around 16 000 tonnes, since then they have decreased to around 4344 tonnes in 2018 (Figure 6.1.4 and Table 6.1.5). The decrease in catches is the result of increased vigilance by the managers to constrain catches to those advised and also lesser interest by the fleet in the stock. 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 which can also be seen in recent years (Figures 6.1.7 and 6.1.8). 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. However, as is the case for mean length, mean age in catches in 2012 increased, and is estimated closer to 11 years in the most recent years (Figures 6.1.9). The reason for this change is not known as there is no marked difference in the spatial distribution of the fishery; however, reduced fishing pressure may be a factor.

6.3.3.2 Surveys

As mentioned above, greater silver smelt is a difficult species to survey in trawl surveys and the indices derived from the both the spring and autumn surveys have high CVs. Occasional spikes in the indices without any clear trend characterize the spring survey biomass indices (without stratification). 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 2018 are at a higher level than in 1994–2001. The juvenile index (spring survey) 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 (Figures 6.1.10 and 6.1.11).

The observed trends in the biomass indices from the autumn survey have a considerably different trend than those observed in the spring survey (Figure 6.1.10). According to the autumn survey, biomass increased more or less year on year from 2000 to 2008 but then decreased in 2009 and 2010. The total biomass index in the autumn survey showed slight variations until 2014 when the index increased to the highest value observed.

There is a clear gradient in mean length of greater silver smelt with depth, larger fish being in deeper water. Fishing for greater silver smelt in 5.a is banned at depths less than 400 meters. The autumn survey index for depth greater than 400 meters is therefore considered the best indicator of available biomass to the fishery and is used in the advice procedure. As noted in the section above, the Winsorized index appears to be less sensitive to the few large hauls in the 2009 and 2014 survey years (Figure 6.1.11).

6.3.3.3 F_{proxy}

Changes in relative fishing mortality (F_{proxy} = Yield / Survey biomass at depths greater than 400 m) are presented in Figure 6.1.13. F_{proxy} was relatively stable in 2004 to 2006 but then increased slowly from 2006 to 2008. This was mainly driven by increases in catches. The decrease in 2009 is the result of a very high value of the index in that year but the decrease between 2010 and 2012 is due to decrease in catches as the index was at similar levels between the two years (Figure 6.1.13).

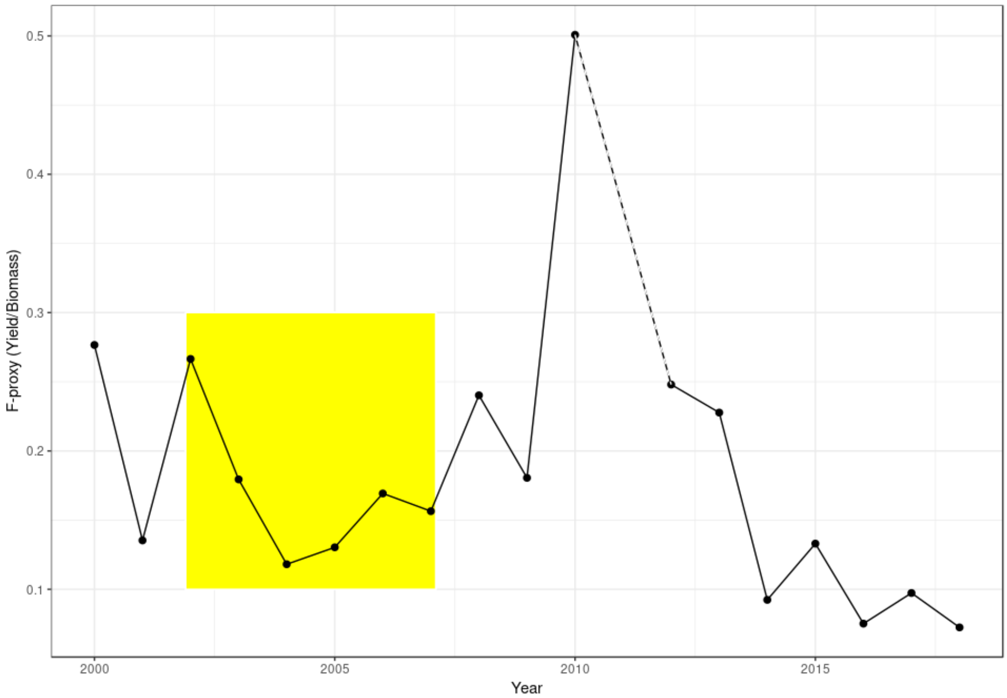


Figure 6.1.13 Greater silver smelt in 5.a and 14. Changes in relative fishing mortality (Fproxy). The index used is the >400 m Winsorized index from the Icelandic autumn survey (see text for further details).

6.3.3.4 Analytical assessment

No analytical assessment presented this year.

6.3.3.5 Comments on the assessment

The assessment was conducted according to the stock annex.

6.3.4 Management considerations

Exploitation of greater silver smelt in 5.a has been reduced in recent years, coming down from a relatively high level in 2010, to levels lower than the average exploitation rate in the reference period.

Although catches have increased substantially in 14 in the past two years, stock structure for this species is unclear, catches are quite distant between 14 and 5.a, and therefore it is possible that section 14 and 5a should be treated as separate stocks (Figure 6.1.13). These data and Greenlandic biomass indices should be considered in the next benchmark. Nonetheless, the catches reported from section 14.b in recent years (Table 6.1.3) has coincided with a period of low harvest rates in Icelandic waters. Therefore, the addition of these data does not change interpretations of stock status or advice given in previous years.

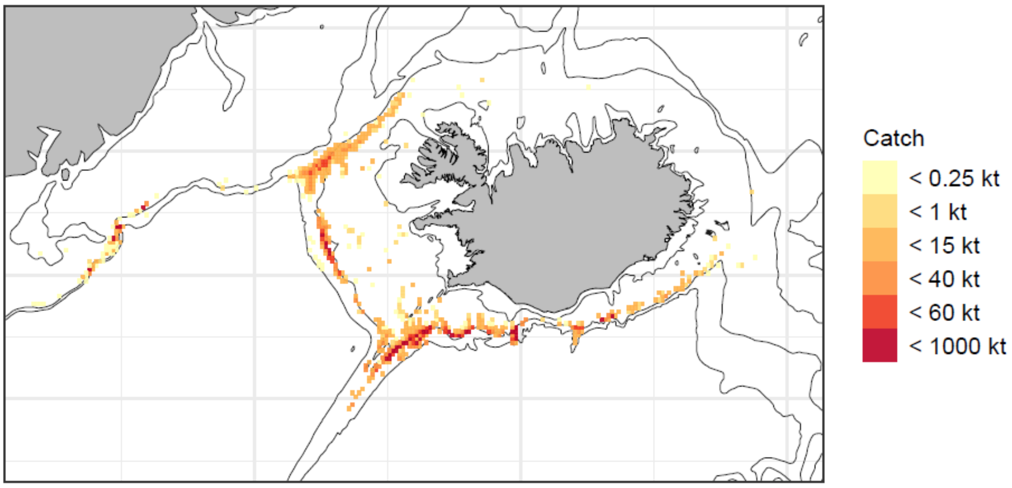


Figure 6.1.13. Spatial distribution of catches from logbook data in sections 14 (east Greenland) and 5.a. (Iceland).

6.3.4.1 Ecosystem considerations for management

Greater silver smelt is a semi-pelagic species, so questions regarding whether the index covers the full stock distribution and how aggregating behaviour affects indicators of biomass. Therefore, biomass indices should continuously be evaluated for effectiveness and compared with other sources of information regarding stock status. With this in mind, potential changes in stock distribution and growth should be monitored closely, as well as the importance of this stock as a forage species (especially at younger ages) to other species in the area. These factors do not currently seem to be an issue in current management but should be monitored carefully.

6.4 Greater silver smelt (*Argentina silus*) in 5.b and 6.a

6.4.1 The fishery

The target fisheries on greater silver smelt in Divisions 5.b and 6.a are mainly conducted by Faroese and European trawlers. In 2018, the catches in 5.b were mainly taken by three pairs of Faroese pair trawlers deploying bentho-pelagic trawls (99%) while the catches in 6.a were mostly taken by European trawlers (65%) and the remainder mainly by Faroese trawlers (35%, inside the Faroese EEZ) (Table 6.4.1, Figure 6.4.1).

Historically, greater silver smelt were only taken as bycatch in the shelf-edge deep-water fisheries and either discarded or landed in small quantities. Targeted fisheries for greater silver smelt in Faroese waters did not develop until the mid-1990s and the early 2000s for Division 6.a.

In Faroese waters, the greater silver smelt fishing grounds, from the mid-1990s to 2007, were located north and west on the Faroe Plateau and around Faroe Bank/Lousy Bank mainly at depths between 300 and 700 meters. Since 2008, the Faroese fishery has extended the fishing grounds to include the area on the Wyville-Thomson Ridge south of the islands (Figure 6.4.2). Since 2012 around 50% of the Faroese catches were caught on the Wyville-Thomson Ridge (in Divisions 5.b and 6.a, inside the Faroese EEZ).

The European fisheries on silver smelt mostly takes place on the shelf edge within Divisions 6a, 5.b and 4.a. New information from the self-sampling program carried out by the European fisheries (Pelagic Freezer-trawler Association, PFA) was presented to the Working Group in 2018 and updated in 2019 (Pastoors, WD 2019). The self-sampling program consists of historical information derived from skipper's notes (2002-2018) and new information collected as part of the research program within the PFA. A preliminary overview of catch rates of silver smelt (both *Argentina silus* and *Argentina Sphyraena*) from these fisheries is shown in Figure 6.4.3.

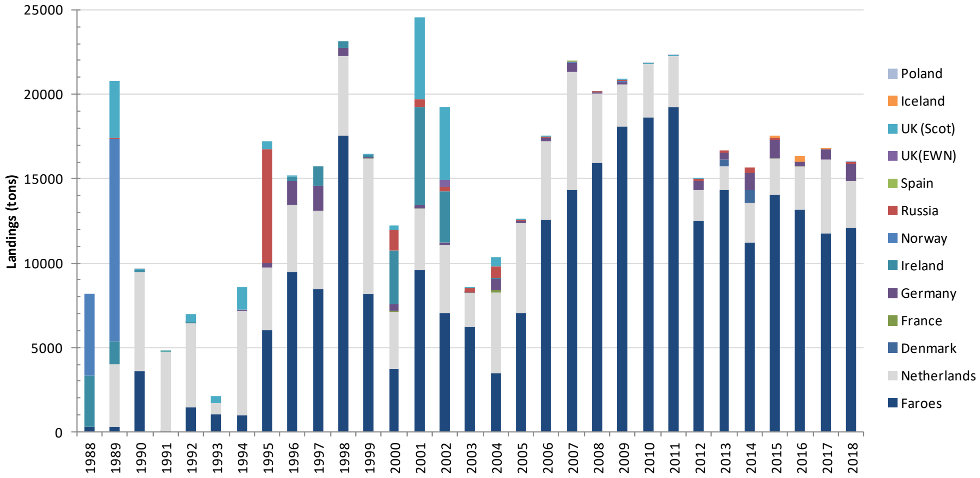


Figure 6.4.1. Greater silver smelt in 5.b and 6.a. Total landings of greater silver smelt in 5.b and 6.a by countries.

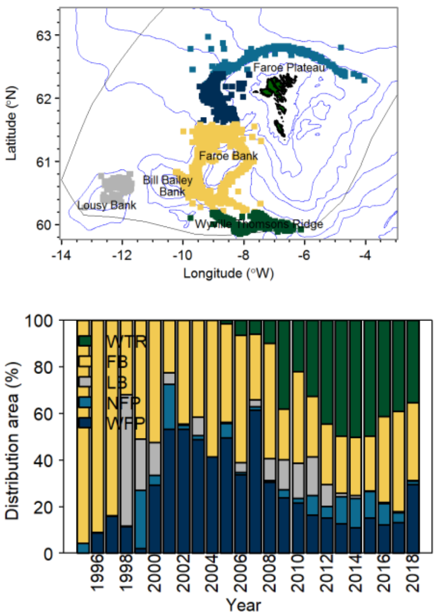


Figure6.4.2. Greater silver smelt in 5.b. Spatial distribution of the Faroese directed trawl fishery of greater silver smelt (upper) and distribution of the greater silver smelt catch divided into five main areas in Faroese waters (lower). WFP- west of the Faroe Plateau, NFP- north of the Faroe Plateau, LB- Lousy Bank, FB- Faroe Bank, WTR- Wyville Thomson Ridge.

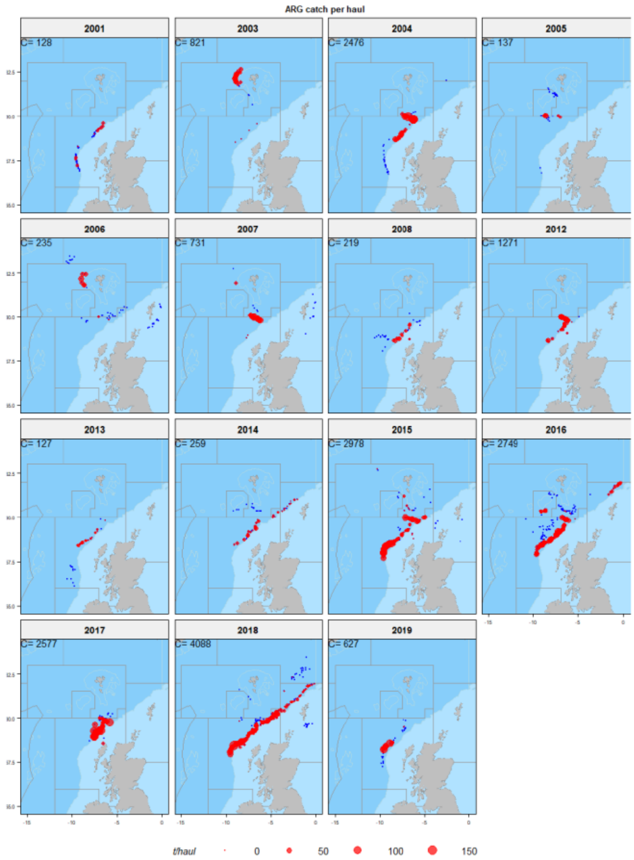


Figure 6.4.3. Greater silver smelt in 5.b and 6.a. Catch rates of Argentines in PFA self-sampled fisheries. Total self-sampled catch (C) in t/haul. Blue dots are zero catches for argentines (targeted to other species, mostly blue whiting)

6.4.2 Landing trends

Landings in Division 5.b increased rapidly from 2004 (5300 tonnes) to 2006 (12 500 tonnes) and further increased with landings in 2011 being 15 600 tonnes (Table 6.4.2). Since then landings have been around 10 000–13 000 tonnes, in 2018 the preliminary catch was 10 265 tonnes in 5.b. The reduction in greater silver smelt catches in 5.b in 2012 was probably a combination of the introduction of quotas for greater silver smelt in Faroese waters, the effect that the boats were targeting mackerel rather than greater silver smelt, and a shift in fishing more in the Wyville-Thomson area inside the Faroese EEZ that is partly in Division 6.a.

In Division 6.a landings have increased, reaching a maximum of 14 466 tonnes in 2001 and then decreased. Since 2004 landings varied between 5000 and 7500 tonnes. Preliminary landings in 2018 were 5769 tonnes.

6.4.3 ICES Advice

ICES advises that when the precautionary approach is applied, landings should be no more than 9629 tonnes in each of the years 2020 and 2021. Discarding is known to take place, but ICES cannot quantify the corresponding catches.

6.4.4 Management

The EU introduced TAC management for greater silver smelt in 2003 and sets a TAC for the EU fishery in Subareas 5, 6 and 7 (separate EU TACs exist for greater silver smelt in areas 1 and 2, and in areas 3a and 4). TAC for the EU fishery in Subareas 5, 6 and 7 for the period 2014-2019 is presented in the table below.

In the period from 2010–2013, the Faroese greater silver smelt fishery was managed by an agreement between the Faroese fleet that were licensed to conduct direct greater silver smelt fishery and the Faroese authorities, guided by the stock assessment and scientific advice of Faroe Marine Research Institute. Under this agreement, total annual landings should not exceed 18 000 tonnes in the Faroese EEZ. There was no advice from ICES that was specific for the Faroese greater silver smelt component. Regulation was through a general regulation of fishing days for the trawler group. There were also limitations in e.g. minimum size, bycatch, mesh size and fishing area restrictions.

In 2014, the Faroese authorities introduced species-specific TAC for greater silver smelt applicable for Faroese trawlers fishing inside the Faroese EEZ. Six trawlers had licences to target greater silver smelt, the technical measures continued to apply and the TAC are presented in the table below. The reason for this reduction in TAC was the decrease in the biomass index as estimated by the exploratory assessment of greater silver smelt in Faroese waters.

The table below summarizes the ICES advice for greater silver smelt and the TACs that have been set by the Faroese authorities and the European Union. The summed TACs of the Faroe Islands and EU exceed the ICES advice for the years where advice has been provided for this stock unit.

	Area\Year	2014	2015	2016	2017	2018	2019
ICES advice	5b, 6a	*	*	10030	10030	12036	12036
TAC Faroe Islands	5b, 6a	16000	14400	13000	11500	11700	11700
TAC EU	5,6,7 1)	4316	4316	4316	3884	4661	4661
Summed TACs		20316	18716	17316	15384	16361	16361

1) The EU TAC applies to all of areas 5, 6 and 7. However, only minor catches have been taken outside of divisions 5.b and 6.a.

6.4.5 Data available

Data on length, round weight and age were available for greater silver smelt from samples taken from Faroese and European landings. There were also catch and effort data from logbooks for the Faroese trawlers and from the PFA fisheries in the Northeast Atlantic (Pastoors, WD 2019).

Biological data (mainly length and round weight), as well as catch and effort data were available for greater silver smelt from the two annual Faroese groundfish surveys on the Faroe Plateau. These surveys are especially designed for cod, haddock and saithe. In addition, a Faroese deep-water survey has been conducted since 2014 and this covers the greater silver smelt fishery areas.

6.4.5.1 Landings and discards

Landings data are presented by area and countries (Tables 6.4.1 and 6.4.2, Figure 6.4.1). Landings were available for all relevant fleets.

Discarding is banned inside the Faroese EEZ and all catches are assumed to be landed. In the European Union, the landing obligation for pelagic fisheries entered into force from 2015 onwards. Catches of all species caught during pelagic fisheries are to be landed, except for protected species which need to be immediately discarded after capture. From 2019 onwards, the EU landing obligation will be applied to demersal fisheries.

For this stock unit, information on discards from non-Faroese fisheries are available from InterCatch and from other sources (Table below). It is assumed that bycatches are generally to be landed.

In Subareas 6 and 7 greater silver smelt can represent a significant discard of the trawl fisheries on the continental slope, particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004). New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain, so in 2014–2015 there appears to have been no Spanish discards of this species in Subarea 6 (only in 7).

Based upon on-board observations from EU data collection framework (DCF) sampling, the catch composition of the French mixed trawl fisheries in 5.b, 6 and 7 include 5.3% of greater silver smelt, based upon data for year 2011 (Dubé *et al*., 2012). This species was discarded in that fishery; representing 25.3% of the discards. Raised to the total landings from that fishery an estimate of 280 tonnes of discarded greater silver smelt was estimated for 2011. Based upon similar level of the fishery in 2010–2012 this figure was considered to apply also to recent years.

The discards in 2014–2018 were mainly in Division 6.a and it was from the French and Scottish deep-water fisheries (data from WGDEEP and InterCatch) (table below). For the years 2014-2018 the average discard rates are 4.6% of the total catches.

The landings statistics are regarded as being adequate for assessment purposes.

	Division 5.b			Division 6.a				5.b and 6.a	
Year	France	Germany	Nether-lands	France	Germany	Nether-lands	Scotland	Total	% of catches
2014		28		808	92		653	1581	9.2
2015				161			109	270	1.5
2016	12			200			1451	1663	9.2
2017	31		0	217		9	14	270	1.6
2018	2			118			67	187	1.2

6.4.5.2 Length compositions

Length frequency distributions of commercial catches are from Faroese commercial trawl catches in 5.b (Figure 6.4.4) and from the PFA fisheries in Divisions 4a, 5b and 6a (Pastoors, WD 2019) (Figure 6.4.5). Length measurements from the Dutch fishery in 6.a were available (Figure 6.4.6).

Length distributions from the Faroese spring- and summer groundfish surveys on the Faroe Plateau in Division 5.b are presented in Figures 6.4.7 and 6.4.8.

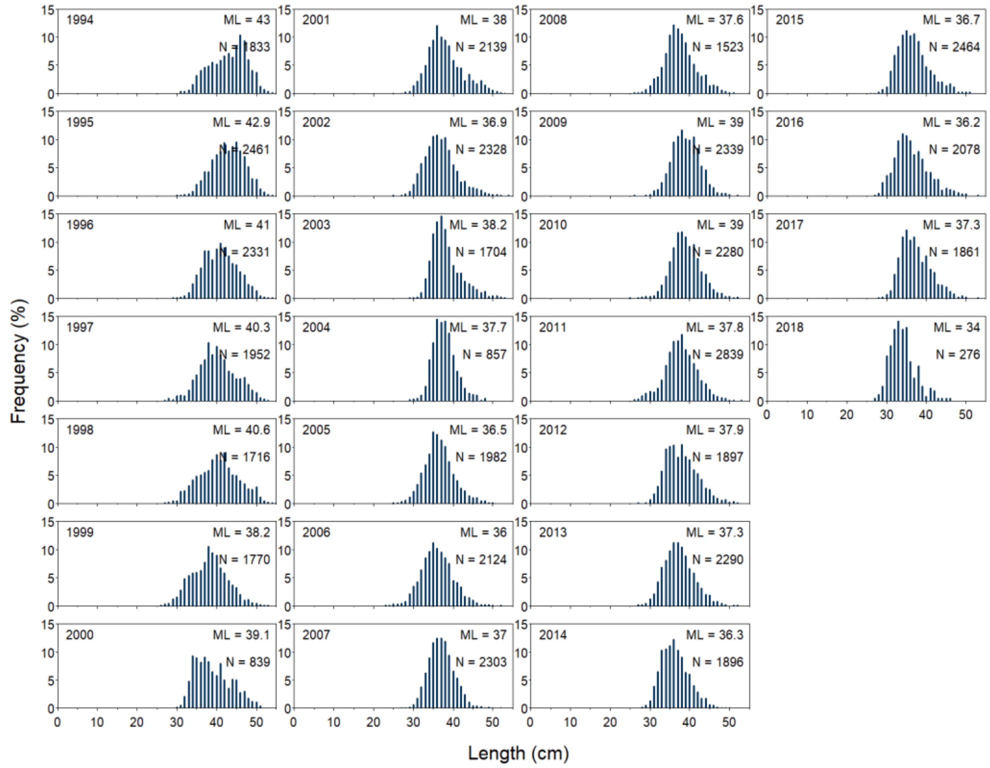


Figure 6.4.4. Grater silver smelt in 5.b. Length frequencies of greater silver smelt in the Faroese catches. ML= mean length (cm) and N= number of length measurements.

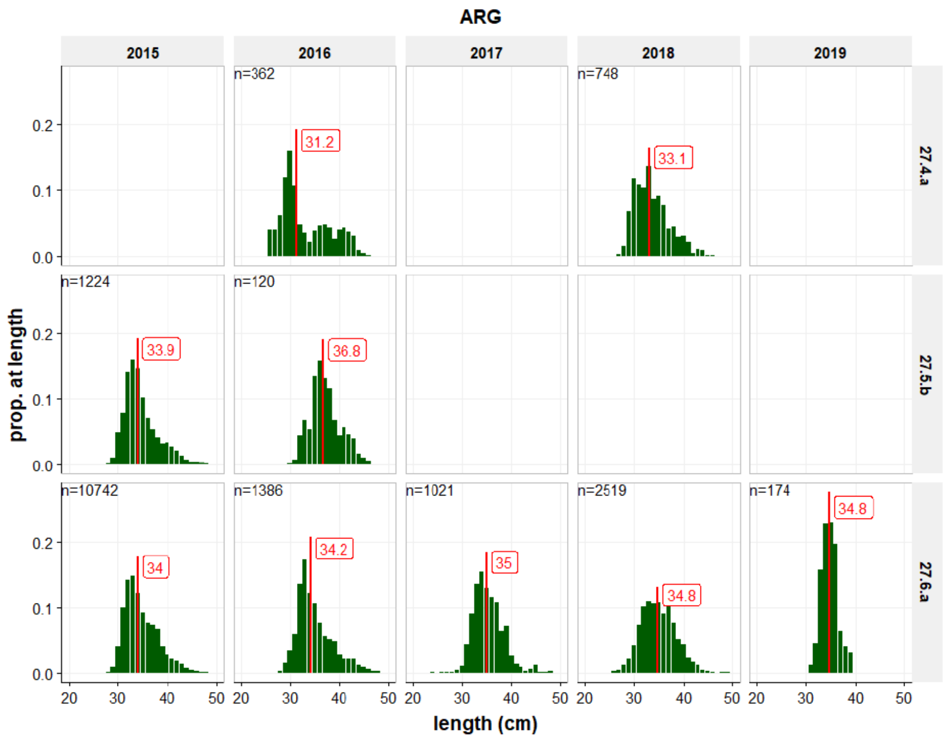


Figure 6.4.5. Greater silver smelt in 5.b and 6.a. Relative length frequencies in PFA self-sampled fisheries in division 4a, 5b and 6a. Median length in red. Number of length measurement in top left (Pastoors, WD WGDEEP 2019).

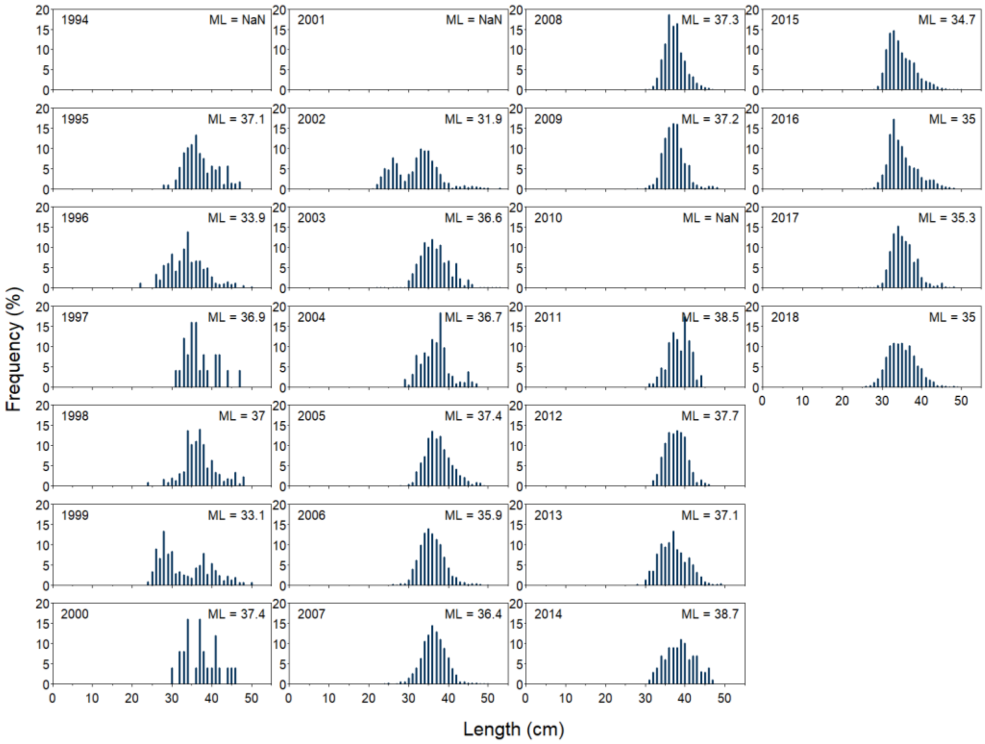


Figure 6.4.6. Greater silver smelt in 6.a. Length frequencies of greater silver smelt from the Dutch trawl catches in Division 6.a (data from InterCatch and other sources). ML= mean length (cm).

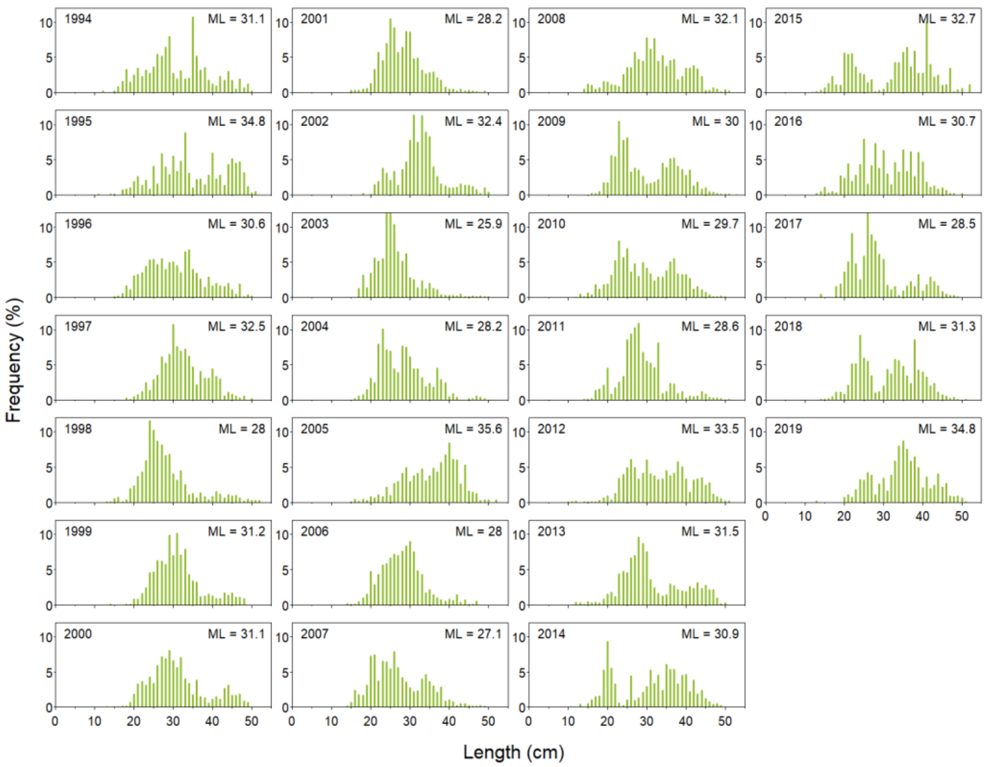


Figure 6.4.7. Greater silver smelt in 5.b. Length frequencies from the Faroese spring groundfish survey. ML= mean length. Greater silver smelt is sampled from a subsample of the total catch, so the values are multiplied to total catch.

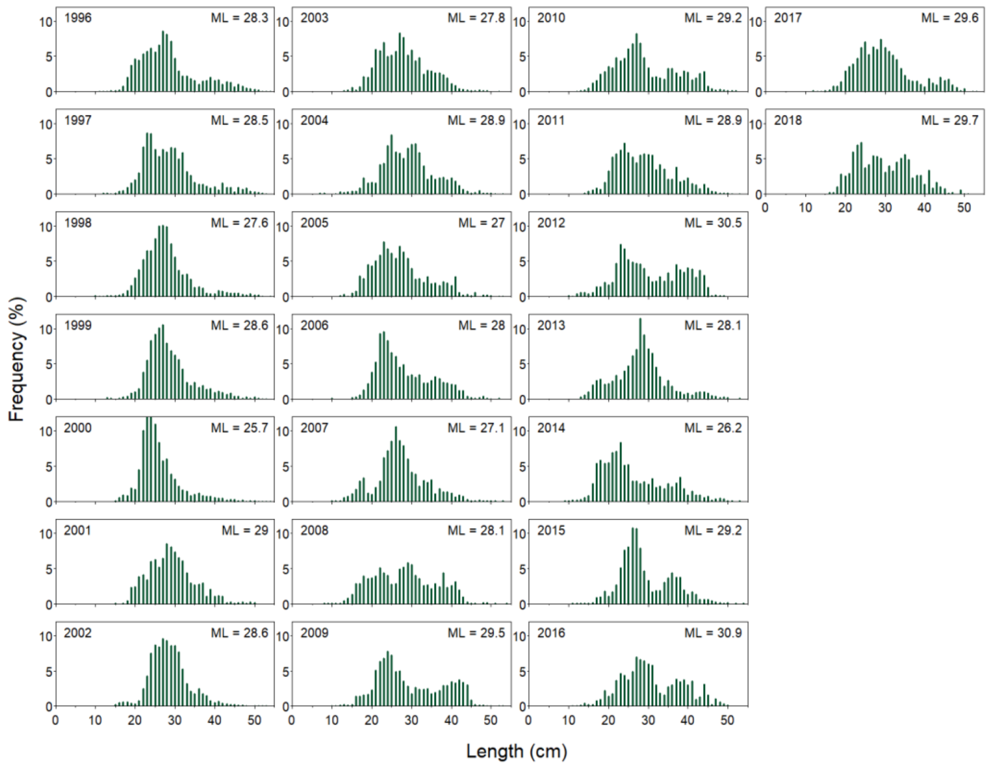


Figure 6.4.8. Greater silver smelt in 5.b. Length frequencies from Faroese summer groundfish survey. ML= mean length. Greater silver smelt is sampled from a subsample of the total catch, so the values are multiplied to total catch.

6.4.5.3 Age compositions

Age frequency distributions from Faroese landings in Faroese waters are presented in Figure 6.4.9. These data were used in the exploratory assessment. In addition, age data are available from the Dutch and Scottish fishery in Division 6.a in some years.

There are also sporadic age data of greater silver smelt from the Faroese groundfish surveys in Division 5.b.

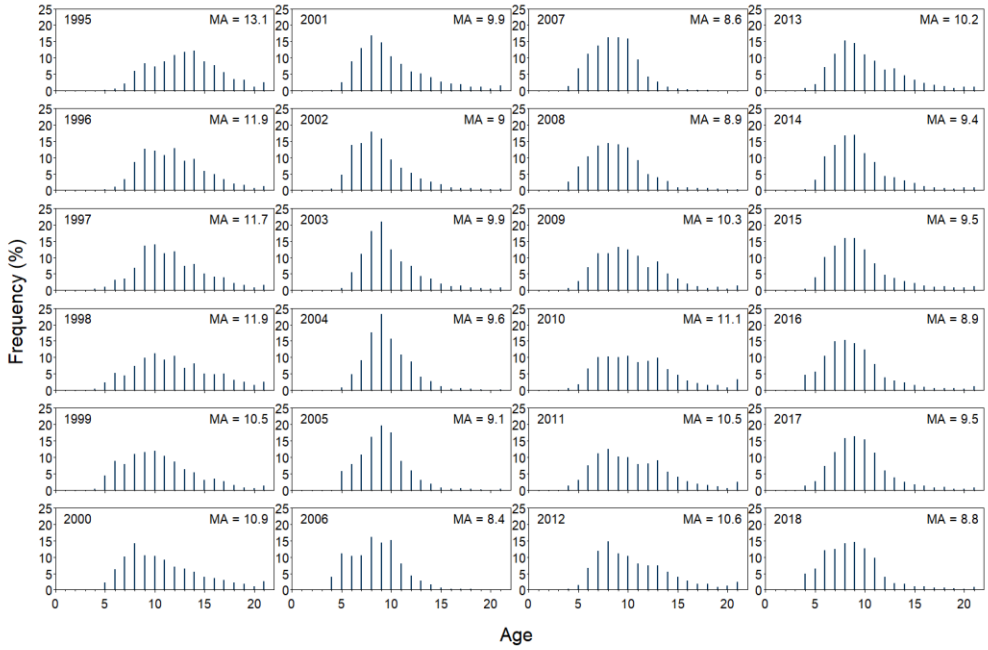


Figure 6.4.9. Greater silver smelt in 5.b. Age frequencies used in the exploratory assessment in 5.b from commercial pair trawlers with mean age (MA) 1995–2018.

6.4.5.4 Weight-at-age

Weight-at-age data of greater silver smelt from the Faroese commercial trawl fisheries are presented in Figure 6.4.10. These data were used in the exploratory assessment. Data were also available from the Dutch fishery in Division 6.a in some years (Figure 6.4.17).

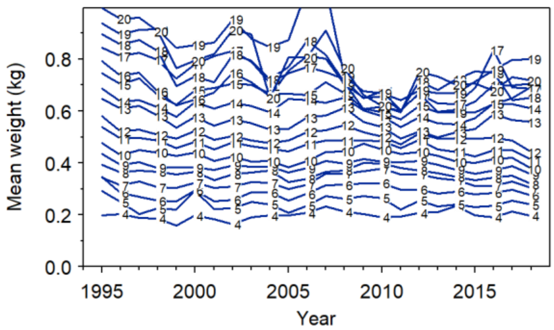


Figure 6.4.10. Greater silver smelt 5.b. Mean weight-at-ages 4–21+ of greater silver smelt in the commercial catch.

6.4.5.5 Maturity and natural mortality

Most of the greater silver smelt caught in commercial catches in Division 5.b is mature (Ofstad, WD14 WGDEEP 2017).

No new data on natural mortality were presented. Natural mortality was set to 0.1 in the exploratory assessment (stock annex).

6.4.5.6 Catch, effort and research vessel data

A standardized cpue series from commercial trawlers targeting greater silver smelt in Faroese waters (Division 5.b) is shown in Figure 6.4.11. To investigate sequential depletion cpue were calculated for the five main fishing areas in Faroese EEZ and compared (Figure 6.4.11).

Cpue indices for greater silver smelt from the annual Faroese groundfish surveys for cod, haddock and saithe in Division 5.b are shown in Figure 6.4.12. Comparison of the cpue from the commercial fishery and the summer groundfish survey are shown in Figure 6.4.12.

A preliminary standardized cpue series from the PFA self-sampled fisheries in Division 6.a is presented in Figure 6.4.13. This new cpue series is under development for the European pelagic fisheries (Pastoors, 2019) based on the skippers' logbooks and self-sampling data. The series is expected to be available for the upcoming benchmark for greater silver smelt in 2020.

Density (mean kg/h for the whole survey period) and spatial distribution from the same survey is shown in Figure 6.4.14. It has to be noted that these surveys have very few stations (<5) deeper than 500 m and are therefore only likely to cover the juveniles adequately. The adult part of the population is not fully covered by these surveys and they may not necessarily reflect correctly the temporal variation of the biomass of the stock.

A Faroese deep-water trawl survey was initiated in 2014 and repeated annually since, covering the slope and banks around the Faroes. This deep-water survey covers the fishing area for greater silver smelt in Faroese EEZ (Figure 6.4.15).

Explorations on silver smelt abundance in Scottish deepwater survey have been initiated and are expected to be available for the upcoming benchmark meeting in 2020.

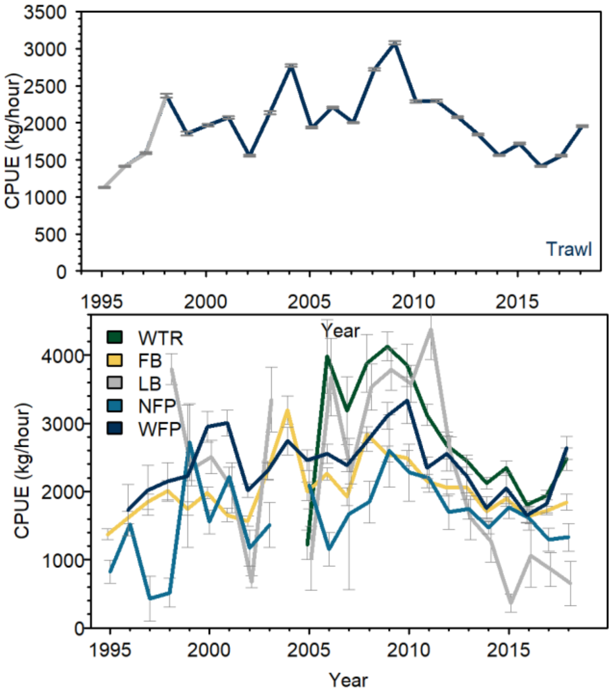


Figure 6.4.11. Greater silver smelt in 5.b. Standardized cpue from pair trawlers fishing greater silver smelt where catch of greater silver smelt is more than 50% of total catch in each haul (upper). Comparison of the commercial Faroese greater silver smelt cpue (kg/hour) from the five main fishing areas. WFP- west of the Faroe Plateau, NFP- north of the Faroe Plateau, LB- Lousy Bank, FB- Faroe Bank, WTR- Wyville-Thomson Ridge (lower).

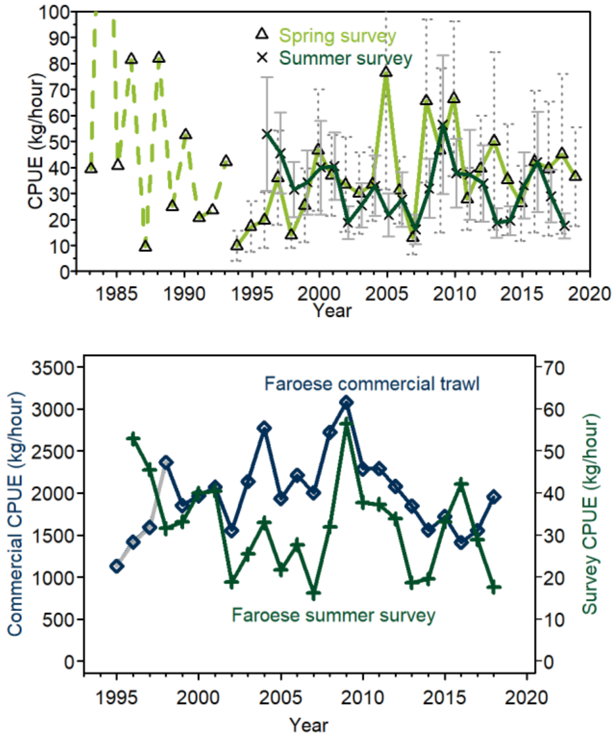


Figure 6.4.12. Greater silver smelt in 5.b. Standardized cpue from Faroese groundfish surveys on the Faroe Plateau (upper). Arrows +- SE and the data from 1983–1993 was not standardized. Comparisons between the cpue from the summer groundfish survey and the commercial trawler series (lower).

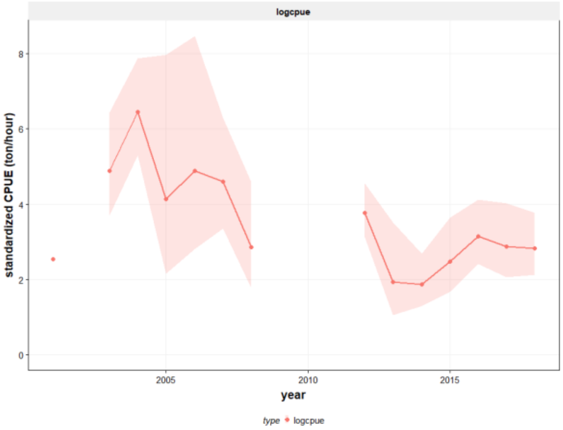


Figure 6.4.13. Greater silver smelt in 6.a. Standardized cpue from PFA self-sampled fisheries (Pastoors, WD WGDEEP 2019).

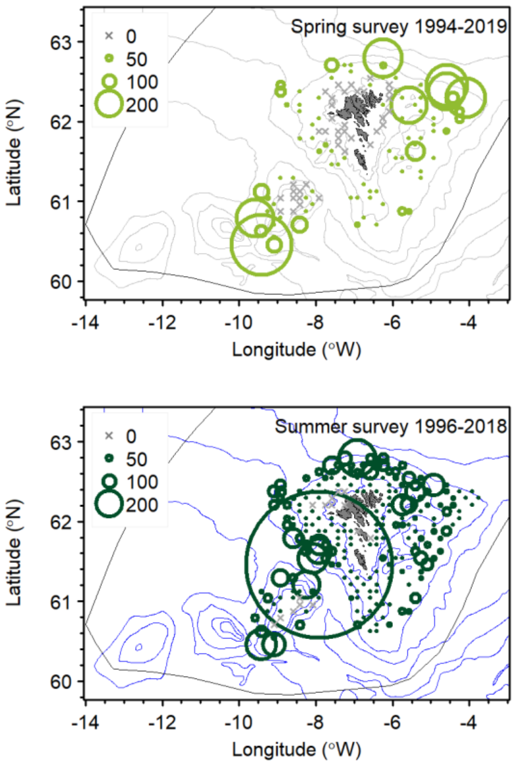


Figure 6.4.14. Greater silver smelt in 5.b. Density and spatial distribution of greater silver smelt in the annual spring (upper) - and summer (lower) groundfish surveys on the Faroe Plateau and the Faroe Bank as average (kg/hour). Depth contour line is for 100, 200 and 500 m.

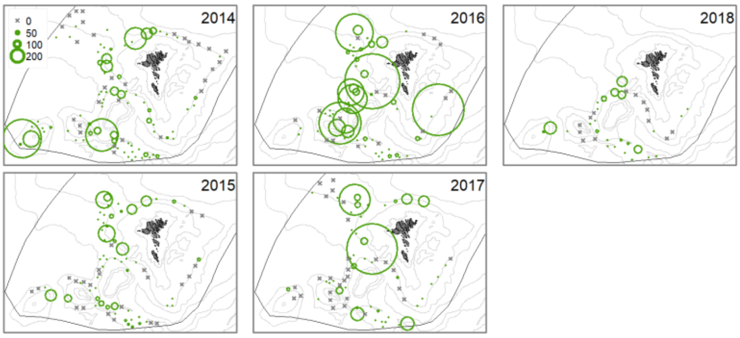


Figure 6.4.15. Greater silver smelt in 5.b. Density and spatial distribution of greater silver smelt in the deep-water surveys in 2014-2018 (kg/hour). Depth contour line is for 100, 200 and 500 m.

6.4.6 Data analyses

In Divisions 5.b and 6.a, landings have increased since 1994–2007 (Figure 6.4.1). In the period 2007 to 2011, the landings have been stable at a level between 20 000 and 22 000 tonnes. The landings decreased to a level around 15 000–17 000 tonnes in 2012–2018 (Table 6.4.2, Figure 6.4.1).

Length and age distributions

In Division 5.b the mean length and age in the Faroese landings decreased from 1994 to 2000 and have been stable since then (Figures 6.4.4, 6.4.9, 6.4.16). This trend probably reflects a gradual change during and following the first years of exploitation of a virgin stock (Ofstad, WD WKDEEP 2010). The variation in mean length during the latest years could be due to different depths sampled in the various areas, as the size of greater silver smelt is known to increase with increasing depth (Figure 6.4.16). Generally, the Faroese bottom surveys catch individuals with length less than 30 cm at depths shallower than 350 m whereas larger individuals (35–40 cm) are found deeper.

For the whole period 1995–2018, mean lengths in Dutch landings were mainly between 34 to 38 cm (Figures 6.4.5 and 6.4.6).

After 2003, the mean length of greater silver smelt from Faroese and Dutch trawlers landings was very similar, around 36–39 cm (Figure 6.4.16). The low mean lengths observed in the Dutch fishery (1996, 1999, 2002) are probably caused by the catch being a mixture of *Argentina silus* and *A. spyraena* or because the Dutch trawlers in these years fished in shallower waters than in other years or that the data are from discard not landings. The Dutch data are from other sources before 2016 and from the ICES InterCatch database after 2016. The length frequency used for 2015-2018 are from the PFA self-sampling fishery (Pastoors, WD 2019).

The mean lengths by age of greater silver smelt sampled in the Faroese and Dutch fishery are comparable (Figure 6.4.17), allowing the use of Faroese age–length data in an exploratory age-based assessment.

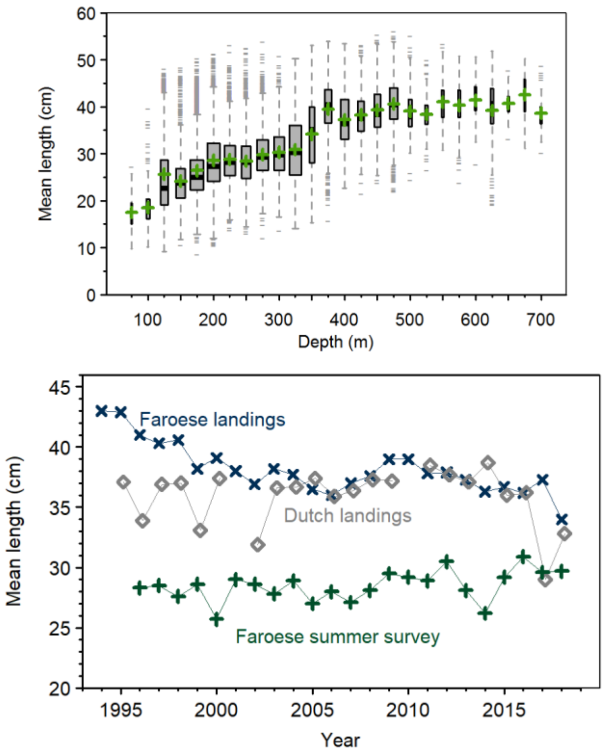


Figure 6.4.16. Greater silver smelt in 5.b and 6.a. Mean length at different depth interval (e.g. 100 is 100–124 m) from various surveys in Faroese area (upper). Comparison of mean length at year from Faroese- and Dutch landings and from the Faroese summer survey (lower).

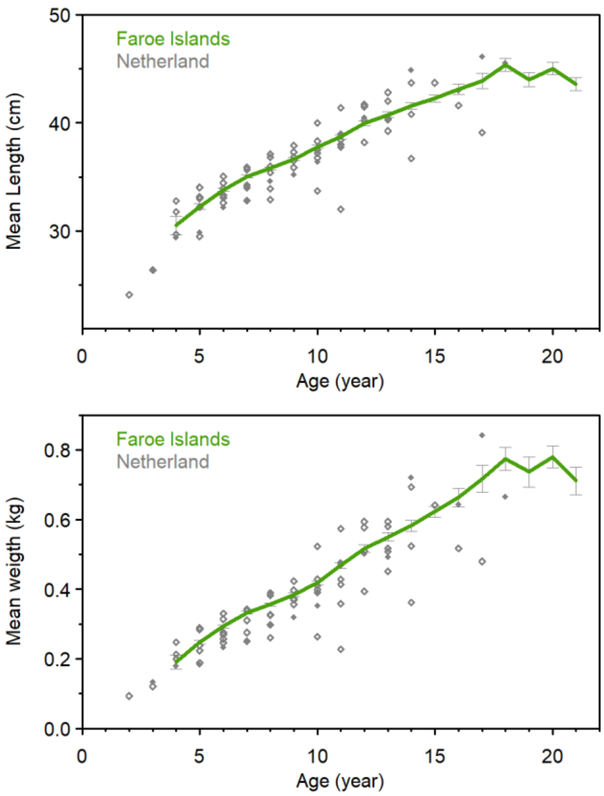


Figure 6.4.17. Greater silver smelt in 5.b and 6.a. Comparisons of greater silver smelt mean length-at-age (upper) and mean weight-at-age (lower) in the commercial Faroese fisheries (green line) and Dutch fisheries (grey symbols). Dutch data are from InterCatch and other sources.

Commercial and survey cpue series.

The Faroese commercial cpue (Division 5.b) increased until 2010 and has decreased slightly until 2014. A slight increase was observed in 2015, small decrease in 2016 and a small increase again in 2017 and 2018 (Figure 6.4.11). The period from 1995 to 1997 is believed to be a "learning" period, i.e. the cpue is not believed to be proportional to abundance in those years.

To investigate if the commercial cpue might be maintained by sequential fishing on different aggregations inhabiting different fishing ground a calculation of the cpue for each of the five different fishing areas was conducted (Figure 6.4.11). The cpue for the "new" fishing area primarily used after 2008 were slightly higher for the period 2005–2011. Even so, the cpues still appear to show the same temporal pattern.

The Faroese summer survey biomass index showed actually the same main trends as in the Faroese commercial cpue, except in 2016-2018 (Figure 6.4.12). Given the low turnover rate (high turnover time) in this species one would not expect to see large changes in abundance by year, indicating that short-term fluctuations may be caused by random events and inadequate sampling. The shallow depth range sampled by the survey (very few stations deeper than 500 m) covers the juveniles adequately but not necessarily the adults since large individuals are generally found at greater depths.

A preliminary standardized cpue index from the PFA fisheries was presented for Division 6.a (Figure 6.4.13, Pastoors, WD 2019). The PFA commercial series do also show an increase in 2017 and 2018 as the Faroese commercial series does. The PFA fisheries data will be finalized prior the benchmark meeting in 2020.

Exploratory assessment

An exploratory age-based stock assessment of greater silver smelt in Faroese waters was presented to the WGDEEP 2019. It was an update from last year's SAM.

The input data for the age-based assessment model was catch data for all countries fishing greater silver smelt particularly Faroe Islands and Netherlands, age compositions representing the Faroese fishery and growth data for the Faroese fleet. As showed earlier in this report, the Dutch length and age data were comparable with the Faroese data. There are two tuning series in the assessment 1) the Faroese summer survey used as a recruitment index (ages 4 to 6, as suggested by WGDEEP in 2016) and 2) the commercial cpue series from the Faroese commercial trawlers logbooks. At the meeting in 2019 a corresponding commercial cpue series for the Dutch fishery was presented.

The results of the exploratory SAM assessment are summarised in Figure 6.4.18. The output from SAM was very unstable and it was difficult to find input and settings so the model converged. The WG suggested investigating different mortality (0.1, 0.15 and 0.2), try with age 5 as the age of recruitment and use ages 6-21 in the commercial tuning series.

A closer investigation of the catch number at age data for greater silver smelt showed that there is not a clear cohort pattern. This could be one of the reasons for the poor performance of the SAM assessment.

Although the exploratory age-based stock assessment has not been benchmarked, it seems to indicate the trend in stock size and fishing mortality and may provide a valid perception of the temporal variation of the stock.

The greater silver smelt assessment input files will be updated with additional data and further investigated before the benchmark meeting in 2020.

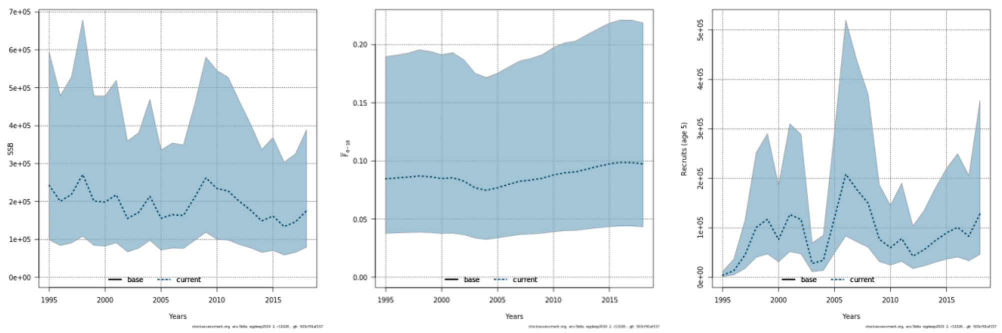


Figure 6.4.18. Greater silver smelt in 5.b and 6.a. Spawning biomass, fishing mortality and recruitment of greater silver smelt in Divisions 5b and 6a, output from the exploratory age-based assessments done in SAM.

6.4.6.1 Reference points

There are no accepted reference points for this stock unit. The Length Based Indicator (LBI) is used as F_{MSY} indicator.

6.4.7 Comments on the assessment

For this stock unit, advice is given every second year, so the advice for 2020 also applies for 2021. The advice is based on trends in the cpue (kg/hour) from the Faroese summer survey on the Faroe Plateau (DLS method 3.2). The advice for 2016–2017 was, for the first time, given for the new advisory unit (Divisions 5.b and 6.a).

Work is ongoing to calculate cpue series for the European fishery, which could be compared with the Faroese commercial cpue series. Results are expected to be ready before the benchmark of greater silver smelt in 2020.

A benchmark of silver smelt stocks in the Northeast Atlantic is foreseen in February 2020. The benchmark will focus on new genetic information on the stock structure, new data series that have been made available and the application of appropriate quantitative methods to assess the state of the stocks.

6.4.8 Management considerations

In Faroese waters, the greater silver smelt fishery is managed by Faroese authorities. The quota of greater silver smelt in the Faroese EEZ has been reduced from 16 000 tonnes (for 2014) to 11 700 in 2018 and 2019 (Table in Chapter 6.4.4). The reason for this was the decrease in the spawning–stock biomass index from the exploratory assessment in 2018.

The TACs by the European Union for areas 5, 6 and 7 are set for the European fisheries only. This TAC mostly applies to the fishery in Divisions 5.b and 6.a where the bulk of the catches are taken.

There appears to be no agreement between the Faroe Islands and EU on the setting of an overall TAC for greater silver smelt in 5.b and 6.a. As a consequence, the sum of the TACs of the Faroe Islands and EU has exceeded the scientific ICES advice from 2016 onwards (Table in Chapter 6.4.4).

6.4.9 Application of MSY proxy reference points

Length Based Indicator (LBI)
At the ICES WKPROXY meeting in November 2015 a screening method (Length-based indicators and reference points) was tried on greater silver smelt in Divisions 5.b and 6.a (ICES, WKPROXY 2015). These input data are updated with the latest values. The input data were the length frequency distribution from Faroese commercial trawlers fishing in the Faroese EEZ 1994–2018 or length frequency distribution from Dutch trawlers fishing in 6.a, mean weight-at-length per year was the same as used in the exploratory SAM assessment, L_{mat} = 34.8 cm, L_{inf} = 44.7 cm, combined sex.

The results show that greater silver smelt in Divisions 5.b and 6.a was fished sustainably at levels close to optimum yield and with exploitation at MSY levels based on the length-based indicator model (Tables below and Figure 6.4.18).

Area 5.b	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2013	1.01	1.01	1.02	92%	1.30	1.03
2014	0.95	0.98	0.99	88%	1.24	1.03
2015	0.95	0.98	1.04	87%	1.26	1.04
2016	0.95	0.95	1.04	83%	1.25	1.04
2017	1.01	1.01	1.03	94%	1.30	1.03
2018	0.89	0.92	0.95	66%	1.16	1.01

Area 6.a	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2013	1.01	0.98	1.00	92%	1.29	1.03
2014	1.01	1.03	1.03	96%	1.33	1.06
2015	0.95	0.92	0.96	71%	1.21	1.01
2016	0.95	0.95	0.99	75%	1.22	1.01
2017	0.95	0.95	0.96	85%	1.21	1.00
2018	0.89	0.92	0.96	75%	1.19	1.03

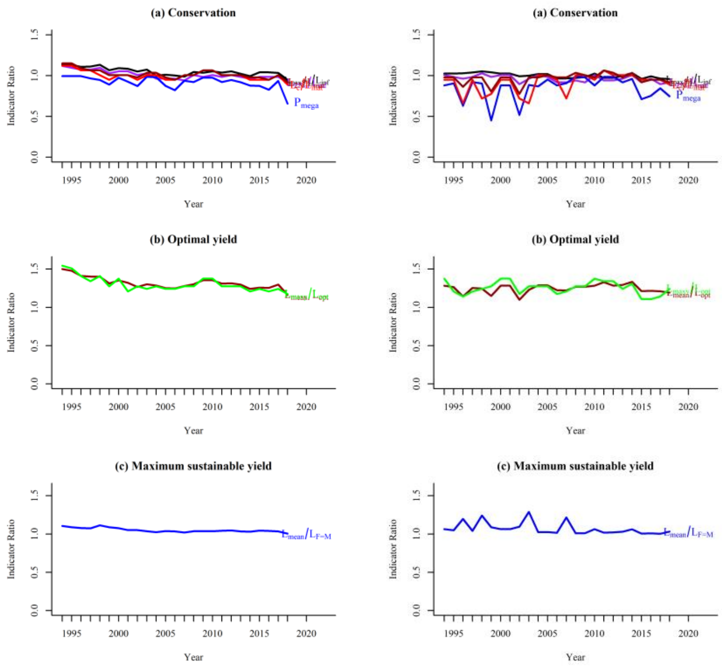


Figure 6.4.18. Grater silver smelt in 5.b and 6.a. LBI output figures for Division 5.b (left) and 6.a (right).

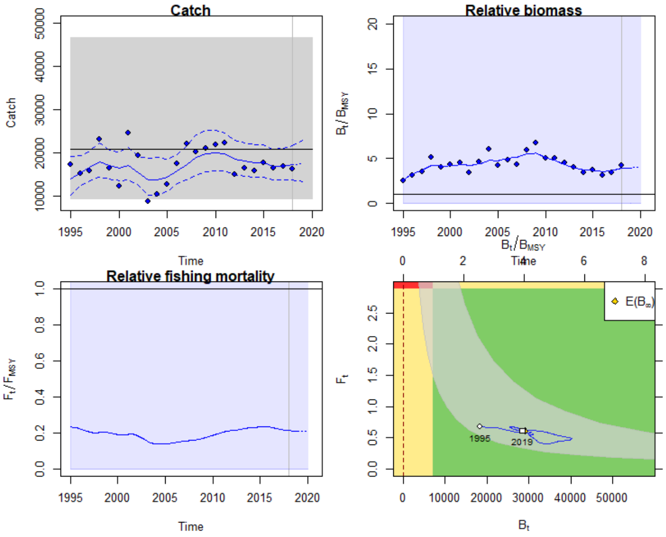
Stochastic Production model in Continuous Time (SPiCT)

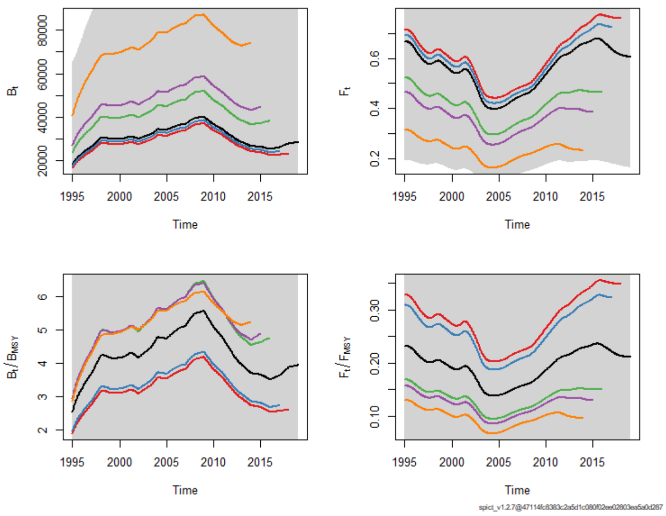
The input data for catch was a time-series of total catches for area 5.b and 6.a together from 1995-2018. The abundance index was from the Faroese annual trawl summer survey. In addition, the Faroese commercial trawl series was also used as a more representative series of the exploited biomass as the Faroese summer survey do not cover the fishery distribution for greater silver smelt.

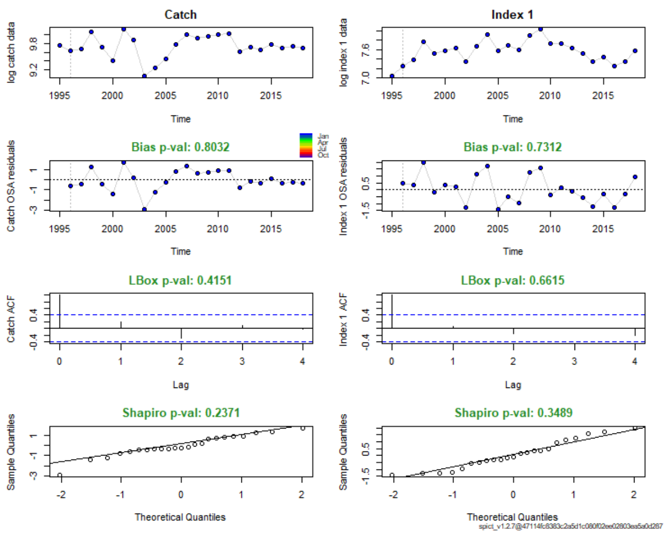
SPiCT did not give any reliable results using the Faroese annual trawl summer survey as abundance index, even if several different settings were tried such as α=1, β=1 and n=2 (as suggested in the WKProxy review, WGDEEP report 2017). The results had in common a very wide confidence interval and very different output numbers each time a parameter was changed and the model did not converge.

SPiCT was also tried with the Faroese commercial trawl series, with almost the same results. There is too little contrast in the input data, but the model converged with settings α=1, β=1 and n=2. The results showed that the biomass has been above the biomass reference point (Btrigger=BMSY/2) and the fishing mortality has been below the F_{MSY} proxy. Example of the output figures is showed below.

The conclusion was still that the SPiCT model cannot be used for aru-5b6a assessment unit.


Catch
Relative biomass
Relative fishing mortality
Time
E(B∞)
1995
2019


Time


Catch
Index 1
Bias p-val: 0.8032
Bias p-val: 0.7312
LBox p-val: 0.4151
LBox p-val: 0.6615
Shapiro p-val: 0.2371
Shapiro p-val: 0.3489
Theoretical Quantiles
Sample Quantiles
Lag
Time

6.4.10 Tables

Table 6.4.1. Greater Silver Smelt 5.b and 6.a. WG estimates of landings in tonnes. * landings in 2018 are preliminary.

Greater silver smelt (*Argentina silus*) 5.b

Year	Faroes	France	Ger-many	Ice-land	Ire-land	Nether-lands	Nor-way	Po-land	UK(E&W)	UK (Scot)	Russia	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	5							23	15		8229
2000	3713	64								247	1185	5209
2001	9572				1					94	414	10 081
2002	7058					5				144	264	7471
2003	6261					51				1	245	6558
2004	3441					1125				42	702	5310
2005	6939					15					59	7013
2006	12 524										35	12 559
2007	14 085					0.4	32				8	14 126
2008	14 930						3				19	14 952
2009	14 200										28	14 228
2010	15 567									40	2	15 609
2011	15 578										8	15 586
2012	9744										110	9854
2013	11 109										114	11 223

Year	Faroes	France	Germany	Iceland	Ireland	Netherlands	Norway	Poland	UK(E&W)	UK (Scot)	Russia	TOTAL
2014	9747		110								339	10 196
2015	13 025	0	40	132							115	13 312
2016	11 129		38	345		31				0	3	11 547
2017	9424		1	63		2					6	9496
2018*	10114	0						1			150	10265

Table 6.4.1. (Continued).

Greater silver smelt (*Argentina silus*) 6.a

Year	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	UK(E&W)	UK(Scot)	Russia	Spain	TOTAL
1988					3040		4884					7924
1989		188			1325	3715	11984		3369			20581
1990		689		14	110	5870			112			6795
1991			7			4709			10			4726
1992			1		100	4964			466			5531
1993						663			406			1069
1994				43		6217			1375			7635
1995		483		284		3706			465			4938
1996				1384	295	3953						5632
1997				1496	1089	4684						7269
1998				464	405	4687						5556
1999				24	168	8026		5				8223
2000			19	403	3178	3389						6989
2001			7	189	5838	3655			4777			14466
2002			1	150	3035	4020		424	4136			11766
2003				126	1	1932			80			2039

Year	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	UK(E&W)	UK(Scot)	Russia	Spain	TOTAL
2004			147	652	46	3707			507			5059
2005		103	10	125	18	5317			61			5634
2006		53		213		4628			3		1	4897
2007		254		589		6969	3				2	7817
2008		991		10		4156	3					5160
2009		3923		115	0.5	2488	83		6	36		6651
2010		3060				3143	3		20	11		6237
2011		3655			0.1	3050		2	2			6709
2012		2781	2	538	0.2	1785		5	5	1		5115
2013	388	3197		417	0	1430				13		5445
2014	711	1495		908		2332				21		5467
2015		1055		1027		2154	0					4236
2016		2050	0	228		2495						4773
2017		2304		599		4405	2					7310
2018		1973	8	1001		2763				18		5769

Table 6.4.2. Greater silver smelt (*Argentina silus*) (5.b and 6.a).

Year	5.b	6.a	Total
1988	287	7924	8211
1989	227	20581	20808
1990	2888	6795	9683
1991	60	4726	4786
1992	1443	5531	6974
1993	1063	1069	2132
1994	960	7635	8595
1995	12286	4938	17224
1996	9498	5632	15130
1997	8433	7269	15702
1998	17570	5556	23126
1999	8229	8223	16452
2000	5209	6989	12198
2001	10081	14466	24547
2002	7471	11766	19237
2003	6558	2039	8597
2004	5310	5059	10369
2005	7013	5634	12647
2006	12559	4897	17456
2007	14126	7817	21943
2008	14952	5160	20112
2009	14228	6651	20879
2010	15609	6237	21846
2011	15586	6709	22295
2012	9854	5115	14969
2013	11223	5445	16668
2014	10196	5467	15663
2015	13312	4236	17548

Year	5.b	6.a	Total
2016	11547	4773	16320
2017	9496	7310	16806
2018*	10265	5769	16033

6.5 Greater silver smelt (*Argentina silus*) in 6.b, 7, 8, 9,10 and 12

6.5.1 The fishery

The fisheries from this area is very minor and there are no directed fisheries.

6.5.2 Landing trends

Landings from this area are reported from 1966–2018. Landings increased until 2002 to 4662 tons then declined again to low levels of less than a ton in 2016. In 2017 and 2018 the landings were 8 t and 36 t, respectively. Landings from the twelve last years have been less than 50 tons. The main landings have been from Subareas 6b and 7 where Ireland were fishing for some years between 2000 and 2003.

6.5.3 ICES Advice

Advice is given every other year. The 2017 advice was from area 6b, 7, 8, 9, 10 and 12, and stated "ICES advises that when the precautionary approach is applied, landings should be no more than 14 tonnes in each of the years 2018 and 2019. Discarding is known to take place, but ICES cannot quantify the corresponding catches.".

6.5.4 Management

The EU introduced TAC management in 2003. For 2019 the EU TAC in Subareas 5, 6 and 7 is 4661 tonnes. Catches of blue whiting may include unavoidable by-catches of greater silver smelt in the area.

6.5.5 Data available

6.5.5.1 Landings and discards

Landings data are presented by area and countries (Tables 6.5.1–6.5.5, Figure 6.5.1). Discards data from the four last years are presented in Table 6.5.6. Discards are mainly from the Spanish fishery and from Subarea 7. The discards were very high compared to the landings. However, the discards since 2014 were reduced compared to the years before.

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas 6 and 7 particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004) (Table 6.5.7). Information have been available on discards in 2009 and 2012 in Basque country and Spanish fisheries in Subareas 6–7, and Divisions 5.3.abcd and northern 9.a. These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain. Same applies for discards registered by the Netherlands. Based upon on-board observations from DCF sampling, the catch composition of the French mixed trawl fisheries in 5.b, 6 and 7 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. It should be noted that after redefinition of stock structure in 2015 area 6.a is not included in this stock.

6.5.5.2 Length compositions

The size compositions of *Argentinas* spp. from Porcupine survey since 2009 is presented in Figure 6.5.2.

6.5.5.3 Age compositions

No new data on age composition were presented.

6.5.5.4 Weight-at-age

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

6.5.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

6.5.5.6 Catch, effort and research vessel data

Spanish bottom-trawl surveys have been carried out in Subarea 7 (Porcupine) since 2001. Recent investigations have revealed that survey catches from the Spanish Porcupine survey contain both *A. Silus* and *A. Sphyraena* (Figures 6.5.2, 6.5.3 and 6.5.4). Abundance and biomass indices from survey catches of mixed *A. silus* and *A. sphyraena* is presented in Figure 6.5.4. The Spanish survey only goes to 400 m and is unlikely to fully cover the depth range of greater silver smelt.

6.5.6 Data analyses

Length and age distributions

The size compositions from Porcupine Bank in Subarea 7 have no obvious trend towards smaller fish but these data may by disturbed by the relative species composition *A. silus* and *A. sphyreana* (Figure 6.5.2).

Commercial and survey cpue series

For Subarea 7, abundances and biomass indices from the Spanish porcupine survey have been showing a decreasing trend from 2002 until 2011 but have been rising since then until 2016 (Figure 6.5.4). The index has decreased for *A.silus* the last two years compared to 2016. However, the survey is unlikely to cover all the exploitable biomass of the stock as it only goes down to 400 meters.

Exploratory assessment

No exploratory assessment was presented.

Biological reference points

SPiCT was run on the landings dataseries (1973–2016) and the biomass index series from Porcupine bank (2001–2016) at WGDEEP 2017, but it did not converge.

6.5.7 Comments on the assessment

Advice is given every second year for this stock and this year's advice applies for 2020 and 2021.

It should be noted that lesser silver smelt (*Argentina sphyraena*) may in some southerly areas have been included in the landing figures. According to research on the Spanish Porcupine survey where both species appear lesser silver smelt are smaller and occupies shallower areas than greater silver smelt (Figures 6.5.2, 6.5.3 and 6.5.4). The proportion of lesser silver smelt in the fisheries is not believed to be large but further investigations should be undertaken.

The biomass index is only from the Porcupine bank and is therefore not covering the total stock area.

6.5.8 Management considerations

The trends for Porcupine bank survey biomass indices have increased in 2015 and 2016 but are declining in 2017 and 2018.

6.5.9 References

Dubé, B., J. Dimeet, M.-J. Rochet, A. Tétard, O. Gaudou, C. Messannot, L. Fauconnet, Y. Morizur, A. Biseau, and M. Salaun. 2012. Observations à bord des navires de pêche professionnelle. Bilan de l'échantillonnage 2011.

Girard, Marine & Alain Biseau. 2004. Preliminary results concerning spatial variability of the catch in the ICES Subarea VI: Composition and importance of the discard fraction. 8 p. WD WGDEEP 2004

6.5.10 Tables and Figures

Table 6.5.1. Greater Silver Smelt in 6.b. WG estimates of landings in tonnes. *landings in 2018 are preliminary.

Year	Faroes	Germany	Ireland	Netherlands	Scotland	Russia	Spain	TOTAL
1979								
1980		13						13
1981		525						525
1982								
1983		4						4
1984								
1985								
1986								
1987								
1988								
1989								
1990			300					300
1991				5				5
1992			220		1			221
1993					3			3
1994					20			20
1995	1114							1114
1996								
1997								
1998								
1999			178					178
2000			1355			29		1384
2001					62	68		130
2002					1	29		30
2003					6	120		126
2004				11		12		23
2005						4		4

Year	Faroes	Germany	Ireland	Netherlands	Scotland	Russia	Spain	TOTAL
2006								
2007								
2008						1	8	9
2009								
2010								
2011								
2012								
2013								
2014						20.5		20.5
2015								0
2016								0
2017								0
2018*								0

Table 6.5.2. Greater Silver Smelt in 7. WG estimates of landings in tonnes. *landings in 2018 are preliminary.

Year	France	Germany	Ireland	Netherlands	Scotland	Norway	Poland	Spain	UK E/W	TOTAL
1972										
1973	40									103
1974							63			
1975										
1976										
1977			1							1
1978		404					5			409
1979		103								103
1980										
1981										
1982						666				666
1983						595				595
1984						163				163
1985										
1986						258				258
1987						50				50
1988						100				100
1989						200				200
1990		23		1						24
1991				9						9
1992				254						254
1993				505						505
1994				39						39
1995		73	6	431						510
1996		10								10
1997				12						12
1998										
1999			50							50
2000		79	166	244				34		523

Year	France	Germany	Ireland	Netherlands	Scotland	Norway	Poland	Spain	UK E/W	TOTAL
2001	5		1592	2	2782			34		4415
2002			4433		2			2		4437
2003			95	19				5		119
2004				13	19			15		47
2005		26	1		14			17		58
2006								40		40
2007								35		35
2008										
2009	13		1					6		20
2010	10			8				2	3	23
2011		4			8					12
2012		2			1					3
2013				1						1
2014				1						1
2015				5						5
2016	0			0				0		0
2017				8						8
2018*				31				1	32	

Table 6.5.3. Greater Silver Smelt in 8. WG estimates of landings in tonnes. *landings in 2018 are preliminary.

Year	Netherlands	Spain	TOTAL
2002	195		194.61
2003	43		42.525
2004	23		22.722
2005	202		202.29
2006			0
2007			0
2008		10	10
2009			0
2010			0
2011	1		1
2012			0
2013			0
2014	1.1		1.1
2015			0
2016		0	0
2017		0	0
2018*		3.9	3.9

Table 6.5.4. Greater Silver Smelt 9. WG estimates of landings in tonnes. *landings in 2018 are preliminary.

Year	Netherlands	Spain	Portugal	TOTAL
2006				0
2007	1			1
2008			0.5	0.5
2009			1.9	1.9
2010			1.9	1.9
2011			0.9	0.9
2012			1.9	1.9
2013*				0
2014				0
2015				0
2016				0
2017				0
2018*		0.1		0.1

Table 6.5.5. Greater Silver Smelt 12. WG estimates of landings in tonnes. *landings in 2018 are preliminary.

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
1988					0
1989					0
1990					0
1991					0
1992					0
1993	6				6
1994					0
1995					0
1996	1				1
1997					0
1998					0
1999					0
2000		2			2
2001					0
2002					0
2003					0
2004			4	625	629
2005				362	362
2006					0
2007					0
2008					0
2009					0
2010					0
2011					0
2012		31			31
2013					0
2014					0
2015					0
2016					0

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
2017					0
2018*					0

Table 6.5.6. Discard data from 2015-2018 from Subarea 6b, 7-1012.

Year	Spain				UK (Scotland)
	6b	7	8	9	6b
2015	0.7	28			0.5
2016		237	2	1	
2017	1.82	148.8			0.3
2018	2.9	97.9	1.8	0.8	0.3

Table 6.5.7. Discards by Spain and Netherlands from before the redefinition of the stock area (Subarea 6,7 and 8) from 2003–2014.

Year	Spain	Denmark	Germany	Sweden	Netherland	Total
2003	2807				1247	4053
2004	3075				300	3375
2005	2438				0	2438
2006	1250				149	1399
2007	2038				45	2083
2008	3060				58	3118
2009	4109				74	4183
2010	2006				23	2029
2011	2050				6	2056
2012	177				26	203
2013	91			21	20	133
2014	160	6	120	1	111	398

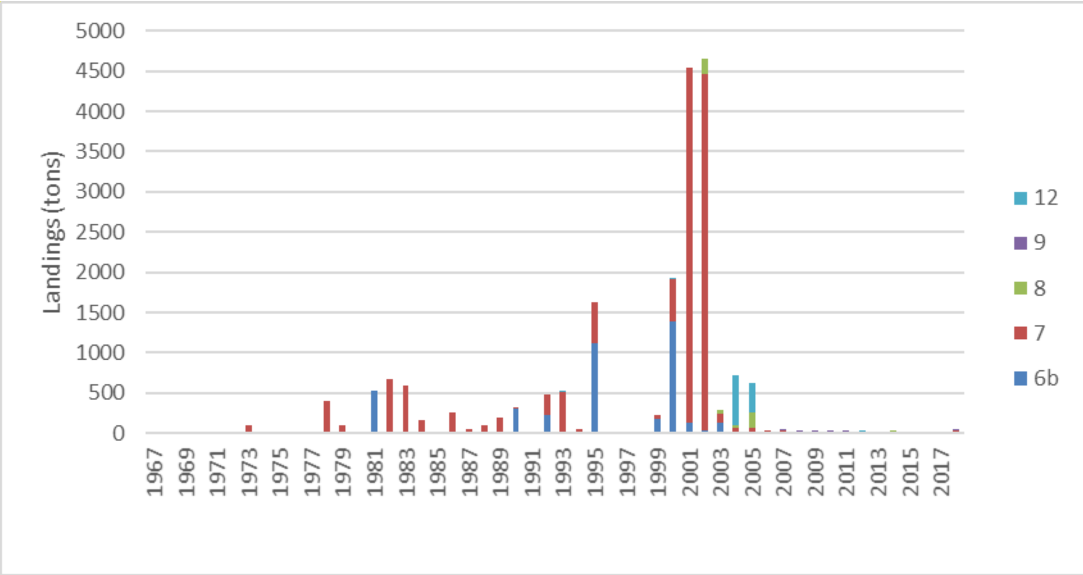


Figure 6.5.1. Total landings from 1966–2018 of greater silver smelt in 6.b, 7, 8, 9, 10 and 12.

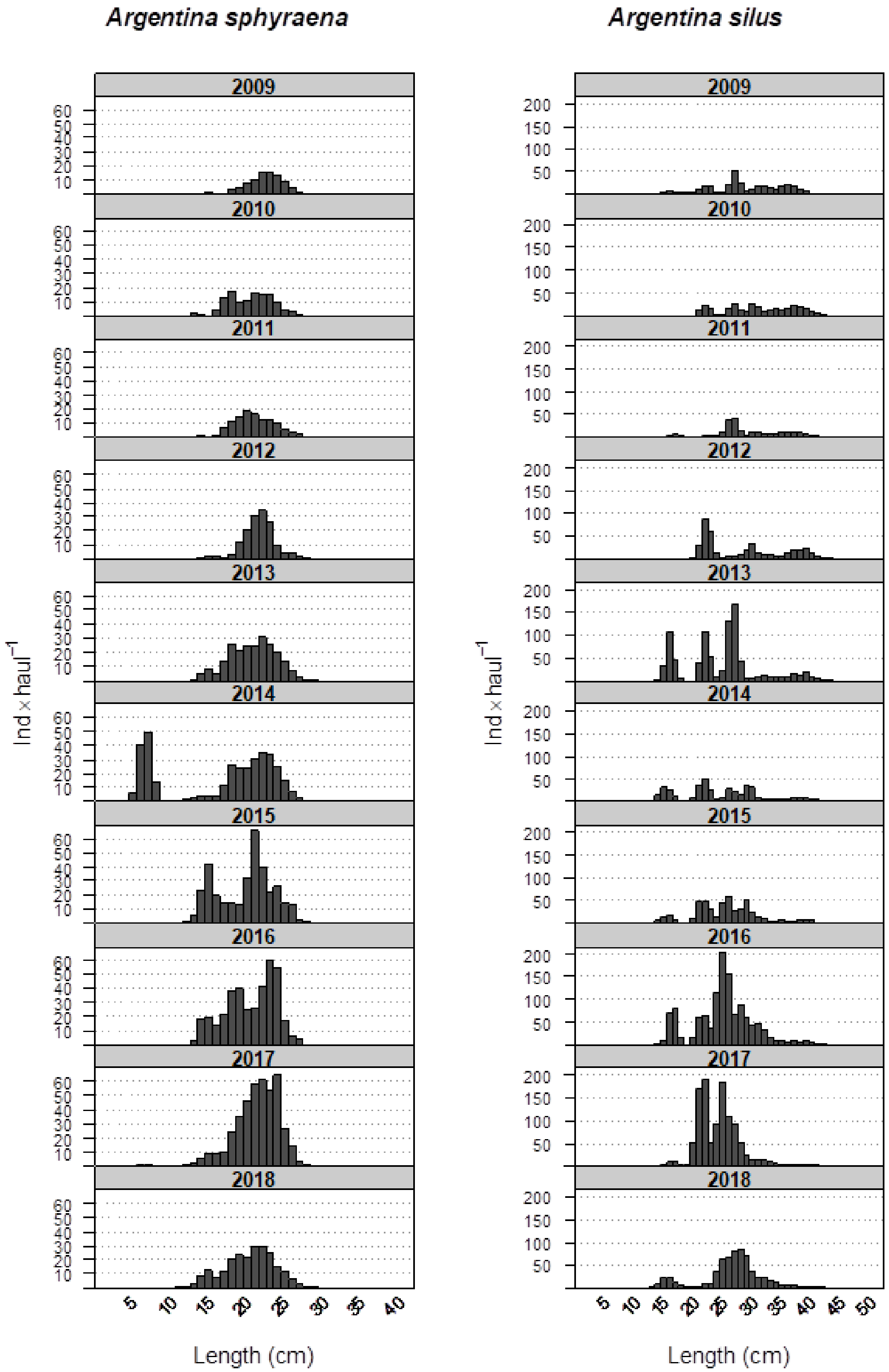


Figure 6.5.2. Mean stratified length distributions of *Argentina* spp. in Spanish Porcupine surveys from 2009-2018.

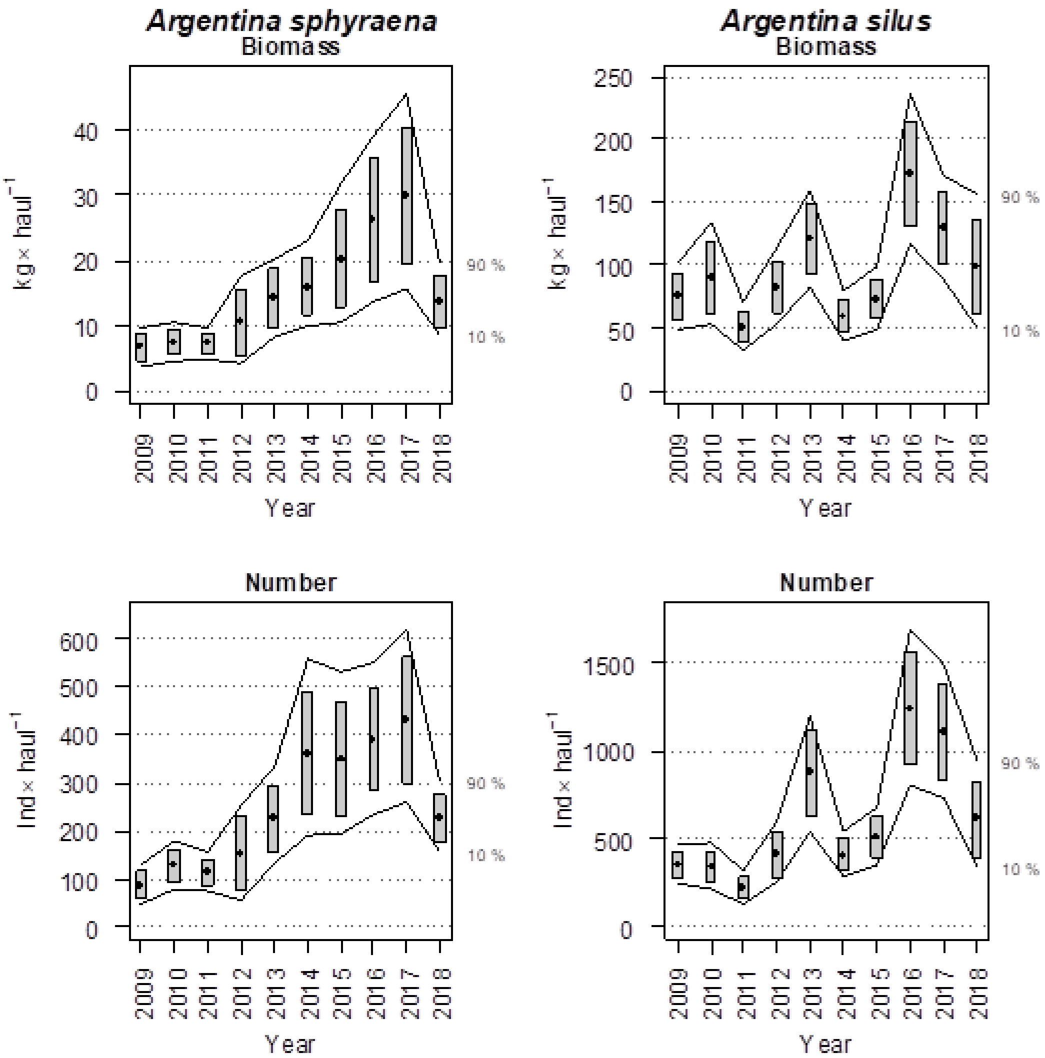


Figure 6.5.3. Evolution of *Argentina sphyraena* and *Argentina silus* biomass and abundance indices in Porcupine surveys (2009-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

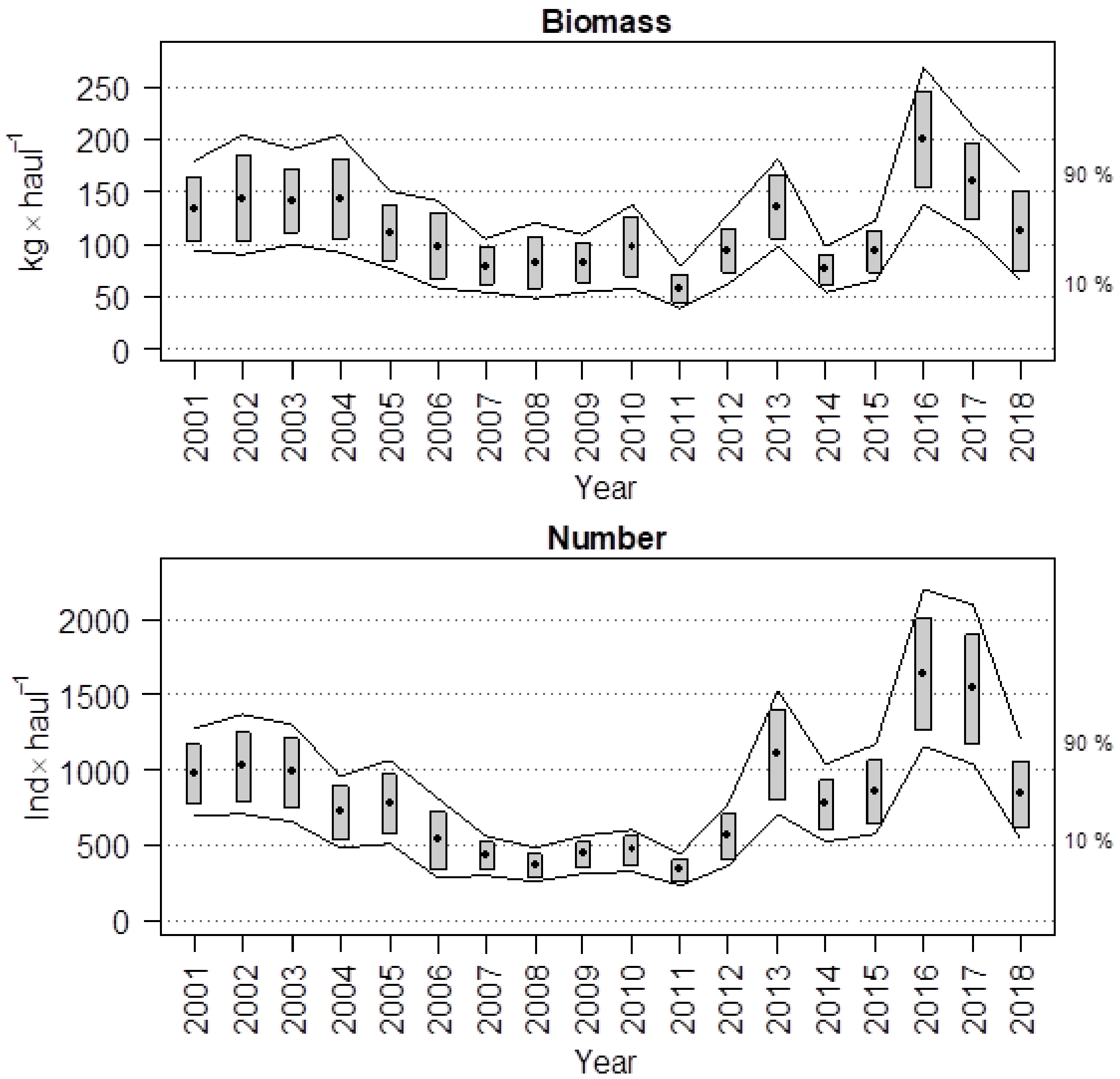


Figure 6.5.4. Evolution of *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

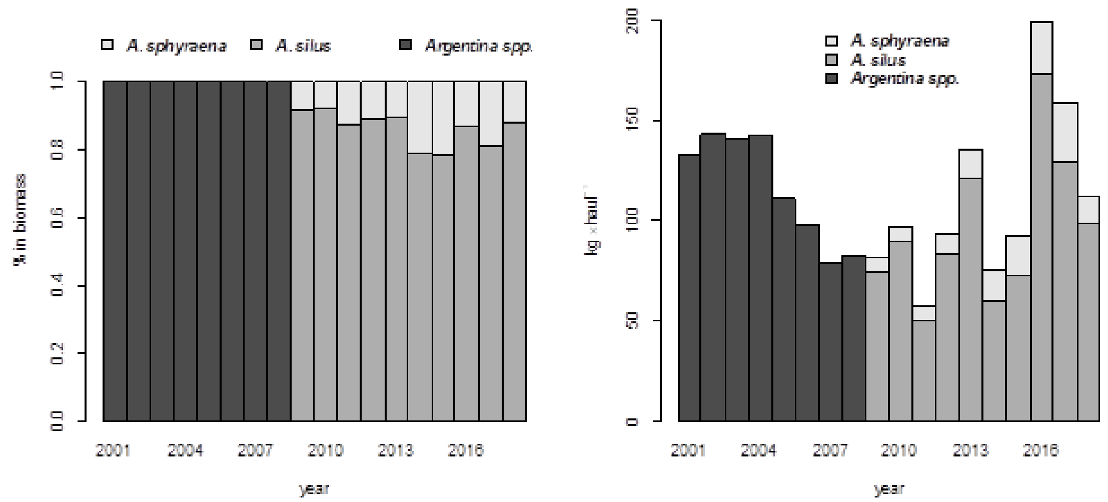


Figure 6.5.5. Share and abundance of Argentine species in Porcupine Bank surveys (2001–2018).

7 Orange roughy (*Hoplostethus atlanticus*) in the Northeast Atlantic

7.1 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 6;
- Subarea 7;
- Orange roughy in all other areas.

Given the scarcity of spatial fisheries data, biological and genetics data, 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. Such local aggregations may not be separated biological populations, i.e. a biological population may comprise several local aggregations. However the sequential depletion of local aggregations could lead to depletion at stock level. Therefore, ICES has recommended that where the small-scale distribution is known, this be used to define smaller and more meaningful management units.

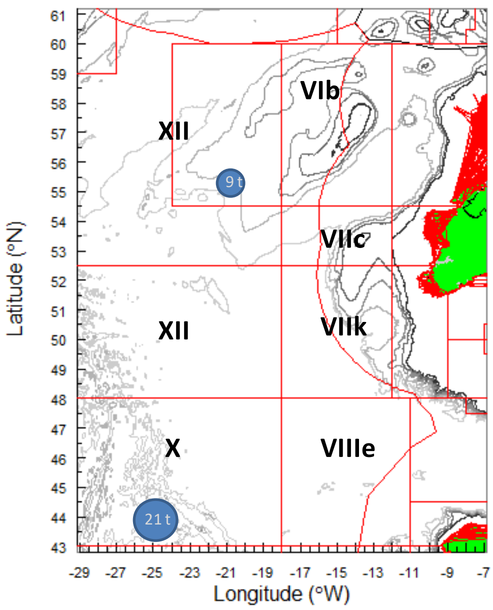


Figure 7.1.1. Faroese catches for orange roughy by ICES areas in Northeast Atlantic in 2018.

7.2 Orange roughy (*Hoplostethus Atlanticus*) in Subarea 6

7.2.1 The fishery

There was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Irish vessels fished there for two years starting in 2001, but directed fisheries had ceased by 2006. No fishing and no catch was reported for the year 2017. From 2017, following the ban of trawling deeper than 800 m in EU waters and for EU vessels in International waters (EU regulation 2016/2336 of 14 December 2016), catch by EU vessels are expected negligible of null.

7.2.2 Landings trends

Table 7.2.1 and Figure 7.2.1 show the landings data for orange roughy for ICES Subarea 6 as reported to ICES or as reported to the Working Group. In recent years, only a small landing, 700 kg rounded to 1 tonne in Table 7.2.1 was landed by the Faroe Islands in 2016. The cumulative landings in Area 6 since 1988 were 7188 tonnes. There was no landings in 2017-18.

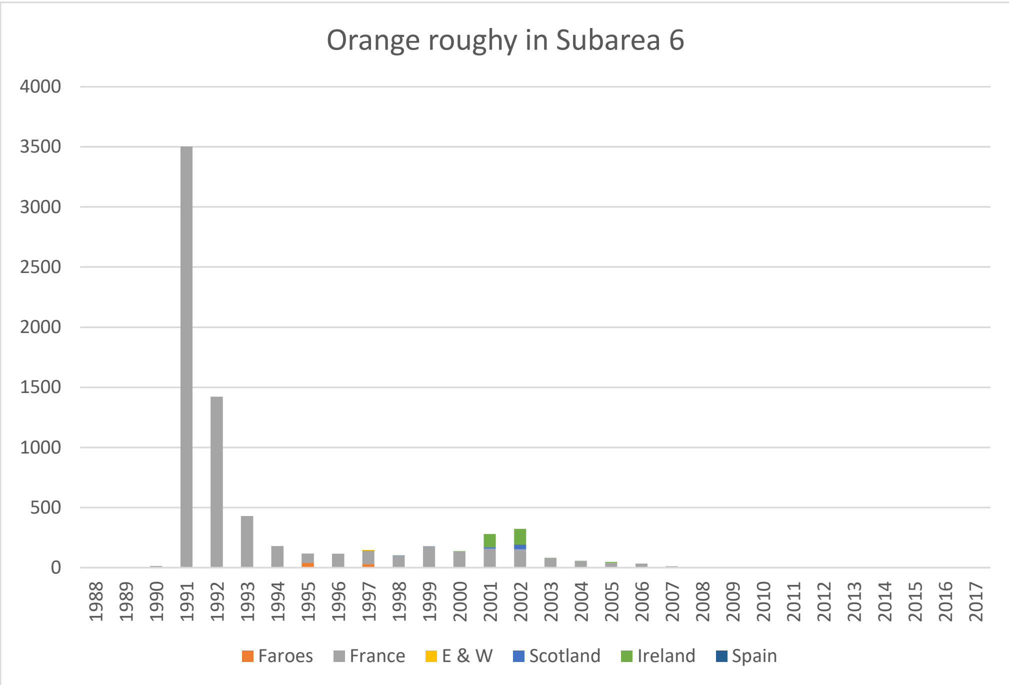


Figure 7.2.1. Time-series of orange roughy landings by country in ICES Subarea 6.

7.2.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

7.2.4 Management

In 2003 a TAC was introduced for orange roughy in Subarea 6, this TAC remained at 88 tonnes until 2006. In order to align the TAC with landings, the TAC for EU vessels in Area 6 was reduced annually between 2007 and 2009. A zero TAC has been set for orange roughy in Subarea 6 since 2010.

Landings in relation to TAC are displayed in Table 7.2.2.

Table 7.2.2. EU TACs and landings in EU and international waters of 6.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	88	81	81
2004	88	56	56
2005	88	45	45
2006	88	33	33
2007	51	12	12
2008	34	5	5
2009	17	2	2
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	1
2017	0	0	0
2018	0	0	0

7.2.5 Data available

7.2.5.1 Landings and discards

Landings are in Table 7.2.1.

Raised discard weights were not available for 2014 and 2015.For 2016 and 2017, discards were estimated to 0 -zero). In 2018 there was no reported landings and discards to ICES.

7.2.5.2 Length compositions

Length distributions are available from historical observer programmes and current deep-water surveys. Available information can be found in the stock annex.

7.2.5.3 Age compositions

No new information. Available information can be found in the stock annex.

7.2.5.4 Weight-at-age

No information.

7.2.5.5 Maturity and natural mortality

No new information. Available information can be found in the stock annex.

7.2.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

7.2.6 Data analyses

No new analysis was performed in 2017.

7.2.7 Management considerations

The fisheries for orange roughy in Subareas 6 and 7 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.. However since the ban of trawling deeper than 800 m the overlap between existing fisheries and the distribution of orange roughy might be minimal in EU waters of Subarea 6.

Due to the closure of the fishery in Subareas 6 and 7 and trawling ban deeper than 800 m there are no fishery-dependant data to evaluate the status of the stocks.

Assessment of the susceptibility of orange roughy populations in Subareas 6 and 7 to recent and current deep-water trawl fisheries (see WGDEEP 2014, Section 7.3) has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remains, such as on the ″flat″ fishing grounds in Subarea 6 on the continental slope to the northwest of Ireland extending to the west of Scotland. The overlap between orange roughy distribution and current fishery seems to generate a small bycatch. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in Subareas 6 and 7, the impact of current fisheries is considered sustainable.

The zero EU TAC implies that no EU fishing for the species is allowed. The application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the northeast Atlantic implies that bycatch in EU trawl fisheries might be minor as a consequence of the ban of fishing deeper than 800 m with trawls in this regulation. Possible bycatch should be minor because the fraction of orange rough biomass occurring shallower than 800 m is minor or inexistent.

Table 7.2.1. Orange roughy catch in Subarea 6.

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

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1993	-	429	-	-	-	-	429
1994	-	179	-	-	-	-	179
1995	40	74	-	2	-	-	116
1996	0	116	-	0	-	-	116
1997	29	116	1	-	-	-	146
1998	-	100	-	-	-	2	102
1999	-	175	-	-	0	1	176
2000	-	136	-	-	2	-	138
2001	-	159	-	11	110	-	280
2002	n/a	152	-	41	130	-	323
2003	-	79	-	-	2	-	81
2004	-	54	-	-	2	-	56
2005	-	41	-	-	6	-	47
2006		32			1		33
2007		12					12
2008		5					5
2009		3					3
2010		0					0
2011		0					0
2012		0					0
2013		1(1)					3**
2014		0					0
2015							0
2016	1						1
2017							0

7.3 Orange roughy (*Hoplostethus Atlanticus*) in Subarea 7

7.3.1 The fishery

After the collapse of the fishery in Subarea 6, 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.

7.3.2 Landings trends

Table 7.3.1 and Figure 7.3.1 show the landings data for orange roughy as reported to ICES or as reported to the Working Group.

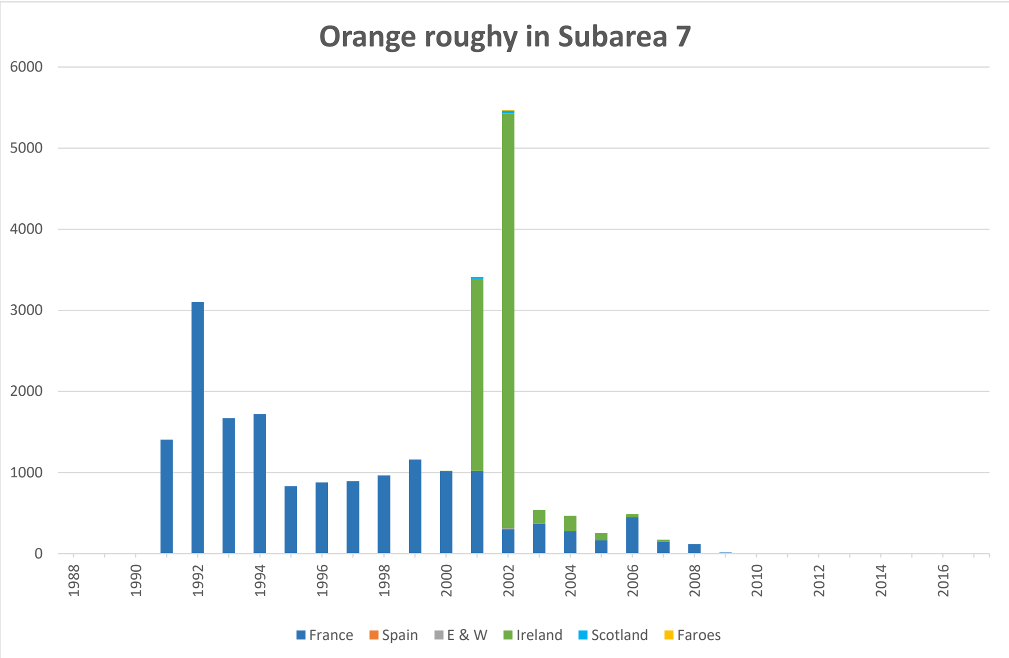


Figure 7.3.1. Time-series of orange roughy landings by country in ICES Subarea 7.

7.3.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the North-east Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

7.3.4 Management

A TAC for orange roughy in Subarea 7 was first introduced in 2003. Landings in relation to TAC are displayed in the table below:

Table 7.3.2. EU TACs and landings in EU and international waters of Subarea 7.

		Landing (t)	
Year	**TAC (t)**	**EC vessels**	**Total**
2003	1349	541	541
2004	1349	467	467
2005	1149	255	255
2006	1149	489	489
2007	193	172	172
2008	130	118	118
2009	65	15	15
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0

The TAC for orange roughy in Subarea 7 was set to 0 t for 2016 and 2017. No catch was reported.

7.3.5 Data available

7.3.5.1 Landings and discards

Landings are shown are in Table 7.3.1.

There was no landings since 2010. Discards of Orange roughy from the French mixed deep-water fishery in Subareas 6 and 7 were estimated from observer data. In recent years, discards estimated at fleet level have been calculated for total discards and by species. In 2012, the estimated discards of orange roughy was 400 kg.

In 2017 a reported discard in InterCatch of 30 kg in Division 7.d from France was clearly the results of a coding error in the fisheries statistic system.

7.3.5.2 Length compositions

No new information available. Historic information can be found in the stock annex.

7.3.5.3 Age compositions

No new information available. Historic information can be found in the stock annex.

7.3.5.4 Weight-at-age

No data.

7.3.5.5 Maturity and natural mortality

No new information available. Historic information can be found in the stock annex.

7.3.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

7.3.6 Management considerations

The fisheries for orange roughy in Subareas 6 and 7 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 in 2010-2016 was not significant (<1 tonne). Due to the closure of the fishery in Subareas 6 and 7 there are limited fishery-dependant data to evaluate the status of the stocks. Also, current fisheries-independent monitoring programmes are insufficient to monitor the recovery of the stocks in Subareas 6 and 7.

PSA Assessment of the susceptibility of orange roughy populations in Subareas 6 and 7 to recent and current deep-water trawl fisheries has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remained, such as the northern slope of the Porcupine Bank. Fishing effort ceased in this location in 2009 but returned from 2010 onwards. In the same area, scientific trawl surveys have confirmed the presence of orange roughy including juveniles (see ICES, 2012). The overlap between orange roughy distribution and current fishery seemed to generate small bycatch before 2016. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in Subareas 6 and 7, the impacts of fisheries in 2010-16 was considered sustainable.

The zero EU TAC implies that no EU fishing for the species is allowed. For 2017, the application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic implies that bycatch in EU trawl fisheries might be minor as a consequence of the ban of fishing deeper than 800 m with trawls in this regulation. Possible bycatch should be minor or inexistent because the fraction of orange rough biomass occurring shallower than 800.

Table 7.3.1. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus,* by country in Subarea 7. Reported landings after 2012 have been 0 and the table was not expanded for these years

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

*Preliminary.

7.4 Orange Roughy (*Hoplostethus atlanticus*) In Subareas 1, 2, 4, 5, 8, 9, 10, 12 and 14 and Division 3.a

7.4.1 The fishery

Fisheries have been conducted in Divisions 5.a–b and Subareas 8, 10 and 12. Most started in the early 1990s, the exception being Subarea 10 which started in 1996. Since 2010, fisheries are mainly occurring in subareas 10 and 12, with sporadic catches in 5.a, 5.b and 9. In recent years, one Faroese trawler operated a small directed fishery in ICES Subareas 10 and 12. Information on this fishery is presented in WD Ofstad, 2019.

7.4.2 Landing trends

Table 7.4.0 and Figure 7.4.1 show the landings data for orange roughy for the ICES areas as reported to ICES or as reported to the Working Group.

Landings from the single trawler fishing in subareas 10 and 12 have been between 50 and 150 tonnes per year since 2014. They amounted to 150 tonnes in 2017. During the two last years, these landings were from subarea 10 only. In 2018, 20.65 tonnes was caught in Subarea 10 and 8.75 tonnes in Subarea 12.

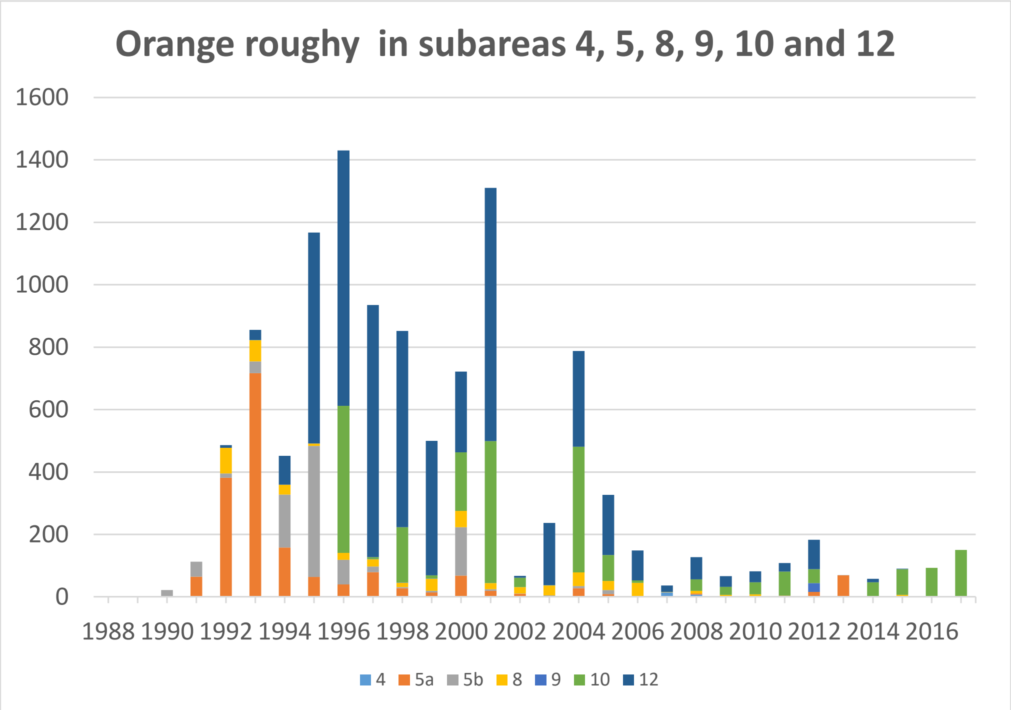


Figure 7.4.1. Time-series of orange roughy landings by subarea in all ICES areas (except subareas 6 and 7).

7.4.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

7.4.4 Management measures

The EU TAC is set to for 0. The TAC applies to Community waters and EC vessels in international waters. Landings in relation to EU TAC are shown in Table 7.4.1.

In the NEAFC Regulatory Area, targeted fisheries for orange roughy are not permitted to vessels of the contracting parties, which must take measures to decrease bycatch (Recommendation 6: 2016).

In addition there are a number of management measures that are currently in place in the NEAFC regulatory area in relation to bottom trawling in known VMEs and outside existing fishing areas.

Table 7.4.1. EU TACs and landings in Community waters and waters not under the sovereignty or jurisdiction of third countries of 1, 2, 3, 4, 5, 8, 9, 10, 11, 12 and 14.

		Landing (t)	
Year	EU TAC (t)	EC vessels	Total
2005	102	71	278
2006	102	58	149
2007	44	16	36
2008	30	8	112
2009	15	5	62
2010	0	<1	83
2011	0	4	124
2012	0	28	167
2013	0	0	57
2014	0	0	58
2015	0	0	84
2016	0	0	0
2017	0	0	0
2018	0	0	0

7.4.5 Data available

7.4.5.1 Landings and discards

Landings are in Table 7.4.0. In recent years, Faroe Islands continued the fishery for orange roughy. The Faroese catches were 93 and 150 tonnes in area 10, respectively in 2016 and 2017. In 2016 and 2017, small discards were reported by Spain in Division 8.c and 9.a, 500 and 225 kg respectively in 2016 and 2017. In 2018 reported discards were 120 kg by Spain from Division 8.c.

7.4.5.2 Length composition

Sampling of lengths, weight and gender of orange roughy was carried out by trained crew members on board the single Faroese fishing vessel operating in this fishery. Samples were taken randomly from the catch. The length distribution of the catch is between 50–70 cm total length (Figure 7.4.1), which is the same as in the Faroese experimental fishery in the nineties (Thomsen, 1998). The average length and weight of orange roughy females and males were around the same in 2011–2018 compared with the results from the experimental fishery in 1992–1998 (Thomsen, 1998) (Table 7.4.2).

Table 7.4.2. Mean length and weight by sex. From sampling by trained crew members on board the single Faroese fishing vessel targeting orange roughy.

Year	Area	Month	Average length (cm)		Average weight (kg)		
			Female	Male	Female	Male	
1992–1998	Faroe Islands		61.4	58.6	4.4	3.7	Thomsen, 1998
	Hatton Bank		64.6	62.8	4.9	4.3	Thomsen, 1998
	Reykjanes Ridge		58.9	56.4	3.6	3	Thomsen, 1998
	North of Azores		60.6	59.7	3.9	3.7	Thomsen, 1998
2011	10.b	Feb., Mar.	61.4	60.5	3.5	3.2	
2012	10.b	Feb.	61.4	60.8	3.5	3.2	
2013	10.b	Jan.	60.9	57.7	4.3	3.8	
2014	10.b	Jun., Jul.	62.1	58.4	4.2	3.7	
2015	10.b	Jul., Aug.	59.0	58.3	3.7	3.5	
2016	10.b	Jun., Oct., Nov.	61.4	58.7	4.3	3.7	
2017	10.b	Nov.	60.6	57.5	3.9	3.4	
2018	10.b, 12.c	Feb.	63.4	60.1	4.2	3.8	

7.4.5.3 Age composition

No data.

7.4.5.4 Weight-at-age

No data.

7.4.5.5 Maturity and natural mortality

No data.

7.4.5.6 Catch, effort and research vessel data

Catch and effort data were collected on a haul-by-haul basis in the Faroese fishery.

Orange roughy is caught occasionally in the stratified bottom trawl survey in East Greenland (Division 14.b) (Nielsen et.al., 2019). The species was only caught in 2008, 2013, 2014 and 2015 (Figure 7.4.2). In 2014 and 2015, estimated biomass was 1.7 t and 1.1 t, respectively, and all other years it was zero or very close to. No length distributions are calculated because of too few specimens (N<20) has been caught.

7.4.6 Data analysis

No data analysis was carried out in 2018

7.4.7 Management considerations

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible.

The zero EU TAC implies that no EU fishing for the species is allowed. The application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic implies that bycatch in EU trawl fisheries might be minor as a consequence of the ban of fishing deeper than 800 m with trawls in this regulation. Possible bycatch should be minor because the fraction of orange rough biomass occurring shallower than 800 m is minor or inexistent. With the exception of the black scabbardfish fishery in 9.a, where bycatch of orange roughy are not known to occur, there are no EU longline fishery at depth where orange roughy occurs.

In 2015–2018 all landings from the stock were caught in the NEAFC RA.

7.4.8 References

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7.4.9 Tables and Figures

Table 7.4.0a. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division 5.a.

Year	Iceland	Total
1988	-	0
1989	-	0
1990	-	0
1991	65	65
1992	382	382
1993	717	717
1994	158	158
1995	64	64
1996	40	40
1997	79	79
1998	28	28
1999	14	14
2000	68	68
2001	19	19
2002	10	10
2003	0	0
2004	28	28
2005	9	9
2006	2	2
2007	0	0
2008	4	4
2009	<1	<1
2010	<1	<1
2011	4	4
2012	16	16
2013	54	54
2014	0	0

Year	Iceland	Total
2015	0	0
2016	0	0
2017	0	0
2018	0	0

Table 7.4.0b. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division 5.b.

Year	Faroes	France	Total
1988	-	-	0
1989	-	-	0
1990	-	22	22
1991	-	48	48
1992	1	12	13
1993	36	1	37
1994	170	+	170
1995	419	1	420
1996	77	2	79
1997	17	1	18
1998	-	3	3
1999	4	1	5
2000	155	0	155
2001	1	4	5
2002	1	0	1
2003	2	3	5
2004		7	7
2005	3	10	13
2006	0	0	0
2007	0	1	1
2008	0	<1	<1
2009	<1	2	2
2010	<1	<1	<1
2011	0	0	0
2012	0	0	0
2013	1		1
2014	0		0
2015	0		0
2016	0	0	0

Year	Faroes	France	Total
2017	0	0	0
2018	0	0	0

Table 7.4.0c. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 8.

Year	France	Spain	E & W	Total
1988	-	-	-	0
1989	0	-	-	0
1990	0	-	-	0
1991	0	-	-	0
1992	83	-	-	83
1993	68	-	-	68
1994	31	-	-	31
1995	7	-	-	7
1996	22	-	-	22
1997	1	22	-	23
1998	4	10	-	14
1999	33	6	-	39
2000	47	-	5	52
2001	20	-	-	20
2002	20	-	-	20
2003	31			31
2004	43			43
2005	29			29
2006	43			43
2007	1			1
2008	8			8
2009	13			13
2010	8			8
2011	0			0
2012	0			0
2013	0			0
2014				0
2015	6			6
2016	0			0

Year	France	Spain	E & W	Total
2017	0	0	0	0
2018				

Table 7.4.0d. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 9.

Year	Portugal	Spain(1)	Total
1990	0	-	0
1991	0	-	0
1992	0	-	0
1993	0	-	0
1994	0	-	0
1995	0	-	0
1996	0	-	0
1997	0	1	1
1998	0	1	1
1999	0	1	1
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	4	0	4
2012	28		28
2013	0		0
2014			0
2015			0
2016			0
2017			0

Year	Portugal	Spain(1)	Total
2018			0

Included in landings from Subarea 9 until 2002

Table 7.4.0e. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 10.

Year	Faroes	France	Norway	E & W	Portugal	Ireland	Total
1989	-	-	-	-	-		0
1990	-	-	-	-	-		0
1991	-	-	-	-	-		0
1992	-	-	-	-	-		0
1993	-	-	1	-	-		1
1994	-	-	-	-	-		0
1995	-	-	-	-	-		0
1996	470	1	-	-	-		471
1997	6	-	-	-	-		6
1998	177	-	-	-	-		177
1999	-	10	-	-	-		10
2000	-	3	-	28	157		188
2001	84	-	-	28	343		455
2002	30	-	-	-	-		30
2003		1					1
2004	384					19	403
2005	128	2					130
2006	8						8
2007	0						0
2008	37						37
2009	26						26
2010	39						39
2011	77						77
2012	45						45
2013	0						0
2014	47 (1)						47
2015	83 (1)						83
2016	93 (1)						93
2017	150 (1)						150

Year	Faroes	France	Norway	E & W	Portugal	Ireland	Total
2018	21						21

Landings 2014–2017 were from Division 10.b

Table 7.4.0f. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 12.

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1989	-	0	-	-	-			-	0
1990	-	0	-	-	-			-	0
1991	-	0	-	-	-			-	0
1992	-	8	-	-	-			-	8
1993	24	8	-	-	-			-	32
1994	89	4	-	-	-			-	93
1995	580	96	-	-	-			-	676
1996	779	36	3	-	-			-	818
1997	802	6	-	-	-			-	808
1998	570	59	-	-	-			-	629
1999	345	43	-	43	-			-	431
2000	224	21	-	-	2			12	259
2001	345	14	-	-	2		450	-	811
2002	+	6	-	-	-		0	-	6
2003		64				136	0	-	200
2004	176	131					0		307
2005	158	36					0		193
2006	81	15							96
2007	20								20
2008	71								71
2009	34								34
2010	35								35
2011	27								27
2012	94								94
2013	2								2
2014	11								11
2015	1								1
2016	0								0
2017	0								0

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
2018	9								9

Table 7.4.0g. Orange roughy total international landings in the ICES area, excluding Subareas 6 and 7.

Year	4	5.a	5.b	8	9	10	12	All areas
1988		0	0	0	0	0	0	0
1989		0	0	0	0	0	0	0
1990		0	22	0	0	0	0	22
1991		65	48	0	0	0	0	113
1992		382	13	83	0	0	8	486
1993		717	37	68	0	1	32	855
1994		158	170	31	0	0	93	452
1995		64	420	7	0	0	676	1167
1996		40	79	22	0	471	818	1430
1997		79	18	23	1	6	808	935
1998		28	3	14	1	177	629	852
1999		14	5	39	1	10	431	500
2000		68	155	52	0	188	259	722
2001		19	5	20	0	455	811	1310
2002		10	1	20	0	30	6	67
2003		+	5	31	0	1	200	237
2004		28	7	43	0	403	307	788
2005		9	13	29	0	83	193	327
2006		2	0	43	0	8	96	149
2007	14		1	1	0	0	20	36
2008	7	4	<1	8	0	37	71	127
2009	0	1	2	3	0	26	34	66
2010	0	<1	<1	8	0	39	35	82
2011	0	4	0	0	<1	77	27	108
2012		16	0	0	28	45	94	183
2013		54	1	0	0	0	2	57
2014						47	11	58
2015				6		83	1	90
2016						93		93

Year	4	5.a	5.b	8	9	10	12	All areas
2017						150		150
2018						21	9	30

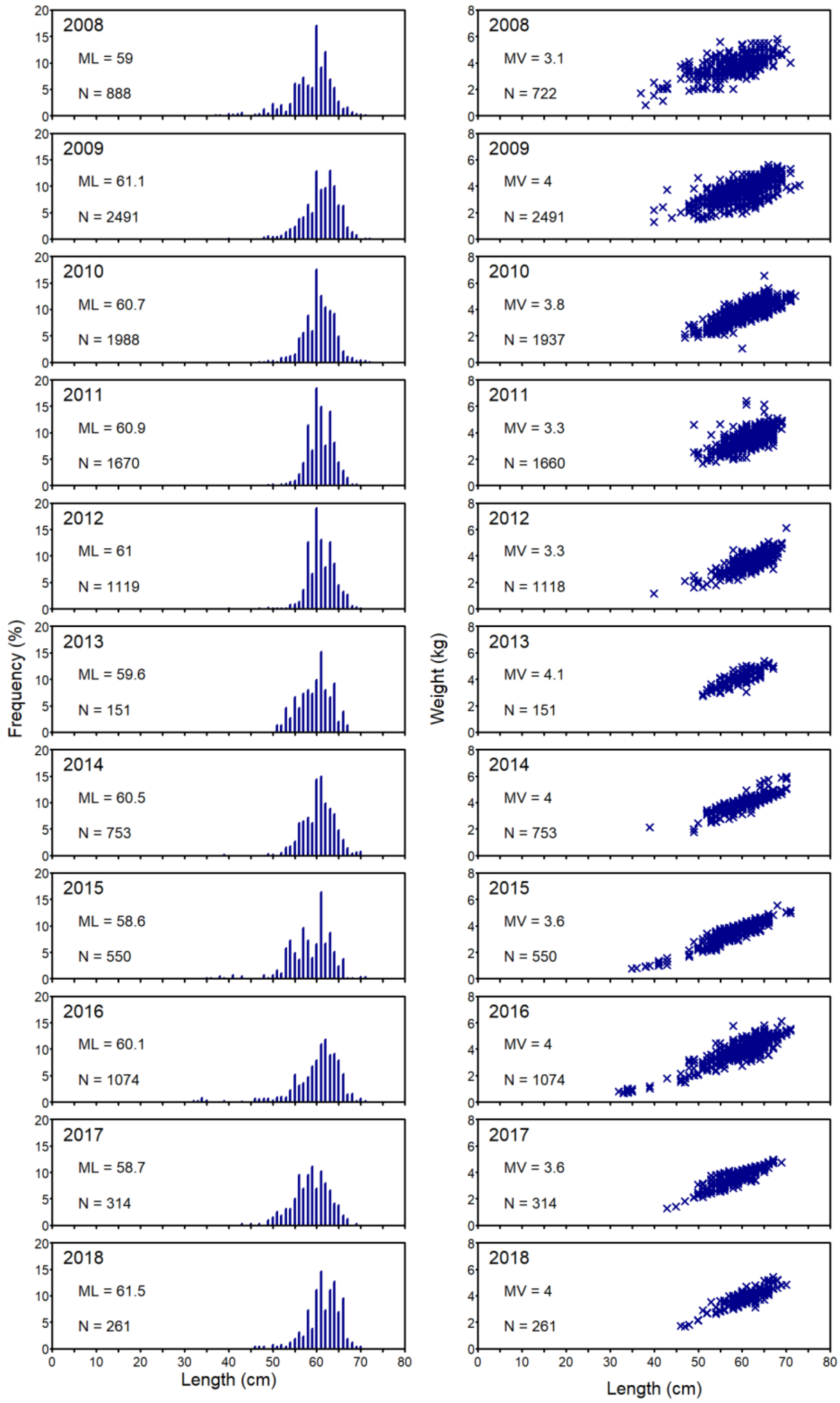

Figure 7.4.1. Length distribution and length–weight relation of orange roughy in Faroese catches 2008–2018.

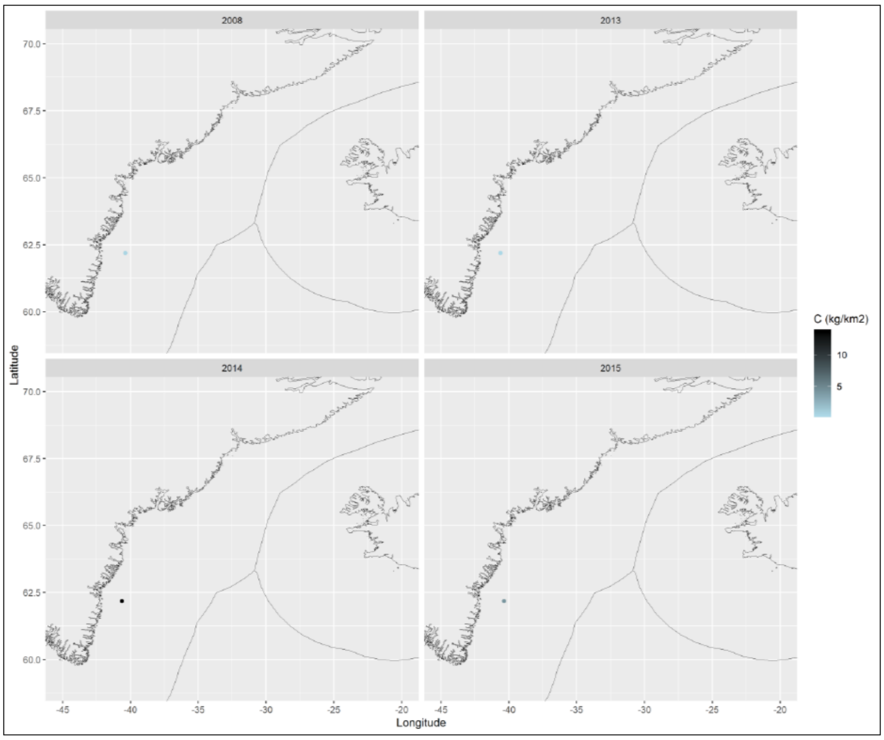

Figure 7.4.2. Distribution of survey catches of orange roughy at East Greenland in 1998–2016. No survey in 2001, 2017 and 2018.

8 Roundnose grenadier (Coryphaenoides rupestris)

8.1 Stock description and management units

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic:

- Skagerrak (Division 3.a);
- The Faroe-Hatton area, Celtic sea (Divisions 5.b and 12.b, Subareas 5, 7);
- the Mid-Atlantic Ridge 'MAR' (Divisions 5.b, 12.c, Subdivisions 5.a1, 12.a.1, 14.b.1);
- All other areas (Subareas 1, 2, 4, 8, 9, Division 14.a, Subdivisions 5.a.2, 14.b.2).

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.

In the 2010s, genetic analyses have brought forward information regarding the 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. Knutsen *et al*. (2012) covered a larger geographic range including East and West Atlantic as well as Artic areas and found significant genetic structure. Parts of this structure, notably in peripheral (Canada) and bathymetrically isolated basins (Skaggerak and Trondheimsleia (off Norway)), was found to represent distinct biological populations with limited present connectivity with central Atlantic and West European slope. Off the British Isles (Irish slope, Rockall, and Rosemary Bank), the magnitude of genetic structure was found weak. This lack of definition could reflect that samples from this area represent a single, widespread population. On the other hand, a 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 for grenadier. . These sites may therefore represent distinct demographical populations, where there is a sufficient gene flow to maintain genetic similarity in terms of allele frequency but the demography is driven by local/regional recruitment and growth with a minor contribution of large scale migrations of juveniles and adults or transport of larvae. .

The current stock units are consistent with the study from Knutsen *et al*. (2012) except that the unit covering subareas 1, 2, 4, 8, and 9, Division 14.a, and subdivisions 14.b.2 and 5.a.2, should not be considered as a demographic stock or a genetic population because it includes Artic and Atlantic areas in which roundnose grenadier was found to be genetically different. This unit might be only considered as an aggregations of areas where roundnose grenadier occurs at low to moderate density and is not subject to significant continuous exploitation.

8.2 Roundnose Grenadier (*Coryphaenoides rupestris*) in Division 5.b and 12.b, Subareas 6 and 7

8.2.1 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 5.b, 6.a, 5.b.2 and Subareas 7, 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 6.b.1 and 12.b.

8.2.2 Landings trends

Official French landings have been revised for 2017 and are preliminary for 2018.

Evidence of substantial mismatches between observer and official Spanish data of landings in Subarea 6 and Division 12.b were presented at WGDEEP in 2010. This has raised some concerns regarding possible misreporting between the different species of grenadiers (*Coryphaenoidesrupestris, Macrourusberglax* and *Trachyrincusscabrus*). This issue is still present for 12.b and 6.b landings but according to official Spanish catch data it concerns a much smaller proportion of grenadier catch. Catches of *Macrourus berglax* and *Trachyrincus scabrus* were almost absent from the catches over the 2009–2011 period. In 2012, 6 t of *Trachyrincus scabrus* were reported in 6, 188 t in 12.b. 2013 landings data show around 179 t and 195 t of *Macrourus berglax* reported in 6.b and 12.b respectively. No landings were reported for *Trachyrincus scabrus* since 2014.

Over the past two decades, landings from Division 5.b, have reached more than 3800 t in 1991 and more than 2000 t in 2001. Between these two periods, the landings were low (less than 700 t in 1994). After 2001, landings decreased to about 1000 t in 2002 but increased further to about 1840 t in 2005 and then decreased to 74 t in 2011. In 2018, the provisional landings in 5.b are 6 t. These landings are exclusively from French trawlers (Table 8.2.0a).

In Subarea 6, the highest landings were observed in 2001 (close to 15 000 t) and have decreased to around 1060 t in 2014. Provisional landings are 513 t in 2018. Most of these landings are caught by French and Spanish trawlers (Table 8.2.0b), with small amounts from Scotland.

In Subarea 7, landings close to 2000 t were recorded in 1993–1994, recent annual landings are much lower (from 200-400 t/year in 2005–2007, to 34 t in 2011). Only 2 tonnes were reported in 2018 from France (Table 8.2.0c).

In ICES Division 12.b, 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 832 t in 2014. In 2015 the landings went down to 314 and then increased again slightly until the 600 t in 2016 and 1001 in 2017. In 2018, provisional landings are around the 998 t (Table 8.2.0d).

There were significant Faroese landings in the mid-1990s, but this fishery disappeared in the 2000s and now amounts for a few tons some years. French fisheries have landed up to 1700 t in 2004 but to almost no landings since 2007.

The landings data are considered uncertain in Division 12.b, because of the possibility of unreported landings in international waters, which is a serious issue for assessment. In addition to this, none of the national landings data were reported by new ICES divisions and some landings were allocated to divisions according to working group knowledge of the fisheries.

8.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, catches should be no more than 3971 tonnes in each of the years 2019 and 2020. If discard rates do not change from the average of 2015–2017, this implies landings of no more than 3693 tonnes.

8.2.4 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 5.b and Subareas 6 and 7, a TAC was set at 2558 t for 2019 and 2558 t for 2020. The TAC since EC regulation 1367/2014 was a combined value for roundnose grenadier and roughhead grenadier (*Macrourus berglax*). For 2019 and 2020, this TAC set by EC regulation 2018/2025 is only for roundnose grenadier but with the following rule that "any bycatches for roughhead grenadier should be limited to 1% of each Member State's quota of roundnose grenadier and counted against that quota, in line with the scientific advice".

The rationale for this change is explained in the EC regulation: "According to the advice provided by ICES, limited on-board observations show that the percentage of roughhead grenadier has been less than 1% of the reported catches of roundnose grenadier. On the basis of those considerations, ICES advises that there should be no directed fisheries for roughhead grenadier and that bycatches should be counted against the TAC for roundnose grenadier in order to minimise the potential for species misreporting. ICES indicates that there are considerable differences, of more than an order of magnitude (more than ten times), between the relative proportions of roundnose and roughhead grenadier reported in the official landings and the observed catches and scientific surveys in the areas where the fishery for roughhead grenadier currently occurs. There are very limited data available for this species, and some of the reported landing data are considered by ICES to be species misreporting. As a consequence, it is not possible to establish an accurate historical record of catches of roughhead grenadier".

In Subareas 8, 9, 10, 12 and 14 the TAC was set at 2281 t in 2019 and 2281 t for 2020. This TAC covers areas with minor roundnose grenadier catches (8, 9 and 10), part of this assessment area (Division 12.b, the western slope of the Hatton bank) and the Mid-Atlantic Ridge (Divisions 12.a,c and Subarea 14). The main countries having quotas allocations under this TAC are Spain and Poland. Therefore these quota allocations are based upon historical landings in 12.b for Spain and in 12.a,c (Mid-Atlantic Ridge) for Poland.

The table below summarizes the TACs in the two management areas and landings in the assessment area.

	5.b, 6, 7		8, 9, 10, 12, 14		Total international Landings 5.b, 6, 7, 12.b	ICES predicted
estimates	EU TAC	EU Landings	EU TAC	EU Landings 12.b		catch corresp. to advice
2005	5253	5777	7190	8782	14558	-
2006	5253	4676	7190	4361	9037	-
2007	4600	3778	6114	4258	8036	< 6000
2008	4600	3102	6114	2432	5534	< 6000
2009	3910	4046	5197	5335	9381	< 6000
2010	3324	3461	5197	2759	6220	< 6000
2011	2924	1577	4573	1578	3155	< 6000
2012	2546	1440	3979	666	9103	< 6000
2013	4297	1517	3581	796	3841	< 6000
2014	4297	1147	3223	832	2072	< 6000
2015**	4010	701	3644	314	1015	< 5433
2016**	4078	767	3279	599	1366	< 5511
2017**	3052	661	2623	1001	1662	≤ 3897
2018**	3120	521	2099	998	1519	≤ 3971
2019*	2558		2281			≤ 3971
2020*	2558		2281			≤ 3971

*** provisional.**

**** combined TAC for roundnose grenadier and roughhead grenadier.**

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 12.b.

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.

8.2.5 Data available

8.2.5.1 Landings and discards

Landings time-series data per ICES areas are presented in Table 8.2.0a-e.

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 12 were allocated to Division 12.b (western Hatton bank) or 12.a,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 has been consistent and stable for the period 2004–2010 with about 30% of the weight and 50% of the number of roundnose grenadier caught being discarded, because of small size. This figure is higher than from previous sampling programme where the discarding rate in the French fisheries was estimated slightly above 20% in 1997–1998 (Allain *et al*., 2003). These differences may have come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. Since then, the discard rate has been reduced to 12% of the weight of the catch (29% in number of individuals) in 2011 and 6% in weight in 2012 (24% in numbers). In 2013, discards accounts for 15% of the catch in weight and 32% in number. In 2014, discards accounts for 6% of the catch in weight and 16% in number. In 2015 and 2016, discards accounted for 5% of the catch in weight and 15 to 17% in number. In 2017, discards were 6% in weight and 15% in number. In 2018, discards accounted for 3% in weight and 8% in number.

The reduction of discards is related to:

1. a change of depth of the French fleet towards shallower waters; and
2. attempts to avoid areas where discards are high.

<u>Spanish Observer programme (Hatton Bank):</u> discard data are available from the Spanish Observer Programme. For the period 2004–2015, observers have covered on average 15±10% (range 3–39%) of the fleet fishing days in Division 6.b, and 12±8% (range 2–33%) in Division 12.b. Although occasionally the discards reached 26% of the total observed weight catch in the period 1996–2015, they are negligible in most sampled months. Annual average discards are 7% (range 0–21%) in weight in both Divisions 6.b and 12.b (range 0–26%). These discards, however, correspond to undersized individuals. Discards data for 2011 were not presented as they are considered to be inaccurate but provided again for 2012 and onwards. In 2017, in area 6.b and 12.b, the discard rate is around 4.7% in weight (5.05% in 6.b and 4.6% in 12.b). In 2018, the discard rate is estimated to be around 2.5% (1.6% in 6.b and 3% in 12.b).

8.2.5.2 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 8.2.1–8.2.3).

8.2.5.3 Age composition

No new data.

8.2.5.4 Weight-at-age

No new data.

8.2.5.5 Maturity and natural mortality

No new data.

8.2.5.6 Research vessel survey and cpue

Research vessel survey

Data were available from the Marine Scotland deep-water survey since the years 1998 and from stats squares 41E0 through 45E0. This survey operates now on a biannual basis therefore no survey was carried out in 2016. Last survey occurred in 2015.

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 2014 and 2015. In 2015, data from only one boat were available therefore the value this year was not included into the assessment. Discards are not available from those datasets therefore only lpues are calculated and provided for roundnose grenadier. Owing to the decreasing of quotas in recent years, the fishery now operates on a smaller area. Further, in 2012 data for only two vessels were available at the time of the working group. As a result, the data only covered two of the five small areas previously considered for this lpue series. The time-series should then be interpreted with caution. The observed lpue is unlikely to represent properly the trend in the stock because the change in abundance in unfished areas are not considered. Indices have not been compiled since 2016 due to the very low number of boats.

Lpue from the Faroese commercial fleet

The commercial cpue series is from trawlers, where the criteria were that grenadier contributed more than 30% of the total catch.

Logbook data for the period 1985–2009 have been quality controlled. The cpue are from a subset of the commercial ships: all available logbooks from 6–8 otterboard trawlers mainly fishing in deep water, 4–8 pairtrawlers 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 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 measure for each trawl haul/setting, which was back-transformed prior to use. The reason for this selection of hauls was to try to get a series that represents changes in stock abundance.

Roundnose grenadier is only fished by large trawlers and the main fishing area is on the slope around the Faroe Bank.

The cpue data were available in 2014 but the figure is not accurate because of a very small number of hauls with more than 30% of grenadier since 2011 (one in 2014).

Effort from the Spanish commercial fleet.

Figure 8.2.4 shows the evolution of the combined effort applied by the fleet in divisions 6.b and 12.b, as total fishing power by area (considering boat power and number of fishing days), and total effort for the whole area (Kw). The general tendency in all cases is to decrease the number of days and thus, the total fishing power applied. The time-series has been set up for the years 2010-2018.

8.2.6 Data analyses

8.2.6.1 Benchmark assessments

Trends from length distribution and individual weight

For France, the modal discarded length has remained constant (Figures 8.2.1–8.2.2) at around 11 cm while the average pre-anal length of the individuals in the landings has decreased from 20.8 cm in 1990 to around 15.5 cm since 2011. There is an increasing trend in the landings since then. The mean pre-anal length for landings was 15cm in 2018 (Figure 8.2.5).

Size–frequency data provided by Spain for the period 2002–2015 in 6 and 12.b shows the modal length (PAFL) of landings to be closely similar between divisions with female being larger than male by around 2 cm (Figure 8.2.6). The modal length of discards is around 9.5 cm. Over the period 2002–2018, 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 14cm for females and 13.5 to 12.4 cm for males) until 2009. Over the period 2009–2018, in both 6 and 12.b, the mean length in landings has increased by two centimetres for both males and females in 2010–2011. Few discards data were available by the time of the working group. No new information is available on Spanish discards.

The difference of modes of the length distributions of landed catch between the Spanish fleet in Divisions 6 and 12.b and the French fleet is possibly because of different sorting habits in relation to different markets.

It is therefore important that length distribution of the landings and discards are provided to the working group by all fleets exploiting the stock.

Time-series of mean individual weight from the Marine Scotland Deepwater Science survey shows no clear trends because of big confidence intervals. Average weight is around 0.42 kg in 2016 and 0.73 kg in 2017 but with very wide confidence intervals (Figure 8.2.7).

Trends in abundance indices

Marine Scotland Deep-water Science survey (MSDSS)

The working group was provided this year with an update of the survey indices. There is an increasing trend of abundance over the period 2011–2013. Since 2015, there is however a decrease and the index was close to the long term average of the series. (Figure 8.2.8).

Lpue from the Faroese commercial fleet

The cpue is stable for the period 2009–2010 although it is above average in 2011. After that period, the small number of hauls carrying more than 30% of grenadier makes cpue estimates highly inaccurate (Figure 8.2.9). No new data has been available since 2014.

Lpue from the Spanish commercial fleet in 12.b

Some basic lpue indices were estimated for the Spanish fleet in order to include the 12.b landings into the assessment. 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 variable since then with a tendency to decrease (Figure 8.2.10), since there seems to be a change in the fishing habits, with a growing tendency for vessels to use this area as a stopover, either on the way out or on the way back, of other fishing grounds, mainly to the NAFO area.Lpue from the French tallybooks

The overall trend in abundance (Figure 8.2.11–8.2.12) shows a decline from 2000 to 2003 and has been stable until 2015 when the series stops. Due to the low number of boats, the time series is no longer usable for assessment.

Stock assessment

The assessment method for this stock has changed in 2018. In 2016, an assessment was possible to provide category 1 advice for the part of the stock in subareas 6 and 7 and Division 5.b, while the advice for the part of the stock occurring in Division 12.b was a catch-only assessment (category 5). LPUE data from haul-by-haul data provided by French trawlers were used in previous assessments for subareas 6 and 7 and Division 5.b. The decrease in activity and number of boats now prevents the use of those indices in the assessment. An exploratory model using a new index (Marine Scotland Deepwater Survey) that was available up to 2017 was examined. However, this model formulation and the use of this survey as a biomass indicator have not been benchmarked, and the perception of stock status differs from that in the previous model. The advice this year is therefore based on the framework for advice for ICES category 5 stocks for the entire stock.

Discard data are available back to 1996. Discards have not been included in the assessment as it was considered that sorting patterns of discards and landings in earlier years may have been different.

8.2.7 Management considerations

Previous simulations suggest that fishing mortality is below F_{MSY}.

8.2.8 Benchmark preparation

This stock has been benchmarked in 2010 and the assessment methodology based on the surplus production model has not been revised since then. At that time it was considered the assessment was considered to be of category 3. In 2012, this stock assessment was classified as category 1 due to development of short-term forecast.

Yet, some issues have not been resolved since the 2010 benchmark.

Stock area includes 12.b but the current assessment is only considered to be reliable for 5b, 6, 7 because 12.b landings are likely to include landings of roughhead grenadier (*Macrourus berglax*) in past years. Therefore the assessment for the whole area has only be exploratory since 2010. Some work is needed to clean out this time-series if accurate catch data for the different grenadier species are available or if the composition of species is known from observers at sea. An attempt to update the landings data in 6 and 12.b was done in 2018 with no revision to the data due to the lack of additional information. Discard time-series is available since 1996 and properly quantified since then. It is supposed from various exploratory runs that discard rates might have been higher at the beginning of the fishery. Because of this, discards have not been included in the current assessment and the impact of this is unknown. The reconstruction of a time-series of discard rates is required for the whole time-series. No new information has been available since then. Prior estimates of discards can only be addressed at the moment through assumptions to be tested.

Additionally, some issues have appeared since then:

- Estimates of r (intrinsic growth rates of the surplus production model) are possibly too high in regards of stock dynamics. This should be explored from modelling and data exploration. The lack of contrast between indices from observation and those predicted using estimates of r is a concern as trends from the model seem to increasingly differ over the years.
- A workaround to the problem above would be to use another model taking account additional information that are not currently taken account by the model such as length distributions and giving more value to recent information from survey indices.
- The French tallybooks, due to the decrease of effort and number of vessels in the deep-water French fisheries are no longer representative to derive abundance indices. The Marine Scotland Science Deep-water survey is available on a biannual basis in line with advisory years and a sufficient time-series and has been integrated into the assessment over the last 3 years. However, comparisons with the French tallybooks show some strong differences of biomass which leaves some doubt on biomass estimates. The reason for those differences have to be investigated.
- Multi Year Catch Curves are no longer available. Other indicator of stock status may be considered using for example, length or individual weight.

8.2.9 Table and Figures

Table 8.2.0a. Working Group estimates of landings of roundnose grenadier from Division 5.b.

Year	Faroes	France	Nor way	Germ any	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
1988				1				1
1989	20	181		5	52			258
1990	75	1470		4				1549
1991	22	2281	7	1				2311
1992	551	3259	1	6				3817
1993	339	1328		14				1681
1994	286	381		1				668
1995	405	818						1223
1996	93	983		2				1078
1997	53	1059						1112
1998	50	1617						1667
1999	104	1861	2			29		1996
2000	48	1699		1		43		1791
2001	84	1932						2016
2002	176	774				81		1031
2003	490	1032				10		1532
2004	508	985	0	0	6	0	76	1575
2005	903	884	1	0	1	0	48	1837
2006	900	875	0	0	0	0	0	1775
2007	838	862	0	0	0	0	0	1700
2008	665	447	0	0	0	0	0	1112
2009	322	122	0	0	0	0	2	446
2010	229	381	0	0	0	0	1	611
2011	63	11	0	0	0	0	0	74
2012	16	28	0	0	0	0	0	44
2013	24	36	0	0	0	0	0	60
2014	33	44	0	0	0	0	0	77

Year	Faroes	France	Norway	Germany	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
2015	24	28	0	0	0	0	0	52
2016	30	7	0	0	0	0	0	38
2017	9	21	0	0	0	0	0	30
2018*	0	6	0	0	0	0	0	6

*Provisional.

Table 8.2.0b. Working Group estimates of landings of roundnose grenadier from Subarea 6.

Year	Estonia	Faroes	France	Germany	Ireland	Lithuania	Norway	Poland	Russia	Spain	UK (E+W)	UK (Scot)	TOTAL
1988		27		4							1		32
1989		2	2211	3								2	2218
1990		29	5484	2									5515
1991			7297	7									7304
1992		99	6422	142			5				2	112	6782
1993		263	7940	1								1	8205
1994			5898	15	14							11	5938
1995			6329	2	59							82	6472
1996			5888									156	6044
1997		15	5795		4							218	6032
1998		13	5170				21			3			5207
1999			5637	3	1					1			5642
2000			7478		41		1			1002	1	433	8956
2001	680	11	5897	6	31	137	32	58	3	6942	21	955	14773
2002	821		7209		12	1817		932			6	741	11538
2003	52	32	4924		11	939		452	3			185	6598
2004	26	12	4574	0	8	961	0	13	72	1991	0	72	7729
2005	80	24	2897	0	17	92	1	0	71	468	0	44	3694
2006	34	25	1931	0	5	112	0	0	0	252	0	15	2374
2007	0	10	1552	0	2	31	0	0	0	354	0	4	1953

Year	Esto-nia	Fa-roes	France	Ger-many	Ire-land	Lithua-nia	Nor-way	Po-land	Rus-sia	Spain	UK (E+W)	UK (Scot)	TO-TAL
2008	0	6	1433	0	0	23	0	0	16	336	0	27	1841
2009	0	6	1090	0	0	0	0	0	0	279	0.3	15	1391
2010	0	13	1271	0	0	0	2	0	0	189	1.2	23	1500
2011	0	4	1112	0	0	0	0	0	0	335.89	0	8	1460
2012	0	0	1088	0	0	0	0	0	0	257.87	2	0	1348
2013	0	0	934	0	0	0	0	0	0	475.89	6.2032	0	1416
2014	0	0	630	0	0	0	0	0	0	429.4	0	0	1060
2015	0	0	364	0	0	0	0	0	0	274.51	0	0	638
2016	0	0	422	0	0	0	0	0	0	298.4	0	5.368	725
2017	0	0	99	0	0.5	0	0	0	0	523.32	0	8	631
2018*	0	0	184	0	0	0	0	0	0	323	0	5.95	513

*** Provisional.**

Table 8.2.0c. Working Group estimates of landings of roundnose grenadier from Subarea 7.

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

Year	Faroes	France	Ireland	Spain	UK (Scot)	TOTAL
1999		892		4		896
2000		859				859
2001		938	416			1354
2002	1	449	605		3	1058
2003		373	213		1	587
2004	0	248	320	0	0	568
2005	0	191	55	0	0	246
2006		248	138	0	0	386
2007		207	20	0	0	227
2008		27				27
2009		59				59
2010		41				41
2011		34				34
2012		48		0.18		48
2013		40				40
2014		11				11
2015		10				10
2016		4				4
2017		0				0
2018*	0	2	0	0	0	2

* provisional.

Table 8.2.0d. Working Group estimates of landings of roundnose grenadier from Subarea 12.b

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1988													0
1989			0						52				52
1990			0										0
1991			14						158				172
1992			13										13
1993		263	26	39									328

Year	Es-to-nia	Fa-roes	France**	Ger-many	Ice-land	Ire-land	Lithu-ania	Spain	USSR/Rus-sia	UK (E+W)	UK (Scotl.)	Nor-way	Total
1994		457	20	9									486
1995		359	285										644
1996		136	179		77			1136					1528
1997		138	111					1800					2049
1998		19	116					4262					4397
1999		29	287					8251	6				8573
2000		6	374	9				5791		9	6		6195
2001		2	159			3		5922			7	1	6094
2002			14				18	10045		1	2		10080
2003			539			1	31	11663			1		12235
2004		8	1 693				120	10880	91		4		12796
2005	20	5	508				13	7804	81		350		8782
2006	27	1	85				6	4242					4361
2007	140	2	0				8	4108					4258
2008		0	0				3	2416	13				2432
2009								5335					5335
2010			1					2758					2759
2011		3						1575					1578
2012		9						657					666
2013								796					796
2014		3.6						828.72					832
2015								313.99					314
2016								599.48					599
2017								1001					1001
2018*								998.53					998

*** Preliminary.**

**** French landings reported in former ICES Subarea 12 allocated to 12.b.**

Table 8.2.0e. Working Group estimates of landings of roundnose grenadier unallocated landings in 5.b, 6 and 12.

Year	Unallocated
1988	0
1989	0
1990	0
1991	0
1992	0
1993	0
1994	0
1995	0
1996	0
1997	0
1998	0
1999	0
2000	0
2001	208
2002	504
2003	952
2004	0
2005	0
2006	0
2007	0
2008	0
2009	0
2010	0
2011	0
2012	6997.0
2013	1522.0
2014	92.0
2015	0
2016	0

Year	Unallocated
2017	0
2108*	0

* Provisional.

Table 8.2.0f. Working Group estimates of landings of roundnose grenadier 5.b, 6, 7 and 12.b.

Year	5.b	6	7	12.b	Unallocated	5.b,6,7	Overall total
1988	1	32	0	0	0	33	33
1989	258	2218	222	52	0	2698	2750
1990	1549	5515	215	0	0	7279	7279
1991	2311	7304	489	172	0	10104	10276
1992	3817	6782	1556	13	0	12155	12168
1993	1681	8205	1916	328	0	11802	12130
1994	668	5938	1922	486	0	8528	9014
1995	1223	6472	1295	644	0	8990	9634
1996	1078	6044	1051	1528	0	8173	9701
1997	1112	6032	1038	2049	0	8182	10231
1998	1667	5207	1157	4397	0	8031	12428
1999	1996	5642	896	8573	0	8534	17107
2000	1791	8956	859	6195	0	11606	17801
2001	2016	14773	1354	6094	208	18143	24445
2002	1031	11538	1058	10080	504	13627	24210
2003	1532	6598	587	12235	952	8717	21904
2004	1575	7729	568	12796	0	9872	22668
2005	1837	3694	246	8782	0	5777	14559
2006	1775	2374	386	4361	0	4535	8896
2007	1700	1953	227	4258	0	3880	8138
2008	1112	1841	27	2432	0	2980	5411
2009	446	1391	59	5335	0	4046	9381
2010	611	1500	41	2759	0	2152	4911
2011	74	1460	34	1578	0	1568	3146

Year	5.b	6	7	12.b	Unallocated	5.b,6,7	Overall total
2012	44	1348	48	666	6997	1440	9103
2013	60	1416	40	796	1522	1517	3835
2014	77	1060	11	832	92	1147	2072
2015	52	638	10	314	0	701	1015
2016	38	725	4	599	0	767	1366
2017	30	631	0	1001	0	661	1662
2018*	6	513	2	998	0	521	1519

*** Preliminary.**

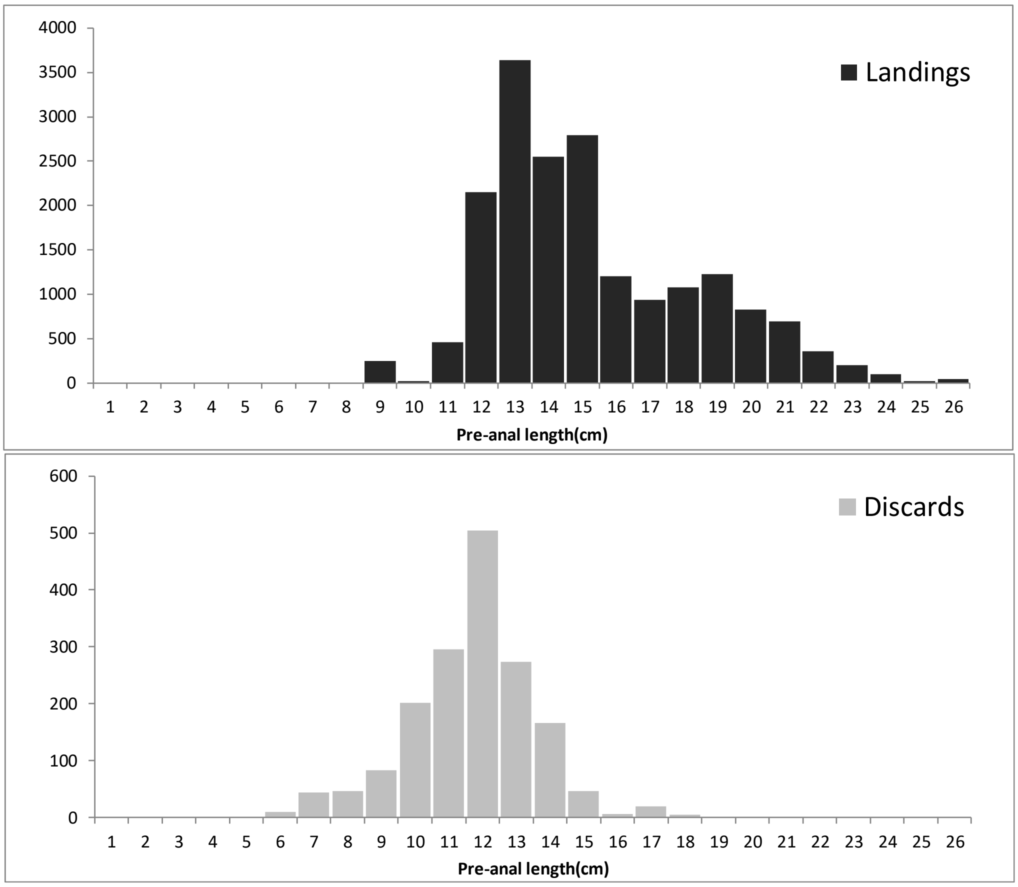

Figure 8.2.1. Length distribution of the landings and discards of the French fleet in Division 5.b, 6, 7 based from on-board observations in 2018.

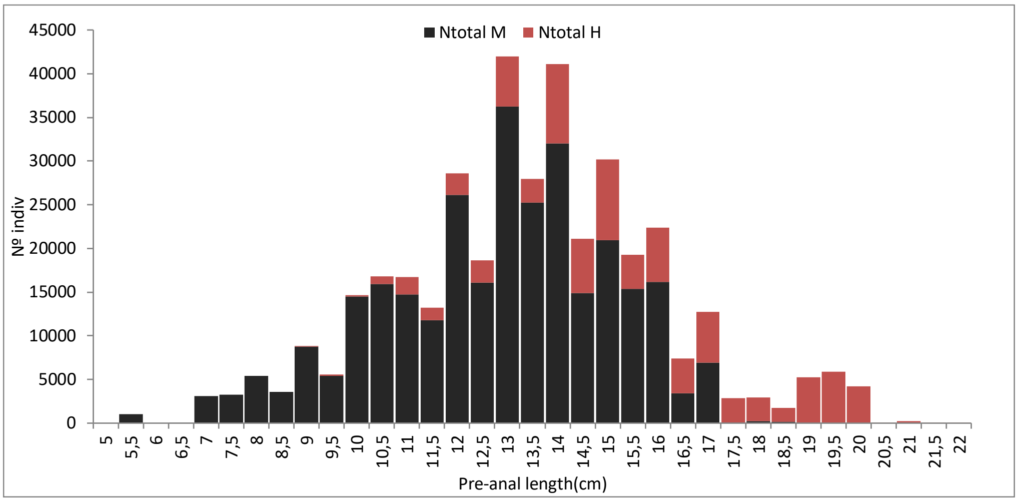

Figure 8.2.2. Length distribution of the landings of the Spanish fleet in Division 6.b based from on-board observations in 2018.

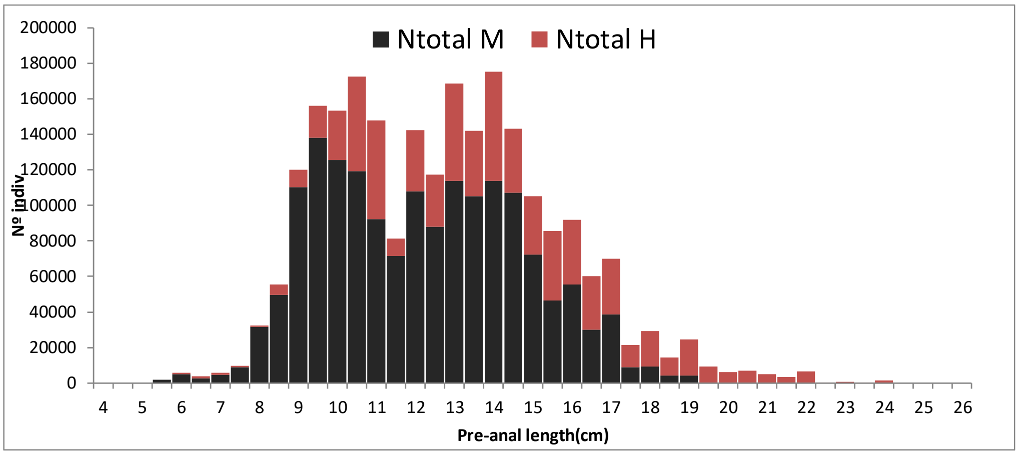

Figure 8.2.3. Length distribution of the landings of the Spanish fleet in Division 12.b based from on-board observations in 2018.

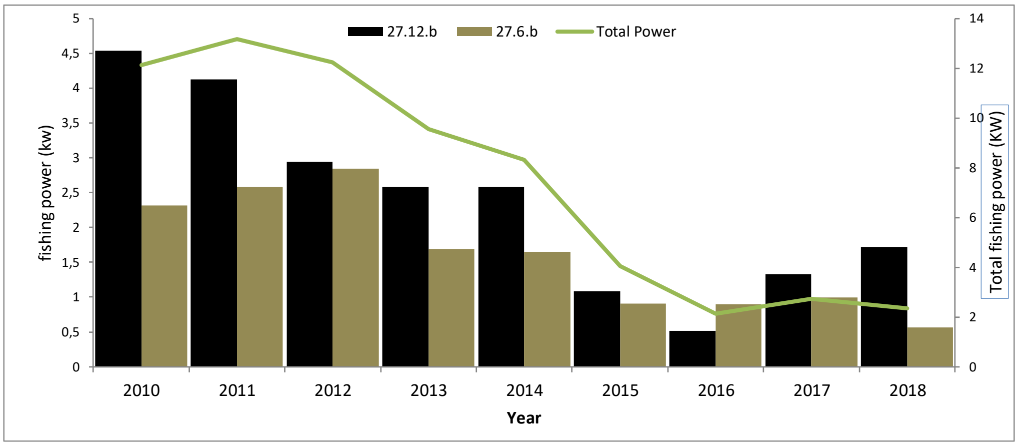

Figure 8.2.4. Evolution of the fishing effort per area, and the total for the entire area of the stock (x 100.000). Note that the total effort, has a different scale to fit the graph space.

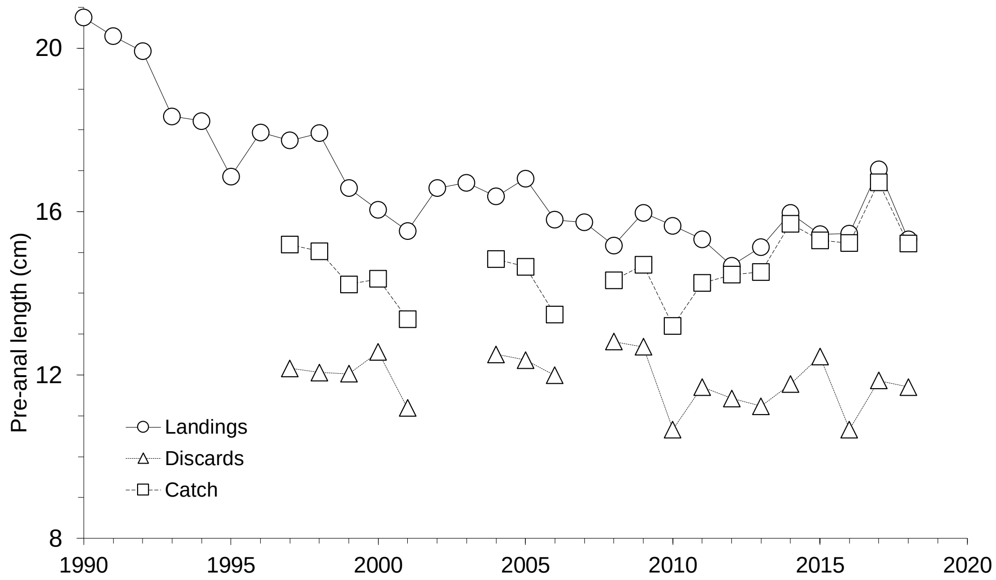

Figure 8.2.5. Evolution of the pre-anal length of roundnose grenadier in the French landings, catch and discards, 1990–2018.

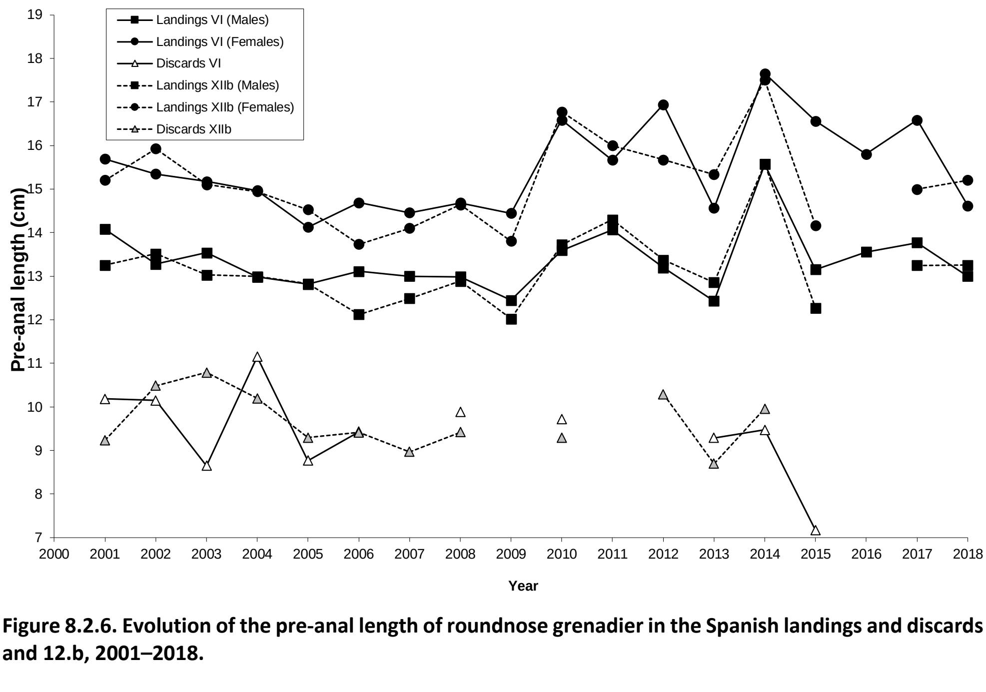

Figure 8.2.6. Evolution of the pre-anal length of roundnose grenadier in the Spanish landings and discards in Divisions 6.b and 12.b, 2001–2018.

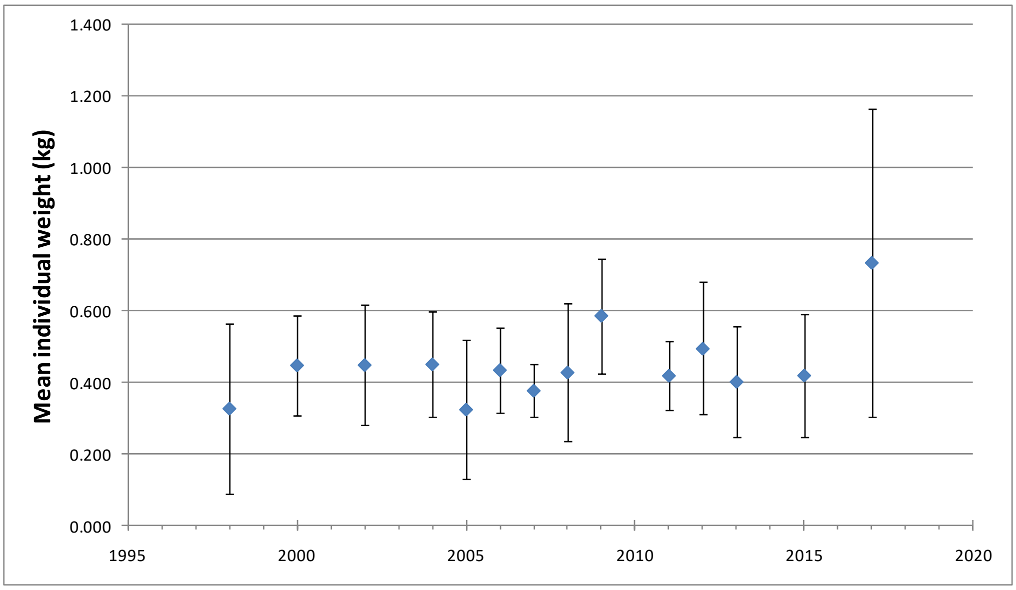

Figure 8.2.7. Mean individual weight of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

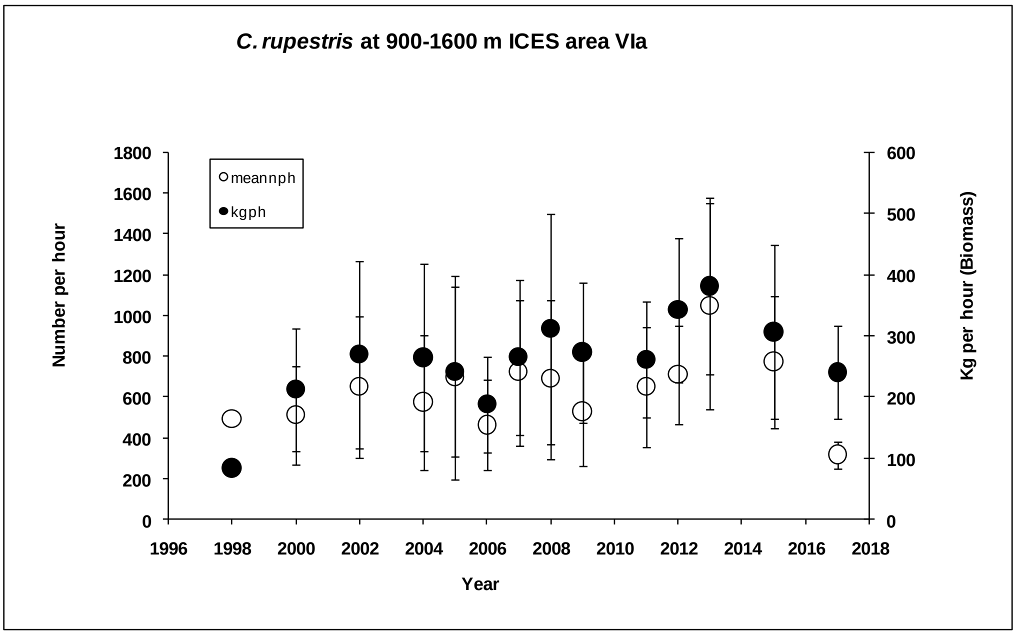

Figure 8.2.8. Abundance indices of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

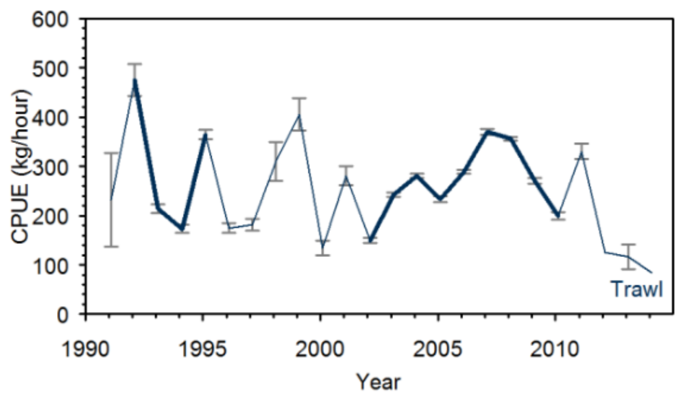

Figure 8.2.9. Roundnose grenadier in 5.b. Cpue from otter-board trawlers. Criteria: >30% of roundnose grenadier in the catch.

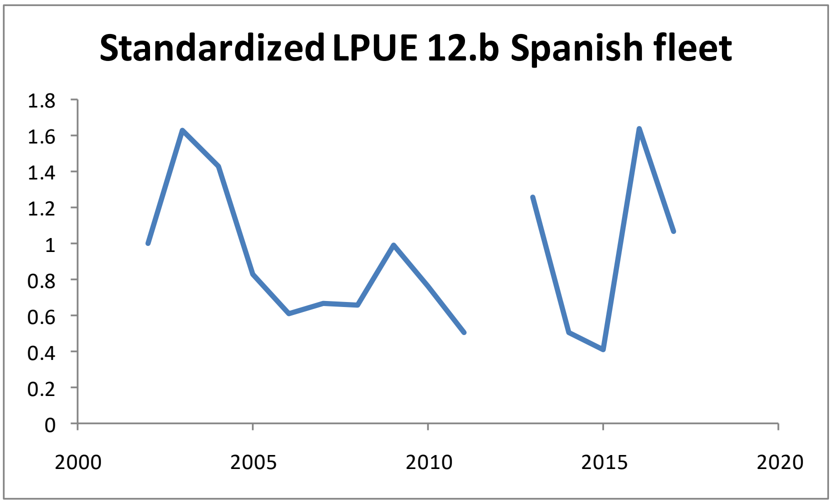

Figure 8.2.10. Lpue from the Spanish commercial fleet operating in 12.b.

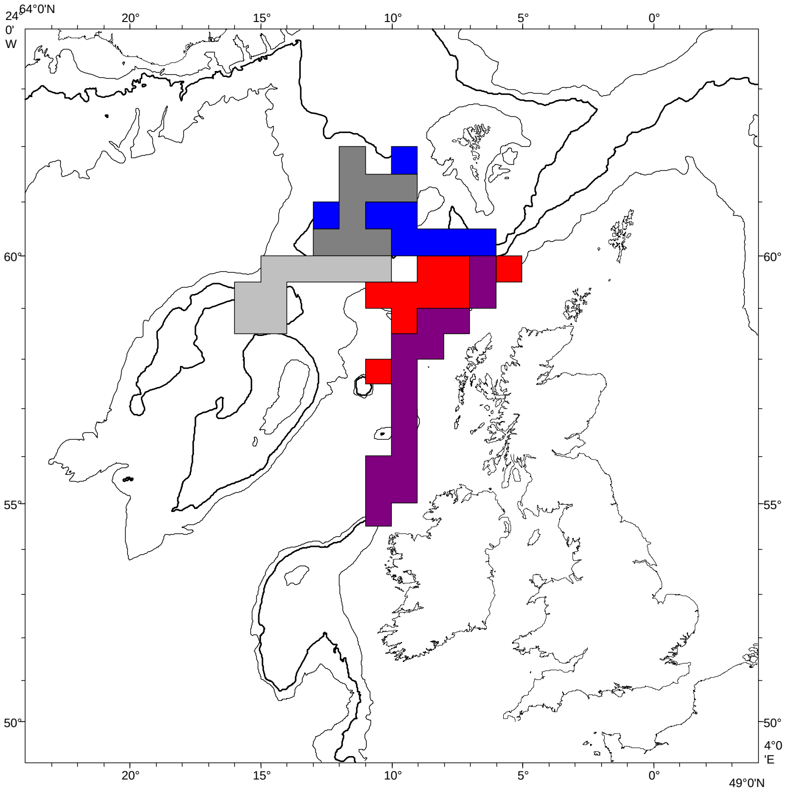

Figure 8.2.11. Reference areas (set of statistical rectangles) used to calculate French lpues (brown: New grounds in 5 (new5), grey new grounds in 6 (new6); red: others in 6 (other6); purple: edge in 6 (edge6); blue: all grounds in 7 (ref7). Depth contours are 200, 1000 and 2000 m.

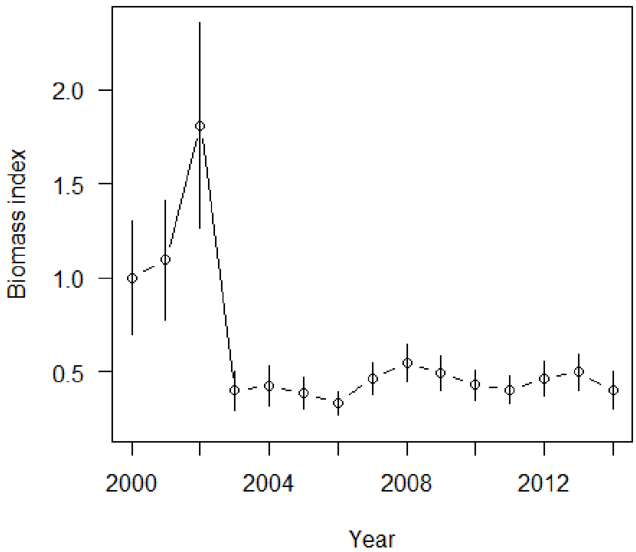

Figure 8.2.12. Time-series of abundance indices (calculated based upon the tallybook data). The grenadier abundance was predicted for the mean length of all tow carried out in every rectangle of the two small areas (edge6, other6) and averaged across rectangle.

8.3 Roundnose grenadier (*Coryphaenoides rupestris*) in Division 3.a

8.3.1 The fishery

From the late 1980s until 2006 a Danish directed fishery for roundnose grenadier was conducted in the deeper part of Division 3.a. 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 3.a.

8.3.2 Landing trends

The total landings by all countries from 1988–2018 are shown in Table 8.3.0 and Figure 8.3.0.

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.

8.3.3 ICES Advice

The Advice for 2019 and 2020 is: "ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2019 and 2020".

8.3.4 Management

The directed fishery for roundnose grenadier was stopped in April 2006 based on agreements between Norway and the EU, and has been prohibited since. Norway and the EU has introduced a mandatory use of sorting grids in shrimp fisheries in order to minimize the bycatch of fish.

In Council Regulation (EU) No 2018/2020, fixing for 2019 and 2020 the fishing opportunities for EU vessels for fish stocks of certain deep-sea fish species, a TAC was set to 50 tons for each years, for EU vessels in EU waters and international waters of Subarea 3. Since there is no area outside national jurisdiction (international waters) in 3.a, this regulation applies to EU waters unless other agreements are negotiated with Norway.

8.3.5 Data available

8.3.5.1 Landings and discards

Landings data are presented in Table 8.3.0. Discards are reported from both the Swedish and Danish fishery but only Danish discards are noticeable for 2018 (Table 8.3.2); Danish discards were 2.9 t in 2018.

8.3.5.2 Length compositions

Since the directed fishery has stopped there is no new information on size compositions from commercial catches other than the data given for the period 1996–2006 in the stock annex.

Updated information on size distribution from the Norwegian shrimp survey is provided in Figure 8.3.1.

8.3.5.3 Age composition

Age data are available from 1987 and from 2007-2018 (Figure 8.3.4).

These age data (until 2013) are presented in Bergstad *et al*., 2014.

8.3.5.4 Bycatch effort and cpue

There is no new information on bycatch on this species.

Earlier, there has been estimated bycatch of roundnose grenadier in Norwegian shrimp fishery in ICES Division 4.a and 3.a (Figure 8.3.2). These bycatch estimates were not obtained by sampling of the commercial catches but derived using the mean annual Norwegian shrimp trawl survey catches of grenadier at depths <400 m and annual effort in the shrimp trawl fishery. The shrimp fishery in this area is mainly conducted shallower than the primary depth range of roundnose grenadier. It should be noted that commercial vessels fishing in the relevant areas use sorting grids to reduce bycatch, a device not used in the survey, hence survey-based estimates of bycatches are likely to be overestimates.

8.3.5.5 Survey indices

There is updated information on the survey indices from the shrimp survey (Figure 8.3.3). The indices are given as biomass (kg/h) and abundance (number/h). The Norwegian annual shrimp survey conducted since 1984 samples deeper parts of the Skagerrak and northeastern North Sea (3.a and 4.a), including the depth range where the roundnose grenadier occurs (mainly 300–600 m) (Bergstad, 1990b). The minor area >600 m is an ammunition and warship dumping ground with warning against fishing. The survey is considered to adequately sample the main distribution area of roundnose grenadier, and the sample sizes by year (no. of tows at depths >300 m and >400 m) are presented in Table 8.3.1.

8.3.6 Data analyses

An earlier study analysed the time-series of abundance of roundose grenadier through the time-series (Bergstad *et al*., 2014). Catch rates in terms of biomass (kg/h) and abundance (nos/h) were calculated for stations 300 m and deeper (Figure 8.3.3). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration. The published analysis also includes a time-series of small grenadier, i.e. <5 cm PAL, illustrating variation in recruitment.

8.3.6.1 Trends in landings, effort and estimated bycatches

Collated information on landings and survey-based estimates of bycatch suggest that the removals of roundnose grenadier are now at low levels in Division 4.a and 3.a. Although the discards from the fishery in this area now is reported to be at the same level as the landings, the level on reported total catch is still low and in the range of what it has been since 2007.

There is no longer a directed fishery for grenadier in this area and data on effort and cpue is therefore not available from the commercial catches. The earlier evaluation of the Danish cpue data were presented in ICES (2007) but these cpue data do not provide any clear indications of stock development and status for the time of the directed fishery which ceased in mid–2006.

Landings are now insignificant and represent bycatches from other fisheries. The estimated bycatch of roundnose grenadier from the Norwegian shrimp fishery is shown to be at low levels (less than 100 tonnes /year) but since both the landings and survey catches are at very low levels now and the stock does not seem to recover, there is some concern that mortality from reported current bycatch levels are not fully accounted for. The application of sorting grids most probably reduces retained bycatch, but there is some uncertainty with regards to survival rates during passage of the grids for this species.

8.3.6.2 Size compositions

The recent length distributions from the Norwegian survey data contrasts with the 1991–2004 distributions by not having a distinct mode of small fish as seen in the early 1990s (Bergstad *et al*., 2014). The pulse of juveniles appearing in the early 1990s appears to have represented the only major recruitment event through the time-series 1984–present. Recently some small juveniles appear every year in the survey, but there is no indication of a pronounced recruitment pulse as observed in the early 1990s.

The Danish and Norwegian length distributions, sampled from commercial landings and survey catches, respectively, agree well for those years covered by samples from both countries (1987 and 2004–2006) (See stock annex for information on the Danish length distributions from the directed fishery). Note that both in 1987 and 2004 there appear to be two clearly distinguishable components in the Danish length compositions. In the Norwegian data, several years show two modes and it is possible to follow the more abundant occurrence of juveniles<5 cm (PAL) through several years.

8.3.6.3 Biomass and abundances indices from survey

The survey catch rates in terms of biomass (kg/h) and abundance (nos/h) varied strongly through the time-series, but elevated levels were observed from 1998 to 2005. The indices have declined since 2004 with both biomass and abundance being lowest on record in 2017, but show a small increase for 2019. Since the directed fishery is stopped and the bycatches from other fisheries are expected to be low, it is uncertain why the survey catches still are very low compared to the levels before 2000.

8.3.6.4 Age data

The age distributions from recent year contrast with distributions from the 1980s (Bergstad, 1990b) in terms of proportions of old fish (e.g. >20 years) (Figure 8.3.4). After the exploitation pulse in 2003–2005, the proportion of old fish has declined to very low levels (Bergstad *et al*., 2014). In recent years, i.e. after 2006 the mean age in the catches has increased somewhat, but the proportion of fish >20 years remains low.

Analyses of size distributions and the time-series of survey abundance of small juveniles by Bergstad *et al*. (2014) suggested that only a single very abundant recruitment event occurred during the period 1984–2019, perhaps only a single major year class. This event rejuvenated the stock and enhanced abundance in subsequent years.

8.3.6.5 Biological reference points

SPiCT was run on the landings data series (1988-2018) and the roundnose biomass index series from the Norwegian shrimp survey (1985-2018) but it did not converged (Table 8.3.2)

8.3.7 Comments on assessment

In 2018, the working group decided to upgrade this stock to a 3.2 category using the biomass index from the Norwegian shrimp survey, derived from the relevant depth range of the species in this area.

8.3.8 Management considerations

The decline in abundance after 2005–2006 suggested by the Norwegian shrimp survey catch rates probably reflect the combined effect of the enhanced targeted exploitation in 2003–2005 and low recruitment in the years following the single recruitment pulse in the early 1990s. The percentage of fish >15 cm is at a lower level as in the late 1980s and early 1990s, and there is no suggestion of a new recruitment pulse as seen in the 1990s. Recent age distributions almost lack the >20 years old component which was prominent in the 1980s.

Since the targeted fishery has stopped and the bycatch in the shrimp fishery seems low, the potential for recovery of the roundnose grenadier in Skagerrak may be good. Abundance levels has declined since 2004 and in 2017 it was the lowest recorded during the survey period 1984–2018. However, this year indices show a small increase but still as low levels. Rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade. Additionally, there is some uncertainty regarding the effect of the sorting grid in the shrimp fishery and this could be the source of an unknown mortality.

Table 8.3.0. Roundnose grenadier in Division 3.a. 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

Year	Denmark	Norway	Sweden	TOTAL
2007	+	1		1
2008	+	+		+
2009	2	+	+	2
2010	1	+	+	1
2011		0		0
2012	1	0		1
2013	1	0		1
2014	0,6	0	0,4	1
2015	0,6	+	+	0.6
2016	1,1	0,3	0,01	1,4
2017	0,7	0,03	0,03	0,76
2018*	0,3	0,06		0,36

*** Preliminary data.**

8.3.9 Tables and Figures

Table 8.3.1. Summary of data on the bottom-trawl survey series, 1984-2019. Rg- rock-hopper groundgear. '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 2019 survey are included. All trawls were fitted with a 6mm mesh codend 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

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
2008	FEB	HM	3271	Campelen 1800 20mm/40, Rg and strapping*	18	5	73
2009	JAN/FEB	HM	3271	"	25	7	91
2010	JAN	HM	3271	"	24	7	98
2011	JAN	HM	3271	"	22	7	93
2012	JAN	HM	3271	"	20	5	65
2013	JAN	HM	3271	"	28	8	101
2014	JAN	HM	3271	"	16	7	69
2015	JAN	HM	3271	"	28	9	92
2016	JAN	HM	3271	"	28	9	108
2017	JAN	KB	3271	"	30	9	128
2018	JAN	KB	3271	Campelen 1800 20mm/40, Rg and strapping**	27	8	111
2019	JAN	KB	3296	Campelen 1800 20mm/40, Rg and strapping***	27	8	119

* Path width of the tow constrained by a 10 m rope connecting the warps, 200 m in front of otter boards. ** Path width of the tow constrained to a 15 m rope connecting the warps, 100 m in front of the otter boards. *** Same trawl and strapping but from 2019 there are inserted several floaters on the trawl to lighten the trawl (Nordsjørigging).

Table 8.3.2. Discards (tons) reported for roundnose grenadier in 3a from 2014-2018.

Year	Denmark	Sweden	Norway	TOTAL
2014		0.4		0.4
2015	1			1
2016	0.1	0.9		1
2017		1.6		1.6
2018	2.9	0.01		2.9

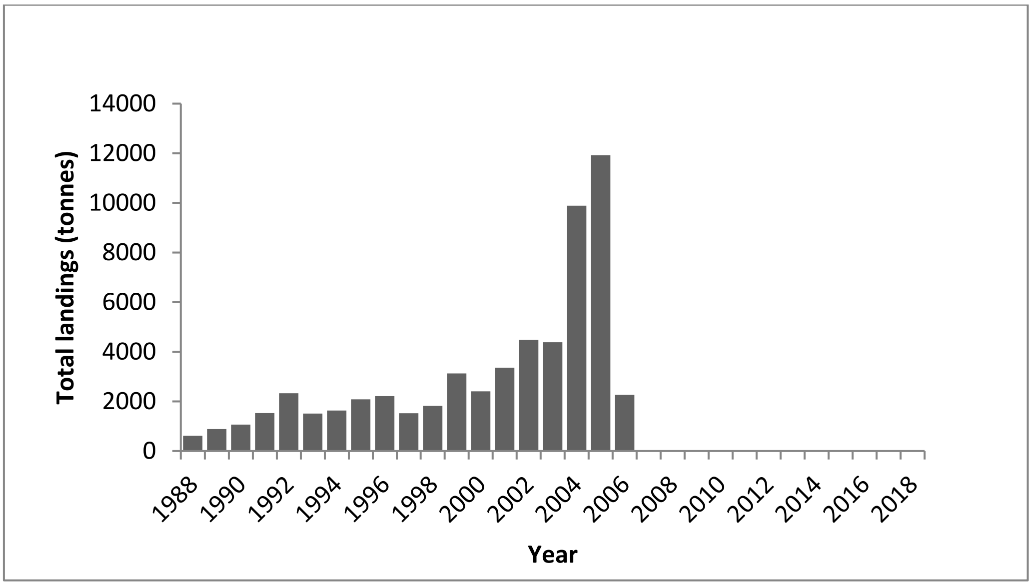

Figure 8.3.0. Landings of roundnose grenadier from Division 3.a. Landings from 2007–2018 are insignificant.

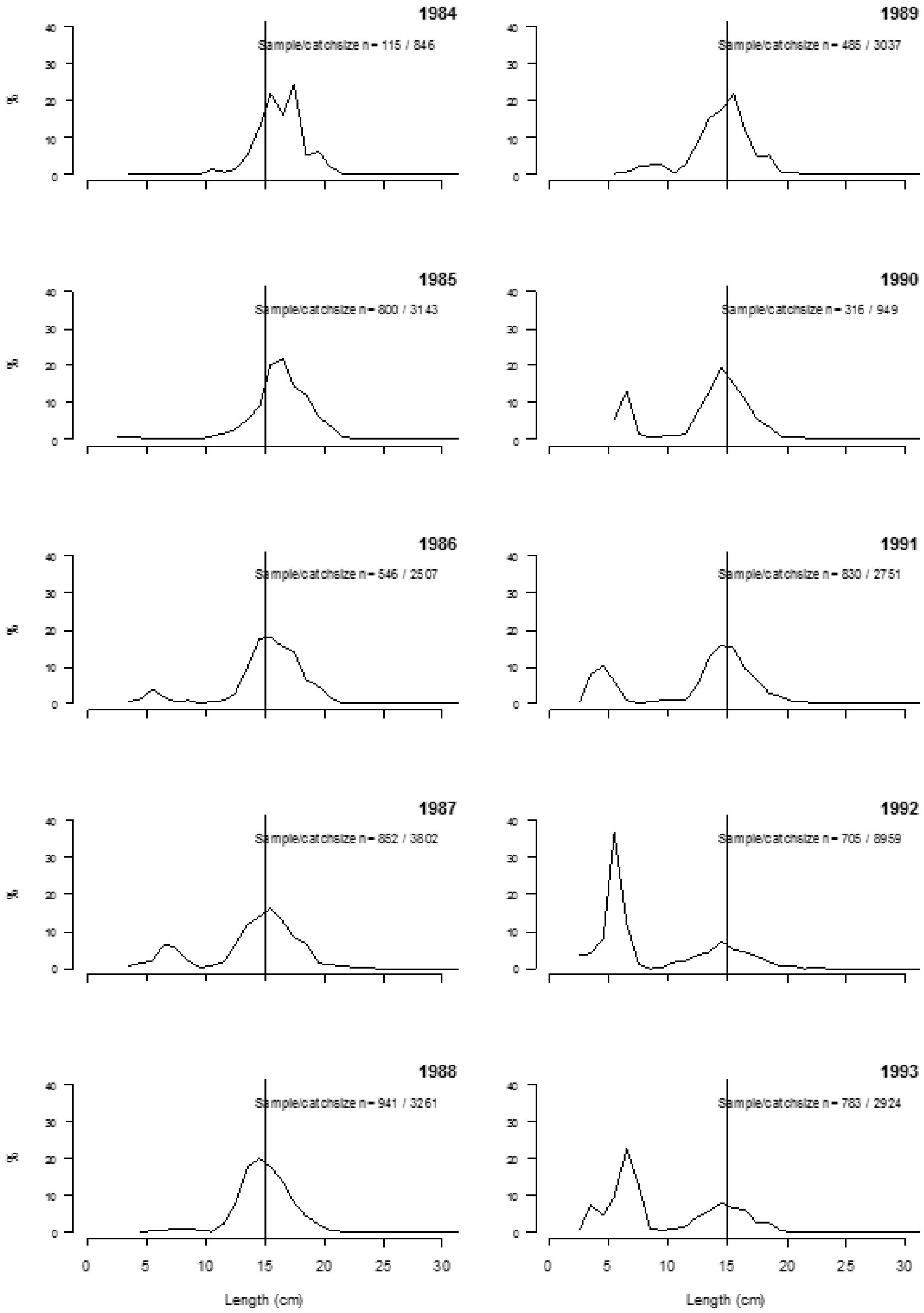

Figure 8.3.1. Length–frequency distributions for roundnose grenadier, 1984–2019. Data from Norwegian shrimp survey, all catches deeper than 300 m. Length is measured as pre-anal length in cm. The distributions are calculated as percent-number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

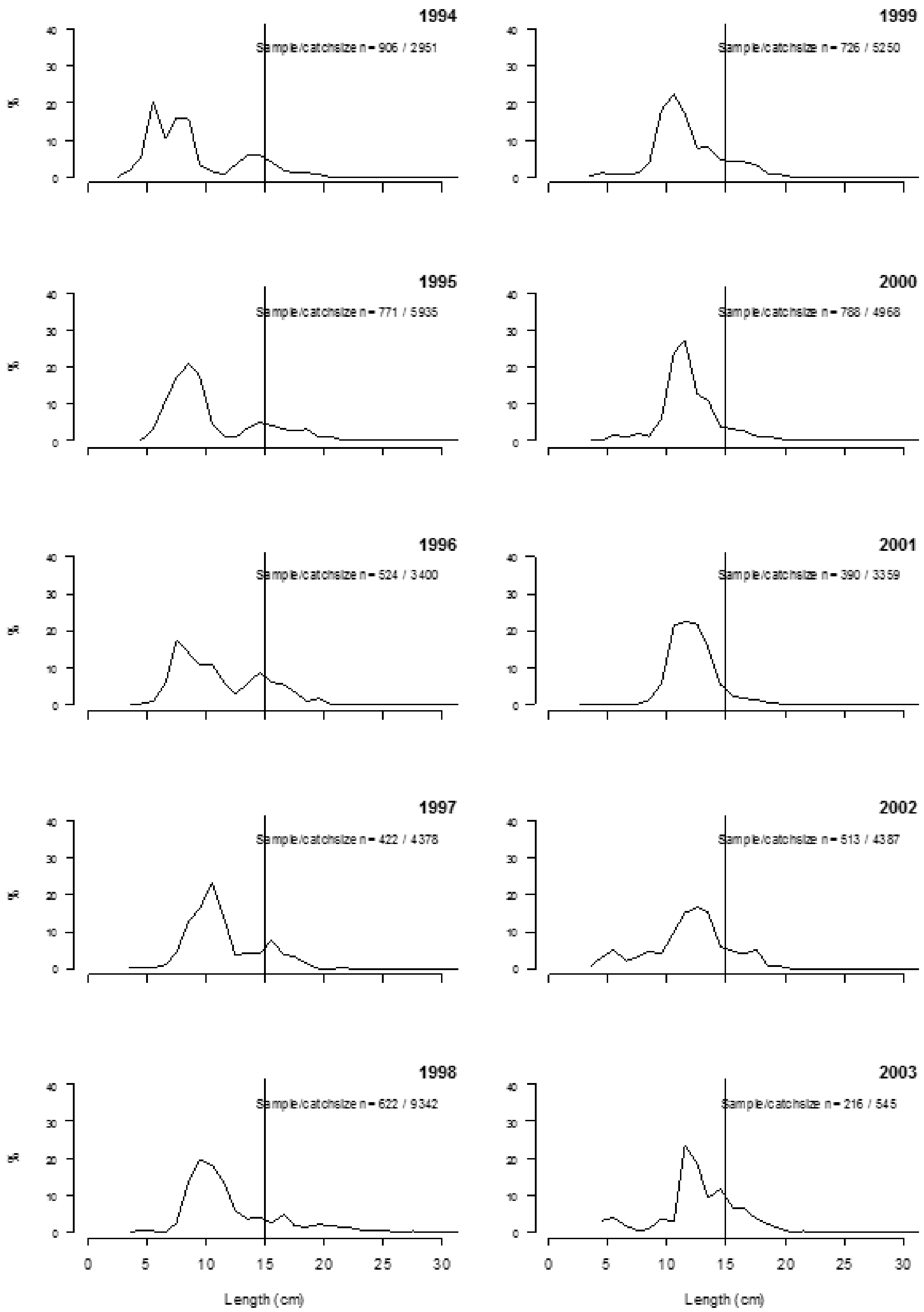

Figure 8.3.1. (Con't).

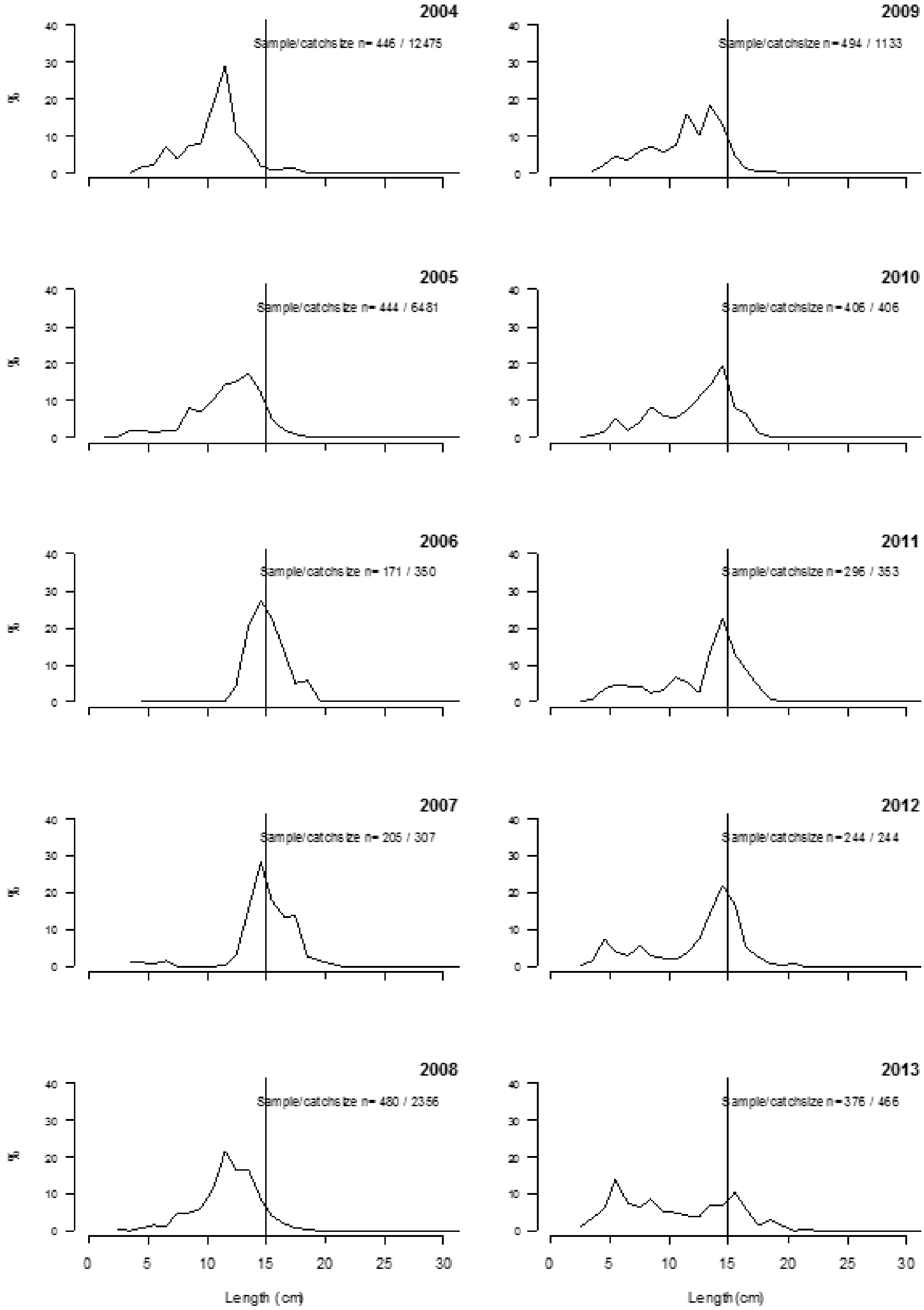

Figure 8.3.1. (Con't).

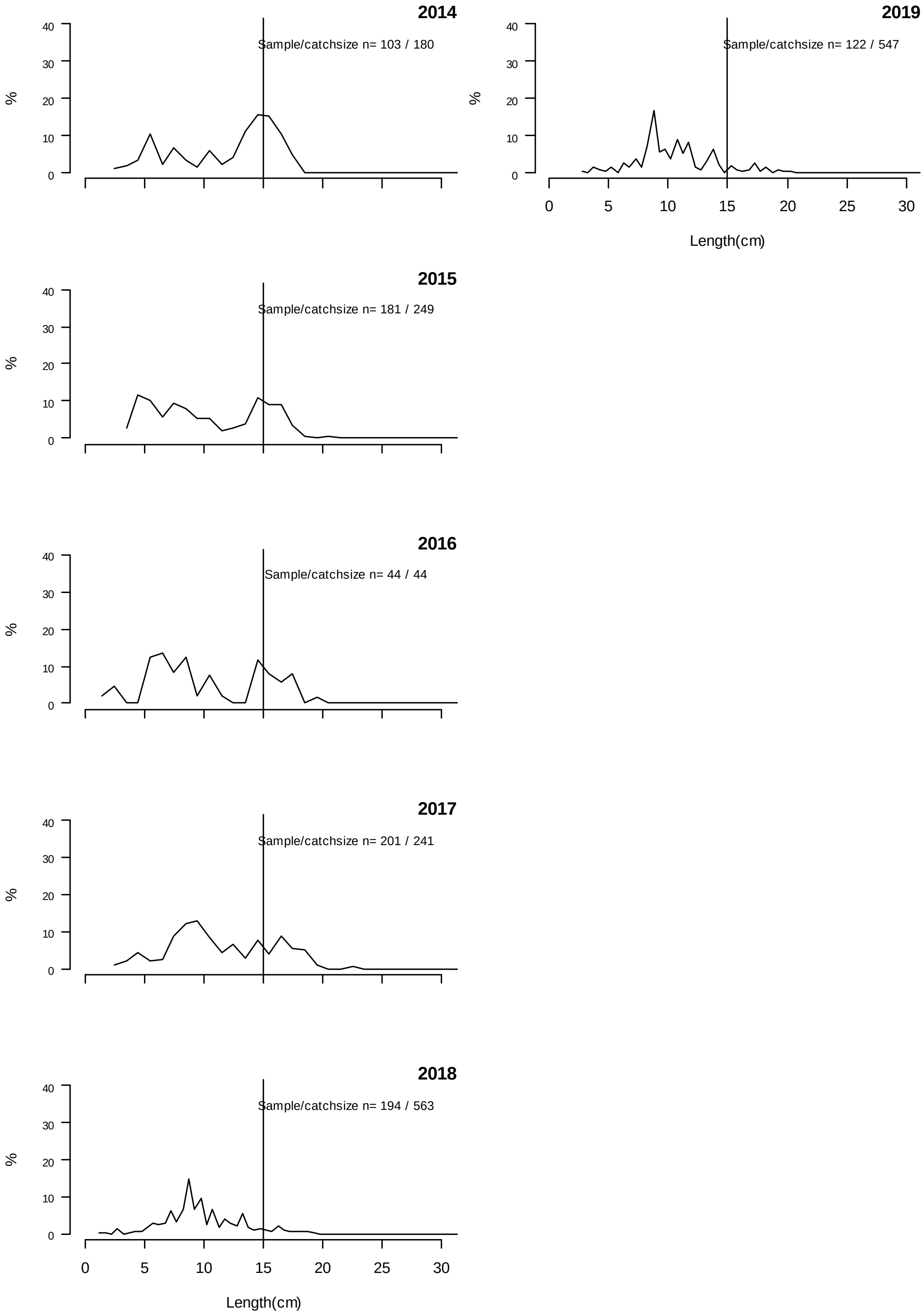

Figure 8.3.1. (Con't).

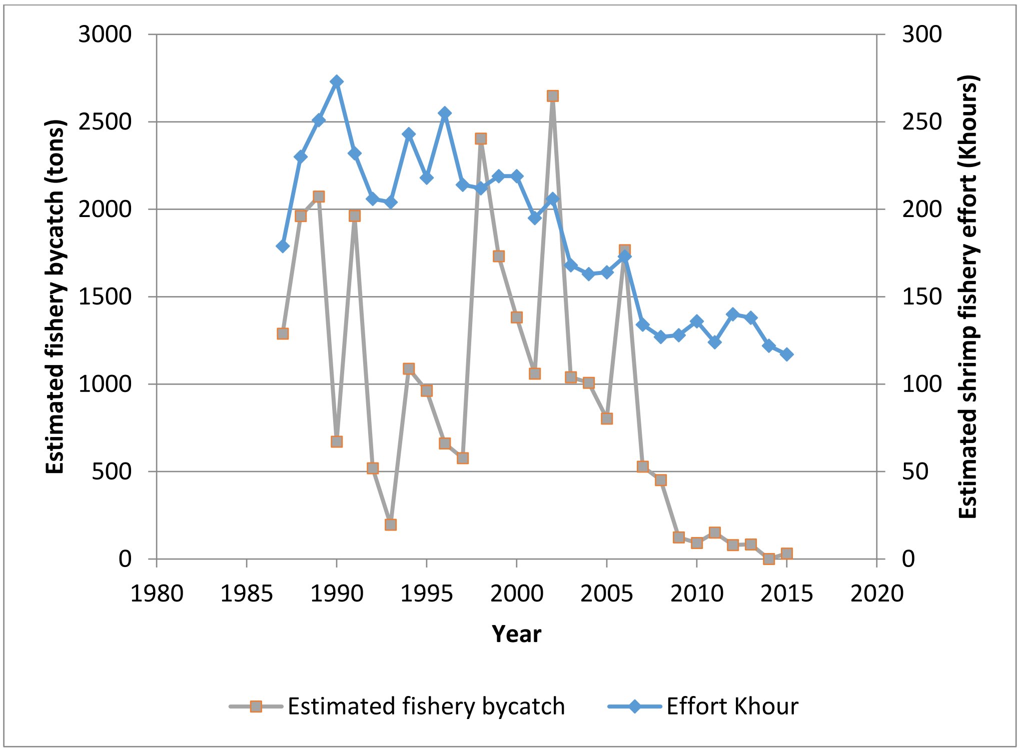

Figure 8.3.2. Estimated bycatch of roundnose grenadier in the Norwegian shrimp fishery in ICES Division 4.a and 3.a, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

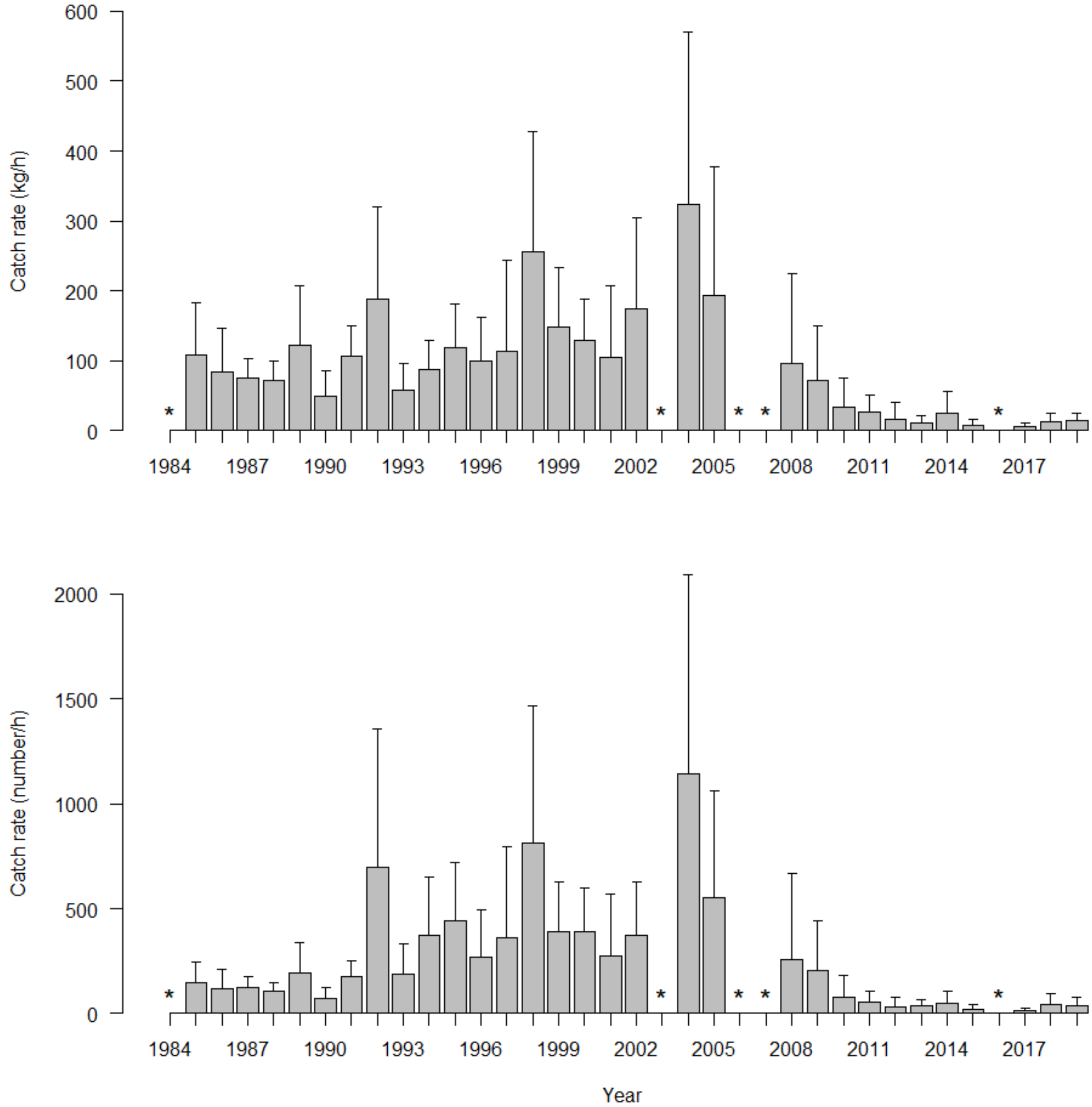

Figure 8.3.3. Survey catch rates in biomass (kg/h) and abundance (nos/h) of grenadier 1984–2019. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m, thus the primary grenadier habitat was not sampled for those years. For 2016 data from the shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded. For the other years the survey is thought to cover the distribution area of roundnose grenadier Lines indicate estimates of 2SE (Updated from Bergstad *et al*., 2014).

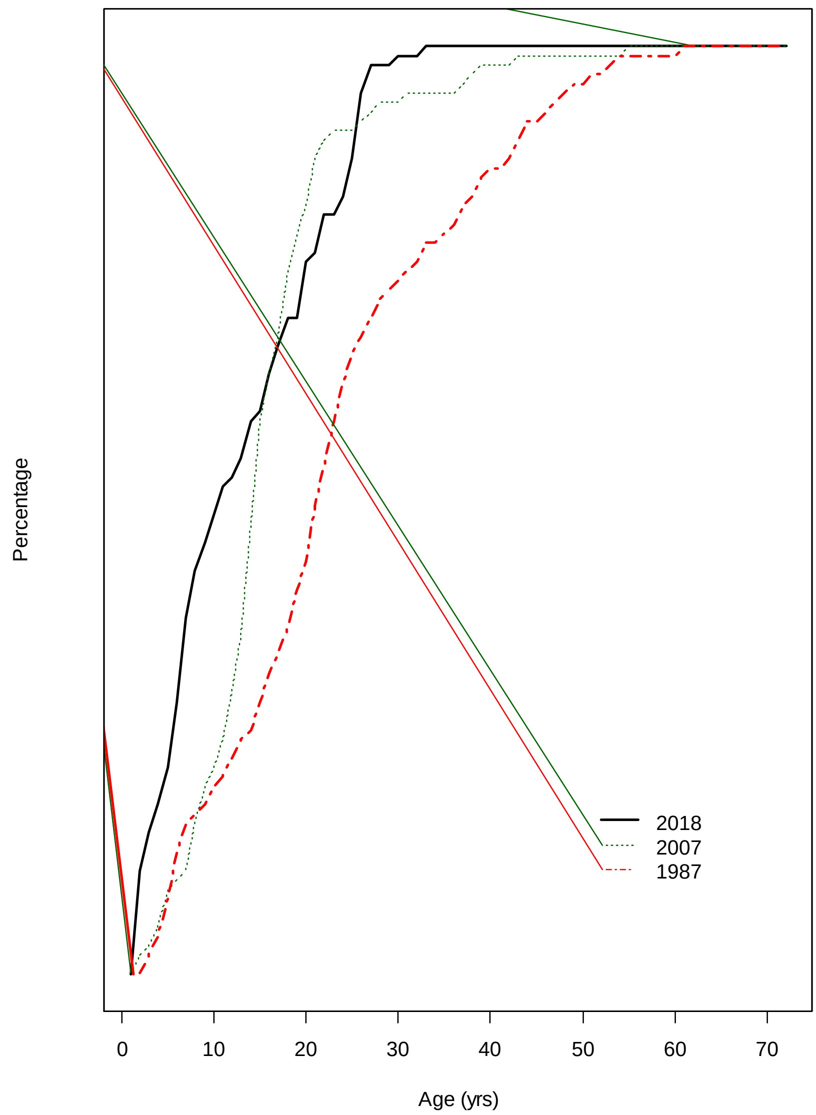

Figure 8.3.4. Cumulative age distributions of roundnose grenadier in the Skagerrak. Data from survey catches in the Skagerrak in 1987, 2007 and 2018. The distribution from 1987 was modified from Bergstad (1990). Data from 2007 were collected on the deep-water fish survey in April. Data from 2018 are from shrimp survey in Skagerrak.

Table 8.3.2. Results and summary from SPiCT

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: 89.4421145
Euler time step (years):  1/16 or 0.0625
Nobs C: 31,  Nobs I1: 30

Priors
    logn  ~  dnorm[log(2), 2^2]
 logalpha  ~  dnorm[log(1), 2^2]
  logbeta  ~  dnorm[log(1), 2^2]

Model parameter estimates w 95% CI
           estimate       cilow        ciupp    log.est
 alpha  8.700785e-01   0.3485353 2.172051e+00 -0.1391718
 beta   1.163066e-01   0.0194382 6.959103e-01 -2.1515255
 r      9.080990e-02   0.0003363 2.452237e+01 -2.3989868
 rc     5.343200e-02   0.0001729 1.651067e+01 -2.9293458
 rold   3.785190e-02   0.0000989 1.448563e+01 -3.2740742
 m      7.866687e+03   0.5749000 1.076444e+08  8.9703923
 K      4.903497e+05 321.2573772 7.484428e+08 13.1028740
 q      2.636000e-04   0.0000001 4.660712e-01 -8.2409103
 n      3.399085e+00   0.5758304 2.006455e+01  1.2235063
 sdb    3.633264e-01   0.2075553 6.360044e-01 -1.0124537
 sdf    1.565235e+00   1.1959380 2.048567e+00  0.4480356
 sdi    3.161225e-01   0.1911917 5.226871e-01 -1.1516256
 sdc    1.820471e-01   0.0316585 1.046832e+00 -1.7034899

Deterministic reference points (Drp)
          estimate       cilow        ciupp   log.est
 Bmsyd 2.944561e+05 180.6749688 4.798916e+08 12.592885
 Fmsyd 2.671600e-02   0.0000865 8.255335e+00 -3.622493
 MSYd  7.866687e+03   0.5749000 1.076444e+08  8.970392
Stochastic reference points (Srp)
       estimate cilow ciupp log.est rel.diff.Drp
 Bmsys      NaN        NaN         NaN
 Fmsys      NaN   NaN   NaN      NaN          NaN
 MSYs       NaN   NaN   NaN      NaN          NaN

States w 95% CI (inp$msytype: s)
                  estimate    cilow        ciupp   log.est
 B_2018.00      4.039745e+04 22.77422 7.165797e+07 10.606522
 F_2018.00      6.430000e-05  0.00000 1.262993e-01 -9.651181
 B_2018.00/Bmsy          NaN      NaN          NaN       NaN
 F_2018.00/Fmsy          NaN      NaN          NaN       NaN

Predictions w 95% CI (inp$msytype: s)
                prediction      cilow        ciupp   log.est
 B_2019.00      3.973631e+04 21.9894810 7.180588e+07 10.590021
 F_2019.00      8.010000e-05  0.0000000 1.762148e-01 -9.431844
 B_2019.00/Bmsy          NaN        NaN          NaN       NaN
 F_2019.00/Fmsy          NaN        NaN          NaN       NaN
```

Catch_2019.00 3.145162e+00 0.2563082 3.859434e+01 1.145865
E(B_inf)

8.3.10 References

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8.4 Roundnose Grenadier (*Coryphaenoides rupestris*) in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 (Oceanic Northeast Atlantic and northern Reykjanes Ridge)

8.4.1 The fishery

The fishery on the Northern Mid-Atlantic Ridge (MAR) started in 1973, when dense concentrations of roundnose grenadier were discovered by USSR exploratory trawlers. Roundnose grenadier aggregations may have occurred on 70 seamount peaks between 46–62°N, but only 30 of them were commercially important and subsequently exploited. Since the early 1990s, fisheries on MAR have been sporadic and much smaller in scale. USSR/Russian fleet has the maximum length of the history of fishery and took the greatest volume of landings. Since 2010, Russian fleets abandoned the fishery, which is almost exclusively exploited by Spain in recent years.

8.4.1.1 Landings trends

The highest annual catch (almost 30 000 t) was taken by the Soviet Union in 1975 (Figure 8.4.1, see Stock Annex for detailed information) and in subsequent years the Soviet catch varied from 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (data on catch are not available). Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish demersal multispecies 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 12.c. Total catches were 30 t and 12 t respectively including 13 t and 5 t of roundnose grenadier. In 2010, Russian trawler caught 73 t roundnose grenadier during a short-term fishery (two days) in the southern part of the Division 10.b.

Also in 2008, the Spanish fleet targeting redfish on the MAR reported landings of roundnose grenadier in 14.b.1 totalling 1722 tonnes. Since 2010, roundnose grenadier became a target species. In 2011 official landings in 14.b.1 increased to 2239 t. In subsequent years total estimated landings amounted to of 1860, 1790 and 2065 t in 2012, 2013 and 2014 respectively (Table 8.4.2). To these figures an unallocated catch in 14.b.1 of 1098 and1015 t must be added in 2012 and 2014, respectively. The total estimated preliminary catch in 2014 consists of 3466 t including Spanish catch in 14.b.1, negligible Faroese and French bycatches in 10.a, 12.a and 14.b.1 and discards. In 2015 total Spanish catch was declared as 862 t (533 and 329 tonnes in 14.b.1 and 12.a.1 respectively; Table 8.4.3). In 2016 the landings were estimated as 660 t. No catches were reported by other countries. Landings in 2018 was obtained from Spanish vessels only. Preliminary official landings for 2018 are 27 t, all in Division 12.a.1. (Table 8.4.1 and 8.4.3).

There has been uncertainty in the amount of Spanish landings in 2015-2016, and previous report include different figures. Additionally, most landings of roundnose grenadier from the NEAFC Regulatory Area are caught in Division 12.b and 6.b.1, which are part of another stock (rng.27.5b6712b). The current report only includes official data from ICES official catch statistics.

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8.4.1.2 ICES Advice

ICES advice applicable to 2018 and 2019

"ICES advises that when the precautionary approach is applied, landings should be no more than 717 tonnes in each of the years 2018 and 2019. ICES cannot quantify the corresponding catches."

ICES advice applicable to 2020–2023

The ICES framework for category 5 stocks was applied for the 2020-2023 advice (ICES, 2018). ICES considers that a precautionary reduction of catches should be implemented unless there is sufficient data to access the current level of exploitation of the stock.

The precautionary buffer (20% reduction in landings) was applied in the 2015 advice and the available new data (catch statistics) do not change the assessment of the stock. There is no data on abundance trends but in the absence of fishing, the stock is expected to rebuild from the past depletion caused by exploitation before the 2000s. Therefore, ICES advises that when the precautionary approach is applied, landings should be no more than 717 tonnes in each of the years 2020 to 2023. ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.

8.4.1.3 Management

There is a TAC for the roundnose grenadier in Subareas 8, 9, 10, 12 and 14. It applies to European Union (EU) waters and EU vessels in international waters (See Section 8.1.2). The EU TAC combined ICES advices on catch for 2 stocks: the roundnose grenadier in divisions 10.b and 12.c, and in subdivisions 12.a.1, 14.b.1, and 5.a.1 and the roundnose grenadier in subareas 6 and 7, and divisions 5.b and 12.b. This allows for the realization of the full amount of TAC in any of these areas. For 2019, NEAFC recommendation (Rec. 6:2019) on the conservation and management of roundnose grenadier (*Coryphaenoides rupestris*) and other grenadiers in the NEAFC Regulatory Area (Divisions 10.b and 12.c, and Subdivisions 12.a.1 and 14.b.1) specifies:

1. A total allowable catch limitation of 717 tonnes of roundnose grenadier is established.
2. No direct fisheries for roughhead grenadier and roughsnout grenadier should be authorised, and bycatches of these grenadiers as well as other grenadiers (Macrouridae) should be counted against the total allowable catch of roundnose grenadier specified in Point 1.

3. Contracting Parties shall submit all data on the relevant fishery to ICES, including catches, bycatches, discards and activity information. Catches should be reported by species. Unidentified grenadiers should be recorded as Macrouridae.

8.4.2 Data available

8.4.2.1 Landings and discards

Landings are given in Tables 8.4.1–8.4.3. The information on landings have been variable and at a considerably lower level down to insignificant in 2017 and 2018.. Landings from the 1970s to the 1990s were reported to be mostly from pelagic trawling. In the 2000s there has been pelagic trawling in Division 14 and bottom trawling in Division 12. There were no discards of roundnose grenadier on Russian trawlers where smallest fish and waste were used for fishmeal processing. The information on discards rate is very limited. An assessment of discards was conducted in 2014, when the discards on Spanish target fishery estimated by scientific observers was at level of 386 t (Tables 8.4.2). No discards have been reported from 2015-2018. Discard rates of roundnose grenadier in other fisheries have declined and this can be attributed to the decline of the deep-water fishery overall.

8.4.2.2 Length compositions

No new data on length compositions were presented.

8.4.2.3 Age compositions

No new data on age compositions were presented.

8.4.2.4 Weight-at-age

No new weight-at-age data are available.

8.4.2.5 Maturity and natural mortality

No new data on natural mortality are available.

8.4.2.6 Catch, effort and research vessel data

Catch and cpue data are given in the Stock Annex. There are gaps in the cpue time-series due to lack of catch statistics for 1973 and 1982 and absence of target fishery in 1994–1995 and 2006–2009 (data for some years cannot be used owing to short fishing periods). Effort data for each subareas and divisions are available for Russian fleet in 2003–2009. Effort data for Spanish fleet is available for 2010–2018, but information remains very uncertain.

8.4.3 Data analyses

Substantial landings were recorded in the 1970s and 1980s. Since then, landings have been variable and at a considerably lower level down to insignificant in 2017 and 2018. ICES cannot quantify the corresponding catches.

Since 2010 the official Spanish cpue and effort data are available (see Stock Annex). The current effort is low compared to the effort developed by USSR vessels in the 1970s and the cpue seems also low. Long-term comparison is debilitated by the lack of standardisation of fleet and vessel type. The Spanish cpue in Subdivisions 14.b.1 were on maximum historical levels in 2011. In 2012–2013 the cpue declined and was stable in 2014–2015. The time-series of the cpue for Subdivisions 12.a.1 is very limited.

8.4.4 Biological reference points

No attempt was made to propose reference points for this stock.

8.4.5 Comments on the assessment

No analytical assessments were carried out.

8.4.6 Management considerations

Active roundnose grenadier fishery was resumed in 2010, but the current status is unknown due to insufficient data. . The landings series is very limited and the cpue data are very uncertain. The cpue can be use as indicator of the state of stock in future.

8.4.7 References

Vinnichenko V., Khlivnoy V. 2008. New data on distribution of young roundnose grenadier (*Coryphaenoides rupestris*) in the North Atlantic Grenadiers of the world oceans: Biology, stock assessment and fisheries. American Fisheries Society, 2008. 119–124 pp.

8.4.8 Tables and Figures

Table 8.4.1. Working group estimates of catch for roundnose grenadier from Subareas 12.a.1 and 12.c, between 2012 and 2018 (data from 1973-2011 is shown in the Stock Annex)

Year	USSR/Russia	Poland	Latvia	Faroes	Spain	Lithuanian	Total
2012					864	4	868
2013					118		118
2014				4			4
2015					329		329
2016					289		289
2017[3]					16*		16
2018[3]					27*		27

[1]–revised catch data
[2]– official ICES data
[3]– preliminary data.
* Subareas 12.a.1 only

Table 8.4.2. Working group estimates of catch for roundnose grenadier from Subdivision 14.b.1.

Year	USSR/Russia	Spain	Unallocated	Discards	Total
1976	11				11

1982	153				153

1997	3361				3361
1998					
1999					
2000	5				5
2001	69				69
2002	4	235[2]			239
2003		272[2]			272
2004	201				201
2005					
2006					
2007		57			57

Year	USSR/Russia	Spain	Unallocated	Discards	Total
2008		1722			1722
2009					
2010		753			753
2011		2239			2239
2012		1860	1098		2958
2013		1790			1790
2014		2065	1015	386	3466
2015		533			533
2016		371			371
2017[3]		68			68
2018[3]	0	0	0	0	0

[1]–revised catch data [2]– official ICES data [3]—preliminary statistics.

Table 8.4.3. Working group estimates of catch of roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1, by area.

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
1973	820	0	226	0	1046
1974	12561	0	5874	0	18435
1975	0	0	29894	0	29894
1976	0	170	4545	11	4726
1977	0	0	9347	0	9347
1978	0	0	12310	0	12310
1979	0	0	6145	0	6145
1980	0	0	17419	0	17419
1981	0	0	2954	0	2954
1982	0	0	12472	153	12625
1983	0	0	10300	0	10300
1984	0	0	6637	0	6637
1985	0	0	5793	0	5793
1986	0	0	22842	0	22842
1987	0	0	10893	0	10893

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
1988	0	0	10606	0	10606
1989	0	0	9495	0	9495
1990	0	0	2838	0	2838
1991	0	0	7510	0	7510
1992	0	0	1979	0	1979
1993	0	249	2912	0	3161
1994	0	0	1132	0	1132
1995	0	0	359	0	359
1996	0	3	344	0	347
1997	0	1	6710	3361	10072
1998	0	1	7600	0	7601
1999	0	3	1151	0	1154
2000	0	0	2325	5	2330
2001	0	0	1716	69	1785
2002	0	0	737	239	976
2003	0	0	510	272	782
2004	0	1	444	201	646
2005	0	799	600	0	1399
2006	0	0	1	0	1
2007	0	0	2	57	59
2008	0	0	13	1722	1735
2009	0	0	5	0	5
2010	0	73	0	753	826
2011	0	0	0	2239	2239
2012	0	0	868	2958	3826
2013	0	0	118	1790	1908
2014	0	0	4	3466	3470
2015	0	0	329	533	862
2016	0	0	289	371	660

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
2017[1]	0	0	16*	68	84
2018[1]	0	0	27*	0	27

[1]—preliminary statistics. * Subareas 12.a.1 only.

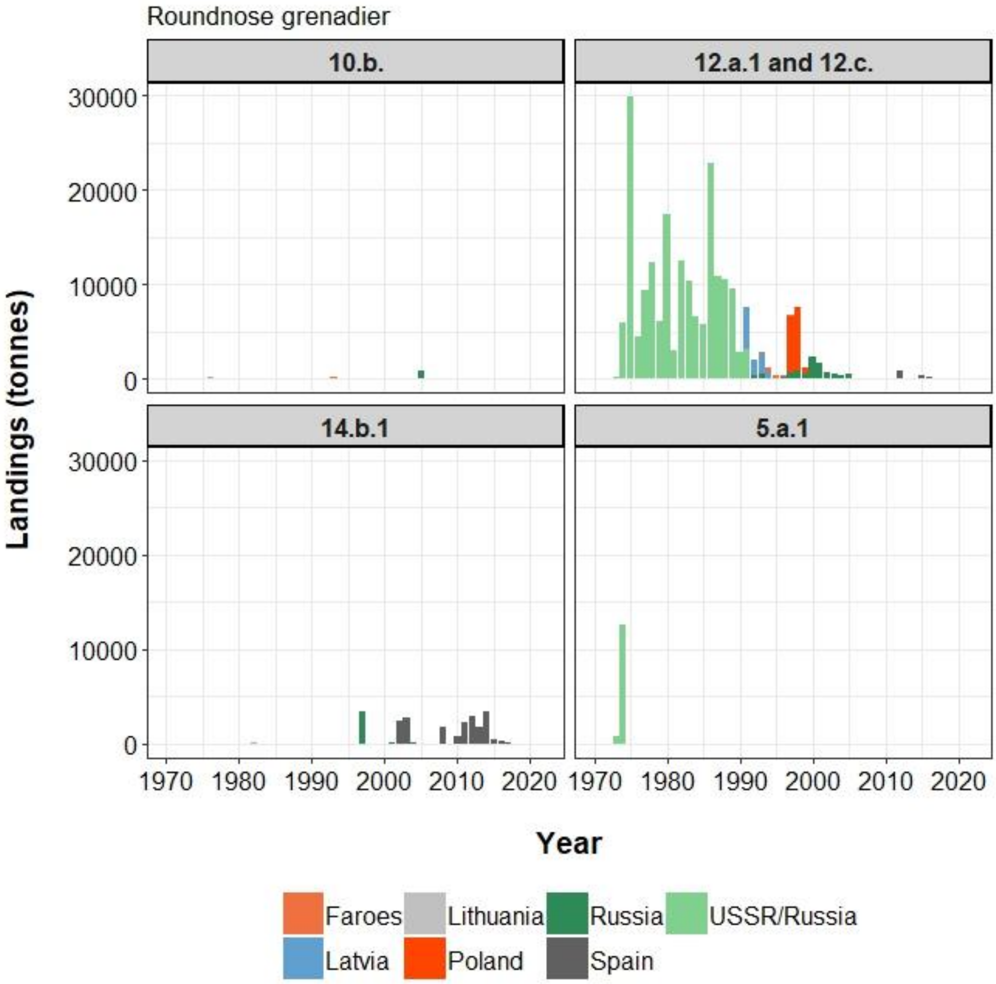

Figure 8.4.1. Landings of roundnose grenadier in ICES Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 in 1973–2018.

8.5 Roundnose grenadier (*Coryphaenoides rupestris*) in subareas 1, 2, 4, 8, and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2 (Northeast Atlantic and Arctic Ocean)

8.5.1 The fishery

Areas of the main fisheries are covered in the other sections for roundnose grenadier. Landings of roundnose grenadier in subareas 1, 2, 4, 8, and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2 are mostly small bycatch of trawl fisheries for other species.

8.5.1.1 Landings trends

Landing statistics by countries in the period 1990–2016 are presented in Tables 8.5.1–8.5.5.

In the Subareas 1 and 2 the catch of roundnose grenadier in 2016 comprised 4 t and was mainly taken as bycatch by Norwegian fleet. Moreover, insignificant catch of species was declared by France, from 1990 landings varied from 0 to 101 t (Table 8.5.1). The major contribution to the total catch was made by Norway. Roundnose grenadier was partly taken in mixed deep-water fisheries; directed local fisheries in Norwegian fjords for this species also exist. Earlier French landings, that reached 41 t, were assigned to this species however a recent revision of the data indicates that previous landings are more likely to correspond to roughhead grenadier, so there is no French landings for roundnose grenadier in Subareas 1 and 2.

In Subarea 4, the catch of roundnose grenadier in 2016 was mainly taken by the French fleet and comprised 2 t. The vessels of Norway and Scotland also had negligible catches. During 1990–2012 total landings in this area varied between 0 and 372 t (Table 8.5.2). The main contribution to the total catch was made by the Danish fleet in 2004. Roundnose grenadier is caught as incidental bycatch in this area by Scottish and Norwegian vessels in insignificant amount as well. As detected for French landings of this species in Subareas 1 and 2, earlier landings of roundnose grenadier in Subarea 4 are likely to correspond to roughhead grenadier but 2014 landings are well assigned. Four tons in 2014 may correspond to catch of roundnose close to the Norwegian deep or to misreported roughhead along the slope of the northern North Sea.

During 1990–2016, the landings of roundnose grenadier within Icelandic waters (Division 5.a) varied 2 to 398 t and were caught by Iceland (Table 8.5.3). Maximum landings were registered in 1992–1997 when 198–398 t were caught annually as bycatch in mixed deep-water fisheries, but it should be noted that it can include other grenadier species till 1990. In recent years, roundnose grenadier landings from 16 to 81 t were taken in Icelandic waters as bycatch in trawl fisheries for Greenland halibut and redfish.

Roundnose grenadier landings in Subareas 8 and 9 during 1990–2014 were minor and amounted 0 to 28 t annually (Table 8.5.4)..

Landings from Subdivision 14.b.2 (Greenland and Icelandic waters) in 1990–2016 varied from 1 to 126 t (Table 8.5.5). There is no directed fishery for roundnose grenadier in these areas. The majority of landings is taken as bycatch by Greenland, Germany and Norway during Greenland halibut bottom-trawl fisheries. In 2015 catch was 38 t that mainly was taken by Greenland.

In 2003–2005 unallocated landings were assigned to Subareas 1, 2, 4,8, 9 and Division 5.a.2 and 14.b.2, the values were 208, 504, and 952 t respectively (Table 8.5.6).

8.5.1.2 ICES advice

ICES advice applicable to 2015

"The 2012 advice for this stock is biennial and valid for 2013 and 2014 (ICES, 2012). New data available do not change the perception of the stock. Therefore, the advice for this fishery in 2015 is the same as the advice for 2013: 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."

ICES advice applicable to 2016 and 2017

"ICES advises that when the precautionary approach is applied, landings should be no more than 65 tonnes in each of the years 2016–2017. ICES cannot quantify the corresponding catches."

ICES advice applicable to 2018 and 2019

"ICES advises that when the precautionary approach is applied, landings should be no more than 65 tonnes in each of the years 2018 and 2019. ICES cannot quantify the corresponding catches."

8.5.1.3 Management

There is a TAC management of the roundnose grenadier fisheries in Subareas 1, 2, 4, 8, 9, Division 5.a and Subdivision 14.b.1 for European Community vessels. In eastern Greenland, main fishing operations are in Subdivision 14.b.2 and here, TAC of roundnose and roughead grenadier combined has been 1000 t since 2010 to 2018. In international waters there are NEAFC regulation of efforts in the fisheries for deep-water species.

8.5.2 Data available

8.5.2.1 Landings and discards

Landings are given in Table 8.5.1–8.5.5. Estimated discards owing to bycatch in Spanish fisheries for demersal fish in 8 and 9 did not exceed 2 t in 2012, and did not reached to 1 t in subsequent years. National catch statistics of Greenland were used to update catches in subarea 14.b.2 from 1999 to 2018. The latter may include both landings from Greenland and other countries vessels, wherefore it was unclear whether this implies double count with landings reported by other countries. A potential over-reporting is suspected for roundnose grenadier, as the scientific survey has revealed that roughhead grenadier is present in bigger amounts in ICES 14.b.2. – a trend which is not supported by catches (WGDEEP 2019: WD05 and WD06).

8.5.2.2 Length compositions

No data.

8.5.2.3 Age compositions

No data.

8.5.2.4 Weight-at-age

No data.

8.5.2.5 Maturity and natural mortality

No data.

8.5.2.6 Catch, effort and research vessel data

The Greenlandic annual bottom trawl survey is the main source for fishery-independent data for roundnose grenadier in subarea 14.b.2 (Greenland waters). This survey is depth stratified covering depths from 400-1500 m using Alfredo trawl towed at a speed between 2.5-3.0 knots with a 30 min bottom time (tows of at least 15 min are accepted). Survey period span from 1998 to present although no survey in 2001, 2017 and 2018 was carried out.

8.5.3 Data analyses

Length distributions from ICES subarea 14.b.2 exhibit varying modes between years. Typically, sizes between 3 cm to 10 cm dominates but no clear temporal pattern is evident (Fig. 8.5.1). In 2016, the highest index biomass and abundance was found at depths between 1001-1500 m (Table 8.5.7). Estimated index biomass of roundnose grenadier show that since 1998 until 2016, the biomass generally decreased (from 3039 t in 1998 to 170 t in 2016) yet some years like 2003 and 2012, higher amounts of roundnose grenadier were registered (Fig. 8.5.2).

No assessment.

Biological reference points

There are no reference points for this stock.

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.

8.5.4 Comments on the assessment

No assessment.

8.5.5 Management considerations

This is a bycatch fishery and advice should take into account advice for other stocks.

8.5.6 Tables and Figures

Table 8.5.1. Working group estimates of landings of roundnose grenadier from Subareas 1 and 2.

Year	Faroes	Denmark	Germany	Norway	Russia/USSR	Germany	UK (E+W)	France	TOTAL
1990			2		12	3			17
1991			3	28					31
1992		1		29					30
1993				2					2
1994			12						12
1995									0
1996									0
1997	1			100					101
1998				87	13				100
1999				44	2				46
2000									0
2001							2		2
2002				11	1				12
2003				4					4
2004				27					27
2005				12					12
2006				6	2				8
2007				11	1				12
2008				10					10
2009				8					8
2010				17	6				23
2011				16					16
2012				5					5
2013				17					17
2014				4					4
2015				11					11
2016				2				0	2

Year	Faroes	Denmark	Germany	Norway	Russia/USSR	Germany	UK (E+W)	France	TOTAL
2017				4				<1	4
2018				21				<1	21

Table 8.5.2. Working group estimates of landings of roundnose grenadier from Subarea 4.

Year	Germany	Norway	UK (Scot)	Denmark	France	TOTAL
1990	2					2
1991	4					4
1992			4	1		5
1993	4					4
1994	2			25		27
1995	1		15			16
1996			5	7		12
1997			10			10
1998						0
1999		5				5
2000						0
2001				17		17
2002		1	26			27
2003		1	11			12
2004			1	371		372
2005		2				2
2006		4				4
2007		1				1
2008						0
2009						0
2010		2	0			2
2011		0	0			0
2012		1				1
2013						0
2014					3	3

Year	Germany	Norway	UK (Scot)	Denmark	France	TOTAL
2015		1	<1		1	2
2016		0	0		1	1
2017		<1			<1	<1
2018		<1			<1	<1

Table 8.5.3. Working group estimates of landings of roundnose grenadier from Division 5.a.2.

Year	Faroes	Iceland*	Norway	UK (E+W)	Denmarck	Greenland	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					80

Year	Faroes	Iceland*	Norway	UK (E+W)	Denmarck	Greenland	TOTAL
2013		84					84
2014		36					36
2015		22			2		24
2016		52					52
2017						2	2
2018		0					0

*** includes other grenadiers from 1990 to 1996.**

Table 8.5.4. Working group estimates of landings of roundnose grenadier from Subareas 8 and 9.

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

Year	France	Spain	TOTAL
2010	1		1
2011	1		1
2012	0		0
2013	0		0
2014	0		0
2015	1		1
2016	0	0	0
2017	0	0	0
2018	0	0	0

Table 8.5.5. Working group estimates of landings of roundnose grenadier from Division 14.a and Subdivision 14.b.2.

Year	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	Estonia	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	138		19					262
2000		41	107		5					153
2001		11	80		7	2	72			172
2002		25	61		15	1	1			103
2003			70		5	1				76
2004		27	110							137
2005			69		6	1				76
2006		35	79		17					131
2007	1		43		1					45

Year	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	Estonia	TOTAL
2008			31					12		43
2009			45		2					47
2010		33	61		7					101
2011		32	138		4					174
2012			126		1					127
2013			129		2					131
2014	0		100		7				4*	111
2015			179							179
2016			79							79
2017*			119							119
2018		59	157		1					217

*** Estonian landings in 2014 not reflected in ICES catch statistic.**

Table 8.5.6. Working group estimates of landings of roundnose grenadier from 1, 2, 4, 5.a.2, 8, 9, 14.a and 14.b.2.

Year	1+2	4	5.a.2	8+9	14.b.2	14.a	Unallocated	Total
1990	17	2	7	5	47		0	78
1991	31	4	48	1	29		0	113
1992	30	5	210	12	31		0	288
1993	2	4	276	18	26		0	326
1994	12	27	210	5	15		0	269
1995	0	16	398	0	27		0	441
1996	0	12	140	1	25		0	178
1997	101	10	198	0	57		0	366
1998	100	0	120	20	126		0	366
1999	46	5	129	16	262		0	458
2000	0	0	54	4	153		0	211
2001	2	17	40	7	172		208	238
2002	12	27	60	3	103		504	205
2003	4	12	57	2	76		952	151
2004	27	372	181	2	137		0	719

Year	1+2	4	5.a.2	8+9	14.b.2	14.a	Unallocated	Total
2005	12	2	76	7	76		0	173
2006	8	4	62	28	131		0	233
2007	12	1	16	10	45		0	84
2008	10	0	29	8	43		0	90
2009	8	0	46	1	47			102
2010	23	2	59	1	101			186
2011	16	0	62	1	174			253
2012	5	1	80	0	127			213
2013	17	0	84	0	131			232
2014	4	3	36	0	111			154
2015	11	2	22	1	179			216
2016	2	1	0	0	79	2		84
2017	4	<1	2		119			125
2018	21	<1	0	0	217	2		240

Table 8.5.7 Biomass (t) and abundance (in numbers) with SE of roundnose grenadier expressed as mean catch per km² and total biomass by Q-subarea and depth stratum in ICES subarea 14.b.2 in 2016. Q-subareas encompass Q1-Q5 (see Nielsen *et al*. 2019) for which area and number of survey hauls in 2016 are listed.

				Biomass			**Abundance**		
Subarea	Depth strata	Area	Hauls	Mean/km²	Biomass	SE	Mean/km²	Abundance	SE
Q1	401-600	6975	12	0.0000	0.0	0.0	0.0	0	0
Q2	401-600	1246	5	0.0000	0.0	0.0	0.0	0	0
	601-800	1475	7	0.0000	0.0	0.0	0.0	0	0
	801-1000	1988	10	0.0015	3.1	2.2	4.9	9839	6566
	1001-1500	6689	7	0.0193	128.9	43.2	45.8	306453	107017
Q3	401-600	9830	11	0.0000	0.0	0.0	0.0	0	0
	601-800	3788	14	0.0000	0.0	0.0	0.0	0	0
	801-1000	755	6	0.0000	0.0	0.0	0.0	0	0
Q5	401-600	1819	3	0.0000	0.0	0.0	0.0	0	0
	601-800	257	6	0.0000	0.0	0.0	0.0	0	0
	801-1200	256	5	0.0214	5.5	2.1	384.2	98206	41556
	1201-1400	986	9	0.0311	30.6	15.7	109.0	107419	55057
	1401-1500	615	5	0.0035	2.1	1.3	13.2	8132	5020
All		36679	100	0.0046	170.2	46.0	14.5	530050	128000

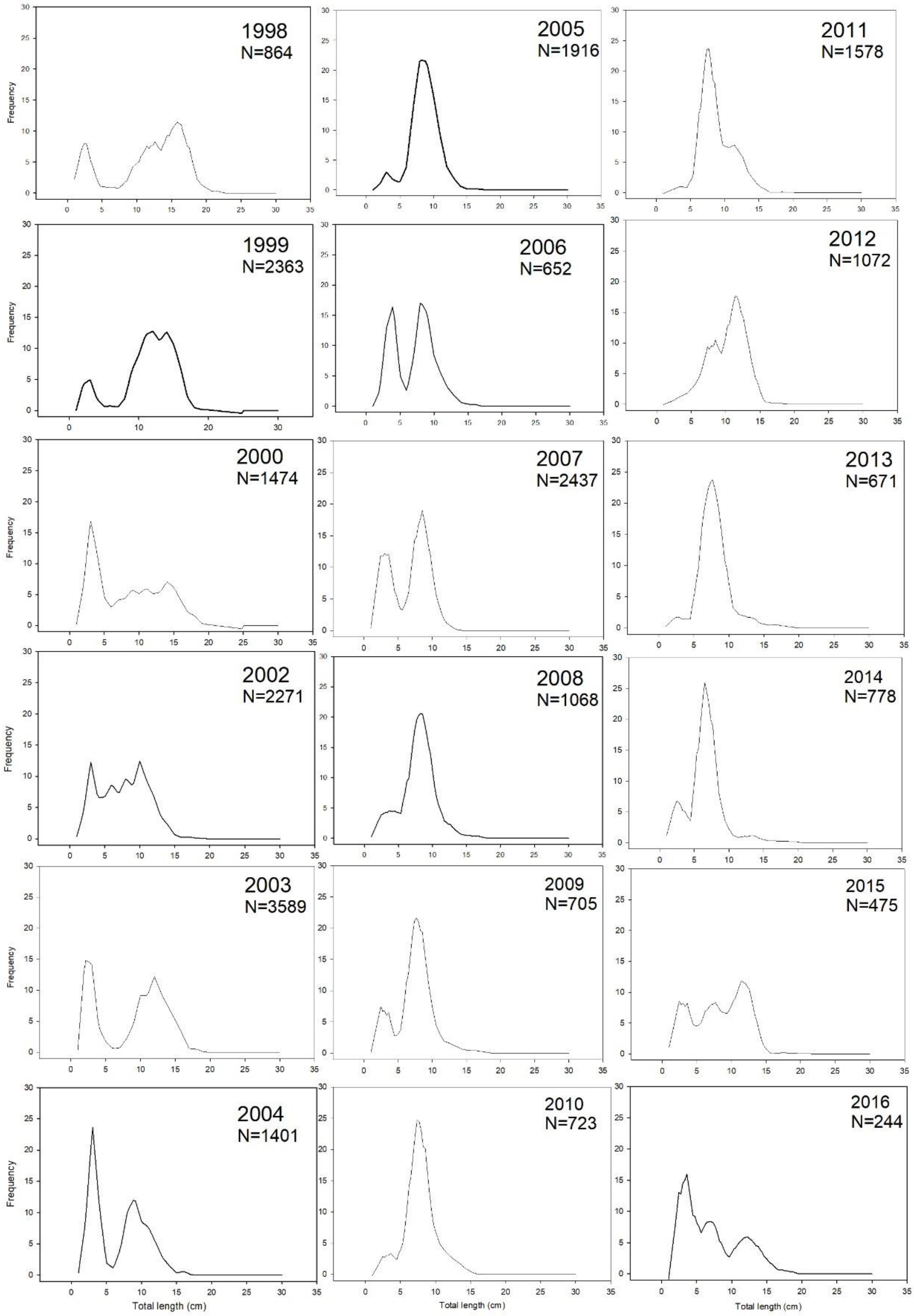

Figure 8.5.1. Length frequency distribution of roundnose grenadier for years 1998-2016 in ICES subarea 14b2. No survey in 2001, 2017 and 2018.

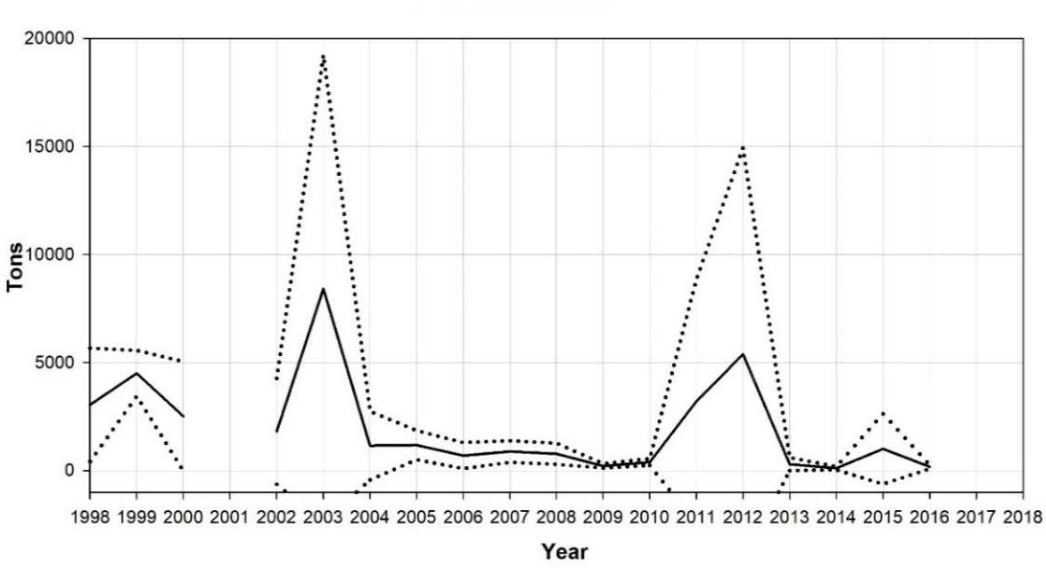

Figure 8.5.2. Total biomass of roundnose grenadier (solid line) in ICES subarea 14b2 plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

9 Black scabbardfish (*Aphanopus carbo*) in the Northeast Atlantic

9.1 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 at the north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are benthopelagic. The life cycle is completed in just one area and either small- or large-scale migrations occur seasonally.

The stock structure in the whole Northeast Atlantic is still uncertain. Nevertheless, all the available information supports the assumption of a single stock from Faroese waters and the west of the British Isles down to Portugal (Farias *et al.*, 2013). The links with other areas such as ICES Subarea 10 is less clear, as in this Subarea two different species *A. carbo* and *A. intermedius* coexist (Besugo *et al.*, 2014 WD).

Prior to the 2014 benchmark meeting (WKDEEP, 2014), WGDEEP has considered three assessment units for black scabbardfish (ICES, 2011):

1. Northern (Divisions 27.5.b. and 27.12.b and Subareas 27.6 and 27.7);
2. Southern (Subareas 27.8 and 27.9);
3. Other areas (Divisions 27.3.a and 27.5.a Subareas 27.1, 27.2, 27.4, 27.10, and 27.14).

The Northern component comprises the black scabbardfish exploited mainly by trawlers while the Southern component by deep-water longliners from Division 27.9.a. In the other areas, the species is exploited by both longliners and trawlers, but till 2010 the overall landings from those areas were globally much lower than at the other two management units. However, in recent years, fishing activity in ICES Division 27.5.a has been regular, with landings rounding about 300 ton per year, but decreasing between 2017 and 2018. To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, in 2016, WGDEEP agreed to include ICES Division 27.5.a in the Northern component.

Furthermore, based on the linkage between the Northern and Southern management units, WKDEEP 2014 concluded that despite the management advice is provided for each of the two management units, the advice should be given by considering the status of bsf-nea stock as a whole. The reason for the maintenance of two distinct units when management purposes are considered is related to the fact that the stock is subjected to two main distinct exploitation regimes (different fishing gears and exploited size ranges of the species).

All evidences available support the existence of one single stock doing a clockwise migration within these areas. A dynamic population model was developed for assessing the stock by considering the two components: Northern and Southern. The model was benchmarked at WKDEEP 2014.

The link between the Northern and Southern components and the other areas, excluding ICES Division 27.5.a, is less clear. The component "Other areas" is treated separately from Northern and Southern components.

The present report is structured maintaining the initial separation between units, except for topics related with the stock assessment and the advice.

9.2 Black scabbardfish in Divisions 27.5.b and 27.12.b and Subareas 27.6 and 27.7

In this section, fisheries, landings trends, and applicable management are presented for Divisions 27.5.b and 27.12.b and Subareas 27.6 and 27.7, but the stock assessment data analyses and management considerations apply to these areas combined with ICES Subareas 27.8 and Divisions 27.9.a and 27.5.a.

ICES Division 27.5.a has previously been included in "Other areas", however, in 2016, WGDEEP decided to include ICES Division 27.5.a in the Northern Component both for stock assessment analyses and for management considerations.

9.2.1 The fishery

Excluding Faroes Islands (Division 27.5.b) in 2019 there was no other updated information on the fisheries taking place in the Northern Component area.

In Division 27.5.b, black scabbardfish is fished by large trawlers and the main fishing area is on the slope around the Faroe Bank and on the Wyville-Thomsen ridge close to the southernmost Faroese EEZ boarder (Figure 9.2.1). In Faroese waters, the black scabbardfish fishery is managed through a fishing licencing scheme. Since 2013, only one trawler has had licence to fish black scabbardfish as a targeted species.

Faroese commercial trawlers use a star trawl with 486 meshes, 160 mm with a net mesh size of 80 mm. Black scabbardfish is usually fished at depths from 600 to1000 m and the trawling hours varies from 6 to 8h, but may last less if the species is very abundant (Ofstad, 2019 WD).

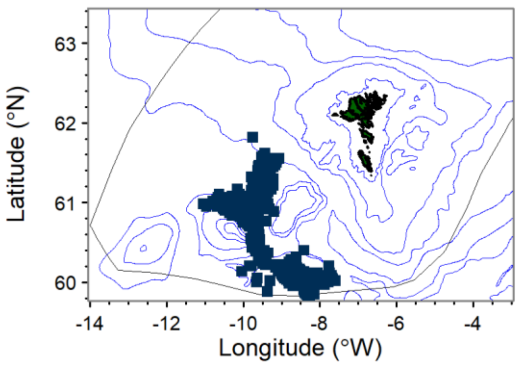

Figure9.2.1. Faroese main fishing grounds of black scabbardfish in Subarea 27.5.b (fishing hauls in which the species contributed with more than 50% of the total catch). (Source: Ofstad, 2019 WD)

9.2.2 Landings trends

The historic landings trends on this assessment unit are described in the stock annex.

Total landings from the ICES Division 27.5.b and Subareas 27.6, 27.7 and 27.12 show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend until 2005 (Figure 9.2.2). In 2006, there was a peak in landings and since then landings decreased, particularly in ICES Divisions 27.6 and 27.7. This was majorly driven by the EU TAC management adopted (Figure 9.2.2). From 2009 until 2016, landings have been stable, fluctuating around about 3000 Ton per year. In 2017, there was a slight decrease, followed by an increase in 2018.

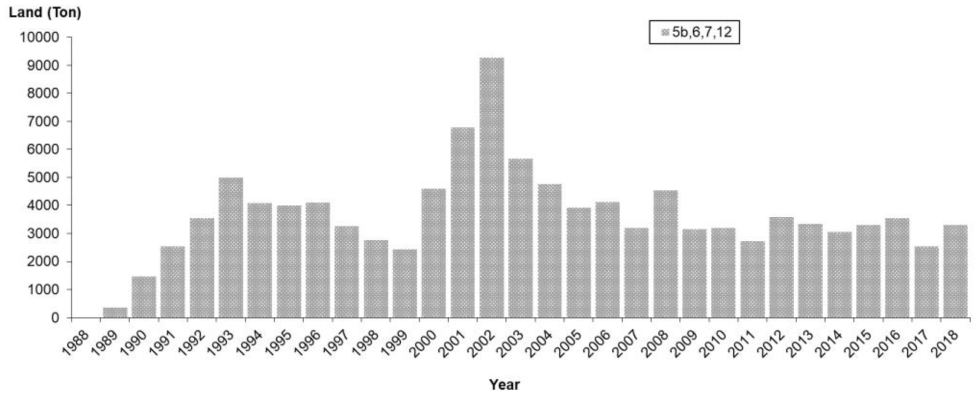

Figure9.2.2. bsfnea Northern component annual landings time-series for ICES Division 27.5.b and Subareas 27.6 plus 27.7 and 27.12.

In earlier years, French landings represented more than 75% of the Northern Component total landings, but in 2002 and 2006 they just represented about 50%. From 2009 to 2012, the relative importance of French landings, particularly at ICES Subarea 27.6, augmented, decreased until 2015 and increased until 2017 to decrease again from 2017 to 2017. During that period, Spanish landings of black scabbardfish followed an inverse trend to those of French landings, whereas Faroese landings increased, determining an increase in their relative contribution (Figure 9.2.3).

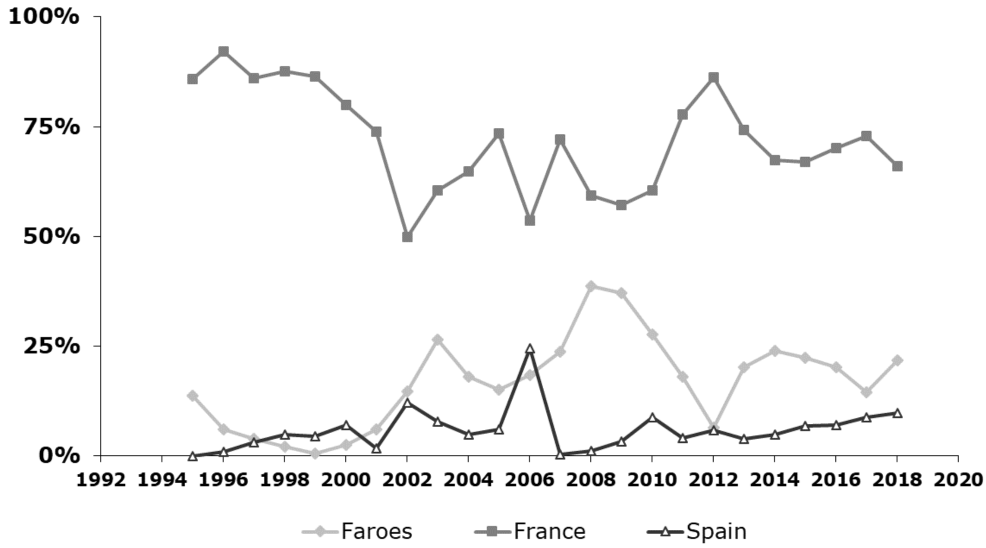

Figure 9.2.3 bsfnea Northern component French, Spanish and Faroese relative contribution to the annual landings for the Northern component.

9.2.2.1 ICES Advice

The latest ICES advice for 2018 and 2019 was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 5914 tonnes in each of the years 2019 and 2020.*

Distributed by area this corresponds to annual catches of no more than 2812 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2735 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 367 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.".

9.2.3 Management

Since 2003, the management of black scabbardfish adopted for EU vessels fishing in EU and international waters, includes a combination of TAC and licensing system. TACs and total landings of EU vessels in Subareas 27.5, 27.6, 27.7, and 27.12, from 2006 to 2018, are presented in Table 9.2.1. 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.

Table 9.2.1. Black scabbardfish TACs and total landings of EU vessels in Subareas 27.5, 27.6, 27.7, and 27.12 between 2006 and 2018.

Year	EU TAC 27.5, 27.6, 27.7 & 27.12	Landings 27.5.b, 27.6, 27.7 and 27.12
2006	3042	4127
2007	3042	3192
2008	3042	4532
2009	2738	3160
2010	2547	3202
2011	2356	2733
2012	2179	3592
2013	3051	3332
2014	3966	3048
2015	3649	3291
2016	3357	3545
2017	2954	2530
2018	2600	2544

9.2.4 Data available

9.2.4.1 Landings and discards

In 2019, updated landing data were made available for the major fishing countries operating in the ICES Division 27.5.b and Subareas 27.6, 27.7 and 27.12 (Table 9.2.2) and for ICES Division 27.5.a (Table 9.4.2c).

Update discard data were also provided for major fishing countries operating at the Northern component area. The level of black scabbardfish discards, as previously observed, is low. Based on the discard data available for the Northern component, it is concluded that discards of black scabbardfish are negligible.

9.2.4.2 Research vessel data

Since September 2014, a Faroese deep-water survey has been conducted to investigate bottom fishes at deep waters and other areas than those the annual Faroese groundfish surveys covers (Ofstad, 2019). The main studied species are tusk, blue ling, greater silver smelt, black scabbardfish, roundnose grenadier, deep-water redfish and Greenland halibut.

Faroese deep-water surveys are held onboard the research vessel "Magnus Heinason". The trawl gear used is a star trawl with 40 mm mesh size in the cod-end. Rockhopper ground gear, 120 m bridles and Thyborøn-trawl doors. Fishing hauls has a mean duration of one hour, but the fishing haul duration (i.e. the time interval between the time when the gear reaches the bottom till it is hauled up from the bottom) may vary. The adopted sampling procedures are the same as those of the annual groundfish surveys. After each fishing haul the total catch is sorted by species and total weight is determined for each species. Further samples are also collected with the aim of obtaining data on specimens´ length and weight. For the main species subsamples are also collected to determination of sex, maturity and age.

In Faroese waters black scabbardfish is mainly distributed on the slope north of the Faroe Bank and on the Wyville-Thomsen ridge (Figure 9.2.3.), which corresponds to the main Faroese fishing areas. A closer look shows that the species is only caught in the area north-west of the Faroes and never caught on the Faroe Plateau (Figure 9.2.4.).

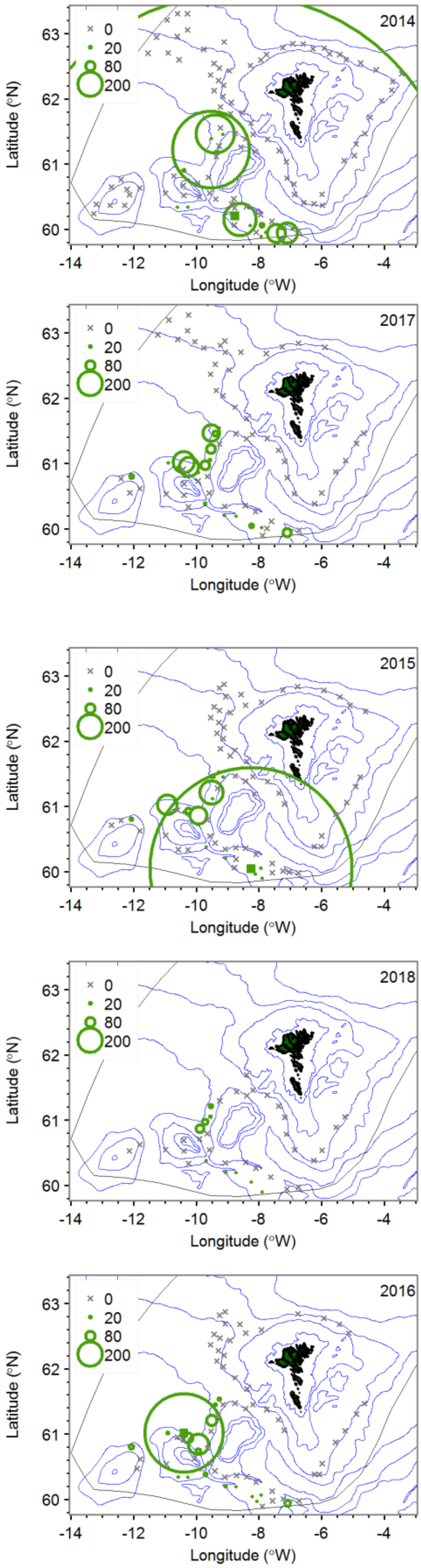

Figure 9.2.3. Black scabbardfish 5.b. Spatial distribution of CPUE (kg/h) from the deep-water surveys in 2014- 2018. The green squares show the position of the largest catch. (Source: Ofstad, 2019).

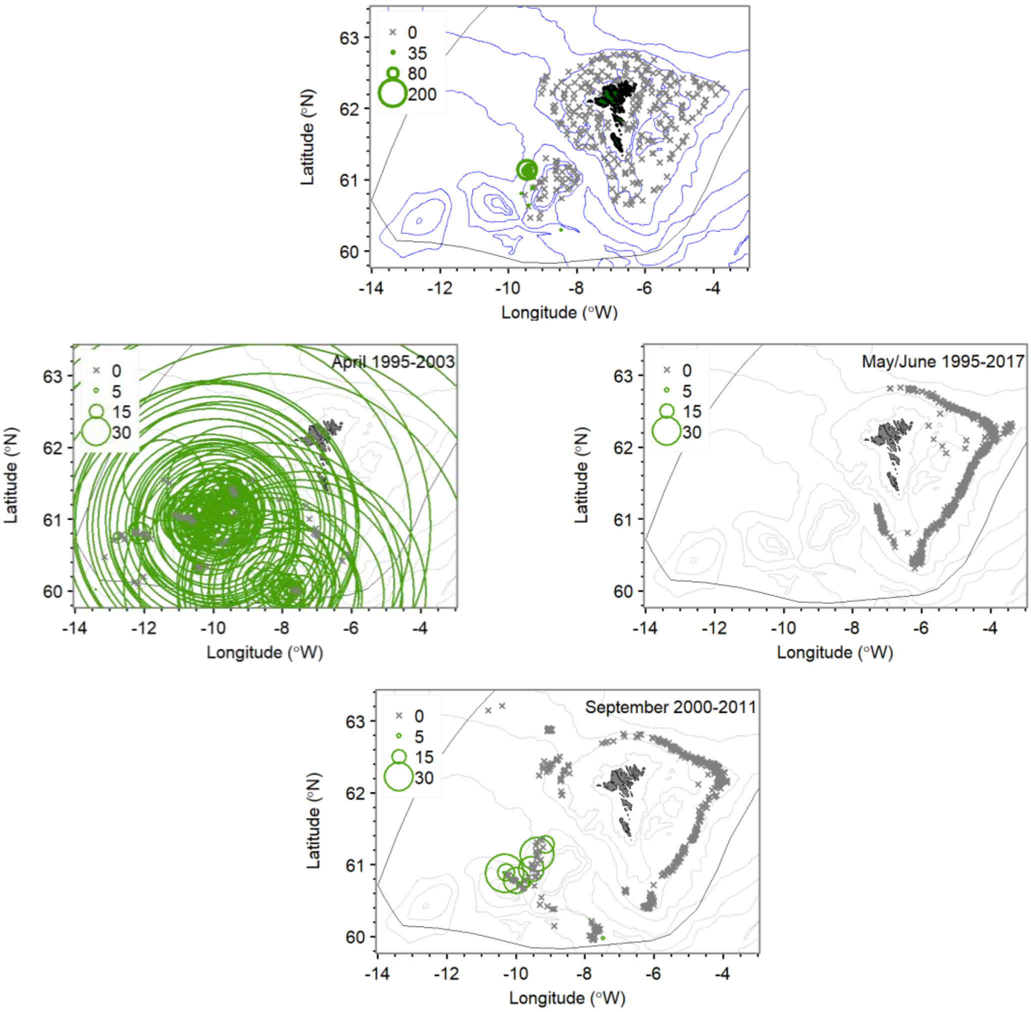

Figure 9.2.4. Black scabbardfish 5.b. Spatial distribution, CPUE (kg/h), from different surveys. Annual groundfish surveys, August 1996-2017 (upper left), Blue ling surveys, April 1995-2003 (upper right), Greenland halibut surveys, May/June 1995-2017 (lower left) and Redfish surveys, September 2000-2011 (lower right). (Source: Ofstad, 2019)

Based on the collected oceanographic data during the surveys it is evident that the species occurs at depths deeper than 500 m with temperatures higher than 6°C (Figure 9.2.5.) those conditions correspondent to the oceanic temperature and depth in Faroese waters (Figure 9.2.6.).

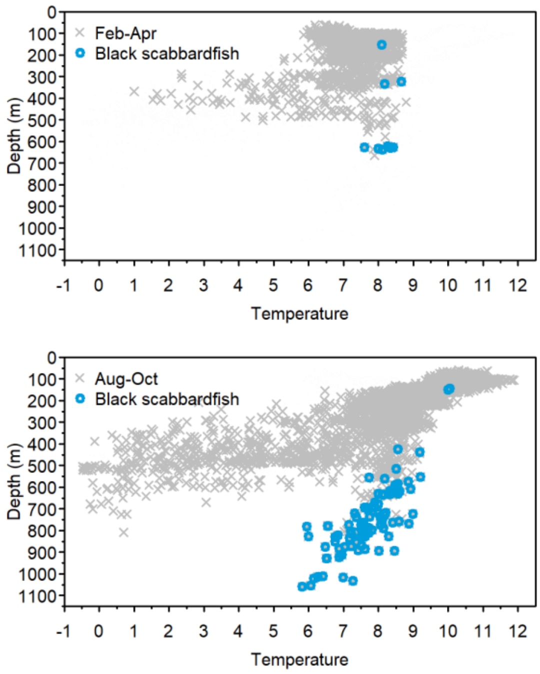

Figure 9.2.5. Black scabbardfish 5.b. Temperature and depth distribution of black scabbardfish (blue dots) and catch with no black scabbardfish (grey crosses) in February-April (left) and August-October (right). (Source: Ofstad, 2019)

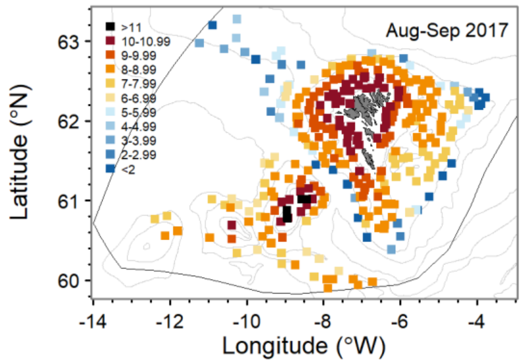

Figure 9.2.6. Temperature and depth distribution in Faroese waters August-September 2017. (Source: Ofstad, 2019)

9.2.4.3 Length compositions

The annual length frequency distribution based on French on-board observer data are presented for the period 2004-2017 (Figure 9.2.7.). For this time period and apart from a slight increase in the mean length is observed in the latter 4–5 years, no major other differences were noted.

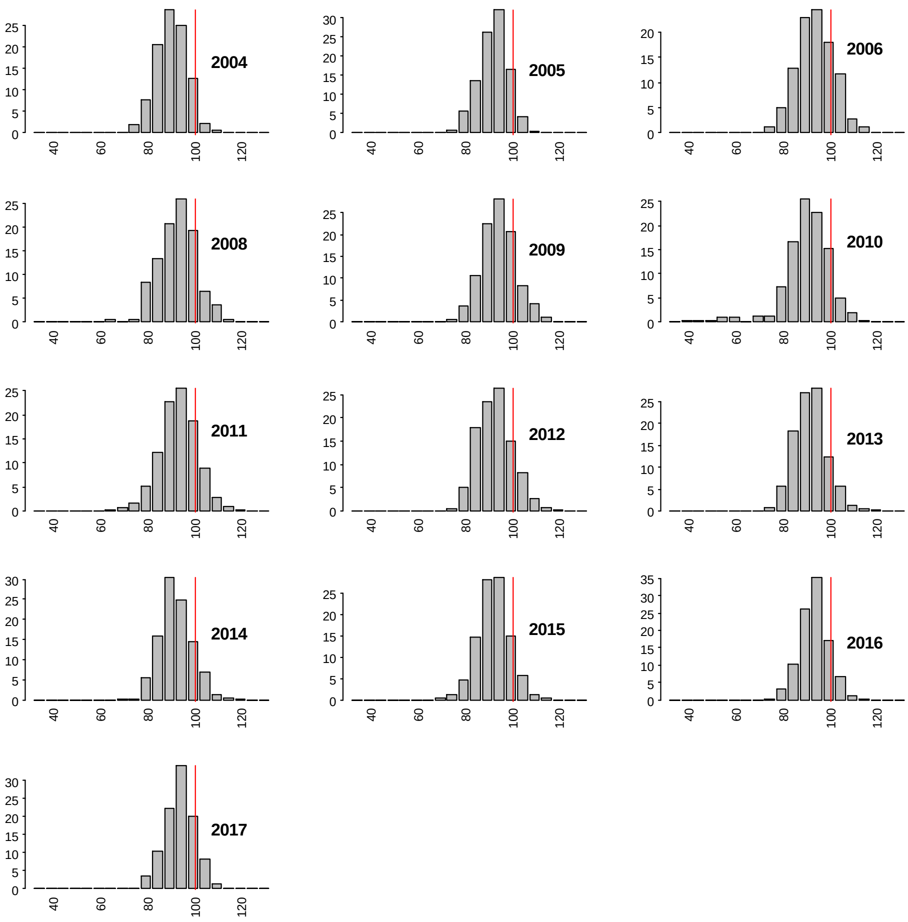

Figure 9.2.7. bsfnea Northern component - Annual frequency length distribution of black scabbardfish based on French observer data collected on-board commercial vessels (2008–2017). The red vertical line indicates the length of 1st maturity of the species.

For that period, the temporal evolution of the mean length by quarter and shows no trends (Figure 9.2.8), which supports the stability on the length structure of the exploited population during that period.

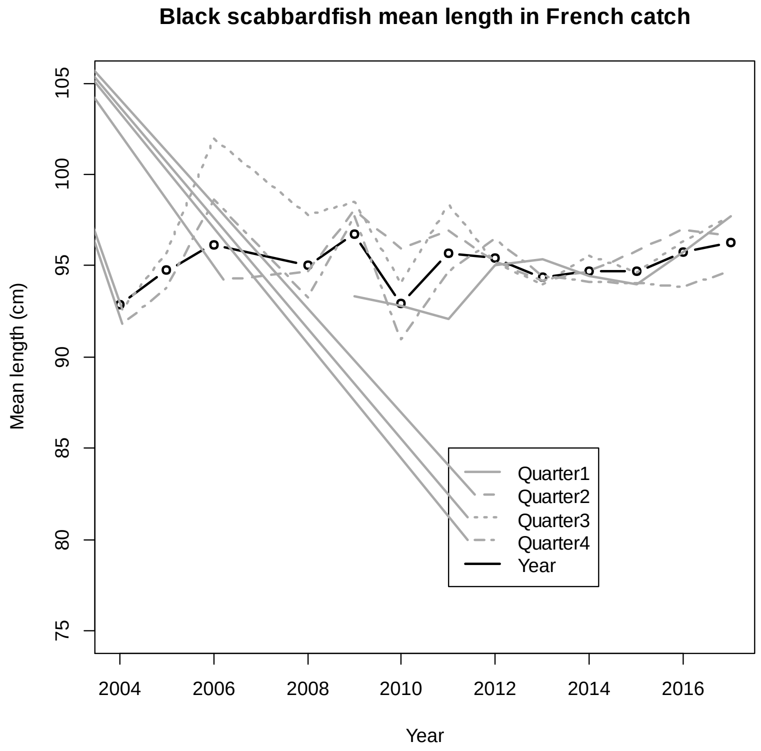

Figure 9.2.8. bsfnea Northern component – Mean length estimates of black scabbardfish by quarter for the period 2008-2017. Data were collected under the French on-board observer program. (Source: Ofstad, 2019)

For the period 2014-2018, the annual length-frequency distributions based on sampled from Faroese landings and Faroese deep-water surveys are presented in Figure 9.2.9. The mean length of the exploited population is around 90-92 cm, which is about the same mean length as in the deep-water survey (Figure 9.2.9).

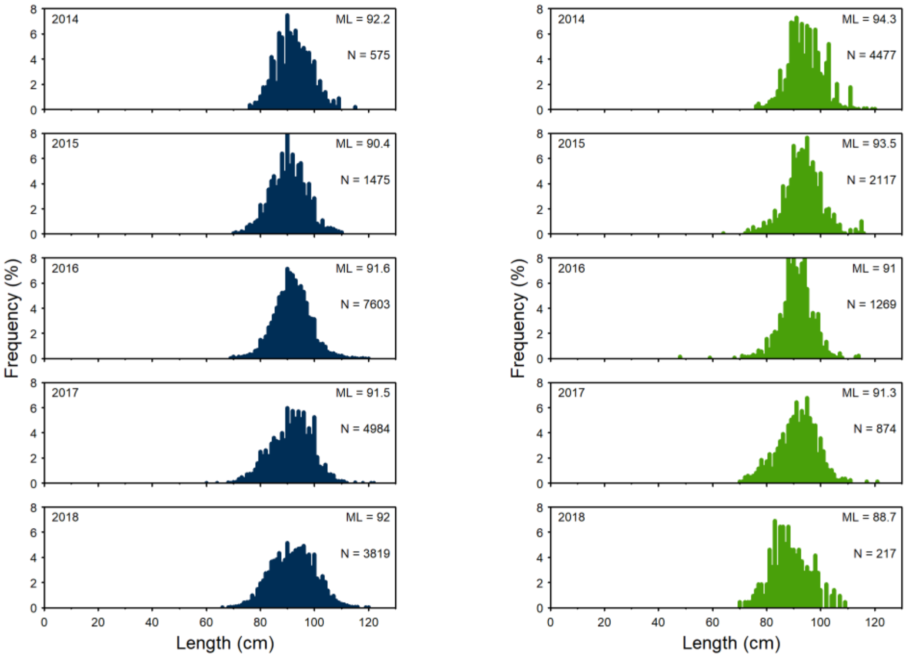

Figure 9.2.9. bsfnea Northern component – Length-frequency distribution from the landings (left) and the deep-water survey (right) in 2014-2018. (Source: Ofstad, 2019)

For 2014 and 2015, the annual length frequency distributions for ICES Division 6.b and ICES Subarea 12 were constructed based on the length data collected under Spanish on-board observer program (Fig. 9.2.10). The ranges of the length frequency distributions are similar in the two geographic areas and fishing fleets. In both specimens with Total length smaller than 103 cm predominate.

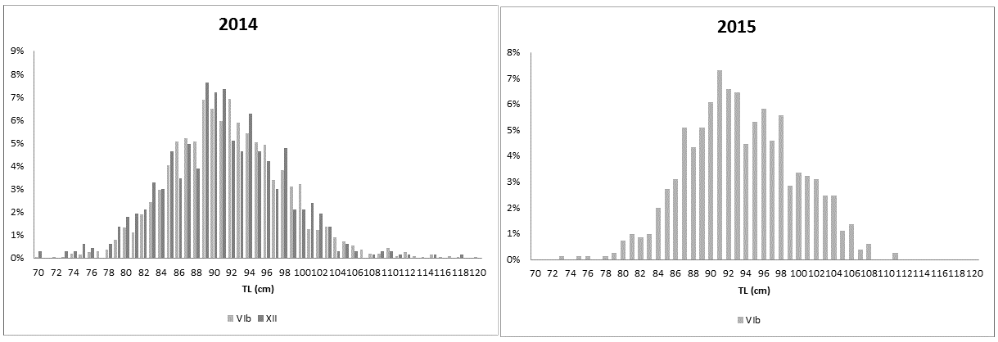

Figure 9.2.10. bsfnea Northern component – Length frequency distribution based on Spanish on-board observations in 2014 (a) and in 2015 (b) in Division 6.b and Subarea 12.

The length data available for the Northern Component suggests a similar length structure of the exploited population between the different fishing fleets. The French length data series is the longest and because of that French data is used to calculate the total catches, in number, grouped in the two length classes considered in the assessment model (the two length classes are: C2, which includes specimens from 70 to 103 cm TL(total length), and C3, which are specimens larger than 130 cm TL (WGDEEP 2018 report Table 9.2.1).

9.2.4.4 Age compositions

The exploited population is not structured by age because the assessment approach followed to assess the stock is a stage-based model, with stages defined according to length.

9.2.4.5 Weight-at-age

No data on weight-at-age are available.

9.2.4.6 Maturity and natural mortality

The information available for ICES Subareas 5.b, 6, 7 and 12 consistently points out to the predominance of small and immature specimens.

9.2.4.7 Catch, effort and research vessel data

The standardized French CPUE series covering the period 1998-–2017 is presented in Figure (9.2.11). Estimates were made for one vessel in each ICES rectangle, for the mean fishing depth by rectangle, and determined by averaging over rectangles by area. CPUE was estimated by six-month time periods as: SEM1= months 3–8 of the year; SEM 2=month 9–12 of the year, plus months 1 and 2 of the next year. The use of an index by semester instead of a yearly index was driven by a clear seasonal pattern in CPUE with higher catch rates in autumn-winter.

Since no French CPUE data were available for 2015, WGDEEP agreed to use the 2014 data in the assessment model. There are no evidences of great changes on the abundance or biomass in recent years. This assumption is consistent with both the Scottish and Iceland surveys.

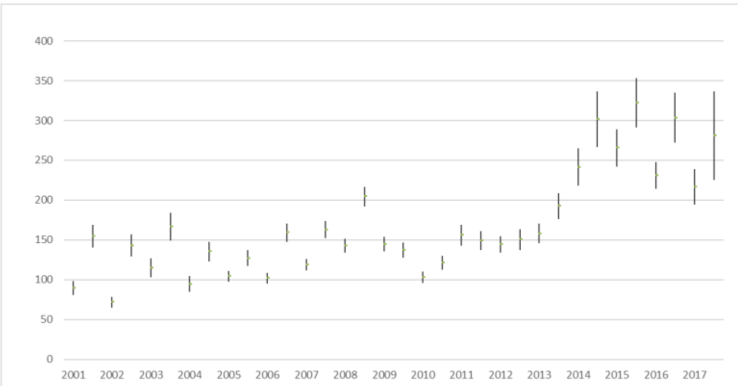

Figure 9.2.11. bsfnea Northern component CPUE by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

Scottish research survey data have been provided to WGDEEP. The annual biomass and abundance index estimates obtained for hauls deeper than 500 and shallower than 1600 m are presented in Figure 9.2.12. After 2012, both the annual biomass and annual abundance indices are at higher levels, indicating that the population at the Northern component has been increasing.

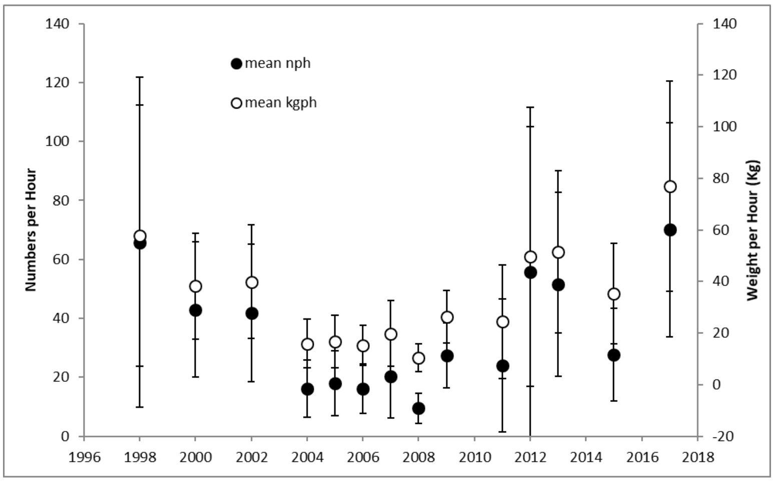

Figure 9.2.12. bsfnea Northern component. Annual biomass and abundance indices of black scabbardfish estimated for depths deeper than 500 m and shallower than 1600 m.

In ICES Division 27.5.a the Icelandic Autumn survey biomass index series for all sizes (Total biomass), for specimens larger than 90 cm and 110 cm (Figure 9.2.12) show despite the variability consistent increasing trends. The abundance of black scabbardfish smaller than 80 cm shows a decreasing trend that is particularly evident by the end of the time series (Figure 9.2.13.).

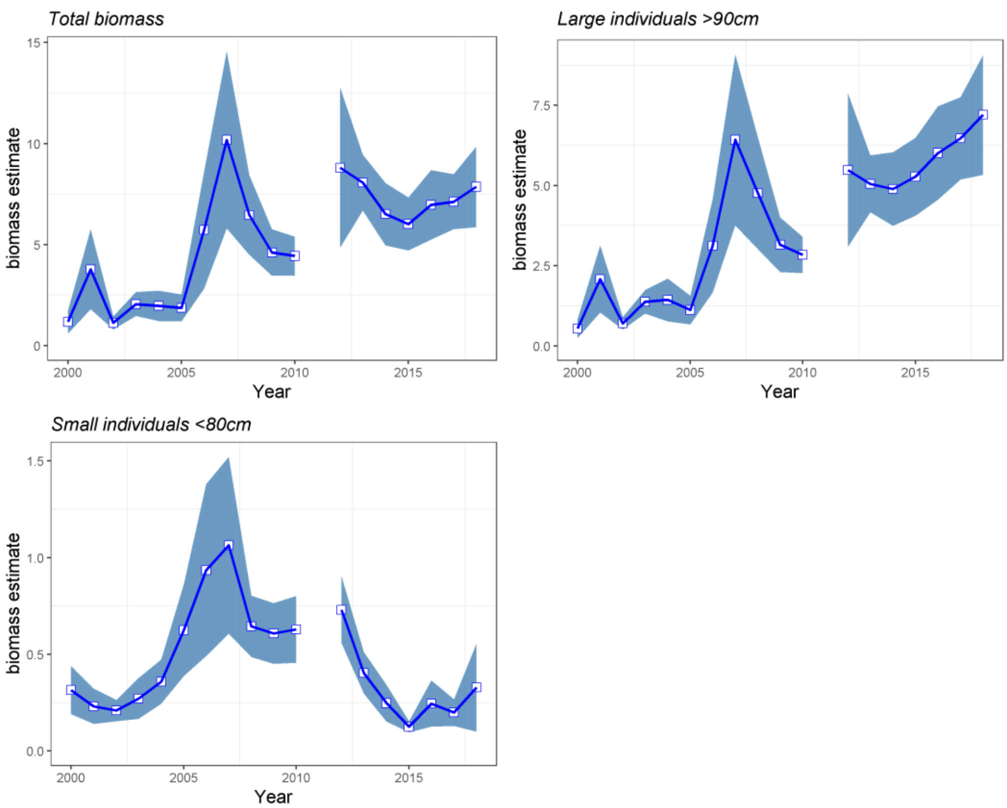

Figure 9.2.13. bsfnea Northern component. 95% Confidence interval of the biomass indices for all sizes (Tot. Biomass) and for specimens larger than 90 cm (Biomass >90 cm) and 110 cm (Biomass >110 cm) along with abundance of black scabbardfish smaller than 80 cm (Abundance <80 cm) from the 2015 Icelandic Autumn survey.

Faroese commercial CPUE from 2000 and onwards calculated using fishery data from large Faroese trawlers, and restricted to fishing hauls where black scabbardfish represents more than 30% of the total catch and for fishing haul with a duration larger than 2 hours is presented in Figure 9.2.14. The mean CPUE for the whole period was 250 kg/h and from 2013 to 2015 the CPUE was twice the overall mean value, about 508 kg/hour (Figure 9.2.14).

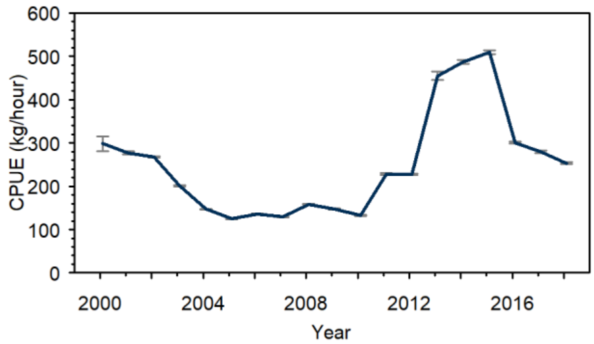

Figure 9.2.14. bsfnea Northern component. Standardized CPUE (kg/hour) from Faroese commercial trawlers (> 1000 HK). Criteria: black scabbardfish >30% of total catch and effort > 2 hours per haul. (Source: Ofstad, 2019)

9.2.5 Data analyses

For the major fishing countries exploiting the northern and southern stock components in the ICES area, the landing data are considered reliable and discards are considered minor.

As this is not an advice year no new evaluation of the stock status using the benchmark model is presented. Only the CPUE series are presented.

9.2.6 Management considerations

Available information does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, however most available evidences support it. In face of these evidences catches from ICES Division 5.a were included in the Northern component in the assessment of the stock.

WGDEEP does not assess fisheries in Madeira (Eastern Central Atlantic area, CECAF) or in other areas outside the ICES area. Nonetheless, it is admitted that the incorporation of CECAF data could provide a global perception of the whole dynamics of the stock.

In 2015, STECF provided an exploratory assessment of the status of the species around Madeira (STECF-14–15). It was mentioned that, for the period 2000–2013, there was a general decline in fishing capacity and fishing effort. The number of vessels has also declined by 41% (34 to 20 vessels). Furthermore, in the second half of the last decade, some Madeiran vessels targeting the black scabbardfish have moved to new fishing grounds, some of them located outside the EEZ of Madeira (SE of the Azores and off the Canaries), although most of the fishery still remains concentrated off the islands of Madeira and Porto Santo (Figure 9.2.15).

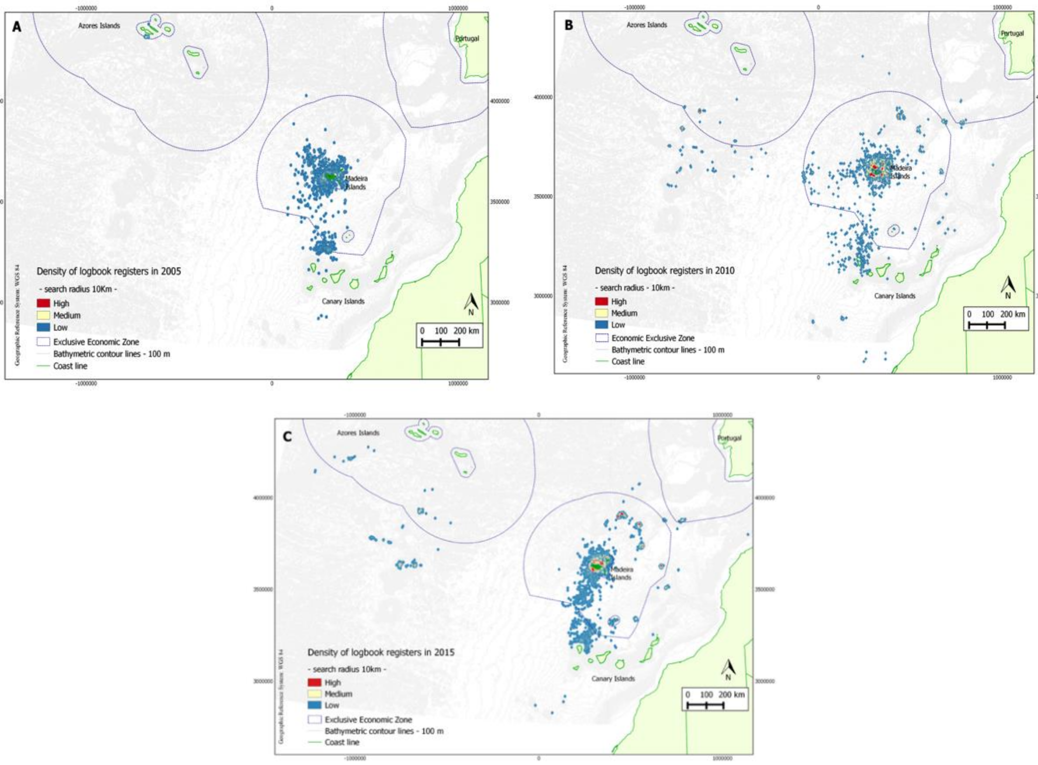

Figure 9.2.15 bsf.27.nea. CECAF area. Density plots illustrating the geographical distribution of the fishing sets with catches in 2005 (A), 2010 (B) and 2015 (C) (Delgado *et al.*, 2018).

WGDEEP 2018 analysed the Madeiran longliners landings from 1990 to 2017 recorded at the Regional Fisheries Department of Madeira (Figure 9.2.16). Annual landings have been decreasing since the 1998 peak, with a slight but constant recovery in the last six years, wherein around 2163 tons were landed in 2017. EU has set TACs for 2017 and 2018 for EU and international waters of CECAF 34.1.2 (BSF/C3412-) of 2488 and 2189 ton, respectively.

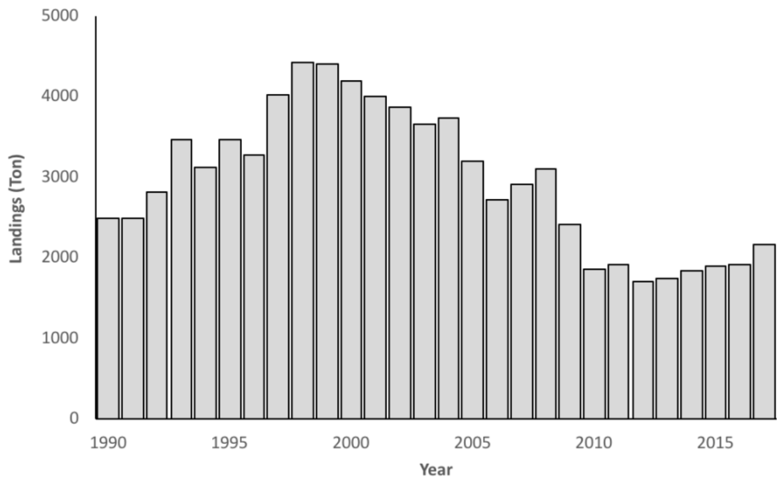

Figure 9.2.16. bsf.27.nea Time-series of annual Portuguese landings at CECAF area.

Following the methodology adopted at WGDEEP 2016, standardized annual catch estimates for the period from 1990 to 2017 of the nineteen resources (ordered in terms of total weight catch) and grouped into four groups (1, large pelagic; 2, elasmobranchs; 3, small pelagic; and 4, demersal) were determined based on data extracted from DSI/DRP database (Figure 9.2.17). The WGDEEP 2018 results do not support that given the diversity of species which includes different taxonomic groups, lifestyles and both short- and long-lived organisms, the declining trends are reflecting changes on resources abundance which may imply that Madeiran waters are subject to severe over-exploitation (ICES, 2018). Further studies and a careful interpretation of trend variations of some resources are still required. It may happen that in some cases landing trends are not only related to the resources' abundance in Madeiran waters, but subject to other factors like variations on the market regulation (e.g. small pelagic fishery), environmental, application of TAC's and quotas, etc.

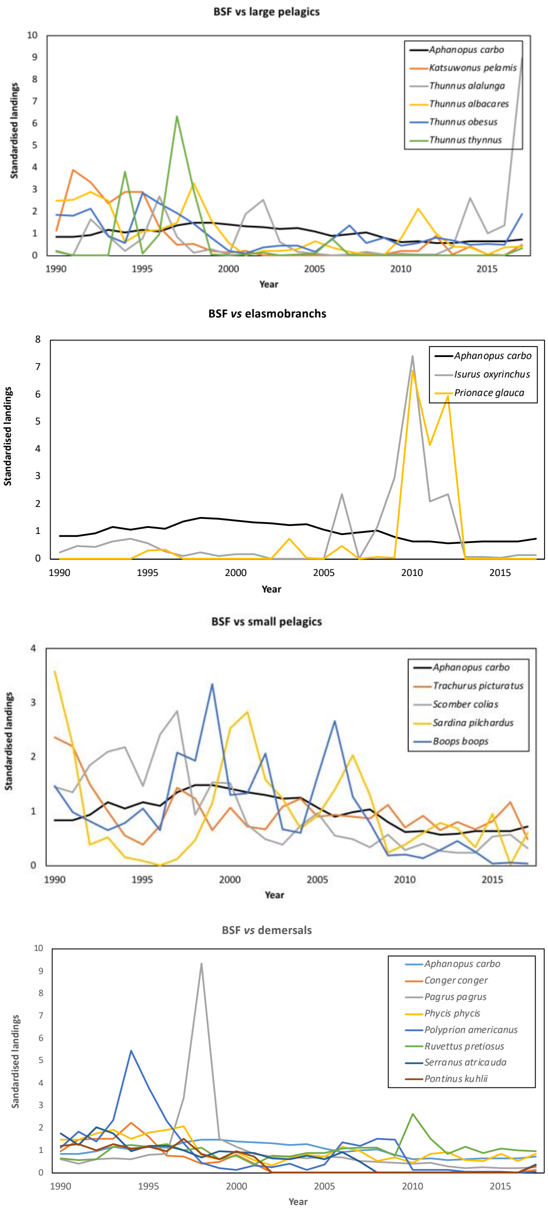

Figure 9.2.17 bsf.27.nea. CECAF area. Trends in standardised landings of black scabbardfish and the 19-other top ranked species in Madeiran landings.

The annual total length–frequency distributions of the exploited population caught by the Madeiran longline fleet in CECAF area for the period 2009–2017 indicates no changes on the length range between years nor on the mean length (Figure 9.2.18).

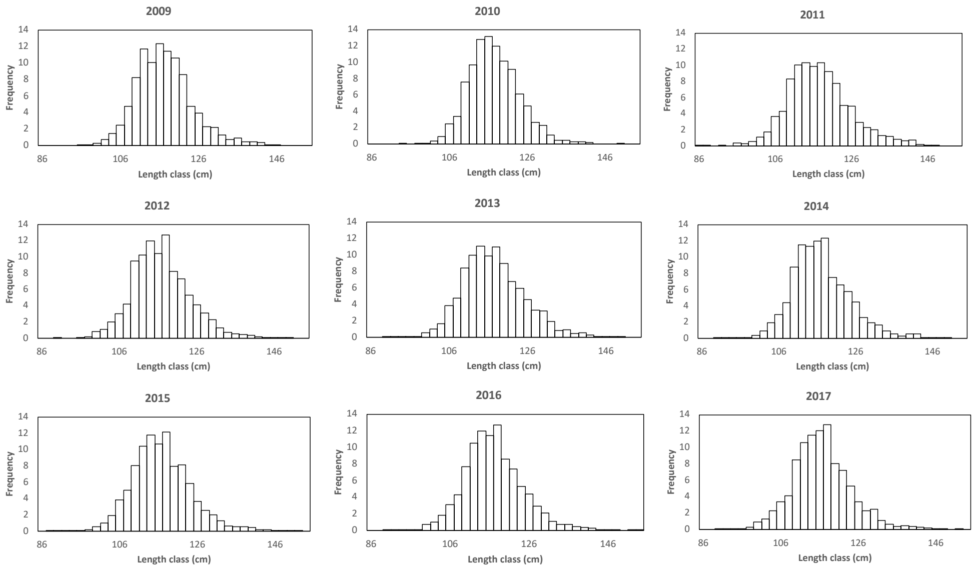

Figure 9.2.18. bsf.27.nea CECAF. Annual length–frequency distribution of specimens landed by the Portuguese longliners operating along CECAF area.

9.2.7 Tables

Table 9.2.2a. Landings of black scabbardfish from Division 27.5.b. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	Faroes			France	Germany*		Scotland	E&W&NI	Russia**	Total
	27.5.b.1	27.5.b.2	27.5.b	27.5.b	27.5.b.1	27.5.b				
1988					.	.	-			
1989	-	-		170	.	.	-			170
1990	2	10		415	.	.	-			427
1991	-	1		134	-	-	-			135
1992	1	3		101	-	-	-			105
1993	202	-		75	9	-	-			286
1994	114	-		45		1	-			160
1995	164	85		175			-			424
1996	56	1		129			-			186
1997	15	3		50			-			68
1998	36	-		144			-			180
1999	13	-		135			6			154
2000			116	186			9			311
2001	122	281		457			20			880
2002	222	1138		304			80			1744
2003	222	1230		172			11			1635
2004	80	625		94			70			869
2005	65	363		106			20			553
2006	54	637		93						784
2007	78	596		116						790
2008	94	787	828	159						1868
2009	117	852		96			1			1067
2010	102	715		142			31			990
2011	67	371		115						553
2012	84	43		115						242
2013	38	379	159	160						735

Year	Faroes			France	Germany*		Scotland	E&W&NI	Russia**	Total
2014	400	181	143	0	0	0	0	0	1	725
2015	549	181	0	211			1			941
2016			712	52						765
2017	285	14		112			0			412
2018	324	229		41			-			594

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.2b. Landings of black scabbardfish from Division 12. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	Faroes	France	Scotland	Spain	Germany*	E&W&NI	Ireland	Total
1988					.			0
1989		0			.			0
1990		0			.			0
1991		2			-			2
1992		7			-			7
1993	1051	24			93			1168
1994	779	9			45			833
1995	301	8						309
1996	187	7		41				235
1997	102	1		98				201
1998	20	324		134				478
1999		1	0	109				109
2000	1	5		237				243
2001		3		115				118
2002		0	1	1117		0		1119
2003		7		444			1	452
2004	95	10	1	230				337
2005	127	14		239			0	380
2006	8	0		1009				1017
2007	0		0	9			0	9
2008	1		0	53			0	54
2009	156			103		0	0	259
2010	27	1		180		0	0	208
2011	24	1		113				138
2012				47				47
2013	1			50				51
2014				149				149
2015				51				51
2016				82				82

Year	Faroes	France	Scotland	Spain	Germany*	E&W&NI	Ireland	Total
2017	0			68				68
2018				125				125
*STATLAND data from 1988 to 2011.								

Table 9.2.2b. Continued.

	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
1988		-	.	.	.		0
1989		-	.	.	.		0
1990		-	.	.	.		0
1991		-	.	.	-		0
1992		-	.	-	-		0
1993		-	.	-	-		0
1994		-	.	-	-		0
1995		-	.	-			0
1996	0	-	.				0
1997							0
1998							0
1999							0
2000							0
2001							0
2002							0
2003		1		1			2
2004				1			1
2005					1		1
2006					2		2
2007					7		7
2008			4				4
2009							0
2010							0
2011							0

	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
2012						907	907
2013						289	289
2014							0
2015							0
2016							0
2017							0
2018							0

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.2c. Landings of black scabbardfish from subarea 6. Working group estimates.

Year	France				Faroes		Ireland		Scotland	Spain	Total
	27.6	27.6.a	27.6.b	27.6.a	27	27.6.b	27.6.a	27.6.a	27.6.b	27.6.a	
1988						.					0
1989		138	0	46		.		-	-		184
1990		971	53			.		-	-		1023
1991		2244	62			-		-	-		2307
1992		2998	113	3		-		-	-		3113
1993		2857	87		62	-		-	-		3006
1994		2331	55			15		2	-		2403
1995		2598	15			3		14	4		2634
1996		2980	1			2		36	<0.5		3019
1997		2278	16		3			147	88		2533
1998		1553	7					142	6		1708
1999		1610	8					133	58		1809
2000		2971	27					333	41		3371
2001		3791	29		3			486	145		4454
2002		3833	156	2				603	300		4894
2003		2934	67	45				78	9		3132
2004		2637	99	59				100	24		2919
2005	3	2533	59	38				18	62		2714

Year	France			Faroes			Ireland		Scotland	Spain	Total
2006	-	1713	36	59			1	63	0		1872
2007	-	1991	4	44	37		0	53	0		2129
2008	-	2348	0	37	0		0	26	0		2412
2009	15	1609	1	39	0		0	80	0		1744
2010	-	1778	1	72			0	73	0		1923
2011	5	1791	3	31				1	0		1830
2012	-	1509	0	3				34	0		1546
2013		1799	9	6				57			1871
2014	0	1902	0	4	2	0		110			2018
2015		1870		1				124		10	2004
2016		2336						96		9	2441
2017		1714		64				101		3	1882
2018		1601		-	-			65	0	0	1667

Table 9.2.1c. Continued.

Year	Germany*	Netherlands **			Lithuania**	Estonia**	Poland**	Russia**	Unallocated	Total
	27.6.a	27.6.a	27.6.b	27.6	27.6.a	27.6.b	27.6.b	27.6.b		
1988	.	-	-		.	.		.		0
1989	.	-	-		.	.	-	.		0
1990	.	-	-		.	.	-	.		0
1991	-	-	-		.	-	-	-		0
1992	-	-	-		-	-	-	-		0
1993	48	-	-		-	-	-	-		48
1994	30	-	-		-	-	-	-		30
1995	-	-	-		-	-	-	-		0
1996	-	-	-		-	-	-	-		0
1997		-	-		-	-	-	-		0
1998		-	-		-	-	-	-		0
1999		11	-		-	-	-	-		11
2000		7	-		-	-	-	-		7
2001		-	-		3	225	-	226		454
2002		21	2		9		2			34
2003			2		12	7	2	7		30
2004					85	5		5		95
2005					5	11		11		27
2006					1	3		3		7
2007										0
2008		14						1		15
2009										0
2010										0
2011										0
2012									690	690
2013									189	189
2014	0	3	0		0	0	0	0	0	3
2015				5						5

Year	Germany*	Netherlands **	Lithuania**	Estonia**	Poland**	Russia**	Unallocated	Total
2016		1						1
2017		0						0
2018								0

***STATLAND data from 1988 to 2011.**

****STATLAND data.**

Table 9.2.2d. Landings of black scabbardfish from Division 7. Working group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	France								Ireland			Scotland	E&W&NI	Spain	Total
	7	7.a	7.b	7.c	7.d-g	7.h	7.j	7.k	7.b,j	7.c	7.k	7.b,c,j,e,k	7.j,k	7	
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	-	-	13	36	2	9	63	6	-	-	-	-	-	31	160
2013		0	21	86	1	12	67	1	-	-	-	-	-	9	196
2014		0	14	79	0	9	50	0	-	-	-	.	.		153
2015			26	39	1	3	48		-	-	-			1	118

Year	France						Ireland			Scotland	E&W&NI	Spain	Total
2016	6	0	52	3	30	0	-	-	-			1	92
2017	1	0	4	1	9	0	-	-	-	0		0	15
2018	0	0	0	6	29	0		0				0	35

Table 9.2.2e. Landings of black scabbardfish from Division 6 and 7. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

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

Year	Ireland	E&W&NI	Total
2012	-	-	0
2013	-	-	0
2014	-	-	0
2015	-	-	0
2016	-	-	0
2017	-	-	0
2018		0	0

9.3 Black scabbardfish in Subareas 27.8, 27.9

9.3.1 The fishery

The main fishery taking place in these subareas is derived from Portuguese longliners. This fishery was described in 2007 WGDEEP report (Bordalo-Machado and Figueiredo, 2007 WD) and updated later by Bordalo-Machado and Figueiredo (2009).

The French bottom trawlers operating mainly in Subareas 6 and 7 have a small marginal fishing activity in Subarea 27.8. In 2014 and 2015, Spain has also reported catches of black scabbardfish in Subareas 27.8 and 27.9 but they are relatively low.

9.3.2 Landings trends

Landings in Subareas 27.8 and 27.9 are almost all from the Portuguese longline fishery that takes place in Subarea 9.a, representing more than 99% of the total landings (Figure 9.3.1).

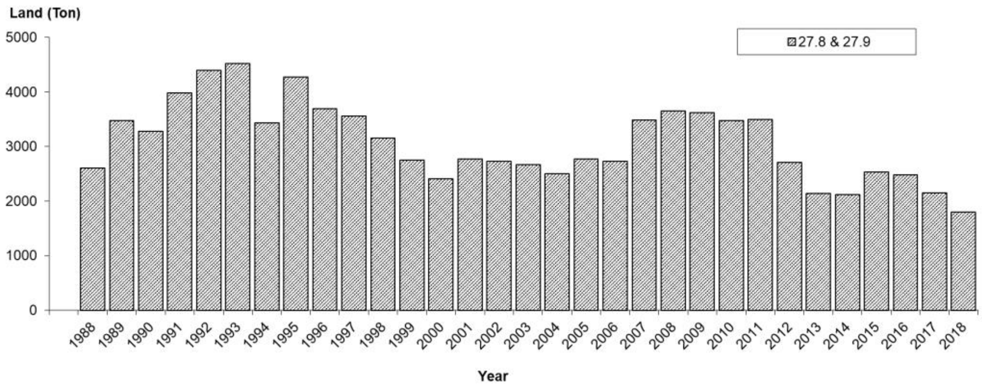

Figure 9.3.1. bsfnea. Southern Component. Annual landings for ICES Subareas 8 and Division 9.a.

9.3.3 ICES Advice

The latest ICES advice for 2019 and 2020 was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 5914 tonnes in each of the years 2019 and 2020.*
Distributed by area this corresponds to annual catches of no more than 2812 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2735 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 367 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a..".

9.3.4 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 until 2015, as well as, the total landings in Subareas 27.8, 27.9 and 27.10 are presented in Table 9.3.1.

Table 9.3.1. Black scabbardfish TACs and total landings of EU vessels in Subareas 27.8, 27.0, and 27.10 between 2006 and 2018.

Year	EU TAC 27.8,27.0,27.10	EU Landings in 27.8 and 27.9	EU Landings in 27.10**
2006	3042	2726	65
2007	4000	3481	0
2008	4000	3647	75
2009	3600	3620	162
2010	3348	3470	102
2011	3348	3494	164
2012	3348	2711	462
2013	3700	2140	206
2014	3700	2118	30
2015	3700	2532	240
2016	3700	2476	86
2017	3330	2151	70
2018	2997	1737	14

**** The proportion of *A. intermedius* in the catches is considered high but is not quantified.**

9.3.5 Data available

9.3.5.1 Landings and discards

New information on the discards of deep-water species produced by the Portuguese on-board sampling programme (EU DCR/NP) was presented.

Discards of most species carried out by Portuguese vessels operating deep-water set longlines (targeting black scabbardfish) within the Portuguese ICES Division 27.9.a were not 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. The black scabbardfish discard mortality is mainly caused by shark and cetacean predation on hooked black scabbardfish and is relatively low when compared to landings. Consequently, discards are not likely to play a significant role in the assessment of this species.

9.3.5.2 Length compositions

Length–frequency distribution of the black scabbardfish landed at Sesimbra landing port (ICES 27.9.a) by the Portuguese longline fleet obtained under the DCF/EU landing sampling program is presented in Figure 9.3.2.

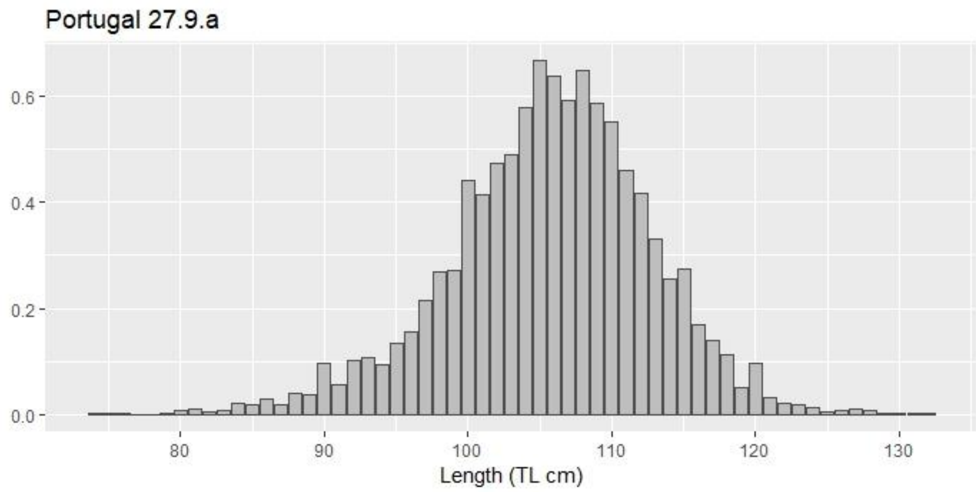

Figure 9.3.2. bsfnea. 2018 length–frequency distribution of black scabbardfish exploited by the deep-water longline fishery for ICES Subareas Division 27.9.a.

9.3.5.3 Age compositions

The black scabbardfish population is not structured by ages because the approach followed to assess the stock is a stage-based model. The age growth parameters are used to construct the prior distribution for the probability a specimen transits from C2 to C3 length group during one semester taking into account the length structure of the population inhabiting the Southern area (for further details see the Stock Annex).

9.3.5.4 Weight-at-age

No new information on age was presented.

9.3.5.5 Maturity and natural mortality

In ICES Subarea 27.9.a only immature and early developing specimens have been observed (Figueiredo, 2009, WGDEEP WD). Mature individuals only occurred in Madeira (Figueiredo *et al*., 2003), 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).

9.3.5.6 Catch, effort and research vessel data

The annual standardized Portuguese CPUE series covering the period 1998- 2018 is presented in Figure (9.3.2).

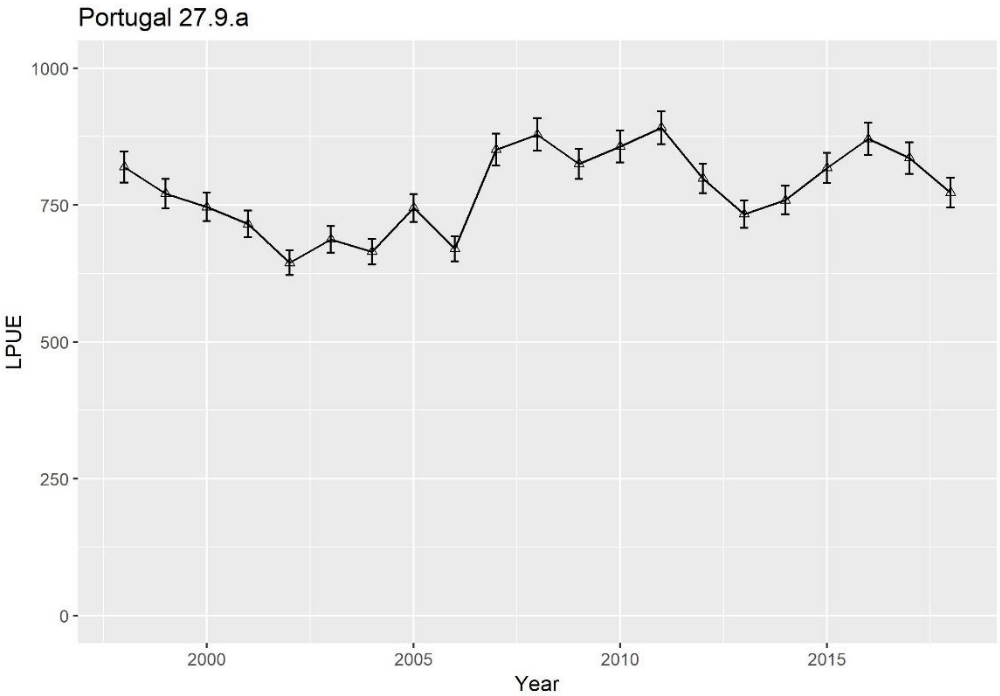

Figure 9.3.2. bsfnea Southern Component. Standardized Portuguese CPUE.

9.3.6 Data analyses

For the major fishing countries exploiting the northern and southern stock components in the ICES area, the landing data are considered reliable and discards are considered minor.

As this is not an advice year no new evaluation of the stock status using the benchmark model is presented. Only the CPUE series are presented.

9.3.7 Management considerations

Management considerations are described in section 9.1.6.

Table 9.3.2a. Black scabbardfish from Subarea 27.9. Working Group estimates of landings.

Year	Portugal	France	Spain	Total
1988	2602			2602
1989	3473			3473
1990	3274			3274
1991	3978			3978
1992	4389			4389
1993	4513			4513
1994	3429			3429
1995	4272			4272
1996	3686			3686
1997	3553		0	3553
1998	3147		0	3147
1999	2741		0	2741
2000	2371		0	2371
2001	2744		0	2744
2002	2692			2692
2003	2630	0		2630
2004	2463			2463
2005	2746			2746
2006	2674			2674
2007	3453			3453
2008	3602			3602
2009	3601			3601
2010	3453		0	3453
2011	3476			3476
2012	2668		12	2680
2013	2130			2130
2014	2109			2109
2015	2527		0	2527
2016	2456		0	2456

Year	Portugal	France	Spain	Total
2017	2117		0	2117
2018	1727		0	1727

Table 9.3.2b. Black scabbardfish from Subarea 27.8. Working group estimates of landings.

Year	France						Spain					Total
	8	8.a	8.b	8.c	8.d	8.e	8.a	8.b	8.c	8.d.2		
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

Year	France				Spain					Total
2012	10	0		3					18	32
2013	5	0	0	2					3	10
2014	7	0	0	3						9
2015	5	0							0	5
2016	2	0		1					16	19
2017	2	0		0					32	35
2018	4	2	0	4	34	12	1	18		74

9.4 Black scabbardfish other areas (1, 2, 3.a, 4, 10, 5.a, 14)

9.4.1 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 Subareas 1–4. Those levels may just indicate that the species has a low occurrence in those areas. On the contrary, landings from other areas, particularly in 10, indicate that the level of abundance of the species appears to be significant.

In recent years, fishing activity on black scabbardfish in ICES Division 5.a has been regular, with landings rounding about 300 ton *per* year. To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, WGDEEP2016 agreed to include ICES Division 5.a in the Northern component.

No further information is available on the Faroese exploratory trawl fishery that was taking place in the Mid-Atlantic Ridge area, starting from 2008.

9.4.2 Landings trends

In ICES Subarea 10 landings have been variable but in recent years landings have increased, reaching 464 tonnes in 2012. Since 2010, Icelandic landings in ICES Subarea 27.5.a have significantly increased, being stable around 300 t in recent years. The 111 tonnes reported in 2010 in ICES Subarea 27.14 are misreported.

9.4.3 ICES Advice

The latest ICES advice for 2017 and 2018 was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 5914 tonnes in each of the years 2019 and 2020.*

Distributed by area this corresponds to annual catches of no more than 2812 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2735 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 367 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.."

9.4.4 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 2018 by subarea are presented next (Table 9.4.1).

In 2010, 2013, and 2014, the TACs have been exceeded, particularly in 2010. More information is needed to track the situation.

Table 9.4.1. Black scabbardfish TACs in Subareas 27.1, 27.2, 27.3 and 27.4 and total landings of EU vessels in Subareas 27.2, 27.3, 27.4, 27.5a, and 27.14 between 2006 and 2018.

Year	EU TAC 27.1, 27.2, 27.3 and 27.4	EU Landings 27.2, 27.3, 27.4, 27.5.a, and 27.14
2007	15	1
2008	15	0
2009	12	5
2010	12	127
2011	12	1
2012	9	39
2013	9	51
2014	9	10
2015	9	2
2016	9	10
2017	9	0
2018	9	1

*** TACs and landings for subarea X are included in Table 9.3.4.**

9.4.5 Data available

9.4.5.1 Landings and discards

Landings are given in Tables 9.4.2a–e and in Figure 9.4.1. In Subareas 2, 4 and 14 reported landings are considered to be misreported although it is not known to what extent.

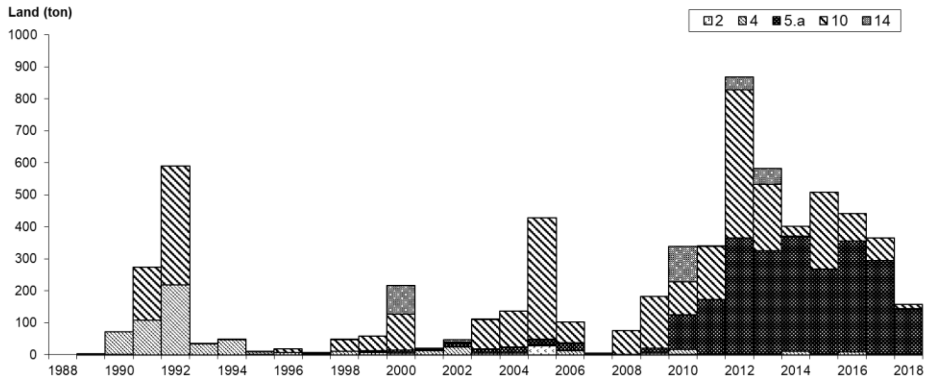

Figure 9.4.1. Annual landings for black scabbardfish by ICES Subareas 2, 4, 5.a, 10 and 14.

Greenland catches of black scabbardfish have been null in years between 1998 and 2018, except 2010 and 2011. For these two later years 100 and 300 kg were reported from trawl bycatch (Fig. 9.4.2.). All catches are in September.

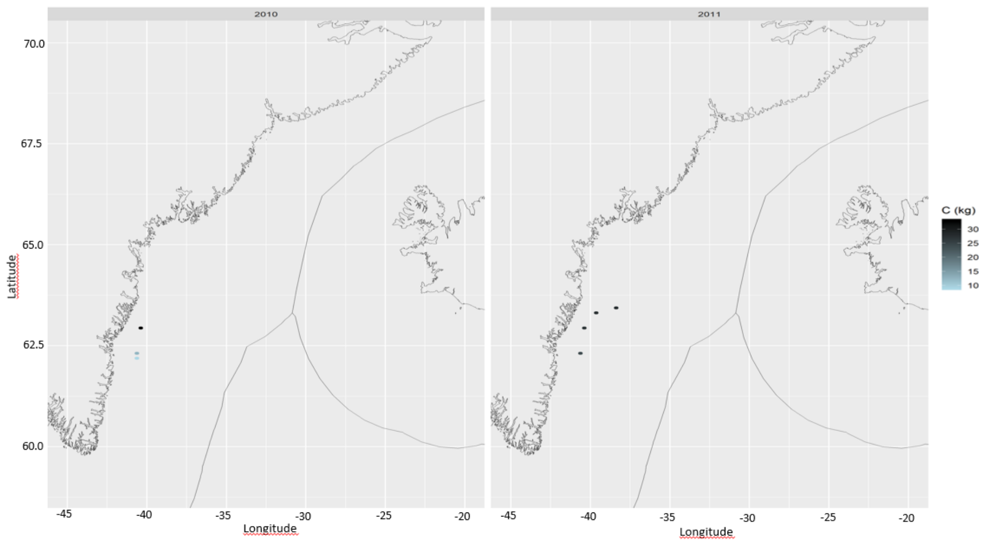

Figure 9.4.2. bsfnea Black scabbardfish in 14. Distribution of commercial catches of black scabbard fish (in Kg) in East Greenland from 2010 and 2011. (Source: Nielsen *et al.*, 2019b WD)

9.4.5.2 Research vessel data

From 1998 to 2016, the Greenland Institute of Natural Resources conducted stratified bottom trawl surveys in East Greenland (ICES Subarea 27.14.b). The survey is held onboard R/V Pâmiut. The depth of surveyed area ranged from 400 to 1500 m (Nielsen *et al.*, 2019a WD).

Until 2008, the survey took place in June but for almost all years it was affected by the ice covering the east coast of Greenland during early summer. From 2008 onwards surveys have been held in August/September and the ice problems were eliminated. The 2008 survey was combined with a new shrimp/fish survey that uses a different trawl gear and operates at more shallow waters than the Greenland halibut survey. The combination of the two surveys led to a change in trawling hours so that most of the stations since 2008 were taken during night-time. Details on the survey namely information on survey design, vessel and trawling gear and handling of the catch see NWWG working document for Greenland halibut (Christensen & Hedeholm 2016).

Black scabbardfish was rarely caught in the survey; the species did not occur in 1998, 1999, 2000, 2002, 2003, 2006 and 2016 surveys. In 2013 and 2015, the species was caught in one station out of an average number of 78 stations, whereas it was found in 4-6 stations in 2011, 2012 and 2014. For these years, catches ranged from 0.7 kg to 21.7 kg. In 2015, the species was only registered in Q5 at depths between 801-1200 m, where most of the biomass has also been observed in previous years (Figure 9.4.3.)

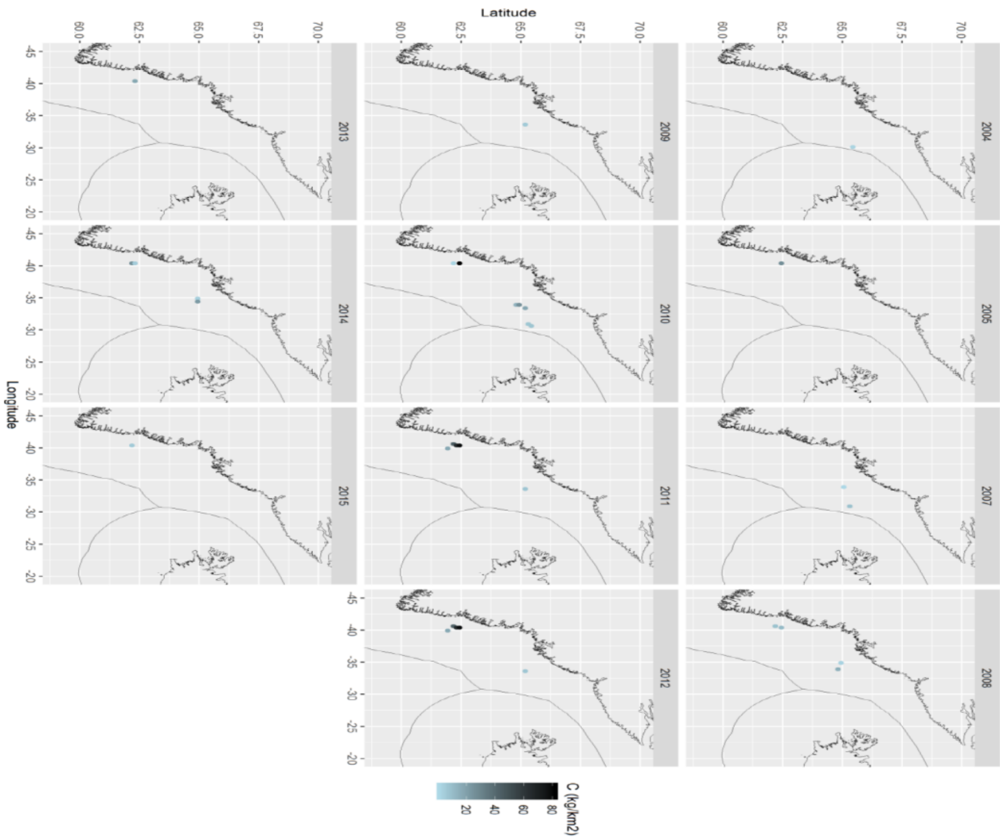

Figure 9.4.3. bsfnea Black scabbardfish in Subarea 27.14. Distribution of survey catches of black scabbard fish at East Greenland (ICES Division 27.14.b) in 1998-2016. No survey in 2001, 2017, and 2018. (Source: Nielsen *et al.*, 2019a WD)

In 2008 and 2010-2012, the estimated biomass varied between 32.8 t and 56.4 t, whereas in all the other years the biomass was less than 7.9 t. This is most likely because black scabbardfish is pelagic and deep living, hence it is not fully fished by the fishing gear (bottom trawl). Hence the biomass estimates are considered not to reflect the actual biomasses in the surveyed area. The length frequency distributions based on 2011 and 2012 surveys show a wide mode between 70 cm and 110 cm (Fig. 9.4.4).

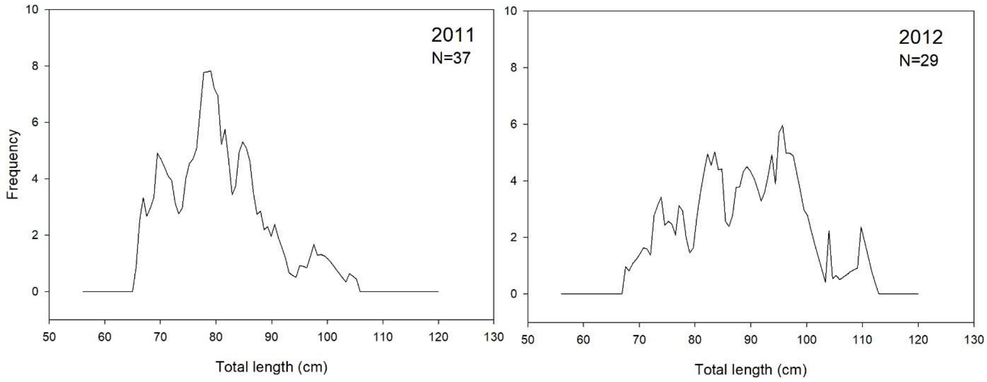

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Figure 9.4.4 bsfnea Black scabbardfish in Subarea 27.14. Length distribution of black scabbardfish at East Greenland (ICES Division 27.14.b) for 2011 and 2012. Survey years with n<20 are not shown. No survey in 2001, 2017 and 2018. (Source: Nielsen *et al.*, 2019a WD)

Length frequency distributions based on the Icelandic Autumn surveys for the period 2000–2018 are presented in Figure 9.4.5.

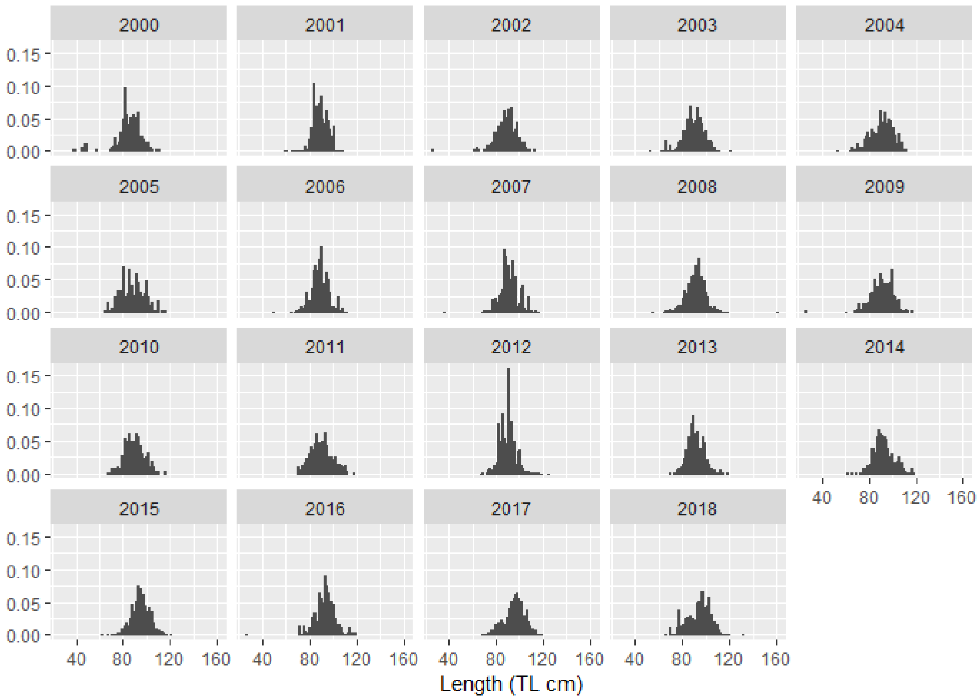


Figure 9.4.5. bsfnea Black scabbardfish in Division 27.5.a: length distribution from the Icelandic Autumn survey, from 2000–2018.

9.4.5.3 Age compositions

No data were available.

9.4.5.4 Weight-at-age

No data were available.

9.4.5.5 Maturity and natural mortality

No new data were available.

9.4.5.6 Catch, effort and research vessel data

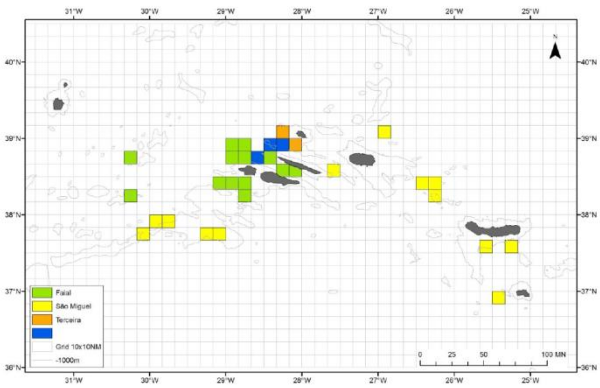
See section 9.2.4.6 where the Icelandic (ICES Division 27.5.a) series of biomass indices for all sizes (Total biomass) and for specimens larger than 90 cm and 110 cm are shown along with abundance of black scabbardfish smaller than 80 cm from the Icelandic Autumn survey provided by Iceland.

9.4.6 Data analyses

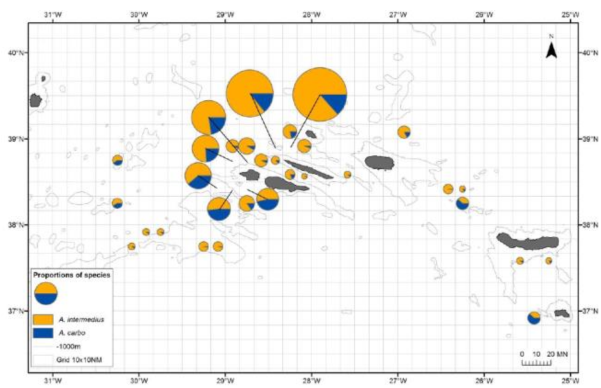
In Subarea 27.10, the commercial interest for the exploitation of black scabbardfish has varied over time, but apart from the data presented from the Faroese exploratory survey in 2008, the data available are only landings.

Results from the Azores (MARPROF project, unpublished data), based on counting of the vertebrae indicate that two species of *Aphanopus* coexist in ICES Division 27.10.a, *A.carbo* and *A. intermedius* (Besugo *et al.*, 2014 WD).

The spatial distribution of the proportion of co-occurrence of the two species, presented in Figure 9.4.6, shows that the overall proportion of *A. intermedius* in relation to the overall catches of *Aphanopus* species is about 0.75. It is important to note that the proportion can vary according to the sampling location.



(a)



(b)

Figure 9.4.6 – bsfnea. Other areas. Map of the sampling locations (a) and estimates of the proportion of each *A. carbo* and *A. intermedius* at different sampling points (b).

9.4.7 Comments on the assessment

Excluding ICES Division 27.5.a, and despite the variability on the overall landings along the years, data available suggest that ICES Subarea 27.10 is an area of major concentration of the species. This spatial aspect is consistent with the current perception on the spatial distribution of the species at NE Atlantic. However, the co-occurrence of two different species, *A. carbo* and *A. intermedius*, in ICES Subarea 27.10 (Besugo *et al.,* 2014 WD) needs to be, in the future, taken into consideration to provide advice for this stock.

9.4.8 Management considerations

The information available does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, although most of the evidence available does support it. In face of this evidence ICES Division 27.5.a data was included in the Northern component.

The co-occurrence of two different species, *A. carbo* and *A. intermedius*, in ICES Subarea 27.10 needs to be considered when providing advice for this stock.

9.4.9 Tables

Table 9.4.2a. Black scabbardfish other Areas: Subareas 2 and 3. Working Group estimates of landings.

Year	France	Faroes	Iceland*	France	Total
		27.2.a	27.2.a.2	27.3.a	
1988					0
1989	0				0
1990	1				1
1991	0				0
1992	0				0
1993	0				0
1994	0				0
1995	1				1
1996	0				0
1997	0				0
1998	0				0
1999	-				0
2000	-				0
2001	-				0
2002	-				0
2003	-				0
2004	-				0
2005	0	27			27
2006	-	-			0
2007	-	0			0
2008	-	-			0
2009	-	-			0
2010	0	-			0
2011	-	-			0
2012					0
2013	-	-			0

Year	France	Faroes	Iceland*	France	Total
2014	-	-			0
2015	-	-			0
2016	-	-		0	0
2017	-	-		-	0
2018	-	.	13	-	13

*** Preliminary catch statistics**

Table 9.4.2b. Black scabbardfish other Areas: Subarea 27.4. Working Group estimates of landings. E is England, W is Wales, NI is Northern Ireland.

Year	France				Scotland				Germany *	E&W&NI	Netherlands**	Total
	27.4	27.4.a	27.4.b	27.4.c	27.4	27.4.a	27.4.b	27.4.c	27.4.a	27.4.a	27.4.c	
1988						-			.	-		0
1989	3					-			.	-		3
1990	70					-			.	-		70
1991	107					-			-	-		107
1992	219					-			-	-		219
1993	34					-			-	-		34
1994	45					-			3	-		48
1995	6					2			-	-		8
1996	6					1			-	-		7
1997	0					2			-	-		2
1998	2					9			-	-		11
1999		4				3			-	-		7
2000		2				3			-	-		5
2001		1				10			-	1		12

2002		0				24			-			24
2003		0				4			-			4
2004		4	1			0			-			5
2005		1	1			0			-			2
2006		13				0	0	0	-			13
2007		1	0			-			-			1
2008		0				0			-			0
2009		5	0			-	-	-	-	-		5
2010		13	2			-	-	-	-	-		15
2011		-	1			-	-	-	-	-		1
2012		0				-	-	-	-	-		0
2013		1	0	0		-	-	-				1
2014		10	0	0		0	0	0	0	0		10
2015		2	0	0		0	0	0	0	0		2
2016		9	-	-								9
2017		0	-	0		0	0	0				0
2018	-	1	-	0	0	-	-	-		0	0	1

*STATLAND data

**Preliminary catch statistics

Table 9.4.2c. Black scabbardfish other areas: Subarea 27.5.a. Working group estimates of landings.

Year	Iceland	Faroes	Total
1988	-		0
1989	-		0
1990	-		0
1991	-		0
1992	-		0
1993	0		0
1994	0		0
1995	0		0
1996	0		0
1997	1		1
1998	0		0
1999	6		6
2000	10		10
2001	5		5
2002	13		13
2003	14		14
2004	19		19
2005	19		19
2006	23		23
2007	1		1
2008	0		0
2009	15		15
2010	109		109
2011	172		172
2012	365		365
2013	325	0	325
2014	360	-	360
2015	265	0	265

Year	Iceland	Faroes	Total
2016	346		346
2017	294		294
2018	142		142

Table 9.4.2d. Black scabbardfish other Areas: Subarea 27.10. Working group estimates of landings.

Year	Faroes	Portugal	France	Ireland	Total
1988	-	-			0
1989	-	-	0		0
1990	-	-	0		0
1991	-	166	0		166
1992	370	-	0		370
1993	-	2	0		2
1994	-	-	0		0
1995	-	3	0		3
1996	11	0	0		11
1997	3	0	0		3
1998	31	5	0		36
1999	-	46	-		46
2000	-	112			112
2001		+			0
2002	2	+			2
2003		91	0		91
2004	111	2			113
2005	56	323		0	379
2006	10	55			65
2007	0	0		0	0
2008	75	0		0	75
2009	157	5		0	162
2010	53	49		0	102
2011	25	139			164

Year	Faroes	Portugal	France	Ireland	Total
2012	4	458			462
2013		206			206
2014	30	-			30
2015	234	7			240
2016	50	36			86
2017	7	63			70
2018	-	14			14

Table 9.4.1f. Black scabbardfish other Areas: Subarea 27.14. Working Group estimates of landings.

Year	Faroes	Spain	Greenland	Unallocated	Total
	27.14		**27.14.b**		
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		0
2000		90	0		90
2001		0	0		0
2002		8	0		8
2003		2	0		2
2004			0		0
2005	0		0		0
2006			0		0

Year	Faroes	Spain	Greenland	Unallocated	Total
2007	0		0		0
2008	0		0		0
2009	0		0		0
2010		111	0		111
2011	0		0		0
2012		39	0	49	88
2013		50	0	40	90
2014	0	0	0	0	0
2015	0	0	0	0	0
2016			0		0
2017	0	0	0	0	0
2018	0		0		0

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10 Greater forkbeard (*Phycis blennoides*) in all ecoregions

10.1 The fishery

Greater forkbeard is as a bycatch species in the traditional demersal longline and trawl mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling in Subareas 6, 7, 8 and 9.

Spanish, French, Norwegian and UK trawl and longline are the main fleets involved in this fishery. Since 2009, 67% of landings have come from Subareas 6 and 7. Although it is not a large economic species in the all Northeast Atlantic, however, is locally important for certain fleets (LLS and OTB) fishing in subareas 6 and 7 with base port mainly in the North West of Spain and in France. 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. Many countries are involved in the fishery in subareas 1,2,3,4 that accounted the 15.5% of total landings since 2009, but most of the landings are traditionally reported by the Norwegian fleets. Russian, Swedish, Faroese and the Icelandic fisheries in the Northeast Atlantic (Division 5b) land small and occasional quantities of greater forkbeard as bycatch of the trawler fleet targeting roundnose grenadier, tusk and ling on Hatton and Rockall Banks.

A further 13.6% of landings in this period come from the French and Spanish trawl and longline fleets in Subareas 8 and 9 (mainly from 8). In Subarea 9 since 2001 small amounts of *Phycis* spp (probably *Phycis phycis*) have been landed in ports of the Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil. Portuguese landings of *P. blennoides* are scarce, but important amounts of *Phycis* spp and *Phycis* species are reported every year in Subarea 9. Portuguese landings of *P. blennoides* present a marked seasonal pattern, being particularly higher between March and July. Reasons for this marked seasonality are unknown, but may be related to abundance variations of this species or to seasonality patterns in other fisheries where this species is taken as bycatch (Lagarto *et al.*, 2016).

Minor quantities of *Phycis blennoides* are landed by Portugal in Subarea 10 and by Norwegian and in recent years Faroese vessels in Divisions 5.a and 5.b. The Azores deep-water fishery is a multispecies and multigear fishery dominated by the main target species *Pagellus bogaraveo*. Target species can change seasonally according to abundance and market prices, but *P. blennoides,* representing less than 0.5% of total deep-water landings in the last five years, can be considered as bycatch.

10.2 Landings trends

Tables 10.0a–h and Figure 10.1 show landings of greater forkbeard by country and subarea.

In Subareas 1, 2, 3 and 4 only Norwegian landings are significant reaching 210 t in 2018 in these combined subareas. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery. The quantity of this bycatch depends on market price. After eight years without *P. blennoides* records, in 2002 the Norwegian fleet reported 315 t in Subareas 1 and 2 and 561 t in Subareas 3 and 4, since then the landings of this country have been significant but lower than in 2002. Denmark reported in 2016 and 2017 small landings in subareas 3 and 4 (3 and 5 t), however in 2018 landings increased strongly to 37 t. Historically in 5.b the main landings come from France and Norway. However in 2011 and 2012 the landings reached the highest values because Faroes reported 310 t and 145 t respectively. After these years, combined landings in this subdivision dropped to low levels as before because the Faroese fleet did report only 0.15 t in the period from 2013 to 2017. Landings reported in 2018 by all countries were 12 t. Traditionally, the most important landings in the Northeast Atlantic are recorded in 6 and 7 from Spain, France, Norway, UK and Ireland. Historical landings decreased since the peak of 4967 t in 2000 and they are especially low in 2009 and 2010 due to the low landings reported by Spain in those years. In 2018 the international reported landings were 1264 t, mainly by France (458 t) and Spain (453 t).

The main landings from Subareas 8 and 9 come from Spanish fleets. The average combined landings in the last ten years is 263 t. In 2010 landings were the lowest of the series mainly due to the reduction of landings reported by Spain.

Historically in Subarea 10 landings come only from Portugal. In 2107 for first time this country didn't reported any landing but in 2018 reached 14 t. After a peak to 136 t in 1994 and 91t in 2000 the average in the last ten years is 10 t. In 2014 for first time France reported 0.2 t in this subarea..

Although since 1991 many countries were involved in the fishery in Subarea 12 only in the period 2002–2009 Spain reported significant landings. From 2013 onwards no country reported landings in this subarea.

10.3 ICES Advice

For 2017 and 2018 ICES advised on "the basis on the precautionary approach that landings should be no more than 1682 tonnes".

10.4 Management

Biannual EU TACs for 2017 and 2018 and landings in in the same years by ICES subarea are shown below. Landings in Subareas 1, 2, 3 and 4 include Norwegian landings while only EU TACs are shown. In all subareas landings were lower than the EU TAC in this period.

According to the Council Regulation (EU) 2018/2025, the TACs for roundnose grenadier in ICES subareas 1, 2 and 4 (North Sea) and greater forkbeard in ICES subareas 1 to 10, 12 and 14 should no longer be set. The ICES advice establishes that the absence of TACs would result in no or a low risk of unsustainable exploitation.

PHYCIS BLENNOIDES	EU TAC		TOTAL INTERNATIONAL LANDINGS	
Subarea	2017	2018	2017	2018
1, 2, 3, 4	33	29	235	252
5, 6, 7	2166	1928	1082	1276
8, 9	285	254	186	258
10, 12	58	52	0	14
Total	2542	2263	1503	1801

10.5 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.

10.6 Data available

10.6.1 Landings and discard

Landings are presented in Table 10.0a–h and in Figure 10.1. Landings by fishing gear in 2018 are shown in the Table 10.1. The discards estimates from 2013–2018 accounted 36%, 34%, 49%, 25%, 25% and 11% of the total catches respectively (Table 10.2a). In 2018 the main reported discards come from Subarea and8 (26%), 7 (22%), and 6 (21%). Length frequencies of commercial fleets available indicate that discards in 2015 affected specially to individuals smaller than 17 cm of which the 100% were discarded. In 2016 and 2017 the range of discarded greater forkbeard increased affected in high proportion also to individuals smaller than 36 cm and 45 cm respectively, but in 2018 the size of the individual discarded took place in the range from 8 to 33 cm (Figure 10.2).

Series of Effort data (kWd) since 2014 of the Spanish, French, Swedish, UK (Scotland) and Irish fleets (OTB, LLS and GTR) have been provided by subarea (Table 10.3). The effort for a given year is calculated as the sum of kWd of those fleets/countries reported information in InterCatch.

10.6.2 Length compositions

Figures 10.3, 10.4, 10.5, and 10.6 present the length–frequency distributions of Spanish Groundfish Survey in the Porcupine bank, Northern Spanish Shelf bottom-trawl and Portuguese Crustacean Surveys/*Nephrops* TV Surveys (PT-CTS (UWTV (FU 28–29) until 2017, and French IBTS until 2016.

10.6.3 Age compositions

No new data available.

10.6.4 Weight-at-age

This year there is presented the accumulated mean weight-at-length of the international commercial landings and discards reported to InterCatch from 2016 to 2018 (Figure 10.7).

10.6.5 Maturity and natural mortality

No New information of L_{mat}, L_{inf} and K was provided for the Spanish Data Call to the WG.

	Value	Reference	Comments
L_{mat}	53.89	CV=3.4%	both sex, n=960, years: 2015+2016+2017
L_{inf}	91.46	CV=6.3%	both sex, n=1045, years: 2015+2016+2017
K	0.142	CV=10%	both sex, n=1045, years: 2015+2016+2017

10.6.6 Catch, effort and research vessel data

In 2018 the following surveys covering the continental slope of Subareas, 3, 4, 6, 7, 8, and 9.a have been included in the analysis of biomass and abundance indices (Figure 10.8):

- Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS) in Divisions 7.c and 7.k. Biomass and abundance of greater forkbeard from 2001 to 2018 are presented in Figure 10.9.
- French EVHOE IBTS (FR-EVHOE) in Divisions 7.f,g,h,j; and 8.a,b,d). data of abundance and biomass raised to the total subarea have been provided for a series from 1997 to 2018. (Figures 10.10).
- Irish Groundfish survey (IGFS) in Divisions 6.a South and 7.b. Abundance and biomass Indices (nº per hour and kg per hour) from the period 2005 to 2018. This survey provides abundance indices for the total catches and for individuals <32 cm by shelf and slope strata (Figure 10.11).
- Northern Spanish Shelf bottom-trawl survey (SP-NGFS) in Divisions 9.a and 8.c. Biomass and abundance (kg/30 min tow and No/30 min tow) of greater forkbeard in the Cantabrian Sea from 1990 to 2018 are presented in Figure 10.12.
- North Sea IBTS survey (NS-IBTS) in Divisions 4.abc, 3.a and 3.c. Abundance in number per hour from 1976 to 2018 is presented in Figure 10.13.
- Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) in Divisions 5.b, 6.ab, 7.ab. No new information is available since 2015. Abundance in number per hour from 1986 to 2014 is presented in Figure 10.14.
- Scottish Deep-water trawler survey in Divisions 6.a. Biomass and abundance of greater forkbeard until 2017 are presented in the Figure 10.15. As it is a biennial survey there is no new data in 2018.
- Portuguese crustacean surveys/*Nephrops* TV Survey (PT-CTS (UWTV (FU 28–29) in Division 9.a South, Biomass in kg per hour from 1997 to 2018 is presented in Figure 10.16.

10.7 Data analyses

In the Spanish Groundfish Survey in the Porcupine bank the biomass of *Phycis blennoides* further decreased this last year, reaching the lowest value of the time series (5.7 ± 0.8 kg haul-1). Despite the low abundance, more recruits from 10 to 20 cm were found than the previous year (Figure 10.3). Biomass and abundance have been decreasing for four years in a row (Figure 10.9). This species is becoming more and more difficult to find in the north of the study area. This last survey, spots of biomass were mainly found in the southern and deepest depth strata (450-800 m) (Figure 10.17). (Ruiz-Pico *et al.* 2019).

The EVHOE IBTS survey in Divisions 7.f,g,h,j and 8.a,b,d indicates an increase in biomass since 1996, with peaks in 2004, 2007 and 2012 and a decrease since 2013. However landings have decreased from 2012 onwards since the most important peak in 2011. Similarly, the abundance shows no clear trend in the series, but has also peaks in 2002, 2007 and 2012. An important decrease was also observed since this year until 2016. In 2018 a slight recovery is recorded compared with values in 2016(Figure 10.10). The mean length has increased since the beginning of the series reaching the highest value in 2005 and 2016. No new data of length are available since 2016 (Figure 10.5).

Iris GFS indicates an increase in the abundance (No/hour) and biomass (Kg/hour) from 2009 to 20132 and 2013 respectively. From these years onwards a decrease in both parameters is shown to 2017 that is the lowest value of the series. In 2018 a slight recovery is recorded compared with values in 2017. (Figure 10.11).

In Northern Spanish Shelf bottom-trawl survey in 2018 the biomass of *Phycis blennoides* in standard hauls (0.26 ± 0.05 Kg·haul^{-1}) had a slight increase but remained among the low values of the time series. The abundance (2.94 ± 0.53 ind·haul^{-1}) decreased following the fluctuations (ups and downs) of recruitment over the last decade (**Error! Reference source not found.**). The length d istribution in standard hauls was similar to the previous year, most of individuals were small (between 12 and 21 cm) and large individuals, which ranged from 25 to 54 cm, were still missing. In contrast, in additional deeper hauls, large individuals who ranged from 25 to 58 cm were abundant and just a few specimens from 12 to 19 cm were found (Figure 10.4). In 2018, *P. blennoides* was caught between 133 m and 693 m and it was widespread in the sampling area (**Error! Reference source not found.** 10.18) (Blanco *et al*., 2019).

The NS-IBTS shows an increase on abundance since 1976. The abundance recorded in 2012 (40.2 individuals/hour) is the most important of the series although the trend shows a decrease since this year to 2016 (Figure 10.13). In 2017 the survey recovered one of the highest abundance values (23.9 individuals/hour) but in 2018 dropped again to 14.4.

No data for 2015 and 2016 have been updated in the DATRAS system for the SWC-IBTS. The trend series of abundance until 2014 is shown in the Figure 10.14.

The Scottish Deep-water trawler survey covers a core area of the continental slope of the Rockall Trough (6.a) from between 55 to 59°N long with the slope stratified by depth at 500, 1000, 1500 and 1800 m. Historical series of biomass index show a tooth saw profile since 1998, with a minimum of 5.9 kg/hour in 2009 to a maximum 14.8 kg/hour in 2013. In 2017 an important increase of the biomass was recorded reaching the peak of the series with 46.1 kg/hour. The abundance shows also an increase in 2017 with similar levels to those recorded in 2012 and 2013 (Figure 10.15)

In the Portuguese survey in 9.a south the series of biomass show a decrease trend since 1997 to 2004 but with significant peaks in 1999 and 2002. In recent years the *P. blennoides* standardized biomass index estimates are above the overall mean, showing an increasing trend, particularly from 2013 to 2018 (a slight decrease was observed in 2017 in relation to 2016 (Moura *et al* 2019). Values biomass are in the range of 0 kg/hour to 2.33 kg/hour (Figure 10.16). In the years 2008–2010, catch rates were relatively high in all geographical areas. Length data from specimens caught during held between 1997 and 2016 support that these years were of strong recruitment, particularly the years 2007 and 2008 (Figure 10.6). The size range observed in the Portuguese continental coast, indicating that the species is able to complete the life cycle in this area.

WGDEEP reiterates its previous view that although the data provided by the surveys have increased the area covered in the ecoregion, neither the available surveys nor discard data cover yet the entire distributional stock, especially in Subareas 1 and 2.

10.7.1 Exploratory assessment

No analytical assessment was presented in WGDEEP 2019.

10.7.2 Comments on the assessment

No analytical assessment was presented in WGDEEP 2019.

10.8 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.

In the subareas 3 and 4 the NS IBTS survey shows an increase trend since 1976, more noticeable from 2010 onwards. In the areas Subareas 6, and 7 covered by the Porcupine and Irish IGFS surveys and the indices indicate a decrease in the abundance since 2013, and in biomass since 2014. However, in the northern area of the Subarea 6 covered by the Scottish deep-water survey it is observed an important increase of the biomass in 2017 perhaps due to the high abundance recorded in 2011 to 2013. The trend in Subarea 8 shows an increase in biomass and abundance until 2012 and a decrease in biomass from 2014 to 2018.. In Division 9.a south annual standardized biomass and abundance indexes suggest an increase of biomass and abundance since 2013.

On the other hand, landings in all ecoregions has been reduced since 2013 below the biennial TAC established for this period. In this sense , although the TAC was increased in 2015 and 2016 to 2856 t landings reported have been below of this figure especially in 2017 in which landings consumed only 59% of TAC As greater forkbeard is a bycatch of the traditional demersal trawl and longline mixed fisheries, discards of this species are considered high. Although greater forkbeard is mainly a bycatch species, however, it is locally important for certain fleets fishing in subareas 6 and 7 with base port mainly in the North West of Spain (and France??). Due to the species is a bycatch and not all the countries involved in the fishery report data to InterCatch, the discard cannot be quantified for the whole stock and are very variable from year to year. In the same sense, the commercial length frequencies are only partially available from some countries and areas and the historical series is short. According to the information available, reported discards are high and decreased in last years represented 51%, 55%, 95%, 34%, 34% and 12%of the annual landings from the period 2013–2018. That means the total TAC has been not reached since 2013 and even since 2016 if we consider the discards reported. The only exception is in subareas 1,2,3,4 in which the amounts landed have been historically above the TAC due to the landings of Norway are not affected by the EU TAC regulation.

According to the Council Regulation (EU) 2018/2025, the TACs for greater forkbeard in ICES subareas 1 to 10, 12 and 14 should no longer be set (from 2019 onwards). It can be supposed that if the TAC for this stock is removed these fleets could increase the both landings and discards of greater forkbeard.

10.9 Application of MSY proxy reference points

A Stochastic Production Model in Continuous Time (SPiCT) was applied in 2017 to The GFB stock using the historical series of landings since 1998 and the standardized biomass indicator (average) from six surveys: IGFS-WIBTS-Q4, EVHOE-WIBTS-Q4F, SpGFS-WIBTS-Q4, SpGFS-WIBTS-Q4, SDS, PT-CTS (UWTV (FU 28–29) from the period 2005–2016.

Residuals could not be calculated because estimation did not converge, so a new input was performed shortening the series of landings to the same period of the Index series (from 2005 to 2016), but again the estimation did not converge.

The inputs and results of the first attempt are shown in the Figures 10.19 and 10.20.

10.10 Tables and Figures

Table 10.0a. Greater forkbeard *(Phycis blennoides*) in the Northeast Atlantic. Working group estimates of landings.

YEAR	1+2	3+4	5B	6+7	8+9	10	12	TOTAL
1988	0	15	2	1898	533	29	0	2477
1989	0	12	1	1815	663	42	0	2533
1990	23	115	38	1921	814	50	0	2961
1991	39	181	53	1574	681	68	0	2596
1992	33	145	49	1640	702	91	1	2661
1993	1	34	27	1462	828	115	1	2468
1994	0	12	4	1571	742	136	3	2468
1995	0	3	9	2138	747	71	4	2972
1996	0	18	7	3590	814	45	2	4476
1997	0	7	7	2335	753	30	2	3134
1998	0	12	8	3040	1081	38	1	4180
1999	0	31	34	3455	673	41	0	4234
2000	0	11	32	4967	724	91	6	5831
2001	8	27	102	4405	727	83	8	5360
2002	318	585	149	3417	715	57	81	5321
2003	155	233	73	3287	661	45	82	4536
2004	75	143	50	2606	720	37	54	3685
2005	51	83	46	2290	519	22	77	3087
2006	49	139	39	2081	560	15	42	2925
2007	47	239	56	1995	586	17	37	2978
2008	117	245	45	1418	446	18	17	2307
2009	82	149	22	796	203	13	44	1309
2010	132	186	61	824	69	14	0	1287
2011	113	179	319	1257	321	11	0	2201

YEAR	1+2	3+4	5B	6+7	8+9	10	12	TOTAL
2012	98	199	169	1802	366	6	0	2641
2013	83	179	11	1588	275	8	0	2143
2014	97	214	24	1566	360	9	0	2269
2015	121	215	34	1471	323	10	0	2174
2016	187	273	13	1265	263	10	0	2012
2017	80	155	9	1073	186	0	0	1503
2018	60	192	12	1264	258	14	0	1801

Table 10.0b. Greater forkbeard *(Phycis blennoides*) in Subareas 1 and 2. Working group estimates of landings.

YEAR	NORWAY	FRANCE	RUSSIA	UK (SCOT)	UK (EWNI)	GERMANY	FAROE ISLANDS	TOTAL
1988	0							0
1989	0							0
1990	23							23
1991	39							39
1992	33							33
1993	1							1
1994	0							0
1995	0							0
1996	0							0
1997	0							0
1998	0							0
1999	0	0						0
2000	0	0						0
2001	0	1	7					8
2002	315	0		1		2		318
2003	153	0				2		155
2004	72	0	3	0				75
2005	51	0						51
2006	46	0	3					49

YEAR	NORWAY	FRANCE	RUSSIA	UK (SCOT)	UK (EWNI)	GERMANY	FAROE ISLANDS	TOTAL
2007	41	0	5	1	0			47
2008	112	0	4	1			0	117
2009	76	0	6	0				82
2010	127	4						132
2011	107	6						113
2012	98	0.4						98
2013	83	0.1		0				83
2014	96	0.4						97
2015	121							121
2016	187	0.3		0				187
2017	79	0.7		1				80
2018	60	0.1						60

Table 10.0c. Greater forkbeard *(Phycis blennoides*) in Subareas 3 and 4. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK (EWNI)	UK (SCOT)(1)	GERMANY	DENMARK	SWEDEN	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

YEAR	FRANCE	NORWAY	UK (EWNI)	UK (SCOT)[1]	GERMANY	DENMARK	SWEDEN	TOTAL
2002	2	561	1	21	0			585
2003	1	225	0	7				233
2004	2	138		3				143
2005	2	81	0	1				83
2006	1	134	3					139
2007	1	236	0	2				239
2008	0	244		1				245
2009	4	142		3				149
2010	3	182		1				186
2011	17	160		1				179
2012	1	198						199
2013	1	178	0	0				179
2014	1	210		3				214
2015	1	213		1				215
2016	1	267		2		3		273
2017	1	140		9		5	0	155
2018	1	150		2		37	2	192

(1) Includes Moridae, in 2005 only data from January to June.

Table 10.0d. Greater forkbeard *(Phycis blennoides)* in Division 5b. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK(SCOT)[1]	UK(EWNI)	FAROE ISLANDS	RUSSIA	ICELAND	TOTAL
1988	2	0						2
1989	1	0						1
1990	10	28						38
1991	9	44						53
1992	16	33						49
1993	5	22						27
1994	4							4
1995	9							9
1996	7							7

YEAR	FRANCE	NORWAY	UK(SCOT)[1]	UK(EWNI)	FAROE ISLANDS	RUSSIA	ICELAND	TOTAL
1997	7	0						7
1998	4	4						8
1999	6	28	0					34
2000	4	26	1	0				32
2001	9	92	1	0				102
2002	10	133	5	0				149
2003	11	55	7	0				73
2004	9	37	2	2				50
2005	7	39		0,3				46
2006	8	26			6			39
2007	11	34	0	0	9	2	0	58
2008	10	20	0		4	11	1	46
2009	0	13	3		3	2	0	24
2010	2	45	3	1	11		2	62
2011	7				310		1	319
2012	6	5			145	7	7	169
2013	7	3	0				0	11
2014	7	14	0		0		2	24
2015	5	27					2	34
2016	7	3	0				3	13
2016	7	3	0				3	13
2017	9		0					9
2018	5	7						12

[1] Includes Moridae in 2005 only data from January to June.

Table 10.0e. Greater forkbeard *(Phycis blennoides*) in Subareas 6 and 7. Working group estimates of landings.

YEAR	FRANCE	IRELAND	NORWAY	SPAIN(1)	UK (EWNI)	UK (SCOT) (2)	GERMANY	RUSSIA	FAROE ISLANDS	TOTAL
1988	252	0	0	1584	62	0				1898
1989	342	14	0	1446	13	0				1815
1990	454	0	88	1372	6	1				1921
1991	476	1	126	953	13	5				1574
1992	646	4	244	745	0	1				1640
1993	582	0	53	824	0	3				1462
1994	451	111		1002	0	7				1571
1995	430	163		722	808	15				2138
1996	519	154		1428	1434	55				3590
1997	512	131	5	46	1460	181				2335
1998	357	530	162	530	1364	97				3040
1999	314	686	183	824	929	518	1			3455
2000	671	743	380	1613	731	820	8	2		4967
2001	683	663	536	1332	538	640	10	4		4405
2002	613	481	300	1049	421	545	9	0		3417
2003	469	319	492	1100	245	661	1	1		3287
2004	441	183	165	1131	288	397		1		2606
2005	598	237	128	979	179	164		5		2290
2006	625	68	162	1075	148			2	0	2081
2007	578	56	188	875	117	179		2		1995
2008	711	43	174	236	31	196		27	0	1418
2009	304	7	222	48	31	184		1		796
2010	383	8	219	23	14	173		3	1	824
2011	378	6	309	326	27	210				1257
2012	381	9	225	992	1	194				1802
2013*	451	16	289	583	3.4	246		0		1588
2014	468	25	159	769	9	135				1566
2015	451	37	135	716	26	105				1471

YEAR	FRANCE	IRE-LAND	NOR-WAY	SPAIN(1)	UK (EWNI)	UK (SCOT) (2)	GER-MANY	RUS-SIA	FAROE IS-LANDS	TO-TAL
2016	412	13	97	641	13	90				1265
2017	431	6	134	399	14	88				1073
2018	458	10	203	453	20	121				1264

(1) Landings of *Phycis* spp Included from 1988 to 2012.

(2)Includes Moridae in 2005 only data from January to June.

* Preliminary.

Table 10.0f. Greater forkbeard *(Phycis blennoides)* in Subareas 8 and 9. Working group estimates of landings.

YEAR	FRANCE	PORTUGAL	SPAIN(1)	UK(EWNI)	UK (SCOT)	TOTAL
1988	7	29	74			110
1989	7	42	138			187
1990	16	50	218			284
1991	18	68	108			194
1992	9	91	162			262
1993	0	115	387			502
1994		136	320			456
1995	54	71	330			455
1996	25	45	429			499
1997	4	30	356			390
1998	3	38	656			697
1999	8	41	361			410
2000	36	91	375			502
2001	36	83	453			573
2002	67	57	418			542
2003	28	45	387			461
2004	44	37	446			527
2005	58	22	312	0		392
2006	54	10	257			321
2007	32	14	510	0		556
2008	41	13	123			178
2009	8	13	183	0		203

YEAR	FRANCE	PORTUGAL	SPAIN[(1)]	UK(EWNI)	UK (SCOT)	TOTAL
2010	10	12	48		0	69
2011	13	13	295			321
2012	46	5	315			366
2013	31	8	234	2		275
2014	38	6	315		0	360
2015	38	8	278			323
2016	30	7	226		0	263
2017	18	9	159		0	186
2018	31	9	218		0	258

(1) **Landings of *Phycis spp* Included from 1988 to 2012.**

Table 10.0g. Greater forkbeard *(Phycis blennoides)* in Subarea 10. Working group estimates of landings.

YEAR	PORTUGAL	FRANCE	TOTAL
1988	29		29
1989	42		42
1990	50		50
1991	68		68
1992	91		91
1993	115		115
1994	136		136
1995	71		71
1996	45		45
1997	30		30
1998	38		38
1999	41		41
2000	91		91
2001	83		83
2002	57		57
2003	45		45
2004	37		37

YEAR	PORTUGAL	FRANCE	TOTAL
2005	22		22
2006	15		15
2007	17		17
2008	18		18
2009	13		13
2010	14		14
2011	11		11
2012	6		6
2013	8		8
2014	9	0	9
2015	10		10
2016	10		10
2017			0
2018	14		14

Table 10.0h. Greater forkbeard *(Phycis blennoides*) in Subarea 12. 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

YEAR	FRANCE	UK(SCOT)[(1)]	NORWAY	UK(EWNI)	SPAIN[(2)]	RUSSIA	TOTAL
2001	0	1	6	1			8
2002	0		2	4	74		81
2003	3		8	0	71		82
2004	3		6		44		54
2005	1	0	0		75		77
2006					42		42
2007					37		37
2008	0				17		17
2009	1		0		37	6	44
2010	0						0
2011	0						0
2012	0						0
2013							0
2014	0						0
2015							0
2016							0
2017							0
2018					0		0

(1) Includes Moridae in 2005 only data from January to June.

(2) Landings of *Phycis spp* Included from 1988 to 2012.

Table 10.1. ***Phycis*** **spp. European landings (t) by métier in 2018.**

Landings (t)	2018
Denmark	37
GNS_DEF	0
MIS_MIS	0
OTB_CRU	1
OTB_DEF	36
SDN_DEF	0
SSC_DEF	0
France	495
GNS_DEF_100-119_0_0_all	23
LLS_DEF	23
MIS_MIS_0_0_0_HC	13
OTB_DEF_>=120_0_0	119
OTB_DEF_>=70_0_0	2
OTB_DEF_100-119_0_0	80
OTB_DEF_70-99_0_0	13
OTB_DWS_>=120_0_0_all	76
OTB_DWS_100-119_0_0_all	5
OTT_CRU_>=70_0_0	4
OTT_CRU_100-119_0_0	1
OTT_DEF_>=70_0_0	12
OTT_DEF_100-119_0_0	124
Ireland	10
OTB_DEF_100-119_0_0_all	7
OTB_DEF_70-99_0_0_all	2
Portugal	24
LLS_DWS	14
MIS_MIS_0_0_0	10
OTB	0
Spain	671

GNS_DEF_>=100_0_0	6
GNS_DEF_120-219_0_0	1
GNS_DEF_60-79_0_0	1
GNS_DEF_80-99_0_0	12
GTR_DEF_60-79_0_0	1
LHM_DEF_0_0_0	0
LLS_DEF_0_0_0	379
MIS_MIS_0_0_0_HC	1
OTB_DEF_>=55_0_0	81
OTB_DEF_>=70_0_0	9
OTB_DEF_100-119_0_0	145
OTB_DEF_70-99_0_0	14
OTB_DWS_100-129_0_0	0
OTB_MCD_>=55_0_0	12
OTB_MPD_>=55_0_0	7
PTB_DEF_>=70_0_0	0
PTB_MPD_>=55_0_0	2
UK (England)	20
GNS_DEF	0
LLS_DEF	0
MIS_MIS_0_0_0_HC	0
OTB_CRU	0
OTB_DEF	19
UK(Scotland)	124
LLS_DEF_0_0_0_all	23
MIS_MIS_0_0_0_HC	1
OTB_DEF_>=120_0_0_all	100

Table 10.2a. Reported discards (ton) of *P. blennoides* from 2013 to 2018.

ton	2013	2014	2015	2016	2017	2018
DISCARDS	1185	1166	2068	677	513	219
LANDINGS	2143	2269	2175	2012	1503	1801
CATCHES	3328	3435	4243	2689	2016	2020

Table 10.3. Effort (kWd) of *P. blennoides*, from 2014 to 2108.

2014	2	3	4	5	6	7	8	9	12
Spain					500 409	534 570	4 676 906	1 330 671	
Sweden		6 908 723	1 666 360						
Ireland			1 019		754 232	9 955 488	619		1 756
2015									
Spain					544 731	6 497 141	15 584 384	12 579 168	
Sweden		6 252 366	2 103 825						
2016									
Spain					567188	4775689	14675183	6589323	
Sweden		881							
UK(Scotland)			11779125	36663		68448	221		
France	548084	213152	3863520	590412	6498055	45211426	46962821		
2017									
Spain	634609	7400	4477482	370400	4837947	52468986	49011507		
France					599343	5277665	10744748	6355509	
2018									
Spain					777454	6031907	12200931	6328978	
France	273756		3464213	91587	2836092	24868686	20649432		

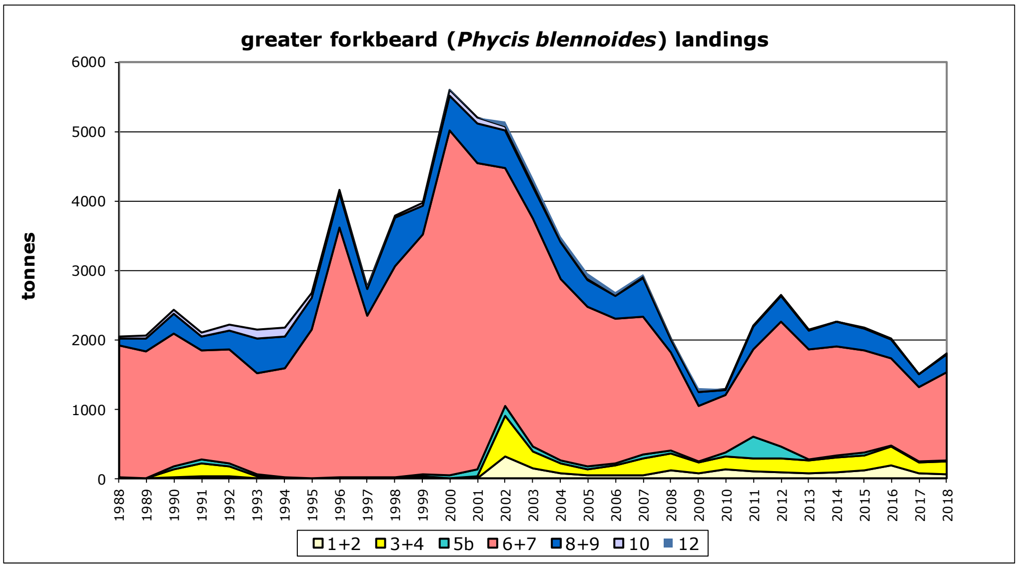
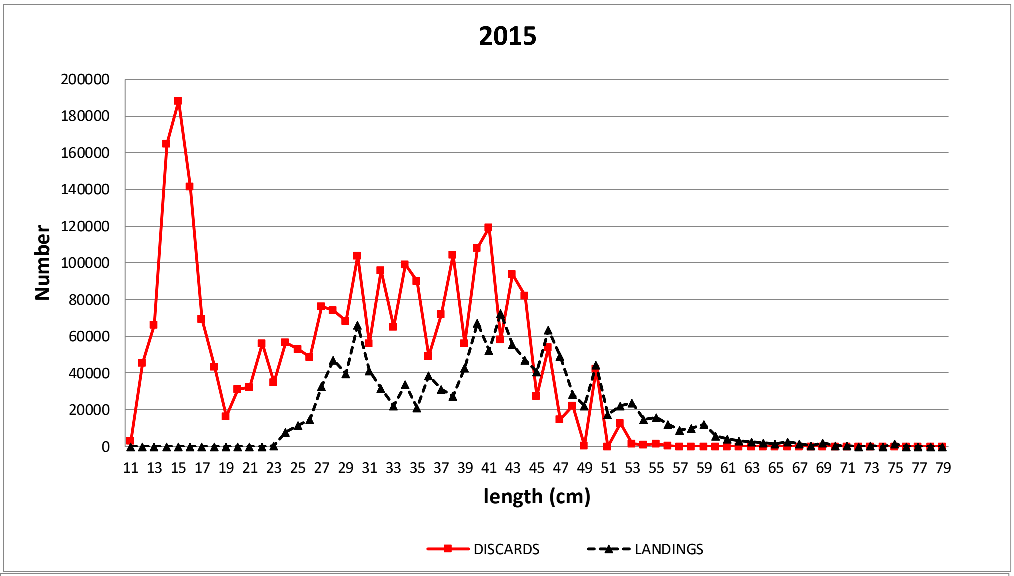
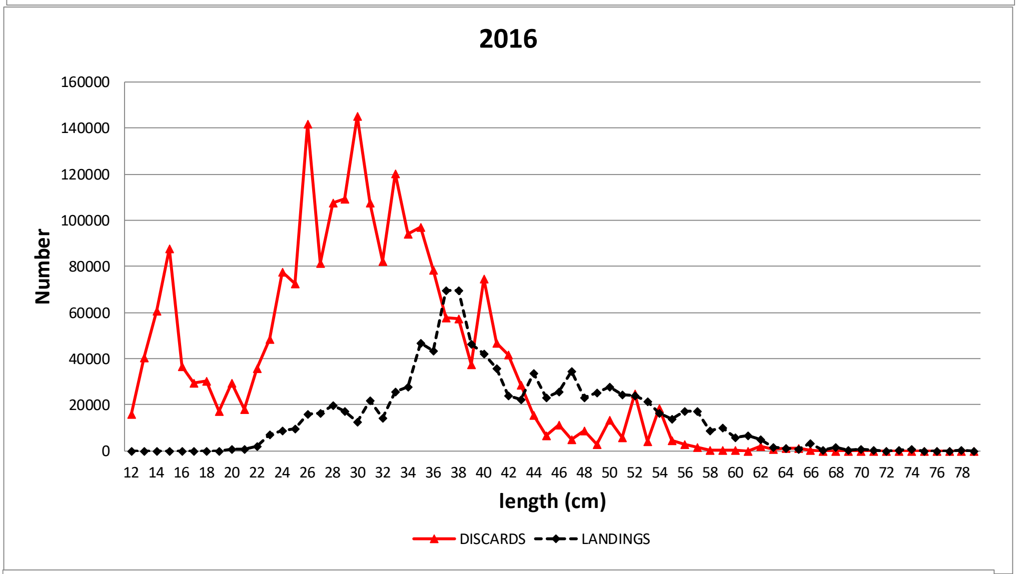
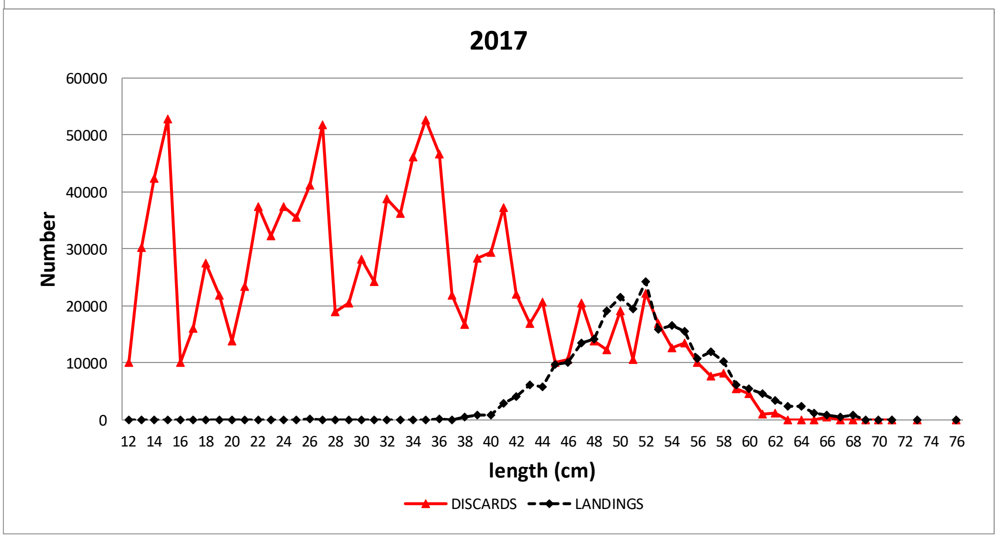


Figure 10.1. Greater forkbeard landing trends in all ICES subareas since 1988.


2015
Number
length (cm)
DISCARDS
LANDINGS


2016
Number
length (cm)
DISCARDS
LANDINGS


2017
Number
length (cm)
DISCARDS
LANDINGS

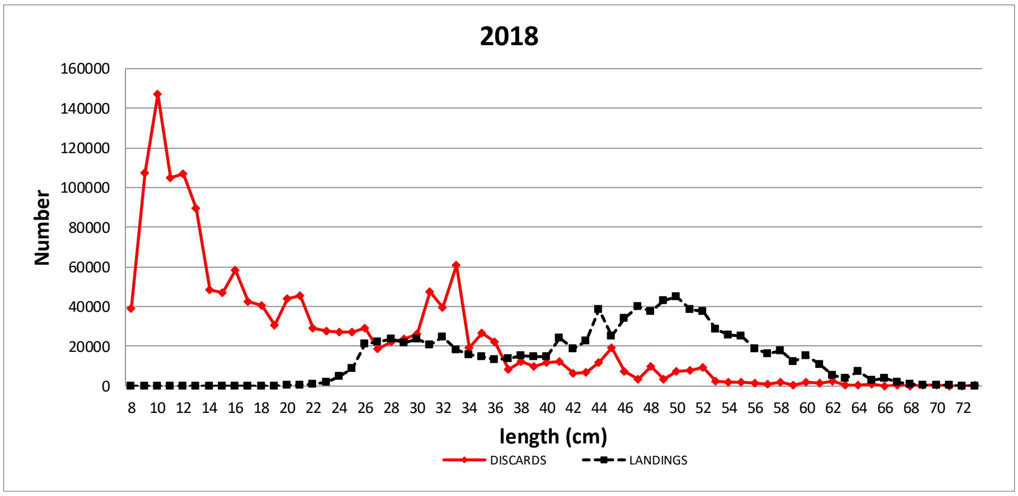


Figure 10.2. Commercial length frequencies of the greater forkbeard landings and discards from 2015 and 2018 from the France, Spain, Ireland, Portugal UK (England) and UK (Scotland).

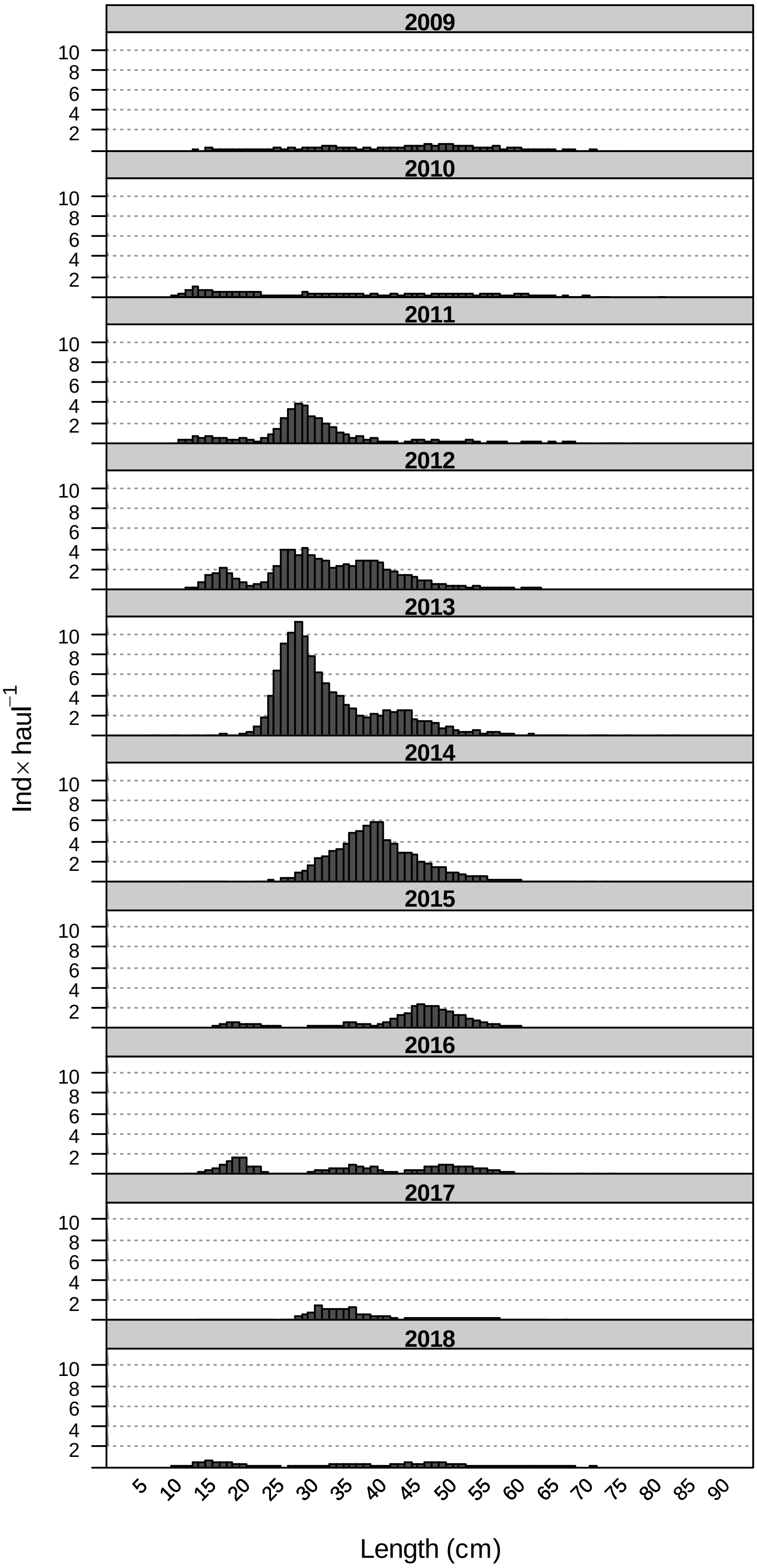


Figure 10.3. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Porcupine survey (Divisions 7.c and 7.k) time-series (2009–2018).

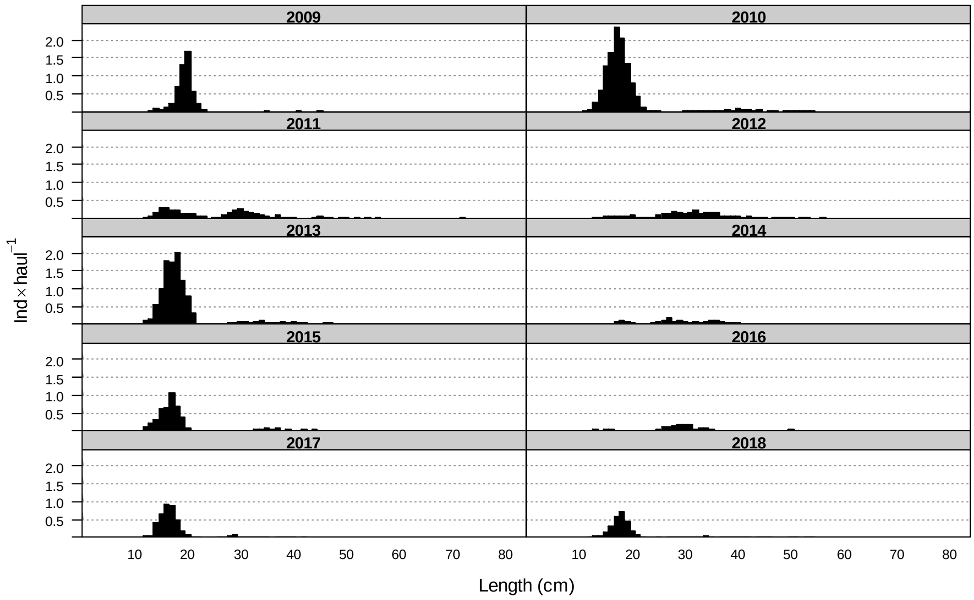


Figure 10. 4. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Northern Spanish Shelf survey (8.c and 9.a) in the period 2009–2018.

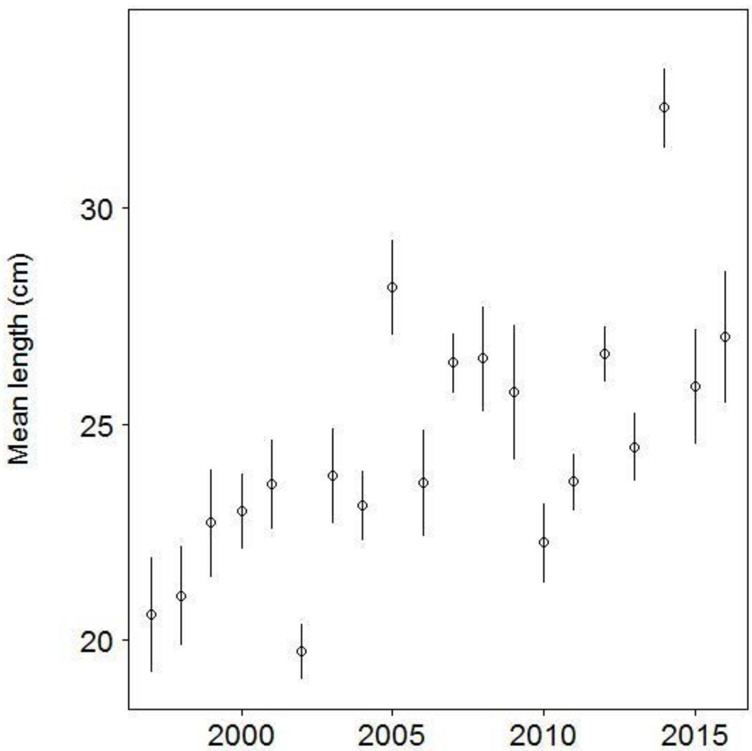


Figure 10. 5. Greater forkbeard series of mean length from the French IBTS survey Divisions 7.fghj and 8.abd until 2016.

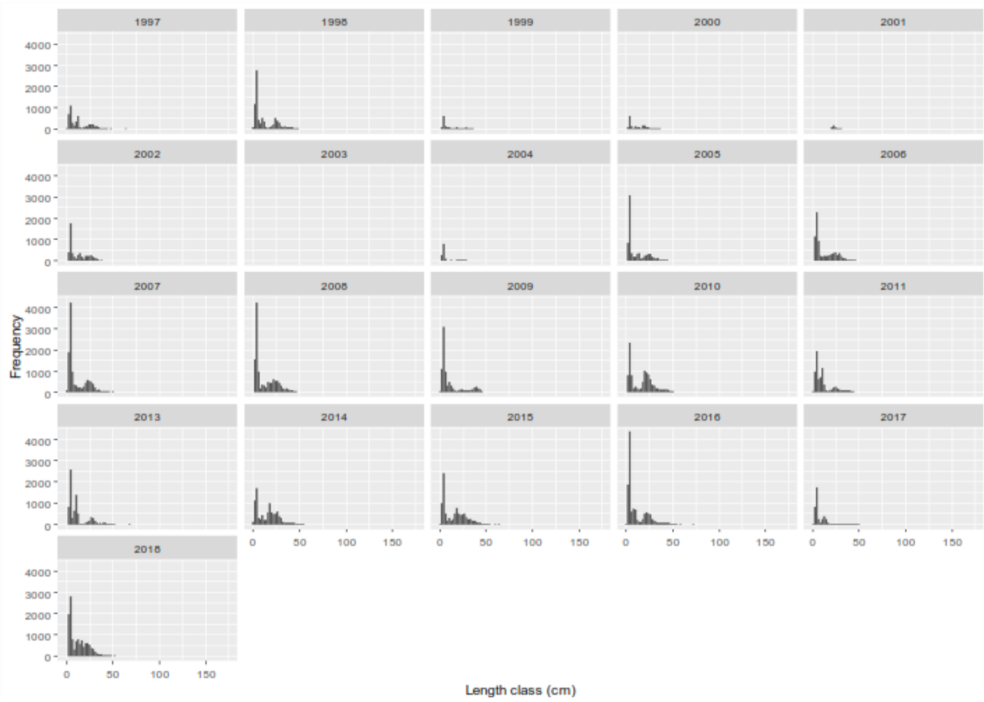


Figure 10.6. Length frequency distribution of the greater forkbeard in the PT-CTS (UWTV (FU 28-29)

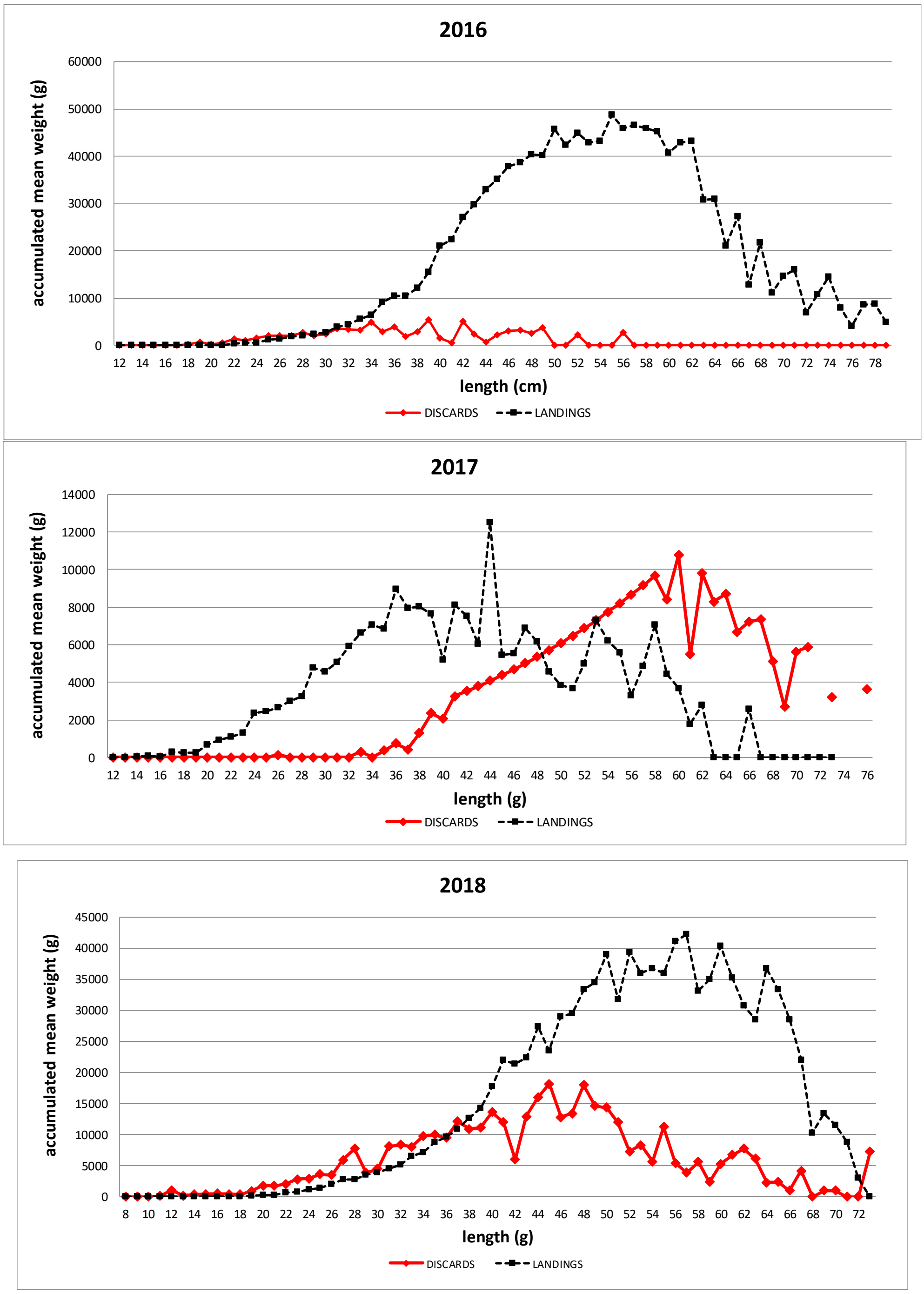


Figure 10.7 Accumulated mean weight at length of the international commercial landings and discards reported to Inter-Catch from 2016 to 2018.

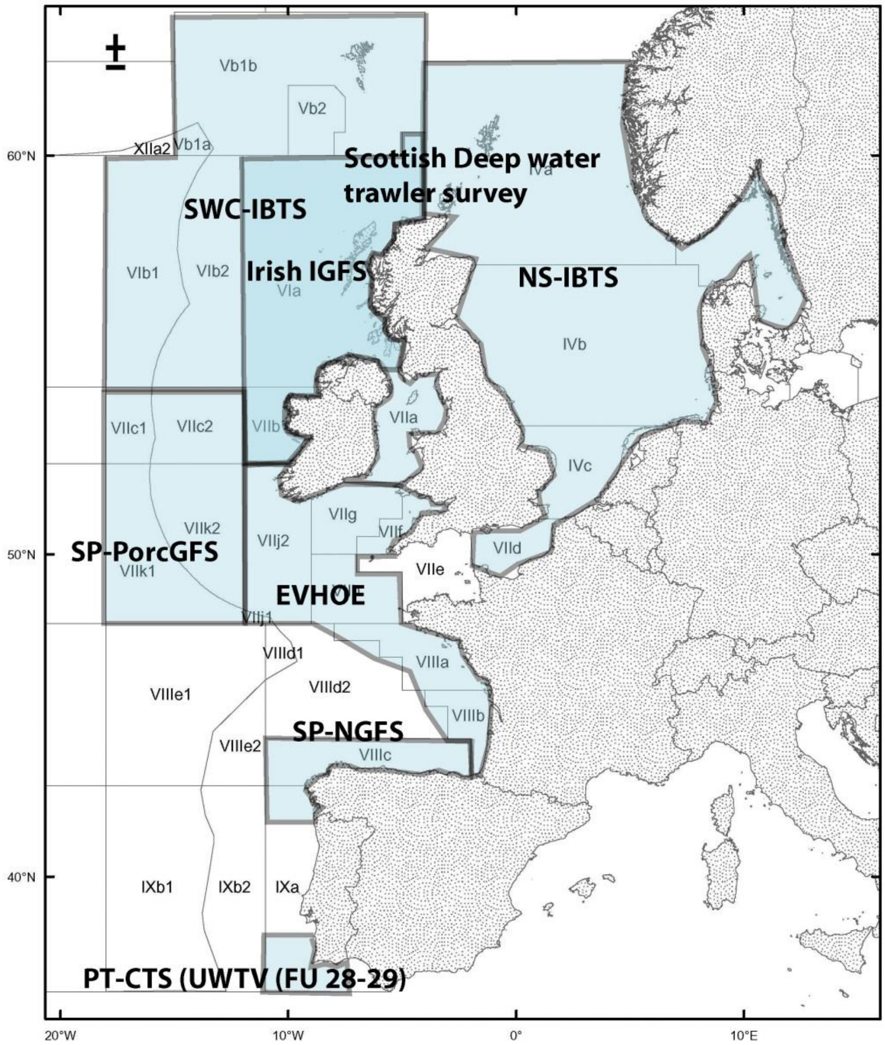


Figure 10.8. Map of the Divisions covered by the eight surveys used in the trend analysis of abundance and biomass of GFB.

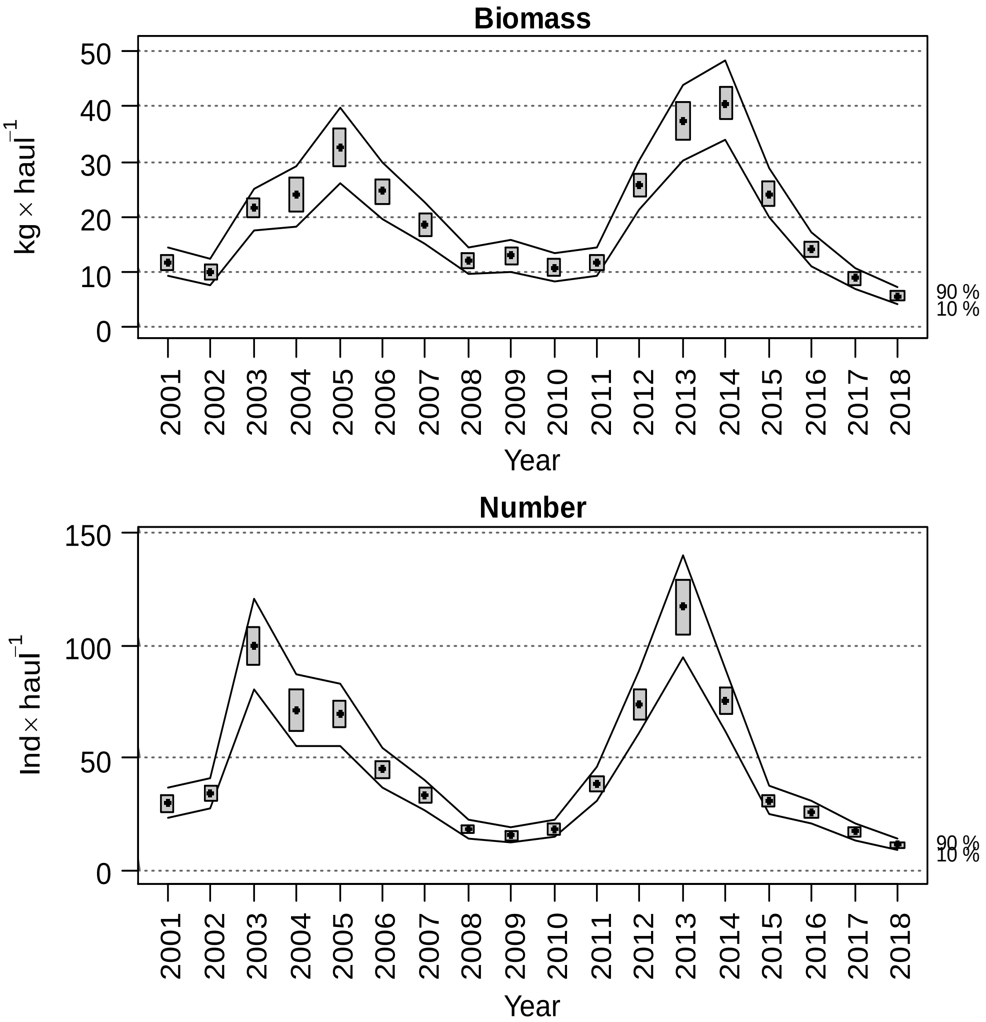


Figure 10.9. Evolution of *Phycis blennoides* biomass and abundance indices during Porcupine Survey time-series (2001–2018) in Divisions 7.c and 7.k. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (? = 0.80, bootstrap iterations = 1000).

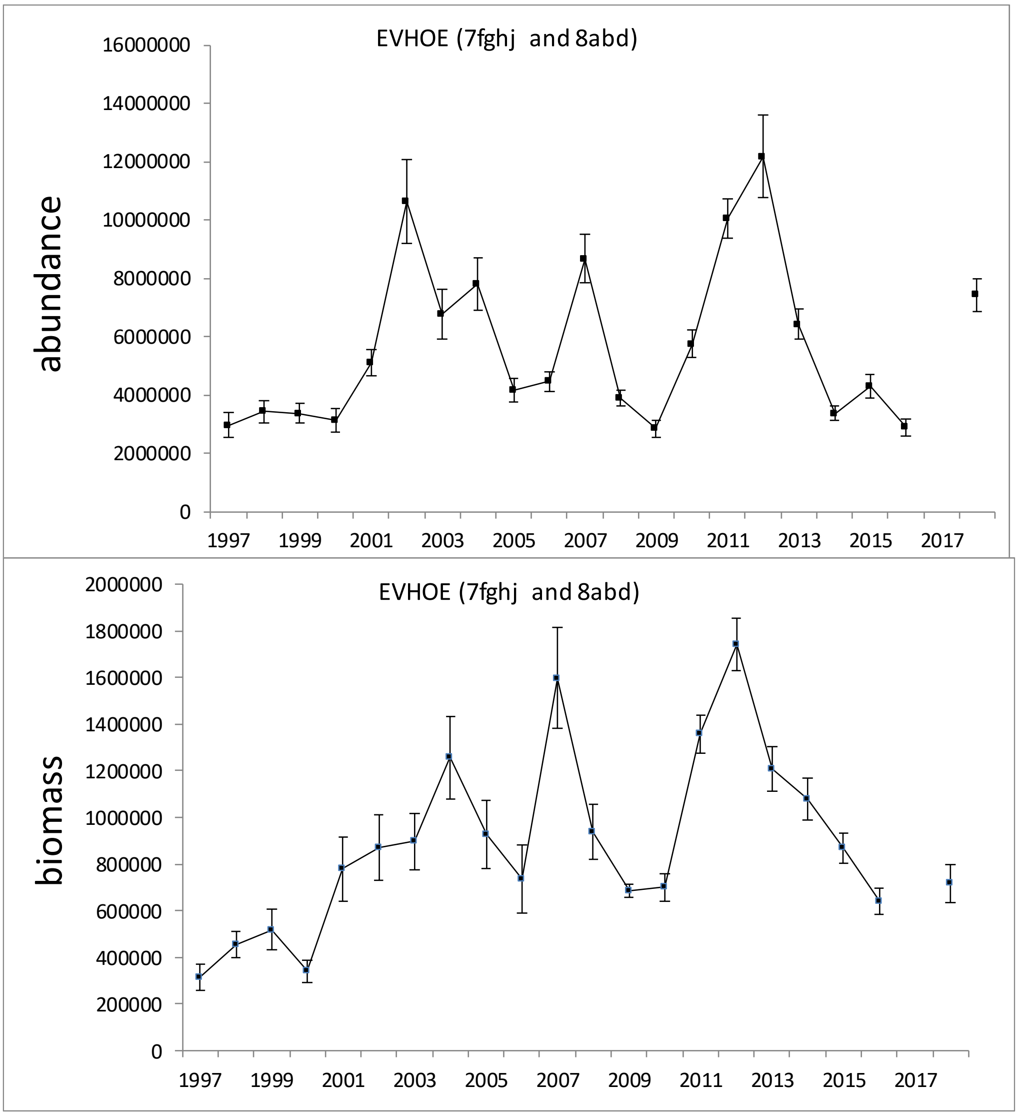


Figure 10.10. Greater forkbeard series of abundance and biomass of the French EVHOE IBTS survey in the Divisions 7.fghj and 8.abd combined until 2018

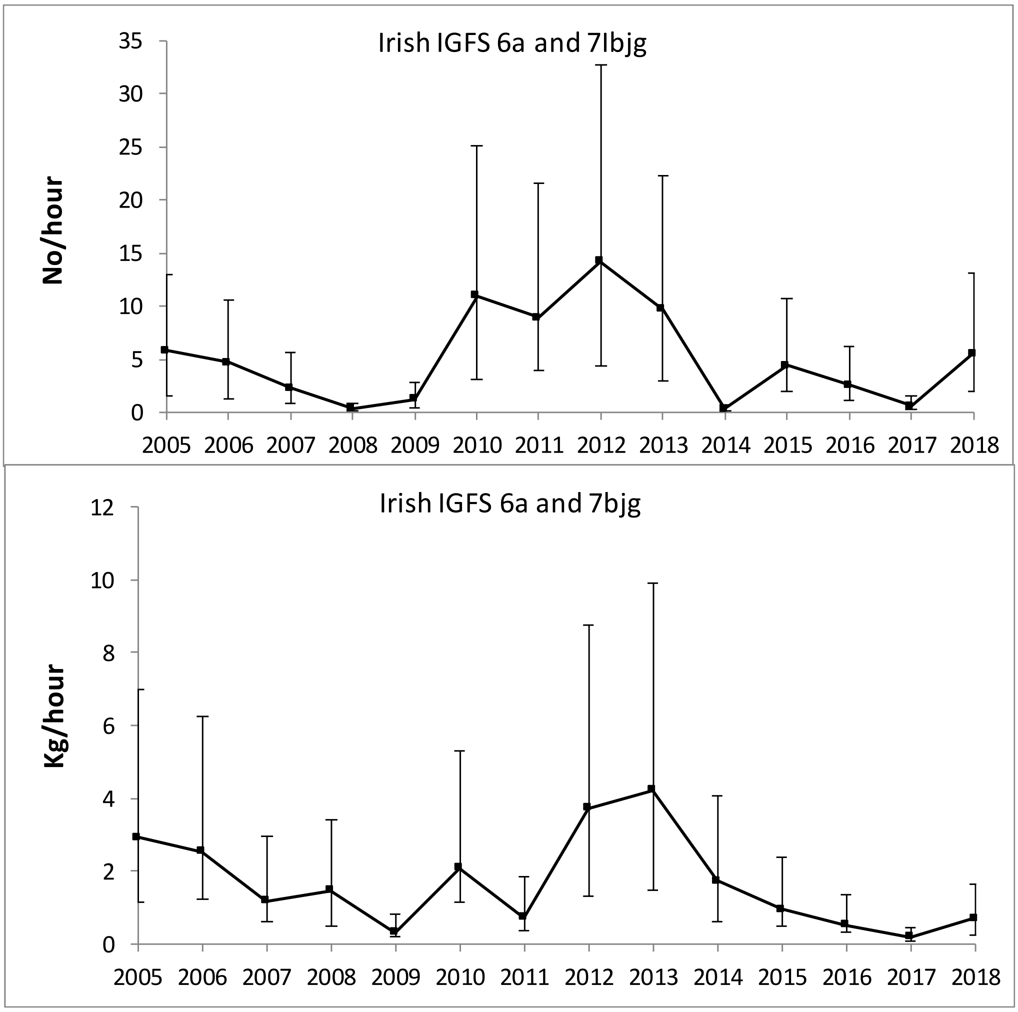
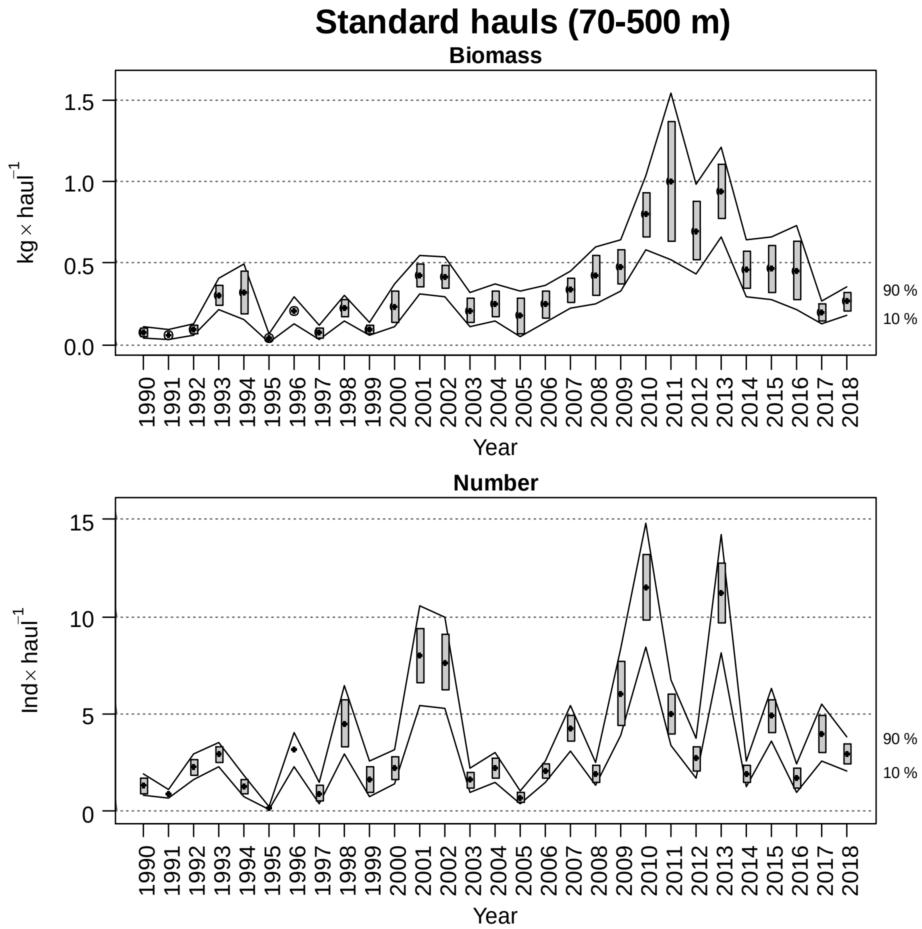


Figure 10.11. Abundance and biomass Indices (nº per hour and kg per hour) of Greater forkbeard total catches of the Irish IGFS Survey in the slope and shelf strata, 2005–2018.



Standard hauls (70-500 m)
Biomass
kg × haul⁻¹
1.5
1.0
0.5
0.0
90 %
10 %
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Year
Number
Ind× haul⁻¹
15
10
5
0
90 %
10 %
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Year

Figure 10.12. Changes in *Phycis blennoides* abundance index (kg/tow and No/tow) during northern Spanish Shelf bottom-trawl survey time-series (1990–2018) in Divisions 9.a and 8.c.

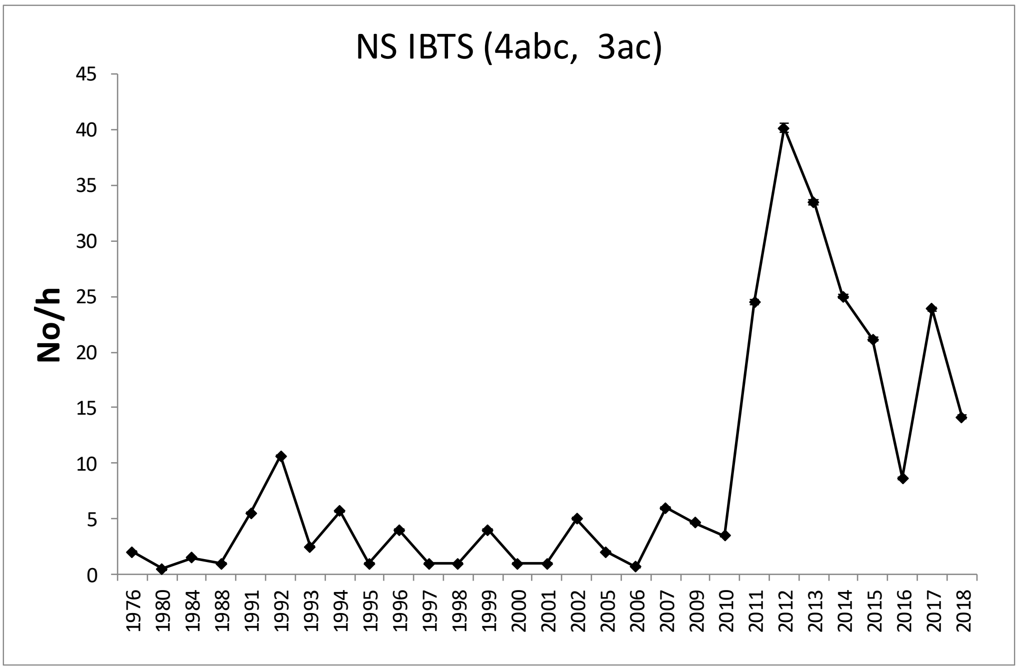


Figure 10.13. Greater forkbeard series of abundance (No/hour of the North Sea IBTS survey (NS-IBTS) until 2018 in Divisions 4.abc and 3.ac.

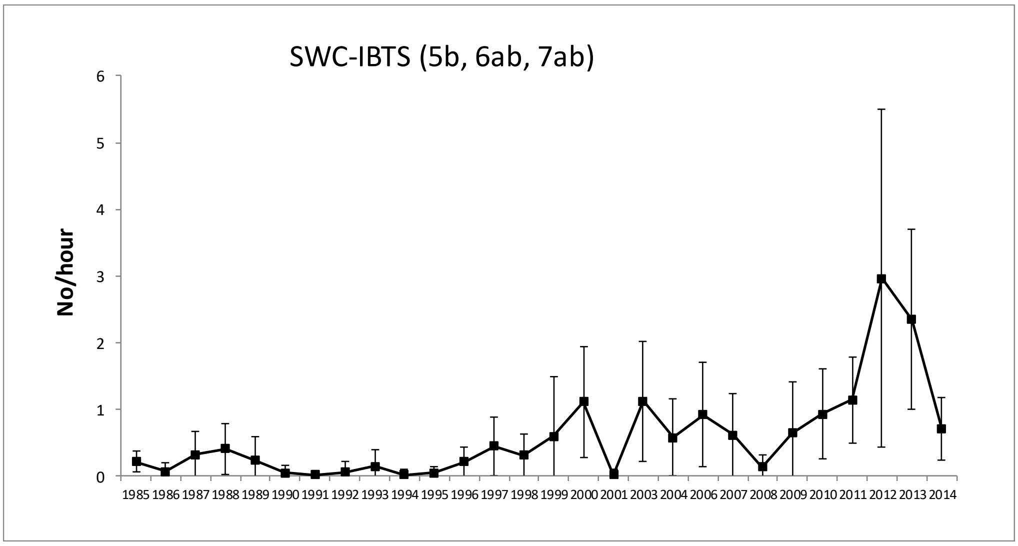


Figure 10.14. Greater forkbeard series of abundance (No/hour) of the Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) until 2014 in Divisions 5.b, 6.ab and 7.ab.

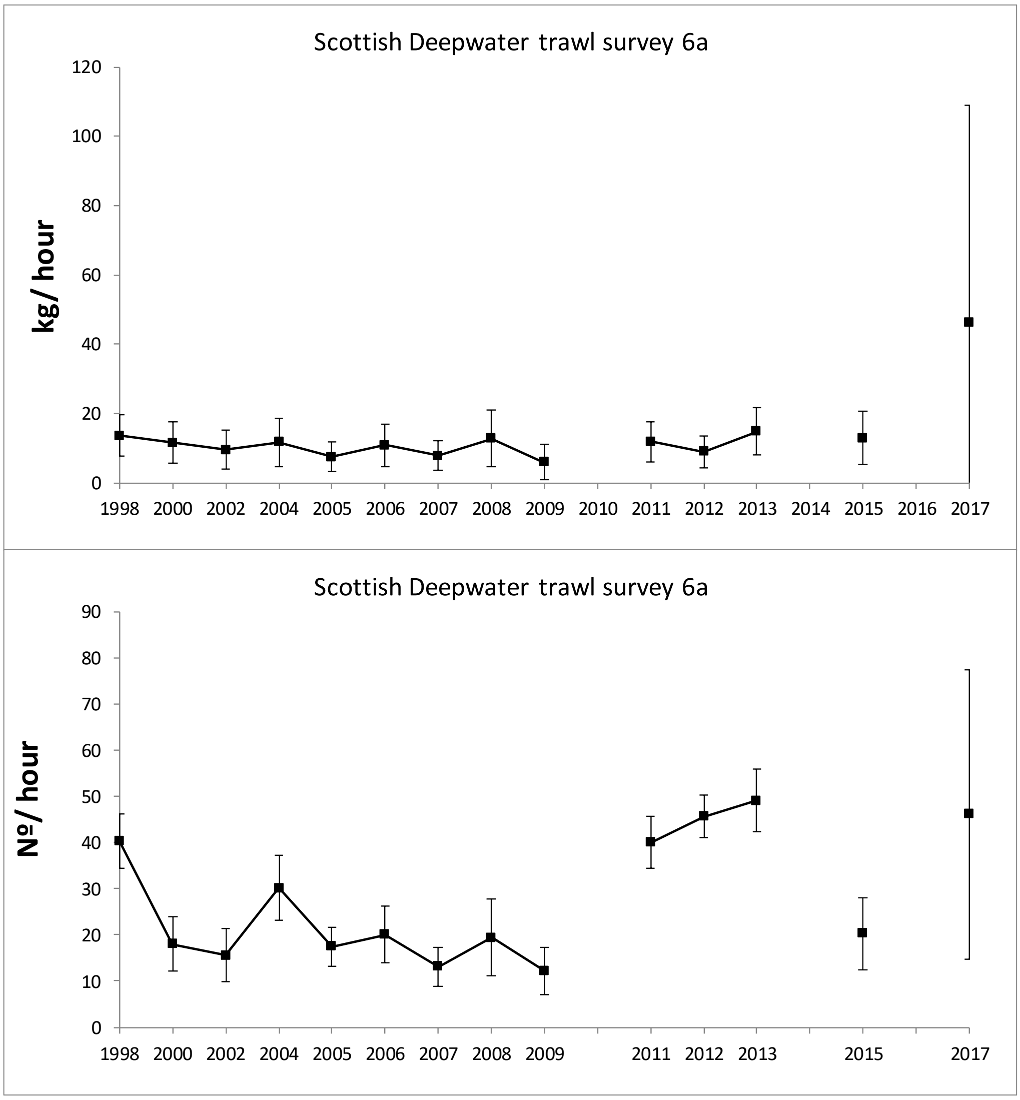


Figure 10.15. Greater forkbeard series of biomass (kg/hour) and abundance (Nº/hour) of the Scottish Deep-water trawl survey until 2017 in Division 6.a.

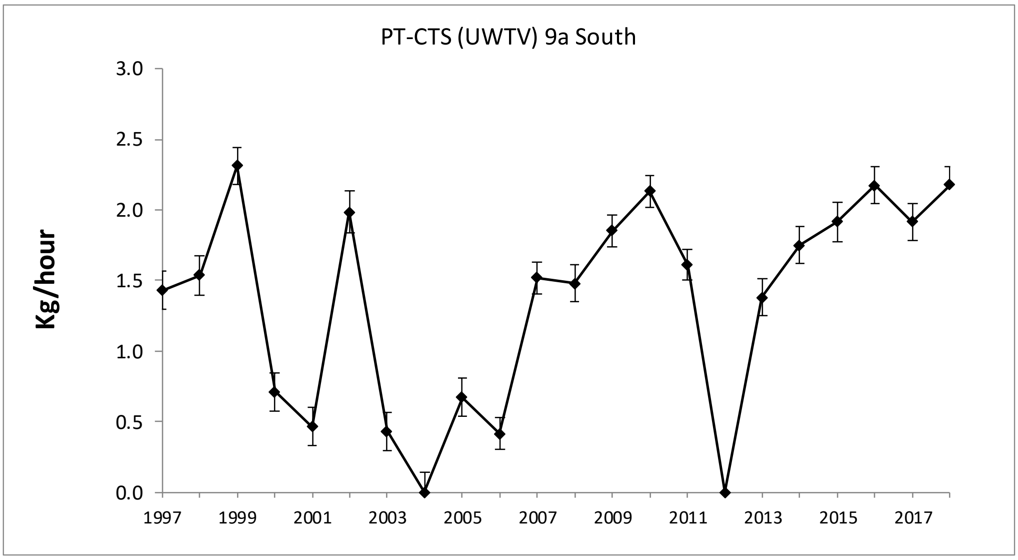


Figure 10.16. Greater forkbeard series of Standardized biomass index (kg.hour-1) of the Portuguese PT-CTS (UWTV (FU 28–29) survey until 2018 in the Division 9.a South. CPUE values estimated for the sector "Milfontes".

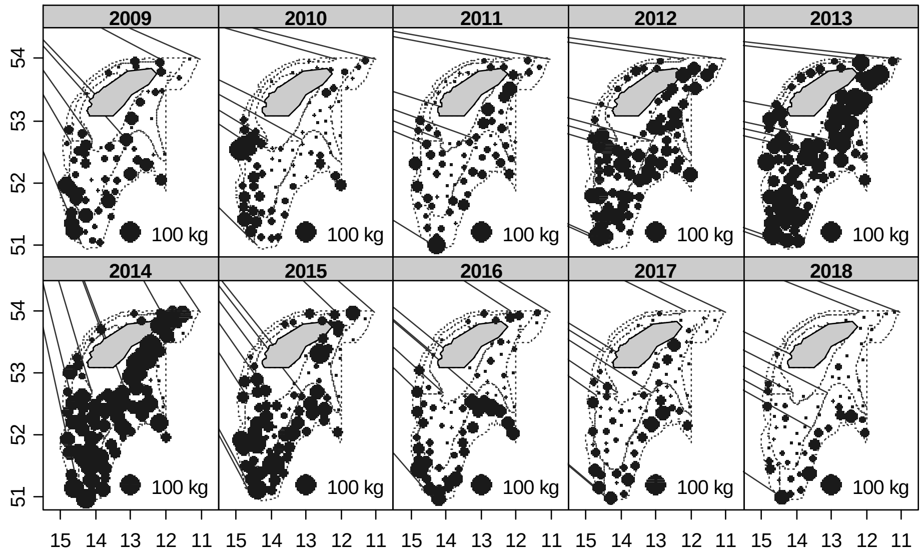


Figure 10.17. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys between 2009 and 2018.

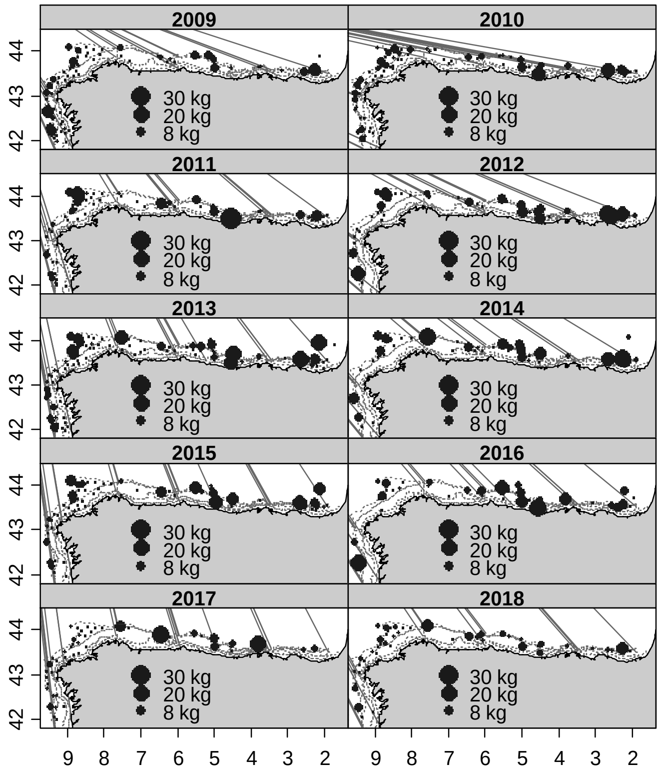


Figure 10.18. Catches in biomass of greater forkbeard on the Northern Spanish Shelf bottom-trawl surveys during the period: 2009–2018.

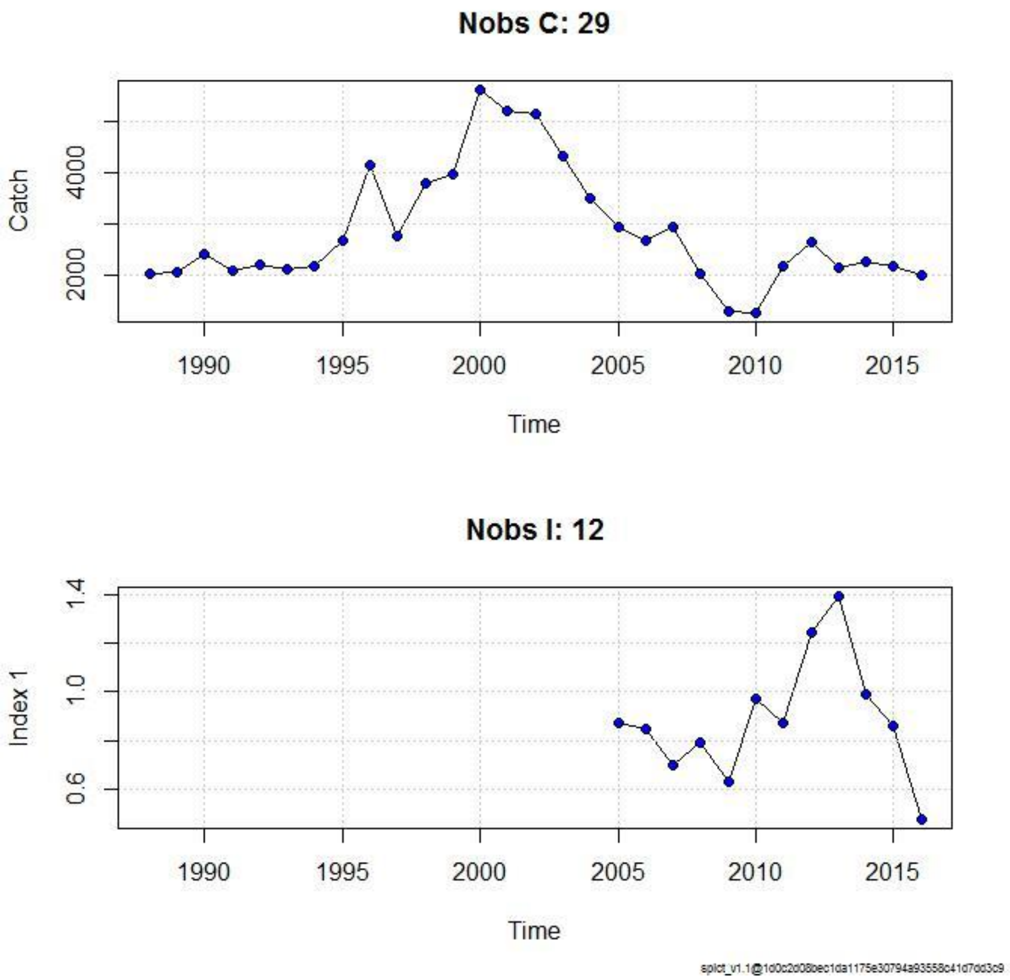


Figure 10.19. Inputs of the SPICT model used in the Greater Forkbeard stock.

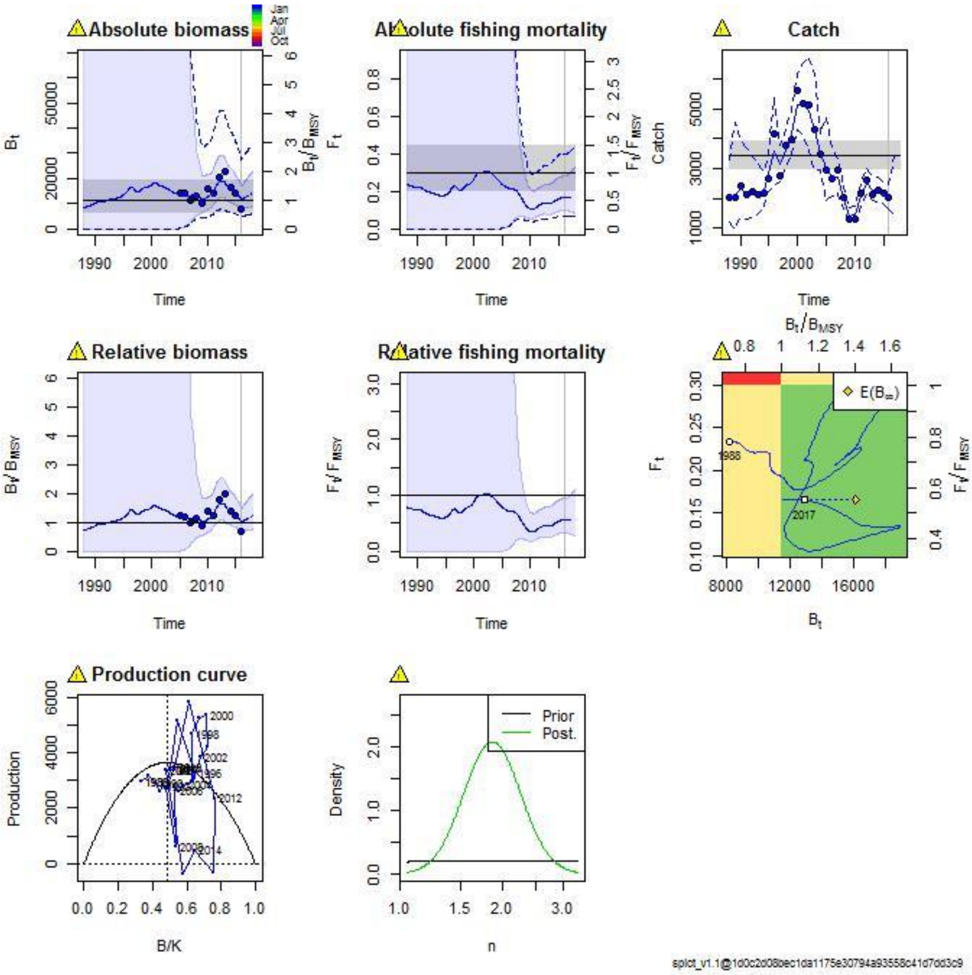


Figure 10.20. Results of the SPICT model for the Greater Forkbeard stock.

10.11 References

Lagarto N., Moura, T., Figueiredo I. 2016. Greater forkbeard Phycis blennoides in Portuguese waters (ICES division IXa). Working Document for the ICES Working Group on Biology and Assessment of Deep-sea Fisheries Resources Copenhagen, 20 -27th April 2016. 12 pp.

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11 Alfonsinos/Golden eye perch (*Beryx* spp.) in all ecoregions

11.1 The fishery

Alfonsinos, *Beryx splendens* and *Beryx decadactylus*, are generally considered as bycatch species in the demersal trawl and longline mixed fisheries targeting deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as *Beryx* spp.

The proportions of each species in the catches are not well known. Detailed landings data by species are available only for the Portuguese (Azores) hook and line fishery in Division 10a2, where the landings of *B. decadactylus* averaged 20% of the catches of both species in the last twenty 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 (10.b) between 1993 and 2000 and some minor landings as bycatch in fisheries targeting other species since 2000. There are no target fisheries currently occurring in Mid-Atlantic Ridge (NEAFC) area since 2000 (see Section 4). Currently landings are reported from bycatch fisheries occurring in the NEAFC regulatory area (RA) of ICES Division 10.b from Faroese vessels and in the EEZ of Portugal (Subarea 9), Spain (6, 7, 8 and 9), France (6, 7 and 8), and from a small-scale target fishery based in the Azores operation in Division 10.a (See Table 11.1 c, d and e).

11.2 Landings trends

The available landings data for Alfonsinos, (*Beryx* spp), by ICES subarea/division as officially reported to ICES or to the working group, are presented in Tables 11.1(a–g), 11.2 and 11.3 and Figures 11.1–11.5. Total landings are stabilized since 2005, due to management measures introduced (TAC/quotas and effort regulation), being around 355 t between 2005 and 2018, with high landings during 2012 (605 t). Current catches are 301 t. Faroes reported a landing of 141 t for 2015 and 48 t for 2016 from area 10.b.

11.3 ICES Advice

ICES advises that when the precautionary approach is applied, landings should be no more than 224 tonnes in each of the years 2019 and 2020. ICES cannot quantify the corresponding catches.

11.4 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 252 t for EC vessels is in force for the period 2019–2020 (see historical developments on the table down).

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. These measures were updated during 2015-2018. A network of MPAs was implemented on the Azores with closed access to deep-water fisheries (including Sedlo, D. J Castro and Formigas seamounts). The seamount (Condor) was closed to the fishery. There are NEAFC regulations of effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats on the RA. (http://neafc.org/managing_fisheries/measures/current).

Regulation	Species	Year	ICES Area	TAC	Landings
Reg 2270/2004	*Beryx* sp	2005	3, 4, 5, 6, 7, 8, 9, 10, 12	328	422
	Beryx sp	2006	3, 4, 5, 6, 7, 8, 9, 10, 12	328	367
Reg 2015/2006	*Beryx* sp	2007	3, 4, 5, 6, 7, 8, 9, 10, 12	328	396
	Beryx sp	2008	3, 4, 5, 6, 7, 8, 9, 10, 12	328	405
Reg 1359/2008	*Beryx* sp	2009	3, 4, 5, 6, 7, 8, 9, 10, 12	328	382
	Beryx sp	2010	3, 4, 5, 6, 7, 8, 9, 10, 12	328	296
Reg 1225/2010	*Beryx* sp	2011	3, 4, 5, 6, 7, 8, 9, 10, 12	328	331
	Beryx sp	2012	3, 4, 5, 6, 7, 8, 9, 10, 12	328	596
Reg 1262/2012	*Beryx* sp	2013	3, 4, 5, 6, 7, 8, 9, 10, 12	312	272
	Beryx sp	2014	3, 4, 5, 6, 7, 8, 9, 10, 12	296	282
Reg. 1367/2014	*Beryx* sp	2015	3, 4, 5, 6, 7, 8, 9, 10, 12	296	224
	Beryx sp	2016	3, 4, 5, 6, 7, 8, 9, 10, 12	296	252
Reg. 2285/2016	*Beryx* sp	2017	3, 4, 5, 6, 7, 8, 9, 10, 12	280	240
	Beryx sp	2018	3, 4, 5, 6, 7, 8, 9, 10, 12	280	301
Reg. 2025/2018	*Beryx sp*	2019	3, 4, 5, 6, 7, 8, 9, 10, 12	252	
	Beryx sp	2020	3, 4, 5, 6, 7, 8, 9, 10, 12	252	

11.5 Stock identity

No new information.

11.6 Data available

11.6.1 Landings and discards

Tables 11.1a–g, describe the alfonsinos landings by subarea and country. Discards results for the Azorean longliners were reported during 2014 (WD, Pinho, 2014) and were not updated. Annual longline discard estimates by year for the sampled trip vessels with alfonsinos catches during the period 2004–2011 range from 0.8% to 8.6% for *B splendens* and 0.07% to 10.2% for the *B. decadactylus* (Table 11.4). These discards are mostly a result of the management measures such as TAC and minimum length.

11.6.2 Length compositions

Length composition in Azorean catches are shown for both species in Figures 11.6 (*Beryx splendens*) for 1991–2016 and 11.7 (*Beryx decadatylus*) for the period 1993–2016. This information was not updated for the 2017 and 2018 because data was not available.

Azorean spring bottom longline survey length compositions were updated (WD Medeiros-Leal *et al*., 2019) and are shown for both species in Figures 11.8 and 11.9.

Annual mean length from the Azorean survey for both species are presented in Figures 11.10 to 11.11. Fishery information was not updated because data was not available.

11.6.3 Age compositions

No new information about age compositions of *Beryx* species was available during the WGDEEP meeting. This information was already reported to the working group but there are not relevant changes on the growth of the species.

11.6.4 Weight-at-age

No new information.

11.6.5 Maturity, sex-ratio, length–weight and natural mortality

No new information was available to the working group. The DCF information was summarized in the 2010 report and there are no relevant changes on the biology of the species.

11.6.6 Catch, effort and research vessel data

Standardized fishery cpue was not updated, available information is resumed on last year report (ICES, 2018).

Abundance indices from the Azorean longline survey were updated (WD Medeiros-Leal *et al*., 2019) and are presented for the alfonsino (*Beryx splendens*) (Figure 11.12) and golden eye perch (*Beryx decadactylus*) (Figure 11.13).

11.7 Data analyses

Total landings declined in the late 1990s and have since 2003 stabilized at about 370 tonnes (for the two species combined), with a peak of 605 t in 2012 due to the landings reported by Spain for Areas 6–7. Species-specific landings trends in the Azores fishery showed similar trends for both species (Figure 11.4 and 11.5).

A reduction on the small fish (<20 cm) is observed on the landings for *B splendens* since 2005 due to the minimum length regulations. Length compositions present in general a mode around 30 cm with the exception of the period 2004–2007 (Figure 11.6). Considering a length of first maturity around 35 cm fork length (FL), it appears that the Azorean fishery have caught mainly immature fish. However, this may be a selective effect of the hook and line fisheries or an uncertainty on the maturity estimates.

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 on 32 cm and 42 cm during the last five years (Figure 11.7).

Survey length compositions for *B splendens* and *B decadactylus* show that relatively small numbers of *B decadactylus* are caught on the survey on the sampled depth strata (50–1200m) (Figures 11.8 and 11.9). For *B splendens* a mode around 25–30 cm is observed and *B decadactylus* show a bimodal or trimodal distribution.

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, with small decreases throughout the time series and returning to maintained of the 27 cm fork length (Figure 11.10). *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 until 2011 around 35 cm and increasing thereafter since 2012 (38 cm) until 2018 (Figure 11.11).

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 between 2010 to 2013, followed by a decrease in 2016 until 2018 (Figure 11.12). 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 until 2011 decreasing until 2017, increasing again in 2018 (Figure 11.13).

The working group express concerns on the reliability of these indices as an indicator of North East Atlantic abundance index due to the relatively small numbers of individuals caught each year particularly for *B. decadactylus*. The survey may not be designed for these highly mobile and aggregative species particularly for *B. decadactylus*. Therefore the working group thinks the approach taken in 2012, i.e. to base advice on catch history to be appropriate.

11.7.1 Exploratory analysis

11.7.1.1 Length-based indicators

Length-based indicators were not calculated this year because fishery data was not available. However, LBI assessment was re-explored last year (ICES, 2018).

11.8 Comments on the assessment

No assessment was carryout this here.

11.9 Management considerations

As a consequence of their spatial distribution associated with seamounts, their life history and their aggregating behaviour, alfonsinos are considered to be easily overexploited by trawl fishing; they can only sustain low rates of exploitation. Population dynamics are uncertain with recent estimates suggesting high longevity (>50 years), while other estimates suggest a longevity of ~15 years. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire subpopulations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed.

11.10 References

ICES. 2018. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 11- 18 April 2018, ICES Headquarters, Copenhagen. ICES CM 2018/ACOM:14.

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11.11 Tables and Figures

Table 11.1a. Landings (tonnes) of *Beryx* spp. from Subarea 4.

YEAR	FRANCE	TOTAL
1988	0	0
1989	0	0
1990	1	1
1991	0	0
1992	2	2
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0

YEAR	FRANCE	TOTAL
2015	0	0
2016	0	0
2017	0	0
2018*	3	3

*Preliminary.

Table 11.1b. Alfonsinos (*Beryx* spp.) from Division 5.b.

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

YEAR	FAROES	FRANCE	TOTAL
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018*	0	0	0

*Preliminary.

Table 11.1c. Alfonsinos (*Beryx* spp.) from Subareas 6 and 7.

YEAR	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

YEAR	FRANCE	E & W	SPAIN	IRELAND	SCOTLAND	TOTAL
2005	15	0	55	0		70
2006	27	0	51	0		78
2007	17	1	47	0		65
2008	22	0	32	0		54
2009	9	0	0	0	1	10
2010	4	0	0	0	1	5
2011	7	0	33	0	0	40
2012	4	0	337	0	0	341
2013	14	1	33	0	0	77
2014	10	0	38	0	0	49
2015	6	0		6	0	12
2016	5	0.45	13	0	1	20
2017	7	0	11	0	0	18
2018*	10	0.209	19	0	0	29

*Preliminary.

Table 11.1d. Alfonsinos (*Beryx* spp.) from Subareas 8 and 9.

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

YEAR	FRANCE	PORTUGAL	SPAIN	E & W	TOTAL
2000	7	40	117	4	168
2001	6	43	179	0	228
2002	13	60	151	14	238
2003	10	0	95	0	105
2004	21	53	209	0	283
2005	9	45	141	0	195
2006	8	20	64	3	97
2007	8	45	67	0	120
2008	5	42	54	0	101
2009	1	42	18	0	61
2010	12	27	1	0	41
2011	4	21	40	0	65
2012	4	11	27	0	42
2013	5	17	4	0	26
2014	3	18	81	0	102
2015	3	0	59		61
2016	3	1	71	0	76
2017	3	2	67	0	73
2018*	6	52	52	0	110

*** Preliminary.**

Table 11.1e. Alfonsinos (*Beryx* spp.) from Subarea 10.

	10.a	**10.b**				
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

	10.a	10.b				
YEAR	PORTUGAL	FAROES	NORWAY	RUSSIA**	E & W	TOTAL
1994	644		0	837		1481
1995	529	0	0	200		729
1996	550	0	0	960		1510
1997	379	5	0			384
1998	229	0	0			229
1999	175	0	0	550		725
2000	203	0	0	266	15	484
2001	199	0	0	0	0	199
2002	243	0	0	0	0	243
2003	172	0	0	0	0	172
2004	139	0	0	0	0	139
2005	157	0	0	0	0	157
2006	192	0	0	0	0	192
2007	211	0	0	0	0	211
2008	250	2	0	0	0	252
2009	311	1	0	0	0	312
2010	240	0	0	5	0	245
2011	226	4	0	5	0	235
2012	213	10	0	0	0	222
2013	168	0	0	0	0	168
2014	131	0	0	0	0	131
2015	151	141	0	0	0	292
2016	156	48	0	0	0	204
2017	149	0	0	0	0	149
2018*	159	0	0	0	0	159

*** Preliminary.**

**** Not official data from ICES Area 10.b.**

Table 11.1f. Alfonsinos (*Beryx* spp.) from Subarea 12.

YEAR	FAROES	TOTAL
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995	2	2
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	2	2
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0

YEAR	FAROES	TOTAL
2017	0	0
2018*	0	0

* Preliminary.

Table 11.1g. Landings of Alfonsinos (*Beryx* spp.) from 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*		

YEAR	PORTUGAL	TOTAL
2012*		
2013*		
2014*		
2015*		
2016*		
2017*		
2018*		

* No information.

Table 11.1h. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subarea/division.

YEAR	4	5.b	6+7	8+9	10.a	10.b	12	TOTAL
1988			0	0	225	0		225
1989			12	0	260	0		272
1990	1	5	8	1	338	0		353
1991			0	0	371	0		371
1992	2	4	3	1	450	0		460
1993			1	0	533	195		729
1994			5	2	644	837		1488
1995		1	3	82	529	200	2	817
1996			178	88	550	960	0	1776
1997			26	135	379	5	0	545
1998			81	268	229	0	0	579
1999			75	201	175	550	0	1001
2000			133	168	203	281	0	785
2001			180	228	199	0	0	607
2002			95	238	243	0	0	577
2003			84	105	172	0	0	361
2004			64	283	139	0	0	485
2005			70	195	157	0	0	422
2006			78	97	192	0	0	367

YEAR	4	5.b	6+7	8+9	10.a	10.b	12	TOTAL
2007			65	120	211	0	0	396
2008	0	0	54	101	250	2	0	407
2009	0	0	10	61	311	1	0	383
2010	0	0	5	41	240	5	0	291
2011	0	0	40	65	226	9	2	342
2012	0	0	341	42	213	10	0	605
2013	0	0	77	26	168	0	0	272
2014	0	0	49	102	131	0	0	282
2015	0	0	12	61	151	141	0	365
2016	0	0	20	76	156	48	0	300
2017	0	0	18	73	149	0	0	240
2018*	2.57	0	29	110	159	0	0	301

***Preliminary.**

Table 11.3. Reported landings of *Beryx splendens* and *B. decadactylus* in the Azores (ICES Division 10a2).

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

YEAR	*B. Splendens*	*B. Decadactylus*	TOTAL
2002	223	20	243
2003	150	22	172
2004	110	29	139
2005	134	23	157
2006	152	40	192
2007	165	46	211
2008	187	63	250
2009	243	68	311
2010	189	51	240
2011	179	47	226
2012	175	37	213
2013	140	28	168
2014	109	22	131
2015	120	31	151
2016	127	29	156
2017	119	30	149
2018*	107	50	157

***Preliminary.**

Table 11.4. Annual percentage of *Beryx* spp. discarded by year in the Azores (ICES Division 10a2) from the sampled trip vessels that caught and discard alfonsinos.

SPECIES	2004	2005	2006	2007	2008	2009	2010	2011
Beryx splendens	1,79	1,87	1,55	1,02	1,19	8,64	4,69	0,76
Beryx decadactylus	0,37	0,07	1,31	0,14	0,57	10,18	2,36	0,95

Table 11.5. Nominal and standardized CPUE series (kg 10^{-3} hooks scaled to the mean) for alfonsino *Beryx splendens*, Beryx decadactylus and species combined from the Azorean bottom longline fishery. LCI and UCI indicate estimated 95% confidence bounds.

	Beryx comb				*B. splendens*				*B. decadactylus*			
Year	**Nominal**	**Standardized**	**LCI**	**UCI**	**Nominal**	**Standardized**	**LCI**	**UCI**	**Nominal**	**Standardized**	**LCI**	**UCI**
1990	0.86	1.01	0.77	1.25	0.01	0.02	0	0.04	0.18	1.02	0.75	1.29
1991	1.24	1.36	1.03	1.7	1.05	1.29	0.63	1.96	1.49	2.88	1.41	4.35
1992	0.19	1.07	0.76	1.38	0.04	0.18	-0.02	0.37	0.07	2.08	1.47	2.7
1993	1.26	1.38	1.02	1.75	1.11	2.22	1.25	3.2	2.06	1.87	0.85	2.89
1994	1.51	1.3	0.93	1.67	1.28	1.24	0.52	1.95	2.68	1.37	0.67	2.06
1995	0.78	1.32	1	1.65	0.7	0.79	0.3	1.27	1.24	1.68	0.92	2.43
1996	2.59	1.61	1.13	2.1	2.74	2.51	1.3	3.72	2.58	1.65	0.73	2.57
1997	0.48	1.04	0.75	1.32	0.49	0.97	0.45	1.48	0.56	0.8	0.44	1.17
1998	0.74	0.94	0.71	1.17	0.79	0.9	0.49	1.32	0.67	0.83	0.41	1.25
1999	0.98	0.91	0.7	1.13	1.19	1.31	0.82	1.81	0.4	0.51	0.22	0.79
2000	0.96	0.82	0.63	1.01	1.1	1.47	0.93	2	0.63	0.71	0.29	1.14
2001	1.4	0.78	0.58	0.99	1.72	1.34	0.75	1.92	0.52	0.5	0.19	0.81
2002	1.46	0.87	0.63	1.12	1.74	1.12	0.61	1.63	0.7	0.69	0.23	1.15
2003	0.7	0.5	0.38	0.62	0.8	0.46	0.25	0.67	0.46	0.46	0.18	0.74
2004	0.84	0.62	0.46	0.78	0.98	0.85	0.49	1.21	0.49	0.57	0.23	0.92
2005	0.91	0.81	0.63	1	1.1	0.87	0.5	1.25	0.41	0.44	0.2	0.69
2006	1.12	0.86	0.65	1.07	1.18	1.03	0.6	1.46	1.13	0.7	0.27	1.12
2007	1.1	0.78	0.57	0.99	1.2	1.2	0.7	1.7	0.96	0.58	0.19	0.97
2008	1.07	1.08	0.81	1.35	1.12	1.05	0.6	1.5	1.11	0.84	0.33	1.35
2009	1.31	1.21	0.91	1.5	1.34	1.4	0.82	1.99	1.45	0.86	0.34	1.38
2010	1.06	1.13	0.89	1.37	1.03	0.95	0.54	1.36	1.4	1.05	0.54	1.56
2011	0.89	1.3	1.04	1.56	0.91	1.03	0.59	1.46	1	1.03	0.57	1.49
2012	1.29	1.35	1.08	1.62	1.33	1.02	0.56	1.48	1.4	0.86	0.48	1.24
2013	0.74	1.07	0.86	1.28	0.75	0.67	0.36	0.99	0.87	0.74	0.43	1.05
2014	0.43	0.56	0.46	0.67	0.38	0.35	0.17	0.54	0.68	0.72	0.42	1.02
2015	0.64	0.62	0.5	0.73	0.61	0.45	0.22	0.68	0.88	0.84	0.45	1.23
2016	0.44	0.69	0.55	0.83	0.32	0.3	0.15	0.45	0.98	0.72	0.34	1.1

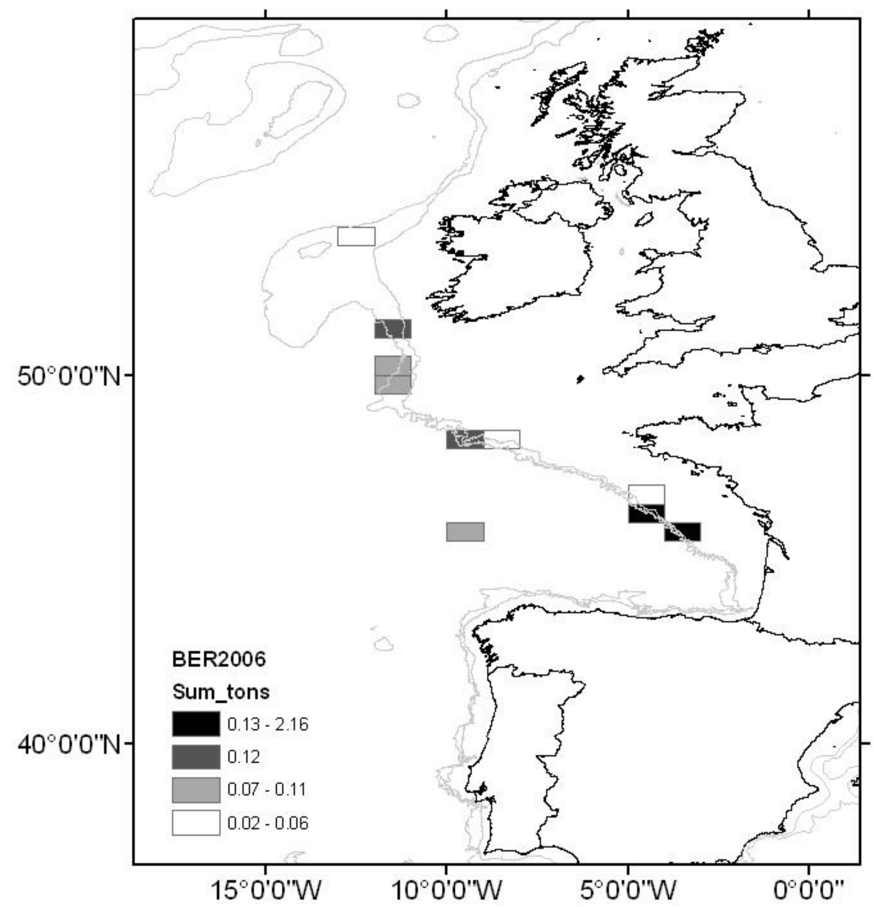


Figure 11.1. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

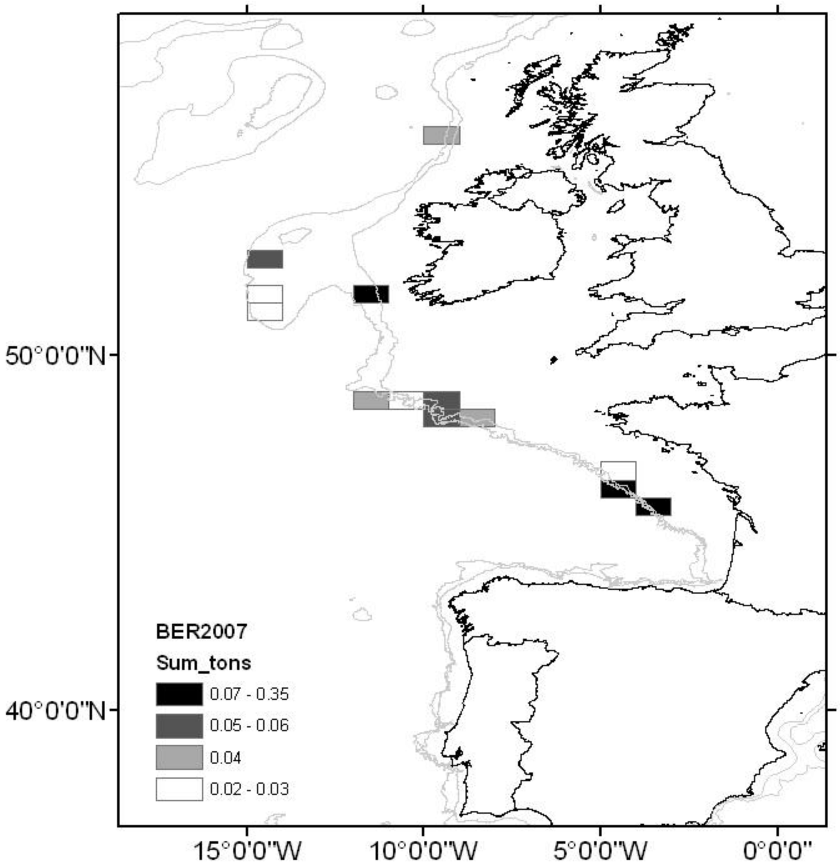


Figure 11.2. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

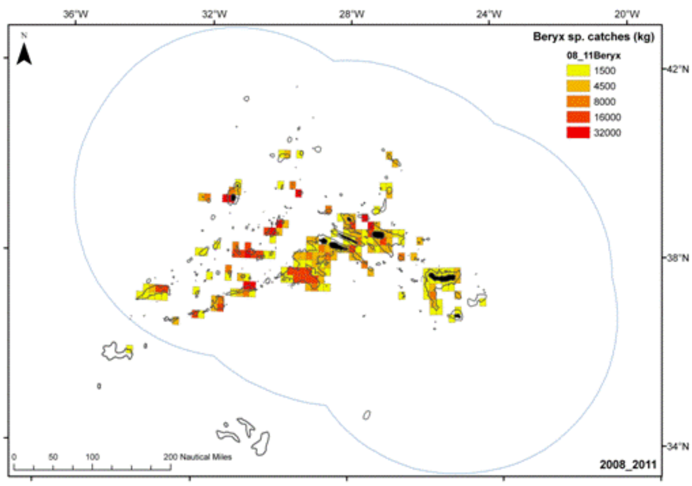


Figure 11.3. Catches of alfonsinos by Azores vessels, 2008–2011 (ICES, 10a2).

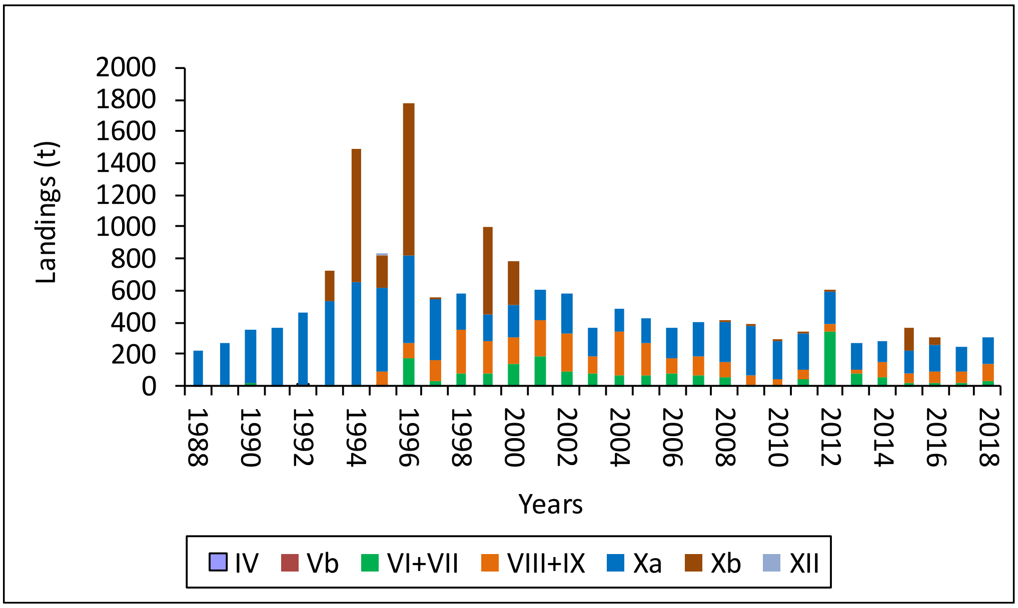


Figure 11.4. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subarea/division.

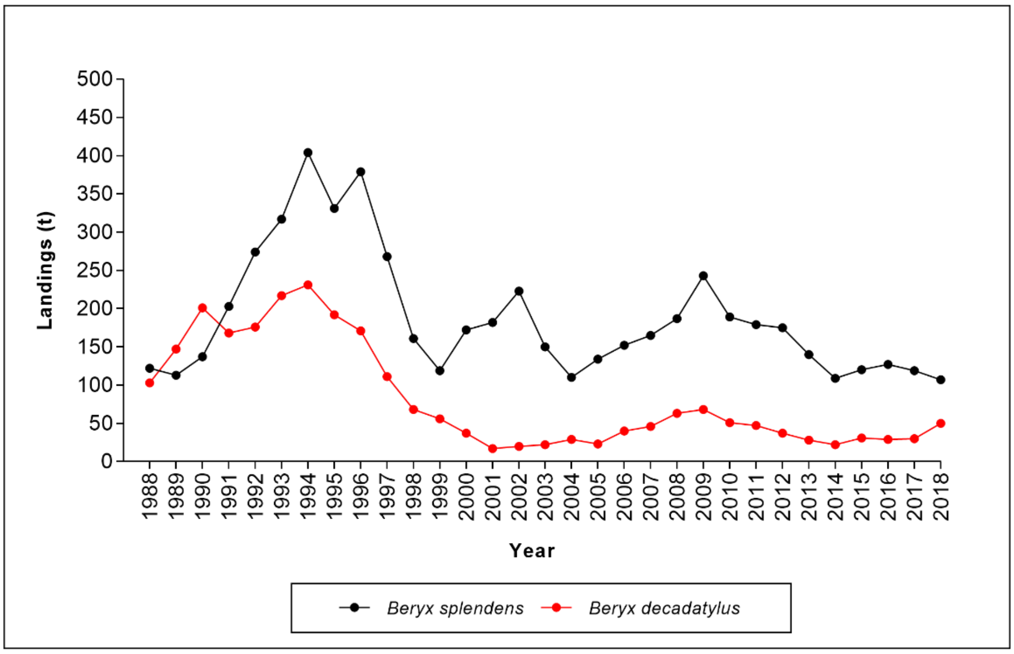


Figure 11.5. Landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Subarea 10a2).

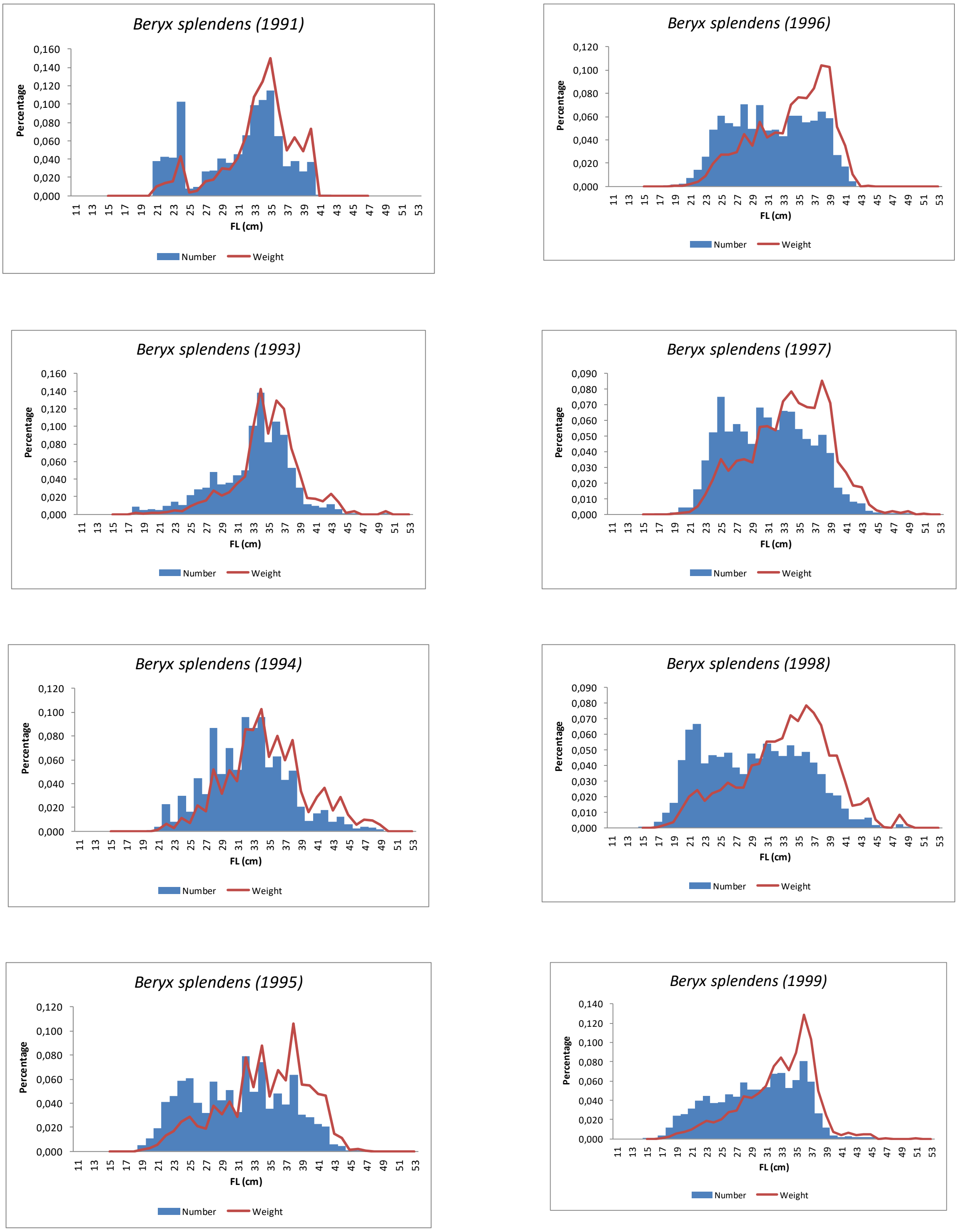


Figure 11.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in weight.**

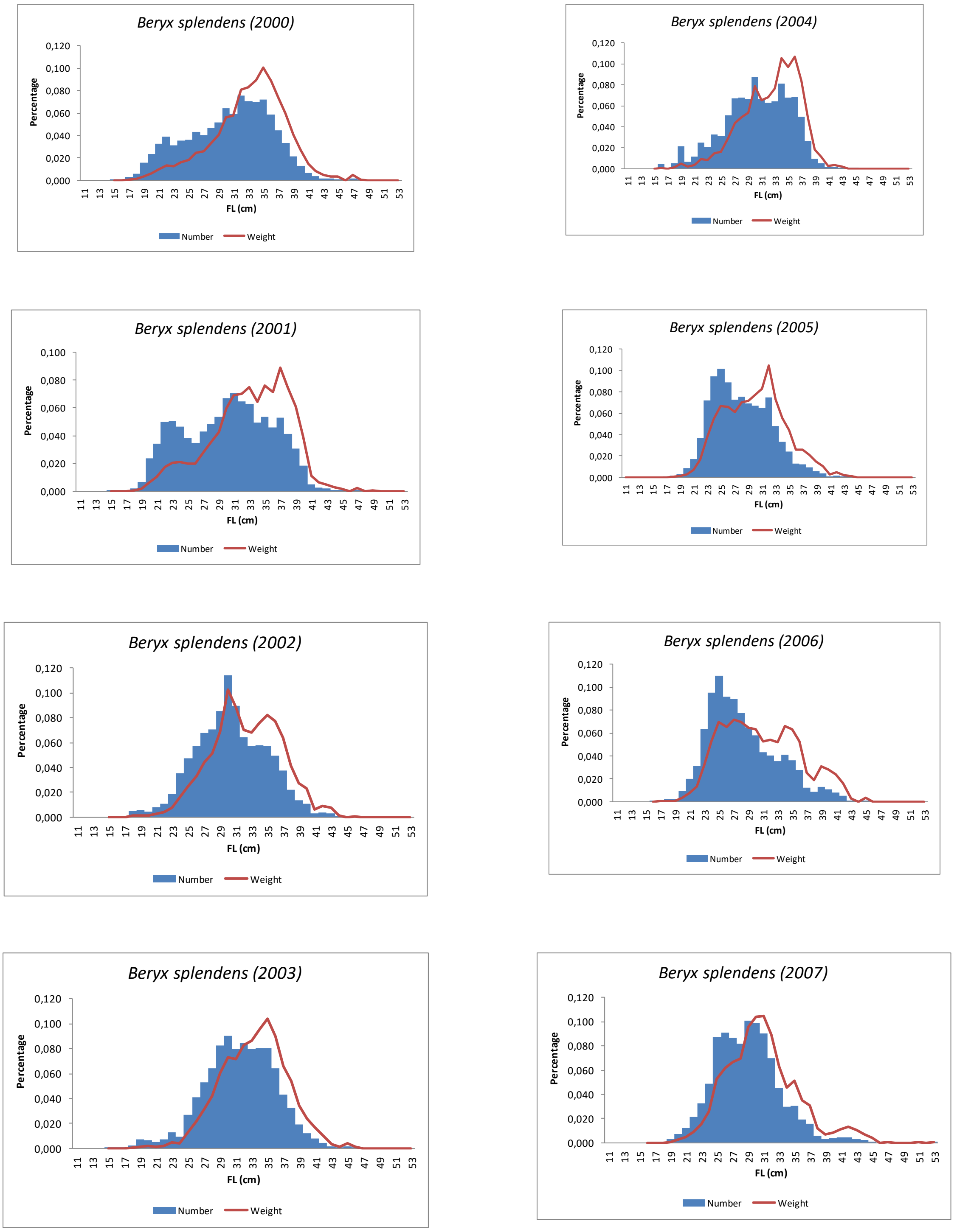


Figure 11.6 (Cont). *Beryx splendens* Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.

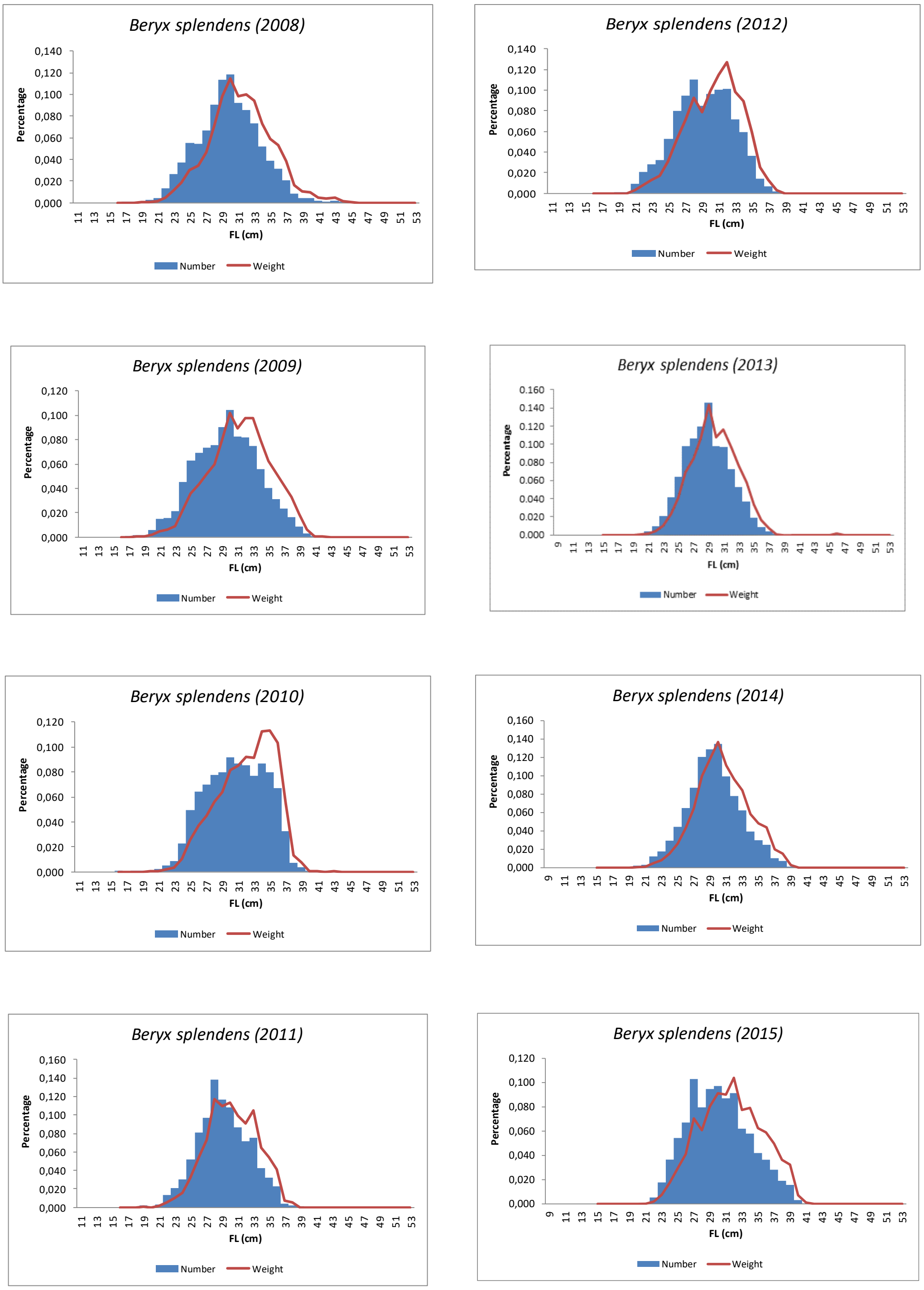


Figure 11.6 (Cont). ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

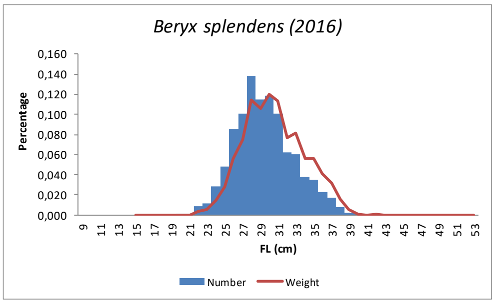


Figure 11.6 (Cont). *Beryx splendens* Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.

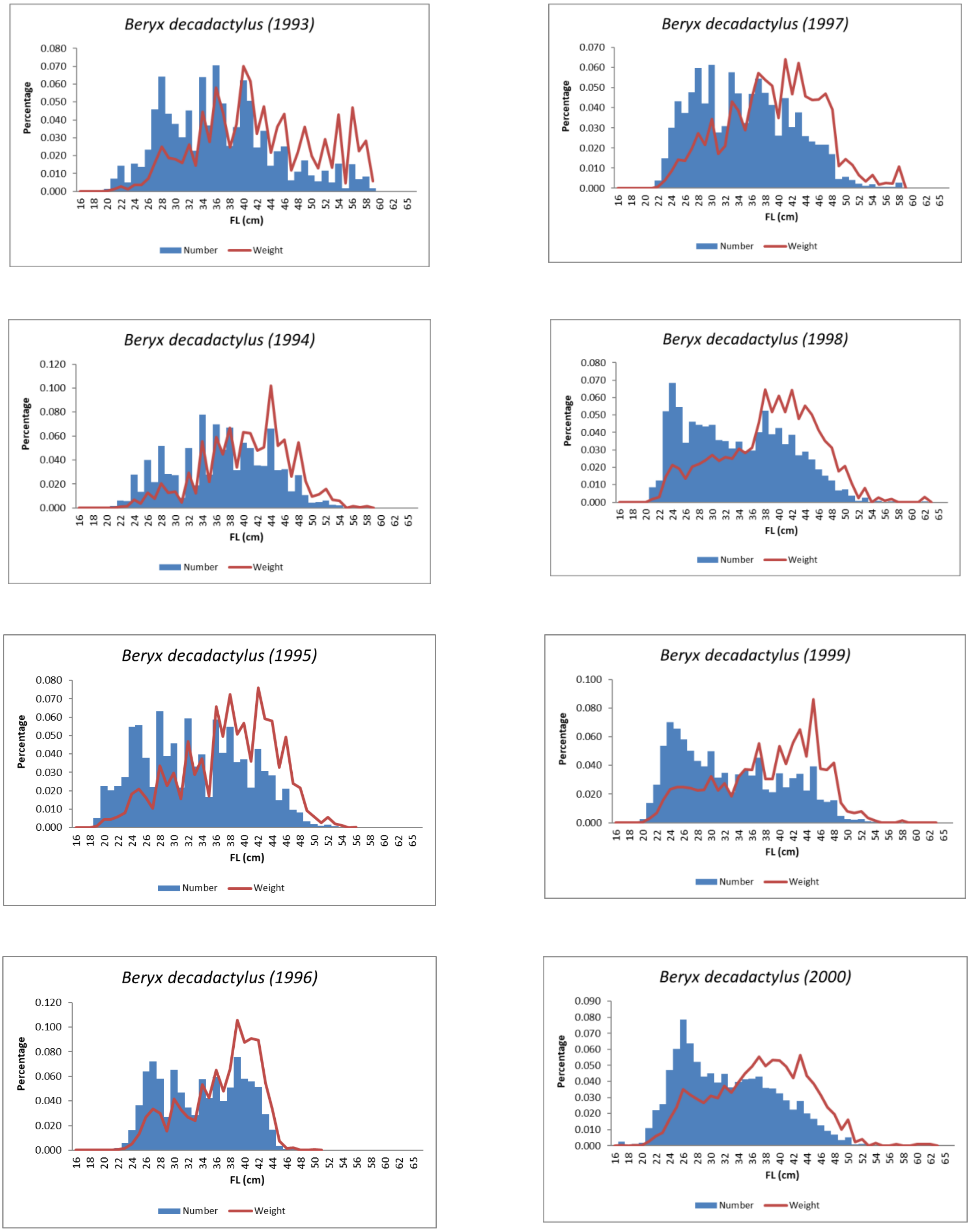
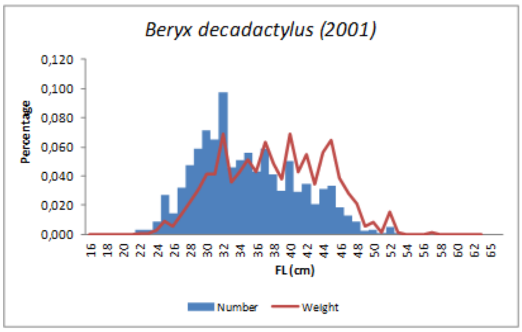
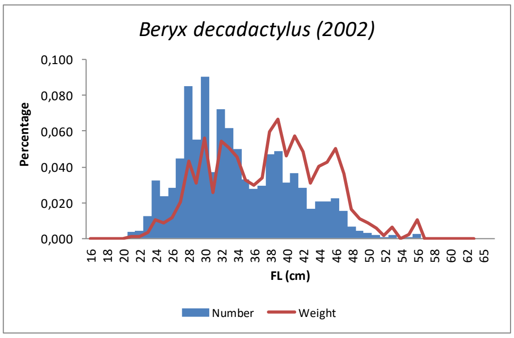
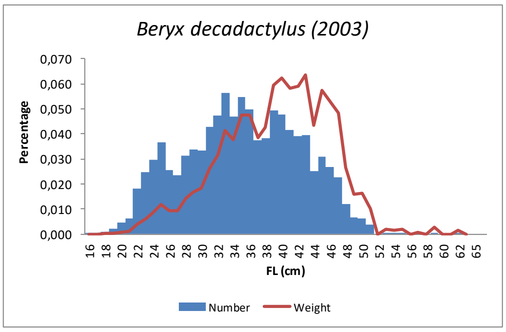
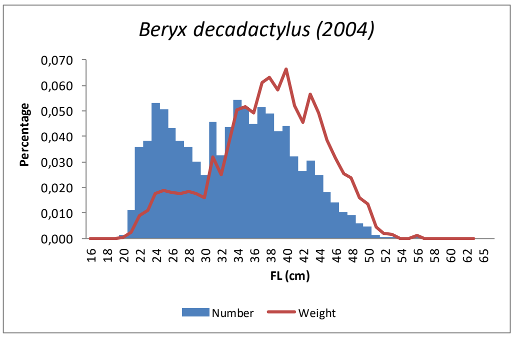


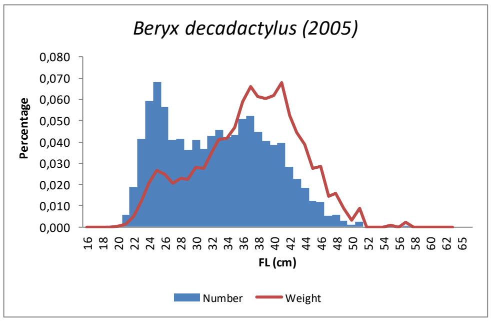
Figure 11.7. ***Beryx decadactylus*** **Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

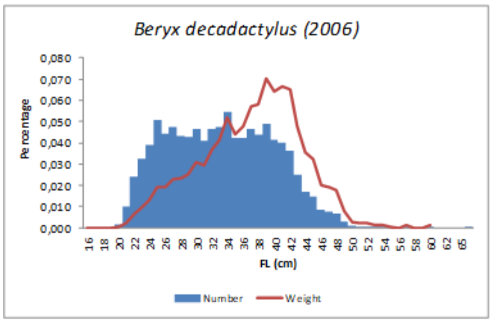


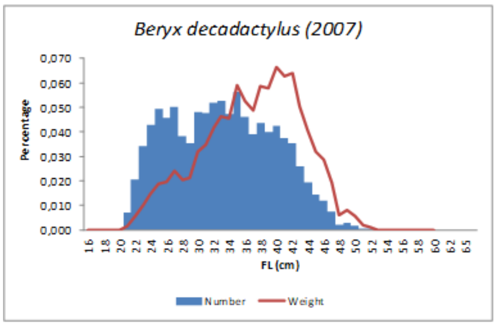












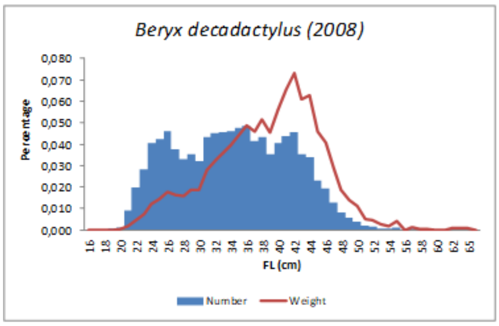


Figure 11.7 (Cont). *Beryx decadactylus* Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.

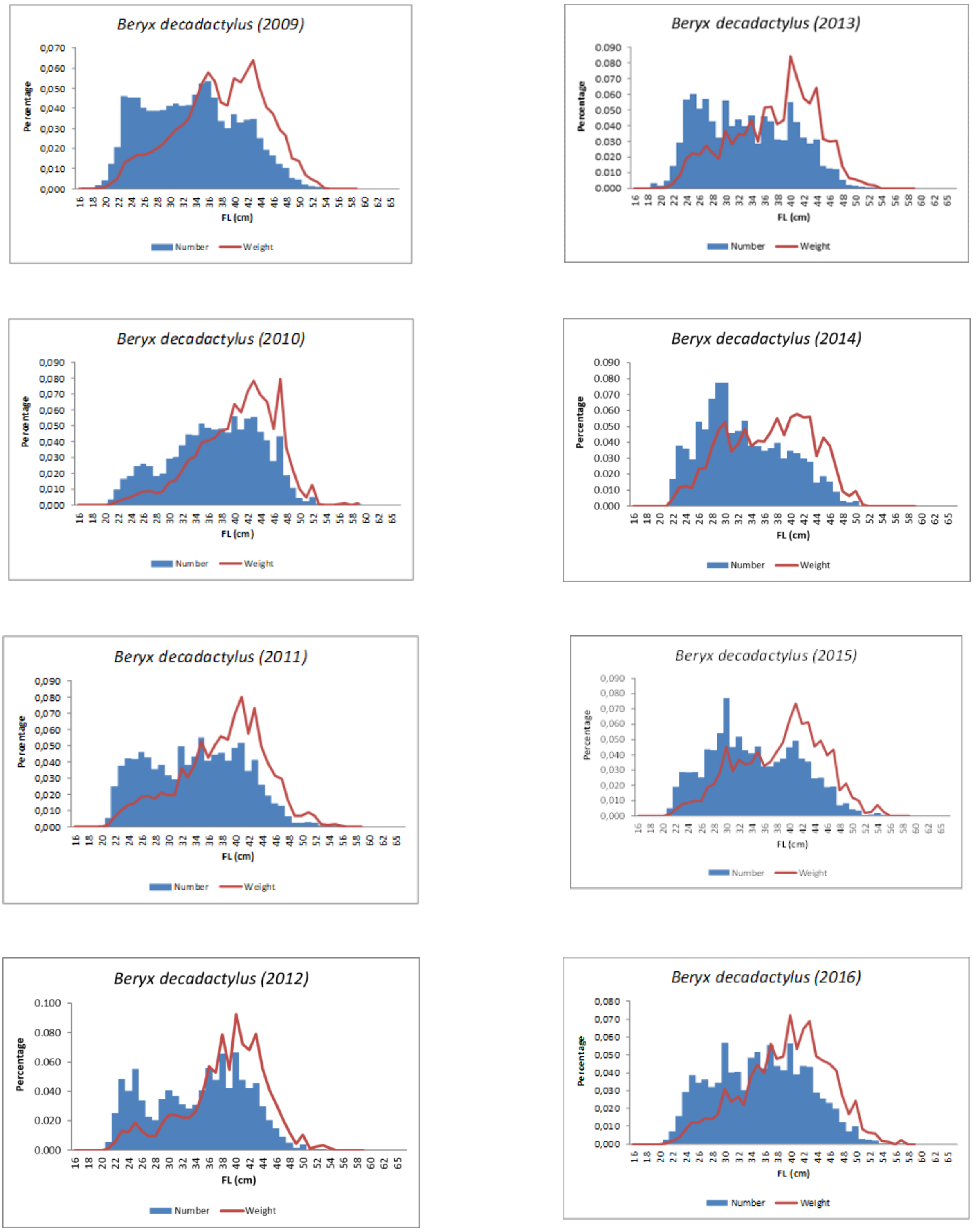


Figure 11.7 (Cont). ***Beryx decadactylus*** **Length distribution of the catch from the Azores (ICES Subarea 10a2). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

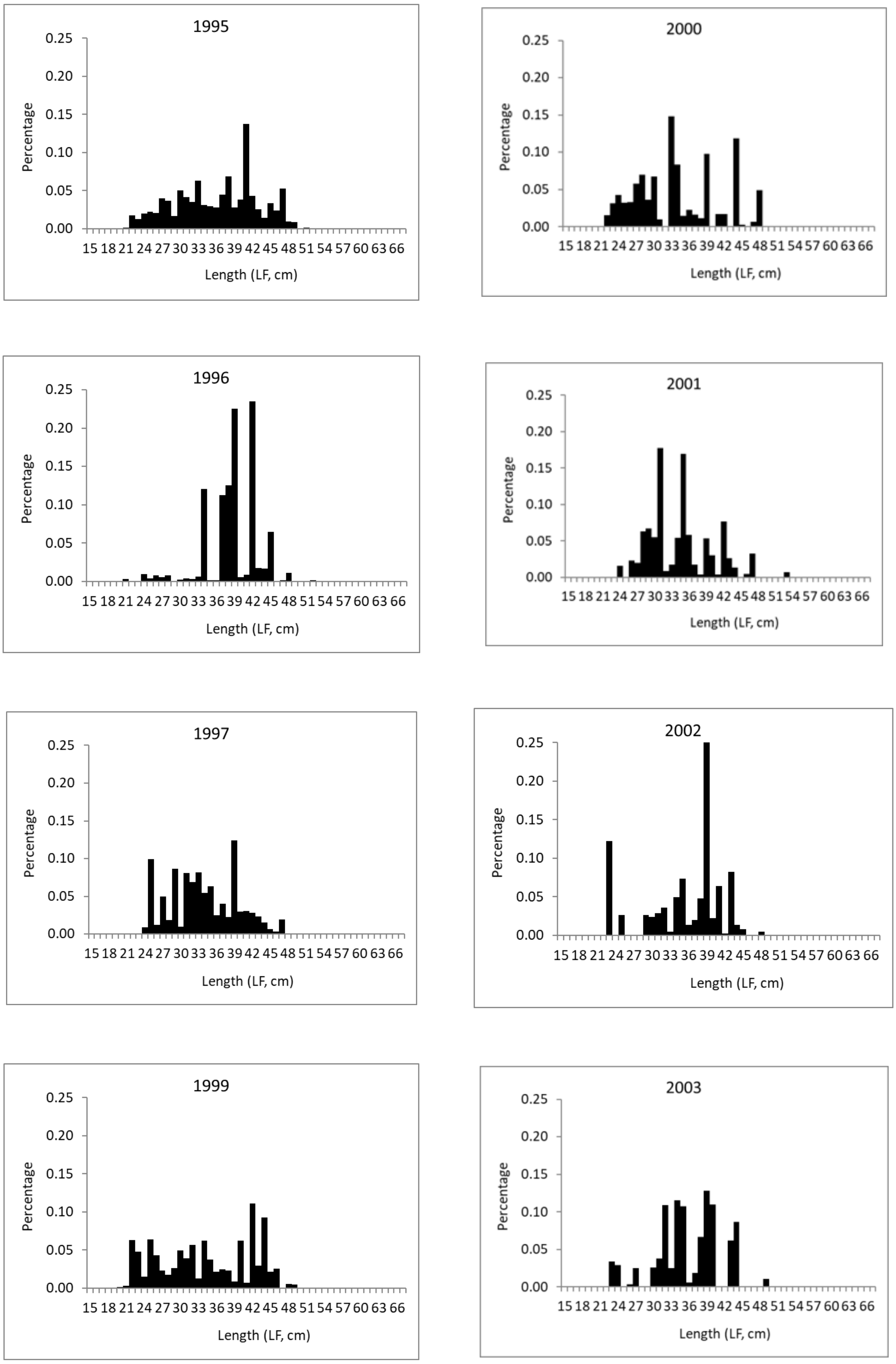


Figure 11.8. Beryx decadactylus survey length compositions by year from the Azores (ICES Subarea 10a2).

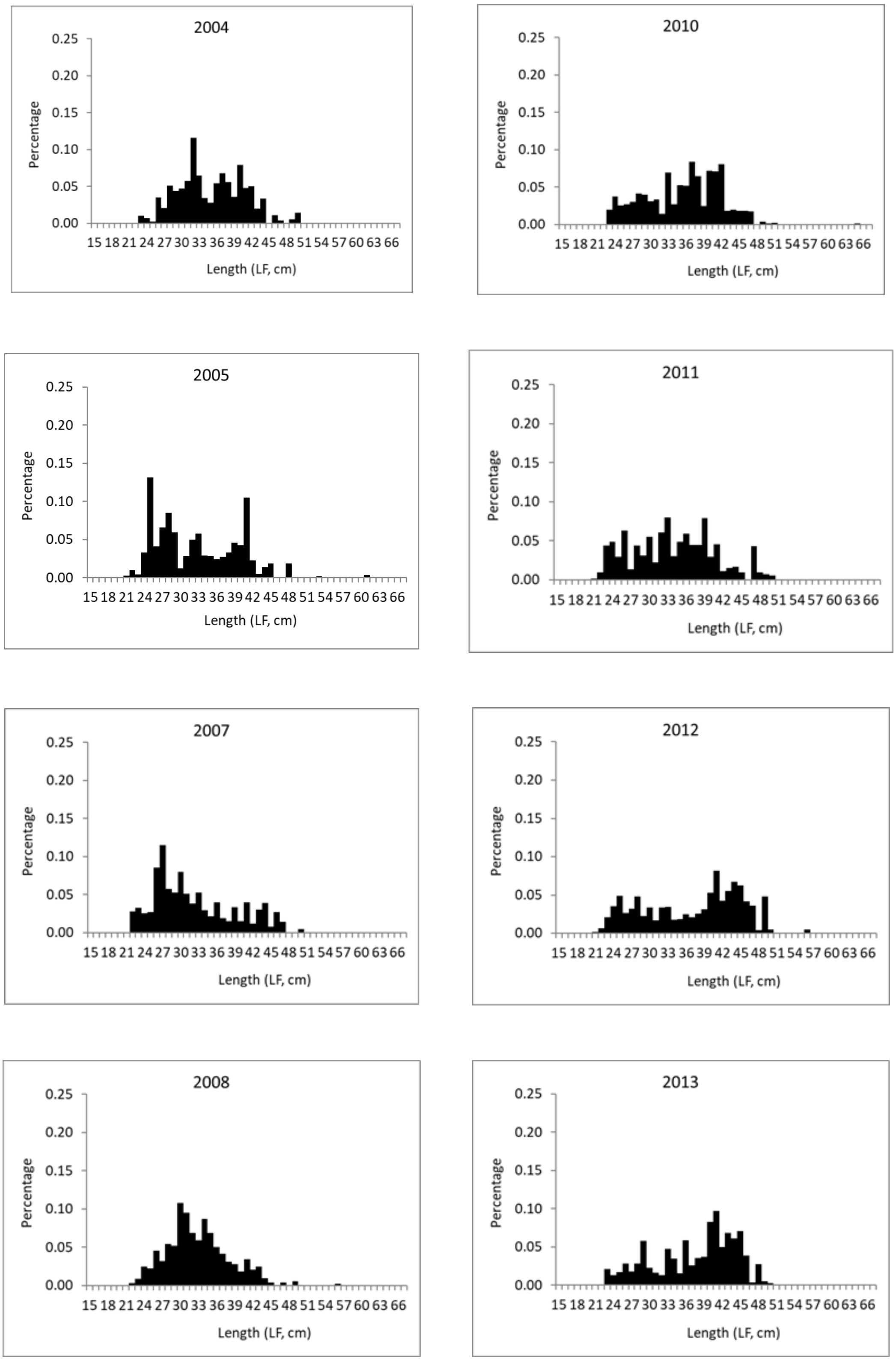


Figure 11.8 (Cont). ***Beryx decadactylus*** **survey length compositions by year from the Azores (ICES Subarea 10a2).**

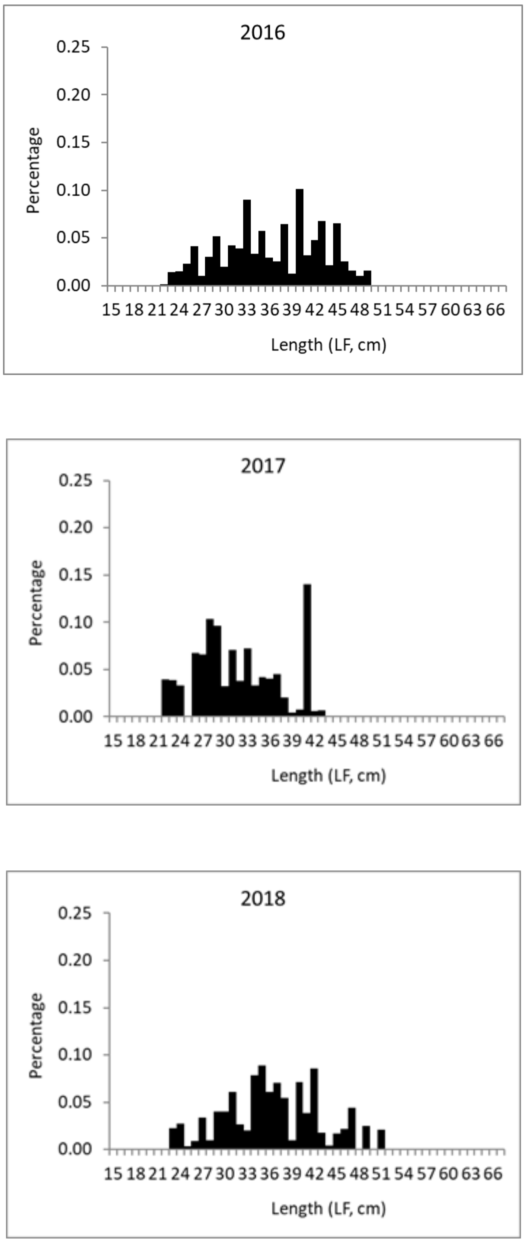


Figure 11.8 (Cont). Beryx decadactylus survey length compositions by year from the Azores (ICES Subarea 10a2).

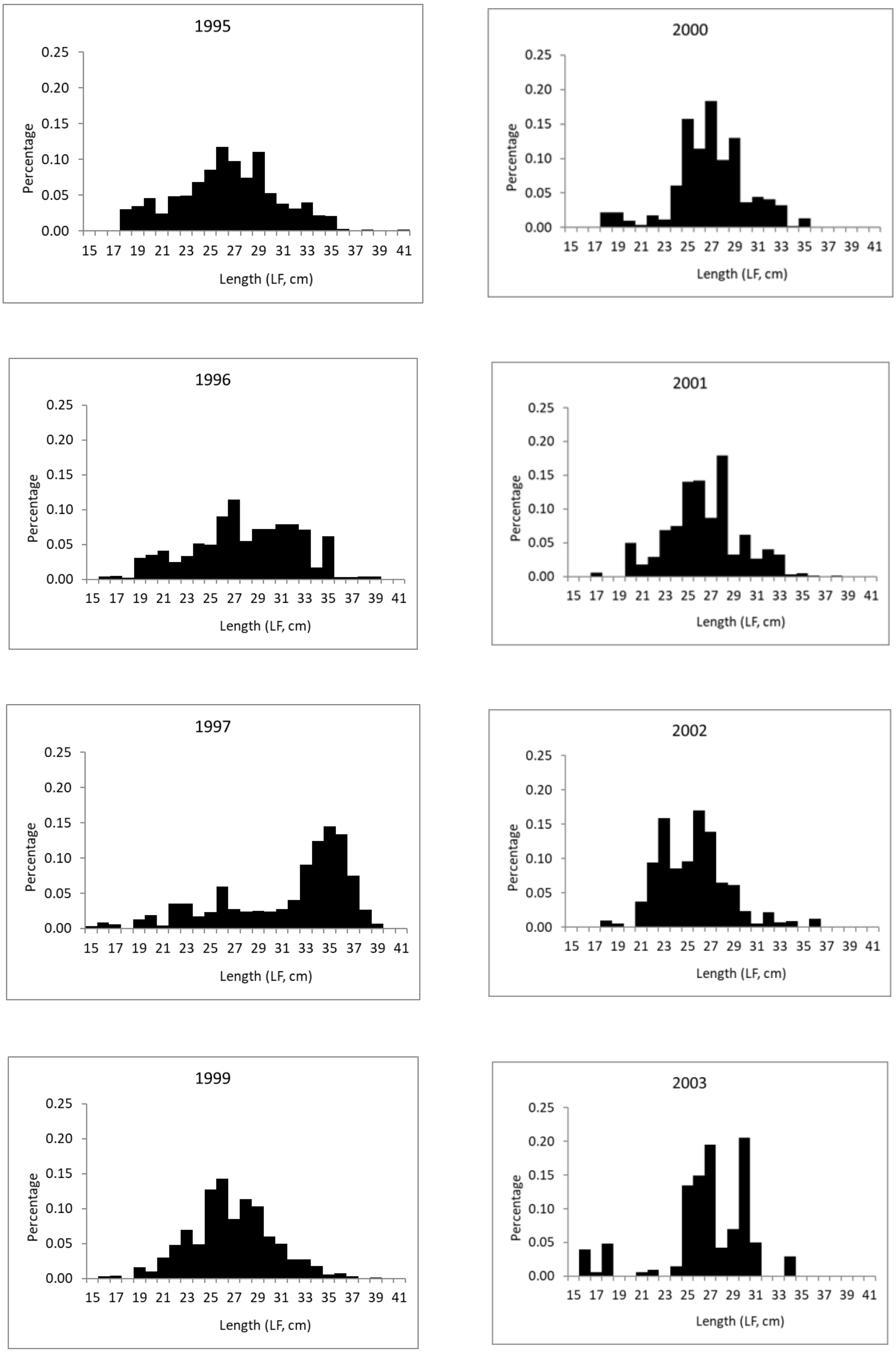


Figure 11.9. Beryx splendens survey length compositions, by year from the Azores (ICES Subarea 10a2).

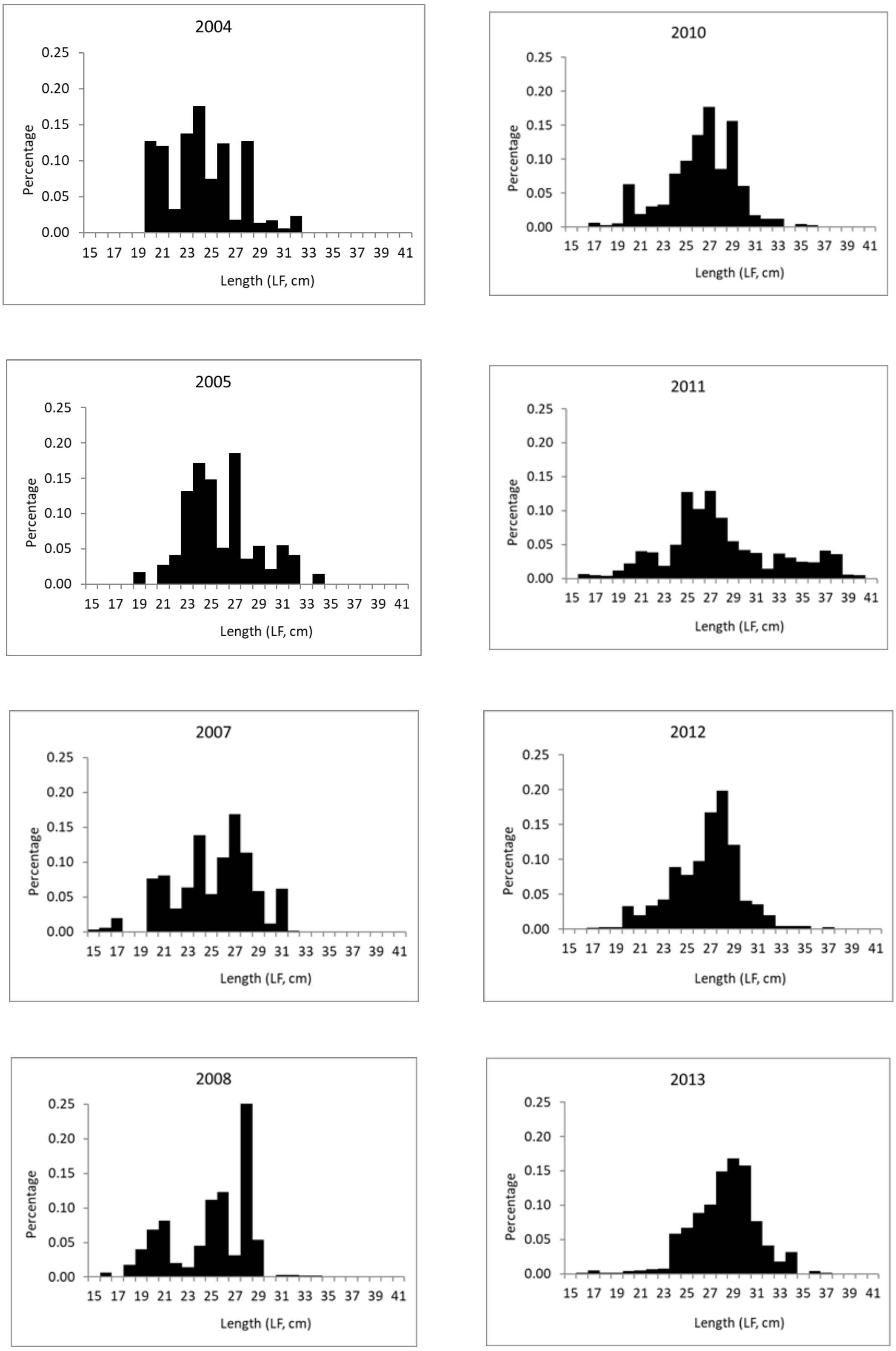
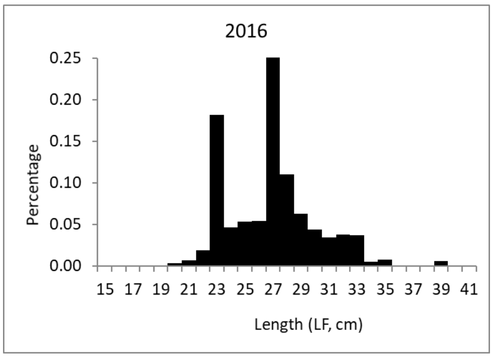
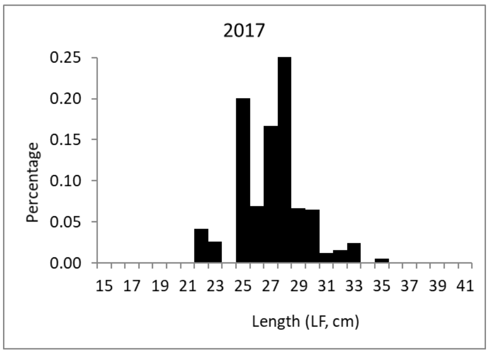


Figure 11.9 (Cont). Beryx splendens survey length compositions, by year from the Azores (ICES Subarea 10a2).





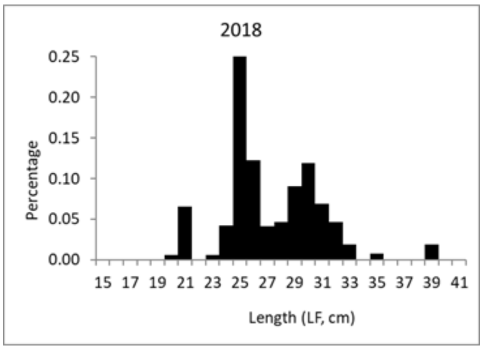


Figure 11.9 (Cont). Beryx splendens survey length compositions, by year from the Azores (ICES Subarea 10a2).

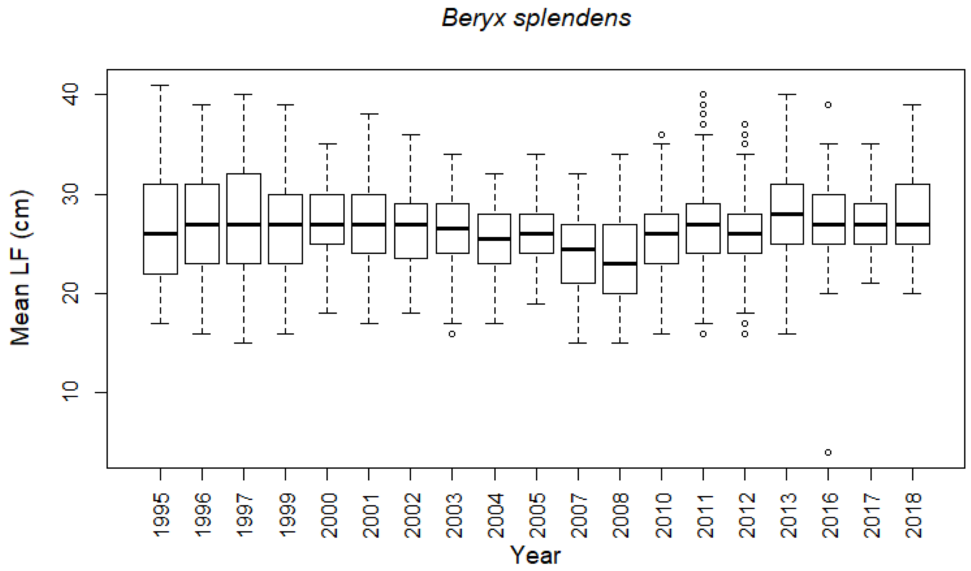


Figure 11.10. Annual mean length of *Beryx splendens* from the bottom longline survey (ICES Subarea 10a2).

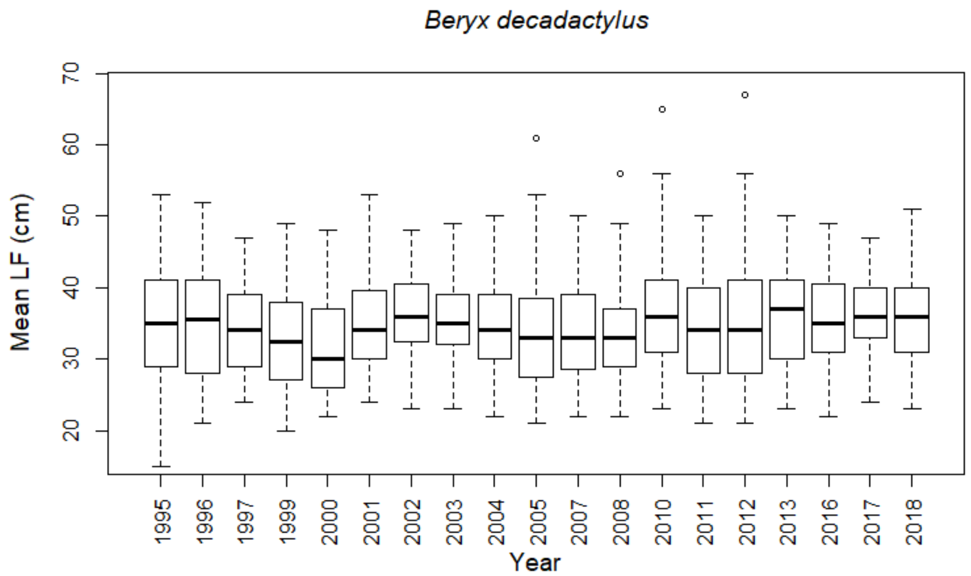


Figure 11.11. Annual mean length of *Beryx decadactylus* from the bottom longline survey (ICES Subarea 10a2).

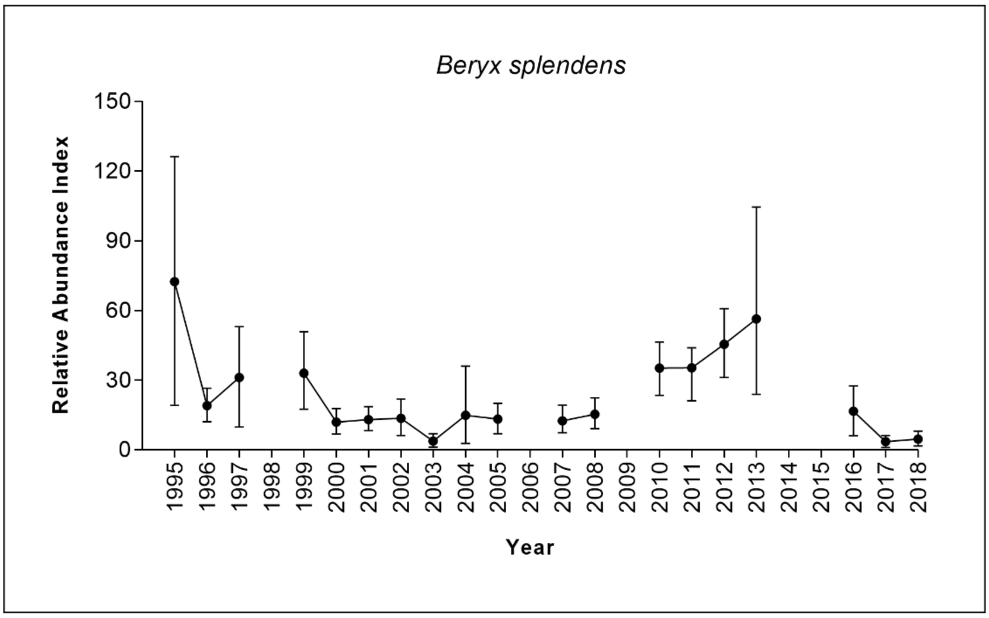


Figure 11.12. Annual bottom longline survey abundance index in number available for the alfonsinos (*Beryx splendens*) from the Azorean deep-water species surveys (ICES Subarea 10a2).

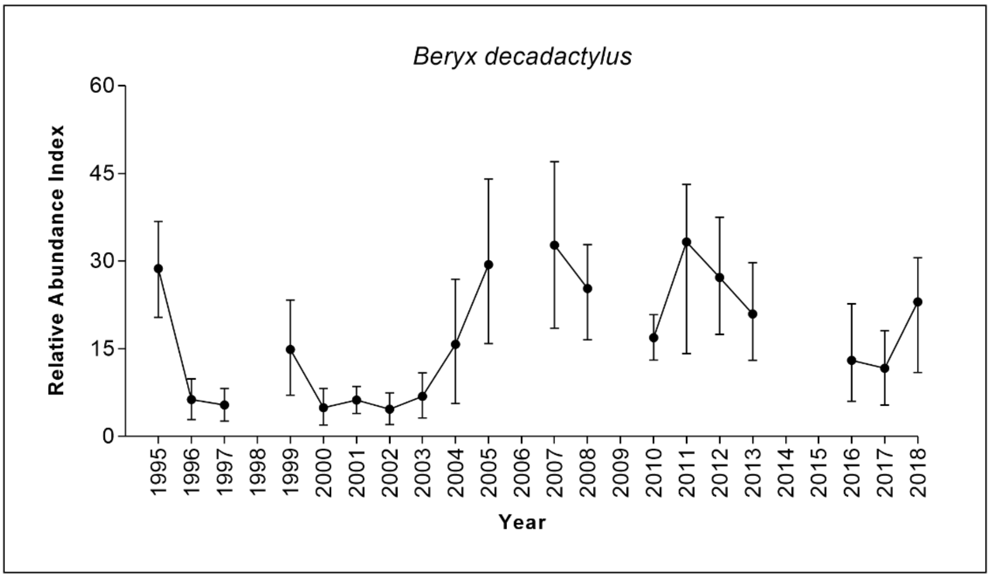


Figure 11.13. Annual bottom longline survey abundance index in number available for the golden eye perch (*B. decadactylus*) from the Azorean deep-water species surveys (ICES Subarea 10a2).

12 Blackspot seabream (*Pagellus bogaraveo*)

12.1 Stocks description and management units

ICES considered three different components for this species: a) Subareas 6, 7, and 8; b) Subarea 9, and c) Subarea 10 (Azores region).

The interrelationships of the blackspot seabream from Areas 6, 7, and 8, and the northern part of Area 9.a, 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 9.a where the main current fishery currently occurs.

Studies show that there are no genetic differentiation between populations from different locations within the Azores region (east, central and west group of Islands, and Princesa Alice Bank) but there are genetic differences between Azores (ICES Area 10.a.2) and mainland Portugal (ICES Area 9.a) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth, suggest that Area 10 component of this stock can effectively be considered as a separate assessment unit. Not genetic structure has been found on the Atlantic continental shelf with small genetic differentiation between the Mediterranean Sea and the Atlantic (Stockley *et al*., 2005, Pinera *et al*., 2013).

12.2 Blackspot seabream in Subareas 6, 7 & 8

12.2.1 The fishery

From the 1950s to the 1970s, the blackspot seabream was exploited mainly by French and Spanish bottom offshore trawlers, by artisanal pelagic trawlers in the eastern Bay of Biscay (ICES Divisions 8.a,b), and by Spanish longliners in the Cantabrian Sea (ICES Division 8.c), 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 (1988–2018), most of the estimated landings from the Subareas 6, 7 and 8 were taken by Spain (70%), followed by France (18%), UK (12%) and Ireland (1%).

The fishery in Subareas 6, 7 and 8 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 8 represent 67% and Subareas 6 and 7 33% of total accumulated landings. At present the blackspot seabream catches in these areas are almost all bycatches of longline and otter trawl fleets from France, Ireland and Spain.

12.2.2 Landings trends

Landings data by ICES Subareas reported to the working group are shown in Table 12.2.1a–c. Figure 12.2.1a presents an overview of the historical series of landings in Subareas 6, 7 and 8 since the middle of the last century. Figure 12.2.1b shows, in greater detail, landings of the same subareas since 1988. In 2014 UK (Scotland) reported landings for first time in 7.j, and Netherlands in 2017 and 2018 in Subarea 7. This ICES division is however part of the historical area of distribution of the species (Olivier, 1928; Desbrosses, 1932).

For these three subareas combined, landings decreased from 461 t in 1989 to 52 t in 1996, increased again to a peak in 2007 (324 t) and then decreased in parallel to the reduction of the TAC in following years from 256 t in 2014 and to 133 ton in 2018.

12.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017 and 2018.

12.2.4 Management

The EU TAC for the Subareas 6, 7 and 8 was set for fish time in 2003 and has been reduced since this year from 350 t to 144 t in 2017 Landings in 2007, 2010, 2012, 2015 and 2016 were slightly above the TAC. A minimum landing size of 35 cm applied from 2010 to 2012 and a minimum conservation reference size of 33 cm applies since 11 May 2017 (commission implementing regulation (EU) 2017/787 of 8 may 2017).

Pagellus bogaraveo		
year	TAC	landings
2003	350	129
2004	350	183
2005	298	158
2006	298	139
2007	298	324
2008	298	159
2009	253	203
2010	215	281
2011	215	177
2012	215	257
2013	196	295
2014	178	256
2015	169	177
2016	160	164
2017	144	124

The Common fisheries policy states that "Recreational fisheries can have a significant impact on fish resources and Member States should, therefore, ensure that they are conducted in a manner that is compatible with the objectives of the CFP" (Regulation (EU) no 1380/2013 of the European

Parliament and of the Council). Therefore a short account of regulations relevant to blackspot seabream in recreational fisheries is given here.

In Ireland and UK, there is no regulation applicable to recreational catches, however the Irish Specimen Fish Committee recommends that all recreational catches be returned alive, and the SI No. 747 of 2004 forbids commercial catching of blackspot seabream except where it is less than 5% of the total catch. In France, specific regulation for blackspot seabream set in 2019 forbids the landings of individuals smaller than 35 cm and the fishing of this species from 1 of January to 30 of June. Besides the French regulation forbids the catch, landing and sale of this species to the purse seine fleet and stablished several catch limits by trip or by year to the rest of the fleets (trawlers, gillnetters and liners)

Since 2019 Spain has been stablished closure areas with the aim to protect the juveniles of this species (MAPA 2019). The regulation bans the Spanish trawling and deep-water long-liners fleets to fish in several areas of the centre and west of Division 8.c from April to September.

12.2.5 Data available

12.2.5.1 Landings and discards

The Spanish, French and UK extended landing-series of *P. bogaraveo* in Northeast Atlantic were updated (Figure 12.2.1b). Landings in recent years dropped according to the continuous reduction of the biannual TAC since 2003.

Historically, discards are considered negligible and since estimates are available in 2014 they were reported an average of 1.8 t/in all subareas representing between 0.6%–1.7% of the annual catches. Discards resulting from low quotas are compulsory as the fishery for the species was closed. In 2015 and 2016, discards in French fisheries may have resulted from legal closures of quota (MEDDE, 2015; MEEM, 2016). As the blackspot seabream is a highly valued species, it is likely that these reported discards are carcasses in bad condition recovered from nets, misidentification of the species in on-board observation and discards related to low quotas.

Misidentification in on-board observation may occur as the species occurs at low abundance and for similar sparids species occur (*P. acarne*, *P. erythrinus*, *P. bellotii* and *Pagrus pagrus*).

12.2.5.2 Length compositions

Length–frequency distribution of commercial landings and discards in 2015, 2016 and 2018are presented (Figure 12.2.2). Length frequency distribution of discards reported data in InterCatch in 2017 were very scarce, therefore no length distribution for this year is presented.

12.2.5.3 Age compositions

No age data were available to the working group. No age estimations are carried out for this stock.

12.2.5.4 Weight-at-age

Mean size and weight-at-age (Table 12.2.2) derived from Guéguen (1969) and Krug (1998) were used by Lorance (2011) in a yield-per-recruit model to simulate the effect of fishing mortality on the blackspot seabream stock of Bay of Biscay.

12.2.5.5 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)).

12.2.5.6 Catch, effort and research vessel data

At the current level of abundance, the blackspot seabream is rarely caught in the northern surveys by French EVHOE IBTS (Divisions 8.f,g,h,j; 8.a,b, and 7.d), Irish IGFS (Divisions 6.a South and 7.b), by Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS) in Divisions 7.c and 7.k and in the Northern Spanish Shelf Groundfish Survey (SP-NGFS in Divisions 8c and 9a). In French surveys, similar to the current western IBTS, from early 1980s when the stocks were already low it was still in 40–60% of the hauls. This proportion dropped to close to zero by 1985 (Lorance, 2011). This observation indicates that the current survey is appropriate to detect and monitor a recovery of the stock if ever it happens.

P. bogaraveo is a scarce species in the Northern Spanish Shelf Groundfish Survey (Divisions 8c and 9a), on average since 1990 this species appeared only in the 2,3% of the total hauls (Figure 12.2.3). In 2014 for first time in last three years the Northern Spanish Shelf bottom-trawl survey (SP-NGFS) reported catches of only 0.02 kg/hour (juveniles from 21 cm to 24 cm). In 2015 this species reached a high abundance value compared to the mean values of the time-series, both in biomass and number, except the values of 1998 and 2005, unusually high. In 2016, this species was only found in three hauls and the stratified biomass was 0.031 $Kg{\cdot}haul^{-1}$. This last survey the biomass and abundance dropped after the slight increase of 2015. In 2017, both biomass (0.01 ± 0.01 $Kg{\cdot}haul^{-1}$) and abundance (0.07 ± 0.07 $ind{\cdot}haul^{-1}$) kept the decreasing trend after the peak in 2015. The few specimens found this last year ranged from 22 cm to 27 cm, similar to 2016 but with the absence of the smallest individuals between 19 cm and 21 cm and also those largest ones of 31 cm. In 2017 the geographic distribution of *P. bogaraveo* remained similar to 2016, basically captured in the central area of the Cantabrian Sea. In 2018 both biomass (0.01 ± 0.01 $Kg{\cdot}haul^{-1}$) and abundance (0.06 ± 0.03 $ind{\cdot}haul^{-1}$) followed the decreasing trend after the peak in 2015 (Figure 12.2.4) Only six specimens were found this last year and ranged from 22 cm to 27 cm, as in 2017 (Figure 12.2.5). in 4 hauls mainly in the central area of the Cantabrian Sea (**Error! Reference source not found.**12.2.6) (Blanco *et al*., 2019)..

Catch of blackspot seabream in the EVHOE survey have been too rare to allow the calculation of a survey indicator. However, data from the survey are in accordance with a possible recent increase. In particular, a large catch of more than 1000 individuals occurred in the 2016 survey. Although, one single event is not significant, it is noteworthy that it occurred in the area where on-board observations of the species occur and fishers report an increase occurrence. These indications do not allow revising the stock status which should still be considered to lag below any possible reference point. They however imply that a rebuilding has probably started. A quick appraisal of the level of occurrence that would be expected if the stock rebuilt to past levels can be found from two surveys carried out in the Bay of Biscay only in 1973 and 1976 with the same protocol and gear as the current EVHOE survey, but covering only strata of Bay of Biscay shelf up to 200 m (Figure 12.2.7).

In 1973 and 1976, blackspot seabream was caught in 25% and 55 % of the hauls respectively (Figure 12.2.8). Since the start of the current survey series in 1987, it has always been caught in less than 5% of the hauls in the same strata, some years not at all. In the same strata, it was caught in one out of more than 60 in each of 2015 and 2016. Therefore a ten to thirty-fold increase in occurrence might occur to consider that the stock rebuilt to level from the 1960s and 1970s, where catch amounted to 15 000 t/year.

The current monitoring with on-board observations and the EVHOE survey is insufficient to monitor this rebuilding accurately, while the stock is still low. The increase occurrence in on-board observations is however consistent with fishers reporting more encounter. If the increase persists, which is likely under the current management, occurrences in on-board observations and the survey might become significant in the next few years.

12.2.6 Data analyses

Landings since 1988 are well below those recorded in the period from 1960 to 1986 in which landings ranged from 2000 t to up to 13 000 t (Figure 12.2.1a). Catches recorded in the surveys are very scarce and are mainly juveniles smaller than 30 cm.

There are reports from fishers that the abundance of the blackspot seabream is increasing to the north of the Bay of Biscay, between 47 and 48°N. This latitude range is the main area where small catch of blackspot seabream have occurred in the 2000. When TACs were set from 2003, there were some conflicts between métiers in this area mainly with small artisanal handliners requesting vessels targeting pelagic species, mostly sardine with trawls and seine, to avoid any bycatch of blackspot seabream. The introduction of the TAC and national quota had an impact on fishing practices.

In the same area, fishers report to encounter more frequently the species in recent years. This was investigated using on-board observations in French fisheries (Figure 12.2.9). The method used consisted in estimating the proportion of fishing operations where the species was caught (landings and discards combined) in French on-board observations to the south of 49°N. The limit at 49°N north was set to include the south of the Celtic Sea to the West of Brittany, where the species was historically abundant. This was made for all bottom trawls types combined and all bottom nets combined for years 2010 to 2016. Some increasing trend in the proportion of hauls with catch of the species can actually be seen for bottom trawls, although the proportion of positive hauls is still small (Figure 12.2.10).

12.2.7 Biological reference points

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

12.2.8 Management considerations

In the 2014 advice, ICES recommends the establishment of a recovery plan for the stock. This stock is collapsed and the advice is to reduce mortality by all means to allow the stock to rebuild, however nor a recovery plan nor scientific studies to support this recommendation have been ever applied in these subareas, only a minimum landing size of 35 cm was applied but only for the period from 2010–2012.

Measures should include protection for areas where juveniles occur. Recreational fisheries may be a significant proportion of the mortality of those juveniles owing to their coastal distribution. This was confirmed for the stock in Subarea 10 (Pinho, 2015).

The TAC was slightly exceeded in 2015, 2016 and 2018

12.2.9 References

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12.2.10 Tables and Figures

Table 12.2.1a. Blackspot seabream in Subareas 6 and 7; WG estimates of landings by country.

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	UK (Scot)	CH. ISLANDS	NETHERLANDS	TOTAL
1988	52	0	47	153		0		252
1989	44	0	69	76		0		189
1990	22	3	73	36		0		134
1991	13	10	30	56		14		123
1992	6	16	18	0		0		40
1993	5	7	10	0		0		22
1994	0	0	9	0		1		10
1995	0	6	5	0		0		11
1996	0	4	24	1		0		29
1997	0	20	0	36				56
1998	0	4	7	6				17
1999	2	8	0	15				25
2000	4	n.a.	3	13				20
2001	2	11	2	37				52
2002	4	0	9	13				25
2003	13	0	7	20				40
2004	33		4	18				55
2005	29		4	7				41
2006	36	0	8	19				63
2007	46	0	27	57				130
2008	39	0	2	22				63
2009	34	1	16	10				61
2010	22	0	40	1				62
2011	21		11	4				37
2012	38		118					156
2013	28		146	4				178
2014	15		35	9	0			60

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	UK (Scot)	CH. ISLANDS	NETHERLANDS	TOTAL
2015	13	0	21					34
2016	24	0	15	1	0			40
2017	15	1	19	1		0	0	37
2018	17	0	2	1			1	22

Table 12.2.1b. Blackspot seabream in Subarea 8; WG estimates of landings by country.

YEAR	FRANCE*	SPAIN	UK (E & W))	TOTAL
1988	37	91	9	137
1989	31	234	7	272
1990	15	280	17	312
1991	10	124	0	134
1992	5	119	0	124
1993	3	172	0	175
1994	0	131	0	131
1995	0	110	0	110
1996	0	23	0	23
1997	18	7	0	25
1998	18	86	0	104
1999	13	84	0	97
2000	11	189	0	200
2001	8	168	0	176
2002	10	111	0	121
2003	6	83	0	89
2004	37	82	8	128
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	5	137	0	142
2010	61	157	0	218

YEAR	FRANCE*	SPAIN	UK (E & W))	TOTAL
2011	19	122	0	141
2012	18	82	0	101
2013	26	91	0	117
2014	36	161	0	196
2015	18	125	0	143
2016	7	117	0	124
2017	3	85	0	89
2018	6	105	0	111

Table 12.2.1c Blackspot seabream in Subareas 6, 7 and 8; WG estimates of landings by subarea.

YEAR	6 AND 7*	8*	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

YEAR	6 AND 7*	8*	TOTAL
2007	130	193	324
2008	63	95	159
2009	61	142	203
2010	62	218	281
2011	37	141	177
2012	156	101	257
2013	178	117	295
2014	60	196	256
2015	34	143	177
2016	40	124	164
2017	37	89	126
2018	22	111	133

Table 12.2.2 Mean size and weight-at-age of Blackspot seabream 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

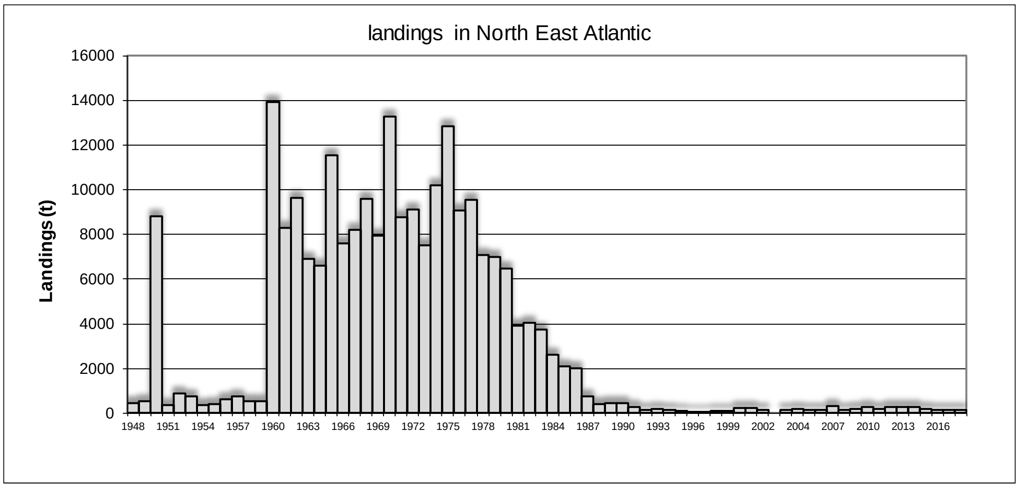

Figure 12.2.1a. Time-series of Blackspot seabream landings from 1948–2018 in Northeast Atlantic (Subareas 6, 7 and 8).

Reference/Source (1) of reconstructed landings data for blackspot 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 10: 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 9: 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 12.2.3. -Years 1983–1987: Landings of *P.bogaraveo* (*sic*) from Division 9.a correspond only to southern 9.a (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 12.2.4. -Years 1948–1984: Landings of *P.bogaraveo* (*sic*) from "Division 8.c" mainly Division 8.c (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 1988–2018 WGDeep official data

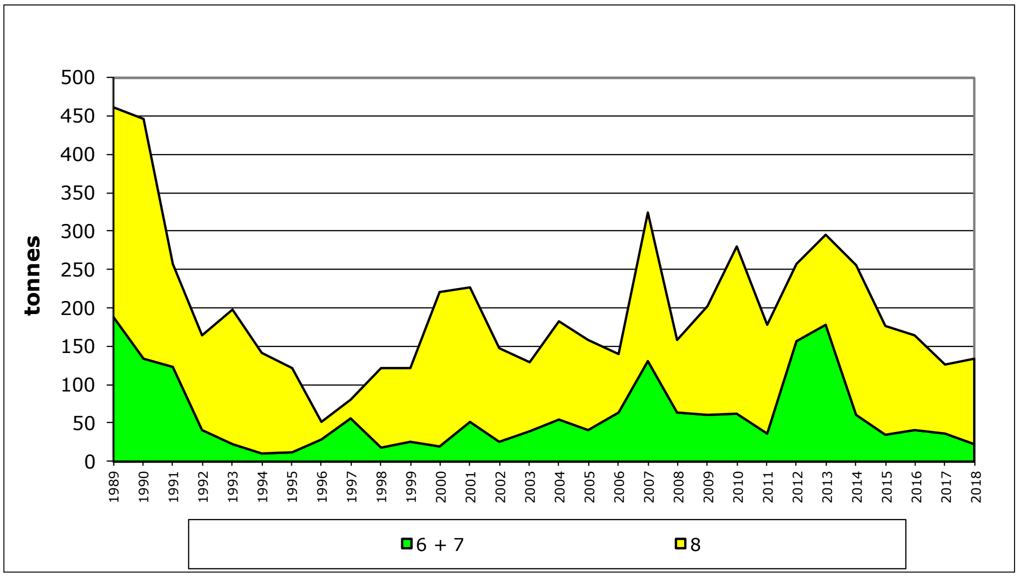

Figure 12.2.1b. Blackspot seabream landing trends in ICES Subareas 6 and 7 since 1988.

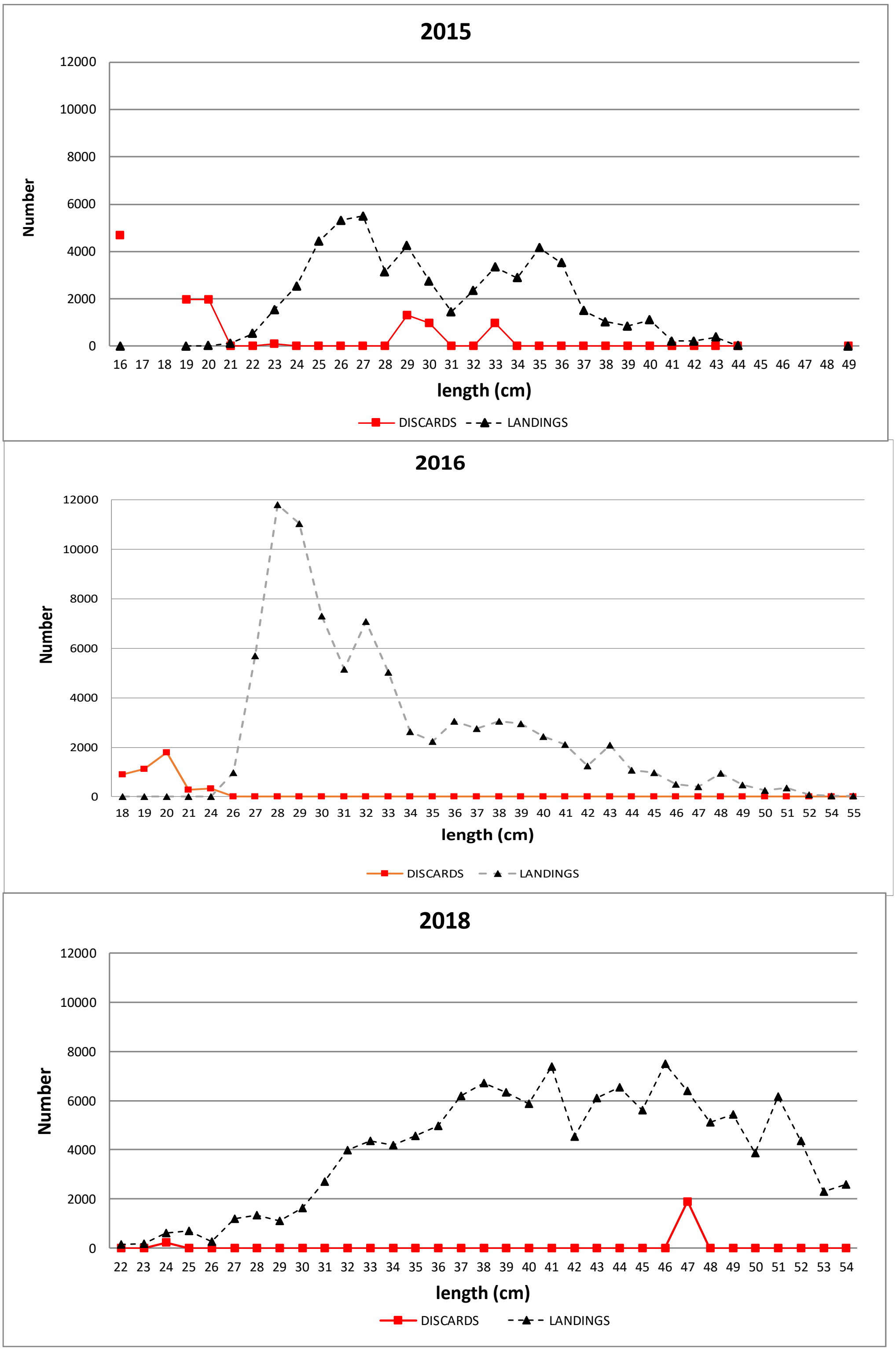

Figure 12.2.2. Length frequencies of the blackspot seabream in commercial catches, landings and discards in 2015, 2016 and 2018 in Subareas 6, 7 and 8.

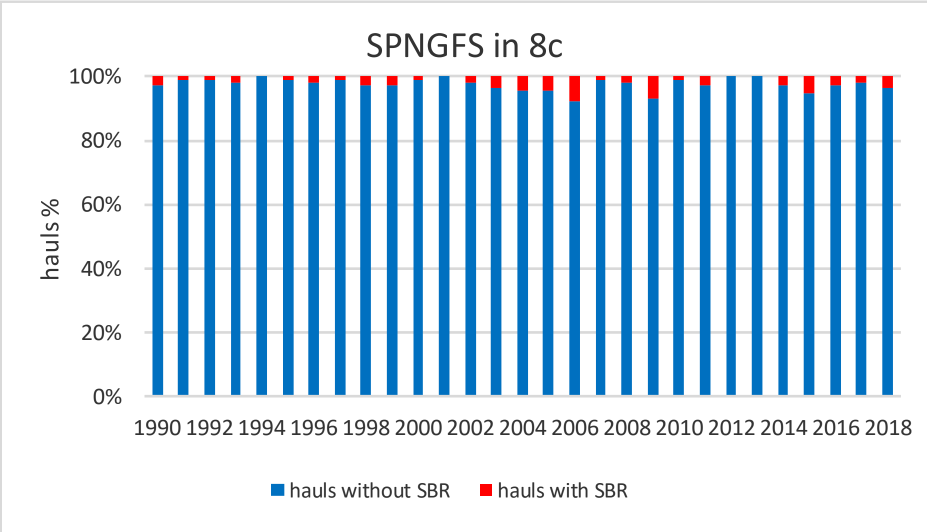

Figure 12.2.3. Occurrence (%) of the Blackspot seabream (P. bogaraveo) in Northern Spanish Shelf survey time-series (1990–2017).

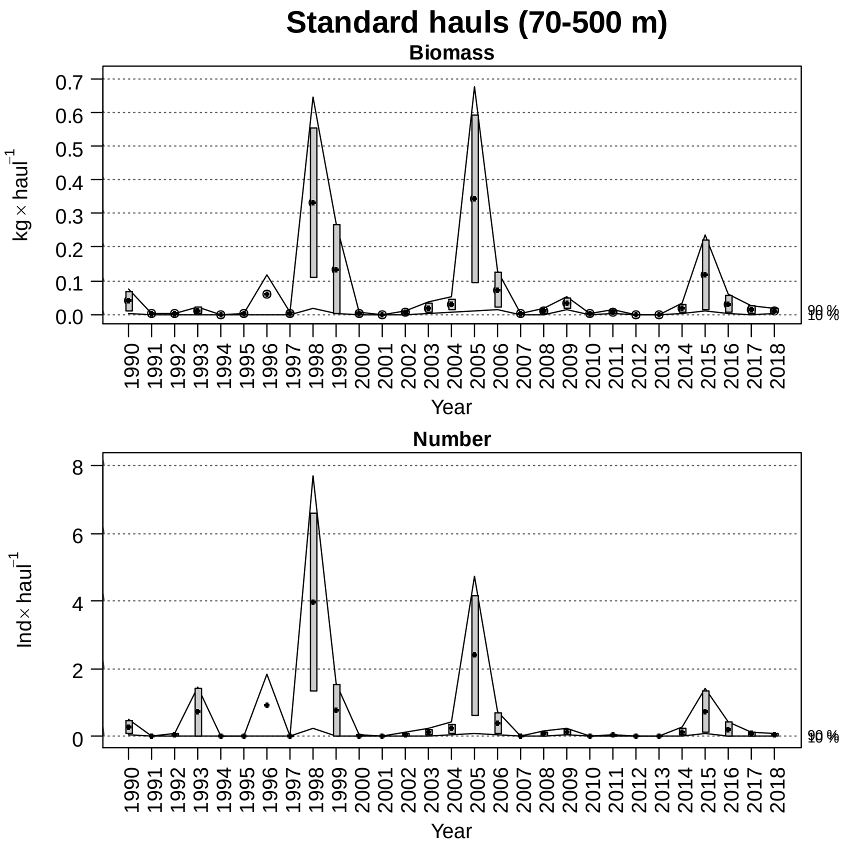

Figure 12.2.4. Evolution of Blackspot seabream (*P. bogaraveo*) mean stratified abundance in Northern Spanish Shelf survey time-series (1990–2018).

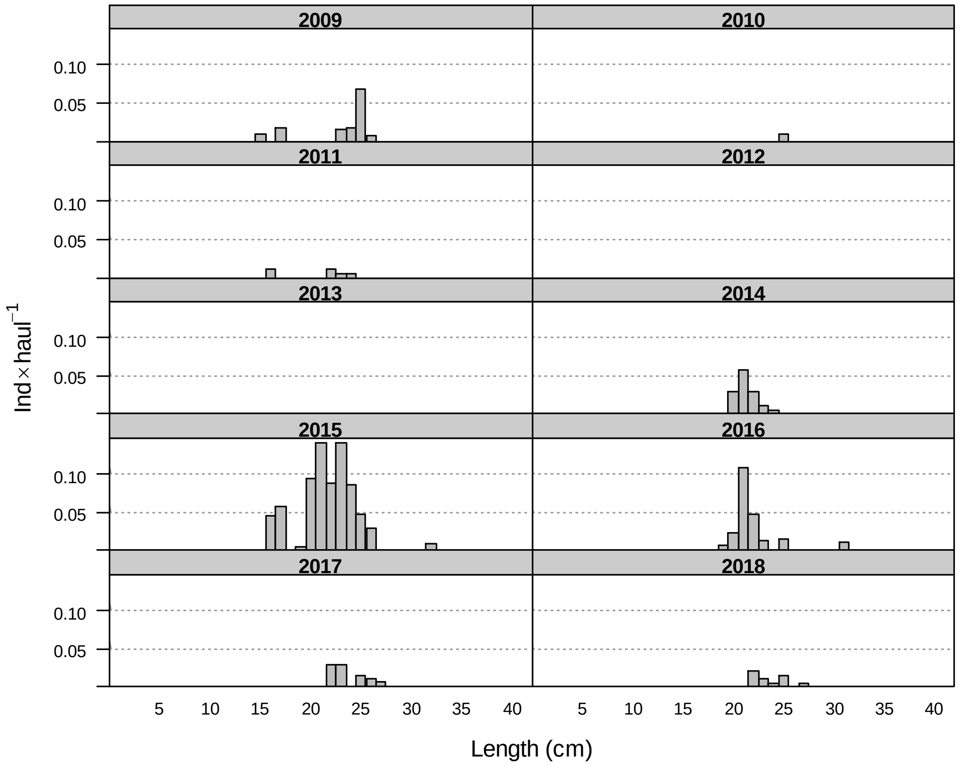

Figure 12.2.5. Mean stratified length distributions of Blackspot seabream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2009–2018), no data before 2009.

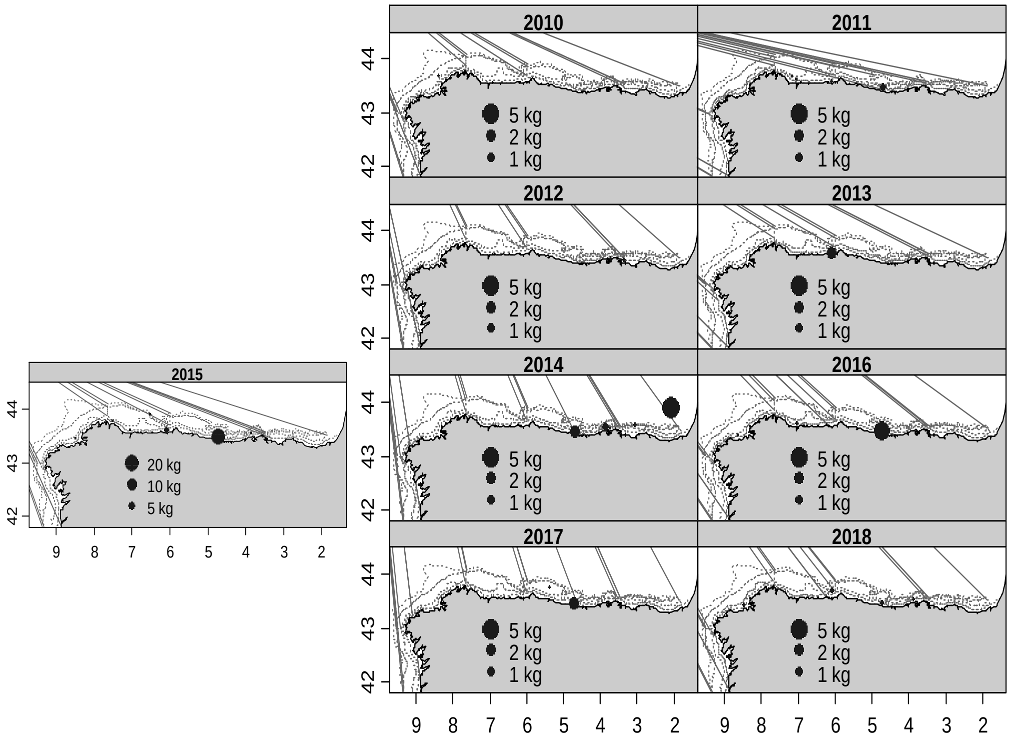

Figure 12.2.6. Catches in biomass of Blackspot seabream on the Northern Spanish Shelf bottom-trawl surveys, 2003–2018. 2015 survey is plotted apart due to scale problem.

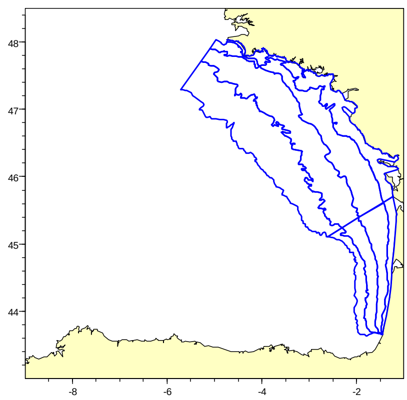

Figure 12.2.7. Strata covering the Bay of Biscay shelf, sampled in the current EVHOE survey and in two previous surveys in 1973 and 1976.

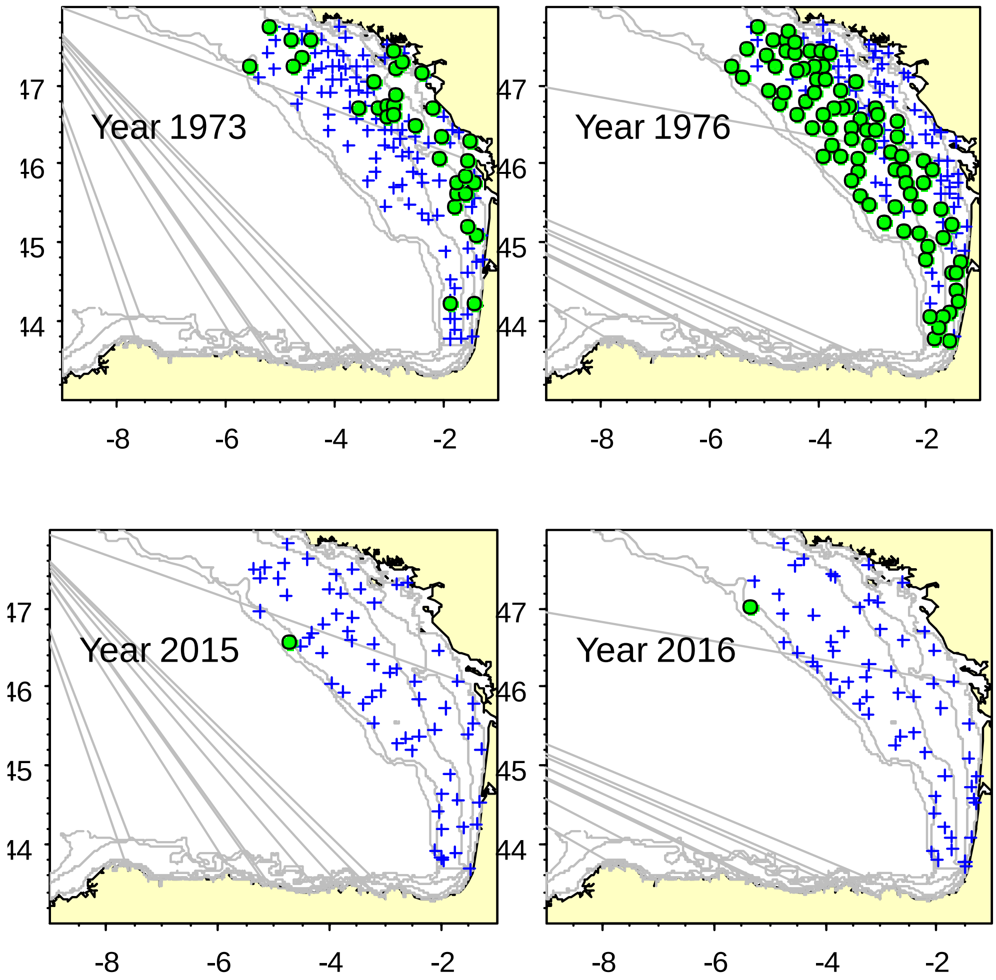

Figure 12.2.8. Occurrences of Blackspot seabream in surveys carried out in 1973 and 1976 and in the EVHOE survey in 2015 and 2016.

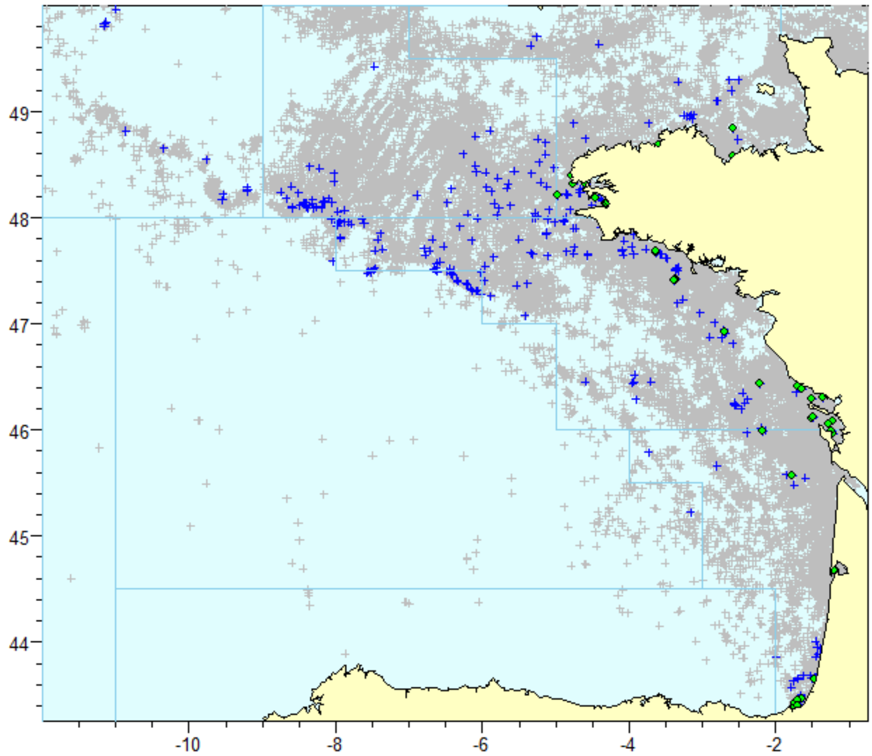

Figure 12.2.9. Geographical distribution on catch of the Blackspot seabream in French on-board observations 2010–2016 in the Bay of Biscay and southern Celtic Sea, all métiers. (Grey) all haul/sets observed, (Blue crosses) hauls with catch of blackspot seabream, (Green dots) hauls with catch of blackspot seabream<20 cm which species identification may be uncertain.

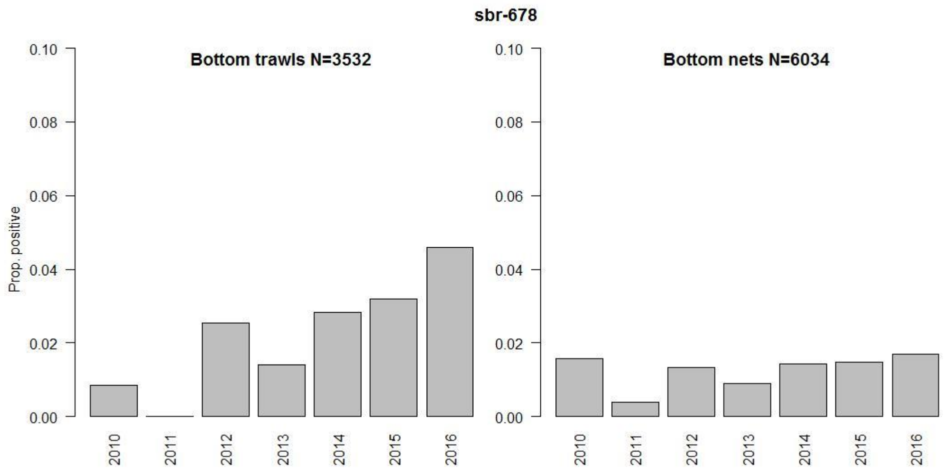

Figure 12.2.10. Proportion of fishing operations with catch of Blackspot seabream in bottom trawls (left) and bottom net (right) in French fisheries to the south of 49°N (ICES Divisions 8.a–d and the southern part of 7.d and 7.h–k).

12.3 Blackspot seabream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)

12.3.1 The fishery

Pagellus bogaraveo is caught by Spanish and Portuguese fleets in Subarea 27.9. Spanish landings data from this area are available from 1983, Portuguese data from 1988 and Moroccan information from 2001. European landings in Subarea 27.9, most of which are taken with lines, are from Spain (±60%) and Portugal (±40%) 2013–2018.

An update of the available information on the Spanish target fishery, from the southern part of Subarea 27.9, Strait of Gibraltar area, has been provided to the Working Group (Gil *et al.*, WD 10 to the 2019 WGDEEP). Currently, less than 40 Spanish vessels are involved in the fishery. The fishing grounds of the Spanish fleet are on both sides of the Strait of Gibraltar and near, i.e. mostly less than 20 nautical miles, the main ports (Tarifa and Algeciras). It should be noted that not all the catches/landings come exclusively from ICES Subarea 9: however it was considered from the same stock although the fishing grounds encompass areas of different Regional Organizations/Commissions (ICES, GFCM and CECAF). Fishing takes advantage of the fluctuation of the tide at depths from 350 to 700 m with "*voracera*" gear, a mechanized handline. Since 2002 other artisanal vessels have joined the blackspot seabream fishery from Conil port, although they operate in other fishing grounds and use longlines. This section of the fleet counts currently about six vessels. Landings are aggregated into commercial categories due to the wide size range of the catch and size varying prices. Historically these categories have varied with time but from 1999 onwards have remained the same in all ports.

In addition, Moroccan longliners have been fishing in the Strait of Gibraltar area since 2001. These are about 102 vessels that are mainly based in Tangier. The average technical characteristics of these vessels are: 20 GRT and 160 HP. Moreover, 435 artisanal vessels (±15 CV, ≤2 GRT and 4–6 m length) also target this species in the Strait of Gibraltar area (COPEMED II, 2015). The WG considers the account of Moroccan data appropriate as the fishery operates in the same area as the Spanish fishery and obviously targets the same stock. Landings information was also available from GFCM Subregional Committee on the Western Mediterranean meeting (2019).

Detailed information from Portuguese fisheries has been updated to the Working Group by Serra-Pereira *et al.* (WD 11 to the 2019 WGDEEP) and Farias and Figueiredo (WD 14 to the 2019 WGDEEP). As well as in other Spanish places in Subarea 27.9, it is admitted that there is no target fishery towards blackspot seabream in Portugal mainland although the species can be seasonally targeted: the species is usually caught as bycatch of fisheries targeting other species. The majority of deep-water species landings as fresh fish in mainland Portugal correspond to the polyvalent fleet, which uses mainly longlines, while landings from trawlers are the second more relevant. The main landing ports (≈89% of the species mainland Portugal total landings) from North to South are: Matosinhos, Aveiro, Nazaré, Peniche, Sesimbra and Sagres.

Peniche (Portuguese central western coast) is the most important landing port for blackspot seabream (landings between 1999 and 2018 represented nearly 50% of the Portuguese landings of the species in ICES 27.9.a. The species is mainly landed between December and March: this pattern could reflect differences on the species' availability (coinciding with the spawning season) or differences on skippers' seasonal fishing grounds preferences (Farias and Figueiredo, WD 14 to the 2019 WGDEEP).

12.3.1.1 Landing trends

Since 1990, the maximum catch was reached in 1993–1994 and 1997 (about 1000 t) whereas the minimum (167 t) in 2018 (Figure and Table 12.3.1). It should be noted that not all Spanish landings from the Strait of Gibraltar come from ICES Subarea 27.9. Moroccan landings are supposed to be outside ICES Subarea 27.9.

12.3.1.2 Ecosystem considerations

The Strait of Gibraltar plays a key role as a route of passage for many migratory marine species as well as an important foraging area: oceanographic features in this region generate upwelling of nutrient-rich waters and, therefore, a high primary production that can support a diverse food web. In this ecosystem, the blackspot seabream and the Atlantic bluefin tuna occupy high trophic levels. The dwindling black spot seabream catches in recent years coincide with the rebound of bluefin tuna biomass in the region, and so the blackspot seabream fishermen blame the scarcity of its catches to the pressure exerted by bluefin tuna on its target species, either directly by predation or indirectly by competition for the same resources. University of Cadiz (Spain) is running the VORATUN Project (CTM2017-82808-R: Study of blackspot seabream-bluefin tuna interactions in the food web of the Strait of Gibraltar with analysis of stomach contents and stable isotopes: Impact on fisheries), from 2018 till 2020, that hopefully will contribute to a better understanding of the possible relationships between both species.

Sanz-Fernández *et al*. (2019) suggests that the main factor responsible for the decline in the abundance of blackspot seabream in the Strait of Gibraltar is fishery overexploitation and that environmental conditions (such as water temperature anomaly, salinity anomaly and the NAO index) had a one-off effect which, depending on the year, favoured or harmed the recovery of the stock.

12.3.2 Advice

The ICES advice for 2019 and 2020 was "that when the precautionary approach is applied, catches should be no more than 149 tonnes in each of the years 2019 and 2020. All catches are assumed to be landed. ICES notes that the distribution of the stock extends outside Subarea 9. ICES recommends the establishment of a management plan that covers the entire stock distribution area."

12.3.3 Management

Since 2003, TAC and Quotas have been applied to the blackspot seabream fishery in Subarea 27.9. The table below shows a summary of *P. bogaraveo* recent years' TACs and European countries landings in this Subarea.

Pagellus bogaraveo **TACs and total landings in European countries in Subarea 27.9 in recent years.**

P. bogaraveo	2012–2013		2014–2015		2016–2017		2018–2019	
ICES Subarea	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings
9	780 – 780	295 –180	780 – 374	262 –153 (142*)	183 – 174	165 (77*) –130 (18*)	165 – 149	91 (4*) –

***from InterCatch info: landings from adjacent waters of the Strait of Gibraltar (FAO 34.1.11 and FAO 37.1.1).**

There is a minimum conservation reference size of 33 cm for this species in the Regions 1–5 (as defined in Article 2 of Regulation (EC) No 850/98) since 11 May 2017 (Commission Implementing Regulation (EU) 2017/787 of 8 May 2017). This size coincides with the previously applied in the Mediterranean Sea. The European Commission granted the exemption for the Strait of Gibraltar target fishery, which is expressed in the discard plan for certain demersal fisheries in South-Western waters for the period 2019-2021 (Commission Delegated Regulation (EU) 2018/2033).

European landings have always been below the adopted TACs although these have been reduced over the years. However, in the year 2016, considering other areas such as FAO 34.1.11 and FAO 37.1.1, European countries landings (242 t) are above the 2016 TAC (183 t) for ICES Subarea 27.9 (Figure 12.3.1).

12.3.4 Stock identity

Stock structure of the species in ICES Subarea 27.9 is still unknown.

Several tagging surveys (56 days at sea in 2001, 2002, 2004, 2006 and 2008) have been conducted in the Strait of Gibraltar area. A total of 4500 fish were tagged, of which 404 recaptures have been reported. No significant movements have been observed, although local migrations were noted: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain within this area as a resident population (Gil, 2006). Recaptures of tagged fish have also been reported by the Moroccan fishery.

Farias and Figueiredo (WD 14 to the WGDEEP 2019) presents information on blackspot seabream spatial distribution from Portuguese research surveys, considering the relative frequency of fishing hauls with species catch rates higher than 5 specimens in the 1990-2017 surveys. It is concluded that the species is not evenly distributed along the surveyed area, being more frequently caught at specific grounds, suggesting a patchy distribution. In the northern coast of Portugal, the species is caught down to 100 m deep, whereas preferred habitats are between 200 and 400 m deep in the southwestern coast (Figure 12.3.2).

12.3.5 Data available

12.3.5.1 Landings and discards

Historical landing data series available to the Working Group are described in Section 12.3.1 and detailed in Table 12.3.1. It should be noted that since 2015 Spanish landings include adjacent areas, not only ICES Subarea 27.9 (data are not separated in earlier years). Besides, Morocco landings from the Strait of Gibraltar area are available since 2001 and it supposed to take place outside ICES Subarea 9.

Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). For this species discards can be assumed to be zero or negligible for most assessment purposes and those that do occur are mainly related to catches of small individuals: therefore, for this stock, all catches are assumed to be landed at this moment.

12.3.5.2 Length compositions

Length frequencies of landings are available for the Spanish "*voracera*" blackspot seabream target fishery in the Strait of Gibraltar (1983–2018). Figure 12.3.3 show the updated length distribution data (from Gil *et al.*, WD 10 to the 2019 WGDEEP). The table below shows the mean and median landed size since 1997

Summary statistics of *Pagellus bogaraveo* landed sizes by year since 1997.

Year	Mean	Std. Dev.	Median	Year	Mean	Std. Dev.	Median
1997	35.98	8.58	35	2008	37.76	7.38	36
1998	34.33	8.96	34	2009	38.29	7.11	37
1999	36.23	7.63	36	2010	36.06	7.77	35
2000	36.79	6.88	36	2011	36.31	8.34	34
2001	37.11	7.14	37	2012	36.39	7.95	35
2002	38.10	6.95	38	2013	34.76	7.82	34
2003	38.35	7.12	38	2014	37.11	6.90	36
2004	36.56	7.68	35	2015	39.08	6.33	38
2005	36.79	7.78	35	2016	37.47	6.78	37
2006	35.87	8.08	35	2017	37.72	5.92	37
2007	37.26	7.43	36	2018	37.84	6.07	37

Only one mean value (in 1998) is lower than the 2013 year´s mean landing size. Median values are well below the mean in recent years. However, changes are small and gradual. There seem to be a long-term slight decline, despite the mean length ups and downs over the last decade (Figure 12.3.3).

Farias and Figueiredo (WD 14 to the WGDEEP 2019) present length the frequency distribution by fishing gear (and its correspondence to commercial size categories) for 2014 – 2016 landings in the port of Peniche (Figure 12.3.4).

12.3.5.3 Age compositions

Age and growth, based on otolith readings, were revised at the ICES WKAMDEEP2 meeting (September, 2018): A one-page template manual was first discussed and amended by the Group at the start of the meeting. Then this template was filled in for each species based on a demonstration of common practice by an expert reader of that species, followed by discussions in plenary. The finally agreed one-pagers are considered both necessary and sufficient as basis for a generic age reader of deepwater fish to be able to produce reasonably accurate and precise age estimates of each species. However, for this species the reading proved to be difficult, with low percentage of agreement (34.7) between the 12 participating age readers and high Coefficient of Variation (CV = 30.8), which is the consequence of low precision between the readers (i.e. difference of several years among readers for the same otolith). One of the reasons for these results might have been the inclusion of age readers with no or very limited experience. Restricting the comparisons to the two highest ranked readers for each species resulted in a reduction of CV to 15.7, close to the value that ICES (2013) considered more realistic and acceptable.

12.3.5.4 Weight-at-age

No new information was presented to the group.

12.3.5.5 Maturity and natural mortality

Blackspot seabream is a hermaphrodite species. Gil *et al*. (WD 10 to the 2019 WGDEEP) present the percentage of males, females and hermaphrodites from biological samplings as well as an estimation of length at which sex change occurs for several years (Figure 12.3.5 and Table 12.3.2).

Serra-Pereira *et al*. (WD 11 to the 2019 WGDEEP) give information about the survivability experiments in Portugal mainland. The observed survival rate of blackspot seabream captured by demersal longline after 6h was 97% and 86% after 36 hours, similar to those obtained for the same species in other areas and fisheries: the estimated survival rate for hooks and lines in the Azores Islands (ICES Subarea 10) was 90.2% (average husbandry of 21 days with an average transport duration of 36 hours) while for the "*voracera*" target fishery in the Strait of Gibraltar (ICES Subarea 9) it was 90.6% after 5 hours.

12.3.5.6 Catch, effort and research vessel data

Figure 12.3.6 and Table 12.3.3 present CPUE information, restricted to the Strait of Gibraltar fishery (Gil *et al.*, WD 10 to the 2019 WGDEEP). Effort, as indicated, from sales sheets is not standardized and is potentially underestimated in some years as the effort unit chosen may be inappropriate while standardized CPUE estimated from VMS analysis shows the same trend. Figure 12.3.7 and Table 12.3.4 present the summary statistics of the VMS index. In 2013, 2017 and 2018 the median value is 0, meaning that at least 50% of the target fishing trips got zero blackspot seabream catches.

Farias and Figueiredo (WD 14 to the WGDEEP 2019) identify two reference fleets landing at Peniche port: a total of 26 fishing vessels (with more than 9 fishing trips per year and more than 6 months with positive landings of the species) were selected for the polyvalent (longliners) while 4 fishing vessels (with more than 9 fishing trips per year and more than 5 months with positive landings of the species) were selected for the trawl fleet. The GLM estimates of the reference fleets' CPUE, considered as landed weight per fishing trip by year, for the selected model are also presented in the WD. Catch rates derived from longliners are slightly higher than those from trawl – this probably reflects a difference on the species length composition between the two fleets: trawlers mainly catch small size specimens while longlines catch larger ones.

12.3.5.7 Data analyses

The trend is fairly clear in the target fishery of the Strait of Gibraltar. Landings declined significantly until 2013 which may be considered as an indication of a substantial reduction in exploitable biomass. Current CPUE levels may also be consistent with an overexploited population. However, the analysis of the Portuguese (Peniche) reference fleets' CPUE is not in accordance with the decreasing trend from the Strait of Gibraltar target fishery: longlines and bottom trawl catch rates are relatively stable.

12.3.6 Management considerations

A TAC regime (149 t) was established for 2019 and 2020 for whole Subarea 27.9. Although the advice aims to reduce total catch within the whole fishing area, it should be noted that the current TAC does not limit the whole fishery because it only applies to Subarea 27.9, nevertheless catches in the GFCM area 37.1.1 and CECAF area 34.1.11 should be reported (Council Regulation (EU) 2016/2285). Recent landings are below the corresponding TAC levels but in 2016, European landings (including other areas such as FAO 34.1.11 and FAO 37.1.1) were above the 2016 TAC.

The combination of the minimum size of 33 cm for this species and the landing obligation (EU Regulation 2013/1380) might have an effect on certain fisheries: the exemption from the landing obligation of the target fishery of the Strait of Gibraltar "*voracera*" gear) does not yet apply to the blackspot seabream catches by the demersal longline fisheries in Portuguese Mainland waters (ICES Subarea 27.9).

WGDEEP reiterates its advice of a need for a recovery plan for the Strait of Gibraltar fisheries: vital to its success is the involvement of non-EU countries (primarily Morocco).

It should be noted that GFCM started a work plan to establish a management plan for this target fishery in 2019 (Recommendation GFCM/41/2017/2 on the management of blackspot seabream fisheries in the Alboran Sea, geographical subareas 1 - 3, for a two-year transition period). The 2019 SRC-WM endorsed the advice on the status of blackspot seabream in the Strait of Gibraltar – based on a combination of two production models (SPiCT and BioDyn) and a Length Cohort Analysis (LCA), all producing compatible results – whereby the stock was considered in overexploitation and overexploited, with current fishing mortality estimated to be around twice F_{MSY} and biomass considered to be between 14 to 22 % B_{MSY}. The SRC-WM also suggested that the experts would continue pursuing the benchmark work on this species during the intersession, submitting the information to the next meeting of WGSAD in November 2019 and/or perform any additional activity needed to submit final results to the next SRC-WM (GFCM, 2019).

As well as in other ICES Subareas (27.6, 27.7, 27.8 and 27.10), measures should include protection for areas where juveniles occur: recreational fisheries may be a significant proportion of the mortality of those juveniles owing to their coastal distribution.

Finally, it should be noted that the population occurring at the western coast of Portugal appears not to be adequately managed considering the status of the population heavily exploited in the Strait of Gibraltar. CPUE analysis of the Peniche reference fleets is not in accordance with the abundance trend from the Strait of Gibraltar "*voracera*" fleet. Therefore, it might not be appropriate to infer the population ecological status of *P. bogaraveo* in Portuguese waters based on Spanish data from the Strait of Gibraltar, where a target fishery takes place (Farias and Figueiredo, WD 14 to the 2019 WGDEEP).

12.3.7 Tables and Figures

Table 12.3.1. Blackspot seabream (*Pagellus bogaraveo*) in Subarea 27.9: Working Group estimates of landings (in tonnes). Spanish landings from 2012 are official statistics.

Year	Portugal	Spain	Morocco*	Unallocated	TOTAL
1983		101			101
1984		166			166
1985		196			196
1986		225			225
1987		296			296
1988	370	319			689
1989	260	416			676
1990	166	428			594
1991	109	423			532
1992	166	631			797
1993	235	765			1000
1994	150	854			1004
1995	204	625			829
1996	209	769			978
1997	203	808			1011
1998	357	520			877
1999	265	278			543
2000	83	338			421
2001	97	277	19		374 (19*)
2002	111	248	37		259 (37*)
2003	142	329	24		471 (24*)
2004	183	297	34		480 (34*)
2005	129	365	39		494 (39*)
2006	104	440	74		544 (74*)
2007	185	407	90		592 (90*)
2008	158	443	77		601 (77*)
2009	124	594	99		718 (99*)

Year	Portugal	Spain	Morocco*	Unallocated	TOTAL
2010	105	379	107		484 (107*)
2011	74	259	136		333 (136*)
2012	143	60	122	92	295 (122*)
2013	90	91	92		181 (92*)
2014	59	203	118		262 (118*)
2015	66	87 (142**)	219		295 (219*)
2016	70	95 (77**)	159		242 (159*)
2017	69	61 (18**)	188		148 (188*)
2018	58	29 (8**)	72		95 (72*)

***Morocco landings are available from the Subregional Committee on the Western Mediterranean 2019 meeting, which includes a benchmark workshop on blackspot seabream (GFCM SCR-WM 2019)**

****Figures in brackets includes blackspot seabream from other areas (FAO 34.1.11. and FAO 37.1.1).**

Table 12.3.2. Blackspot seabream Spanish biological samplings from the Strait of Gibraltar target fishery: estimation of Total Length (cm) at sex change (adapted from Gil *et al*., WD 10 to the 2019 WGDEEP).

Year	Number of samples	TL (cm)*	TL (cm)**	% of samples with TL between 29 and 40 cm
2003	391	39.0	36.0	55
2004	930	35.0	33.2	70
2005	310	38.9	34.9	53
2006	678	36.8	34.6	67
2007	584	37.6	34.9	68
2008	509	37.5	34.6	65
2009	325	38.5	35.7	65
2014	285	35.3	34.0	76
2015	238	34.0	33.6	93
		Mean= 36.96	Mean= 34.61	
		SD= 1.82	SD= 0.91	
* TL at sex change estimated from different length ranges by year				
**TL at sex change estimated from the same length range (290-400 cm) every year				

Table 12.3.3. Spanish "*voracera*" blackspot seabream fishery of the Strait of Gibraltar (ICES Subarea 27.9): Estimated CPUE using sales sheets or VMS data as effort unit (adapted from Gil *et al.*, WD 10 to the 2019 WGDEEP).

Year	cpue	VMS cpue
1983	78	
1984	76	
1985	71	
1986	61	
1987	76	
1988	73	
1989	89	
1990	77	
1991	70	
1992	86	
1993	85	
1994	94	
1995	60	
1996	104	
1997	77	
1998	61	
1999	55	
2000	45	
2001	56	
2002	47	
2003	53	
2004	47	
2005	68	
2006	70	
2007	51	
2008	52	
2009	67	55
2010	46	38

Year	cpue	VMS cpue
2011	42	31
2012	35	21
2013	30	14
2014	39	22
2015	49	32
2016	41	27
2017	33	14
2018	18	4

Table 12.3.4. Spanish “*voracera*” blackspot seabream fishery of the Strait of Gibraltar: Summary statistics from VMS CPUEs (adapted from Gil *et al*., WD 10 to the 2019 WGDEEP).

Year	#Fishing trips	Mean	Median	25%percentile	75%percentile
2009	8373	54.82	48.8	17.85	82.34
2010	7238	37.98	28.34	5.417	54.32
2011	6160	30.97	24.52	0	46.86
2012	3685	21.48	15.01	0	34.38
2013	2695	14.77	0	0	24.36
2014	4191	22.49	12.27	0	38.01
2015	4234	32.44	20.12	0	50.65
2016	2724	26.99	11.58	0	39.78
2017	1740	14.20	0	0	20.58
2018	1046	4.21	0	0	5.12

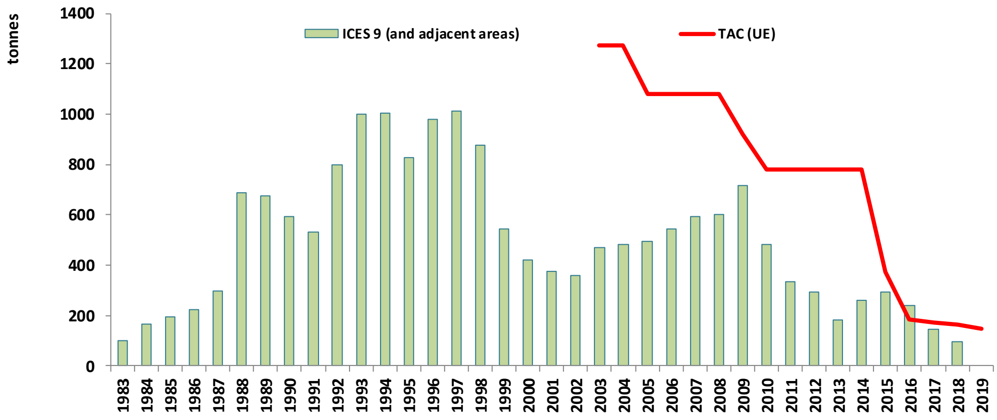

Figure 12.3.1. Blackspot seabream in ICES Subarea 27.9 (and adjacent waters): Total European landings (Morocco landings are not included) and EU TACs. Since 2015 landings from Strait of Gibraltar includes other areas (FAO 34.1.11 and FAO 37.1.1).

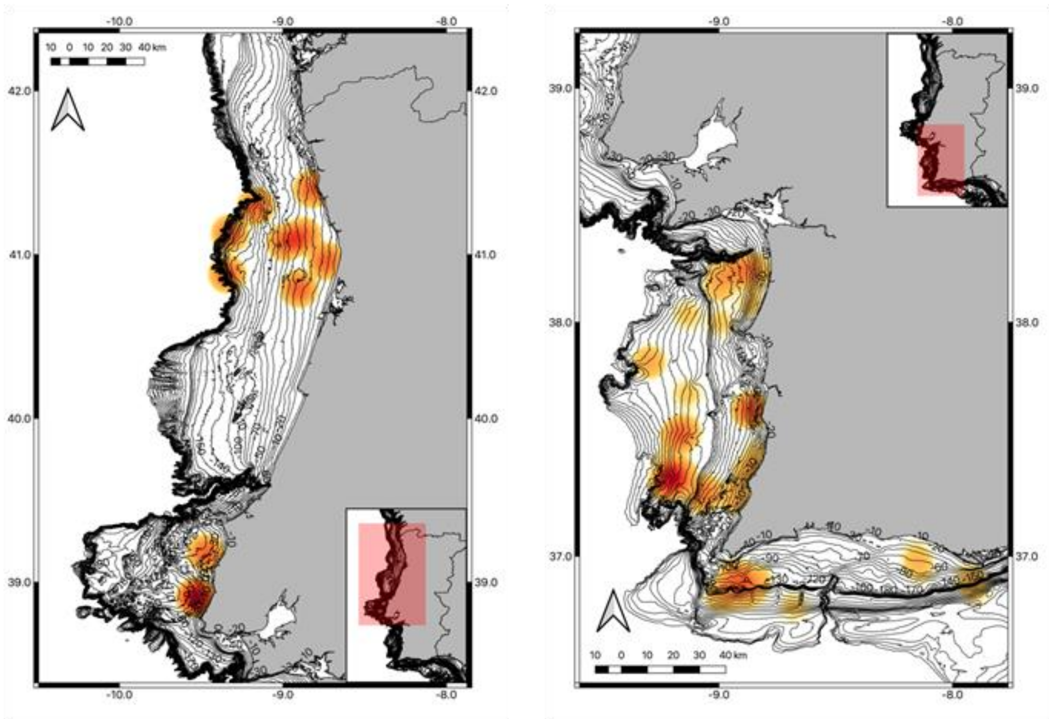

Figure 12.3.2. Blackspot seabream in ICES Subarea 9: Distribution *of Pagellus bogaraveo* along the Portuguese coast based on Portuguese surveys from the period between 1997-2011 and 2013-2017. The coloured blotches are hauls with *Pagellus bogaraveo* catches over 5 n.h-1. The colour intensity of the blotches reflects species occurrence (from Farias and Figueiredo, WD 14 to the 2019 WGDEEP).

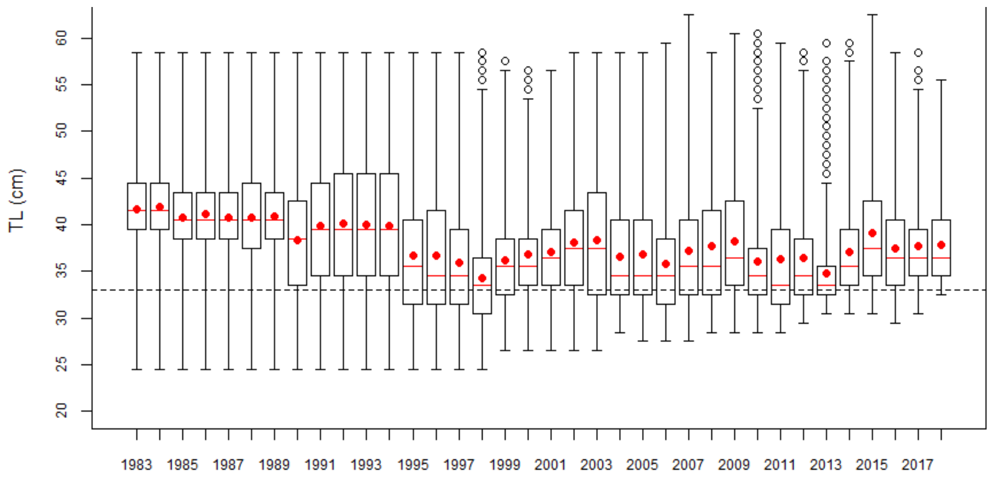

Figure 12.3.3. Spanish "*voracera*" blackspot seabream fishery of the Strait of Gibraltar: 1983–2018 (from Gil *et al*., WD 10 to the 2019 WGDEEP). Dashed line (at 33 cm) represents the current minimum landing size for the species in Atlantic NE and Mediterranean European waters.

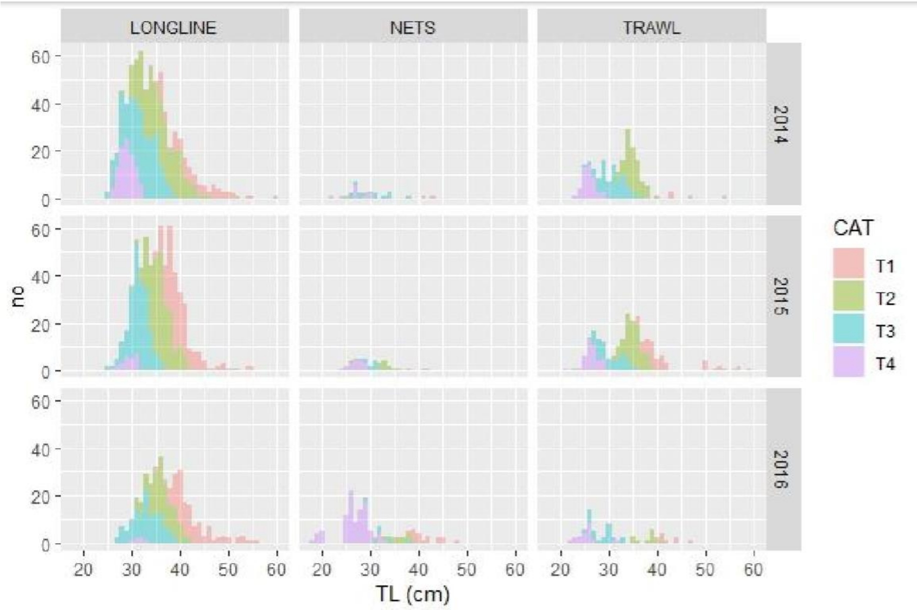

Figure 12.3.4. Peniche (Portugal) landing port: *Pagellus bogaraveo* length frequency distribution by fishing gear and its correspondence to commercial size categories for the year 2014 to 2016 (from Farias and Figueiredo, WD 14 to the 2019 WGDEEP).

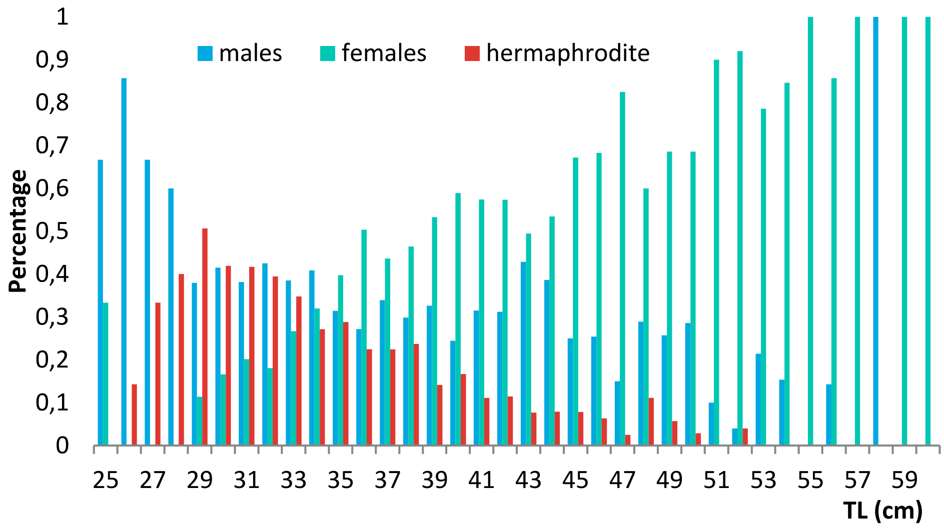

Figure 12.3.5. Blackspot seabream Spanish biological samplings from the Strait of Gibraltar target fishery: percentage of males, females and hermaphrodites by Total Length (cm) (from Gil *et al.*, WD 10 to the 2019 WGDEEP).

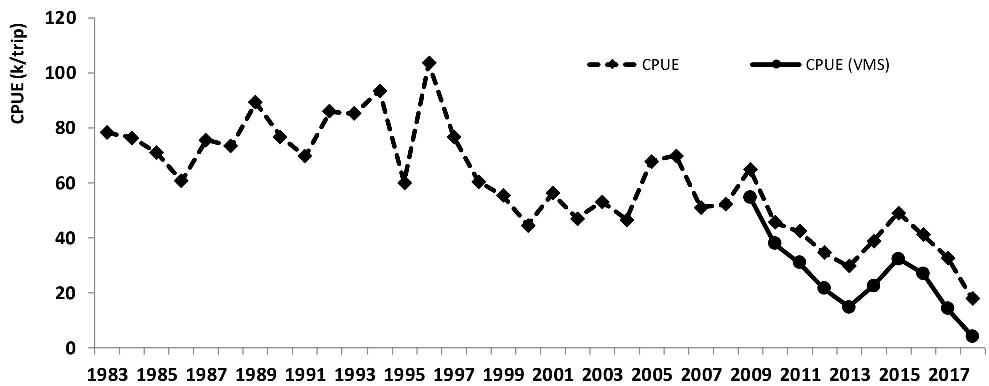

Figure 12.3.6. Blackspot seabream in ICES Subarea 27.9: Spanish "*voracera*" target fishery of the Strait of Gibraltar estimated CPUE, using sales sheets (dashed line: 1983-2018) and VMS data as unit of effort (solid line: 2009-2018) (from Gil *et al.*, WD 10 to the 2019 WGDEEP).

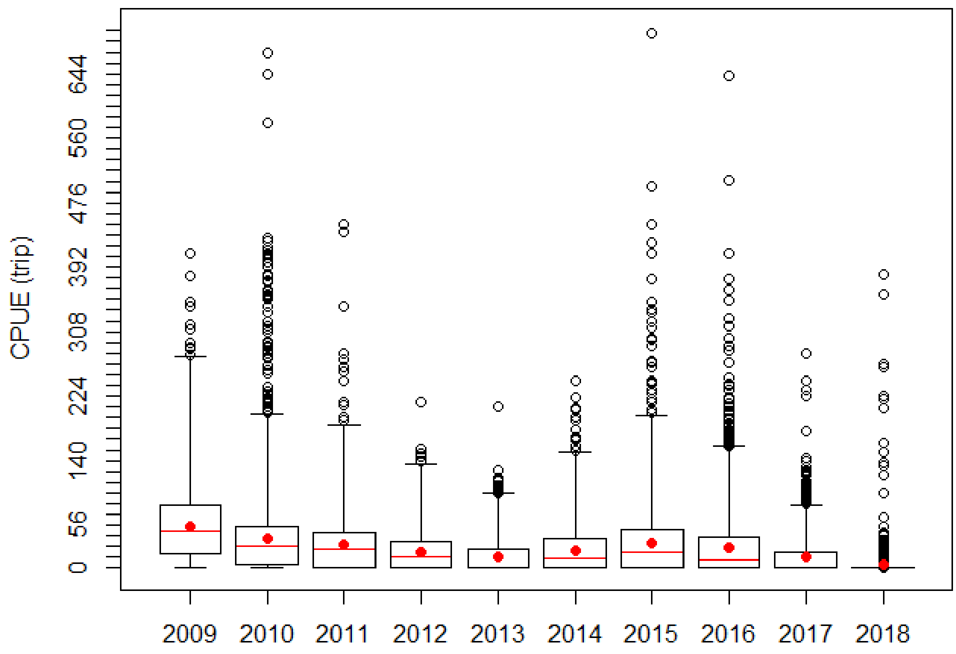

Figure 12.3.7. Blackspot seabream in ICES Subarea 27.9: Summary statistics from VMS index: mean value (red dots), median value (red lines), Interquartile Range plus Q1-3IQR and Q3+3IQR (box and whiskers) and outliers (circles). (from Gil *et al*., WD 10 to the 2019 WGDEEP).

12.3.8 References

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12.4 Blackspot seabream (*Pagellus bogaraveo*) in Division 10.a2

12.4.1 The fishery

Blackspot seabream has been exploited in the Azores (Area 10.a.2), 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*., 2009; Pinho *et al.,* 2014). The artisanal fleet is composed of small open deck boats (<12 m) that operate in local areas near the coast of the islands using several types of handlines. Longliners are closed deck boats (>12 m) that operate in all areas but during the last years the fishery is only authorized to operate on offshore (>6 nm) banks and seamounts (Pinho *et al.,* 2014; Diogo *et al.,* 2015). The tuna fishery caught, until the end of the nineties, juveniles (age 0) of blackspot seabream as live bait, but in a seasonal and irregular way because these catches depend on tuna abundance and on the occurrence of other preferred bait species like *Trachurus picturactus* (Pinho *et al*., 2014).

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.

12.4.2 Landings trends

Historically, landings increased from 400 t at the start of the eighties to approximately 1000 t at the start of the nineties (Figure 12.4.1), due to the development of new markets, increased fish value, entry of new and modern boats, better professional education of the fisher and introduction of bottom longline gear, permitting the expansion of the exploitable area to deeper waters, banks, and seamounts as well as the expansion of the fishing season (ICES, 2006). Between 1990 and 2009 the annual landings have fluctuated around 1000 t, with a peak in 2005. Important expansion of the fishery to offshore seamounts occurred during this period, particularly made by the longline fleet as a consequence of spatial management measures introduced. During the period 2010–2012 the landings decreased significantly to an average of 641 t, which correspond to about 57% of the TAC during that period, maintaining thereafter around this value due to the TAC introduced. In general, a continuous decrease has been observed since 2005. Currently the fishery is highly constrained by management measures. Landings of 2017 are 499t and 445t in 2018.

12.4.3 ICES Advice

ICES advises that when the precautionary approach is applied, catches should be no more than 576 tonnes in 2019. All catches are assumed to be landed.

12.4.4 Management

Under the European Union Common Fisheries policy a TAC was introduced in 2003 (EC. Reg. 2340/2002). The recent time-series of TACs and landings are given below.

Year	2007	2008	2009	2010	2011	2012	2013	2014
EU TAC	1136	1136	1136	1136	1136	1136	1022	920
Landings	1070	1089	1042	687	624	613	692	663
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**		
EU TAC	690	517	517	517	576	576		
Landings	701	515	499	445				

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 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 and bottom gillnets was forbidden in the Azores region.

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 to allow a multidisciplinary research (ecological, oceanography and geological). During 2015, 2016 and 2017 additional technical measures were introduced limiting the fishing area for longliners, updated the minimum landing size to 33cm and introducing marine protected areas for coastal and oceanic areas. Undersize proportion of fish permitted on board of fishing levels was updated introducing a lower tolerance limited. A close season to reduce effort on the spawning aggregations was introduce (covering the period January 15 and end of February) and implemented in 2016. During 2017 new license limitations were introduced for littoral hook and line fisheries. Since 2018 the quota is managed by quarter, island and vessel.

12.4.5 Data available

12.4.5.1 Landings and discards

Total annual landings data are available since 1980. However, detailed and precise landing data are available for the assessment since 1990 (WD Pinho *et al.*, 2018a). Landings from Area 10.a.2 are presented in the Table 12.4.1 and Figure 12.4.1.

Information on the discards in the longline fishery has been collected in the Azores by a team of observers on board the longline fleet. This information was presented during the 2012 meeting and was not updated since then. On average about 0.6% of blackspot seabream was discarded annually on sampled trips between 2004 and 2012.

12.4.5.2 Length compositions

Length composition data of the catch of the fishery is available for the period 1990 to 2016. However data from 1990–1994 is based on low sampling coverage and so are not presented here. Data for subsequent years are presented in Figure 12.4.2. Fishery length data for 2017 and 2018 was not available.

Length compositions are similar to those from surveys (Figure 12.4.3) with a mode around 25–31 cm. Large quantities of adult individuals greater than 40 cm are observed in the fishery for the years 1999, 2002 and 2005 and decreasing thereafter. This increase may be relate to catchability factors. The length distributions of fishery data present some sort of truncation for the last five years because the reduction of juveniles due to minimum size measures and a reduction of large individuals.

Length compositions from survey (Figure 12.4.3) since 2016 have present an increase for different length classes and a shift of modes to the following cohorts in the next years (2017 and 2018). More large individuals were observed during this last two years.

12.4.5.3 Age compositions

The information is available from the survey until 2018 but are not presented here because it is not relevant to the current assessment.

12.4.5.4 Weight-at-age

No new information was presented to the group because there are no relevant changes on the biology of the species.

12.4.5.5 Maturity, sex-ratio and natural mortality

Maturity and sex-ratio data were updated in accordance with the methods outlined in the stock annex. Natural mortality was reviewed in 2015 exploring several empirical methods for the M estimation. A mean value of M=0.3 was estimated but with a considerable uncertainty.

12.4.5.6 Catch, effort and research vessel data

Standardized fishery cpue was not updated for 2019 because fishery data was not available for the last two years (Table 12.4.2).

Survey data were updated (WD Medeiros-Leal *et al*. 2019) and are resumed on Table 12.4.3 and Figure 12.4.4.

12.4.6 Data analyses

The Azorean bottom longline survey targeting *Pagellus bogaraveo* is reliable for abundance estimates, since the survey design is adapted to the stock behaviour covering most of the species habitat (with exception of seamounts around Mid-Atlantic Ridge) (Table 12.4.4). The survey time-series is not continuous because in some years there was no survey. The annual values were computed using statistical areas I-IV because area VI was not sampled in some years (1996 and 2008). Survey indices from 1995 to 2018 show no trend with a high value every three years until 2005 and for the years of 2016, 2017 and 2018 (Figure 12.4.4). The 2017 correspond to the year with the highest index value observed on the time series. 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 or result of management measures (Diogo *et al*., 2015). However, the survey abundance indices from 2010–2013 are on the range of lowest values with a decrease trend. This period correspond to the lowest catch observed during the last 19 years being on average 60% of the precedent years (1995–2009) (Figure 12.4.1).

Survey abundance indices of mature and immature follows the same trend of the total abundance estimates (Figure 12.4.5-12.4.8). Mean length of mature stock for the entire period (1995–2018) is around 37 cm (Figure 12.4.7) and immature about 25 cm (Figure 12.4.8). Mature fish mean length increased from 36 cm in 1995 to 41 cm in 2000 and decreased thereafter until 36 cm in 2013, with an increase for the last three years (2016, 2017 and 2018). Variance of the estimates is high.

No analytical assessment was carried out this year.

Exploratory analysis

Length-based indicators

Length-based indicators were explored during the 2017 meeting and was not calculated for this year because fishery length data is not available.

Comments on the explanatory analysis

Survey abundance index is the only information available for the assessment. Survey data show an important increase on the relative abundance index for the last three years (2016-2018) relative to the previous period. The observed increase is consistent through all statistical survey areas. The lack of updated fishery abundance data to compare the observe trend make it difficult to interpret the mean of this large increase. Catches in recent years are highly constrained by severe management measures.

12.4.7 References

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12.4.8 Tables and Figures

Table 12.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2).

Year	Azores (10.a.2)	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

Year	Azores (10.a.2)	Total
2007	1063	1070
2008	1089	1089
2009	1042	1042
2010	687	687
2011	624	624
2012	613	613
2013	692	692
2014	663	663
2015	701	701
2016	515	515
2017	499	499
2018	445	445

Table 12.4.2. Nominal and standardized bottom longline fishery abundance index (scaled cpue to the mean) of the black-spot seabream (*Pagellus bogaraveo)* in Subarea 10.

YEAR	NOMINAL cpue	STANDARDIZED cpue	Lower CI	Upper CI
1990	0.92	0.97	0.87	1.08
1991	0.92	0.94	0.81	1.07
1992	0.96	0.98	0.78	1.17
1993	0.79	1.01	0.87	1.15
1994	0.97	1.01	0.84	1.18
1995	1.09	1.08	0.92	1.23
1996	1.24	1.5	1.25	1.75
1997	1.63	1.32	1.1	1.53
1998	1.03	1.21	1.06	1.35
1999	1.1	1.3	1.16	1.44
2000	0.82	0.82	0.75	0.9
2001	1.12	0.96	0.84	1.07
2002	1.24	1.02	0.9	1.15
2003	0.98	1	0.91	1.1
2004	1.42	1.08	0.96	1.19

YEAR	NOMINAL cpue	STANDARDIZED cpue	Lower CI	Upper CI
2005	1.71	1.16	1.06	1.27
2006	1.26	0.95	0.86	1.04
2007	1.34	1.22	1.09	1.36
2008	1.21	1.13	1.02	1.24
2009	1.18	0.96	0.88	1.05
2010	0.62	0.72	0.66	0.78
2011	0.59	0.76	0.69	0.82
2012	0.62	0.81	0.74	0.88
2013	0.64	0.91	0.83	0.99
2014	0.67	0.83	0.76	0.90
2015	0.56	0.74	0.68	0.80
2016	0.39	0.61	0.56	0.67
2017	na	na	na	na
2018	na	na	na	na
na – not available				

Table 12.4.3. Survey relative abundance index in number of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2).

Year	Lower	Index	Upper
1995	88	105	125
1996	33	42	49
1997	33	48	58
1998	na	na	na
1999	80	112	143
2000	38	52	67
2001	58	67	78
2002	126	138	150
2003	66	86	103
2004	69	94	120
2005	118	143	166
2006	na	na	na
2007	54	79	106
2008	84	102	119
2009	na	na	na
2010	53	67	83
2011	52	70	87
2012	49	60	69
2013	38	47	55
2014	na	na	na
2015	na	na	na
2016	114	135	158
2017	125	155	182
2018	92	126	136

na = Not available.

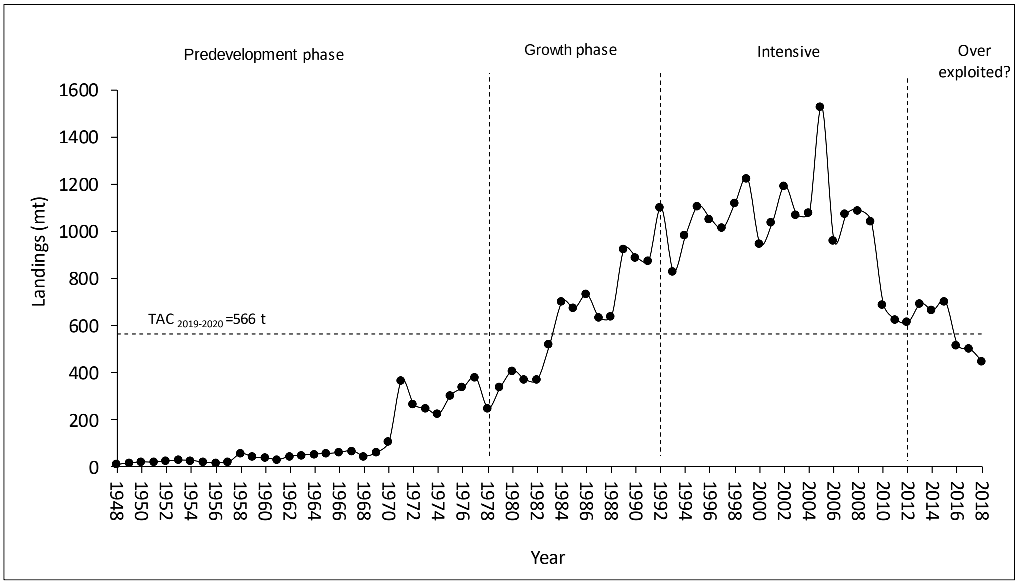


Figure 12.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2). Main technical management measures introduced to the fishery are also shown on the graph.

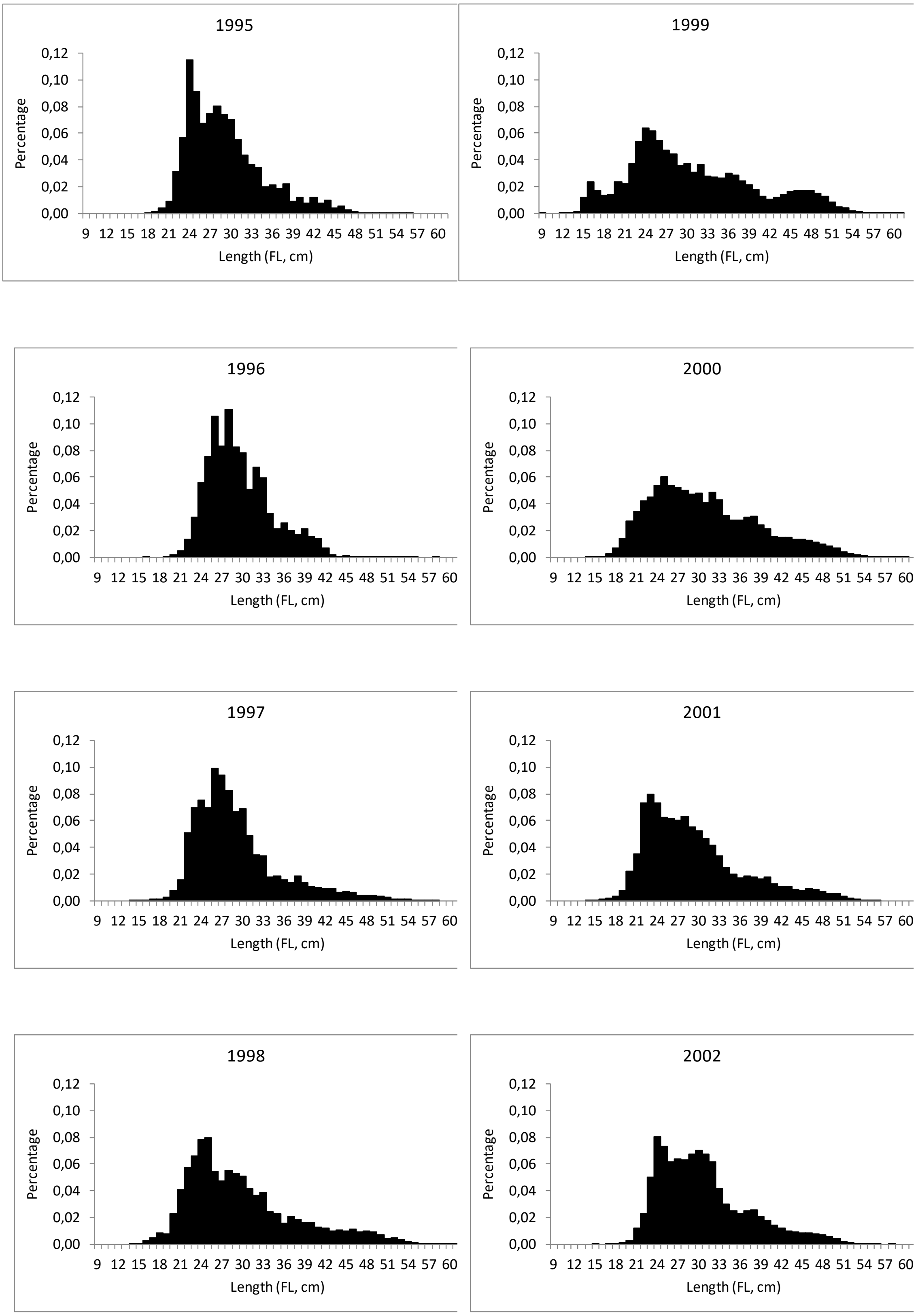


Figure 12.4.2. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2016 (ICES Area 10.a.2).

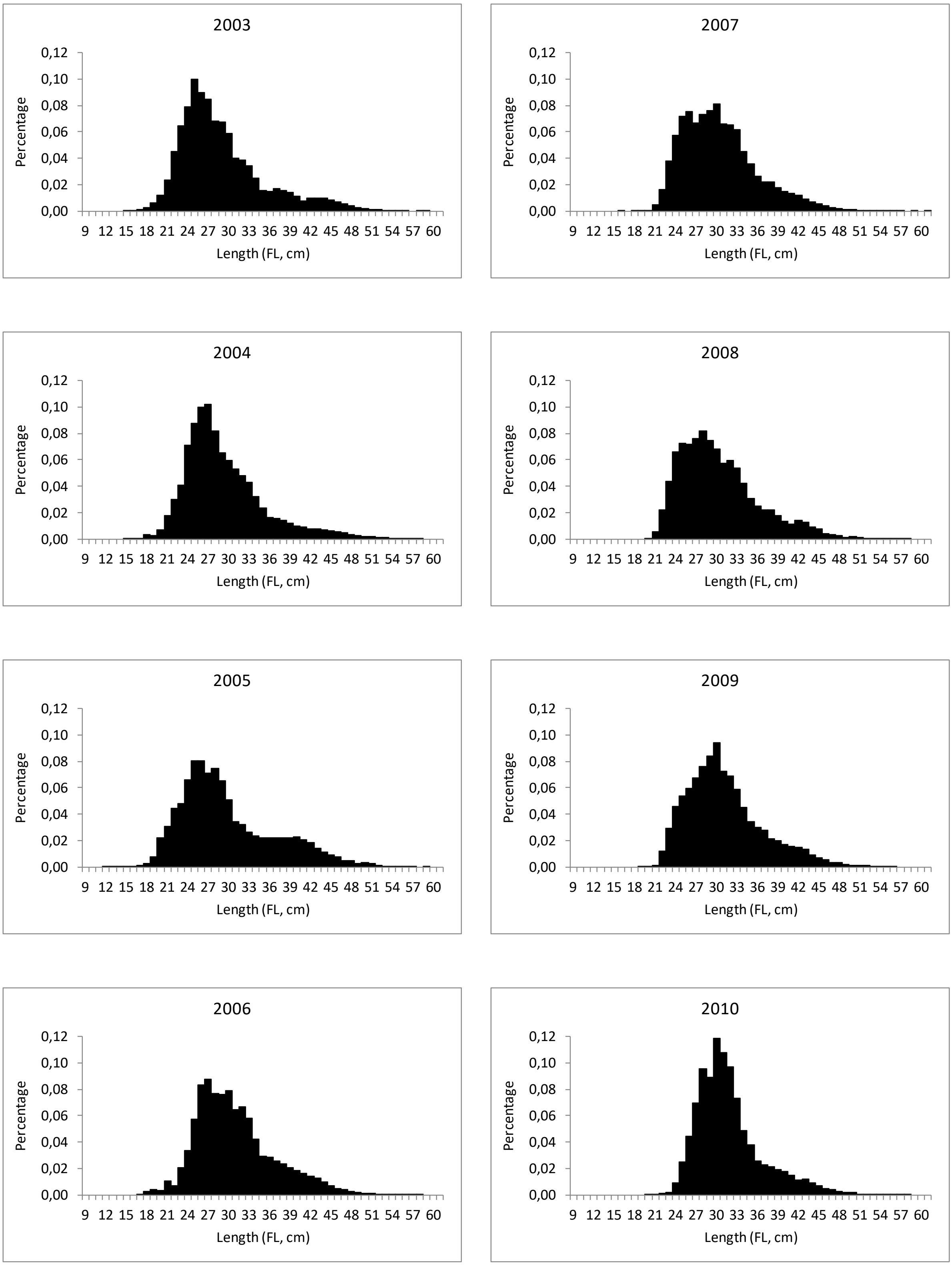


Figure 12.4.2. (Cont.). Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2016 (ICES Area 10.a.2).

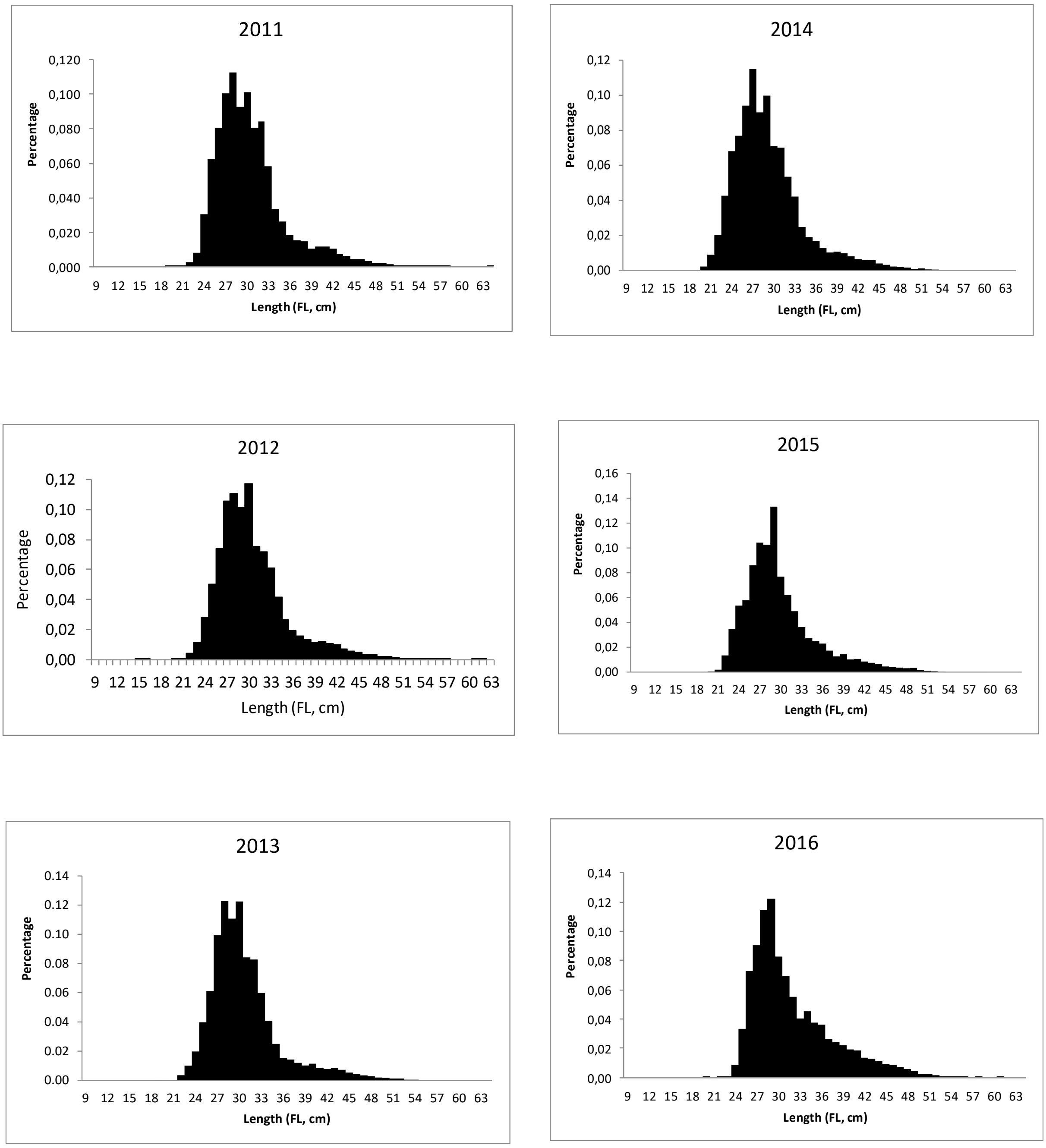


Figure 12.4.2. (Cont.) Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2016 (ICES Area 10.a.2).

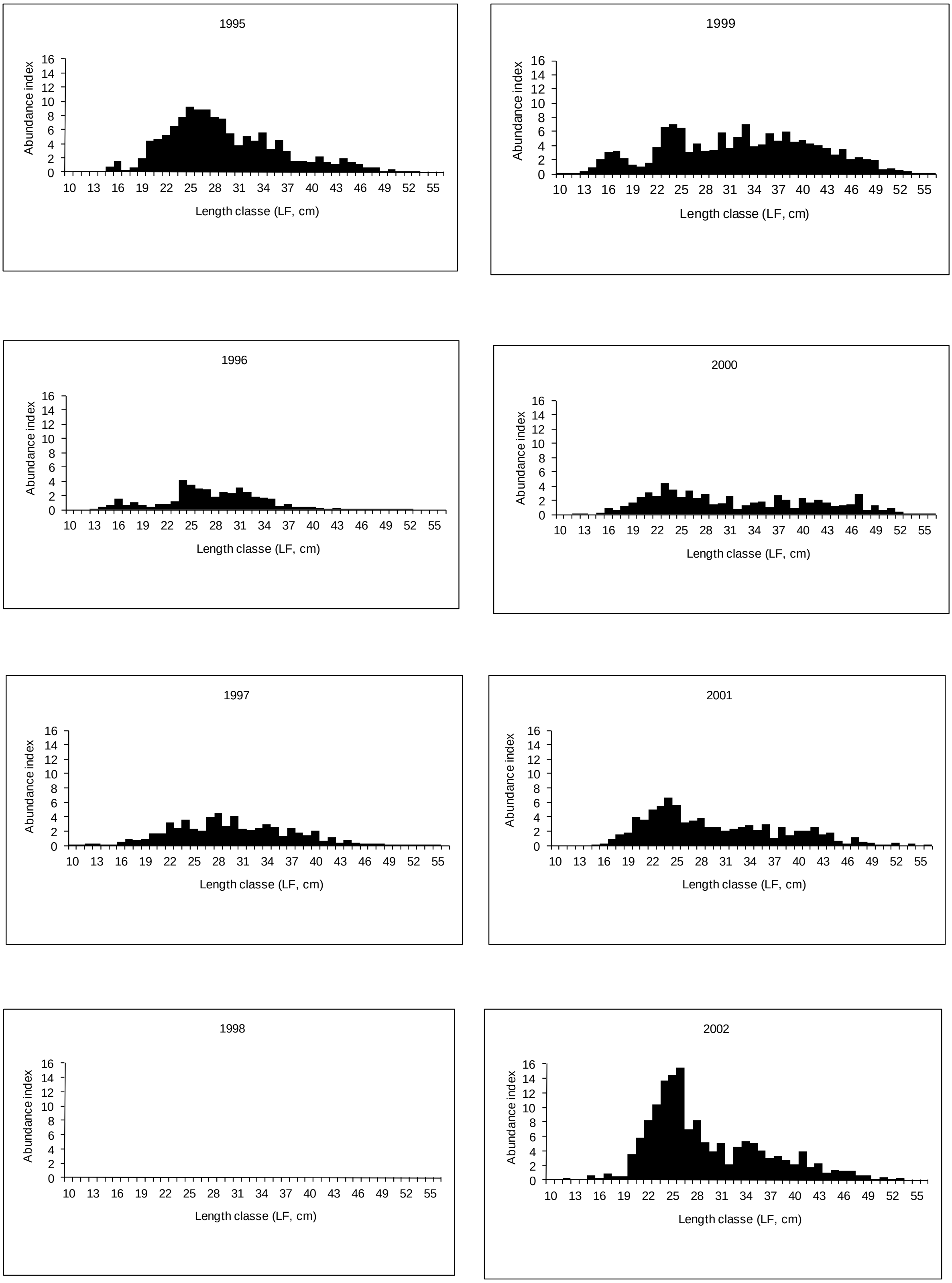


Figure 12.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2018 (ICES Area 10.a.2).

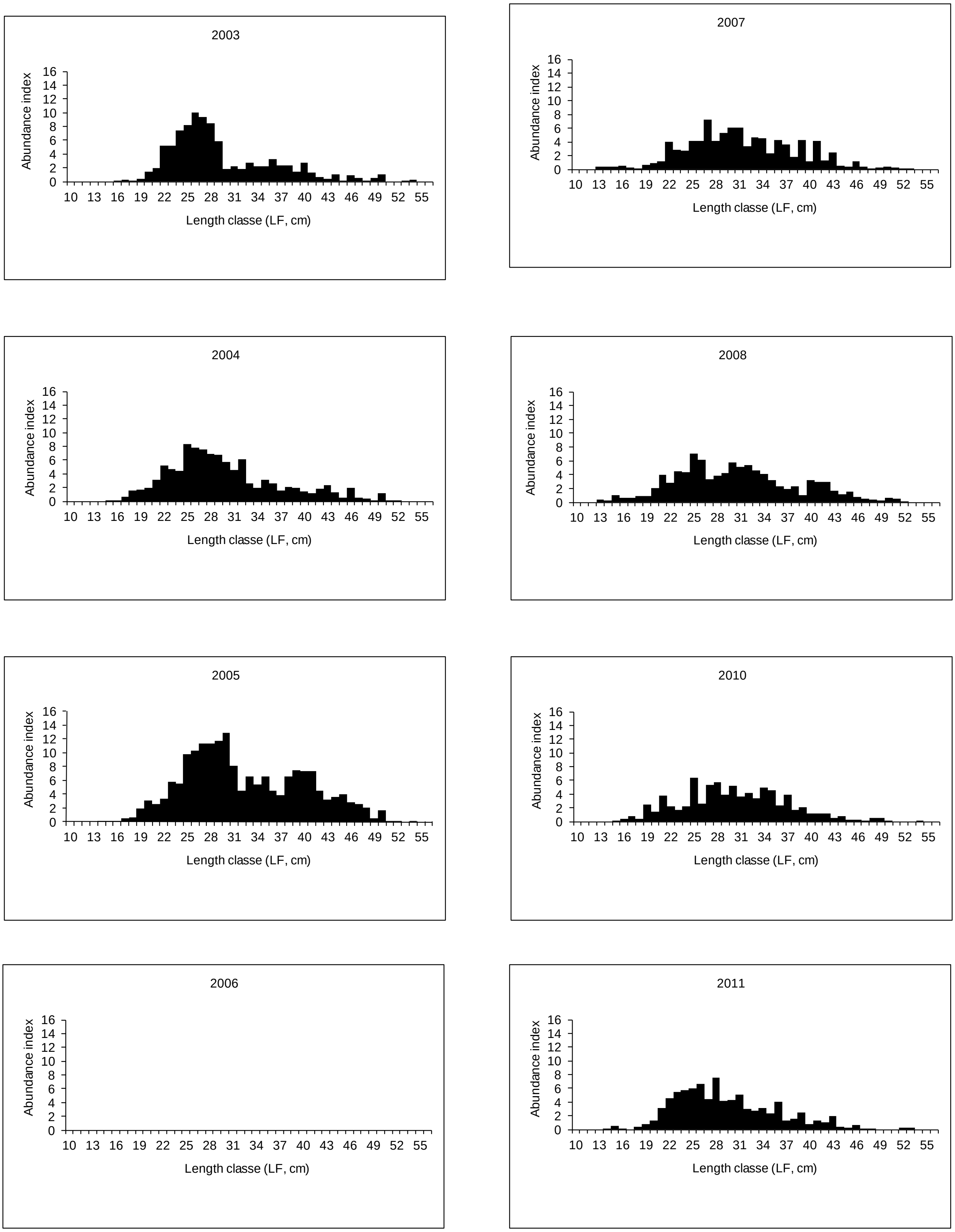
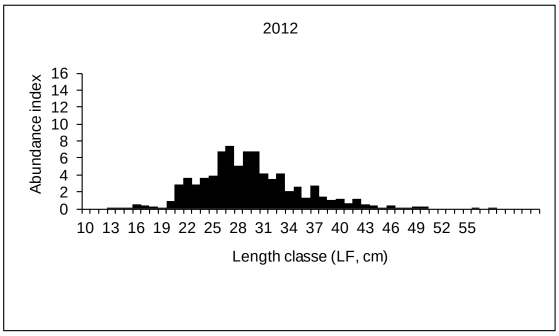
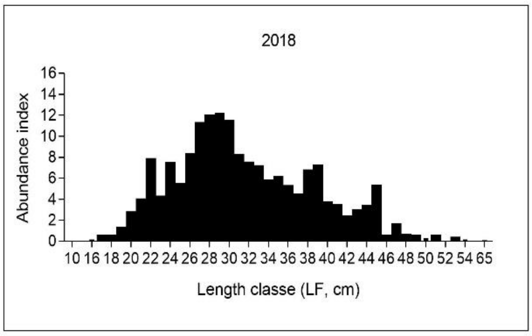
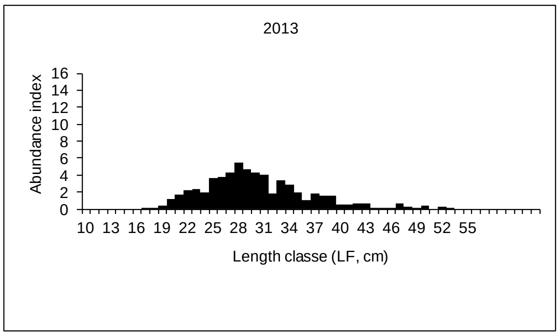
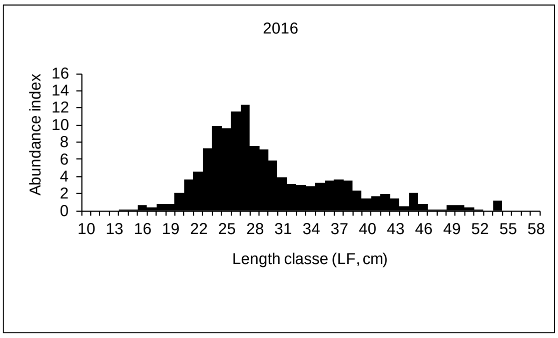


Figure 12.4.3. (Con't). Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2018 (ICES Area 10.a.2).









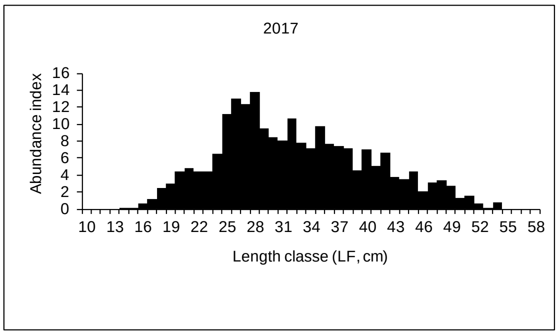


Figure 12.4.3. (Con't) Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2018 (ICES Area 10.a.2).

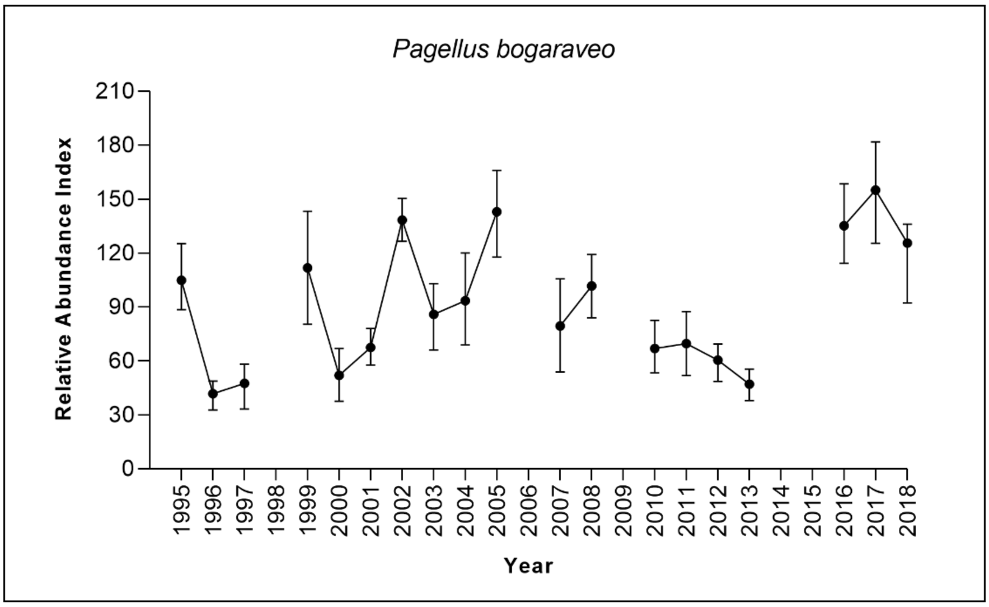


Figure 12.4.4. Annual abundance in number (Relative Population Number) of *Pagellus bogaraveo* from surveys for the period 1995–2018 (ICES Area 10.a.2).

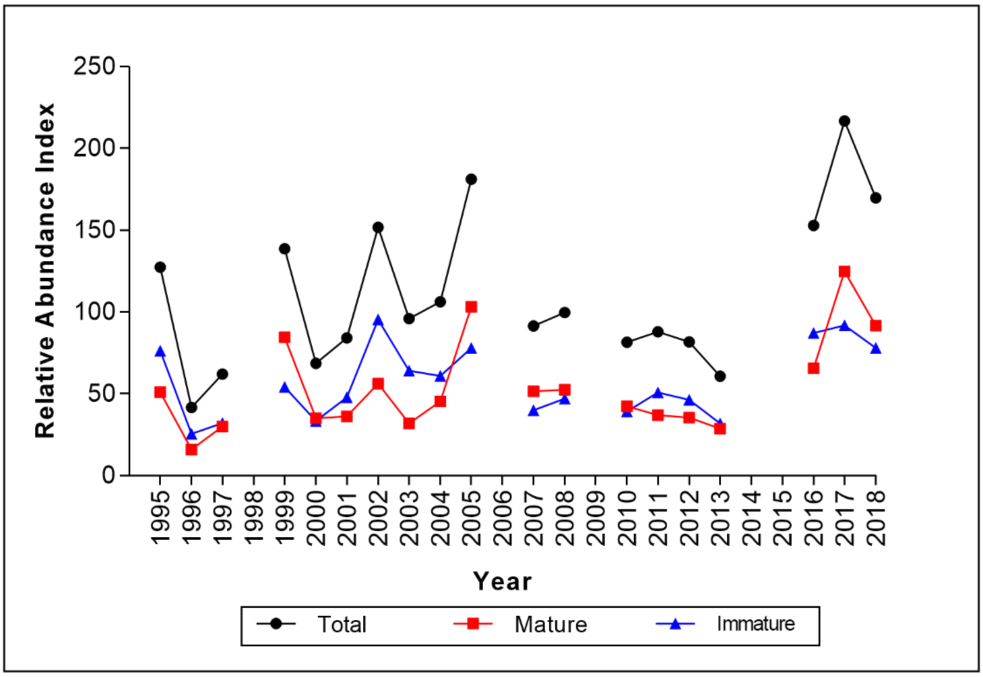


Figure 12.4.5. Survey abundance indices trends for mature, immature and total stock for the period 1995–2018 (ICES Area 10.a.2).

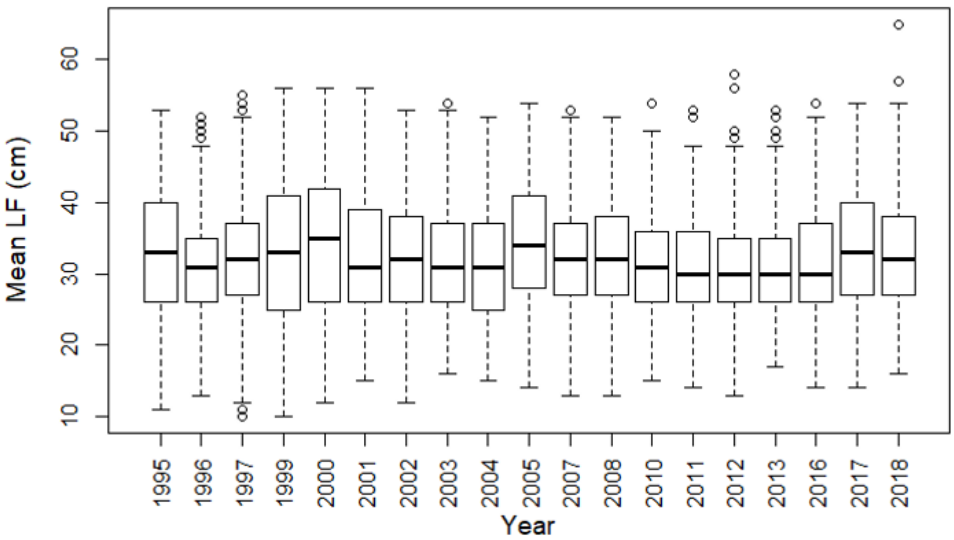


Figure 12.4.6. Annual mean length from survey length compositions (1995–2018) (ICES Area 10.a.2).

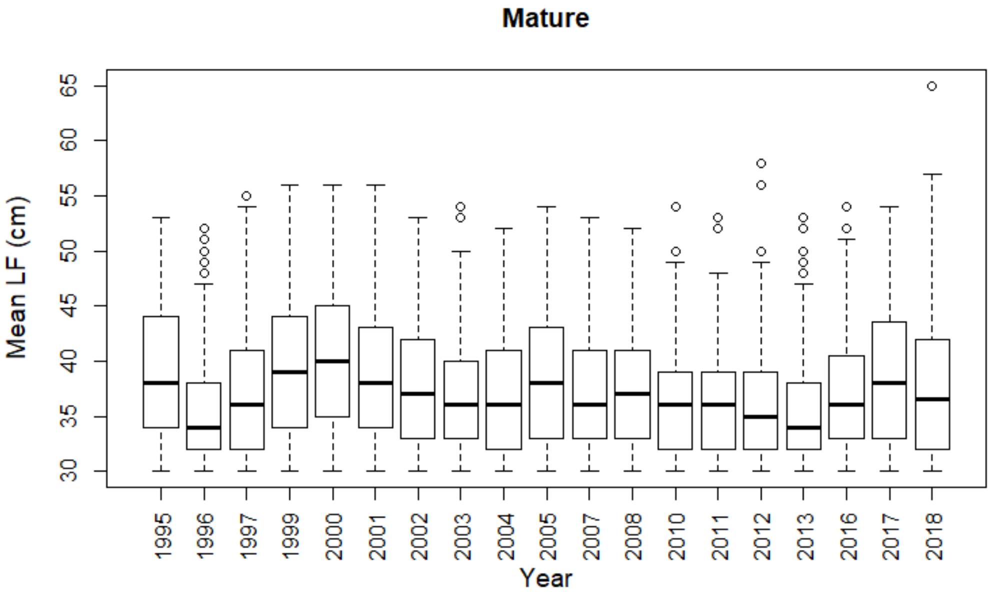


Figure 12.4.7. Annual mean length of mature individuals from the Azorean longline survey (1995-2018).

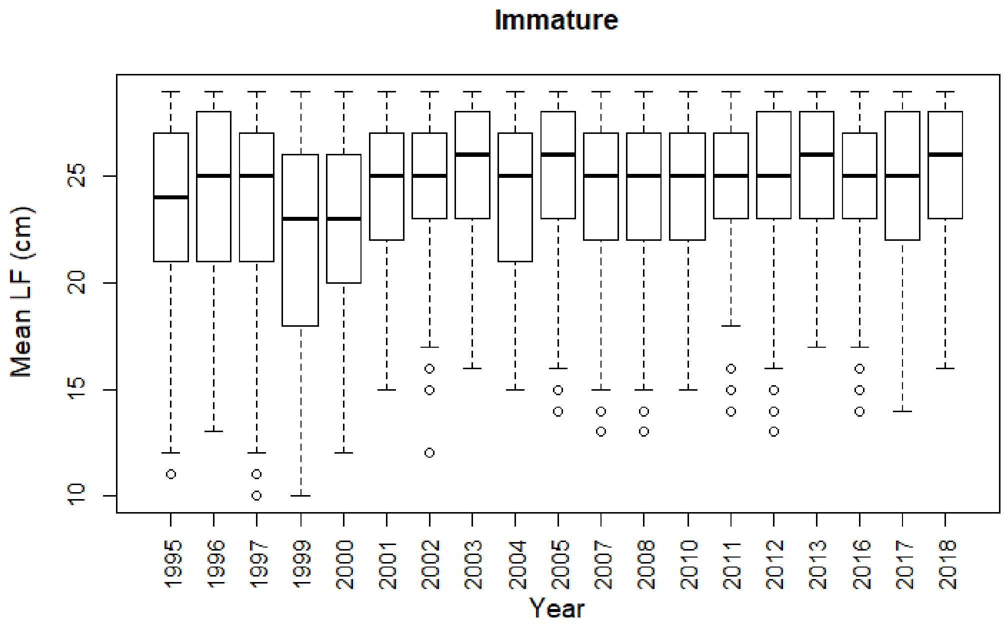


Figure 12.4.8. Annual mean length of immature individuals from the Azorean longline survey (1995-2018).

13 Roughhead grenadier (*Macrourus berglax*) in the Northeast Atlantic

13.1 Stock description and management units

The population structure of roughhead grenadier in the Northeast Atlantic is poorly known. The species occurs at small abundance in some areas, mostly to the North of 60°N. The assessment unit considered by ICES is the whole Northeast Atlantic, this does not postulate anything about the population structure.

13.2 The fishery

Roughhead grenadier has a low commercial value and the scarce landing data available correspond mostly to landed bycatch. However, unusually large catches (> 500 t) were reported in Subarea 6 in 2005–2007, in Subarea 12 in 2002, 2006 and 2009 as well as in Subarea 14 in 2010–2014. Afterwards in 2015–2017, the level of reported landings returned to past levels. These large catch are considered doubtful and suspected to correspond to species misreporting.

Roughhead grenadier is mostly caught with bottom trawl but catches in Subarea 14 and Division 12.a are from the Spanish fleet targeting redfish and were taken with pelagic trawl, a GLORIA type in the first year (2010) and a modified alfonsinos pelagic trawl in the following years.

The Spanish fleet fishing grenadiers on the Mid-Atlantic ridge (MAR) consists of ten trawlers with an average length of 62 m and average Gross Tonnage of roughly 1000 t, although the maximum number of ships present in the fishing ground in any given year is seven. This fleet alternates the redfish and grenadier fisheries. Most landings are taken in 14.b.1, where the fishing season lasts between three and seven months. Effort and catches peak in late spring and early summer.

13.3 Landings trends

Because there is no stock defined or management units, this section describes the landings data available for the different ICES divisions.

In Subareas 1 and 2 there are landing records since 1990. The highest landings (400-800) occurred in the three first years and declined significantly thereafter. Since 2005 they are in the range of 30 to 50 t, except a higher level to 100 tonnes in 2016. Most landings are from Norway with a smaller contribution from Russia. Landings from France are occasional and negligible, below 0.5 t in most years (Table 13.1).

Landing records from Subareas 3 and 4 also started in 1990 and have been very low, peaking in 2005 at 39 t. The remaining years landings oscillated between 0 and 10 t, mostly to Norway, France, UK (Scotland) and Ireland have also reported landings in a few years (Table 13.2).

In Division 5.a, roughhead grenadier is occasionally caught. Before 2010, reported landings have been mostly below 10 tonnes per year and have increased to about 20 tonnes year afterwards (Table 13.3).

Landings have been reported in 5.b since 1997. The highest catch was 99 t in 1999, but in other years landings were <12 t and in the last three years only 1 t/year was (Table 13.4).

Landings from Subareas 6 and 7 were mostly caught by the Spanish demersal multispecies fishery in Hatton Bank operated by freezer trawlers. The series starts in 1992, with official landings peaking during the period 2011–2013, when they reached 632 t in 2012 due to an exceptional report of 436 t by Lithuania. France has taken part in the fishery for a longer period but with much lower landings. Other minor participants in the fishery are Norway, UK, Ireland and Russia (Table 13.5).

Occasional landings of less than 0.5 tonne have been occasionally reported from Subarea 8. These were considered as coding errors or area misreporting as the species is not known to occur in Subarea 8 and was never caught in surveys in this Subarea.

Official landings in Subarea 12 include landings from both the demersal multispecies fishery in Hatton Bank (12.b) and the pelagic redfish and grenadier fishery on the MAR (12.a). The series starts in 2000, and peaks in 2005 at 2200 t and in 2009 at 2832 t. Thereafter reported landings have decreased to 0 in 2017 (Table 13.6).

Low landings have been reported from Subarea 14 since 1993. In 2010–2014, Spain reported landings of 500–2700 tonnes/years (Table 13.7). Norway, Greenland and Russia reported landings earlier than other countries, and UK has occasionally also recorded very small catches. Landings decreased since 2013 but more strongly in 2014 and 2015 to less than 85 t.

13.4 ICES Advice

The only ICES advice on roughhead grenadier was published in 2015 and states that *"for the years 2016–2020 there should be no directed fisheries for roughhead grenadier, and bycatch should be counted against the TAC for roundnose grenadier to minimise the potential for species misreporting."*

13.5 Management

There is no known management plan for roughhead grenadier in any ICES area. There is a quota for European Union vessels in Greenland waters of subareas 5 and 14. There has been no species-specific EU TAC and management measure for Union vessels in Union and International waters. Since 2015, bycatch of roughhead grenadier by EU vessels in Union and International waters should be reported under the roundnose grenadier quota for the same area and may not exceed 1% of the quota. No directed fisheries of roughhead grenadier are permitted. This accounting of roughhead grenadier landings under quotas for roundnose grenadier was subject to an action for annulment at the EU court of justice and was rejected (http://curia.europa.eu/juris/liste.jsf?language=en&num=C-128/15). In eastern Greenland, main fishing operations are in Subdivision 14.b.2 and here, TAC of roundnose and roughead grenadier combined has been 1000 t since 2010. This TAC has been set by the Greenland Government and is not based on a biological assessment.

13.6 Data available

13.6.1 Landings and discards

Official landing data are available from Subareas 1 and 2 since 1990, from Subareas 3 and 4 since 1992, from Division 5.a since 1996, from Division 5.b since 1997, from Subareas 6 and 7 since 1993, from Subarea 8 for 2002 and 2006, from Subarea 12 since 2000, and from Subarea 14 since 1993.

Discard data for most years from 1996 to 2015 from Subareas 6, 12 and 14, collected by Spanish scientific observers, on-board commercial Spanish trawlers were used to estimate discard rates. Discard rates, estimated as the discarded catch divided by retained catch of the species, are high, averaging 0.77 ± 0.42 (mean ± standard deviation) for Subarea 6, 0.68 ± 0.23 for Subarea 12 and 0.53± 0.50 for Subarea 14.b (Table 13.8).

In 2019, landings data were updated using data reported to InterCatch and preliminary catch statistics. National catch statistics of Greenland were used to update catches in subarea 14b2 from 1999 to 2018. The latter may include both landings from Greenland and other countries vessels, wherefore it was unclear whether this implies double count with landings reported by other countries. A potential misreporting is suspected for roughhead grenadier, as the scientific survey of this species, has revealed that roughhead grenadier is present in bigger amounts in ICES 14.b.2. – a trend which is not supported by catches (WGDEEP 2019, WD05 and WD06).

13.7 Length composition of the landings and discards

No data available.

13.8 Age composition

No data available.

13.9 Weight-at-age

No data available.

13.10 Maturity and natural mortality

No data available.

13.11 Research vessel survey and cpue

13.11.1 Research vessel survey

The Icelandic autumn groundfish survey IS-SMH is the main source of fishery-independent data for *M. berglax* in Icelandic waters. Further, data can be compiled from several other older surveys of exploratory nature.

The IS-SMH survey covers Icelandic shelf and slope at depths from 20–1500 m. It is a stratified systematic survey with standardized fishing methods. Small-meshed bottom trawls (40 mm in the codend) equipped with rock-hopper are towed at a speed of 3.8 knots for a predetermined distance of 3 nautical miles (See the stock annex for greater silver smelt for a detailed description of methodology).

The Greenlandic annual bottom trawl survey is the main source for fishery-independent data for roughhead grenadier in subarea ICES 14b2 (Greenland waters). This survey is depth stratified covering depths from 400-1500 m using Alfredo trawl towed at a speed between 2.5-3.0 knots with a 30 min bottom time (tows of at least 15 min are accepted). Survey period span from 1998 to present with no survey in 2001, 2017 and 2018.

13.11.2 Cpue

The data available to WGDEEP only allow an estimation of non-standardised cpue for the Spanish fleet operating in Subareas 6, 12 and 14 in 1996–2015.

13.12 Data analyses

Length distributions from ICES subarea 14.b.2 show that from 1998 to 2016 a single mode around 19 cm dominated the survey and from 2010 to 2016 a second and smaller mode around 29 cm is also evident (Figure 13.1). From this survey, it is shown that the highest biomass and abundance in subarea 14.b.2 is equally distributed between three depth strata of 601-800 m, 801-1000 m and 1001-1500 m (Table 13.9). Survey estimated index biomass were constant in east Greenland during 1998 to 2007, where after it increased by more than 50% most likely due to onset of night trawling in this time period. The estimated biomass appears constant from 2008 until 2016 (Figure 13.2)

13.13 Benchmark assessments

There has been no benchmark for this stock.

13.14 Management considerations

Only landings are available and the time-series considered reliable is restricted to 1992–2001. Years 2002–2015 are not considered because catches reported in some divisions are significantly larger than the historical landings and there are major doubts about the reality of these catch (ICES, 2014). Information from scientific on-board observers and exploratory surveys in Subareas 6, 12 and 14 indicates that the species occurs at low density over these fishing grounds, making it unlikely that such quantities can have been caught.

There are no biological data (length or age composition, weight-at-age, maturity, mortality) that could be used to assess changes in stock status.

Literature based mostly on survey data from Canadian waters indicates that this is a long-lived, slow-growing species, of low fecundity and vulnerable to overfishing (see Devine and Haedrich, 2008 and references therein; Gonzalez-Costas, 2010). Age estimations from otoliths have found specimens of up to 23 years (Savvatimsky, 1984) and the species has been classified as of concern due to a decline of >90% of the survey index within Canadian waters over a period of 15 years (COSEWIC, 2007).

Thus, no expansion of current fisheries should be permitted until enough data are collected from the exploited population to identify the stock and conduct an appropriate assessment.

13.15 References

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13.16 Tables and Figures

Table 13.1. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subareas 1 and 2.

Year	Germany	Norway	Russia	France	Spain	TOTAL
1988						
1989						
1990	9	580				589
1991		829				829
1992		424				424
1993		136				136
1994						0
1995				1		1
1996				3		3
1997		17		4		21
1998		55				55
1999				<0.5		0
2000		35	13	<0.5		48
2001		74	20	<0.5		94
2002		28	1	<0.5		29
2003		47	30			77
2004		78	1			79
2005		64	13	<0.5		77
2006		74	4	<0.5		78
2007		44	5			49
2008		49	6			55
2009		51	2			53
2010		39	6			45
2011		29				29
2012		54				54
2013		34	1	1		36

Year	Germany	Norway	Russia	France	Spain	TOTAL
2014						
2015	0	26	17	0	+	43
2016		38	62			100
2017	0	41	9	+	0	50
2018	0	89	1	+	0	90

Table 13.2. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subareas 3 and 4.

Year	France	Ireland	Norway	UK (Scot.)	TOTAL
1991					
1992			7		7
1993					
1994					
1995					
1996	4				4
1997	5				5
1998	1				1
1999	< 0.5				
2000	< 0.5	1	3	< 0.5	4
2001	< 0.5	1	9		10
2002	< 0.5		3	< 0.5	3
2003	< 0.5		2		2
2004	< 0.5		< 0.5	1	1
2005	1		38	< 0.5	39
2006	< 0.5				
2007					
2008					
2009					
2010				< 0.5	
2011	2				2
2012	1			< 0.5	1

Year	France	Ireland	Norway	UK (Scot.)	TOTAL
2013	1				1
2014					
2015	+	0	+	0	+
2016	< 0.5		< 0.5		< 1
2017	< 0.5		< 0.5		< 1
2018	< 0.5	0	< 0.5	0	< 0.5

Table 13.3. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in 5.a.

Year	Iceland	Norway	TOTAL
1995			
1996	15		15
1997	4		4
1998	1		1
1999			
2000	2		2
2001	1		1
2002	4		4
2003	33		33
2004	3		3
2005	5		5
2006	7		7
2007	2		2
2008	< 0.5		
2009	5		5
2010	22		22
2011	21		21
2012	16		16
2013	16		16
2014			
2015	20		20

Year	Iceland	Norway	TOTAL
2016	20		20
2017	34		34
2018	0	<0.5	<0.5

Table 13.4. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Division 5.b.

Year	France	Norway	UK (Scot.)	Russia	TOTAL
1997	6				6
1998	9				9
1999	99				99
2000	1				1
2001	2	2			4
2002	3		< 0.5		3
2003	12				12
2004	9		1		10
2005	6				6
2006	10				10
2007	3			2	5
2008	1			2	3
2009					
2010		1			1
2011					
2012	2		1		3
2013	2				2
2014	< 0.5				
2015	1	+	0	0	1
2016					
2017	<0.5	<0.5			0.5
2018	1	4	0	0	5

Table 13.5. Official landings (t) roughhead grenadier (*Macrourus berglax*) in Subareas 6 and 7.

Year	UK (E+W)	France	Norway	UK (SCO)	Spain	Ireland	Russia	Lithuania	TOTAL
1988									
1989									
1990									
1991									
1992									
1993	18								18
1994	5								5
1995	2	2							4
1996		13							13
1997		12							12
1998		10							10
1999		38							38
2000	< 0.5	3		8					11
2001		2	27	16					45
2002		4	2	6					12
2003		8	2		1				11
2004		6		5	0				11
2005		6		2	0				8
2006		10		< 0.5	0	75			85
2007		21			0	18			39
2008		2			222		4		228
2009		12		< 0.5	0				12
2010		8		1	51		1		61
2011		3			346				349
2012		1		4	191			436	632
2013		2			179				181
2014					42				42
2015		11	+		21				32
2016		35			32				67

Year	UK (E+W)	France	Norway	UK (SCO)	Spain	Ireland	Russia	Lithuania	TOTAL
2017		3	1		1	<0.5			5
2018	0	7	0	7	0	0	0	0	14

Table 13.6. Official landings (t) roughhead grenadier (*Macrourus berglax*) in Subarea 12.

Country	Norway	France	Spain	Russia	Lithuania	TOTAL
1999						
2000	7	< 0.5				7
2001	10	< 0.5				10
2002	7		1136			1143
2003	2	< 0.5	223			225
2004	27	< 0.5	725			752
2005		< 0.5	2200	5		2205
2006		< 0.5	968	8		976
2007			420			420
2008			252			252
2009	6		2826			2832
2010			580			580
2011			441			441
2012			526		4	530
2013			210			210
2014			164			164
2015			53			53
2016	<0.5		31			31
2017						0
2018	0	0	0	0	0	0

Table 13.7. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subarea 14.

Country	Greenland	Norway	Russia	Spain	UK (E+W)	TOTAL
1992						
1993	18	34				52
1994	5					5
1995	2					2
1996						
1997						
1998		6				6
1999		14				14
2000						
2001		26				26
2002		49	4			53
2003		33				33
2004		46	9			55
2005	20	30	10			60
2006	4	1	3			8
2007	4	6	9			19
2008	12		3			15
2009	4	3			1	8
2010	12	1	13	1500	1	1527
2011	2		27	1516		1545
2012	14	16	18	2687		2735
2013			32	803		835
2014	62		11	450		523
2015*	38	68	0	12		121
2016	74	73	8	4		159
2017	93	87	17			197
2018	89	97	16	0	0	202

Table 13.8. Average discard rate (discarded catch / total catch) 1996–2015, estimated from data collected by scientific observers on board commercial trawlers.

Year	6.b	12.a	12.b	14.b
1996			0.00	0.00
1997				
1998	0.42		0.56	
1999				
2000		1.00	0.41	0.12
2001	0.94		0.40	0.00
2002	0.79		0.50	1.00
2003	0.65		0.00	0.00
2004	1.00		0.97	
2005				
2006	0.33		0.00	
2007				
2008	0.00		0.04	
2009			0.00	
2010			0.17	
2011				0.13
2012				
2013	1.00		1.00	1.00
2014				
2015	NA	NA	NA	NA
Mean	0.79	1.00	0.37	0.51

Table 13.9. Biomass (t) and abundance (in numbers) with SE of roughhead grenadier expressed as mean catch per km² and total biomass by Q-subarea and depth stratum in ICES subarea 14.b.2 in 2016. Q-subareas encompass Q1-Q5 (see Nielsen *et al.* 2019) for which area and number of survey hauls in 2016 are listed.

				Biomass			***Abundance***		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0.0305	212.9	91.5	28.1	195794	91854
Q2	401-600	1246	5	0.6579	819.7	466.7	615.6	766985	379861
	601-800	1475	7	1.3791	2034.7	746.6	844.3	1245641	356006
	801-1000	1988	10	0.9196	1828.5	503.4	676.8	1345717	458547
	1001-1500	6689	7	0.2539	1698.3	612.7	298.0	1993532	768271
Q3	401-600	9830	11	0.0106	104.2	61.5	12.6	124283	84253
	601-800	3788	14	0.0121	45.7	18.6	7.9	30040	11284
	801-1000	755	6	0.0171	12.9	8.6	12.7	9610	6398
Q5	401-600	1819	3	0.0032	5.9	5.9	4.4	7970	7970
	601-800	257	6	0.0486	12.5	4.1	53.3	13700	2996
	801-1200	256	5	0.1387	35.5	7.9	285.6	72993	15673
	1201-1400	986	9	0.1037	102.2	29.0	147.4	145251	36288
	1401-1500	615	5	0.0672	41.3	14.1	87.7	53912	24270
All		36679	100	0.1896	6954.2	1191	163.7	6005430	1044

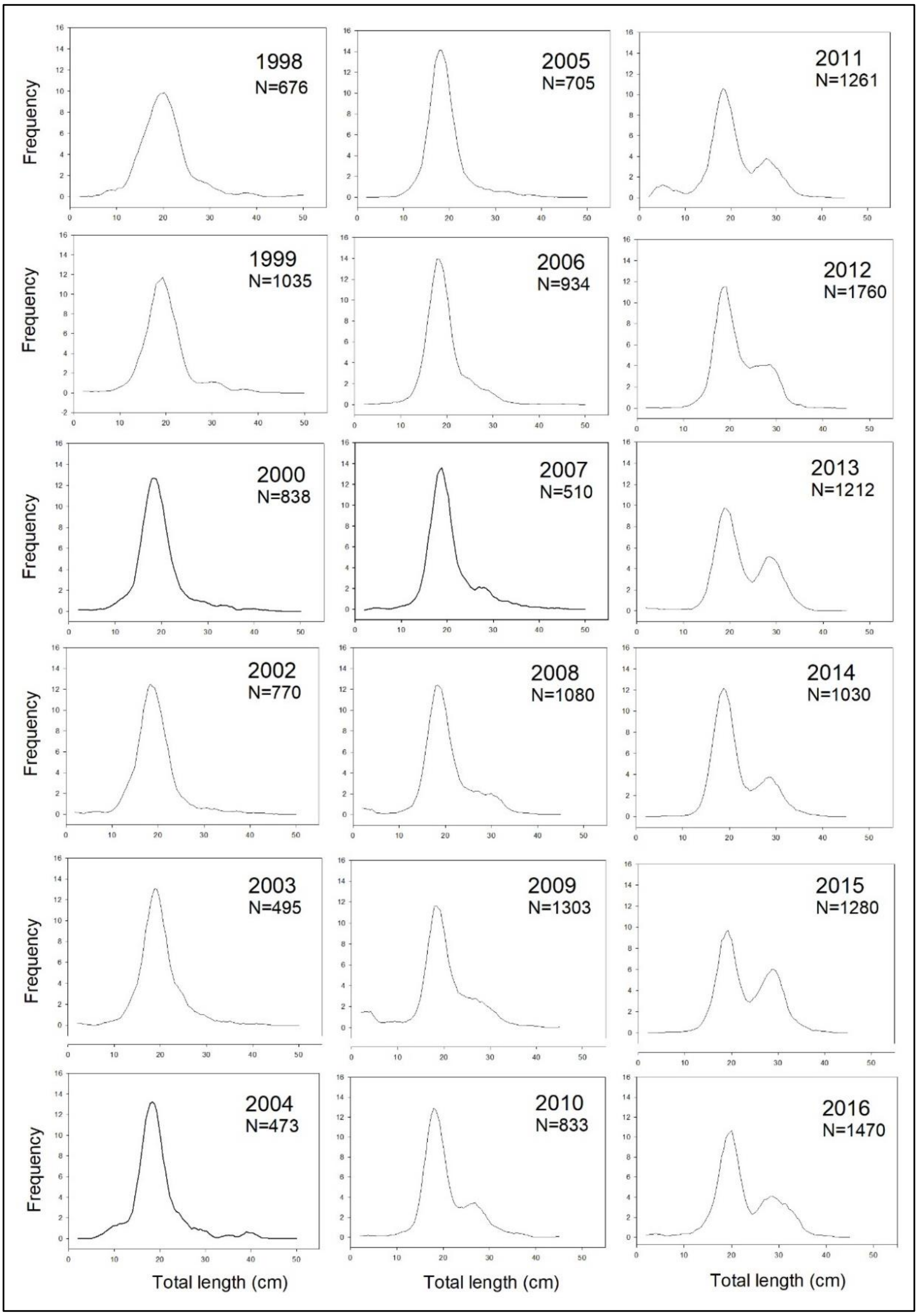

Fig. 13.1. Length frequency distribution of roughhead grenadier for years 1998-2016 in ICES subarea 14b2 (east Greenland). No survey in 2001, 2017 and 2018.

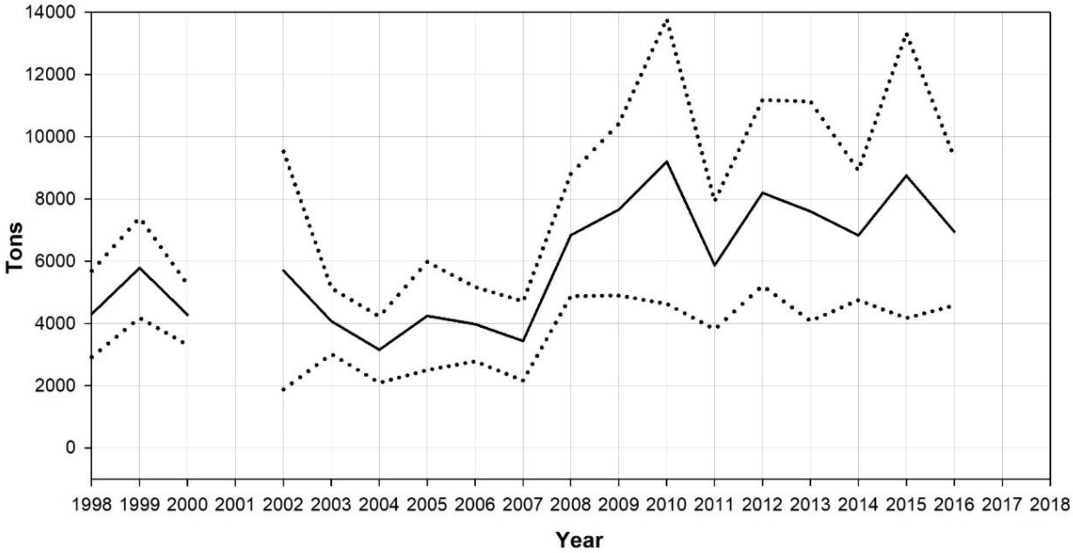

Figure 13.2. Estimated index biomass (solid line) of roughhead grenadier in ICES 14.b.2 plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

14 Roughsnout grenadier (*Trachyrincus scabrus*) in the Northeast Atlantic

14.1 Stock description and management units

There are taxonomic issues with this stock. The roughsnout grenadier (*Trachyrincus scabrus*) was formerly *Trachyrincus trachyrincus,* with various spellings. The roughnose grenadier (*Trachyrincus murrayi*) is a closely related species that is abundant throughout the north of Northeast Atlantic (Jonsson, 1992). The scientific names and spelling of these species changed over time. The similarity of the English names (roughsnout grenadier and roughnose grenadier) can only add more to the confusion.

Along the slope to the west of Scotland in ICES Division 6.a, only *Trachyrincus murrayi* was caught in surveys spanning depths from 500–2000 m and that took place in the 1970s and 1980s (Gordon and Duncan, 1984). In recent years, *Trachyrincus murrayi* is caught by the Marine Scotland deep-water research surveys in sufficient numbers to allow the estimation of population indicators (Neat and Burns, 2010).

Published literature does not report the occurrence of *Trachyrincus scabrus* at significant level in northern areas of the Northeast Atlantic. In particular, there are no records of the species in surveys held along the Mid-Atlantic Ridge (Fossen *et al*., 2008). *Trachyrincus scabrus* is not caught in Icelandic surveys where *Trachyrincus murrayi* is caught in large numbers. Similarly, to the East of Greenland (Division 14.a and 14.b.2) only *Trachyrincus murrayi* is caught in scientific surveys.

T. scabrus has been reported in the Porcupine Seabight (ICES Division 7.j,k) at depths 500–1300 m. The species was also recorded further south in the Cantabrian Sea (ICES Division 8.c). In the latter area, *T. scabrus* was report to occur at a high abundance on the Le Danois Bank (ICES Division 8.b) at depths from 500–800 m (Sanchez *et al*., 2008).

Unlike in the Atlantic Ocean, *Trachyrincus scabrus* occurs in most of the Mediterranean Sea, along the Spanish slope to the Ionian Sea (D'Onghia *et al*., 2004; Moranta *et al*., 2006). In the Mediterranean Sea high abundances were reported at depths ranging from 800–1300 m. In the Mediterranean Sea, *T. scabrus* reaches larger size than the other macrourid species occurring at the same depth range.

Therefore, *T. scabrus* is a species occurring in the Mediterranean Sea and in the Atlantic and does not seem to occur at levels susceptible to support commercial fisheries in most areas north of 52°N.

The other *Trachyrincus* species (*T. murrayi*) occurs in Subareas 5, 6 and 12. There is no known fishery for it. *T. murrayi* does not reach sufficient sizes to be of commercial interest. It is only a bycatch of deep-water fisheries in Subareas 5, 6, 7, 12 and 14.

As *T. scabrus* and *T. murrayi* can be misidentified in fisheries catches this chapter addresses the two species.

Landings of *T. scabrus* were reported for ICES Subareas 6, 12 and 14. In these areas the species is considered to be at most a minor bycatch. The occurrence of the species is even not confirmed in Subareas 12 and 14. It may be that only *T. murrayi*, occurs in these Subareas. Therefore the species identity of commercial landings reported as *T scabrus* needs to be confirmed. WGDEEP considered that the reporting of 0 landings in response to the data call for landings and discards in 2016 to 2018, confirms that landings reported before 2016 were misidentification or coding errors.

14.2 Landings trends

Landings of 57 and 649 tonnes were reported in 2012 and 2014 respectively. In 2014, these came mainly from divisions 12.b and 14.b. (Table 14.1a)

In 2006-2008, Lithuania reported significant landings for subareas 6 and 12 (Table 14.1b, source ICES catch statistics 2006-2015). Landings reported by Spain in 2012-14 are not included in ICES catch statistics 2006-2016. No landings were reported in preliminary catch statistics and InterCatch from 2016 to 2018.

14.3 ICES Advice

The ICES advice for the years 2016–2020 is that "*there should be no directed fisheries for roughsnout grenadier, and bycatch should be counted against the TAC for roundnose grenadier to minimize the potential for species misreporting*."

In the future, *Trachyrincus scabrus* and *T. murrayi*, should be considered non-commercial species and should not be subject to ICES advice any more. Reported landings should be considered as species misreporting.

14.4 Management

There is no current species-specific management measure for the roughsnout grenadier. Despite the advice for years 2016–2020, the EU regulation for TACs of deep-water species in 2017–2018 makes no mention of the roughsnout grenadier (Council regulation (EU) 2016/2285). There is no regulation for this species in other countries (Norway, Iceland, Faroe Islands) where these species should be landed when caught.

The EU regulation 2016/2336 establishing specific conditions for fishing for deep-sea stocks, make no mention of *Trachyrincus* species.

14.5 Data availability

14.5.1 Landings and discards

Landings data are presented in Table 14.1a and 14.1.b.

T. murrayi is discarded by the French deep-water fishery. Both *T. murrayi* and *T. scabrus* are recorded in on-board observation but the identification of these species may be uncertain. The total discards of the two combined have been less than of 0.2% of total catch in deep-water fishing hauls since 2010 (Table 14.2). These species have never been landed by the French fishery. It can be concluded that *T. scabrus* and *T. murrayi* have a minor contribution to the total catch in weight in ICES Divisions 5.b and 6.a and Subarea 7, where the French fishery operates.

Discards of *Trachyrincus* spp. are expected to occur in all deep-water fisheries and also in the other fisheries along the upper slope such as fisheries targeting hake, monkfish and megrims, which may operate down to 800 m.

The stock was included in the data call for 2017 and data were delivered to WGDEEP through InterCatch and file provided by members. France, Spain and Portugal reported through InterCatch and no landings and discards were uploaded. The absence of landings matches expert knowledge that the species is not commercial. The absence of discards from InterCatch may come from the absence of landings so the standard raising variable being absent discards were raised to 0. Faroe Islands, Iceland and Norway, reported landings of deep-water species on the WGDEEP SharePoint and there were no landings of *Trachyrincus* spp. included. As the fisheries from these countries make no discards, there was no catch of roughsnout grenadier or these catch were not identified to species level.

Discards quantities for 2018 were reported to InterCatch by France, Portugal and Spain. The estimated raised discards were 91 kg from France, 651 kg from Spain and 0 from Portugal.

14.6 Length compositions

No length data are available. No length distribution was reported to InterCatch for 2016–2018.

In the Icelandic autumn survey specimens of *T. murrayi* with sizes up to 40 cm total length have been recorded. Nevertheless the bulk of the catch is made of specimens with a length range from 5 to 20 cm.

T. murrayi of 45 cm total length would weigh less than 300 g using the following weight–length relationship estimated Length–weight relationship for *T. murrayi*: W=0.00129 LT^3.232 (Borges *et al.*, 2003).

14.6.1 Age compositions and longevity

No age composition is available. There are, however some studies on growth and longevity.

In the Mediterranean *T. scabrus* has a maximum age of eleven years (Massutti *et al.*, 1995).

Swan and Gordon (2001) analysed otoliths from 218 specimens of *T. murrayi*, with head length ranging from 2.1–11.7 cm and found up to nine growth bands on otolith. Converting the head length (HL) to total length (TL)by using the conversion estimated by the Swan and Gordon (2001): HL=3.630*HL0.402 (n=488), the largest fish in the sample had 42 cm total length, which seems to be at or close to the maximum length of the species in the area.

It can be concluded that the two *Trachyrincus* species appear to have similar longevities, of around ten years. Similar lifespans have been estimated for other small macrourids (Coggan *et al.*, 1999).

14.6.2 Weight-at-age

No weight-at-age data are available.

14.6.3 Maturity and natural mortality

No data were available.

14.6.4 Catch, effort and research vessel data

Population indicators of *T. murrayi* were estimated from data collected during deep-water research surveys held by the Marine Scotland. The abundance and length distribution varied along the period under analysis (2000–2008) and no trend was observed (Neat and Burns, 2008). Scottish survey data for this species were not requested to Marine Scotland in 2018 because the species is not of commercial interest.

14.7 Data analyses

Available data on *T. murrayi* suggest that the species is too small to have commercial interest. In fact, the weight of the largest specimen caught in Icelandic survey (45 cm TL) was not more than 500 g. Available data on *T. scabrus* suggest that the species occurs at too low level in the Northeast Atlantic to support any commercial fishery.

14.7.1 Biological reference points

Not applicable.

14.8 Comments on assessment

Not applicable.

14.9 Management considerations

The roughsnout and roughnose grenadiers are small bycatch in some deep-water fisheries (see example in Table 13.2).

Owing to the smaller size and shorter longevity of *T. murrayi* and *T. scabrus* compared to the target species of deep-water fisheries, levels of fishing mortality that are sustainable to the target species are most likely to be also sustainable for these smaller species.

The only management that can be proposed is to include minor landings of any macrourid species in the TAC of the main grenadier species, the roundnose grenadier. This should not imply any increase of the TAC of roundnose grenadier, because catches of *Trachyrincus* spp. and all other macrourids are small compared to that of the roundnose grenadier in all ICES divisions.

14.10 Recommendation

As the roughsnout and roughnose grenadiers are non-commercial species and are not likely to become of commercial interest in the foreseeable future, it is recommended that these species are no longer considered by ICES in terms of stock assessment.

Reported landings of bycatch of these species should be considered misreporting of other species, most probably of the roundnose grenadier.

Roughsnout and roughnose grenadiers should not be subject of catch advice.

14.11 References

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14.12 Tables

Table 14.1a. Official landings of roughsnout grenadier by ICES Subarea reported by Spain.

Year	Spain 6.b	Spain 12.a	Spain 12.b	Spain 14.b	Total
2012		54		3	57
2013					0
2014	42	4	155	448	649
2015	0	0	0	0	0
2016	0	0	0	0	0

Table 14.1b. Official landings of roughsnout grenadier by ICES Subarea reported by Lithuania.

Year	Lithuania 6	Lithuania 12	Total
2006	506	67	573
2007	442	101	543
2008	49	50	99

Table 14.2. Discards of *T. murrayi* and *T. scabrus* in the French deep-water trawl fishery compared to the catch of the target species and the total landings and discards from 2010 to 2016. Raw observation data, no raising applied.

	2010	2011	2012	2013	2014	2015	2016
Total catch in observed hauls (tonnes)	530	846	652	551	533	377	317
Landings (tonnes)	451	694	526	440	477	334	290
Discards (tonnes)	79	151	126	111	56	43	27
Catch (landings+ discards) of roundnose grenadier, black scabbardfish and blue ling (tonnes)	387	616	456	373	388	257	225
Discards of *T. murrayi* and *T. scabrus* (tonnes)	0.10	0.42	1.16	0.55	0.52	0.12	0.10

15 Other deep-water species in the Northeast Atlantic

15.1 The fisheries

The following species are considered in this chapter: common mora (*Mora moro*) and Moridae, rabbit fish (*Chimaera monstrosa* and *Hydrolagus* spp), Baird's smoothhead (*Alepocephalus bairdii*) and Risso's smoothhead (*A. rostratus*), wreckfish (*Polyprion americanus*), blackbelly rosefish (*Helicolenus dactylopterus*), silver scabbardfish (*Lepidopus caudatus*), deep-water cardinal fish (*Epigonus telescopus*) and deep-water red crab (*Chaceon affinis*). Mora, rabbitfish, smoothheads, blackbelly rosefish and deep-water cardinal fish are taken as bycatch in mixed-species demersal trawl fisheries in Subareas 6, 7 and 12 and to a lesser extent, 2, 4 and 5.

In Subarea 14b, Baird's smoothhead, rabbit fish and species of Moridae are caught as bycatch in demersal trawl fisheries for Greenland halibut (*Reinhardtius hippoglossoides*) but are most likely under reported in official reports from the area.

Mora, wreckfish, blackbelly rosefish and silver scabbardfish are caught in targeted and mixed species longline fisheries in Subareas 8, 9 and 10.

Deep-water red crab were formerly caught in directed trap fisheries principally in Subareas 6 and 7 but this fishery ceased to operate in the ICES area since 2008.

15.1.1 Landings trends

Landings reported to the Working Group are presented in Tables 15.1–15.9 and official landings for 2006–2014 in Tables 15.10–15.17. These official landings were taken from official nominal catch 2006–2014 on the ICES website, similar data are not yet available for 2015–2016.

15.1.2 ICES Advice

ICES has not previously given specific advice on the management of any of the stocks considered in this chapter.

15.1.3 Management

No TACs are set for any of these species in EC waters or in the NEAFC Regulatory Area. None of these species were included in Appendix I of Council Regulation (EC) No 2347/2002 meaning that vessels were 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. They are now included in the Council Regulation (EC) 2016/2336 repealing the previous one.

15.2 Stock identity

No information available.

15.3 Data available

15.3.1 Landings and discards

Landings for all of these species are presented in Tables 15.1–15.9. In 2015, other deep-water species (OTH_COMB) were included in the data call for deep-water species, accompanied with a list of species for which landings data are required. The annual reporting of these species to WGDEEP has varied in quality and quantity. In some years and countries provided a single value for other species combined. Therefore species-specific landings data are incomplete and time-series would need being revised.

In 2016, some data provided to the working group were not suitable. One country reported species which are not deep water, such as coastal Rajidae, another reported American plaice (*Hippoglossoides platessoides*) and Spotted wolffish (*Anarhichas minor*).

In some cases, considerable differences exist between the working group data and therefore, the official catch number for these species are presented in Tables 15.10–15.17. In Subareas 6 and 12 landings of silver scabbardfish are suspected to be misreported (probably of black scabbardfish, *Aphanopus carbo*) as the occurrence of the species is not supported by scientific evidence. These issues remain unresolved but need to be explored further.

The reported landings of blackbelly rosefish was high in 2016 and 2017 but similar to 2012–2013.

15.3.2 Length compositions

For several species data on length compositions are available from survey data. Length distributions of blackbelly rosefish in the Spanish Porcupine survey is shown in Figure 15.1 while Figure 15.2 presents the length–frequency distributions from the Spanish bottom-trawl survey in the Northern Spanish Shelf (SP-NGFS) in Divisions 9a and 8c. Time-series of length distributions of blackbelly rosefish in the Faroese summer groundfish survey is shown in Figure 15.3. Trends in mean length of blackbelly rosefish in the French EVHOE survey (Bay of Biscay) is shown in Figure 15. 4. The length distribution of silver scabbardfish, common mora and wreckfish in Azorean surveys are presented in Figures 15.5, 15.6 and 15.7, respectively.

15.3.3 Age compositions

No new information.

15.3.4 Weight-at-age

No new information.

15.3.5 Maturity and natural mortality

No new information.

15.3.6 Catch, effort and research vessel data

For blackbelly rosefish standardized indices from the Spanish Porcupine Bank Survey (abundance and biomass), the Portuguese longline survey in the Azores Islands (abundance), the

French EVHOE survey (biomass), the cpue series from the Faroese groundfish survey and the Spanish bottom-trawl survey (SP-NGFS) in Divisions 9.a and 8.c are given in Figures 15.7–15.11.

Abundance indices for silver scabbardfish, common mora and wreckfish from the Portuguese longline survey in the Azores Islands are given in Figures 15.12 to 15.14.

Updated figures from 2018 on abundance index, mean length, length composition and distribution by depth for silver scabbardfish, blackbelly rosefish, wreckfish and common mora in the Portuguese longline survey in the Azores is available in WD08, WGDEEP 2019.

15.3.7 Data analysis

In general, modal length of blackbelly rosefish appears to have increased in surveys shown here (Figures 15.1–15.4). Standardized biomass and abundance indices in the Spanish Porcupine Bank Survey (Figure 15.7) declined between 2006 and 2011 but have increased since then and remained at similar level from 2013 to 2015 and decrease again in 2016. In the Azores, the abundance index for this species seems to have declined since 2008 (Figure 15.8) and after increased slightly from 2013 onwards. Trends in biomass in Bay of Biscay (Figure 15.9) and in Faroese (Figure 15.10) survey cpue show an increasing trend for this species since 2010. Similarly, in the SP-NGFS the biomass and abundance of blackbelly rosefish even the decrease in 2016, after the peak of 2015, still above the mean values of the time-series and much above the minimum found in 2010 (Figure 15.11).

The standardized abundance index for silver scabbard fish in the Azores Islands longline survey (Figure 15.12) was at the same low level in 2016 than in 2001–2003. Mean length has declined across the time-series but seems rather increasing since 2005 (Figure 15.5).

The cpue for wreckfish in the Azores Islands longline survey (Figure 15.13) fluctuated greatly with no overall trend between 1995 and 2008. Since 2010, the level has remained low, with the lowest value in 2013. In 2016 the value shows a significant increase. Mean length showed no trend unless the higher value appears in 2016, the last analysed year (Figure 15.7).

The cpue for common mora in the Azores longline survey (Figure 15.14) show no clear trend unless the last year (2016) reach the higher value of the whole series. The mean length seems rather high in 2012 and 2013 but decreases again in 2016 (Figure 15.6).

15.3.8 Comments on the assessment

15.3.9 Management considerations

Currently no advice is required for these stocks.

15.4 Tables and Figures

Table 15.1. Working Group estimates of landings of *Mora moro* and *Moridae* (t).

Year	2	5b	6 and 7	8 and 9	10	12	14b	TOTAL
1988								
1989								
1990					2			2
1991		5	1		4			10
1992			25					25
1993			10					10
1994			10					10
1995				83				83
1996				52				52
1997				88				88
1998			41					41
1999		1	20					21
2000	8	3	159	25		1		196
2001	1	100	194	25		87		407
2002	1	19	159	10	100	13		302
2003		8	327	12	125	15	7	494
2004		1	71	15	87	4		178
2005		1	63	19	69			152
2006		5	111	45	92			253
2007		8	64	18	86			176
2008		4	57	4	53			118
2009		1		5	68			74
2010		11	1	4	54			70
2011		7	86	4	55			152
2012		5	71	1	31			108
2013			99	1	52			152
2014				1	54			55

Year	2	5b	6 and 7	8 and 9	10	12	14b	TOTAL
2015				51	92			92
2016		1	40					41
2017		3	30	62	169			264

Table 15.3. Working group estimates of landings of rabbitfish (t) (*Chimaera monstrosa* and *Hydrolagus* spp).

Year	1 and 2	3 and 4	5a	5b	6 and 7	8	9	12	14	TOTAL
1991			499							499
1992		122	106							228
1993		8	3							11
1994		167	60		2					229
1995			106	1						107
1996		14	32							46
1997		38	16					32		86
1998		56	32		2			42		132
1999		47	9	3	237	2		114		412
2000	6	34	6	54	404	2		48		554
2001	7	23	1	96	797	7		79		1010
2002	15	24		64	570	6		98	1	778
2003	57	25	1	61	469	2		80	4	699
2004	22	40		100	444	6		128	5	745
2005	77	171		63	571	14		249	1	1146
2006	29	17	1	62	325	10			5	449
2007	64	2	1	78	391	3				539
2008	81	12	1	49	370	3				516
2009	89	6	2	6	47			70		220
2010	197	21	7	5	31			25		286
2011	150	7	4	2	88					251
2012	104	17	4	29	475	2		434		1065
2013	103	40	2	30	160	1		56		392

Year	1 and 2	3 and 4	5a	5b	6 and 7	8	9	12	14	TOTAL
2014		4		32	131	4		77		178
2015	79	14		25	30			1		149
2016	78	49		40	225	15	31	4		364
2017	69	32		105	174	1			1	382

Table 15.4. Working Group estimates of landings of Baird's smoothhead (t).

Year	5a	5b	6 and 7	12	14	TOTAL
1991			31			31
1992	10		17			27
1993	3			2		5
1994	1					1
1995	1					1
1996				230		230
1997				3692		3692
1999				4643		4643
1999				6549		6549
2000			978	4146	12	5136
2001			5305	3132		8897
2002			260	12 538	661	13 459
2003			393	6883	632	7908
2004		6	2657	4368	245	7276
2005		1	5978	6928		12 412
2006			4966	3512		8150
2007			2565	1781		4140
2008			896	744		1611
2009			295	508		803
2010			511	317		828
2011			187	252		252
2012			335	472		472

Year	5a	5b	6 and 7	12	14	TOTAL
2013			342	351		693
2014			235 0+	228		463
2015			127 3+	91		218
2016			131	258		389
2017	14		156	326		496
2018			77*	323*		400*
* Only data from Spain						

Table 15.5. Working Group estimates of landings of wreckfish (t).

Wreckfish (*Polyprion americanus*) All areas				
Year	**6 and 7**	**8 and 9**	**10**	**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

Wreckfish (*Polyprion americanus*) All areas				
Year	**6 and 7**	**8 and 9**	**10**	**TOTAL**
1998	12	238	140	390
1999	14	144	133	291
2000	14	123	263	400
2001	17	167	232	416
2002	9	156	283	448
2003	2	243	270	515
2004	2	141	189	332
2005		195	279	474
2006		331	497	828
2007	2	553	662	1217
2008	3	317	513	833
2009	8	13	382	403
2010	3	5	238	246
2011		150	266	416
2012		256	226	482
2013			209	209
2014		95	121	216
2015			116	116
2016	4	19	101	124
2017	9	114	131	254

Table 15.6. Working Group estimates of landings of blackbelly rosefish (t). Data from 2015 are provisional.

Year	3 and 4	5b	6	7	8 and 9	10	TOTAL
1980						18	18
1981						22	22
1982						42	42
1983						93	93
1984						101	101
1985						169	169
1986						212	212
1987						331	331
1988						439	439
1989			79	48	2	481	610
1990	4		69	31	5	480	589
1991	5		99	29	12	483	628
1992	3		112	47	11	575	748
1993	1		87	65	8	650	811
1994	2		62	55	4	708	831
1995	2		62	9		589	662
1996	2		77	10		483	572
1997	1		78	10	1	410	500
1998			53	92	3	381	529
1999	8	64	194	160	29	340	795
2000		16	213	119	33	441	822
2001			177	102	34	301	614
2002			81	115	18	280	494
2003			184	213	124	338	859
2004	2	3	142	291	135	282	855
2005			103	204	206	190	703
2006			59	160	287	209	715
2007			61	259	293	274	887
2008			105	193	214	281	752

Year	3 and 4	5b	6	7	8 and 9	10	TOTAL
2009			182	14	75	267	450
2010			195	6	120	213	294
2011			176	14	149	231	400
2012		2	161	944	1332	190	2629
2013			121	20	1320	235	1696
2014			25	23	141	200	389
2015		+	+			256	256
2016			452	516	537	306	1811
2017		3	135	647	595	344	1724

Table 15.7. Working Group estimates of landings of silver scabbardfish (t).

	6 and 7	8 and 9	10	12	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

	6 and 7	8 and 9	10	12	TOTAL
1997		1725	1115		2840
1998		966	1187		2153
1999	18	3069	86		3173
2000	17	16	27		60
2001	6	706	14		726
2002	1	1832	10		1843
2003		1681	25		1706
2004		836	29		865
2005	57	527	31		615
2006	377	624	35	3	1039
2007	88	649	55	1	793
2008	40	845	63	0	948
2009	44	898	64	25	1031
2010	32	829	68	43	972
2011		927	148	82	1157
2012	655	36	271	244	1206
2013	200		361	123	648
2014	253		713	88	1056
2015			429	41	470
2016	188	134	87	33	442
2017	62	146	112	29	349
2018*	‹1			13	
*Only data from Spain					

Table 15.8. Working Group estimates of landings of deep-water cardinal fish (t).

Year	5b	6	7	8 and 9	10	12	TOTAL
1990					3		3
1991					11		11
1992							0
1993		15	15				30
1994	4	35	182				221
1995	3	20	71				94
1996	8	13	32				53
1997	8	27	22				57
1998		86	29				115
1999	8	54	224	3			289
2000	2	121	181	5	3		312
2001	7	109	284	4			404
2002		97	888	8	14		1007
2003	2	47	1031	5	16	1	1102
2004	1	30	843	10	21	2	907
2005		50	637	8	4		699
2006		30	383	12	10		435
2007		6	218	19	7		250
2008		19	5	6	7		37
2009		8	2	130	7		147
2010		4	6		5		15
2011		3	2	128	5		138
2012		16	4	2	4		26
2013		10	1	1	4		16
2014		4	1	2	2		9
2015					4		4
2016					6		6
2017		12		3	8		23

Table 15.9. Working Group estimates of landings of deep-water red crab (t).

Year	4and5	6	7	8 and 9	12	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	110	75	10	115	309
2010	2	247	79	46	71	445
2011		246	148	37	43	475
2012	10	67	45	10	21	153
2013	3	91	34	18	32	178
2014	1	112	29	3	48	194
2015		151	40	26	74	291
2016		103	55	41	23	222
2017	9	102	48	21		180

Table 15.10. Official landings of *Mora moro* and *Moridae* (t) 2006–2014.

YEAR	27.5	27.6	27.7	27.8	27.9	27.10	TOTAL
2006	1	43	22	17	2	62	147
2007	1	51	51	6	1	52	162
2008	0	38	31	1	0	31	101
2009	0	35	52	1	1	57	146
2010	2	37	46	4	0	55	144
2011	0	38	42	9	0	68	157
2012	0	17	46	14	0	53	130
2013	0	19	71	14	1	86	191
2014	0	5	97	39	0	92	233

Table 15.11. Official landings of rabbitfish (t) (*Chimaera monstrosa* and *Hydrolagus* spp.) 2006–2014.

Year	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.10	27.12	TOTAL
2006	28	1	13	11	24	0	5	0	76	5	163
2007	63	2	13	0	45	4	0	2	47	0	176
2008	79	2	7	2	38	1	0	2	11	0	142
2009	88	1	6	7	42	0	0	0	6	0	150
2010	199	1	21	12	31	1	0	0	23	0	288
2011	149	4	6	13	220	4	1	0	45	0	442
2012	105	2	23	26	265	17	3	0	3	0	444
2013	109	3	37	52	305	2	1	0	0	0	509
2014	83	0	22	64	228	0	0	0	0	5	402

Table 15.12. Official landings of Baird's smoothhead (t) 2006–2014.

YEAR	27.5	27.6	27.7	27.8	27.9	27.12	27.14	TOTAL
2006	0	403	3	67	0	241	0	714
2007	0	192	0	0	0	14	0	206
2008	4	1043	0	0	0	790	42	1879
2009	0	739	0	0	0	776	1	1516
2010	0	672	0	0	0	896	0	1568
2011	0	785	0	0	0	718	0	1503
2012	15	360	1	0	18	551	5	950
2013	0	304	0	0	27	346	0	677
2014	14	248	0	0	15	241	0	518

Table 15.13. Official landings of wreckfish (t) 2006–2014.

YEAR	27.4	27.6	27.7	27.8	27.9	27.10	TOTAL
2006	0	15	52	33	407	498	1005
2007	0	20	197	65	710	686	1678
2008	0	9	149	168	386	523	1235
2009	0	1	245	212	217	395	1070
2010	0	0	232	392	105	240	969
2011	4	6	409	352	144	277	1192
2012	0	0	96	101	154	228	579
2013	0	0	39	46	114	209	408
2014	0	0	8	29	92	142	271

Table 15.14. Official landings of blackbelly rosefish (t) 2006–2014.

YEAR	27.2	27.4	27.5	27.6	27.7	27.8	27.9	27.10	TOTAL
2006	0	0	1	195	839	168	161	209	1573
2007	1	0	1	387	1968	157	363	277	3154
2008	2	0	1	138	1175	314	213	287	2130
2009	0	2	1	150	1320	436	216	317	2442
2010	0	1	0	201	1681	1665	197	216	3961
2011	0	1	3	176	2302	1558	264	239	4543
2012	0	0	1	161	954	991	412	192	2711
2013	0	7	3	131	516	941	386	235	2219
2014	0	1	6	149	489	471	337	224	1677

Table 15.15. Official landings of silver scabbardfish (t) 2006–2014.

YEAR	27.6	27.7	27.8	27.9	27.10	27.12	TOTAL
2006	27	346	83	470	37	3	966
2007	25	68	14	746	55	1	909
2008	24	1	1	900	64	20	1010
2009	43	107	314	396	64	34	958
2010	144	21	284	510	68	66	1093
2011	890	0	35	451	148	105	1629
2012	778	0	2	58	271	286	1395
2013	225	0	1	279	361	144	1010
2014	240	0	2	529	912	91	1774

Table 15.16. Official landings of deep-water cardinalfish (t) 2006–2014.

YEAR	27.6	27.7	27.8	27.9	27.10	TOTAL
2006	27	66	10	17	10	130
2007	10	17	1	29	7	64
2008	5	12	4	7	7	35
2009	10	13	2	32	7	64
2010	7	11	27	3	5	53
2011	4	45	2	1	5	57
2012	16	4	3	1	4	28
2013	10	2	1	1	4	18
2014	5	1	0	1	4	11

Table 15.17. Official landings of deep-water red crab (t) 2006–2014.

YEAR	27.4	27.6	27.7	27.8	27.9	27.12	TOTAL
2006	7	217	72	34	0	123	453
2007	0	163	82	46	5	72	368
2008	10	73	85	31	0	64	263
2009	0	110	75	10	0	115	310
2010	2	247	79	13	33	71	445
2011	0	246	148	12	25	43	474
2012	10	67	45	10	0	21	153
2013	3	91	34	7	11	32	178
2014	1	112	29	3	0	48	193

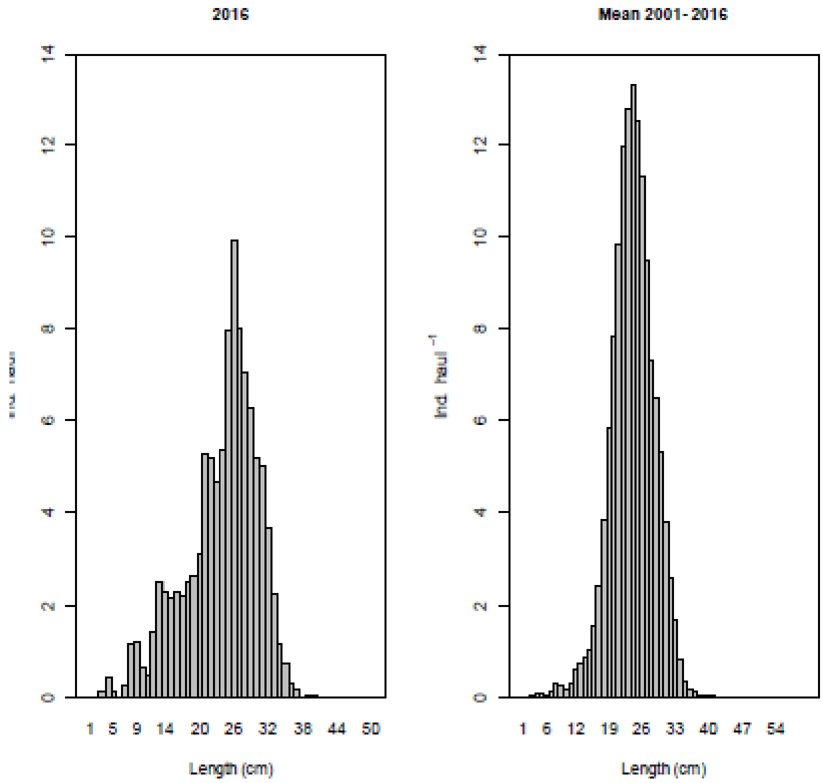


Figure 15.1. Stratified length distributions of blackbelly rosefish (*Helicolenus dactylopterus*) in 2016 Porcupine survey, and mean values during Porcupine survey time-series (2001–2016).

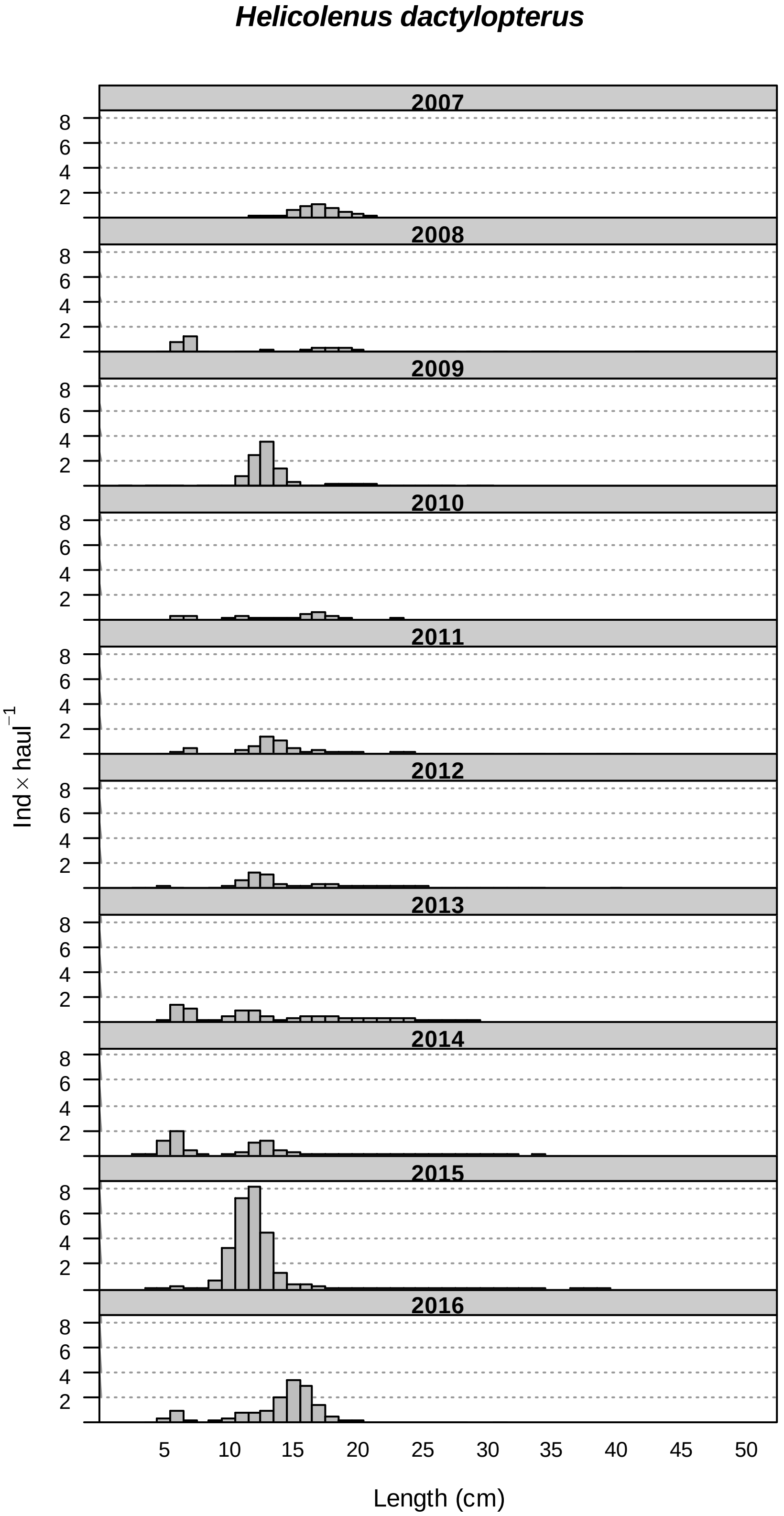


Figure 15.2. Mean stratified length distributions of blackbelly rosefish (*H. dactylopterus*) in Northern Spanish Shelf surveys (2007–2016).

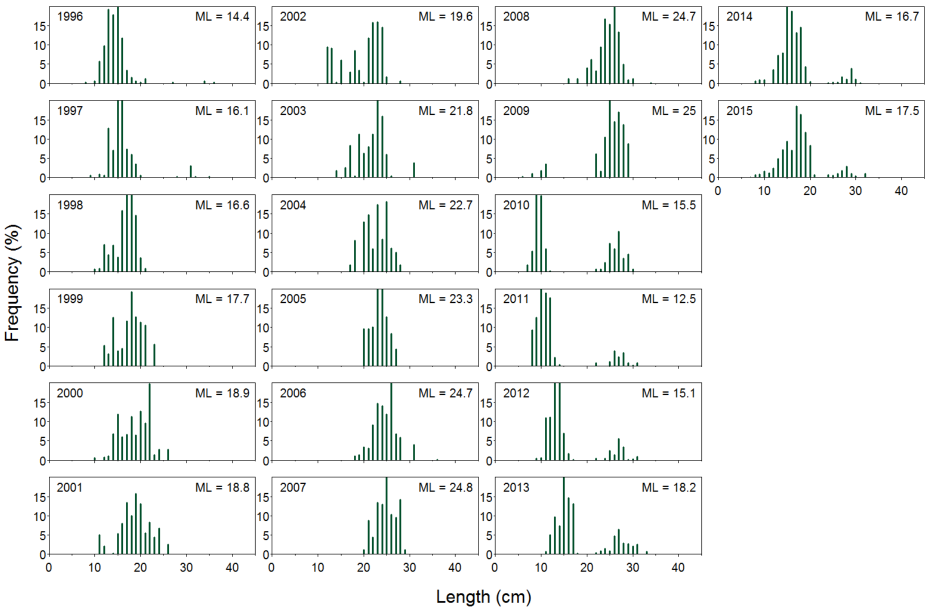


Figure 15.3. Length distributions of *Helicolenus dactylopterus* in Faroese summer survey 1996–2015.

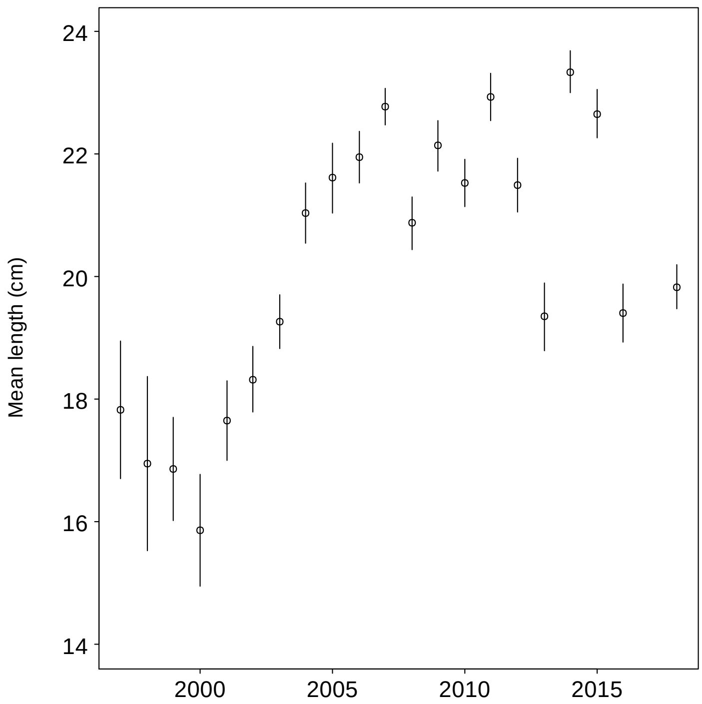


Figure 15.4 Trend in mean length of *Helicolenus dactylopterus* in the French survey in Bay of Biscay and Celtic Sea (EVHOE).

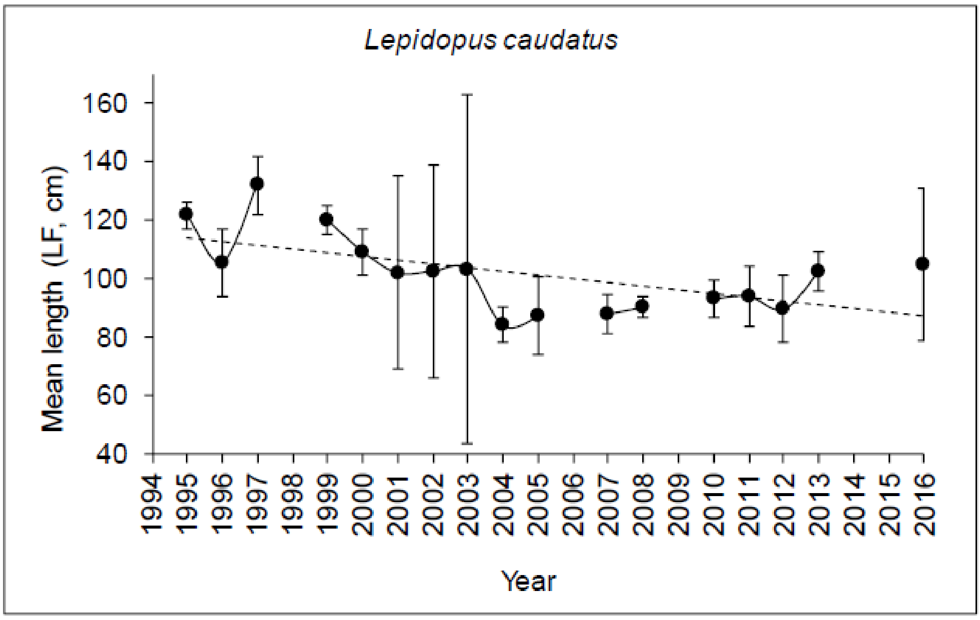


Figure 15.5. Mean length of *Lepidopus caudatus* in Azores bottom longline survey 1995–2016.

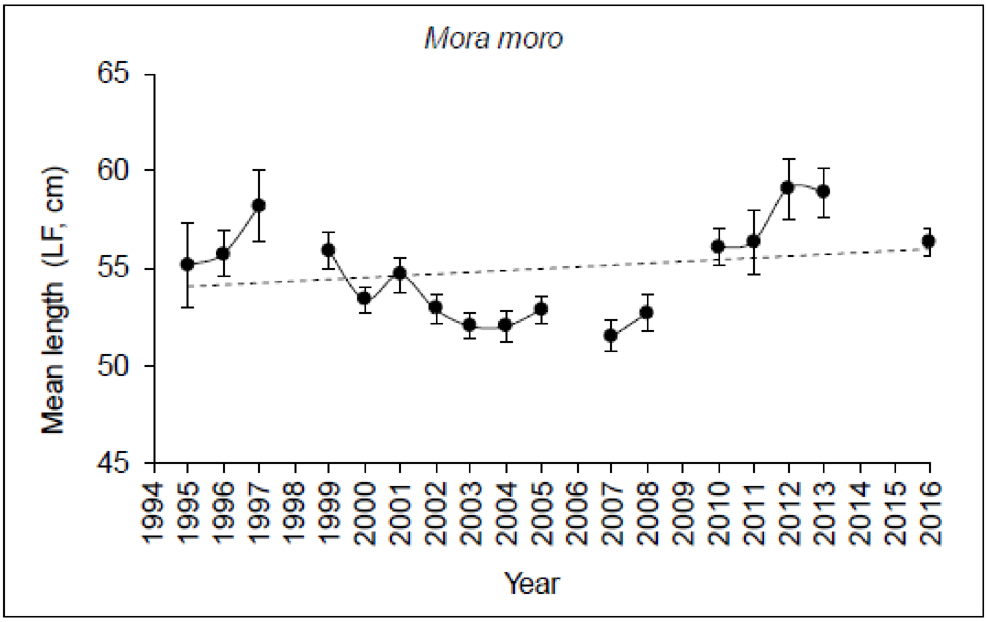


Figure 15.6. Mean length of *Mora moro* in Azores bottom longline survey 1995–2016.

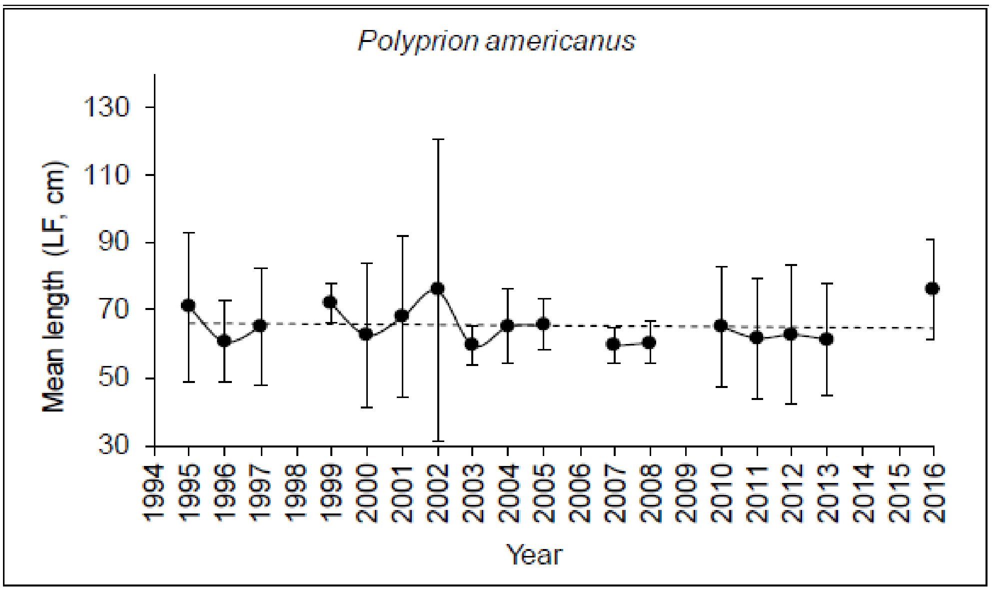


Figure 15.7. Mean length of *Polyprion americanus* in Azores bottom longline survey 1995–2016.

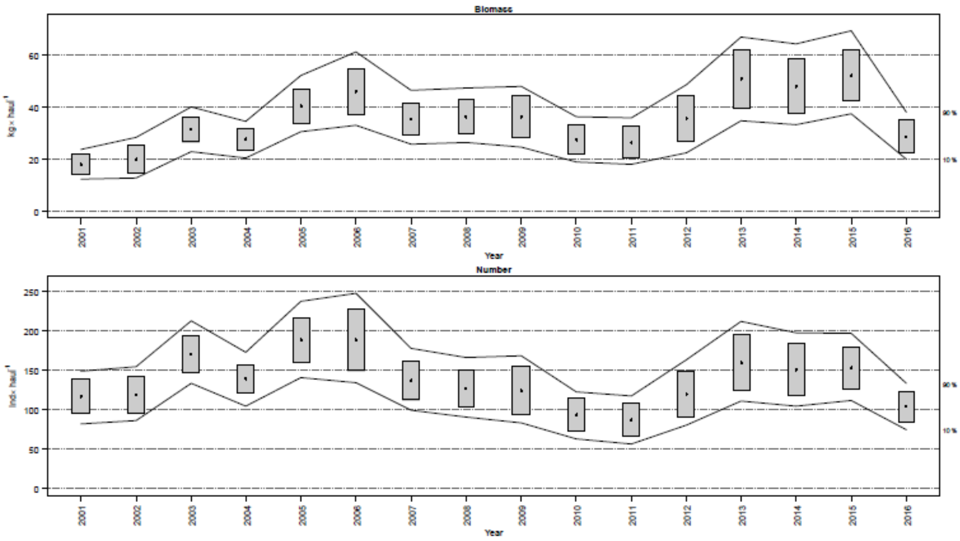


Figure 15.7. Trends of *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time-series (2001–2016). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (□ = 0.80, bootstrap iterations = 1000).

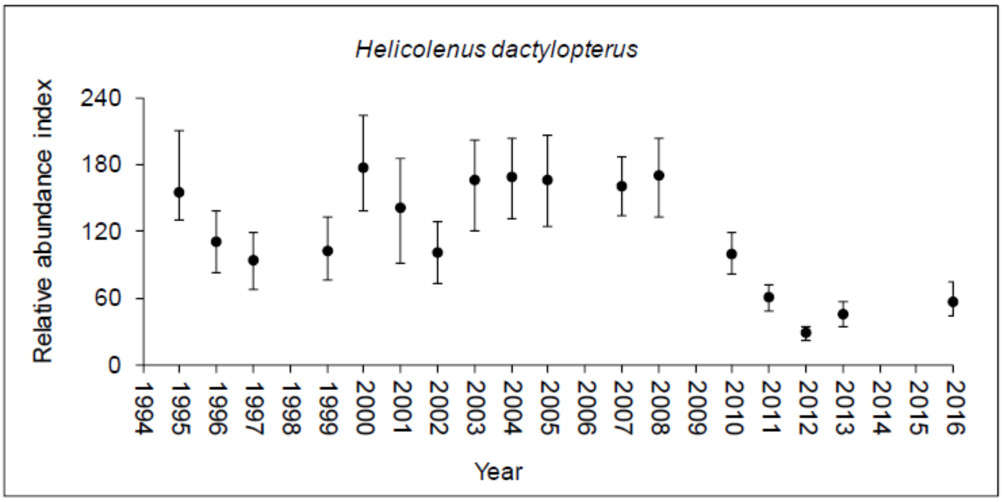


Figure 15.8. Annual bottom longline survey abundance index for *Helicolenus dactylopterus* in Azorean bottom longline surveys.

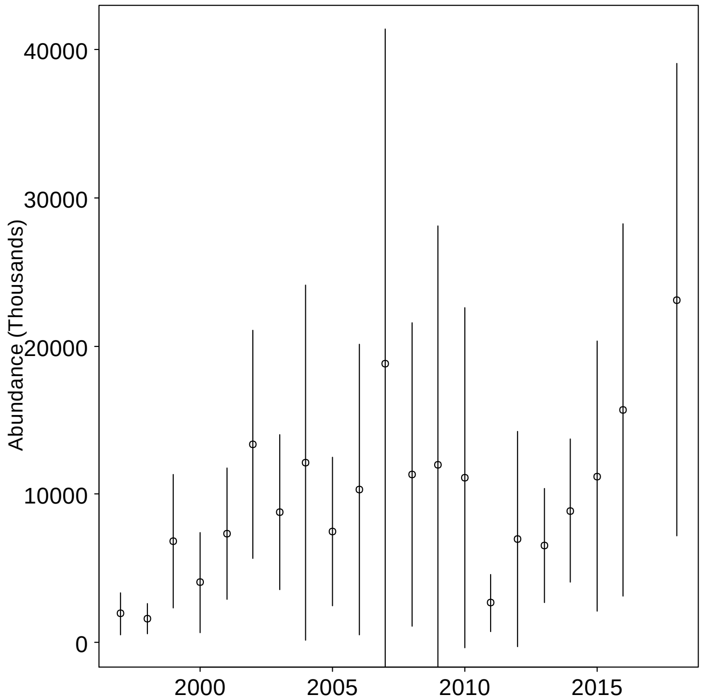


Figure 15.9. Survey abundance index from the French survey (EVHOE) for *Helicolenus dactylopterus*.

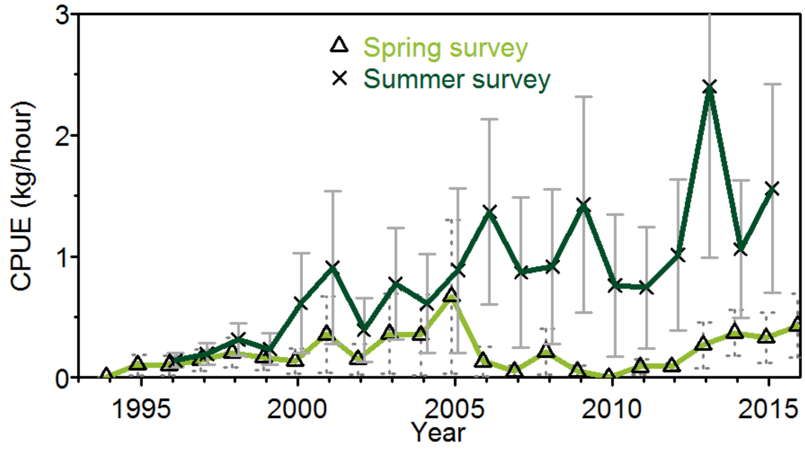


Figure 15.10. Cpue time-series for *Helicolenus dactylopterus* in the Faroese groundfish surveys.

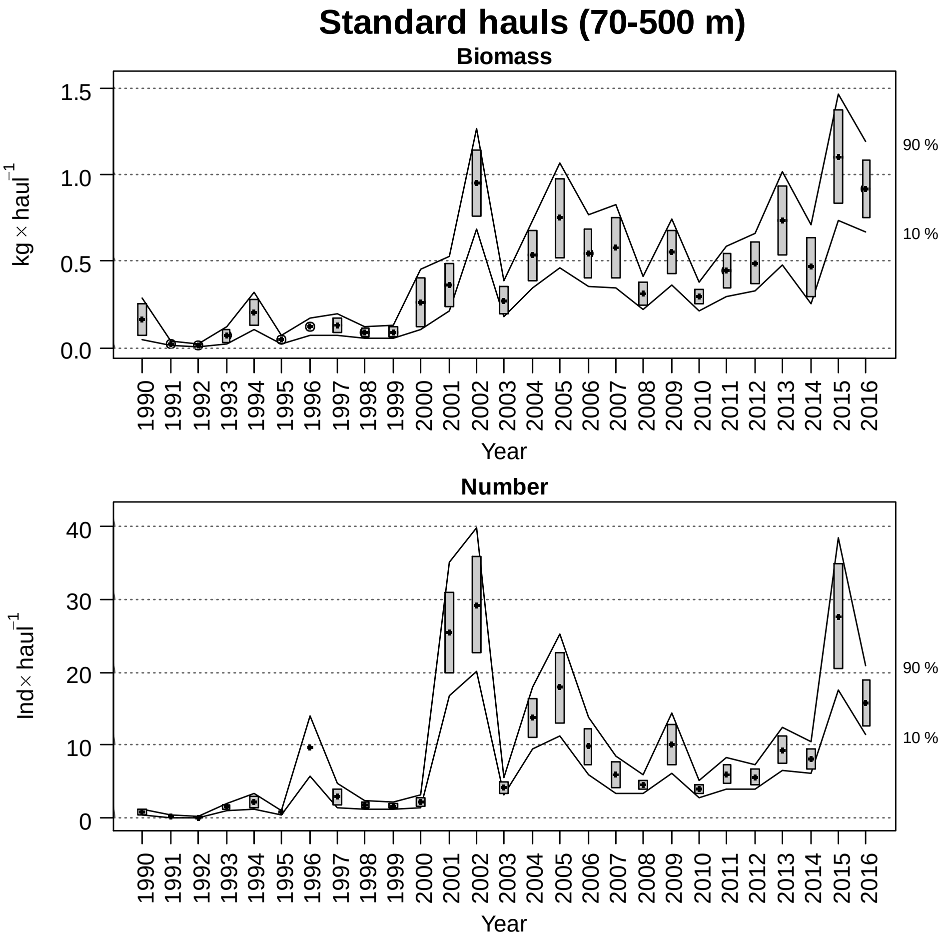


Figure 15.11. Evolution of *Helicolenus dactylopterus* mean stratified biomass and abundance in Northern Spanish Shelf surveys time-series (1990–2016). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000).

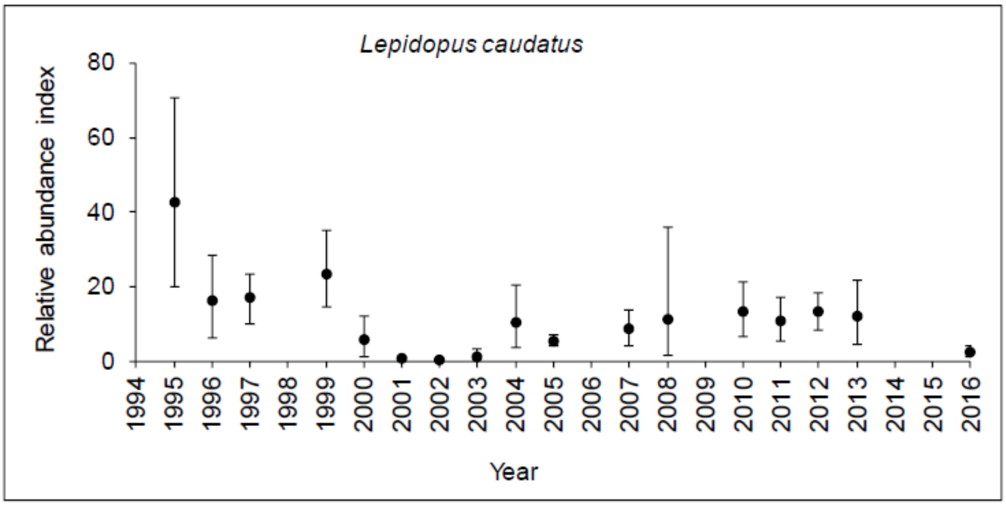


Figure 15.12. Annual bottom longline survey abundance index for *Lepidopus caudatus* in Azorean bottom longline surveys.

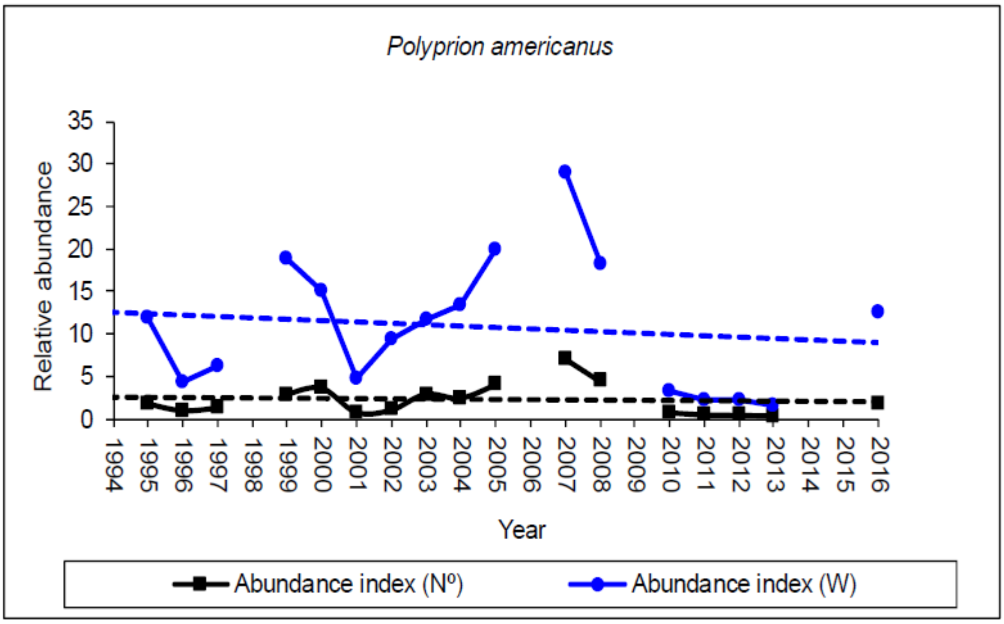


Figure 15.13. Annual bottom longline survey nominal cpue for *Polyprion americanus* in Azorean bottom longline surveys.

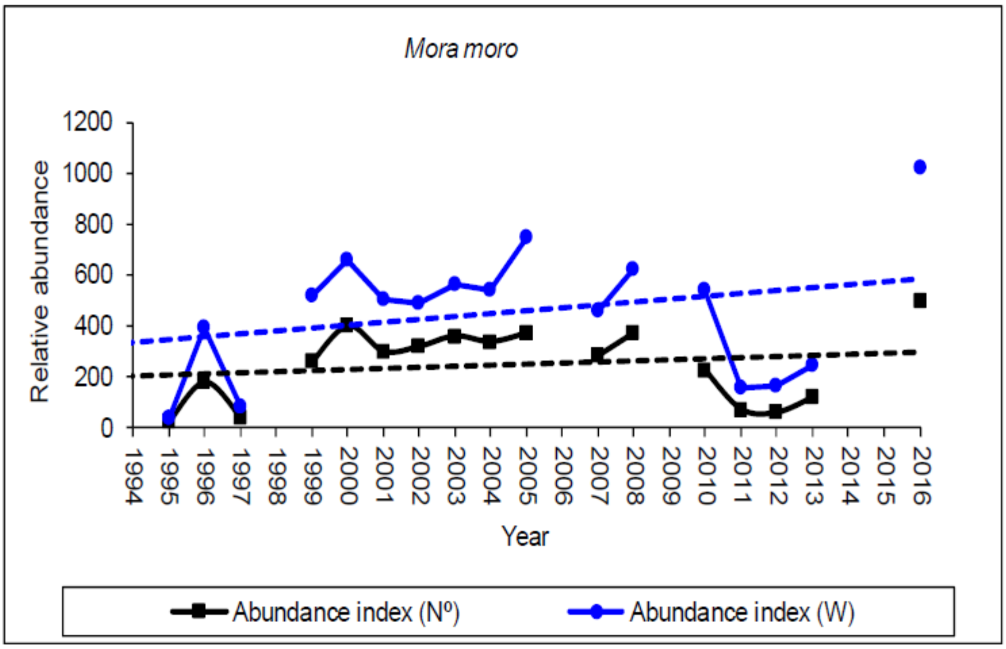


Figure 15.14. Annual bottom longline survey nominal cpue for *Mora moro* in Azorean bottom longline surveys.

Annex 1: List of participants

Participant	Institute	Email	Country of Institute
Bruno Almón Pazos	Instituto Español de Oceanografía, Centro Oceanográfico de Vigo	bruno.almon@ieo.es	Spain
David Miller	International Council for the Exploration of the Sea	david.miller@ices.dk	Denmark
Elvar Halldor Hallfredsson *Co-chair*	Institute of Marine Research Tromsø	elvar.hallfredsson@hi.no	Norway
EriK Berg	Institute of Marine Research Tromsø	erik.berg@hi.no	Norway
Guzmán Diez *by correspondence*	AZTI-Tecnalia Sukarrieta	gdiez@azti.es	Spain
Hege Øverbø Hansen	Institute of Marine Research, Flødevigen Marine Research Station	hege.oeverboe.hansen@hi.no	Norway
Helle Torp Christensen	Greenland Institute of Natural Resources	htch@natur.gl	Greenland
Inês Farias	Portuguese Institute for the Sea and the Atmosphere (IPMA)	ifarias@ipma.pt	Portugal
Ivone Figueiredo	Portuguese Institute for the Sea and the Atmosphere (IPMA)	ifigueiredo@ipma.pt	Portugal
Juan Gil Herrera	Instituto Español de Oceanografía, Centro Oceanografico de Cádiz	juan.gil@ieo.es	Spain
Julius Nielsen	Greenland Institute of Natural Resources	juni@natur.gl	Greenland
Kristin Helle	Institute of Marine Research	kristin.helle@hi.no	Norway
Lise Heggebakken	Institute of Marine Research Tromsø	lise.heggebakken@hi.no	Norway
Lise Helen Ofstad	Faroe Marine Research Institute	liseo@hav.fo	Faroe Islands
Magnus Thorlacius	Marine and Freshwater Research Institute	magnus.thorlacius@hafogvatn.is	Iceland
Mário Rui Rilho de Pinho	University of the Azores, Department of Oceanography and Fisheries	mario.rr.pinho@uac.pt	Portugal

Participant	Institute	Email	Country of Institute
Martin Pastoors	Pelagic Freezer-Trawler Association	mpastoors@pelagicfish.eu	The Netherlands
Pamela Woods	Marine and Freshwater Research Institute	pamela.woods@hafogvatn.is	Iceland
Pascal Lorance *Co-chair*	Ifremer	pascal.lorance@ifremer.fr	France
Rui Vieira	Cefas, Lowestoft Laboratory	rui.vieira@cefas.co.uk	UK
Teresa Moura *by correspondence*	Portuguese Institute for the Sea and the Atmosphere (IPMA)	tmoura@ipma.pt	Portugal

Annex 2: Resolutions

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

2018/2/FRSG10 **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** (WGDEEP), chaired by Pascal Lorance, France, and Elvar Halldor Hallfredsson*, Norway, will meet at ICES Headquarters, 2–9 May 2019 to:

a) Address generic ToRs for Regional and Species Working Groups.

b) Complete the development of Stock Annexes for all the stocks assessed by WGDEEP, based on the most recent agreed assessment.

c) Update the description of deep-water fisheries in both the NEAFC Regulatory Area 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 Regulatory Area. In particular, describe and prepare a first advice draft of any new emerging deep-water fishery with the available data in the NEAFC Regulatory Area.

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

e) Evaluate the stock status of stocks in Icelandic waters for the provision of annual advice in 2019.

f) Evaluate the stock status of stocks for the provision of biennial advice due in 2019.

g) Undertake work on the Special Request from DGMARE on the deletion of TACs. For Greater Silversmelt in subarea 7 (aru.27.6b7-1012), assess the role of the Total Allowable Catch instrument, assessing the risks of limiting the TAC to areas 5 and 6. Assess the potential contribution of the application of other conservation tools in the absence of a TAC.

The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group on the dates specified in the 2019 ICES data call.

WGDEEP will report by 16 May 2019 for the attention of ACOM.

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group

WGDEEP – Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (Draft ToRs)

2019/2/FRSGxx

Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), chaired by Ivone Figueiredo, Portugal and Elvar Halldor Hallfredsson, Norway, will meet at ICES Headquarters, 24 April–1 May 2020 to:

h) Address generic ToRs for Regional and Species Working Groups.

i) Complete the development of Stock Annexes for all the stocks assessed by WGDEEP, based on the most recent agreed assessment.

j) Update the description of deep-water fisheries in both the NEAFC Regulatory Area 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 Regulatory Area. In particular, describe and prepare a first advice draft of any new emerging deep-water fishery with the available data in the NEAFC Regulatory Area.

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

l) Evaluate the stock status of stocks in Icelandic waters for the provision of annual advice in 2019.

m) Evaluate the stock status of stocks for the provision of biennial advice due in 2019.

The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group on the dates specified in the 2020 ICES data call.

WGDEEP will report by xx May 2020 for the attention of ACOM.

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group

Annex 3: Stock Annexes

The table below provides an overview of the WGDEEP stock annexes updated at the WGDEEP 2018 meeting. Stock annexes for other stocks are available on the ICES website Library under the Publication type "Stock Annexes". Use the search facility to find a particular stock annex, refining your search in the left-hand column to include *year*, *ecoregion*, *species* and *acronym* of the relevant ICES expert group

stock ID	stock name	Last updated	Link
aru.27.123a4	Greater silver smelt (Argentina silus) in Subareas 1, 2, and 4, and in Division 3.a (Northeast Arctic, North Sea, Skagerrak and Kattegat))	May 2019	aru27.123a4
bli.25.nea	Blue ling (Molva dypterygia) in subareas 1, 2, 8, 9, and 12, and in divisions 3.a and 4.a	May 2019	bli.25.nea
bli-5a14	Blue ling (Molva dypterygia) in Subarea 14 and Division 5.a (East Greenland and Iceland grounds)	May 2019	bli-5a14
ory.25.nea	Orange roughy (Hoplostethus atlanticus) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	May 2019	ory.25.nea
rng.27.5a10b12ac14b	Roundnose grenadier (Coryphaenoides rupestris) in divisions 10.b and 12.c, and in subdivisions 12.a.1, 14.b.1, and 5.a.1 (Oceanic Northeast Atlantic and northern Reykjanes Ridge)	May 2019	rng.27.5a10b12ac14b
rng.27.5b6712b	Roundnose grenadier (Coryphaenoides rupestris) in subareas 6-7, and in Divisions 5.b and 12.b (Celtic Seas and the English Channel, Faroes grounds, and western Hatton Bank)	May 2019	rng.27.5b6712b
sbr.27.9	Blackspot seabream (Pagellus bogaraveo) in subareas 6–8 (Celtic Seas, the English Channel, and Bay of Biscay)	May 2019	sbr.27.9
sbr.27.678	Blackspot seabream (Pagellus bogaraveo) in Subarea 9 (Atlantic Iberian waters)	May 2019	sbr.27.678

Annex 4: Working documents

List of Working Documents

WD01: Black scabbard fish in Faroese waters (27.5.b), Lise H. Ofstad, Faroe Marine Research Institute

WD02:Faroese orange roughy fishery in ICES area 27.10 and 27.12., Lise H. Ofstad, Faroe Marine Research Institute

WD03: Roundnose grenadier in Faroese waters (27.5.b), Lise H. Ofstad, Faroe Marine Research Institute

WD04: 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), Hege Øverbø Hansen1, Odd Aksel Bergstad1, Terje Jørgensen2

WD05: Survey results of roughhead grenadier, roundnose grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling, and orange roughy in ICES subdivision 14.b.2 in the period 1998–2016, Julius Nielsen, Adriana Nogueira, Helle Torp Christensen

WD06: Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES subdivision 14.b.2 in the period 1999–2018, Julius Nielsen, Adriana Noguerira, Helle Torp Christensen

WD07: On mixed greater silver smelt (Argentina silus) and lesser silver smelt (*Argentina sphyraena*) bycatches in industry fisheries in the North-Sea, Elvar H. Hallfredsson, Lise Heggebakken

WD08: Updating Survey data from the Azores for deep-water species, Wendell M. Medeiros-Leal, Ana M. Novoa-Pabon, Régis V. S. Santos, Helder Silva, Mário R. Pinho.

WD09: PFA report for WGDEEP 2019, Martin Pastoors, 04/05/2019 11:13:27

WD10: The Blackspot seabream Spanish target fishery of the Strait of Gibraltar: updating the available information, Juan Gil, Lucia Rueda, Candelaria Burgos, Carlos Farias, Juan Carlos Arronte, Juan José Acosta and Maria Soriano

WD11: Blackspot seabream (*Pagellus bogaraveo*) in Portugal mainland (ICES Division 27.9.a): fisheries characterization and survivability experiments, Bárbara Serra-Pereira, Pedro Tomé, Tiago Bento, Inês Farias, Ivone Figueiredo

WD12: Results on silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*) and ling (*Molva molva*) from the Porcupine Bank Survey (NE Atlantic),S. Ruiz-Pico, M. Blanco, O. Fernández-Zapico, F. Velasco & F. Baldó

WD13: Results on Greater forkbeard (*Phycis blennoides*), Bluemouth (*Helicolenus dactylopterus*), Spanish ling (*Molva macrophthalma)* and Blackspot seabream (*Pagellus bogaraveo*) of the Northern Spanish Shelf Groundfish Survey, M. Blanco, S. Ruiz-Pico, O. Fernández-Zapico, I. Preciado, A. Punzón, F. Velasco

WD14: Pagellus bogaraveo in Portuguese continental waters (ICES Division 27.9.a), Inês Farias Ivone Figueiredo

WD15: The greater forkbeard Phycis blennoides in Portuguese continental waters (ICES Division 27.9.a), Teresa Moura, Inês Farias, Neide Lagarto, Ivone Figueiredo

Black scabbard fish in Faroese waters (27.5.b).

Lise H. Ofstad, Faroe Marine Research Institute
liseo@hav.fo

Introduction

The objective for this document is to provide information on black scabbard fish in Faroese waters (27.5.b).

Methods

The background data is from both landings and surveys.

In October 2014 the crew onboard the commercial deepwater trawler, which have license to fish black scabbard fish, started to sample length measurements from the black scabbard fish catch. The samples comprised lengths, in cm, of 25 random fish from black scabbard fish hauls. In addition, from summer 2016, weight, in gram, of each fish sampled was recorded. Date, position, total catch of black scabbard fish and sometimes bycatch was recorded on the sample sheets. These information sheets were sent to the Faroe Marine Research Institute where the data were saved in a database.

A deep-water survey has been conducted in September since 2014 to investigate bottom fish in deeper water (< 400 m) and in other areas than the annual Faroese groundfish surveys covers. The main species investigated were tusk, blue ling, greater silver smelt, black scabbard fish, roundnose grenadier, deep-water redfish and Greenland halibut. The aim of the survey was to get length distribution, individual weights, age distribution, gender, maturity and an estimate of biomass of these species.

The research vessel “Magnus Heinason” performed the deep-water survey. The gear used was a star trawl with 40 mm mesh size in the cod-end. Rockhopper ground gear, 120 m bridles and Thyborøn-trawl doors. The duration of the hauls was one hour, from the time the trawl reached bottom until it was hauled up from the bottom again. Star-Oddi minilogs were attached to the trawl doors and logged date, clock, pressure (depth) and temperature.

The catch was treated in the same way as for the annual groundfish surveys, according to the sampling manual for the Faroe Marine Research Institute. The catch was sorted into a commercial catch, which was landed, and a rest-catch, which was not landed. The commercial catch was sorted into fish species all weighed and subsamples were taken for length measurements, and individual weight measurements. A smaller subsample of the main species was taken to determination of sex, maturity and age. Occasionally, stomachs were investigated. The rest-catch was all weighed and subsamples were taken, where lengths and individual weights were recorded.

The fishery

The black scabbard fish fishery in Faroese waters are managed by licences. Since 2013, only one trawler has had licence to fish black scabbard fish as a targeted species. The commercial trawlers used a star trawl with 486 meshes, 160 mm. Mesh size in the net was 80 mm. The usual fishing depth varied between 600-1000 m and the trawling hours varied between six to eight hours, but may last less if the species was very abundant.

The main fishing areas of black scabbard fish in Faroese waters are located on the slope around the Faroe Bank and on the Wyville-Thomsen ridge close to the southernmost Faroese EEZ boarder (Figure 1, Appendix 1).

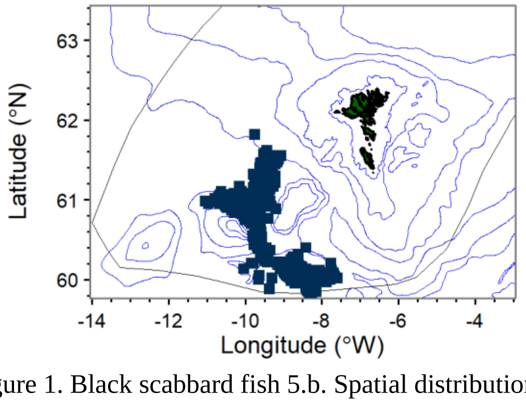


Figure 1. Black scabbard fish 5.b. Spatial distribution of the Faroese commercial trawl fishery of black scabbard fish 2000-2018.

Landings

The mean landings of black scabbard fish in Faroese waters from 1989 to 2018 were 606 t (Figure 2). The highest landings of around 1600-1800 t were in 2002, 2003 and 2008. The preliminary data of 2018 showed that the Faroese landings were 557 t in 5.b.

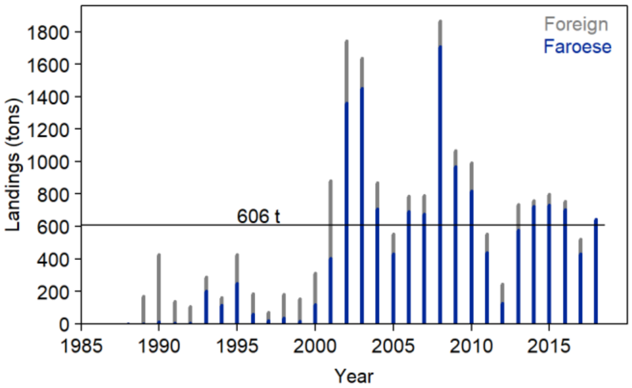


Figure 2. Black scabbard fish 5.b. Nominal landings in Faroese waters.

Spatial distribution

The spatial distribution of black scabbard fish from the deepwater surveys was mainly on the slope north of the Faroe Bank and on the Wyville-Thomsen ridge (Figure 3), which are the main fishing areas. A closer look at different surveys showed that black scabbard fish was only caught in the area north-west of the Faroes and never caught on the Faroe Plateau (Figure 4).

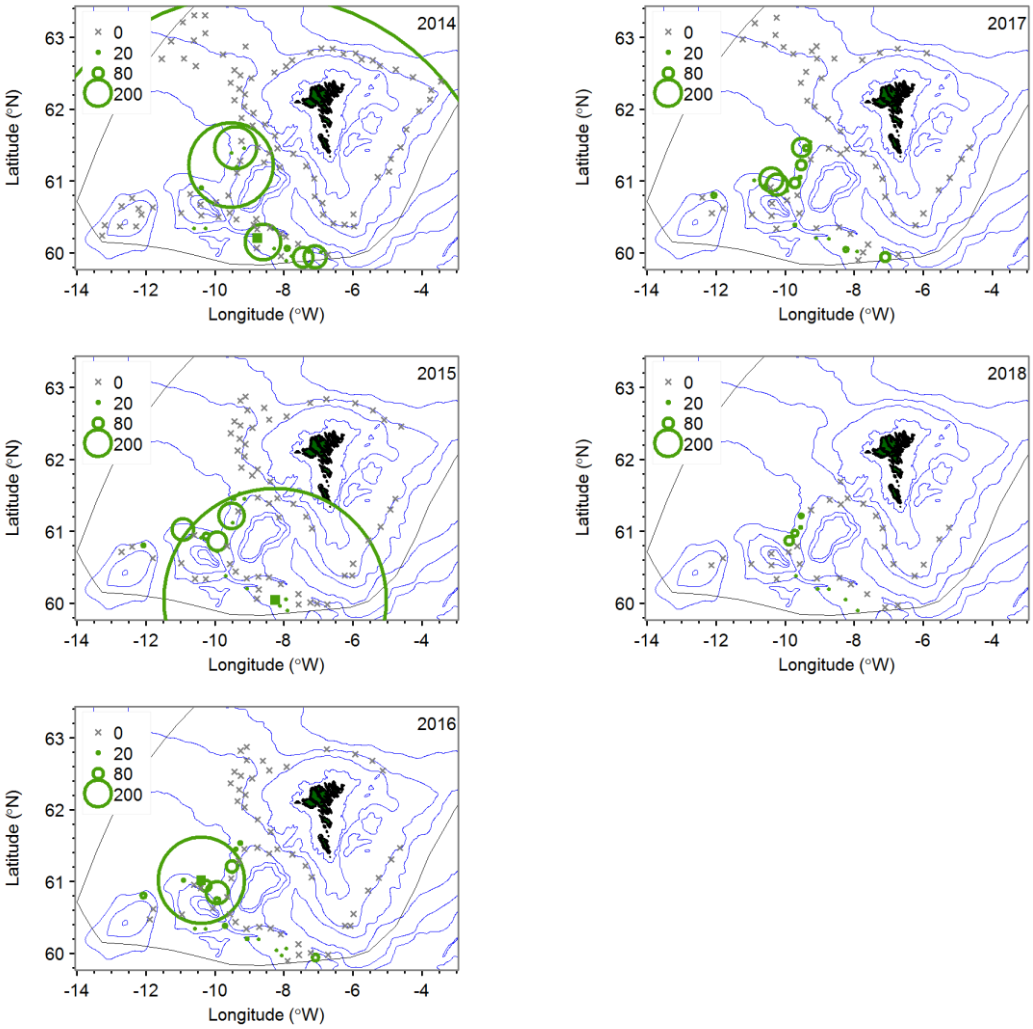


Figure 3. Black scabbard fish 5.b. Spatial distribution of CPUE (kg/h) from the deepwater surveys in 2014- 2018. The green squares show the position of the largest catch.

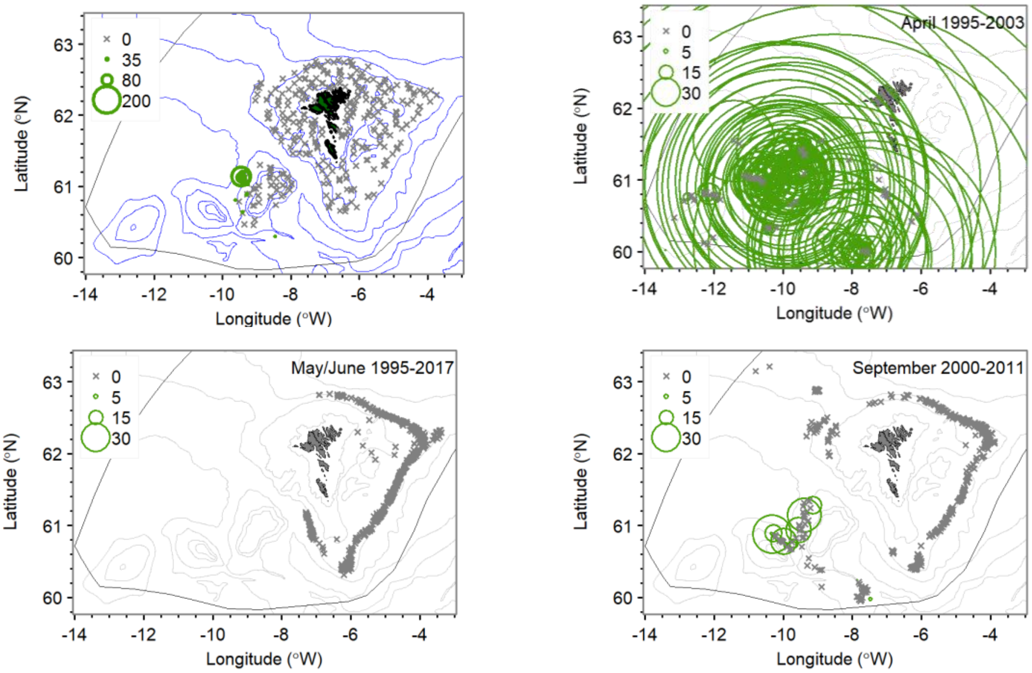


Figure 4. Black scabbard fish 5.b. Spatial distribution, CPUE (kg/h), from different surveys. Annual groundfish surveys, August 1996-2017 (upper left), Blue ling surveys, April 1995-2003 (upper right), Greenland halibut surveys, May/June 1995-2017 (lower left) and Redfish surveys, September 2000-2011 (lower right).

Temperature-depth distribution

An investigation of the black scabbard fish catch according to depth and temperature data showed that black scabbard fish were distributed in depths deeper than around 500 m and temperatures higher than 6°C (Figure 5). This is in accordance with the oceanic temperature and depth distribution in Faroese waters (Figure 6).

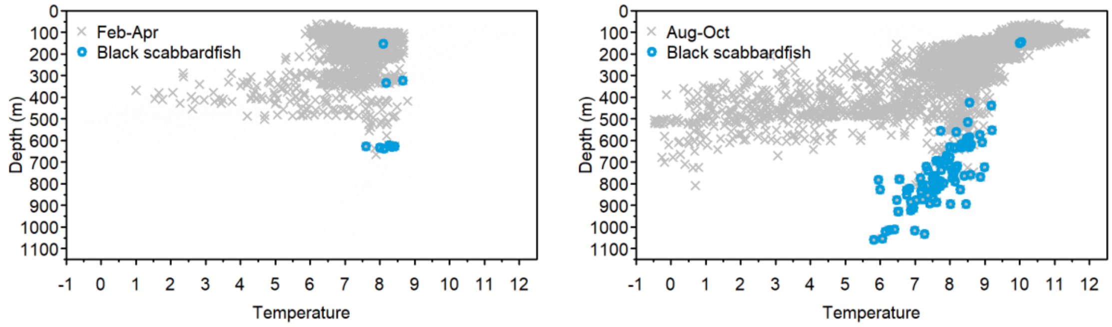


Figure 5. Black scabbard fish 5.b. Temperature and depth distribution of black scabbard fish (blue dots) and catch with no black scabbard fish (grey crosses) in February-April (left) and August-October (right).

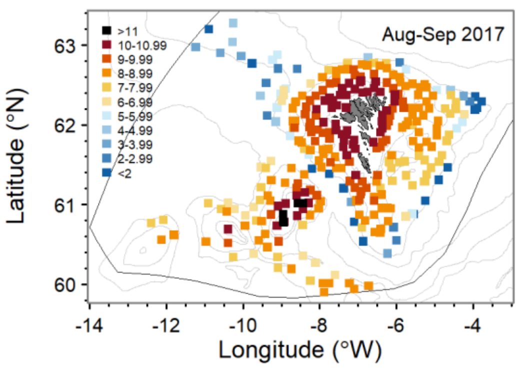


Figure 6. Temperature and depth distribution in Faroese waters August-September 2017.

Length distribution

Annual length-frequency distribution of the Faroese landings data and Faroese deep-water surveys for the period 2014-2018 are presented in Figure 7. The mean length of black scabbard fish in the catches was around 90-92 cm, which is about the same mean length as in the deep-water survey (Figure 7). Numbers of black scabbard fish sampled from the landings and in the deep-water surveys are presented in Table 1. All the sampled fish in the deepwater survey was immature.

Table 1. Black scabbard fish 5.b. Number of fish sampled from the commercial trawler and from the deepwater surveys. * Blue ling survey in April 2018.

	Landings		Deep-water surveys					
Year	Lengths	Weights	Lengths	Round weights	Gender	Maturity	Otoliths	Stomachs
2014	575		4477	785	150	150	150	8
2015	1475		2117	389	78	78	78	9
2016	7603	5077	1269	459	94	94	94	11
2017	4984	4983	874	574	118	118	118	31
2018	3819	3819	598	217	64	64	64	8
2018*			94	94	13	13	13	4

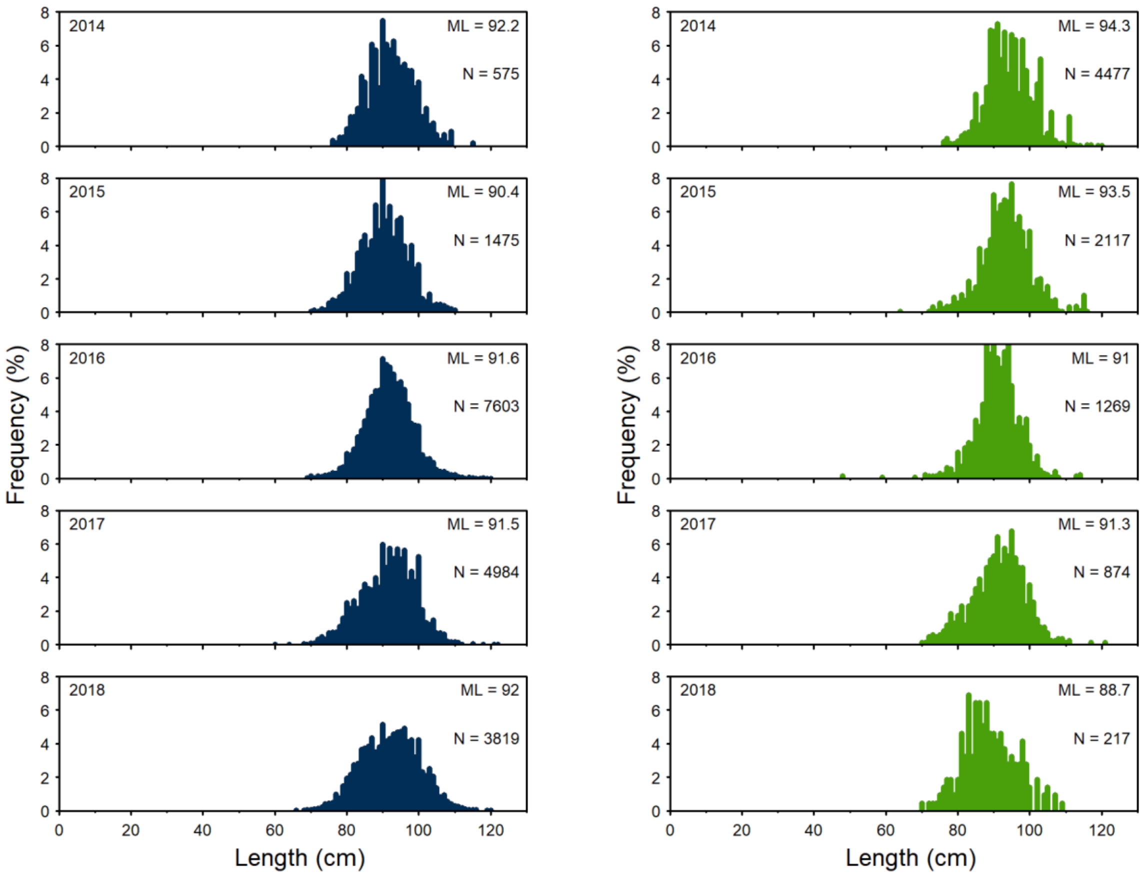


Figure 7. Black scabbard fish 5.b. Length-frequency distribution from the landings (left) and the deepwater survey (right) in 2014-2018.

Length-weights

Comparing mean weight at length from the commercial trawler with the deep-water survey showed that the data are similar (Figure 8). Black scabbard fish of 70 cm length had a round weight around 0.4 kg, 100 cm was 1.5 kg; and the largest fish was 114 cm and 2.4 kg.

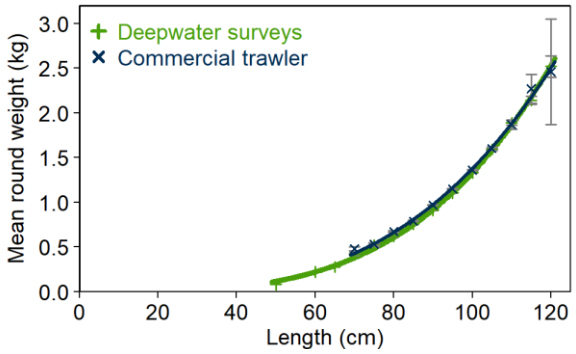


Figure 8. Black scabbard fish 5.b. Length-weight relation comparison between the landings (blue) and the deep-water survey (green).

Growth

In 2018, 77 black scabbardfish otoliths from the Faroese deep-water survey were age read in Portugal (Fariras, 2018). The ages were from 4 to 10 years (Figure 9).

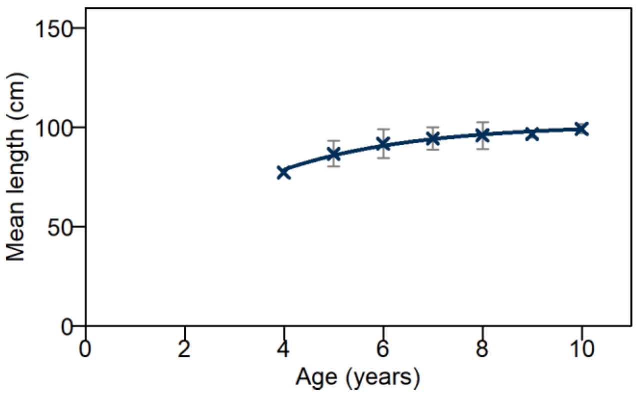


Figure 9. Black scabbard fish 5.b. Age-length relation (N=77).

Commercial cpue

The commercial cpue from 2000 and onwards was based on fishery data from large Faroese trawlers, and only hauls where black scabbard fish represented more than 30% of the total catch and the effort of the hauls were more than 2 hours. The average standardized cpue for the whole period was 250 kg/h. In 2013-2015 the cpue value was twice the mean value, and in 2015 the cpue was at the highest of 508 kg/hour (Figure 10, Table 2). The main reason of this increase is a directed fishery by one large commercial trawler. The cpue in 2018 increased to 306 kg/hour.

Table 2. Black scabbard fish 5.b. Original and standardized cpue from trawlers where black scabbard fish was more than 30% in the haul. N- number of hauls, SE- standard error.

	Original			Fitted		
Year	Mean	SE	Median	Mean	SE	N
2000	466.6	80.3	262.5	297.4	16.7	41
2001	357.9	20.9	279.8	276.5	3.4	184
2002	368.2	15.0	248.6	267.2	1.5	583
2003	259.1	8.8	187.5	200.6	1.4	815
2004	175.8	6.3	138.5	146.5	1.1	454
2005	142.4	4.6	129.4	124.2	1.4	333
2006	160.6	5.0	130.0	135.5	1.2	492
2007	162.2	6.3	122.6	128.9	1.2	481
2008	198.8	7.3	151.3	158.2	1.1	465
2009	180.6	6.4	149.3	147.1	1.1	647
2010	159.6	5.2	125.5	132.2	1.1	553
2011	273.4	12.6	232.9	227.3	2.1	212
2012	274.5	17.3	218.0	227.5	1.4	176
2013	566.3	45.2	446.9	453.2	8.3	71
2014	611.6	32.8	509.2	486.7	4.0	186
2015	653.1	40.5	455.2	508.4	4.1	204
2016	392.6	17.6	295.4	300.4	2.4	325
2017	342.9	15.5	290.3	279.7	3.0	216
2018	318.8	15.3	244.8	253.1	2.0	306

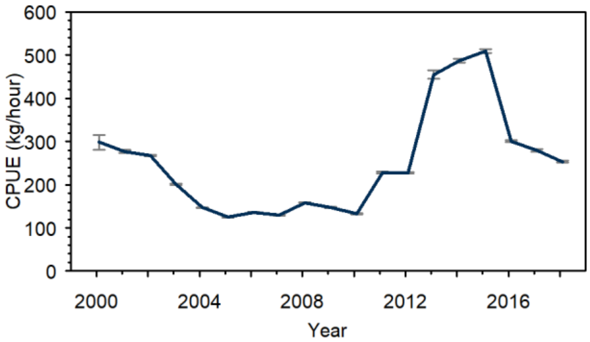
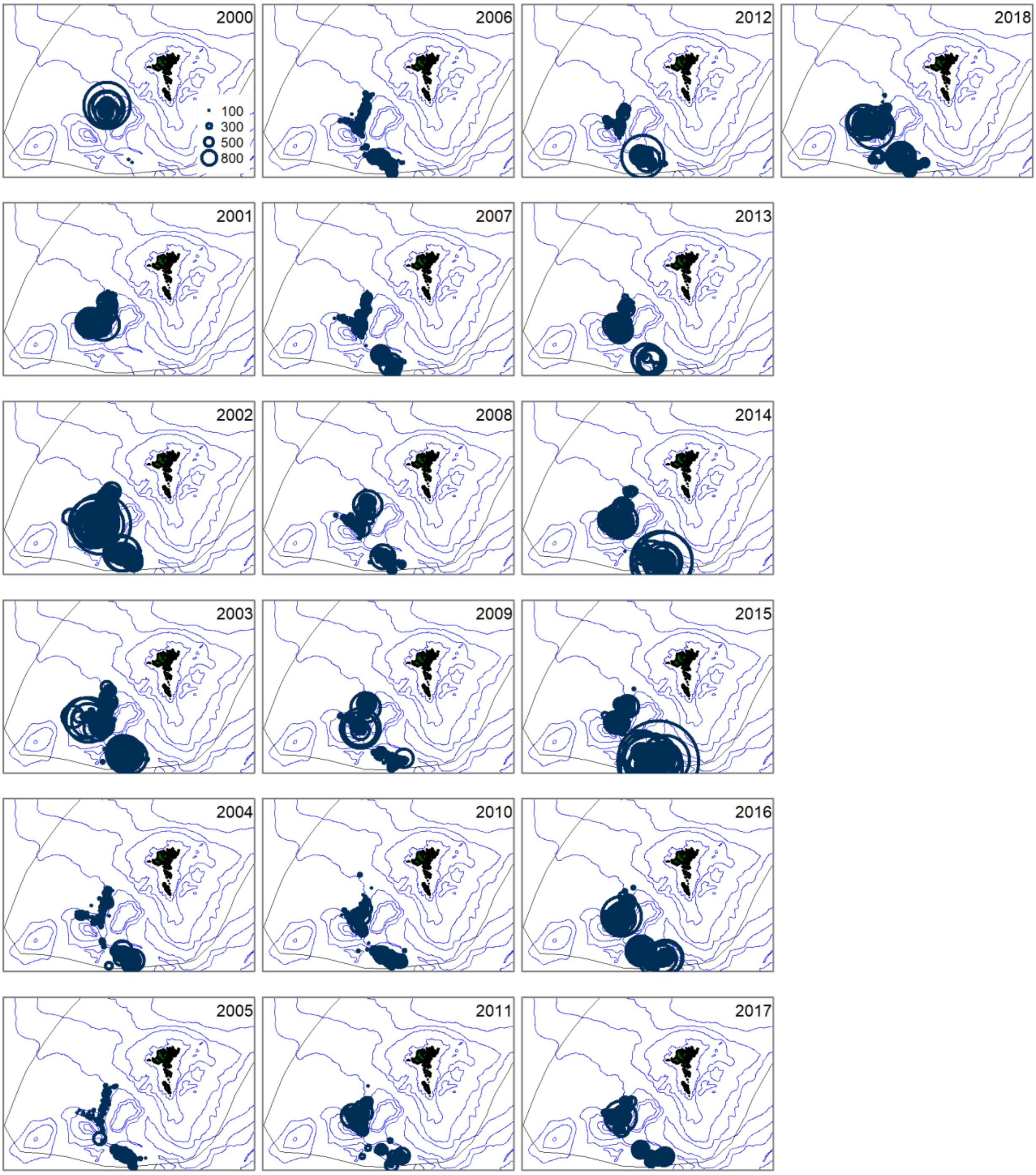


Figure 10. Black scabbard fish 5.b. Standardized cpue (kg/hour) from commercial trawlers (> 1000 HK). Criteria: black scabbard fish >30% of total catch and effort > 2 hours per haul.

References

Fariras, I. 2018. Age reading of Black scabbardfish otoliths. Report. 5 p.

Appendix



Appendix 1. Black scabbard fish 5.b. Spatial distribution (kg/hour) in the commercial trawl fishery per year. Only hauls with more than 30% black scabbard fish of the total catch.

Faroese orange roughy fishery in ICES area 27.10 and 27.12.

Lise H. Ofstad, Faroe Marine Research Institute
liseo@hav.fo

Faroe Islands continued the fishery for orange roughy (*Hoplostethus atlanticus*) in 2018 and the Faroese catches of orange roughy was in total 29.4 tons (Table 1).

Fisheries were undertaken in the period February 2018 in the traditional fishing area in ICES area 27.10 and 27.12. Orange roughy were mainly caught on seamounts north of the Azores (area 27.10). The fishery was carried out with one trawler (M/S Ran) which has many years' experience in the orange roughy fishery.

The logbook information was provided on a haul-by-haul basis. Trained crew members did the biological sampling and lengths, weight and gender of orange roughy were randomly taken from the catch. Around 3.5% of the Faroese landings of 29.4 tons in 2018 were sampled (261 fish). The length distribution of the catch was between 50-70 cm total length (Figure 1), which is the same as in the Faroese experimental fishery in the nineties (Thomsen, 1998). The average length and weight of orange roughy females and males were at the same level in 2011-2018 as compared with the results from the experimental fishery in 1992-1998 (Table 2) (Thomsen, 1998).

Table 1. Catches (tons) of orange roughy from one Faroese trawler in the period 2013-2018 in ICES area 27.10 and 27.12.

Area/Year	2013	2014	2015	2016	2017	2018
27.12	1.869	11.004	1.200			8.750
27.10b		46.668	82.800	93.300	150.100	20.650
Total	1.869	57.672	84.000	93.300	150.100	29.400

Table 2. Mean length and weight of orange roughy

Year	Area	Month	Average length (cm)		Average weight (kg)		
			Female	Male	Female	Male	
1992-1998	Faroe Islands		61.4	58.6	4.4	3.7	Thomsen, 1998
	Hatton Bank		64.6	62.8	4.9	4.3	Thomsen, 1998
	Reykjanes ridge		58.9	56.4	3.6	3.0	Thomsen, 1998
	North of Azores		60.6	59.7	3.9	3.7	Thomsen, 1998
2011	27.10b	Feb., Mar	61.4	60.5	3.5	3.2	
2012	27.10b	Feb.	61.4	60.8	3.5	3.2	
2013	27.10b	Jan.	60.9	57.7	4.3	3.8	
2014	27.10b	Jun., Jul	62.1	58.4	4.2	3.7	
2015	27.10b	Jul., Aug.	59.0	58.3	3.7	3.5	
2016	27.10b	Jun., Oct., Nov.	61.4	58.7	4.3	3.7	
2017	27.10b	Nov.	60.6	57.5	3.9	3.4	
2018	27.10b, 27.12c	Feb.	63.4	60.1	4.2	3.8	

Reference:
Thomsen, B. 1998. Faroese quest of orange roughy in the north Atlantic. ICES CM 1998/O:31.

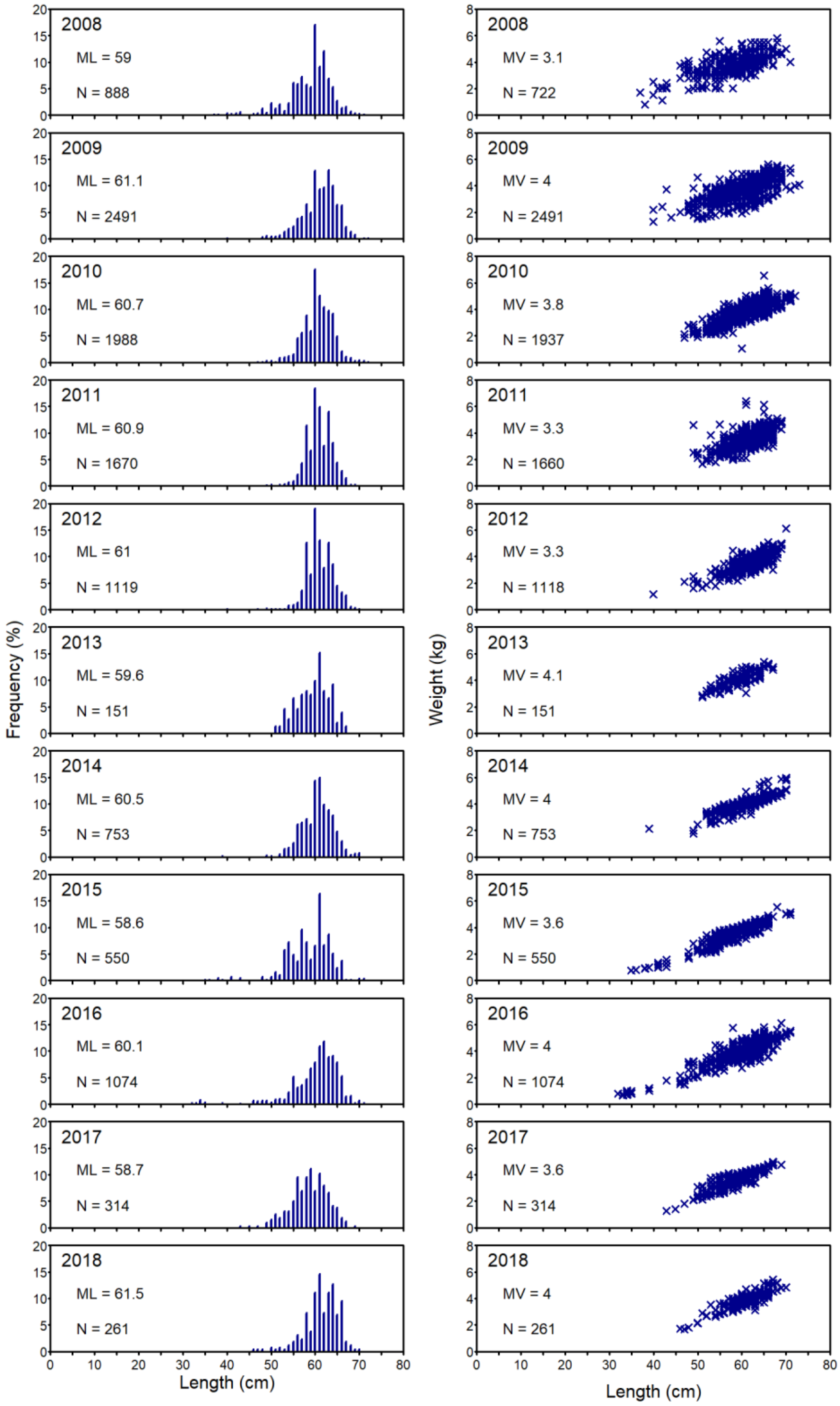


Figure 1. Length distribution (left) and length-weights (right) of orange roughy in 2008-2018. ML = mean length (cm), MV = mean weight (kg) and N = measured individuals.

Roundnose grenadier in Faroese waters (27.5.b).

Lise H. Ofstad, Faroe Marine Research Institute
liseo@hav.fo

Introduction

The objective for this document is to provide information on roundnose grenadier in Division 27.5.b.

Landings

The landings in Faroese waters (ICES Division 27.5.b) are showed in Table 1.

Table 1. Roundnose grenadier 5.b. Nominal landings in Faroese waters.

Year	England/Wales	Faroe Islands	France	Germany	Norway	Russia	Scotland	Total
1988				1				1
1989		20	181	5		52		258
1990		75	1470	4				1549
1991		22	2281	1	7			2311
1992		551	3259	6	1			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	29	104	1861		2			1996
2000	43	48	1699	1				1791
2001		84	1932					2016
2002	81	176	774					1031
2003	10	490	1032					1532
2004		508	985			6	76	1575
2005		903	884		1	1	48	1837
2006		900	875					1775
2007		838	862					1700
2008		665	447					1112
2009		322	122				2	446
2010		229	381				1	611
2011		63	11					74
2012		16	28					44
2013		24	36					60
2014		33	44					77
2015		25	14					39
2016		30	7					37
2017		15	17					32
2018*		21			4			25

Information from deepwater surveys

Overview of the roundnose grenadier sampling from the deepwater surveys in September are showed in Table 2. The mean lengths in the surveys were between 14.8- 17.5 cm (Figure 1). The length- round weight relation is presented in Figure 2. The spatial distribution was mainly on the Wyville-Thomsen ridge (Figure 3).

An investigation of the roundnose grenadier catch according to depth and temperature data showed that roundnose grenadier were distributed in depths deeper than around 600 m and temperatures higher than 6°C (Figure 4). This is in accordance with the oceanic temperature and depth distribution in Faroese waters (Figure 5).

Table 2. Roundnose grenadier 5.b. Sampling overview from the deepwater survey.

	Lengths	Round weights	Gender	Maturity	Otoliths
2014	212	186	85	72	69
2015	210	103	40	40	40
2016	288	139	30	30	30
2017	297	174	52	52	52
2018	94	94	21	21	21

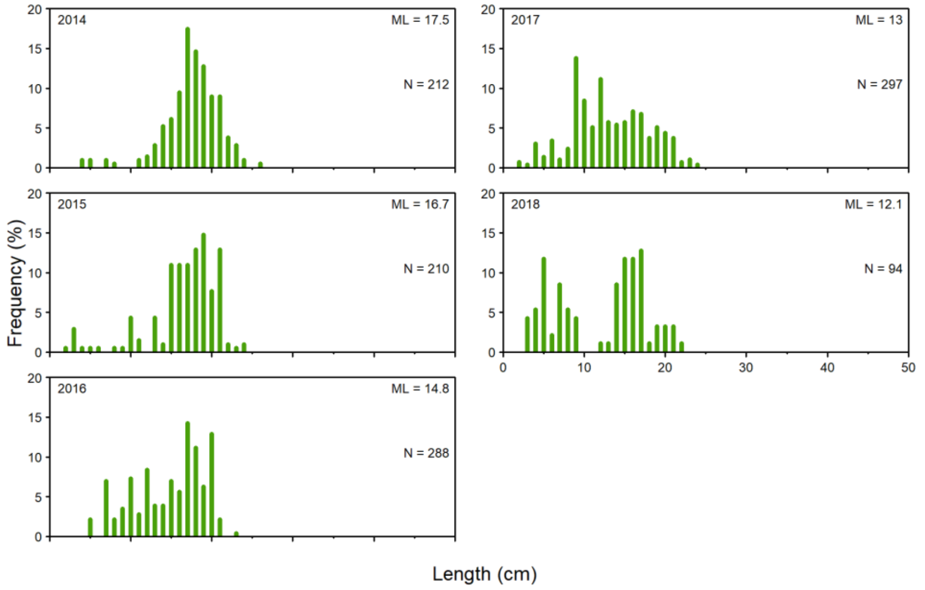


Figure 1. Roundnose grenadier 5.b. Length distribution in the deepwater surveys.

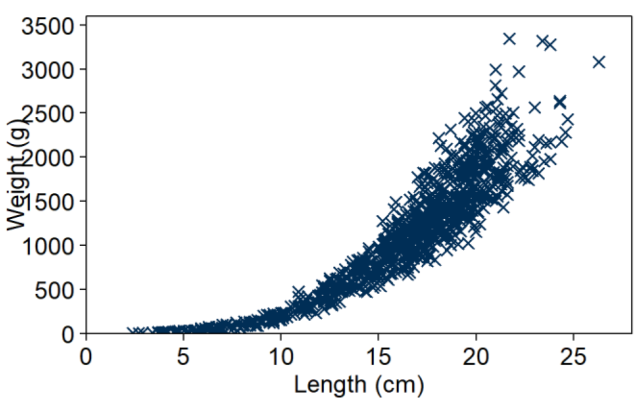


Figure 2. Roundnose grenadier 5.b. Length - round weight relation in the deepwater surveys.

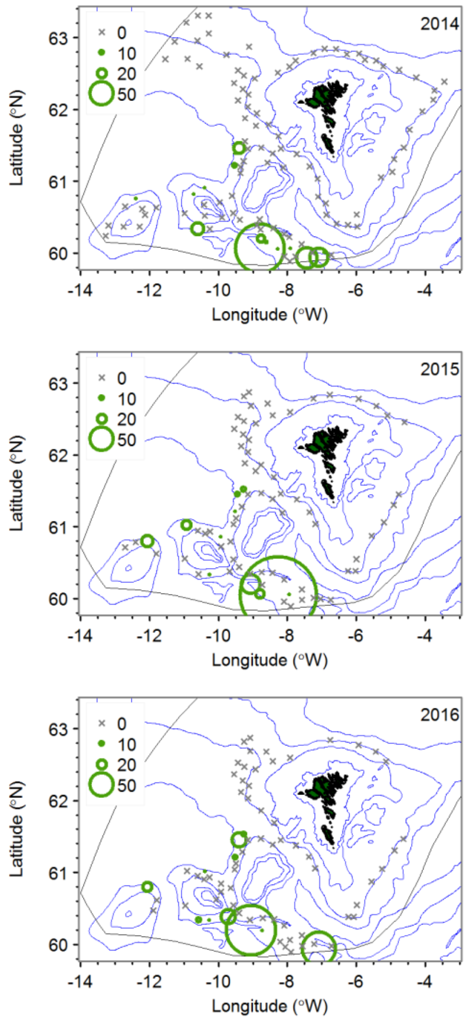


Figure 3. Roundnose grenadier 5.b. Spatial distribution in the deepwater surveys 2014-2018.

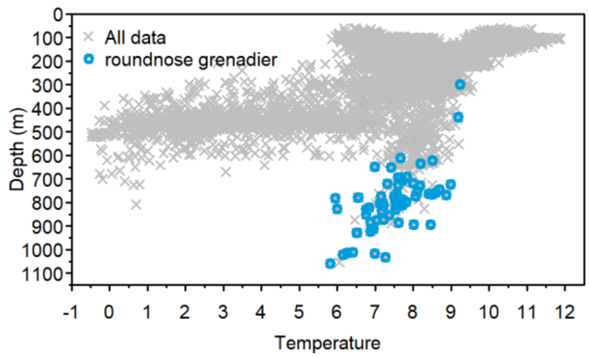


Figure 4. Roundnose grenadier 5.b. Temperature and depth distribution of roundnose grenadier (blue dots) and catch with no roundnose grenadier (grey crosses).

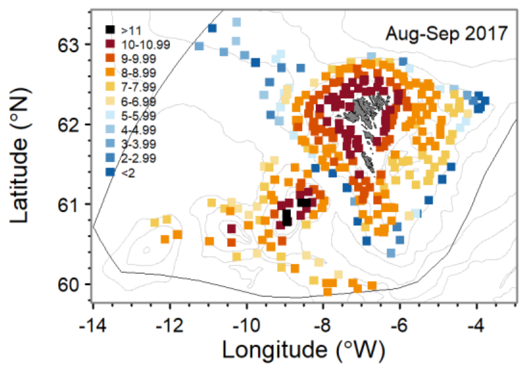


Figure 5. Temperature and depth distribution in Faroese waters August-September 2017.

WD ICES WGDEEP, Copenhagen 2019

Not to be cited without prior reference to the authors

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)

Hege Øverbø Hansen[1], Odd Aksel Bergstad[1] and Terje Jørgensen[2]

[1]Institute of Marine Research, Flødevigen, N-4817 His, Norway
[2]Institute of Marine Research, Bergen, PO Box 1870 Nordnes, N-5817 Bergen, Norway
E-mail: hegeha@hi.no, oddaksel@hi.no, terje.joergensen@hi.no

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 years (Bergstad 1990). It has a limited area of distribution within the Norwegian deep and in the deep Skagerrak basin (300-720m) (ICES Div. 4a & 3a). Analyses using microsatellite DNA have demonstrated that the Skagerrak grenadier is currently likely to be isolated from grenadier elsewhere in its North Atlantic distribution area (Knutsen *et al.*, 2012). In 2003-2005 a major expansion of the previously quite minor targeted grenadier fishery occurred, and this expansion was followed by a complete closure of the fishery from 2006 onwards. Apart from previous targeted exploitation, grenadier is now a minor 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 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 36 years (1984-2019). While the main objective of the survey is to monitor *Pandalus borealis*, the survey samples the entire depth range and distribution area of roundnose grenadier.

We report temporal variation in survey catch rates in terms of biomass and abundance (kg/hour and number/hour), length distributions, occurrence of recruits, and geographical distribution. We also attempt to estimate by-catch in the commercial shrimp fishery. Most of the information in this Working Document is an update of a WD first submitted to WGDEEP in 2009 (Bergstad *et al*. 2009). The survey series is currently the only information available to assess temporal variation and trends for the grenadier in this area. A full analysis of the time-series has been published (Bergstad *et al*., 2014), but this working paper extends the series to include the years 2014-2019.

Material and Methods

Data was collected from the annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research in the years 1984-2019 (Table 1). The survey is a depth stratified shrimp trawl survey with approximately 25% of the stations deeper than 300 m (depth range 117-534 m). The trawl used has small meshes overall and a 6mm cod-end liner and retains all sizes of grenadiers, including the smallest newly settled juveniles (Bergstad 1990, Bergstad and Gordon 1994). The stations are placed at random within strata and subareas, and the same sites area sampled every year. Although some changes occurred over the years (Table 1), the overall standardization was maintained throughout the time series (Bergstad *et al.* 2014).

Catch rates in terms of biomass and abundance were calculated for stations 300 m and deeper, i.e. excluding shallower survey depths where the species only occurs sporadically in small numbers (Bergstad 1990). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration.

Annual length distributions were derived for the pooled standardized catches at 300m and beyond. In cases were catches were subsampled, length distributions were raised to the total catch prior to pooling.

Age data from selected surveys in 1987 and 2007-2018 were plotted as cumulative age distributions. Age and length data from 2008-2018 were analysed for growth parameters.

Standardized mean catches by number of small juveniles of PAL ≤ 5 cm were calculated to show recruitment during the survey period.

A time series of maps showing geographical distributions by year were plotted, representing scaled catch rates at the actual sample sites for each survey year.

In a first attempt to estimate commercial by-catch of grenadier, we derived a time-series of mean survey catch rate of grenadier from depths shallower than 400m (i.e. where shrimp fishing is carried out) and multiplied that with annual estimates of effort in the Norwegian shrimp fishery (extracted from Søvik and Thangstad, 2015). Most of the distribution area of grenadier lies within the Norwegian EEZ and the Norwegian trawler fleet is assumed to be predominant in that area.

Results

Biomass and abundance

The estimates of catch rates in terms of biomass (kg/h) and abundance (nos/h) varied substantially through the time series (Fig.1), but elevated levels were observed from 1998 to 2004. The decline from 2005 continued through the time series until 2017 which was the lowest on record. The observations in 2018 and 2019 remained low, but with a slight increase compared with 2017.

Size and age distributions

The time series of annual length distributions show a major shift in the early 1990s (Fig. 2). From 1992 the proportion of large fish with PAL>15cm declined to less than 10% which contrasts with the pre-1990 distributions dominated by large fish. From 1992, a pronounced mode of small fish can be followed in subsequent years, with modal length increasing through the time series.

The very recent distribution contrasts with the pre-1990 distributions by having low proportions of large fish. The 2019 distribution is dominated with small fish but at low levels compared to the 1990’s.

The cumulative age distribution from the extracted data from 1987 (Bergstad, 1990) contrasts substantially with the distributions from 2007-2018 in terms of proportions of old fish (e.g. >20 years) (Fig. 3). In 1987, the proportion of fish > 20 years was over 50% (Table 4). In 2008, i.e. after the relatively large expansion in landings in 2003-2005 and ban on direct fishing introduced in 2006, only 8% of the aged fish were older than 20 years. In subsequent years the proportion of older fish apparently increased, and recent distribution from 2018 now show 23% fish > 20 years (Table 4). This is still very low compared with the 1987 situation.

Age at length was analysed for the years 2008-2018 (Figure 9) and compared with data from 1987 (Bergstad, 1990) (Table 3). The growth rate coefficient (k) and the length infinity (L∞) for females is lower for 2008-2018 data compared with data from 1987.

Occurrence of juveniles <5cm AFL

There is no indication of a pronounced recruitment pulse as that observed in the early 1990s, neither in the length distributions (Fig 2.), or in the time series of mean abundance of small fish < 5 cm (Fig. 4). The recruitment for 2019 is one of the lowest during the time series.

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 1984-2019. 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 3a and 4a Norwegian shrimp trawl fishery (Fig. 7) illustrate the likely historical variation in by-catch rates in the fishery. 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 1984-2019. 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 2019 abundance and biomass estimates were still at low levels.

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. 5).

The time-series of size distributions also suggest pronounced structural changes during the period 1984-2019. The distributions from the 1980s with a dominance of fish around 15 cm PAL 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. The distributions were dominated by old fish until 2012 although with consecutively low concentrations. From 2013 the distributions changed to younger fish primarily but still with low levels.

The difference in age distribution between 1987 and 2018 is primarily seen in the proportion of older fish, i.e. there is almost no fish older than 30 years in 2018 while almost 25% of the fish was older than 30 years in 1987. The most prominent difference between recent situation and that of 1987 concerning growth, was seen for females. It seems that the bulk of very large and old female individuals seen in 1987 is no longer present in recent years.

High mean survey biomass coincided with very high commercial landings in 2004-05 (Fig. 8). The fishery may have utilized a period of elevated abundance resulting from what appears to be the single large pulse in recruitment in the 36 years surveyed. From recent length distributions no similar pulse in recruitment has been observed.

An interpretation of the patterns observed in the time-series of size and age distributions, the survey abundance index for small juveniles, and the survey index of all sizes combined is that the enhanced fishery in 2003-2005 had the combined effect of eroding both the accumulated fraction of older fish around 30 years that were found in the population in 1987 prior to the fishery and the younger fish resulting mainly from the recruitment pulse in the early 1990s. The very old fish never reappeared, and for two decades recruitment has been consistently at a level well below the level observed in the single high event in the early 1990s. The recent recruitment has probably been too low to produce any increase in abundance.

The reported landings peaked in 2005 at about 11000 tonnes (Fig. 8) and have since declined to about 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 estimate 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 now lower than recent years and there is no suggestion of a new recruitment pulse as seen in the 1990s. The current low abundance and truncated age structure in the population thus reflect both the exploitation and recruitment history spanning the past 2-3 decades. Since the targeted fishery has stopped and the by-catch in the shrimp fishery seems low, there is a potential for recovery of the roundnose grenadier in Skagerrak. However, rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade. The survey information suggests that it may be a feature of this population that only a single good recruitment event may be expected in a period of 3 decades.

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Table 1. Summary of data on the bottom trawl survey series, 1984-2019. 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, KB – RV Kristine Bonnevie. Data from 2019 survey is included. All trawls were fitted with a 6mm mesh cod-end liner.

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
1984	OCT	MS	3230	Shrimp trawl (see text)	10	1	67
1985	OCT	MS	3230	“	21	5	107
1986	OCT/NOV	MS	3230	“	24	9	74
1987	OCT/NOV	MS	3230	“	35	14	120
1988	OCT/NOV	MS	3230	“	31	11	122
1989	OCT	MS	3236	Campelen 1800 35mm/40, Rg	31	7	106
1990	OCT	MS	3236	“	26	5	89
1991	OCT	MS	3236	“	28	9	123
1992	OCT	MS	3236	“	27	10	101
1993	OCT	MS	3236	“	30	10	125
1994	OCT/NOV	MS	3236	“	27	10	109
1995	OCT	MS	3236	“	29	12	103
1996	OCT	MS	3236	“	27	11	105
1997	OCT	MS	3236	“	25	6	97
1998	OCT	MS	3270	Campelen 1800 20mm/40, Rg	23	6	97
1999	OCT	MS	3270	“	27	8	99
2000	OCT	MS	3270	“	25	10	109
2001	OCT	MS	3270	“	18	4	87
2002	OCT	MS	3270	“	24	6	82
2003	OCT/NOV	HM	3230	Shrimp trawl (as in 1984-1988)	13	0	68
2004	MAY	HM	3270	Campelen 1800 20mm/40, Rg	17	6	65
2005	MAY	HM	3270	“	23	8	98
2006	FEB	HM	3270	“	10	0	45
2007	FEB	HM	3270	“	11	1	66
2008	FEB	HM	3271	Campelen 1800 20mm/40, Rg and strapping*	18	5	73
2009	JAN/FEB	HM	3271	“	25	7	91
2010	JAN	HM	3271	“	24	7	98
2011	JAN	HM	3271	“	22	7	93
2012	JAN	HM	3271	“	20	5	65
2013	JAN	HM	3271	“	28	8	101
2014	JAN	HM	3271	“	16	7	69
2015	JAN	HM	3271	“	28	9	92
2016	JAN	HM	3271	“	28	9	108
2017	JAN	KB	3271	“	30	9	128
2018	JAN	KB	3271	Campelen 1800 20mm/40, Rg and strapping**	27	8	111

Table 1. Continued

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
2019	JAN	KB	3296	Campelen 1800 20mm/40, Rg and strapping***	27	8	119

* Path width of the tow constrained by a 10 m rope connecting the warps, 200 m in front of otter boards. ** Path width of the tow constrained to a 15 m rope connecting the warps, 100 m in front of the otter boards. *** Same trawl and strapping but from 2019 there are inserted several floaters on the trawl to lighten the trawl (Nordsjørigging).

Table 2. Mean biomass index and mean abundance index from shrimp survey 1984-2019. Missing data are from surveys that are not representable according to roundnose grenadier catches (less stations > 300 m). Data from 2016 are considered unreliable according to gear inconsistencies.
Mean biomass (kg/h), Mean abundance (n/h), Number (n) and Standard error (SE)

Year	n	(kg/h)	SE(kg/h)	(n/h)	SE(n/h)
1984	10				
1985	21	108.12	38.32	149.95	49.43
1986	24	83.75	32.16	117.83	46.99
1987	35	76.15	13.56	125.80	24.60
1988	31	72.14	13.92	105.19	21.22
1989	31	122.69	43.48	195.94	73.07
1990	26	49.81	18.20	72.66	27.55
1991	28	107.14	22.27	176.86	38.75
1992	27	188.54	67.53	698.52	337.67
1993	30	58.59	19.42	190.33	74.15
1994	27	87.19	21.21	372.96	143.56
1995	29	118.30	32.36	440.62	144.41
1996	27	99.63	31.68	268.01	116.92
1997	25	113.86	66.47	362.72	222.08
1998	23	255.54	87.80	812.82	336.85
1999	27	149.30	42.85	388.83	122.54
2000	25	129.27	30.39	389.06	107.71
2001	18	105.33	51.84	272.99	151.99
2002	24	174.77	66.27	371.70	129.97
2003	13				
2004	17	324.38	125.48	1143.35	487.33
2005	23	193.65	93.81	550.42	260.94
2006	10				
2007	11				
2008	18	95.58	65.81	259.10	208.53
2009	25	72.72	39.81	207.41	121.84
2010	24	33.24	21.47	77.21	54.81
2011	22	26.84	12.61	54.76	27.05
2012	20	16.69	11.97	34.40	23.83
2013	28	11.48	4.92	35.06	16.90
2014	16	25.62	15.76	49.56	28.69
2015	28	7.28	4.59	21.19	12.14
2016	28				
2017	30	6.64	2.41	15.74	6.73
2018	27	12.88	6.60	41.91	26.13
2019	27	14.59	5.77	40.09	18.05

Table 3. Estimated parameters of von Bertalanffy growth function on data from Skagerrak shrimp survey 2008-2018 and Skagerrak survey in 1987 as reported by Bergstad 1990. k=growth coefficient, L_∞=asymptotic length, t_0=theoretical age when length is zero.

	Estimated parameter			
Parameter	**Shrimp survey 2008-2018**		**Skagerrak survey 1987**	
	Females	**Males**	**Females**	**Males**
k	0,088	0,082	0,100	0,105
L_∞	15,92	14,23	18,1	14,7
t_0	-2,956	-5,376	-0,9	-1,5

Table 4. Cumulative percentages (%) for selected ages from 1987 and 2007-2018.

	Age				
Year	**5**	**10**	**20**	**30**	**50**
1987	9	21	45	75	96
2007	10	23	83	94	96
2008	22	40	92	99	100
2009	14	30	88	93	100
2010	12	29	71	96	99
2011	6	23	65	94	99
2012	10	28	48	96	100
2013	14	28	56	92	99
2014					
2015	7	17	48	95	100
2016					
2017	14	52	81	94	99
2018	23	50	77	99	100

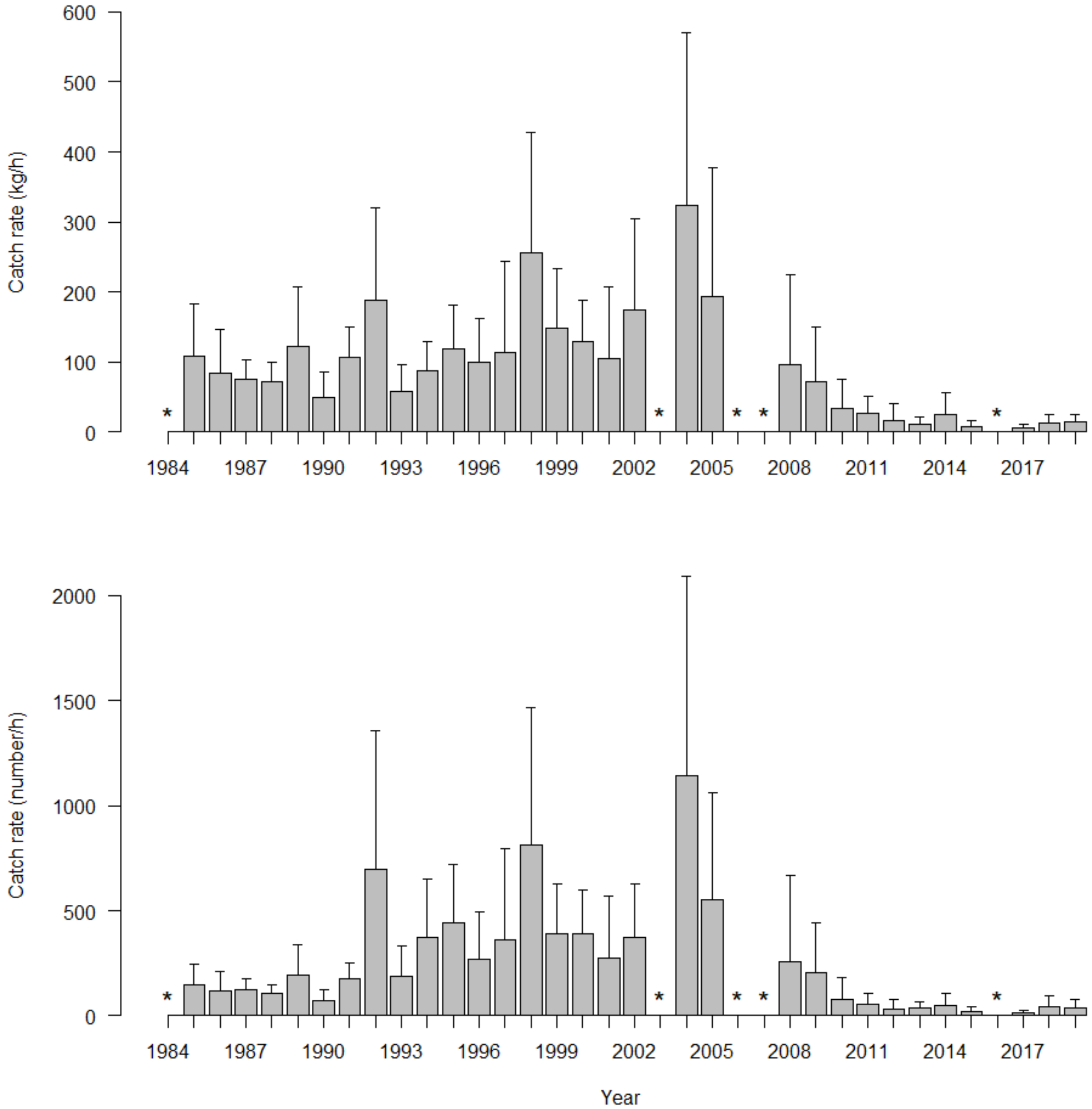


Figure 1. Standardized survey catches of grenadier, 1984-2019. Upper: Biomass (kg/h), Lower: Abundance (number/h). *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those years were excluded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.

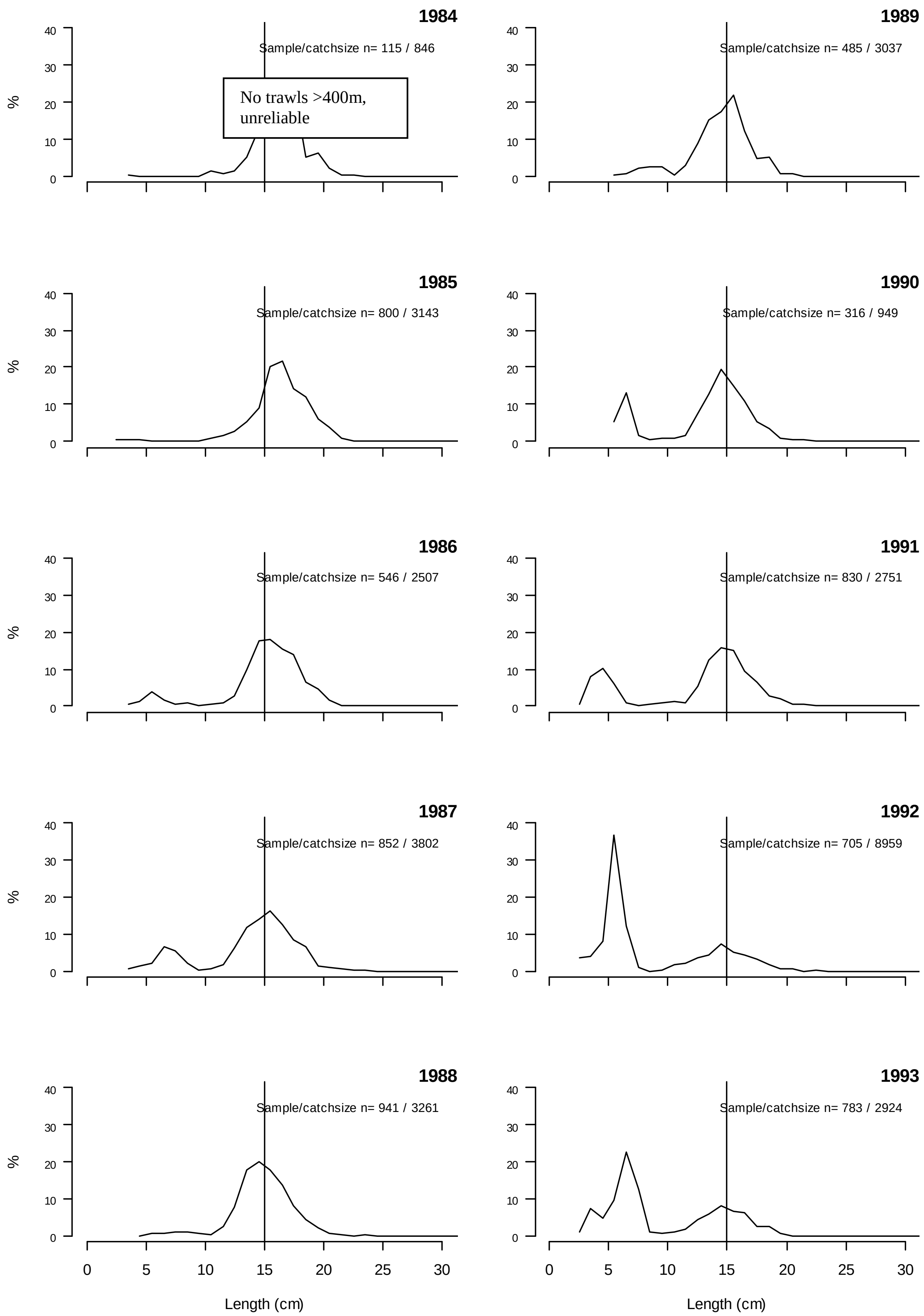
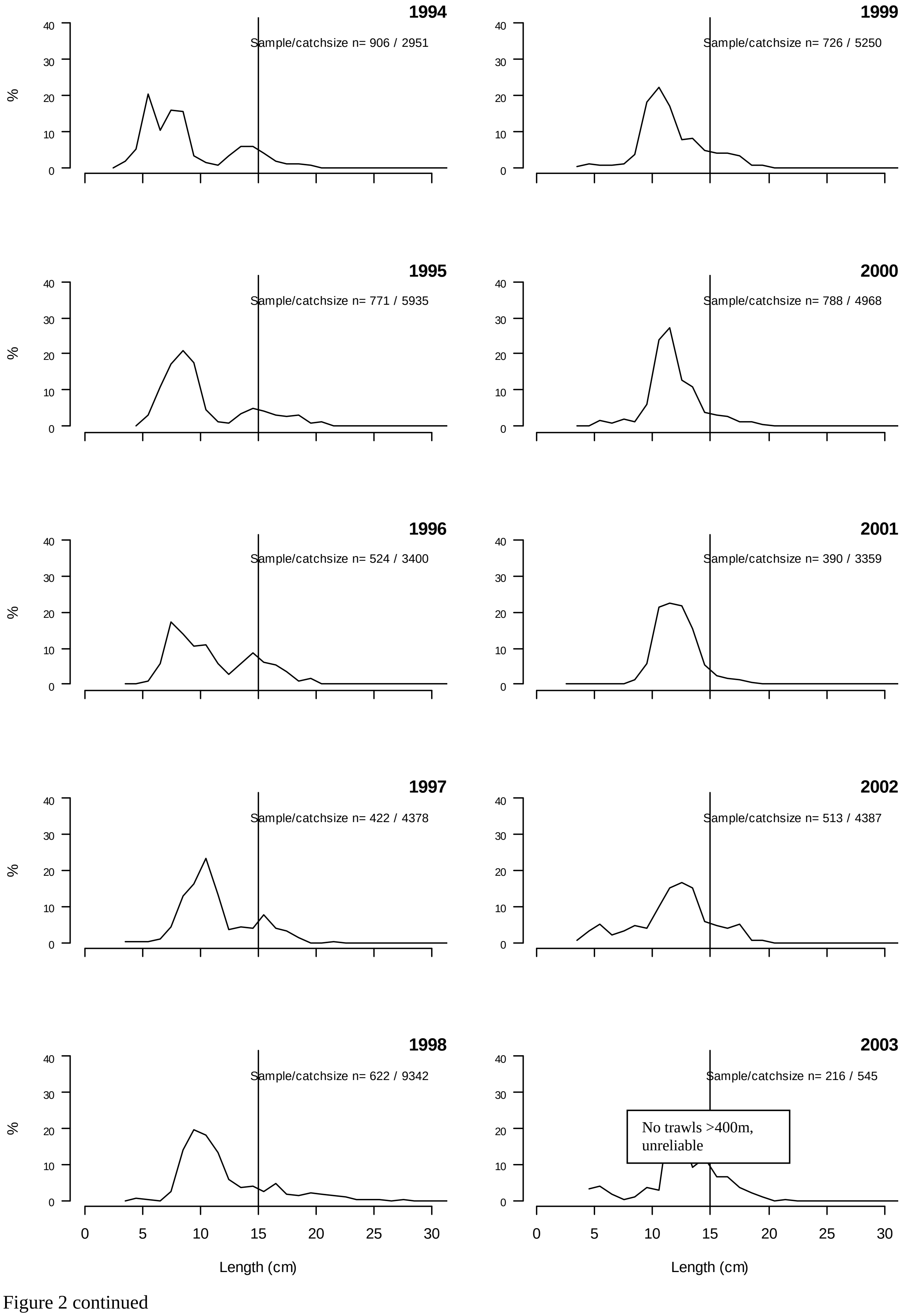


Figure 2. Length distributions of roundnose grenadier from annual *P. borealis* surveys, 1984-2018. Length is measured as PAFL (cm). The length distributions are calculated as percentage number of fish in each centimetre length interval standardized to total catch number and trawling distance for each station each year. *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those years should be excluded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.



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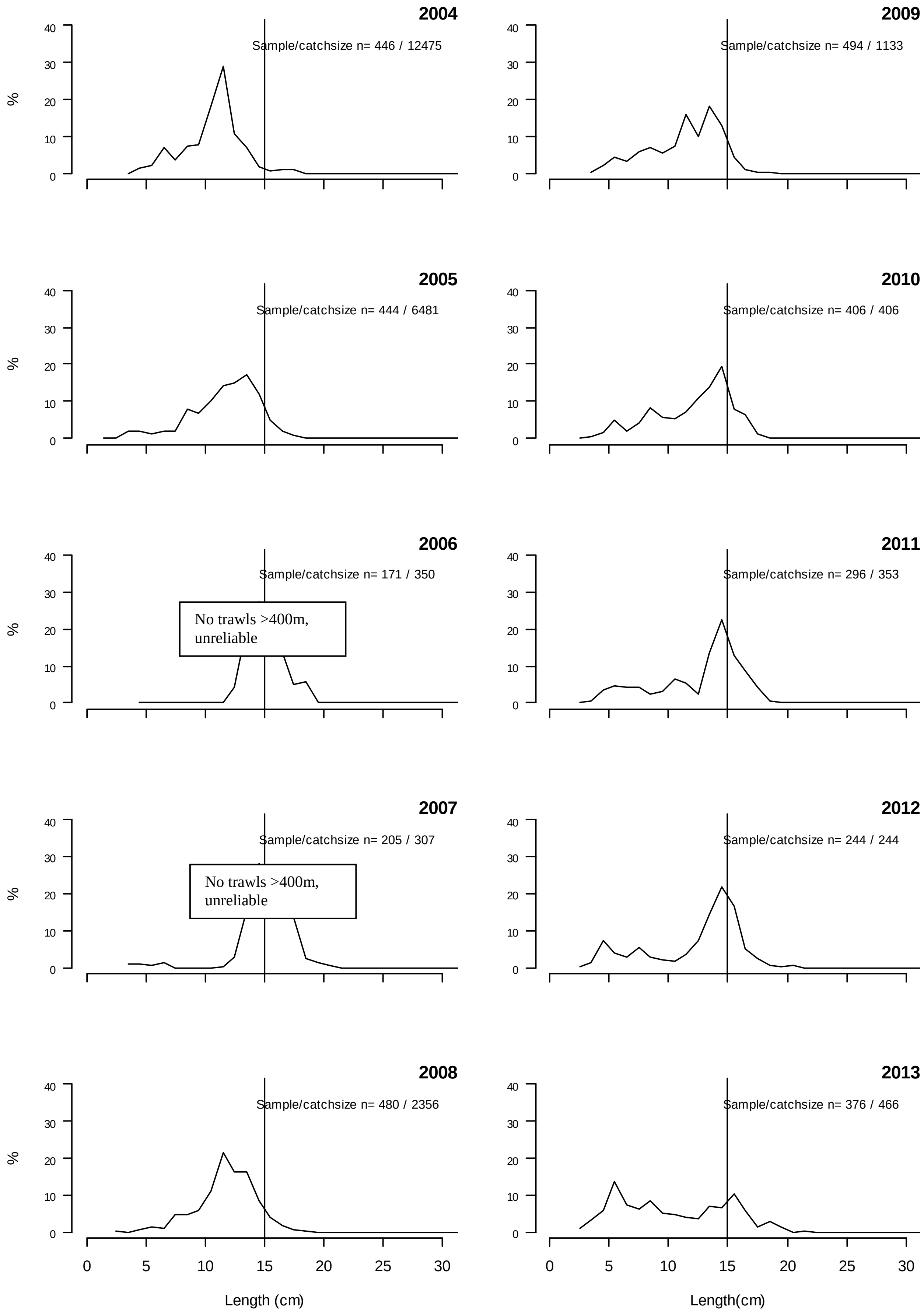

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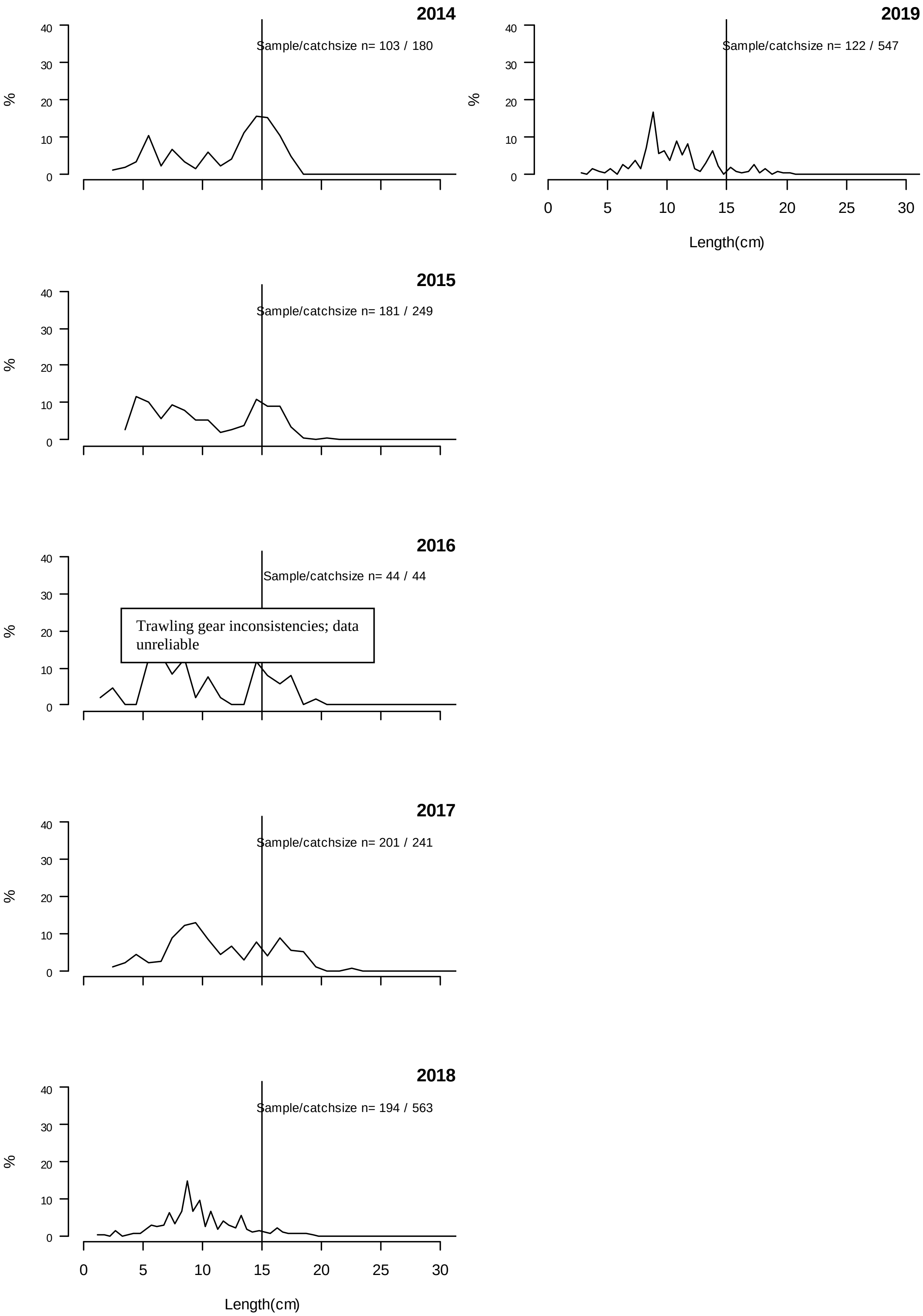


Figure 2. Continued

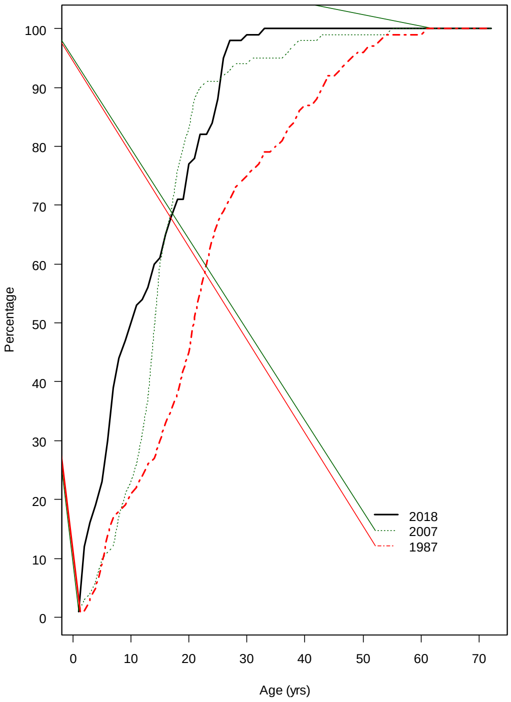


Figure 3. Cumulative age distributions of roundnose grenadier in the Skagerrak. Data from survey catches in Skagerrak in 1987, 2007 and 2018. The distribution from 1987 was modified from Bergstad (1990). Data from 2007 were collected from a deepwater survey in April 2007 and data from 2018 was derived from the annual shrimp survey.

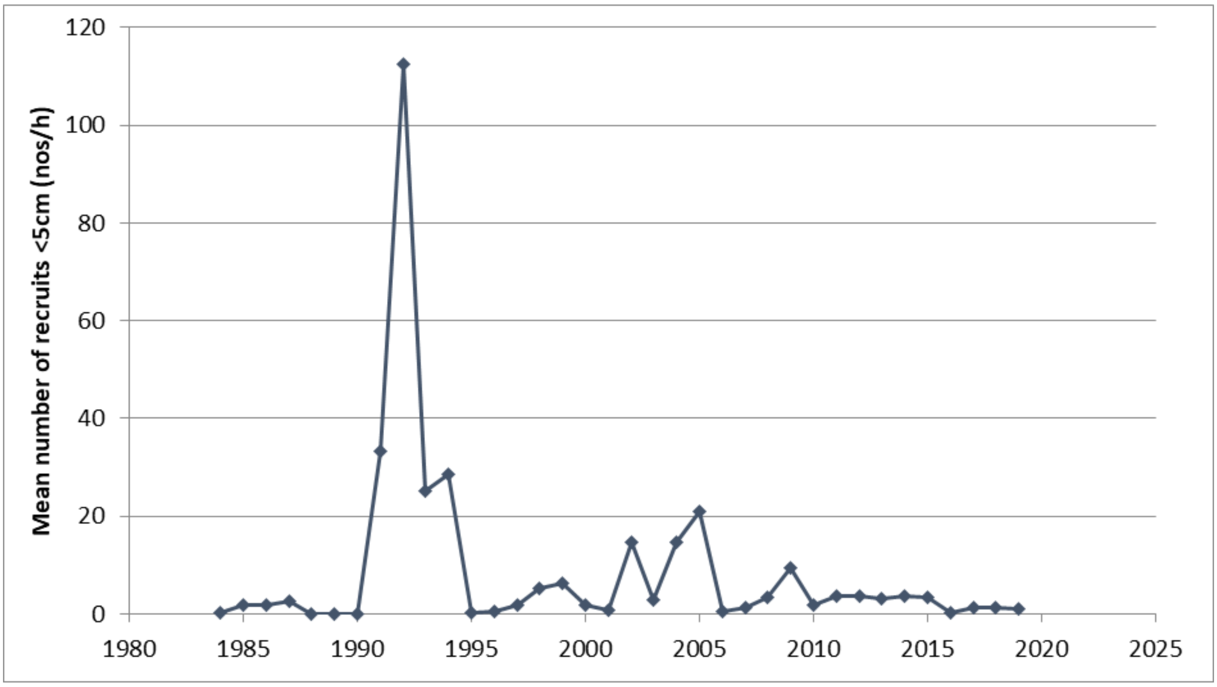


Figure 4. Mean catch rate of roundnose grenadier of PAFL ≤ 5 cm, 1984-2019. Data from shrimp survey, trawls deeper than 300 m. *In 1984,2003,2006 and 2007, no trawls were made deeper than 400 m, and data from these years should be disregarded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.

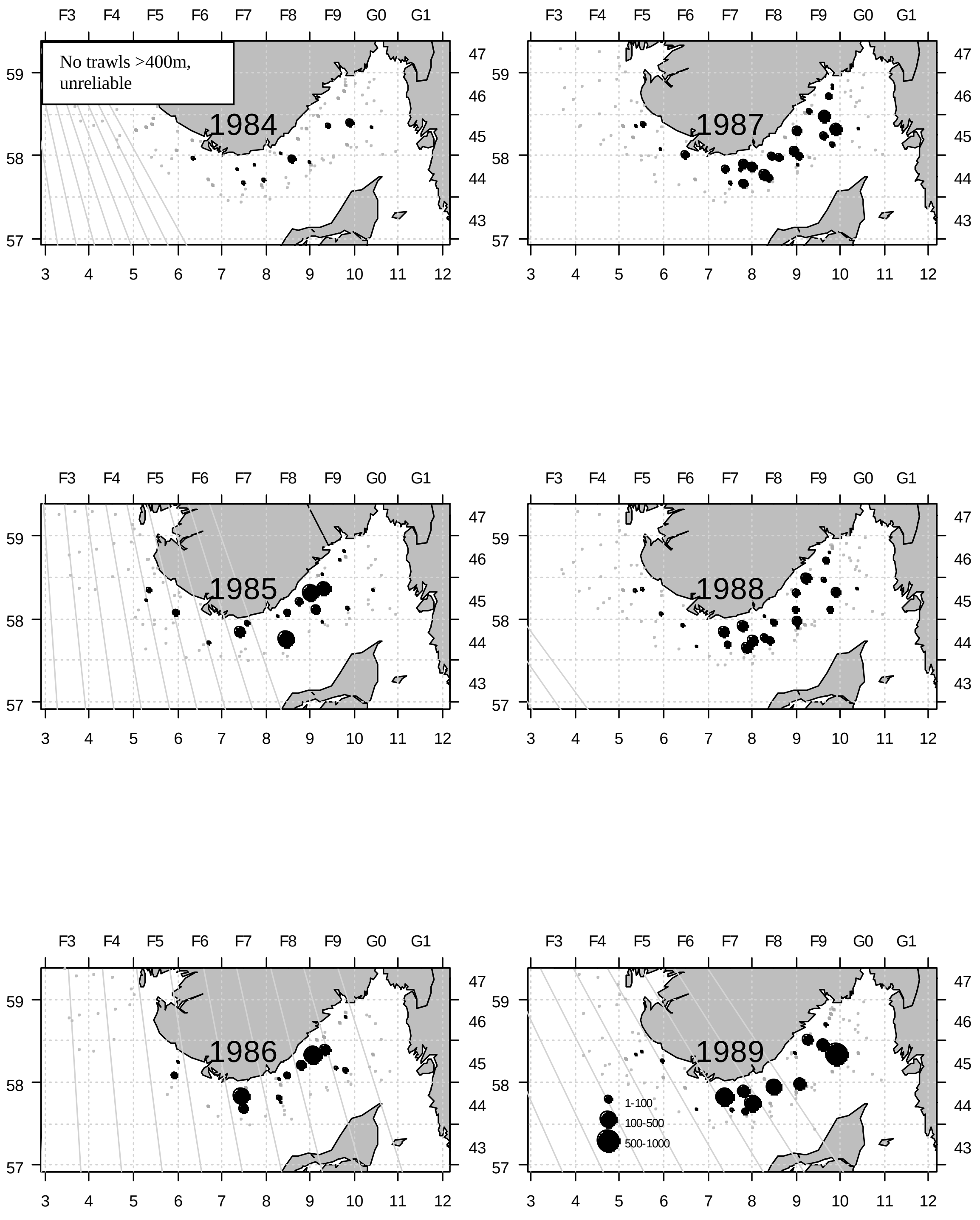


Figure 5. Geographical distribution of catches of roundnose grenadier (kg/h) from 1984-2018. Data from shrimp survey, trawls deeper than 300 m. Grey circles are trawls with no catch of grenadier. *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those years should be excluded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.

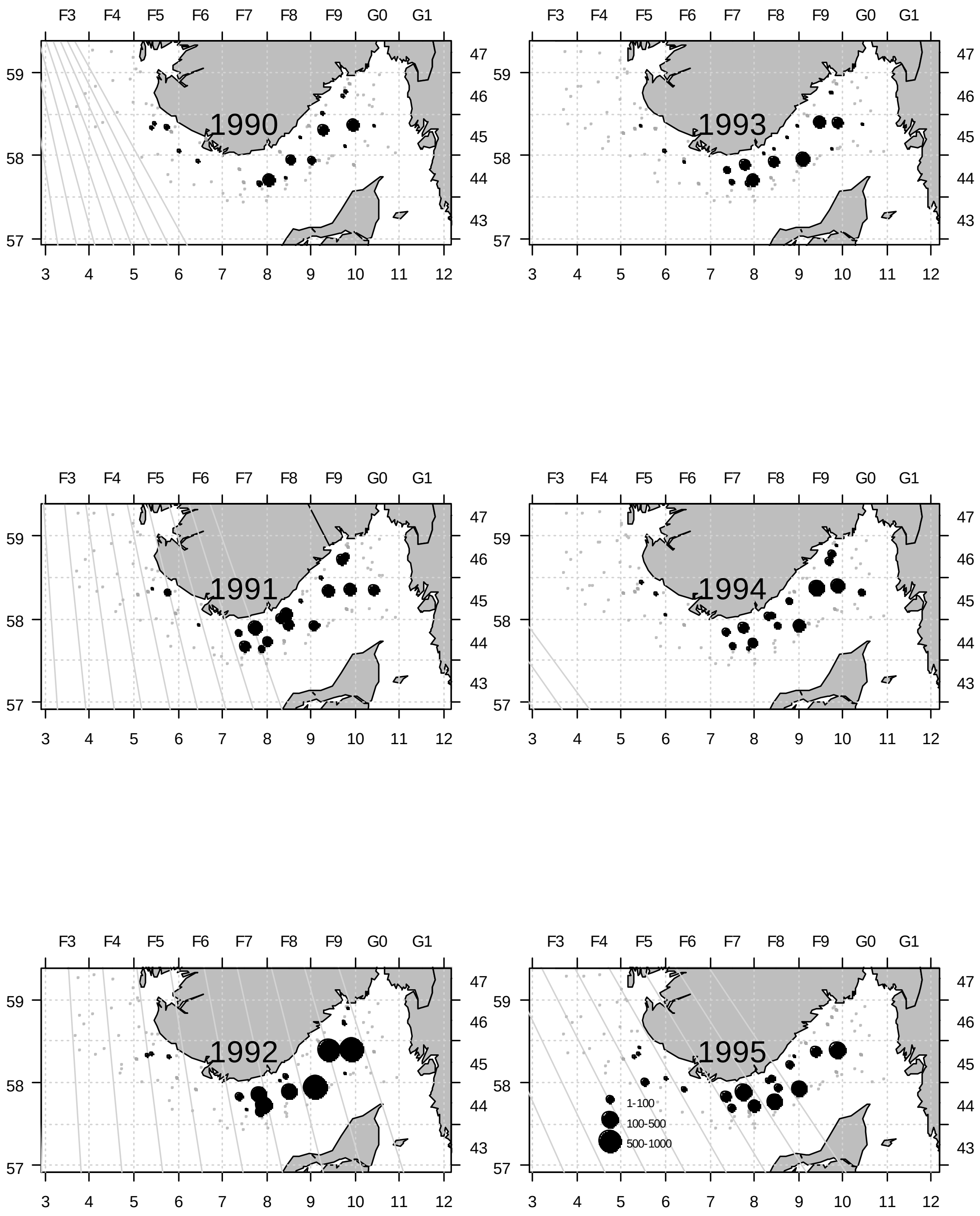


Figure 5 continued.

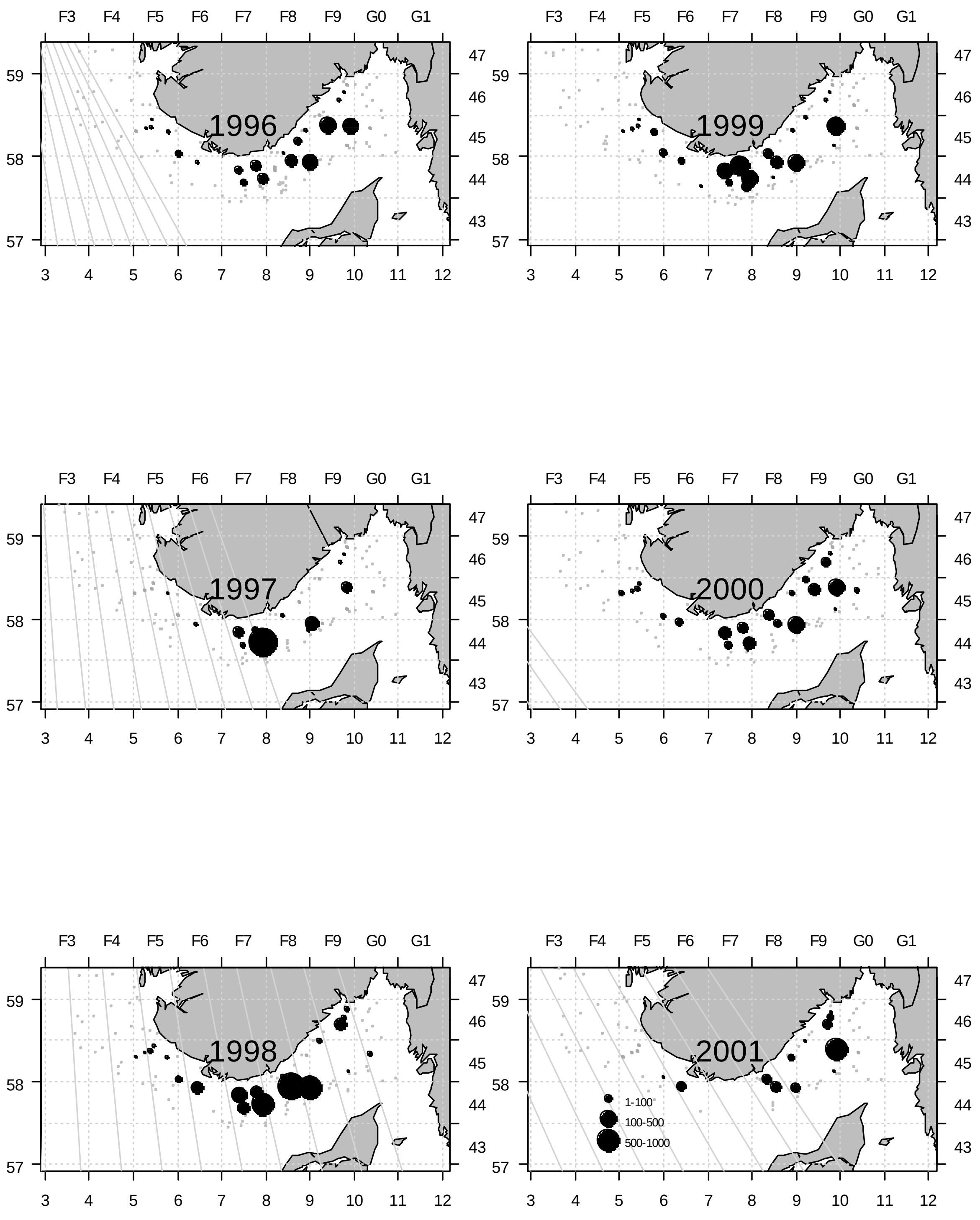


Figure 5 continued.

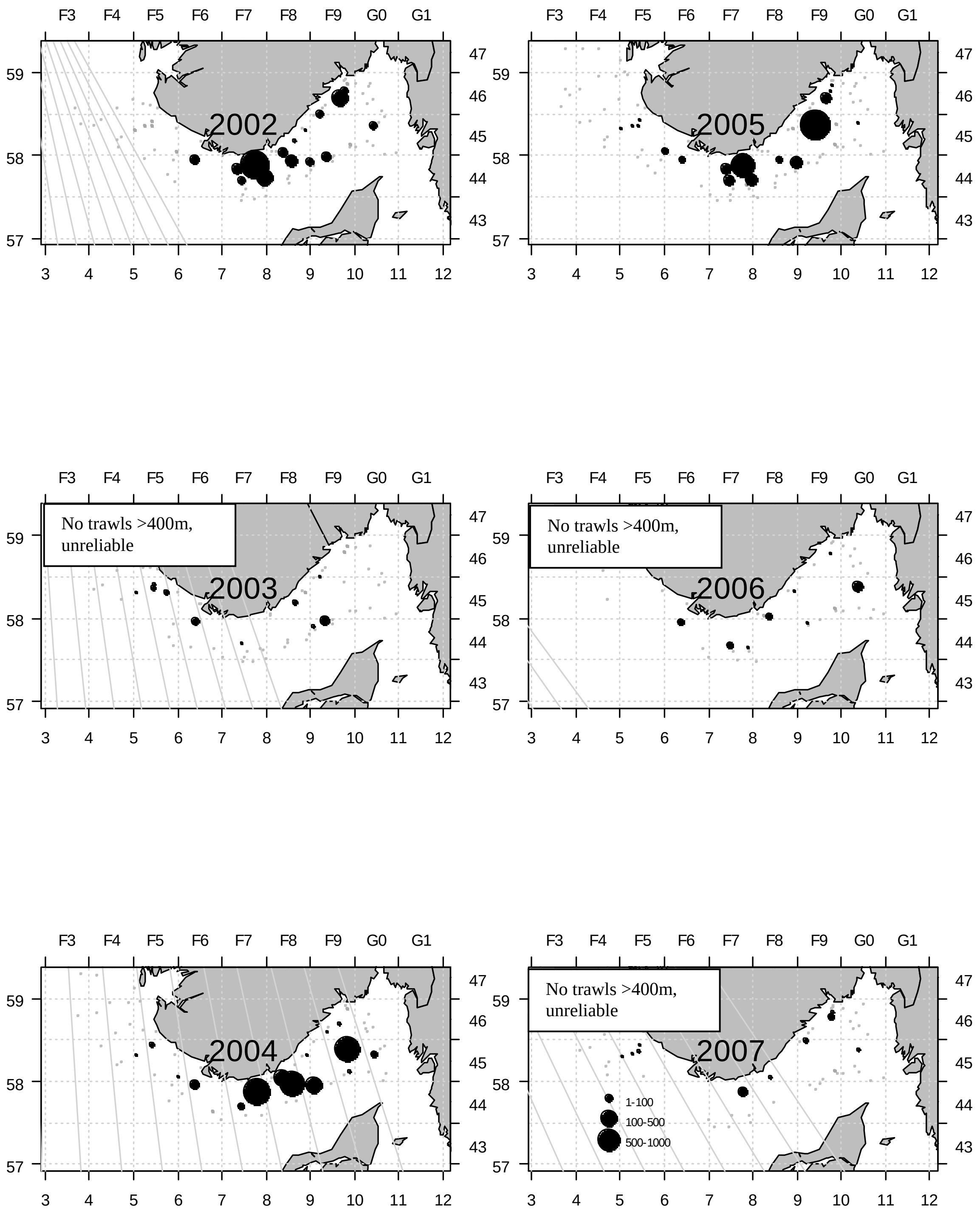


Figure 5 continued.

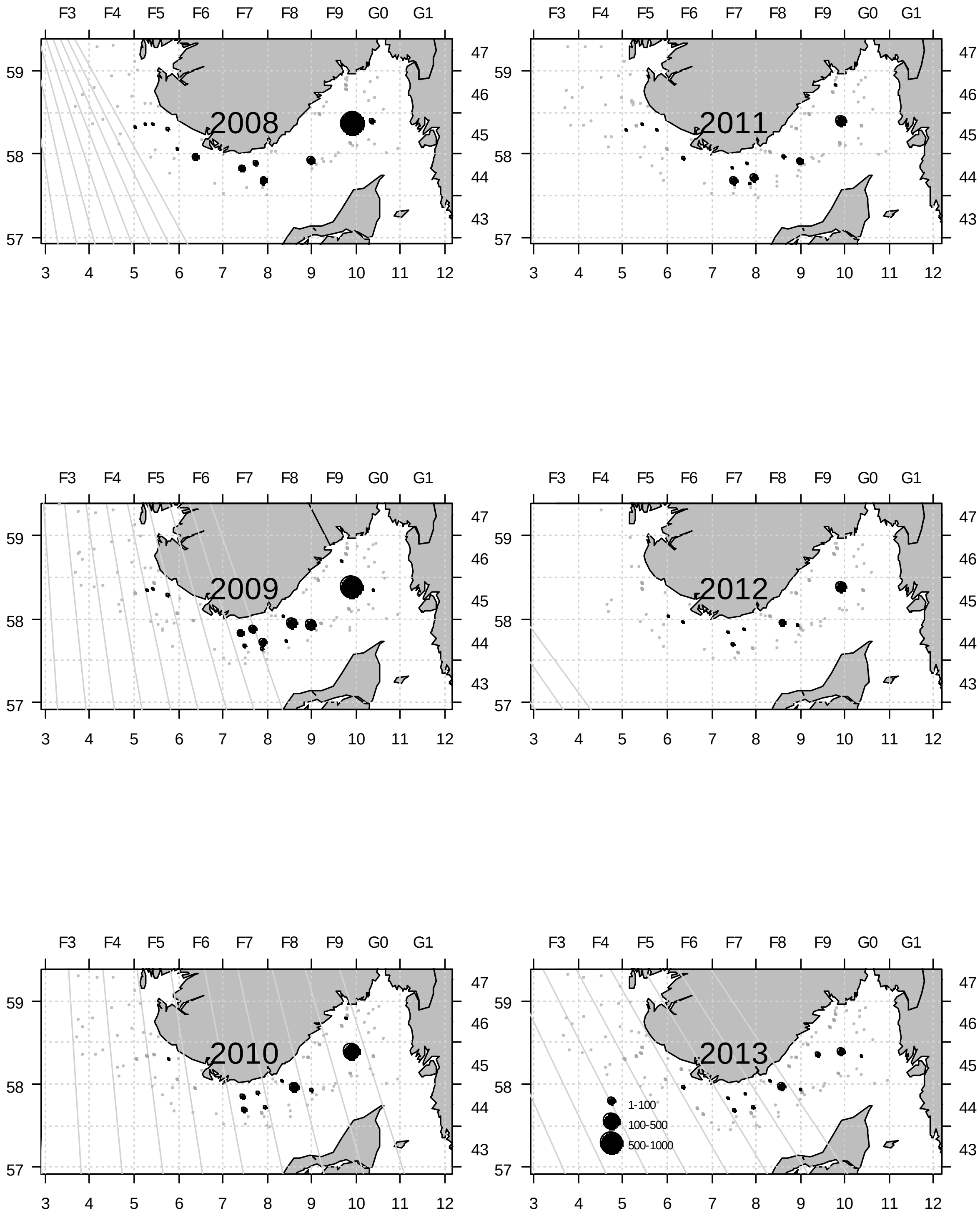


Figure 5 continued.

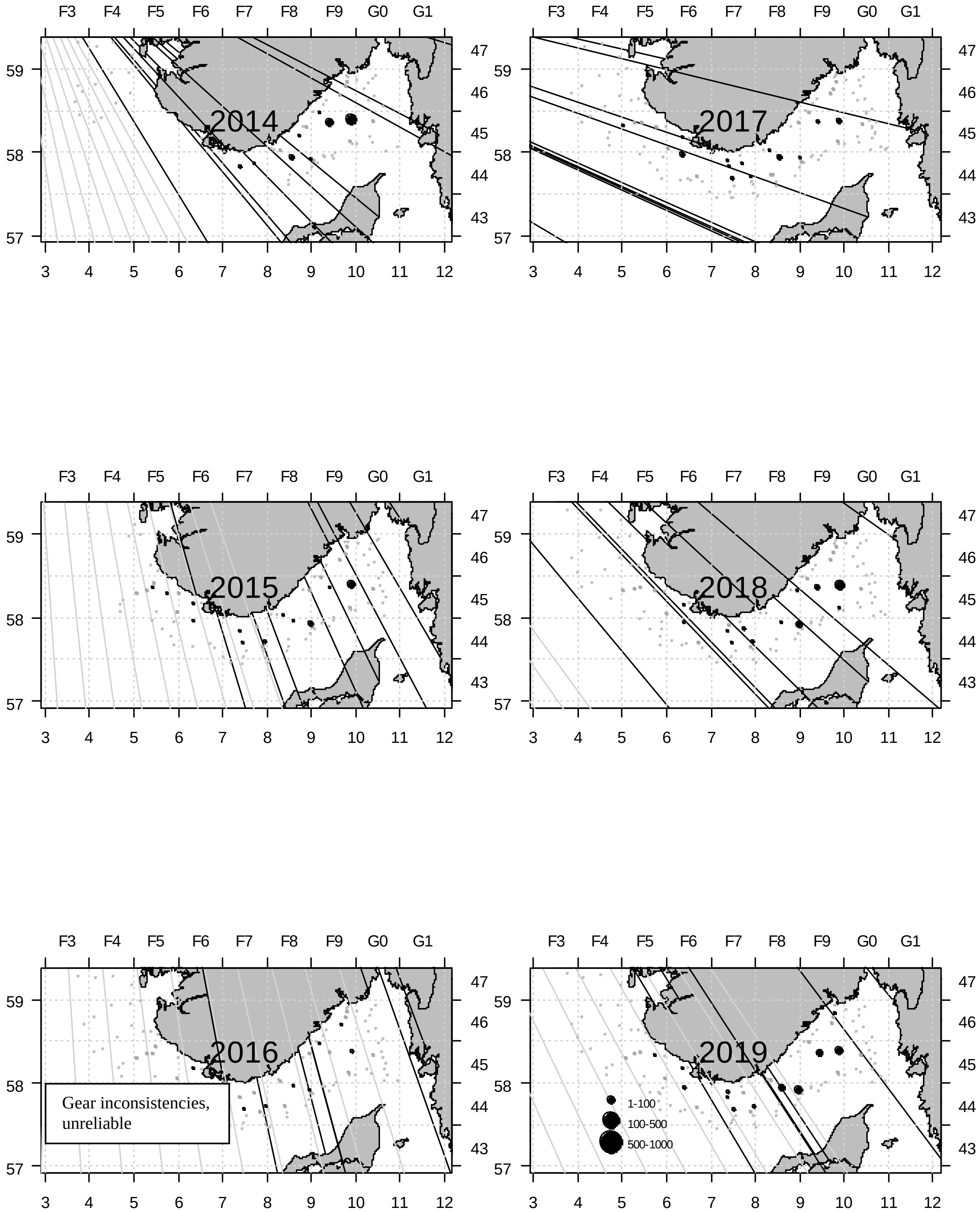


Figure 5 continued

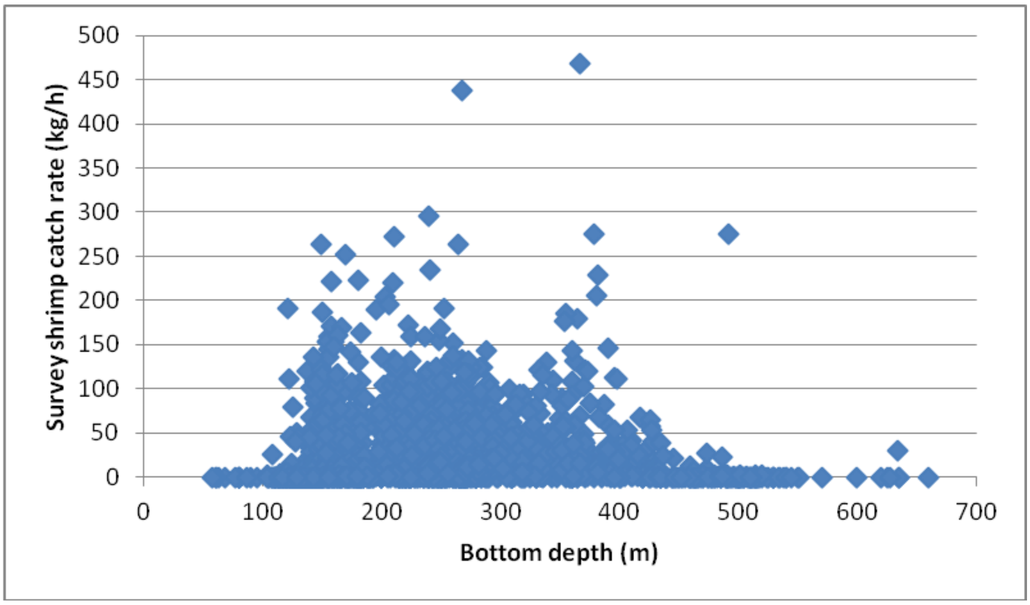


Figure 6. Depth distribution of deepwater shrimp (*Pandalus borealis*) as illustrated by catch rates in the Norwegian shrimp trawl survey, 1984-2013.

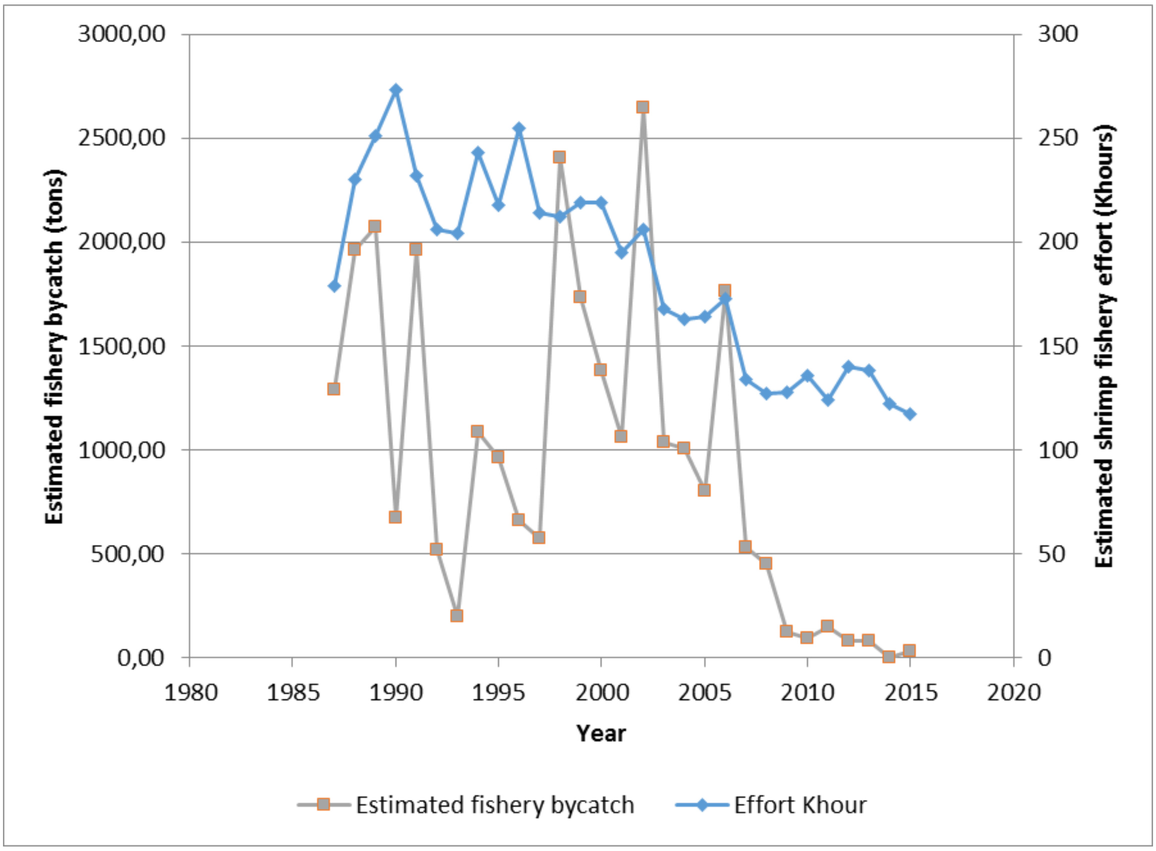


Figure 7. Estimated by-catch of roundnose grenadier in the Norwegian shrimp fishery in ICES Div. 3a and 4a, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

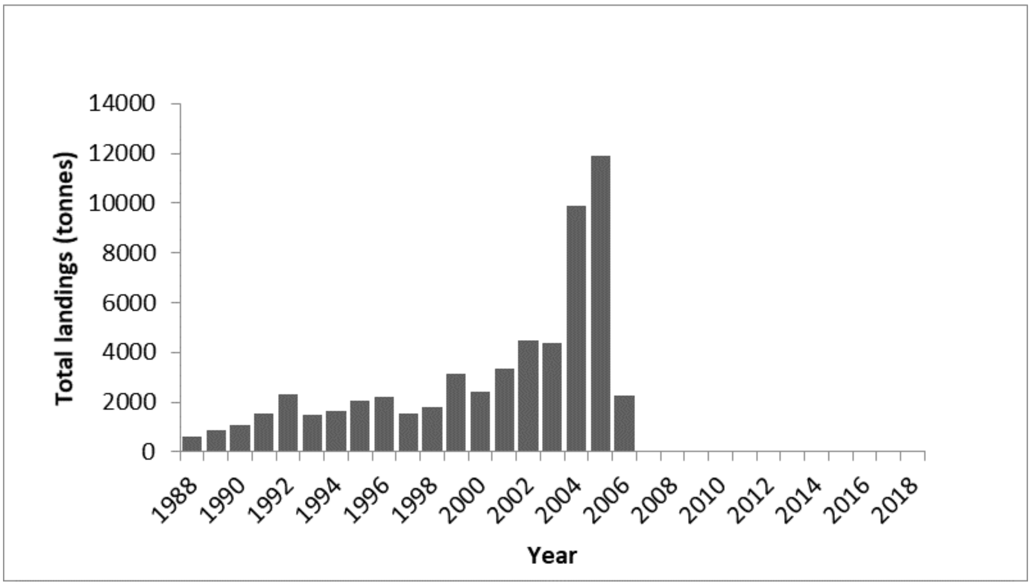


Figure 8. Total reported landings of roundnose grenadier in ICES Division 3a, 1988-2018. Landings from 2007 and later is very small and all less than 2 tons.

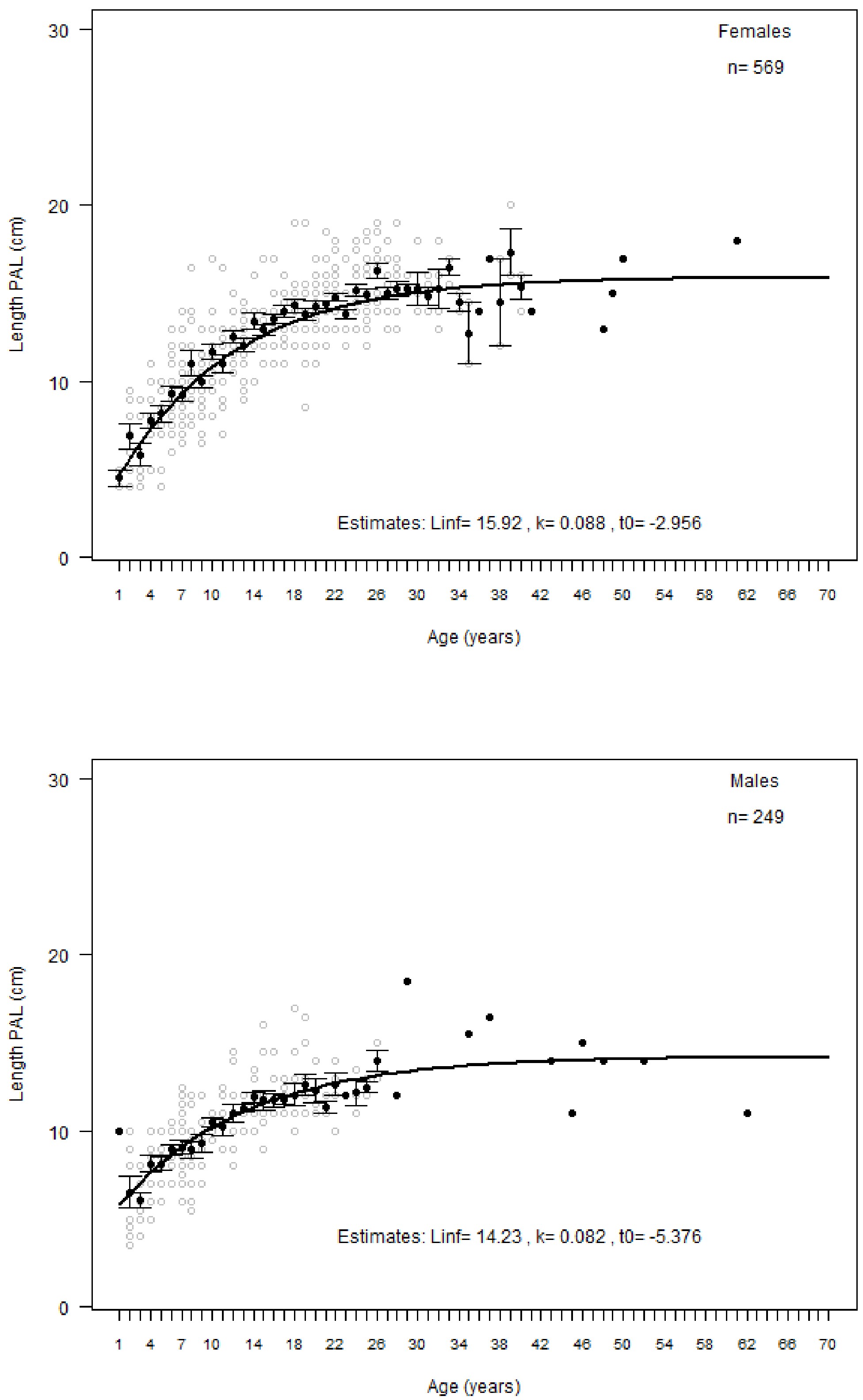


Figure 9. Length at age for female and male roundnose grenadier; data from Skagerrak 2008-2018. Mean values are estimated with ±SE where there is more than one value. Estimated von Bertalanffy growth curves with parameters for females and males.

Survey results of roughhead grenadier, roundnose grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling, and orange roughy in ICES subdivision 14.b.2 in the period 1998-2016

By

Julius Nielsen, Adriana Nogueira, and Helle Torp Christensen

Greenland Institute of Natural Resources

3900 Nuuk, Greenland

Introduction

A stratified bottom trawl survey in East Greenland (ICES 14b) has been conducted by the Greenland Institute of Natural Resources, from 1998 to 2016, at depths between 400 to 1500 m with R/V Pâmiut. Survey results (biomass and abundance estimates and length frequency distribution) are presented for roughhead grenadier (*Macrourus berglax*), roundnose grenadier (*Coryphaenoides rupestris*), greater silver smelt (*Argentina silus*), blue ling (*Molva dypterygia*), tusk (*Brosme brosme*), black scabbard fish (*Aphanopus carbo*), ling (*Molva molva*), and orange roughy (*Hoplostethus atlanticus*). Only roughhead grenadier and roundnose grenadier from ICES division 14b have previously been reported to NWWG (Christensen & Hedeholm 2016).

This document contains the available information on the species mentioned above, in ICES division 14b from scientific surveys since 1998. No survey was conducted in 2001, 2017 and 2018.

Materials and methods

The Greenland halibut surveys in East Greenland (ICES 14 b) were initiated in 1998. Until 2008, the survey was conducted in June, and had in almost all years suffered under the ice coverage found at the east coast of Greenland during early summer. Therefore, from 2008 and onwards surveys have taken place in August/September without ice induced problems. Also, in 2008 the survey was combined with a new shrimp/fish survey using a different trawl gear at more shallow waters than the Greenland halibut survey. The combination of the two surveys led to a change in trawling hours so that most of the stations since 2008 were taken during night-time.

Stratification

The survey was planned to cover ICES Area 14b from between the 3-nm line and the 200-nm line or the midline to Iceland at depths from 400 to 1500 m. The survey area was stratified in 5 Subareas Q1-Q5 (**Table 1, Fig. 1**). Area Q1 consists of one depth stratum 401-600 m on Dohrn Bank in the northern part of the survey area. Area Q2 is the shelf area in the northern part of the survey area and is sub-divided in the depth strata 401-600, 601-800, 801-1000 and 1001-1500 m. Area Q3 is a large area with depths generally below 800 m. The stratification in the area has not been changed: 401-600, 601-800 and 801-1000 m. The slope, >1000 m, has not been covered due to steep and rough bottom. Area Q4 is not covered due to steep and rough bottom. Area Q5 is sub-divided in the depth strata 401-600, 601-800, 801-1200, 1201-1400 and 1401-1500 m. One stratum, Q6, off Southeast Greenland has been included in previous survey plans, but it has never been possible to make any hauls in the area due to ice and rough bottom. Therefore, Q6 has been excluded from the survey area since 2004. Survey areas of all Q-areas are presented in **Table 1**.

Vessel and gear and handling of the catch

For information on survey design, vessel and trawling gear and handling of the catch see NWWG working document for Greenland halibut (Christensen & Hedeholm 2016).

Trawling procedure

Towing time is usually 30 min, but towing times down to 15 min are accepted. Towing speed is between 2.5-3.0 kn and is estimated from the start and end positions of the haul. Since 2008, most trawling has taken place during night-time.

Results and discussion

The available data from scientific surveys reveal the evaluated species are present in ICES division 14b in very different quantities. Below are presented data for each species with focus in the most recent year the species has been registered. Overall length distributions are shown only for years when more than 20 specimens of a given species were available.

Roughhead grenadier (*Macrourus berglax*, RHG)

The biomass has been at a similar level from 1998 to 2007, where it ranged between 3151 t to 5702 t (**Table 3, Fig. 2**). The biomass then increased from 2008 until 2016 where it ranged between 5871 t to 9208 t (**Table 3, Fig. 2**). This increase could be linked to, that the survey design was changed, so that most stations from 2008 and onwards were taken during night time.

The biomass since 2008 appears stabil although fluctuating (**Fig. 2**).

In 2016, roughhead grenadier was caught in 75 of the 100 hauls. Catches ranged from 0.6 kg to 284 kg pr haul. The species was found in all strata, with the majority of the biomass in Q2 similar to previous years (**Table 4, Fig. 3**). In 2016, the biomass was 6954 t (S.E. = 1191), which is a decrease from 2015 (**Table 3**). The highest densities were seen in Q2, at depths from 601-800 m and 801-1000 m (**Table 4**). **T**he abundance in 2016, was estimated $6.005*10^6$ (S.E. =$1.044*10^6$) and follows the same pattern as the biomass (**Table 3**).

The overall length distribution in 2016 was dominated by a clear mode at 19 cm similar to previous years (**Fig. 4**). Since 2010, a smaller second mode around 29 cm is present in the time series (**Fig. 4**), which most likely is caused by sex specific growth patterns.

Roundnose grenadier, RNG (*Coryphaenoides rupestris*).

Biomass for roundnose grenadier has been at low levels throughout the time series, exhibiting a decreasing trend from 3039 t in 1998 to 170 t in 2016, only peaking in 2003 (8415 t) and 2012 (5382 t) (**Table 5, Fig. 5**).

In 2016, the highest densities were found in Q2 at depths from 1001-1500 m (**Table 6**). The estimated biomass of 170 t (S.E. = 46) is a reduction from 2015 (**Table 5)**. In 2016, roundnose grenadier was caught in 22 of the 100 hauls and catches ranged from 0.2 kg to 12.8 kg. The species was found in both Q2 and Q5 with the majority of the biomass in Q2 similar to previous years (**Table 6, Fig. 6**). The abundance in 2016, was estimated to $0.53*10^6$ (S.E = $0.128*10^6$) and follows the same pattern as the biomass (**Table 5**).

The overall length distribution throughout the time series is dominated by a mode around 9 cm (**Fig. 7**). In years with small samples sizes (N<500) this modes diminishes (e.g. year 2015 and 2016).

Greater silver smelt ARS (*Argentinus silus*).

Biomass for greater silver smelt has been increasing from 1998 t (6.4 t) to 2016 (808.1 t), peaking in 2014 (2166.7 t) (**Table 7, Fig.8**) and the estimated biomass in 2016 of 808.1 t (S.E.=360.4 t) is an increase from 2015 (**Table 7**). In 2016, greater silver smelt was caught in 26 of the 100 hauls. Catches ranged from 0.1 kg to 46.9 kg. The species was found in Q3, but the vast majority of the biomass was in Q2 and Q5 as in previous years (**Table 8, Fig. 9**).

In 2016, the abundance was estimated to $1.61*10^6$ (S.E. = $0.89*10^6$) and generally follows the same patterns as biomass (**Table 7**).

The overall length distribution shows that from 2003-2011 and 2014-2016 catches were dominated by a mode around 30-40 cm whereas a second mode around 20 cm was evident in years 2012-2013 (**Fig. 10**).

Tusk USK (*Brosme brosme*, USK).

Biomass for tusk has been low until 2010 (mean biomass = 18.2 t), with no catches in 1998, 1999 and 2005. From 2010 untill 2016, the biomass has been distinctly higher (mean biomass = 275 t) ranging from 78.8 t (2014) to 504.0 t (2013) (**Table 9, Fig. 11**).

In 2016, the biomass was 371.9 t (S.E. = 92.1), which is an increase from 2015 (**Table 9**). The highest densities were observed in Q3 at depths between 401-600 m (**Table 10**). In 2016, tusk was caught in 24 of the 100 hauls and catches ranged from 0.5 kg to 5.5 kg. The species were caught in Q2, Q3 and Q5 (**Table 10, Fig. 12**).

In 2016, the abundance was estimated $0.326*10^6$ (S.E. = $0.082*10^6$) (**Table 9**).

The overall length distribution for all years are based on relatively low sample sizes (N<100) but it appears that a mode between 40-50 cm is dominating all years (**Fig. 13**).

Blue ling (*Molva dypterygia*, BLI).

Biomass for blue ling has been low from 1998 to 2005 (mean biomass =138.4 t). From 2006 untill 2016, the biomass have been distinctly higher (mean biomass = 786.5 t) ranging from 158 t (2007) and 1365 t (2012) (**Table 11, Fig. 14**). In 2016, the biomass was 433 (S.E. = 155), which is almost the same as in 2015 (**Table 11**). In 2016, blue ling was caught in 15 out of 100 hauls. Catches ranged from 0.3 kg to 28.3 kg. The species was caught in Q3 and Q4, but with the vast majority in Q2 at depths between 401-600 m as in previous years (**Table 12, Fig. 15**).

In 2016, the abundance was estimated to $0.183*10^6$ (S.E. = $0.067*10^6$) and generally follows biomass estimates.

The overall length distribution shows that before 2013, a mode just below 80 cm dominated whereas the mode is slightly above 80 cm from 2013 and onwards (**Fig. 16**).

Black scabbard fish (*Aphanopus carbo*, BSF).

Black scabbard fish are rarely caught in this survey.There were no catches years 1998, 1999, 2000, 2002, 2003, 2006 and 2016. In 2013 and 2015, the species was caught only in one station each year out of an average number of 78 stations, whereas it was found in 4-6 stations in 2011, 2012 and 2014. For these years, catches ranged from 0.7 kg to 21.7 kg. In 2015, it was only registered in Q5 at depths between 801-1200 m (**Table 14, Fig. 18**), where the majority of the biomass also has been observed in previous years.

In 2008 and 2010-2012, the biomass was estimated between 32.8 t and 56.4 t, whereas all other years the biomass was less than 7.9 t (**Table 13**). This is most likely because that this pelagic and deep living pelagic fish is not targeted by the applied type of bottom trawl and hence the estimated biomasses (**Fig. 17**) are not truly reflective of actual biomasses in the investigated area.

Overall length distributions from 2011 and 2012 show a wide mode between 70 cm and 110 cm (**Fig. 19**).

Ling, LIN (*Molva molva*).

Ling are not commonly caught in this survey. There were no catches from 1998 to 2004, 2008, 2013-2014 and 2016. Except from 2011, where the estimated biomass was 267.8 t (S.E. = 14.8 t) (**Table 15**), yearly estimated biomass were 10-fold less or zero evidencing that ling do not commonly occur in the investigated area (**Table 15, Fig. 20, Fig. 21**).

In 2015, ling was caught three times out of 84 hauls in both Q2, Q3 and Q5 at depths between 601-800 m (**Table 16**). Abundance follows biomass estimates and in 2015, estimated abundance was $0.009*10^6$ (**Table 15**).

The overall length distribution shows that specimens were shorter in 2011 (mode 40-50 cm) than in 2010 (mode=90-100) and further that less fishes were caught in 2011 (**Fig. 22**) where, on the other hand, the estimated biomass was more than 10 times higher. This is explained by the fact that in 2011 all ling were caught in Q3 at 601-800 m – a depth stratum which conducts 26.3 % of the total area of all strata combined (**Table 1**).

Orange roughy, HAT (*Hoplostethus atlanticus*)

Orange roughy is not commonly caught in this survey. The species was only catches in 2008, 2013, 2014 and 2015 (**Fig. 24**). In 2014 and 2015, estimated biomass was 1.7 t and 1.1 t, respectively, and all other years it was zero or very close to (**Table 17**, **Fig. 23**). In 2015, all fish were caught in Q3 at depths between 801-1200 m (**Table 18**). No length distributions are shown as too few specimens (N<20) has been caught.

References

Christensen HT, and Hedeholm R. 2016. Survey for Greenland halibut in ICES Area 14B, August/September 2015. Working Paper for ICES Northwestern Working Group April-May, 2016

Tables and figures

Table 1. Areas (km^2) and their percentage distribution for subareas and depth strata (m). Q4 areas are not included in the % calculation as no trawling station have been possible to take here due to unsuitable bottom.

Subarea	Depth strata	Area	% distribution
Q1	401-600	6975	18.7
Q2	401-600	1246	3.3
Q2	601-800	1475.4	3.9
Q2	801-1000	1988.3	5.3
Q2	1001-1500	6689.4	17.9
Q3	401-600	9830.2	26.3
Q3	601-800	3788.1	10.1
Q3	801-1000	755.4	2.0
Q3	1001-1200	191.1	0.5
Q3	1201-1400	213.3	0.6
Q3	1401-1500	312.9	0.8
Q4	401-600	2053.6	
Q4	601-800	665.7	
Q4	801-1000	336.2	
Q4	1001-1200	549.9	
Q4	1201-1400	1147	
Q4	1401-1500	940.5	
Q5	401-600	1819.4	4.9
Q5	601-800	257.1	0.7
Q5	801-1200	255.6	0.7
Q5	1201-1400	985.5	2.6
Q5	1401-1500	614.5	1.6
Sum (without Q4)		37397.2	100

Table 2. Number of valid hauls for all years. No survey in 2001, 2017 and 2018.

	Stratum													
	Q1 401-600	Q2 401-600	Q2 601-800	Q2 801-1000	Q2 1001-1500	Q3 401-600	Q3 601-800	Q3 801-1000	Q5 401-600	Q5 601-800	Q5 801-1200	Q5 1201-1400	Q5 1401-1500	Total
1998	5	3	7	8	11	6	3	2	2	0	2	2	3	54
1999	2	4	5	7	12	7	4	0	2	2	4	2	2	53
2000	2	3	6	6	12	9	4	2	1	2	4	2	2	55
2001	-	-	-	-	-	-	-	-	-	-	-	-	-	
2002	0	3	6	6	10	3	1	0	0	2	4	3	2	40
2003	3	4	6	5	9	1	5	2	0	1	3	1	0	40
2004	2	4	5	7	3	9	4	0	3	3	3	5	3	51
2005	0	4	6	9	3	1	8	1	0	1	4	6	4	47
2006	0	5	6	12	4	2	2	0	1	3	3	3	2	43
2007	2	3	5	9	3	3	5	0	2	2	4	6	2	46
2008	4	3	5	9	3	2	5	2	2	2	4	4	1	46
2009	4	4	5	9	5	5	10	3	2	3	4	6	3	69
2010	2	4	6	8	3	5	7	2	0	1	3	5	3	49
2011	7	1	6	8	4	6	6	5	1	3	3	8	4	62
2012	7	4	8	10	7	4	7	4	2	3	4	5	2	67
2013	10	5	5	8	4	9	11	4	1	6	5	9	3	80
2014	7	5	7	7	7	6	12	5	2	6	6	3	3	76
2015	11	5	7	8	7	8	10	5	3	6	2	7	5	84
2016	12	5	7	10	7	11	14	6	3	6	5	9	5	100
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	
2018	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3. Biomass (t) and abundance (10^6), with SE, of roughhead grenadier. No survey in 2001, 20017 and 2018.

	Roughhead grenadier			
Year	Biomass	SE	Abun.	SE
1998	4298	694	3.984	0.500
1999	5788	807	6.357	0.979
2000	4275	486	4.797	0.494
2001	-	-		-
2002	5702	1915	6.527	3.049
2003	4067	529	4.369	0.644
2004	3151	533	2.814	0.267
2005	4239	873	5.231	1.226
2006	3972	597	4.600	0.621
2007	3435	637	3.590	0.446
2008	6841	984	6.590	0.819
2009	7658	1382	7.175	1.133
2010	9208	2291	7.536	1.162
2011	5871	1032	5.678	1.056
2012	8201	1494	7.310	1.170
2013	7606	1766	5.757	1.213
2014	6831	1043	5.439	0.714
2015	8750	2292	5.647	1.239
2016	6954	1191	6.005	1.044
2017	-	-	-	-
2018	-	-	-	-

Table 4. Biomass (t) and abundance (in numbers) with SE of roughhead grenadier expressed as mean catch per km^2 and total biomass by subarea and depth stratum in 2016.

					Biomass			*Abundance*	
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0.0305	212.9	91.5	28.1	195794	91854
Q2	401-600	1246	5	0.6579	819.7	466.7	615.6	766985	379861
	601-800	1475	7	1.3791	2034.7	746.6	844.3	1245641	356006
	801-1000	1988	10	0.9196	1828.5	503.4	676.8	1345717	458547
	1001-1500	6689	7	0.2539	1698.3	612.7	298.0	1993532	768271
Q3	401-600	9830	11	0.0106	104.2	61.5	12.6	124283	84253
	601-800	3788	14	0.0121	45.7	18.6	7.9	30040	11284
	801-1000	755	6	0.0171	12.9	8.6	12.7	9610	6398
Q5	401-600	1819	3	0.0032	5.9	5.9	4.4	7970	7970
	601-800	257	6	0.0486	12.5	4.1	53.3	13700	2996
	801-1200	256	5	0.1387	35.5	7.9	285.6	72993	15673
	1201-1400	986	9	0.1037	102.2	29.0	147.4	145251	36288
	1401-1500	615	5	0.0672	41.3	14.1	87.7	53912	24270
All		36679	100	0.1896	6954.213	1191	163.7	6005430	1044

Table 5. Biomass (t) and abundance (10^6) of roundnose grenadier. No survey in 2001, 2007 and 2018.

	Roundnose grenadier			
Year	Biomass	SE	Abun.	SE
1998	3039	1312	4.947	1.594
1999	4497	527	10.149	1.070
2000	2507	1265	6.242	2.588
2001	-	-	-	-
2002	1812	1225	7.322	4.558
2003	8415	5411	23.801	12.177
2004	1152	792	4.369	1.841
2005	1174	338	5.884	1.813
2006	689	300	3.782	0.968
2007	879	251	8.310	2.491
2008	773	243	4.297	1.278
2009	211	53	1.436	0.371
2010	391	76	2.382	0.354
2011	3211	2823	9.237	6.692
2012	5382	4778	15.333	13.531
2013	295	152	1.471	0.695
2014	106	36	0.826	0.323
2015	999	816	3.066	2.106
2016	170	46	0.530	0.128
2017	-	-	-	-
2018	-	-	-	-

Table 6. Biomass (t) and abundance (in numbers) with SE of roundnose grenadier expressed as mean catch per km^2 and total biomass by subarea and depth stratum in 2016.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0.0000	0.0	0.0	0.0	0	0
Q2	401-600	1246	5	0.0000	0.0	0.0	0.0	0	0
	601-800	1475	7	0.0000	0.0	0.0	0.0	0	0
	801-1000	1988	10	0.0015	3.1	2.2	4.9	9839	6566
	1001-1500	6689	7	0.0193	128.9	43.2	45.8	306453	107017
Q3	401-600	9830	11	0.0000	0.0	0.0	0.0	0	0
	601-800	3788	14	0.0000	0.0	0.0	0.0	0	0
	801-1000	755	6	0.0000	0.0	0.0	0.0	0	0
Q5	401-600	1819	3	0.0000	0.0	0.0	0.0	0	0
	601-800	257	6	0.0000	0.0	0.0	0.0	0	0
	801-1200	256	5	0.0214	5.5	2.1	384.2	98206	41556
	1201-1400	986	9	0.0311	30.6	15.7	109.0	107419	55057
	1401-1500	615	5	0.0035	2.1	1.3	13.2	8132	5020
All		36679	100	0.0046	170.2	46.0	14.5	530050	128000

Table 7. Biomass (t) and abundance (10^6) of greater silver smelt. No survey in 2001, 2007 and 2018.

	Greater silver smelt			
Year	Biomass	SE	Abun.	SE
1998	6.4	3.9	0.015	0.011
1999	3.4	3.4	0.009	0.009
2000	8.6	5.0	0.025	0.014
2001	-	-	-	-
2002	67.1	40.9	0.231	0.147
2003	250.5	149.2	0.772	0.470
2004	96.9	36.0	0.303	0.116
2005	55.1	19.6	0.186	0.068
2006	167.2	58.5	0.472	0.177
2007	126.6	45.8	0.384	0.143
2008	240.7	105.5	0.609	0.280
2009	347.5	155.5	0.748	0.344
2010	370.7	100.9	0.753	0.206
2011	432.2	145.0	1.146	0.406
2012	483.4	166.3	0.958	0.295
2013	643.6	173.5	1.240	0.310
2014	2166.7	942.4	4.365	1.790
2015	257.6	71.7	0.507	0.120
2016	808.1	360.4	1.610	0.890
2017	-	-	-	-
2018	-	-	-	-

Table 8. Biomass (t) and abundance (in numbers) with SE of greater silver smelt expressed as mean catch per km^2 and total biomass by subarea and depth stratum in 2016.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0	0	0	0	0	0
Q2	401-600	1246	5	0.0015	1.8	1.8	3.7	4662	46621
	601-800	1475	7	0.1342	197.9	94.7	163.5	241265	98266
	801-1000	1988	10	0.0185	36.9	25.1	26.0	51711	32812
	1001-1500	6689	7	0.0011	7.6	7.6	1.8	11909	11908
Q3	401-600	9830	11	0.0095	93.7	77.0	15.9	156261	107986
	601-800	3788	14	0	0	0	0	0	0
	801-1000	755	6	0	0	0	0	0	0
Q5	401-600	1819	3	0.2516	457.8	338.1	609.2	1108340	877036
	601-800	257	6	0.0458	11.8	2.2	130.1	33453	6470
	801-1200	256	5	0.0007	0.19	0.19	2.4	615	615
	1201-1400	986	9	0	0	0	0	0	0
	1401-1500	615	5	0.0008	0.49	0.5	2.4	1489	1489
All		36679	100	0.0220	808.1	360.4	43.9	1609705	890000

Table 9. Biomass (t) and abundance (10^6) of tusk. No survey in 2001, 2017 and 2018.

	Tusk			
Year	Biomass	SE	Abun.	SE
1998	0	0	0	0
1999	0	0	0	0
2000	4.5	4.5	0.001	0.001
2001	-	-	-	-
2002	54.7	30.6	0.182	0.102
2003	3.5	2.6	0.014	0.007
2004	4.4	4.4	0.010	0.010
2005	0	0	0	0
2006	16.5	7.7	0.019	0.008
2007	18.4	14.9	0.012	0.007
2008	69.2	29.5	0.166	0.094
2009	47.4	22.3	0.112	0.055
2010	225.7	113.6	0.369	0.207
2011	113.6	48.4	0.093	0.040
2012	353.5	261.9	0.142	0.067
2013	504.0	159.8	0.286	0.068
2014	78.8	19.1	0.080	0.016
2015	277.9	87.1	0.186	0.048
2016	371.9	92.1	0.326	0.082
2017	-	-	-	-
2018	-	-	-	-

Table 10. Biomass (t) and abundance (in numbers) with SE of tusk expressed as mean catch per km^2 and total biomass by subarea and depth stratum in 2016.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0.0000	0.0	0.0	0.0	0	0
Q2	401-600	1246	5	0.0257	32.0	15.2	20.5	25544	10480
	601-800	1475	7	0.0030	4.4	3.0	4.4	6434	4156
	801-1000	1988	10	0.0184	36.6	35.2	26.2	52179	49612
	1001-1500	6689	7	0.0000	0	0	0.0	0	0
Q3	401-600	9830	11	0.0225	221.1	72.2	18.3	179779	60754
	601-800	3788	14	0.0057	21.4	8.6	5.9	22243	8538
	801-1000	755	6	0.0027	2.1	2.1	2.0	1484	1484
Q5	401-600	1819	3	0.0282	51.3	41.4	19.3	35201	17663
	601-800	257	6	0.0085	2.2	1.5	8.2	2112	1534
	801-1200	256	5	0.0030	0.8	0.8	2.4	614	614
	1201-1400	986	9	0.0000	0	0	0.0	0	0.0
	1401-1500	615	5	0.0000	0	0	0.0	0.0	0.0
All		36679	100	0.0101	371.9	92.1	8.9	325591	82000

Table 11. Biomass (t) and abundance (10^6) of blue ling. No survey in 2001, 2007 and 2018.

	Blue ling			
Year	Biomass	SE	Abun.	SE
1998	127	68	0.048	0.017
1999	171	70	0.071	0.029
2000	243	110	0.200	0.084
2001	-	-	-	-
2002	110	23	0.131	0.026
2003	125	33	0.110	0.020
2004	82	33	0.089	0.043
2005	111	31	0.083	0.015
2006	570	265	0.356	0.131
2007	158	57	0.137	0.058
2008	871	405	1.015	0.575
2009	1240	618	0.861	0.354
2010	892	158	0.689	0.194
2011	588	233	0.665	0.319
2012	1365	194	0.986	0.369
2013	1248	412	0.572	0.159
2014	869	288	0.475	0.128
2015	418	162	0.204	0.074
2016	433	155	0.183	0.067
2017	-	-	-	-
2018	-	-	-	-

Table 12. Biomass (t) and abundance (in numbers) with SE of blue ling expressed as mean catch per km^2 and total biomass by subarea and depth stratum in 2016.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	12	0	0	0	0	0	0
Q2	401-600	1246	5	0.2295	287.0	144.9	78.9	98273	56534
	601-800	1475	7	0.0462	68.2	34.6	21.1	31123	15821
	801-1000	1988	10	0.0108	21.4	21.4	2.9	5738	5738
	1001-1500	6689	7	0.	0	0	0	0	0
Q3	401-600	9830	11	0.0034	33.8	33.8	2.0	19838	19838
	601-800	3788	14	0	0	0	0	0	0
	801-1000	755	6	0	0	0	0	0	0
Q5	401-600	1819	3	0.0095	17.2	17.2	13.1	23909	23909
	601-800	257	6	0.0116	3.0	2.4	8.7	2229	1130
	801-1200	256	5	0.0120	3.1	3.1	7.2	1844	1844
	1201-1400	986	9	0	0	0	0	0	0
	1401-1500	615	5	0	0	0	0	0	0
All		36679	100	0.012	432.6	155.0	5.0	182952	67000

Table 13. Biomass (t) and abundance (10^6) of black scabbard fish. No survey in 2001, 2017 and 2018.

	Black scabbard fish			
Year	Biomass	SE	Abun.	SE
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	-	-	-	-
2002	0	0	0	0
2003	0	0	0	0
2004	0.8	0.8	0.004	0.004
2005	1.7	1.7	0.001	0.001
2006	0	0	0	0
2007	2.3	2.0	0.007	0.005
2008	37.5	33.3	0.034	0.027
2009	2.7	2.7	0.003	0.003
2010	56.4	25.1	0.083	0.035
2011	39.9	26.7	0.056	0.036
2012	32.8	9.5	0.034	0.012
2013	1.8	1.8	0.002	0.002
2014	7.9	4.9	0.007	0.004
2015	1.5	1.5	0.002	0.002
2016	0	0	0	0
2017	-	-	-	-
2018	-	-	-	-

Table 14. Biomass (t) and abundance (in numbers) with SE of black scabbard fish expressed as mean per km^2 and total biomass by subarea and depth stratum in 2015.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km²	Biomass	SE	Mean/km²	Abundance	SE
Q1	401-600	6975	11	0	0	0	0	0	0
Q2	401-600	1246	5	0	0	0	0	0	0
	601-800	1475	7	0	0	0	0	0	0
	801-1000	1988	8	0	0	0	0	0	0
	1001-1500	6689	7	0	0	0	0	0	0
Q3	401-600	9830	8	0	0	0	0	0	0
	601-800	3788	10	0	0	0	0	0	0
	801-1000	755	5	0	0	0	0	0	0
Q5	401-600	1819	3	0	0	0	0	0	0
	601-800	257	6	0	0	0	0	0	0
	801-1200	256	2	0.0059	1.5	1.5	8.4	2153	2153
	1201-1400	986	7	0	0	0	0	0	0
	1401-1500	615	5	0	0	0	0	0	0
All		36679	84	0.00004	1.5	1.5	0.06	2154	2153

Table 15. Biomass (t) and abundance (10^6) of ling. No survey in 2001, 2017 and 2018.

	Ling			
Year	Biomass	SE	Abun.	SE
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	-	-	-	-
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	15.7	15.7	0.009	0.009
2006	29.9	29.9	0.006	0.006
2007	14.6	10.3	0.025	0.020
2008	0	0	0	0
2009	3.1	3.1	0.004	0.004
2010	19.2	17.9	0.008	0.008
2011	267.8	251.2	0.492	0.485
2012	19.9	19.9	0.006	0.006
2013	0	0	0	0
2014	0	0	0	0
2015	23.4	14.8	0.009	0.006
2016	0	0	0	0
2017	-	-	-	-
2018	-	-	-	-

Table 16. Biomass (t) and abundance (in numbers) with SE of ling expressed as mean per km^2 and total biomass by subarea and depth stratum in 2015.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	11	0	0	0	0	0	0
Q2	401-600	1246	5	0	0	0	0	0	0
	601-800	1475	7	0.0087	12.7843	12.7843	1.7	2527.5	2527.5
	801-1000	1988	8	0	0	0	0	0	0
	1001-1500	6689	7	0	0	0	0	0	0
Q3	401-600	9830	8	0	0	0	0	0	0
	601-800	3788	10	0.0015	5.6999	5.6999	1.4	5407.9	5407.9
	801-1000	755	5	0	0	0	0	0	0
Q5	401-600	1819	3	0	0	0	0	0	0
	601-800	257	6	0.0192	4.9455	4.9455	4.8	1236.4	1236.4
	801-1200	256	2	0	0	0	0	0	0
	1201-1400	986	7	0	0	0	0	0	0
	1401-1500	615	5	0	0	0	0	0	0
All		36679	84	0.00006	23.4	14.8	0.3	9172	6000

Table 17. Biomass (t) and abundance (10^6) of orange roughy. No survey in 2001, 2017 and 2018.

	Orange roughy			
Year	Biomass	SE	Abun.	SE
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	-	-	-	-
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0.2	0.2	0.001	0.001
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	<0.1	<0.1	0.001	0.001
2014	1.7	1.7	0.002	0.002
2015	1.1	1.1	0.002	0.002
2016	0	0	0	0
2017	-	-	-	-
2018	-	-	-	-

Table 18. Biomass (t) and abundance (in numbers) with SE of orange roughy expressed as mean per km^2 and total biomass by subarea and depth stratum in 2015.

				Biomass			*Abundance*		
Subarea	Depth strata	Area	Hauls	Mean/km^2	Biomass	SE	Mean/km^2	Abundance	SE
Q1	401-600	6975	11	0	0	0	0	0	0
Q2	401-600	1246	5	0	0	0	0	0	0
	601-800	1475	7	0	0	0	0	0	0
	801-1000	1988	8	0	0	0	0	0	0
	1001-1500	6689	7	0	0	0	0	0	0
Q3	401-600	9830	8	0	0	0	0	0	0
	601-800	3788	10	0	0	0	0	0	0
	801-1000	755	5	0	0	0	0	0	0
Q5	401-600	1819	3	0	0	0	0	0	0
	601-800	257	6	0	0	0	0	0	0
	801-1200	256	2	0.0043	1.0874	1.0874	8.4	2153.3	2153.3
	1201-1400	986	7	0	0	0	0	0	0
	1401-1500	615	5	0	0	0	0	0	0
All		36679	84	0.00003	1.1	1.1	0.06	2153	2153.3

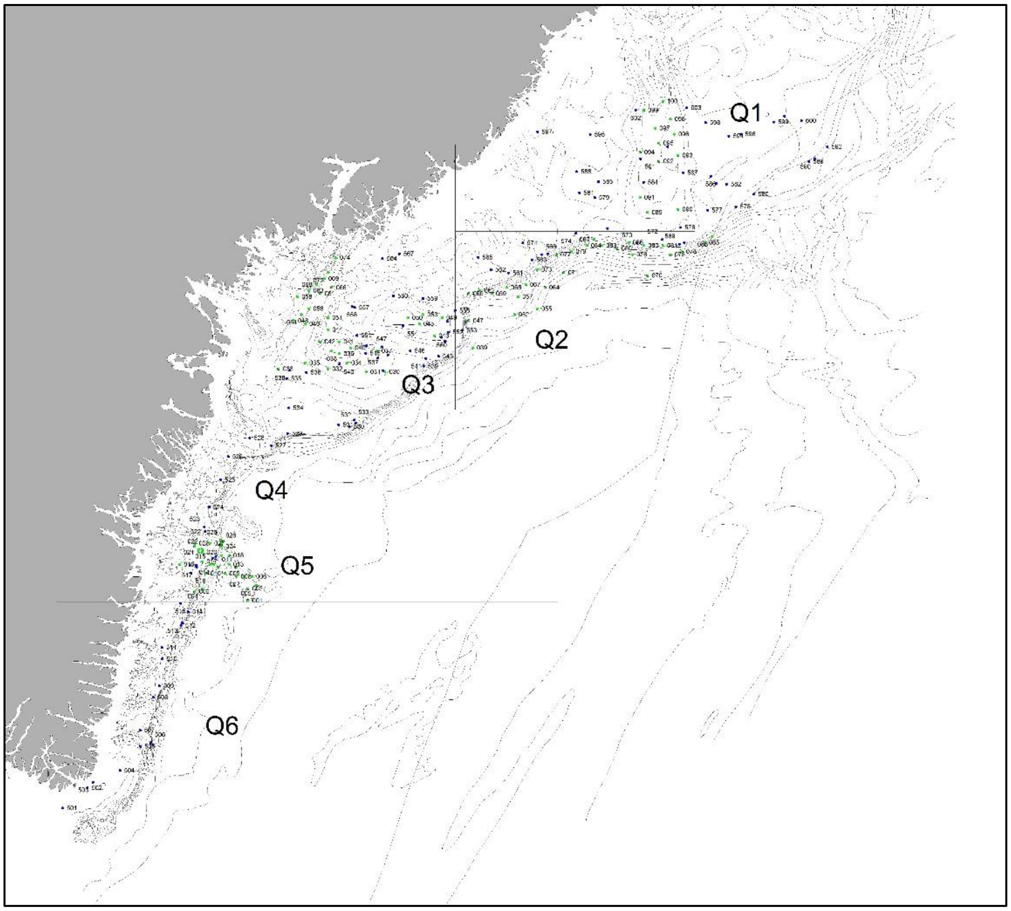


Figure 1. Location of survey Q-areas in east Greenland (ICES subarea 14.b.2). Planned trawling station from 2016 are plottet.

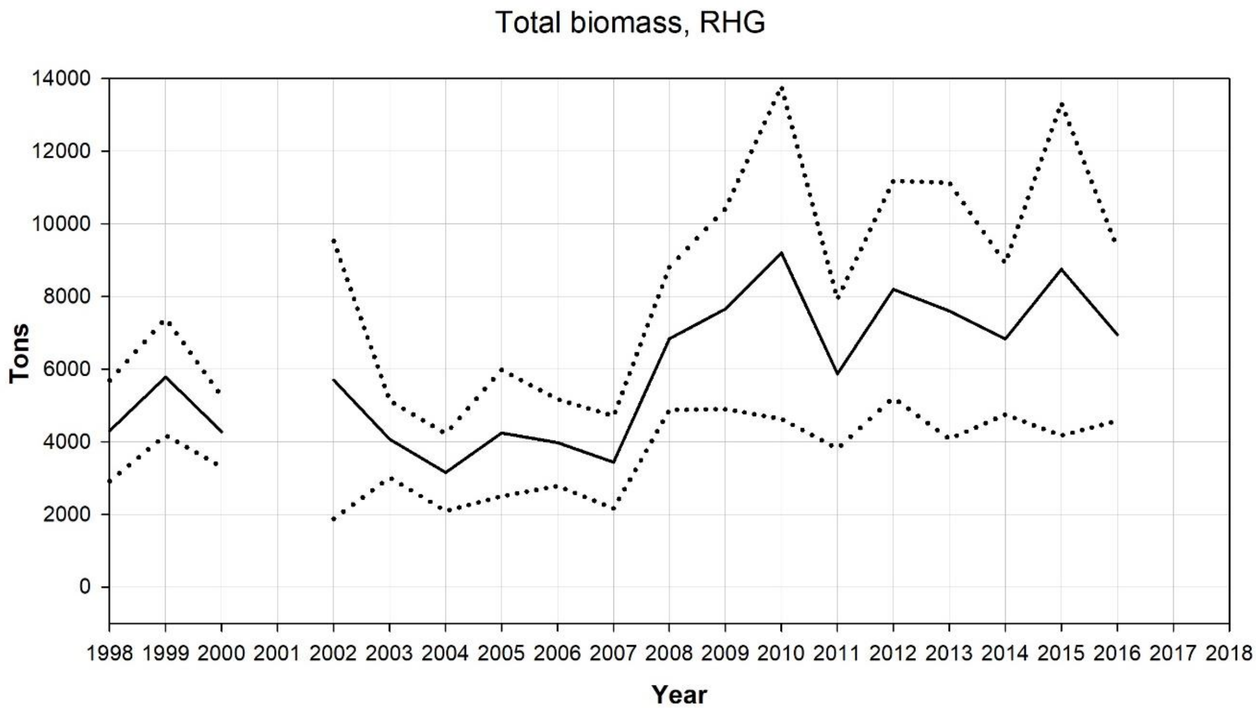


Figure 2. Total biomass (solid line) of roughhead grenadier plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

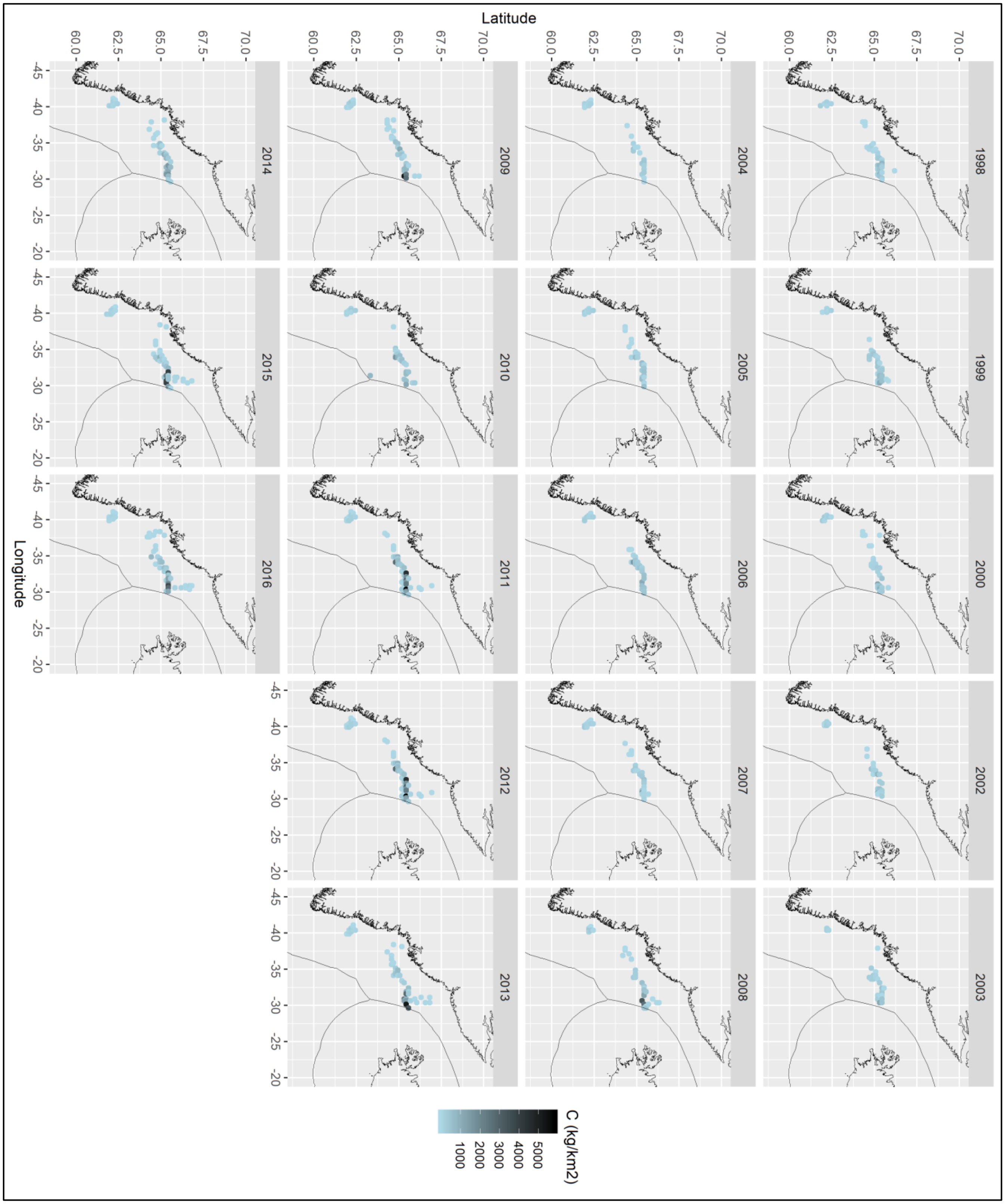


Figure 3. Distribution of survey catches of roughhead grenadier at East Greenland (ICES 14b), in 1998-2016. No survey in 2001, 2017, and 2018.

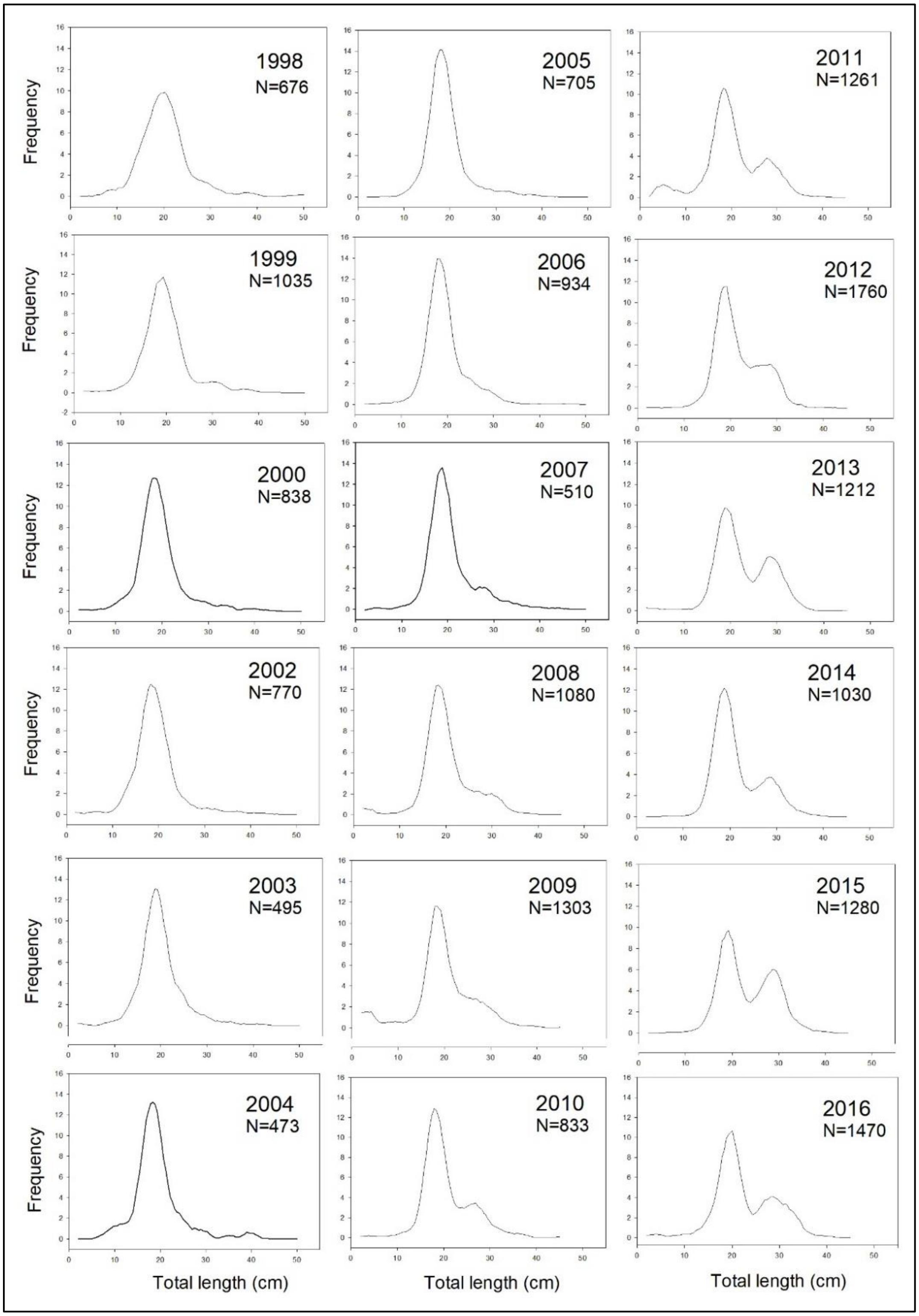


Fig. 4. Length frequency distribution of roughhead grenadier for years 1998-2016. No survey in 2001, 2017 and 2018.

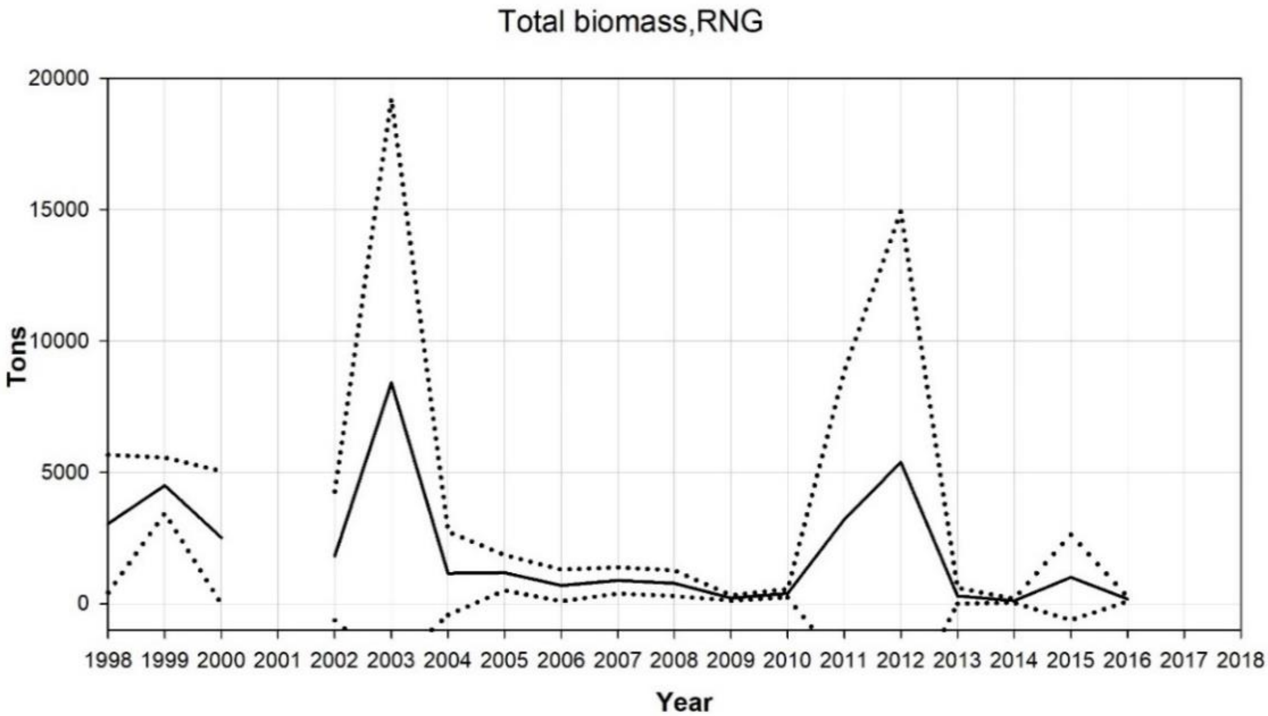


Fig. 5. Total biomass of roundnose grenadier (solid line) plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

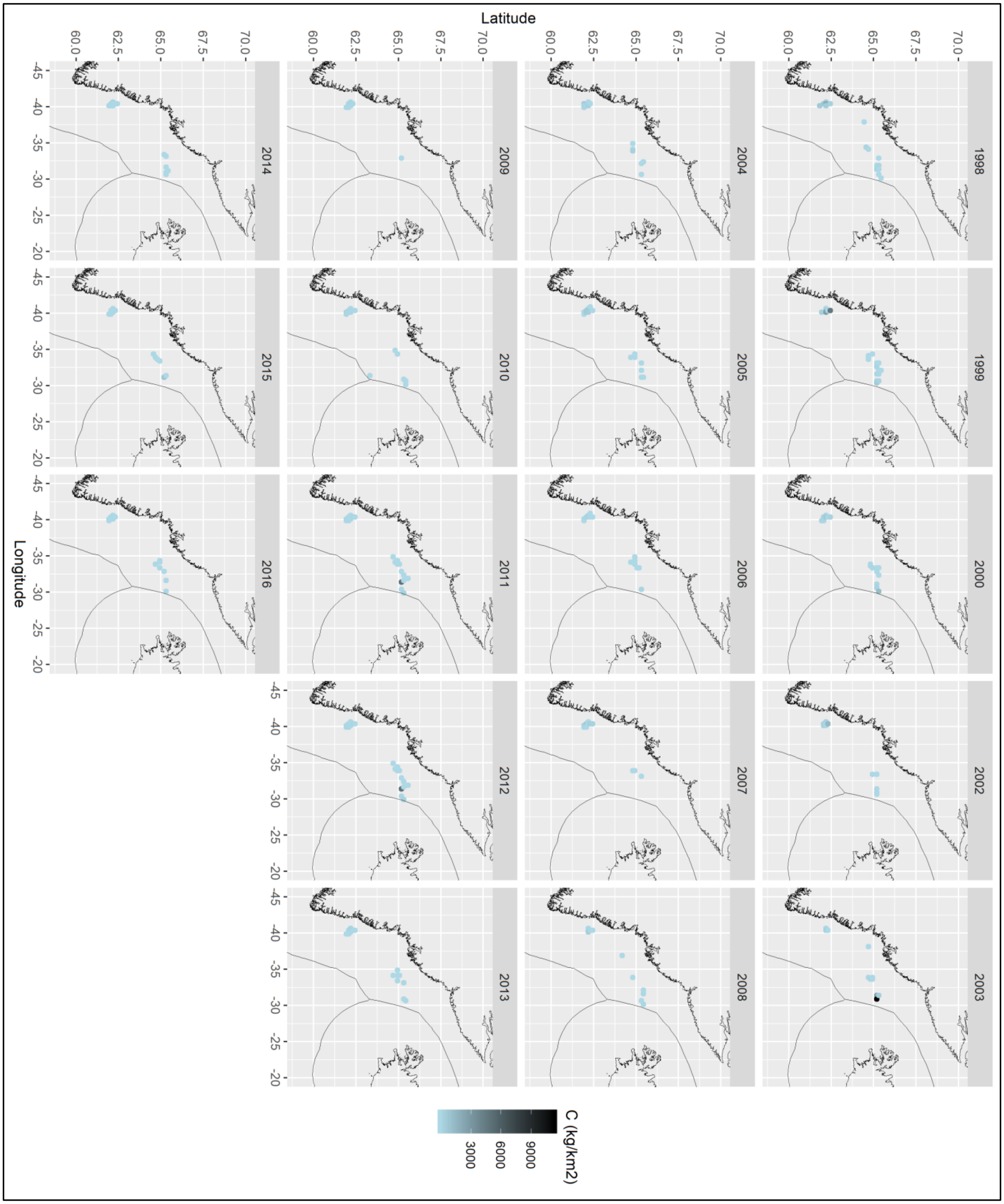


Figure 6. Distribution of survey catches of roundnose grenadier at East Greenland (ICES 14B) in 1998-2016. No survey in 2001, 2017, and 2018.

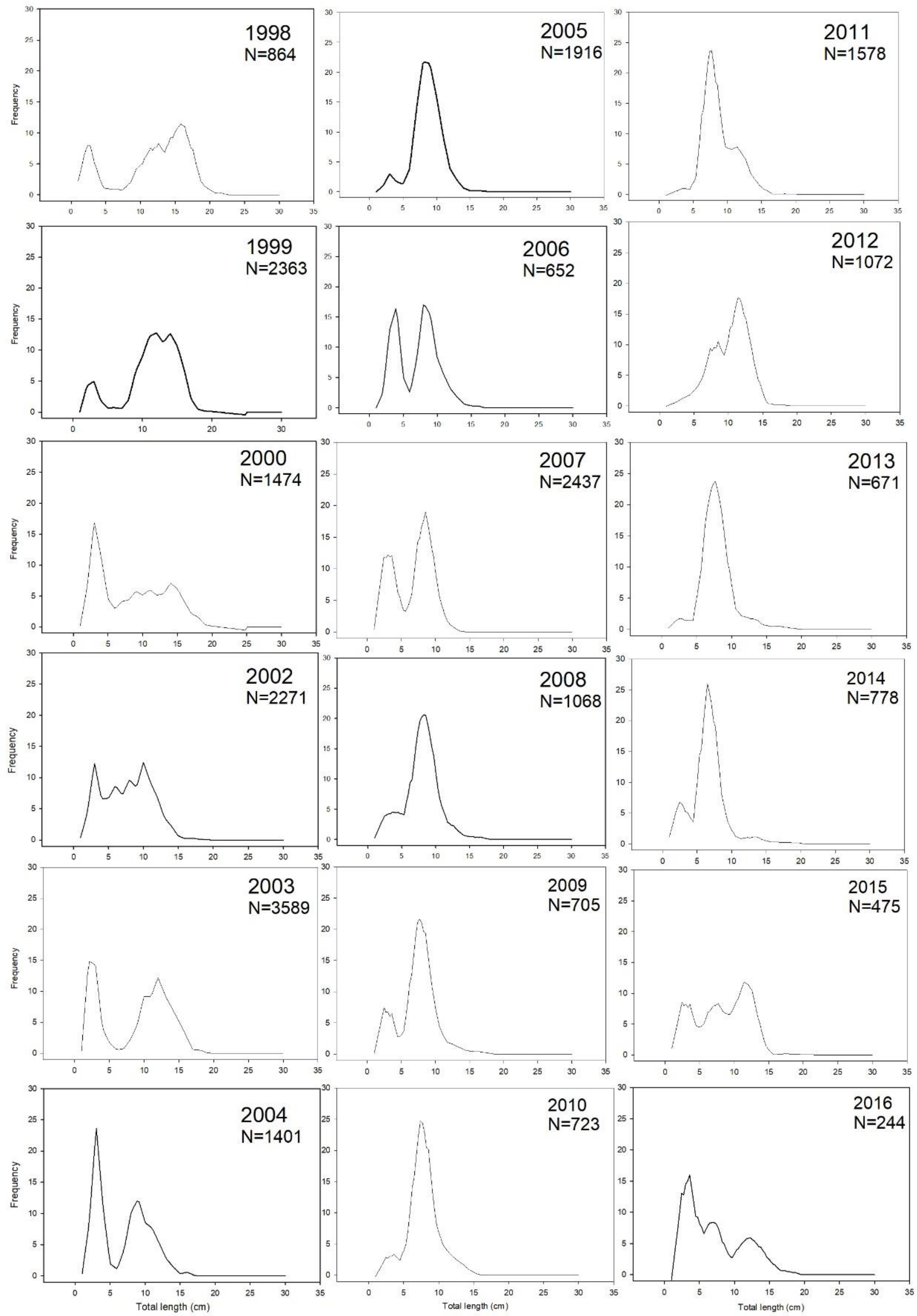


Fig. 7. Length frequency distribution of roundnose grenadier for years 1998-2016. No survey in 2001, 2017 and 2018.

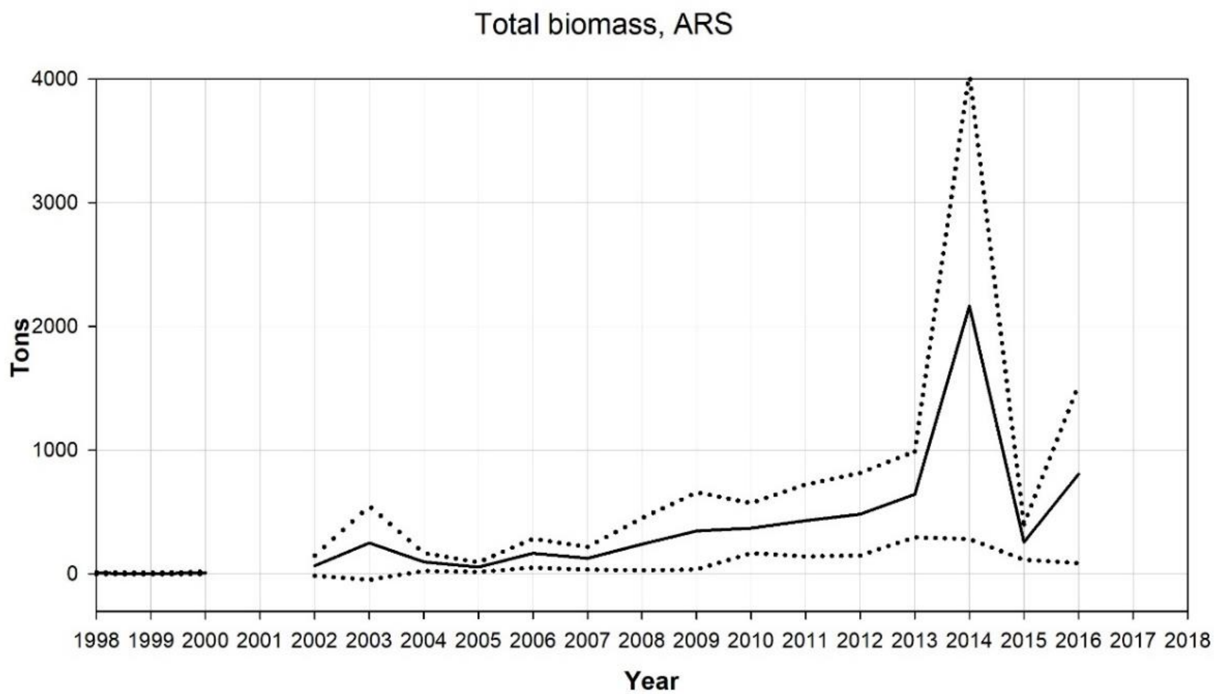


Fig. 8. Total biomass (solid line) of greater silver smelt plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

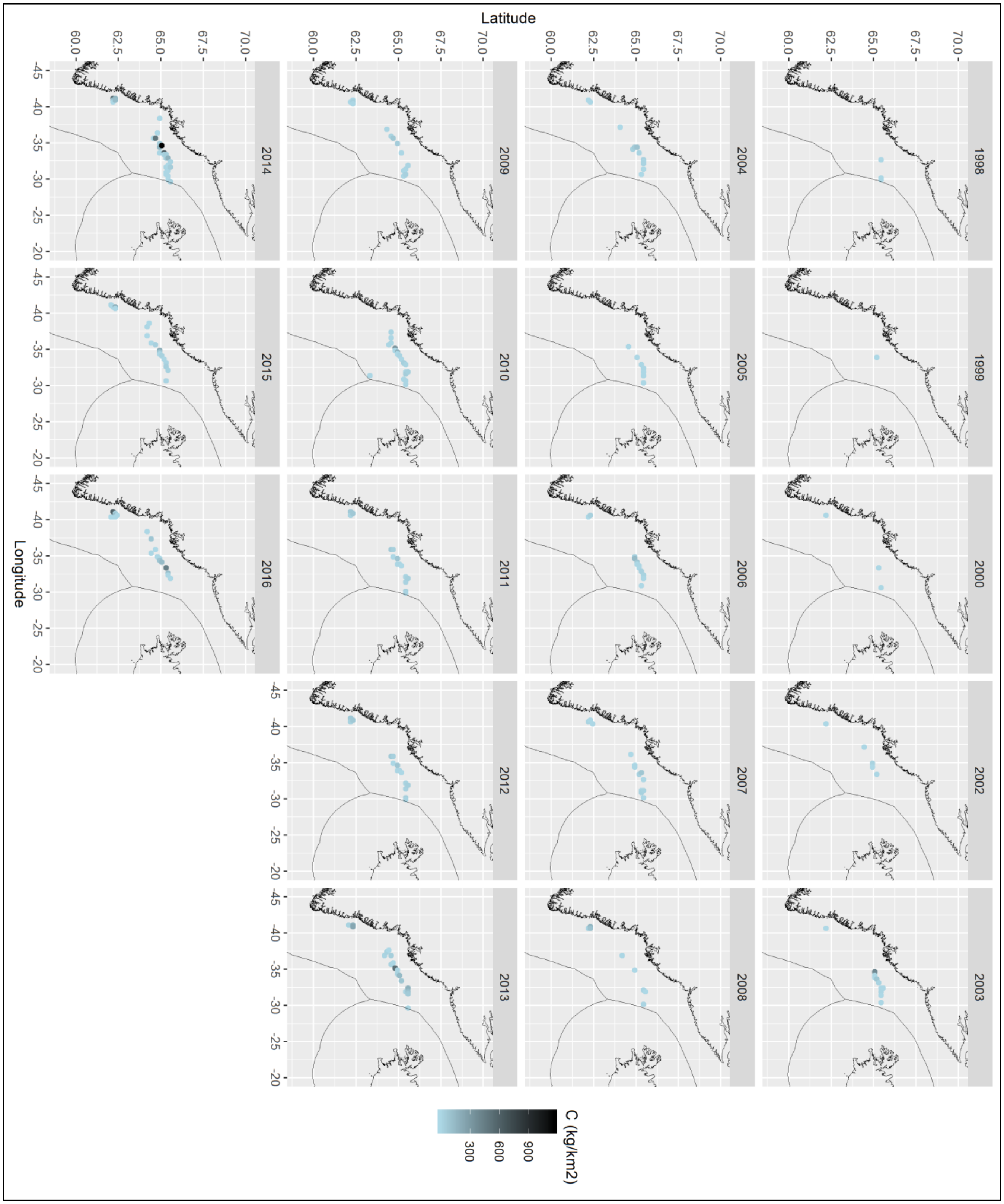


Fig. 9. Distribution of survey catches of greater silver smelt at East Greenland (ICES 14b) in 1998-2016. No survey in 2001, 2017, and 2018.

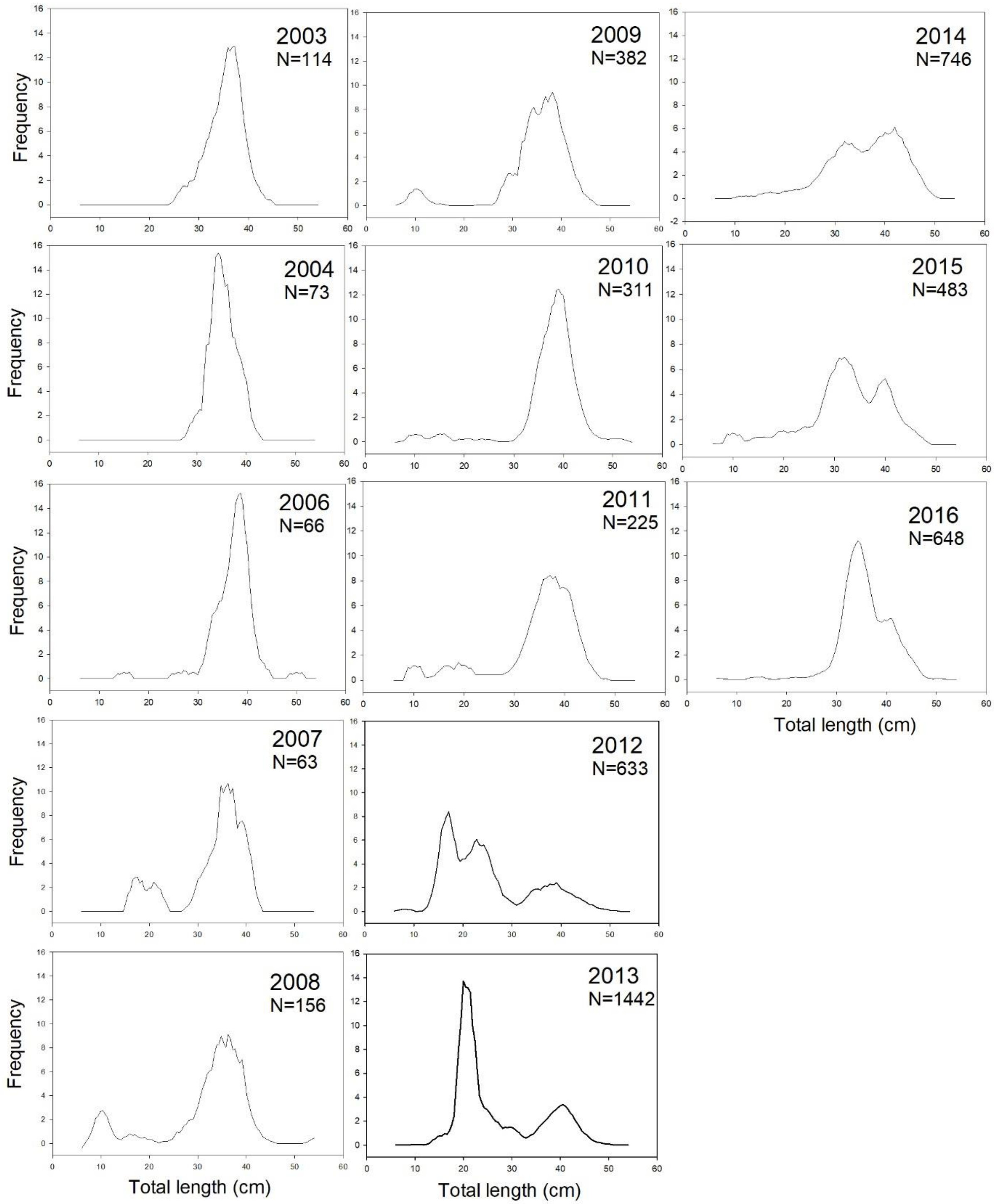


Fig. 10. Length frequency distribution of greater silver smelt by year 1998-2016. Years with N<20 are not shown. No survey in 2001, 2017 and 2018.

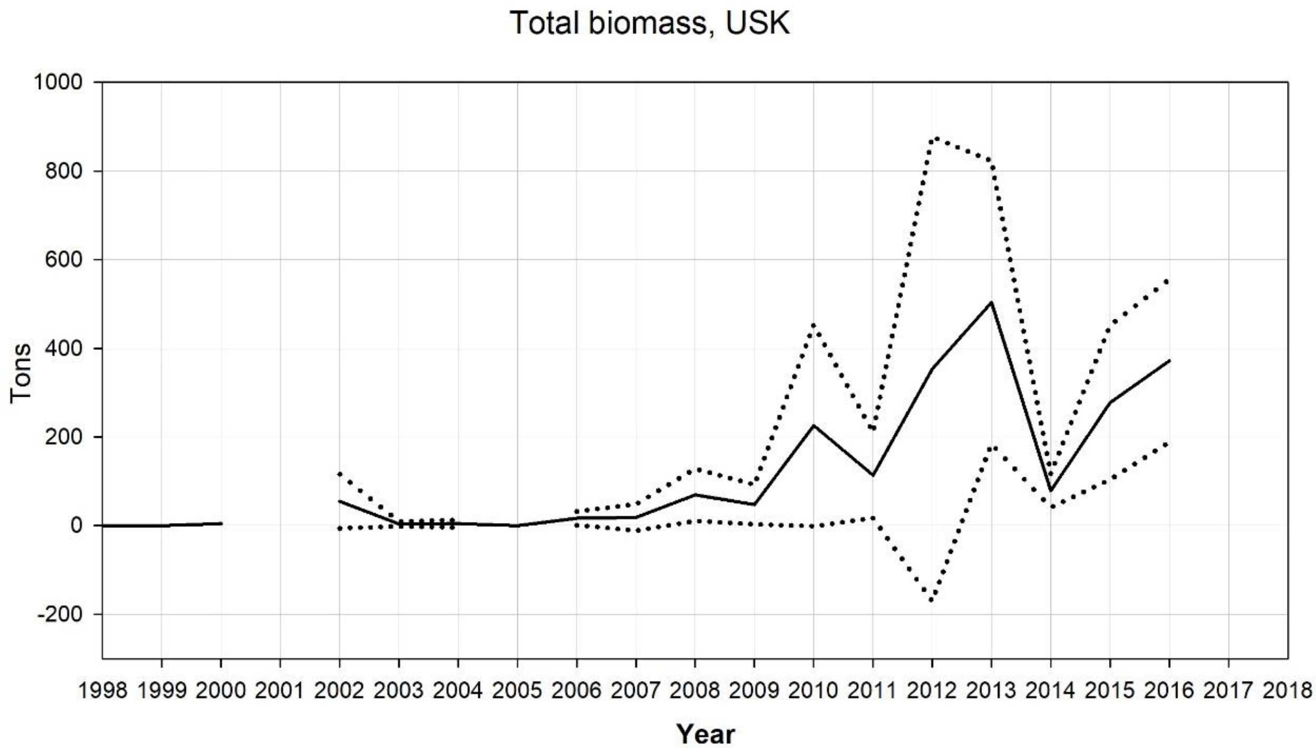


Fig. 11. Total biomass of tusk (solid line) plotted with +/-2*SE. No survey in 2001, 2017 and 2018.

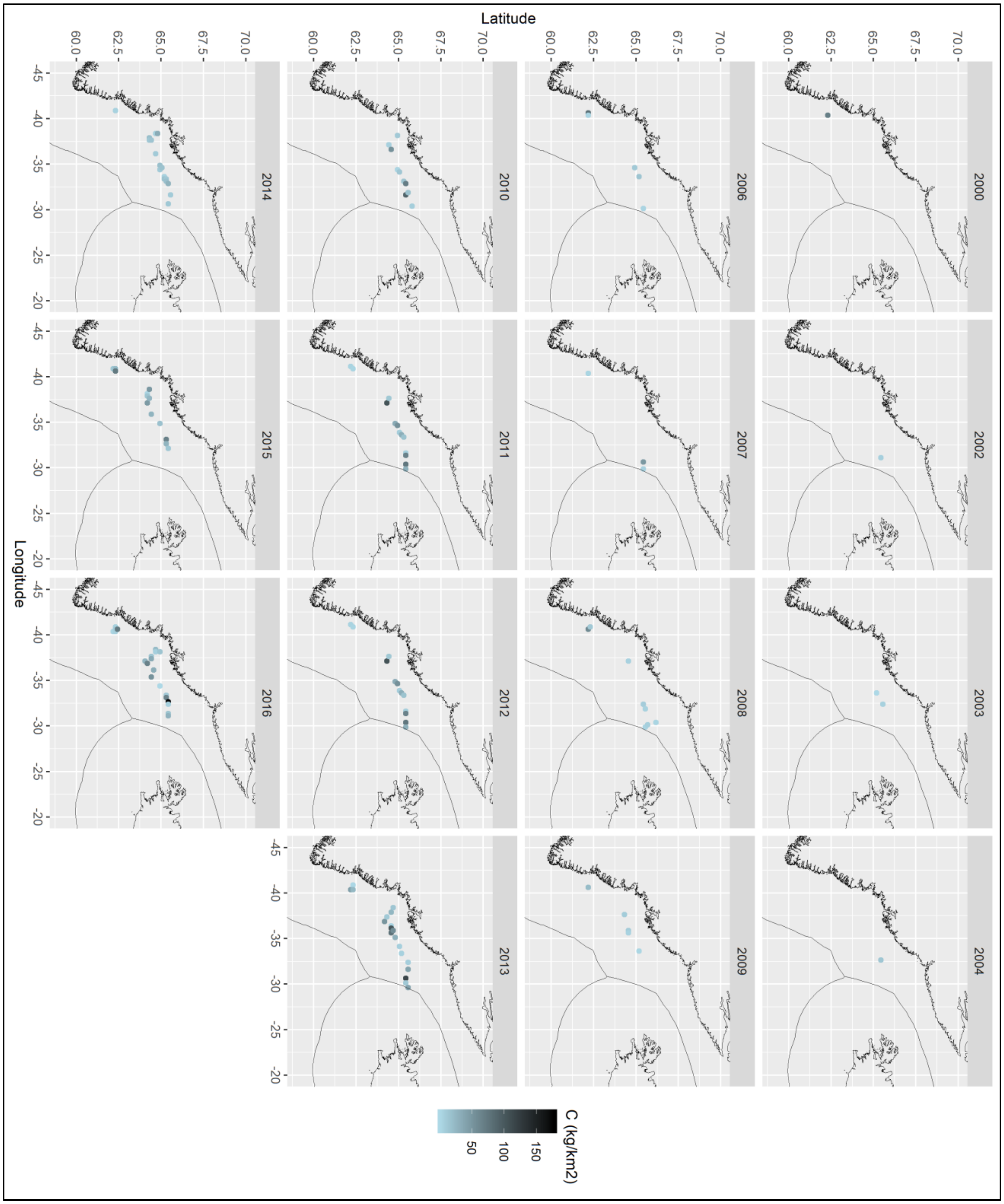


Fig. 12. Distribution of survey catches of tusk at East Greenland (ICES 14b) in 1998-2016. No survey in 2001, 2017, and 2018.

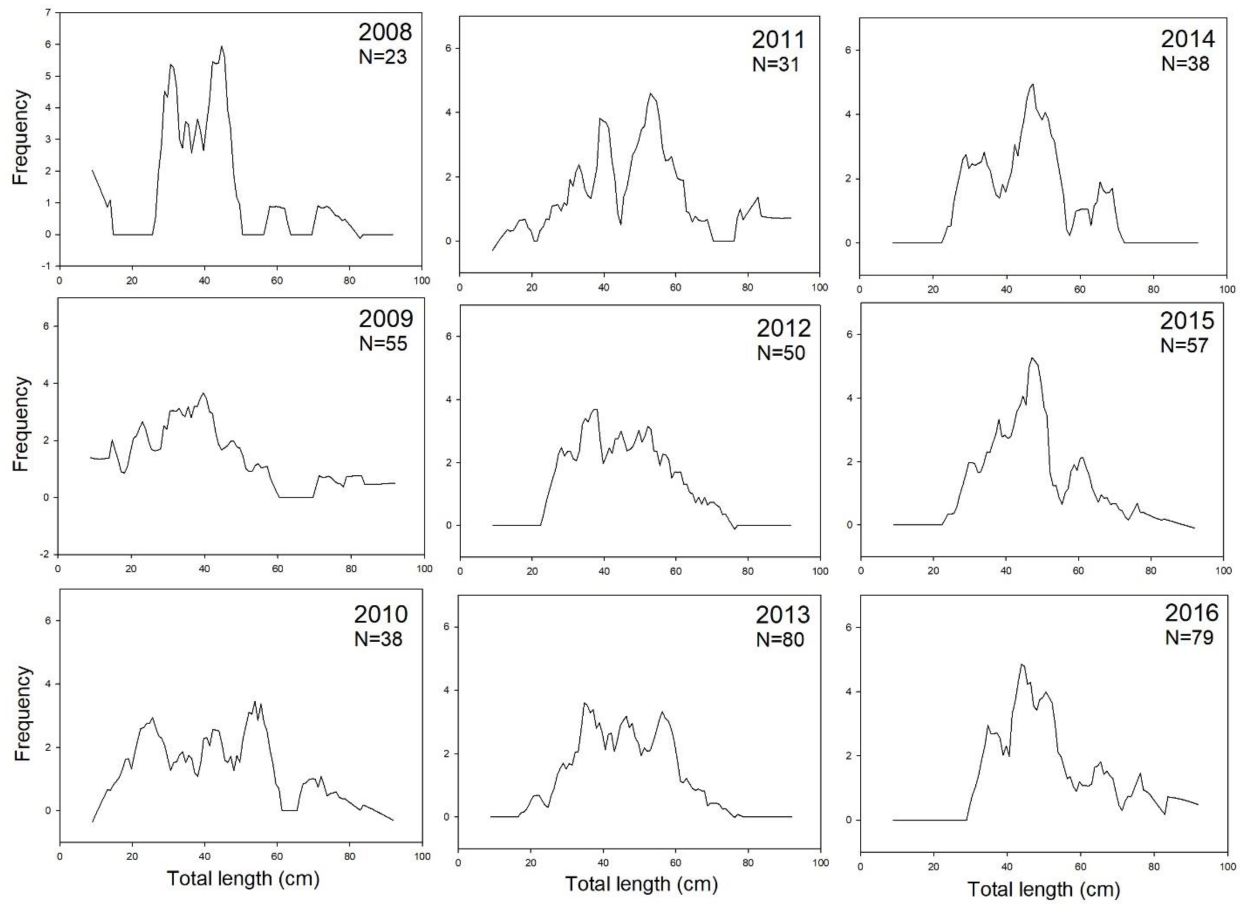


Fig. 13. Length frequency distribution of tusk by year 1998-2016. Years with N<20 are not shown. No survey in 2001, 2017 and 2018.

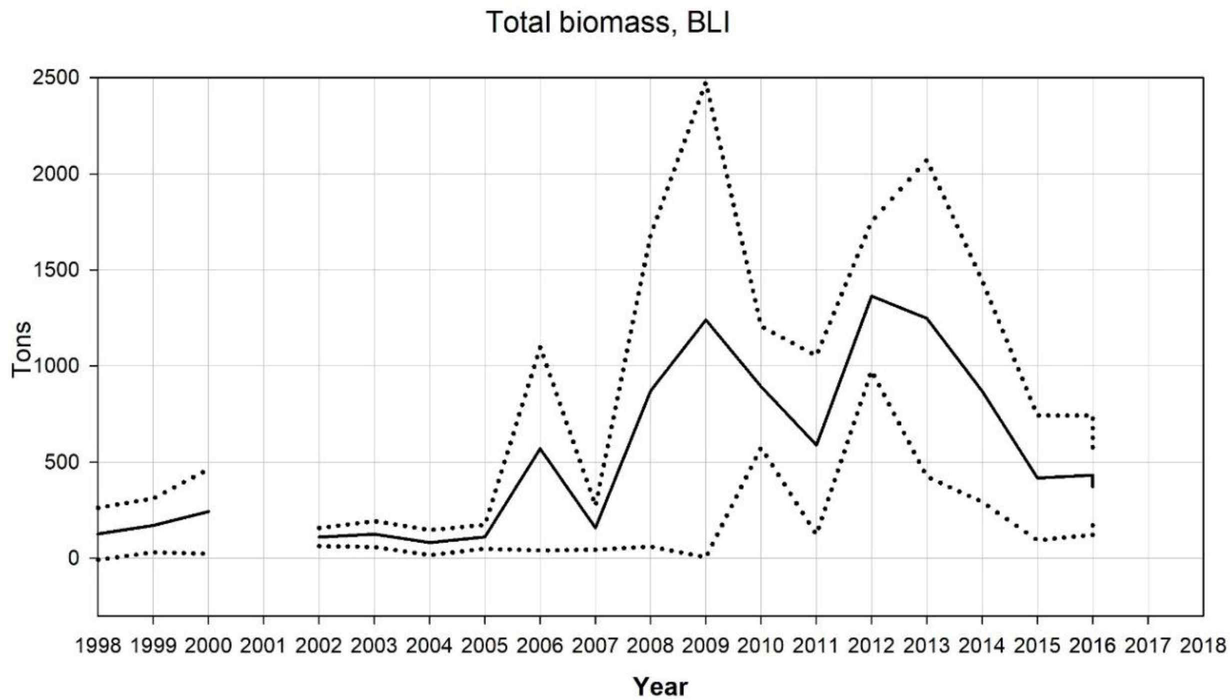


Fig. 14. Total biomass of blue ling (solid line) plotted with +/-2*SE. No survey in 2001, 2017 and 2018.

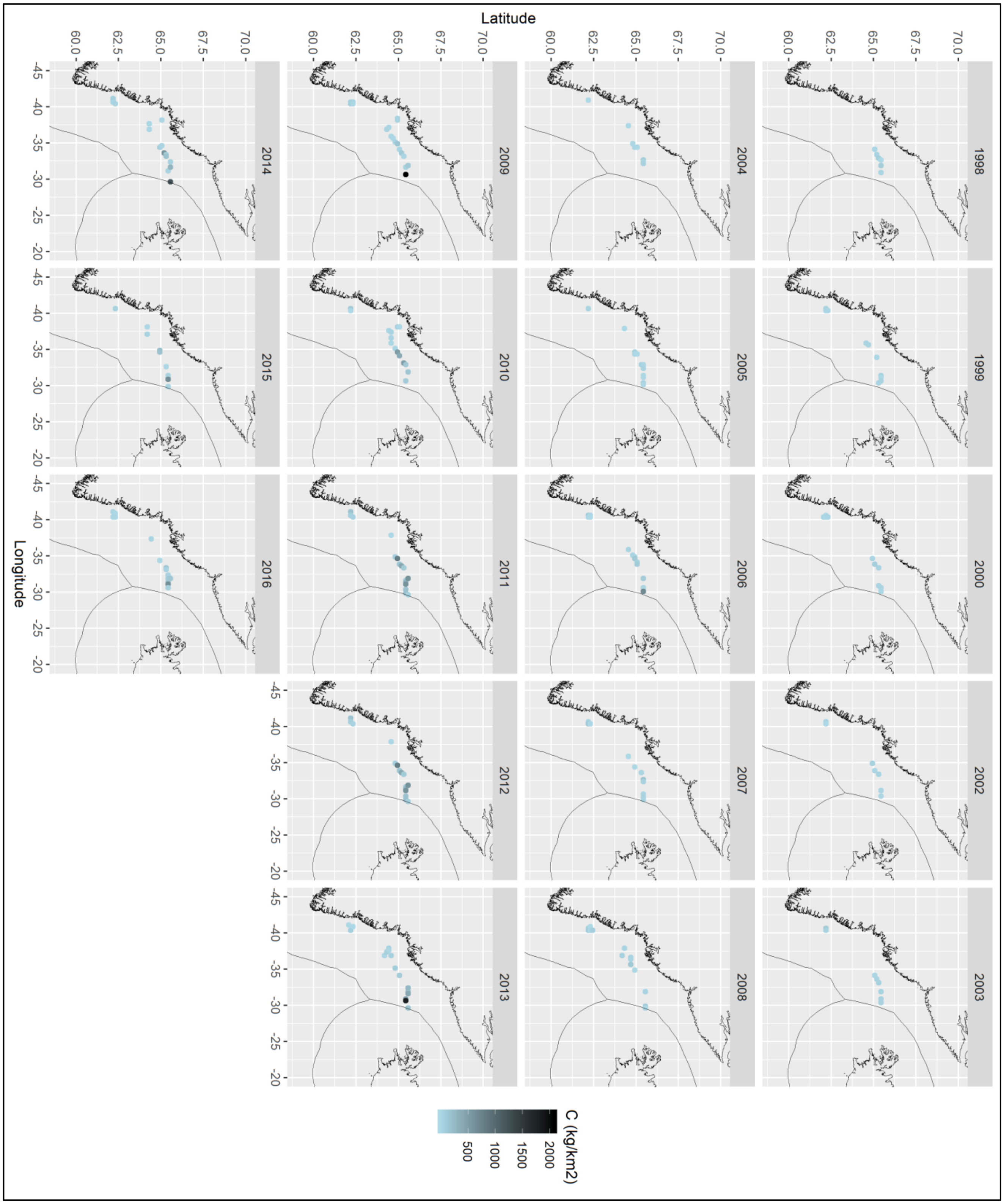


Fig. 15. Distribution of survey catches of blue ling at East Greenland (ICES 14b) in 1998-2016. No survey in 2001, 2017, and 2018.

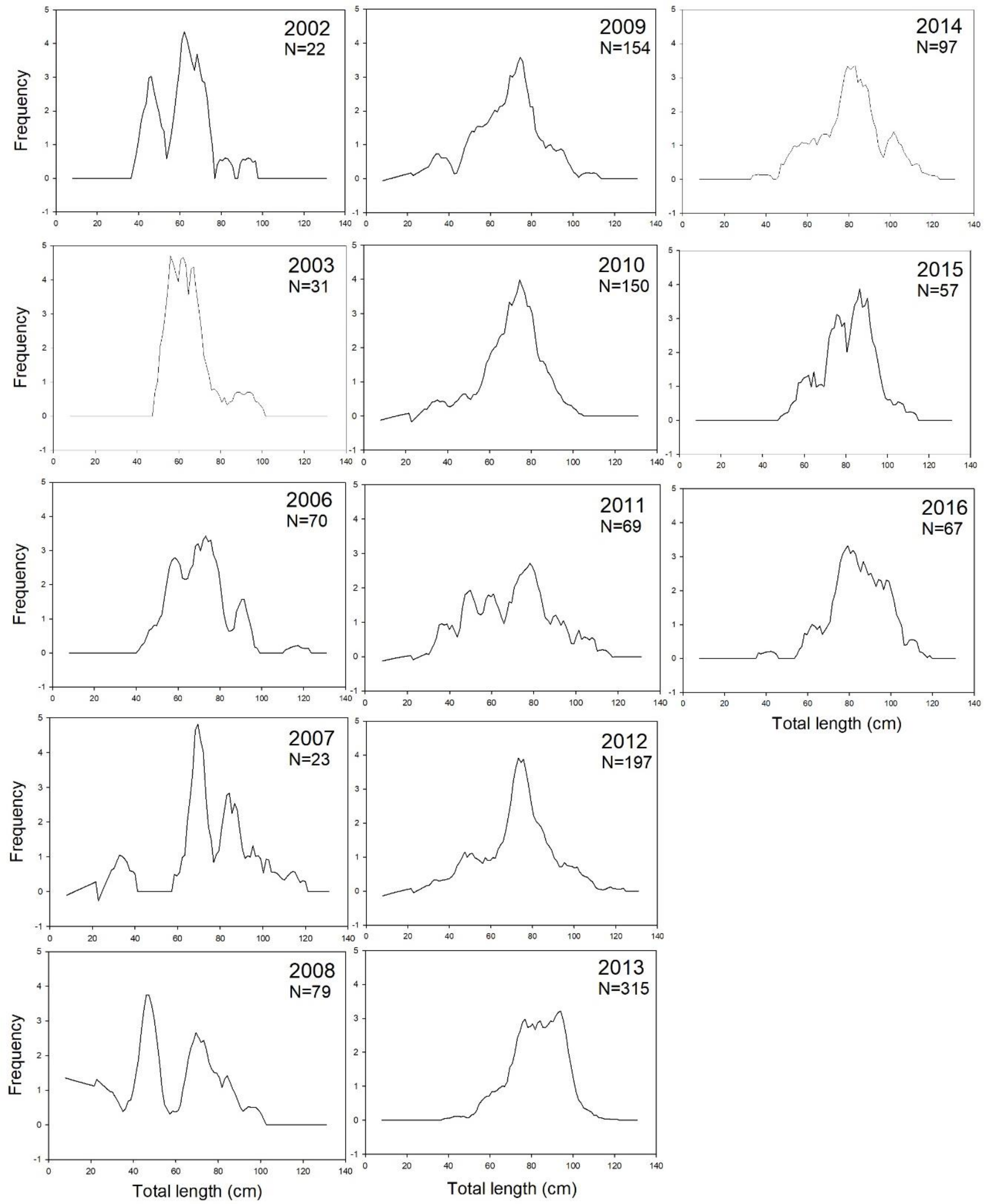


Fig. 16. Length frequency distribution of blue ling by year 1998-2016. Years with N<20 are not shown. No survey in 2001, 2017 and 2018.

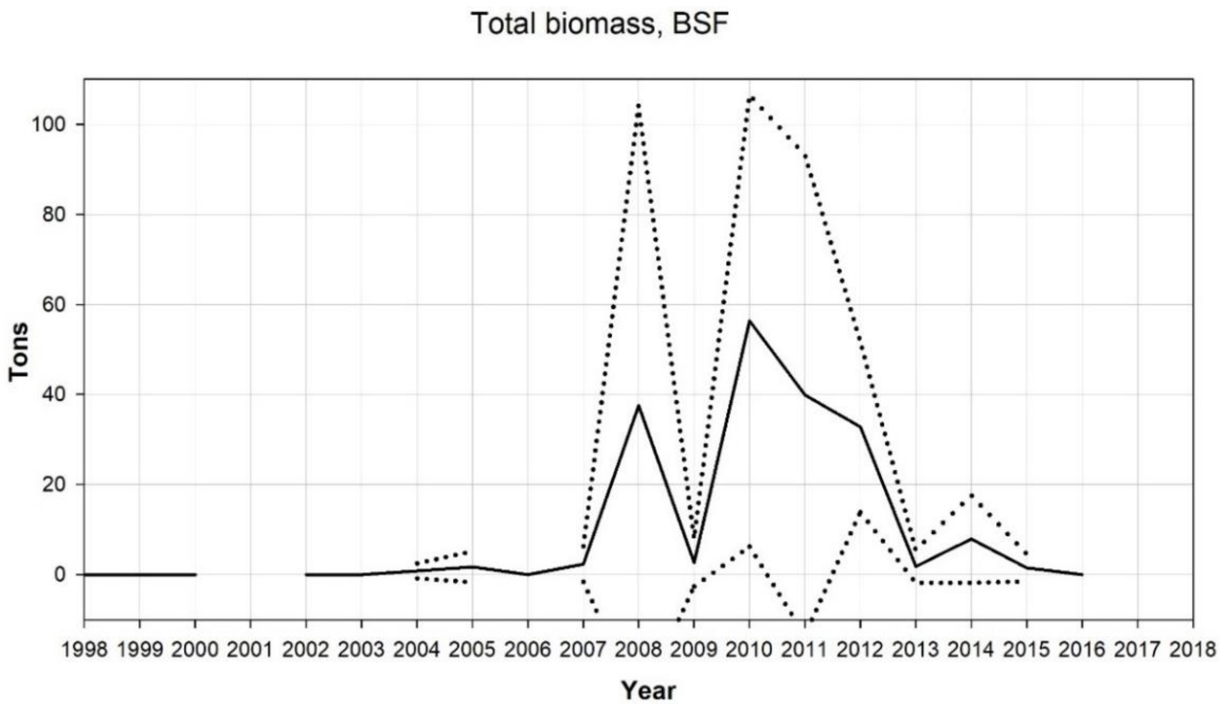


Fig. 17. Total biomass (solid line) of black scabbard fish plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

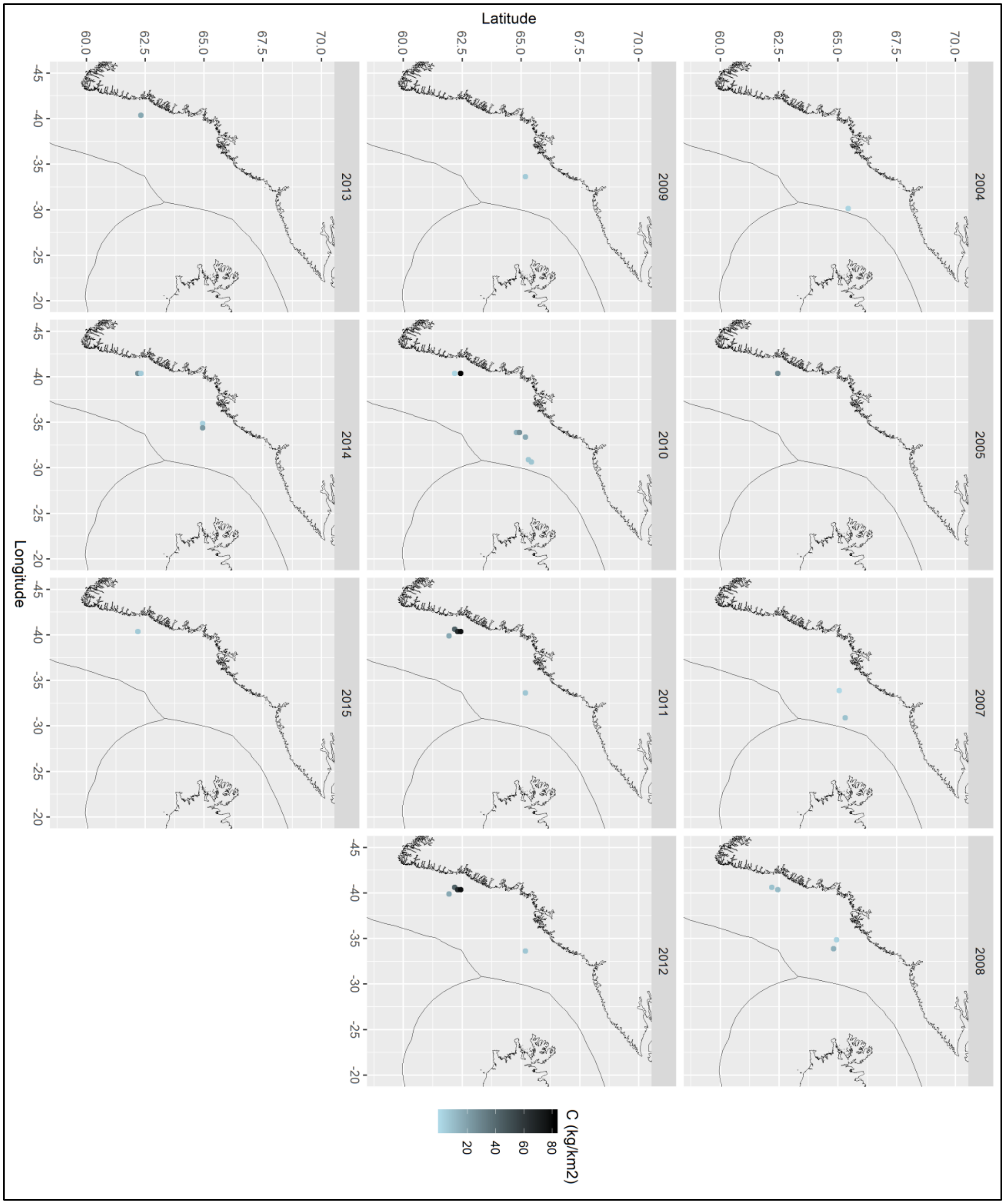


Fig. 18. Distribution of survey catches of black scabbard fish at East Greenland (ICES 14b) in 1998-2016. No survey in 2001, 2017, and 2018.

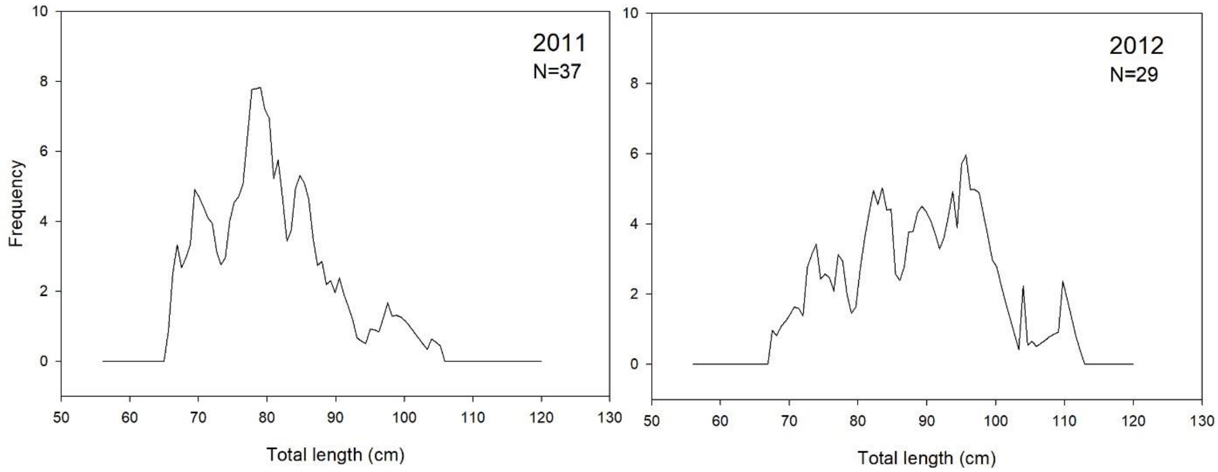


Fig. 19. Length (ICES 14b) distribution of black scabbard fish by year 1998-2016. Years with N<20 are not shown. No survey in 2001, 2017 and 2018.

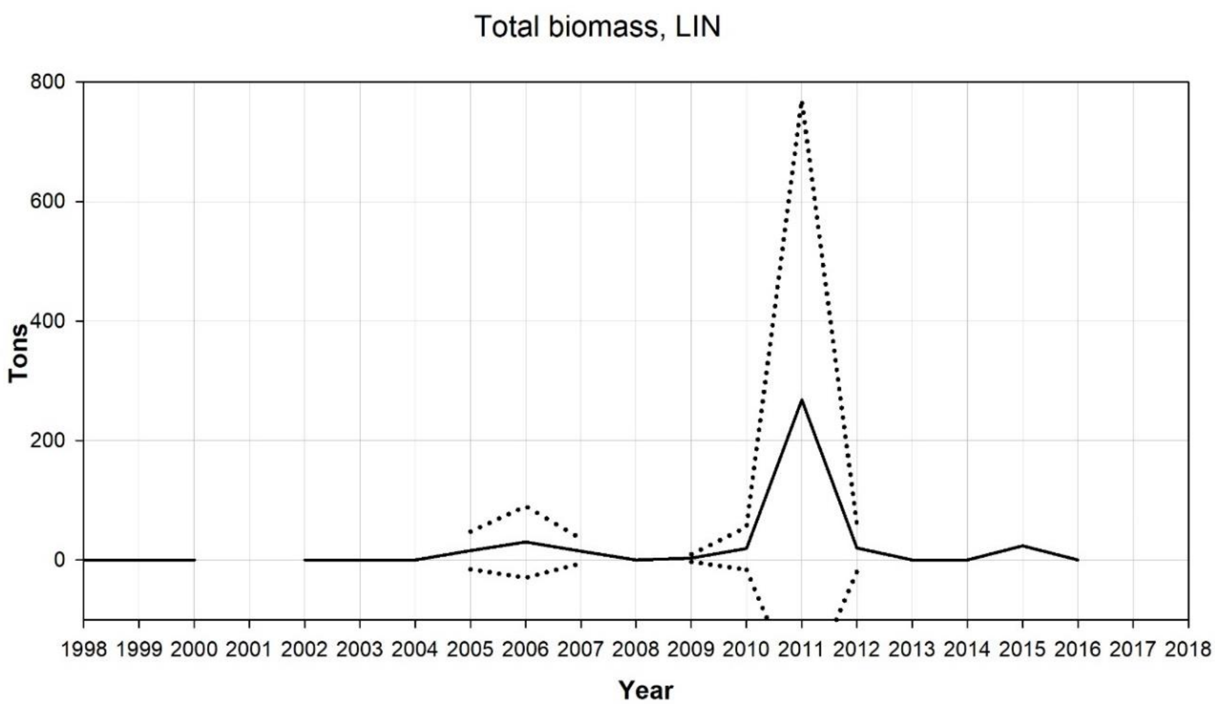


Fig. 20. Total biomass of ling (solid line) plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

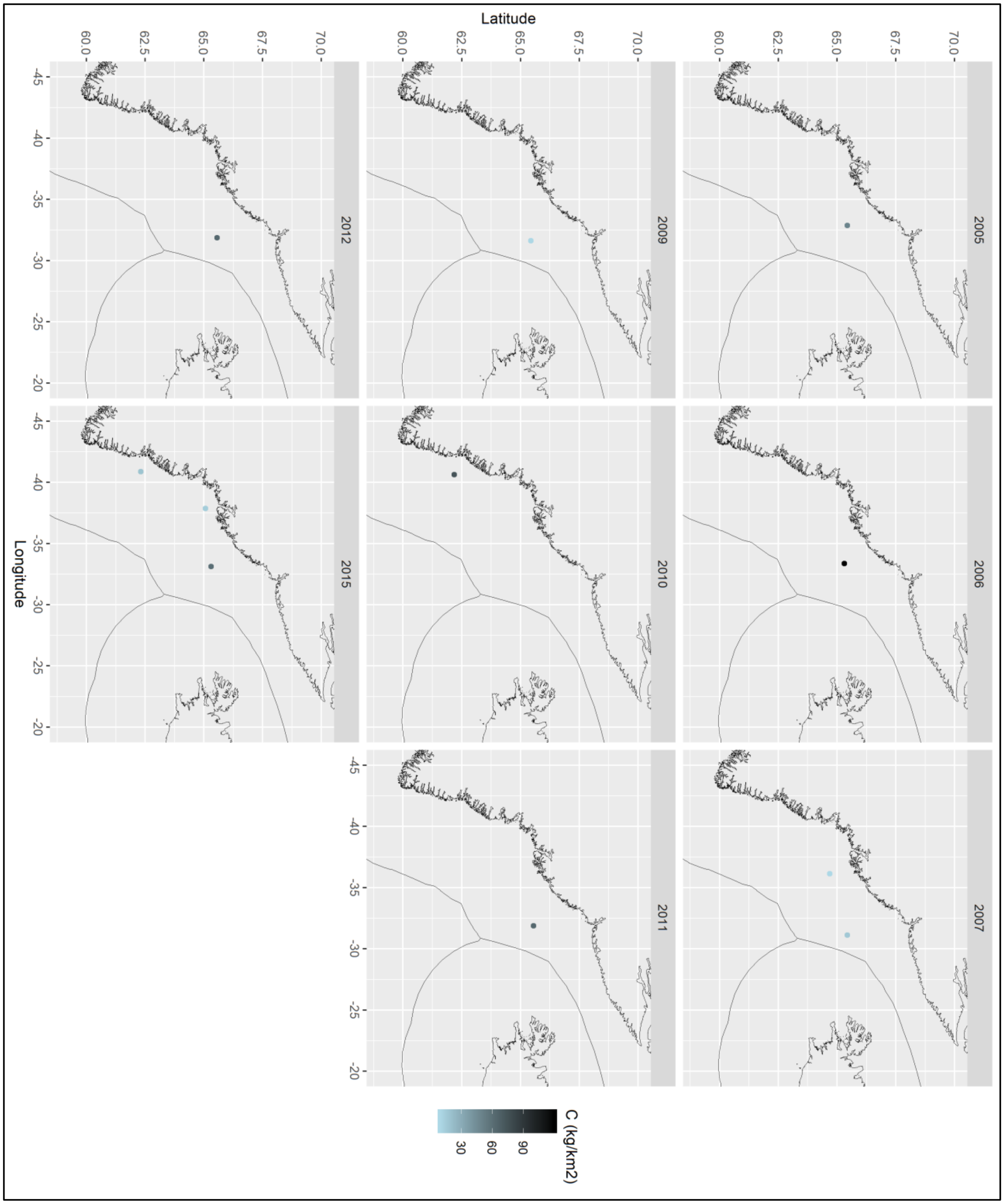


Fig. 21. Distribution of survey catches of ling at East Greenland (ICES 14b) in 1998-2016. No survey in 2001, 2017, and 2018.

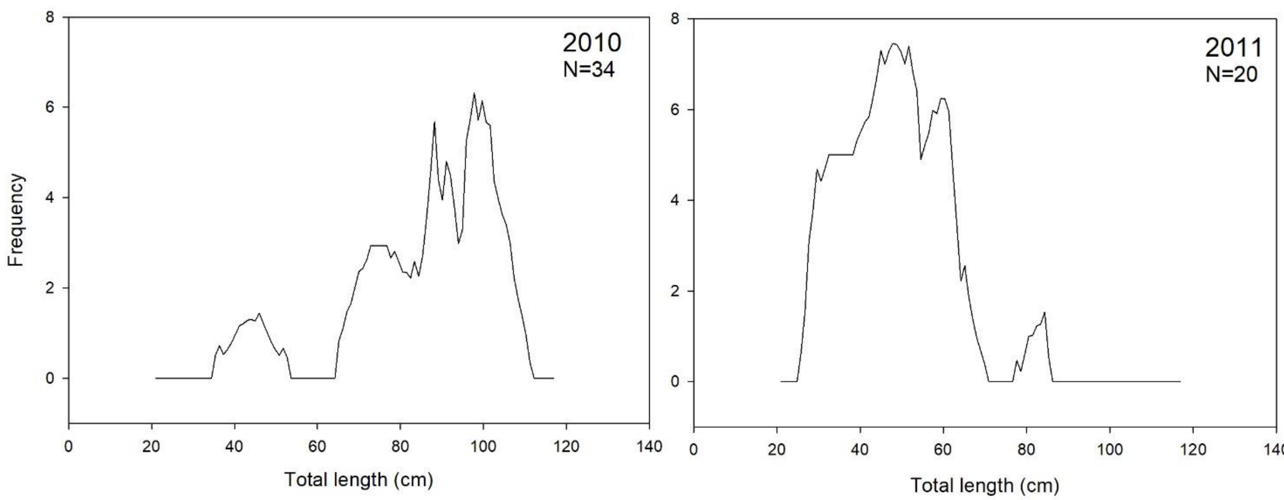


Fig. 22. Length frequency distribution of ling by year 1998-2016. Years with N<20 are not shown. No survey in 2001, 2017 and 2018.

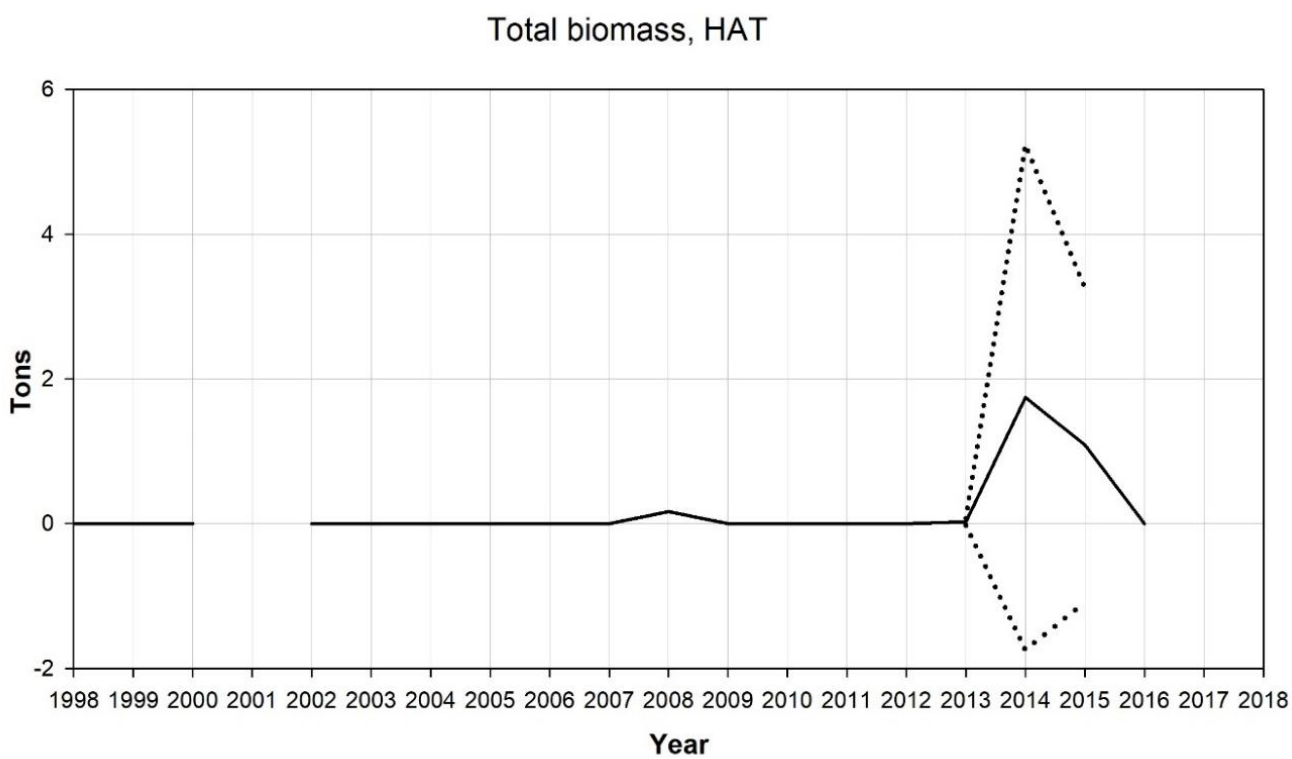


Fig. 23. Total biomass of orange roughy (solid line) plotted with +/- 2*SE. No survey in 2001, 2017 and 2018.

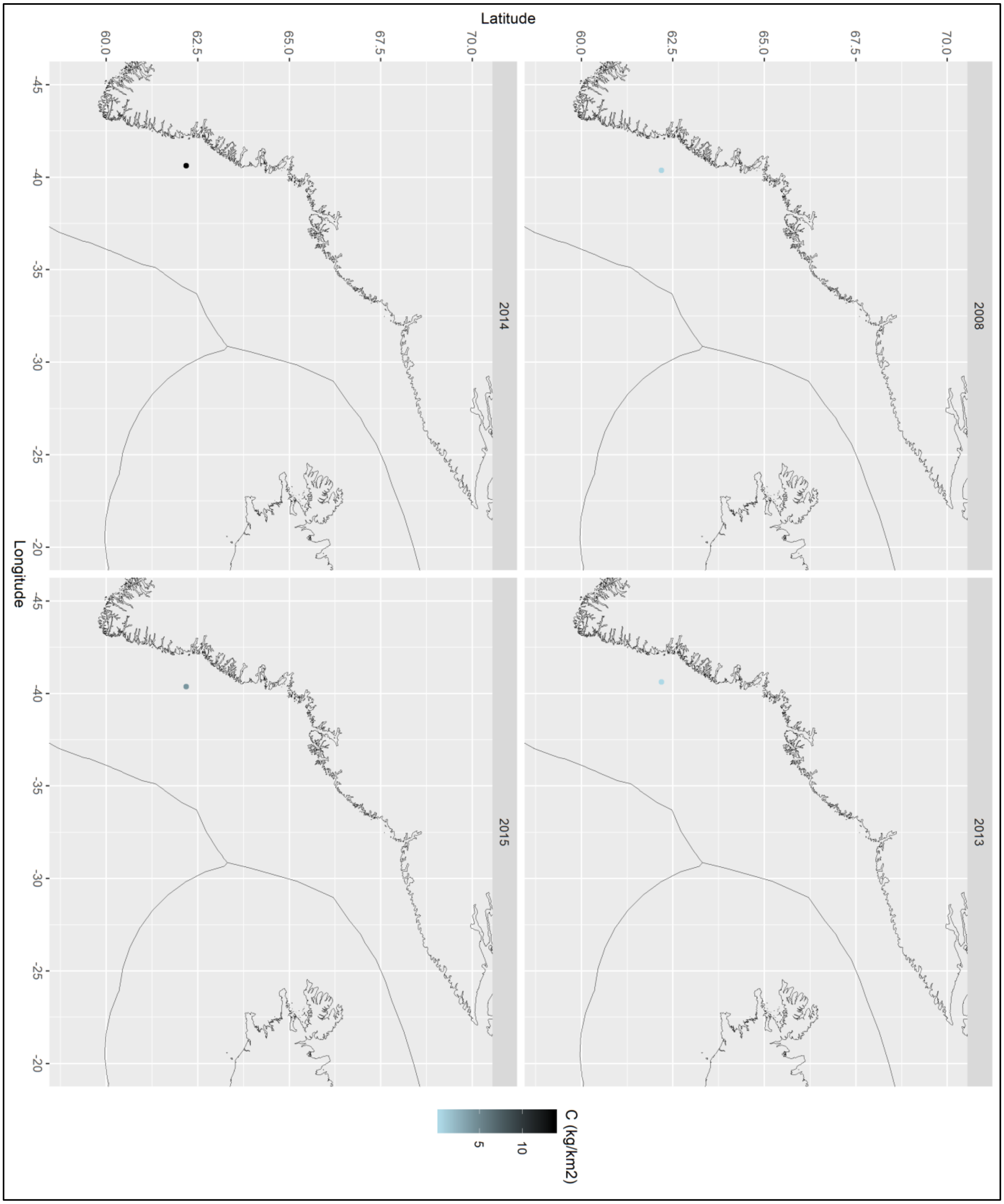


Fig. 24. Distribution of survey catches of orange roughy at East Greenland in 1998-2016. No survey in 2001, 2017, and 2018.

Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES subdivision 14.b.2 in the period 1999-2018

By

Julius Nielsen, Adriana Noguerira and Helle Torp Christensen

Greenland Institute of Natural Resources

3900 Nuuk, Greenland

Introduction

This document present logbook data from the commercial trawl and long line fishery in ICES 14b in the time period 1999 to 2018. The species presented here are roundnose grenadier (*Coryphaenoides rupestris*), roughhead grenadier (*Macrourus berglax*), greater silver smelt (*Argentina silus*), blue ling (*Molva dypterygia*), tusk (*Brosme brosme*), black scabbard fish (*Aphanopus carbo*) and ling (*Molva molva*). No information was available for orange roughy (*Hoplostethus atlanticus*).

Of the evaluated species, quotas have been set on grenadiers (roughhead grenadier and roundnose grenadier combined), tusk, blue ling and greater silver smelt. For grenadiers, TAC in 2007 was 3000 t, in 2008-2009 it was 2000 t and from 2010-2018 TAC has been 1000 t. For greater silver smelt, TAC in 2013-2015 was 10.000 t whereafter no qoutas has been set. For tusk, TAC in 2014 was 500 t and from 2015-2018 TAC was 1500 t. In 2014, TAC for blue ling was 500 t. No scientific advice has been made for any of these species and the TAC is set by the Government of Greenland.

Materials and methods

Since 2008, logbooks have been mandatory for vessels greater than 30'ft (9.4 m). Data on all landings are reported to the Greenland Fishery License Authority (GFLK). Trawlers and longliners gather information on their fishery haul by haul, including effort and location for individual fishing events and send the data to GFLK on a weekly basis. The data presented here is a mix of targeted catches and bycatch during fishery for Greenland halibut (*Reinhardtius hippoglossoides*).

Results and discussion

Roundnose grenadier (*Coryphaenoides rupestris*, RNG)

Catches of roundnose grenadier have been relatively stable (annual mean catch=88.2 tons) throughout the evaluated time period (1999 to 2018) ranging from 30.9 tons (2008) to 140.8 tons (2015) (**Table 1, Fig. 1, Fig. 2).** The vast majority of this catch is by trawlers (**Fig. 1**) and is taken from April to August (**Table 2**).

The high catches of roundnose grenadier compared to roughhead grenadier (see below) is surprising, as it is roughhead grenadier which has the highest biomass all years of the scientific survey (see Nielsen et al. 2019). This suggests that possibly there is some degree of misidentification of species, confounding the logbook data of roundnose grenadier and roughhead grenadier. Regardless of this, the TAC of 1.000 tons for grenadiers in East Greenland (roughhead and roundnose grenadier combined) is not reached any years.

Roughhead grenadier (*Macrourus berglax*, RHG).

There are no catches of roughhead grenadier between 1999 and 2004. From 2005 to 2013 the average catch was 7.9 t, whereas it increased to an average of 71.4 t between 2014 and 2018 (**Table 1, Fig. 3, Fig. 4**). Before 2014, the catch is dominated by trawlers, but from 2014 and onwards catches are strongly dominated by longliners from February to April (**Fig. 3, Table 3**). As presented for roundnose grenadier, the catch of roughhead grenadier is possibly underestimated due to incorrect species identification. From 2014 until 2018 reported catches of roughhead grenadier on long lines are much higher (**Fig. 3**), which could be linked to the onset of targeted long line fishery after tusk in 2014 (**Fig. 9**).

Greater silver smelt (*Argentina silus*, ARS).

There are no reported catches of greater silver smelt from 1999 to 2013 (**Table 1**). In 2014 to 2016, trawl catches ranged from 4.2 t to 16.1 t (increasing each year) and in 2017 and 2018 catches were 666.1 t and 425 t, respectively (**Fig. 5, Fig. 6**). This increase, is due to the onset of targeted pelagic trawl fishery for the species in 2015 mainly in from April to May (**Fig. 5, Table 4**). In years where no catches are reported, this is most likely due to improper reporting of bycatch species in the Greenland halibut fishery.

Blue ling (M*olva dypterygia*, BLI).

Catches of blue ling are relatively low and constant between 1999 to 2018 (annual mean catch =10.8 t, **Table 1, Fig. 7+8**). Blue ling is mostly caught in trawl fisheries (**Fig. 7**) both during spring and autumn (**Table 5**). The composition between line and trawl catches remains relatively constant except in 2015, where the largest trawl catch of 65.5 t is reported (**Fig. 7**).

Tusk (*Brosme brosme*, USK).

Catches of tusk have been low between 1999 to 2014, and were much lower (mean annual catch=31.5 t) compared to from 2015 to 2018 (mean annual catch =624.5 t) (**Table 1, Fig. 9, Fig. 10**). The catch is dominated by long lines throughout the time series (**Fig. 5**). The increase in catches since 2015 is caught throughout the year (**Table 6**) and corresponds with the initiation of the targeted fishery for tusk in 2014 where TAC was 500 t. In 2015 until 2018, TAC was increased by the Greenland government to 1500 t.

Black scabbard fish (*Aphanopus carbo*, BSF).

Catches of black scabbard fish have been zero all years except 2010 and 2011 where 100 and 300 kg were reported from trawl bycatch (**Table 1, Fig. 11+12**). All catches are in September (**Table 7**).

Ling (*Molva molva*, LIN).

Catches of ling are fluctuating between years with no apparent trend over time. In 2005, 2006, 2008 and 2015 catches were above 15 t, whereas catches were below 5 t in 2000-2003, 2007, 2009-2010, 2013 and 2017-2018 (**Table 1, Fig. 13, Fig. 14**). The majority of catches are from long lines and were caught throughout the year (**Table 8, Fig. 13**).

References

Nielsen, J, Nogueira A, Christensen HT (2019). Survey results of roughhead grenadier, roundnose grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling, and orange roughy in ICES division 14b in the period 1998-2016. WD05. WGDEEP 2019.

Figures and tables

Table 1. Catches (t) of roundnose grenadier (RNG), roughhead grenadier (RHG), greater silver smelt (ARS), blue ling (BLI), tusk (USK), black scabbard fish (BSF) and ling (LIN) from 1999 to 2018.

Year	RNG	RHG	ARS	BLI	USK	BSF	LIN
1999	138.1	0.0	0.0	0.2	7.2	0.0	8.2
2000	95.5	0.0	0.0	1.5	0.0	0.0	0.0
2001	74.7	0.0	0.0	0.6	23.6	0.0	0.7
2002	55.5	0.0	0.5	0.2	0.0	0.0	0.3
2003	54.5	0.0	0.0	2.7	2.2	0.0	0.2
2004	107.2	0.0	0.0	7.3	17.5	0.0	9.2
2005	61.9	20.0	0.0	5.7	40.2	0.0	18.4
2006	78.6	4.4	0.0	5.9	102.4	0.0	18.6
2007	43.4	4.1	0.0	1.3	20.0	0.0	1.5
2008	30.9	11.7	0.0	5.2	33.7	0.0	18.8
2009	44.6	3.6	0.0	5.4	16.4	0.0	4.7
2010	61.1	11.6	0.0	8.4	15.1	0.1	3.4
2011	138.0	2.2	0.0	8.3	91.1	0.3	5.0
2012	126.0	13.5	0.0	13.2	74.6	0.0	5.1
2013	128.9	0.3	0.0	15.9	28.2	0.0	2.4
2014	99.8	62.1	4.2	13.9	168.3	0.0	8.0
2015	140.8	38.2	12.2	65.5	887.8	0.0	21.3
2016	64.4	74.8	16.1	8.6	610.1	0.0	15.3
2017	92.9	92.8	666.6	12.0	768.3	0.0	4.5
2018	126.8	89.1	425.1	33.6	688.0	0.0	4.6

Table 2. Monthly catches (t) of roundnose grenadier between 1999 and 2018.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1999	12.5	23.7	20.4	23.8	0.9	5.2	5.1	8.8	9.5	14.8	11.5	1.9
2000	0.2	21.3	13.4	9.5	5.7	11.9	8.1	10.8	8.5	1.0	3.8	1.4
2001	0.0	0.0	1.8	0.7	2.7	17.8	27.3	13.9	3.4	2.4	2.4	2.4
2002	0.0	0.0	2.0	5.7	3.6	16.4	18.7	4.8	0.9	0.3	2.1	0.8
2003	0.0	0.0	1.0	3.2	11.2	10.7	9.8	7.5	4.3	4.8	1.6	0.3
2004	0.0	0.0	0.1	8.2	6.5	19.6	33.0	21.1	7.9	4.8	3.5	2.6
2005	0.0	0.0	0.0	1.4	2.7	16.5	27.1	10.2	2.9	1.0	0.0	0.1
2006	0.0	0.0	0.1	16.3	15.2	8.5	6.6	26.1	2.9	0.2	2.4	0.4
2007	0.0	0.1	0.3	3.7	13.0	9.1	8.2	4.8	1.6	1.3	1.0	0.5
2008	1.5	0.0	0.2	5.5	6.4	6.6	3.4	3.8	1.4	1.8	0.3	0.0
2009	0.0	0.0	0.9	3.4	9.4	8.4	9.6	4.9	3.6	1.9	2.0	0.4
2010	0.0	0.0	0.4	7.7	12.2	8.9	10.4	9.3	7.1	1.8	3.1	0.1
2011	0.0	0.0	2.6	7.3	18.2	43.1	36.7	16.3	5.8	3.8	2.9	1.2
2012	0.0	0.0	2.2	9.1	33.8	30.2	21.0	22.1	4.0	3.3	0.3	0.0
2013	0.0	0.0	2.9	15.5	27.6	38.3	21.4	12.7	1.2	6.0	2.8	0.3
2014	0.0	0.4	4.4	11.9	16.9	19.3	15.9	5.5	8.4	12.5	1.4	3.2
2015	3.0	0.5	21.2	42.8	18.4	4.6	13.1	12.4	13.6	3.2	1.6	6.2
2016	0.0	0.8	4.6	10.8	14.4	10.8	16.0	4.9	1.7	0.4	0.0	0.0
2017	0.0	0.5	11.4	18.1	17.1	8.2	19.8	7.8	3.5	5.2	0.6	0.6
2018	0.0	1.6	17.4	23.4	9.4	10.8	46.5	15.9	1.3	0.5	0.0	0.0

Table 3 Monthly catches (t) of roughhead grenadier between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0	4.0	10.1	0.1	5.8	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	1.4	1.8	0.2	1.1	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	1.8	1.6	0.6	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.4	2.0	1.6	2.8	2.7	1.5	0.8	0.0	0.0
2009	0.0	0.0	0.1	0.7	1.5	0.4	0.0	0.1	0.7	0.0	0.1	0.0
2010	0.0	0.0	0.0	0.0	2.2	1.0	4.2	1.2	0.1	2.8	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.4	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	8.6	4.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	21.4	28.3	1.4	7.2	0.2	0.0	0.0	0.0	3.6
2015	0.0	0.0	17.1	17.6	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
2016	0.0	26.1	30.9	13.4	0.0	2.5	1.5	0.4	0.0	0.0	0.0	0.0
2017	0.0	0.0	50.5	41.9	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
2018	0.0	0.0	50.5	37.1	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0

Table 4. Monthly catches (t) of greater silver smelt between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.5	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.5	0.0	10.1	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.9	0.4	0.0	0.0	14.8	0.0	0.0	0.0
2017	0.0	0.0	0.0	100.2	564.3	1.7	0.4	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	30.1	241.3	139.8	0.0	0.0	0.0	0.0	13.9	0.0	0.0

Table 5. Monthly catches (t) of blue ling between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.1	0.0	0.2	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.3	0.2	1.0	1.3	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.4	0.6	0.2	2.2	1.0	0.9	0.8	0.3	1.0
2005	0.0	0.0	0.0	1.0	0.2	1.3	2.0	0.4	0.8	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	1.4	3.7
2007	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.0	0.1	0.0	0.0
2008	3.2	0.0	0.0	0.0	0.2	0.1	0.0	0.8	0.1	0.8	0.0	0.0
2009	0.0	0.0	0.0	0.5	2.7	2.0	0.0	0.0	0.2	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.4	0.2	0.0	1.5	4.9	1.1	0.2	0.1
2011	0.0	0.0	0.1	0.0	0.3	2.4	0.3	1.0	1.2	1.9	1.1	0.1
2012	0.0	0.0	0.7	2.1	1.8	1.3	0.1	1.9	2.9	2.4	0.0	0.0
2013	0.0	0.0	1.1	1.1	1.3	0.4	0.1	2.1	0.1	7.0	2.8	0.0
2014	0.0	0.6	1.4	0.6	2.1	1.9	0.5	2.9	1.3	2.4	0.0	0.2
2015	0.0	1.5	1.9	0.5	0.7	0.4	0.7	0.1	26.0	32.9	0.0	0.7
2016	0.0	1.0	1.0	0.4	1.4	0.1	0.3	0.0	4.4	0.0	0.0	0.0
2017	0.0	0.4	3.3	2.2	0.1	0.7	2.2	0.6	1.2	1.3	0.0	0.0
2018	1.6	0.6	3.3	8.8	0.8	1.2	0.5	0.1	0.5	15.1	0.9	0.0

Table 6. Monthly catches (t) of tusk between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.1	0.2	0.0	4.7	1.4	0.8	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.5	10.9	1.6	0.6	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	2.2	1.3	4.1	3.1	5.6	1.1
2005	0.0	0.0	1.8	0.1	1.7	3.3	4.0	0.3	6.3	9.3	13.2	0.2
2006	0.0	0.0	2.4	2.5	4.1	0.8	0.5	6.7	1.1	1.7	3.1	79.3
2007	0.0	0.0	0.0	0.0	0.0	3.9	7.5	0.2	5.5	2.7	0.0	0.0
2008	25.6	0.0	0.0	0.0	1.4	0.7	0.0	3.8	0.0	2.2	0.0	0.0
2009	0.0	0.0	0.0	1.0	1.1	0.1	5.5	8.6	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.1	0.7	4.7	5.5	4.1	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	2.9	5.5	12.9	6.0	15.3	48.5	0.0	0.0
2012	0.0	0.0	0.0	0.0	1.8	12.1	11.4	33.7	9.9	5.7	0.0	0.0
2013	0.0	0.0	1.3	16.6	1.3	0.8	0.9	0.0	0.4	6.2	0.8	0.0
2014	0.0	0.0	0.0	4.1	1.2	54.2	29.3	49.6	29.3	0.4	0.2	0.0
2015	49.6	0.0	0.0	0.0	9.4	46.1	58.6	471.8	252.2	0.0	0.1	0.1
2016	0.0	0.0	1.4	24.2	49.4	101.9	206.0	34.7	148.0	16.7	13.9	13.8
2017	11.1	44.3	153.2	1.3	0.1	231.2	86.2	94.5	106.2	1.1	15.8	23.4
2018	1.0	0.0	107.6	52.7	3.0	301.4	46.8	23.5	113.8	9.3	5.5	23.4

Table 7. Monthly catches (t) of black scabbard fish between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8. Monthly catches (t) of ling between 1999 and 2018.

	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.6	0.6	2.1	3.9	0.1
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.4	0.5	7.7	0.0	0.0
2005	0.0	0.0	0.1	0.0	2.7	0.1	0.0	4.8	0.7	8.4	1.7	0.0
2006	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.0	0.0	0.0	18.2
2007	0.0	0.0	0.0	0.4	0.2	0.2	0.4	0.3	0.0	0.0	0.0	0.0
2008	17.8	0.0	0.0	0.0	0.1	0.0	0.0	0.9	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	1.7	0.9	1.3	0.5	0.1	0.2	0.0	0.0
2010	0.0	0.0	0.1	0.7	0.7	0.1	0.1	0.0	0.0	0.0	1.7	0.0
2011	0.0	0.0	0.6	1.0	0.0	0.0	1.6	1.8	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.2	0.2	1.1	0.3	0.1	2.2	0.7	0.1	0.2	0.0
2013	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	2.3	3.0	2.4	0.2	0.0	0.0	0.0
2015	10.3	0.1	0.0	0.0	0.7	1.9	1.8	3.4	3.1	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.4	0.1	3.5	8.6	0.1	0.9	0.4	0.0	1.3
2017	0.6	0.3	0.0	0.4	0.2	0.9	0.7	1.2	0.2	0.0	0.0	0.0
2018	0.0	0.5	0.1	0.0	0.0	0.7	0.0	3.2	0.1	0.0	0.0	0.0

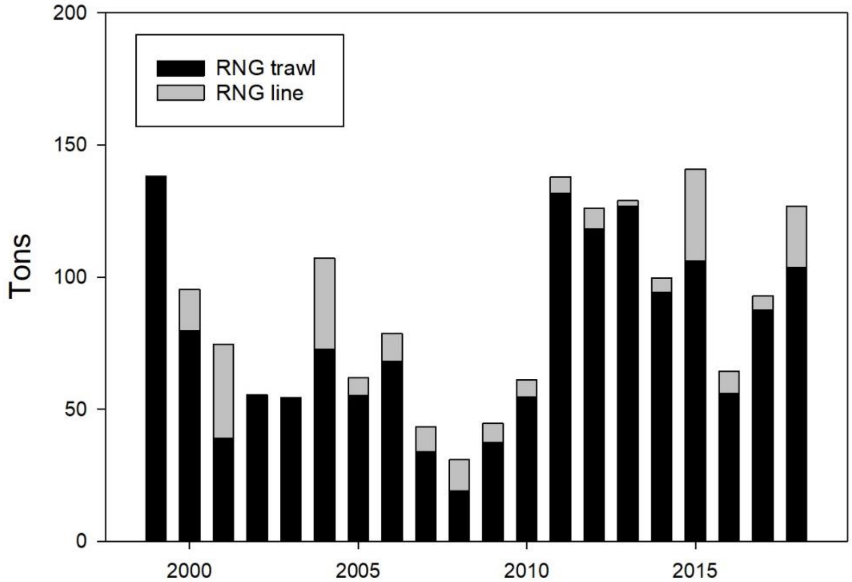


Figure 1. Trawl and long line catches of roundnose grenadier (t) in East Greenland (ICES 14b) from 1999 to 2018.

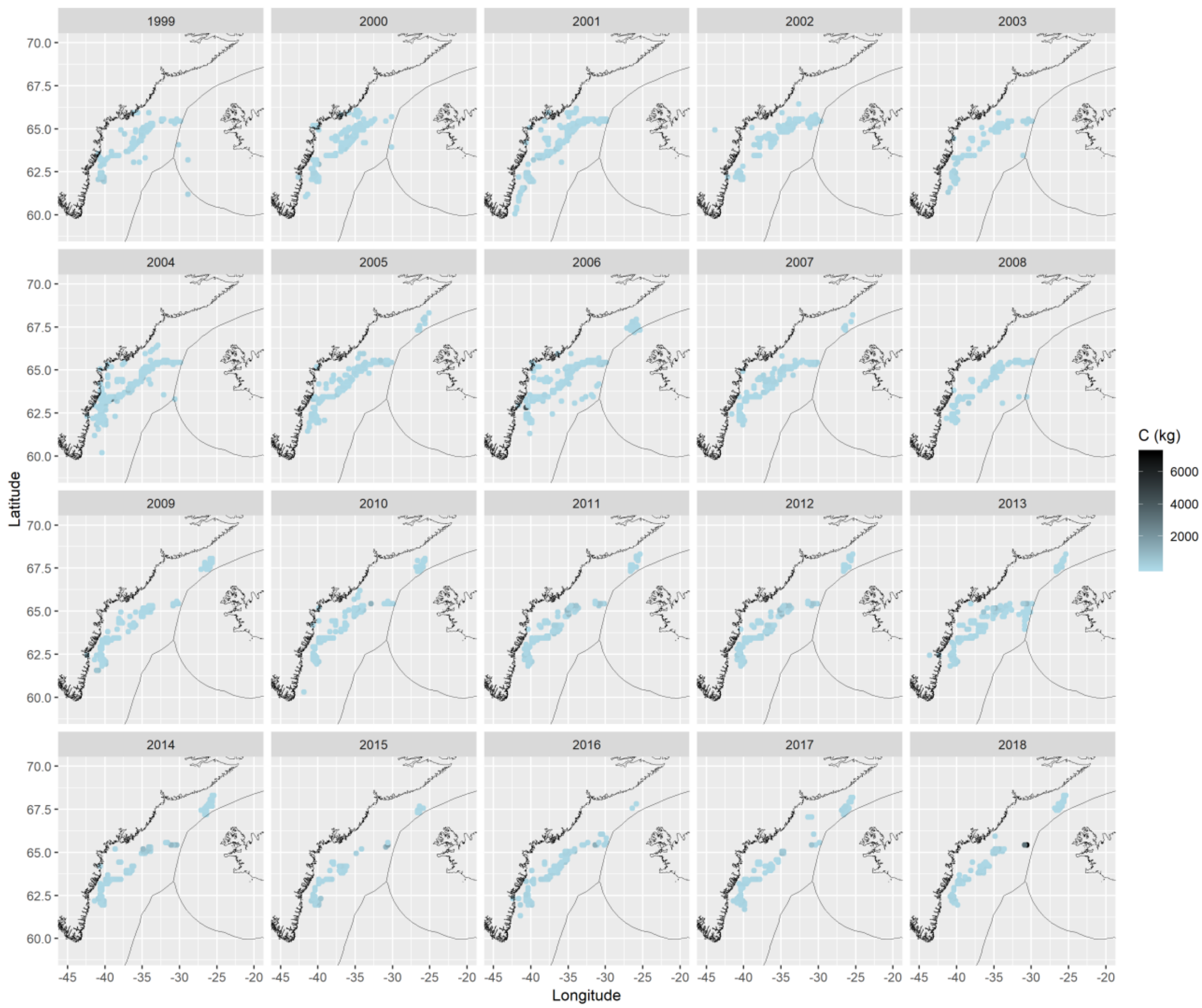


Fig. 2. Distribution of commercial catches, C (kg), of roundnose grenadier in East Greenland from 1999 to 2018.

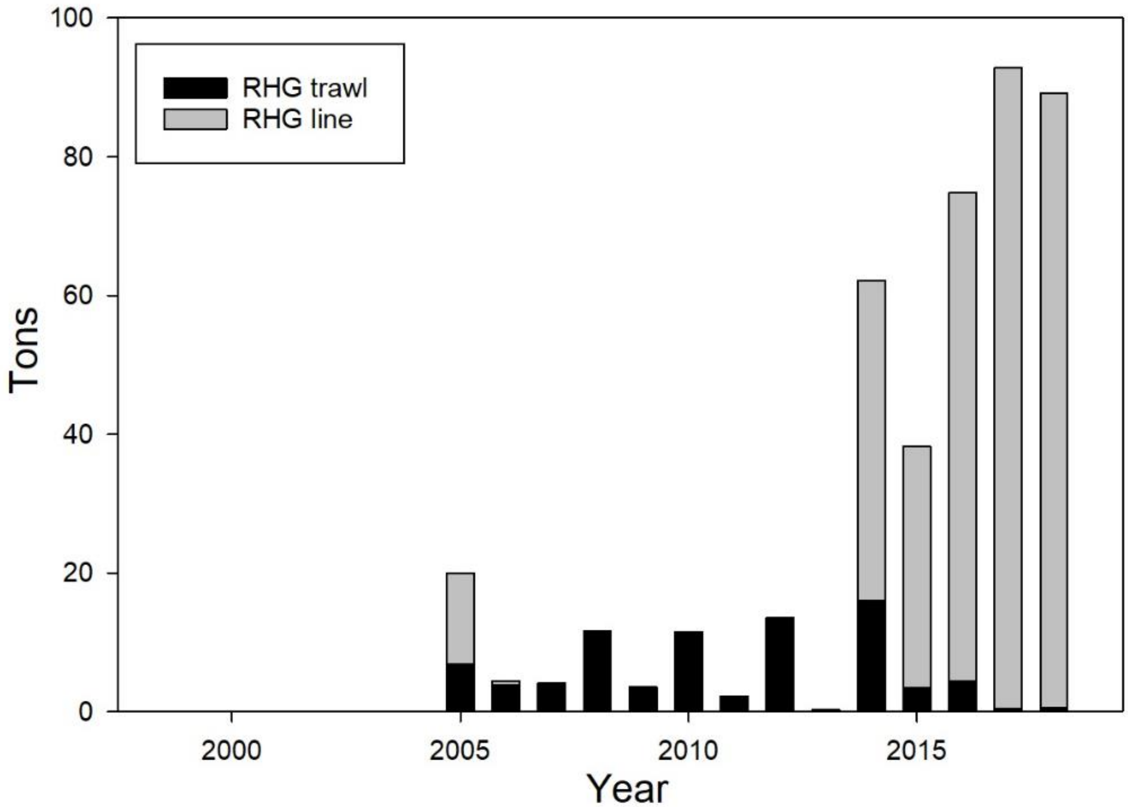


Figure 3. Trawl and long line catches of roughhead grenadier (t) in East Greenland (ICES 14b) from 1999 to 2018.

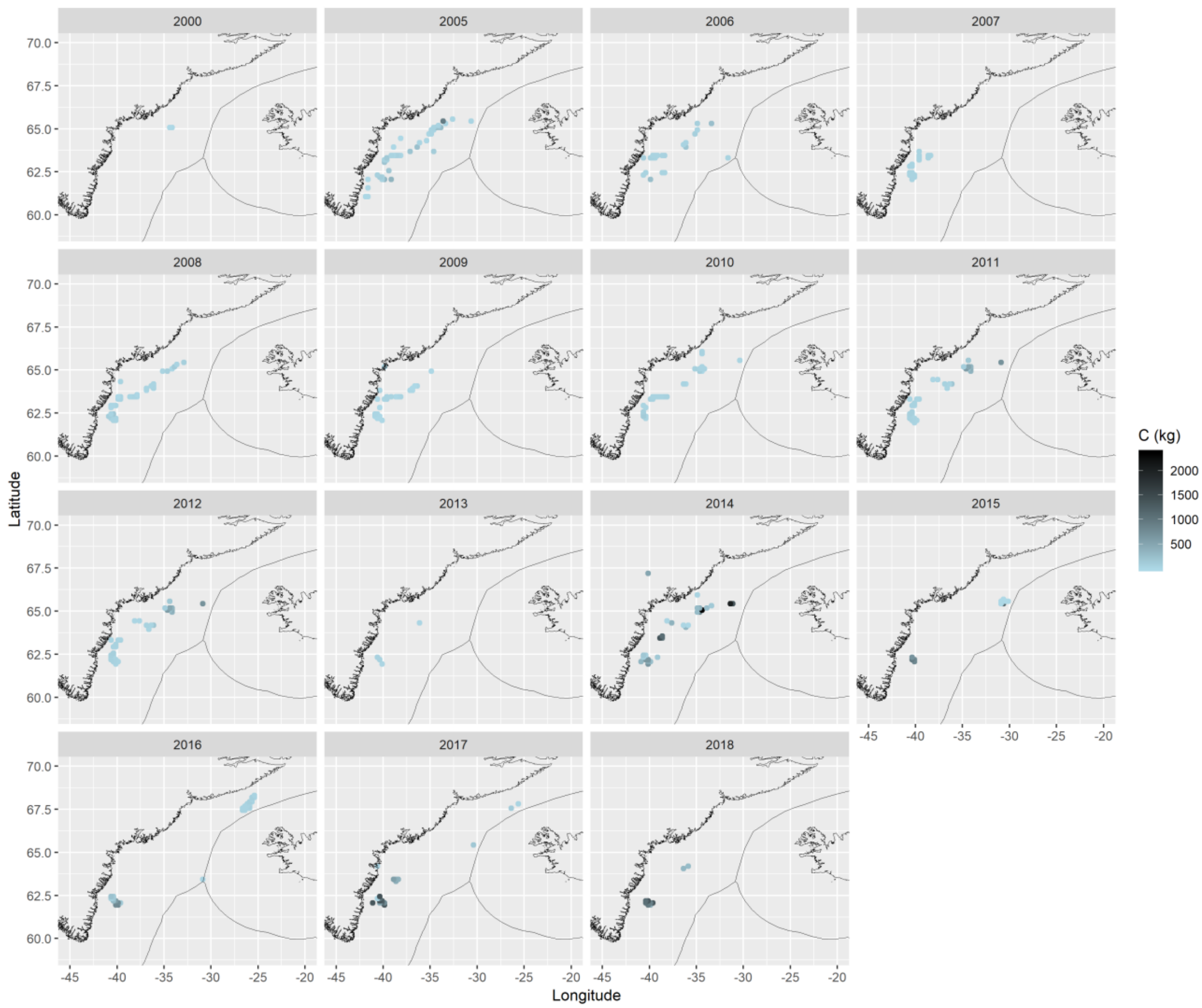


Fig. 4. Distribution of commercial catches, C (kg), of roughhead grenadier in East Greenland from 1999 to 2018.

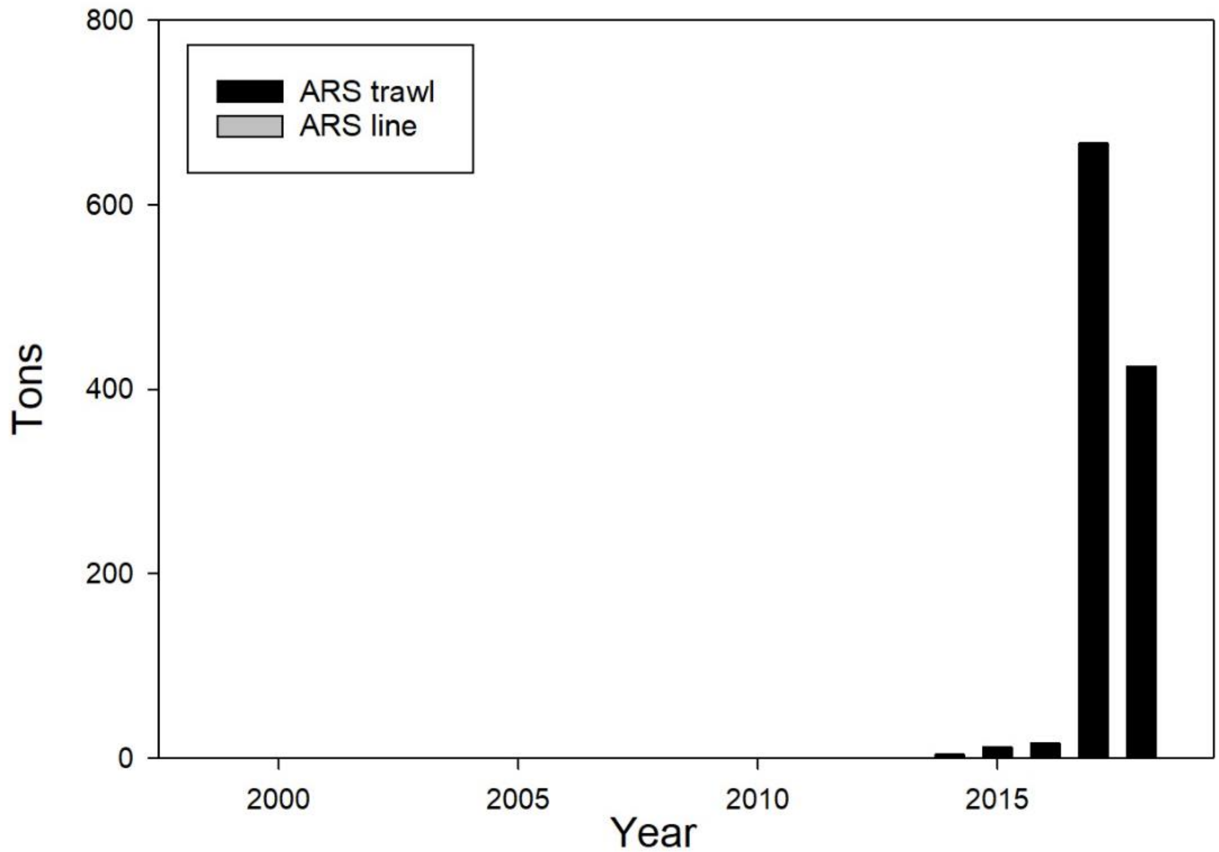


Figure 5. Trawl and long line catches of greater silver smelt (t) in East Greenland (ICES 14b) from 1999 to 2018.

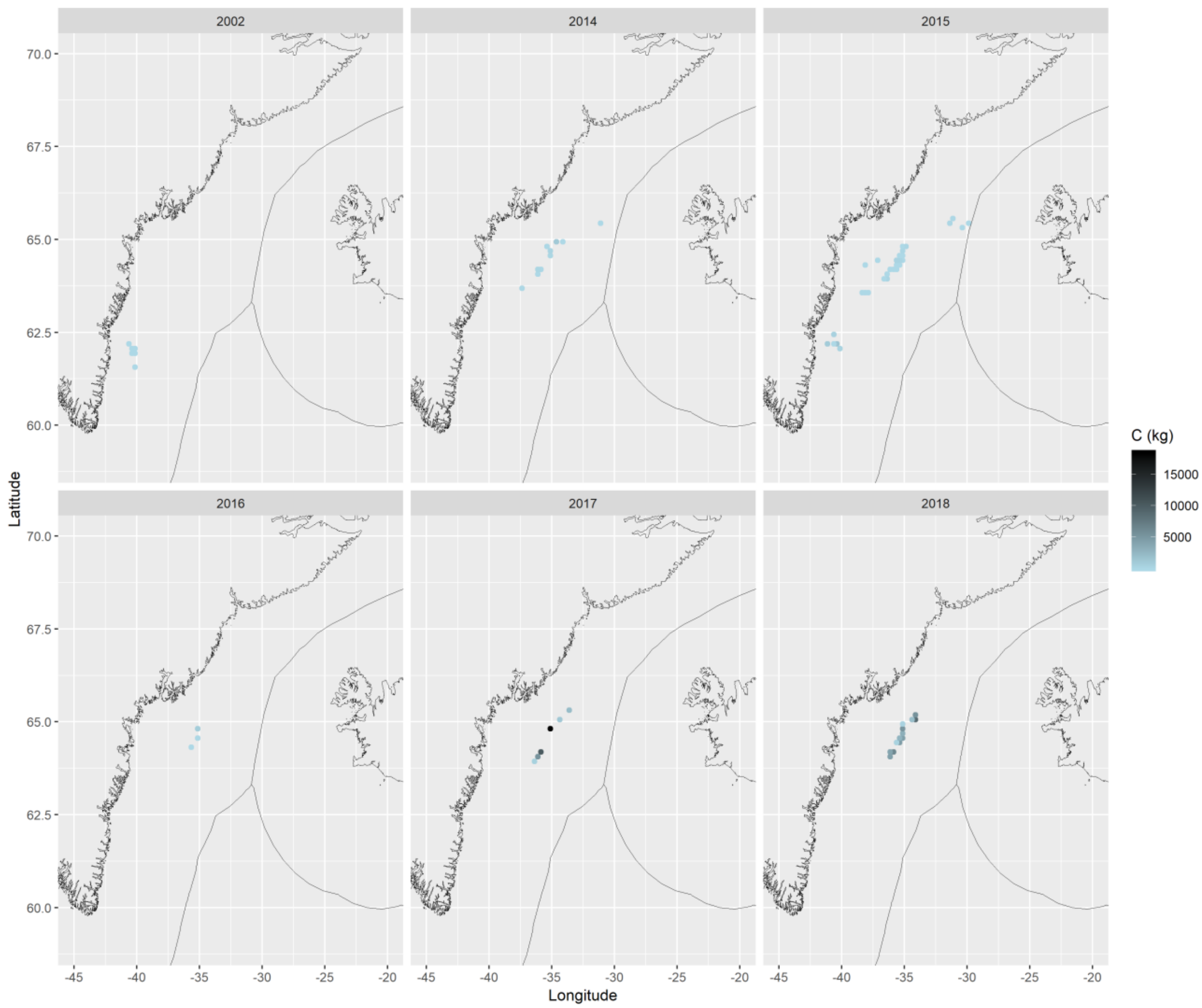


Fig. 6. Distribution of commercial catches, C (kg), of greater silver smelt in East Greenland from 1999 to 2018.

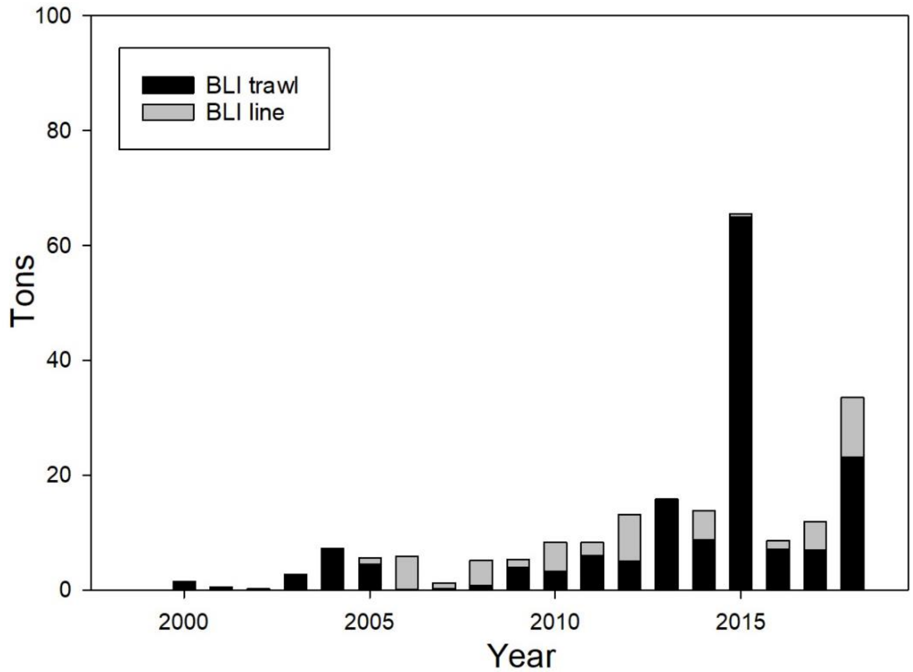


Figure 7. Trawl and long line catches of blue ling (t) in East Greenland (ICES 14b) from 1999 to 2018.

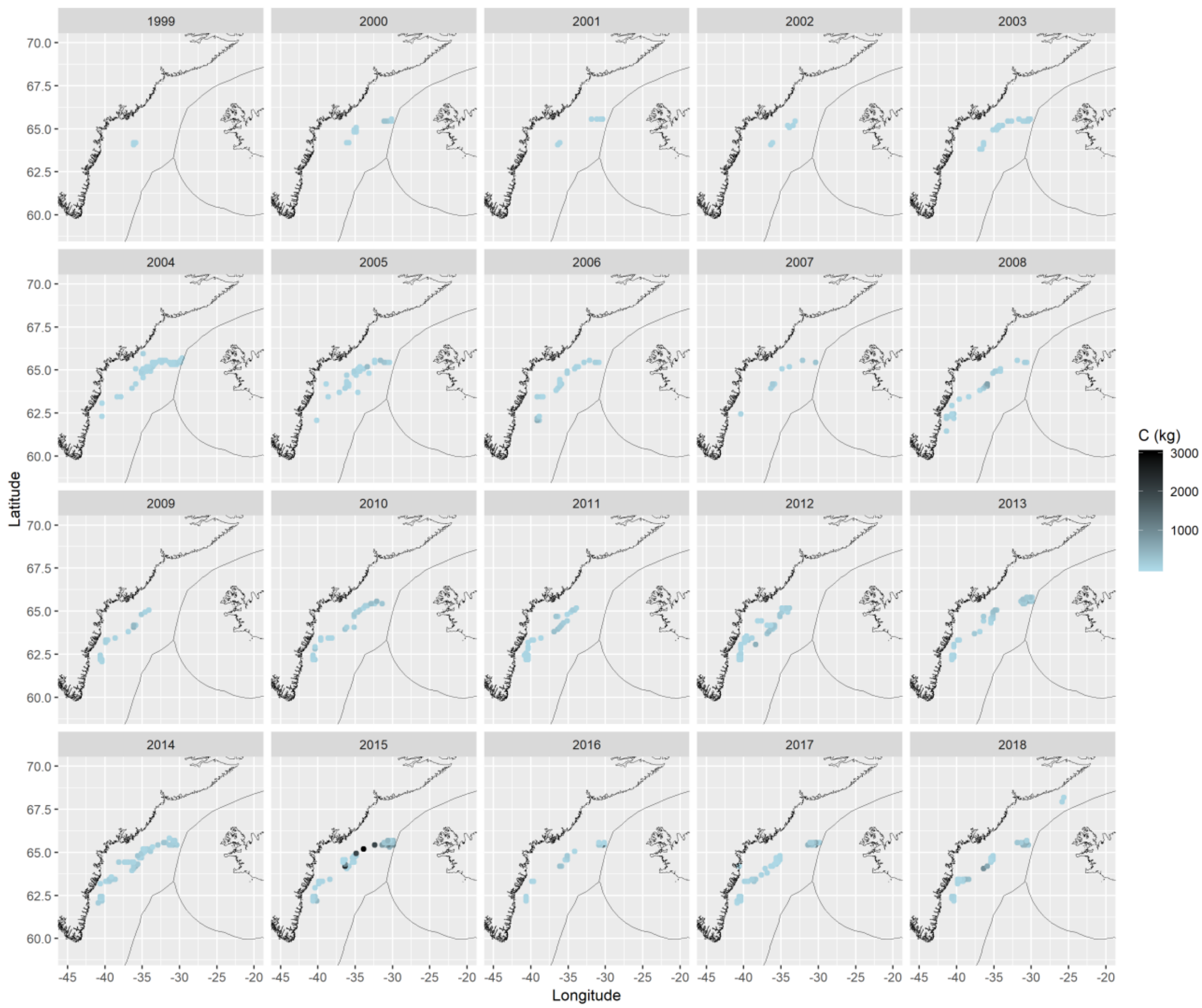


Fig. 8. Distribution of commercial catches, C (kg), of blue ling in East Greenland from 1999 to 2018.

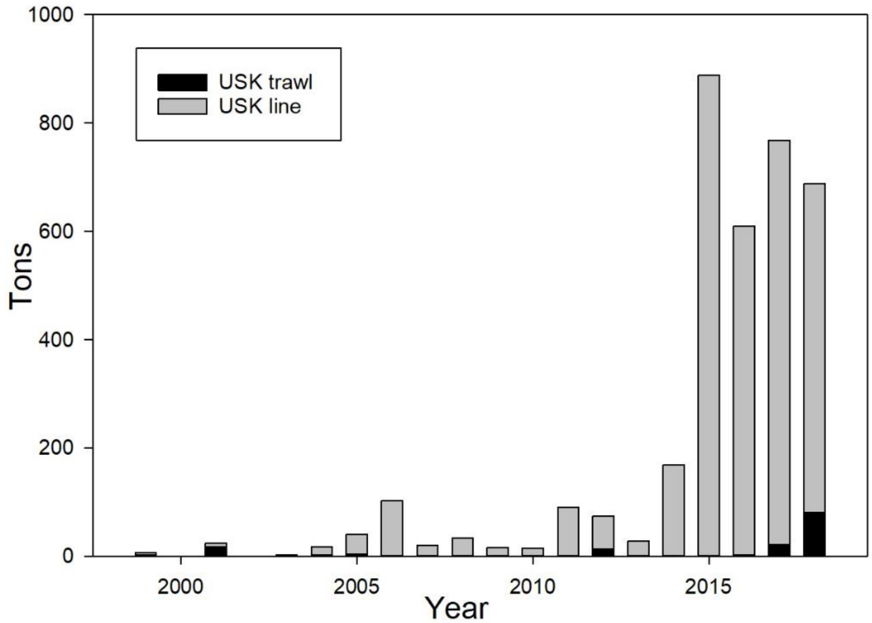


Figure 9. Trawl and long line catches of tusk (t) in East Greenland (ICES 14b) from 1999 to 2018.

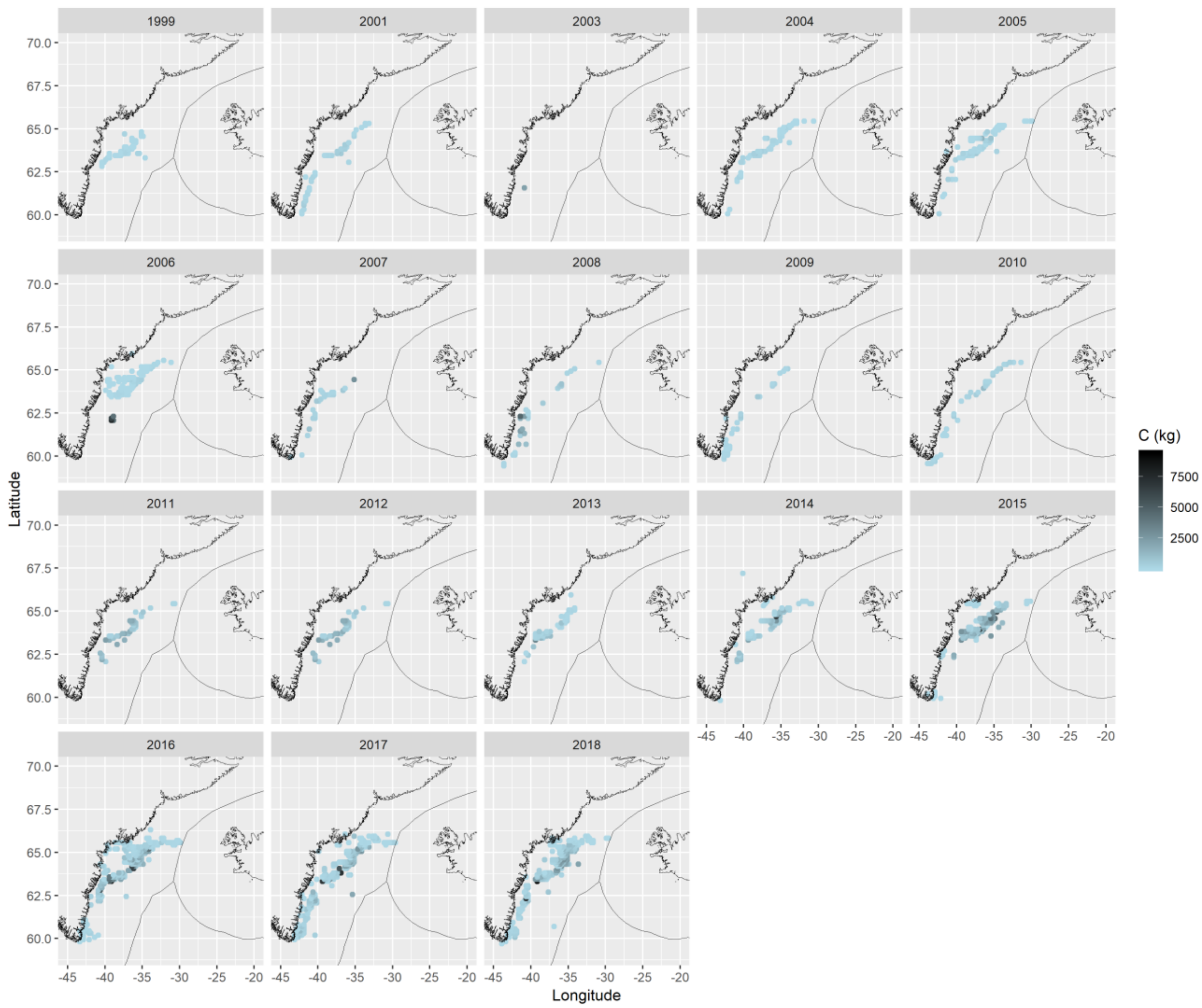


Fig. 10. Distribution of commercial catches, C (kg), of tusk in East Greenland from 1999 to 2018.

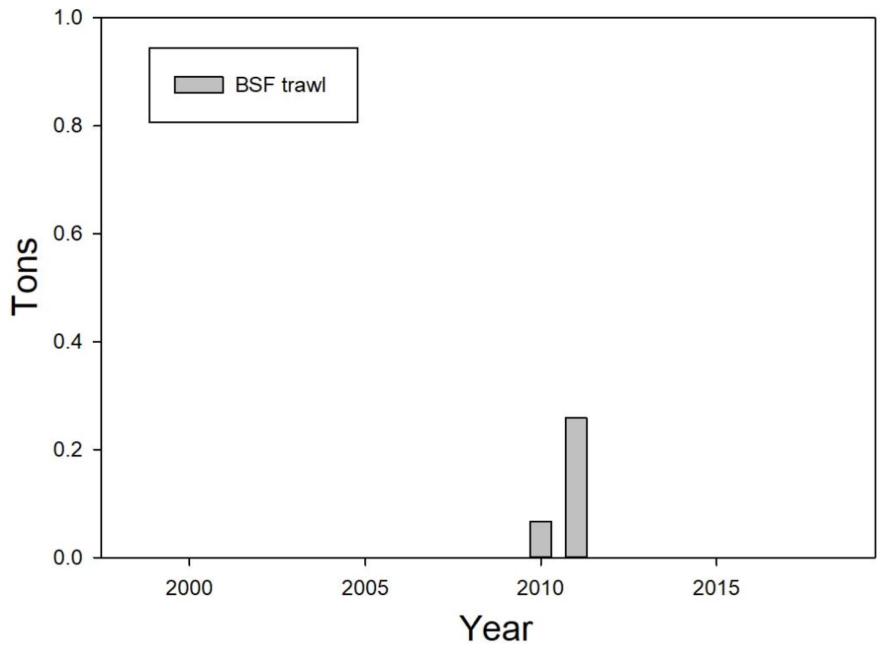


Figure 11. Trawl catches of black scabbard fish (t) in East Greenland (ICES 14b) from 1999 to 2018.

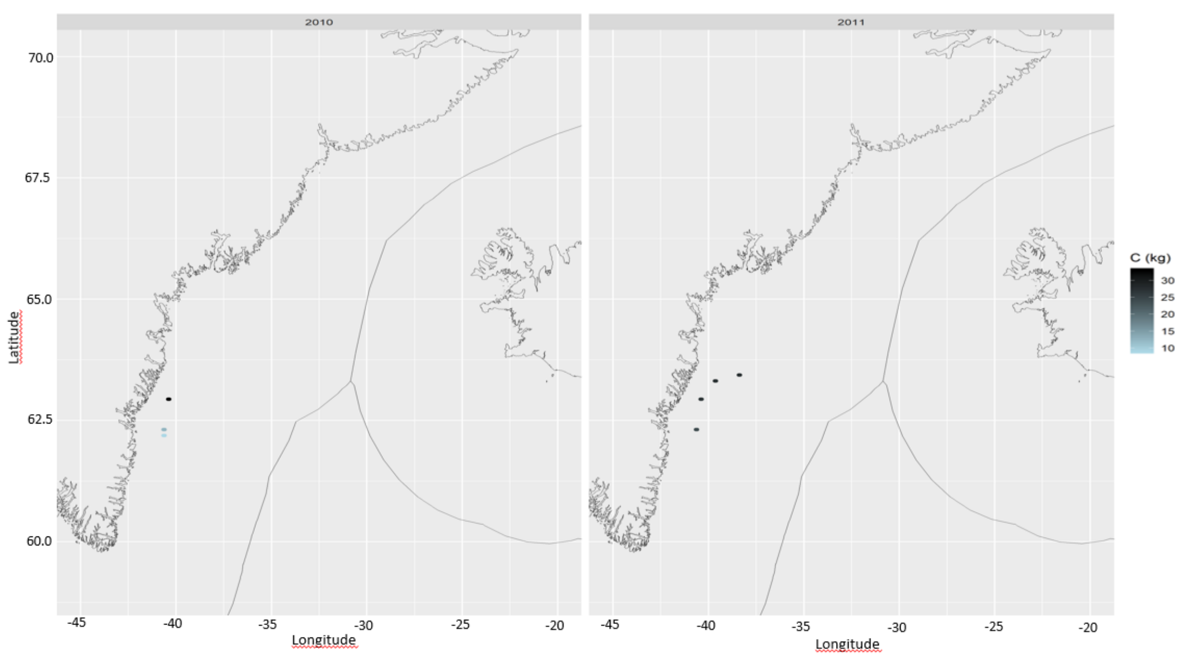


Fig. 12. Distribution of commercial catches, C (kg), of black scabbard fish in East Greenland from 1999 to 2018.

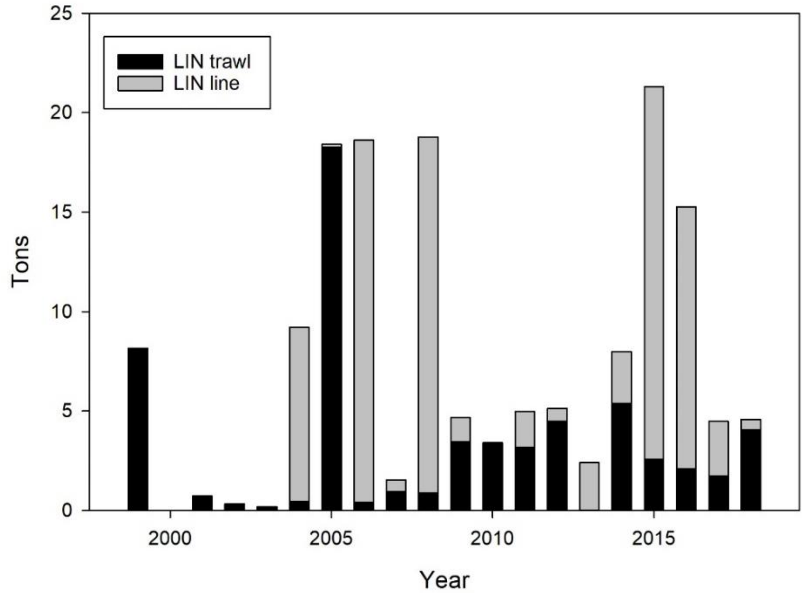


Figure 13. Trawl and long line catches of ling (t) in East Greenland (ICES 14b) from 1999 to 2018.

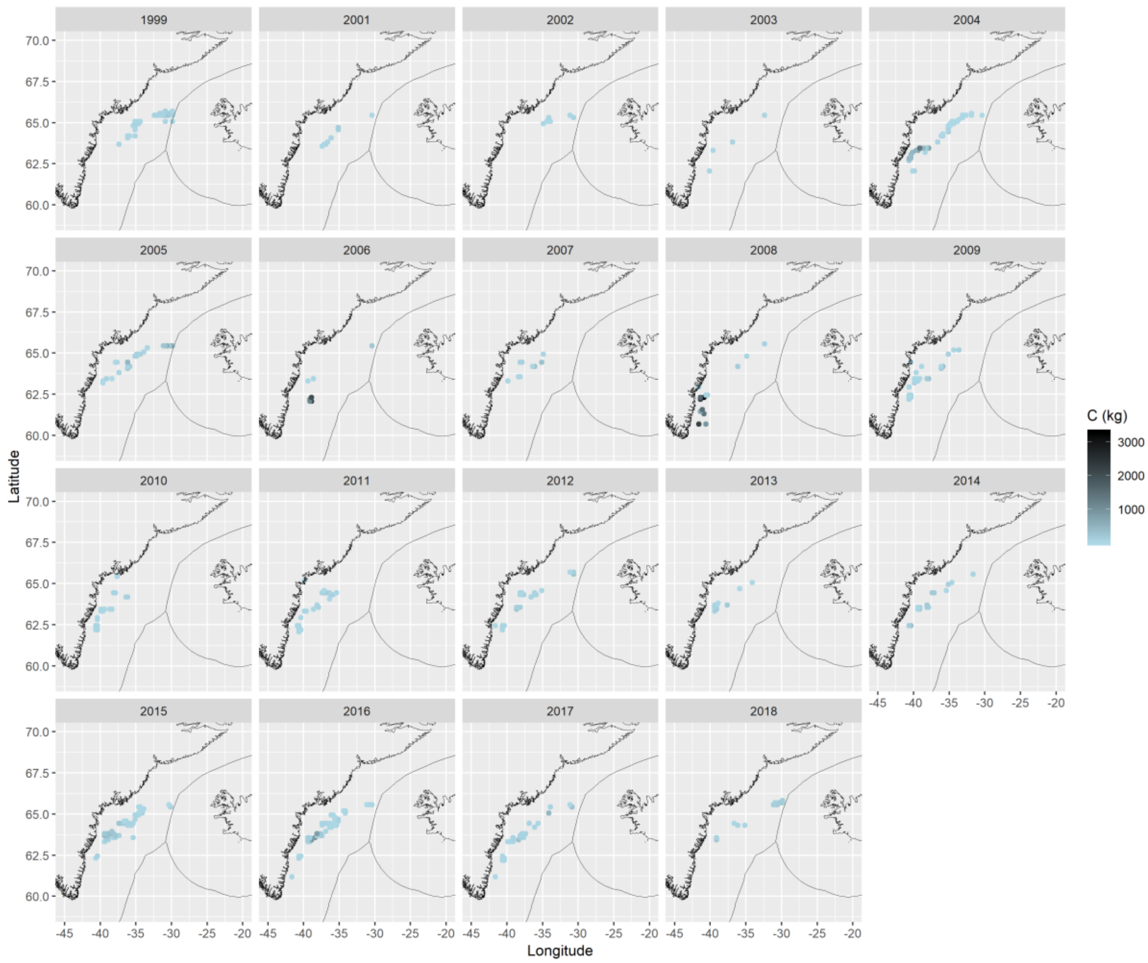


Fig. 14. Distribution of commercial catches, C (kg), of ling in East Greenland from 1999 to 2018.

On mixed greater silver smelt (*Argentina silus*) and lesser silver smelt (*Argentina sphyraena*) bycatches in industry fisheries in the North-Sea

Elvar H. Hallfredsson and Lise Heggebakken

Introduction

Registered bycatch of grater silver smelt in the industrial fisheries for reduction in the North Sea are substantial and increasing since 2012 (Figure 1). These catches are considerable fractions of the total fisheries opportunities for the stock as advised by ICES, 15 656 t each year 2017 and 2018 (stock = greater silver smelt in ICES subareas 1, 2, and 4, and in Division 3.a). Even though these catches have been taken as solely greater silver smelt within ICES based on earlier studies of argentines in the area (Bergstad 1993) the catches have been registered in the fisheries as either greater or lesser silver smelt or mix of both. The two species are difficult to distinguish by visual observations and misreporting my easily occur. To address this a thorough species identification was done based on samples from the fisheries. The conclusion points in the direction that the catches are overwhelmingly greater silver smelt.

The greater silver smelt is a more northerly species than lesser silver smelt, but the distribution areas overlap in the North Sea.

Material and methods.

Thirteen Samples with in total 267 fish were collected by the Norwegian fishing vessel "Mostein" in active fishing (figure 1) between 7/6 and 6/7 2018. The samples were kept frozen until examination by IMR at land.

The examined taxonomic measures were; number of muscles segments, gill rakes and pectoral fin rays, and eye diameter/snout length ratio. In addition, total length, sex, maturity stage were registered, otoliths were collected for age determination, each fish was photographed individually, and tissue samples taken for genetics. Genetic samples are being worked up, and results are not presented here.

Eye diameter vs. snout length and number of muscles segments were reexamined using the photos on screen, and it turned out that the initial visual examination was inaccurate. Thus, results based on the photo examination are presented for these measures.

Results

Figure 4-7 show the percentages distributions of specimens for each taxonomic measurement by fish length. In all cases the results are in align with that majority of the specimens were greater silver smelt (table 1). Fish length was in the range 14-34 cm, distributed with two mods with maximum around 19 and 30 cm, respectively (figure 8). The examined fish was by large not sexually mature, with maturity stage one (figure 9).

Figure 10 shows he most securely identified lesser silver smelt by taxonomic measures, compared to a greater silver smelt of similar length. Figure 11 sows a gill rake from a greater silver smelt.

Discussion

The results here seem to underpin to large extend the current praxis in ICES to consider the bycatch of argentines in the North Sea industrial fisheries as being greater silver smelt.

In a the frozen samples eye diameter vs. snout length and numbers of muscle segments were difficult to determine with accuracy, compared to the more thorough examination by photo where one can zoom in on particular parts of the fish. It is possible that direct visual counting of muscle segments is more precise on fresh fish, but this is still a cumbersome undertaking. Counting of gill rakes is possibly not a practical thing to do for the fishermen either. The counting of pectoral fin rays thus might be the achievable alternative for visual detstinction between greater- and lesser silver smelt in the fisheries, with more than 15 rays indicating grater silver smelt, even though this will lead to some borderline cases with exact 15 rays.

It may be that counting number of muscle segments is the easier and faster way if it is done on fresh specimens, and not frozen as here, and it can be done without binoculars. In addition, it might not need be needed to count every fish because in similar sized fish one can easily see if they have the same amount of myomeres or not. As the majority of the specimens available here turned out to be greater silver smelt further investigations should be done with several specimens of each species available.

It is worth noticing that the ratio between eye diameter and snout length was not easy to achieve correctly with direct visual inspection, as this taxonomic measure apparently is the best-known criteria to distinguish between greater- and lesser silver smelt among layman.

This study is limited in scope when it comes to number of samples and specimens, as well as temporal and spatial coverage. Further investigations are highly recemented.

References

Bergstad, O.A., 1993. Distribution, population structure, growth, and reproduction of the greater silver smelt, *Argentina silus* (Pisces, Argentinidae), of the Skagerrak and the north-eastern North Sea. ICES J. Mar. Sci., 50(2): 129-143.

ICES. 2018. Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 11–18 April 2018, ICES HQ, Copenhagen, Denmark.
ICES CM 2018/ACOM:14. 771 pp.

Tables

Table 1. Percent lesser- and greater silver smelt according to the different taxonomic measures (see text). Borderline see fig. 4-7.

%	Eye diam. vs. snout length	Muscle segments	Gill rakes	Pectoral fin rays
Borderline	8	6		13
Lesser silver smelt	10	0	3	6
Greater silver smelt	82	94	97	81

Figures

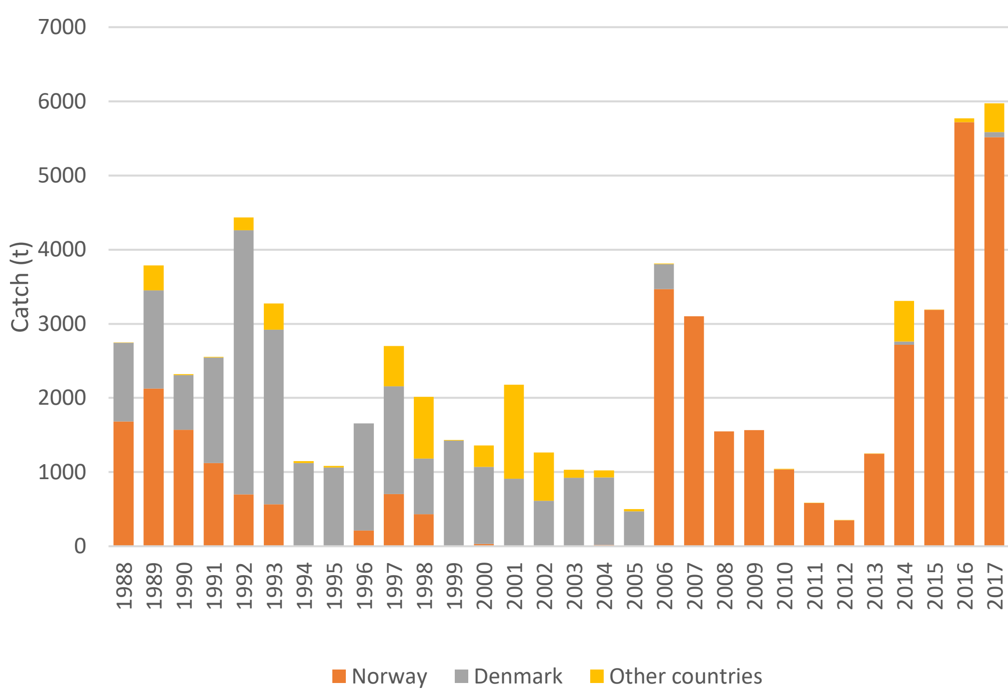


Figure 1. Catches of argentines in the Norwegian fisheries in the North Sea (ICES areas 3 and 4 (ICES WGDEEP report 2018).

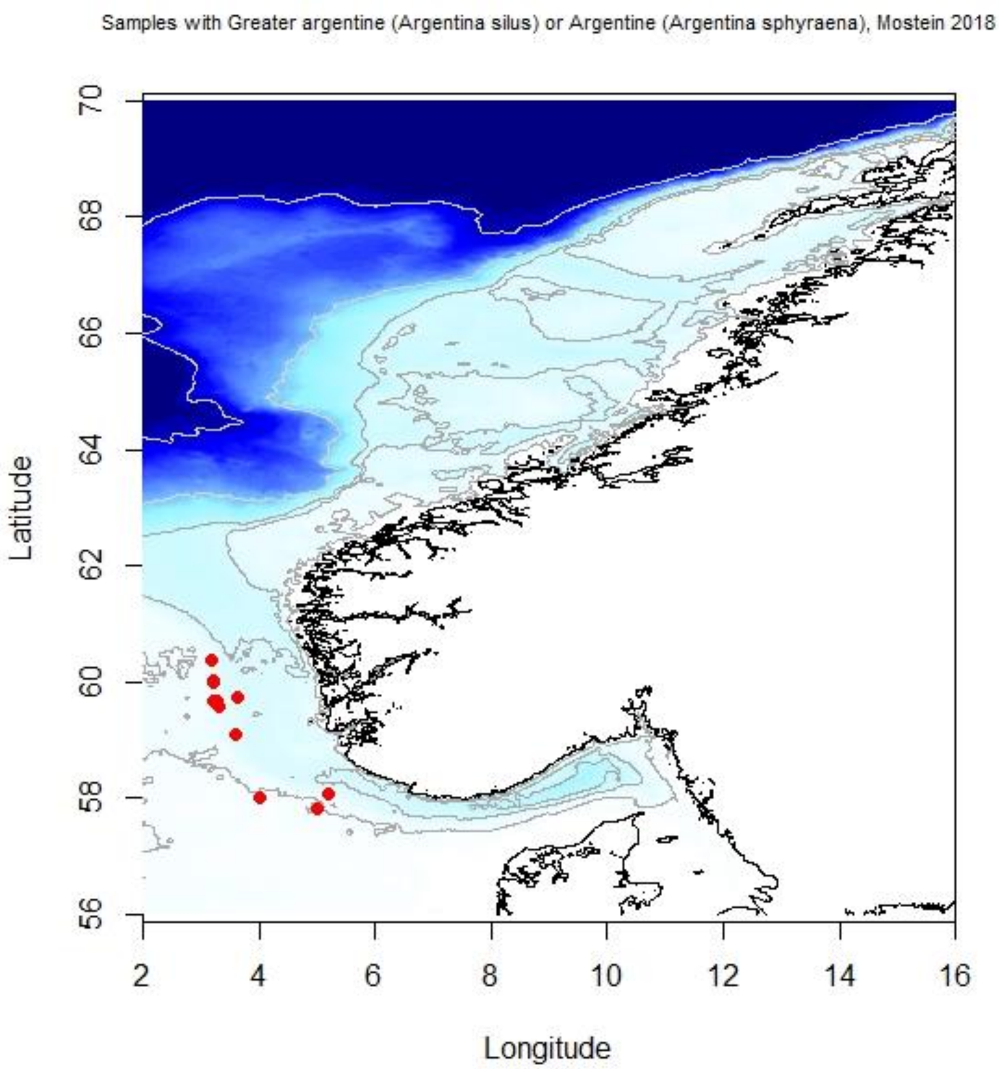


Figure 1. Map that show were samples were taken by the Norwegian fishing vessel "Mostein" between 7/6 and 6/7 2018, and used in this study.

IMR Fish Systematics 2017

Identification of argentines in Norwegian waters

Argentina silus

greater argentine or
greater silver smelt

North Sea to Barents Sea
100-1400 m, 70 cm

Argentina sphyraena

argentine or
lesser silver smelt

North Sea, Norwegian Sea
50-450 m, 32 cm

	Argentina silus	***Argentina sphyraena***
number of myomeres (muscle segments)	64-70 (i.e. more, but narrower segments)	50-56 (i.e. fewer, but broader segments)
number of gillrakers on lower part of first gill arch	11-17	7-10
number of pectoral fin rays	15-18	12-15
eye diameter	equal to or greater than snout length	equal to er less than snout length
max. size	70 cm, but seldom larger than 50 cm	32 cm
distribution	North Sea, Norwegian Sea, Barents Sea	North Sea, Norwegian Sea

Figure 3. Identification key to distinguish between greater silver smelt and lesser silver smelt (Rupert Wienerroither pers. comm.).

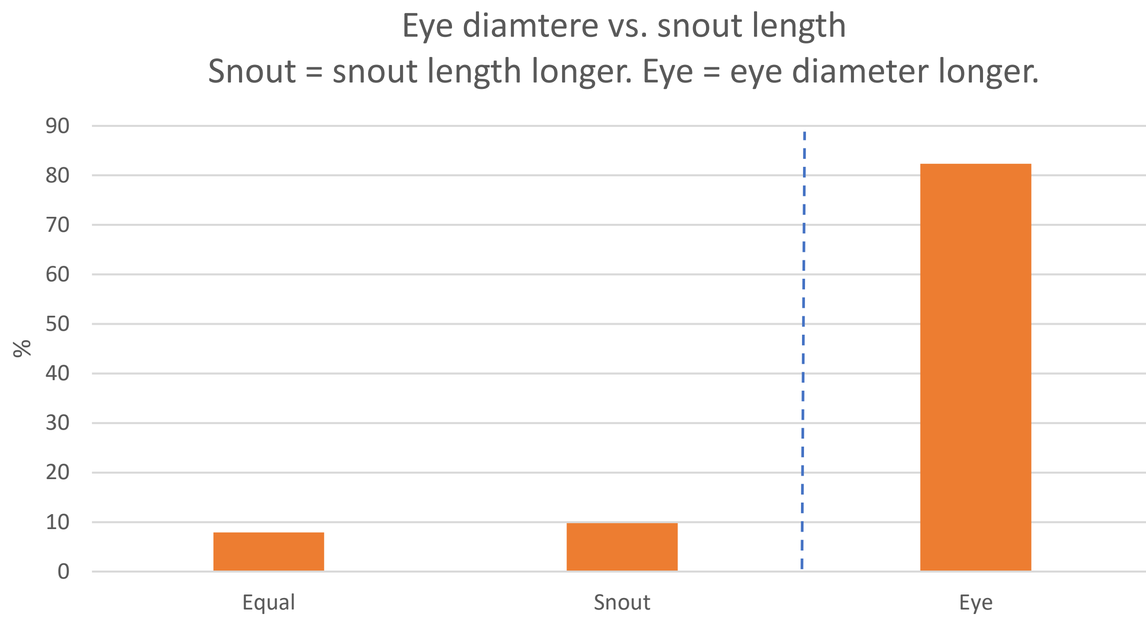


Figure 4. If the snout length is longer than the eye diameter (Snout) the fish is lesser silver smelt, while vice versa if eye diameter is longer then snout length (Eye) the fish is considered greater silver smelt.

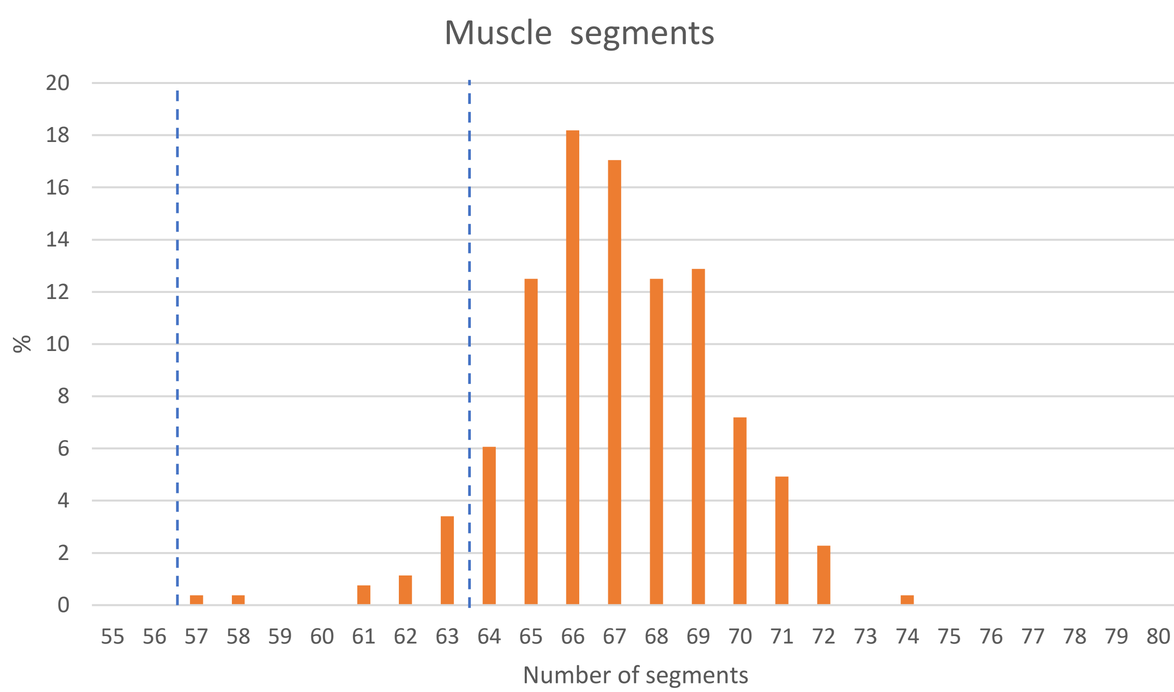


Figure 5. Number of muscle segments. Blue dotted lines show boundaries for the taxonomic measure. Less than 57 are lesser silver smelt while 64 or more are greater silver smelt.

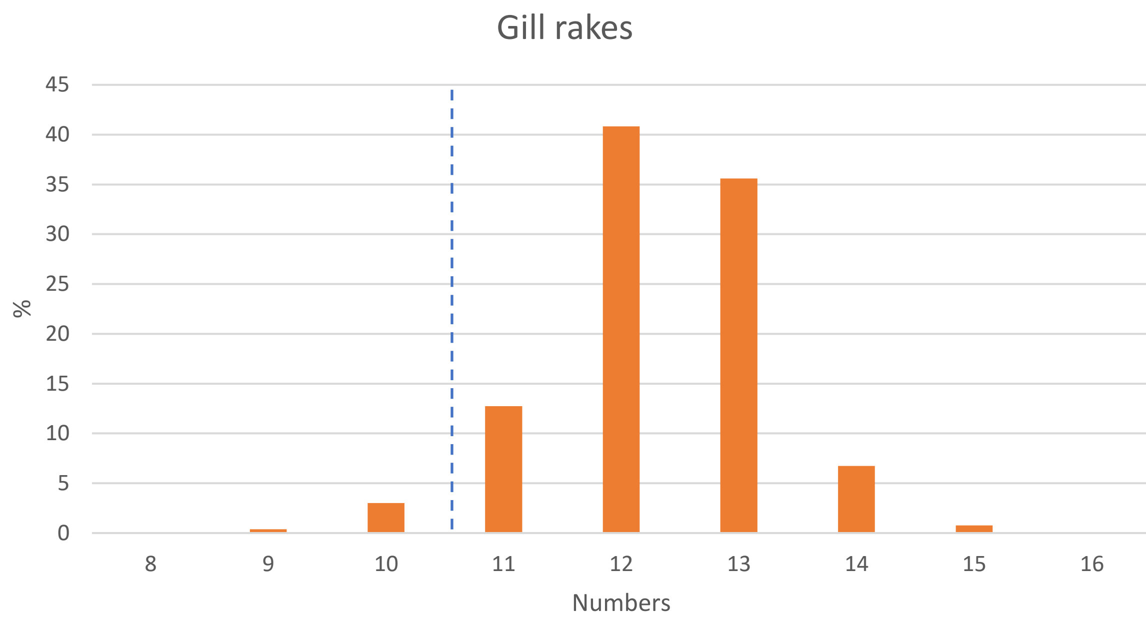


Figure 6. Number of gill rakes. More than 10 are greater silver smelt.

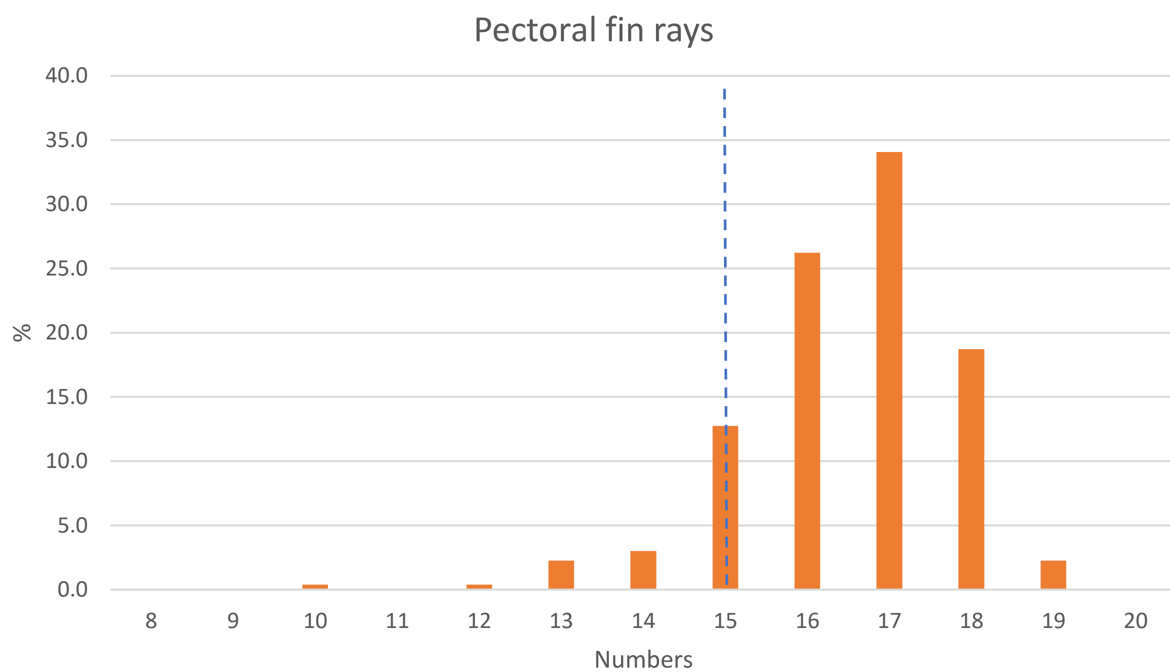


Figure 7. Number of pectoral fin rays. More than 15 are greater silver smelt.

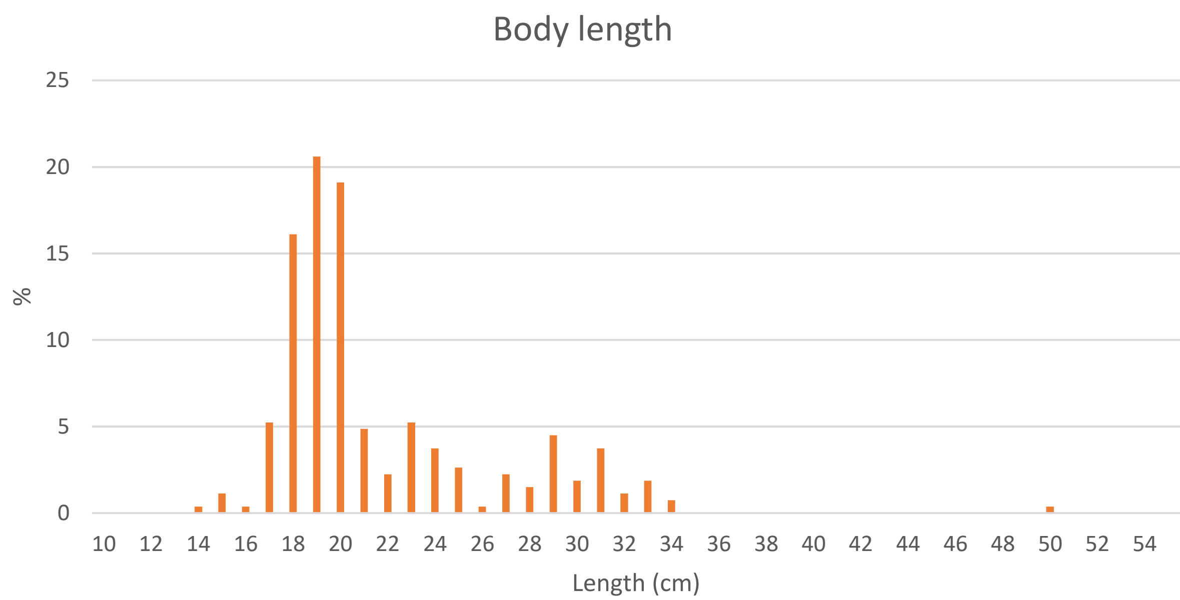


Figure 8.Length distribution, all examined specimens.

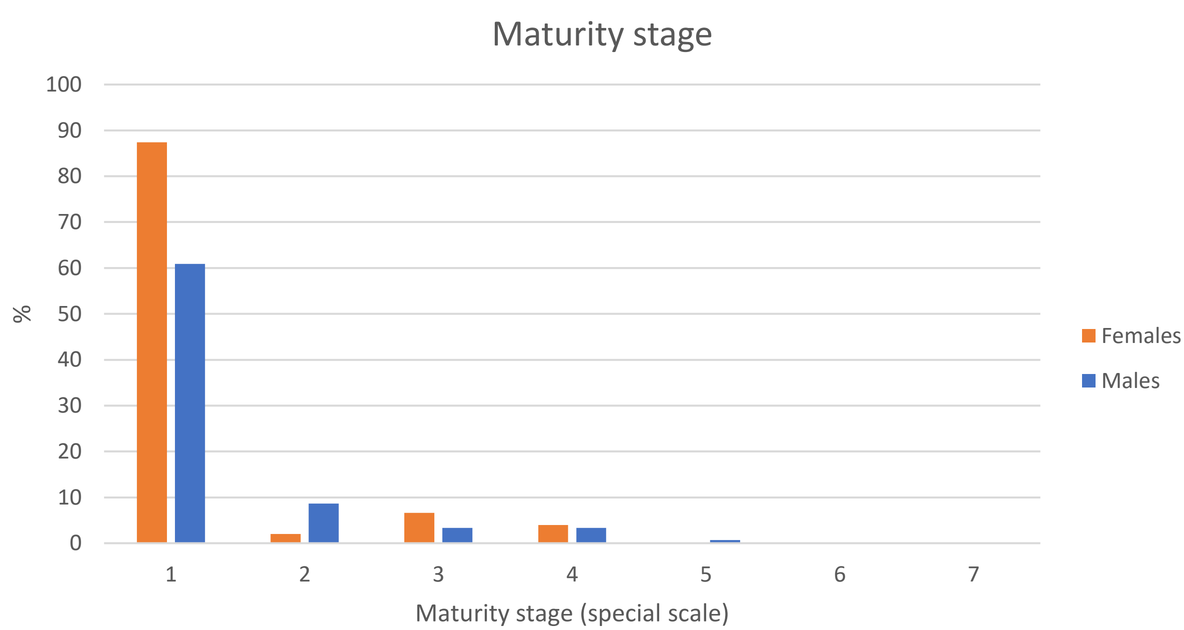


Figure 9. Maturity stage, all examined specimens.

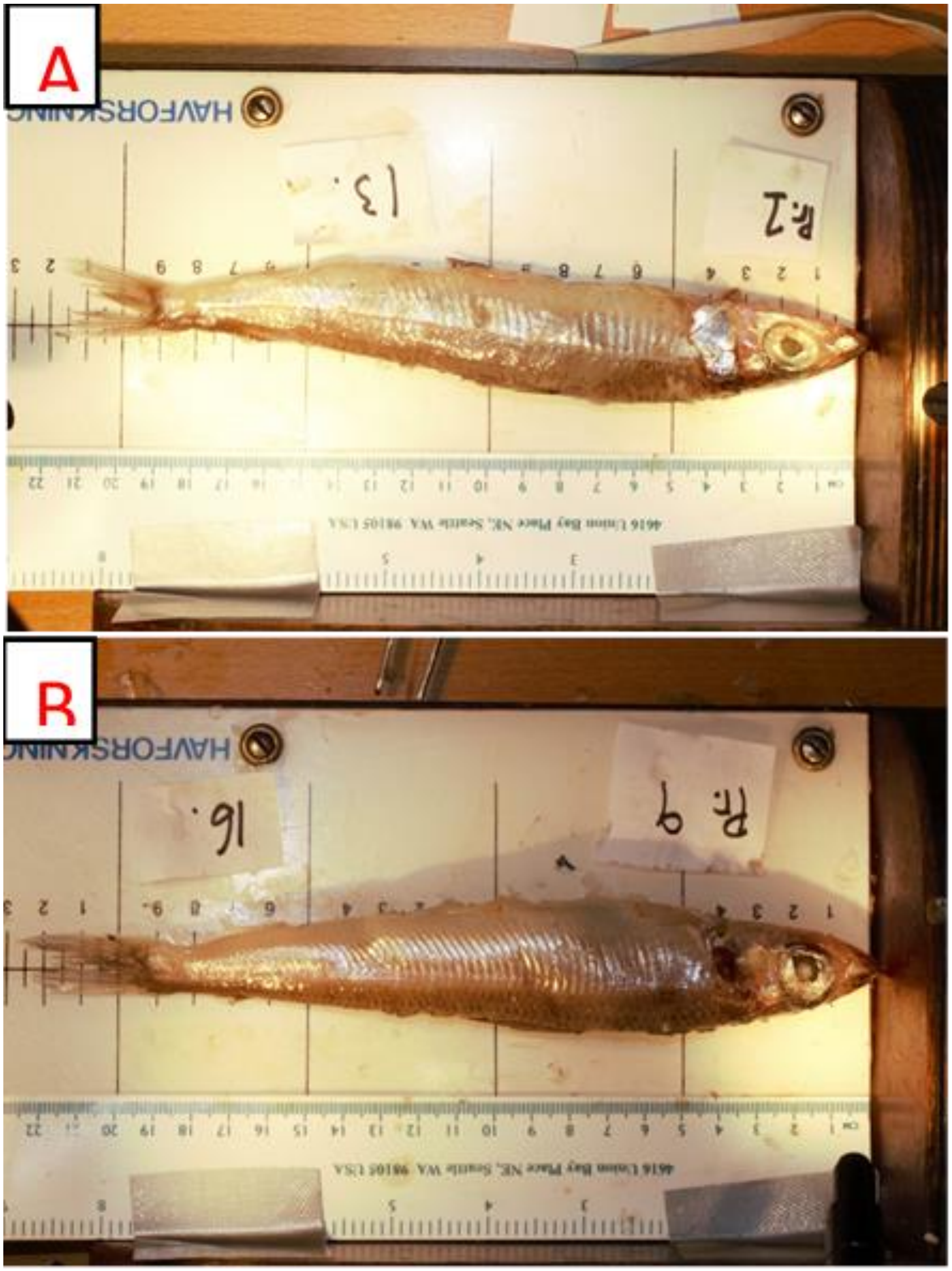


Figure 10. A) Sample 1, fish no 13. The most securely identified lesser silver smelt by taxonomic measures. Muscle segments = 46, gill rakes = 9, pectoral gill rays = 12, eye diameter and snout length equal. Body length 22.2 cm.
B) Sample 9, fish no 16. Greater silver smelt by taxonomic measures, of similar length. Muscle segments = 66, gill rakes = 12, pectoral gill rays = 17, eye diameter longer than snout length. Body length 22.6 cm.

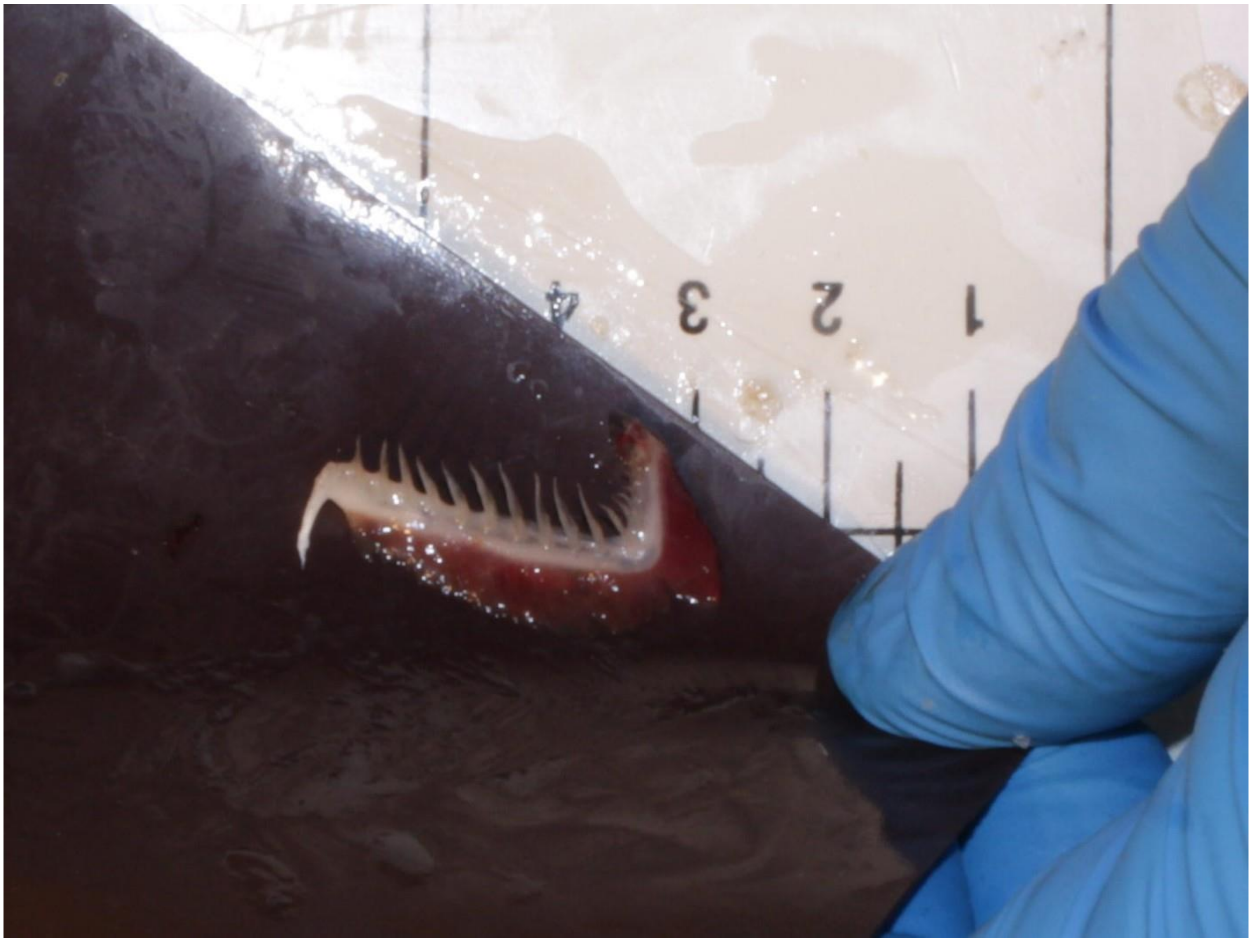


Figure 11. Gill rakes fish no 6, sample no 2.

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2019).

Updating Survey data from the Azores for deep-water species

by

Wendell M. Medeiros-Leal, Ana M. Novoa-Pabon, Régis V. S. Santos, Helder Silva and Mário R. Pinho.

Department of Oceanography and Fisheries (DOP)
9901-862 -Azores
mario.rr.pinho@uac.pt

Abstract

This paper resumes the information for the deep-water species (annex I and II from the EC regulations) from the Azorean Spring Bottom Longline survey for the 2019 ICES working group WGDEEP. Annual abundance indices, the mean abundance index by depth stratum, 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 and length composition also are presented for other less abundant specie on the survey or non-commercial species.

Introduction:

Since 1995, a bottom 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 primarily directed for the abundance estimation of red seabream (*Pagellus bogaraveo*) the principal target specie of the multispecific and multigear demersal fishery in the Azores (ICES subdivision 10a2) 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 10a2 (ICES WGNEACS, 2010).

The objective of this paper is to resume the survey information of deep-water species to the WGDEEP 2019.

Material and methods

The Azorean Spring Bottom Longline Survey data from 1995 to 2018 was used 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, banks and main seamounts from 0 to 1200m. However, the survey is design for abundance estimates of benthopelagic species from 0 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 exploratory and ecological proposes. In order to be comparable along all survey time series, annual abundance index was computed for the depth strata 0-600m, and the 95% confidence interval estimated. For less abundant deep-water species on the survey, like *Phycis blennoides* and *Polyprion americanus*, or species with broader depth distribution like deep-water *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 1995-2018 and annual mean length were computed 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 interannual variability is observed on the abundance indices. Trends of the annual abundance for other species caught on the survey are also presented in the annex I.

Data on this paper covers the period 1995-2018. There is no information for 1998, 2006, 2009, 2014 and 2015 because there was no survey. Abundance index from the surveys seems to confirm the trend observed on the landings time series (see WD Pinho, 2017) for some species (e.g. *Beryx* sp, *Mora moro*, *P. bogaraveo* and *Lepidopus caudatus*) (Fig. 1). In general, relative abundance index during 2018 is maintained at low level for most species with the exception of red seabream (*P. bogaraveo*), blackbelly rosefish (*Helicolenus dactylopterus*) and Alfonsino (*Beryx decadactylus*) for which a significant increase is observed. The increase observed for red seabream seems to be consistent along the different statistical areas (see WD Pinho, 2016).

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 *L. caudatus* (Fig.2).

For the deepest species, like for exemple M. *moro* an increased trend is observed on the abundance index, and a decrease for the *P. americanus* and *P. blennoides*, because the Azorean Bottom Longline Survey is design for abundance estimation on the strata 50-600m (until 800 m after 2004) originally targeting the red (blackspot) seabream *Pagellus bogaraveo*. For some of this deep-water species, the survey may not be design because the range of the species distribution is broader than the survey coverage for abundance estimation purposes and little is known about the species dynamic. Thus, generalization about some stock status must be interpreted with care. Besides that, ecological and environmental factors and others factors associated to the fishery gear may affecting the abundance estimation of the annual Azorean spring bottom longline survey. More detail analysis is necessary exploring for example GLM approaches that future work should address.

Length composition and mean length

Mean length composition for some deep-water species, for the period 1995-2018, 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, mainly for *P. bogaraveo*, *H. dactylopterus* and *Beryx* spp. Annual mean length presents a stable or decrease trend but with high variability along time for almost all species (Fig.4).

Discussion

The depth distribution of the majority of the species reported here is relatively well sampled by the current survey design, with the exception for *Mora moro* and *Lepidopus caudatus*. However, survey sampling coverage by stratum is an issue because it is not homogeneous along time. Abundance is comparable for all-time series for depth strata 0-600m. The strata 600-1200m was covered without replication (only one transept) by stratum. Since 2004 the survey coverage increased to 800m with at least two replicates by stratum. For the years 1996 and 2008 statistical area from western Islands were not covered. The contribution of this area to the total abundance is very small and does not change the trend if considered in the computations. It has been argued that for the deepest strata (600-1200m) the environment is much stable and so replication may not change the trend in the abundance.

High interannual variability is observed on the abundance of some species, like *Pagellus bogaraveo,* which make difficult the trend interpretation (see WD Pinho 2016). Analysis done until now do not show evidence of problems related with gear saturation, competition or soak time, variables that influence the catch rate dynamic of a longliner. However, these issues should be better explored by GLM approach on future work, analyzing particularly the effect of other species.

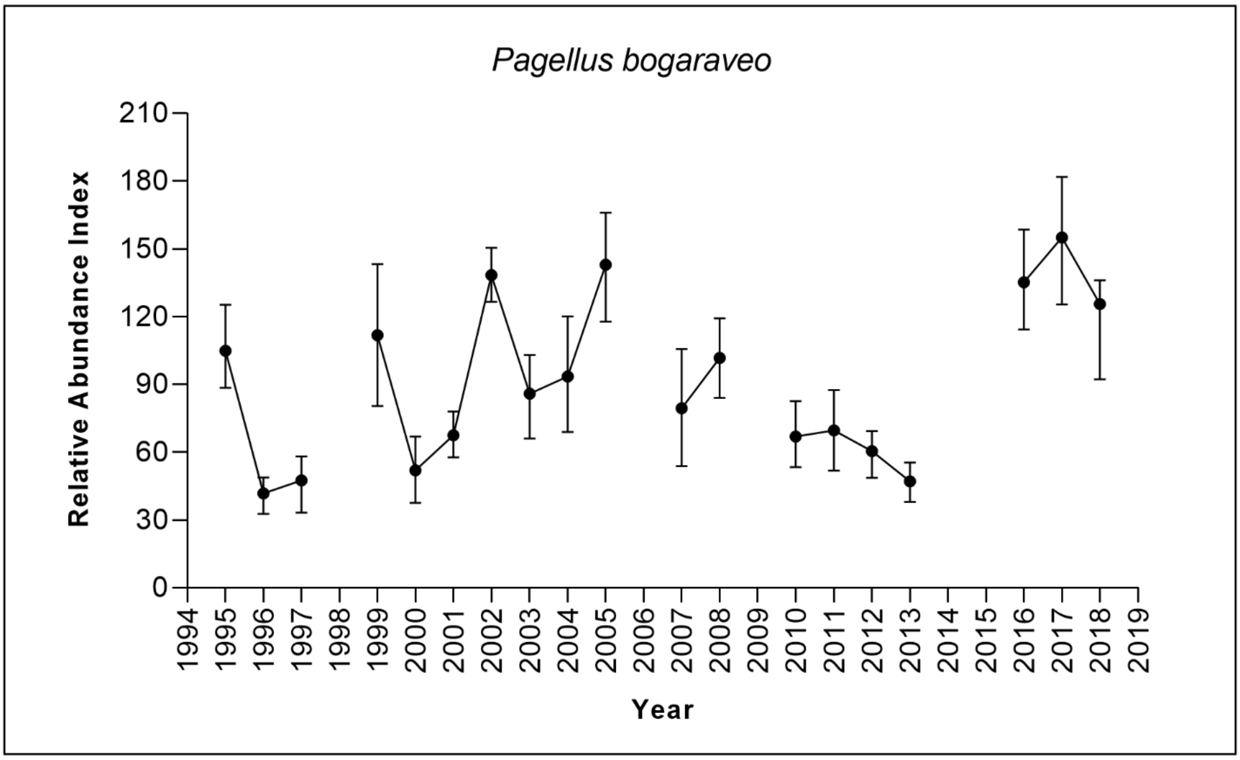
References

ICES (WGNEACS report) 2010. Report of the Working Group for North-east Atlantic Continental Slope Survey. ICES CM 2010/SSGESST:16, REF. SCICOM, ACOM.

Pinho, M. R. 2016. Survey data from the Azores to address the special request to revise the 2016 advice for Red Seabream (X) and alfonsinos. ICES WGDEEP WD 2016.

Pinho, M. R. 2017. Resuming data from deep-water fishery of the Azores. ICES WGDEEP WD 2017.

Abundance index



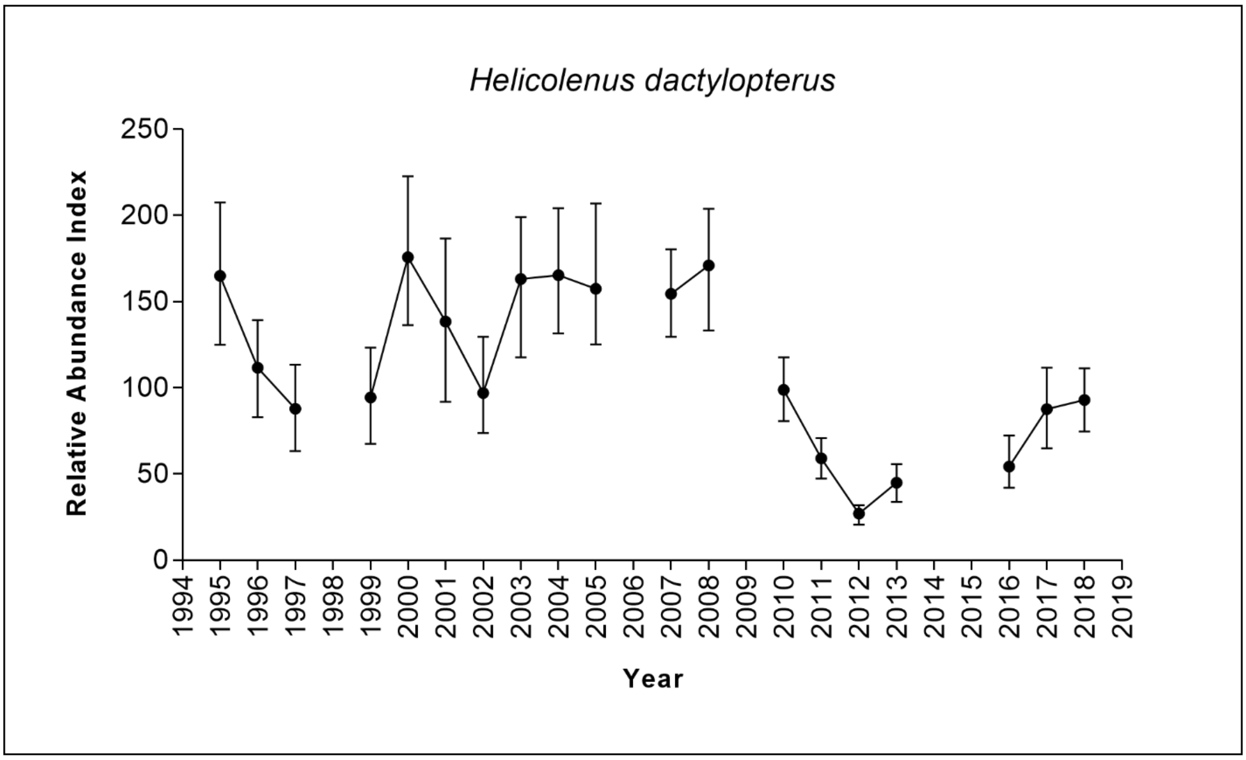
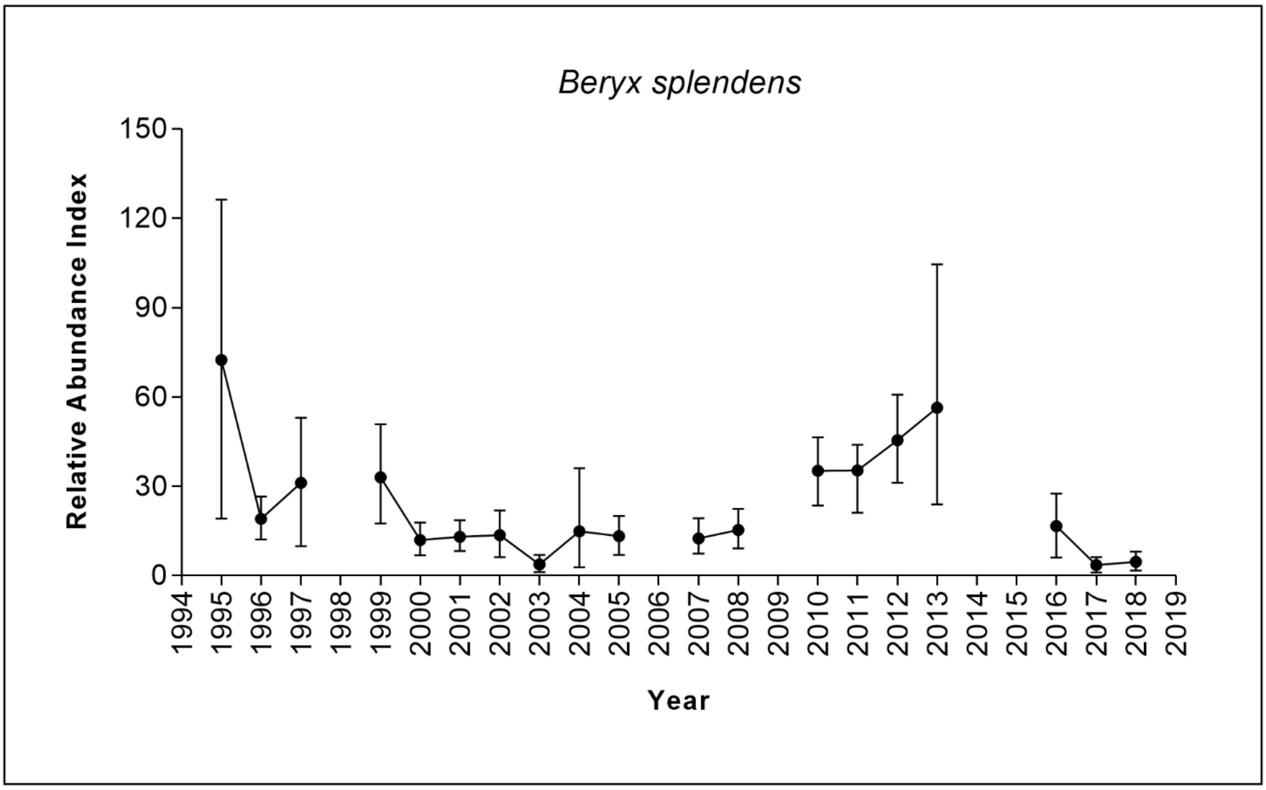


Figure 1. Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species (1995-2018).



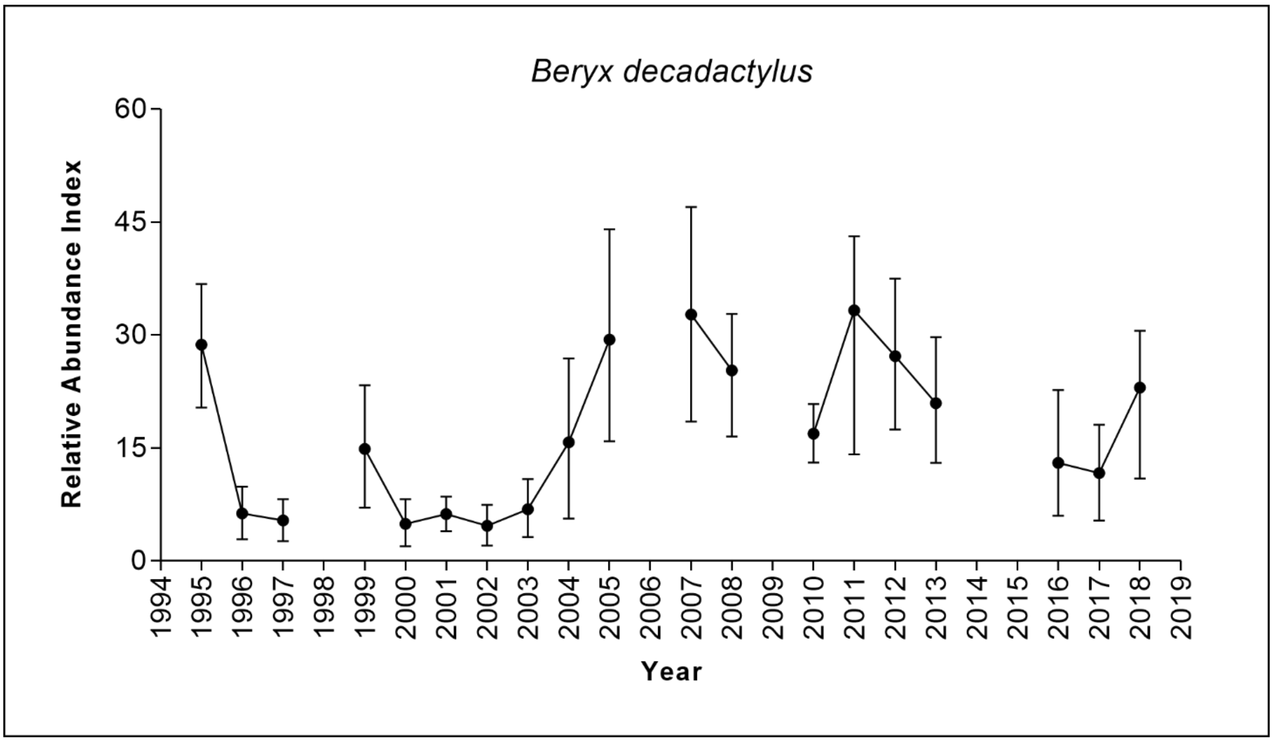
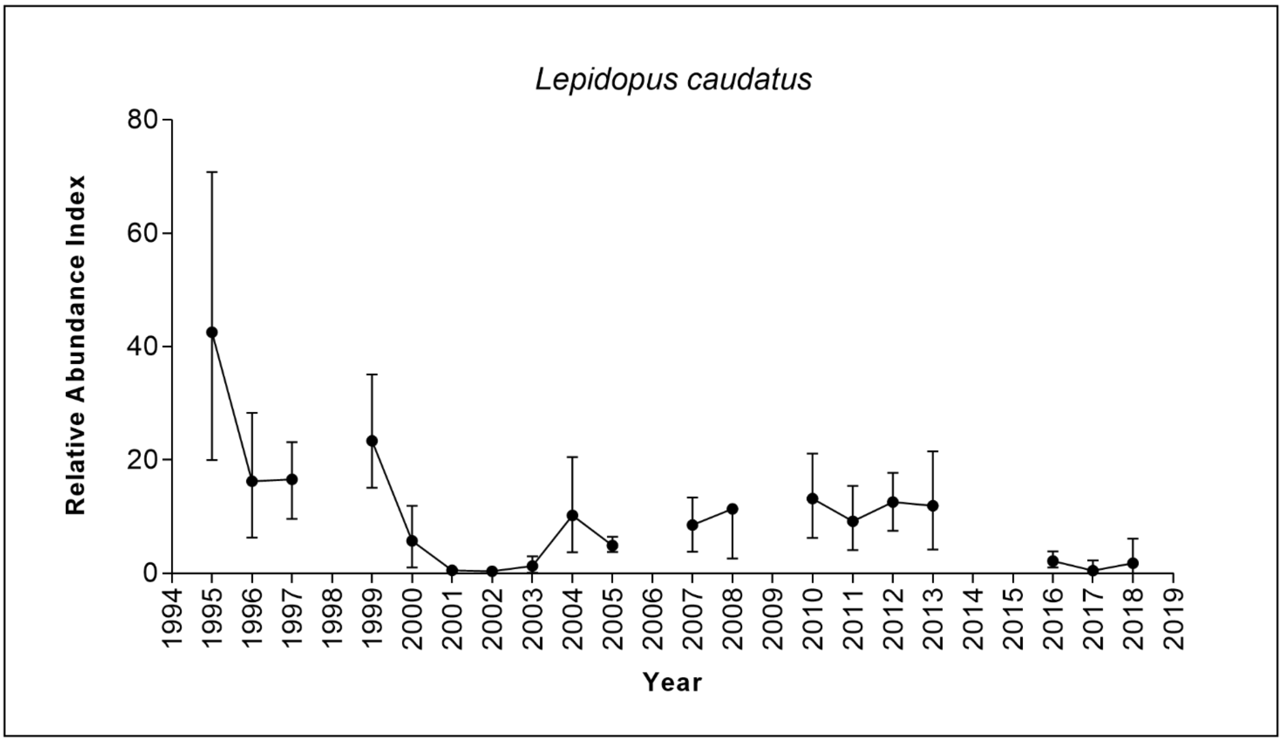


Figure 1 (Cont). Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species (1995-2018).



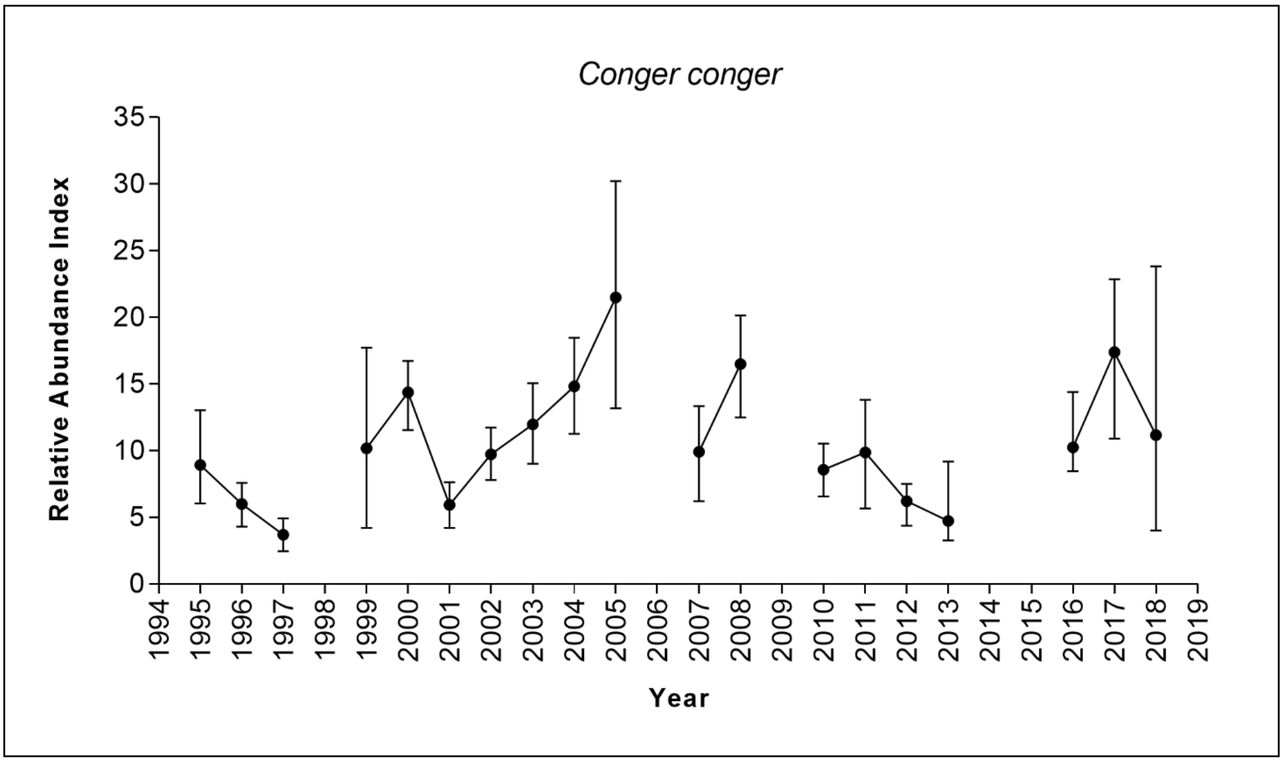
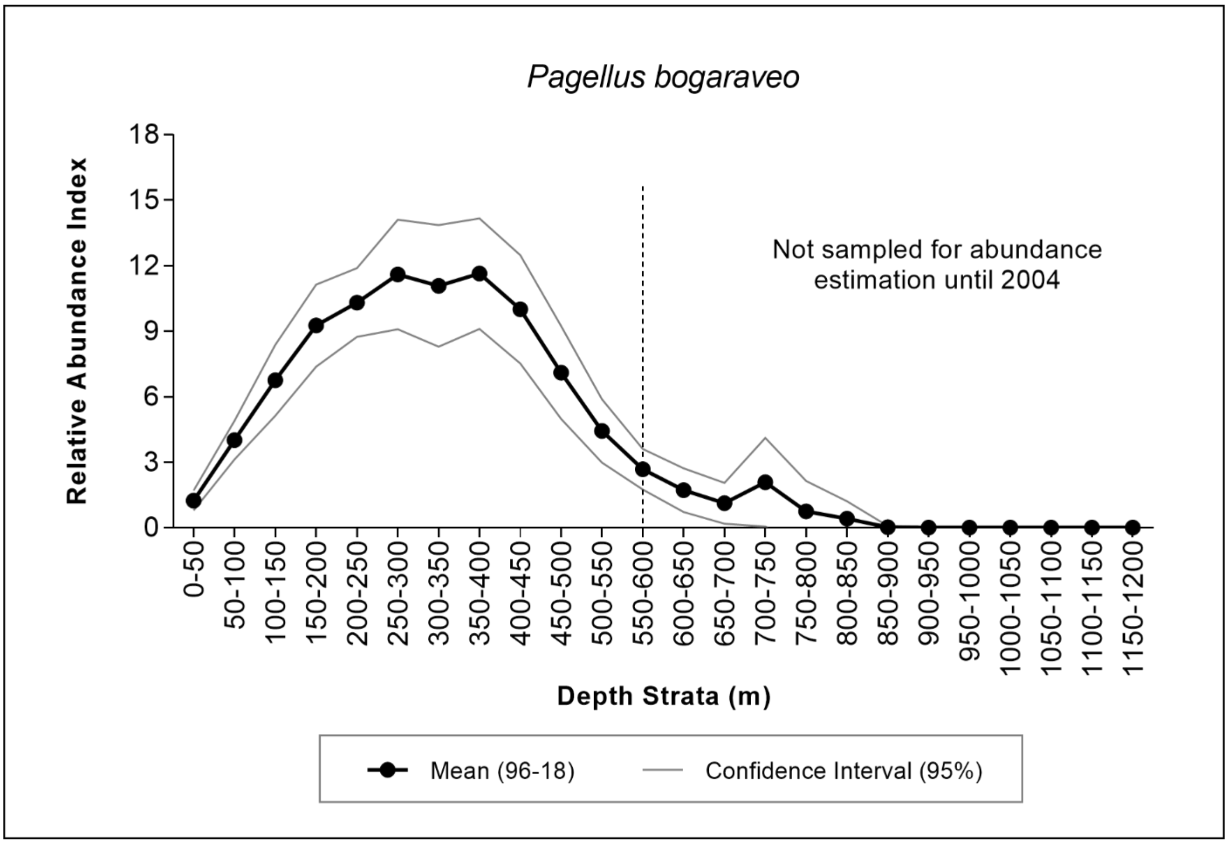


Figure 1(Cont.). Annual bottom longline survey abundance index in number available for some of the Azorean deep-water species (1995-2018).

Distribution by depth



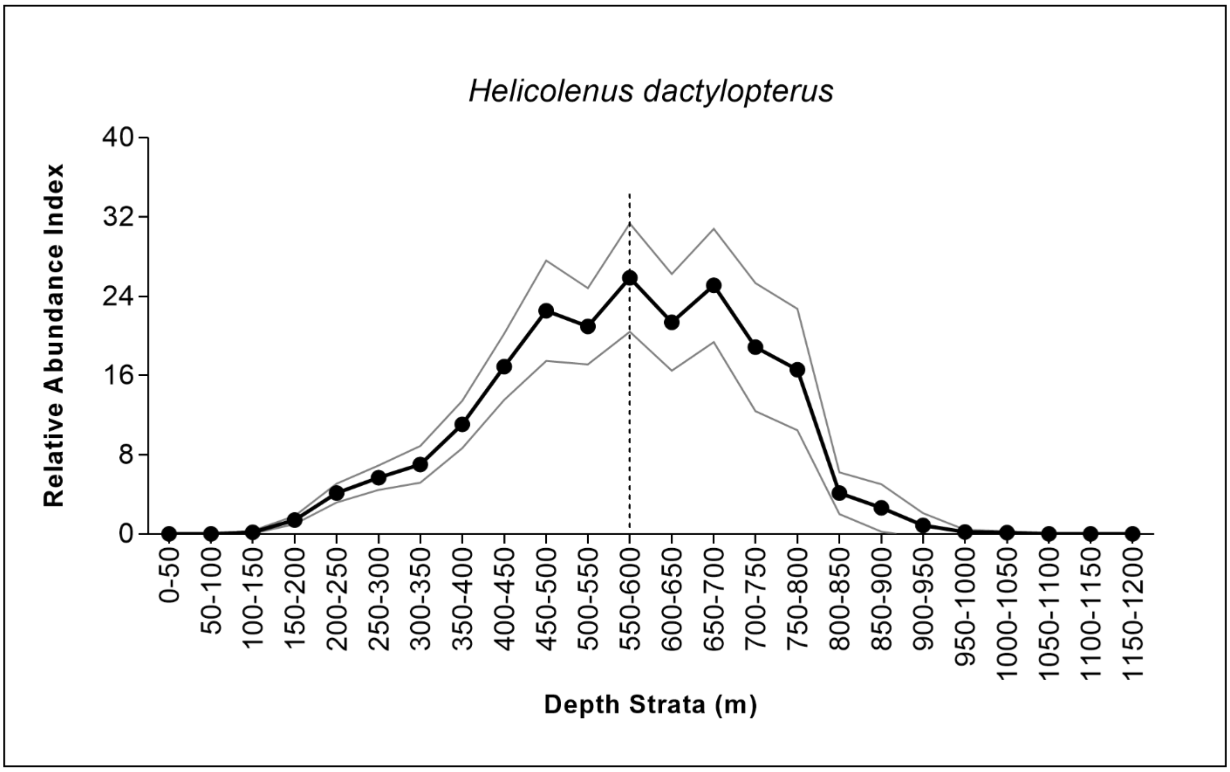
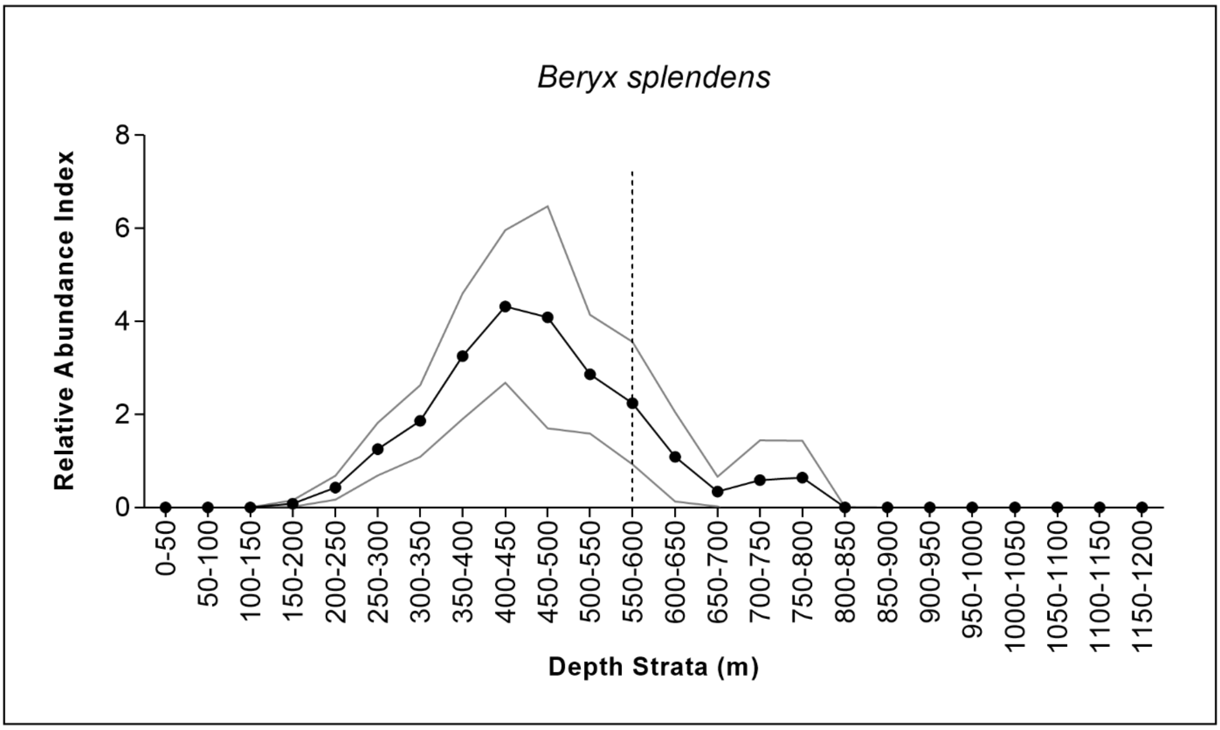


Figure 2.Mean abundance index by depth stratum for the period 1996-2018.



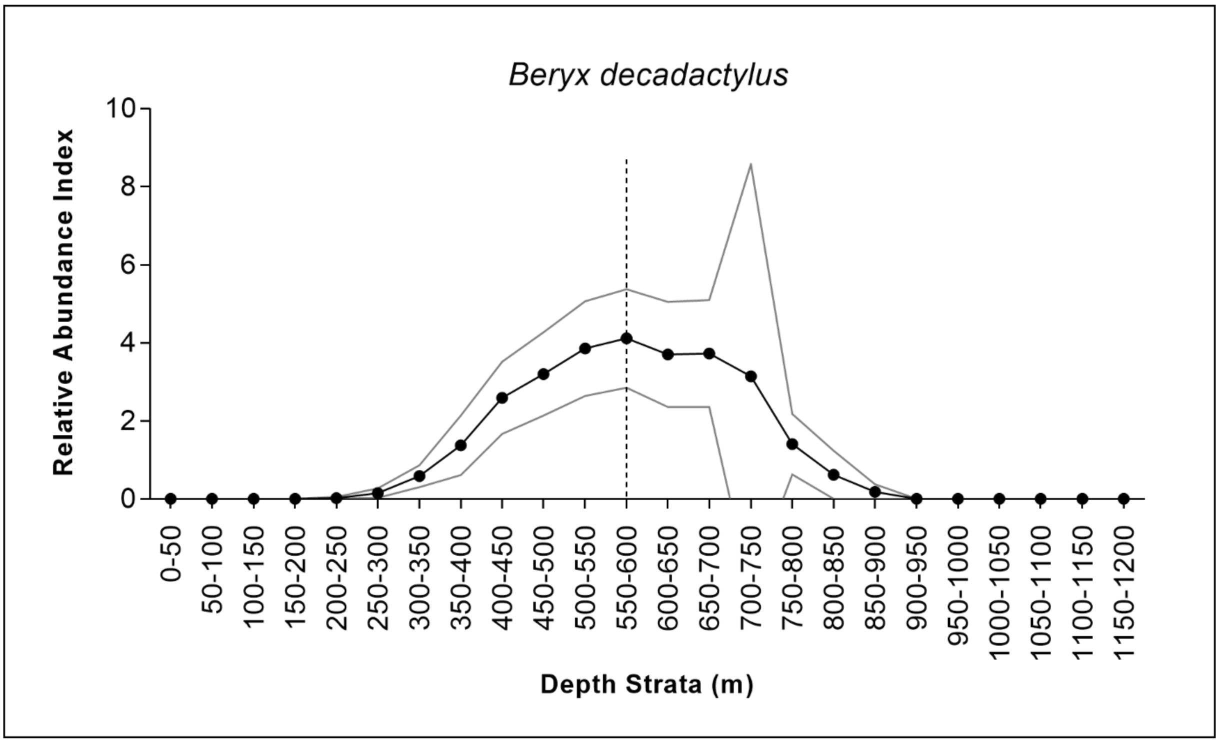
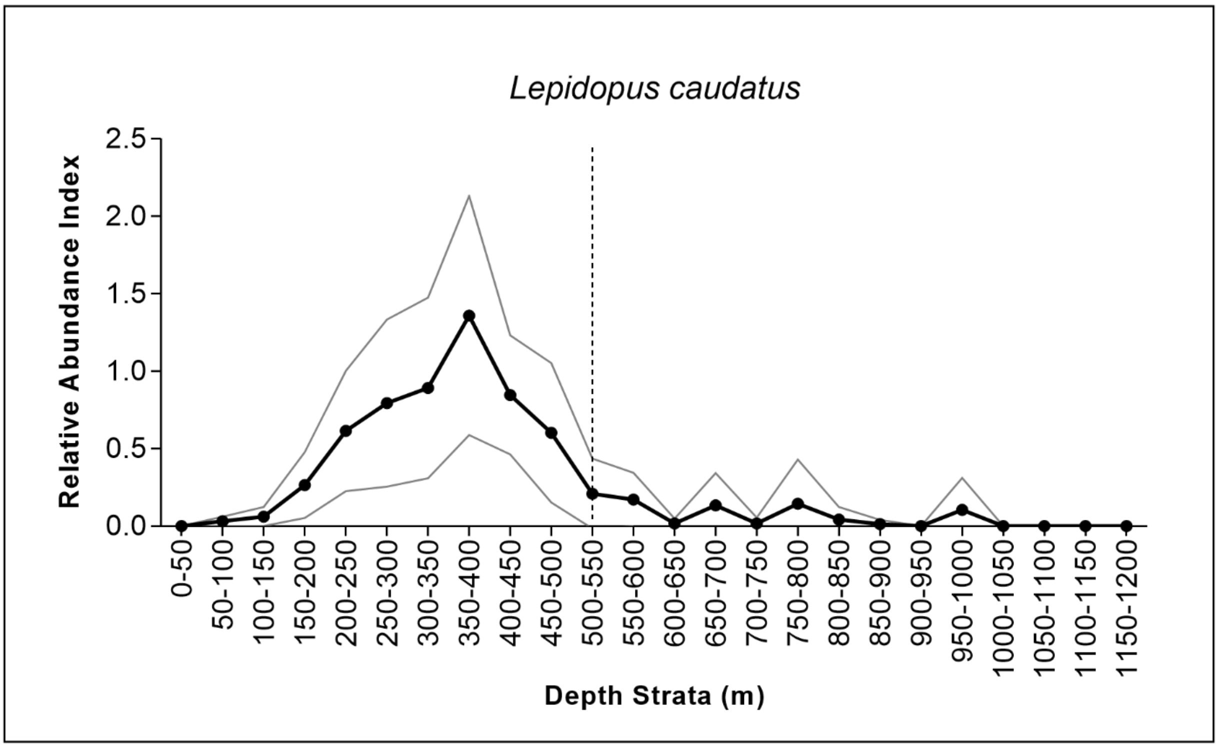


Figure 2 (Cont). Mean abundance index by depth stratum for the period 1996-2018.



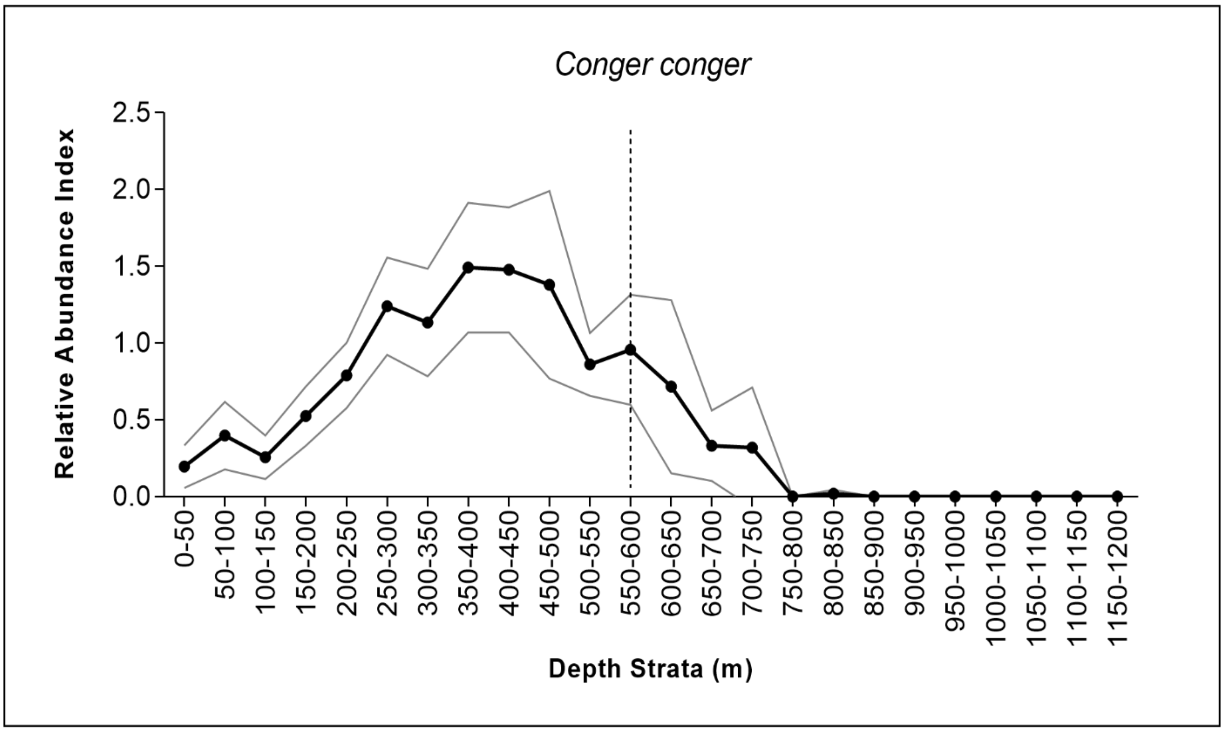
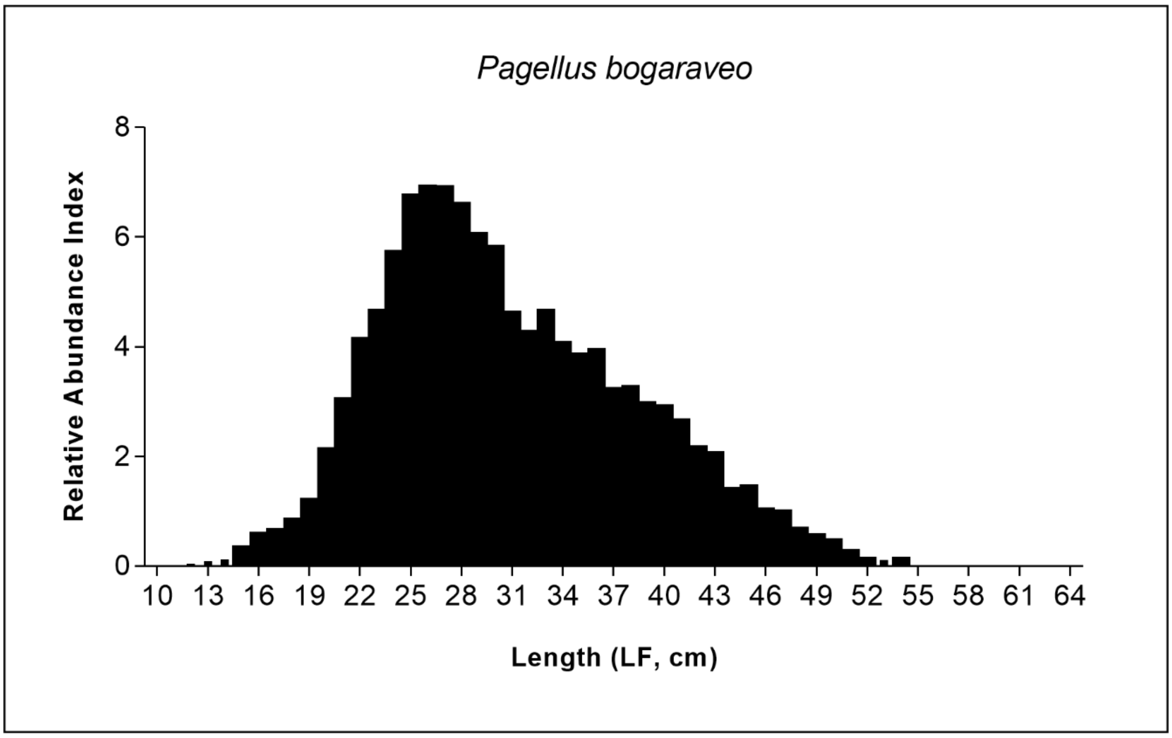


Figure 2 (Cont). Mean abundance index by depth stratum for the period 1995-2018.

Length composition



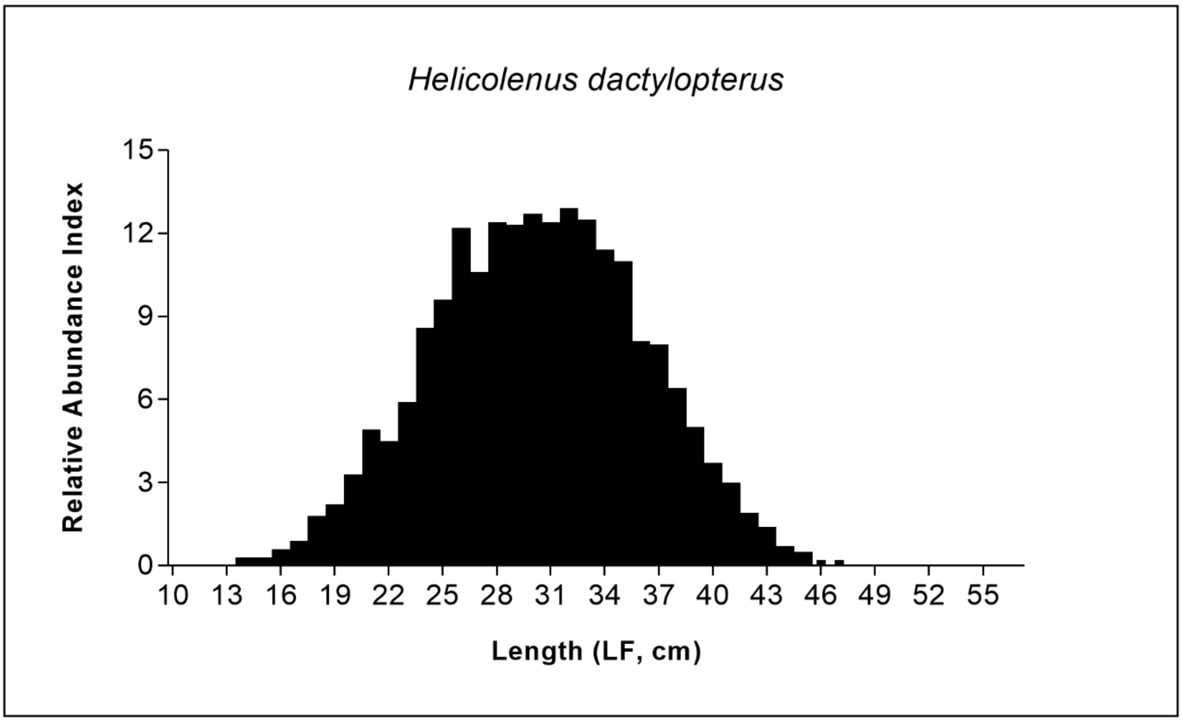
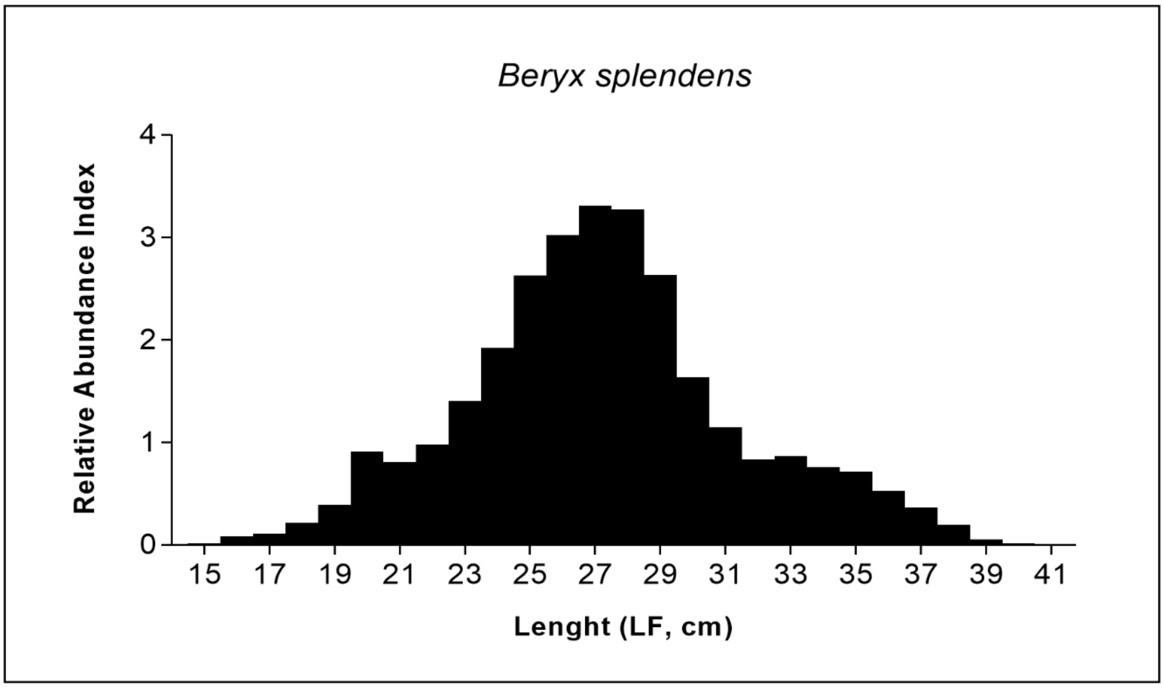


Figure 3. Mean length composition for the period 1995-2018 for some of the Azorean deep-water species.



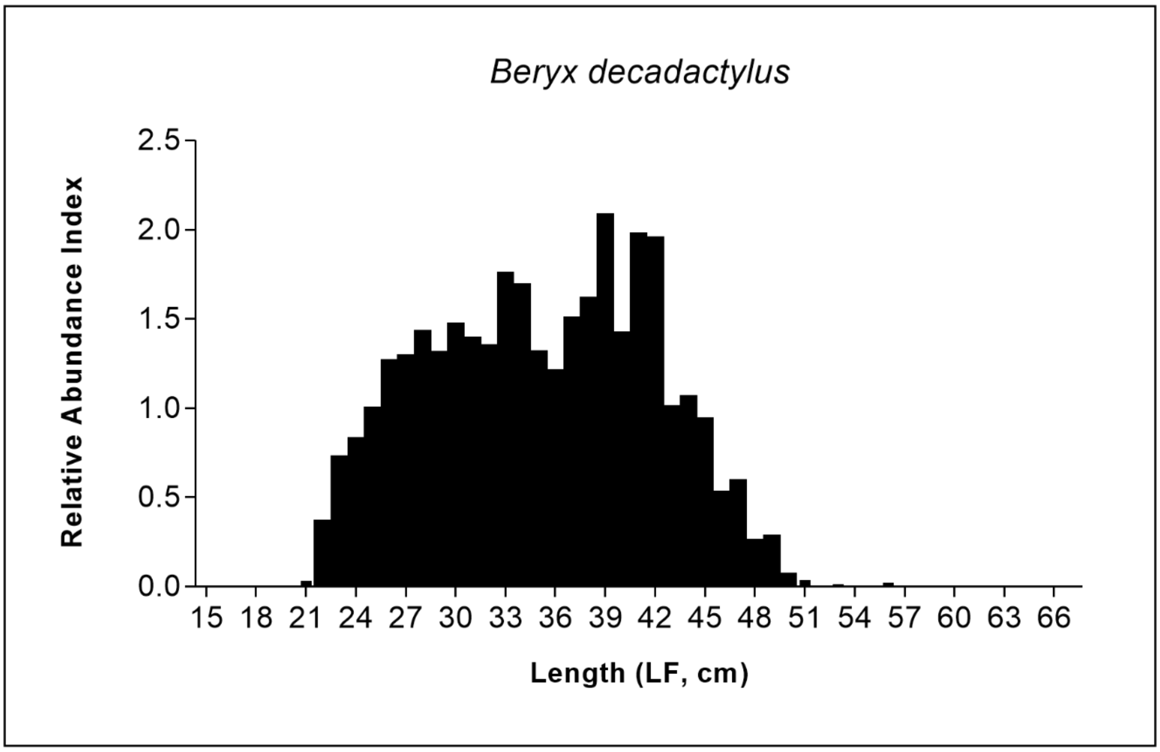
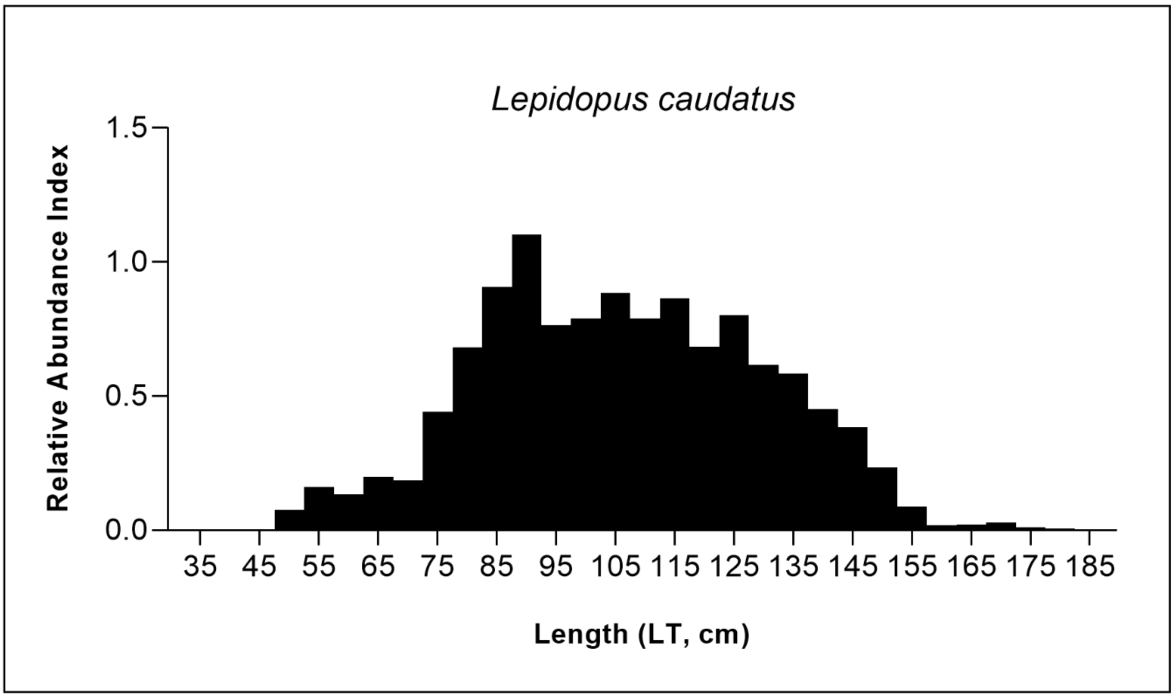


Figure 3 (Cont). Mean length composition for the period 1995-2018 for some of the Azorean deep-water.



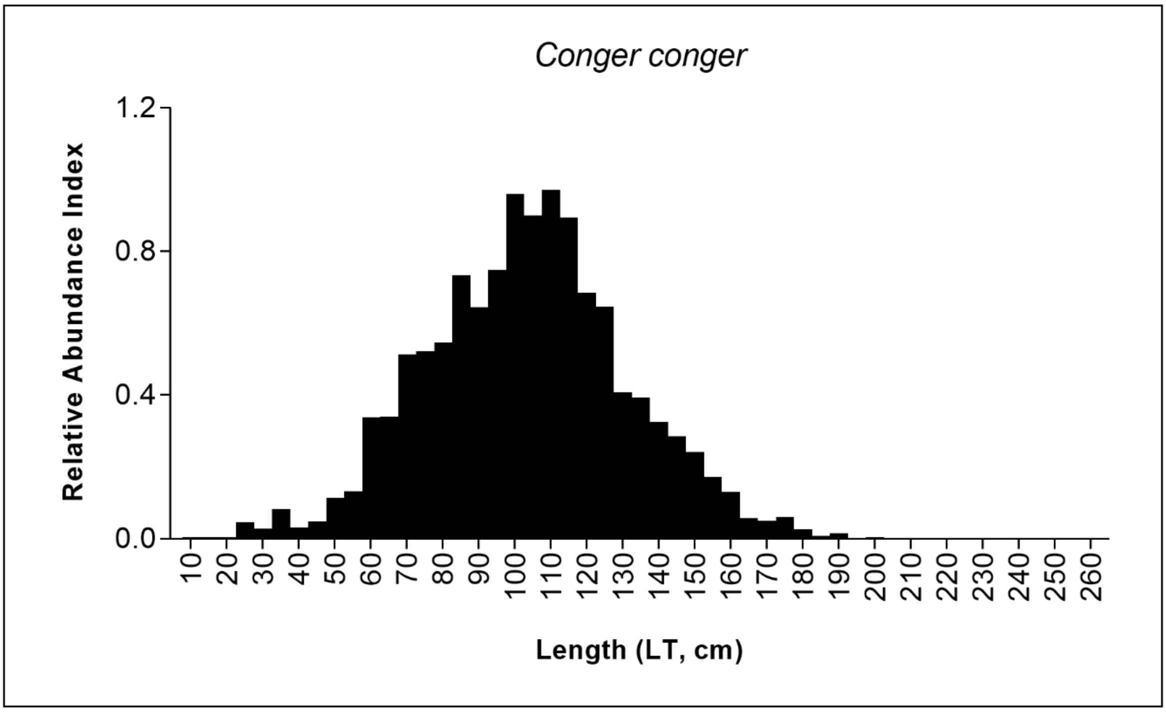
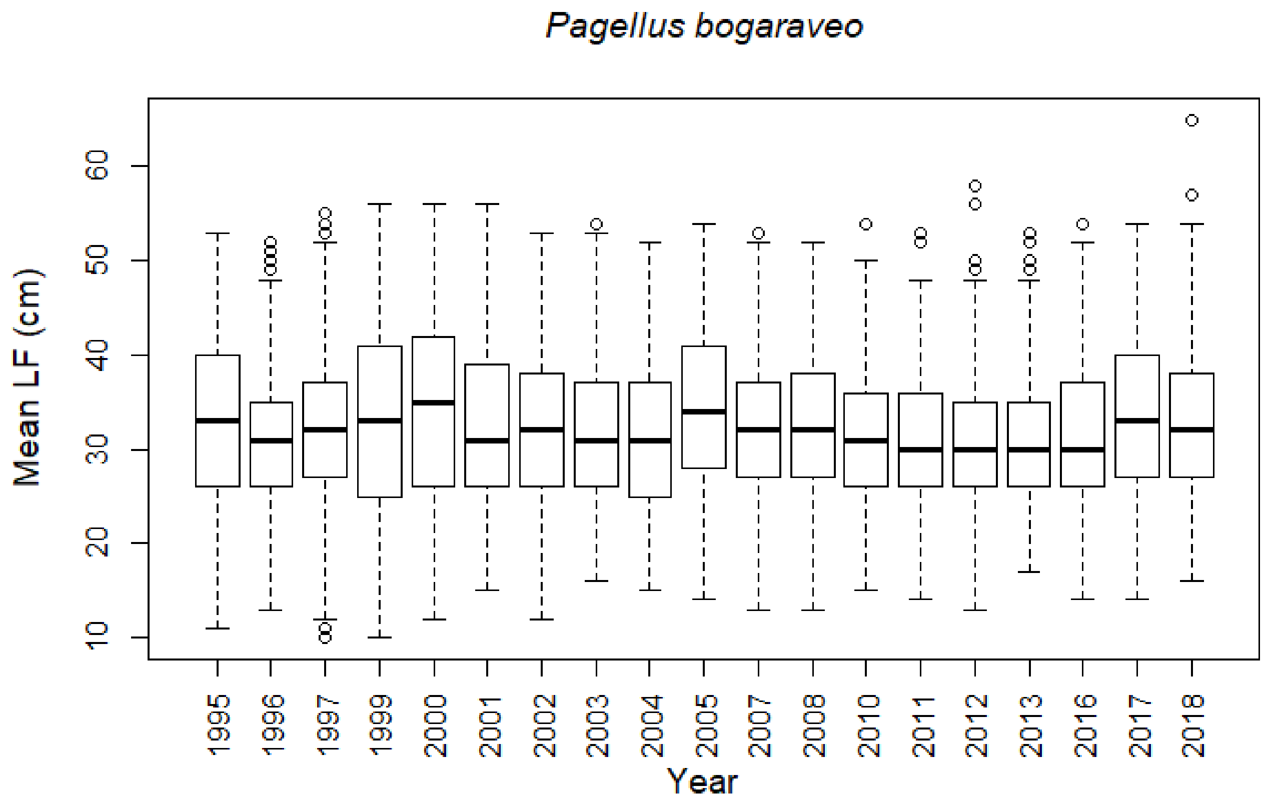


Figure 3 (Cont). Mean length composition for the period 1995-2018 for some of the Azorean deep-water species.

Mean length



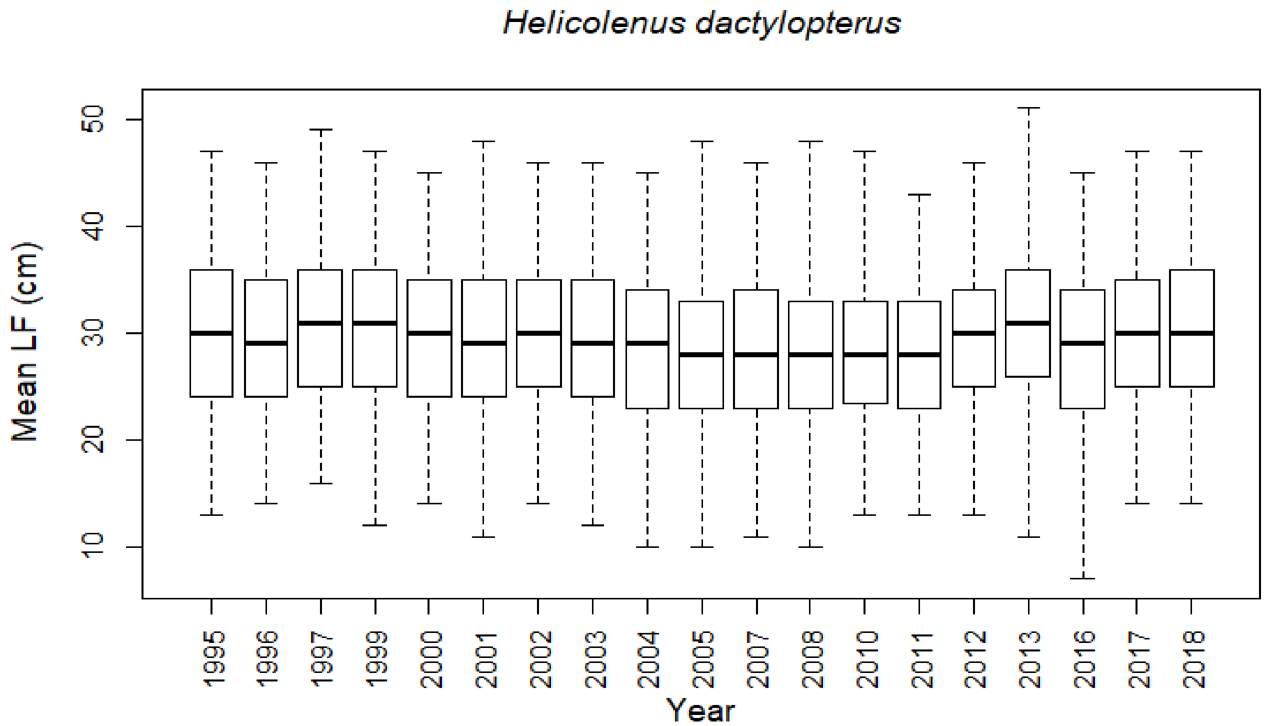
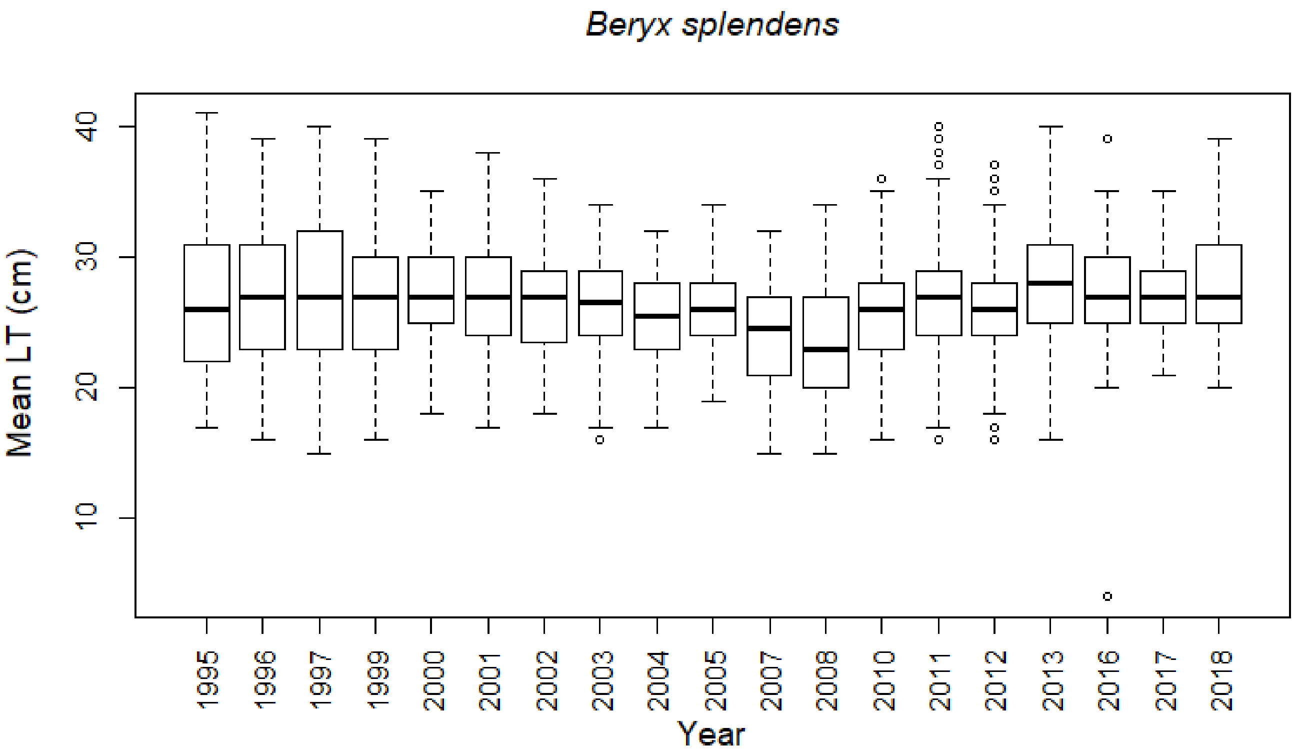


Figure 4. Annual mean length for some deep-water species.



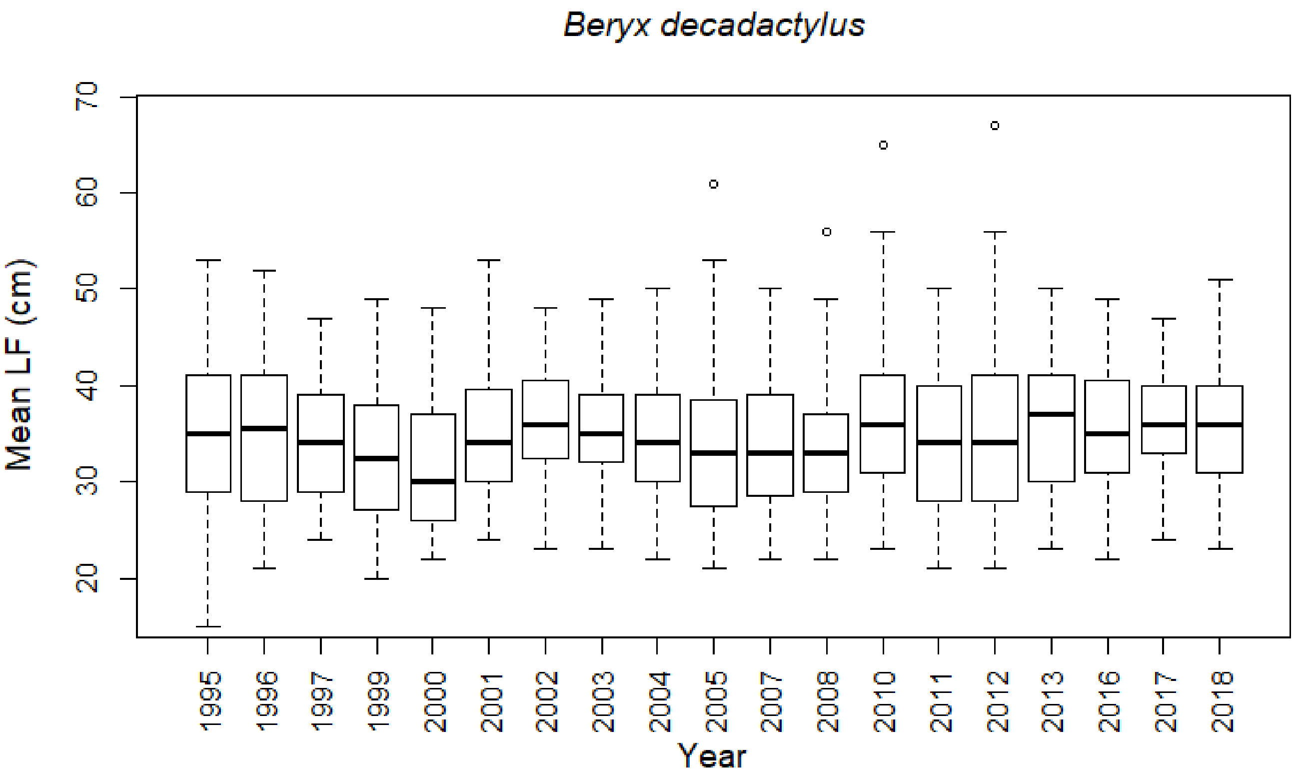


Figure 4 . (Cont) Annual mean length for some deep-water species.

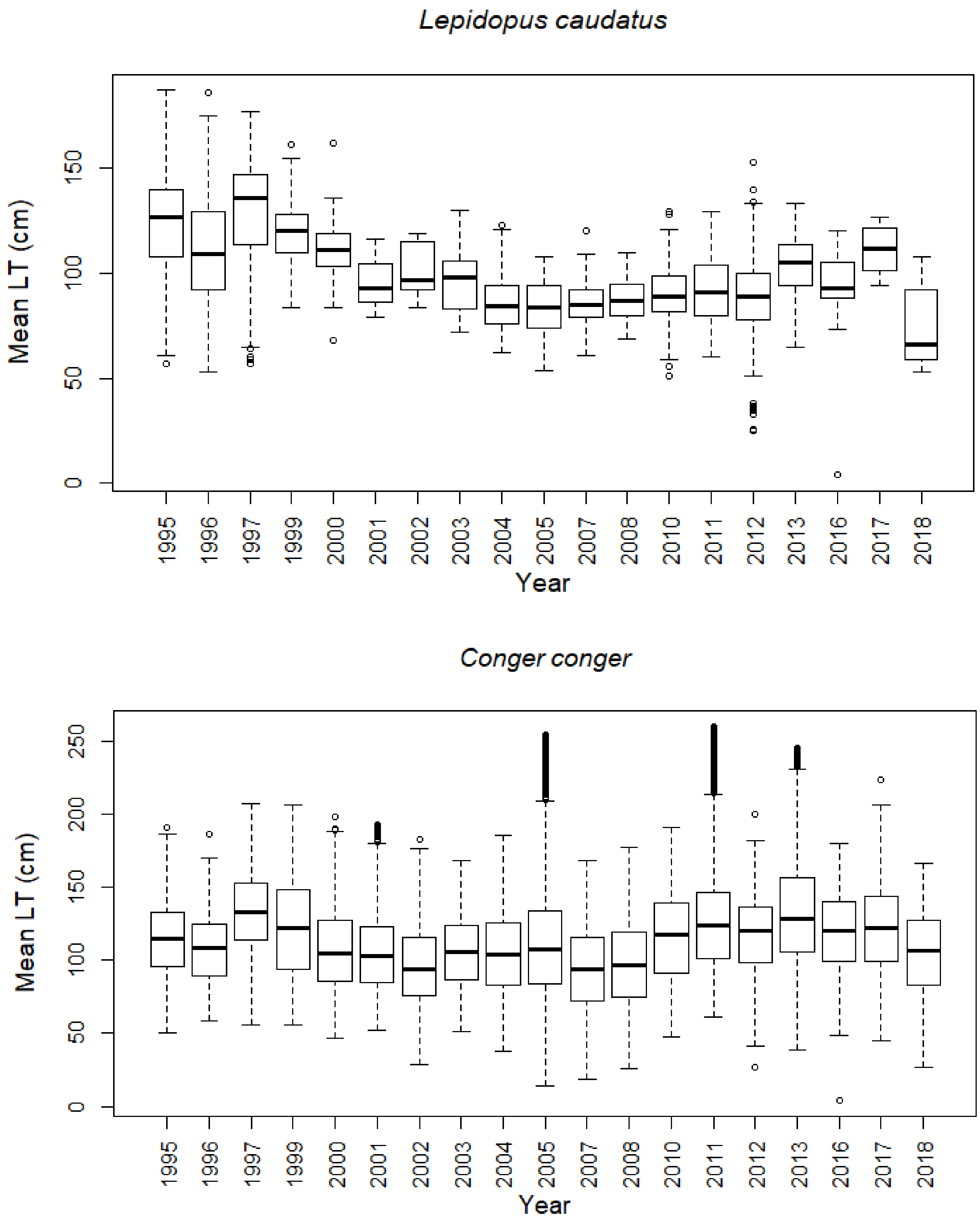


Figure 4 (Cont). Annual mean length for some deep-water species.

Annex I: Other specie

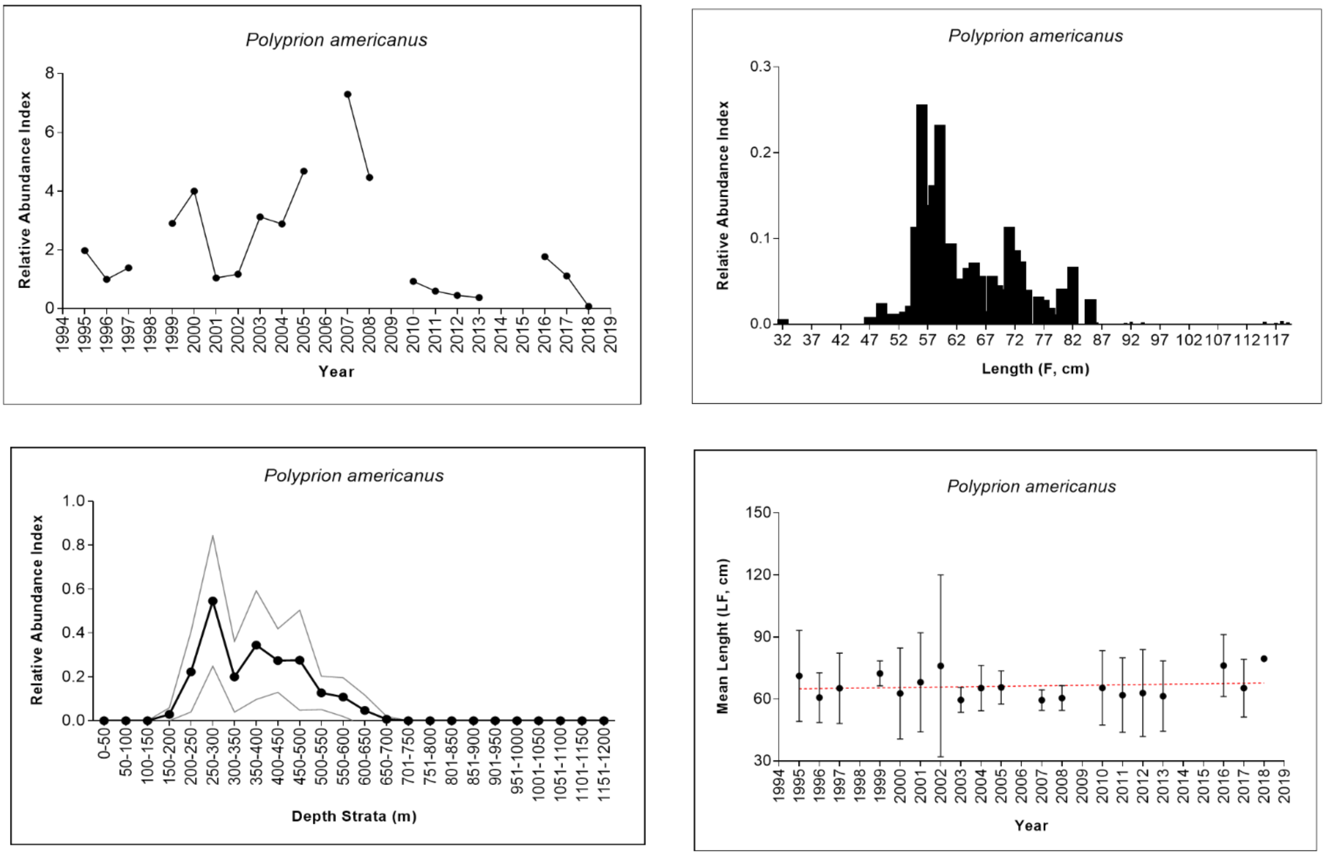


Figure I.1. Resumed survey information for *Polyprion americanus*.

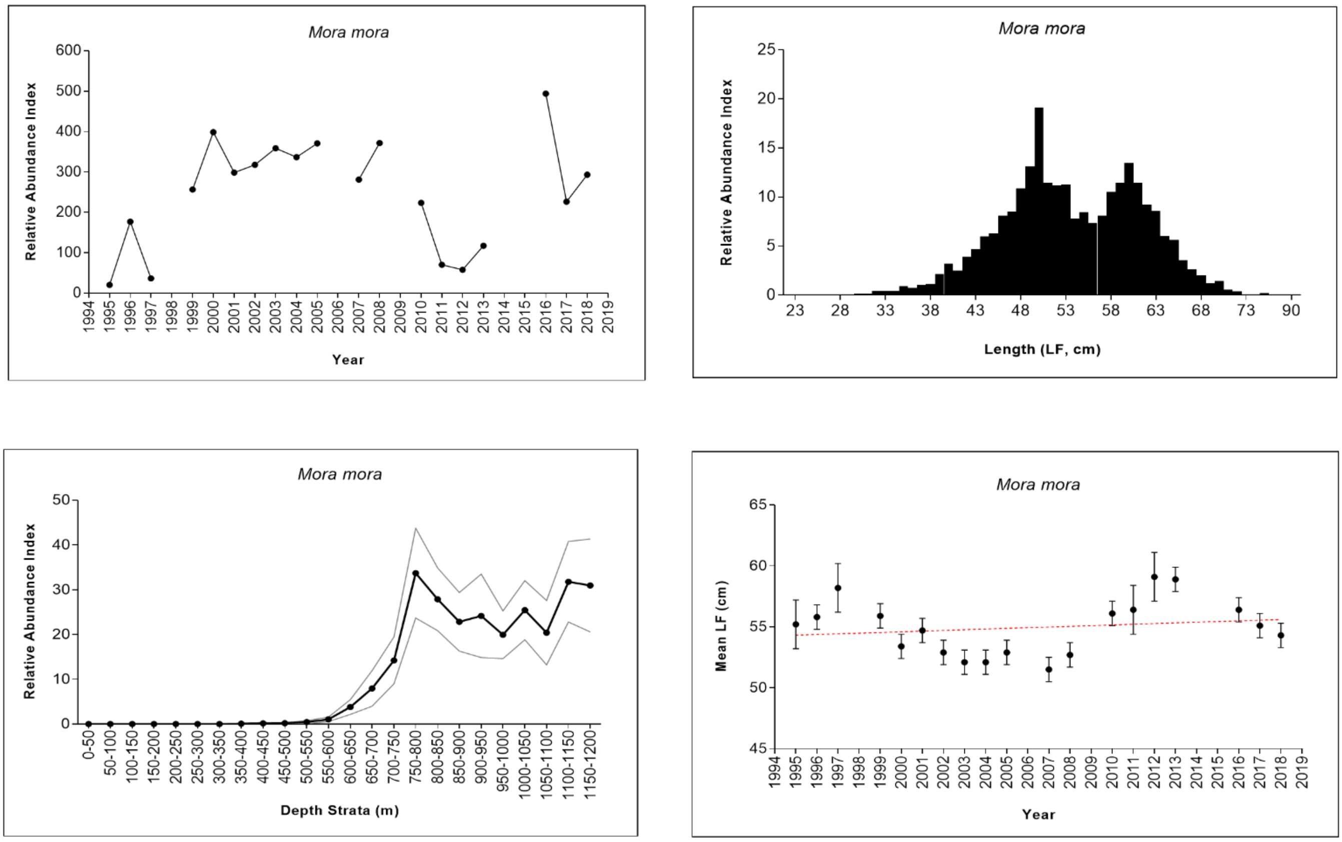


Figure I.2. Resumed survey information for *Mora mo*ro.

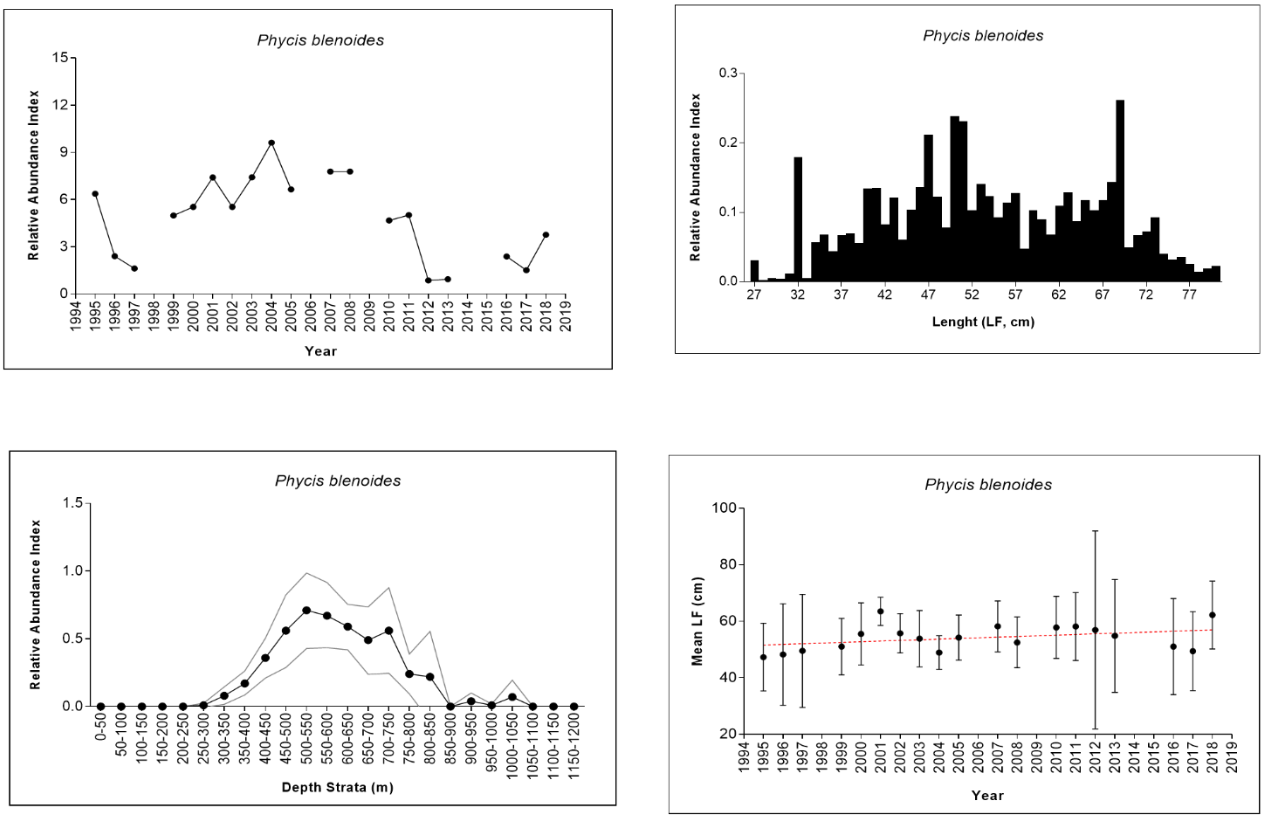


Figure I.3. Resumed survey information for *Phycis blenoides*.

PFA report for WGDEEP 2019

Martin Pastoors, 04/05/2019 11:13:27

Summary

This report summarizes the self-sampling data collected by the Pelagic Freezer-trawler Association (PFA) with a focus on Argentines or Silversmelts. The self-sampling data consists of two main sources: (1) the historical catch per haul data derived from a limited number private logbooks of skippers, and (2) the self-sampling program that has been initiated from 2015 onwards on an increasing number of freezer-trawlers. The self-sampling program has standardized and harmonized the existing practice in the freezer-trawler fisheries where skippers would keep catch per haul data and several gear and position characteristics for their own future reference. In addition, the self-sampling program includes some information on the biological composition of the catches and on some vessels additional length samples are taken to derive length frequencies.

A standardized CPUE series is presented based on a GLM on logcpue with year, vessel and depth as explanatory variables. An exploration is presented of using two alternative assumptions: without increase in technical efficiency and with a 2% increase in technical efficiency. The latter represents a generally assumed increase in efficiency of fishing vessels.

1 Introduction

The Pelagic Freezer-trawler Association (PFA) is an association that has ten member companies that together operate 19 (in 2018) freezer trawlers in six European countries (www.pelagicfish.eu). In 2015, the PFA has initiated a self-sampling programme that expanded the ongoing monitoring programmes on board of pelagic freezer-trawlers by the specialized crew of the vessels. The primary objective of that monitoring programme is to assess the quality of fish. The expansion in the self-sampling programme consists of recording of haul information, recording the species compositions per haul and regularly taking random length-samples from the catch. The self-sampling is carried out by the vessel quality managers on board of the vessels, who have a long experience in assessing the quality of fish, and by the skippers/officers with respect to the haul information. The scientific coordination of the self-sampling programme is carried out by Martin Pastoors (PFA chief science officer) with support of Floor Quirijns (contractor).

The self-sampling information is collected using standardized and protected Excel worksheets. Each participating vessel will send in the information collected during a trip by the end of the trip. The data will be checked and added to the database by Floor Quirijns and/or Martin Pastoors, who will also generate standardized trip reports (using RMarkdown) which will be sent back to the vessel within one or two days. The compiled data for all vessels is being used for specific purposes, e.g. reporting to expert groups, addressing specific fishery or biological questions and supporting detailed biological studies. The PFA publishes an annual report on the self-sampling programme.

The historical data retrieval program has been based on skippers' private logbooks that have been kept for fisheries practice recording. This data delivers information on the catch composition by haul and species. As part of a generic effort to retrieve the historical information, excel based versions of the logbooks have been converted into a standardized database. A major effort has been spent in making the information from the skippers' logbooks consistent and useable, so that the units are consistent between vessels and years. In addition, the species composition has been approximated from the logbooks using automated techniques. For example, skippers may have described the catch of a certain haul as "her 10% hom" which would then be converted to 90% herring and 10% horse mackerel. All conversion have been fully documented in R code. For this report, skippers' logbooks of 4 vessels have been used covering the period 2000-2015. Skippers' logbooks for two more vessels are also available but have not been fully processed and checked at the time of the WGDEEP 2018 meeting.

The freezer-trawler fishery is mostly focussed on the key target species herring, mackerel, horse mackerel and blue whiting. However, during the months april to june there is also a more limited directed fishery for greater argentine (Argentina silus) and lesser argentine (Argentina sphyraena), mostly in ICES division 27.6.a and 27.4.a. Trips were selected when at least 50 tonnes of argentines was caught during a trip. Because there is some uncertainty on the species allocation, the results are only presented on the supra-level of argentines (arg) and not on the individual species.

2 Results

Overview of trips, catches and sampling

An overview of all the self-sampling trips in 2001-2019 during which at least 50 tonnes of argentines were taken, is shown in Table 1. All argentine species have been combined (i.e. greater silversmelt and lesser silversmelt). The number of vessels for which information is available prior to 2015 is somewhat limited because only a few of the vessels for which data is available participated in the fishery for silversmelt. From 2015 onwards (the start of the self-sampling program) there has been an expansion of the number of vessels involved and a standardization of methodologies.

year	nvessels	ntrips	ndays	nhauls	catch	nlength	catch/trip	catch/day	catch/haul
2001	1	1	21	69	3,760	0	3,760	179	54
2003	1	1	28	72	3,882	0	3,882	138	53
2004	1	2	53	133	7,595	0	3,797	143	57
2005	1	1	24	42	4,220	0	4,220	175	100
2006	1	1	33	54	4,260	0	4,260	129	78
2007	1	1	29	67	3,710	0	3,710	127	55
2008	1	1	22	50	3,735	0	3,735	169	74
2012	1	2	45	118	5,664	0	2,832	125	48
2013	1	1	19	42	1,605	0	1,605	84	38
2014	1	1	28	55	3,901	0	3,901	139	70
2015	3	4	77	165	12,570	37,290	3,142	163	76
2016	3	5	124	273	21,804	19,722	4,360	175	79
2017	4	4	74	195	19,164	22,682	4,791	258	98
2018	9	9	185	475	36,843	39,999	4,093	199	77
2019*	2	2	25	62	7,708	2,694	3,854	308	124
(all)	.	36	787	1,872	140,421	122,387	.	.	.

Table 1: PFA selfsampling summary of argentine trips (>50 ton/trip) with the number of days, hauls, trips, vessels, catch (tonnes), number of fish measured and average catch rates (ton/trip, ton/day, ton/haul). The asterisk indicates a partial year.

In the following table, only the data on argentines are selected.

year	nvessels	ntrips	ndays	nhauls	catch	nlength	catch/trip	catch/day	catch/haul
2001	1	1	7	10	128	0	128	18	12.8
2003	1	1	14	32	821	0	821	59	25.7
2004	1	2	27	71	2,556	0	1,278	95	36
2005	1	1	4	5	137	0	137	34	27.4
2006	1	1	5	8	235	0	235	47	29.4
2007	1	1	12	26	731	0	731	61	28.1
2008	1	1	7	15	219	0	219	31	14.6
2012	1	2	25	71	1,271	0	636	51	17.9
2013	1	1	11	23	127	0	127	12	5.5
2014	1	1	18	34	259	0	259	14	7.6
2015	3	4	60	132	2,978	12,067	744	50	22.6
2016	3	5	78	152	2,808	1,867	562	36	18.5
2017	4	4	54	102	2,577	1,023	644	48	25.3
2018	9	9	141	327	4,092	3,028	455	29	12.5
2019*	2	2	10	21	627	174	314	63	29.9
(all)	.	36	473	1,029	19,566	18,159	.	.	.

Table 2: PFA selfsampling summary for ARGENTINES only with the number of days, hauls, trips, vessels, catch (tonnes), number of fish measured and average catch rates (ton/trip, ton/day, ton/haul). The asterisk indicates a partial year.

Species composition

Species compositions in self-sampled fisheries for argentines were derived from the descriptions within the skippers' logbooks or from the estimated species compositions by haul. Table 2 summarizes the total catch of argentines and all other species combined during those trips. During the fisheries of freezer-trawlers, multiple fisheries and area may be carried out during a single trip, so that the catches of other species than silversmelt could have been taken in different areas.

species	englishname	2001	2003	2004	2005	2006	2007	2008	2012	2013	2014	2015	2016	2017	2018	2019
arg	argentines	128	821	2,556	138	236	731	220	1,272	127	259	2,979	2,808	2,577	4,093	628
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
whb	blue whiting	2,971	1,184	3,724	4,082	3,174	810	3,514	1,672	1,446	3,591	8,877	17,839	15,760	30,464	6,954
her	herring	0	1,878	1,315	0	813	2,139	0	0	0	0	550	0	0	1,270	0
hom	horse mackerel	0	0	0	0	0	0	0	2,187	20	0	20	202	156	181	0
mac	mackerel	661	0	0	0	7	26	0	404	2	14	34	163	569	517	126
hke	hake	0	0	0	0	0	0	0	104	9	36	100	751	94	243	0
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
oth	.	0	0	0	0	30	3	1	25	2	0	11	110	9	73	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
(all)	(all)	3,760	3,882	7,595	4,220	4,260	3,710	3,735	5,664	1,605	3,901	12,570	21,873	19,163	36,840	7,709

Table 3: Total catch (tonnes) by species in PFA self-sampled fisheries for argentines. Main species

Catch rates by haul

Catch rates of Argentines during trips when a certain amount of argentines were caught during a trip (>50 tonnes). The blue dots identify the hauls during those trips where no argentines were caught.

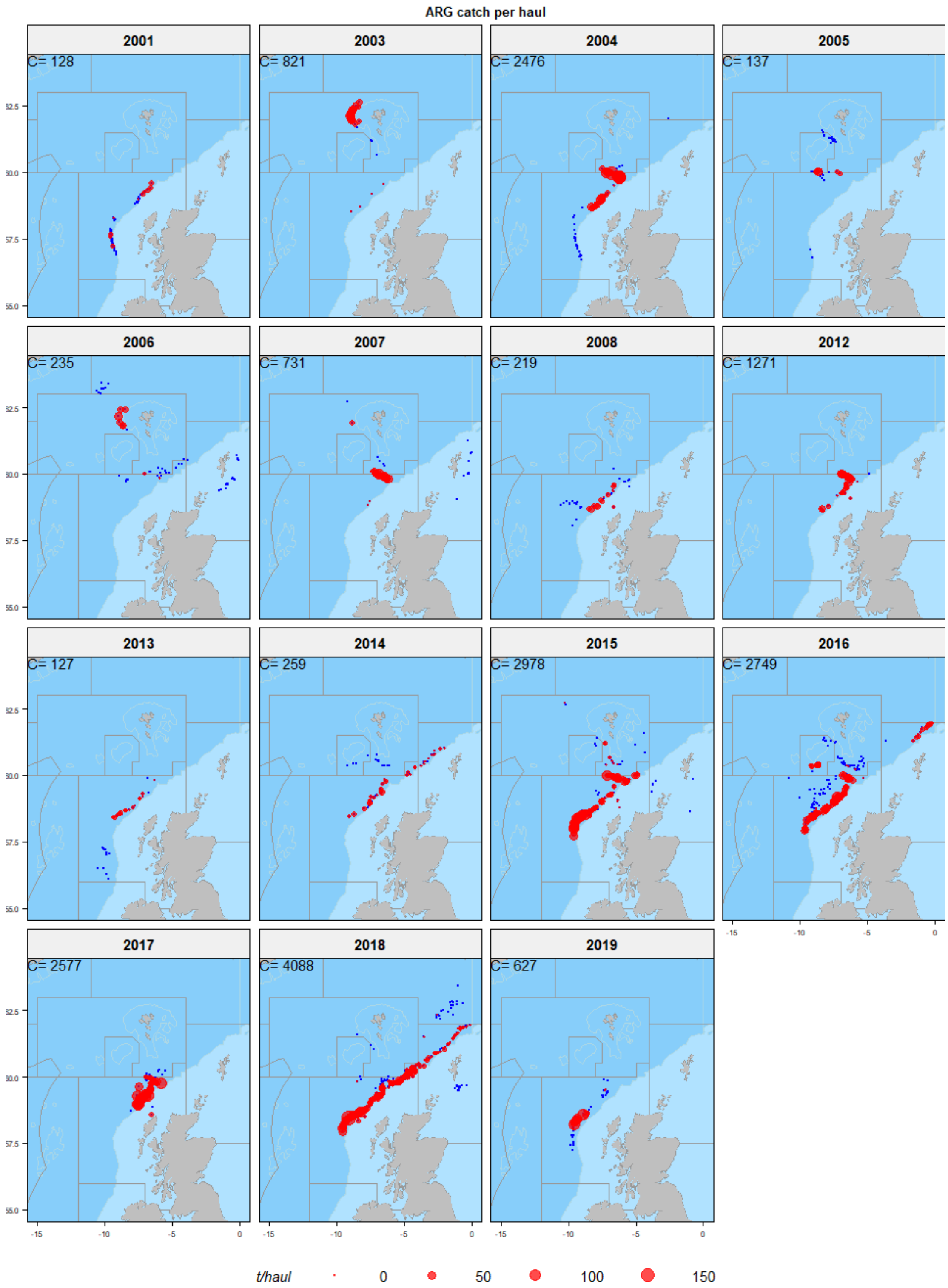


Figure 1: Catch rates of Argentines in PFA self-sampled fisheries in the Northeast Atlantic. Total self-sampled catch (C) of argentines in tonnes. Blue dots are hauls with zero catches for argentines (mostly blue whiting)

Summed catch of Argentines per half ICES square

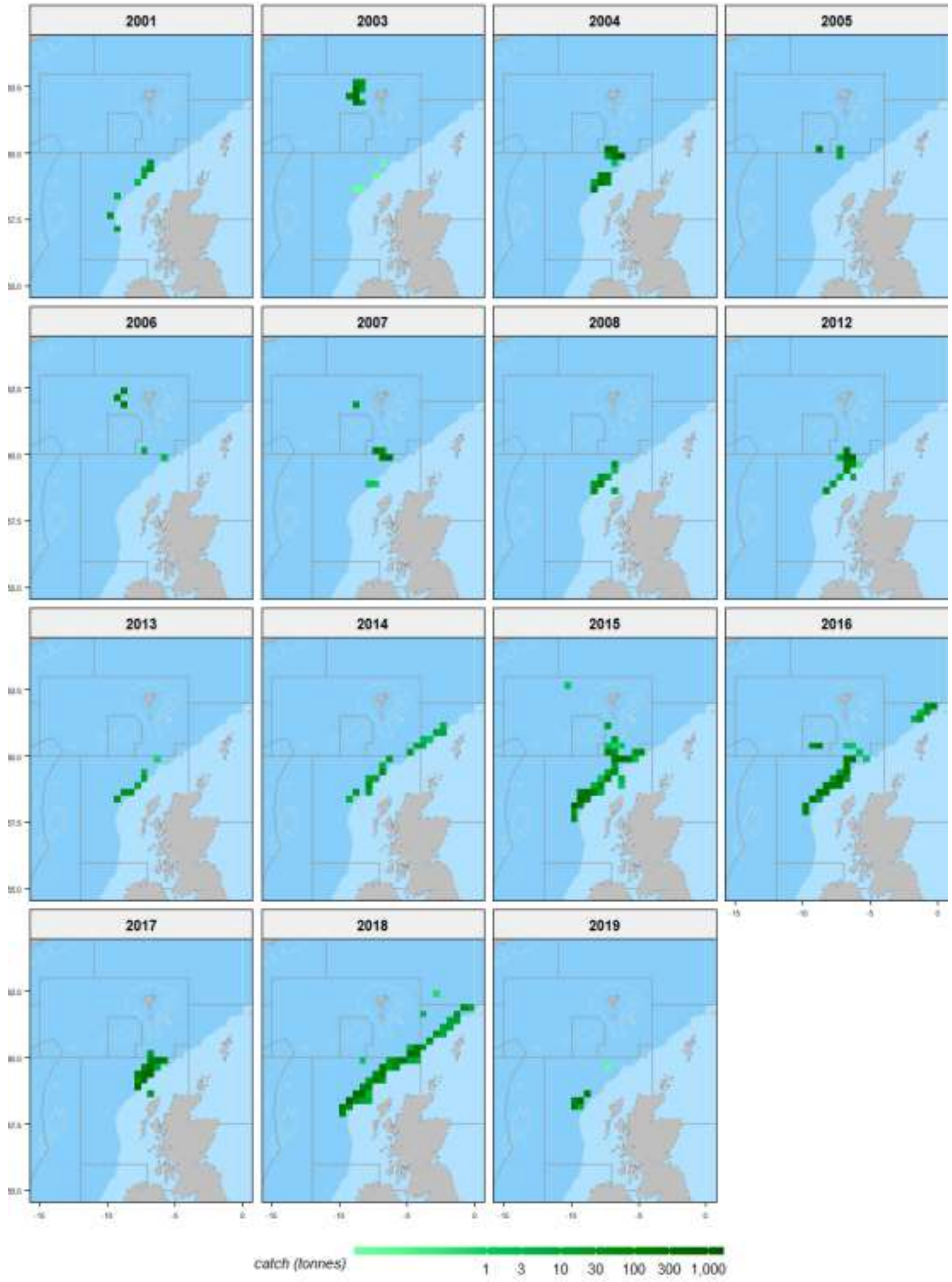


Figure 2: Catch of Argentines by half ICES rectangles in PFA self-sampled fisheries in the Northeast Atlantic. Total self-sampled catch (C) in tonnes

Length compositions

Relative length compositions of Argentines.

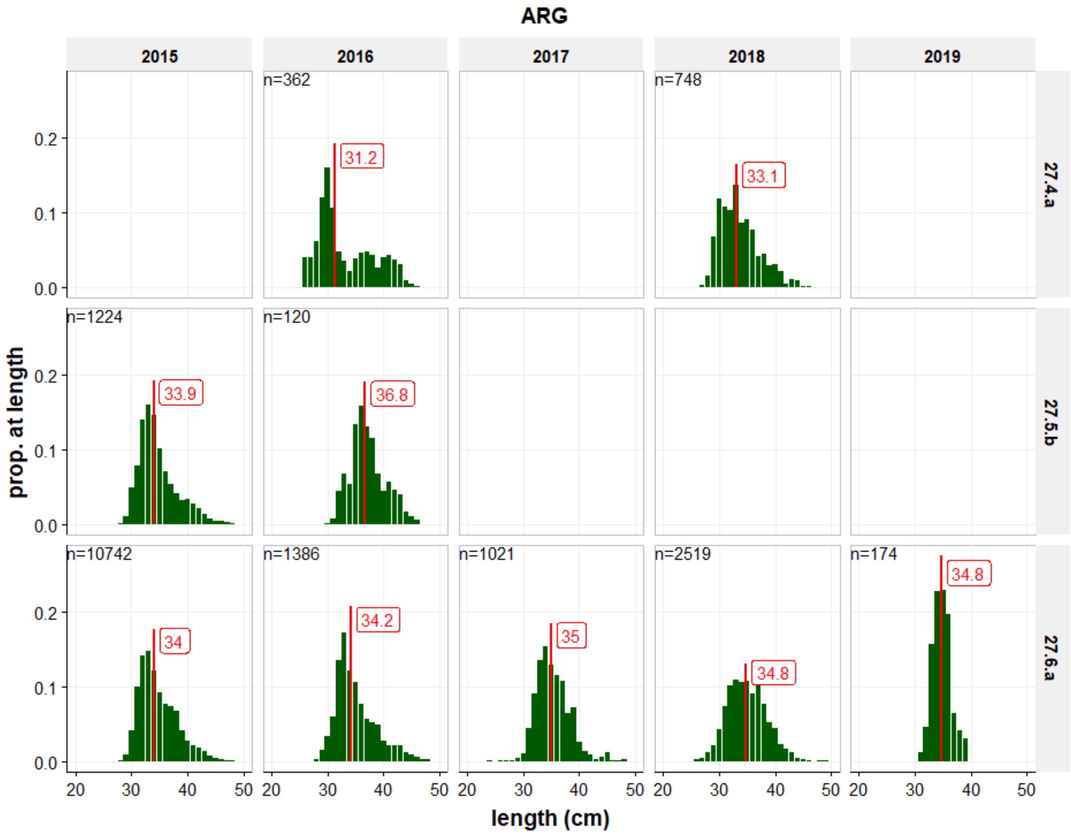


Figure 3: Relative length frequencies of argentines in PFA self-sampled fisheries in divisions 4a, 5b and 6a. Median length in red. Number of length measurements in top left

Catch at depth

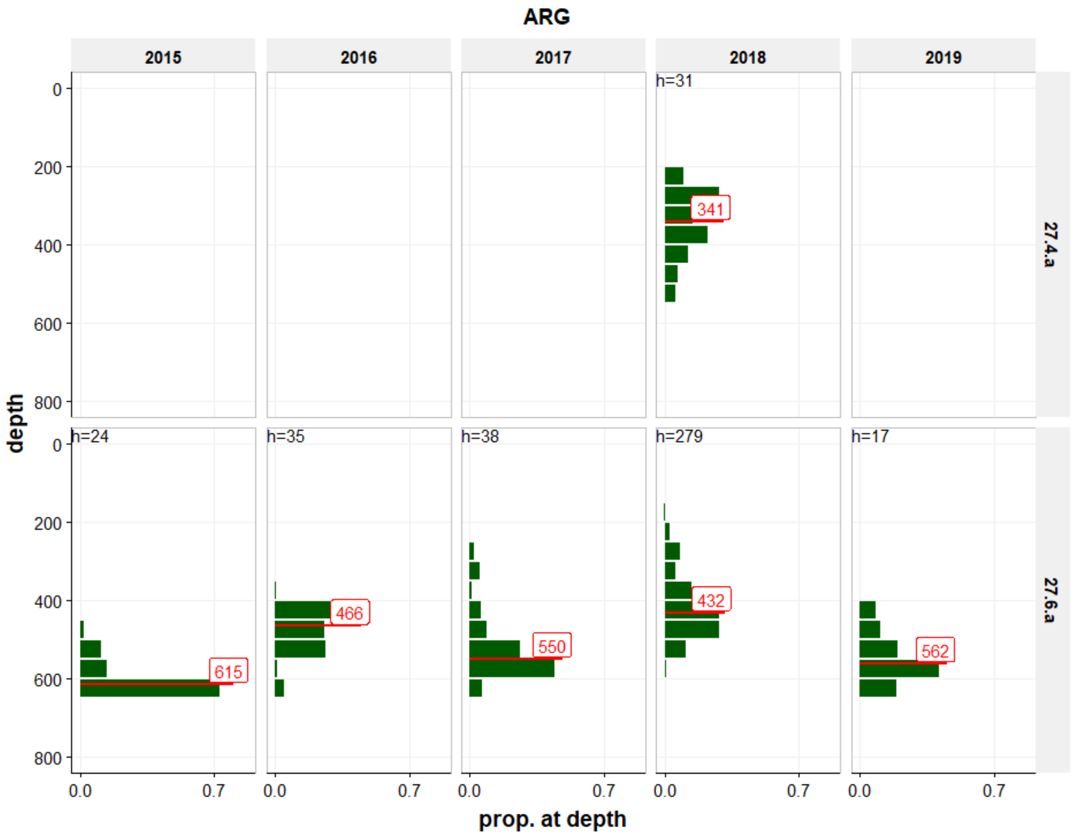


Figure 4: Relative catch at depth of argentines in PFA self-sampled fisheries in divisions 4a and 6a for trips for which depth information was available. Median depth indicated in red. Number of hauls in black. No depth information was available for trips in division 5b

CPUE index

The catch rate in the fishery for argentines can be highly fluctuating between hauls. Catch rate has been defined as catch (tons) per hour, catch per day or catch per week. Catch rates can be expressed on a nominal scale or on a log scale. Figure Average catch rates have first been calculated for each square (dx=0.5, dy=0.25) and per per vessel, where then averaged over the vessels and then averaged over the rectangles. Calculations have been carried out both on the raw catch per day and on the logged catch per day which were then back-transformed to real units. To avoid the influence of very small bycatches of argentines, the calculation of catch per hour only included hauls where the catch per hour was larger than 1 ton/hour.

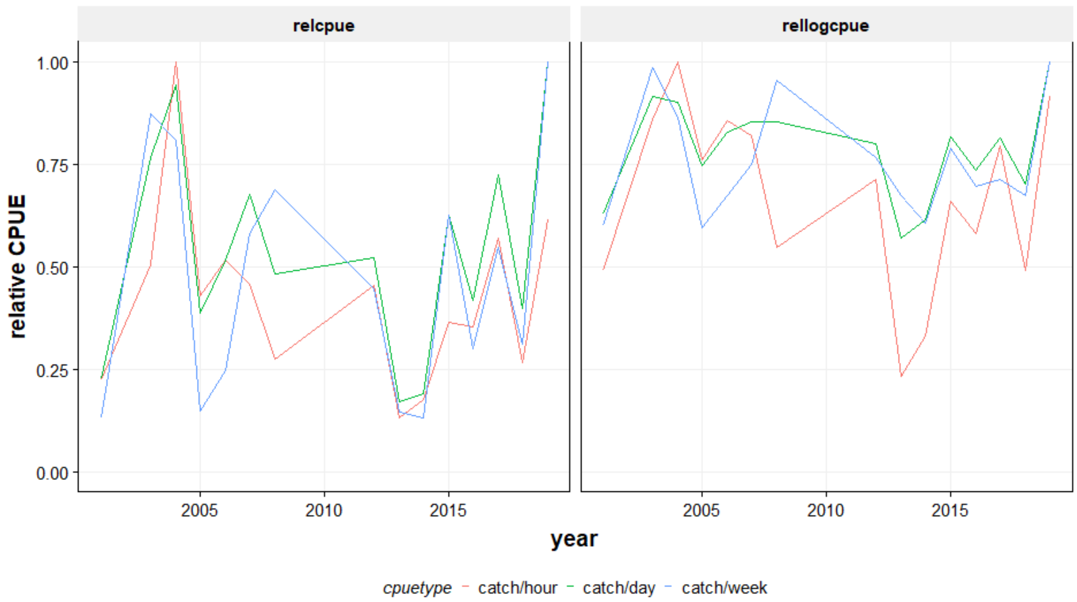


Figure 5: Argentines CPUE metrics by hour, day and week and expressed on a nominal relative scale (left) or on a logarithmic relative scale (right)

Basic GLM

The basic GLM is estimated with only the year as the explanatory variable and using the three different log CPUE metrics (catch/hour, catch/day, catch/week).

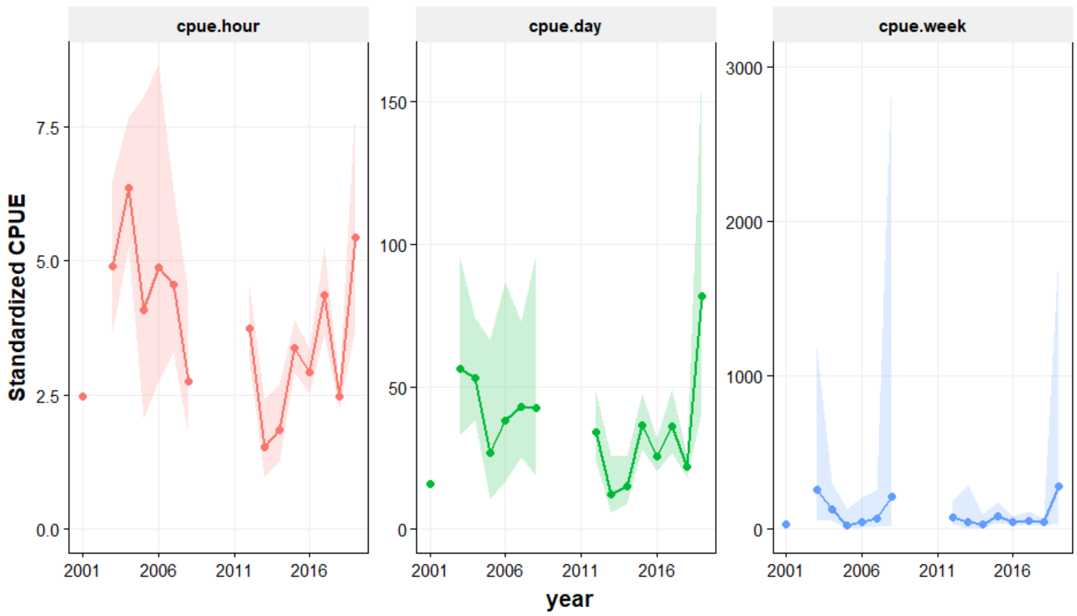


Figure 6: Argentines: Basic model fitted as GLM to logCPUE and year

Exploring the impacts of potentially other explanatory variables

Calculation of AIC values associated with different explanatory variables for argentines CPUE when using in addition to the year factor. This demonstrates that the vessel is by far the most dominant factor to take into account in the final model.

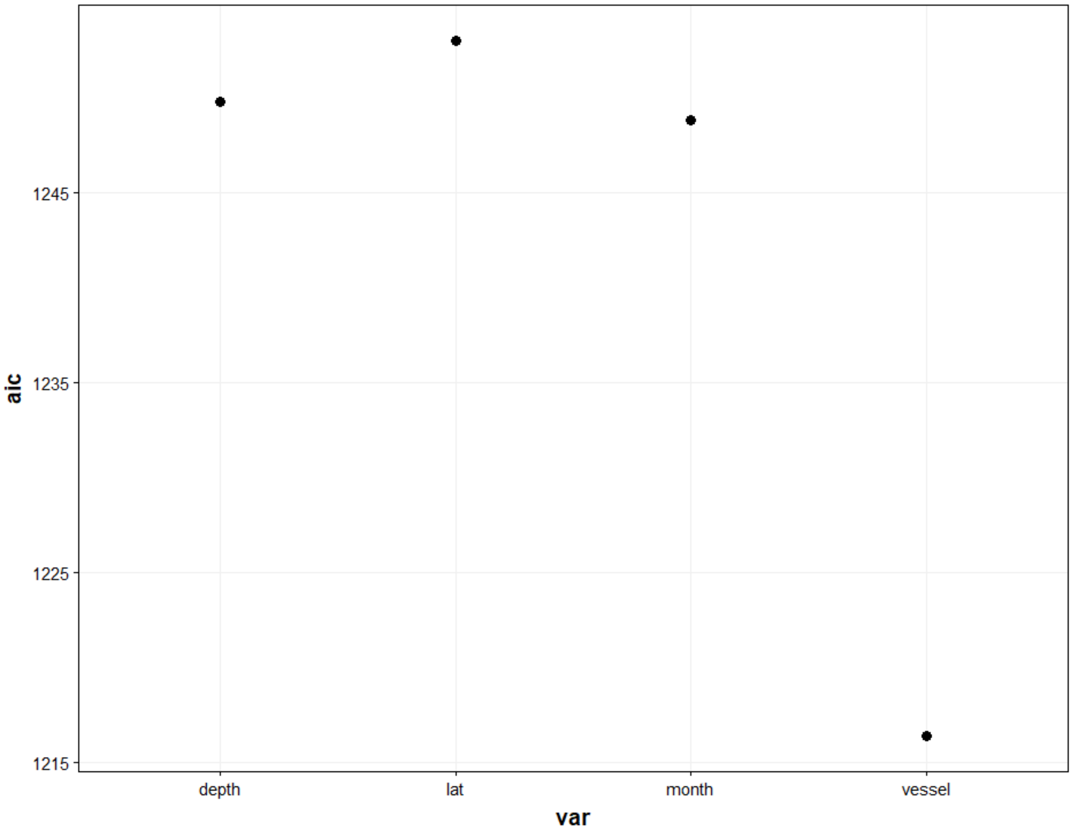
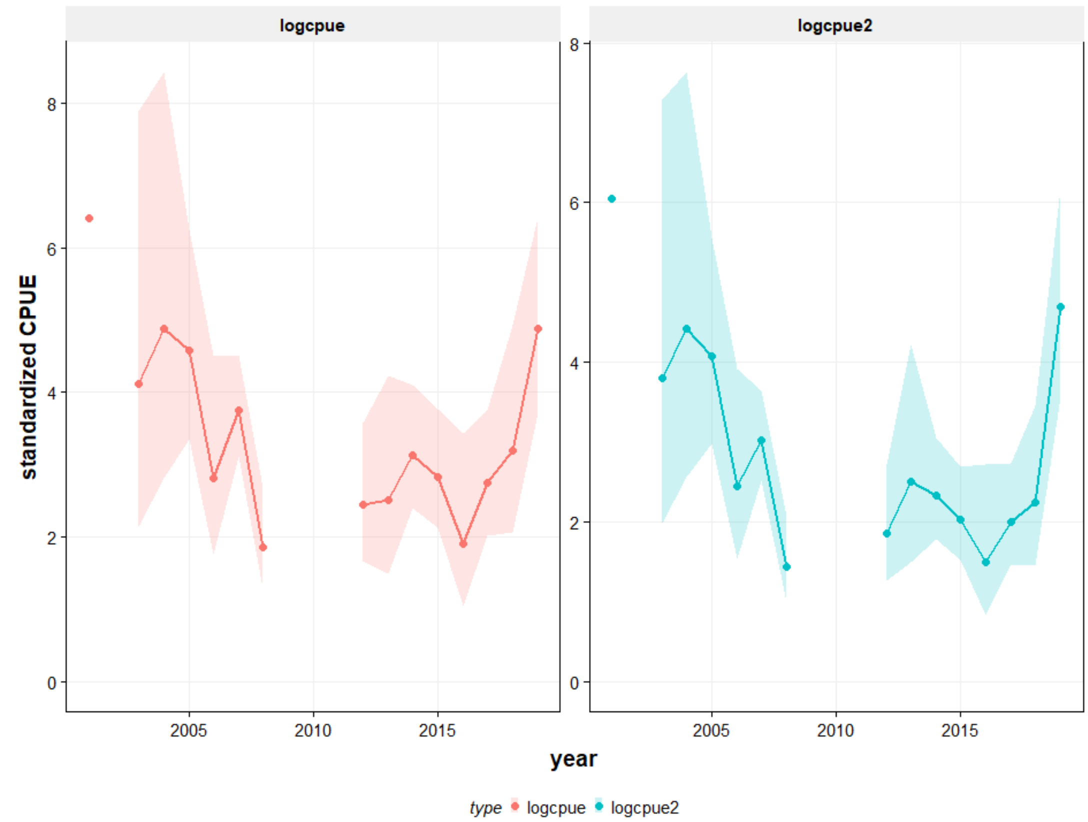
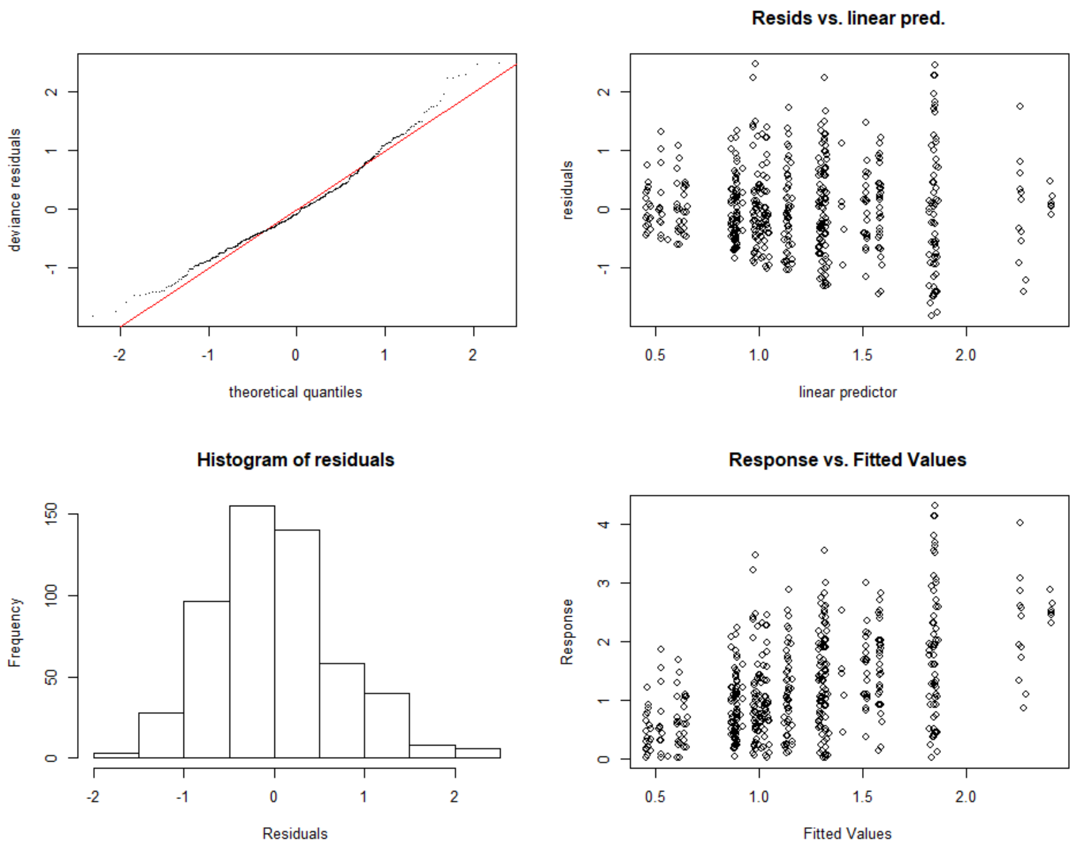


Figure 7: Argentines: exploring the effects of different explanatory variables on the AIC of the model

The final logCPUE model for argentines

The final model takes into account the year factor and the vessel factor. Depth has been included, but actually does not change anything to the model fitting. Two different versions are explored in the final model: 1) using logCPUE per hour and 2) logCPUE per hour, corrected for an assumed 2% increase in technical efficiency by year. Results do nog appear to be very sensitive to the 2% efficiency increase. It should be noted that the values for 2019 are only based on a few hauls and should be discounted as true indication of CPUE.


logcpue
logcpue2
standardized CPUE
0
2
4
6
8
2005
2010
2015
year
type logcpue logcpue2


deviance residuals
theoretical quantiles
Resids vs. linear pred.
residuals
linear predictor
Histogram of residuals
Frequency
Residuals
Response vs. Fitted Values
Response
Fitted Values

```
'gamm' based fit - care required with interpretation.
Checks based on working residuals may be misleading.

Analysis of Deviance Table

Model: gaussian, link: identity

Response: logcpue

Terms added sequentially (first to last)

       Df Deviance Resid. Df Resid. Dev
NULL                     533     378.15
year   14   71.131       519     307.02
vessel  8   28.230       511     278.79
depth   1    0.031       510     278.76
```

Figure 8: Argentines: final GLM model and diagnostics. logcpue is compared to logcpue2 (assuming 2% increase in efficiency)

3 Discussion and conclusions

This working document is a second PFA document for WGDEEP, and reports on the PFA catch and effort over the periode 2001-2019. All trips were selected where at least 50 tonnes of argentines were caught. The document presents the spatial distribution of catches, the length compositions and proportions of the catch at depth. New in this document, compared to last year, is that an initial modelling of CPUE has been included which will be finalized prior to the benchmark meeting in 2020. It should be noted that the historical catch data is still somewhat limited as the historical records have only been made available by a few vessels so far.

By the end of 2018, 16 vessels were participating in the PFA self-sampling programme in one way or another. This is about 90% of the freezer-trawler fleet. However, the fishery for argentines is only carried out by a limited number of vessels within the fleet.

As a first test of consistency, length distribution for argentines by division and vessel were compared (figure below). Only length compositions were used where This indicates that there is only one area-year combination where multiple vessels have been operating and that in that area, a reasonable consistency between vessels exists, although some checks are still required.

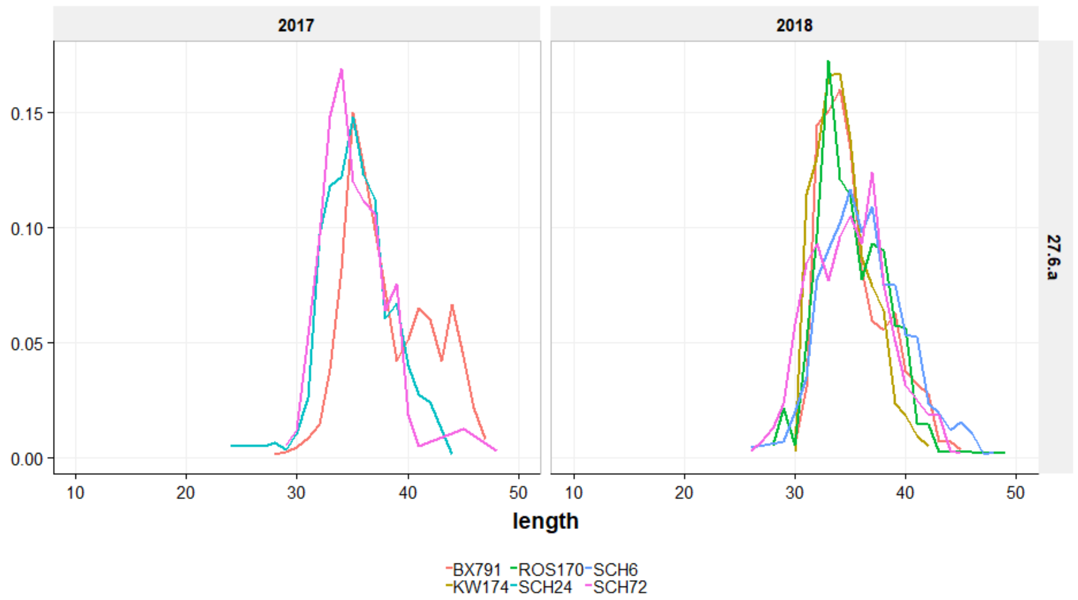


Figure 9: Argentines: comparison of relative length compositions per vessel

4 Acknowledgements

The skippers, officers and the quality managers of many of the PFA vessels have put in a lot of effort to make the PFA the self-sampling work. Without their efforts, there would be no self-sampling. A special thanks to all the skippers who made their personal logbooks available for this analysis.

5 More information

Please contact Martin Pastoors (mpastoors@pelagicfish.eu) if you would have any questions on the PFA self-sampling programme or the specific results presented here.

6 Annex: Argentines length-frequencies by year, quarter and area

year	quarter	division	species	length	catchnumber	prop
2015	q2	27.5.b	arg	28	1141	0.002
2015	q2	27.5.b	arg	29	6095	0.011
2015	q2	27.5.b	arg	30	28091	0.049
2015	q2	27.5.b	arg	31	44088	0.078
2015	q2	27.5.b	arg	32	79154	0.139
2015	q2	27.5.b	arg	33	91036	0.16
2015	q2	27.5.b	arg	34	83202	0.146

2015	q2	27.5.b	arg	35	57897	0.102
2015	q2	27.5.b	arg	36	39679	0.07
2015	q2	27.5.b	arg	37	30805	0.054
2015	q2	27.5.b	arg	38	23402	0.041
2015	q2	27.5.b	arg	39	18177	0.032
2015	q2	27.5.b	arg	40	18759	0.033
2015	q2	27.5.b	arg	41	15191	0.027
2015	q2	27.5.b	arg	42	12449	0.022
2015	q2	27.5.b	arg	43	7989	0.014
2015	q2	27.5.b	arg	44	4477	0.008
2015	q2	27.5.b	arg	45	2413	0.004
2015	q2	27.5.b	arg	46	2318	0.004
2015	q2	27.5.b	arg	47	1305	0.002
2015	q2	27.5.b	arg	48	435	0.001
2015	q2	27.6.a	arg	28	4044	0
2015	q2	27.6.a	arg	29	100054	0.008
2015	q2	27.6.a	arg	30	513481	0.042
2015	q2	27.6.a	arg	31	1223070	0.099
2015	q2	27.6.a	arg	32	1728455	0.14
2015	q2	27.6.a	arg	33	1807575	0.147
2015	q2	27.6.a	arg	34	1495691	0.121
2015	q2	27.6.a	arg	35	1125726	0.091
2015	q2	27.6.a	arg	36	949683	0.077
2015	q2	27.6.a	arg	37	893482	0.072
2015	q2	27.6.a	arg	38	818099	0.066
2015	q2	27.6.a	arg	39	507373	0.041
2015	q2	27.6.a	arg	40	342130	0.028
2015	q2	27.6.a	arg	41	255024	0.021
2015	q2	27.6.a	arg	42	226381	0.018
2015	q2	27.6.a	arg	43	157058	0.013
2015	q2	27.6.a	arg	44	94946	0.008
2015	q2	27.6.a	arg	45	51924	0.004
2015	q2	27.6.a	arg	46	27000	0.002
2015	q2	27.6.a	arg	47	3968	0
2015	q2	27.6.a	arg	48	4120	0
2015	q2	27.6.a	arg	49	533	0
2015	q2	27.6.a	arg	50	533	0
2016	q2	27.4.a	arg	26	16399	0.04
2016	q2	27.4.a	arg	27	16399	0.04
2016	q2	27.4.a	arg	28	25770	0.062
2016	q2	27.4.a	arg	29	49719	0.12
2016	q2	27.4.a	arg	30	66327	0.16
2016	q2	27.4.a	arg	31	43888	0.106
2016	q2	27.4.a	arg	32	19575	0.047
2016	q2	27.4.a	arg	33	14889	0.036
2016	q2	27.4.a	arg	34	8798	0.021
2016	q2	27.4.a	arg	35	15878	0.038
2016	q2	27.4.a	arg	36	19367	0.047
2016	q2	27.4.a	arg	37	19627	0.047
2016	q2	27.4.a	arg	38	17988	0.043
2016	q2	27.4.a	arg	39	11143	0.027
2016	q2	27.4.a	arg	40	16878	0.041
2016	q2	27.4.a	arg	41	17971	0.043
2016	q2	27.4.a	arg	42	15289	0.037
2016	q2	27.4.a	arg	43	12580	0.03
2016	q2	27.4.a	arg	44	3567	0.009
2016	q2	27.4.a	arg	45	1770	0.004
2016	q2	27.4.a	arg	46	885	0.002
2016	q2	27.5.b	arg	30	583	0.002
2016	q2	27.5.b	arg	31	2334	0.008
2016	q2	27.5.b	arg	32	14008	0.045
2016	q2	27.5.b	arg	33	21013	0.068
2016	q2	27.5.b	arg	34	16544	0.053
2016	q2	27.5.b	arg	35	41396	0.133
2016	q2	27.5.b	arg	36	49338	0.159
2016	q2	27.5.b	arg	37	40292	0.13
2016	q2	27.5.b	arg	38	35635	0.115

2016	q2	27.5.b	arg	39	21006	0.068
2016	q2	27.5.b	arg	40	13960	0.045
2016	q2	27.5.b	arg	41	17658	0.057
2016	q2	27.5.b	arg	42	14123	0.045
2016	q2	27.5.b	arg	43	12330	0.04
2016	q2	27.5.b	arg	44	5288	0.017
2016	q2	27.5.b	arg	45	3508	0.011
2016	q2	27.5.b	arg	46	1754	0.006
2016	q2	27.6.a	arg	26	539	0
2016	q2	27.6.a	arg	27	539	0
2016	q2	27.6.a	arg	28	7904	0.003
2016	q2	27.6.a	arg	29	37538	0.016
2016	q2	27.6.a	arg	30	82308	0.034
2016	q2	27.6.a	arg	31	142694	0.059
2016	q2	27.6.a	arg	32	326783	0.135
2016	q2	27.6.a	arg	33	416122	0.172
2016	q2	27.6.a	arg	34	292063	0.121
2016	q2	27.6.a	arg	35	254942	0.105
2016	q2	27.6.a	arg	36	186087	0.077
2016	q2	27.6.a	arg	37	136579	0.056
2016	q2	27.6.a	arg	38	125478	0.052
2016	q2	27.6.a	arg	39	117069	0.048
2016	q2	27.6.a	arg	40	66155	0.027
2016	q2	27.6.a	arg	41	49334	0.02
2016	q2	27.6.a	arg	42	51430	0.021
2016	q2	27.6.a	arg	43	52189	0.022
2016	q2	27.6.a	arg	44	29105	0.012
2016	q2	27.6.a	arg	45	19986	0.008
2016	q2	27.6.a	arg	46	12617	0.005
2016	q2	27.6.a	arg	47	6097	0.003
2016	q2	27.6.a	arg	48	4587	0.002
2017	q2	27.5.b	arg	34	5931	0.5
2017	q2	27.5.b	arg	36	5931	0.5
2017	q2	27.6.a	arg	24	5931	0.001
2017	q2	27.6.a	arg	26	5931	0.001
2017	q2	27.6.a	arg	27	5931	0.001
2017	q2	27.6.a	arg	28	8603	0.001
2017	q2	27.6.a	arg	29	29980	0.005
2017	q2	27.6.a	arg	30	68918	0.011
2017	q2	27.6.a	arg	31	276041	0.044
2017	q2	27.6.a	arg	32	568712	0.091
2017	q2	27.6.a	arg	33	843024	0.134
2017	q2	27.6.a	arg	34	961418	0.153
2017	q2	27.6.a	arg	35	803121	0.128
2017	q2	27.6.a	arg	36	722279	0.115
2017	q2	27.6.a	arg	37	670725	0.107
2017	q2	27.6.a	arg	38	401335	0.064
2017	q2	27.6.a	arg	39	446256	0.071
2017	q2	27.6.a	arg	40	158534	0.025
2017	q2	27.6.a	arg	41	87325	0.014
2017	q2	27.6.a	arg	42	58770	0.009
2017	q2	27.6.a	arg	43	19708	0.003
2017	q2	27.6.a	arg	44	33350	0.005
2017	q2	27.6.a	arg	45	78245	0.012
2017	q2	27.6.a	arg	46	10150	0.002
2017	q2	27.6.a	arg	47	3825	0.001
2017	q2	27.6.a	arg	48	13297	0.002
2018	q2	27.2.a	arg	27	20	0.013
2018	q2	27.2.a	arg	28	20	0.013
2018	q2	27.2.a	arg	29	20	0.013
2018	q2	27.2.a	arg	30	140	0.089
2018	q2	27.2.a	arg	31	140	0.089
2018	q2	27.2.a	arg	32	160	0.101
2018	q2	27.2.a	arg	33	240	0.152
2018	q2	27.2.a	arg	34	220	0.139
2018	q2	27.2.a	arg	35	200	0.127
2018	q2	27.2.a	arg	36	60	0.038

2018	q2	27.2.a	arg	37	40	0.025
2018	q2	27.2.a	arg	38	40	0.025
2018	q2	27.2.a	arg	39	40	0.025
2018	q2	27.2.a	arg	40	40	0.025
2018	q2	27.2.a	arg	41	40	0.025
2018	q2	27.2.a	arg	42	40	0.025
2018	q2	27.2.a	arg	43	40	0.025
2018	q2	27.2.a	arg	44	20	0.013
2018	q2	27.2.a	arg	45	20	0.013
2018	q2	27.2.a	arg	46	20	0.013
2018	q2	27.2.a	arg	47	20	0.013
2018	q2	27.4.a	arg	27	3701	0.003
2018	q2	27.4.a	arg	28	15932	0.015
2018	q2	27.4.a	arg	29	72453	0.068
2018	q2	27.4.a	arg	30	125388	0.118
2018	q2	27.4.a	arg	31	114178	0.108
2018	q2	27.4.a	arg	32	109309	0.103
2018	q2	27.4.a	arg	33	144735	0.137
2018	q2	27.4.a	arg	34	90662	0.086
2018	q2	27.4.a	arg	35	95342	0.09
2018	q2	27.4.a	arg	36	81529	0.077
2018	q2	27.4.a	arg	37	44232	0.042
2018	q2	27.4.a	arg	38	46688	0.044
2018	q2	27.4.a	arg	39	30399	0.029
2018	q2	27.4.a	arg	40	32068	0.03
2018	q2	27.4.a	arg	41	22533	0.021
2018	q2	27.4.a	arg	42	5008	0.005
2018	q2	27.4.a	arg	43	11019	0.01
2018	q2	27.4.a	arg	44	10438	0.01
2018	q2	27.4.a	arg	45	1354	0.001
2018	q2	27.4.a	arg	46	1354	0.001
2018	q2	27.4.a	arg	47	416	0
2018	q2	27.5.b	arg	30	1407	0.167
2018	q2	27.5.b	arg	33	1407	0.167
2018	q2	27.5.b	arg	36	1407	0.167
2018	q2	27.5.b	arg	37	1407	0.167
2018	q2	27.5.b	arg	38	1407	0.167
2018	q2	27.5.b	arg	44	1407	0.167
2018	q2	27.6.a	arg	26	27266	0.002
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2018	q2	27.6.a	arg	29	308315	0.021
2018	q2	27.6.a	arg	30	635099	0.042
2018	q2	27.6.a	arg	31	1100752	0.073
2018	q2	27.6.a	arg	32	1513907	0.101
2018	q2	27.6.a	arg	33	1621289	0.108
2018	q2	27.6.a	arg	34	1592064	0.106
2018	q2	27.6.a	arg	35	1609088	0.107
2018	q2	27.6.a	arg	36	1355191	0.09
2018	q2	27.6.a	arg	37	1523940	0.101
2018	q2	27.6.a	arg	38	1157494	0.077
2018	q2	27.6.a	arg	39	768490	0.051
2018	q2	27.6.a	arg	40	668618	0.045
2018	q2	27.6.a	arg	41	348246	0.023
2018	q2	27.6.a	arg	42	248860	0.017
2018	q2	27.6.a	arg	43	179657	0.012
2018	q2	27.6.a	arg	44	53758	0.004
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2018	q2	27.6.a	arg	46	23125	0.002
2018	q2	27.6.a	arg	47	2111	0
2018	q2	27.6.a	arg	48	12554	0.001
2018	q2	27.6.a	arg	49	8800	0.001
2019	q2	27.6.a	arg	31	18133	0.012
2019	q2	27.6.a	arg	32	65196	0.045
2019	q2	27.6.a	arg	33	226917	0.156
2019	q2	27.6.a	arg	34	329449	0.226
2019	q2	27.6.a	arg	35	332852	0.229

2019	q2	27.6.a	arg	36	285264	0.196
2019	q2	27.6.a	arg	37	93638	0.064
2019	q2	27.6.a	arg	38	59745	0.041
2019	q2	27.6.a	arg	39	43831	0.03

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The Blackspot seabream Spanish target fishery of the Strait of Gibraltar: updating the available information

Juan Gil, Lucia Rueda, Candelaria Burgos, Carlos Farias, Juan Carlos Arronte, Juan José Acosta and Mar Soriano
Centro Oceanográfico de Cádiz
Puerto Pesquero. Muelle de Levante s/n
11006 Cádiz, Spain

Abstract

This paper includes the available information of the Blackspot seabream (Pagellus bogaraveo) Spanish target fishery in the Strait of Gibraltar updating the documents presented in previous years with the information from 2018. Data about landings, CPUEs, spatial distribution and landings' length frequencies are presented for discussion within the 2019 WGDEEP.

1. Introduction and fishery description

Since the early 1980´s a Spanish artisanal fishery targeting Blackspot seabream (*Pagellus bogaraveo*, namely "*voraz*") has developed in the Strait of Gibraltar area (ICES 9a South). This fishery has already been broadly described in previous Working Documents presented to the ICES WGDEEP (Gil *et al*., 2000; Gil and Sobrino, 2001, 2002 and 2004; Gil *et al*., 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016a, 2016b, 2017 and 2018). Spanish Blackspot seabream fishery in the Strait of Gibraltar is almost a mono-specific fishery (it represents 74% from the total landed species) and constitutes a fleet component by itself (Silva *et al*., 2002).

In 2006, 2008, 2010, 2012, 2014, 2016 and 2018 different trials were attempted to assess this resource within the ICES WGDEEP (ICES, 2006, 2008, 2010, 2012, 2016 and 2018). 2018 scientific advice was based on abundance indexes (DLS category 3). All the available information from this target fishery (including the abundance index used as the basis for the assessment) were updated with 2018 data.

Thus, the main objective of this paper is to provide to the 2019 ICES WGDEEP a summary of the available information of this deep-water fishery located in a very narrow place of the ICES area 9.

2. Material and methods

Fishery information from the sale sheets was gathered for the period 1983-2018 including monthly landings, monthly number of sales (as a proxy of fishing trip) and the number of days in which those sales were carried out. Moreover, landings length distributions were also estimated from the data collected by IEO monitoring program (Gil *et al*., 2000).

Geo-referenced information from SLSEPA devices (a sort of Vessel Monitoring System) on the "*voracera*" fleet operating at the Strait of Gibraltar have been more recently available (from 2009 onwards). This monitoring system, locally called "green boxes" (to differentiate them from the EU VMS "blue boxes"), sends every three minutes to a control centre several information about the fishing activity: time, positions, course and speed. Data were filtered and analyzed, according to the protocols proposed by Burgos *et al*., 2013, to estimate fishing effort, catch rates and the spatial distribution of the Blackspot seabream target fishery.

Length at sex change were estimated for each year from the biological sampling conducted by the IEO monitoring program. It was calculated as the median of the total length for a specific range of length frequencies. Two different approaches were used for this range: 1) the range of the length frequencies of each specific year, which was estimated as the range including the smallest and largest length where both males and female individuals are found; and 2) using the same length range for all years (290-400 mm TL).

3. Results and discussion

3.1. <u>Landings</u>: Figure 1 shows a continuous increase of Spanish landings from the beginning of the time series reaching a maximum in 1994. Since then landings´ trend decreased until 2002, despite the peaks in 1996 and 1997. Again, it shows an increasing trend from 2003 to 2009, decreasing afterwards except for a slight increase in 2014. Landings in the last year (2018) show the lowest values of the series, with only 8 tons landed from the Spanish "voracera" fleet.

Until now, discards can be assumed to be zero or negligible. However, the established minimum landing size of 33 centimeters for the species (both for NE Atlantic and Mediterranean Sea) and the landing obligation (EU Regulation 2013/1380) don´t might have an effect on the discards of this target fishery because its high survival exemption .

Hence landings are currently being used as a proxy of catches. However, it should be noted that not all the Spanish catches/landings come exclusively from ICES area 9 but they are considered from the same stock unit because the fishing area (Strait of Gibraltar) is placed between different Advice bodies/Regional Fisheries Organizations (ICES, GCFM and CECAF) boundaries (Figure 2). In fact, last years Spanish Blackspot seabream landings available at InterCatch tool comprise three different areas: 27.9.a (ICES), 34.1.11 (CECAF) and 37.1.1 (GFCM).

Data from Moroccan longliners fishing Blackspot seabream in the Strait of Gibraltar area are available since 2001. The information are available on FAO GFCM statistics (WGSAD and SRC-WW) so, when possible, it is included in the WGDEEP landings estimates because Moroccan boats target the same population sharing the main fishing grounds with Spain (ICES, 2016).

3.2. CPUEs: Nominal abundance index shows ups and downs throughout the historical series (Figure 3). It is important to emphasize that the effort unit chosen (number of sales) may not be appropriate as it does not accounts for the missing effort (when catches are equal to zero). So in the most recent years the missing effort might increase substantially due to the observed decrease in the resource (fishing boats with no catches and hence no sale sheet records). Therefore, the CPUE trend since the first fishery´s decline (1997) should be interpreted with caution because it cannot be a real image of the resource abundance. A severe decreasing trend is observed since 2010, despite increases in 2014 and 2015, similar to the observed trend in landings.

Table 1 updates the available information from regional VMS (SLSEPA), following the data compilation and process described in Burgos *et al*. in 2013.

Figure 3 shows that nominal CPUE estimated from total landings and number of sales decreased in the period 2009-2013 from 67 to 30 k fishing trip^{-1} for the total "*voracera*" fleet while the decrease of the CPUE from the VMS fleet, in the same period, goes from 64 till 19 k fishing trip^{-1}. Afterwards, it increases until 49 and 45 k fishing trip^{-1} in 2015 to decrease again till 18 and 14 k fishing trip^{-1} in 2018, respectively. As expected, CPUE from the VMS fleet decline has lower values than nominal CPUE because of the fact of the missing effort due to zero catches.

Figure 4 presents some descriptive statistics from the annual VMS CPUE estimates in order to provide a sort of uncertainty level on the estimates. It is clear that the distribution of the CPUE per fishing trip does not follow a normal distribution therefore we cannot use its standard deviation to create a confidence interval. In 2013, 2017 and 2018 the median value is 0, which means that at least in 50% of the fishing trips got zero catches (missing effort in the nominal CPUE because there isn't sale sheet record).

Table 1. Estimates of fishing effort and CPUEs (2013-2018) from the "*voracera*" fleet targeting Blackspot seabream based on regional VMS data (SLSEPA) and fishery statistics (sales sheets). These year´s values are used in the DLS 3.2 method to give the scientific advice for 2019 and 2020.

Data Source		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fleet equipped with SLSEPA devices (green boxes)	No. Boats	85	82	82	60	60	61	60	47	41	24
	No. Sales	7200	5863	4711	2946	2086	2989	3079	1873	1017	309
	Fishing days (trips)	8373	7238	6160	3686	2695	4191	4234	2724	1740	1046
	Fishing operations (hauls)	60593	46579	38345	22329	14140	21110	21449	12930	7852	3853
	Blackspot seabream Landings (kg)	459010	274882	190786	79163	39799	94261	137344	73508	24716	4402
	CPUE 1 (Landings/Sales)	64	47	40	27	19	32	45	39	24	14
	CPUE 2 (Landings/Fishing days)	55	38	31	21	15	22	32	27	14	4
	CPUE 3 (Landings/Hauls)	8	6	5	4	3	4	6	6	3	1
	Proportion (%) of missing effort ([Fishing days-No. Sales]/Fishing days)	14	19	24	20	23	29	27	31	42	70
Total 'voracera' fleet	No. Boats	98	94	86	68	62	61	62	58	54	33
	No. Sales	8892	6932	5659	3638	2222	3527	3384	2418	1038	429
	Estimated Fishing days (trips) CPUE2 (Landings/VMS)	10564	9627	7741	5867	4480	6119	5137	3696	3027	1814
	Fishing operations (hauls)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Blackspot seabream Landings (kg)	579140	316546	239751	126006	66159	137623	166651	99727	42991	7633
	CPUE 1 (Landings/Sales)	67	52	42	35	30	39	49	41	41	18

3.3. Length frequencies: The mean length of landings seems to have decreased in two different periods: from 1995 to 1998 and from 2009 to 2013 (Figure 5). Knowledge about the geographic and bathymetric distribution related to length of the species is scarce. Such spatial and bathymetric distribution of Blackspot seabream is likely to be heterogeneous, which could explain the different landed mean length between the main landing ports: Tarifa and Algeciras, being lower in Algeciras.

3.4. Length at sex change: Table 2 shows the estimated lengths at sex change for each year (when biological samplings were available) for

1) specific length ranges for each year, and

2) using the same length range for all years.

When specific length ranges for each year were used, length at sex reversal varied between 340 mm in 2015 to 390 mm in 2003 (Mean=369.91; SD=18.23). When the same length range was used for all the years the length at sex reversal varied between 332 mm in 2004 to 360 mm in 2003 (Mean=346.11; SD=9.13). Figure 6 shows the percentage of individuals by sex (male, female and hermaphrodite) and length class.

Table 2. Estimation of total length (TL; mm) at sex change from Blackspot seabream Spanish biological samplings (Strait of Gibraltar)

Year	Number of simples	TL sex change specific range per year (mm)	TL range chosen per year	TL sex change range 290-400 mm for all years (mm)	% of data with TL between 290 and 400
2003	391	390	290 -510	360	0.55
2004	930	350	300-540	332	0.7
2005	310	389	290-530	349	0.53
2006	678	368	290-520	346	0.67
2007	584	376	290-540	349	0.68
2008	509	375	290-540	346	0.65
2009	325	385	290-560	357	0.65
2014	285	353	300-520	340	0.76
2015	238	340	300-490	336	0.93
		Mean= 369.61		Mean= 346.11	
		SD= 18.23		SD= 9.13	

4. Main conclusions

The general trend for the time series of both, landings and CPUEs, continues showing a decreasing pattern during the last years, exhibiting the lowest values of the whole series in 2018. This might be a consequence of an overexploitation status of the stock, which is addressing the fishery into a critical situation.

Acknowledgments

We would like to express our most sincere gratefulness to all those institutions and people for their collaboration in the execution of the monitoring of the Spanish "*voracera*" fishery: Spanish Institute of Oceanography (IEO), Consejería de Agricultura y Pesca de la Junta de Andalucía and Tarifa´s Fishermen Brotherhood and 1st sale fishmarket.

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Figure 1. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: total landings (1983-2018).

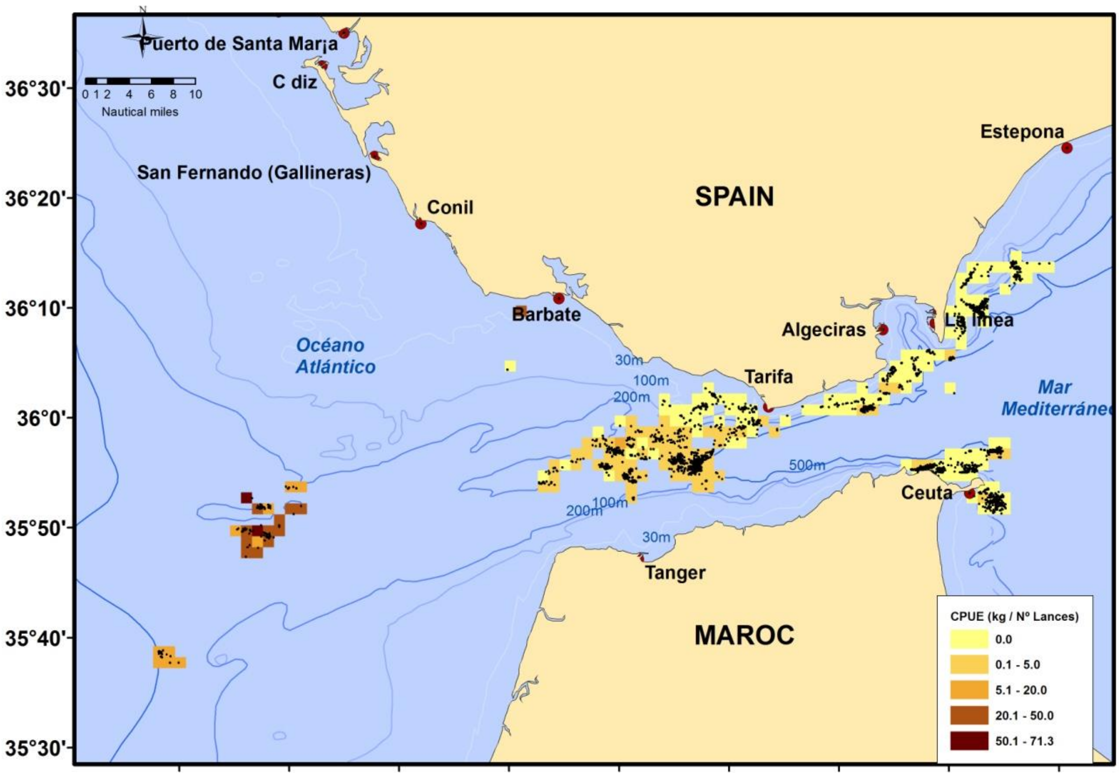

Figure 2. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: spatial distribution of CPUE (kg number of fishing sets^{-1}) from the SLSEPA device (2018).

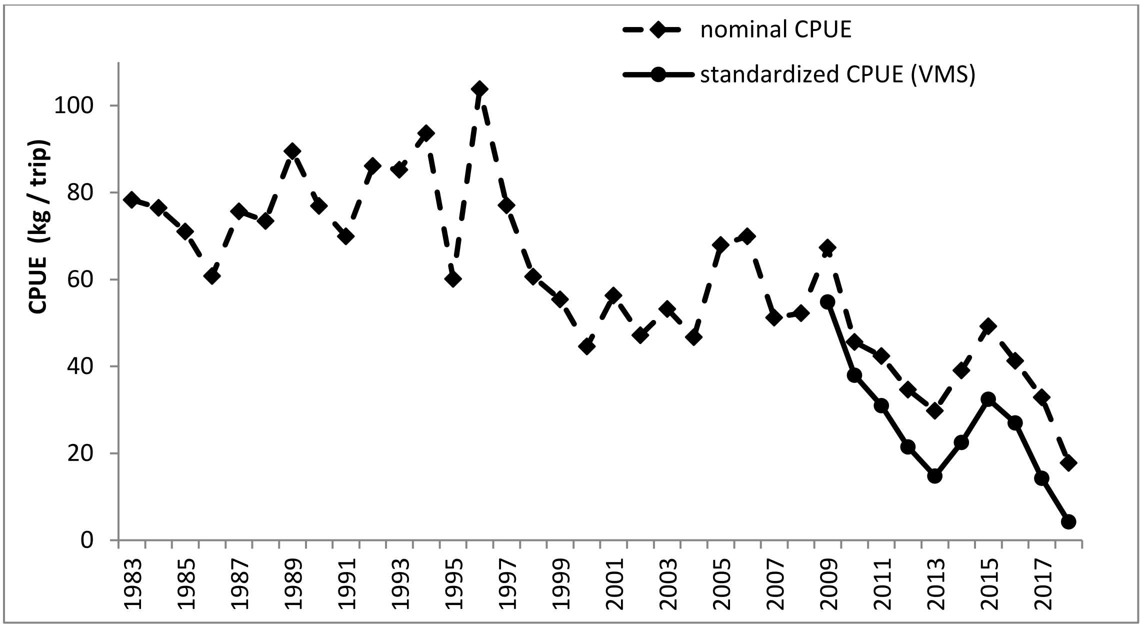

Figure 3. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: nominal (sale sheets) CPUE (1983-2018) and standardized (VMS) CPUE (2009-2018).

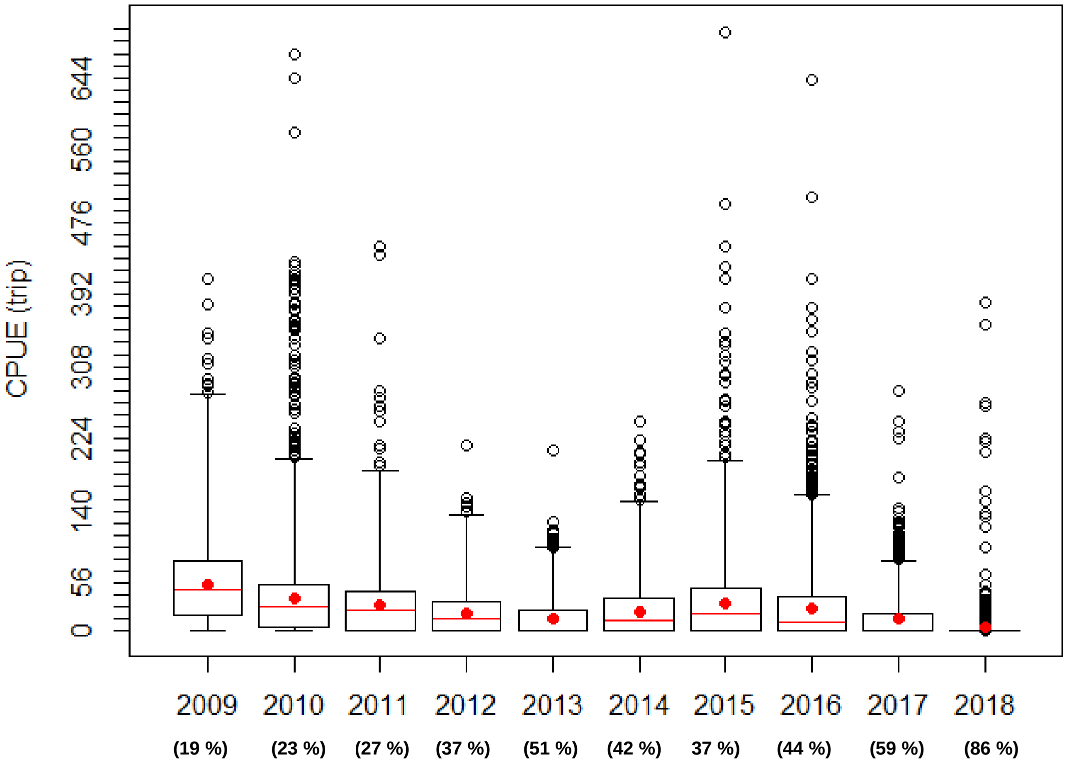

Figure 4. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: CPUEs from VMS descriptive statistics (red dot: mean value, red line: median value, box and whiskers: Interquartile Range plus Q_1-3IQR and Q_3+3IQR, circles: outliers). Percentages below every year indicate percentage of data with missing effort (percentage of fishing trips with CPUE=0).

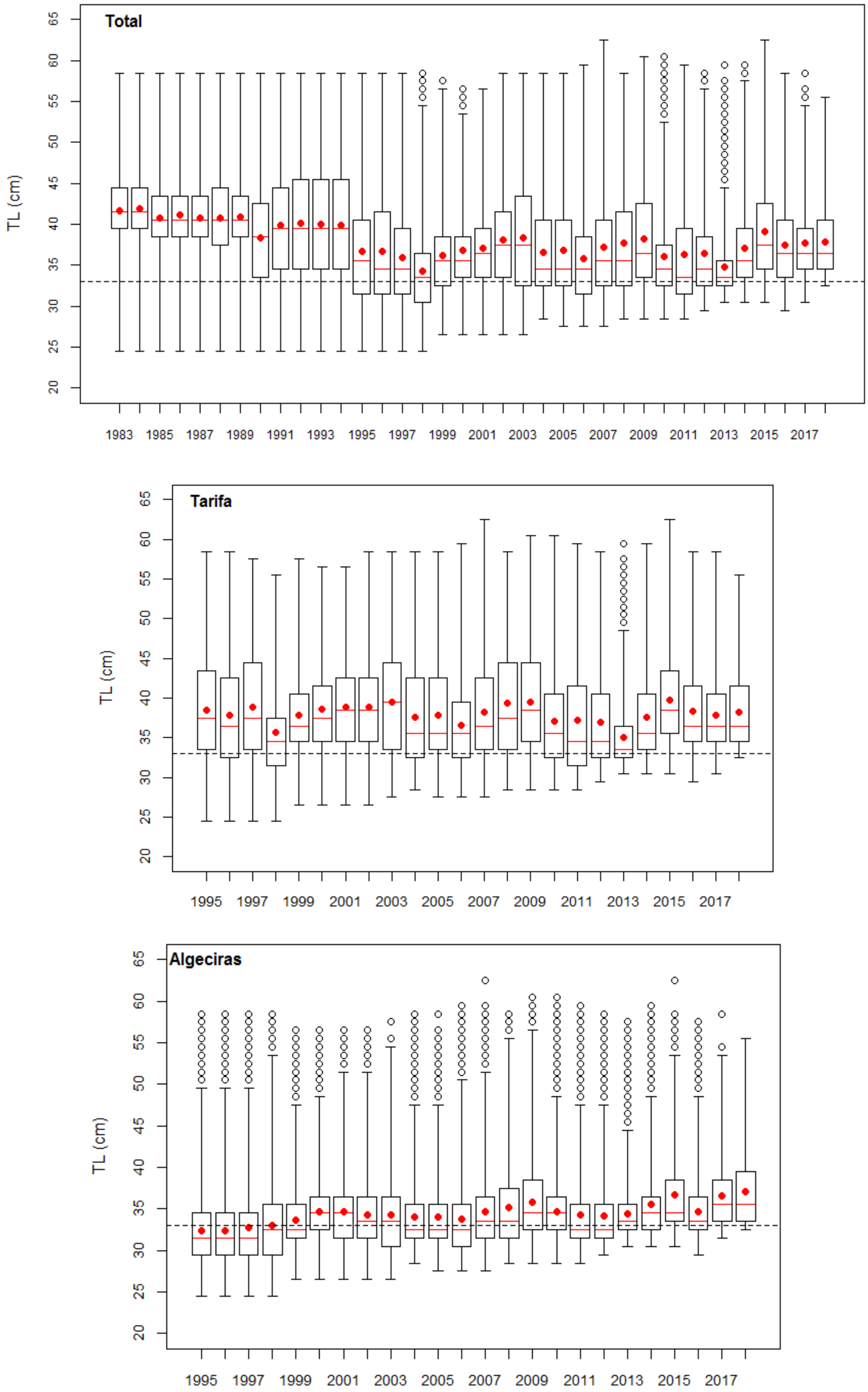

Figure 5. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: landings' length distribution (Total and by fishing harbor) descriptive statistics (red dot: mean value, red line: median value, box and whiskers: Interquartile Range plus Q_1-3IQR and Q_3+3IQR, circles: outliers).

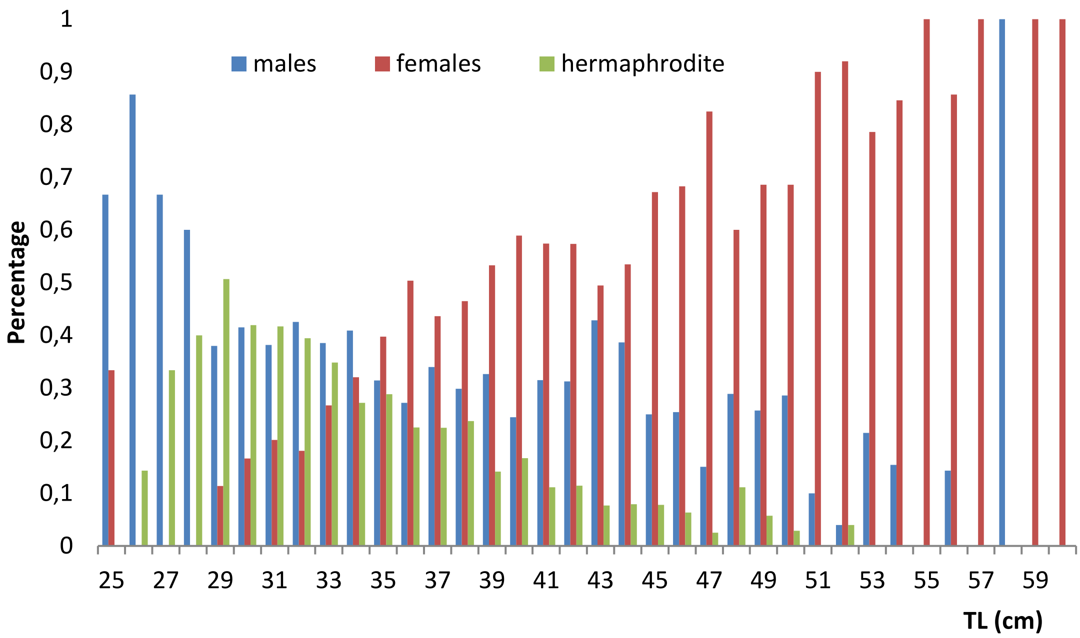

Figure 6. Percentage of male, female and hermaphrodite individuals by length class.

Blackspot seabream (*Pagellus bogaraveo*) in Portugal mainland (ICES Division 27.9.a): fisheries characterization and survivability experiments

Authors: Bárbara Serra-Pereira, Pedro Tomé, Tiago Bento, Inês Farias and Ivone Figueiredo

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1. Preamble

The EU Common Fisheries Policy (CFP) aims to ensure that fishing activities conducted by European Union fleets contribute to long-term environmental, economic and social sustainability of marine resources. Regarding by-catches, one of the measures implemented to reduce unwanted catches and reduce the impact of commercial fishing is the landing obligation of all discards of species subject to catch limits (TAC and quotas) caught during fishing activities (EU Regulation 1380/2013 article 15).

The implementation of EU Regulation 1380/2013 has been a gradual process since 2015, with full implementation in 2019. During this period, the Scientific, Technical, and Economic Committee for Fisheries (STECF) reviewed the Joint Recommendations from Member States regional groups (STECF, 2013, 2014a-c, 2015a-b, 2016, 2018), which include: *definitions of fisheries and species, de minimis and high survivability exemptions, fixation of minimum conservation references sizes additional technical measures to implement the landing obligation, and the documentation of catches.* The STECF recommendations are the basis to build the Delegated Regulations that have been establishing the discard plans for each regional group since 2015 (e.g. for the South-Western waters: Commission Delegated Regulation (EU) 2015/2439; Commission Delegated Regulation (EU) 2016/2374; Commission Delegated Regulation (EU) 2017/2167; Commission Delegated Regulation (EU) 2018/2033).

Regarding blackspot seabream ("red seabream") *Pagellus bogaraveo*, the Joint Recommendation of the South-Western Waters Regional Group has requested for 2019 a high survivability exemption from the landing obligation for the "voracera" fishery in south of Spain (ICES Division 27.9.a) and for the hooks and lines fisheries in the Azores (ICES Subarea 27.10) (STECF, 2018). The European Commission granted the exemption for those two fisheries and areas which are expressed in the discard plan for certain demersal fisheries in South-Western waters for the period 2019-2021 (Commission Delegated Regulation (EU) 2018/2033). The exemption from the landing obligation does not apply to catches of blackspot seabream by the demersal longline fisheries in Portuguese Mainland waters (ICES Division 27.9.a).

The present report summarizes the information on fisheries catching blackspot seabream in Portuguese mainland waters as well as the scientific data derived from survivability experiments conducted onboard the longline fishery. This aims to constitute the scientific support for the exemption request to be extended to the blackspot seabream longline fishery in Portuguese mainland waters (ICES Division 27.9.a).

2. The Iberian blackspot seabream stock (ICES Division 27.9.a) - Fisheries and management

At the Northeast Atlantic, the stock structure of blackspot seabream is still unknown. Despite that, for management purposes, ICES has adopted three different stock components. These components were just defined to better record the available information but did not assume the existence of three different populations (ICES, 2007). Since 2003, the Iberian stock has been managed through TAC and quotas. The quota assigned to Portugal has been decreasing; in 2018 the established TAC for that area was 165 tonnes, with a quota of 35 tonnes for Portugal.

The stock structure of the species in ICES Division 27.9.a is unknown but tagging surveys conducted in the Strait of Gibraltar showed that, although local migrations were observed, the species do not undertake significant movements (Gil, 2006). It was also verified that despite the species feeding grounds be distributed along the entire area, the species remains as a resident population. Also, the information derived from IPMA research surveys, along Portuguese mainland waters, indicate that the species has a localized distribution (Fig. 1) with high concentrations associated to particular topographic characteristics (Farias et al., 2018). These observations are in agreement with studies from other areas where it is known that the species has a patchy distribution, being commonly associated to seamounts, while species connectivity between seamounts is attributed to larval dispersal (Biagi et al., 1998; Menezes et al. 2001; Lorance, 2011; Félix-Hackradt et al., 2013).

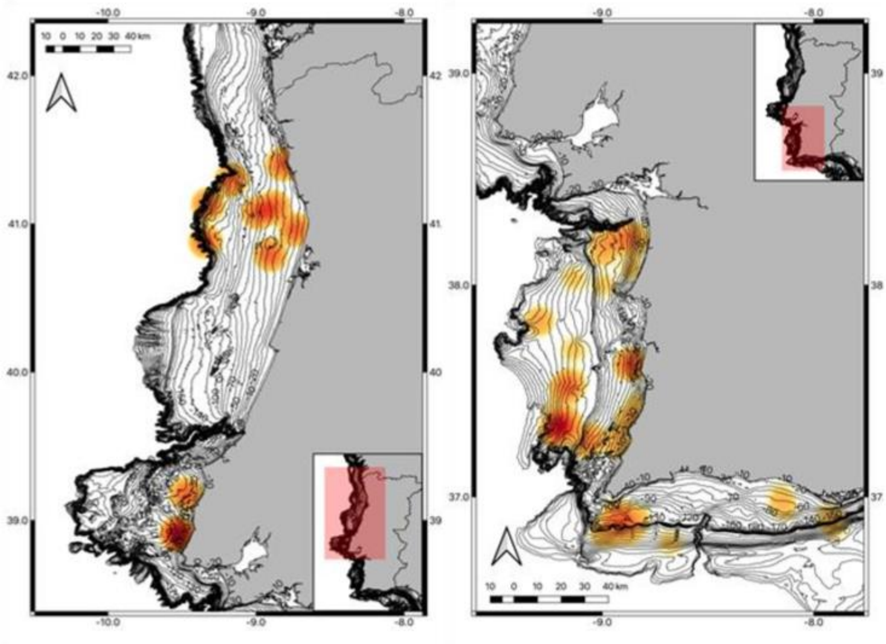

Figure 1. Distribution of blackspot seabream *Pagellus bogaraveo* along the Portuguese coast based on Portuguese surveys conducted by IPMA (1997-2011 and 2013-2017). The coloured blotches are hauls with blackspot seabream catches over 5 n.h^{-1}. The colour intensity of the blotches reflects species occurrence. (Adapted from Farias et al., 2018).

In Iberian waters (ICES Division 27.9.a), the main EU fishery is a target longline fishery held by Spain off the Strait of Gibraltar. In this division, Spanish landings account for almost 70% of the species EU total landings and the remaining is assigned to Portugal mainland (ICES, 2018).

In Portugal mainland, the blackspot seabream is mainly caught as by-catch from fisheries targeting other species although it can be seasonally targeted. The Portuguese discard information collected under DCF indicates that discards of this species are negligible. This is considered plausible as the species has a high commercial value. Furthermore, discards when occurring are mainly associated to small individuals, i.e. with length smaller than the minimum landing size (MLS) (ICES, 2018). In Portugal mainland, 25 cm (total length, T_L) is the value of the MLS adopted for the species (Portuguese legislation: Portaria n. 27/2001, 15 January 2001).

Landings of this species are mainly derived from the polyvalent fleet, which annually represent around 70% of the total species landed weight (around 75% in 2018). The vessels belonging to the polyvalent segment are commonly licensed for several fishing gears, but species landings are mainly derived from demersal longline fishing operations. A seasonal pattern on species landings is observed throughout the year, with higher values at the last quarter of the year and sometime at the early months of the first quarter. The period of higher landings coincides with species spawning season (Farias et al., 2018).

From 2009 to 2018, species landings of blackspot seabream from the polyvalent fleet varied from 30 to 69 tonnes (Table 1). The main landing port is Peniche (centre region); in this port landings from the polyvalent fleet and for the latest three years (2016 to 2018) represented on average nearly 71% of the total (Fig. 2). Sagres (south region, Algarve) is the second landing port and landings in this port represented on average less than 16%. The number of polyvalent vessels with demersal longline licenses and with positive landings of the species has been decreasing since 2009. This tendency appears to be directly associated to the restrictive annual quotas assigned to Portugal. In the last three years around 80 vessels have landed the species.

Figure 2. Total landings (in tonnes) of blackspot seabream *Pagellus bogaraveo* by fleet, during the period 2009 to 2018.

Year	Trawl fleet	Polyvalent fleet
2009	29	67
2010	24	57
2011	22	53
2012	44	69
2013	31	58
2014	19	40
2015	23	43
2016	23	47
2017	21	48
2018	14	44

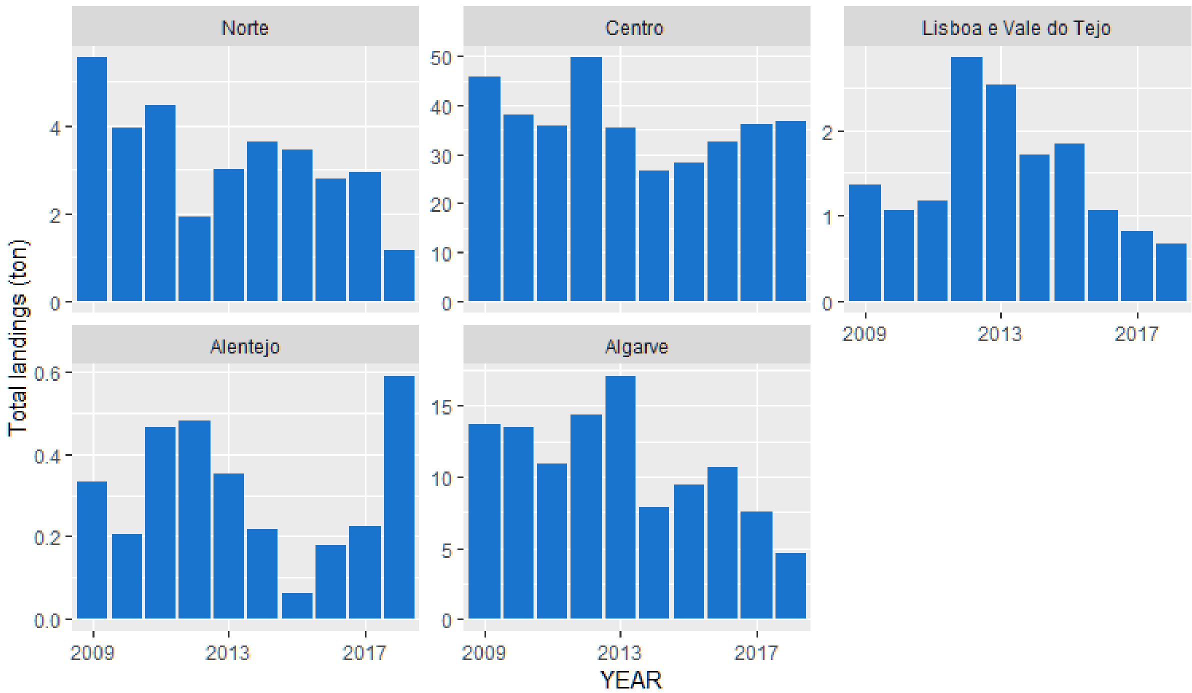

Figure 2. Total landings (in tonnes) of blackspot seabream *Pagellus bogaraveo* from the polyvalent fleet, during the period 2009 to 2018, by region. From north to south: "Norte" (N), "Centro" (C), "Lisboa e Vale do Tejo" (C), Alentejo (SW), and "Algarve" (S).

3. Survivability experiments

The survivability experiments of blackspot seabream were conducted by IPMA under the PP-centro Project (MAR 2020) onboard a longliner from Peniche landing port. This experiment resulted from a collaboration with the Peniche local artisanal fishery association (Cooperativa dos Armadores de Pesca Artesanal, CAPA), which facilitated the experiments onboard an associated vessel.

The experiments took place during the peak of the blackspot seabream´s fishing season, more precisely from January to April 2019. The trips were performed onboard one demersal longliner vessel (17 m LOA, 40 tons, 179 HP), representative of the polyvalent fleet operating off Peniche.

The demersal longline gear used is similar to those operated by the other polyvalent vessels. The longline gear consists of a 2.0 mm diameter monofilament mainline, with 0.9 mm diameter monofilament gangions of approximately 1.5 m attached directly to the mainline, at intervals of around 1.8 m. The longline is lifted off the bottom by a plastic buoy ("bóia") at intervals of 22 hooks and weighted down with small rocks ("pedra") in between (Fig. 3). The fishing gear used in each haul was composed, on average, by 8 segments, each with 190 hooks (hook size number 9 and using Atlantic mackerel as bait). The mean soaking time of each haul was about 6 ± 3 hours.

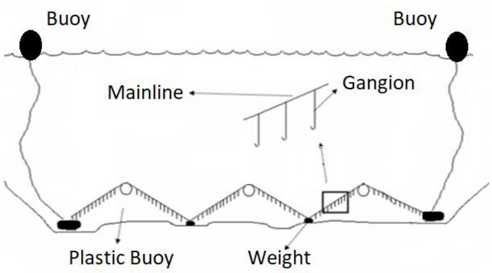

Figure 3. Schematic representation of the longline gear used in the experiments.

The survivability experiments occurred at four fishing trips, with a total of 41 fishing hauls. The geographic location of the fishing hauls from where specimens were analysed were off Peniche, centre of Portugal mainland waters (Fig. 4). The bottom depths of fishing hauls varied from 180 to 402 m (mean depth around 270 m).

The depth range of fishing hauls from which specimens were selected for the captive experiments was representative of the overall depth range (Fig. 5A). In addition, fishing effort and hauling speed range from those fishing hauls were similar to the whole fishing hauls set (Fig. 5B-C). To allow 36h observation period the soaking time of the hauls selected for the captive experiments was shorter (Fig. 5D).

A total of 1841 specimens were captured on the sampled trips. During the second trip and due to the time spent on the procedure to estimate time-to-mortality, not all specimens were sampled for vitality assessment.

For the sampled fishing hauls, the mean discard rate of blackspot seabream, in number, per fishing haul was 0.2%. The reason for discarding was related to the minimum landing size established for the species.

The experiments performed onboard were oriented towards the estimation of three variables that characterize the survivability of blackspot seabream: vitality assessment after capture, time-to-mortality and short-term survival. For each of these a brief description of the procedure adopted as well as the results are next presented

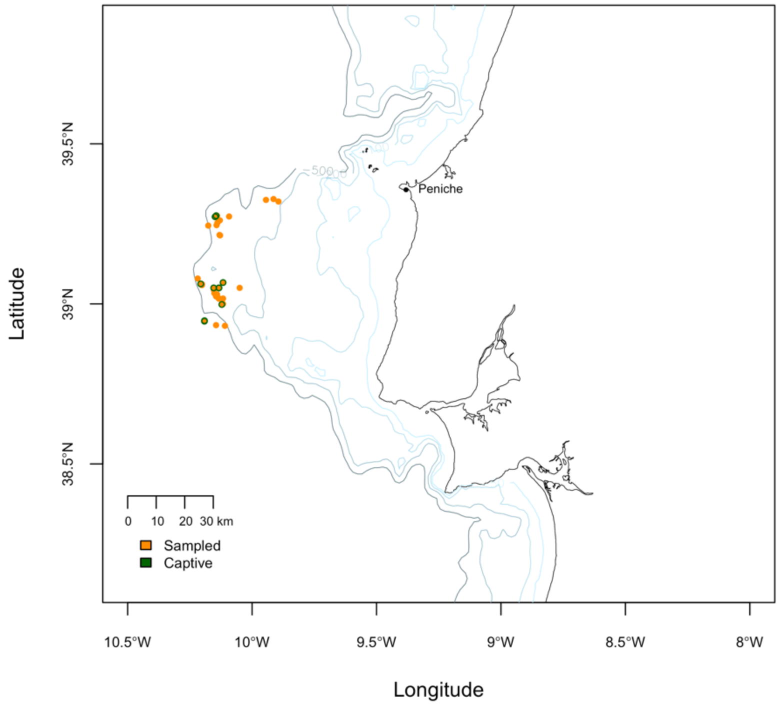

Figure 4. Map of sampling locations off Peniche with blackspot seabream *Pagellus bogaraveo* captured by longline (n=41). Hauls containing samples used for short-term survivability experiments are highlighted in green.

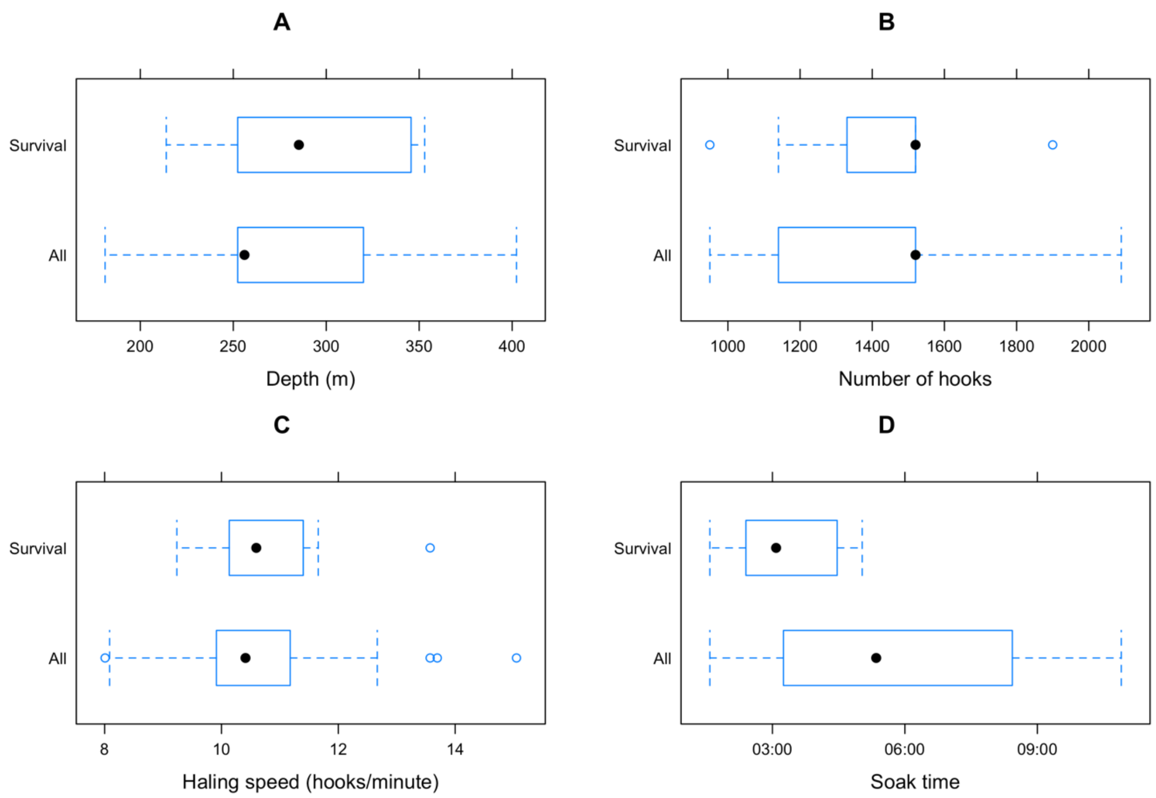

Figure 5. Features comparison between all sampled longline hauls and those selected for short-term survivability experiments: A) fishing depth (m), B) fishing effort (number of hooks), C) hauling speed (hooks.minute^{-1}) and D) soaking time.

3.1. Vitality assessment after capture

After arriving on deck, the number of blackspot seabream caught at each fishing haul as well as the fraction of retained or discarded were registered. Each specimen was measured, the vitality status assigned (Table 2) and the occurrence of body lesions registered (Table 3). The criteria adopted to assign either the vitality status or body lesions followed guidelines from both the STECF (STECF, 2013) and the ICES Working Group on Methods for Estimating Discard Survival (WKMEDS) (ICES, in press).

Table 2 Description of the criteria used to assess vitality status of blackspot seabream *Pagellus bogaraveo* after capture.

Vitality status		Description
1	Excellent	Fish with strong body movement and fast respiratory reflexes of the mouth and operculum.
2	Good	Fish with moderate body movement and respiratory reflexes of the mouth and operculum. Actively reacts to stimuli.
3	Poor	Fish without body movement, weak respiratory reflexes of the mouth and operculum.
4	Dead	Without body movement or respiratory reflexes and not responding to stimuli.

Table 3. Description of the body lesions assessed after capture and during the captive observations of blackspot seabream *Pagellus bogaraveo*.

	Lesion	Description
1	Mouth damaged	Lip and/or jaw damaged by the hook
2	Fin fraying	Fins damaged
3	Scale loss	Obvious area of scale loss
4	Wounding	Deep cuts on body, with exposed flesh
5	Haemorrhage	Head or body haemorrhage
6	Stomach eversion	Stomach eversion
7	Eye damaged	Eye punctured by the hook or swollen by pressure decrease
8	Operculum	Operculum opened with gills exposed

For vitality assessment, a total of 1434 specimens of blackspot seabream were sampled. Specimens' size ranged from 26 to 63 cm T_L, and in all size classes, the majority of the specimens were found in Excellent vitality status (Table 4 and Fig. 6).

Table 4. Number of specimens of blackspot seabream *Pagellus bogaraveo* sampled for each experiment, by vitality status.

Vitality status	Vitality assessment	Time-to-mortality	Survival
1=Excellent	1240	85	56
2=Good	157	28	3
3=Poor	28	6	-
4=Dead	9	-	-
n	1434	119	59

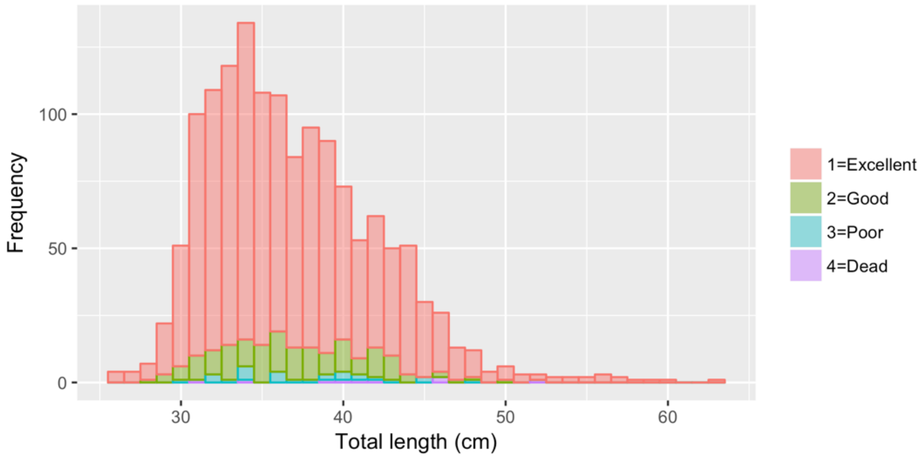

Figure 6. Length distribution (cm) of blackspot seabream *Pagellus bogaraveo* sampled, by vitality status (1 = Excellent; 2 = Good; 3 = Poor; 4=Dead).

The vitality status according to soaking time is presented in Table 5. No differences were found on the proportion of specimens in Excellent, Good or Poor conditions between soaking time. In fact, for the different soaking time, most of the specimens was found in the first category, as 85% to 89% of the specimens were found in Excellent status. Dead specimens were recorded for longer soaking times (more than 8 hours), but in very low proportion (1% in 8 hours soaking time and 2% in 11 hours soaking time). Considering all the sampled hauls, the observed at-vessel-mortality of blackspot seabream was 0.6% if considered only the dead or 2.6% if considered both dead and specimens in Poor conditions.

Table 5. Vitality status of blackspot seabream *Pagellus bogaraveo* caught by longline with different soaking times

	Soaking time (hours)			
Vitality status	02:00	05:00	08:00	11:00
1=Excellent	0.87	0.85	0.87	0.89
2=Good	0.11	0.12	0.10	0.08
3=Poor	0.01	0.03	0.02	0.01
4=Dead	0.00	0.00	0.01	0.02
n	366	541	386	141

Body lesions were observed in most of the captured specimens and these were associated to the hooking process. The main lesions registered were mouth damage (98%) and eye damage (2.4%) (Fig. 7). The remaining lesions were considered rare (less than 1%). Those two main body lesions were found in similar proportions between vitality status.

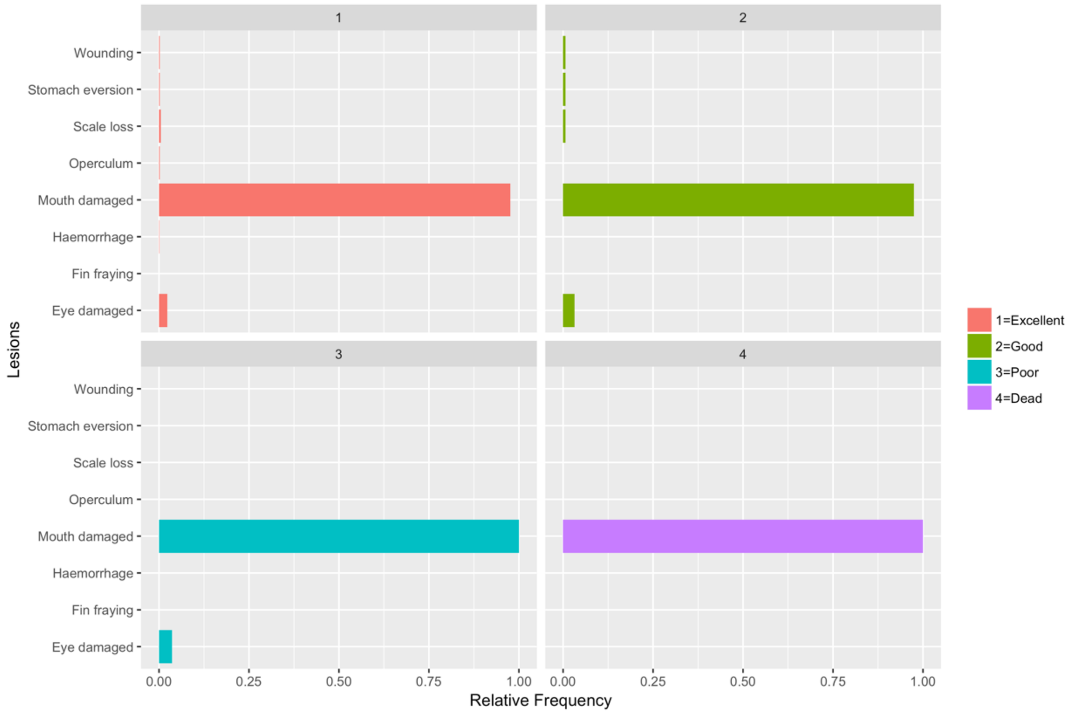

Figure 7. Proportion of occurrence of body lesions, by vitality status (1 = Excellent; 2 = Good; 3 = Poor; 4=Dead) in blackspot seabream *Pagellus bogaraveo* after capture by longline.

3.2. Time-to-mortality

For each fishing haul a sample of specimens was collected to be used to estimate the time-to-mortality (TTM) after capture. This variable corresponds to the time required to induce mortality during air exposure. The proportion of survivors *versus* time after capture is used to estimate the time at which 50% of individuals are expected to be dead while being exposed to air (Benoît et al., 2013).

Also, for each sampled specimen the vitality status (Table 2) and a selection of reflex action mortality predictors (RAMP's) were assessed for every 5-minute interval, after arrival on deck. The 5-minute observations continued until specimen's death, i.e., when all reflexes were absent. The reflex action mortality predictors adopted are described in Table 6, and where selected following the STECF recommendations (STECF, 2013).

Table 6. Description of the reflex action mortality predictors (RAMP's) assessed on blackspot seabream *Pagellus bogaraveo* during the time-to-mortality observations.

	Reflex	Description
1	Body Flex 2	Fish bends his body when placed in a smooth surface
2	Operculum Closure	The operculum closes when its force opened
3	Mouth Closure	The mouth closes when its force opened
4	Dorsal Fin Erection	The dorsal fin erects when the fish is restrained or touched

TTM data were fitted to non-parametric Kaplan-Meier survival models using R package survival (Therneau, 2019). Previously, the effects of the two factors, vitality status and soaking time, on TTM was evaluated by fitting a Generalized Linear Model.

A sample of 119 specimens was selected to estimate the TTM after capture, 85 were in Excellent, 28 in Good and 6 in Poor vitality status (Table 4). Specimens measured from 30 to 50 cm T_L.

The results of the adjusted Generalized Linear Model to evaluate the effect of the vitality status and soaking time on TTM, showed the existence of significant differences for the variable vitality status (Table 7). TTM was lower for specimens on both Good and Poor vitality status than those in Excellent vitality status. Specimens observed with a soaking time of 5h showed a significant lower TTM than those with 3h, but probably due to the two specimens observed in Poor conditions for that subset, and absent from the latter.

Table 7. Generalized Linear Model results on the effect of vitality status and soaking time on the time-to-mortality after air expose of blackspot seabream *Pagellus bogaraveo* caught by longline.

	Estimate	s.d	P
(Intercept)	47.011	1.743	**<0.01**
Vitality=Good	-8.43	2.20	**<0.01**
Vitality=Poor	-20.01	4.36	**<0.01**
Soaking time=05:00	-5.01	2.52	**0.05**
Soaking time=08:00	-1.03	2.29	0.65
Soaking time=11:00	-0.98	3.62	0.79

Specimens assigned to Excellent vitality status presented a TTM varying from 25 to 90 minutes (average TTM 45.3 minutes), while those in Good vitality TTM varied between 25 and 55 minutes (average TTM 37.1 minutes) and those in Poor vitality TTM ranged from 15 to 35 minutes (average TTM 23.3 minutes) (Fig. 8).

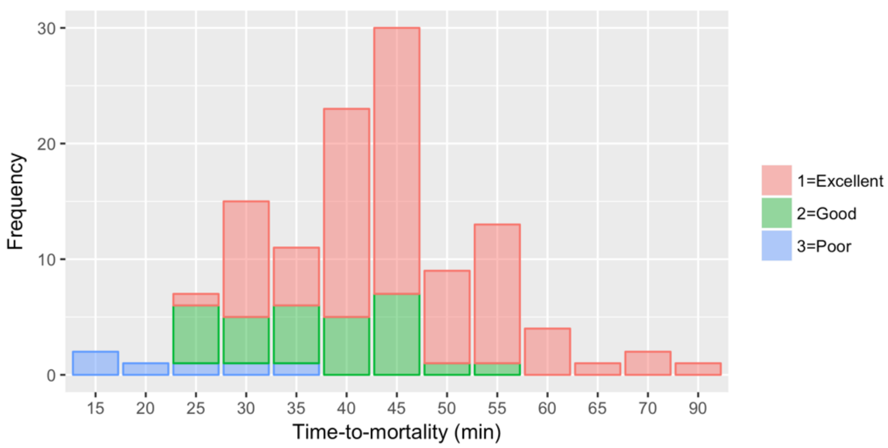

Figure 8. Distribution of time-to-mortality by vitality status (1 = Excellent; 2 = Good; 3 = Poor) of blackspot seabream *Pagellus bogaraveo* caught by longline.

TTM data fitted to non-parametric Kaplan-Meier survival models showed significant differences between vitality status ($p<0.01$); the estimated capacity to survive when exposed to air was higher for specimens with Excellent vitality status (Fig. 9 and Table 8). The time at which 50% of individuals are expected to die after being exposed to air, is 45 minutes for species in Excellent vitality status after capture, 38 minutes for those in Good condition and 23 minutes for specimens in Poor vitality status. Due to the low number of specimens, the estimated TTM for specimens in Poor condition has a high uncertainty.

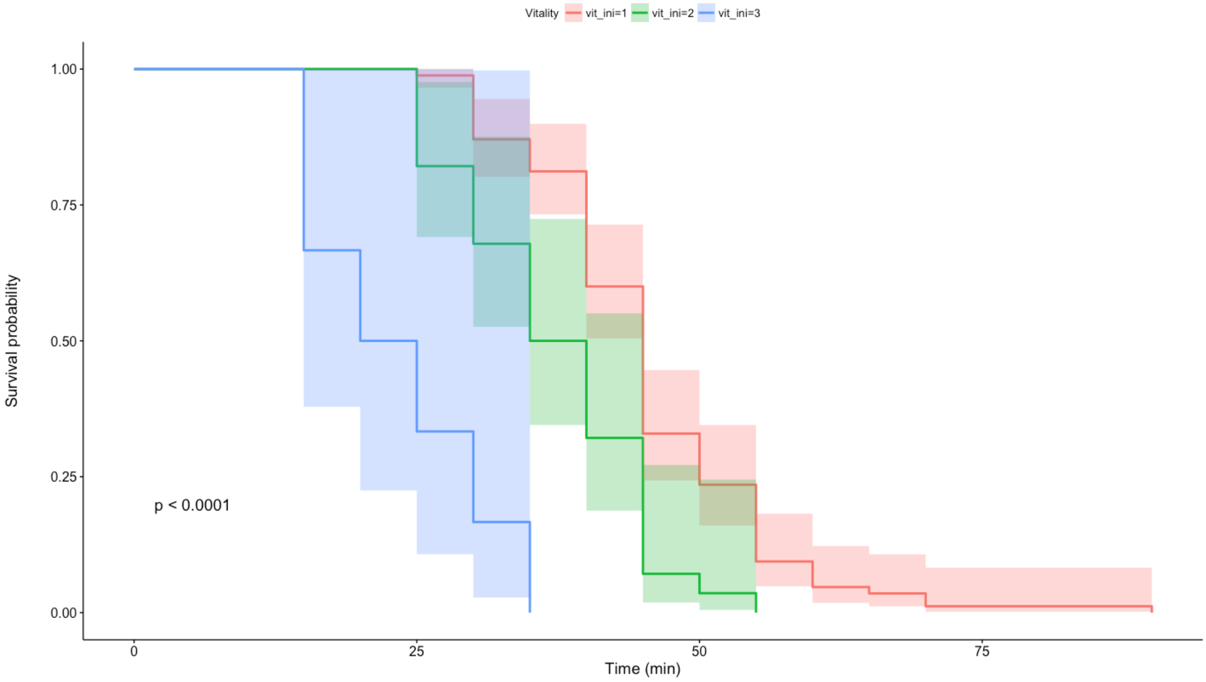

Figure 9. Kaplan-Meier curve fitted to time-to-mortality data by vitality status after capture (1 = Excellent; 2 = Good; 3 = Poor) of blackspot seabream *Pagellus bogaraveo* captured by longline. Shaded areas represent 95% confidence intervals. The p-value from the comparison between vitality status is also presented.

Table 8. Kaplan-Meier survival model output fitted to TTM data by vitality status for blackspot seabream *Pagellus bogaraveo* captured by longline. (Time: time points at which the curve has a step; n.risk: number of specimens contributing at time t; n.event: number of events that occur at time t; survival: estimated survival at time t; s.e.: standard error; CI: confidence interval)

Vitality status = Excellent

time	n.risk	n.event	survival	s.e.	lower 95% CI	upper 95% CI
25	85	1	0.9882	0.0117	0.96558	1
30	84	10	0.87	0.04	0.80	0.95
35	74	5	0.81	0.04	0.73	0.90
40	69	18	0.60	0.05	0.50	0.71
45	51	23	0.33	0.05	0.24	0.45
50	28	8	0.24	0.05	0.16	0.35
55	20	12	0.09	0.03	0.05	0.18
60	8	4	0.05	0.02	0.02	0.12
65	4	1	0.04	0.02	0.01	0.11
70	3	2	0.01	0.01	0.00	0.08

Vitality status = Good

time	n.risk	n.event	survival	s.e.	lower 95% CI	upper 95% CI
25	28	5	0.82	0.07	0.69	0.98
30	23	4	0.68	0.09	0.53	0.88
35	19	5	0.50	0.09	0.35	0.72
40	14	5	0.32	0.09	0.19	0.55
45	9	7	0.07	0.05	0.02	0.27
50	2	1	0.04	0.04	0.01	0.25

Vitality status = Poor

time	n.risk	n.event	survival	s.e.	lower 95% CI	upper 95% CI
15	6	2	0.67	0.19	0.38	1.00
20	4	1	0.50	0.20	0.22	1.00
25	3	1	0.33	0.19	0.11	1.00
30	2	1	0.17	0.15	0.03	1.00

3.3. Short-term survival

The short-term survival of blackspot seabream under captive conditions was evaluated based on a subsample of specimens collected from longline fishing hauls. The specimens were maintained for a period of a maximum of 36 hours. To guarantee the maximum time in captivity, specimens were sampled from the first haul of each fishing day.

Specimens were handled in the same way used normally by the vessel's crew, particularly on the extraction of specimens from hooks. Before placing the specimens in the captivity tank, specimens were sampled following the same sampling protocol used on the vitality assessment. The sampling process commonly lasted less than 30 seconds per fish.

The selected specimens were placed in the captivity tank (volume ~ 540 l). The tank had isothermal isolation (double-walled with polyurethane insulation injected into the walls), continuous supply of fresh seawater, and was semi-covered by an isothermal lid to allow the exit of the excessive water from the surface (Fig. 10). Water aeration was maintained by a strong and continuous seawater flow from the vessel's pump. Water temperature, pH and salinity were monitored twice a day.

Figure 10. Tank used for captive observations of short-term survival of blackspot seabream *Pagellus bogaraveo* onboard a commercial longliner.

In each captivity experiment, an average of 7 specimens were maintained in the tank. Important to note that during the monitorization period, dead specimens were immediately removed from the tank. Observations of the vitality status were performed every hour at the first 6 hours, then at 12 and 24 hours after capture. Following the same periods until completing 36 h of observation.

A modified scale (Table 9) was adopted to assess vitality of the specimens maintained in the tank. The individual behaviours and reflexes selected for scoring of RAMP are described in Table 10. Underwater cameras were used to register behavioural patterns.

Observed data were fitted to non-parametric Kaplan-Meier survival models using R package survival (Therneau, 2019).

Table 9. Description of the criteria used to assess vitality of blackspot seabream *Pagellus bogaraveo* adapted to captive observations.

Vitality status		Description
1	Excellent	Fish with normal swimming behaviour and vertical body orientation. Regular respiratory reflexes of the mouth and operculum.
2	Good	Fish with abnormal body orientation and/or with fluctuation difficulties (i.e fish swim laterally or with head facing down). Regular respiratory reflexes of the mouth and operculum.
3	Poor	Fish with abnormal body orientation and/or with fluctuation difficulties (i.e fish swim laterally or with head facing down). Weak body movement, generally standing still near the bottom of the tank or sometimes with body spasms. Weak respiratory reflexes of the mouth and operculum.
4	Dead	Fish without body movement or respiratory reflexes and not responding to stimuli.

Table 10. Behaviour/Reflex actions for scoring of Reflex Action Mortality Predictor during captive observations of blackspot seabream *Pagellus bogaraveo*.

	Behaviour	Description
1	Orientation*	Fish swims in normally upright position
2	*Head complex**	Regular respiratory pattern of ventilation with mouth and operculum
3	Exploration	Fish explores all the area in the tank
4	Aggregation	Fish swims in group
5	Scratch	Fish rubbing against the walls of the tank

* Reflex action used in previous studies as “Reflex Action Mortality Predictor” (RAMP)

A total of 59 specimens of blackspot seabream were selected for the captive observations, 56 specimens were selected with Excellent vitality status, and 3 were selected with Good vitality status (Table 4). The length of sampled specimens varied from 27 to 43 cm T_L (average of 33 cm T_L).

The water temperature in the tanks was maintained stable at 15-16 ºC, the salinity ranged from 35 to 37 and pH ranged from 8.1 to 8.3. During the sampled trips the sea surface temperature was around 14ºC.

Survival data fitted to non-parametric Kaplan-Meier survival models showed no significant differences between vitality status ($p=0.74$). After 36h period the estimated survival rate of blackspot seabream caught by longline was 86% (Fig. 11 and Table 11).

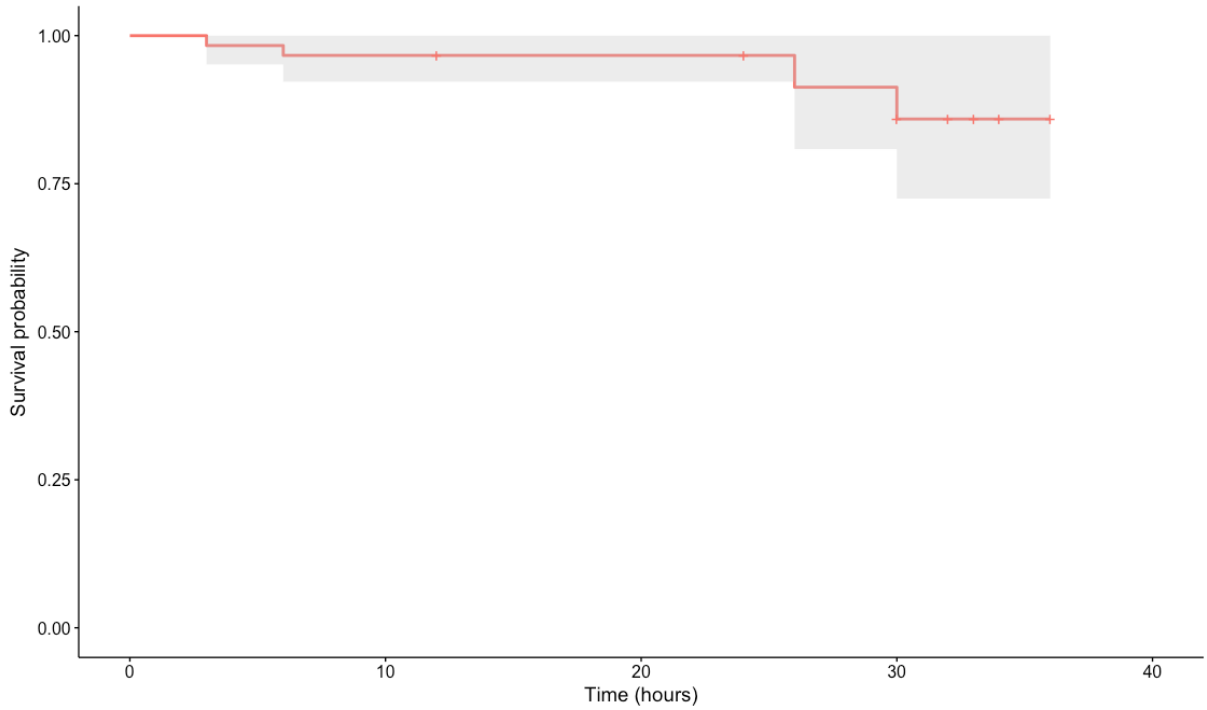

Figure 11. Kaplan-Meier curve fitted to survival data of blackspot seabream *Pagellus bogaraveo* captured by longline. Shaded areas represent 95% confidence intervals.

Table 11. Kaplan-Meier survival model output for blackspot seabream *Pagellus bogaraveo* captured by longline. (Time: time points at which the curve has a step; n.risk: number of specimens contributing at time t; n.event: number of events that occur at time t; survival: estimated survival at time t; s.e.: standard error; CI: confidence interval)

time	n.risk	n.event	survival	s.e.	lower 95% CI	upper 95% CI
3	60	1	0.98	0.02	0.95	1.00
6	59	1	0.97	0.02	0.92	1.00
26	18	1	0.91	0.06	0.81	1.00
30	17	1	0.86	0.07	0.73	1.00

4. Discussion and conclusion

The high survivorship estimated for the blackspot seabream in longline fisheries such as in Cadiz and Azores gives support for the results obtained for the Portuguese mainland longline fishery.

Based on Portuguese fishermen´s knowledge and on their traditional fishing strategy and hauling process behaviour, the majority of blackspot seabream specimens caught by demersal longline arrive on-board alive and lasting in that condition for some time. According to fishermen, the great majority of specimens released to the sea immediately take an active behaviour by swimming rapidly to the bottom. In addition, the handling process of this high valued species is also an extra factor contributing for this high survivorship after capture. Also, the mean price of the specimens is highly depreciated for injured specimens.

Those fishermen evidences were the main reasons for their prompt availability to conduct the onboard experiments and to include scientific observers in a demersal longliner from the mainland Portugal polyvalent fleet (ICES Division 27.9.a).

The longline fishing gear used in the experiment and which is similar to the other in Portugal mainland do not technically differ from Azorean "palangre pedra-bóia" (stone-buoy longline). Both can be considered semi-pelagic, as the longline is lifted off the bottom by buoys and weighted down with small weights in between (Sousa et al., 1999). While the Azores tend to target more consistently blackspot seabream, both the Azorean and the mainland Portuguese longliners may target species other than the blackspot seabream. In both regions as well as in Cadiz, the species has a restrictive spatial distribution, being typically aggregated near prominent rocky bottoms or seamounts between 100 and 400 m depths (Sousa et al., 1999).

Regarding the Spanish fishery although the Portuguese mainland fishery have similarities with it, in the "voracera", the soaking time is significantly shorter (15-30 minutes) (STECF, 2018). This variable however was found to not be significant on the results obtained in the present study.

Given the low levels of discards of blackspot seabream in the demersal longline fishery operating in mainland Portugal, although not quantified, are expected to be low. Not only because the species has a high commercial value, but also the demersal longline fishery is size selective and captures mostly fish with length above the minimum landing size of 25 cm. In the experiments, the observed discard rate was very low (0.2% specimens per fishing haul).

The main results obtained during the onboard experiments conducted by IPMA in a commercial longliner operating at Portugal mainland waters (ICES Division 27.9.a) are:

- **The experiments conducted in the current study were carried out following the normal fishing activity of the longline commercial fishery operating in mainland Portugal.**

- **The majority of the specimens of blackspot seabream *Pagellus bogaraveo* were found to be in Excellent (85-89%) or Good (8-12%) conditions**, independent of the duration of the soaking time. The body lesions assessed in this study seem not to affect the observed vitality status after capture. The estimates of the vitality after capture of blackspot seabream obtained in this study were similar to those observed for the bottom longlines and hand lines in the Azores fishery (ICES Subarea 27.10), with the present study showing a slightly higher percentage of fish in Excellent conditions (RDFAAR, 2018). In that area, 76% and 73% were found in Excellent conditions when captured by bottom longline and hand lines, respectively.

- **The at-vessel-mortality observed in the sampled trips was 0.6-2.6%**. In comparison, in the Azorean fisheries, the at-vessel mortality was estimated to be higher for both bottom longline (15%) and hand lines (12%) (RDFAAR, 2018). As the mean fishing depth was similar in both studies, the differences may be related to other factors such as hauling speed.

- **The time at which 50% of individuals are expected to die after being exposed to air, ranged from 45 minutes for specimens in Excellent vitality status to 23 minutes for specimens in Poor vitality status. No differences were found between different soaking times.** These results reinforce the high resistance of blackspot seabream to fishing and other stressors like air exposure. They also provide a quantification of the maximum time that fish may be kept on deck before being released alive to the sea, as a proposal of good practices to be applied onboard by the commercial fleet. However, it is recommended that the sorting procedure should be as fast as possible to allow for a higher probability of survival for those that are released to the sea.

- **The observed survival rate of blackspot seabream captured by demersal longline after 36 hours was 86%.** The results obtained in this study were similar to those obtained for the same species in other areas and fisheries, based on captivity studies (RDFAAR, 2018; Ruiz-Jarabo, in press). The estimated survival rate for hooks and lines in the Azores (ICES Subarea 27.10) was 90.2%, for an average husbandry of 21 days and to an average transport duration of 36 hours. That estimated for "voracera" in southern Spain (ICES Division. 9a) was 90.6% after 5h and that obtained after 6h in the present study was 97%.

In face of the results obtained which followed the recommendations of the STECF (STECF, 2013) and ICES WGMEDS (ICES, in press) it is considered the existence of scientific evidences for inclusion of the demersal longline fishery operating in Portugal mainland waters (ICES Division 27.9.a) in the exemption of the landing obligation applied to blackspot seabream *Pagellus bogaraveo* in EU South-western waters.

The relevant results to be evaluated by STECF for the high survivability exemption for blackspot seabream *Pagellus bogaraveo* caught by demersal longline in ICES Division 9a are summarized in Table 12.

Table 12. Summary of high survivability exemption for blackspot seabream *Pagellus bogaraveo* caught in ICES Division 9a by demersal longline.

Country	Exemption applied for (species, área, gear, type)	Species as bycatch or target	Number of vessels subject to the LO	Landings (by LO subject vesssels)	Estimated discards	Estimated catch	Discard rate	Estimated discard survival proxies from provided studies
PRT	LLS_DEM	By-catch (seasonally targeted)	80 vessels	46 tonnes	Negligible (mostly related T_L < MLS)	Around 46 tonnes	Near 0%	86% survival after 36h At-vessel mortality=0.6-2.6% Excellent Vitality assessment after capture =85-89%

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Working Document to be presented to the Working Group on the
Biology and Assessment of Deep Sea Fisheries Resources

ICES WGDEEP, 2nd - 9th May 2019,

Results on silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*) and ling (*Molva molva*) from the Porcupine Bank Survey (NE Atlantic)

S. Ruiz-Pico[1], M. Blanco[1], O. Fernández-Zapico[1], F. Velasco[1] & F. Baldó[2]

Instituto Español de Oceanografía

(1) Centro Oceanográfico de Santander
Promontorio San Martín s/n
39004 Santander, Spain

(2) Centro Oceanográfico de Cádiz
Muelle de Levante (Puerto Pesquero)
P.O. Box 2609
11006 Cádiz, Spain

Abstract

This working document presents the results of the most significant deep fish species caught on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2018. Biomass, abundance, distribution and length ranges were analysed for silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater fork-beard (*Phycis blennoides*), ling (*Molva molva*) and Spanish ling (*Molva macrophthalma*). Despite the general biomass decline of these target species this last survey, signs of recruitment were found.

Introduction

The Spanish bottom trawl survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been carried out annually in the third-quarter (September) since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in the area (ICES 2017).

The aim of this working document is to update the results (abundance indices, length frequency and geographic distributions) of the most common deep water fish species on Porcupine bottom trawl surveys after the results presented previously (Baldó *et al.* 2008, Velasco *et al.* 2009, 2011, 2012, 2013, Fernández-Zapico *et al*. 2015, 2017, Ruiz-Pico *et al.* 2016, 2018). The species analysed were: *Argentina silus* (greater silver smelt), *Argentina sphyraena* (lesser silver smelt), *Helicolenus dactylopterus* (bluemouth), *Phycis blennoides* (greater forkbeard), *Molva molva* (ling) and *Molva macrophthalma* (Spanish ling).

Material and methods

The Spanish Ground Fish Survey on the Porcupine bank (SP-PORC-Q3) has been annually carried out since 2001 onboard the R/V "*Vizconde de Eza*", a stern trawler of 53 m and 1800 Kw. The area covered extends from longitude 12° W to 15° W and from latitude 51° N to 54° N, following the standard IBTS methodology for the western and southern areas (ICES 2017). The sampling design was random stratified to the area (Velasco and Serrano, 2003) with two geographical sectors (Northern and Southern) and three depth strata (> 300 m, 300 – 450 m and 450 - 800 m) (Figure 1). Hauls allocation is proportional to the strata area following a buffered random sampling procedure (as proposed by Kingsley et al., 2004) to avoid the selection of adjacent 5×5 nm rectangles. More details on the survey design and methodology are presented in ICES (2017).

The reduction in the tow duration (20 instead of 30 minutes) applied in the last three surveys worked successfully. Now the catches have been reduced and are easier to handle for the team who sort it, but they are still abundant enough to be representative samples. The biomass indices of the entire time series are not affected by this reduction because the results of these last surveys were extrapolated to 30 minutes of trawling time to keep up the time series.

Results and discussion

In 2018, 80 valid standard hauls and 3 additional hauls were carried out (Figure 1).

The total mean catch per haul decreased slightly the last year (Figure 2). Fish represented 93% of the total stratified catch and the deep water fishes considered represented 15% of that total fish catch, with the following percentages per species: *Argentina silus* (70%), *Helicolenus dactylopterus* (15%), *Argentina sphyraena* (10%), *Phycis blennoides* (4%), *Molva macrophtalma* (1%) and *Molva molva* (0.5%).

In 2018, the biomass of these deep water species decreased. Species such as *M. macrophtalma*, *M. molva* and *P. blennoides* have been following a downward trend since the last four years, reaching even the lowest values of the time series this last survey, like *P. blennoides*. In contrast, more recruits of all of these species were found compared to the previous year. Specifically, *H. dactylopterus* showed the most remarkable peak in the overall time series and signs of recruitment of *M. macrophtalma* and *P. blennoides* was found as well, despite their low biomass.

Argentina silus (greater silver smelt) and *Argentina sphyraena* (lesser silver smelt)

In 2018, the biomass and abundance of both species of *Argentina* decreased. *A. silus*, the most contributing species in the overall percentage of silver smelt, followed the downward trend of the previous year, whereas *A. sphyraena* broke the 6 year upward trend, dropping abruptly this last survey (Figure 3; Figure 4; Figure 5).

This last survey, both species where barely found in the north of the bank. Specifically, there were no traces of *A. silus* in that area and there were a few spots of biomass of *A. sphyraena* where it was usually found (Figure 6 and Figure 7).

Despite the low abundance per size in both species this lastest survey, a few small specimens were found. *A. silus* showed more specimens from 12 to 18 cm than the previous year, and a few more specimens from 28 to 39 cm. *A. sphyraena* also showed more specimens from 11 to 14 cm than the previous year but low abundance of large specimens (Figure 8).

Helicolenus dactylopterus (bluemouth)

Although bluemouth is not requested in ICES DCF Data Call, the biomass and abundance is significant in the area and useful for the assessment of the species (ICES, 2015).

In the last survey, the biomass of *H. dactylopterus* decreased but the abundance increased (Figure 9). Following the increasing recruitment trend of the previous years, in 2018 even a greater peak of specimens between 1 and 10 cm was found (Figure 10), explaining that abundance increase.

The geographical distribution of *H. dactylopterus* showed even lesser presence in the north of the bank than the previous year. A large amount of recruits was found from 222 to 570 m in the southeast area of the bank and on the Irish shelf (Figure 11).

The figure 12 showed the greatest peak of specimens from 6 to 9 cm over the time series (recruits were also found in 2017 but smaller, around 4 cm). In contrast, low abundance of large specimens was found.

***Phycis blennoides* (greater fork-beard)**

The biomass of *Phycis blennoides* further decreased this last year, reaching the lowest value of the time series (5.7 ± 0.8 kg haul^{-1}). Biomass and abundance have been decreasing for four years in a row (Figure 13).

This species is becoming more and more difficult to find in the north of the study area. This last survey, spots of biomass were mainly found in the southern and deepest depth strata (450-800 m) (Figure 14).

Despite the low abundance, more recruits from 10 to 20 cm were found than the previous year (Figure 15 and Figure 16).

***Molva molva* (ling) *and Molva macrophthalma* (Spanish ling)**

These two species were comparatively analysed in this working document like in the previous reports, since *M. macrophtalma* was identified, because initially had been misidentified as ling. Then, it was found that *M. molva* was scarcer than *M. macrophtalma* in the area.

Both species have been following a downward trend since 2014. This last survey, the biomass and abundance decresed reaching the lowest value of the time series (0.7 kg haul^{-1} and 0.2 ind. haul^{-1} in *M. molva* and 1.8 kg haul^{-1} and 3.7 ind. haul^{-1} in *M. macrophtalma*) (Figure 17).

Both species showed a reduced distribution ranges this last survey. Few spots of biomass of *M. molva* were found in the west and on the Irish shelf whereas the biggest spots of biomass of *M. macrophtalma* were only found in the west (Figure 18).

Small specimens of both species were more abundant this last survey than the two previous years, despite their low biomass (Figure 19). Recruits of *M. macrophtalma* from 11 to 26 cm increased (Figure 20) and a few specimens of *M. molva* (smaller than 40 cm) were found.

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Figures

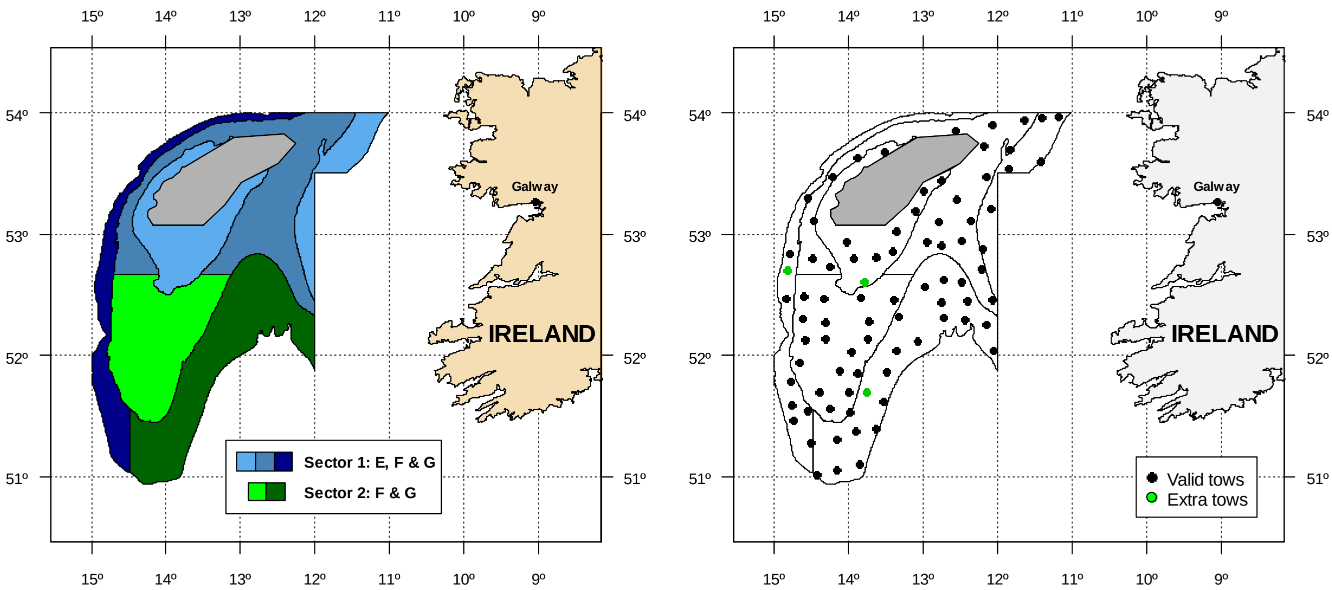

Figure 1. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed in 2018

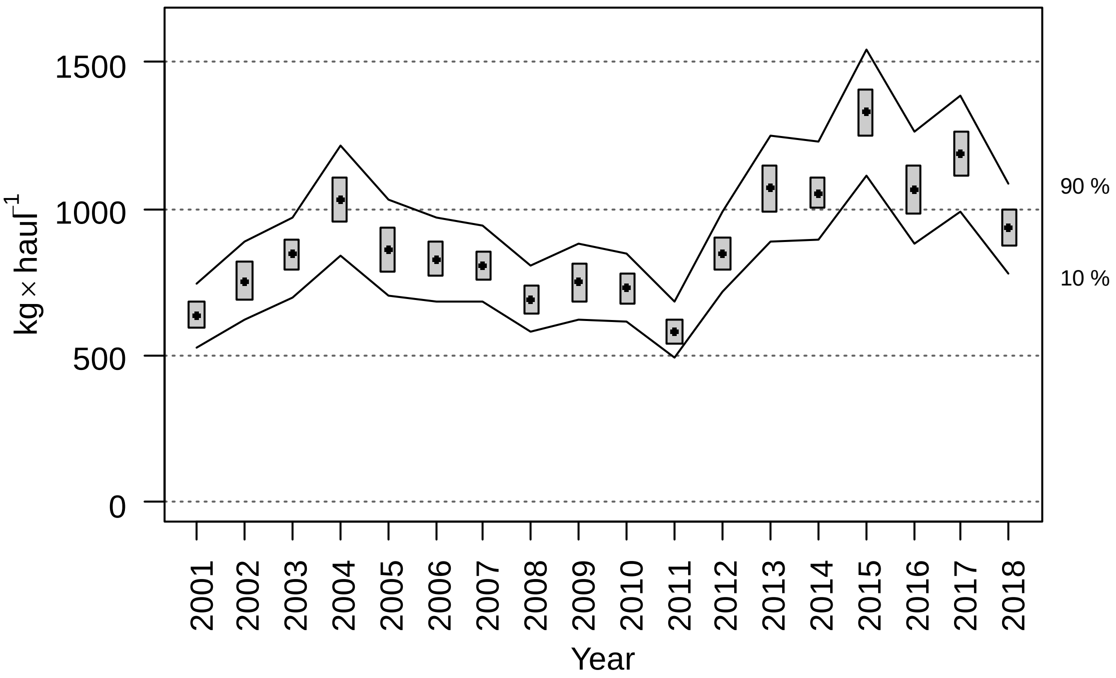

Figure 2. Evolution of the total catch in Porcupine surveys (2001-2018)

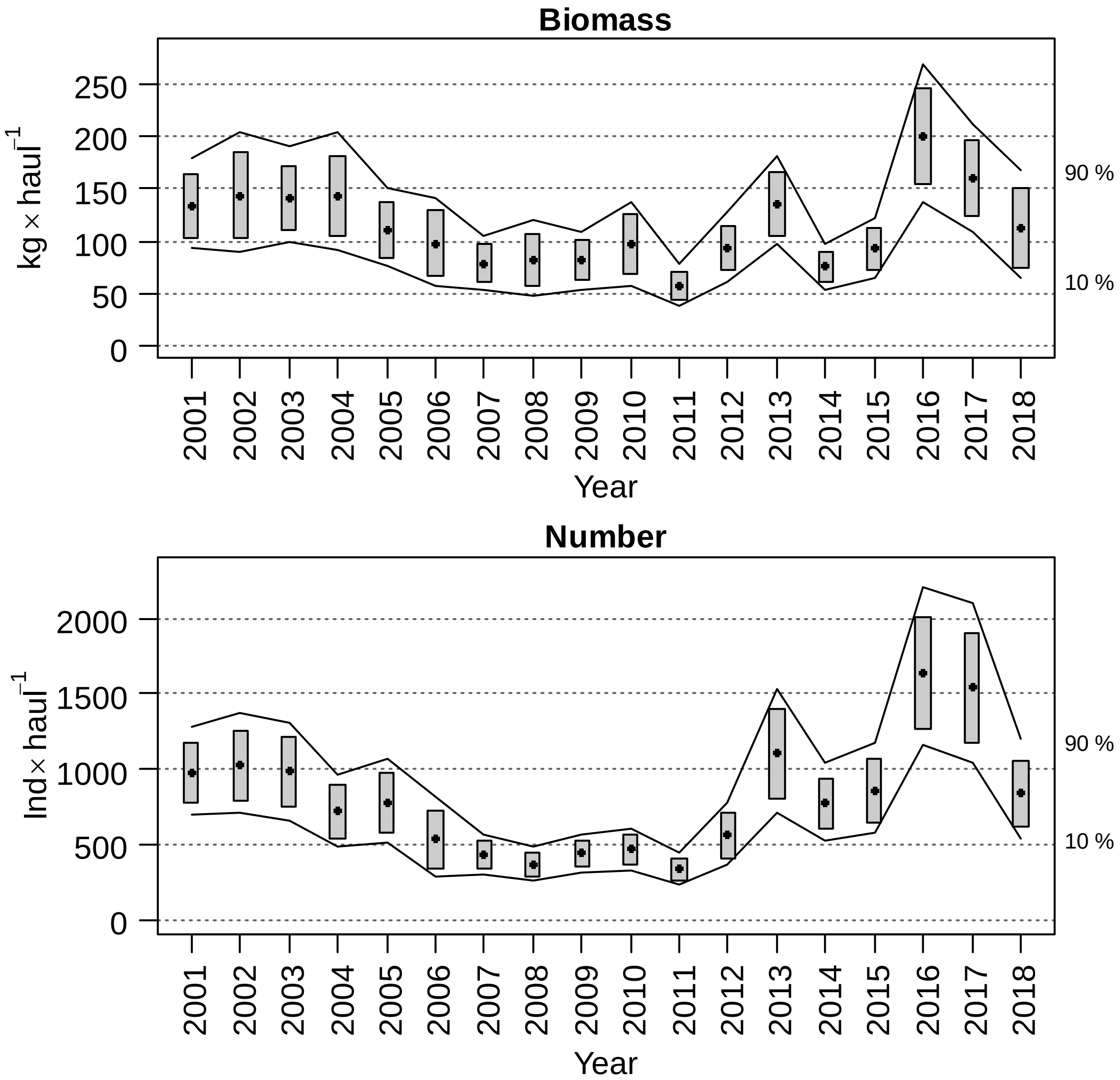

Figure 3. Evolution of *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

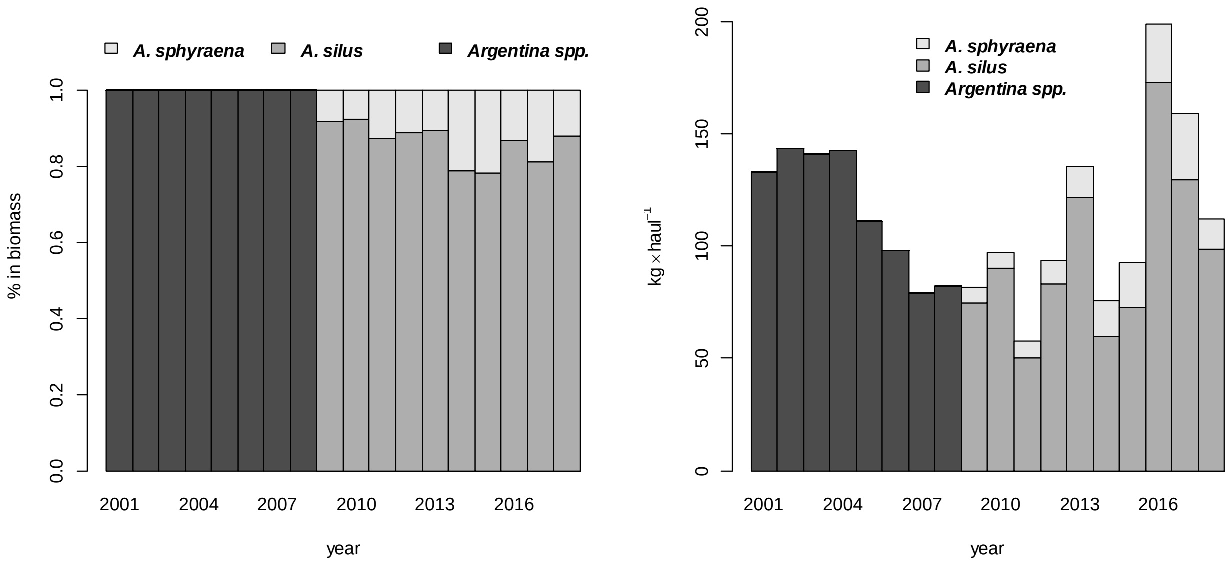

Figure 4. Share and abundance of Argentine species in Porcupine surveys (2001-2018)

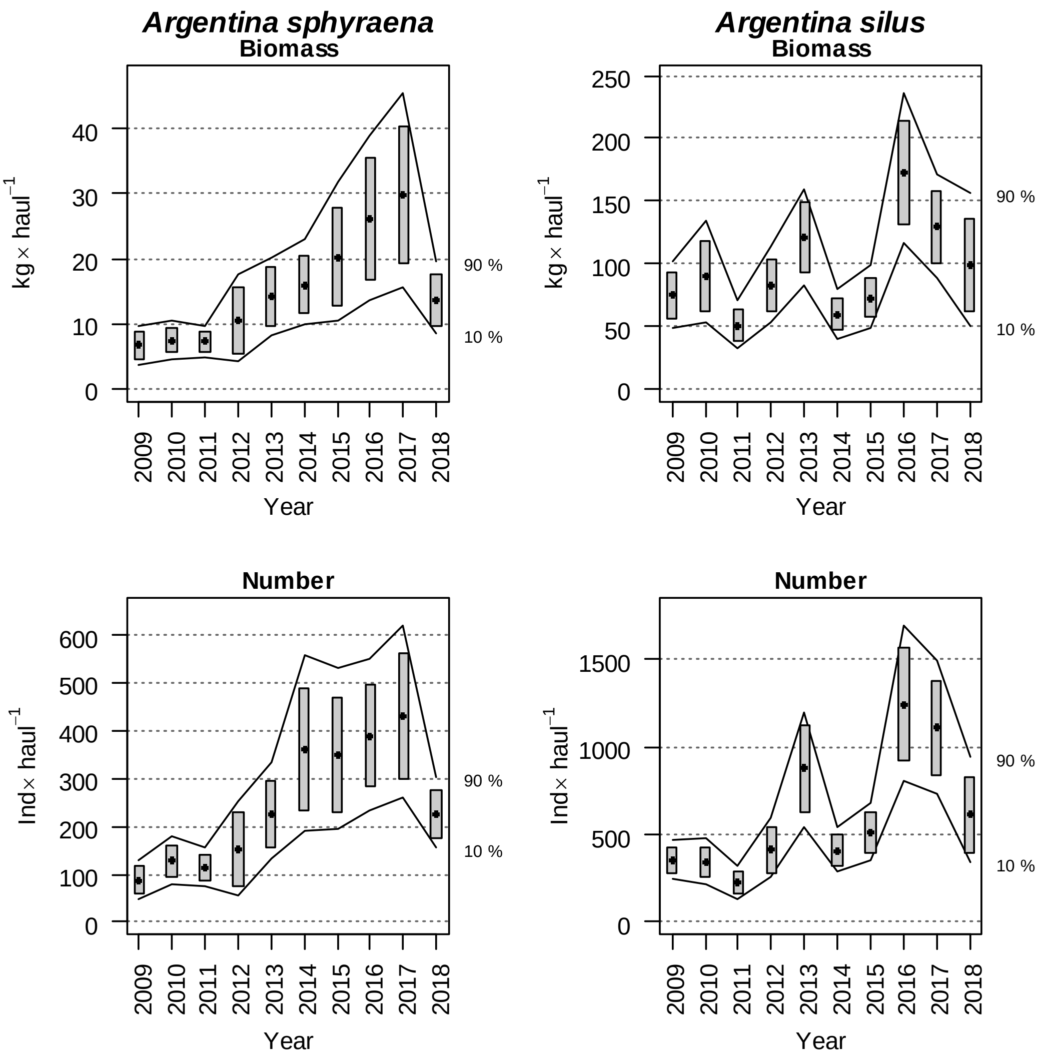

Figure 5. Evolution of *Argentina sphyraena* and *Argentina silus* biomass and abundance indices in Porcupine surveys (2009-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

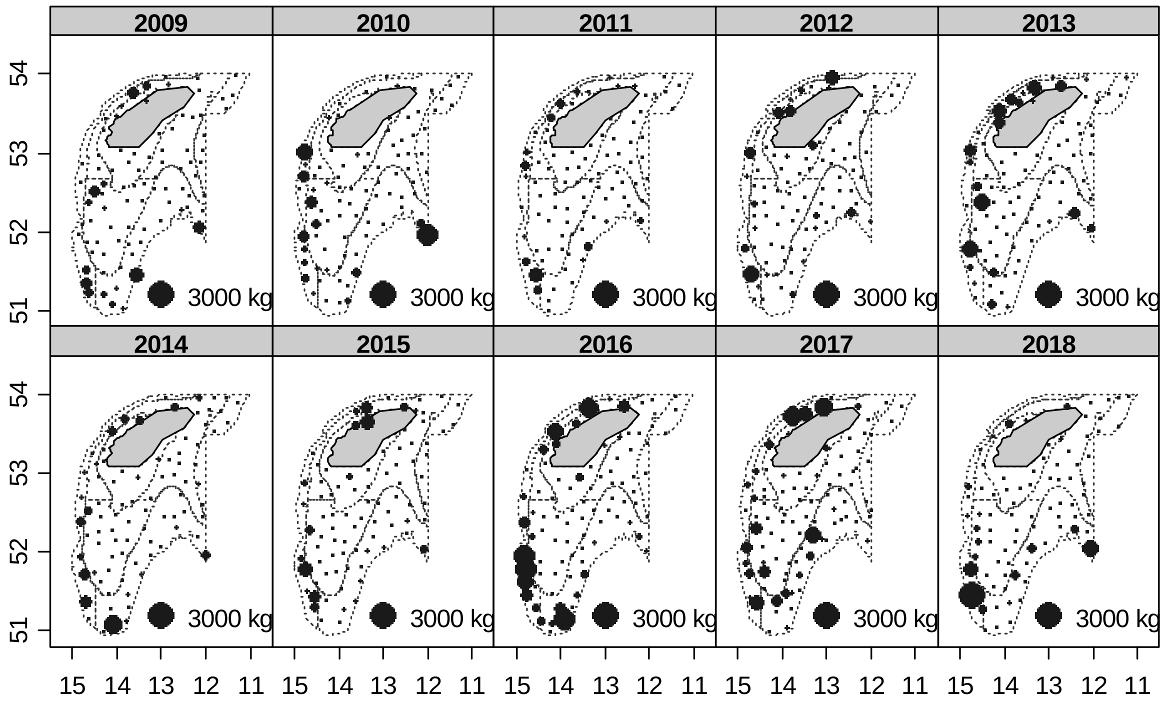

Figure 6. Geographic distribution of *Argentina* spp. catches (kg/30 min haul) in Porcupine surveys (2009-2018)

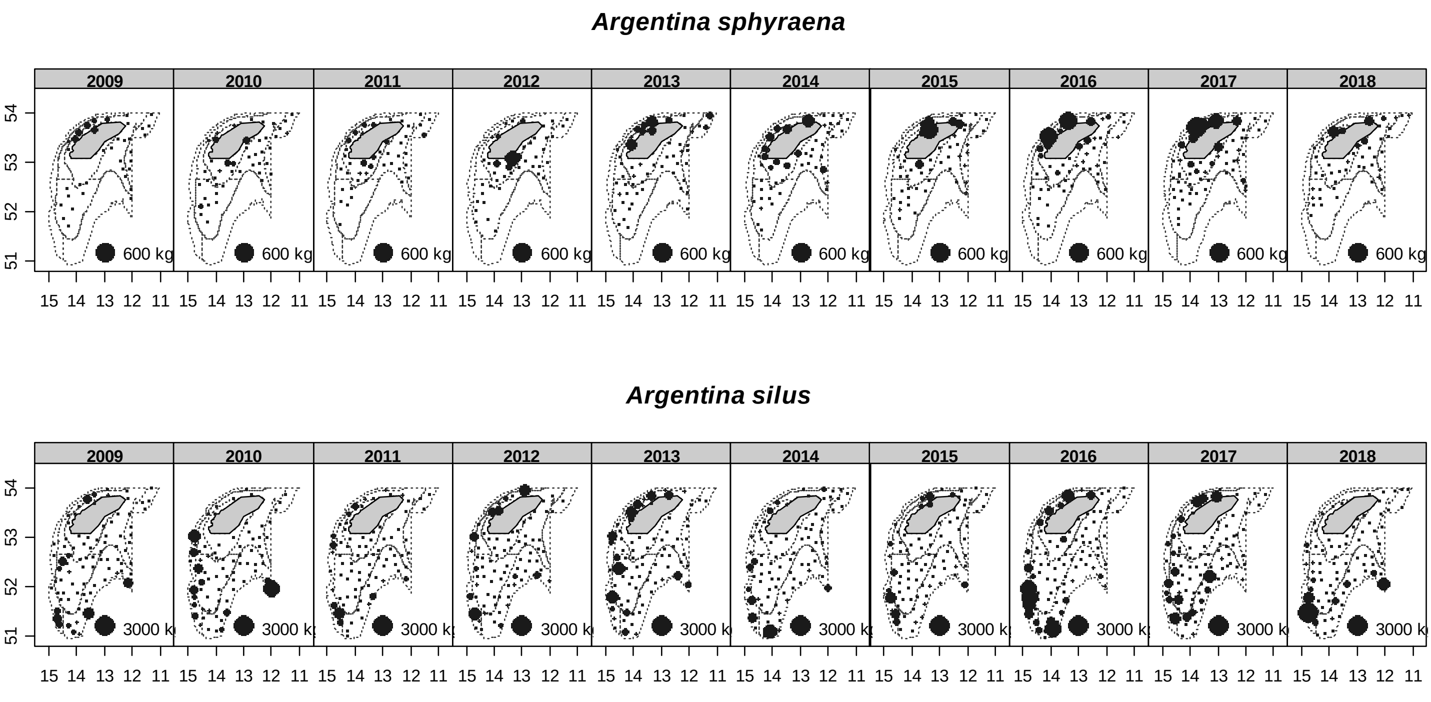

Figure 7. Geographic distribution of *Argentina sphyraena* and *Argentina silus* catches (kg/30 min haul) in Porcupine surveys (2009 - 2018)

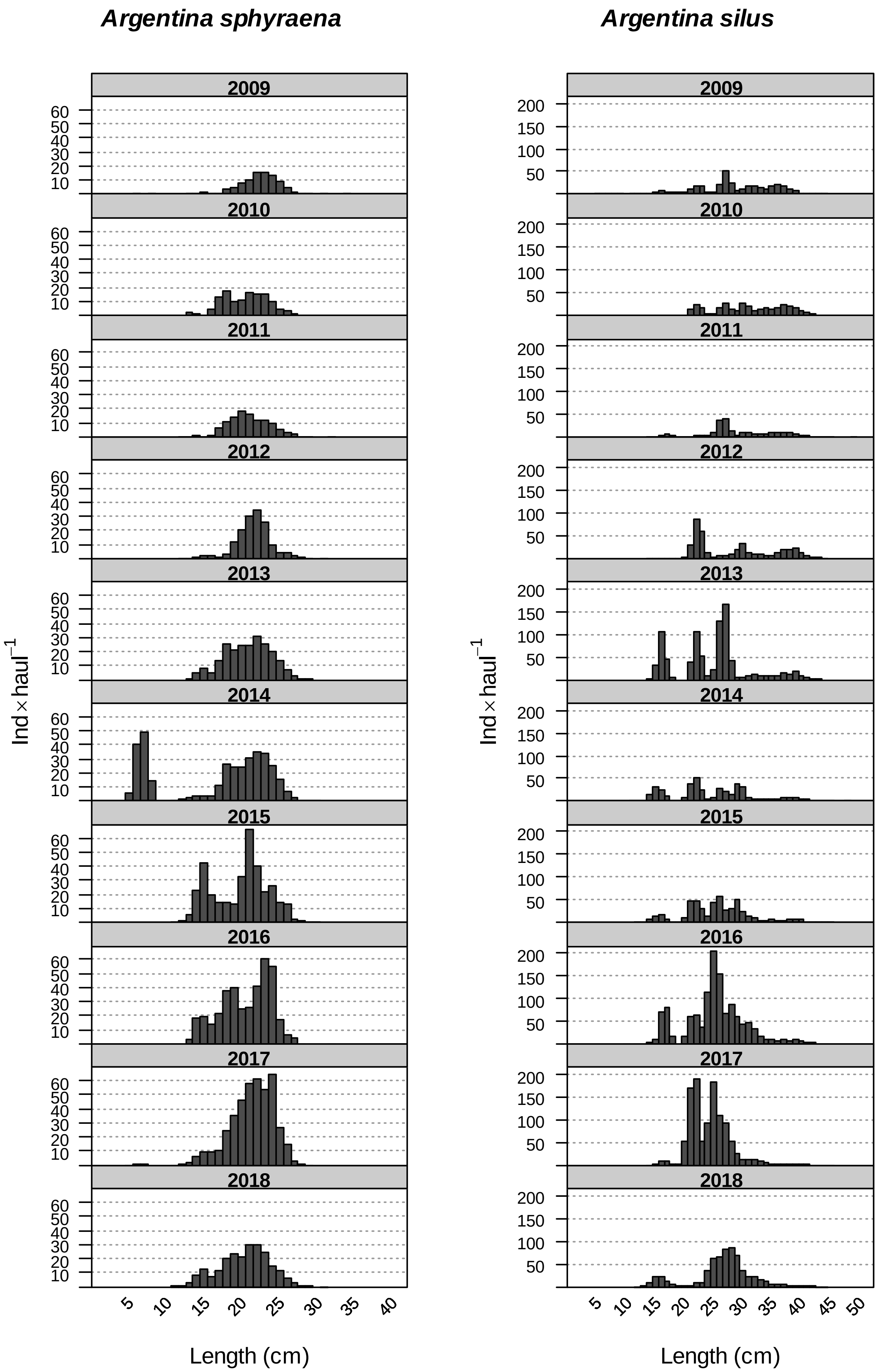

Figure 8. Mean stratified length distributions of *Argentina sphyraena* and *Argentina silus* in Porcupine surveys (2009-2018)

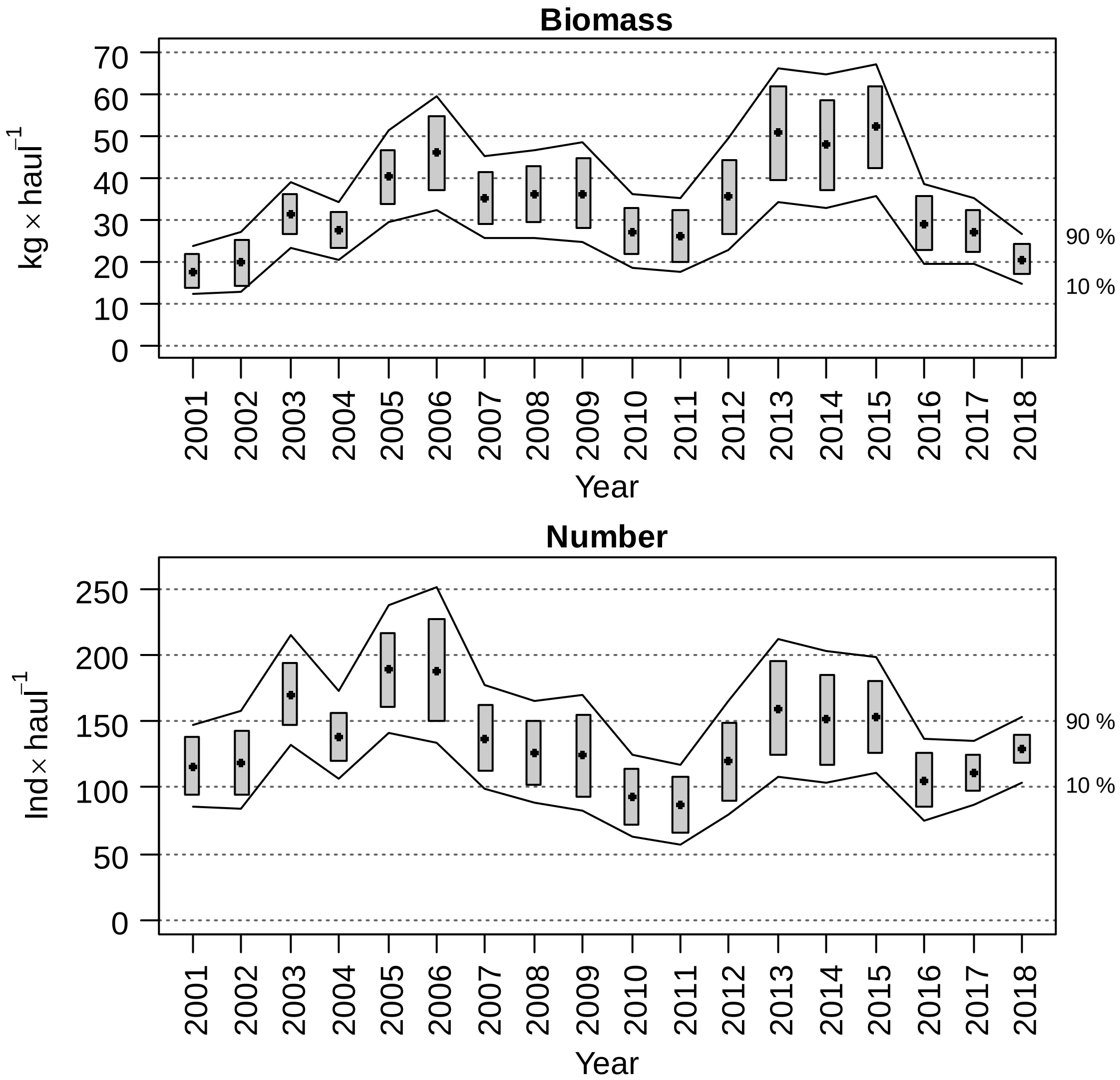

Figure 9. Evolution of *Helicolenus dactylopterus* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

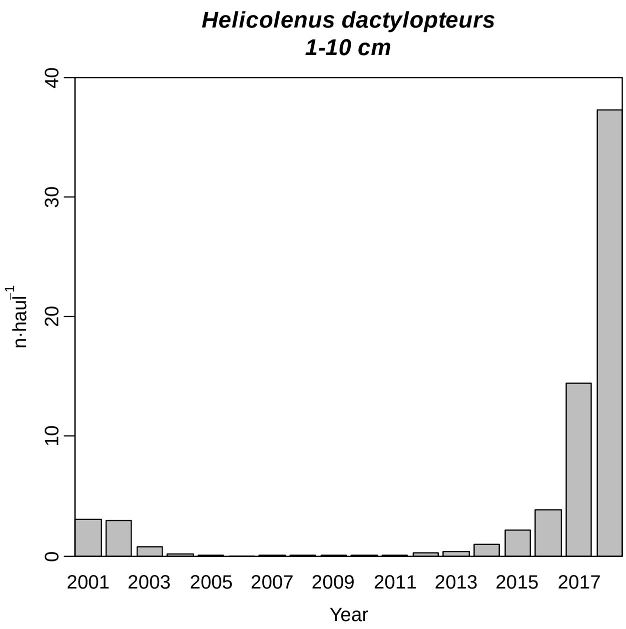

Figure 10. Mean stratified abundance of *Helicolenus dactylopterus* recruits (1-10 cm) in Porcupine surveys (2001-2018)

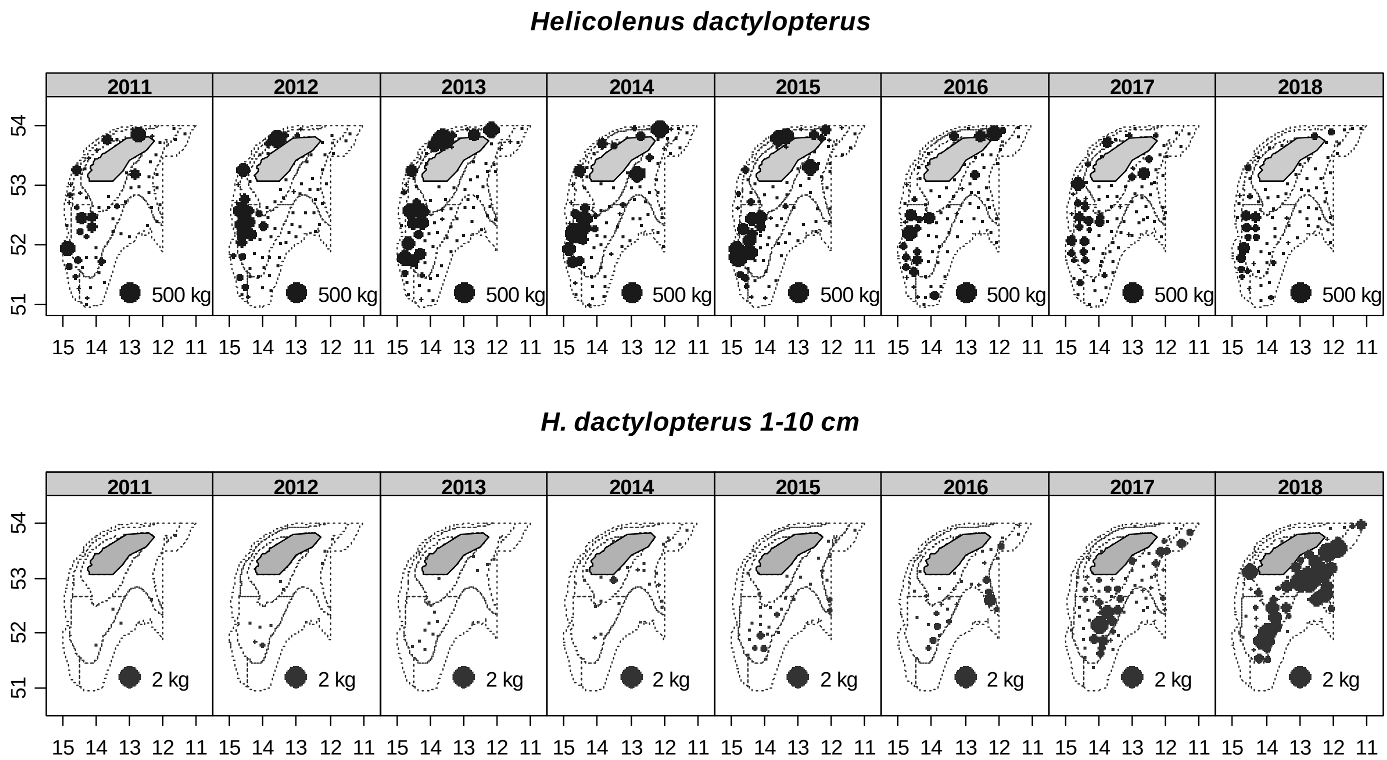

Figure 11. Geographic distribution of *Helicolenus dactylopterus* catches (kg×30 min haul-1) and *H. dactylopterus* recruits (1-10 cm) in Porcupine surveys (2011-2018)

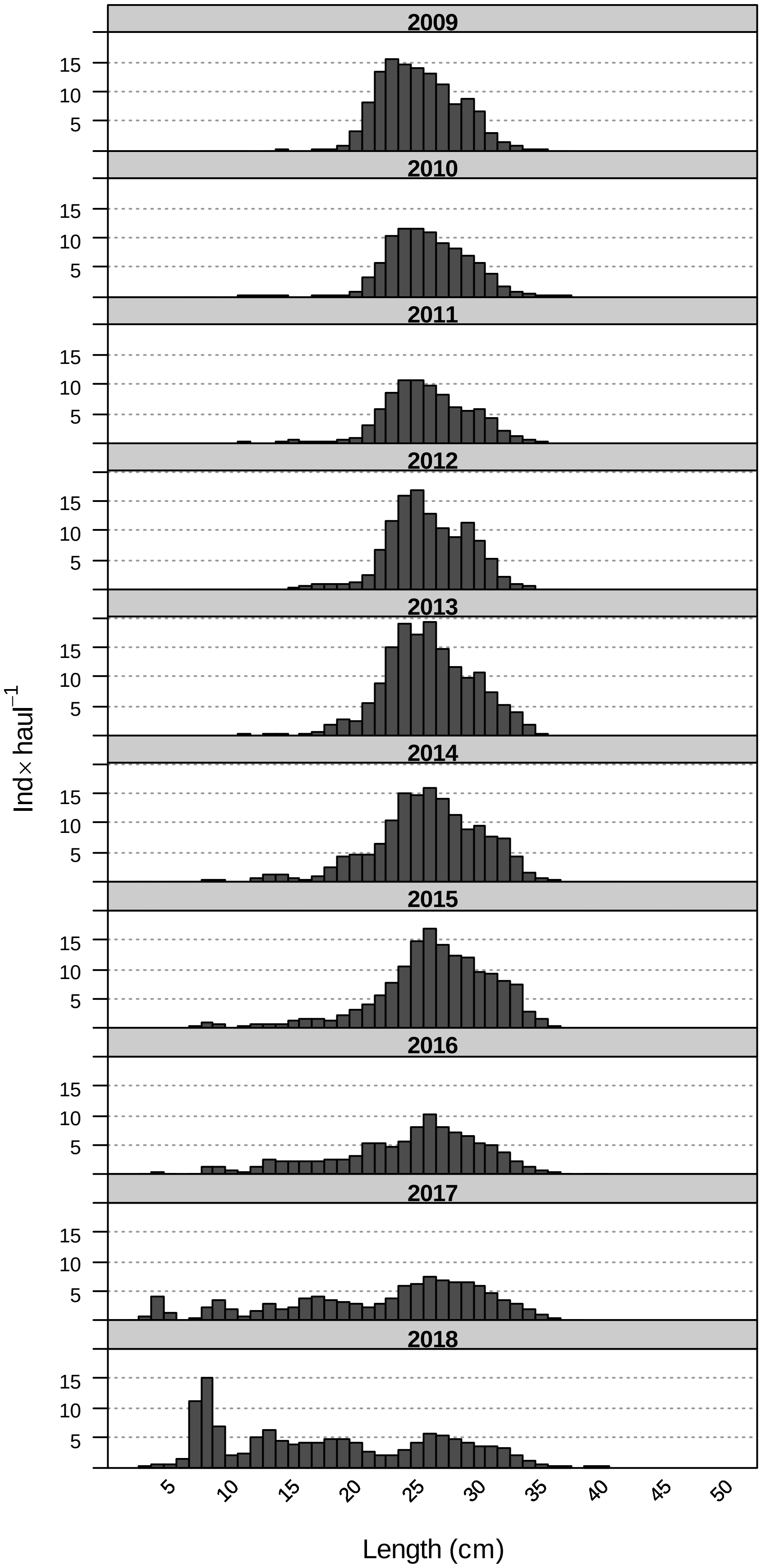

Figure 12. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys (2009-2018)

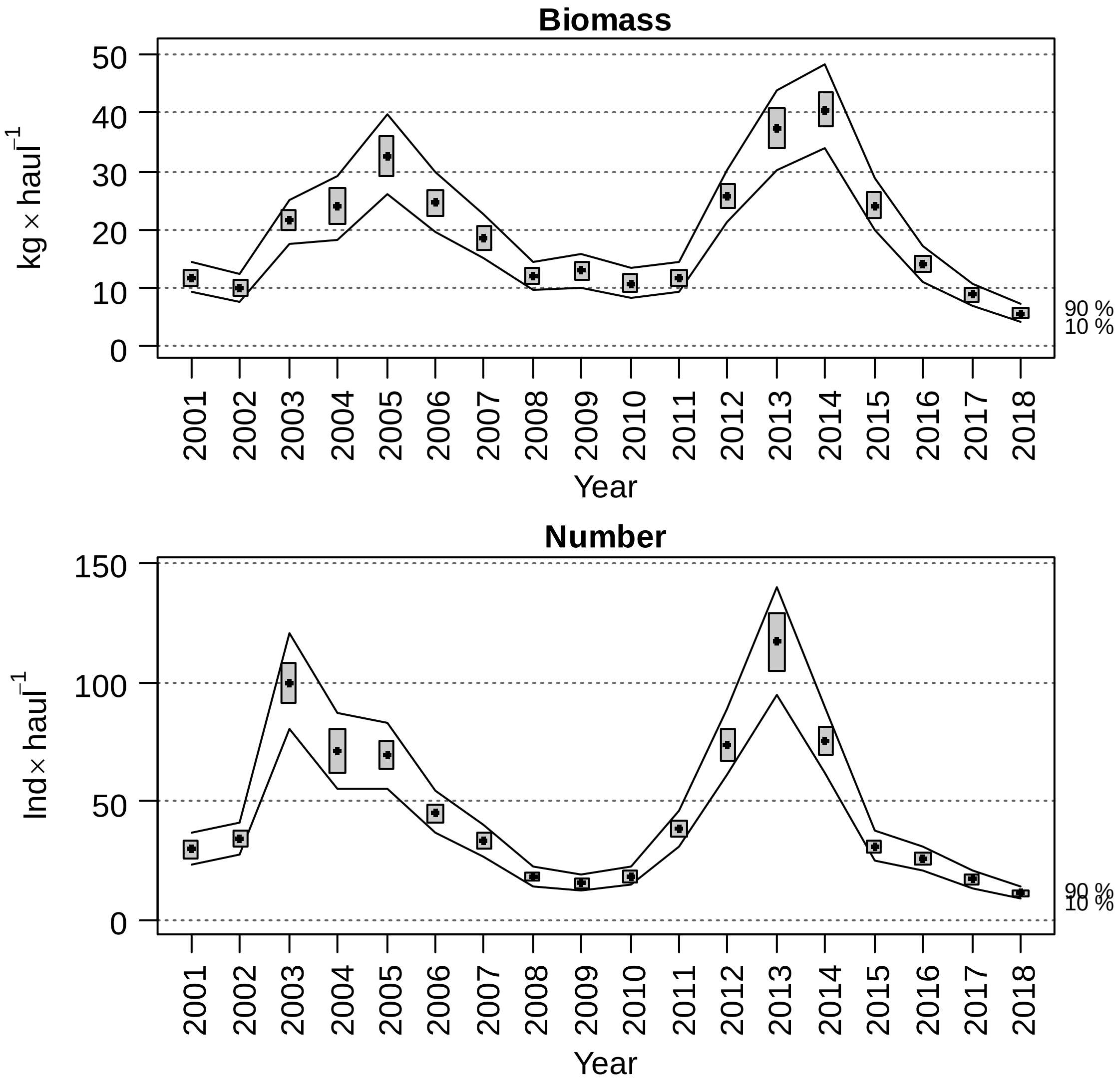

Figure 13. Evolution of *Phycis blennoides* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

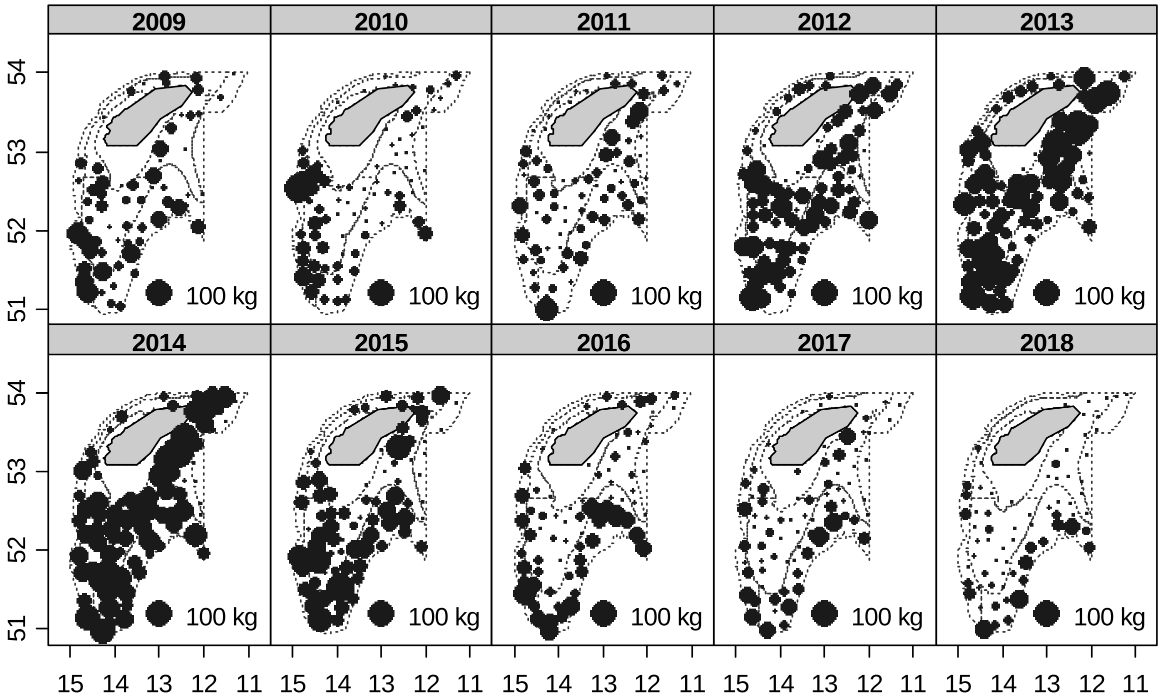

Figure 14. Geographic distribution of *Phycis blennoides* catches (kg×30 min haul^{-1}) in Porcupine surveys (2009-2018)

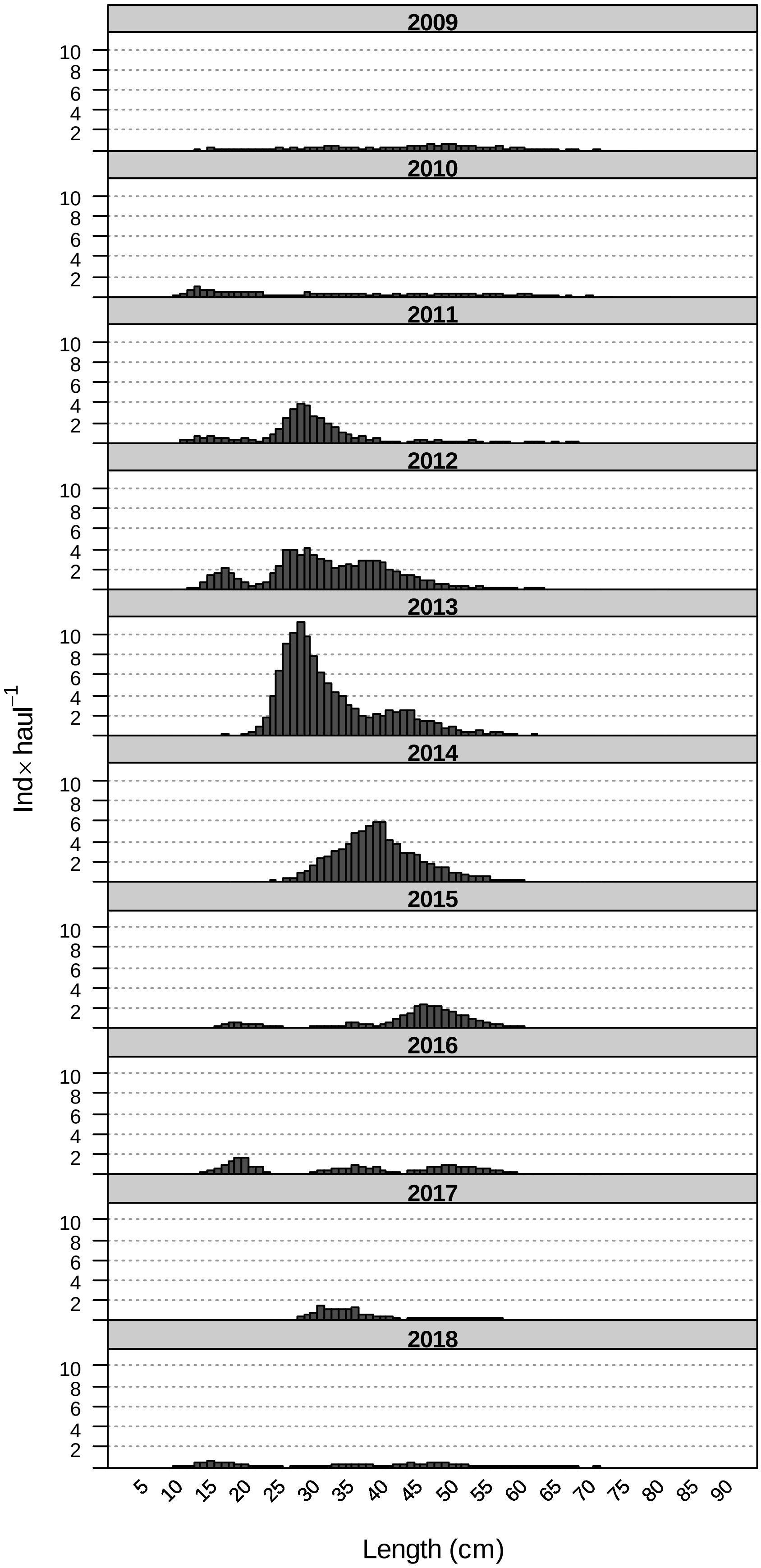

Figure 15. Mean stratified length distributions of *Phycis blennoides* in Porcupine surveys (2009-2018)

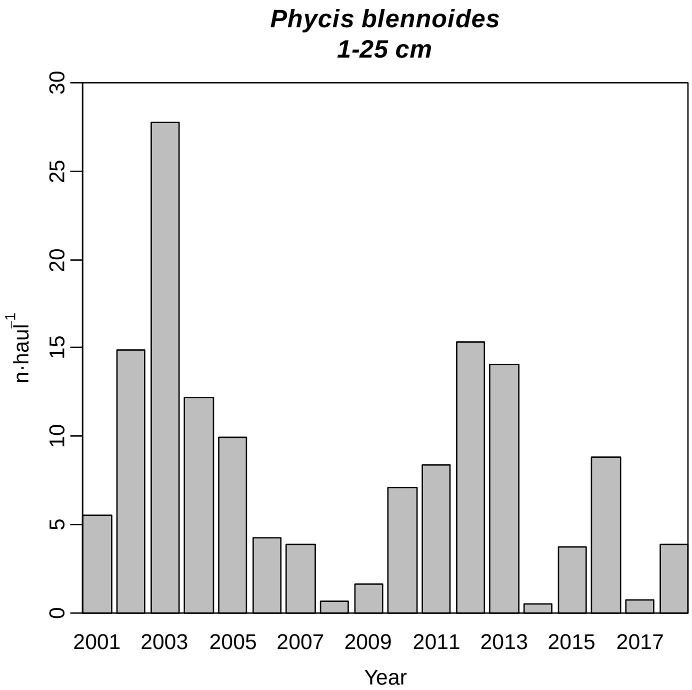

Figure 16. Mean stratified abundance of *Phycis blennoides* recruits (1-25 cm) in Porcupine surveys (2001-2018)

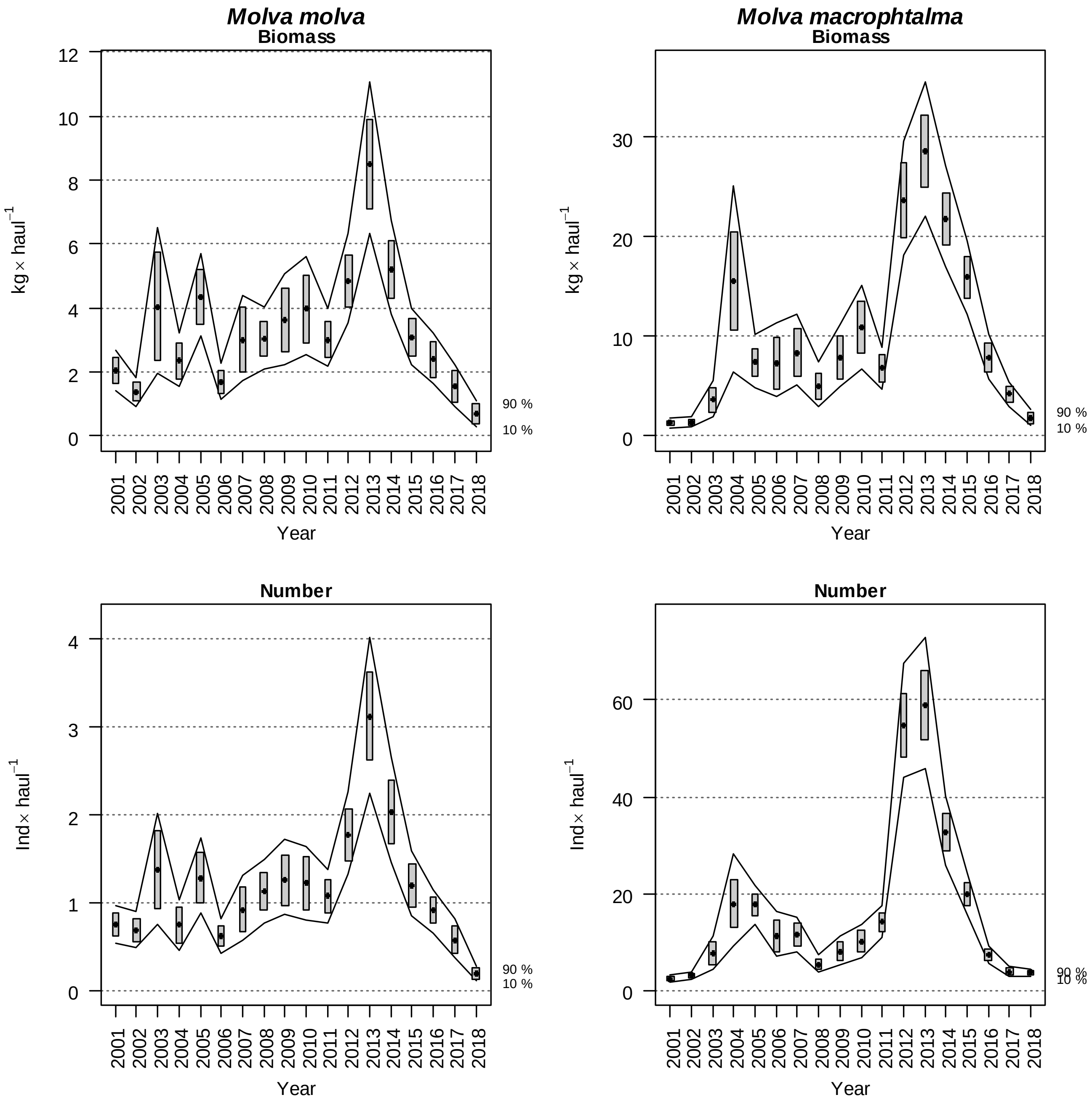

Figure 17. Evolution of *Molva molva* and *Molva macrophtalma* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

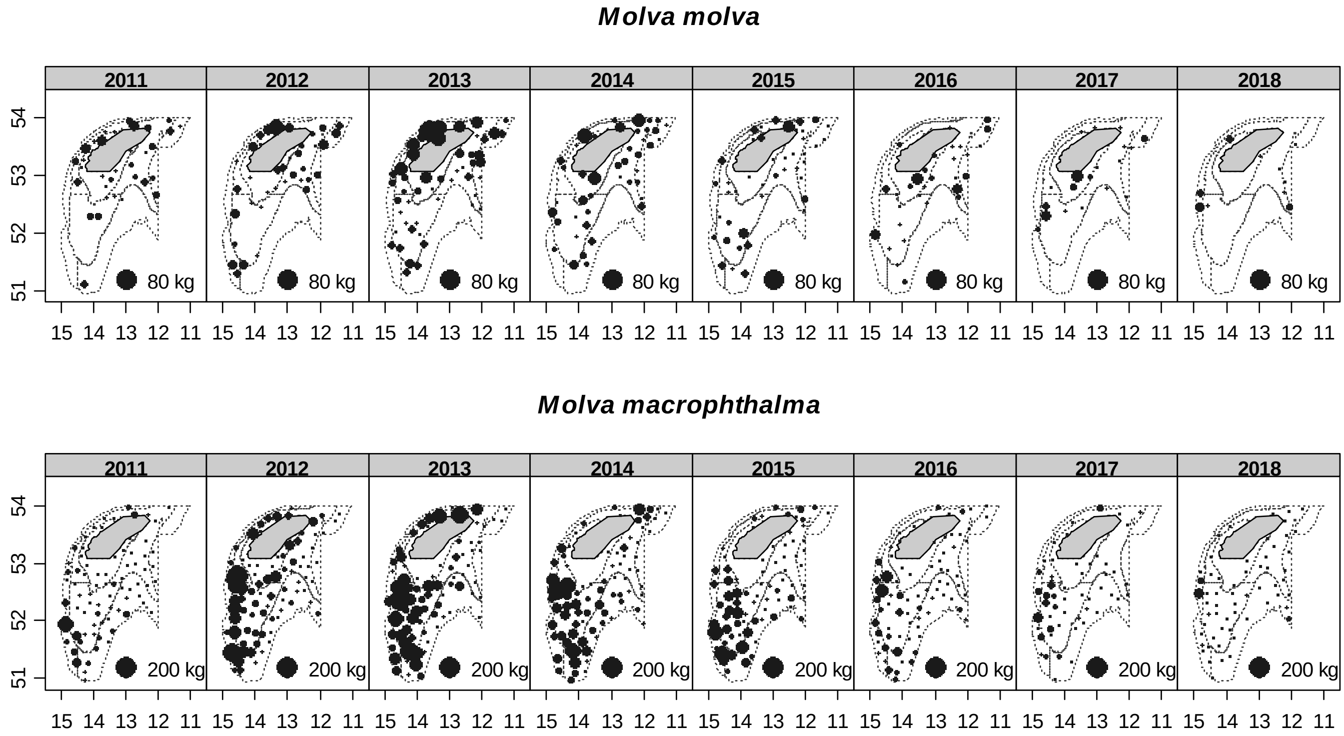

Figure 18. Geographic distribution of *Molva molva* and *Molva macrophtalma* catches (kg×30 min haul^{-1}) in Porcupine surveys (2011-2018)

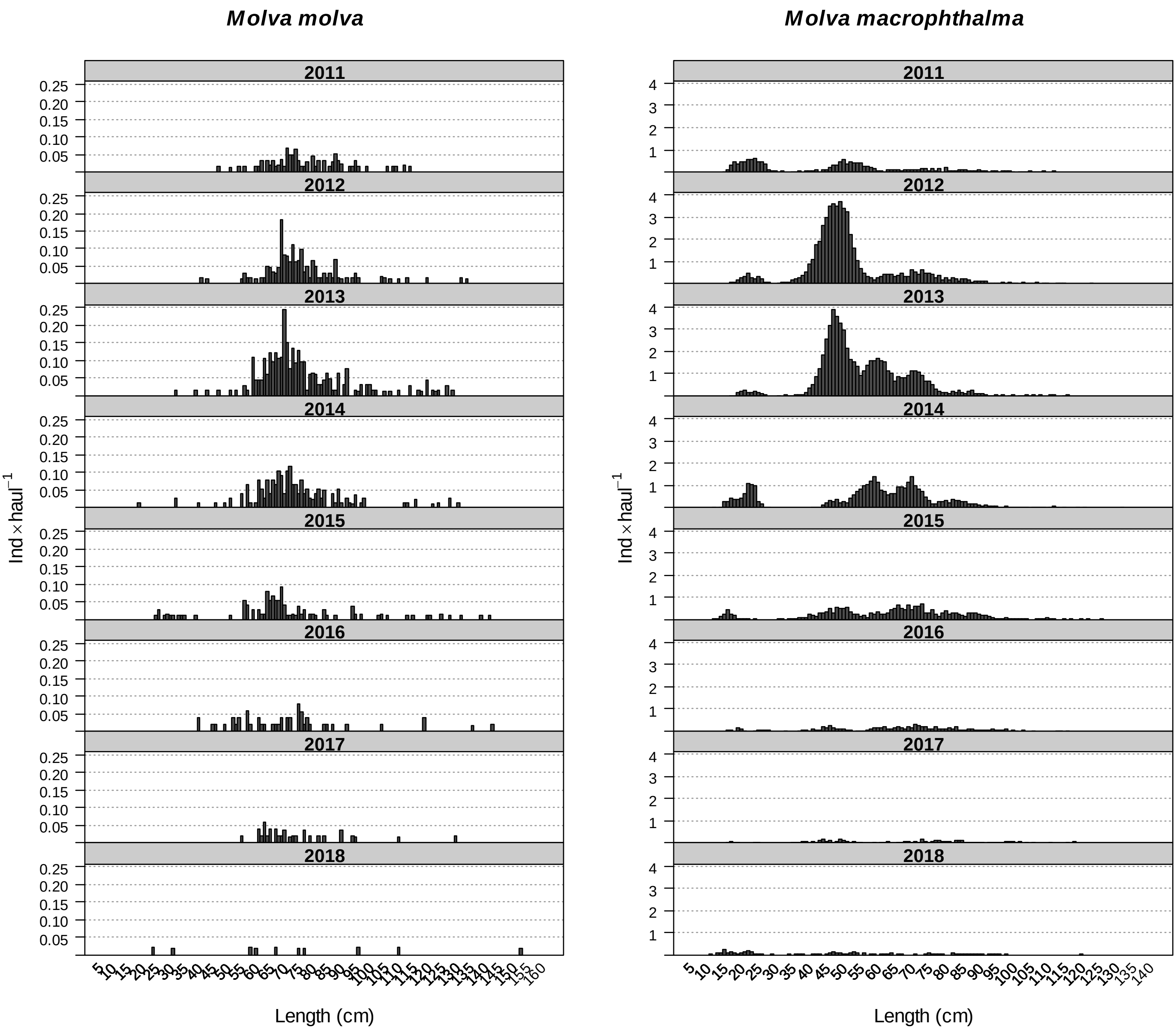

Figure 19. Mean stratified length distributions of *Molva molva* and *Molva macrophtalma* in Porcupine surveys (2011-2018)

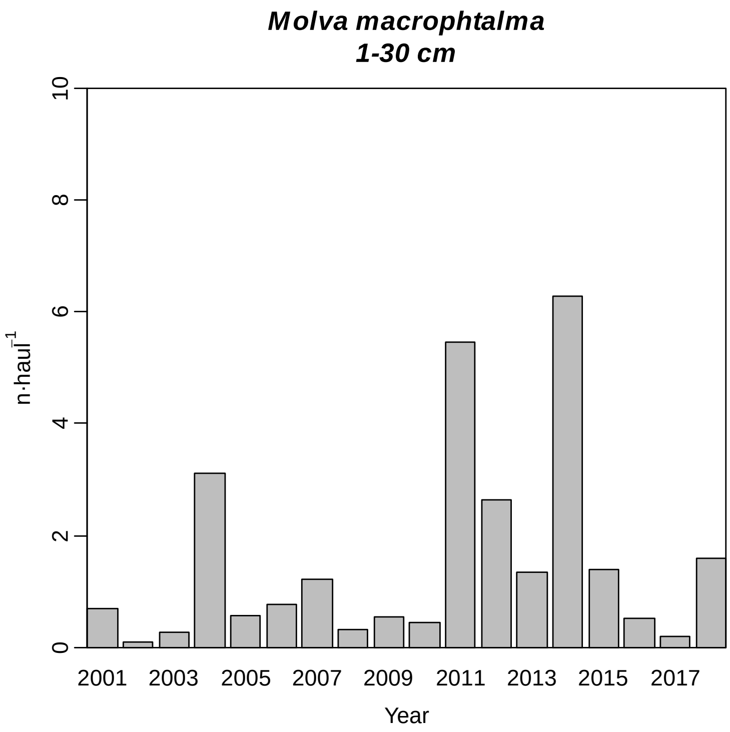

Figure 20. Mean stratified abundance of *Molva macrophtalma* recruits (1- 30 cm) in Porcupine surveys (2001-2018)

Working Document to be presented to the Working Group on the
Biology and Assessment of Deep Sea Fisheries Resources

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Results on Greater forkbeard (*Phycis blennoides*), Bluemouth (*Helicolenus dactylopterus*), Spanish ling (*Molva macrophthalma*) and Blackspot seabream (*Pagellus bogaraveo*) of the Northern Spanish Shelf Groundfish Survey

M. Blanco, S. Ruiz-Pico, O. Fernández-Zapico, I. Preciado, A. Punzón, F. Velasco

Instituto Español de Oceanografía, Centro Oceanográfico de Santander
P.O. Box 240, 39080 Santander, Spain

Abstract

This working document presents the results on the most significant deep fish species on the Spanish Groundfish Survey on Northern Spanish shelf in 2018. Biomass, abundance, distribution and length ranges were analysed for Greater forkbeard (*Phycis blennoides*), Bluemouth (*Helicolenus dactylopterus*), Spanish ling (*Molva macrophthalma*) and blackspot seabream (*Pagellus bogaraveo*).

In standard hauls *P. Blennoides* continues among the low values of the time series despite a slight increase in biomass, *H. dactylopterus* follows the downward trend but is still within the high values of the time series. *M. macrophthalma* stayed steady in terms of biomass but rose up its abundance to one of the highest values, due to a remarkable peak of recruitment. Signs of recruitment were also found for *P. Blennoides* and *H. dactylopterus*. *Pagellus bogaraveo* keeps on being scarce.

Introduction

The bottom trawl survey on the Northern Spanish Shelf has been carried out every autumn since 1983, except in 1987, to provide data and information for the assessment of the commercial fish species and the ecosystems on the Galician and Cantabrian shelves (ICES Divisions 8c and 9a North).

The aim of this working document is to update the results (abundance indices, length frequency and geographic distribution) of the most common deep water fish species on the bottom trawl surveys on the Northern Spanish Shelf after the results presented previously (Fernández-Zapico *et al.* 2018). The species analyzed were *Helicolenus dactylopterus* (bluemouth), *Phycis blennoides* (greater forkbeard), *Molva macrophthalma* (spanish ling) and *Pagellus bogaraveo* (blackspot seabream). Although results on *Helicolenus dactylopterus* were not included in the ICES data call, they are also updated considering its remarkable abundance and geographical distribution in the surveyed area, and the fact that these indices were used in the WGDEEP report when reviewing the abundance and status of the stock on the north-eastern Atlantic.

Material and methods

The area covered in the Northern Spanish Shelf Groundfish Survey on the Cantabrian Sea an Off Galicia (Divisions 8c and Northern part of 9a; SPNGFS) extends from longitude 1° W to 10° W and from latitude 42° N to 44.5° N, following the standard IBTS methodology for the western and southern areas (ICES, 2017). The sampling design is random stratified with five geographical sectors (MF: Miño-Finisterre, FE: Finisterre-Estaca de Bares, EP: Estaca de Bares - Peñas, PA: Peñas - Ajo, AB: Ajo - Bidasoa) and three depth strata (70-120 m, 121-200 m and 201-500) (Figure 1, ICES, 2017). The shallower depth stratum was changed in 1997 from 30-100 m to 70-120 m.

Nevertheless, some extra hauls are carried out every year, if possible, to cover shallower (<70 m) and deeper (>500 m) grounds. These additional hauls are plotted in the distribution maps, although they are not included in the calculation of the stratified abundance indices since the coverage of these grounds (shallower and deeper) are not considered representative of the area. Nevertheless, the information from these depths is considered relevant due to the changes in the depth distribution of fishing activities in the area (Punzón et al. 2011) and these hauls are also used to define the depth range of the species.

Results

In 2018, 132 valid hauls were carried out; 113 of them were performed into the standard sampling strata and 17 extra hauls were carried out outside the standard sampling strata (2 of them shallower than 70 m, 12 of them between 500 m and 800 m and 3 more extra hauls ("zero fishing effort area").

In this year survey, fishes represented about 94% of the total stratified catch. The deep water fishes analyzed in this report were found in standard hauls (70 m - 500 m) but also in the additional hauls deeper than 500 m, therefore the standardized indices most probably underestimate the real biomass (the majority of these species showed even more than a half of its biomass out of the standard stratification). For this reason, the present report shows the catches in standard and deeper additional hauls, although the latter are not considered standardized indices.

Biomass increased for greater forkbeard in 2018 and decreased for bluemouth, whereas the abundance in number has decreased slightly for both species. In additional hauls, the biomass and abundance of greater forkbeard slightly decreased whereas Bluemouth, slightly increased. Signs of recruitment were found for both species and larger individuals were captured in deep additional hauls, result that also occurs for spanish ling.

Biomass of *Molva macrophthalma* in standard hauls stayed steady in the last survey, but rose up strongly its abundance, due to an important recruitment, though not in the deep additional hauls, where decreased specially in biomass but also in terms of abundance because of the shortage of large individuals.

Blackspot seabream kept the decreasing trend after 2015 and was only captured in standard hauls.

Phycis blennoides (greater forkbeard)

In 2018 the biomass of *Phycis blennoides* in standard hauls (0.26 ± 0.05 Kg·haul^{-1}) had a slight increase but remained among the low values of the time series. The abundance (2.94 ± 0.53 ind·haul^{-1}) decreased following the fluctuations (ups and downs) of recruitment over the last decade (Figure 2).

A note to highlight is that 62.74% of the biomass of *Phycis blennoides* catch in the survey was found deeper than 500 m, with 23.07% of the hauls with this species carried out at that depth. In these additional hauls deeper than 500 m, biomass and abundance still follow the decreasing trend from 2014 (Figure 3).

In 2018, *P. blennoides* was caught between 133 m and 693 m and it was widespread in the sampling area (Figure 4).

The length distribution in standard hauls was similar to the previous year, most of individuals were small (between 12 and 21 cm) and large individuals, which ranged from 25 to 54 cm, were still missing. In contrast, in additional deeper hauls, large individuals who ranged from 25 to 58 cm were abundant and just a few specimens from 12 to 19 cm were found (Figure 5 and Figure 6).

***Helicolenus dactylopterus* (bluemouth)**

Although bluemouth is not requested for ICES DCF Data Call, the biomass and abundance is significant in the area and useful for the assessment of the species (ICES, 2017).

In 2018 the biomass of bluemouth in standard hauls (0.76 ± 0.17 $Kg\cdot haul^{-1}$) followed the decreasing trend from 2015, however maintaining high values for the historical series. The abundance in number (13.77 ± 2.49 $ind\cdot haul^{-1}$) has also decreased from the last year (Figure 7).

In addition, 8.33% of the hauls with *H. dactylopterus* were found deeper than 500 m, containing the 10.71% of the biomass caught in 2018. Catches in these additional hauls have slightly risen both in biomass and in abundance, but still among the low values of the time series (Figure 8).

H. dactylopterus was found between 95 m and 696 m in 2018 and mainly in the Galician area, like in previous years. However, the highest biomass was found in a single haul in sector Ajo-Bidasoa which hadn't shown since 2015 (Figure 9). Recruits (4-8 cm) were still appearing in the Galician area but from 95 to 305 m (Figure 10).

Length distribution in standard hauls showed a slight decrease of recruits in this last survey but the two usual modes in sizes 6 cm and 12 cm. In the additional deeper hauls, the individuals were larger with a mode in 23 cm (Figure 11 and Figure 12).

***Molva macrophthalma* (spanish ling)**

In 2018, biomass of *M. macrophthalma* in standard stratification (0.15 ± 0.02 $Kg\cdot haul^{-1}$) stayed steady whereas its abundance (5.09 ± 0.91 $ind\cdot haul^{-1}$) has risen 3.7 times, reaching one of the high values of the time series due to a recruitment peak (Figure13). However in additional deep hauls where most biomass is usually found (near 69% this last surveywith only 9% of the hauls deeper than 500 m), the biomass and abundance slightly decreased because large individuals were hardly found (Figure 1414).

M. macrophthalma was found between 131 m and 693 m in 2018 and was widespread in the study area but almost absent in the southern Galician area (Figure 15). Juveniles (< 30 cm) reached an important number this last year and were distributed throughout the study area but with more abundance at the eastern part of the Cantabrian Sea where were usually found (Figure 16).

The length distribution in the standard stratification mainly presented juveniles from 16 to 31 cm with a remarkable mode in 23 cm this last year whereas in additional deeper hauls larger specimens from 53 to 109 cm were shown (Figure 17 and Figure 18).

Pagellus bogaraveo (blackspot seabream)

P. bogaraveo is a scarce species in the Northern Spanish Shelf Groundfish Survey. In 2018, both biomass (0.01 ± 0.01 Kg·haul^{-1}) and abundance (0.06 ± 0.03 ind·haul^{-1}) followed the decreasing trend after the peak in 2015 (Figure 19).

P. bogaraveo were only found in 4 hauls mainly in the central area of the Cantabrian Sea (Figure 20).

Only six specimens were found this last year and ranged from 22 cm to 27 cm, as in 2017 (Figure 21).

Acknowledgements

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Figures

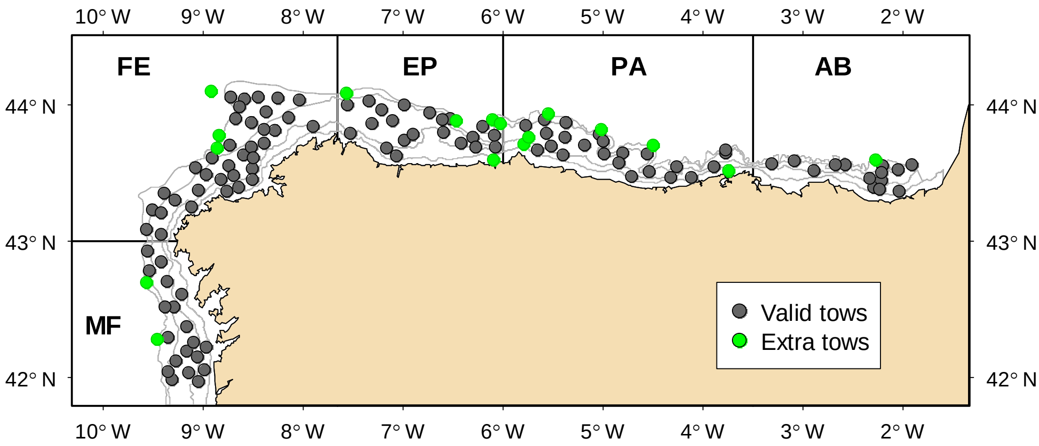


Figure 1 Stratification design and hauls on the Northern Spanish shelf groundfish survey in 2018; Depth strata are: A) 70-120 m, B) 121 – 200 m and C) 200 – 500 m. Geographic sectors are MF: Miño-Finisterre, FE: Finisterre-Estaca, EP: Estaca-cabo Peñas, PA: Peñas-cabo Ajo, and AB: Ajo-Bidasoa.

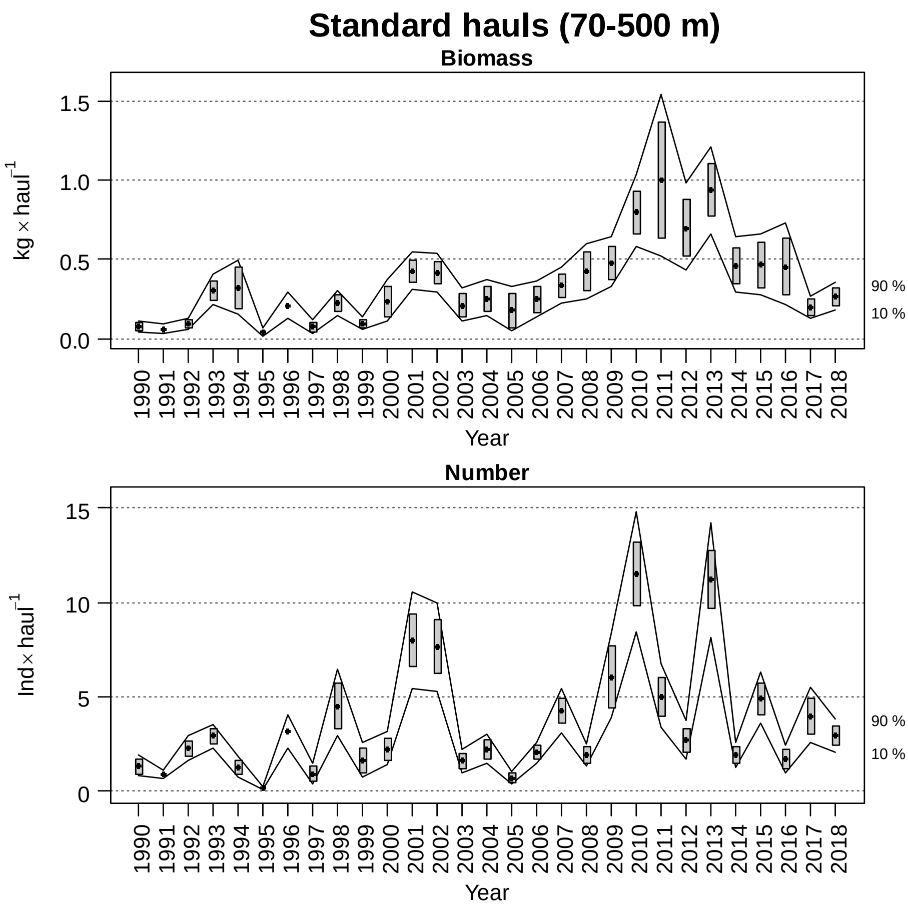


Figure 2 Evolution of *Phycis blennoides* mean stratified biomass and abundance in standards hauls between 1990 and 2018. Boxes mark parametric standard error of the stratified biomass and abundance indices. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000).

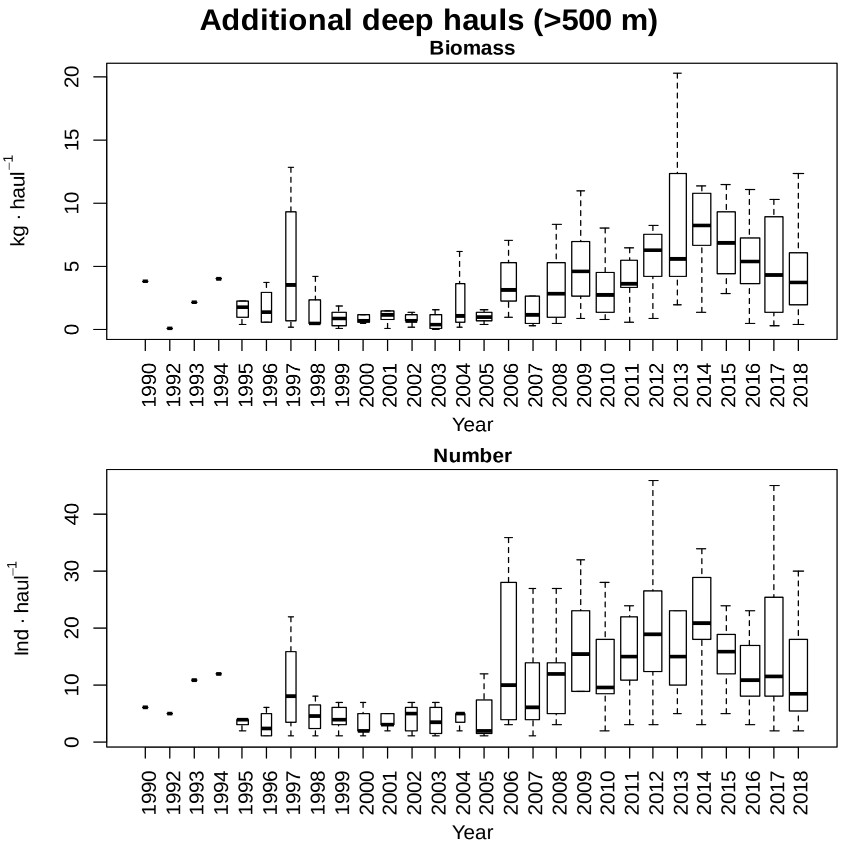


Figure 3 Evolution of biomass and abundance of *Phycis blennoides* in additional hauls out of the standard stratification (>500 m) between 1990 and 2018. Boxes mark parametric standard error of the biomass in additional hauls. Lines mark the median and whiskers the interquartile range.

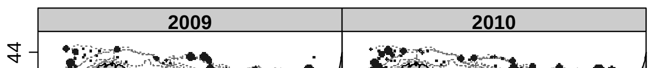


Figure 4. Geographic distribution of *Phycis blennoides* catches (kg·haul^{-1}) during the Northern Spanish Shelf bottom trawl surveys in the last decade: 2009-2018.

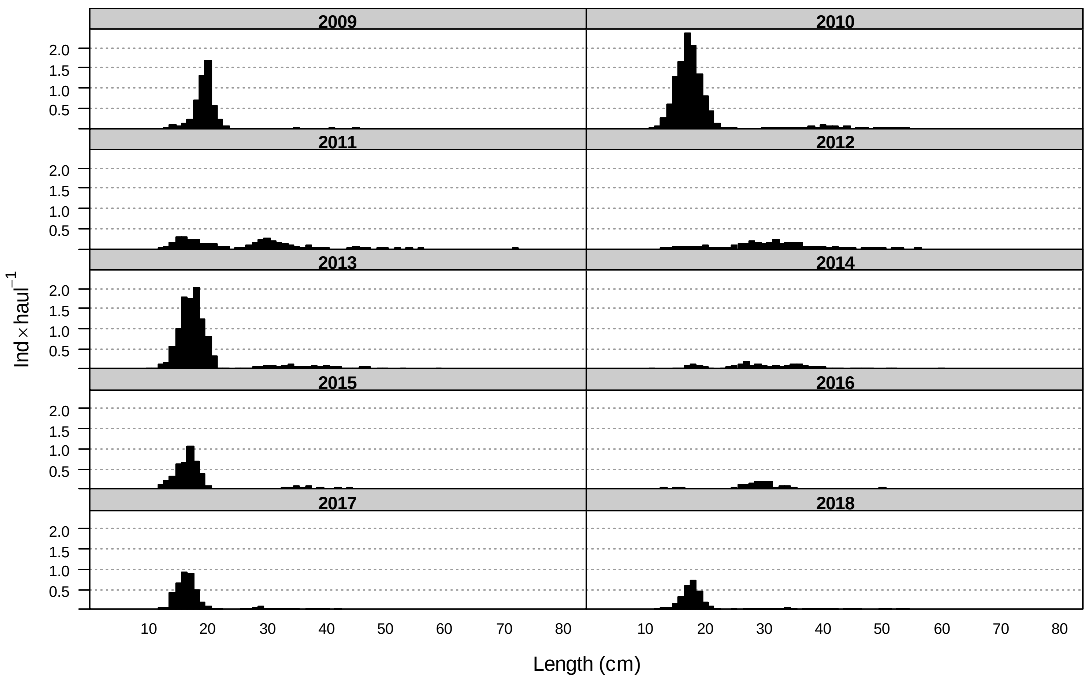


Figure 5. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Northern Spanish Shelf surveys last decade (2009-2018).

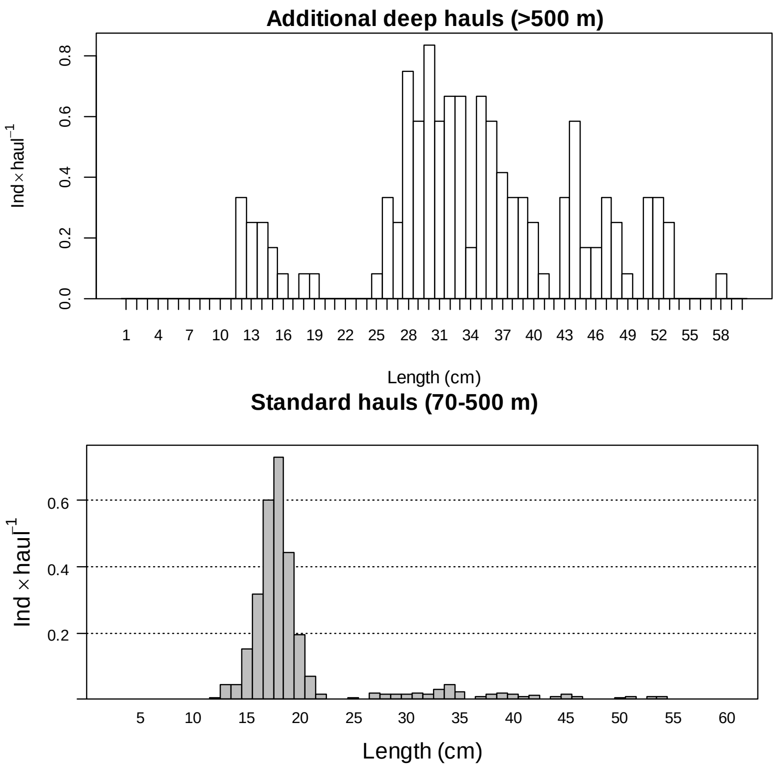


Figure 6. Mean length distributions of *Phycis blennoides* in additional hauls (>500 m) and in the standard hauls (70-500 m) in the North Spanish Shelf survey 2018.

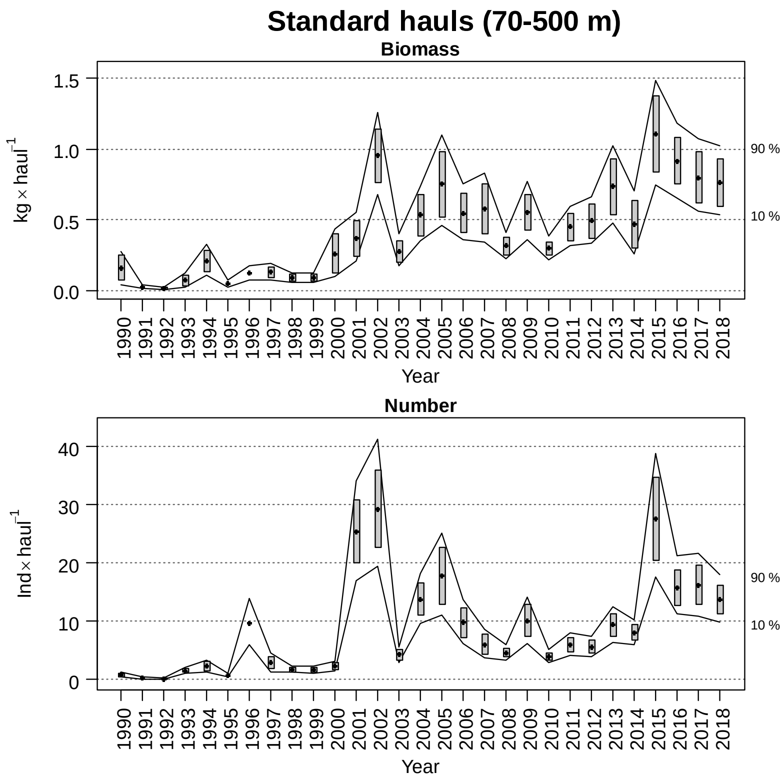


Figure 7. Evolution of *Helicolenus dactylopterus* mean stratified biomass and abundance in Northern Spanish Shelf surveys time series (1990-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000).

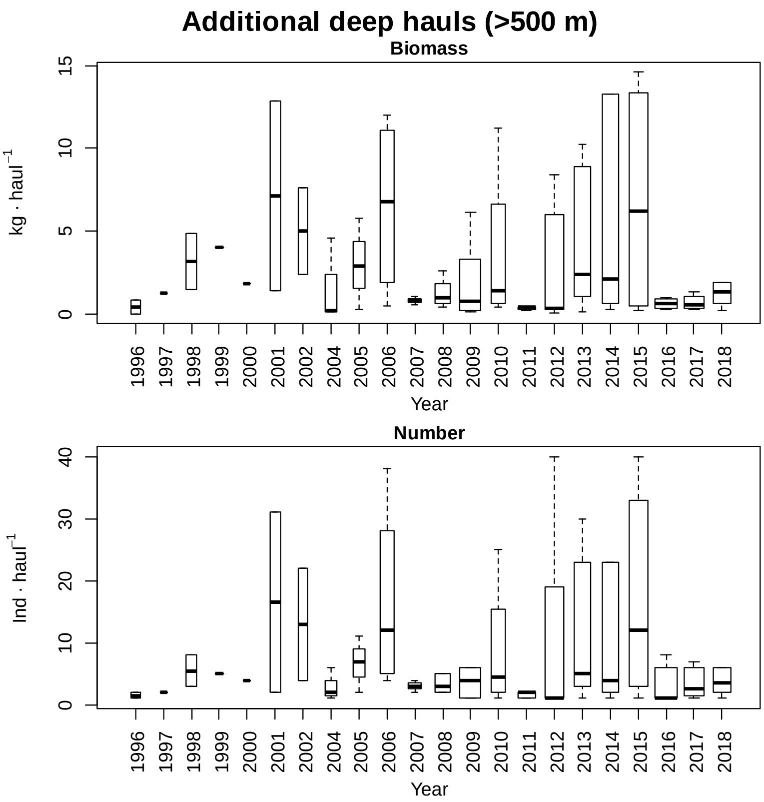


Figure 8 Evolution of biomass and abundance of *Helicolenus dactylopterus* in additional hauls out of the standard stratification (>500 m) between 1996 and 2018. Boxes mark parametric standard error of the biomass in additional hauls. Lines mark the median and whiskers the interquartile range.

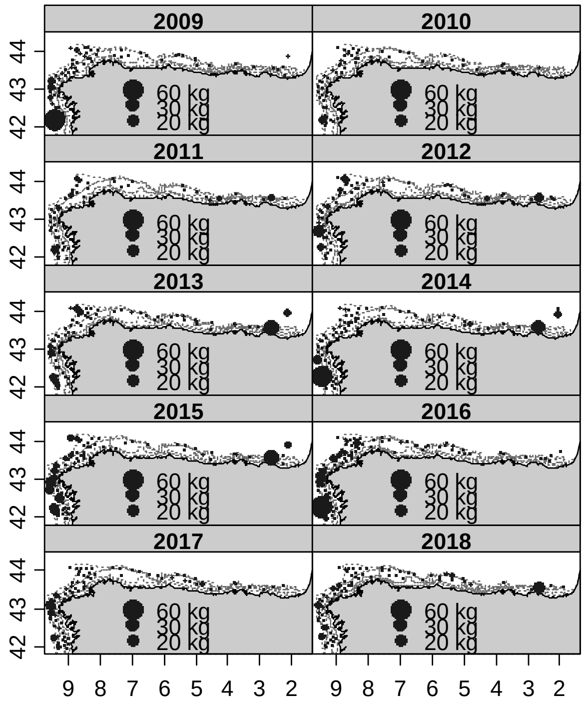


Figure 9 Geographic distribution of *Helicolenus dactyloperus* catches (kg·haul^{-1}) during the Northern Spanish Shelf bottom trawl surveys in the last decade: 2009-2018.

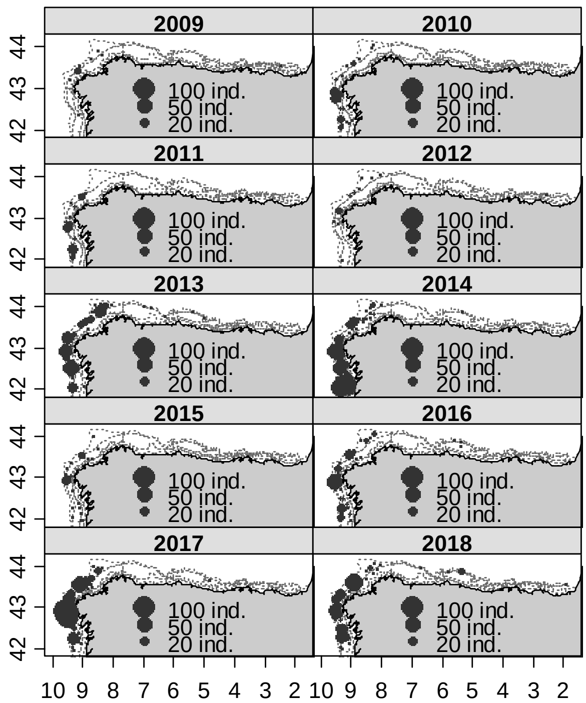


Figure 10 Geographic distribution of recruits of *Helicolenus dactylopterus* (0 - 8 cm) during the Northern Spanish Shelf bottom trawl surveys in the last decade: 2009-2018.

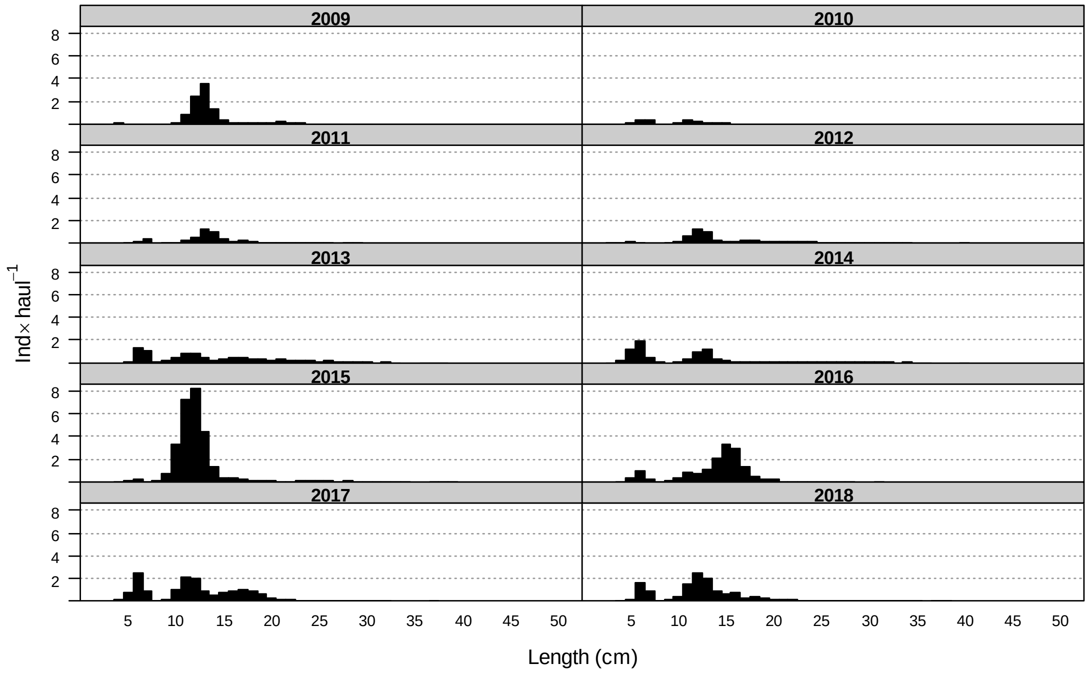


Figure 11 Mean stratified length distributions of bluemouth (*H. dactylopterus*) in Northern Spanish Shelf surveys (2009-2018).

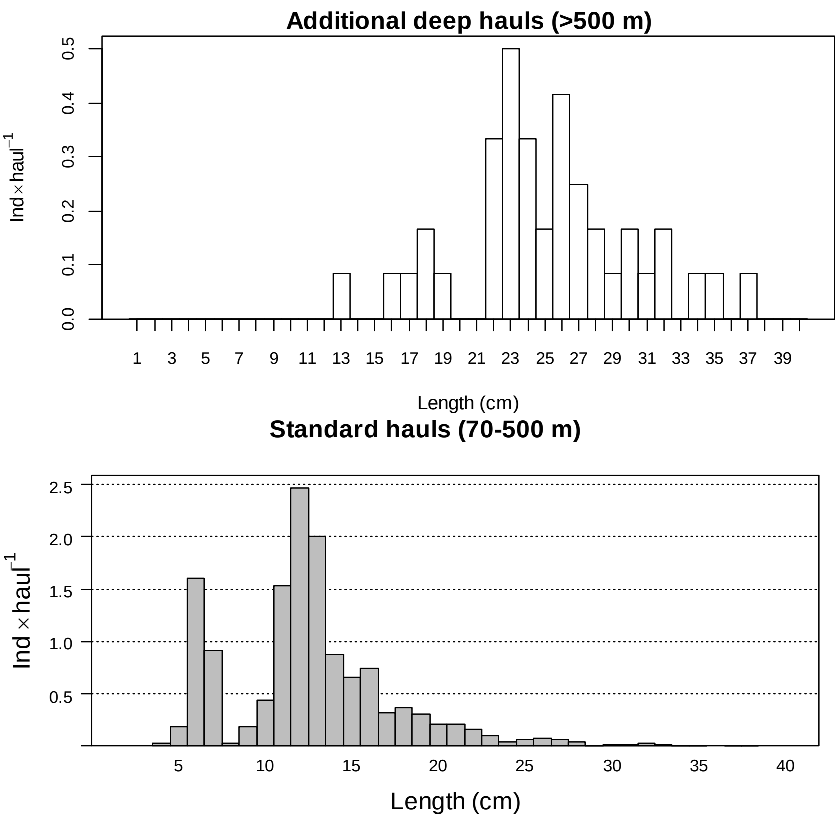


Figure 12 Mean length distributions of *Helicolenus dactylopterus* in additional hauls (>500 m) and in the standard hauls (70-500 m) in the North Spanish Shelf survey 2018.

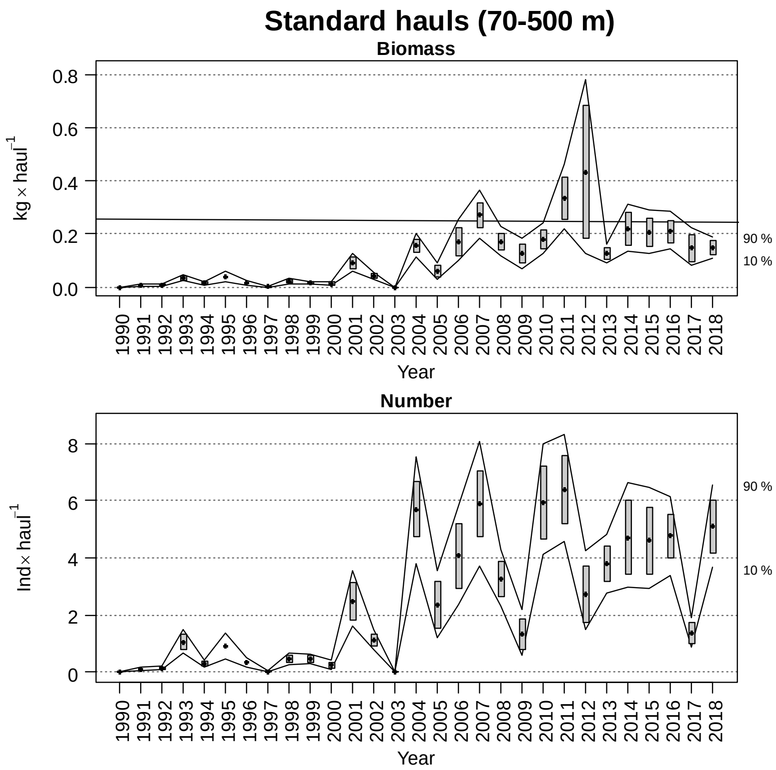


Figure 13 Evolution of *Molva macrophthalma* mean stratified biomass and abundance in Northern Spanish Shelf surveys time series (1990-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000).

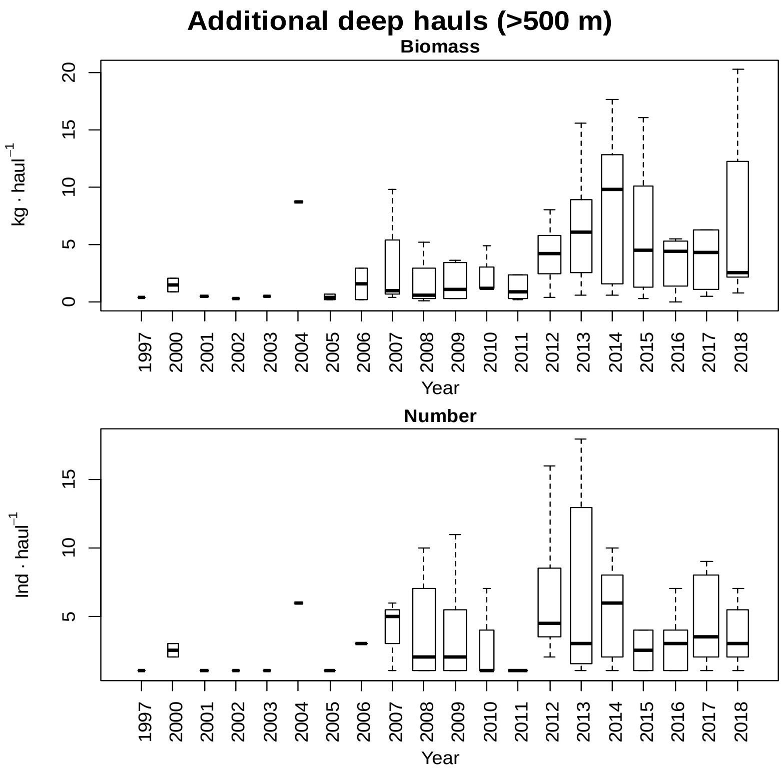


Figure 14 Evolution of biomass and abundance of *Molva macrophthalma* in additional hauls out of the standard stratification (>500 m) between 1997 and 2018. Boxes mark parametric standard error of the biomass and abundance in additional hauls. Lines mark the median and whiskers the interquartile range.

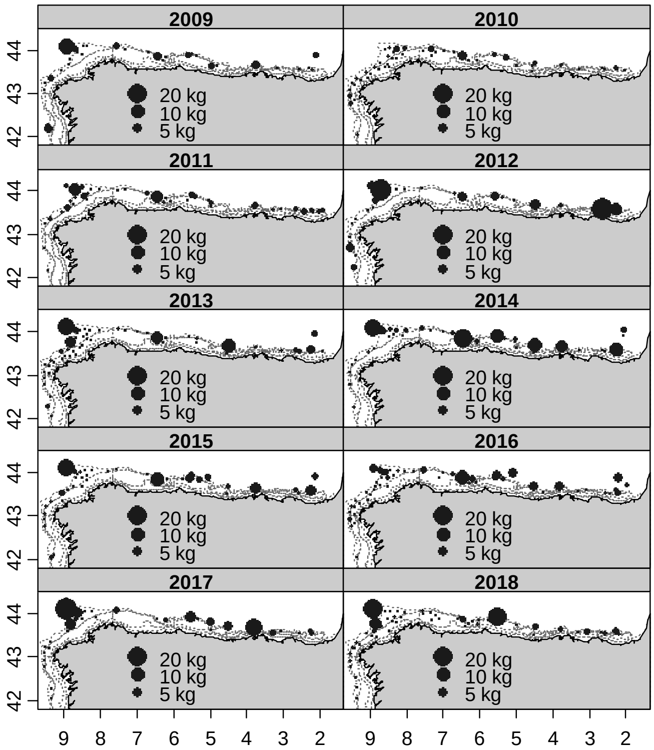


Figure 15 Geographic distribution of *Molva macrophtalma* catches (kg·haul^{-1}) during the Northern Spanish Shelf bottom trawl surveys during the last decade: 2009-2018.

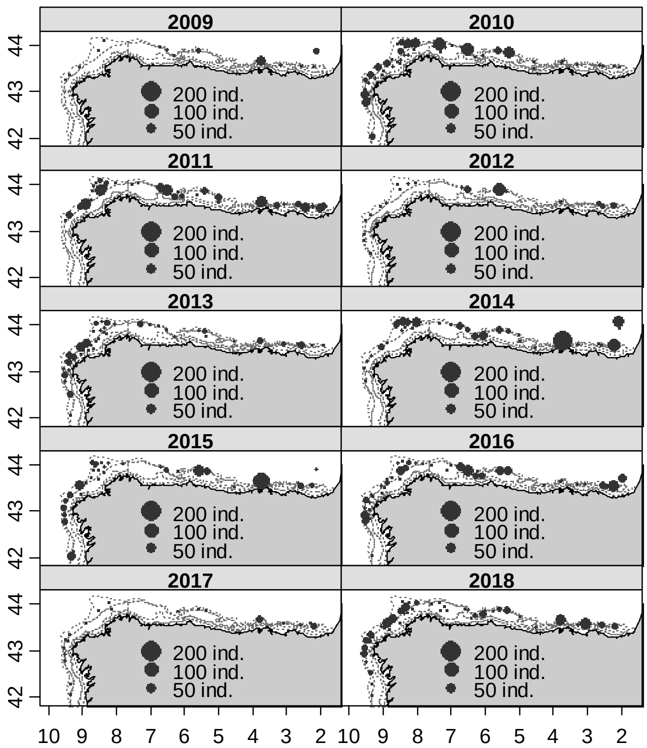


Figure 16 Geographic distribution of *Molva macrophtalma* juveniles (0-30 cm) during the Northern Spanish Shelf bottom trawl surveys during the last decade: 2009-2018.

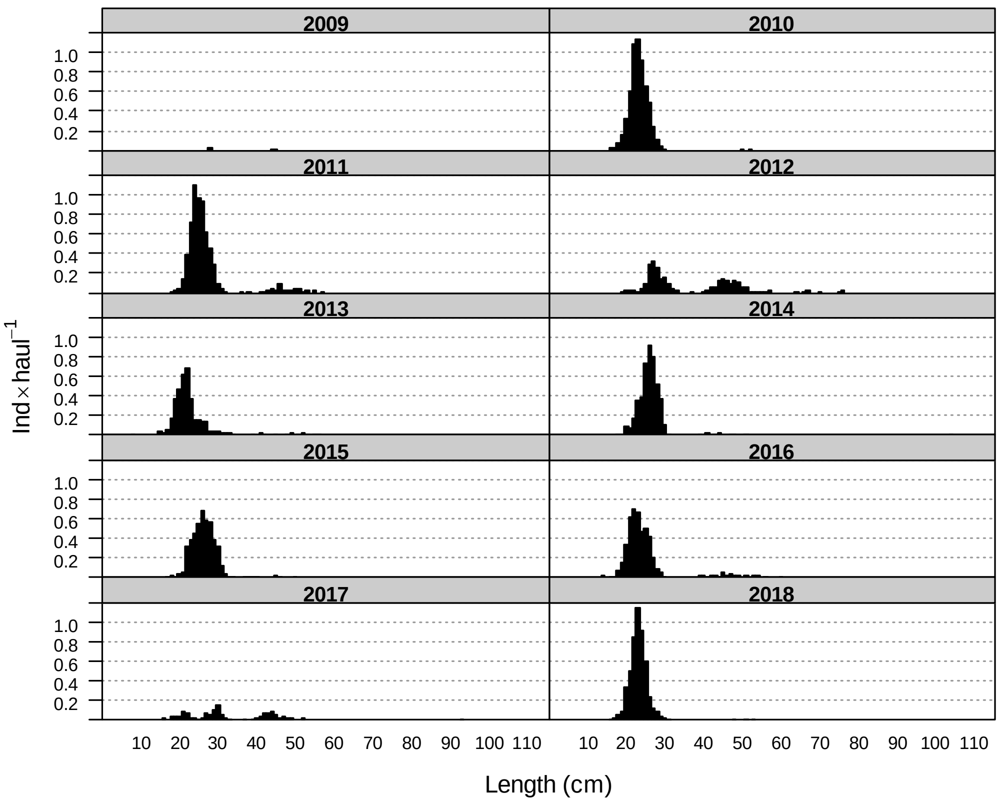


Figure 17 Mean stratified length distributions of Spanish ling (*M. macrophthalma*) in Northern Spanish Shelf surveys (2009-2018).

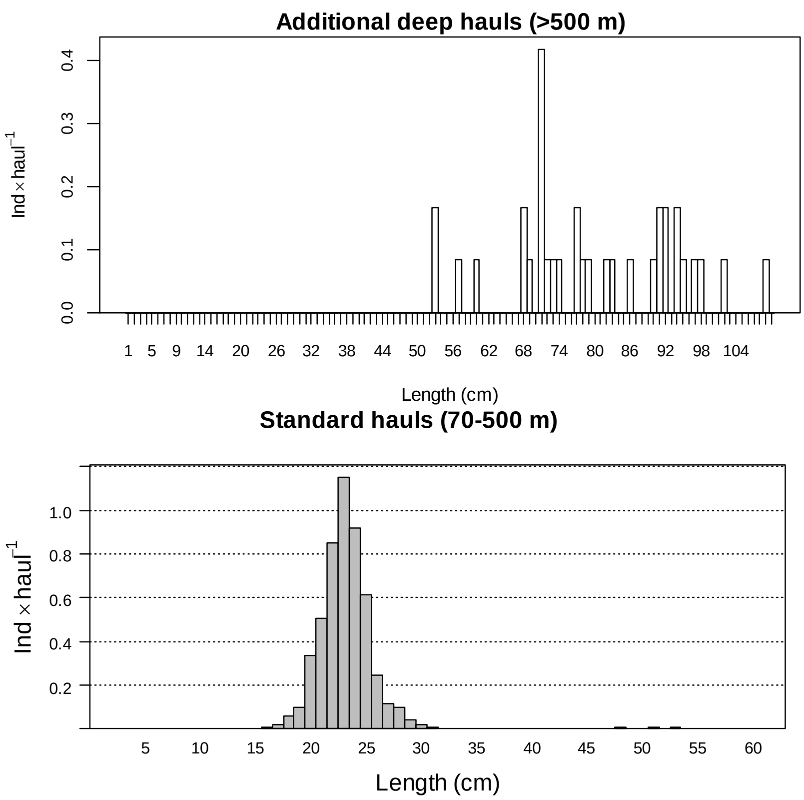


Figure 18 Mean length distributions of *Molva macrophtalma* in additional hauls (>500 m) and in the standard hauls (70-500 m) in the North Spanish Shelf survey 2018.

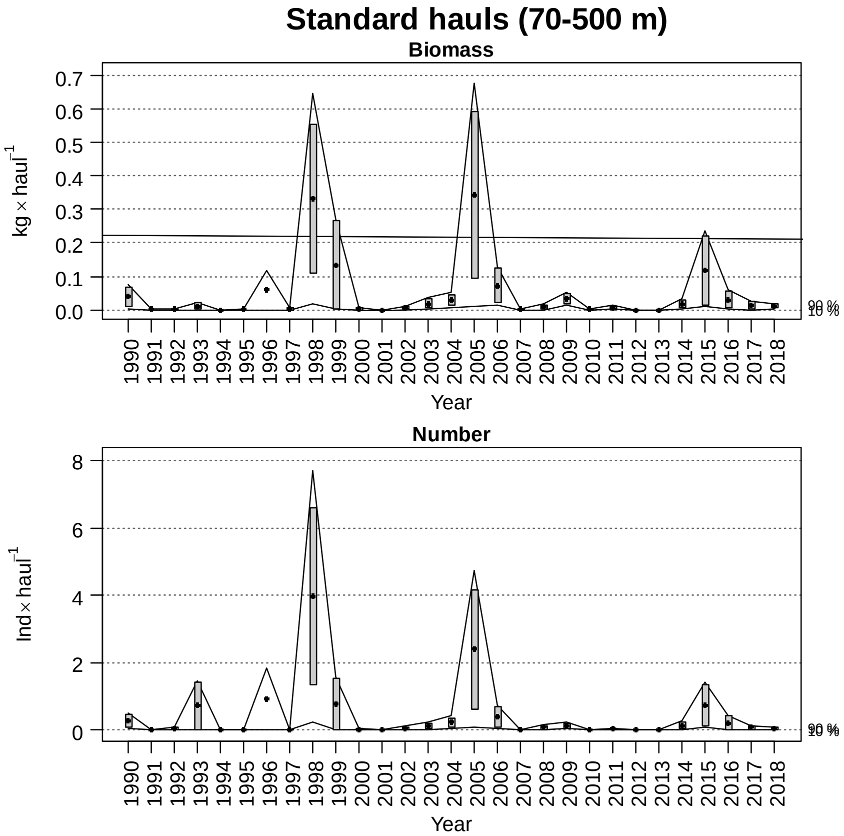
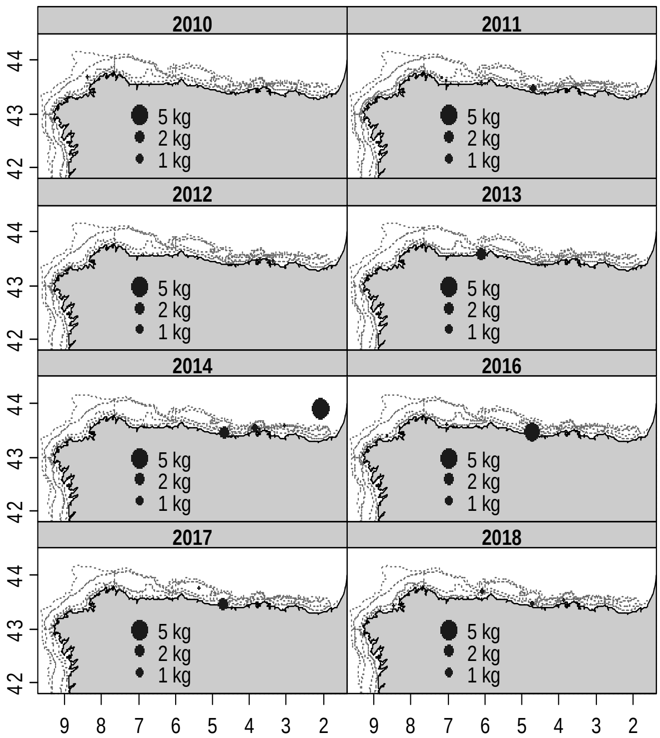


Figure 19 Evolution of blackspot seabream (*P. bogaraveo*) mean stratified abundance in Northern Spanish Shelf surveys time series (1990-2018).



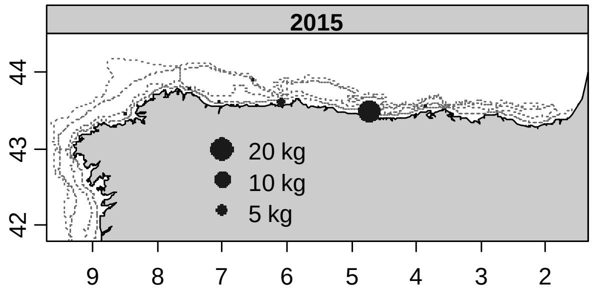


Figure 20 Geographic distribution of *Pagellus bogaraveo* catches (kg·haul^{-1}) during the Northern Spanish Shelf bottom trawl surveys from 2010 to2018, 2015 survey is plotted apart due to scale problem.

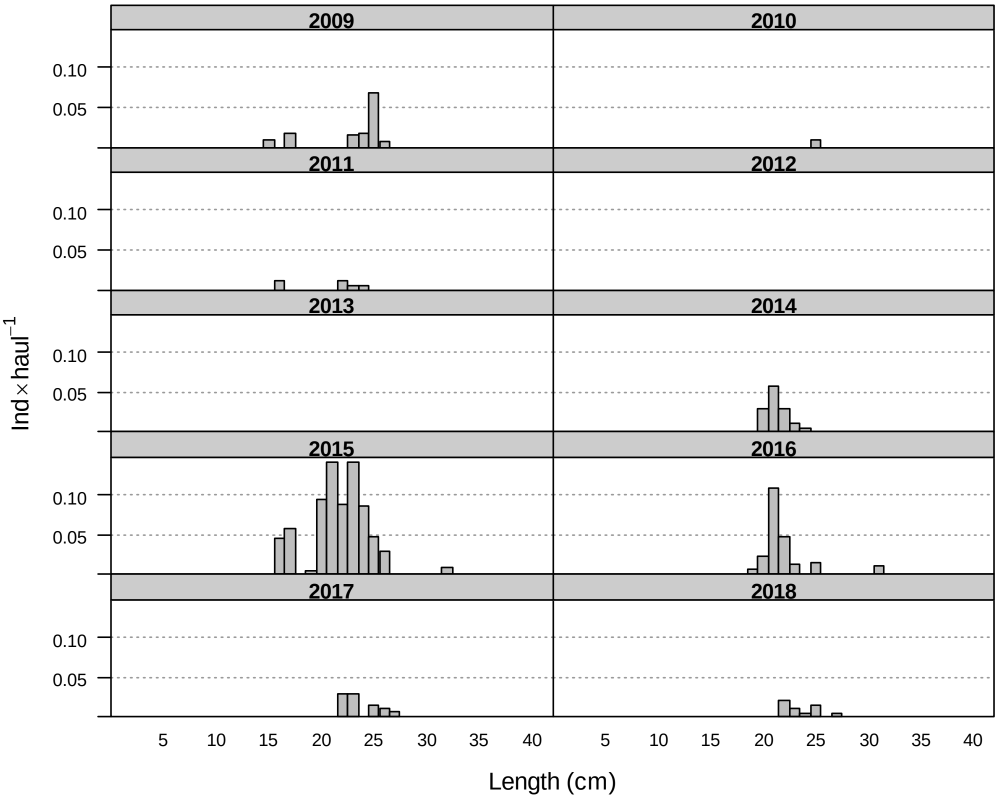


Figure 21 Mean stratified length distributions of blackspot seabream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2009-2018)

Working Document for the ICES Working Group on Biology and Assessment of Deep-Sea Fisheries Resources

Copenhagen, 2nd – 9th May 2019

Pagellus bogaraveo in Portuguese continental waters (ICES Division 27.9.a)

Inês Farias and Ivone Figueiredo

Instituto Português do Mar e da Atmosfera

Abstract

This working document reviews the available information on the biology and ecology of *Pagellus bogaraveo*, the blackspot seabream, and presents data from fisheries and research surveys taking place in Portuguese waters (ICES Division 27.9.a).

1. INTRODUCTION

Pagellus bogaraveo (Brünnich, 1768), the blackspot seabream, distributes from the south of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1932; Pinho and Menezes, 2005) occurring from the continental shelf to 700 m deep and on seamounts (Morato et al., 2001).

Spatial dynamics knowledge on the species for several European areas refers that breeding occurs in shallow waters and that there is an ontogenetic migration towards deeper waters (Olivier, 1928; Desbrosses, 1932; Morato et al., 2001; Spedicato et al., 2002). Furthermore, it is observed that juveniles remain in shallow waters (at depths above 170 m) close to the coast in the Azores (Menezes et al., 2001), the Bay of Biscay (Lorance, 2011), and the Mediterranean Sea (Biagi et al., 1998; Félix-Hackradt et al., 2013). Juveniles with total length (TL) between 150 and 180 mm migrate along the slope to depths below 200 m while fish over 40 cm TL have been occasionally caught in coastal waters (Priol, 1932).

In Atlantic waters the main spawning period occurs during the 1st quarter at Cadiz region (Gil, 2010) and in the Azores the peak of spawning is from March to April (Martins *et al.*, 2007).

The species is a protandric hermaphrodite; individuals being first functional males and then developing into functional females (Buxton and Garratt, 1990; Krug, 1990; Gil, 2006). Given the growth model proposed for the species in the Bay of Biscay (Guéguen, 1969), age of first maturity is about 8 years old.

In the Northeast Atlantic, *P. bogaraveo*'s stock structure is unkown. However genetic studies on the species showed a restricted gene flow among the populations located in the Azores (ICES Division 10.a.2) and those on the Portuguese continental slope (ICES Division 9.a) and Madeira (Stockley *et al.*, 2005). Given the uncertainty on stock structure ICES adopts, for management purposes, three different components for the species: a) Subareas 6, 7, and 8; b) Subarea 9; and c) Subarea 10 (Azores) (ICES, 2007). These components were established to better record the available information and do not implicate the existence of three different stocks of *P. bogaraveo*. The interrelationships between the northernmost component (Subareas27. 6, 27.7, and 27.8) and the component in the northern part of Division 27.9.a, as well as the species migratory movements within these areas have been observed through tagging methods (Guéguen, 1974). However, there is no evidence of movement to the southern part of Division 9.a (Straight of Gibraltar), where the current main fishery occurs (ICES, 2017).

In ICES Division 27.9.a, a Spanish longline fishery operating in the Strait of Gibraltar targets *P. bogaraveo*. This fishery has been managed as a regulated open-access fishery from its initial exploitation, in 1983, until 1998. In 2001, Moroccan longliners started a targetted fishery in the same area. Thus, nowadays tw directed fisheries are taking place in the Spanish and Moroccan Exclusive Economic Zone (EEZ) (ICES, 2017).

In mainland Portugal, the species is mainly caught as by-catch of fisheries targeting other species. Peniche (Portuguese central western coast) is the most important landing port (landings between 1999 and 2017 represented nearly 50% of the Portuguese landings of the species in ICES 9.a). The species is mainly landed between December and March, which coincides with the main spawning period in Cadiz region (Gil, 2010).

Fishery data and information collected through enquiries made to Peniche skippers with experience on *P. bogaraveo* fishing (Araújo et al., 2016) showed that: i) the species tends to be concentrated at specific fishing grounds, being mainly caught at depths around 250 m; ii) the substrate of those fishing grounds are mainly composed by muddy sand, rock, and sand; iii) the range of species length is similar between the different fishing grounds. Most skippers considered that fish size and catch rates were directly related to bottom topography, as well as, time of the year. Some refer that, during winter, the species migrates, driven by environmental condition or biological factors (e.g., reproduction).

2. METHODOLOGY

2.1. Fisheries data

Portuguese landings in ICES division 27.9.a were characterized. Fisheries dependent data were collected from commercial landings for the period 2009-2018.

Total landings in weight (ton) and value (euro) were analysed by year and NUTS (Nomenclature of Territorial Units for Statistics). The level 2 NUTS for the Portuguese continental territory are: North, Centre, Lisbon and the river Tagus Valley, Alentejo, and Algarve. The EU NUTS classification system is a regional system that divided each EU Member States territorial area into units. This system provides a harmonised hierarchy between regions (https://ec.europa.eu/eurostat/web/regions/background). Following the criteria adopted under this system, mainland Portugal is divided into 5 different NUTS II corresponding to its “regions”: North; Centre; Lisbon Metropolitan Area; Alentejo; Algarve (Figure 1).

Figure 1. Division of mainland Portugal into 5 different NUTS II corresponding to its "regions": North; Centre; Lisbon Metropolitan Area; Alentejo; Algarve

The annual total weight of landings (TW_Landed) by Portugues NUTS II and fishing fleet segment (Polyvalent and Trawl) is plotted. For each fishing segments and for the main representative NUTSII the TW_Landed is plotted by month.

The number of distinct vessels that landed the species is presented per year and for the two main fishing segments.

For Peniche landing port (NUTS II "Centro"), blackspot seabream is separated by commercial size (since 2009): category 1 corresponds to the largest specimens while category 3 corresponds to the smallest ones. The length data collected in Peniche under the Portuguese DCF sampling program is analysed in order to evaluate the level of overlapping between the commercial size categories.

A Reference Fleet for each fishing segment was identified for the main landing port, Peniche at NUTS II "Centro". The criteria adopted for the selection of fishing vessels were defined in accordance with the number of fishing trips with positive landings of species during the period 2014 to 2017 and the number of months of the year during which the fishing vessels landed the species.

After the selection of the vessels, the whole fishery data available at fishing trip level for each selected vessel was further analysed. The landed weight of the species (in kg) per fishing trip corresponds to the total weight landed by the vessel after each trip. A trip is defined from the moment the vessel leaves the dock to when it returns to the dock. The landed weight per fishing trip data were standardized through the adjustment of generalized linear models (GLM). Several GLM were adjusted and the model with the best adjustment was selected based on the AIC criterion and using residual analysis and standard error.

2.2. Surveys

Blackspot seabream data from the Portuguese crustacean surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))) and the Portuguese Autumn Groundfish Surveys (PT-GFS) conducted by the Portuguese Institute for the Sea and Atmosphere (IPMA) from 1990 to 2018 were analysed. A more detailed description of these survey series is presented in Annex I. Although IPMA survey design is considered inadequate to estimate species abundance or species biomass, because the species occurrence appears to be higher at nontrawlable areas. The information on blackspot seabream collected in the surveys that took place between 1990 and 2018 is presented, the species spatial distribution is mapped and the places with higher frequency of fishing hauls with the species are identified.

3. RESULTS

3.1. Official landings

In the period between 2009 and 2018, the species was landed in several Portuguese landing ports in all five NUTS II of the Portuguese continental coast (Figure 1). For the three main NUTS II, the mean price per Kg along the months of the yeas for the Polyvalent fleet (Fig. 2) and Trawl fleet (Fig. 3) show variations, with higher values predominantly occurring at the beginning and at the end of the year.

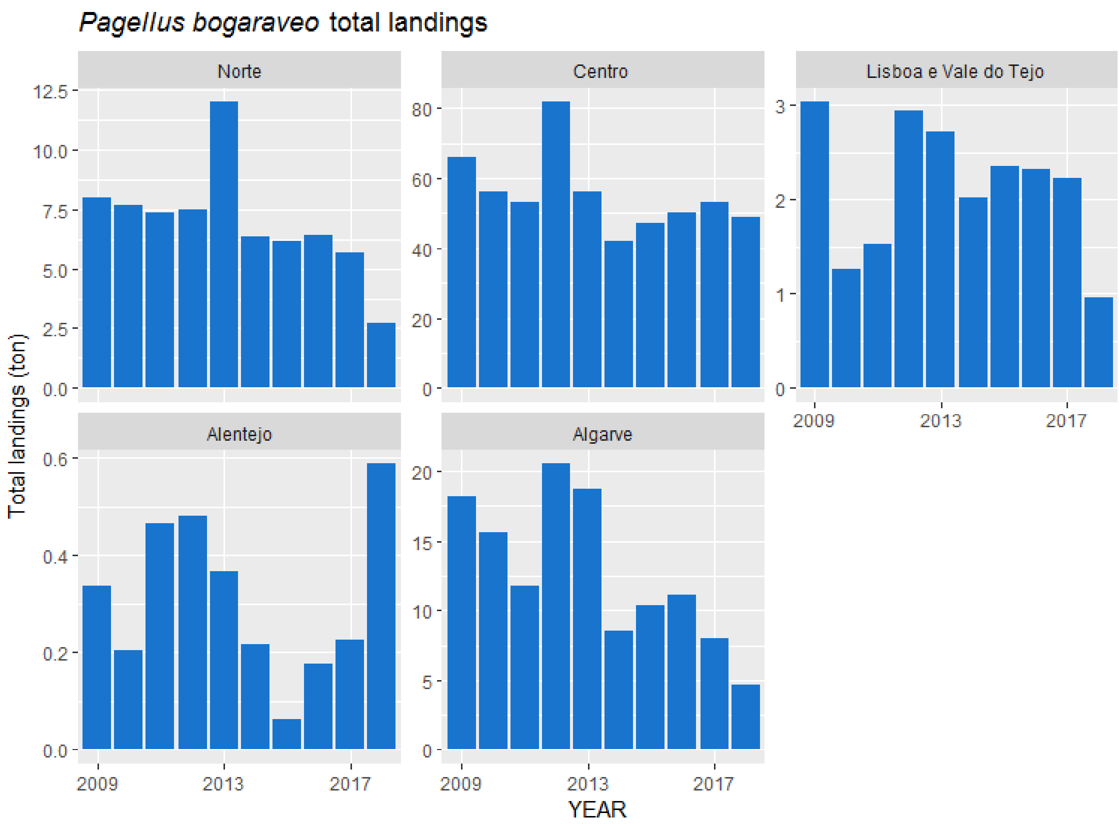


Figure 2. Total landings of *Pagellus bogaraveo* in weight (ton) in mainland Portugal ports by NUTS II and year between 2009 and 2018.

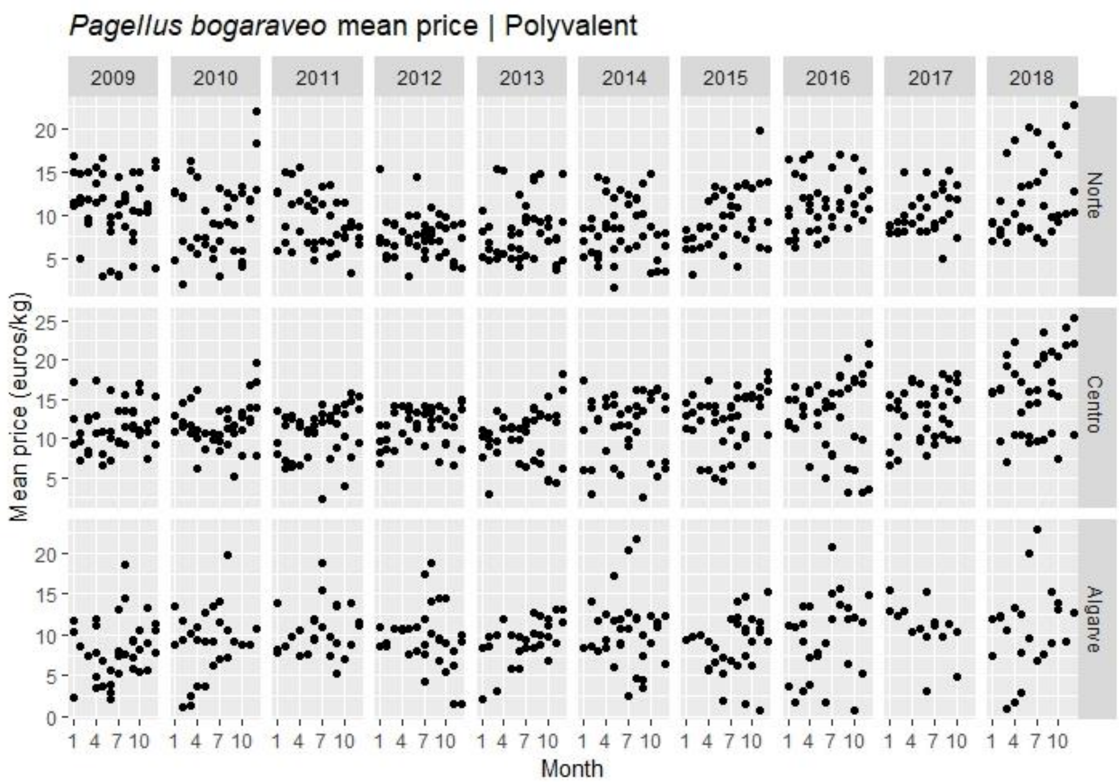


Figure 3. Mean price (in euro per Kg) of *Pagellus bogaraveo* landed by the polyvalent fleet by NUTS II along the month of the years between 2009 and 2018.

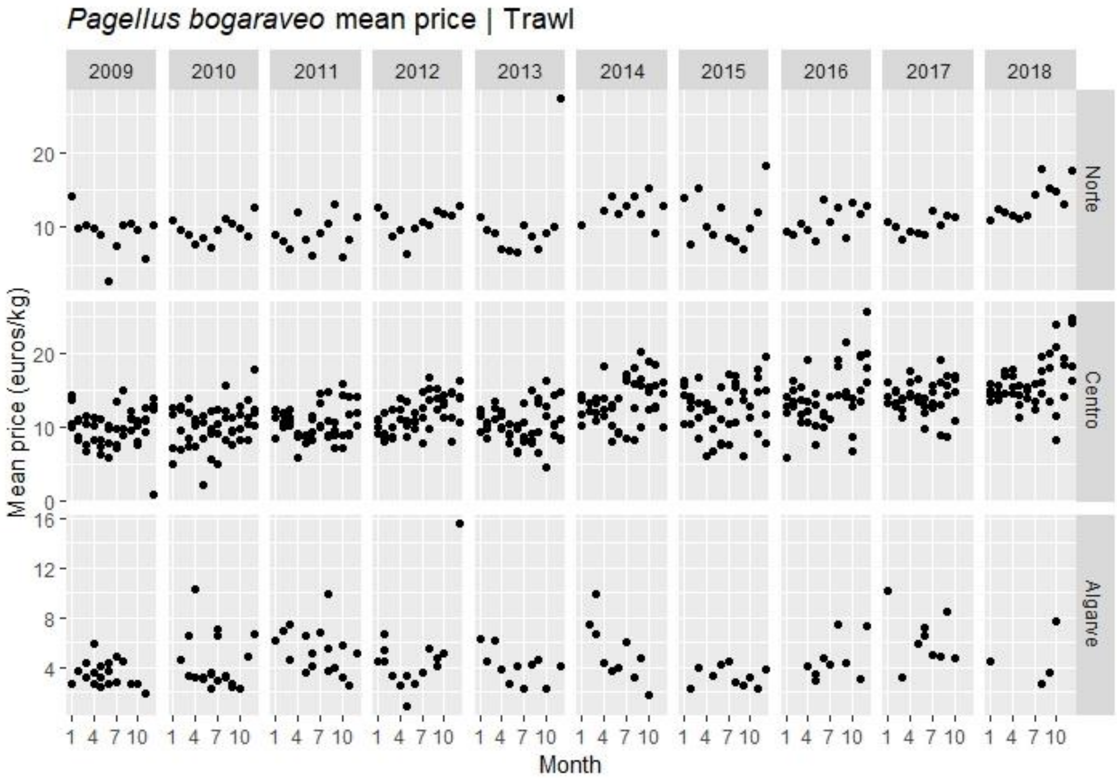


Figure 4. Mean price (in euro per Kg) of *Pagellus bogaraveo* landed by the Trawl fleet by NUTS II along the month of the years between 2009 and 2018.

For for the main NUTS II, Centro and Algarve and for each fleet segment, landings per month show a seasonal trend (Fig. 4 and 5), with higher values registered in the first quarter and in the last two months of the year (in some years, a smaller peak is noticeable at the summer months) (Fig. 4).

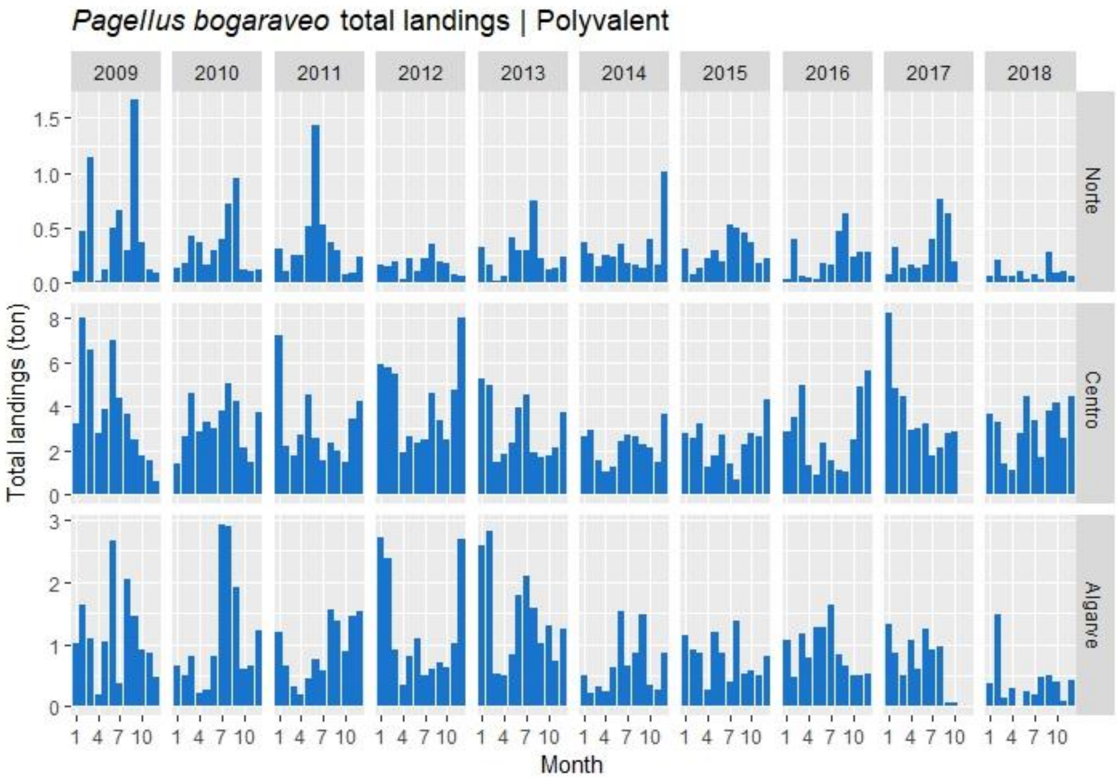


Figure 5. ***Pagellus bogaraveo*** **landings (tons) from the polyvalent fleet by month and year at “Centro” and “Algarve” NUTS, from 1999 to 2018.**

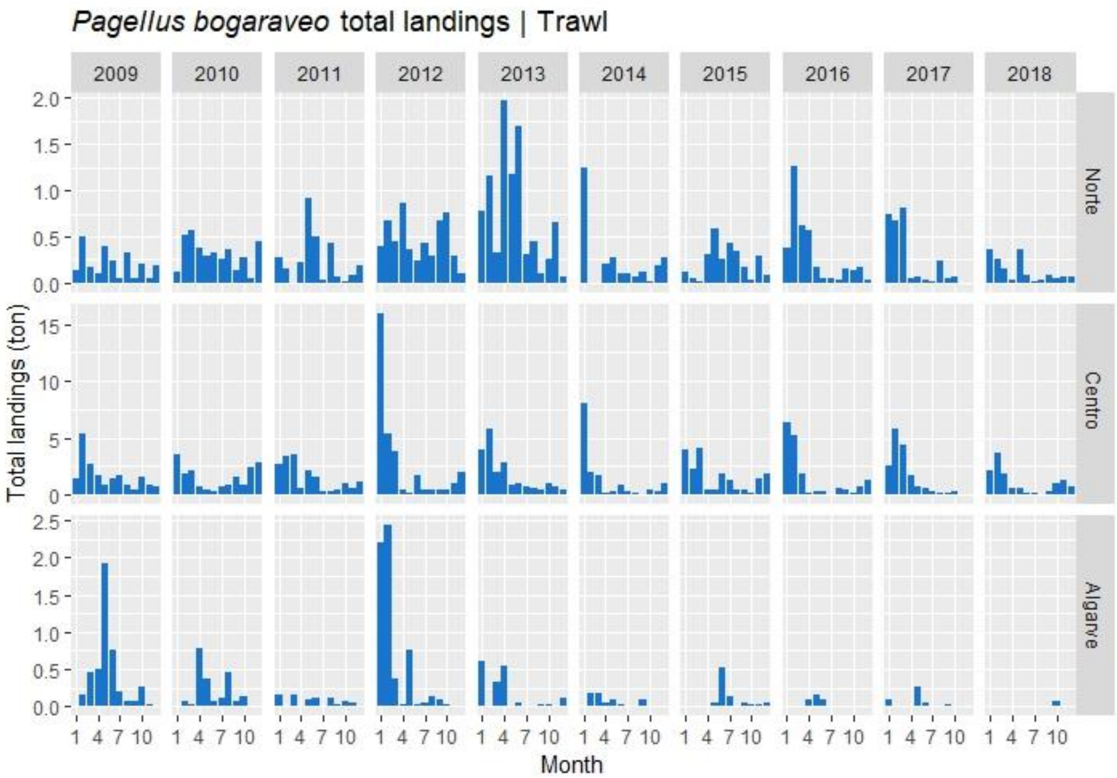


Figure 6. ***Pagellus bogaraveo*** **landings (tons) from the trawl fleet by month and year at “Centro” and “Algarve” NUTS, from 1999 to 2018.**

For Peniche landing port, the total landed weight by commercial size category and fleet segment show that commercial size categories 1 and 2 are mainly landed by the polyvalent fleet while trawl landings are mainly composed by commercial size category 4. DCF length sampling data support the fact that commercial size classes reflect differences on specimen´s size (Fig. 6). Despite the overlap between adjacent commercial size categories, it is clearly that total length ranges of categories 1 and 4 are clearly separated.

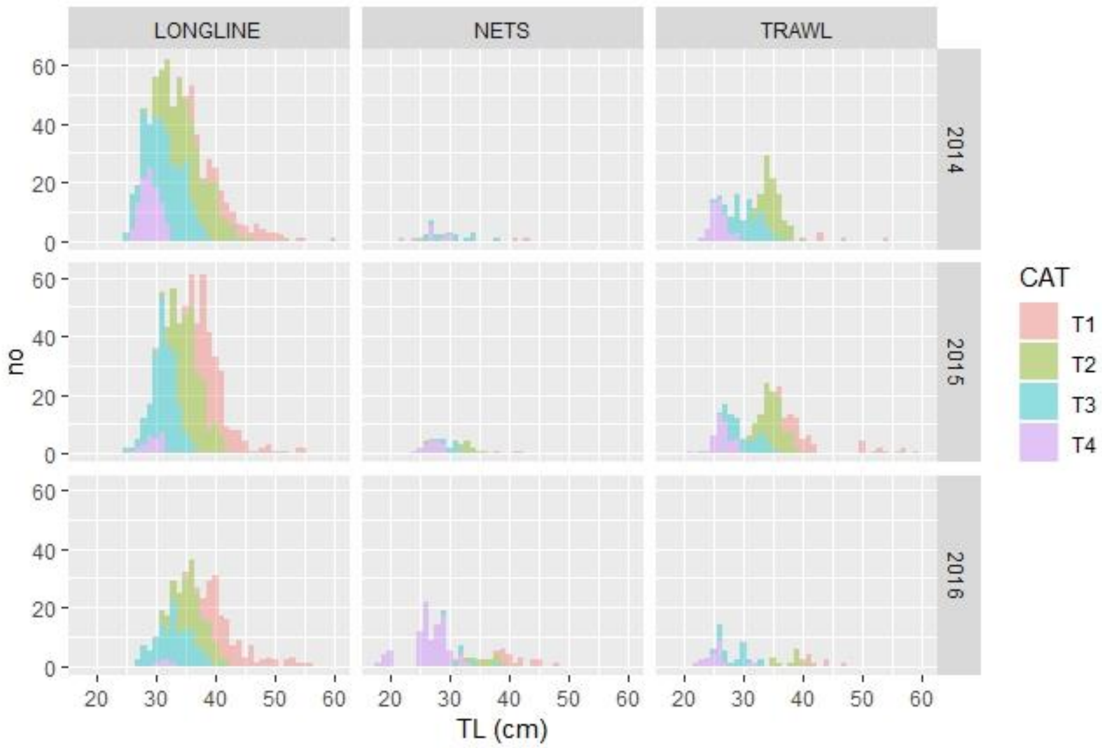


Figure 7. ***Pagellus bogaraveo*** **length frequency distribution by fishing gear and its correspondence to commercial size categories for the year 2014 to 2016.**

The total number of vessels landing *P. bogaraveo* for each fishing segment shows a trending decrease from 1999 to 2018 (Fig. 7), probably reflecting the continuous EU TAC reduction in Subarea 27.9.a since 2004 (ICES, 2017).

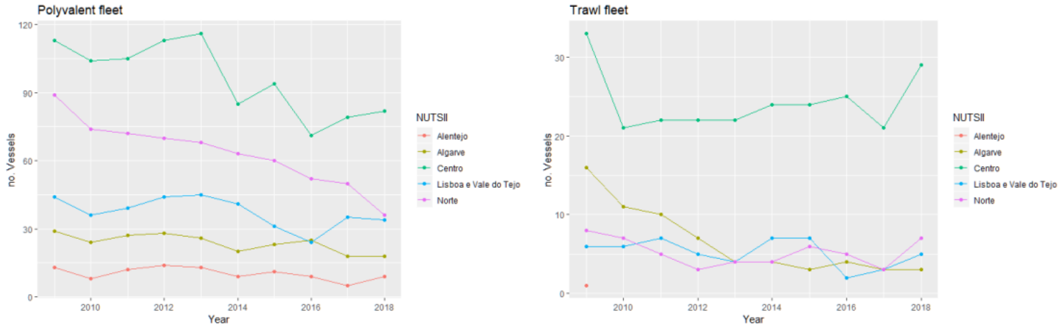


Figure 8. Total number of distinct vessels from the Polyvalent and Trawl segment landing *Pagellus bogaraveo* by year in mainland Portugal, from 1999 to 2018.

For each fishing segment and for the period between 2014 to 2017, the number of fishing trips with positive landings of the species and the number of months of the year during which the fishing vessels landed the species are presented in Figures 7-10.

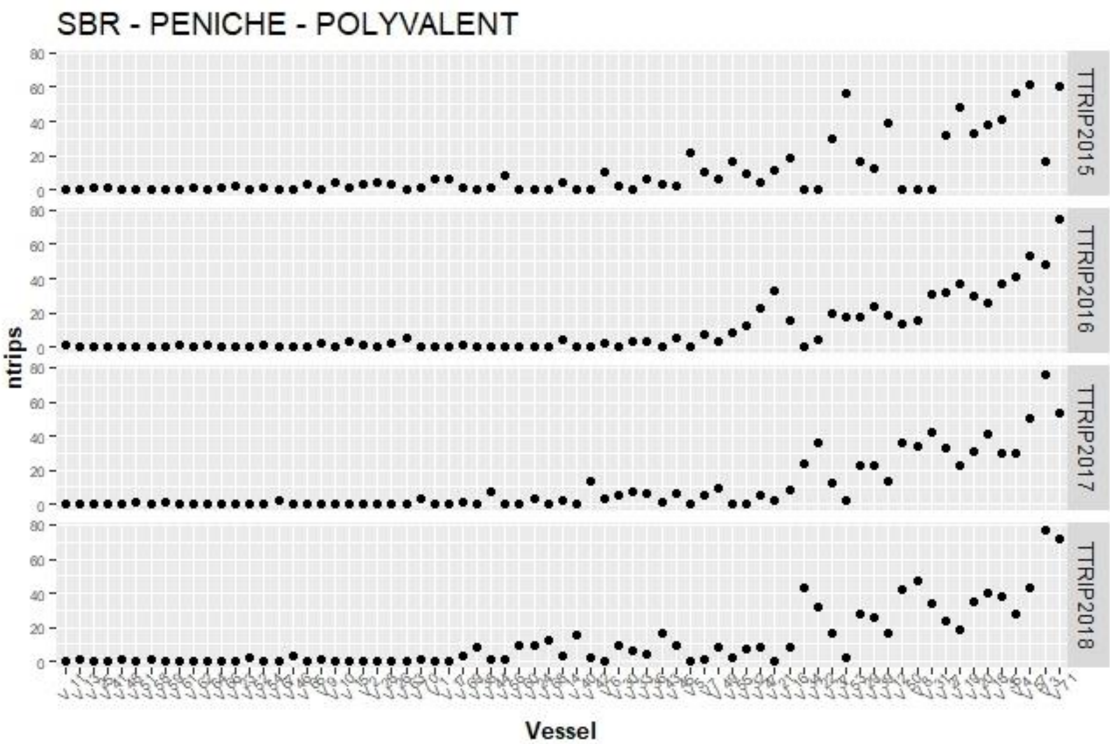


Figure 9. Peniche Polyvalent fishing segment. Total number of trips with landings of *Pagellus bogaraveo* by distinct vessels for the years between 2015 and 2018.

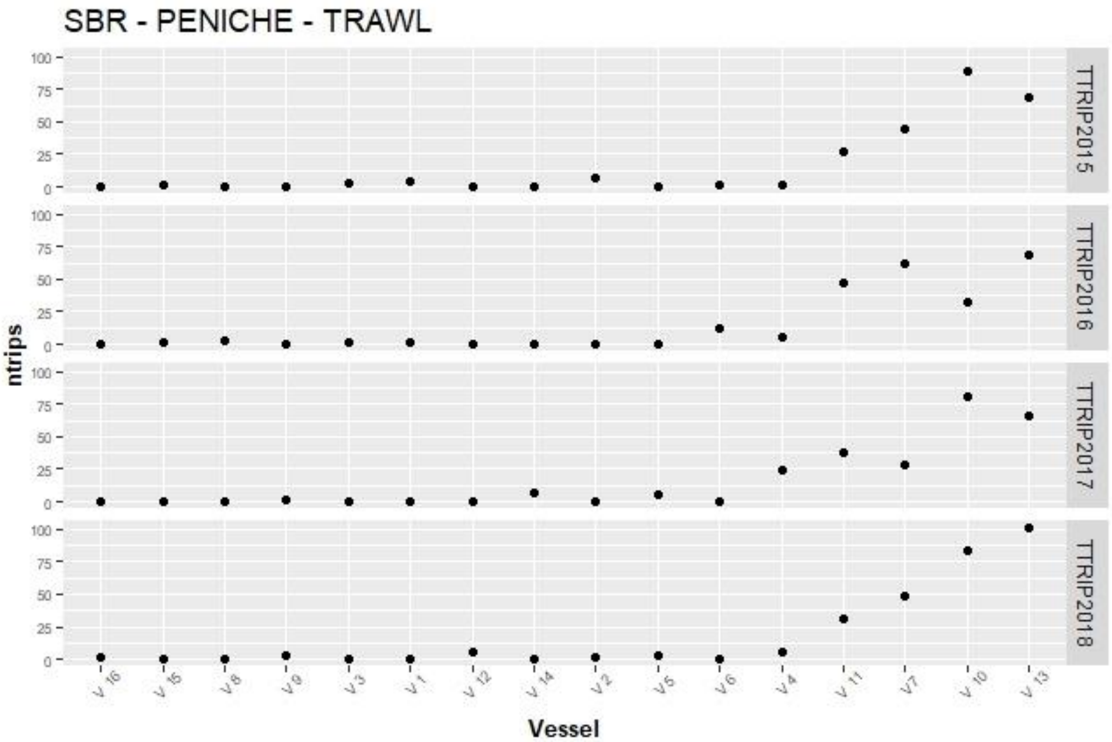


Figure 10. Peniche Trawl fishing segment. Total number of trips with landings of *Pagellus bogaraveo* by distinct vessels for the years between 2015 and 2018.

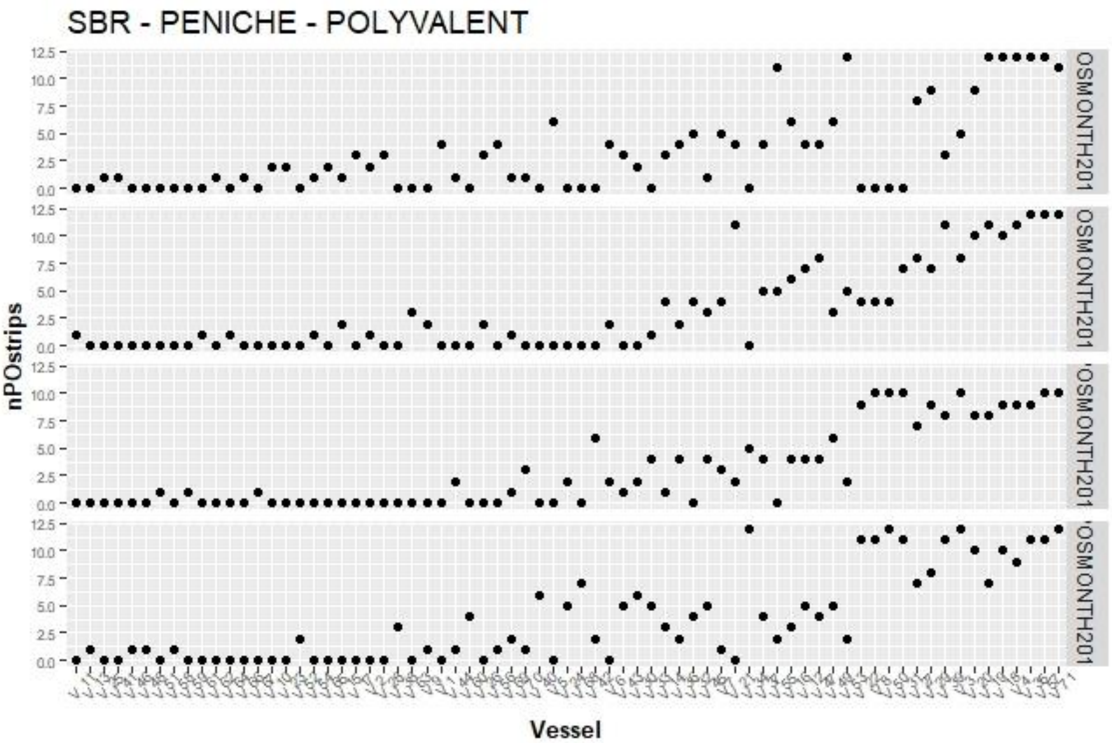


Figure 11. Peniche Polyvalent fishing segment. Number of months within the year with landings of *Pagellus bogaraveo* by distinct vessels for years between 2015 and 2018.

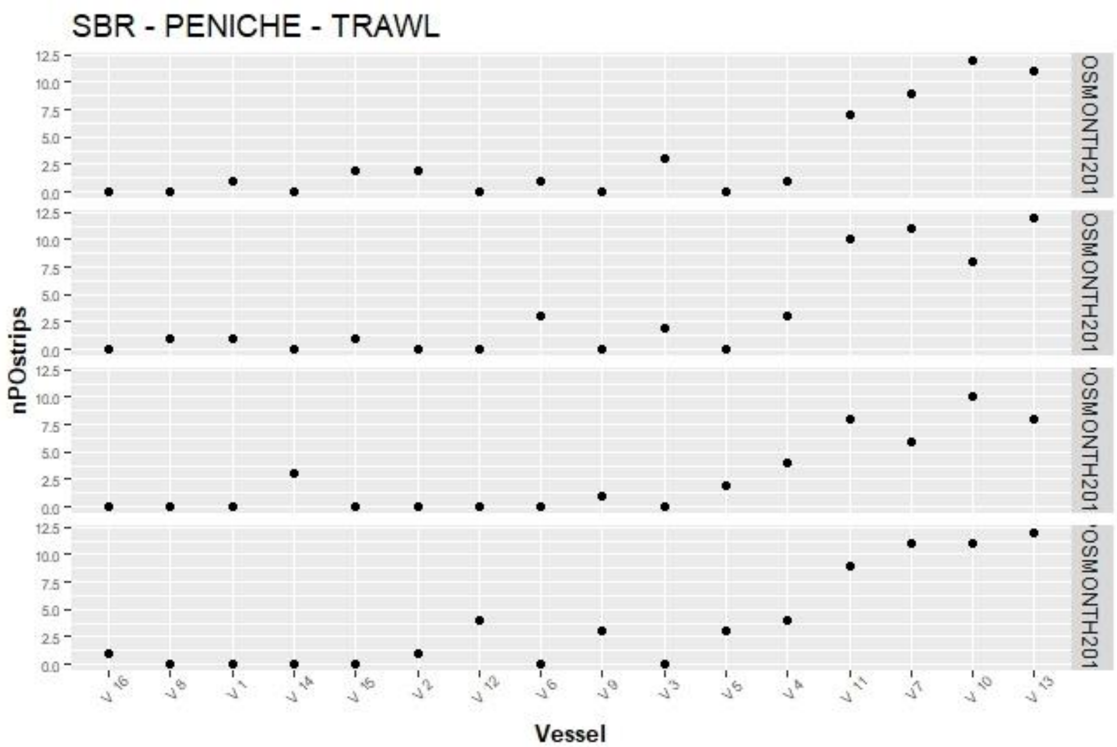


Figure 12. Peniche Trawl fishing segment. Number of months within the year with landings of *Pagellus bogaraveo* by distinct vessels for the years between 2015 and 2018.

For the Polyvalent fishing segment, the criteria dopted for the selection of fishing vessel were: more than 9 fishing trips per year and more than 6 months with positive landings of the species. Based on these criteria a total of 26 fishing vessels were selected for the “REFERENCE FLEET- POLYVALENT-PENICHE”. The GLM estimates of the CPUE here considered as landed weight per fishing trip by year for the selected model are presented in Figure 12.

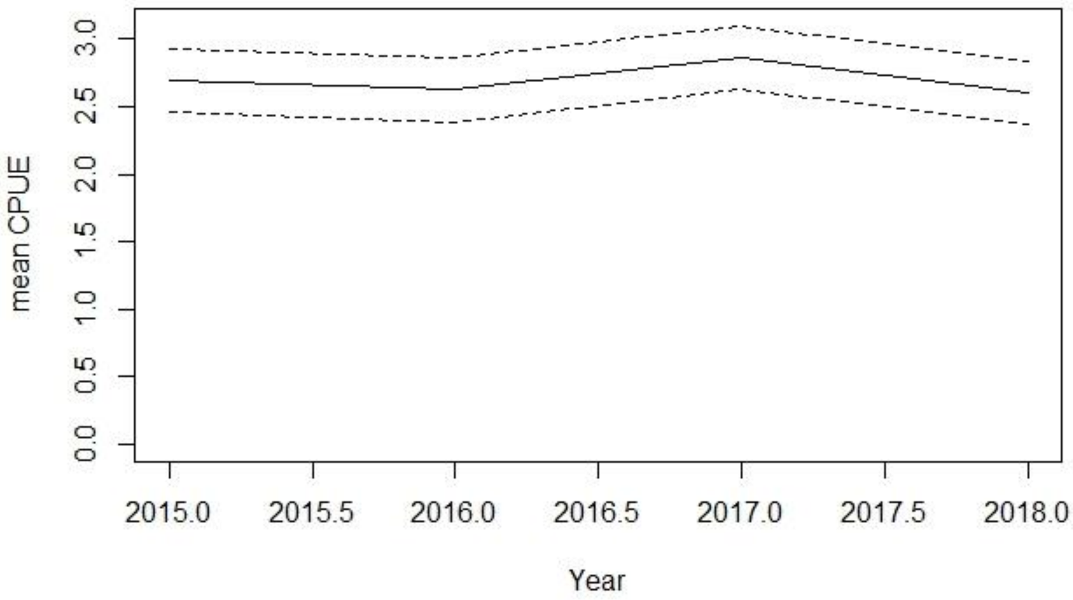


Figure 13. Peniche Polyvalent fishing segment Reference Fleet. Standardized annual estimates of log(CPUE + 0.1) for the period 2015 to 2016.

The adjustment of the fitted model is presented in Figure 13 where no strong violations of the model assumptions are apparent.

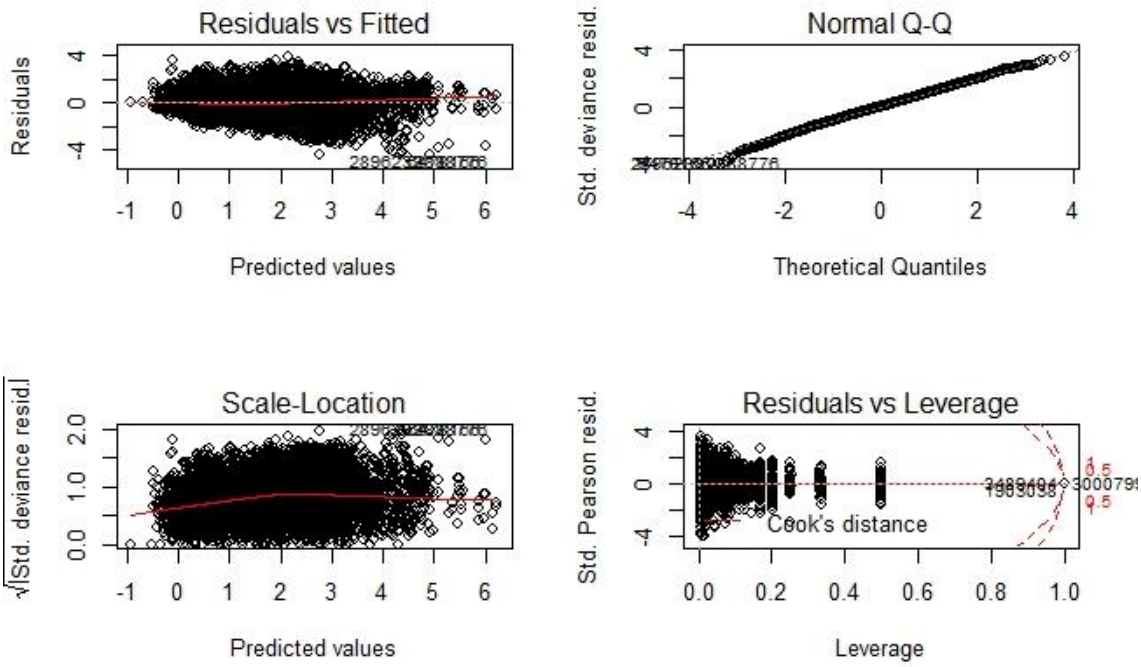


Figure 14. Peniche Polyvalent fishing segment Reference Fleet.

For the Trawl fishing segment, the criteria adopted for the selection of fishing vessel where: more than 9 fishing trips per year and more than 5 months with positive landings of the species. Based on these criteria a total of 4 fishing vessels were selected for the "REFERENCE FLEET- TRAWL-PENICHE". The GLM estimates of the CPUE here considered as landed weight per fishing trip by year for the selected model are presented in Figure 14.

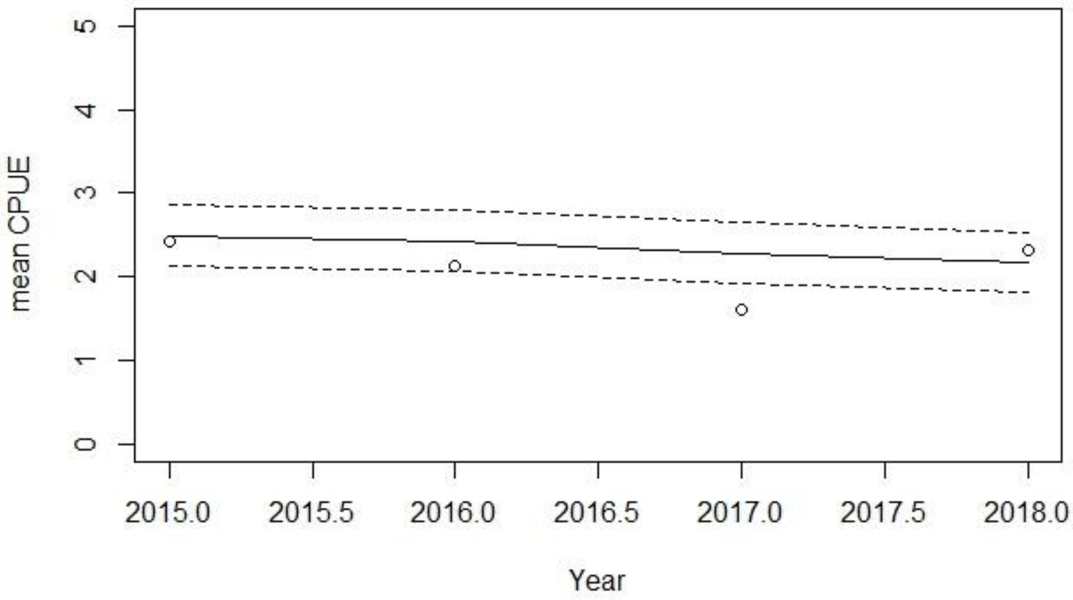


Figure 15. Peniche Trawl fishing segment Reference Fleet. Standardized annual estimates of log(CPUE + 0.1) for the period 2015 to 2016.

The adjustment of the fitted model is presented in Figure 15 where no strong violations of the model assumptions are apparent.

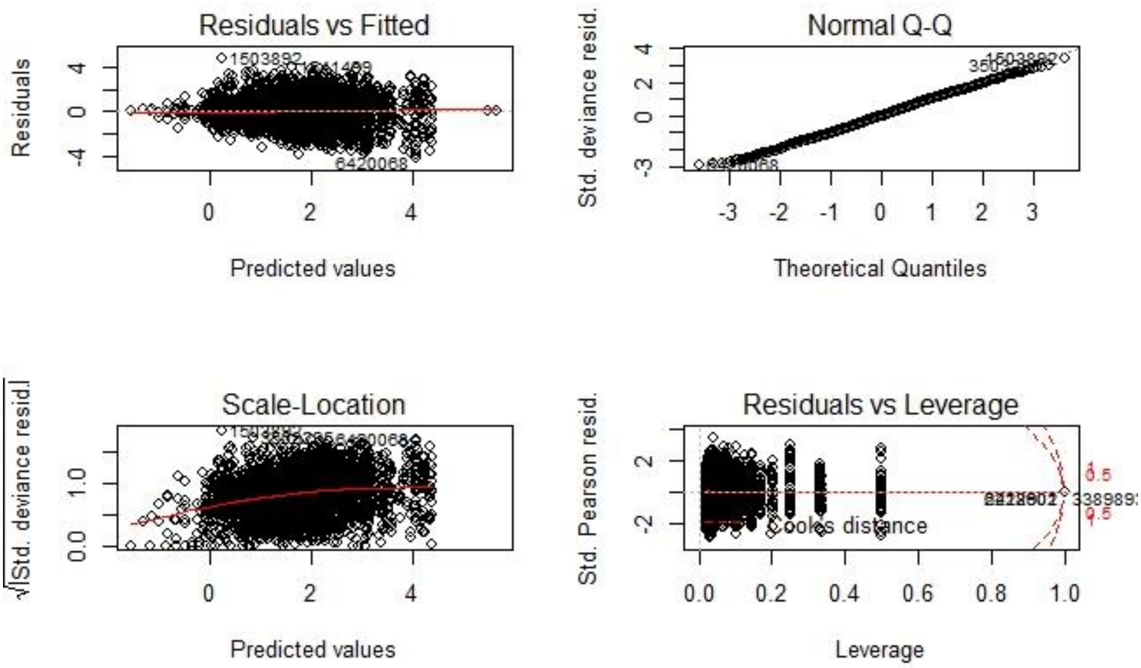


Figure 16. Peniche Trawl fishing segment Reference Fleet.

3.2. Surveys

The frequency of fishing hauls with blackspot seabream catch rates higher than 5 specimens is mapped in Figure 16. The spatial distribution of the species suggests a patchy distribution. The species is not evenly distributed along the surveyed area, being more frequently caught at specific grounds.

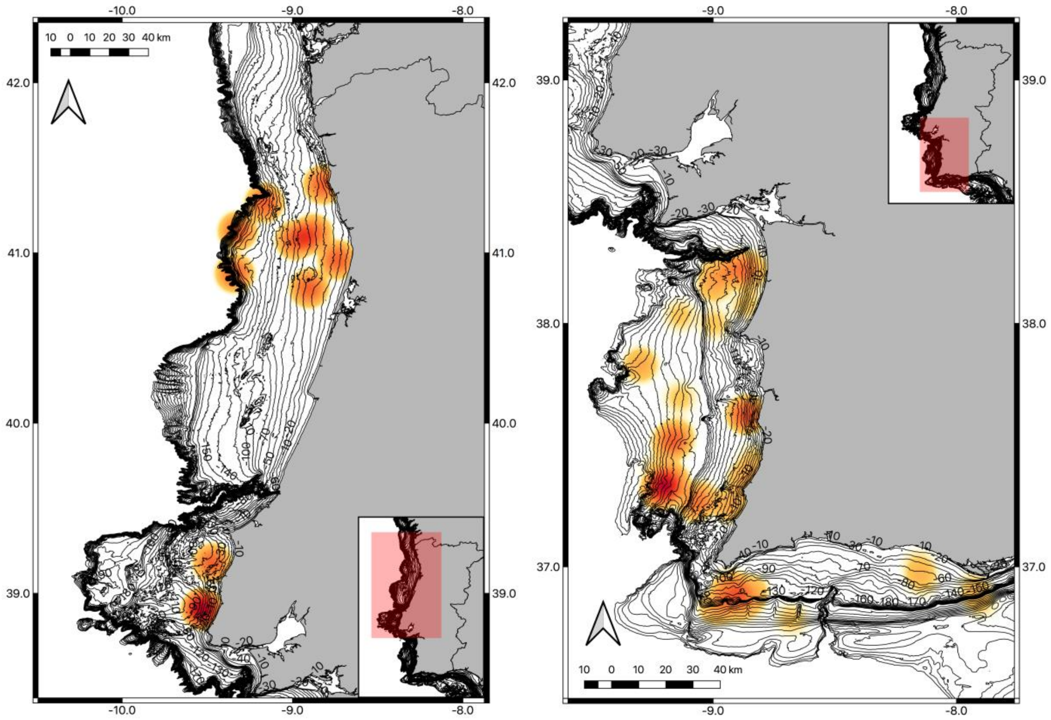


Figure 17. Distribution of *Pagellus bogaraveo* along the Portuguese coast based on Portuguese surveys from the period between 1997-2011 and 2013-2017. The colored blotches are hauls with *Pagellus bogaraveo* catches over 5 n.h^{-1}. The color intensity of the blotches reflects species occurrence. (source: Farias et al., 2018)

CONCLUSIONS

The results from Portuguese data analyses together with the observed trends on the Spanish/Morocco longliner fisheries lead to consider that the Subarea 27.9.a management component, admitted by ICES, is too extended. Particularly, the population occurring at the western coast of Portugal appears not to be adequately managed considering the status of the population heavily exploited at Cadiz region. The analysis of CPUE for the refence fleet is not in accordance with the abundance trend from Cadiz region. Therefore, it is not appropriate to infer the population ecological status of *P. bogaraveo* in Portuguese waters based on Spanish data from the Gulf of Cadiz and Gibraltar, where target fisheries are known to take place.

Finally, the localized and patchy distribution that characterises the species as well as its site fidelity to specific topographic features may be further considered a support for the proposal of more spatialized management components in ICES 27.9.a. Small functional units can be considered a more reasonable solution for assessment purposes of the blackspot seabream 27.9.a stock.

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ANNEX I

The PT-CTS (UWTV (FU 28-29) survey takes place since 1997 and the main objective is to monitor the abundance and distribution of the main crustacean species, namely the Norway lobster *Nephrops norvegicus*, the rose shrimp *Parapenaeus longirostris*, and the red shrimp *Aristeus antennatus*. This survey is conducted during the 2nd quarter (May-July) of the year and covers the southwestern coast (Alentejo, FU 28) and southern coast (Algarve, FU 29) from 200 to 750 m deep. The surveys have been carried out with the Portuguese RV “Noruega”.

The PT-GFS surveys’s main objective is to monitor the abundance and distribution of hake *Merluccius merluccius* and horse mackerel *Trachurus trachurus* recruitment (Cardador et al., 1997). This survey is performed along the Portuguese continental coast, extending from latitude 41°20'N to 36°30'N (ICES Division 9a) between 20 to 500 m deep (750 m until 2003). The surveys have been carried out with the Portuguese RV “Noruega”, using a Norwegian Campell Trawl net (1800/96 NCT) with a 20 mm codend mesh size and groundrope with bobbins.

Working Document for the ICES Working Group on Biology and Assessment of Deep-Sea Fisheries Resources

Copenhagen, 2nd – 9th May 2019

Teresa Moura, Inês Farias, Neide Lagarto and Ivone Figueiredo

The greater forkbeard *Phycis blennoides* in Portuguese continental waters

(ICES Division 27.9.a)

Instituto Português do Mar e da Atmosfera

Abstract

This working document reviews IPMA available information on the biology and ecology of *Phycis blennoides*, the greater forkbeard, and presents data from fisheries and IPMA research surveys taking place in Portuguese waters (ICES 27.9.a).

1. INTRODUCTION

The greater forkbeard *Phycis blennoides* is a demersal species from the family Gadidae widely distributed in the north-eastern Atlantic from Norway and Iceland to Cape Blanc in West Africa and in the Mediterranean (Massutí et al, 1996). It is typically distributed on the bottom along the continental shelf and slope, at depths ranging between 60 and 1000 m deep (or deeper) (Massutí et al., 1996; Casas and Pineiro 2000; Garcia et al., 2000). In the northwest Mediterranean the maximum abundance was observed between 200 and 400 m deep (Massutí et al, 1996). In this area, reproduction occurs from January to May (Massutí et al., 1996). However, in ICES Divisions 27.8.c and 27.9.a spawning is thought to occur in November-December (Casas and Piñeiro, 2000).

The greater forkbeard presents a discrete recruitment pattern (Ragonese et al., 2002). In the Mediterranean (Ragonese et al., 2002), the size of species transition from the pelagic to the demersal habitat is around 5.0 cm (total length). This size is relatively smaller than in the Atlantic waters, around 5.9 cm (Casas and Piñeiro, 2000). Growth parameter estimates in the Gulf of Tunis were TL_{inf} = 57.17 cm, k = 0.193 $year^{-1}$, t_0 = –1.578 year for females, and TL_{inf} =44.74 cm, k = 0.313 $year^{-1}$, and t_0 =–1.210 year for males. Females grow faster than the males, and the latter did not exceed 45 cm (Romdhani et al., 2016).

In Portuguese continental waters, georeferenced abundance and size data for the greater forkbeard suggests that this species is capable to complete the life cycle in the area, as the whole species size range is observed (Lagarto et al., 2017). As in other geographic areas (e.g., Massutí et al., 1996 for the Mediterranean) a depth effect on specimen's size is observed, with larger specimens occurring at deeper depths (Lagarto et al., 2017).

2. METHODOLOGY

2.1. Fisheries dependent data

Portuguese landings in ICES division 27.9.a were characterized. Fisheries dependent data were collected from commercial landings for the period 2009-2018. Landed weight (in kg) per trip corresponds to the vessels´ landing after each trip. A trip is defined from the moment the vessel leaves the dock to when it returns to the dock.

Total landings in weight (ton) were analysed by year, by month and by NUTS (Nomenclature of Territorial Units for Statistics). The level 2 NUTS for the Portuguese continental territory are: North, Centre, Lisbon and the river Tagus Valley, Alentejo, and Algarve (Figure 1).

Figure 1. Division of the Portuguese territory in level 2 NUTS (Source: www.pordata.pt)

The fishing vessels with landings of greater forkbeard and forkbeard were characterized, particularly the length-over-all (LOA) by fishing gear, NUTS area and year. The behaviour of the fishing fleet was also investigated, particularly if the vessels land the species in a single port or in more than one landing port in each month.

2.2. Sampling Length data

The greater forkbeard is sampled for total length in several Portuguese landing ports under the national data collection program (PNAB/DCF). Length frequency distribution by length class of 1cm was evaluated by fleet (trawl and polyvalent) and by year (from 2014 to 2018).

2.3. Research surveys

Fishery independent data are available from two survey series (see annex I for further information). From these, the Portuguese Crustacean Surveys/ Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))) provided the most complete spatial coverage information to investigate the spatial species dynamics in the Portuguese continental coast, given the depth range covered by fishing hauls performed in these surveys, which goes down to 750 m deep.

The uncertainty in species identification in the first years of the survey series and to avoid misidentification errors (it is possible that misidentification problems with *Phycis phycis* have occurred in the past), data were restricted to depths ranging between 500 and 750 m deep for further analysis (including abundance index standardization). In addition, given the low number of fishing hauls, two geographical areas (or sectors) were not considered (Lisboa and Arrifana).

Biomass index

The *P. blennoides* biomass index (catch weight per trawling hour) was standardized using the individual fishing haul catches obtained from the Portuguese Crustacean Surveys/ Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))).

The PT-CTS (UWTV (FU 28-29) are conducted by the Portuguese Institute for the Sea and Atmosphere (IPMA, ex-IPIMAR) and the main objective is to monitor the abundance and distribution of the main crustaceans species, namely the Norway lobster *Nephrops norvegicus*, the rose shrimp *Parapenaeus longirostris* and the red shrimp *Aristeus antennatus*. PT-CTS (UWTV (FU 28-29)) have been conducted during the 2nd quarter (May-July) of the year and cover the southwest coast (Alentejo, FU 28) and south coast (Algarve, FU 29). The surveys have been carried with the Portuguese RV "Noruega", which is a stern trawler of 47.5 m length, 1500 horse power and 495 GRT. A regular grid composed by 22 rectangles in FU 28 and 59 rectangles in FU 29 is used, with one station within each rectangle. Each rectangle has 6.6´ of latitude x 5.5´ of longitude for the SW coast and *vice-versa* for the south coast, corresponding approx. to 33 nm^2. The grid was designed for a trawl survey to cover the main crustacean fishing grounds within the range of 200-750 m. The hauls fishing operations are carried out during daytime with a speed of 3 knots and the duration of each tow change in 2005 from 60 to 30 min. Although the crustacean species are the target (Norway lobster, rose shrimp and red and blue shrimp), data from all other taxa and species are also collected, as well as marine litter.

Generalized linear models (GLM) were adjusted to biomass index values and several factors were used as explanatory variables. In the essayed models the biomass index ($Kg.h^{-1}$) was the response variable. Apart from the factor year, the remaining predictors were selected depending on their significance after the model adjustment. GLM models were adjusted through the use of package 'MASS' (Venables and Ripley, 2002) implemented in R software. Given the relative high percentage of zeroes in the response variable, the error model was assumed to follow a Tweedie random variable, whose probability density function is expressed as:

$$f(y:\mu,\sigma^2,p) = a(y:\sigma^2,p)exp\left\{-\frac{1}{2\sigma^2}d(y:\mu,p)\right\}$$

where μ is the location parameter (mean of the distribution); σ^2 is the diffusion parameter and; p is the power parameter.

The Tweedie family of distributions is a family of exponential models with variance $Var(Y) = \sigma^2.\mu p$; depending on the p value it includes several distributions (Dunn and Smyth, 2008; Jørgensen, 1997). When $1<p < 2$ the distribution corresponds to mixed distributions known as compound Poisson models (Jørgensen, 1997) that in the present case, and due to the high frequency of zeroes, seems to be the most appropriate distribution to use.

The estimation of the p parameter was done following the procedure proposed by Shono (2008). According to this, the p parameter is estimated by maximizing the profile log-likelihood across the grid values of p in the range of $1 < p < 2$ through the explicit form of the probability density function. The package 'Tweedie' (Dunn, 2009) implemented in R was used to estimate p.

The selected biomass index model included the factors Year and Sector and the continuous variable Depth:

CPUE= Year+Sector+Depth -1

Model´s adequacy was checked through the analysis of residuals. Fitted values were transformed ($2\mu^{1-(p/2)}$) to the constant information-scale, so that the expected pattern for the compound Poisson distribution was a straight line (McCullagh and Nelder, 1989; Draper et al., 1998; Ortiz and Arocha, 2004). Residuals analysis was performed using Tweedie quantiles, and the graphical tools for residuals set with the tweedie distribution (qqplots) were constructed. Three types of plots were examined: (i) histogram of the deviance residuals; (ii) deviance residuals and Pearson residuals against the standardized fitted values to check for systematic departures from the assumptions underlying the statistical distribution; and (iii) Tweedie QQ-plot (with Tweedie quantiles) for deviance residuals and for Pearson residuals.

For the selected biomass index model, the annual biomass index predictions in the original scale were obtained following the procedure referred in Candy (2004). The estimates of the variance of the sum of linear predictors used to estimate the approximate confidence intervals of annual indices were determined using the delta method implemented at the R package 'msm' (Jackson, 2013). The delta method is an approach for computing confidence intervals for functions of maximum likelihood estimates. This method allows finding approximations of the variance of functions of random variables based on Taylor series (Oehlert, 1992).

3. RESULTS

3.1. Fishery dependent data

In Portuguese continental coast there are no fisheries targeting the greater forkbeard, the species is mainly caught as by-catch of other fisheries. Information from logbook indicates that the species is commonly caught by the demersal longline fisheries.

Historical landings are low, which can be related to the relatively low commercial value of the species and to the reduced fishing effort of the Portuguese fisheries at deeper grounds. The quality of landing data on the species have problems, as misidentification errors are known to occur; *P. blennoides* is commonly misidentified with its congener *Phycis phycis*. Official statistics include a commercial category corresponding to a higher taxonomic level, *Phycis* spp. In landings assigned to *Phycis* spp. (~1 tonne in 2017) the fraction corresponding to *P. blennoides* is unknown.

Landings and fleet descriptions, for *Phycis* species, are presented below.

Phycis blennoides

In mainland Portugal, nearly all *P. blennoides* landings are reported in the Centre (NUTS II "Centro"). Species landings are primarily from Peniche landings port, with negligible landings in Figueira da Foz and Nazaré. In 2018, landings in Lisbon region (NUTS II "Lisboa e Vale do Tejo") by Trawl segment reached the order of magnitude of landings in the Centre.

Phycis blenoides is mainly landed by the polyvalent fleet segment, where landings represent around 98% of landings in weight (Fig. 2). The polyvalent segment (or multi-gear fleet) includes vessels of different LOA usually licensed to operate with more than one fishing gear (most commonly gill and trammel nets, longlines and traps). At the same fishing trip, different gears can be deployed, targeting different species, with different mesh sizes, with or without defined fishing grounds and with or without a seasonal character.

At Peniche landing port, a seasonal trend on *P. blennoides* landings is evident; in polyvalent segment the higher values are registered in the summer months and lower in the winter months (Fig. 3). Reasons for this seasonality are unknown, but might be related to the fleet spatial dynamics and to changes on their target species.

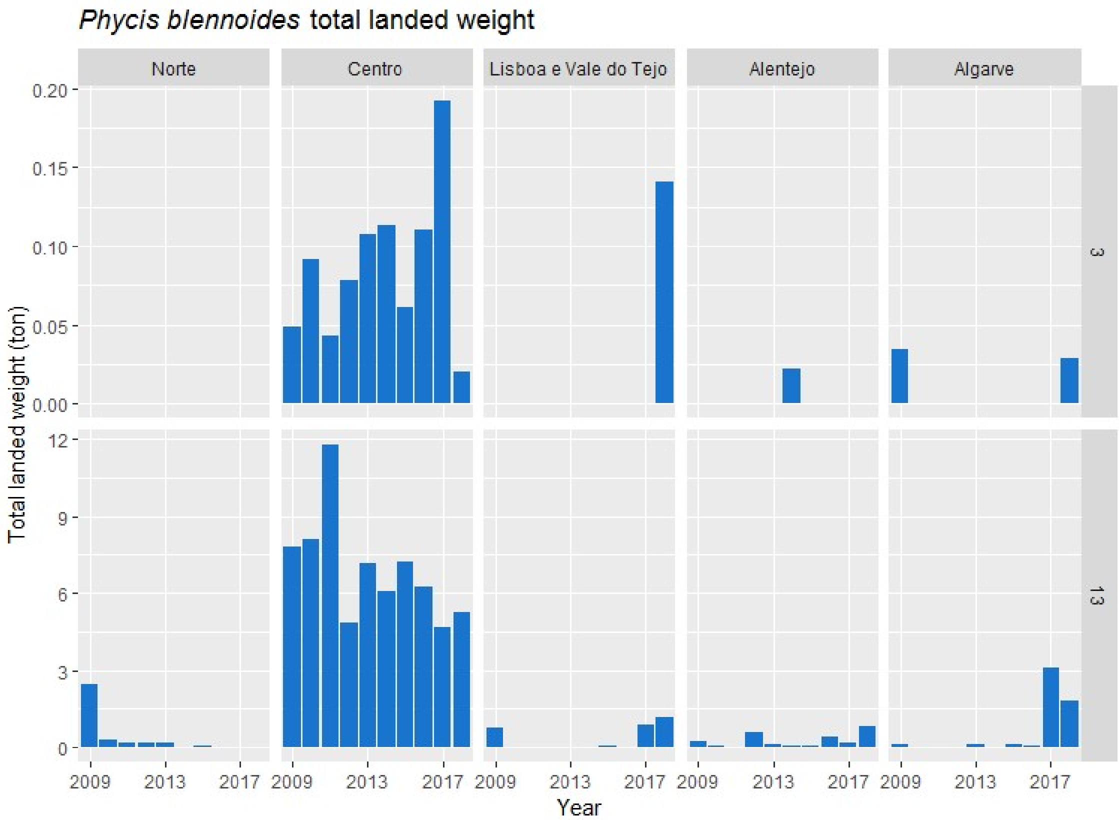

Figure 2. Greater forkbeard, *Phycis blennoides*, total landings in weight (ton) by métier (3 is trawl; 13 is polyvalent) by NUTS in mainland Portugal between 2009 and 2018.

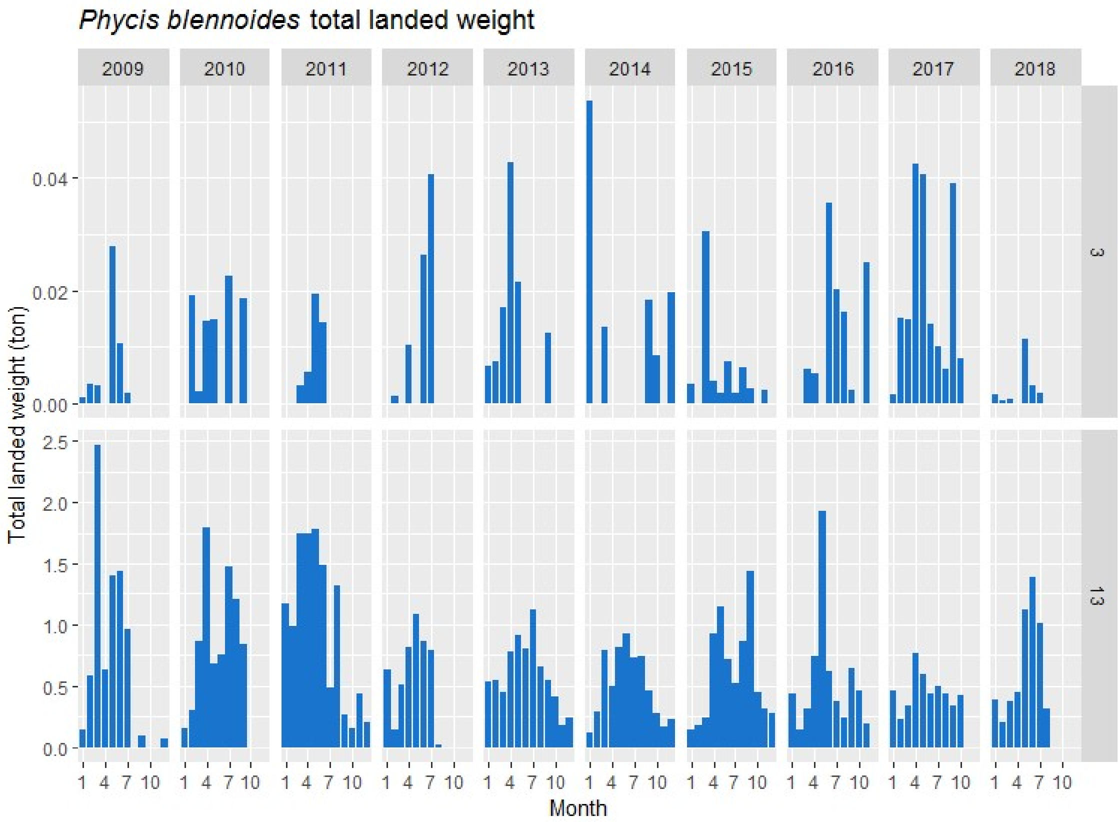

Figure 3. Greater forkbeard, *Phycis blennoides*, total monthly landings in weight (ton) by métier (3 is trawl; 13 is polyvalent) at Peniche landing port (Centre NUTS II) between 2009 and 2018.

The fleet from which *P. blennoides* landings are derived belong to the polyvalent fleet (Fig. 4). Most vessels land in just one single landing port (Fig. 5) and vessels with landings in two different landing ports during the same month were mainly detected in the summer months. Five different landings port was the maximum number of ports where a vessel landed the species in one month.

The LOA of vessels belonging to the polyvalent varied between 5 and 25 m, with the larger ones being registered in the Centre ("Centro"). At the Centre NUTSII particularly at Peniche, the LOA of vessels belonging to the Trawl segment landing port reach the highest values (Fig. 6).

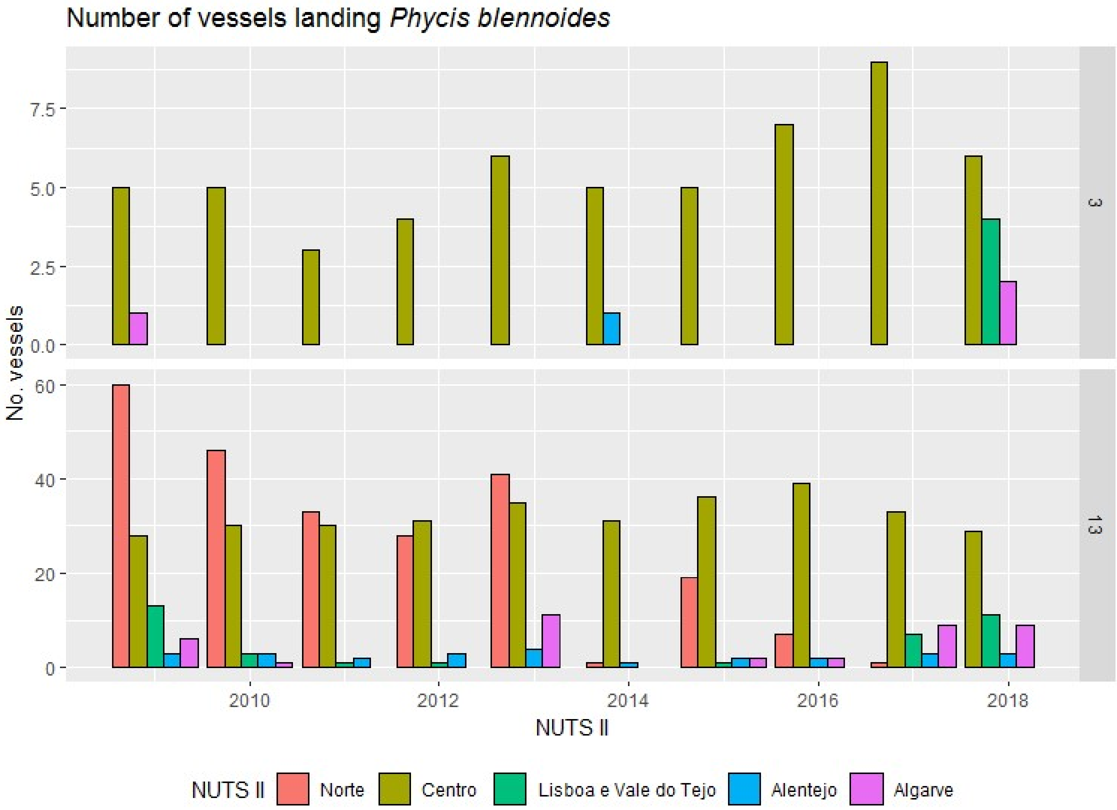

Figure 4. Number of vessels landing greater forkbeard, *Phycis blennoides*, by métier (3 is trawl; 5 is purse seine; 13 is polyvalent) in mainland Portugal between 2009 and 2018.

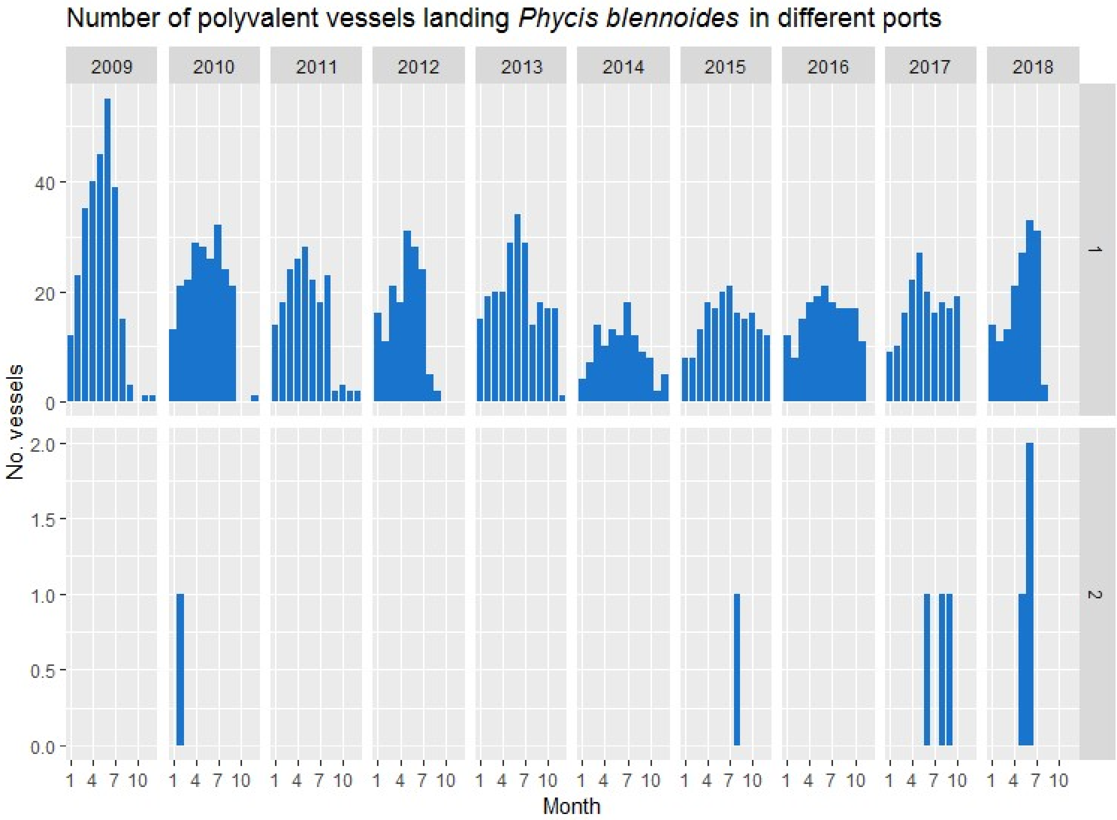

Figure 5. Number of polyvalent vessels landing greater forkbeard, *Phycis blennoides*, by number of ports where they land the species (1 and 2) in mainland Portugal between 2009 and 2018.

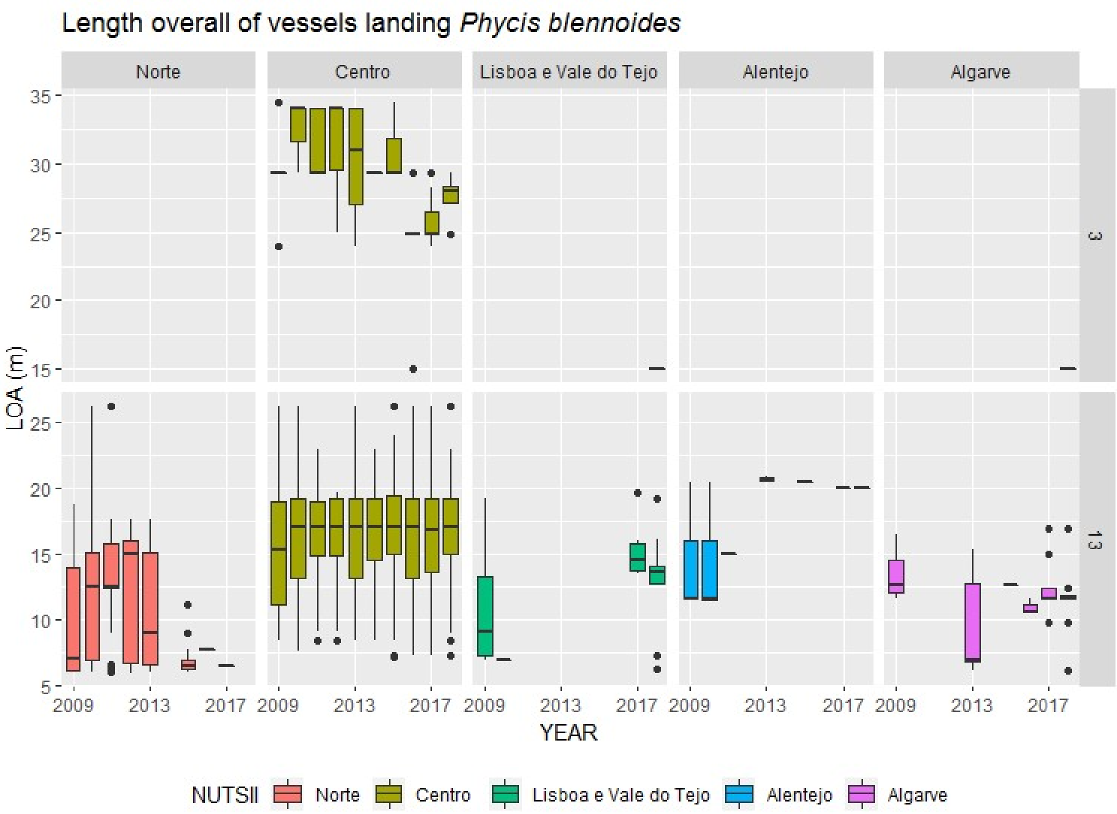

Figure 6. Length overall (LOA, m) of vessels landing greater forkbeard, *Phycis blennoides*, by métier (3 is trawl; 5 is purse seine; 13 is polyvalent) by NUTS II in mainland Portugal between 2009 and 2018.

Phycis phycis

In mainland Portugal, *P. phycis* landings are mainly reported in the Centre (NUTS II "Centro"), for both the Trawl and Polyvalent segments. "Algarve" NUTS II is the second important region and landings are mainly derived from purse seiners, with landing values particularly high since 2013 (Fig. 7). From 2013 to 2017 landings from purse seiners in the Centre also increased, contrarily to landings attributed to the Polyvalent and Trawl fishing segment, which decreased.

Peniche is the most important landing port for *P. phycis*. Similarly to *P. blennoides* the great amount of landings come from the Polyvalent fleet and, in a lesser extent, from the Trawl fleet. In Peniche, landings have decreased from 2009 to 2013 stabilizing since then for the two segment fleets (Fig. 8).

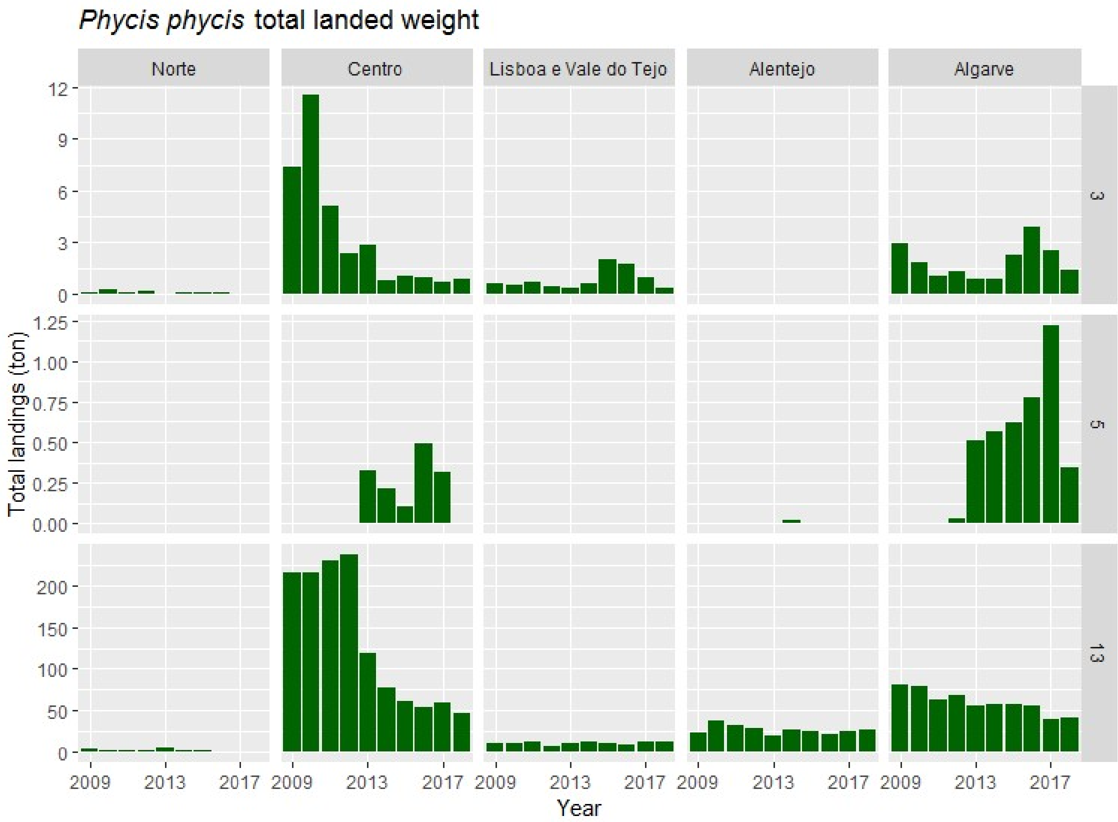

Figure 7. Forkbeard, *Phycis phycis*, total landings in weight (ton) by métier (3 is trawl; 5 is purse seine; 13 is polyvalent) by NUTS in mainland Portugal between 2009 and 2018.

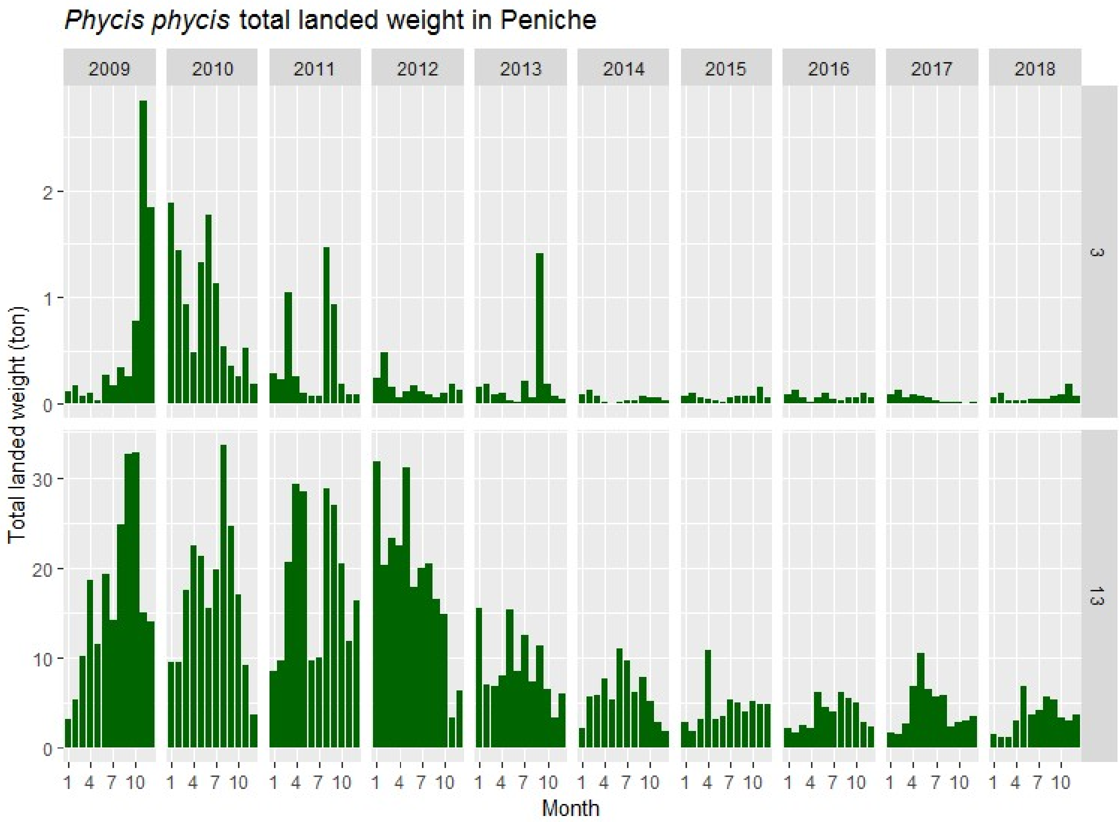

Figure 8. Forkbeard, *Phycis phycis*, total monthly landings in weight (ton) by métier (3 is trawl; 13 is polyvalent) at Peniche port (Centre NUTS II) between 2009 and 2018.

The number of vessels landing *P. phycis* has been stable along the years (Fig. 9). The number vessels from the Trawl segment is high in the Centre (NUTS II "Centro"), whereas landings from purse seiner and Polyvalent vessels are higher in the Algarve.

Most vessels landed *P. phycis* in one single port in each month, but vessels from belonging to Polyvalent or Trawl segments showed landings in two or three different ports during the same month (Fig. 10 and 11).

In general, vessels belonging to Trawl segment have a higher length overall than other vessels (Fig. 12). Landings from the "North" landing ports are higher than those from the "Algarve" and the mean LOA in latter region is also smaller than that at the "North".

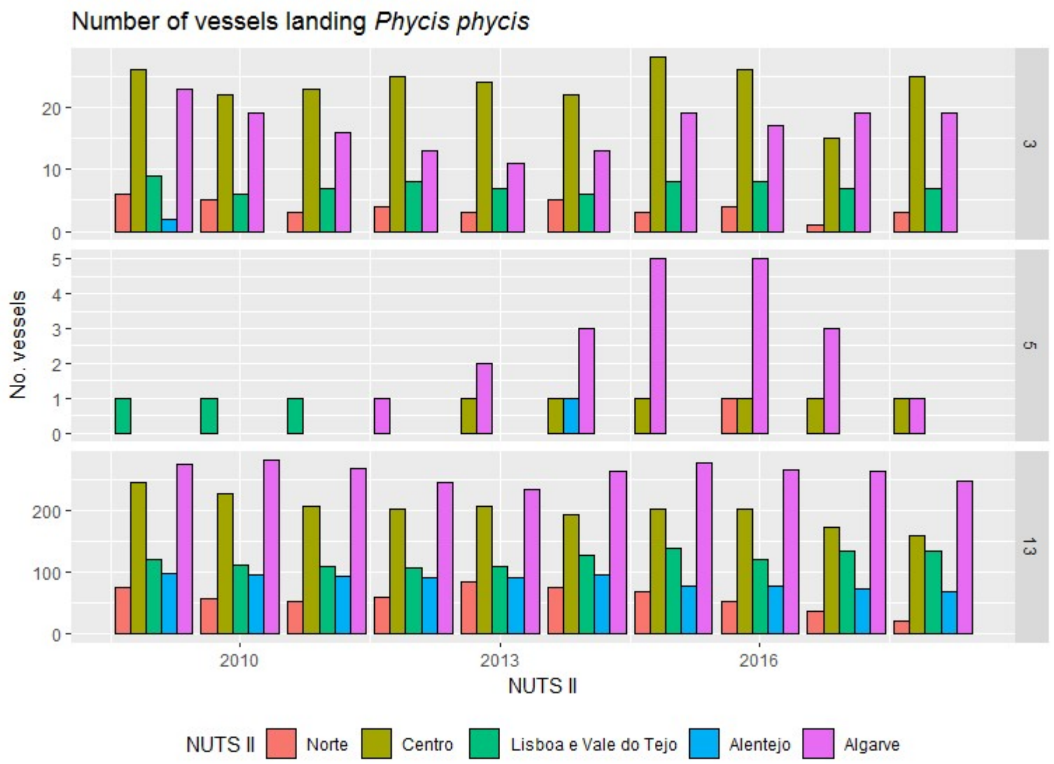

Figure 9. Number of vessels landing greater forkbeard, Phycis blennoides, by métier (3 is trawl; 5 is purse seine; 13 is polyvalent) in mainland Portugal between 2009 and 2018.

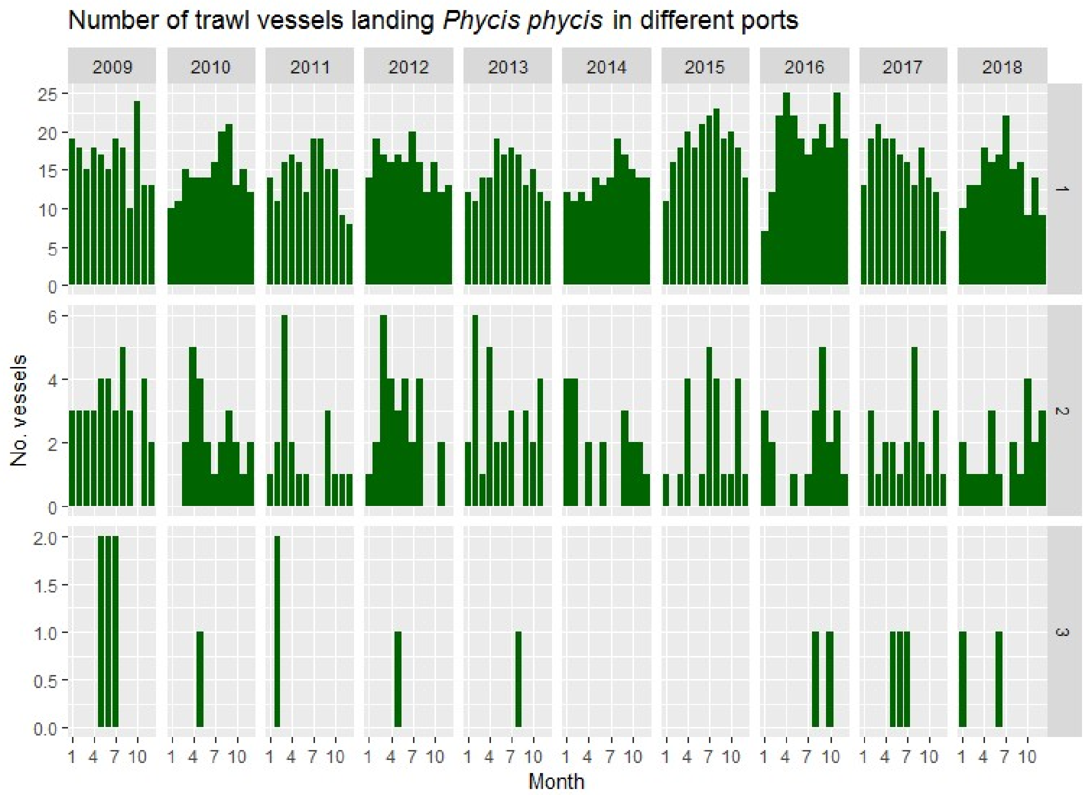

Figure 10. Number of trawl vessels landing forkbeard, *Phycis phycis*, by number of ports where they land the species (1 to 3) in mainland Portugal between 2009 and 2018.

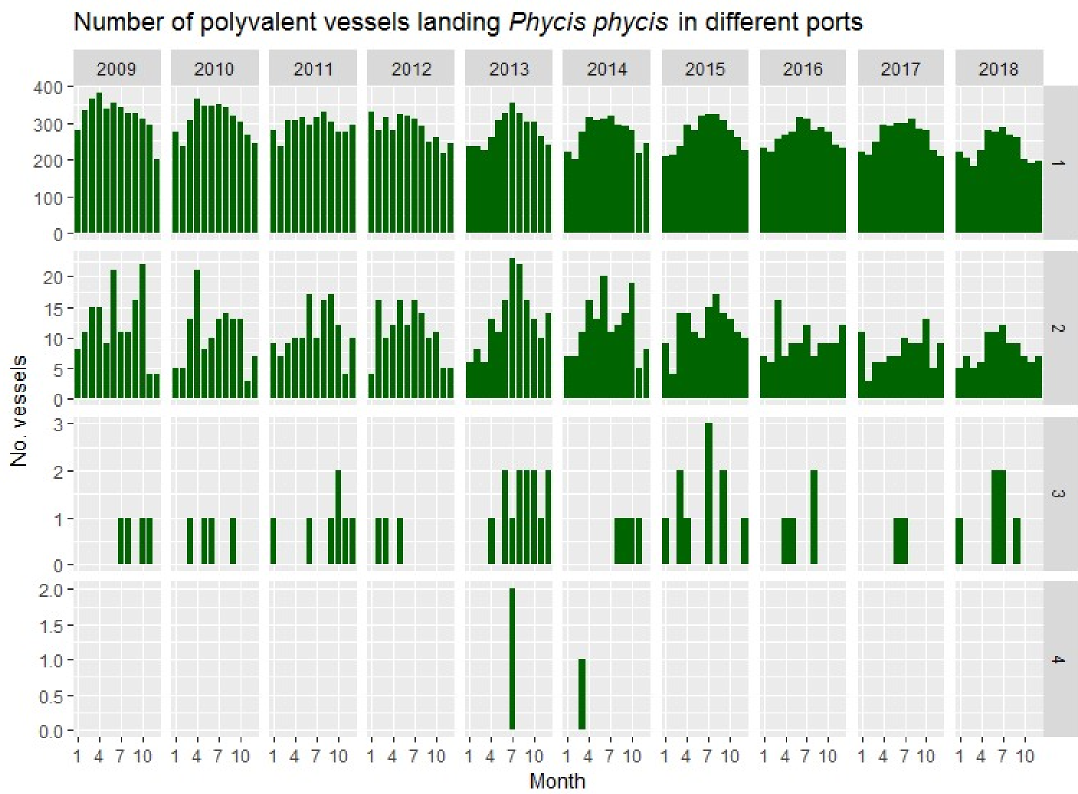

Figure 11. Number of polyvalent vessels landing forkbeard, *Phycis phycis*, by number of ports where they land the species (1 to 3) in mainland Portugal between 2009 and 2018.

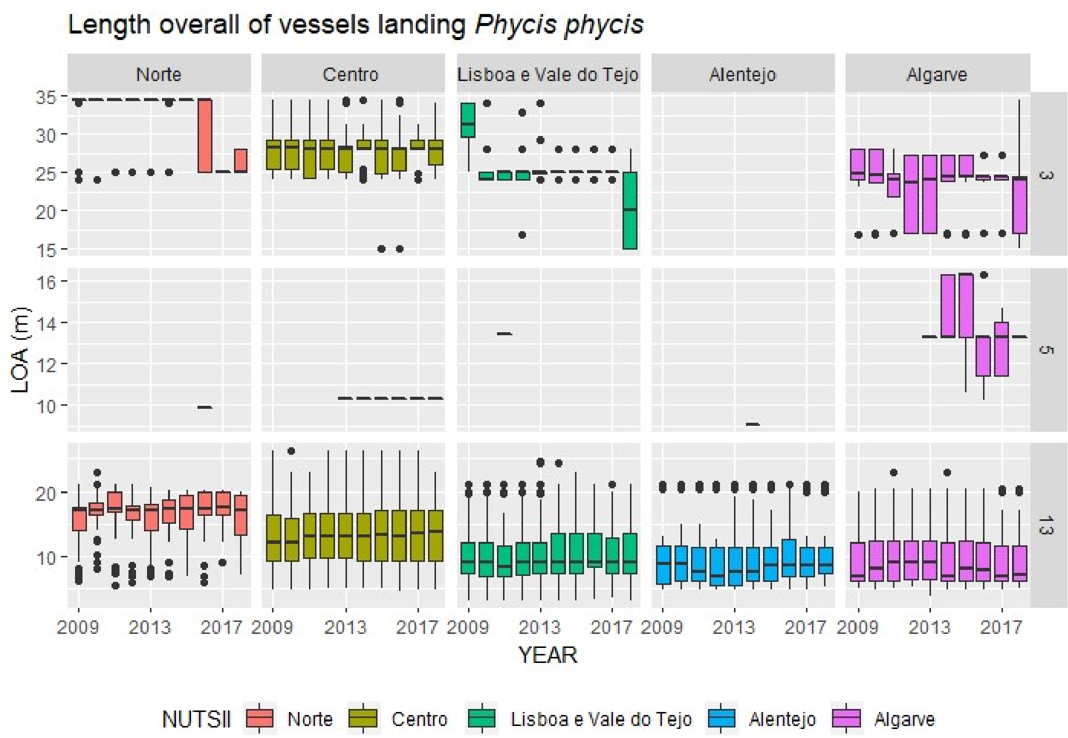

Figure 12. Length overall (LOA, m) of vessels landing forkbeard, Phycis phycis, by métier (3 is trawl; 5 is purse seine; 13 is polyvalent) by NUTS II in mainland Portugal between 2009 and 2018.

3.2. Sampling Length data

Under DCF program, the total length of sampled *P. blennoides* specimens ranged from 17 to 78 cm. Length frequency distribution are present in Figure 13. There are differences on length distribution between fishing gears: for Trawl the length distribution is skewed to small sizes.

The length frequency distributions constructed using the samples from trawlers targeting crustaceans presented several modes. This pattern may reflect depth range of the fishing grounds visited: these trawlers may target the Norway lobster *Nephrops norvegicus* (at 200-800 m deep) or the red shrimp *Aristeus antennatus* (at 100-350 m deep) (ICES, 2017).

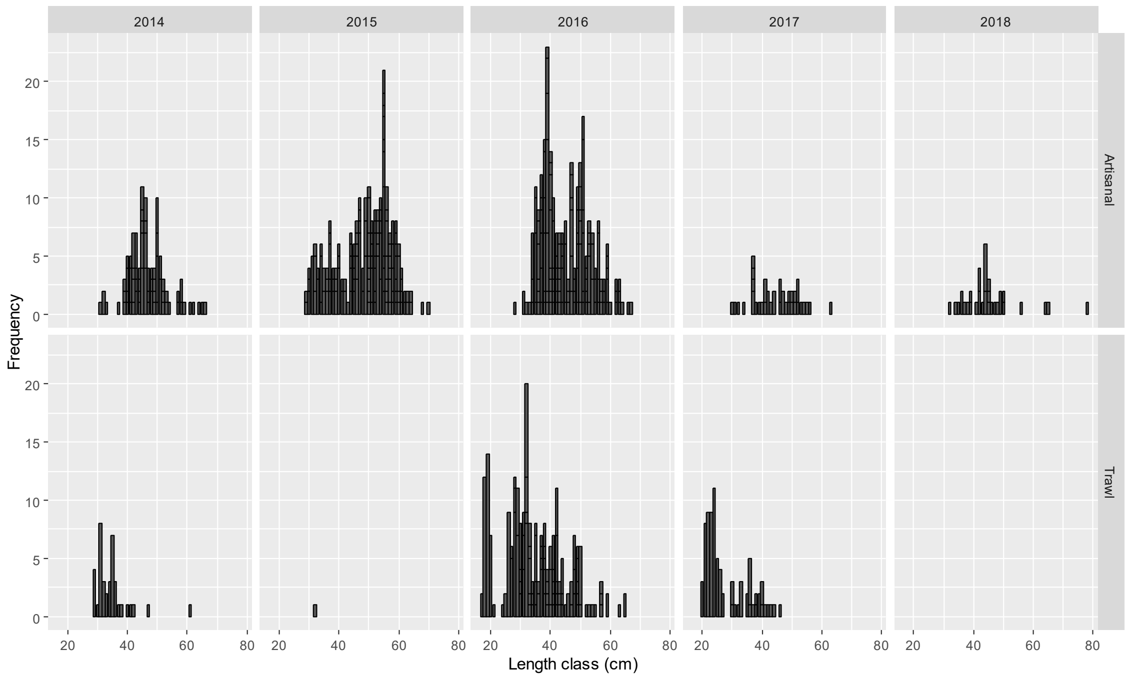

Figure 13. Length frequency distribution of the greater forkbeard in Portuguese landings by fleet and by year.

3.3. Surveys

Given the spatial distribution of *P. blennoides*, the data used to model the species biomass was obtained from the Portuguese crustacean surveys/Nephrops TV Surveys PT-CTS (UWTV (FU 28-29)) from 1997 to 2017.

Data from PT-CTS (UWTV (FU 28-29))) surveys conducted from 1997 to 2015 were used to assess the bathymetric distribution of *P. blennoides*. Table 2 presents the species total catch (in number and in kg) by *depth stratum*. At the earlier years of the survey time series and given the uncertainty in species identification data set used to analyse survey information(including abundance index standardization) was restricted to depths ranging between 500 and 750 m deep. By this it is expected to reduce misidentification errors (it is possible that misidentification problems with *Phycis phycis* have occurred in the past). In addition, given the low number of hauls, two geographical areas (or sectors) were not considered (Lisboa and Arrifana).

The range of *P. blennoides* length caught in the PT-CTS (UWTV (FU 28-29))) surveys varied between 5 and 70 cm. The length frequency distributions are presented by survey in Figure 14. For most of the years, two modes are observed. The modes are consistently registered at about 10 and 25 cm. The length frequency distributions are similar among depth strata and geographical areas (Lagarto et al., 2017).

Given the fact that the species has a defined reproductive season and that the age and size at maturity are at 3-4 year old and 53.9 cm, respectively (Cohen et al., 1990; Kelly, 1997; data provided by Spain at ICES WGDEEP datacall 2018), it is likely that the survey data mainly reflects the juvenile biomass belonging to two consecutive cohorts. At the northwest of the Iberian coast (ICES divisions 27.8.c and 27.9.a) the species spawning occurs from October to December (Casas and Piñeiro, 2000). Since the Portuguese survey takes place in May/June it is likely that the smaller specimens caught have grown about 10 cm during 6-9 months.

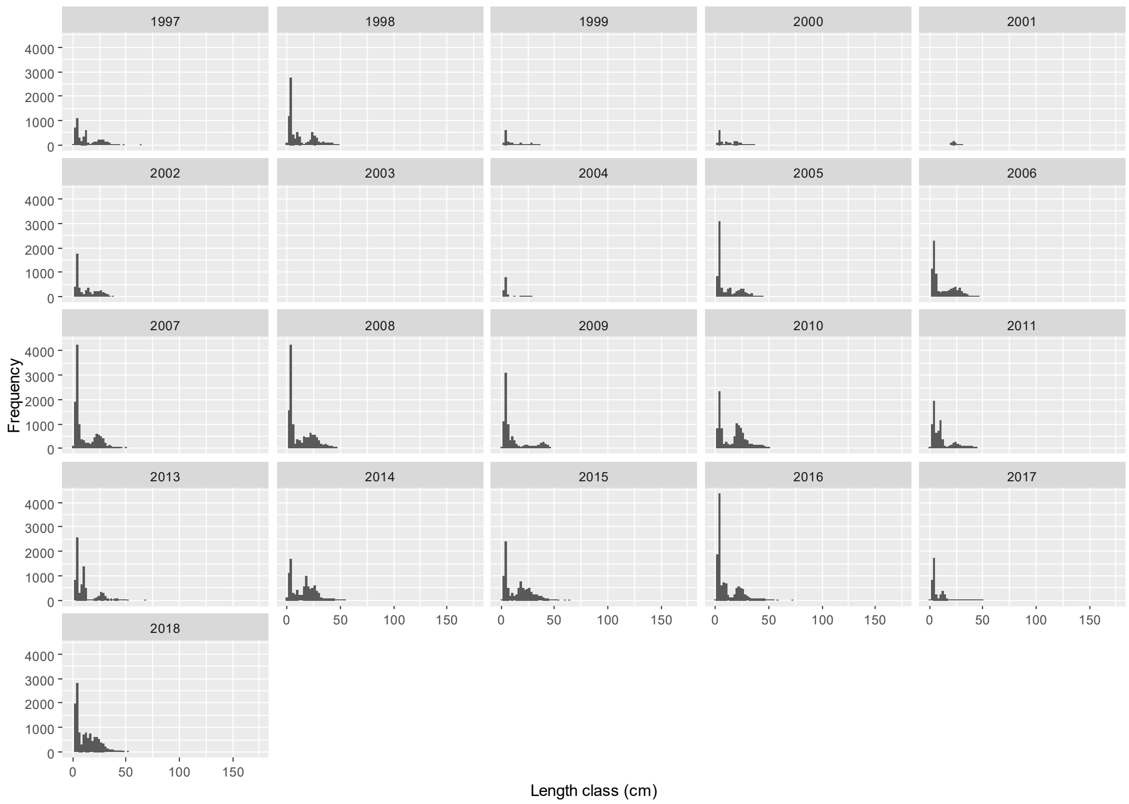

Figure 14. Length frequency distribution of the greater forkbeard in the PT-CTS (UWTV (FU 28-29))) survey by year.

Biomass index

Standardized biomass index (kg.hour-1) estimates for the sector Milfontes are presented in Figure 15 and Table 2. This sector was chosen based on its full sampling coverage and high biomass of the greater forkbeard on catches. The standardized biomass index of the species increases in 2018 being above the overall mean. The abundance index for 2017–2018 (2.05 $Kg.h^{-1}$) was 5% higher than the mean observed in the preceding three years (1.95 $Kg.h^{-1;}$ 2014–2016).

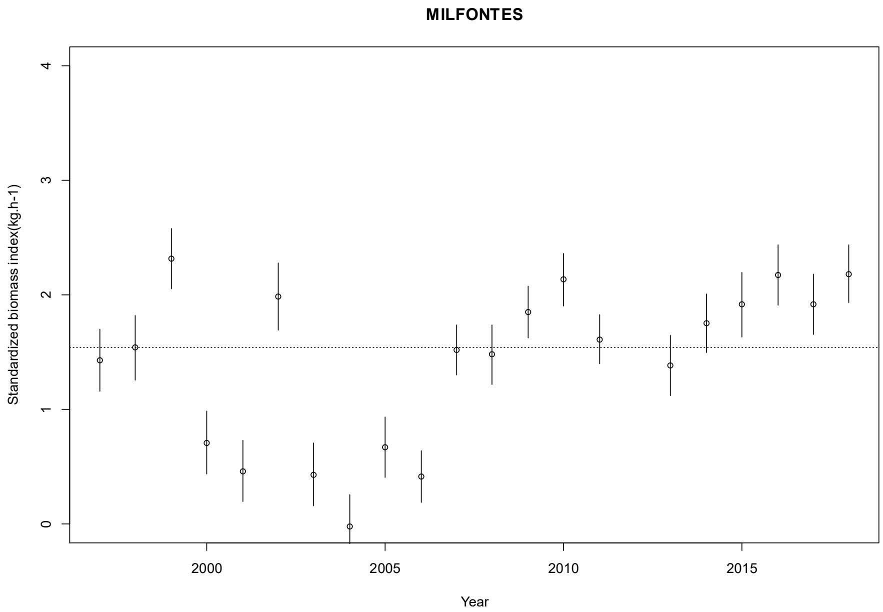

Figure 15. Standardized biomass index (kg.hour^{-1}) for the Portuguese Crustacean Surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))) undertaken between 1997 and 2018. CPUE values estimated for the sector "Milfontes".

Table 2. Standardized biomass index (kg.hour^{-1}) for the Portuguese Crustacean Surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))) undertaken between 1997 and 2018 (no survey was conducted in 2012). Number of hauls included in the analysis by year and CPUE values estimated for the sector "Milfontes".

Year	n hauls [200, 750[m	Milfontes (kg.hour^{-1})	s.e.
1997	36	1.43	0.27
1998	51	1.54	0.28
1999	23	2.31	0.26
2000	45	0.71	0.27
2001	48	0.46	0.27
2002	48	1.98	0.29
2003	54	0.43	0.27
2004	51	0.00	0.28
2005	59	0.67	0.26
2006	59	0.41	0.23
2007	61	1.52	0.22
2008	62	1.48	0.26
2009	58	1.85	0.22
2010	47	2.13	0.23
2011	43	1.61	0.21
2012	---	---	---
2013	65	1.38	0.26
2014	66	1.75	0.26
2015	53	1.91	0.28
2016	64	2.17	0.26
2017	57	1.92	0.26
2018	47	2.18	0.25

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ANNEX I

The Portuguese crustacean surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29))) survey is conducted by the Portuguese Institute for the Sea and Atmosphere (IPMA) and takes place since 1997 and the main objective is to monitor the abundance and distribution of the main crustacean species, namely the Norway lobster *Nephrops norvegicus*, the rose shrimp *Parapenaeus longirostris*, and the red shrimp *Aristeus antennatus*. This survey is conducted during the 2nd quarter (May-July) of the year and covers the southwestern coast (Alentejo, FU 28) and southern coast (Algarve, FU 29) from 200 to 750 m deep. The surveys have been carried out with the Portuguese RV "Noruega".

The Portuguese Autumn Groundfish Survey's (PT-GFS) main objective is to monitor the abundance and distribution of hake *Merluccius merluccius* and horse mackerel *Trachurus trachurus* recruitment (Cardador et al., 1997). This survey is performed along the Portuguese continental coast, extending from latitude 41°20'N to 36°30'N (ICES Division 9a) between 20 to 500 m deep (750 m until 2003). The surveys have been carried out with the Portuguese RV "Noruega", using a Norwegian Campell Trawl net (1800/96 NCT) with a 20 mm codend mesh size and groundrope with bobbins.

Annex 5: Audits

Audit of bli.27.5a14

Date: 09/05/2019

Auditor: Bruno Almón Pazos

General

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: survey trend-based
3. Forecast: not presented
4. Assessment model: Survey trend with indices based on F_{proxy}
5. Data issues: no issues
6. Consistency: Consistent with previous years
7. Stock status: F<Fmsy Stock size Unknown
8. Management Plan: None
9. General comments

The report was well documented with updated data, revised and completed in 2019. The advice was drafted consistently with the correspondent chapter in the report. Some concerns about the stock status were the biomass index is high but recruitment has been low or missing for several years are well reflected in the report and the draft advice.

Technical comments

None

Conclusions

The assessment has been performed correctly

Audit of (bli.nea)

Date: 09/05/2019

Auditor: Bruno Almón Pazos

General

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1. Assessment type: update
2. Assessment: trends
3. Forecast: not presented
4. Assessment model: Catch trends-based assessment
5. Data issues: no issues
6. Consistency: Consistent with previous
7. Stock status: Biomass below any possible candidate reference point
8. Management Plan: None
9. General comments

The report was well documented with updated data, revised and completed in 2019. The advice was drafted consistently with the correspondent chapter in the report.

Technical comments

Stock Annex needs to be updated.

Conclusions

The assessment has been performed correctly

Audit of Ling (Molva molva) in subareas 1 and 2 (Northeast Arctic)

Date: 13/05/2019

Auditor: Inês Farias

General

The major ling fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries.

For single stock summary sheet advice:

1. Assessment type: Update
2. Assessment: Cpue trends-based assessment
3. Forecast: Not presented
4. Assessment model: A standardized cpue series from the Norwegian longline reference fleet was used as index for the stock development.
5. Data issues: Data available are as described in stock annex. Discarding is considered to be negligible.
6. Consistency: As the stock indicator has increased over several years and fishing pressure is below FMSY proxy, the precautionary buffer was not applied this year, although it had been applied for the revised 2012 advice.
7. Stock status: ICES assesses that fishing pressure on the stock is below FMSY; no reference points for stock size have been defined for this stock.
8. Management Plan: ICES is not aware of any agreed management plan for this stock in this area.

General comments

This was a well documented, well ordered and considered section.

Having all the previous track-changes visible made it somewhat difficult for me (unexperienced auditor) to follow the document. I did not accept those changes because I didn't know if I was supposed to.

Technical comments

All changes I made to the document were formatting issues, following the ICES Style Guide.

I left one comment on Table 1 (check the reference: if it is 2017, it is missing from the Sources and references section) and three comments on Table 9 (three landings values that are different from the totals in Table 8).

Conclusions

The assessment has been performed correctly

Audit of Ling (*Molva molva*) in subareas 6–9, 12, and 14, and in divisions 3.a and 4.a (Northeast Atlantic and Arctic Ocean)

Date: 14/05/2019

Auditor: Inês Farias

General

For single stock summary sheet advice:

1. Assessment type: Update
2. Assessment: Cpue trends-based assessment
3. Forecast: Not presented
4. Assessment model: Standardized cpue series from the Norwegian longline reference fleet
5. Data issues: Data are as described in stock annex. Discards are estimated at 5.9% of the catch over the last three years.
6. Consistency: The stock size relative to candidate reference points is unknown, but the stock has been increasing since 2004. Therefore, the precautionary buffer was not applied. The average discard rate in the three last years was 5.15.92 %, and this has been used to provide landings advice
7. Stock status: ICES assesses that fishing pressure on the stock is below FMSY; no reference points for stock size have been defined for this stock.
8. Management Plan: ICES is not aware of any agreed management plan for this stock in this area.

General comments

This was a well documented, well ordered and considered section.

Technical comments

All changes I made to the document were formatting issues, following the ICES Style Guide. I have doubts regarding the application of the ICES rounding rules to B_index, High, and Low in Table 10. I did not change this values.

I left one comment on Table 10 (the values in Catch are the Landings).

Conclusions

The assessment has been performed correctly

Audit of usk.27.1-2

Date: 09/05/2019

Auditor: Bruno Almón Pazos

General

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1. Assessment type: update
2. Assessment: trends
3. Forecast: not presented
4. Assessment model: none
5. Data issues: no issues
6. Consistency: Consistent with previous
7. Stock status: F< F_{MSY} and B > MSY $B_{trigger}$
8. Management Plan: None

General comments

The report was well documented with updated data, revised and completed in 2019. The advice was drafted consistently with the correspondent chapter in the report.

Technical comments

Stock Annex needs to be updated.

Conclusions

The assessment has been performed correctly

Audit of usk.27.5a14

Date: 09.05.2019

Auditor: Julius Nielsen

General

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: Analytical length-based assessment (Gadget model) that uses catches in the model and in the forecast
3. Forecast: presented
4. Assessment model: Gadget model
5. Data issues: Suitable data have been updated
6. Consistency: Consistent with previous years
7. Stock status: HR<HRMGT and SSB>SSBMGT
8. Management Plan: Short-term projection as specified in the stock annex.

General comments

None

Technical comments

None

Conclusions

The assessment has been performed correctly

Audit of Greater silver smelt (Argentina silus) in subareas 7–10 and 12, and in Division 6.b (other areas)

Date: 13/05/2019

Auditor: Ivone Figueiredo

General

The stock is planned to be benchmarked in 2020

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: Survey trends-based assessment

3. Forecast: not presented
4. Assessment model: -
5. Data issues: No issues Main data input acoustic index from Spanish Porcupine Bank survey.
6. Consistency: The biomass index used from the Spanish Porcupine Bank survey includes two species, greater and lesser silver smelt; however, the proportion of lesser silver smelt is < 20%.

In 2019, discard data from Spain and Netherlands for 2003 onwards is presented. It is not possible to determine a discard rate that would be applicable to catches in the next two years.

1. Stock status: ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.
2. Management Plan: ICES is not aware of any agreed management plan for this stock in this area

<u>General comments</u>

Well documented.

Minor suggestion and comments were sent to the stock coordinator.

<u>Technical comments</u>

No major comments apart from those sent to the stock coordinator

<u>Conclusions</u>

The assessment has been performed following ICES guidance on data-limited stocks

Audit of Greater silver smelt (Argentina silus) in divisions 5.b and 6.a (Faroes grounds and west of Scotland)

Date: 13/05/2019

Auditor: Ivone Figueiredo

<u>General</u>

The stock is planned to be benchmarked in 2020

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: Survey trends-based assessment
3. Forecast: not presented
4. Assessment model: -
5. Data issues: No major issues. Major input data Summer index from the Faroese groundfish survey in Division 5.b.
6. Consistency: This is a new advice unit for greater silver smelt in 2015. This stock has not been benchmarked although an assessment for greater silver smelt was benchmarked in 2010 (ICES, 2010
7. Stock status: ICES assesses that fishing pressure on the stock is below FMSY; no reference points for stock size have been defined for this stock..
8. Management Plan: ICES is not aware of any agreed precautionary management plan for the stock in this area

<u>General comments</u>

Well documented, well ordered and considered section

Minor suggestion and comments were sent to the stock coordinator.

Technical comments

No major comments apart from those sent to the stock coordinator

Conclusions

The assessment has been performed correctly

Audit of (ling 27.5b)

Date: 12 may 2019

Auditor: Erik Berg

General

An exploratory assessment of ling in Division 5.b was done by using the age-based model SAM. The SAM model fitted the cpue-data well, but the log q residuals showed some seasonal problems in following the cohorts.

The assessment is based on survey trends and trends in commercial cpue. The advice is based on the 2 over 3 rule.

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: survey trends and commercial cpue
3. Forecast: not presented
4. Assessment model:survey trends
5. Data issues: The two Faraoes surveys have opposite trends. The Norwegian commercial cpue has a downward trend, although this is based on few vessels/fishing days.
6. Consistency: YES
7. Stock status: No biomass reference point, F>Fmsy in 2018 based on LBI
8. Management Plan: None

General comments

The report is OK and the basis of advice is explained.

Technical comments

Conclusions

The assessment has been performed correctly

Audit of (Sbr27.10)

Date: 12.05.2019

Auditor: Erik Berg

General

The assessment is based on survey trend. The advice is based on the 2 over 3 rule.

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1. Assessment type: update
2. Assessment: survey trends
3. Forecast: not presented
4. Assessment model: survey trends
5. Data issues: The survey abundance index is missing for several years. The three last point on the index are among the highest observed.
6. Consistency: The survey index was assumed to be very uncertain. Now there are 3 consistent points close to each other. The survey index is assumed to reflect te status of the stock.
7. Stock status: No reference points are established for the stock
8. Management Plan: None

General comments

Allthough the index are missing som years, the survey is assumed to reflect the stock trend. Catches have decreased and survey index increased in the latest years.

Technical comments

Conclusions

The assessment has been performed correctly, however one should follow the stock index closely the coming years, since the 2 over 3 years advice is based on years rather long time back in history.

Audit of aru.27.5a14

Date: 09.05.19

Auditor: Julius Nielsen

General

Including data from the Greenland survey presented in the 2019 meeting needs to be considered for this stock.

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1. Assessment type: update
2. Assessment: trends
3. Forecast: not presented
4. Assessment model: none
5. Data issues: suitable data have been updated
6. Consistency: Consistent with previous year
7. Stock status: F<FMSY PROXY

8. Management Plan: None
9. General comments

This was a well documented with new updated data from both Iceland and Greenland. The data from Greenland was composed by a data series of survey and catch data from 1998 and 1999, respectively. The survey data from Greenland was not used for biomass index because adding a survey would require a benchmark.

Technical comments

No comment

Conclusions

The assessment has been performed correctly

Audit of aru.27.123a4

Date: 13 May 2019

Auditor: Martin Pastoors

General

Assessment is based on the survey trends from the acoustic survey that is carried out every second year. The intermediate years are interpolated. The advice is based on the 2 over 3 rule.

For single stock summary sheet advice:

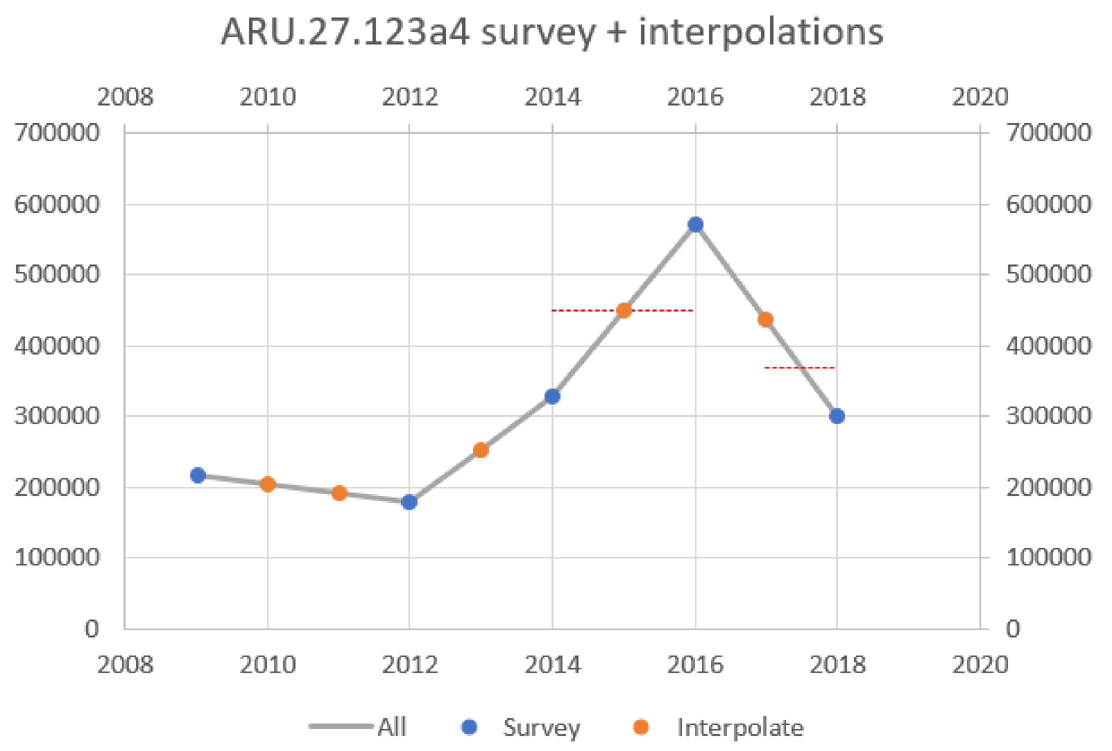
1. Assessment type: Update assessment
2. Assessment: Survey trends (with missing years interpolated)
3. Forecast: Not presented
4. Assessment model: Survey trends
5. Data issues: No issues with the data
6. Consistency: OK
7. Stock status: Cannot be assessed relative to reference points
8. Management Plan: No

General comments

The assessment was well documented and explained.

Technical comments

Because the advice is based on the 2 over 3 rule from a biennial survey, it would be good to include the interpolations into the WG report, as in the example below.



The calculation of reference points using length based indicators is not well described in the report. There is no overview of the input data or the diagnostics and output data.

Conclusions

The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Yes

Is the assessment according to the stock annex description?

Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

Not applicable

Have the data been used as specified in the stock annex?

Yes

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

Yes

Is there any **major** reason to deviate from the standard procedure for this stock?

No

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Yes

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Done

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

Done

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

OK

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☐ The advised value of catches should be the same as presented in the catch options table. Not relevant

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded. Not relevant

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP. Not relevant

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☐ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☐ Check if the labels for the years are correct.

☒ Compare the status table with the F and SSB plots they should show the same information. Stock status relative to reference points is shown with tickmarks which were not given in the previous advice.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

Not applicable

For each of the rows in the table ensure that:

☐ The year is correct,

☐ The value is correct,

☐ The notes are correct and

☐ The sources are correct.

Catch options table:

Not applicable

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

Not applicable

☐ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under "Other options".

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

Not applicable

☐ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

The text notes that by-catch of greater silver smelt in the industrial fisheries in area 4 and division 3a has been increasing rapidly since 2012. This is not clear from the tables.

Reference points

☐ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

The input and output data to the reference point calculation has not been provided in the WG report.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

Sometimes the shrimp survey is described as Norwegian survey in 3a and sometimes as Norwegian survey in 4.a and 3.a.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☒ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

Is there a problem with the TAC in subareas 1 and 2 in 2018 and 2019. The values are only 10% of values the previous years.

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☒ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☒ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Audit of rng.27.5a10b12ac14b

Date: 09/05/2019

Auditor: Pascal Lorance

General

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: no assessment
3. Forecast: not presented
4. Assessment model: none
5. Data issues: Landings data properly updated, no other data for the stock
6. Consistency: Consistent with previous
7. Stock status: unknown
8. Management Plan: none
9. General comments

The report was well documented with data updated, revised and completed in 2019. The advice was drafted consistently with the Stock Annex.

Technical comments

No comment

Conclusions

The assessment has been performed correctly

Audit of rng.27.1245a8914ab

Date: 09/05/2019

Auditor: Pascal Lorance

General

For single stock summary sheet advice:

1. Assessment type: none
2. Assessment: not presented
3. Forecast: not presented
4. Assessment model: none (category 6 stock)

5. Data issues: Data used for advice are landings only. Data from Greenland surveys, which were not known to WGDEEP before were presented. These data are presented in the report and not used for assessment, in particular because they are for Division 14 only. Landings data may comprise a combination of species are described in the report.
6. Consistency: ICES stock category 6 method applied like in the previous advice (2017).
7. Stock status: unknown
8. Management Plan: None

General comments

The report for this stock was improved in 2019 thanks to new data brought by new members of the expert group. The stock annex was updated about available and historic data. However there is probably not enough data to assess the stock in another category than ICES category 6.

Technical comments

Conclusions

The assessment has been performed correctly

Audit of usk.27.3a45b6a7-912b

Date: 09.05.19

Auditor: Julius Nielsen

General

For single stock summary sheet advice:

1. Assessment type: Update
2. Assessment: CPUE trend based with SPiCT and LBI used for stock status with respect to reference points.
3. Forecast: not presented
4. Assessment model: none
5. Data issues: suitable data have been updated.
6. Consistency: Consistens with previous years
7. Stock status: F<FMSY and SSB unknown
8. Management Plan: None
9. General comments

Technical comments

No comments

Conclusions

The assessment has been performed correctly

Audit of lin.27.5a

Date: 11/05/2019

Auditor: Juan Gil Herrera

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

1. Assessment type: update
2. Assessment: analytical (ICES category 1)
3. Forecast: not presented
4. Assessment model: gadget model
5. Data issues: Only the Icelandic spring survey is used. Covers the full depth range and geographical distribution of the stock
6. Consistency: Annual advice under a management plan (from 1st September till the next year end of August). Last year (2018) was accepted and the model was benchmarked in 2014.
7. Stock status: fishing pressure on the stock is at HRMSY and spawning-stock size is above MSY Btrigger
8. Management Plan: The Icelandic Ministry of Industries and Innovation's fisheries management plan for Icelandic ling has been evaluated by ICES in 2017.

General comments

It so well documented, the Stock Annex is a really good example. So, it was quite easy to follow using the assessment description of the in the Stock annex (as well as the Report). Finally, comparison with previous Advice Sheet was really quick.

Technical comments

Last update of the Sock annex was in May 2017. Since the assessment is annual and the same method has been used in 2018 and 2019, only minor details (HR_{MSY} in Table 1 instead of F_{MSY}) needs to be corrected. Check Figure 2 and clarify if is related to Reference biomass (or SSB?) and includes some text in the legend (prior to 2017 like with Harvest Rates?). Third column from Table 10 only related to "SSB", so "ref. biomass 75+ cm" (tonnes) should be deleted (its values appears in the last column).

Conclusions

The assessment has been performed correct and consistently with previous year (2018).

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Yes

Is the assessment according to the stock annex description?

Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

There is a benchmarked (Icelandic) management plan for this stock in 2017

Have the data been used as specified in the stock annex?

Yes

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

A short term forecast was run according to the Stock Annex (and Management Plan benchmark)

Is there any **major** reason to deviate from the standard procedure for this stock?

None

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

The update assessment has been considered valid for advice for the EG.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table. ☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☒ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☒ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol). F_{MSY} should be replaced by HR_{MSY}. AIso HR_{MSY} symbol in 2016 doesn´t coincide with the 2018 Advice Sheet but the value changes when the assessment is update.

☒ Check if the labels for the years are correct.

☒ Compare the status table with the F and SSB plots they should show the same information.

☒ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct,

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☒ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☒ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under "Other options".

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☒ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.) Yes, it was benchmarked by ICES in 2017

Quality of the assessment

☒ Are the units in plots correct? Yes

☒ Are the titles in the plots correct including F (age range) recruitment (age).

☒ The red line correspond to the year of assessment (except F which is year of assessment -1)

☒ Each plot should have five lines. Harvest rates were not calculated prior to the 2017 assessment but also Reference biomass (or SSB?) has only 3 lines: clarify which biomass (Reference or SSB) are related to the Figure and also included in the legend that were not calculated prior to 2017 (like the Harvest Rates)

☒ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information" But according to the single stock guidelines the default should be "There is no additional available information" as appears in the Advice Sheet. I don´t really know if this "additional" matters or not!!

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☐ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added).

Summary of the assessment

☒ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F. Third column from Table 10 only related to "SSB" so "ref. biomass 75+ cm" (tonnes) should be deleted (its values appears in the last column).

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Audit of: usk.27.12ac

Date: 10/05/2019

Auditor: Juan Gil Herrera

<u>General</u>

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

1. Assessment type: Update
2. Assessment: No assessment (ICES DLS Category 6)
3. Forecast: None
4. Assessment model: None
5. Data issues:
6. Consistency:
7. Stock status: Unknown
8. Management Plan: ICES is not aware of any agreed precautionary management plan in this area.

<u>General comments</u>

Not so well documented, because the scarce of data. There are insufficient data to assess this stock (ICES DLS Category 6) and the same advice was given but now for the 5 next years (2020-2024) but I don´t really understand the last sentence at the Catch scenarios subchapter: "The advice is given for five years, unless a significant increase in catches is observed" because there´s not reported landings since 2012. Might be my English and also that I can´t attend the last 2 days of the WGDEEP when this Advice Sheet was presented to the EG,

<u>Technical comments</u>

Last update of the Sock annex was in March 2011. Only some landing statistics are available, with sporadic very low catches showing no trend. No reported catches for this stock since 2012. No discard data were available.

<u>.Conclusions</u>

The assessment has been performed correct and consistently with previous year (2017). Minor details might be corrected.

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Yes

Is the assessment according to the stock annex description?

Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

No management plan

Have the data been used as specified in the stock annex?

Absolutely

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

There´s no assessment

Is there any **major** reason to deviate from the standard procedure for this stock?

Nope

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

The update assessment has been considered valid for advice for the EG.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year’s advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☐ Compare the status table with the F and SSB plots they should show the same information.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☐ The notes are correct,

☒ The sources are correct.

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t); ☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☐ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under "Other options".

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☐ Are the units in plots correct? Yes

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☐ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☐ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☐ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information" but in the Advice sheet appears a similar one: "No additional information available"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☐ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added).

Summary of the assessment

☐ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☐ Check if the column names are correct mainly recruitment age and age range for F.

☒ If the stock is category 5 or 6 then it should read "There is no assessment for this stock" (in this area were additionally written in the Advice Sheet)

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Annex 6: EU-DGMARE request to analyse TAC for Greater Silver Smelt in subarea 7

ICES was requested by EU-DGMARE to analyse for Greater Silver Smelt in subarea 7 (TAC currently covering subareas 5, 6 and 7) and Boarfish in subarea 8b and 8c (TAC currently covering subareas 6, 7 and 8) the role of the Total Allowable Catch instrument. It is asked to assess the risks of limiting the TAC for Greater Silver Smelt to areas 5 and 6 and for Boarfish to areas 6 and 7 in light of the requirement to ensure that the stocks concerned are exploited sustainably in the short and medium term.

ICES was further requested to assess the potential contribution of the application of other conservation tools in absence of TACs for Greater Silver Smelt in subarea 7 and for Boarfish in subarea 8b and 8c to the requirement that the stocks concerned are managed in a sustainable manner.

WGDEEP 2019 addressed the request for Greater Silver Smelt. Similar requests were submitted to WGDEEP in 2018 for a number of species. This approach was first developed in 2017 to address an EU special request on risk to the stock of dab and flounder of having no catch limits.

Methods

The existing data on official landings, ICES catch estimates, survey indicators, price at first sale, and biological characteristics were used to evaluate the risk of removing the TAC of greater silver smelt in Subarea 7. Since there is no analytical assessment and the absolute fishing mortality (F) is not known and the request was only answered in a qualitative manner on the basis of the existing data from the assessment and available sources.

Following previous similar requests for other stocks, the six questions pertaining to the fishery were examined:

1. *Was the TAC restrictive in the past?*
2. *Is there a targeted fishery for the stock or are the species mainly discarded?*
3. *Is the stock of large economic importance or are the species of high value?*
4. *How are the most important fisheries for the stock managed?*
5. *What are the fishing effort and stock trends over time?*
6. *What maximum effort of the main fleets can be expected under management based on F_{MSY} (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

In addition, the overall risk for the stocks have been considered in terms of its biology (aggregating, sex change, long lived, low productivity, forage fish, ecosystem importance) and catchability, e.g. the degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted). In order to synthesize the conclusions on the questions in the request, the following considerations were added to provide a consistent process and summary approach:

1. *Does the species/stock/group (hereafter just called stock) have characteristics that places it at high relative risk?*
    a) In terms of its general biology, e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem importance;
    b) In terms of its catchability, e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted.

2. *Is the present TAC/management influenced by past unsustainable practices?*
   a) If yes, are those fisheries still active?
   b) Was the stock targeted?
3. *Can these or new unsustainable practices return if the TAC is removed?*
   a) Can they be targeted with the present fleet?
   b) Are they heavily discarded?
   c) Is the stock valuable?
4. *Are there alternatives to a TAC to manage this stock?*
   a) Can they be managed as companion species through target TACs (if applicable)?
   b) Can they be spatially managed?
   c) Any other mechanism?

The available information was summarized in terms of the vulnerability of the stock, knowledge gaps (including the limited data available), the potential reaction of the fishery to the removal of TAC (Is a target fishery likely to develop?), and potential alternative management measures.

Greater silver smelt in subarea 7

Background

The TAC of greater silver smelt which cover Subarea 7 applies to Union and international waters of 5, 6 and 7 (ARU/567.). Greater silver smelt in Subarea 7 is evaluated by ICES in an assessment unit with covers ICES Division 6b and subareas 7, 8, 9, 10 and 12 (aru.27.6b7-1012). Advisory units considered by ICES were revised in 2015 based on the distribution of the species in surveys and the main fishing grounds being sufficiently isolated. Of four stocks of greater silver smelt within ICES, identified this way, the fisheries presently are mainly on the other three stocks. The intention for the aru.27.6b7–1012 stock has been to monitor if fisheries develop in the stock area. Landings from the assessment unit aru.27.6b7–1012 have been no more than a few tens of tons per year in the last decade (Table 1). In the 1980s and 1990s landings of a few hundreds of tonnes per year were reported, most of which was caught in Subarea 7. These declined to almost nothing in the late 1990s but peaked thereafter to more than 4000 tonnes in 2001 and 2002 coming again mostly form Subarea 7. ICES considers that these high landings in the early 2000 may have been misreported fish species other than silver smelt. Landings in the 1980s and 1990s may also have included misreporting, although greater silver smelt is known to have been included in some prepared dished by the fish processing industry. Greater silver smelt can be a very significant discard of the trawl fisheries of the continental slope of Subareas 6 and 7 particularly at depths 300–700 m (table 1). Information have been available on discards in 2009 and 2012 in Basque country and Spanish fisheries in Subareas 6–7, and Divisions 5.3.abcd and northern 9.a. These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain (ICES WGDEEP report 2017). Same applies for discards registered by the Netherlands. Based upon on-board observations from DCF sampling, the catch composition of the French mixed trawl fisheries in 5.b, 6 and 7 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. It should be noted that after redefinition of stock structure in 2015 area 6.a is not included in this stock.

1. *Was the TAC restrictive in the past?*

As the TAC covers subareas 5, 6 and 7 it is not possible to evaluate whether it was restrictive for subarea 7. There are target fisheries for greater silver smelt in Union waters of divisions 5b and 6a, where the species is more abundant than in Subarea 7. As they fish their quotas in those areas, it is likely that target fisheries have no reason to fish the species in areas where it is lesser abundant.

Before the landings obligation, demersal fisheries for hake, megrim and monkfish and deep-water fisheries have had a small bycatch of greater silver smelt, which was discarded. This bycatch averaged to about 300 tonnes in 2016–18.

2. *Is there a targeted fishery for the stock or are the species mainly discarded?*

In recent year there was no target fisheries for greater silver smelt in Subarea 7.

3. *Is the stock of large economic importance or are the species of high value?*

Greater silver smelt is a species of secondary economic importance and of low/moderate value. However, the economic importance and value of greater silver smelt increased, in the last decade, as processed food products were developed.

4. *How are the most important fisheries for the stock managed?*

Current fisheries on the stock are bycatch, which were discarded until the landings obligation. TACs and quotas are the primary management tool in Subarea 7.

5. *What are the fishing effort and stock trends over time?*

There is no dedicated effort to the stock.

The aru.27.6b7-1012 stock advice is based on development in a Spanish survey in Porcupine bank. The survey biomass index showed a steep upward trend in 2014-2016, but has been declining since then (Figure 1 and 2).

6. What maximum effort of the main fleets can be expected under management based on *FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

Because past peak landings may have been misreporting of other species, the level of landings from Subarea 7 that the stock sustained in some years is considered to have been about 500 tonnes. Such landings have not been caught in the last 10–12 years. It is unclear to which extend the substantial bycatch registered in area 6, 7 and 8 in 2003–2011 were taken in area 7. Under the current management, total catch, landings and discards, but mostly discarded bycatch, are much lesser. If changes in distribution occur and dens concentrations develop in area 7 they may attract direct fisheries.

Vulnerability

Greater silver smelt is relatively long-lived with a longevity >20 years. The species is also aggregating, it forms mesopelagic shoals that can be detected by acoustics and targeted with pelagic trawls. In Norwegian waters of ICES subareas 1 and 2, an acoustics survey is used to assess the abundance. Targeted fisheries in subareas 1, 2, 5 and 6 operated with pelagic trawl.

The ecosystem importance of the species is not quantified, it is however a forage fish found in the diet of upper slope predators such as hake, monkfish and demersal deep-water fish.

Knowledge gap

The absolute level of the biomass in subarea 7 is not known. The Porcupine Bank survey is indicative for relative abundance level compared to past abundance, but the effect of fishery on the abundance is unknown.

Potential reaction of fishery to the removal of TAC (*Is a target fishery likely to develop?*)

If dense shoals occur in Subarea 7, pelagic fisheries could easily detect and exploit these at unsustainable level. If such shoals do not exist no reaction of fisheries is expected. As active fisheries on shoals of greater silver smelt operate in Division 6a, it is possible that aggregations of interest for fisheries also occur at least seasonally in Subarea 7, particularly in the northern part of the area.

Suitable management measures if the TAC was removed.

The current ICES advice recommends to limit catch to a low level. Possible seasonal aggregations of greater silver smelt in the North of the Subarea should be considered as extension of the more abundant stock form divisions 5b and 6a. In the absence of a TAC of greater silver smelt in Subarea 7, the potential risk is the development of target fishing on possible aggregations. To prevent this the fisheries should be monitored carefully so that TAC, or similar management action, can be reintroduced on short notice in case of very rapid increase in catches as has been observed in other greater silver smelt fisheries. A mechanism based on a maximum proportion of bycatch of greater silver smelt per fishing operation and in the total catch in other fisheries could be considered. Bycatch of GSS in other fisheries should be kept at absolute minimum.

Table 1 Greater silver smelt in subareas 7–10 and 12, and in Division 6.b. History of the official total landings, landings by area and discard. All weights are in tonnes.

Year	6b	7	8	9	12	Discards*	Total landings
1966							0
1967							0
1968							0
1969							0
1970							0
1971							0
1972		0					0
1973		103					103
1974		0					0
1975		0					0
1976		0					0
1977		1					1
1978		409					409
1979		103					103
1980	13	0					13
1981	525	0					525
1982	0	666					666
1983	4	595					599
1984	0	163					163
1985	0	0					0
1986	0	258					258
1987	0	50					50
1988	0	100			0		100
1989	0	200			0		200
1990	300	24			0		324
1991	5	9			0		14
1992	221	254			0		475
1993	3	505			6		514

Year	6b	7	8	9	12	Discards*	Total landings
1994	20	39			0		59
1995	1114	510			0		1624
1996	0	10			1		11
1997	0	12			0		12
1998	0	0			0		0
1999	178	50			0		228
2000	1384	523			2		1909
2001	130	4415			0		4545
2002	30	4437	195		0		4662
2003	126	119	43		0	4053	288
2004	23	47	23		629	3374	722
2005	4	58	202		362	2437	626
2006	0	40	0	0	0	1398	40
2007	0	35	0	1	0	2082	36
2008	9	0	10	1	0	3118	20
2009	0	20	0	2	0	4182	22
2010	0	23	0	2	0	2029	25
2011	0	12	1	1	0	2056	14
2012	0	3	0	2	31	202	36
2013	0	1	0	0	0	132	1
2014	20	1	1	0	0	1365	22
2015	0	5	0	0	0	29	5
2016	0	0	0	0	0	240	0
2017	0	8	0	0	0	151	8
2018	0	32	4	0	0	367	36

*** Discards by Spain and Netherlands from before the redefinition of the stock area (Subarea 6,7 and 8) from 2003–2014. Discard data from 2015–2018 from Subarea 6b, 7-10 and 12.**

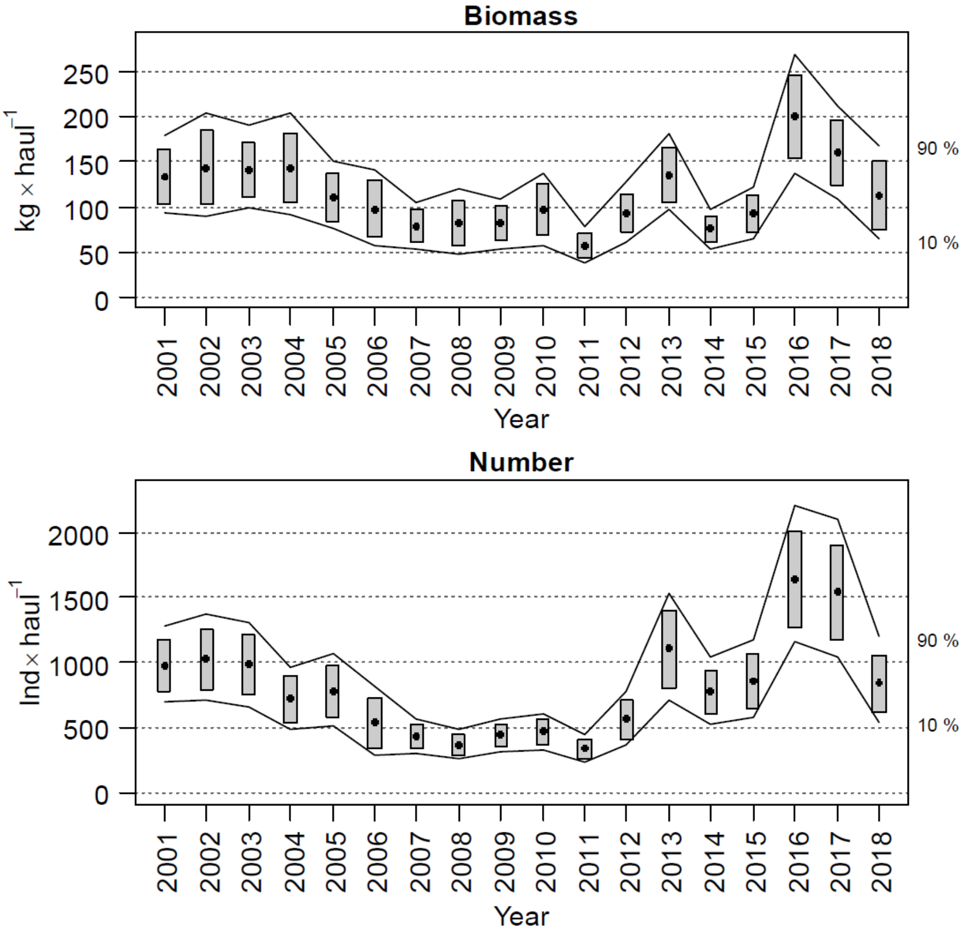


Figure 1. Evolution of Argentina spp. (mainly *Argentina silus*) biomass and abundance indices in Porcupine surveys (2001–2018). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000) (Ruiz-Pico *et al* 2019, ICES WGDEEP 2019 WD12).

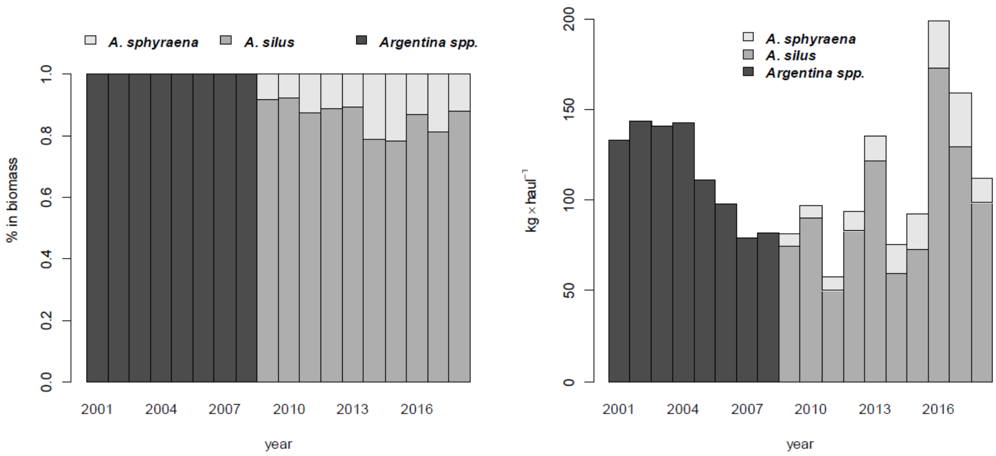


Figure 2. Share and abundance of Argentine species in Porcupine surveys (2001–2018) (Ruiz-Pico et al 2019, ICES WGDEEP 2019 WD12).

Reviews

Review 1: Stage 4 Species: Stock by Stock Impression of whether the summary of the questions and data *provide a solid background to say Y/N to lifting TAC.*

1. *Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?*

In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important

In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

Greater silver smelt is slow growing and relatively log-lived (>20 years). It is a forage species – prey for species such as hake and other deepwater fish. It is an aggregating species, forming shoals that can be detected using acoustic gear. It can therefore be targeted by pelagic trawls. The stock structure is unknown. The assessment stock definition was changed in 2015 – subarea 7 fell into one of four stocks, while most of the present fisheries fall within the other stocks.

There is no dedicated effort on the species, but catches were discarded in fisheries for other species such as hake and monkfish i.e. trawl fisheries.

2. *Is the present TAC/management influenced by past unsustainable practices?*

If yes, are those fisheries still active?

Was the stock targeted?

There is no targeting of the species in this sub-area and larger past catches may have been confounded with other species and market driven. The management of this species is mainly through TACs and quotas. Past landings figures are confounded by being lumped together with other species.

A survey biomass index based on the Spanish survey on Porcupine bank showed increases in biomass between 2014 and 2016, and recent declines. The current level of biomass in subarea 7 in unknown. An assessment is also not available.

The report finds that a value of 500t is likely to be sustainable but the basis for this is unclear. The report also does not include the TACs over time which would be useful.

3. *Can these or new unsustainable practices return if the TAC is removed?*

Can they be targeted with present fleet?

Are they heavily discarded?

Is the stock valuable?

In the past decade the stock was not targeted and was largely discarded until the landings obligation commenced. It is a bycatch species in this subarea. The stock is of low to moderate value, but this value has increased in the last decade as processed food products were developed.

These species can be targeted using pelagic trawls as has been shown in subareas 1,2,5 and 6. If shoals appear in subarea 7, then a targeted fishery could develop and, as such, active management would be required.

4. *Are there alternatives to a TAC to manage this stock?*

Can they be managed as companion species through target TACs (if applicable)?

Can they be spatially managed?

Any other mechanism? E.g. Multi-Year TACs (MYTAC).

The report clearly states that removal of the TAC of greater silver smelt in subarea 7 would require a monitoring process to rapidly re-introduce TACs if a targeted fishery develops (which is possible). It proposes a maximum proportion of bycatch per fishing operation as well as in the total catch be considered. Bycatch of greater silver smelt in other fisheries should also be kept to a minimum.

5. *Conclusion*

The report provides adequate information to make a decision about the risks associated with removing the TAC, including advice as to what alternatives should be put in place of a TAC. These conclusions are reasonable given the information provided, although the justification of the 500t sustainable catch value needs a bit more justification. It would also be helpful if the TACs are also included in the table.

Review 2: Special request by EC (DG MARE) to assess the risks of limiting the TAC for greater silver smelt to areas 5 and 6 and further to assess the potential contribution of the application of other conservation tools in absence of TACs for greater silver smelt in subarea 7 to the requirement that the stock is managed in a sustainable manner.

The Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP, 2019) addressed this special request by the European Commission (DG MARE). The methodology used by the WG to address this request followed closely the approach, which was applied before for similar requests to remove TAC as a management tool (e.g. for dab and flounder, ICES 2017). Six questions with regard to the main fisheries and the stock were examined:

1. *Was the TAC restrictive in the past?*
2. *Is there a targeted fishery for the stock or are the species mainly discarded?*
3. *Is the stock of large economic importance or are the species of high value?*
4. *How are the most important fisheries for the stock managed?*
5. *What are the fishing effort and stock trends over time?*
6. *What maximum effort of the main fleets can be expected under management based on F_{MSY} (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

In addition to these questions, the overall risk of the stock in terms of biology and catchability was considered and the available information summarized with regard to vulnerability, knowledge gaps, potential reaction of the fishery to TAC removal, and alternative management measures.

General comments

The method description is clear and it seems that all available data on catch, landings, discards and relevant survey indices were used to address the special request. However, the six main questions defined were only partly answered or further clarification is needed in some cases. It might be that due to the data limitation it was not possible to give a reasonable answer to all questions, but this should be stated clearly then. There is only very little information about the main fleets catching (not targeting) greater silver smelt in subarea 7. How did the fishing effort developed over time in this area? Although it can be concluded, based on the presented information, that currently the risk to the greater silver smelt stock of having no catch limit in subarea 7 is rather low. This is mainly due to the absence of a directed fishery and low abundance of greater silver smelt in subarea 7. However, a clear statement or conclusion on this is missing somehow. The potential risk of the development of a targeting fleet in subarea 7 on possible aggregations especially in its northern part is clearly described in the last paragraph and reasonable measures to prevent unsustainable exploitation in such case are given.

Specific comments

Methods

Clearly described and structured.

Background

The given detailed information on discards at the end of the paragraph is somewhat unclear. In table 1 the discard data time series is from 2003 to 2018. Here it reads as if only data are available for single years and for single fleets. Were these data used to construct the longer discard time series? Should be clarified or reformulated if necessary.

Questions examined

1. *Was the TAC restrictive in the past?*

Although it is not possible to assess whether the TAC was restrictive for subarea 7 it would be informative to display the TAC development and quota uptake for the whole TAC area.

Was the average bycatch of about 300t in 2016-2018 landed? Does this paragraph refer only to subarea 7?

2. *Is there a targeted fishery for the stock or are the species mainly discarded?*

Please add that the species is mainly discarded. At least this is what is displayed in table 1.

3. *Is the stock of large economic importance or are the species of high value?*

Is it possible to display the development of market price over time? Might this species become more important when the target fishery on other species is more restricted?

4. *How are the most important fisheries for the stock managed?*

Which fisheries catch greater silver smelt (bycatch)?

5. *What are the fishing effort and stock trends over time?*

What is the trend in effort of the main fleets catching greater silver smelt (not targeting)?

6. *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

What is the basis for the 500t? Is it catch or landings?

Vulnerability

Is the conclusion then, that the vulnerability of the species is high?

Knowledge gap

It might be that there are even more knowledge gaps, e.g. amount of discards.

Potential reaction of fishery to the removal of TAC

o.k.

Suitable management measures if the TAC was removed

o.k.