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

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i Executive summary

The ICES working group on biology and assessment of deep-sea fisheries resources (WGDEEP) provides scientific advice on 30 assessment units including stocks of deep-water species and those on deep shelf areas. All ICES categories are present, from full analytical assessment (category 1) to stocks with negligible landings where catches primarily are discard and bycatch (category 6). Advice is provided in time intervals of 1 to 5 years for different stocks, with 1- and 2-years intervals as the most common.

First draft of advice was prepared for 20 stocks this year. Available time-series for international landings and discards, fishing effort, survey indices and biological information were updated for all stocks and are presented in Sections 3–16 of the report.

Exploratory assessments were presented to the meeting for blue ling in 5a and 14 using GADGET model and greater silver smelt in 5a and 14 using SAM model.

Results were presented from benchmark in January 2024 (WKBMYSYSPICT3) for greater silver smelt in area 1,2,3a and 4, blackspot seabream in area 9 and blackspot seabream in area 10. Upcoming benchmarks are on blue ling in 5a and 14, greater silver smelt 5a and 14 and blackscabbard fish. Blackspot seabream in 9 is one of the stocks in an upcoming Stock Synthesis benchmark.

Main conclusions regarding each stock with advice in 2024:

Alfonsinos in the Northeast Atlantic is a Category 5 stock with precautionary reductions of catches. The stock is comprised of two species (*Beryx splendens* and *Beryx decadactylus*). Most of the catch data comes from the Azores region, where detailed species-specific landing data, survey abundance index, and length composition are uniquely available. The ICES rfb-rule was applied for the first time this year, based on information for the most captured species (*Beryx splendens*).

For Atlantic wolffish in Division 5.a (Iceland grounds) spawning stock biomass has been going up since 1995 but recruitment decreased until 2010. Since 2010, recruitment has remained stable and has increased slightly in recent years. Spawning stock biomass and fishing pressure are at sustainable levels. The advice for 2024/25 is substantially higher than for 2023/24 due to an upward revision/higher biomass levels and lower fishing pressure.

Black scabbardfish in the Northeast Atlantic has been showing a reduction in abundance, mostly driven by the decrease of fishing effort and catches in the Northern component, probably associated with the ban of trawling below 800 m. As a consequence of changes in effort targeted to black scabbardfish of the French trawl fleet that operates in the Northern component, the accepted assessment model could not be updated. The rfb rule was applied for the first time this year to the Northern (ICES Division 5.b, subareas 6–7, and Division 12.b) and Southern (ICES Subarea 8 and Division 9.a) components separately. The length-based fishing pressure proxy ($L_{F=M}/L_{mean}$) is at F_{MSY} proxy for the Southern component and slightly above for the Northern component.

The recruitment of blue ling in division 5.a and subarea 14 has been low since 2010. Biomass indices have increased in recent years and the biomass index doubled between 2022 and 2023, resulting in a higher advice for 2024/25 and 2025/26.

Blue ling in 5b, 6, 7, 12 is a new stock unit that previously did not include area 12. Revision of stock structure for blue ling in ICES was initiated at WGDEEP 2023 as a request to the Stock

Identification Methods Working Group (SIMWG). SIMWG concluded in advance of the 2024 meeting. Catches in area 12 primarily come from 12b.

The blue ling stock in 1, 2, 3a and 4 is new after revision of stock structure of blue ling within ICES. Suggested advice from WGDEEP is zero catch for the years 2025-2028. The landings have declined over the years. The stock is regarded as depleted based on very limited data.

Blackspot seabream in subareas 6, 7 and 8 catches declined significantly in the 1970s–80s, and this is considered to reflect depletion in stock biomass. Three bottom trawl surveys take place in the area of the stock, but the species is currently rarely caught in these surveys. If the population increases substantially, this should be reflected in these bottom trawl survey indices.

Rfb rule was applied for the first time for blackspot seabream of subarea 9. In contrast to earlier assessments information of this stock is now strictly related to Subarea 9, and the information from the Strait of Gibraltar was removed. Fishing pressure is at F_{MSY} proxy while the stock indicator (Portuguese reference fleet standardized CPUE) is above $I_{trigger}$.

Greater silver smelt in ICES areas 1, 2, 3a and 4 was benchmarked in 2024 (WKBMSYSPiCT3). The benchmark allowed for reconsidering input data, adding new data, and adding data not used in previous benchmark. SPiCT was accepted as assessment and forecast method for this stock and the assessment in year 2024 is generally in accordance with the benchmark.

For greater silver smelt in division 5.a and subarea 14, the spawning stock biomass has reached a historical high and fishing mortality remains relatively low. Recruitment estimates are low in the past three years but were relatively high prior to these. Spawning stock biomass and fishing pressure are at sustainable levels, but the TAC has not been fished for the past decade which has resulted in higher species transfers from greater silver smelt to other stocks in the Icelandic transfer quota system. Advice for 2024/25 increased slightly from 2024/25.

For greater silver smelt in 5b and 6a fishing mortality and the spawning stock biomass are at sustainable levels. The recruitment is very constant. Upon applying the MSY approach, the catch advice increased slightly compared to last year's advice.

For ling in Division 5.a, the spawning stock biomass and the fishing mortality are at sustainable levels. Recruitment of age 2 decreased from high levels in 2008 in and have remained stable for the past years. The advice for 2024/2025 is approximately the same as in 2023/2024.

For ling in Division 5b the recruitment has been very low since 2018 causing the spawning stock to go below Blim in 2024 and the same can be expected in foreseeable future. The fishing mortality is high, as well as the catch, but are expected to decrease for the coming years. ICES issued a zero advice for 2024 and chances are high that this will be reiterated for 2025.

For tusk in Division 5.a and Subarea 14, the total stock biomass has increased since 2020 and the spawning stock biomass is slightly above Blim. Fishing mortality has declined and recruitment of age 1 shows an increase for the past decade. The advice in 2024/25 is higher than the advice in 2023/24 due to an increase in spawning stock biomass.

For tusk in 6b landings since 2001 have been low and generally decreasing. Apart from closed areas, no management measures apply exclusively to this stock. No updated abundance index is available.

For Tusk in 12ac no landings have been reported since 2015. No recent data are available and the catch advice from WGDEEP is zero for 2025 to 2029, as it has been in 2018 and onwards.

The advice on orange roughy in subareas 1-10, 12 and 14 is given for four years. This is an seamount aggregating species and currently there are no evidences that the stock is recovering from overexploited status. Historical catches were updated.

Greater Forkbeard in Northeast Atlantic is a bycatch species in both deep-water and shelf fisheries. Discard rate is high and variable from year to year but many of the countries involved in the fishery report discard since 2013. Although it is in low values since 2016 the biomass index from six surveys indicates an increase trend since the minimum recorded in 2020. The rfb-rule was applied for first time in 2024.

Roundnose grenadier in subareas 6-7 and divisions 5.b and 12.b landings have declined since 2004. Recent survey indices remain stable, but the implementation of the EU deep sea bottom trawling ban combined with changes in fishing location, has led to a decrease in activity.

Roundnose grenadier in 3a is at present at low levels. The low index values are presumably a result from earlier exceptionally high catches and low recruitment.

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	2023
Reporting year in cycle	1/1
Chair(s)	Elvar H. Hallfredsson, Norway
	Juan Gil Herrera, Spain
Meeting venue and dates	24-30 April 2024, Copenhagen, Denmark (31 participants)

1 Ecosystem productivity and ecosystem approach in WGDEEP stocks

1.1 Ecosystem productivity and ecosystem approach for deep-water stocks

Changes in stock productivity and species distributions are considered to be linked to warming sea surface temperatures (Maltby et al., 2023; Townhill et al., 2023), although this is not very well documented for deepwater fish stocks. Predicting responses to climate change and understanding of cumulative pressures from human activities remains constrained by limited long-term monitoring.

Deepwater fish stocks tend to show slower growth rates, but higher age of maturity and longevity compared to species typically found in shallower waters, which relate to intrinsic natural mortality (Drazen and Haedrich, 2012; Priede, 2017). The lower productivity of deepwater ecosystems is accounted for in population dynamics models of stocks assessed by WGDEEP. In addition, ICES considers changes in ecosystems and fisheries productivity to assess and advice on the impact of fisheries on fish stocks, biodiversity, and ecosystems to progress towards an ecosystem-based approach for the provision of advice (ICES, 2020). This information is summarised in the Ecosystem and Fisheries Overviews. While ICES has a leading role in the advisory framework to support the implementation of an ecosystem approach (Ballesteros et al., 2018), there remains practical limitations related to data availability and quality, and uncertainties associated with complex models (Karp et al., 2023), particularly for deepwater stocks.

The advice on fishing opportunities is based on rules, indicators and reference points (when defined) that embed the underlying principles to inform ICES advice based on ecosystem-based approach (Roux and Pedreschi, 2024). For example, For ICES category 1 stocks this is conveyed in the assessment, forecast and advice by using the stock specific life history traits. For the numerous Category 3 stock assessed by WGDEEP, a population indicator (usually a biomass index from a scientific survey or CPUE series from the fisheries) is used to estimate 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 as 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.

Many fish stocks assessed by WGDEEP remain data-limited under the ICES approach to advice on fishing opportunities. Several aspects of life-history traits and ecology, including spatial distribution and stock identity of many deepwater species and their connectivity, and the understanding of effects of fishing activities in the ecosystem remains limited. ICES WGDEEP work have cross-links with other expert groups to help addressing these information gaps and developing assessment methods.

1.2 Ecosystem considerations for selected WGDEEP stocks

Ecosystem considerations are presented for those WGDEEP stocks where appropriate and relevant knowledge is available. Not all 30 WGDEEP stocks have been subject to this ecosystem consideration so far, and this listing is thus not complete. 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 remains at a low 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.

1.2.1 Blackspot sea bream (*Pagellus bogaraveo*) in Subarea 10 (Atlantic Iberian waters)

The stock reported in this section is from the Azores EEZ (ICES 10.a2). It is distributed along the coastal areas of the islands and seamounts up to 700m. Recruitment occurs on the coastal areas and juveniles migrate subsequently to offshore seamounts. The assessment of the stock is based on the survey trends and currently it is considered intensively exploited. Survey relative abundance indices trends presents high inter annual variability. Causes for this variability may be related to catch dynamics between fish and gear (competition, gear saturation, forage behaviour, etc.) or with environmental effects. Both factors seem to affect catchability. Further studies are necessary to better understand both effects on the abundance estimates.

1.2.2 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. In 2018, the biomass indicator was at high level and implied an increase of the catch advice according to survey trend-based assessment. However, as the index of small fishes indicated that the recruitment had been very low since 2010, an increase of adult stock catches seemed 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. The recruitment is still at low levels.

1.2.3 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.

1.2.4 Ling (*Molva molva*) in subareas 3, 4, 6-9, 12 and 14 (Northeast Atlantic and Arctic Ocean)

The standardized CPUE series from the Norwegian longline fleet operating in subareas 4 and 6 was used as an indicator of stock development. These show an increasing trend from 2002 to 2016 and fluctuations over the last years. The application of the ICES Category 3 rule lead to an advice catch for 2024-2025 slightly lower than the previous advice (also for the first year a new assessment method (rfb rule) was used. 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. Ling is also caught in declining number in the French Southern Atlantic Bottom trawl survey (EVHOE) occurring in ICES divisions 7g-k and 8a,b,d, with no catch in 2021 and 2022. The overall trend suggests a clear decline of ling in the survey area. Surveys data suggest that the species' abundance is decreasing in southern areas (subareas 7 and 8 in particular), landings are also decreasing in these areas.

1.2.5 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 in one area and either small- or large-scale migrations occur. So far, the known spawning grounds occur in CECAF areas (Madeiran and Canary Islands waters). Juveniles recruit in Northern areas. These particularities are taken into consideration by ICES model adopted to monitor the stock dynamics.

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. However in recent years, the Icelandic abundance index, the French LPUE index from the west of Scotland show a decreasing trend while both the Icelandic and the Scottish survey biomass indices have been increasing. The analysis of these trends suggests that the level of recruitment have been decreasing. This effect is unlikely to result from an increasing fishing pressure because (1) the TAC set for black scabbardfish have been stable for several years and (2) in EU waters the ban of trawling in areas deeper than 800 m has strongly reduced the fraction of the species habitat which can be exploited as the depth range of the species extends down to 2000 m. Therefore, the observed decrease might be due to ecosystem effects. Acting ecosystem factors may be:

- Changes in the abundance of prey species. In particular the black scabbardfish preys upon blue whiting, which SSB increased in 2011-2016 and have decreased in more recent year (ICES, 2019);
- Changes in abundance of predators. After the heavy exploitation in the 1990s and early 2000, TACs for deep-water species were introduced in 2003 and gradually decreased thereafter. The black scabbardfish fish is one of the most productive deep-water species, with a faster growth than its potential predators particularly deep-water sharks. Target fishing from deep-water sharks have been strongly restricted since 2006 with the ban of deep-water nets and was further restricted in 2012 after the introduction of a 0 TAC for deep-water sharks that applies for all gears. The latter might have been an incentive to diverge fishing to locations where sharks were a small proportion of commercial catches. Lastly the ban, in 2016, of trawling deeper than 800 m in EU waters might have resulted in reduction of deepwater-sharks bycatch to low levels in trawl fisheries. Although no

reliable indicator of deep-water shark abundance is available, population might be increasing in recent years and thus increasing the predation on black scabbardfish.

1.2.6 Greater forkbeard (*Phycis blennoides*) in all ecoregions

ICES currently considers greater forkbeard as a single-stock for the entire NE Atlantic, although the stock structure be more complex. Further studies would be required to justify change to the current assumption. Fishing is a major disturbance factor of the continental shelf communities of the regions. As the fishery of greater forkbeard is mainly a bycatch of trawler fishery in all ecoregions the main ecosystem effects are the impact on the sediment compound.

1.3 The percentage of the total catch that has been taken, and emerging fisheries, in the NEAFC regulatory areas last year

WGDEEP stocks are distributed broadly across the NEAFC Convention Area, with catches of some stocks occurring within the NEAFC Regulatory Area (RA). In the table 1.1 in the WGDEEP 2020 report the WG presented the most likely landings from these RA areas in 2019 based on the official reports and discussions within the WG. For relevant stocks with advice this year the estimated percentage of the total catch that has been taken in the NEAFC Regulatory Area last year is reported in the advice sheets.

No new emerging deep-water fishery were discovered with the available data in the NEAFC Regulatory Area.

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Contents

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 continuously increased 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 types of deep-water fisheries occur in the area: 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. Import to note that inside the Azorean EEZ trawling is prohibited. Azorean fishery targets 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 is primarily determined by the 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 performed by a small-scale fleet mainly comprised by small vessels (<12 m; 90% of the total fleet), using mainly traditional bottom longline and several types of handlines. The Azorean ecosystem is a seamount and island slope type and fishing operations occur in all available areas, from the islands coasts to the multiple seamounts within the Azorean EEZ. The fishery takes place at depths down to 1000 m, catching species from different community 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. More than 40 seamounts have been subsequently 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 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*), golden redfish (*Sebastes norvegicus)* 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 is suspected that IUU fishing occurred by vessels from other areas, but the scale of such activity is unknown.

In recent years, the fishing activity has declined substantially (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 Faroese fishery for orange roughy has not been conducted for some years.

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 because of the interdiction by the local Portuguese 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. 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. During the last decade it was observed an expansion of the fishing area for this fleet class.

Also in one other fleet component, the medium size boats, ranging from 12–16 m, 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 2-3 decades, 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. Spain have reported regularly landings of roundnose grenadier from subdivision 14.b1 and 12a.1 In 2020 the official Spanish landings were reported 131t from 12.a1.

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. During 2020 Spain reported a landing of 0.272t from 12.a1.

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 for the most recent years’ (2009–2014) catches were 45–313 t for both Subareas. There are no landings reported since 2016.

Longline fisheries for redfish: In 1996 a small fleet of Norwegian longliners began a fishery for golden 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). During 2019 Faroe report landings of 5 t from area 10.

Current status*:* In the recent years and in ICES Subareas 10 and 12, the deep-water fisheries in the MAR reduced to very low levels. This reduction is 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 where technological interactions are observed. In the past, the bycatches were 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 are available to assess such effects in these areas. The stock structure of each of those species is unknown. It is not known whether the trawler fleets has fished in international waters of the MAR 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. There are studies on 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 the management of the fisheries 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). Since 1998, some technical measures were also introduced by the Azores regional government. These include fishing restrictions by area, vessel type and gear, fishing licences based on landing thresholds, minimum lengths, marine protected areas and closed seasons and updated thereafter. Some of the target fisheries are managed based on quota by quarter, island and vessel.

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 management measure aims to prevent expansion of 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). The 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.

2.7 References

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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).

	ALFONSINOS (Beryx spp.)	ARGENTINES (Argentina silus)	BLUE LING (Molva dypterigia)	BLACK SCABBARDFISH (Aphanopus carbo)	BLUEMOUTH (Helicolenus dactylopterus)	DEEP WATER CARDINAL FISH (Epigonus telescopus)	GREATER FORKBEARD (Phycis blennoides)	LING (Molva molva)	MORIDAE	ORANGE ROUGHY (Hoplostethus atlanticus)	RABBITFISHES (Chimaerids)	RAGIDAE	ROUGHHEAD GRENADIER (Macrourus berglax)	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)	BEAKED REDFISH (Sebastes mentela)	SHARKS, VARIOUS	SILVER SCABBARDFISH (Lepidopus caudatus)	SMOOTHHEADS (Alepocephalidae)	Trachipterus sp	TUSK (Brosme brosme)	WRECKFISH (Polyprion americanus)	TOTAL
1995	731		602	304	589		75	50		676				644	1115		1385	789			18	244	7222
1996	1510	1	814	455	483		47	2		1289				1739	1052		1264	826	230		158	243	10113
1997	384		438	203	410		32	9		814	32			8622	1012		891	1115	3692		30	177	17861
1998	229		451	253	381		39	2		806	42			11979	1119		1051	1187	4643		1	140	22323
1999	725	2	1363	224	340		41	2		441	115		3	9696	1222		50	86	6549		1	133	20993
2000	484		607	357	452	3	100	7	1	447	48		7	8602	947		1069	28	4146		5	268	17578
2001	199		675	134	301		91	59	88	839	79		10	7926	1034		1208	14	3592		52	232	16533
2002	243		1270	1062	280	14	63	8	113	28	98		7	11 468	1193		35	10	12538		27	283	17272
2003	172		1069	502	338	16	56	19	140	201	81		2	10 805	1068		25	25	6883		83	270	10950
2004	139	4	644	384	282	21	46		91	711	128		28	10 748	1075		6	29	4368		16	189	8161
2005	161		35	198	190	4	22	2	69	324	193		8	513	1383		14	31	6872		66	279	10364
2006	192		65	73	209	10	134		127	104			8	86	958		104	35			64	497	2666
2007	211		1		275	7	201		86	20				2	1070		63	55			19	664	2674
2008	252			80	281	7	18		53	108				13	1089		12	63				513	2489
2009	312			162	267	7	26	1	68	26	22		6	5	1042		1	64			2	382	2393
2010	245		72	240	213	5	14		54	74	0		0	1691	687		7	68			107	238	3715
2011	232		0	163	231	5	11		55	112			0	3366	624		5	148			0	266	5218
2012	222		16	16	190	4	6	0	31	139	2		2726	2724	613		31	282	160	54	29	226	7441
2013	168		9	206	235	4	8	0	52		6		868	1907	692		70	0	17			209	4398
2014	131			85	200	2	9		54	47			448	2075	663			713				121	4493
2015	292		0	7	256	4	10	1	92	84				862	701			429			1	116	2856
2016	156			86	306		10		186	93				660	515			87				101	2200
2017	149	0	0	63	333	5	15	0	169	<1	0	70	0	84	499	2277	75	101	0	0	0	128	3967
2018	157	0	28	17	283	4	75	0	140	0	0	60	0	27	474	2873	0	65	0	0	506	80	4790
2019	143	0	1	21	187	9	13	0	116		0	43	0	215	481	2403	0	65	0	0	0	80	3779
2020	139	0	0	11	130	5	9	0	59	0	0	5	0	131	491	2205	1	88	0	0	0	81	3356
2021*	124	0	0	0	160	4	8	11	10	0		4	0	0	565	51	0	83	0	0	0	68	1088

***- 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

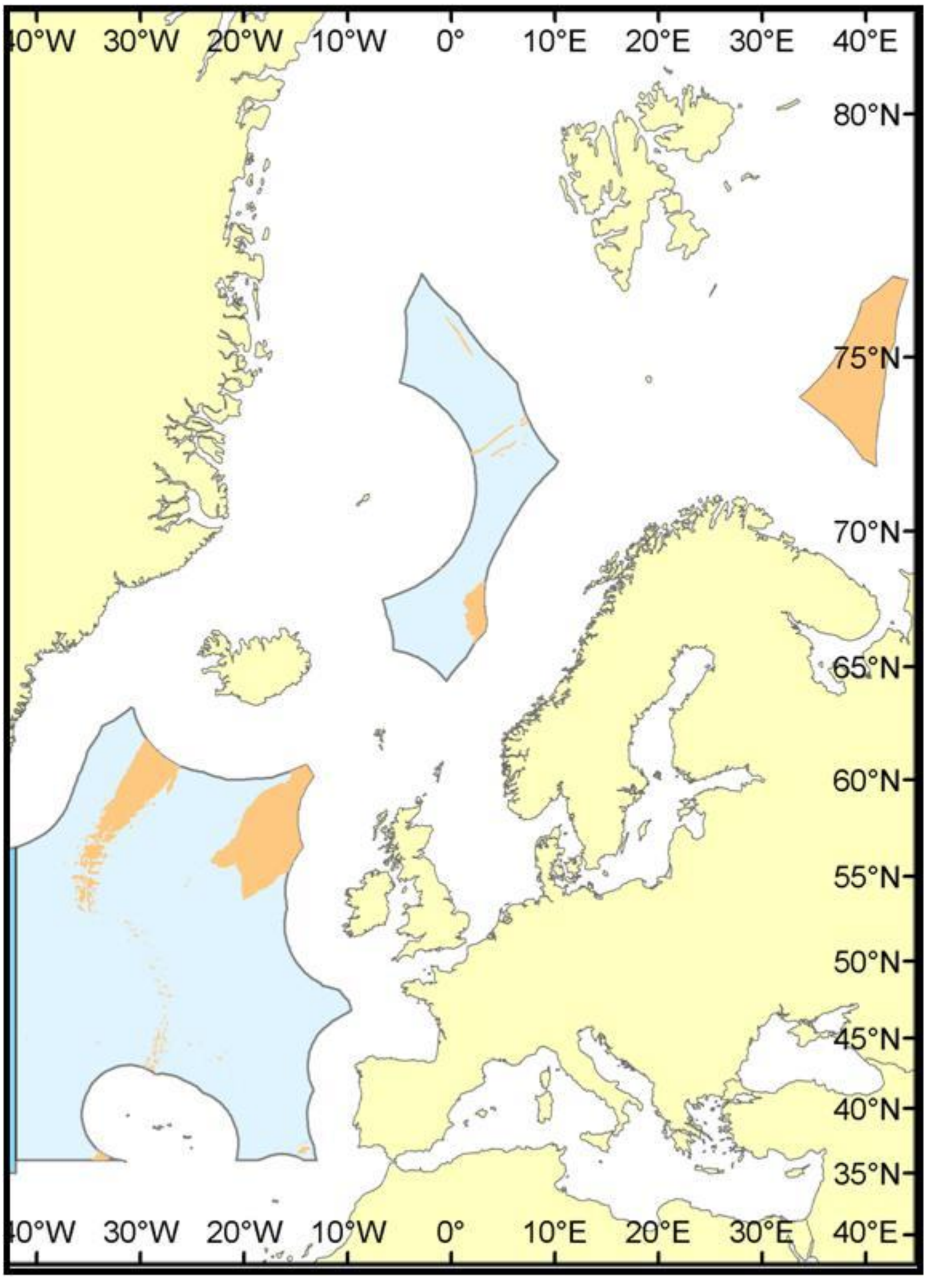

Figure 2.7.1. The NEAFC Regulatory Area (area beyond national jurisdiction) in the Northeast Atlantic (light blue polygons) with superimposed subareas shallower than 2000 m (light brown patches). Note that the NEAFC RA in the Barents Sea is entirely shallower than 2000 m, and that a high Arctic NEAFC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

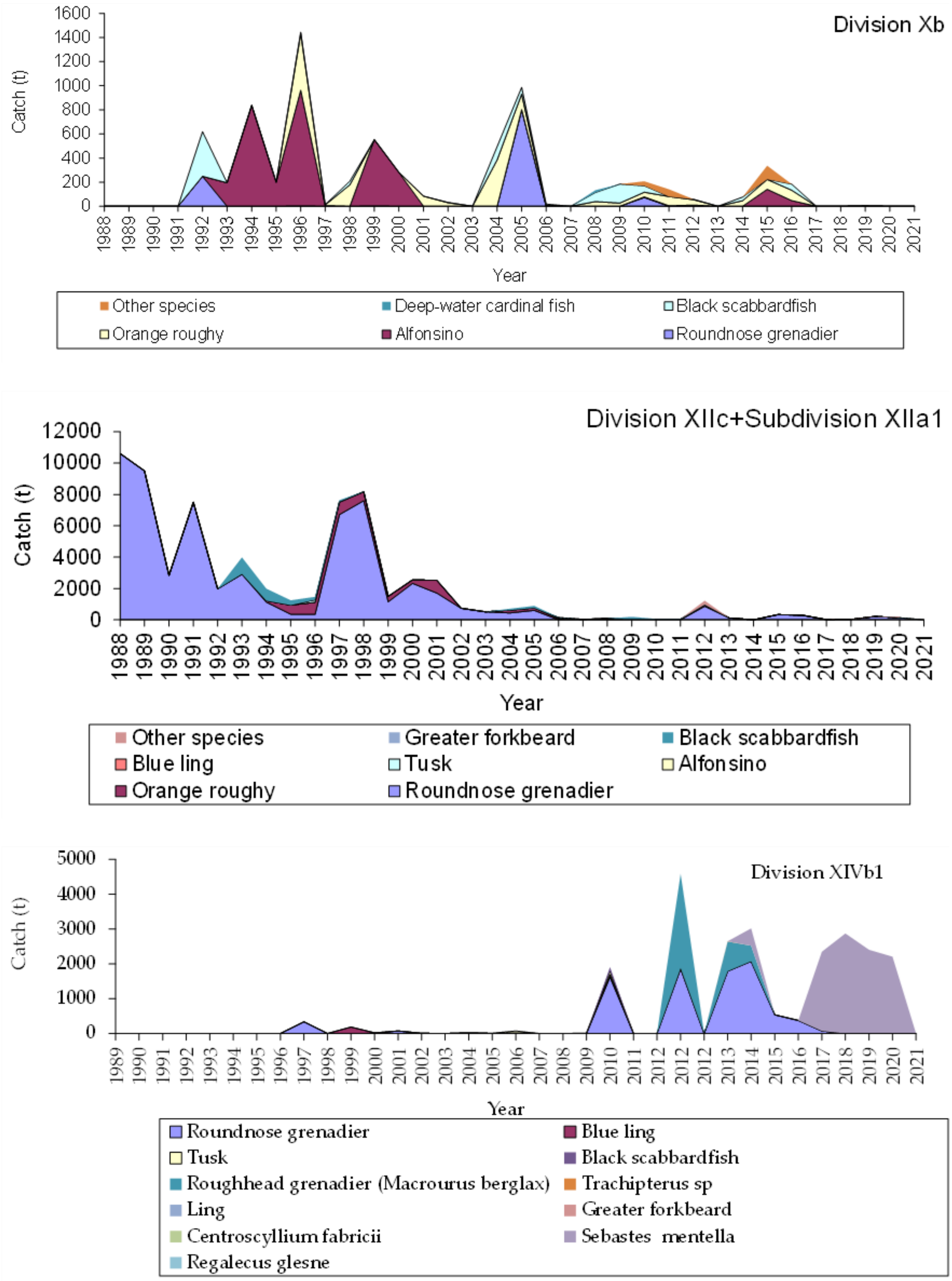

Figure 2.7.2. Annual catch of major deep-water species on MAR in 1988–2020.

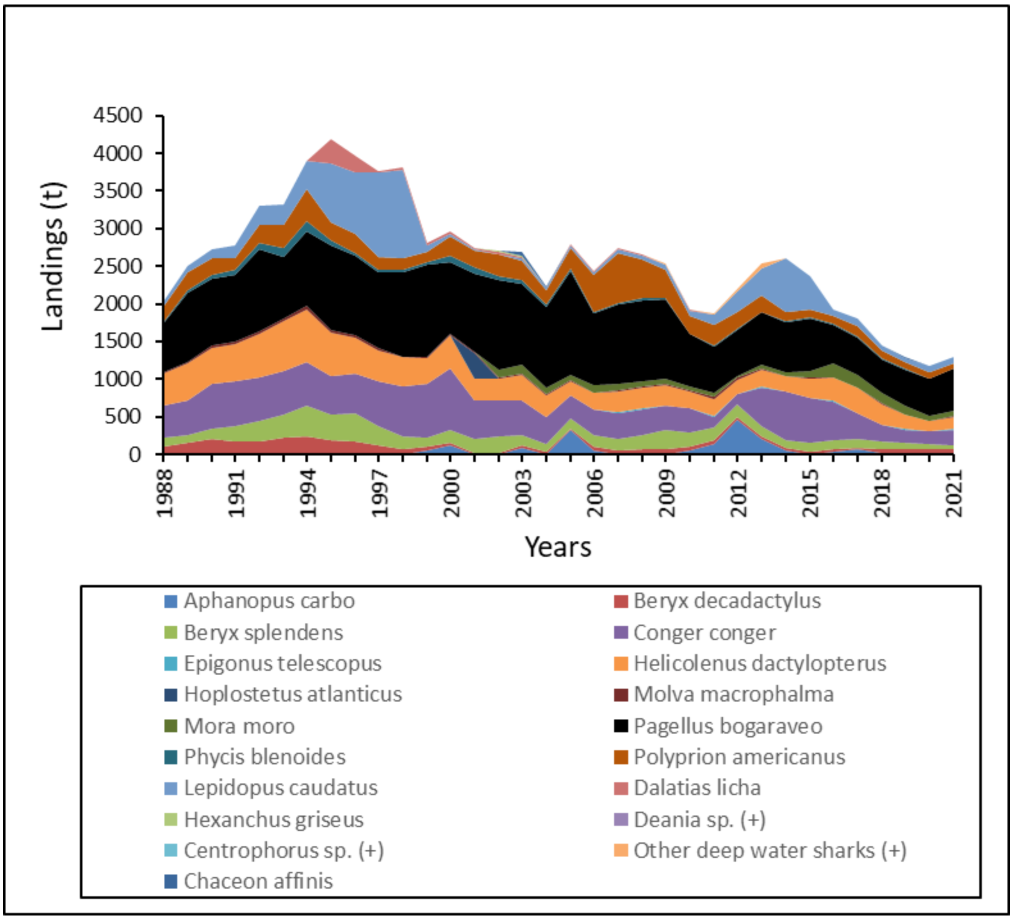

Figure 2.7.3. Annual landings of major deep-water species in Azores from hook and line fishery (1988–2020).

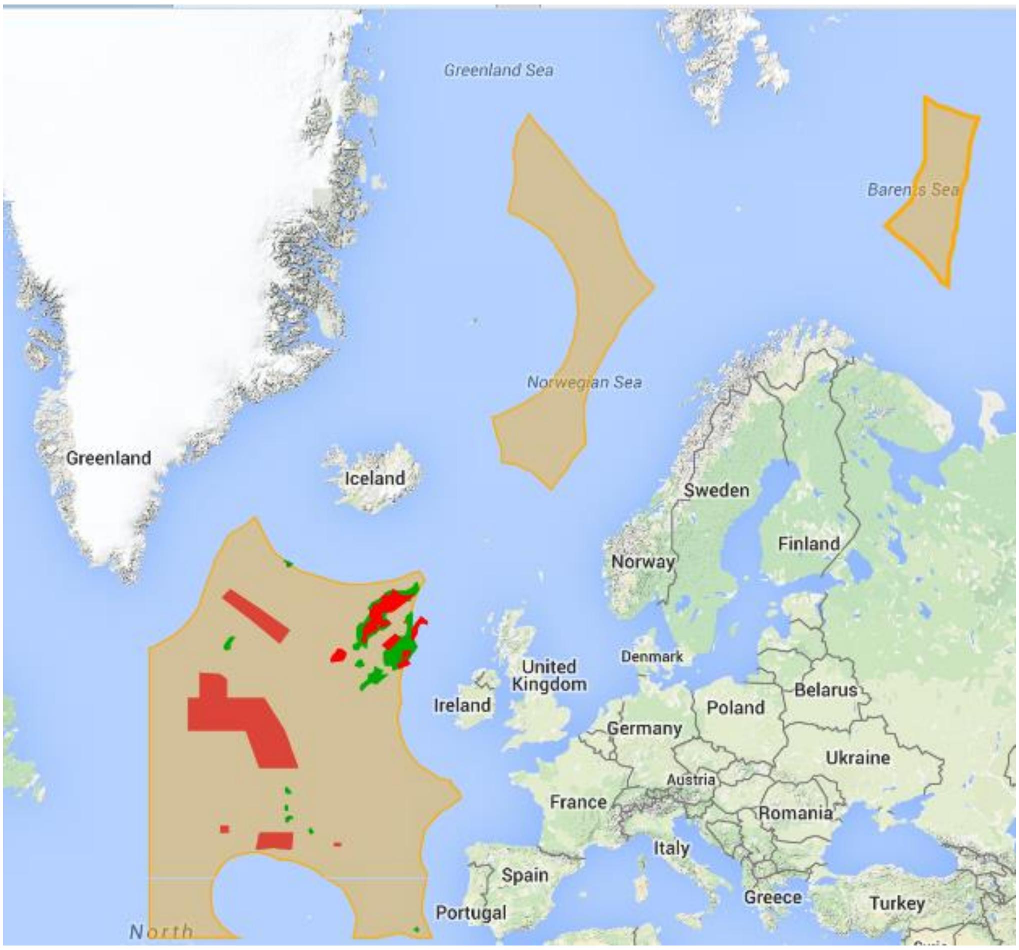

Figure 2.7.4. The regulatory area of NEAFC (light brown) and subareas of the Mid-Atlantic Ridge, seamounts and the Rockall-Hatton areas designated as bottom fishing closures (red), and 'existing fishing areas (green). Areas outside closures and 'existing fishing areas' are only open to pre-assessed exploratory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

Contents

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.

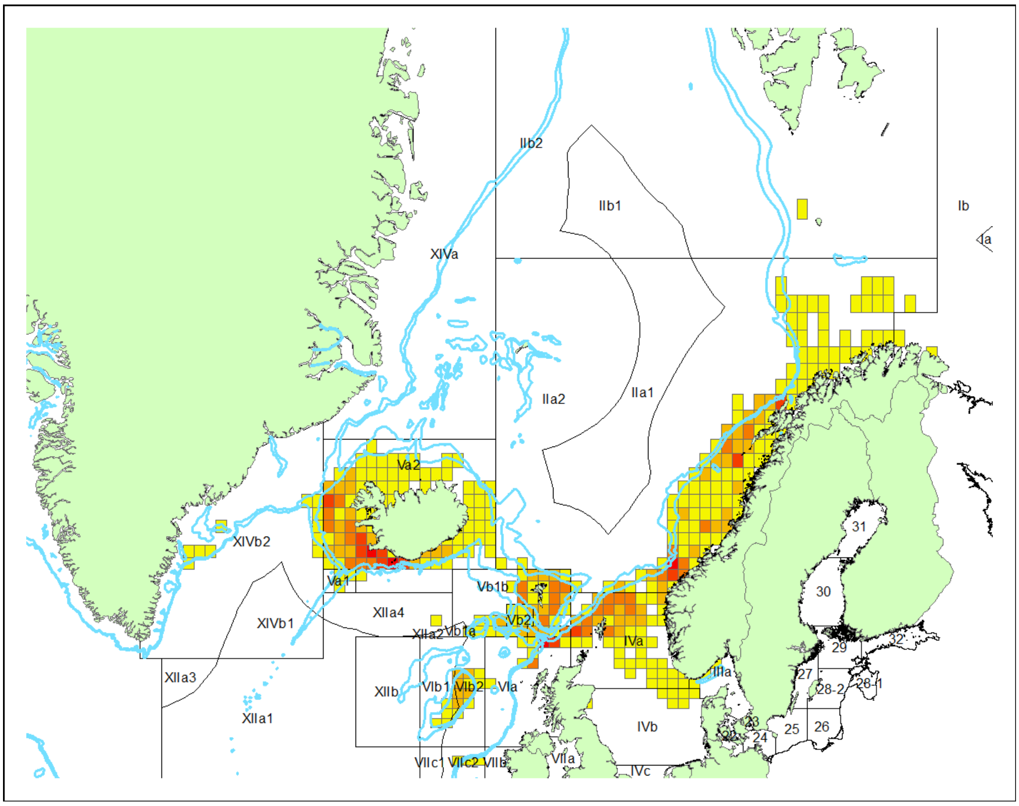

Figure 3.1. Map of fishery distribution (catches) in 2013 (data from Iceland, Faroes and Norway).

A study on population genetic structure of ling in the Northeast Atlantic 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) (Gonzales *et al.*, 2015). 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.

3.1.1 References

Blanco Gonzalez, E., Knutsen, H., Jorde, P. E., Glover, K. A., and Bergstad, O. A. 2015. Genetic analyses of ling (*Molva molva*) in the Northeast Atlantic reveal patterns relevant to stock assessments and management advice. – ICES Journal of Marine Science, 72: 635–641.

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

3.2.1 The fishery

General description of the fishery in Faroese waters is presented in the stock annex. Ling is mainly caught by longliners. Trawlers catch it as bycatch in the saithe fishery. In 2023 the fleet which is comprised of longliners and trawlers were mainly fishing on the slope on the Faroe Plateau and somewhat to the South East on the Faroe Bank and Wyville-Thomson Ridge (Figure 3.2.1). In recent years, foreign catches are mainly caught by the Norwegian longliners.

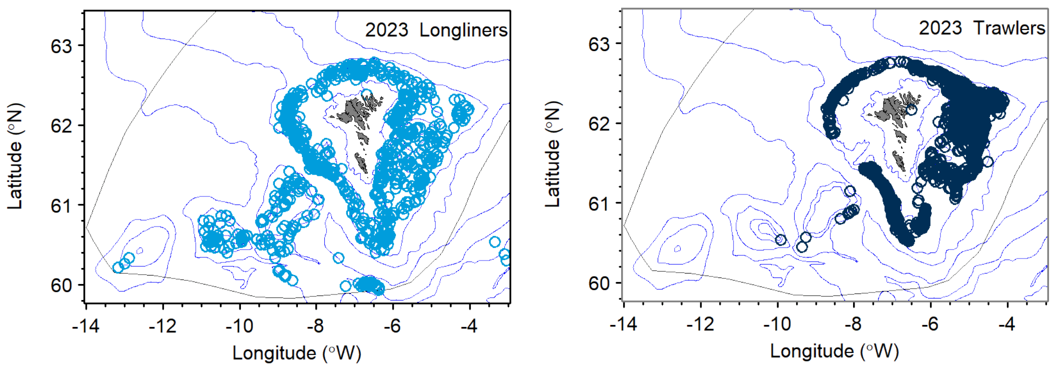

Figure 3.2.1. Ling in 5.b. Spatial distribution in 2023 of the Faroese longliner fishery (left) and pair trawler fishery (bycatch in saithe fishery, right).

3.2.2 Landings trends

Landing statistics for ling by nation for the period 1988–2023 are given in Tables 3.2.1–3.2.3 and total landings data since 1904 are available and shown in Figure 3.2.2. The history of the fishery is described in the stock annex.

Total landings in Division 5.b have in general been very stable since the 1970s varying between around 4000 and 7000 tonnes. From 1990–2005 around 20% of the catch was fished in area 5.b2, and in the period 2006–2021 it has decreased to around 10%. In 2023, 22% of the catch was fished in 5.b2. Preliminary landings of ling in 2023 was 5200 tons of which the Faroes caught 80%. Foreign catches were low between 2011 and 2013 due to no bilateral agreement on fishing rights between the Faroes, Norway and EU.

Around 50–75% of the ling in 5.b was caught by longliners and the rest mainly as bycatch by trawlers (25–40%) (Table 3.2.4).

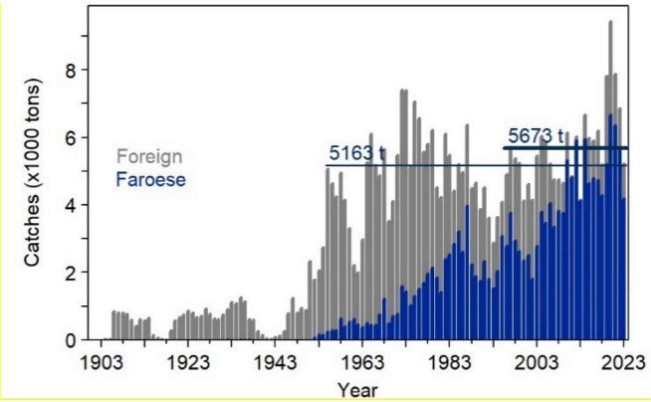

Figure 3.2.2. Ling in 5.b. Total international catches since 1904. Mean catches since 1955 were around 5160 tons. Catches in the assessment period since 1996 were approximately 5700 tons.

3.2.3 ICES Advice

ICES advises that when the MSY approach is applied, catches in 2024 should be zero tonnes because the SSB is predicted to be under Blim under the F=0 scenario. All catches are assumed to be landed. ICES is not in a position to advice on the corresponding level of fishing effort.

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. Other nations fishing ling in Division 5.b are regulated by TACs. The recommended minimum landing size for ling is 60 cm (total length) which is not enforced due to the discard ban. Regulation is set for juvenile catch and a maximum of 25% of the ling catch (per settings/hauls) can be juveniles e.g., smaller than 75 cm.

Since 1977 a bilateral agreed quota exists between Norway and Faroe Islands except for 2011–2013. For 2024, catches by Norway are as follows; 2600 tons ling/blue ling.

Since 2021 (Brexit), the TAC of 5 tonnes in UK Subarea 5 (UK and international waters) has been divided between EU an UK with 4 tonnes and 1 tonnes, respectively.

3.2.5 Data available

Data on length, gutted weight and age are available for ling from the Faroese landings and Table 3.2.5 give an overview of the level of sampling since 1996.

There are also catch and effort data from logbooks for the Faroese longliners and trawlers. In addition, there are data available on catch per unit effort from Norwegian longliners fishing in Faroese waters.

From the two annual Faroese groundfish surveys on the Faroe Plateau targeting cod, haddock and saithe, biological data (mainly length and round weight, Table 3.2.6) as well as catch and effort data are available.

With regards to the compilation of catch at age for 2023 it was necessary to merge two randomised samples from the trawlers to the longlines in order to increase the number of measurements to a satisfactory level.

Landings and discards

Landing data is available for all relevant fleets. The discard of ling is negligible. 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.

3.2.5.1 Length composition

Length composition data is available from Faroese commercial longliners and trawlers and from two groundfish surveys (Figures 3.2.3–3.2.5).

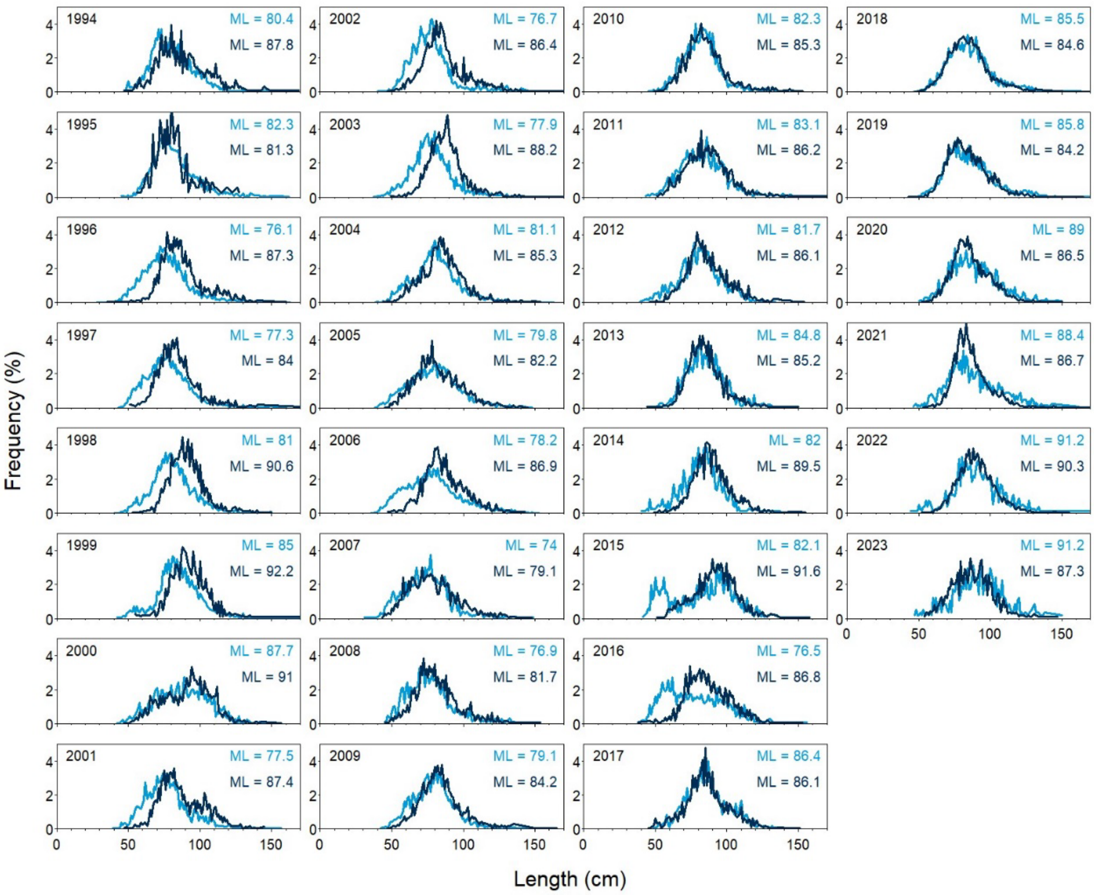

Figure 3.2.3. Ling in 5.b. Length frequencies from the landings of ling from Faroese longliners (>110 GRT, turquoise line) and Faroese trawlers (>1000 HP, dark blue line) (1994-2023). ML- mean length.

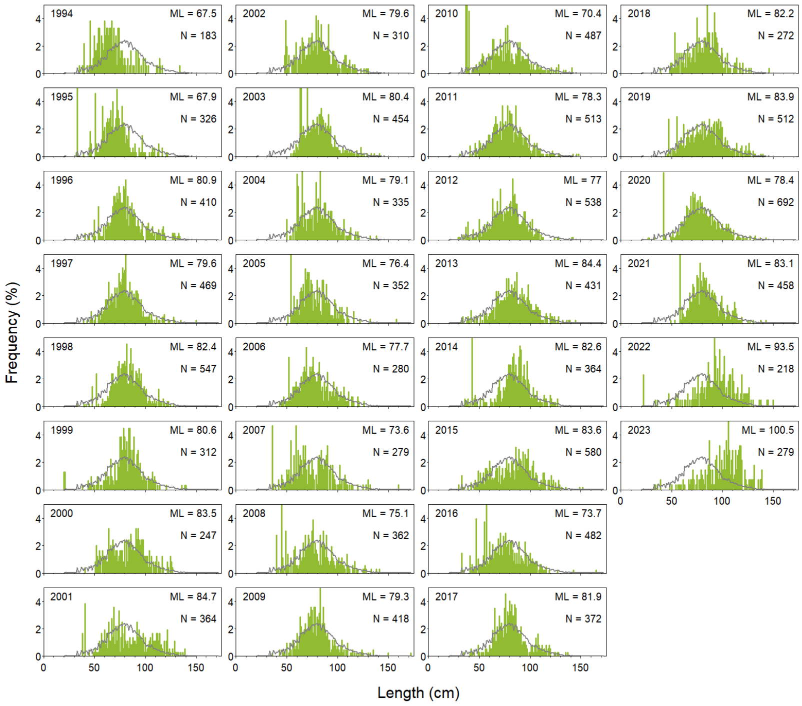

Figure 3.2.4. Ling in 5.b. Length frequencies from the groundfish spring survey (1994-2023). ML- mean length, N–number of calculated length measurements, grey line- mean of all years. Small individuals are often sampled from a subsample of the total catch and scaled up to total catch.

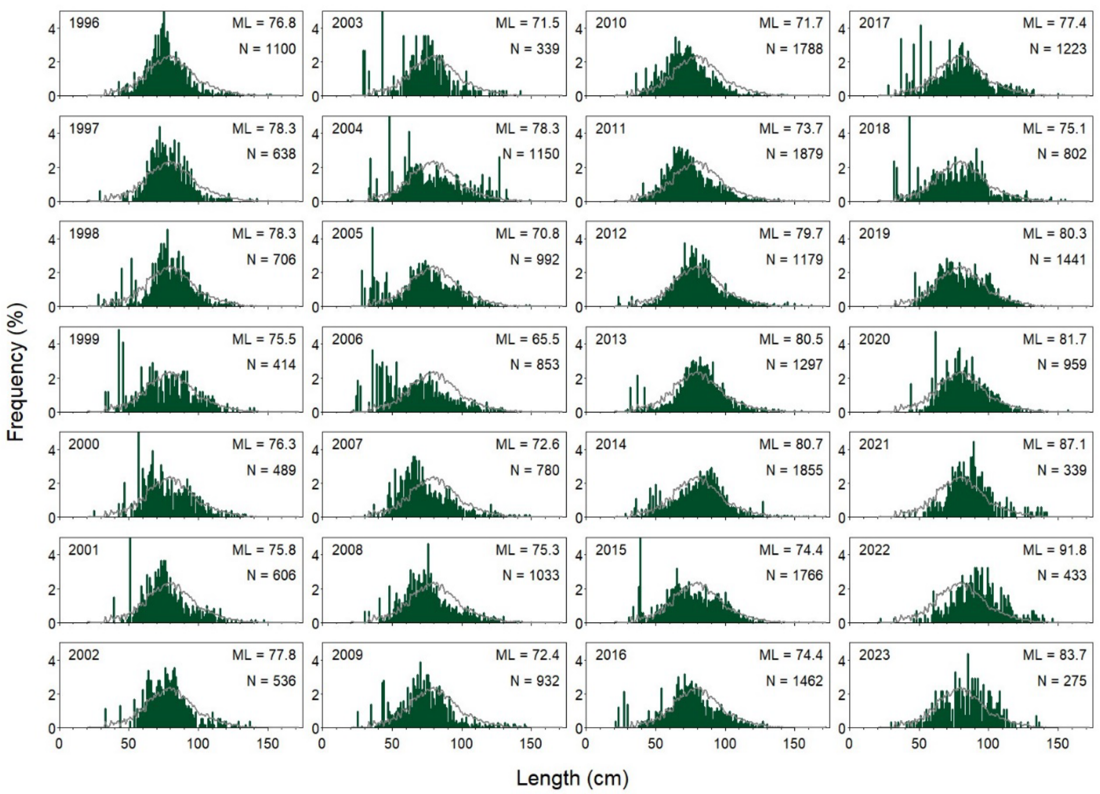

Figure 3.2.5. Ling in 5.b. Length frequencies from the groundfish summer survey (1996-2023). ML- mean length, N–number of calculated length measurements, grey line- mean of all years. Small individuals are often sampled from a subsample of the total catch and scaled up to total catch.

3.2.5.2 Catch-at-age

Catch-at-age data are available from the Faroese fishery in 5.b since 1996. In 2020, a new ALK-program was used to calculate catch number at age (see ICES, 2021, Stock annex). The most frequent age classes in the landings are 5-9 years old (Figure 3.2.6 and Table 3.2.7). Consistency plots of the catch at age data is shown in Figure 3.2.7.

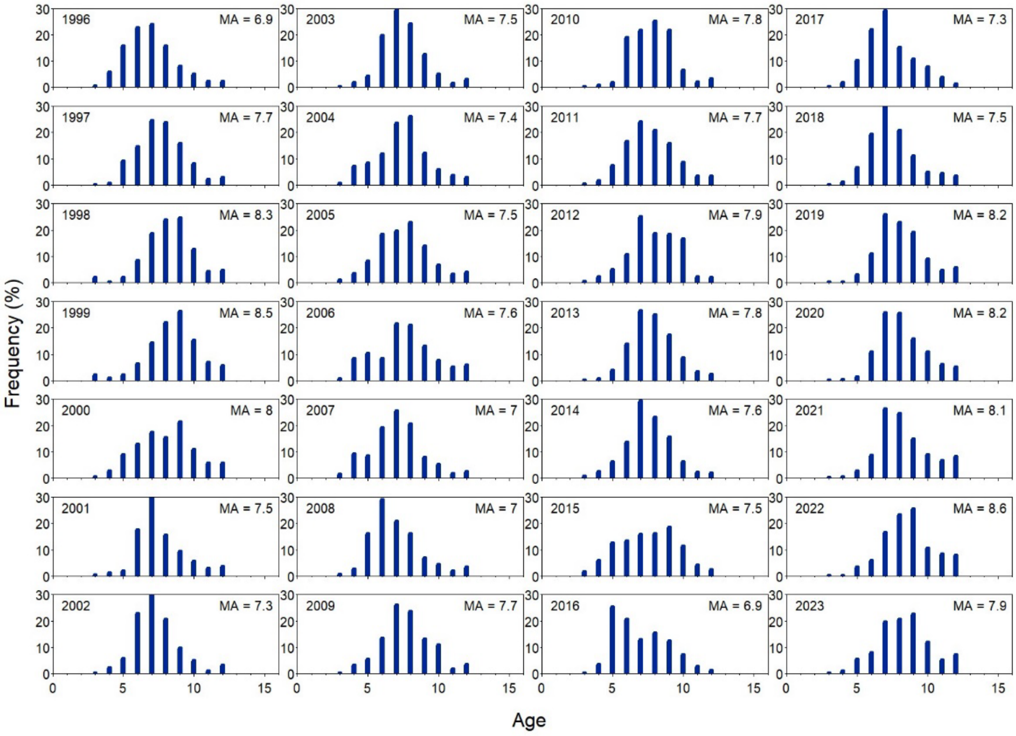

Figure 3.2.6. Ling 5.b. Catch-at-age from the commercial fleets in the assessment (1996-2023). MA- mean age.

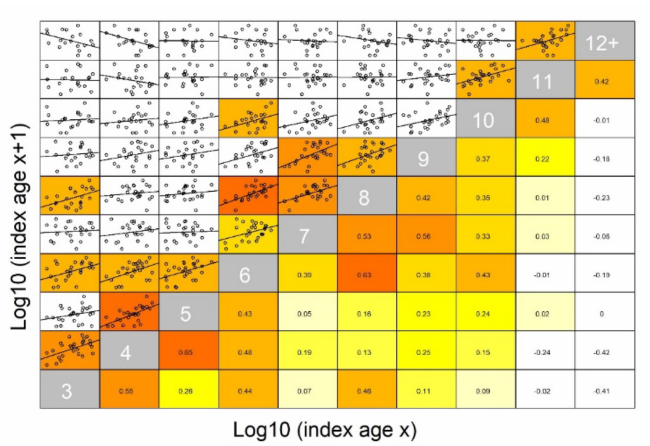

Figure 3.2.7. Ling 5.b. Consistency plots of catch-at-age used in the assessment.

3.2.5.3 Weight-at-age

Mean weight-at-age data from the landings in 5.b is available (Stock annex, ICES, 2021). There are no long-term trends in the mean weights over the period (Figure 3.2.8 and Table 3.2.8).

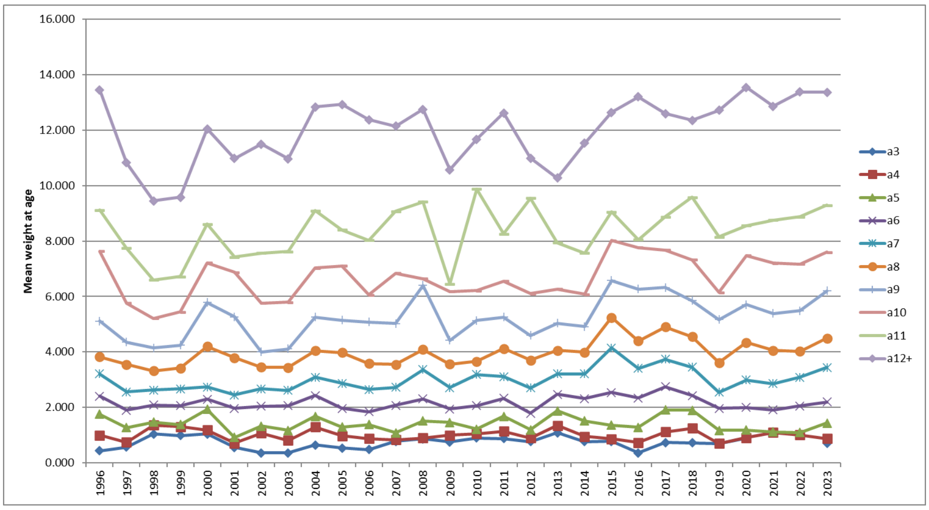

Figure 3.2.8. Ling in 5.b. Mean weight-at-age in the catches (1996-2023).

3.2.5.4 Maturity and natural mortality

Fixed proportion mature at age used in the assessment is presented in the table below. More information of this and maturity ogives of ling are presented in the stock annex.

Age	3	4	5	6	7	8	9	10	11	12+
Prop. mature	0.00	0.04	0.19	0.50	0.79	0.93	0.98	1.00	1.00	1.00

No information is available on natural mortality of ling in 5.b. Natural mortality of 0.15 was assumed for all ages in the assessment. That is the same as used for ling in Division 5.a.

3.2.5.5 Catch, effort and research vessel data

Commercial CPUE series

Catch per unit of effort (CPUE) data is available from three commercial series; the Faroese longliners, the Faroese pair trawlers (bycatch in saithe fishery) and Norwegian longliners fishing in Division 5.b. Although no obvious problems were detected in the commercial tuning series, in terms of series trends or problems arising from aggregating fish or fishery targeting, the WKBARFAR benchmark decided not to use the commercial series in the tuning of the assessment model (ICES, 2021). The CPUE series of the Faroese fishery are described in stock annex for ling in 5b whilst the standardized CPUE data from Norwegian longliners operating in Division 5.b are described in the stock annex for ling in 2.a (Section ling in 1 and 2).

Fisheries-independent CPUE series

Survey biomass indices (kg/h) for ling are available from the annual groundfish trawl surveys on the Faroe Plateau targeting cod, haddock, and saithe. The spring survey takes place in February/March (ICES acronym: G1264) while the summer survey is conducted in August (ICES acronym: G3284). Both surveys cover the main fishing grounds and most of the stock spatial distribution in Faroese waters. More detailed information on the surveys and standardization of the data are described in the stock annex. WKBARFAR benchmark adopted both the spring- and summer groundfish surveys as a tuning series of the assessment model (ICES, 2021).

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 for both longline and trawl from 74–79 cm in 2007 to around 83–86 cm in 2010 to 2021 and has been increasing over the recent years (Figure 3.2.3). Length composition data are similar in both Faroese trawlers and longliners. Mean length from 2003 to 2009 from the Norwegian longline fleet in Faroese waters was estimated at 87 cm.

Length composition from the two groundfish surveys on the Faroe Plateau shows high interannual variation in mean length. The length varies from 65 to 85 cm which may partly be explained by occasional high abundance of individuals smaller than 60 cm (Figures 3.2.4–3.2.5). The mean length in the surveys have increased by 7-10 cm each year since 2021 (83-83 cm) to spring 2023 (100 cm), indicating missing recruitment.

3.2.6.1 Fluctuations in abundance

Faroese longline CPUE series and trawl bycatch CPUE series showed an increasing trend since around 2001 to a maximum in 2019 (144 kg/1000 hooks, 73 kg/hour), where the longline series started to decrease whereas the trawler bycatch series was still around maximum level (Figure 3.2.9). Norwegian longline series display an overall increase from 50 kg/1000 hooks in 2004 to the highest value of 216 kg/1000 hooks in 2017 and it has decreased in recent years (Figure 3.2.9). It must be noted that there are less than 100 fishing days from Norwegian longliners in Faroese waters in 2009–2014.

The two survey abundance series indicate a stable situation from the late 1990s and an increase to a higher level since 2010, but they have overall decreased since 2020 (Figure 3.2.10).

A size-based recruitment index is compiled for individuals smaller than 40 cm (Figure 3.2.13). The index indicates high recruitment in the period 2013-2018. There has been a decrease since 2016 and has been on a very low level since 2019 in both surveys. In addition, another recruitment index is calculated based on small juveniles (2–3 cm in length) from the annual 0-group survey on the Faroe Plateau since 1983. The index also showed indications of high recruitment in some years (Figure 3.2.12). No juvenile ling individuals are found in the 0-group survey since 2020, with the exception of a single in the 2023 survey.

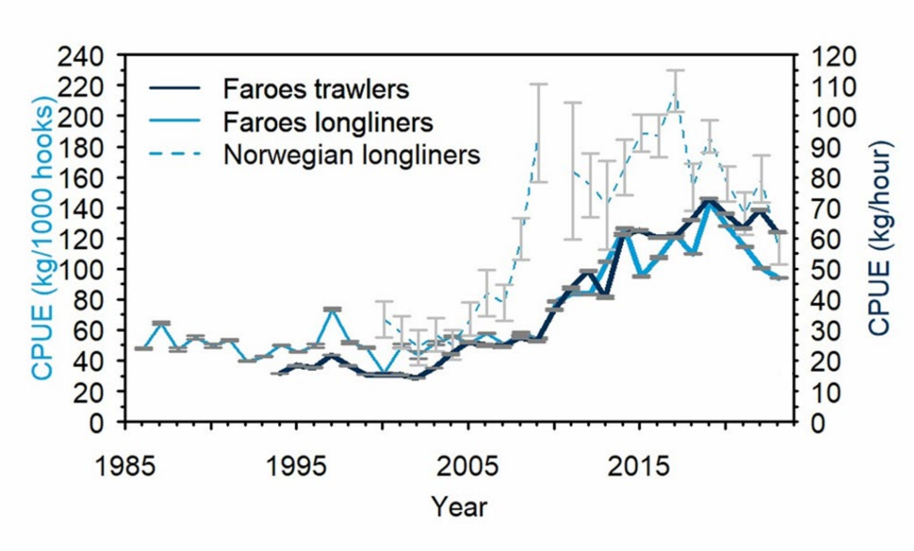

Figure 3.2.9. Ling in 5.b. Standardized CPUE from Faroese pair trawlers (bycatch, dark blue line), Faroese longliners (turquoise line) and Norwegian longliners (turquoise stippled line) fishing in Faroese waters. Data from Faroese trawlers are from hauls where ling was caught and saithe >60% of the total catch. Data from Faroese longliners (>110 GRT) are from sets where ling >30% of the total catch. The error bars show SE. Vertical bars display 95% confidence intervals in the Norwegian data.

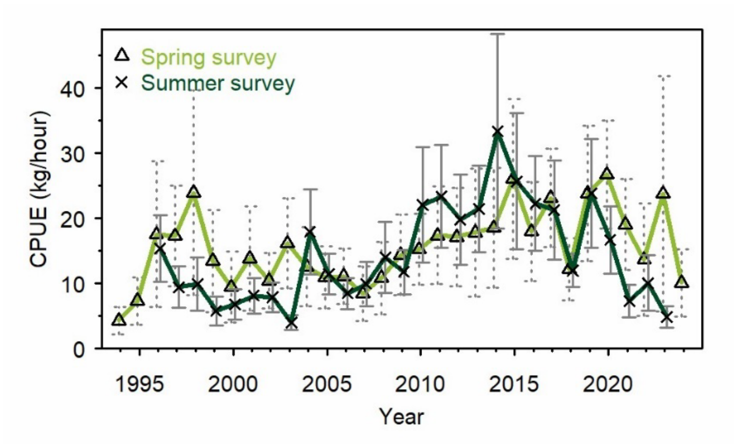

Figure 3.2.10. Ling in 5.b. Standardized CPUE (kg/hour) from the two annual Faroese groundfish surveys on the Faroe Plateau with standard errors.

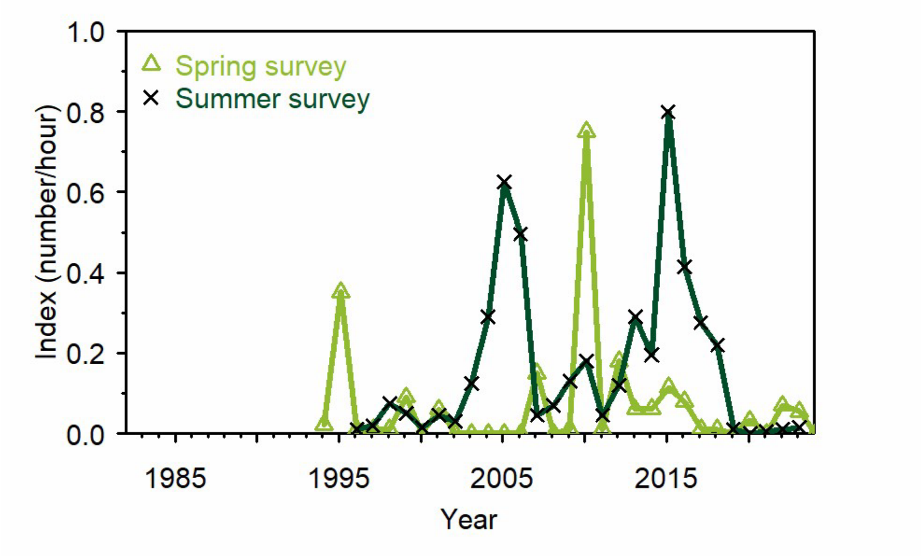

Figure 3.2.11. Ling in 5.b. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

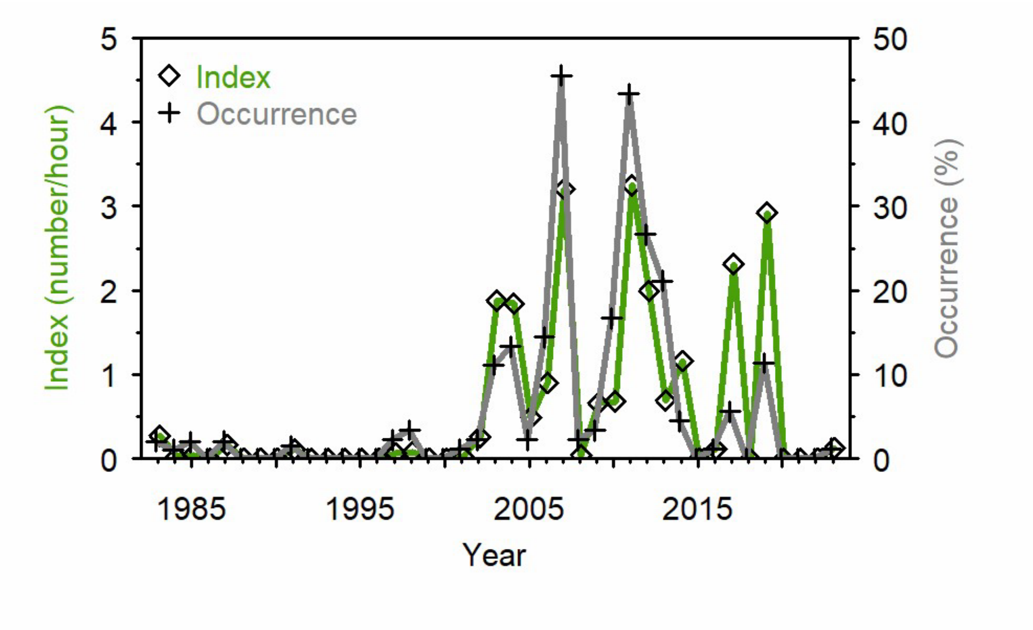

Figure 3.2.12. Ling in 5.b. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

3.2.6.2 Stock assessment

Ling in 5b was updated to Category 1 using SAM as the basis for advice at the WKBARFAR benchmark in 2021 (ICES, 2021 and stock annex).

Analytical assessment using SAM

The input for the SAM model was catch at age for ages 3 to 12+ and for years back to 1996. Maturity at age is compiled from the Faroese survey data and it is fixed for the assessment period. Natural mortality is set to 0.15 for all ages and years. The age-disaggregated tuning series were the Faroese summer survey, ages 3 to 11 (1996-2023) and the Faroese spring survey, ages 4 to 11 (1998-2023). The SAM model configuration settings are described in detail in the stock annex.

Age disaggregated indices from the spring- and summer surveys are presented in Table 3.2.9 and 3.2.10. They show periods of good year classes around 2015. Indications of good year classes were also confirmed in the 0-group survey (Figure 3.2.12). In 2023, these good year classes are at an age that decrease in the fishery and it seems like the recruitment is at a low level. This indicates that the survival of these year classes has been lower than for other year classes. Stratified catch rates (kg per hour) show increased levels from 2010 to 2019 in both surveys. The index has decreased in recent years

(Figure 3.2.10). The internal consistency of the summer survey measured as the correlation between the indices for the same year class in two adjacent years is good, with r^2 ranging from 0.5 to 0.7 for the best-defined age groups (Figure 3.2.13). The internal consistency of the spring index is overall inferior to that of the the summer index (Figure 3.2.14). Ling is fully recruited to the survey at around age 5.

The results and diagnostics of the final assessment **lin.27.5b_wgdeep2024** (stockassessment.org) are presented in Tables 3.2.11-3.2.14 and Figures 3.2.15-3.2.19.

Results from the SAM assessment shows that the spawning stock biomass (SSB) has peaked around 2017 to 2021 although it has decreased in recent years.(Figure 3.2.15, Tables 3.2.11, 3.2.13). Fishing mortality ($F_{6\text{-}10}$) in 2023 was high (Figure 3.2.15, Tables 3.2.11, 3.2.12).

Fishing pressure on the stock is above F_{MSY} but just below F_{pa} and F_{lim}; spawning-stock size is below MSY $B_{trigger}$ and below B_{pa} and B_{lim}.

The model diagnostics are shown as model fits to the data (Figure 3.2.16), residuals (Figure 3.2.17), leave-one-out analysis (Figure 3.2.18), retrospective analysis (Figure 3.2.19) and parameter estimates (Table 3.2.14). Model residuals are randomly distributed and the leave one out analysis shows that the model is robust. Mohn's rho parameters are estimated at -2%, 7% and 44% for the spawning stock biomass, F and recruitment, respectively.

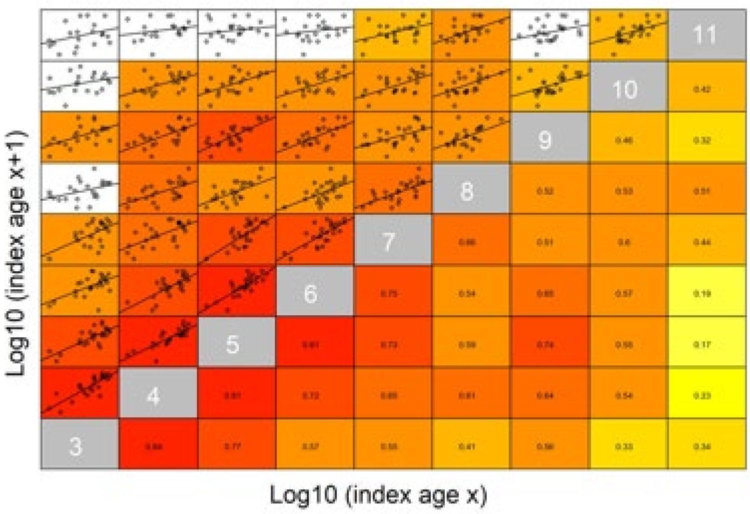

Figure 3.2.13. Ling in 5.b. Consistency plot of catch-at-age in the summer survey tuning series in the assessment.

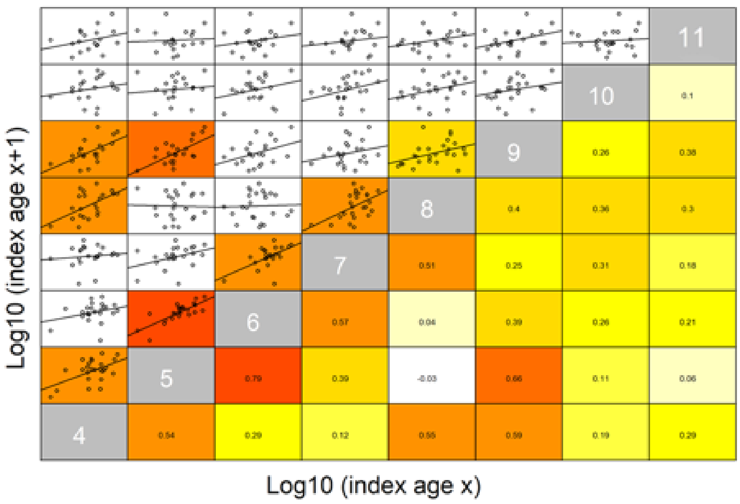

Figure 3.2.14. Ling in 5.b. Consistency plot of catch-at-age in the spring survey tuning series in the assessment.

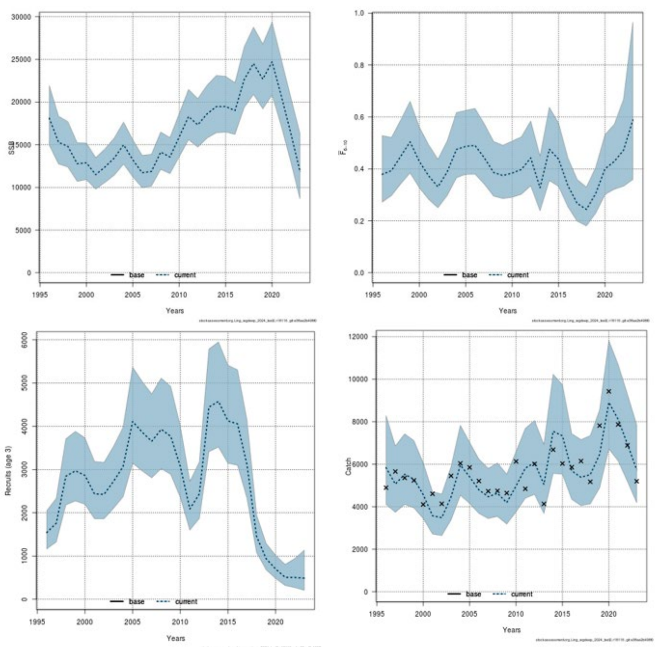

Figure 3.2.15. Ling in 5.b. Output from SAM. Results per year for spawning stock biomass (tonnes, upper left), fishing mortality ($F_{6\text{-}10}$, upper right), recruitment (age 3, thousands, lower left) and catch (tonnes, lower right). Stippled line is median, shaded area is 95% CI and x- is actual catch.

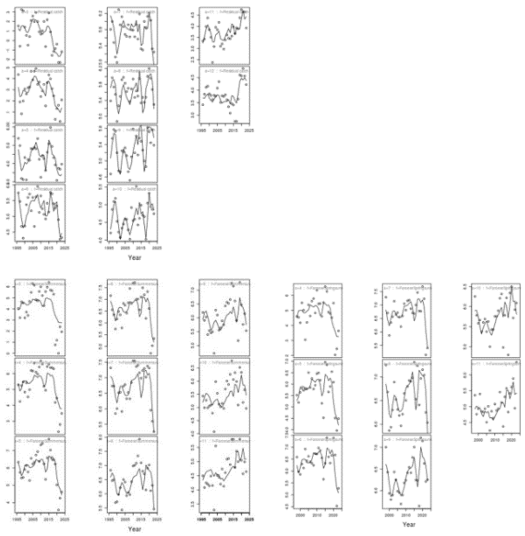

Figure 3.2.16. Ling in 5.b. Output from SAM. Model fit of data; catch (upper left), summer survey (lower left) and spring survey (lower right).

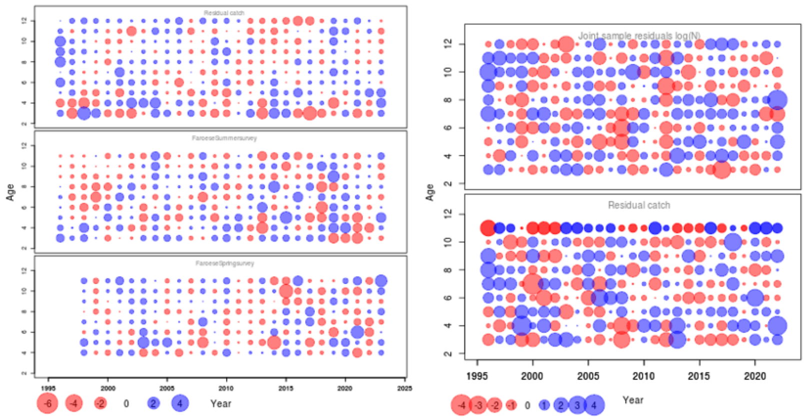

Figure 3.2.17. Ling in 5.b. Output from SAM. Model residuals (left) and process errors (right).

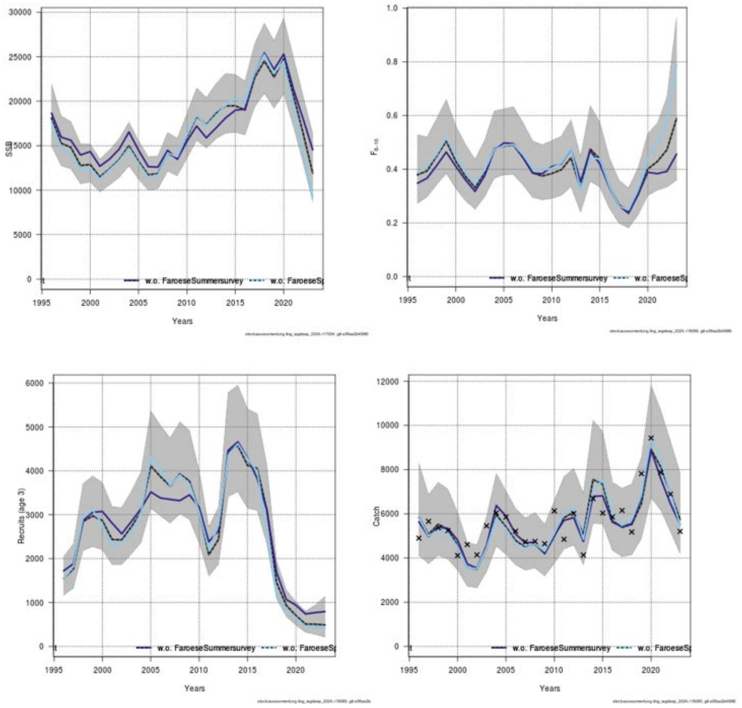

Figure 3.2.18. Ling in 5.b. Output from SAM. Leave-one-out analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

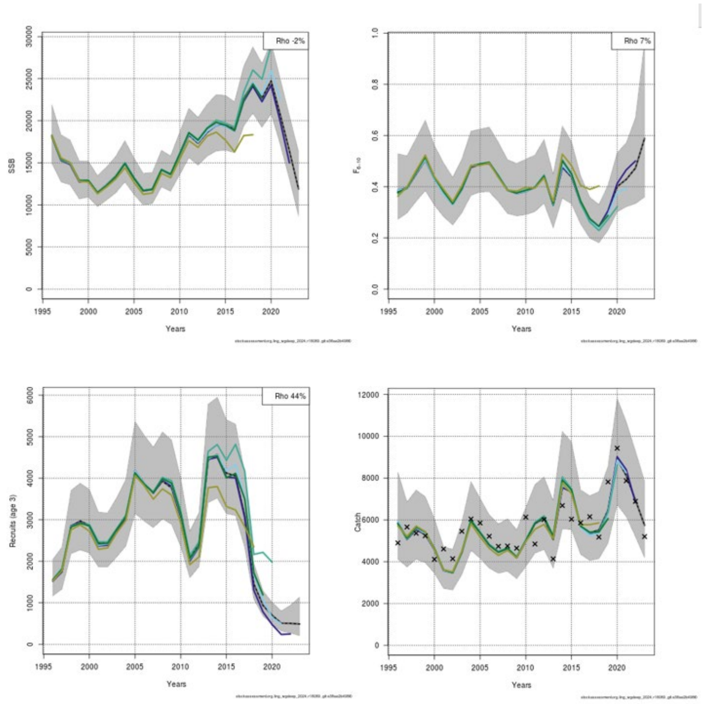

Figure 3.2.19. Ling in 5.b. Output from SAM. Retrospective analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

3.2.6.3 Quality of the assessment

Ling 5.b was benchmarked in 2021 (ICES, 2021), where the assessment was upgraded from a trend-based assessment (Category 3) to the SAM state-space model. the current assessment is very consistent with previous assessments (Figure 3.2.20).

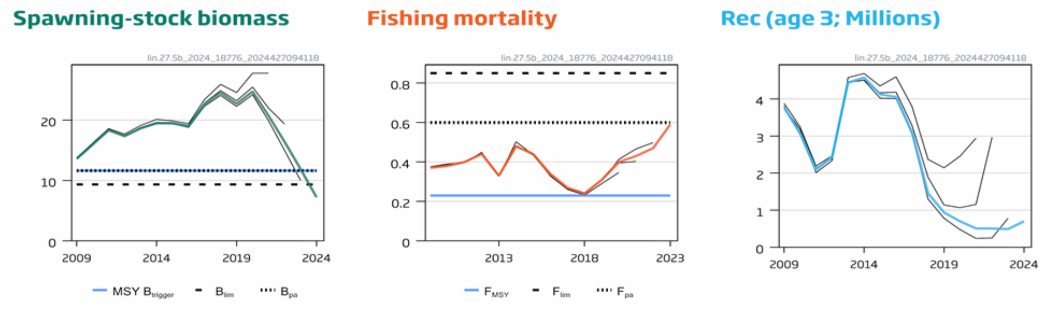

Figure 3.2.20. Quality of the assessment.

3.2.7 Short-term prediction

Settings for the short-term forecast are presented in the stock annex and the output in **lin.27.5b_wgdeep2024** (stockassessment.org).

3.2.7.1 Input data

The assumptions made for the interim year and in the forecast are presented in the table below. The resampling of median recruitment was changed to 5 years instead of 25 years at WGDEEP 2023, as ADGDEEP recommended to use a shorter period because of low recruitment. The most recent recruitment datapoint was excluded because it was considered very inaccurate.

Variable	Value	Notes
$F_{ages\ 6–10}$ (2024)	0.59	$F_{sq} = F_{2023}$
SSB (2025)	4738	Short-term forecast fishing at F_{sq}; tonnes.
$R_{age\ 3}$ (2024/2025)	700	Median recruitment, resampled from the years 2018–2022; Thousands.
Total catch (2024)	3321	Short-term forecast using F_{sq}; Tonnes.

3.2.7.2 Results

The current assessment shows that the SSB increased gradually during the time period of 2016-2021 and has decreased substantially in recent years due to extraordinary low recruitment. In this context the short term forecast plays an important role when providing the advice. The fishing mortality was very high in 2023 and assumptions about 2024 and onwards are crucial to the perception of the stock in the future. The stock has in 2024 already gone below Blim and Btrigger and will likely decrease even more in the near future. The F MSY approach (F=0.094) and the zero fishing option both give an SSB of around 5000 tons in 2026. This leads to a zero catch advice for 2025.

Catch options for scenarios with F_{MSY}, F_{pa}, F_{lim}, F_{sq} and F = 0 is presented in Table 3.2.15.

Year	F_{6-10}			Recruitment (thousands)			SSB (tonnes)			Catch (tonnes)			TSB (tonnes)		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
2023	0.594	0.370	0.938	498	211	1189	11992	8898	16611	5676	4177	7697	14118	10605	19348
2024	0.594	0.370	0.938	700	505	1455	7224	4145	11846	3321	2459	4413	9255	5710	14344
2025	0	0	0	700	505	1455	4738	2234	9177	0	0	0	7000	4025	11685
2026	0	0	0	700	505	1455	5906	3012	10323	0	0	0	8365	5148	13324
2027	0	0	0	700	505	1455	7153	3938	11961	0	0	0	9848	6281	15042
2028	0	0	0	700	505	1455	8676	5201	13874	0	0	0	11461	7624	17049

3.2.8 Reference points

Biological reference points for ling in 5.b are shown in the Table below. Description of the reference points calculation is given in the stock annex and in ICES, 2021. In 2021 the definition of F_{pa} of 0.62 was changed to be the same as $F_{p0.5}$.

$MSY_{Btrigger}$	5thPerc_SSB_{msy}	B_{pa}	B_{lim}	F_{pa}	F_{lim}	F_{p05}	$F_{msy\_unconstr}$	F_{MSY}
11627	21707	11627	9340	0.6	0.85	0.6	0.23	0.23

3.2.9 Comments on assessment

All signals from the commercial catches and also surveys indicate that ling stock in Division 5.b at present is in a state with very low recruitment, and this is also confirmed in the assessment. The substantial drop in recruitment since 2016 has led to the stock to decline below B_{lim} in 2024 and according to the short term forecast this situation will continue in the coming years..

We investigated the configuration for F in the SAM model for the younger ages which resulted in narrower confidence interval when the F for ages 3, 4, 5, 6 were estimated separately lin27_5b_wgdeep2024exploratoryconfiguration (stockassessment.org). The change in Mohn´s rho for SSB and F was minimal. However, the Mohn's rho for recruitment increased from 44% to 65%. This concluded to revert to original configurations for the assessment.

3.2.10 Management consideration

Stability in landings and abundance indices do suggest that ling stock in Division 5.b has been stable since middle of the 1980s, with an increasing trend in biomass in the last decade. 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 recruitments in last decade compared to earlier, but there has been a drop in recruitment since 2016 (Figure 3.2.15).

The Faroese effort management system introduced in 1996 is in force for the demersal fleets operating on the Faroe Plateau. A preliminary management plan using a harvest control rule was adopted by the Faroese fisheries authorities in 2020 and applied for the first time for the calendar year 2021. The number of fishing days was decided according to the stock status of cod, haddock, and saithe. Although the management plan opens up for the development of special bycatch rules, this has not yet been integrated. The management plan has not been evaluated by ICES.

Ling is not yet addressed specifically in the management plan although this likely will happen in the current revision process of the management plan. Even though the number of fishing days may not yet regulate the fishing pressure on demersal fish tightly enough due to un-used days, an enforced reduction of 20% for Group 3-5 (longliners) from 2023 to 2024 begins to limit the exerted fishing mortality for Group 3 (large longliners). Also, the 1:3 rule for getting three days in the deep areas in exchange for one day in the shallow areas was changed to 1:2. Hence, the fishing mortality on ling will likely decrease in the near future. There is a minimum landing size for ling of 60 cm that may limit the fishing mortality on young ling somewhat. Also, the exploitation of ling is influenced by regulations aimed at other groundfish species, i.e., cod, haddock, and saithe, such as closed areas. Fisheries by other nations are regulated by TACs.

3.2.11 Ecosystem considerations

Since on average 69% of the catches are taken by longlines, the remaining by trawls, the effects of the ling fishery on the bottom fauna and benthic ecosystem are moderate (Table 3.2.4).

3.2.12 Future research and data requirements

The number of samples from the commercial fisheries have been decreasing in recent years and it would be preferred to increase the number of samples.

3.2.13 References

ICES. 2021. ICES fisheries management reference points for category 1 and 2 stocks. ICES Advice Technical Guidelines. https://doi.org/10.17895/ices.advice.7891

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3.2.14 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

Year	Denmark(2)	Faroes	France	Germany	Norway	E&W(1)	Scotland (1)	Russia	Total
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
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
2019		4862	25		1983		27		6895
2020		5642	16		2537		83		8277
2021		5074	11		1444		0		6529
2022		4503	3		895		113		5513
2023*		3631	6		323		97		4058

***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

Year	Faroes	France	Norway	Scotland	Total
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
2017	359		542		901
2018	428		78	6	512
2019	338		580	2	920
2020	1015		128	6	1149
2021	1268		72		1340
2022	1200		89	40	1330
2023*	545		553	44	1142

***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

Year	5.b1	5.b2	5.b
2016	5180	710	5890
2017	5294	901	6195
2018	4673	512	5185
2019	6895	920	7816
2020	8277	1149	9427
2021	6529	1340	7869
2022	5513	1330	6843
2023*	4058	1142	5200

***Preliminary.**

Table 3.2.4. Ling in 5.b. Catch distribution by fleet and total catch in 1996 to 2021. * preliminary catch.

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
1996	31	68	1	4896
1997	37	62	1	5657
1998	39	61	0	5359
1999	37	62	1	5238
2000	42	57	1	4109
2001	37	61	1	4609
2002	41	57	1	4139
2003	33	65	2	5453
2004	25	73	1	6039
2005	27	72	1	5849
2006	24	75	1	5213
2007	33	66	1	4731
2008	24	75	1	4747
2009	27	72	1	4643
2010	23	76	1	6129
2011	29	71	1	4843
2012	30	70	0	6011
2013	29	70	0	4132

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
2014	28	72	0	6684
2015	42	58	0	6031
2016	37	62	1	5857
2017	31	69	0	6148
2018	34	66	0	5185
2019	39	61	0	7816
2020	31	69	0	9427
2021	23	77	0	7869
2022	22	77	1	6885
2023	30	69	1	5200*
Average	31	68	1	5673

Table 3.2.5. Ling in 5.b. Overview of the sampling from commercial landings since 1996.

	Lengths			Gutted weights			Ages		
Year	Longliners	Trawlers	Other	Longliners	Trawlers	Other	Longliners	Trawlers	Other
1996	5003	1426	48	290	120	0	709	375	0
1997	6493	1407	0	361	180	0	1195	331	0
1998	4163	1651	193	180	358	0	723	358	0
1999	3024	1067	445	180	120	60	240	180	60
2000	1719	1793	0	120	240	0	120	240	0
2001	2243	1562	0	180	240	0	180	240	0
2002	1845	2454	0	60	120	0	120	180	0
2003	4533	2052	0	120	240	0	421	240	0
2004	4350	2477	0	990	179	0	480	179	0
2005	4995	2172	0	3097	120	0	420	120	0
2006	4936	1291	0	3576	1082	0	157	119	0
2007	2077	1662	172	1034	447	172	60	60	0
2008	1432	1087	0	1215	730	0	60	0	0
2009	2127	2246	0	2102	2246	0	112	120	0
2010	1421	2502	422	1421	2436	422	60	120	0

	Lengths			Gutted weights			Ages		
Year	**Longliners**	**Trawlers**	**Other**	**Longliners**	**Trawlers**	**Other**	**Longliners**	**Trawlers**	**Other**
2011	1438	1765	202	1438	1188	202	0	0	0
2012	1413	1397	0	1283	1164	0	50	0	0
2013	1040	1437	0	1040	1036	0	0	0	0
2014	827	1953	205	827	1242	205	0	20	0
2015	820	1724	0	820	1351	0	40	170	0
2016	1432	1329	0	1432	928	0	180	180	0
2017	1201	1776	0	1201	1225	0	239	241	0
2018	2717	4726	0	2717	4726	0	659	1013	0
2019	2890	3576	0	2890	3576	0	300	592	0
2020	1276	2698	0	705	1911	0	360	569	60
2021	1220	3002	0	1220	3002	0	414	840	0
2022	817	3551	0	817	3551	0	298	760	0
2023	577	1102	0	577	1102	0	150	236	0

Table 3.2.6. Ling in 5.b. Overview of the sampling from spring-, summer and other surveys since 1996. * Have gender but not maturity.

	Lengths			Round weights			Ages			Gender and maturity		
Year	**Spring**	**Sum-mer**	**Other**	**Spring**	**Sum-mer**	**Other**	**Spring**	**Sum-mer**	**Other**	**Spring**	**Sum-mer**	**Other**
1996	398	1013	235	129	216	26	0	0	11	0	0	15
1997	460	631	274	0	247	79	0	0	0	0	0	0
1998	514	648	280	190	462	173	0	0	0	230*	20	5
1999	300	372	84	252	355	62	0	0	0	248*	3	7
2000	245	433	498	244	360	313	0	0	0	14	1	0
2001	347	553	600	265	503	472	0	0	0	28	0	2
2002	285	510	542	222	477	389	0	0	0	0	0	0
2003	389	284	660	345	284	582	0	0	0	0	0	0
2004	284	857	418	284	802	345	0	0	0	0	0	0
2005	321	821	172	264	719	161	0	0	0	0	0	0

	Lengths			Round weights			Ages			Gender and maturity		
Year	Spring	Sum-mer	Other	Spring	Sum-mer	Other	Spring	Sum-mer	Other	Spring	Sum-mer	Other
2006	271	647	220	264	612	214	0	0	0	0	1	0
2007	268	729	99	247	662	99	0	0	0	0	0	0
2008	309	973	66	208	779	65	0	0	0	0	10	0
2009	413	859	152	371	608	152	0	0	0	0	0	0
2010	395	1637	125	281	1021	125	0	0	0	0	0	0
2011	507	1826	167	411	1400	165	0	0	0	3	0	0
2012	518	1160	145	518	1109	144	0	0	0	0	0	0
2013	427	1232	120	427	1105	120	100	78	96	100	78	114
2014	336	1725	674	330	1280	658	161	195	200	177	195	206
2015	562	1440	1077	496	1043	962	92	92	234	100	91	235
2016	409	1366	550	409	1265	550	131	191	110	131	193	110
2017	372	1004	306	308	914	247	124	201	112	126	203	115
2018	265	712	682	265	687	682	228	221	343	227	222	345
2019	490	1318	465	435	1089	465	144	147	155	144	147	162
2020	649	900	274	578	884	273	181	140	99	182	140	99
2021	427	339	415	391	338	413	199	288	227	199	288	227
2022	214	433	69	210	397	69	152	367	57	152	367	58
2023	192	275	22	192	175	155	150	263	53	150	171	143

Table 3.2.7. Ling in 5.b. Catch numbers at age (*1000) used in the assessment.

Year/Age	3	4	5	6	7	8	9	10	11	12+
1996	4.61	78.35	217.21	315.07	331.78	218.24	107.42	66.60	28.09	30.47
1997	0.55	6.75	146.07	238.84	402.52	390.43	257.69	129.96	30.65	46.49
1998	25.65	2.33	24.05	108.31	240.07	309.48	320.41	162.44	53.70	61.29
1999	22.75	7.35	22.63	74.23	167.75	257.56	306.70	178.02	79.40	63.87
2000	4.08	21.44	75.97	109.44	146.73	130.44	181.12	92.52	46.92	47.02
2001	1.72	13.75	22.35	215.75	540.89	193.18	116.06	68.42	33.26	44.27
2002	0.61	23.90	68.27	271.06	371.53	244.48	113.10	58.66	10.70	37.57

2003	1.52	25.89	64.96	302.49	453.02	371.62	189.99	76.46	21.85	44.53
2004	8.17	105.61	123.96	177.67	354.74	394.72	183.83	85.85	52.06	43.07
2005	13.02	48.96	121.94	271.20	293.16	340.27	204.43	98.64	46.65	59.31
2006	7.26	106.18	132.44	107.98	279.51	275.68	168.54	98.24	64.85	76.51
2007	18.96	134.46	122.59	276.73	372.36	299.89	113.57	72.91	22.21	33.42
2008	7.34	32.64	214.41	386.01	276.34	215.38	91.76	55.91	24.63	43.71
2009	2.49	40.18	69.00	168.71	328.79	295.46	164.51	136.75	19.61	42.54
2010	1.96	10.95	25.69	285.53	325.54	378.05	326.26	94.46	29.59	45.48
2011	2.76	17.90	82.28	189.47	276.87	238.35	180.57	98.56	36.85	37.23
2012	7.33	32.67	71.90	158.38	374.58	280.16	274.01	249.81	31.86	28.24
2013	0.53	4.75	37.42	137.06	261.82	246.96	171.52	83.66	31.18	21.83
2014	8.82	37.92	101.19	225.79	486.84	382.35	259.59	101.01	35.07	31.81
2015	18.28	75.68	161.86	170.67	205.68	207.57	240.45	146.60	52.78	30.18
2016	2.46	53.49	395.66	320.91	199.76	238.59	193.40	110.50	39.20	15.73
2017	0.21	22.12	139.53	305.36	403.18	210.10	147.90	105.84	50.66	15.70
2018	0.32	11.62	75.56	222.94	347.56	239.32	128.53	55.74	48.96	38.21
2019	0.43	1.43	50.59	193.19	458.31	405.07	337.82	155.72	79.56	100.16
2020	0.68	3.78	21.72	208.12	495.24	492.70	303.70	205.84	115.21	96.53
2021	0.10	5.02	42.28	134.06	414.55	386.18	231.97	139.74	102.93	129.46
2022	0.10	1.18	40.15	71.67	205.89	290.99	319.16	130.11	104.19	95.81
2023	0.31	8.10	52.54	75.60	189.96	199.67	218.38	115.11	50.41	68.16

Table 3.2.8. Ling in 5.b. Weighted mean weights at age used in the assessment.

Year/Age	3	4	5	6	7	8	9	10	11	12+
1996	0.437	1.033	1.815	2.549	3.356	3.949	5.054	7.143	8.600	12.509
1997	0.689	0.772	1.271	1.932	2.602	3.487	4.427	5.643	7.740	10.415
1998	1.038	1.345	1.469	2.112	2.728	3.500	4.486	5.599	6.786	10.064
1999	0.987	1.299	1.377	2.092	2.739	3.552	4.462	5.843	7.122	10.506
2000	1.037	1.402	2.005	2.517	2.855	4.374	5.775	7.157	8.622	11.587
2001	0.549	0.858	1.154	2.093	2.651	3.983	5.555	7.207	8.136	11.429
2002	0.660	1.081	1.351	2.146	2.888	3.728	4.665	6.798	7.239	11.995

Year/Age	3	4	5	6	7	8	9	10	11	12+
2003	0.701	0.818	1.181	2.225	2.890	3.732	4.463	6.123	7.585	11.290
2004	0.654	1.292	1.674	2.251	3.093	4.042	5.271	6.923	9.080	13.031
2005	0.528	0.964	1.300	2.006	2.890	3.950	5.241	7.034	8.270	12.661
2006	0.495	0.876	1.378	1.867	2.719	3.710	5.145	6.323	7.987	12.332
2007	0.788	1.010	1.216	2.092	2.841	3.651	5.138	6.915	9.019	12.339
2008	0.872	0.942	1.534	2.317	3.295	4.070	5.944	6.713	9.197	12.625
2009	0.796	1.006	1.462	1.965	2.830	3.556	4.514	6.124	7.682	10.750
2010	0.897	1.049	1.248	2.072	3.133	3.730	5.066	6.311	9.372	11.798
2011	0.901	1.173	1.705	2.358	3.165	4.159	5.277	6.564	8.211	12.429
2012	0.770	0.929	1.342	2.043	2.845	3.804	4.716	6.169	8.646	11.149
2013	1.036	1.352	1.912	2.519	3.238	4.048	5.013	6.282	7.947	10.466
2014	0.765	0.963	1.540	2.400	3.424	4.225	5.275	6.356	8.056	11.528
2015	0.775	0.864	1.438	2.565	3.940	4.812	6.233	7.580	8.947	12.918
2016	0.500	0.805	1.364	2.585	3.610	4.575	6.269	7.711	9.064	13.436
2017	0.672	1.085	1.867	2.846	3.763	4.952	6.445	7.821	9.049	12.586
2018	0.735	1.231	1.878	2.516	3.578	4.632	5.886	7.411	9.537	12.299
2019	0.702	0.707	1.294	2.030	2.703	3.738	5.176	6.298	8.056	12.321
2020	0.930	0.995	1.205	2.062	3.013	4.206	5.585	7.200	8.462	12.949
2021	0.757	1.096	1.114	1.943	2.926	4.039	5.394	7.108	8.649	12.734
2022	0.769	0.981	1.104	2.076	3.102	4.078	5.496	7.096	8.862	13.205
2023	0.694	0.875	1.480	2.128	3.198	4.330	5.905	7.371	8.910	13.127

Table 3.2.9. Ling in 5.b. Spring survey input to the tuning series in the assessment.

Year	Effort/Age	4	5	6	7	8	9	10	11
1998	99	9.89	24.55	71.72	145.22	139.42	109.23	51.43	21.05
1999	100	9.32	17.96	39.25	81.76	79.70	61.73	32.54	11.70
2000	100	6.56	28.07	35.01	35.48	35.38	37.82	26.64	13.93
2001	100	24.58	33.24	54.15	57.28	37.88	32.66	28.81	22.10

Year	Effort/Age	4	5	6	7	8	9	10	11
2002	100	15.14	30.60	45.98	70.90	54.61	36.26	21.67	12.77
2003	100	2.10	33.42	101.31	126.24	98.29	61.98	27.26	12.56
2004	100	6.69	32.83	61.94	77.23	68.05	51.93	29.60	13.89
2005	100	21.42	66.62	75.03	82.55	55.15	39.79	21.59	9.09
2006	100	10.26	34.55	59.54	70.37	48.54	38.40	27.83	14.98
2007	100	27.50	51.54	55.93	49.14	39.00	29.58	14.88	7.01
2008	99	32.19	32.12	50.88	72.16	49.44	35.93	22.52	12.70
2009	100	12.53	38.37	83.48	115.08	77.42	48.14	22.83	10.35
2010	100	56.82	63.62	82.75	90.90	66.86	51.17	31.64	16.06
2011	102	23.41	67.54	108.40	131.17	91.45	62.01	32.31	13.43
2012	100	23.31	47.92	95.85	131.63	101.62	69.24	36.49	13.89
2013	100	9.97	17.30	70.18	95.52	99.77	60.88	49.70	23.41
2014	99	24.90	9.11	28.35	81.17	106.26	86.14	54.74	16.70
2015	96	69.48	101.31	53.80	76.77	143.87	106.13	14.00	7.62
2016	100	52.22	94.11	163.49	109.75	68.63	51.51	32.53	20.20
2017	90	11.96	25.69	65.83	157.08	124.76	45.87	45.23	23.65
2018	99	11.88	35.88	55.86	87.03	60.08	27.86	11.99	12.39
2019	100	9.12	69.58	77.89	87.17	106.18	137.35	56.81	22.55
2020	91	21.93	39.91	147.74	198.27	116.33	115.87	60.55	25.11
2021	100	0.77	9.08	79.38	138.28	114.14	75.59	30.44	35.88
2022	100	1.16	5.27	9.27	17.17	51.76	49.72	37.44	14.13
2023	91	3.46	8.06	17.73	20.23	38.05	47.33	40.23	54.78

Table 3.2.10. Ling in 5.b. Summer survey input to tuning series in the assessment.

Year	Effort/Age	3	4	5	6	7	8	9	10	11
1996	200	11.38	39.70	111.95	256.77	300.86	185.77	98.00	45.83	17.95
1997	200	4.94	13.89	61.94	140.89	168.21	128.83	73.46	29.36	11.85
1998	201	20.92	38.21	45.48	114.95	168.79	133.77	83.41	39.23	14.09
1999	199	18.93	47.30	46.45	61.87	68.93	58.80	43.86	29.08	13.34

Year	Effort/Age	3	4	5	6	7	8	9	10	11
2000	200	4.89	25.12	73.80	95.02	81.32	61.06	50.79	31.30	12.60
2001	200	8.27	45.07	92.59	131.29	135.02	78.89	46.75	32.41	17.82
2002	199	6.10	18.48	63.43	113.29	136.87	99.41	48.59	23.73	12.67
2003	200	21.61	29.24	39.10	65.24	73.98	45.50	22.43	11.78	5.36
2004	200	48.54	97.79	139.48	184.82	167.07	133.66	106.36	79.13	51.71
2005	200	106.85	95.08	101.27	171.28	176.16	122.33	89.16	50.75	18.26
2006	200	93.25	155.98	111.89	122.50	111.92	75.77	51.65	33.39	17.12
2007	199	25.15	88.26	168.60	189.28	135.89	84.28	56.02	30.35	13.32
2008	200	22.87	78.03	204.72	349.54	111.51	78.49	72.37	34.51	22.90
2009	200	52.94	121.59	117.20	184.95	188.36	124.15	63.02	28.61	12.40
2010	200	81.20	179.96	302.53	436.20	378.24	216.37	123.76	59.79	20.05
2011	200	36.65	146.14	327.38	451.03	376.30	221.33	141.50	81.09	32.33
2012	202	14.74	36.49	102.95	221.93	316.95	240.56	137.37	71.99	33.48
2013	202	52.95	28.43	42.21	224.36	330.64	312.16	157.45	105.37	26.94
2014	200	78.55	125.02	142.89	140.83	258.05	557.88	281.63	175.20	65.24
2015	200	119.36	145.39	420.17	242.21	215.94	240.78	253.17	85.59	65.09
2016	199	60.14	116.01	222.53	358.31	275.61	178.93	147.10	111.26	24.05
2017	203	57.55	118.45	148.43	271.06	299.32	165.99	74.49	80.68	43.59
2018	202	41.65	109.80	129.74	98.40	226.02	93.65	35.76	32.80	29.95
2019	200	0.43	13.05	100.61	304.17	319.17	199.48	288.33	135.81	65.70
2020	199	0.65	17.08	30.13	147.82	297.51	222.50	128.20	112.15	30.95
2021	200	0.20	2.08	7.17	22.09	77.24	90.12	63.61	35.77	19.27
2022	198	2.16	3.23	14.02	30.22	53.62	107.53	92.58	57.63	29.10
2023	198	1.38	6.48	19.89	40.91	38.32	46.46	50.08	28.30	20.61

Table 3.2.11. Ling in 5.b. Estimated recruitment, spawning stock biomass (SSB), and average fishing mortality.

Year	$R_{(age\ 3)}$	Low	High	SSB	Low	High	$Fbar_{(6-10)}$	Low	High	TSB	Low	High
1996	1544	1165	2048	18105	14950	21925	0.379	0.272	0.528	28852	24366	34164
1997	1762	1328	2338	15284	12737	18340	0.393	0.297	0.521	22319	19023	26187
1998	2845	2183	3708	14810	12389	17704	0.449	0.343	0.588	23641	20377	27427

Year	$R_{(age\ 3)}$	Low	High	SSB	Low	High	$Fbar_{(6-10)}$	Low	High	TSB	Low	High
1999	2971	2273	3882	12776	10715	15234	0.504	0.385	0.660	22090	19121	25522
2000	2865	2199	3733	12877	10913	15195	0.429	0.328	0.561	24759	21510	28498
2001	2436	1864	3185	11495	9799	13483	0.373	0.283	0.493	19332	16795	22251
2002	2426	1861	3164	12397	10590	14512	0.331	0.250	0.437	21379	18565	24619
2003	2727	2104	3535	13435	11435	15785	0.388	0.298	0.507	21796	18905	25129
2004	3070	2370	3976	14993	12736	17651	0.475	0.366	0.617	25298	21994	29098
2005	4111	3150	5366	13221	11234	15560	0.487	0.379	0.625	22311	19432	25617
2006	3867	2969	5036	11721	9987	13757	0.490	0.380	0.633	21303	18572	24436
2007	3652	2809	4748	11868	10157	13867	0.442	0.341	0.573	23541	20523	27004
2008	3930	3021	5113	14137	12123	16486	0.386	0.295	0.505	27519	23961	31605
2009	3768	2887	4917	13568	11623	15838	0.374	0.286	0.491	26206	22807	30112
2010	3071	2357	4001	15928	13604	18650	0.384	0.291	0.507	28489	24753	32790
2011	2088	1600	2724	18304	15600	21477	0.398	0.302	0.524	31466	27267	36311
2012	2437	1872	3173	17333	14729	20396	0.442	0.335	0.584	27159	23493	31398
2013	4443	3413	5785	18624	15786	21973	0.327	0.239	0.449	32143	27845	37104
2014	4577	3520	5950	19473	16406	23114	0.476	0.355	0.637	31822	27568	36733
2015	4125	3145	5410	19482	16498	23006	0.438	0.333	0.576	33108	28777	38092
2016	4055	3100	5304	19002	16216	22268	0.336	0.254	0.443	32085	27870	36938
2017	3105	2333	4132	22651	19381	26474	0.267	0.198	0.359	38302	33215	44169
2018	1455	1085	1950	24518	20894	28771	0.244	0.18	0.33	38395	33148	44472
2019	939	683	1291	22697	19216	26808	0.305	0.230	0.406	30917	26505	36063
2020	700	482	1015	24727	20830	29353	0.400	0.301	0.532	31091	26434	36570
2021	507	320	805	20702	17164	24969	0.429	0.322	0.571	24607	20549	29465
2022	505	271	941	16417	13071	20620	0.472	0.334	0.669	19010	15240	23712
2023	489	211	1133	11905	8679	16331	0.589	0.359	0.965	13974	10296	18967

Table 3.2.12. Ling in 5.b. Estimated fishing mortality at age.

Year /Age	3	4	5	6	7	8	9	10	11	12
1996	0.002	0.013	0.056	0.151	0.313	0.392	0.483	0.557	0.463	0.463
1997	0.002	0.009	0.041	0.125	0.294	0.404	0.526	0.618	0.518	0.518

Year /Age	3	4	5	6	7	8	9	10	11	12
1998	0.002	0.008	0.036	0.118	0.307	0.457	0.625	0.738	0.625	0.625
1999	0.002	0.009	0.035	0.120	0.331	0.518	0.717	0.835	0.706	0.706
2000	0.001	0.008	0.031	0.106	0.286	0.445	0.614	0.692	0.590	0.590
2001	0.001	0.007	0.028	0.100	0.266	0.388	0.522	0.590	0.492	0.492
2002	0.001	0.008	0.031	0.108	0.268	0.361	0.439	0.478	0.394	0.394
2003	0.001	0.012	0.043	0.141	0.339	0.441	0.504	0.517	0.429	0.429
2004	0.002	0.019	0.063	0.187	0.428	0.540	0.60	0.621	0.510	0.510
2005	0.002	0.021	0.068	0.190	0.426	0.539	0.614	0.665	0.573	0.573
2006	0.003	0.021	0.067	0.185	0.415	0.526	0.616	0.710	0.623	0.623
2007	0.003	0.021	0.066	0.182	0.396	0.476	0.545	0.614	0.532	0.532
2008	0.002	0.015	0.051	0.149	0.333	0.403	0.480	0.568	0.491	0.491
2009	0.001	0.010	0.038	0.119	0.292	0.380	0.488	0.594	0.523	0.523
2010	0.001	0.008	0.031	0.103	0.269	0.386	0.532	0.631	0.572	0.572
2011	0.001	0.008	0.034	0.106	0.265	0.386	0.569	0.664	0.601	0.601
2012	0.001	0.010	0.040	0.118	0.283	0.417	0.647	0.747	0.661	0.661
2013	0.001	0.006	0.029	0.085	0.198	0.300	0.500	0.553	0.515	0.515
2014	0.001	0.011	0.053	0.145	0.310	0.437	0.748	0.738	0.662	0.662
2015	0.001	0.012	0.061	0.151	0.297	0.409	0.663	0.668	0.598	0.598
2016	0.001	0.009	0.053	0.132	0.248	0.332	0.493	0.472	0.441	0.441
2017	0.000	0.006	0.037	0.103	0.207	0.276	0.392	0.357	0.345	0.345
2018	0.000	0.004	0.031	0.090	0.191	0.259	0.361	0.320	0.326	0.326
2019	0.000	0.004	0.032	0.098	0.223	0.327	0.462	0.417	0.441	0.441
2020	0.000	0.005	0.043	0.130	0.295	0.418	0.611	0.548	0.591	0.591
2021	0.000	0.006	0.051	0.152	0.338	0.457	0.629	0.567	0.622	0.622
2022	0.000	0.007	0.058	0.171	0.383	0.510	0.707	0.591	0.621	0.621
2023	0.001	0.010	0.085	0.238	0.517	0.640	0.853	0.696	0.669	0.669

Table 3.2.13. Ling in 5.b. Estimated stock numbers at age.

Year/Age	3	4	5	6	7	8	9	10	11	12
1996	1544	2039	2337	2342	1857	1005	444	185	74	116

Year/Age	3	4	5	6	7	8	9	10	11	12
1997	1762	1304	1709	1886	1714	1171	591	237	91	104
1998	2845	1532	1131	1347	1401	1092	673	300	111	101
1999	2971	2421	1349	983	982	856	595	309	123	99
2000	2865	2477	2066	1214	778	577	429	253	114	95
2001	2436	2482	2089	1683	1006	526	310	194	110	100
2002	2426	2104	2114	1753	1311	684	321	157	90	112
2003	2727	2121	1821	1746	1379	860	410	185	82	118
2004	3070	2359	1871	1531	1266	842	474	212	99	113
2005	4111	2605	1972	1515	1107	709	424	227	96	111
2006	3867	3553	2176	1538	1081	623	359	196	101	102
2007	3652	3329	2941	1748	1093	619	319	170	81	94
2008	3930	3074	2744	2319	1236	642	338	156	81	89
2009	3768	3411	2552	2169	1612	798	384	179	75	90
2010	3071	3309	2856	2145	1610	983	481	208	85	85
2011	2088	2689	2909	2353	1656	1034	562	245	95	82
2012	2437	1740	2336	2385	1803	1081	611	272	108	83
2013	4443	1997	1398	1992	1863	1137	600	282	108	84
2014	4577	4018	1687	1205	1525	1403	672	325	134	97
2015	4125	3891	3598	1415	928	972	803	252	134	101
2016	4055	3395	3349	2788	1136	614	558	347	111	108
2017	3105	3547	2726	2672	2046	809	376	304	184	120
2018	1455	2840	3047	2184	2070	1395	516	226	184	185
2019	939	1229	2523	2568	1811	1330	966	321	145	232
2020	700	812	1056	2086	2032	1293	803	520	183	210
2021	507	607	650	915	1571	1267	768	360	258	189
2022	505	435	532	519	666	961	669	367	174	207
2023	489	434	393	439	367	405	488	270	183	175

Table 3.2.14. Ling 5.b. Output from SAM. Model parameters.

Parameter name	par	Sd(par)	Exp(par)	Low	High
logFpar_0	-10.226	0.251	0.000	0.000	0.000
logFpar_1	-9.062	0.146	0.000	0.000	0.000
logFpar_2	-8.254	0.108	0.000	0.000	0.000
logFpar_3	-7.519	0.108	0.001	0.000	0.001
logFpar_4	-7.046	0.109	0.001	0.001	0.001
logFpar_5	-6.822	0.111	0.001	0.001	0.001
logFpar_6	-6.595	0.114	0.001	0.001	0.002
logFpar_7	-6.406	0.121	0.002	0.001	0.002
logFpar_8	-9.680	0.171	0.000	0.000	0.000
logFpar_9	-8.625	0.088	0.000	0.000	0.000
logFpar_10	-7.811	0.087	0.000	0.000	0.000
logFpar_11	-7.224	0.087	0.001	0.001	0.001
logFpar_12	-6.903	0.088	0.001	0.001	0.001
logFpar_13	-6.620	0.089	0.001	0.001	0.002
logFpar_14	-6.488	0.095	0.002	0.001	0.002
logSdLogFsta_0	-1.175	0.201	0.309	0.207	0.462
logSdLogN_0	-1.165	0.166	0.312	0.224	0.434
logSdLogN_1	-2.599	0.279	0.074	0.043	0.130
logSdLogObs_0	-0.678	0.064	0.508	0.447	0.577
logSdLogObs_1	0.247	0.129	1.280	0.990	1.656
logSdLogObs_2	-0.346	0.128	0.708	0.547	0.915
logSdLogObs_3	-0.690	0.109	0.502	0.403	0.624
logSdLogObs_4	-0.201	0.130	0.818	0.631	1.060
logSdLogObs_5	-1.018	0.081	0.361	0.307	0.425
transfIRARdist_0	-1.626	0.241	0.197	0.122	0.318
transfIRARdist_1	-0.514	0.203	0.598	0.399	0.897
itrans_rho_0	1.419	0.268	4.133	2.420	7.057

Table 3.2.15. Ling 5.b. Forecast of recruitment (thousands), SSB (tonnes), catch (tonnes) and TSB (tonnes) when $F=F_{sq}$ in 2023 and 2024 and different scenarios such as $F=F_{MSY}$, F=0, $F=F_{pa}$, $F=F_{lim}$, $F=F_{sq}$. Median values showed.

	Year	F_{6-10}	Recruitment	SSB	Catch	TSB
$F=F_{sq}$, then F_{MSY}	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0.23	700	4738	1005	7000
	2026	0.23	700	4734	1000	7206
$F=F_{sq}$, then 0	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0	700	4738	0	7000
	2026	0	700	5906	0	8365
$F=F_{sq}$, then $F_{pa}=F_{p0.5}$	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0.6	700	4738	2195	7000
	2026	0.6	700	3446	1579	5843
$F=F_{sq}$, then F_{lim}	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0.85	700	4738	2784	7000
	2026	0.85	700	2808	1636	5196
$F=F_{sq}$	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0.594	700	4738	2180	7000
	2026	0.594	700	3464	1574	5862
$F=F_{sq}$ then $F_{MSY}*SSB_{2024}/MSYB_{trigger}$	2023	0.594	498	11992	5676	14118
	2024	0.594	700	7224	3321	9255
	2025	0.127	700	4738	584	7000
	2026	0.127	700	5198	642	7671

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, are well documented. Currently the major fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries, and bycatches of ling are taken by other gears, such as trawls and handlines. Historically around 50% of the Norwegian landings were taken by longlines and 45% by gillnets, partly in directed ling fisheries and as bycatch in other fisheries. This distribution between the gear types seem to be changing and in 2023 the gillnet fishery was landing 49% and longliners 45 % of the total catches. 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 in 2022 and in 2023. There was no fishery in the NEAFC regulatory area in 2023.

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 2022 the total number of hooks per year has varied considerably, but with a downward trend since 2002.(for more information see Helle, WD 2024).

The cod stock in the Barents Sea has been very abundant for years, but now there is a downward trend in the cod stock which has resulted in lower quotas. Most likely the of lower quotas for cod has resulted in the observed increase in fishing pressure on ling.

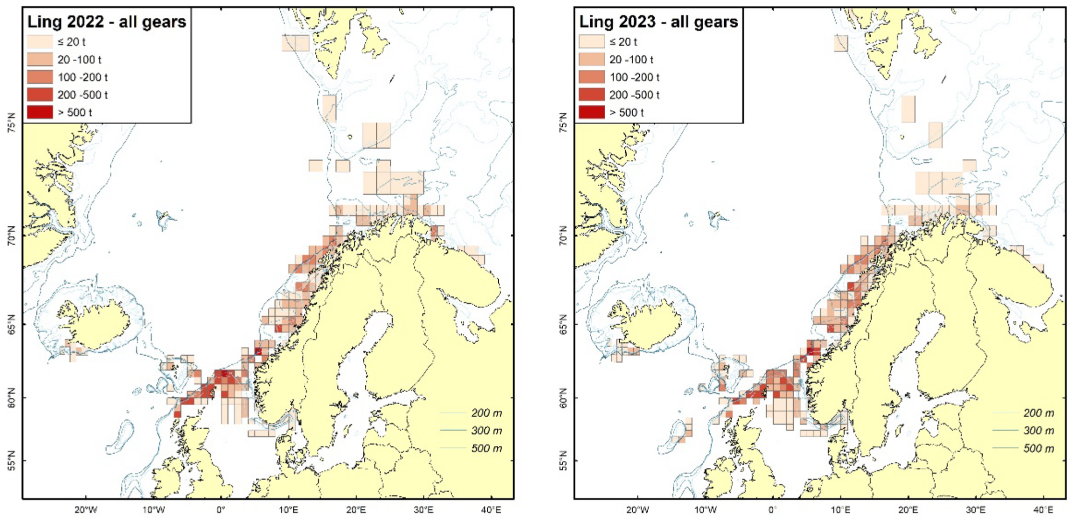


Figure 3.3.1. Distribution of the total catch of ling in Subareas 1 and 2 taken by the Norwegian fishery in 2022 and in 2023.

3.3.2 Landings trends

Landing statistics by nation in the period 1988–2023 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. After this the landings declined to 8000 tons in 2017 followed by two years with high landings, above 11 000 tons. The preliminary landings for 2023 are10 300 t. Total international landings in Areas 1 and 2 are given in Figure 3.3.2.

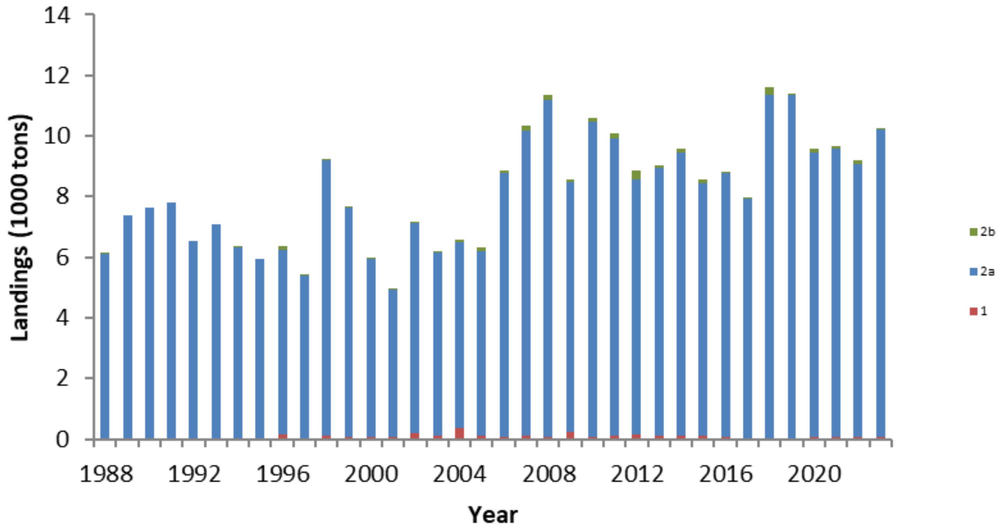


Figure 3.3.2. Total international landings of ling in Subareas 1 and 2.

3.3.3 ICES Advice

Advice for 2024 and 2025: ICES advises that when the MSY approach is applied, catches should be no more than 8 600 tonnes in each of the years 2024 and 2025.

Advice based on the ICES rfb-rule

The assessment is based on ICES rfb-rule for data limited stocks for the first time this year, where life history traits, exploitation characteristics and other relevant parameters for data-limited stocks are considered (ICES 2021). The rfb-rule has the following form:

$$A_{y+1} = A_{y-1}\ r\ f\ b\ m$$

where A_{y+1} is the advised catch, A_{y-1} is last years advice, r corresponds to the trend in biomass index (as in the current ICES "2 over 3" rule), f is a proxy for the exploitation (mean catch length divided by an MSY reference length) and b a biomass safeguard (reducing the catch when biomass index drops below a trigger value).

The former advice when the ICES "2 over 3" rule was set to 10 454 tonnes.

r is the ratio of the mean of the last two survey indices and the mean of the three preceding values or:

$$r = \frac{\sum_{i=y-2}^{y-1} I_1 /2}{\sum_{i=y-3}^{y-5} I_1 /3}$$

f is the length-ratio component where:

$$f = \frac{\overline{L}_{y-1}}{L_{F=M}}$$

where $\overline{L}$ is is the mean catch length above $L_{F=M}$. $L_{F=M}$ is calculated as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty$$

where L_c is length at first capture and $L\infty$ is von Bertalanffy $L\infty$. L_∞ for ling is 127 cm

b is the biomass safeguard and is used to reduce catch advice when index falls below trigger,

$$b = min(1, I_y - 1/I_{trigger})$$

where $I_{trigger}$ = $i_{loss\omega}$

m is a multiplier based on stock growth. K for ling is < 0.11 and therefore m is 0.95.

3.3.4 Management

In 2024, Norway has a quota for ling in areas 1 and 2 of 8 600 tonnes. There is no minimum landing size for the Norwegian EEZ.

In international and union waters of 1 and 2 UK has a TAC of 7 tons, while EU has a TAC of 24 tons.

3.3.5 Data available

3.3.5.1 Landings and discards

Amounts landed were available for all relevant fleets. No discards were reported in 2023. The Norwegian fleets are now regulated by TACs, and there is a ban on discarding, the incentive for illegal discarding is, however, believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

3.3.5.2 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 2023. 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.

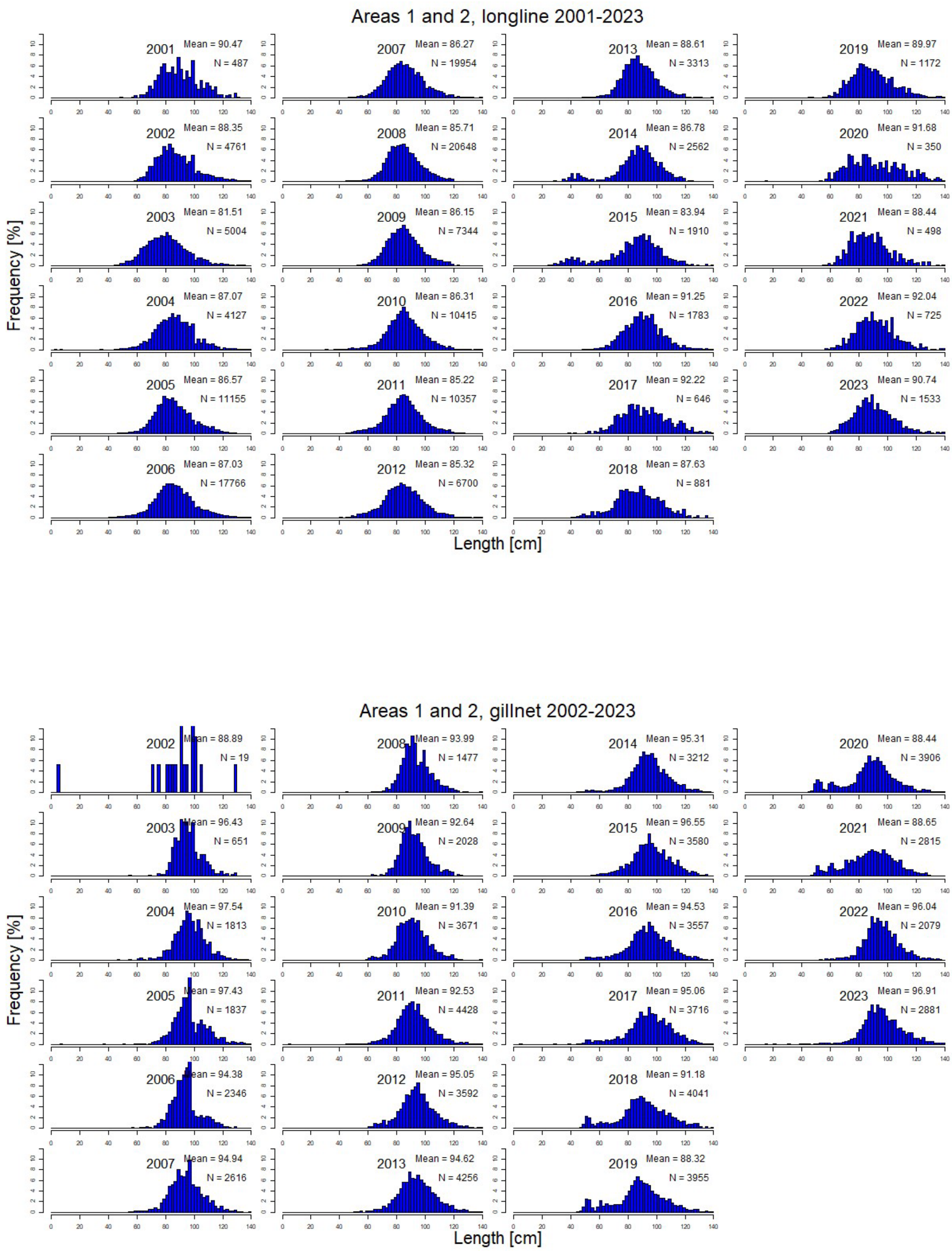


Figure 3.3.3. Plots of the length distributions of ling in Subareas 1 and 2 combined for the period 2001 to 2023 from the Norwegian Reference fleet.

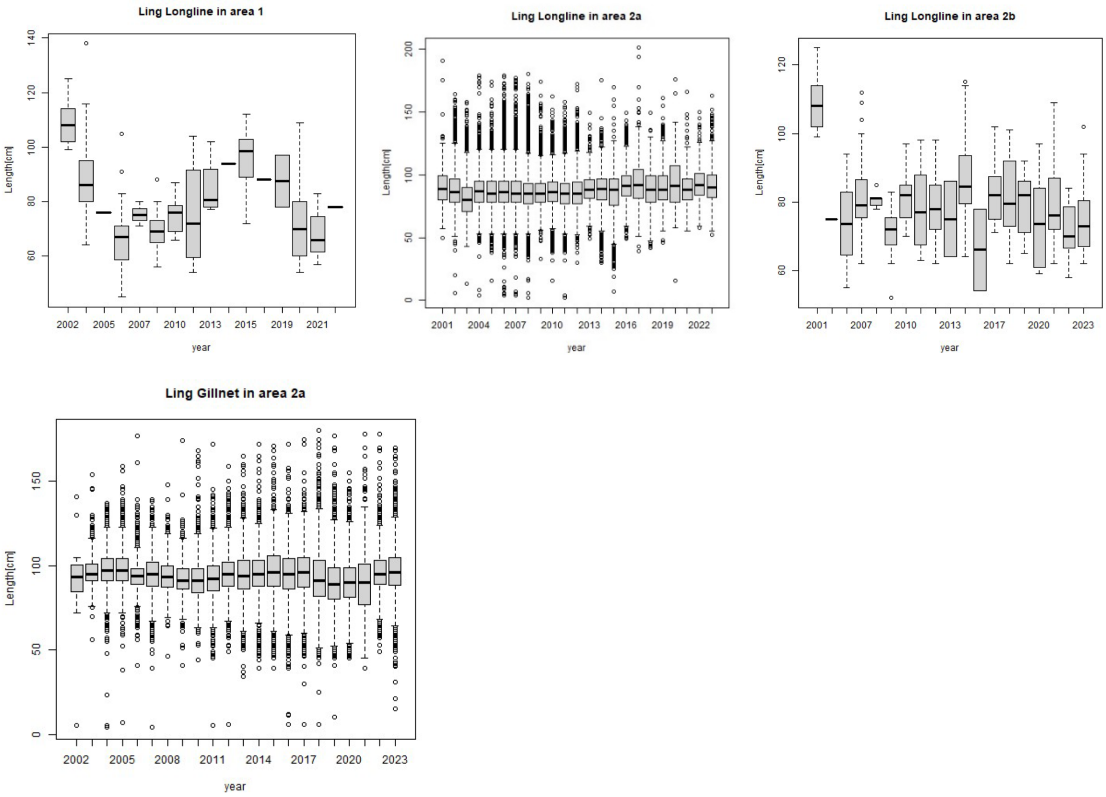


Figure 3.3.4. Box and whiskers plots for the length of ling in Areas 1, 2a and 2b for the period 2001 to 2023 from the Norwegian Reference fleet.

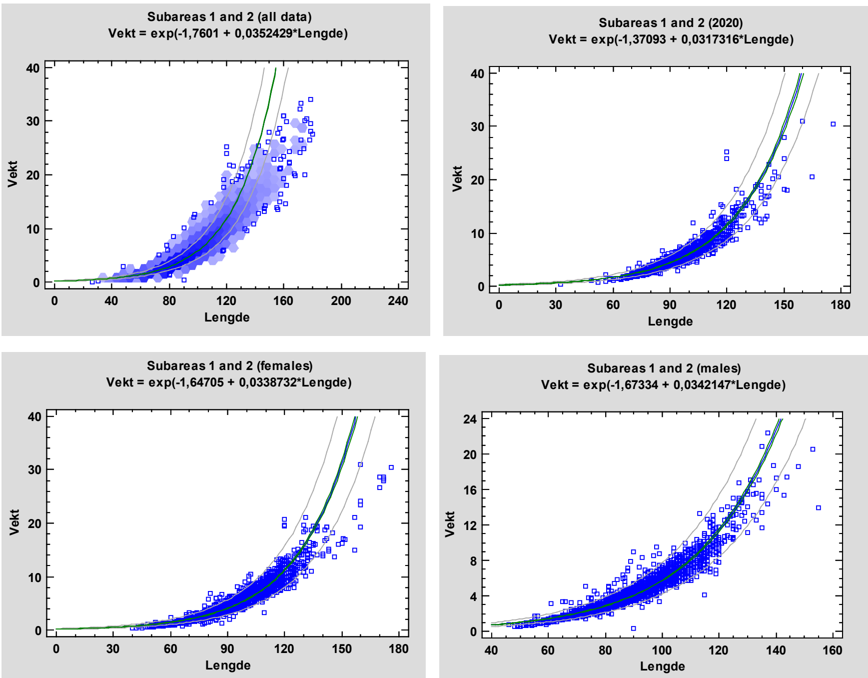
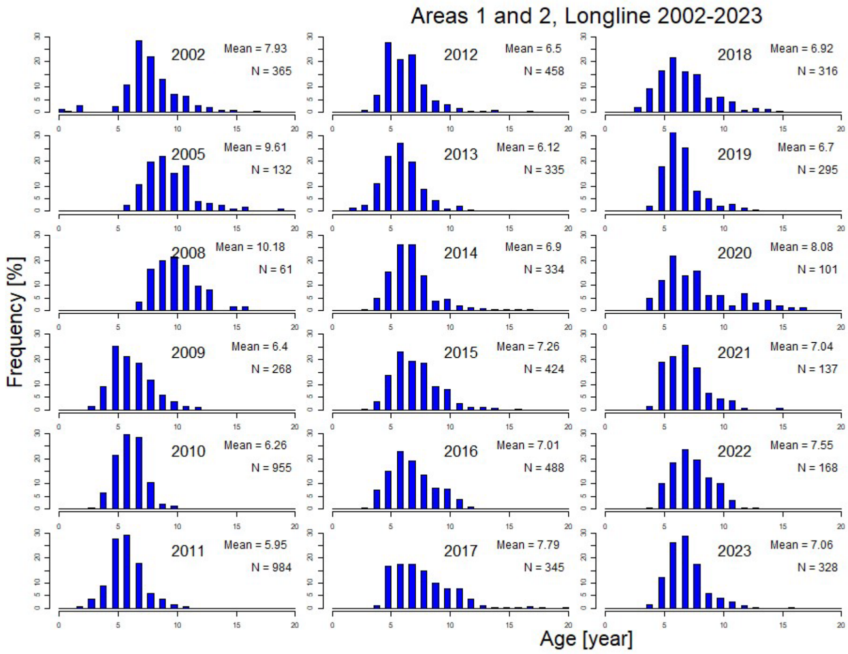


Figure 3.3.5. Weight–length relationship for the period 2008–2020, and only for 2020 (upper panel) and for females and for males, separately (lower panel). Data were collected by the Norwegian Reference Fleet.

3.3.5.3 Age compositions

The Catch-at-age composition for the longline fishery and for the gillnet fishery for 2010–2023 (Figure 3.3.6), and box and whiskers plots for the estimated age distribution of catch for each area are in Figure 3.3.7.



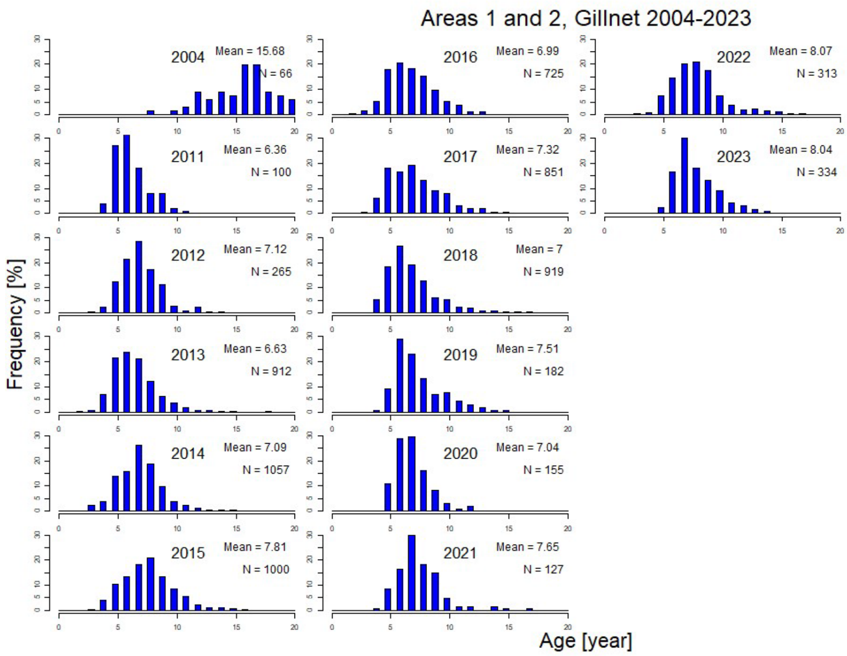


Figure 3.3.6. Ling in Areas 1 and 2, Catch-at-age compositions based on data from the Reference fleet, longliners and gillnetters.

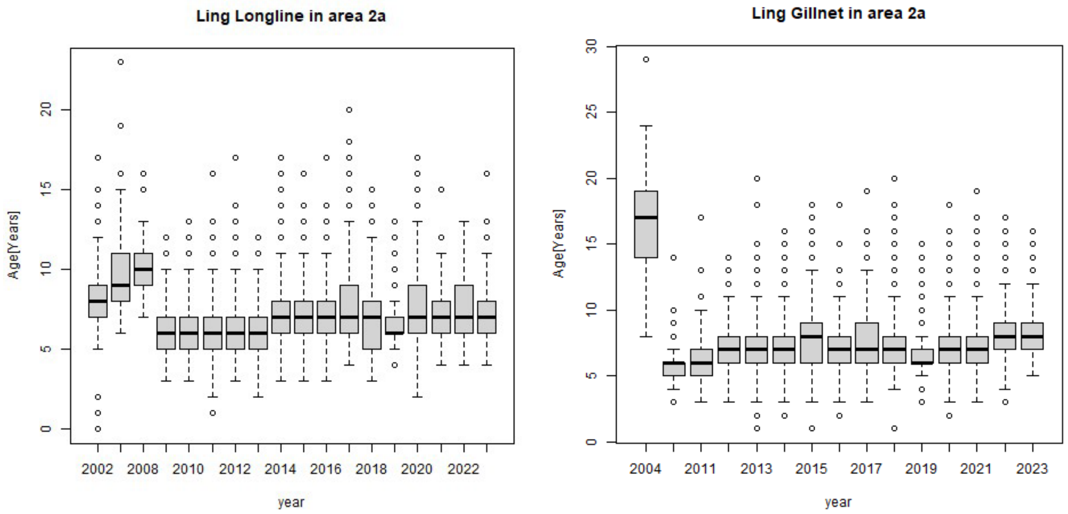


Figure 3.3.7. Age composition of the fish caught by longliners and gillnetters during the period 2002–2023.

3.3.5.4 Length and weight -at-age

Figure 3.3.8 shows the average mean length at age and mean weight at age for the years 2009–2020.

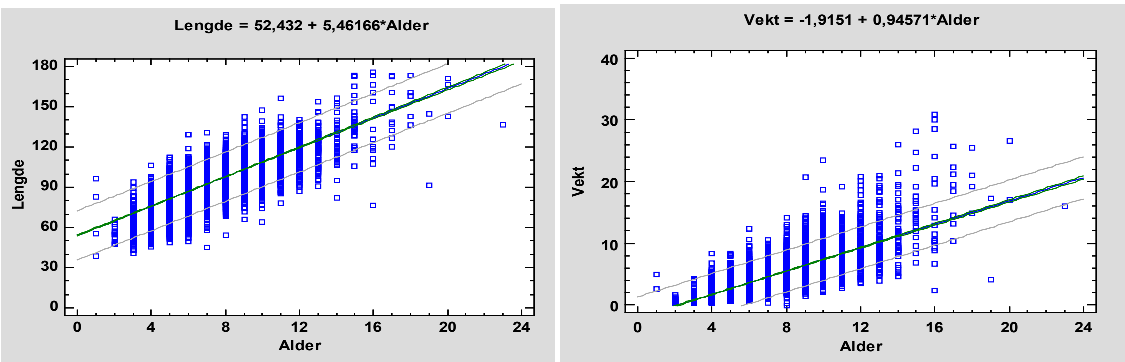


Figure. 3.3.8. Average mean length and mean weight versus age for the period 2010–2020.

3.3.5.5 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

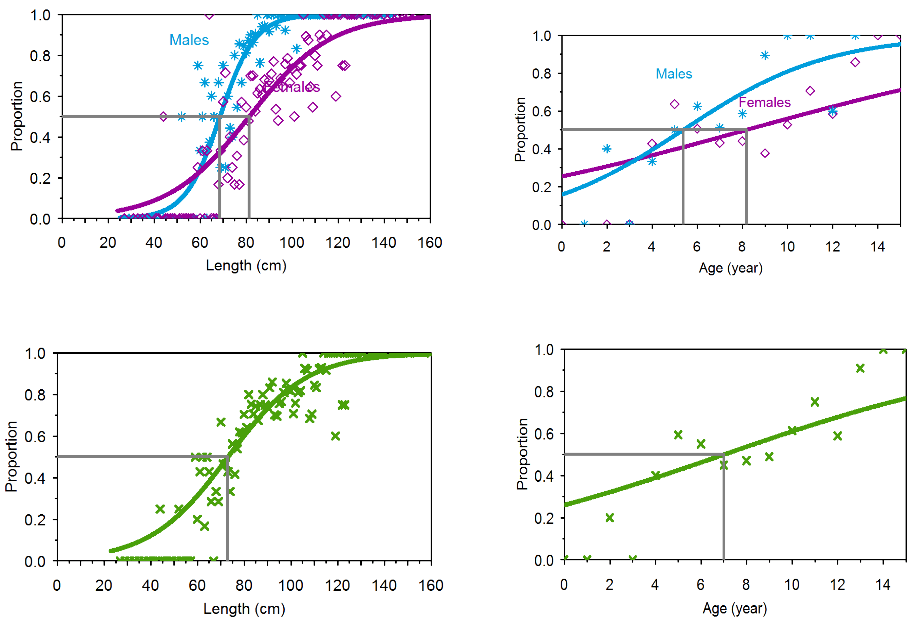


Figure 3.3.9. Maturity ogives for ling in Areas 1 and 2: males and females (upper panel) and for males and females combined (lower panel).

3.3.5.6 Catch and effort data

Two standardized cpue series for 2000–2023 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.

3.3.6 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 2023. It appears that the mean length in Area 1 has varied slightly, while the mean length in Areas 2a and 2b has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery.

Age distribution

In Figures 3.3.6 and 3.3.7 are plots of the age distributions in Area 1 and 2 for 2001 to 2023. It appears that the mean age in Area 2a has been very stable. The average age 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 period until 2017, after 2017 there was a declining trend and then a stable trend. The method is described in Helle *et al.*, 2015.

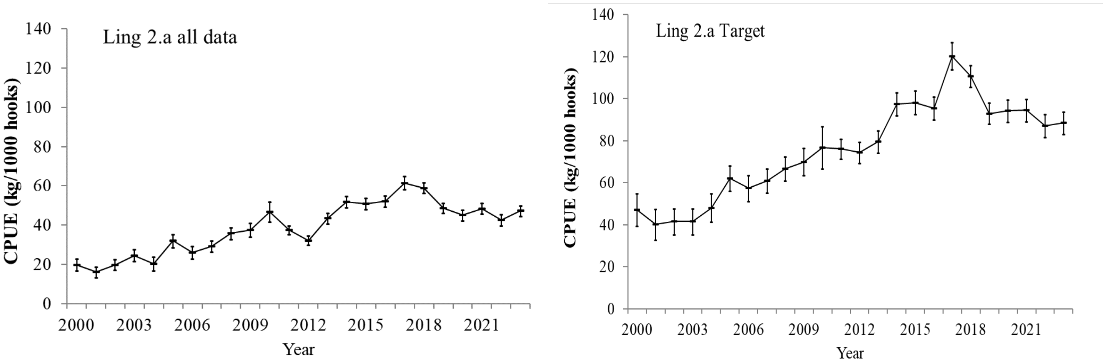


Figure 3.3.10. Estimate of cpue (kg/1000 hooks) for ling in Area 2a based; on all available data, and on catches when ling was considered the target species for 2000–2023. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

3.3.7 Comments on the assessment data analyses

The two cpue series, based on all data and when ling were targeted, show a stable and positive trend from 2001 until 2017, after this there has been a downward trend. However, the LBI indicates that ling is fished sustainably (see section 3.3.9).

3.3.8 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 even with the recent decline 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 appear to have increased.

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 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.

3.3.9 Application of rfb-rule

2023 was the first year the rfb-rule was applied for ling in 1 and 2. Previously the "3 over 2 rule has been used. The biomass index is based on the CPUE calculated from logbook data from the Norwegian longline fleet 2000-2022 when ling was targeted (more than 30 percent of the daily catch) (Helle et al. 2015). The length data is from the Norwegian longline reference fleet. To get reliable values for K and Linf has been challenging. K=0.11 is the same as in ling subareas 3, 4, 6–9, 12, and 14 and Linf the same as was used for LBI (see chapter 3.3.10)

Rfb-rule:

- r is calculated as the average of last two years values, divided by average of three preceding years values which results in r=0.91 (Figure 3.3.11. Table 3.3.2)

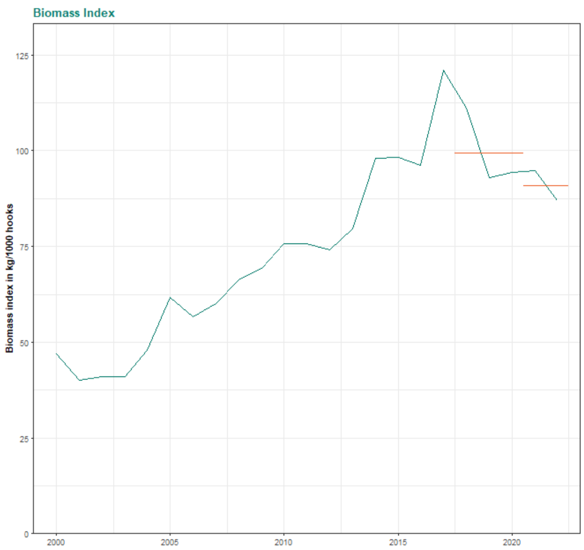


Figure 3.3.11: Ling in 1 and 2. Biomass index since 2000. The red lines show the average of last two years values and the three preceding years.

- *f* is the length-ratio component. The mean length of last years´ catch was 93 cm and the target reference length (L*c* or length at first capture * 0.75 + length ∞ * 0.25) is **98** (figure xxx).

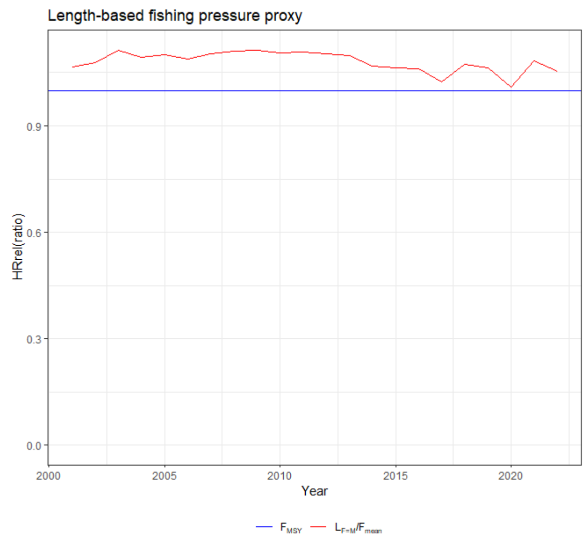


Figure 3.3.12: Ling in 1 and 2. Ling in subareas 1 and 2. Index ratio of the average length relative to the expected length when fishing mortality equals natural mortality ($L_{mean}/L_{F=M}$) for the Norwegian longline fleet from the length-based indicator method used for the evaluation of the exploitation status The exploitation status is below the $F_{MSY\ proxy}$ when the index ratio value is higher than 1.

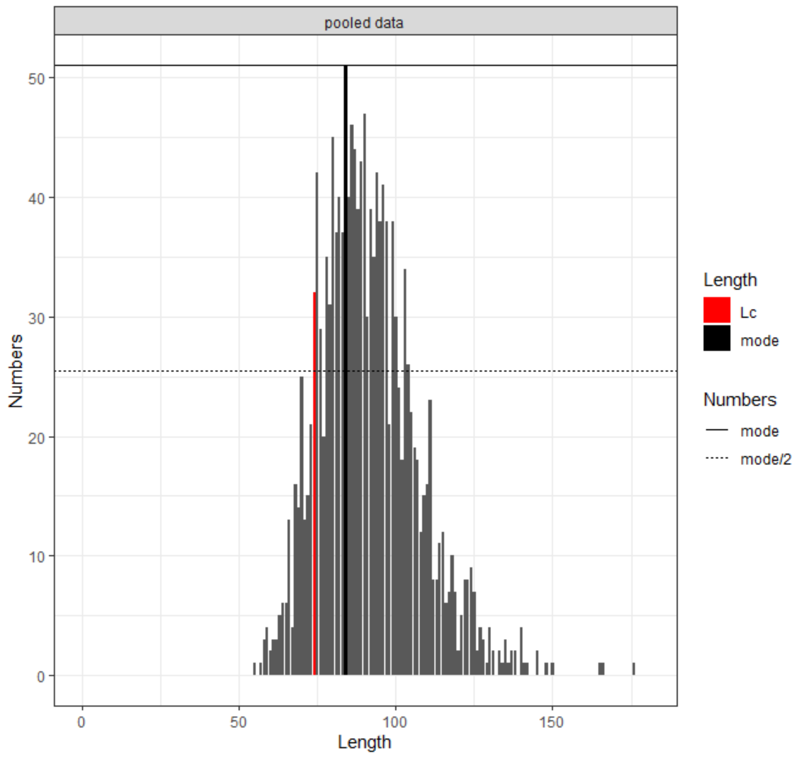


Figure 3.3.13: Ling in 1and 2. Length frequency distribution from catches. Black line is the length of modal abundance, the red line is the length at first capture.

- *b* is the biomass safeguard and is used to reduce catch advice when index falls below trigger. The lowest index or the I_{loss} for ling is 40 and was recorded in the year 2001. $I_{trigger}$ is I_{loss} *1.4 or 56 (Figure 3.3.14). Biomass index this year is above $I_{trigger}$ and *b* is therefore 1.

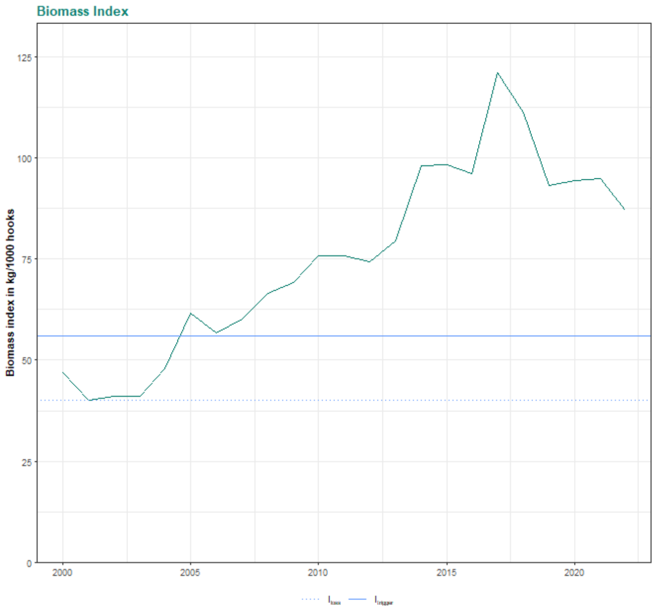


Figure 3.3.14: Ling in 1 and 2. Biomass index values since 2000. The blue line is the $I_{trigger}$ and the doted is the lowest observed value (I_{loss}).

- *m* is the tuning parameter and for slow growing species (with von Bertanlaffy K<0.2), *m* equals to 0.95.

Table 3.3.2. Ling Subareas 1 and 2. The basis for the catch scenarios. Catches are in tonnes.*

Previous catch advice for A_y (2022/23)	10 454 tonnes
Stock biomass trend	
Index A (2021, 2022)	91
Index B (2018, 2019, 2020)	99
r: stock biomass trend (index ratio A/B)	0.91
Fishing pressure proxy	
Mean catch length ($L_{mean} = L_{2022}$)	93cm
MSY proxy length ($L_{F=M}$)	98 cm
f: fishing pressure proxy relative to MSY proxy ($L_{2022}/L_{F=M}$)	0.95
Biomass safeguard	
Last index value (I_{2022})	97
Index trigger value ($I_{trigger} = I_{loss} \times 1.4$)	56
b: index relative to trigger value, $\min\{I_{2022}/I_{trigger}, 1\}$	1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
Stability clause (+20%/−30% compared to A_y, only applied if $b \geq 1$)	Not applied
Discard rate	0 %
Catch advice for 2024 and 25**	8 600 tonnes
% advice change^	−17.7%

* The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.
** Formula [$A_y \times r \times f \times b \times m$]
^ Advice value for 2024 and 2025 relative to the advice value for 2023 (-1854 tonnes).

3.3.10 Application of the Length-based indicator method (LBI)

The Length-based indicator method (LBI) were applied for ling in Areas 1 and 2.

<u>Length-based indicator method (LBI)</u>
The input parameters and the length distributions of the catches for the period 2001–2023 are in Table 3.3.3and Figure 3.3.15. The length data used in the LBI model are from the Norwegian gill netter and longline fleet.

Table 3.3.3. Ling in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length–frequency distribution	2001–2023	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	

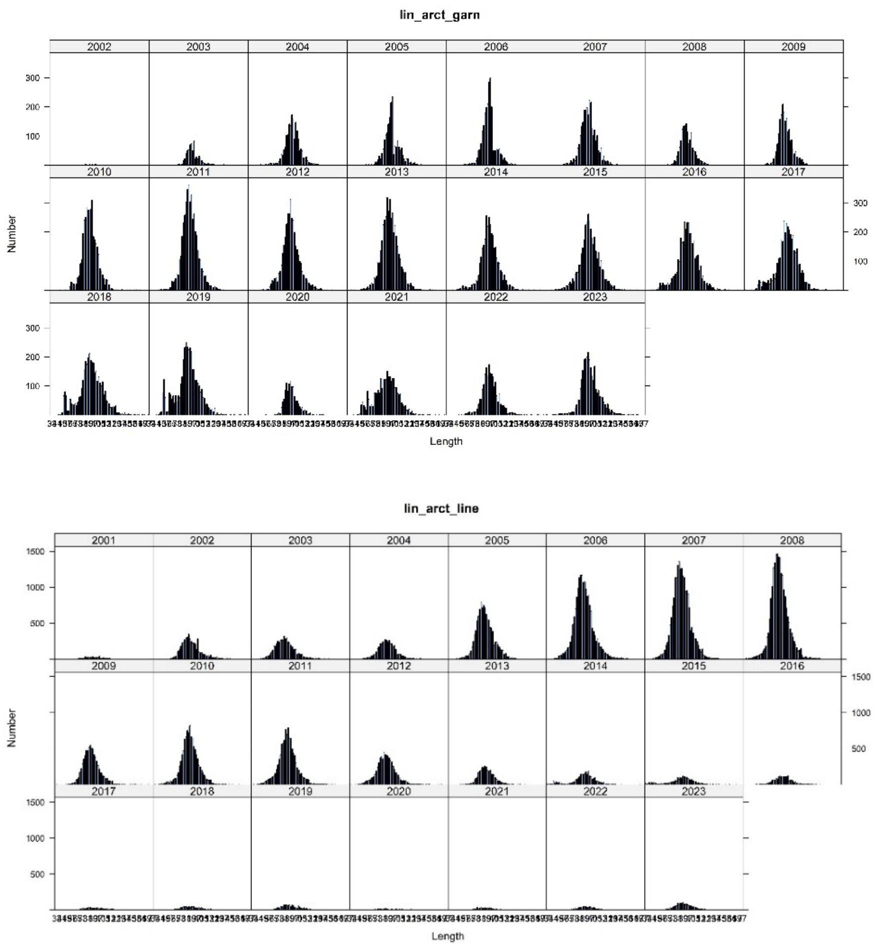


Figure 3.3.15. Ling in arctic waters (1, 2.a, 2.b), upper panel are length data from gillnetters, lower are from longliners. Catch length distributions, 2 cm length classes, for the period 2001–2023 (sex combined).

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 3.3.16a and b.

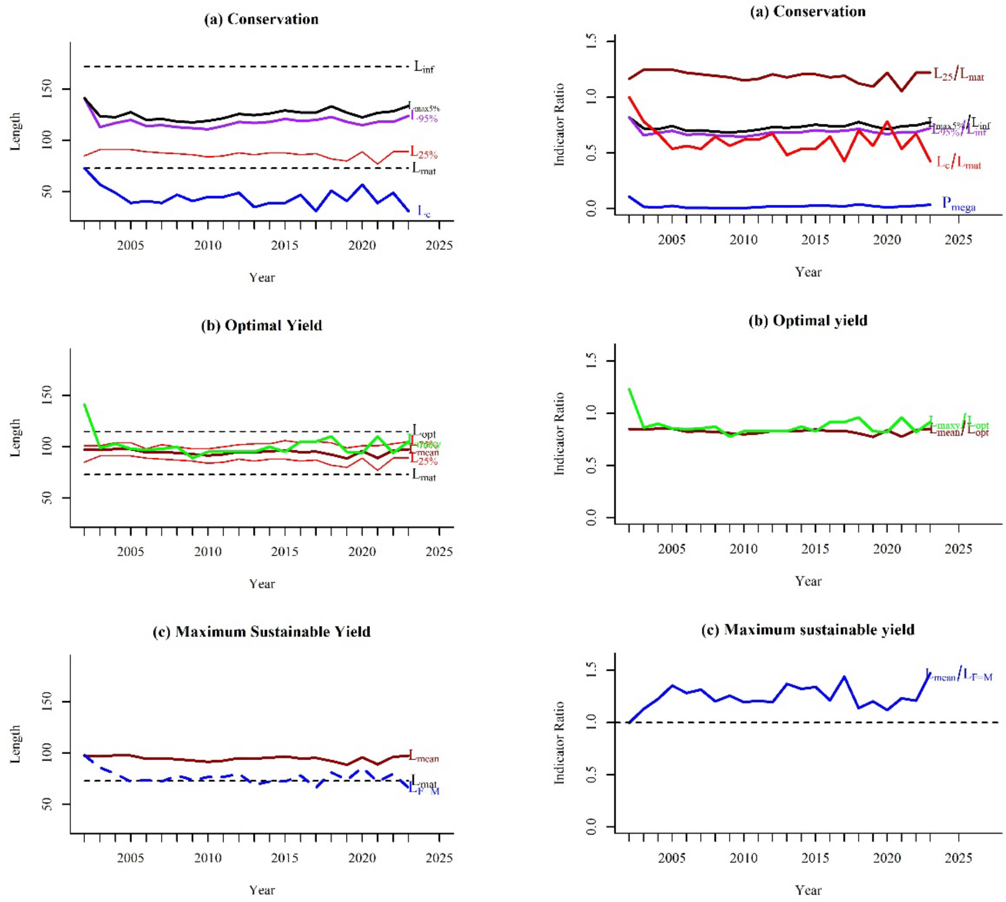


Figure 3.3.16a. Ling from gillnetters in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

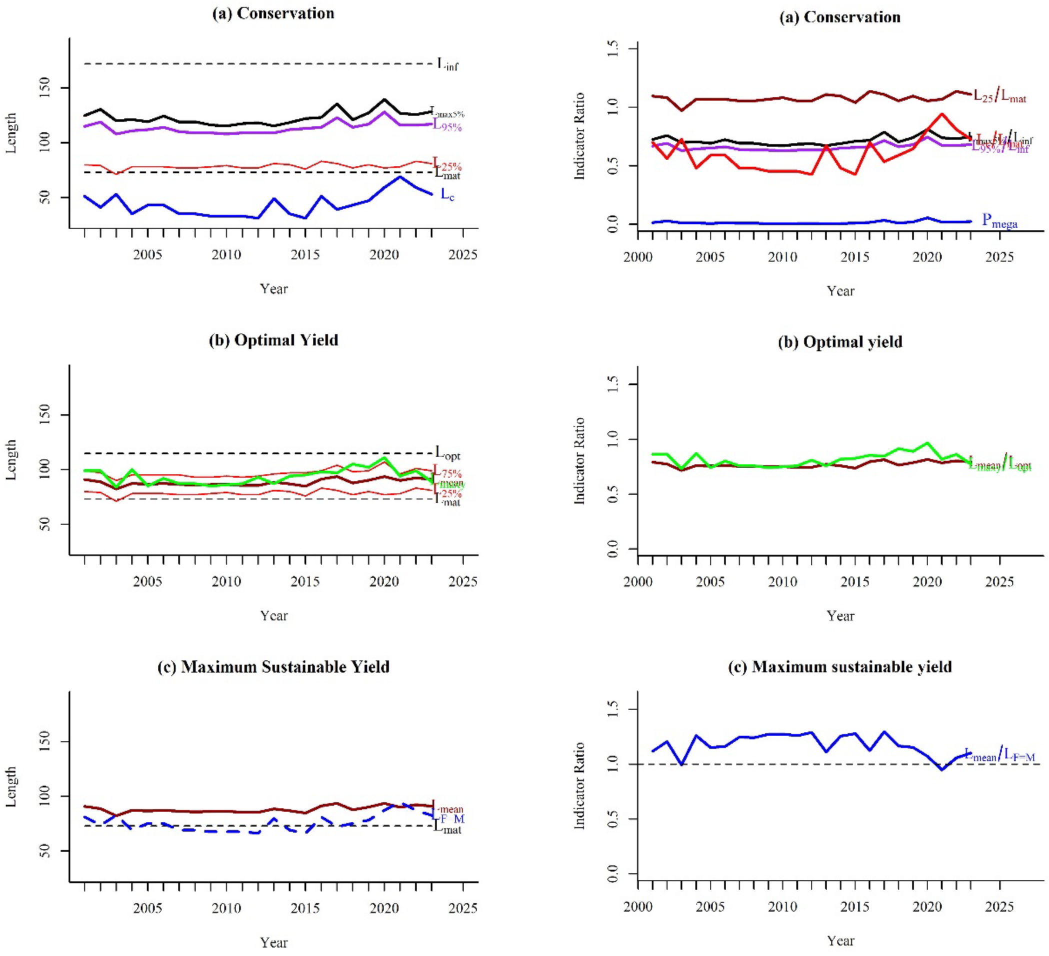


Figure 3.3.16b. Ling from longliners in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

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 3.3.16). In 2021–2023, $L_{25\%}/L_{mat}$ was also greater than 1 (Table 3.3.4), 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 3.3.16) and between 0.71 and 0.75 in 2021–2023 (Table 3.3.4), 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 3.3.16), which indicates that ling in arctic waters are fished sustainably. Regarding model sensitivity, the MSY value was always greater than 0.90.

Table 3.3.6. gives the outcomes of all estimates from the LBI, based on data from the gillnet and the longline fishery provided by the Norwegian reference fleet.

Conclusion: The overall perception of the stock during the period 2021–2023 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 3.3.4a. Ling (gillnetters)in arctic waters (1, 2.a, 2.b). The 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**
2021	0,53	1,05	0,74	2 %	0,78	1,23
2022	0,67	1,22	0,75	2 %	0,84	1,21
2023	0,42	1,22	0,78	3 %	0,85	1,47

Table 3.3.3b. Ling (longliners) in arctic waters (1, 2.a, 2.b). The 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**
2021	0,95	1,07	0,74	2 %	0,78	0,95
2022	0,81	1,14	0,73	2 %	0,80	1,06
2023	0,73	1,11	0,75	2 %	0,79	1,10

Table 3.3.5Ling 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			
	2021	2022	**2023**	
MSY (F/F_{MSY})	✔	✔	✔	Fished sustainably
	Stock size			
	2020	2021	**2022**	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

Table 3.3.6 Outcomes from the LBI, based on data from the gillnet and the longline fishery provided by the Norwegian reference fleet.

	Gillnet			Longline		
Year	**2021**	**2022**	**2023**	**2021**	**2022**	**2023**
L75	101	103	105	96	101	99
L25	77	89	89	78	83	81
Lmed	90	95	96	87	91	89
L90	110	112	117	108	110	109
L95	118	118	124	116	116	117
Lmean	88,95	96,36	97,47	89,99	92,29	91,13
Lc	39	49	31	69	59	53
LFeM	72,25	79,75	66,25	94,8	87,3	82,8
Lmaxy	110	94	105	94	99	89
Lmat	73	73	73	73	73	73
Lopt	114,67	114,67	114,67	114,7	114,7	114,7
Linf	172	172	172	172	172	172
Lmax5%	126,92	128,32	133,59	126,9	125,6	128,5
Lmean/LFeM	1,23	1,21	1,47	0,9	1,1	1,1
Lc/Lmat	0,53	0,67	0,42	0,9	0,8	0,7
L25/Lmat	1,05	1,22	1,22	1,1	1,1	1,1
Lmean/Lmat	1,22	1,32	1,34	1,2	1,3	1,2
Lmean/Lopt	0,78	0,84	0,85	0,8	0,8	0,8
L95/Linf	0,69	0,69	0,72	0,7	0,7	0,7
Lmaxy/Lopt	0,96	0,82	0,92	0,8	0,9	0,8
Lmax5%/Linf	0,74	0,75	0,78	0,7	0,7	0,7
Pmega	0,02	0,02	0,03	0,0	0,0	0,0
Pmegaref	0,3	0,3	0,3	0,3	0,3	0,3

3.3.11 References

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3.3.12 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
2019	37					37
2020	73					73
2021	71					71
2022	60					60
2023*	73					73

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
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	9	16	11155			129		4		1	5	11332
2019	5	24	9	11216			60		1			1	11316
2020	8	13	5	9323	1	1	42		2				9395
2021	7	46	2	9395		1	36		1				**9480**
2022	3	22	1	8980					1		1		**9008**
2023	11	7	4	10133					3				**10158**

*** *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

Year	Norway	E & W	Faroes	France	Total
2015	95				95
2016	53				1
2017	28				28
2018	238				238
2019	55				55
2020	96				96
2021	108				108
2022	113				113
2023*	27				27

***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

Year	1	2.a	2.b	All areas
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	162	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
2017	43	7900	28	7971
2018	34	11332	238	11604
2019	37	11321	55	11413
2020	73	9395	96	9564
2021	71	9480	108	9659
2022	60	9008	113	9181
2023*	73	10158	27	10258

***Preliminary.**

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

3.4.1 The fishery

The fishery for ling in Icelandic waters has not changed substantially in recent years. Around 100-300 longliners annually report catches of ling, around 30-200 gillnetters and around 60-140 trawlers. Most of ling is caught on longlines (Figure 3.4.1 and Table 3.4.1) which has increased since 2000 to around 66% in 2023. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2007 to approximately 2% in 2023. Catches in trawls have varied less and have been at around 20-30% of Icelandic catches. (Figure 3.4.1, Table 3.4.1). Most of the ling caught by Icelandic longliners is caught at depths less than 300 m, and by trawlers at less than 400 m (Figure 3.4.2). The main fishing grounds for ling as observed from logbooks are in the south, southwestern and western part of the Icelandic shelf (Figure 3.4.3 and Figure 3.4.4). The main trend in the spatial distribution of catches according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf two decades ago. Around 50% of ling catches are caught on the southwestern part of the shelf (Figure 3.4.4). In recent years, the main fishing pressure has shifted towards shallower waters (Figure 3.4.2).

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

Year	Bottom trawl	Gill nets	Longlines	Bottom trawl	Gill nets	Longlines	Other	Total catch
2000	143	184	289	890	704	1538	77	3284
2001	131	232	254	639	1061	1093	79	3362
2002	124	203	235	852	648	1282	61	4519
2003	119	172	244	850	454	2210	70	4270
2004	116	165	234	977	545	2017	187	4606
2005	116	127	260	1497	501	2046	268	5198
2006	106	99	259	1697	629	3732	225	7405
2007	106	86	251	1642	633	4042	282	7591
2008	96	68	208	1927	477	5004	330	9283
2009	88	78	208	2193	723	6232	468	10773
2010	87	69	197	2528	363	6532	444	10963
2011	82	61	201	2625	222	5595	348	9626
2012	81	62	206	2509	245	7479	462	11817
2013	85	62	209	2808	345	6779	266	11581
2014	78	57	220	2717	673	8728	231	14246
2015	75	55	207	2802	650	7766	333	13035
2016	72	55	186	2426	681	5244	232	9884
2017	71	48	171	2063	556	4903	171	8766
2018	68	47	151	2114	387	4061	195	8062
2019	61	33	148	2009	115	4688	180	8269
2020	67	36	124	1985	138	3540	174	7061
2021	66	39	119	2074	126	3812	99	7128
2022	64	30	103	2236	262	4059	242	7657
2023	62	32	88	2497	175	5648	232	8534

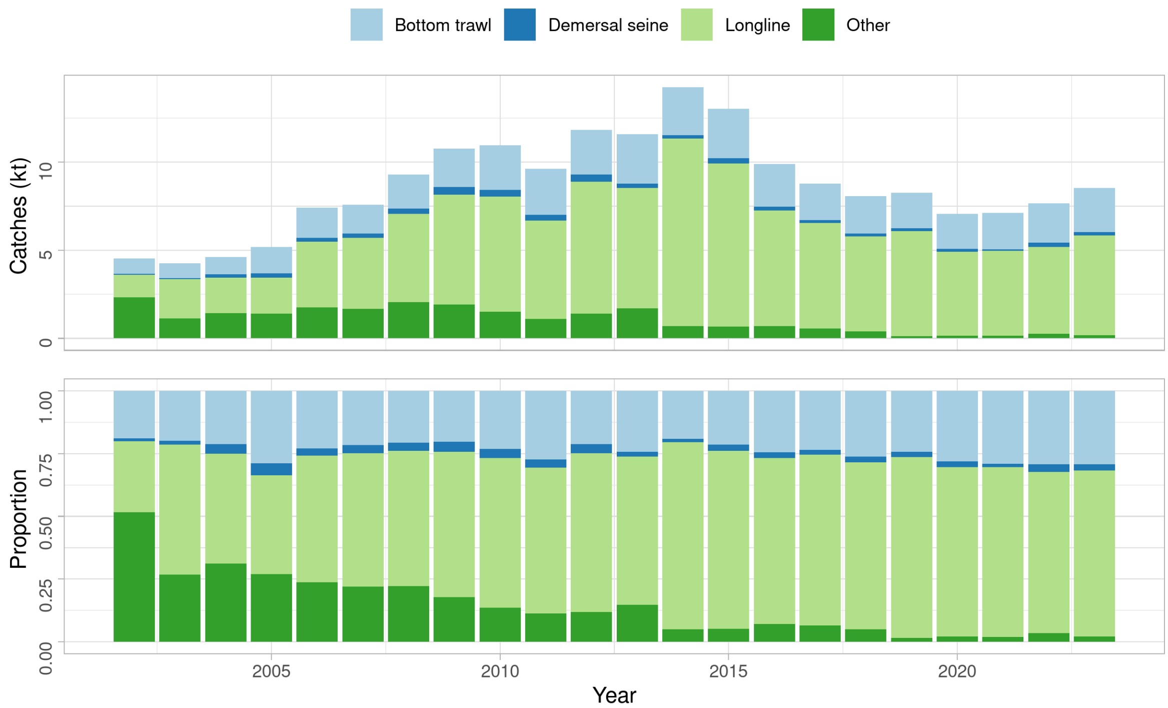


Figure 3.4.1: Ling in 5.a. Commercial catches by gear as registered in Icelandic logbooks.

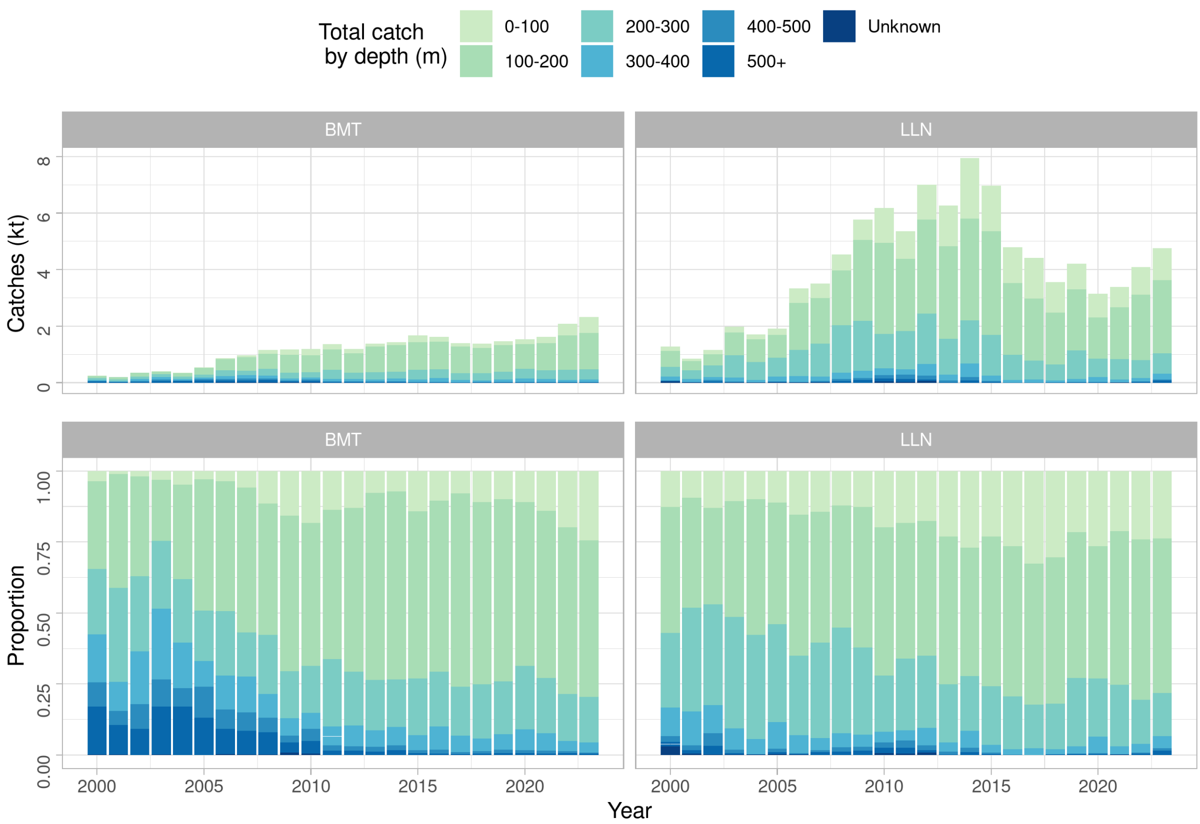


Figure 3.4.2: Ling in 5.a. Depth distribution of catches in 5.a according to logbooks. Bottom trawl (BMT) is on the left and longline (LLN) on the right.

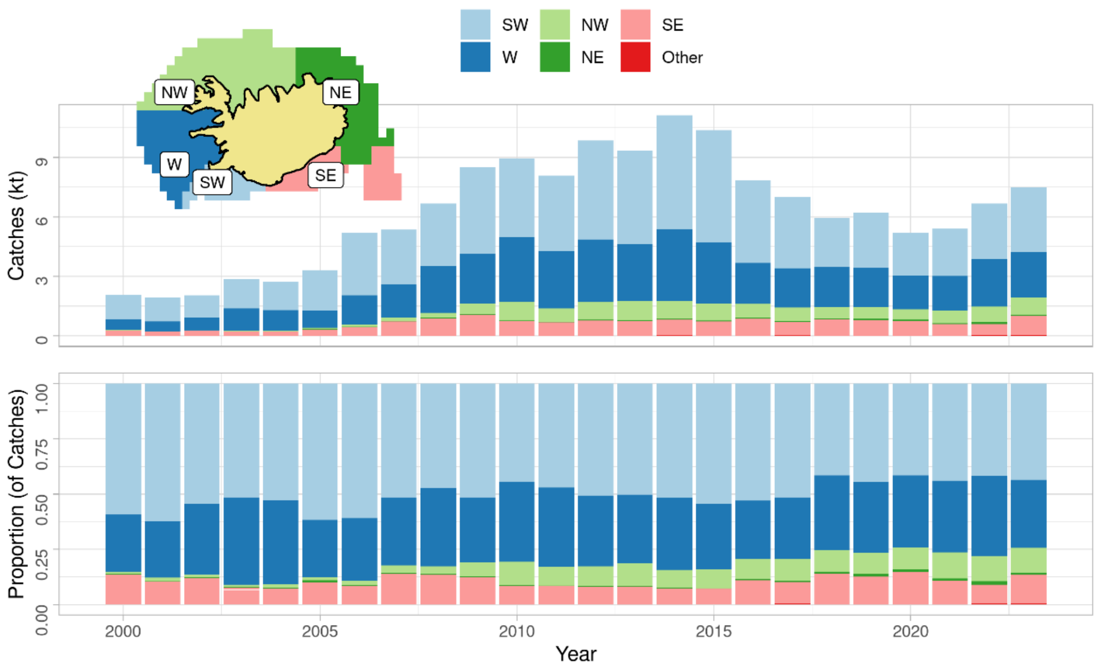


Figure 3.4.3: Ling in 5.a. Changes in spatial distribution of the Icelandic fishery as reported in logbooks. All gears combined.

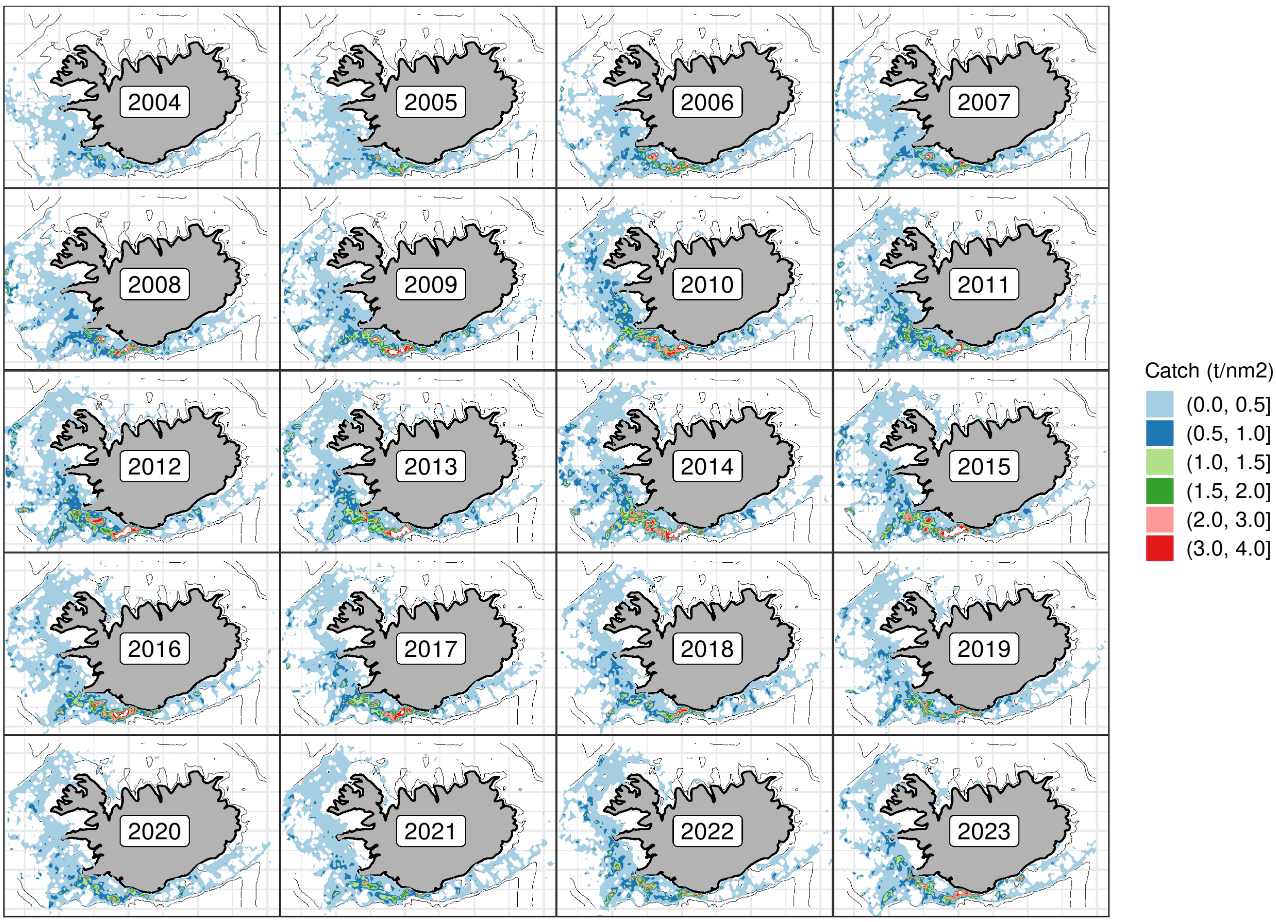


Figure 3.4.4: Ling in 5.a. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

3.4.2 Landing trends

In 1950 to 1971, landings of ling in Icelandic waters ranged between 7000 to more than 15000 tonnes. Landings decreased between 1972 and 2000 to as little as 3000 tonnes as a result of most foreign vessels being excluded from the Icelandic EEZ. In 2001-2010, catches increased constantly and reached 11000 tonnes in 2010 and remained at that level for the most part until 2014, when the catches increased to 14000 tonnes. Since 2014, ling catches have reduced and in 2023, 8534 tons were landed (Table 3.4.2 and Figure 3.4.5).

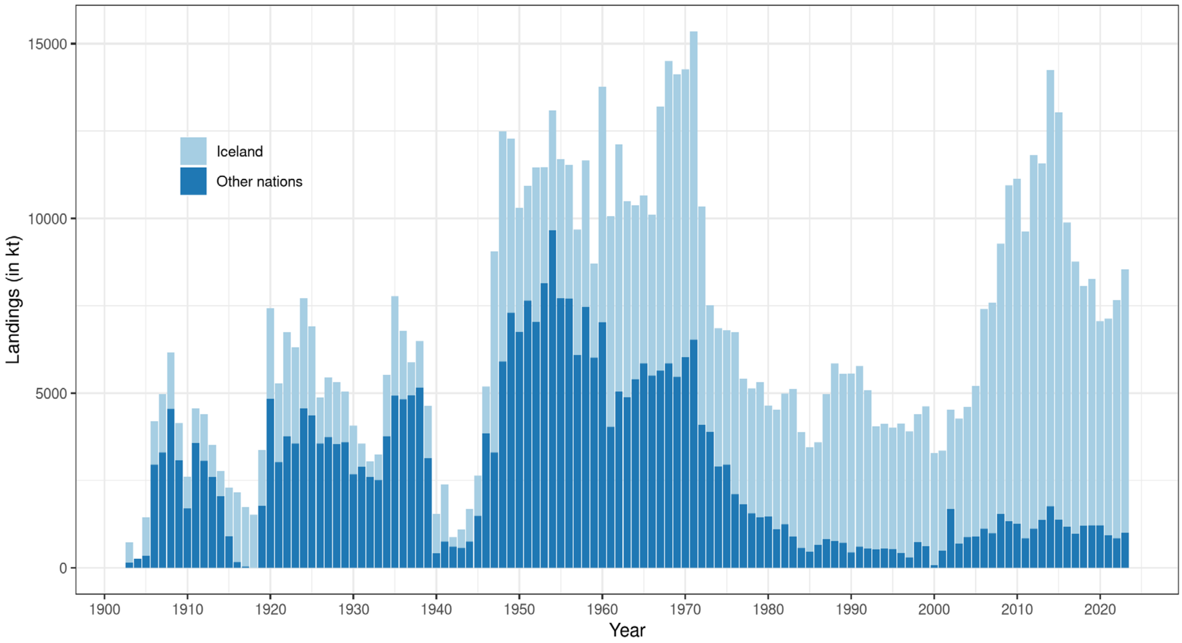


Figure 3.4.5: Ling in 5.a. Landings in 5.a

Table 3.4.2: Ling in 5.a. Percentage of landed catch by gear as reported from logbooks in 5.a.

Year	Bottom trawl	Gill nets	Longlines	Other	Total
1995	25	23	38	14	3552
1996	26	20	39	14	3747
1997	25	17	46	12	3607
1998	23	19	47	11	3695
1999	20	17	54	9	4003
2000	23	22	48	8	3214
2001	17	37	38	8	2881
2002	23	23	45	9	2845
2003	16	13	62	9	3590

Year	Bottom trawl	Gill nets	Longlines	Other	Total
2004	18	15	54	14	3727
2005	23	12	47	18	4315
2006	20	10	59	11	6285
2007	21	10	61	8	6599
2008	19	6	65	10	7741
2009	16	8	65	12	9616
2010	16	4	66	15	9868
2011	19	3	64	15	8789
2012	13	2	70	15	10695
2013	16	3	67	14	10257
2014	12	5	75	9	14246
2015	15	5	71	9	13035
2016	18	7	66	8	9884
2017	17	6	68	8	8766
2018	20	5	67	9	8062
2019	20	1	72	6	8269
2020	24	2	67	8	7061
2021	29	2	68	1	7128
2022	29	3	64	3	7657
2023	29	2	66	3	8534

3.4.3 Data available

In general sampling is considered good from commercial catches from the main gears and seems to cover the spatial distribution of catches (Figure 3.4.6). Similarly, sampling does seem to follow the temporal distribution of catches (Figure 3.4.7).

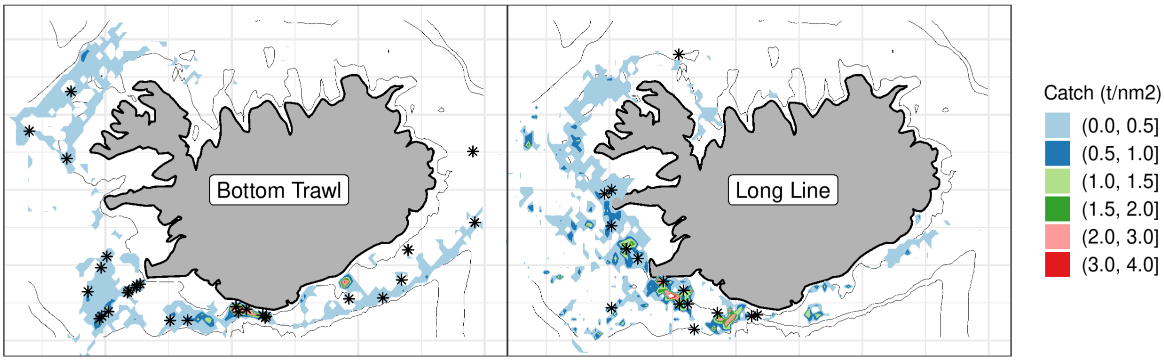


Figure 3.4.6: Ling in 5.a. Fishing grounds in 2023 as reported by catch in logbooks (tiles) and positions of samples taken from landings (asterisks) by longliners and trawlers.

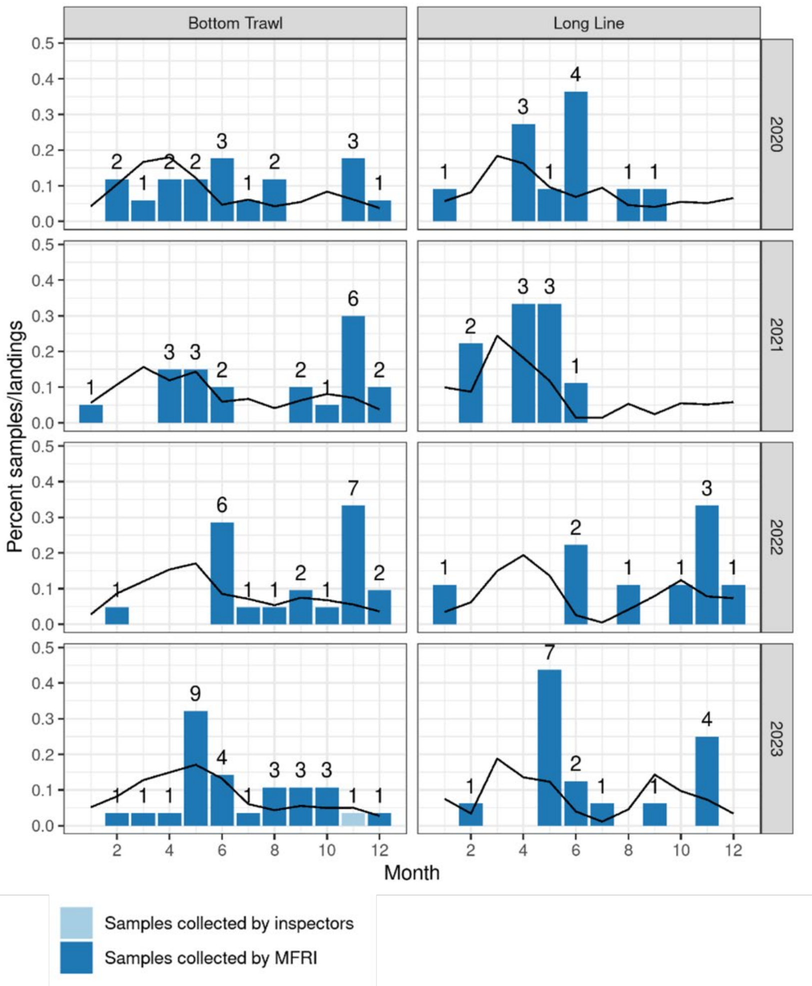


Figure 3.4.7: Ling in 5.a. Ratio of samples by month (bars) compared with proportion landings by month (black line) split by year and main gear types. Numbers above the bars indicate number of samples by year, month and gear.

3.4.4 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) (ICES (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 stock annex (ICES 2022c) and Iceland fisheries overview (ICES 2022a).

3.4.5 Length composition

An overview of available length measurements is given in table 3.4.3. Most of the measurements are from longlines. The number of available length measurements has been increasing in recent years in line with increased landings. Length distributions from the Icelandic longline and trawling fleet are presented in Figure 3.4.8. Sampling from commercial catches of ling is considered good; both in terms of spatial and temporal distribution of samples (Figure 3.4.7). Mean length as observed in length samples from catches decreased from 2005-2008 (Figure 3.4.8). This may be the result of increased recruitment in recent years rather than increased fishing effort. Mean length has gradually increased since 2015 and the mean length in 2022 was the highest recorded. 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 10; but from longlines the age is between 6 to 11.

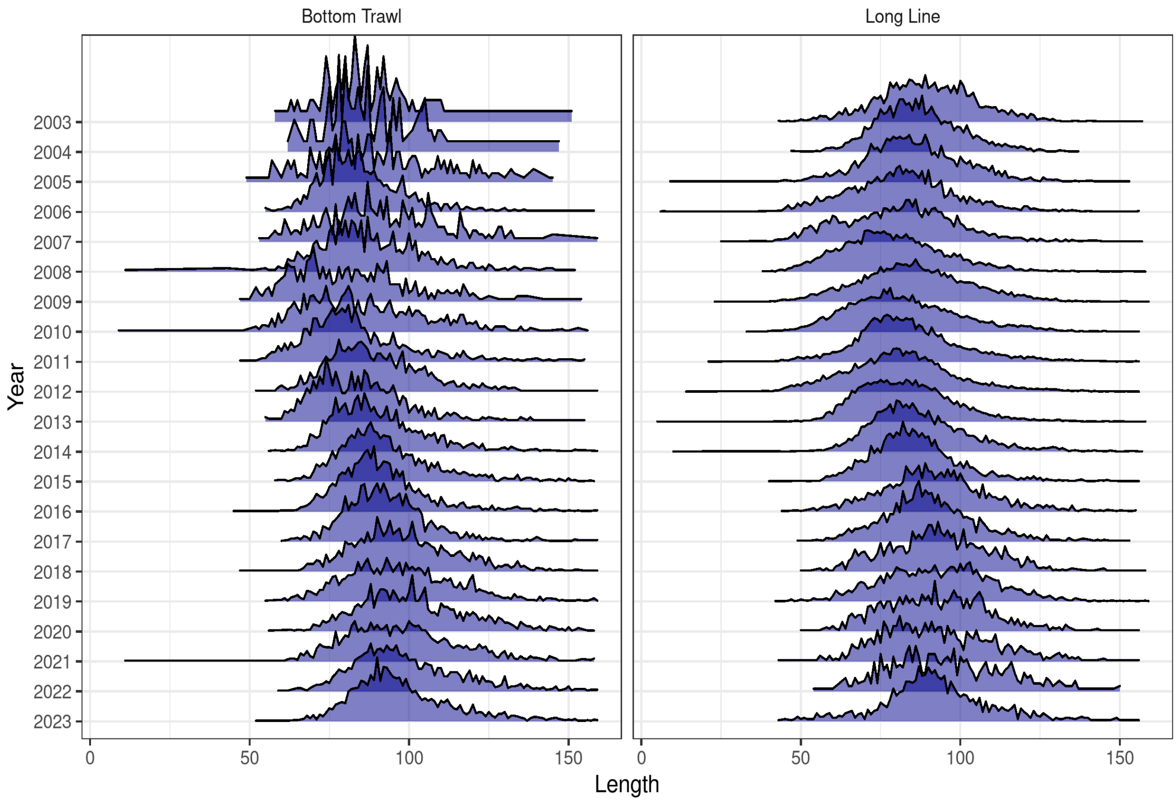


Figure 3.4.8: Ling in 5.a. Length distribution from the Icelandic fleet from 2003-2023.

Table 3.4.3: Ling in 5.a. Number of available length and age measurements from Icelandic commercial catches.

Year	Length measurements					Age measurements					
	BMT	DSE	GLN	LLN	Other	LLN	GIL	DSE	BMT	Other	Total
2000	383	0	566	1624	6	650	200	0	150	0	1000
2001	37	0	493	1661	0	550	193	0	37	0	780
2002	221	0	366	1504	0	519	166	0	150	0	835
2003	280	0	300	2404	143	900	100	0	100	50	1150
2004	141	46	348	2640	150	750	50	46	100	50	996
2005	499	101	31	2323	180	750	0	0	181	50	981
2006	1558	0	645	3354	405	1138	289	0	450	100	1977
2007	400	76	0	3661	0	1300	0	50	100	0	1450
2008	969	15	357	5847	150	1950	150	0	315	50	2465
2009	966	0	410	9014	450	2550	150	0	250	150	3100
2010	1200	0	57	7322	1200	2498	50	0	450	400	3398
2011	1995	150	0	7248	750	2546	0	50	450	250	3296
2012	2748	150	85	12770	1337	3526	50	50	541	400	4567
2013	2337	122	267	10771	1344	2590	100	50	350	450	3540
2014	5053	120	1286	6448	2964	665	225	20	399	514	1823
2015	5667	0	1563	3315	3052	595	300	0	484	520	1899
2016	3673	0	2039	2483	1212	440	345	0	460	220	1465
2017	3189	0	485	1637	1226	310	85	0	370	225	990
2018	1603	0	559	1424	712	245	100	0	310	120	775
2019	1830	0	0	3598	819	385	0	0	340	140	865
2020	1718	0	4	1099	498	225	40	0	355	102	722
2021	2028	0	0	1056	466	180	0	0	398	100	678
2022	1805	0	370	563	1534	183	80	0	400	338	981
2023	2423	0	90	1284	0	320	20	0	564	0	904

3.4.6 Age composition

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 (ICES (2011):WD07). Substantial progress has been made since 2010. Now aged otoliths are available from the 2000 onwards (Table 3.4.3). Most of the ling caught in the Icelandic spring survey is between age 5 and 10 but from longlines the age is between 6 and 11.

Figure 3.4.9: Ling in 5.a. Catch at age from the commercial fishery in Iceland waters. Bar size is indicative of the catch in numbers and bars are coloured by cohort.

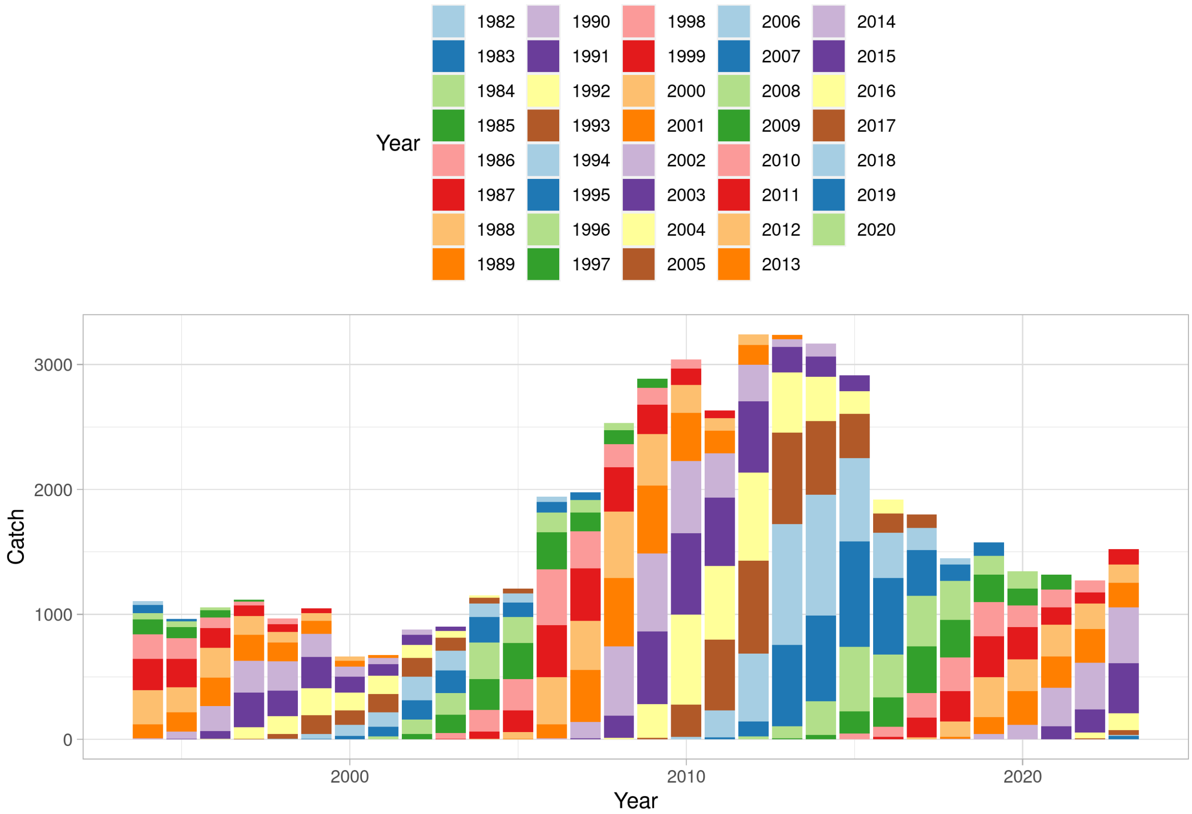


Figure 3.4.10: Ling in 5.a. Catch at age from the commercial fishery in Iceland waters. Biomass caught by year and age; bars are coloured by cohort.

3.4.7 Weight at age in catch

Mean weight at age in the catch is shown in Figure 3.4.11. Catch weights of the older year classes (8-12 years) have been increasing in recent years and have mostly been above average since 2018. The opposite is seen in catch weights of younger age classes, where the mean weight has been below the average for the past years.

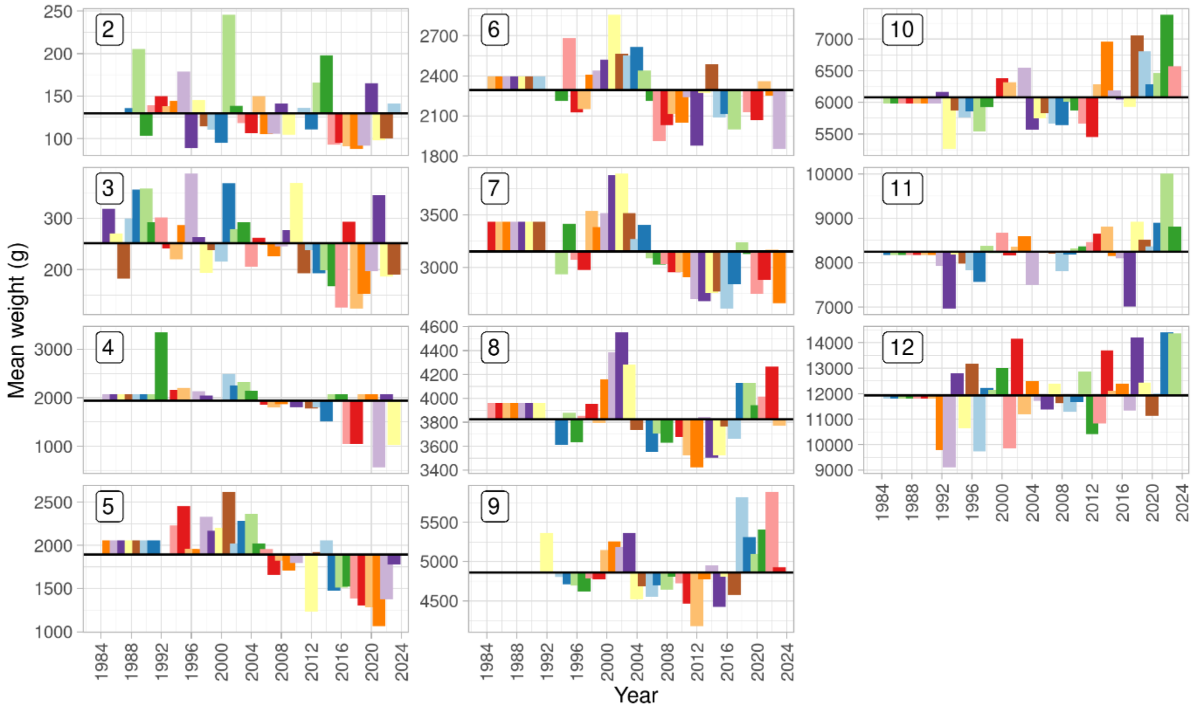


Figure 3.4.11: Ling in 5.a. Mean weight at age in the catch from the commercial fishery in Icelandic waters. Bars are coloured by cohort.

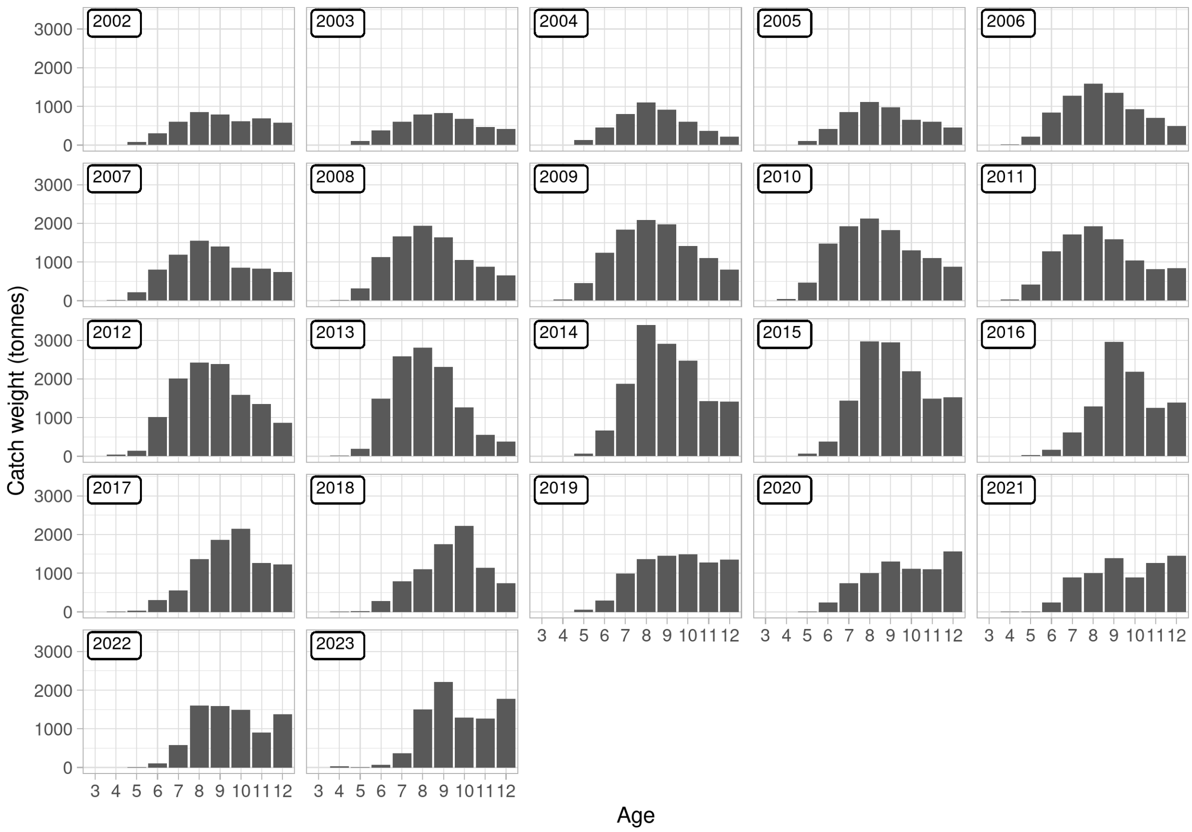


Figure 3.4.12: Ling in 5.a. Catch weights by age from the commercial fishery in Icelandic waters.

3.4.8 Catch, effort and research vessel data

3.4.8.1 CPUE and effort

The CPUE estimates of ling in Icelandic waters have not been considered representative of stock abundance.

3.4.8.2 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. 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. In addition, a gillnet survey is conducted in areas closer inshore every April during cod spawning periods, designed to sample the cod spawning stock. A detailed description of the Icelandic spring, autumn groundfish surveys and the gillnet surveys are given in the stock annex. Figure 3.4.13 shows both a recruitment index and the trends in biomass from both surveys. Length distributions from the spring survey are shown in Figure 3.4.15 (abundance) and changes in spatial distribution in the spring survey are presented in Figure 3.4.14.

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 3.4.9). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices gradually increased until 2017, but decreased thereafter until 2021. Since then, the indices have been ascending, reaching their highest recorded value in the time series in 2024. The index of the large ling (80 cm and larger) shows similar trend as the total biomass index (Figure 3.4.13). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003 to 2007 and but then decreased by around 25% and remained at that level until 2010. Then the juvenile index fell to a very low level in 2014 and has fluctuated at a low level since. (Figure 3.4.13). However, 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 3.4.13).

The shorter autumn survey shows that biomass indices were low from 1996 to 2000 but have increased since then (Figure 3.4.13). 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 3.4.13). 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.

April (gillnet) survey indices at length and age were available from 2002. Northern extensions to the survey were added in 2002 so 1998 - 2001 data were excluded. ALKs from the spring survey were used directly as this survey occurs directly after that spring survey.

Changes in spatial distribution as observed in surveys: According to the spring survey, most of the increase since 2010 in ling abundance is in the western area, but an increase can be seen in most areas. However, most of the index in terms of biomass comes from the southwestern area, or around 40% compared to around 30% between 2003 and 2011. A similar pattern is observed in the autumn survey.

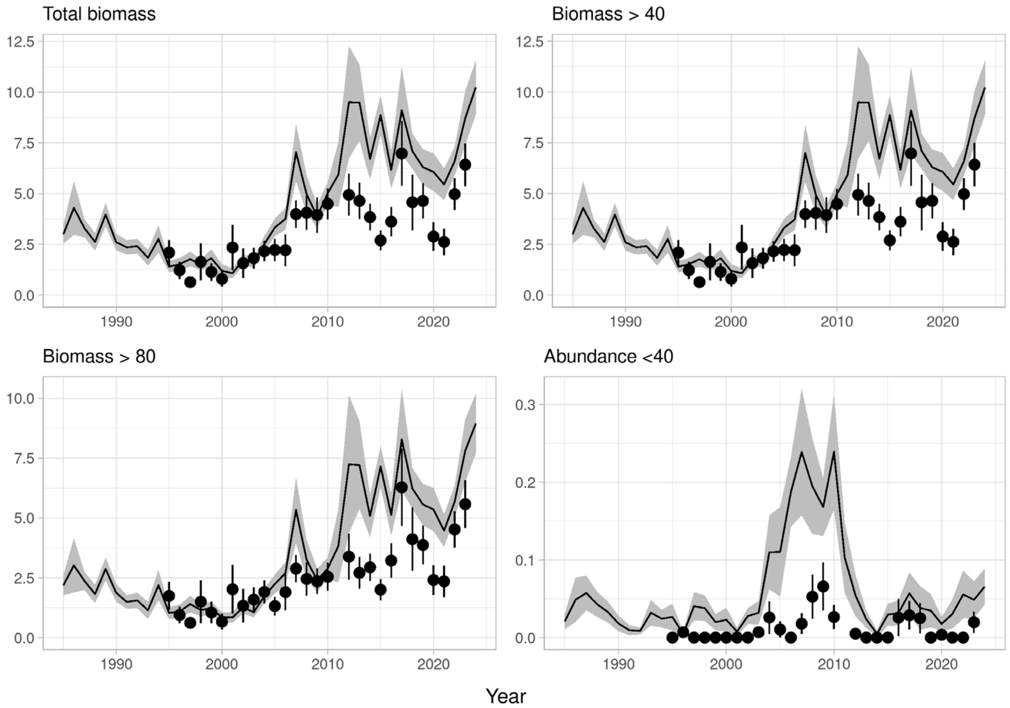


Figure 3.4.13: Ling in 5.a. Total biomass indices, biomass indices larger than 40 cm, biomass indices larger than 80 cm and abundance indices <40 cm. The lines with shaded area show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shaded areas and vertical lines indicate +/- standard error.

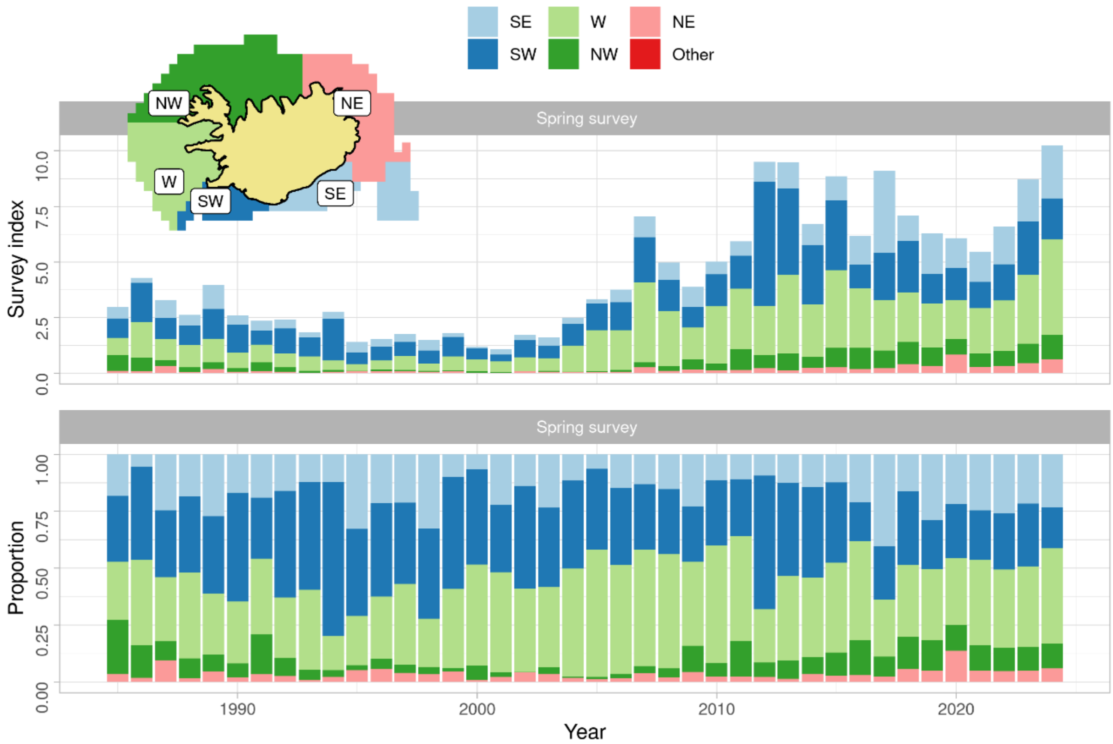


Figure 3.4.14: Ling in 5.a. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

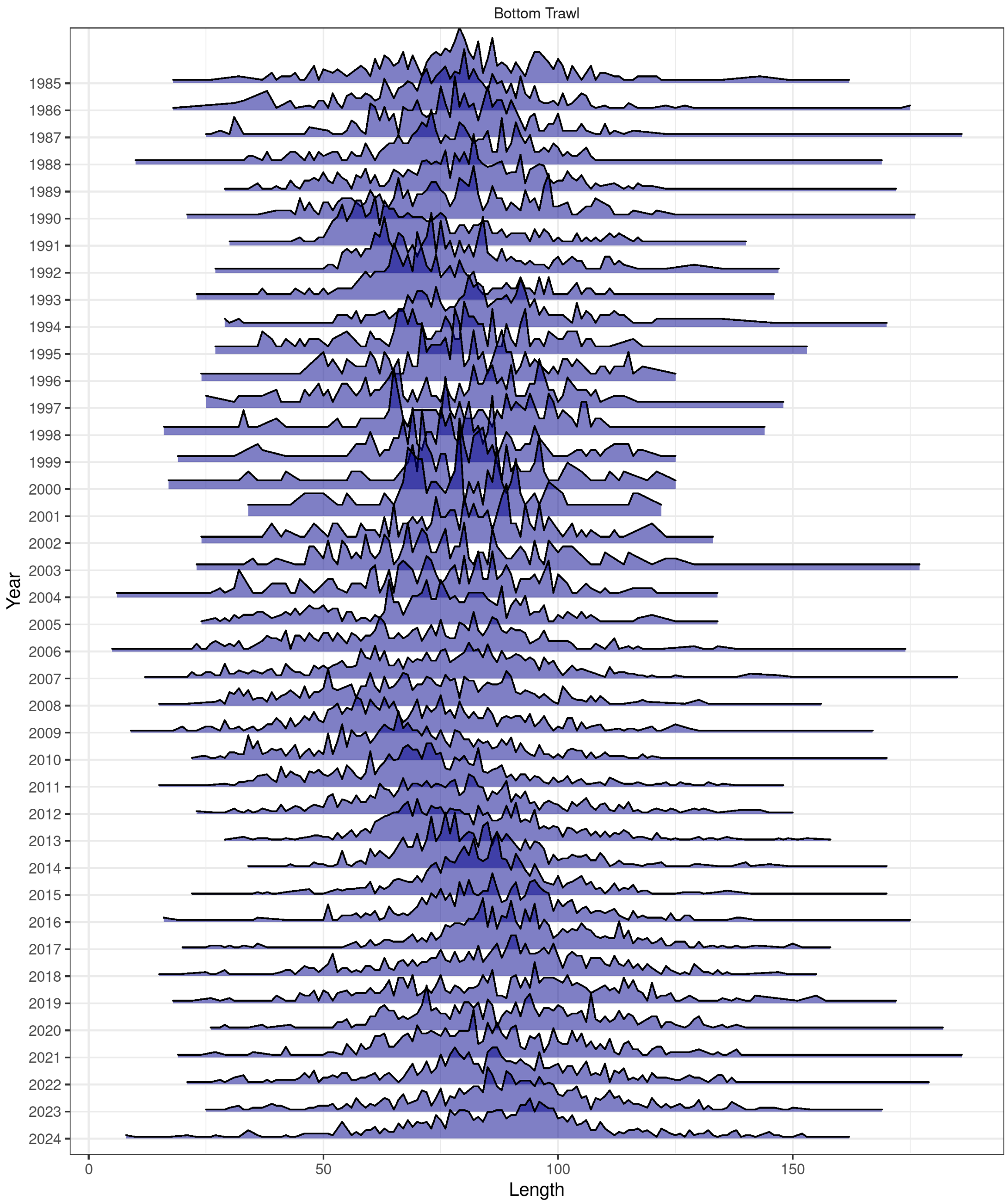


Figure 3.4.15: Ling in 5.a. Length distribution (grey area) from the spring survey. Black lines are the average mean of the period.

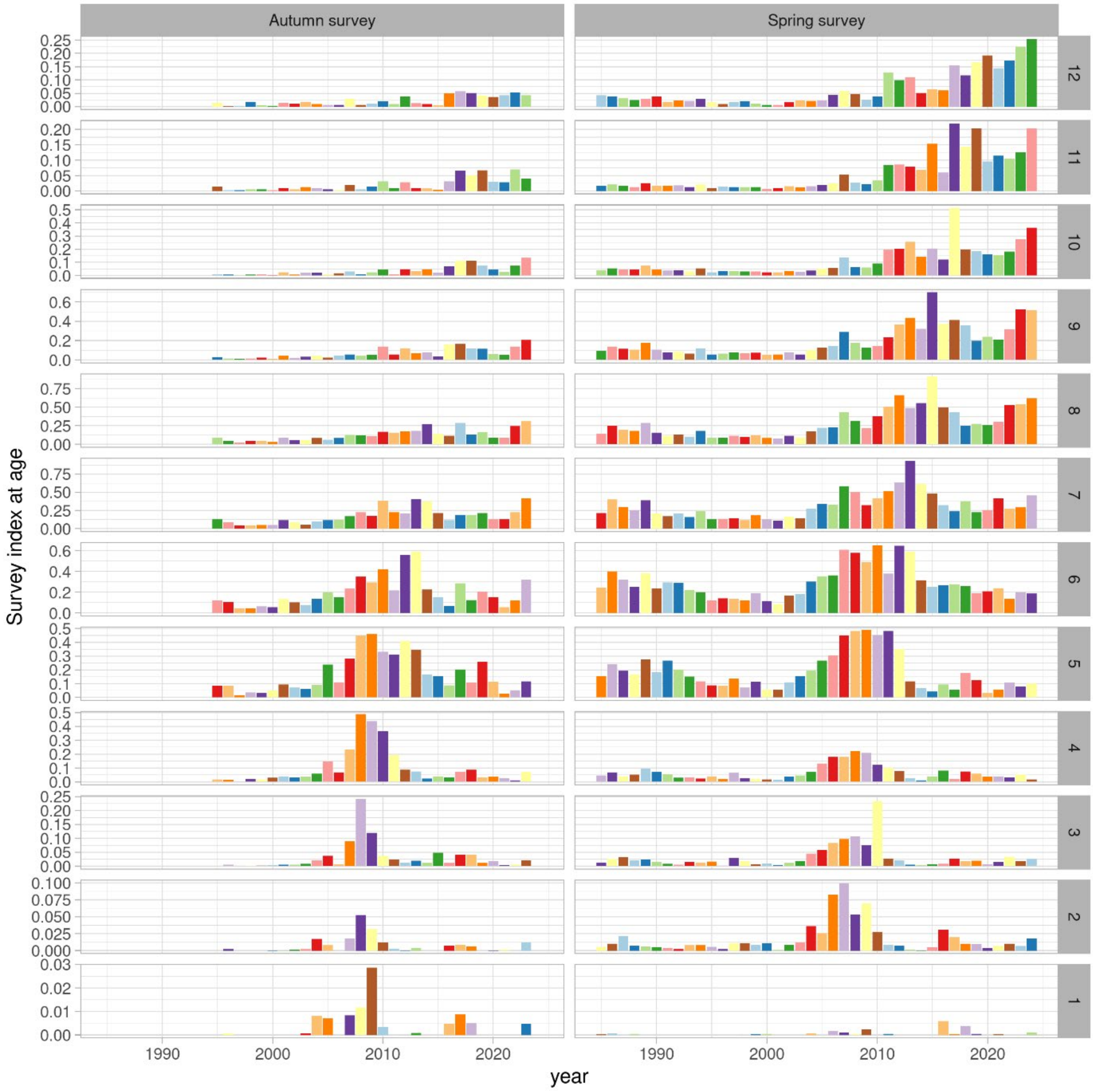


Figure 3.4.16 Ling in 5.a. Age disaggregated indices in the autumn survey (left), gillnet survey (middle) and the spring survey (right). Fill colours indicate cohorts. Note different scales on y-axes.

3.4.9 Stock weight at age

Mean weight at age in the survey is shown in Figure 3.4.17. Stock weights are obtained from the groundfish survey in March and are also used as mean weight at age in the spawning stock.

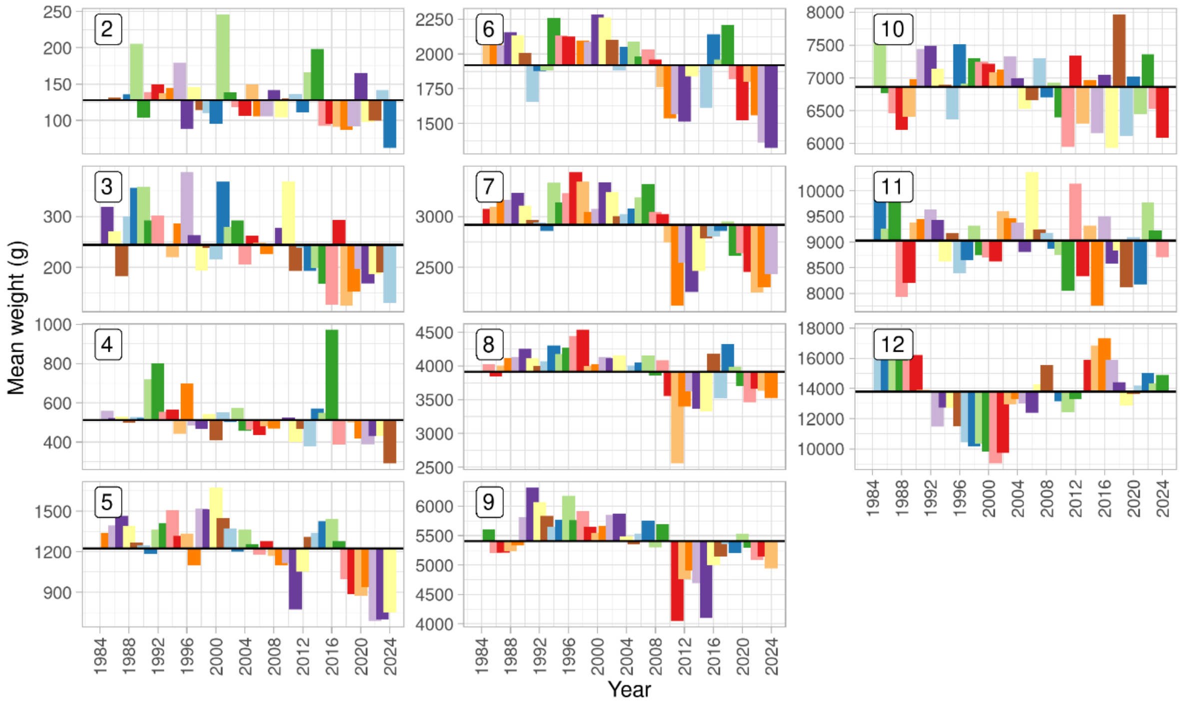


Figure 3.4.17: Ling in 5.a. Stock weights from the spring survey in Icelandic waters. Bars are coloured by cohort.

3.4.10 Stock maturity

Ling in Icelandic waters are mature at the age of 5-8 years and 60-80 cm total length. Maturity at age data is taken from the spring groundfish survey in March and prior to 1985 the proportion mature is assumed fixed at 1985 levels. Maturity-at-age five, six and seven has been decreasing for the past few years (Figure 3.4.18 and Figure 3.4.19), and in 2023, the mean length at maturity was around 75 cm (Figure 3.4.20).

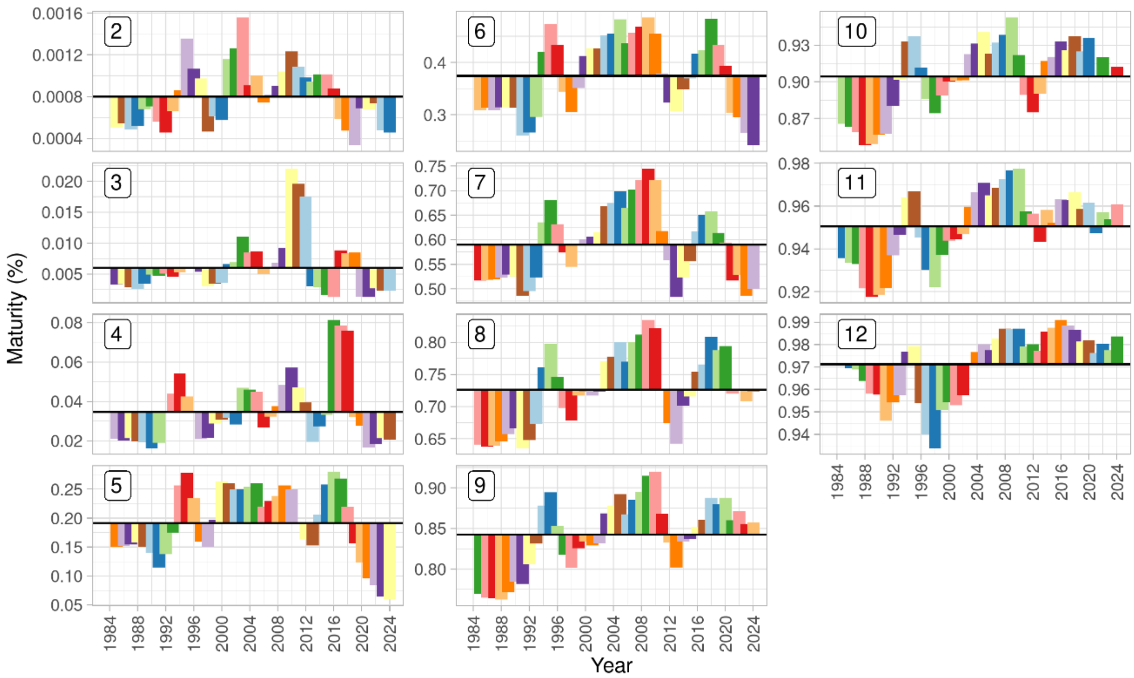


Figure 3.4.18: Ling in 5.a. Maturity at age in the survey. Bars are coloured by cohort. The values are used to calculate the spawning stock.

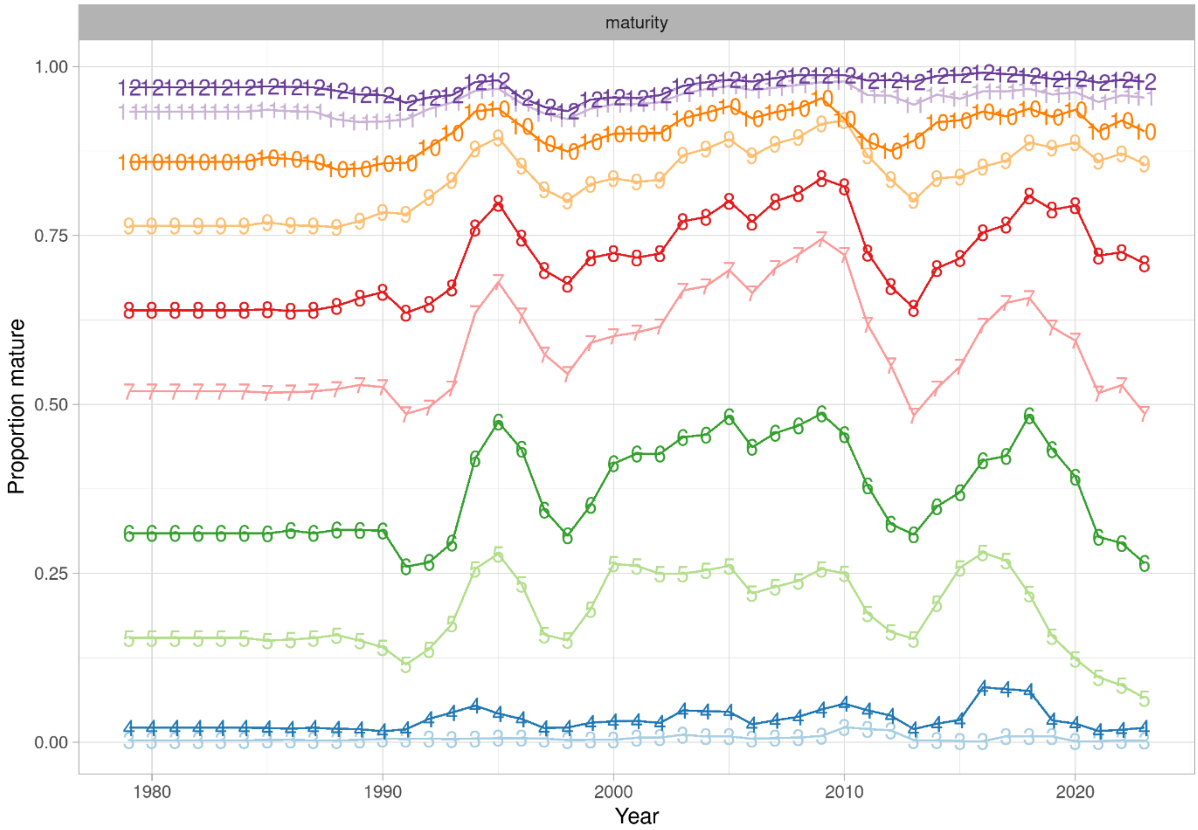


Figure 3.4.19: Ling in 5.a. Proportion mature at age from the spring survey.

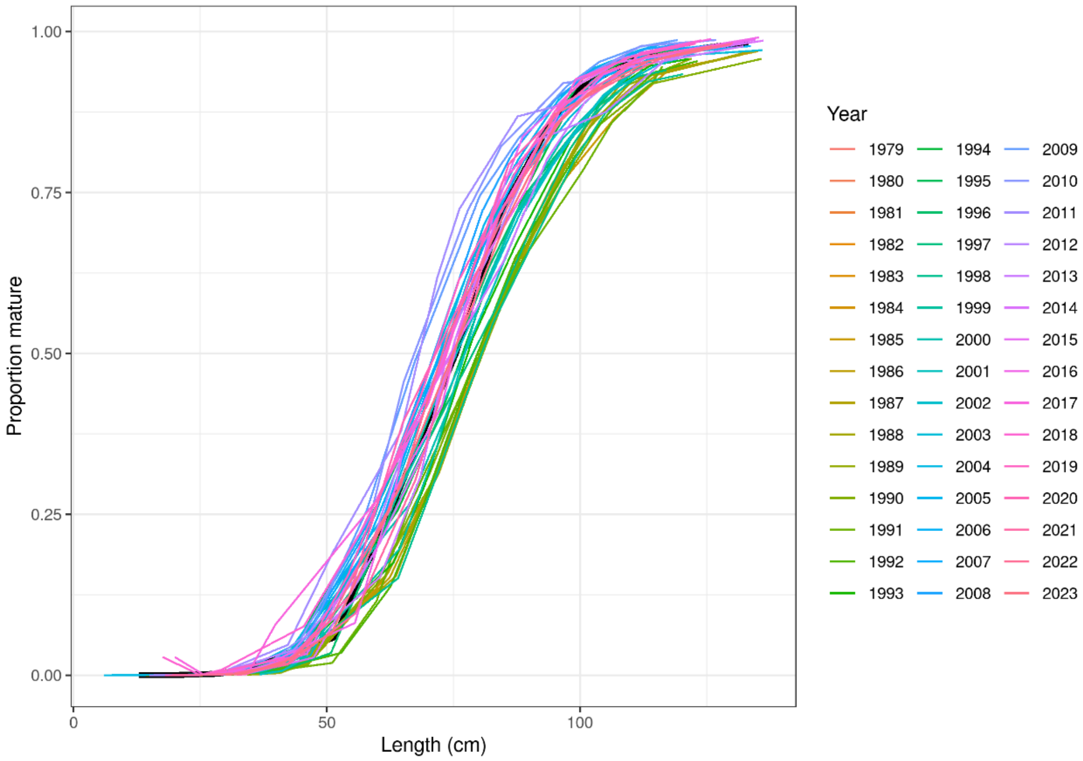


Figure 3.4.20: Ling in 5.a. Proportion mature at length from the spring survey. The black line is year 2024.

3.4.11 Data analyses

3.4.11.1 Analytical assessment using SAM

In 2022, Ling in 5.a was re-assessed as the previously benchmarked Gadget model had begun to show great instability in retrospective patterns in recent years. As a part of a Harvest Control Evaluation requested by Iceland, the stock was benchmarked (WKICEMSE, ICES 2022b) which resulted in changes in the assessment method and updated reference points. Model setup and settings are described in the stock annex (ICES 2022c).

3.4.11.2 Data used and model settings

Data used for tuning are given in the stock annex (ICES 2022c)

3.4.12 Diagnostics

3.4.12.1 Model fit

Figure 3.4.23 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 group. Summed up over survey biomass the model overestimates the biomass in the terminal years.

The model fit to survey indices and catch are shown in figure 3.4.21 and the overview of model parameter estimates are shown in Figure 3.4.26.

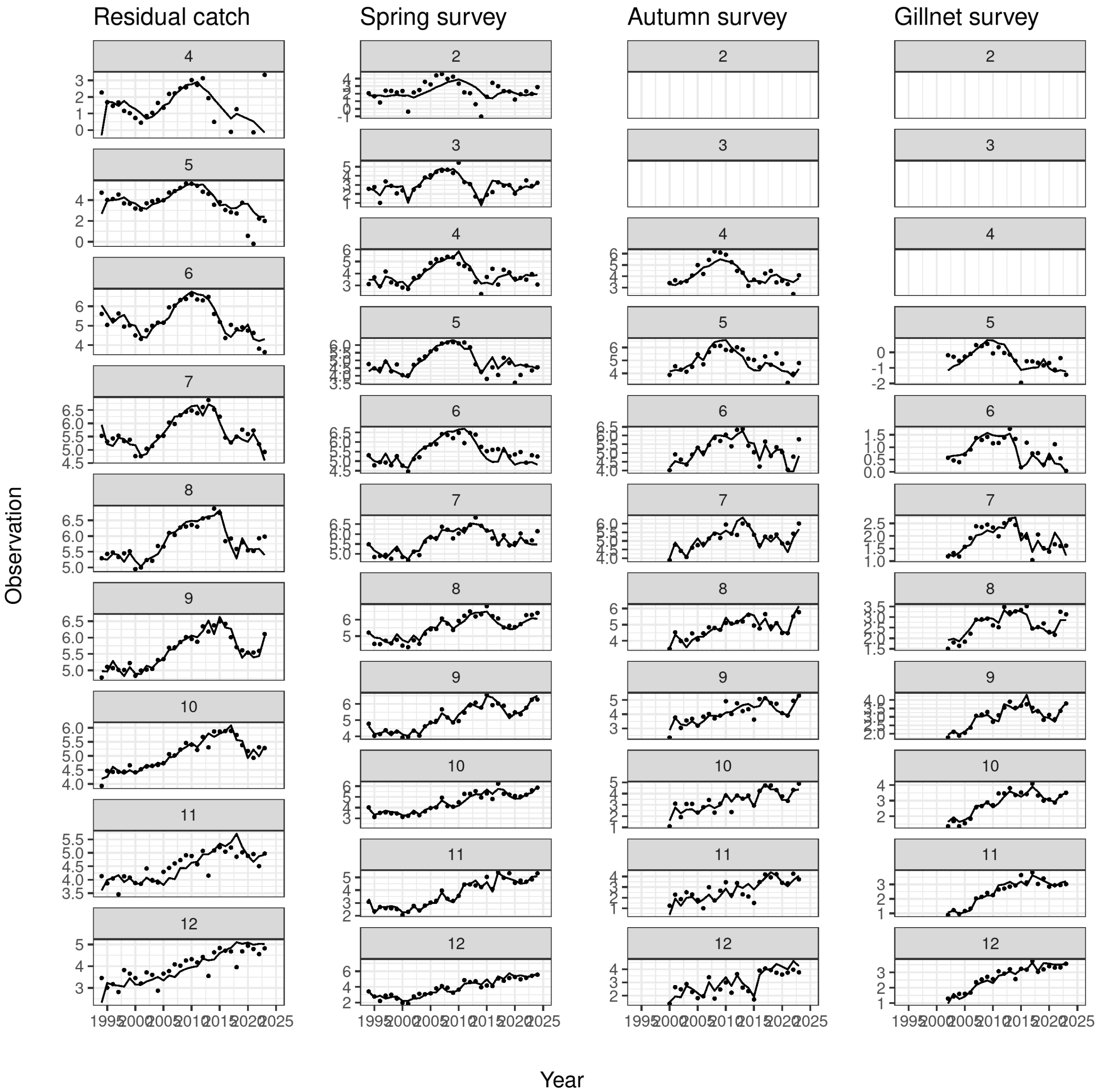


Figure 3.4.21: Ling in 5.a. Model fit to catches, spring survey, autumn survey and gillnet indices.

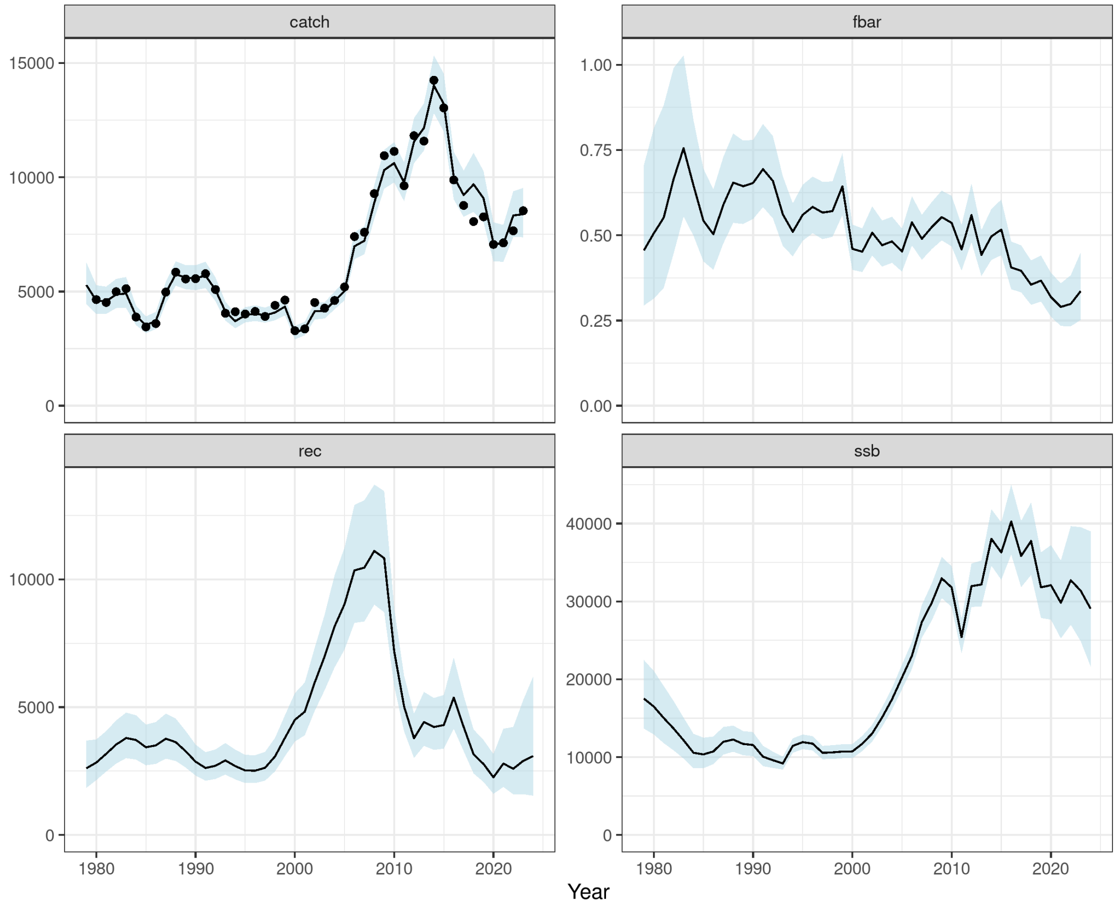


Figure 3.4.22: Ling in 5.a. Model results of population dynamics overview: estimated catch, average fishing mortality over ages 8 - 11 (Fbar), recruitment (age 2), and spawning stock biomass (SSB).

3.4.13 Results

Population dynamics of the ling estimated in this model show a clear trend of a high recruitment period from 2004 - 2010, corresponding with increased spawning stock biomass (SSB) and catches during the 2010 - 2019 period. Despite this trend, fishing mortality has remained rather steady or slightly declined (Figure 3.4.22).

3.4.13.1 Retrospective analysis

The results of an analytical retrospective analysis are presented. The analysis indicates that there was an upward revision of biomass over the first 2 years of the 5-year peel followed by a downward revision of biomass (SSB) over the last 3 years, and subsequently a downward then upward revision of F. This period of larger retrospective patterns is the result of rapidly changing biomass levels. Estimates of recruitment are decently stable except for the apparent peak in 2017 - 2018. As explained in reference to the survey indices, this is likely the influence of highly variable survey indices that, for the smallest sizes in the most recent years, have no repeated observations at larger sizes with which this influence can be tempered. Therefore, it is expected that these recruitment peaks may simply be the result of uncertainty in survey indices and are likely to disappear in the coming assessment years.

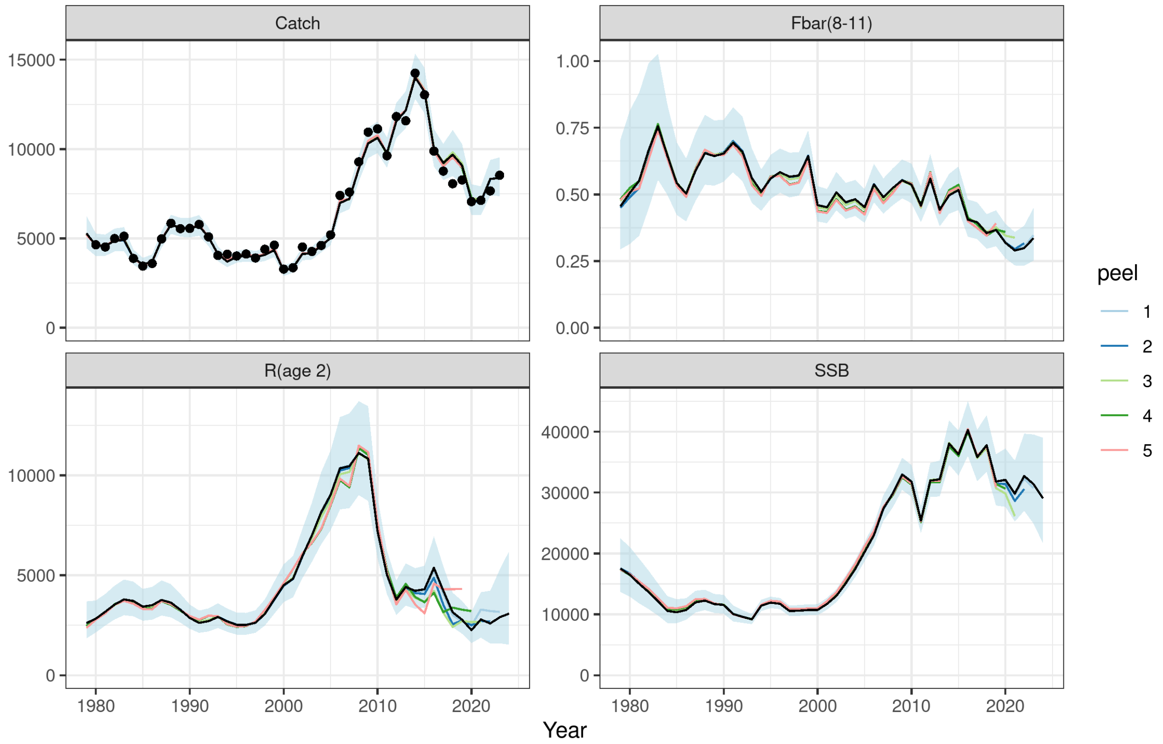


Figure 3.4.23: Ling in 5.a. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 2) are shown.

Mohn's rho was estimated to be -0.0568 for SSB, 0.0911 for F, and 0.221 for recruitment.

Neither observation nor process residuals show obvious trends (Figures. 3.4.24 and 3.4.25).

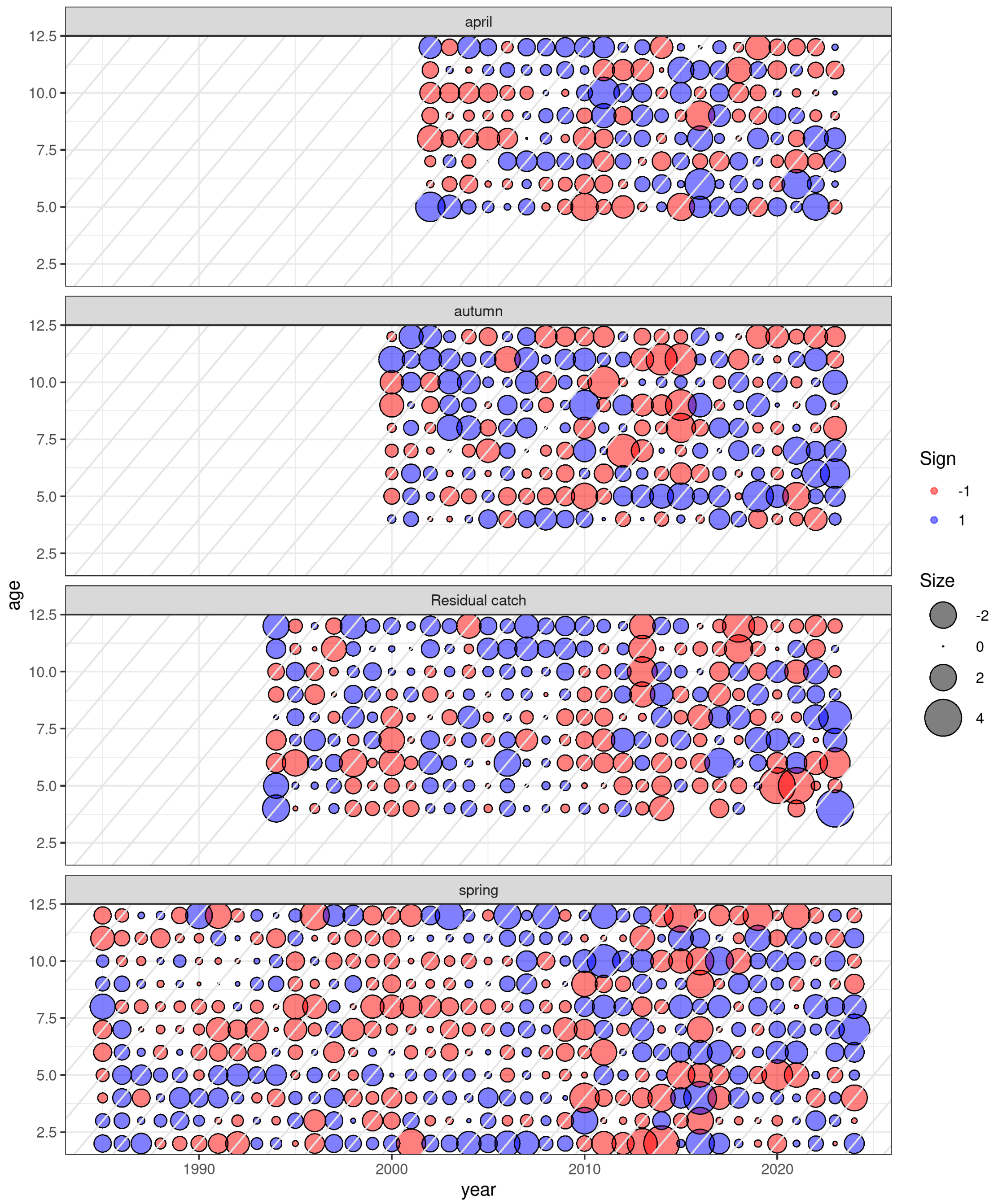


Figure 3.4.24: Ling in 5.a. Observation error residuals of the SAM model.

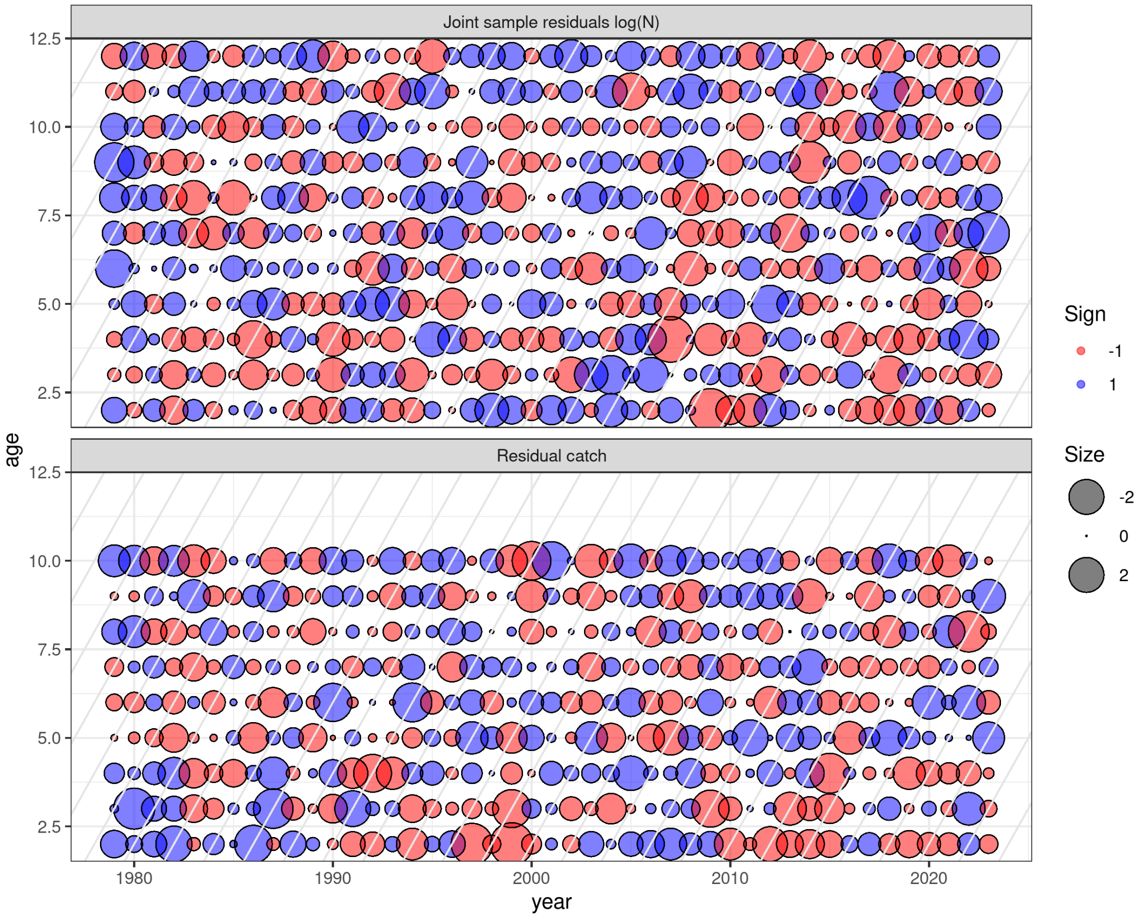


Figure 3.4.25: Ling in 5.a. Process error residuals of the SAM model.

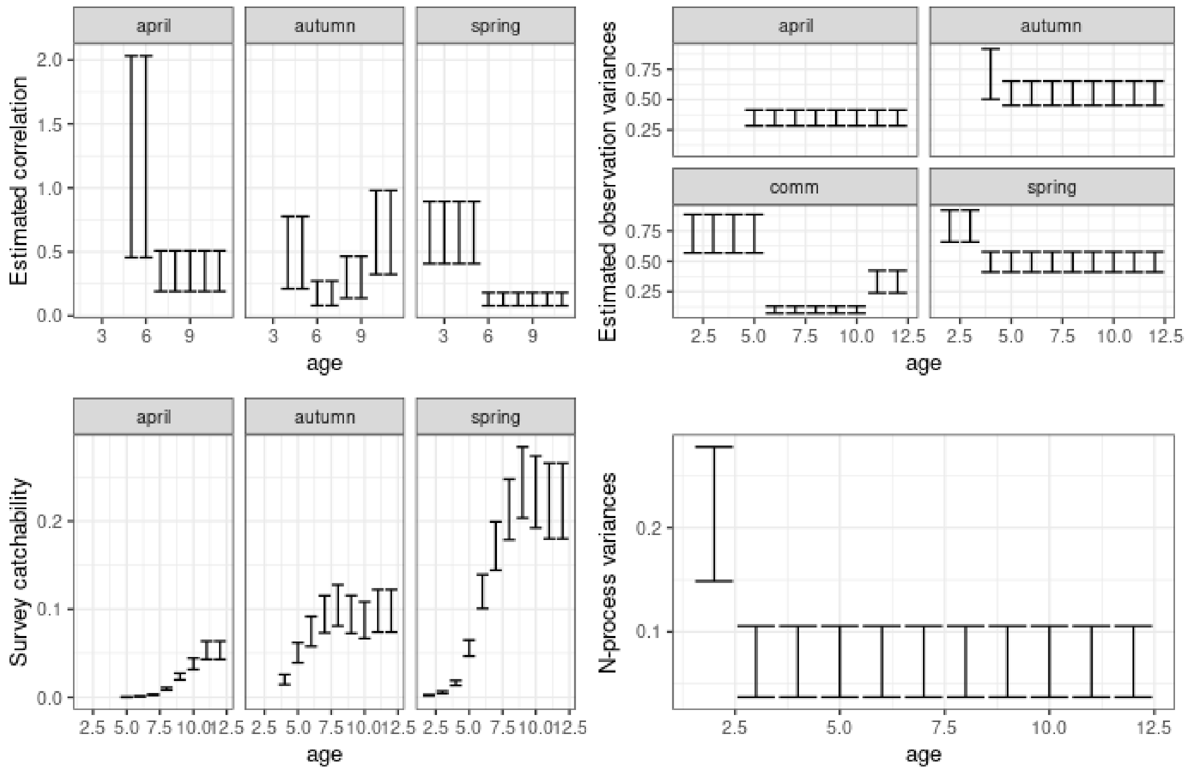


Figure 3.4.26: Ling in 5.a: Illustration of estimated model parameters.

3.4.13.2 Reference points

As part of the WKICEMP 2022 (ICES 2022d) HCR evaluations, the following reference points were defined for the stock.

Table 3.4.4: Ling in 5.a Reference points, values, and their technical basis.

Framework	Reference point	Value	Revised technical basis
MSY Approach	MSY $B_{trigger}$	11100	B_{pa}
	F_{MSY}	0.30	F that produces MSY in the long term
Precautionary Approach	B_{lim}	9000	B_{loss} (SSB in 1993)
	B_{pa}	11100	B_{lim} x $e^{1.645*\sigma B}$, using the default σ_B=0.2
	F_{lim}	0.95	Fishing mortality that in stochastic equilibrium will result in median SSB at B_{lim}
	F_{pa}	0.62	F_{p05}, maximum F at which the probability of SSB falling below B_{lim} is <5%
Management plan	MGT $B_{trigger}$	11100	No lower than MSY $B_{trigger}$
	F_{MGT}	0.30	No higher than F_{msy}

The management plan proposed by Iceland is:

The proposed HCR for the Icelandic Ling fishery, which sets a TAC for the fishing year y/y+1 (September 1 of year y to August 31 of year y+1) based on a fishing mortality F_{MGT} of 0.30 applied to ages 8 to 11 modified by the ratio SSB_y/MGT $B_{trigger}$ when SSB_y < MGT $B_{trigger}$, maintains a high yield while being precautionary as it results in lower than 5% probability of SSB < B_{lim} in the medium and long term. WKICEMSE 2022 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

3.4.14 Management

The Icelandic Ministry of Food, Agriculture and Fisheries 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 MFRI and the set TAC from 2002/2003 to 2013/2014 but amounted to less than two thirds in 2015/2016 (Table 3.4.5). 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 (Figure 3.4.27) and additional catches by Norway and the Faroe Islands, taken in accordance with 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.

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 (ICES 2022c).

Table 3.4.5: Ling in 5.a. TAC recommended for ling in 5.a by the Marine and Fisheries Research Institute, national TAC and total landings.

Fishing Year	MFRI Advice	National TAC	Landings
1999/00			3 961
2000/01			3 451
2001/02	3 000	3 000	2 968
2002/03	3 000	3 000	3 715
2003/04	3 000	3 000	4 608
2004/05	4 000	4 000	5 238
2005/06	4 500	5 000	6 961
2006/07	5 000	5 000	7 617
2007/08	6 000	7 000	8 560
2008/09	6 000	7 000	10 489
2009/10	6 000	7 000	10 713
2010/11	7 500	7 500	10 095
2011/12	8 800	9 000	11 133
2012/13	12 000	11 500	12 445
2013/14	14 000	13 500	14 983
2014/15	14 300	13 800	13 166
2015/16	16 200	15 000	11 229
2016/17	9 343	8 143	8 426
2017/18	8 598	7 598	8 573
2018/19	6 255	5 200	8028
2019/20	6 599	5299	7154
2020/21	5700	5700	7214
2021/22	4735	4735	6699
2022/23	6098	6098	8437

Fishing Year	MFRI Advice	National TAC	Landings
2023/24	6566	6566	
2024/25	6479		

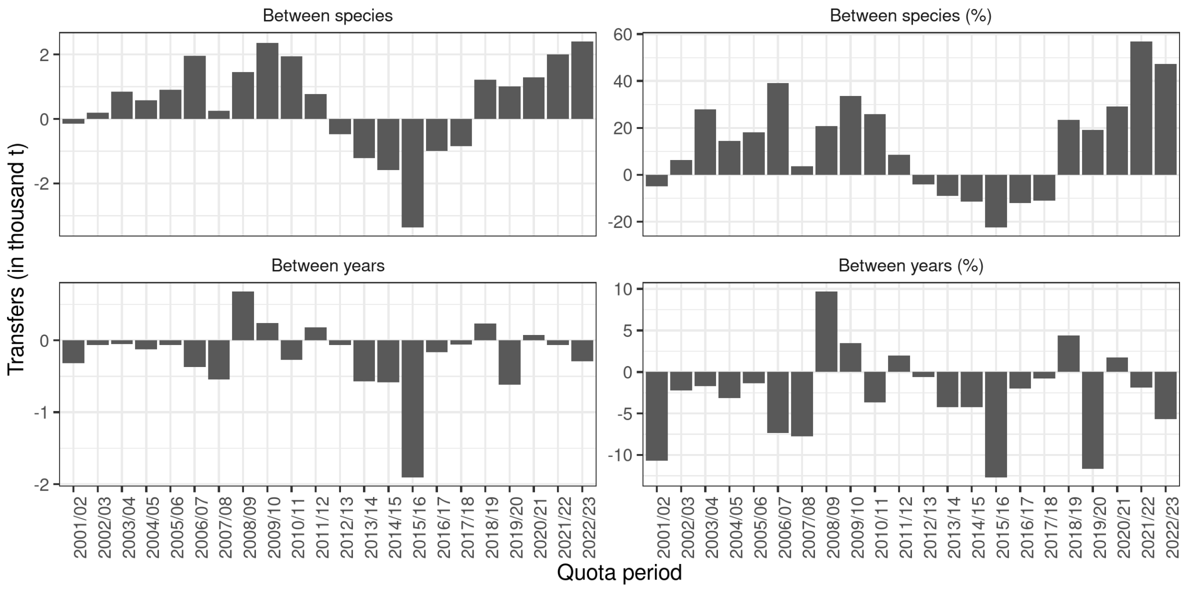


Figure 3.4.27: Ling in 5.a. Net transfer of quota in the Icelandic ITQ system by fishing year. Between species (upper): Positive values indicate a transfer of other species to ling, but negative values indicate a transfer of ling quota to other species. Between years (lower): Net transfer of quota for a given fishing year (may include unused quota).

3.4.15 Management considerations

All the signs from commercial catch data and surveys indicate that ling is at present in a good state, even though the survey indices show downward trend in most recent years. This is confirmed in the SAM 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.

Table 3.4.6: Ling in 5.a. Landings (tonnes) by country in 5.a.

Year	Faroe Islands	Germany	Iceland	Norway	UK
2002	1631	0	2843	45	0
2003	570	2	3585	108	5
2004	739	1	3727	139	0
2005	682	3	4313	180	20
2006	962	1	6283	158	0
2007	807	0	6599	185	0

Year	Faroe Islands	Germany	Iceland	Norway	UK
2008	1366	0	7738	179	0
2009	1157	0	9616	172	0
2010	1095	1	9868	168	0
2011	588	0	8789	249	0
2012	875	0	10695	248	0
2013	1030	0	10213	294	0
2014	1604	0	12483	158	0
2015	1132	0	11653	250	0
2016	952	0	8702	230	0
2017	730	0	7792	244	0
2018	993	0	6866	203	0
2019	1023	0	7061	184	0
2020	971	0	5853	237	0
2021	832	0	6205	91	0
2022	706	0	6818	132	0
2023	825	0	7531	178	0

Table 3.4.7. Ling in 5.a. Estimates of spawning–stock biomass (SSB) in thousands of tonnes, recruitment at age 2 (thousands), fishing mortality over ages 8 - 11 (Fbar) and catch from SAM.

Year	Recruitment			SSB			Total	F		
	Age 2	97.5%	2.5%		97.5%	2.5%	Catch	Ages 8-11	97.5%	2.5%
	thousands			tonnes			tonnes			
1979	2607	3702	1836	17529	22480	13668	5284	0.45	0.70	0.29
1980	2830	3746	2139	16508	21083	12926	4601	0.50	0.81	0.31
1981	3175	4074	2475	15038	19153	11807	4577	0.55	0.88	0.34
1982	3536	4491	2784	13679	17208	10874	4868	0.66	0.99	0.45
1983	3793	4800	2998	12175	15085	9826	4907	0.75	1.03	0.55
1984	3718	4697	2943	10566	13006	8583	3931	0.65	0.84	0.50
1985	3432	4329	2720	10350	12499	8571	3525	0.54	0.70	0.42
1986	3508	4433	2776	10726	12644	9099	3710	0.50	0.63	0.40

Year	Recruitment			SSB			Total	F		
1987	3769	4763	2983	11966	13873	10321	4928	0.59	0.73	0.48
1988	3635	4572	2891	12262	14056	10696	5764	0.65	0.80	0.54
1989	3279	4085	2632	11695	13354	10242	5600	0.64	0.78	0.53
1990	2867	3547	2318	11562	13218	10114	5575	0.65	0.78	0.55
1991	2619	3244	2115	10063	11465	8832	5696	0.69	0.83	0.58
1992	2705	3351	2183	9599	10703	8610	5072	0.66	0.79	0.55
1993	2918	3610	2359	9187	10062	8388	4121	0.56	0.67	0.47
1994	2696	3352	2169	11442	12414	10546	3701	0.51	0.59	0.44
1995	2526	3145	2029	11921	12908	11009	3964	0.56	0.65	0.48
1996	2518	3130	2025	11727	12690	10838	4036	0.58	0.67	0.51
1997	2628	3259	2118	10548	11442	9724	3953	0.57	0.66	0.49
1998	3069	3801	2478	10602	11534	9745	4080	0.57	0.66	0.50
1999	3794	4691	3068	10714	11650	9854	4336	0.64	0.74	0.56
2000	4500	5559	3643	10727	11683	9849	3185	0.46	0.53	0.40
2001	4817	5970	3886	11711	12733	10771	3366	0.45	0.52	0.39
2002	5966	7349	4843	13034	14161	11997	4133	0.51	0.59	0.44
2003	6997	8653	5658	15094	16400	13892	4159	0.47	0.54	0.41
2004	8179	10209	6552	17431	18889	16086	4590	0.48	0.56	0.42
2005	9047	11291	7248	20220	21876	18690	5023	0.45	0.52	0.39
2006	10378	12982	8296	23013	24846	21315	6979	0.54	0.62	0.47
2007	10484	13162	8351	27369	29573	25329	7221	0.49	0.56	0.43
2008	11123	13755	8995	29851	32345	27550	8891	0.52	0.60	0.46
2009	10838	13505	8698	32994	35758	30443	10316	0.55	0.63	0.48
2010	7193	8895	5816	31812	34563	29280	10619	0.54	0.62	0.47
2011	5015	6235	4034	25429	27754	23299	9768	0.46	0.53	0.40
2012	3772	4746	2998	31969	34901	29283	11557	0.56	0.65	0.48
2013	4398	5590	3460	32193	35298	29362	12157	0.44	0.52	0.38
2014	4208	5354	3308	38072	41892	34601	14012	0.50	0.58	0.43
2015	4285	5471	3356	36308	40209	32785	13205	0.52	0.60	0.44

Year	Recruitment			SSB			Total	F		
2016	5363	6944	4142	40286	45051	36025	10023	0.40	0.48	0.34
2017	4216	5448	3263	35840	40372	31817	9219	0.40	0.47	0.33
2018	3141	4121	2394	37759	42719	33374	9685	0.35	0.43	0.30
2019	2760	3699	2059	31796	36304	27847	9080	0.37	0.44	0.31
2020	2243	3151	1597	32065	37223	27622	7118	0.32	0.39	0.26
2021	2818	4200	1891	29799	35220	25213	7066	0.29	0.36	0.23
2022	2524	4135	1541	32695	39642	26965	8328	0.30	0.38	0.23
2023	2869	5241	1570	31333	39519	24842	8382	0.34	0.45	0.25
2024	3054	6171	1511	29017	38985	21598	7264	0.33	0.52	0.22

3.4.16 Ecosystem considerations

In 2010 to 2013, the distribution of ling expanded to the north and recruitment peaked (Figure 3.4.4 and Figure 3.4.13). These suggest favourable environmental conditions during this time; however, recruitment has returned to previous levels and therefore biomass levels are naturally expected to follow. In addition, there have been no obvious changes in maturity patterns or growth through time. Demographic patterns of ling should be monitored as other Icelandic demersal species have exhibited recent changes (e.g., haddock). Multispecies interactions are not currently considered to be a concern for the assessment.

3.5 Ling (*Molva molva*) in subareas 3, 4, 6–9, 12 and 14 (Northeast Atlantic and Arctic Ocean)

3.5.1 The fishery

Significant fisheries for ling are conducted in subareas 3 and 4 at least since the 1870s pioneered by Swedish longliners. Since the mid-1900s, the major ling targeted fishery is Division 4.a where Norwegian longliners fished around Shetland and in the Norwegian Deep. There are little catches in ICES Division 3.a. The Norwegian total landings in 2022 in subareas 3 and 4 were: 53% taken by longlines, 28% by gillnets, 18% by trawls, and the remainder by other gears. 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.bc) are bycatches from various other fisheries.

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

Catches from Norwegian vessels in subareas 4 and 6 dropped from 5834 tonnes in 2020 to 1266 tonnes in 2021 as a consequence of a reduction in their access to British waters, and increased again to 7732 tonnes in 2022 and to 5119 tonnes in 2023.

In Subarea 7, in recent years, the bulck of landings was caught in divisions g–k. 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 (60%) were taken by trawls in this area.

Landings in subareas 8 and 9, 12 and 14 are bycatches from various fisheries and are minor compared to subareas 4 and 6. In addition landings from Subarea 7 have been declining over the past 3 decades, and are now at low level whilst they were comparable to landings from subareas 4 and 6 30 years ago.

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 but increased to 30 in 2020. The number of vessels declined mainly because of changes in the law concerning the quotas for cod and absence of agrement between Norway and the United Kingdom. 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 divisions 4.a and 6.a. During the period 1974 to 2020 the total number of hooks per year has varied considerably, but with a downward trend since 2000. This is also reflected in the number of fishing days (Figure 3.5.1).

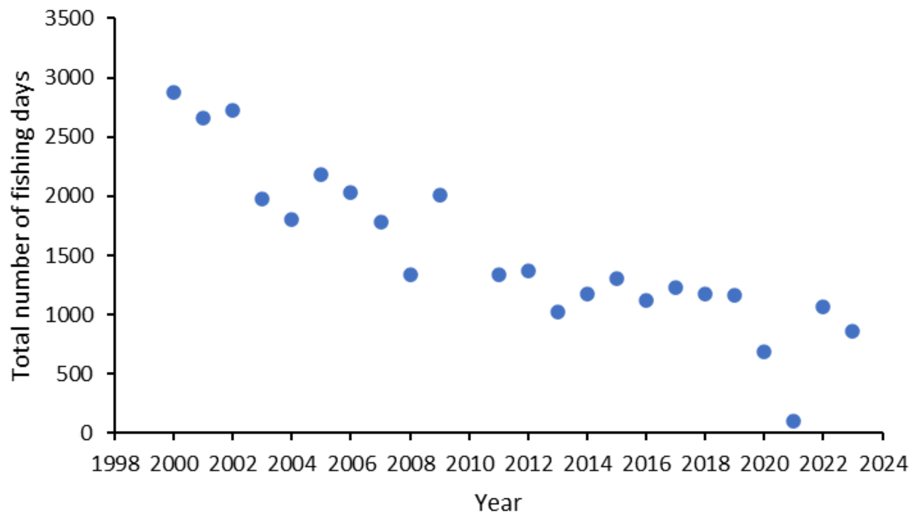


Figure 3.5.1. Ling in subareas 3, 4, 6–9, 12 and 14, total fishing days by the Norwegian longliners (2000-2023).

The French fishery

French vessels operating mainly in subareas 4.a, 6a, 7b-k, 8 and are mainly trawlers, gillnetters and longliners.

The number of French trawlers operating in the stock area and catching ling (more than 1 t) has decreased from 166 in 2014 to 25 in 2023 whereas the number of French longliners is relatively stable from 2014 to 2023 (Table 3.5.3). In 2014, 52 French gillnetters were operated in the stock area. Since 2015, the number of French gillnetters is around 30-40 vessels (Table 3.5.3).

The Spanish fishery

The bulk of Spanish landings since 2012 are from Division 6.a. The Spanish catches of ling in ICES Subarea 7, are mostly in divisions b, c and g–k, and are 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.

3.5.2 Landings trends

Landing statistics for ling by country and area in the period 2001–2023 are in section 3.5.10 and in Figures 3.5.2 and 3.5.3. For the early time-series, from 1988 to 2000, only international landings by area are presented (table 3.5.2), see stock annex for details of landings by country and area before 2000. Detailled landings by area and country are presented for the time-series 2001-2023 only (Tables 3.5.1a to 3.5.1n in section 3.5.10).

There was a decline in landings from 1988 to 2003, and since landings have been stable and slightly increasing until 2019, a marked decreased occurred in 2020 and 2021. In 2022, landings increased again to a level similar to years 2016-2019, at 18 556 tonnes. In 2023, landings decreased compared to the level in 2022 to reach a level similar to years 2003-2018 (15 055 tonnes).

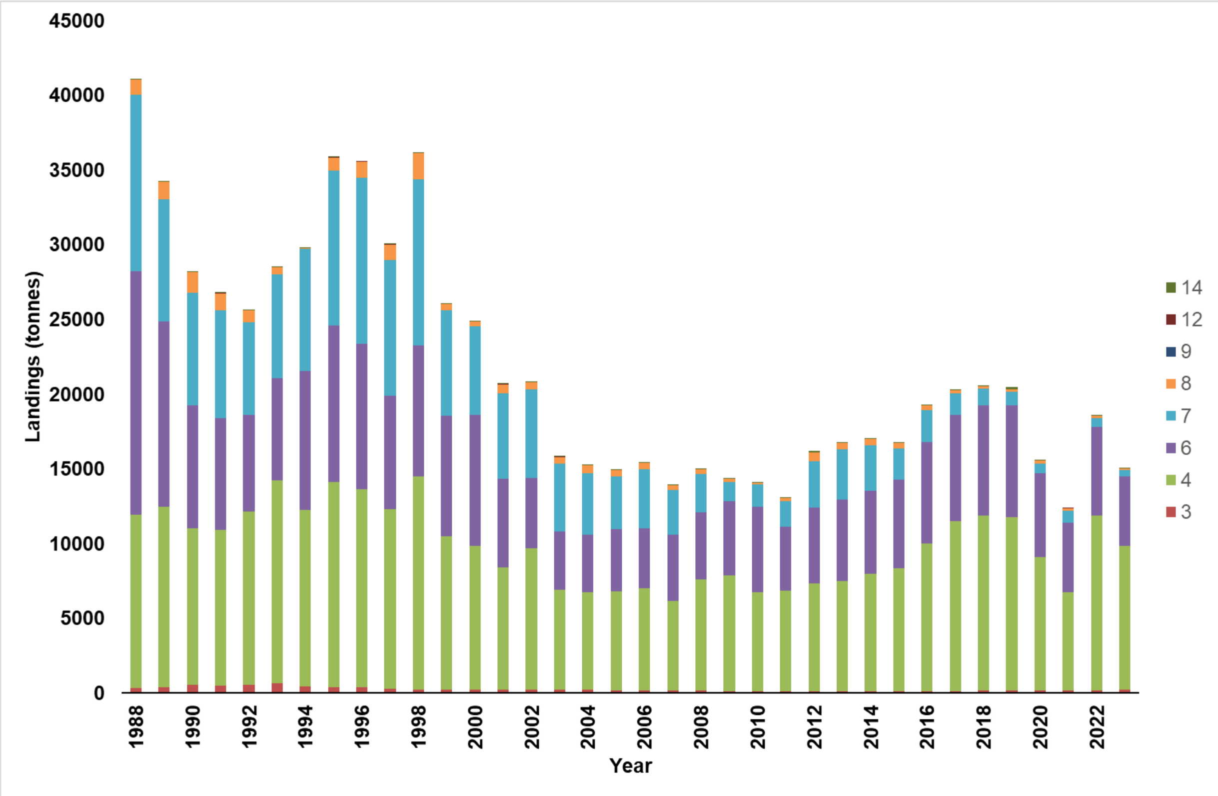


Figure 3.5.2. International landings of ling in subareas 3, 4, 6–9, 12 and 14 from 1988 to 2023.

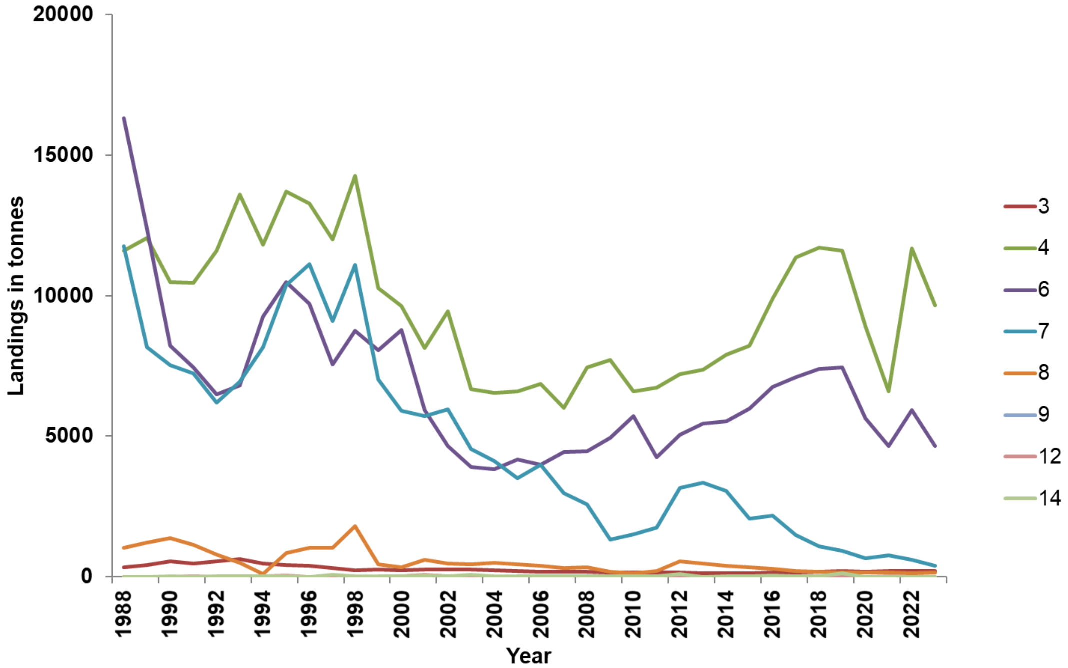


Figure 3.5.3. International landings of ling in subareas 3, 4, 6–9, 12 and 14 from 1988 to 2023.

3.5.3 ICES Advice

ICES advises that when the MSY approach is applied, catches should be no more than 13 317 tonnes in each of the years 2024 and 2025. If discard rates do not change from the average of the last three years (2020–2022), this implies landings of no more than 12 785 tonnes.

3.5.4 Management

Norway has a licensing scheme in EU waters. The Norwegian quota in EU waters (5.b, 6 and 7) was respectively 8000 t and 2000 t in 2020 and 2021. In 2020, the Faroe Islands had a quota of 200 t in divisions 6.a and 6.b and 50 t in 2021. Since 2022, Norwegian quota in 5.b, 6 and 7 and Feroes quota in 6.a et 6.b have been set to zero

The quota for the EU in Norwegian waters of Subarea 4 was set at 700 in 2022 and at 500 tonnes since 2023.

The Norwegian quota in EU waters decreases since 2021 as a consequence of UK waters between separated from EU waters following the Brexit.

Table 3.5. EU TACs (in tonnes) in EU and international waters (2016-2020; pre Brexit), EU and UK TAC in EU, UK and international waters in the stock area and EU quota in Norwegian waters (2016–2024).

	2016	2017	2018	2019	2020	2021	2022	2023	2024

Division 3.a (EU waters)	87	87	87	170	179	175	144	144	144
Subarea 4 (UK and EU waters)	2912	3494	3843	4035	4237	3813	3127	2577	2266
Subarea 4 (Norwegian waters)	950	1350	1350	1350	1350	900	700	500	500
Subareas 6, 7, 8, 9 and 10, international waters of 12 and 14	16 997	20 396	20 396	20 396	20 396	18 356	15 052	12 371	10 907
Sum of TACs set on the stock	20 946	25 327	25 676	25 951	26 162	23 244	19 023	15 592	13 817

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 are no information about discards. Discards by countries are given in Table 3.5.4. In all years discards are <5% but are however included in the assessment. The bulk of the discard is from UK (Scotland).

Data for 2023 were taken from InterCatch for UK (England, Scotland, Northern Ireland), Ireland, Sweden, France, Netherland, Norway, Spain, Denmark and Germany and from ICES preliminary catch statistics for other countries (Belgium, Faroes Islands, Greenland, Guernsey, Isle of Man). The comparison of the two data sources was good.

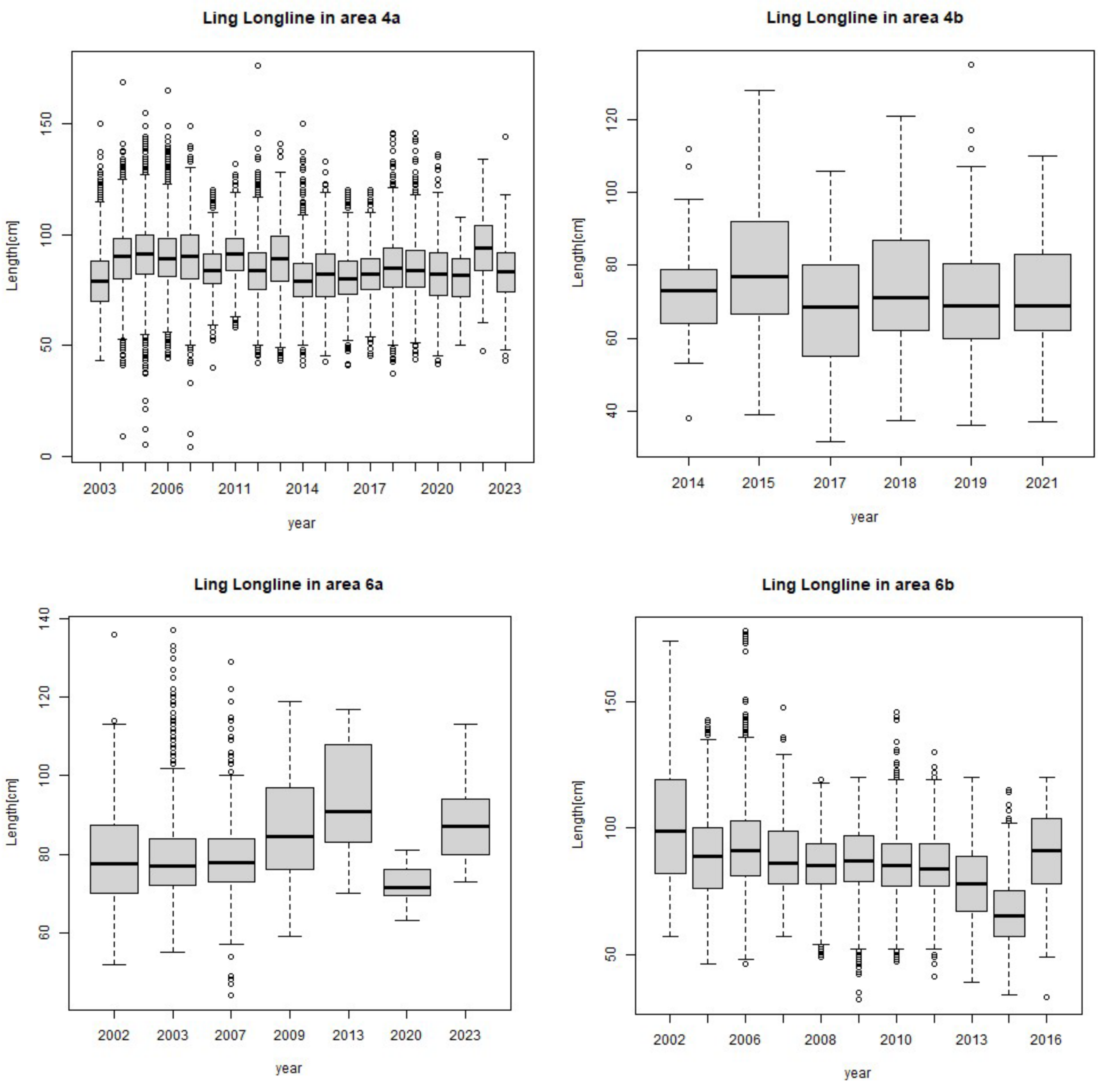
Table 3.5.4. Ling in subareas 3, 4, 6–9, 12 and 14, total discards of ling by country for the years 2012 to 2023.

	Denmark	Spain	Ireland	France	Sweden	UK (Scotland)	UK (England)	Germany	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	20881	7.74
2017	1	10	105	71	2	959			1147	21443	5.35
2018	1		43	89		876	3		1012	21566	4.69
2019	3	8	70	13		993	9		1096	21837	4.85
2020	4	37	19	1	0	346	0		407	15664	0.081
2021	1	15	36	4	5	213	0		274	12541	2.17
2022	5	20	16	NA	9	262	0		316	18 872	1.68
2023	0	39	6	4	12	493	3	1	558	15 438	3.61

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 divisions 4.a, 6.a, 6.b for ling are shown in Figures 3.5.4–3.5.6, respectively. Data are from the Norwegian longline reference fleet. The length-weight relationship from sex combined is $W=0.0055*TL^{3.0120}$.



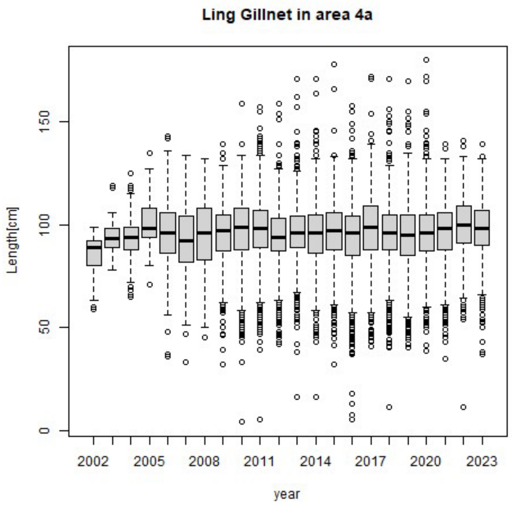
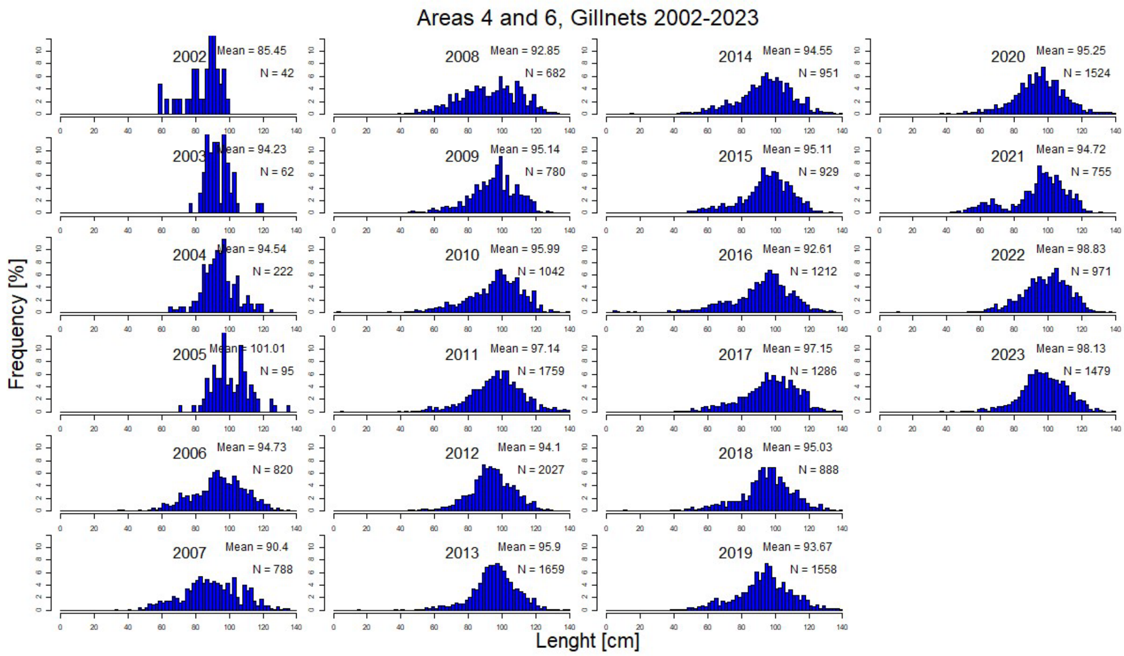


Figure 3.5.4. Ling in subareas 3, 4, 6–9, 12 and 14, time-series of mean length of ling caught by the Norwegian longline reference fleet in divisions 4.a, 4.b, 6.a and 6.b (note that some years are missing in some divisions).



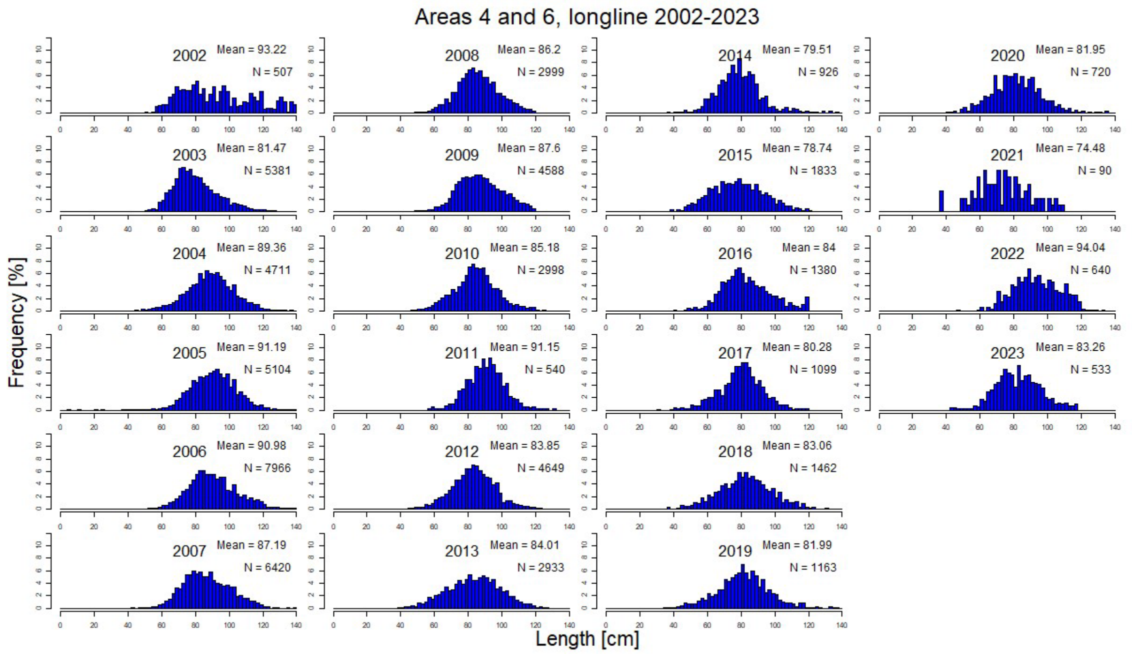


Figure 3.5.5. Ling in subareas 3, 4, 6–9, 12 and 14. Length distributions of ling in division 3.a, 4.a, 6.a and 6.b based on data from the Norwegian reference fleet.

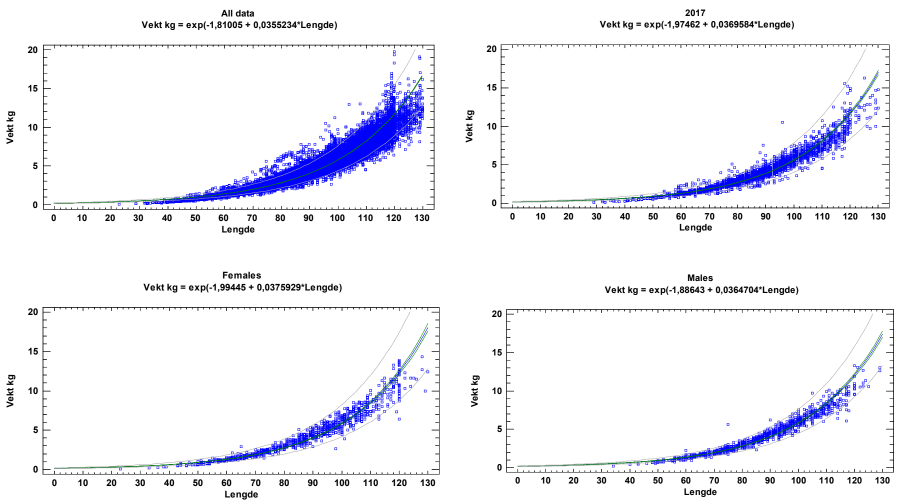


Figure 3.5.6. Ling in subareas 3, 4, 6–9, 12 and 14. Weight as a function of length for ling based on all available Norwegian data.

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

The length distribution of catches of ling in the Spanish Porcupine survey, reflect first the declining of number caught in this survey (3.5.7). Further individual remaining in 2021-2022 are small; for more information see Ortiz P. *et al*. (WD 2024).

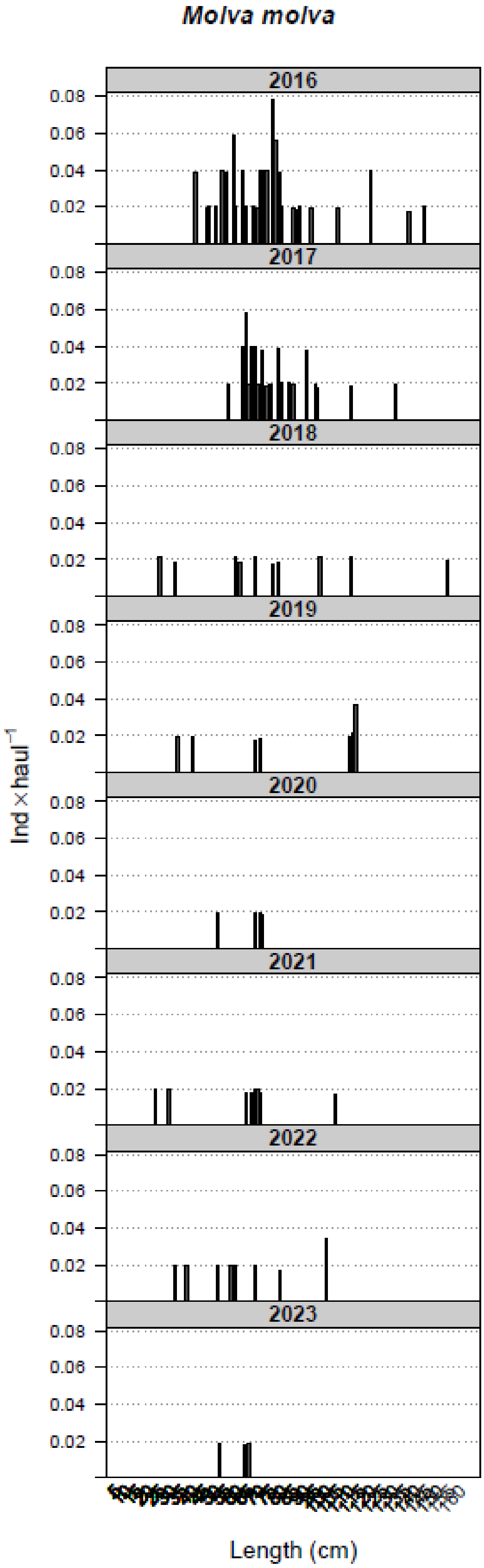

Molva molva
2016
2017
2018
2019
2020
2021
2022
2023
0.08
0.06
0.04
0.02
Ind × haul⁻¹
Length (cm)

Figure 3.5.7. Ling in subareas 3, 4, 6–9, 12 and 14. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey in the period 2016–2023.

3.5.5.3 Age compositions

Estimated age distributions for the years 2009–2023 based on data from the Norwegian Reference fleet for areas 4 and 6 (Figure 3.5.8) and box and whisker plots for the age composition of the fish taken by longliners and gillnetters in divisions 3.a, 4.a, 4.b and 6.b (Figure 3.5.9).

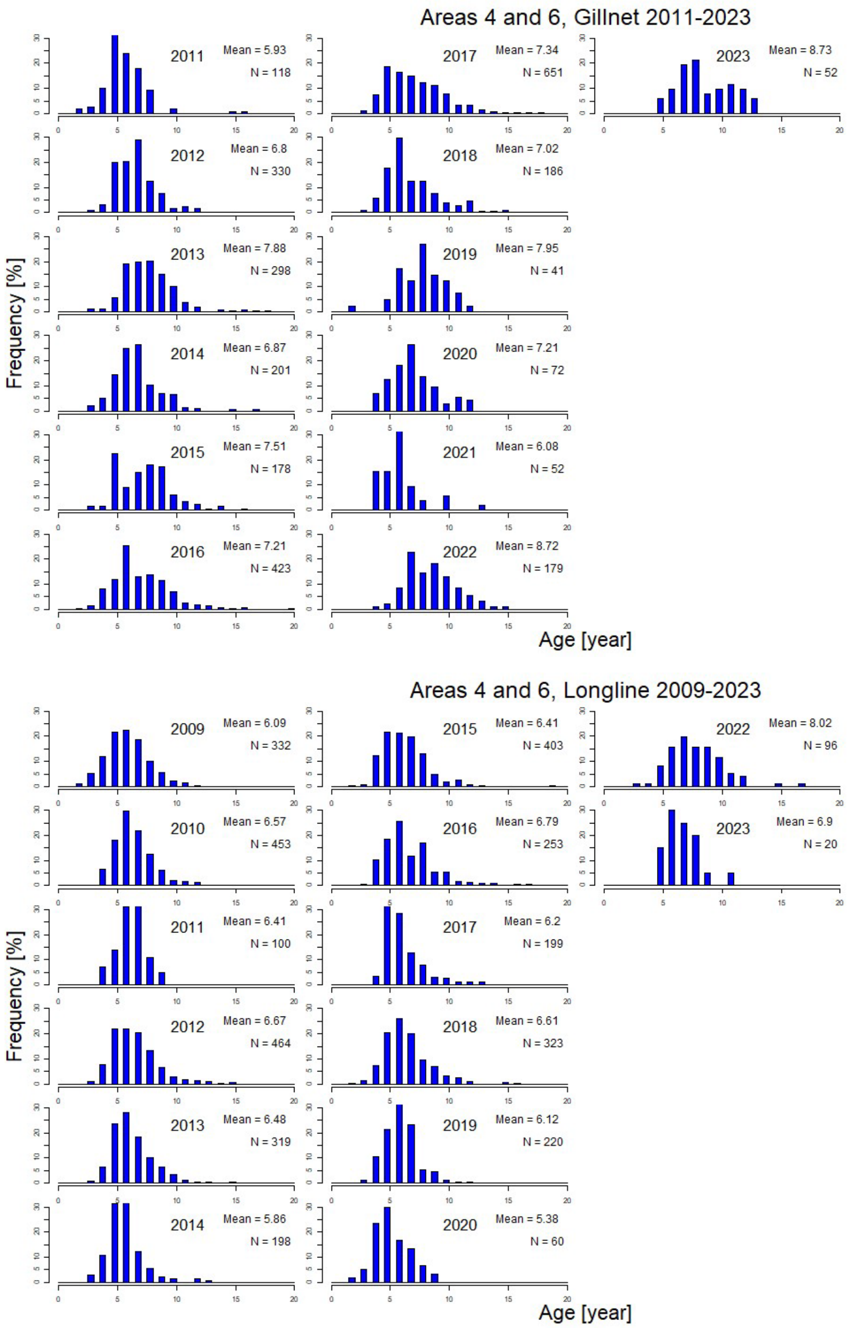


Figure 3.5.8. Ling in subareas 3, 4, 6–9, 12 and 14. Age distributions for ling areas in subareas 4 and 6 combined for all catches taken by longliners and by gillnetters.

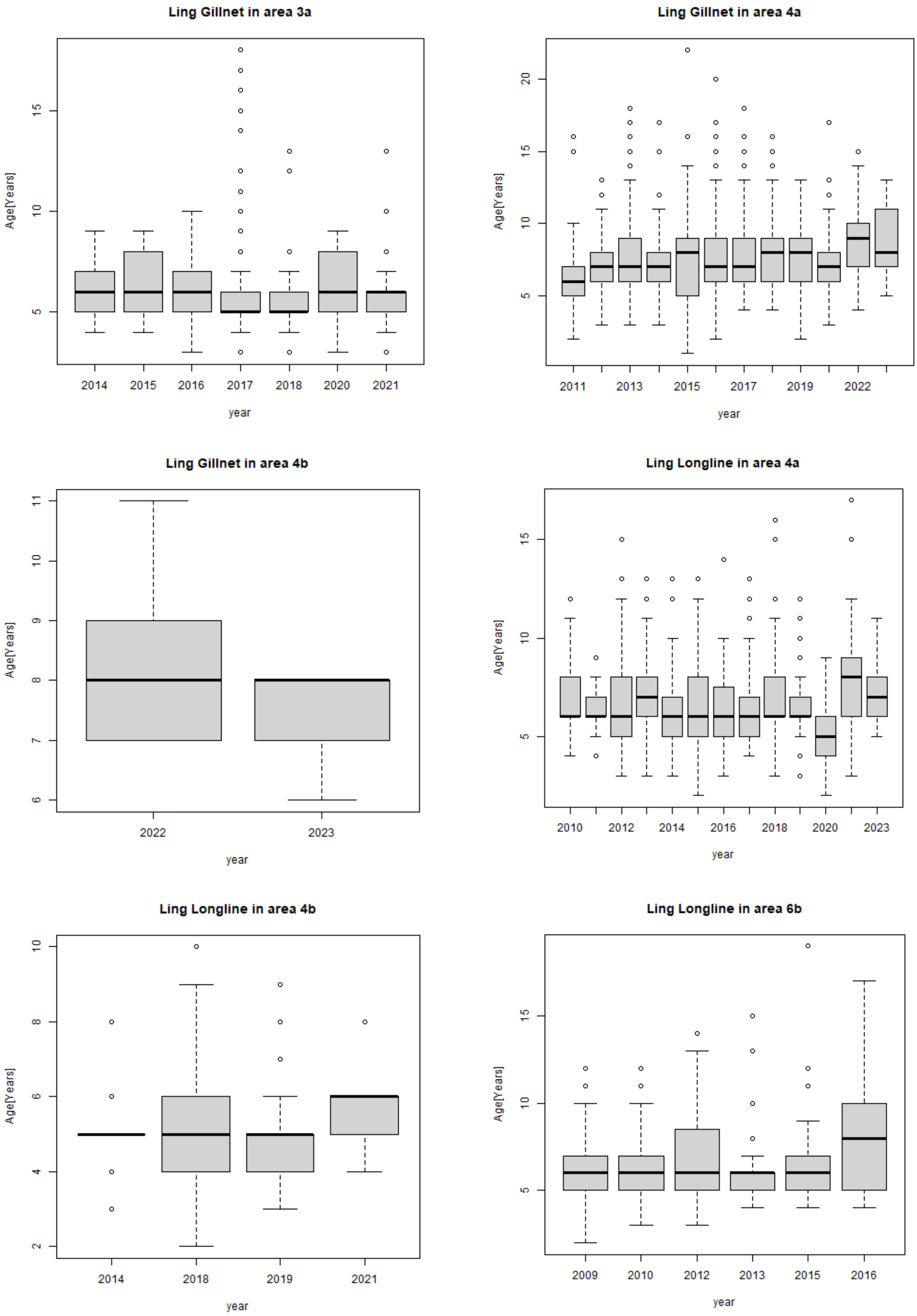


Figure 3.5.9. Ling in subareas 3, 4, 6–9, 12 and 14. Average age of ling catches by longliners and gillnetters by division.

3.5.5.4 Weight-at-age

Weight and length at age for all age readings of ling from divisions 4.a and 6.a from 2009 to 2017 sampled from the longliners in the Norwegian reference fleet show quite linear relationships (Figure 3.5.10).

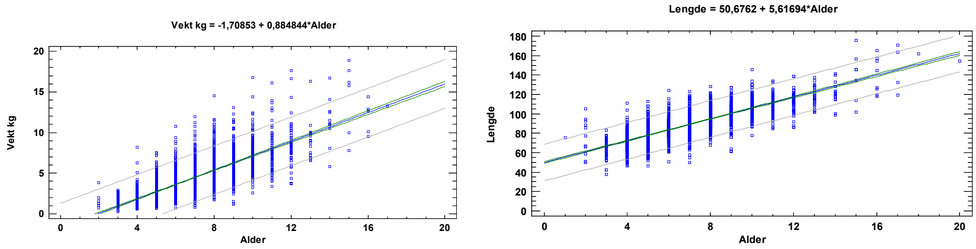


Figure 3.5.10. Ling in subareas 3, 4, 6–9, 12 and 14. Weight versus age and length versus age for ling (combined data from 2009 to 2017) for divisions 4.a and 6.a based on the Norwegian longliner reference fleet.

3.5.5.5 Maturity and natural mortality

Similar estimates have been found in other area, e.g. Age at fist maturity around 5–7 years (60–75 cm lengths) with males maturing at a slightly younger age than females (Magnusson *et al.*, 1997).

See stock annex, no new data in 2023.

3.5.5.6 Growth

In 2021, preliminary new estimates of growth of ling were presented for the Celtic Sea, an area with no previous growth estimates for the species (Vieira and Visconti, 2021). The range of growth estimate for the species is wide (see stock annex). The estimate from the Celtic Sea, which is rather average of available estimates for the species and was estimated from Subarea 7, which is central in the stock area, was used for the calculation of the rfb rule.

3.5.5.7 Natural mortality

Natural mortality is also poorly known. For the adjacent stocks in the Faroese and Icelandic ecoregions (lin.27.5a and lin.27.5b) a natural mortality of 0.15 is assumed, the same is used here.

3.5.5.8 Catch, effort and research vessel data

Spanish Porcupine Bottom Trawl Survey

Spanish Porcupine Bottom Trawl Survey (SP-PORC) in 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 (Ortiz P., *et al.*, WD 2024). The survey provides estimates of biomass and abundance indices. The stratification and location of station is shown in Figure 3.5.11.

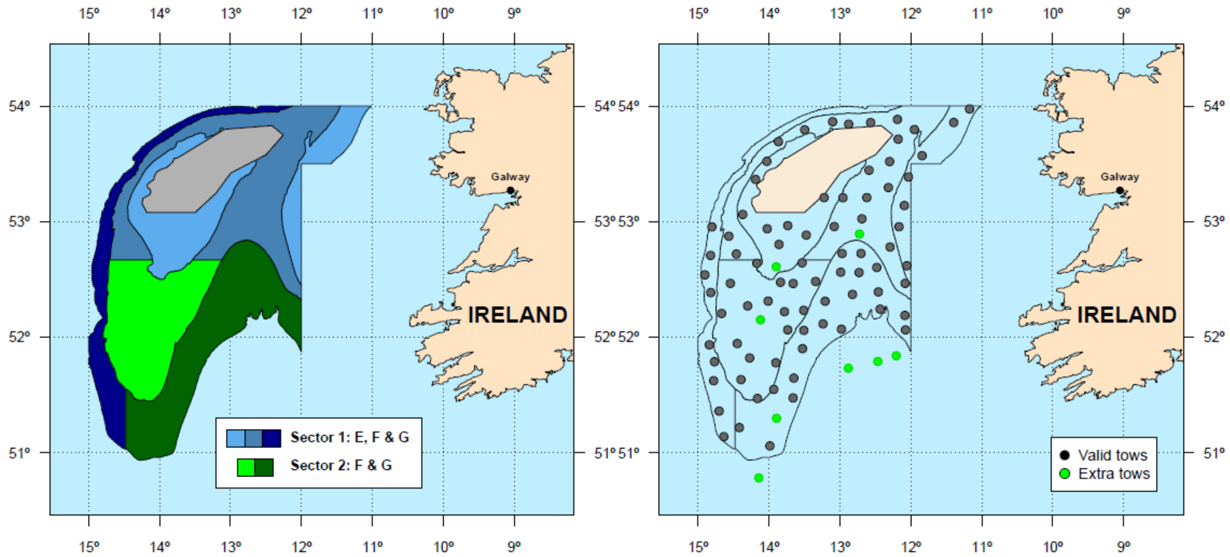


Figure 3.5.11. Ling in subareas 3,4, 6–9, 12 and 14. Left: Stratification design used in the Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank denotes a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls in 2023.

French Southern Atlantic Bottom trawl survey (EVHOE)

Ling are caught in small numbers in the French Southern Atlantic Bottom trawl survey (EVHOE). Population indices (based on swept area for biomass, mean length, etc.) for the Bay and Biscay and Celtic Sea (ICES divisions 7g-k and 8a,b,d) combined were provided for years 1997–2023 (Figure 3.5.15). The survey covers depths from 30 to 600 m and is stratified by depth and latitude.

Commercial cpues

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 2000–2023. Selected vessels were those with a total landed catch of ling, tusk and blue ling of more than 8 t per 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. Standardised cpue series are calculated using data from official logbooks starting from 2000 (Helle *et al.* 2015). As the Norwegian fleet had no access to UK waters in 2021, Norwegian landings in 4.a and 6.a were much lesser in 2021 compared to other years, so that 2021 data were unsuitable to calculate the CPUE. The standardized time-series of cpue used for assessment is based on the subset of fishing trips where ling make up more than 30% of the total catch. This subset is considered to represent targeted fishing.

3.5.6 Data analyses

Length data analysis

Mean length of the commercial catches by the Norwegian longlining reference fleet fluctuate around 90 cm in divisions 4.a and 6.a (Figure 3.5.4). In Division 6.b there may have been a decline in mean length up to 2015 then larger fish were landed in 2016, more recent data are missing (Figure 3.5.4). In division 4b, catches are slightly smaller than in 4.a. (Figure 3.5.4). When all data for these areas are combined for longliners and for gill netters the average length is about 10 cm higher for gill netters than for longliners (Figure 3.5.4)

Ling smaller than 50 cm are not caught in significant number in surveys. The length distributions of ling caught in surveys suggest a disappearance of large fish both on the Porcupine bank (Figure 3.5.7) and in the area covered by the EVHOE survey, divisions 7g-j and 8abd (Figure 3.5.12). For more information, see Ortiz P., *et al*., WD 2024.

Ling are caught in small in declining number in EVHOE, with no catch in the two last years (Figure 3.5.12, top left panel). They are however presented (Figure 3.5.12) and their overall trend suggest a clear decline of ling in the survey area.

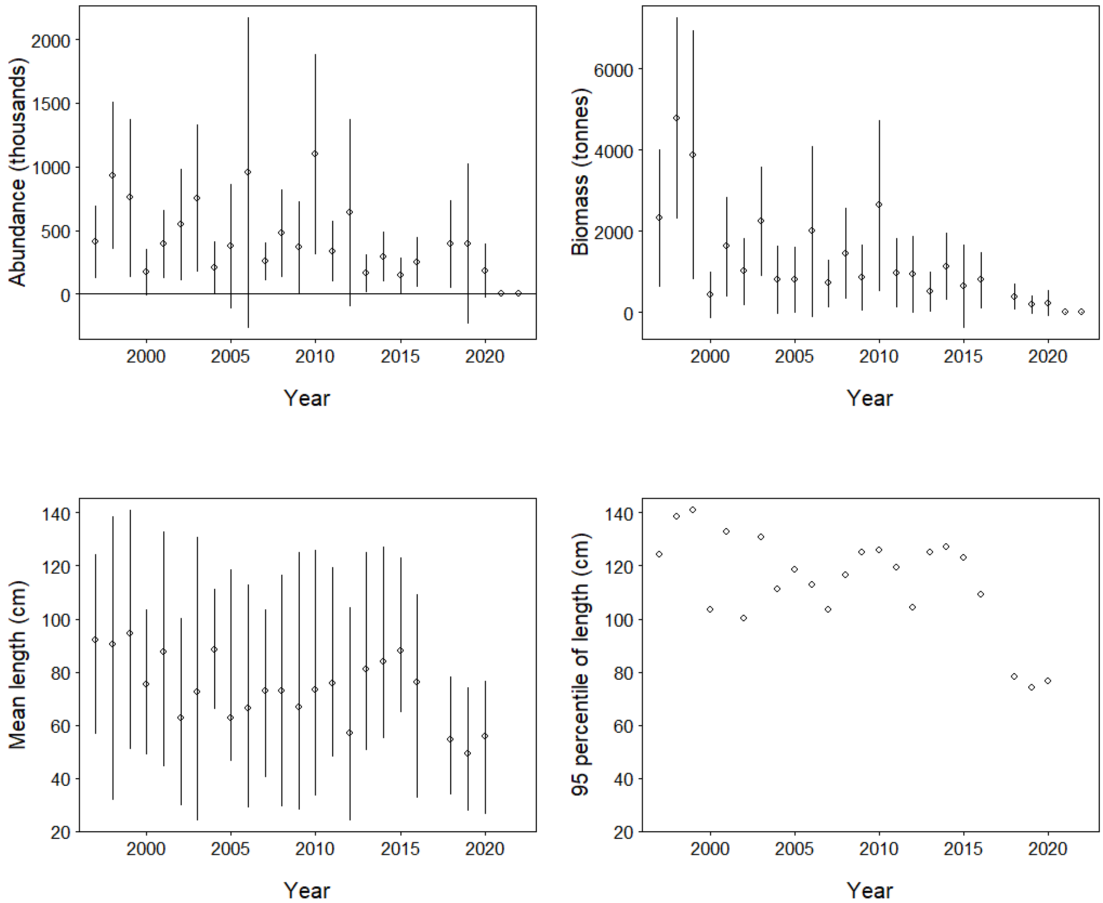


Figure 3.5.12. Ling in subareas 3, 4, 6–9, 12 and 14. Population indices (swept area raised abundance and biomass, mean length and 95 percentile of the length distribution) of ling in the Bay and Biscay and Celtic Sea (ICES divisions 7.g,hjk and 8.a,b,d) from the French EVHOE survey (W-IBTS-Q4), 1997–2022 (except 2017).

Spanish Porcupine Bank survey

Estimated biomass and abundance indices based on data from the Porcupine Survey for the years 2001–2023 are in Figure 3.5.13. The abundance indices for ling based on the survey were quite stable from 2001–2012. After the peak in 2013 there has been a large decline to a very low level.

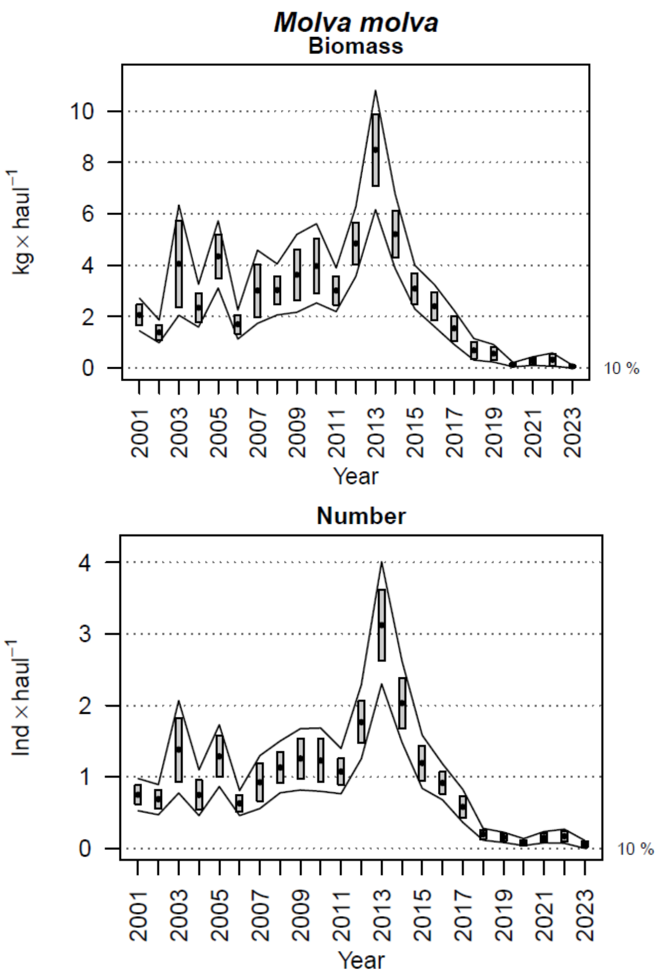


Figure 3.5.13. Ling in subareas 3,4, 6–9, 12 and 14. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2023. Boxes mark the parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

Spatial distribution and occurrences from the combination of bottom trawl surveys

Data from seven surveys (NS-IBTS Q1 and Q3 [G1022, G2829], IE-IGFS [G 7212], NIGFS [G7144, G7655], SP-PORC [G5768], FR-EVHOE [G9527], SCOWCGFS [G4748, G4815] and SCOROC [G4436] were combined to explore long-term change in the spatial distribution of the species. Only occurrences were plotted.

Comparing surveys earlier years, where only data for the North Sea are available to the most recent five years, the species became rarer in the central North Sea (red oval on figure 3.5.14) and occurred in more haul in the Northern North Sea and Skagerrak (green ovals). Surveys data during the last 15 years suggest that there was an increase in Northern area (6.a North of Ireland and 4.a, 3.a) and a decrease in Southern Area (Porcupine bank, Celtic Sea, Biscay).

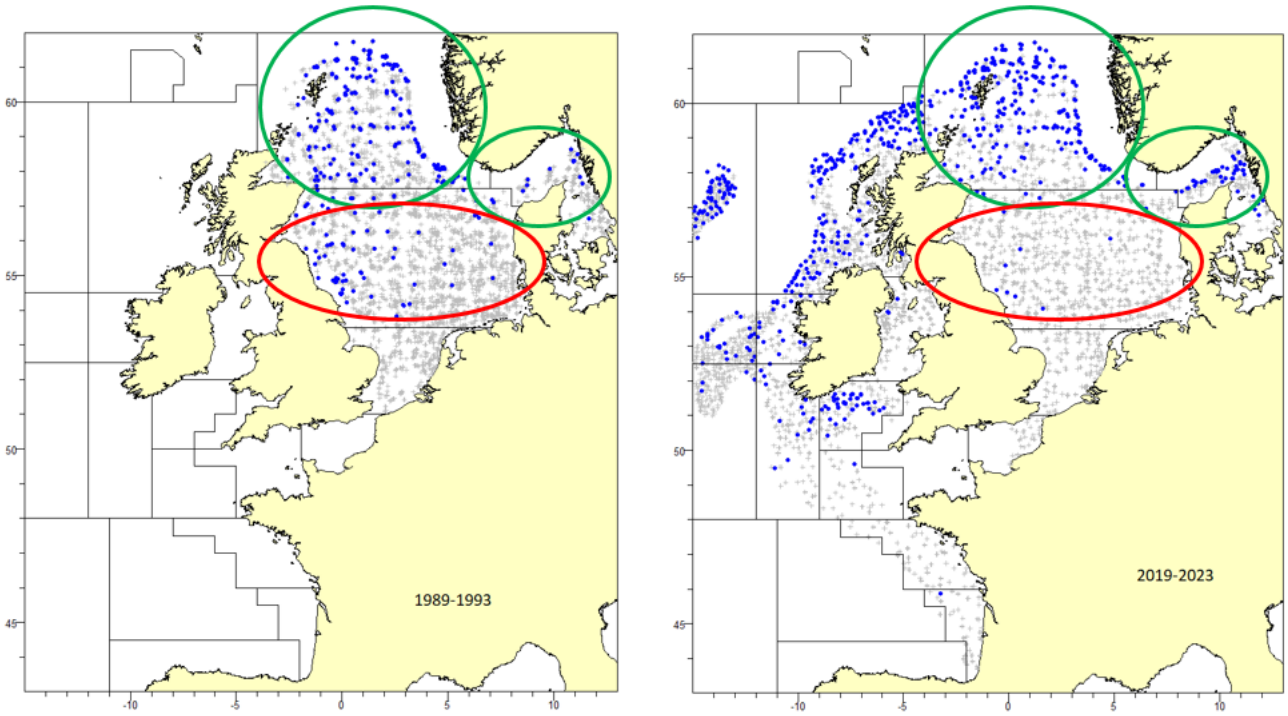
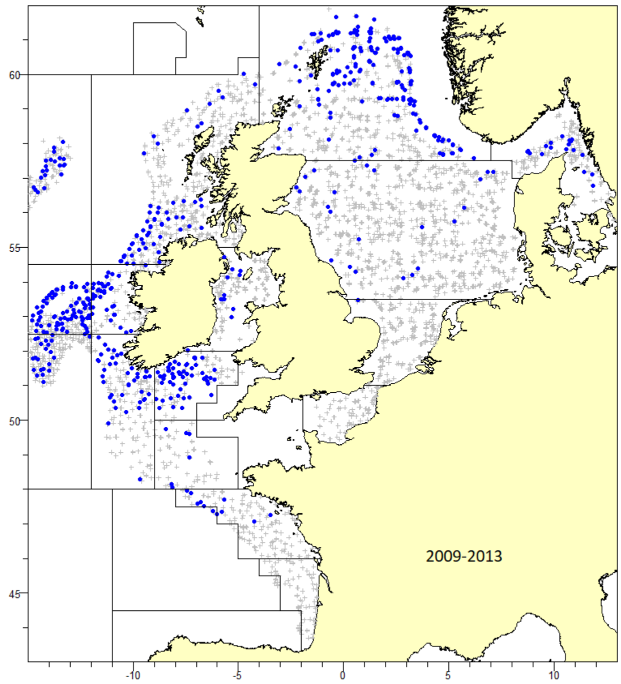


Figure 3.5.14. Ling in subareas 3, 4, 6–9, 12 and 14. Occurrence of ling in bottom trawl surveys during 2 five years periods separated by 30 years.



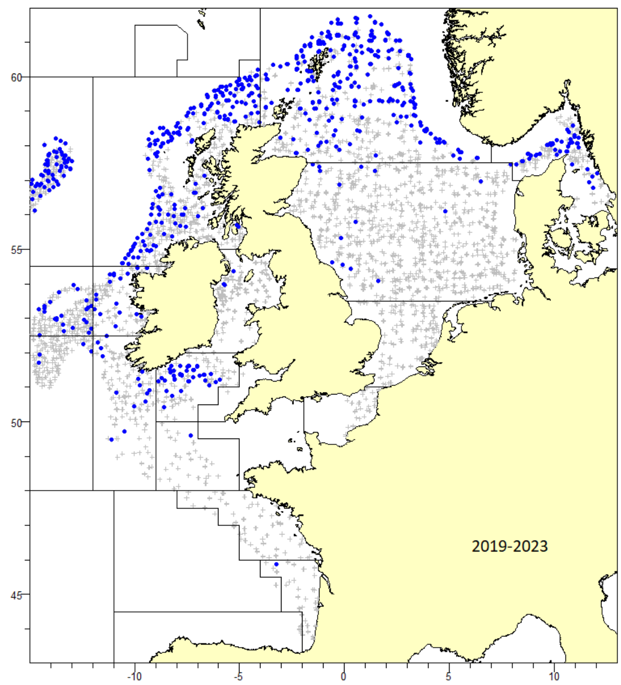


Figure 3.5.15. Ling in subareas 3, 4, 6–9, 12 and 14. Occurrence of ling in surveys during 2 five years periods, ten years apart.

Cpue series based on the Norwegian longline fleet

Figure 3.5.14 shows the Norwegian CPUE series from 2000 to 2023. In Division 4.a there was a steady increase in CPUE from 2002 until 2016 then a stabilization with fluctuations over the last years. In divisions 6.a and 6.b there was also an increasing trend from 2002 to 2016 followed by fluctuations of increases and decreases in recent years in 6.a and 6.b. There was no data in 6.b from 2019 to 2022. In 2023, CPUE data is available at a level close to 2007 level.

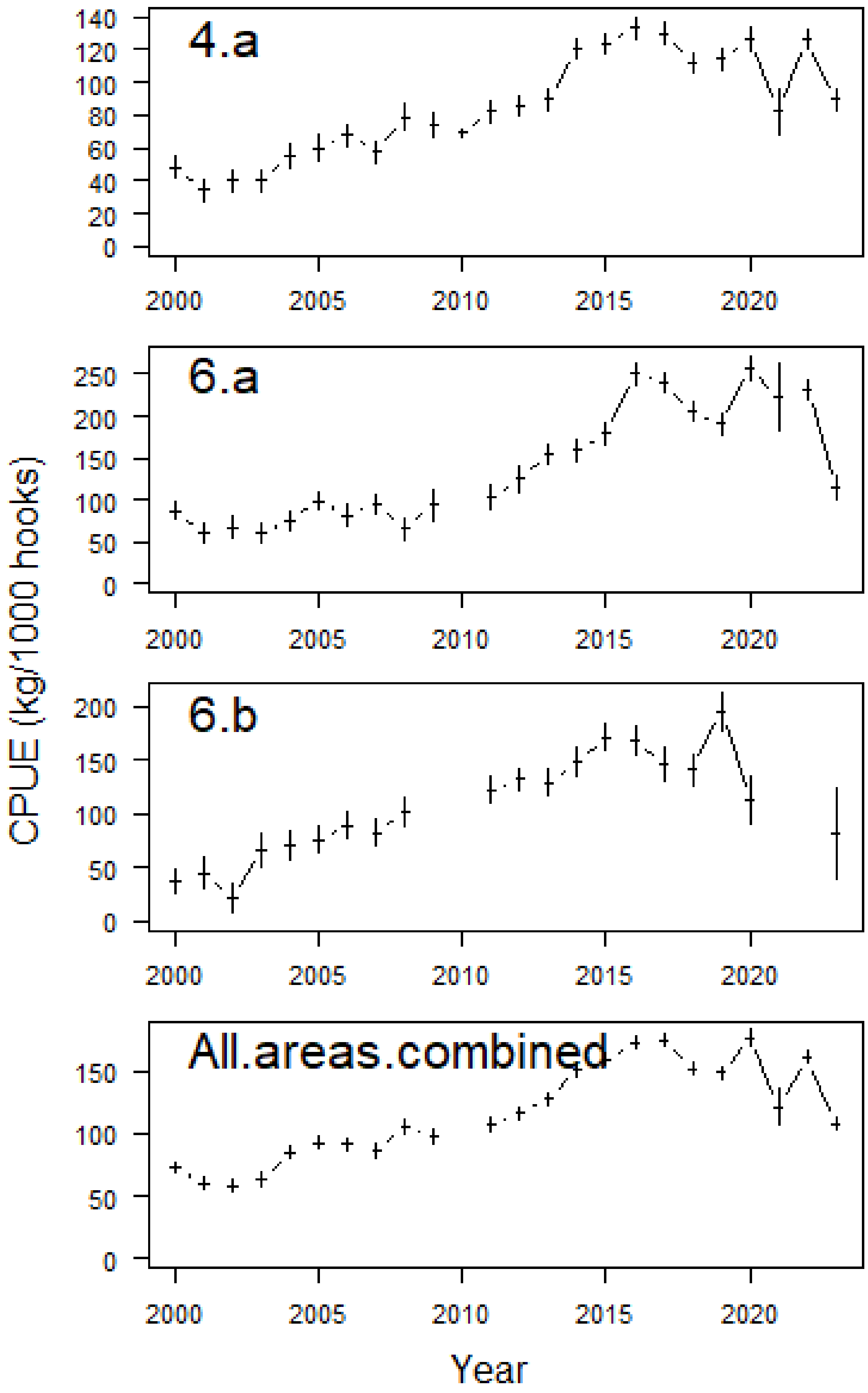

4.a
6.a
6.b
All.areas.combined
CPUE (kg/1000 hooks)
Year
2000
2005
2010
2015
2020

Figure 3.5.14. Ling in subareas 3, 4, 6–9, 12 and 14. Cpue series for ling for the period 2000-2023 based on data when ling was targeted. The bars denote the 95% confidence intervals. All. areas.combined : data combined from divisions 3.a, 4.a, 4.b, 6.a and 6.b.

The index used for advice on the stock since 2015 is the combination of all data for the 3 divisions (4.a, 6.a and 6.b) when ling was targeted (Figure 3.5.15); no update in 2023. Nevertheless, previous' years report showed that the time-series was similar when targeted fishing and all fishing for ling were considered.

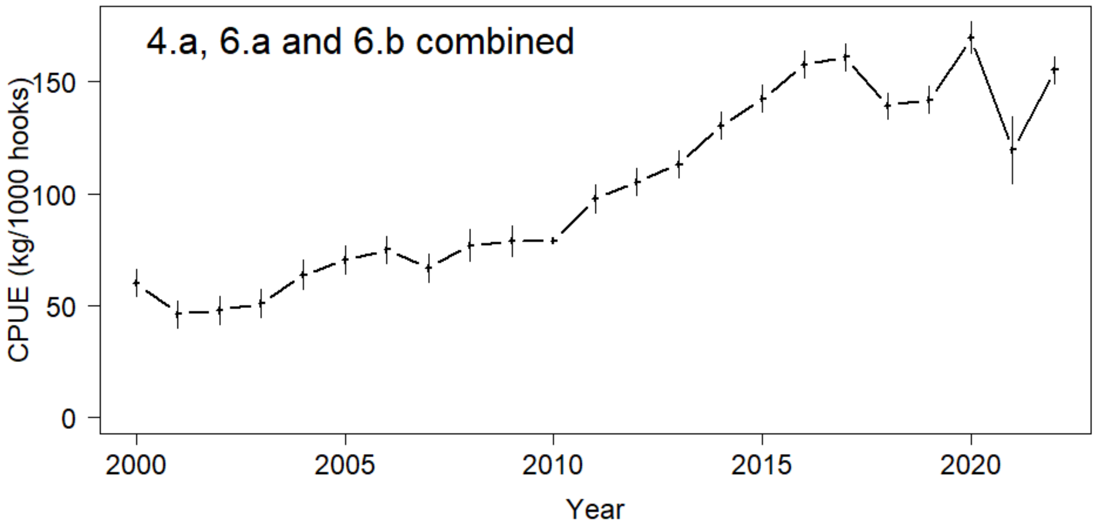


Figure 3.5.15. Ling in subareas 3, 4, 6–9, 12 and 14. Cpue series for ling, divisions 4.a, 6.a and 6.b combined, for the period 2000–2022 for target fishing, as used in the assessment. The bars depict the 95% confidence intervals.

3.5.7 Stock assessment

The stock assessment conducted in 2023 was based on the rfb rule, a number of data analyses were made to check that parameters used in the rfb rule were robust and representative.

The length distribution was taken from InterCatch and included landings and discards data from the main fleets. The length distribution appeared similar for all quarters (Figure 3.5.16) and the mode and *Lc* of the distribution were the same for the landings and discards combined and for landings only.

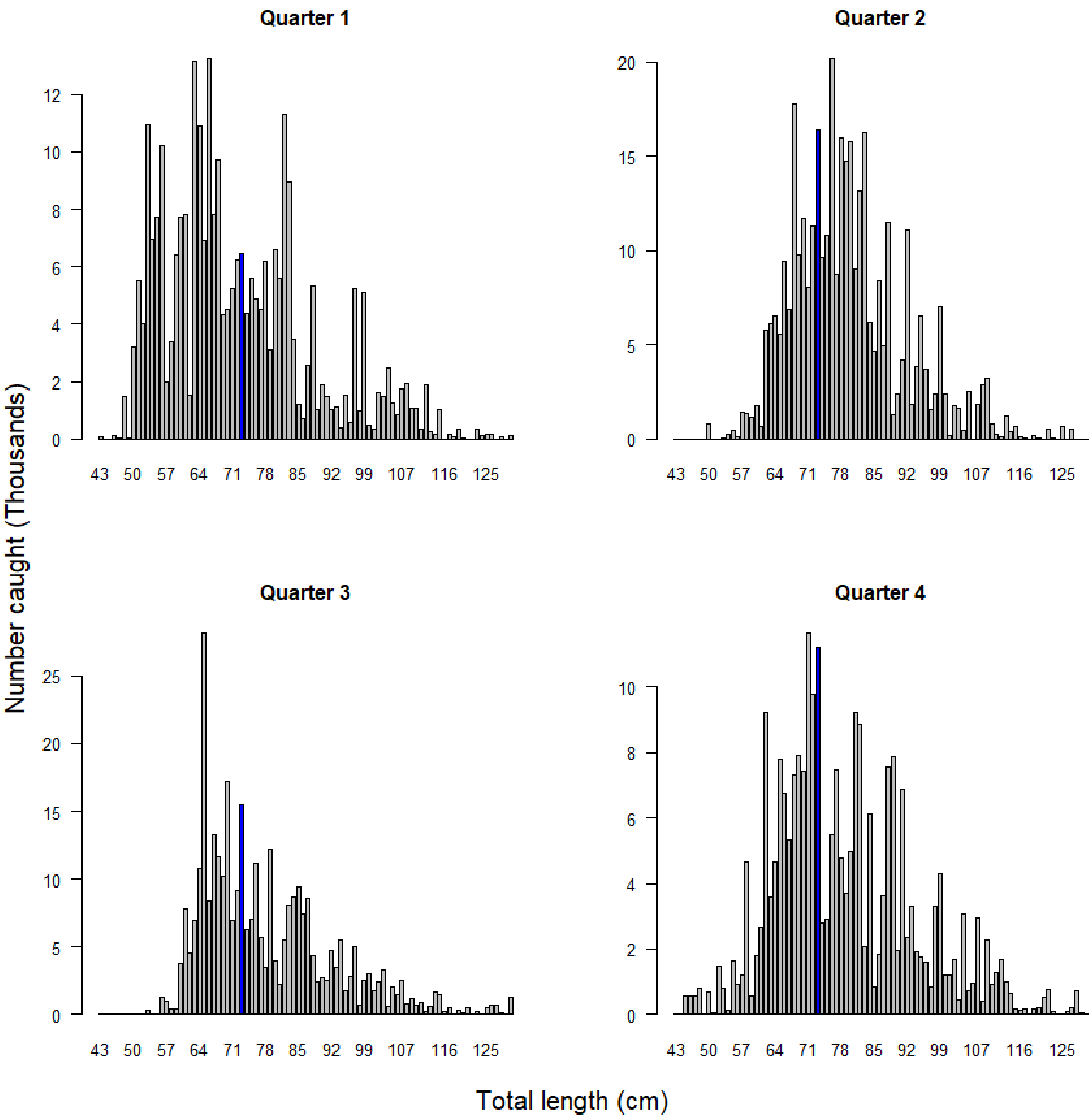


Figure 3.5.16. Ling in subareas 3, 4, 6–9, 12 and 14, quarterly length distribution of the catch from InterCatch. The bar for the mode of the length distribution for the whole year (2023) is coloured in blue. Small numbers below 40 cm and above 130 cm not shown for legibility.

The effect on the estimated mode and length at first capture (*Lc*) of the bin width used for the length distribution, was explored for bins of 1 to 5 cm (Figure 3.5.17). The large the bin with, the higher the resulting advice for next years (table 3.5.8). The group decide to use 2 cm length bins, which smoothed properly the length distribution. The estimate L infinity from the Celtic Sea, which is rather average of available estimates for the species and was estimated from Subarea 7, which is central in the stock area, was used for the calculation of the rfb rule. The calculation used for advice is in bold in table 3.5.8.

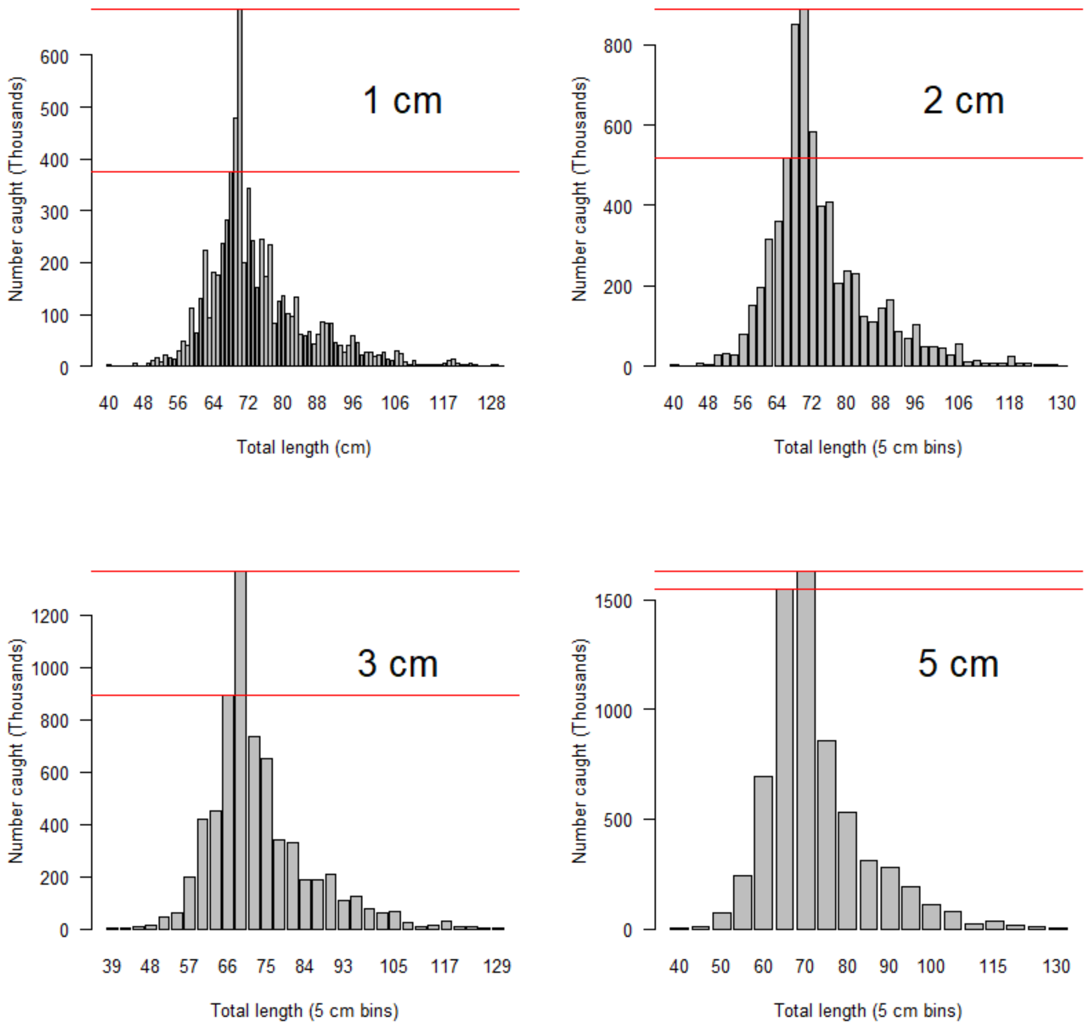


Figure 3.5.17. Ling in subareas 3, 4, 6–9, 12, and 14, effect of bins width on the estimated mode and Lc for the length distribution of the whole year (2022). Horizontal lines represent the height of the mode and that of the size class corresponding to Lc.

Table 3.5.8. Ling in subareas 3, 4, 6–9, 12, and 14. Application of the rfb rule with a range of L∞ values and bin widths.

L_∞	k	bin	Lc	Lbar	Advice 2023	r	b	m	$L_{F=M}$	f	Advice 2024
119	0.136	1	68.5	79.3419426	15092	1.03285342	1	0.95	81.125	0.97802086	14483
119	0.136	2	67	78.6430894	15092	1.03285342	1	0.95	80	0.98303862	14557
119	0.136	3	67.5	79.5606061	15092	1.03285342	1	0.95	80.375	0.98986757	14658
119	0.136	5	67.5	81.0689782	15092	1.03285342	1	0.95	80.375	1.00863425	14936
148.81	0.11	1	68.5	79.3419426	15092	1.03285342	1	0.95	88.5775	0.89573473	13264
148.81	**0.11**	**2**	**67**	**78.6430894**	**15092**	**1.03285342**	**1**	**0.95**	**87.4525**	**0.89926634**	**13317**
148.81	0.11	3	67.5	79.5606061	15092	1.03285342	1	0.95	87.8275	0.90587351	13415
148.81	0.11	5	67.5	81.0689782	15092	1.03285342	1	0.95	87.8275	0.92304777	13669
160	0.103	1	68.5	79.3419426	15092	1.03285342	1	0.95	91.375	0.86831127	12858
160	0.103	2	67	78.6430894	15092	1.03285342	1	0.95	90.25	0.87139157	12904
160	0.103	3	67.5	79.5606061	15092	1.03285342	1	0.95	90.625	0.87791014	13000
160	0.103	5	67.5	81.0689782	15092	1.03285342	1	0.95	90.625	0.89455424	13247
266.7	0.047	1	68.5	79.3419426	15092	1.03285342	1	0.95	118.05	0.67210455	9953
266.7	0.047	2	67	78.6430894	15092	1.03285342	1	0.95	116.925	0.67259431	9960
266.7	0.047	3	67.5	79.5606061	15092	1.03285342	1	0.95	117.3	0.67826604	10044
266.7	0.047	5	67.5	81.0689782	15092	1.03285342	1	0.95	117.3	0.69112513	10234

3.5.8 Comments on the assessment

No assessment was conducted in 2024.

In 2023, the rfb rule was applied for assessment. The *f* factor of the rule was calculated using length distribution data from InterCatch for 2022. For this stock, previously assessed using the 2 over 3 rule, InterCatch data for previous did not include length data so that a time series of the length indicator was no available. Previous LBI estimates using data from Norwegian longliners only, showed that the MSY indicator, $L_{F=M}/L_{mean}$ (inverse of the f multiplier in the rfb rule) indicated overexploitation of the stock in years 2018-2020 (see ICES 2020, 2021), which is in line with the 2023 assessment using data from most fleets and gears.

Surveys data suggest that the species' abundance is decreasing in southern areas (subareas 7 and 8 in particular), landings data also show a decline in these areas. In contrast, surveys suggest an increasing abundance in subareas 4 and 6. This increasing abundance is consistent with a rather low mean length in the catch, because more abundance implies recruitment of young fish, so that limiting catches for a while should allow for a larger stock of larger fish in the next few years.

The Norwegian data do not include Subarea 7, where Norwegian vessels do not operate. The Spanish survey on the Porcupine bank showed a stable biomass from 2001- 2012, a peak in 2013 and a sharp downward trend to low levels in 2018-2022 (Figure 3.5.13) In Subarea 7, the landings have decreased from around 11 000 tons in the end of the 1990s to less than 1000 tonnes in recent years. For other areas, the landings have been stable or increasing. The EVHOE survey in the Bay of Biscay (Subarea 8) and Celtic Sea (divisions 7.g-j) shows a monotonous decline trends from 1997 to 2022 with no catch in the two last years.

3.5.9 Management considerations

The 2022 assessment suggests that the stock is exploited beyond MSY limits. Previous exploratory assessments (see ICES, 2020, 2021) indicated the same diagnostic. However, the previous assessment based on the 2 iover 3 rule was more optimistic as the CPUE is increasing. It is worth noting that surveys in subareas 4 and 6 also suggest an increasing stock. Nevertheless, the increasing CPUE, does not balance the high MSY Fishing pressure proxy ($L_{F=M}/L_{mean}$, inverse of the f multiplier in the rfb rule) so that the 2022 assessment results in an advice for lower catches in 2024 and 2025 compared to the previous advice. Recent catches have been larger the recent advices so that bringing the stock to a better state requires substantial decrease in the catch.

Subareas 6 and 7 suggest different abundance trends than in subareas 4 and 6. The CPUE applies to subareas 4 and 6. The difference between southern subareas 7 and 8 and more northern dubareas 4 (primarily Division 4.a) and 6, suggest that the stock needs being further investigated.

3.5.10 Tables

Table 3.5.1a. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Subarea 3, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales.

Year	Belgium	Denmark	Germany	Norway	Sweden	E&W	France	Netherlands	Total
2001		125	+	102	35				**262**
2002		157	1	68	37				**263**
2003		156		73	32				**261**
2004		130	1	70	31				**232**
2005		106	1	72	31				**210**
2006		95	2	62	29				**188**
2007		82	3	68	21				**174**
2008		59	1	88	20				**168**
2009		65	1	62	21				**149**
2010		58		64	20				**142**
2011		65		57	18				**140**
2012		66	<1	61	17				**144**
2013		56	1	62	11				**130**
2014		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				**177**
2019		139		38	27			0	**204**
2020		123	0	35	17			4	**179**
2021		144	0	42	14	0	0	0	**200**
2022	0	156	0	39	16	0	0	1	**212**
2023	0	149	1	46	20	0	0	0	**216**

Table 3.5.1b. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Division 4.a, data from ICES landings statistics, Intercatch and preliminary catch statistics. Neth.: Netherlands, E&W: England and Wales, N.I: North Ireland, Scot.: Scotland.

Year	Belgium	Denmark	Faroes	France	Germany	Neth.	Norway	Sweden[1)]	E&W	N.I.	Scot.	Total
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		308	111		6925	11	78		2761	**11230**
2018		980		842	114	2	6326	14			3270	**11548**
2019	0	1022		926	130	5	6062	16	74		3208	**11443**
2020	0	651		647	93	15	4472	31	34	0	2855	**8798**
2021	0	604	0	896	111	8	1250	35	83	1	3516	**6504**
2022	0	597	0	888	85	1	6665	60	58	0	3253	**11607**
2023	0	405	16	844	48	1	4306	69	15	0	3855	**9559**

[(1)] Includes 4b 2001–1993.

Table 3.5.1c. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from divisions 4.bc, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales, IOM: Isle of Man.

Year	Belgium	Denmark	France	Sweden	Norway	E&W	Scotland	Germany	IOM	Netherlands	Total
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**
2016	14	42		6	50	7	9	21		1	**150**
2017	9	36		9	74	4	9			2	**143**
2018	9	38		8	62		8	36		1	**162**
2019	13	41		12	55	2	6	26		3	**158**
2020	16	37	0	8	31	4	4	14		5	**119**
2021	14	27	0	8	16	2	0	10		4	**81**
2022	10	29	0	12	17	2	0	6			**76**
2023	16	40	0	6	38	2			0	1	**103**

Table 3.5.1d. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Division 6.a, data from ICES landings statistics, Inter-catch and preliminary catch statistics. E&W: England and Wales, IOM: Isle of Man, N.I: North Ireland, Scot.: Scotland.

Year	Belgium	Denmark	Faroes	France	Germany	Ireland	Norway	Spain	E&W	IOM	N.I.	Scot.	Total
2001				774	3	70	1869	142	106			2179	**5143**
2002				402	1	44	973	190	65			2452	**4127**
2003				315	1	88	1477	0	108			1257	**3246**
2004				252	1	96	791	2	8			1619	**2769**
2005			18	423		89	1389	0	1			1108	**3028**
2006			5	499	2	121	998	0	137			811	**2573**
2007			88	626	2	45	1544	0	33			782	**3120**
2008			21	1004	2	49	1265	0	1			608	**2950**
2009			30	418		85	828	116	1			846	**2324**
2010			23	475		164	989	3	0			1377	**3031**
2011			102	428		95	683	8				1683	**2999**
2012			30	585		47	542	862				1589	**3655**
2013			50	718		54	1429	899	10			1500	**4660**
2014			0	937		39	1006	1005	6			1768	**4761**
2015				891		65	1214	961	4			1629	**4764**
2016			92	1005		156	1313	1109	9			1975	**5659**
2017			5	870		156	1530	1500	3			2244	**6308**
2018				831		156	2185	1560				1922	**6654**
2019				927		142	1616	1689	1			2168	**6543**
2020			22	845		200	1084	1277	3		0	1522	**4953**
2021	0	0	9	878	0	189	0	1007	3	0	0	2220	**4306**
2022	0	0	7	1015	0	76	1051	1799	2			1741	**5691**
2023			79	665		70	715	1472	5			1376	**4382**

Table 3.5.1e. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Division 6.b, data from ICES landings statistics, Intercatch and preliminary catch statistics.

Year	Faroes	France)	Germany	Ireland	Norway	Spain	E&W	N.I.	Scotland	Russia	Total
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**
2016	56			35	821	2	4		170		**1088**
2017	5		2	59	498	7	2		219	1	**793**
2018			2	59	408	6			255		**730**
2019		5	1	102	459	9	1		326	1	**904**
2020		1		106	247	4	0	0	330		**688**
2021	2	6	0	76	0	4	3	3	241	0	**335**
2022	47	0	0	50	0	3	0		137	NA	**237**
2023	52			21	60	4			122		**259**

Table 3.5.1f. Ling in subareas 3,4, 6–9, 12 and 14. Landings from Division 7.a, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales, IOM: Isle of Man, N.I: North Ireland.

Year	Belgium	France	Ireland	E&W	IOM	N.I.	Scotland	Total
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**
2016	1		10				13	**24**
2017			9				15	**24**
2018		1	9				8	**18**
2019	2		3				7	**12**
2020	1	0	0	0	0	4	0	**5**
2021	0	0	0	0	0	5	0	**5**
2022	0		0	0	0	3	0	**3**
2023	0			0		2		**2**

Table 3.5.1g. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from divisions7.bc, data from ICES landings statistics, Inter-catch and preliminary catch statistics. E&W: England and Wales.

Year	France	Germany	Ireland	Norway	Spain	E&W	Scotland	Total
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**
2016	93		46	6	172	46	207	**570**
2017	90		32		133	34	26	**315**
2018	57		39		138	32		**266**
2019	53		0		238	14	8	**313**
2020	47		25	0	67	11	4	**154**
2021	24	0	0	0	94	10	1	**129**
2022	17	0	0	0	130	8	1	**156**
2023	14				27	4	3	**48**

Table 3.5.1h Ling in subareas 3, 4, 6–9, 12 and 14. Landings from divisions 7.de, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales.

Year	Belgium	Denmark	France	Ireland	E&W	Scotland	Ch. Islands	Nether-lands	Spain	Total
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
2015	5		204		137			1		347
2016	3		141		149					293
2017	4		104		94					**202**
2018	3		85		32			**1**		**121**
2019	2		54		59			3		**118**
2020	2		49	0	36	0	0	1	0	**88**
2021	2	0	49	0	46	0	0	1	0	**98**
2022	1		42	0	29	0			0	**72**
2023	1		38		34		0			**73**

Table 3.5.1i. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Divisions 7.f, data from ICES landings statistics, Inter-catch and preliminary catch statistics. E&W: England and Wales.

Year	Belgium	France	Ireland	E&W	Scotland	Total
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**
2016	25	51	1	34	3	**114**
2017	7	20	1	19		**47**
2018	5	18	1	19		**43**
2019	4	11		11		**26**
2020	6	14	0	13	0	**33**
2021	4	17	0	14	0	**35**
2022	3	12	0	10	0	**25**
2023	2	5		8		**15**

Table 3.5.1j. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from divisions 7.g-k, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales, N.I: North Ireland, Scot.: Scotland.

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [(1)]	E&W	N.I.	Scot.	Total
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**
2016	10		383		549		107	114		9	**1172**
2017	10		298		392		85	91		12	**888**
2018	6		170		333		76	62			**647**
2019	7		143		212		57	43		3	**465**
2020	8	0	116	0	177		50	34		2	**387**
2021	5	0	133	0	268	0	51	51	1	1	**510**
2022	7	0	105	0	157	0	30	38	0	3	**340**
2023	6		74		117		29	29		0	**255**

[(1)] Includes 7.b c until 2011

Table 3.5.1k. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Subarea 8, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales, Scot.: Scotland.

Year	Belgium	France	Spain	E&W	Scot.	Ireland	Total
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**
2016		207	77	3			**287**
2017		156	43	2			**201**
2018		145	34	4			**183**
2019		139	23			1	**163**
2020		147	15	0	0	0	**162**
2021		133	18				**151**
2022	0	110	23	0			**133**
2023	0	117	24				**141**

Table 3.5.1l. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Subarea 9, data from ICES landings statistics, Inter-catch and preliminary catch statistics.

Year	Spain	Total
2001	0	**0**
2002	0	**0**
2003	0	**0**
2004		
2005		
2006		
2007	1	**1**
2008		
2009		
2010		
2011		
2012	1	**1**
2013-2021(*)	0	**0**
2022	3	**3**
2023	0	**0**

(*) there were no reported landings in 2013-2021

Table 3.5.1m. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Subarea 12, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales.

Year	Faroes	France	Norway	E&W	Scotland	Germany	Ireland	Total
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**
2016								**0**
2017								**0**
2018								**0**
2019								**0**
2020								**0**
2021	0	0	11	0	0	0	0	**11**
2022	0	0	0	0	0	0	0	**0**
2023		0	0	00	0	00		**0**

Table 3.5.1n. Ling in subareas 3, 4, 6–9, 12 and 14. Landings from Subarea 14, data from ICES landings statistics, Intercatch and preliminary catch statistics. E&W: England and Wales.

Year	Faroes	Germany	Iceland	Norway	E&W	Scotland	Russia	Green-land	Total
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**
2016	9	1		10			1	15	**35**
2017	1			1			2	5	**7**
2018								5	**5**
2019				128				2	**130**
2020									
2021									
2022	0	0	0	1	0	0			**1**
2023	0							2	**2**

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	9247	384	6909	1879		73	1182	846	218	3578	339	1	7	26	**24 916**
2001	262	7857	284	5143	788		94	1226	807	220	3360	594	0	59	37	**20 720**
2002	263	9152	309	4127	533		126	964	891	453	3526	467	0	8	23	**20 756**
2003	261	6433	234	3246	660		112	524	788	176	2940	436		19	83	**15 912**

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
2004	236	6306	241	2769	1064		97	640	801	161	2427	492		0	19	**15 240**
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	18	**14960**
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	19	**15433**
2007	174	5858	159	3120	1314		43	358	710	125	1749	312		0	7	**13929**
2008	175	7259	200	2950	1513		15	259	569	187	1541	345		0	20	**15033**
2009	149	7408	314	2324	2635		48	131	363	106	673	186		1	8	**14346**
2010	142	6398	201	3031	2687		44	253	294	69	848	134		0	6	**14107**
2011	140	6508	211	2999	1259		28	208	425	155	936	201		1	8	**13079**
2012	145	7018	192	3655	1390		14	1013	436	167	1520	552	1	4	111	**16218**
2013	130	7197	176	4660	795		30	1010	482	224	1608	459		0	2	**16773**
2014	120	7749	141	4761	774		29	532	605	334	1557	395		0	17	**17014**
2015	125	8069	147	4764	1215		19	560	347	88	1065	337		0	21	**16757**
2016	152	9740	150	5659	1088		24	570	293	114	1172	287			35	**19284**
2017	138	11230	143	6308	793		24	315	202	47	888	201		0	7	**20296**
2018	177	11548	162	6654	730		18	266	121	43	647	183		0	5	**20554**
2019	204	11443	158	6543	904		12	313	118	26	465	163		0	130	**20479**
2020	179	8798	119	4953	688		10	134	88	33	4387	162			1	**15552**
2021	200	6504	81	4306	335		5	129	98	35	510	151	0	11	0	**12365**

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**
2022	212	11607	76	5691	237	0	3	156	72	25	340	133	3	0	1	**18556**
2023	216	9559	103	4382	259	0	2	48	73	15	255	141	0	0	2	**15055**

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Contents

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

4.1 Stock description and management units

Blue ling stock units considered by ICES in the past decade are:

- bli.27.5a14 blue ling (*Molva dypterygia*) in Icelandic and Greenland waters
- bli.27.5b67, Blue ling (*Molva dypterygia*) in subareas 6–7 and Division 5.b (Celtic Seas and Faroes grounds)
- bli.27.nea, Blue ling (*Molva dypterygia*) in subareas 1, 2, 8, 9, and 12, and in divisions 3.a and 4.a (Northeast Atlantic)

ICES assessments were carried out for these units at least since 2012. The latter, bli.27.nea, previously labelled bli-oth for "other" being a grouping of all remaining areas where the species was presumed to occur out of the two main fishing grounds since the 1990s. The 2012 ICES advice stated that this stock unit was "*a combination of isolated fishing grounds. These areas are grouped due to lack of data*", in particular with Subarea 12 being separated from subareas 1-4 by subareas 5 and 6 (Figure 4.1.1).

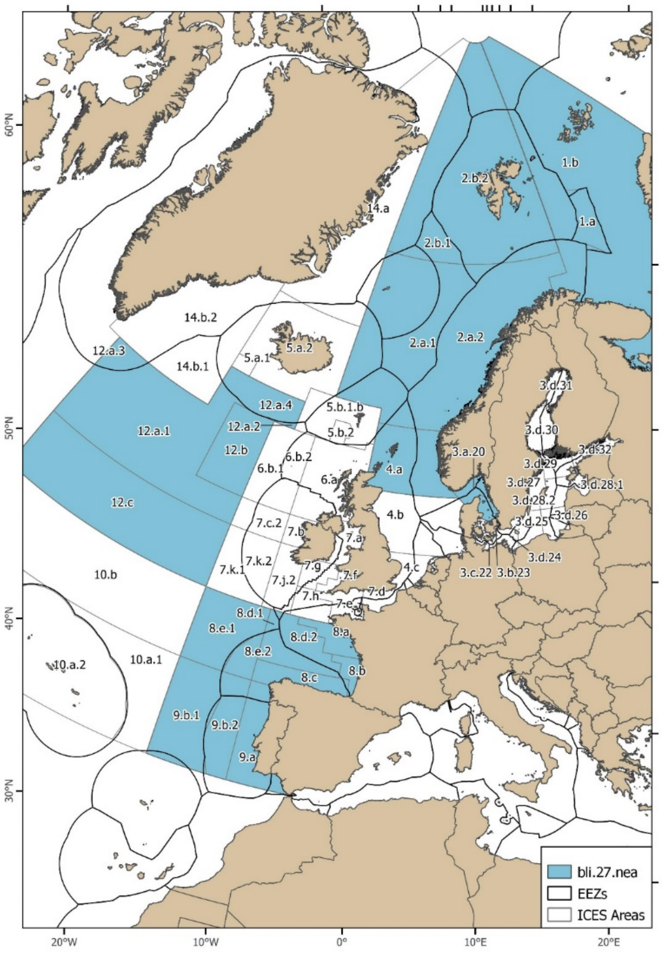

Figure 4.1.1. ICES areas of the stock unit of blue ling in subareas 1, 2, 8, 9, 12 and divisions 3a and 4.a (bli.27.nea) .

WGDEEP revised the stock areas. A working document (Hansen et al., 2023) was presented in 2023 and reviewed by SIMWG in 2024. The working document was based upon a recent genetic study (McGill et al., 2023) and bathymetric and hydrological features of the northeast Atlantic. Based upon the genetic study, the WD suggested that blue ling from the Atlantic basin (subareas 5-12) should be separated from blue ling from the North Sea and Norwegian Sea (subareas 1-4). Based on bathymetric and hydrological features, it further suggested that blue ling from on the mid-Atlantic Ridge (divisions 12.a.& and 12.c) should be considered related to blue ling from Icelandic and Greenland waters (bli.27.5a14), whilst blue ling from the western Hatton bank (Division 12.c) should be considered related to blue ling from the Celtic Seas and Faroes grounds (bli.27.5b67) Lastly, the WD also reported that blue ling is not caught in the EVHOE survey [G9527], which covers divisions 7g-k and 8abd, upon to 51° 40' N. In this survey, all individuals of the genus *Molva* have were examined during several years. No individual was ascribed to *Molva dypterygia*, instead all individuals caught along the slope were *Molva macrophtalma*, the Spanish ling.

SIMWG agreed that Subareas 8 and 9 should be excluded from blue ling stock assessment units. In fact, this was the practice already taken by WGDEEP for the past decade, where blue ling landings reported from subareas 8 and 9 were not included in landings considered for assessment and advice purposes. SIMWG also concluded that "*there is no doubt that the "Norwegian" fish from areas 2 and 4 are distinct from area 6 (and possibly 5)*", and supported "*the consideration that it is unlikely that blue ling from area 12 are the same population as blue ling in areas 1,2,4a, and 3a.*". Lastly SIMWG considered that "*Although a separation of blue ling in "western" and "eastern" part of area 12 would formally not be appropriate, it would appear logical and could be considered in stock simulations to improve the assessment*".

The stock structure in subareas 5, 6 and 7 was not call into question by WGDEEP, in particular because the last 20 years of stock assessment clearly show different populations dynamics between bli.27.5a14 and bli.27.5b67.

Based upon the conclusions from SIMWG, WGDEEP refined the previous bli.27.nea and replaced it by a bli.27.123a4 (blue ling (*Molva dypterygia*) in Northeast Arctic, North Sea, Skagerrak and Kattegat). Following, the practice, confirmed by SIMWG, of not considering subareas 8 and 9 for blue ling the only remaining area from bli.27.nea is Subarea 12. Current fisheries in this subarea are minor and there was even no catch in the two last years. Subarea 12 is unlikely to be a standalone stock because it does not include shallower waters where juveniles (< 40 cm TL) blue ling occur and are caught in Icelandic and Faroese surveys. Owing to the insignificant level of landings and the absence of support for a separation of western and eastern parts of Subarea 12, WGDEEP decided to extent the stock area of bli.27.5b67 to Subarea 12. At ADGDEEP 2024 this was refined as based on bathymetry Division 12b (western Haddon Banks) can be considered connected to Subarea 6 for depths suitable for blue ling. The same does not apply to the remaining parts of area 12, and it was concluded that Division 12a and 12c should be considered a separate stock component to which ICES advice does not apply. Therefore, three stock units of blue ling are considered for assessment as previously but these are now consistent with the most recent genetic information available, and each stock unit is spatially consistent. The revised stock units are:

- bli.27.5a14, blue ling (*Molva dypterygia*) in Icelandic and Greenland waters.
- bli.27.5b6712, blue ling (*Molva dypterygia*) in Celtic Seas, Faroes grounds, Rockall and Western Hatton Banks.
- bli.27.123a4, blue ling(*Molva dypterygia*) in Northeast Arctic, North Sea, Skagerrak and Kattegat.

Following this revision of stock assessment units, there are three unit as previously and revised stock units are spatially consistent (Figure 4.1.2).

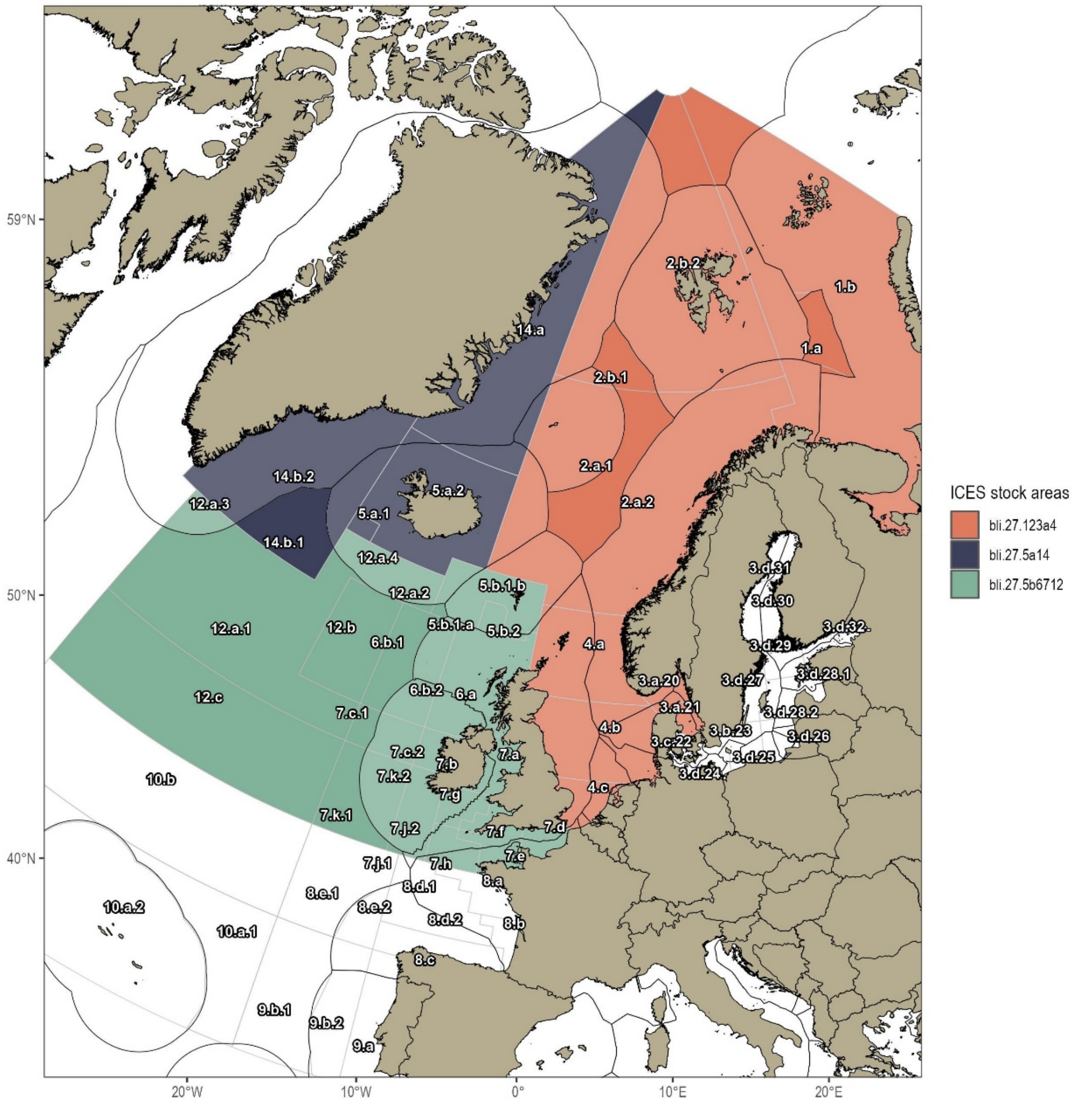

Figure 4.1.2. Revised stock units: bli.5a14, (unchanged, dark blue), bli.27.123a4 (modified from previous bli.27.nea, by excluding Atlantic areas, orange) and bli.27.5b6712 (addition of Subarea 12 to previous unit bli.2.5b67, green).

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

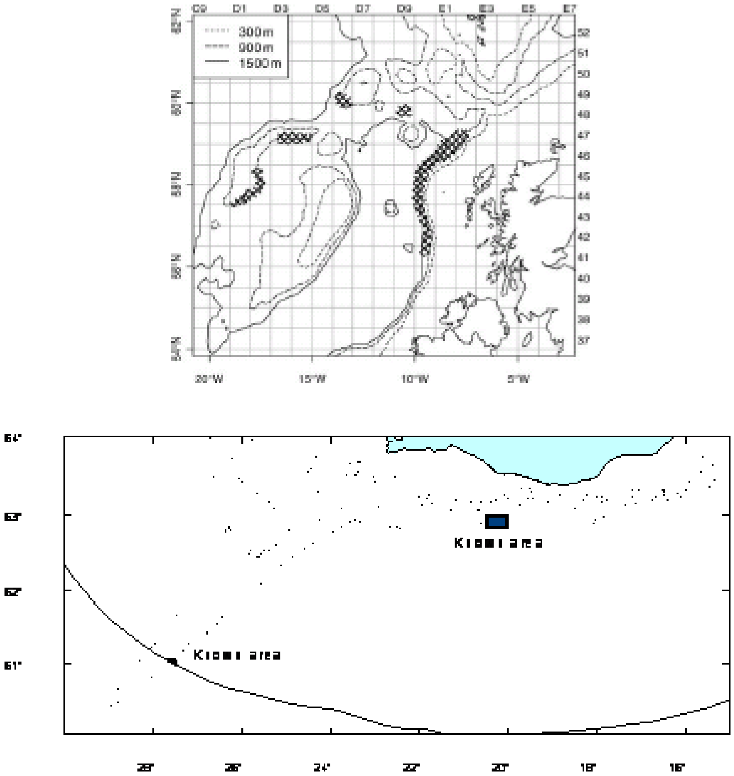

Figure 4.1.3. Known spawning areas of blue ling in Icelandic water (lower panel) and to the West of Scotland (upper panel, from Large *et al*., 2010).

Figures 4.1.4 and 4.1.5 show the time-series of landings by country and refined stock unit since 1966.

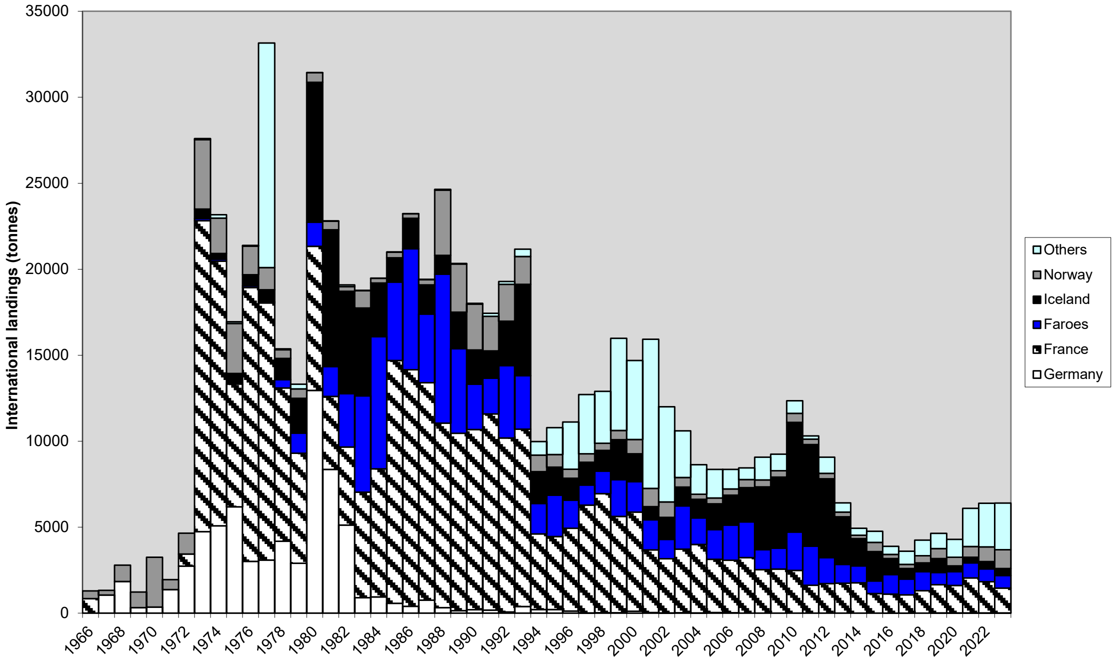

Figure 4.1.4. Total international landings of blue ling in the Northeast Atlantic, by country, 1966–2021.

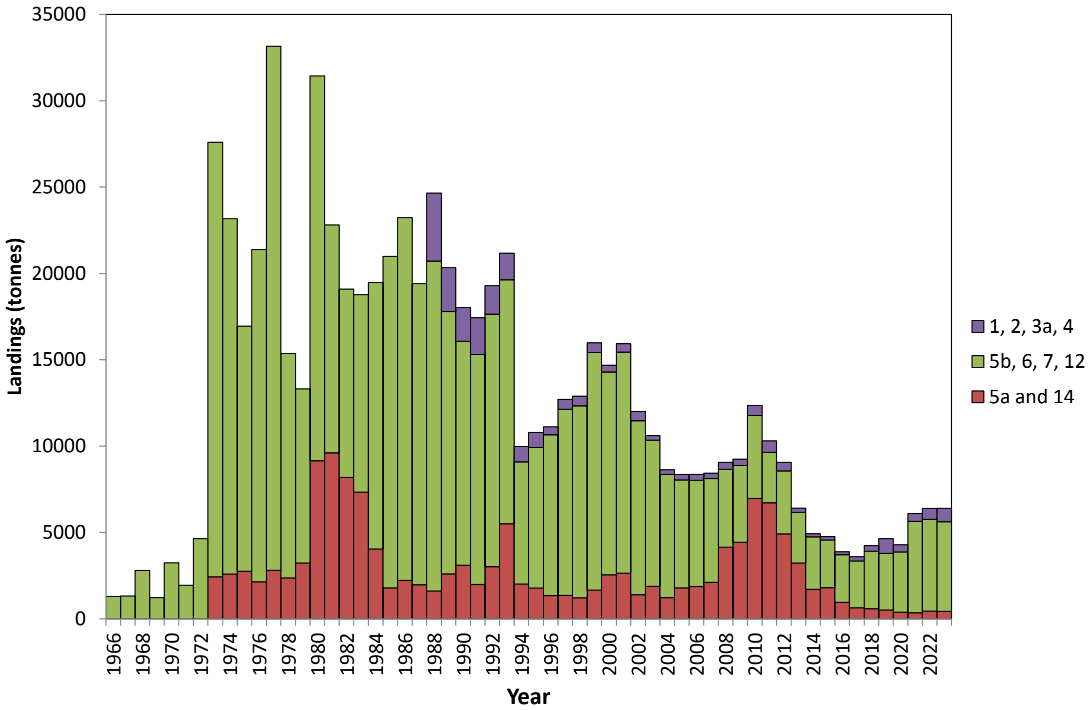

Figure 4.1.5. Total international landings of blue ling in the Northeast Atlantic, by refined stock unit, 1966–2023.

4.2 Blue ling (*Molva dypterygia*) in 5a and 14

4.2.1 Fishery

The geographical distribution of the Icelandic blue ling fisheries from 2004 to 2023 (Figure 4.2.1 and Figure 4.2.2), indicates an expansion of the fishery of blue ling to north-western waters. This increase may partly be the result of increased availability of blue ling in the north-western area.

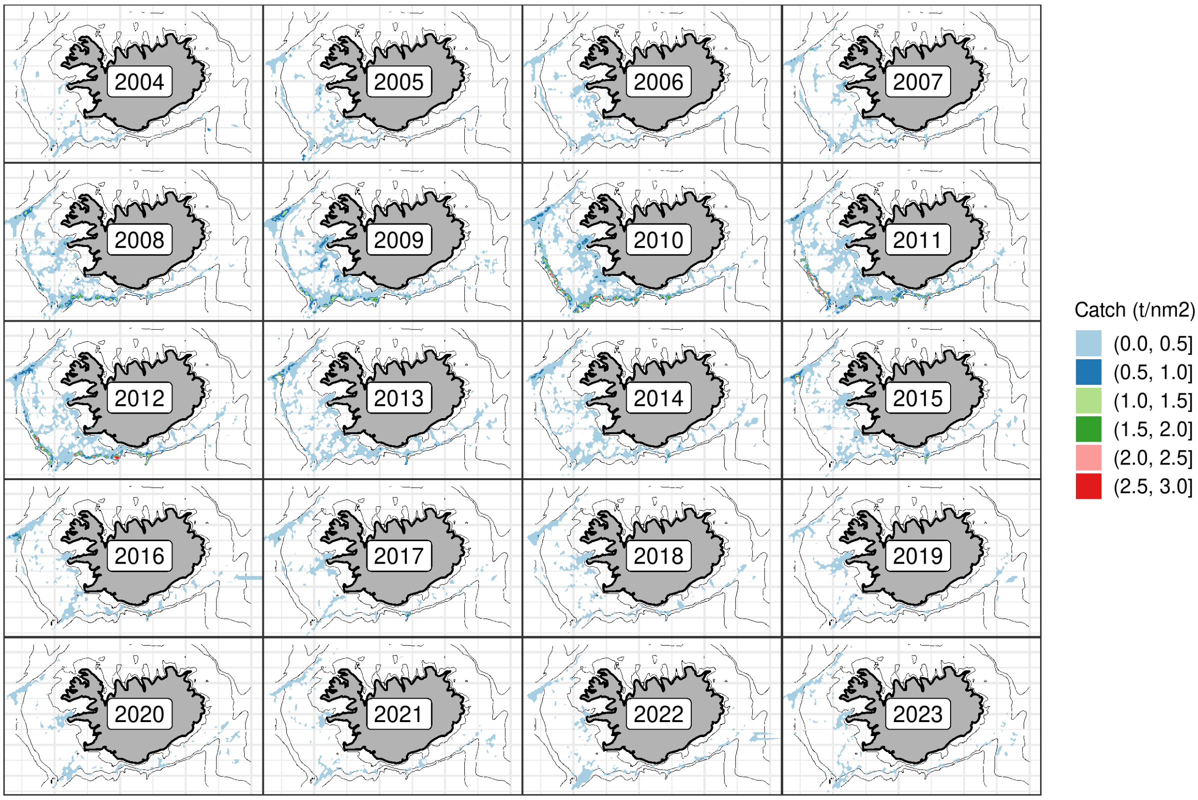

Figure 4.2.1. Blue ling in 5.a and 14. Geographical distribution of the Icelandic blue ling fishery since 2004 as reported in logbooks. All gear types combined.

Before 2008, most blue ling catches were by trawlers, as bycatch in fisheries targeting Greenland halibut, redfish, cod and other demersal species (Table 4.2.2). 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 2008 there was a substantial change in the fishery for blue ling (Table 4.2.2 and Figure 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.

In 2015–2023, the trend has reversed; the proportion of longline catches decreased to 20–30% and longliners started fishing in shallower waters. From 2008-2014, longline catches were mostly taken at depths greater than 500 m. Now, the depth distribution resembles the one observed before 2008, or at depths less than 400 m. (Figure 4.2.4).

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

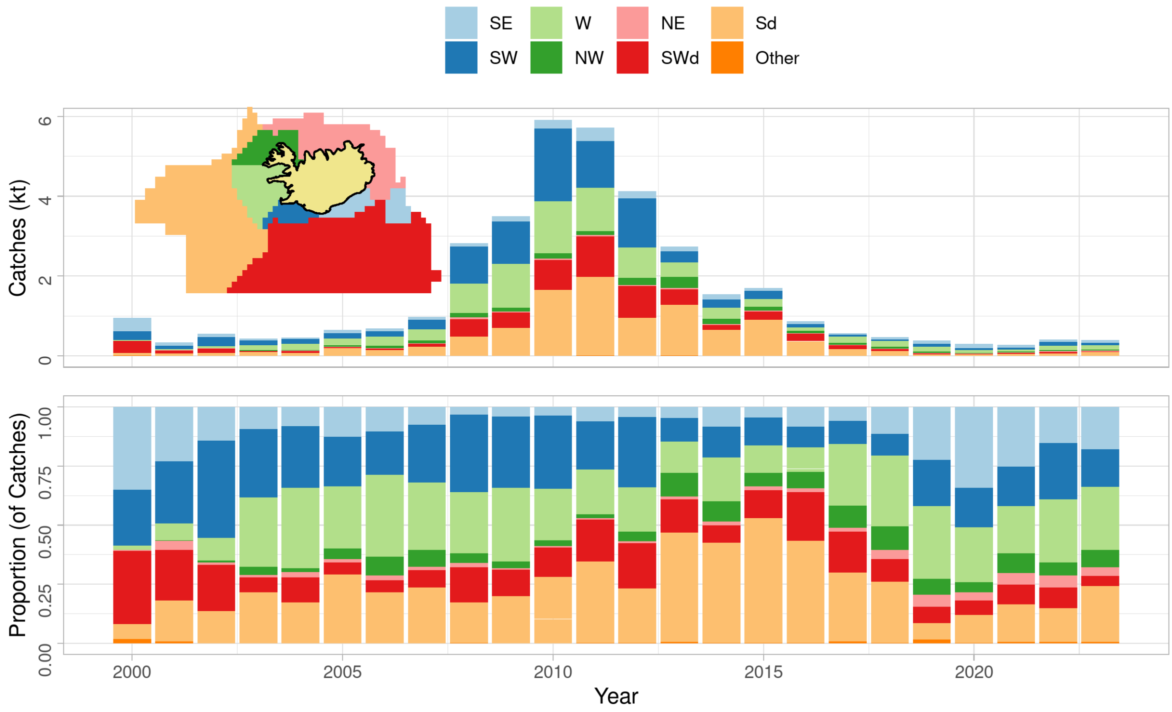

Figure 4.2.2: Blue ling in 5.a and 14. Catch distribution and proportions by area according to logbooks. All gears combined.

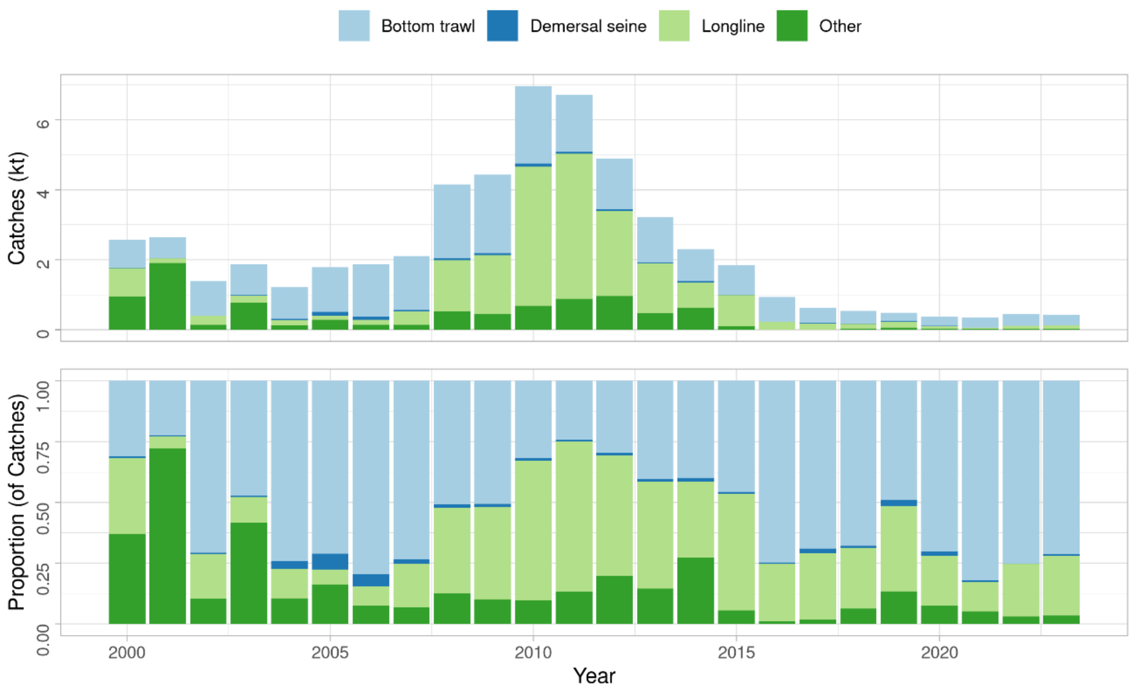

Figure 4.2.3: Blue ling in 5.a and 14. Total catch (landings) and proportion by fishing gear since 2000. according to log-books.

In 2023, the total landings of the Icelandic fleet were 404 t (Table 4.2.2). Between 2006 and 2010, the catches of blue ling increased by more than 370%; the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet. Since then, catches decreased substantially due to increased management procedures. Now, blue ling is mainly caught as by-catch in the redfish and Greenland halibut fisheries (Table 4.2.2).

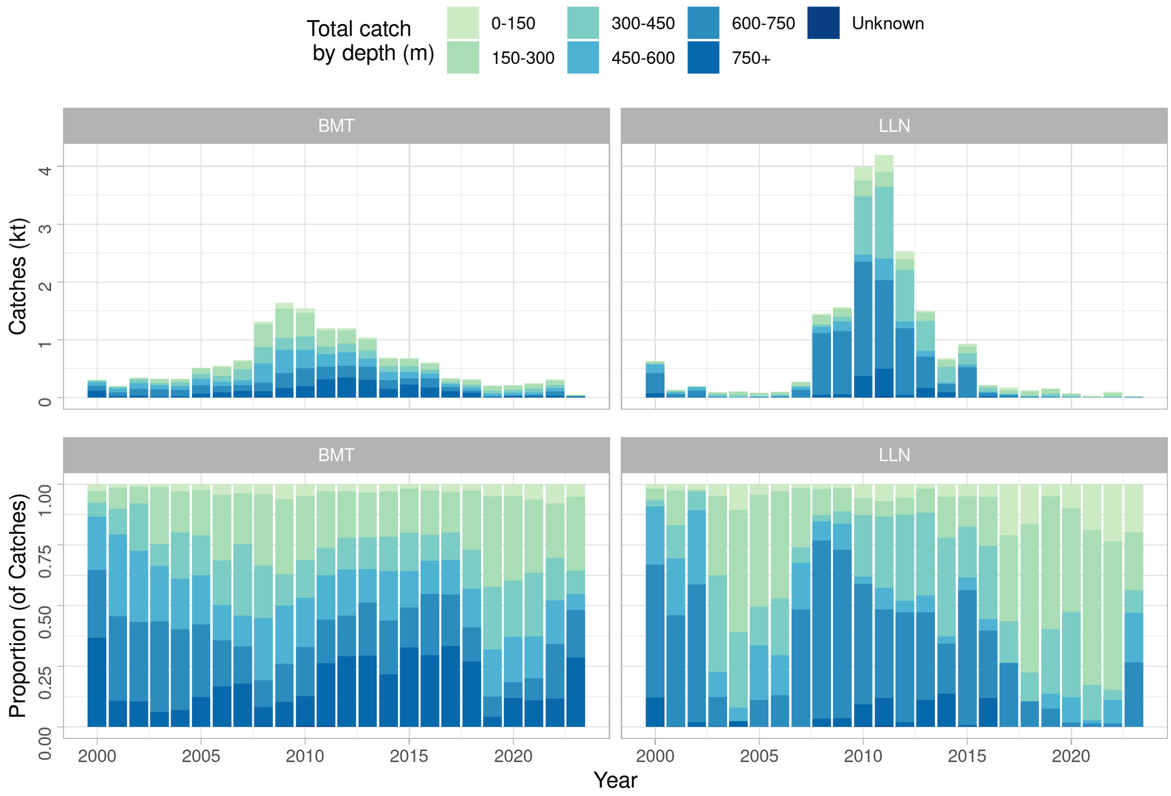

Figure 4.2.4: Blue ling in 5.a and 14. Depth distribution and proportion of longlines (LLN) (right) and trawls (BMT) (left) catches according to logbook entries.

4.2.2 Landings trend

The preliminary total landings in 5.a. in 2023 were 412 t of which the Icelandic fleet caught 404 t. (Table 4.2.2 and Figure 4.2.5). Catches of blue ling in ICES Division 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 ICES Division 5.a decreased substantially due to increased management procedures (Table 4.2.2).

Total international landings from Subarea 14 (Table 4.2.3) 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). Since then, no further information is available on this fishery. The high landing values in Subarea are very occasional, and in most years, total international landings have been between 50 and 200 t. Preliminary landings in 2023 were 6 t.

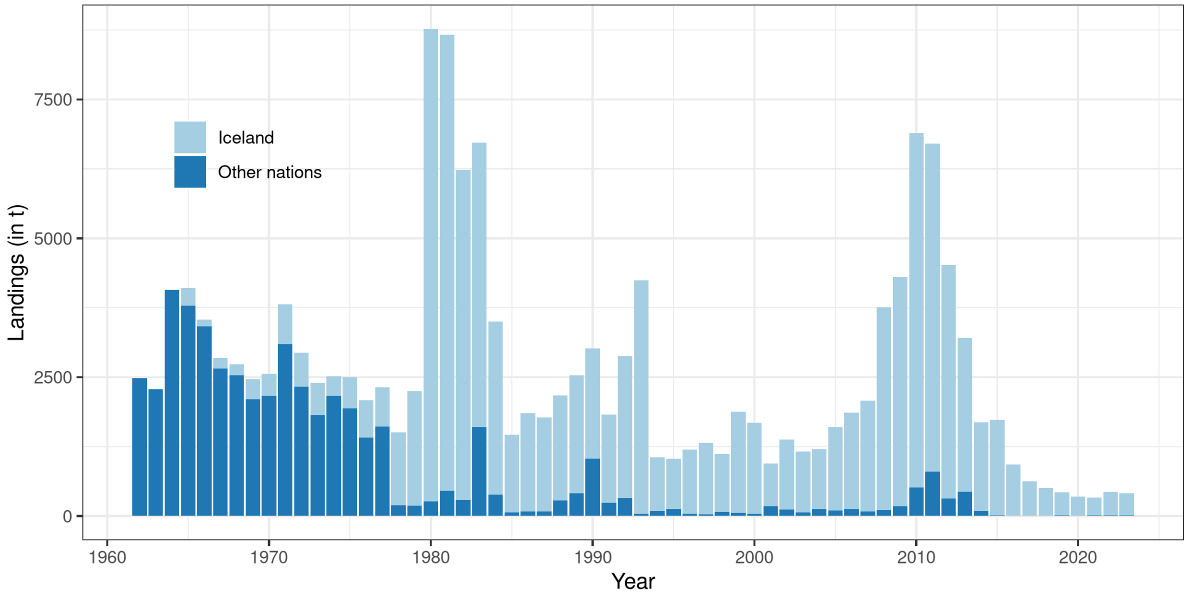

Figure 4.2.5: Blue ling in 5.a and 14. Nominal landings in 5.a.

4.2.3 ICES advice

The assessment is based on ICES rfb-rule for data limited stocks for the first time in 2021, where life history traits, exploitation characteristics and other relevant parameters for data-limited stocks are considered (ICES 2021). The rfb-rule has the following form:

$$A_{y+1} = A_{y-1}\ r\ f\ b\ m$$

where A_{y+1} is the advised catch, A_{y-1} is last years advice, r corresponds to the trend in biomass index (as in the current ICES "2 over 3" rule), f is a proxy for the exploitation (mean catch length divided by an MSY reference length) and b a biomass safeguard (reducing the catch when biomass index drops below a trigger value).

Latest advice (2022/2024) was 259 t.

r is the ratio of the mean of the last two survey indices and the mean of the three preceding values or:

$$r = \frac{\sum_{i=y-2}^{y-1} I_1\ /2}{\sum_{i=y-3}^{y-5} I_1\ /3}$$

f is the length-ratio component where:

$$f = \frac{\bar{L}_{y-1}}{L_{F=M}}$$

where $\bar{L}$ is is the mean catch length above $L_{F=M}$. $L_{F=M}$ is calculated as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty$$

where L_c is length at first capture and $L\infty$ is von Bertalanffy $L\infty$.

b is the biomass safeguard and is used to reduce catch advice when index falls below trigger,

$$b = min(1, I_y - 1/I_{trigger})$$

where $I_{trigger} = i_{loss\omega}$

m is a multiplier based on stock growth. K for blue ling is < 0.2 and therefore m is 0.95.

As the generic simulations on the rfb-rules were based on a biennial catch advice, the last years advice (2022/2023) is rolled over to this year's advice (2023/2024) (ICES 2023)

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. Since 2021/2022, other species have been transferred to blue ling for the first time since it was regulated into the ITQ system.

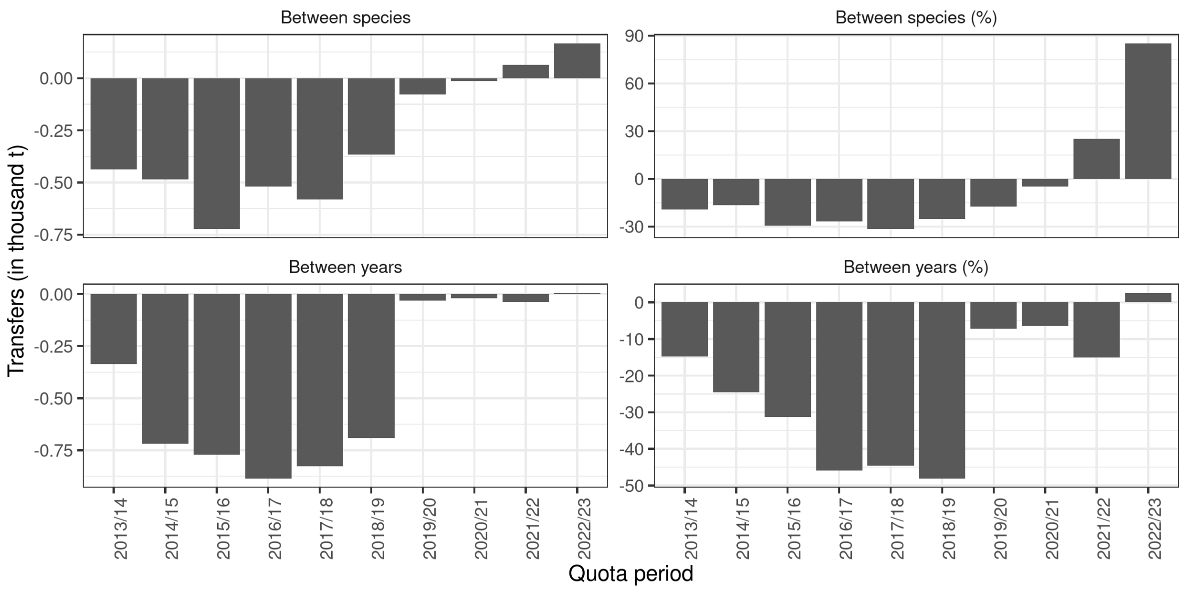

Figure 4.2.6: Blue ling in 5.a and 14. Net transfer of quota, from blue ling to other species and between years, in the Icelandic ITQ system by fishing year.

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 Table 4.2.2 and Table 4.2.3. Discarding is banned in the Icelandic fishery. There is no available information on discarding of blue ling. Being a relatively valuable species and not being subjected to TAC constraints prior to 2013/2014 fishing year nor minimum landing size there should be little incentive to discard blue ling.

4.2.5.2 Length composition

Length distributions from the Icelandic trawl and longline catches for the period 2002– 2022 are shown in Figure 4.2.8. No length measures were called for from commercial catches in 2017. In 2022, nine sample were collected from commercial catch i.e., three from longlines and six from bottom trawls (Figure 4.2.7).

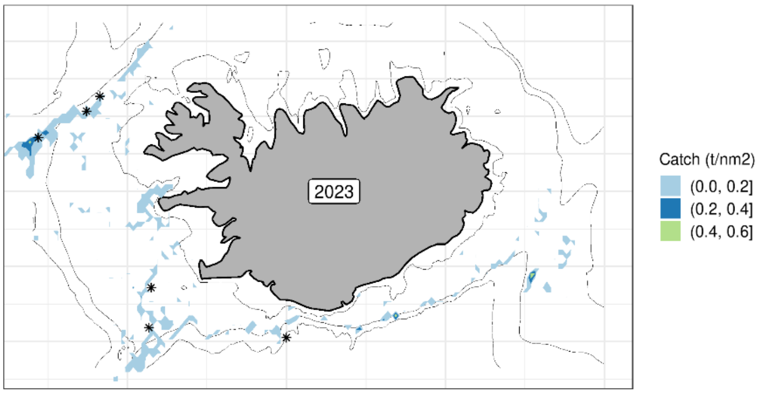

Figure 4.2.7: Blue ling in 5a. Distribution of catches in 2023 and location of samples.

Mean length from catches increased from 83 cm in 2003 to 103 cm in 2018. Mean length from from catches in 2023 was 94 cm. On average mean length from longlines is higher than from trawls.

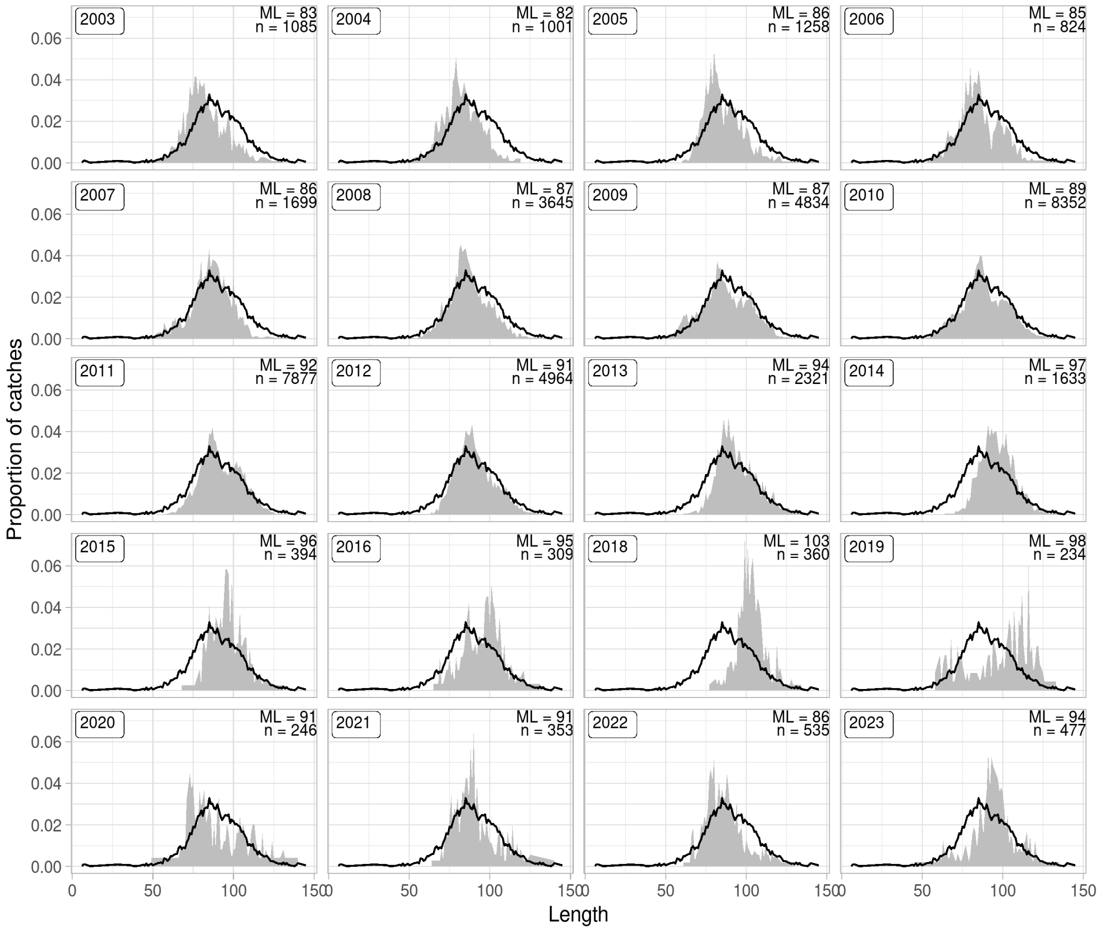

Figure 4.2.8: Blue ling in 5a. Length distribution of blue ling from catch (grey area). Black line is the mean for the period. No data available in 2017.

4.2.5.3 Age composition

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

Catch per unit effort and effort from the Icelandic trawl and longline fleet are given in Figure 4.2.9. 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 and therefore no attempt has been made to standardize the series.

However, looking at fluctuations in CPUE may be informative regarding the development of the fishery. CPUE from longlines was high from 2008 to 2013 but has decreased markedly since then. CPUE from trawls has been gradually decreasing in the period.

Effort from longlines peaked in 2009 but has since then decreased sharply. Effort from trawls peaked in 2011 but has remained relatively stable since. Non-standardised estimates of CPUE and fishing effort from longlines and trawls, based on logbook data where blue ling was recorded in catches.

Figure 4.2.9: Blue ling in 5.a and 14. Catch per unit effort (left) and effort (right) from longlines (blue) and trawls (blue) in 5.a based on logbook data where blue ling was recorded in catches.

Time-series stratified abundance and biomass indices from the spring (G3239) and autumn (G4493) trawl surveys are shown in Figure 4.2.10.

The length distributions from the autumn survey and its spatial distribution are presented in Figure 4.2.11 and Figure 4.2.12. 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.

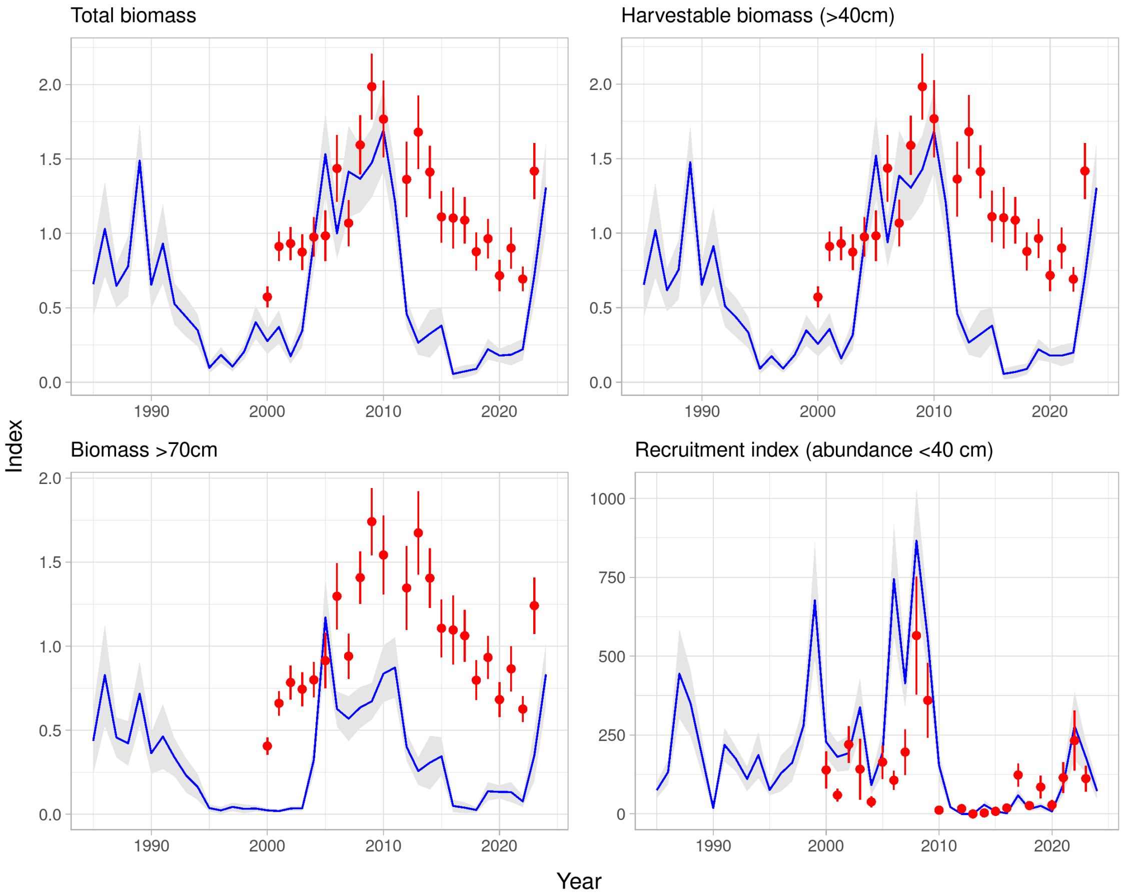

Figure 4.2.10: Blue ling in 5.a and 14. Survey abundance indices for blue ling in the Icelandic autumn survey since 2000 (red points and vertical lines) and the spring survey since 1985 (faded lines and shaded area). Total biomass index (top-left), biomass of 40 cm and larger (top-right), biomass of 70 cm and larger (bottom-left) and abundance - standard error of the estimate. Biomass in thousand tonnes.

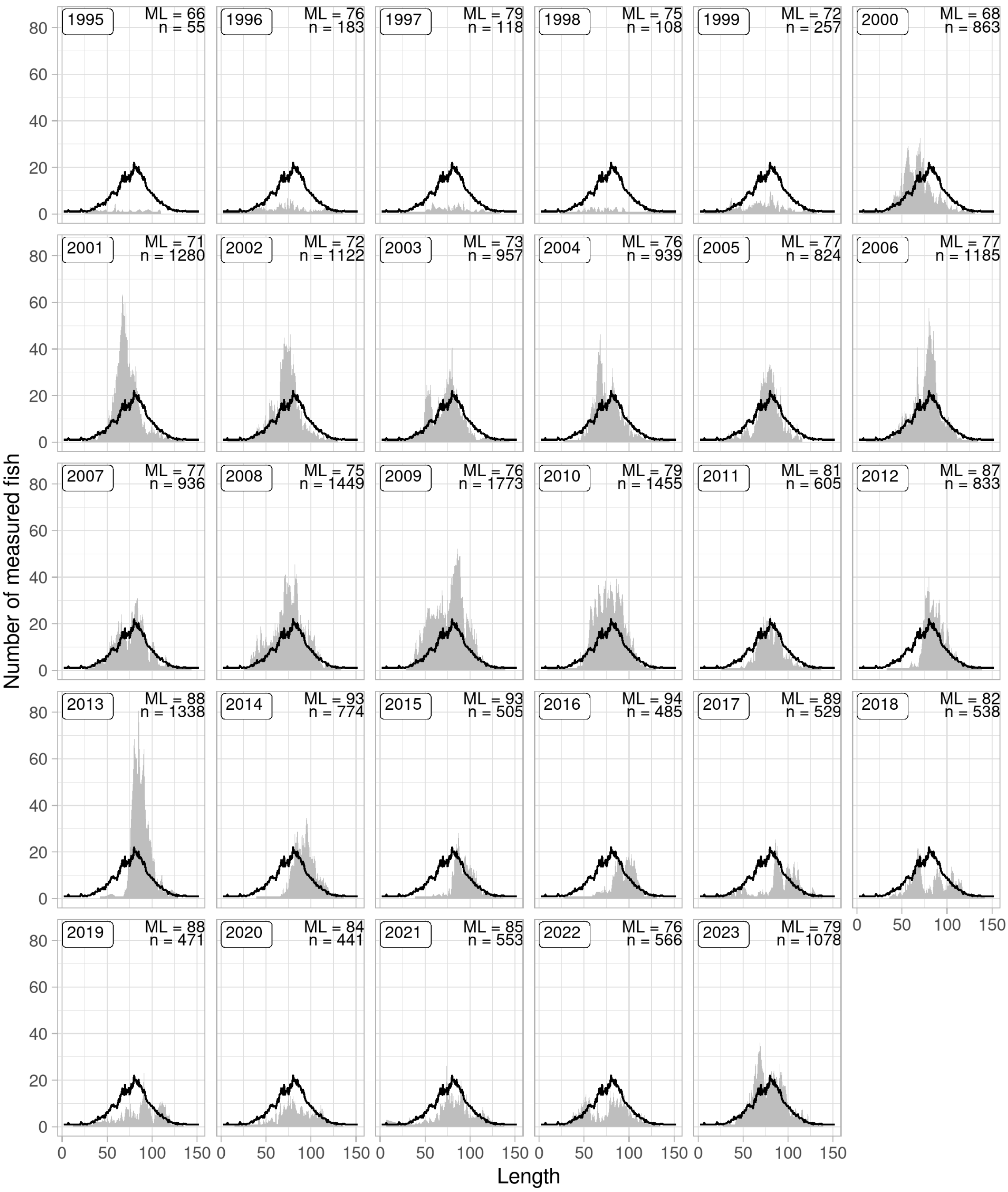

Figure 4.2.11: Blue ling in 5.a and 14. Length distribution from the Icelandic autumn survey since 1995. Black line is the average by length over the displayed period.

Figure 4.2.12: Blue ling in 5.a and 14. Spatial distribution of biomass index from the Icelandic autumn survey in 2000-2023.

4.2.6 Data analysis

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 (Table 4.2.2).

In 2005 longliners caught 108 tonnes of blue ling when trawlers caught 1261 tonnes or 84% of the total catches (1496 tonnes). In 2011 trawlers caught 1630 tonnes, out of 5904 tonnes or 28%, but longliners 4140 tonnes or 70%. Since then, the proportion taken by longliners has decreased and in 2023 longliners caught 104 t or 25% of the catches, trawls 304 t or 74% and other gear approximately 4 t, or 1%. As longliners take on average larger specimens of blue ling, this will have resulted in an overall change in the selection pattern in 2006–2015.

Total catches by the Icelandic fleet decreased between 2010 and 2013 and this decrease is mainly the result of decrease in trawls fishing activity in 2011 and longlines in 2012 and 2013. The expansion of the longline fleet to deeper waters (Figure 4.2.4) may be the result of decreased catch rates in shallower areas.

CPUE and effort: CPUE indices from commercial catches are not considered a reliable index of stock abundance. The rapid CPUE increase from longlines should not be viewed as an increase in stock biomass but rather as the result of increased interest by the longline fleet and its expansion into deeper waters (Figure 4.2.4). In 2011 to 2012 there was a slight decrease in CPUE from longline but the CPUE increased again in 2013 to its highest value in the time-series. CPUE from trawling has remained at low levels while effort increased until about 2009 after which it has decreased (Figure 4.2.9).

Surveys The spring survey covers only the shallower part of the depth distributional range of blue ling and shows high interannual variance (Figure 4.2.12). Since the spring indices do not cover the depths where the highest abundance of blue ling is found, it is unknown to what extent they reflect actual changes in total blue ling biomass. The shorter autumn survey, which goes to greater depths and is therefore more likely to reflect the true biomass dynamics, does indicate that there was an increase in blue ling biomass 2007-2009 (Figure 4.2.12). Since 2010 the biomass index 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 2010 it had decreased again and remained low until 2022, when an increase was observed (Figure 4.2.11 and Figure 4.2.12). Consequently, the average length recorded in the autumn survey has been greater since 2009 but decreased again in 2022 to levels comparable to those prior to 2010. Note that due to industrial action, only part of the autumn survey was conducted in 2011.

Analytical assessment

Exploratory stock assessment on blue ling using gadget

An exploratory stock assessment of blue ling using the Gadget model was presented at WGDEEP 2012. Updated results of the model were presented at WGDEEP 2024.

4.2.6.1 Comments on the assessment and advice

The assessment is based on the rfb-rule for ICES category 3 data-limited stocks and last years advise is rolled over to this year as the generic simulations on the rfb-rules were based on a biennial catch advice. The Icelandic autumn trawl survey (IS-SMH) was used as the index for the stock development. The advice is in accordance to $A_{y+1} = A_{y-1}\ r\ f\ b\ m$ or 259 t * 1.226 * 1.019 * 1 * 0.95 which result is advice for 2024/2026 set at 307 t (19% increase from last advice). From 2019-2021, the advice was based on the ICES framework for data limited stocks (Category 3.2) where the ratio of the mean of the last two survey indices (Index A) to the mean of the three preceding values (Index B) is multiplied by the last years advice.

4.2.6.3 The application of rfb-rule

- r is calculated as the average of last two years values, divided by average of three preceding years values which results in r=1.23 (Figure 4.2.13, Table 4.2.5)

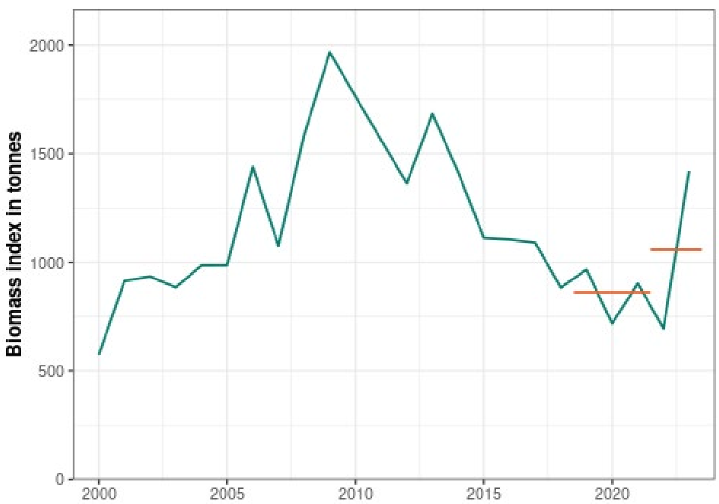

Figure 4.2.13: Blue ling in 5.a and 14. Biomass index since 2000. No index is in the year 2011 (No survey). The red lines show the average of last two years values and the three preceding years.

- *f* is the length-ratio component. The mean length of last years´ catch was 97.06 cm and the target reference length (L*c* or length at first capture * 0.75 + length ∞ * 0.25) is **95.25** (Figure 4.2.14).

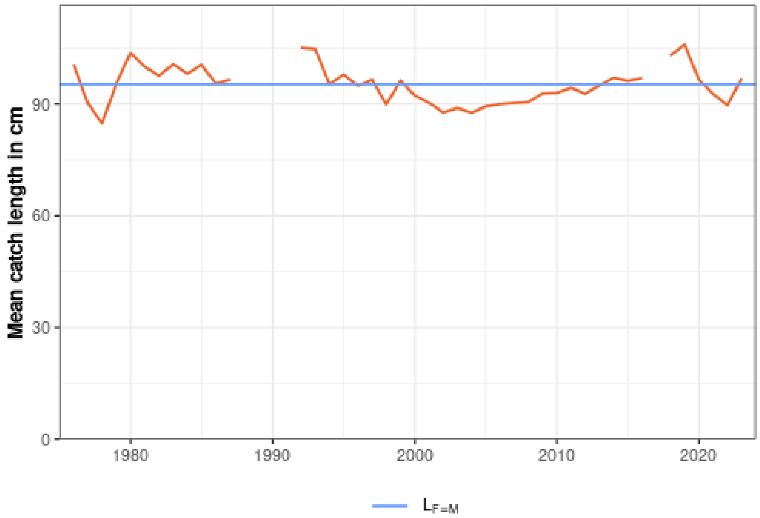

Figure 4.2.14: Blue ling in 5.a and 14. Mean length of blue ling from catches since 1980. The blue dashed line shows the target reference length.

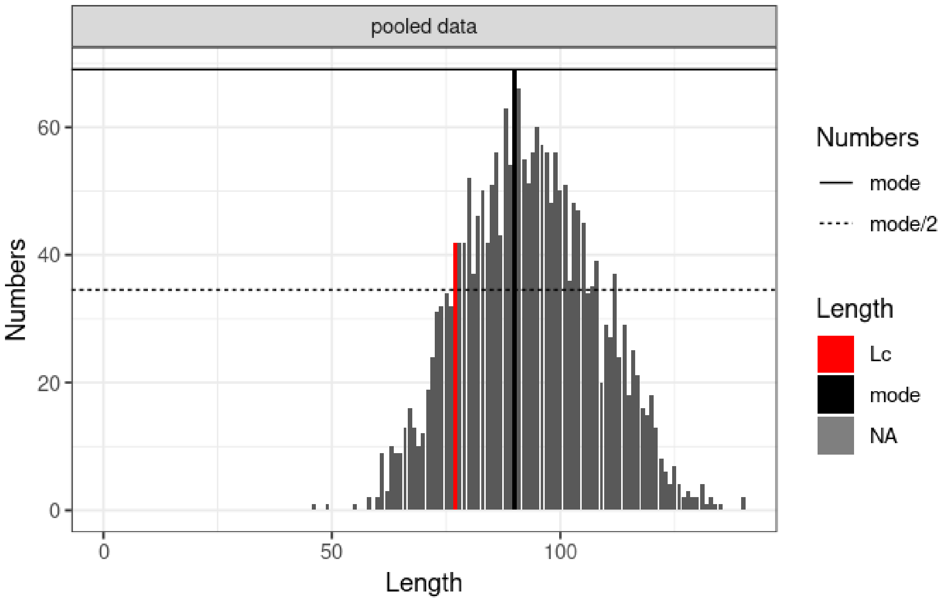

Figure 4.2.15: Blue ling in 5.a and 14. Length frequency distribution from catches. Red line is the length of modal abundance, the orange line is the length at first capture, green line is the target reference length, and the blue line is the L∞.

- *b* is the biomass safeguard and is used to reduce catch advice when index falls below trigger. The lowest index or the I_{loss} for blue ling is 574 and was recorded in the year 2000. $I_{trigger}$ is I_{loss} *1.4 or 803.75 (Figure 4.2.15). Biomass index this year is 1420 and abowe $I_{trigger}$ and *b* is therefore 1.

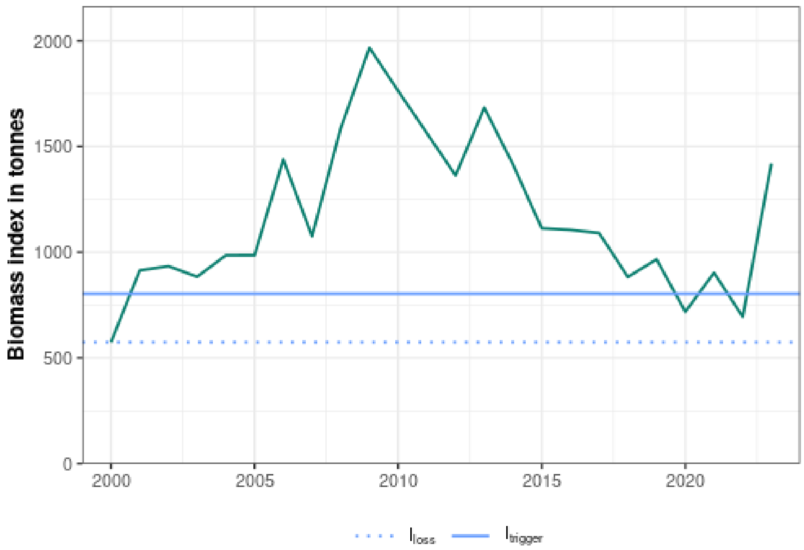

Figure 4.2.16: Blue ling in 5.a and 14. Biomass index values since 2000. The red line is the $I_{trigger}$ and the red dot is the lowest observed value (I_{loss}).

- *m* is the tuning parameter and for slow growing species (with von Bertanlaffy K<0.2), *m* equals to 0.95. For annual catch advice however, m equals 1.00.

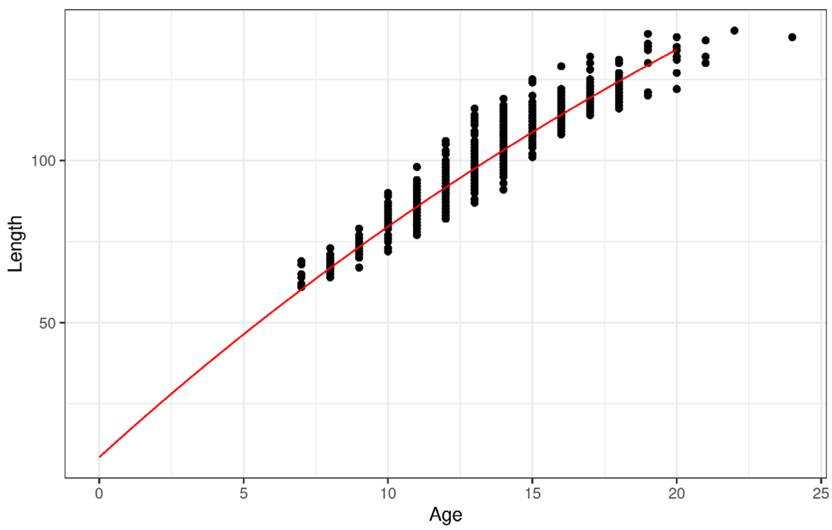

Figure 4.2.17: Blue ling in 5.a and 14. The von Bertalanffy growth curve (red line) fitted to age and length data for blue ling.

4.2.6.4 Exploring sensitivity of *f* with other L∞ values.

The *f* and TAC are sensitive to different *L*∞ values (Figure 4.2.18, Table 4.2.1). The L∞ used in the assessment is the maximum length from Icelandic catches. The 99th and 95th percentiles were tested for sensitivity, as well as the *L*∞ from fishbase.org. Table 4.2.1 shows how higher *L*∞ values decrease *f* by increasing the target reference length. Increased *L*∞ values result in lower TAC as it decreases *f*.

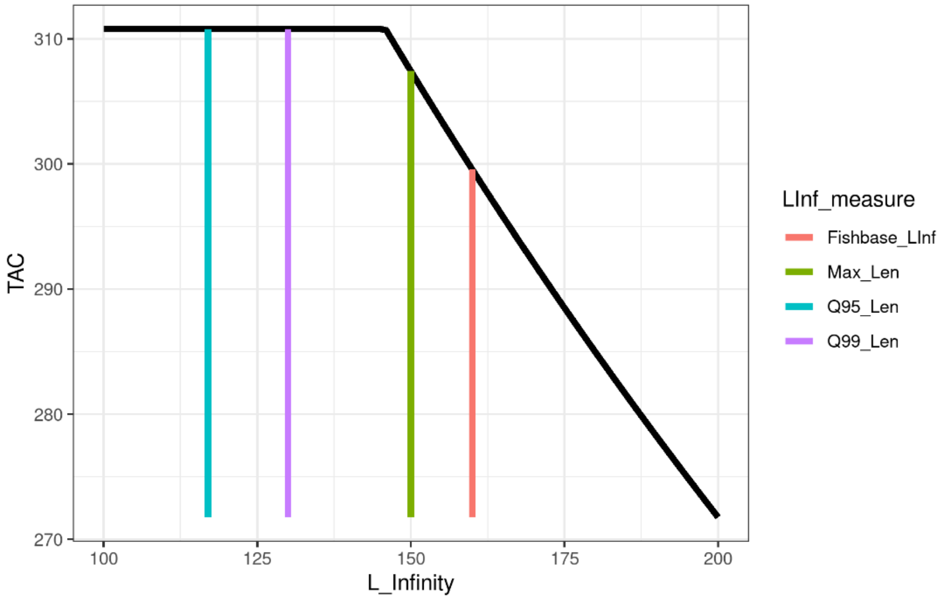

Figure 4.2.18: Blue ling in 5.a and 14. TAC sensitivity to different L∞ values. Blue line shows the 95th percentile to the maximum length value (117 cm), purple line is the 99th percentile to the maximum value (130 cm), green line is the maximum length value (150 cm) and the red line shows the fishbase.org value (160 cm).

Table 4.2.1: Blue ling in 5.a and 14. Parameter sensitivity to different L∞ values. The max length value is 150 cm, the 99th percentile of maximum length value is 130 cm, the 95th percentile is 117 cm and the fishbase.org value is 160 cm.

Component	L∞ (max length)	L∞ (99th percentile)	L∞ (95th percentile)	L∞ (fishbase.org)
Previous advice	259	259	259	259
Index A	1058	1058	1058	1058
Index B	862	862	862	862
Ratio	1.23	0.933	0.933	0.933
$L_{F=M}$ (target reference length)	95.25	90.25	87	97.75
f (length ratio)	1.02	1.08	1.12	0.993
Biomass safeguard	1	1	1	1
Multiplier	0.95	0.95	0.95	0.95
I_{loss}	574	574	574	574
$I_{trigger}$	804	804	804	804
Initial advice	307	324	337	300
Stability clause applied	0	1	1	0

Component	L∞ (max length)	L∞ (99th percentile)	L∞ (95th percentile)	L∞ (fishbase.org)
Final advice	307	311	311	300
Advice change	+19	20	20	16

4.2.7 Management considerations

Landings have decreased considerably in the last year and as blue ling 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.

Table 4.2.2: Blue ling in 5.a and 14. Number of Icelandic boats with blue ling landings and their total landings in 5a.

Year	Bottom trawl (tonnes)	Gill nets (tonnes)	Longlines (tonnes)	Other (tonnes)	Bottom trawl (n boats)	Gill nets (n boats)	Longlines (n boats)	Total catch (tonnes)
2000	801	13	808	13	110	18	45	1634
2001	597	24	131	10	110	28	40	762
2002	986	15	256	8	107	14	41	1264
2003	883	6	197	11	105	14	47	1098
2004	894	5	145	39	113	19	53	1089
2005	1261	8	108	119	107	16	10	1502
2006	1477	13	151	94	107	16	69	1736
2007	1544	22	374	54	98	24	90	1998
2008	2111	28	1454	60	95	25	92	3653
2009	2242	136	1677	75	89	31	87	4129
2010	2201	91	3978	107	85	31	96	6378
2011	1630	76	4140	59	81	24	97	5904
2012	1449	274	2425	58	79	22	78	4207
2013	1300	14	1422	34	75	20	73	2770
2014	923	11	721	32	73	15	85	1688
2015	821	9	883	13	67	18	89	1727

Year	Bottom trawl (tonnes)	Gill nets (tonnes)	Longlines (tonnes)	Other (tonnes)	Bottom trawl (n boats)	Gill nets (n boats)	Longlines (n boats)	Total catch (tonnes)
2016	701	3	219	7	66	11	62	931
2017	436	1	172	12	58	8	58	622
2018	363	2	133	5	65	6	62	503
2019	238	3	170	13	58	11	63	424
2020	264	1	76	7	58	9	51	349
2021	286	2	42	2	59	10	45	321
2022	338	2	96	1	57	7	42	438
2023	304	0.1	104	4	52	5	41	412

Table 4.2.3: Blue ling in 5.a and 14. Landing in ICES Division 14. Source: STATLANT database and WD02 (Annex 2).

YEAR	FAROE	GERMANY	GREENLAND*	ICELAND	NORWAY	RUSSIA	SPAIN	UK	TOTAL
1983	0	621	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	79
1991	0	105	5	0	0	0	0	45	155
1992	0	27	2	0	50	0	0	32	111
1993	0	16	0	3124	103	0	0	22	3265
1994	1	15	0	300	11	0	0	57	384
1995	0	5	0	117	0	0	0	19	141
1996	0	12	0	0	0	0	0	2	14
1997	1	1	0	0	0	0	0	2	4
1998	48	1	0	0	1	0	0	6	56
1999	0	0	0	0	1	0	66	7	74
2000	0	1	0	4	0	0	889	2	86
2001	1	0	0	11	61	0	1631	6	1710

YEAR	FAROE	GERMANY	GREENLAND*	ICELAND	NORWAY	RUSSIA	SPAIN	UK	TOTAL
2002	0	0	0	11	1	0	0	0	12
2003	0	0	0	0	36	0	670	5	711
2004	0	0	0	0	1	0	0	7	8
2005	2	0	0	0	1	0	176	8	187
2006	0	0	0	0	3	1	0	0	4
2007	19	0	0	0	1	0	0	0	20
2008	1	1	0	0	2	0	381	0	385
2009	1	0	0	0	3	0	111	4	119
2010	1	3	0	0	9	0	34	0	47
2011	0	6	0	0	2	0	0	1	9
2012	0	3	0	367	9	0	0	0	379
2013	0	9	4	0	0	0	0	3	16
2014	2	8	1	606	3	0	0	0	620
2015	0	5	65	23	1	0	0	0	94
2016	1	7	0	0	0	0	0	0	8
2017	0	2	4	0	4	0	0	0	10
2018	0	5	16	0	12	0	0	0	33
2019	0	7	20	0	36	0	0	0	63
2020	0	7	18	0	2	0	0	0	27
2021	0	6	1	0	9	0	0	0	16
2022	0	5	0	0	7	0	0	0	12
2023	0	6	6	0	2	0	0	0	14

Table 4.2.4: Blue ling in 5.a and 14. Advised TAC, national TAC and total landings since the quota year 2013/2014.

Fishing Year	MFRI Advice	National TAC	Iceland	Others	Landings
2013/14	2400	2400	1653	101	1754
2014/15	3100	3100	1898	41	1939
2015/16	2550	2550	1734	90	1828
2016/17	2032	2032	932	23	955
2017/18	1956	1956	554	79	592

Fishing Year	MFRI Advice	National TAC	Iceland	Others	Landings
2018/19	1520	1520	424	62	424
2019/20	483	483	371	5	376
2020/21	406	406	365	12	377
2021/22	334	334	369	3	372
2022/23	259	259	477	10	437
2023/24	259	259			
2024/25	307				
2025/26	307				

Table 4.2.5: Blue ling in 5.a and 14.: Landings from Icelandic fishing grounds (5a)

Year	Faroe	Germany	Iceland	Norway	UK
2002	28	4	1264	74	10
2003	16	16	1098	6	24
2004	38	9	1083	49	27
2005	24	31	1496	20	26
2006	63	22	1734	27	11
2007	78	0	1995	4	13
2008	88	0	3653	21	0
2009	178	0	4129	5	0
2010	515	0	6378	13	0
2011	797	0	5904	2	0
2012	312	0	4207	2	0
2013	435	0	2769	2	0
2014	70	0	1588	30	0
2015	12	0	1712	4	0
2016	6	0	925	0	0
2017	4	0	619	0	0
2018	28	0	502	0	0
2019	28	0	415	4	0
2020	6	0	343	0.1	0

Year	Faroe	Germany	Iceland	Norway	UK
2021	1	0	323	7	0
2022	1	0	427	10	0
2023	1	0	404	8	0

Table 4.2.6: Blue ling in 5.a and 14. Catches along with survey biomass index (larger than 40 cm) from the Icelandic Autumn survey, the calculated Fproxy (Catches in Iceland and Greenland)/Index) and the length-based fishing pressure proxy ($L_{F=M}$/L_{mean}) which is used for the evaluation of the exploitation status.

Year	Iceland	Greenland	Index	Fproxy	$L_{F=M}$ / (L_{mean})
2000	1635.88	574.1	896.00	4.41	1.12
2001	761.81	914.3	1710.00	2.70	1.21
2002	1264.67	934.1	12.00	1.37	1.21
2003	1098.03	884.4	711.00	2.05	1.15
2004	1089.91	985.4	8.00	1.11	1.16
2005	1502.33	985.7	187.00	1.71	1.11
2006	1736.04	1439.3	4.00	1.21	1.11
2007	1998.09	1075.5	20.00	1.88	1.11
2008	3653.18	1586.6	385.00	2.55	1.09
2009	4129.24	1967.2	119.00	2.16	1.10
2010	6377.87	1763.5	47.00	3.64	1.08
2011	No data	No data	No data	No data	1.03
2012	4206.66	1363.3	378.98	3.36	1.04
2013	2769.87	1683.9	16.18	1.65	1.01
2014	1687.64	1415.2	619.57	1.63	0.99
2015	1727.36	1113.2	94.58	1.64	0.99
2016	930.79	1105.7	8.66	0.85	1.00
2017	622.26	1090.7	9.44	0.58	No data
2018	502.96	883.0	32.83	0.61	0.92
2019	423.98	966.7	62.55	0.50	0.97
2020	349.31	718.1	26.81	0.52	1.05

Year	Iceland	Greenland	Index	Fproxy	$L_{F=M}$ / (L_{mean})
2021	331.86	902.7	16.44	0.39	1.05
2022	437.83	695.0	12.63	0.65	1.10
2023	412.28	1420.1	14.81	0.30	1.01

4.2.9 References

ICES. 2012. “Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 28 March–5 April, 2012, Copenhagen, Denmark. ICES Cm 2012/Acom:17.” International Council for the Exploration of the Seas; ICES publishing.

ICES. 2021. Tenth Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE X). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.5985

ICES. 2023. Eleventh Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks(WKLIFE XI). ICES Scientific Reports. 5:21. 74 pp. https://doi.org/10.17895/ices.pub.22140260

4.3 Blue Ling (*Molva dypterygia*) in Division 5.b and subareas 6, 7 and 12

Since 2024, Subarea 12 is considered as a part of this stock unit (see details in § 4.1) instead of bli.27.nea.

4.3.1 The fishery

In the last decade, the main fisheries have been from French, Faroese and Scottish trawlers. Faroese vessels have been fishing almost exclusively in ICES Division 5.b, French and Scottish vessels have been mostly fishing in ICES Division 6.a, with a smaller catch in ICES Division 5.b from French trawlers. Scottish vessels have been catching an increasing proportion of annual international landings and became the main fishing fleet in 2023. The two other countries, which contribute notably to the total catch are Norway and Spain. In 2023, Basque fleet (Spain) fished in subdivision 5.b.1 (119 tonnes with longline). Total international landings from Subarea 7 have been decreasing since the late 1990s and were less than 0.1% of the total catch in 2023.

Landings by Faroese trawlers are mostly taken in the spawning season. Historically, this was also the case for French trawlers fishing in ICES divisions 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. Since 2016 trawling is banned deeper than 800 m, whist blue ling is abundant down to at least 1200 m.

The directed fisheries on spawning aggregations for blue ling on Hatton Bank (ICES Division 12.b) are no longer conducted. In this area blue ling has represented a significant bycatch of trawl fisheries for mixed deep-water species; especially from Spanish freezer trawlers. Blue ling is now only taken as bycatch of other fisheries taking place in this area.

In recent years, an increasing proportion of the catch has been from hooks and lines. Trawlers represented 94 % and 79% of the landings in 2019 and 2022 respectively, whilst the contribution of longliners to total landings increased from 6% to 20% in the same period. In 2023, trawlers represented 66% of the landings whereas longliners represented 32% of the landings As in previous years, all Norwegian catch were from longliners. The Spanish fleet has a component of longliners, which represented one quarter of Spanish catches in 2019 and increased to 97% in 2023. Scottish landings increased from about 720 tonnes in 2018-2020 to 2281 t in 2023, representing 44% of total landings.

4.3.2 Landings trends

See the stock annex for the time-series of landings from 1966 to 1999. Total international landings from Division 5.b (Tables 4.3.1a–h, Figure 4.3.1 and stock annex) peaked in the late 1970s at around 21 000 t and then declined until 2010. Thereafter landings have oscillated between 1000 and 1950 tonnes per year.

Landings from Subarea 12 which primarily are from the western slope of Hatton Bank (ICES Division 12.b) are since 2015 very low and zero landings were reported in 2022 and 2023.

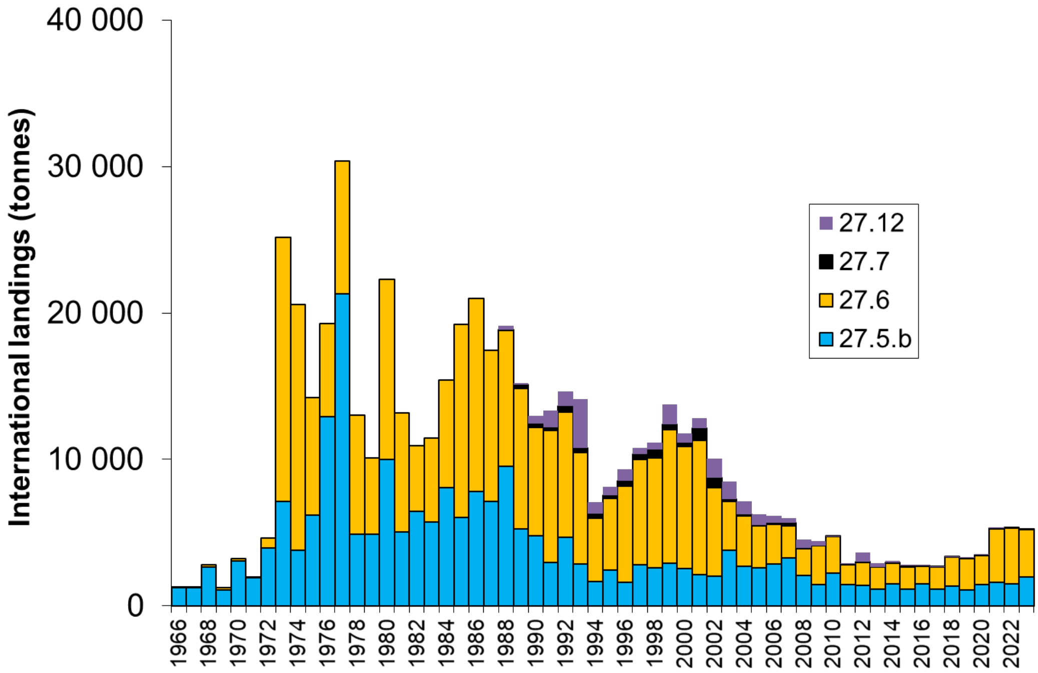

Figure 4.3.1. International landings for bli.27.5b67 in ICES subareas 6, 7 and 12 and Division 5.b.

The landings from Subarea 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 2010s, the landings declined to an historical low level of less than 1300 tonnes in 2016 but have increased since to more than 2000 tonnes in 2019 and increased again to near 3800 tonnes in 2022 (Table 4.3.1c). Although significant in the past, landings in Division 6.b were minor in the last 10 years and null in the last three years (Table 4.3.1d).

Landings from Subarea 7 are comparatively small, mostly less than 500 t per year in the whole time-series and less than 50 t during the last ten years, except in 2015 when 78 t were landed (Table 4.3.1e).

Landings in 2023 at 5187 decreased slightly from 5308 t in 2022which was the highest record since 2007, and remain well below the advice and TAC levels.

4.3.3 ICES Advice

The ICES advice for 2023 and 2024 is "when the MSY approach is applied, catches should be no more than 10 952 tonnes in 2023 and no more than 10 972 tonnes in 2024."

4.3.4 Management

This stock is classified as Category 4 in the NEAFC categorization of deep-sea species/stocks which implies that fisheries are primarily restricted to Coastal State exclusive economic zones (EEZs) and therefore management measures are not taken by NEAFC unless complementary to coastal state conservation and management measures.

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 in ICES Division 5.b, and subareas 6 and 7. TACs are fixed according to bilateral agreements between EU and Faroe Islands and EU and Norway. The EU TAC includes quotas for Norway and the Faroe Islands and the EU had a quota for ling and blue ling in Faroese waters (1885 t in 2019 and 2020). This EU quota in Faroese waters was divided in national quotas between Germany, France and UK. This quota has been set to zero since 2021.

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.

Agreement about TAC between Faroe Islands, the United Kingdom of Great Britain and Northern Ireland for 2023: UK stocks for transfer to Faroes ICES subareas 6, 7 of 250 tonnes blue ling (western) and Faroe stocks for transfer to UK ICES Division 5.b of 180 tonnes blue ling and ling (Agreed record of fisheries consultations between the United Kingdom of Great Britain and Northern Ireland and the Faroe Islands for 2023, https://www.gov.uk/government/publications/fisheries-bilateral-agreement-with-the-faroe-islands-for-2023/agreed-record-of-fisheries-consultations-between-the-united-kingdom-of-great-britain-and-northern-ireland-and-the-faroe-islands-for-2023).

				QUOTA INCLUDED IN EU TAC				EU QUOTA IN FAROESE WATERS OF 5.b(1)	INTERNA-TIONAL
Year	Area	ICES advice	EU TAC	EU	Norway	Faroe	UK(4)		landings
2006	67	Biennial		3137	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	23 90	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	2748
2016	5b67	5046	5046	4746	150(2)	150(3)		2100	3043
2017	5b67	11 314	11 314	11 014	150(2)	150(3)		2000	2669
2018	5b67	10 763	10 763	11 463	150(2)	150(3)		2000	3322
2019	5b67	11 778	11 778	11 378	250(2)	150(3)		1885	3218
2020	5b67	11 150	11 150	10 750	250(2)	150(3)		1885	3478
2021	5b67	11522	11 522	8908	0	0	2614	0	5286
2022	5b67	10 859	10 859	8332	0	0	2527	0	5308
2023	5b67	10 952	10 952	8341	0	0	2611	0	5187
2024	5b67	10 972	10972	8279	0	0	2693	0	

(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) Since 2021, the share of fishing opportunities agreed between UK and EU are included in the EU regulation

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.

From 2015 to 2024, the EU TAC in EU and international waters was set to the level of the ICES catch advice. As a significant fraction of the catch comes from Faroese waters, setting the EU TAC at the level of the ICES advice implied that the ICES advice could have been overrun without any illegal catch, so creating a risk of exploiting the stock beyond the recommended level.

In 2009, the EU introduced protection areas of spawning aggregations of blue ling on the edge of the Scottish continental shelf (6.a) and at the edge of Rosemary Bank (6.a). Fishing for blue ling is restricted in known spawning areas during 3 months corresponding to the spawning season. 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. This regulation and the coordinate of the prohibited area are included in regulation 2019/1241 of the European parliament and of the Council. Since 2021 and the Brexit, these spawning areas are no longer in EU but in UK waters. 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 Subdivision 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*. (2010), see Figure 4.1.3. The ban of fishing with mobile gears in contact with the seafloor deeper than 800 m included in EU and UK regulations, imply that since 2016 part of depth distribution of blue ling has been devoid of fishing effort from trawlers.

Blue ling has been subject to a minimum conservation reference (MCRS) of 70 cm in EU Northwestern and South-Western waters (EU regulation 2019/124). This regulation also applies to the NEAFC RA. The impact of this MCRS regulation is minor as the proportion of blue ling smaller than 70 cm has always been minor.

4.3.5 Data availability

4.3.5.1 Landings and discards

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

Like in recent years, in 2023, landings data by country and ICES Division were extracted from InterCatch for all countries, expect for the Faroe Islands for which official Faroese landings were taken from the ICES preliminary statistics. Even if the landings were available through InterCatch for all the country (except Faroe Islands) a comparison between the two datasets available was realize. The comparison of the two data sources was good. From all countries, except the Faroe Islands, landings estimates submitted to InterCatch were used.

Data submitted to InterCatch showed that international discards in 2018-23 were less than 1% of landings for countries reporting through InterCatch. Faroese vessels are considered making no discards. This low discarding proportion comes from the absence of catch of small blue ling on most of the fishing grounds. Overall, discarding is well below the maximum level of 5% for considering it negligible in ICES advice. No catch in international waters were reported in 2022 and 2023.

4.3.5.2 Length compositions

Length composition times-series previously used were all updated (see below section 4.3.6 data analyses). The availability of length composition data is insufficient, in 2023, the number of length measurements reported in InterCatch from countries other than France was 22, although these countries represented 3188 tonnes landed and 61% of total landings. Length composition data from the Faroe Islands have been based upon variable numbers of annual measurements along the time-series (, but mostly more than 1000 fish measured sine 2014), but only 208 and 108 fish were measured in 2022 and 2023 respectively (Figure 4.3.2). As a consequence, the estimated length composition of the landings is mostly derived from French data, which correspond to less than 30% of total landings.

4.3.5.3 Age compositions

Age estimations have been carried out by France since 2009, using a consistent protocol (see stock annex) so even though ageing is not validated for this species, comparable data are now available for 14 years.

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. Since the stock was benchmarked in 2014, the length–weight relationship used comes from the Faroese surveys, which cover a wide range of size (see stock annex).

4.3.5.5 Maturity and natural mortality

No new data.

4.3.5.6 Catch, effort and research vessel data

Catch data were updated, discards data reported to InterCatch were negligible (less than 1% of total catch). Effort data are not used for modelling the stock's dynamics.

Abundance and biomass indices from surveys were all available. Blue ling is sampled in three Faroese surveys and one Scottish survey.

Commercial cpues

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 2000–2023. Selected vessels were those with a total landed catch of ling, tusk and blue ling of more than 8 t per 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. Standardised cpue series are calculated using data from official logbooks starting from 2000 (Helle *et al.* 2015).

4.3.6 Data analyses

4.3.6.1 Landing trends

The time-series of landings are available in Tables 4.3.1a-h.

In Subarea 12, after relatively high levels for the period 2001–2005 recent landings have declined. Spain has for many years been the only country reporting landings from this area; since 2021 there are no Spanish landings from Subarea 12. The reported landings from this Subarea have always been from Division 12b; however, from 2019-20 there was also some landings from Division 12a. For 2021, the landings are from 12.a.4 (5 t from Norwegian landings). In 2022 and 2023 no landings were recorded.

The part of landings inside the NEAFC Regulatory Area is very low and is zero since 2021 (Table 4.3.2).

4.3.6.2 Length compositions

Possible recruitment inputs are visible in length compositions of Faroese commercial catches in some years, e.g. 2007–2009, 2011, 2015, 2017 to 2023 (Figure 4.3.2).

In the sampling of Faroese landings, large numbers of fish have been measured between 2015 and 2021, making this data set useful to appraise change in the stock. On the contrary, in years 2000 to 2014 and in 2023, the number of fish measured seemed low.

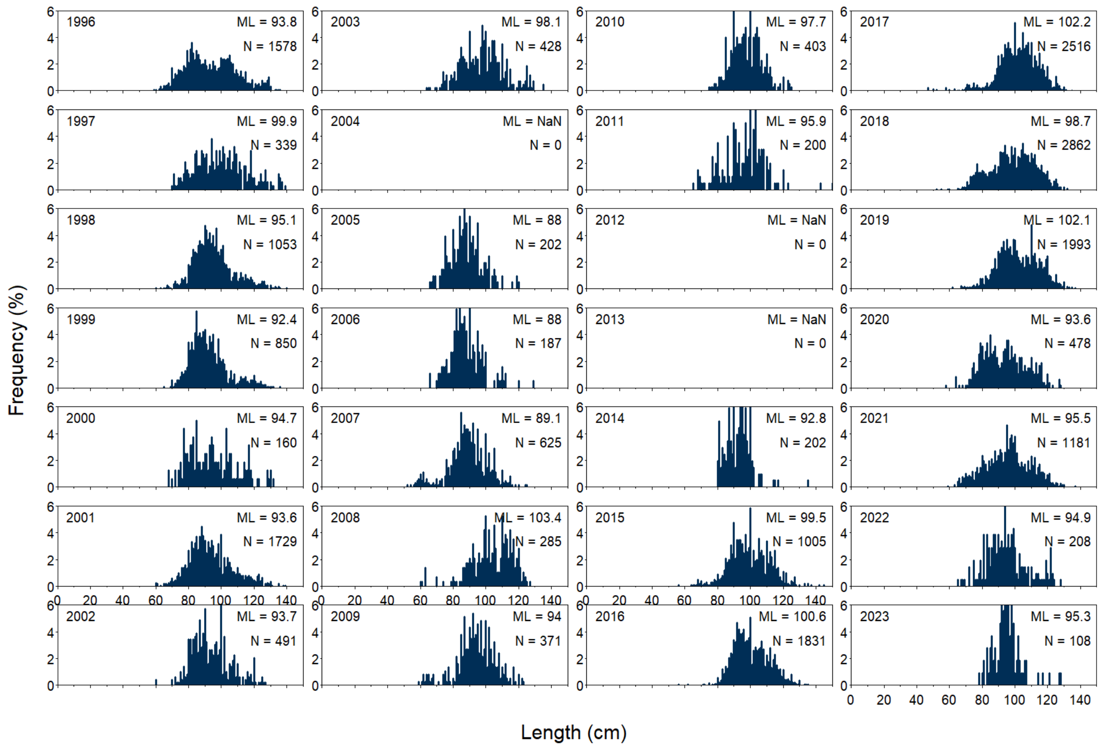

Figure 4.3.2. Length composition of blue ling landings from Faroese otter-board trawlers >1000 HP in Division 5.b from 1996 to 2023.

Small blue ling (between 40 and 60 cm total length) were caught in higher proportion during both survey, occurring on the Faroe Plateau, in 2017-2020 than during most of the time series (Figures 4.3.3 and 4.3.4).

The length distribution of the Faroese deep-water survey initiated in 2014 is shifted to the right compared to the surveys occurring on the Faroe Plateau, which is expected as blue ling move to deeper areas with age. Nevertheless, in 2019 the deep-water survey also shows a higher proportion of smaller (60-80 cm) individuals, this proportion was high again in 2022 and 2023 (Figure 4.3.5).

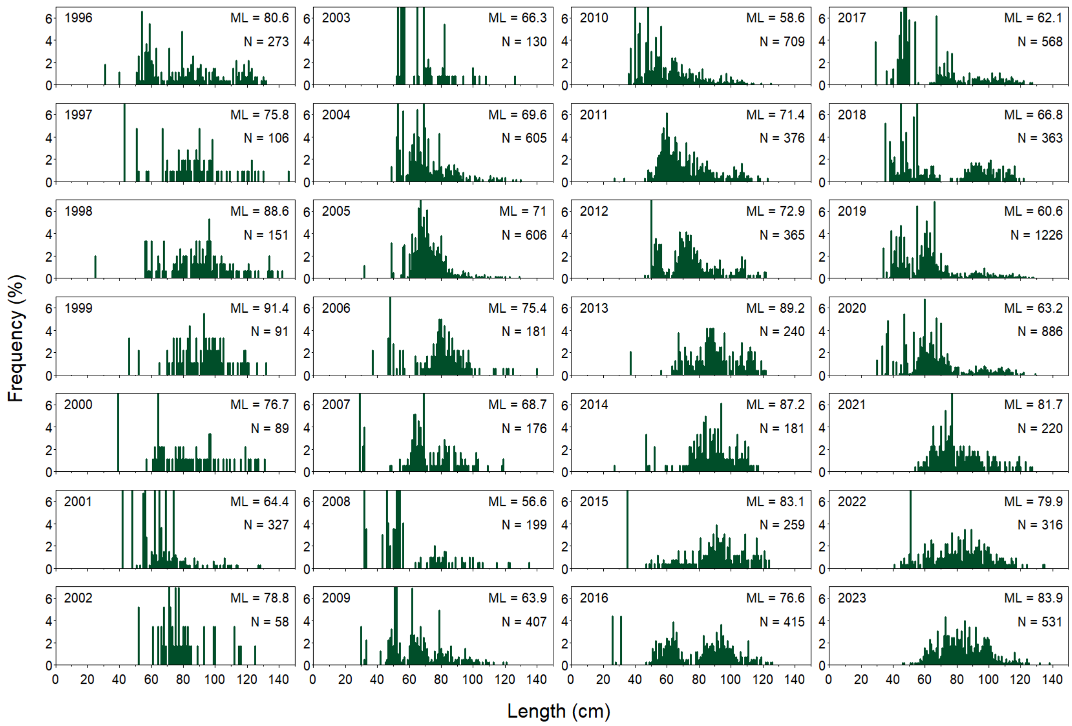

Figure 4.3.3. Length composition of blue ling in the Faroese summer groundfish survey on the Faroe Plateau (1996-2023).

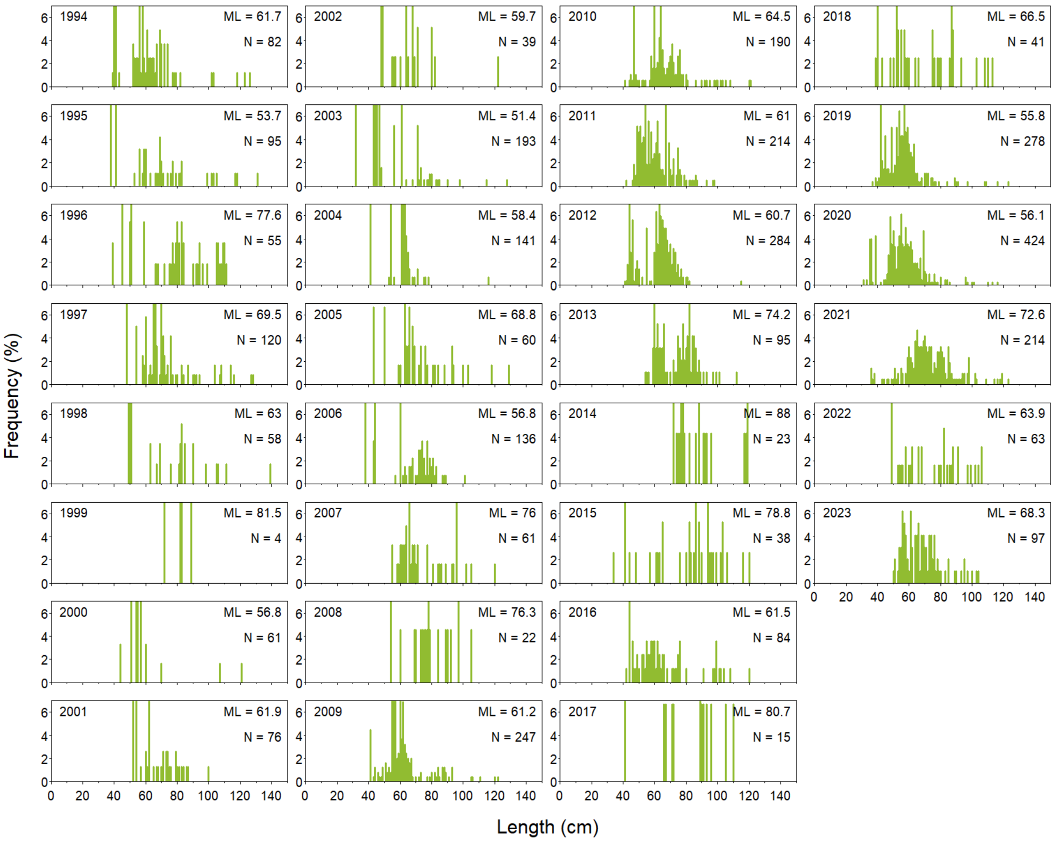

Figure 4.3.4. Length composition of blue ling in the Faroese spring groundfish survey on the Faroe Plateau (1994-2023).

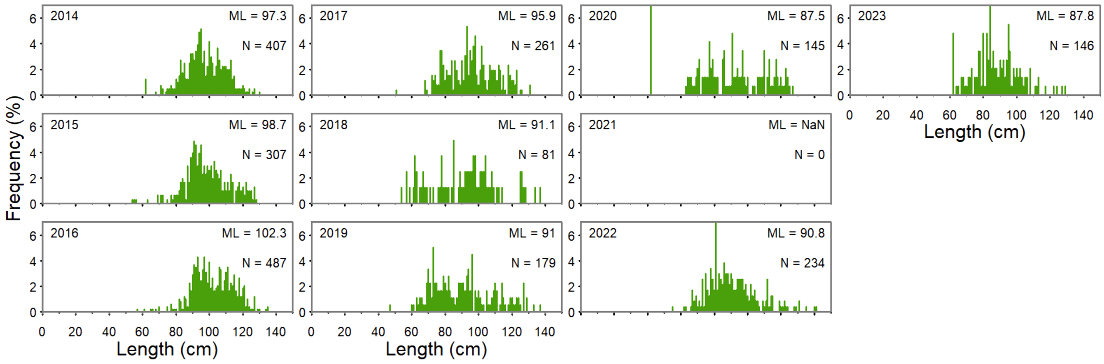

Figure 4.3.5. Length composition of blue ling in the Faroese deep-water survey in Faroese waters (2014-2023). No deep-water survey in 2021.

The estimated length composition shows an increasing proportion of larger fish from the 2000s to the mid-2010s, followed by a decrease (Figure 4.3.6). The recent decrease reflects a larger income of small fish (recruitment) as in 2014-2018 the stock biomass increased and the fishing mortality was low. Since 2020, a slightly increased is observed.

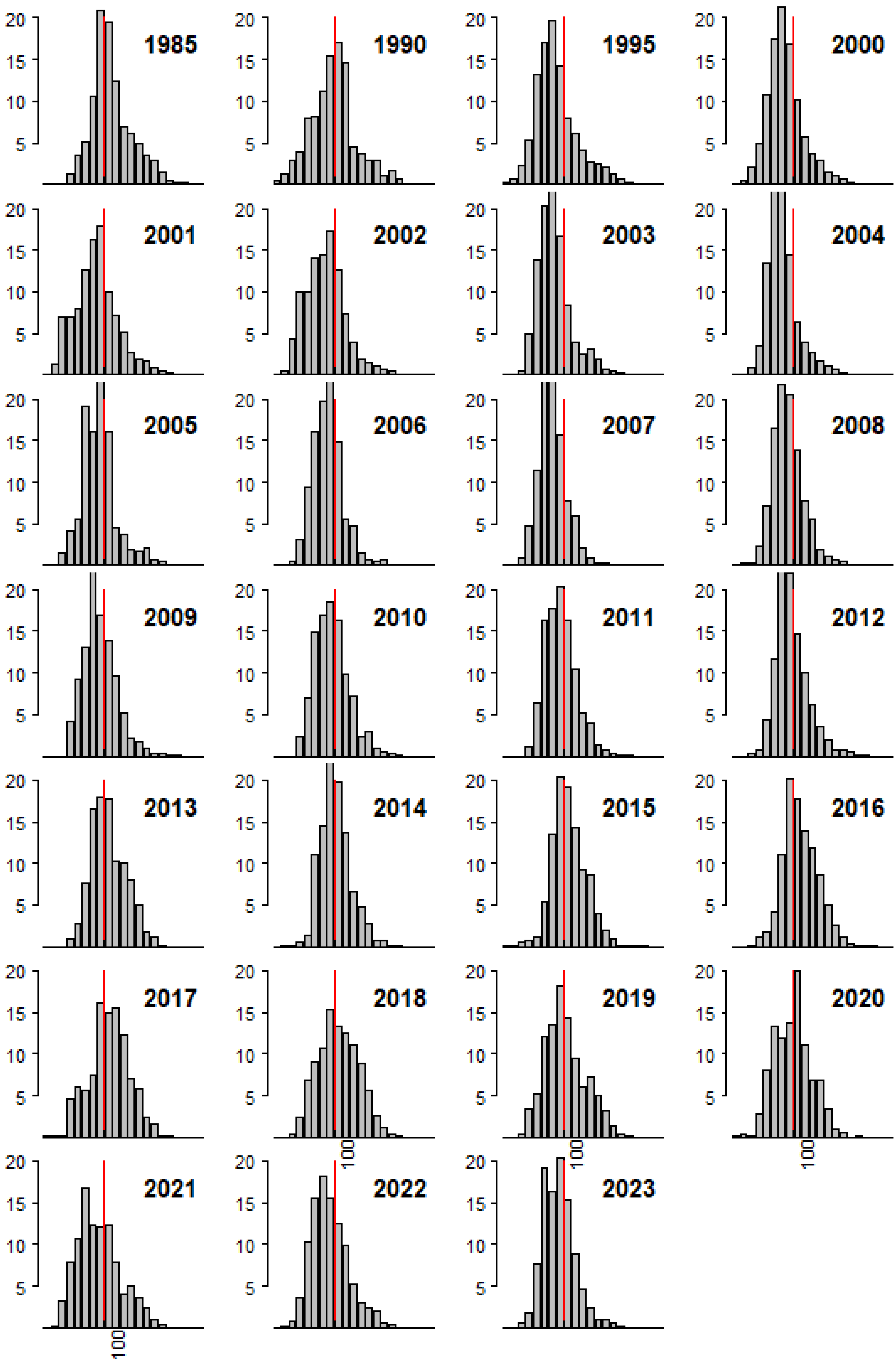
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Figure 4.3.6. Length distribution of landings from 1984 to 2023 by 5 cm intervals. The red line represents the 100 cm size class. Length distribution based upon French landings only in 1985-2011, combining French and Faroese length distribution in 2012-2023. Before 2000, only data for every 5th year are shown.

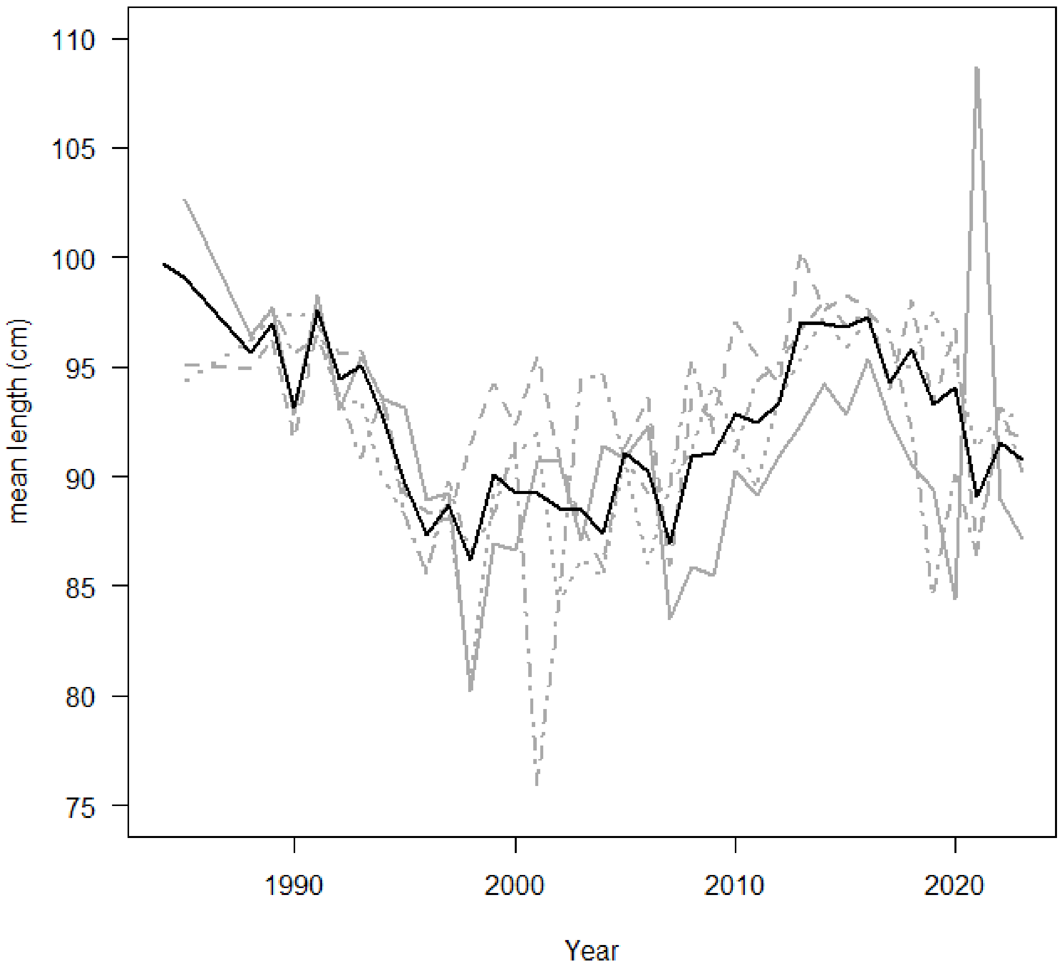

Figure 4.3.7. Quarterly mean length estimated 1984–2023 (no data in 1986-87, some years based upon French data only).

4.3.6.3 Abundance and biomass indices

For the last decade, the previously used indicators of abundance and occurrence of blue ling smaller than 80 cm also reflect this abundance of juveniles in Faroese surveys. Indeed, juveniles are caught regularly in both surveys, in particularly during the summer survey, but in variable abundance, with smaller number in the last three years (Figure 4.3.8).

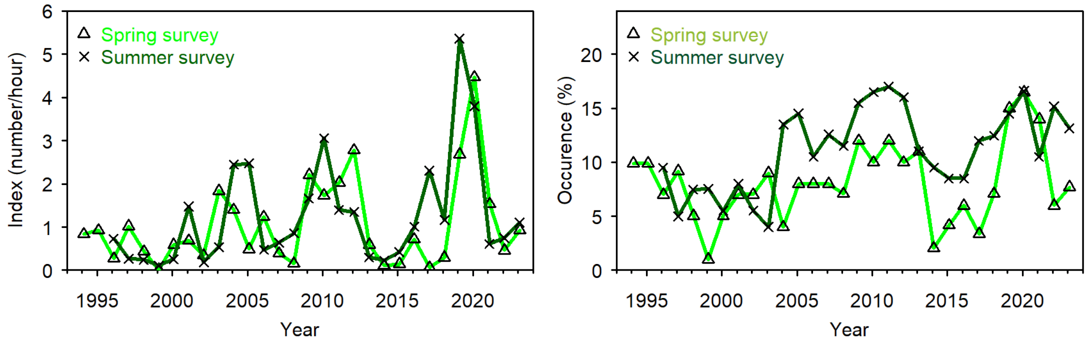

Figure 4.3.8. Index (number/hour) of juvenile (<80 cm) blue ling caught in groundfish surveys on the Faroe Plateau from 1994 to 2023 (left figure) and occurrence (in percentage; right figure).

For the summer survey, the indices of total biomass from Faroese are uncertain with high values in 1996, 2004, 2005 and since 2009 (Figure 4.3.9).For the last decade, the spring summer shows a sharp increase after a low level in 2017 (Figure 4.3.9). However, in 2022 another decreased is observed. Over the last decades, the indices from the two surveys did not track each other. Spring survey's information seem uncertain whereas summer survey's information are more informatives. The depth range (mostly <500 m) of these surveys do not extend down to the core depth distribution of blue ling. The indices include all hauls and are calculated using a design-based stratification.

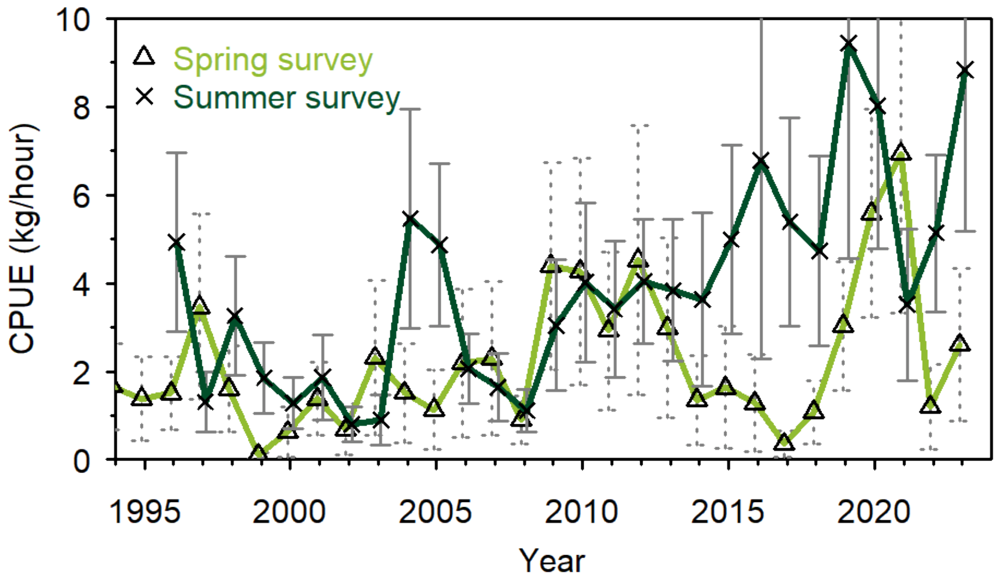

Figure 4.3.9. Biomass indices (kg.hour^{-1}) of blue ling in Faroese surveys from 1994 to 2023.

Indices from the Marine Scotland trawl deepwater survey carried out on the fisheries research survey SCOTIA are uncertain (Figure 4.3.10, Table 4.3.3) probably owing to the small number of hauls per year and the aggregating distribution of blue ling. The indices are averaged numbers and weights caught per haul carried out in the depth range 400 to 1600 m (n = 414 hauls for the whole time-series), which is the core range of the species along the Scottish slope. Only hauls from the Scottish slope are included, excluding data from Rockall and seamounts. The survey was performed biennially since 2013 and annually before (with no surveys in 1999, 2001, 2003 and 2010). The 2021 and 2023 surveys were carried out in October/November instead of mostly September in previous years, but the availability of blue ling is not known to change at this late summer/autumn season.

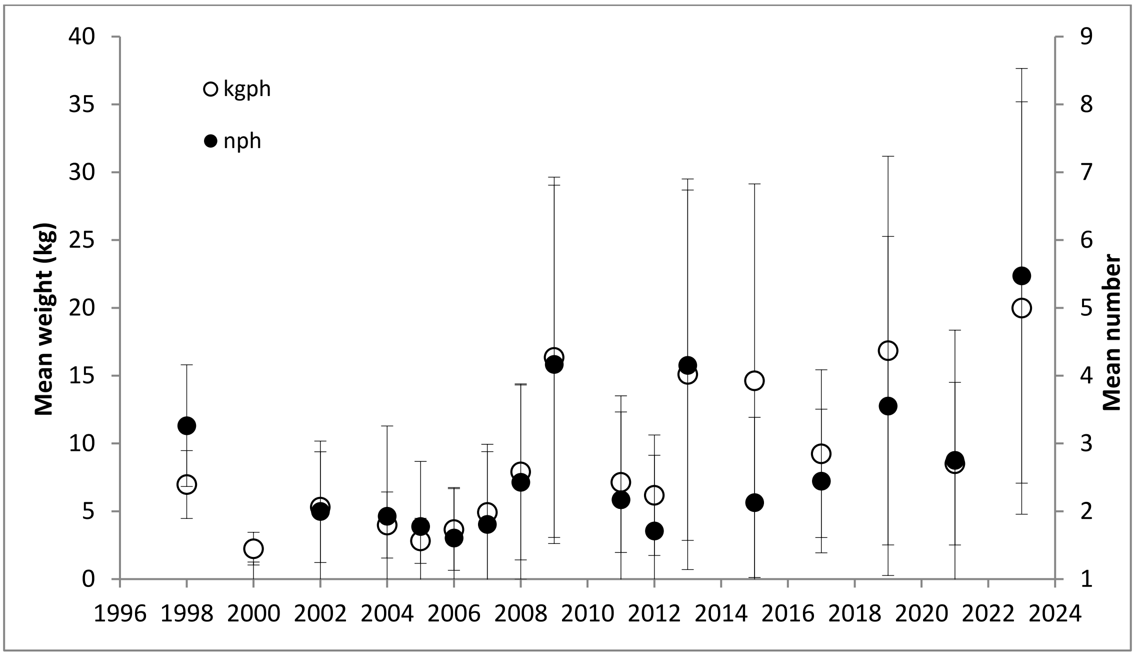

Figure 4. 3.10. Biomass and abundance indices of blue ling from the Marine Scotland deep-water survey.

4.3.6.4 Cpue series based on the Norwegian longline fleet

Figure 4.3.11 shows the Norwegian CPUE series from 2000 to 2023. In Division 5.b and subareas 6 and 7 the CPUE was stable until 2020. An increase is observed in 2021 and then the CPUE decrease but a level higher than 2020.

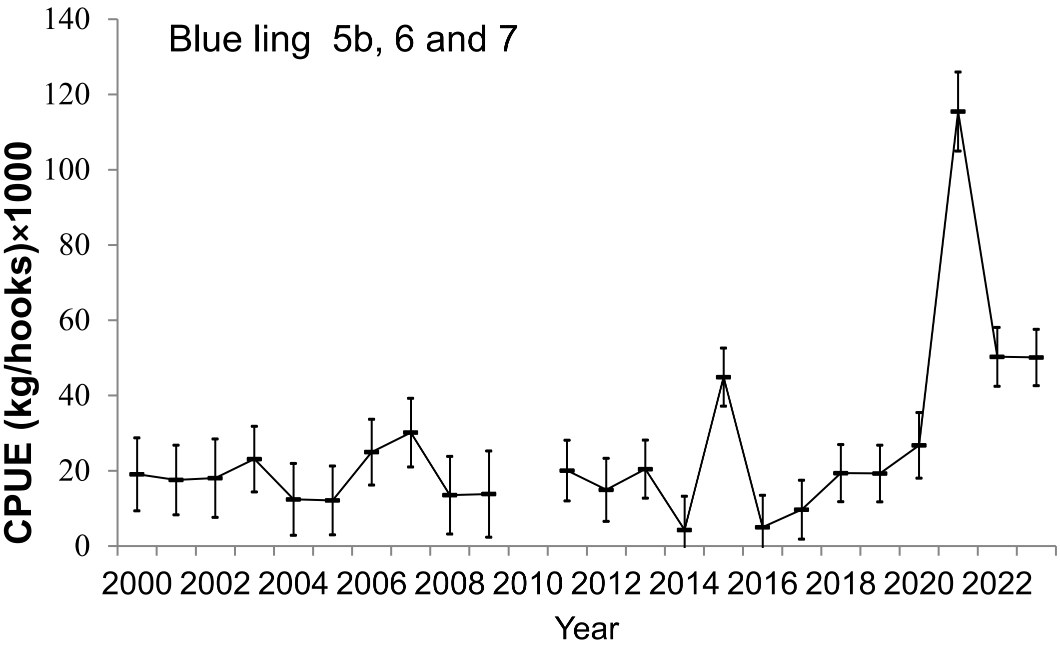

Figure 4.3.11. Blue ling in Division 5.b and subareas 6 and 7. Cpue series for blue ling for the period 2000-2023 based on data when blue ling was targeted. The bars denote the 95% confidence intervals.

4.3.7 Stock assessment

The assessment was carried with the benchmarked method using the Multi-Year Catch Curve (MYCC) model (Trenkel et al., 2012), see also the stock annex. Two distinct assessments were done including or not landings from Subarea 12, in order to allow to appraise the effect of the addition of these landings, following the change in the stock definition, on the assessment. Other data used, quarterly length distributions and individual length-at-age were the same in the two assessment.,The assessment described below is the assessment including Subarea 12, denoted "catch 5b6712". Differences with the assessment without this Subarea, denoted "catch 5b67", are described afterwards.

Following exploratory run which produced unexpected results, length-at-age appeared to be problematic. In four last years, larger length-at-age than previously were estimated. It was concluded that recent age readings were poorly reliable because of change in the reading scheme. Length at age estimated for years 2020-2023 were considered inconsistent with the known slow growth of blue ling. Clearly the large number of individuals of 80 to 100 cm estimated to be 5 to 7 years of in 2020-2023 is not realistic for the species as being a deviation from the previous understanding of the species growth described in the stock annex "*there is a general agreement that blue ling recruits to this stock at a size of 70–80 cm have an age of 6–8 years*". As a consequence, age-length data from 2020-2023 was considered unsuitable (Figure 4.3.12). In order to carry out the assessment, age-length data from years 2009-2013 were applied over the whole time-series. For years 2009 to 2013, age and length data estimated for every year were used. As the model estimated proportion at age with variance, for each the following 10 years, 2014-2023, a sample of individuals from years 2009-2013 was drawn and used instead of the original age-length data for that year. The number of individuals drawn was the mean number of individuals with age readings in 2014-2023.

The application of age-length data from some years to other years implies that the proportion of ages in a given length class is not properly estimated. This effect is expected to be less problematic in blue ling where the assessment relies on age classes 9-19+, and, more importantly is less problematic than applying age-length data with a strong trend in mean length-at-age.

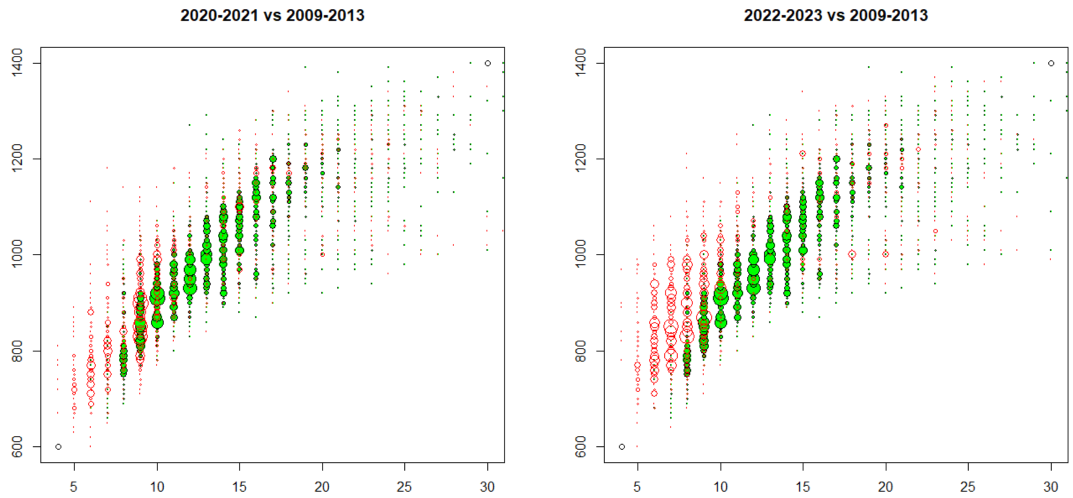

Figure 4.3.12. Blue ling in Division 5.b and subareas 6, 7 and 12. Length-at-age estimated for individuals samples in 2009-2013 (green bubbles) compared to individuals sampled in 2020-2021 (left) and 2022-2023 (right).

The fit of the model to the landings, considered equivalent to total catch as discards are negligible was good for recent years. The model shows erratic variation for years 1995-2003 where the quality of catch data was probably poorer and age data to fit the model start only in 2009 and do not inform much on early years (Figure 5.3.13a). The fit to proportion-at-age is generally correct, age 9 in the last years was not well fitted, but there is only one data points to fit this value (Figure 5.3.3b). Age 9 in the two early years were also not well fitted which come from a low proportion of this age groups in these years, while larger numbers of the same cohorts were caught in subsequent years. Importantly, the plot does not show a cohort effect.

The recruitment (estimated at age 9, the first fully recruited age group), is estimated to be increasing in recent years after low levels in 2014-2017. This is to compare to mean length in the catch, which was higher in 2013-2016 (Figure 5.3.7), the recent decrease in size is therefore due to more incoming young fish. Note that mean length in the catch include all catch (including age 6-7 not fully recruited) whilst recruitment in the model is age 9. The geometric mean of the estimated recruitment over years 1995-2023 is about 3 millions individuals and is used as the value for the 2024 recruitment. Overall, the variation of recruitment over time is moderate. Much larger recruitment variations are observed in the stock in 5a and 14 (bli.27.5a14) where blue ling smaller than 40 cm are caught in survey in variable number with a range of years with almost no recruitment in the 2010s (Figure 4.2.10). The difference may be due to different population dynamics, where the stock in 5a and 14 would be more variable (the period of low recruitment was followed by one of low biomass) or the effect of density-dependence where at age 9 small and large cohort are no longer much different.

The fishing mortality was high until the early 2000s and decline afterward (Figure 4.3.15, Table 4.3.1). The fishing mortality included in table 4.3.1 is the total mortality from the MYCC minus the fixed natural mortality of 0.11. The declining of the fishing mortality from 2003 is considered to be the effect of The TAC introduced in 2003. In previous years, there was no effective management measure for the stock. From 2003 to 2010, the TAC was decreased, restricted catches and drove the fishing mortality to lower levels. In recent years, the TAC was no longer restrictive but other management measures, including the ban of trawling below 800 m, closed areas and restrictions to fishing on spawning aggregations, constrained the fishing activity. The average fishing mortality over the 10 last years is estimated to 0.054, well below the F_{MSY} reference point (0.12). The fishing mortality is however increasing in recent year, mainly from increasing landings of longliner fleets.

The model output is numbers at ages 9 to 19+, the spawning stock biomass, is calculated by multiplying these number by mean weight at age. Table 4.3.1 present the total number (ages 9 to 19+). The biomass has increased since 2003, where it was at the lowest level over the assessment period (1995-2023). In the two last year it was close to 100 000 tonnes. The 2003 biomass level can be considered as the historic lowest level, considering that the catch had decreased since the 1970s, over a period where management measures did not actually constrained catches of blue ling.

Since 2016, there has been a trend in the retrospective pattern with new assessment estimating a lower SSB and a higher F than the previous. The 2024 assessment results in biomass similar to those estimated in 2022 and the fishing mortality being slightly below 2022 estimated values (Figure 4.3.16). Overall, since the 2014 benchmark, the estimated fishing mortality after 2009 has been estimated substantially below the F_{MSY} reference point for the stock.

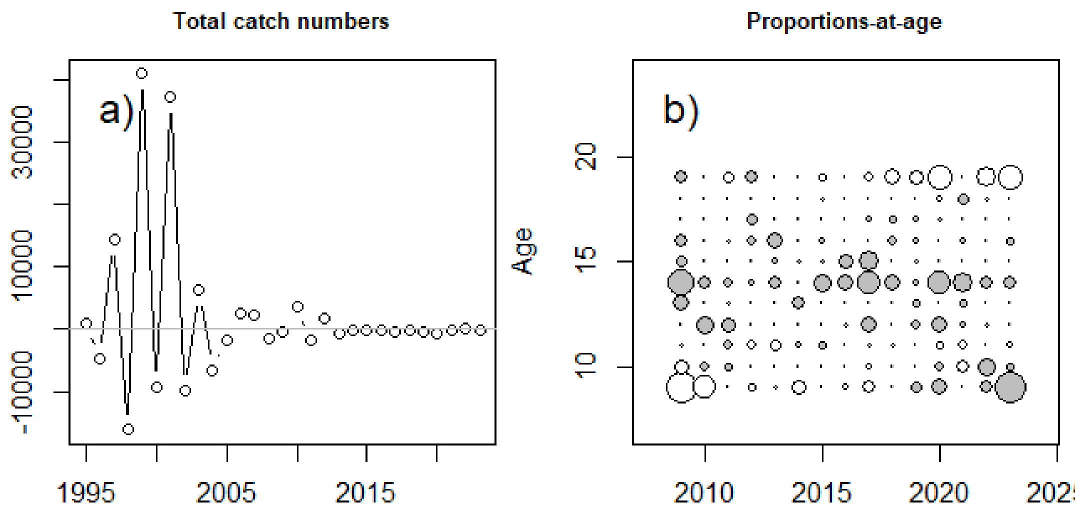

Figure 4.3.13. Diagnostic plot of the fit to the MYCC, a) residuals and b) proportion-at-age.

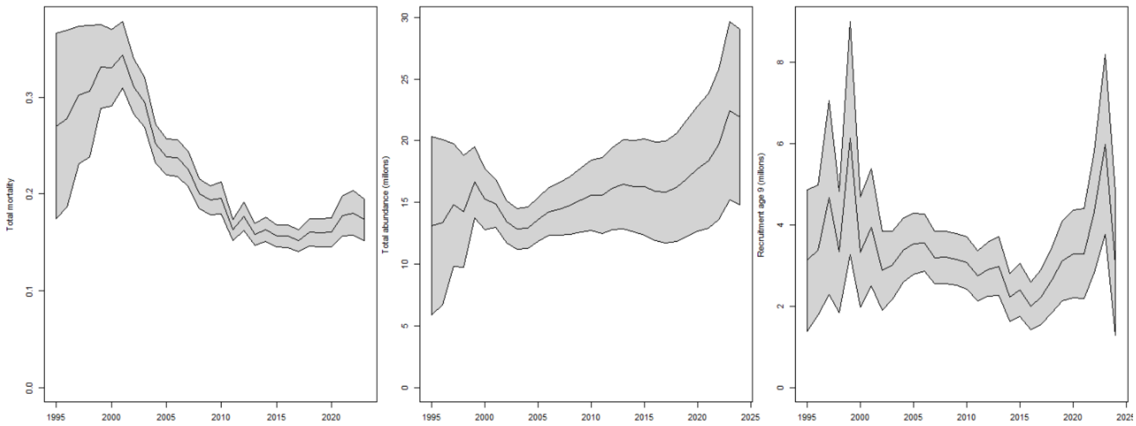

Figure 4.3.14. Model estimates 1995-2024, (left) total mortality Z, (centre) total abundance of fully recruited age groups (9 and older), (right) recruitment.

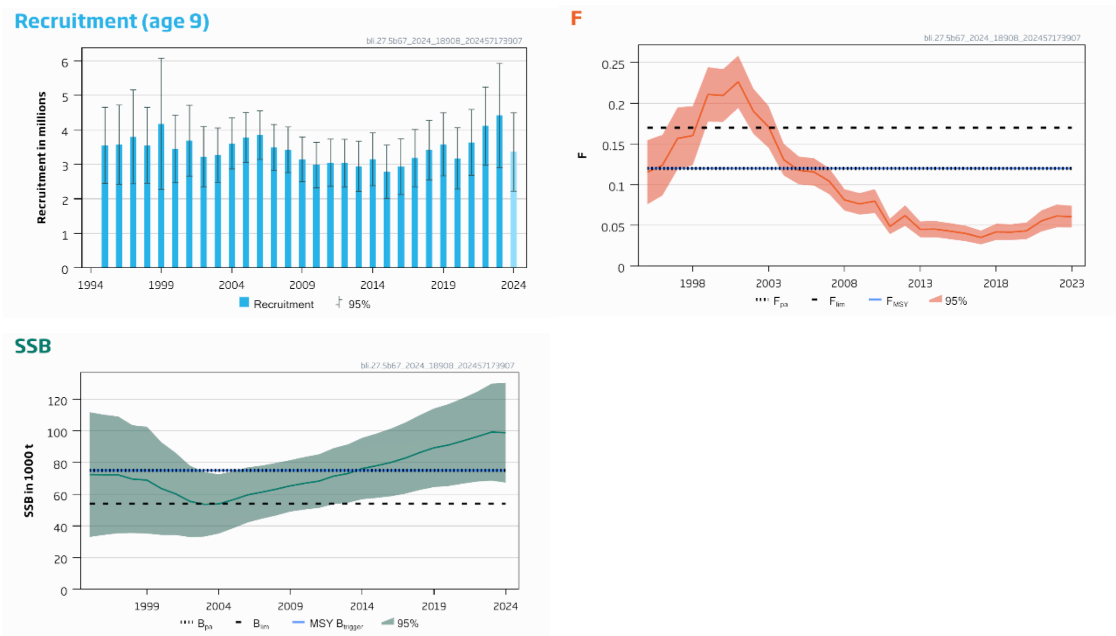

Figure 4.3.15. Model estimates of the recruitment, fishing mortality and spawning stock biomass. Weights in thousand tonnes and recruitment in millions (assessment catch 5b6712).

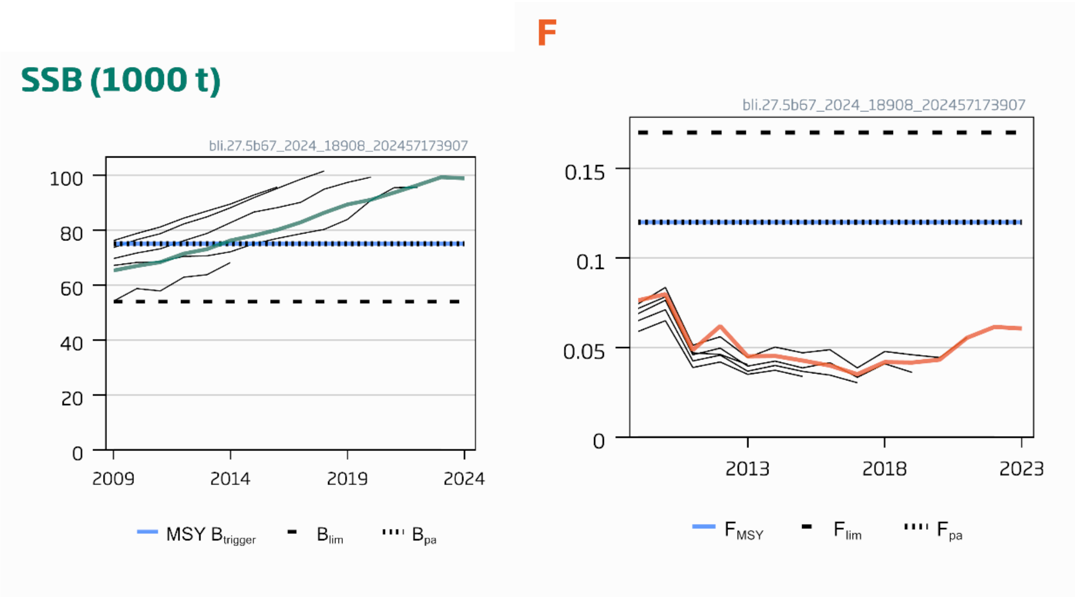

Figure 4.3.16. Retrospective plot of the SSB and fishing mortality (assessment catch 5b6712).

Table 4.3.1. Model estimates of the recruitment, fishing mortality and spawning stock biomass. Assessment including catches from Subarea 12 (catch 5b6712).

	F			Recruits (millions)			Total number (millions)			SSB (tonnes)		
Year	Lower	Estimate	Upper	Lower	Estimate	Upper	Lower	Estimate	Upper	Lower	Estimate	Upper
1995	0.076	0.115	0.155	2.443	3.549	3.925	12.140	17.797	23.454	33004	72441	111877
1996	0.087	0.124	0.161	2.424	3.571	4.097	12.806	17.779	22.752	34263	72276	110288
1997	0.119	0.157	0.195	2.434	3.795	5.165	13.860	17.866	21.872	35329	72237	109144
1998	0.124	0.160	0.197	2.450	3.552	3.913	13.679	17.233	20.787	35501	69556	103610
1999	0.177	0.211	0.244	2.272	4.173	7.934	14.880	17.325	19.770	35158	68926	102694
2000	0.177	0.210	0.242	2.466	3.445	3.376	13.815	16.014	18.213	34282	63618	92954
2001	0.194	0.227	0.259	2.659	3.686	3.785	13.408	15.319	17.230	34228	60237	86246
2002	0.162	0.190	0.218	2.347	3.218	2.800	12.314	14.159	16.004	32906	55491	78075
2003	0.145	0.171	0.197	2.478	3.267	2.576	11.887	13.754	15.621	33236	53619	74003
2004	0.111	0.131	0.150	2.863	3.604	2.672	12.079	13.988	15.897	35118	53863	72608
2005	0.100	0.117	0.135	3.052	3.777	2.738	12.799	14.772	16.745	38497	56507	74517
2006	0.099	0.116	0.132	3.141	3.845	2.707	13.524	15.612	17.700	42111	59542	76973
2007	0.088	0.104	0.120	2.819	3.486	2.327	13.684	15.946	18.208	44503	61315	78126
2008	0.068	0.081	0.095	2.759	3.421	2.266	13.818	16.292	18.766	46564	63209	79853
2009	0.063	0.076	0.090	2.493	3.143	2.044	13.901	16.598	19.295	49040	65315	81590
2010	0.065	0.080	0.095	2.319	2.977	1.957	13.828	16.753	19.678	50336	66960	83585
2011	0.039	0.049	0.058	2.360	3.043	2.079	13.728	16.900	20.072	51350	68334	85317
2012	0.049	0.062	0.075	2.336	3.030	2.105	14.036	17.450	20.864	53724	71434	89143
2013	0.035	0.045	0.055	2.215	2.943	2.140	13.980	17.635	21.290	54610	73077	91543
2014	0.035	0.045	0.055	2.379	3.145	2.408	14.356	18.246	22.136	56821	76247	95673
2015	0.033	0.043	0.053	2.006	2.781	2.156	14.286	18.402	22.518	57660	78031	98403
2016	0.030	0.040	0.050	2.125	2.930	2.359	14.393	18.725	23.057	58720	80119	101518
2017	0.027	0.035	0.044	2.352	3.180	2.633	14.774	19.296	23.818	60343	82844	105344
2018	0.032	0.042	0.052	2.550	3.410	2.932	15.438	20.099	24.760	62655	86318	109981
2019	0.032	0.042	0.051	2.663	3.577	3.269	16.119	20.843	25.567	64481	89346	114211

2020	0.033	0.043	0.054	2.281	3.171	2.823	16.229	21.080	25.931	65162	91057	116952
2021	0.042	0.055	0.069	2.680	3.634	3.466	16.821	21.719	26.617	66663	93672	120682
2022	0.047	0.062	0.076	2.982	4.112	4.648	17.593	22.519	27.445	67985	96391	124798
2023	0.047	0.061	0.074	2.903	4.416	6.683	18.448	23.385	28.322	68585	99235	129886
2024				2.221	3.356	3.808	18.145	23.072	27.999	67325	98870	130416

<u>Difference between the assessments "catch 5b6712" and "catch 5b67"</u>

Over the assessment period, catches from Subarea 12 represented an average 9% and 1% in the periods 1995-2013 and 2014-2023 respectively (Figure 4.3.1). Despite the low contribution of Subarea 12 to recent catches, the effect of these catch on the assessment was substantial. This is because higher catches at the start of the assessment period imply larger cohorts. Catches from Subarea 12 were not sampled, basically because there were landed in countries not sampling or caught by freezer trawlers. Previously Subarea 12was treated in the stock unit bli.27.nea (sea section 4.1 and 4.4 and was considered depleted. If this is right and if samples from Subarea 12 were available, the biomass depletion should be reflected by the disappearance over time of larger/older fish from this area, which the model would capture. Instead of that, the stock dynamics is modelled using sampling data from the previous stock area.
As a consequence, the assessment for catch 5b67 estimate a smaller biomass. The time series of SSB is similar to the 2022 assessment until 2019, and lower biomass are estimated for more recent years. The fishing mortality is similar to that estimated in2022.

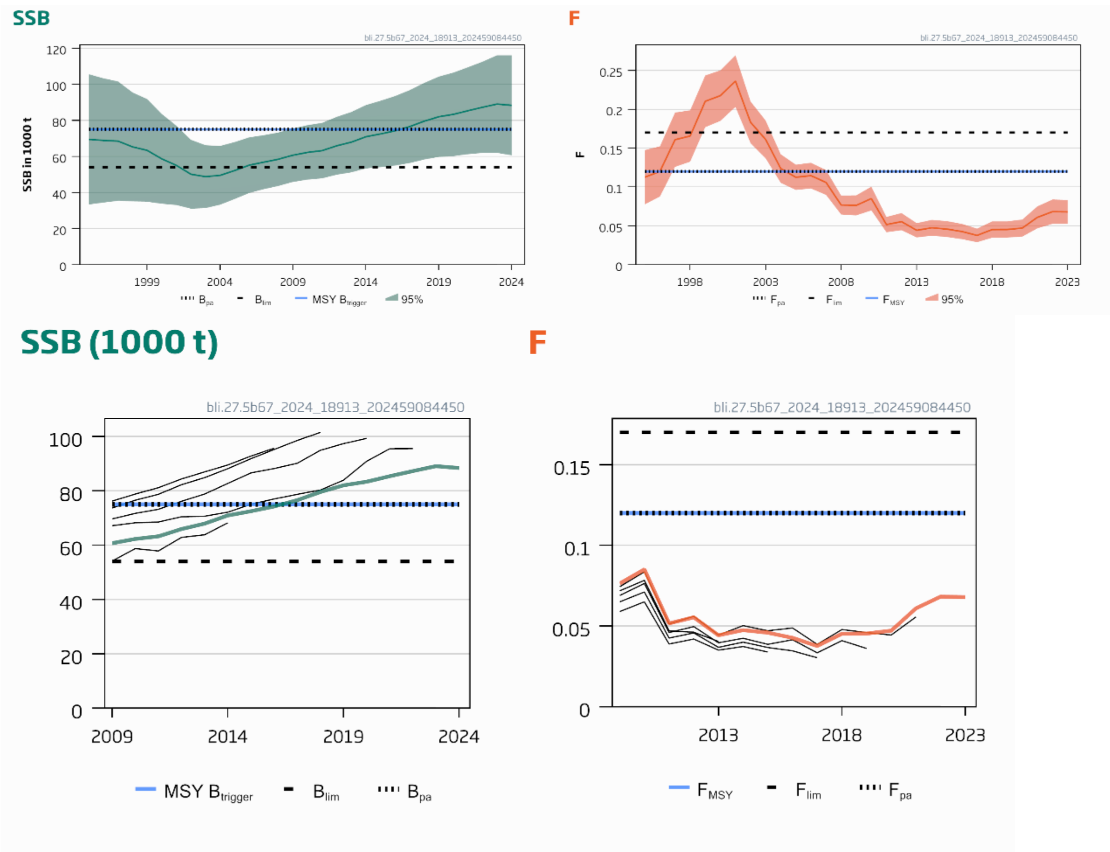

Figure 4.3.17. Spawning stock biomass, fishing mortality and rRetrospective plot of the SSB and fishing mortality for the assessment catch 5b67 (catch time-series used in previous years).

Confidence intervals and models fit are similar for the two assessments and not presented for catch 5b67. Overall the assessment including catch from Subarea 12 (catch 5b6712) estimates a larger stock with higher recruitment, stock number and SSB and similar same fishing mortality (mostly because the fishing mortality value is in both very low) as the assessment without Subarea 12 (catch 5b67) (Figure 4.3.18).

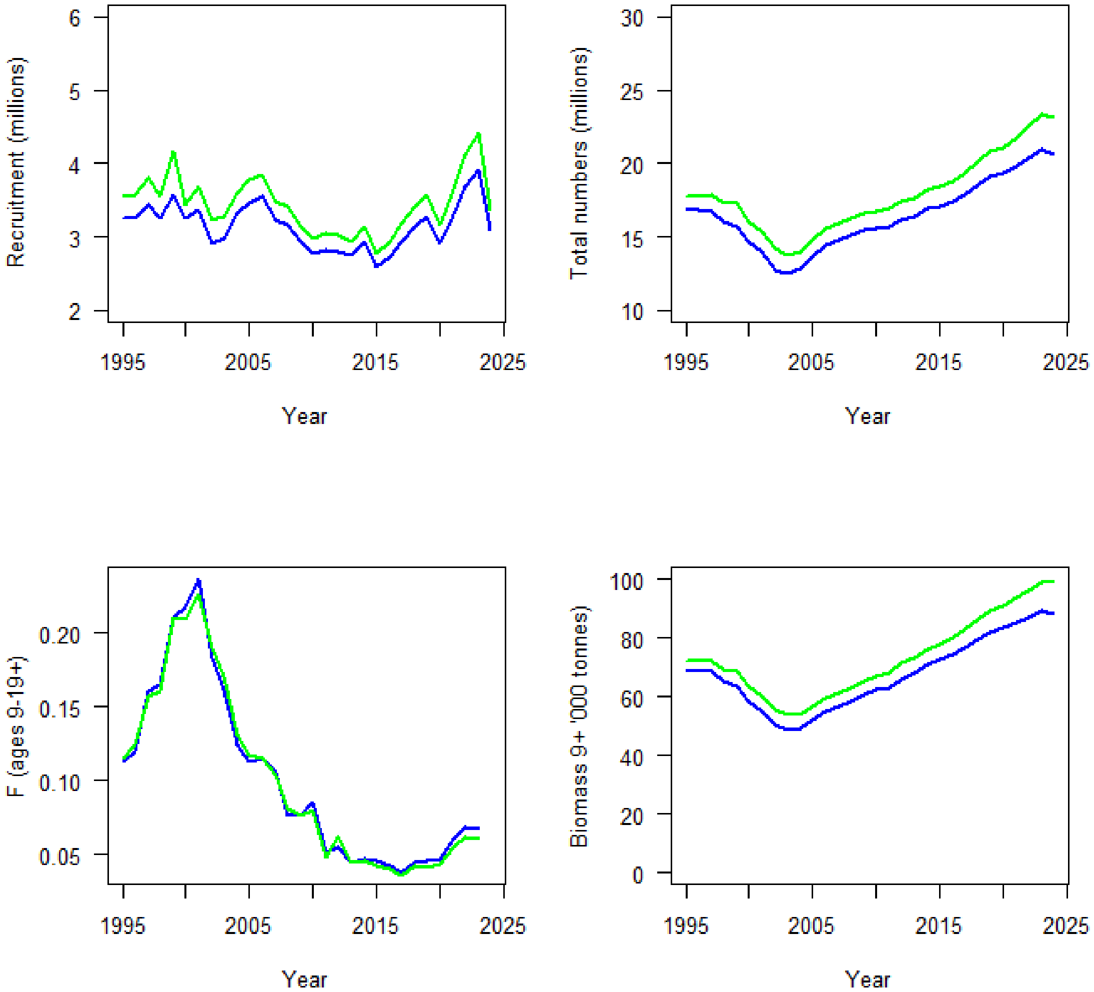

Figure 4.3.18. Comparison of assessment results including catches from Subarea 12 (catch 5b6712, green lines) and excluding these catches (catch 5b67, blue lines).

Table 4.3.2. Model estimates of the recruitment, fishing mortality and spawning stock biomass. Assessment excluding catches from Subarea 12 (catch 5b6712).

	F			Recruits (millions)			Total number (millions)			SSB (tonnes)		
Year	Lower	estimate	Upper	Lower	estimate	Upper	Lower	estimate	Upper	Lower	estimate	Upper
1995	0.078	0.113	0.148	-92.367	3.260	4.216	12.031	16.896	21.761	33348	69470	105591
1996	0.087	0.124	0.161	2.424	3.571	4.097	12.806	17.779	22.752	34462	68908	103354
1997	0.119	0.157	0.195	2.434	3.795	5.165	13.860	17.866	21.872	35411	68513	101614
1998	0.124	0.160	0.197	2.450	3.552	3.913	13.679	17.233	20.787	35144	65318	95492
1999	0.177	0.211	0.244	2.272	4.173	7.934	14.880	17.325	19.770	34923	63377	91830
2000	0.177	0.210	0.242	2.466	3.445	3.376	13.815	16.014	18.213	33788	58691	83594
2001	0.194	0.227	0.259	2.659	3.686	3.785	13.408	15.319	17.230	33057	55070	77083

		F			Recruits (millions)			Total number (millions)			SSB (tonnes)	
2002	0.162	0.190	0.218	2.347	3.218	2.800	12.314	14.159	16.004	31070	50171	69273
2003	0.145	0.171	0.197	2.478	3.267	2.576	11.887	13.754	15.621	31365	48814	66262
2004	0.111	0.131	0.150	2.863	3.604	2.672	12.079	13.988	15.897	33235	49533	65831
2005	0.100	0.117	0.135	3.052	3.777	2.738	12.799	14.772	16.745	36403	52198	67993
2006	0.099	0.116	0.132	3.141	3.845	2.707	13.524	15.612	17.700	39746	55181	70616
2007	0.088	0.104	0.120	2.819	3.486	2.327	13.684	15.946	18.208	41879	56845	71811
2008	0.068	0.081	0.095	2.759	3.421	2.266	13.818	16.292	18.766	43638	58476	73314
2009	0.063	0.076	0.090	2.493	3.143	2.044	13.901	16.598	19.295	45882	60708	75534
2010	0.065	0.080	0.095	2.319	2.977	1.957	13.828	16.753	19.678	47163	62271	77379
2011	0.039	0.049	0.058	2.360	3.043	2.079	13.728	16.900	20.072	47836	63234	78632
2012	0.049	0.062	0.075	2.336	3.030	2.105	14.036	17.450	20.864	49888	65921	81955
2013	0.035	0.045	0.055	2.215	2.943	2.140	13.980	17.635	21.290	51179	67918	84657
2014	0.035	0.045	0.055	2.379	3.145	2.408	14.356	18.246	22.136	53351	70925	88500
2015	0.033	0.043	0.053	2.006	2.781	2.156	14.286	18.402	22.518	54086	72478	90869
2016	0.030	0.040	0.050	2.125	2.930	2.359	14.393	18.725	23.057	54949	74223	93497
2017	0.027	0.035	0.044	2.352	3.180	2.633	14.774	19.296	23.818	56324	76548	96773
2018	0.032	0.042	0.052	2.550	3.410	2.932	15.438	20.099	24.760	58303	79537	100772
2019	0.032	0.042	0.051	2.663	3.577	3.269	16.119	20.843	25.567	59740	82012	104285
2020	0.033	0.043	0.054	2.281	3.171	2.823	16.229	21.080	25.931	60175	83328	106480
2021	0.042	0.055	0.069	2.680	3.634	3.466	16.821	21.719	26.617	61255	85362	109469
2022	0.047	0.062	0.076	2.982	4.112	4.648	17.593	22.519	27.445	61965	87254	112543
2023	0.047	0.061	0.074	2.903	4.416	6.683	18.448	23.385	28.322	62009	89063	116117
2024				2.221	3.356	3.808	18.145	23.072	27.999	60640	88365	116091

Reference points

Reference points the stock were defined 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 analysis (ICES 2016). This is because the only input available, at the time was the Stock reduction analysis (SRA) as the MYCC did 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. B_{lim} was set as B_{loss}, the lowest biomass estimate in the time-series (here the time-series of biomass from the SRA estimated in 2014).

Reference points for bli-5b67 estimated by WKMSYref4 (ICES, 2016).

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 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 mean of B_{MSY} could not be projected in a projection taking account of recruitment variability.

4.3.8 Issues on the assessment

The availability of length composition data was insufficient. In 2023, the number of length measurements reported in InterCatch from countries other than France was 22, although these countries represented 3188 tonnes landed and 61% of total landings. Length composition data from the Faroe Islands have been based upon variable numbers of annual measurements along the time-series (, but mostly more than 1000 fish measured since 2014), but only 208 and 108 fish were measured in 2022 and 2023 respectively (Figure 4.3.2). As a consequence the estimated length composition of the landings is mostly derived from French data, which correspond to less than 30% of total landings in 2023. Further, the contribution of longline catch has increased over time to 32 % in 2023 and there is not length sampling of these catches.

4.3.9 Management considerations

International landings have been well below the ICES advice for several years. This is the consequence of several factors including:

- in Faroese waters, fleets have other resources available and do not target particularly blue ling,
- in EU waters the major fishing country has been France since the 1970s, the French fleets of large trawlers has reduced and the remaining vessels fish primarily for saithe and hake,
- historically most of the landings were caught in quarter 2 during the spawning season, the fishing for spawning blue ling has been restricted from 2009 in particular in Division 6.a from the EU (COUNCIL REGULATION (EC) No 43/2009 of 16 January 2009) and since 2021 a similar has been enforced by UK, the ban of trawling deeper than 800 m for EU fleets since 2016, reduced the access to the stock which depth distribution extends deeper., this regulation was transcripted to the UK regulation and therefore continues to apply.

4.3.10 Tables

Table 4.3.1a. Landings of blue ling in Subdivision 5.b.1 (see stock annex for years before 2000). UK: United Kingdom; E & W: England and Wales; Scot.: Scotland.

YEAR	FAROES	FRANCE(1)	GERMANY(1)	NORWAY	UK (E & W) (1)	UK (Scot.)	IRELAND	RUSSIA(1)	SPAIN	TOTAL
2000	1677	575	1	163	33			1		2450

YEAR	FAROES	FRANCE(1)	GERMANY(1)	NORWAY	UK (E & W) (1)	UK (Scot.)	IRELAND	RUSSIA(1)	SPAIN	TOTAL
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		74	1					1884
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	401		8			0	5		1213
2013	440	543		0			0	3		986
2014	730	606		29						1365
2015	621	142	0	140	0		0	0		903
2016	1100	302	0	74	0		0	0		1476
2017	766	267	0	21	0	3	0	0		1057
2018	818	220	0	150	0	0	0	0		1188
2019	573	385		29						987
2020	697	580	0	87		5	0			136é9
2021	651	477	0	212		10				1350
2022	635	502	0	251		59	0	NA		1447
2023	547	762		190		91			119	1673

(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	0	20
2017	88	9	0	0	97
2018	151	0	0	0	151
2019	64	56	0	0	120
2020	102	4	0	0	106
2021	196	88	0	0	284
2022	4	55	1	0	60
2023	27	228	22		277

Table 4.3.1c. Landings of blue ling in Division 6.a (see stock annex for years before 2000). E & W: England and Wales.

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	1185			86	6		47		1329
2013	2	1128			132	11		203		1476
2014		1109			18			278		1405
2015	0	920	0	0	127	83	8	371	0	1509
2016	0	776			37	124	0	273	0	1210
2017	0	777	0	0	29	44	0	641	0	1491
2018		1066			87	72		735		1970
2019		1235			67	92		718		2112
2020		985			28	244		710		1967
2021	1	1472	0	0	0	367	0	1797	0	3637
2022	0	1278	0	0	47	389	0	2082	0	3796
2023	1	697		0	67	297		2168		3230

Table 4.3.1d. Landings of blue ling in Division 6.b (see stock annex for years before 2000). E & W: England and Wales.

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				5		3						211	219
2013				9				0				34	43
2014								3				1	4
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

YEAR	POLAND	RUSSIA	FAROES	FRANCE	GERMANY	NORWAY	E & W	SCOTLAND	ICELAND	IRELAND	ESTONIA	SPAIN	TOTAL
2019						3		1				5	9
2020	0		0	0	0	0	2	0	0	6	0		8
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
2022	0		0	0	0	0	0	0	0	0	0	0	0
2023	0		0			0					0	0	0

[(1)] **Includes unallocated catch.**

Table 4.3.1e. Landings of blue ling in Subarea 7 (see stock annex for years before 2000). E & W: England and Wales.

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	18	0	21	5	0	0	0	44
2013	35	0	0	0	0	0	0	35
2014	26				3	2		31
2015	11	0	63	0	3	1	0	78
2016	8	0	0	0	0	1	1	10
2017	'	1	0	0	1	0	0	6
2018	4	0	0	0	0	0	0	4
2019	4	0	35	0	0	0	0	39
2020	4	0	0	0	24	0	0	28
2021	6	0		0	8		0	14
2022	0	0	0	4	0	0	0	0
2023	1	0	6	0	0	0	0	7

Table 4.3.1.f. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea 12.

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	unallocated	Total
1988		263											263

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	unallocated	Total
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
2015				12									12
2016				29									29

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	unallocated	Total
2017				28									28
2018				24									24
2019				10									10
2020				13									13
2021							5						5
2022				0									0
2023				0									0

Table 4.3.1g. Total landings by country. UK: United Kingdom; E & W: England and Wales; Scot.: Scotland.

Year	Estonia	Faroes	France(1)	Germany(1)	Iceland	Ireland	Lithuania(2)	Norway(2)	Poland	Russia (1)	Spain	UK (E & W)	UK (Sco)	Unallocated	Total
2000	0	1766	5747	97	14	89	0	512	0	1	579	606	2343	0	**11754**
2001	85	1649	3627	13	2	819	16	680	0	0	1276	525	4110	0	**12802**
2002	0	1101	3140	4	0	579	28	638	0	3	1561	250	2767	0	**10071**
2003	5	2472	3687	1	0	30	66	344	16	2	1141	26	677	0	**8467**
2004	3	1475	3960	1	0	20	38	52	1	25	880	15	657	0	**7127**
2005	0	1655	3082	0	0	13	9	122	0	15	770	11	573	0	**6250**
2006	0	1939	3037	0	0	5	2	106	0	20	554	10	478	0	**6151**
2007	0	1881	3213	0	0	2	1	253	0	37	438	17	160	0	**6002**
2008	0	975	2501	0	0	0	2	110	0	122	580	2	212	0	**4504**

2009	0	978	2547	0	0	0	0	83	0	1	478	0	346	0	**4433**
2010	0	1539	2453	0	0	0	0	160	0	0	297	0	360	0	**4809**
2011	0	1167	1480	0	0	0	0	104	0	0	91	0	74	0	**2916**
2012	0	1015	1609	0	0	0	0	102	0	5	443	0	47	427	**3648**
2013	0	575	1715	0	0	0	0	132	0	3	223	0	205	76	**2929**
2014	0	880	1741	0	0	0	0	53	0	0	81	3	285	0	**3043**
2015	0	703	1119	0	0	0	0	366	0	0	189	11	372	0	**2760**
2016	0	1113	1086	0	0	1	0	111	0	0	171	0	281	0	**2763**
2017	0	854	1048	1	0	0	0	60	0	0	93	1	644	0	**2701**
2018	0	969	1290	0	0	0	0	237	0	0	102	0	736	0	**3334**
2019	0	638	1624	0	0	0	0	155	0	0	142	0	719	0	**3278**
2020	0	799	1569	0	0	0	0	121	0	0	287	0	715	0	**3491**
2021	0	848	1955	0	0	0	0	305	0	0	375	0	1807	0	**5290**
2022	0	639	1781	0	0	0	0	353	0	0	393	0	2142	0	**5308**
2023	0	575	1424	0	0	0	0	485	0	0	422	0	2281	0	**5187**

Table 4.3.1h. Blue ling landings in Division 5.b and subareas 6, 7 and 12 (see stock annex for years before 2000).

YEAR	5.b	6	7	12	TOTAL
2000	2524	8352	284	594	**11 754**
2001	2114	9178	835	675	**12 802**
2002	2024	6053	676	1318	**10 071**
2003	3815	3338	122	1192	**8 467**

YEAR	5.b	6	7	12	TOTAL
2004	2700	3459	63	905	**7 127**
2005	2575	2891	74	710	**6 250**
2006	2850	2733	67	501	**6 151**
2007	3296	2188	164	354	**6 002**
2008	2060	1846	34	564	**4 504**
2009	1461	2649	11	312	**4 433**
2010	2244	2478	37	50	**4 809**
2011	1469	1343	49	55	**2 916**
2012	1424	1548	44	632	**3 648**
2013	1121	1519	35	254	**2 929**
2014	1523	1409	31	80	**3 043**
2015	1128	1542	78	12	**2 760**
2016	1496	1228	10	29	**2 763**
2017	1154	1513	6	28	**2 701**
2018	1339	1967	4	24	**3 334**
2019	1108	2121	39	10	**3 278**
2020	1475	1975	28	13	**3 491**
2021	1634	3637	14	5	**5 290**
2022	1507	3796	5	0	**5 308**
2023	1950	3230	7	0	**5 187**

Table 4.3.2. Blue ling in subareas 6–7 and Division 5.b. Landings inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES as well as official landings. Weights are in tonnes (time-series revised in 2024 following the addition of Subarea 12).

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total landings	Proportion inside the NEAFC RA (%)
2014	81	2962	3043	2.7
2015	43	2717	2760	1.58
2016	47	2716	2763	1.71
2017	48	2653	2701	1.79

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total landings	Proportion inside the NEAFC RA (%)
2018	30	3304	3334	0.90
2019	15	3263	3278	0.45
2020	19	3472	3491	0.54
2021	5	5285	5290	0.09
2022	0	5308	5308	0
2023	0	5187	5187	0

Table 4.3.3. Abundance (nb.hour^{-1}) and biomass (kg.h^{-1}) indices from the Scottish deep-water survey in ICES Division 6.a. Lower in upper bounds of 95% confidence intervals of the mean are estimated assuming a normal distribution. *: no survey conducted this year.

Year	Number per hour			Weight per hour (kg)			Number of hauls
	Lower bound	Mean	Upper bound	Lower bound	Mean	Upper bound	
1998	2.366	3.263	4.160	4.47	6.97	9.48	19
1999*							
2000	0.462	0.857	1.252	1.04	2.25	3.45	35
2001*							
2002	0.964	2.000	3.036	1.22	5.31	9.39	27
2003*							
2004	0.599	1.929	3.258	1.55	3.99	6.43	28
2005	0.820	1.778	2.736	1.16	2.82	4.48	18
2006	0.864	1.607	2.350	0.65	3.66	6.67	28
2007	0.739	1.810	2.880	-0.08	4.93	9.94	21
2008	0.994	2.429	3.863	1.42	7.91	14.39	28
2009	1.524	4.167	6.809	3.07	16.35	29.64	24
2010*							
2011	0.641	2.172	3.703	1.96	7.14	12.32	20
2012	0.596	1.711	2.826	1.74	6.18	10.63	27
2013	1.571	4.154	6.738	0.70	15.10	29.51	23
2014*							
2015	0.875	2.130	3.386	0.12	14.63	29.14	24
2016*							

Year	Number per hour			Weight per hour (kg)			Number of hauls
	Lower bound	Mean	Upper bound	Lower bound	Mean	Upper bound	
2017	1388	2.447	3.506	3.06	9.25	15.43	29
2018*							
2019	1.053	3.554	6.054	2.52	16.85	31.18	18
2020*							
2021	0.834	2.753	4.671	2.52	8.51	14.51	17
2022*							
2023	2.415	5.473	8.530	4.79	19.99	35.19	28

4.3.11

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

4.4.1 The fishery

This chapter was earlier concerned with bli.27.nea stock with inclusion of subareas 12, 8 and 9. In 2024, the refining of the stock area has been done and these subareas are now not in this assessment anymore (see section 4.7 "Comments on assessment" for further information).

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

In divisions 2a and 4a there is a bycatch from the longline, trawl and gillnet fisheries on ling, tusk, saithe and Greenland halibut.

In other ICES subareas blue ling is taken in minor quantities.

4.4.2 Landing trends

Landings data are presented in Tables 4.4.0a–e. There are also historical landings from the Norwegian fishery, mainly from division 2.a, back from 1896 (Figure 4.4.1). Landings are now reported from ICES subareas and divisions 1, 2.a, 3.a and 4. In 2023, 99% of the landings came from subareas 2 and 4 and this was mainly Norwegian landings. In 2019 and from Subarea 1, Iceland has landed 45% of total landings from the whole stock area but there are some uncertainties about this number. Since 2020, Iceland had no landings from this area.

During the whole time-series, around 95% or more of the total landings were taken in subareas 2 and 4 combined.

For all areas, a continuous decline on landings have been observed after the higher landing levels in the 1988–1993 period and total landings are now 35% of that level. However, the total landings have increased since 2016 which was the lowest level recorded since 1988. As a result of the Icelandic landings from Subarea 1, the total landings from 2018-2019 more than doubled (348-862 tons).

4.4.3 ICES Advice

The ICES advice for 2024 to 2027 is:

"*ICES advise that when precautionary approach is applied, there should be zero catches in each of the years 2024 to 2027. Closed areas to protect spawning should be maintained*."

4.4.4 Management

For 2023-2024, in United Kingdom and international waters of subareas 2 and United Kingdom and Union waters of 4, a precautionary TAC for EU vessels was set to 20 tonnes and United Kingdom vessels to 7 tonnes. In European Union waters of ICES Division 3a, a precautionary TAC for EU vessels was set to 4 tonnes. There is no TAC for Norwegian waters. However, there is no directed fishery, and the allowed bycatch is set to 10%.

A precautionary TAC for EU and UK vessels in international waters of ICES Subarea 12 was set to 77 tonnes and only applicable to bycatches; no directed fishery for blue ling was allowed in this area. The TAC is divided between EU and UK as 76 and 1 tons respectively. TACs for vessels in EU waters, United Kingdom and international waters of ICES Division 5b, and subareas 6 and

7 were set to 10952 tons; of this a quota for UK vessels was set to 2611 tonnes and EU vessels to 8341.

4.4.5 Data availability

4.4.5.1 Landings and discards

Landings and discards data are presented in Table 4.4.0a–e and 4.4.1 respectively. The discards data from Scotland were revised in 2021 and the Scottish discards were updated in the table for 2015-2020 (Table 4.4.1).

4.4.5.2 Length compositions

Length compositions from the Norwegian fishery from 2002-2023 are available (Figure 4.4.2). Length compositions from the Spanish fishery from 2017 in Stock Annex.

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 ubareas 1, 2 and 4 and ICES Division 3a combined (Figure 4.4.3). The CPUE series was calculated for the time period 2000–2023 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 (Figures 4.4.4-4.4.5) and discard data. 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 since the fishery is exclusively done on larger individuals.

The overall landings have declined for all areas and the mean landings are now only 35% 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 2019 Iceland landed 389 tons (45% of total landings for the whole stock area) which were assigned to Subarea 1. For 2020-23 and for Subarea 1, there were no Icelandic landings and the total landings are back on recent, low levels.

The historical Norwegian landings, mainly in Division 2a 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 since then and for 2023, landings were 569 tons. Norway landed 416 tons of the total and 71% came from gillnets, 18% from longlines and 14% from bottom trawls.

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.

The landings in Subarea 4 increased with 100% from 2021-2022 (127-262 tons). This came from increased Norwegian landings from this area. For 2023 the landings were at same level as the year before. French and Faroese landings for 2023 is 2 and 18 tons respectively; Norwegian landings was 190 tons.

The landings from Subarea 4 are now back on the level from early 2000. The landings have fluctuated between 376 and 43 tonnes since early 2000. An analyse of the French 2023 landing data by gear type revealed that 14% of the blue ling was taken with bottom trawl and 86% with longlines. 29% of the Norwegian landings were taken with bottom trawl; 63% with longlines and 8% with gillnets.

Denmark and Scotland report discards from Division 4a. A revision of the Scottish discard data for 2015-2020 was done. The revised values for Scottish discards increased, especially in 2019. Total discards are now less than 2 tons.

The Norwegian length compositions from the longline, gill net and trawl fishery from 2002-2023 show some years inclusions of smaller fish. It is also possible to follow a dominant group of ages from year to year in some periods (from 2009-2014 and 2015-2021).

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

The Norwegian CPUE series shows a low level and varies without any trend for the years 2000–2023. However, there might be an increase in the two last years.

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

The earlier assessment for bli.27.nea has been carried out on a wide stock area spanning from eastern areas 1-4 to western Subarea 12 and southern subareas 8 and 9. In 2023 there was written a working document (Hansen *et al*., 2023) that argued for refining this stock area. The basis for this was 1) the new documentation from genetic analyses that separated the eastern and western areas (McGill *et al*., 2023) and 2) earlier information showing that individuals from subareas 8 and 9 now can be ascribed to the spanish ling (*Molva macropthalma*).

The working document was reviewed by Stock Identification Methods Working Group (SIMWG) in 2024 and their conclusion was that splitting the area into one eastern and one western part would be reasonable and also that the southern areas should be excluded from the future stock areas. The McGill *et al.* 2023 had no samples from Subarea 12. Therefor there could not conclude precisely to split this subarea in two. Since the catches from Subarea 12 have ceased, we recommend that the whole Subarea 12 would be pasted to bli.27.5b67 (see also the detailed new stock description in section 4.1 “Stock description and management units”.

The new proposed stock areas for blue ling would then be: bli.123a4, bli.5b6712 and the existing area 5a14. Since there are no catches from Subarea 12 anymore, the same data would be used for assessing the new stock bli.1-4 as used when assessing the previous and current advice.

This proposition was presented and discussed at the WGDEEP meeting 2024 and the meeting concluded that the splitting of eastern and western areas, excluding the subareas 8 and 9 and inclusion of Subarea 12 to 5b67 would be the way forward.

Assessment is based on catch trends. Landings have declined since the 90's (Figure 4.4.7 and 4.4.8) and are thought to represent stock status. However, there was some concern about the 2020 year increase in Norwegian landings in Subarea 4. In this subarea, blue ling is bycatch in ling and tusk fishery and these bycatch landings may come from a shift to larger proportion of gill nett landings in the fishery for ling. The landings from 2021 were again low but could be a result of reduced access to fishing areas due to Brexit and no Norwegian quota in UK waters of Subarea 4. This explanation strengthens as landings for 2022 and 2023 again increased as the quotas were accepted between UK and Norway.

4.4.8 Management considerations

Trends in landings suggest serious depletion in Subarea 2 and perhaps also for the other subareas. However, landings have increased recently in subareas 2 and 4. Landings in other subareas and divisions are minor but there is some evidence of a persistent decline.

The advice given in 2023 for bli.27.nea remains appropriate also for bli.27.123a4.

All bycatches of blue ling from subareas and divisions treated in this section are taken within EEZ.

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
2019	389					389
2020		1				1
2021		1		+		1
2022						0
2023*		+		1		1

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

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	Russia	Total
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
2016	22	7	0.059		57		1			87
2017	57	5			112		3			177
2018	112	4			124	0,105	0,69			241
2019	48	7			321					376
2020		2			237					239
2021	29	4			289		2			324
2022	78	5			286					369
2023*	152	1			416					569

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

Year	Denmark	Norway	Sweden	France	Total
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
2017		0.775			1
2018	0.286	0.97	0.085		1
2019	0.885	0.63	0.047		2
2020	0.775	0.948	0.070		2
2021	1.360	1.259	0.128		3
2022	2.725	2.252	0.1		5
2023*	1.206	1.778	0.164		3

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

Year	Denmark	Faroes	France	Germany	Norway	E & W	Scotland	Ireland	Swe-den	Neth-er-lands	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

Year	Denmark	Faroes	France	Germany	Norway	E & W	Scotland	Ireland	Swe-den	Neth-er-lands	Total
2016	+		6	+	74		6				87
2017	+		3		65	+	5				73
2018	3		3	+	50	+	3				60
2019	3		12		66	+	4				85
2020	7		21	+	138		10				176
2021	4		78	+	16	+	29		+	+	127
2022	4	22	32	+	203		1		+		262
2023*	1	2	19	+	191		4		+		216

Table 4.4.0e. 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). According to new stock area without subarea 12, new column added for landings without subarea 12.

Year	1	2	3	4	12	Total	Total without Subarea 12
1988	10	3537	22	363	263	4195	3932
1989	8	2058	23	457	70	2616	2546
1990	4	1412	21	495	552	2484	1932
1991	3	1479	21	620	1147	3270	2123
1992	5	1039	38	553	971	2606	1635
1993	1	1020	23	412	3336	4792	1456
1994	3	419	18	421	752	1613	861
1995	5	359	20	477	573	1434	861
1996	2	267	12	179	788	1248	460
1997	1	291	21	269	417	999	582
1998	1	278	6	280	438	1003	565
1999	1	291	6	264	1353	1915	562
2000	3	249	14	129	594	989	395
2001	1	208	24	252	675	1160	485
2002	1	149	9	376	1318	1853	535
2003	0	147	19	92	1192	1450	258

Year	1	2	3	4	12	Total	Total without Subarea 12
2004	1	174	19	83	905	1182	277
2005	1	197	49	66	710	1023	313
2006	0	202	42	94	501	839	338
2007	0	262	0	62	354	678	324
2008	0	333	2	74	564	973	409
2009	1	285	0	89	312	687	375
2010	1	422	0	155	50	628	578
2011	3	486	0	176	55	720	665
2012	1	338	0	166	632	1137	505
2013	0	202	1	43	254	500	246
2014	4	127	0	50	80	261	181
2015	0	113	0	83	12	208	196
2016	1	87	1	87	29	205	176
2017	0	177	1	73	28	279	251
2018	22	241	1	60	24	348	324
2019	389	376	2	85	10	862	852
2020	1	239	2	176	13	431	418
2021	1	295	3	127	5	431	426
2022	0	369	5	262	0	636	636
2023*	1	569	3	216	0	789	789

Table 4.4.1 Blue ling in subarea 27.123a4. Discards from 2015-2023. Discards are taken from InterCatch except for Scotland 2015-2020 which is estimated after a revision in 2021.

Year	Denmark	Scotland	Sweden	Total discards	Scotland old[1]
2015		0			
2016		0			
2017	0.808	2.403		3.211	0.117
2018	0.300	0.774		1.074	0.002
2019	0.750	14.110		14.860	0,023
2020	1.448	0		1.448	0

2021	0.051	2.887	0.487	3.425
2022	0.173	0.492		0.665
2023		1.6	0.206	1.806

[1] The old InterCatch values for discards from Scotland; revised in 2021. The new values are estimated from 2015-2020.

4.4.10 Figures

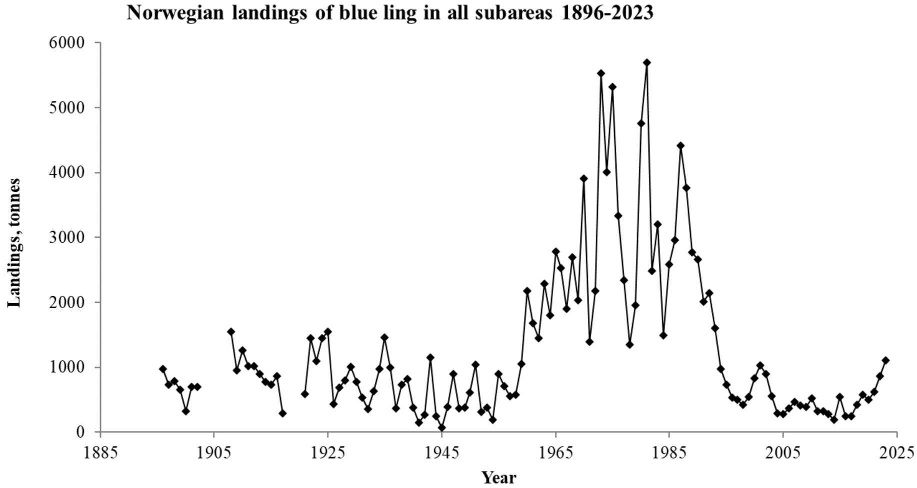

Figure 4.4.1. Reported Norwegian landings on blue ling from 1896–2023.

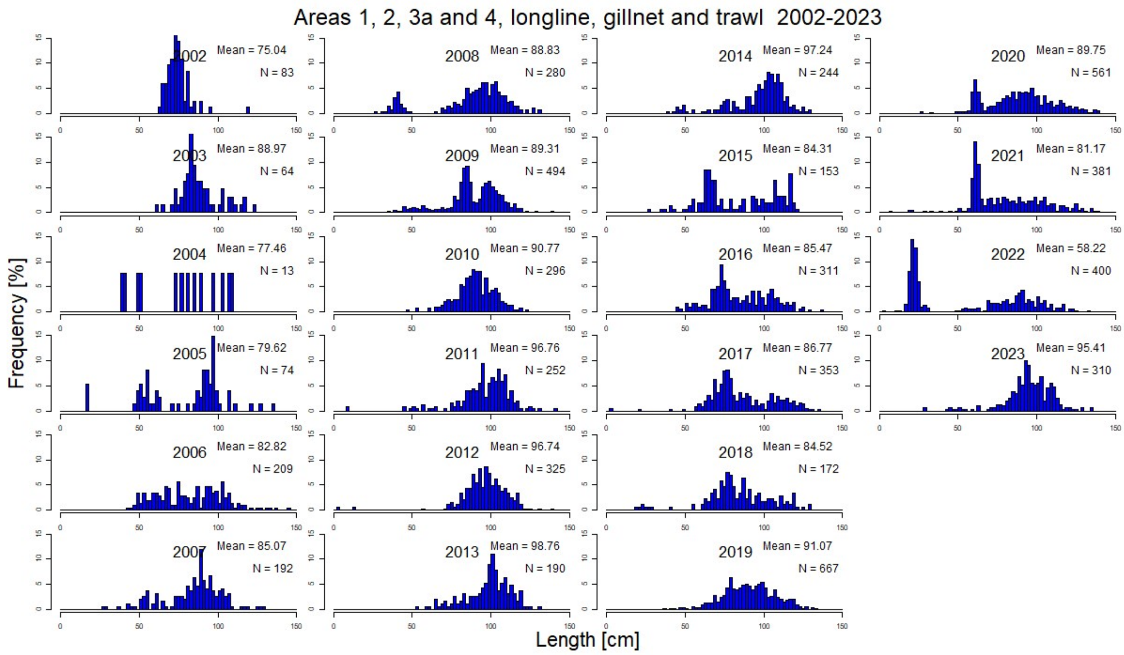

Figure 4.4.2. Length compositions from Norwegian fishery from 2002-2023.

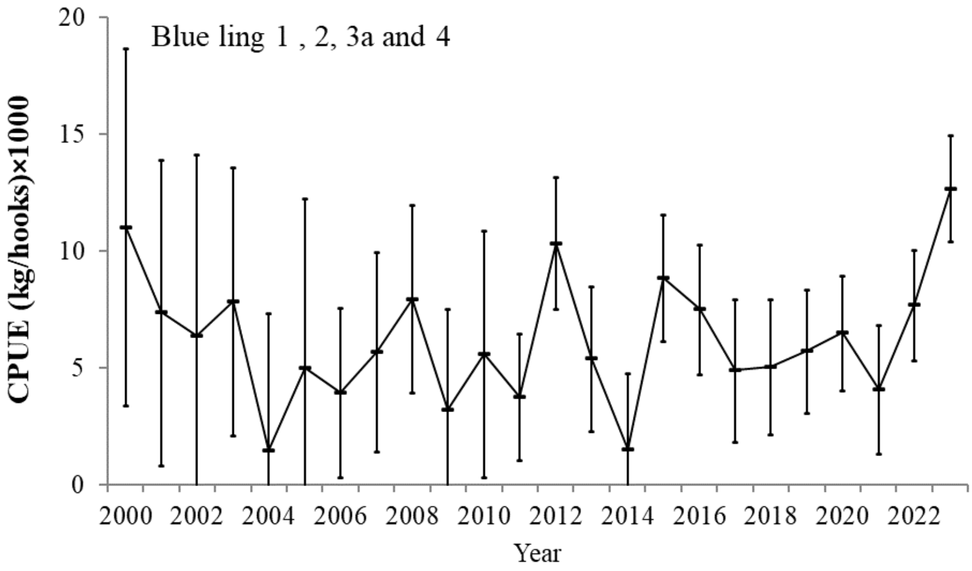

Figure 4.4.3. Norwegian cpue (kg/1000 hooks) from longlines catches in areas 1, 2, 3.a and 4 from 2000–2023.

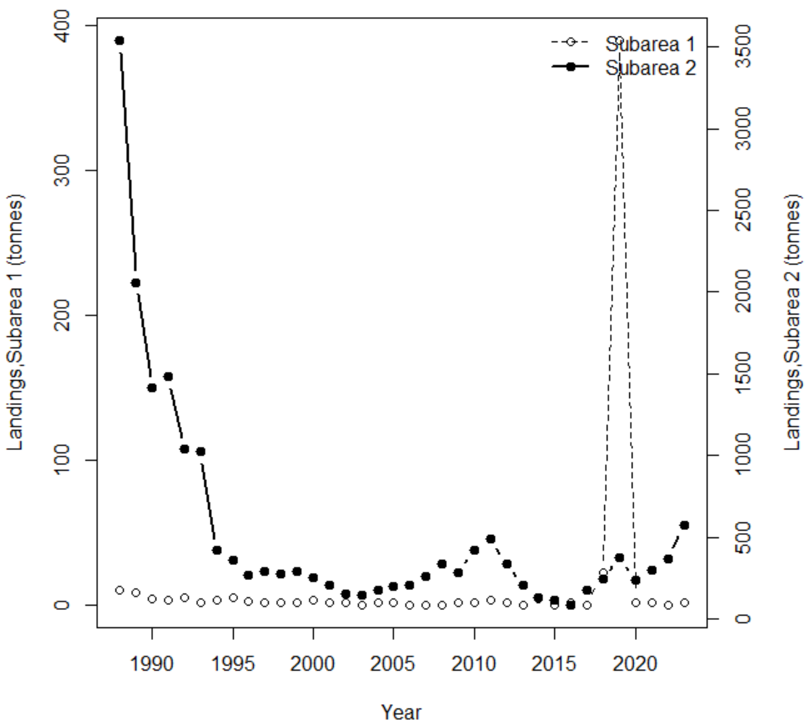

Figure 4.4.4. Landings of blue ling in subareas 1 and 2 from 1988-2023. Subarea 1: open circles, left axis. Subarea 2: filled circles, right axis.

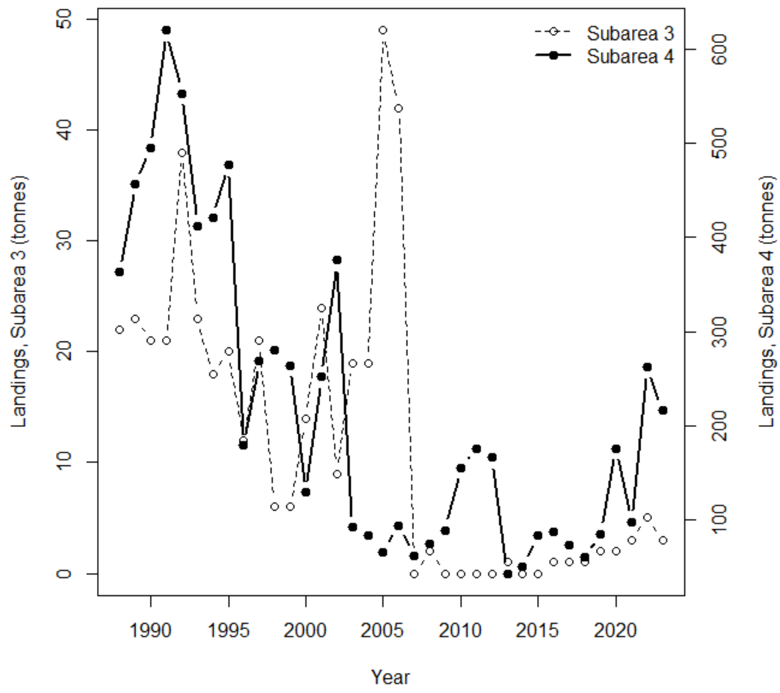

Figure 4.4.5. Landings of blue ling in subareas 3 and 4 from 1988-2023. Subarea 3: open circles, left axis. Subarea 4: filled circles, right axis.

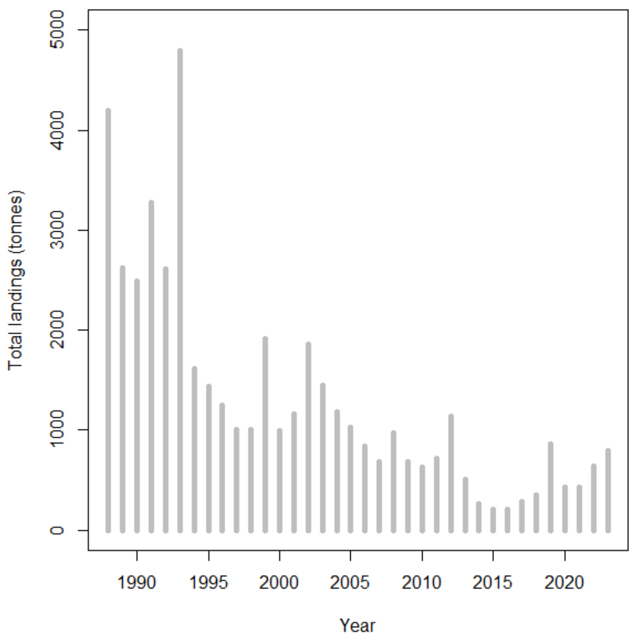

Figure 4.4.6. Total landings of blue ling from stock area bli.27.nea from 1988-2023 (the old stock area bli.27.nea)

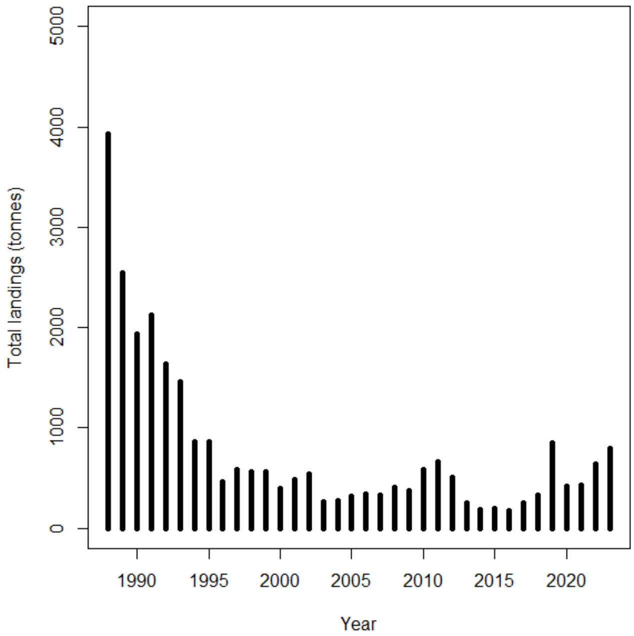

Figure 4.4.7. Total landings of blue ling from stock area 1,2,3a,4 from 1988-2023.

4.5 References

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Contents

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.

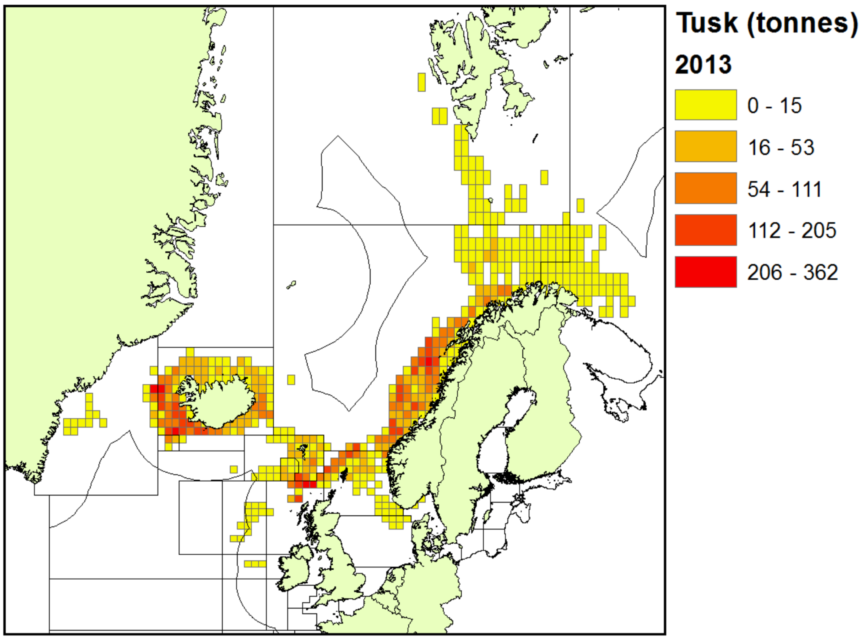

Figure 5.1. Reported landings of tusk in the ICES area by statistical rectangle in 2013. Data are from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in account for 99% of all reported landings in the ICES area.

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

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, 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 have been continually decreasing in the past few years (Table 5.2.1). Most of tusk in 5.a, around 96% of catches in tonnes, is caught by longlines, and this proportion has been relatively stable since 1992 (Table 5.2.2).

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

	Number of Boats				Catch (Tonnes)			
Year	Bottom trawl	Gill nets	Longlines	Bottom trawl	Gill nets	Longlines	Other	Total catch
2000	120	175	370	100	44	4564	29	5114
2001	108	224	350	87	63	3248	24	4838
2002	103	174	304	88	93	3722	17	5563
2003	97	148	305	65	41	3941	11	5598
2004	90	129	303	92	28	3007	8	4830
2005	87	101	324	115	19	3398	7	5044
2006	85	82	338	100	40	4912	7	6601
2007	74	65	308	104	38	5834	11	7537
2008	75	59	255	126	42	6762	7	8629
2009	75	65	239	115	72	6757	9	8679
2010	70	62	228	97	52	6761	9	8976
2011	63	54	221	72	24	5742	9	7701
2012	65	68	228	64	13	6255	13	7872
2013	66	43	233	76	15	4911	12	6302
2014	62	43	249	87	18	6045	12	6163
2015	55	32	228	71	7	4745	13	4835
2016	59	32	206	61	6	3420	7	3494
2017	52	31	180	48	5	2481	5	2540
2018	55	27	158	83	8	2840	4	2940
2019	49	23	154	103	7	3323	9	3445

	Number of Boats				Catch (Tonnes)			
2020	55	23	126	108	31	3037	9	3187
2021	51	18	123	112	12	2649	5	2779
2022	51	26	109	110	17	2446	4	2577
2023	53	32	94	91	10	2939	5	3046

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 western and southwestern part of the Icelandic shelf (Figure 5.2.2 and Figure 5.2.3). The proportional catch in the northwest has increased over the years. 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.

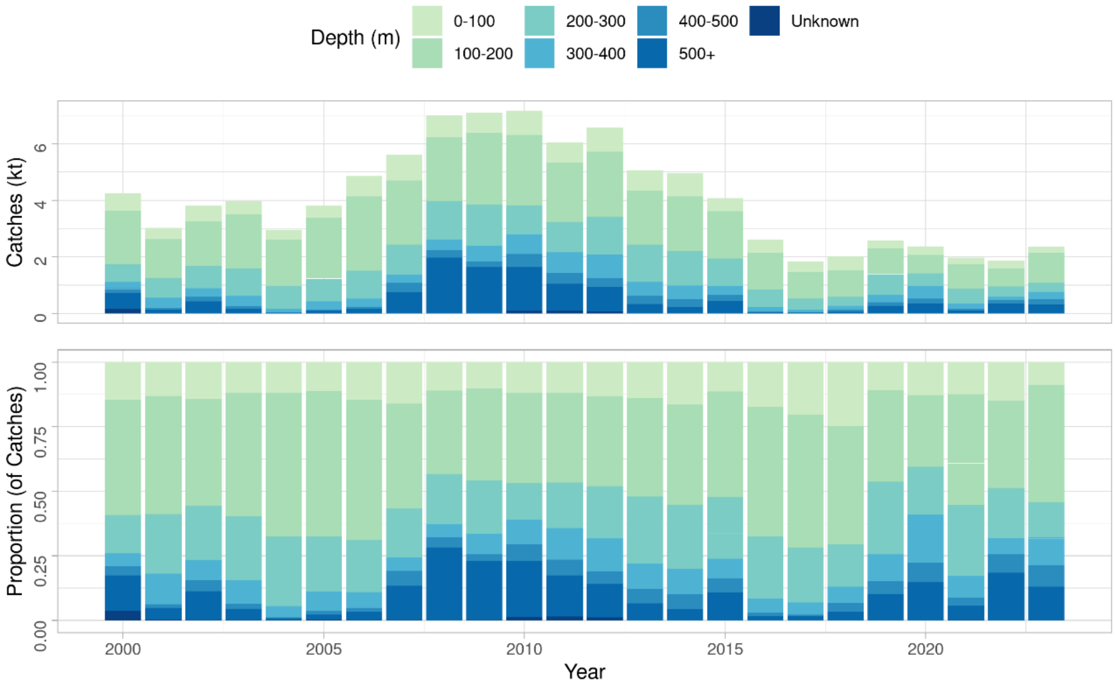

Figure 5.2.1: Tusk in 5.a and 14. Depth distribution of catches in 5.a according to logbooks. All gears combined.

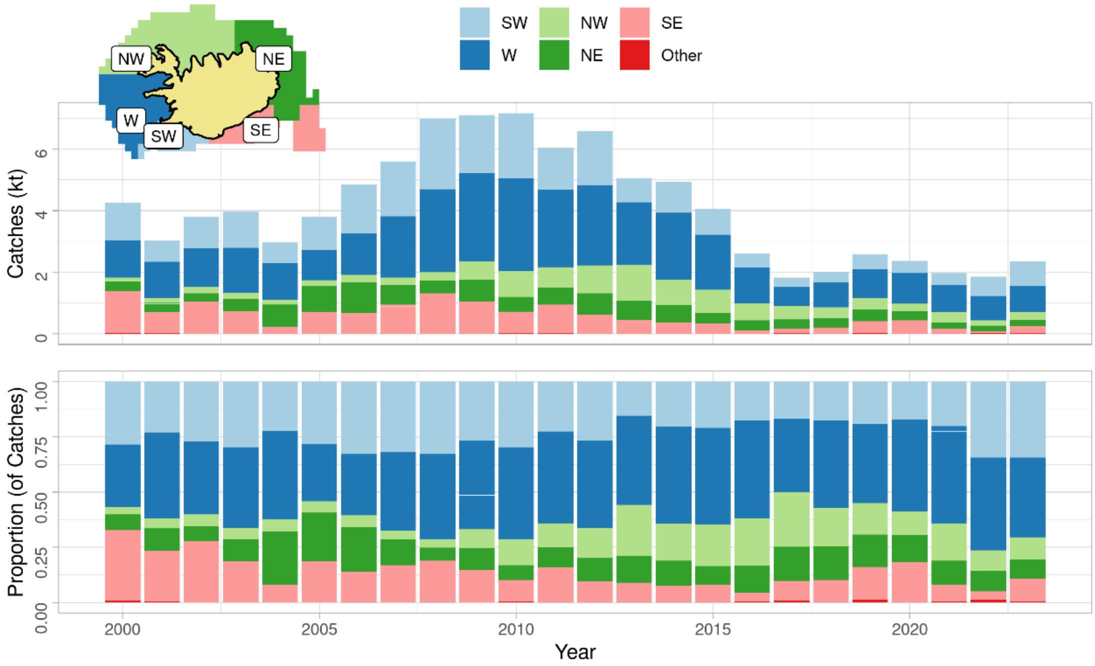

Figure 5.2.2: Tusk in 5.a and 14. Catch distribution and proportions by area according to logbooks. All gears combined.

Figure 5.2.3: Tusk in 5.a and 14. Geographical distribution (tonnes) of the Icelandic longline fishery since 2004, as reported in logbooks by the Icelandic fleet.

5.2.2 Landing trends

The total annual landings from ICES Division 5.a were around 3046 tonnes in 2023 (Table 5.2.1), 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 5.2.4).

The foreign catch (mostly from the Faroe Islands, but also from Norway) of tusk in Icelandic waters has always been considerable. Until 1990, between 40–70% of the total annual catch from ICES Division 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 5.2.2).

Landings in 14 have always been low compared to 5.a, rarely exceeding 100 t. However, around 1659 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 (WD02, Annex to this report) also reflect this trend. Around 592 tonnes in 2019 were caught in the 14 mainly by Norwegian, Faroese and Greenlandic vessels (Table 5.2.3). This has however increased in 2023 to about 782 tonnes. As the Icelandic TACs were relatively low during this period, this constituted over 25% of the annual catch.

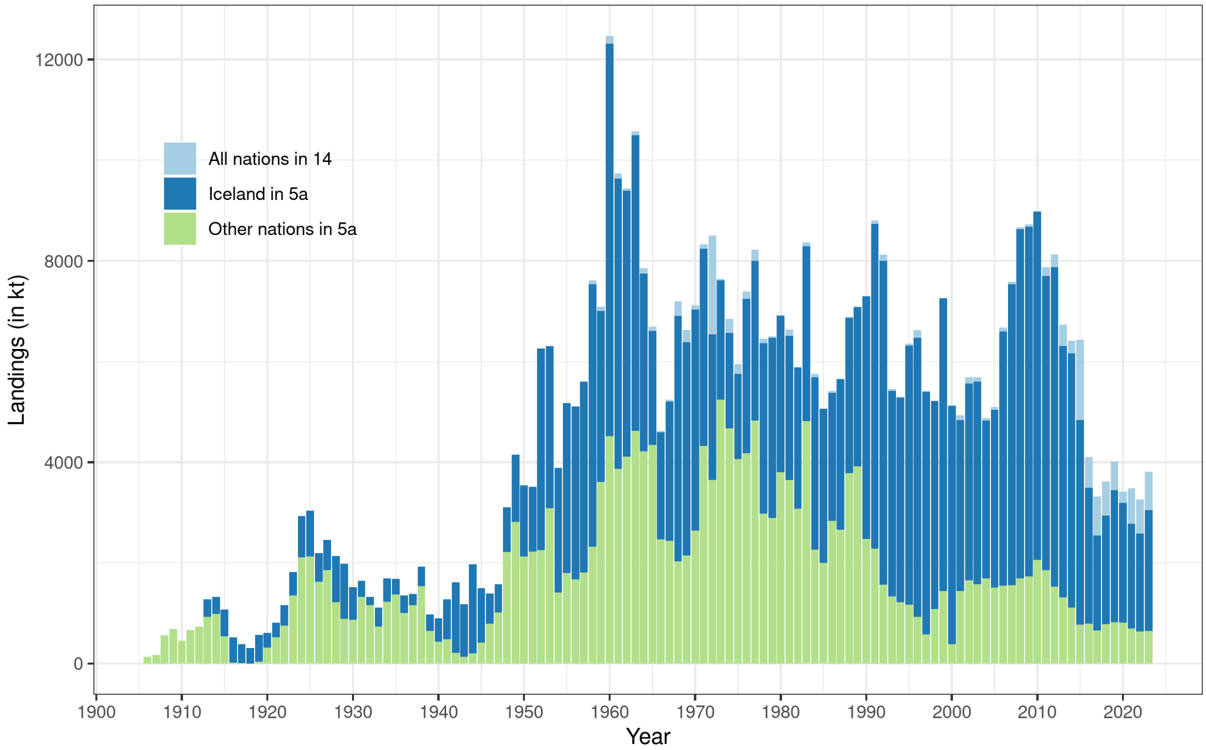

Figure 5.2.4: Tusk in 5.a and 14.Nominal landings within Icelandic waters by Icelandic vessels (light blue) or foreign vessels (dark blue), or within Greenlandic waters (orange). (source for 14: STATLANT).

Table 5.2.2. 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

YEAR	FAROE	DENMARK	GERMANY	ICELAND	NORWAY	UK	TOTAL
1994	1212	0	0	4612	0	0	5824
1995	979	0	1	5245	0	0	6225
1996	872	0	1	5226	3	0	6102
1997	575	0	0	4819	0	0	5394
1998	1052	0	1	4118	0	0	5171
1999	1035	0	2	5794	391	2	7224
2000	1154	0	0	4714	374	2	6244
2001	1125	0	1	3392	285	5	4808
2002	1269	0	0	3840	372	2	5483
2003	1163	0	1	4028	373	2	5567
2004	1478	0	1	3126	214	2	4821
2005	1157	0	3	3539	303	41	5043
2006	1239	0	2	5054	299	2	6596
2007	1250	0	0	5984	300	1	7535
2008	959	0	0	6932	284	0	8175
2009	997	0	0	6955	300	0	8252
2010	1794	0	0	6919	263	0	8976
2011	1347	0	0	5845	198	0	7390
2012	1203	0	0	6341	217	0	7761
2013	1092	0.12	0	4973	192	0	6257
2014	728	0	0	4995	306	0	6029
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
2019	549	0	0	2579	316	0	3444
2020	558	0	0	2590	272	0	3420
2021	341	0	0	2049	389	0	2780
2022	288	0	0	1932	357	0	2577

YEAR	FAROE	DENMARK	GERMANY	ICELAND	NORWAY	UK	TOTAL
2023	336	0	0	2399	311	0	3046

Table 5.2.3. Tusk in 5.a and 14. Nominal landings by nations in 14.

YEAR	FAROE	GREENLAND	GERMANY	ICELAND	NORWAY	RUSSIA	SPAIN	UK	TOTAL
1980	0	0	13	0	0	0	0	0	13
1981	110	0	10	0	0	0	0	0	120
1982	0	0	10	0	0	0	0	0	10
1983	74	0	11	0	0	0	0	0	85
1984	0	0	5	0	58	0	0	0	63
1985	0	0	4	0	0	0	0	0	4
1986	33	0	2	0	0	0	0	0	35
1987	13	0	2	0	0	0	0	0	15
1988	19	0	2	0	0	0	0	0	21
1989	13	0	1	0	0	0	0	0	14
1990	0	0	2	0	7	0	0	0	9
1991	0	0	2	0	68	0	0	1	71
1992	0	0	0	3	120	0	0	0	123
1993	0	0	0	1	39	0	0	0	40
1994	0	0	0	0	16	0	0	0	16
1995	0	0	0	0	30	0	0	0	30
1996	0	0	0	0	157	0	0	0	157
1997	0	0	0	10	9	0	0	0	19
1998	0	0	0	0	12	0	0	0	12
1999	0	0	0	0	8	0	0	0	8
2000	0	0	0	11	11	0	3	0	25
2001	3	0	0	20	69	0	0	0	92
2002	4	0	0	86	30	0	0	0	120
2003	0	0	0	2	88	0	0	0	90
2004	0	0	0	0	40	0	0	0	40
2005	7	0	0	0	41	8	0	0	56

YEAR	FAROE	GREENLAND	GERMANY	ICELAND	NORWAY	RUSSIA	SPAIN	UK	TOTAL
2006	3	0	0	0	19	51	0	0	73
2007	0	0	0	0	40	6	0	0	46
2008	0	33	0	0	7	0	0	0	40
2009	12	15	0	0	5	11	0	0	43
2010	7	0	0	0	5	0	0	0	12
2011	20	0	0	131	24	0	0	0	175
2012	33	0	0	174	46	0	0	0	253
2013	2	0	0.3	401	24	0	0	0	427
2014	145	74	0.1	0	35	0	0	0	254
2015	759	785	0.2	0	55	0	0	0	1599
2016	243	182	3	0	178	0	0	0	606
2017	281	335	0.4	0	141	0	0	0	757
2018	345	108	0	0	228	0	0	0	681
2019	41	66	1	0	458	0	0	0	566
2020	0	41	2	0	114	0	0	0	157
2021	260	59	2	0	380	0	0	0	701
2022	35	87	1	0	558	0	0	0	681
2023	170	115	0.4	0	479	0	0	0	764

5.2.3 Data available

In general sampling is considered appropriate from commercial catches from the main gear (longlines), although the quantity of samples has decreased substantially in recent years. 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 (ICES (2012)). The sampling coverage by gear in 2023 is shown in Figure 5.2.6.

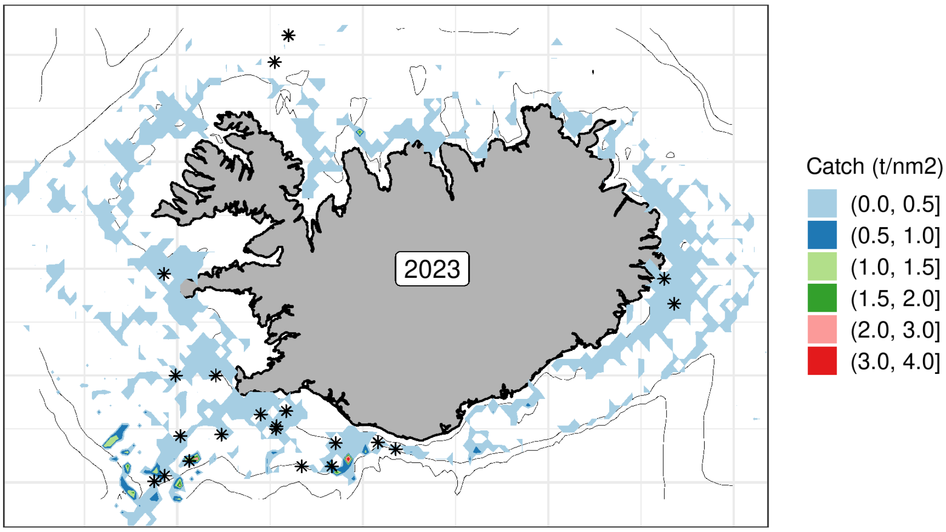

Figure 5.2.6: Tusk in 5.a and 14. Fishing grounds in 2023 as reported by catch in logbooks (tiles) and positions of samples taken from landings (asterisks) by longliners.

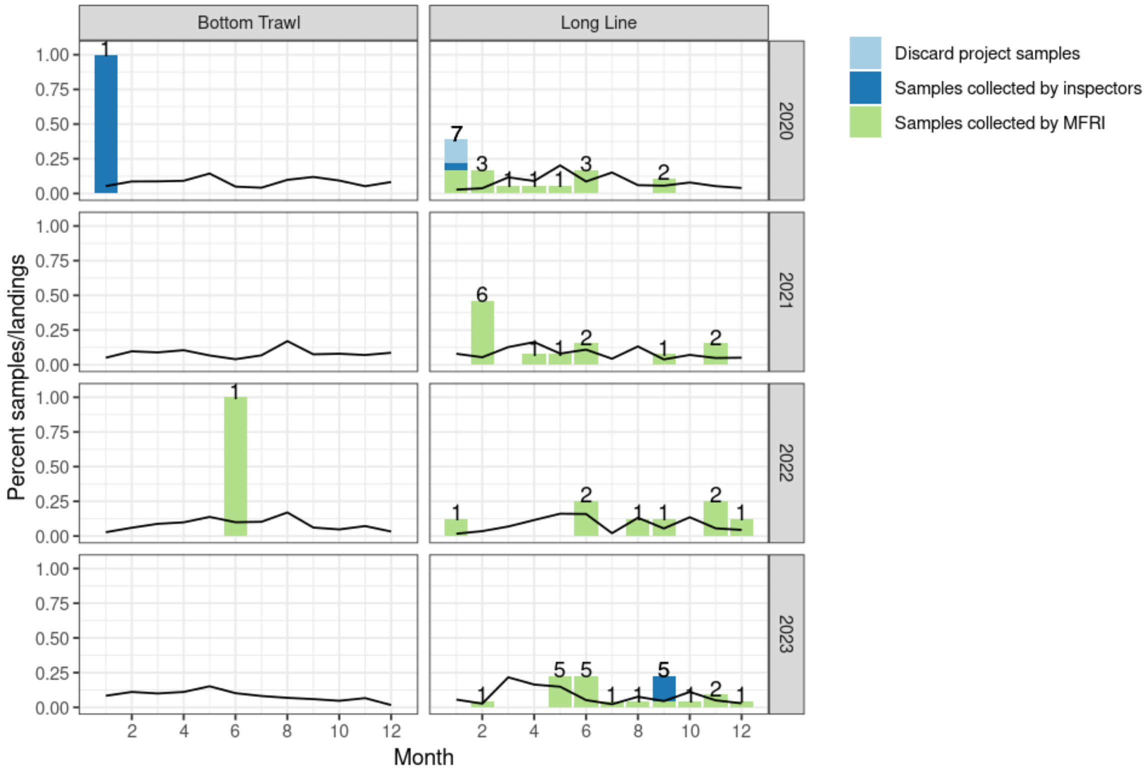

Figure 5.2.7: Tusk in 5.a and 14. Ratio of samples by month (bars) compared with proportion landings by month (black line) split by year and main gear types. Numbers above the bars indicate number of samples by year, month and gear.

5.2.3.1 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) (ICES (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 and Iceland fisheries overview (ICES (2022b) and ICES (2022a)). Landings for tusk in Greenlandic waters are obtained from the STATLANT database. Figures reported by the Greenland Institute of Natural Resources (ICES (2014):WD06) are in agreement. No information is available on discards in Greenlandic waters.

5.2.3.2 Length compositions

An overview of available length measurements from 5.a is given in Table 5.2.6. 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 longline and bottom trawl fishery are shown in Figures 5.2.8 and from the spring survey in Figure 5.2.16, respectively.

No length composition data from commercial catches in Greenlandic waters are available.

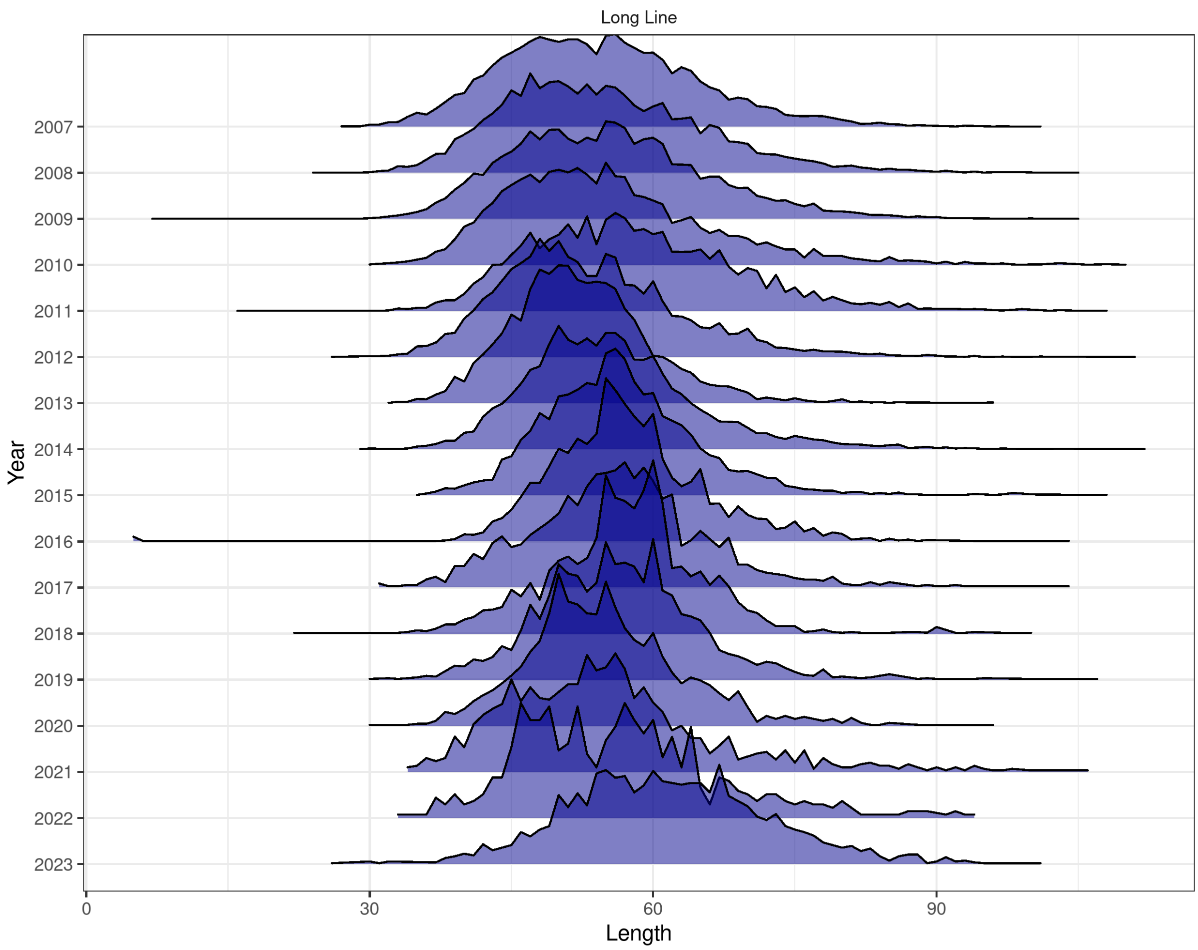

Figure 5.2.8: Tusk in 5.a and 14. Length distributions from Icelandic commercial catches.

Table 5.2.5. Tusk in 5.a and 14. Number of available length measurements from Icelandic (5.a) commercial catches.

Year	Bottom trawl	Demersal seine	Gill net	Long lines	Other
2000	0	0	0	2995	0

Year	Bottom trawl	Demersal seine	Gill net	Long lines	Other
2001	0	0	0	3097	151
2002	0	0	0	2843	0
2003	0	0	0	8444	0
2004	150	0	0	3809	0
2005	21	0	0	5820	0
2006	472	0	0	4861	0
2007	150	0	167	11936	0
2008	0	0	0	20963	0
2009	0	0	0	21451	0
2010	0	0	0	9084	0
2011	0	0	0	8158	0
2012	150	0	0	11867	0
2013	0	150	0	6469	0
2014	0	0	0	11748	0
2015	0	0	0	4821	0
2016	0	0	0	4844	0
2017	0	0	0	1710	0
2018	0	0	0	2781	0
2019	0	0	0	2952	0
2020	1	0	0	2336	0
2021	0	0	0	1499	26
2022	83	0	0	682	461
2023	0	0	0	2671	0

5.2.3.3 Age compositions

Table 5.2.6 gives an overview of otolith sampling intensity by gear types from 2008 to 2023 in 5.a. Since 2010, considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2008–2023. The age data are used as input for the SAM assessment. It is expected that the effort in ageing of tusk will continue. Catch at age by year class is shown in Figure 5.2.9 and 5.2.10.

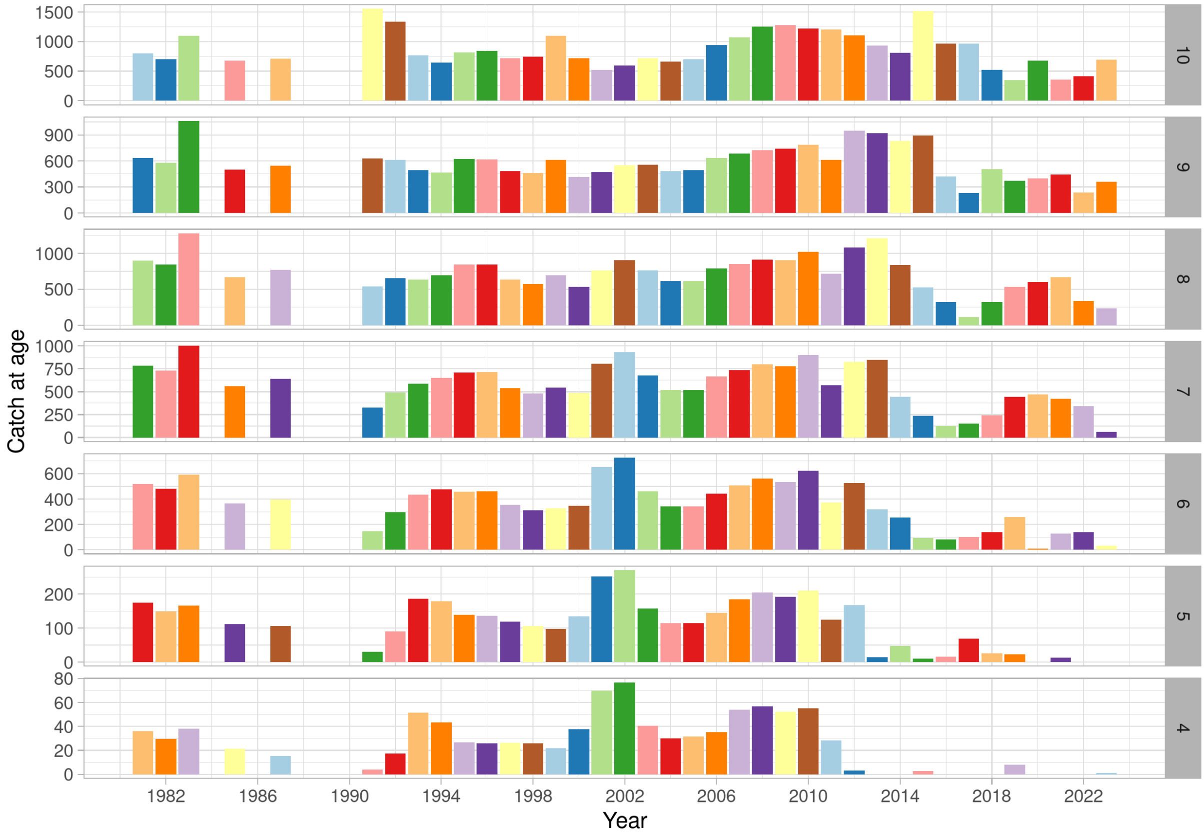

Figure 5.2.9: Tusk in 5.a and 14. Catch at age from the commercial fishery in Iceland waters. Bar size is indicative of the catch in numbers and bars are coloured by cohort.

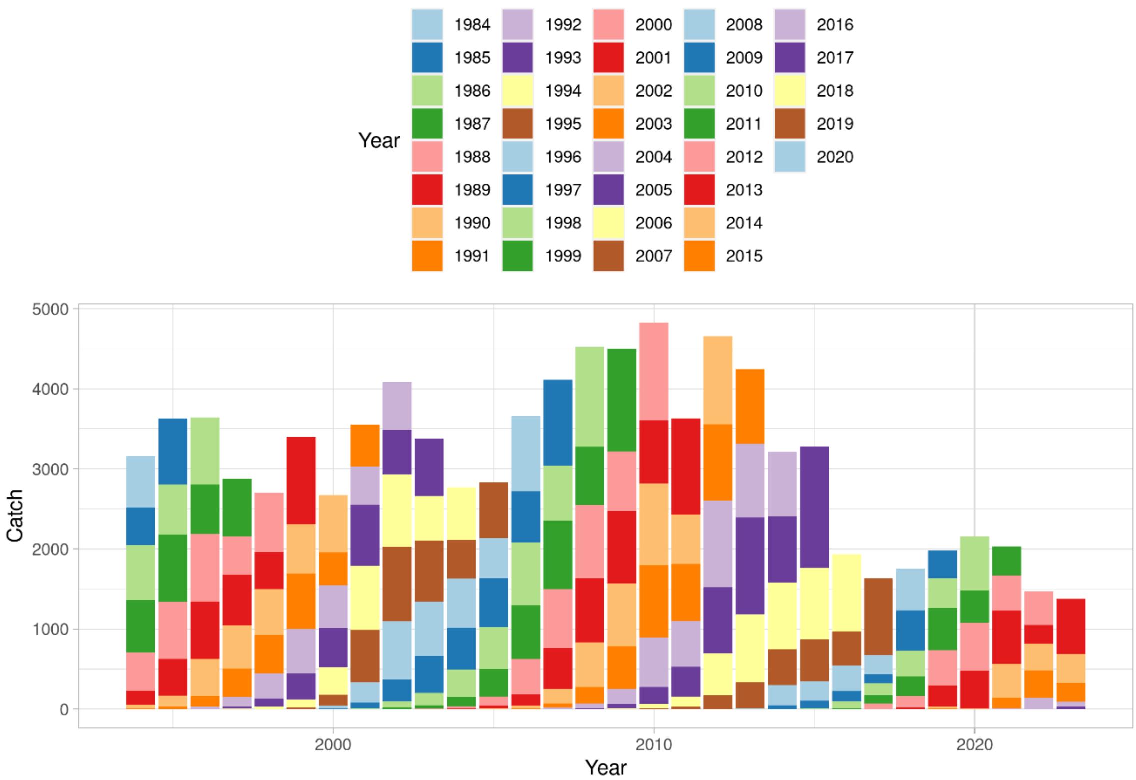

Figure 5.2.10: Tusk in 5.a and 14. Catch at age from the commercial fishery in Iceland waters. Biomass caught by year and age; bars are coloured by cohort.

Table 5.2.6. 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	No. samples (catch)	No. otoliths (catch)	No.samples (survey)	No.aged (survey)
2008	32	1600	282	475
2009	27	1350	277	434
2010	29	1449	241	363
2011	28	1400	270	728
2012	35	1750	285	750
2013	23	1150	275	536
2014	28	620	241	559
2015	26	555	260	573
2016	14	290	259	676
2017	8	160	245	571
2018	9	180	247	549
2019	15	330	251	704

Year	No. samples (catch)	No. otoliths (catch)	No.samples (survey)	No.aged (survey)
2020	14	290	250	647
2021	15	291	278	811
2022	14	287	313	897
2023	18	355	302	954

5.2.3.4 Weight at age

Weight-at-age from catch in 5.a is shown in Figure 5.2.11. No data are available from 14. Catch weights of three year old is stable and around the average, whereas the other age groups show more variability between years (Figure 5.2.11). The three oldest year classes are the most common in the catch, and recently, younger tusk has become less common in catch (Figure 5.2.12).

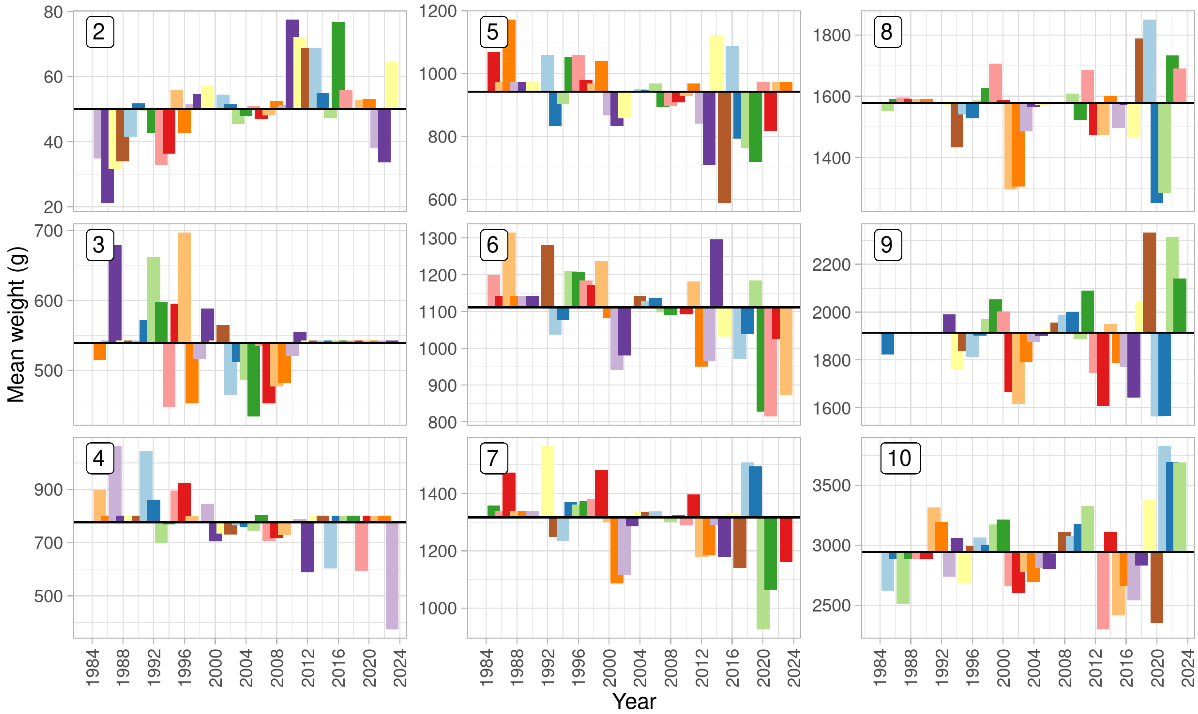

Figure 5.2.11: Tusk in 5.a and 14. Mean weight at age in the catch from the commercial fishery in Icelandic waters. Bars are coloured by cohort.

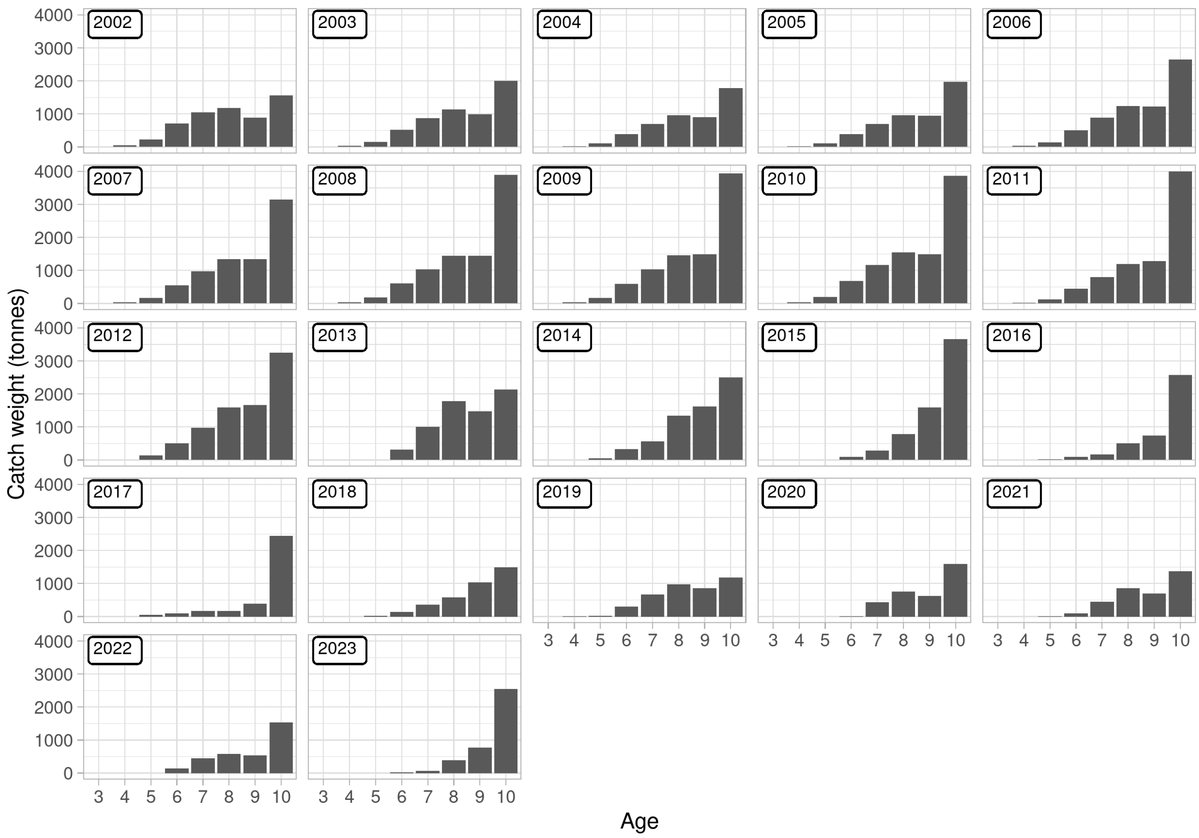

Figure 5.2.12: Tusk in 5.a and 14. Catch weights by age from the commercial fishery in Icelandic waters.

5.2.3.5 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.

5.2.4 Survey data

5.2.4.1 Icelandic survey data (ICES Subarea 27.5a)

Information on abundance and biological parameters from tusk in Icelandic waters is available from the Icelandic groundfish survey in the spring and the Icelandic autumn survey. In addition, a gillnet survey is conducted in areas closer inshore every April during cod spawning periods, designed to sample the cod spawning stock. A detailed description of the Icelandic spring, autumn groundfish surveys and the gillnet surveys are given in the stock annex (ICES 2022c). The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the tusk fishery. 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. Figure 5.2.13 shows 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 distribution (Figure 5.2.14).

Length distribution from the autumn and spring survey is shown in figure 5.2.16 and the survey index at age from the spring survey in figure 5.2.17. Since 2014, the survey indices of younger tusk have been increasing. This is also apparent in the length distribution from the spring survey, where smaller tusk have become more frequent.

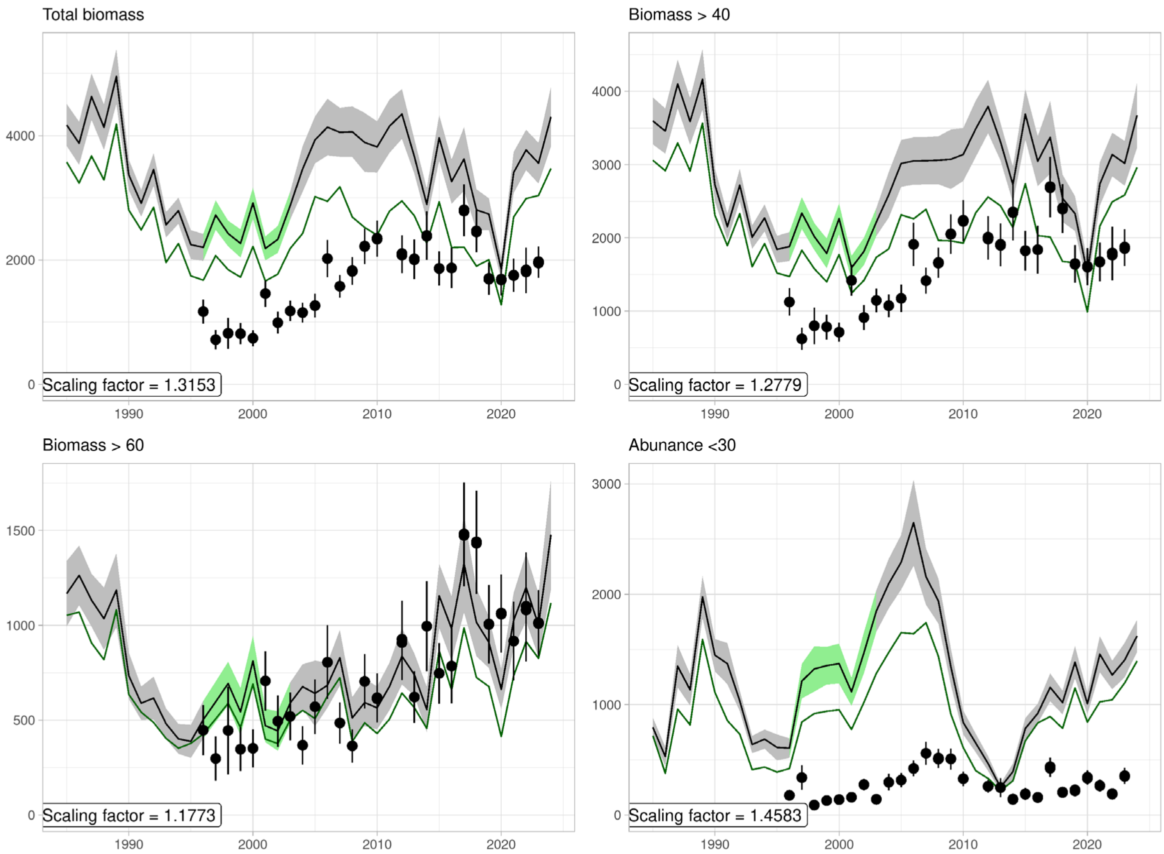

Figure 5.2.13: Tusk in 5.a and 14. Aa) Total biomass indices, b) biomass indices larger than and including 40 cm, c) biomass indices larger than and including 60 cm and d) abundance indices smaller than and including 30 cm. The lines with shaded areas show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shaded area and vertical lines indicate +/- standard error. Green line is the index excluding the Iceland-Faroe Ridge.

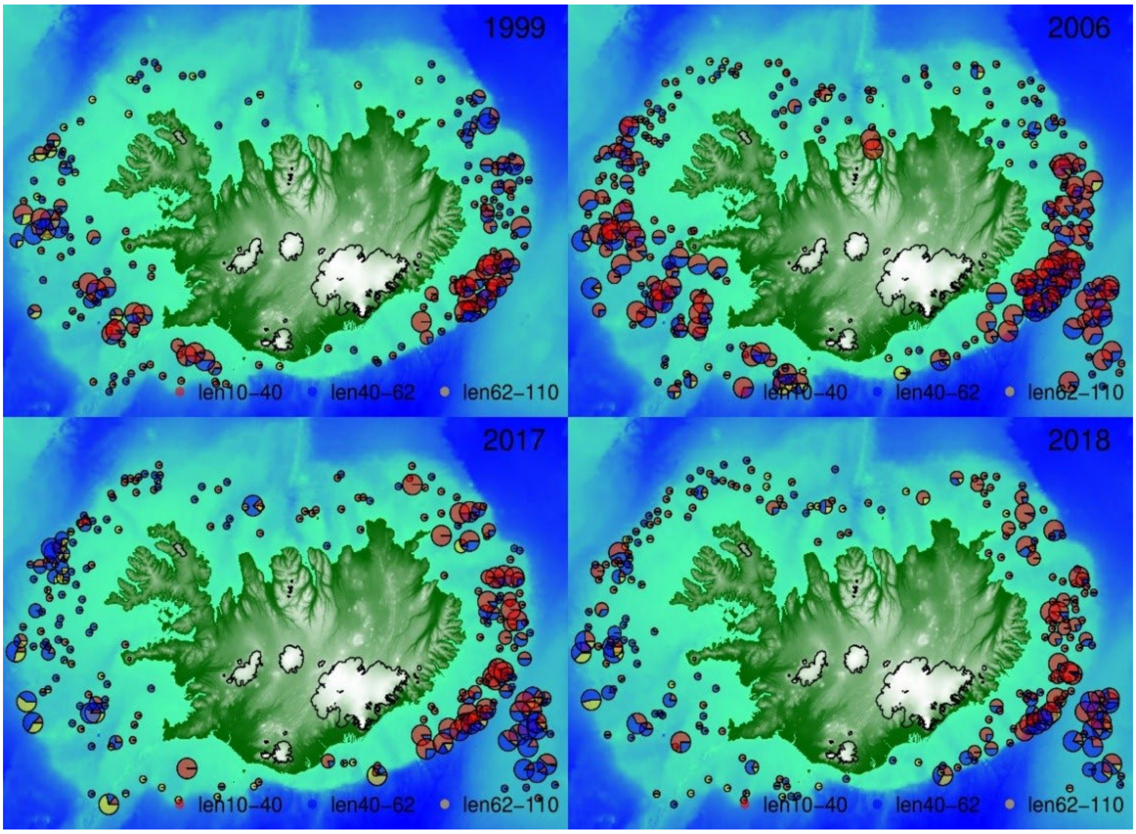

Figure 5.2.14: Tusk in 5.a and 14. Changes in spatial distribution divided by size. Size of pie is indicative of numbers of specimens caught at the tow-station.

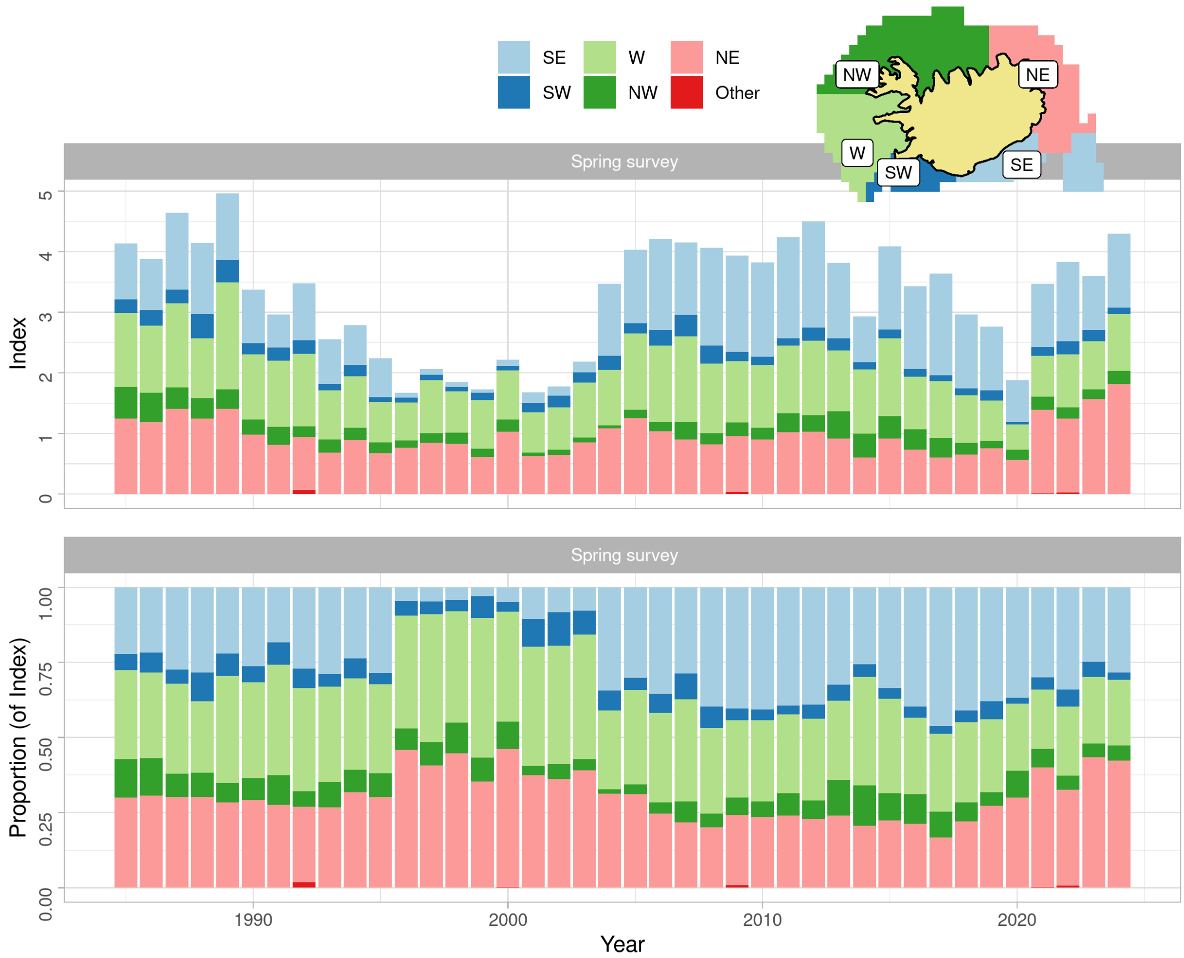

Figure 5.2.15: Tusk in 5.a and 14. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

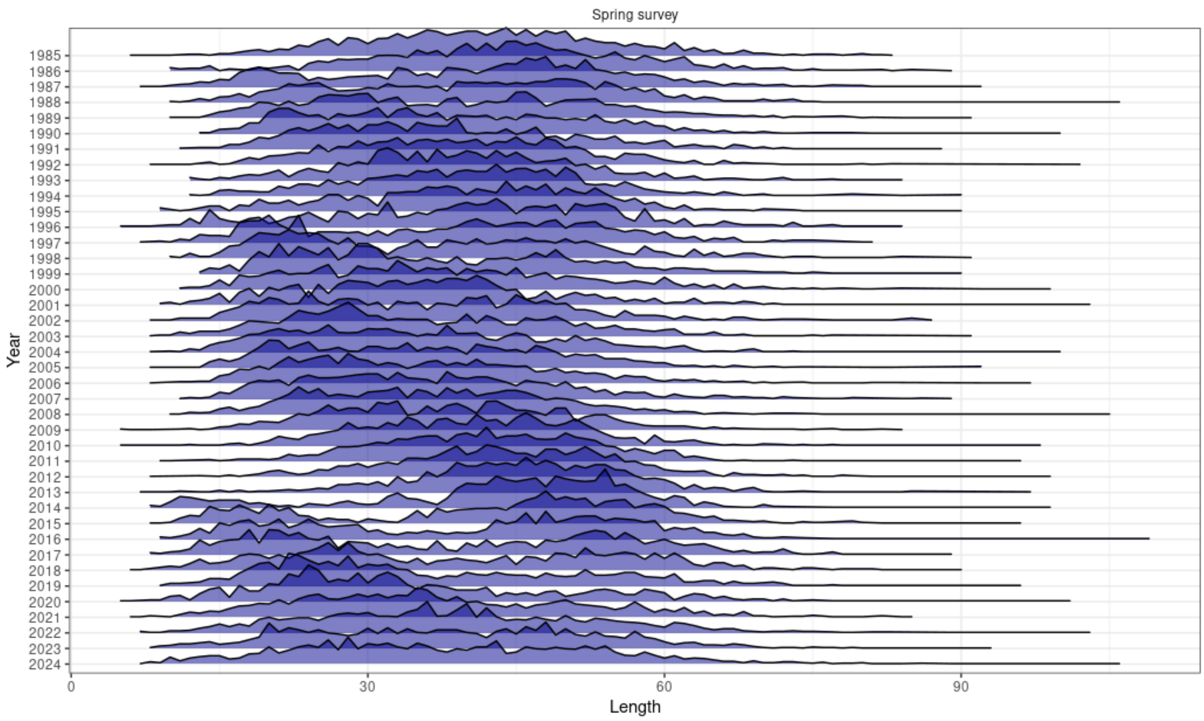

Figure 5.2.16: Tusk in 5.a and 14. Length distribution from the spring survey.

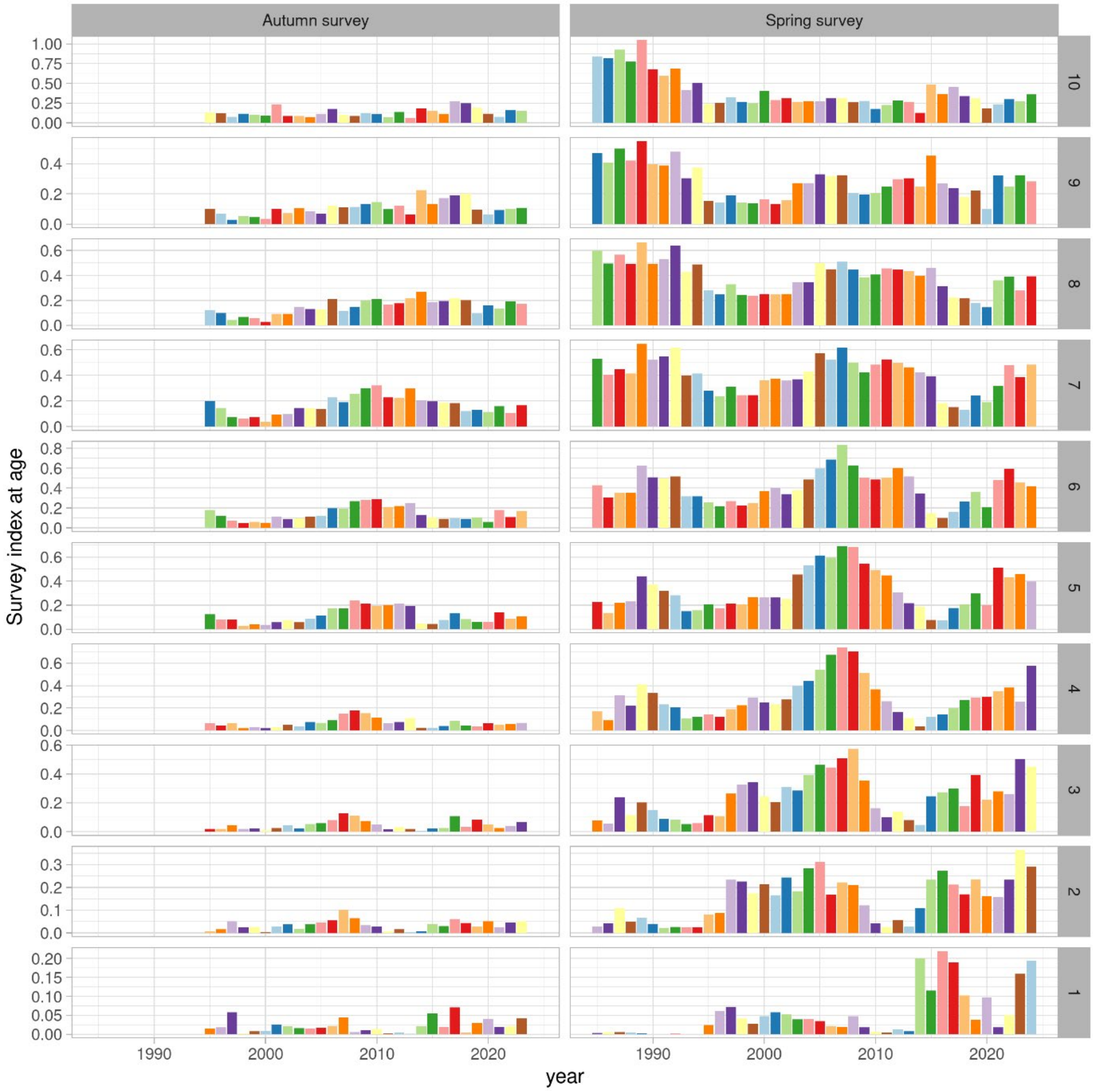

Figure 5.2.17. Tusk in 5.a and 14. Age disaggregated indices in the autumn survey (left) and the spring survey (right). Fill colours indicate cohorts. Note different scales on y-axes.

5.2.4.2 Stock weight at age

Mean weight at age in the survey is shown in Figure 5.2.18. Stock weights are obtained from the groundfish survey in March and are also used as mean weight at age in the spawning stock. Mean weight of the oldest year classes has been gradually increasing since the early 2000s, whereas the mean weight at age of younger tusk is more variable between years (Figure 5.2.18)

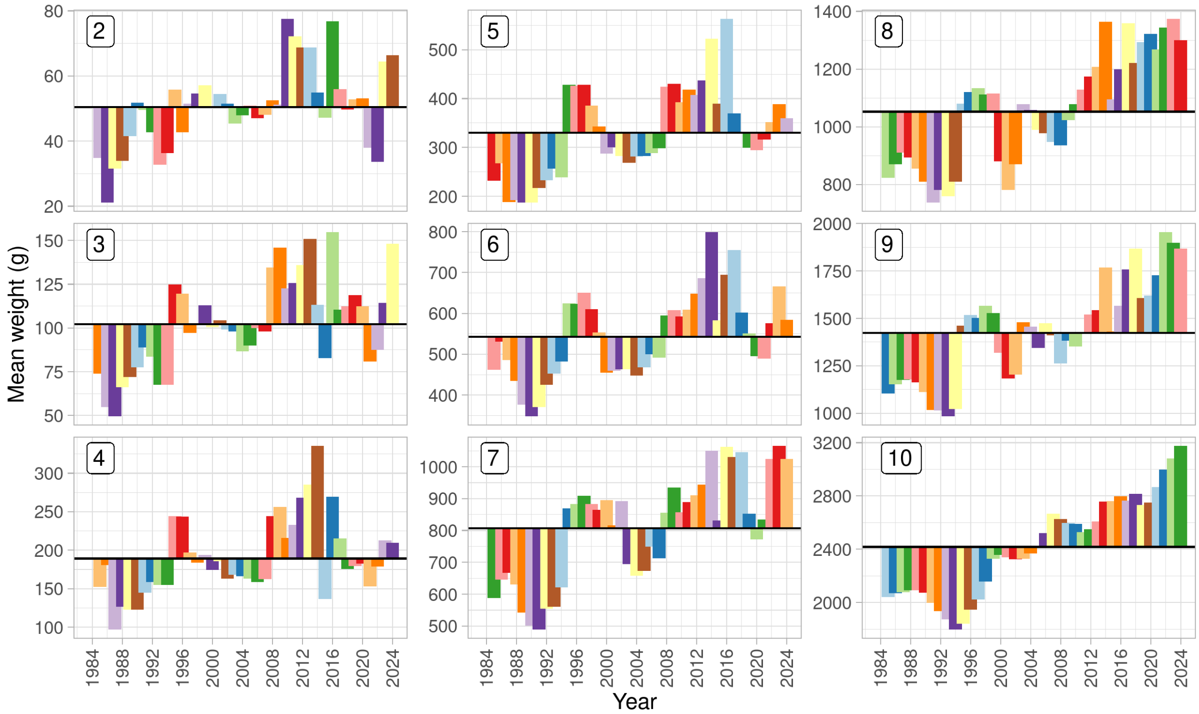

Figure 5.2.18: Tusk in 5.a and 14. Stock weights from the spring survey in Icelandic waters. Bars are coloured by cohort.

5.2.4.3 Stock maturity at age

Maturity at age data is taken from the autumn groundfish survey and calculated based on maturity at length each year and length distributions of fish assigned to each age. The spring survey data is not used because maturation patterns appeared to occur at larger fish and differed between sexes. From 1994 to 2000, the proportion mature at age increased gradually in age groups 5 to 10, but steadily declined after until the year 2015. Since then, there has been an upward trend in the proportion of individuals reaching maturity at older ages, with maturity approaching the mean (Figure 5.2.19 and Figure 5.2.20).

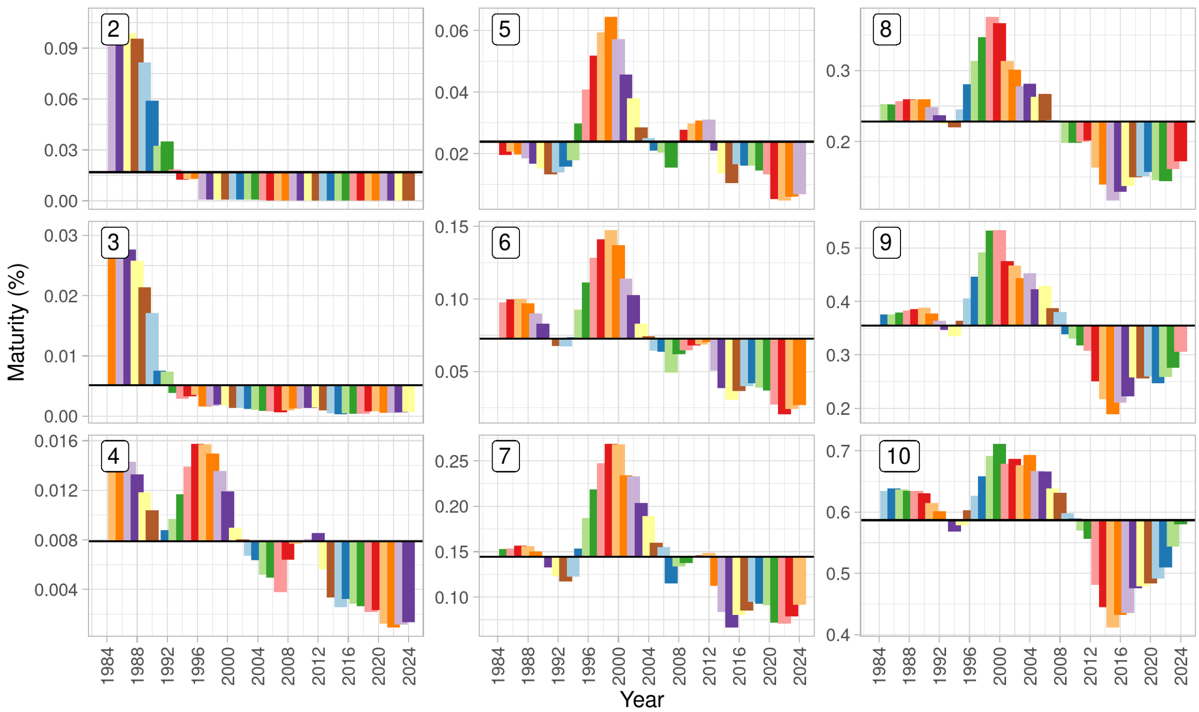

Figure 5.2.19: Tusk in 5.a and 14. Maturity at age in the autumn survey. Bars are coloured by cohort. The values are used to calculate the spawning stock.

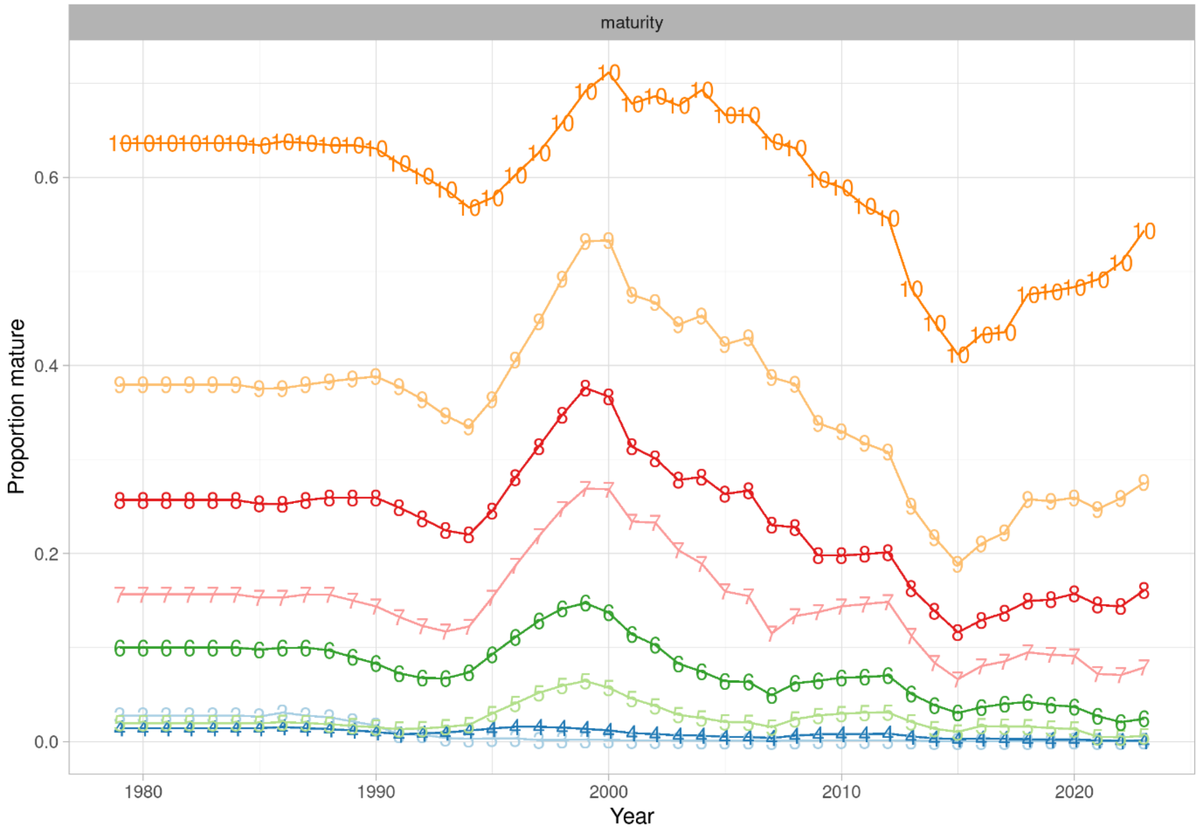

Figure 5.2.20: Tusk in 5.a and 14. Proportion mature at age from the autumn survey.

5.2.4.4 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 0.15 for all age groups.

5.2.4.5 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 5.2.21 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 5.2.22.

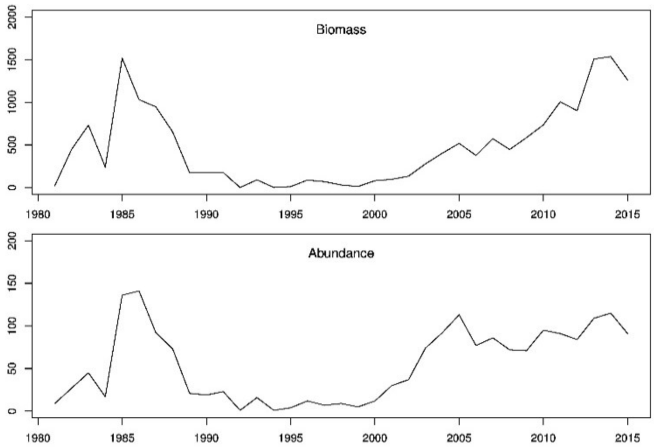

Figure 5.2.21: Tusk in 5.a and 14. Biomass and abundance estimates from the Walter Herwig survey in 14. The data are just the total number caught and then converted to weight.

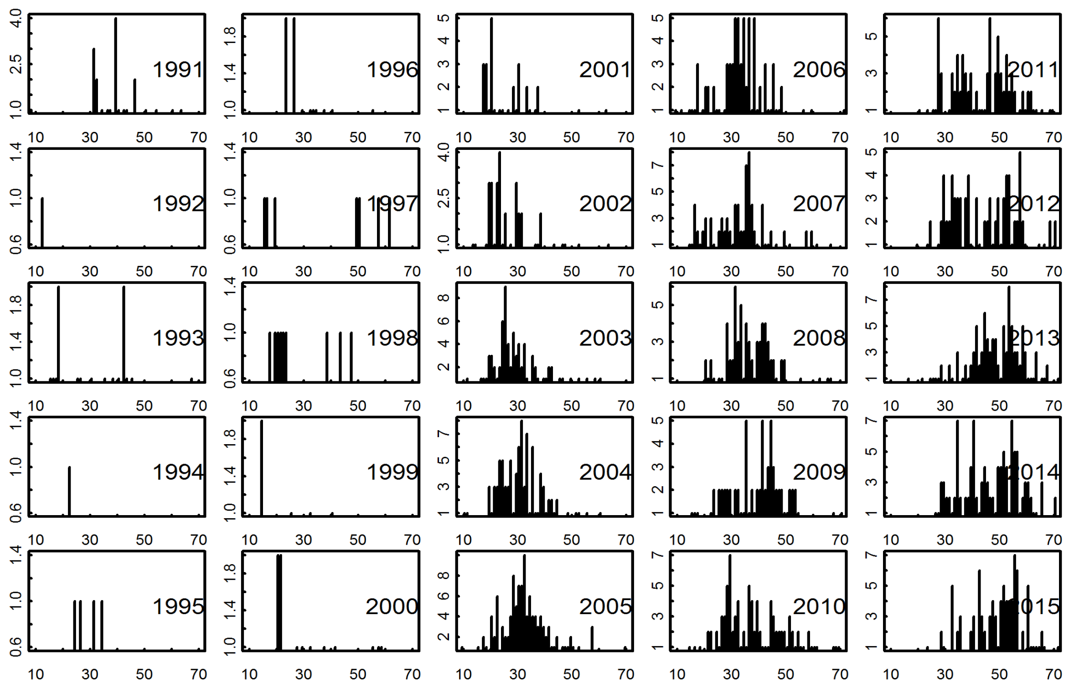

Figure 5.2.22: Tusk in 5.a and 14. Length distributions from the Walter Herwig survey in 14.

5.2.4.6 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 (ICES (2019) :WD05). 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.

5.2.5 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. Catches decreased from around 9000 tonnes in 2010 to 3046 tonnes in 2023. This decrease is mainly because of reductions in landings by the Icelandic longline fleet and to a lesser extent Faroese and Norwegian landings (Table 5.2.2 and Table 5.2.3). This has resulted in less overshoot of landings relative to set TAC (Table 5.2.4), except in the last two years when the stock has experienced an all-time low. As this all-time low is more likely due to the low recruitment during 2010–2011 rather than overexploitation, so is expected to increase as subsequent higher recruitment levels grow to fishable sizes.

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) decreased substantially but increased again and has remained at relatively high similar level as in 2011 (Figure 5.2.13). The same holds for the index of tusk larger than 60 cm (spawning–stock biomass index). 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 25% of the index is from the SE area. However only around 4% of the catches are caught in this area (Figure 5.2.2 and Figure 5.2.3). The change in juvenile abundance between 2006 and recent years can be clearly seen in Figure 5.2.13 and Figure 5.2.14 where in 2006 juveniles (<40 cm) were all over the southern part of the shelf but can hardly be seen in recent years.

5.2.5.1 Analytical assessment using SAM

From 2010-2021, s Gadget model (Globally applicable Area Disaggregated General Ecosystem Toolbox, see www.hafro.is/gadget) was used for the assessment of tusk in 5.a (See stock annex for details, ICES 2022c). In 2022, Tusk in 5.a and 14 was re-assessed as the previously benchmarked Gadget model had begun to show great instability in retrospective patterns in recent years. As a part of a Harvest Control Evaluation requested by Iceland, the stock was benchmarked (WKICEMSE 2022b) which resulted in changes in the assessment method and updated reference points. Model setup and settings are described in the stock annex (ICES 2022c).

5.2.5.2 Data used by the assessment and model settings

Data used for tuning and the model configuration are given in the stock annex.

5.2.5.3 Model fit

The model fit to survey indices and catch at age data are shown in Figures 5.2.14 and 5.2.15. Generally, the model closely follows the catch-at-age and spring survey data, which are in good agreeance. The autumn survey is noise but generally follows the same pattern. Fits to the landings (total biomass removals) and April gillnet survey (age 10 abundance) are much noisier. An overview of model parameter estimates are shown in Figure 5.2.30.

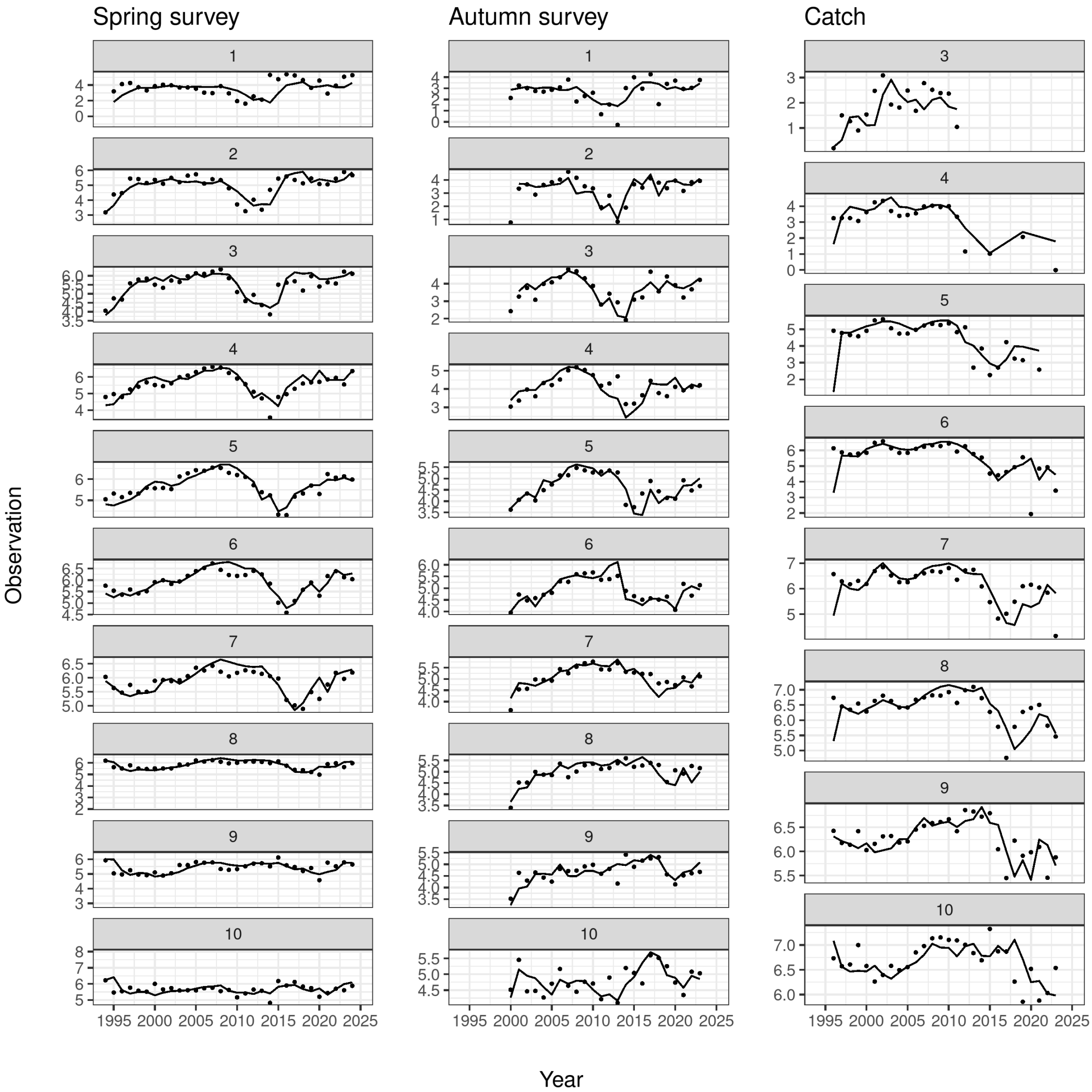

Figure 5.2.24: Tusk in 5.a and 14. Model fit to catches, spring survey and autumn survey indices.

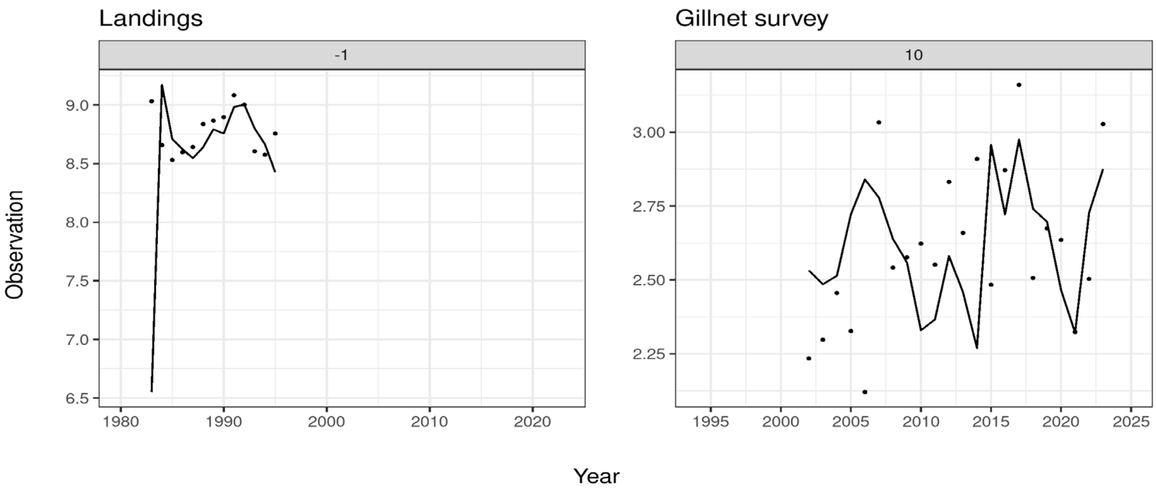

Figure 5.2.25: Tusk in 5.a and 14. Model fit to landings and gillnet indices.

5.2.5.4 Model results

The spawning stock gradual declined prior to 1995, although prior to 1985 the model is informed by very little data so uncertainty is high. The period 1995 - 2015 was steady, with a gradual decline thereafter that continued until 2021, when biomass levels have started to increase again. This pattern is likely due to a distinctive low point in recruitment in 2011 - 2012, which has since then increased to relatively high levels. Therefore, given moderate fishing levels, spawning stock biomass is expected to increase over the next several years as the newest higher recruitment levels grow into the fishable population. The previous peak in recruitment (2004 - 2005) likely did not increase spawning stock biomass levels substantially during this period due to higher fishing rates and catch values during 2008 - 2010, when these fish would have been entering the fishery (Figure 5.2.26).

Figure 5.2.26: Tusk in 5.a and 14. Model results of population dynamics overview: estimated catch, average fishing mortality over ages 7 - 10 (Fbar), recruitment (age 1), and spawning stock biomass (SSB).

5.2.5.5 Retrospective analysis

The results of an analytical retrospective analysis are presented (Figure 5.2.27). The analysis indicates generally consistent model results over the 5-year peel. Mohn's rho was estimated to be 0.0219 for SSB, 0.0317 for F, and 0.0866 for recruitment. Recruitment indices generally tend to be uncertain as there are few repeated observations at larger sizes with which recruitment can be confirmed. However, the good fit to survey indices at age 1 (Figure 5.2.24), suggests that recent high recruitment estimates are reliable. In addition, a peak in recruitment sizes of tusk followed by a sharp decline in 2020 are reflected in length distribution data as a rather large but steep peak in proportions of fish that have begun to shift right (to larger sizes) with no obvious new peaks of small sizes taking its place (Figure 5.2.8). Therefore, it is likely that the increase in biomass observed this year will continue in the next year or so.

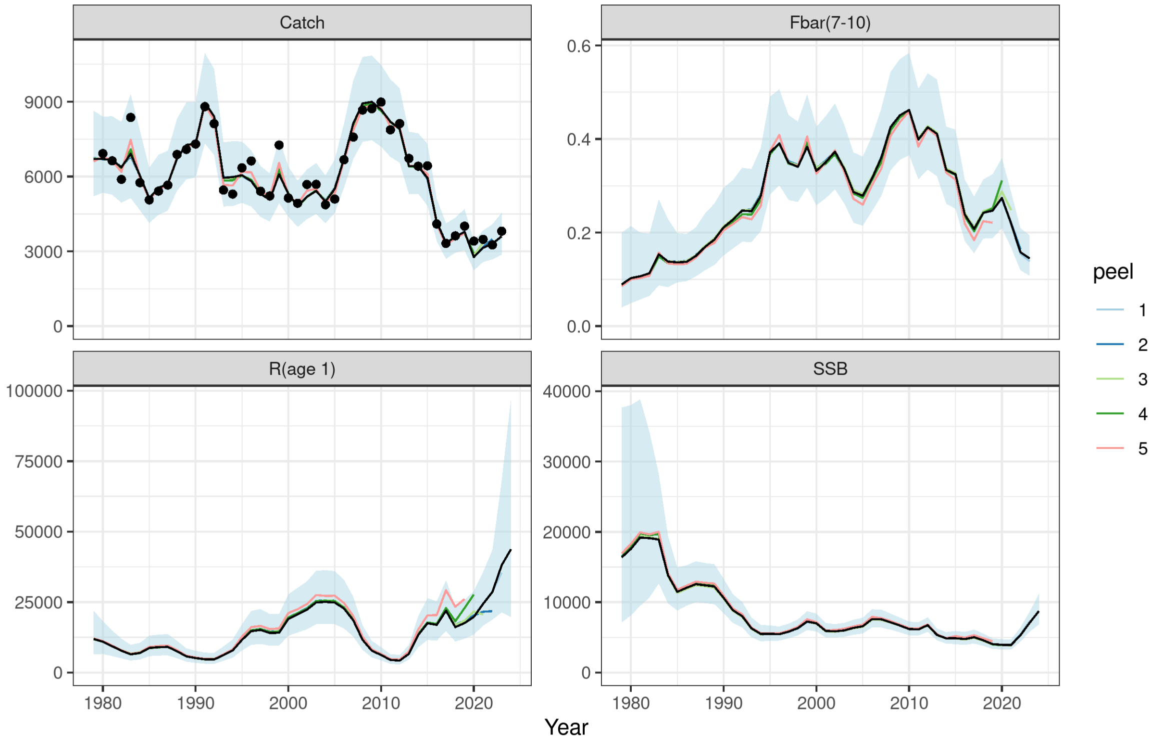

Figure 5.2.27: Tusk in 5.a and 14. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 3) are shown.

Observation and process residuals show slight trends in autocorrelation and some blocks of time where the model was consistently over- or underestimating the model. (Figs. 5.2.28 and 5.2.29). However, a better model configuration could not be found in the benchmark that would remove these patterns, and similar model configurations gave similar model results (WKICEMP, ICES 2022d).

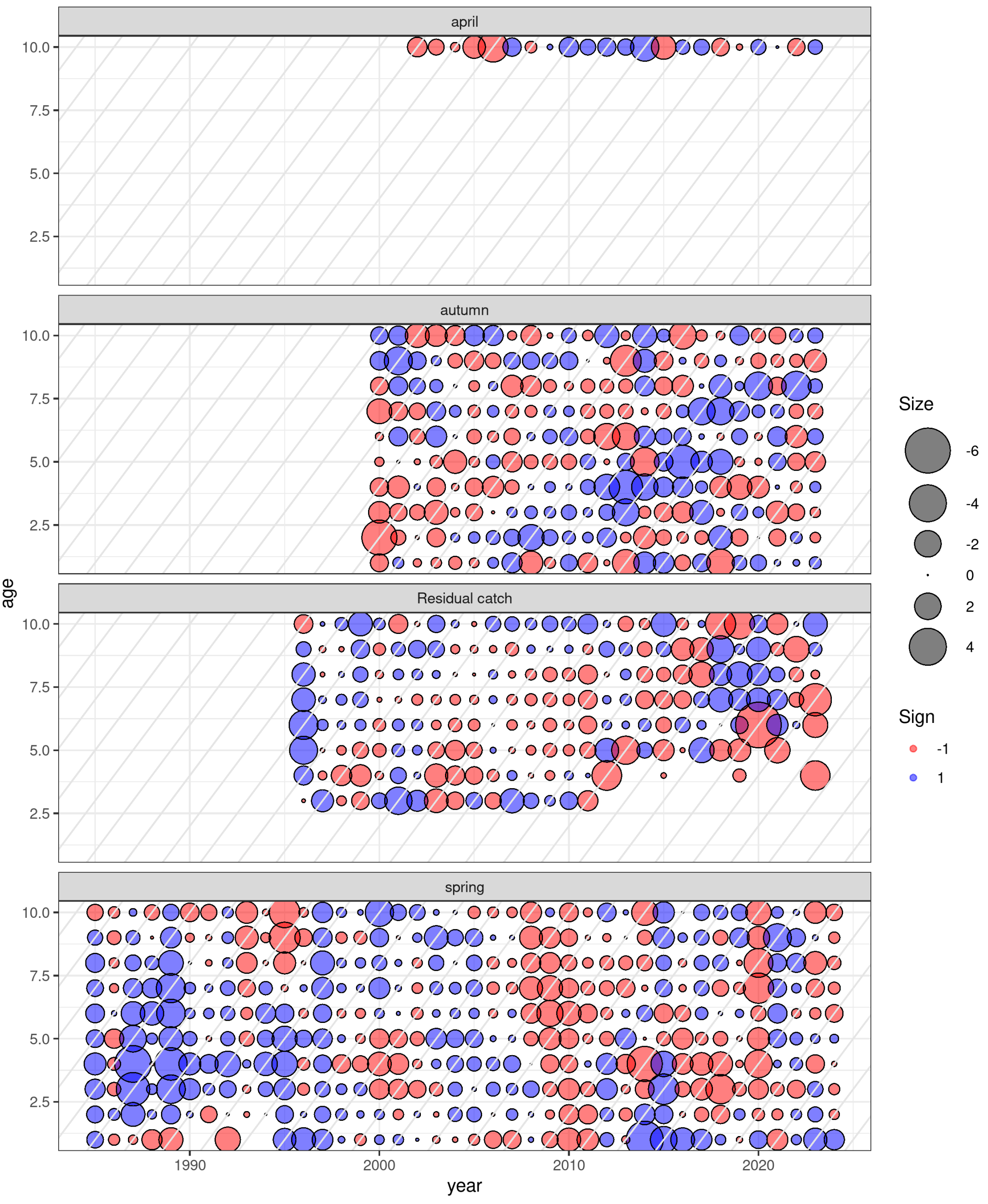

Figure 5.2.28: Tusk in 5.a and 14. Observation error residuals of the SAM model.

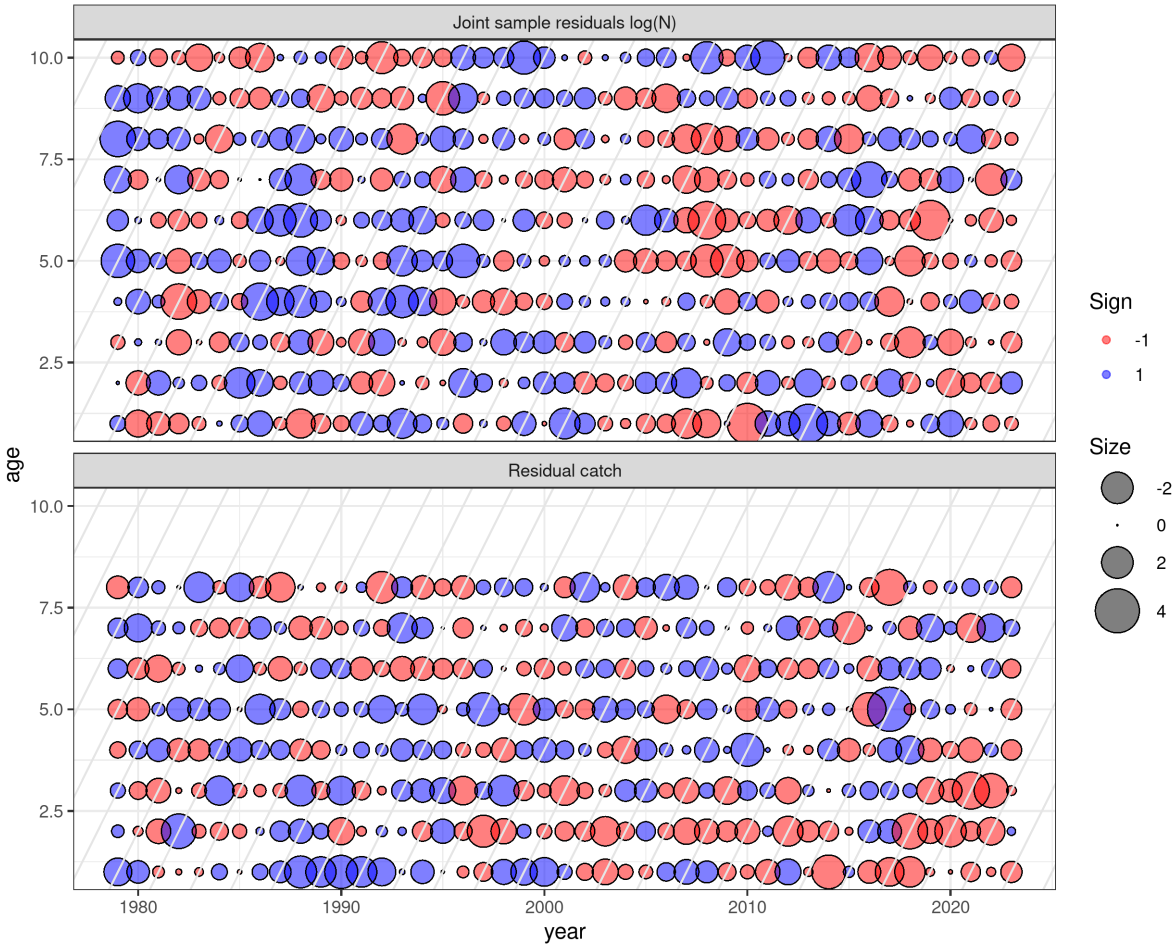

Figure 5.2.29: Tusk in 5.a and 14. Process error residuals of the SAM model.

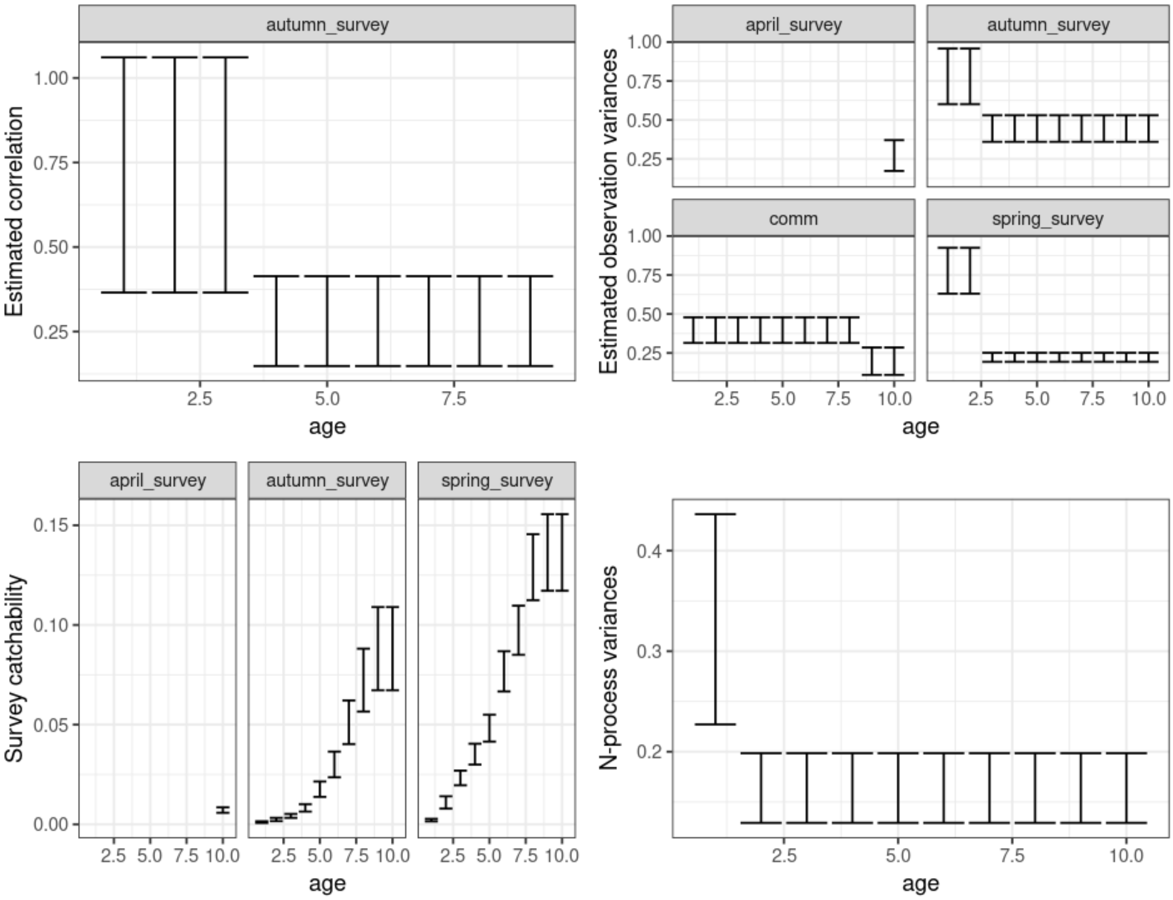

Figure 5.2.30: Tusk in 5.a and 14. Illustration of estimated model parameters.

5.2.5.6 Reference points

In the past, yield-per-recruit-based reference points, estimated as described in the stock annex, were used as proxies for Fmsy. Fmsy from a Y/R analysis is 0.24 and F0.1 is 0.15. WGDEEP 2014 recommended using Fmsy=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 (ICES 2017), the following reference points were defined for the stock. The management plan accepted at that time was: The spawning–stock biomass trigger (MGT Btrigger) 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 Btrigger:

TACy/y+1 = HRmgt*BRef,y

When SSBY is below MGT Btrigger:

TACy/y+1 = HRmgt* (SSBy/MGT Btrigger) * Bref,y

WKICEMSE 2017 concluded that the HCR was precautionary and in conformity with the ICES MSY approach, but the model started to show instability in retrospective patterns and was then benchmarked in 2022.

As part of the WKICEMP 2022, HCR evaluations requested by Iceland the following reference points were defined for the stock.

Table 5.2.7: Tusk in 5.a and 14. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	4800	B_{pa}
	F_{MSY}	0.23	Limited by F_{pa}, maximum F at which the probability of SSB falling below B_{lim} is <5%
Precautionary approach	B_{lim}	3400	B_{pa} x $e^{-1.645 * \sigma B}$
	B_{pa}	4800	B_{loss} (SSB in 2016)
	F_{lim}	0.44	Fishing mortality that in stochastic equilibrium will result in median SSB at B_{lim}.
	F_{pa}	0.23	Maximum F at which the probability of SSB falling below B_{lim} is <5%
Management plan	MGT $B_{trigger}$	4800	According to the management plan
	F_{MGT}	0.23	According to the management plan

The management plan proposed by Iceland is:

The proposed HCR for the Icelandic Tusk fishery, which sets a TAC for the fishing year y/y+1 (September 1 of year y to August 31 of year y+1) based on a fishing mortality F_{mgt} of 0.23 applied to ages 7 to 10 modified by the ratio SSB_y/MGT $B_{trigger}$ when SSB_y < MGT $B_{trigger}$, maintains a high yield while being precautionary as it results in lower than 5% probability of SSB < B_{lim} in the medium and long term. WKICEMSE 2022 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

5.2.6 Management

The Icelandic Ministry of Food, Agriculture and Fisheries 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 TACs were not filled, until the past two years when the TAC has been exceptionally low (Table 5.2.4).

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 5.2.31 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. In the 2017/2018-2019/2020 fishing years, net transfers were negative again with tusk quota being converted to other species, while 2020/2021 and 2021/2022 shows an overshoot of the quota. In 2023/2024, tusk quota was transferred to other species.

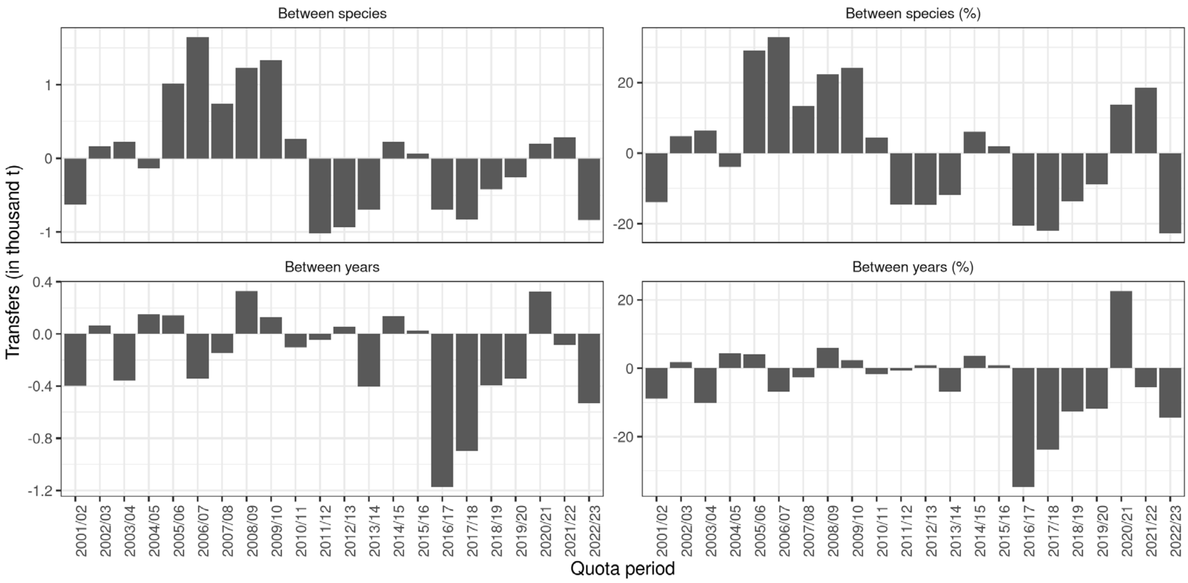

Figure 5.2.31: Tusk in 5.a and 14. Net transfer of quota in the Icelandic ITQ system by fishing year. Between species (upper): Positive values indicate a transfer of other species to tusk, but negative values indicate a transfer of tusk quota to other species. Between years (lower): Net transfer of quota for a given fishing year (may include unused quota).

Table 5.2.4. 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	MFRI Advice	National TAC	Landings
2001/02		4 500	4 876
2002/03	3 500	3 500	5 046
2003/04	3 500	3 500	4 958
2004/05	3 500	3 500	4 901
2005/06	3 500	3 500	5 928
2006/07	5 000	5 000	7 942
2007/08	5 000	5 500	7 279
2008/09	5 000	5 500	8 162

Fishing Year	MFRI Advice	National TAC	Landings
2009/10	5 000	5 500	8 382
2010/11	6 000	6 000	7 777
2011/12	6 900	7 000	7 401
2012/13	6 700	6 400	6 833
2013/14	6 300	5 900	5 881
2014/15	4 000	3 700	4 958
2015/16	3 440	3 000	3 494
2016/17	3 780	3 380	2 407
2017/18	4 370	4 370	3 139
2018/19	3 776	3 100	3 232
2019/20	3 856	3 856	3 241
2020/21	2 289	2 289	2 949
2021/22	2 172	2 172	2 421
2022/23	4 464	4 464	3 059
2023/24	5 139	5 139	
2024/25	5 914		

5.2.7 Management considerations

Increased catches in 14.b, and now 14.a also., from less than 100 tonnes in previous years to 900 tonnes in 2015, are of concern. In 2023, catches were also substantial, close to 800 tonnes. 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 assessment. Recruitment in 5.a shown high levels after a low in 2011. 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.

5.2.7.1 Ecosystem considerations

Tusk has recently exhibited spatial changes in length distributions (Figure 5.2.14), 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, ling, plaice, wolffish, see WKICEMP 2022, ICES 2022d). Tusk biomass levels have recently decreased, possibly as a result of increased natural mortality and environmental factors. However, the causes for this, such as multispecies interactions, are unknown and not currently considered in the assessment.

Table 5.2.8. Tusk in 5.a and 14. Estimates of biomass, biomass spawning–stock biomass (SSB) in thousands of tonnes and recruitment at age 1 (millions) and fishing mortality from the SAM model.

YEAR	BIOMASS	SSB	REC1	CATCH	F
1979	39055	16360	11896	6711	0.089
1980	39785	17573	10942	6706	0.103
1981	39931	19179	9327	6663	0.107
1982	38946	19099	7741	6370	0.113
1983	38793	18908	6464	6918	0.154
1984	31853	13821	6952	6032	0.138
1985	28982	11473	8708	5129	0.136
1986	29518	12040	8990	5541	0.138
1987	29824	12565	9085	5709	0.150
1988	29818	12388	7538	6722	0.170
1989	30118	12230	5728	7267	0.185
1990	27260	10606	5125	7323	0.211
1991	24750	8850	4690	8960	0.228
1992	23664	8007	4640	8414	0.247
1993	19324	6268	6165	5950	0.246
1994	17584	5478	7838	5979	0.278
1995	19457	5504	11580	6054	0.372
1996	18452	5446	14651	5815	0.391
1997	19078	5805	15101	5306	0.349
1998	19432	6312	14042	5069	0.341
1999	20808	7254	14101	6093	0.383
2000	19801	6993	19019	5304	0.332
2001	19850	5917	20646	4817	0.350
2002	20867	5847	22284	5192	0.373
2003	22341	5983	24861	5423	0.336
2004	24230	6344	25054	4999	0.287
2005	27463	6574	24838	5510	0.279
2006	30786	7595	22679	6715	0.316

YEAR	BIOMASS	SSB	REC1	CATCH	F
2007	32707	7556	18519	8130	0.360
2008	36110	7134	11594	8932	0.426
2009	34826	6679	7735	8998	0.451
2010	30833	6186	6205	8686	0.462
2011	29829	6122	4476	8202	0.399
2012	29961	6735	4218	7909	0.425
2013	27831	5342	6642	6421	0.411
2014	27374	4857	13326	6409	0.334
2015	22954	4874	17458	5945	0.325
2016	23470	4757	16906	4175	0.239
2017	22966	5011	21931	3333	0.208
2018	21181	4572	16110	3581	0.242
2019	20886	4039	17551	3784	0.247
2020	20486	3934	19733	2769	0.274
2021	22751	3918	24355	3144	0.219
2022	29213	5308	28568	3310	0.158
2023	35801	7086	38064	3606	0.145
2024	40987	8749	43736	3502	0.146

5.2.8 References

ICES. 2011. “Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 2 March–8 March, 2011, Copenhagen, Denmark. ICES Cm 2011/Acom:17.” International Council for the Exploration of the Seas; ICES publishing.

2012. “Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 28 March–5 April, 2012, Copenhagen, Denmark. ICES Cm 2012/Acom:17.” International Council for the Exploration of the Seas; ICES publishing.

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2022b. Iceland request for evaluation of a harvest control rule for tusk in Icelandic waters. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, sr.2022.6d, https://doi.org/10.17895/ices.advice.19625823

2022c. “Stock Annex: Tusk (Brosme brosme) in Division 5.a (Iceland grounds).” International Council for the Exploration of the Seas; ICES publishing. Unpublished

2022d. Workshop on the evaluation of assessments and management plans for ling, tusk, plaice and Atlantic wolffish in Icelandic waters (WKICEMP). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.19663971.v1

2022c. “Stock Annex: Tusk (Brosme brosme) in Division 5.a (Iceland grounds).” International Council for the Exploration of the Seas; ICES publishing. Unpublished

2022d. Workshop on the evaluation of assessments and management plans for ling, tusk, plaice and Atlantic wolffish in Icelandic waters (WKICEMP). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.19663971.v1

5.3 Tusk (*Brosme brosme*) on the Mid-Atlantic Ridge (Subdivision 12.a1)

5.3.1 The fishery

Tusk is bycatch in the gillnet and longline fisheries in Subdivision 12.a1 .

5.3.2 Landings trends

Landing statistics by nation in the years 1988 to 2023 are shown in Table 5.3.1 and Figure 5,3,1.

No landings have been reported since 2012.

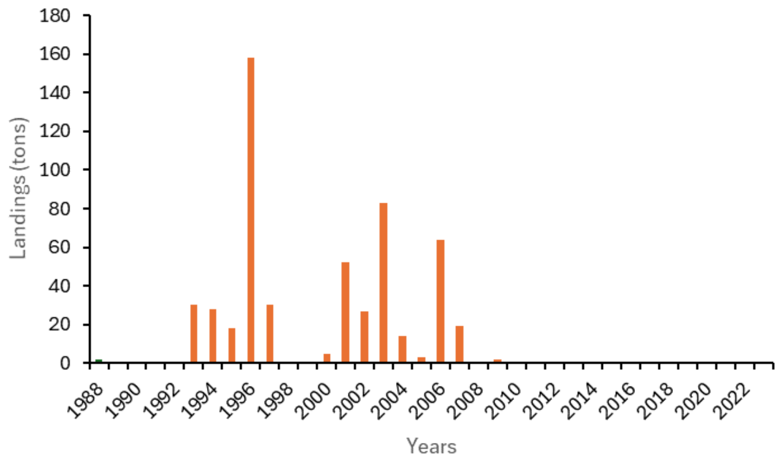

Figure 5.3.1. Total yearly landings in subdivision 12.a1 for 1988-2023.

5.3.3 ICES Advice

Advice for **2020 to 2024:** ICES advises that when the precautionary approach is applied, there should be zero catches in each of the years from 2020 to 2024.

5.3.3.1 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 consider 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.a1. WG estimate of landings.

Tusk 12.a1

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

Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
1996	7	-	9	142			158
1997	11	-	+	19			30
1998				-			~~1~~0
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
2014							0
2015							0
2016							0
2017							0
2018							0
2019							0
2020							0
2021							0
2022							0
2023							0

*Preliminary.

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

Year	12.a1	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	1
2013	0	0
2014	0	0
2015	0	0
2016	0	0

Year	12.a1	All areas
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	0	0
2022	0	0
2023*	0	0

***Preliminary.**

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

5.4.1 The fishery

Tusk are only caught as bycatch and not targeted in trawl, gillnet, or longline fisheries in Division 6.b. Norway has traditionally landed the largest catch of tusk in Division 6.b. During the period 1988–2020 Norwegian vessels have reported 70-80% of the total landings. Since January 2007, parts of the Rockall Bank have 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 25-27 since 2014. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The total number of days the fleet has been fishing in Division 6.b per year was a maximun of 464 fishing days in 2002 to 60 days in 2020. In 2021 and 2022, there was no fishing by Norwegian vessels in Division 6.b. In 2023 one Norwegian vessel fished in 6.b. (Figure 5.4.1).

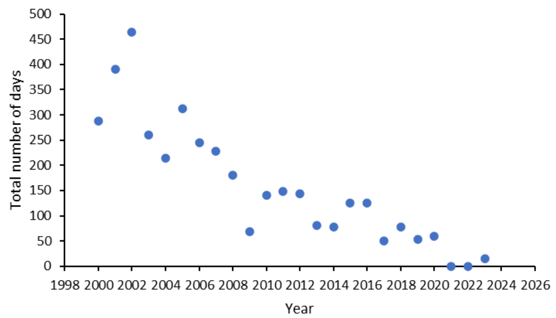

Figure 5.4.1. Estimated total number of days the Norwegian longline fleet fished for tusk (bycatch) during the period 2000 to 2023 based on logbooks.

5.4.2 Landings trends

Landing statistics by nation for the period 1988–2023 are in Table 5.4.1.

Landings varied considerably between 1988 and 2000. Landings peaked at 2344 t in 2000, and since 2000 have been much lower, and declining. In 2014 the catch was 38 tons, an all-time low during this period, while in 2015 the total catch increased to 226 tons, in 2023 the landings decreased to 31 tons (Figure 5.4.2).

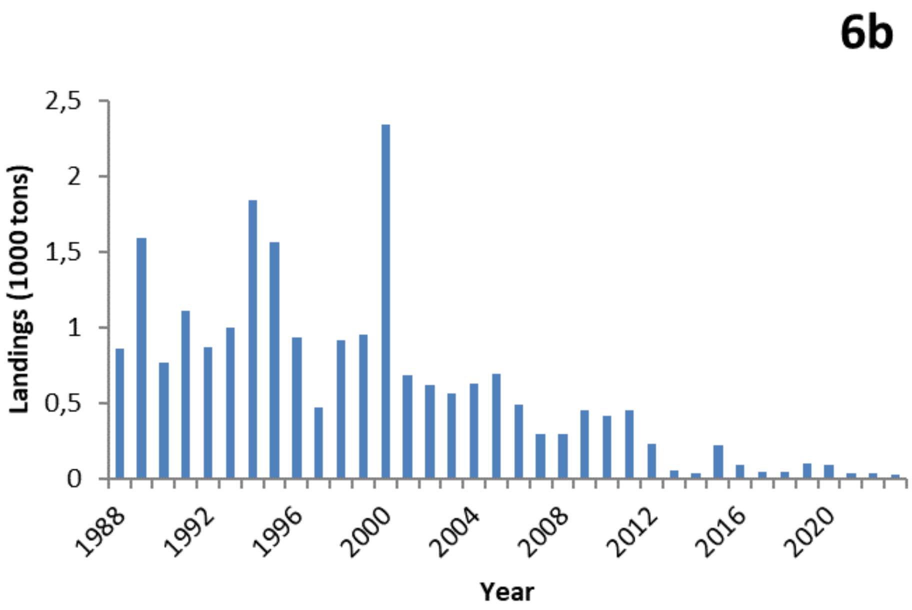

Figure 5.4.2. The international total landings of tusk from Division 6.b.

5.4.3 ICES Advice

ICES advises that when the precautionary approach is applied, catches should be no more than 224 tonnes in each of the years 2023 and 2024. If discard rates do not change from the average of the last three years (2019–2021), this implies landings of no more than 197 tonnes.

5.4.4 Management

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

Norway has a quota in UK waters in Subarea 6 set at 450 t in 2024.

The EU and UK TACs cover subareas 5, 6, 7 and the EU TAC was in 2024 set at 4868 t, while the UK TAC was set at 2072 t. Total TAC 6940 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. An overview over landings and discards are shown in Table 5.4.2.

Table 5.4.2. Landings, discards, total catch, and percentage discards of the total catch of tusk in 6.b since 2016.

Year	Landings	Discards	Total catches	% Discards
2016	90	7	97	7
2017	47	14	61	23
2018	47	21	68	31
2019	100	12	112	11
2020	91	24	116	21
2021	40	1	41	2.4
2022	40	0.3	40	0.8
2023	31	1	32	3.2

5.4.5.2 Length compositions

No new length composition data were available.

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 collecting and entering data from official logbooks into an electronic database in 2003, and data are now available for 2000–2020. 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.

5.4.6.1 Norwegian longline cpue

The CPUE series based on the Norwegian longliners show a decrease from 2000 to 2007. After this the CPUE had been at a low but stable level. No data was available for 2021 and 2022. (Figure 5.4.3).

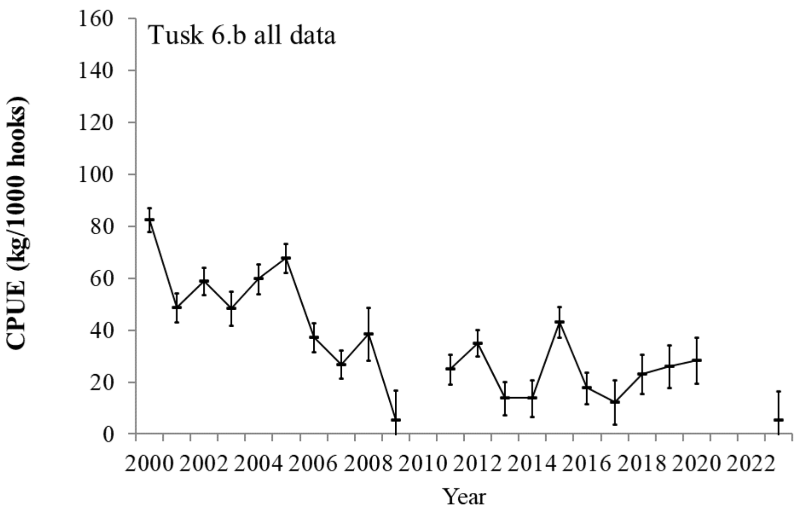

Figure 5.4.3. Estimated cpue (kg/1000 hooks) series for tusk in Division 6.b based on skipper's logbooks (during the period 2000–2023). The bars denote the 95% confidence intervals.

5.4.6.2 Biological reference points

No new data were presented.

5.4.7 Comments on the assessment

There are no assessments for tusk in this area.

5.4.8 Management considerations

Landings since 2001 have been low and generally decreasing. Except for 2015, landings have been very low (maximum 100 t per year) since 2013 (Table 5.4.1, Figure 5.4.2).

The decreasing fishing effort in Division 6.b. 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 Divison 6.b per year has decreased from a maximun of 464 fishing days in 2002 to 60 days in 2020, no fishery was carried out by Norway in 2021 and 2022 (Figure 5.4.1). In 2023 one Norwegian vessel fished in 6.b.

The CPUE series also shows a decreasing trend until 2007, after which bottom contacting gears were banned in Division 6.b. Since 2007, CPUE has been generally low but stable (Figure 5.4.3).

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 that a cpue series, which is based only on commercial catch data, truly tracks abundance.

In general, any assessment method based only on commercial catch data needs to be applied with increased caution. Assessments that use only commercial data are problematic because the relationship between trends in commercial catch rates and population size is normally unknown and probably varies from year to year.

5.4.9 Application of MSY proxy reference points

Length-based indicator method (LBI)

There is not enough length data or other biological data to apply the LBI method. Life history parameters such as L_{mat} have previously been based on tusk caught within Faroese waters. However, Rockall tusk is genetically different from tusk in neighbouring areas (Knutsen *et al*. 2009), and it is very likely that life history parameters like L_{mat} may also be different. Until these values have been established for Division 6.b, the use of the LBI method is not considered appropriate. No new length data or other biological data are available for 2023.

5.4.10 References

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

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	Spain	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	Spain	Total
2017				2		37			8			47
2018				2		35			10			47
2019				9		70			21			100
2020				9		51			31			91
2021		1		5					34			40
2022	3			6					31			40
2023*	4			4		13			9		1	31

***Preliminary.**

Table 5.4.1. (Continued).

Tusk, total landings in Division 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

Year	6.b	All areas
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
2016	90	90
2017	47	47
2018	47	47
2019	100	100
2020	91	91
2021	40	40
2022	40	40
2023*	31	31

***Preliminary.**

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

5.5.1 The fishery

Tusk are 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 other gears. For other nations, tusk is bycatch in trawl and longline fisheries.

Figure 5.5.1 shows the spatial distribution of the total catch by the Norwegian longline fishery in2023. 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 2023. 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 2023 the total number of hooks per year has varied considerably, but with a downward trend from 2002 to 2018. After 2018 the number og hooks per year has increased but not to the level in 2002. (For more information see Helle, WD 2024).

Since the total number of hooks per year considers 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 2011–2023 is 40% 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.

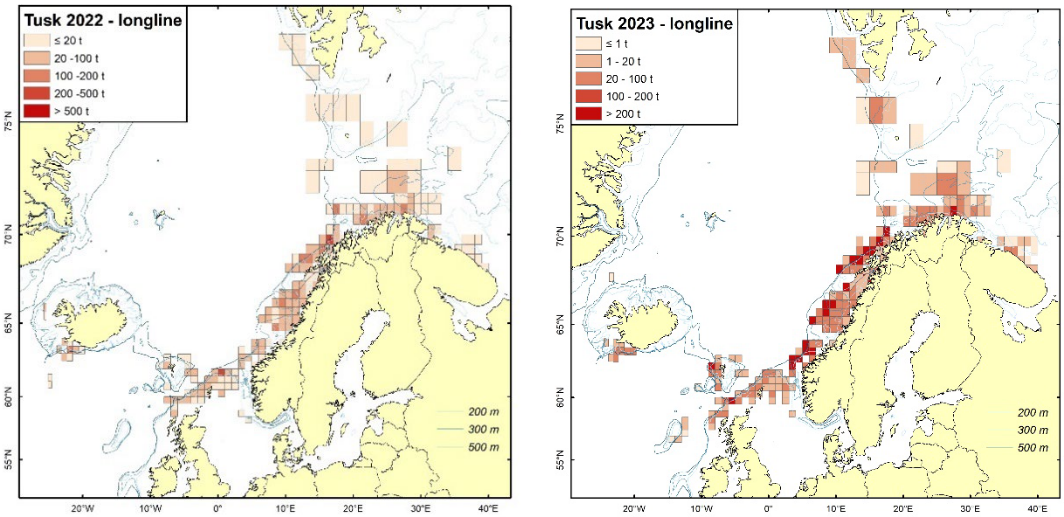

Figure 5. 5.1. Distribution of catches for the Norwegian longline fishery in Subareas 1 and 2 in 2022 and 2023.

5.5.2 Landings trends

Landing statistics by nation from 1988 to 2023 are given in Table 5.5.1a–d. Landings declined from 1989 to 2005, afterwards the landings increased and varied around 10.000 t. (Figures 5.5.2 and 5.5.3). The preliminary landings for 2023 are 10 792 t.

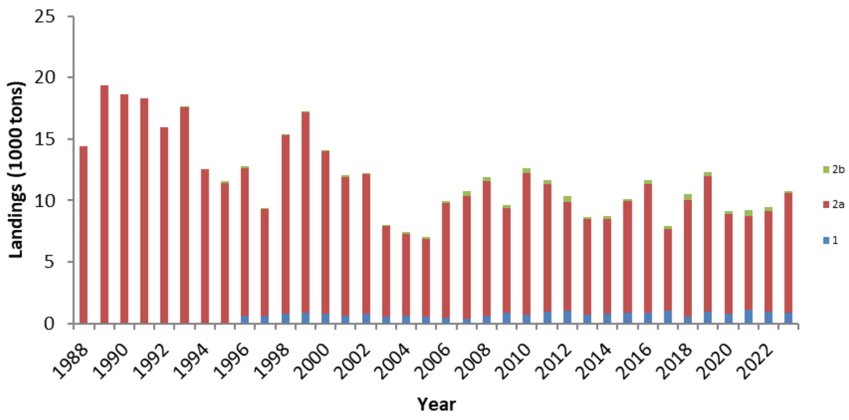

Figure 5.5.2. Total yearly landings of tusk in Areas 1 and 2 for 1988–2023.

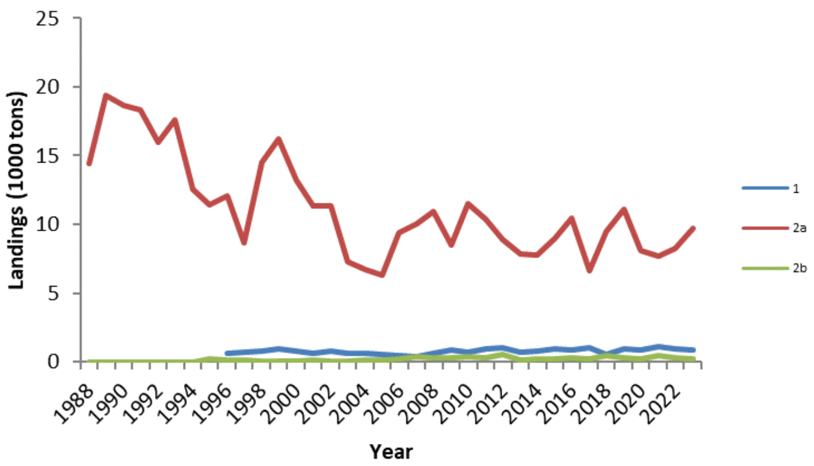

Figure 5.5.3. Total yearly landings of tusk in Areas 1 and 2 for 1988–2023.

5.5.3 ICES Advice

ICES advises that when the MSY approach is applied, catches should be no more than 8 071 tonnes in each of the years 2024 and 2025..

Advice based on the ICES rfb-rule

The assessment is based on ICES rfb-rule for data limited stocks for the first time this year, where life history traits, exploitation characteristics and other relevant parameters for data-limited stocks are considered (ICES 2021). The rfb-rule has the following form:

$$A_{y+1} = A_{y-1}\ r\ f\ b\ m$$

where A_{y+1} is the advised catch, A_{y-1} is last years advice, r corresponds to the trend in biomass index (as in the current ICES "2 over 3" rule), f is a proxy for the exploitation (mean catch length divided by an MSY reference length) and b a biomass safeguard (reducing the catch when biomass index drops below a trigger value).

The former advice when the ICES "2 over 3" rule was set to 8 076tonnes.

r is the ratio of the mean of the last two survey indices and the mean of the three preceding values or:

$$r = \frac{\sum_{i=y-2}^{y-1} I_1 /2}{\sum_{i=y-3}^{y-5} I_1 /3}$$

f is the length-ratio component where:

$$f = \frac{\overline{L}_{y-1}}{L_{F=M}}$$

where $\overline{L}$ is is the mean catch length above $L_{F=M}$. $L_{F=M}$ is calculated as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty$$

where L_c is length at first capture and $L\infty$ is von Bertalanffy $L\infty$. L_∞ for the tusk is 66.7 cm.

b is the biomass safeguard and is used to reduce catch advice when index falls below trigger,

$$b = min\left(1, I_y - 1/I_{trigger}\right)$$

where $I_{trigger}$ = $i_{loss\omega}$

m is a multiplier based on stock growth. K for ling tusk is < 0.17 and therefore m is 0.95.

Management

In 2024, the Norwegian quota for tusk in areas 1 and 2 of 8,071tonnes. There is no minimum landing length in the Norwegian EEZ.

5.5.4 Data available

5.5.4.1 Landings and discards

The amount landed is available for all the relevant fleets. The Norwegian fleets are now regulated by TACs, and there is a ban on discarding. The incentive for illegal discarding is, however, believed to be small. No discards were reported in 2023. 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 2001–2023.

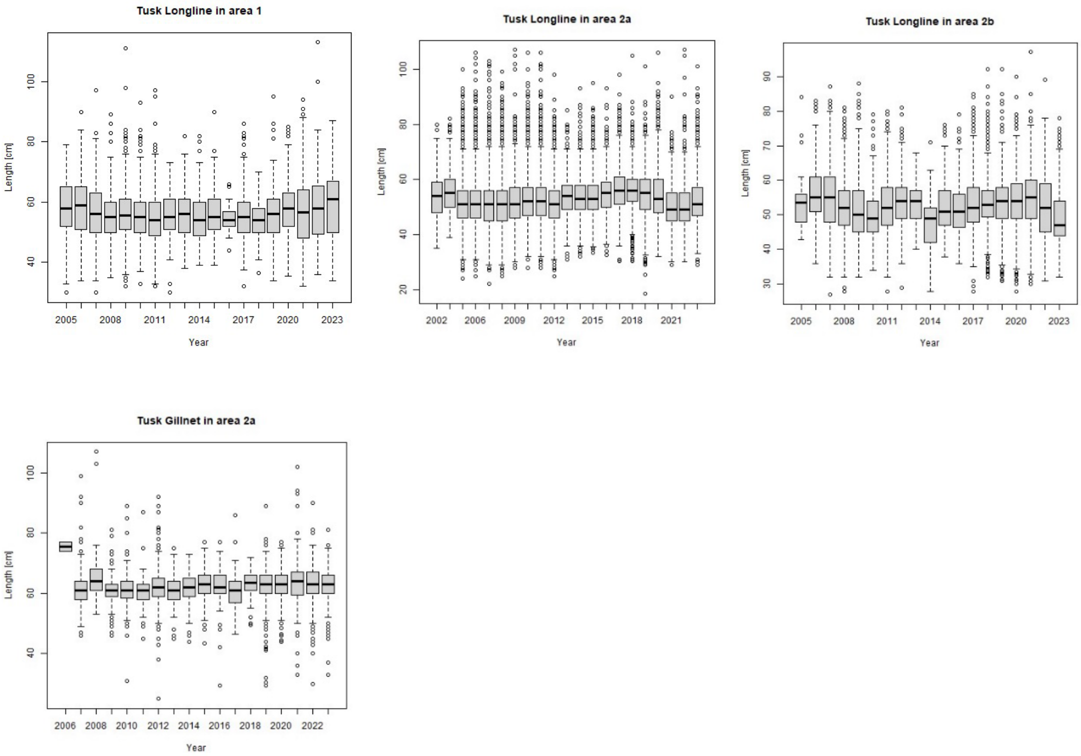

Figure 5.5.4. Box and whisker plots showing the length distribution of tusk. The data were provided by the Norwegian reference fleet for the period 2001–2023.

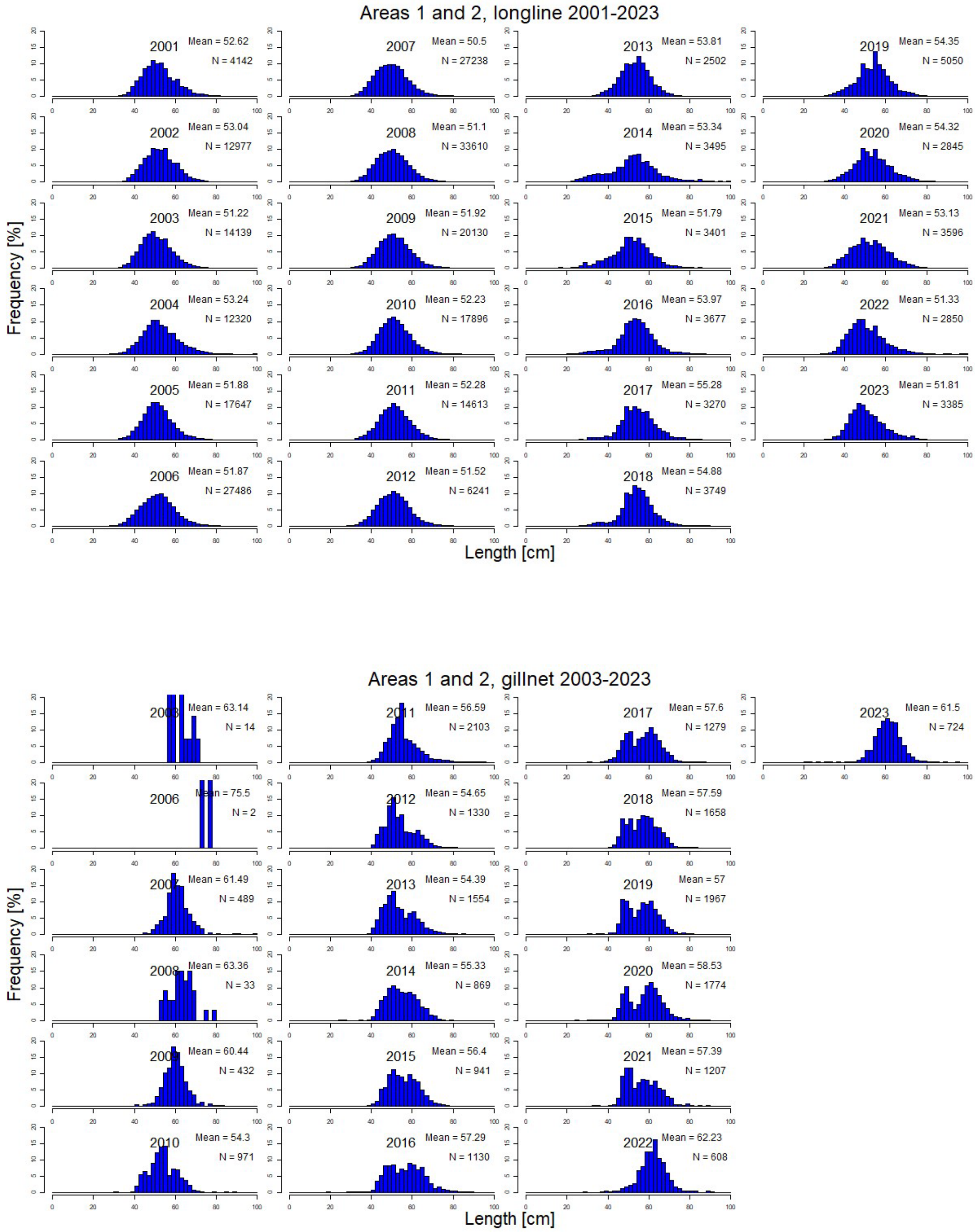

Figure 5.5.5. The estimated length distributions of the catch of tusk by Norwegian longliners and gillnetters combined for the Areas 1, 2.a and 2.b.

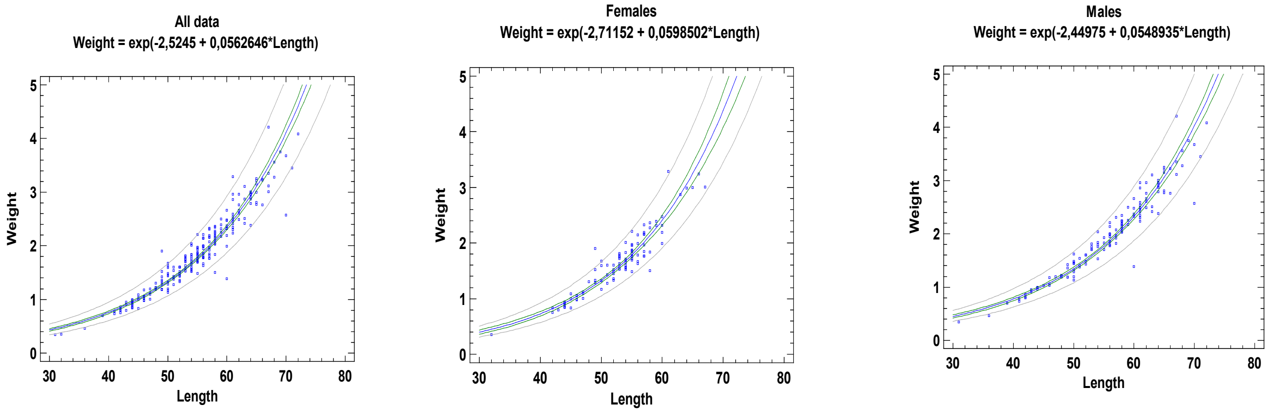

Figure 5.5.6. Length–weight relationship for tusk.

5.5.4.3 Age compositions

No new data are available.

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

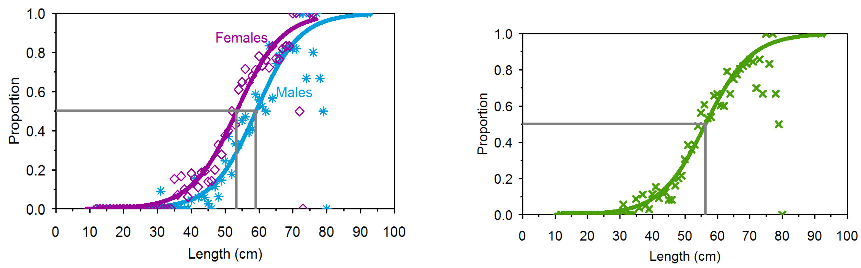

Figure 5.5.7. Tusk Area 1 and 2, Maturity ogive on length for males and females, and all data combined.

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 2000–2023. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t each year and with a total length above 21 m. 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, 2024. Two cpue series, one based on all data and one when tusk was targeted were presented (Figure 5.5.8). No research vessel data are available.

5.5.5 Data analyses

Length distribution

In Figures 5.5.4 and 5.5.5 are plots of the length distributions in Area 1 and 2 for 2001 to 2023. It appears that the mean length in Area 1 has varied slightly, while the mean length in Areas 2a and 2b has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery. In 2023 the average length was 5181 cm in the longline fishery and 61.5 cm in the gillnet fishery.

Assessment

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

CPUE

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 have been relative stable since 2011, but with a declining trend the last five years for the targeted fishery (Figure 5.5.8).

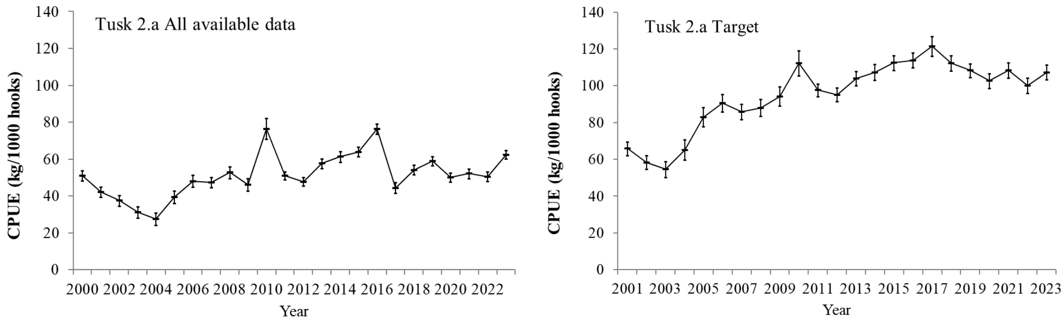

Figure 5.5.8. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbook data for 2000–2023. The bars denote the 95% confidence interval.

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

The fishing pressure on tusk has decreased considerably. The number of longline vessels fishing for tusk has decreased by about 65 percent from 2000 to 2018, and has been stable at 26 vessels thereafter.

The cod stock in the Barents Sea was very abundant for many years, but now there is a downward trend resulting in lower quotas. Because of lower quotas for cod the fishing pressure on tusk has increased considerably. To keep the fishing pressure down due to the decreased cod quota it was introduced a quota for tusk in 2023.

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.

5.5.1 The application of the rfb-rule

2023 was the first year the rfb-rule was applied for tusk in 1 and 2. Previously the “3 over 2”-rule has been used. The biomass index is based on the CPUE calculated from logbook data from the Norwegian longline fleet 2000-2022. The length data is from the Norwegian longline reference fleet. To get reliable values for K and Linf has been challenging. There is an ongoing work where these issues are being addressed and linf is set to 66.7, but in lieu of an estimate for k, the estimate from COSEWIC. (2012), where K=0.17 has been used.

Rfb-rule:

- r is calculated as the average of last two years values, divided by average of three preceding years values which results in r=0.97 (Figure 5.5.9, Table 5.5.2)

Figure 5.5.9: Ling in 1 and 2. Biomass index since 2000. The red lines show the average of last two years values and the three preceding years.

- *f* is the length-ratio component. The mean length of last years´ catch was 53 cm and the target reference length (L*c* or length at first capture * 0.75 + length ∞ * 0.25) is **49** (figure 5.5.10).

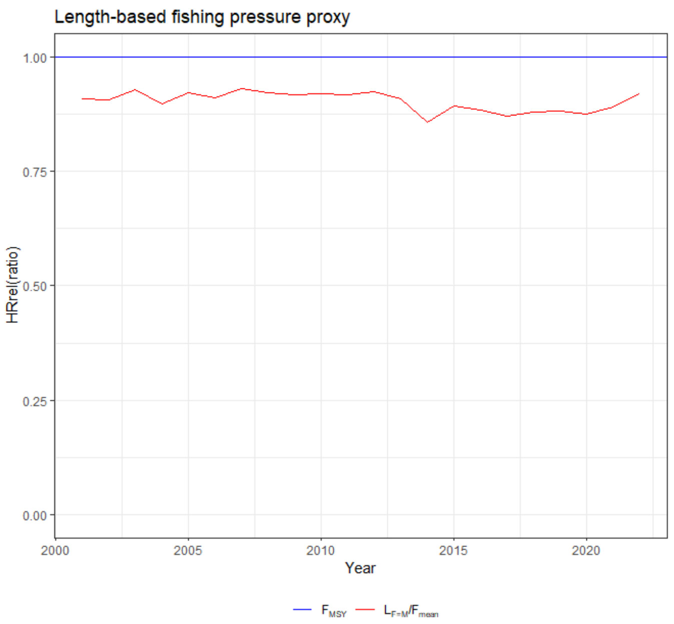

Figure 5.5.10: Ling in 1 and 2. Ling in subareas 1 and 2. Index ratio of the average length relative to the expected length when fishing mortality equals natural mortality ($L_{mean}/L_{F=M}$) for the Norwegian longline fleet from the length-based indicator method used for the evaluation of the exploitation status. The exploitation status is below the $F_{MSY\ proxy}$ when the index ratio value is higher than 1.

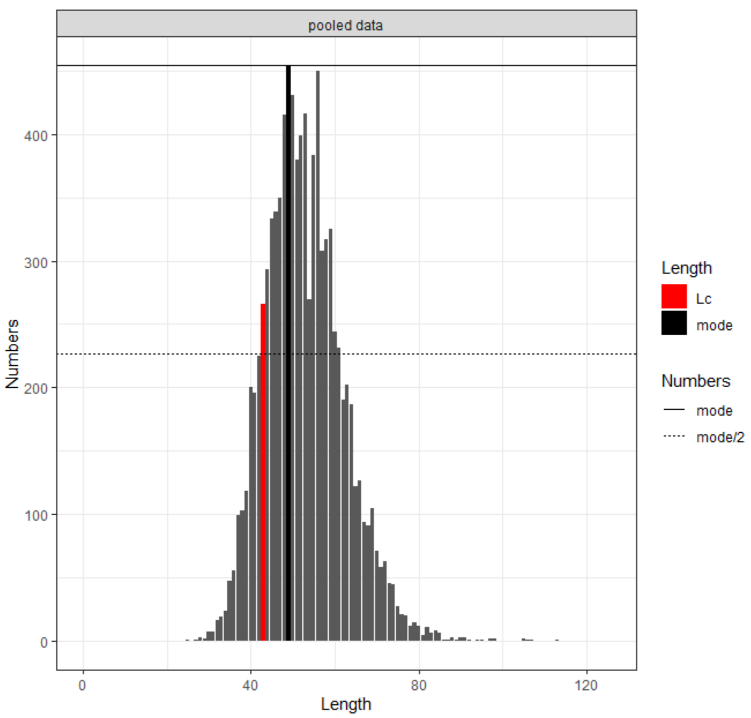

Figure 5.5.11: Tusk in 1and 2. Length frequency distribution from catches. Black line is the length of modal abundance, the red line is the length at first capture.

- *b* is the biomass safeguard and is used to reduce catch advice when index falls below trigger. The lowest index or the I_{loss} for tusk is 55 and was recorded in the year 2003. $I_{trigger}$ is I_{loss} *1.4 or 76 (Figure 5.5.12). Biomass index this year is above $I_{trigger}$ and *b* is therefore 1.

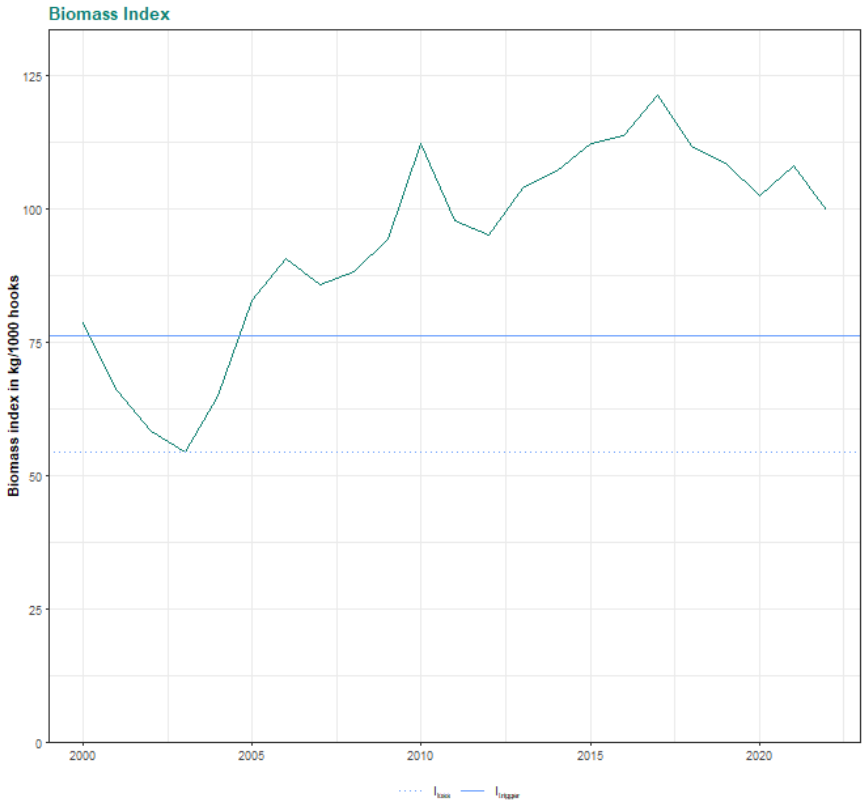

Figure 5.5.12: Ling in 1 and 2. Biomass index values since 2000. The blue line is the $I_{trigger}$ and the doted is the lowest observed value (I_{loss}).

- *m* is the tuning parameter and for slow growing species (with von Bertanlaffy K<0.2), *m* equals to 0.95.

Table 5.5.2 Tusk Subareas 1 and 2. The basis for the catch scenarios^. Catches are in tonnes.*

Previous catch advice A_y	8076 tonnes
Stock biomass trend	
Index A (2021, 2022)	104
Index B (2018, 2019, 2020)	107
r: stock biomass trend (index ratio A/B)	0.97
Fishing pressure proxy	
Mean catch length ($L_{mean} = L_{2022}$)	53 cm
MSY proxy length ($L_{F=M}$)	49 cm
f: fishing pressure proxy relative to MSY proxy ($L_{2022}/L_{F=M}$)	1.09
Biomass safeguard	
Last index value (I_{2022})	100
Index trigger value ($I_{trigger} = I_{loss} \times 1.4$)	76
b: index relative to trigger value, min{$I_{2021}/I_{trigger}$, 1}	1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
Stability clause (+20%/−30% compared to A_y, only applied if b ≥ 1)	Not applied
Discard rate	0 %
Catch advice for 2024 and 25**	8071 tonnes
% advice change^	-0.06%

^ The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.
** Formula [$A_y \times r \times f \times b \times m$]
^ Advice value for 2024/2025 relative to the advice value for 2021/2022 (5 tonnes).

5.5.2 Application of MSY proxy reference points

Summary of SPiCT from benchmark meeting; for tusk in Subareas 1 and 2

It was not possible for the group to recommend or approve a SPiCT assessment for this stock. The reason for this was primarily the construction of the CPUE index; the CPUE index itself was not disregarded but it was not regarded suitable for the SPiCT model. Two points were pointed out as problematic; the targeting effect and technological creep. Especially handling the targeting effect; the spatial-time interactions must be solved before data can be used by SPiCT.

The recommendations from the benchmark were to enhance the standardization of the CPUE and either try an integrated model or try SPiCT again with the new CPUE. The stock should continue to be assessed as category 3 stock.

Input data for tusk arctic was the landings time series with historical landings back to 1908-2020. The abundance index was the CPUE index from the longline fishery from 2000-2020. Two variants of the CPUE index were used; one with all catches and one with only catches with more than 30% tusk.

The model was run with priors on initial depletion level and on the shape of the production curve.

The catch series is almost stable at the end of the series; this together with the very steep increase in the 30% CPUE made the CPUE to drive the model. The increase in all catches CPUE is not as pronounced as the targeted CPUE and that is probably why the model fits better to this scenario.

The very steep increase in CPUE over the short time is problematic as the model estimate the stock to be 2–4 times BMSY and to have F below FMSY. The very high r (0,3–1,0) seems to be unrealistic as the expected value for r should be 0.12 for tusk (SPMpriors from Fish-Life). The very long catch time series (with low and high catches) and the short CPUE time series by the end of the catch time series period probably entails alternative states that are hidden to current SPiCT runs.

Stock status assessed by SPiCT indicated that B was above BMSY and F below FMSY. Other models were tried that came to contradictory conclusions. The development on B and F from SPiCT were to the assessors not totally unrealistic as the result plots to some extent resembled the history of the fishery and the believed present stock status for tusk in this area. The problem is that F probably was higher in the 1970–1980s than the model estimate. Together with the increase in CPUE this probably makes the results from the SPiCT model to be too optimistic.

The assessments on SPiCT could not be approved according to the uncertainty in the CPUE index and due to the observed inconsistencies described above. Link to the benchmark report: https://www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=37488

Results for the LBI, WGDEEP 2023

Information and data

The input parameters and the catch's length distribution for the period 2001-2023 are in the following tables and figures. The length data used in the LBI model are from the Norwegian long-liner fleet. The length data are not raised to total catch.

Table 5.5.3 Tusk in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length frequency distribution	2001-2023	Norwegian long-liners (Reference fleet)	
Length-weight relationship	$0.0106 * length^{3.0168}$	Norwegian long-liners (Reference fleet) and survey data.	combined sex
L_{MAT}	56 cm	Norwegian long-liners (Reference fleet) and survey data.	
L_{inf}	66.7 cm (L_{max})	Norwegian long-liners (Reference fleet) and survey data.	

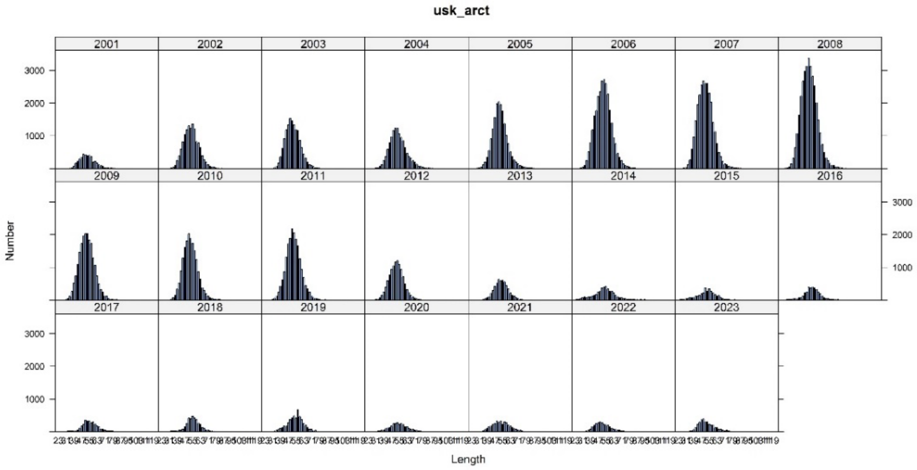

Figure 5.5.9 Tusk in arctic waters (1, 2a, 2b). The length distribution (2 cm length bins) based on data from the Norwegian longline fleet for the period 2001–2023 (sex combined).

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.

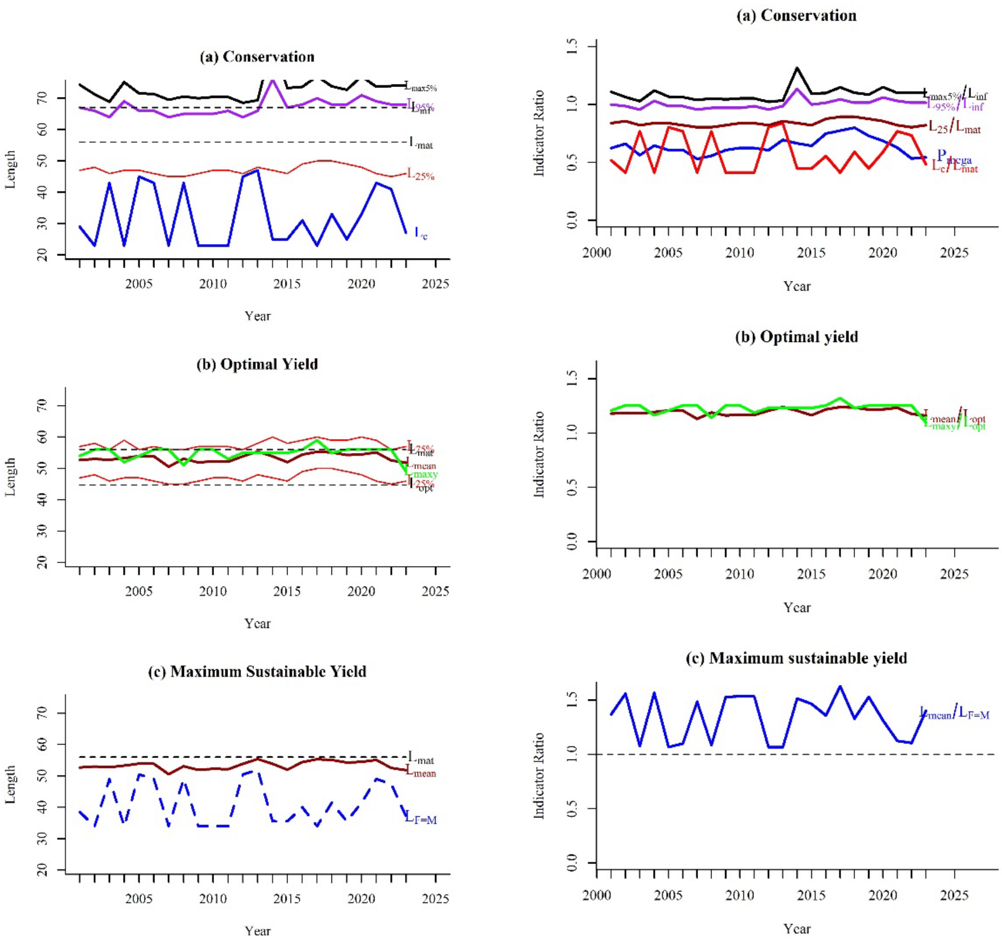

Figure 5.5.14 Tusk in arctic waters (1, 2.a, 2.b). Using length indicators ratios for sex combined to examine three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

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. 14, Table 6.5.4). 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 above 1 in 2020-2023 (Table 6.5.10). 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 2021 to2023 (Figure 4.3.14), which indicates that tusk in arctic waters is fished sustainably for these years.

Conclusion: The overall perception of the stock during the period 2020–2023 is that tusk in arctic waters seems to be fished sustainably(Table 6.5.4). 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). The 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**
2021	0,77	0,82	1,10	63 %	1,23	1,12
2022	0,73	0,80	1,10	53 %	1,18	1,11
2023	0,48	0,82	1,10	54 %	1,16	1,40

Table 5.5.5 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				
	2021	2022	2023	
MSY (F/F_{MSY})	✓	✓	✓	Fished sustainably
Stock size				
	2019	2020	2021	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

5.5.3 References

COSEWIC. 2012. COSEWIC assessment and status report on the Cusk Brosme brosme in Canada.Committee on the Status of Endangered Wildlife in Canada. Ottawa. 85 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

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Pennington, M., and Strømme, T. (1998). Surveys as a research tool for managing dynamic stocks. Fisheries Research 37, 97–106.Rosenbaum, P.R.2002. Observational Studies (second ed.), Springer-Verlag, New York, NY (2002) (377 pp.)

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https://www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=37488

5.5.4 Tables

Table 5.5.1 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
2019	944	1		1			946
2020	813	4					817
2021	1073	9					1082
2022	935						935

2023	863	863

***Preliminary.**

Table 5.5.1 b. Tusk in Division 2.a. Official landings.

Year	Faroes	France	Ger-many	Green-land	Norway	E & W	Scot-land	Russia	Ire-land	Ice-land	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

Year	Faroes	France	Ger-many	Green-land	Norway	E & W	Scot-land	Russia	Ire-land	Ice-land	Total
2014	10	9	1		7682		7	38			7743
2015	19	5			8906	1		90			9021
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
2019	13	3	3		10980			70		1	11070
2020	18	1	1	1	7964			92		2	8079
2021	5	4			7564	3		98			7674
2022	19	4	4		8213					4	8241
2023*	43	1	3		9692	2				4	9745

*Preliminary.

(1) Includes 2.b.

Table 5.5.1 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

Year	Norway	E & W	Russia	Ireland	France	Total
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
2017	153		81			234
2018	427		37			464
2019	241		53			294
2020	200		26			226
2021	408		63			471
2022	311					311
2023*	184					184

Table 5.5.1 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

Year	1	2a	2b	All areas
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
2017	1037	6655	234	7926
2018	557	9466	464	10487
2019	946	11070	294	12310
2020	817	8079	226	9122
2021	1082	7674	471	9227
2022	935	8241	311	9487

Year	1	2a	2b	All areas
2023	863	9745	184	10792

***Preliminary.**

5.6 Tusk (*Brosme brosme*) in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12

5.6.1 The fishery

Tusk is bycatch in the trawl, gillnet and longline fisheries in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and 12. Norway has traditionally landed the major proportion of the 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 1988–2023, 34% of the landings have been in Area 4, 48% in Division 5.b, and 16% in Area 6.a.

In Division 5.b, tusk was mainly fished by longliners (around 90% of the catch), and the rest of the catch of tusk was taken by large trawlers. The main fishing grounds for tusk are on the slope around the Faroe Plateau and on the Faroe Bank in areas deeper than approximately 200 m. The Norwegian longline fishery decreased from an average 15 days per vessel in 2019 to 12 days per vessel in 2023.

5.6.2 Landings trends

Landing statistics by nation in 1988–2023 are in Table 5.6.1 and are shown by year in Figure 5.6.1.

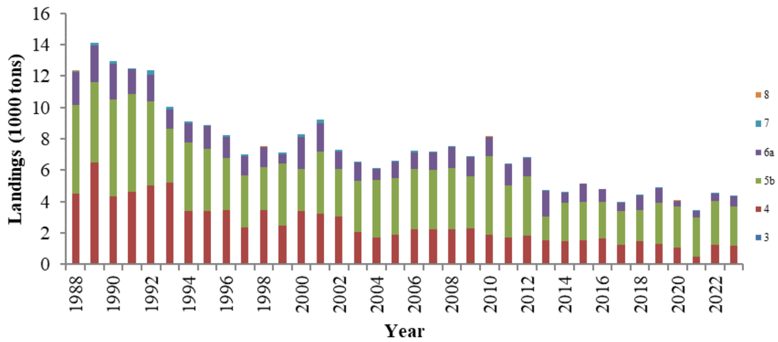

Figure 5.6.1. Landings of tusk per year for 1988–2023.

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 4332 tons in 2023 (Figures 5.6.1 and 5.6.2).

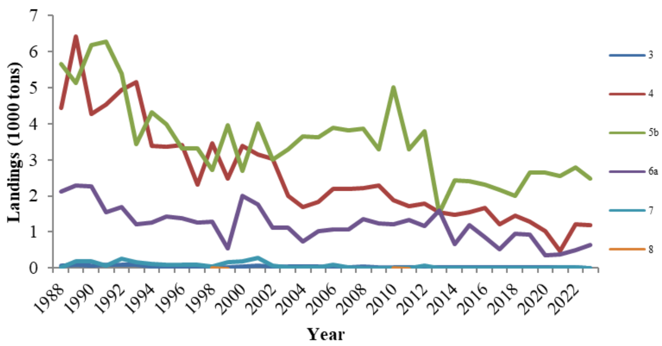

Figure 5.6.2. Landings of tusk by area for 1988–2023.

5.6.3 ICES Advice

Advice for 2024 and 2025: ICES advises that when the MSY approach is applied, catches should be no more than 6 924 tonnes in each of the years 2024 and 2025. If discard rates do not change from the average of the last five years (2018–2022), this implies landings of no more than 6 804 tonnes.

Advice based on the ICES rfb-rule

The assessment is based on ICES rfb-rule for data limited stocks for the first time this year, where life history traits, exploitation characteristics and other relevant parameters for data-limited stocks are considered (ICES 2021). The rfb-rule has the following form:

$$A_{y+1} = A_{y-1}\ r\ f\ b\ m$$

where A_{y+1} is the advised catch, A_{y-1} is last years advice, r corresponds to the trend in biomass index (as in the current ICES "2 over 3" rule), f is a proxy for the exploitation (mean catch length divided by an MSY reference length) and b a biomass safeguard (reducing the catch when biomass index drops below a trigger value).

The former advice when the ICES "2 over 3" rule was set to 7821 tonnes.

r is the ratio of the mean of the last two survey indices and the mean of the three preceding values or:

$$r = \frac{\sum_{i=y-2}^{y-1} I_1\ /2}{\sum_{i=y-3}^{y-5} I_1\ /3}$$

f is the length-ratio component where:

$$f = \frac{\bar{L}_{y-1}}{L_{F=M}}$$

where $\bar{L}$ is is the mean catch length above $L_{F=M}$. $L_{F=M}$ is calculated as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty$$

where L_c is length at first capture and $L\infty$ is von Bertalanffy $L\infty$. Tusk in this stock has L_∞ of 77.9 cm

b is the biomass safeguard and is used to reduce catch advice when index falls below trigger,

$$b = min\left(1, I_y - 1/I_{trigger}\right)$$

where $I_{trigger} = i_{loss\omega}$

m is a multiplier based on stock growth. K for tusk is < 0.17 and therefore m is 0.95.

5.6.4 Management

There are a licensing scheme and effort limitation in Division 5.b. The minimum landing length for tusk in Division 5.b is 40 cm. Norway has a bilateral quota with Faroe Islands in 5.b, which is 1300 t tusk for 2024 (sínámillum-fiskiveiðiavtalan-millum-føroyar-og-noreg-fyri-2024.pdf).

In 2024, the Faroese Party 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 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, if catches in this area do not exceed 500 tonnes of deep-sea species (fiskiveiðiavtala-millum-føroyar-og-russland-fyri-2024.pdf).

There is an agreement between the United Kingdom of Great Britain and Northern Ireland and Faroe Islands for 2024 (sínámillum-fiskiveiðiavtala-millum-føroyar-og-russland-fyri-2024.pdf).

In the North Sea (ICES 4), Norwegian vessels can fish up to 30,000 tons of demersal fish in the UK zone. The quota for the EU in the Norwegian zone (Subarea 4) is set at 50 t, but only three vessels can be operating simultaneously Norwegian vessels have a TAC of 650 tons tusk in ICES 6

EU TACs for 2015-2024 are given in table 5.6.2a and 5.6.2b.

Table 5.6.2.a. TACs tusk in subareas 4 and 7–9, and in divisions 3.a, 5.b, 6.a (Before Brexit). All weights are in tonnes. (2015-2023)

Year	TAC EU Subarea 3	TAC EU Subarea 4 (EU waters)	TAC EU Subarea 4 (Norwegian waters)	TAC EU, Subareas 5,6, 7	TAC Norway2.a and 5.b,4, 6 and 7
2015	29	235	170	937	2923
2016	29	235	170	937	2923
2017	29	235	170	937	2923
2018	31	251	170	1207	2923
2019	31	251	170	1207	2923
2020	31	251	170	1207	2923
2021		251	-	4294	-

Table 5.6.2.b. TACs tusk in subareas 4 and 7–9, and in divisions 3.a, 5.b, 6.a. All weights are in tonnes. After Brexit.

Year	TAC EU Subarea 3	TAC EU Subarea 4 (EU waters)	TAC UK Subarea 4 (UK waters)	TAC EU Subarea 4 (Norwegian waters)	TAC EU, Subareas, 5, 6 ,7	TAC UK Subareas 5, 6 and 7	TAC Norway Subarea 6	TAC UK waters to Norway Subarea 4 (UK waters)
2021	-	149	102	-	3037	1257	-	-

Year	TAC EU Sub-area 3	TAC EU Subarea 4 (EU waters)	TAC UK Sub-area 4 (UK waters)	TAC EU Sub-area 4 (Norwegian waters)	TAC EU, Subareas, 5, 6 ,7	TAC UK Subareas 5, 6 and 7	TAC Norway Subarea 6	TAC UK waters to Norway Sub-area 4 (UK waters)
2022	-	136	92	50 (TAC Not relevant)	3029	1265	650	30 000*
2023		136	92	50 (TAC Not relevant)	3022	1272	380	30 000*
2024		124	84	50 (TAC Not relevant)	4868	2072	380	30 000*

*** Norwegian vessels can fish up to 30,000 tons of demersal fish in the UK zone Subarea 4**

.NEAFC recommended that in 2009 the effort in areas beyond national jurisdictions should 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 2013–2023 (Table 5.6.3), and by area and country for 2020 (Table 5.6.4).

Table 5.6.3 Total discards of tusk by country for 2013 to 2022.

	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
2019			5	63		5	4862	73	4931	1.5
2020		2		67			4065	69	4134	1.7
2021	1		1	71		3	3408	76	3484	2.2
2022	1			51	1	1	4550	54	4604	1.2
2023	1.3		0.4	29.2	2	0.3	4328	33	4361	0.8

Table 5.6.4. Discards of tusk in 2022 by area on country.

Area	Country	Discards
27.3.a.	Denmark	2.0
27.4.a	France	0.4
27.4	Germany	0.3
27.4	UK (Scotland)	29
27.5.b	UK(Scotland)	0.2
27.6a	Spain	1.3
Total		**33**

5.6.5.2 Length compositions

Norwegian reference fleet data

Figure 5.6.3a and b shows the estimated length distributions of tusk in divisions 4.b, 5.b and 6.a based on data provided by the Norwegian reference fleet for 2001–2023, and Figure 5.6.4 shows the estimated length distributions of the catch of tusk by Norwegian longliners, combined, for divisions 4.a, 5.b and 6.a.

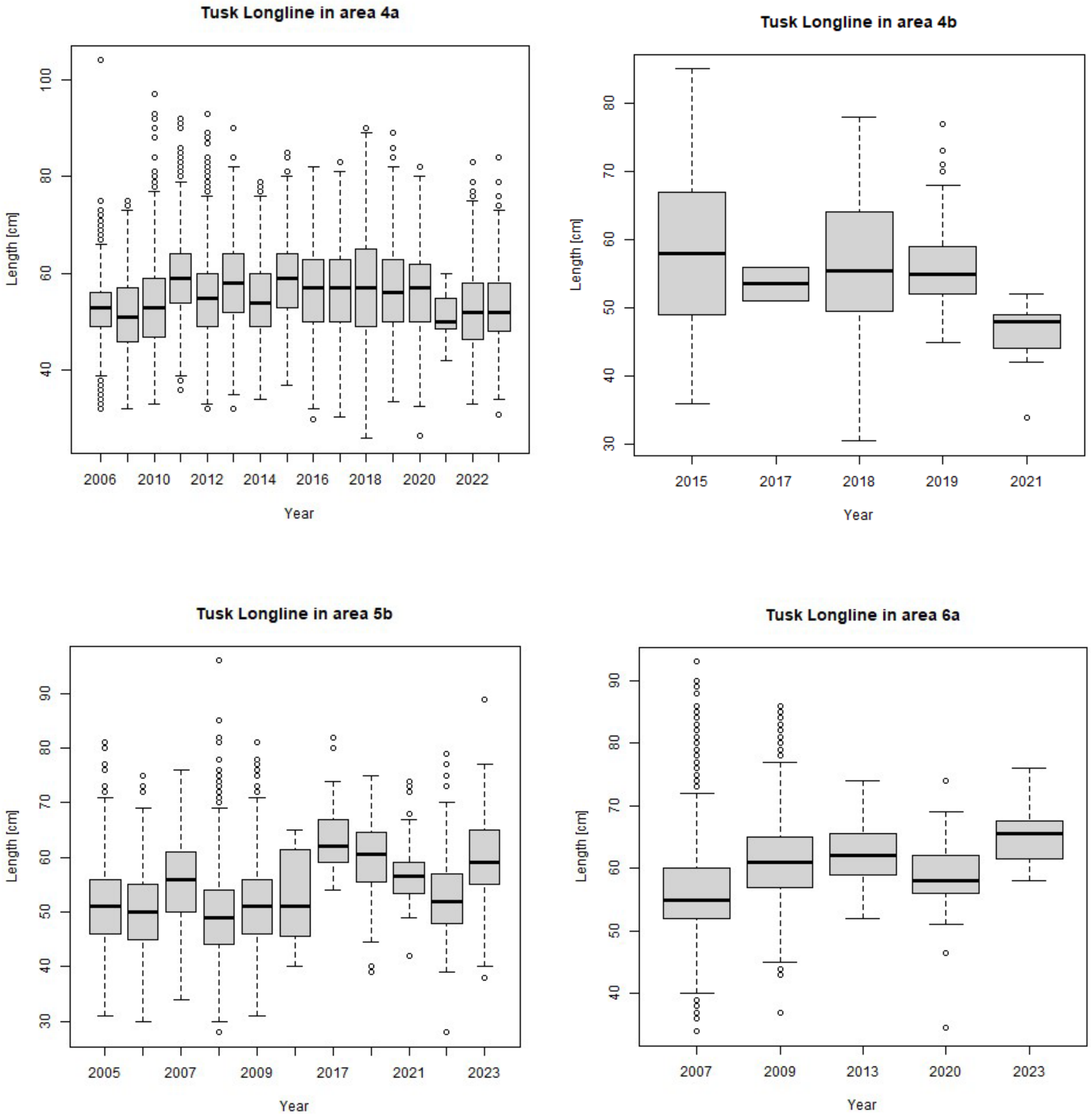

Figure 5.6.3a. Length distributions of tusk in Areas 4.a, 4.b, 5.b and 6.a for 2001–2023, based on longline data from the Norwegian reference fleet.

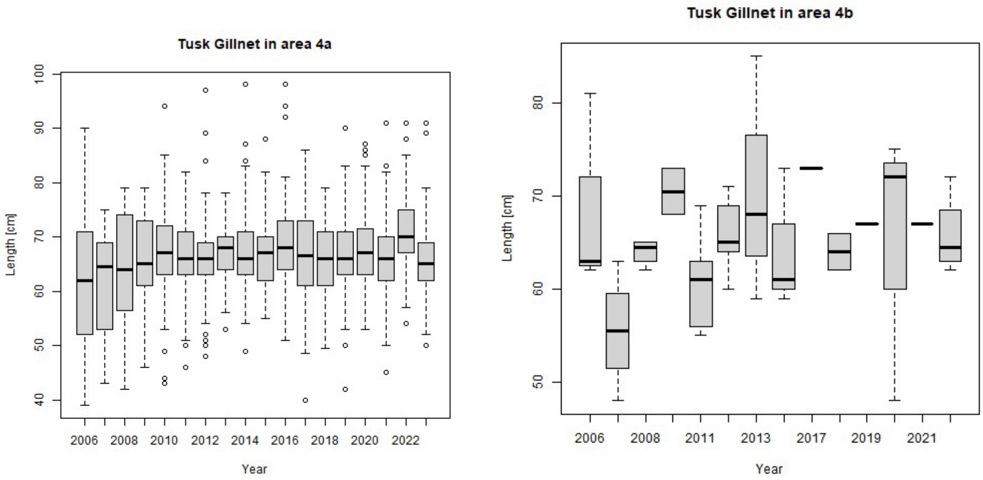

Figure 5.6.3b. Length distributions of tusk in Areas 4.a, 4.b, 5.b and 6.a for 2001–2023, based on gillnet data from the Norwegian reference fleet.

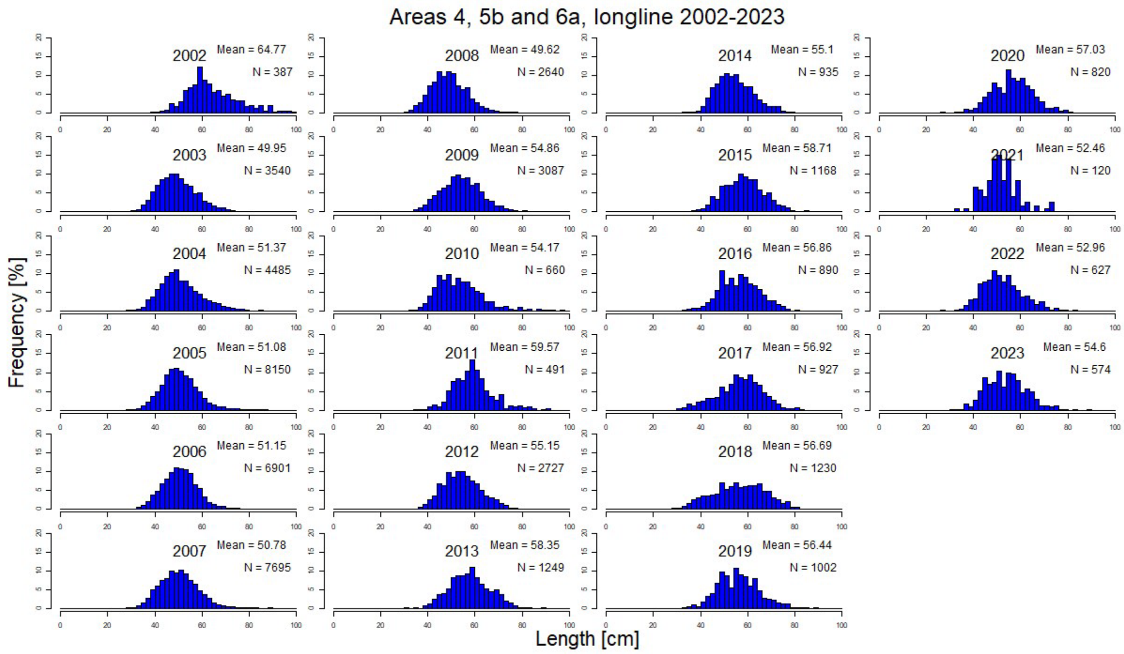

Figure 5.6.4. The estimated length distributions of the catch of tusk by Norwegian longliners, combined, for Areas 4.a, 5.b and 6.a.

Faroese length data

In Division 5.b is 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 the annual spring- and summer groundfish surveys conducted on the Faroe Plateau are presented in Figures 5.6.6 and 5.6.7. In WGDEEP Report 2020 length distributions of tusk caught in other surveys in Division 5.b such as deep water survey (2014- present), Greenland halibut survey (1995- present), redfish trawl survey (2003-2011) and blue ling trawl survey (2000-2003) was presented.

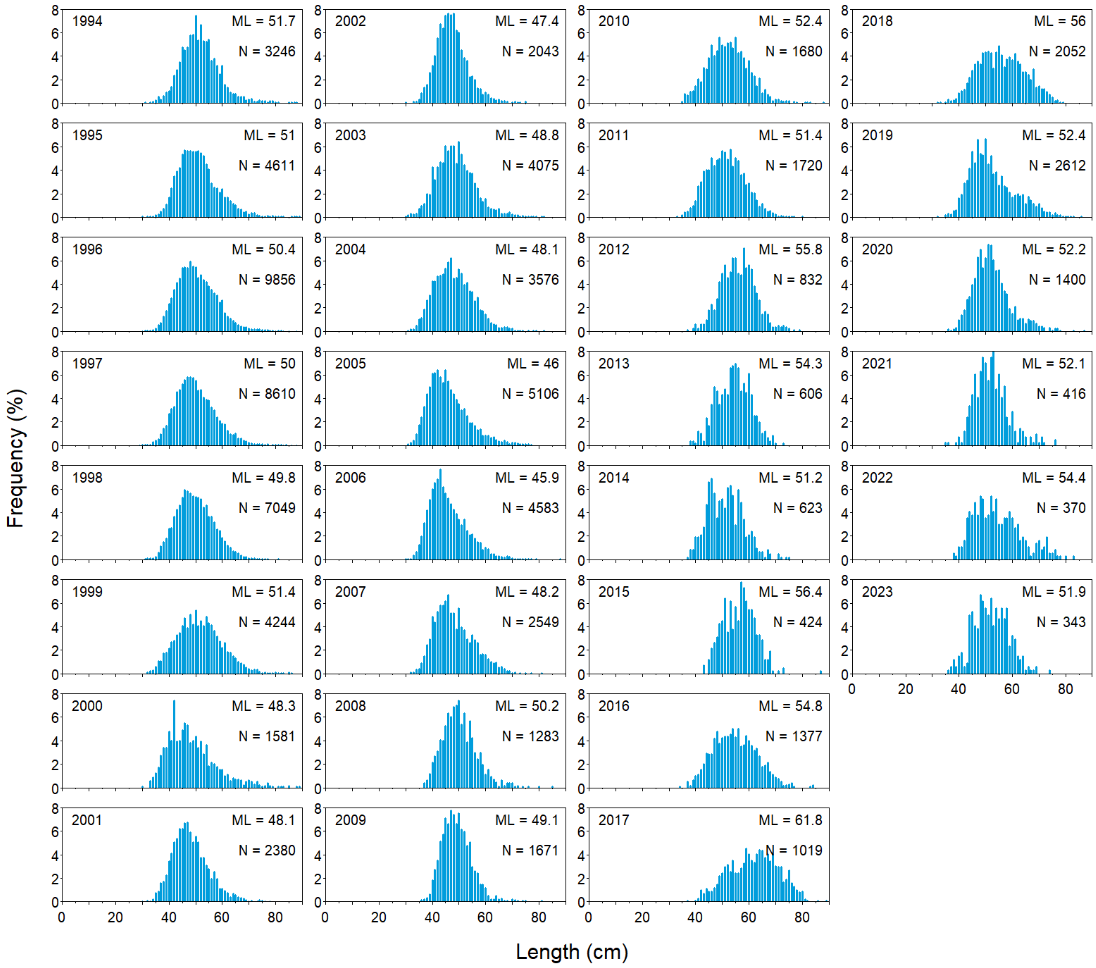

Figure 5.6.5. Length distributions of the catch of tusk by Faroese longliners (>100 BRT) in Division 5.b. ML- mean length in cm, N- number of length measures.

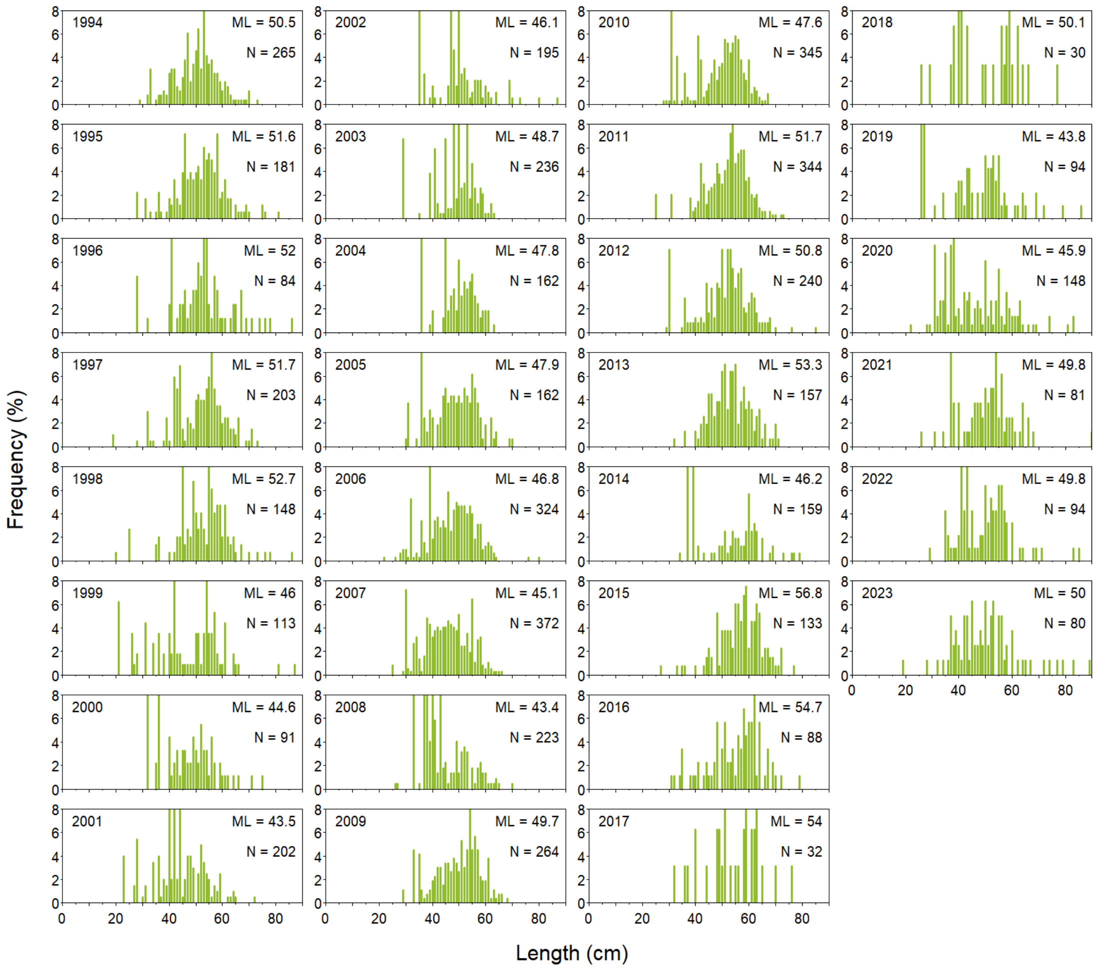

Figure 5.6.6. Length distributions of tusk in Division 5.b based on data from the Faroese spring groundfish surveys. ML- mean length, N- number of calculated length measures. Small tusk are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

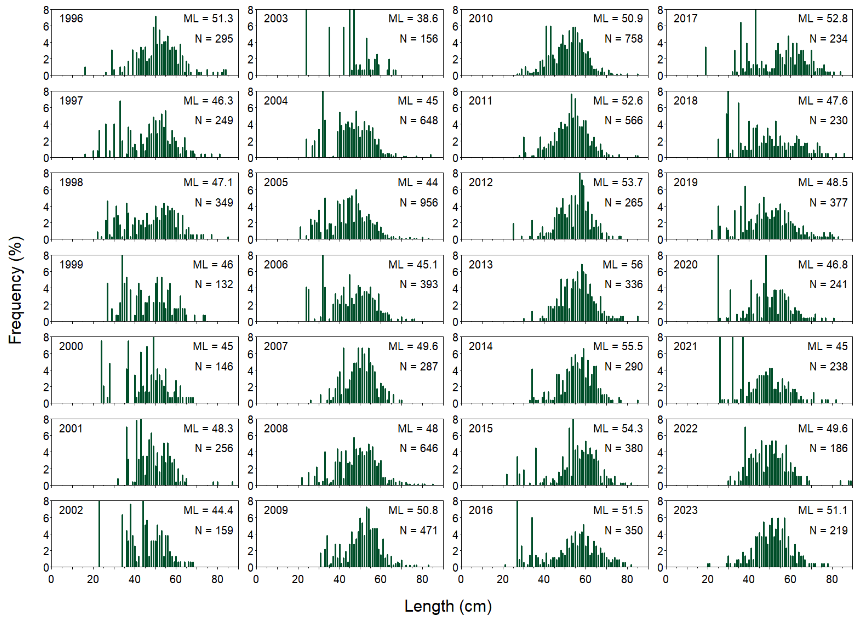

Figure 5.6.7. Length distributions of tusk in Division 5.b based on data from the Faroese summer groundfish surveys. ML- mean length, N- number of calculated length measures. Small tusk are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

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

Norway started in 2003 to collect and enter data from official logbooks into an electronic database, and data are now available for 2000–2023. 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.

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 distributional 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 divisions 4.a, 5.b and 6.a, have varied slightly with a slightly declining trend the last three years (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 53 cm in 2022 and 54.6 cm in 2023.

Faroese length distributions, based on data from Faroese longliners fishing in Division 5.b, varied mainly between 44 and 61 cm (average 51.9 cm), and there were less larger individuals compared to previous years.
In 2023, the mean length was 54.4 cm and most of the landings were between 43 and 62 cm (Figure 5.6.5).

The mean length of tusk sampled in the Faroese spring groundfish survey varied between 37 and 60 cm (Figure 5.6.6) while the mean length of tusk sampled in the summer groundfish survey, which had a larger sample size, varied between 43 and 59 cm (Figure 5.6.7). Few tusks smaller than 30 cm are reported to be caught in these surveys. Cpue trends

4.a

Two cpue series for tusk in Division 4.a based: Norwegian longline data were on all the catches and data 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. The series based on the targeted fishery shows a clear and positive upward trend from 2002 until 2013, after 2013 to2021 there was a declining trend, this trend is especially clear for the targeted fishery (Figure 5.6.8). Due to late agreement on TAC in area 4a the CPUE for 2021 is based on a low number of fishing days and may therefore not show the correct trend. There was a slight increasing trend in 2022 and 2023 for the targeted fishery.

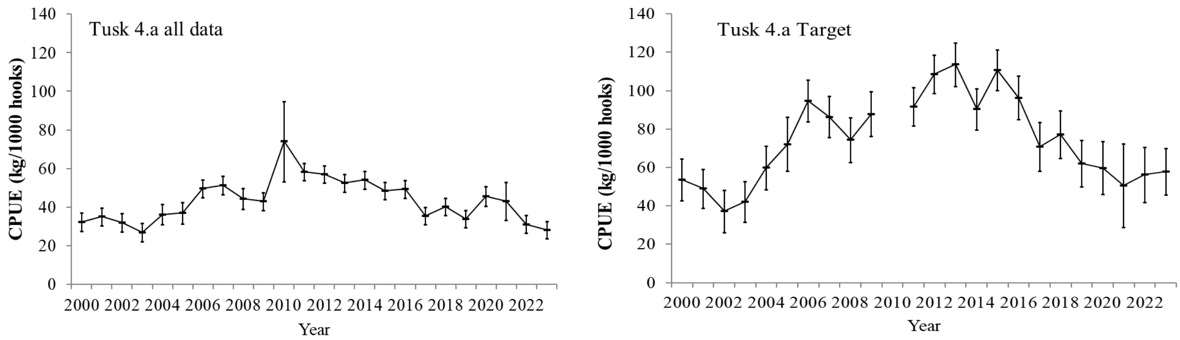

Figure 5.6.8. Tusk cpue series in 4.a for 2000–2023 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

5.b

The standardized cpue from the annual Faroese groundfish survey in spring (1994-present) and summer (1996-present) are in Figure 5.6.9. In addition, a cpue series for the spring survey, 1983-1993, based on non-stratified data are also shown in Figure 5.6.9. The cpue series for the annual groundfish surveys shows a very slight upward trend from 2022-2023 but has otherwise shown a downward trend during the last few 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 < 40 cm, generated by the Faroese summer groundfish survey on the Plateau, shows a downward trend since 2019(Figure 5.6.10).

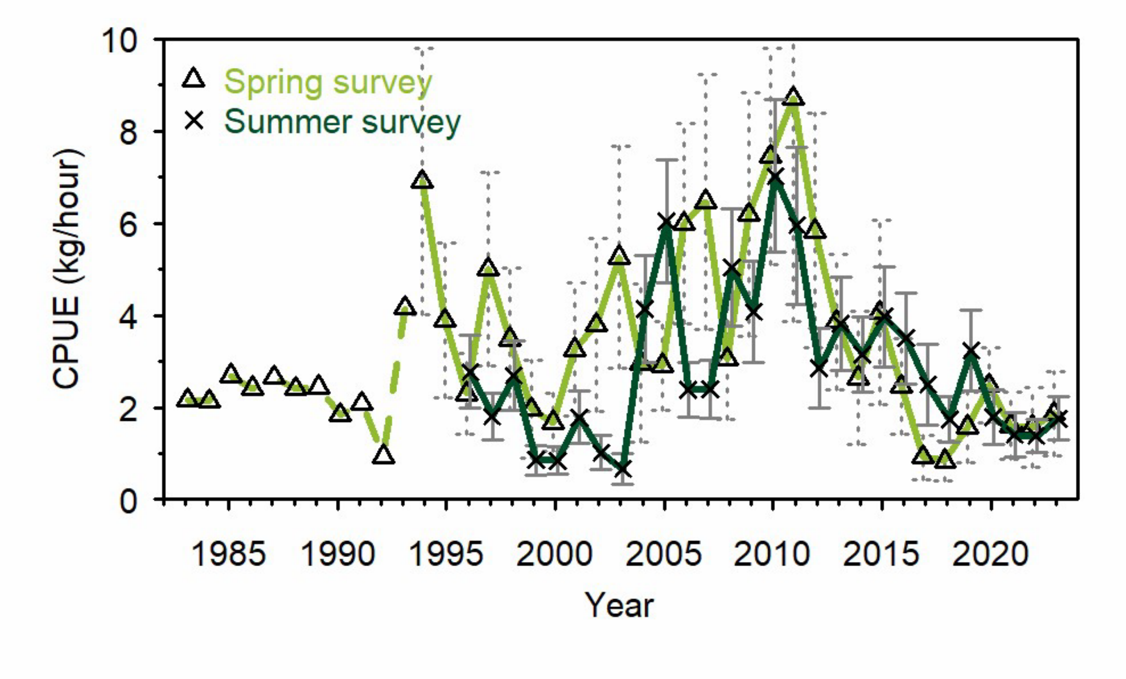

Figure 5.6.9a. Tusk 5.b. Standardized cpue from the annual trawl groundfish surveys. The spring survey data from 1983–1993 are not stratified.

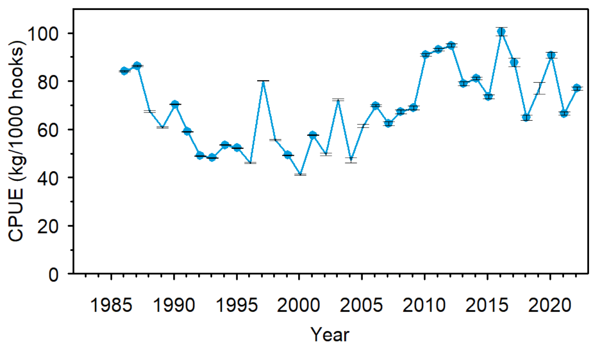

Figure 5.6.9b. Tusk cpue series in 5.b 1986–2022 for Faroese longliners based on tusk >30% of the catch. The bars denote the 95% confidence intervals.

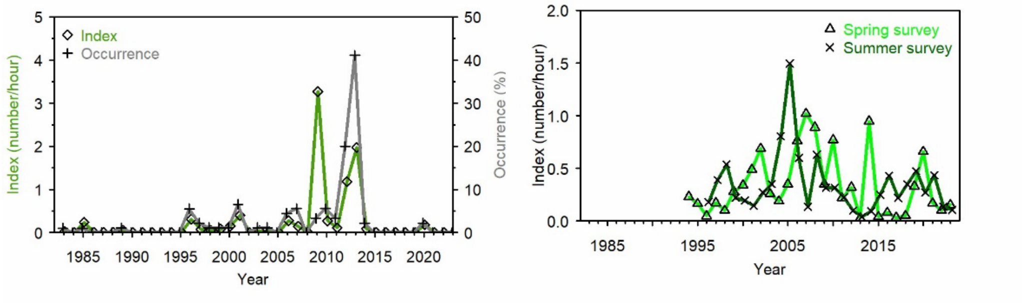

Figure 5.6.10. Tusk 5.b. Abundance index for tusk (2–3 cm in length in number/hour) on the Faroe Plateau based on the 0-group survey (left figure) and abundance index for tusk <40 cm from the annual spring and summer trawl survey on the Faroe Plateau (right figure).

The cpue series based on the Norwegian longline data shows a stable trend from 2000 to 2008, increased until 2012, decreased until 2017, a relatively large increase in 2018 and then decreased in 2019 and 2023(Figure 5.6.11).

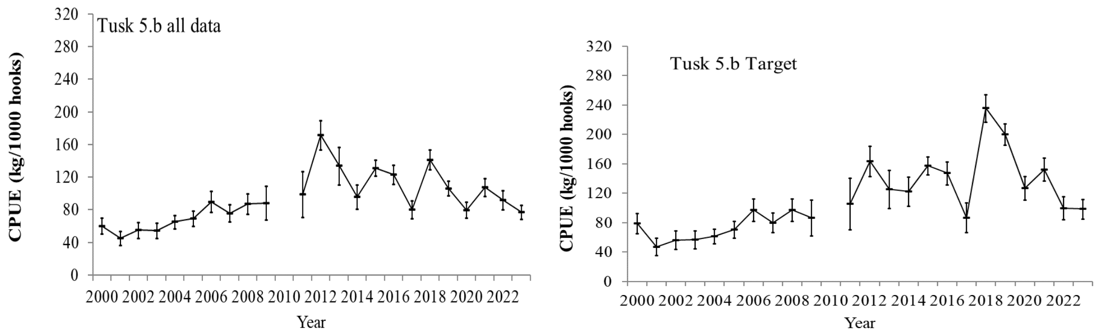

Figure 5.6.11. Tusk cpue series in 5.b for 2000–2023 for the Norwegian longliners based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

6.a

In Division 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 increasing level until 2021 when all data are used (Figure 5.6.12). There was decline in 2022 and 2023.

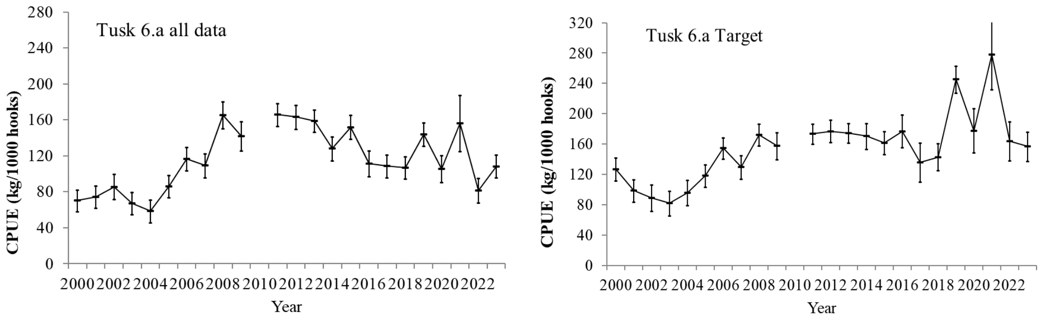

Figure 5.6.12. Two cpue series for tusk in area 6.a from 2000–2023 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

Combined cpue series for "Tusk areas 4, 5b and 6a"

A cpue series for merging all areas, data from the Norwegian longline fleet was combined with divisions 4.a, 4.b, 5.b and 6.a.

Two cpue series were estimated: based on using all available data and when tusk was targeted (daily catches when tusk made up more than 30% of the total catch, Figure 5.6.13).

The combined Norwegian longline cpue series shows an increasing trend from 2000 to 2010, after 2010 cpue was at a high and stable level (Figure 5.6.13). The CPUE from 2021 is very uncertain due to very limited catch data.There was a slightly declining trend the two last years.

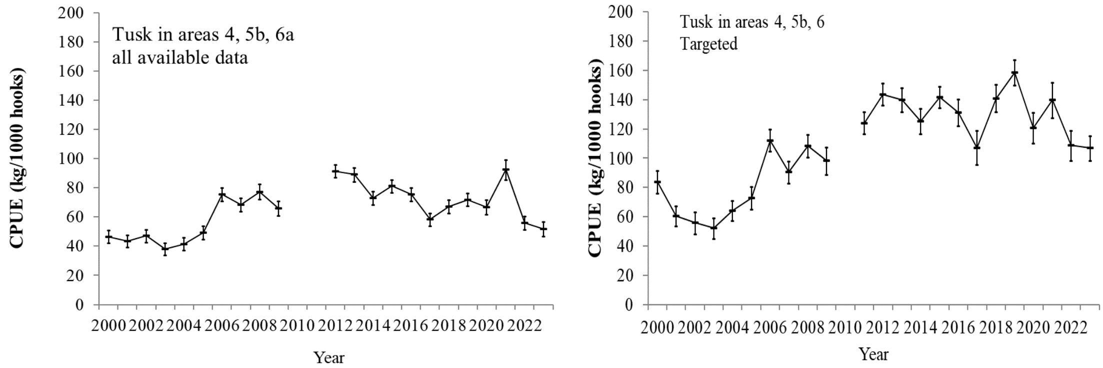

Figure 5.6.13. A combined cpue series for all "other tusk" areas for 2000–2023 based on data from the Norwegian longline fleet when tusk was targeted (>30% of total catch). The bars denote the 95% confidence intervals.

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 are usually best covered by the Norwegian longline fleet and WGDEEP decided that a combined cpue series should be made to give advice for the entire area, and that the data from the targeted fishery should be used. In 2021, there was no agreement on quota sharing between Norway, the UK, and the EU and consequently, there was no fishing by Norwegian vessels in Subarea 6.a. and the UK part of Subarea 4, and hence not enough data calculate a valid CPUE for the entire area. It appears that the fishing pattern has changed slightly after Corona in 2021 and no quota agreement with the UK in 2022 and the data used in the CPUE should be used with caution.

5.6.8 Management considerations

Tusk landings from all subareas have been relatively stable since 2013. A cpue series, based on the Norwegian longline fishery when all areas are combined, shows a stable or positive trend since 2003. The combined Norwegian longline cpue series shows an increasing trend from 2000 to 2010, after 2010 the cpue series based on targeted catches shows a high and stable level. The two CPUE series show very different trends, and the series will be recalculated. For more information, see section 5.6.9.

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 The application of the rfb-rule

This is the first year the rfb-rule is applied for tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12. Previously the "3 over 2"-rule has been used. The biomass index is based on the CPUE calculated from logbook data from the Norwegian longline fleet 2000-2022. The length data is from the Norwegian longline reference fleet. To get reliable values for K and Linf has been challenging. There is an ongoing work where these issues are being addressed and linf is set to 77.9, but in lieu of an estimate for k, the estimate from COSEWIC. (2012), where K=0.17 has been used.

Rfb-rule:

- r is calculated as the average of last two years values, divided by average of three preceding years values which results in r=0.90 (Figure 5.6.14, Table xxx)

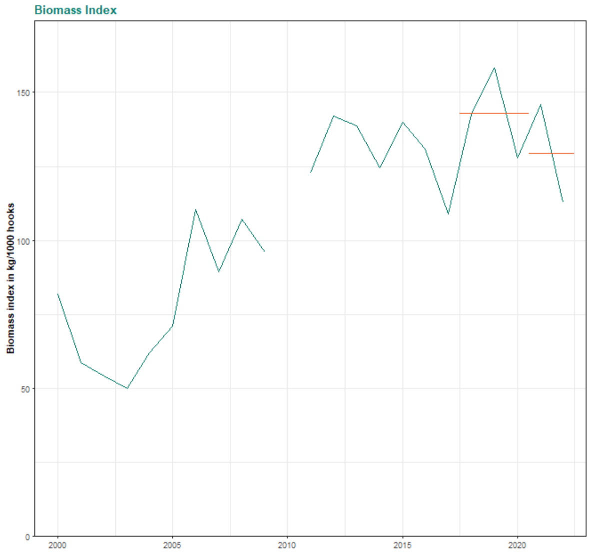

Figure 5.6.14: Tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12. Biomass index since 2000. The red lines show the average of last two years values and the three preceding years.

- *f* is the length-ratio component. The mean length of last years´ catch was 54 cm and the target reference length (L*c* or length at first capture * 0.75 + length ∞ * 0.25) is **52** (figure 5.6.15).

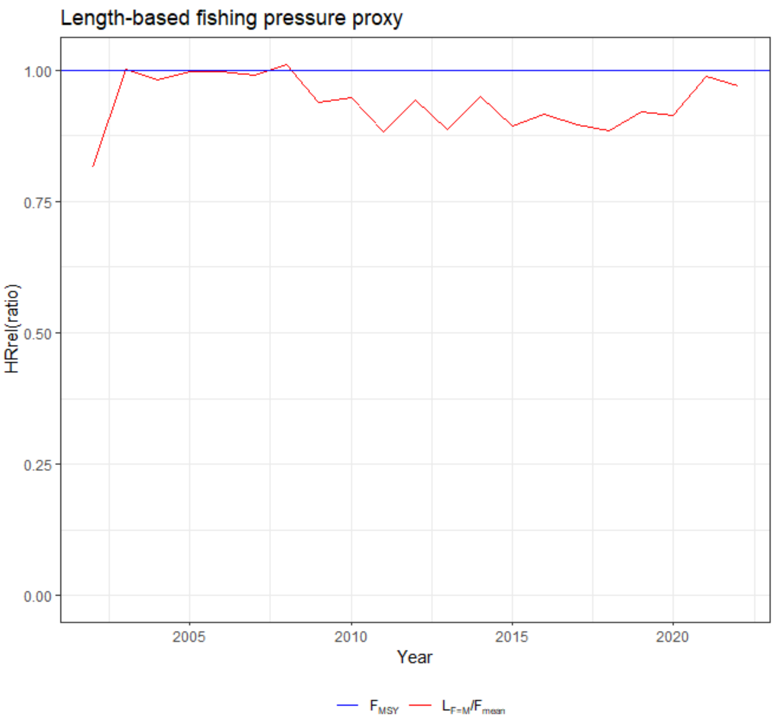

Figure 5.6.15: Tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12. Index ratio of the average length relative to the expected length when fishing mortality equals natural mortality ($L_{mean}/L_{F=M}$) for the Norwegian longline fleet from the length-based indicator method used for the evaluation of the exploitation status. The exploitation status is below the $F_{MSY\ proxy}$ when the index ratio value is higher than 1.

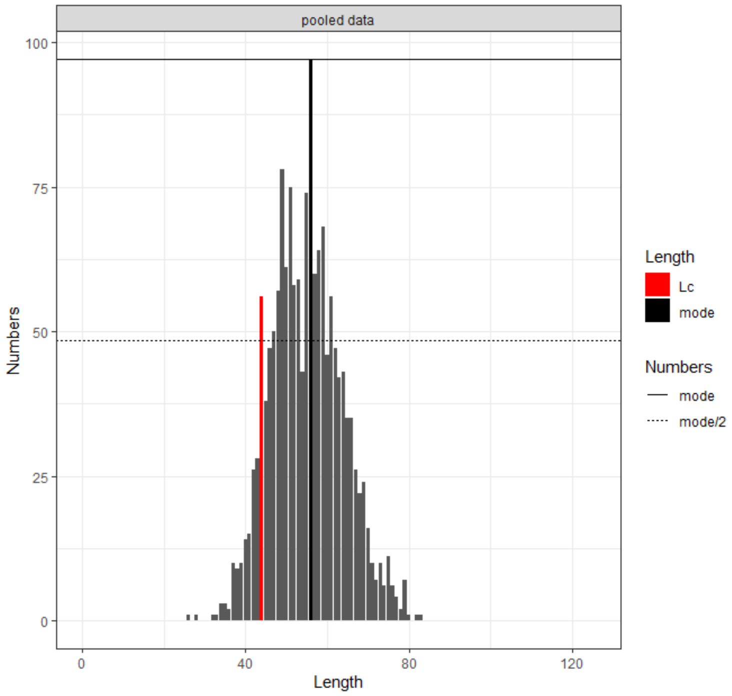

Figure 5.6.16: Tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12. Length frequency distribution from catches. Black line is the length of modal abundance, the red line is the length at first capture.

- *b* is the biomass safeguard and is used to reduce catch advice when index falls below trigger. The lowest index or the I_{loss} for tusk is 50 and was recorded in the year 2003. $I_{trigger}$ is I_{loss} *1.4 or 70 (Figure 5.6.17). Biomass index this year is above $I_{trigger}$ and *b* is therefore 1.

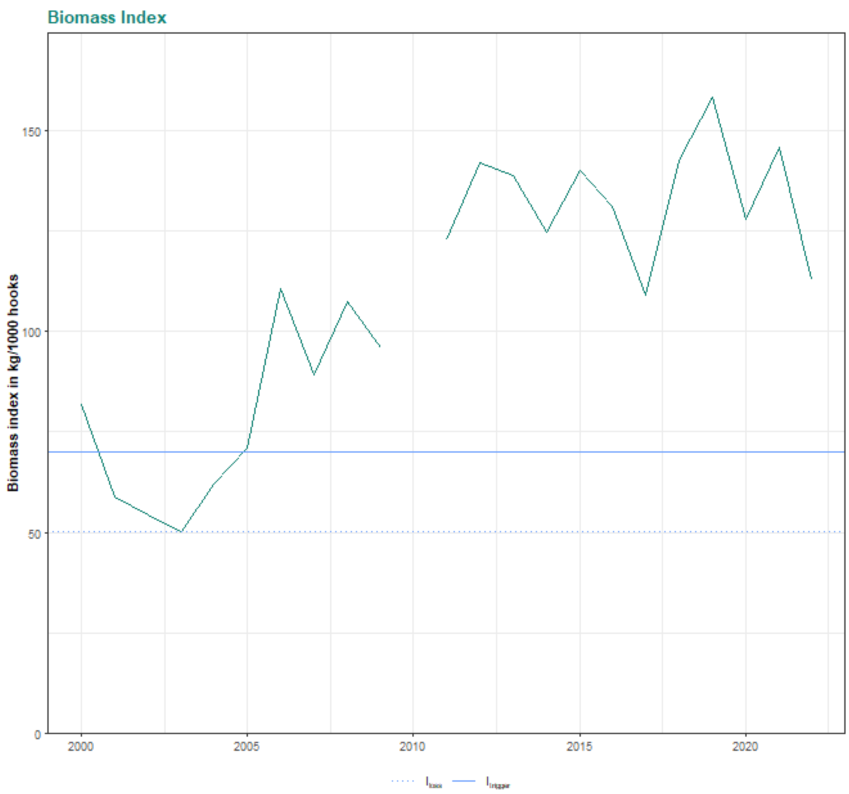

Figure 5.6.17: Tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12.. Biomass index values since 2000. The blue line is the $I_{trigger}$ and the doted is the lowest observed value (I_{loss}).

- *m* is the tuning parameter and for slow growing species (with von Bertanlaffy K<0.2), *m* equals to 0.95.

Table 5.6.5 Tusk in areas 3.a, 4, 5.b, 6.a, 7, 8, 9 and other areas of 12. The basis for the catch scenarios^. Catches are in tonnes.*

Previous catch advice A_y	7821 tonnes
Stock biomass trend	
Index A (2021, 2022)	129.28
Index B (2018, 2019, 2020)	142.96
r: stock biomass trend (index ratio A/B)	0.90
Fishing pressure proxy	
Mean catch length ($L_{mean} = L_{2022}$)	54cm
MSY proxy length ($L_{F=M}$)	52 cm
f: fishing pressure proxy relative to MSY proxy ($L_{2022}/L_{F=M}$)	1.03
Biomass safeguard	
Last index value (I_{2022})	113
Index trigger value ($I_{trigger} = I_{loss} \times 1.4$)	70
b: index relative to trigger value, min{$I_{2022}/I_{trigger}$, 1}	1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
Stability clause (+20%/−30% compared to A_y, only applied if b ≥ 1)	Not applied
Discard rate	0 %
Catch advice for 2024 and 25**	6924 tonnes
% advice change^	-11.5 %

^ The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.

** Formula [A_y × r × f × b × m]

^ Advice value for 2024/2025 relative to the advice value for 2023 (5 tonnes).

5.6.10 Application of MSY proxy reference points

Summary of SPiCT from benchmark meeting; tusk in Areas 3.a, 4, 5b, 6a, 7, 8, 9, 10, 12, 14

It was not possible for the group to recommend or approve a SPiCT assessment for this stock. The reason for this was primarily the construction of the CPUE index; the CPUE index itself was not disregarded but it was not regarded suitable for the SPiCT model. Two points were pointed out as problematic; the targeting effect and technological creep. Especially handling the targeting effect; the spatial-time interactions must be solved before data can be used by SPiCT.

The recommendations from the benchmark was to enhance the standardization of the CPUE and either try an integrated model or try SPiCT again with the new CPUE. The stock should continue to be assessed as category 3 stock.

The assessments on SPiCT could not be approved according to the uncertainty in the CPUE index and due to the observed inconsistencies described above. Link to the benchmark report: https://www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=37488

Results for the LBI, WGDEEP 2023

Information and data

The input parameters and the catch length composition for the period 2002-2023 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 5.6.6. 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	2002–2018	Faroese long-liners fishing in Division 5.b	Data combined from both sources
	2002-2023	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}	77.9 cm (L_{max})	Norwegian long-liners (Reference fleet)	

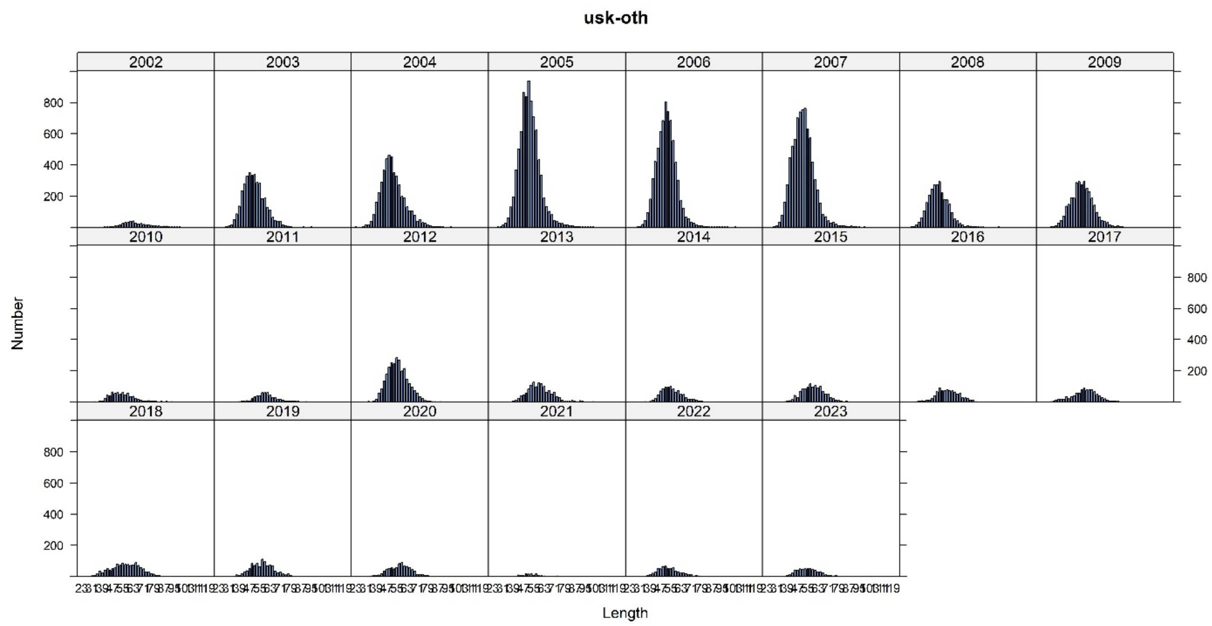

Figure 5.6.18. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Catch length distributions (2 cm bins) have not been raised to total catch for the period 2002–2023 (combined sexes).

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 5.6.15.

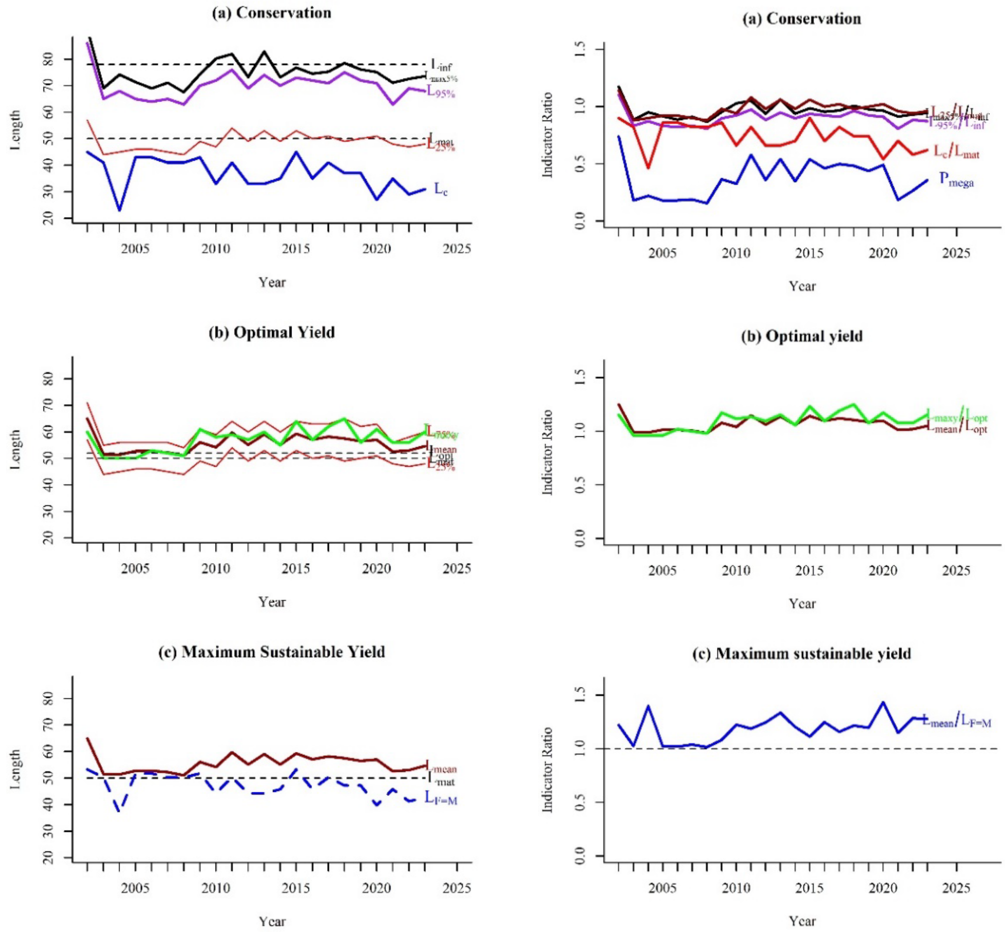

Figure 5.6.19 Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Screening of length indicators ratios for sexes combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

<u>Analysis of results</u>

The conservation model for immature tusk shows that both L_c/L_{mat} and $L_{25\%}/L_{mat}$ is around or above 1 (Figure 5.6.19). In 2021-2023, the ratios were between 0.94 and 0,96 (Table 5.6.7). 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 0.9 for the whole period (Figure 5.6.19), and between 0.91 and 0.94 during the period 2021-2023 (Table 5.6.7), which is above the baseline, 0.8.

The MSY indicator, $L_{mean}/L_{F=M}$, was more than 1 for all three years (Figure 5.6.7), which indicates that tusk in other areas were fished sustainably been fished sustainably.

Table 5.6.7. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). The results based on 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**
2021	0,70	0,96	0,91	18 %	1,01	1,15
2022	0,58	0,94	0,93	26 %	1,02	1,28
2023	0,62	0,96	0,94	36 %	1,05	1,28

Conclusions

The overall perception of the tusk stock in these areas during the period 2021–2023, based on the LBI results, is that tusk seems to have been fished sustainably during the last year (Table 5.6.7.). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 5.6.8. 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			
	2021	2022	2023	
MSY (F/F_{MSY})	✓	✓	✓	Fished sustainably

	Stock size			
	2021	2022	2023	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

Table 5.6.8. Outcomes from the LBI, based on data from the longline fishery provided by the Norwegian reference fleet.

Year	2021	2022	2023
L75	56	58	60
L25	48	47	48
Lmed	52	52	55
L90	60	65	65
L95	63	69	68
Lmean	52.57	53.00	54.60
Lc	35	29	31
LFeM	45.75	41.25	42.75
Lmaxy	56	56	60
Lmat	50	50	50
Lopt	52	52	52
Linf	78	78	78
Lmax5%	71.17	72.60	73.61
Lmean/LFeM	1.15	1.28	1.28
Lc/Lmat	0.7	0.58	0.62
L25/Lmat	0.96	0.94	0.96
Lmean/Lmat	1.05	1.06	1.09
Lmean/Lopt	1.01	1.02	1.05
L95/Linf	0.81	0.88	0.87
Lmaxy/Lopt	1.08	1.08	1.15
Lmax5%/Linf	0.91	0.93	0.94
Pmega	0.18	0.26	0.36

Pmegaref	0.3	0.3	0.3

5.6.11 References

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https://www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=37488

5.6.12 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
2019	1	7	0	8
2020	1	12	0	13
2021	2	12		14
2022	1	16		17
2023*	1	6		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

Year	Denmark	Faroes	France	Germany	Norway	Sweden(1)	E & W	N.I.	Scotland	Ireland	Total
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
2017	37		5	2	1121				41		1206
2018	37		6	1	1341	1			53		1439
2019	46		9	2	1139	1	4		46		1247
2020	46		8		898	5	2		65		1024
2021	26		20		231	4	7		162		450
2022	22	1	33	2	1069	8	5		73		1212
2023*	12	2	31	2	1032	10			102		1191

(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

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	Sweden	Total
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
2016	2		5		2				9
2017	1		16					1	18
2018	1		15	1					17
2019	1		31	1					33
2020	1		8						9
2021	1		9					1	11
2022			2					1	3

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	Sweden	Total
2023*	1		2					0	3

[(1)] Includes 4.c.

***Preliminary.**

Tusk 5.b1

Year	Denmark	Faroes(4)	France	Germany	Norway	E & W	Scotland (1)	Russia	Spain	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	Spain	Total
2017		1472	18		544		1			2035
2018		1119	14		849		1			1983
2019		1110	13		835		2			1960
2020		1302	18		1139		3			2462
2021		1157	14		830					2001
2022		1679	9		706		7			2401
2023*		1483	10		495		8		6	1996

1) Included in $5.b_2$ until 1996.

(2) Includes $5.b_2$.

(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

Year	Faroe	Norway	E & W	Scotland [1]	France	Total
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
2016		42				42
2017		135				135
2018		21				21
2019	71	611			2	684
2020	161	30				191
2021	235	307				542
2022	286	113				399
2023*	146	339				485

(1)Includes 5.b1.

(2)See 5.b1.

(3)Included in 5.b1.

***Preliminary.**

Contents

6 Greater silver smelt *(Argentine silus)*

Greater silver smelt *(Argentine 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 (WD10, 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

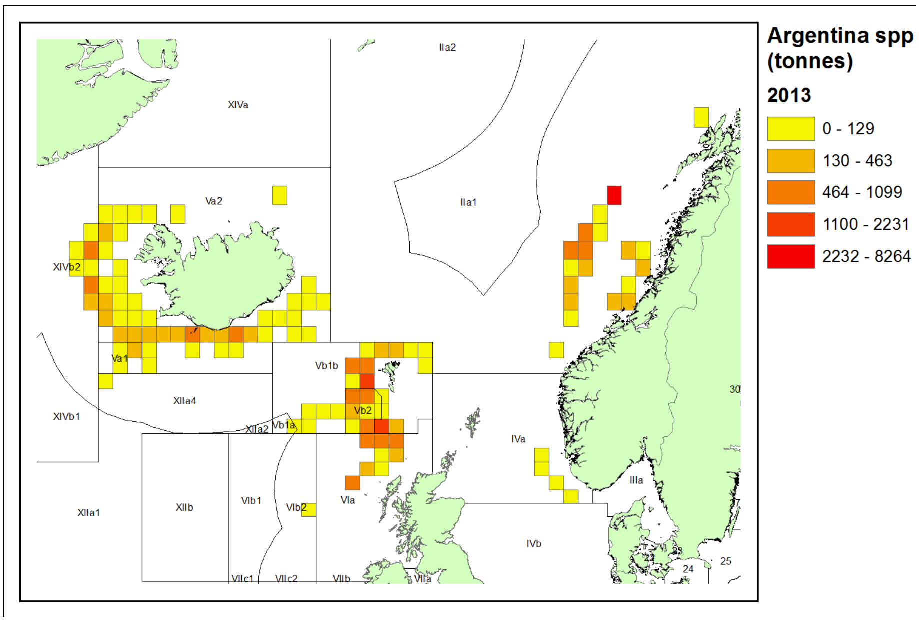

Figure 6.1.1. Catches of greater silver smelt by Iceland, Norway, Faroes and the Netherlands in 2013. Some catches of *A. sphyraena* and *Argentina* unidentified may be included in the Norwegian and Dutch landings.

Stock structure was a subject at the WKGSS 2020 benchmark for greater silver smelt (ICES 2021), where three of these stock units were benchmarked for the first time. The stock in ICES areas 6b, 7-10 and 12 (aru.27.6b7–1012) has not been benchmarked.

Preliminary results from genetic studies presented to the benchmark were not conclusive regarding stock structure (Seljestad et al. 2020, ICES WKGSS WD4). Further genetic investigation should be encouraged to underpin biological segregation of stock units.

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. Catches in this area increased substantially after 2012 with peak in 2018. While the years 2019-2021 show a declining trend, the catches from this area have increased again in the past two years (Figure 6.2.1).

6.2.2 Landing trends

International landings are summarised in Tables 6.2.1–6.2.4, and Figures 6.2.1 and 6.2.2. Note that historical data from ICES in years 1957-1988 has been updated. The variation through the time-series prior to 2014 primarily reflects the developments in the Norwegian target fisheries in Subarea 2. The landings from Division 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. Since 2014 the bycatch in the North Sea (Subarea 4) has been increasing gradually to substantial levels, and in 2020 amounting close to half of the total catch. In 2021 and 2022, the bycatch decreased to less than 40 percent of the total catch, while for 2023 the bycatch increased to more than half of total catch.

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 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 21685 t 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 12000 t per year in accordance with annual TAC regulations reintroduced in 2007. In 2018 the landings increased to 15832 t, while in 2019 the landings were 12501 t. In 2020 these catches are reduced to 8705 t, while for 2021 the catches increased by 1000 t to 9706 t. For 2022 and 2023 the catches are reduced to 7550 t and 7097 t, respectively, which is a record low catch amount for the last 20 years.

Since 2014 a marked increase is observed in catches in subareas 3 and 4, and these have risen in 2018, 2019 and 2020 to substantial 8067 t, 7210 t and 7215 t, respectively. In 2021 these catches declined to 3734 t, while for 2022 and 2023 the catches in subareas 3 and 4 increased to 4768 t and 7820 t, respectively. 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. In the end of 2018, 267 samples of Argentines from the industry were 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 (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 2020 total landings were 16129 t (Table 6.2.1–6.2.3). Landings from subareas 1 and 2 were 8705 t and the remainder were reported from Subarea 4 and Division 3.a. The total landings were substantially higher than the ICES advice for 2019, primarily due to by-catch landings in the North Sea. In 2021 the total landings were 13271 t, hence landings from subareas 1 and 2 were 9706 t and the remainder were reported from Subarea 4 and Division 3.a. For 2021 the total landings are still higher than the ICES advice given for 2021, however the landings for 2021 are declining compared to 2020. In 2022 the total landings were 12211 t, where landings from subareas 1 and 2 were 7550 t and the remainder from Subarea 4 and Division 3.a. As for 2021, the total landings for 2022 are higher than the ICES advice given for 2022. Total landings for 2023 is 14686 t, with 7097 t reported from subareas 1 and 2, and the remainder from Subarea 4 and Division 3.a.

6.2.3 ICES Advice

In 2023 ICES advised that, when the MSY approach is applied, catches should be no more than 9 499 tonnes in each of the years 2024 and 2025. All catches are assumed to be landed.

6.2.4 Management

For a period after 1983 a Norwegian precautionary unilateral annual TAC was applied in Division 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 12000 t unilateral Norwegian TAC was introduced in 2007 and this TAC was maintained until 2015 when for 2016 it was increased to 13047 t, which also was the TAC for 2017. In 2018 and 2019 the TAC was 13770 t. The TAC in the direct fisheries for 2020 and 2021 was 9033 t. The TAC in the direct fisheries is 7603 t for 2022 and 2023. 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. Usually around 25 trawlers are active in the fishery.

In 2016, RTC-regime (Real Time Closures) was implemented to the direct fisheries in Subarea 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 greater 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 divisions 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 2020 the EU TAC for subareas 1+2 was 90 t, and for subareas 4 + 3 the TAC was 1234 t. For 2021 the EU TAC for subareas

1+2 was 34 t, while for subareas 4 + 3 the EU TAC was 796 t. For 2022 the EU TAC is 9 t in UK and international waters of 1 and 2, and 199 t in UK and EU waters of 4 and EU waters of 3[1] . For both 2021 and 2022 UK TAC was 25 t in area 1 and 2, and 13 t in 3a and 4c [2]. For years 2023 and 2024 the EU TAC and the UK TAC in subareas 1+2 is 34 t and 25 t, respectively. In subarea 3a and 4c, the EU TAC is 796 t and the UK TAC is 13 t for years 2023 and 2024.[3]

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 2014–2023 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. Note that Denmark in 2020 updated their official statistics from catches in Division 3a and Subarea 4 in years 1966-2020. The differences in catches from Denmark is shown in Figure 6.2.25. For total catches, all countries combined, the updated Danish catches does not have an impact for the total catches (Figure 6.2.26). In 2020, Denmark started reporting catches on Argentines and not by species due to difficulties in distinguishing between *A.silus* and *A.sphyraena*.

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 Division 2.a for the period 2009–2023 and for bycatches by Norwegian vessels in Division 4.a for the years 2011, 2013, and 2015-2023 (Figure 6.2.5 and 6.2.6). For each year these distributions are derived by pooling multiple samples from landing sites and samples provided by commercial vessels (Hallfredsson *et al.* 2016, WGDEEP 2016, WD).

Length information is available from the Norwegian slope March/April survey in Division 2.a conducted in 2009 and 2012, and biennially since then (Figure 6.2.7) (Heggebakken *et al.* 2020, WKGSS WD18).

Length information is available from the annual Norwegian shrimp survey in Divisions 3.a and 4.a, 1984–2024 (Figure 6.2.8).

Length distributions from Dutch landings in 2018 in Subarea 4 is available in Figure 6.2.23. Length distributions from discards are available from Division 3a (Swedish fisheries) in years 2019-2023, and from Scottish fisheries from Subarea 4 in years 2016-2023 (Figure 6.2.24).

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[1] final-tacs-2022.pdf (europa.eu)

[2] Outcomes of annual negotiations for UK fishing opportunities in 2021 and 2022 (publishing.service.gov.uk)

[3] EU-UK for 2023 (europa.eu)

6.2.5.3 Age compositions

Age compositions from Norwegian catches 2013-2022 are presented in Figure 6.2.9. Age distributions from the Norwegian slope survey and the shrimp survey in North Sea/Skagerrak are shown in Figure 6.2.10.

6.2.5.4 Weight-at-age

No new data on weight-at-age were presented to the meeting. Length at age and length-weight relations were scrutinized at the WKGSS 2020 benchmark workshop on greater silver smelt (ICES 2021).

6.2.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented to the meeting, but these were scrutinized at the 2020 benchmark workshop.

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 (subareas 1 and 2). Acoustic index from this survey is used in the SPiCT assessment. Additionally, trawl surveys were conducted in Division 2.a in 2003–2005.

Surveys were conducted in early 1990-ties in the Norwegian Sea and south–east slope with acoustics, pelagic and bottom trawl (Monstad and Johannessen, 2003), the ones in spring 1990-1992 are used in the SPiCT assessment.

For Subarea 4 and Division 3.a information is available from the Norwegian shrimp survey in years 1984–2024. Stations are in the depth range of 80-660 meters, with around 25% of the stations deeper than 300 meters. The survey has been conducted in different seasons, and this may affect the index for greater silver smelt. The index did not perform well with SPiCT (ICES 2021).

6.2.6 Data analyses

6.2.6.1 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 major changes in the shape of size composition in the recent ten years when the target fishery has been regulated with TACs and other measures.

Age distributions in the Norwegian slope survey are rather even through the years with a mode around age six to eight, while the 2020, 2022 and 2023 age distribution in the North Sea/Skagerrak survey is bimodal with more juveniles of age one to three as well (Figure 6.2.10). The fishery is mainly conducted shallower than 400 m.

The shape of the length distributions in both numbers and biomass in the Norwegian slope survey have varied through the years, but low numbers and biomass are apparent in the 2018 survey while 2020, 2022 and 2024 surveys show higher values (Figure 6.2.7).

In Division 3.a the length distributions throughout the 1984–2024 shrimp survey time-series are bimodal since 2018, as the age distribution in 2020, 2022 and 2023, with marked appearance of larger fish around 30 cm (Figure 6.2.8).

In Division 4.a size distributions from the bycatch (Figure 6.2.6) are to some extent bimodal in years 2015 to 2020 and in year 2023 and suggest that the catches comprise rather variable but smaller fish than those in the target fishery landings in Division 2.a. Mean length in 2023 from the target fishery in Division 2.a was 35.77 cm, while mean length from Division 4.a was 21.14 cm in 2023. This probably reflects that the slope of the Norwegian Deep in Division 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).

6.2.6.2 Commercial CPUE and survey series

In Subarea 2 biomass estimates based on the acoustic observations show a decreasing trend from 2014-2018, the 2020 estimate shows an increase, while the acoustic estimates for 2022 are at the same level as for 2018. For 2024, the acoustic index doubled compared to 2022 levels (strata 1A and 2A in Figure 6.2.11). Greater silver smelt spatial distribution shows highest concentrations in approximately 62-70°N (Figure 6.2.12), which agrees to where the direct fisheries are mostly conducted. The index was recalculated using the StoX software at the 2020 benchmark. The 2020 survey was affected by complications related to covid19 restrictions and bad weather conditions. As a result, the area North of 67°N was not covered, being an area with lowest biomass of greater silver smelt in the survey (stratum 3 in Figure 6.2.11) and it is suggested to exclude that area from the index that is used in SPiCT (ICES 2021).

Swept area biomass indices and swept area abundance indices for greater silver smelt from the annual Norwegian shrimp survey in Division 3.a and south-eastern parts of Division 4.a are shown in Figure 6.2.13. The indices are calculated using StoX, which is now the recommended program for calculating survey estimates from acoustic and swept area surveys at IMR (Johnsen *et al.* 2019) (Heggebakken *et al.* 2020, WKGSS WD18). Seasonality of the survey has varied through the years, and this may affect the index for greater silver smelt. It was conducted in October 1984-2002, in May 2004-2005, in February 2006-2007 and in January since then.

The indices in terms of numbers and weight from the survey in Divisions 3.a and 4.a suggest pronounced variation and trends (Figure 6.2.13). The survey catches rates first declined steadily and then rather abruptly to unprecedented low levels in 2006. After 2010, indices showed an abrupt increase until around 2015 and have been at a relatively high level since then.

A preliminary catch CPUE based on electronic logbook data from the direct fisheries in Division 2.a is shown in Figure 6.2.14. For the pelagic trawls CPUE, year 2013 is the one with highest value, followed by a declining trend until 2016 and a slight increase after that (Heggebakken *et al.* 2020, WKGSS WD18). For the bottom trawls CPUE, the trend is increasing, apart from year 2015 which showed the lowest CPUE for all years. The CPUE series was examined at the 2020 benchmark and considered not applicable to the assessment at present stage. It is foreseeably a labour-intensive task to get the old logbooks digitalized, and a cost-benefit consideration is needed based on further analysis of the electronical logbook data and experience with CPUE series from other areas.

6.2.6.3 Assessment

From 2015 to 2020 the ICES 2 over 3 rule (ICES 2012) was used for biennial advice along with a LBI assessment. At a benchmark in 2020 (WKGSS 2021) SPiCT (Pedersen and Berg 2017) was not accepted as analytical assessment but the biomass trend output was accepted as an input index to the 2 over 3 rule, but this praxis was rejected in 2022 when the rfb-rule (ICES WKLIFE X) was applied. New benchmark in 2024 (WKBMSYSPiCT3, ICES 2024) allowed for reconsidering input data, add new data and data not used in the 2020 benchmark, and a thorough investigation of SPiCT as assessment and forecast method for this stock. At the benchmark surplus production model in SPiCT was accepted for assessment of the stock.

Input data are total catches from since the direct fishery was licensed, i.e. 1983 until present (2023) as reported to ICES (Figure 6.2.1 and Table 6.2.1), and the acoustic biomass index from the

Norwegian slope and deep shelf areas survey in ICES Area 2a 1990, 1991, 2009, 2012 and every other year since then (Figure 6.2.11 and Table 6.2.5).

Priors are used on the production curve (locked to Schaefer model), intrinsic growth rate r and standard deviation on the biomass process. SPiCT default priors on alpha and beta are deactivated.

Summary of the final assessment is shown in Table 6.2.6 and Figure 6.2.15. According to the assessment the current fishing pressure is below the FMSY while the biomass is over BMSY (B_2024.25/BMSY = 1.28, F_2024.25/FMSY = 0.72)

The one-step-ahead residuals for observations diagnostics were all within adequate levels except normality for catch data, which had Shapiro p-value of 0.0074 (Figure 6.2.16). This was not considered to alter the overall assessment.

Analysis of process residuals were all within adequate levels (Figure 6.2.17).

Comparison of prior and posterior distributions reviles that sdb has quite similar prior and posterior distributions while posterior distribution of r is displaced to higher values compared to the prior distribution (Figure 6.2.18).

Retrospective analysis shows some discrepancy when years are removed, especially for retrospective years –4 and –5 (Figure 6.2.19). This may, at least partly, be caused by few survey points in the index and the surveys being conducted every other year (Figure 6.2.20).

A hindcast analysis was carried out to check the ability of the SPiCT model to predict the index by removing a data point and keeping the catch information (Figure 6.2.20). The MASE predictor was calculated and was below 1 (0,814), which is considered good.

The robustness of the model was verified by checking whether the initial values influenced the parameter estimates (Table 6.2.7). Thirty trials were run. All except two converged and the difference in distance was not profound.

The SPiCT assessment is considered as a marked improvement compared to the previous ICES rfb rule-based advice and is accepted by the benchmark. However, due to notion of general uncertainty in the assessment it is recommended to use lower fractile (15%) than in the ICES standard rule. Different management scenarios are shown in Table 6.2.8 and Figure 6.2.21.

Forecast for two years catch advice was predicted by SPiCT assuming status quo F during the intermediate year (2024) and summing up the predicted catch per time step (C_t = F_t * B_t * dt) for 2025 and 2026 of the two-year management period (2025-2027).

6.2.7 Comments on the assessment

The assessment is in accordance with the WKBMSYSPiCT3 benchmark.

Due to covid19 complications, the 2020 Norwegian slope survey in subareas 1 and 2 did not cover the northernmost survey area (stratum 3). The biomass estimates for this stratum has been minor compared to stratum 1A and 2A (Figure 6.2.11). Thus, the SPiCT analysis was run with summed biomass estimates for stratum 1A and 2A, leaving out stratum 3.

The greater silver smelt acoustic biomass index used in the 2024 benchmark was calculated in an earlier version of the StoX software (Johnsen *et. al*. 2019). In the current assessment, the latest StoX version is applied, and the resulting indices are compared to the earlier indices (Figure 6.2.22). There are some discrepancies between the indices calculated in the different StoX version. The 2024 WGDEEP considered the differences minor and that the index calculated in the new version of StoX can be used in the assessement. For further examination of the index and the effect of applying the recalculated biomass index in the SPiCT assessment, see WD12 from WGDEEP 2024 (Heggebakken and Hallfredsson, 2024).

Existing abundance, length and age data series for this stock are rather short compared to potential life span of the species (approx. 30 years). However, if the time-series are maintained they may support more analytical assessment in the future. Electronic logbooks were introduced in the Norwegian fisheries in 2011 but are not available digitally for earlier years. Before 2011 the fishing vessels were obliged to keep logbooks, and have them available in case of inspection, but not to deliver them to the government. Thus, it is foreseeably a labour-intensive task to get the old logbooks digitalized, and a cost-benefit consideration is needed based on further analysis of the electronic logbook data and experience with CPUE series from other areas. It is currently unknown if the CPUE reliably will reflect the dynamics in the population. The acoustic surveys in 1990-1992 and CPUE from the fisheries are the only source of data that have been analysed for information on historical development of the stock before 2009. In a working document (Heggebakken and Hallfredsson; WD12) all occurrence of greater silver smelt in IMR surveys were registered, giving a good overview of the distribution of the species. For these surveys' coverage, duration and gears used varies, still some of these surveys may potentially be used for separate, or joint, indices for the stock but further analysis is needed.

6.2.8 Management considerations

Advice is given every second year for this stock and the 2024 advice applies for 2025 and 2026.

The bycatch in Subarea 4 (North Sea) has increased rapidly since 2012 and total catch in this area reached levels of around 7 to 8 thousand tonnes. In 2023 the catches in Subarea 4 were 7586 t, which is more than catches in the direct fisheries in subareas 1 and 2 (7097 t). This is an alarming level as the bycatches are not well regulated. 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 for the most part they are greater silver smelt catches (Hallfredsson and Heggebakken 2019, ICES WGDEEP 2019 WD7).

6.2.9 References

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6.2.10 Tables and Figures

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. * Preliminary landings.

year	Denmark	Sweden	Ireland	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Lithua-nia	Iceland	SUM
1988	412	0	0	1	0	13014	5	14	0	0	0	0	0	13446
1989	178	0	0	0	335	10495	0	23	1	0	0	0	0	11032
1990	2090	0	0	13	5	10686	0	0	0	0	0	0	0	12794
1991	1478	0	0	0	3	8864	0	0	6	1	0	0	0	10352
1992	2060	0	0	1	70	8932	0	0	101	0	0	0	0	11164
1993	4215	0	0	0	298	8481	0	0	56	0	0	0	0	13050
1994	2678	0	0	0	0	6221	0	0	614	0	0	0	0	9513
1995	309	0	0	357	0	6419	0	0	20	0	0	0	0	7105
1996	2809	0	0	0	0	6817	0	0	0	0	0	0	0	9626
1997	1327	542	0	1	0	5167	0	0	0	0	0	0	0	7037
1998	3854	428	0	169	277	8655	0	0	0	0	0	0	0	13383
1999	2190	0	0	0	7	7151	0	0	18	0	0	0	0	9366
2000	368	273	10	0	3	6107	0	195	18	9	0	0	0	6983
2001	490	1011	3	0	0	14360	0	7	233	28	0	0	0	16133

year	Denmark	Sweden	Ireland	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Lithua-nia	Iceland	SUM
2002	510	484	4	0	0	7406	0	0	164	0	0	0	0	8568
2003	507	42	0	4	617	8351	0	7	22	4	4	0	0	9558
2004	2117	0	36	4	4277	11574	0	4	12	0	0	0	0	18024
2005	275	0	0	1	28	17066	0	16	0	0	14	0	0	17400
2006	36	0	0	6	0	25149	0	4	2	0	0	0	0	25197
2007	92	0	0	0	0	16373	0	1	0	0	0	0	0	16466
2008	0	0	0	0	0	13424	0	0	0	0	0	0	0	13424
2009	12	0	0	0	0	13495	0	0	0	0	0	0	0	13507
2010	65	0	0	0	0	12865	0	0	33	0	0	0	0	12963
2011	12	0	0	0	0	12060	0	0	0.4	4	0	0	0	12076
2012	51	0	0	0	0	12352	0	0	0	1.2	114	0	18	12536
2013	126	0	0	0	0	13227	0	0	0	2.3	0	0	0	13355
2014	130	1	0	204	345	14471	0	0	0	1	0	0	0	15152
2015	19	1	0	0	0	15235	0	0	0	0	0	0	0	15255
2016	57	1	0	38	11	18835	0	7	0	1.4	0	0	0	18950
2017	22	1	0	0	10	17788	0	35	0	0	0	0	0	17856
2018	9	4	0	67	152	23609	0	9	0	0	0	0	0	23850
2019	64	0	0	143	349	19172	0	8	0	0	0	0	0	19736

year	Denmark	Sweden	Ireland	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Lithua-nia	Iceland	SUM
2020	308	0	0	0	222	15534	21	8	0	0	0	35	0	16128
2021	0	0	0	439	24	12804	4	0	0	0	0	0	0	13271
2022	84	0	0	0	2	12124	0	0	0	0	0	0	0	12210
2023*	6	0	0	0	15	14665	0	0	0	0	0	0	0	14686

Table 6.2.2. Greater Silver Smelt in 1 and 2. WG estimates of landings in tonnes. *Preliminary landings.

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

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
1999			7145			18				7163
2000		3	6075		195	18	2			6293
2001			14357		7	5				14369
2002			7405			2				7407
2003		575	8345		7	2	4	4		8937
2004		4235	11557		4					15796
2005			17063		16			14		17093
2006			21681		4					21685
2007			13272		1					13273
2008			11876							11876
2009			11929							11929
2010			11831			23				11854
2011			11476			0.4				11476
2012			12002				0.2	114	18	12134
2013			11978				0.3			11979
2014			11752							11752
2015			12049							12049
2016			13115		7		0.4			13122

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
2017		10	12277		35					12322
2018	0.2	0.4	15823		8.5					15832
2019			12493		8					12501
2020			8697		8					8705
2021			9706							9706
2022		1.5	7548			0.4				7550
2023*		0.7	7096							7097

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. *Preliminary landings.

Year	Denmark	Germany	Norway	Sweden	TOTAL
1988	412		27		439
1989	1		236		237
1990	390		1150		1540
1991	206		800		1006
1992	193		634		827
1993	1256		487		1743
1994	486				486
1995	5				5

Year	Denmark	Germany	Norway	Sweden	TOTAL
1996	0		159		159
1997	110		703	542	1355
1998	54		413	428	895
1999	1		2		3
2000	0		4	273	277
2001	0			1011	1011
2002	(44)			484	484 (44)
2003	(6)			42	42 (6)
2004	6 (2)		1		7 (2)
2005	0				0
2006	(72)				0 (72)
2007					0
2008	(3)				0 (3)
2009	(45)				0 (45)
2010	(19)				0 (19)
2011	(14)				0 (14)
2012	(11)				0 (11)
2013	(40)				0 (40)
2014	(4)		2	1	3 (4)

Year	Denmark	Germany	Norway	Sweden	TOTAL
2015			22	1	23
2016	(10)		101	1	102 (10)
2017	(6)		3	(1)	3 (7)
2018	(12)			(3.6)	(15.6)
2019	(27)			(66)	(93)
2020	6 (4)				6 (4)
2021				(1.4)	(1.4)
2022	(4)			(0.2)	(4.2)
2023*	(3)			(1)	(4)

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. *Preliminary landings.

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	Russia	Lithuania	Poland	TOTAL
1988			1		1655						1656
1989	176			335	1892	1					2404
1990	1700		13		421						2134
1991	1272	1		3	323	6					1605
1992	1866		1	70	64	101					2102
1993	2959			298	81	56					3394

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	Russia	Lithuania	Poland	TOTAL
1994	2192				4	24					2220
1995	304				1	20					325
1996	2809				54						2863
1997	1217		1		1						1219
1998	3800		129	277	21						4227
1999	2188			7	4						2199
2000	368	7			28		10				413
2001	491	28			3	228	3				753
2002	510 (1005)				1	162	4				677 (1005)
2003	507 (120)		4	42	6	20					579 (120)
2004	2117 (61)		4	42	16	12	36				2227 (61)
2005	275 (35)		1	28	3						307 (35)
2006	36 (2)		6		3468	2					3512 (2)
2007	92 (1)				3101						3193 (1)
2008	(49)				1548						1548 (49)
2009	13 (48)				1566						1579 (48)
2010	65 (41)				1034	10					1109 (41)
2011	11 (5)	4			584						599 (5)

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	Russia	Lithuania	Poland	TOTAL
2012	51 (2)	1			350						402 (2)
2013	126 (27)	2			1249						1377 (27)
2014	130 (7)	1	204	345	2717						3397(7)
2015	19 (218)				3164						3183 (218)
2016	57 (4)	1	38	11	5619	(24)					5726 (28)
2017	22 (36)				5508	(388)					5540 (424)
2018	9 (4)		67	152	7786	(38)		6			8020 (42)
2019	63 (28)		143	349	6679	(39)					7234 (67)
2020	301 (15)			222	6837	(100)			35	21	7416 (115)
2021			439	24	3098	(168)				4	3565(168)
2022	85 (46)				4576	(58)					4661 (104)
2023*	6 (2)			14	7566	(225)					7586 (227)

Table 6.2.5. Acoustic biomass index based on Norwegian continental slope and deep shelf surveys, as estimated in the StoX application.

Year	Biomass (t)
1990	239420
1991	188706
1992	167296
2009	432611

Year	Biomass (t)
2012	334332
2014	525429
2016	492644
2018	466724
2020	631096
2022	407121
2024	833919

Table 6.2.6. Summary of the final SPiCT assessment.

```
Convergence: 0  MSG: both X-convergence and relative convergence (5)
Objective function at optimum: 15.4961307
Euler time step (years):  1/16 or 0.0625
Nobs C: 41,  Nobs I1: 11

Priors
   logn  ~  dnorm[log(2), 0^2] (fixed)
 logsdb  ~  dnorm[log(0.132), 0.5^2]
   logr  ~  dnorm[log(0.291), 0.5^2]

Model parameter estimates w 95% CI
              estimate        cilow         ciupp    log.est
 alpha       1.7082664    0.4894417     5.9622509  0.5354791
 beta        1.5922030    0.4415582     5.7412829  0.4651186
 r           0.4445737    0.1714821     1.1525739 -0.8106394
 rc          0.4445737    0.1714821     1.1525739 -0.8106394
 rold        0.4445737    0.1714821     1.1525740 -0.8106393
 m       17929.9660024 13323.1464737  24129.7115124  9.7942287
 K      161322.7668344 53364.2260572 487686.9210324 11.9911624
 q           6.1329020    1.9996441    18.8095904  1.8136680
 n           1.9999999    1.9996080     2.0003920  0.6931472
 sdb         0.1148939    0.0449500     0.2936736 -2.1637458
```

```
 sdf         0.1231032     0.0412091      0.3677437 -2.0947325
 sdi         0.1962695     0.1076046      0.3579932 -1.6282667
 sdc         0.1960052     0.1366427      0.2811569 -1.6296139

Deterministic reference points (Drp)
            estimate          cilow          ciupp    log.est
 Bmsyd 80661.3825047 26682.1122953 243843.461701 11.298015
 Fmsyd     0.2222869     0.0857411      0.576287 -1.503786
 MSYd  17929.9660024 13323.1464737  24129.711512  9.794229
Stochastic reference points (Srp)
            estimate          cilow           ciupp    log.est rel.diff.Drp
 Bmsys 79145.6491395 26278.2760455 238373.0868369 11.279045  -0.01915119
 Fmsys     0.2190383     0.0838816      0.5719703 -1.518509  -0.01483105
 MSYs  17331.0053595 12912.8031781  23260.9250391  9.760252  -0.03456006

States w 95% CI (inp$msytype: s)
                      estimate          cilow           ciupp    log.est
 B_2024.25      101489.7570465 32585.9118731 316092.7589034 11.5277132
 F_2024.25           0.1578899     0.0465967      0.5349995 -1.8458570
 B_2024.25/Bmsy      1.2823163     0.7753958      2.1206398  0.2486681
 F_2024.25/Fmsy      0.7208326     0.4028190      1.2899084 -0.3273484

Predictions w 95% CI (inp$msytype: s)
                    prediction          cilow           ciupp    log.est
 B_2026.00      101545.9855896 31382.5334740 328577.2704711 11.5282670
 F_2026.00           0.1578903     0.0447229      0.5574179 -1.8458550
 B_2026.00/Bmsy      1.2830268     0.8045120      2.0461567  0.2492219
 F_2026.00/Fmsy      0.7208340     0.3711861      1.3998415 -0.3273464
 Catch_2025.00   16030.8115601 10097.4208206  25450.7486456  9.6822679
 E(B_inf)        98318.1357000            NA              NA 11.4959638
```

Table 6.2.7. Output of the sensitivity analysis concerning the initial parameter values (check.ini)

```
Distance        m        K     q  n  sdb  sdf sdi  sdc
Basevec      0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 1      0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 2      0.12 17929.97 161322.9 6.13  2 0.11 0.12 0.2 0.2
Trial 3      1.82 17930.01 161324.6 6.13  2 0.11 0.12 0.2 0.2
Trial 4      0.16 17929.97 161322.6 6.13  2 0.11 0.12 0.2 0.2
Trial 5      0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 6      0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 7      0.00       NA       NA   NA NA   NA   NA  NA  NA
```

```
Trial 8      0.04 17929.97 161322.7 6.13  2 0.11 0.12 0.2 0.2
Trial 9      1.16 17929.95 161321.6 6.13  2 0.11 0.12 0.2 0.2
Trial 10     0.24 17929.99 161322.5 6.13  2 0.11 0.12 0.2 0.2
Trial 11     1.62 17930.02 161324.4 6.13  2 0.11 0.12 0.2 0.2
Trial 12     0.25 17929.97 161323.0 6.13  2 0.11 0.12 0.2 0.2
Trial 13     0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 14     0.00 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 15     0.08 17929.96 161322.9 6.13  2 0.11 0.12 0.2 0.2
Trial 16     0.00       NA       NA   NA NA   NA   NA  NA  NA
Trial 17     0.13 17929.96 161322.6 6.13  2 0.11 0.12 0.2 0.2
Trial 18     0.35 17929.97 161322.4 6.13  2 0.11 0.12 0.2 0.2
Trial 19     0.45 17929.98 161323.2 6.13  2 0.11 0.12 0.2 0.2
Trial 20     0.04 17929.96 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 21     0.34 17929.97 161322.4 6.13  2 0.11 0.12 0.2 0.2
Trial 22     1.47 17929.91 161321.3 6.13  2 0.11 0.12 0.2 0.2
Trial 23     0.01 17929.96 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 24     0.10 17929.97 161322.7 6.13  2 0.11 0.12 0.2 0.2
Trial 25     0.83 17929.97 161323.6 6.13  2 0.11 0.12 0.2 0.2
Trial 26     0.17 17929.96 161322.6 6.13  2 0.11 0.12 0.2 0.2
Trial 27     0.14 17929.98 161322.9 6.13  2 0.11 0.12 0.2 0.2
Trial 28     0.23 17929.97 161323.0 6.13  2 0.11 0.12 0.2 0.2
Trial 29     0.02 17929.97 161322.8 6.13  2 0.11 0.12 0.2 0.2
Trial 30     2.49 17930.03 161325.2 6.13  2 0.11 0.12 0.2 0.2
```

Table 6.2.8. Management scenarios based on the WGDEEP assessment for first and second year, respectively. "ICES_2024_f15" is scenario with 15 fractiles.

Scenario	1st year: Catch	1st year: F/Fmsy	1st year: B/Bmsy	2nd year: Catch	2nd year: F/Fmsy	2nd year: B/Bmsy
Fish at Fmsy	21661	1.00	1.22	20658	1.00	1.17
Keep current F	16031	0.72	1.28	16035	0.72	1.28
No fishing	17	0.00	1.47	19	0.00	1.63
ICES_2024_f15	16732	0.75	1.27	16640	0.75	1.27

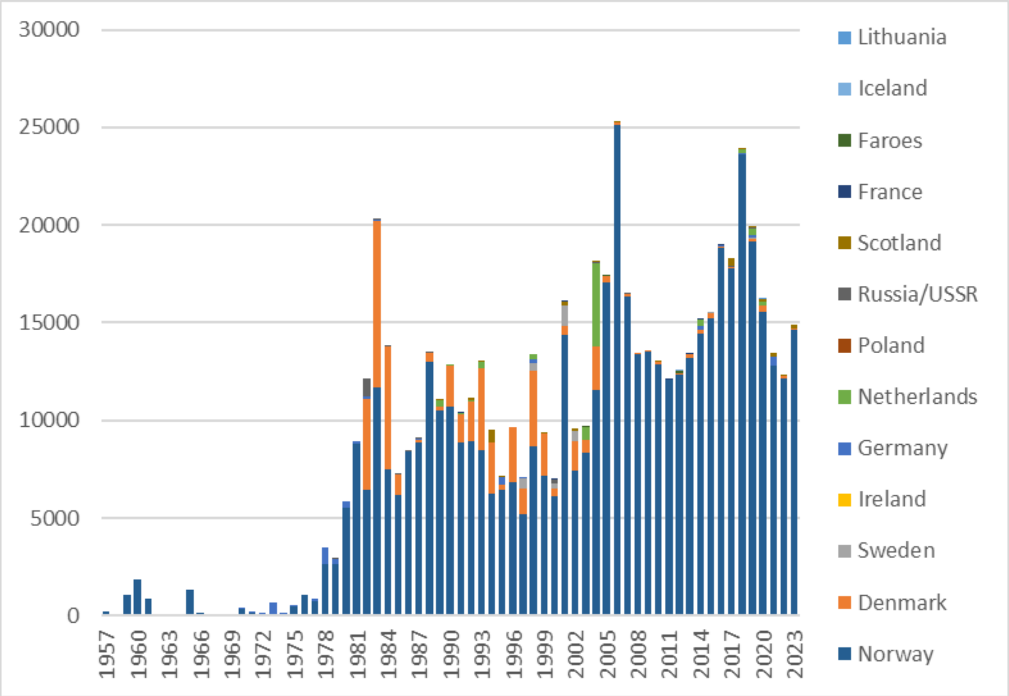


Figure 6.2.1. Total catch (tons) of greater silver smelt in subareas 1, 2, 3 and 4.

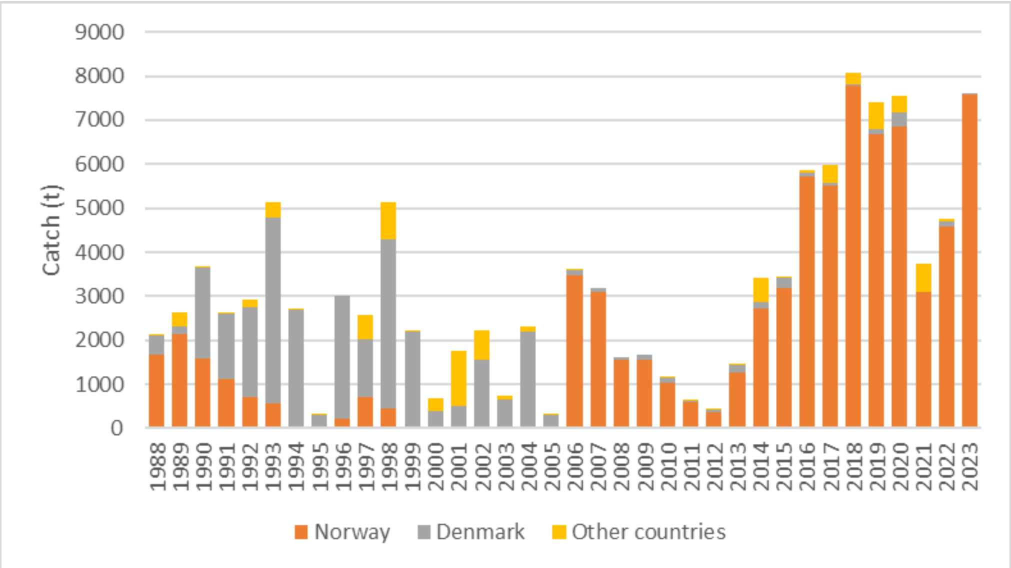


Figure 6.2.2. Total catch of greater silver smelt in subareas 3 and 4, by countries.

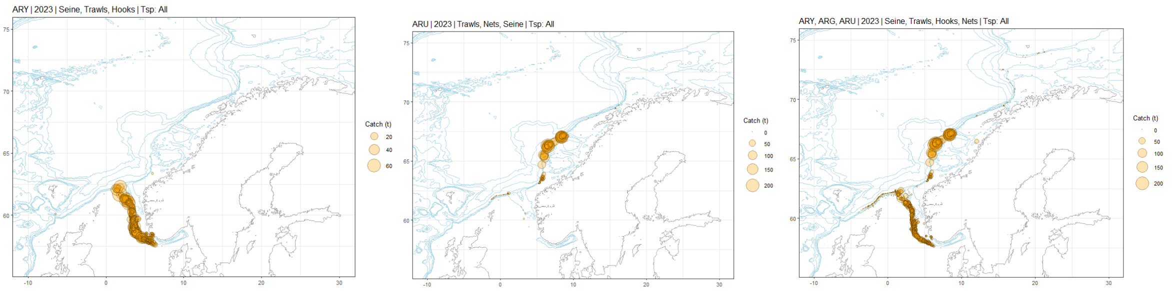


Figure 6.2.3. Norwegian catches in 2023 based on logbooks, including bycatch. Left, middle and right panels show catches registered as lesser silver smelt, greater silver smelt and mix of both species, respectively. Bubble sizes reflect sizes of single catches. NB: Catch representing max bubble size varies between panels.

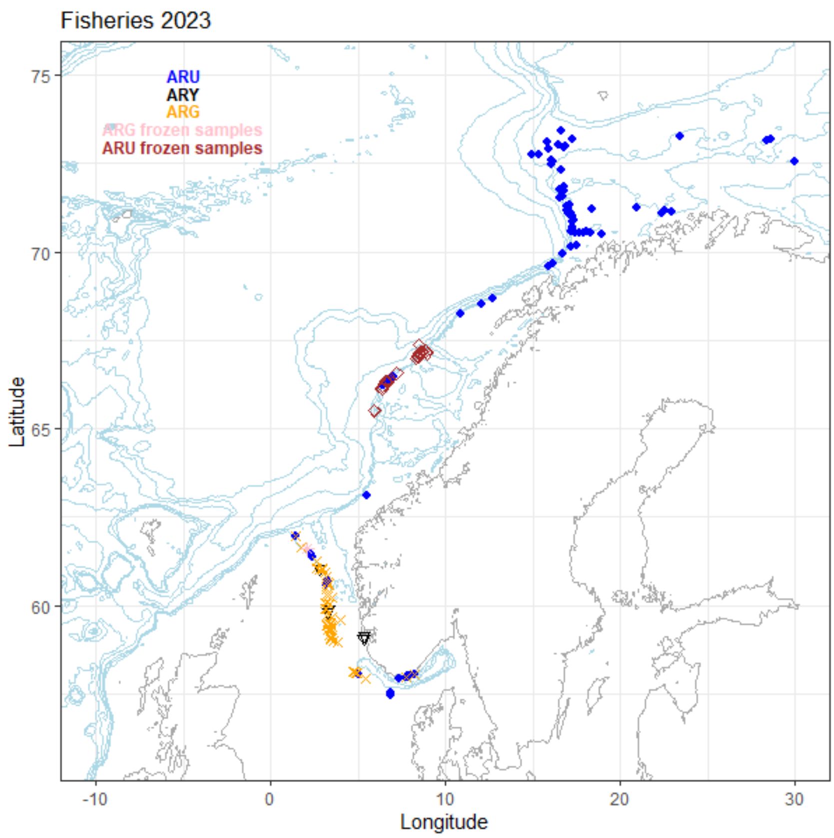


Figure 6.2.4. Positions from the fisheries for 2023 with length measurement landed as GSS, LSS, GSS/LSS and frozen samples.

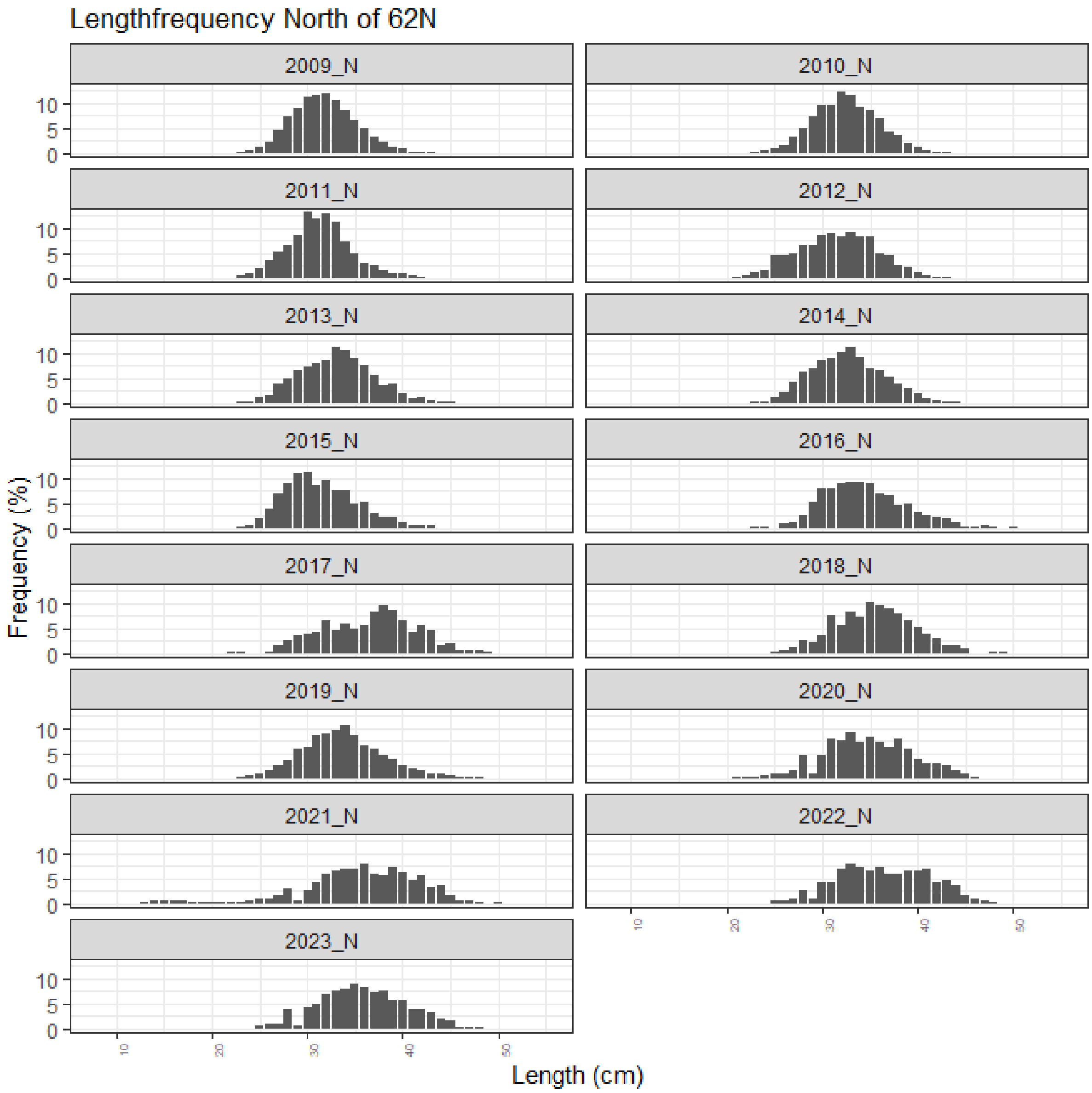


Figure 6.2.5. Greater silver smelt in subareas 1, 2, and 4 and Division 3.a. Length distributions (% numbers) from the target fisheries in 2009–2023 north of 62°N (approximately subareas 1 and 2).

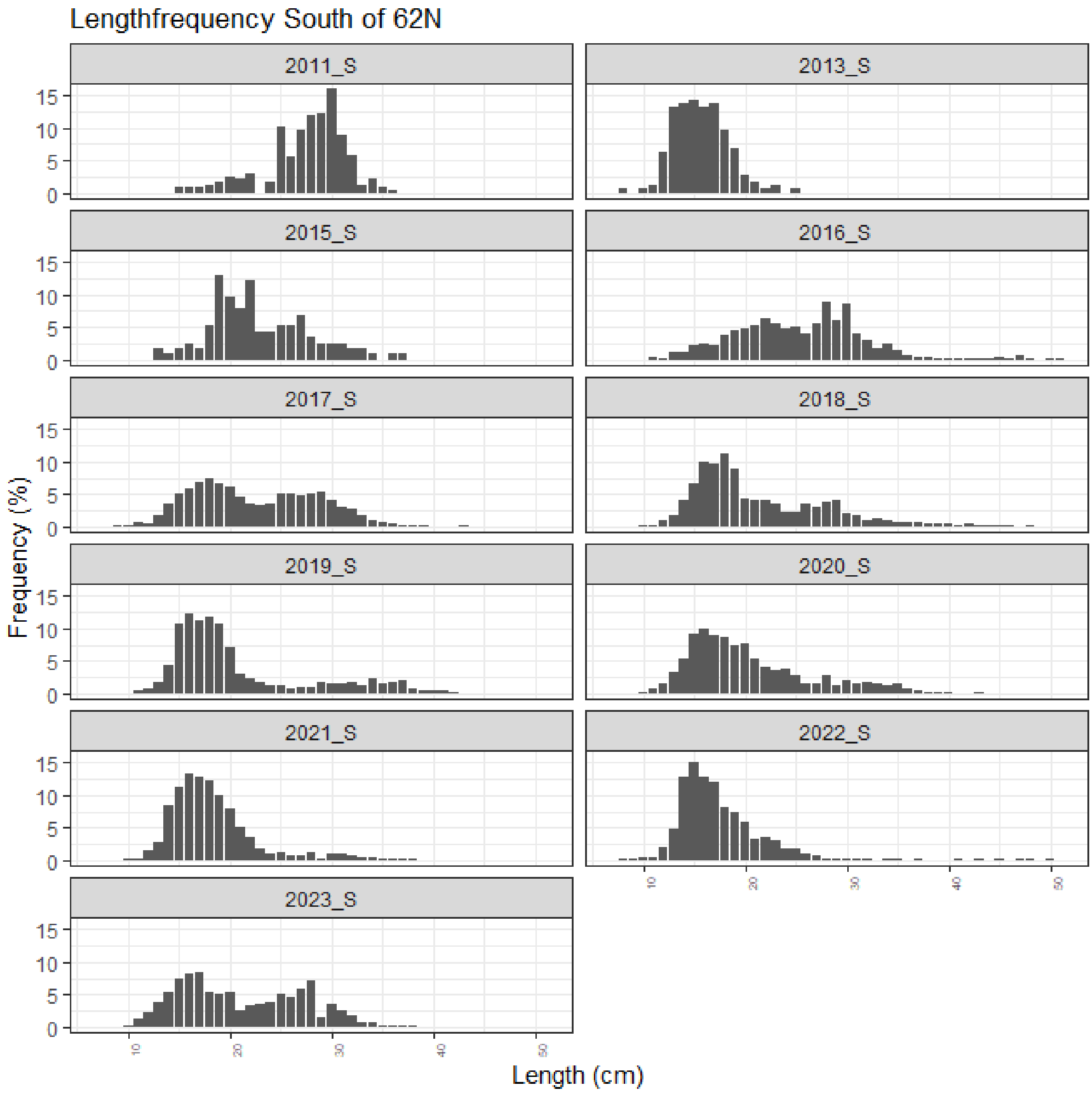


Figure 6.2.6. Greater silver smelt in 1, 2, 3.a and 4. Length distributions in annual samples from Norwegian bycatches south of 62°N (approximately subareas 3 and 4).

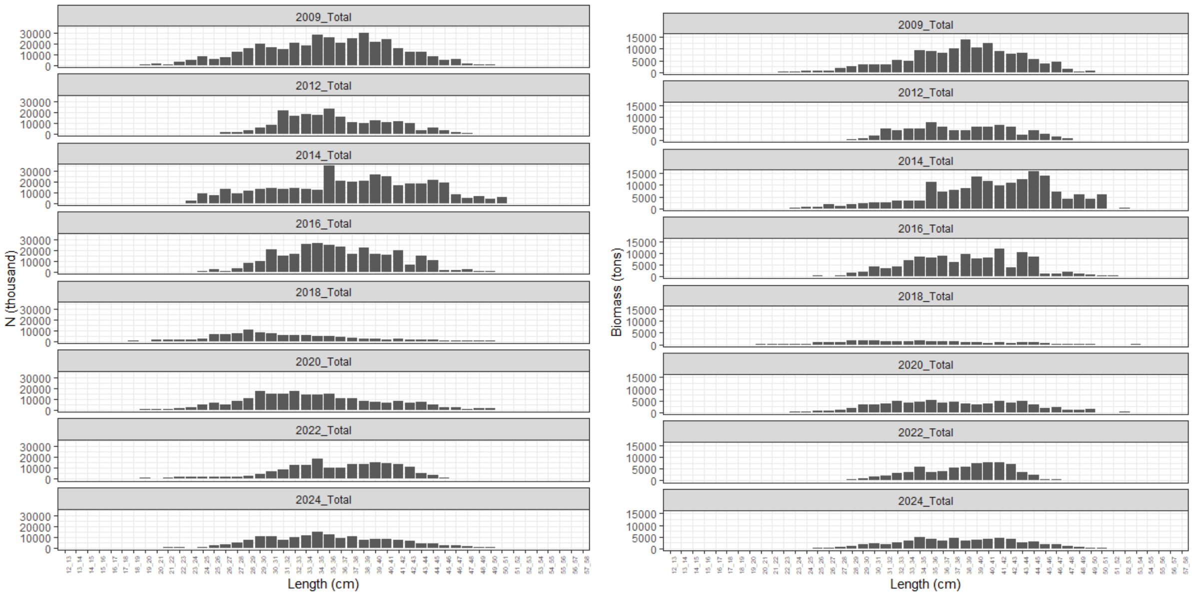


Figure 6.2.7. Length distributions in numbers (left panels) and biomass (tons) (right panels) for greater silver smelt in the Norwegian Sea south-east slope survey in 2009, 2012, 2014, 2016, 2018, 2020, 2022 and 2024. Swept area estimates from StoX.

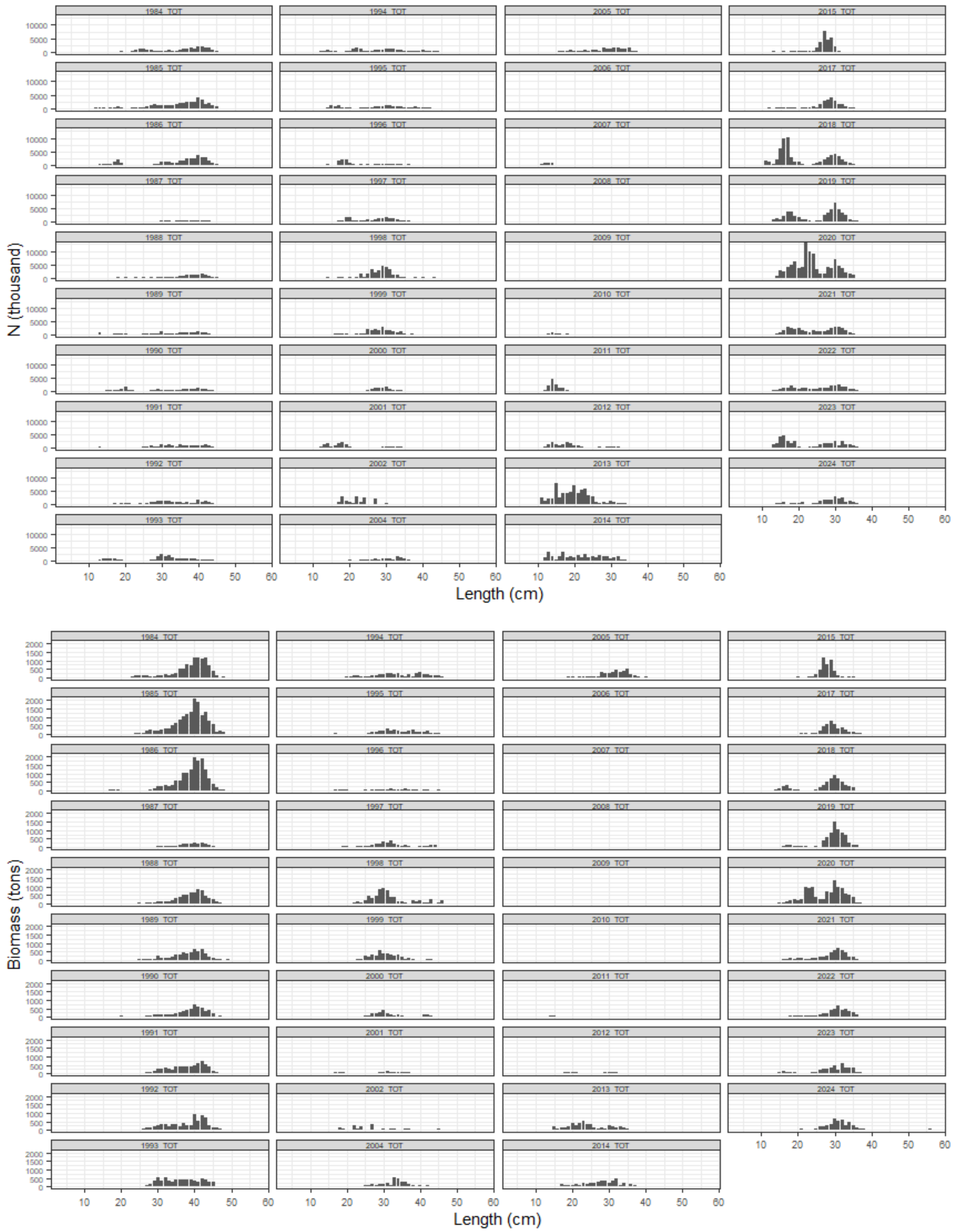


Figure 6.2.8. Length distributions in numbers (upper panels) and biomass (lower panels) for greater silver smelt in the North Sea/Skagerrak survey.

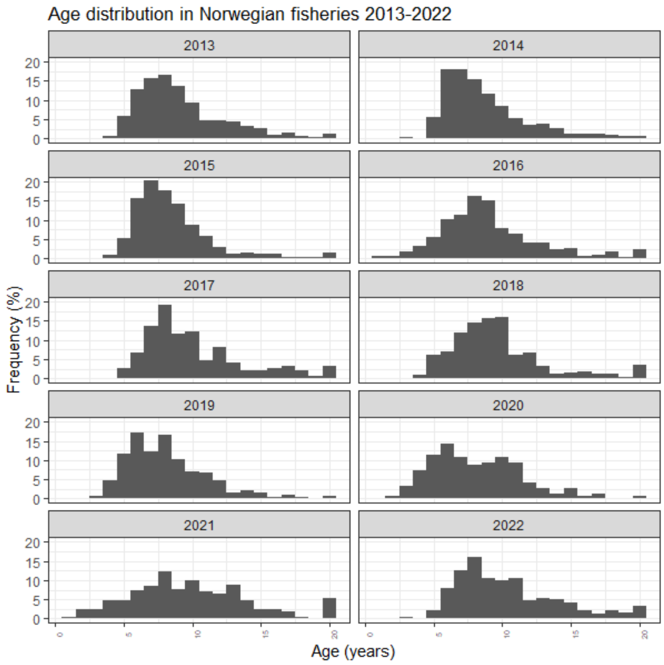


Figure 6.2.9. Greater silver smelt in 1, 2, 3, and 4. Age composition of Norwegian landings samples, 2013-2020. Age 20 is an age 20+group.

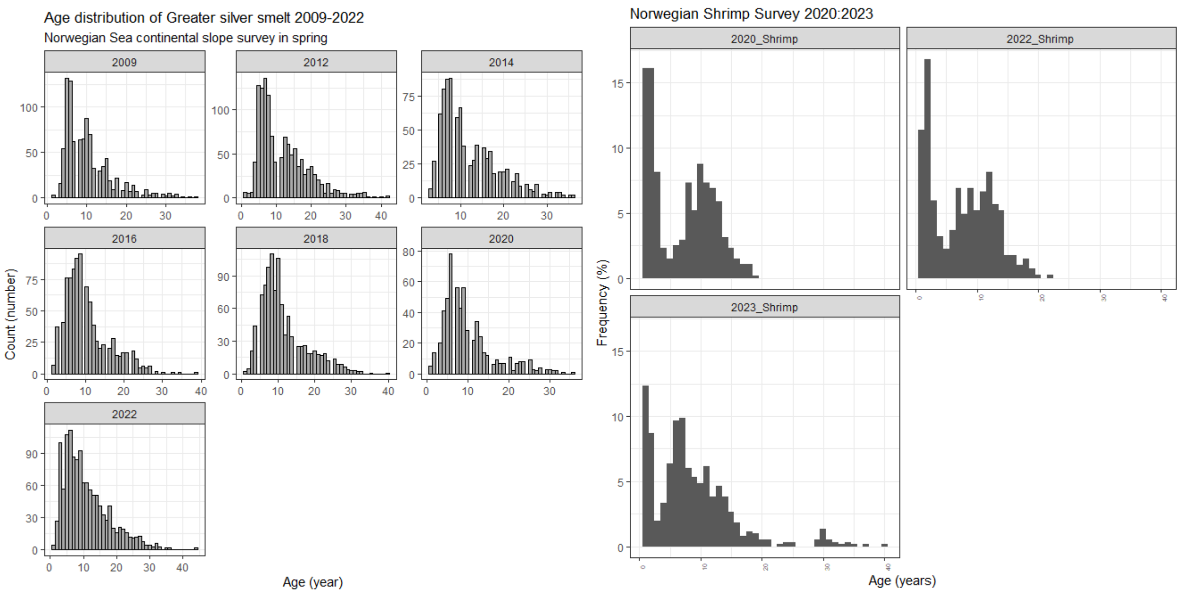


Figure 6.2.10. Age distributions of greater silver smelt from the Norwegian slope survey 2009-2022 (left panels) and the Norwegian Shrimp survey in North Sea/Skagerrak 2020, 2022 and 2023 (right panels).

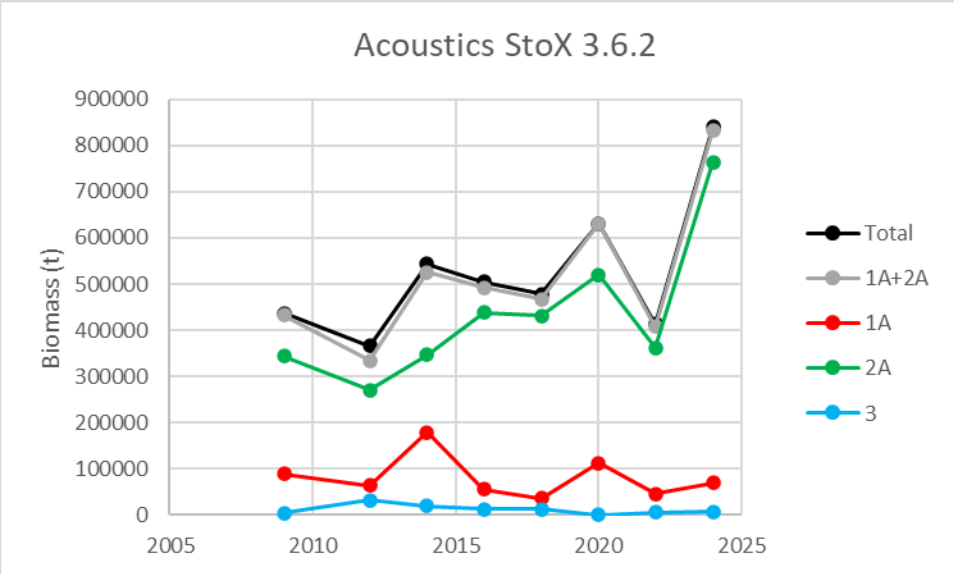


Figure 6.2.11. Acoustic index from the Norwegian Slope survey in subareas 1 and 2. Biomass estimates for different strata (1A, 2A and 3) in the survey are shown, as well as summed estimates for 1A and 2A and total for all strata. Stratum 3 was not covered in 2020 due to covid19 complications in the conduct of the survey.

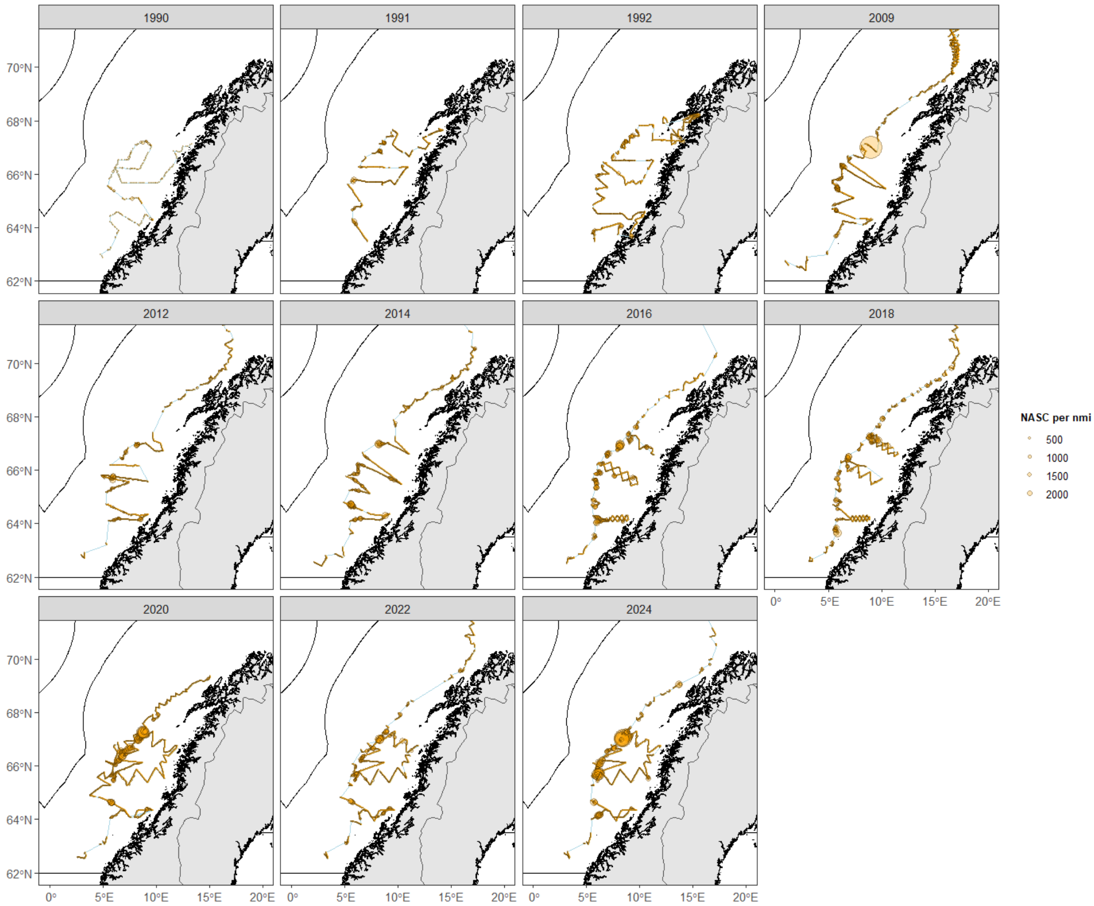
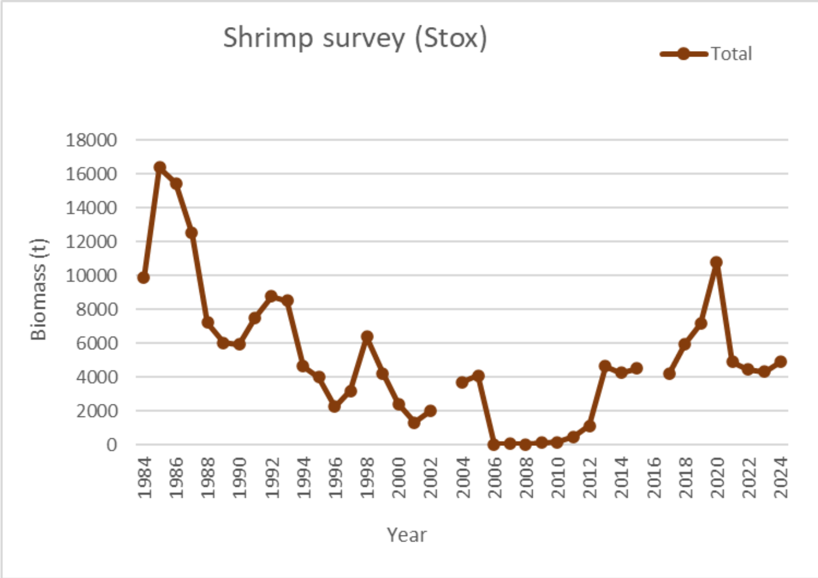


Figure 6.2.12. Greater silver smelt in Division 2.a. Acoustic backscattering strength estimates (SA-values) in Norwegian continental shelf and slope surveys March–April 2009, 2012, 2014, 2016, 2018, 2020, 2022 and 2024. Acoustic backscattering strength estimates (SA-values) in the Norwegian Sea and south-east slope survey conducted in spring 1990-1992.



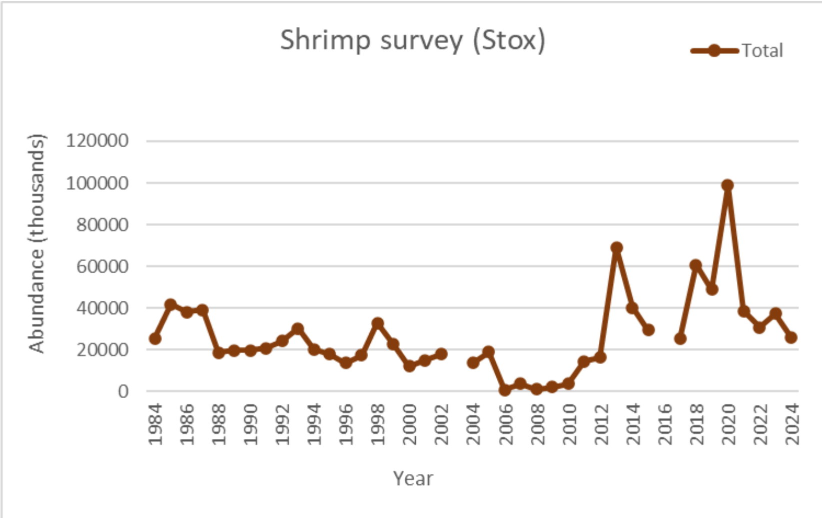


Figure 6.2.13. Swept area total biomass index (upper panel) and swept area total abundance index (lower panel) for greater silver smelt in the shrimp survey in North Sea/Skagerrak. Seasonality of the survey has varied through the years. It was conducted in October 1984-2002, May 2004-2005, February 2006-2007 and in January since then.

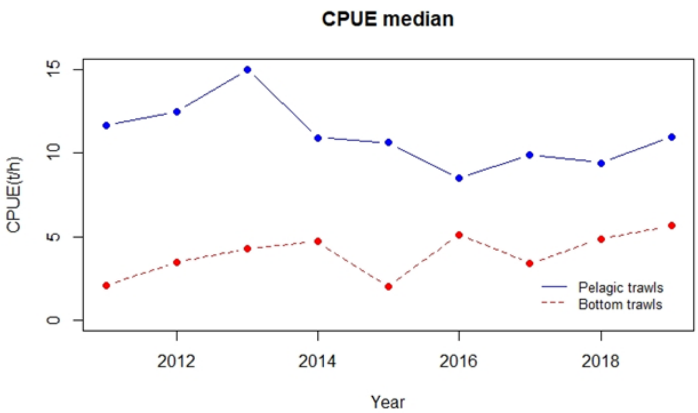


Figure 6.2.14. CPUE from the Norwegian direct fisheries on greater silver smelt in Division 2.a, based on electronic logbooks 2011-2019.

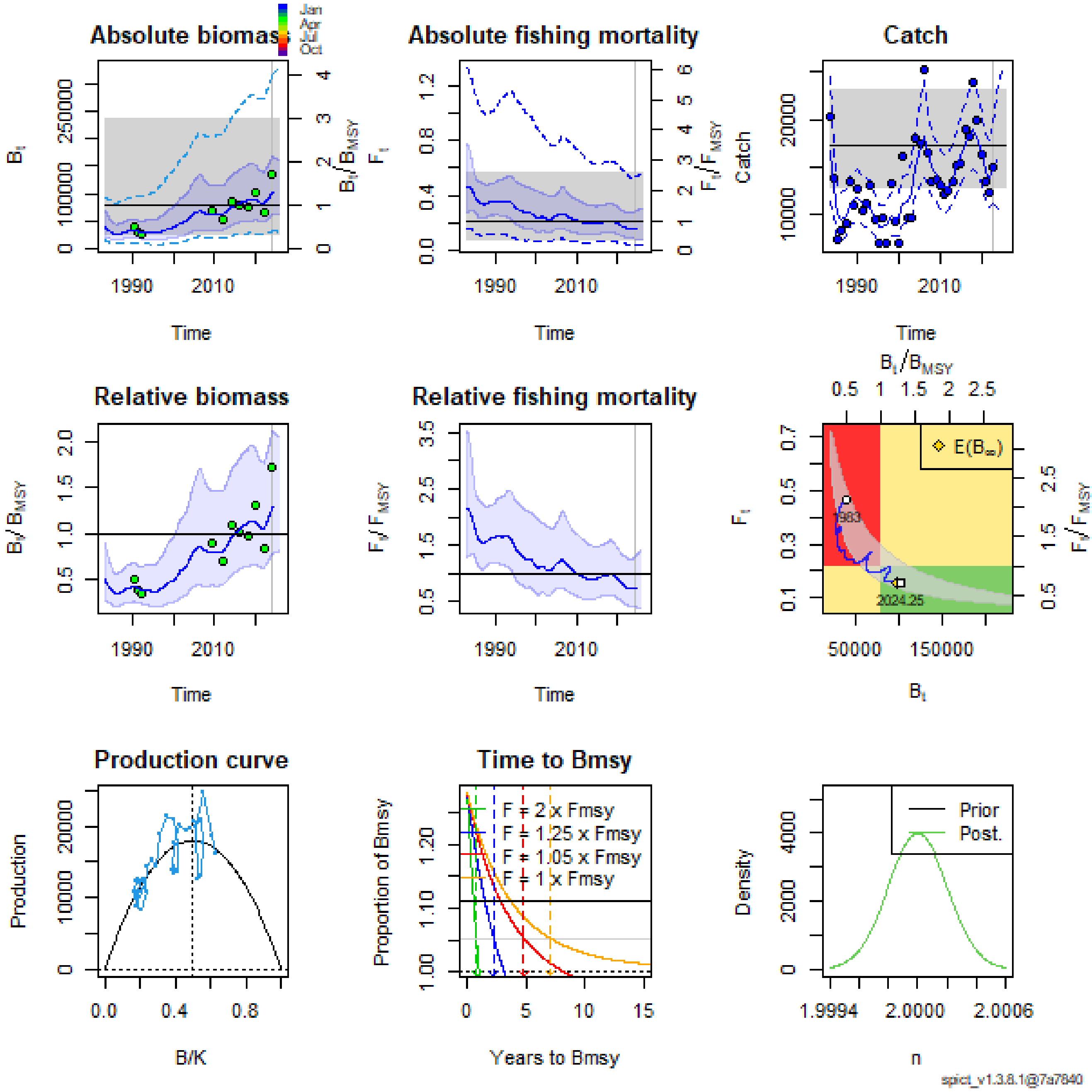


Figure 6.2.15. SPiCT, model fit.

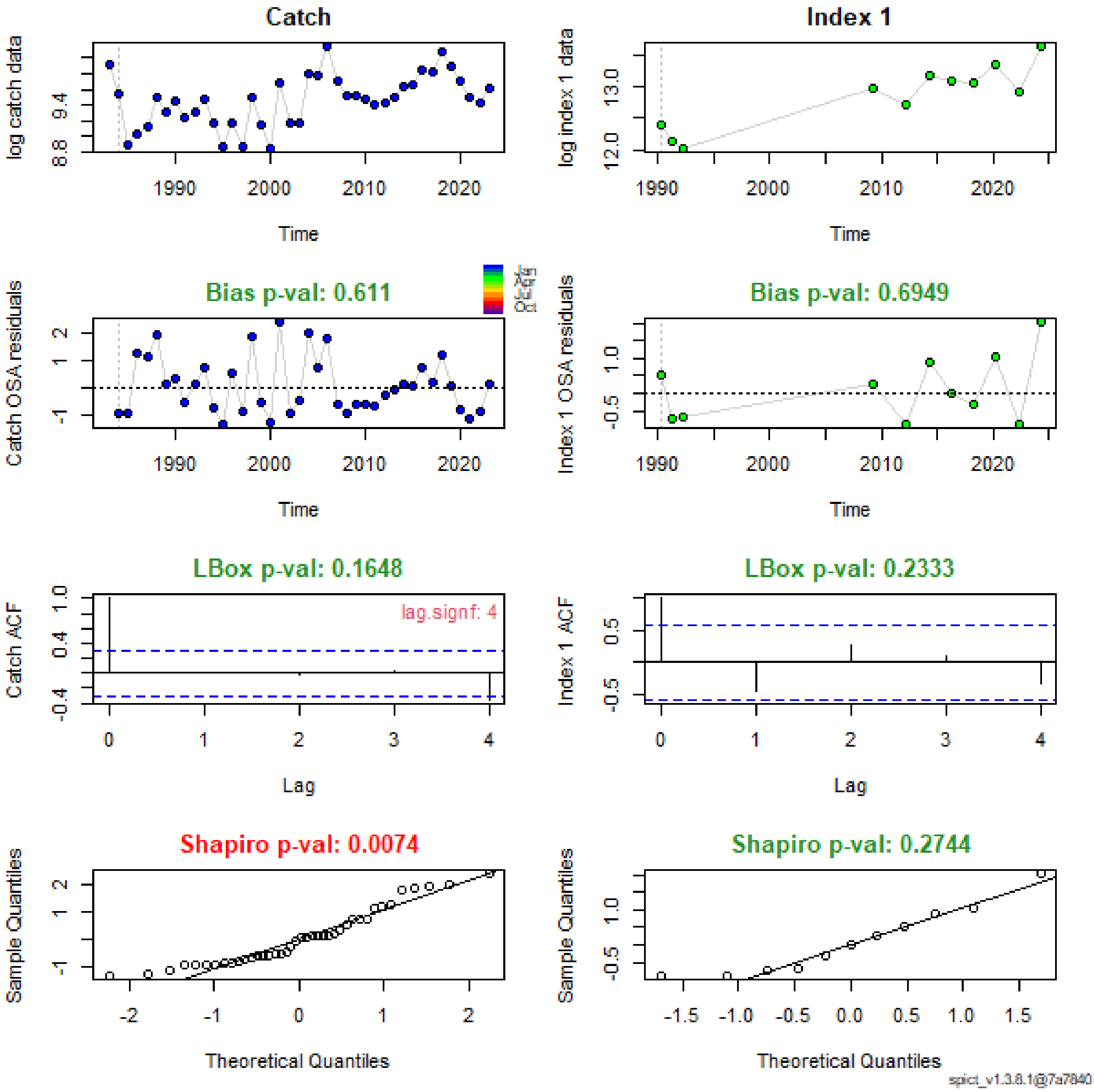


Figure 6.2.16. One-Step-Ahead residuals for observations. Input data to the SPiCT analysis.

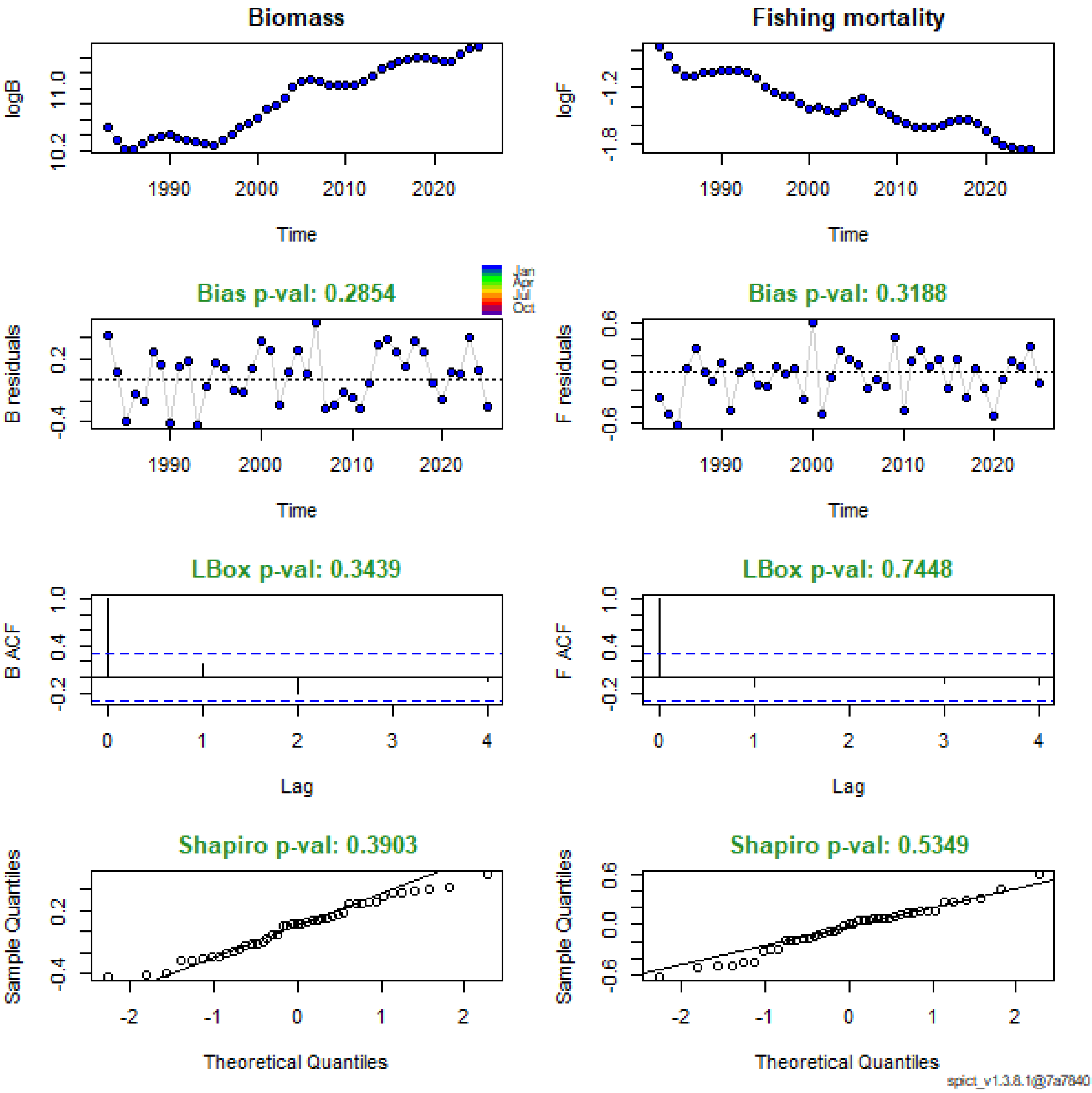


Figure 6.2.17. Process residuals.

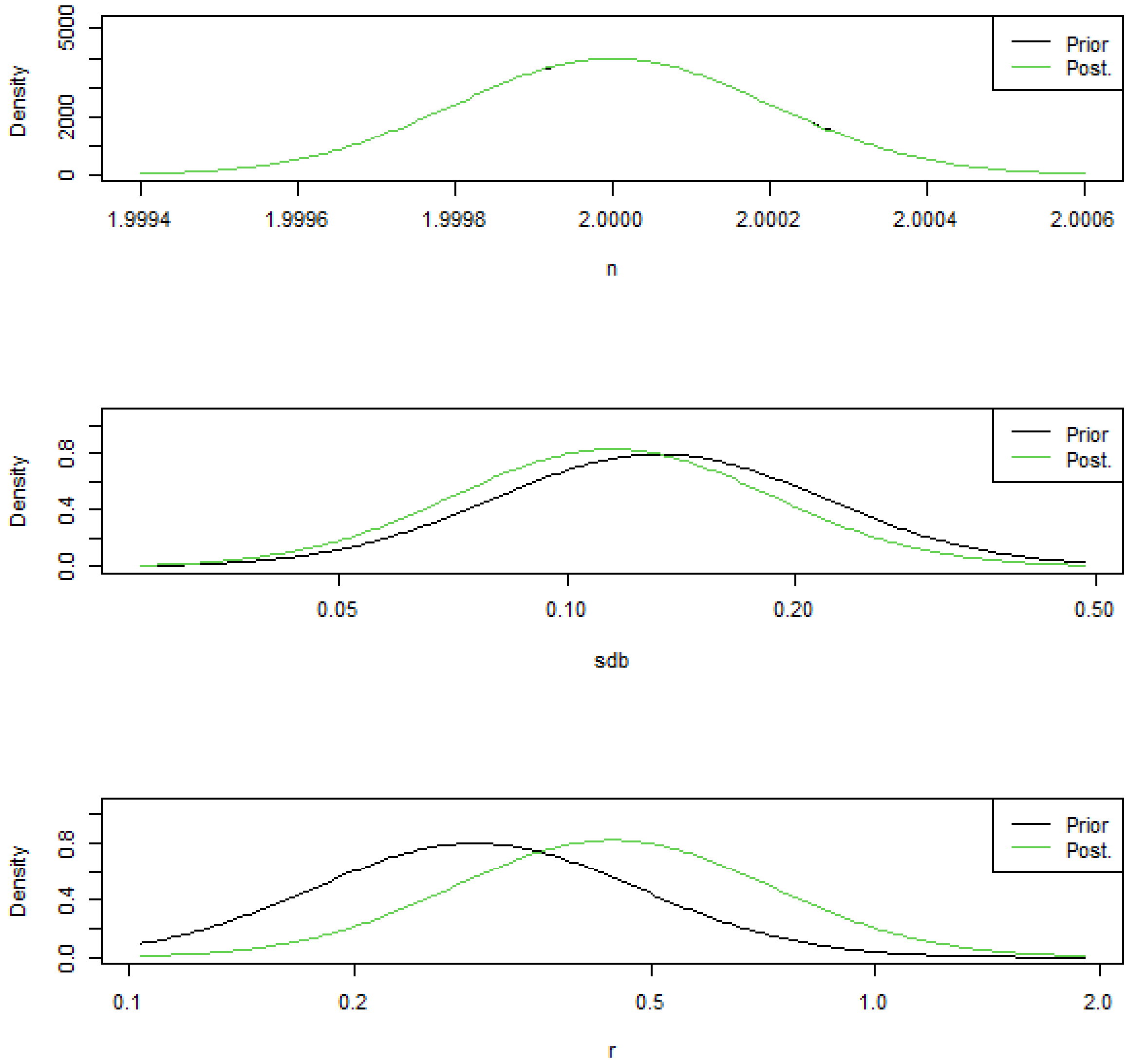


Figure 6.2.18 Prior and posterior distributions.

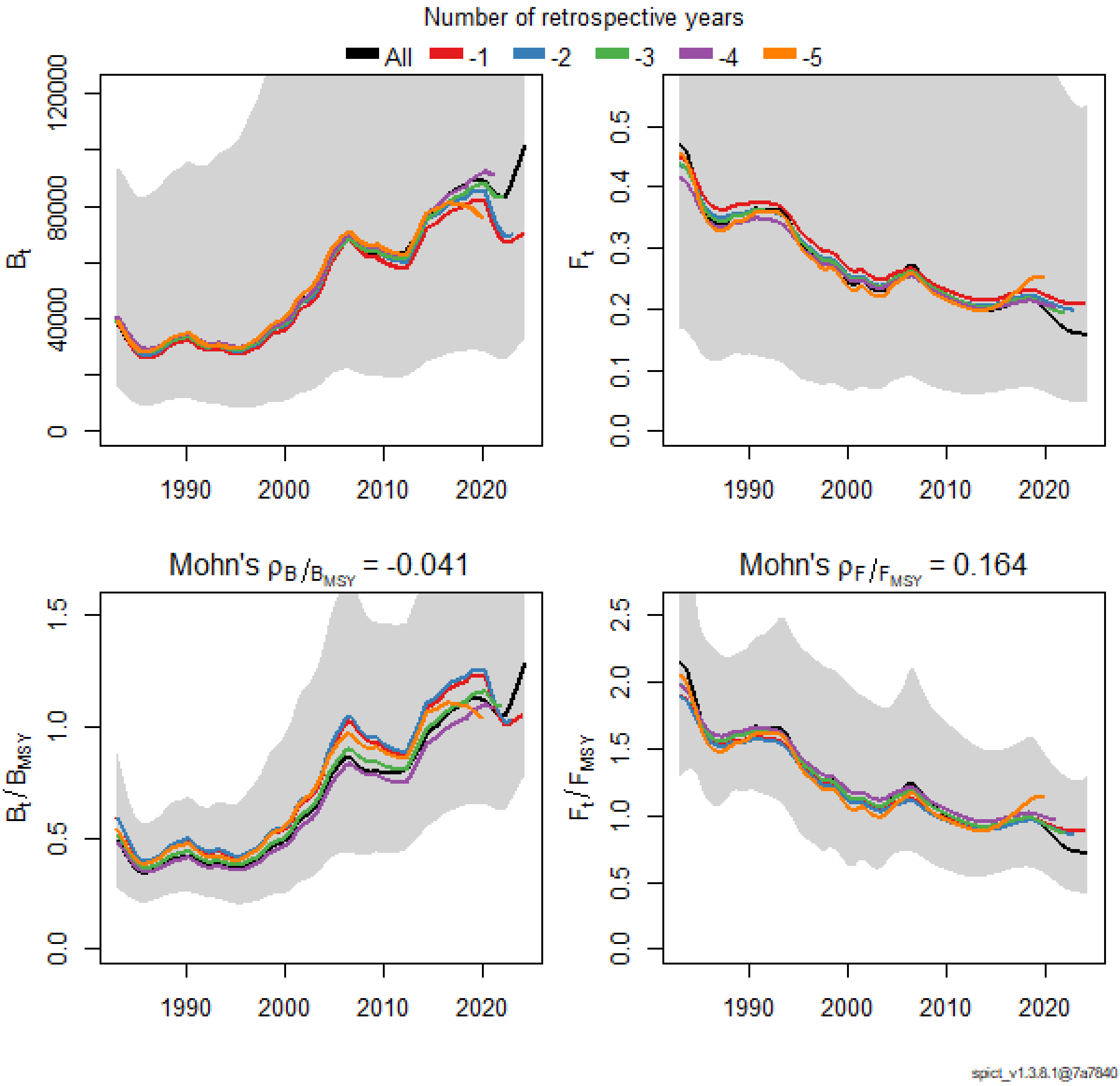


Figure 6.2.19. Retrospective analysis.

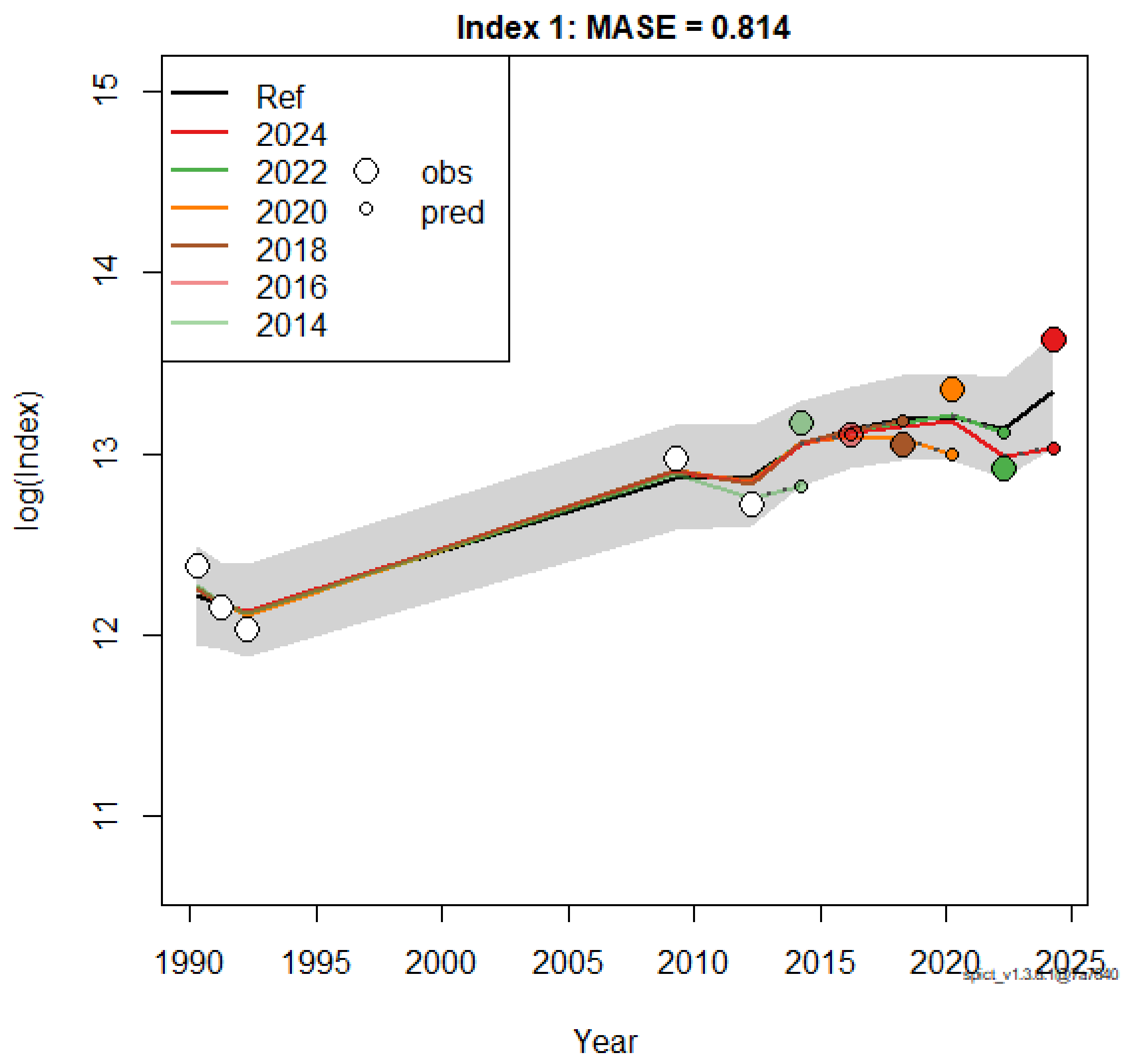


Figure 6.2.20. Hindkast plot with MASE predictor.

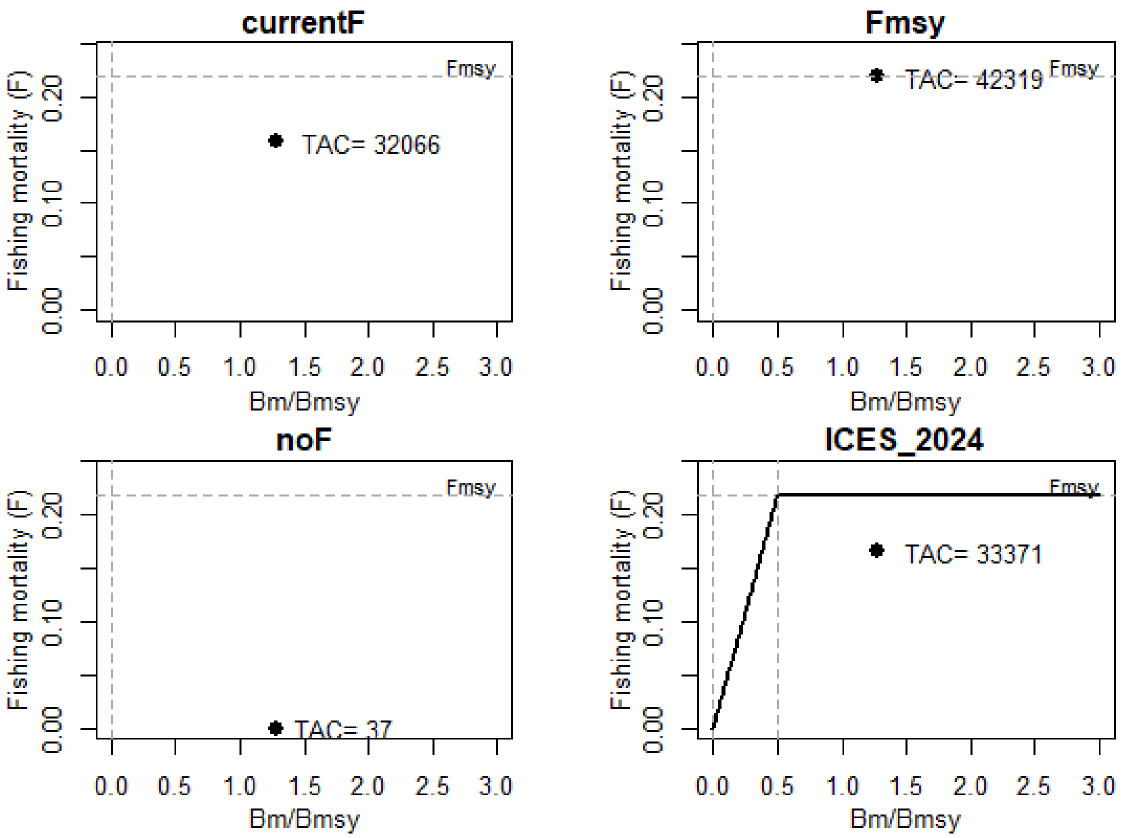


Figure 6.2.21. Management scenarios, the management is given for two years with separate TACs for each year, while in this figure the TACs is summed for two years combined.

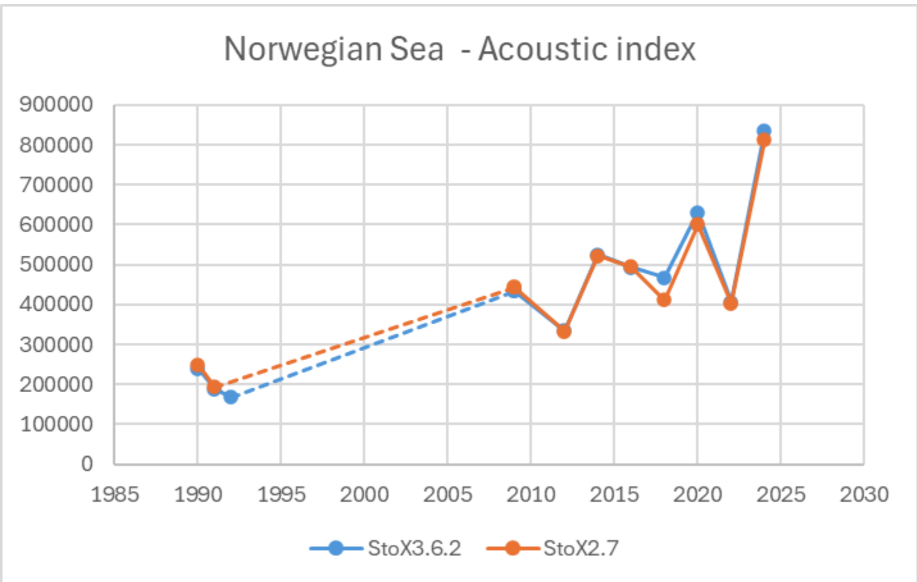


Figure 6.2.22. Acoustic biomass indices from the Norwegian Sea south-east slope survey; differences between strata in year 1990-1992 and 2009-2024 using StoX 2.7 (orange) and StoX 3.6.2 (blue).

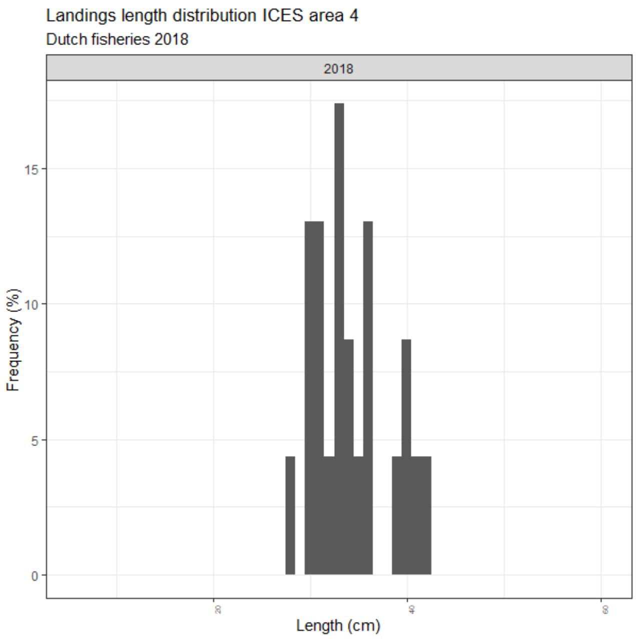


Figure 6.2.23: Dutch landings Subarea 4 in 2018.

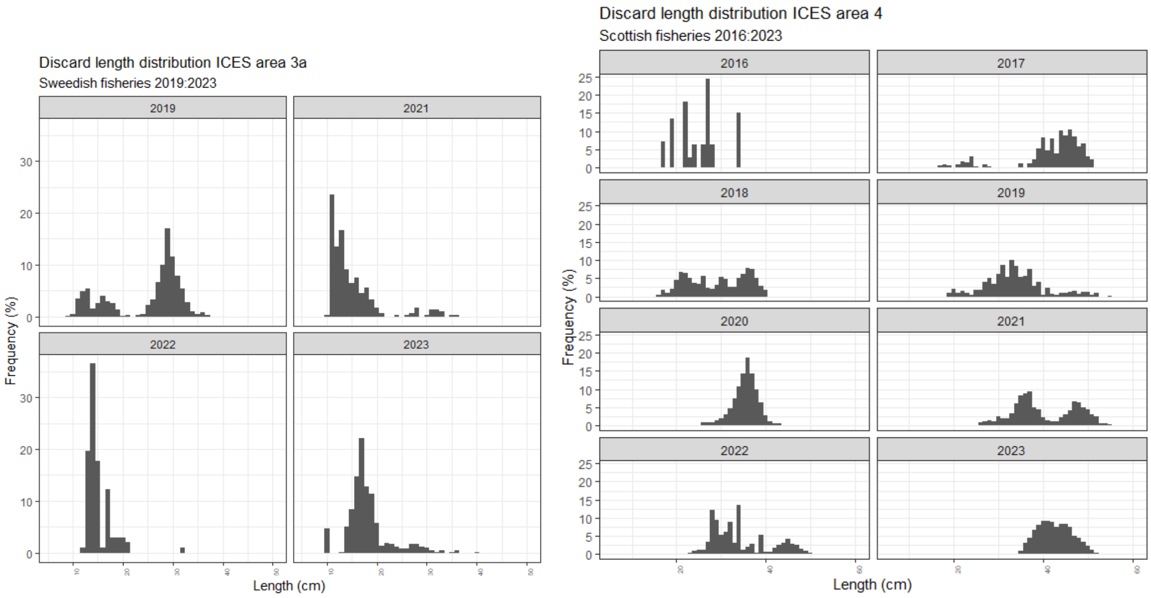


Figure 6.2.24: Discards division 3a (Sweden) and Subarea 4 (Scotland), in years 2019-2023 and 2016-2023, respectively.

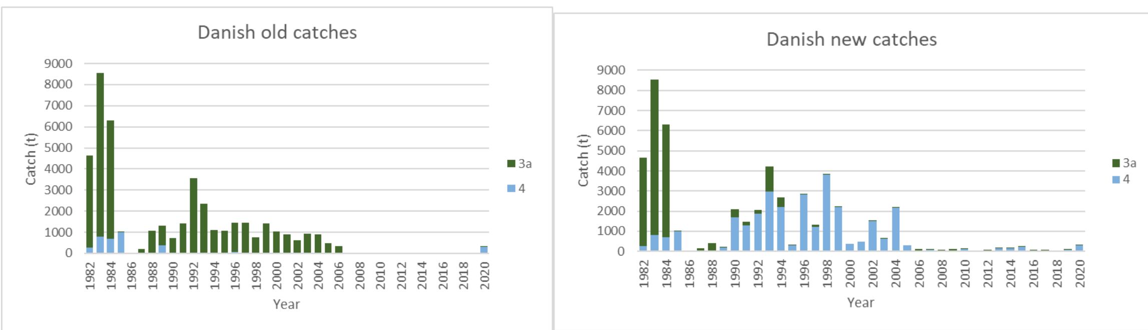


FIGURE 6.2.25: Danish catches from Division 3a and Subarea 4. Left panel showing distribution of catches reported before 2020, right panel shows catches updated in 2020.

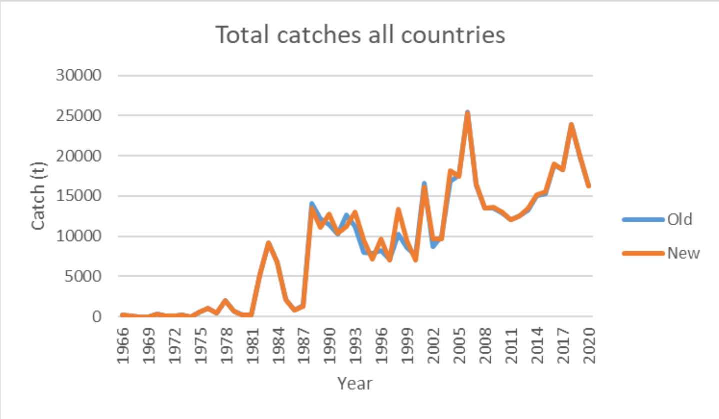


Figure 6.2.26: Total catch for all countries combined. Comparing the previous reported Danish catches with the updated catches.

6.3 Greater silver smelt (*Argentina silus*) in 5.a and 14

6.3.1 The fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m, as targeted fishing is only allowed at depths greater than 400 m (Figure 6.3.1). 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. This caused the landings to increase significantly in the past with the highest amount recorded in 2010, despite relatively low, but rising, recent levels (Table 6.3.1).

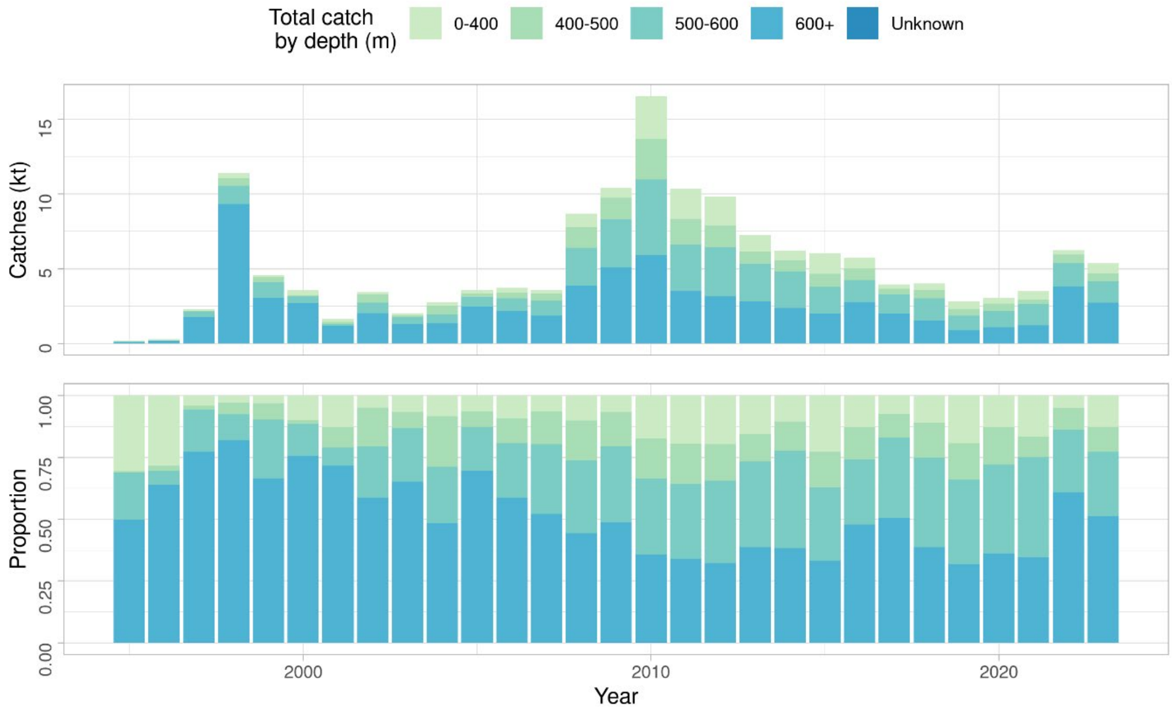


Figure 6.3.1: Greater silver smelt in 5.a and 14. Depth distribution of catches in 5.a according to Icelandic logbooks. All gear combined.

Table. 6.3.1. Greater silver smelt in 5.a and 14. Landings (tonnes) records from the Icelandic directorate of Fisheries and Greenland (WD05, annexed to this report).

Year	Inside the NEAFC RA	Outside the NEAFC RA		Landings (tonnes)
		Section 5.a	Section 14.b	
1988				240
1989				8
1990				113
1991				246
1992				657
1993				1526
1994				756
1995				586
1996				881
1997				3935
1998				15242
1999				6681

Year	Inside the NEAFC RA	Outside the NEAFC RA		Landings (tonnes)
		Section 5.a	Section 14.b	
2000				5657
2001				3043
2002				4960
2003				2680
2004				3645
2005				4482
2006				4769
2007				4227
2008				8778
2009				10828
2010				16428
2011				10516
2012				9289
2013	0	7155		7155
2014	0	6344	4	6348
2015	0	6058	12	6070
2016	0	5646	16	5662
2017	0	4344	666	5010
2018	0	4035	425	4460
2019	0	3208-9	1	3210
2020	0	3775	22	3797
2021	0	4140	15	4155
2022	0	6886	28	6914
2023	0	5268	0	5268

6.3.2 Fleets

Since 1996 between 20 and 40 trawlers have annually reported catches of greater silver smelt in 5.a (WGDEEP 2019, Table 6.3.2). The trawlers participating in the greater silver smelt fishery also target redfish (*Sebastes marinus* and *S. mentella*) and to a lesser extent Greenland halibut and blue ling. The number of hauls peaked in 2010, but have decreased since then in line with lower total catches except for the two past years when both catches and number of hauls were rather high. In most years, over 50% of the greater silver smelt catches were taken in hauls where the species composed more than 50% of the catch (Table 6.3.2).

Table 6.3.2: Greater silver smelt in 5.a. Information on the fleet reporting catches of greater silver smelt.

Year	Number of trawlers	Number of hauls	Reported catch (kg)	No. hauls which GSS > 50% of catch	Proportion of reported catch in hauls where GSS > 50%
1987	1	14	4740	3	0.6751055
1988	2	146	224700	50	0.5718736
1990	1	24	46350	10	0.6256742
1991	13	114	74210	7	0.2641153
1992	23	275	230782	16	0.2032221
1993	25	317	772031	98	0.7282091
1994	16	151	304550	52	0.7832868
1995	24	200	180736	21	0.4039040
1996	22	307	259660	29	0.4039898
1997	26	874	2281654	355	0.8216162
1998	40	2683	11388707	1991	0.9465763
1999	25	1509	4563652	810	0.8485031
2000	23	1301	3549812	608	0.7971971
2001	26	794	1606420	245	0.6920637
2002	32	1160	3158313	468	0.7440289
2003	30	1176	2005477	213	0.4732091
2004	27	1052	2732879	292	0.6527805
2005	30	1388	3557625	335	0.7069759
2006	31	1554	3735916	355	0.6897529
2007	27	1275	3469927	416	0.7179114
2008	31	3256	8568592	848	0.6478629
2009	34	3555	10425146	1010	0.6804055
2010	36	4846	16499826	1821	0.7271470
2011	32	3309	10237373	961	0.7151100

Year	Number of trawlers	Number of hauls	Reported catch (kg)	No. hauls which GSS > 50% of catch	Proportion of reported catch in hauls where GSS > 50%
2012	32	3395	9775676	988	0.7103783
2013	34	2743	7246715	609	0.6418890
2014	29	2363	6195337	487	0.6076312
2015	39	2195	5835439	356	0.5735490
2016	36	2096	5718623	385	0.5926304
2017	34	1363	3894310	236	0.5844221
2018	36	1440	3892702	215	0.4785869
2019	40	1169	2569762	143	0.5063064
2020	40	1170	2968000	174	0.4750000
2021	45	1166	2279819	189	0.6629520
2022	37	1697	4523619	468	0.7358009
2023	44	1992	3468605	348	0.6355702

6.3.3 Targeting and mixed fisheries issues in the Greater Silver Smelt fishery in 5.a

6.3.3.1 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 (ICES 2021).

6.3.3.2 Spatial distribution of catches through time

Spatial distribution of catches (5.a and 14) in 2000– 2023 is presented in Figure 6.3.2 and Figure 6.3.3. Most of the catches have been from the southern edge of the Icelandic shelf. However, since 1993, 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 (Figure 6.3.2).

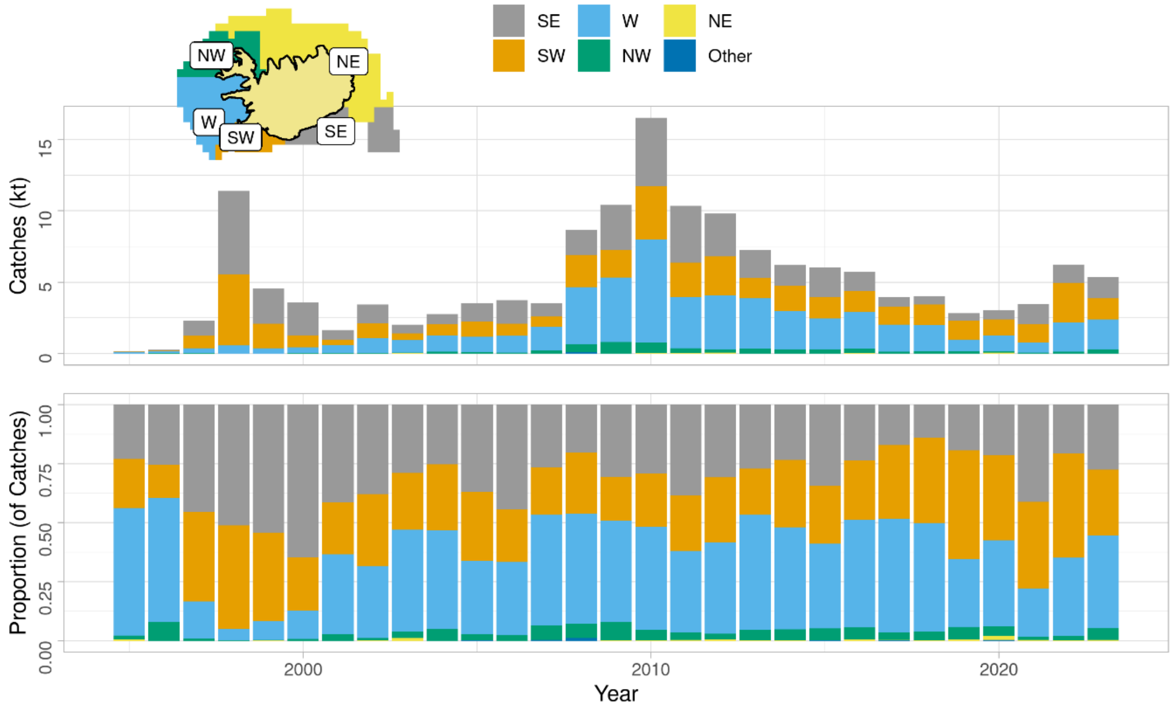


Figure 6.3.2: Greater silver smelt in 5.a and 14. Spatial distribution of catches defined by regions deeper than 400 m by year (See stock annex for details). Above are the catches on absolute scale and below in proportions. All gears combined.

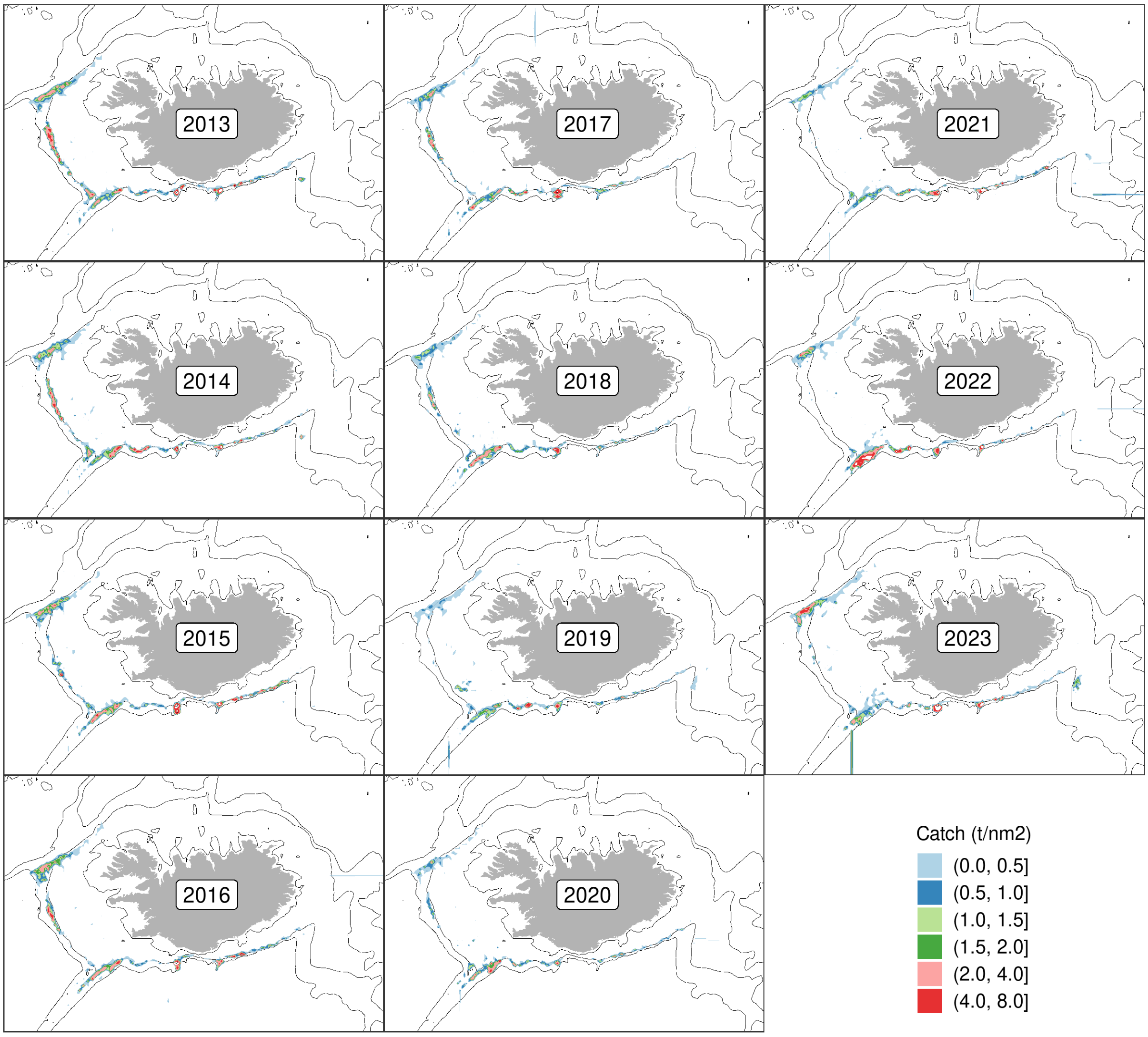


Figure 6.3.3: Greater silver smelt in 5.a and 14. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

6.3.4 Landing trends

Landings of Greater Silver Smelt are presented in Table 6.3.1 and Figure 6.3.4. 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. After 2007 landings 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 2023 amounted to 5268 tonnes in 14 and 5.a. Substantial landings were reported in Greenlandic waters in 2017 and 2018; however, these exploratory directed fisheries appear to have ceased in 2019 but should be monitored for reappearance.

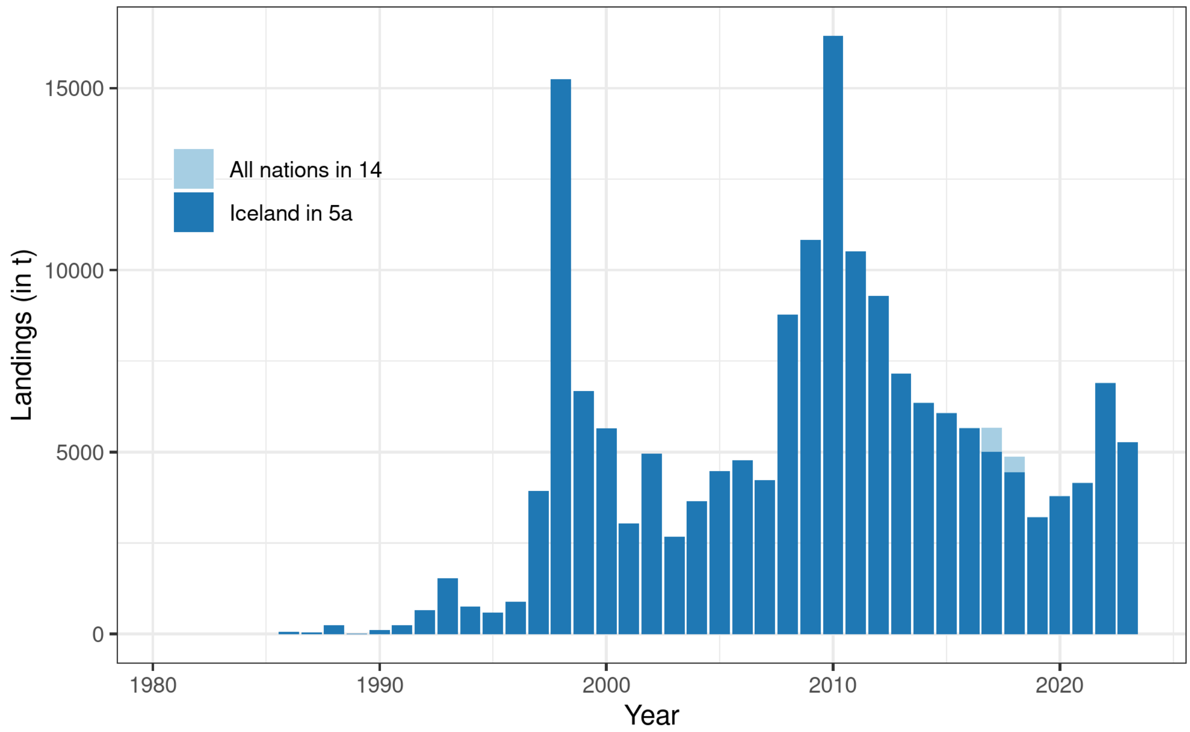


Figure 6.3.4: Greater silver smelt in 5.a and 14. Nominal landings. 23 tonnes were landed by foreign vessels (England and Wales) in 1999, which is the only year of catches reported by foreign vessels.

6.3.5 Data available

In general sampling is considered representative from commercial catches, as one of the requirements of owning a fishing license for greater silver smelt is the retention of scientific samples (Table 6.3.3). Samples were only obtained from bottom trawls. The sampling does seem to cover the spatial and temporal distribution of catches. The sampling coverage in 2023 is shown in Figure 6.3.5. Recent years have experienced a large decline in sampling but for 2023 sampling was increased to acceptable levels. No age data were collected in 2019.

Table 6.3.3: 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. otoliths aged
1997	48	4991	31	1447	1059
1998	148	15557	114	6966	889
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	
2004	34	996	7	225	84
2005	49	3708	14	772	
2006	29	4186	13	616	525

Year	No. length samples	No. length measurements	No. otolith samples	No. otoliths	No. otoliths aged
2007	14	2158	8	285	272
2008	44	3726	39	1768	1387
2009	53	5701	36	1746	1574
2010	134	16351	68	3370	3120
2011	63	6866	40	1953	1774
2012	43	4440	31	1492	603
2013	47	4925	34	710	704
2014	39	4709	16	350	340
2015	11	1275	8	221	217
2016	45	5879	13	285	283
2017	29	3466	21	430	416
2018	12	1437	9	185	181
2019	8	1010	0	40	40
2020	12	1566	6	130	130
2021	14	1301	6	195	194
2022	8	603	8	165	165
2023	26	2701	22	439	436

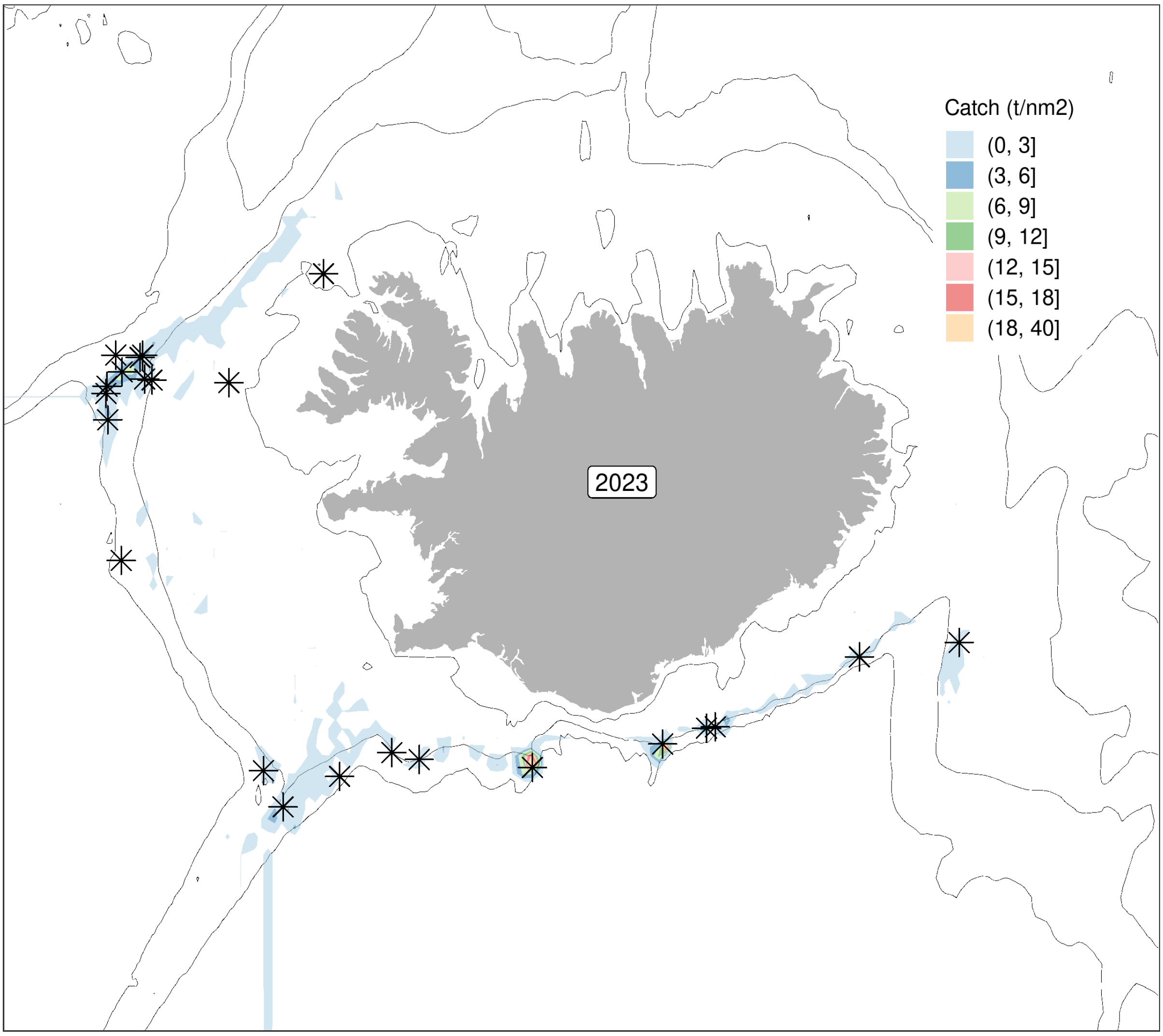


Figure 6.3.5: Greater silver smelt in 5.a and 14. Fishing grounds in 2023 as catches reported in logbooks (tiles) and positions of samples taken from landings (asterisks).

6.3.6 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.

6.3.7 Catch, effort and research vessel data

6.3.7.1 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.

6.3.7.2 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, as it covers deeper waters where larger greater silver smelt are found and fished (> 400 m, due to a regulation requiring this). Figure 6.3.6 gives trends in biomass density and juvenile density (numbers) for the spring survey in 1985 to 2024 and for the autumn survey to 2023. Figure 6.3.7 gives the most recent catch quantities and locations of surveys. 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 because 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. For example, survey indices in 1999 and 2014 are especially high in comparison with survey indices from adjacent years (Figure 6.3.6). The indices for 2021-2023 are the highest in the timeseries but as they are not isolated this is likely a sign of increasing population size. Winsorisation has been done in the past to reduce the effects of large hauls. However, winsorisation is not necessary for the gadget model and has not been used since 2020. No substantial changes in proportional catch by area is seen in general (Figure 6.3.8).

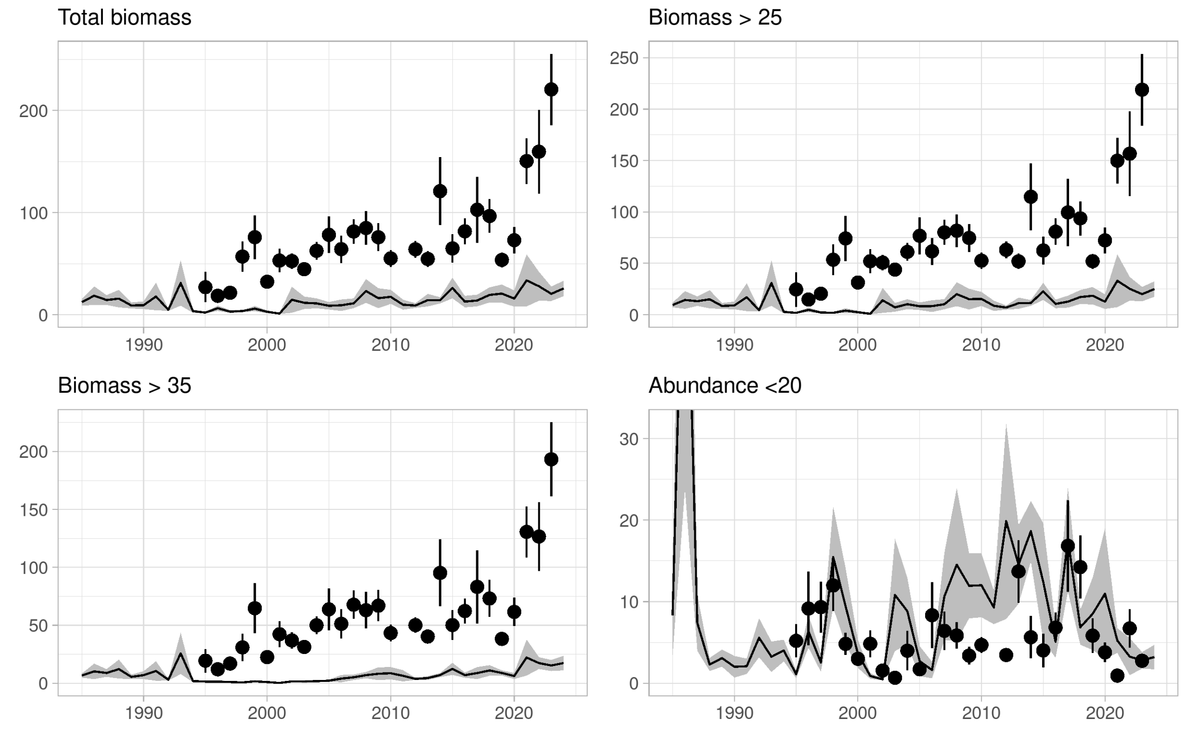


Figure 6.3.6. Greater silver smelt in 5.a and 14. Indices calculated from the Icelandic spring survey (black lines and shaded area) and from the autumn survey (dots and vertical lines). Vertical lines and shaded area represent +/- 1 standard error.

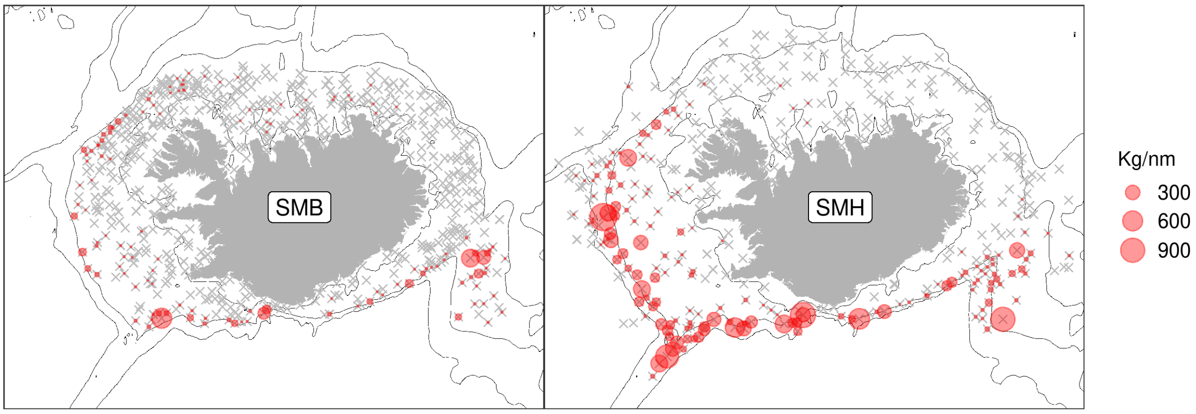


Figure 6.3.7: Greater silver smelt in 5.a and 14. Abundance and distribution of greater silver smelt in the spring survey (SMB) in 2023 and in the autumn survey (SMH) in 2022.

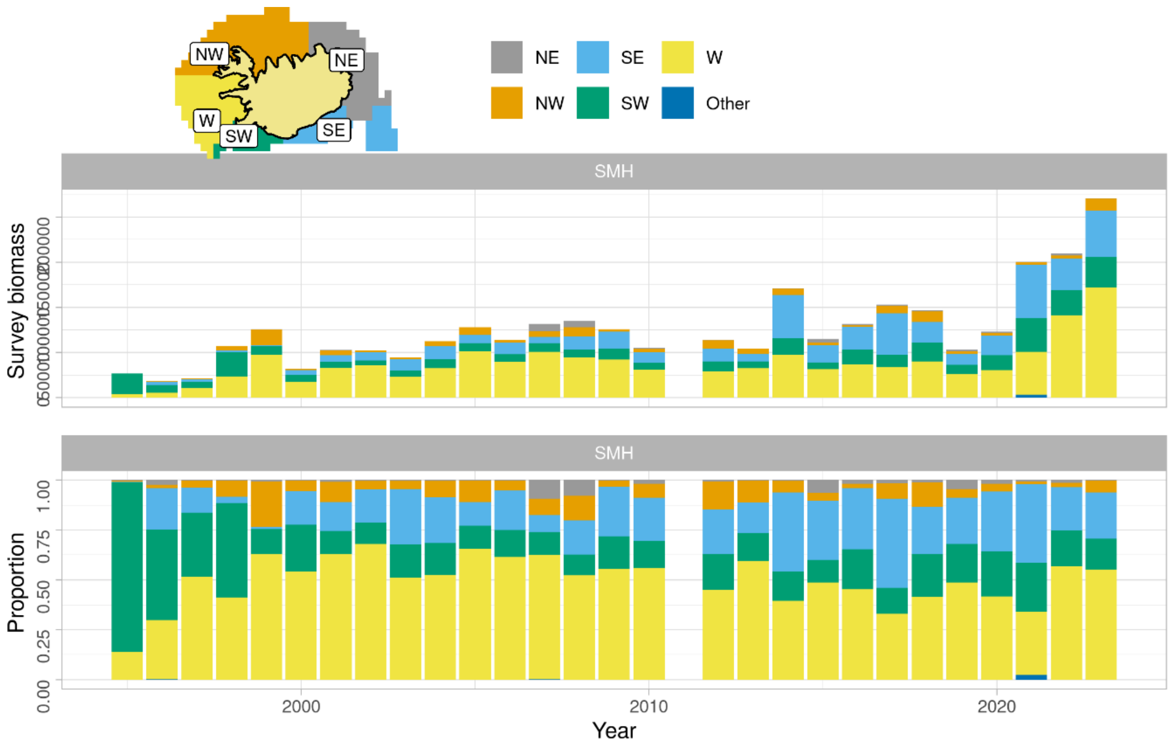


Figure 6.3.8: Greater silver smelt in 5.a and 14. Estimated survey biomass in the autumn survey by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

6.3.7.3 Length compositions

Table 6.3.2 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 Figure 6.3.9 and Figure 6.3.10 respectively. Length distributions from the autumn survey are rather stable, with 2023 being close to the long-term average (Figure 6.3.9).

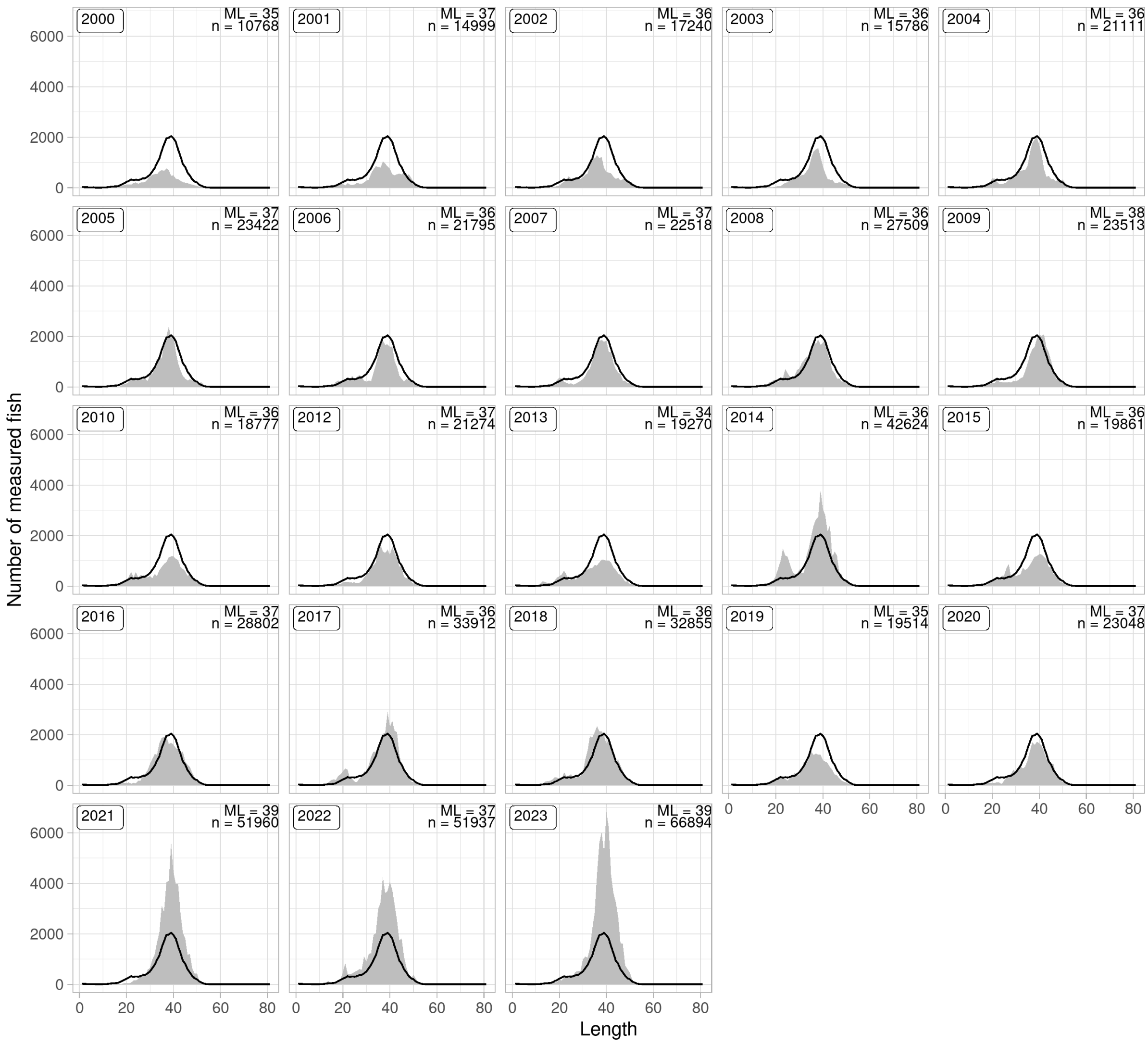


Figure 6.3.9: Greater silver smelt in 5.a and 14. Length distribution from the autumn survey. The black line shows the mean for all years.

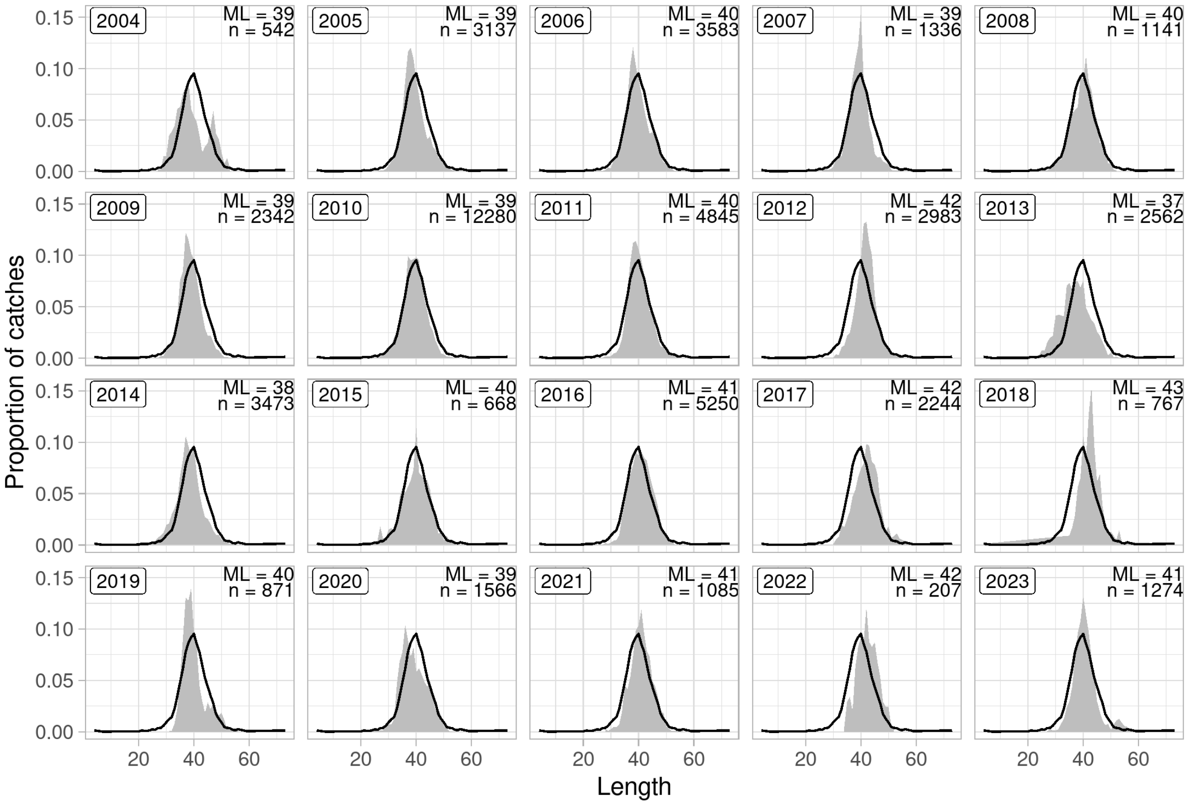


Figure 6.3.10: Greater silver smelt in 5.a and 14. Length distributions from commercial catches.

6.3.7.4 Age compositions

Table 6.3.2 gives the number of samples and measurements available for calculations of catch in numbers of greater silver smelt in 5.a. Age distributions estimated as catch in numbers are given in Figure 6.3.11 & 6.3.12.

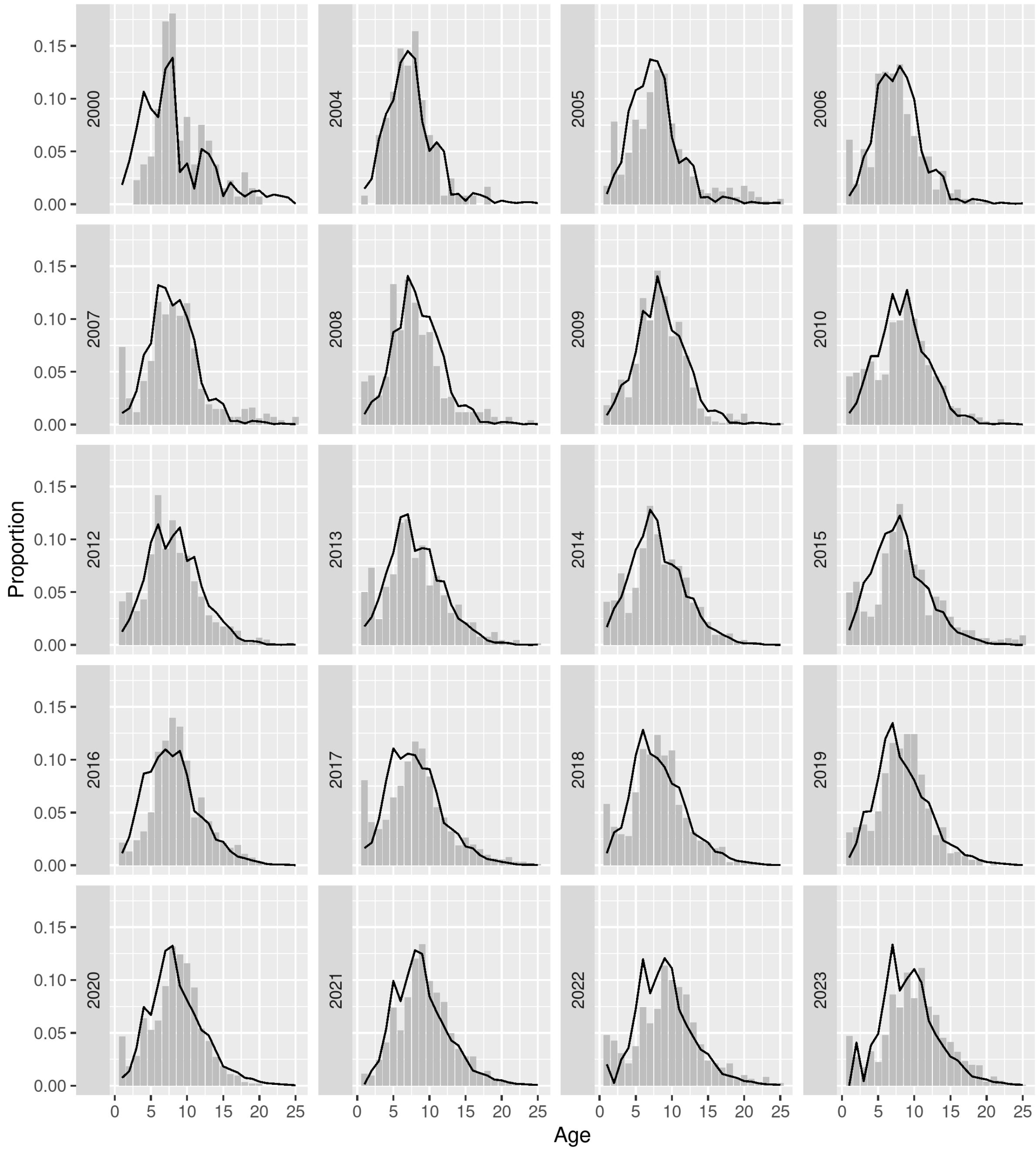


Figure 6.3.11: Greater silver smelt in 5.a and 14. Age distributions in proportions in 5.a from the Icelandic autumn survey.

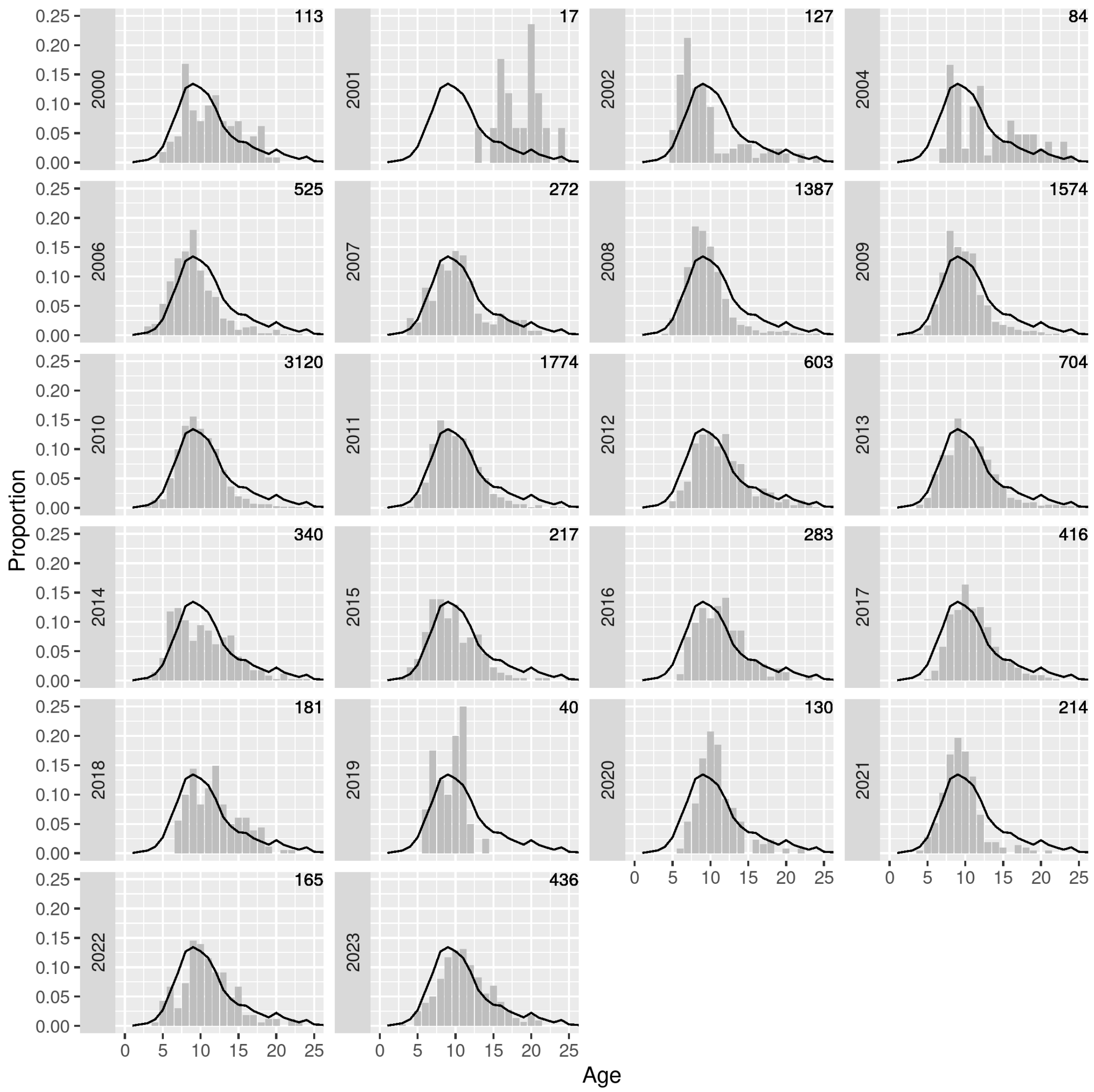


Figure 6.3.12: Greater silver smelt in 5.a and 14. Catch proportion at age. Number of aged individuals are displayed in the upper right corner.

6.3.7.5 Weight at age

Biological data from spring, fall, and commercial data were combined to analyse growth. Von Bertalanffy growth curves were fitted and plotted within a series of time periods, including 2016–2019, 2011–2015, 2006–2010, 2001–2005, 1994–2000, and prior to 1994 to increase sample sizes for estimating each curve. The exponential length–weight relationship is extremely consistent across periods. In general, there is very little variation between periods, although females can be seen to grow to larger sizes than males.

6.3.7.6 Maturity at age and natural mortality

Estimates of maturity ogives of greater silver smelt in 5.a were presented at the WKGSS 2020 meeting for both age and length (WKGSS 2020) 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.

6.3.8 Data analyses

6.3.8.1 Landings and sampling

Spatial distribution of catches in 5.a has not change markedly in recent years (Figure 6.3.2 and Figure 6.3.3). Landings of greater silver smelt increased rapidly from 2007 to 2010 when they peaked at around 16 000 tonnes, then they decreased to 3120 in 2019 but reached 9188 tonnes in 2023 which is similar to 2012 (Figure 6.3.4 and Table 6.3.1). 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 was a slight increase in mean length in 2012 which can also be seen in the past decade (Figure 6.3.10). 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 (Figure 6.3.12). 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.

6.3.9 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 2023 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 (Figure 6.3.6).

The observed trends in the biomass indices from the autumn survey have a considerably different trend than those observed in the spring survey (Figure 6.3.6). According to the autumn survey, biomass increased more or less year on year from 2000 to 2008 but then decreased in 2009 and 2010. The total biomass index in the autumn survey showed slight variations until 2014 when the index increased to a higher value than observed previously. In 2019 it decreased substantially for two years but has since increased to the highest in the timeseries.

There is a clear gradient in mean length of greater silver smelt with depth, larger fish being in deeper water, and therefore no abundance index is presented for the spring survey. 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.

6.3.9.1 Analytical assessment using Gadget

In 2020 a model of greater silver smelt in Icelandic and Greenlandic waters developed in the Gadget framework (see http://www.hafro.is/gadget for further details) was benchmarked for the use in assessment (WKGSS 2020). In 2022 and 2023, Gadget version 3 was used instead of Gadget 2 which was used in the benchmark. Gadget 3 is the same in every way, except that it uses template model builder (TMB), which allows it to utilize TMB’s automatic differentiation procedures. This way it produces models that can be optimized faster by using R optimisers (rather than gadget 2 which only has inbuilt optimisers).

6.3.9.2 Data used and model settings

Data used for tuning and model settings used in the Gadget model are described in more detail in the stock annex (ICES 2020).

6.3.9.3 Diagnostics

6.3.9.4 Observed and predicted proportions by fleet

Overall fit to the predicted proportional length and age–length distributions is close to the observed distributions, with the exception of a small peak of small-sized fish (Figures 6.3.14, 6.3.15, 6.3.16, 6.3.17). This peak does not shift from year to year and therefore is considered to exist because of high catchability in aggregations of small fish rather than cohorts in recruitment peaks. These peaks are likely absent from commercial data due to the requirement of fishing at > 400 m depth.

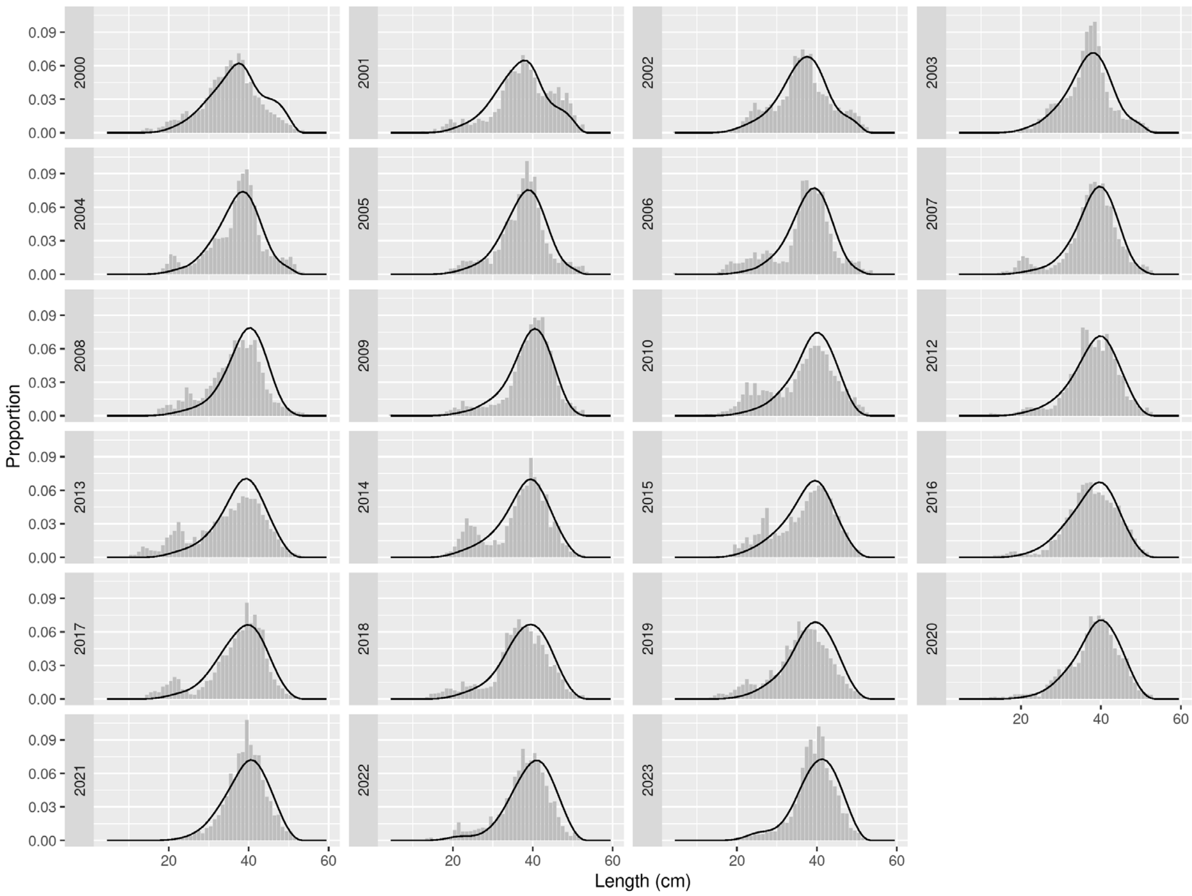


Figure 6.3.14: Greater silver smelt in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions in the autumn survey (grey lines and points)

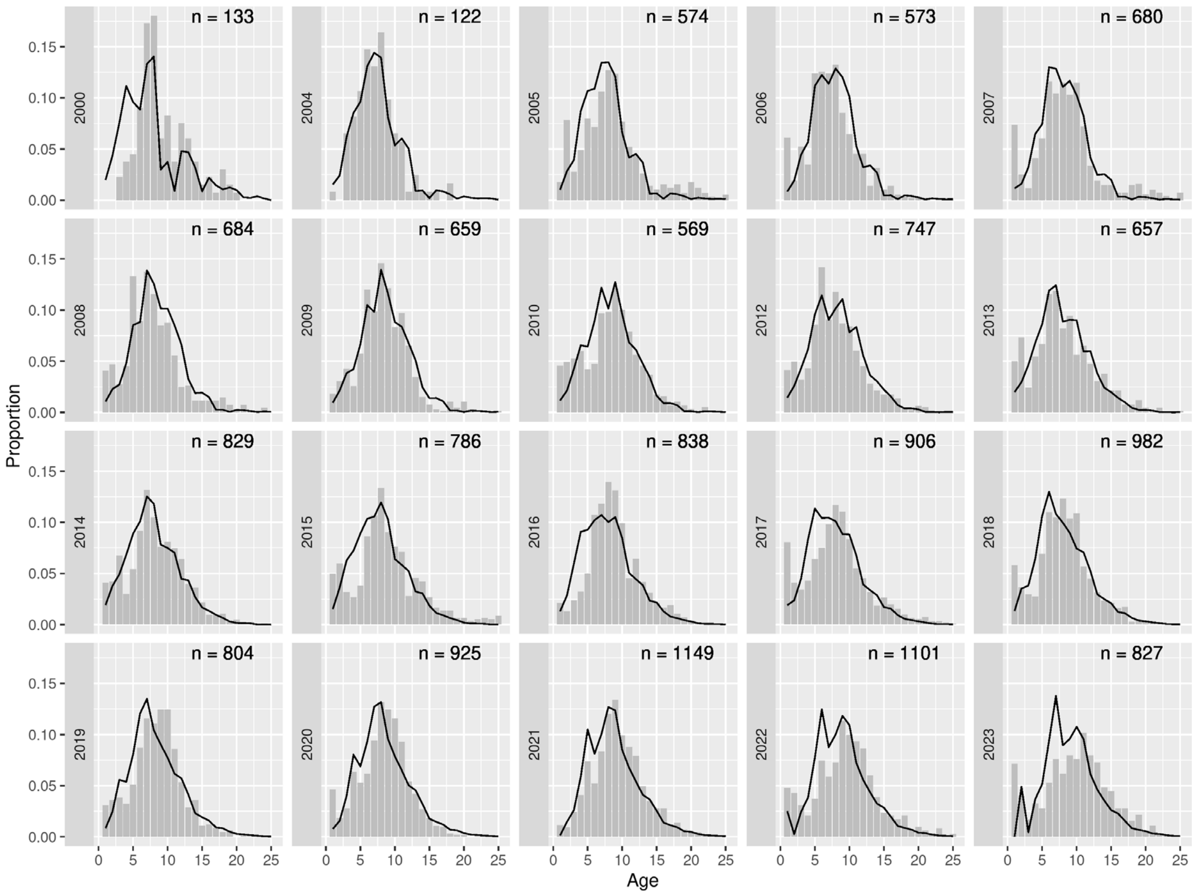


Figure 6.3.15: Greater silver smelt in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in the autumn survey catches (grey lines and points).

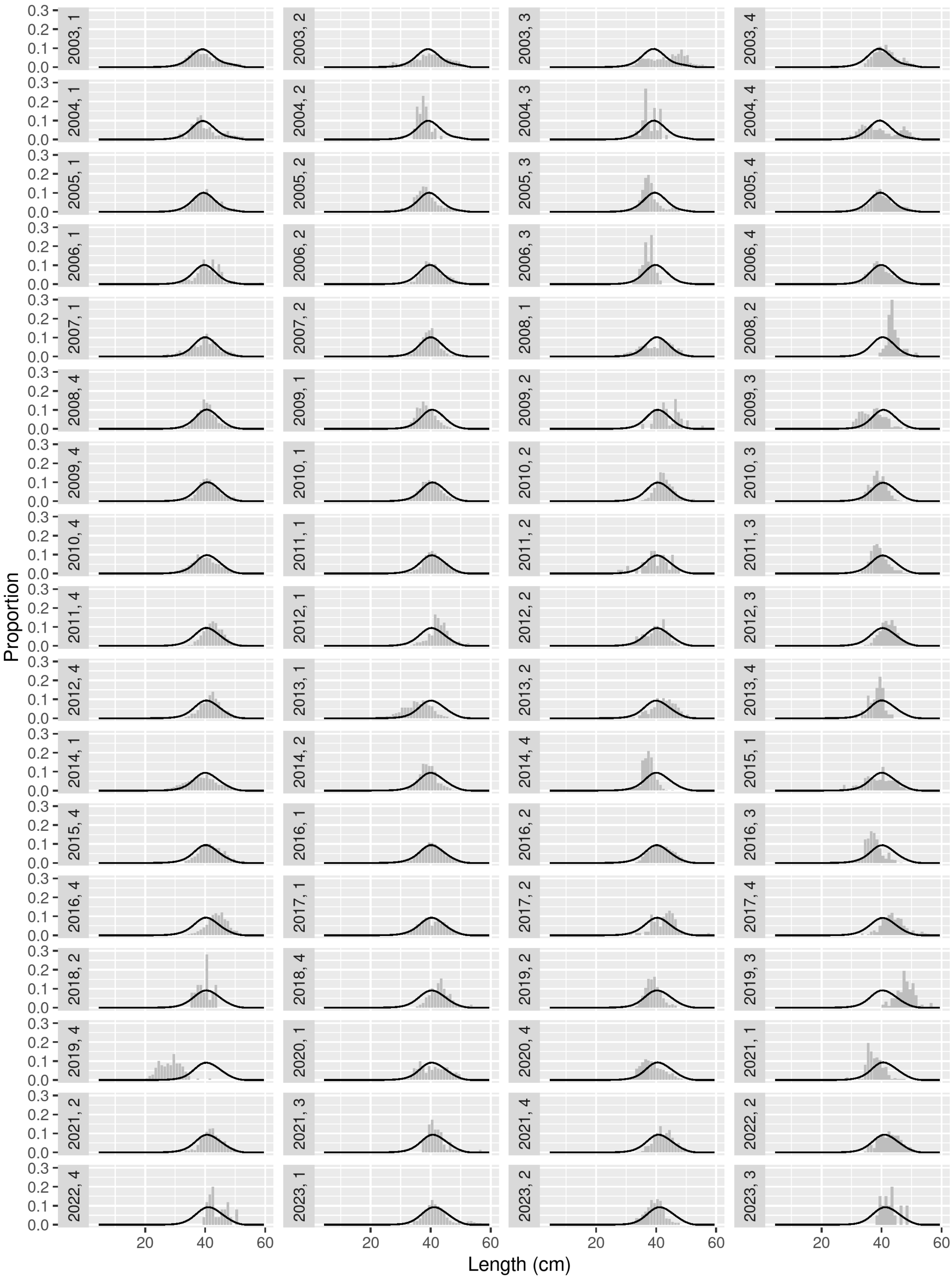


Figure 6.3.16: Greater silver smelt in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions from commercial catches (grey lines and points).

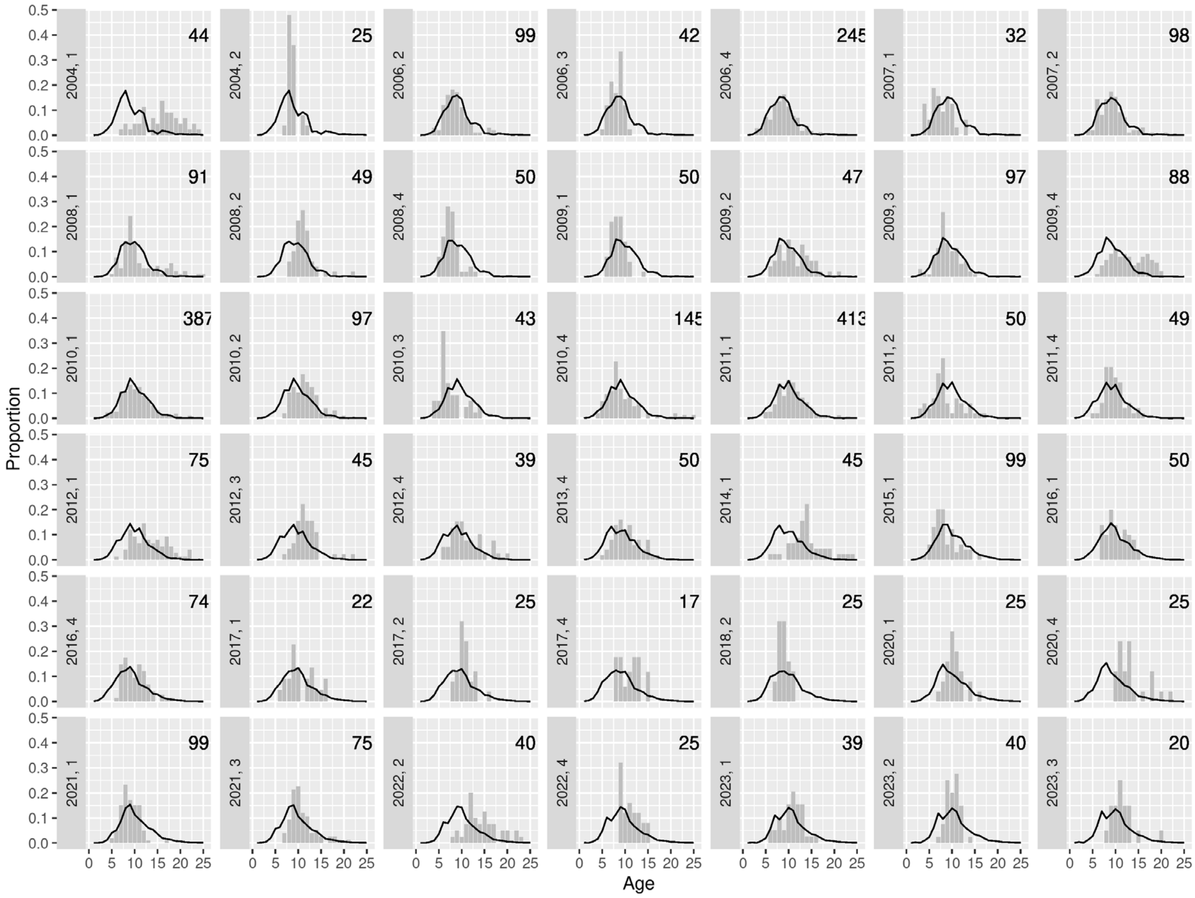


Figure 6.3.17: Greater silver smelt in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in commercial catches (grey lines and points).

6.3.9.5 Model fit

Figure 6.3.18 shows the overall fit to the survey indices described in the stock annex. In general, the model appears to follow the stock trends historically. In previous category 3 assessments of this stock, the autumn survey was winsorized due to high variability in the survey index, which can also be seen here, as survey indices are not winsorized or standardized before being used. The peak observed in the two smallest size classes (10-25 and 25-30) are likely due to selectivity and aggregation and not cohort dynamics. The terminal estimate has a large overestimation indicating the potential for overestimation of biomass However, this year's indices for large-sized fish are at a historical high, indicating that last year's values were more likely to be relatively accurate. These high values may be the result of high variability in the survey index numbers in general, however. If survey indices are lower again next year, the model fit is likely to experience a correction to lower predicted index values.

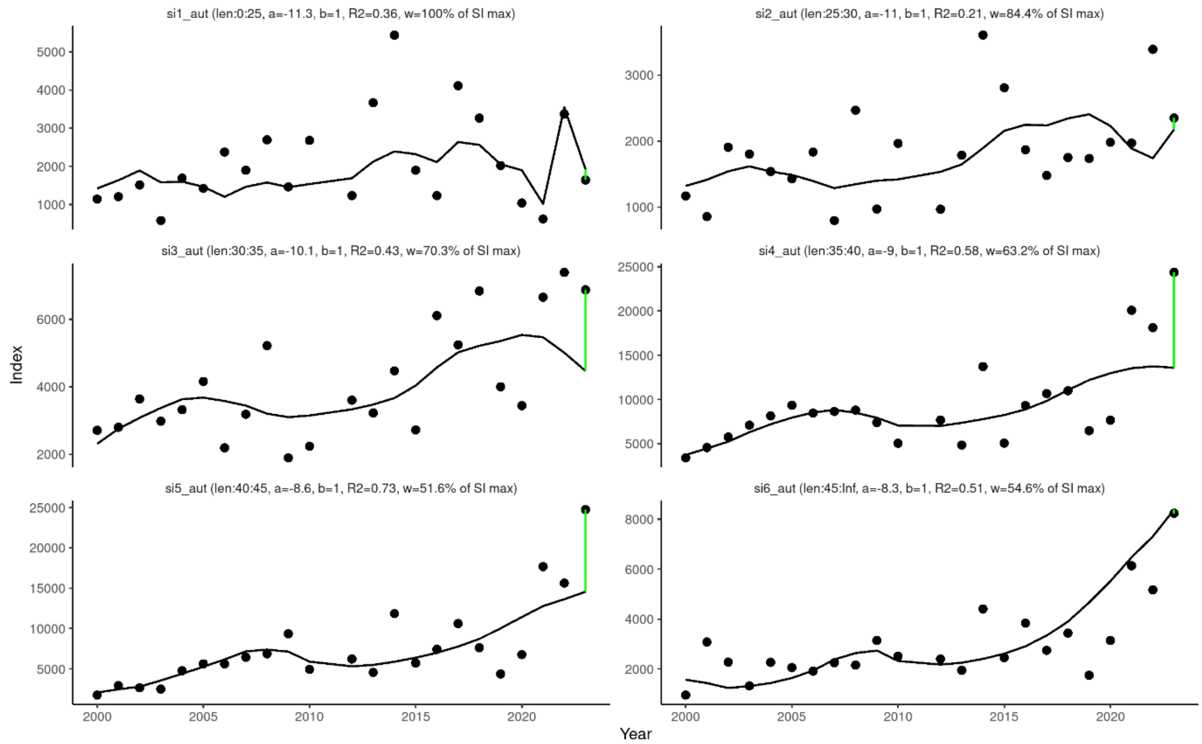


Figure 6.3.18: Greater silver smelt in 5.a. Fitted autumn survey index by length group from the Gadget model (black line) and the observed number of greater silver smelt caught in the survey (points). The green line indicates the difference between the terminal fit and the observations.

6.3.10 Results

The results are presented in Table 6.3.4 and Figure 6.3.19. Recruitment increased until 2021 which may have been the result of high variability in survey indices. Recruitment has decreased substantially in the past three years. Spawning–stock biomass has increased since 2012 and reached the highest SSB estimate in 2023. Fishing mortality for greater silver smelt (age 6–14) has decreased from around 0.2 in 2010 to 0.03 over the past several years, due to greater regulation of the fishery as well as reduced commercial interest. Uncertainty was estimated by spatially bootstrapping the data and refitting the assessment model to resampled data. The spatial bootstrap entails refitting the model to 100 sets of data resampled by spatial areas to maintain spatial correlation in the data (see the stock annex). The base model assessment results appear unbiased as it corresponds well with the median of results (Figure 6.3.19). Asymmetry in the confidence intervals is likely to be the result of a small number of model runs with a set of resampled data that are a poor representation of the actual data. For this reason, it was suggested by WGDEEP to improve the spatial bootstrap methods so that they better represent variation in the data.

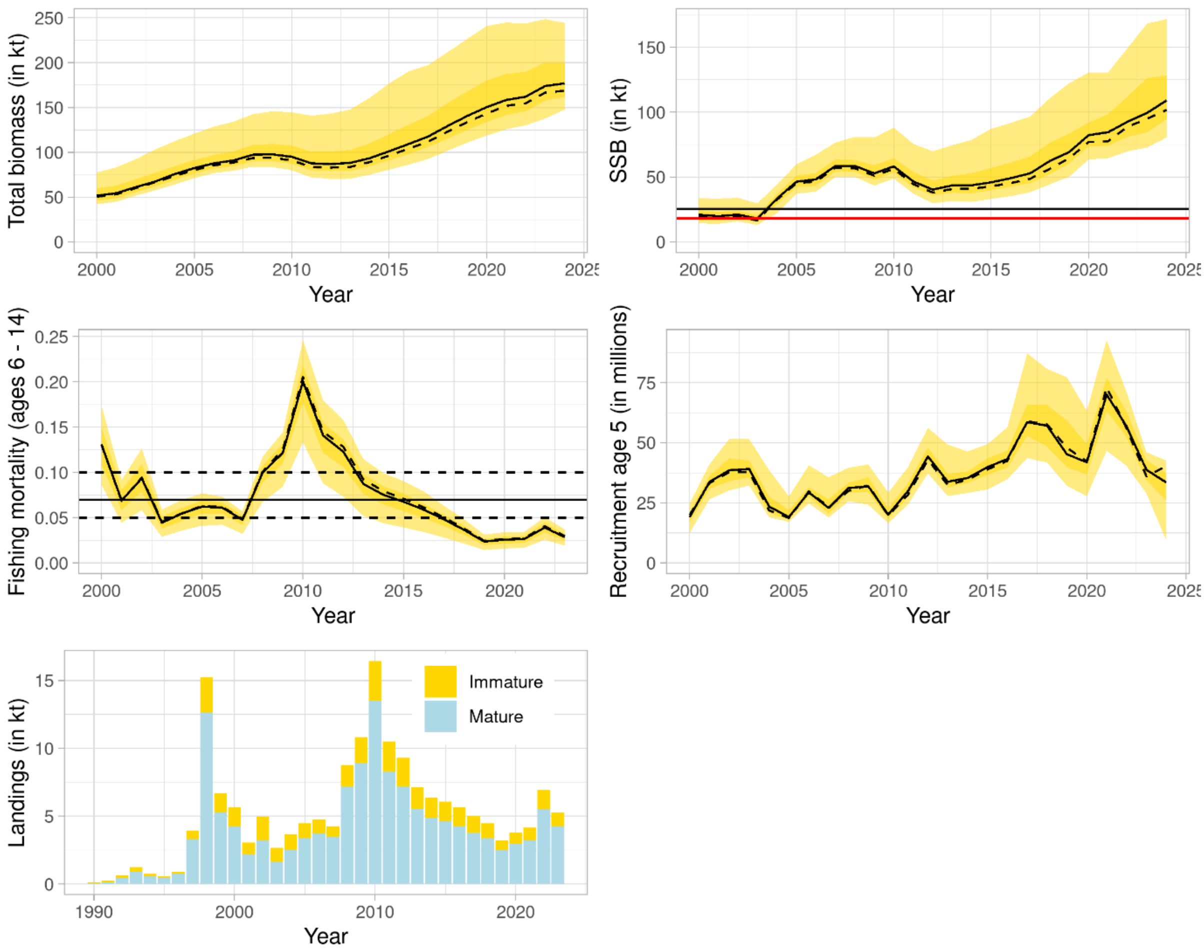


Figure 6.3.19: Greater silver smelt in 5.a and 14. Estimated biomass, spawning stock biomass (SSB), fishing mortality for fully selected fishes, recruitment and total catches. The black solid line in the SSB plot represents Bpa and the solid red line indicates Blim. The horizontal solid line in the fishing mortality plot indicates the fishing mortality used in the ICES MSY advice rule, whereas the horizontal dashed lines indicate the bounds of the realized fishing mortality resulting from the advice rule given the uncertainty in the assessment. Uncertainty was estimated by spatially bootstrapping the data and refitting the assessment model to resampled data. Outer yellow ribbons with red borders indicate 90% interquantile ranges, whereas inner yellow ribbons indicate 50% interquantile ranges. The central line indicates the median, and the dashed line is the base model run for the assessment upon which advice is based.

Table 6.3.4: Greater silver smelt in 5.a. Gadget assessment model results including input catch values (tonnes), estimated spawning stock biomass (SSB, tonnes), recruitment (Rec., age 5 in millions), and fishing mortality (age 5). Projections are given in the last year. All values in 2024 result from projections, as well as F and Catch values from 2022.

Year	Total Biomass	Catch	SSB	Rec.	F
2000	50436	5657	19833	20020	0.131
2001	53143	3043	19100	33220	0.068
2002	60148	4960	19732	37850	0.094
2003	66714	2680	16535	37860	0.045
2004	73688	3645	32410	21860	0.055
2005	80194	4482	45185	18710	0.063
2006	85410	4769	46541	29770	0.062

Year	Total Biomass	Catch	SSB	Rec.	F
2007		4227	57162	23280	0.049
2008	93580	8778	56732	29980	0.101
2009	93897	10828	51011	32310	0.125
2010	90992	16428	56264	19740	0.21
2011	83726	10516	44571	28430	0.145
2012	82905	9289	38070	42880	0.128
2013	83754	7155	40776	32440	0.092
2014	89086	6348	40899	34640	0.079
2015	96397	6080	42917	38940	0.071
2016	104087	5662	45303	42440	0.061
2017	111833	5010	48624	58940	0.050
2018	122990	4460	56314	57660	0.038
2019	133669	3212	64433	47960	0.024
2020	143291	3802	76958	42200	0.027
2021	151828	4156	77580	73130	0.027
2022	154698	6914	88730	56080	0.041
2023	166633	5268	94874	36530	0.030
2024	168681		100196	41270	

6.3.10.1 Retrospective analysis

An analytical retrospective analysis is presented. The analysis indicates that there were downward revisions of biomass over the first four years of the 5-year peel followed by an upward revision of biomass (SSB) over the last year. As a result, there was an upward then downward revision of F. Estimates of recruitment are decently stable.

Mohn's rho was estimated to be -0.017 for SSB, 0.063 for F, and -0.109 for recruitment.

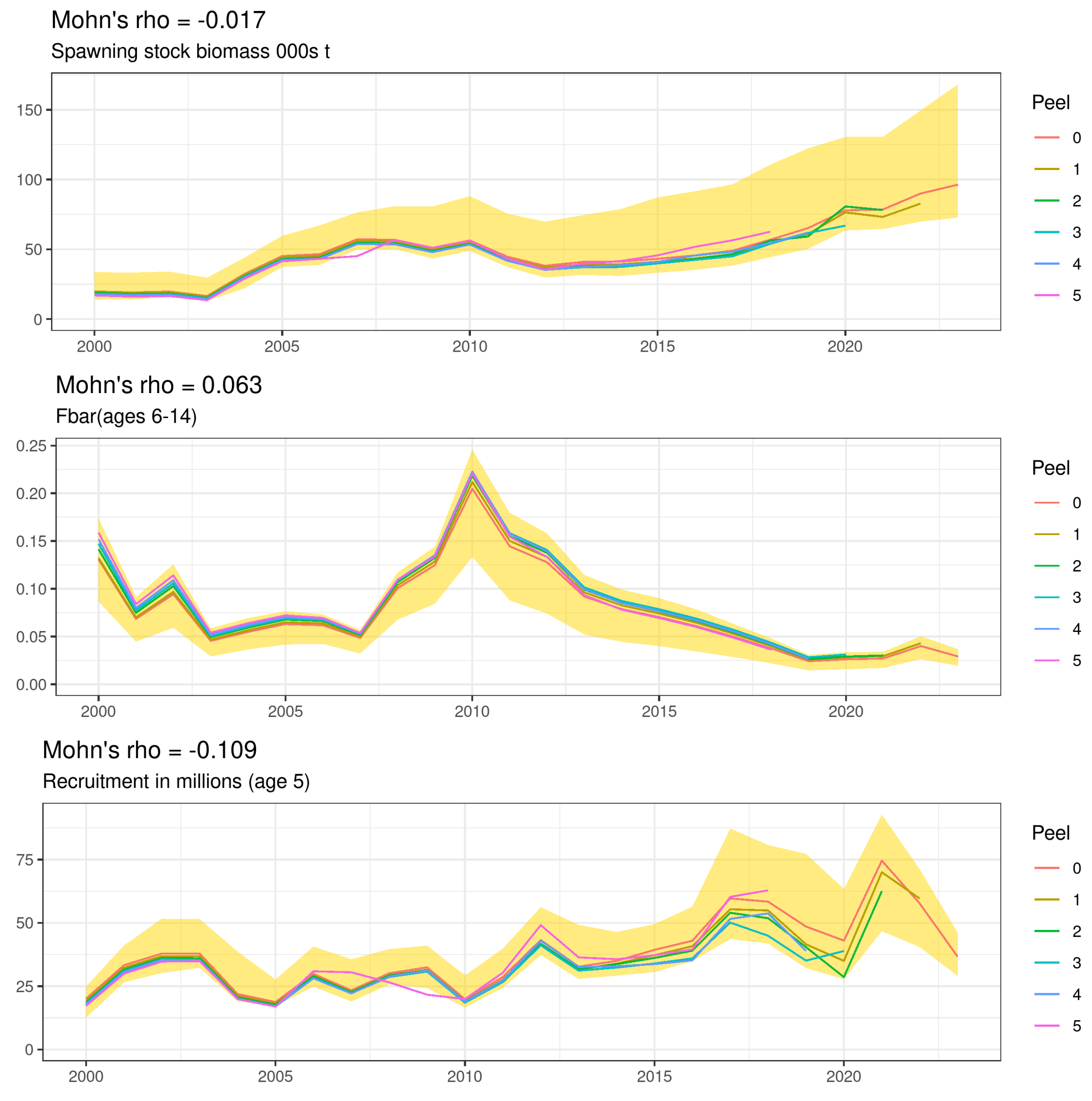


Figure 6.3.20: Greater silver smelt in 5.a and 14. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 5) are shown.

6.3.11 ICES advice

In 2020 this stock was benchmarked (WKGSS 2020) and a length- and age-based assessment was accepted as a category 1 assessment method. The ICES MSY advice rule is applied for this stock in 2024/2025 advice. Last year's advice amounted to 12080 tonnes.

6.3.12 Management

The Icelandic Ministry of Industries and Innovation 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. 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 (ICES 2016).

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 between 7600 and 9300 in the following 6 years but has been higher since (Table 6.3.5). Flexibility is built into the Icelandic fisheries management system in which quota is automatically transformed for use for constraining species when it is available. As this stock is consistently caught at levels lower than the TAC in recent years, it has been a source of quota that may be used to fish other species (Table 6.3.5).

Table 6.3.5: Greater silver smelt in 5.a. TAC recommended for greater silver smelt in 5.a by the Marine and Fisheries Research Institute, national TAC and total landings.

Fishing Year	MFRI Advice	National TAC	Landings
2010/11	8 000		12 091
2011/12	8 000		8 410
2012/13	8 000		11 038
2013/14	8 000	8 000	7 243
2014/15	8 000	8 000	6 849
2015/16	8 000	8 000	6 018
2016/17	7 885	7 885	3 570
2017/18	9 310	9 310	5 159
2018/19	7 603	7 603	2 807
2019/20	9 124	9124	3775
2020/21	8729	8729	4282
2021/22	9244	9244	6550
2022/23	11520	11520	5430
2023/24	12080		

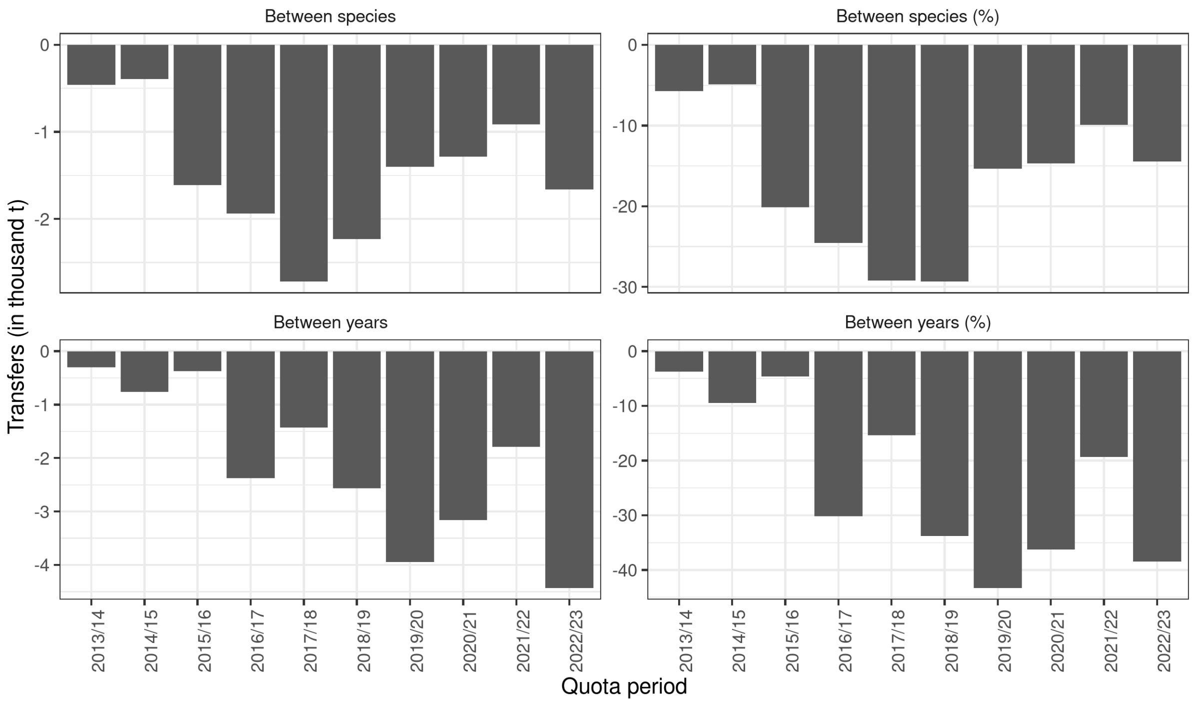


Figure 6.3.21: Greater silver smelt in 5.a and 14. An overview of the net transfers of quota between years and species transformations in the fishery in 5.a.

6.3.13 Current advisory framework

As a part of the WKGSS 2020 benchmark proceedings (WKGSS 2020), the following reference points were defined for the stock:

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	25.44 kt	B_{pa}
-	F_{msy}	0.14	Median F that maximises the median long-term catch in stochastic simulations with 7-year block-bootstrapped recruitment, scaled according to a hockey stick recruitment function with the breakpoint set to B_{lim}.
-	$F_{p.05}$	0.07	The fishing mortality that has an annual 5% probability of of SSB < B_{lim}.
Precautionary approach	B_{lim}	18.3 kt	SSB(2003), corresponding to B_{loss} as the fishing level in relation to F_{msy} is unclear and model uncertainty high
-	B_{pa}	25.44 kt	$B_{lim} * e^{1.645*\sigma}$ where $\sigma = 0.2$
-	F_{lim}	0.24	F corresponding to 50% long-term probability of SSB > B_{lim}
-	F_{pa}	0.16	$F_{lim}/e^{1.645*\sigma}$ where $\sigma = 0.25$
MSY advice rule	F_{msy}	0.07	F such that $F \leq F_{msy}$, $F \leq F_{pa}$, and $F \leq F_{0.05}$, long-term yield is consistent with MSY while leading to high stock biomass
-	MSY $B_{trigger}$	25.44	Set as B_{pa}

Figure 6.3.22: Greater silver smelt in 5.a and 14. Reference points.

The ICES MSY advice rule is applied for this stock. The decision which allocates catches to the fleets requires 1) an expected quantity of catch to be removed that will complete total catch removals for the current fishing season, 2) a 1-year projection to determine the amount of biomass available to fish, and 3) application of projected fishing effort according to F_{msy} to determine the expected catch from fishing at this level. Advised catch is set to this value while $SSB_y > B_{trigger}$, scaled by $\frac{SSB_y}{B_{trigger}}$ while while $B_{lim} \leq SSB_y < B_{trigger}$, and set to 0 while $SSB_y \leq B_{lim}$. Further information on how these reference points were generated and the model setting for short-term projections can be found in WKGSS 2020 report (WKGSS 2020).

The current intermediate year assumption regarding catch is set equal to the TAC during the fishing season (last quarter of year y and quarters 1 – 3 in year y + 1) and projections for the following year run at a selected harvest rate. However, the recommended TAC in recent years has been much higher than recorded landings. Therefore, for sensitivity analysis, projections were also run using intermediate year catch assumptions which are more indicative of recorded landings than TAC. Catches were previously assumed to be *status quo*, calculated as the average of the previous three years, but catches in 2022 were much higher than in previous years. The average of the previous three years is, hence, not representative of the current year. Catches were calculated by summing up the first quarter of 2024 with quarter 2 and 3 in 2023 and forecast catches at F_{mgt} in the fourth quarter.

Age 1 recruitment estimates are highly uncertain from the most recent three years. Therefore, in forecasts, it is proposed to use the geometric mean of the three years previous to these values (e.g. for 2024, this would be the geometric mean of age 1 recruitment estimates from years 2021–

2023). The projected recruitment reported from the model output is for age 5 because recruitment estimated for ages 1-4 are highly uncertain.

6.3.14 Management considerations

Exploitation of greater silver smelt has been reduced in recent years, coming down from relatively high levels in 1998 and 2010, to levels lower than the average exploitation rate in the reference period.

6.3.14.1 Ecosystem considerations for management

Shorter periods of reduced biomass due to high fishing rates are observed in the history of greater silver smelt fishing in Iceland. However, there has been a general trend since the mid-1990s of a decrease in biomass levels from the mid-1980s to the mid-1990s, during which catch records are unreliable so the general reduction cannot directly be attributed to fishing, followed by a general increase in biomass in the past two decades. It is likely that a combination of lower fishing rates and favourable environmental conditions have led to high recruitment levels over the past decade.

6.3.15 References

ICES. 2014. "Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP). ICES Scientific Reports. 1:21., Copenhagen, Denmark. ICES Cm 2014/Acom:17." International Council for the Exploration of the Seas; ICES publishing. https://doi.org/10.17895/ices.pub.5262.

2016. "Stock Annex: Greater silver smelt (Argentina silus) in Subarea 14 and Division 5.a (East Greenland and Iceland grounds)." International Council for the Exploration of the Seas; ICES publishing.

ICES. 2021. Benchmark Workshop of Greater silver smelt (WKGSS; Outputs from 2020 meeting). ICES Scientific Reports. 3:5. 485 pp. https://doi.org/10.17895/ices.pub.5986.

6.4 Greater silver smelt (*Argentina silus*) in 5.b and 6.a

6.4.1 The fishery

The fishery on greater silver smelt in Divisions 5.b and 6.a is mainly conducted by Faroese and European trawlers. In 202, catches in 5.b were taken by three pairs of Faroese pair trawlers deploying bentho-pelagic trawls while catches in 6.a were mostly taken by European trawlers (68%) and the remainder mainly Germany (11%) and by previously mentioned Faroese trawlers (15%, inside the Faroese EEZ) (Table 6.4.1 and Figure 6.4.1).

Historically, greater silver smelt was caught as bycatch in the shelf-edge deep-water fisheries and either discarded or landed in small quantities. The fishery for greater silver smelt in Faroese waters in 5.b did not develop until the mid-1990s and for 6.a in the early 1990s.

Fishing grounds for greater silver smelt in Faroese waters were located north and west on the Faroe Plateau and around the banks southwest of Faroe Plateau mainly at depths between 300 and 700 meters (mid-1990s to 2007). Since 2008 the Faroese fishery has extended fishing activities to include areas on the Wyville-Thomson Ridge south of the Faroe Plateau. Around 50% of the Faroese catches are caught on the Wyville-Thomson Ridge (in Divisions 5.b and 6.a, inside the Faroese EEZ) since 2012.

European fishery on silver smelt takes place mostly on the shelf edge within Divisions 6.a, 5.b and 4.a. Information from the self-sampling program carried out by the European fisheries (Pelagic Freezer-trawler Association, PFA) has been presented since 2018. The self-sampling program consists of historical information derived from skipper's notes (2002 - present) and new information collected as part of the research program within the PFA. An overview of catch rates of silver smelt (*Argentina spp.*) from both the Faroese and European fisheries is shown in Figure 6.4.2.

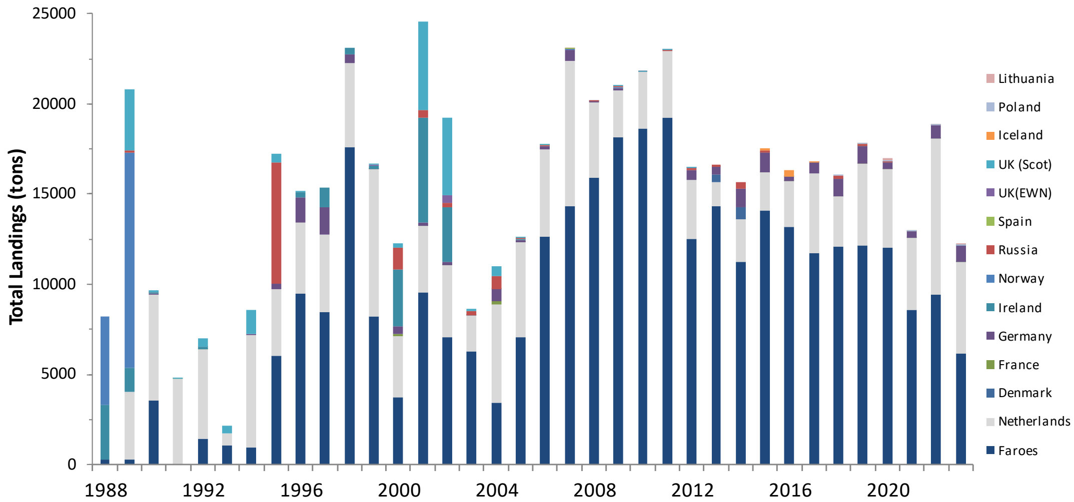


Figure 6.4.1. Greater silver smelt in 5.b and 6.a. Total landings of greater silver smelt in 5.b and 6.a by countries since 1988.

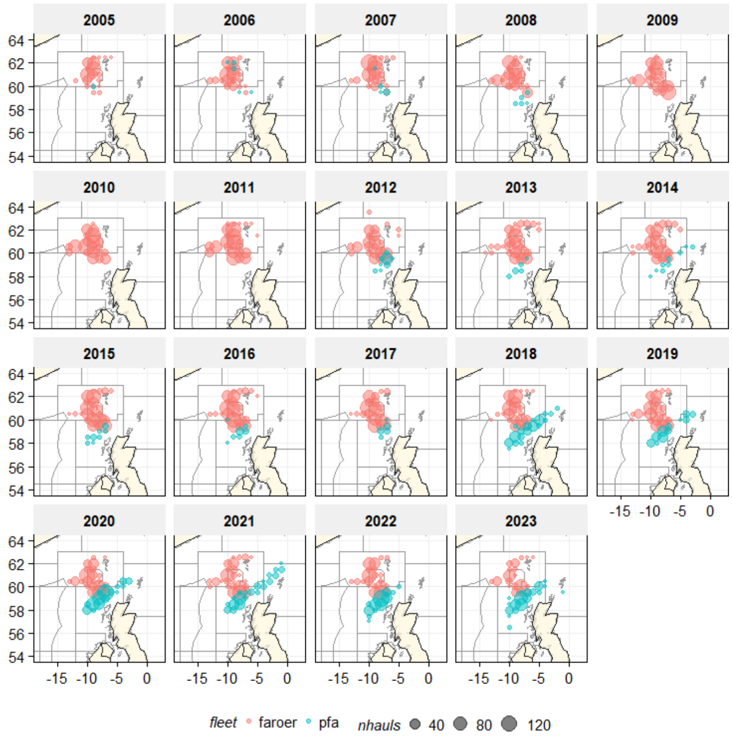


Figure 6.4.2. Greater silver smelt in 5.b and 6.a. Effort (number of hauls) of commercial fisheries available for standardized CPUE calculation in Faroese fishery (red circles) and PFA fishery (blue circles) since 2005.

6.4.1.1 Landing trends

Landings in Division 5.b increased rapidly from 2004 (5300 tonnes) to 2006 (12 500 tonnes) and further increased in 2011 to 15 600 tonnes (Table 6.4.2). Landings have oscillated between 10 000 to 13 000 tonnes since 2012. The reduction of catches in 5.b since 2012 was probably due to several factors, e.g., the introduction of quotas for greater silver smelt in Faroese waters, a shift for mackerel and the relocation of effort to the Wyville-Thomson Ridge.

Landings in Division 6.a have been fairly stable at around six to eight thousand tonnes apart from three spikes in 1989 (20 581 tonnes), 2001 (14 466 tonnes) and 2022 (12 467 tonnes).

Catches in 2023 were 5 040 tonnes in Division 5.b and 7 205 tonnes in Division 6.a.

6.4.2 ICES Advice

ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 18 966 tonnes.

6.4.3 Management

The EU introduced total allowable catch (TAC) management for greater silver smelt in 2003 setting a TAC quota 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 3.a and 4). Since 2021 the UK has set a species-specific TAC quota for greater silver smelt in Subareas 5, 6 and 7. In 2014, the Faroese authorities introduced a species-specific TAC quota for greater silver smelt for Faroese trawlers (6 vessels) within the Faroese EEZ. ICES advice and TACs issued by UK, EU and Faroese authorities are all summarised in Table 6.4.3.

From 2010 to 2013, the Faroese greater silver smelt fishery was managed by an agreement between the Faroese fleet and the management authorities that within the Faroese EEZ the total annual landings should not exceed 18 000 tonnes. The management of the fishery was regulated by fishing days for the trawler fleet with technical limitations such as minimum size, bycatch, mesh size and area restrictions. This management was based on scientific advice from the Faroe Marine Research Institute (FAMRI) on the Faroese "stock" component. A decrease in the biomass index as estimated by the age-based exploratory assessment resulted in a decline of TAC from 2014 to 2017.

The ICES advised catch for 2022 was nearly three times as high as the last catch advice issued in 2019 for 2020 and 2021. The advice in 2019 was based on a category 3 trend-based assessment and has now been upgraded to an analytical assessment; advice is provided annually following the MSY approach.

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6.4.4 Data available

Data on length, round weight and age are available for greater silver smelt from Faroese and European landings. Catch and effort data from Faroese trawler logbooks and from the PFA fisheries in the Northeast Atlantic are also available (Hintzen, N. WD19 WGDEEP 2024).

Fishery-independent biological data is available from the annual ground fish summer survey on the Faroe Plateau since 1995. The survey targets cod, haddock and saithe. In addition, a deep-water survey has been conducted since 2014 covering the fishery distribution within the Faroese EEZ.

A Scottish deepwater survey (MSS Deepwater Slope Survey) is also included in the SAM assessment as a biomass index. The survey covers the distribution of the European fishery in 6.a (Olsen, WD18 WGDEEP2024; Campbell 2020, WD01 WKGSS).

6.4.4.1 Landings and discards

The landings statistics are regarded as being adequate for assessment purposes. Landing data for all relevant fleets disaggregated by area and country is presented in Tables 6.4.1 and 6.4.2, and Figure 6.4.1.

Discarding is prohibited within the Faroese EEZ. All catches are assumed to be landed. A landing obligation in the European Union for pelagic fisheries was implemented in 2015. Catches of all species in the pelagic fishery are to be landed, except for protected species which are to be immediately released after capture. The EU landing obligation was applied to demersal fisheries in 2019.

Discards from foreign nations are reported to ICES (Table 6.4.4). Bycatches are assumed to be landed.

Substantial levels of discards occur in the trawl fishery conducted in Subareas 6 and 7 on the continental slope at depths of 300 to 700 m (Girard and Biseau, WGDEEP WD 2004). Discards reported by Spain in 2012 and 2013 were revised downwards. No discards from Spain were reported in Subarea 6 in 2014 - 2018.

Based upon on-board observations from the EU data collection framework (DCF) sampling, the catch composition in the French mixed trawl fisheries for 2011 in 5.b, 6 and 7 include 5.3% of greater silver smelt representing 25.3% of the discards in that fishery (Dubé *et al*., 2012). Most of the discards in Division 6.a were reported in the French and Scottish deep-water fisheries since 2014 (data from ICES) (Table 6.4.4). Discard data reported to ICES represent on average 2.6% of the total catches since 2014.

6.4.4.2 Length compositions

Commercial length frequency distributions are available from the Faroese pair-trawler fleet in 5.b and 6.a (Figure 6.4.3) and from PFA fisheries in Divisions 4a, 5b and 6a (Figure 6.4.4).

Fishery-independent length compositions data is obtained from the Faroese summer ground fish survey on the Faroe Plateau in Division 5.b are presented in Figures 6.4.5. Length distributions from the Faroese deep water survey are presented in Figure 6.4.6.

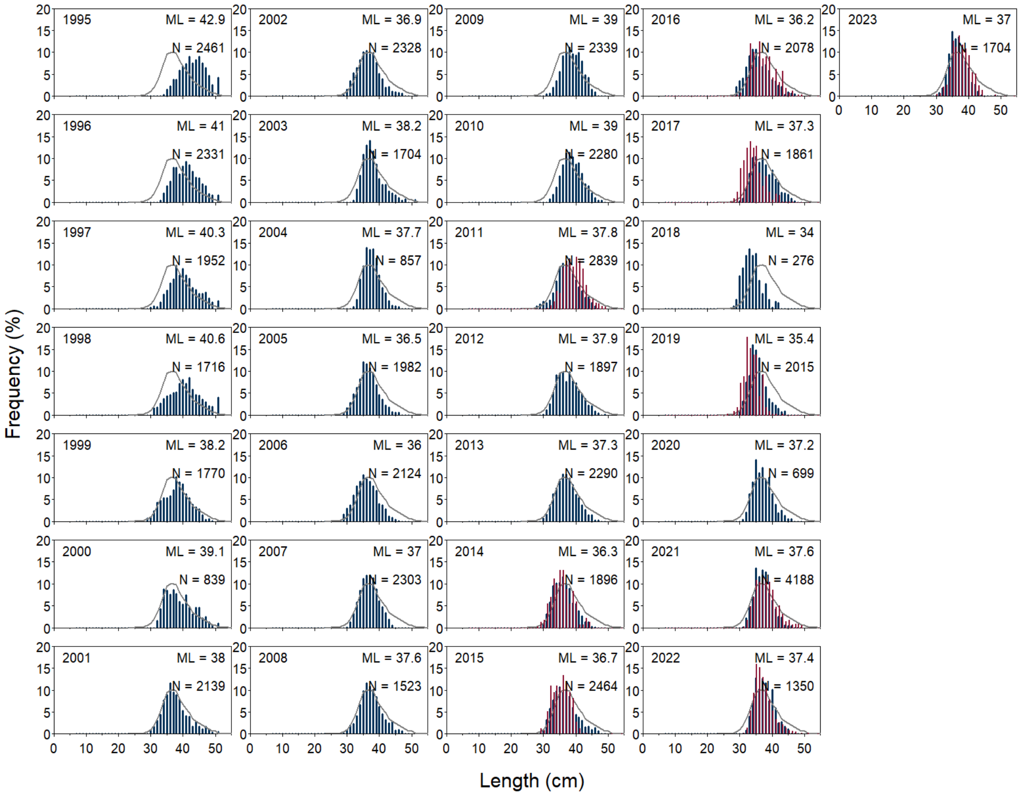

Figure 6.4.3. Greater silver smelt in 5.b. Length frequencies of greater silver smelt in the Faroese catches from 1995 to present. Blue bars are catches within area 5b and red bars are catches within area 6a. Curves are the average over whole time frame. ML= mean length (cm) and N= number of length measurements.

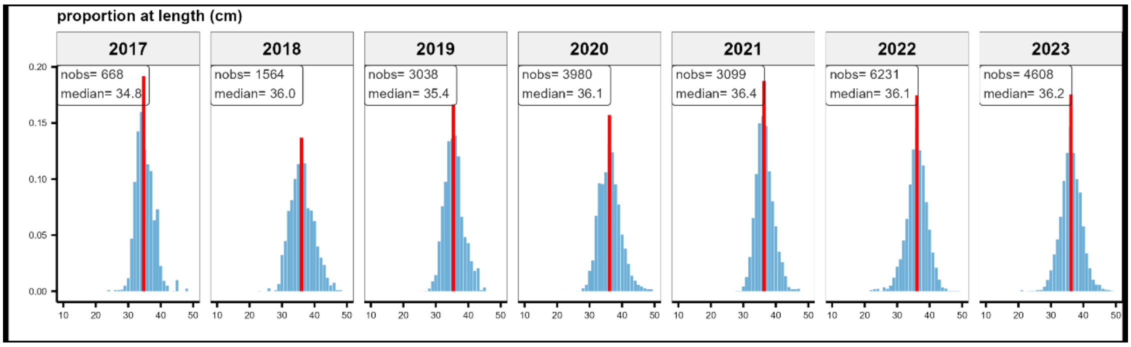

Figure 6.4.4. Silver smelt (*Argentine spp.)* in 5.b and 6.a. Relative length frequencies in PFA self-sampled fisheries in division 4a, 5b and 6a from 2016 to present. Number of length measurement (nobs) and median length (cm, red) in top left.

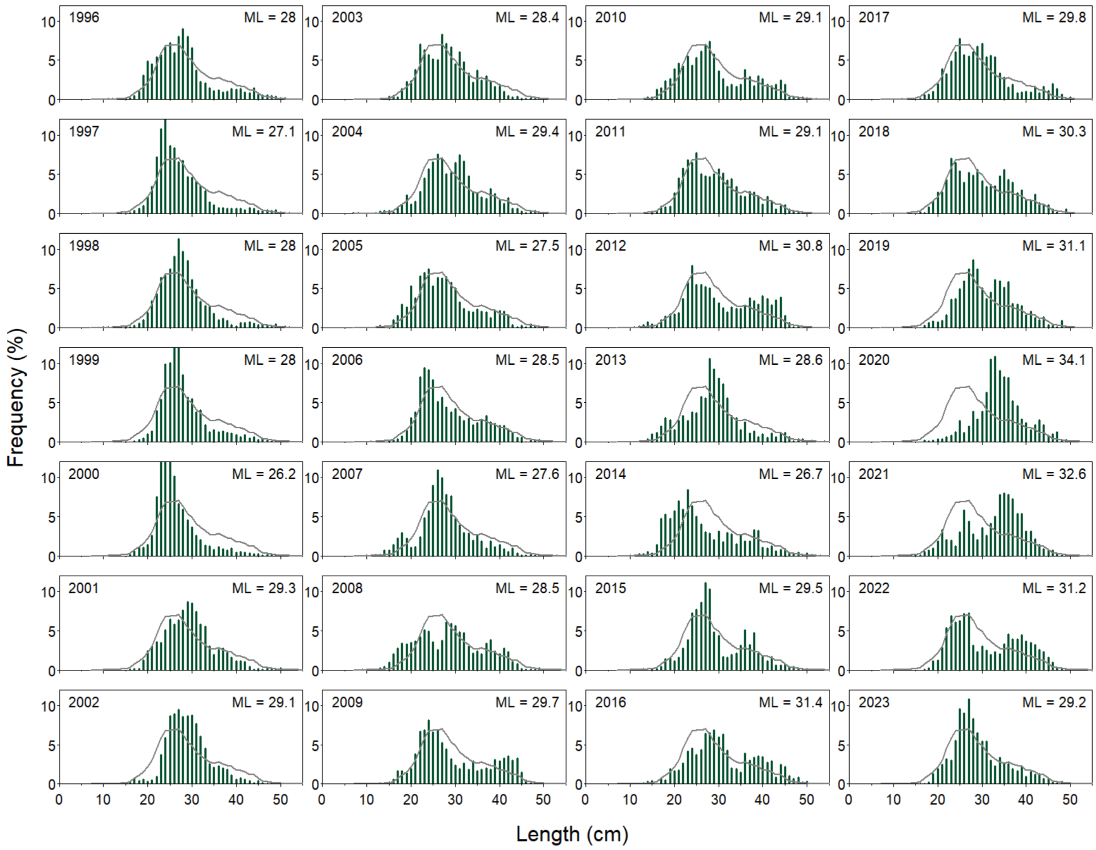

Figure 6.4.5. Greater silver smelt in 5.b. Length frequencies from Faroese ground fish summer survey from 1996 to present. Greater silver smelt is sub sampled of the total catch i.e., the values of greater silver smelt are scaled to reflect total catch. ML= mean length.

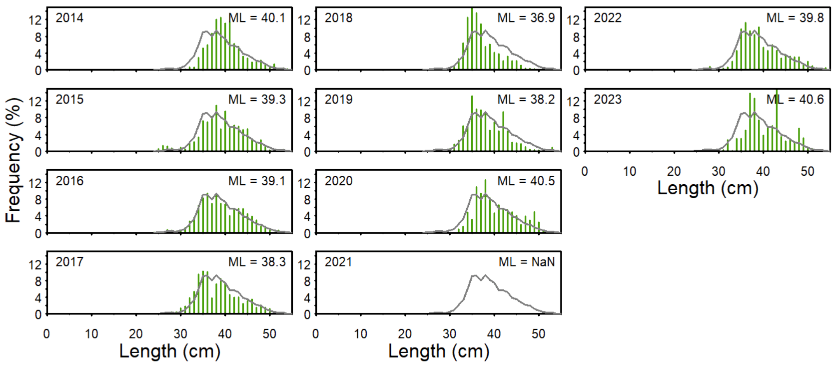

Figure 6.4.6. Greater silver smelt in 5.b. Length frequencies from the Faroese deep water survey from 2014 to present, excluding 2021 when the deepwater survey was not conducted .. ML = mean length.

6.4.4.3 Catch at age (CAA)

Catch at age compiled in InterCatch framework is presented in Figure 6.4.7 and Table 6.4.5. These data are used in the age-based state-space fish stock assessment SAM. Additional data from the Netherland and Scottish fishery in Division 6.a is also used in the compilation of the catch at age. The computation of the catch at age is described in detail in the stock annex.

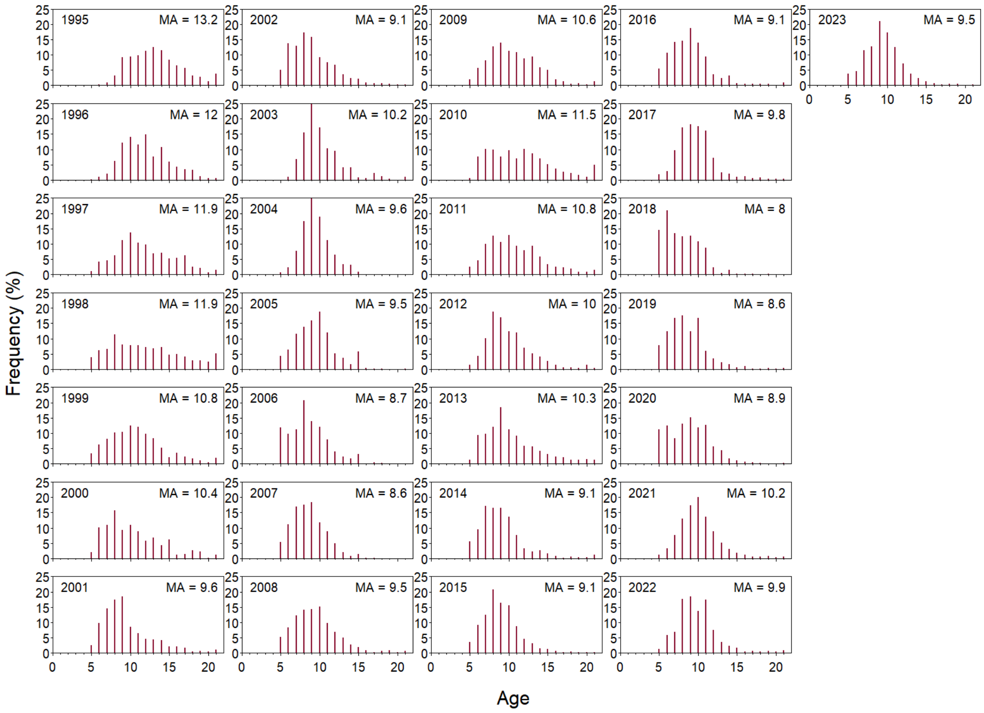

Figure 6.4.7. Greater silver smelt in 5.b and 6.a. Catch at Age (CAA) used in the SAM assessment in 1995 to present. Prior to 2005 only CAA from the Faroese data has been used. From 2005 to present the combined CAA from Faroese and EU data have been used (compiled in InterCatch). MA= mean age.

6.4.4.4 Weight-at-age

Catch weight at age is compiled in InterCatch framework (Figure 6.4.8 and Table 6.4.6). Data from 1995 to 2005 is only available from the Faroese fishery in Division 5.b. The low weight at age values of greater silver smelt older than 15 years in 2019 are potentially due to the low age sample size of old fish (Figure 6.4.8). Stock weights are assumed to be equal to catch weight.

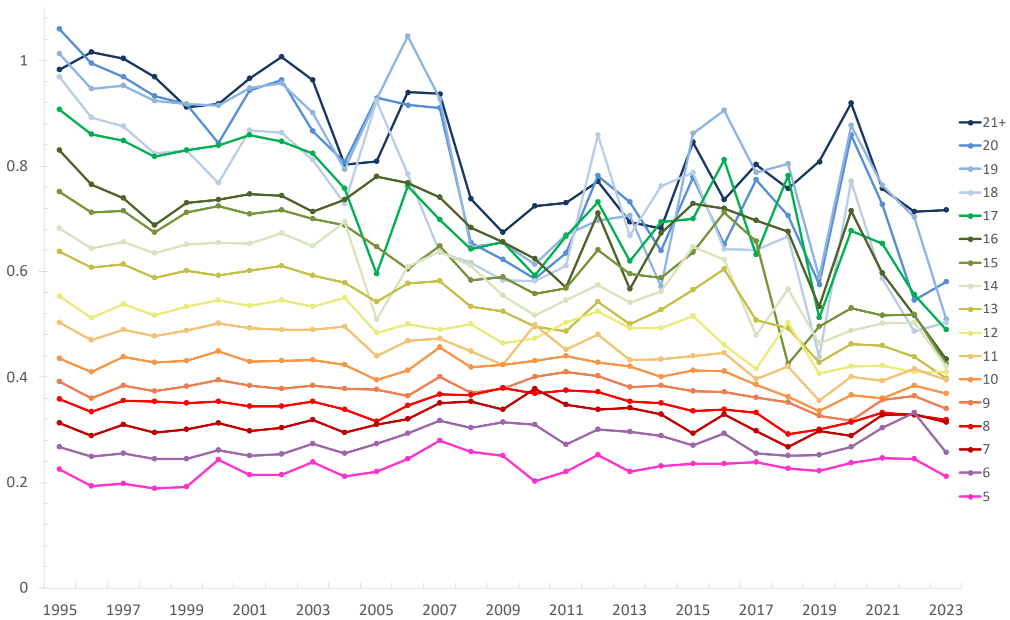

Figure 6.4.8. Greater silver smelt 5.b and 6a. Mean weight-at-age of greater silver smelt in the commercial catch within 5.b and 6.a.

6.4.4.5 Maturity and natural mortality

The composition of the commercial catches consists mostly of mature individuals in Division 5.b (ICES, 2021a).

Maturity at age is estimated from the Faroese surveys for the period 2000-2019 and it is fixed for the whole assessment period (Table 6.4.7).

Natural mortality is set to 0.15 (ICES, 2021a).

6.4.4.6 Catch, effort and research vessel data

Fishery-dependent data is available from Faroese trawler logbooks (1995-present) and the PFA self-sampling program (2005-2008, 2012-present). The catch from Faroese trawlers accounts for more than 80% of the total Faroese landings since 2005. Therefore, the period 2005-present was chosen for calculating a CPUE index. The PFA self-sampling logbooks account for varying percentages of the total registered catch by Germany and Netherland in Division 5.b and 6.a.

The Faroese summer groundfish survey is used as a tuning series for the assessment. The survey is carried annually on the Faroe Plateau since 1996 (Figure 6.4.9; ICES, 2023, Stock annex). The summer survey has very few stations deeper than 500 m, and therefore is likely to only cover the greater silver smelt juveniles adequately and possibly not the adult population. This means the survey might not necessarily reflect correctly the temporal variation of the biomass of the stock that is better covered by the Faroese deep water survey. The spring survey series, conducted in February/March since 1994, needs closer investigation before it can be used as a tuning series due to large inter-annual variations.

The Faroese deep-water trawl survey has been conducted in September since 2014, covering the slope and banks including the fishing grounds for greater silver smelt in the Faroese EEZ (5.b and 6.a) (ICES, 2024, Stock annex). No Faroese deep water survey was conducted in 2021. The standardized index is presented in Figure 6.4.9.

The Scottish MSS Deepwater slope survey covers the fish community in the deep waters to the northwest of Scotland and has been conducted irregularly since 1998. It has shown that greater silver smelt are found at depths between 400m and 750m (Campbell, WD01 WKGSS2020). A CPUE from this survey has been standardized (Figure 6.4.9) and the number of hauls per year where greater silver smelt is encountered is generally around 10 (Olsen, WD18 WGDEEP2024; ICES, 2024, stock annex).

At the benchmark meeting in 2020, another standardized combined CPUE series for the Faroese and European (PFA) fisheries was presented using a GLM model that incorporates year, week and depth category as explanatory variables (Figure 6.4.9; Quirijins, F. J. and Pastoors, M. A., WD03 WKGSS2020; Pastoors, WD01 WGDEEP2021). In 2023, a fleet (identifying either Faroese or PFA) was added to the model as co-variate to account for the differences in fishing practice, spatial distribution and fleet characteristics. Analyses also suggested that this fleet identifier was highly significant. A single fleet analysis is also routinely carried out to assess the year trends in CPUE for the data by Faroese and PFA fisheries separately. This indicates that the variability is substantially higher in the PFA series compared to the Faroese series (See stock annex). Parameter estimates for explanatory variables are routinely checked and described in Hintzen, N. (WD19, WGDEEP 2024). Commercial CPUE may be influenced by changes in greater silver smelt quotas and fishing season/market factors but these influences were regarded as minor in comparison to variations in stock biomass.

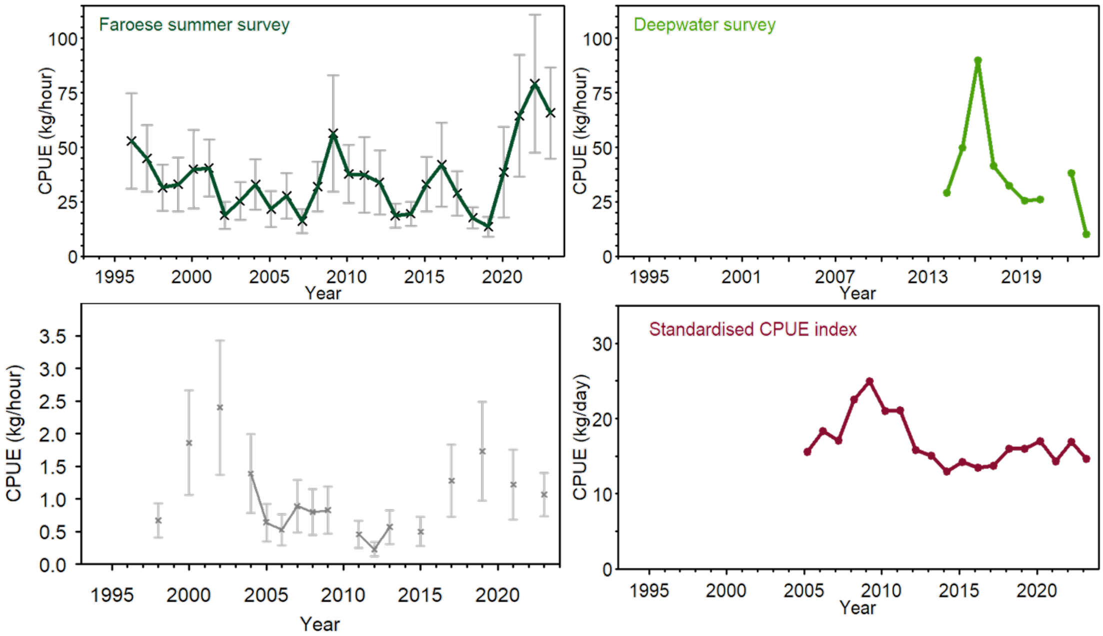

Figure 6.4.9. Survey indices with confidence intervals from 1) the Faroese summer survey (since 1995) top left, 2) Faroese deepwater survey (since 2014, excluding 2021) top right, 3) MSS Slope Deep Water (since 1998, irregularly) bottom left, and 4) combined standardized CPUE with confidence intervals from Faroese and EU fisheries from 2005 to last data year

6.4.5 Data analyses

6.4.5.1 Length and age distributions

In Division 5.b the mean length and age of greater silver smelt in the Faroese landings decreased from 1994 to 2000 and have been stable since then (Figures 6.4.3, 6.4.10). This trend probably reflects a gradual change during and following the first years of exploitation of a virgin stock (Ofstad, L. H., WD10 WKDEEP 2010). The variation in mean length during recent 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 as reported in WKGSS 2020. 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.

Mean landing size from the Netherland is around 34-38 cm (Figure 6.4.10).

Since 2003, mean length of greater silver smelt from Faroese and Netherland trawlers is very similar, around 36–39 cm (Figure 6.4.10). The low mean lengths observed in the Netherlands fishery (1996, 1999, 2002) could be due to the catch being a mixture of *Argentina silus* and *A. spyraena* or due to the Netherland trawlers operating in shallower waters. Another explanation could be that the data are from discard not landings.

Mean length in the catch from the fishery in the Faroes, PFA and Netherland as well as from the Faroese deepwater survey are comparable allowing the use of Faroese age-length data in the age-based assessment. The Faroese summer survey on the other hand has a lower mean length which is due to the shallow waters covered in the summer survey (Figure 6.4.10). However, this survey covers the distribution of juveniles which the other indices do not.

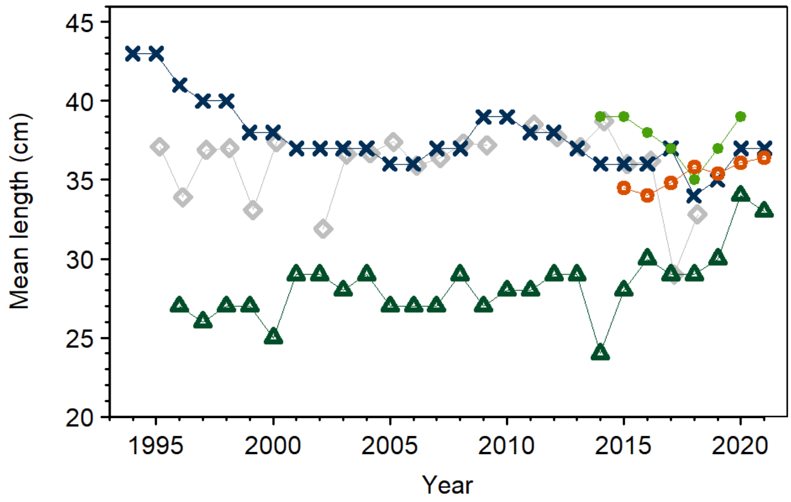

Figure 6.4.10. Greater silver smelt in 5.b and 6.a. Comparison of median lengths at year from Faroese catches (Blue crosses), PFA (open orange circles) and Netherland (grey diamonds) catches and from the Faroese summer (dark green triangles) and deepwater surveys (green filled circles).

6.4.5.2 Stock assessment

The SAM model is based on catch at age for ages 5 to 21+ and initiated in 1995 (Table 6.4.5). Catch at age data from 1995 to 2004 is derived from Faroese sampling raised to international catches. Catch at age data since is derived from InterCatch whereby the age-based data is only contributed by Faroe Islands and the Netherlands. Age classes of 5-year-old and older are used in the assessment. However, information on younger age groups (2-4) is available in InterCatch.

Maturity at age is fixed for the assessment period and natural mortality is set to 0.15 for all ages and years (ICES, 2021)

The age-disaggregated tuning series were the Faroese summer survey, ages 5 to 12 years (since 1997, Table 6.4.8) and the Faroese deepwater survey, ages 5 to 14 years (2014-2020, Table 6.4.9).

The Scottish deepwater slope survey (since 1998, irregular, Table 6.4.10) and the combined commercial Faroese and EU trawlers catch per unit effort (since 2005, Table 6.4.10) were used as biomass indices in the tuning of the assessment.

The model configuration has a correlated error structure for the age-based survey information (Faroese summer survey, Faroese deepwater survey). The model configuration required 23 estimated parameters (Table 6.4.11).

Other details regarding the age based state-space fish stock assessment (SAM) can be found in the stock annex.

Diagnostics and results of the SAM model 2024_aru.27.5b6a_assessment on TAF are shown in the Figures and Tables below:

- Model fits to the data (Figures 6.4.12-6.4.13)
- Standardized one-step-ahead residuals (Figure 6.4.14)
- Leave-one-out analysis (Figure 6.4.15)
- Retrospective analysis (Figure 6.4.16)
- Estimated correlations between age groups for each fleet (Figure 6.4.17)
- Comparison of SSB, Fbar, Recruitment and Catch between last years and present year SAM runs(Figure 6.4.18 and Table 6.4.13)
- Parameter estimates (Figure 6.4.19, Table 6.4.12)
- Selectivity patterns by pentad (Figure 6.4.20)

In order to minimize systematic year effects, the final SAM model included correlated errors across ages (Figure 6.4.19). Residuals were more randomly distributed after the correlated errors were taken into account.

The retrospective pattern shows that recruitment has been underestimated (Figure 6.4.16). All the retrospective runs fall within the confidence intervals of the final assessment. Mohn's rho parameters are estimated at 1%, -0.4% and 5% for the spawning stock biomass, F and recruitment, respectively.

The results from SAM shows that the spawning stock biomass (SSB) currently around 86 000 tonnes (Figure 6.4.18, Tables 6.4.13, 6.4.15) which is slightly above B_{pa} and $MSYB_{trigger}$ and well above B_{lim}. The fishing mortality ($F_{6\text{-}14}$) has varied but has been below F_{MSY} since 2014 (Figure 6.4.18, Tables 6.4.13, 6.4.14). The model-estimated catch in the years since 2014 has been lower than the observed catch except in 2021 and 2022.

Parameter estimates of the model are in the Table 6.4.12 and compared with the previous assessment in the Figure 6.4.19. Overall, parameter estimates are highly comparable between years.

The estimated selectivity by year is shown in Figure 6.4.20, organized by pentad. The estimated selectivities are highly variable between years and show large variations in estimated selectivities, especially at the older ages. This has impacts on the short term forecast that is based on the most recent selectivity taken forward.

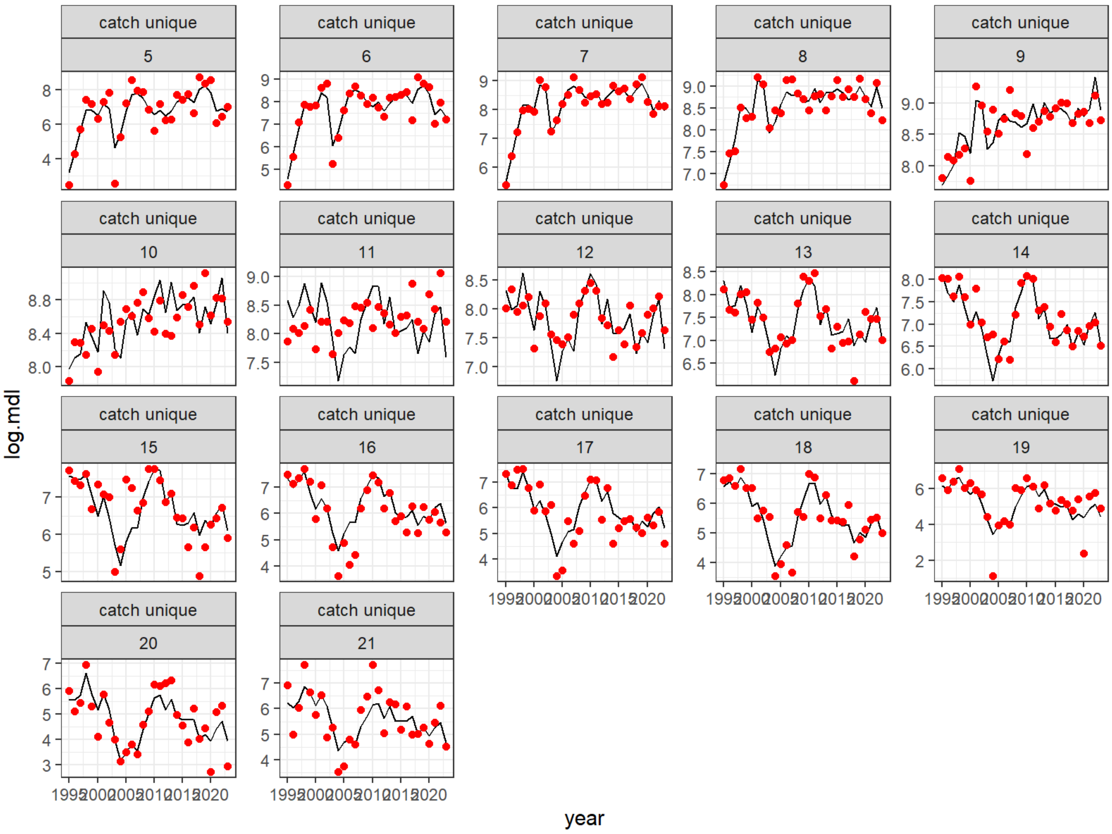

Figure 6.4.12. Greater silver smelt in 5.b and 6.a. Fit of the assessment model to the catches at age.

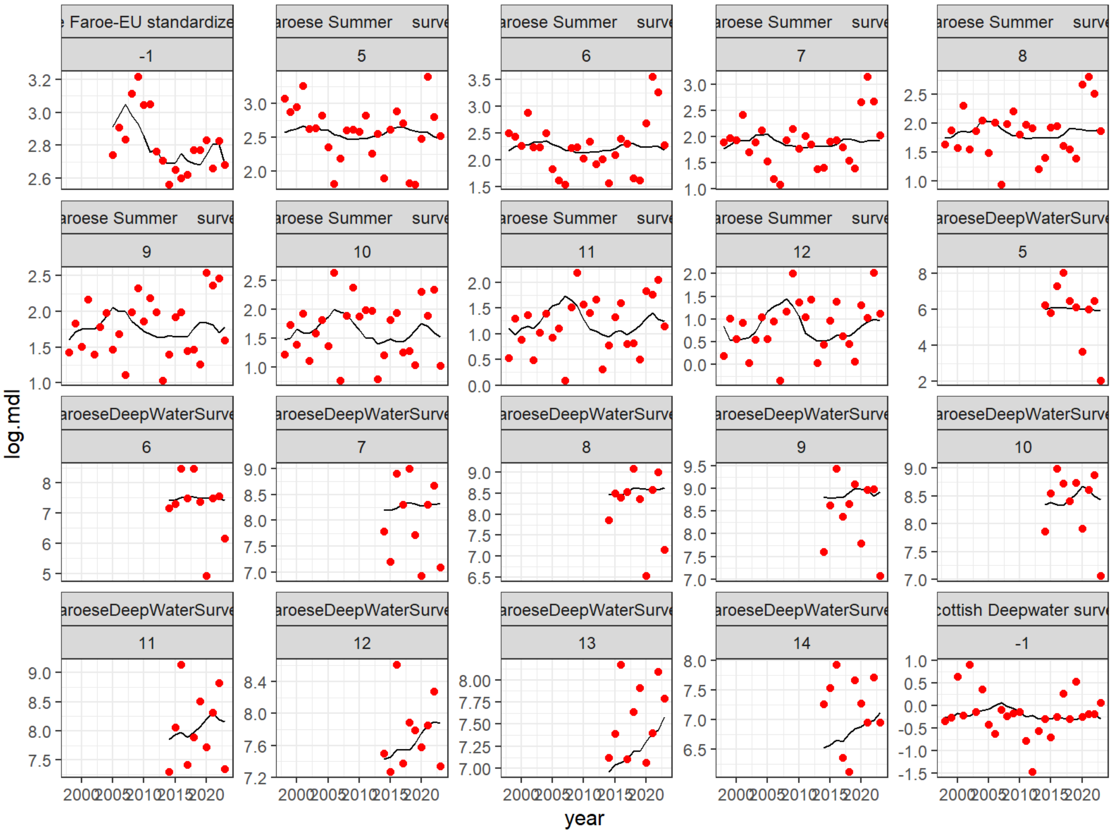

Figure 6.4.13. Greater silver smelt in 5.b and 6.a. Fit of the assessment model to the Faroese summer survey (F1 FSS), the Faroese deepwater survey (F2 FDWS), the MSS Deepwater slope survey (F3 SDWS) and the Faroese-EU standardized CPUE series (F4 CPUE).

Figure 6.4.14. Greater silver smelt in 5b and 6a. Standardized one-step-ahead residuals from the SAM model.

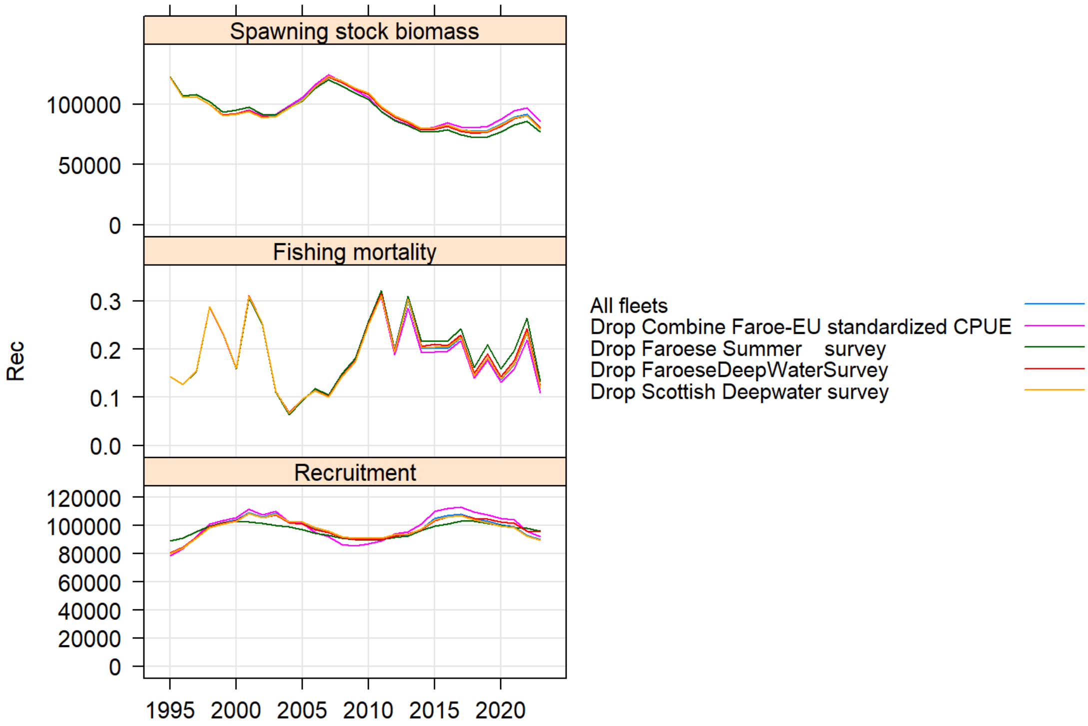

Figure 6.4.15. Greater silver smelt in 5b and 6a. Leave-one-out analysis of Catch (1st), SSB (2nd), fishing mortality (3rd), recruitment (4th). Black line and grey band indicated the final assessment with 95th percentiles.

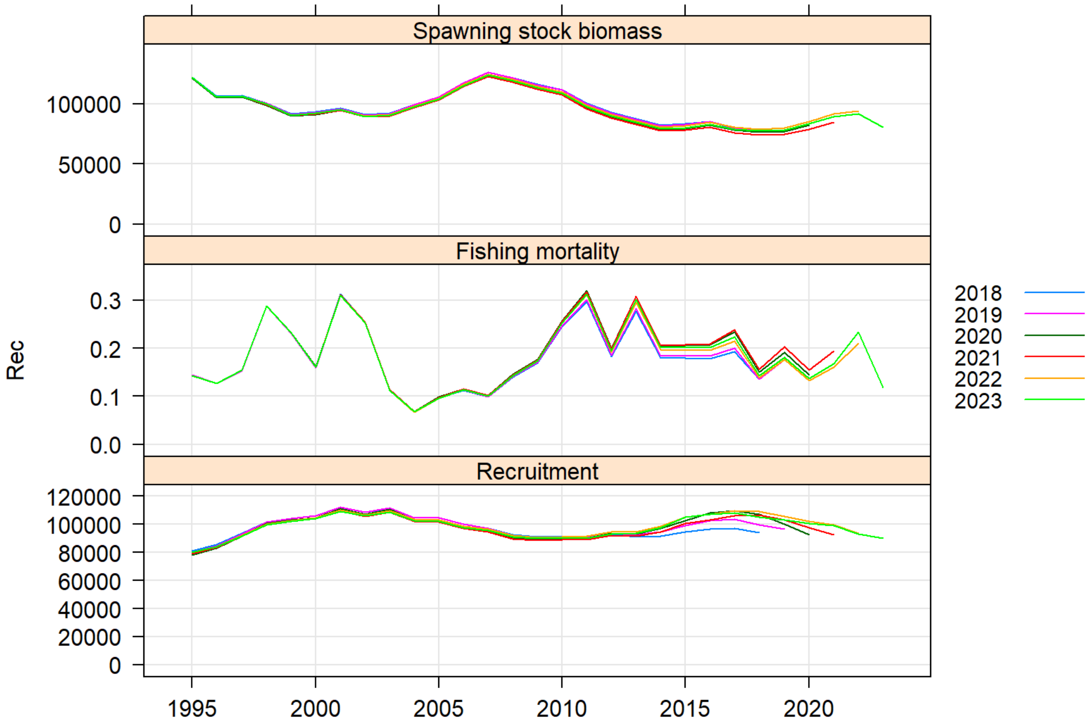

Figure 6.4.16. Greater silver smelt in 5b and 6a. Retrospective analysis with 5 peels in SSB (upper), fishing mortality (middle), recruitment (lower). Mohn's rho value indicated in top left of each panel.

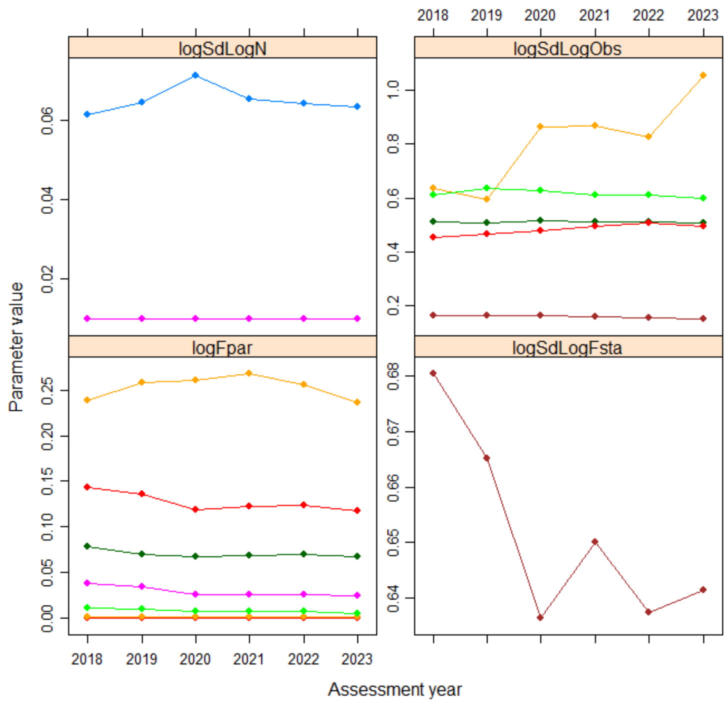

Figure 6.4.19. Greater silver smelt in 5.b and 6.a. Comparison of parameter estimates for the retrospective peels.

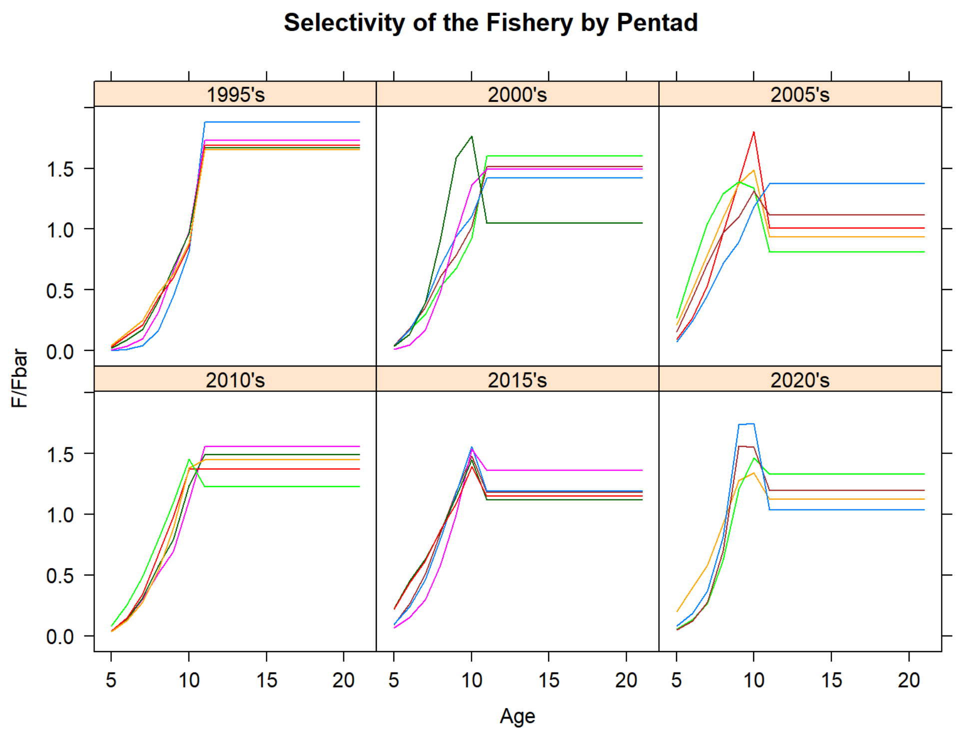

Figure 6.4.20. Greater silver smelt in 5.b and 6.a. Selectivities from the SAM model by year, organized by pentad of 5 years.

6.4.6 Quality of the assessment

The assessment of greater silver smelt was benchmarked in 2020 (ICES, 2021a), where the assessment was upgraded from a trend-based to a SAM state-space model using catch at age information and four indexes. A comparison of parameter estimates between the previous assessment and present assessment indicates that the model results are largely comparable, although F is estimated somewhat higher than in the 2023 assessment (Figure 6.4.20). There is a consistent, but small, underestimation of recruitment. The Mohn's rho values from the retrospective analysis are below the required thresholds.

In the 2021 assessment, a substantial discrepancy was discovered between the calculated catch in tonnes from InterCatch and the SAM estimated catch in tonnes. The discrepancy mostly occurred in the period from 2015 to 2020. Part of the discrepancy derives from the truncation of the age-range used in the assessment model where only age 5 and up have been used whereas in InterCatch catch at age information is available from age 2 onwards. In 2021, comparison of the catch in tonnes that was and that was not included in the assessment explained part of the discrepancy between observed catch and modelled catch, but still a noticeable discrepancy remained (ICES. 2021b). This could potentially be due to a mis-match between the catch at age information from InterCatch and the SAM model configuration. In both 2022 and 2023 the predicted catch is just below observed catch and therefore has ended the period of underestimation of catch.

6.4.7 Short term forecast

In 2024, a stochastic short-term forecast was carried out using a forecast developed in FLR where previously stockassessment.org was used. The FLR version was chosen due to its ability to be integrated more easily in TAF and to allow for specific assumptions to be made regarding recruitment that were not possible in stockassessment.org. Recruitment was based on a 3-year geometric mean recruitment (2021-2023) and mean weights was based on 5 year averages. A thousand new replicates of stock numbers and selectivities were generated from the final assessment fit making use of the variance-co-variance matrix. Future recruitment prediction was calculated for each replicate.

A particular challenge in the forecast of this stock is the way to deal with the discrepancy between the SAM estimates of catch and the InterCatch estimated catch as well as a deviance in TAC and actual landings. At the 2022 assessment several forecast options were explored and a catch constraint based on the ratio of TAC to catch since 2010 on the intermediate year was introduced. The working group developed a method to estimate uptake of the quota in the interim year. The process calculates the uptake of the TAC as a ratio of ICES landings over summed TAC of the Faroes, EU and UK TACs for the years since 2010. It then fits a linear model on the ΣTAC-uptake datapoints and uses this relationship to predict the expected uptake given the agreed TAC in the interim year. This results in an expected catch in the interim year. Results are shown in figure 6.4.21 and table 6.4.21.

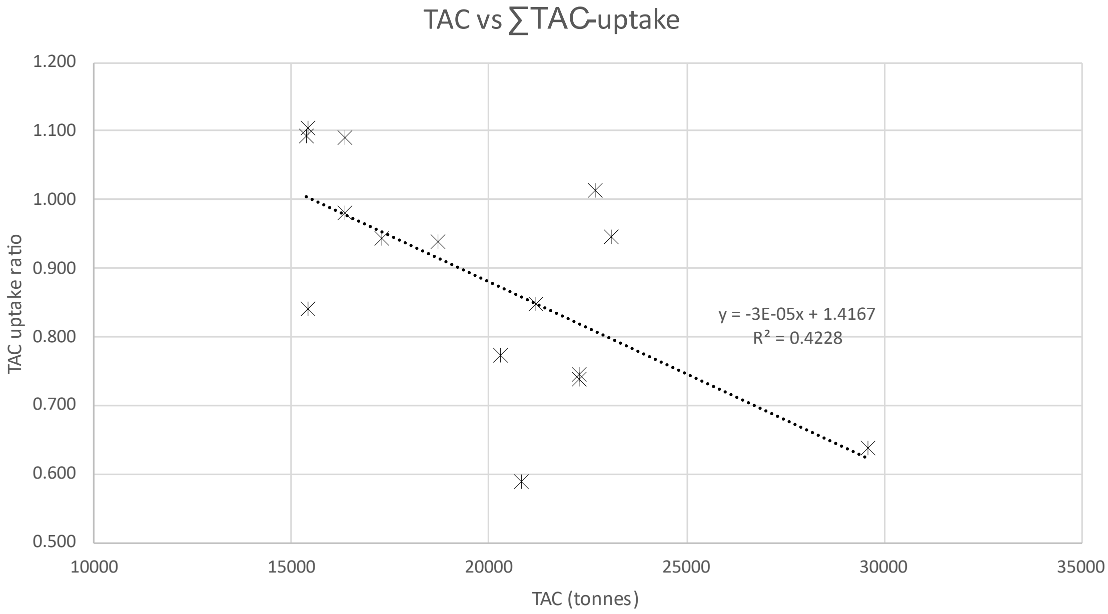

Figure 6.4.21. Greater silver smelt in 5.b and 6.a. Estimated F-at-age in the WGDEEP 2022 and 2023 final assessments as well as the ratio between these F estimates.

6.4.8 Reference points

Reference points for this stock were estimated at the benchmark meeting WKGSS 2020 (ICES, 2021). Two types of reference points are referred to when giving advice for Category 1 stocks: precautionary approach (PA) reference points and maximum sustainable yield (MSY) reference points.

With the updated technical guidelines on reference points (ICES (2021). 16.4.3.1. ICES fisheries management reference points for category 1 and 2 stocks. ICES Advice Technical Guidelines.), the procedure for estimating fishing mortality reference points have changed. F_{pa} is now set at $F_{p0.5}$ = 0.33. The previously estimated F_{lim} (=0.29) is no longer considered relevant, as it is lower than the new F_{pa}. F_{MSY} is estimated at F=0.24 (Table 6.4.18).

6.4.9 Management considerations

The quota of greater silver smelt in the Faroese EEZ has been reduced from 16 000 tonnes (2014) to 11 700 in 2018 and 2019 (Table 6.4.3). 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.

No bilateral agreement between the UK, EU and the Faroe Islands exists to set an overall TAC of greater silver smelt in 5.b and 6a. The sum of quotas of the Faroe Islands, UK and EU has exceeded the scientific ICES advice since 2016, except for in 2022 (Table 6.4.3).

6.4.10 Future research and data requirements

The WG recommends that work be done to further explore the assessment and forecast issues that have been identified for this stock. Based upon the new ICES Benchmark guidelines and outcome of these analyses, potential solutions could be presented for the working group at next WGDEEP. The most pressing issues are:

- Revisit the whole time series of catch at age and weight at age in order to resolve the discrepancy between modelled catch and observed catch. Special attention should be devoted to the allocation criteria for assigning catch at age proportions to unsampled strata. Furthermore, the catch weight at age estimates need attention as the lack of samples of fish older than 15 years, in some years, highlights the need to combine catch at age and weight at age samples in the allocation process that is currently handled separately in Division 5b and 6a.
- Review the short-term forecast assumptions and method in the light of the discrepancy between the SAM estimates of catch and the InterCatch estimated catch and revisiting the catch at age and weight at age matrices.
- Revisit, if needed, the biological reference points in the light of the new guidelines from ACOM.
- Investigate the model's sensitivity to catches in the most recent years which is showing quite a large variability in the selectivity at age over the years. The change in the selectivity estimated in the model driving the difference in the forecast (Figure 6.4.20) should be investigated too.

6.4.11 References

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6.4.12 Tables

Table 6.4.1. Greater Silver Smelt 5.b and 6.a. WG estimates of landings in tonnes. *preliminary data

Division 5.b														**TOTAL**
Year	**Den-mark**	**Faroes**	**France**	**Germany**	**Greenland**	**Iceland**	**Ireland**	**Netherlands**	**Norway**	**Poland**	**UK(E&W)**	**UK (Scot)**	**Russia**	
1988		287												287
1989		111											116	227
1990		2885											3	2888
1991		59										1		60
1992		1439											4	1443
1993		1063												1063
1994		960												960
1995		5534											6752	12286
1996		9495										3		9498
1997		8433												8433
1998		17570												17570
1999		8186	5								23	15		8229
2000		3713	64									247	1185	5209
2001		9572					1					94	414	10081
2002		7058						5				144	264	7471
2003		6261						51				1	245	6558
2004		3441						1125				42	702	5310
2005		6939						15					59	7013
2006		12554											35	12589
2007		14085						441	32				8	14566
2008		14930							3				19	14952
2009		14200											28	14228
2010		15567										40	2	15609
2011		15578											8	15586
2012		9744											110	9854
2013		11109											114	11223

Division 5.b Year	Den-mark	Faroes	France	Germany	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	UK(E&W)	UK (Scot)	Russia	TOTAL
2014		9747		110									339	10196
2015		13025	0	40		132							115	13312
2016		11129		38		345		31				0	13	11557
2017		9424		1		63		2					6	9496
2018		10114	0							1			150	10265
2019	0	9194		2		6				4			87	9292
2020	0	8416								0			22	8438
2021	0	5411				20								5431
2022		6368			0	15								6383
2023*		5040	0									0		5040

Table 6.4.1 (Continued).

Division 6.a Year	Den-mark	Faroes	France	Germany	Ireland	Lithuania	Netherlands	Norway	Poland	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		4309							6894
1998				464	405		4696							5565
1999				24	168		8188			5				8385
2000			19	403	3178		3436							7036
2001			7	189	5838		3654				4777			14465

Division 6.a Year	Den-mark	Faroes	France	Germany	Ireland	Lithuania	Netherlands	Norway	Poland	UK (E&W)	UK (Scot)	Russia	Spain	Total
2002			1	150	3035		4009			424	4136			11755
2003				26	1		1958				80			2065
2004			147	652	46		4335				507			5687
2005		103	10	125	18		5276				61			5593
2006		52		213			4841				3		1	5110
2007		254		589			7621	3					2	8469
2008		991		10			4186	3						5190
2009		3923		115			2616	83			6	36		6779
2010		3060					3139	7			20	11		6237
2011		3655					3724			2	2			7383
2012		2781		538			3248			5	5	1		6578
2013	388	3197		417	0		1380					13		5395
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		1974	8	1001			2763	5				18		5769
2019		2980	4	953	6		4540		29			28	0	8538
2020		3629	8	384	0	114	4330		111				0	8576
2021		3141	17	336	0		4019		1		3		0	7518
2022	4	3040	1	728	4		8664	0	21	6				12467
2023*	15	1116	0	886	0	13	5074		102		0		0	7205

Table 6.4.2. Greater silver smelt (*Argentina silus*) (5.b and 6.a). *preliminary data

Year	5.b	6.a	Total Landings	Discard 5.b	Discard 6.a	Total catches
1988	287	7924	8211			8211
1989	227	20581	20808			20808
1990	2888	6795	9683			9683
1991	60	4726	4786			4786

Year	5.b	6.a	Total Landings	Discard 5.b	Discard 6.a	Total catches
1992	1443	5531	6974			6974
1993	1063	1069	2132			2132
1994	960	7635	8595			8595
1995	12286	4938	17224			17224
1996	9498	5632	15130			15130
1997	8433	6894	15327			15327
1998	17570	5565	23135			23135
1999	8229	8385	16614			16614
2000	5209	7036	12245			12245
2001	10081	14465	24546			24546
2002	7471	11755	19226			19226
2003	6558	2065	8623			8623
2004	5310	5687	10997			10997
2005	7013	5593	12606			12606
2006	12589	5110	17699			17699
2007	14566	8469	23035			23035
2008	14952	5190	20142			20142
2009	14228	6779	21007			21007
2010	15609	6237	21846			21846
2011	15586	7383	22969			22969
2012	9854	6578	16432			16432
2013	11223	5395	16618			16618
2014	10196	5467	15663	28	1553	17244
2015	13312	4236	17548		270	17818
2016	11557	4773	16330	12	1651	17993
2017	9496	7310	16806	31	239	17076
2018	10265	5769	16033	2	185	16220
2019	9292	8538	17830		86	17916
2020	8438	8576	17014	0	127	17141
2021	5411	7514	12925		157	13105

Year	5.b	6.a	Total Landings	Discard 5.b	Discard 6.a	Total catches
2022	6368	12461	18829		242	19008
2023*	5040	7205	12245		192	12438

Table 6.4.3. Greater silver smelt in 5.b and 6.a. Overview of ICES advice and TACs set by the Faroese authorities and the European Union for greater silver smelt in area 5.b and 6.a.

Year/Area	ICES advise (5.b and 6.a)	Faroe Islands Quota (5.b and 6.a)	EU Quota ˆ (5, 6, 7)	UK Quota (5, 6, 7)	TACs Summed
2014	-	16000	4316	-	20316
2015	-	14400	4316	-	18716
2016	10030	13000	4316	-	17316
2017	10030	11500	3884	-	15384
2018	12036	11700	4661	-	16361
2019	12036	11700	4661	-	16361
2020	7703	11700	3729	-	15429
2021	7703	11700	3521	208	15429
2022	24493	18000	10976	650	29626
2023	17078	12700	7670	454	20824
2024	17695	12800	7929	469	21198

ˆ 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.

Table 6.4.4. Greater silver smelt in 5.b and 6.a. Discards of greater silver smelt in tons per country per area from 2014 to last data year along with discard percentage of combined annual catch. *preliminary data

Year	Area 5.b				Area 6.a					Areas combined 5.b and 6.a	
	France	Germany	Netherlands	UK(Scotland)	France	Germany	Netherlands	Spain	UK(Scotland)	Total	% of catches
2014		28			808	92			653	1581	8.4
2015					161				109	270	1.5
2016	12				200				1451	1663	8.5
2017	31		0		217		9		14	270	1.6
2018	2				118				67	187	1.1
2019					13			9	64	86	0.5

Year	Area 5.b				Area 6.a					Areas combined 5.b and 6.a	
	France	Germany	Netherlands	UK(Scotland)	France	Germany	Netherlands	Spain	UK(Scotland)	Total	% of catches
2020				0				2	124	127	0.7
2021								0	156	157	1.2
2022								83	159	243	1.3
2023				0				104	88	192	1.5

Table 6.4.5. Greater silver smelt in 5.b and 6.a. Catch numbers at age (*1000) used in the assessment.

Year/Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
1995	12	76	222	851	2459	2534	2610	3036	3361	3086	2264	1765	1502	880	728	370	1005
1996	73	267	593	1747	3435	3999	3278	4201	2145	3055	1708	1258	986	952	373	167	148
1997	306	1205	1358	1828	3246	3969	3023	2843	2010	2058	1524	1569	1803	725	603	233	423
1998	1696	2688	2911	5015	3542	3443	3418	3155	2996	3174	2065	2212	1853	1303	1251	1053	2228
1999	1282	2416	3070	3891	3932	4710	4551	3674	3144	2021	802	1351	883	681	425	203	772
2000	544	2603	2780	4026	2355	2819	2293	1499	1736	1086	1562	324	368	679	557	61	317
2001	1472	5606	8333	9983	10595	4920	3714	2646	2498	2420	1196	1178	1001	241	383	323	692
2002	2468	6843	6436	8571	7810	4590	3682	3302	1802	1144	1102	487	355	318	299	107	132
2003	13	195	1397	3127	5149	3458	2093	1924	849	822	148	112	458	255	83	-1	193
2004	189	614	2097	4678	7288	5109	3016	1750	925	869	268	37	28	34	3	-1	34
2005	1369	2042	3643	4388	5007	5959	3795	1608	1180	506	1795	131	35	51	-1	-1	43
2006	5299	4377	5040	9345	6286	5454	3613	1819	1030	747	1425	57	244	99	66	-1	-1
2007	2896	6064	9147	9561	10031	6435	4865	2695	1110	495	771	84	100	39	-1	30	-1
2008	2571	4011	5955	6882	6928	7314	4738	3294	2475	1370	951	493	166	302	427	97	387
2009	948	2722	3810	6031	6586	5334	5115	4101	4409	2767	2345	974	642	254	375	168	657
2010	272	3599	4722	4665	3586	4561	3293	4695	4037	3234	2375	1719	1235	1095	752	484	2275
2011	1328	2319	5104	6500	5439	6604	4779	4092	4776	3041	1740	1328	1196	972	461	458	836

Year/Age	5	6	7	8		9	10	11	12	13	14	15	16	17	18	19	20	21+
2012	503	1576	3595	6732		6044	4432	4266	2547	1862	1491	962	492	255	242	138	504	154
2013	526	3631	3846	4651		7141	4342	3533	2263	2174	1610	1227	884	876	532	501	563	517
2014	2225	3731	6778	6517		6540	5390	3023	1298	919	1046	637	301	101	229	180	143	487
2015	1666	4151	5676	9401		7438	7057	4023	2064	1483	736	624	362	182	227	121	96	181
2016	2360	4656	6133	6351		8134	6084	4118	1609	1042	1376	286	198	243	215	220	49	441
2017	781	1331	4326	7605		8074	7851	7174	3177	1070	955	491	528	263	382	175	184	148
2018	6955	9988	6424	5987		6075	5155	4142	1154	268	697	160	192	193	42	151	-1	-1
2019	4332	6840	9146	9626		6795	9150	3272	1956	1255	943	285	520	153	118	224	86	196
2020	5274	5867	3906	6108		7040	5537	5945	2696	2049	839	523	316	279	168	11	15	103
2021	441	1144	2553	4391		5891	6805	4632	3003	1762	1061	626	428	206	234	270	160	238
2022	631	2920	3410	8751	9131	6767	8633	3716	1765	1142	824	288	347	247	328	208	460	
2023	1110	1377	3356	3712	6183	5102	3684	2074	1112	680	367	197	99	148	135	19	92	

Table 6.4.6. Greater silver smelt in 5.b and 6.a. Mean weight at age used in the assessment.

Year/Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
1995	0.225	0.268	0.312	0.358	0.392	0.435	0.503	0.553	0.638	0.681	0.751	0.830	0.906	0.968	1.013	1.060	0.982
1996	0.194	0.249	0.289	0.334	0.359	0.409	0.470	0.512	0.608	0.643	0.711	0.764	0.860	0.891	0.946	0.994	1.015
1997	0.198	0.256	0.309	0.355	0.383	0.438	0.489	0.538	0.614	0.656	0.715	0.739	0.848	0.875	0.952	0.969	1.003

Year/Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
1998	0.189	0.245	0.295	0.354	0.373	0.428	0.477	0.517	0.588	0.634	0.674	0.687	0.818	0.824	0.923	0.932	0.968
1999	0.192	0.244	0.301	0.350	0.382	0.431	0.488	0.533	0.601	0.652	0.712	0.730	0.829	0.830	0.917	0.917	0.912
2000	0.243	0.262	0.313	0.353	0.395	0.448	0.501	0.546	0.592	0.655	0.724	0.736	0.839	0.767	0.915	0.843	0.918
2001	0.214	0.250	0.298	0.345	0.383	0.429	0.492	0.535	0.602	0.653	0.709	0.746	0.858	0.867	0.948	0.943	0.966
2002	0.215	0.254	0.303	0.344	0.378	0.431	0.490	0.545	0.610	0.672	0.717	0.744	0.847	0.863	0.957	0.962	1.007
2003	0.239	0.273	0.318	0.353	0.384	0.432	0.490	0.533	0.592	0.649	0.700	0.713	0.823	0.812	0.900	0.866	0.963
2004	0.212	0.255	0.294	0.339	0.378	0.423	0.496	0.550	0.579	0.694	0.687	0.736	0.757	0.728	0.793	0.807	0.802
2005	0.221	0.273	0.309	0.316	0.376	0.394	0.440	0.484	0.542	0.509	0.647	0.780	0.595	0.923	0.926	0.92	0.808
2006	0.244	0.293	0.321	0.346	0.364	0.412	0.469	0.500	0.577	0.609	0.604	0.768	0.762	0.784	1.046	0.916	0.940
2007	0.279	0.317	0.351	0.367	0.400	0.457	0.473	0.489	0.581	0.637	0.648	0.741	0.698	0.636	0.923	0.910	0.934
2008	0.259	0.303	0.353	0.365	0.370	0.418	0.449	0.500	0.533	0.611	0.584	0.683	0.642	0.617	0.646	0.655	0.738
2009	0.251	0.314	0.339	0.379	0.378	0.423	0.423	0.464	0.524	0.555	0.589	0.656	0.656	0.584	0.654	0.622	0.674
2010	0.203	0.309	0.377	0.368	0.401	0.430	0.499	0.473	0.495	0.516	0.558	0.624	0.592	0.582	0.613	0.586	0.724
2011	0.220	0.272	0.348	0.375	0.410	0.439	0.452	0.503	0.486	0.546	0.568	0.569	0.667	0.610	0.670	0.634	0.730
2012	0.252	0.301	0.339	0.371	0.402	0.428	0.480	0.524	0.542	0.574	0.640	0.710	0.731	0.859	0.697	0.781	0.771
2013	0.221	0.296	0.342	0.354	0.380	0.420	0.432	0.493	0.500	0.541	0.595	0.567	0.620	0.668	0.706	0.731	0.693
2014	0.231	0.289	0.330	0.350	0.383	0.400	0.434	0.493	0.528	0.562	0.588	0.673	0.694	0.761	0.571	0.639	0.682
2015	0.235	0.271	0.293	0.335	0.373	0.413	0.439	0.515	0.565	0.647	0.636	0.729	0.700	0.788	0.861	0.779	0.845

Year/Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
2016	0.236	0.293	0.329	0.338	0.371	0.411	0.445	0.461	0.605	0.622	0.711	0.719	0.811	0.642	0.905	0.652	0.736
2017	0.239	0.256	0.298	0.333	0.361	0.385	0.396	0.415	0.507	0.479	0.657	0.697	0.632	0.641	0.787	0.773	0.802
2018	0.23	0.251	0.273	0.291	0.358	0.366	0.414	0.503	0.494	0.538	0.424	0.682	0.767	0.666	0.804	0.706	0.757
2019	0.222	0.252	0.298	0.301	0.326	0.335	0.355	0.407	0.427	0.464	0.495	0.534	0.512	0.438	0.589	0.576	0.808
2020	0.237	0.27	0.287	0.318	0.317	0.366	0.406	0.43	0.463	0.488	0.53	0.715	0.677	0.771	0.877	0.859	0.919
2021	0.246	0.303	0.328	0.332	0.356	0.36	0.393	0.422	0.459	0.501	0.517	0.597	0.653	0.587	0.763	0.727	0.757
2022	0.244	0.333	0.330	0.328	0.364	0.384	0.415	0.410	0.438	0.503	0.518	0.516	0.556	0.487	0.703	0.545	0.713
2023	0.211	0.257	0.314	0.318	0.341	0.369	0.394	0.409	0.397	0.421	0.425	0.434	0.489	0.504	0.509	0.580	0.717

Table 6.4.7. Greater silver smelt 5.b and 6a. Maturity proportion by age used in the assessment for greater silver smelt.

Year/Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
Prop mature	0.13	0.29	0.52	0.75	0.89	0.96	0.98	0.99	1	1	1	1	1	1	1	1	1

Table 6.4.8. Greater silver smelt in 5.b and 6.a. Faroese summer survey input to tuning series in the assessment.

Year	Effort/Age	5	6	7	8	9	10	11	12
1998	0.201	4.317	2.435	1.336	1.033	0.832	0.672	0.339	0.242
1999	0.199	3.556	2.281	1.446	1.310	1.250	1.120	0.735	0.551
2000	0.2	3.828	1.909	1.393	0.969	0.902	0.805	0.483	0.354
2001	0.2	5.236	3.559	2.256	2.024	1.758	1.367	0.782	0.504

Year	Effort/Age	5	6	7	8	9	10	11	12
2002	0.199	2.778	1.863	1.107	0.951	0.806	0.603	0.325	0.209
2003	0.2	2.795	1.875	1.323	1.303	1.192	0.970	0.555	0.346
2004	0.2	3.352	2.446	1.680	1.556	1.453	1.234	0.806	0.569
2005	0.2	2.103	1.245	0.919	0.894	0.866	0.786	0.507	0.354
2006	0.2	1.234	1.002	0.664	1.500	1.080	2.775	0.607	0.515
2007	0.199	1.779	0.933	0.595	0.516	0.607	0.433	0.220	0.142
2008	0.2	2.713	1.834	1.378	1.475	1.469	1.318	0.914	0.645
2009	0.2	2.727	1.869	1.717	1.838	2.040	2.160	1.783	1.495
2010	0.2	2.662	1.521	1.183	1.216	1.288	1.298	0.965	0.789
2011	0.2	3.370	2.084	1.492	1.451	1.777	1.455	0.811	0.570
2012	0.202	1.927	1.355	1.269	1.370	1.469	1.437	1.064	0.843
2013	0.202	2.559	1.489	0.795	0.669	0.564	0.440	0.271	0.209
2014	0.2	1.336	0.952	0.816	0.821	0.806	0.671	0.436	0.310
2015	0.2	2.727	1.614	1.353	1.387	1.370	1.228	0.752	0.524
2016	0.199	3.571	2.184	1.387	1.416	1.470	1.379	0.983	0.805
2017	0.203	2.990	2.001	1.207	1.010	0.853	0.699	0.446	0.372
2018	0.202	1.245	1.046	0.934	0.943	0.870	0.717	0.452	0.314
2019	0.2	1.220	1.007	0.805	0.803	0.708	0.566	0.332	0.215

Year	Effort/Age	5	6	7	8	9	10	11	12
2020	0.199	2.380	2.910	2.870	2.909	2.548	1.996	1.246	0.738
2021	0.2	5.960	6.969	4.648	3.319	2.131	1.326	1.17	0.564
2022	0.198	3.300	5.254	2.911	2.344	2.064	2.064	1.558	1.509
2023	0.198	2.490	1.934	1.529	1.295	0.982	0.558	0.629	0.616

Table 6.4.9. Greater silver smelt in 5.b and 6.a. Faroese Deepwater survey input to tuning series in the assessment .

Year	Effort/Age	5	6	7	8	9	10	11	12	13	14
2014	0.110	50.9	128.5	243.1	258.5	202.4	260.8	148.1	181.5	124.4	142.8
2015	0.078	22.8	103.7	94.0	346.0	391.9	360.4	222.2	100.4	114.2	131.0
2016	0.073	110.8	358.0	547.2	332.9	943.6	601.8	697.3	412.3	265.5	208.1
2017	0.073	216.4	126.8	282.5	357.2	307.4	430.8	116.8	111.8	85.7	40.7
2018	0.038	19.4	144.70	245.8	268.5	174.7	135.1	80.5	80.6	63.1	13.7
2019	0.052	19.7	68.2	96.1	182.7	380.2	268.1	213.2	103.9	116.6	91.4
2020	0.031	1.2	4.2	31.4	21.1	75.2	84.9	69.9	60.7	36.4	44.5
2021	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2022	0.062	39.9	118.3	363.1	503.2	497.5	442.9	418.7	243.0	203.1	138.7
2023	0.051	0.4	23.9	61.2	64.8	59.8	59.4	79.1	78.8	123.2	53.5

Table 6.4.10. Greater silver smelt in 5.b and 6.a. Standardised biomass index from the Scottish MSS Deepwater Slope survey and the combined Faroe-EU CPUE used as input to tuning series in the assessment.

Year	Scottish deepwater survey	Combined Faroe-EU CPUE
1998	0.71	
1999	-1	
2000	1.92	
2001	-1	
2002	2.50	
2003	-1	
2004	1.43	
2005	0.66	15.2
2006	0.54	18.1
2007	0.91	16.8
2008	0.80	22.5
2009	0.84	24.8
2010	-1	20.7
2011	0.46	20.8
2012	0.23	15.5
2013	0.57	14.8
2014	-1	12.8
2015	0.50	14.6
2016	-1	13.0
2017	1.31	13.6
2018	-1	15.2
2019	1.72	15.7
2020	-1	16.5
2021	0.83	13.9
2022	-1	16.3
2023	1.07	14.0

Table 6.4.11. Greater silver smelt in 5.b and 6.a. Model configuration with 23 parameters.

$minAge	5
$maxAge	21
$maxAgePlusGroup	1 0 0 0 0
$keyLogFsta	
catch	0 1 2 3 4 5 6 6 6 6 6 6 6 6 6 6 6
Faroese summer survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Faroese deep water survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Scottish deep water slope survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Standardised CPUE	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$corFlag	2
$keyLogFpar	
catch	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Faroese summer survey	0 1 2 3 4 5 5 5 -1 -1 -1 -1 -1 -1 -1 -1
Faroese deep water survey	6 7 8 9 10 10 10 10 10 10 -1 -1 -1 -1 -1 -1 -1
Scottish deep water slope survey	11 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Standardised CPUE	12 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$keyQpow	All -1
$keyVarF	
catch	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Faroese summer survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Faroese deep water survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Scottish deep water slope survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Standardised CPUE	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$keyVarLogN	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
$keyVarObs	
catch	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Faroese summer survey	1 1 1 1 1 1 1 1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Faroese deep water survey	2 2 2 2 2 2 2 2 2 2 -1 -1 -1 -1 -1 -1 -1
Scottish deep water slope survey	3 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Standardised CPUE	4 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$obsCorStruct	"ID" "AR" "AR" "ID" "ID"
$keyCorObs	
catch	NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
Faroese summer survey	0 0 0 0 0 0 0 -1 -1 -1 -1 -1 -1 -1 -1 -1
Faroese deep water survey	1 1 1 1 1 1 1 1 1 -1 -1 -1 -1 -1 -1 -1
Scottish deep water slope survey	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
Standardised CPUE	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$stockRecruitmentModelCode	0
$noScaledYears	0
$keyScaledYears	
$keyParScaledYA	
$fbarRange	6-14
$keyBiomassTreat	-1 -1 -1 5 5
$obsLikelihoodFlag	"LN" "LN" "LN" "LN" "LN"
$fixVarToWeight	0
$fracMixF	0
$fracMixN	0
$fracMixObs	0 0 0 0 0
$constRecBreaks	
*The second keyVarLogN parameter, representing process error, is fixed at a value of log(0.01) in the model.	

Table 6.4.12. Greater silver smelt in 5.b and 6.a. Model parameter estimates.

Parameter	Value	CV
logFpar	-8.82936	0.10519
logFpar	-8.98796	0.10453
logFpar	-9.1065	0.104256
logFpar	-8.88131	0.104379
logFpar	-8.6277	0.105103
logFpar	-8.38976	0.106412
logFpar	-11.9064	0.150707
logFpar	-8.95999	0.061627
logFpar	-5.37378	0.351135
logFpar	-3.72425	0.3443
logFpar	-2.70055	0.335063
logFpar	-2.14326	0.322805
logFpar	-1.44333	0.308266
logSdLogFsta	-0.44388	0.133492
logSdLogN	-2.75902	0.294865
logSdLogN	-4.60517	NA
logSdLogObs	-0.67507	0.039355
logSdLogObs	-0.70152	0.110377
logSdLogObs	0.055156	0.173511
logSdLogObs	-0.51584	0.172963
logSdLogObs	-1.88924	0.177109
transfIRARdist	-1.96711	0.250818
transfIRARdist	-1.3846	0.415003

Table 6.4.13. Greater silver smelt in 5.b and 6.a. Assessment summary. Weights are in tonnes, recruitment in thousands. High and Low indicate 95% confidence intervals.

Year	Recruitment			Spawning-stock biomass			Land-ings	Dis-cards	Fishing mortality		
	Low	Age 5	High	Low	SSB	High			Low	Ages 6–14	High
	thousands			tonnes			tonnes				
1988							8211				
1989							20808				
1990							9683				
1991							4786				
1992							6974				
1993							2132				
1994							8595				
1995	6751	80041	94886	1102	1221	135290	17224		0.11	0.144	0.187
1996	7261	84172	97563	9572	1059	117227	15130		0.098	0.127	0.164
1997	8072	91810	104422	9623	1065	117953	15327		0.12	0.154	0.197
1998	8767	99608	113161	9036	1000	110749	23135		0.23	0.29	0.36
1999	9040	102321	115810	8231	9079	100146	16614		0.184	0.23	0.29
2000	9218	104076	117506	8366	9221	101626	12245		0.125	0.161	0.21
2001	9598	109423	124746	8624	9499	104635	24546		0.25	0.31	0.39
2002	9374	106049	119973	8182	8970	98351.2	19226		0.2	0.25	0.32
2003	9510	108506	123794	8266	9059	99284.7	8623		0.086	0.113	0.147
2004	9070	102614	116089	8893	9757	107042	10997		0.051	0.068	0.09
2005	8997	102052	115746	9482	1040	114184	12606		0.073	0.096	0.128
2006	8611	97734	110926	1049	1151	126470	17699		0.088	0.114	0.147
2007	8398	95529	108663	1124	1236	135965	23035		0.078	0.101	0.131
2008	7958	91222	104564	1080	1190	131088	20142		0.113	0.143	0.182
2009	7840	89940	103168	1026	1133	125222	21007		0.138	0.174	0.22
2010	7882	90206	103232	9805	1087	120656	21846		0.2	0.25	0.32
2011	7883	90271	103368	8769	9760	108626	22969		0.25	0.31	0.39
2012	8144	93106	106439	8071	8983	99978.2	16432		0.152	0.194	0.25
2013	8170	93546	107102	7601	8489	94805.8	16618		0.24	0.3	0.38
2014	8532	97741	111967	7128	7957	88826.7	15663	1581	0.157	0.2	0.26
2015	9087	105012	121347	7164	8033	90086.7	17548	270	0.158	0.2	0.26
2016	9224	107113	124371	7360	8307	93755.5	16330	1663	0.156	0.2	0.26
2017	9271	108190	126253	6929	7881	89657.1	16806	270	0.171	0.22	0.29
2018	9016	105306	122989	6742	7744	88964.5	16033	187	0.108	0.143	0.191
2019	8742	103101	121590	6770	7826	90471.2	17830	86	0.137	0.182	0.24
2020	8408	100601	120367	7138	8362	97973.9	17014	127	0.101	0.138	0.187
2021	8152	99322	121003	7588	8968	105986	12948	157	0.12	0.168	0.24
2022	7388	93156	117456	7636	9147	109570	18849	242	0.157	0.23	0.35
2023	6896	90214	118008	6496	8046	99651.6	12245	192*	0.076	0.119	0.185
2024	7515	93527*	117842	6863	8617	108070					

* Preliminary.

** Mean 2021–2023 recruitment from stochastic forecast

Table 6.4.14. Greater silver smelt in 5.b and 6.a. Estimated fishing mortality at age.

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1995	0.000	0.002	0.006	0.024	0.064	0.117	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
1996	0.001	0.005	0.013	0.040	0.084	0.124	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220
1997	0.003	0.014	0.027	0.063	0.106	0.149	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257
1998	0.010	0.035	0.062	0.125	0.173	0.249	0.486	0.486	0.486	0.486	0.486	0.486	0.486	0.486	0.486	0.486	0.486
1999	0.010	0.034	0.058	0.110	0.146	0.206	0.384	0.384	0.384	0.384	0.384	0.384	0.384	0.384	0.384	0.384	0.384
2000	0.007	0.028	0.048	0.085	0.109	0.148	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257	0.257
2001	0.013	0.057	0.110	0.189	0.244	0.315	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
2002	0.010	0.043	0.100	0.176	0.238	0.279	0.359	0.359	0.359	0.359	0.359	0.359	0.359	0.359	0.359	0.359	0.359
2003	0.001	0.005	0.019	0.055	0.108	0.154	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168
2004	0.002	0.009	0.027	0.062	0.108	0.120	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071
2005	0.009	0.026	0.052	0.094	0.134	0.174	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097
2006	0.024	0.057	0.090	0.125	0.156	0.169	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107
2007	0.027	0.069	0.106	0.131	0.141	0.135	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
2008	0.022	0.062	0.103	0.139	0.158	0.187	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160
2009	0.012	0.042	0.080	0.125	0.155	0.206	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239
2010	0.008	0.035	0.076	0.130	0.176	0.281	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394
2011	0.011	0.043	0.097	0.181	0.248	0.386	0.465	0.465	0.465	0.465	0.465	0.465	0.465	0.465	0.465	0.465	0.465

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2012	0.007	0.029	0.066	0.130	0.190	0.266	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267	0.267
2013	0.010	0.038	0.084	0.160	0.266	0.415	0.435	0.435	0.435	0.435	0.435	0.435	0.435	0.435	0.435	0.435	0.435
2014	0.017	0.052	0.098	0.160	0.220	0.292	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247
2015	0.018	0.054	0.103	0.171	0.240	0.299	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239
2016	0.019	0.049	0.093	0.161	0.237	0.314	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241
2017	0.014	0.034	0.067	0.130	0.222	0.343	0.303	0.303	0.303	0.303	0.303	0.303	0.303	0.303	0.303	0.303	0.303
2018	0.033	0.065	0.091	0.123	0.164	0.208	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160
2019	0.040	0.079	0.112	0.158	0.198	0.253	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209	0.209
2020	0.028	0.054	0.080	0.127	0.176	0.184	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155
2021	0.009	0.022	0.045	0.105	0.203	0.246	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223	0.223
2022	0.011	0.029	0.064	0.163	0.365	0.363	0.279	0.279	0.279	0.279	0.279	0.279	0.279	0.279	0.279	0.279	0.279
2023	0.010	0.021	0.044	0.096	0.206	0.207	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123

Table 6.4.15. Greater silver smelt in 5.b and 6.a. Estimated stock numbers at age.

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1995	24.40	97.16	246.94	885.47	2199.65	2922.47	5363.56	4124.23	4051.70	3355.83	1952.61	1544.71	1528.52	718.25	471.67	260.12	506.24
1996	77.86	306.20	578.64	1410.08	2541.66	3326.79	3999.42	2940.96	2261.04	2221.18	1839.62	1070.30	846.72	837.89	393.69	258.51	419.93
1997	277.79	905.23	1453.78	2407.31	2999.63	3473.92	4917.83	3176.38	2335.76	1795.76	1763.76	1460.94	849.83	672.31	665.35	312.62	538.75
1998	887.75	2547.90	3417.35	5369.22	5045.52	5096.60	7191.11	5577.82	3603.02	2649.56	2036.78	2000.33	1656.94	963.41	762.38	754.58	965.70
1999	900.84	2654.10	3438.63	4808.30	4741.67	4289.63	4961.26	3148.78	2442.32	1577.06	1159.59	891.36	875.31	725.07	421.36	333.50	752.56
2000	691.17	2229.53	3088.64	4011.90	3653.43	3571.34	3664.70	2062.67	1309.54	1016.14	655.91	482.34	370.63	363.98	301.52	175.13	451.43
2001	1322.52	4559.01	7082.96	9320.00	8476.99	7422.77	7218.12	4043.88	2272.54	1443.73	1120.80	722.98	531.98	408.58	401.16	332.34	690.45
2002	962.95	3639.87	6357.52	8474.61	8143.12	6443.23	5207.24	3130.53	1753.94	984.29	625.62	486.00	313.24	230.62	177.11	173.83	443.01
2003	105.41	439.30	1361.02	2782.42	3874.52	3715.51	2659.19	1599.33	962.13	539.10	302.11	192.08	149.35	96.17	70.84	54.40	189.42
2004	232.57	799.75	1889.26	3645.31	4324.00	3303.46	1320.98	859.42	516.26	310.82	174.14	97.49	62.00	48.22	31.02	22.87	78.69
2005	872.64	2096.52	3744.74	5368.45	6146.19	5217.05	2063.19	1425.10	927.93	556.86	335.49	187.98	105.19	66.91	52.04	33.48	109.59
2006	2181.04	4507.05	5914.69	7145.02	6798.10	5767.66	2383.46	1765.42	1218.95	794.23	476.21	286.89	160.89	90.02	57.25	44.53	122.44
2007	2383.02	5099.05	6620.40	6612.19	6084.65	4373.44	2114.47	1434.36	1062.93	733.84	478.44	286.49	172.76	96.90	54.21	34.48	100.59
2008	1848.59	4461.37	5979.94	6628.18	5961.28	5933.16	3841.04	3141.47	2132.77	1580.86	1091.47	711.80	425.94	257.05	144.21	80.64	201.02
2009	1022.56	2948.64	4606.25	5591.43	5497.45	5589.85	5276.81	4068.43	3324.10	2257.71	1674.05	1155.89	754.07	451.04	272.28	152.73	298.47
2010	694.45	2441.37	4320.00	5822.39	5837.11	6909.12	6880.83	5480.79	4224.99	3449.33	2343.86	1738.46	1200.68	783.58	468.56	282.85	468.92
2011	916.11	2989.98	5480.52	7748.39	7950.11	8384.71	6825.75	4572.57	3638.89	2804.90	2288.20	1555.54	1154.13	797.31	520.47	311.13	499.19
2012	643.16	2022.81	3790.45	5613.17	5824.54	5686.34	3576.55	2316.03	1552.02	1234.04	951.21	775.50	527.41	391.40	270.45	176.61	274.80

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2013	877.89	2787.66	4798.20	7049.06	8144.08	8166.05	5682.76	3559.92	2306.14	1546.77	1228.79	947.23	771.91	525.23	389.85	269.45	449.66
2014	1491.03	3745.71	5714.43	6964.33	6906.61	5833.96	2978.30	1958.80	1225.45	794.30	533.21	423.23	326.28	265.75	180.93	134.30	247.78
2015	1778.74	4036.16	5940.28	7547.47	7394.96	6247.01	3138.99	1943.59	1279.35	799.60	518.30	348.30	276.28	213.08	173.39	118.11	249.41
2016	1871.28	3947.33	5585.83	6967.02	7345.47	6333.50	3296.32	2141.98	1325.86	873.54	545.37	353.55	237.86	188.59	145.48	118.29	250.84
2017	1417.69	2794.60	4378.79	5988.46	6839.15	6870.34	3854.20	2726.03	1769.33	1095.55	722.17	450.61	292.15	196.73	155.89	120.27	305.05
2018	3142.01	5361.17	6078.11	6339.25	5622.28	4458.11	2134.63	1385.65	980.05	635.69	393.76	259.69	161.91	105.00	70.75	56.04	152.90
2019	3712.54	6188.79	7316.51	8050.40	7482.25	6084.16	3129.26	1995.04	1295.33	916.37	594.18	368.23	242.91	151.31	98.16	66.15	195.37
2020	2546.85	4201.57	4975.88	6317.15	6531.68	4972.60	2600.00	1659.65	1057.85	686.71	485.92	315.08	195.29	128.89	80.20	52.03	138.69
2021	856.61	1703.75	2858.40	5116.56	7395.64	6370.65	4240.32	2679.99	1711.67	1090.90	707.90	501.16	324.98	201.41	133.01	82.75	196.77
2022	978.06	2236.44	4101.18	8003.84	12223.77	8628.27	4795.22	3559.36	2247.13	1435.26	914.67	593.34	420.27	272.57	168.88	111.57	234.46
2023	819.35	1567.15	2839.86	4891.39	7247.38	4451.66	1960.99	1480.85	1098.87	693.47	442.94	282.26	183.08	129.72	84.14	52.10	106.79

Table 6.4.16. Greater silver smelt in 5.b and 6.a. Short term forecast with catch constraint in interim year. High and low indicates 95% confidence intervals.

Intermediate year assumptions				
		Value	low	high
TAC	2024	17967		
Advice	2024	17995		
F_{bar}	2024	0.119	0.076	0.185
Catch	2024	17967	17967	17967
Recruitment	2024-2026	93527	75159	117842
SSB	2024	86173	68636	108070

Forecast options						
Scenario	**Catch**	**Fbar**	**SSB**	**%SSB change**	**% catch change**	**%Advice change**
	2025	**2025**	**2026**			
F_{MSY}	18966	0.24	78348	-6	6	7
F=0	0	0	95429	15	-100	-100
$F_{sq(2024)}$	21198	0.27	76369	-8	-18	-20
F_{pa}	25013	0.33	73032	-12	39	41
SSB (2026) = MSY $B_{trigger}$	13794	0.16	82999	0	-23	22
SSB (2026) = B_{lim}	40423	0.61	59730	-28	125	128

Table 6.4.18. Greater silver smelt in 5.b and 6.a. Reference points, values, their technical basis and source.

Framework	**Reference point**	**Value**	**Technical basis**	**Source**
MSYapproach	MSY $B_{trigger}$	82 999	B_{pa}; in tonnes	(ICES, 2021a)
	F_{MSY}	0.24	Stochastic simulations (EqSim) with segmented regression fixed at B_{lim}	(ICES, 2021a)
Precautionary approach	B_{lim}	59 730	$B_{lim}=B_{pa}/(\exp(\sigma \times SSB \times 1.645), \sigma=0.2)$; in tonnes	(ICES, 2021a)
	B_{pa}	82 999	B_{loss}, lowest observed SSB (2014) from 2020 benchmark; in tonnes	(ICES, 2021a)
	F_{lim}	Not defined	F_{lim} was set to 0.29 at WKGSS which is below new F_{pa} based on F_{p05}. F_{pa} in WKGSS was set to 0.2.	

Framework	Reference point	Value	Technical basis	Source
	F_{pa}	0.33	The F that provides a 95% probability for SSB to be above B_{lim} (F_{P05}).	(ICES, 2021a)

6.5 Greater silver smelt (*Argentina silus*) in 6.b, 7, 8, 9,10 and 12

6.5.1 The fishery

The fisheries in this area are very minor and there are no directed fisheries.

6.5.2 Landing trends

Landings from this area are reported from 1966–2023. Landings increased until 2002 to 4662 tons then declined again to low levels of less than a ton in 2016. Landings from 2006 until 2022 have been less than 50 tons, except for 76 t in 2020. The main landings have been from Division 6b and Subarea 7 where Ireland was fishing for some years between 2000 and 2003.

Landings in Division 6.b and subareas 7–10 and 12 are small. Considerable discarding is known to occur in some fisheries in the Porcupine Bank outer shelf and upper slope fisheries for demersal and deep-water fish. These fisheries do not land greater silver smelt. Targeted fisheries for greater silver smelt that existed prior to 2006 have not operated significantly in these areas since then. It is considered more likely that variations in landings over time reflect market opportunities rather than fish abundance.

6.5.3 ICES Advice

Advice is given every other year. The 2023 advice for area 6b, 7, 8, 9, 10 and 12, stated "ICES advises that when the MSY approach is applied, catches should be no more than 87 tonnes in each of the years 2024 and 2025. If discard rates do not change from the average of the last seven years (2015-2022), this implies landings of no more than 16 tonnes." ICES previously gave advice on landings for this stock. Because discard data are now available, the present advice is provided for catch.

6.5.4 Management

The EU introduced TAC management in 2003. For 2023 and 2024, the EU TAC is 7670 t whilst the UK TAC is 454 t in Subareas 5, 6 and 7. 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 nine last years are presented in Table 6.5.6. Discards data before 2015 is presented in Stock Annex. Discards from 2015 to 2019 and from 2021 to 2023 are mainly from the Spanish fishery and from Subarea 7 while for 2020 the discards were around 50 t from both the Spanish fishery and the Scottish fishery. For previous years, the discards were very high compared to the landings. In 2020 this shifted, with Dutch landings of 62 t from Subarea 7. However, for the last three years the landings have declined again and are now, respectively, approximately 35, 14 and 0.1 percent of the total catch.

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 7, Stock Annex). 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.

ICES considers that the high landings of silver smelt seen in the early 2000s (Table 6.5.1 and 6.5.2, and Figure 6.5.1.) may have resulted from misreporting of fish species other than silver smelt. There is currently no directed fishery and bycatches of greater silver smelt are discarded in fisheries for other species (primarily hake, monkfish, and megrim).

6.5.5.2 Length compositions

The size compositions of Argentina spp. from Porcupine survey since 2012 is presented in Figure 6.5.2.

Length distribution from discards is available in InterCatch for 2015 (Scotland), 2016 (Scotland and Spain), 2017 (Spain and Scotland), 2018 (Spain and Scotland), 2019 (Spain), 2020 (Scotland and Spain), 2021 (Spain), 2022 (Spain) and 2023 (Spain). Length distributions from discards is presented in Figure 6.5.7. For landings, length distributions are available from 2020 (Netherland). Comparison of length distributions from landings and discards from 2020 is shown in Figure 6.5.8.

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* (Table 6.5.7 and Figures 6.5.2 - 6.5.6). 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 covers depths 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

In previous years, the size compositions from Porcupine Bank in Subarea 7 have not shown any obvious trend towards smaller fish, but these data may be disturbed by the relative species composition of *A. silus* and *A. sphyreana* (Figure 6.5.2 and 6.5.5). In 2019, however, despite the low abundance per size of *A. silus* from the last survey, small specimens (around 17 cm) were found. For *A. silus*, this shows the highest amount of small specimens in the last ten years. A second small mode was found around 28 cm. For 2020, the length composition from the survey for *A. silus* shows that the mode around 22 cm increased greatly. The survey conducted in 2021 did not show any trends regarding the length composition as the amount of *A. silus* was low. For 2022, the length composition still shows a bi-modal distribution, while for 2023 the bi-modal length composition is absent. However, the number of specimens is considerably lower than showed in 2020. For, *A. sphyraena*, a single mode is showed around 22 cm since 2017 (Figure 6.5.2).

Commercial and survey cpue series

For Subarea 7, abundance and biomass indices from the Spanish porcupine survey showed a decreasing trend from 2002 until 2011, were rising from 2012 until 2016 but have had a downward trend since then (Figure 6.5.4). The index has decreased for *A. silus* since 2016 apart from relatively high estimates in 2020 (Figure 6.5.3). However, the survey is unlikely to cover all the exploitable biomass of the stock as it only covers depth down to 400 meters. In 2019, the biomass of both species of Argentina continued decreasing whereas the abundance increased slightly (Table 6.5.7 and Figure 6.5.4). *A. silus*, the most contributing species in the overall percentage of silver smelt, followed the downward trend of the previous year's whereas *A. sphyraena* increased abruptly both regarding biomass and abundance (Table 6.5.7 and Figure 6.5.3). However, the index from the survey conducted in 2020 shows that both the biomass and the number of *A. silus* increased considerably, breaking the downward trend of recent years, and staying in the medium-high values of historical series. *A. sphyraena*, by contrast, decreased sharply, getting medium-low values of the time series. For 2021 the trend for *A. sphyraena* continued at 2020 values, while both the biomass and abundance of *A. silus* declined to a historical low level. For 2022 the trend for both species, considering biomass and abundance, increased. In 2023, both biomass and abundance for *A. sphyraena* increased slightly while for *A. silus* biomass had a slight decrease and abundance were on same level as for 2022.

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. SPiCT was also run before WGDEEP 2023 on the catch dataseries (1966-2022) and the biomass index series from Porcupine Bank (2001-2022), but either this time did SPiCT converge.

6.5.7 Assessment

According to the recommendations from WKLIFE X, the ICES-rfb rule was applied for a trend-based advice (ICES, 2023). The Spanish Porcupine bank survey greater silver smelt index (Table 6.5.7 and Figure 6.5.3) was used for the stock development. The advice is based on the recent advised catches (2023), multiplied by the ratio of the mean of the last two index values (index A) and the mean of the three preceding values (index B), a ratio of observed mean length in the catch relative to the target mean length, a biomass safeguard, and a precautionary multiplier. The stability clause was considered and applied to limit the decrease in catch advice to 30%. The discard rate (mean 2015–2022) was 82%. The biomass index, index A and index B is shown in Figure 6.5.9. The pooled lengths from years 2015-2022 is shown in Figure 6.5.10. Note that the pooled lengths are from discards, hence the Lc, length at first capture, is not representative for landings. Age data were not available for this stock and growth parameters from the nearby greater silver smelt stock in Faroes waters and west of Scotland (ICES areas 5b and 6a) were applied. The parameters from von Bertalanffys growth function used in the rfb calculations were

L∞ = 48 cm and k = 0.225 yr-1. Ltrigger is 40 kg haul-1. The stock size is above MSY Btrigger proxy (Itrigger) (Figure 6.5.9), and the fishing pressure is above FMSY proxy (Figure 6.5.11).

6.5.8 Comments on the assessment

Advice is given every other year for this stock and last advice applies for 2024 and 2025.

It should be noted that lesser silver smelt (*A. 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, and 6.5.6). 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.

A SPiCT model with the Spanish Porcupine survey as a biomass index was explored before the meeting but did not converge. This indicates that a production model is not appliable to the stock with the currently available data. Thus, in accordance with ICES guidelines (ICES, 2023) a trend-based rfb rule assessment is applied.

6.5.9 Management considerations

The trends for Porcupine bank survey biomass indices for Argentina species have increased in 2015 and 2016, declined in 2017, 2018 and 2019, increasing again in 2020 before declining to a historical low level in 2021 before increasing again in 2022 and remained at the same level as 2022 in 2023.

6.5.10 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

ICES. 2023. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, section 1.1.1. https://doi.org/10.17895/ices.advice.22240624

6.5.11 Tables

Table 6.5.1. Greater Silver Smelt in 6.b. WG estimates of landings in tonnes. *landings in 2023 are preliminary. For years 1979-1999, see Stock Annex.

Year	Faroes	Germany	Ireland	Netherlands	Scotland	Russia	Spain	TOTAL
2000			1355			29		1384
2001					62	68		130
2002					1	29		30
2003					6	120		126
2004				11		12		23
2005						4		4
2006								
2007								
2008						1	8	9
2009								
2010								
2011								
2012								
2013								
2014						20.5		20.5
2015								0
2016								0
2017								0
2018								0
2019						1		1
2020						11		11
2021								0
2022								0
2023*								0

Table 6.5.2. Greater Silver Smelt in 7. WG estimates of landings in tonnes. *landings in 2023 are preliminary. For years 1972-1999, see Stock Annex.

Year	France	Germany	Ireland	Netherlands	Scotland	Nor-way	Poland	Spain	UK E/W	TOTAL

2000		79	166	244		34		523
2001	5		1592	2	2782	34		4415
2002			4433		2	2		4437
2003			95	19		5		119
2004				13	19	15		47
2005		26	1		14	17		58
2006						40		40
2007						35		35
2008								
2009	13		1			6		20
2010	10			8		2	3	23
2011		4			8			12
2012		2			1			3
2013				1				1
2014				1				1
2015				5				5
2016	0			0		0		0
2017				8				8
2018				31		1		32
2019			0	5				5
2020			1	62				63
2021				34				34
2022				16				16
2023*								0

Table 6.5.3. Greater Silver Smelt in 8. WG estimates of landings in tonnes. *landings in 2023 are preliminary.

Year	Netherlands	Spain	Ireland	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
2019		1.6	0.5	2.1
2020		1.6		1.6
2021		0.3		0.3
2022	1.5			1.5
2023*				0

Table 6.5.4. Greater Silver Smelt 9. WG estimates of landings in tonnes. *landings in 2023 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
2019				0
2020				0
2021				0
2022		0.06		0.06
2023*		0.02		0.02

Table 6.5.5. Greater Silver Smelt 12. WG estimates of landings in tonnes. *landings in 2023 are preliminary. For years 1988-1999, see Stock Annex.

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
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
2017					0
2018					0
2019					0
2020					0
2021					0
2022					0
2023*					0

Table 6.5.6. Discard data from 2015-2021 from Subarea 6b, 7-1012. *discards in 2023 are preliminary

Year	Spain				UK (Scotland)	TOTAL
	6b	7	8	9	6b	
2015	0.7	28			0.5	29.2
2016		237	2	1		240
2017	1.82	148.8			0.3	151
2018	2.3	97.9	1.8	0.8	10	112.8
2019	5	146	0.2	0.1	0.29	152
2020	2	44.6	7.4	2.9	50	107
2021	2	59.1	0.4	0.2	0.033	62
2022	2.1	98.7	5.5	2.3	0.2	108.8
2023*	4.2	13.6	0.08	0.03		18

Table 6.5.7. Greater silver smelt in subareas 7–10 and 12, and in Division 6.b. Assessment summary. Biomass index from the Spanish Porcupine Bank survey for both greater and lesser silver smelt. Also given is the biomass index for *A. silus* only and the proportion between the two species. High and low refer to standard errors.

Year	*Argentina sp.*			*Argentina silus*			Proportion of *A. silus*/*A. sphyrena* in the survey
	kg haul^{-1}	Low	High	kg haul^{-1}	Low	High	
2001	133.17	72.76	193.57				
2002	143.72	62.36	225.08				
2003	141.33	82.19	200.47				
2004	142.76	68.42	217.09				
2005	111.15	59.60	162.69				
2006	98.05	36.29	159.81				
2007	79.03	43.71	114.35				
2008	82.16	32.93	131.40				
2009	79.74	43.65	115.83	72.95	37.69	108.21	0.91
2010	97.39	41.19	153.59	89.97	34.02	145.91	0.92
2011	57.57	32.38	82.75	50.32	25.85	74.78	0.87
2012	93.52	51.51	135.53	83.02	42.52	123.53	0.89
2013	135.63	76.35	194.91	121.50	66.25	176.75	0.90
2014	75.59	48.41	102.77	59.57	35.53	83.61	0.79
2015	92.80	53.82	131.79	72.56	41.95	103.18	0.78
2016	199.00	109.49	288.51	172.94	92.32	253.55	0.87
2017	159.31	89.22	229.41	129.63	73.41	185.86	0.81
2018	112.36	38.57	186.16	98.72	25.44	172.00	0.88
2019	92.59	70.69	114.49	67.60	48.07	87.13	0.73
2020	125.34	87.95	162.72	109.81	75.28	144.34	0.88
2021	43.40	33.05	53.75	28.59	22.39	34.78	0.66
2022	96.54	74.66	118.42	71.04	54.58	87.51	0.74
2023	90.70	64.96	116.44	59.64	36.53	82.75	0.66

6.5.12 Figures

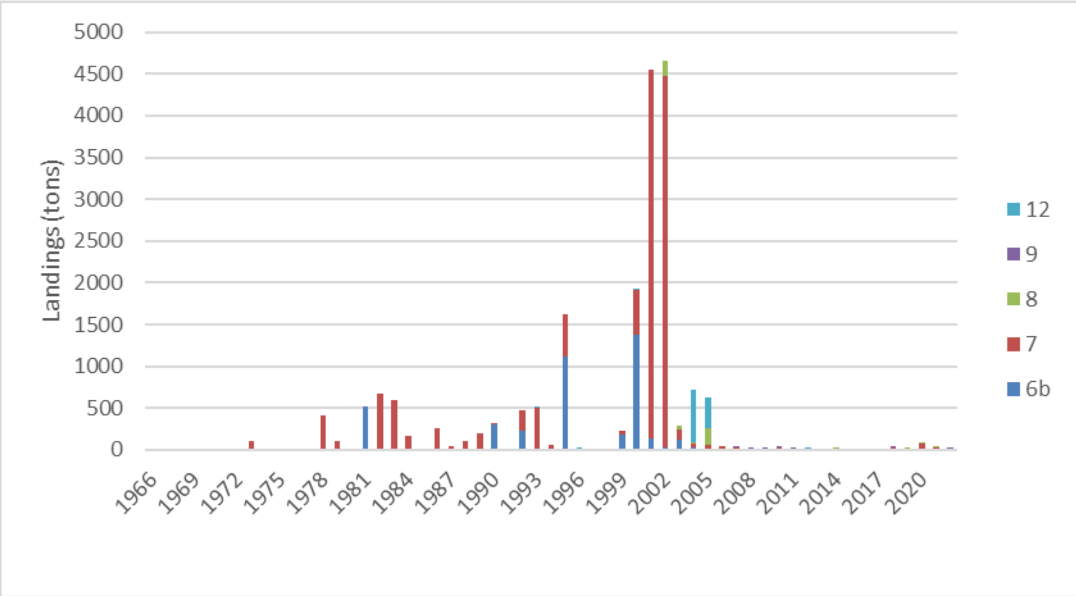


Figure 6.5.1. Total landings from 1966–2023 of greater silver smelt in 6.b, 7, 8, 9, 10 and 12.

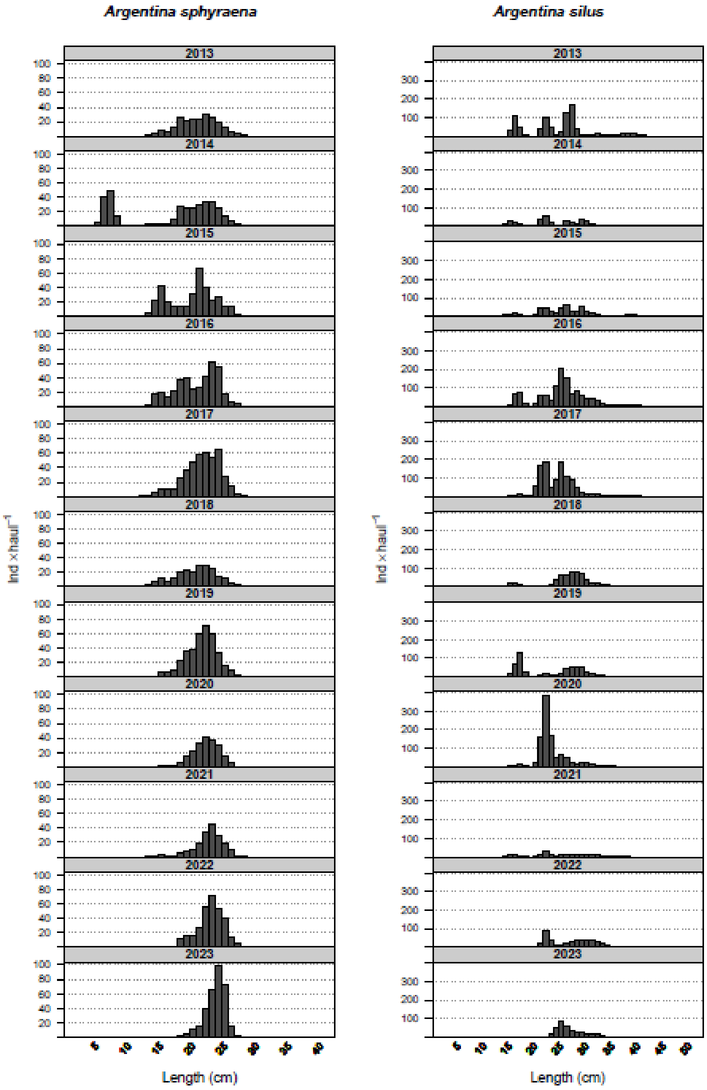


Figure 6.5.2. Mean stratified length distributions of *Argentina* spp. in Spanish Porcupine surveys from 2012–2023. Note different range in the y-axis values between species.

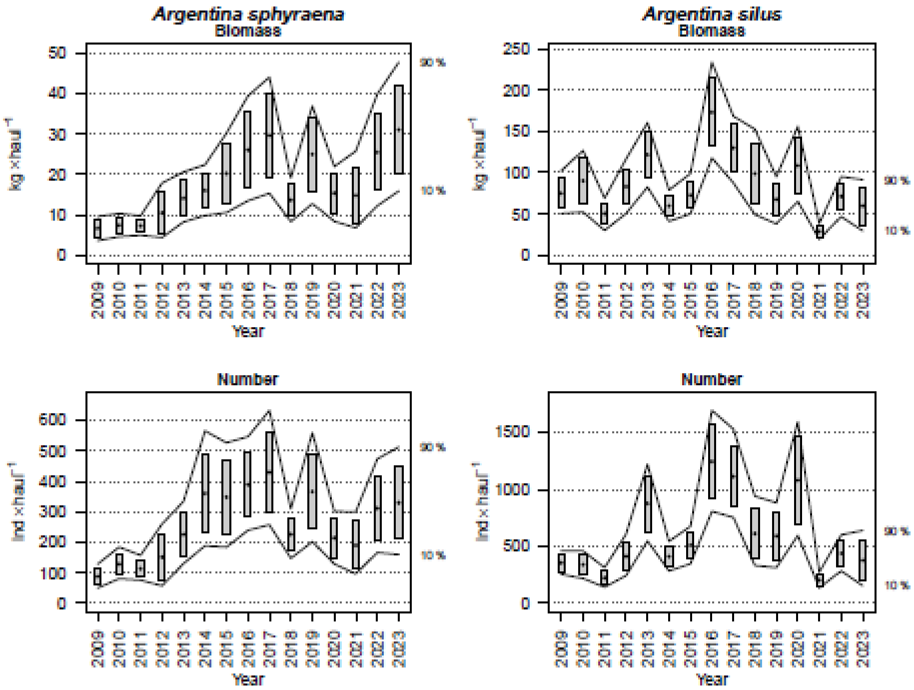


Figure 6.5.3. ***Argentina sphyraena*** **and** ***Argentina silus*** **biomass and abundance indices in Porcupine surveys (2009–2023). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).**

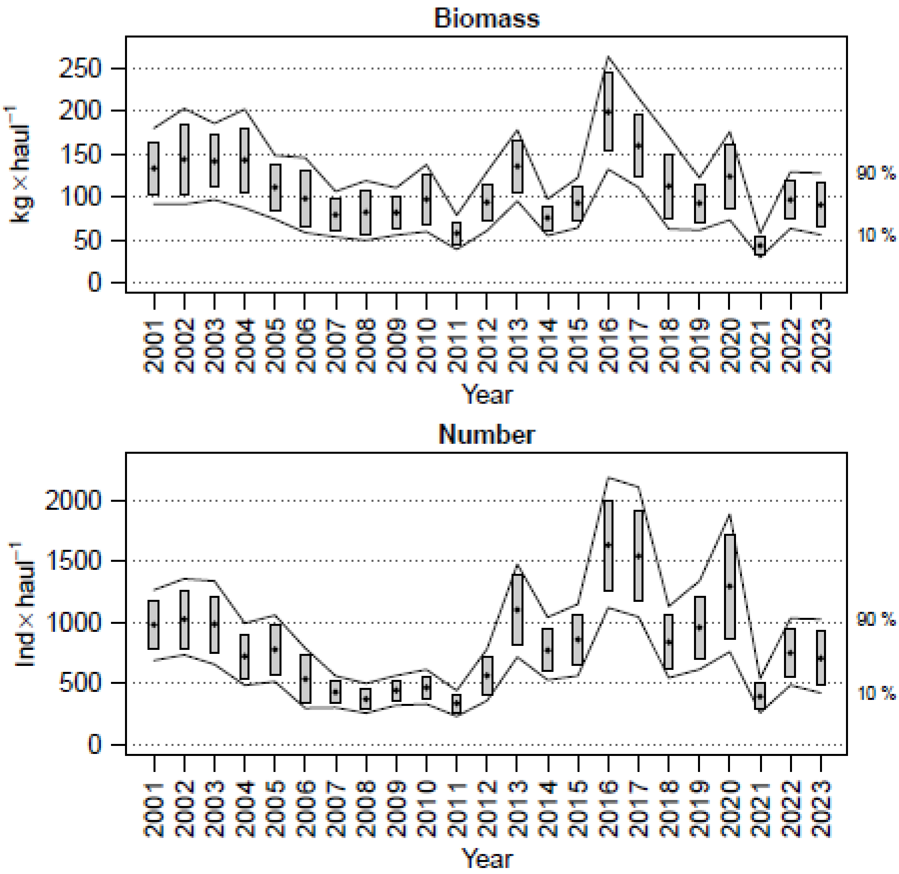


Figure 6.5.4. Argentina spp. (mainly Argentina silus) biomass and abundance indices in Porcupine surveys (2001-2023). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

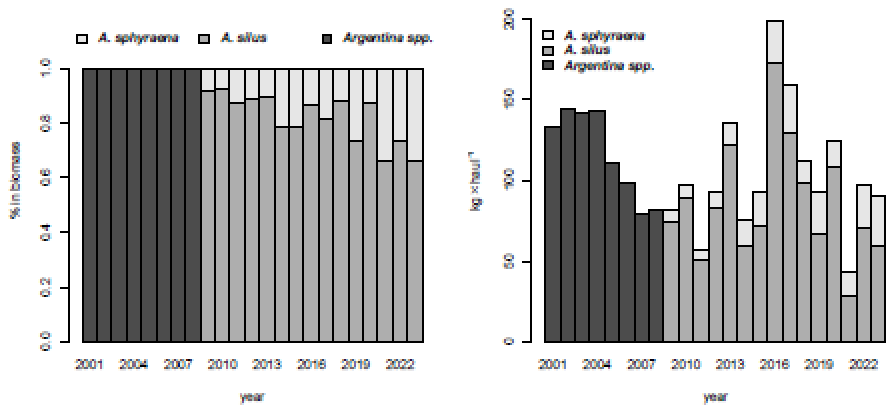


Figure 6.5.5. Share and abundance of Argentine species in Porcupine Bank surveys (2001–2023).

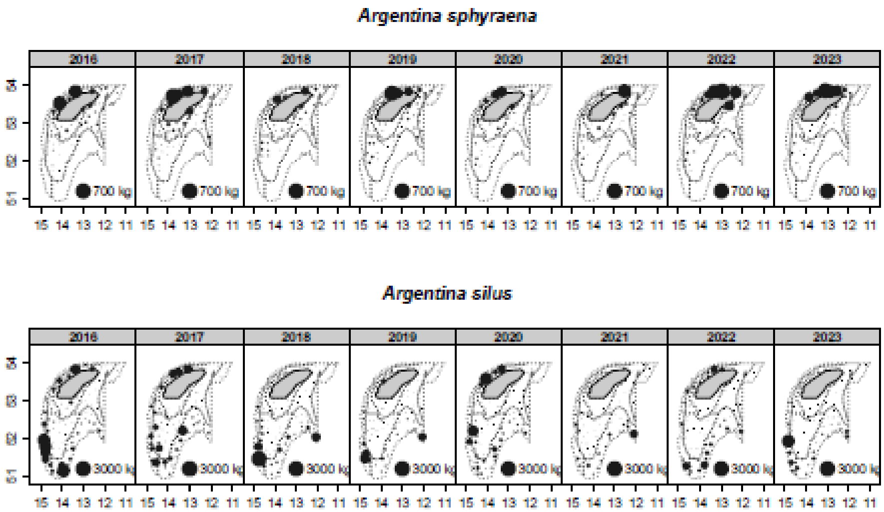


Figure 6.5.6. Geographic distribution of *Argentina sphyraena* and *Argentina silus* catches (kg/30 min haul) in Porcupine surveys (2016 - 2023)

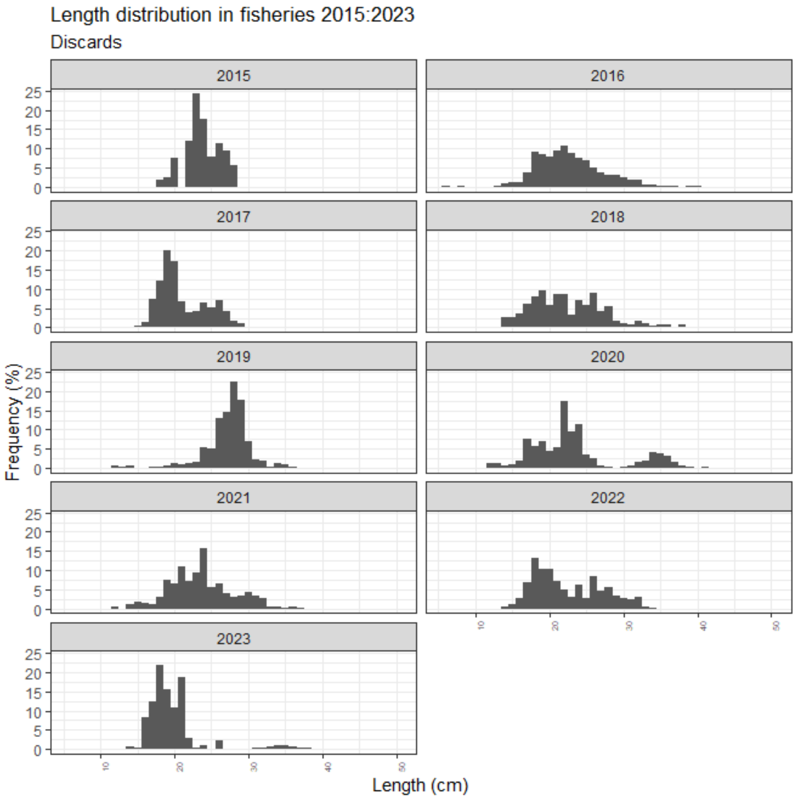


Figure 6.5.7. Length distribution from discard 2015-2023, all areas combined.

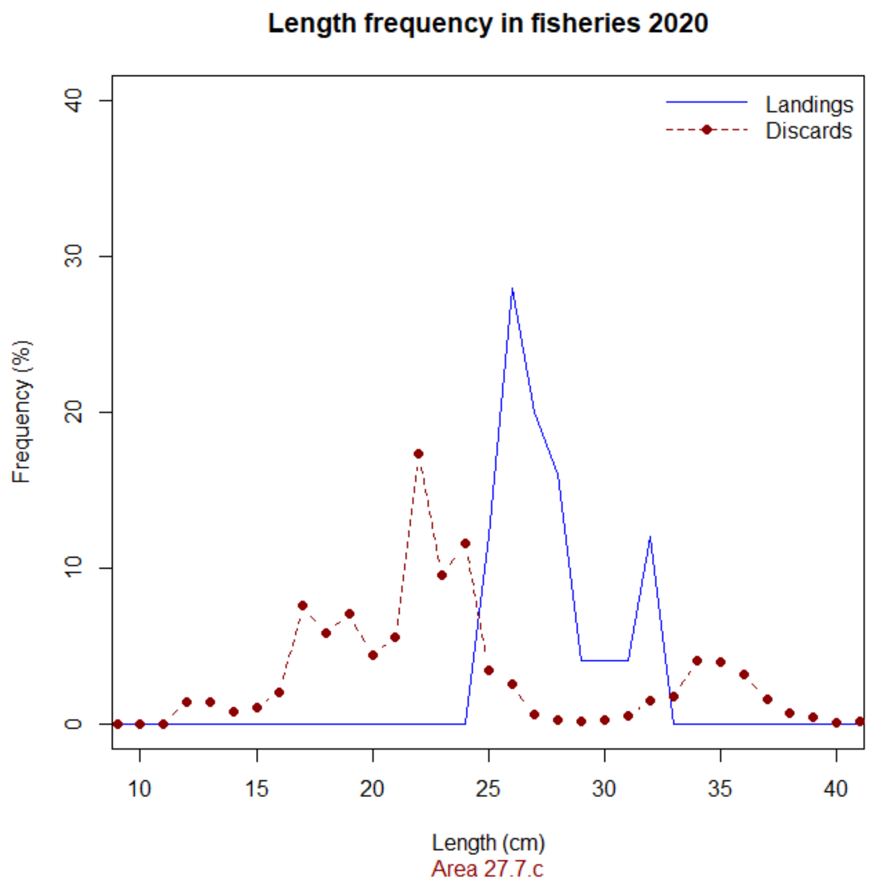


Figure 6.5.8. Length distribution from discard and landings from area 27.7.c in 2020.

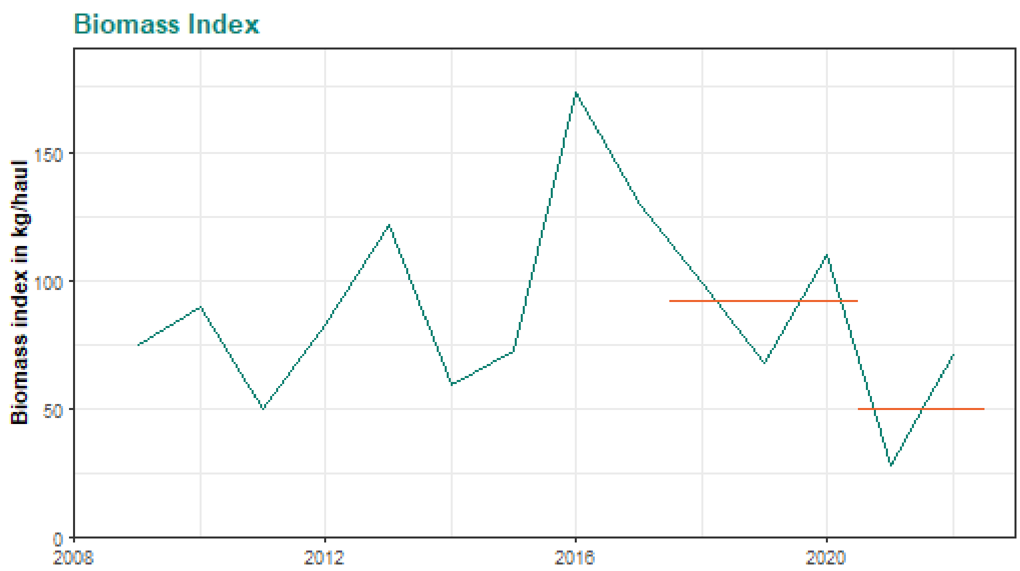


Figure 6.5.9. Biomass index year 2009-2022. Red horizontally lines indicating Index A (2021 and 2022) and index B (2018-2020).

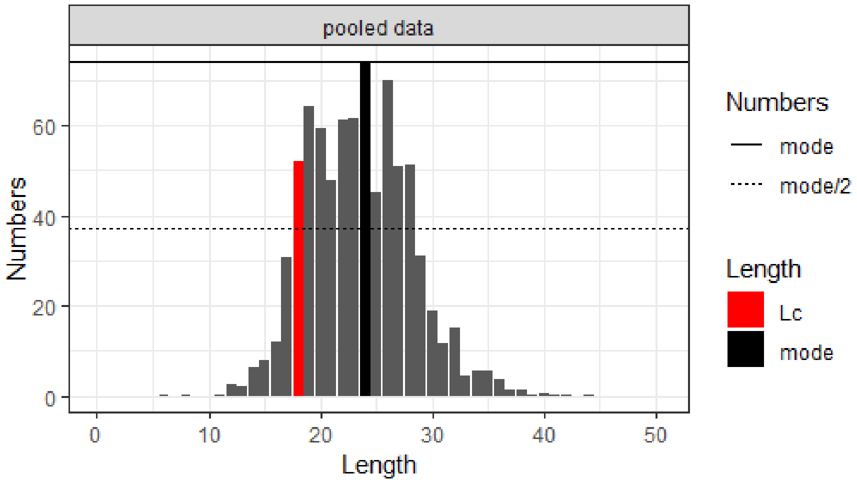


Figure 6.5.10. Pooled length distribution (years 2015-2022), including Lc and mode length.

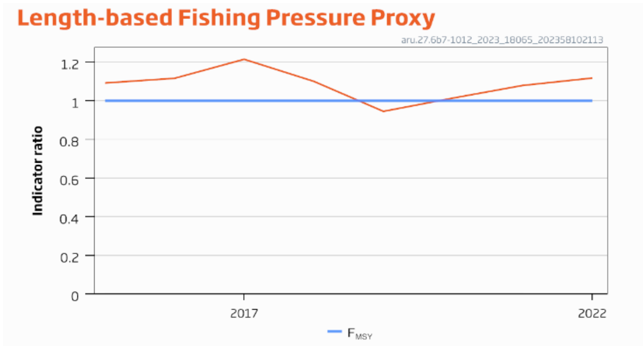


Figure 6.5.11. Length-based fishing pressure proxy. Indicator ratio LF= M/Lmean (inverse of the indicator ratio, f) from the length-based indicator (LBI) method is used for the evaluation of the exploitation status. The proxy fishing pressure is less than that corresponding to the FMSY proxy (LF= M) when the indicator ratio value is lower than 1 (shown by the horizontal blue line).

Contents

7 Orange roughy (*Hoplostethus atlanticus*) in the Northeast Atlantic

7.1 Stock description and management units

The stock structure of this species is unknown. The information available is insufficient to admit the existence of separate populations of orange roughy in the North Atlantic.

For assessment purposes, ICES considers three assessment units along ICES area:

- Subarea 6;
- Subarea 7;
- Orange roughy in all other areas.

Given the scarcity of spatial fisheries data, biological and genetics data, WGDEEP have not altered these assessment units.

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 represent different 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 should be used to define smaller and more meaningful management units. In other words, where aggregations are known, their biomass should be estimated to derive small-scale catch levels that can be sustained at aggregation level. Nevertheless, the methodology to do that is hardly available.

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 in the early 1990s. Irish vessels exploited aggregations further south in divisions 7c and 7k in the early 2000, but directed fisheries had ceased by 2006. No fishing and no catch were reported for years 2017-2022. In 2023 Scotland reported a small catch of 0.1256 tonnes for subdivision 6.b. 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 to be negligible or none.

7.2.2 Landings trends

Table 7.2.1 and Figure 7.2.1 show the landings (ICES estimates) data for orange roughy for ICES Subarea 6 as reported to ICES or as reported to the WGDEEP. In recent years, only a small landing, 700 kg rounded to 1 tonne (Table 7.2.1) was landed by the Faroe Islands in 2016, while a small landing of 125.6 kg for subdivision 6.b has been landed by Scotland in 2023. There were no landings in 2017-2023.

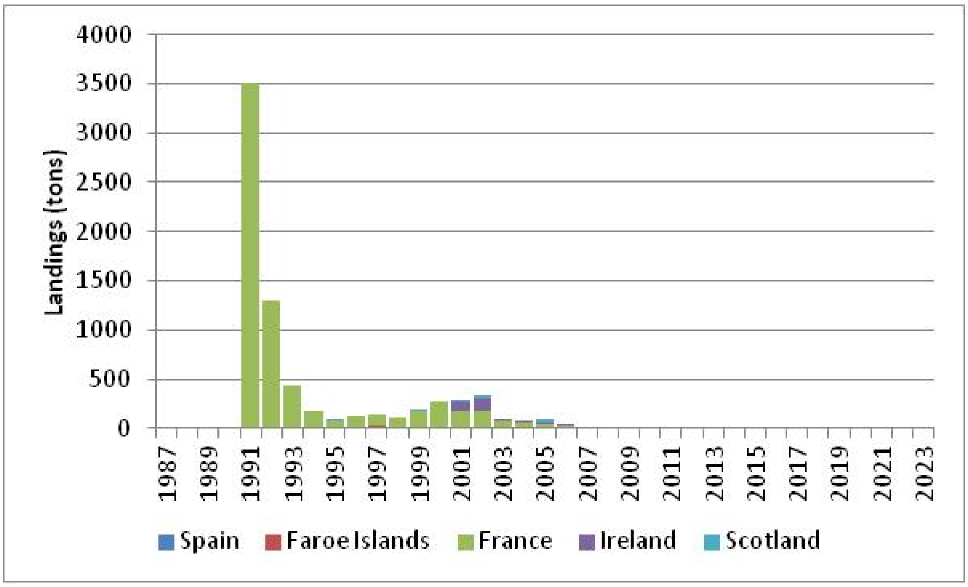


Figure 7.2.1. Time-series of orange roughy landings by country in ICES Subarea 6.

7.2.3 ICES Advice

The ICES advice was published in 2024 for 2025–2028. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catches in each of the years 2025–2028.

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. Zero TACs have been set for orange roughy in all EU waters since 2010. In recent years, the species is prohibited in all EU waters.

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)	EU vessels	Total
2003	88	81	81
2004	88	56	56
2005	88	45	92
2006	88	32	32
2007	51	12	12
2008	34	12	12
2009	17	10	10
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
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	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 2018-2022 there was no reported landings nor 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 2023. However, the catch figures were revised by comparing with official ICES catch statistics, previous ICES estimates and expert judgement of corrections.

7.2.7 Management considerations

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-dependent data to evaluate the status of the stocks.

PSA assessment of the susceptibility of orange roughy populations in Subareas 6 and 7 to current and deep-water trawl fisheries (see WGDEEP 2014, Section 7.3) has shown a strong reduction in risk over time when fisheries directed targeting practices stopped and continued with mixed deep-water trawl fisheries. Before the ban of trawling deeper than 800 m, some spatial overlap between the species and fisheries remained, 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. Following the application of the ban of bottom trawling deeper than 800 m (EU regulation 2016/2336) this bycatch might be minor in EU fisheries because the fraction of orange roughy biomass occurring shallower than 800 m is minor or nonexistent.

Table 7.2.1. Orange roughy catch in Subarea 6.

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1987		4					4
1988	-	2	-	-	-	-	2
1989	-	4	-	-	-	-	4

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1990	-	8	-	-	-	-	8
1991	-	3502	-	-	-	-	3502
1992	-	1296	-	-	-	-	1296
1993	-	428	-	-	-	-	428
1994	-	178	-	-	-	-	178
1995		73	-	2	-	-	75
1996		120	-		-	-	120
1997	29	115		-	-	-	144
1998	-	106	-	-	-	11	117
1999	-	175	-	11		4	190
2000	-	263	-	-		7	270
2001	-	163	-	12	103	6	284
2002		178	-	31	119	3	331
2003	-	79	-	-	2	-	81
2004	-	54	-	-	2	-	56
2005	-	51	-	35	6	-	92
2006		31			1		32
2007		12					12
2008		12					12
2009		10					10
2010		0					0
2011		0					0
2012		0					0
2013		0					0
2014		0					0
2015							0
2016	1						1
2017							0
2018							0

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
2019							0
2020							0
2021							0
2022							0
2023				0			0

7.3 Orange roughy (*Hoplostethus Atlanticus*) in Subarea 7

7.3.1 The fishery

After the first few years (1991-93) of the fishery in Subarea 6, the main fishery for orange roughy in the northern hemisphere was in Subarea 7. This fishery peaked in 2002 and rapidly declined thereafter. Some targeted fishing from a few or even one single 20–24 m trawler 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.

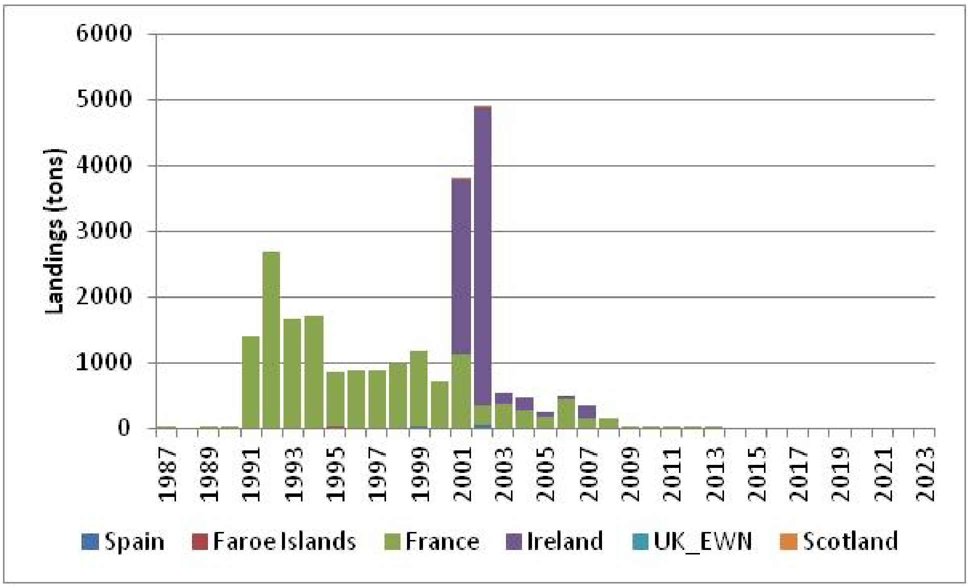


Figure 7.3.1. Time-series of orange roughy landings by country in ICES Subarea 7.

7.3.3 ICES Advice

The ICES advice was published in 2024 for 2025–2028. 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 2025–2028.

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)**	**EU vessels**	**Total**
2003	1349	543	543
2004	1349	465	465
2005	1149	265	265
2006	1149	491	491
2007	193	361	361
2008	130	158	158
2009	65	36	36
2010	0	8	8
2011	0	4	4
2012	0	3	3
2013	0	2	2
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0

The TAC for orange roughy in Subarea 7 was set to 0 t for 2023. No catch was reported.

7.3.5 Data available

7.3.5.1 Landings and discards

Landings are shown in Table 7.3.1.

There were no landings since 2010 until 2021 where 0.003 tonnes were reported from France in InterCatch from Division 7.e, which should be considered as an error in landings statistics as orange roughy does not occur in 7.e, which does not include depth suitable to the species. 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. More recent discards are lesser because the main depth range of the species is no longer accessible to bottom trawlers in EU and UK waters.

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

See section 6.1.1. Management considerations.

Table 7.3.1. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus,* by country in Subarea 7.

Year	France	Spain	E & W	Ireland	Scotland	Faroes	Total
1987	1						1
1988	-	-	-	-	-	-	0
1989	2	-	-	-	-	-	2
1990	1	-	-	-	-	-	1
1991	1406	-	-	-	-	-	1406
1992	2683	-	-	-	-	-	2683
1993	1664	-	-	-	-	-	1664
1994	1719	-	-	-	-	-	1719
1995	827	-	-	-	-	40	867

Year	France	Spain	E & W	Ireland	Scotland	Faroes	Total
1996	890	-	-	-	-	-	890
1997	890	-	-	-	-	-	890
1998	972	15	-	-	-	-	987
1999	1157	32	-	-	-	-	1189
2000	720	7	-			-	727
2001	1118	6	1	2656	22	-	3803
2002	293	50	14	4528	24	5	4914
2003	370			173			543
2004	276	1		188			465
2005	168	7		90			265
2006	451	2		38			491
2007	161			200			361
2008	158			0			158
2009	36			0			36
2010	8			0			8
2011	4			0			4
2012	3			0			3
2013	2			0			2
2014	0			0			0
2015	0			0			0
2016	0			0			0
2017	0			0			0
2018	0			0			0
2019	0			0			0
2020	0			0			0
2021	0			0			0
2022	0			0			0
2023	0			0			0

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 of these fisheries 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 the period 2011-2019, one Faroese trawler operated a small directed fishery in ICES Subareas 10 and 12 (Ofstad, 2020). In recent years, Iceland had catches in 5a.

7.4.2 Landing trends

Table 7.4.0 and Figure 7.4.1 show ICES estimates of landings of orange roughy from ICES subareas 1, 2, 4, 5, 8, 9, 10, 12 and 14 and Division 3.a. There was no catch of orange roughy in 2020. In 2021, around 4 tonnes were landed, mainly in Subdivision 5a and in 2022 this increased to 19 tonnes landed in 5a, while in 2023 it decreased to 15 tonnes.

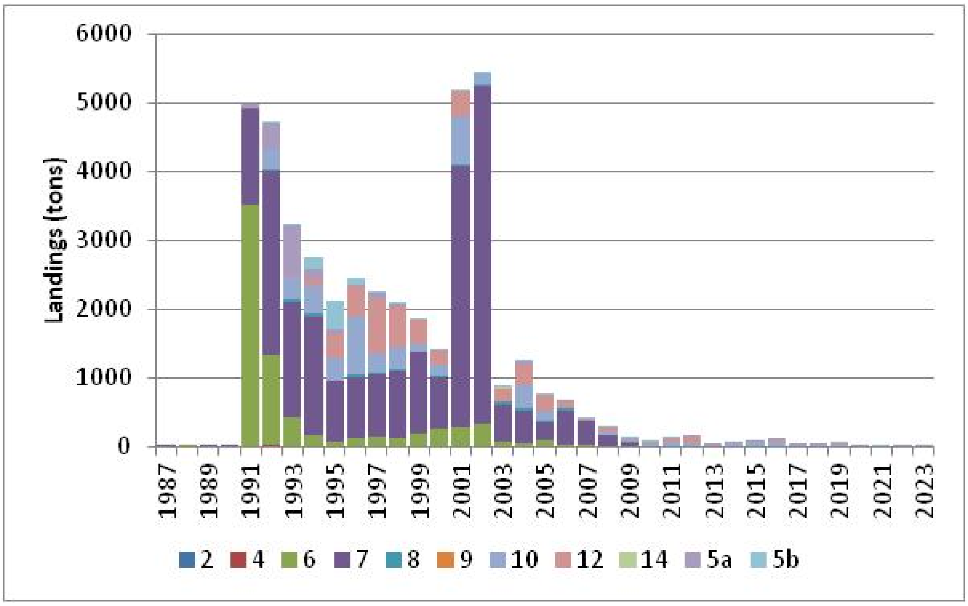


Figure 7.4.1. Time-series of orange roughy landings by subarea in all ICES areas.

7.4.3 ICES Advice

The ICES advice was published in 2024 for 2025–2028. 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 2025–2028.

7.4.4 Management measures

The EU TAC is set to 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)	EU vessels	Total
2005	102	112	411
2006	102	57	148
2007	44	18	38
2008	30	10	118
2009	15	23	84
2010	0	6	80
2011	0	1	130
2012	0	5	160
2013	0	0	59
2014	0	0	70
2015	0	0	90
2016	0	0	99
2017	0	0	46
2018	0	0	48
2019	0	0	60
2020	0	0	3
2021	0	0	4
2022	0	0	19
2023	0	0	15

7.4.5 Data available

7.4.5.1 Landings and discards

Landings are in Table 7.4.0. In recent years, Iceland had a fishery for orange roughy in 5a. No Faroese fishery has been in Subarea 10 since 2019. In 2016 and 2017, small discards were reported by Spain in divisions 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. There was no catch of orange roughy in 2020. In 2021, 0.070 tonnes were reported from Scotland for Subdivision 4a and 3.587 tonnes from Iceland for Subdivision 5a. In 2022, 19 tonnes were reported from Iceland in 5a, 0.0034 tonnes from ES in 8c and 0.026 tonnes from France in 8b. In 2023 Iceland reported 14.518 tonnes for subdivision 5.a.

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 2011–2019 compared with the results from the experimental fishery in 1992–1998 (Thomsen, 1998) (Table 7.4.2). In 2019, only length measurements were taken, no sex or weight measurements were available. There was no new information on length composition since 2019.

Table 7.4.2. Mean length and weight by sex and combined (comb.). From sampling by trained crew members on board the single Faroese fishing vessel targeting orange roughy. [a] Thomsen, 1998.

Year	Area	Month	Average length (cm)			Average weight (kg)	
			Female	Male	Comb.	Female	Male
1992-1998[a]	Faroe Islands		61.4	58.6		4.4	3.7
1992-1998[a]	Hatton Bank		64.6	62.8		4.9	4.3
1992-1998[a]	Reykjanes ridge		58.9	56.4		3.6	3.0
1992-1998[a]	North of Azores		60.6	59.7		3.9	3.7
2011	27.10b	Feb., Mar.	61.4	60.5	60.9	3.5	3.2
2012	27.10b	Feb.	61.4	60.8	61.0	3.5	3.2
2013	27.10b	Jan.	60.9	57.7	59.6	4.3	3.8
2014	27.10b	Jun., Jul.	62.1	58.4	60.5	4.2	3.7
2015	27.10b	Jul., Aug.	59.0	58.3	58.6	3.7	3.5
2016	27.10b	Jun., Oct., Nov.	61.4	58.7	60.1	4.3	3.7
2017	27.10b	Nov.	60.6	57.5	58.7	3.9	3.4
2018	27.10b, 27.12c	Feb.	63.4	60.1	61.5	4.2	3.8
2019	27.10b, 27.12cd	Feb., Mar.			61.4		

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.

There was no information available of orange roughy in ICES division 14.b in the period 1999-2019 (Nilsen, 2020).

7.4.6 Data analysis

No data analysis was carried out in 2023.

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 Subarea 9.a, where bycatch of orange roughy are not known to occur, there are no EU longline fisheries at depth where orange roughy occurs.

Concerns were raised at the WGDEEP 2020 about potential sequential depletion of orange roughy at seamounts. It was recommended to perform an analysis of available VMS-data and investigate the fishing grounds exploited by this fishery.

In 2015–2019 all landings from the stock were caught in the NEAFC RA. In 2020-2023 catches were small and mostly outside the NEAFC RA.

7.4.8 References

ICES. 2014. Report of the Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 4–11 April 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:17. 862 pp.

Nilsen, J., Nogueira, A., and Christensen, H.T. 2019. Survey results of roughhead grenadier, roundnose grenadier, greater silver smelt, blue ling, tusk, black scabbardfish, ling, and orange roughy in ICES subdivision 14.b.2 in the period 1998-2016. WD05 WGDEEP 2019.

Nilsen, J. 2019. Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES division 14b in the period 1999-2019. WD02 WGDEEP 2020.

Ofstad, L.H. 2020. Faroese fishery of orange roughy in ICES areas 10 and 12. WD01 WGDEEP 2020.

Thomsen, B. 1998. Faroese quest of orange roughy in the North Atlantic. Copenhagen (Denmark), ICES.

7.4.9 Tables and Figures

Table 7.4.0a. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Division 5.a.

Year	Iceland	Total
1987		0
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	0	0
2000	0	0
2001	0	0
2002	10	10
2003	0	0
2004	28	28
2005	8	8
2006	2	2
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	16	16

Year	Iceland	Total
2013	57	57
2014	12	12
2015	6	6
2016	6	6
2017	39	39
2018	19	19
2019	0	0
2020	3	3
2021	0	0
2022	19	19
2023	15	15

Table 7.4.0b. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Division 5.b.

Year	Faroes	France	Scotland	Total
1987				0
1988	-	-		0
1989	-	-		0
1990	-			0
1991	-			0
1992		3		3
1993	36	1		37
1994	170	+		170
1995	419	0		419
1996	77	2		79
1997	3	0		3
1998	-	2		2
1999	4	0		4
2000	0	1		1
2001	1	4		5
2002	1	0		1

Year	Faroes	France	Scotland	Total
2003	2	4		6
2004		7		7
2005	3	1	12	16
2006	0	0		0
2007	0	2		2
2008	0	1		1
2009	1	1		2
2010	0	1		1
2011	12	0		12
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
2019	0	0		0
2020	0	0		0
2021	4	0		4
2022	0	0		0
2023	0	0		0

Table 7.4.0c. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Subarea 8.

Year	France	Spain	E & W	Total
1987				0
1988	-	-	-	0
1989	0	-	-	0
1990	0	-	-	0
1991	0	-	-	0
1992	31	-	-	31

Year	France	Spain	E & W	Total
1993	58	-	-	58
1994	29	-	-	29
1995	7	-	-	7
1996	22	22	-	44
1997	1	26	-	27
1998	5	0	-	5
1999	0	0	-	0
2000	40	-	-	40
2001	23	-	-	23
2002	22	-	-	22
2003	31			31
2004	42			42
2005	27	4		31
2006	43	0		43
2007	1	0		1
2008	1	1		2
2009	22	0		22
2010	4	0		4
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	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0

Year	France	Spain	E & W	Total
2022	0	0	0	0
2023	0	0	0	0

Table 7.4.0d. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Subarea 9.

Year	Portugal	Spain	Total
1990	0	-	0
1991	0	-	0
1992	0	-	0
1993	0	-	0
1994	0	-	0
1995	0	-	0
1996	0	-	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	0	0	0
2012	5	0	5
2013	0	0	0
2014	0	0	0

Year	Portugal	Spain	Total
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0

Table 7.4.0e. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Subarea 10.

Year	Faroes	France	Norway	E & W	Portugal	Ireland	NZealand	Total
1987								0
1988								0
1989	-	-	-	-	-			0
1990	-	-	-	-	-			0
1991	-	-	-	-	-			0
1992	-	-	-	-	274			274
1993	-	-	1	-	317		1	318
1994	-	-	-	-	405			405
1995	-	-	-	-	331			331
1996	470	-	-	-	366			836
1997	6	-	-	-	267			273
1998	177	-	-	-	160			337
1999	-	-	-	-	117			117
2000	-	3	-	-	157			160
2001	84	-	-	-	161		450	695
2002	30	-	-	-	122			152
2003		-						0

Year	Faroes	France	Norway	E & W	Portugal	Ireland	NZealand	Total
2004	320					19		339
2005	129	2						131
2006	8							8
2007	0							0
2008	37							37
2009	26							26
2010	39							39
2011	82							82
2012	45							45
2013	0							0
2014	47							47
2015	83							83
2016	86							86
2017	7							7
2018	21							21
2019	31							31
2020	0							0
2021	0							0
2022	0							0
2023	0							0

(1) Landings 2014–2019 were from Division 10.b

Table 7.4.0f. Working Group estimates of landings in tonnes of orange roughy, *Hoplostethus atlanticus*, in Subarea 12.

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1987									0
1988									0
1989	-	0	-	-	-			-	0
1990	-	0	-	-	-			-	0
1991	-	0	-	-	-			-	0
1992	-	5	-	-	-			-	5

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1993	24	1	-	-	-			-	25
1994	89	4	-	-	-			-	93
1995	273	83	-	-	-			-	356
1996	403	33	3	-	-			-	439
1997	802	6	-	-	-			-	808
1998	570	21	-	-	-			-	591
1999	345	0	-	2	-			-	347
2000	155	21	-	6	2			14	198
2001	345	14	-	3	-			-	362
2002	+	6	-	2	-			-	8
2003		64		1		136		-	201
2004	146	132		20					298
2005	159	35							225
2006	81	14							95
2007	20								20
2008	71								71
2009	34								34
2010	35								35
2011	35								35
2012	94								94
2013	2								2
2014	11								11
2015	2								2
2016	7								7
2017	0								0
2018	9								9
2019	29								29
2020	0								0
2021	0								0

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
2022	0								0
2023	0								0

Table 7.4.0g. Orange roughy total international landings in tonnes in the ICES area, excluding Subareas 6 and 7.

Year	2	4	5.a	5.b	8	9	10	12	14	All areas
1987			0	0	0	0	0	0		0
1988			0	0	0	0	0	0		0
1989			0	0	0	0	0	0		0
1990			0	0	0	0	0	0		0
1991		10	65	0	0	0	0	0		75
1992		32	382	3	31	0	274	5		727
1993		1	717	37	58	0	318	25		1156
1994		2	158	170	29	0	405	93		857
1995		8	64	419	7	0	331	356		1185
1996			40	79	44	0	836	439		1438
1997	14		79	3	27	0	273	808		1204
1998		4	28	2	5	0	337	591		967
1999		1		4	0	0	117	347		469
2000				1	40	0	160	198		399
2001				5	23	0	695	362		1085
2002			10	1	22	0	152	8		193
2003			+	6	31	0	0	201	11	249
2004			28	7	42	0	339	298	4	718
2005			8	16	31	0	131	225	0	411
2006			2	0	43	0	8	95	0	148
2007		14	0	2	1	0	0	20	1	38
2008		7	0	1	2	0	37	71	0	118
2009		0	0	2	22	0	26	34	0	84
2010		0	0	1	4	0	39	35	1	80
2011		0	0	12	0	0	82	35	0	130

Year	2	4	5.a	5.b	8	9	10	12	14	All areas
2012		0	16	0	0	5	45	94	0	160
2013		0	57	0	0	0	0	2	0	59
2014		0	12	0	0	0	47	11	0	70
2015		0	6	0	0	0	82	2	0	90
2016		0	6	0	0	0	86	7	0	99
2017		0	39	0	0	0	7	0	0	46
2018		0	19	0	0	0	21	9	0	49
2019		0	0	0	0	0	31	29	0	60
2020		0	3	0	0	0	0	0	0	3
2021		0	0	4	0	0	0	0	0	4
2022		0	19	0	0	0	0	0	0	19
2023		0	14	0	0	0	0	0	0	14

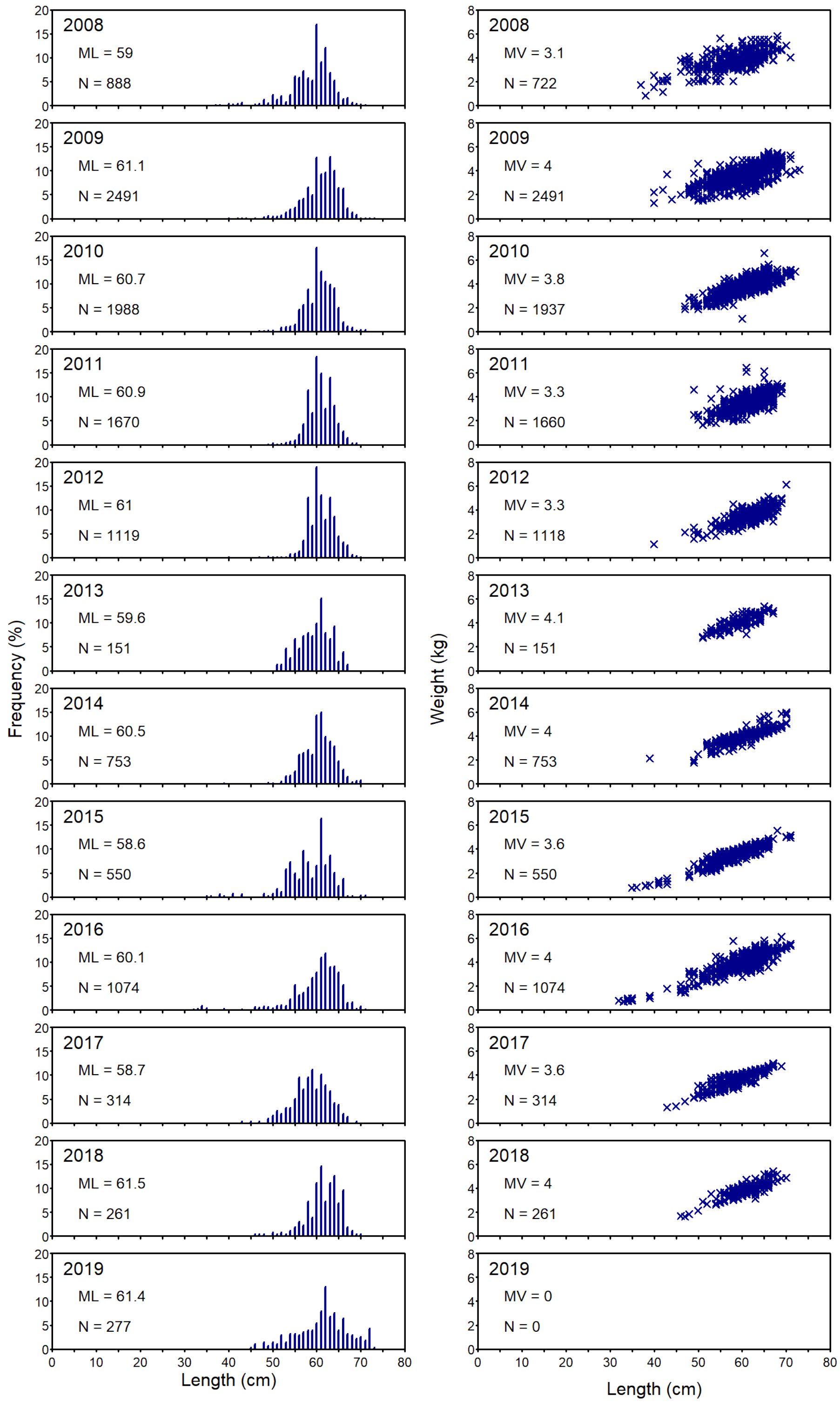


Figure 7.4.1. Length composition and length–weight relation of orange roughy in Faroese catches 2008–2019. There were no weight measurements of orange roughy in 2019.

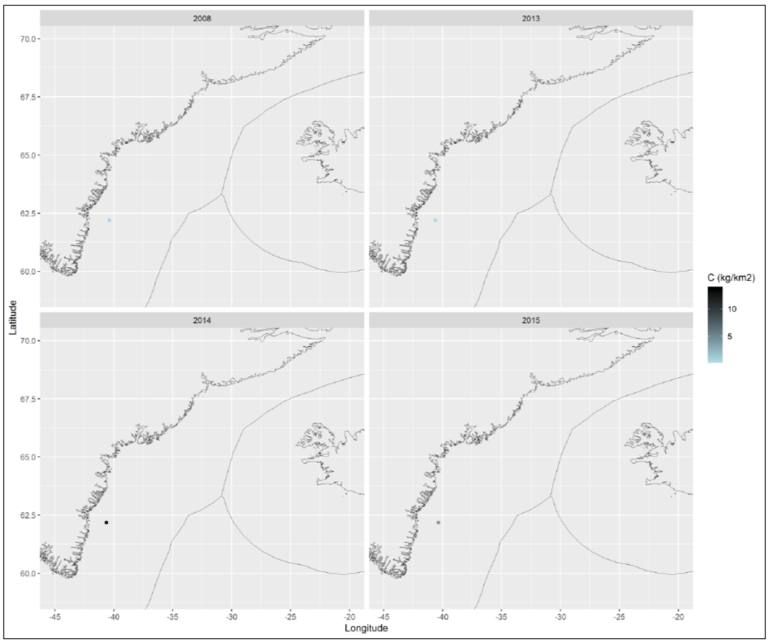


Figure 7.4.2. Distribution of survey catches of orange roughy at East Greenland in 1998–2016. No survey in 2001, 2017.

Contents

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 6, 7);
- the Mid-Atlantic Ridge 'MAR' (Divisions 10.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 aggregation 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 have historically been 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, while the Spanish trawling fleet has until recently been operating further offshore along the western slope of the Hatton Bank in ICES Divisions 6.b.1 and 12.b.

8.2.2 Landings trends

Over the past two decades, landings from Division 5.b, reached more than 3800 t in 1992 and more than 2000 t in 2001. Between these two periods, the landings have remained between 1000-2000 t (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. Since then, landings have continued to gradually decreased. In the period 2011-2021, landings in 5.b were exclusively from French and Faroese trawlers (Table 8.2.0a), with a small contribution from Norway and Scotland in 2022 of less than 1 t each. Total catches for 2022 accounted for 8 t and 3 t in 2023.

In Subarea 6, the highest landings were observed in 2001 (close to 15 000 t) and then decreased progressively to around 513 t in 2018, 202 t in 2019 and 319 t in 2020. Most of these landings were traditionally caught by French and Spanish trawlers (Table 8.2.0b), with small amounts from Scotland. Landings in 2021 were 116 t almost exclusively from French trawlers. In 2022, 119 t were reported, being the 87% captured by France, with small catches from Norway and Scotland. Provisional data for 2023 total 29 t, contributed by France and, to a lesser extent, Scotland.

In Subarea 7, landings close to 2000 t were recorded in 1993–1994, although recent annual landings are much lower (from 200-400 t/year in 2005–2007, to around 10 t in 2014-15). Only 2 t were reported in 2018 and less than 1t in 2019, increasing slightly to 5 in 2020. Landings in 2021-2023 were exclusively from French trawlers, with 3 t, 0.5 t and 0.1 t in the years 2021, 2022 and 2023 respectively (Table 8.2.0c).

In ICES Division 12.b, the recent landings are exclusively from Spanish trawlers. After a peak to more than 12 700 t in 2004, reported landings have decreased to about 5300 t in 2009, 2900 t in 2011 and 992 t in 2014. In 2015 the landings went down to 363 t and then increased again slightly until the 632 t in 2016 and around 1000 in 2017 and 2018. In 2019, the landings decreased again to around 50% of the previous year (460t), and have been continue to decrease drastically since then, with 268t in 2020. Since 2021 catches have remained at 0 t (Table 8.2.0d).

In the mid-1990s Faroese landings were significant, but this fishery ended in the 2000s and now only few tonnes are landed. In 2004 French fisheries have landed up to 1700 t but since 2007 almost no landings were registered.

Official landings have been revised for 2022 and are preliminary for 2023.

8.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, catches should be no more than 3177 tonnes in each of the years 2023 and 2024. All catches are assumed to be landed.

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 2205 t for 2023 and 1579 t for 2024. The TAC since EC regulation 1367/2014 was a combined value for roundnose grenadier and roughhead grenadier (*Macrourus berglax*). Since 2019, 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. Based on 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 for 2023 was set at 1541 t and 1959 t for 2024. 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 were 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		7, 9, 10, 12, 14		Total international Landings 5.b, 6, 7, 12.b	ICES predicted
esti-mates	EU TAC	EU Land-ings	EU TAC	EU Landings 12.b		catch corresp. to advice
2005	5253	5777	7190	8782	14558	-
2006	5253	4535	7190	4361	8896	-
2007	4600	3880	6114	4258	8138	< 6000
2008	4600	2980	6114	2432	5412	< 6000
2009	3910	2566	5197	6377	8943	< 6000
2010	3324	1421	5197	2910	4332	< 6000
2011	2924	790	4573	2905	3695	< 6000
2012	2546	546	3979	1343	1889	< 6000

	5.b, 6, 7		7, 9, 10, 12, 14		Total international Landings 5.b, 6, 7, 12.b	ICES predicted
esti-mates	EU TAC	EU Land-ings	EU TAC	EU Landings 12.b		catch corresp. to advice
2013	4297	760	3581	991	1752	< 6000
2014	4297	558	3223	988	1546	< 6000
2015**	4010	744	3644	363	707	< 5433
2016**	4078	732	3279	623	1005	< 5511
2017**	3052	633	2623	1001	1634	≤ 3897
2018**	3120	521	2099	998	1519	≤ 3971
2019	2558	232	2281	457	689	≤ 3971
2020	2558	356	2281	268	624	≤ 3971
2021	639	140	572	0	140	≤ 3177
2022	639	127	572	0	127	≤ 3177
2023*	2 205	32	1 541	0	32	≤ 3177
2024	1 579		1 959			

*** provisional.**

**** combined TAC for roundnose grenadier and roughhead grenadier.**

After the introduction of TACs in 2003 and 2005, the reported landings have decreased.

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 Faroese waters, the catch of roundnose grenadier is subject to a minimum size of 40 cm total length.

The fishery of this species was affected by the EU regulation 2016/2336 establishing specific conditions for fishing for deep-sea stocks, namely a ban for bottom trawling at depths > 800 m.

Table below shows landings of Roundnose grenadier (subareas 6 and 7 and divisions 5.b and 12.b), inside and outside the the NEAFC Regulatory Area (RA), as estimated by ICES, as well as total landings. Weights are in tonnes.

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total land-ings	Proportion inside the NEAFC RA (%)
2017	1506	129	1635	92
2018	1322	198	1520	86
2019	544	145	689	79
2020	396	229	625	63
2021	5	136	141	4
2022	0	127	127	0
2023	0	32	32	0

8.2.5 Data available

Landings and discards

Landings time-series data per ICES areas are presented in Tables 8.2.0a-e.

Landings data by ICES area were available for France, Norway and UK (England, Wales and Scotland) since 2005 and for Spain since 2010. 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 in years prior to 2010.

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 2004 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. Between 2014 and 2018, discards rates decreased, ranging between 3-6% of the catch in weight and 8-17% in number. In the period 2019-2022 reported discard rates were almost negligible (close to 0 % in weight), with a estimation for 2023 of 3.8% of the total catch.

The reduction of discards is related to:

1. a change of depth of the French fleet towards shallower waters
2. attempts to avoid areas where discards are high.
3. overall effort reduction in all fleets and in all areas

<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. Discards data for 2011 were not presented as they are considered to be inaccurate but provided again for 2012 and onwards. Although in the period 1996–2015 the discards occasionally reached 26% of the total observed weight catch, they were negligible in most sampled months. Annual average discards were around 7% (range 0–21%) in weight in both Divisions 6.b and 12.b (range 0–26%) for that period. These discards, however, correspond to undersized individuals.

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), and around 0.32% in 2019 (0.39% in 6.b.1 and 0.26% in 12.b). The sampling programs were suspended in most of 2020, due notably to administrative problems and to a lesser extend to covid-19, so there is no new discard information for 2020. In 2021-2023 there were no fishing effort in the area by the Spanish fleet.

Length composition of the landings and discards

Length composition of landings and discards were available for France and Spain covering different periods and areas (Figures 8.2.1–8.2.5).

8.2.5.1 Age composition

No new data.

8.2.5.2 Weight-at-age

No new data.

8.2.5.3 Maturity and natural mortality

No new data.

8.2.5.4 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 2022. Last survey occurred in 2023.

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

In 2023 no new information was presented as the fishing effort has been greatly reduced. Historical standardized LPUE information based on haul by haul data from French skipper's personal tallybooks is included in the Stock annex.

LPUE from the Faroese commercial fleet

In 2023 no new information was presented as the fishing effort has been greatly reduced and more recent landings were below 1t. Historical standardized LPUE information can be consulted in the stock annex.

CPUE from the Spanish commercial fleet.

No new information was submitted in 2023, as fishing effort has been considerably reduced and there have been no catches in the area since 2020. Historical information related to CPUE can be found in the stock annex.

8.2.6 Data analyses

Trends from length distribution and individual weight

For France, the modal discarded length has remained constant over time (Figure 8.2.1) 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 around 14 cm in 2018-2019, 16 cm in 2020 and around 17 in the period 2021-2023 (Figure 8.2.4).

Modal length for landings in 12.b and 6.b1 shows some differences, being in general those from 12.b smaller (Figures 8.2.2 and 8.2.3). Size–frequency data provided by Spain for the period 2001–2019 in 6.b.1 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 8.2.5). The modal length of discards is around 9.5 cm. Over the period 2001–2019, 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 2009–2020, in both 6.b.1 and 12.b, the mean length in landings has increased by two centimetres for both males and females in 2010–2014, with a tendency to decrease after 2015. 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 in the period 2017-2023 has varied between a maximum of around 0.75 kg in 2017, and minimum values of slightly over 0.4 in 2023 (Figure 8.2.6).

Trends in abundance indices

Marine Scotland Deep–water Science survey (MSDSS)

Data on Marine Scotland Deep-water Science survey was available for WGDEEP2024. There is an increasing trend of abundance over the period 2011–2013. Since 2015, there is however, a decrease and the index were close to the long term average of the series. (Figure 8.2.7). Provisional data for 2023 show an increase in the number of individuals, although the mean weight is lower than in previous years.

Lpue from the Faroese commercial fleet

In 2023 no new information was presented and the CPUE series available for the Faroese commercial fleet ended in 2014. The historical CPUE time series can be found in the stock annex.

CPUE from the Spanish commercial fleet in 12.b

CPUE indices based on revised catches for the period 2010-2020 were estimated for the Spanish fleet in order to include the 12.b landings into the assessment. The CPUE has declined from 2010 to 2014 with a peak in 2017 followed by a decline in 2018. Preliminary data shows and a slight increase in 2019 (Figure 8.2.8). The general tendency of the total catches has been variable previous to 2010, with a general tendency to decrease since 2004. After that it 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

In 2023 no new information was presented. Stock annex includes the historical CPUE time series, which was available from 2010 to 2015.

Stock assessment

The advice on this stock is based on the framework for advice for ICES category 5 stocks for the entire stock since 2018.

In 2016, it was possible to provide advice on stock as category 1 advice for the part of the stock in subareas 6 and 7 and Division 5.b, but 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.

In 2020, an exploratory model using a new index available up to 2019 (Marine Scotland Deep-water Survey) was examined. However, this model formulation and the use of this survey as a biomass indicator was not benchmarked yet.

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.

The ICES framework for category 5 stocks was applied for the 2018-2024 advice. 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 last applied in 2020, so it should be applied again in 2024. Therefore, ICES advises that when the precautionary approach is applied, catches should be no more than 2542 tonnes in each of the years 2025 and 2026. All catches are assumed to be landed.

ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.

This stock is classified as Category **1** in the NEAFC categorization of deep-sea species/stocks which implies that NEAFC requires stock-specific management measures since the entire or a significant proportion of the catch is taken in the NEAFC regulatory area.

Previous stock assessment issues

This stock was benchmarked in 2010 and the assessment methodology based on the surplus production model has not been revised since then. At that time 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. Since 2018, the ICES framework for category 5 stocks was applied due to the constant decrease of information that prevents the application of other more insightful models.

8.2.7 Management considerations

Previous simulations suggest that fishing mortality is below F_{MSY}.

8.2.8 Benchmark preparation

At this moment, there is no planned benchmark for this stock. In the current state, more work is needed to investigate what is the most appropriate approach to try to integrate the available information and develop a model that represents the dynamics of the stock.

Table 8.2.0a. Working Group estimates of landings (t) of roundnose grenadier from Division 5.b.

Year	Faroes	France	Nor way	Germ any	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
1988	0	0	0	1	0	0	0	1
1989	20	181	0	5	52	0	0	258
1990	75	1470	0	4	0	0	0	1549
1991	22	2281	7	1	0	0	0	2311
1992	551	3259	1	6	0	0	0	3817
1993	339	1328	0	14	0	0	0	1681
1994	286	381	0	1	0	0	0	668
1995	405	818	0	0	0	0	0	1223

Year	Faroes	France	Nor way	Germ any	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
1996	93	983	0	2	0	0	0	1078
1997	53	1059	0	0	0	0	0	1112
1998	50	1617	0	0	0	0	0	1667
1999	104	1861	2	0	0	29	0	1996
2000	48	1699	0	1	0	43	0	1791
2001	84	1932	0	0	0	0	0	2016
2002	176	774	0	0	0	81	0	1031
2003	490	1032	0	0	0	10	0	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
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
2019	19	11	0	0	0	0	0	30
2020	20	13	0	0	0	0	0	33
2021	12	10	0	0	0	0	0	22
2022	1	6	<1	0	0	0	<1	8
2023*	<1	2	0	0	0	0	1	3

*Provisional.

Table 8.2.0b. Working Group estimates of landings (t) of roundnose grenadier from Subarea 6.

Year	Estonia	Faroes	France	Germany	Ireland	Lithuania	Norway	Poland	Russia	Spain	UK (E+W)	UK (Scot)	TOTAL
1988	0	27	0	4	0	0	0	0	0	0	1	0	32
1989	0	2	2211	3	0	0	0	0	0	0	0	2	2218
1990	0	29	5484	2	0	0	0	0	0	0	0	0	5515
1991	0	0	7297	7	0	0	0	0	0	0	0	0	7304
1992	0	99	6422	142	0	0	5	0	0	0	2	112	6782
1993	0	263	7940	1	0	0	0	0	0	0	0	1	8205
1994	0	0	5898	15	14	0	0	0	0	0	0	11	5938
1995	0	0	6329	2	59	0	0	0	0	0	0	82	6472
1996	0	0	5888	0	0	0	0	0	0	0	0	156	6044
1997	0	15	5795	0	4	0	0	0	0	0	0	218	6032
1998	0	13	5170	0	0	0	21	0	0	3	0	0	5207
1999	0	0	5637	3	1	0	0	0	0	1	0	0	5642
2000	0	0	7478	0	41	0	1	0	0	1002	1	433	8956
2001	680	11	5897	6	31	137	32	58	3	6942	21	955	14773
2002	821	0	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
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	769	1.2	23	2079
2011	0	4	1112	0	0	0	0	0	0	682	0	8	1806
2012	0	0	1088	0	0	0	0	0	0	454	2	0	1544
2013	0	0	934	0	0	0	0	0	0	661	6	0	1601
2014	0	0	630	0	0	0	0	0	0	471	0	0	1101

Year	Esto-nia	Fa-roes	France	Ger-many	Ire-land	Lithua-nia	Nor-way	Po-land	Rus-sia	Spain	UK (E+W)	UK (Scot)	TOTAL
2015	0	0	364	0	0	0	0	0	0	282	0	0	646
2016	0	0	422	0	0	0	0	0	0	330	0	5.5	757
2017	0	0	99	0	0.5	0	0	0	0	496	0	8	602
2018	0	0	184	0	0	0	0	0	0	323	0	6	513
2019	0	0	128	0	0	0	0	0	0	68	0	6	202
2020	0	0	204	0	0	0	0	0	0	108	0	5.5	318
2021	0	1	106	0	0	0	0	0	0	0	0	9	116
2022	0	0	104	0	0	0	<1	0	0	0	0	15	119
2023*	0	0	18	0	0	0	0	0	0	0	0	11	29

*** Provisional.**

Table 8.2.0c. Working Group estimates of landings (t) of roundnose grenadier from Subarea 7.

Year	Faroes	France	Ireland	Spain	UK (Scot)	TOTAL
1988	0	0	0	0	0	0
1989	0	222	0	0	0	222
1990	0	215	0	0	0	215
1991	0	489	0	0	0	489
1992	0	1556	0	0	0	1556
1993	0	1916	0	0	0	1916
1994	0	1922	0	0	0	1922
1995	0	1295	0	0	0	1295
1996	0	1051	0	0	0	1051
1997	0	1033	0	5	0	1038
1998	0	1146	0	11	0	1157
1999	0	892	0	4	0	896
2000	0	859	0	0	0	859
2001	0	938	416	0	0	1354
2002	1	449	605	0	3	1058
2003	0	373	213	0	1	587

Year	Faroes	France	Ireland	Spain	UK (Scot)	TOTAL
2004	0	248	320	0	0	568
2005	0	191	55	0	0	246
2006	0	248	138	0	0	386
2007	0	207	20	0	0	227
2008	0	27	0	0	0	27
2009	0	59	0	0	0	59
2010	0	41	0	0	0	41
2011	0	34	0	0	0	34
2012	0	48	0	0.2	0	48
2013	0	40	0	0	0	40
2014	0	11	0	0	0	11
2015	0	10	0	0	0	10
2016	0	4	0	0	0	4
2017	0	0	0	0	0	0
2018	0	2	0	0	0	2
2019	0	0.8	0	0	0	0.8
2020	0	5	0	0	0	5
2021	0	2.5	0	0	0	2.5
2022	0	0.5	0	0	0	0.5
2023*	0	0.1	0	0	0	0.1

*** provisional.**

Table 8.2.0d. Working Group estimates of landings (t) of roundnose grenadier from Subarea 12.b

Year	Esto-nia	Fa-roes	France ***	Ger-many	Ice-land	Ire-land	Lithua-nia	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Nor-way	Total
1988													0
1989			0						52				52
1990			0										0
1991			14						158				172
1992			13										13

Year	Estonia	Faroes	France ***	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1993		263	26	39									328
1994		457	20	9									486
1995		359	285										644
1996		136	179		77			1136					1528
1997		138	111					1800					2049
1998		19	116					4262					4397
1999		29	287					8251	6				8573
2000		6	374	9				5791		9	6		6195
2001		2	159			3		5922			7	1	6094
2002			14				18	10045		1	2		10080
2003			539			1	31	11663			1		12235
2004		8	1 693				120	10880	91		4		12796
2005	20	5	508				13	7804	81		350		8782
2006	27	1	85				6	4242					4361
2007	140	2	0				8	4108					4258
2008		0	0				3	2416	13				2432
2009								5335					5335
2010			1					2910					2911
2011		3						2905					2908
2012		9						1343					1352
2013								991					991
2014		3.6						988					992
2015								363					363
2016								632					632
2017								1001					1001
2018								998.53					999
2019		3						454					457
2020	0	0	0	0	0	0	0	268	0	0	0	0	268

Year	Estonia	Faroes	France ***	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
2021	0	0	0	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0	0	0	0
2023*	0	0	0	0	0	0	0	0	0	0	0	0	0

* Preliminary.

Table 8.2.0e. Working Group estimates of landings (t) 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

Year	Unallocated
2010	0
2011	0
2012	0
2013	0
2014	0
2015	0
2016	0
2017	0
2108	0
2019	0
2020	0
2021	0
2022	0
2023*	0

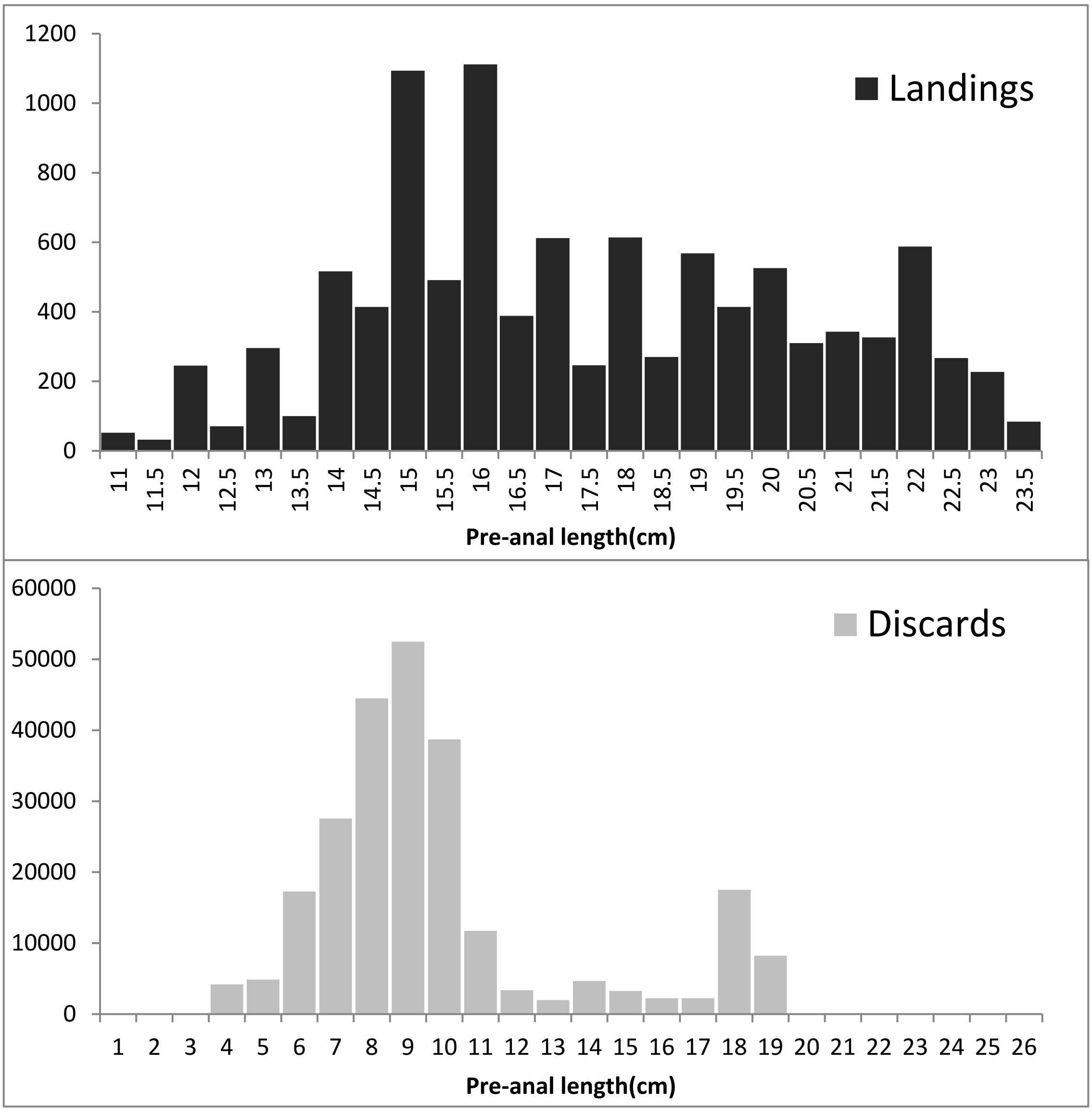
* Provisional.

Table 8.2.0f. Working Group estimates of landings (t) 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

Year	5.b	6	7	12.b	Unallocated	5.b,6,7	Overall total
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	2079**	41	2911**	0	2731**	5643**
2011	74	1805**	34	2907**	0	1914**	4822**
2012	44	1542**	48	1352**	0**	1634**	2986**
2013	60	1601**	40	991**	0**	1701**	2692**
2014	77	1100**	11	992**	0**	1188**	2180**
2015	52	646**	10	363**	0	708**	1071**
2016	38	777**	4	632**	0	819**	1452**
2017	30	603**	0	1001	0	633**	1634**
2018	6	513	2	998	0	521	1519
2019	30	202	1	457	0	233	689
2020	33	318	5	268	0	356	624
2021	22	116	2	0	0	140	140
2022	8	119	0.5	0	0	128	128
2023*	3	29	0.1	0	0	32	32

*** Preliminary. ** Revised catches, updated in 2020.**



Figures 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. Figures reflect data from 2023 for Landings and 2022 for Discards.

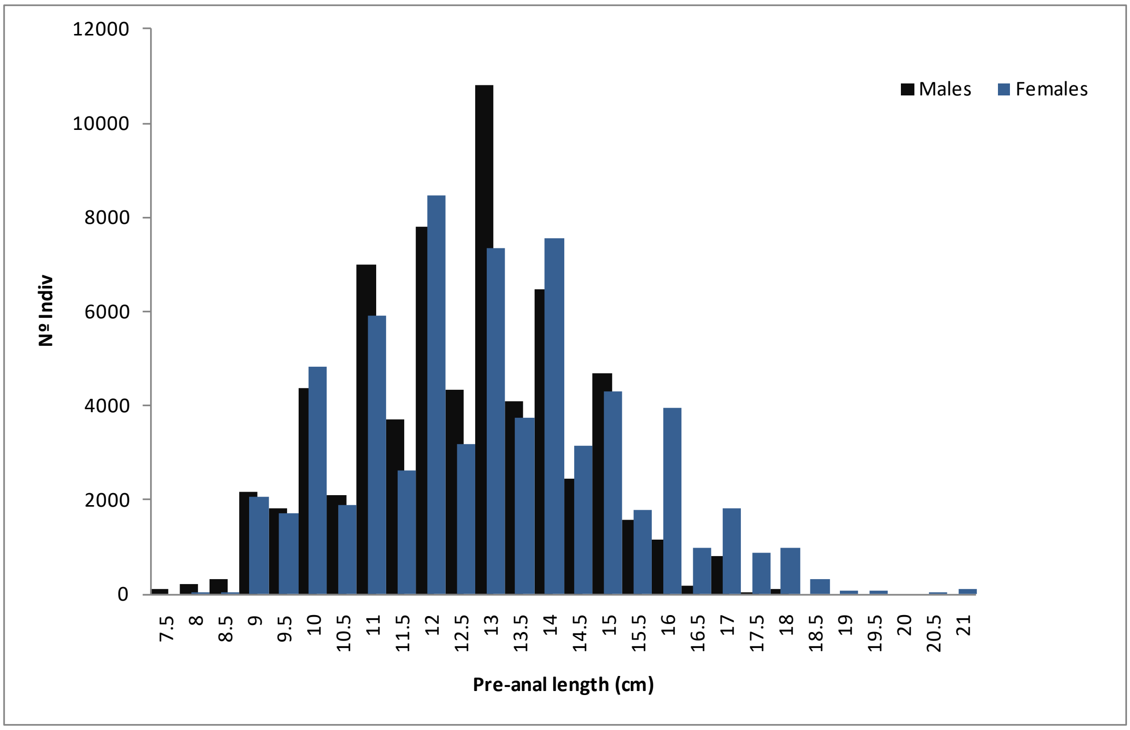


Figure 8.2.2. Length distribution of the landings of the Spanish fleet in Division 6.b.1 based from on-board observations in 2019. No new information was available in 2020-2023.

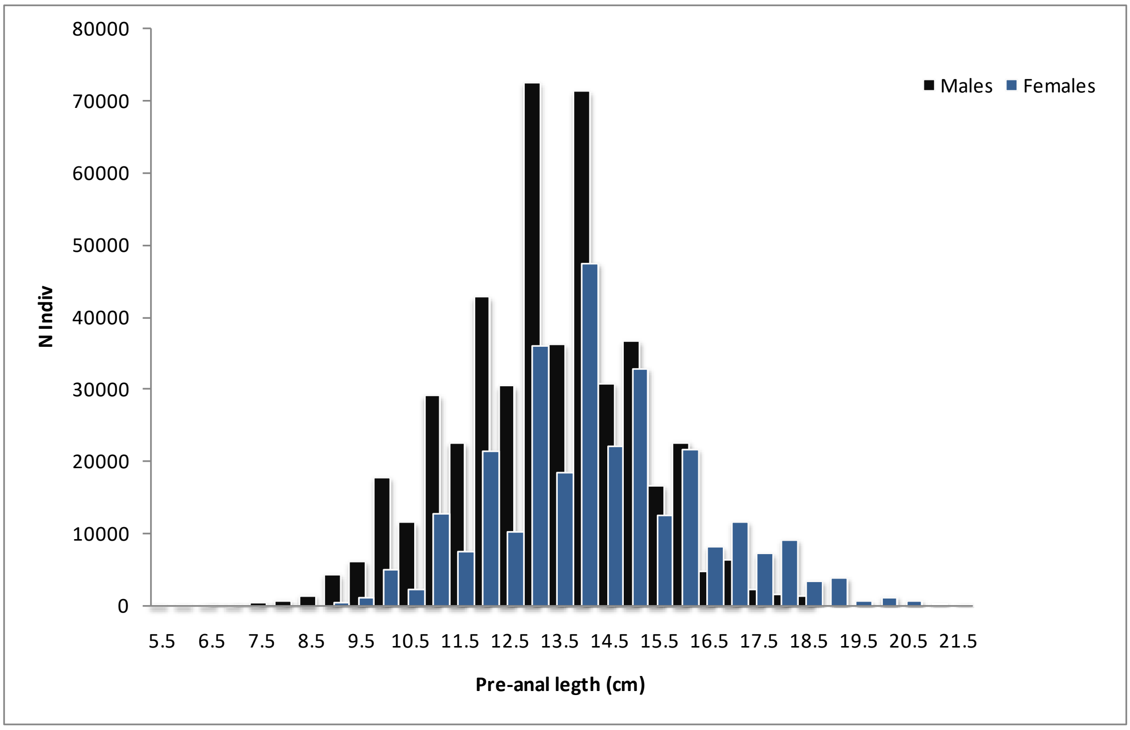


Figure 8.2.3. Length distribution of the landings of the Spanish fleet in Division 12.b based from on-board observations in 2019. No new information was available in 2020-2023.

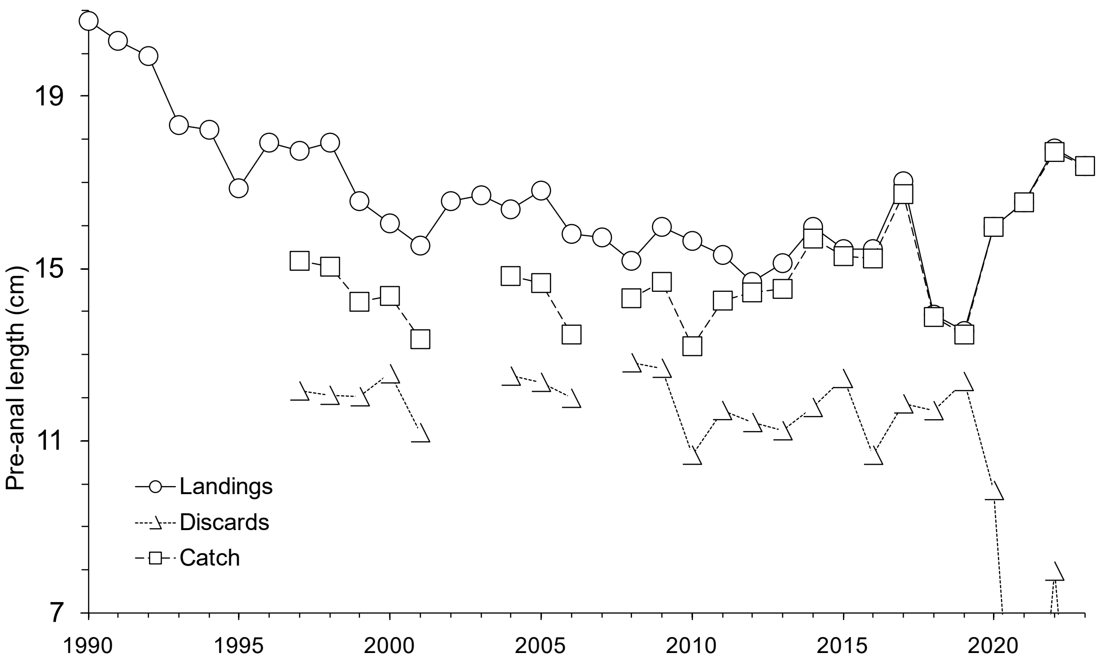


Figure 8.2.4. Evolution of the pre-anal length of roundnose grenadier in the French landings, catch and discards, 1990–2023. No information was available on discards for 2021-2022.

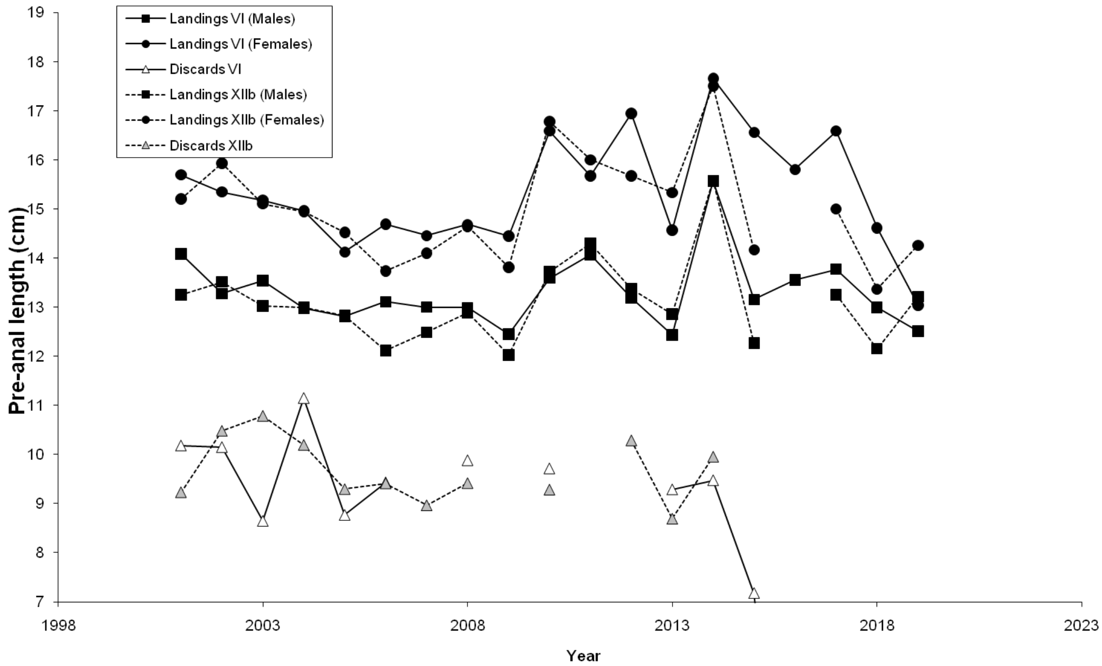


Figure 8.2.5. Evolution of the pre-anal length of roundnose grenadier in the Spanish landings and discards in Divisions 6.b and 12.b, 2001–2019. No new discard or landings length distribution information in 2020-23.

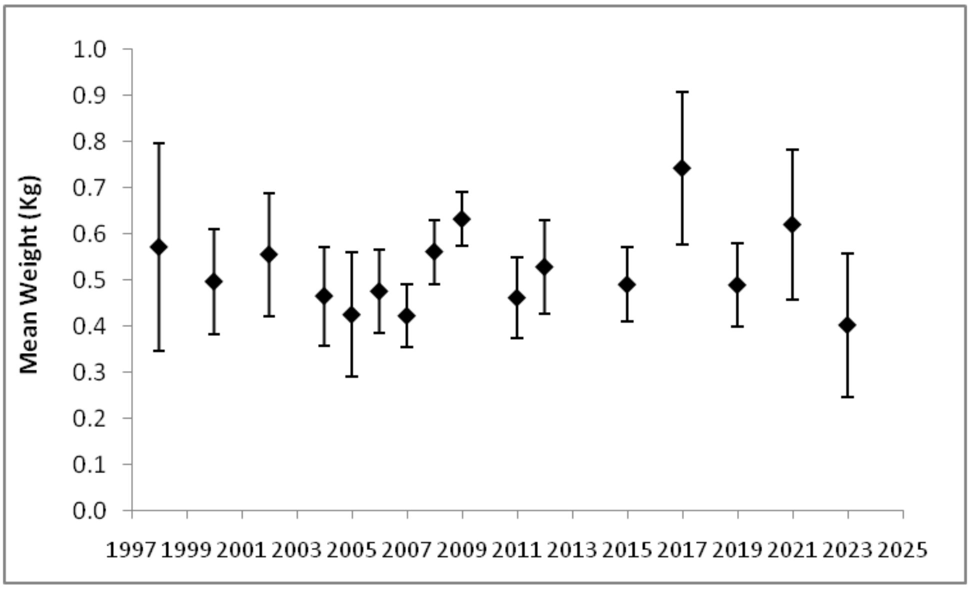


Figure 8.2.6. Mean individual weight of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

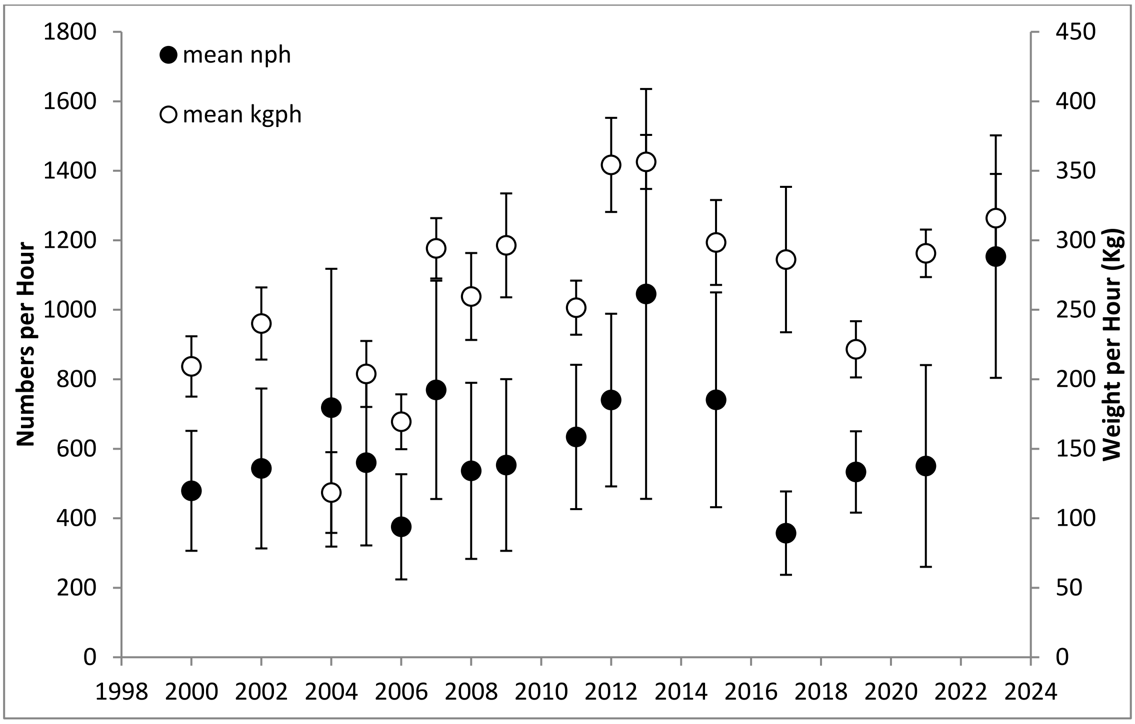


Figure 8.2.7. Abundance indices of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

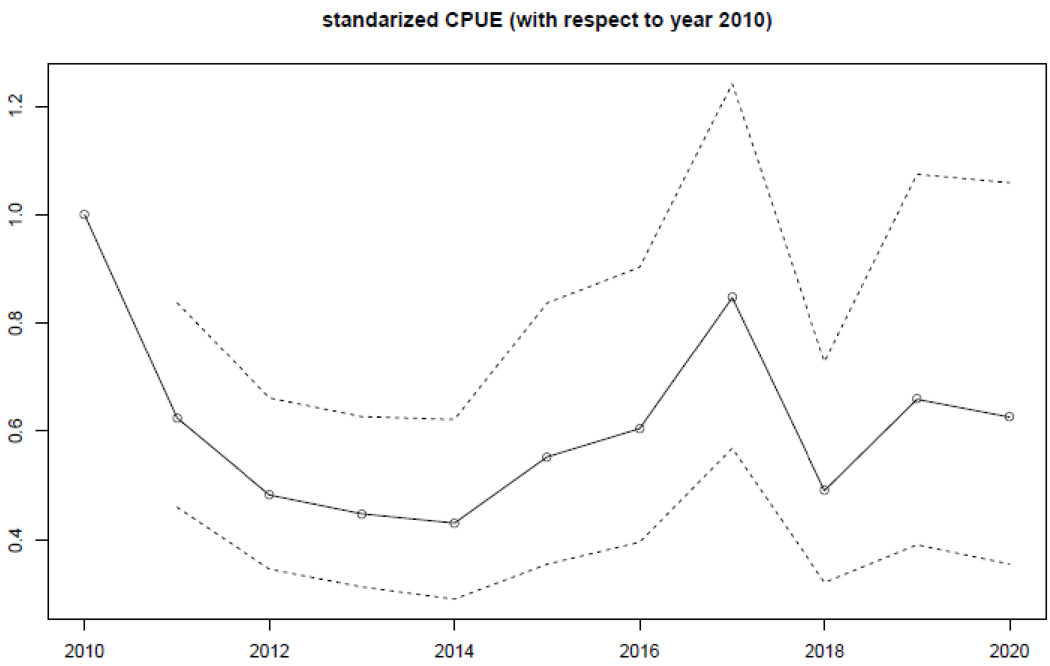


Figure 8.2.8. CPUE from the Spanish commercial fleet operating in 6.b.1 and 12.b. Dotted lines represent the confidence intervals. No new data available since 2020.

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 1988–2023 are shown in Table 8.3.0 and Figure 8.3.0.

The landings from the directed Danish fishery ceased in 2007 and the total landings have since been minor (<2 tonnes). The landings are now by-catches from other fisheries, mostly the shrimp fishery.

8.3.3 ICES Advice

The 2023 and 2024 advice for rng.3a is: “ICES advices that when the precautionary approach is applied, there should be zero catch in each of the years 2023 and 2024”.

8.3.4 Management

The directed fishery for roundnose grenadier was stopped in April 2006 based on agreements between Norway and the EU. The directed fishery has then been prohibited since 2006. 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 2023/194 of 30 January 2023, fixing for 2023 and 2024 the fishing opportunities for EU vessels for fish stocks of certain deep-sea fish species, a precautionary TAC was set to 2 tons for each year, 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. There is no TAC for Norwegian vessels in Norwegian waters but the agreed regulation between EU and Norway apply for this area.

8.3.5 Data available

8.3.5.1 Landings and discards

Landings data from 1988-2023 are presented in Table 8.3.0. Discards have been reported from both the Swedish and Danish fishery since 2014 (Table 8.3.2).

8.3.5.2 Length compositions

Since the Danish 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 (see stock annex for further details).

Updated information on size distribution from the Norwegian shrimp survey is provided in Figure 8.3.2. Length measurements are given in pre anal fin length (PAFL) in cm.

8.3.5.3 Age composition

Age data are available from a deep-sea species survey in 1987 and from the Norwegian shrimp survey in 2007-2024 (Table 8.3.3).

Age data were derived using age determination by transverse sections of sagittal otoliths and reading method with broken reading axis as developed by Bergstad (1990).

These age data are presented in Bergstad *et al*., 2014.

8.3.5.4 Bycatch effort and cpue

Data from the Norwegian reference fleet have been analysed from 2013-2023 to estimate the percent of trawls catching roundnose grenadier in the shrimp fishery (Table 8.3.5).

8.3.5.5 Survey index

The Norwegian annual shrimp survey conducted since 1984 samples deeper parts of the Skagerrak and north-eastern 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. The survey indices from the shrimp survey were updated with new information from 2024 (Table 8.3.4 and Figure 8.3.3). The indices are given as biomass (kg/h) and abundance (number/h).

8.3.6 Data analyses

An earlier study analysed the time-series of abundance of roundnose 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 pre anal fin length (PAFL), illustrating variation in recruitment.

8.3.6.1 Trends in landings, effort and estimated bycatches

Collated information on landings and discards suggest that the removals of roundnose grenadier are now at low levels in Division 3.a. Discard has been reported since 2014. Although the discards from the fishery in this area from recent years was reported to be at the same level as the landings for some years, the level on reported total catch was still low and in the range of what it has been since 2007. However, Denmark reported 21 and 13 tons of discards from 2022 and 2023, respectively. This means that total catches have increased for the two last years and now the total bycatch is mainly from discards. The level of total catch (20 tons in 2023) is still low compared with landings before 2005.

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 status nor stock development for the time of the directed fishery, which ceased in mid–2006.

Landings and discards have been insignificant and have been represented as bycatches from other fisheries since 2006. Data from the Norwegian reference fleet show that catches of roundnose grenadier in the Norwegian shrimp fishery is low (Table 8.3.5). For 2023, Denmark and Sweden only reports discards and the level on these discards have increased recently.

8.3.6.2 Size compositions

The recent length distributions from the Norwegian shrimp 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 (PAFL) through several years.

8.3.6.3 Biomass and abundances indices from survey

The survey catch rate 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. The index for 2024 show a small increase since the lowest record in 2017. 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 frequency distributions from recent years contrast with distributions from the 1980s (Bergstad, 1990b) in terms of proportions of old fish (e.g. >20 years) (Table 8.3.3). 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 1984–2023, perhaps only a single major year class. This event rejuvenated the stock and enhanced abundance in subsequent years.

8.3.7 Comments on assessment

In 2022, the rb-rule was used for the assessment for the first time. This rule was chosen when lacking a SPiCT assessment and length measurements from the fisheries.

$I_{trigger}$ is calculated as I_{loss}×1.4 and I_{loss} was defined as the lowest value in the Norwegian shrimp survey index in the period before the collapse (1990) (I_{loss}=49.82), giving $I_{trigger}$ = 69.73 kg/h. The r would be the "2 over 3 rule" giving 1.39, the multiplier m = 0.5

In 2018, the stock was upgraded to a 3.2 category stock 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 to be overall 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 1984–2024. However, there has been a small increase in the index since 2017 but still at very low levels. Rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade.

8.3.9 References

Bergstad, O.A. 1990b. Distribution, population structure, growth and reproduction of the roundnose grenadier *Coryphaenoides rupestris* (Pisces:Macrouridae) in the deep waters of the Skagerrak. *Marine Biology* 107: 25–39.

Bergstad, O.A., H.Ø. Hansen and T. Jørgensen. 2014. Intermittent recruitment and exploitation pulse underlying temporal variability in a demersal deep-water fish population. ICES Journal of Marine Science, 71: 2088–2100.

8.3.10 Tables and Figures

Table 8.3.0. Roundnose grenadier in Division 3.a. WG estimates of landings (tons).

Year	Denmark	Norway	Sweden	TOTAL
1988	612		5	617
1989	884		1	885
1990	785	280	2	1067
1991	1214	304	10	1528
1992	1362	211	755	2328
1993	1455	55		1510
1994	1591		42	1633
1995	2080		1	2081
1996	2213			2213
1997	1356	124	42	1522
1998	1490	329		1819
1999	3113	13		3126
2000	2400	4		2404
2001	3067	35		3102
2002	4196	24		4220
2003	4302			4302
2004	9874	16		9890
2005	11 922			11 922
2006	2261	4		2265
2007	+	1		1
2008	+	+		+
2009	2	+	+	2
2010	1	+	+	1
2011		0		0
2012	1	0		1
2013	1	0		1
2014	0.6	0	0.4	1

Year	Denmark	Norway	Sweden	TOTAL
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
2019	0.9	0.09	+	1
2020	0.4	0.8	+	1.2
2021	0.4	0.5	+	0.9
2022	0.9	0.7	+	1.6
2023*	+	0.9	0	0.9

*** Preliminary data.**

Table 8.3.1. Summary of data on bottom-trawl survey series from the Norwegian shrimp survey, 1984-2024. 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, KB-RV Kristine Bonnevie, GS-RV G.O.Sars. Data from 2024 survey are included. All trawls were fitted with a 10mm 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	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

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
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
2019	JAN	KB	3296	Campelen 1800 20mm/40, Rg and strapping***	27	8	119
2020	JAN	KB	3296	""	26	7	106
2021	JAN	KB	3296	""	27	8	113
2022	JAN	KB	3296	""	28	8	119
2023	JAN	KB	3296	"	29	8	116

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
2024	JAN	GS	3296	“	27	7	97

*** 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 2014-2023.

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
2019	0.5	0.08		0.6
2020	0	0		0
2021	0	0		0
2022	21.7	2.2		23.9
2023	13.3	5.9		19.1

Table 8.3.3. Cumulative percentages (%) for selected ages from the deep-sea species survey in 1987 and from the Norwegian shrimp survey in 2007-2024

	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

	Age				
Year	**5**	**10**	**20**	**30**	**50**
2016					
2017	14	52	81	94	99
2018	23	50	77	99	100
2019	8	37	64	92	100
2020	40	64	83	97	100
2021	20	55	83	97	100
2022	33	53	81	95	99
2023	22	50	79	92	100
2024	39	66	91	97	100

Table 8.3.4. Mean biomass index and mean abundance index from the Norwegian shrimp survey 1984-2024. 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.

Number stations>300m (n) 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

Number stations>300m (n) 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)**
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
2020	26	18.72	11.48	63.02	38.07
2021	27	9.59	5.03	26.14	14.19
2022	28	23.87	10.94	75.20	35.61
2023	29	19.24	8.89	38.81	19.10
2024	27	29.21	17.40	132.10	71.98

Table 8.3.5. Proportion of tows with shrimp trawl that caught roundnose grenadier. Data from Norwegian Reference fleet. The Reference fleet represents a selection of vessels fishing for shrimp (n=2).

Year	Total number of shrimp trawl	Number of trawl hauls that caught roundnose grenadier	Catch of roundnose grenadier (kg)	% of the total catch
2013	243	0		0
2014	288	2		0.69
2015	1489	14		0.94
2016	4811	23		0.48
2017	3798	20	29	0.53
2018	2849	19		0.67
2019	1233	4	80	0.32
2020	61	6		9.84
2021	176	10	50	5.68
2022	162	2		1.23
2023	220	5		2.27

Table 8.3.6. Mean average catch (kg/km^2) from the Swedish bottom trawl survey 2018-2021 (not updated).

Year	nHauls>=300 m	nHauls with catch	mean	var	sd	se
2018	15	11	114.6	24921.9	157.9	40.8
2019	10	4	128.2	157271.1	396.6	125.4
2020	14	11	381.3	223687.7	473.0	126.4
2021	7	2	272.6	114841.2	338.9	128.1

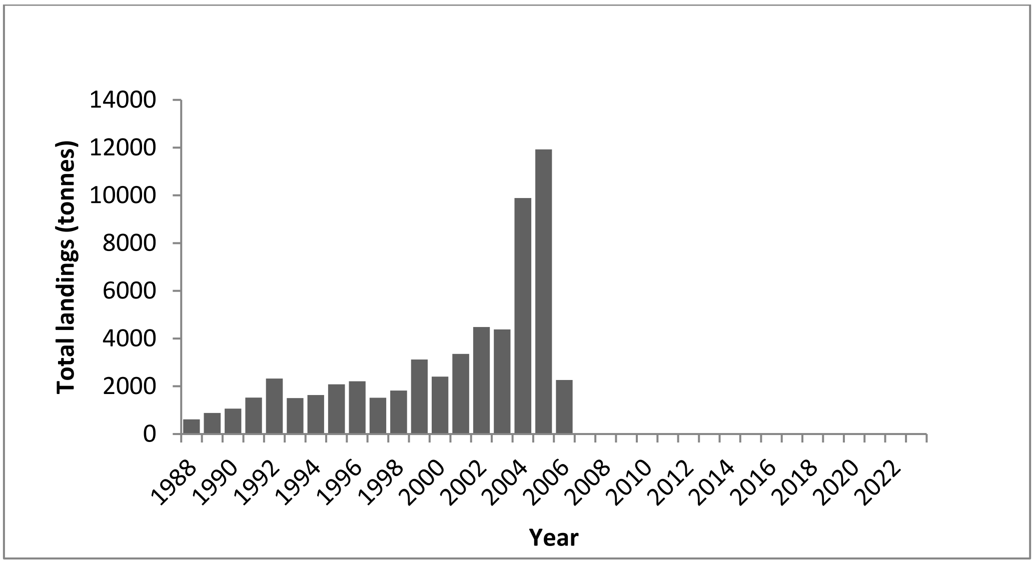


Figure 8.3.0. Landings of roundnose grenadier from Division 3.a. Landings from 2007–2023 are insignificant.

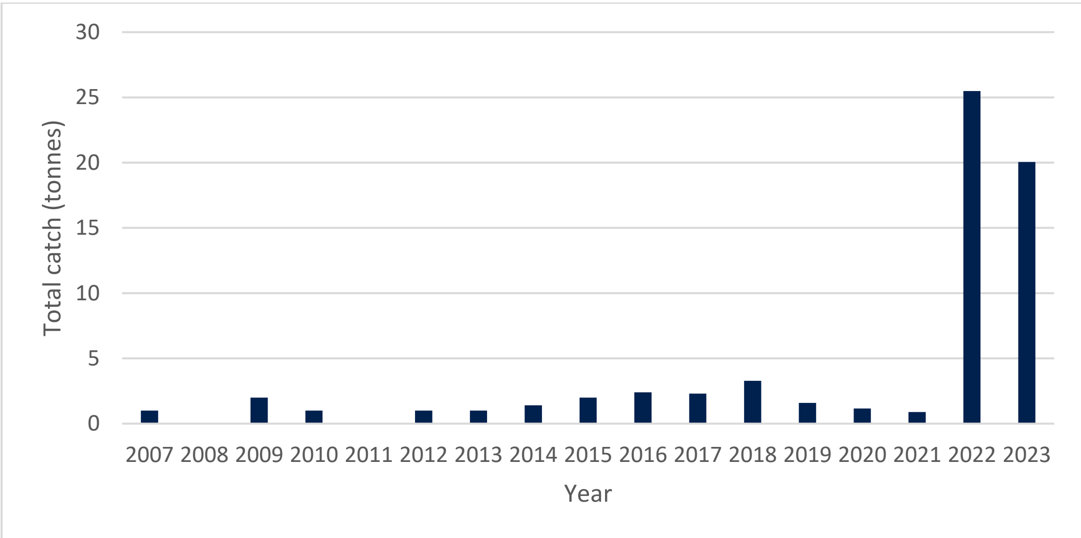


Figure 8.3.1. Total catches of roundnose grenadier from Division 3.a 2007-2023. From 2014 discards are included to the catches.

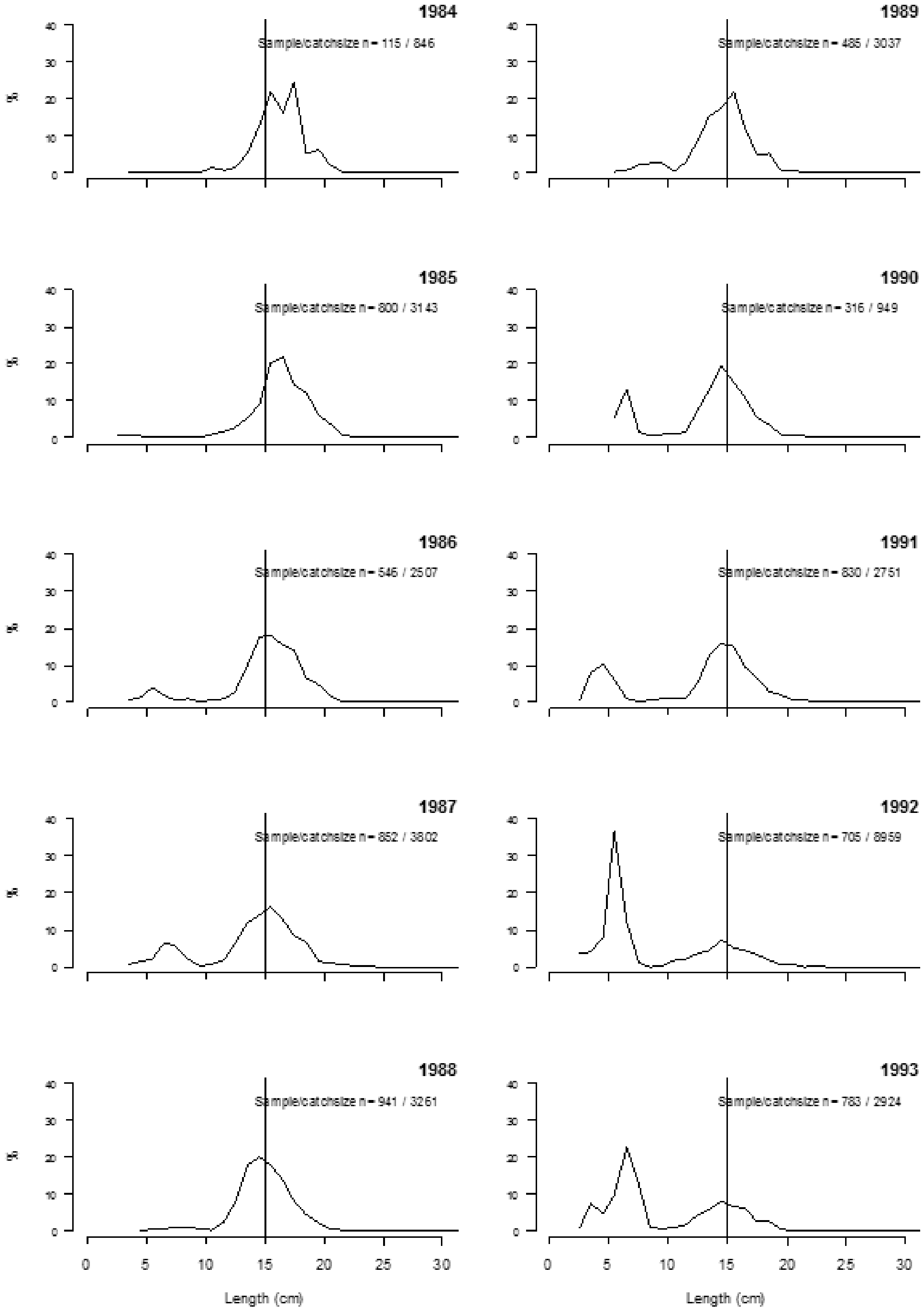


Figure 8.3.2. Length–frequency distributions for roundnose grenadier, 1984–2024. Data from Norwegian shrimp survey, all catches deeper than 300 m. Length is measured as pre-anal fin length in cm (PAFL). The distributions are calculated as percent number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

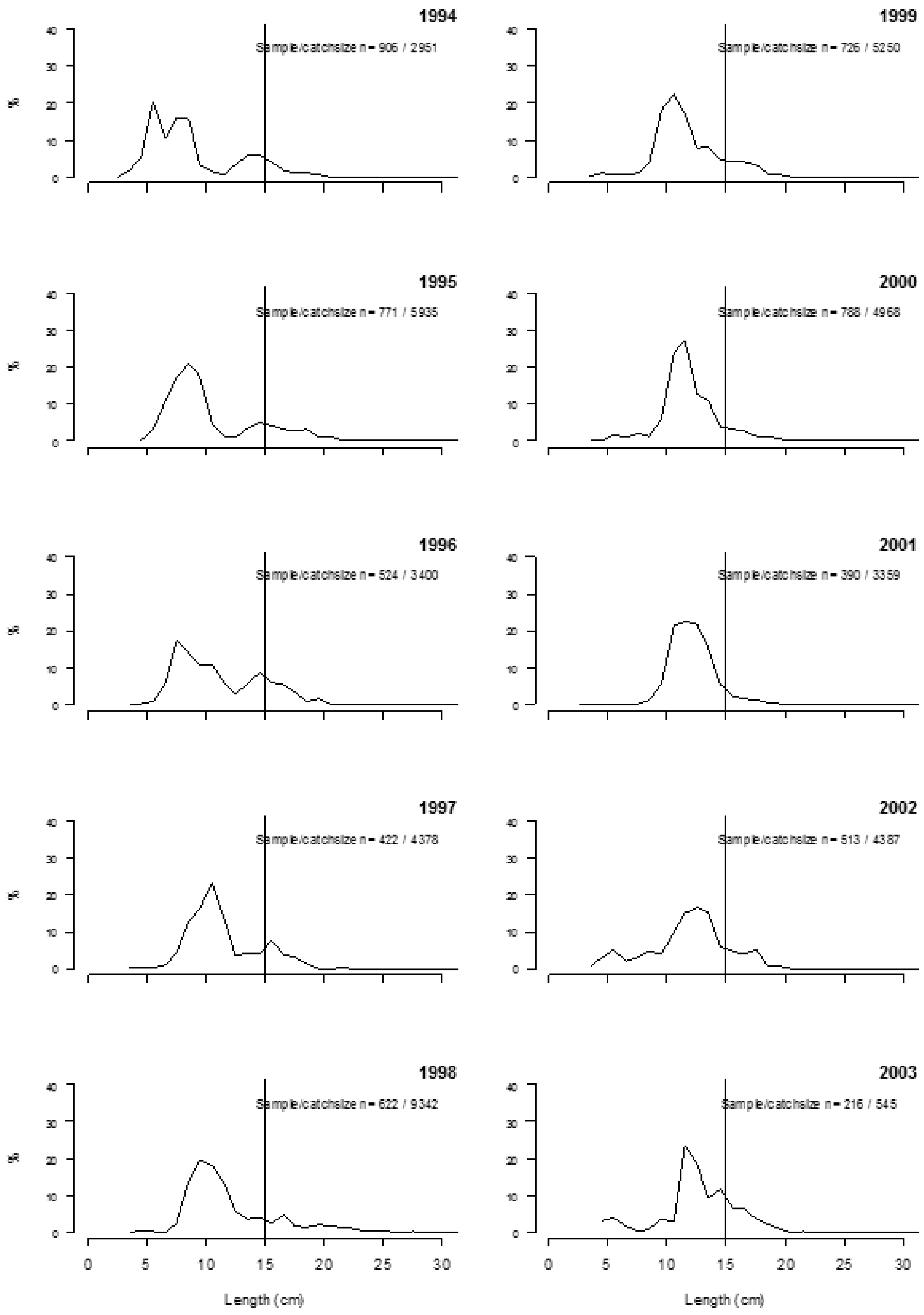
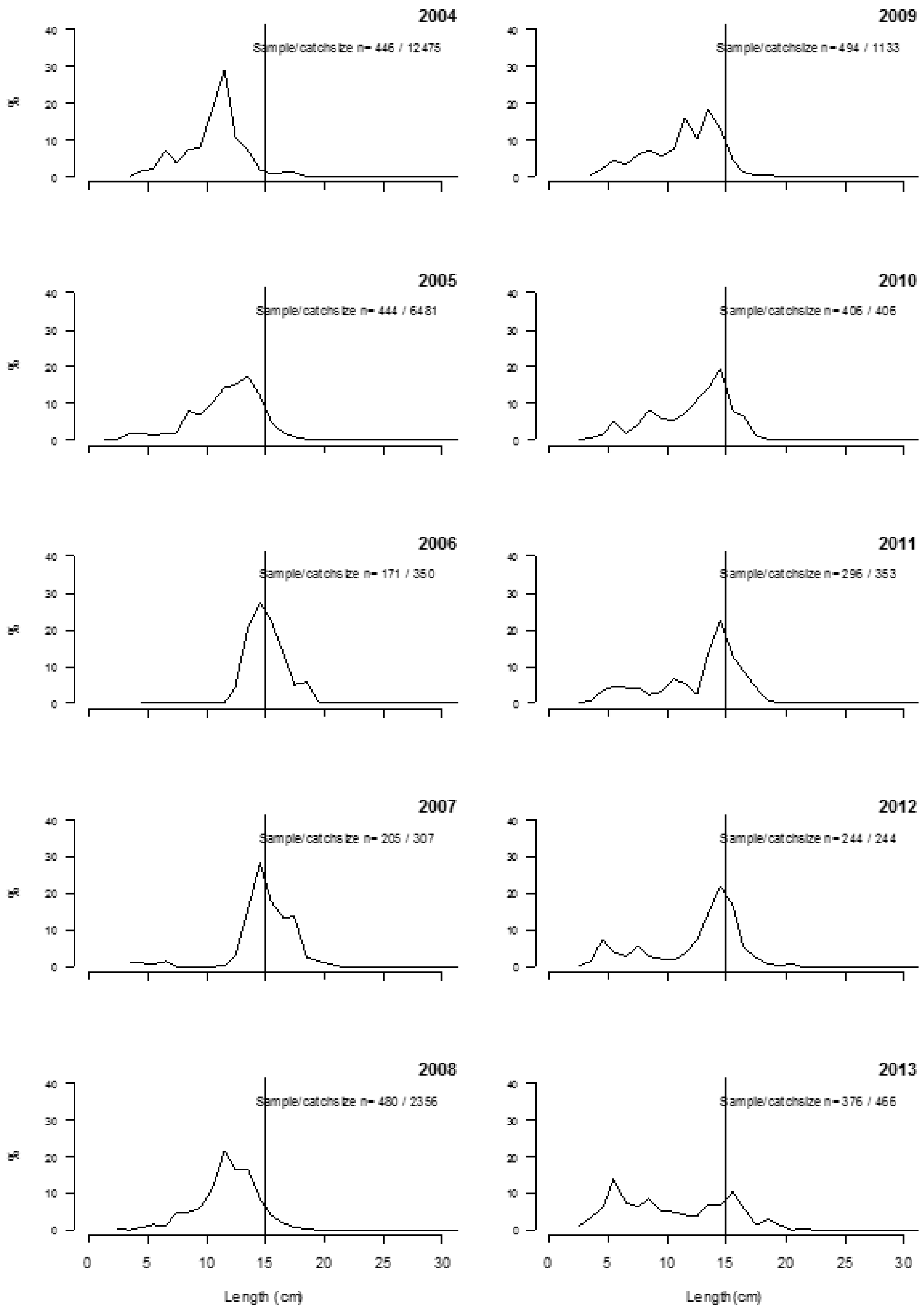


Figure 8.3.2. (Con't).



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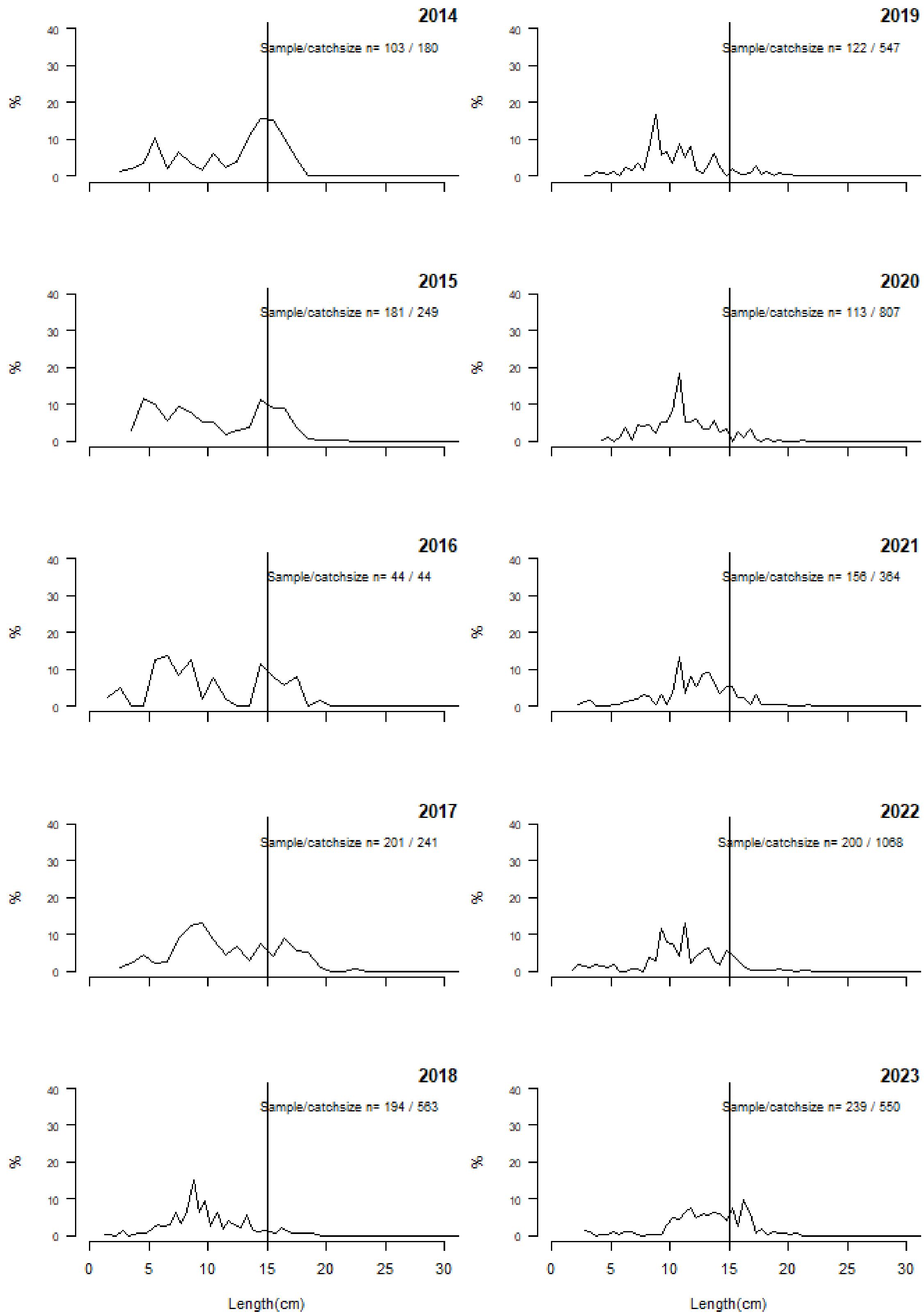


Figure 8.3.2. (Con't).

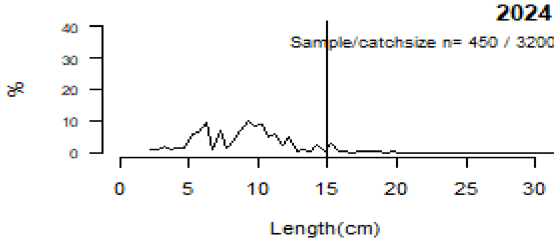


Figure 8.3.2. (Con't).

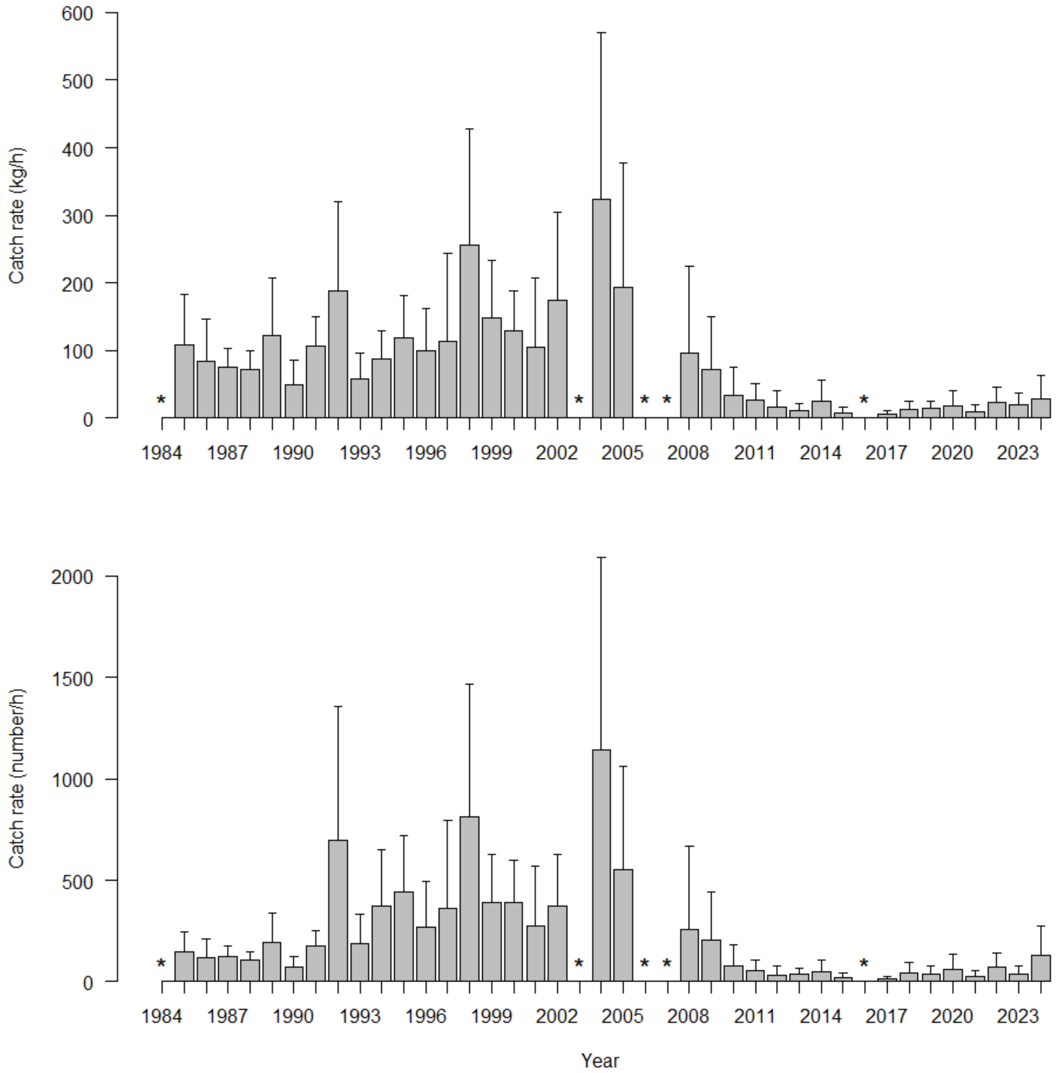


Figure 8.3.3. Survey catch rates in biomass (kg/h) and abundance (nos/h) of grenadier 1984–2024 in the Norwegian shrimp survey. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m, thus the primary grenadier habitat was not sampled for those years. For 2016 data 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).

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 9.4.1, see Stock Annex for detailed information) and in subsequent years the Soviet catch varied from 2800 to 22 800 tonnes 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 catches 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.

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 tonnes. In subsequent years total estimated landings amounted to 1860, 1790 and 2065 t in 2012, 2013 and 2014 respectively (Table 9.4.2). To these figures an unallocated catch in 14.b.1 of 1098 and 1015 t must be added in 2012 and 2014, respectively. The total 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. Catches have been reported only by Spain since 2015. In 2015 total Spanish catch was declared as 862 t (533 and 329 tonnes in 14.b.1 and 12.a.1 respectively; Table 9.4.3). In 2016 the landings were estimated at 660 tonnes. In 2017 and 2018, official landings were considerably low, not exceeding 84 tonnes. In 2019 the landings increased to 215 tonnes and in 2020 decreased to 131 tonnes, all in Division 12.a.1. (Table 9.4.1 and 9.4.3). In 2021, 2022 and 2023, zero tonnes were reported.

There has been uncertainty in the number of Spanish landings in 2015–2016, and previous reports 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 data for 2023 based on preliminary official landings from InterCatch.

8.4.1.2 ICES Advice

ICES advice applicable to 2020–2023

"ICES advises that when the precautionary approach is applied, landings should be no more than 459 tonnes in each of the years 2024, 2025, 2026, and 2027. ICES cannot quantify the corresponding catches.".

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 9.1.2). 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 2021, NEAFC recommendation (Rec. 5:2021) 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 574 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, by-catches, discards and activity information. Catches should be reported by species. Unidentified grenadiers should be recorded as Macrouridae.*

NEAFC Regulatory Area includes regulations prohibiting bottom-fishing activities for the protection of Vulnerable Marine Ecosystems (VMEs). The Regulation (EU) 2016/2336 (EU, 2016) sets out specific requirements for the protection of VMEs from fishing operations that use bottom-contacting gears below a depth of 400 m. It also stipulates that no authorization shall be issued for the purpose of fishing with bottom trawls at a depth of below 800m. It applies to EU and UK vessels in EU and UK waters and EU and UK vessels in international waters.

8.4.2 Data available

8.4.2.1 Landings and discards

From earlier years data are WGDEEP estimates based on national submissions to ICES which are not fully included in InterCatch. Landings are given in Tables 9.4.1–9.4.3. The information on landings have been variable and at a considerably lower level down to insignificant in 2017 and 2018 but have increased to about 215 tonnes in 2019 and reached 131 tonnes in 2020. In 2021, 2022 and 2023, zero tonnes were reported. The landing reduction is associated with the change in fishing behaviour generated by the implementation of EU Regulation nº. 2016/2336 which severely restricted existing NEAFC bottom-fishing areas (Figure 9.4.2). 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 the smallest fish and waste were used for fishmeal processing. The information on discards is very limited. An assessment of discards was conducted in 2014, when the discards on Spanish target fishery estimated by scientific observers was at a level of 386 tonnes (Tables 9.4.2). No discards have been reported from 2015–2023. Discards 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 2010–2020, but the 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 have decreased considerably to around 27 tonnes in 2018. In 2019 and 2020, landings reached 215 and 131 tonnes, respectively, all in Subdivision 27.12.a.1. Provisional landings are zero tonnes in 2021 and 2022. 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 Stock assessment

The ICES framework for category 5 stocks was applied for the 2024–2027 advice (ICES, 2023). 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 2023 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 state caused by exploitation before the 2000s. Therefore, ICES advises that when the precautionary approach is applied, landings should be no more than 459 tonnes in each of the years 2024 to 2027. ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.

This stock is classified as Category 1 in the NEAFC categorization of deep-sea species/stocks which implies that NEAFC requires stock-specific management measures since the entire or a significant proportion of the catch is taken in the NEAFC regulatory area.

8.4.5 Biological reference points

No attempt was made to propose reference points for this stock.

8.4.6 Comments on the assessment

No analytical assessments were carried out.

8.4.7 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.

8.4.8 References

EU. 2016. Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002.

ICES. 2023. Roundnose grenadier (*Coryphaenoides rupestris*) in Divisions 10.b and 12.c, and Subdivisions 12.a.1, 14.b.1, and 5.a.1 (Oceanic Northeast Atlantic and northern Reykjanes Ridge). In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, rng.27.5a10b12ac14b. https://doi.org/10.17895/ices.advice.21828432

ICES. 2022. New information regarding vulnerable habitats in the NEAFC Regulatory Areas. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, vme.neafc. https://doi.org/10.17895/ices.advice.21261369

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.

8.4.9 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 2022 (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					16*		16
2018					27*		27
2019					215*		215
2020					131*		131
2021					0		0
2022					0		0
2023[1]					0		0

[1]–preliminary statistics. * 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			239
2003		272			272

Year	USSR/Russia	Spain	Unallocated	Discards	Total
2004	201				201
2005					
2006					
2007		57			57
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		68			68
2018	0	0	0	0	0
2019	0	0	0	0	0
2020	0	0	0	0	0
2021	0	0	0	0	0
2022	0	0	0	0	0
2023[1]		0			0

[1]–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

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
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
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

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
2008	0	0	13	1722	1735
2009	0	0	5	0	5
2010	0	73	0	753	826
2011	0	0	3	2239	2242
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
2017	0	0	16*	68	84
2018	0	0	27*	0	27
2019	0	0	215*	0	215
2020	6	0	131*	0	137
2021	0	0	0	0	0
2022	0	0	0	0	0
2023[1]	0	0	0	0	0

[1]–preliminary statistics. * Subareas 12.a.1 only.

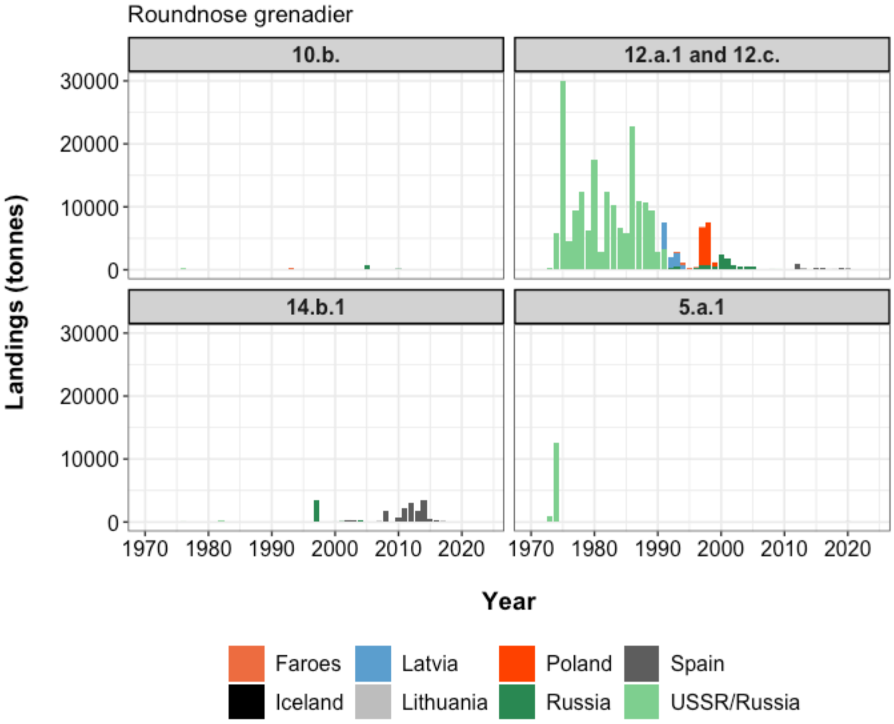


Figure 8.4.1. Landings of roundnose grenadier in ICES Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 in 1973–2023.

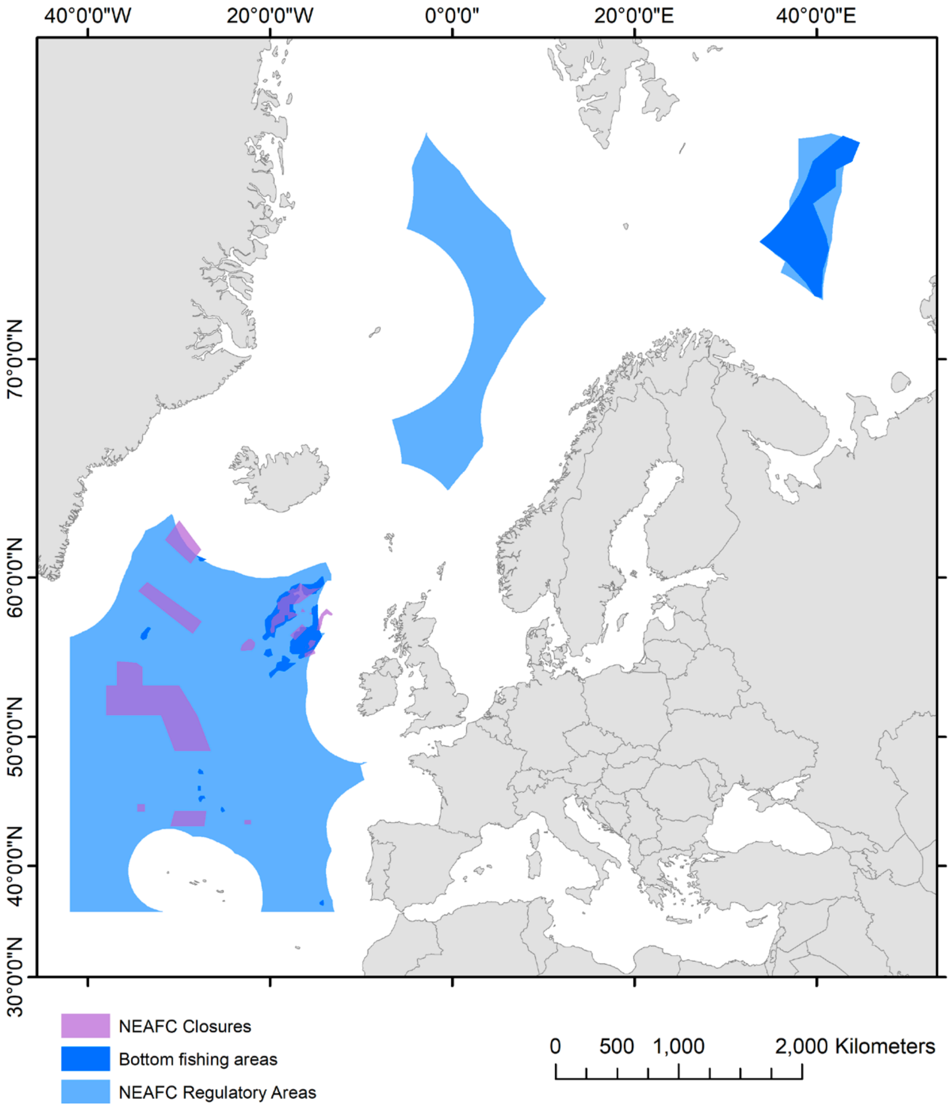


Figure 8.4.2. Northeast Atlantic Fisheries Commission (NEAFC) Regulatory Areas, showing NEAFC bottom fishing closures for Vulnerable Marine Ecosystems (VMEs) protection and existing NEAFC bottom-fishing areas. Source: ICES (2022).

8.5 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)

8.5.1 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.

8.5.1.1 Landings trends

The highest annual catch (almost 30 000 t) was taken by the Soviet Union in 1975 (Figure 9.4.1, see Stock Annex for detailed information) and in subsequent years the Soviet catch varied from 2800 to 22 800 tonnes 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 catches 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.

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 tonnes. In subsequent years total estimated landings amounted to 1860, 1790 and 2065 t in 2012, 2013 and 2014 respectively (Table 9.4.2). To these figures an unallocated catch in 14.b.1 of 1098 and 1015 t must be added in 2012 and 2014, respectively. The total 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. Catches have been reported only by Spain since 2015. In 2015 total Spanish catch was declared as 862 t (533 and 329 tonnes in 14.b.1 and 12.a.1 respectively; Table 9.4.3). In 2016 the landings were estimated at 660 tonnes. In 2017 and 2018, official landings were considerably low, not exceeding 84 tonnes. In 2019 the landings increased to 215 tonnes and in 2020 decreased to 131 tonnes, all in Division 12.a.1. (Table 9.4.1 and 9.4.3). In 2021, 2022 and 2023, zero tonnes were reported.

There has been uncertainty in the number of Spanish landings in 2015–2016, and previous reports 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 data for 2023 based on preliminary official landings from InterCatch.

8.5.1.2 ICES Advice

ICES advice applicable to 2020–2023

"ICES advises that when the precautionary approach is applied, landings should be no more than 459 tonnes in each of the years 2024, 2025, 2026, and 2027. ICES cannot quantify the corresponding catches.".

8.5.1.3 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 9.1.2). 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 2021, NEAFC recommendation (Rec. 5:2021) 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 574 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, by-catches, discards and activity information. Catches should be reported by species. Unidentified grenadiers should be recorded as Macrouridae.*

NEAFC Regulatory Area includes regulations prohibiting bottom-fishing activities for the protection of Vulnerable Marine Ecosystems (VMEs). The Regulation (EU) 2016/2336 (EU, 2016) sets out specific requirements for the protection of VMEs from fishing operations that use bottom-contacting gears below a depth of 400 m. It also stipulates that no authorization shall be issued for the purpose of fishing with bottom trawls at a depth of below 800m. It applies to EU and UK vessels in EU and UK waters and EU and UK vessels in international waters.

8.5.2 Data available

8.5.2.1 Landings and discards

From earlier years data are WGDEEP estimates based on national submissions to ICES which are not fully included in InterCatch. Landings are given in Tables 9.4.1–9.4.3. The information on landings have been variable and at a considerably lower level down to insignificant in 2017 and 2018 but have increased to about 215 tonnes in 2019 and reached 131 tonnes in 2020. In 2021, 2022 and 2023, zero tonnes were reported. The landing reduction is associated with the change in fishing behaviour generated by the implementation of EU Regulation nº. 2016/2336 which severely restricted existing NEAFC bottom-fishing areas (Figure 9.4.2). 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 the smallest fish and waste were used for fishmeal processing. The information on discards is very limited. An assessment of discards was conducted in 2014, when the discards on Spanish target fishery estimated by scientific observers was at a level of 386 tonnes (Tables 9.4.2). No discards have been reported from 2015–2023. Discards of roundnose grenadier in other fisheries have declined and this can be attributed to the decline of the deep-water fishery overall.

8.5.2.2 Length compositions

No new data on length compositions were presented.

8.5.2.3 Age compositions

No new data on age compositions were presented.

8.5.2.4 Weight-at-age

No new weight-at-age data are available.

8.5.2.5 Maturity and natural mortality

No new data on natural mortality are available.

8.5.2.6 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 2010–2020, but the information remains very uncertain.

8.5.3 Data analyses

Substantial landings were recorded in the 1970s and 1980s. Since then, landings have been variable and have decreased considerably to around 27 tonnes in 2018. In 2019 and 2020, landings reached 215 and 131 tonnes, respectively, all in Subdivision 27.12.a.1. Provisional landings are zero tonnes in 2021 and 2022. 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.

8.5.4 Stock assessment

The ICES framework for category 5 stocks was applied for the 2024–2027 advice (ICES, 2023). 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 2023 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 state caused by exploitation before the 2000s. Therefore, ICES advises that when the precautionary approach is applied, landings should be no more than 459 tonnes in each of the years 2024 to 2027. ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.

This stock is classified as Category 1 in the NEAFC categorization of deep-sea species/stocks which implies that NEAFC requires stock-specific management measures since the entire or a significant proportion of the catch is taken in the NEAFC regulatory area.

8.5.5 Biological reference points

No attempt was made to propose reference points for this stock.

8.5.6 Comments on the assessment

No analytical assessments were carried out.

8.5.7 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.

8.5.8 References

EU. 2016. Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002.

ICES. 2023. Roundnose grenadier (*Coryphaenoides rupestris*) in Divisions 10.b and 12.c, and Subdivisions 12.a.1, 14.b.1, and 5.a.1 (Oceanic Northeast Atlantic and northern Reykjanes Ridge). In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, rng.27.5a10b12ac14b. https://doi.org/10.17895/ices.advice.21828432

ICES. 2022. New information regarding vulnerable habitats in the NEAFC Regulatory Areas. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, vme.neafc. https://doi.org/10.17895/ices.advice.21261369

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.

8.5.9 Tables and Figures

Table 8.5.1. Working group estimates of catch for roundnose grenadier from Subareas 12.a.1 and 12.c, between 2012 and 2022 (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					16*		16
2018					27*		27
2019					215*		215
2020					131*		131
2021					0		0
2022					0		0
2023[1]					0		0

[1]–preliminary statistics. * Subareas 12.a.1 only

Table 8.5.2. 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			239
2003		272			272

Year	USSR/Russia	Spain	Unallocated	Discards	Total
2004	201				201
2005					
2006					
2007		57			57
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		68			68
2018	0	0	0	0	0
2019	0	0	0	0	0
2020	0	0	0	0	0
2021	0	0	0	0	0
2022	0	0	0	0	0
2023[1]		0			0

[1]–preliminary statistics.

Table 8.5.3. 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

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
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
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

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
2008	0	0	13	1722	1735
2009	0	0	5	0	5
2010	0	73	0	753	826
2011	0	0	3	2239	2242
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
2017	0	0	16*	68	84
2018	0	0	27*	0	27
2019	0	0	215*	0	215
2020	6	0	131*	0	137
2021	0	0	0	0	0
2022	0	0	0	0	0
2023[1]	0	0	0	0	0

[1]–preliminary statistics. * Subareas 12.a.1 only.

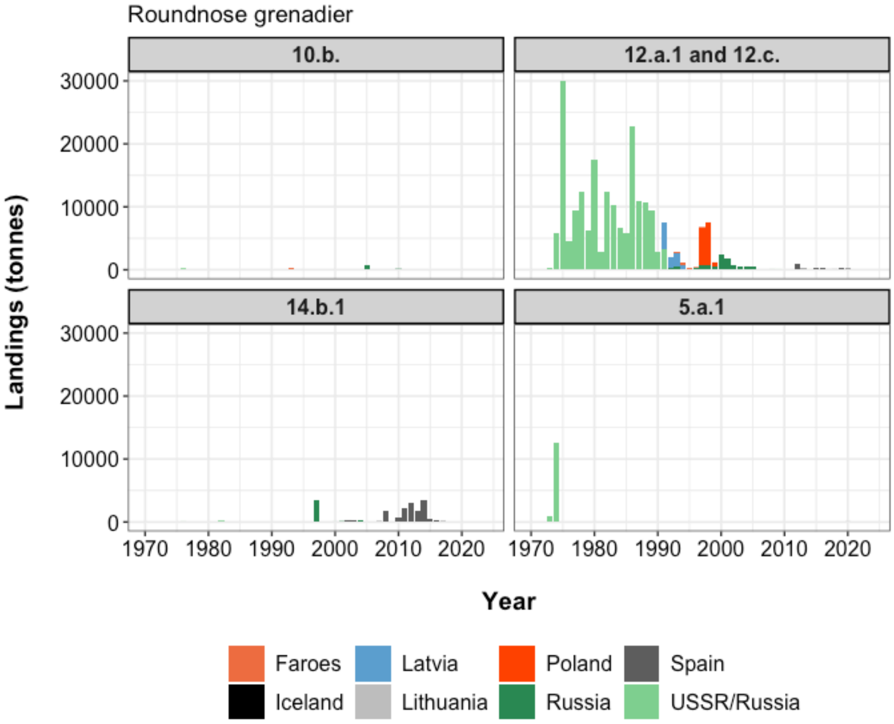


Figure 8.5.1. Landings of roundnose grenadier in ICES Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 in 1973–2023.

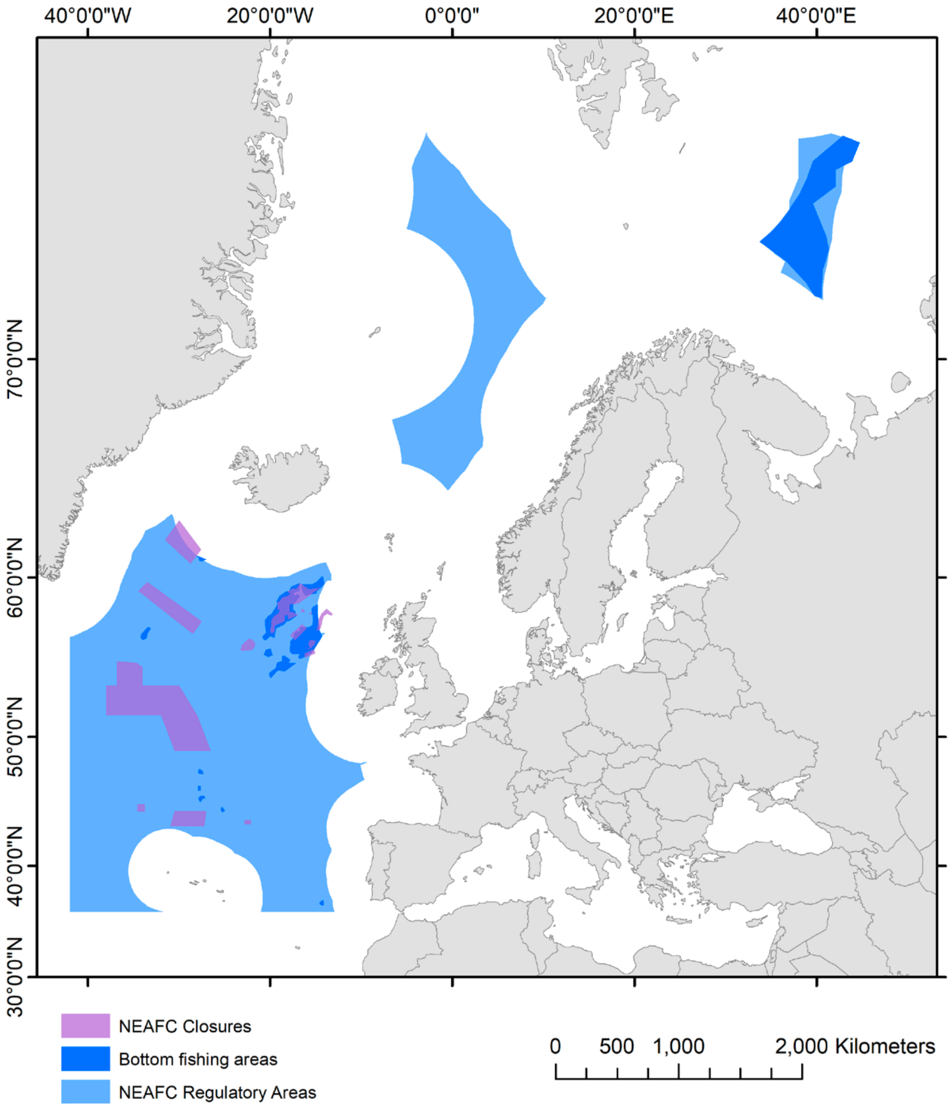


Figure 8.5.2. Northeast Atlantic Fisheries Commission (NEAFC) Regulatory Areas, showing NEAFC bottom fishing closures for Vulnerable Marine Ecosystems (VMEs) protection and existing NEAFC bottom-fishing areas. Source: ICES (2022).

Contents

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, from the Strait of Denmark, southwards to about 30°N (Nakamura & Parin, 1993). Juveniles are mesopelagic and adults benthopelagic. The life cycle of the species is not completed in just one area and large-scale migrations occur seasonally.

Scientific evidences suggest one single stock doing a clockwise migration between northern European waters (ICES subareas 5, 6 and 7 and Division 27.12.b) and southern European waters (subareas 8 and 9) down to Madeira in the CECAF area, where spawning occurs (Farias *et al.*, 2013). The existence of a second nursey area in the northernmost area of distribution of the species was proposed based on the analysis of the otolith core trace element composition (Farias *et al.*, 2022) which appears to be consistent with the occurrence of mature specimens off Iceland that had been previously reported (Magnússon and Magnússon, 1995). The connexion between the northern and southern components and the other areas, in particular Azorean waters and the mid-Atlantic Ridge, is less clear. In Azorean waters (Subarea 10), Madeira, and the Canaries (Stefanni & Knutsen, 2007; Stefanni *et al.*, 2009; Biscoito *et al.*, 2011; Besugo *et al.*, 2014 WD), two different species, the black scabbardfish (*Aphanopus carbo*) and the intermediate scabbardfish (*A. intermedius)*, coexist. This latter species is not subject to assessment by ICES.

ICES considers one single assessment unit in the Northeast Atlantic. Because of the different characteristics of fisheries and life stage occurring in each area, this report is organised in four sections treating fisheries in northern, southern, other areas, and CECAF. ICES provides scientific advice for the northern and southern components in ICES area. ICES does not assess fisheries in Madeira (Eastern Central Atlantic area, CECAF) or in other areas outside the ICES area.

Section 9.2 "Black scabbardfish (*Aphanopus carbo*) in subareas 27.5, 27.6 and 27.7 and Division 27.12.b" presents data and analyses on fisheries and catches in the Northern component of the ICES areas, as well as results of the model for the overall stock. The modelling relies on a state-space dynamic population model benchmarked at WKDEEP 2014 (ICES, 2015). In these areas the bulk of the catch is by trawlers.

Section 9.3 "Black scabbardfish (*Aphanopus carbo*) in subareas 27.8 and 27.9" presents data and analyses where the main fishery is from deep-water longliners in Division 27.9.a, which represents the Southern component of the ICES areas.

Section 9.4 " Black scabbardfish (*Aphanopus carbo*) in other areas" presents data and analyses for other areas, namely Division 27.3.a and subareas 27.1, 27.2, 27.4, 27.10, and 27.14. Data are mostly about longline fisheries. Since, 2010 the overall landings from these areas were globally much lower than at the other two management units.

Section 9.5 " Black scabbardfish (*Aphanopus carbo*) in CECAF area" presents data and analysis of fisheries and landings in CECAF area 34.1.2, where a directed bottom longline fishery operates. Although ICES does not asses this fishery, it is admitted that the incorporation of reliable CECAF data could provide a wider perception of the stock dynamics.

9.2 Black scabbardfish (*Aphanopus carbo*) in subareas 27.5, 27.6 and 27.7 and Division 27.12.b

In this section, fisheries, landings trends, and applicable management are presented for divisions 27.5.a, 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 and ICES subareas 27.8 and divisions 27.9.a.

ICES Division 27.5.a, initially included in "Other areas", has been included in the Northern Component since 2016, both for stock assessment analyses and for management considerations.

9.2.1 The fishery

In the Northern Component area, the fishing effort from EU vessels has been greatly reduced due to the EU Regulation 2016/2336 of 14 December 2016 (EU, 2016) that bans fishing with bottom trawls at a depth below 800 metres. This ban has had impacts on the French bottom deep-water fishery that catches the black scabbardfish (Figure 9.2.1).

In Division 27.5.b, black scabbardfish was initially fished by large trawlers that operated on the slope around the Faroe Bank and on the Wyville-Thomsen ridge close to the southernmost Faroese EEZ boarder. In Faroese waters, the black scabbardfish fishery is managed through a fishing licencing scheme and 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 to 1000 m and the haul duration varies from 6 to 8h, but may last less in case of large catch (Ofstad, 2023 WD).

9.2.2 Landings trends

The historic landing trends on this assessment unit are described in the stock annex.

Total landings from the ICES Division 27.12.b and subareas 27.5, 27.6, and 27.7 show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend until 2008 (Figure 9.2.1). The peak in landings was registered in 2002 and came mainly from landings in ICES subareas 27.6 and 27.7. The 2002 peak appears to be mainly driven as a response to the EU TAC management (Figure 9.2.1). From 2009 until 2016, landings have been stable, fluctuating around about 3000 tonnes per year. Since 2017, the landings have been decreasing.

Since 2010, Icelandic landings in ICES Division 27.5.a have increased, remaining stable around 300 t between 2012 and 2017, and decreasing since then (Table 9.2.4f).

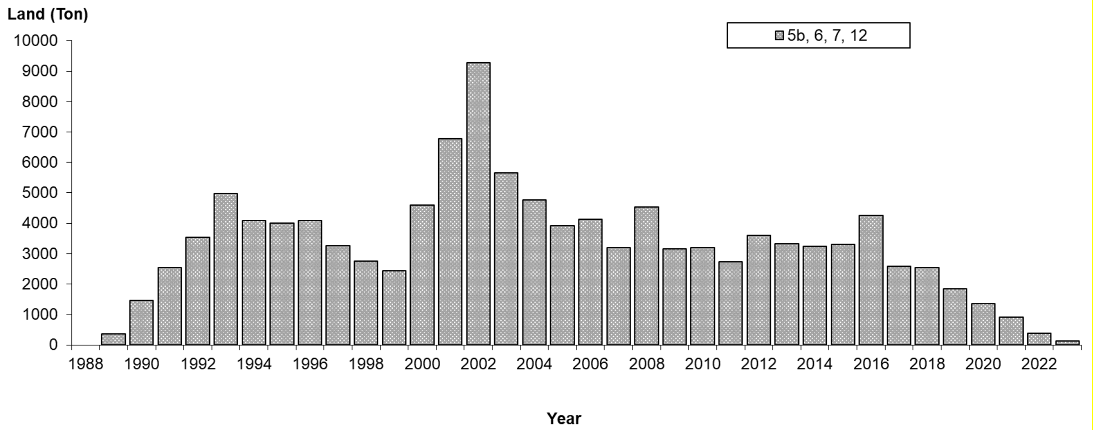


Figure 9.2.1. bsf.27.nea Northern component annual landings time-series for ICES subareas 27.5, 27.6, 27.7, and 27.12.

In early years, French landings represented more than 75% of the Northern component total landings, but in 2002 and 2006 they just represented about 50% (Figure 9.2.2). The relative importance of French landings, particularly at ICES Subarea 27.6, had an increasing trend from 2009 to 2012, a decreasing trend until 2020 to increase again until 2022, and decrease in 2023. From 2013 to 2018, Spanish landings of black scabbardfish showed a slight increased, decreasing from 2018 onwards, whereas Faroese landings increased from 2017 to 2020, which resulted on a rise in their relative contribution, but is decreasing since then. Icelandic landings' contribution was relatively higher in 2012, decreased afterwards, but has markedly increased since 2021.

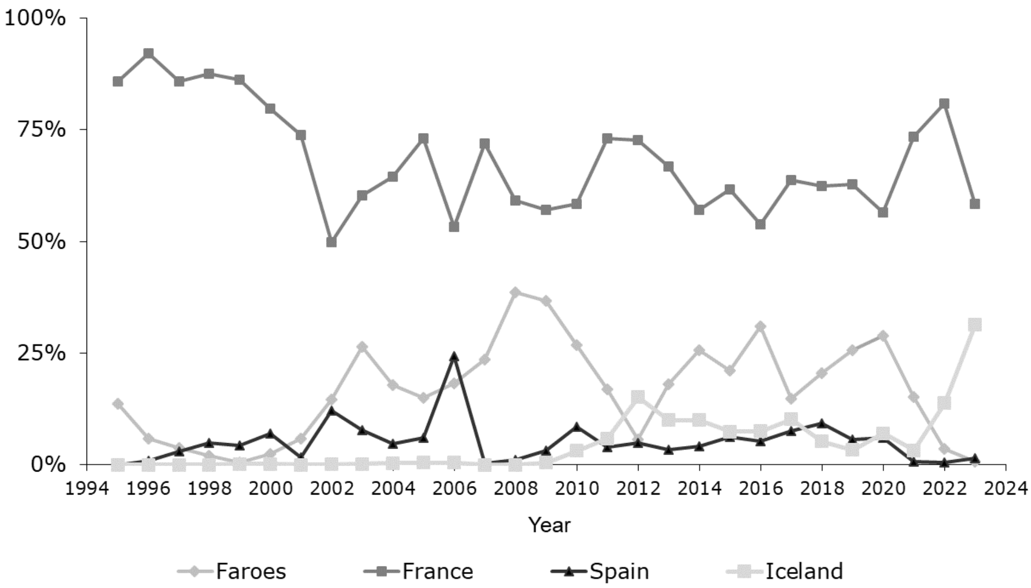


Figure 9.2.2 bsf.27.nea Northern component Faroese, French, Spanish, and Icelandic relative contribution to the annual landings for the Northern component.

9.2.3 ICES Advice

The latest ICES advice, in 2022, was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 4214 tonnes in each of the years 2023 and 2024.*"

9.2.4 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 2020, 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 EU TAC.

Given the EU Regulation 2016/2336 of the European Parliament and of the Council of 14 December 2016 (EU, 2016), "No fishing authorisation shall be issued for the purpose of fishing with bottom trawls at a depth below 800 metres", black scabbardfish catches from trawl fishing grounds deeper than 800 meters are null for EU vessels since 2017.

Table 9.2.1. Black scabbardfish TACs and total landings of EU vessels in ICES subareas 27.5, 27.6, 27.7, and 27.12 from 2006 to 2023.

Year	EU TAC 27.5, 27.6, 27.7 & 27.12	Landings 27.5, 27.6, 27.7 and 27.12
2006	3042	4150
2007	3042	3194
2008	3042	4533
2009	2738	3159
2010	2547	3421
2011	2356	2900
2012	2179	2408
2013	3051	3229
2014	3966	3599
2015	3649	3567
2016	3357	4597
2017	2954	2886
2018	2600	2686
2019	2470	1903
2020	2470	1453
2021	583	938
2022	583	453
2023	1710	175
2024	1292	

9.2.5 Data available

9.2.5.1 Landings and discards

In 2024, updated landing data were made available for the major fishing countries operating in ICES subareas 27.5, 27.6, 27.7, and 27.12 (Table 9.2.4).

Updated discard data were also provided for major fishing countries operating at the Northern component area. Based on the discard data available for this component, it is concluded that discards of black scabbardfish are negligible.

9.2.5.2 Research vessel data

Scottish research survey data have been provided to WGDEEP. The survey takes place every two years. The annual biomass and abundance index estimates (kg per hour and mean numbers per hour of trawling for each haul with 95 % confidence intervals) obtained for hauls deeper than 500 and shallower than 1600 m are presented in Figure 9.2.3 (Jaworski, 2024, pers. comm.). After 2012, both the annual biomass and annual abundance indices are at higher levels, indicating that the population at the Northern component has been stable. The value in 2022 is much higher than the rest of the series and has a high uncertainty because in one haul at 1005 m depth the number of black scabbardfish specimens caught was unexpectedly high.

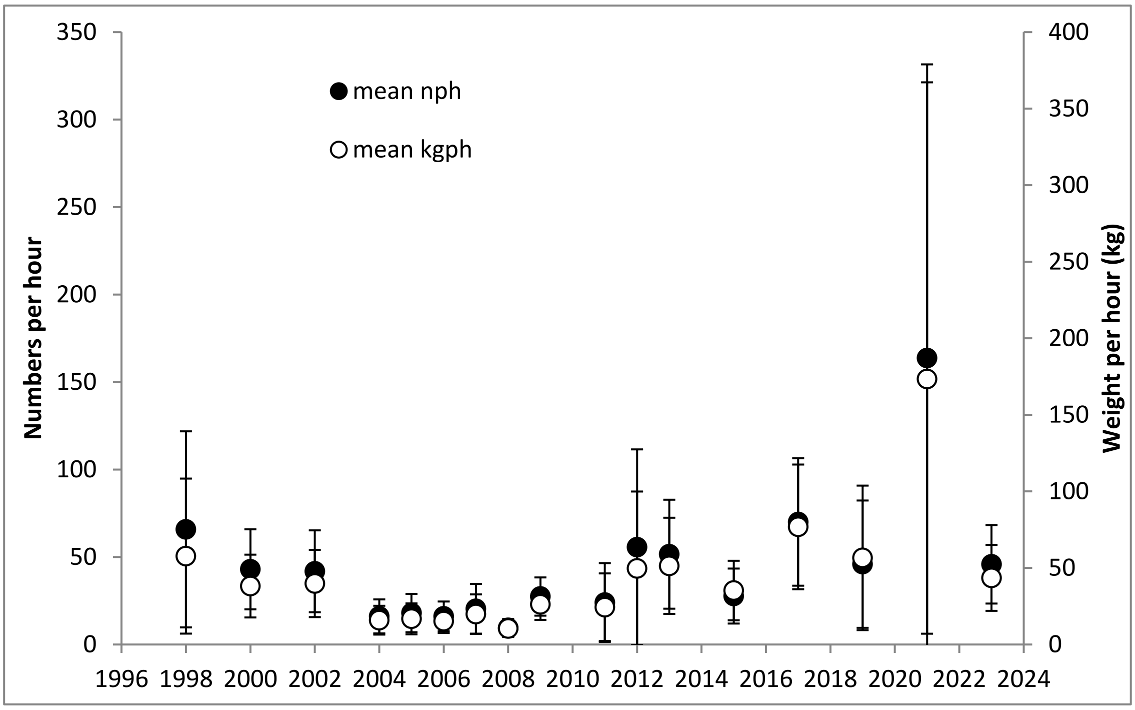


Figure 9.2.3. bsf.27.nea Northern component. Annual biomass and abundance indices of black scabbardfish estimated for depths deeper than 500 m and shallower than 1600 m, from 1998 to 2023. Seamounts/Rockall not included. (Source: Jaworski, A., 2024, pers. comm.)

In ICES Division 27.5.a, the Icelandic Autumn survey biomass index series for all sizes (Total biomass) and specimens larger than 90 cm are at the higher level of the whole series are presented for the period between 2000 and 2019 (Figure 9.2.4). Black scabbardfish abundance index from

Icelandic Autumn survey shows an overall decreasing trend since 2013 however it is at higher levels than those registered at the beginning of the series (Figure 9.2.5).

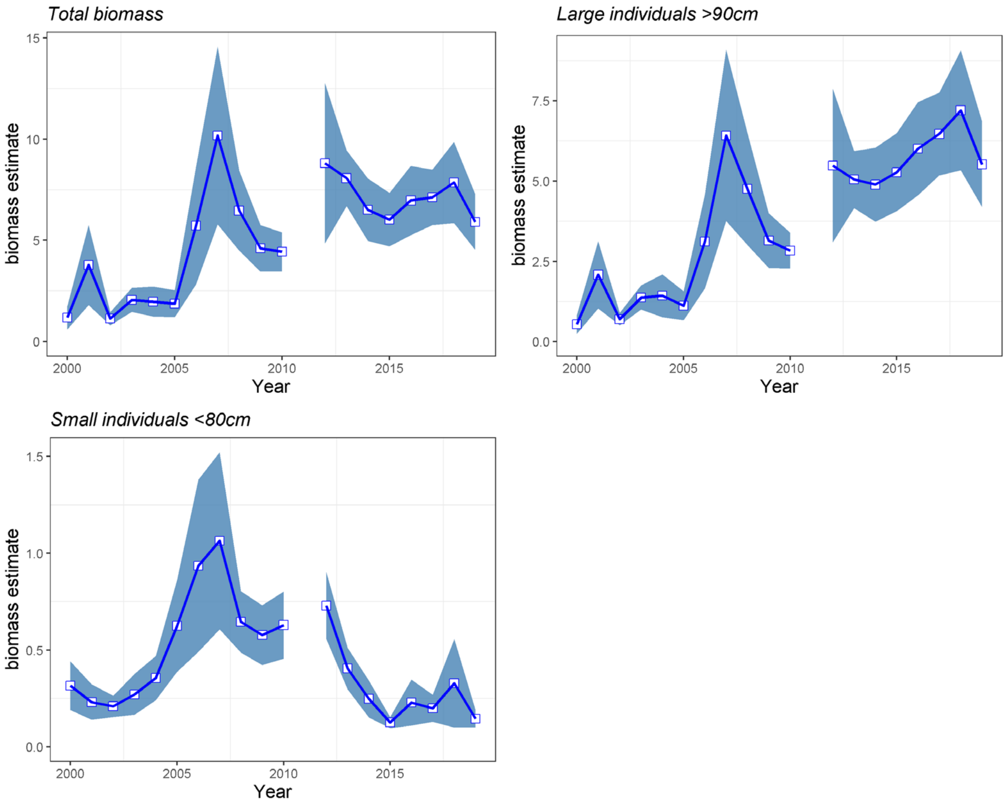


Figure 9.2.4. bsf.27.nea Northern component. Black scabbardfish biomass index with 95% confidence interval from the Icelandic Autumn survey from 2000 to 2019 for all sizes (Total biomass, upper left); specimens larger than 90 cm (Large individuals >90 cm, upper right); specimens smaller than 80 cm (Small individuals <80 cm, lower left). (Source: Jakobsdottir, K., 2020, pers. comm.)

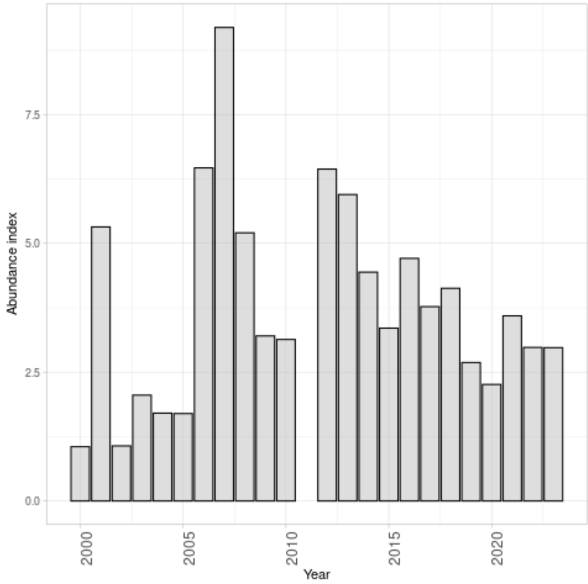


Figure 9.2.5. bsf.27.nea Northern component. Abundance of black scabbardfish from Icelandic Autumn survey from 2000 to 2023.

Regarding the Scottish survey data, the recent abundance and biomass indices are at similar levels when comparing with the beginning of the time-series (1998) and higher than in the mid-2000's, whereas for the Icelandic survey the abundance and biomass indices are at higher levels than at the beginning of the time-series (2000).

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 WD). The main species studied 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 have 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 procedure is the same as those adopted for Faroese 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 9.2.6), which correspond to the main Faroese fishing areas. A closer look shows that the black scabbardfish is only caught in the area north-west of the Faroes and never caught on the Faroe Plateau (Figure 9.2.7). In 2020, only 31 out of the 75 hauls planned for the survey were performed due to the weather conditions and problems with the vessel.

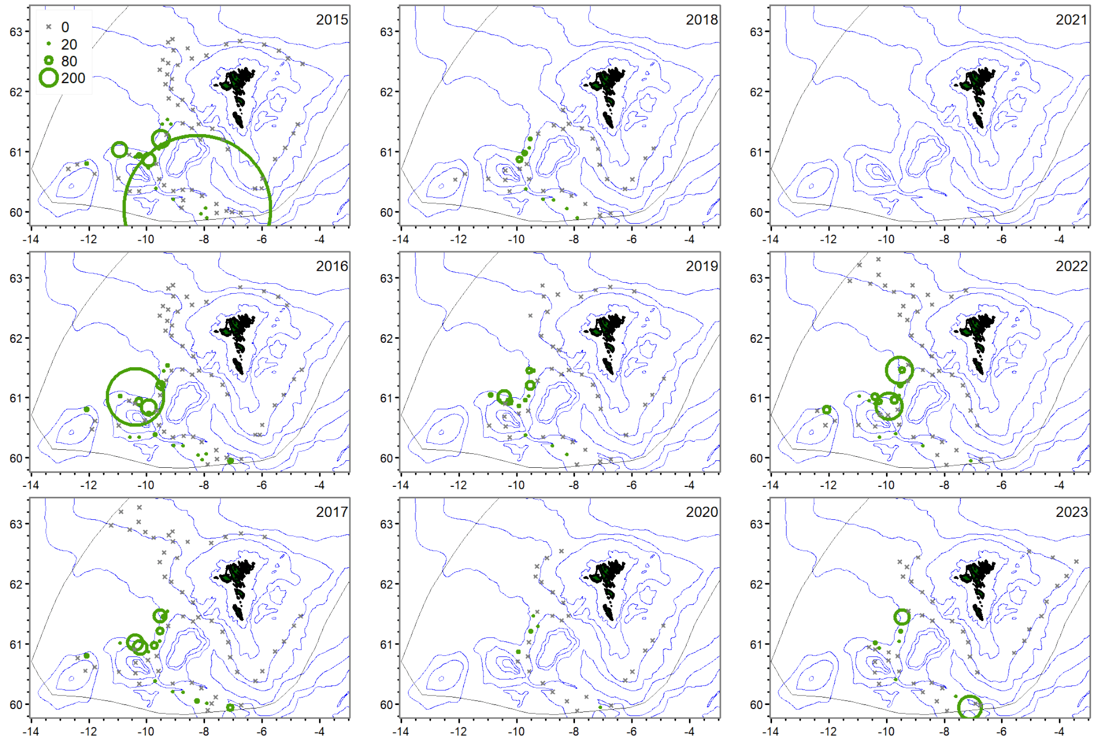


Figure 9.2.6. bsf.27.nea Northern component. Black scabbardfish in Division 27.5.b. Spatial distribution of CPUE (kg/h) from the deep-water surveys in 2015-2023. (Source: FAMRI, 2024, *pers*).

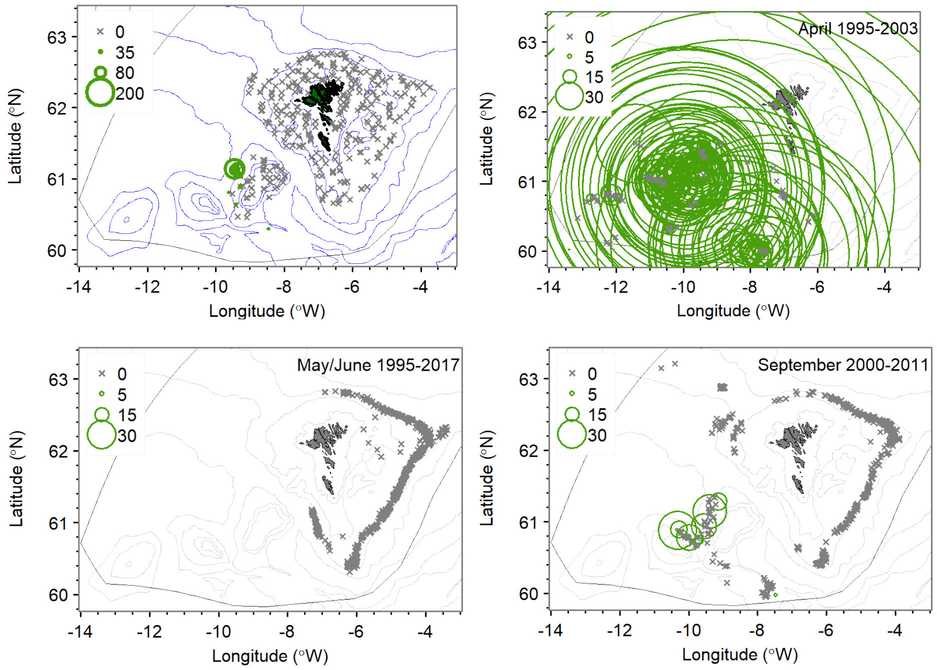


Figure 9.2.7. bsf.27.nea Northern component. Spatial distribution, CPUE (kg/h), from different surveys. Annual groundfish surveys, August 1996-2017 (upper left), Blue ling surveys, April 1995-2003 (upper right), Greenland halibut surveys, May/June 1995–2017 (lower left) and Redfish surveys, September 2000-2011 (lower right). (Source: Ofstad, 2019, WD)

Oceanographic data collected in Faroese surveys indicate that the species occurs at depths below 500 m, in waters with temperature higher than 6°C (Figure 9.2.8). These two conditions are registered at the oceanic Faroese waters (Figure 9.2.9).

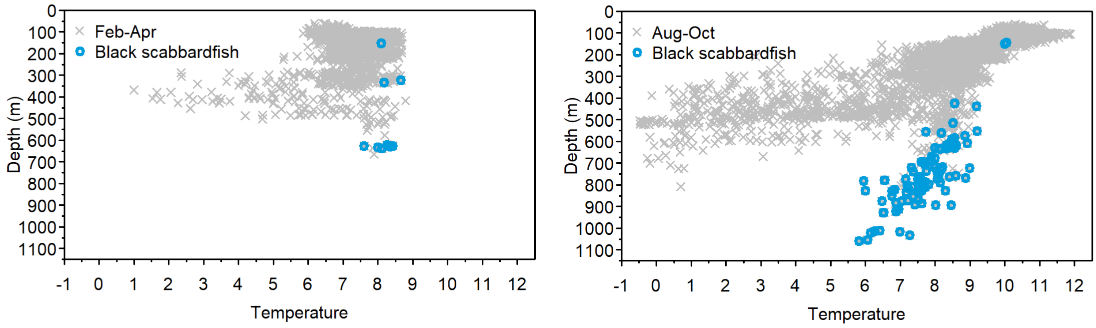


Figure 9.2.8. bsf.27.nea Northern component. Temperature and depth distribution of black scabbardfish (blue dots) and catch with no black scabbardfish (grey crosses) in February-April (left) and August-October (right). (Source: Ofstad 2019, WD).

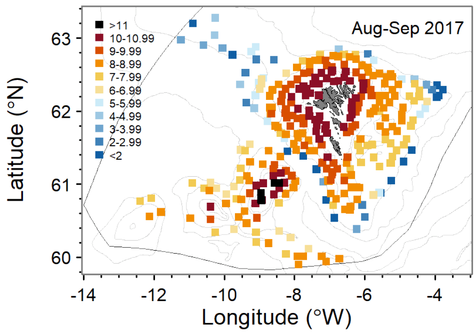


Figure 9.2.9. Temperature and depth distribution in Faroese waters August-September 2017. (Source: Ofstad, 2019, WD)

9.2.5.3 Length compositions

The annual length frequency distributions, based on French on-board observer data, for the period 2004-2023 are presented in Figure 9.2.10. The length frequency distribution is similar between years and reflects a predominance of immature individuals, i.e. specimens with less than 103 cm total length.

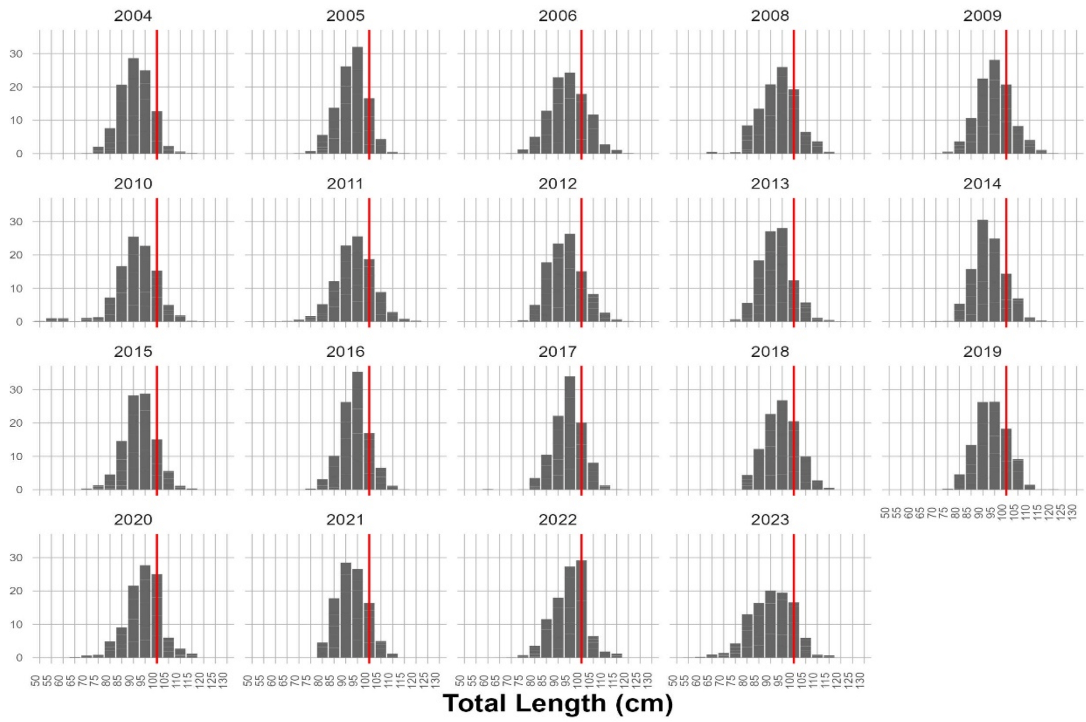


Figure 9.2.10. bsf.27.nea Northern component. Annual frequency length distribution of black scabbardfish based on French observer data collected on-board commercial vessels (2004–2023). The red vertical line indicates the length of 1st maturity of the species.

For the period 2004–2023, the temporal evolution of the mean length shows no trend in the Northern component (Figure 9.2.11), reflecting a stability on the length structure of the exploited population. In quarter 4, the lower mean length values were registered in 2010, 2020, and 2023, which may be associated with a high recruitment signal.

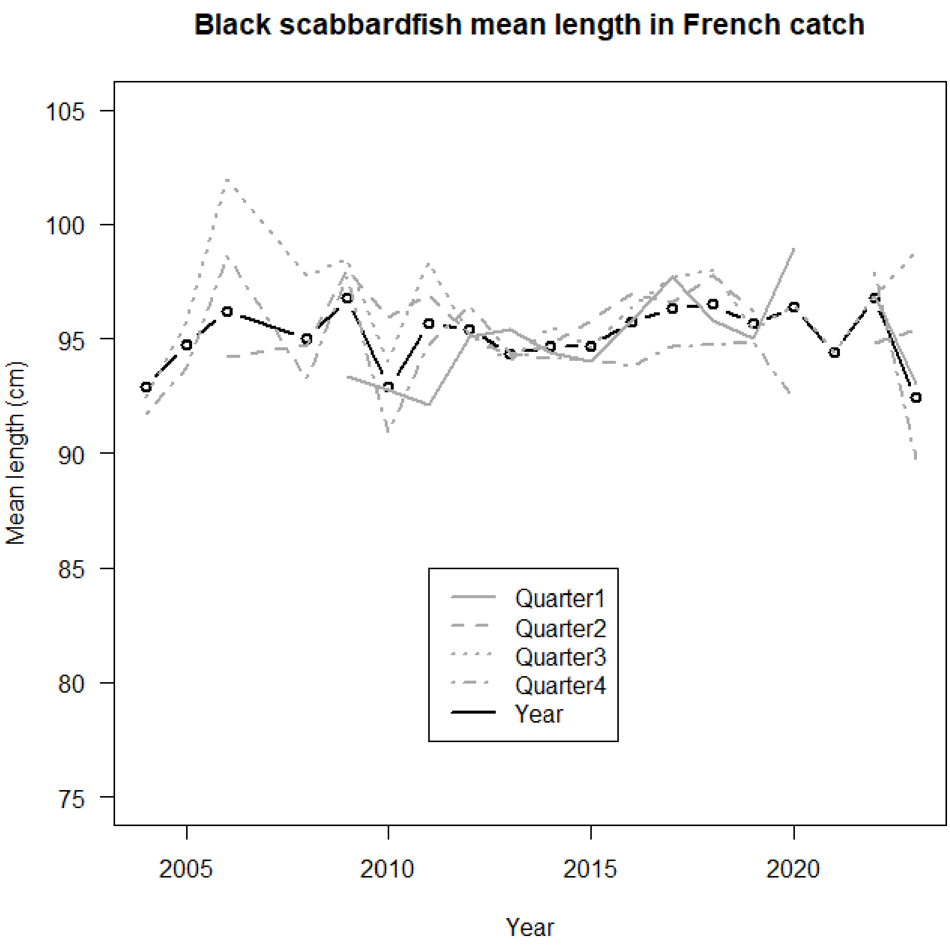


Figure 9.2.11. bsf.27.nea Northern component. Mean length estimates of black scabbardfish by quarter for the period 2004-2023. Data were collected under the French on-board observer program.

For the period 2014–2022, the annual length-frequency distributions based on samples collected at Faroese landings and Faroese deep-water surveys are presented in Figure 9.2.12. The mean length of the exploited population is around 90-92 cm, which is about the same mean length registered at the deep-water survey. In 2020, the Faroese survey length distribution includes specimens with length between 20 and 40 cm which were not registered before. Also, in 2020, the upper limit of the length range is lower than those from the previous years. The length frequency distribution for 2020 is not considered representative as it is based on 91 specimens and in the survey only 31 out of the 75 hauls planned were performed, due to the weather conditions and problems with the vessel.

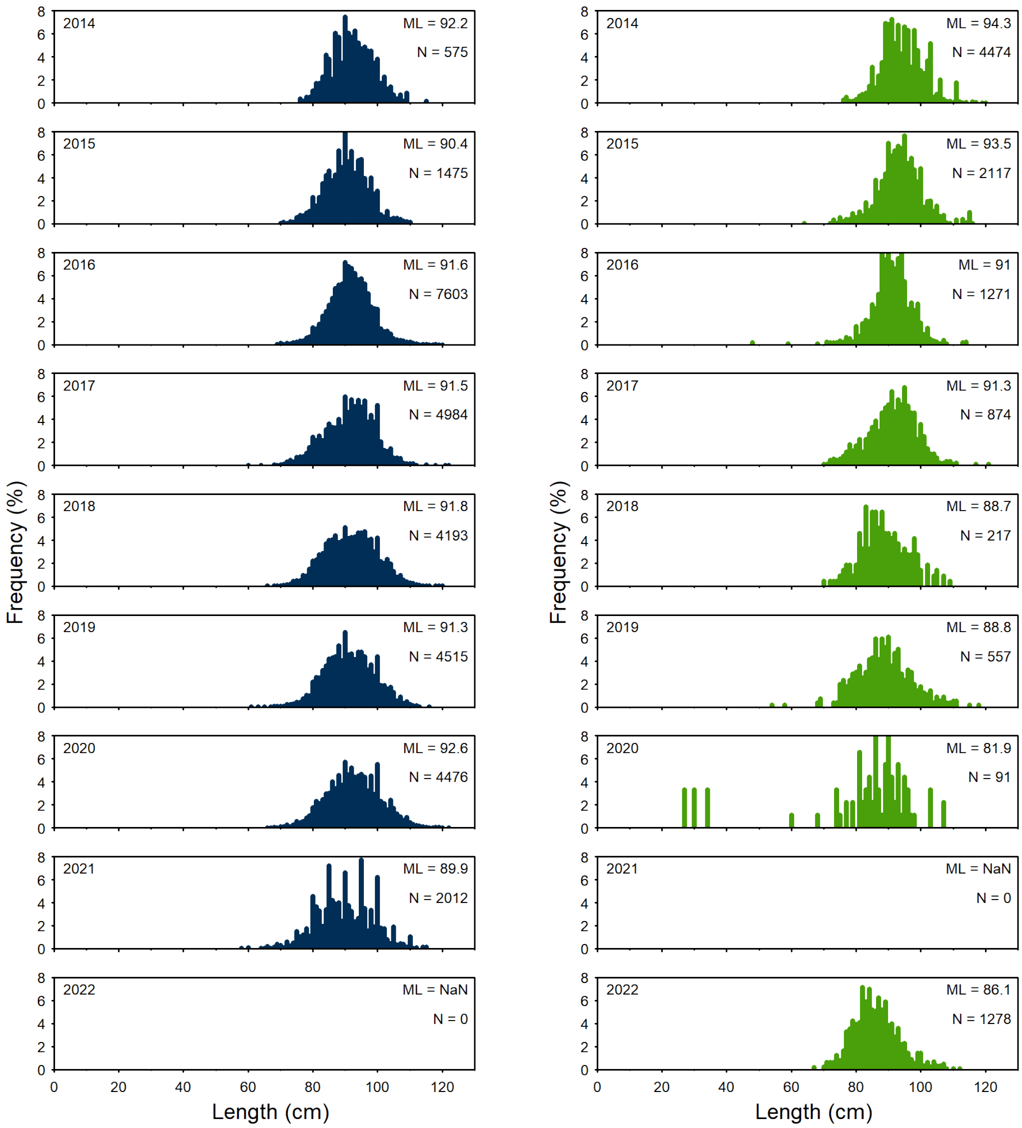


Figure 9.2.12. bsf.27.nea Northern component. Length-frequency distribution from the landings (no samples in 2022) (left) and the deep-water survey (no survey in 2021) (right) in 2014-2022. (Source: Ofstad, 2023 WD)

In 2024, no new length information was provided by Spain for ICES Division 27.6.b and ICES Subarea 27.12. For 2014 and 2015, the annual length frequency distributions for ICES Division 27.6.b and ICES Subarea 27.12 were constructed based on the length data collected under Spanish on-board observer program (Figure 9.2.13).

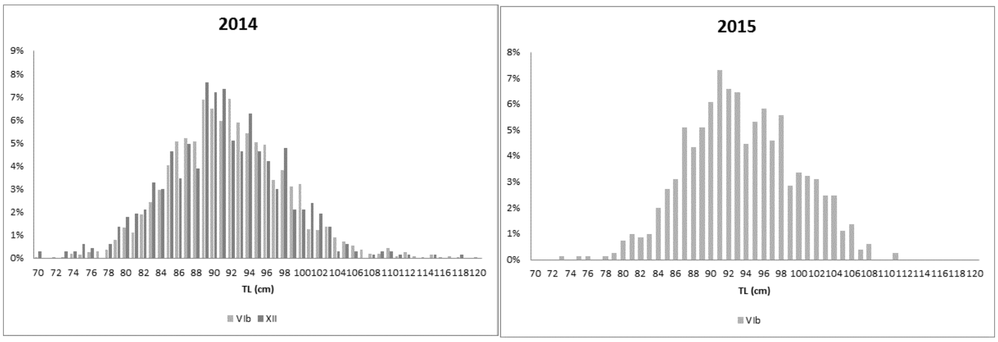


Figure 9.2.13. bsf.27.nea Northern component. Length frequency distribution based on Spanish on-board observations in 2014 (a) and in 2015 (b) in Division 6.b and Subarea 12.

Length frequency distributions for ICES Division 27.5.a based on the Icelandic Autumn surveys for the period 2000–2023 are presented in Figure 9.2.14.

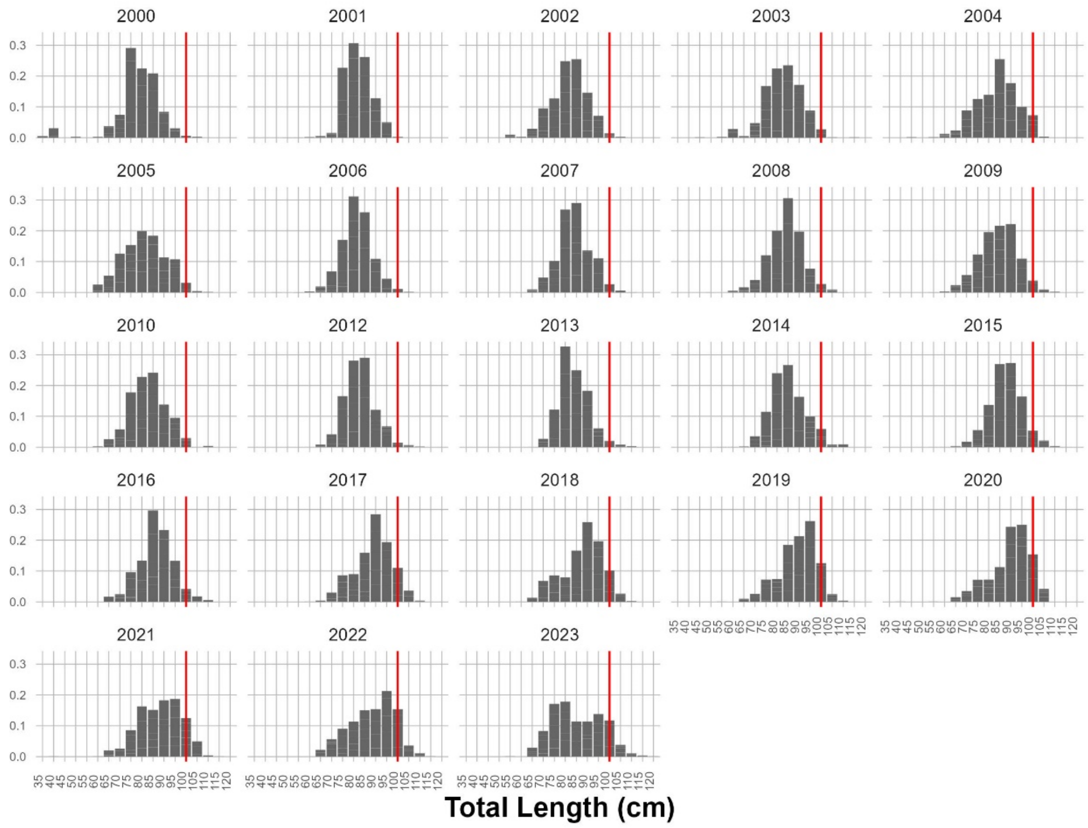


Figure 9.2.14. bsf.27.nea Northern component. Black scabbardfish in Division 27.5.a: length distribution from the Icelandic Autumn survey, from 2000 to 2023. The red vertical line indicates the length of 1st maturity of the species.

The length data available for the Northern component suggests a similar length structure of the exploited population between the different fishing fleets and specimens with total length smaller than 103 cm predominate.

French data is used to calculate the total catches, in number, grouped by 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 103 cm TL).

9.2.5.4 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.

9.2.5.5 Weight-at-age

No data on weight-at-age are available.

9.2.5.6 Maturity and natural mortality

The information available for ICES Subareas 27.5.b, 27.6, 27.7, and 27.12 consistently points out to the predominance of small and immature specimens.

9.2.5.7 Catch and effort data

Applying the same methodology adopted by France to standardize the CPUE including the periods beyond the EU bottom trawling ban the standardised French CPUE for the period 1998–2023 is presented in Figure 9.2.15.

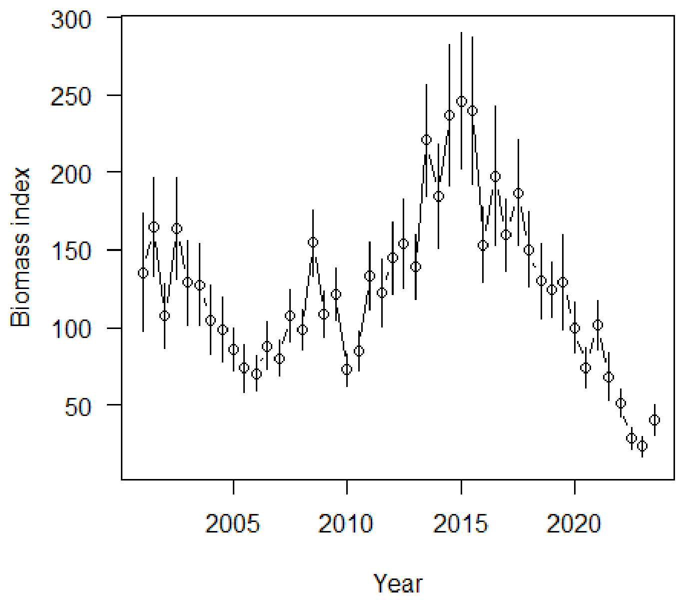


Figure 9.2.15. bsf.27.nea Northern component. CPUE by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

WGDEEP 2024 concluded that for the more recent years of the time series, the French CPUE was no longer an indicator of relative biomass for the Northern component. This results from the fact that after the EU bottom trawl ban the traditional fishing grounds for black scabbardfish were no longer available for the French trawl fleet.

The trends in the abundance or biomass are different between the French CPUE and both the Scottish (Figure 9.2.3) and the Icelandic (Figure 9.2.5) surveys.

In recent years and due to the bottom trawl ban for waters deeper than 800 m, the French trawl fleet that traditionally catch black scabbardfish has displaced their fishing effort to shallower depths (Figure 9.2.16). Important to note that the distribution of the species according to data from the Scottish deep-water survey shows that the species is more frequent at depths between 800 and 1000 m in this area.

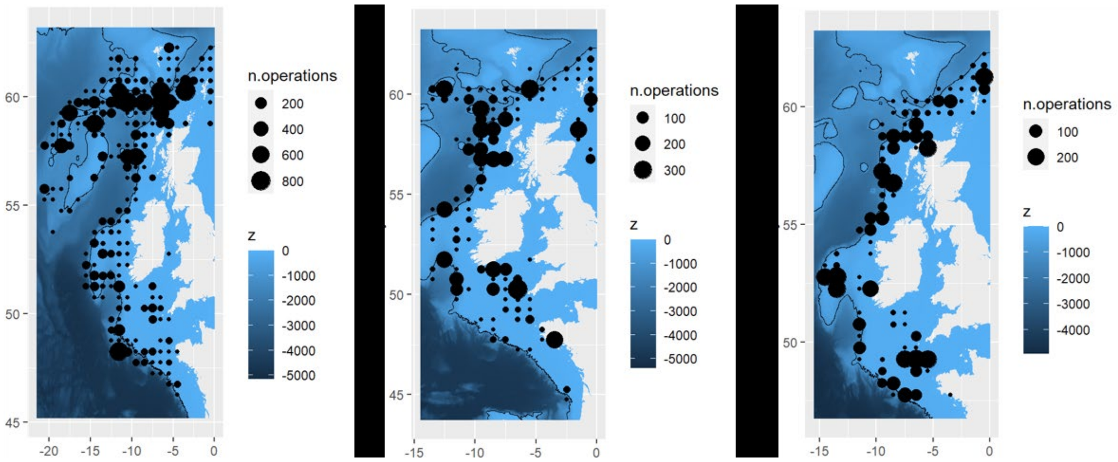


Figure 9.2.16. bsf.27.nea Northern component. Number of fishing operations by ICES statistical rectangle during 1st period (left panel), 2nd period (middle panel) and 3rd period (right panel). The contour lines represent the 1000 meters bathymetry. (Source: Figueiredo et al., 2024 WD)

The analysis of the number of the different bottom trawlers fleet, total number of fishing operations (Figure 9.2.17) and total catch of black scabbardfish by year from the French deep-water trawl suggest three different time periods of fishing activity:

1. 2002-2010 - High number of fishing operation;
2. 2011-2016 - High total catch of black scabbardfish;
3. 2017-2022 - After the EU bottom trawl ban.

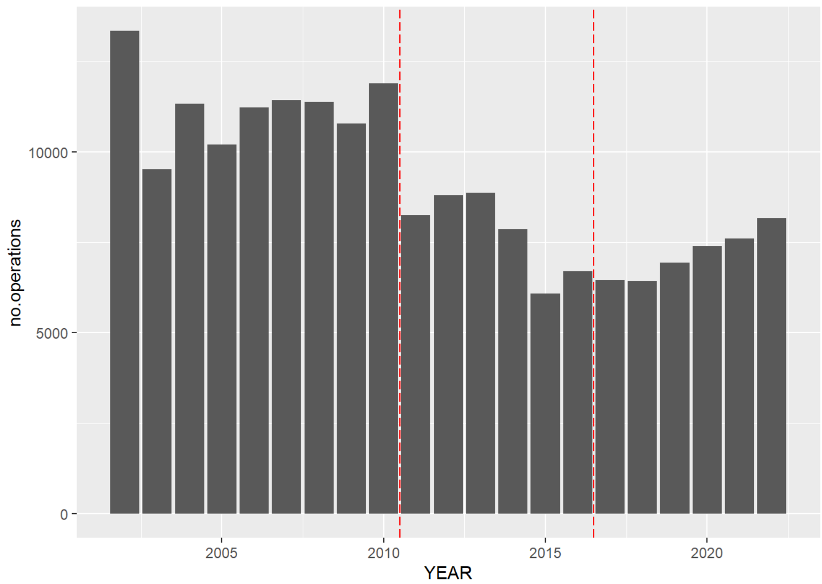


Figure 9.2.17. bsf.27.nea Northern component. Total number of fishing operations by year derived from the fishing operations with positive catches of black scabbardfish. Red lines show the limits of the three time periods: 2002-2010; 2011-2016; 2017-2022. (Source: Figueiredo et al., 2024 WD)

The spatial distribution of visited rectangles over time shows that, in recent years, the activity of the French deep-water trawl fishery with catches of black scabbardfish is concentrated in the northeast area, an area of oceanographic interest due to its dynamics and complex bathymetry, and that the number of vessels with positive landings of the species has decreased (Figure 9.2.18).

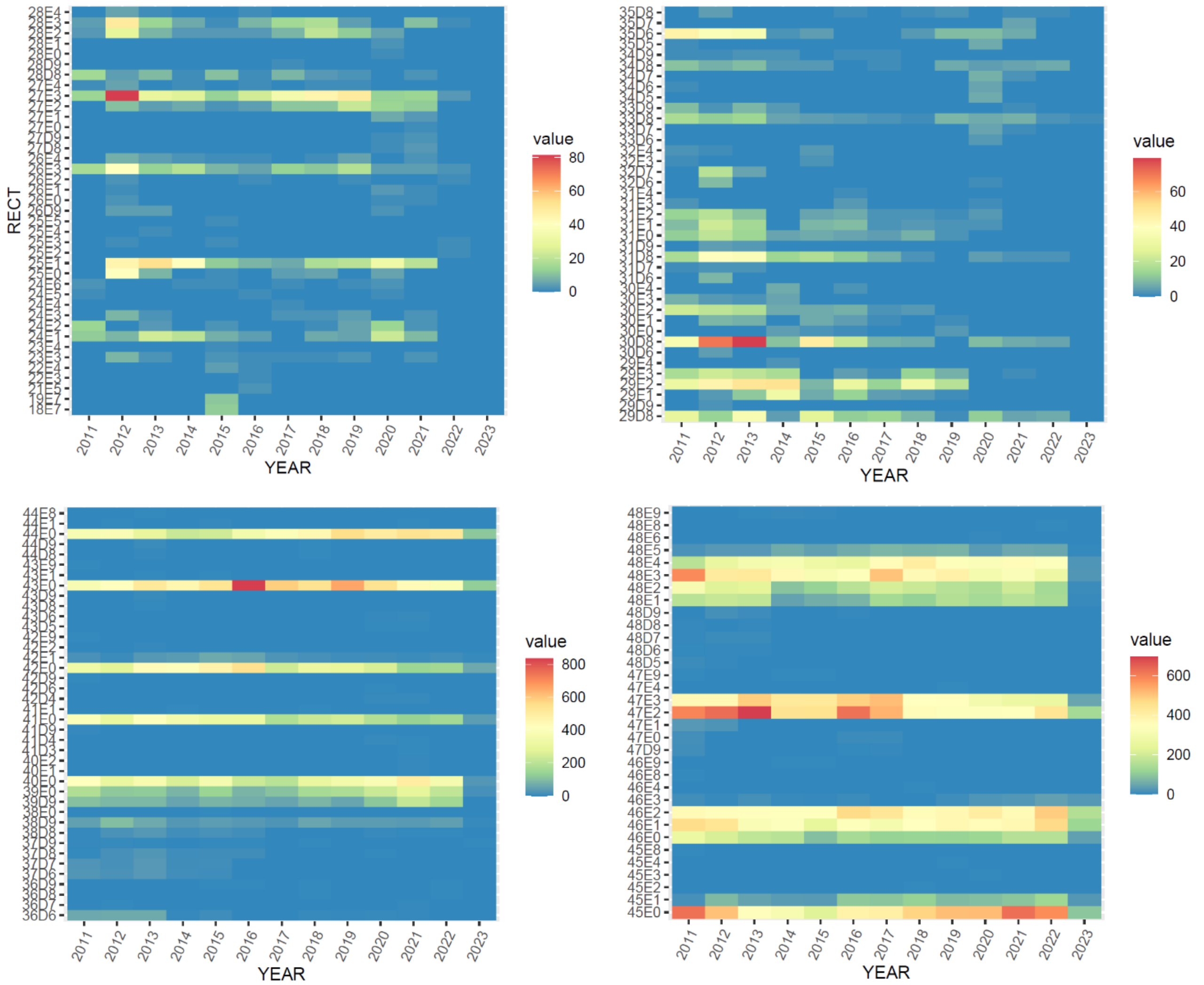


Figure 9.2.18. bsf.27.nea Northern component. Total number of fishing operations from the French deep-water trawl fishery derived from fishing vessels that have had fishing operations with positive catches of black scabbardfish by ICES rectangles between 2002 and 2022. RECT is the ID of each ICES rectangles.

Faroese commercial CPUE, between 2000 and 2021, 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 9.2.19. The CPUE from 2013 to 2015 the CPUE was twice the overall mean value. However, after 2016, the level of CPUE was similar to the start of the series. The temporal changes of CPUE appear to be related with changes of species target. In more recent years the fishery is mainly targeting blue ling. In 2022, the commercial trawler that had a fishery licence for black scabbardfish was sold, having only 8 black scabbardfish hauls in that year (Ofstad, 2023, WD). For that reason, CPUE was not updated for 2022 and 2023. The Faroese CPUE is thus not considered for monitoring the populations.

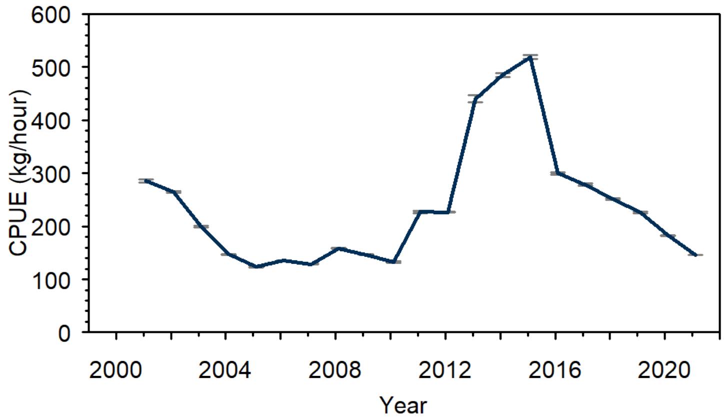


Figure 9.2.19. bsf.27.nea Northern component. Standardised CPUE (kg/hour) from Faroese commercial trawlers (> 1000 HK) in Division 27.5.b. Criteria: black scabbardfish >30% of total catch and effort > 2 hours per haul. (Source: Ofstad, L., 2022, pers. comm.).

9.2.6 Data analyses

WGDEEP 2024 tried to adjust the model previously benchmarked for bsf.27.nea.

For that purpose and for each component, the following information was considered:

- Catches in weight are converted into numbers and aggregated by six-month time periods defined 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. Note: The model includes a parameter that accommodates for the uncertainty on the input catch data.
- The landing data are considered reliable and discards are minor.
- Northern component: standardized fishing effort is derived from the standardised French CPUE.
- Southern component: standardized fishing effort is derived from the standardised Portuguese CPUE.

Furthermore, the distribution of the parameter related to emigration to the Northern component (recruitment) is unknown since survey data available is insufficient to derive a prior distribution for this parameter. Note that the Scottish survey is held every two years and at a time period out of the migration season. Due to the lack of a reliable recruitment index, a non-informative prior distribution is adopted in the model.

Model settings

Abundances of black scabbardfish at the Northern and Southern components are estimates based on two Bayesian state-space models. Under each model two separated processes run simultaneously but not independently since the migration from Northern to the Southern component is taken into account when fitting the model for the Southern component.

Model outputs provide posterior distributions of the stochastic state processes parameters associated with the species life cycle and with the migration processes. The prior distributions of those parameters are defined in a way that each of them incorporates the information available both on the biology and the fishery. More details on the definition of the prior distributions and on the model are described in the Stock Annex.

Model adequacy

Model fitting is evaluated for each model separately. For the Northern component, the **C2** and **C3** length groups catch estimates in semester *s* (that are equal to the median of the posterior distributions of those state process vector components in the **s** semester) are compared with the corresponding observational catch values. For the Southern model, the catch estimates in semester **s** are obtained in the same way as for the Northern component and these are compared with the corresponding observational catch values.

In 2024, the catch estimates (posterior medians) of C2 and C3 length classes combined and the corresponding observed catch in Northern and Southern components did not show a good fit. For both components, the range of the 95% credible intervals are relatively narrow, particularly for the semesters at the end of the studied period (Figure 9.2.20).

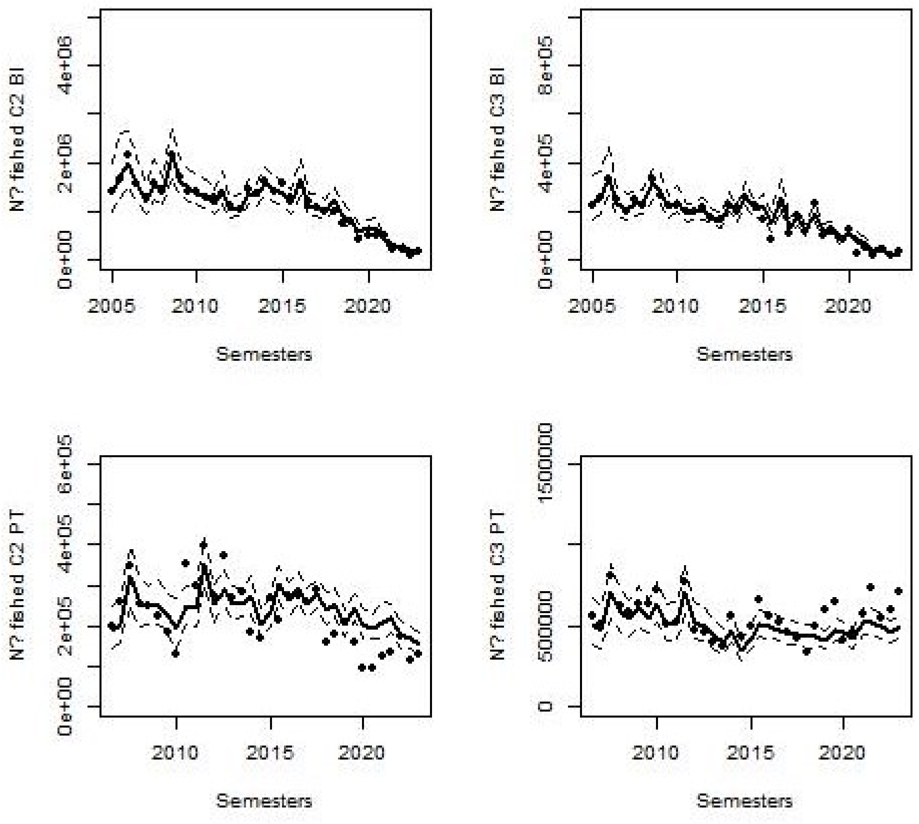


Figure 9.2.20. bsf.27.nea. Estimated catches (solid line) and 95% credible intervals (dashed lines), for Northern component C2 length group (upper left), C3 length group (upper right) and Southern component C2 length group (lower left) and C3 length group (lower right). Observed catches are represented by black dots.

MSY proxy reference points

Length-based indicators (LBIs) proposed by ICES for stocks in categories 3 and 6 were applied to the exploited population in the whole ICES area, that corresponds to the combined overall length frequency distribution of black scabbardfish from French length sampling in the Northern component (divisions 27.5.b, 27.6.a, and 27.6.b.1) and Portuguese length sampling in the Southern component (Division 27.9.a) for the period between 2019 and 2023. The length frequency distributions of 4 cm interval class were used. The life history parameters used for calculating the reference points, were L_{mat} = 103 cm (Figueiredo *et al.*, 2003) and L_{inf} = 159 cm (Vieira *et al.*, 2009).

The following traffic light table presents the final results from the combined length distribution of black scabbardfish in the Northern and Southern components for the period from 2019 to 2023 (Table 9.2.2).

Table 9.2.2. bsf.27.nea Northern and Southern components. LBI screening method ratios between 2019 and 2023.

		Conservation						Optimizing Yield	MSY
		L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{95\%}/L_{inf}$	L_{maxy}/L_{opt}	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	$L_{mean}/L_{F=M}$
Year	Ref.	> 1	> 1	> 0.8	≈ 1	> 0.8	>30%	≈ 1 (>0.9)	≥ 1
2019		0.95	0.95	0.73	1.01	0.75	5%	1.01	0.95
2020		0.68	0.97	0.74	1.01	0.75	5%	0.99	1.13
2021		0.76	1.00	0.74	1.05	0.76	6%	1.00	1.08
2022		0.99	1.00	0.74	1.01	0.76	8%	1.03	0.94
2023		0.99	1.01	0.74	1.01	0.75	5%	1.03	0.94

The length at first catch was smaller than the length at first maturity in all years. Most indicators of conservation state of the stock are below the desirable levels because they are based on length frequency analysis, which is shunt to lower lengths in the Northern component. These indicators are considered less informative given the available knowledge on species length-structure which are closely related to the tail of the frequency distribution. For this species, it should be possible to provide stock status by expert judgement, using indicators based on scientific knowledge on the species and the fishery.

The MSY indicator ($L_{mean}/L_{F=M}$) was above 1 in 2020 and 2021 and close to 1 in the other years. The optimizing yield indicator (L_{mean}/L_{opt}) was approximately 1 in all analysed years.

LBI results show that the stock is at an adequate status as the exploitation levels are above the length-based indicator of MSY.

9.2.7 Comments on the assessment

Because the model could not be fit in 2024, two approaches for the scientific advice were proposed. The first proposal was a roll-over of the advice given in 2022, since a benchmark is planned for 2024-2025. Alternatively, the rfb rule was applied for each component separately. In the latter case, it is important to remark that the exploitation pattern differs between the two components:

- the Northern component exploits the immature fraction of the population with total length predominantly below the size of first maturity (103 cm, Figueiredo *et al*., 2003);
- the Southern component exploits the adult fraction of the population with mean total length above the size of first maturity.

Roll-over

In 2024, the model showed a very poor fit which is most likely a result of changes in the French trawl fishery effort. As has been stated in previous years, the fishing effort from EU vessels in the Northern Component area has been greatly reduced due to the EU Regulation 2016/2336 (EU, 2016) that bans fishing with bottom trawls at a depth below 800 metres, with impacts on the French bottom deep-water fishery that catches the black scabbardfish.

MSY approach

In 2024, the ICES framework for category 3 stocks (rfb rule, ICES, 2023a) was applied to provide advice to black scabbardfish stock in the NE Atlantic. The advice for the whole stock was divided amongst the two components by applying the 5-year mean of the ratio between the TACs for each component to have a previous advice catch for each component.

Southern component

For the Southern component (Subarea 8 and Division 9.a), standardized landings-per-unit-effort (LPUE, in $kg.trp^{-1}$) was used as an indicator of stock development. The advice is based on the previous catch advice multiplied by the ratio between the mean of the last two years' index value (Index A, 2022-2023) over the mean of the previous three years' index (Index B, 2019, 2020, and 2021); a ratio of observed mean length in the catch relative to the target mean length of the whole area (Northern and Southern components); a biomass safeguard; and a precautionary multiplier. For estimating the fishing pressure proxy, the MSY proxy length ($L_{F=M}$) is based on L_c (length at 50% of modal abundance), which is taken from pooled data (2021-2023) from the French and Portuguese fishery length sampling, to cover the differences in length distribution of the whole stock. The basis for the catch scenarios for the Southern component is presented in Table 9.2.3.

Table 9.2.3. bsf.27.nea Southern component. The basis for the catch scenarios for the Southern component*.

Previous catch advice A_y (proportion estimated from previous total advice)		2346 tonnes
Stock biomass trend		
Index A (2022, 2023)		889 $kg.trip^{-1}$
Index B (2019, 2020, 2021)		1035 $kg.trip^{-1}$
r: Stock biomass trend (index ratio A/B)		0.86
Fishing pressure proxy		
Mean catch length ($L_{mean}=L_{2023}$)		108.94 cm
MSY proxy length ($L_{F=M}$)		110.25 cm
Fishing pressure proxy ($L_{F=M\,2023}/ L_{mean}$)		1.01
f: Fishing pressure proxy relative to MSY proxy ($L_{mean}/L_{F=M}$)		0.99
Biomass safeguard		
Last index value (I_{2023})		947 $kg.trip^{-1}$
Index trigger value ($I_{trigger}=I_{loss}\times1.4$)		863 $kg.trip^{-1}$
b: index relative to trigger value, min{$I_{2023}/I_{trigger}$, 1}		1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability		
m: multiplier (generic multiplier based on life history)		0.95
RFB calculation**		1868 tonnes
Stability clause (+20%/-30% compared to A_y, only applied if b≥1)	Not applied	
Discard rate		Negligible
Catch advice for 2025 and 2026		1868 tonnes
% advice change^		-19%

* The figures in the table are rounded. Calculations were carried out with unrounded inputs, and computed values may not match precisely when calculated using the rounded figures in the table.
** Formula [$Ay+1 = Ay \times r \times f \times b \times m$]
^ Advice value for 2025 and 2026 relative to the previous catch advice for 2023 and 2024.

The advice for 2025 and 2026 has decreased by 19%. This is a result of moving to the MSY approach (rfb rule).

<u>Northern component</u>

For the Northern component (Division 5.b, subareas 6–7, and Division 12.b), the advice is based on the previous catch advice multiplied by the ratio between the recent Scottish survey biomass index (kg.hour^{-1}) (Index A, only 2023) over the mean of the two previous years' index (Index B, 2017 and 2019 because the survey takes place every other year); a ratio of observed mean length in the catch relative to the target mean length of the whole area (Northern and Southern components); a biomass safeguard; and a precautionary multiplier. For estimating the fishing pressure proxy, the MSY proxy length ($L_{F=M}$) is based on L_c (length at 50% of modal abundance), which is taken from pooled data (2021-2023) from the French and Portuguese fishery length sampling, to cover the differences in length distribution of the whole stock. The basis for the catch scenarios for the Northern component is presented in Table 9.2.4.

Table 9.2.4. bsf.27.nea Northern component. The basis for the catch scenarios for the Northern component*.

Previous catch advice A_y (proportion estimated from previous total advice)	1868 tonnes
Stock biomass trend	
Index A (2023)	44 kg.hour^{-1}
Index B (2017, 2019)	67 kg.hour^{-1}
r: Index ratio (A/B)	0.65
Fishing pressure proxy	
Mean catch length (L_{mean}=L_{2023})	95.91 cm
MSY proxy length ($L_{F=M}$)	110.25 cm
Fishing pressure proxy ($L_{F=M\ 2023}$/ L_{mean})	1.15
f: multiplier for relative mean length in catches (L_{mean}/$L_{F=M\ 2023}$)	0.87
Biomass safeguard	
Last index value (I_{2023})	43 kg.hour^{-1}
Index trigger value ($I_{trigger}$=I_{loss}×1.4)	15 kg.hour^{-1}
b: multiplier for index relative to trigger min{I_{2023}/$I_{trigger}$, 1}	1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
RFB calculation**	1007 tonnes
Stability clause (+20%/−30% compared to A_y, only applied if b ≥ 1)	Applied
Discard rate	Negligible
Catch advice for 2025 and 2026	1308 tonnes
% advice change^	-30%

* The figures in the table are rounded. Calculations were carried out with unrounded inputs, and computed values may not match precisely when calculated using the rounded figures in the table.

** Formula [$Ay{+}1 = Ay \times r \times f \times b \times m$]

^ Advice value for 2025 and 2026 relative to the previous catch advice for 2023 and 2024.

9.2.8 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 27.5.a were included in the Northern component in the assessment of the stock.

Changes on the fishing depth by the French trawlers might have an impact on catchability and a deeper scrutiny on depth of the French fishing grounds by year is required to incorporate those changes in the assessment model. In recent years the fishing effort on black scabbardfish indicates that the fishing operations are mainly performed at depth strata shallower than 800 m, possible as a response to the EU Regulation trawl ban (EU, 2016).

WGDEEP 2024 supported the need for a benchmark to revisit all the available data and information and decide the more appropriate assessment method for this stock.

9.2.9 Tables

Table 9.2.4a. 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	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
	27.5.b.1	27.5.b.2	27.5.b	27.5.b	27.5.b.1	27.5.b	27.5.b			
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**
2019	395	93		52						**540**
2020	317	102		21			0			**440**
2021	41	101		17			-	-		**159**
2022	3	13		6			-	-		**22**
2023	1	0		2			0	.		4

***STATLAND data from 1988 to 2011.**

****STATLAND data.**

Table 9.2.4b. Landings of black scabbardfish from Division 27.12. 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**

Year	Faroes	France	Scotland	Spain	Germany*	E&W&NI	Ireland	Total
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**
2017	0			68				**68**
2018				125				**125**
2019	0			46				**46**
2020				25				**25**
2021				0				**0**
2022								**0**
2023	-			-				**0**

***STATLAND data from 1988 to 2011.**

Table 9.2.4b. Continued.

Year	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
1988		-	.	.	.		**0**
1989		-	.	.	.		**0**
1990		-	.	.	.		**0**
1991		-	.	.	-		**0**
1992		-	.	-	-		**0**

Year	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
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**
2012						907	**907**
2013						289	**289**
2014							**0**
2015							**0**
2016							**0**
2017							**0**
2018							**0**
2019							**0**
2020							**0**
2021							**0**

Year	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
2022							**0**
2023							**0**

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.4c. Landings of black scabbardfish from Subarea 27.6. Working group estimates.

Year	France			Faroes	Germany		Ireland		Scotland		Spain		Total
	27.6	27.6.a	27.6.b	27.6.a	27.6.a	27.6.b	27	27.6.a	27.6.a	27.6.b	27.6.a	27.6.b	
1988					.	.							**0**
1989		138	0	46	.	.			-	-			**184**
1990		971	53		.	.			-	-			**1023**
1991		2244	62		-	-			-	-			**2307**
1992		2998	113	3	-	-			-	-			**3113**
1993		2857	87		48	-	62		-	-			**3054**
1994		2331	55		30	15			2	-			**2433**
1995		2598	15		-	3			14	4			**2634**
1996		2980	1		-	2			36	<0.5			**3019**
1997		2278	16				3		147	88			**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**
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**

Year	France			Faroes	Germany		Ireland		Scotland		Spain		Total
	27.6	27.6.a	27.6.b	27.6.a	27.6.a	27.6.b	27	27.6.a	27.6.a	27.6.b	27.6.a	27.6.b	
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	0		2		110				**2018**
2015		1870		1					124		10	172	**2280**
2016		2336							96		9	163	**2669**
2017		1714		64					101		3	153	**1970**
2018		1601		-			-		65	0	0	124	**1791**
2019		1124							45		1	52	**1222**
2020		769							20			57	**846**
2021		651		1					34	0			**686**
2022		349							5			0	**354**
2023		94		-	-				13	0		-	107

Table 9.2.4c. Continued.

Year	E&W&NI**	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**
1994		-	-		-	-	-	-		**30**
1995		-	-		-	-	-	-		**0**
1996		-	-		-	-	-	-		**0**
1997		-	-		-	-	-	-		**0**
1998		-	-		-	-	-	-		**0**
1999		11	-		-	-	-	-		**11**

Year	E&W&NI**	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		
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		3	0		0	0	0	0	0	**3**
2015				5						**5**
2016				1						**1**
2017				0						**0**
2018										**0**
2019										**0**
2020										**0**
2021	34									**34**
2022										**0**
2023										**0**

***STATLAND data from 1988 to 2011.**

****STATLAND data.**

Table 9.2.4d. Landings of black scabbardfish from Division 27.7. 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.d	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
	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.d	7	
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**
2019			0	0	0	6	15	0		0					10	**30**
2020			1	0	0	16	15	0		0					6	**38**
2021			0	0		3	18	0						0	7	**28**
2022			0	0	1	0	10	0		0					2	**14**
2023			0	0	-	1	5	0	0	-	.		-	.	3	**9**

Table 9.2.4e. Landings of black scabbardfish from Divisions 27.6 and 27.7. 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**

Year	Ireland	E&W&NI	Total
2006	-	-	**0**
2007	-	-	**0**
2008	-	-	**0**
2009	-	-	**0**
2010	-	-	**0**
2011	-	-	**0**
2012	-	-	**0**
2013	-	-	**0**
2014	-	-	**0**
2015	-	-	**0**
2016	-	-	**0**
2017	-	-	**0**
2018		0	**0**
2019			**0**
2020	0	0	**0**
2021			**0**
2022			**0**
2023	.		**0**

Table 9.2.4f. Landings of black scabbardfish from 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**

Year	Iceland	Faroes	Total
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**
2016	346		**346**
2017	294		**294**
2018	142		**142**
2019	65		**65**
2020	102		**102**
2021	31		**31**
2022	63		**63**
2023	55	-	55

9.3 Black scabbardfish (*Aphanopus carbo*) in subareas 27.8 and 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 these are also relatively low.

9.3.2 Landings trends

Landings in subareas 27.8 and 27.9 are mostly from the Portuguese longline fishery that takes place in Division 27.9.a, which represents more than 96% of the total landings (Figure 9.3.1).

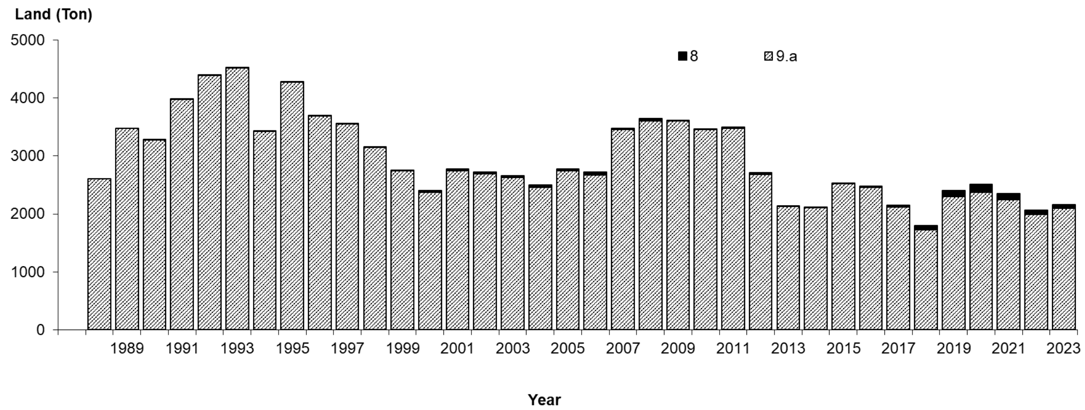


Figure 9.3.1. bsf.27.nea Southern component. Annual landings for ICES Subarea 27.8 and Division 27.9.a.

9.3.3 ICES Advice

The latest ICES advice, in 2022, was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 4214 tonnes in each of the years 2023 and 2024.*"

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 2024, 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, 27.9, and 27.10 from 2006 to 2020.

Year	EU TAC 27.8,27.9,27.10	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	1801	14
2019	2832	2409	20
2020	2832	2507	0
2021	2266	2348	0
2022	2266	2063	0
2023	2130	2163	49
2024	2130		

*** 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

Information on the discards of deep-water species estimated by the Portuguese on-board sampling programme (EU DCR/NP) was the same as previously presented (Fernandes, 2021, WD).

Discards of most species carried out by Portuguese vessels operating deep-water set longlines (targeting black scabbardfish) within the Portuguese part of ICES Division 27.9.a were not quantified at fleet level. The black scabbardfish discards are mainly due to shark and cetacean predation on hooked specimens and are relatively low when compared to catches.

The low frequency of occurrence of discarding and the low number of discarded specimens registered in the sampled hauls and sets lead to assume that discards in the Southern component are negligible.

9.3.5.2 Length compositions

Length–frequency distributions of the black scabbardfish landed at the main landing port for the species in ICES Division 27.9.a (Sesimbra port) by the Portuguese longline fleet derived from the DCF/EU landing sampling program from 2017 to 2023 are presented in Figure 9.3.2.

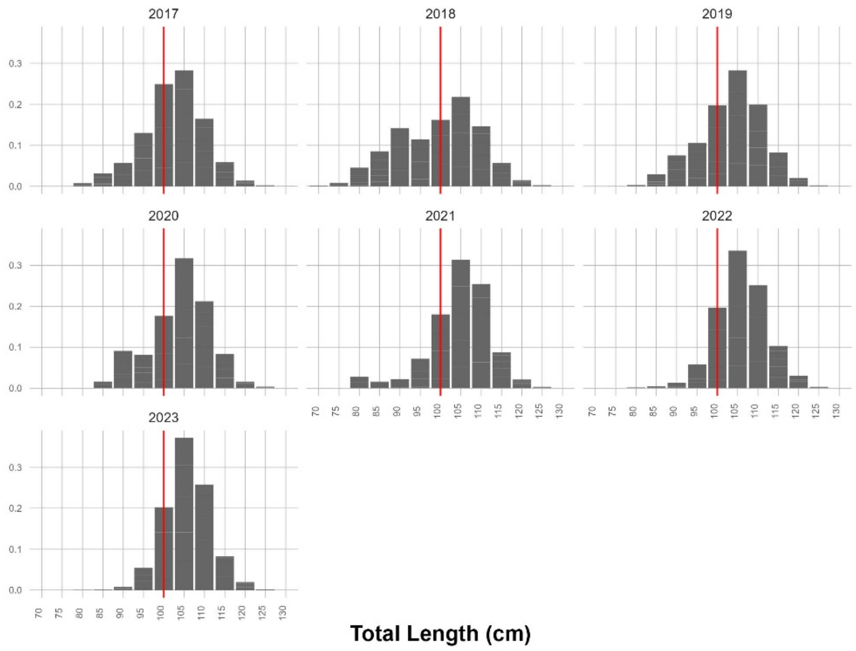


Figure 9.3.2. bsf.27.nea Southern component. Length–frequency distribution of black scabbardfish exploited by the deep-water longline fishery for ICES Division 27.9.a, from 2017 to 2023.

In the last assessment, in 2022, length–frequency distributions of the black scabbardfish from 2001 to 2021 were used, to separate the Southern component into the two length groups (TL (total length): 70 cm < C2 < 103 cm; C3: TL > 103 cm) defined by the assessment approach adopted by WKDEEP 2014 (Table 9.3.2).

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 Division 27.9.a, only immature and early developing specimens have been observed (Figueiredo, 2009, WGDEEP WD; Neves *et al.*, 2009). Mature individuals have only been reported in Madeira (Figueiredo *et al.*, 2003), Canary Islands (Pajuelo *et al.*, 2008), and the Northwestern coast of Africa (Perera, 2008). In those areas, spawners of two congener species (*Aphanopus carbo* and *A. intermedius*) coexist (Stefanni and Knutsen, 2007; Biscoito *et al.*, 2011; Besugo *et al.*, 2014, WD).

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% (Neves *et al.*, 2009).

9.3.5.6 Catch, effort and research vessel data

Standardised Portuguese CPUE series covering the period 1995-2023 are presented by a six-month time period, as: SEM1=months 3-8 of the year; SEM2=month 9-12 of the year plus months 1 and 2 of the following year (Figure 9.3.3). Estimates of CPUE were obtained through the adjustment of a GLM model, in which monthly CPUE is the response variable and Year, Month, and Vessel are the factors. The monthly CPUE was calculated for each vessel as the ratio of the total landed weight (kg) and the number of fishing trips. Only vessels having total annual landings ≥ 1000 Kg and more than one year of landings were considered.

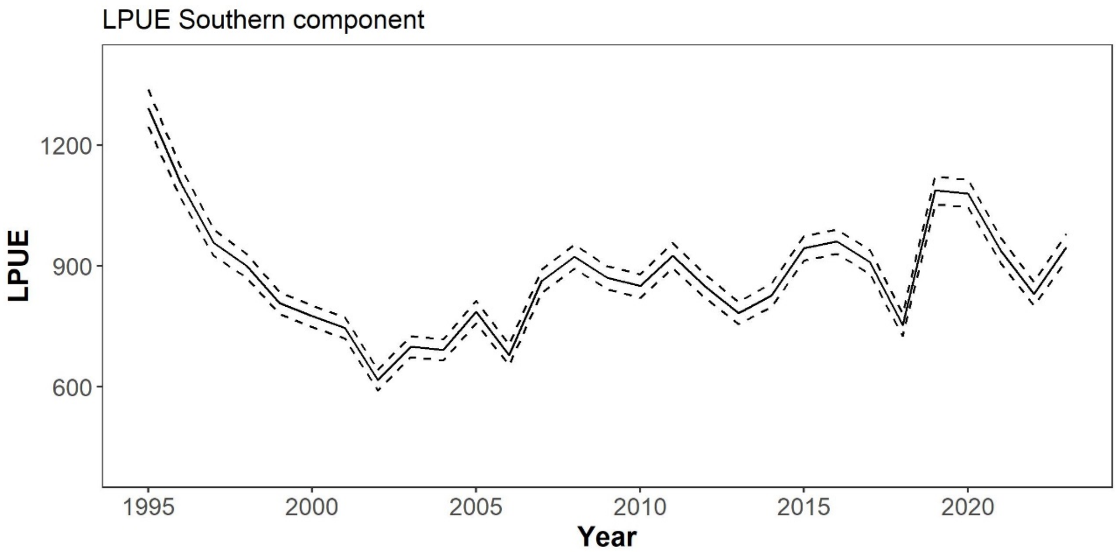


Figure 9.3.3. bsf.27.nea Southern component. Standardised Portuguese CPUE.

9.3.6 Data analyses

Data analyses are described in section 9.2.5. One single assessment is admitted for the stock, which combines data from the two fisheries areas: subareas 27.5, 27.6 and 27.7 and Division 27.12.b; and divisions 27.8 and 27.9 on the other hand.

9.3.7 Management considerations

Management considerations are described in section 9.2.8.

9.3.8 Tables

Table 9.3.3a. 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**

Year	Portugal	France	Spain	Total
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**
2017	2117		0	**2117**
2018	1727		0	**1727**
2019	2302			**2302**
2020	2369		0	**2369**

Year	Portugal	France	Spain	Total
2021	2245		0	**2245**
2022	1994		0	**1995**
2023	2092		0	**2092**

Table 9.3.3b. 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	8	
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**

Year	France						Spain					Total
	8	8.a	8.b	8.c	8.d	8.e	8.a	8.b	8.c	8.d.2	8	
2011		4	0	0	14							**18**
2012		10	0		3						18	**32**
2013		5	0	0	2						3	**10**
2014		7	0	0	3							**9**
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**
2019		12	5		8		45	15	0	22		**108**
2020		19	5	0	14		55	23	1	20	0	**138**
2021		13	12	0	5		36	19	2	17	0	**103**
2022		14	5	0	5		18	11	2	14		**69**
2023		3	9	0	1		20	17	5	16		**71**

9.4 Black scabbardfish (*Aphanopus carbo*) in other areas (27.1, 27.2, 27.3.a, 27.4, 27.10, and 27.14)

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 extremely low levels, such as in subareas 27.1–4. Those levels may just indicate that the species has a low occurrence in those areas. On the contrary, landings from other areas, particularly in Subarea 27.10, indicate that the level of abundance of the species appears to be significant.

To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, WGDEEP 2016 agreed to include ICES Division 27.5.a in the Northern component (ICES, 2016). Consequently, landings information from ICES Division 27.5.a, which was formerly included in the present section, has been moved to section 9.2 of this Report.

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 27.10, landings have been variable since 1991, with reported landings above 300 ton in 1992, 2005, and 2012, but being zero in 1994, 2001, 2007, and between 2020 and 2022. In 2023, 49 ton were reported for Subarea 10.

The 111 tonnes reported in 2010 in ICES Subarea 27.14 are considered as misreporting.

9.4.3 ICES Advice

The latest ICES advice, in 2022, was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 4214 tonnes in each of the years 2023 and 2024.*"

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 2020 by subarea are presented in Table 9.4.1.

In 2010, between 2012 and 2014, and in 2016, 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, and 27.14 and Division 27.5a, from 2007 to 2023.

YEAR	EU TAC 27.1, 27.2, 27.3, and 27.4	EU Landings 27.2, 27.3, 27.4, 27.5a, and 27.14
2007	15	3
2008	15	0
2009	12	20

2010	12	236
2011	12	174
2012	9	453
2013	9	416
2014	9	370
2015	9	268
2016	9	356
2017	9	294
2018	9	156
2019	-	66
2020	-	106
2021	-	33
2022	-	63
2023	-	55

*** TACs and landings for subarea 27.10 are included in Table 9.3.1.**

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 27.2, 27.4, and 27.14 reported landings are considered to be misreported, although it is not known to what extent.

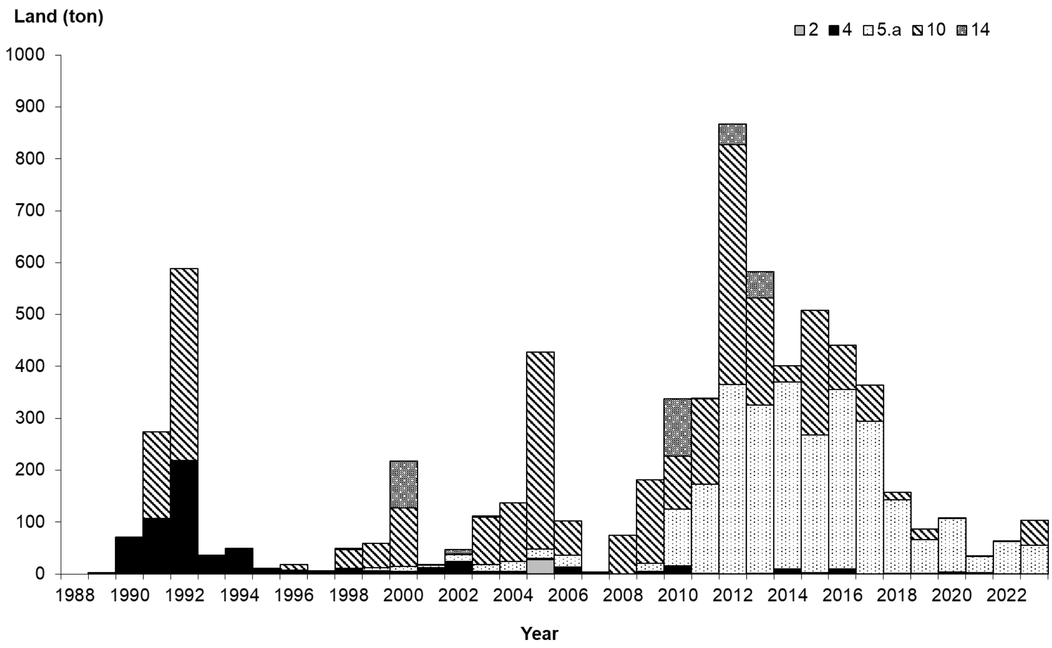


Figure 9.4.1. Annual landings for black scabbardfish in ICES subareas 27.2, 27.4, 27.5a, 27.10, and 27.14, between 1988 and 2023.

Greenland catches of black scabbardfish have been null in years between 1998 and 2023 except 2010 and 2011 (Christiansen and Nogueira, 2024 WD). For these two later years, 100 and 300 kg were reported from trawl bycatch, both in September (Figure 9.4.2).

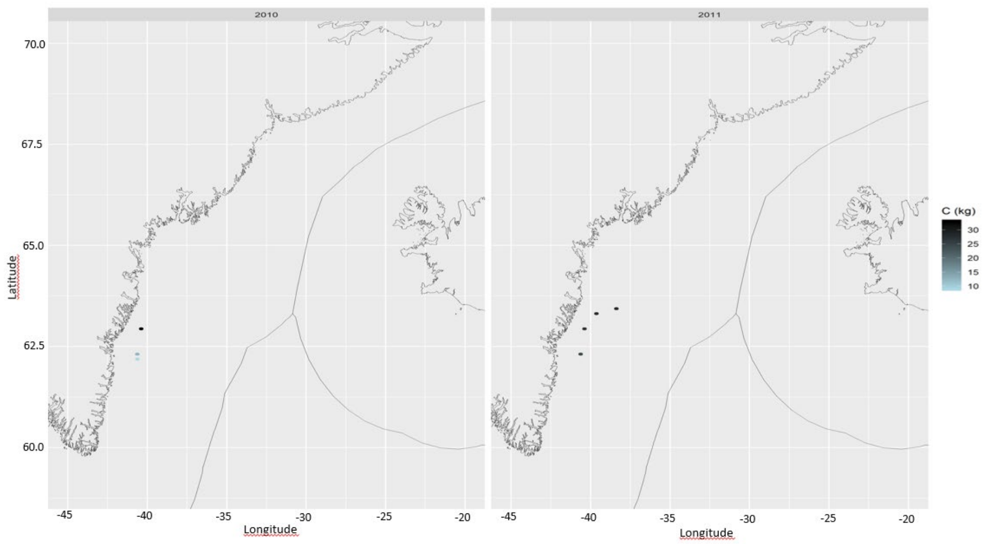


Figure 9.4.2. bsf.27.nea Black scabbardfish in 14. Distribution of commercial catches of black scabbard fish (in Kg) in East Greenland from 2010 and 2011. (Source: Nielsen *et al.*, 2019b WD)

9.4.5.2 Length compositions

No new information has been reported, except for ICES Division 27.5.a, which was included in the Northern component Section 9.2.4.3.

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

In ICES Division 27.14.b, catches of black scabbard fish have been zero all years except 2010 and 2011 when 100 and 300 kg were reported from trawl bycatch from the fishery for Greenland halibut (*Reinhardtius hippoglossoides*) (Nielsen, 2021 WD).

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). The vessel (R/V Paamiut) used for the surveys from 1998-2016 was retired in 2018 before paired trawling experiments with a replacement vessel could be conducted. In 2022, the new vessel owned by GINR, R/V Tarajoq with a Bacalao 476 trawl began a new survey series (Nogueira and Christiansen, 2023, WD).

Black scabbardfish are rarely caught in this survey series (Nogueira and Christiansen, 2023, WD; Christiansen and Nogueira, 2024, WD). The species was caught in the years 2004-2005 and 2007-2015 (Figure 9.4.3). Since the start of the new survey series, it has not been caught. In 2013 and 2015, the species was caught only in 1 station, 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, where the majority of the biomass also has been observed in previous years.

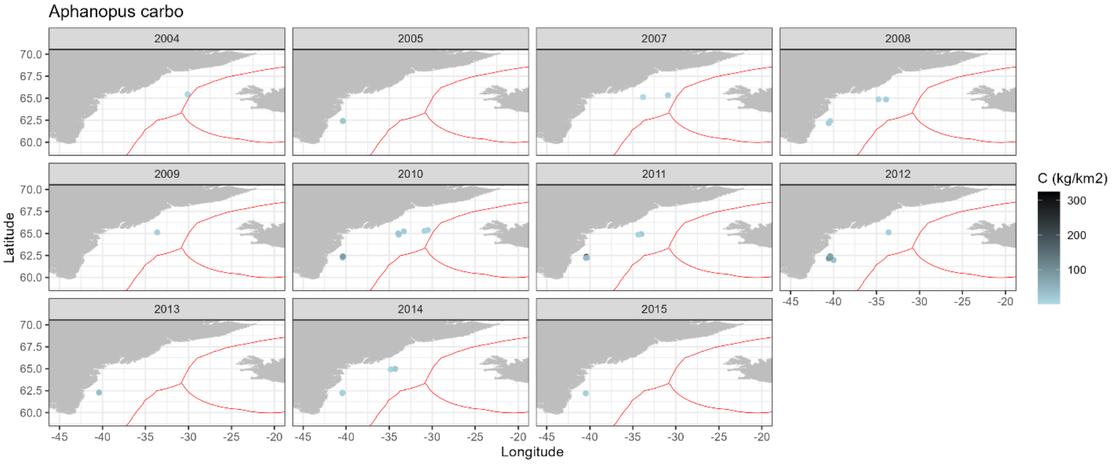


Figure 9.4.3. bsf.27.nea Black scabbardfish in Subarea 27.14. Distribution of survey catches of black scabbard fish at East Greenland (ICES Division 27.14.b) from 1998-2016 and 2022. Figure (Source: Nogueira and Christiansen, 2023 WD)

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 benthopelagic and deep living, hence it is not fully fished by the applied 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 (Figure 9.4.4).

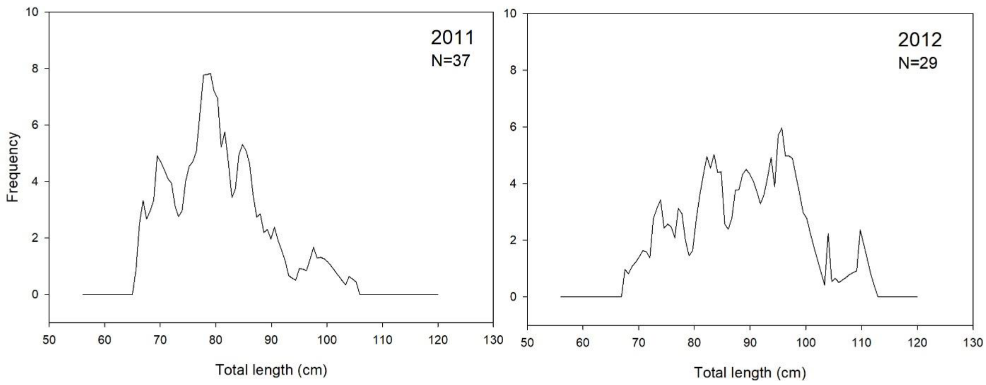
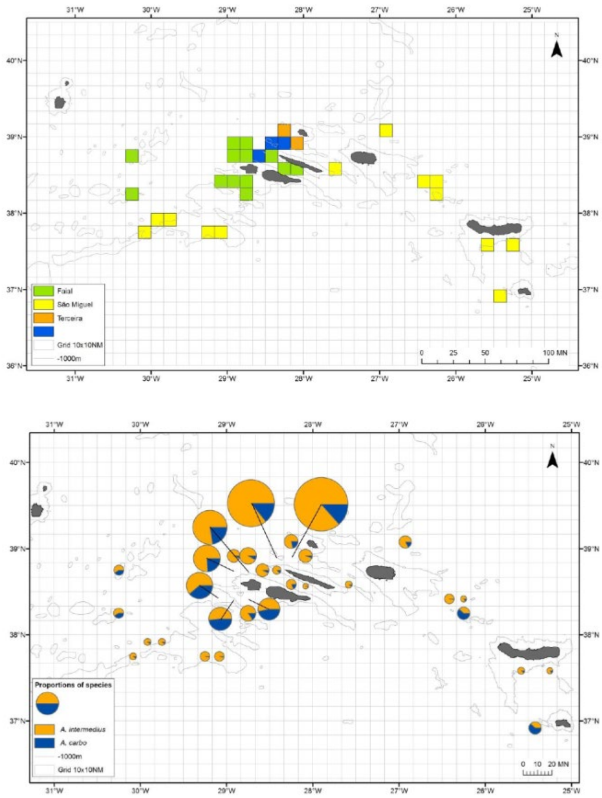


Figure 9.4.4 bsf.27.nea Black scabbardfish in Subarea 27.14. Length distribution of black scabbardfish at East Greenland (ICES Division 27.14.b) for 2011 and 2012. Survey years with n<20 are not shown. (Source: Nielsen *et al.*, 2019a WD)

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 9.4.5, 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 9.4.5. bsf.27.nea. 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) in Division 27.10.a. (Source: Besugo *et al.*, 2014 WD)

9.4.7 Comments on the assessment

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 the evidence is in line with it.

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 27.2 and 27.3. Working Group estimates of landings.

Year	France	Faroes 27.2.a	Iceland* 27.2.a.2	France 27.3.a	Total
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 27.2.a	Iceland* 27.2.a.2	France 27.3.a	Total
2014	-	-			**0**
2015	-	-			**0**
2016	-	-		0	**0**
2017	-	-		-	**0**
2018	-	.	13	-	**13**
2019					**0**
2020	0				**0**
2021					**0**
2022					**0**
2023	.	.	.	.	**0**

*** 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	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**

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	27.4.c	
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**
2019		1											**1**
2020		0	3			0						0	**4**

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	27.4.c	
2021		2			0								**0**
2022											0		**0**
2023		0			-								**0**

Table 9.4.2c. 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**
2012	4	458			**462**
2013		206			**206**
2014	30	-			**30**
2015	234	7			**240**

Year	Faroes	Portugal	France	Ireland	Total
2016	50	36			**86**
2017	7	63			**70**
2018	-	14			**14**
2019	3	17			**20**
2020		0	0	0	**0**
2021		0			**0**
2022		0			**0**
2023	-	49		.	**49**

Table 9.4.2d. Black scabbardfish other areas: Subarea 27.14. Working Group estimates of landings.

Year	Faroes 27.14	Spain	Greenland 27.14.b	Unallocated	Total
1988	-				**0**
1989	-				**0**
1990	-				**0**
1991	-				**0**
1992	-				**0**
1993	-				**0**
1994	-				**0**
1995	-				**0**
1996	-				**0**
1997	-				**0**
1998	2				**2**
1999	-		0		**0**
2000		90	0		**90**
2001		0	0		**0**
2002		8	0		**8**
2003		2	0		**2**
2004			0		**0**

Year	Faroes 27.14	Spain	Greenland 27.14.b	Unallocated	Total
2005	0		0		**0**
2006			0		**0**
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**
2019					**0**
2020		0			**0**
2021					**0**
2022					**0**
2023	-		-		**0**

9.5 Black scabbardfish (*Aphanopus carbo*) in CECAF area

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 reliable CECAF data could provide a wider perception of the stock dynamics. Updated information on the black scabbardfish fishery in Madeira (CECAF 34.1.2) has been presented to WGDEEP (Sousa *et al.*, 2024 WD).

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) (Figure 9.5.1).

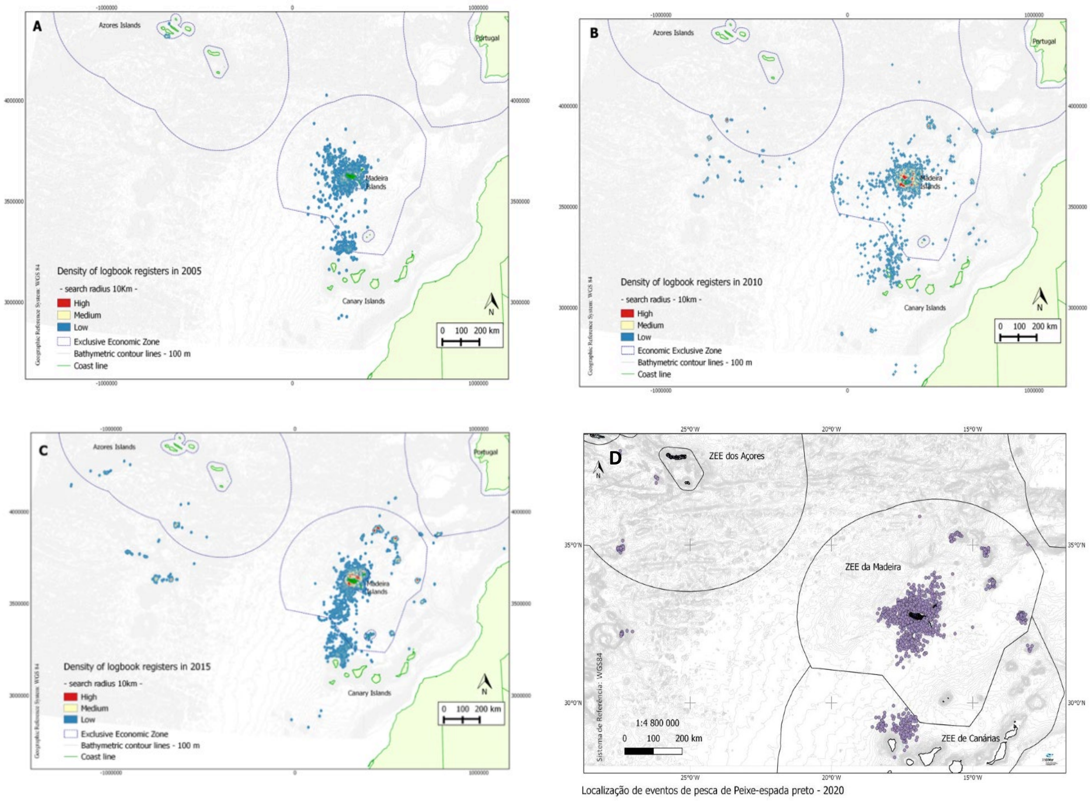


Figure 9.5.1. bsf CECAF area. Density plots illustrating the geographical distribution of the fishing sets with catches in 2005 (A), 2010 (B), 2015 (C) (Delgado *et al*., 2018) and (D) 2020 (Sousa *et al.*, 2021 WD). Density maps were estimated with the software Quantum GIS 2.2, module "heatmap" covering a search radius of 10 Km (Regional Directorate for Fisheries and Sea - Madeira).

Catches in CECAF 34 area were updated with fishery data from Madeiran longliners landings from 1990 to 2023 (Figure 9.5.2). These catches are recorded by the Regional Fisheries Department of Madeira. CECAF catches have been decreasing after the 1998 peak, but a slight increase was observed from 2012 to 2019, remaining around 2000 ton until 2023 (Figure 9.5.2 and Table 9.5.1).

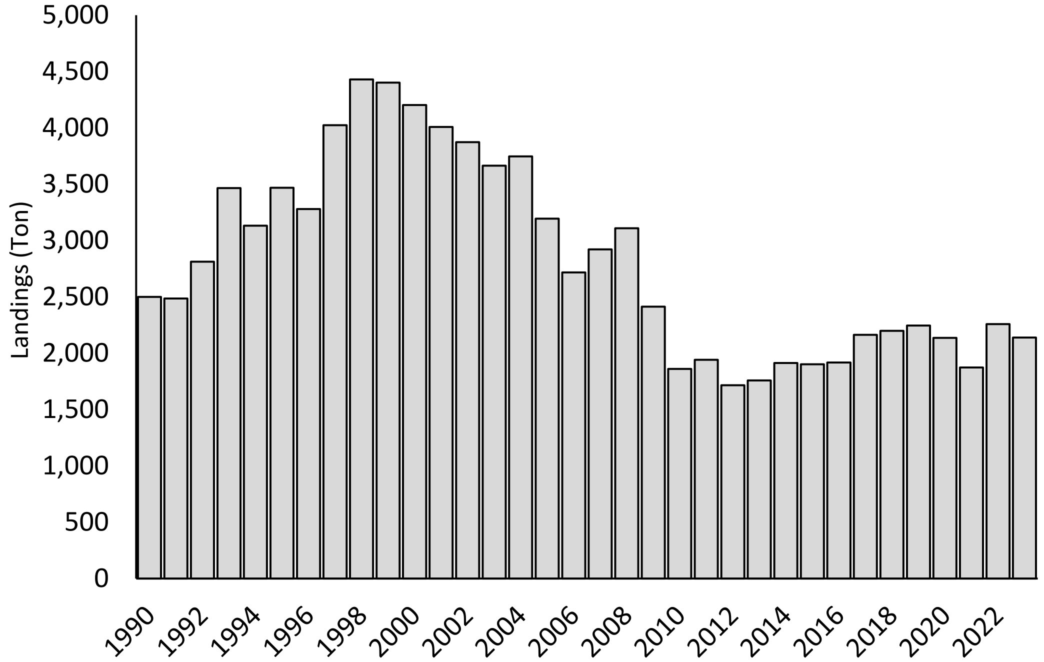


Figure 9.5.2. bsf CECAF 34. Time-series of annual Portuguese landings at CECAF area. (Source: Sousa *et al.*, 2024 WD)

The EU TAC and total catches for CECAF 34 area from 2005 to 2023 are presented in Table 9.5.1.

Table 9.5.1. bsf. Black scabbardfish TACs and total landings in CECAF 34 area between 2005 and 2023.

Year	EU TAC CECAF 34.1.2 area	Landings CECAF 34.1.2. Area
2005	4 285	3 195
2006	4 285	2 717
2007	4 285	2 922
2008	4 285	3 109
2009	4 285	2 413
2010	4 285	1 860
2011	4 071	1 941
2012	3 867	1 716
2013	3 674	1 758
2014	3 490	1 913
2015	3 141	1 902
2016	2 827	1 917
2017	2 488	2 163
2018	2 189	2 199
2019	2 189	2 246

2020	2 189	2 136
2021	2189	1873
2022	2189	2259
2023	2 189	2 139

For the period 2009–2023 (Figure 9.5.3), the total length frequency distributions of the exploited population caught by the Madeiran longline fleet varied between 87 cm and 155 cm (Sousa *et al.*, 2024 WD). From 2010 to 2018, the mean length varied between 117 and 118 cm TL, occurring a decrease to 115-116 cm TL between 2019 and 2023.

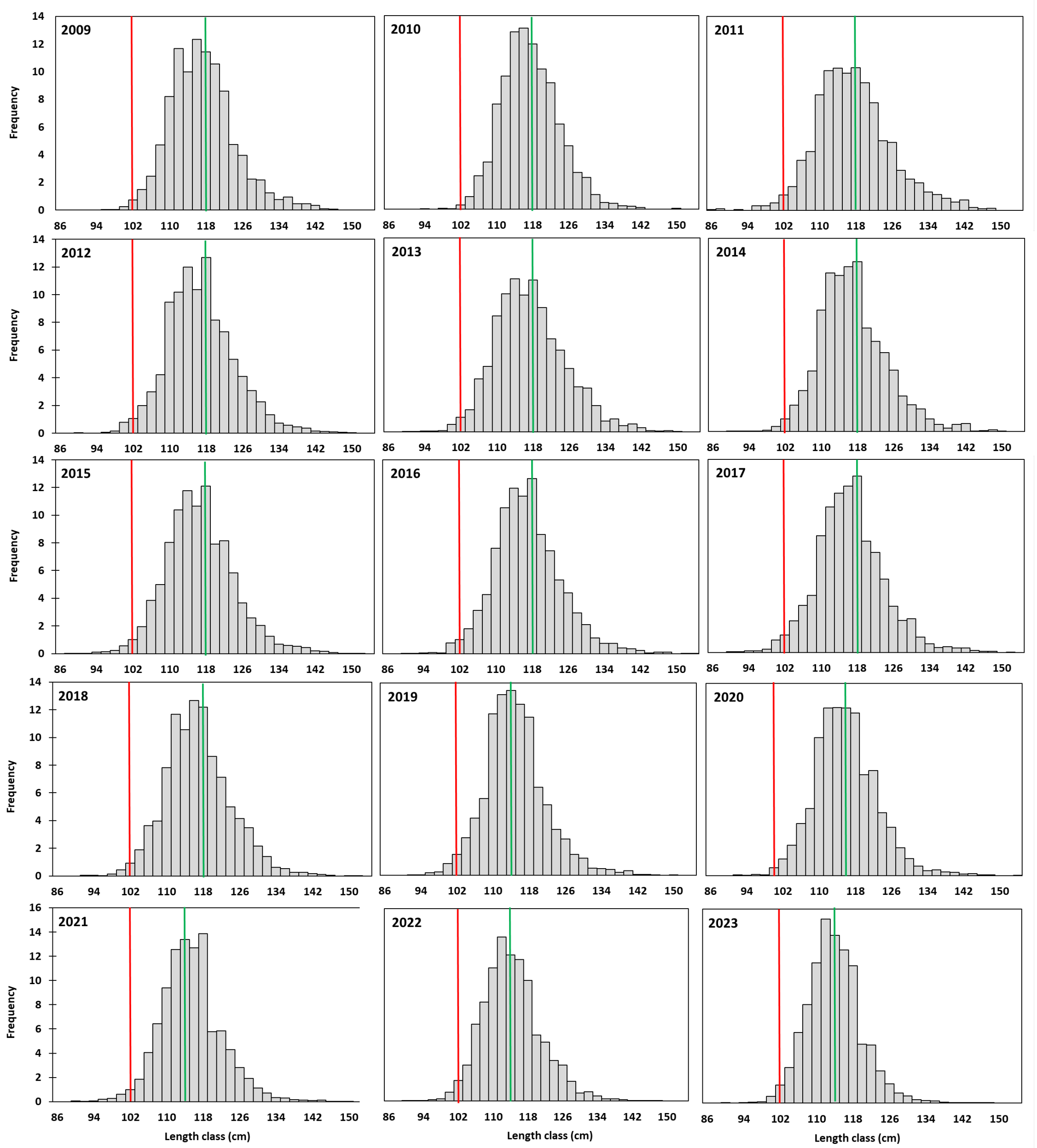


Figure 9.5.3. bsf CECAF. Annual length–frequency distribution of specimens landed by the Portuguese longliners operating along CECAF area. Red line represents the length at first maturity (103 cm) according to Figueiredo *et al.* (2003) and the green line represents the mean annual total length. (Source: Sousa *et al.*, 2024 WD)

In CECAF 34 area, the fishing effort that corresponds to the total number of hooks per year shows a decreasing trend since 2019 (Figure 9.5.4). Such decreasing trend is in line with a reduction in the number of active vessels.

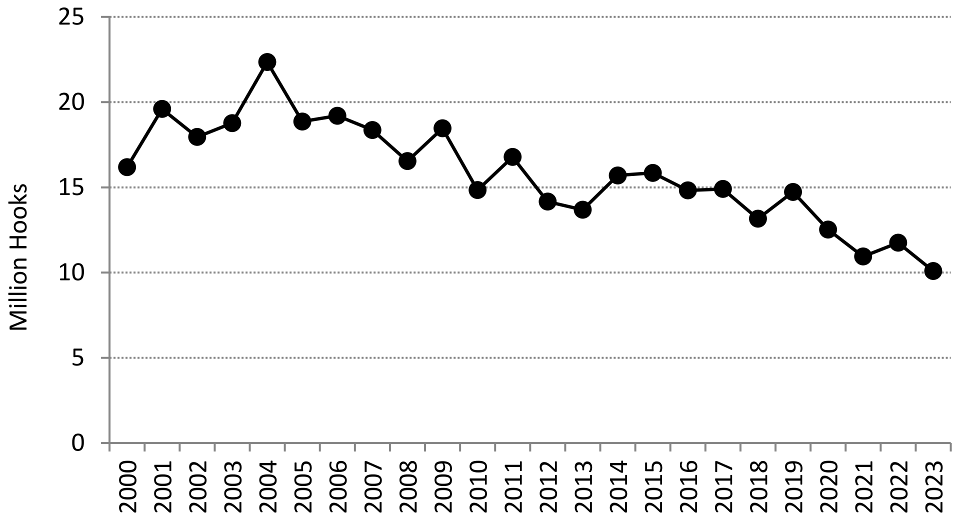


Figure 9.5.4. bsf CECAF 34 area. Time-series of the total annual effort estimated for the CECAF area (million hooks). (Source: Sousa *et al.*, 2024 WD)

The nominal CPUE shows an initial decreasing trend followed by a stable period (2010–2016), a peak in 2018, and an increasing trend between 2019 and 2023 (Figure 9.5.5).

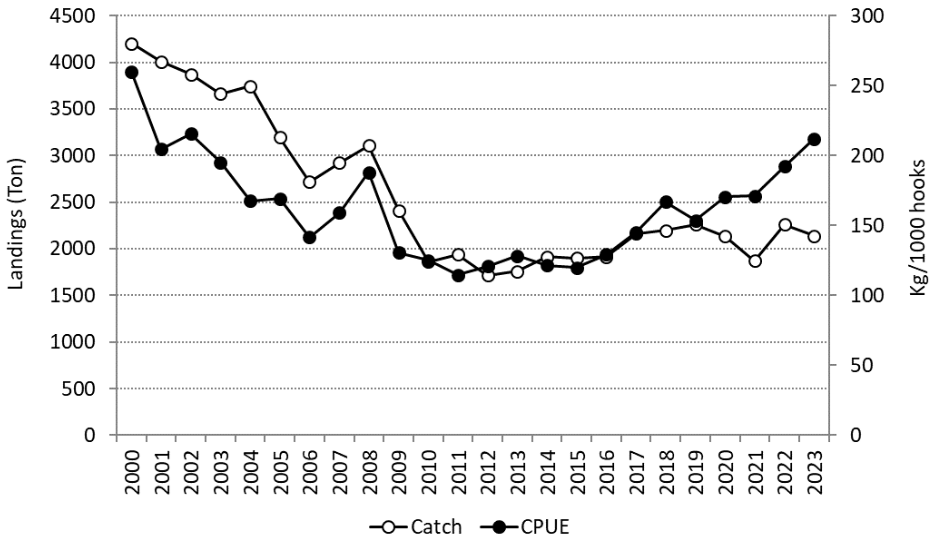


Figure 9.5.5. bsf CECAF 34 area. Time-series of landings per unit effort, nominal CPUE (kg/thousand hooks), in CECAF area. (Source: Sousa *et al.*, 2024 WD)

For the period between 2008 and 2023, a standardised CPUE was obtained by adjusting a GLM model based on daily landings of the commercial drifting longline fishery in CECAF 34 (Figure 9.5.6). The response variable (CPUE) was black scabbardfish catches in weight per fishing haul. The standardized CPUE has been increasing since 2019.

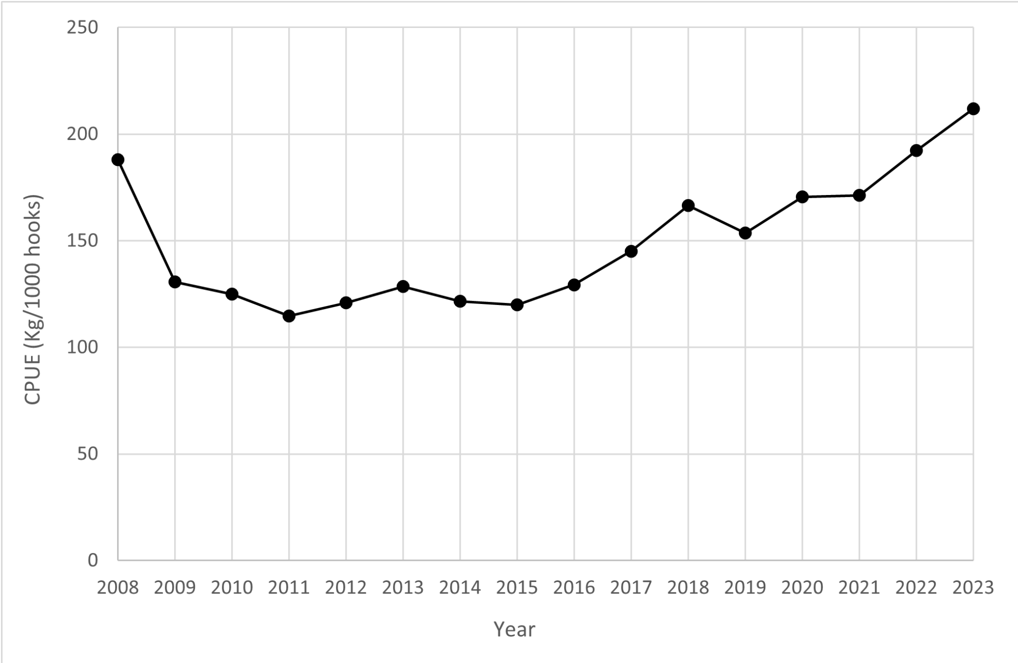


Figure 9.5.6. bsf.27.nea CECAF 34 area. Standardised CPUE (catch weight per fishing haul) from 2008 to 2023. (Source: Sousa *et al.*, 2024 WD)

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Contents

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. In the last ten years 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, and 4 that accounted the 17% of total landings since 2013, 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 16% 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* in subarea 9 decreasing every year since 2000 and 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 in Subarea 10 with zero catches since 2019 and in Division 5.a. There is no directed fishery for greater forkbeard in Faroese waters (Division 5b) and only small amount is landed as bycatch (Ofstad, 2022). In subarea 12 there are not reported landings since 2012 (only 0.5 t by Norway in 2021). In Subarea 10, 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 0.5% of total deep-water landings in the period 2016-2020, can be considered as bycatch.

10.2 Landings trends

Tables 10.0a–i 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 in total 280 t in 2023. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery and 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 currently is the second country in landings and reported their first landings in subareas 3 and 4 in 2016 reaching 70 t in 2020 and 30 t in 2023.

Although historically seven countries contributed to the landings in 5b the main landings in come from Norway. Total landings reached the highest values in 2001 and 2002 with 102 and 149 t respectively.. In 2023 Spain reported 0,9 t for first time. Since 2003 combined landings in this subdivision dropped to lower levels and landings reported in 2023 by all countries were 32 t.

Traditionally, the most important landings in 6 and 7 come from Spain, France, Norway, UK (EW) and UK (Scot) and Ireland. Historical landings decreased since the peak of 4967 t in 2000 and they were particularly low in 2009 and 2010 due to the low landings reported by Spain in those years. After these two years reported international landings increased marginally to 1802 t in 2012 but decreased in last years to 931 t in 2023 with the majority of landings reported from Spain (389 t) and France (285 t).

The main landings from subareas 8 and 9 come from Spanish fleets reaching on average are 244 t in the last ten years. In 2010 landings were the lowest of the series mainly due to the reduction of landings reported by Spain. Reported total landings increased from 321 t in 2021 to 337 t in 2022 but decreased again in 2023 to 314 t..

Historically in Subarea 10 landings come only from Portugal (although France reported 0.2 t in 2014). After the peaks to 136 t in 1994 and 91 t in 2000, the average in this Subarea in the last ten years is 4 t, with zero catches since 2019.

Although since 1991 several countries were involved in the fishery in Subarea 12 only Spain reported significant landings in the period 2002–2009, and since 2013 only Norway reported 0.5 t in 2021 and France 0.0048 in 2023.

10.3 ICES Advice

ICES advice applicable to 2019 and 2020

ICES advised that when the precautionary approach is applied, landings should be no more than 1346 tonnes in each of the years 2019 and 2020. ICES cannot quantify the corresponding catches.

ICES advice applicable to 2021 and 2022

ICES advised that when the precautionary approach is applied, landings should be no more than 861 tonnes in each of the years 2021 and 2022. ICES cannot quantify the corresponding catches.

ICES advice applicable to 2023 and 2024

ICES advises that when the precautionary approach is applied, landings should be no more than 818 tonnes in each of the years 2023 and 2024. ICES cannot quantify the corresponding catches.

10.4 Management

According to the Council Regulation (EU) 2018/2025, the TACs for greater forkbeard in all ICES subareas was no longer be set for 2020 and 2021. The ICES advice establishes that the absence of TACs would result in no or a low risk of unsustainable exploitation. Landings in subareas 1, 2, 3 and 4 include Norwegian landings.

PHYCIS BLENNOIDES	EU TAC	TOTAL INTERNATIONAL LANDINGS	
Subarea	**2023-2024**	**2022**	**2023**
1, 2, 3, 4	no TAC	244	**319**
5, 6, 7	no TAC	914	**963**

PHYCIS BLENNOIDES	EU TAC	TOTAL INTERNATIONAL LANDINGS	
8, 9	no TAC	337	**314**
10, 12	no TAC	0	**0**
Total	no TAC	1495	**1596**

10.5 Stock identity

ICES currently considers greater forkbeard as a single stock for the entire ICES area. It is considered probable that the stock structure is more complex; however further studies would be required to justify change to the current perception of stock boundaries.

10.6 Data available

10.6.1 Landings and discard

Landings are presented in Table 10.0a–i and in Figure 10.1.

Landings by fishing gear in 2022 are shown in Table 10.1a for countries reporting landings to InterCatch.

The estimates of the discard/catches available from 2013–2023 were in the range between 13% and 49% (Table 10.2a). In 2023 the main reported discards come from subareas 7 (81%), 6 (11%), and4 (4%) (Table 10.2b). Discards estimates in the first years of the series should be considered with caution because (i) not all countries report discards (ii) the method for estimating discards may not have been the same in all years. Nevertheless, in recent years (2015 onwards) discards of the most important countries in involved in the fishery (except Norway) are reported in InterCatch.

Series of Effort data (kWd) since 2014 of the Denmark, Ireland, Portugal, Spain, UK (England), UK(Scotland), France, Germany, Netherlands, Norway, UK(Northern Ireland), Sweden, have been provided by subarea (Figure 10.2b). The effort for a given year is calculated as the sum of kWd of those fleets/countries reported information in InterCatch. As greater forkbeard is a bycatch for many of the fleets, reporting catches the presented effort could not be representative specifically for this species.

A standardized CPUE was developed for reference fleet within the polyvalent Portuguese fleet, based on fishery dependent data collected from commercial landings for the period 2009-2020, particularly the landed weight (in Kg) by fishing trip. A fishing trip is defined from the moment the vessel leaves the dock to when it returns to the dock (Table 10.3). The standardized CPUE series, based on commercial data, suggest that the status of the greater forkbeard population inhabiting the Portuguese continental waters in recent years has been stable (Farias et al., 2022). For the period between 1997 and 2016, an increasing trend was also observed for the juvenile component of the population, indicating that the fishing pressure over the Portuguese population had not seriously impaired the recruitment (Lagarto et al., 2017).

10.6.2 Length compositions

Figure 10.2a shows the available length frequencies of commercial fleets and indicates that discards in 2015 affected specially individuals smaller than 17 cm of which 100% were discarded. In 2016 and 2017 the length range of discarded greater forkbeard increased affecting in high proportion also 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, in 2019 and 2020 the situation is similar to 2016 and mostly of the discarded individuals are smaller than 33 cm. The situation in 2021 and 2022 was similar, and the majority of discarded individuals was between 17 and 40 cm. In 2023 the discards affects mainly individuals smaller than 32 cm with a significant mode in the 24 cm.

The Figures 10.3 to 10.6b present the length–frequency distributions of the following surveys:

- Spanish Groundfish Survey in the Porcupine bank in Divisions 7.c and 7.k. from 2001 to 2023 (Figure 10.3).
- Northern Spanish Shelf bottom-trawl in Divisions 9.a and 8.c from 1983 to 2022 (Figure 10.4).
- French EVHOE IBTS until 2020 EVHOE in Divisions 7.f, g, h, j; and 8.a,b,d from 1997 to 2022 (Figure 10.5).
- Portuguese Crustacean Surveys/*Nephrops* TV Surveys (PT-CTS (UWTV (FU 28–29) in Division 9a from 1997 to 2018 (Figure 10.6a).
- Faroes deep-water survey in Division 5b from 2014 to 2022 (Figure 10.6b).
- Azorean survey ARQDAÇO (L6563) in Division 10, from 1995 to 2023 are pre-sented in Figure 10.6c.

10.6.3 Age compositions

Data of age proportion of the commercial Spanish fleets were provided in WGDEEP for subareas 7, 8 and Division 9.a since 2011 (Figure 10.6d). The series show that most of greater forkbeard belongs to the age 1 in all subareas, although in 2019 individuals of age 2 reached 50% of the total and in 2016 61% in Subarea 8 and Division 9.a In 2021, 2022 and 2023 the high proportion of individuals of age 1 decreased significantly and appears for first time fish with age 0. In Subareas 7 and 6 in 2021 all the ages showed more similar proportion, in 2022 older ages (age 3) reached 40% of the total and in 2023 age 2 represented 45% of total. In Subareas 8 and 9 in 2021 the higher proportion belongs to age 2, in 2022 ages 0, 1 and 3 reached values between 33% and 42%. In 2023 age 0 to 3 are in the range of 19% to 25%.

10.6.4 Weight-at-age

The accumulated mean weight-at-length of the international commercial landings and discards reported to InterCatch from 2016 to 2023 was presented (Figure 10.7). The weight of discarded greater forkbeard in 2016, 2018 and 2019 were quite lower than landings weight since overall, the fleets discard the smallest individuals (see Figure 10.2a). In 2021, 2022 and 2023 the landings and discard weight patter are very similar with most of the accumulated weight belonged to individuals larger than 30 cm with a peak in the range of 48-50 cm.

10.6.5 Maturity and natural mortality

No new information was provided to the WG in 2023. Updated Life History parameters were provided in the 2021 Data Call by the Spanish fleet:

	Value	Reference	Comments
L_{mat} males	27.5	CV= 2%	n=388; year= 2018+2019+2020; Males

L_{mat} females	47.2	CV= 3.3%	n=1025; year= 2018+2019+2020; Females
Li_{nf}	111.1	CV=11%	n=1076; year= 2018+2019+2020; Both sex
K	0.13	CV=15%	n=1075; year= 2018+2019+2020; Both sex

10.6.6 Catch, effort and research vessel data

In the WGDEEP 2023 the Faroe Plateau survey was included for first time in the analysis of biomass and abundance indices, completing eleven surveys in total of which SWC-IBTS and PT-CTS (UWTV (FU 28–29) two do not take place since 2014 and 2019 respectively. These surveys cover a significant proportion of the all ecoregions in Divisions 3, 4, 5, 6, 7, 8, 9 (Figure 10.8):

- Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS-(G5768) in Divisions 7.c and 7.k from 170 to 800 m. Biomass and abundance of greater forkbeard from 2001 to 2023 are presented in Figure 10.9.
- French EVHOE IBTS (FR-EVHOE-(G9527) in Divisions 7.f, g, h, j; and 8.a,b,d from 0 to 600 m. Abundance and biomass raised to the total subarea have been provided for a series from 1997 to 2023. This survey did not take place in 2017. (Figure 10.10).
- Irish Groundfish survey (IE-IGFS-(G7212) in Divisions 6.a South and 7.b from 10 to 150 m. Abundance and biomass Indices (nº per hour and kg per hour) from the period 2005 to 2023. 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-(G2784) in Divisions 9.a and 8.c from 35 to 700 m. Biomass and abundance (kg/30 min tow and No/30 min tow) of greater forkbeard in the Cantabrian Sea from 1983 to 2023 are presented in Figure 10.12.
- North Sea IBTS survey (NS-IBTS-(G1022-G2829) in Divisions 4.abc, 3.a and 3.c. from 0 to 2000 m. Abundance in number per hour from 1976 to 2023 is presented in Figure 10.13.
- Scottish Western Coast Groundfish IBTS survey (SWC-IBTS-(G1179-G4299) in Divisions 5.b, 6.ab, 7.ab from 20 to 500 m. No new information is available since 2014 onwards. Abundance in number per hour from 1986 to 2014 is presented in Figure 10.14.
- Scottish Deep-water trawler survey in Divisions 6.a (SCOWCGFS-G4748-G4815) from 300 to 1200 m. Biomass and abundance of greater forkbeard from 1998 to 2023 are presented in Figure 10.15. As it is a biennial since 2014 this survey did not take place in 2016, 2018, 2020 and 2022.
- Portuguese crustacean surveys/*Nephrops* TV Survey (PT-CTS (UWTV (FU 28–29)- G2913) in Division 9.a South from 200 to 750 m, Biomass in kg per hour from 1997 to 2018 is presented in Figure 10.16. This survey did not take place since 2019.
- Faroe Plateau in spring and summer survey in Division 5b (FO-GFS-Q1-Q3-G1264-G3284) from 70 to 510 m. The average biomass of the spring and summer surveys in kg per hour from 1994 to 2023 is presented in Figure 10.17.
- Deep water long line survey PALPROF (L4398) in Division 8c from 600 to 2400 m, Biomass (kg/h) and abundance (No/h) of greater forkbeard from 2015 to 2023 are presented in Figure 10.18.
- Long line Azorean survey ARQDAÇO (L6563) in Subdivision 10,a.2 from 50 to 1200 m, Biomass (kg/ 1000 hooks) of greater forkbeard from 1995 to 2023 are pre-sented in Figure 10.19

10.7 Data analyses

In the Spanish Groundfish Survey in the Porcupine (SP-PorcGFS-(G5768) bank the biomass and abundance of *P. blennoides* was similar to that of the previous year, the values remain among the lowest in the time series (Figure 10.9). Biomass patches were widely found in the south, west and east, but scarcely in the north, as in previous years (Figure 10.19). Most specimens were from 29 cm to 32 cm in this last survey and the recruitment remained at low values similar to those of the previous year (Figure 10.3).

The EVHOE IBTS survey (FR-EVHOE-(G9527) in Divisions 7.f,g,h,j and 8.a,b,d abundance shows no clear trend. The historical series indicates an increase in biomass since 1996, with peaks in 2004, 2007 and 2012 and a decrease from 2013 to 2015 and increases again until 2019. In the period 2020-2023 the biomass decreased compared to the values in the 2019 peak. However, landings have decreased from 2012 onwards since the most important peak was in 2011. (Figure 10.10). The mean length has increased since the beginning of the series reaching the highest value in 2005, 2016 and 2020 (Figure 10.5).

Irish GFS (IE-IGFS-(G7212) indicates an increase in the abundance (No/hour) and biomass (Kg/hour) from 2009 to 2012 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 in biomass is recorded compared with values in 2017 but since this year the trend decreased to 2021. In the period 2021-2023 a slight increase is observed although with low values of biomass and abundance (Figure 10.11).

In Northern Spanish Shelf bottom-trawl survey (SP-NGFS-(G2784) in 2023, 23% of the hauls where *P. blennoides* was found were additional deep hauls (>500 m) and contained 69% of the biomass. This last year the biomass in standard and in those additional deep hauls decreased (Figure 10.12). The geographic distribution of *P. blennoides* remained similar to previous years, being widespread in the sampling area, although with smaller spots of biomass in the Galician area (Figure 10.20). The length distribution in standard hauls continue to show a clear, but smaller mode of recruits at 15-16 cm, (Figure 10.4) (Ruiz-Pico *et al*., 2024).

The NS-IBTS (G1022-G2829) shows an increase on abundance since 1976 although the average abundance recorded until 2010 (3.1 individuals/hour) was lower than 2011 onwards (22.0 individuals/hour). 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 but dropped to 0.2 individuals/hour in 2022 and to 0.7 0.2 individuals/hour in 2023 the lowest values of the series.

No data for 2015 and 2016 have been updated in the DATRAS system for the SWC-IBTS (G1179-G4299). The trend series of abundance until 2014 is shown in the Figure 10.14.

The Scottish Deep-water trawler survey SCOWCGFS-G4748-G4815 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 from 1998 to 2015 with a peak in 2017 of 37.2 kg/hour but dropped to 13.9 kg/hour in 2023. The abundance shows the same profile of the biomass with an important increase from 2011 to 2013 and also a peak in 2017 (53.6 individuals/hour). In 2019 the abundance decreased slightly to similar values found in the period from 2011 to 2013, reaching in 2021 the lowest value since 2015 (Figure 10.15).

In the Portuguese survey in 9.a south (UWTV (FU 28-29) the series of biomass show a decrease trend since 1997 to 2004 but with significant peaks in 1999 and 2002. In recent years *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 of 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, provides evidence that the species is able to complete the life cycle in this area. In 2019 and 2020, the survey was not performed. In 2021, the R/V Mário Ruivo started to operate, but the survey's spatial coverage was smaller and fishing stations in the area where the species is traditionally more abundant were missing (Moura et al., 2022). Therefore, the standardized biomass index has not been updated since 2021 (Farias et al., 2023).

The Faroe Plateau survey in 5b show low catches near to zero from 1994 to 2006, but a continuous increase was registered from 2007 to 2015 in which the highest value in the combined series was recorded (2.13 kg/h), The biomass dropped strongly in 2016 and recovered again in 2017. Since 2017 and important decrease is observed until 2022 and 2023 in which 0.53 kg/h was reached (Figure 10.17). The spatial distribution of greater forkbeard from the bottom trawl groundfish surveys were mainly on the Faroe Plateau deeper than 200 m (Figure 10.21 not updated in 2023). In the deepwater survey greater forkbeard was caught around the Banks and on the Wyville-Thomson ridge. In the Faroese 0-group surveys on the Faroe Plateau in June/July there are 26 registrations of greater forkbeard caught pelagic. The length was between 8-54 mm, mainly around 30-40 mm. 11 of there were caught in the period 1991-1999, 14 in the period 2001-2005 and one in 2022 (Ofstad 2023).

Although is not an abundant species caught in the long line PALPROF survey in 8c, .the biomass and abundance index show an increase trend since 2015 (Figure 10.17) (Diez et al 2024). Most of the individuals are caught in the stratum of 651-1050 m with an average length of 54 cm (range from 34 to 74 cm).

The Azorean survey ARQDAÇO (L6563) in Subdivision 10.a2 since the peak in 2001 the biomass index shows a continuous decrease in with zero catches recorded in 2023. The catches in this long line survey belong to indivuals between 25 and 80 cm with the taking place mainly in the depth range of 450-800 m.

Although the data provided by the surveys have increased the area covered in the ecoregion, neither the available surveys nor discard data cover the Subareas 1 and 2.

10.7.1 Exploratory assessment

Following the guidance on application of the rfb rule, possible estimates of the input values were tested in WGDEEP 2022. Given the uncertainties in the input parameters (e.g. life-history), WGDEEP considers that further discussion with ICES WKLIFE would be required before the implementation of the method to provide landings advise for this stock.

10.7.2 Comments on the assessment

In the WGDEEP 2024 ICES framework for category 3 stocks was applied (rb rule, ICES, 2023a). A combined stock biomass index using the standardized biomass index from the average of the six surveys: IGFS-WIBTS-Q4 (G7212), EVHOE-WIBTS-Q4F (G9527), SpPGFS-WIBTS-Q4 (G5768), SpGFS WIBTS-Q4 (G2784), SDS (G6642), and FO-GFS-Q1-Q3 (G1264-G3284) was used as an index of stock size (Figure 10.24).
The advice is based on the previous catch advice (2024) multiplied by the ratio of the mean of the last two index values (index A) and the mean of the three preceding index values (index B), a biomass safeguard, and a precautionary multiplier. The stability clause was not applied.

The length based and life history parameters used for the advice were:

L(F=M)= Lref= 0.75Lc+0.25Linf	41.2
Lc (2020-2023)	17.9
Iloss	0.62
Itrigger =Iloss*1,4	0.86
k	0.13
Linf (cm) Life history	111.1

The length parameters series from 2025 to 2023 were;

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2020-2023
Lmean (cm)	33.61	34.29	35.87	29.98	35	31	39	37	32	
L (F=M) = Lref (cm)	38	39	37	35	44	45	49	46	44	
f= Lmean/Lref	0.88	0.88	0.96	0.87	0.81	0.70	0.81	0.82	0.73	
1/f	1.14	1.14	1.04	1.15	1.23	1.44	1.24	1.22	1.37	
Lmode (cm)										
Lc (cm)	14	15	13	0.9	21	23	28	24	22	18

The Catch scenario of the RFB-rule in Greater forkbeard in the Northeast Atlantic and adjacent waters was:

Previous catch advice Ay (2024)		818 tonnes
Stock biomass trend		
Index A (2022, 2023)		0.85 kg hr^{-1}
Index B (2019, 2020, 2021)		0.70 kg hr^{-1}
r: Index ratio (A/B)		1.21
Fishing pressure		
Mean catch length (L_{mean} = L_{2023})		32cm
MSY proxy length ($L_{F=M}$)		41cm
Fishing pressure proxy ($L_{F=M\ 2023}$/ L_{mean})		1.3
f: multiplier for relative mean length in catches (L_{mean}/$L_{F=M\ 2023}$)		0.73
Biomass safeguard		
Last index value (I_{2023})		0.95 kg hr^{-1}
Index trigger value ($I_{trigger}$ = I_{loss} × 1.4)		0.86 kg hr^{-1}
b: multiplier for index relative to trigger min{I_{2023}/$I_{trigger}$, 1}		1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability		
m: multiplier (generic multiplier based on life history)		0.95
RFB calculation**		686 tonnes
Stability clause (+20%/−30% compared to A_y, only applied if b ≥ 1)	Not applied	
Discard rate		24%
Catch advice for 2025 and 2026 (rfb calculation)		686 tonnes
Projected landings corresponding to advice***		522 tonnes
% advice change^		-16 %

* The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.

** Formula [Ay+1 = $Ay \times r \times f \times b \times m$]

*** [Advised catch for 2025 and 2026] × [1 – discard rate].

^ Advice value for 2025 and 2026 relative to the advice value for 2024 (818 tonnes).

10.7.3 Management considerations

As Greater Forkbeard 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 increasing trend since 1976, more noticeable from 2010 to 2012, however the trend since 2013 records a continuous and strong decrease. 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 with biomass stabilized at very low values since 2018. 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 but decreasing since then. The trend in Subarea 8 indicated by the Northern Spanish Shelf bottom-trawl (Division 8c) shows a decrease in biomass and abundance since 2011 to 2017 in which a slight increase trend is observed to 2022. On the contrary, the French EVHOE (in Divisions 7.f, g, h, j; and 8.a, b, d) although the overall trend since 1997 shows a slight increase, it is observed several periods of decrease after the peaks in 2013 and 2019. In Division 9.a south annual standardized biomass index of the Portuguese survey suggests an increase of biomass and abundance since 2013. The standardized indicator of the combined six survey index indicates an increase in the biomass in last two years (2020-2021 over the period 2017-2019).

On the other hand, landings in all ecoregions have been reduced since 2013 below the biennial TAC established for this period. In this sense, although the TAC increased in 2015 and 2016 to 2856 t landings reported have always been below, especially in 2017 in which landings were only 59% of TAC. It was supposed that the removing of the TAC from 2019 onwards could increase the landings (and discards) but it does not have affected the decreasing trend.

Although greater forkbeard is a bycatch of the traditional demersal trawl and longline mixed fisheries, and it is only locally important for certain fleets fishing in subareas 6 and 7 with base port mainly in the Northwest of Spain, discards of this species are considered high. Many of the countries involved in the fishery report data to InterCatch, and according to the information available, reported discards to catches ratio are high but have decreased from 2013 to 2023 (36%, 34%, 49%, 25%, 13%, % 17%, 15%, 13, 18% and 23%). Similarly, the commercial length frequency data is only available from some countries and areas and the historical series is not considered robust to be conclusive on observed trends.

10.8 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, SpPGFS-WIBTS-Q4, SpGFS-WIBTS-Q4, SDS, PT-CTS (UWTV (FU 28–29) from the period 2005–2016. The model did not converge, so a new model was adjusted, and the series of landings were shortened 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 10.22 and 10.23.

10.9 Tables and Figures

Table 10.0a. Greater forkbeard *(Phycis blennoides*) in the Northeast Atlantic. Working group estimates of landings.

YEAR	1+2	3+4	5	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**
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**

YEAR	1+2	3+4	5	6+7	8+9	10	12	TOTAL
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**
2019	192	184	18	1242	214	0	0	**1850**
2020	118	187	31	869	281	0	0	**1486**
2021	82	131	13	880	321	0	< 1	**1427**
2022	56	188	26	889	337	0	0	**1495**
2023	85	235	32	931	314	0	0	**1596**

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**

YEAR	NORWAY	FRANCE	RUSSIA	UK (SCOT)	UK (EWNI)	GERMANY	FAROE ISLANDS	TOTAL
2005	51	0						**51**
2006	46	0	3					**49**
2007	41	0	5	1	0			**47**
2008	112	0	4	1			0	**117**
2009	76	0	6	0				**82**
2010	127	4						**132**
2011	107	6						**113**
2012	98	0.4						**98**
2013	83	0.1		0				**83**
2014	96	0.4						**97**
2015	121							**121**
2016	187	0.3		0				**187**
2017	79	0.7		1				**80**
2018	60	0.1						**60**
2019	192	0.04						**192**
2020	118	0.1				0.0		**118**
2021	81	< 0.5	0	< 0.5	0	0	0	**82**
2022	56	<0.5		<0.5				**56**
2023	85	<0.5		<0.5				**85**

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	NETHER-LANDS	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**

YEAR	FRANCE	NORWAY	UK (EWNI)	UK (SCOT)[1]	GERMANY	DENMARK	SWEDEN	NETHER-LANDS	TOTAL
1995	2			1					**3**
1996	2	10		6					**18**
1997	2			5					**7**
1998	1		0	11					**12**
1999	3		5	23					**31**
2000	4		0	7					**11**
2001	6		1	19	2				**27**
2002	2	561	1	21	0				**585**
2003	1	225	0	7					**233**
2004	2	138		3					**143**
2005	2	81	0	1					**83**
2006	1	134	3						**139**
2007	1	236	0	2					**239**
2008	0	244		1					**245**
2009	4	142		3					**149**
2010	3	182		1					**186**
2011	17	160		1					**179**
2012	1	198							**199**
2013	1	178	0	0					**179**
2014	1	210		3					**214**
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**
2019	3	113		3		65	0		**184**
2020	3	111		2	0.1	70		0.4	**187**
2021	3	78	0	3	**	46	0	0	**131**
2022	4	132	0	3	0	49	0		**188**
2023	2	195		8	0	30			**235**

[(1)] Includes Moridae, in 2005 only data from January to June. *Preliminary landings data. **Negligible landings.

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	SPAIN	TOTAL
1988	2	0							2
1989	1	0							1
1990	10	28							38
1991	9	44							53
1992	16	33							49
1993	5	22							27
1994	4								4
1995	9								9
1996	7								7
1997	7	0							7
1998	4	4							8
1999	6	28	0						34
2000	4	26	1	0					32
2001	9	92	1	0					102
2002	10	133	5	0					149
2003	11	55	7	0					73
2004	9	37	2	2					50
2005	7	39		0,3					46
2006	8	26			6				39
2007	11	34	0	0	9	2	0		58
2008	10	20	0		4	11	1		46
2009	0	13	3		3	2	0		24
2010	2	45	3	1	11		2		62
2011	7				310		1		319
2012	6	5			145	7	7		169
2013	7	3	0				0		11
2014	7	14	0		0		2		24

YEAR	FRANCE	NORWAY	UK (SCOT)[1]	UK (EWNI)	FAROE ISLANDS	RUSSIA	ICELAND	SPAIN	TOTAL
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
2019	7	10							18
2020	7	24	0						31
2021*	6	7	0	0	0	0	0		13
2022	4	21	0						26
2023	4	25	2					1	32

(1) Includes Moridae in 2005 only data from January to June. *Preliminary landings data.

Table 10.0e. Greater forkbeard *(Phycis blennoides)* in Subareas 6 and 7. Working group estimates of landings.

YEAR	FRANCE	IRE-LAND	NOR-WAY	SPAIN[1]	UK (EWNI)	UK (SCOT) [2]	UK (N.I)	GER-MANY	RUS-SIA	FAROE ISLANDS	NETH-ER-LANDS	TO-TAL
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

YEAR	FRANCE	IRE-LAND	NOR-WAY	SPAIN[1]	UK (EWNI)	UK (SCOT) [2]	UK (N.I)	GER-MANY	RUS-SIA	FAROE ISLANDS	NETH-ER-LANDS	TO-TAL
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
2016	412	13	97	641	13	90						1265
2017	431	6	134	399	14	88						1073
2018	458	10	203	453	20	121						1264
2019	430	18	187	498	13	95						1242
2020	360	18	72	339	18	62					0.5	869
2021	462	12	0	296	13	96		0	0	0.1	0.3	880
2022	390	3	76	339	8	70		0				889
2023	285	16	121	389	11	107		0			1.2	931

(1) Landings of *Phycis* spp Included from 1988 to 2012.

(2)Includes Moridae in 2005 only data from January to June.

***Preliminary landings data.**

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

YEAR	FRANCE	PORTUGAL	SPAIN[1]	UK(EWNI)	UK (SCOT)	TOTAL
1991	18	68	108			194
1992	9	91	162			262
1993	0	115	387			502
1994		136	320			456
1995	54	71	330			455
1996	25	45	429			499
1997	4	30	356			390
1998	3	38	656			697
1999	8	41	361			410
2000	36	91	375			502
2001	36	83	453			573
2002	67	57	418			542
2003	28	45	387			461
2004	44	37	446			527
2005	58	22	312	0		392
2006	54	10	257			321
2007	32	14	510	0		556
2008	41	13	123			178
2009	8	13	183	0		203
2010	10	12	48		0	69
2011	13	13	295			321
2012	46	5	315			366
2013	31	8	234	2		275
2014	38	6	315		0	360
2015	38	8	278			323
2016	30	7	226		0	263
2017	18	9	159		0	186
2018	31	9	218		0	258
2019	29	7	178	0	-	214

YEAR	FRANCE	PORTUGAL	SPAIN[1]	UK(EWNI)	UK (SCOT)	TOTAL
2020	38	5	238	0	0	281
2021	46	3	272	0	0	321
2022	50	3	283		0	337
2023	41	4	269			314

(1) Landings of *Phycis spp* Included from 1988 to 2012. *Preliminary landings data.

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**
2005	22		**22**
2006	15		**15**
2007	17		**17**
2008	18		**18**
2009	13		**13**

YEAR	PORTUGAL	FRANCE	TOTAL
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**
2019			**0**
2020			**0**
2021*	0	0	**0**
2022			**0**
2023			**0**

***Preliminary landings data.**

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**

YEAR	FRANCE	UK (SCOT)[(1)]	NORWAY	UK (EWNI)	SPAIN[(2)]	RUSSIA	TOTAL
2000	2	4					**6**
2001	0	1	6	1			**8**
2002	0		2	4	74		**81**
2003	3		8	0	71		**82**
2004	3		6		44		**54**
2005	1	0	0		75		**77**
2006					42		**42**
2007					37		**37**
2008	0				17		**17**
2009	1		0		37	**6**	**44**
2010	0						**0**
2011	0						**0**
2012	0						**0**
2013							**0**
2014	0						**0**
2015							**0**
2016							**0**
2017							**0**
2018							**0**
2019							**0**
2020							**0**
2021	**	0	0.5	0	0	0	**0.5**
2022					0		**0**
2023	<0.5						**< 0.5**

(1)Includes Moridae in 2005 only data from January to June.
(2) Landings of *Phycis spp* Included from 1988 to 2012.
***Preliminary landings data. ** Negligible landings data.**

Table 10.0i. Greater forkbeard *(Phycis blennoides*). Working group estimates of landings. Catches inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES for the stock in WGDEEP.

WGDEEP Stock gfb.27.nea	Catch Inside NEAFC RA (t)	Catch Out-side NEAFC RA (t)	Total Catches	Proportion of catch inside the NEAFC RA (%)	NEAFC RA areas where caught
2020	0	1486	1486	0%	
2019	0	1850	1850	0%	
2018	0	1801	1801	0%	
2017	0	1503	1503	0%	
2018	0	1801	1801	0%	
2019	0	1850	1850	0%	
2020	0	585	585	0%	
2021	0	1427	1427	0%	
2022	0	1495	1495	0%	
2023	0	1596	1596	100%	

*Preliminary landings data.

Table 10.1a. Greater forkbeard *(Phycis blennoides*). European landings (t) by métier in 2023.

Landings (t)	2022
Denmark	**30**
GNS_DEF	0.0
OTB_CRU	1.8
OTB_DEF	25.1
SDN_DEF	0.0
SSC_DEF	3.4
MIS_MIS	0.0
Ireland	**16**
MIS_MIS_0_0_0_HC	0.0
OTB_DEF_>=120_0_0_all	14.4
OTB_DEF_70-99_0_0_all	0.0
OTB_CRU_70-99_0_0_all	0.3
OTB_DEF_100-119_0_0_all	1.2
Portugal	**4**
MIS_MIS_0_0_0	4.3
OTB	0.1
Spain	**658**
MIS_MIS_0_0_0_HC	0.9
OTB_DWS_100-129_0_0	0.0
OTB_DEF_70-99_0_0	6.3

OTB_DEF_100-119_0_0	127.8
OTB_DEF_>=70_0_0	12.1
OTB_MCD_>=55_0_0	9.0
GNS_DEF_80-99_0_0	12.9
PTB_MPD_>=55_0_0	0.9
LLS_DEF_0_0_0	378.1
OTB_MPD_>=55_0_0	10.3
GNS_DEF_>=100_0_0	11.5
OTB_DEF_>=55_0_0	81.9
GNS_DEF_120-219_0_0	5.3
GNS_DEF_60-79_0_0	0.8
LHM_DEF_0_0_0	0.0
GTR_DEF_60-79_0_0	0.4
UK (England)	**11**
GNS_DEF	1.0
LLS_DEF	0.0
OTB_CRU	0.1
OTB_DEF	9.2
TBB_DEF	0.5
France	**331**
LLS_DEF	48.1
MIS_MIS_0_0_0	8.8
OTB_DEF_70-99_0_0	11.9
OTB_DEF_100-119_0_0	43.7
OTT-DWS	0.8
GNS_DEF_100-119_0_0_all	28.7
OTT_DEF_100-119_0_0	34.6
OTT_DEF_>=70_0_0	12.1
OTB_DEF_>=70_0_0	2.0
OTB_DEF_>=120_0_0	69.9
OTB_DWS_>=120_0_0_all	31.5
OTT_CRU_100-119_0_0	0.7
OTT_DEF_70-99_0_0	0.0
GNS_DEF_120-219_0_0_all	0.0
OTB_CRU_100-119_0_0_all	0.4
OTM_DEF_100-119_0_0_all	0.0
OTT_DEF_>=120_0_0_all	38.1
OTB_CRU_70-99_0_0_all	0.0
OTT_CRU_70-99_0_0_all	0.0
OTB_DWS_100-119_0_0_all	0.2
OTT-DEF	0.0
OTB_DEF_<16_0_0_all	0.0
Germany	**0**
OTB_DEF	0.0
OTM_DWS	0.2
Netherlands	**1**
OTM_SPF_32-69_0_0_all	1.2
Norway	**426**

GNS_DEF	25.3
LLS_DEF	326.9
OTB_DEF	65.5
SDN_DEF	1.1
FPO_DEF	1.7
Pelagic trawl	5.9
Sweden	**0**
MIS_MIS_0_0_0_HC	0.0
OTB_DEF_>=120_0_0_all	0.0
OTB_CRU_32-69_2_22_all	0.0
GNS_DEF_all_0_0_all	0.0
OTB_CRU_90-119_0_0_all	0.0
MIS_MIS_0_0_0_IBC	0.0
LLS_FIF_0_0_0_all	0.0
OTB_CRU_70-89_2_35_all	0.0
OTB_CRU_32-69_0_0_all	0.0
GTR_DEF_all_0_0_all	0.0
FPO_CRU_0_0_0_all	0.0
SDN_DEF_>=120_0_0_all	0.0
UK(Scotland)	**73**
MIS_MIS_0_0_0_HC	3
OTB_DEF_>=120_0_0_all	76
LLS_DEF_0_0_0_all	39
Total general	**1596**

Table 10.2a. Greater forkbeard *(Phycis blennoides*). Reported of total discards (ton) of *P. blennoides* from 2014 to 2023 and proportion in the catches.

ton	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
LANDINGS	2269	2175	2012	1503	1801	1850	1486	1427	1495	1596
DISCARDS	1166	2068	677	513	263	366	256	215	332	507
CATCHES	3435	4243	2689	2016	2064	2216	1742	1642	1827	2013
DISCARDS/CATCHES	34%	49%	25%	25%	13%	17%	15%	13%	18%	24%

Table 10.2b. Greater forkbeard (*Phycis blennoides*). Reported discards (ton) of P. blennoides from 2013 to 2023 by sub-area.

subarea	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2								0	0	0	0
3	0.9	2	0	6	3	10	10	0	1	3	3
4	334	7	83	99	279	57	42	27	8	18	23
5			1	7	0	0		0	0	0	0

subarea	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
6	769	647	1359	225	51	47	45	32	65	38	54
7			256	301	131	74	245	167	106	254	413
8	82	510	302	25	39	67	18	30	25	12	10
9			67	15	10	7	6		10	6	5
TOTAL	1185	1166	2068	677	513	263	366	256	215	332	507

Table 10.3. Greater forkbeard (*Phycis blennoides*). Annual mean CPUE (Kg/trip) and GLM estimates, of the Portuguese Reference fleet as well as, upper and lower limits of the 95% CPUE confidence intervals for the period 2013-2020.

year	Observation (kg/trip)	CPUE Upper limit	CPUE Estimate (Kg/trip)	CPUE Lower limit
2013	10.39	13.43	10.39	8.04
2014	11.88	16.07	12.25	9.34
2015	10.83	16.09	12.32	9.43
2016	10.28	13.96	10.74	8.27
2017	9.81	12.72	9.68	7.37
2018	10.59	13.43	10.17	7.7
2019	8.83	12.56	9.57	7.29
2020	8.35	11.66	8.88	6.77

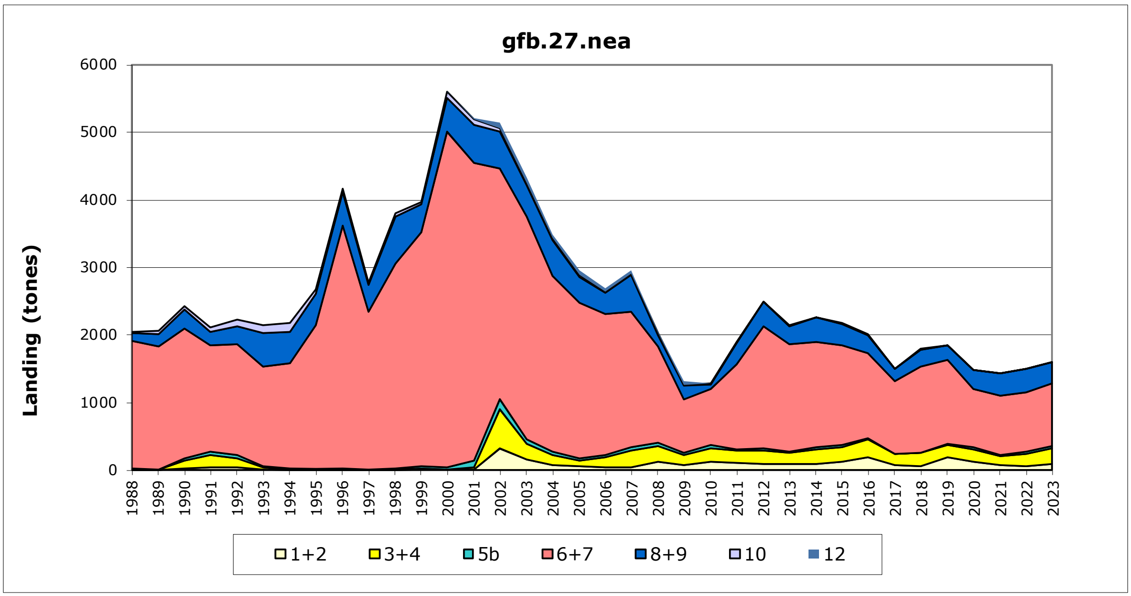

Figure 10.1. Greater forkbeard landing trends in all ICES subareas since 1988.

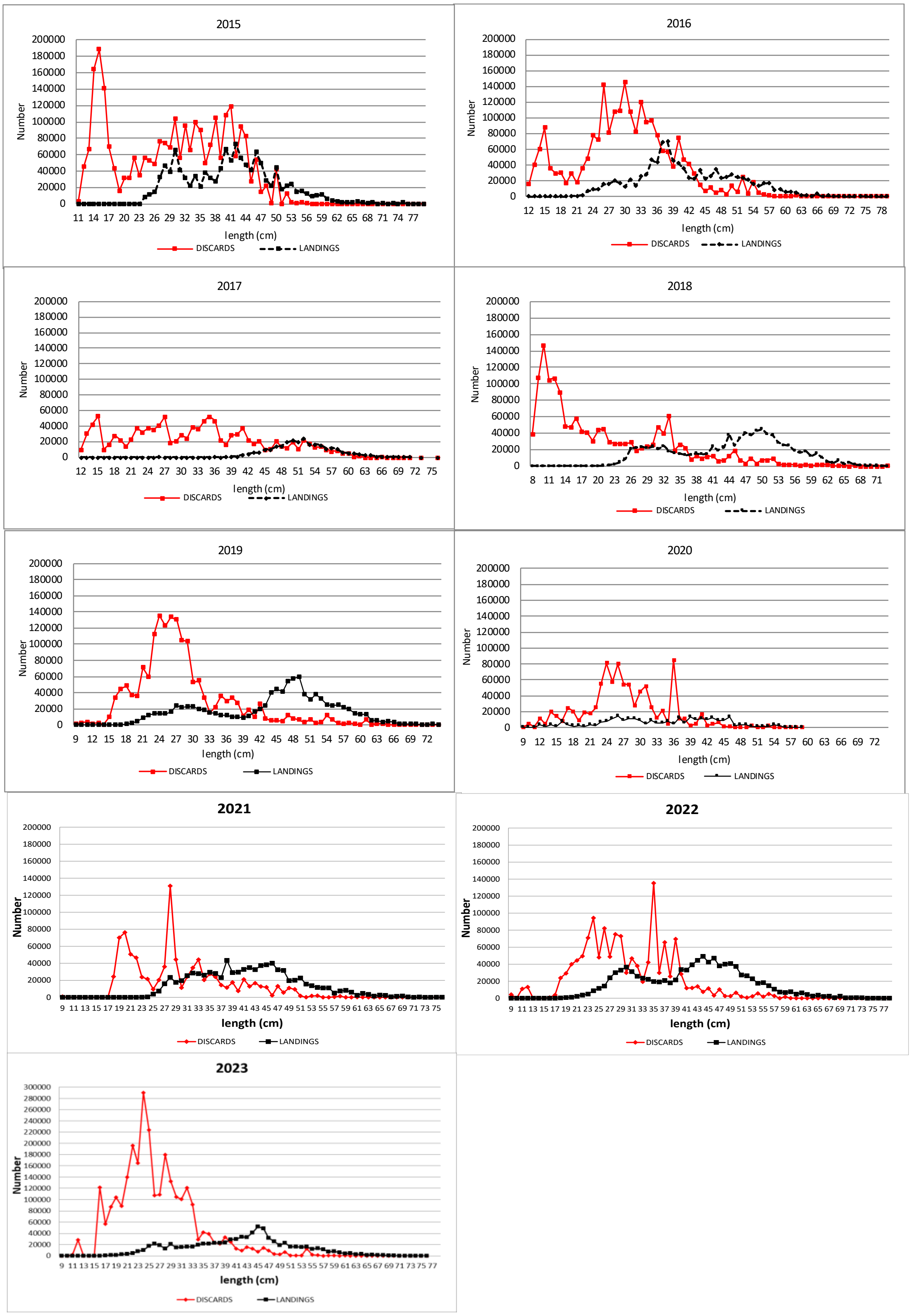

Figure 10.2a. Commercial length frequencies of the greater forkbeard landings and discards from 2015 to 2022 from France, Spain, Ireland, Portugal, Denmark, Sweden, UK (England), and UK (Scotland).

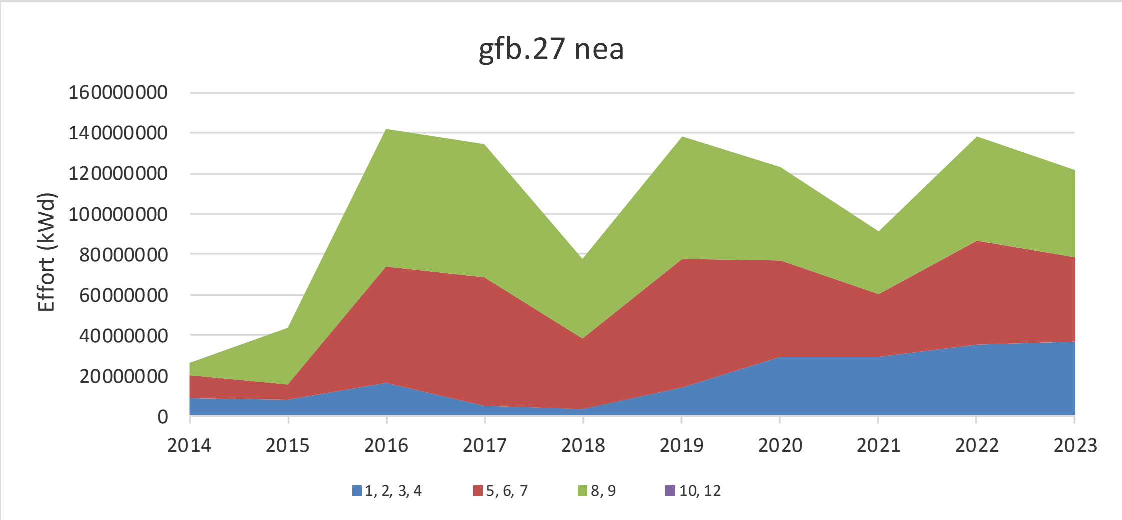

Figure 10.2b. Effort data (kWd) by stock units since 2014.

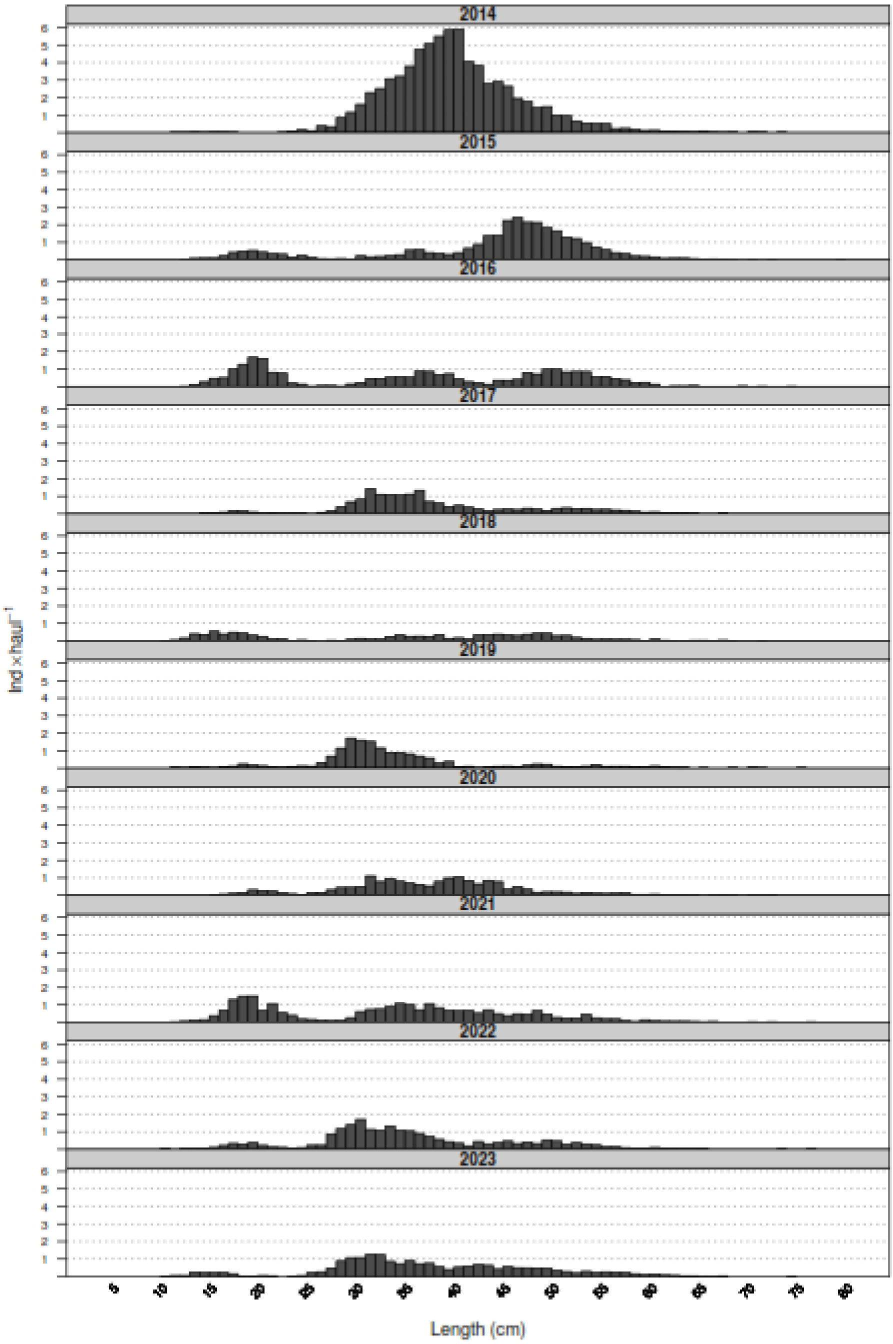

Figure 10.3. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Porcupine survey (Divisions 7.c and 7.k) time-series (2013–2023).

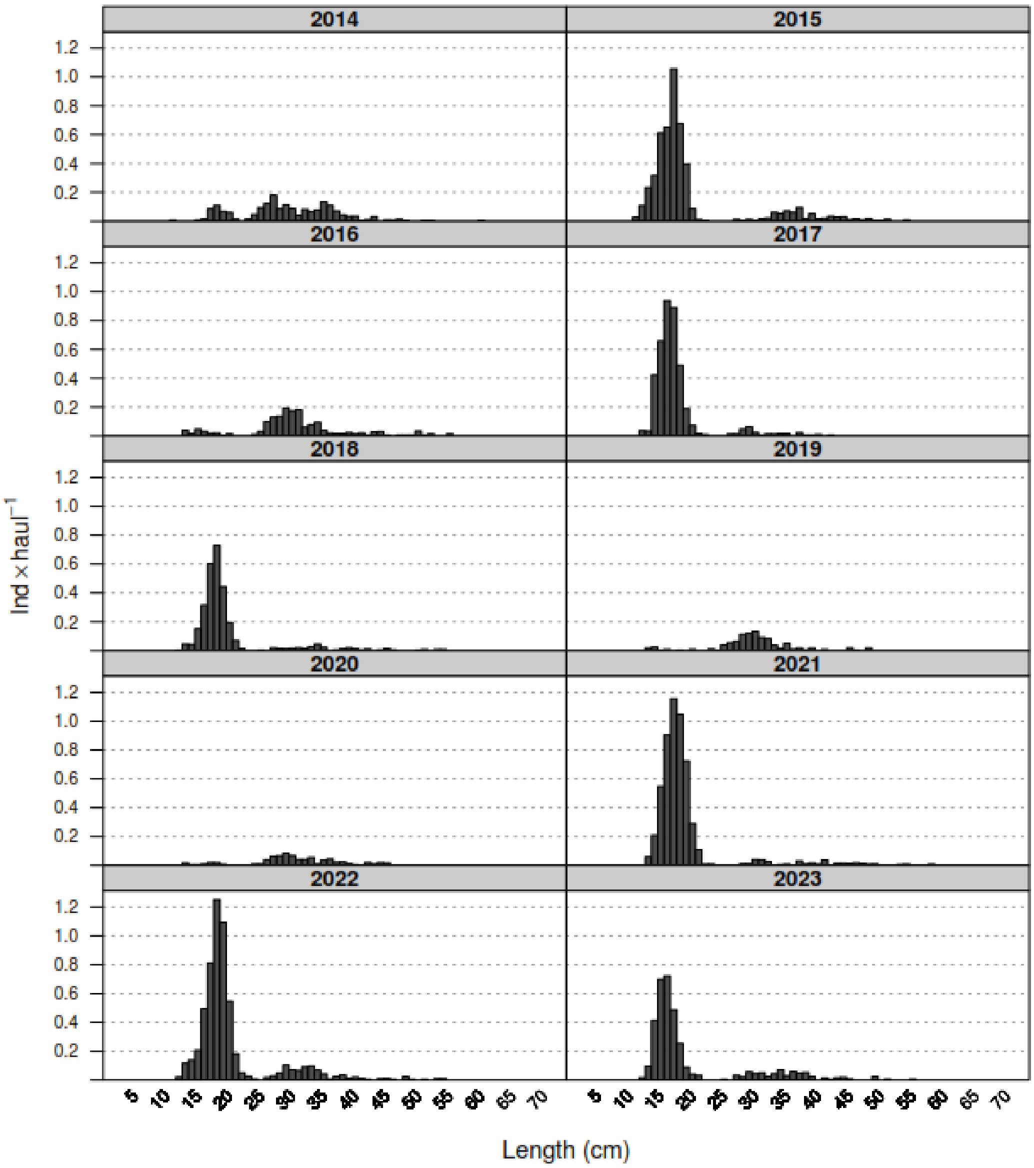

Figure 10. 4. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Northern Spanish Shelf survey (SP-NGFS-(G2784) (8.c and 9.a) in the period 2014–2023.

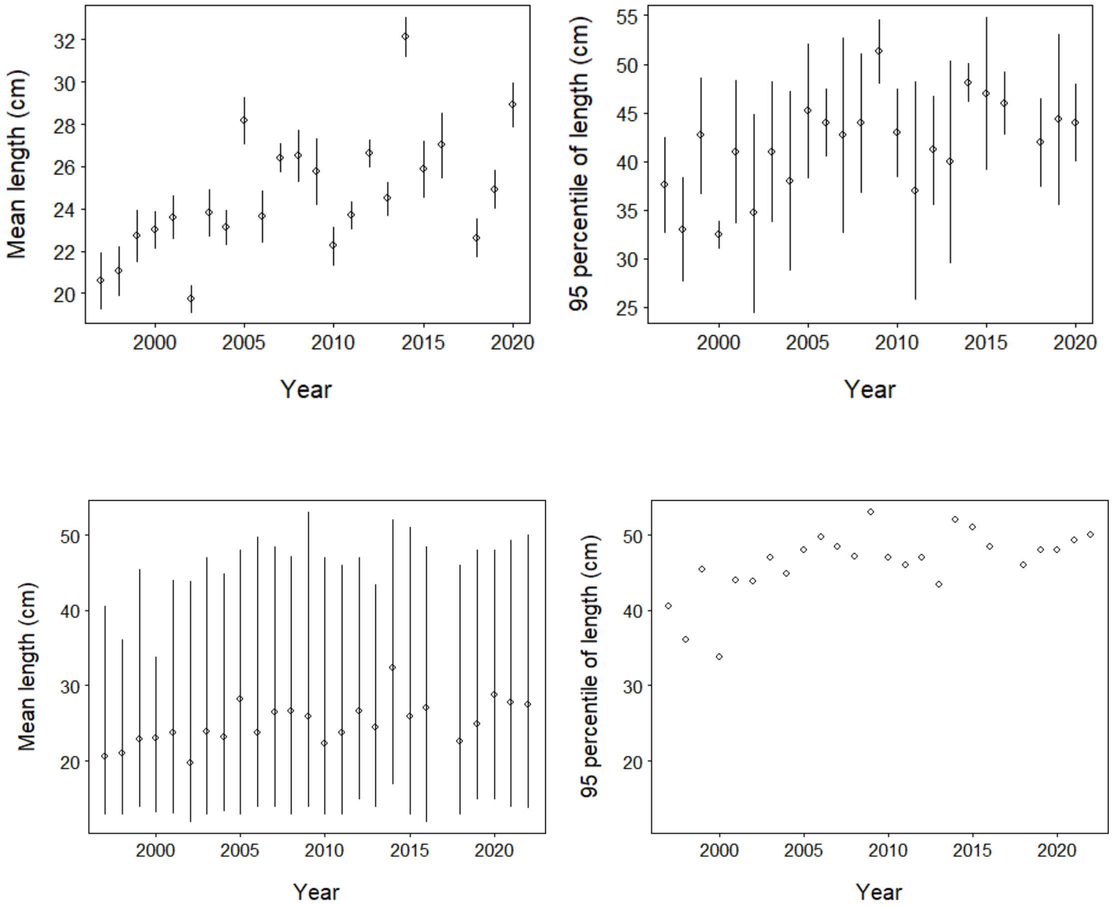

Figure 10.5. Greater forkbeard series of mean length from the French EVHOE IBTS survey Divisions 7.fghj and 8.abd until 2022.

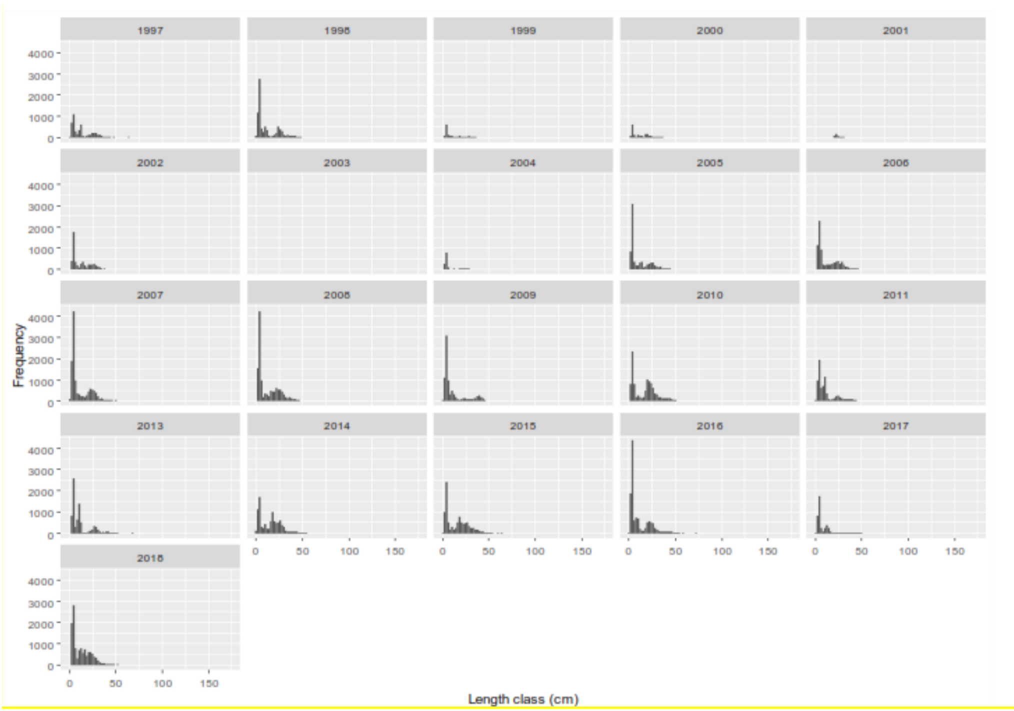

Figure 10.6a. Length frequency distribution of the greater forkbeard in the PT-CTS (UWTV (FU 28-29) until 2018.

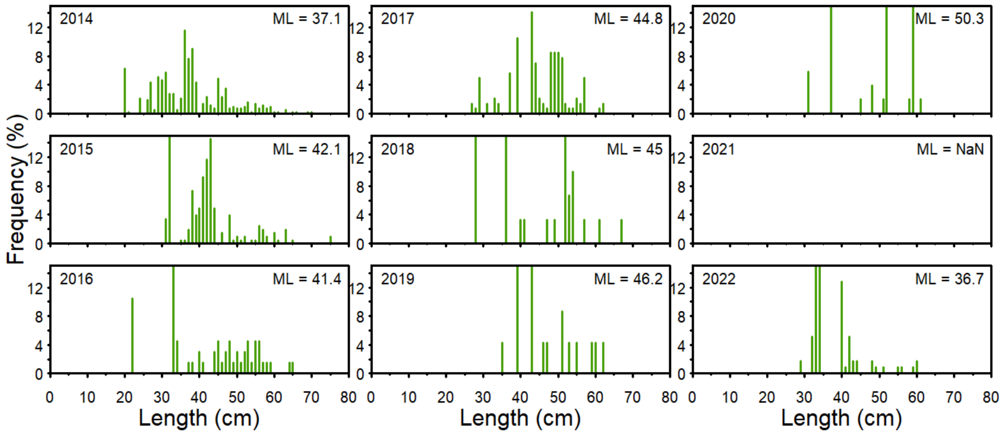

Figure 10.6b. Length-frequency distribution from the Faroe Plateau in spring and summer survey in Division 5b in 2014-2022 (no survey in 2021).

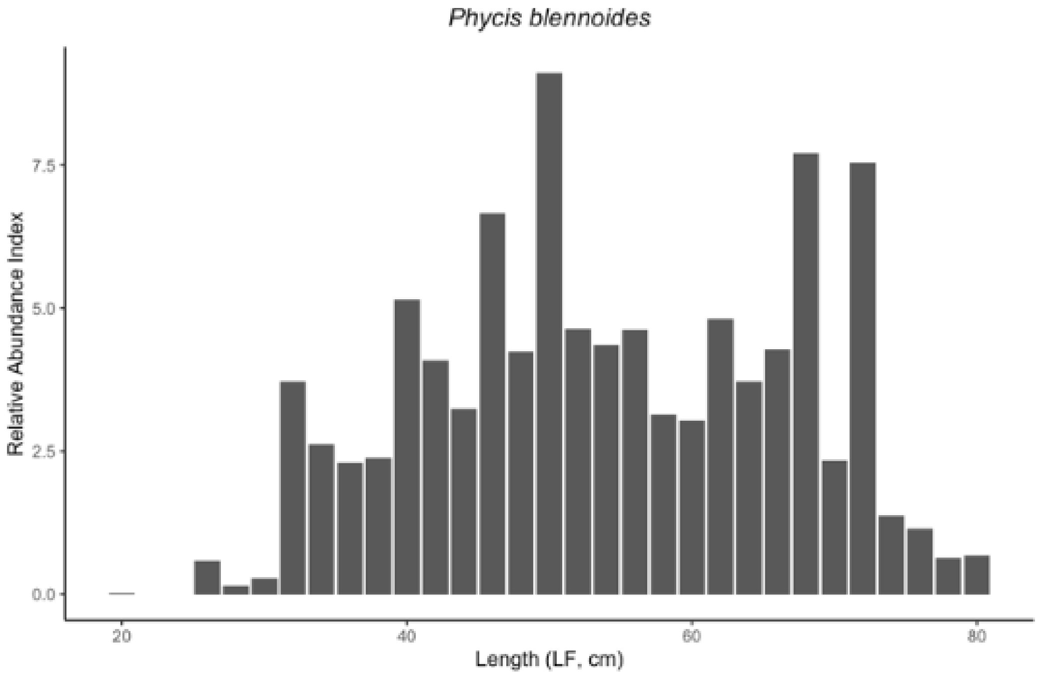

Figure 10.6c Length-frequency distribution from the Azorean survey ARQDAÇO (L6563) in Division 10, from 1995 to 2023

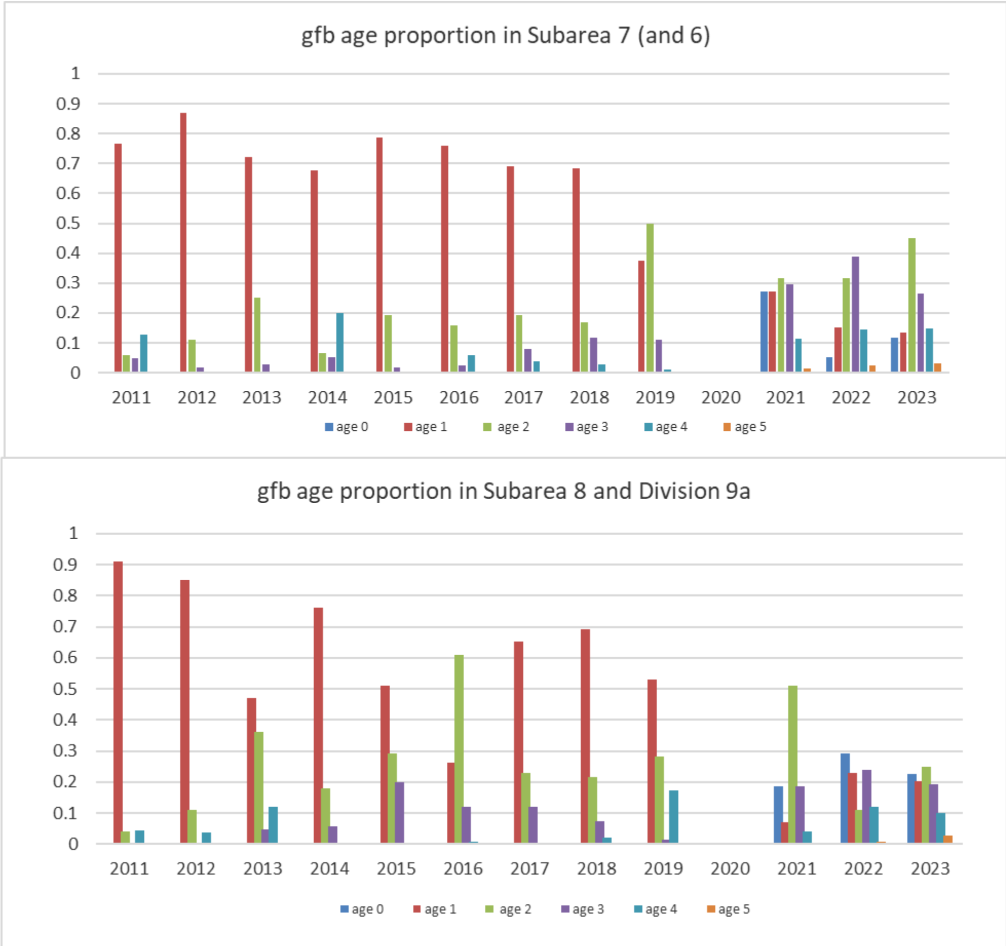

Figure 10.6d. Age proportion of the Spanish commercial fleets from 2011 to 2023 in subareas 7, 8 and Division 9a.

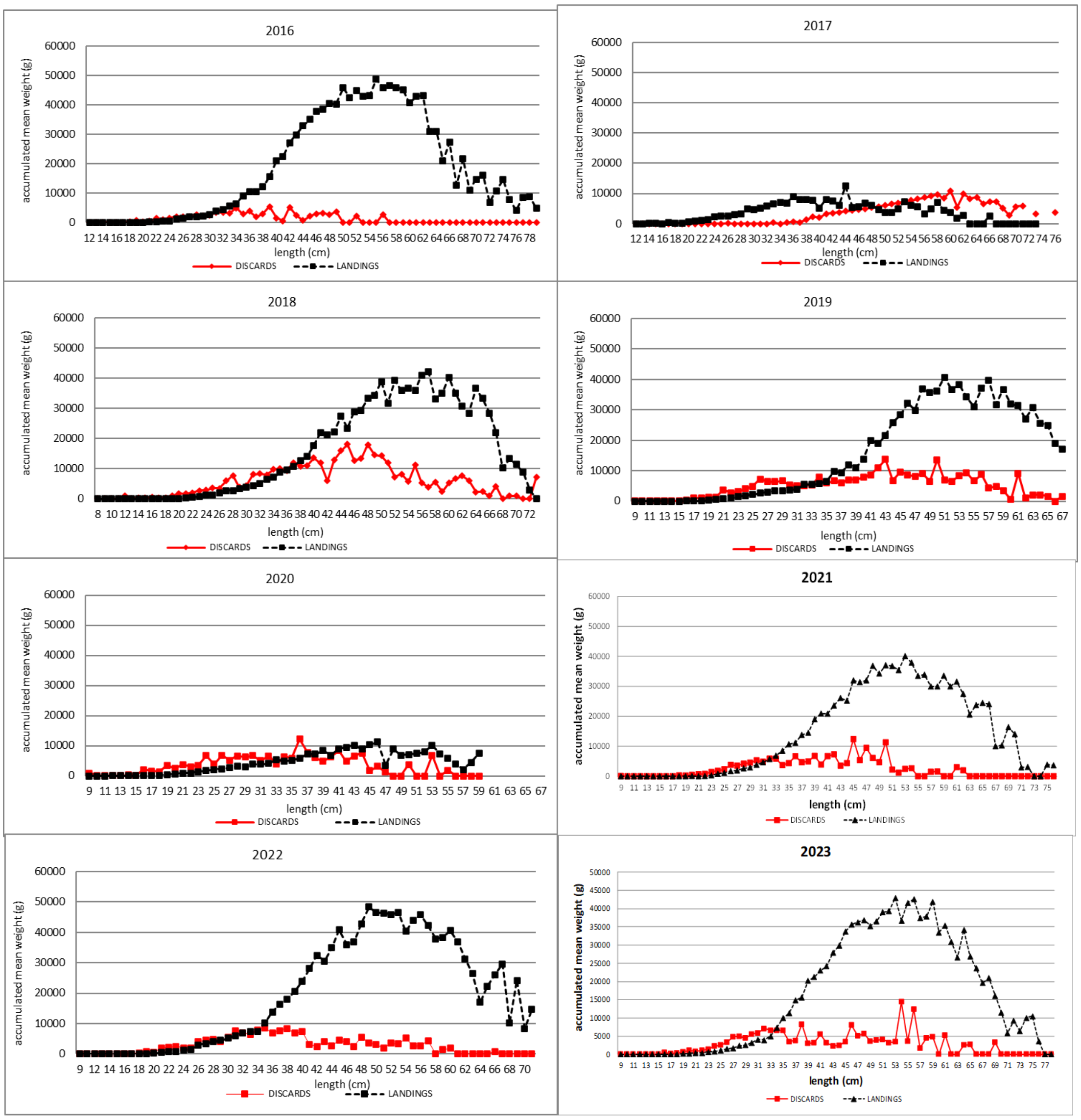

Figure 10.7. Accumulated mean weight at length of the international commercial landings and discards reported to InterCatch from 2016 to 2023.

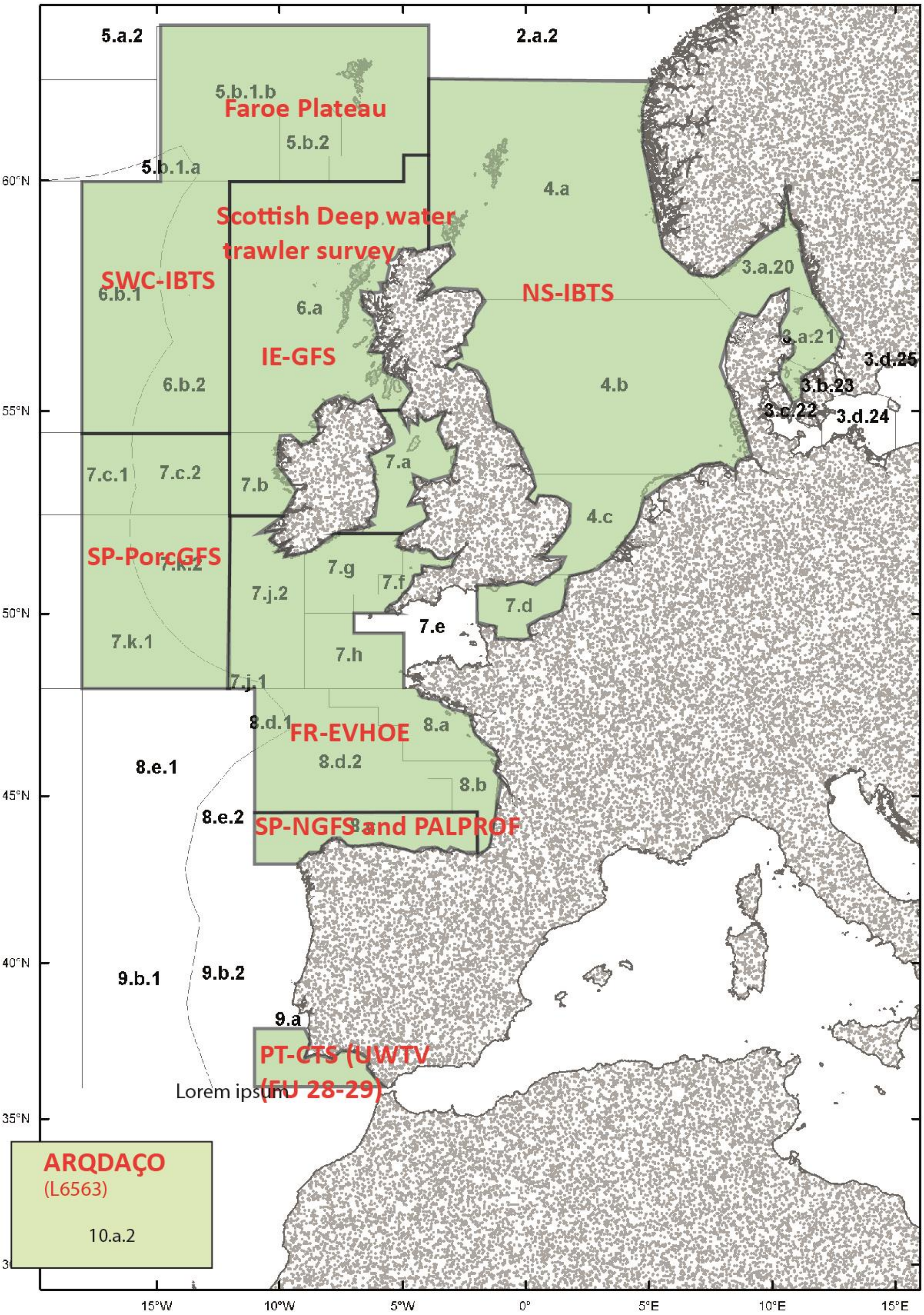

Figure 10.8. Map of the Divisions covered by the eleven surveys used in the trend analysis of abundance and biomass of GFB.

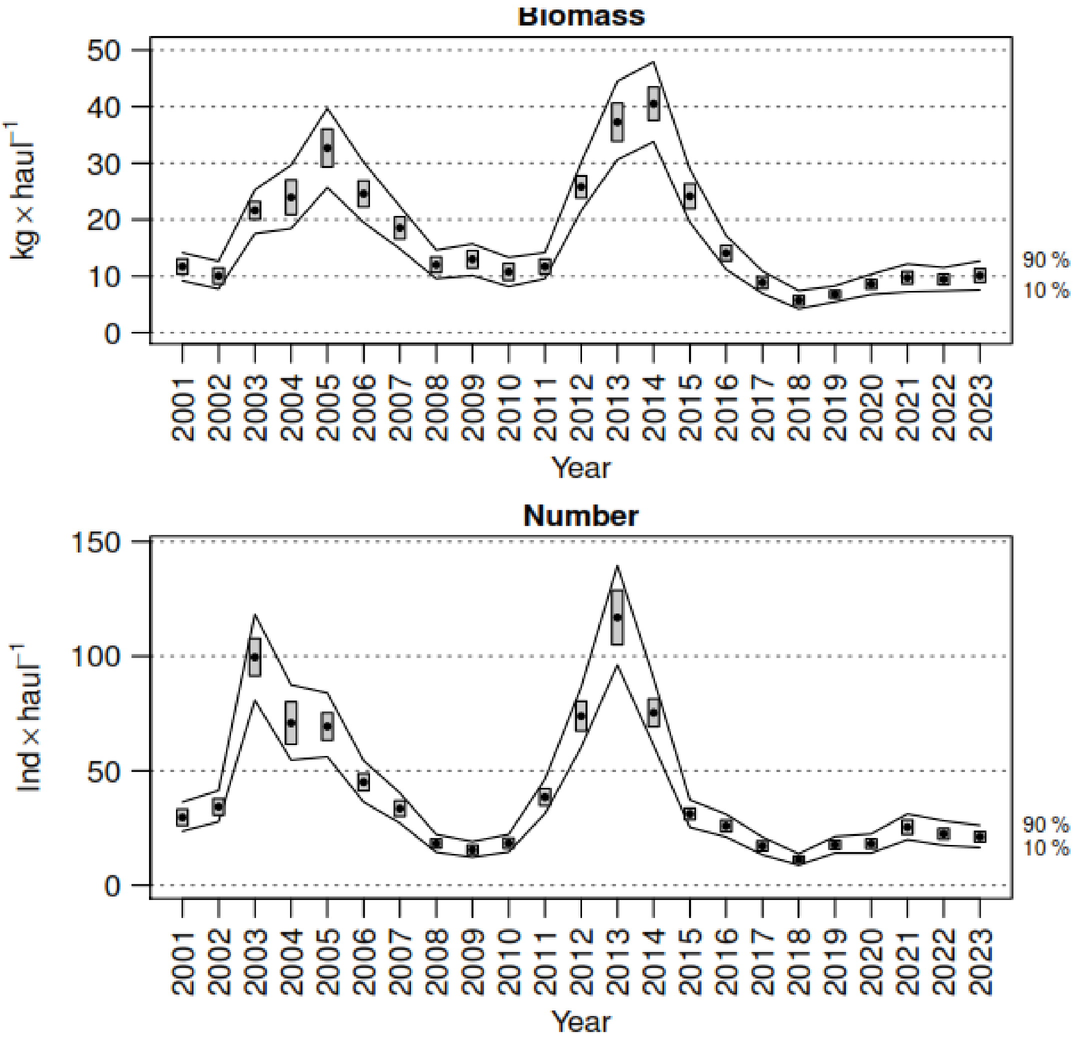

Figure 10.9. Evolution of *Phycis blennoides* biomass and abundance indices during Porcupine Survey (SP-PorcGFS-(G5768) time-series (2001–2023) in Divisions 7.c and 7.k. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000).

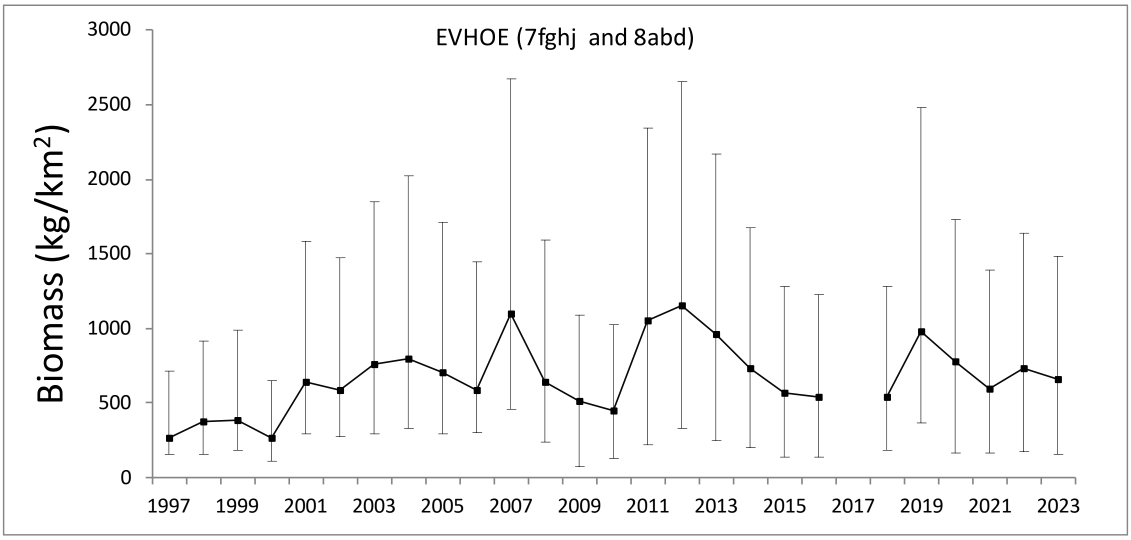

Figure 10.10. Greater forkbeard series of abundance and biomass of the French EVHOE IBTS (FR-EVHOE-(G9527) survey in the Divisions 7.fghj and 8.abd combined until 2023.

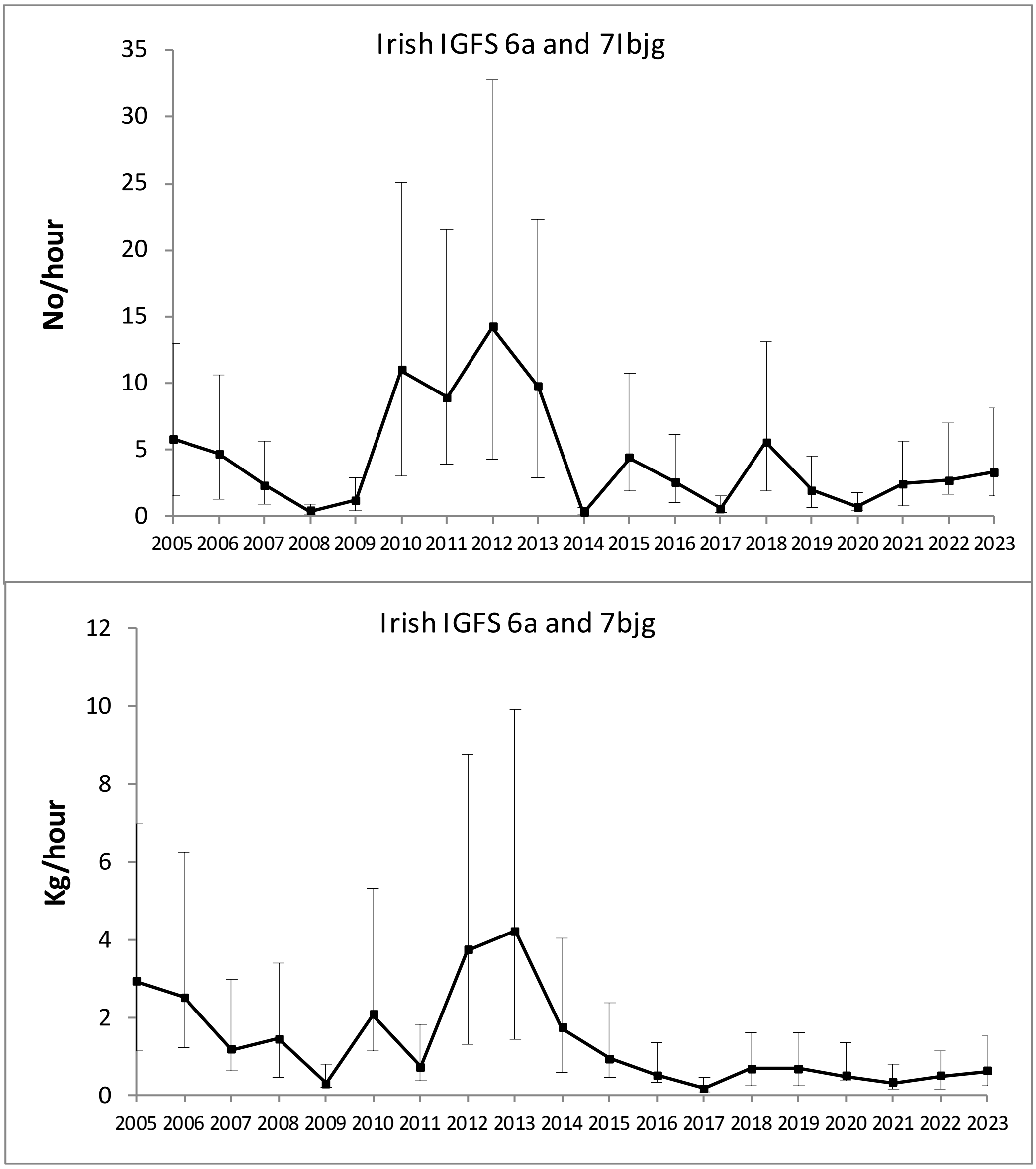

Figure 10.11. Abundance and biomass Indices (no. per hour and kg per hour) of Greater forkbeard total catches of the Irish Groundfish Survey (IE-IGFS-(G7212) in the slope and shelf strata, 2005–2023.

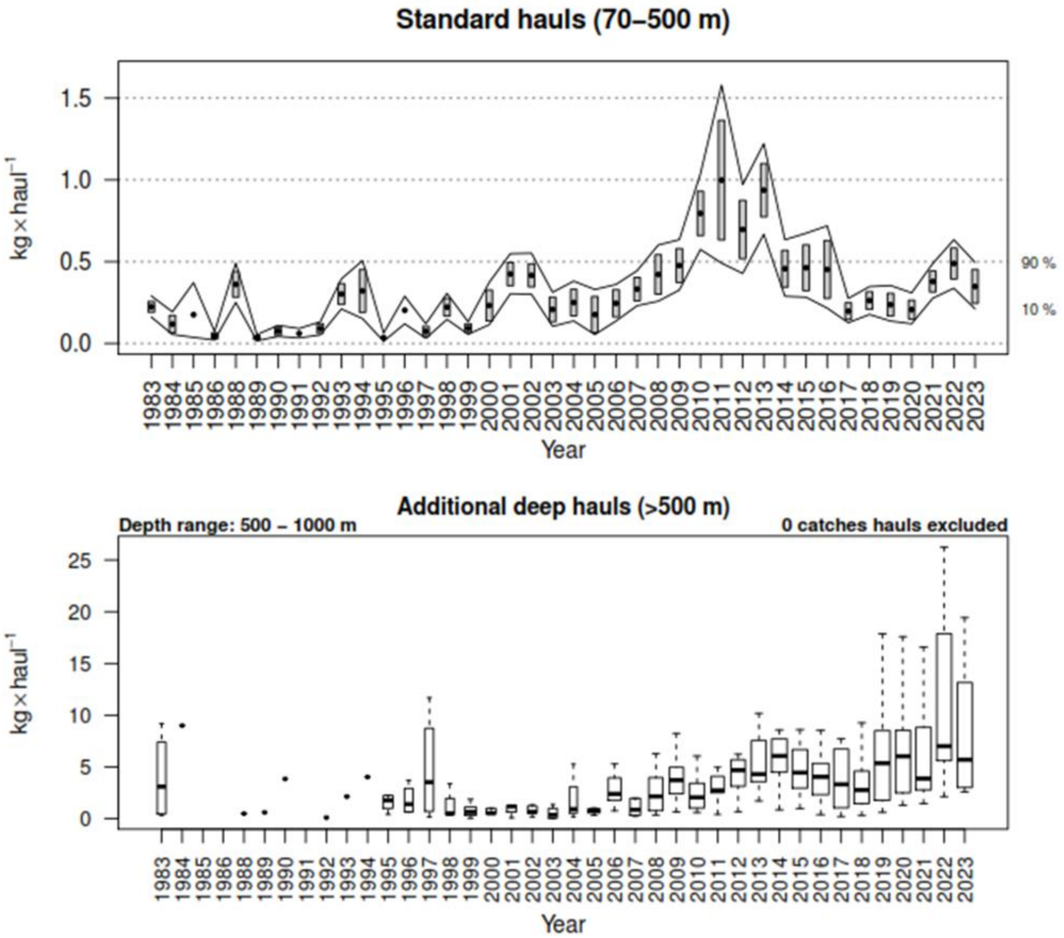

Figure 10.12. Evolution of *Phycis blennoides* stratified biomass index in standard hauls and additional deep hauls during the North Spanish shelf bottom trawl survey (SP-NGFS-(G2784) time series (1983-2023). For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartile of the biomass catches in the deep hauls performed.

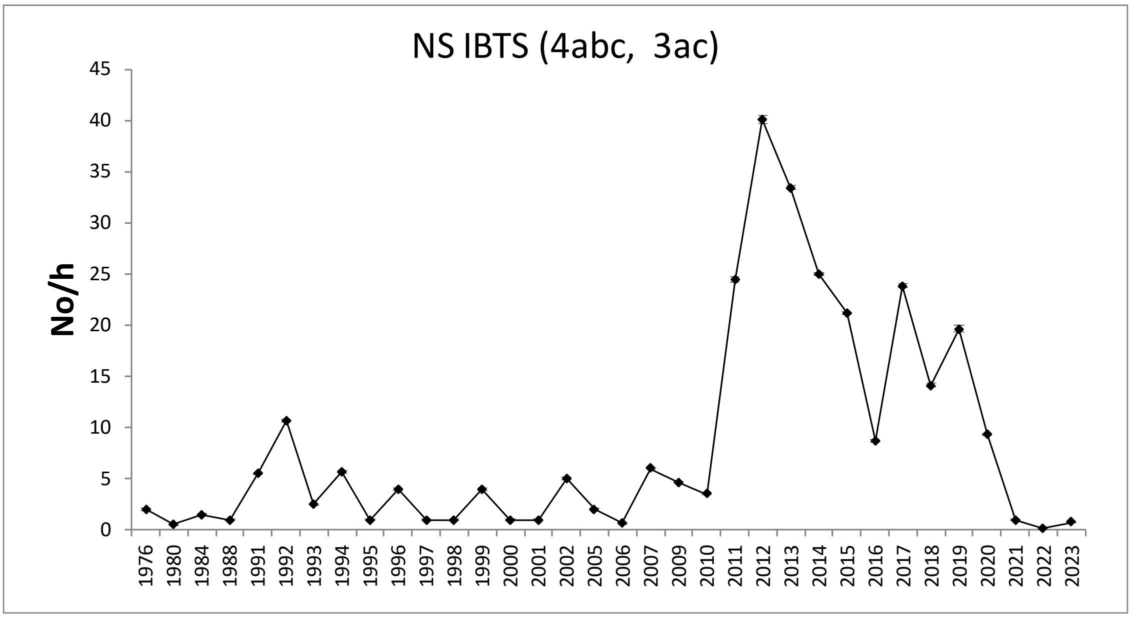

Figure 10.13. Greater forkbeard series of abundance (No/hour) of the North Sea IBTS survey (NS-IBTS) until 2022 in Divisions 4.abc and 3.ac.

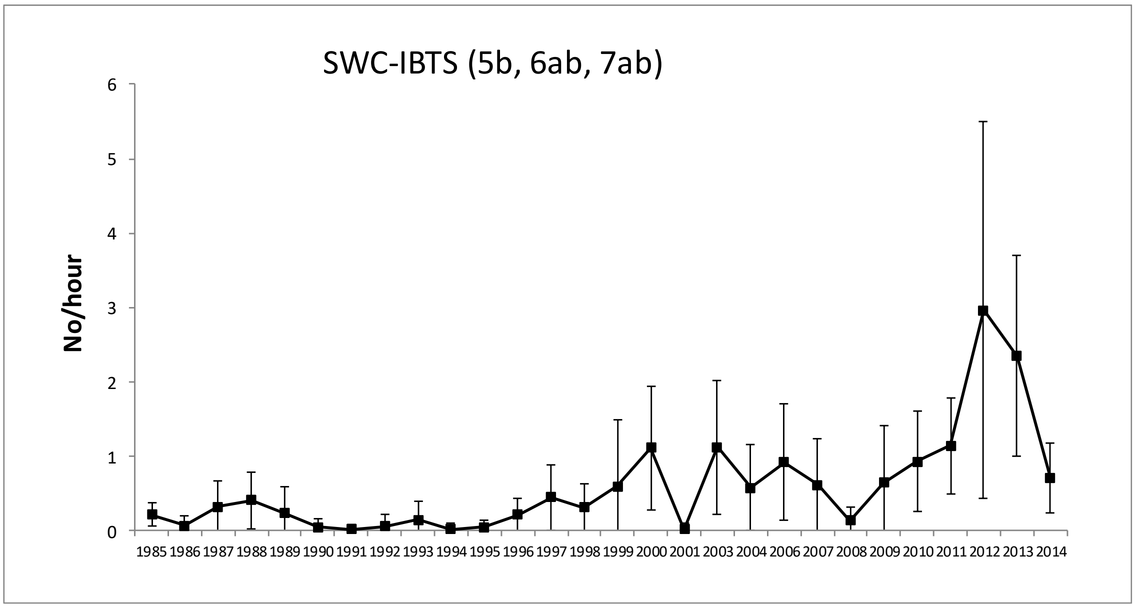

Figure 10.14. Greater forkbeard series of abundance (No/hour) of the Scottish Western Coast Groundfish IBTS survey (SWC-IBTS-(G1179-G4299)) until 2014 in Divisions 5.b, 6.ab and 7.ab.

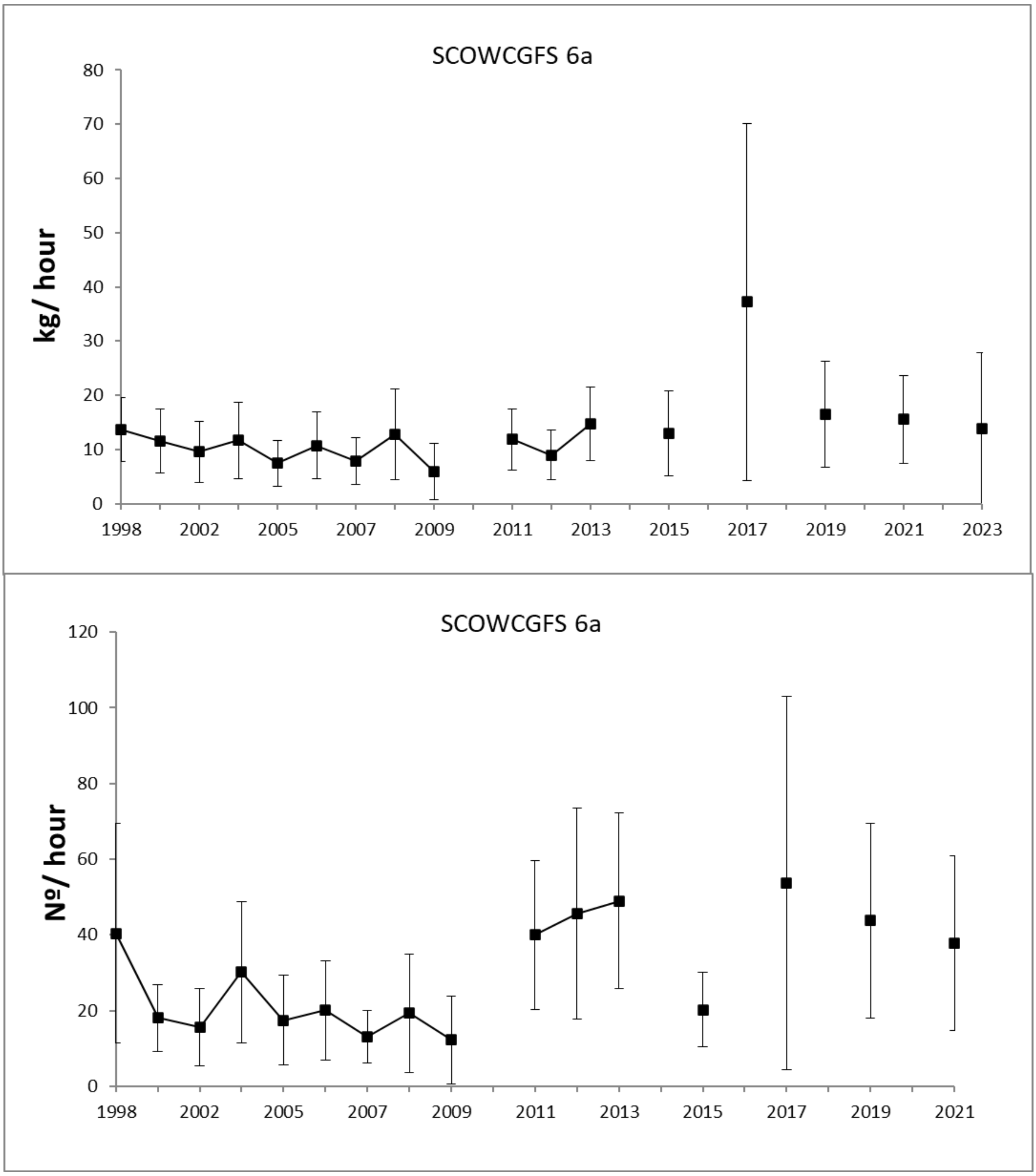

Figure 10.15. Greater forkbeard series of biomass (kg/hour) and abundance (No/hour) of the Scottish Deep-water trawl survey (SCOWCGFS-G4748-G4815 in ICES Division 6.a between 1998 and 2021.

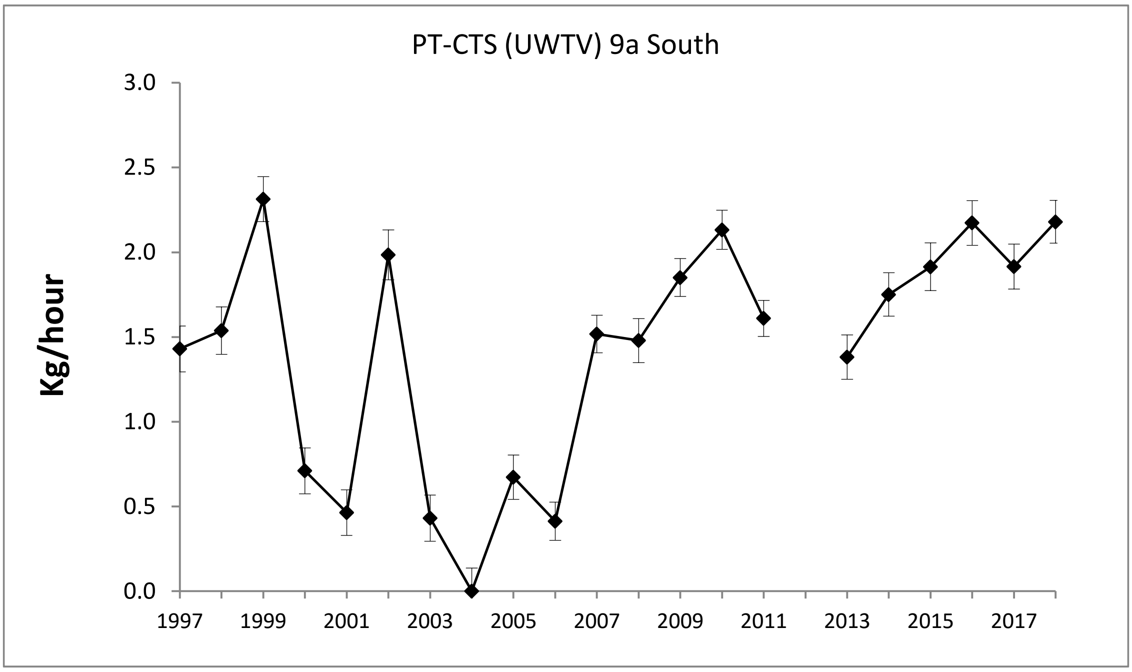

Figure 10.16. Greater forkbeard series of Standardized biomass index (kg.hour-1) of the Portuguese PT-CTS (UWTV (FU 28–29) survey until 2019 in the Division 9.a South. CPUE values estimated for the sector "Milfontes".

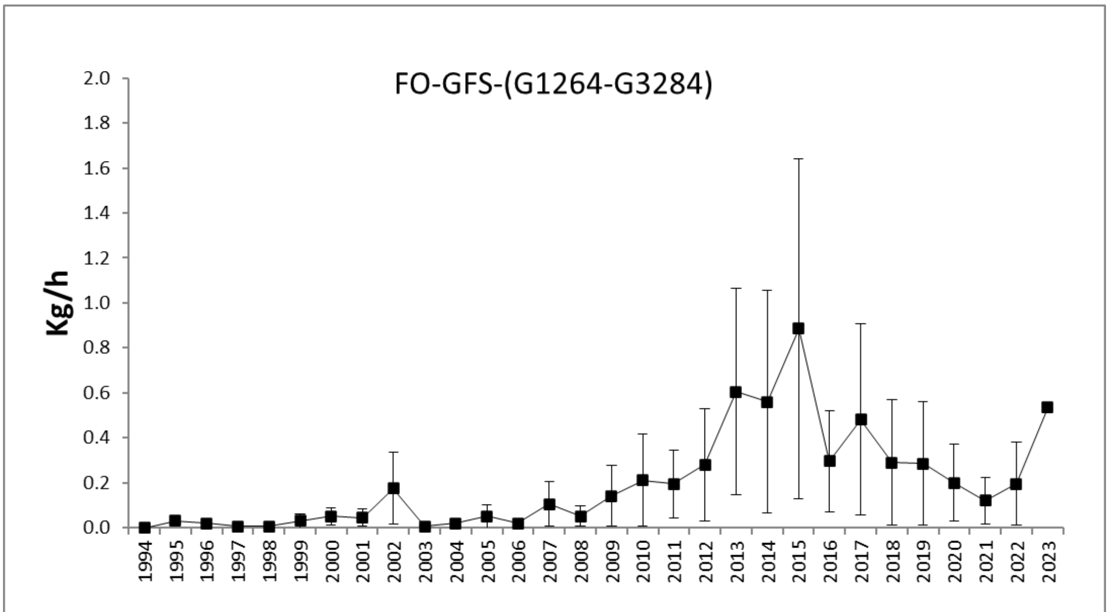

Figure 10.17. Faroe Plateau survey in Division 5b. Data of Biomass (kg/h) from 1994 to 2023 in the combined spring and summer surveys.

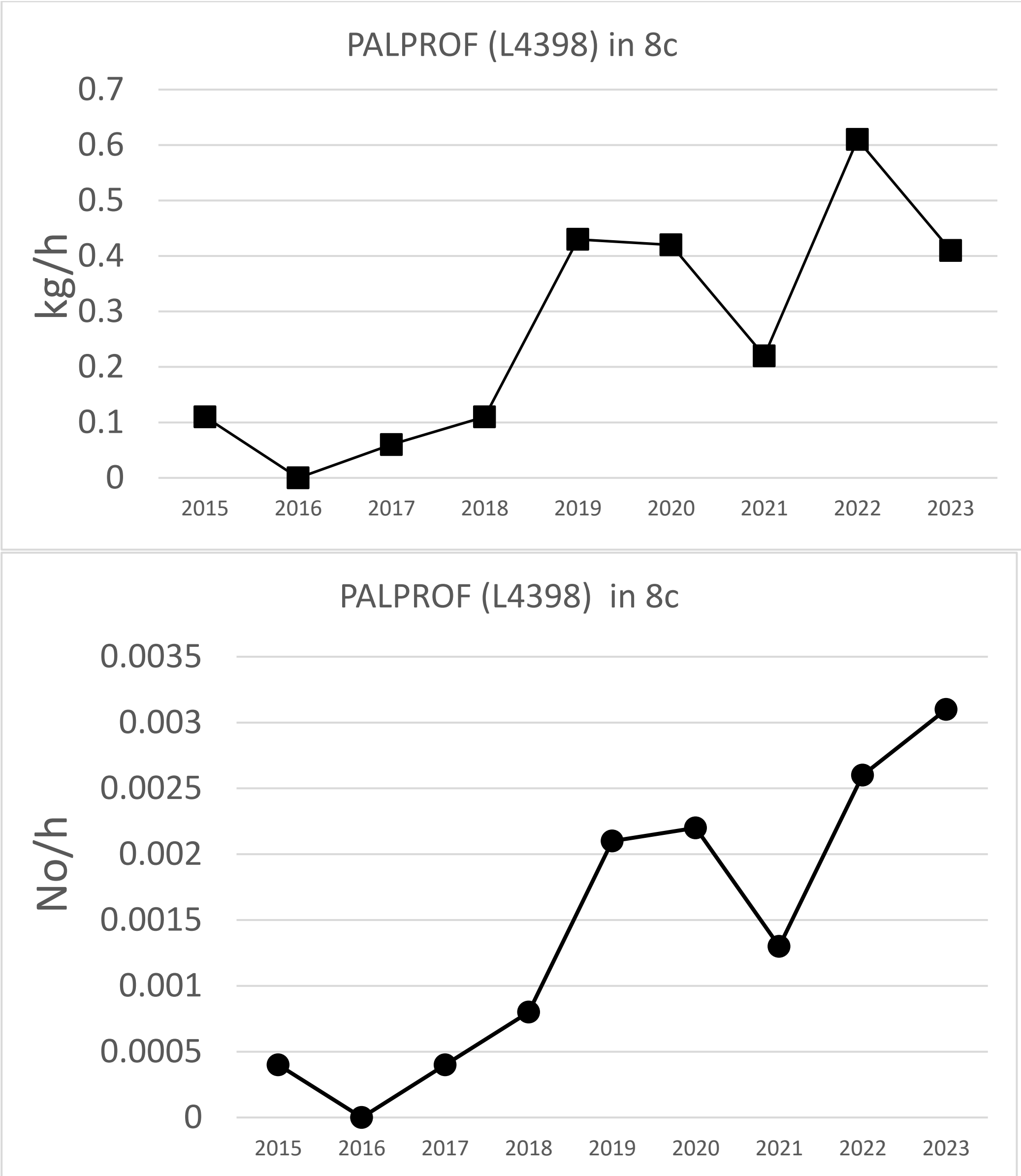

Figure 10.18. Long line PALPROF (L4398) survey in Division 8C. Data of Biomass (kg/h) and Abundance (No/h) from 2015 to 2023.

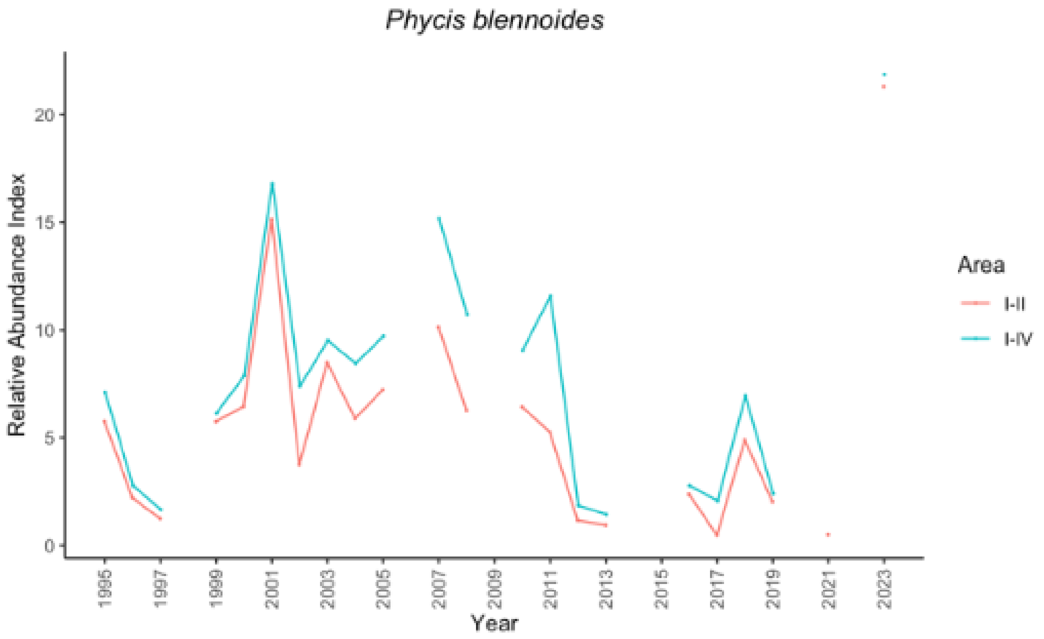

Figure 10.19. Azorean survey ARQDAÇO (L6563) survey in Division 10. Data of Biomass (kg/1000 hooks) from 1995 to 2023.

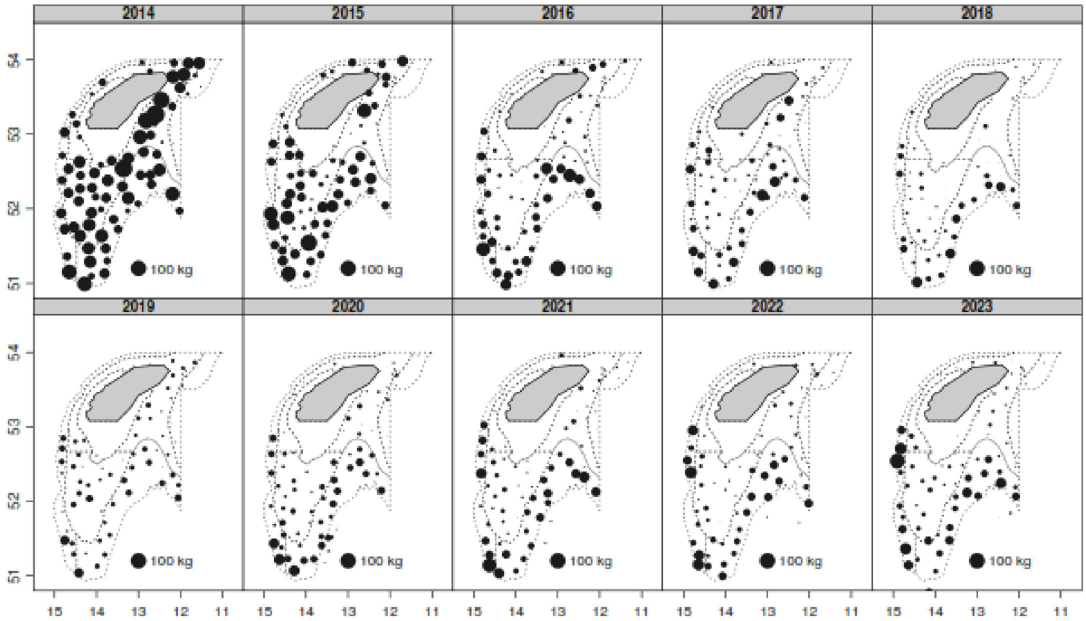

Figure 10.19. Geographic distribution of *Phycis blennoides* catches (kg×30 min haul^{-1}) and recruits (1-25 cm) in the Porcupine surveys (2014-2023).

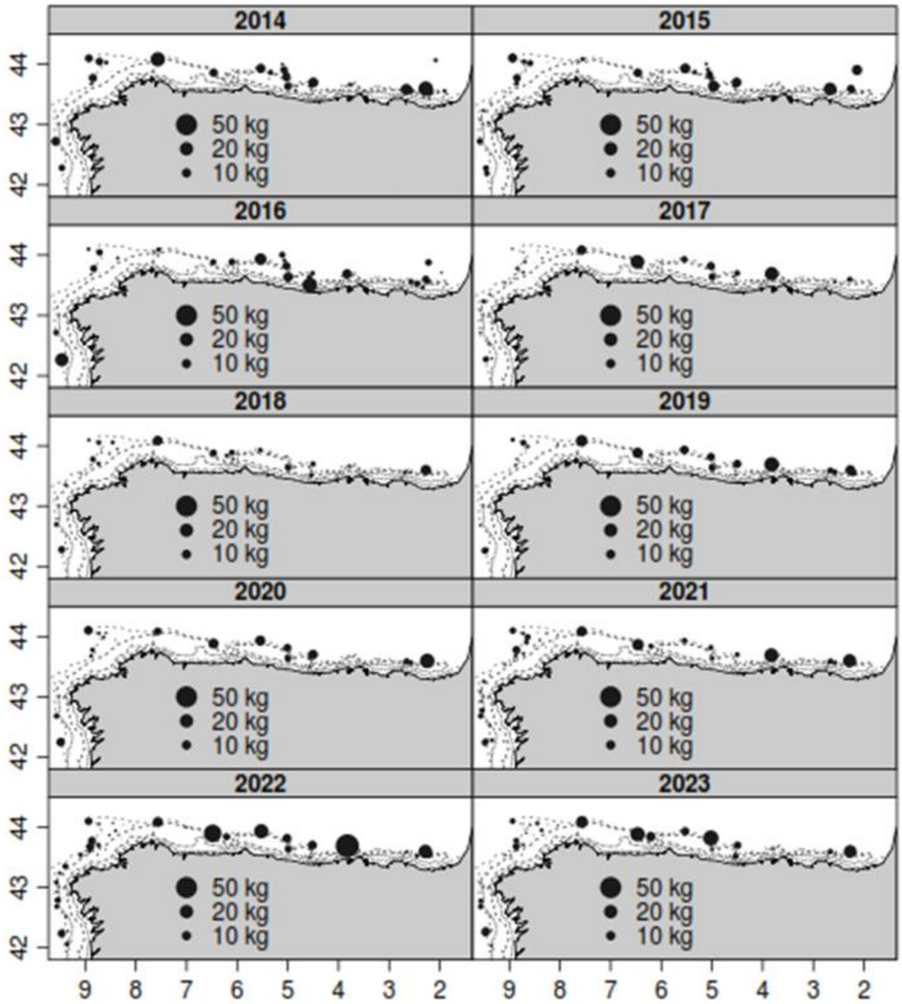

Figure 10.20. Catches in biomass of greater forkbeard on the Northern Spanish Shelf bottom-trawl surveys (SP-NGFS-(G2784) between 2012 and 2023.

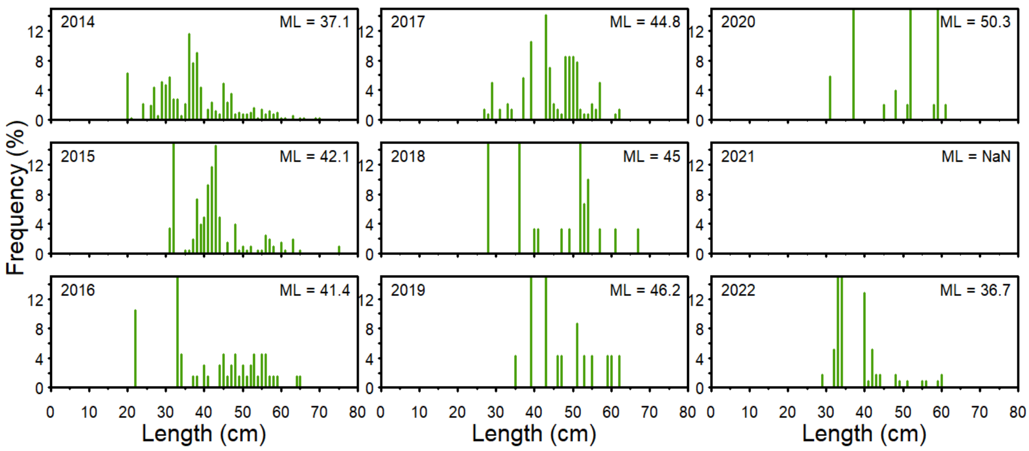

Figure 10.21. Length-frequency distribution from the Faroes deepwater survey from 2014 to 2022 (no survey in 2021).

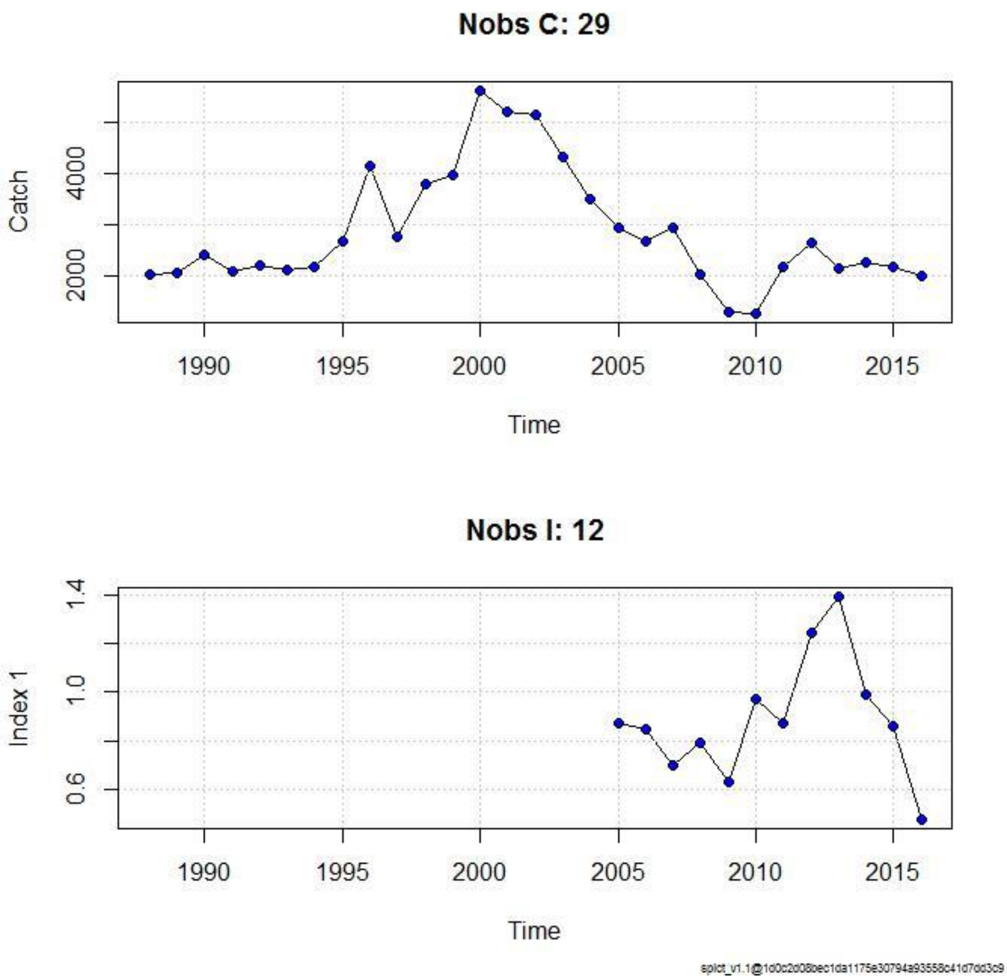

Figure 10.22. Inputs of the SPICT model used in the Greater Forkbeard stock.

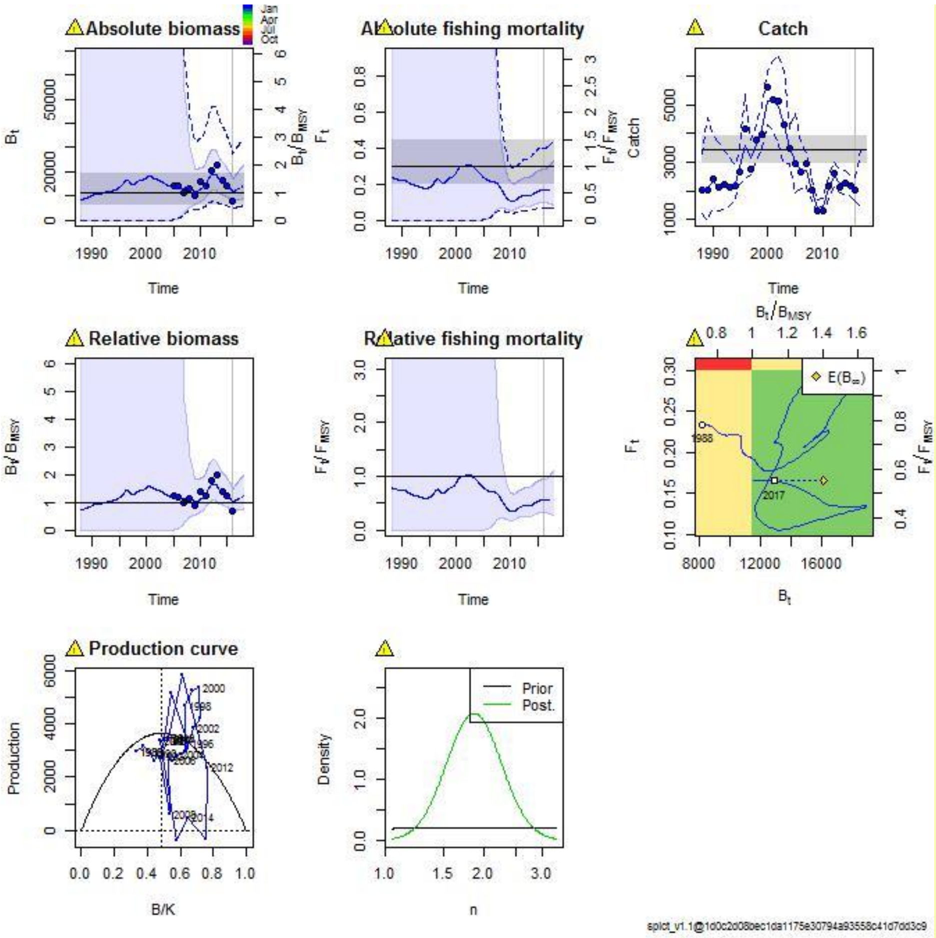

Figure 10.23. Results of the SPICT model for the Greater Forkbeard stock.

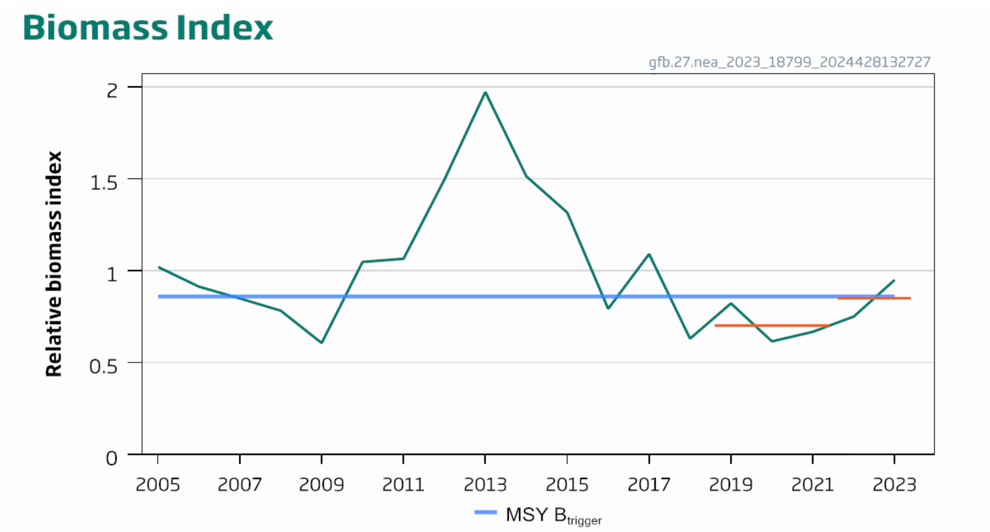

Figure 10.24. Average relative biomass indicator from six five surveys. The horizontal orange lines indicate the average of the biomass index for 2018 to 2020 and for 2021 to 2023

10.10 References

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Contents

11 Alfonsinos/Golden eye perch (*Beryx* spp.) in all ecoregions

11.1 The fishery

Alfonsinos includes two species, *Beryx splendens* and *Beryx decadactylus*. Both are generally considered as bycatch species in the demersal trawl and longline mixed fisheries targeting other deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as B*eryx* spp.

The proportion of each species in the catches is 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 30% of the catches of both species in the last 36 years. Russian trawl fishery targeted *B. splendens* till 2000. Portuguese, Spanish and French trawlers and longliners are the main fleets involved in this fishery.

Landings from a targeted fishery by Russian vessels operating in the NEAFC area (ICES Division 10b) were available for the period 1993–2000 and some minor landings as bycatch in fisheries targeting other species since 2000. Since 2000, there are no target fisheries occurring in the Mid-Atlantic Ridge (NEAFC) (see Section 2).

Currently, landings are reported from bycatch fisheries occurring 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 10a (See Table 11.1a–f).

11.1.1 Landings trends

The available landings data for alfonsinos (*Beryx* spp.) by ICES subarea/division as officially reported to ICES or to the WGDEEP, are presented in Tables 11.1a–i and Figures 11.1–11.3. Total landings are stabilized since 2005, due to EU management measures introduced (TAC/quotas and effort regulation), being around 318 tonnes between 2005 and 2023, with high landings during 2012 (605 t).

11.1.2 ICES Advice

ICES advised that when the precautionary approach is applied, landings should be no more than 179 tonnes in each of the years 2023 and 2024. ICES cannot quantify the corresponding catches.

11.2 Management

Fishing with trawl gears is forbidden in the Azores region (EC. Reg. 1568/2005). A box of 100 miles limiting 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 179 t for EC vessels is in force for the period 2023–2024 (see historical developments in the table down).

Technical measures were introduced in the Azores in 1998. In 2009 new measures were adopted, particularly to control the effort of longliners through restrictions on fishing area, minimum length, gear and effort. These measures were updated from 2015–2019. 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.

NEAFC adopted effort regulations for fisheries targeting deep-water species and in 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* spp.	2005	3, 4, 5, 6, 7, 8, 9, 10, 12	328	422
	Beryx spp.	2006	3, 4, 5, 6, 7, 8, 9, 10, 12	328	367
Reg 2015/2006	*Beryx* spp.	2007	3, 4, 5, 6, 7, 8, 9, 10, 12	328	396
	Beryx spp.	2008	3, 4, 5, 6, 7, 8, 9, 10, 12	328	405
Reg 1359/2008	*Beryx* spp.	2009	3, 4, 5, 6, 7, 8, 9, 10, 12	328	382
	Beryx spp.	2010	3, 4, 5, 6, 7, 8, 9, 10, 12	328	296
Reg 1225/2010	*Beryx* spp.	2011	3, 4, 5, 6, 7, 8, 9, 10, 12	328	331
	Beryx spp.	2012	3, 4, 5, 6, 7, 8, 9, 10, 12	328	596
Reg 1262/2012	*Beryx* spp.	2013	3, 4, 5, 6, 7, 8, 9, 10, 12	312	272
	Beryx spp.	2014	3, 4, 5, 6, 7, 8, 9, 10, 12	296	282
Reg. 1367/2014	*Beryx* spp.	2015	3, 4, 5, 6, 7, 8, 9, 10, 12	296	365
	Beryx spp.	2016	3, 4, 5, 6, 7, 8, 9, 10, 12	296	300
Reg. 2285/2016	*Beryx* spp.	2017	3, 4, 5, 6, 7, 8, 9, 10, 12	280	240
	Beryx spp.	2018	3, 4, 5, 6, 7, 8, 9, 10, 12	280	263
Reg. 2025/2018	*Beryx* spp.	2019	3, 4, 5, 6, 7, 8, 9, 10, 12	252	294
	Beryx spp.	2020	3, 4, 5, 6, 7, 8, 9, 10, 12	252	233
Reg. 1239/2021	*Beryx* spp.	2021	3, 4, 5, 6, 7, 8, 9, 10, 12	224	205
	Beryx spp.	2022	3, 4, 5, 6, 7, 8, 9, 10, 12	224	216
Reg. 194/2023	*Beryx* spp.	2023	3, 4, 5, 6, 7, 8, 9, 10, 12, 14	179	165
	Beryx spp.	2024	3, 4, 5, 6, 7, 8, 9, 10, 12, 14	179	

11.3 Stock identity

No new information.

11.4 Data available

11.4.1 Landings and discards

Tables 11.1a–i describe the alfonsinos landings by subarea and country. 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 11.2). These discards are mostly a result of the Azorean management measures such as TAC and minimum landing size.

11.4.2 Length compositions

Length information from the Northern Spanish Shelf Groundfish Survey (Divisions 8c and Northern part of 9a; SPNGFS) and Spanish Groundfish Survey on the Porcupine Bank (ICES Divisions 7c and 7k; SP-PORC-Q3) was made available for 2023 in WD07 Ortiz et al. (2024) and WD08 Ruiz-Pico et al. (2024).

Fishery length composition (LT, cm) of the landings from the Azores are shown for *Beryx splendens* in Figure 11.4, and for *Beryx decadatylus* in Figure 11.5. Length data from the Azorean spring bottom longline survey were updated (WD05 Novoa-Pabon et al., 2024) and are shown for both species in Figures 11.6 and 11.7.

11.4.3 Age compositions

No new information.

11.4.4 Weight-at-age

No new information.

11.4.5 Maturity, sex-ratio, length–weight and natural mortality

No new information.

11.4.6 Catch, effort and research vessel data

Catch-per-unit-effort (CPUE) was estimated for *Beryx splendens* and *B. decadactylus* as kg per day at sea per vessel using the information gathered through DCF inquiries applied in the Azores (ICES Subdivision 10a2). To reduce the influence of potential drivers (e.g., targeted species, vessel size, métier) on these catch rates, generalised additive mixed models (GAMMs) were used to calculate annual standardised abundance indices. The equation below expresses the general GAMM formulation used:

$$Catch = \exp(\beta_0 + Year + Quarter + Metier + Depth + Target + \alpha Vessel + offset(\log(effort)))$$

The period from 2003 to 2022 was selected for this analysis due to limitations in data availability, particularly the smaller sample sizes in the earlier years of the time series. The categories of vessel size (0–10, 10–12, 12–18, 18–24, and 24–40 meters) and geographic location (sampled islands) were defined based on the frequency of DCF inquiries associated with each. Due to the multiplicity of reported métiers, only those representing more than 50% of total catches were included, specifically LLS_DEF (set longlines for demersal fishes) and LHP_FIF (hand lines for pelagic fishes).

Demersal bottom longline surveys (ARQDAÇO–L6563) have been conducted every spring around the Azores (ICES Subdivision 10a2) since 1995, although surveys were not carried out in 1998, 2006, 2009, 2014, 2015, 2020 and 2022 (WD05 Novoa-Pabon et al., 2024). This survey utilizes a stratified random sampling method, dividing each sampling zone into depth strata at 50 m intervals up to a depth of 1200 m. Longlines are set perpendicular to the isobaths. The catches per unit effort (CPUE) are adjusted for area size to calculate relative biomass indices, expressed in kilograms per 1000 hooks (Pinho et al., 2020). In 2021, the survey's spatial extent was reduced to 50% of the usual sampling area, specifically including only statistical areas I and II. Although areas III and IV were not included, the abundance trends for areas I and II were consistent with those derived from areas I to IV for most species (WD05 Novoa-Pabon et al., 2024).

11.5 Data analyses

11.5.1 Landings

Total landings declined in the late 1990s and since 2003 stabilized at about 328 tonnes (for the two species combined), with a peak of 605 tonnes in 2012 due to the landings reported by Spain for subareas 6–7 (Figure 11.1). Landings of *Beryx* spp. are primarily recorded from Portugal (mainland and Azores), Spain, France, and Russia (Figure 11.2). Nevertheless, a significant majority of these landings are systematically attributed to the Azorean fleet. In years such as 1988, 1991, 2009, and 2010, the Azores accounted for more than 80% of the total landings. Despite temporal variations, the Azorean fleet has consistently accounted for a substantial proportion of the total landings (Figure 11.2).

Species-specific landings trends in the Azores showed similar trends for both species, with *B. splendens* recording the highest capture volumes in most of the time series (Figure 11.3). Since advised catches are assigned for combined species and they have experienced precautionary reductions, the Azorean fleet seems to be focusing its captures on the more valuable species, *B. decadactylus*, leading to a slight shift in the proportions between species in recent years. Furthermore, a regional ordinance (Ordinance No. 2/2024 of January 5, 2024) has introduced limits on local catches of *B. splendens* starting from 2024, prohibiting its fishing once the catch reaches 35 tonnes and permitting only the capture of *B. decadactylus.*

11.5.2 Length compositions

Beryx spp. were found in four hauls between 452 m and 606 m during the SPNGFS in 2023. Two specimens of *B. decadactylus* with 23 and 24 cm in Galician waters, and four specimens of *B. splendens* ranging from 21 to 27 cm in Cantabrian Sea (Figures 11.8–11.9). During the SO-PORC-Q3, six specimens of *B. splendens* from 24 to 35 cm were found in six hauls in the southern and eastern part of the Porcupine Bank (Figures 11.10–11.11). *B. decadatylus* was only caught in the eastern bank area (three specimens with 28 and 32 cm, in two hauls). In the Azores, fishery length compositions show a well-defined mode for *B. splendens* (35 cm) and *B. decadatylus* (40 cm) during the last five years (Figures 11.4–11.5). Survey length compositions for *B. splendens* and *B. decadactylus* show that relatively small numbers of *B. decadactylus* are caught in the survey on the sampled depth strata (50–1200m) (Figures 11.6 and 11.7). For *B. splendens* a mode around 30 cm is observed and *B. decadactylus* show a bimodal or trimodal distribution.

11.5.3 Abundance indices

Abundance indices for *B. splendens*, estimated from Azorean commercial fishery data, exhibited clear peaks in 2006 and 2012 (Figure 11.12). These peaks were followed by notable declines, with the lowest point reached in 2017. In recent years, the index has shown signs of recovery. For *B. decadactylus*, the index remained relatively stable up to 2016, with 2017 marking the lowest point of the time series (Figure 11.13). A significant rise occurred from 2019 onward, with the highest value recorded in 2021. Although the index slightly declined in 2022, it remained relatively high in 2023 compared to the early 2000s. The residual diagnostics and retrospective analysis of the models used to standardise the CPUE for both species are presented in Figures 11.14–11.17.

The ARQDAÇO (L6563) abundance index for *B. splendens* declined between 1995 and 1997 and remained at very low levels until 2007. An upward trend in abundance was observed from 2010 to 2013, followed by a decline from 2016 to 2019, after which it began to increase again (Figure 11.18). For *B. decadactylus*, a decrease was observed starting in 1996, which persisted at low levels until 2003. The levels then increased from 2003 to 2007 and remained high until 2011 before decreasing again until 2016, increasing again in 2023 (Figure 11.19).

11.5.4 Assessment

The stock is currently classified under ICES Category 5. However, considering that (i) the majority of reported catches are attributed to the Azores region, (ii) detailed landings data by species are only available for the Azores, (iii) *B. splendens* represents the species with the highest capture volume, accounting for 70% of catches, and (iv) both survey abundance index trends and fishery length composition data are available for *B. splendens* in recent years in the Azores, it was possible to perform the assessment based on the rfb rule for Category 3 stocks.

Considering this, it was decided to present the following scenarios on advice opportunities:

- Scenario A: rfb catch rule (Category 3). Previous catch last three years Cy (average 2021–2023). Due to the interruption caused by COVID-19 and a strike of the crew members of the research vessel, the ARQDAÇO (L6563) was not carried out in 2020 and 2022; therefore, the abundance indices for these years were interpolated. The index A was calculated using the two most recent years of abundance indices (2022–2023) and B was based on the last three years (2019, 2020, 2021). The indices A and B were calculated to estimate the r – stock biomass trend (index ratio A/B). The fishing pressure proxy (f) were calculated using the length-composition from the fishery for the period 2021–2023.
- Scenario B: precautionary approach (Category 5). For stocks without information on abundance or exploitation, ICES considers that a precautionary reduction of catches should be implemented where there is no ancillary information clearly indicating that the current level of exploitation is appropriate for the stock. The precautionary buffer was applied in 2022 and, therefore, is not applied again.

Following the guidance on the parameter determination for the rfb rule, possible estimates of the input values and some comments are presented in the table below.

Variable	Estimate	Input data	Comment
r: Stock biomass trend	3.2	The Azorean bottom long-line survey was used as the index of stock development.	Index A (2022, 2023) = 8.0 Index B (2019, 2020, 2021) = 2.5
f: Fishing proxy	0.91	Fishery length composition from the landings, collected by DCF (2021–2023). L_{mean} = 35.6 cm $L_{F=M}$ = 39.2 cm	F proxy was estimated from length-based indicators. Data from 2021–2023 was combined. L_c = 34 cm L_{inf} = 55 cm
b: Biomass safeguard $= \min(1, I_{y-1}/I_{\text{trigger}})$ $I_{\text{trigger}} = I_{\text{loss}}\ \omega$, considering $\omega = 1.4$	1	Stock indicator; I_{loss} minimum estimate = 0.82 $I_{trigger}$ = 1.2	
m linked to von Bertalanffy k	0.95	k = 0.125 year^{-1}, estimated from the Von Bertalanffy model.	

Length-based indicators reported from WKLIFE-V were explored using Azorean commercial fishery length compositions from 2021–2023 (discards are not available). Life-history parameters used for this analysis were estimated as the median values of those estimated for this species in the Azores (Santos et al., 2020), as shown in Table 11.3. Computations were performed using R software and the codes were available in the GitHub library of ICES.

Results from the analysis are presented in Table 11.4. Results show that a substantial harvesting occurs after maturity (L_c and $L_{25\%}$>L_{mat}), indicating that immature individuals are being preserved. This was expected since the current minimum landing size (35 cm) is higher than L_{mat} (27cm). For the mature fraction of the population, results suggest that the large individuals are decreasing ($L_{max5\%}$≤L_{inf}). The L_{mean} is close to L_{opt}, suggesting a fishery at levels close to optimum yield. Results of P_{mega} indicator suggest that the mega spawners in the Azorean commercial fishery are lower than 30% throughout the analysed period. The MSY proxy results show that exploitation is above or close to the MSY level (L_{mean}<$L_{F=M}$).

11.6 Comments on the assessment

The working group express concerns on the reliability of the survey abundance indices from the Azores as an indicator of Northeast Atlantic abundance index for *B. decadactylus*. The survey may not be designed for these highly mobile and aggregative species and the low number of individuals caught annually may not be enough to map the abundance of the species.

During 2022, the ARQDAÇO survey did not operate due to a strike of crew members of research vessels. In 2021, the survey covered only 50% of the total sampling area. The sampled area corresponds to the coastal areas of the five islands of the central group and the two main seamounts near the same group of islands. Thus, the entire historical series of the relative abundance index was reconstructed for these statistical areas sampled during the year 2021. Due to the interruption of COVID-19, the bottom longline survey was not carried out in 2020. An interpolated value was used in the advice rule for 2020 and 2022.

Exploratory assessments were performed in order to explore different advice scenarios, including non-interpolated survey indices (i.e., index A: 2023; index B: 2021, 2019, 2018) and fishery-derived CPUE indices. Results were presented and discussed in the WGDEEP 2024 and the catch advices were the same as in scenario A.

11.7 Management considerations

The spatial distribution of the two *Beryx* species is closely associated with seamounts (Figures 11.20–11.22), with *B. decadactylus* exhibiting a wider geographical range (Santos et al., 2019). This behaviour, coupled with their life history, makes this species particularly vulnerable to exploitation and easily overexploited by trawl fishing.

The exploitation of new seamounts should be prohibited to prevent the depletion of entire sub-populations that have not yet been mapped and assessed. Additionally, it is crucial that countries begin reporting data by species to ensure effective management and conservation measures.

11.8 References

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11.9 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**
2019	0	**0**
2020	0	**0**
2021	0	**0**
2022	0	**0**
2023*	0	**0**

***Preliminary.**

Table 11.1b. Landings (tonnes) of *Beryx* spp. from Division 5.b.

YEAR	FAROES	FRANCE	TOTAL
1988			**0**
1989			**0**
1990		5	**5**
1991		0	**0**
1992		4	**4**
1993		0	**0**
1994		0	**0**
1995	1	0	**1**
1996	0	0	**0**
1997	0	0	**0**
1998	0	0	**0**
1999	0	0	**0**
2000	0	0	**0**
2001	0	0	**0**
2002	0	0	**0**
2003	0	0	**0**
2004	0	0	**0**
2005	0	0	**0**
2006	0	0	**0**
2007	0	0	**0**
2008	0	0	**0**
2009	0	0	**0**
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**

YEAR	FAROES	FRANCE	TOTAL
2017	0	0	**0**
2018	0	0	**0**
2019	0	0.1	**0.1**
2020	0	0	**0**
2021	0	0	**0**
2022	0	0	**0**
2023*	0	0	**0**

***Preliminary.**

Table 11.1c. Landings (tonnes) of *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**
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**

YEAR	FRANCE	E & W	SPAIN	IRELAND	SCOTLAND	TOTAL
2017	7	0	11	0	0	**18**
2018	27	0.209	19	0	0	**46**
2019	57		24	0	0	**81**
2020	7	3.1	14	0	0	**25**
2021	6	0	12	0	0	**18**
2022	3	0	9	0	0	**12**
2023*	3	0	7	0	0	**10**

***Preliminary.**

Table 11.1d. Landings (tonnes) of *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**
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	0	**61**
2016	3	1	71	0	**76**

YEAR	FRANCE	PORTUGAL	SPAIN	E & W	TOTAL
2017	3	2	67	0	**73**
2018	6	0	52	0	**58**
2019	5	10	55	0	**70**
2020	10	11	48	0	**69**
2021	6	0	57	0	**63**
2022	9	17	51	0	**76**
2023*	8	13	38	0	**59**

*** Preliminary.**

Table 11.1e. Landings (tonnes) of *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**
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**

	10.a	**10.b**				
2016	156	48	0	0	0	**204**
2017	149	0	0	0	0	**149**
2018	159	0	0	0	0	**159**
2019	143	0	0		0	**143**
2020	139	0	0		0	**139**
2021	124	0	0		0	**124**
2022	127	0	0		0	**127**
2023*	96	0	0		0	**96**

*** Preliminary.**

**** Not official data from ICES Area 10.b.**

Table 11.1f. Landings (tonnes) of *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**
2019	0	**0**
2020	0	**0**
2021	0	**0**
2022	0	**0**
2023*	0	**0**

*** Preliminary.**

Table 11.1g. Landings (tonnes) of *Beryx splendens* and *B. decadactylus* from Madeira (Portugal) outside the ICES area.

YEAR	*B. splendens*	*B. decadactylus*	TOTAL
1988*			
1989*			
1990*			
1991*			
1992*			
1993*			
1994*			
1995	1	0	**1**
1996	11	0	**11**
1997	4	0	**4**
1998	3	0	**3**
1999	2	0	**2**
2000	1	0	**1**
2001	0	0	**1**
2002	0	0	**0**
2003	0	0	**0**
2004	0	0	**0**
2005	0	0	**0**
2006	0	0	**1**
2007	0	1	**1**
2008	0	0	**1**
2009	0	0	**0**
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**

YEAR	*B. splendens*	*B. decadactylus*	TOTAL
2017	0	0	**0**
2018	0	0	**0**
2019	0	0	**0**
2020	0	0	**0**
2021	0	0	**0**
2022	0	0	**0**
2023	0	0	**0**

*** No information.**

Table 11.h. Landings (tonnes) of *Beryx splendens* and *B. decadactylus* from the Azores (ICES Subdivision 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**
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**

YEAR	*B. splendens*	*B. decadactylus*	TOTAL
2017	119	30	**149**
2018	107	50	**157**
2019	92	46	**138**
2020	67	72	**139**
2021	70	54	**124**
2022	63	64	**127**
2023	42	54	**96**

Table 11.1i. Landings (tonnes) of *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**
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**

YEAR	4	5.b	6+7	8+9	10.a	10.b	12	TOTAL
2017	0	0	18	73	149	0	0	**240**
2018	0	0	46	58	159	0	0	**263**
2019	0	0	81	70	138	5	0	**294**
2020	0	0	25	69	139	0	0	**233**
2021	0	0	18	63	124	0	0	**205**
2022	0	0	12	76	127	0	0	**216**
2023*	0	0	10	59	96	0	0	**165**

***Preliminary.**

Table 11.2. Annual percentage of *Beryx splendens* and *B. decadactylus* discarded by year in the Azores (ICES Subdivision 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 11.3. Life-history parameters estimated for *Beryx splendens* in the Azores (ICES Area 10a2).

PARAMETERS	VALUE	DEFINITION	SOURCE
L_{inf} (LT, cm)	55	Asymptotic average maximum length	Santos et al. (2020)
k (year^{-1})	0.125	Growth coefficient of the von Bertalanffy growth model	Santos et al. (2020)
L_{mat} (LT, cm)	27	Length at first maturity	Santos et al. (2020)
M	0.2	Natural mortality	Santos et al. (2020)
M/k	1.55	Ratio of natural mortality and the von Bertalanffy growth coefficient	Santos et al. (2020)

Table 11.4. Traffic light indicators for *Beryx splendens* in the Azores (ICES Area 10a2) from the commercial fishery landings.

YEAR	CONSERVATION				OPTIMISING YIELD	MSY
	L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	$L_{mean}/L_{F=M}$
2021	1.22	1.22	0.72	0.02	0.96	0.91
2022	1.22	1.22	0.72	0.02	0.95	0.9
2023	1.22	1.22	0.73	0.02	0.96	0.9

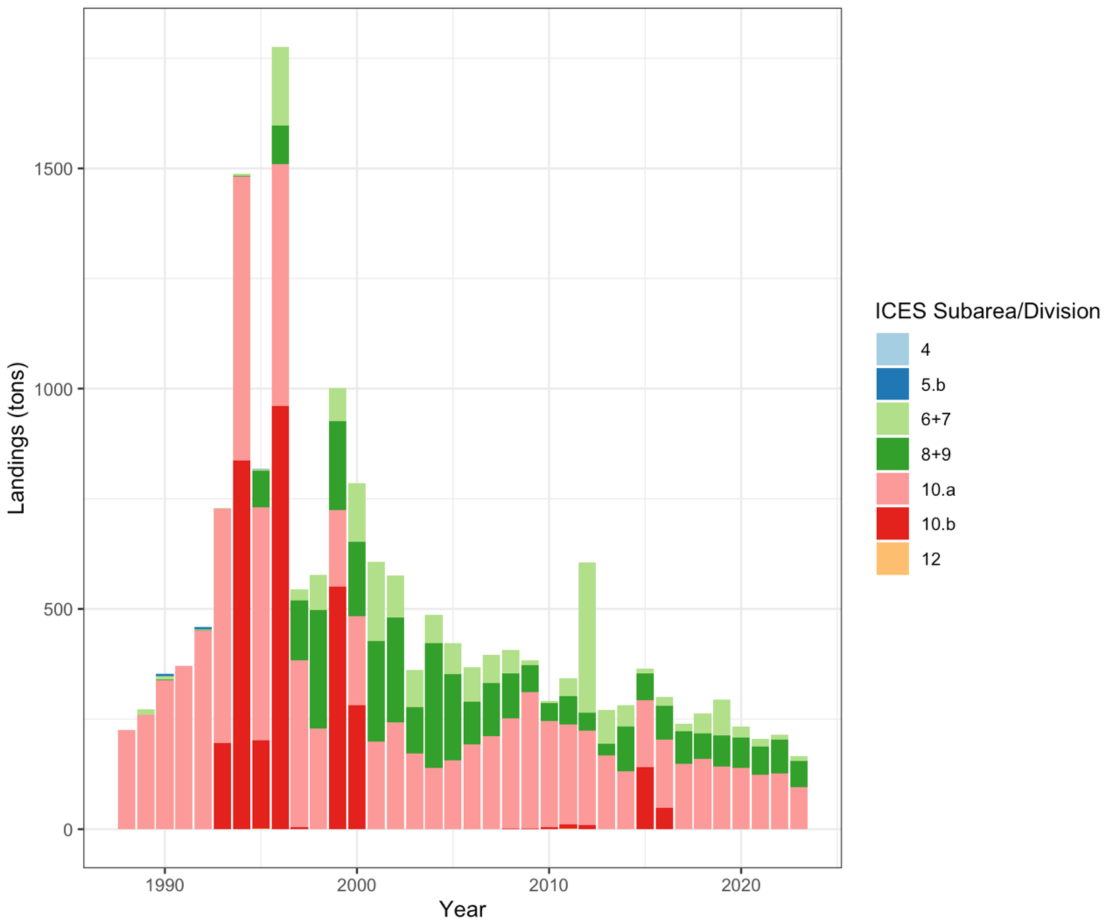


Figure 11.1. Stacked barchart of reported landings (tonnes) of *Beryx* spp. by ICES subarea/division.

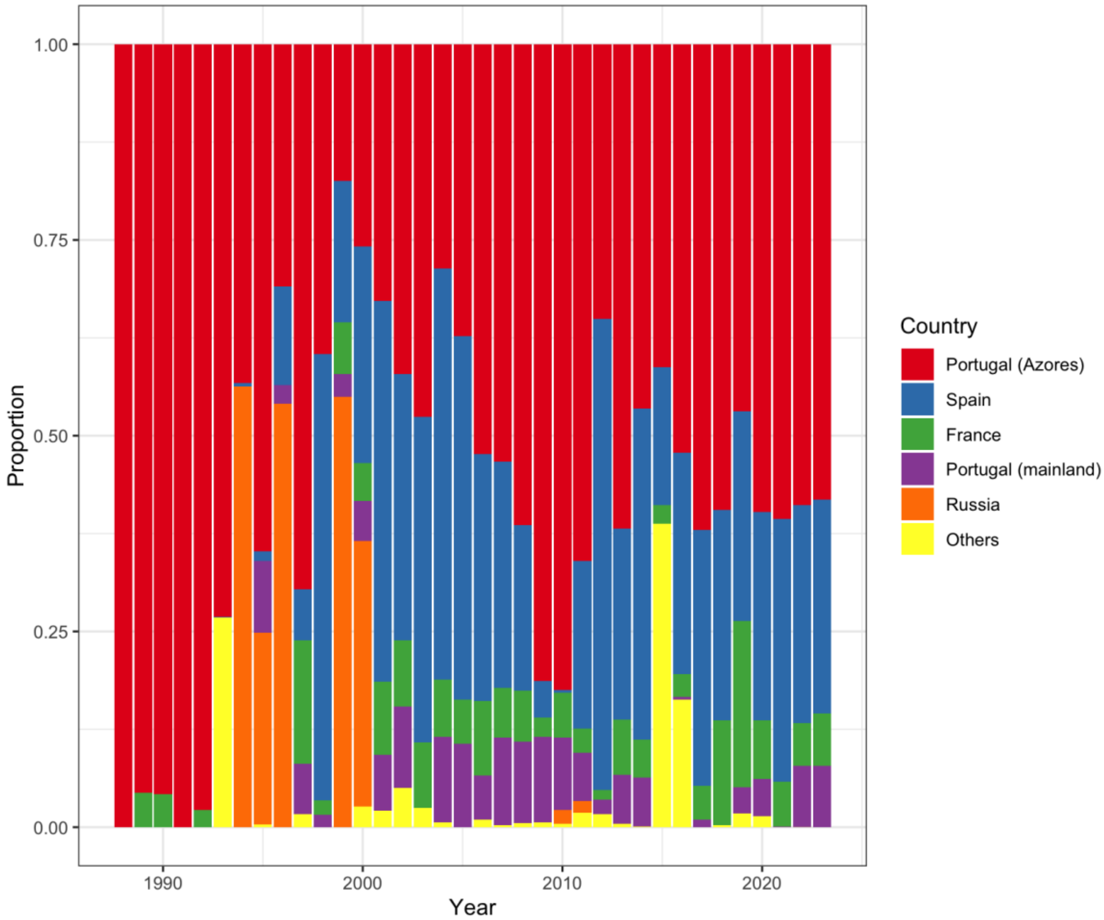


Figure 11.2. Percent stacked bar chart of reported *Beryx* spp. landings by country.

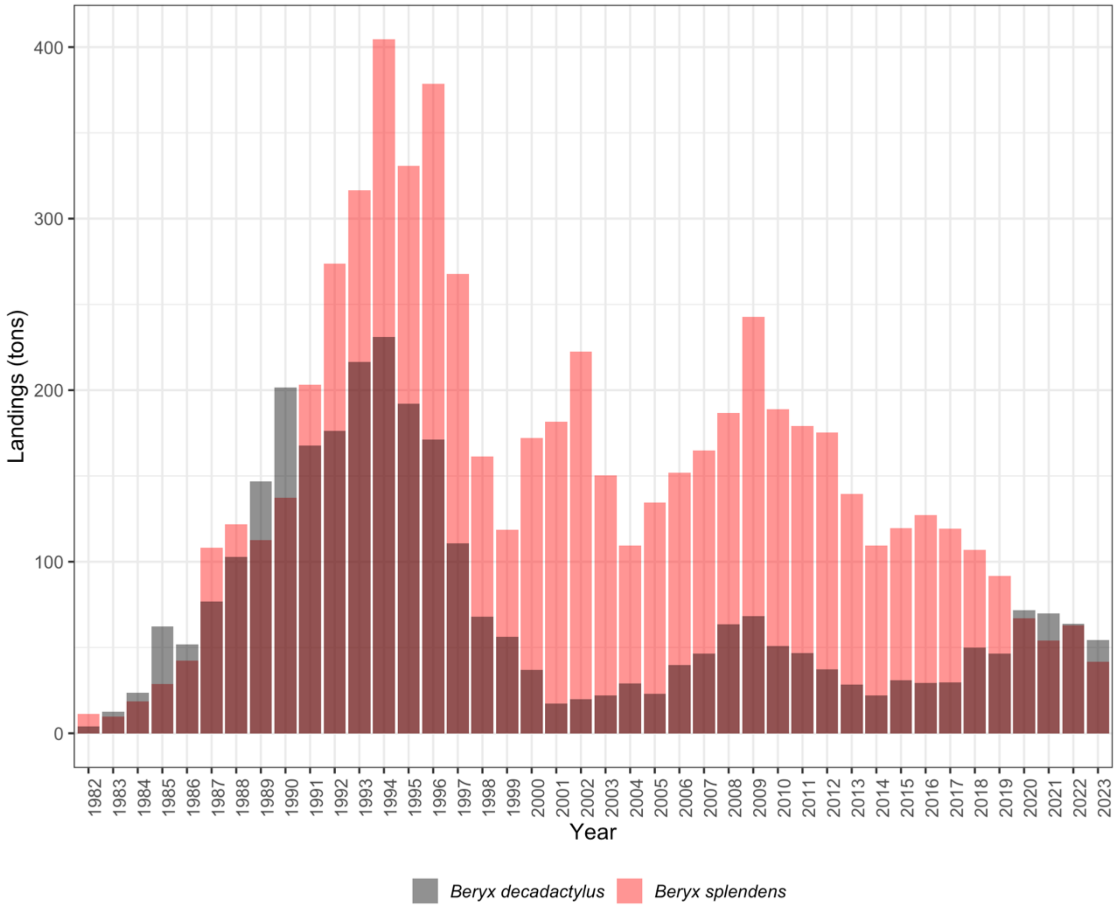


Figure 11.3. Landings (tonnes) of *Beryx splendens* and *B. decadactylus* (overlapped) in the Azores (ICES Subdivision 10a2).

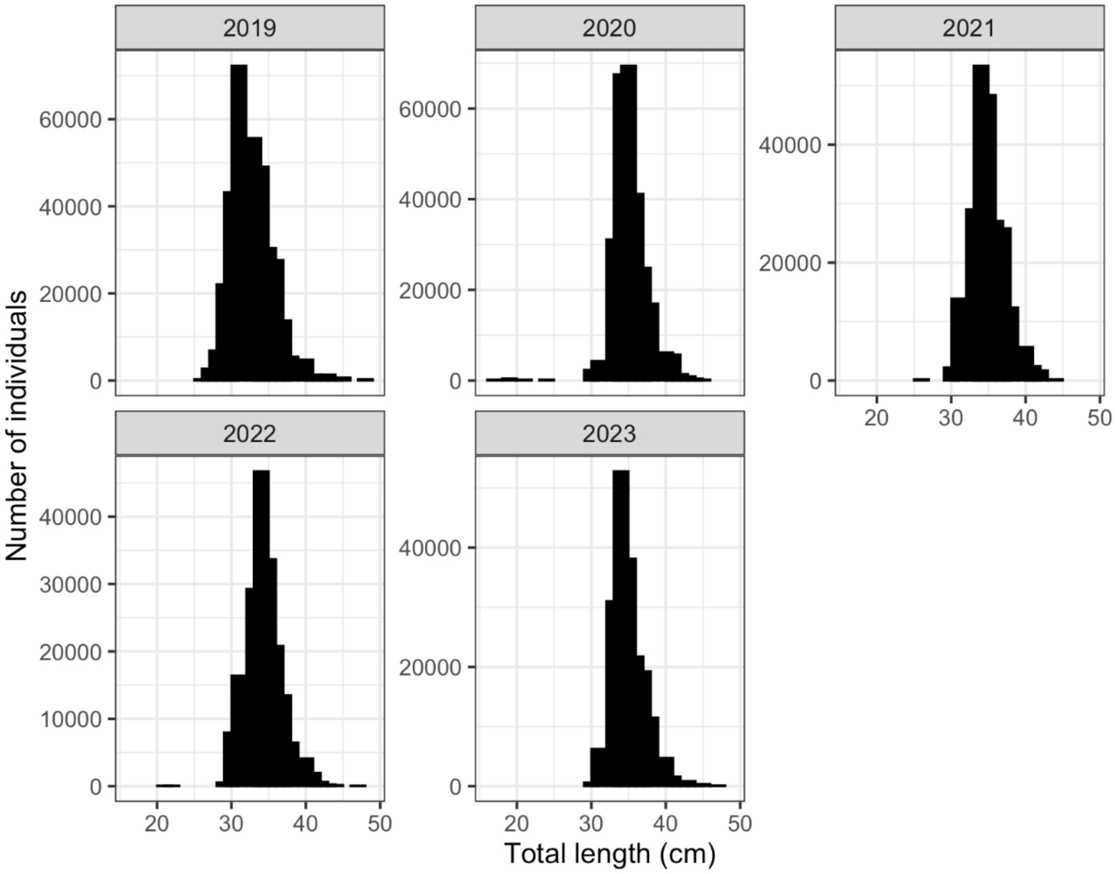


Figure 11.4. Length composition (2-cm class intervals) of *Beryx splendens* from the commercial fishery landings (2019–2023) in the Azores (ICES Subdivision 10a2).

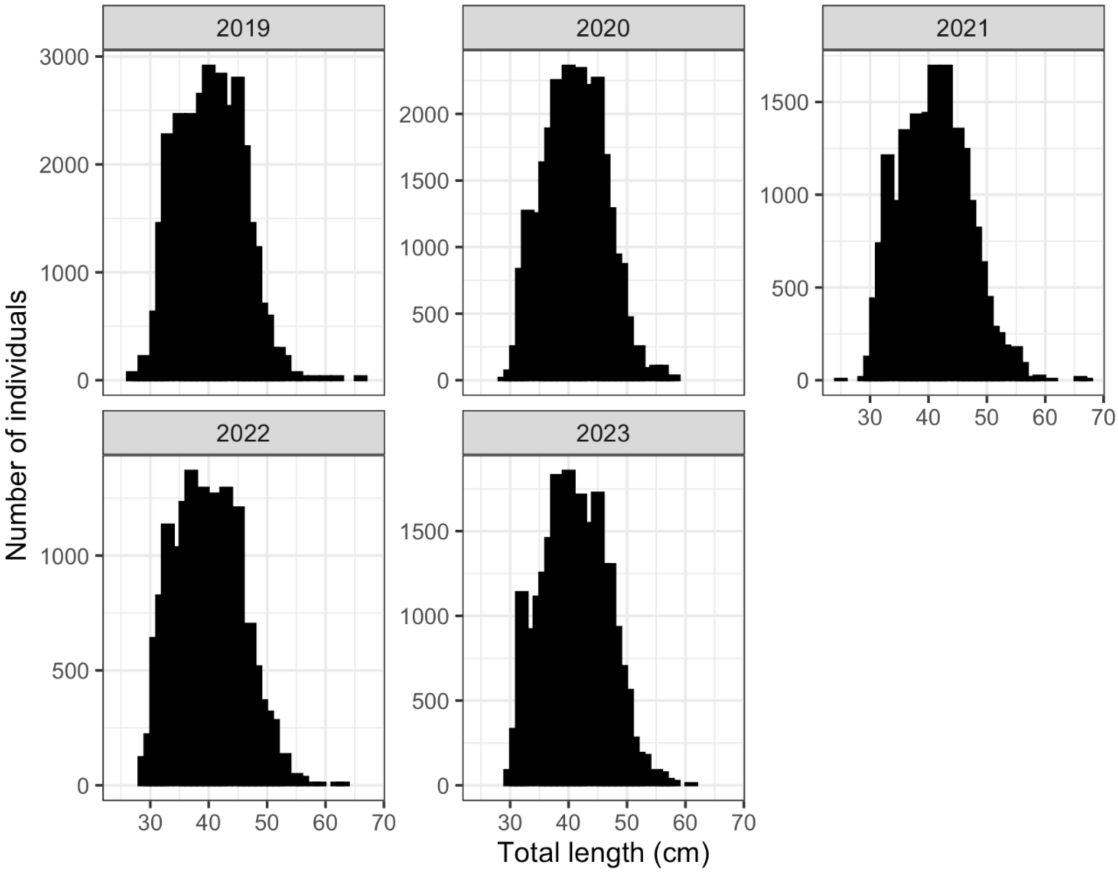


Figure 11.5. Length composition (2-cm class intervals) of *Beryx decadactylus* from the commercial fishery landings (2019–2023) in the Azores (ICES Subdivision 10a2).

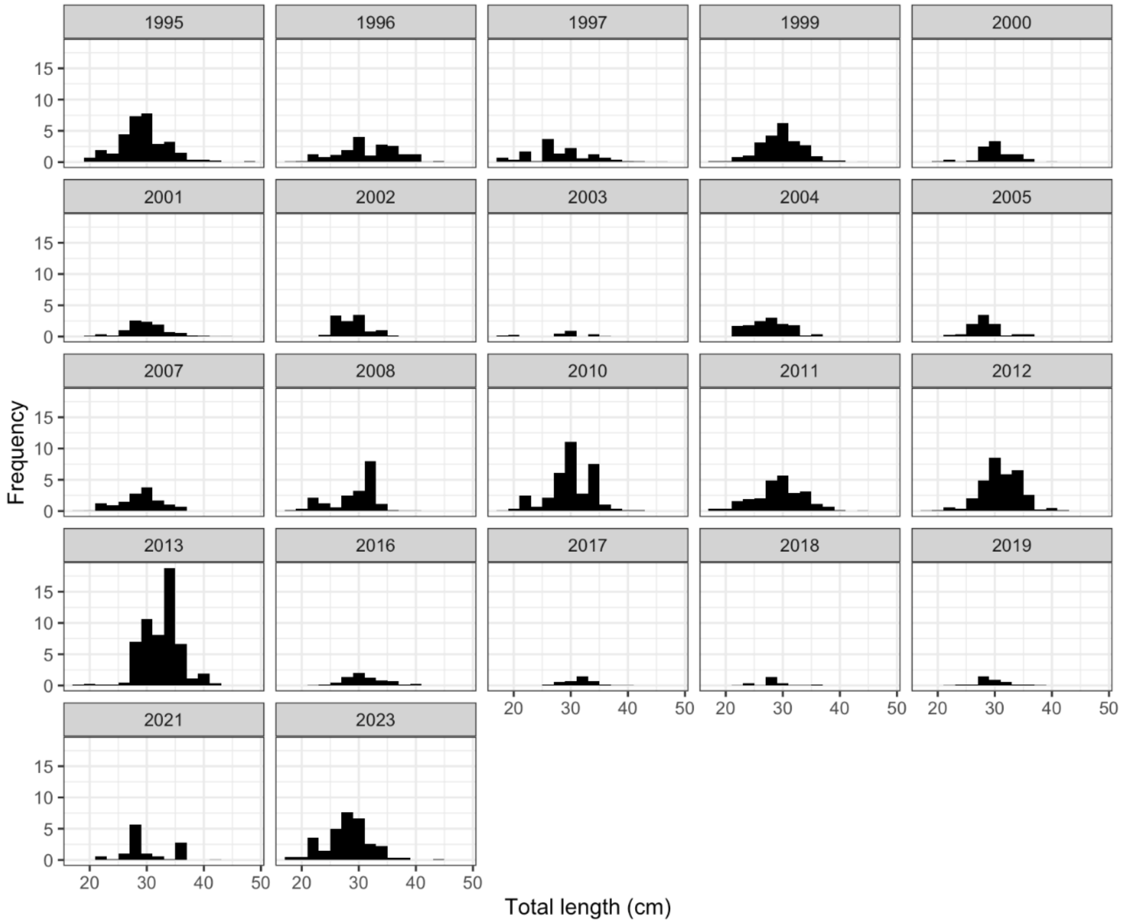


Figure 11.6. Length composition (2-cm class intervals) of *Beryx splendens* from the ARQDAÇO (L6563) survey (1995–2023) across statistical areas I and II in the Azores (ICES Subdivision 10a2).

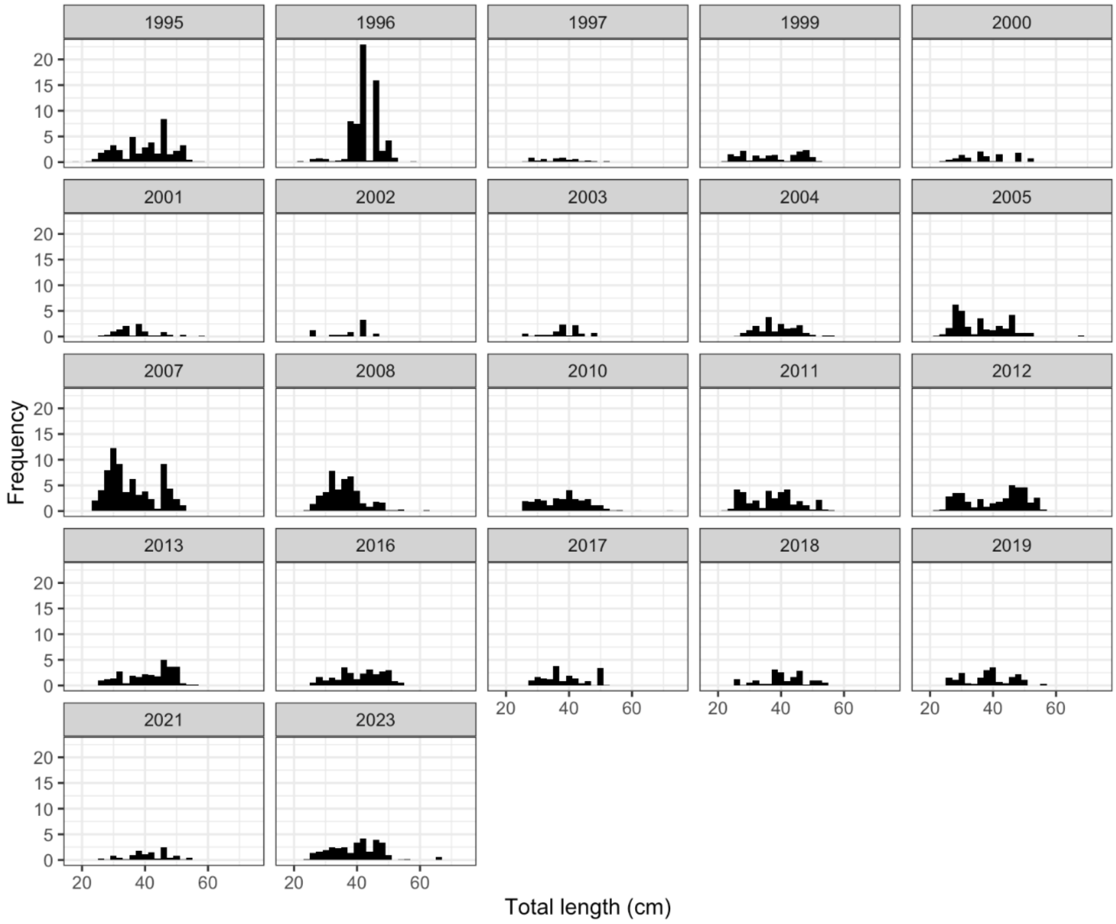


Figure 11.7. Length composition (2-cm class intervals) of *Beryx decadactylus* from the ARQDAÇO (L6563) survey (1995–2023) across statistical areas I and II in the Azores (ICES Subdivision 10a2).

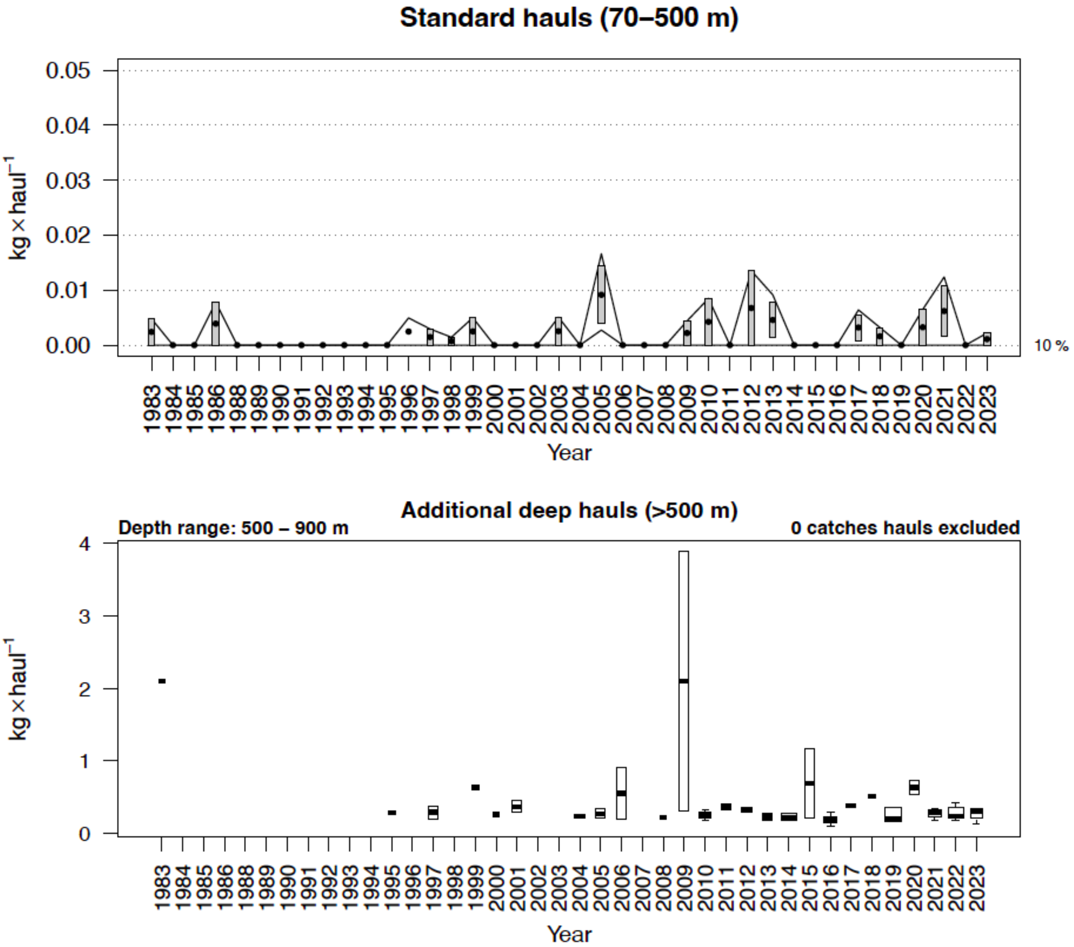


Figure 11.8. Evolution of *Beryx* spp. stratified biomass index in standard hauls and additional deep hauls during the North Spanish shelf bottom trawl survey time series. For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartiles of the biomass catches in the deep hauls performed. Source: WD08 Ruiz-Pico et al. (2024).

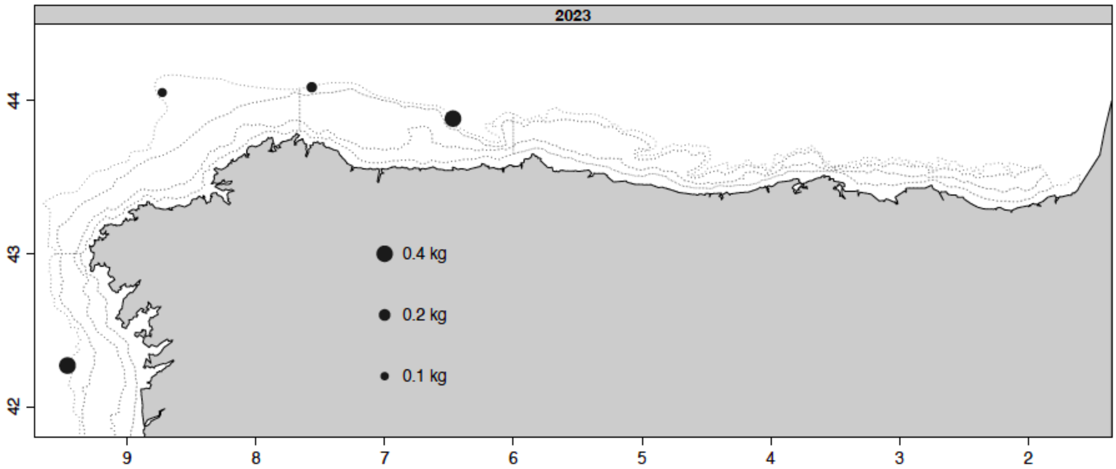


Figure 11.9. Geographic distribution of *Beryx* spp. catches (kg per 30 min haul) in the Northern Spanish shelf groundfish survey in 2023. Source: WD08 Ruiz-Pico et al. (2024).

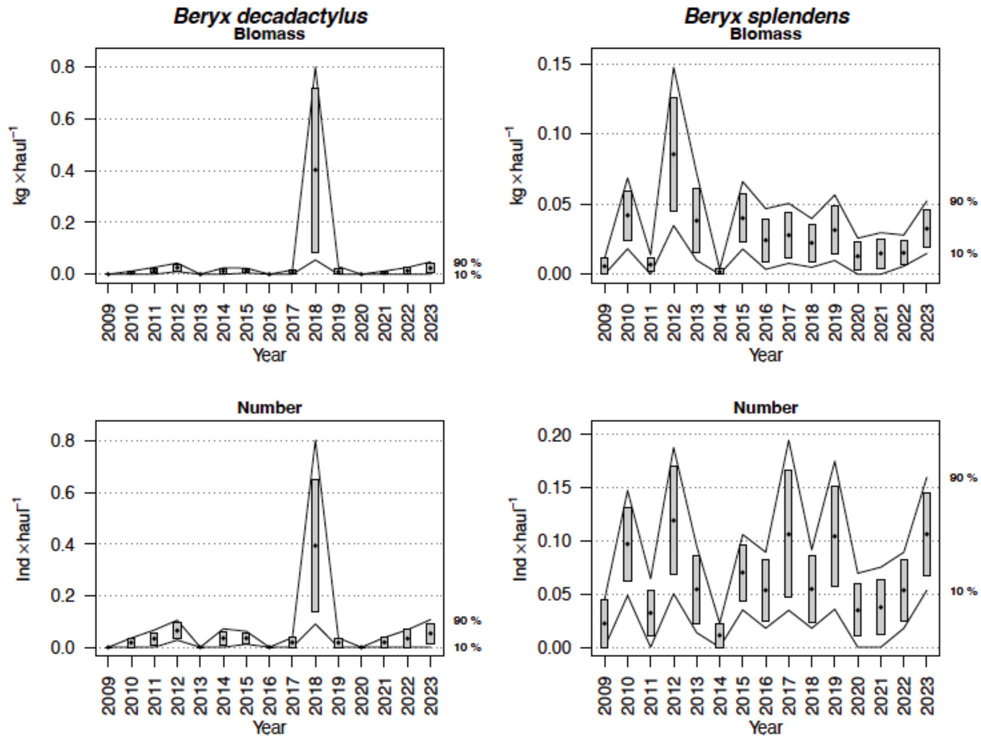


Figure 11.10. Evolution of biomass and abundance indices of *Beryx decadactylus* and *Beryx splendens* in the Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000). Source: WD07 Ortiz et al. (2024).

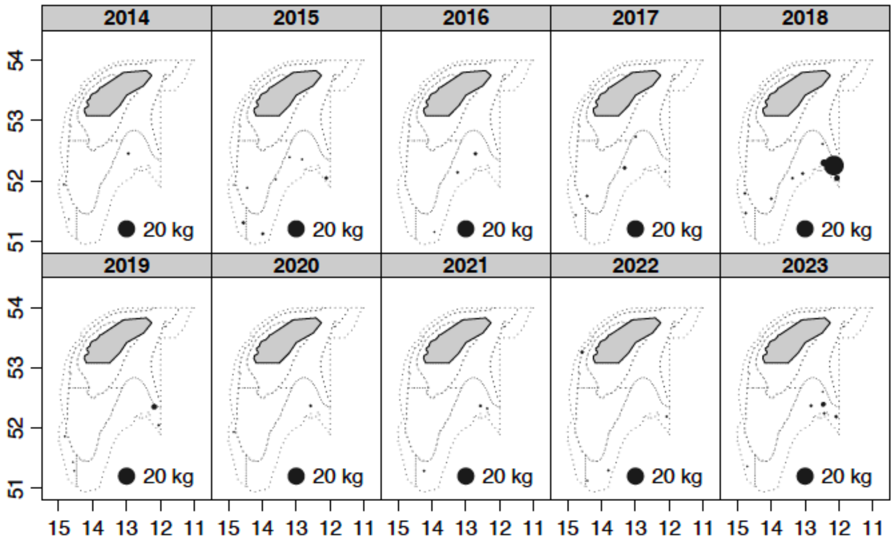


Figure 11.11. Geographic distribution of *Beryx* spp. catches (kg per 30 min haul) in the Porcupine surveys over the last decade. Source: WD07 Ortiz et al. (2024).

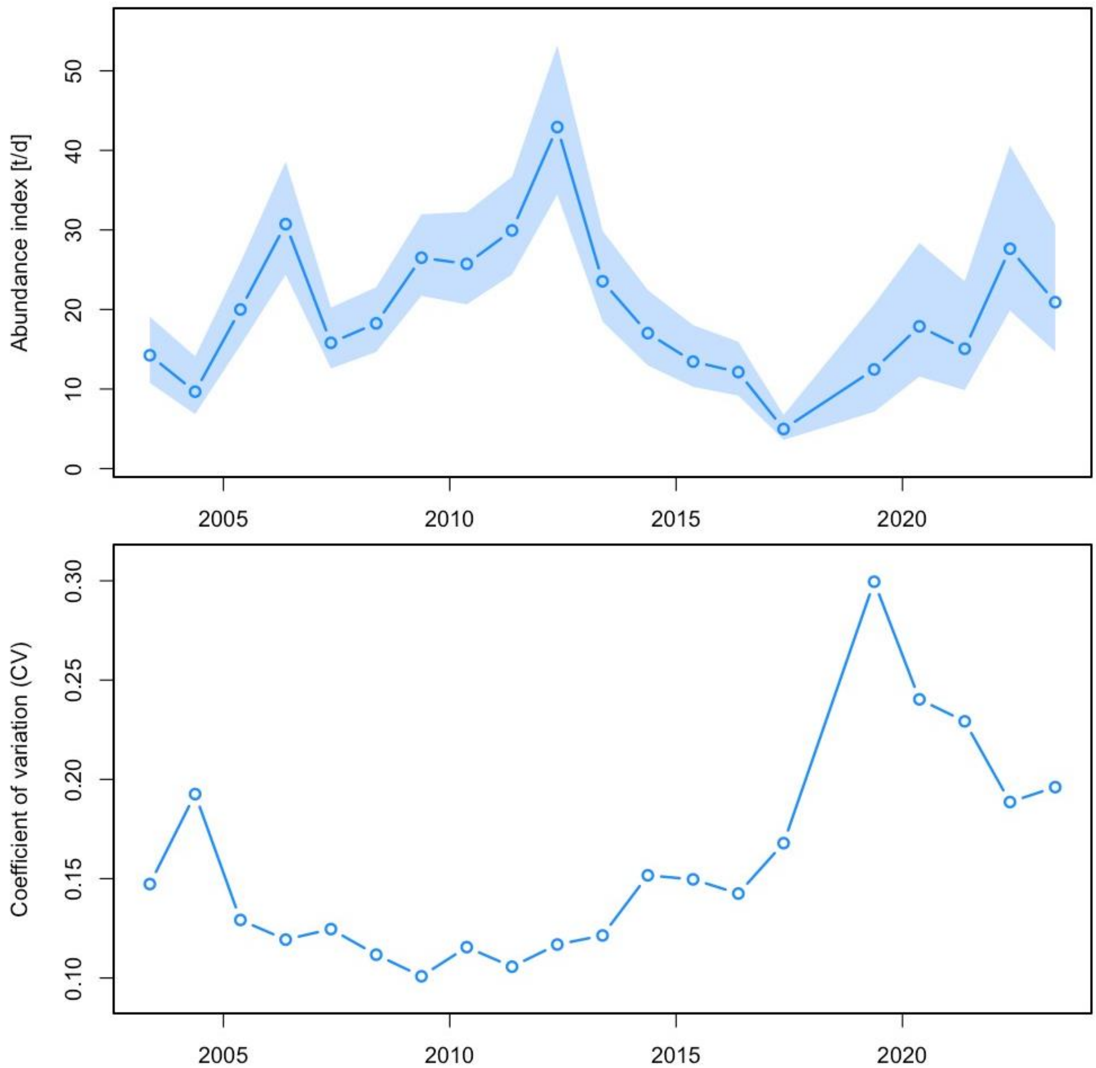


Figure 11.12. Abundance index (in kg per day at sea) and coefficient of variance of *Beryx splendens* estimated from the standardization of catch and effort data obtained from DCF inquiries (2003–2023) in the Azores (ICES Subdivision 10a2).

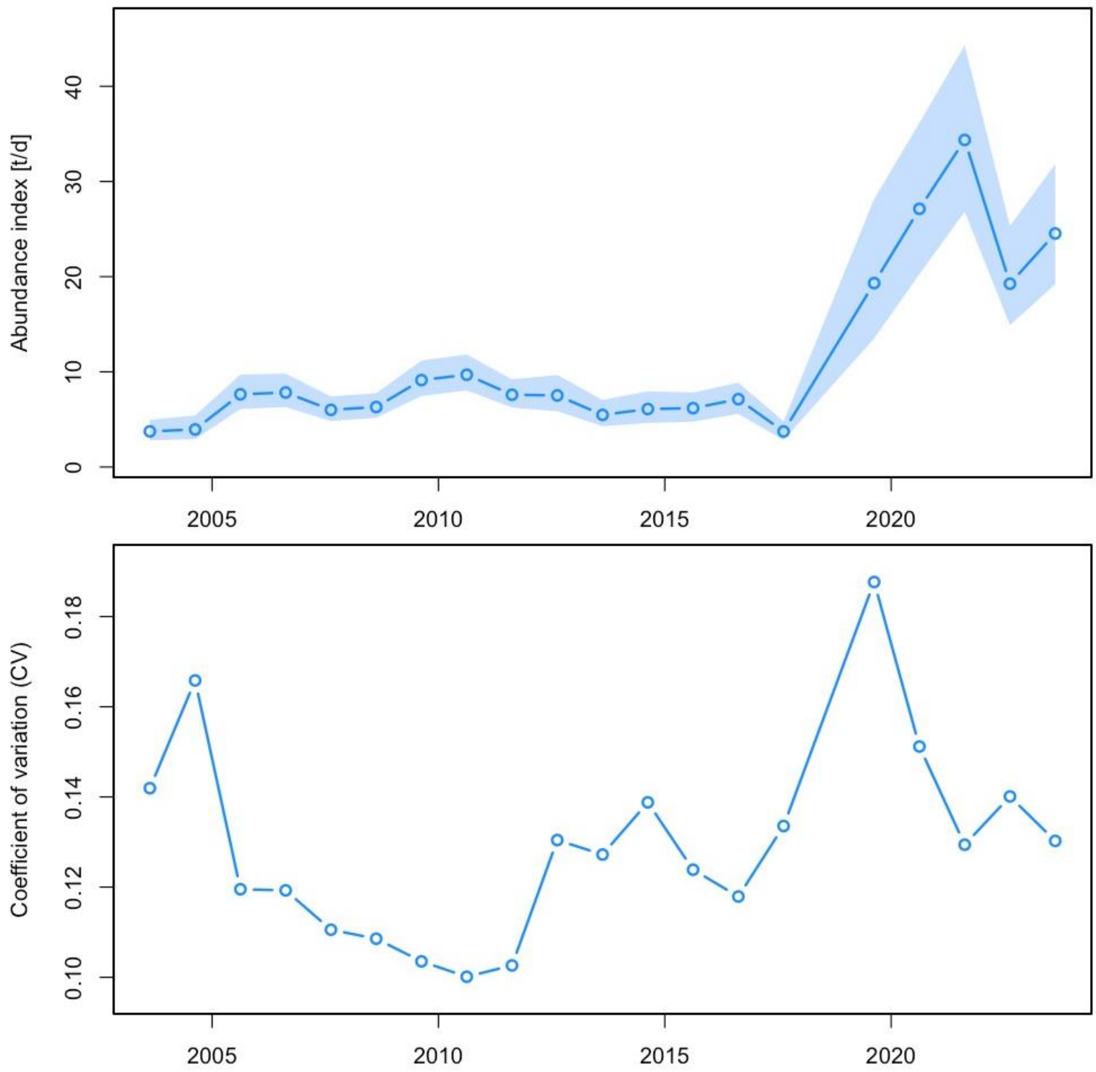


Figure 11.13. Abundance index (in kg per day at sea) and coefficient of variance of *Beryx decadactylus* estimated from the standardization of catch and effort data obtained from DCF inquiries (2003–2023) in the Azores (ICES Subdivision 10a2).

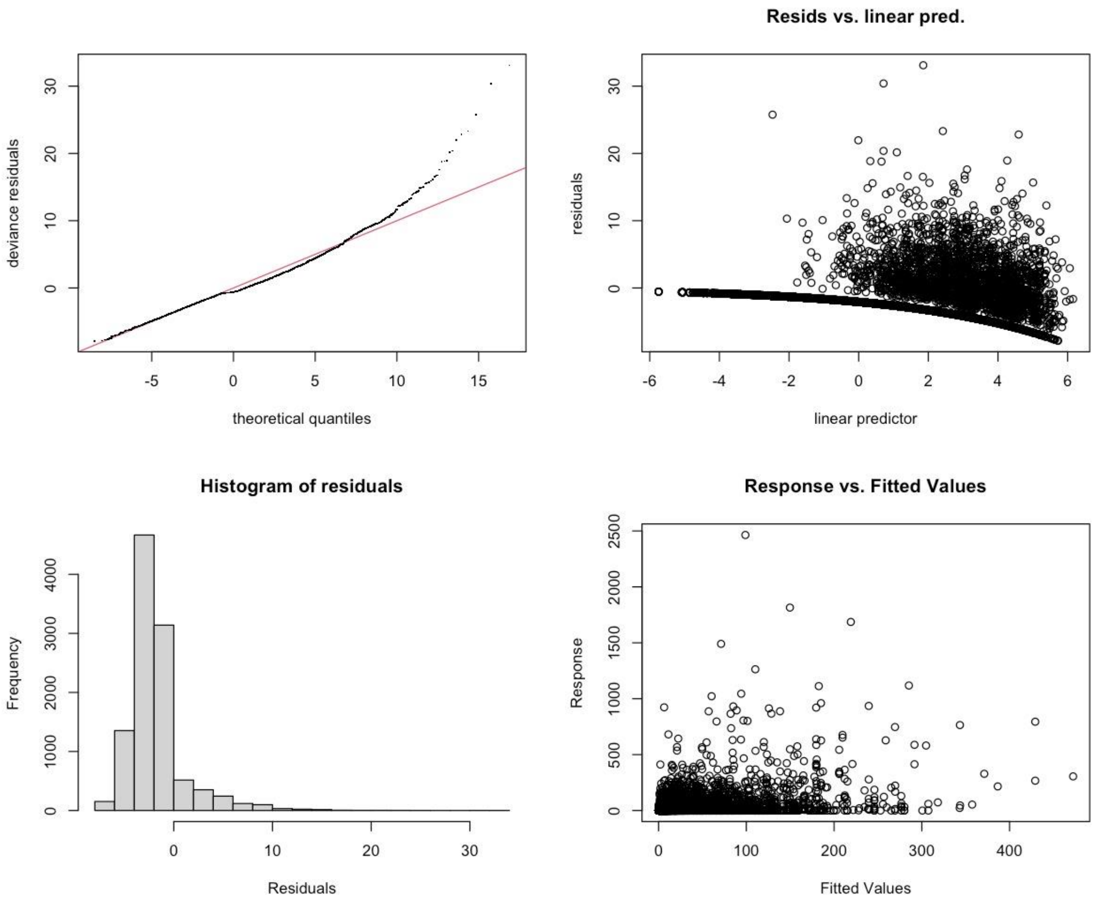


Figure 11.14. Residuals diagnostic of the standardized abundance index of *Beryx splendens* in the Azores (ICES Subdivision 10a2).

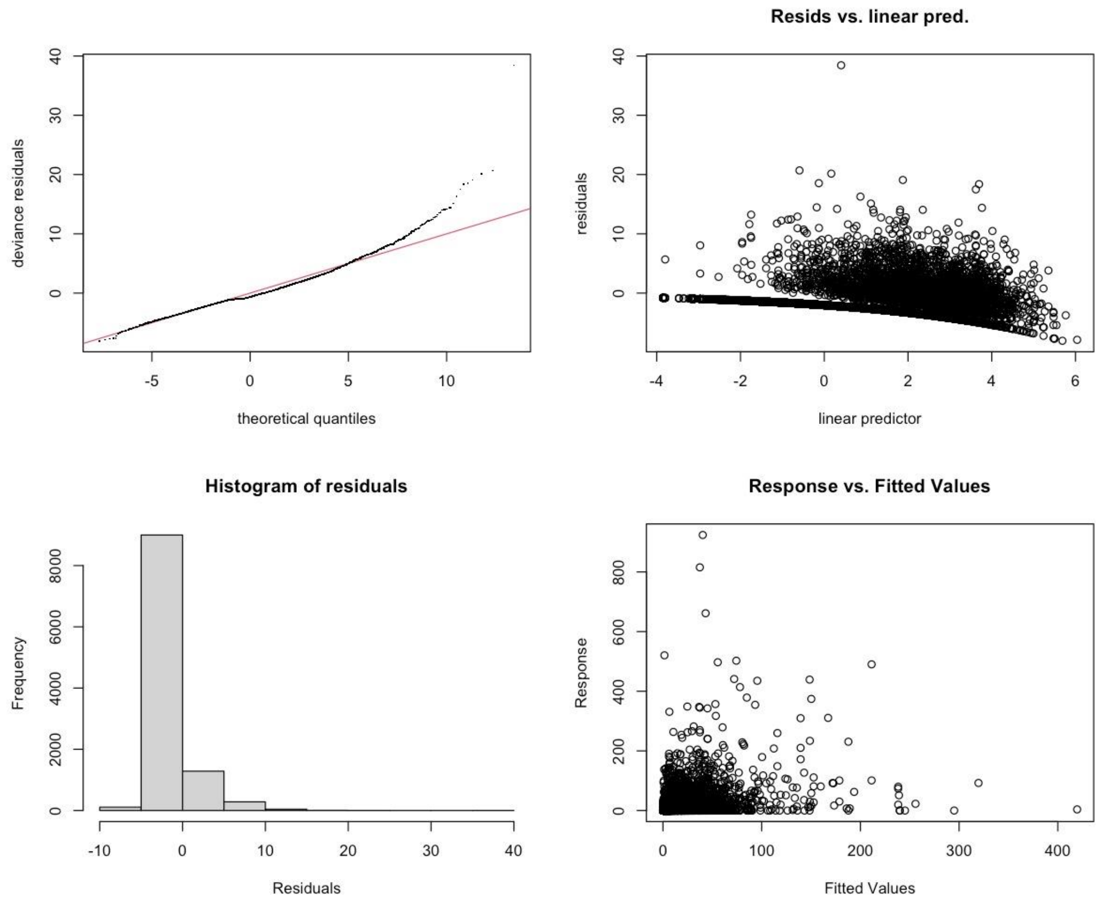


Figure 11.15. Residuals diagnostic of the standardized abundance index of *Beryx decadactylus* in the Azores (ICES Subdivision 10a2).

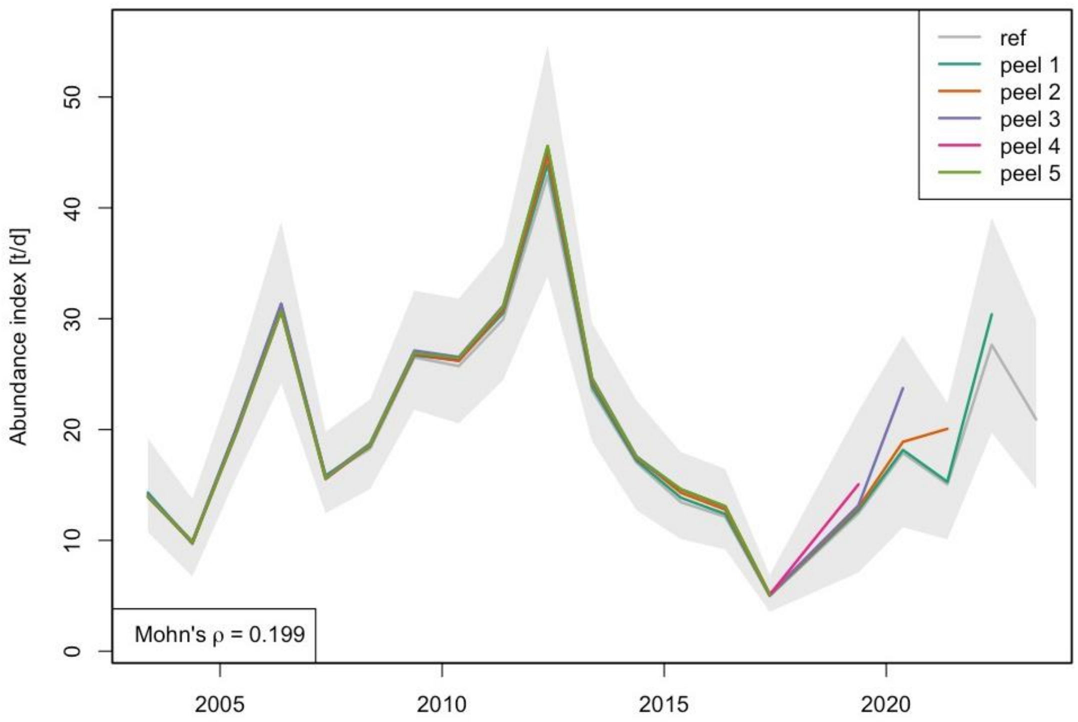


Figure 11.16. Retrospectivity analysis of the of the standardized abundance index of *Beryx splendens* in the Azores (ICES Subdivision 10a2).

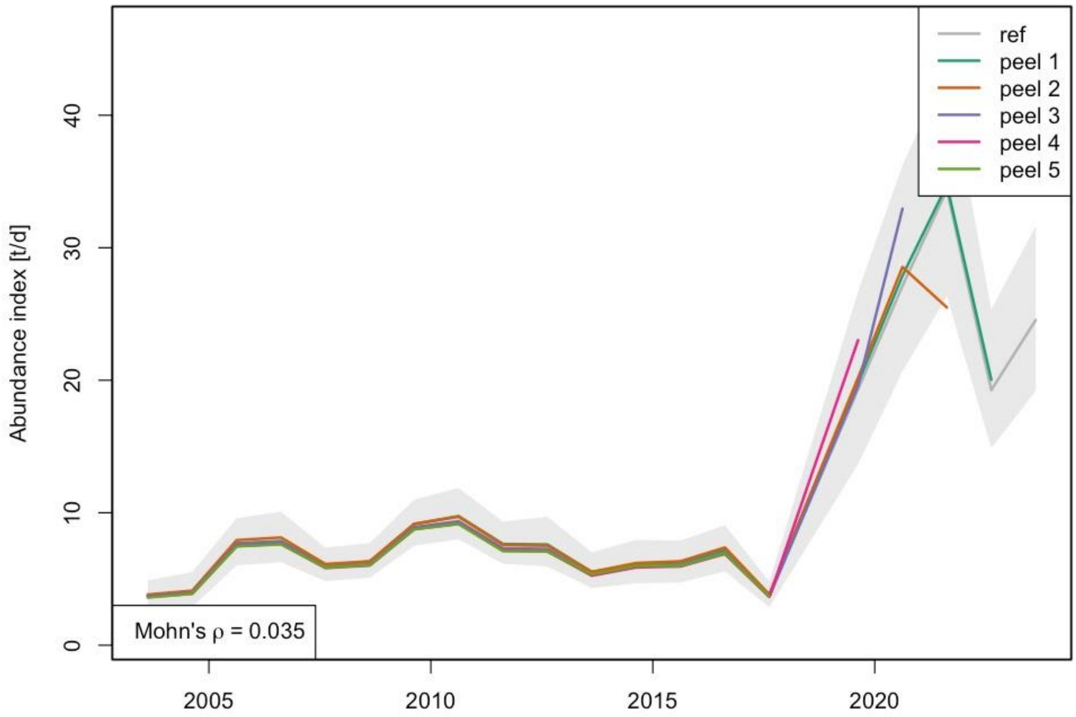


Figure 11.17. Retrospectivity analysis of the of the standardized abundance index of *Beryx decadactylus* in the Azores (ICES Subdivision 10a2).

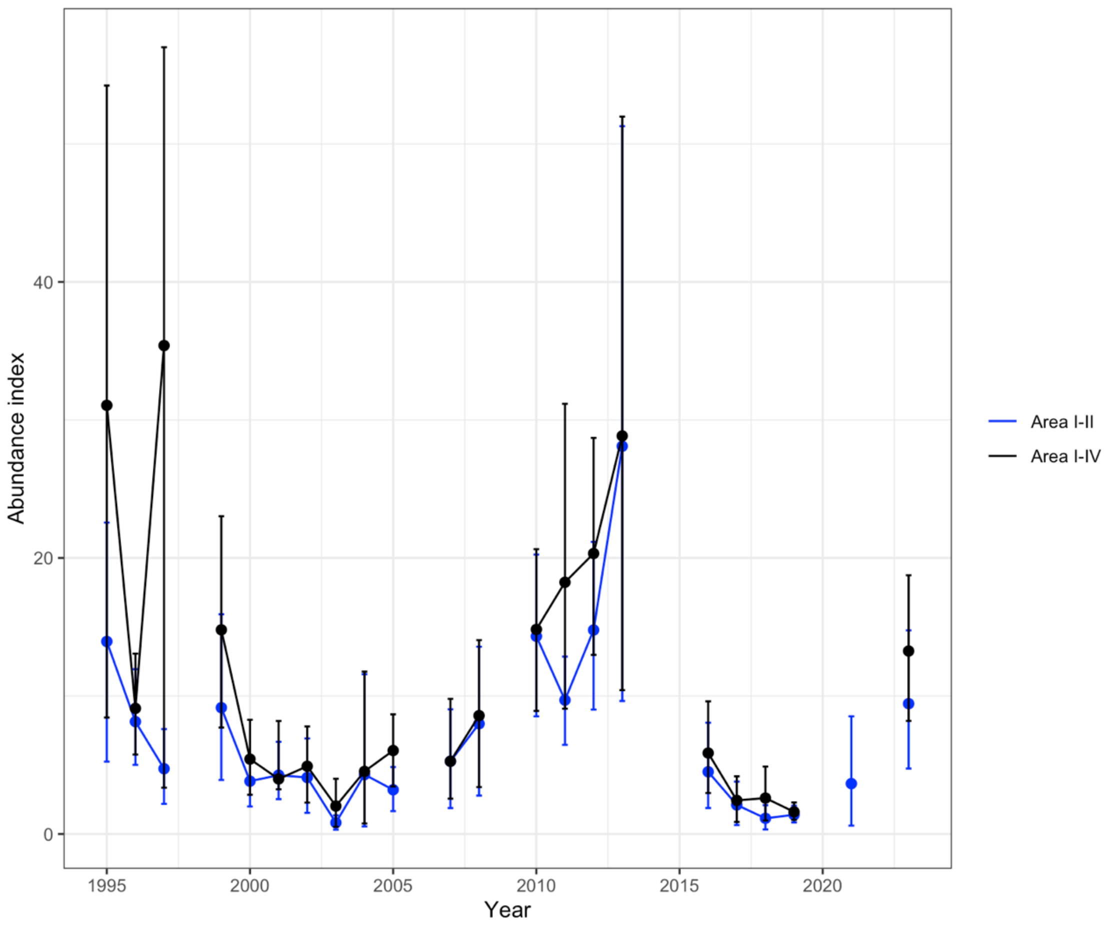


Figure 11.18. Abundance index (in kg per 10^3 hooks) of *Beryx splendens* from the ARQDAÇO (L6563) survey (1995–2023) across statistical areas I and II in the Azores (ICES Subdivision 10a2).

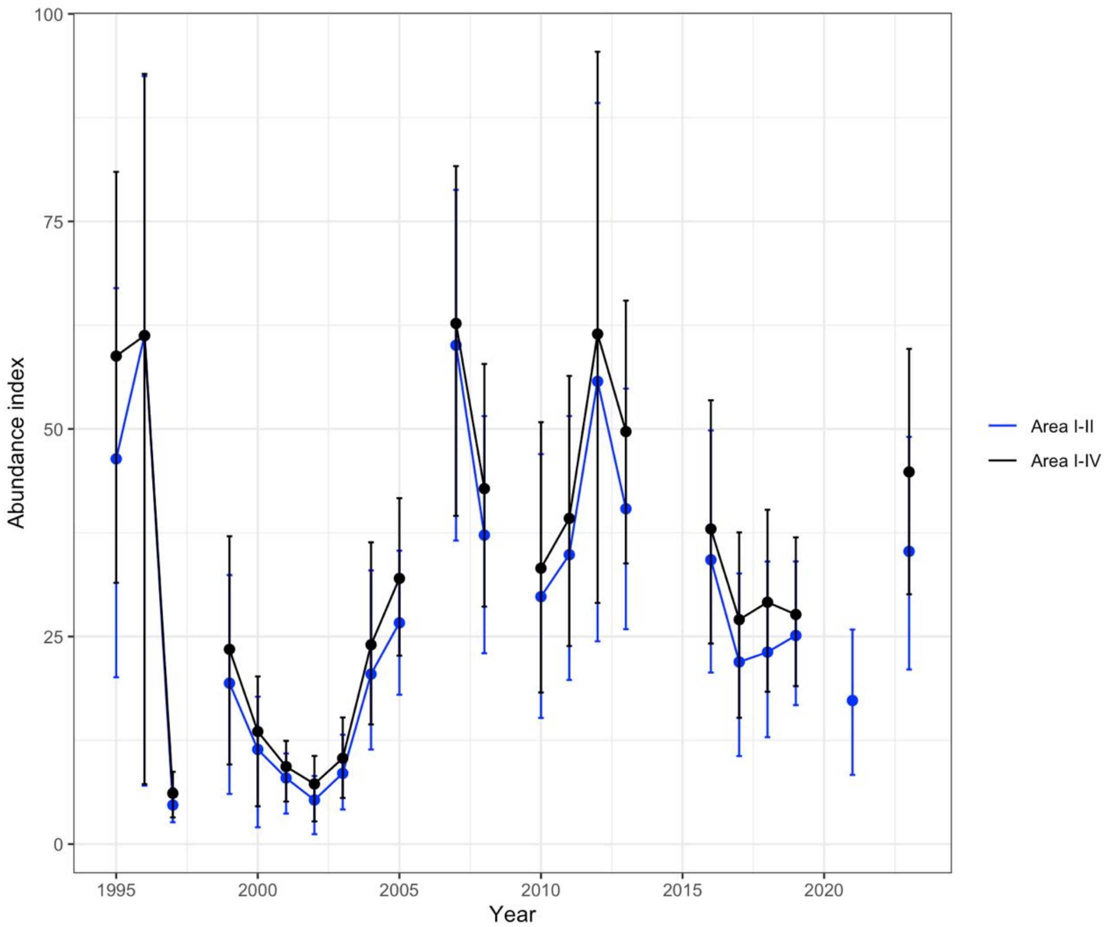


Figure 11.19. Abundance index (in kg per 103 hooks) of *Beryx decadactylus* from the ARQDAÇO (L6563) survey (1995–2023) across statistical areas I and II in the Azores (ICES Subdivision 10a2).

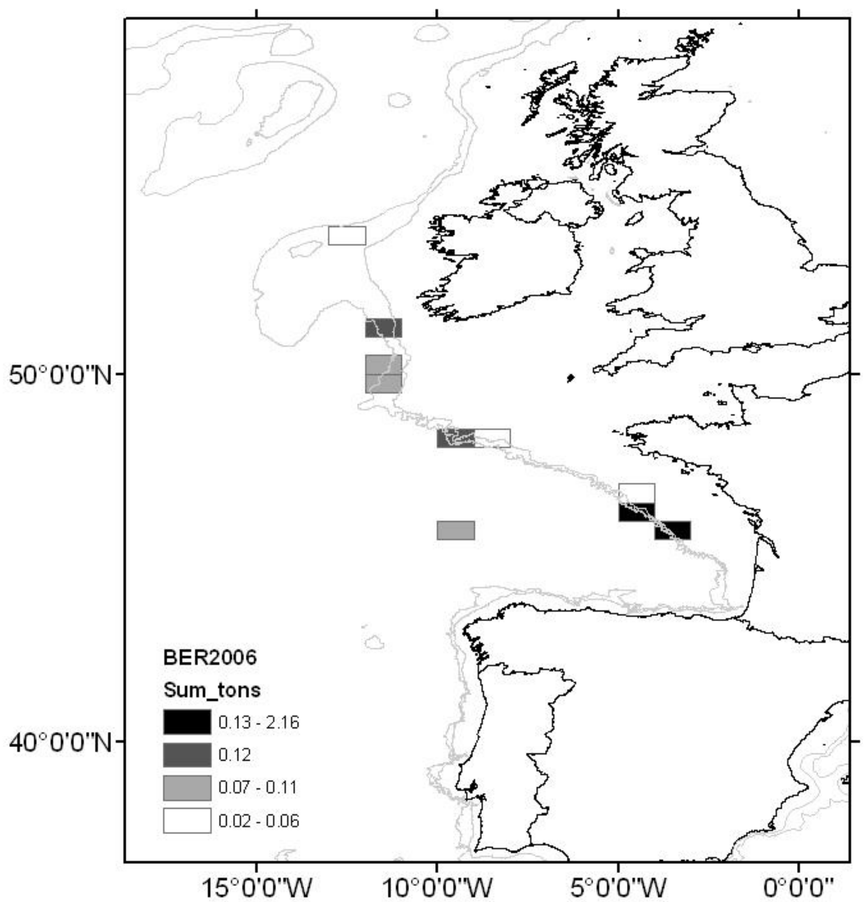


Figure 11.20. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

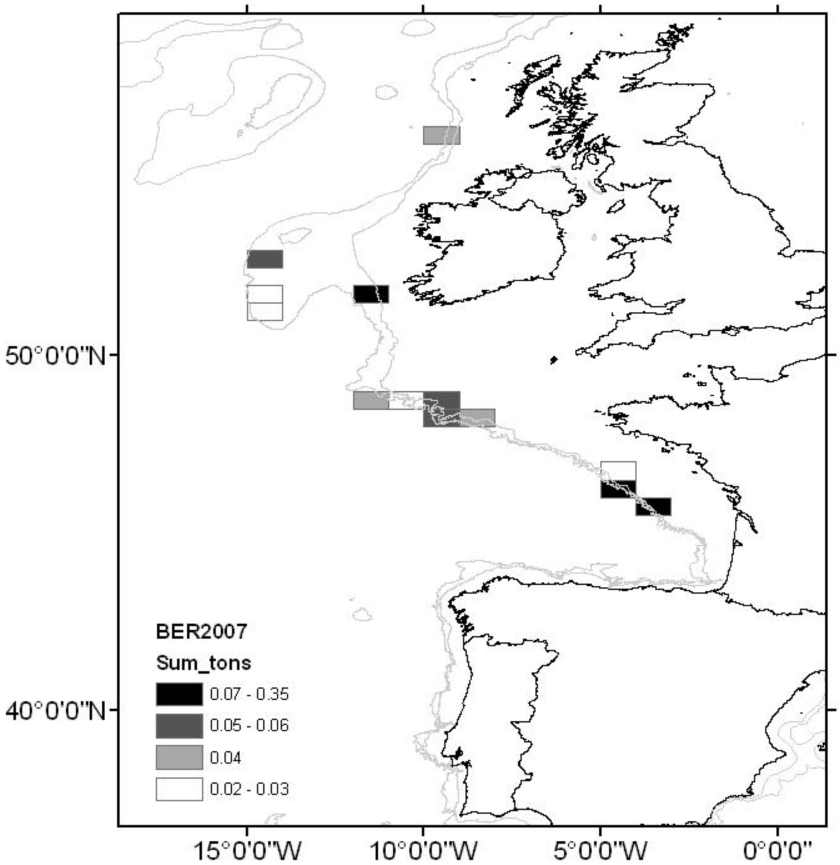


Figure 11.21. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

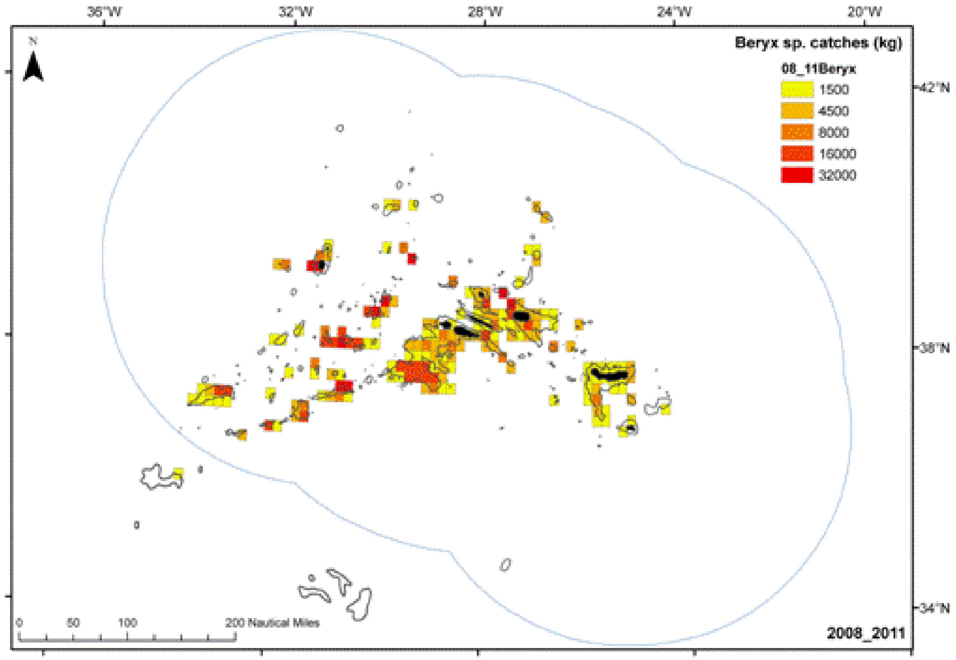


Figure 11.22. Catches of alfonsinos by Azores vessels, 2008–2011 (ICES Subdivision 10a2).

Contents

12 Blackspot seabream (*Pagellus bogaraveo*)

12.1 Stock description and management units

The stock structure of blackspot seabream in ICES area is still unknown. Thus, for stock assessment and scientific advice on management purposes ICES considers three different components: a) Subareas 6, 7, and 8; b) Subarea 9, and c) Subarea 10 (Azores region).

The interrelationships of the blackspot seabream from subareas 6, 7, and 8, and the northern part of Division 9.a, and their migratory movements within these areas have been observed by tagging studies (Gueguen, 1974). However, there is no evidence of movement to the southern part of 9.a where different longline fisheries targeting the species take place, extending outside the ICES area.

Genetics studies show that there is 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 the Azores (ICES Subdivision 10.a.2) and mainland Portugal, ICES Division 9.a (Stockley et al., 2005; Castilho et al., 2022 WD). These results, combined with the known distribution of the species by depth, suggest that Subarea 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., 2007). Unpublished genomic results, using a high number of SNP markers henchwith higher differentiation power than previous studied, show evidence for genetic differentiation between the Atlantic eastern continental margin and the Gulf of Cadiz (Castilho et al., 2022 WD). c

12.2 Blackspot seabream (*Pagellus bogaraveo*) 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).

In the UK the majority of landings were recorded from Divisions 7.d, 7.e, and 7.j, were caught by beam, bottom trawl, and gillnets and are considered to be a small bycatch in fisheries targeting hake, monkfish and lemon sole. For the period 2018–2022, there was some evidence of seasonality in red seabream landings, with a higher proportion landed in the summer and early autumn (June to October). Demersal trawls and gillnets were the main gears, contributing to 79% of the reported UK landings (Vieira et al 2024 WD)

Currently, EU Regulations state that no directed fisheries are permitted under the quota, therefore catches should be only bycatches.

In the period considered (1988–2021), most of the estimated landings from the subareas 6, 7 and 8 were taken by Spain (71%), followed by France (18%), UK (E & W) (10%) and Ireland (1%).

The fishery in Subareas 6, 7 and 8 strongly declined in the mid-1970s, and the stock is seriously depleted (Figure 12.2.1 and Table 12.2.1b). Since the 1980s, the species is mainly a bycatch from otter trawl, longline and gillnet fleets and only a few small-scale hand liners have been targeting the species. Since 1988 the landings from Subarea 8 represent 68% and 32% of total accumulated landings are from subareas 6 and 7. At present the blackspot seabream reported 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 12.2.1 presents an overview of the historical series of landings in Subareas 6, 7 and 8 since the middle of the last century. Figure 12.2.2 shows, in greater detail, landings of the same subareas since 1988. In 2014, UK (Scotland) reported landings for the first time in 7.j, and Netherlands since 2017 and UK (Scot) since 2014 in Subarea 7 respectively. This ICES division represents part of the historical species distribution area (Olivier, 1928; Desbrosses, 1932).

For those three subareas combined, landings decreased from 359 t in 1988 to 52 t in 1996, increased again to a peak in 2007 (324 t) and then decreased to 78 tonnes in 2023. The main driver for the decreasing landings in recent years is considered to be the effect of the TAC, which decreased from 350 tonnes in 2003 to 106 t in 2023 (95 t UE and 11 t UK).

12.2.3 ICES Advice

In 2022, ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2023 and 2024.

12.2.4 Management

The EU TAC for subareas 6, 7, and 8 was set for the first time in 2003 and has been reducing since then from 350 t to 95 t in 2022. Since 2011 an UK TAC was set in 11 t/year. Landings in 2007, 2010, 2012, 2014, 2015, 2016, 2018 and 2021 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 **TACs and total landings in European countries in Subarea 27.6, 7, and 8 in recent years.**

	Pagellus bogaraveo		
year	**EU TAC**	**UK 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

		Pagellus bogaraveo	
2012	215		257
2013	196		295
2014	178		256
2015	169		177
2016	160		164
2017	144		126
2018	130		133
2019	117		98
2020	102		91
2021	95	11	98
2022	95	11	91
2023	95	11	78

Under Common Fisheries Policy it is stated 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.

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 1st of January to 30th of June. Moreover, the French regulation, forbids the catch, landing and sale of this species to the purse seine fleet and established several catch limits by trip or by year to the rest of the fleets (trawlers, gillnetters and liners).

Since 2019 Spain has established 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. Spain also established annually a maximum catch per day to the vessels involved in the fishery in subareas 6, 7, 8.

COMMISSION DELEGATED REGULATION (EU) 2023/56 of 19 July 2022 set a minimum conservation reference size of 40 cm that shall apply until 31 December 2023 in ICES sub-areas 6 and 7 for the catches of red sea-bream in recreational fisheries. In the absence of new rules adopted before 31 December 2023, as of 1 January 2024 the applicable MCRS (Minimum Conservation Reference Sizes) shall be 33 cm.

12.2.5 Data available

12.2.5.1 Landings and discards

The Spanish, French and UK extended landing time-series of *P. bogaraveo* in Northeast Atlantic were updated (Figure 12.2.2). In recent years landings have been dropping in accordance to the continuous reduction of the biannual TAC since 2003.

Historically, discards are considered negligible, and estimates are available since 2014 representing between 0.0 % and 2.7% of the annual catches in all subareas (Table 12.2.2). Discards resulting from low quotas are compulsory as the fishery for the species ceases. 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 observer program may occur as *P. bogaraveo* occurs at low abundance and closely related sparids species, to which it may be confused, also occur (*P. acarne*, *P. erythrinus*, *P. bellotii* and *Pagrus pagrus*).

Between 2018–2022, around 89% of UK landings of seabreams were recorded under one code 'SBX' (seabreams nei) rather than being separated by red (SBR) and black seabream (BRB). Landings of unidentified seabreams (SBX) from those areas where red seabream would be expected to be more abundant (for example, Divisions 7.h and 7.j) have been low. The main area of uncertainty around SBX landings is from Division 7.e (Figure 2), which may comprise some red seabream although several other species of seabream are locally common in Division 7.e (Vieira et al 2024, WD).

Table 12.2.3 shows that since 2017 there were not catches inside the NEAFC Regulatory Area (RA)

12.2.5.2 Length compositions

Length–frequency distribution of commercial landings and discards in 2015-2023, are presented (Figure 12.2.3). Length frequency distribution reported in InterCatch for the year 2017 were very scarce, therefore length distribution for this year is not presented. No length–frequency distribution for discards were presented in 2020, 2022 and 2023as in these years reported discards were 0.

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 12.2.4) derived from Guéguen (1969) and Krug (1998) were used by Lorance (2011) as input data for the yield-per-recruit model used 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 to 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

Regarding the research vessels data of blackspot seabream, the Subareas 6, 7 and 8 are covered by four surveys (Figure 12.2.4), but at the current level of abundance, the blackspot seabream is rarely caught in the northern surveys by French EVHOE IBTS (G9527) divisions 7.f-j and 8.a,b,d, Irish IGFS (G7212) in divisions 6.a South and 7.b,g,j, is a scarce species in the Northern Spanish Shelf Groundfish Survey (G2784) SP-NGFS in Divisions 8c and 9a, and is not caught in the Spanish Groundfish Survey on the Porcupine bank -SP-PorcGFS (G5768) in divisions 7.c and 7.k,

In the Northern Spanish Shelf Groundfish Survey, in 2020 *P. bogaraveo* has been found in additional shallower hauls (<70 m) and standard hauls over the time series. In this last survey, the biomass in standard stratification increased sharply (Figure 12.2.4). Specimens were found in seven hauls from 52 to 132 m, just in one additional shallower hauls at 52 m. The haul with the highest biomass was in the north of the Galician waters at 81 m, and the other six spots of biomass in the Cantabrian Sea (Figures 12.2.5-6). The sizes ranged from 16 to 26 cm (Figure 12.2.7) (Ruiz-Pico et al 2024).

In French surveys, similar to the current western IBTS, from early 1980s when the stock was already low, blackspot seabream was still presented in 40–60% of the hauls. This proportion dropped to around zero by 1985 (Lorance, 2011). This observation indicates that the current survey would allow monitoring the stock if it recovers to past levels. 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 of the stock. In particular, a large catch of more than 1000 individuals in a single hauls occurred in the 2016 survey. In subsequent years only 3 individuals were caught over years 2018-2021 (no survey in 2017), which represent on average for these years less than one catch for 100 hauls. The level of occurrence that would be expected if the stock rebuilt to past levels can be appraised from two surveys carried out in the Bay of Biscay in 1973 and 1976 with the same protocol and gear as the current EVHOE survey (Figure 12.2.8). In 1973 and 1976, blackspot seabream was caught in 25% and 55 % of the hauls respectively (Figure 12.2.9). 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. 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 increasing occurrence in on-board observations is however consistent with fishers reporting more encounters.

In the Irish IGFS blackspot seabream is also very scarce and since 2010 only few kg in were caught in four years of the series. Also, the occurrence along the whole stations in the survey is very low ranging since 2010 from 0% to 4.3% (Table 12.2.5).

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 12.2.1). Catches recorded in the surveys are very scarce and are mainly juveniles smaller than 30 cm.

In 2003, when TACs were set for this species there were conflicts between fishing métiers in this area, 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.1

In the same area, fishers report to encounter more frequently the species in recent years. This was investigated using French on-board observations (Figure 12.2.10). 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 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 trawl 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 12.2.11).

Water samples from the Bay of Biscay (Divisions 8a, 8b, 8c, 8d) collected during the BIOMAN survey in 2017 and 2018 were analysed using the DNA metabarcoding method, wherein a short genomic fragment was amplified via PCR. The majority of samples were obtained from the surface (3-5 m depth), but also by 7-8 vertical profiles spanning depths from 5 to 2000 m or 50 m above the seafloor (Canals et al., 2021) (Figure 12.2.12). Specifically, the targeted genomic region was the "teleo" segment of the 12S mitochondrial gene, focusing on fish (Actinopterygii and Elasmobranchii) (Valentini et al., 2016). Among the 110 samples analysed over both years, DNA from *Pagellus bogaraveo* was identified in only 5 samples, predominantly in superficial waters near the coast in Divisions 8c east and 8b (Figure 11.2.13).

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 Exploratory assessment

12.2.8.1 Method

Acoustic survey

As part of the Bay of Biscay case study of the H2020 project Pandora, a six days acoustic survey was carried out to the west of Brittany, near Sein and Ouessant Islands (France 48°-48°30'N; about 5°West), an area where the species has always occurred (Figure 12.2.14). The two Islands are about 70 km apart. The surveyed areas represent a small proportion of areas where the species is known to occur along the coast of Brittany. A few small areas were surveyed to the West and Southwest of Sein Island and around Ouessant Island using a portable acoustic transducer mounted on small-scale fishing boats (see ICES 2020, for details).

During the survey, handline fishing was carried out to identify species detected by the acoustics. Shoal of pelagic species (mostly sardine in the surveyed area) can be easily distinguished from blackspot seabream, but for other species identification fishing was required. Fishing was done on several location where echo susceptible to be blackspot seabream were received. The species composition caught at these locations was used to categorized the types of echos observed. Four echotypes where defined: (1) pure blackspot seabream, (2) blackspot seabream mixing with other species, (3) demersal species and (4) pelagic species.

Some knowledge of the overall distribution of occurrence of blackspot seabream at the Brittany coast was also collected from a survey of diving clubs, which members filled-in an on-line questionnaire on their sightings of blackspot seabream.

Population dynamics model

An age-structured stock assessment model was further developed based on previous modelling (Lorance 2011) to accommodate the integration of the acoustic biomass estimate from 2019. The data were a reconstructed long term time series of landings, a historic catch-per-unit –effort time series, a short survey time series and the biomass estimate derived from the acoustic survey (Table 3). The developed model has the distinctive characteristic to estimate the spawning biomass of females, which is important for this species where sex change to female occurs at an average age of 6-8 years. Therefore, the biomass of spawning females declines more with fishing mortality than for other stocks.

Table 3 Data sets.

Data set	Years	Source
International landings (ICES area 6, 7, 8)	1956-2018	ICES catch statistics and reconstructed landings from Lorance (2011).
Landings-per-unit-effort (LPUE) for La Rochelle trawlers	1972-1977, 1982-1984	Lorance (2011)
Survey occurrence index	1980-1993, 1996, 1998, 2001	Lorance (2011)
Acoustic biomass estimate	2019	PANDORA project

Given the lack of age-structure data and scarceness of fisheries independent information several model runs were made making different assumptions regarding the proportion of total biomass in the Bay of Biscay represented by the acoustic survey.

Habitat modelling

As part of the H2020 Pandora and the French National DynRose projects, habitat modelling was carried out by applying several Species Distribution Model (SDM) in an Ensemble modelling approach .(de Cubber *et al.*, 2023). The study is carried out at the scale of whole species distribution area, including therefore not only the stock in the Celtic Sea and Bay of Biscay but also the area of the two other stock units considered by ICES (in Iberian and Azorean waters) and the Mediterranean western basin. Occurrence data from a number of sources including (1) French on-board observation, carried out in application of the EU data collection framework (DCF), (2) surveys, (3) CPUEs derived from the vessel monitoring system installed on Spanish artisanal vessels in the Strait of Gibraltar using GPRS/GSM (Burgos et al., 2013) and (4) data available from the WEB such as OBIS. Occurrence data were modelled using several physical chemical and biological environment variables including bathymetric, hydrological, seafloor and water data.

Environmental DNA (eDNA)

In September 2020, a three-day eDNA survey was carried out in the same area as the acoustic survey of 2019.

12.2.8.2 Results

Acoustic survey and population dynamics model

During the survey, blackspot seabream was by far the main catch, other species caught included gurnards, ling, pollack and Ballan wrasse. More than 70% of blackspot seabream caught were larger than 40 cm, and less than 4 % were smaller than the current MCRS of 33 cm (Figure 12.2.15).

A preliminary biomass estimate of 100 t was estimated based on echotype 1 only. The details of the acoustics estimation and echotyping method are not given here. Owing to the length distribution, the 100 tonnes was considered to be fully mature fish. This amount does not represent the total biomass occurring near Brittany because the species occurs along larger part on the Brittany coast. Further the stock component along the French coast is probably much smaller than in the Cantabrian Sea (Division 8c), where roughly 80% of recent landings are caught. Therefore, the population dynamics model was run with several assumed scaling factors (5, 10, 50 and 100), by which this biomass estimate was multiplied (so to fit the model with SSB of 500, 1000, 5000 and 10 000 t in 2019, respectively). These scaling factor represent assumptions of multiplier between the SSB in the surveyed area and the stock SSB. Scaling factors lower than 5 can hardly be assumed, because this would imply that the small areas sampled represented more than 20% of the total stock biomass.

The stock is known to have collapsed in the 1980s. The model estimated that the collapse was caused by fishing mortality reaching values over 0.7 (Figure 12.2.16), driving the stock at low level in the mid-1980s. The scaling factors of the 2019 biomass estimate impact the stock trajectory from the 2000s only. Scaling factors of 50 and 100, result in estimating the stock to have rebuilt to levels similar to the early 1980s. This is not realistic because in this period the species was still caught in one quarter to one third of the hauls during the scientific survey in the Bay of Biscay. The rare catch events in the French EVHOE survey, less that one per year in the last five years, reflects that the current stock is smaller. With scaling factors of 5 and 10, the stock is estimated to be still at a low level but to have between doubled and quadrupled, respectively, since 2000-2002. Suggesting that the rebuilding is on-going. In recent years, the fishing mortality is estimated to decrease for all scaling factors owing declining catches (forced by the TAC) and the increasing biomass.

The stock dynamics can be understood as follows: in the 1970s-80s, the stock decreased and then collapsed because of fishing mortality well above possible MSY reference points for this species. Despite alerts on the obvious collapse, no management measures were introduced before the EU TAC in 2003. Before the TAC, it can be presumed that as soon as a few fish appeared somewhere they were landed owing to the high price of the species and the stock remained at a very low level. From 2003, the TAC has constrained the fishery. The increase can only be slow because of slow growth and late maturity of the species. Further the stock fell to levels well below any possibly MSY $B_{trigger}$, reference point, which implies that the SSB needs to rebuild before producing recruitments of similar abundance than before the collapse.

The questionnaire on their sightings of blackspot seabream. showed that blackspot seabream is seen along the coast of Western and southern Brittany.

Habitat modelling

The habitat modelling suggests that only a low fraction of its potential habitat is occupied (realized habitat) by the blackspot seabream in the Bay of Biscay in recent years (Figure 12.2.17). The results from the habitat modelling and the eDNA sampling were consistent is terms of spatial distribution of the species. So far none of these methods allowed to derive a direct quantitative estimate of the biomass in the area surveyed and both have advantages and inconveniences. For acoustics, one drawback is that fishing operation are needed for identification of echoes and their classification. In the rocky area surveyed, this was done by handlining, which appeared to be selective as more species were identified from eDNA. In particular, with eDNA seabass seemed to occur at a similar abundance as blackspot seabream in the surveyed area, while it was not caught on handlines and the two species may have similar echoes. eDNA has a number of advantages, it covers all species (from microbes to mammals), all habitats (e.g.; both trawlable grounds and waters above rocky outcrops came be sampled with the same method) and does not depend on behaviour (egg daily vertical migration) and does not need identification fishing. However, as no catches are implied, eDNA provides no information of population composition (size, sex).

Environmental DNA (eDNA)

The eDNA sampling showed than the species occurred at about half the locations sampled to the West of Brittany (Figure 12.2.18).

12.2.9 Management considerations

In the 2014 advice, ICES recommend the establishment of a recovery plan for the stock and in 2016, 2018, 2020 and 2022 the general advice recommended zero catch. This stock is collapsed, however, a recovery plan was never applied, and instead a TAC that is reduced every two years was stablished. In this sense, landings in 2007, 2010, 2012, 2014, 2015, 2016, 2018 and 2021 were slightly above the EU TAC. Measures such as a minimum landing size of 35 cm was applied but only for the period from 2010–2012, and since 2019 Spain has established closure areas with the to protect the juveniles in Division 8c. The 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).

Based on the STECF conclusions in previous assessments in which studies represented reasonably sound scientific evidence for the survival of red seabream, the Commission Delegated Regulation (EU) 2020/2015, of 21 August 2020 specified the details of the implementation of the landing obligation to red seabream caught with the artisanal gear voracera in ICES division 9a and with hooks and lines (gear codes: LHP, LHM, LLS, LLD) until 31 December 2022 in ICES subareas 8 and 10 and in ICES division 9a. The regulation specifies that according to the survivability exemption when discarding red sea bream caught shall be released immediately.

12.2.10 Tables and Figures

Table 12.2.1a. Blackspot seabream in subareas 6 and 7; 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
2019	19	0	15	1				35
2020	8		13	0				21
2021	6	0	9	+				15
2022		4	0	6	0		0	11
2023	6	0	5	1			0	11

*Channel Islands

Table 12.2.1b. Blackspot seabream in Subarea 8; 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

YEAR	FRANCE*	SPAIN	UK (E & W))	TOTAL
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	5	137	0	142
2010	61	157	0	218
2011	19	122	0	141
2012	18	82	0	101
2013	26	91	0	117
2014	36	161	0	196
2015	18	125	0	143
2016	7	117	0	124
2017	3	85	0	89
2018	6	105	0	111
2019	4	59	0	63
2020	4	59		63
2021	7	77		84
2022	6	74		80
2023	6	61		67

Table 12.2.1c Blackspot seabream in Subareas 6, 7 and 8; 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

YEAR	6 AND 7	8	TOTAL
1996	29	23	52
1997	56	25	81
1998	17	104	121
1999	25	97	122
2000	20	200	220
2001	52	176	227
2002	25	121	147
2003	40	89	129
2004	55	128	183
2005	41	118	158
2006	63	77	139
2007	130	193	324
2008	63	95	159
2009	61	142	203
2010	62	218	281
2011	37	141	177
2012	156	101	257
2013	178	117	295
2014	60	196	256
2015	34	143	177
2016	40	124	164
2017	37	89	126
2018	22	111	133
2019	35	63	98
2020	21	71	91
2021	15	84	98
2022	11	80	91
2023	11	67	78

Table 12.2.2. Blackspot seabream in subareas 6, 7 and 8; discards reported to ICES in subareas 6, 7 and 8 since 2014.

	Discards (t)	Landings (t)	Catches (t)	Discards/Catches (%)
2014	2.40	256	258	0.9
2015	2.33	177	179	1.3
2016	0.91	164	165	0.6
2014	2.40	256	259	0.9
2015	2.33	177	179	1.3
2016	0.91	164	165	0.6
2017	1.17	126	127	0.9
2018	2.3	133	136	1.7
2019	2.7	98	101	2.7
2020	0	91	91	0
2021	0.4	98	99	0.4
2022	0	91	91	0
2023	1	78	79	1.2

Table 12.2.3. Blackspot seabream in Subareas 6, 7 and 8. Landings inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES for the stock in WGDEEP.

WGDEEP Stock sbr.27.6-8	Catch Inside NEAFC RA (t)	Catch Outside NEAFC RA (t)	Total Catches	Proportion of catch inside the NEAFC RA (%)
2017	0	126	126	0%
2018	0	136	136	0%
2019	0	101	101	0%
2020	0	91	91	0%
2021	0	99	99	0%
2022	0	91	91	0%
2023	0	79	79	0%

Table 12.2.4 Mean size and weight-at-age of Blackspot seabream in Bay of Biscay. From Lorance (2011), derived from Guéguen (1969b) and Krug (1998).

Age group	Mean size (total length, cm)	Mean weight (g)	Proportion of mature females
0			0

Age group	Mean size (total length, cm)	Mean weight (g)	Proportion of mature females
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

Table 12.2.5. Occurrence (kg and % of occurrence in the sampled stations) of the Blackspot seabream (*P. bogaraveo*) in Irish IGFS survey time-series (2010–2020).

	kg	% of occurrence in the stations
2010	0.2	0.8%
2011	0	0
2012	0.1	0.6%
2013	0	0
2014	0	00
2015	0	0

2016	2.1	2.4%
2017	8.2	4.3%
2018	0	0
2019	0	0
2020	0	0
2021	0	0
2022	0	0
2023	0	0

Table 12.2.6. References and sources of reconstructed landings data in the Figure 12.2.1a.

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 1988–2023 landings reported to ICES

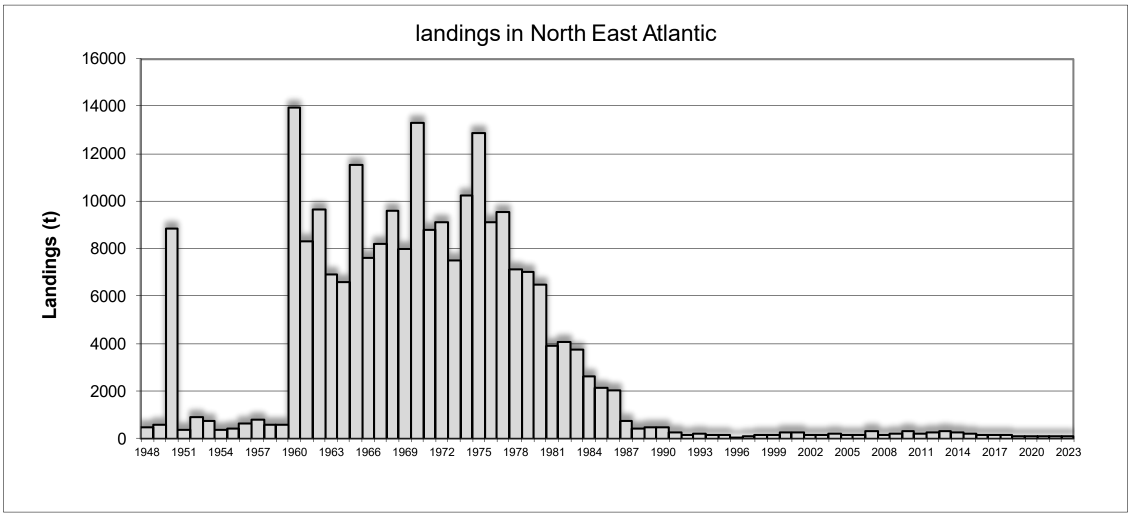
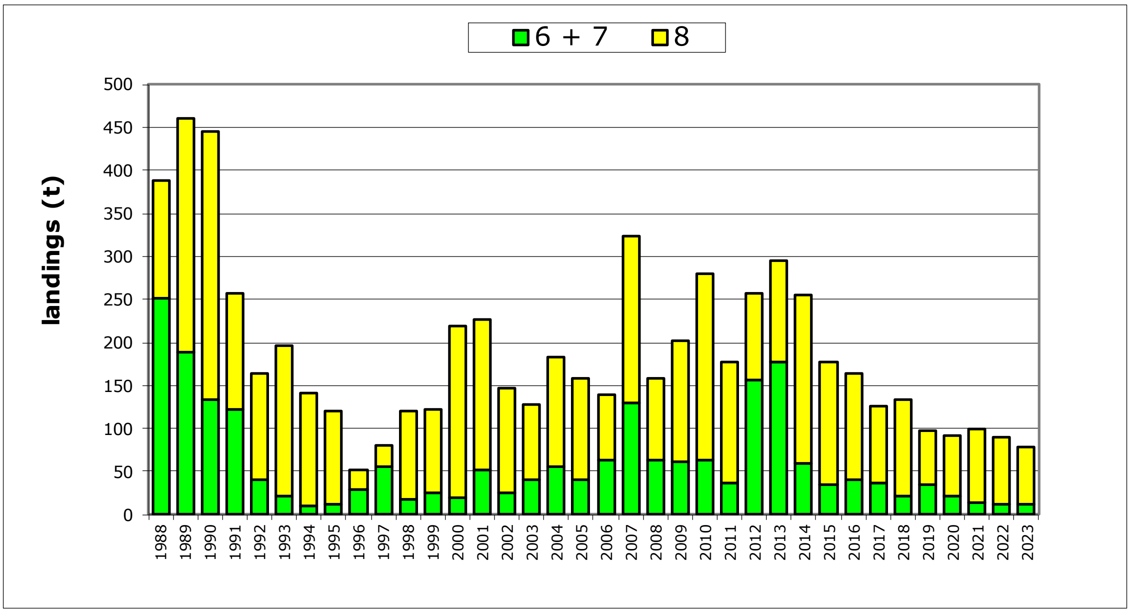


Figure 12.2.1. Blackspot seabream in Subareas 6, 7 and 8. Source of the reconstructed landings of blackspot seabream in the Bay of Biscay from 1948 to 2023.

Figure 12.2.2. Blackspot seabream landing trends in ICES subareas 6 and 7 combined and Subarea 8 since 1988.



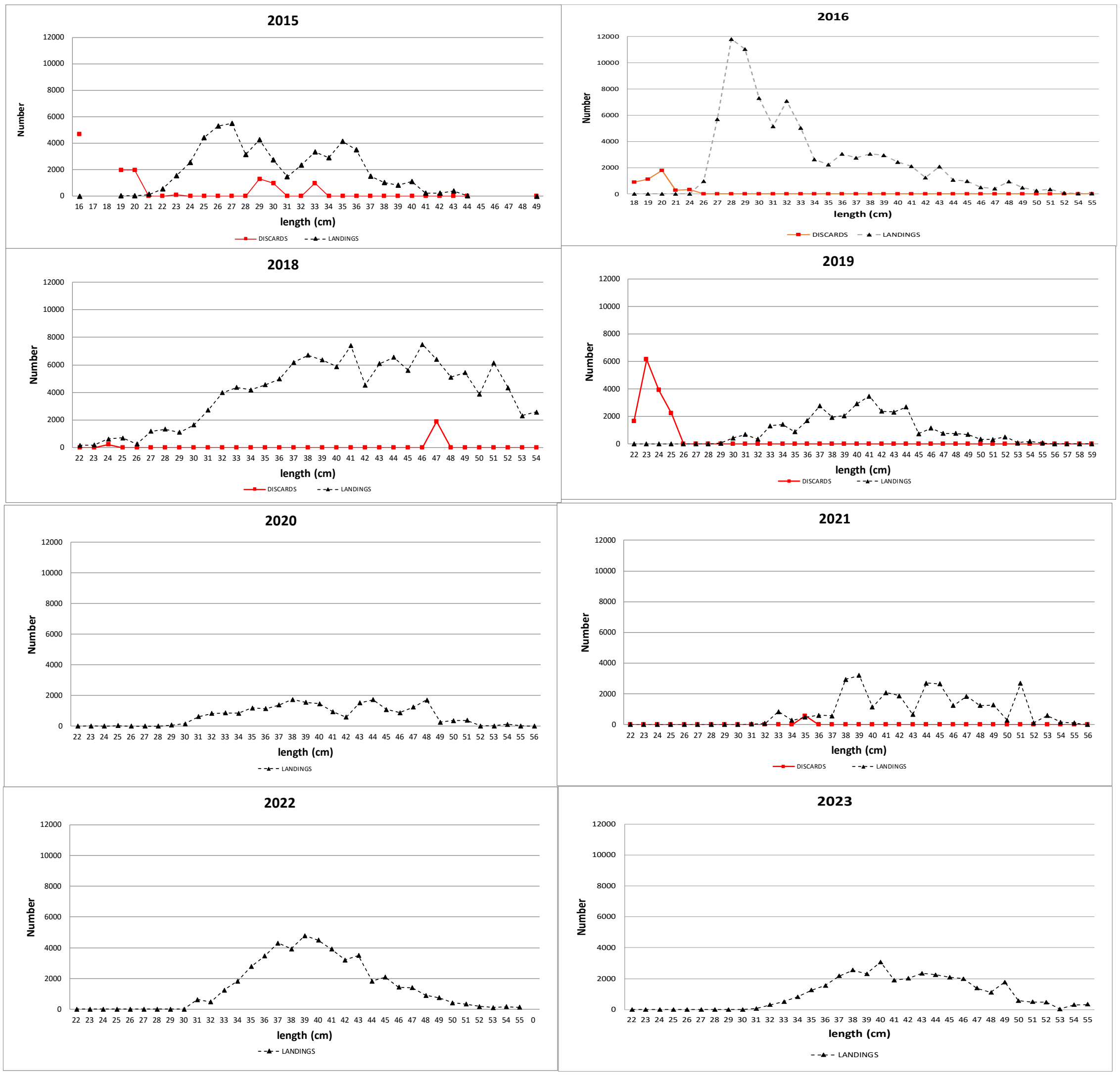


Figure 12.2.3. Length frequencies of the blackspot seabream in commercial catches, landings and discards since 2015, in Subareas 6, 7 and 8 in the period 2015-2023.

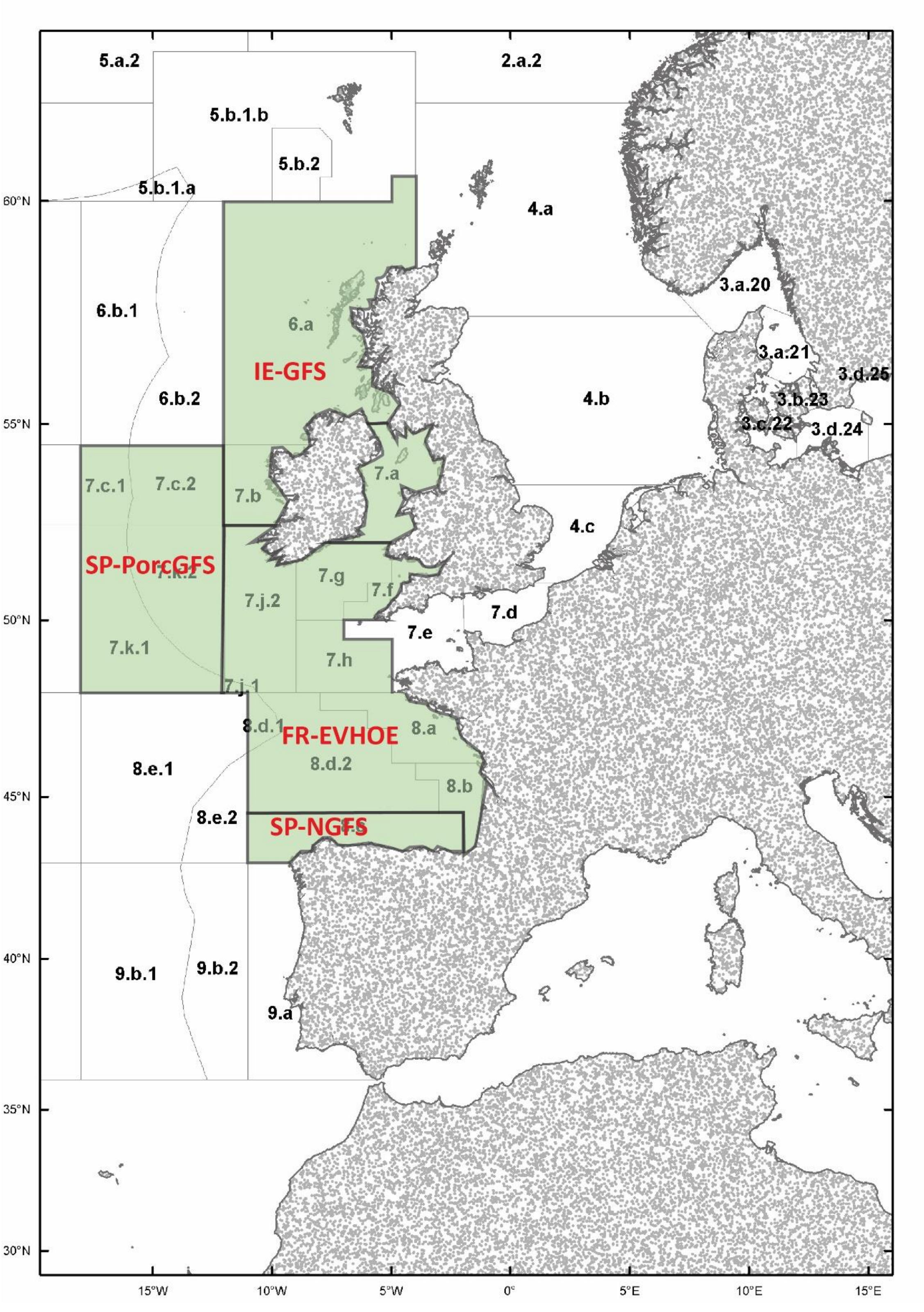


Figure 12.2.4. Map of the Divisions and the four surveys covering the stock rsb.27. 6-8.

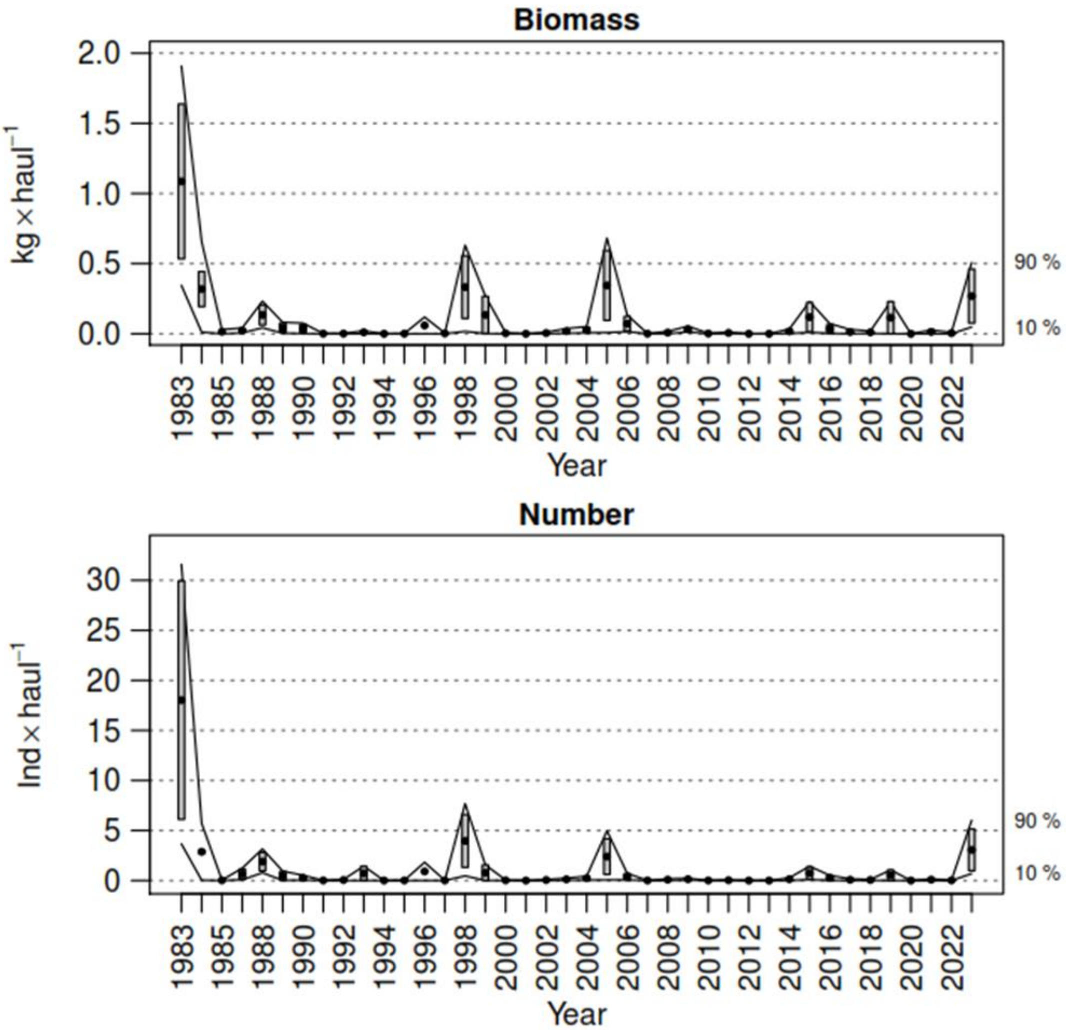


Figure 12.2.4. Evolution of Blackspot seabream (*P. bogaraveo*) mean stratified biomass (upper panel) and abundance (lower panel) in Northern Spanish Shelf survey time-series (1983–2023).

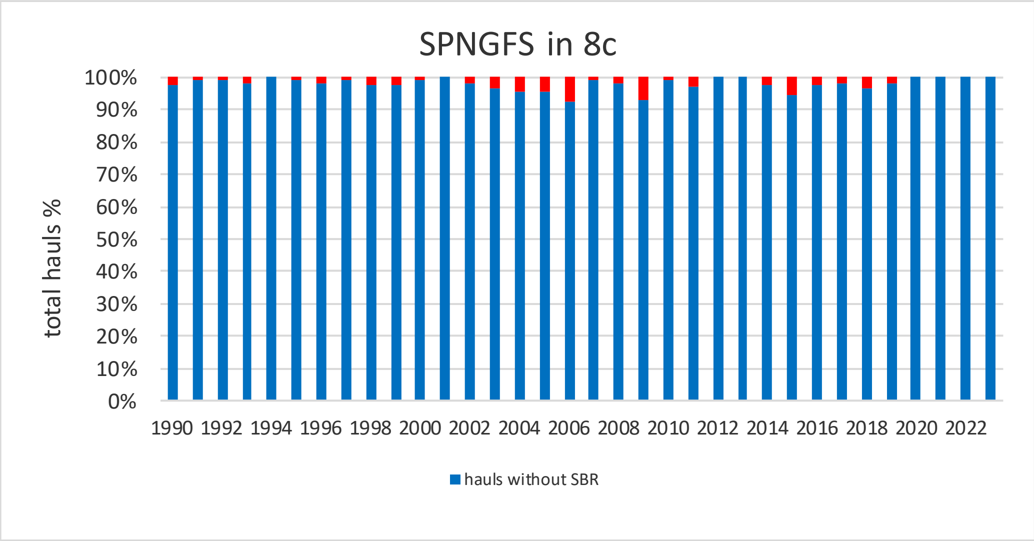


Figure 12.2.5. Occurrence (%) of the Blackspot seabream (*P. bogaraveo*) in Northern Spanish Shelf survey time-series (1990–2023).

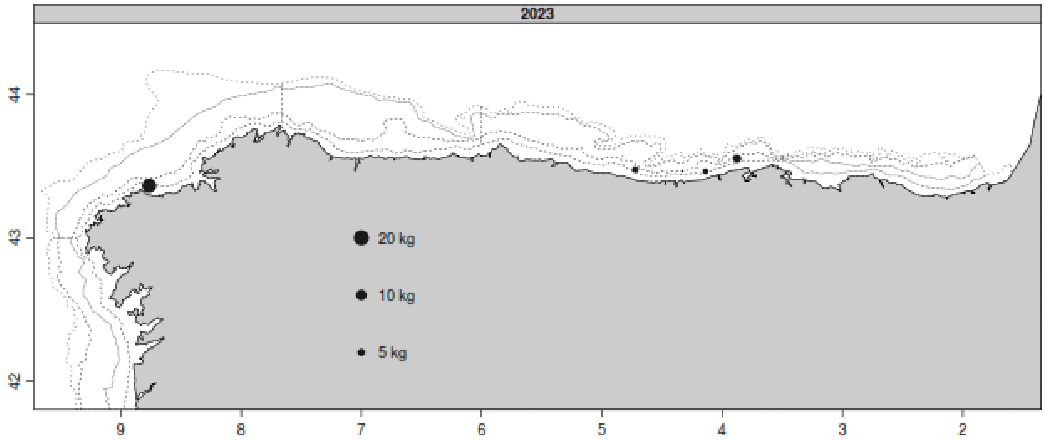


Figure 12.2.6. Catches in biomass of Blackspot seabream on the Northern Spanish Shelf bottom-trawl surveys in 2023.

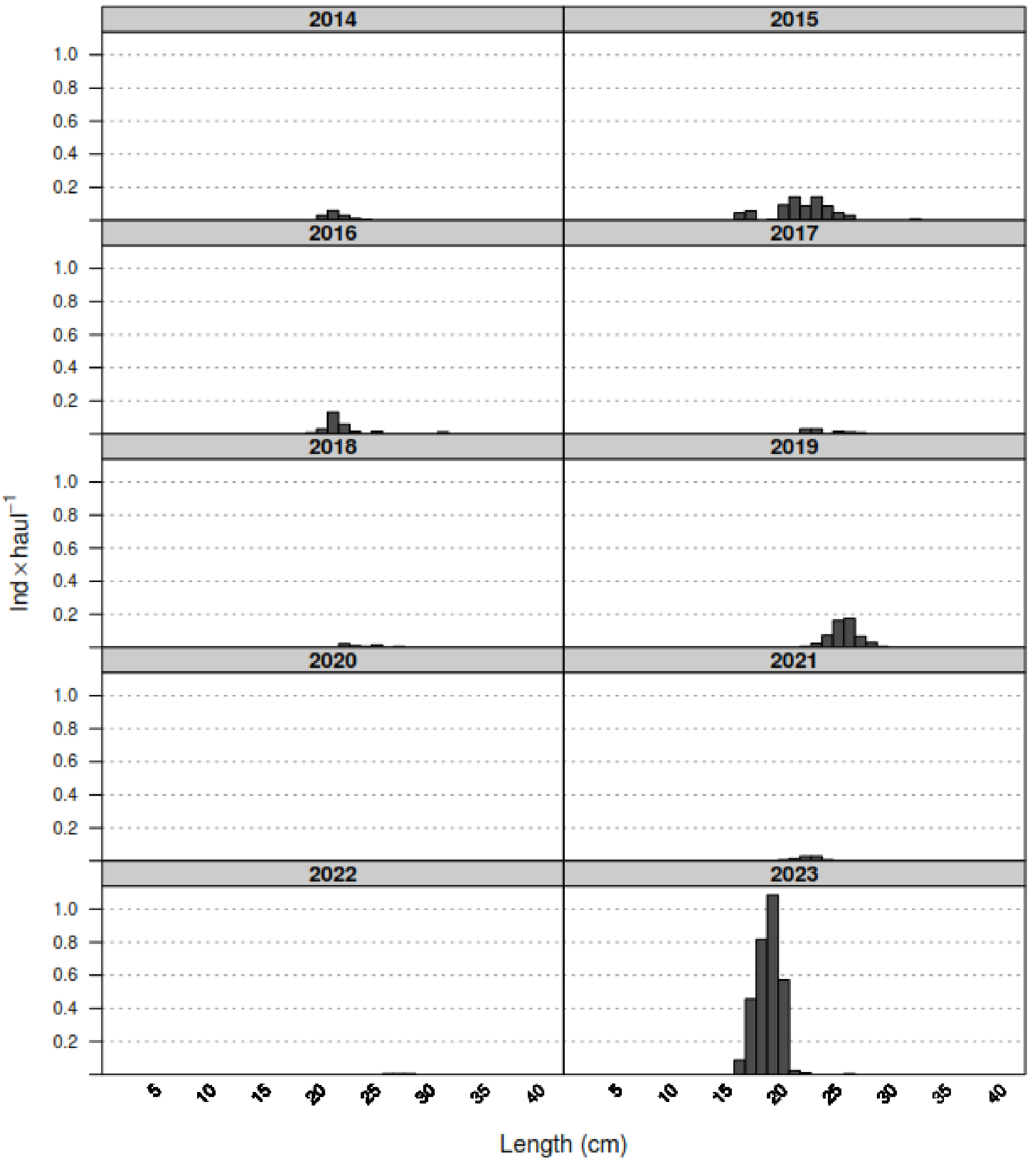


Figure 12.2.7. Mean stratified length distributions of Blackspot seabream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2014–2023).

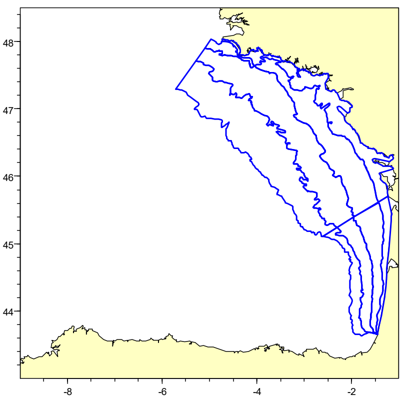


Figure 12.2.8. Strata covering the Bay of Biscay shelf, sampled in the current EVHOE survey and in two previous surveys in 1973 and 1976.

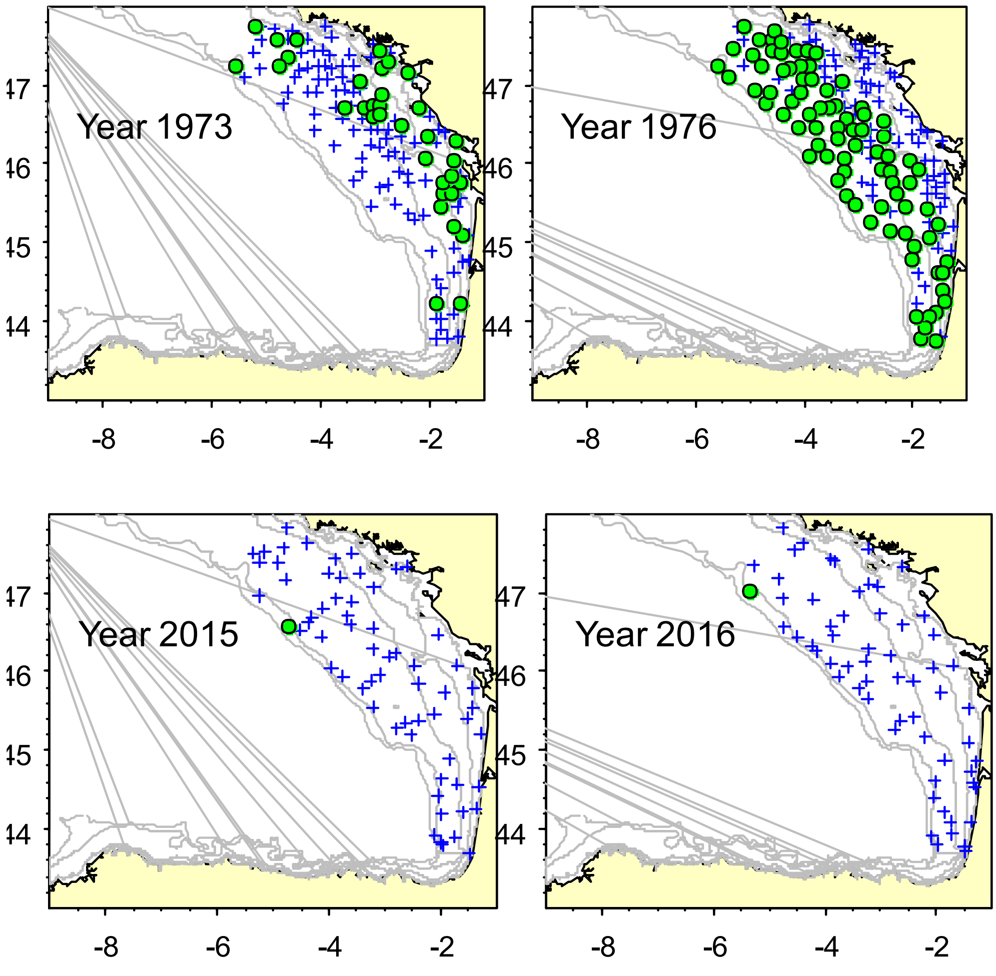


Figure 12.2.9. Occurrences of Blackspot seabream in surveys carried out in 1973 and 1976 and in the EVHOE survey in 2015 and 2016.

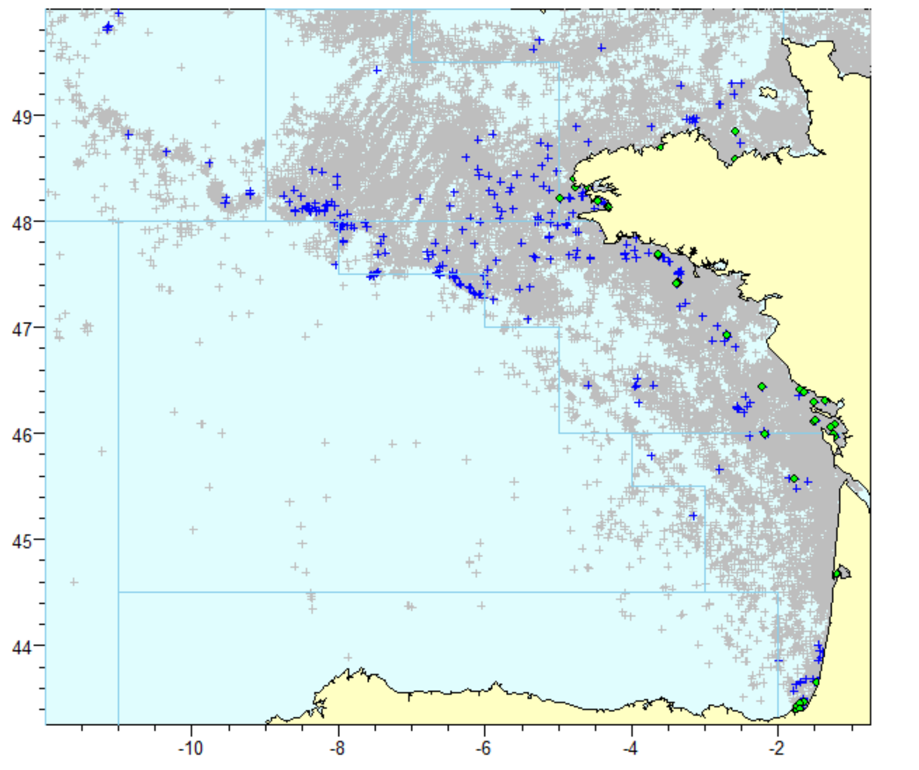


Figure 12.2.10. Geographical distribution on catch of the Blackspot seabream in French on-board observations 2010–2016 in the Bay of Biscay and southern Celtic Sea, all métiers. (Grey) all haul/sets observed, (Blue crosses) hauls with catch of blackspot seabream, (Green dots) hauls with catch of blackspot seabream <20 cm which species identification may be uncertain.

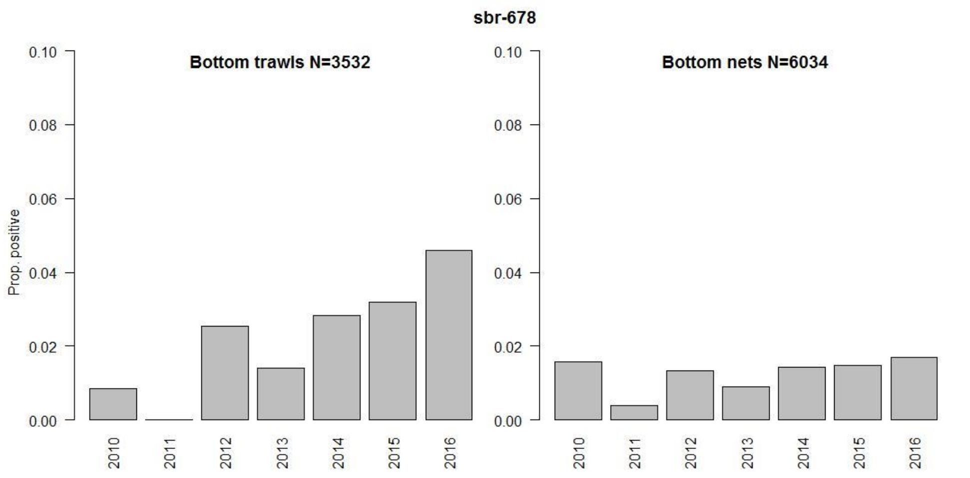


Figure 12.2.11. Proportion of fishing operations with catch of Blackspot seabream in bottom trawls (left) and bottom net (right) in French fisheries to the south of 49°N (ICES divisions 8.a–d and the southern part of 7.d and 7.h–k).

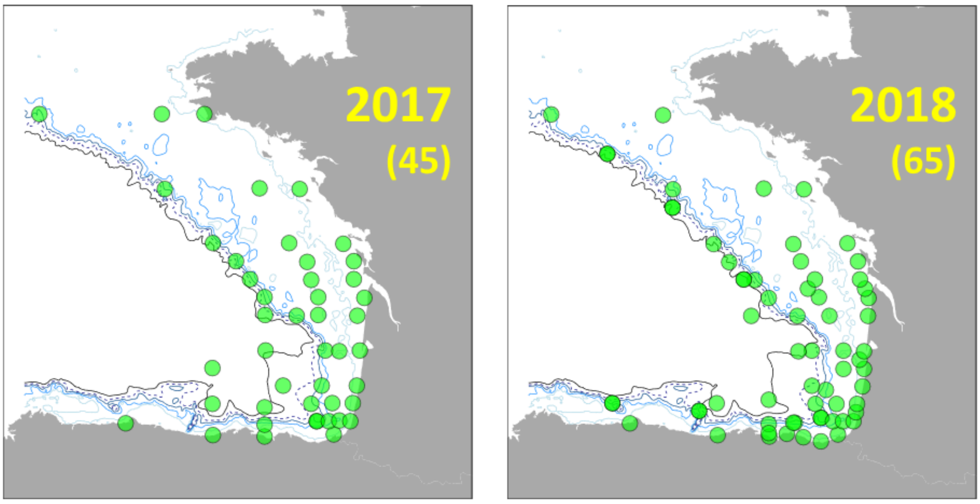


Figure 12.2.12. Geographical distribution of the water samples collected from the Bay of Biscay in 2017 and 2018

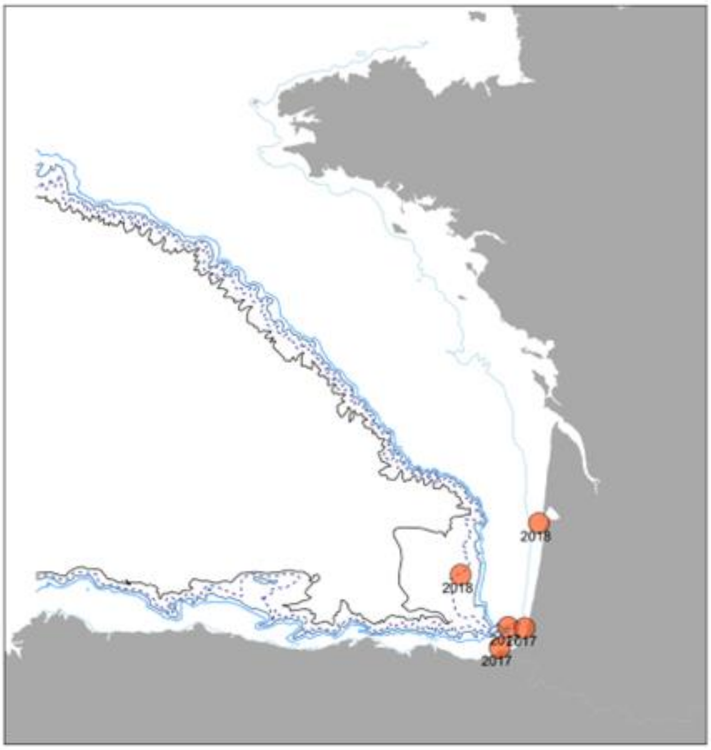


Figure 12.2.13. Location of water samples with positive identification of Red Seabream DNA using the metabarcoding method.

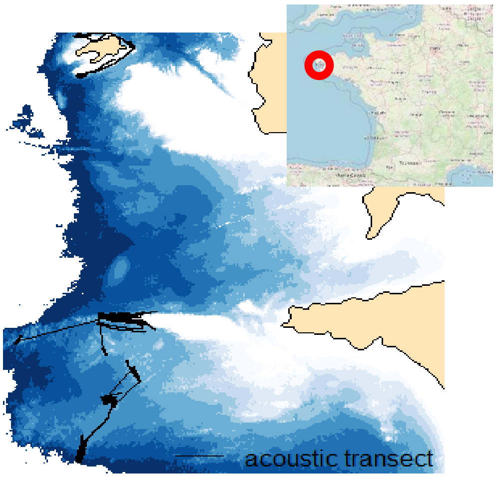


Figure 12.2.14. Surveyed areas and acoustics transits (black lines)

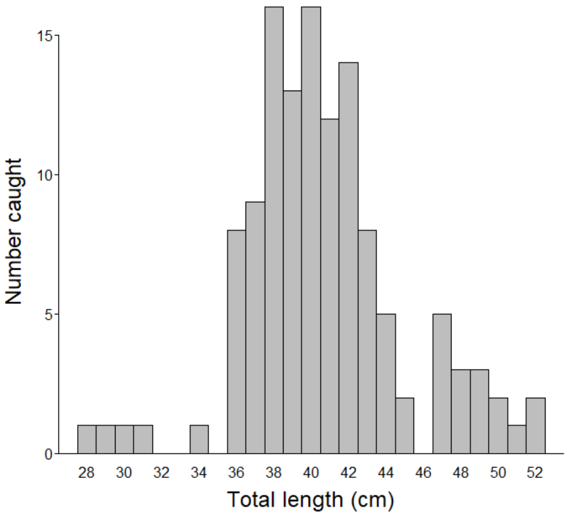


Figure 12.2.15. Length distribution of blackspot seabream caught during the acoustics survey.

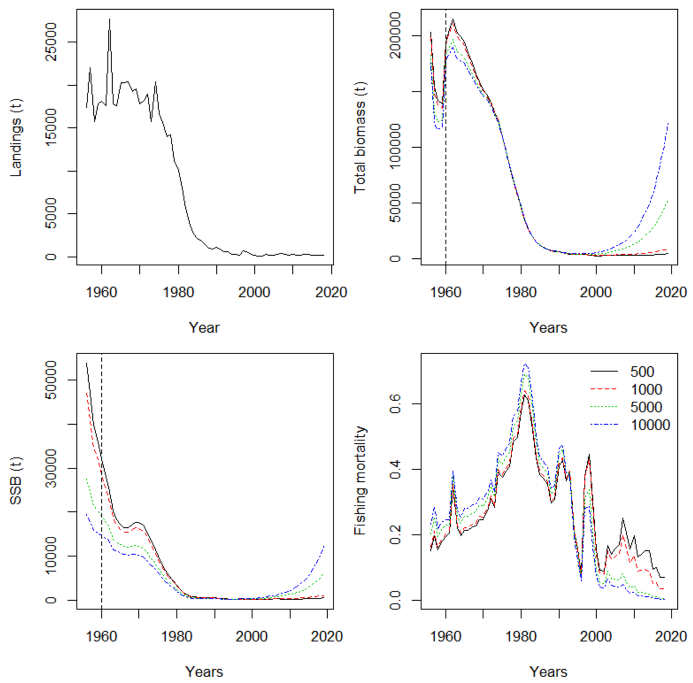


Figure 12.2.16. Time series of international landings and estimated biomasses and fishing mortality for blackspot sea-bream in the Bay of Biscay (ICES area 6, 7 and 8). SSB corresponds to females only. Colors represent runs for different scaling factors applied to the local acoustic survey biomass estimate obtained for a fishing area off Britany (France) in 2019.

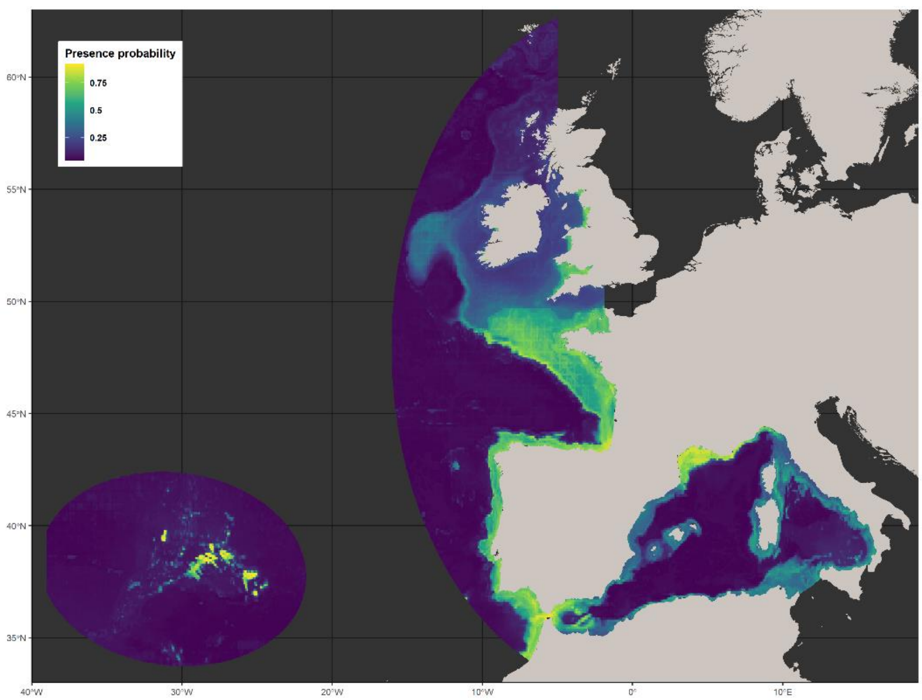


Figure 12.2.17. Potential habitat of the blackspot seabream in the Mediterranean Sea, Azorean waters and European Atlantic shelf estimated from the ensemble modelling (from De Cubber *et al.* , 2023).

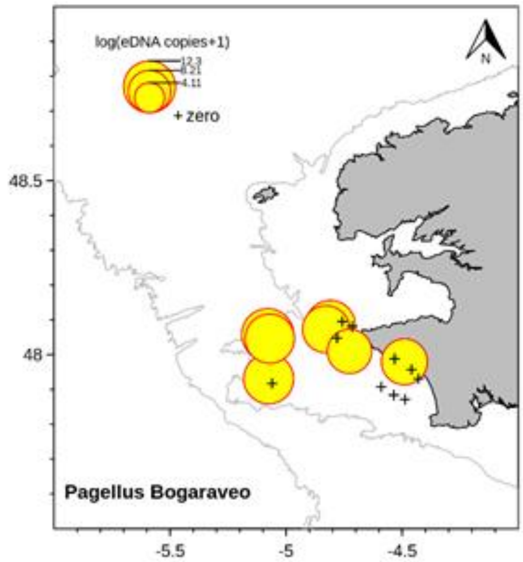


Figure 12.2.18. Number of eDNA copies (log scale) of blackspot seabream by location sampled in September 2020.

12.2.11 References

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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 ICES Subarea 27.9. Portuguese landings data from this area are available from 1988 and Spanish data from 2000. Strait of Gibraltar target fishery (Spain and Morocco) information where currently removed. 2019–2023 European landings in Subarea 27.9 strictu senso are taken from Portugal (>80%) and Spain (<20%). Important to note that these Portuguese landings partially reflect restrictive national quotas constrains in recent years.

Detailed information from Portuguese and Spanish fisheries has been updated in the Benchmark Workshop 3 on development of MSY advice using SPiCT (WKBMSYSPiCT3, ICES 2024) and later to the 2024 WGDEEP. As well as in the other Spanish places from Subarea 27.9, it is admitted that there are no fisheries targeting the blackspot seabream in Portugal mainland although the species can be seasonally targeted (December-January): the species is usually caught as bycatch of fisheries targeting other species. In mainland Portugal, most of species landings are as fresh specimens and are derived from the polyvalent fleet, which uses mainly longlines. The main landing ports (≈89% of the species mainland Portugal total landings) from North to South are: Matosinhos (Portugal North), Aveiro, Nazaré and Peniche (Portugal Centre) and Sagres (Portugal Algarve).

In the Portuguese area of 27.9.a stock, Peniche is the most important landing port for blackspot seabream (landings between 1999 and 2023 represented nearly 50% of the Portuguese landings of the species. The species is mainly landed between December and March: this seasonal fishery pattern can reflect differences on the species' availability (coinciding with the spawning season) or differences on skippers' seasonal fishing grounds preferences (Farias and Figueiredo, WD 15 to the 2023 WGDEEP).

12.3.1.1 Landing trends

Since 2000, the maximum catch in ICES Subarea 9 stricto sensu was reached in 2003–2004 (about 250 t) whereas the minimum (about 40 t) was recorded in the most recent years, 2019-2023 (Figure and Table 12.3.1).

12.3.2 ICES Advice

The ICES advices for 2023 and 2024 was "*that when the precautionary approach is applied, catches should be no more than 114 tonnes in each of the years 2023 and 2024. All catches are assumed to be landed.*"

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 ICES Subarea 27.9 in recent years.**

P. bogaraveo	**2016–2017**		**2018–2019**		**2020–2021**		**2022–2023**	
ICES Subarea	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings
9	183 – 174	90 (75*) – 81 (49*)	165 – 149	67 (20*) – 39 (16*)	149 – 119	47 (11*) – 34 (11*)	119 – 114	36 (4*) – 45 (3*)

***Spanish landings from adjacent waters of ICES Subarea 9 (Strait of Gibraltar) removed from ICES Subarea 9 stricto sensu.**

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 minimum size in the Mediterranean Sea.

European landings have always been below the adopted TACs although these have been reduced over the years.

12.3.4 Stock identity

Stock structure of the species in ICES Subarea 27.9 is still unknown. The species is not evenly distributed along the area, being more frequently caught at specific grounds, suggesting a patchy distribution (Farias and Figueiredo, 2019 WD). Linkages between the Strait of Gibraltar exploited population and the populations in the northern and central area of Subarea 27.9 are unlikely, with no evidence of movements between them. Genetic studies using mitochondrial DNA were inconclusive, showing similar genetic diversity among sampling sites in the NE Atlantic and the Mediterranean (Robalo *et al.*, 2021). More recently, a genotyping-by-sequencing approach revealed the existence of a genetic cluster in the Gulf of Cádiz that, combined with ocean circulation patterns, bathymetry, and the existence of local upwelling, may provide an explanation for the genetic differentiation between the specimens caught in that area and the west coast of continental Portugal (Cunha *et al.*, 2024). Ferrari *et al*. in 2023 strengthened the hypothesis that egg and larval dispersal are fundamental in sustaining the genetic connectivity of blackspot seabream to explain the absence of genetic population structuring in NE Atlantic and Mediterranean samples (from the Bay of Biscay till the Ionian Sea).

Farias and Figueiredo (WD 14 to the WGDEEP 2019) present 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 south-western coast (Figure 12.3.2). There is no evidence of movements between the northernmost component and the southern part of Subarea 27.9 where the Spanish target fishery takes place.

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. The time series was corrected by removing the part of the Portuguese landings that were caught around the Azores before 2000 as well as those corresponding to the Strait of Gibraltar Spanish target fishery. However Table 12.3.1 presents also information reported in previous WGDEEP in order not to lose the track.

Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). Given the low levels of discards, the discarded rate is admitted to be nearly zero for most assessment purposes and those that do occur are mainly related to catches of small individuals. Consequently all catches of blackspot seabream in management are 27.9 are assumed to be landed.

12.3.5.2 Length compositions

Landings length distribution by fishing segment (polyvalent and trawlers) from 2014 until 2023 are presented in Figure 12.3.2 (Farias and Figueiredo, WD 15 to the 2023 WGDEEP). Differences in length distribution between the polyvalent the trawl segments indicate that polyvalent fleet catch larger fish than the trawl fleet because the vessels operate in areas farther from the coast and at higher depths, where larger fish are more common (Farias *et al.*, WD to the 2018 WGDEEP).

The table below shows the mean landed size from the Portuguese polyvalent reference fleet since 2014:

Mean landed size of *Pagellus bogaraveo* from the Portuguese polyvalent fleet since 2014.

Year	Mean
2014	36.82
2015	37.17
2016	38.78
2017	37.32
2018	37.25
2019	37.83
2020	37.75
2021	42.82
2022	39.64
2023	39.51

12.3.5.3 Age compositions

No information was presented to the group.

12.3.5.4 Weight-at-age

No information was presented to the group.

12.3.5.5 Maturity and natural mortality

No information was presented to the group.

12.3.5.6 Catch, effort and research vessel data

Sporadic survey data are not useful for stock assessment. Although some fishery-independent data on the species are available from IPMA and IEO surveys, the number of records is insufficient to monitor species abundance or biomass. The species is not evenly distributed along the surveyed area, being more frequently caught at specific grounds, suggesting a patchy distribution.

The stock-size indicator corresponds to the standardized CPUE from the Portuguese polyvalent fleet, considering only January and December, the months when the species is targeted by the fishery (presented, reviewed and accepted at WKBMSYSPiCT3; ICES, 2024). CPUE was standardized using Generalized Additive Mixed Models (GAMMs), following the guidelines from Winker *et al*. (2013) and Winker *et al*. (2014). Detailed information about the standardization procedure are available in the WKBMSYSPiCT3 Report.

Thus, catch-per-unit-effort (CPUE, kg by trip) from this reference fleet was used as a biomass index based for this species in Subarea 27.9 and its values are shown in Table 12.3.2 and Figure 12.3.3.

The CPUE standardization guidelines for the polyvalent fleet proved not to be adequate for the trawl fishing segment. This mainly derives from the fact that the species is a bycatch of trawlers whose fishing areas are extended and do not cover the preferential area for the species occurrence (seamounts).

12.3.6 Data analyses

The stock identity is still unclear, but linkages between the Strait of Gibraltar populations and the populations in the northern and central area of Subarea 27.9 are unlikely. Considering all the available information and following the recommendations and conclusions from WKBMSYSPiCT3, the Group agreed to remove Strait of Gibraltar data (landings and biomass index) from ICES Subarea 27.9 in order to apply a new assessment approach.

A MSY advice for category 3 stocks based on the stock trend from a biomass index, the mean length in the catch relative to an MSY proxy length and a biomass safeguard was attempted using the *rfb* catch advice.

Main parameters used are resumed in the table below. Last year catch C_y (2023) was applied instead of the last advice. The index A was calculated using the two most recent years of abundance indices (2022–2023) and B was based on the last three years (2019, 2020, 2021). The indices A and B were calculated to estimate the stock biomass trend (*r*, index ratio A/B). The fishing pressure proxy (*f*) was calculated using the length-composition from the fishery for the period 2019–2023. Computations were performed using R software and the codes were available in the GitHub library of ICES.

Variable	Definition	Estimate	Detail
r: Stock biomass trend	*r* = Index A / Index B	1.00	Biomass index derived from commercial LPUE from Portuguese polyvalent fleet: Index A (2022, 2023) = 34.83 kg trip^{-1} Index B (2019, 2020, 2021) = 34.89 kg trip^{-1}
f: Fishing proxy	$\frac{\bar{L}_{y-1}}{L_{F=M}}$	1.00	Length composition of Portuguese fishery (polyvalent and bottom trawl) raised to sbr.27.9 strictu senso for the period 2014-2023. $\bar{L}_{y-1}$ =38.87 cm $L_{F=M}$ = 38.25 cm

b: Biomass safeguard	$b = \min(1, I_{y-1} / I_{\text{trigger}})$ $I_{\text{trigger}} = I_{\text{loss}}\ \omega$, considering $\omega = 1.4$	1	Stock indicator; I_{loss}, = 24.18 (2001) I_{trigger} = 33.85 $\frac{I_{y-1}}{I_{\text{trigger}}} = 1.20$
m: Tuning parameter	linked to von Bertalanffy k	0.95	k < 0.2 yr^{-1} for slow growing species such as deep-water stocks. L_{∞} was estimated as 60 cm TL, lasrgest sample from LFDs
C_y: Catch	last year catches (2023)	45 t	Since no previous catch advice (A_y) exists, the most recent catch (C_{y-1}), or the average of the last three years of catch should be used
A_y: Advice	$A_{y+1} = C_y \times r \times f \times b \times m$	43 t	

12.3.7 Comments on the assessment

The CPUE standardization as well as the historical landings reconstruction performed during WKBMSYSPiCT3 and updated in WGDEEP 2024 are adequate and fulfil the requirements for the application of the *rfb* method. However, its application should take into consideration that the landings as well as fishing activity have been constrained by the quotas.

12.3.8 Management considerations

A TAC regime (114 t) was established for 2023 and 2024 for the 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).

The new advice that catches should be no more than 43 tonnes for 2025 and 2026 is not comparable with previous advices because a new assessment method and input data are being applied.

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.

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.

12.3.9 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	Total with adjacent waters (SoG)	Portugal**	Spain (no SoG)	TOTAL in 27.9 stricto sensu
1988	370	319	689	116	NA	**116**
1989	260	416	676	81	NA	**81**
1990	166	428	594	52	NA	**52**
1991	109	423	532	34	NA	**34**
1992	166	631	797	52	NA	**52**
1993	235	765	1000	74	NA	**74**
1994	150	854	1004	47	NA	**47**
1995	204	625	829	64	NA	**64**
1996	209	769	978	65	NA	**65**
1997	203	808	1011	64	NA	**64**
1998	357	520	877	112	NA	**112**
1999	265	278	543	83	NA	**83**
2000	83	338	421	83	33	**116**
2001	97	277	374	97	41	**138**
2002	111	248	359	111	82	**193**
2003	142	329	471	142	117	**259**
2004	183	297	480	183	57	**240**
2005	129	365	494	129	35	**164**
2006	104	440	544	104	93	**197**
2007	185	407	592	185	45	**230**
2008	158	443	601	158	27	**185**
2009	124	594	718	124	36	**160**
2010	105	379	484	105	33	**138**
2011	74	259	333	74	34	**109**
2012	143	152	203	143	23	**166**
2013	90	91	180	90	40	**130**

Year	Portugal*	Spain	Total with adjacent waters (SoG)	Portugal**	Spain (no SoG)	TOTAL in 27.9 stricto sensu
2014	59	203	262	59	29	**88**
2015	66	87	295	66	17	**83**
2016	70	95	242	70	20	**90**
2017	69	61	147	69	12	**81**
2018	58	29	95	58	9	**67**
2019	36	20	60	36	4	**39**
2020	43	16	62	43	5	**47**
2021	29	16	49	29	5	**34**
2022	33	7	42	33	3	**36**
2023	38	10	47	38	7	**45**

*From previous WGDEEP Reports

**Landings estimates from Portugal mainland, removing those from Azores fishing grounds (1988 - 1999)

Table 12.3.2. Standardized CPUE series estimates for Portuguese reference fleet, predicted values and its 95% confidence interval values .

Year/ Reference fleet	Polyvalent		
	Low	Value	High
2000	40.03	42.52	45.00
2001	21.73	24.18	26.63
2002	30.03	32.45	34.86
2003	39.46	41.87	44.27
2004	32.47	34.86	37.26
2005	42.64	45.01	47.38
2006	40.19	42.57	44.95
2007	39.53	41.91	44.29
2008	55.23	57.62	60.00
2009	33.58	36.01	38.43
2010	46.69	49.09	51.48
2011	49.62	51.99	54.35
2012	54.70	57.05	59.40

2013	56.09	58.46	60.84
2014	62.94	65.34	67.74
2015	43.32	45.66	48.00
2016	35.24	37.59	39.94
2017	28.42	30.77	33.12
2018	37.45	39.84	42.24
2019	33.20	35.62	38.05
2020	32.08	34.43	36.78
2021	32.27	34.63	36.98
2022	26.72	29.08	31.44
2023	38.07	40.57	43.07

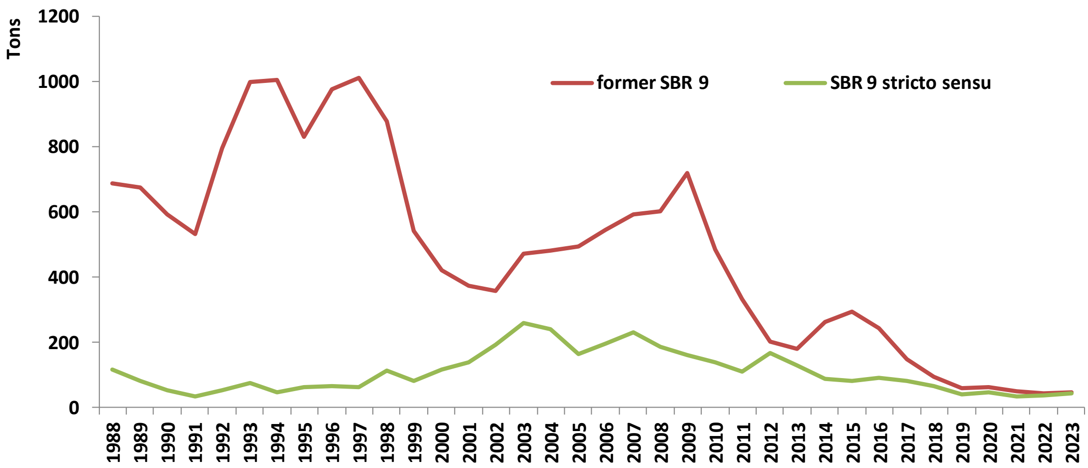

Figure 12.3.1. Blackspot seabream in ICES Subarea 27.9 (and adjacent waters): Total landings including Spanish data from Strait of Gibraltar fishery (red line) and ICES Subarea 27.9 stricto sensu (green line).

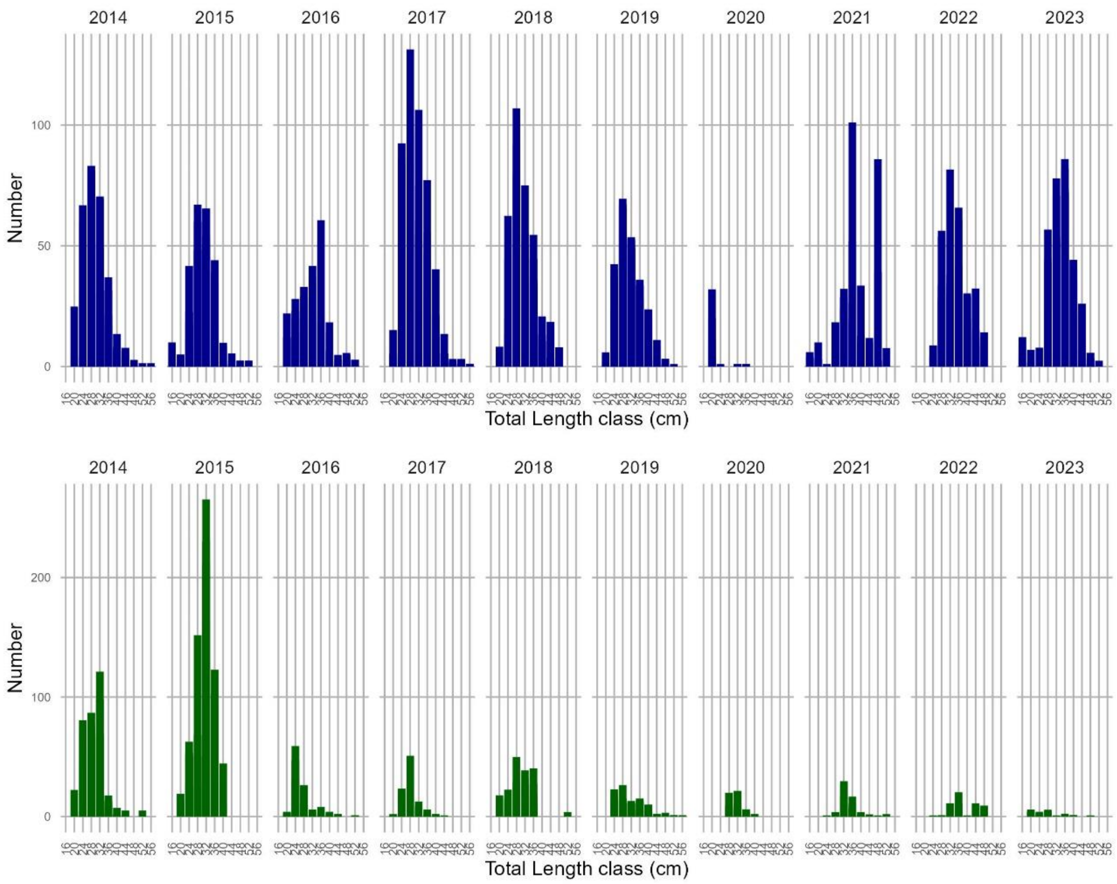

Figure 12.3.2. Blackspot seabream in ICES Subarea 27.9: ***Pagellus bogaraveo*** **length frequency distribution (Portuguese DCF port sampling) by fishing fleet (upper is polyvalent and lower is trawl) for the years 2014 to 2023 raised to Portuguese and Spanish landings (excluding the Strait of Gibraltar). Length classes are aggregated by 4 cm range (from 16-20 cm).**

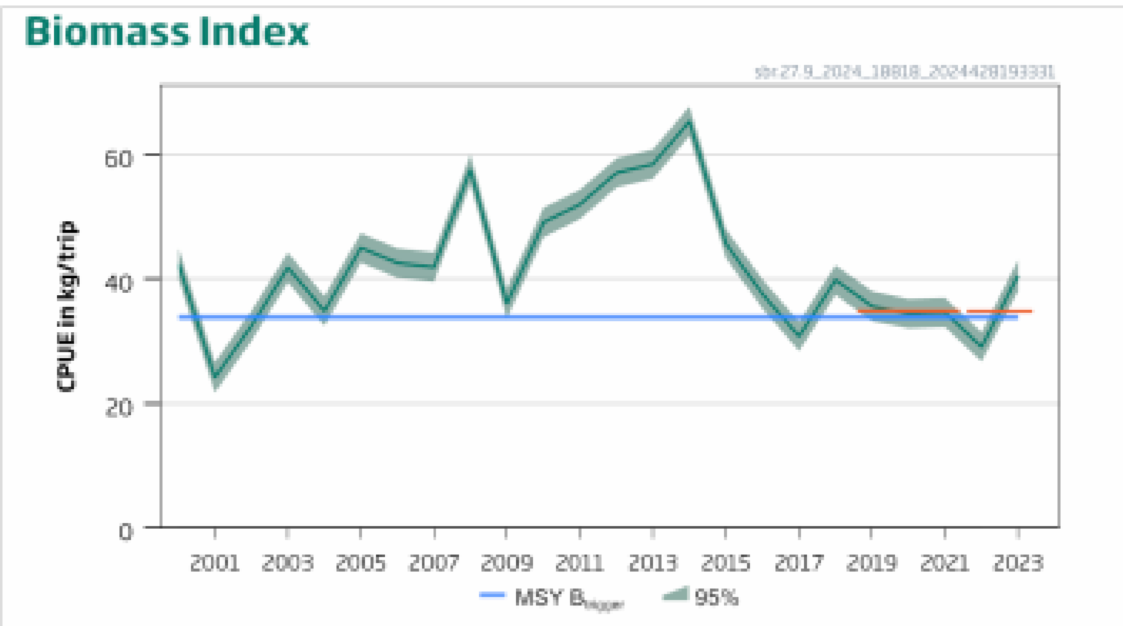

Figure 12.3.3. Blackspot seabream in ICES Subarea 27.9: Standardized CPUE from Portuguese polyvalent reference fleet. The horizontal red lines indicate the average of abundance index in the most recent two years (2022–2023) and

the previous three years (2019–2021). The shaded area on the biomass index plot represents 95% CI. Horizontal blue line represents $I_{trigger}$ as a proxy of MSY $B_{trigger}$.

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Contents

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, although the population structure remains uncertain.

This stock is classified as Category 2 in the NEAFC categorization of deep-sea species/stocks in subareas 4, 12 and 14, which implies that directed fisheries are not authorised and that bycatches should be minimised in the NEAFC RA (NEAFC, 2016). In all other areas, this stock is classified as Category 4 in the NEAFC categorization of deep-sea species/stocks, which implies that fisheries are primarily restricted to Coastal State exclusive economic zones (EEZs) and therefore management measures are not taken by NEAFC unless complementary to coastal state conservation and management measures (NEAFC, 2016).

13.2 The fishery

There is no directed fishery for roughhead grenadier and catches are taken as bycatch from other fisheries. 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. However, these large catches have been considered doubtful and suspected to correspond to species misreporting. In 2021, landings returned to similar amounts of 2018, with most landings reported from ICES subareas 2 and 14, and Division 5.a. Preliminary estimates are suggestive that landings in 2023 reached the highest value since 2012.

Roughhead grenadier was mostly caught with bottom trawl but, in Subarea 14 and Division 12.a, catches with pelagic trawl, a GLORIA type in the first year (2010) and a modified alfonsinos pelagic trawl in the following years, were reported. As significant catches of the species in pelagic trawls are unexpected, these catches could represent species misreporting of roundnose grenadier catches or errors of the reported fishing gear. No catches have been reported in Subarea 12 between 2017 and 2022.

Most landings of roughhead grenadier from ICES Subarea 14 are from Norway and Greenland commercial trawl and longline fishery. Before 2014, the catch was dominated by trawlers, but from 2014 most catches are from the longline fishery. The Spanish fleet fishing grenadiers on the Mid-Atlantic ridge (MAR) historically targeted redfish and grenadier fisheries in Subdivision 14.b.1. This fishery has decreased since 2016, and there are no reported landings from the Spanish fleet since 2017. Preliminary estimates for 2022 indicate that landings from the Norwegian fleet in Subarea 14 reached the highest value since 1993 (187 tonnes).

13.3 Landings trends

In ICES 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 tonnes, except a higher level to 100 tonnes in 2016. Reported landings in subareas 1 and 2 have been constantly higher than 100 tonnes since 2020, reaching 186 tonnes in 2022 and 176 tonnes in 2023. Historically, most landings are from Norway with a smaller contribution from Russia. Landings from France are occasional and negligible, below 0.5 tonnes in most years (Table 13.1).

Reported landings from ICES subareas 3 and 4 also started in 1990 and have been very low, peaking in 2005 at 39 tonnes. Historically, most landings have been reported by Norway, France, UK (Scotland) and Ireland. Since 2006, reported annual landings are negligible. (Table 13.2).

In ICES Division 5.a, roughhead grenadier is occasionally caught. Before 2010, reported annual landings have been mostly below 10 tonnes and have increased to about 20 tonnes per year afterwards. Between 2015-2019 landings ranged between 20 and 40 tonnes. However, reported annual landings by Iceland increased to 44 tonnes in 2020. A total of 56 tonnes were reported in 2021 by Iceland and Norway, and 77 tonnes by Iceland and France in 2022. Reported landings have increased sharply in 2023, almost doubling to 133 tonnes, representing the highest-level from Division 5.a in the time series available to the ICES (1994-2023)(Table 13.3).

Landings have been reported from ICES Division 5.b since 1997. The highest catch was 99 t in 1999, but in other years landings were < 12 t. Since 2013, reported landings have been reported exclusively by French and Norwegian vessels, although at quantities lower than 1 tonne per year, except 4 tonnes reported in 2018 by Norway. Less than 1 tonne have been reported annually since then, however, increasing to around 7 tonnes (mostly from Subdivision 5.b.2) were reported in 2023 by Norway, the highest value since 2006 (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. Official records series started in 1992, with official landings peaking during the period 2011–2013, when they reached 632 tonnes in 2012 due to an exceptional report of 436 tonnes 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). Landings from subareas 6 and 7 have declined since 2004, particularly in the last few years with the implementation of the regulation prohibiting bottom trawling below depths of 800 m. Given the known geographical distribution of the species (Lorance *et al*., 2008), any recent landings in subareas 6 and 7 are considered to be misidentification.

Occasional landings of less than 0.5 tonnes have been reported from Subarea 8. These were considered as coding errors or area misreporting as the species is not known to occur in Subarea 8.

Official records in Subarea 12 include landings from both the demersal multispecies fishery in Hatton Bank (Division 12.b) and the pelagic redfish and grenadier fishery on the MAR (Division 12.a). The historical time-series dates to 2000, reaching 2200 tonnes in 2005 and 2832 tonnes in 2009. No landings have been reported in these areas since 2017, however, very low (negligible) landings were reported by Norway from ICES Subdivision 12.a.4 (southern Iceland) in 2023.(Table 13.6).

Annual landings have been reported from Subarea 14 since 1993 mostly by Norway, Greenland and Russia. Between 2010–2014, Spanish vessels reported between 500 and 2700 tonnes/year in Subarea 14, sharply decreasing since then. More recently, landings decreased to less than 85 tonnes in each of the years 2019-2020, increasing to 146 tonnes in 2021. In 2022, a total of 202 tonnes, mostly from Norway, were reported from Subarea 14, the highest value since 2014, decreasing to 157 tonnes in 2023 (Table 13.7).

13.4 ICES Advice

The previous advice for roughhead grenadier was issued for 2016 to 2020 and stated that *"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."*

The current advice was given in 2020 and states that *"when the precautionary approach is applied, there should be no directed fisheries for roughhead grenadier, and bycatch should be minimized for each of the years 2021 to 2025."*

13.5 Management

WGDEEP is not aware of any management plan for roughhead grenadier within ICES area. Since 2015, bycatch of roughhead grenadier by EU vessels in Union and International waters should be reported under the roundnose grenadier TAC for the same area. Currently, no directed fisheries for roughhead grenadier are permitted in EU and UK waters, including certain ICES areas in international waters. Any bycatch shall be counted against the roundnose grenadier quota and may not exceed 1% of the quota[1]. This stock is also covered by a TAC for grenadiers for EU and Norway in Greenland waters of 5 and 14 (GRV/514GRN)[2]. In eastern Greenland, main fishing operations are in Subdivision 14.b.2 and here, the annual TAC of roundnose and roughhead 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.

Management measures adopted by NEAFC establish a total allowable catch limitation of 574 tonnes of roundnose grenadier in 2021 and no direct fisheries for roughhead grenadier and roughsnout grenadier should be authorised in NEAFC Regulatory Area. Any bycatches of these grenadiers as well as other grenadiers (Macrouridae) should be counted against the total allowable catch of roundnose grenadier. Since then, NEAFC did not renew specific measures for grenadiers. ICES WGDEEP understands that measures are now just covered by the Recommendation 7: 2018 on Deep-Sea Fisheries within the NEAFC Regulatory Area.

There are other management measures that afford protection to deep-water fishery resources in the North-east Atlantic including depth limits on bottom trawling and netting (Regulation (EU) 2016/2336[3]), spatial management (e.g., MPAs) and specific requirements for the protection of Vulnerable Marine Ecosystems (Regulation (EU) 2016/2336 and Regulation (EU) 2022/1614[4]). In terms of current depth limits in EU and UK waters, bottom set gillnets may be deployed to

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[1] Written Record of fisheries consultations between the United Kingdom and the European Union for 2024 (publishing.service.gov.uk)

[2] Regulation (EU) 2023/194 fixing for 2023 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, as well as fixing for 2023 and 2024 such fishing opportunities for certain deep-sea fish stocks.

[3] Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002. http://data.europa.eu/eli/reg/2016/2336/oj/eng

[4] EU. 2022. Commission implementing regulation (EU) 2022/1614 of 15 September 2022 determining the existing deep-sea fishing areas and establishing a list of areas where vulnerable marine ecosystems are known to occur or are likely to occur. http://data.europa.eu/eli/reg_impl/2022/1614/oj

depths less than 600 m, whilst bottom trawling is prohibited at depths greater than 800 m (Regulation (EU) 2019/1241)[5].

There may be other management measures that WGDEEP experts may not be aware of.

13.6 Data available

13.6.1 Landings and discards

Earlier years data are WG estimates based on national submissions to ICES, which are not fully included in InterCatch.

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 $\pm$ 0.42 (mean $\pm$ standard deviation) for Subarea 6, 0.68 $\pm$ 0.23 for Subarea 12 and 0.53$\pm$ 0.50 for Subarea 14.b (Table 13.8).

National catch statistics of Greenland were used to update catches in Subarea 14.b.2 from 1999 to 2022, but no information relative to 2023 was made available to WGDEEP at the time of the writing. Data from recent years 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 more abundant in ICES 14.b.2. (Nogueira and Christiansen, 2023; WD06). Similarly, it is possible that a part of landings in subareas 6 and 7 are probably misidentification, since catches from fishery-independent surveys are negligible.

Since 2019, there was virtually no Russian directed fishery in the deep waters of the Northeast Atlantic and bycatches of roughhead grenadier were obtained in longline fisheries in the Norwegian seas, and in the trawl fisheries targeting Greenland halibut (*Reinhardtius hippoglossoides*) in the eastern part of the Fishing Zone of Greenland (Nogueira and Christiansen, 2023; WD07). Between 2014 and 2018 reported higher catches of roughhead grenadier by Greenland are considered to be linked to the longline fishery targeting tusk (WGDEEP 2022, WD12).

Reported landings of roughhead grenadier inside and outside the NEAFC Regulatory Area are provided in Table 13.9.

There remains some uncertainty given that historical landings and discards data are not always accurately recorded, or not provided by all countries. Therefore, it is noted that available data needs to be reviewed to provide robust estimations.

It should be noted that data from Russian Federation is not available to ICES since 2022 and WG estimates of landings may be underestimated.

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[5] Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005

13.7 Length composition of the landings and discards

No new data was available to ICES WGDEEP in 2024.

13.8 Age composition

No new data was available to ICES WGDEEP in 2024.

Recent studies provided information on age composition and growth parameters for *Macrourus berglax* in the Norwegian Sea shelf edge in ICES subareas 1 and 2, based on pooled length at age data from slope surveys 2009-2018 (Bergstad *et al.*, 2021).

Age was derived from otolith readings. Where data was suitable, age distributions showed that sampled individuals consisted mainly of 5 to 25 years old, but older individuals (up to 30 years old) were also common. The oldest specimens recorded were around 50 years old. Estimated parameters of the von Bertalanffy growth functions were L_{inf}: 27.36 cm PAFL; K: 0.11 year^{-1}; t_0: -0.02 year for females; and L_{inf}: 22.85 cm PAFL; K: 0.13 year^{-1}; t_0: -0.74 year for males.

13.9 Weight-at-age

No new data was available to ICES WGDEEP in 2024.

13.10 Maturity and natural mortality

No new data was available to ICES WGDEEP in 2024. Maturity data was last available for 2019, provided by the Russian investigations in the Norwegian Sea (ICES divisions 2.a and 2b) (WGDEEP 2020, WD23).

13.10.1 Research vessel survey

No new data was available to ICES WGDEEP in 2024.

The Icelandic autumn groundfish survey is the main source of fishery-independent data for *Macrourus berglax* in Icelandic waters. Further, data can be compiled from several other older surveys of exploratory nature.

This 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).

Norway conducts a long-term monitoring survey of deep-water species on the shelf-break and upper slope off Norway and Spitsbergen (between 68 and 80° N in ICES subareas 1 and 2), since the mid-1990s. An analysis of the fisheries-independent time series (1997–2020) suggests that roughhead grenadier is widely distributed between 500-800 m deep. Trends in abundance is more variable, showing a decline in the northern areas, but such trend was not detected towards the southern parts of the Norwegian shelf-edge, suggesting that distribution extends southwards beyond the sampling area (Bergstad *et al.*, 2021). Biomass indices varied without trends in the survey period. A considerable temporal variation in recruitment is reported by Bergstad *et al.* (2021), which can be linked to the seasonal variability in food supply (Priede, 2017).

Greenland's annual bottom trawl survey is the main source for fishery-independent data for roundnose grenadier in Subarea 14 (Greenland waters).

Greenland carried out a bottom buffered bottom trawl fishery-independent survey from 1998 to 2017 (no survey in 2001) on board R/V Paamiut using an Alfredo III bottom trawl. The survey was resumed in 2022, starting a new index survey series, after interruption since 2017, covering areas within the Greenland waters of subarea 14.b.2 (Greenland waters). The survey in 2022 has a new fix station allocation design. The survey is depth stratified and covers the slope and shelf (400-1500 m) between the 3 nm line (baseline) and the 200 nm (Exclusive Economic Zone) or middle line to Iceland. A new research vessel, RV Tarajoq and a new trawl gear, Bacalao 476, with a mesh size of 136 mm and a 30-mm mesh-liner in the cod-end were used. Towing speed is between 2.5-3.0 knots and is estimated from the start and end positions of the haul, with a 30-min bottom time (tows of at least 15 min are accepted). Detailed information is provided in the Working Document available to WGDEEP (Nogueira and Christiansen, 2023; WD06).

13.10.2 CPUE

No new data was available to ICES WGDEEP in 2024. The data available to WGDEEP only allow an estimation of non-standardised CPUE for the Spanish fleet operating in subareas 6, 12 and 14 for the period 1996–2015.

13.11 Data analyses

No new data was available to ICES WGDEEP in 2024.

Length distributions from ICES Subarea 14.b.2 show that from 1998 to 2016 a single mode around 19 cm (total length) dominated the survey and from 2010 to 2016 a second and smaller mode around 29 cm (total length) is also evident (Fig. 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 13.10). Survey biomass index appears stable from 2008 until 2016. The value estimated for 2022 is the highest since the beginning of the time-series, but changes in survey design and effects of gear selectivity in observed changes in length distributions cannot be excluded (Fig. 13.2; Nogueira and Christiansen, 2023; WD06).

13.12 Benchmark assessments

There has been no benchmark for this stock.

13.13 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 certainty of these catches. 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.

Available biological data (length or age composition, weight-at-age, maturity, mortality) does not allow to assess changes in stock status.

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. Available literature suggests a significant gene flow of the roughhead grenadier *Macrourus berglax* across the North Atlantic (Coscia *et al*., 2018), in contrast to the depth-dependent genetic structure found in *Coryphaenoides rupestris* (Gaither *et al*., 2018).

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; González-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).

Whilst roughhead grenadier continue to occur as a bycatch in other fisheries, the proportions reported remain relatively low. There is very limited data available for this species, and some of the reported landings data are considered to be species misreporting. Thus, no expansion of current fisheries should be permitted until adequate data are collected from the exploited population to identify stock structure and conduct an appropriate assessment.

Given the bathymetric distribution of roughhead grenadier in the Northeast Atlantic, the fishery for this species may be affected by the recent EU regulation for the protection of Vulnerable Marine Ecosystems (Regulation (EU) 2022/1614), and specific depth-related regulations on the use of certain gears (Regulation (EU) 2016/2336 and Regulation (EU) 2019/1241).

WGDEEP is aware of Norwegian regulations for fisheries in Norwegian EEZ, and in Jan Mayer and Svalbard (ICES Subarea 2), that define seabed deeper than 1000 m as vulnerable and ban the deployment of bottom-contact gears.

13.14 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

Year	Germany	Norway	Russia	France	Spain	TOTAL
2000		35	13	<0.5		48
2001		74	20	<0.5		94
2002		28	1	<0.5		29
2003		47	30			77
2004		78	1			79
2005		64	13	<0.5		77
2006		74	4	<0.5		78
2007		44	5			49
2008		49	6			55
2009		51	2			53
2010		39	6			45
2011		29				29
2012		54				54
2013		34	1	1		36
2014						
2015	0	26	17	0	+	43
2016		38	62			100
2017	0	41	9	+	0	50
2018[1]	0	89	0	+	0	89
2019[1]	0	141	1	< 0.5	0	142
2020[1]	0	148	5	< 0.5	0	153
2021[1]	0	121		0.1	0	121
2022[1]	0	186	*	0	0	186
2023[1]	0	176	*	0	0	176

[1]**–preliminary statistics. *** information not available.

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

Year	France	Ireland	Norway	UK (Scot.)	TOTAL
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				< 0.5
2007					0
2008					0
2009					0
2010				< 0.5	< 0.5
2011	2				2
2012	1			< 0.5	1
2013	1				1
2014					0
2015	+	0	+	0	+
2016	< 0.5		< 0.5		< 1
2017	< 0.5		< 0.5		< 1
2018[1]	< 0.5	0	< 0.5	0	< 0.5
2019[1]	< 0.5	0	0	0	< 0.5
2020[1]	< 0.5	0	0	0	< 0.5
2021[1]	0.1	0	0	0	0.1

Year	France	Ireland	Norway	UK (Scot.)	TOTAL
2022[1]	< 0.1	0	< 0.1	0	< 0.1
2023[1]	< 0.1	0	< 0.1	< 0.1	< 0.1

[1]–preliminary statistics.

Table 13.3. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in 5.a.

Year	Iceland	Norway	France	Germany	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
2016	20				20
2017	40[1]				40[1]
2018[2]	20	< 0.5			20

Year	Iceland	Norway	France	Germany	TOTAL
2019[2]	28				28
2020[2]	44				44
2021[2]	31	25			56
2022[2]	74	0	3		77
2023[2]	132			1	133

[1]–revised catch data. [2]–preliminary statistics

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					0
2010		1			1
2011					0
2012	2		1		3
2013	2				2
2014	< 0.5				0
2015	1	+	0	0	1
2016					0
2017	< 0.5	< 0.5			0.5

Year	France	Norway	UK (Scot.)	Russia	TOTAL
2019[1]	< 0.5	< 0.5	0	0	< 1
2020[1]	< 0.5	0	0	0	< 0.5
2021[1]	0.4	0.5	0	0	0.9
2022[1]	< 0.5	< 0.1	0	*	< 0.5
2018[1]	1	4	0	0	5

[1]–preliminary statistics. * information not available.

Table 13.5. Official landings (t) roughhead grenadier (*Macrourus berglax*) in Subareas 6 and 7.

Year	UK (E+W)	France	Norway	UK (Scot.)	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

Year	UK (E+W)	France	Norway	UK (Scot.)	Spain	Ireland	Russia	Lithuania	TOTAL
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
2017		3	1		1	< 0.5			5
2018[1]	0	7	0	7	0	0	0	0	14
2019[1]	0	4	2	< 0.5	0	0	0	0	6
2020[1]	0	3	0	< 0.5	0	0	0	0	3
2021[1]		4		2					6
2022[1]	0	2	0	1	0	0	*	0	3
2023[1]	0	2	0	1	0	0	*	0	3

[1]–preliminary statistics. * information not available.

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

Country	Norway	France	Spain	Russia	Lithuania	TOTAL
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[1]	0	0	0	0	0	0
2019[1]			0			0
2020[1]			0			0
2021[1]	0	0	0	0	0	0
2022[1]	0	0	0	*	0	0
2023[1]	< 0.5	0	0	*	0	< 0.5

[1]—preliminary statistics. * information not available.

Table 13.7. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subarea 14.

Country	Greenland	Norway	Russia	Spain	UK (E+W)	Germany	TOTAL
1993	18	34					52
1994	5						5
1995	2						2
1996							0
1997							0
1998		6					6
1999		14					14
2000							0
2001		26					26
2002		49	4				53
2003		33					33

Country	Greenland	Norway	Russia	Spain	UK (E+W)	Germany	TOTAL
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	88[1]	17				198[1]
2018[2]	89	97	16	0	0		202
2019[2]	1	76	5	0			82
2020[2]	18	19	0	0	0	9	46
2021[1]	45	101	0	0	0	0	146
2022[2]	0	187	0	0	0	15	202
2023[2]	0	144	*	0	0	13	157

[1]–revised catch data. [2]–preliminary statistics. * information not available.

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

Year	6.b	12.a	12.b	14.b
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. Roughhead grenadier in the Northeast Atlantic. Landings inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES. Landings in tonnes.

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total landings	Proportion inside the NEAFC RA (%)
2016	4	373	377	1
2017	0	294	294	0
2018	0	330	330	0
2019	0	259	259	0
2020[1]	0	247	247	0
2021[1]	0	330	330	0
2022[1]	0	468	468	0
2023[1]	0	476	476	0

[1]—preliminary statistics.

Table 13.10. 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/km²**	**Biomass**	**SE**	**Mean/km²**	**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

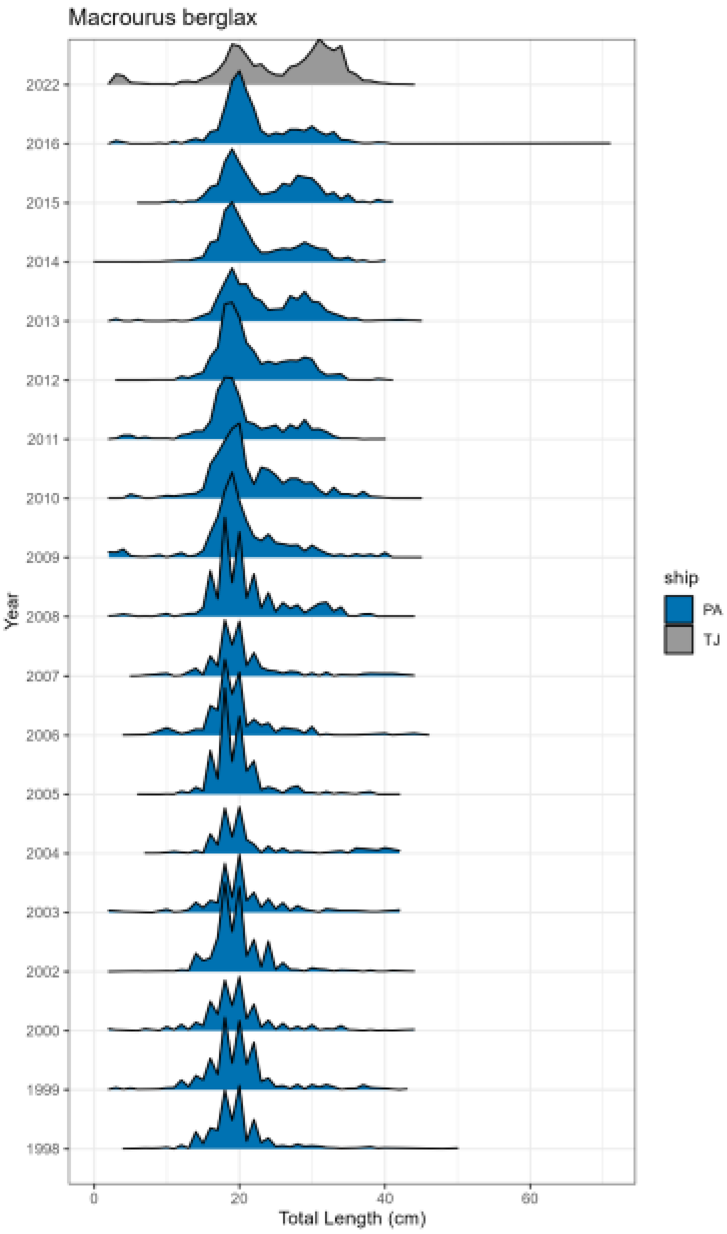

Figure. 13.1. Length frequency distribution of roughhead grenadier sampled in ICES subarea14.b.2, onboard the R/V Paamiut (PA) between 1998-2016, and onboard R/V Tarajoq (TJ) in 2022. No survey was carried out in 2001, and between 2017-2021 (Nogueira and Christiansen, 2023; WD06).

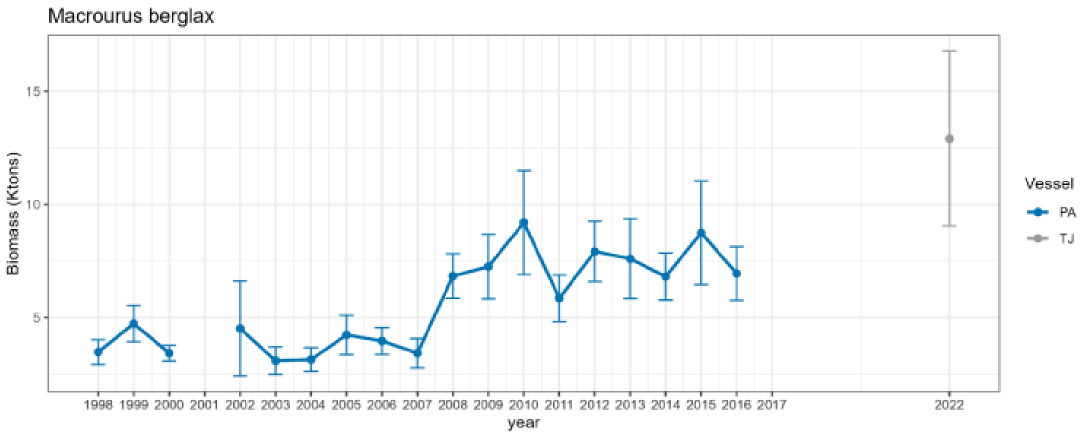

Figure 13.2. Roughhead grenadier (RNG) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2019 on board R/V Paamiut (PA) and on board R/V Tarajoq (TJ) in 2022 (Nogueira and Christiansen, 2023; WD06).

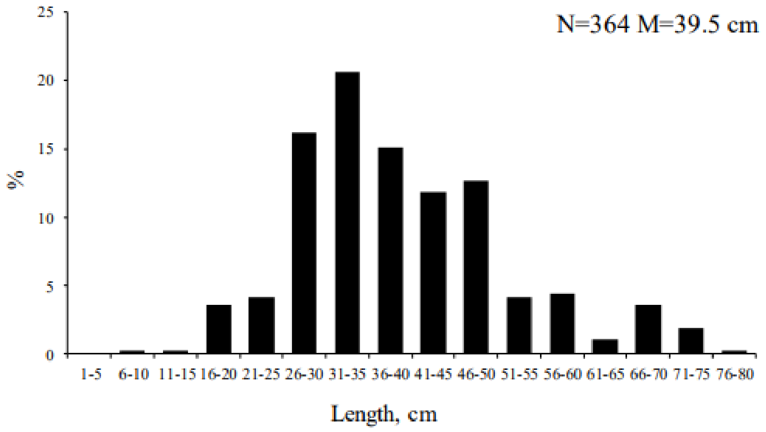

Figure 13.3. Length composition of roughhead grenadier in the Norwegian Sea (subareas 2a and 2b) in 2019 (Aleksandrovand Khlivnoi, 2020; WD23 WGDEEP 2020).

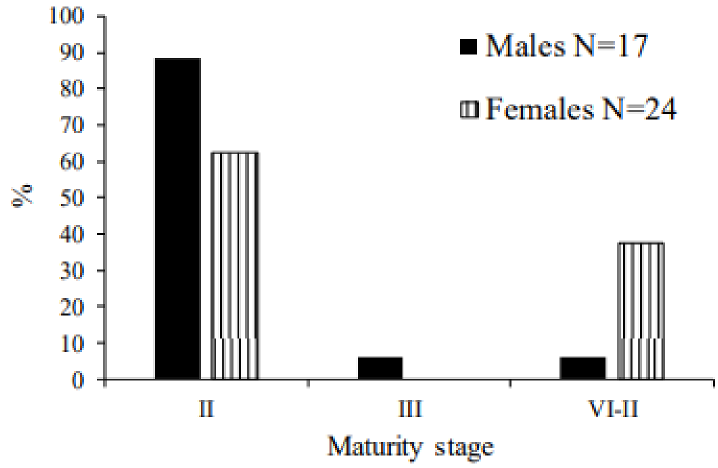

Figure. 13.4. Maturity of roughhead grenadier in the Norwegian Sea (subareas 2a and 2b) in November-December 2019 (Aleksandrovand Khlivnoi, 2020; WD23 WGDEEP 2020).

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Contents

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 common names of these species changed over time. The similarity of the English names (roughsnout grenadier and roughnose grenadier) can increase 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, 1985). In recent years, *Trachyrincus murrayi* was caught by the Marine Scotland deep-water research surveys in sufficient numbers to allow the estimation of population indicators (Neat and Burns, 2010).

In the published literature, there is no report of 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 Subdivision 14.b.2) only *Trachyrincus murrayi* is caught in scientific surveys.

T. scabrus has been reported in the Porcupine Seabight (ICES divisions 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 sizes 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 the most a minor bycatch. The occurrence of the species is 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* before 2016 needs to be confirmed. WGDEEP considered that the reporting of 0 landings in response to the data call for landings and discards from 2016 to 2023, confirms that landings reported before 2016 were misreporting, 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 2006–2017 (downloaded from the ICES website on 24.04.2020). No landings have been reported neither in preliminary catch statistics nor InterCatch from 2014 to 2024. So, there is currently no catches in NEAFC Regulatory Area.

14.3 ICES Advice

The ICES advice for the years 2021–2025 is that "*when the precautionary approach is applied, there should be no directed fisheries for roughsnout grenadier and bycatch should be minimized for each of the years 2021 to 2025*."

The previous advice, for the years 2016–2020 further added " *and bycatch should be counted against the TAC for roundnose grenadier to minimize the potential for 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 and 2019-2020 made no mention of the roughsnout grenadier since. There is no regulation for this species in other countries (Norway, Iceland, Faroe Islands, UK) where these species should be landed when caught.

The EU regulation 2016/2336 establishing specific conditions for fishing for deep-sea stocks, does not mention *Trachyrincus* species.

14.5 Data availability

14.5.1 Landings and discards

No new information. See 2022 report (ICES, 2022).

14.6 Length compositions

No new information. See 2022 report (ICES, 2022).

14.6.1 Age compositions and longevity

No new information. See 2022 report (ICES, 2022).

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

No new information. See 2022 report (ICES, 2022).

14.7 Data analyses

No new information. See 2022 report (ICES, 2022).

14.7.1 Biological reference points

Not applicable.

14.8 Comments on assessment

Not applicable.

14.9 Management considerations

No new information. See 2022 report (ICES, 2022).

14.10 References

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14.11 Tables

Table 14.1a. Official landings of roughsnout grenadier by ICES Division reported by Spain in 2012-2014.

Year	6.b	12.a	12.b	14.b	Total
2012		54		3	57
2013					0
2014	42	4	155	448	649

Table 14.1b. Official landings of roughsnout grenadier by ICES Subarea reported by Lithuania in 2006-2008.

Year	6	12	Total
2006	506	67	573
2007	442	101	543
2008	49	50	99

Contents

15 Atlantic wolffish (*Anarcichas lupus*) in Division 5.a (Icelandic grounds)

15.1 Atlantic wolffish in 5a

15.1.1 Fishery

The main fishing grounds for Atlantic wolffish are in the west and northwest part of the Icelandic shelf. From 2010, the proportion of the catch has been increasing in northwest of Iceland compared to west of Iceland. Catches at the main spawning ground (Látragrunn) west of Iceland have been decreasing since 2008 (Figures 15.1.1 and Figure 15.1.2). About 80% of the catch of Atlantic wolffish is caught at depths less than 120 m. Proportion of the catch taken at depth range 0-60 m decreased from 2003 to 2007, but since then it has been increasing. At the depth range 61-120 m the proportion of the catch has been rather stable since 2000. At depths from 121 to 180 m, which includes the main spawning ground (Látragrunn), the proportion of the catch increased in 2003-2008 but since then it has been decreasing (Figure 15.1.3).

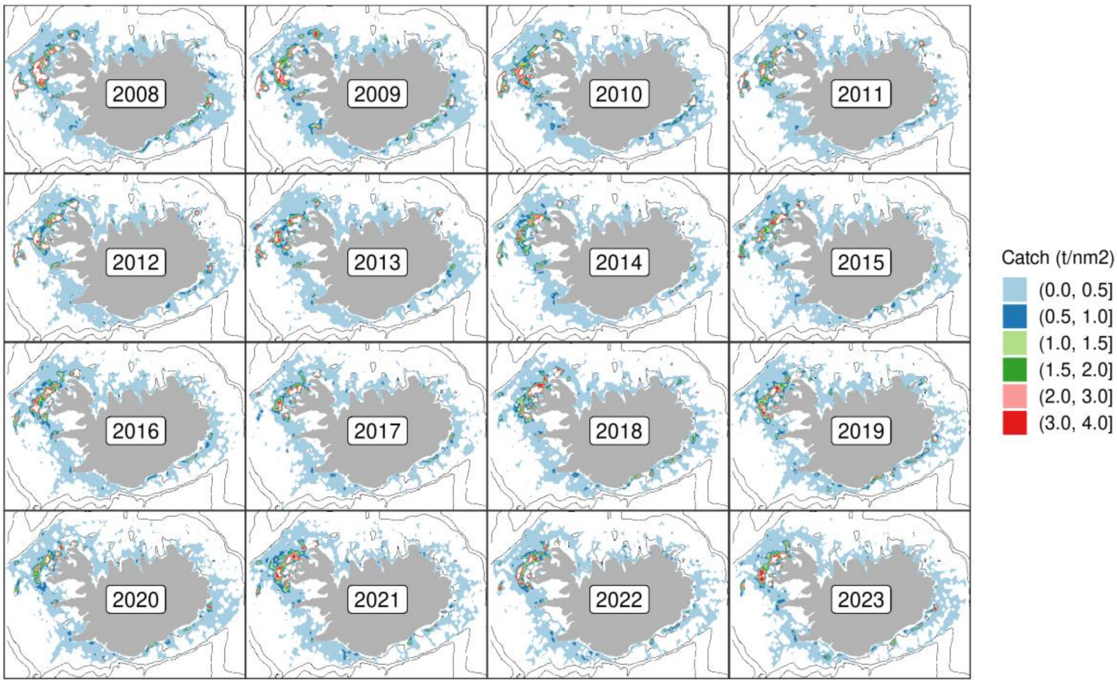

Figure 15.1.1 Atlantic wolffish in 5.a. Geographical distribution of the Icelandic fishery for the past 16 years as reported in logbooks. All gear types combined.

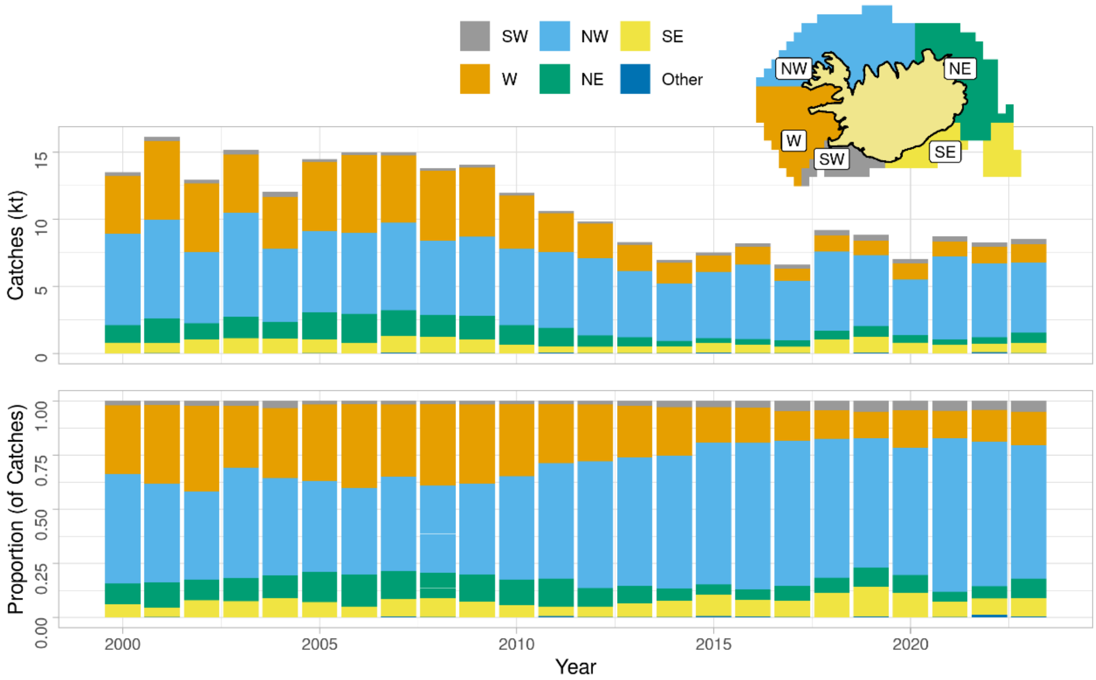

Figure 15.1.2: Atlantic wolffish in 5a. Spatial distribution of the Icelandic fishery by fishing area since 2000 according to logbooks. All gears combined.

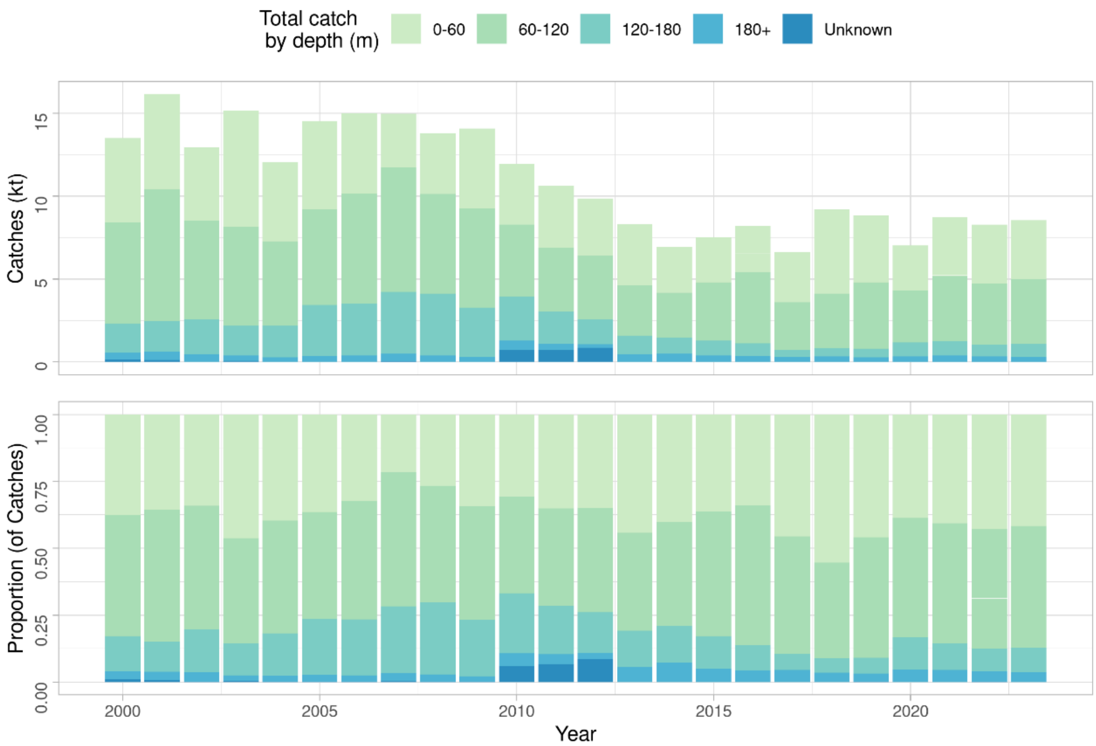

Figure 15.1.3. Atlantic wolffish in 5.a. Depth distribution of demersal trawl, longline and demersal seine catches since 2000 according to logbooks.

15.1.2 Landings trend

More than 97% of the Atlantic wolffish catch is taken by longliners (40-65%), demersal trawlers (20-30%) and demersal seiners (10-20%) (Figure 15.1.4). These proportions have been relatively stable through the years. However, in 2004-2008 longline and demersal trawl catches were similar (40-50%) and in the last three years catches by demersal seiners have been increasing and were greater than in demersal trawlers in 2018 and 2019 (Figure 15.1.4). Since 2001, the number of longliners and trawlers reporting Atlantic wolffish catches of 10 tonnes/year or more has decreased. In the longline fleet, the number of vessels has dropped to roughly a fourth of what it was in 2001. The number of trawlers has also decreased by ~1/3 during the same period (Table 15.1.1).

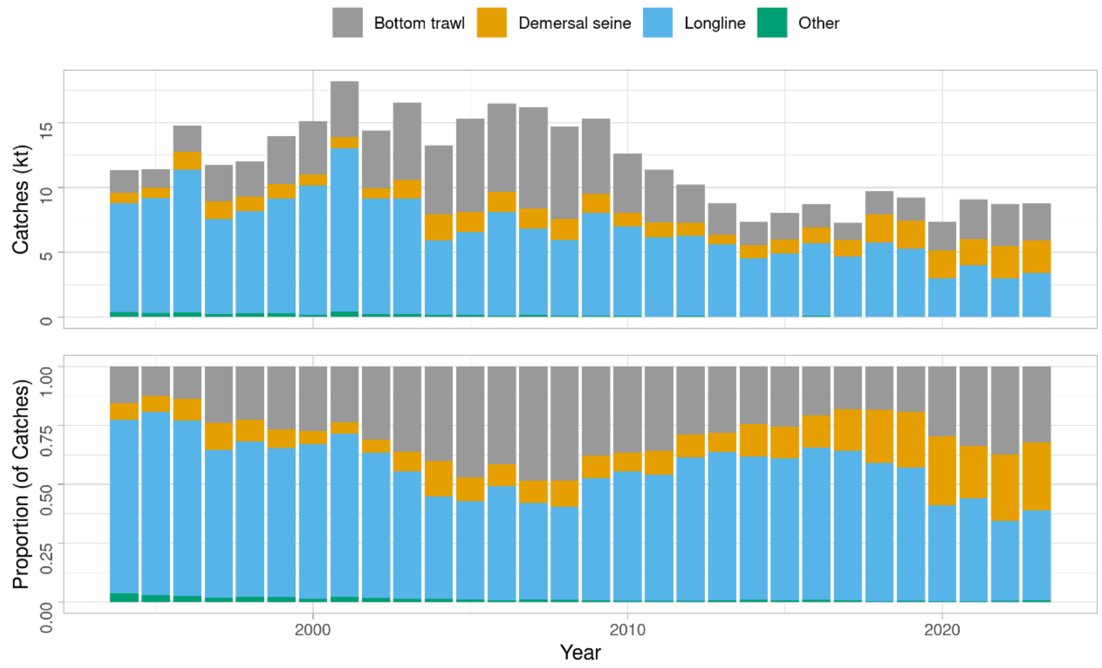

Figure 15.1.4. Atlantic wolffish in 5.a. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

In 1994 and 1995, almost 500 vessels accounted for 95% of the annual catch of Atlantic wolffish in Icelandic waters, but this number had dropped to 200 vessels in 2008 despite higher catches. Since 2010 the number of vessels accounting for 95% of the annual catch are 100 (Figure 15.1.5).

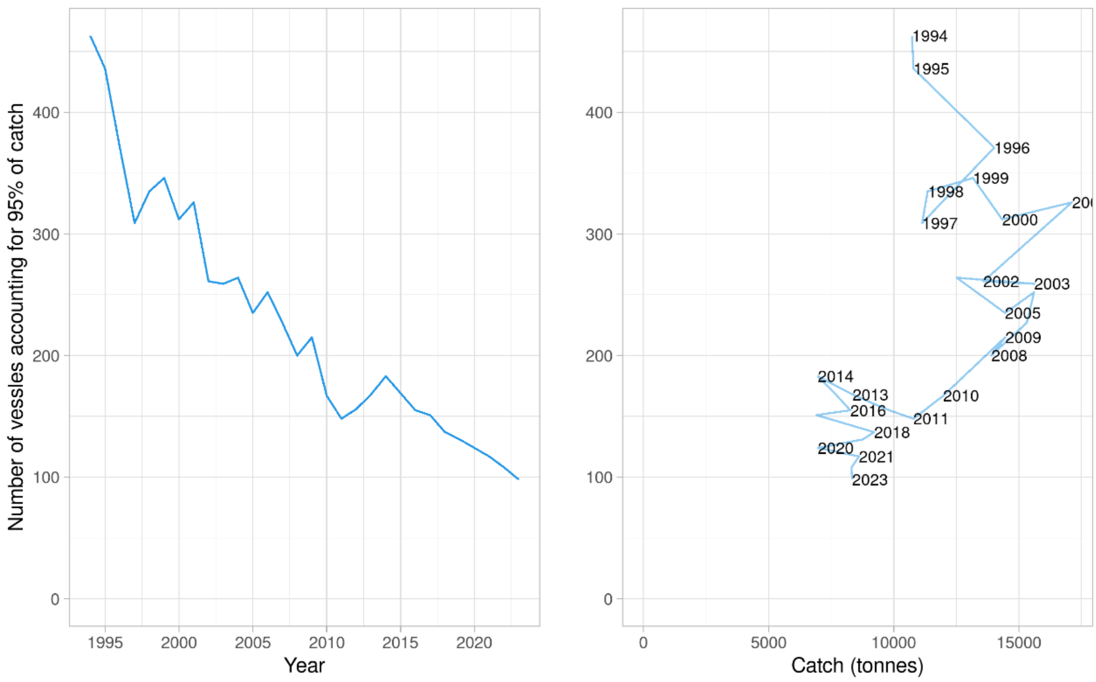

Figure 15.1.5. Atlantic wolffish in 5.a. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

15.1.3 Data available

The commercial catch samples taken are normally representative of the landings with the greatest number of samples taken in areas of high catch intensity (Figure 15.1.7).

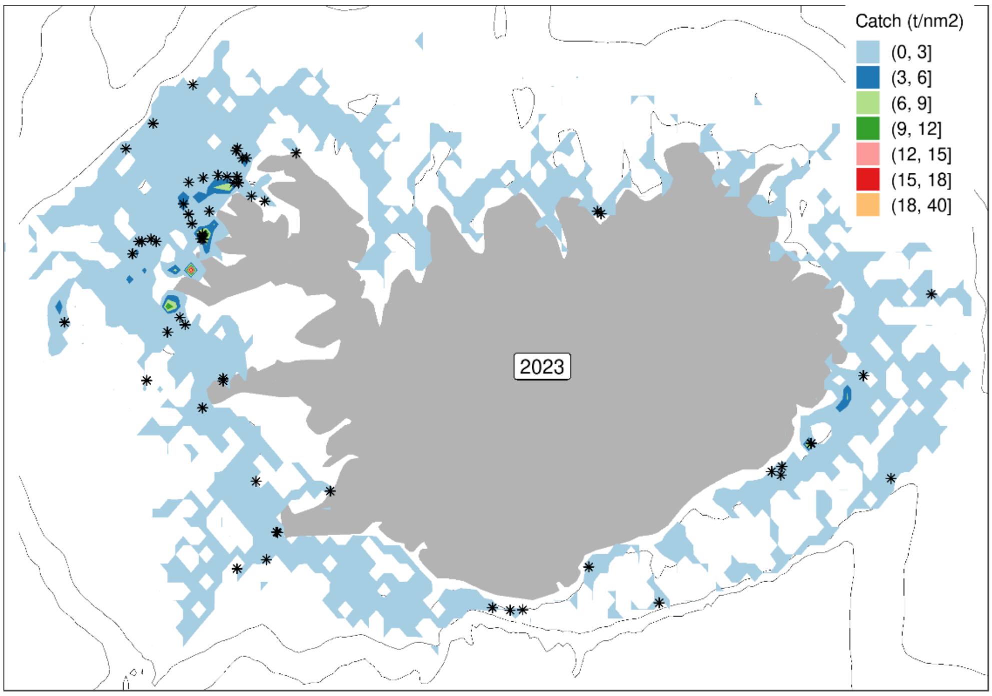

Figure 15.1.7. Atlantic wolffish in 5.a. Fishing grounds in 2023 as reported in logbooks and positions of samples taken from landings (asterisks).

15.1.3.1 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. 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.

15.1.3.2 Length composition

The length distribution of landed Atlantic wolffish has been relatively stable since 2004 (Figure 15.7.8). The average length in the commercial catch increased from about 63 cm in 1998 to about 70 cm in 2011 where from it has been similar.

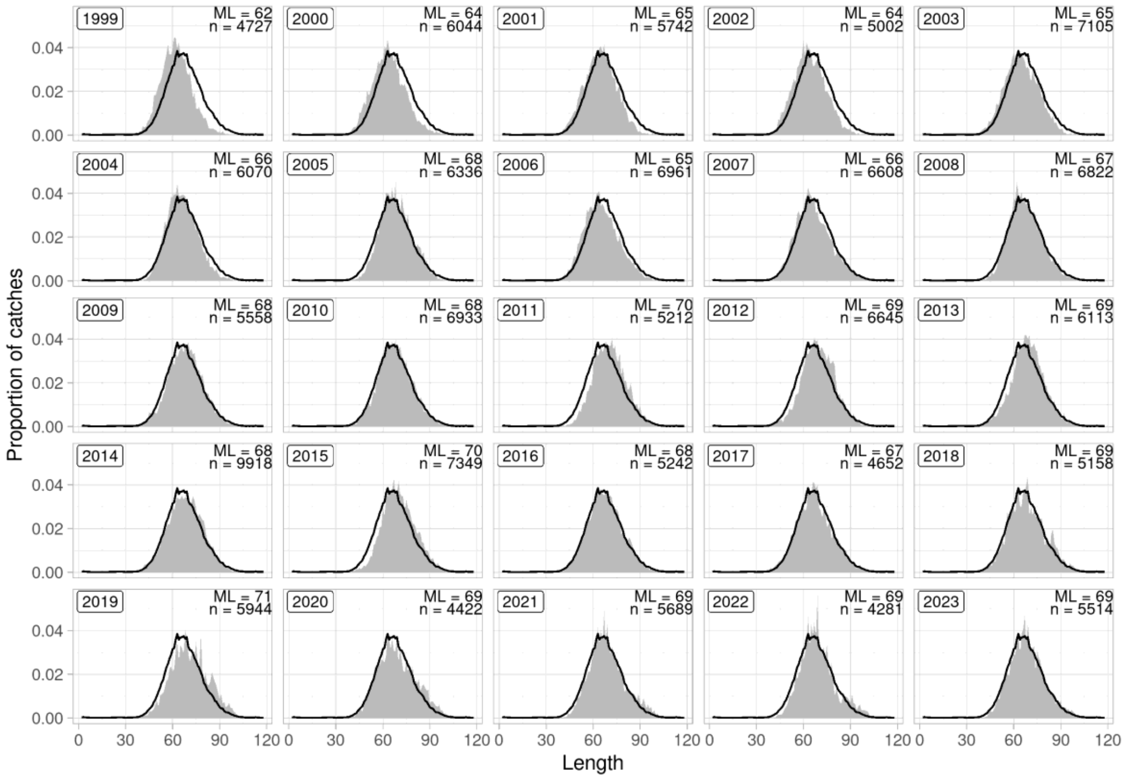

Figure 15.7.8. Atlantic wolffish in 5.a. Length distribution of fish sampled from landed catch. The black line represents the mean length distribution for the period.

Since 2004, the length frequency distribution in the spring survey has been bimodal because of a relatively greater decrease in number of fish at 40–60 cm (Figure 15.7.9). The mean length of Atlantic wolffish has been about 39 cm on average. It was, however, lowest in 1994-2004, about 37 cm, but in these years the recruitment index was high. Due to decreasing recruitment beginning 2004 (Figure 15.7.9), the mean length increased and was on average about 42 cm in 2007-2024 (Figure 15.7.9). Mean length in the autumn survey oscillated from 34-43 cm in 1996-2023, with no clear trend (Figure 15.7.10).

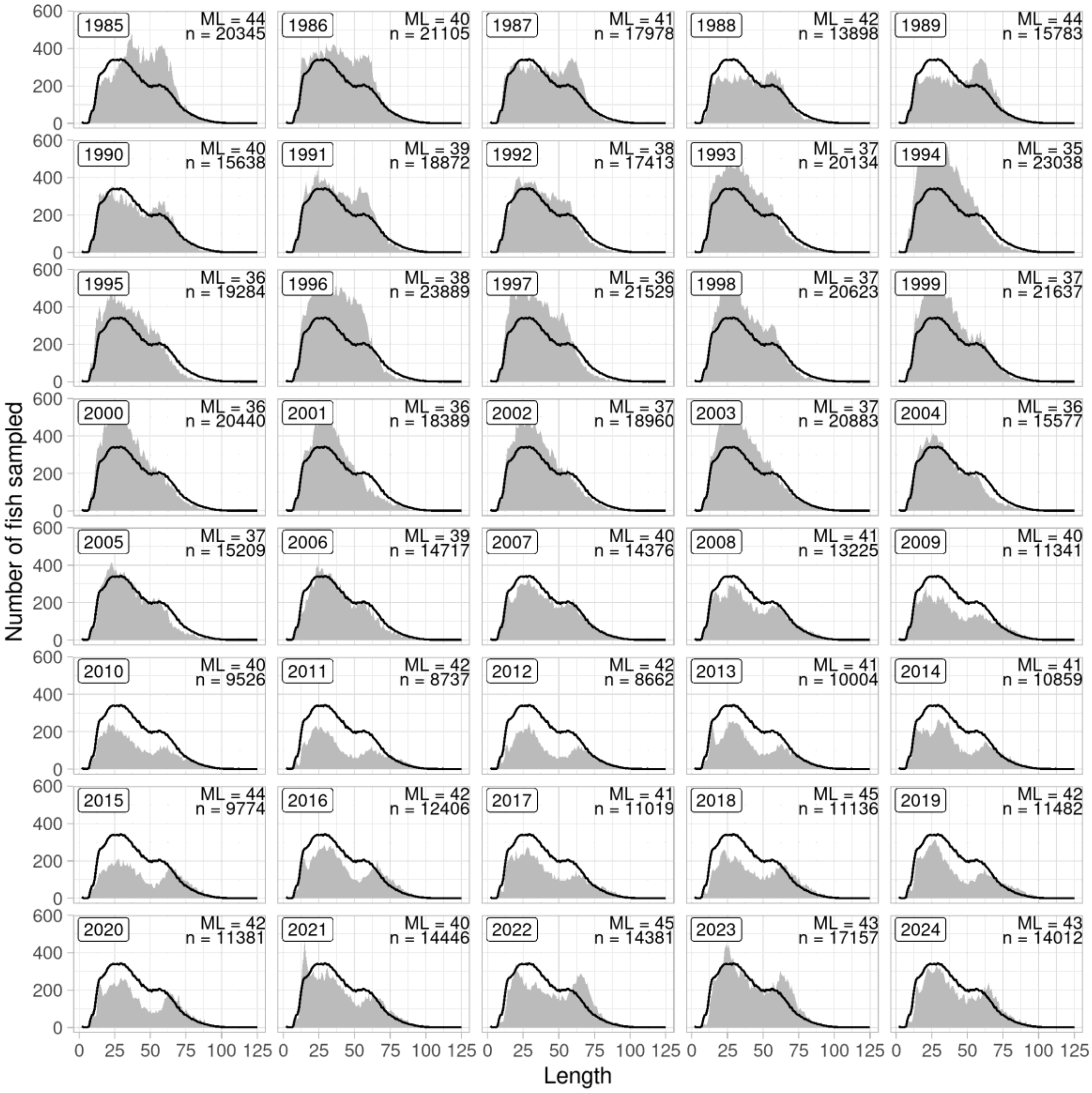

Figure 15.7.9. Atlantic wolffish in 5.a. Length distribution from the spring survey. The black line shows the mean for all years.

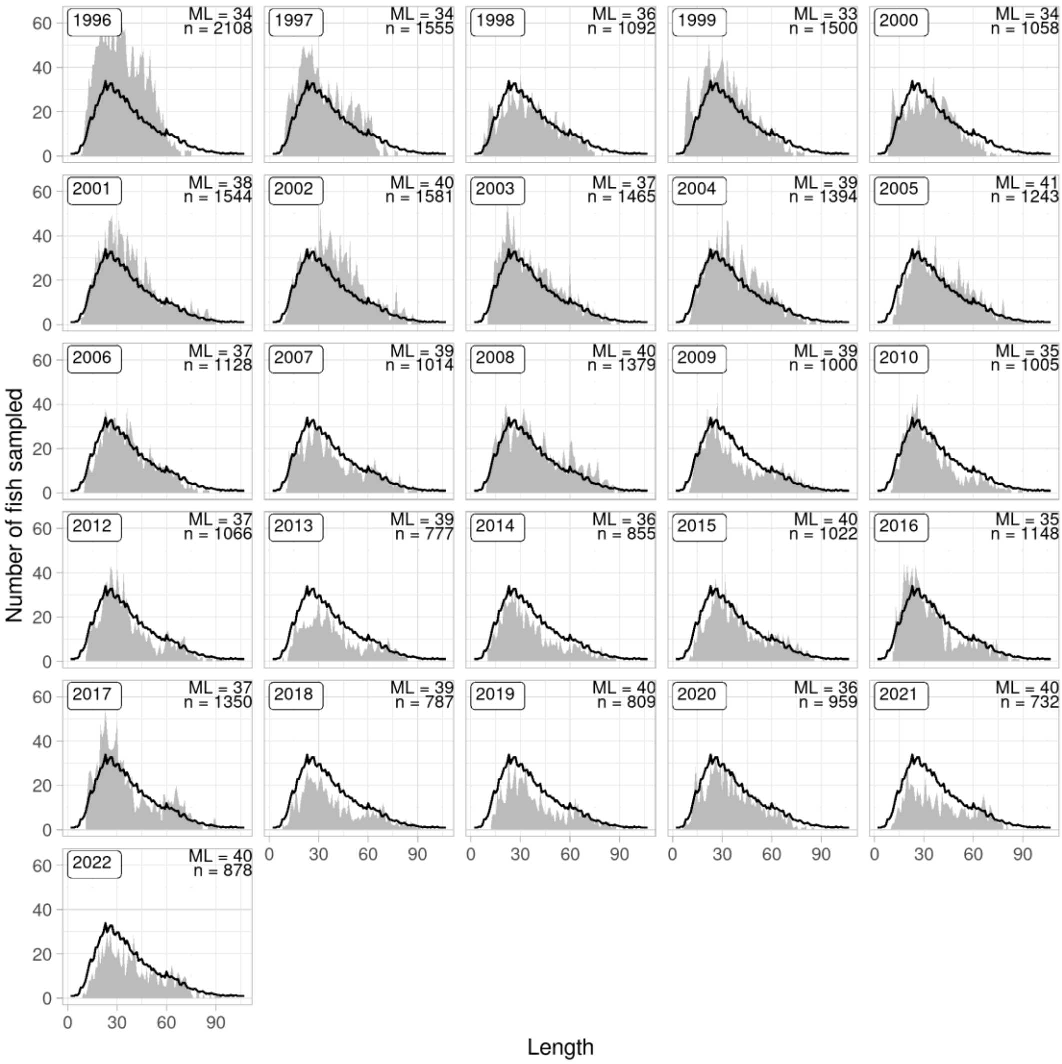

Figure 15.7.10. Atlantic wolffish in 5.a. Length distribution from the autumn survey. The black line shows the mean for all years.

15.1.3.3 Age composition

Age composition data are available from surveys. Commercial age data are available from earlier periods (1978). In samples from commercial landings, the mean age of Atlantic wolffish was around 10.7 years in 1999. Since then, mean age in samples from commercial catches has generally been increasing to around 12 years in recent years.

15.1.3.4 Weight-at-age

Weight-at-age data in Icelandic waters are available from 1996.

15.1.3.5 Maturity and natural mortality

Females have the most reliable maturity designations; a maturation scale for males is unavailable. Therefore, maturity analysis is based on females caught during the autumn survey and in commercial catches from June – December. From these data, maturation occurs close to 60 cm and around age 10 but is highly variable and difficult to measure. No information is available on natural mortality. For assessment and advisory purposes, the natural mortality is set to 0.15 for all age groups.

15.1.3.6 Catch, effort and survey data

CPUE estimates of Atlantic wolffish in Icelandic waters are not considered representative of stock abundance, as changes in fleet composition, technical improvements, and differences in gear setup among other things have not been accounted for when estimating CPUE. Effort of demersal trawl was defined as the number hours towed, and for longline number of hooks. Non-standardized estimates of CPUE in longline (kg/1000 hooks), and demersal trawl (kg/hour), are calculated as the total weight in a set or tow per effort measure. CPUE in longline vessels has oscillated between 50 and 90 kg/100 hooks apart from 2019 and 2023 when it was more than 100. CPUE of demersal trawl increased from about 150 to 300 kg/h in 2000-2005, decreased to 190 in 2009 and increased again to almost 180 in 2015. Since then it has decreased and is now around 170 kg/h (Figure 15.7.11).

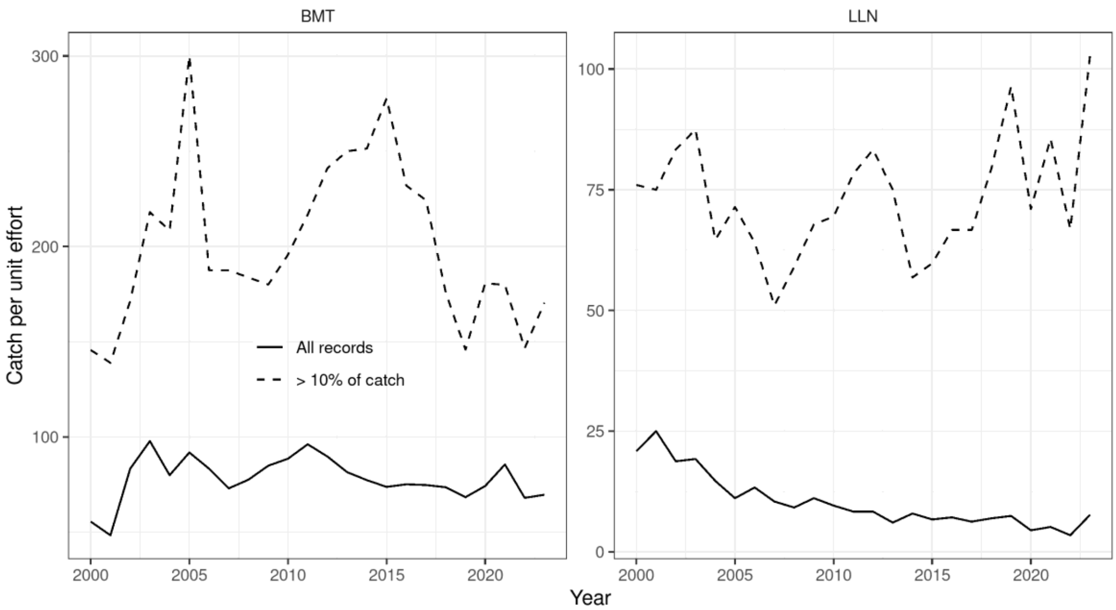

Figure 15.7.11. Atlantic wolffish in 5.a. Non-standardized estimates of CPUE from demersal trawl (kg/h, left) and long-line (kg/1000 hooks, right). Broken line shows cpue where more than 10% was wolffish.

Total biomass and harvestable biomass indices decreased from 1985-1995. In 1996, the biomass index increased to 1998, then decreased to a historical low level in 2010-2012, but has increased since approaching the highest value in 1985 (Figure 15.7.12). The harvestable biomass has generally been increasing from 1995 with considerable oscillations but is at it's highest in the past three years. The recruitment index was high in the years 1992-2003, since 1999 it has been decreasing, which coincides with increasing effort and catch of trawlers at the main spawning ground west of Iceland (Látragrunn) during the spawning and incubation time. The recruitment index reached a historical low level in 2011 and 2014, but since then it has gradually increased. This coincides with the enlarging of the area closure of the spawning/incubation area on Látragrunn from 500 km^2 (in 2002) to 1000 km^2 in October 2010.

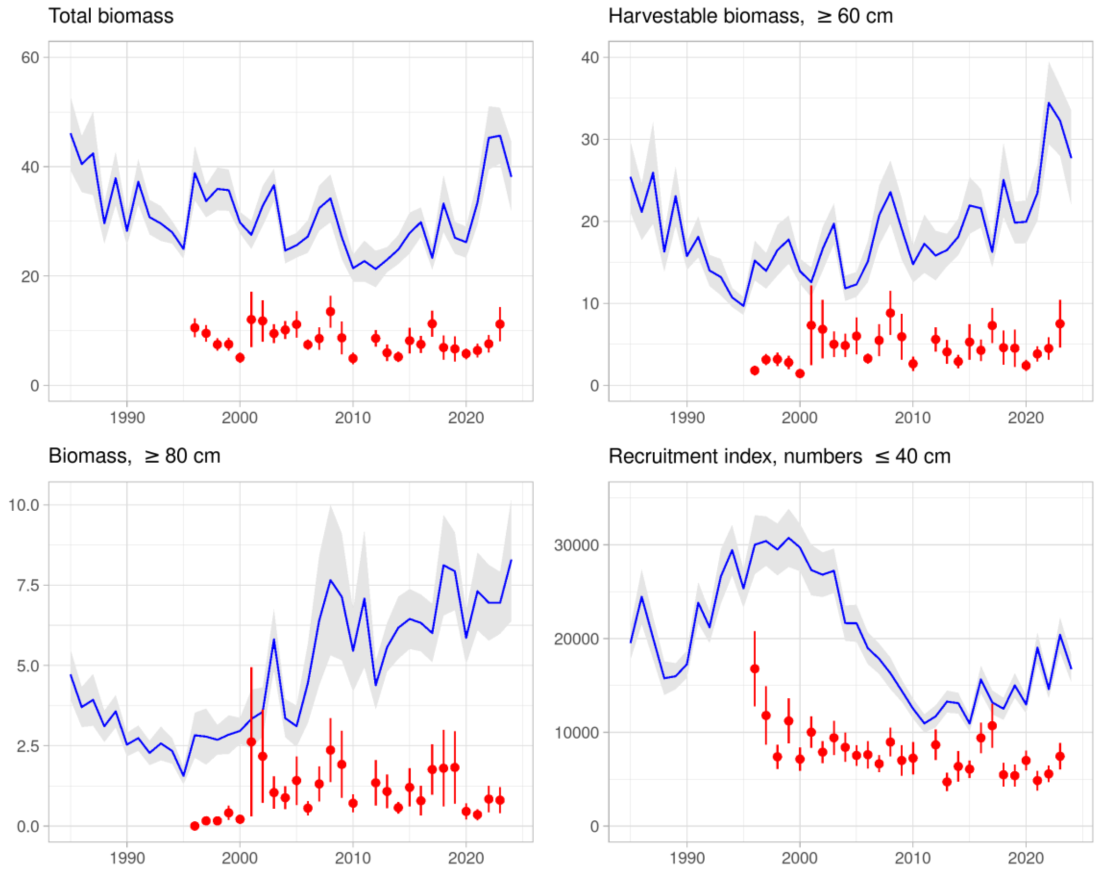

Figure 15.7.12. Atlantic wolffish. Total biomass indices (upper left) and harvestable biomass indices (≥60 cm, upper right), large fish biomass indices (≥80 cm, lower left) and juvenile abundance indices (≤40 cm, lower right), from the spring survey (blue) and the autumn survey (red), along with the standard deviation.

When the spring survey is conducted, Atlantic wolffish are on their feeding grounds which are commonly in relatively shallow waters. In the spring survey, the highest abundance has always been measured in the NW area (Figure 15.7.13).

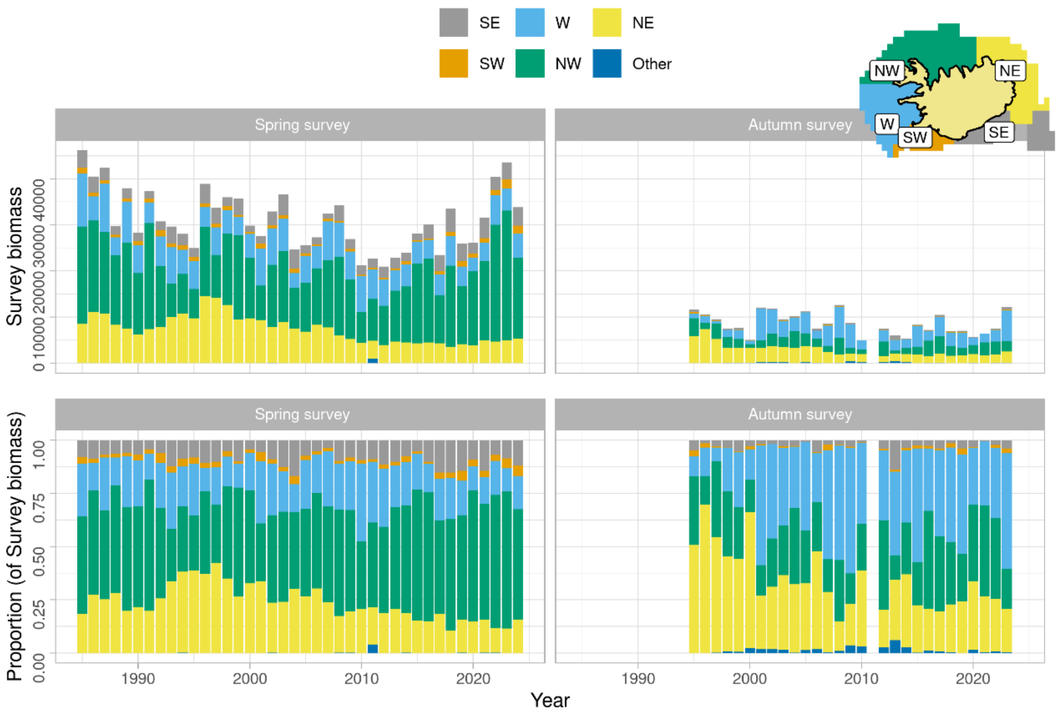

Figure 15.7.13. Atlantic wolffish in 5.a. Spatial distribution of biomass index from the spring and autumn survey.

15.1.4 Data analysis

15.1.4.1 Assessment on Atlantic wolffish in Icelandic waters using SAM

Atlantic wolffish in 5.a is new to ICES where it became a part of the ICES assessment process after an MoU between Iceland and ICES was signed on December 1st, 2019.

During the benchmark in April 2022, a SAM model (State-space stock assessment model) was agreed upon for use in the assessment.

15.1.4.2 Data used by the assessment and model settings

The new assessment model is a statistical catch at age model based on:

- commercial catch-at-age and landings data from 1979 onwards
- the Icelandic spring groundfish survey from 1985
- the autumn groundfish survey in Iceland from 2000. Recruitment at age 1 every year

The maximum age of the model is 16, which is considered a plus group. The assessment showed that SSB has been rather stable over the time period, while fishing mortality has gradually decreased, and recruitment has slightly decreased after 2001 but remained stable.

Natural mortality of 0.15 was chosen for all age groups. During the workshop, a wide range of estimates for natural mortality were tested and none showed a significant improvement in terms of model fit. It was therefore decided to use a M of 0.15.

15.1.4.3 Diagnostics

Fits to the catch-at-age data and survey numbers-at-age indices can be found in Figure 15.1.14). The fit to total catch and landings data can be found in figures 15.5.15) and 15.1.16). Catch and spring survey data are followed the closest by the model, whereas fits to the autumn survey series are slightly noisier but follow a similar pattern. Fits to landings data are quite variable, but more recent catch at age data show a better fit.

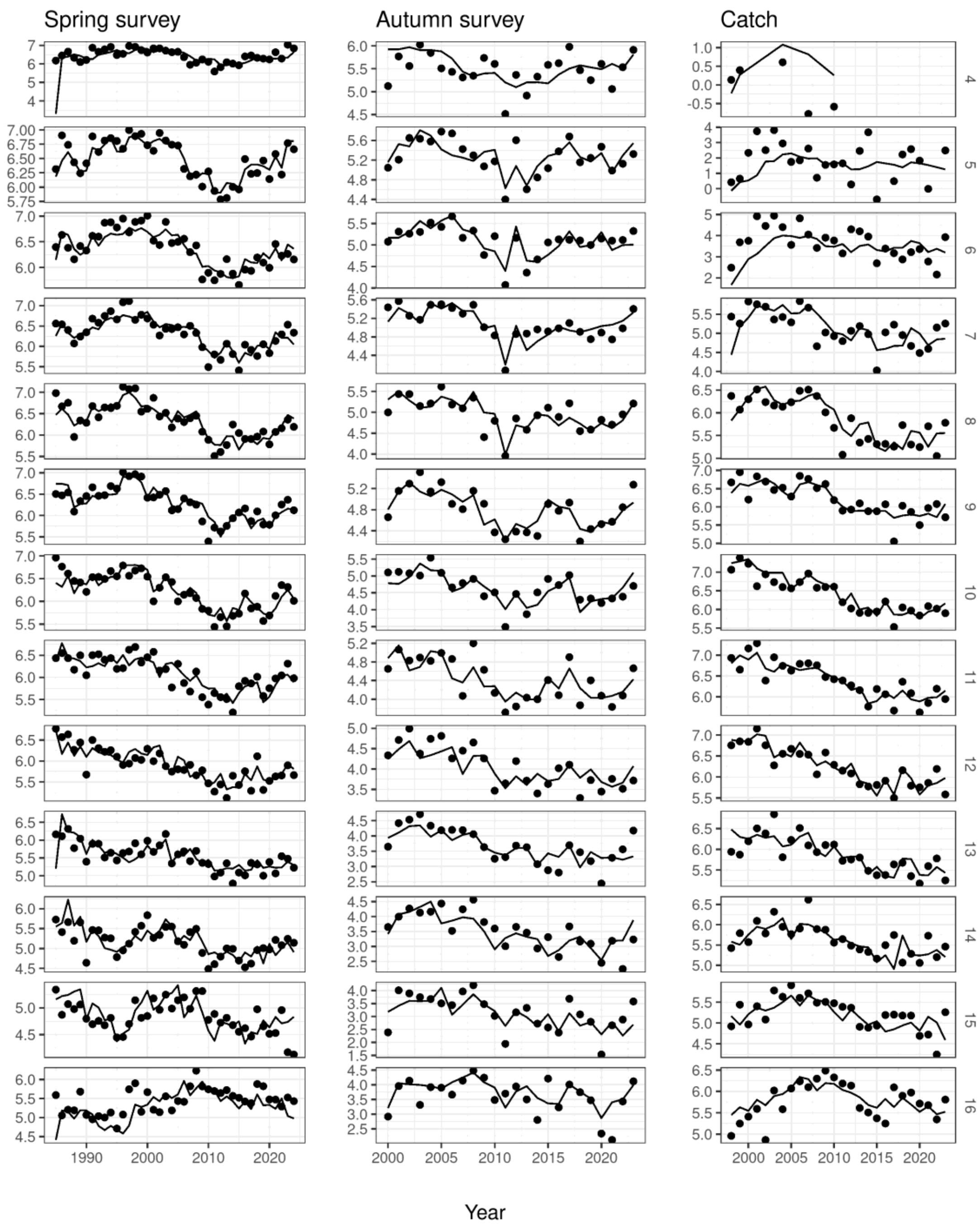

Figure 15.1.14 Atlantic wolffish in 5.a. Fit to the numbers at age input data to the proposed SAM model (columns left to right: spring survey, autumn survey, and catch.

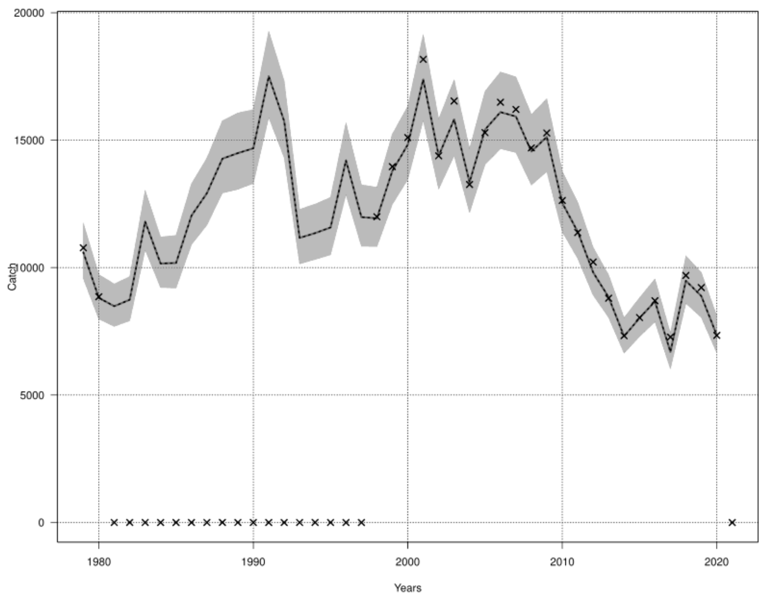

Figure 15.1.15. Atlantic wolffish in 5.a. Fit to the total catch in the proposed SAM model.

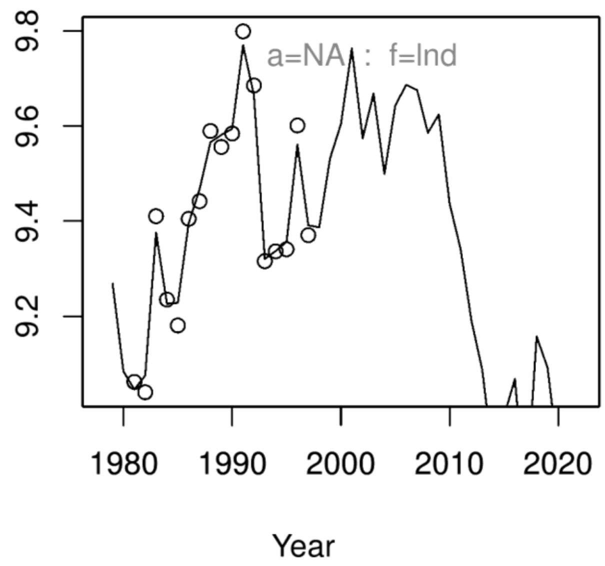

Figure 15.1.16. Atlantic wolffish in 5.a. Fit to the landings input data to the proposed SAM model.

15.1.5 Model results

Model results show that Atlantic wolffish total biomass levels decreased from high levels in 2000 – 2012 but have increased since then and are now at its highest level. Recruitment levels have also increased after being at the lowest level in 2011. Spawning stock biomass has also shown a steady increase since 1992 (Figure 15.1.18).

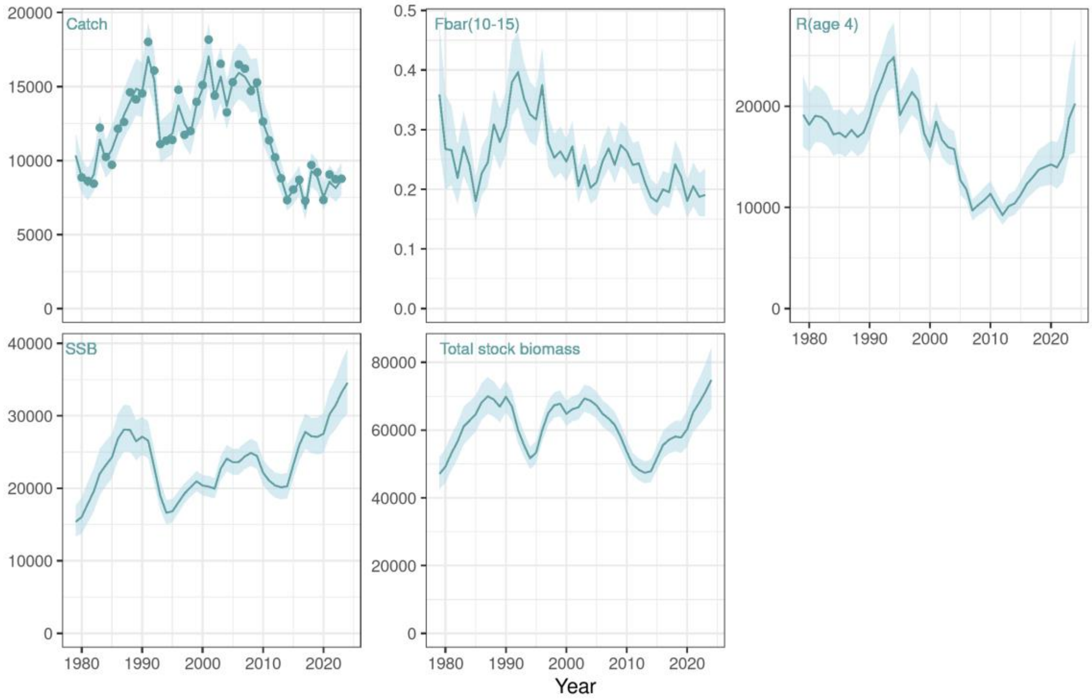

Figure 15.1.18. Atlantic wolffish in 5.a. Estimated biomass, spawning stock biomass (SSB), fishing mortality for fully selected fish and harvest rate, recruitment, total stock biomass and total catches.

3.4.10.1 Retrospective analysis

The results of an analytical retrospective analysis are presented. The analysis indicates relatively stable estimation, except in the earliest peel. Mohn's rho was estimated to be -0.0429 for SSB, 0.0534 for F, and 0.0694 for recruitment.

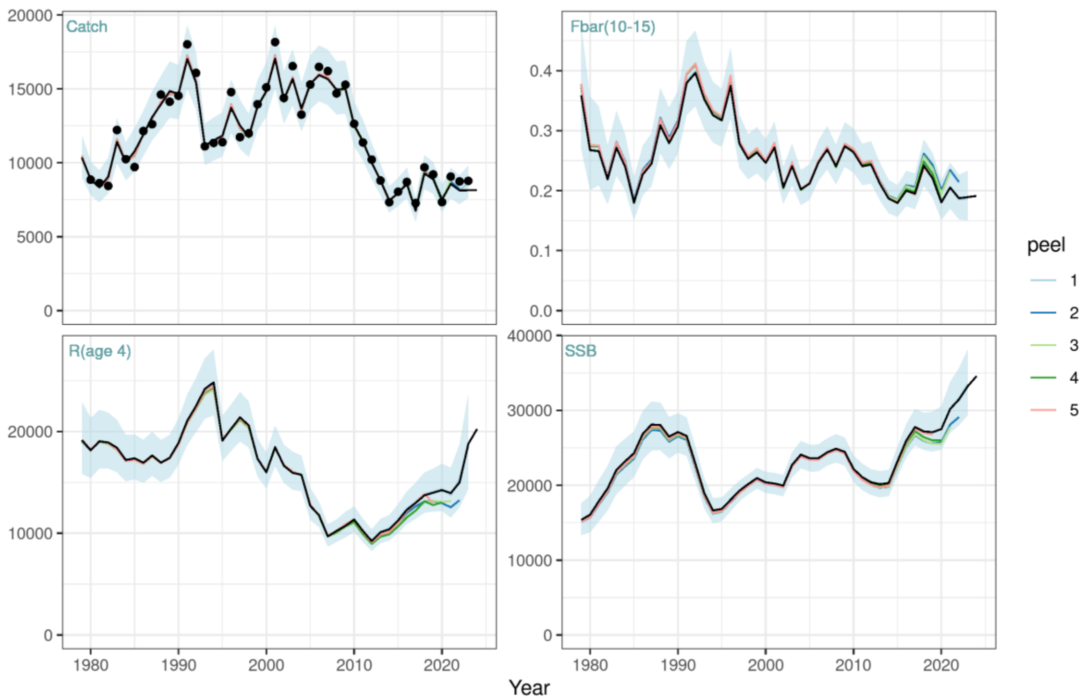

Figure 15.1.19. Atlantic wolffish in 5.a. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 4) are shown.

Neither observation nor process residuals show obvious trends (Figs. 3.4.15 and 3.4.16).

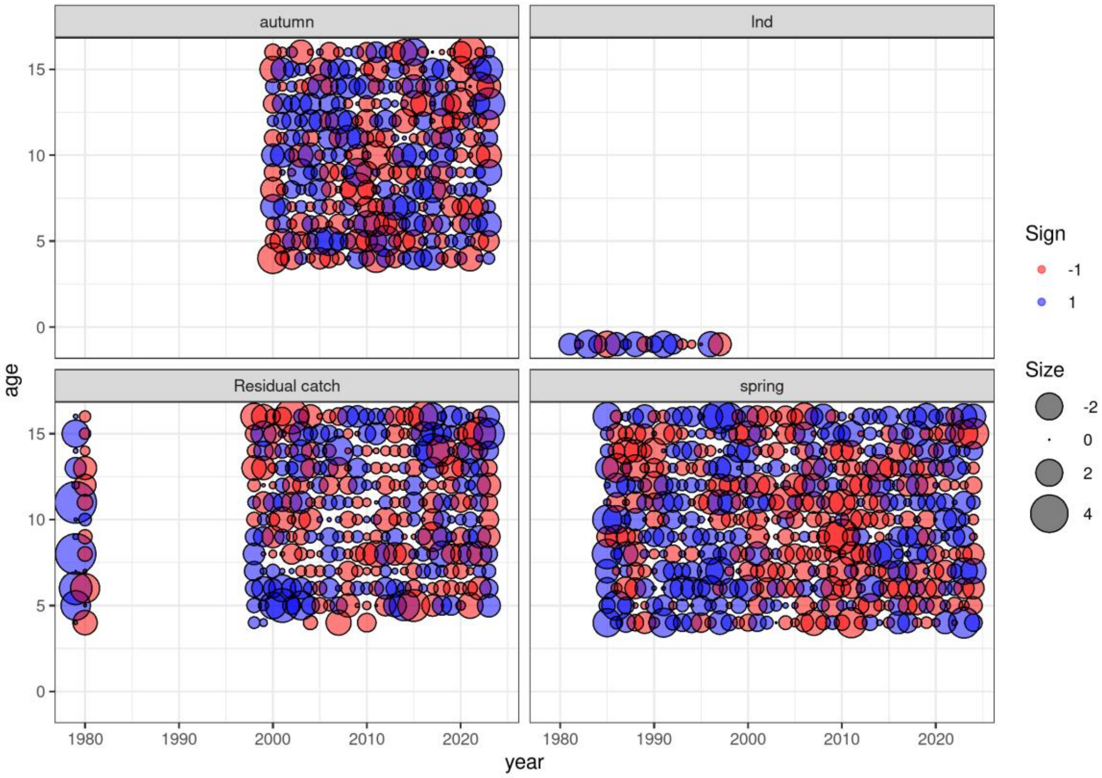

Figure 15.1.20. Atlantic wolffish in 5.a. Observation error residuals of the SAM model.

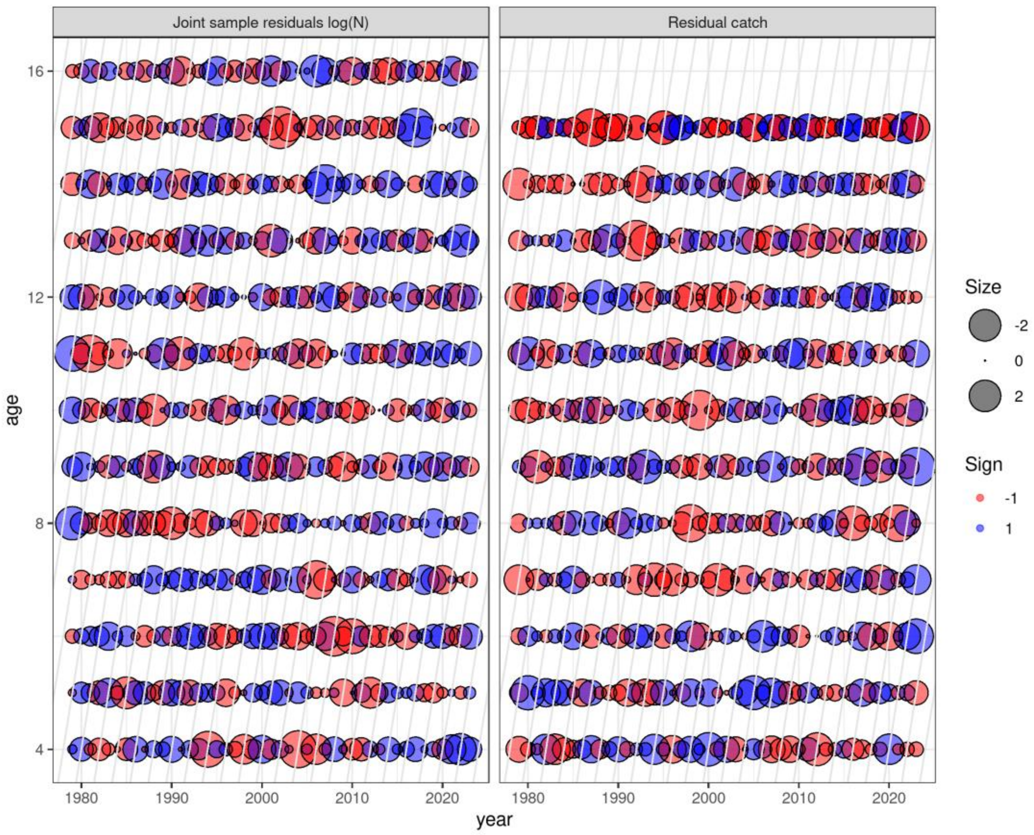

Figure 15.1.21. Atlantic wolffish in 5.a. Process error residuals of the SAM model.

15.1.6 Management

The Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. Atlantic wolffish was included in the ITQ system in the 1996/1997 quota year and as such subjected to TAC limitations. From that time to the fishing year 2004/2005, the catch was on average 5% more than recommended by the MRI, although in some years it was lower than advised TAC. In the fishing years 2005/2006 to 2011/2012, the catch was on average around 34% above the advised TAC. The main reasons were that national TAC was set higher than the advised TAC, and quota of other species were being transferred to Atlantic wolffish quota (Table 15.1.2, Figure 15.1.6). Net transfer of Atlantic wolffish quota for each fishing year is usually less than 10%.

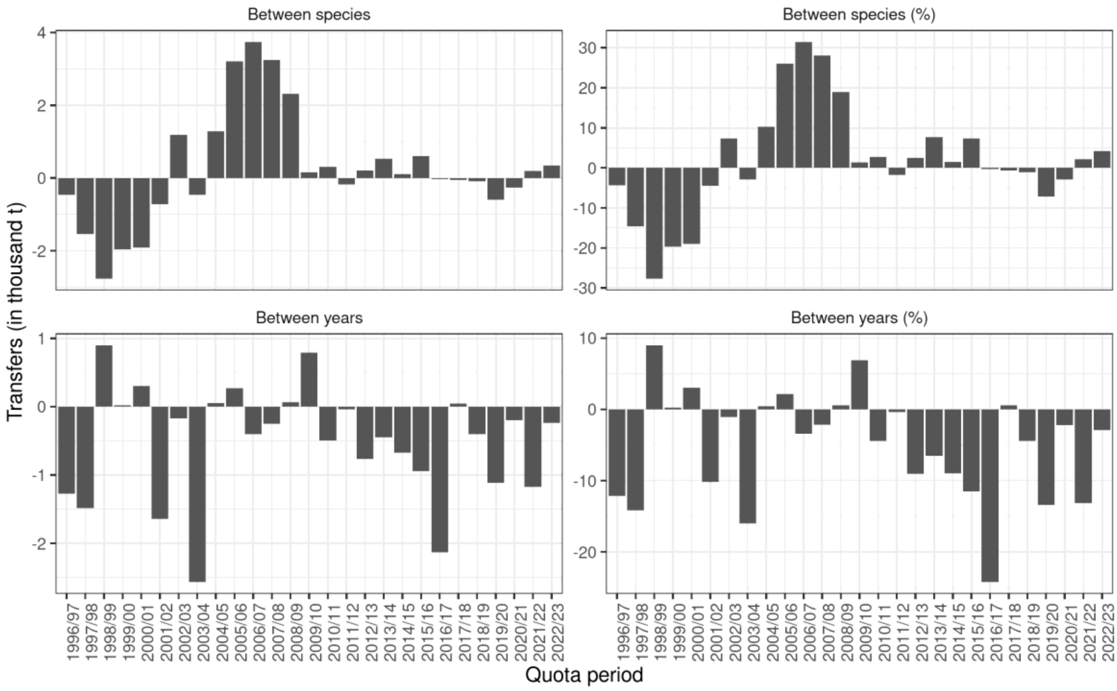

Figure 15.1.22: Atlantic Wolffish in 5.a. Net transfer of quota, from Atlantic Wolffish to other species, in the Icelandic ITQ system by fishing year.

15.1.7 Current Advisory Framework

Reference points were calculated for the stock. This resulted in B_{pa} of 21 000 t, based on the lowest estimate of SSB observed after the 2001 shift in recruitment had been observed (2002), and B_{lim} of 18 500 t. The fishing pressure estimates, defined in terms of fishing mortality applied to ages from 10 to 15, were estimated in accordance with the ICES guidelines. This resulted in an estimate of F_{lim} of 0.33, F_{p05} of 0.20 and F_{MSY} of 0.20. The MSY $B_{trigger}$ was set as B_{pa}.

The proposed HCR for the Icelandic Atlantic wolffish fishery, which sets a TAC for the fishing year y/y+1 (September 1 of year y to August 31 of year y+1) based on a fishing mortality F_{mgt} of 0.20 applied to ages 10 to 15 modified by the ratio SSB_y/MGT $B_{trigger}$ when SSB_y < MGT $B_{trigger}$, maintains a high yield while being precautionary as it results in lower than 5% probability of SSB < B_{lim} in the medium and long term.

15.1.8 Management considerations

A reduction in fishing mortality has led to harvestable biomass and SSB that seem to be stable. Atlantic wolffish is a slow-growing late-maturing species, therefore closures of known spawning areas should be maintained and expanded if needed. Similarly, closed areas fishing where there is high juvenile abundance should also be maintained and expanded if needed.

15.1.9 Ecosystem considerations

Most fishing for Atlantic wolffish occurs in the northwest and west of Iceland, where the fastest growing Atlantic wolffish are found. A likely cause for differences in growth is environmental differences between the relatively warm southwestern waters versus colder northeaster waters. However, Atlantic wolffish are also highly sedentary, especially while guarding nests during spawning and rearing season, and therefore additional metapopulation structure cannot be excluded. Therefore, it is possible that local depletion may occur in more heavily fished areas despite a stable overall biomass level.

Table 15.1.1. Atlantic wolffish in 5.a. Number of Icelandic vessels reporting catch of 10 tonnes/year or more of Atlantic wolffish, and all landed catch divided by gear type.

Number of vessels					Catch (tonnes)				
Year	Long liners	Trawls	Seiners	Other	Longline	Trawl	D. seine	Other	Sum
2000	172	76	20	1	9979	4173	834	241	15227
2001	198	76	19	4	12595	4319	862	394	18170
2002	151	65	14	3	8897	4423	800	304	14424
2003	142	63	25	1	8943	5960	1402	263	16568
2004	109	60	40	2	5746	5349	2010	216	13321
2005	96	64	34	0	6370	7247	1552	177	15346
2006	136	66	32	1	7962	6885	1569	144	16560
2007	124	65	27	1	6655	7857	1551	171	16234
2008	100	60	25	2	5810	7026	1642	152	14630
2009	124	58	34	1	7896	5709	1462	143	15210
2010	82	46	23	2	6923	4531	1033	175	12662
2011	68	36	18	0	6094	4062	1138	97	11391
2012	80	28	21	0	6209	2910	992	103	10214
2013	77	29	19	2	5537	2424	721	110	8792
2014	77	22	17	1	4463	1722	1006	138	7329
2015	68	34	18	2	4828	1926	1097	137	7988

Number of vessels					Catch (tonnes)				
2016	65	37	19	3	5563	1713	1201	148	8625
2017	65	26	19	1	4586	1243	1286	128	7243
2018	67	40	26	4	5657	1689	2185	125	9656
2019	66	36	22	1	5223	1748	2154	90	9215
2020	50	38	25	1	2984	2147	2147	54	7340
2021	51	48	22	1	3941	3047	2012	45	9046
2022	42	49	23	0	2951	3262	2460	55	8728
2023	36	49	20	0	3154	2756	2388	0	8298

Table 15.1.2: Atlantic wolffish in 5.a. Advised TAC, national TAC and total landings since the quota year 2013/2014.

Fishing Year	MFRI Advice	National TAC	Landings
2013/14	7500	7500	7531
2014/15	7500	7500	7862
2015/16	8200	8200	8982
2016/17	8811	8811	7545
2017/18	8540	8540	9515
2018/19	9020	9020	9355
2019/20	8344	8344	7166
2020/21	8761	8761	8974
2021/22	8933	8933	8561
2022/23	8107	8107	8734
2023/24	8344	8344	

Table 15.1.3. Atlantic wolffish. Number of samples and aged otoliths from landed catch of Atlantic wolffish.

Year	Longline		Demersal trawl		Demersal seine	
	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths
2010	29	1669	18	1090	5	285
2011	14	750	15	778	9	550
2012	26	1300	14	700	7	350
2013	25	1249	14	691	5	200
2014	30	800	26	675	28	700

Year	Longline		Demersal trawl		Demersal seine	
2015	25	625	19	479	19	474
2016	25	625	13	325	9	225
2017	23	575	9	220	6	150
2018	22	550	9	225	17	425
2019	22	550	10	276	20	500
2020	9	225	12	350	16	400
2021	14	350	25	625	15	375
2022	3	60	17	465	17	338
2023	12	240	21	420	25	499

Table 15.1.4. Atlantic wolffish in 5.a. Estimates of spawning–stock biomass (SSB) in thousands of tonnes, recruitment at age 4 (thousands), fishing mortality over ages 10 - 15 (Fbar) and catch from SAM.

Year	SSB	Recruitment	Fbar	Catch
1979	15377	19159	0.36	10775
1980	16059	18158	0.27	8857
1981	17869	19048	0.27	8621
1982	19574	18926	0.22	8435
1983	22037	18405	0.27	12214
1984	23206	17204	0.24	10249
1985	24274	17367	0.180	9708
1986	26852	16931	0.23	12147
1987	28104	17651	0.25	12605
1988	28037	16941	0.31	14611
1989	26488	17416	0.28	14128
1990	27115	18888	0.31	14534
1991	26581	21063	0.38	18015
1992	22849	22515	0.40	16079
1993	18979	24200	0.35	11112
1994	16630	24832	0.33	11344
1995	16830	19108	0.32	11393
1996	18054	20278	0.37	14781

Year	SSB	Recruitment	Fbar	Catch
1997	19262	21395	0.28	11737
1998	20143	20610	0.25	11995
1999	20958	17322	0.26	13961
2000	20391	15993	0.25	15101
2001	20229	18466	0.27	18169
2002	19956	16637	0.21	14385
2003	22718	15942	0.24	16536
2004	24089	15749	0.20	13260
2005	23609	1292	0.21	15294
2006	23622	11786	0.25	16488
2007	24399	9691	0.27	16204
2008	24881	10239	0.24	14694
2009	24455	10725	0.27	15280
2010	22174	11349	0.26	12634
2011	21074	10229	0.24	11372
2012	20393	9229	0.24	10217
2013	20135	10099	0.21	8798
2014	20291	10389	0.187	7328
2015	23183	11249	0.179	8041
2016	25954	12307	0.200	8699
2017	27767	12982	0.195	7275
2018	27179	13728	0.24	9694
2019	27086	13986	0.22	9215
2020	27500	14242	0.180	7340
2021	30180	13946	0.21	9063
2022	31447	14992	0.187	8739
2023	33215	18790	0.191	8774
2024	34565	20256		

Contents

16 Other deep-water species in the Northeast Atlantic

16.1 The fisheries

The following species are considered in this chapter: common mora (*Mora moro*) and Moridae, rabbit fish (*Chimaera monstrosa*, *Rhinochimaera atlantica* and *Hydrolagus* spp), Alepocephalidae including 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*) Mediterranean slimehead, also known as silver roughy (*Hoplostethus mediterraneus*), Black gemfish (*Nesiarchus nasutus*) Atlantic thornyhead (*Trachyscorpia cristulata*), greater eelpout (*Lycodes esmarkii*), Norway redfish (*Sebastes viviparus*) and deep-water red crab (*Chaceon affinis*). Deepsea sharks are not considered as these species are in the remit of WGEF. The species considered include all teleost species from annex 1 of Council Regulation (EC) 2016/2336.

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. This fishery reduced strongly from 826 tonnes in 2007 to 125 t in 2008 and have remained at a similar level since.

Although in annex 1 of Council Regulation (EC) 2016/2336 black gemfish and eelpouts (not only greater eelpout but all eelpouts were searched in catch statistics) were never landed from fisheries operating in the ICES area from 2006 to 2017.

16.1.1 Landings trends

Landings reported to ICES are presented in Tables 16.1–16.12, based on ICES catch statistics using historical nominal and the official nominal catches from 2006-2020, downloaded from the ICES website in May 2023. Catch data in 2021 and 2022 were not available as they were not included in preliminary catch statistics and were not reported to InterCatch either.

Mora moro and Moridae have been landed in variable quantity over time from subareas 6 to 10. Landings of chimaerids peaked to around 1000 t in the early 2000s and have shown large year-to-year variations since. Landings of smoothheads peaked to level over 10 000 tonnes in the early 2000s and have been around 400 tonnes in recent years. Landings of wreckfish peaked to more than 1000 tonnes in 2007. The main area is Subarea 10, where landings seem to be on a declining trend. Blackbelly rosefish is landed from subareas 6 to 10, in variable yearly quantity averaging to about 1000t per year. Silver scabbardfish is mostly landed from subareas 8, 9 and 10, landing have decline since the late 1990s. More than 1000 t/year of deepwater cardinal fish was landed in the early 2000. Landings almost ceased in recent years.

Mediterranean slimehead was landed in variable amount with greater quantities from Subarea 9 in years 2012-2015. Atlantic thornyhead was landed in small amount, typically less than one tonne per year from subareas 6, 7 and 8. Norway redfish was mostly landed from Subarea 5, in declining quantity over 2010–2017.

16.1.2 ICES Advice

ICES has not previously given specific advice on the management of any of the stocks considered in this chapter.

16.1.3 Management

No TACs are set for any of these species in EC waters or in the NEAFC Regulatory Area. None of these species 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.

16.2 Stock identity

No information available.

16.3 Data available

16.3.1 Landings and discards

Landings for all these species are presented in Tables 16.1–16.12. 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 to be revised.

In 2016, some data provided to the working group were not suitable. One country reported species which are not deep-water species, such as coastal Rajidae, another reported American plaice (*Hippoglossoides platessoides*) and Spotted wolffish (*Anarhichas minor*).

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.

16.3.2 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 16.1 while Figure 16.2 presents the length–frequency distributions from the Spanish bottom-trawl survey in the Northern Spanish Shelf (SP-NGFS) in Divisions 9a and 8c. Trends in mean length of blackbelly rosefish in the French EVHOE survey (Bay of Biscay) is shown in Figure 16. 3.

The cumulated length distribution of blackbelly rosefish, silver scabbardfish, common mora and wreckfish in Azorean surveys are presented in Figures 16.4, 16.5, 16.6 and 16.7, respectively.

Although not yet explored, CPUE and length distribution from several mentioned species are also available from annual survey data in Faroese waters (Faroese groundfish spring survey (G1264) from 1994-present), Faroese groundfish summer survey (G3284) from 1996-present, Faroese Deep-water survey (G2728) from 2014-present excluding 2021), For rabbitfish, mis-identification of *Chimera opalescens* was confirmed in 2021 which calls for revision of survey data.

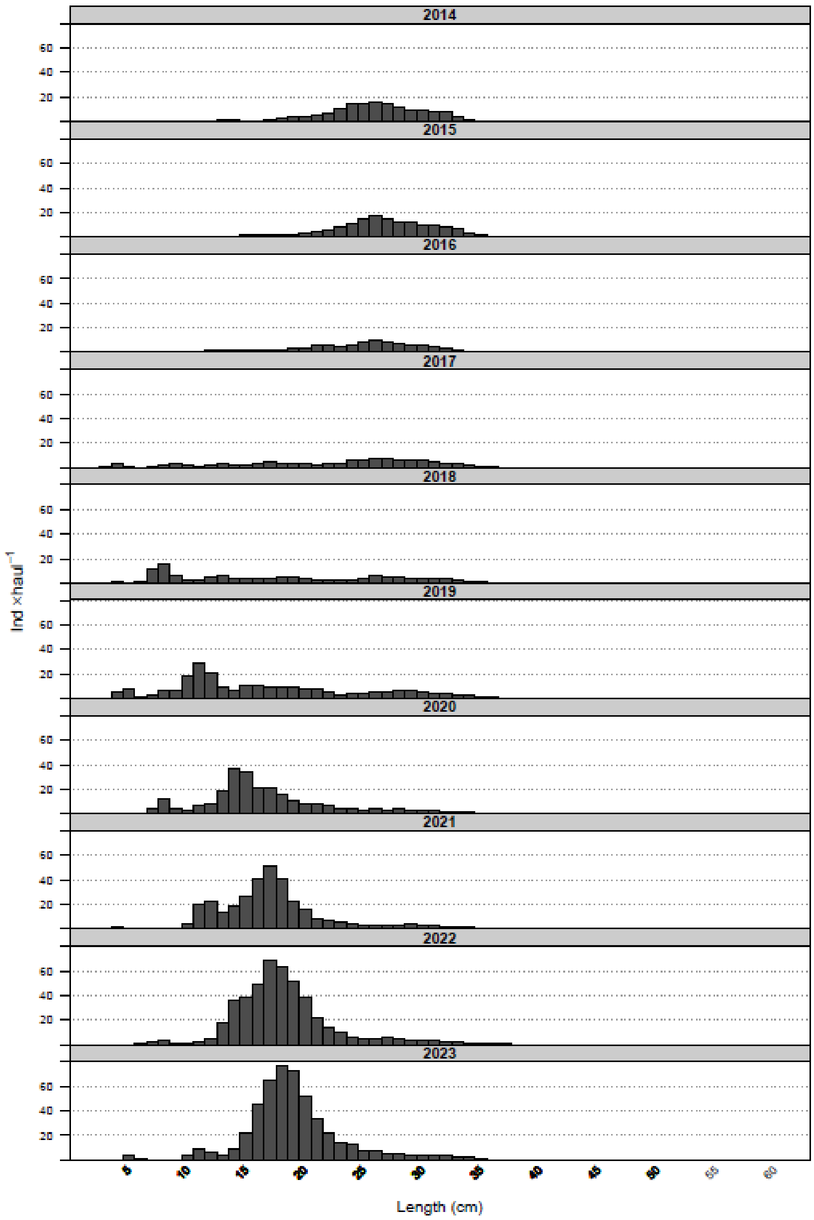

Figure 16.1. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys (2014-2023) (from Ortiz et al., WD 07 to the 2024 WGDEEP).

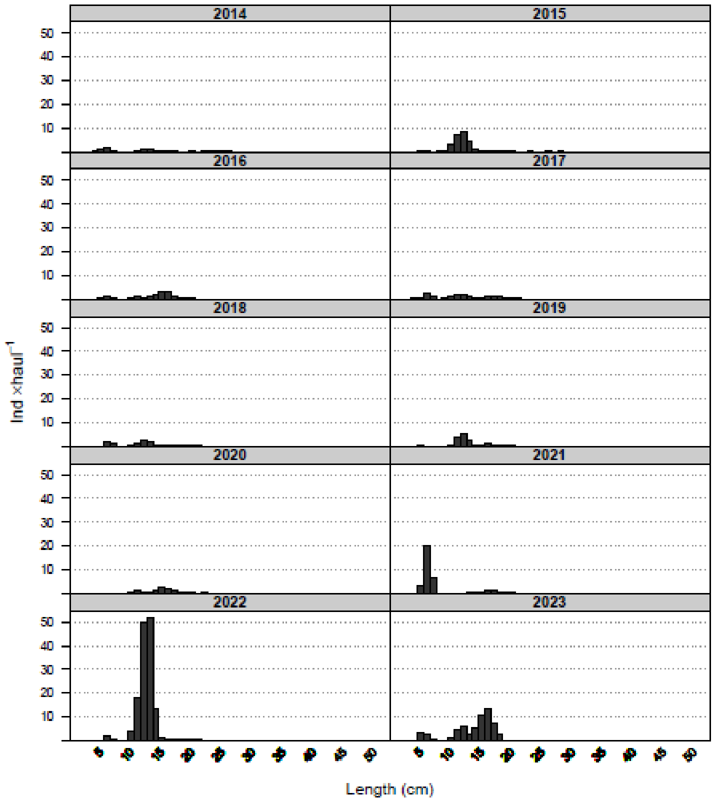

Figure 16.2. Mean stratified length distributions of bluemouth (*H. dactylopterus*) in Northern Spanish Shelf surveys (2014–2023) (from Ruiz-Pico et al., WD 08 to the 2024 WGDEEP).

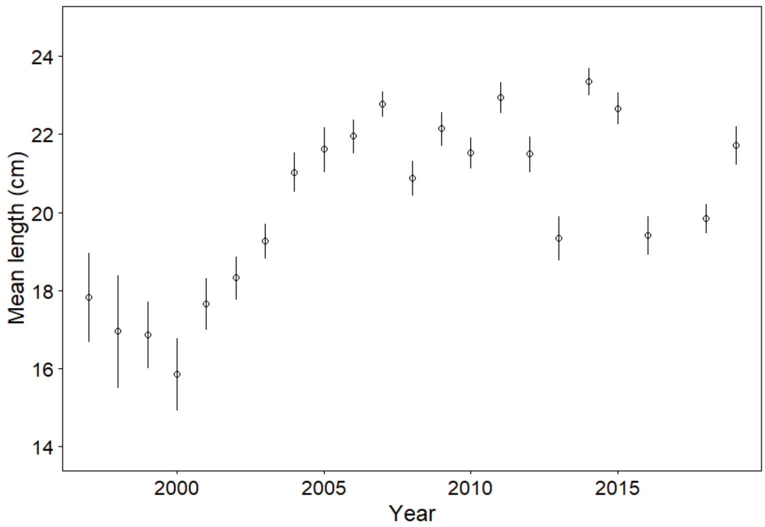

Figure 16.3 Mean length of *Helicolenus dactylopterus* in the French survey in Bay of Biscay and Celtic Sea (EVHOE) from 1997 to 2019 (no survey in 2017).

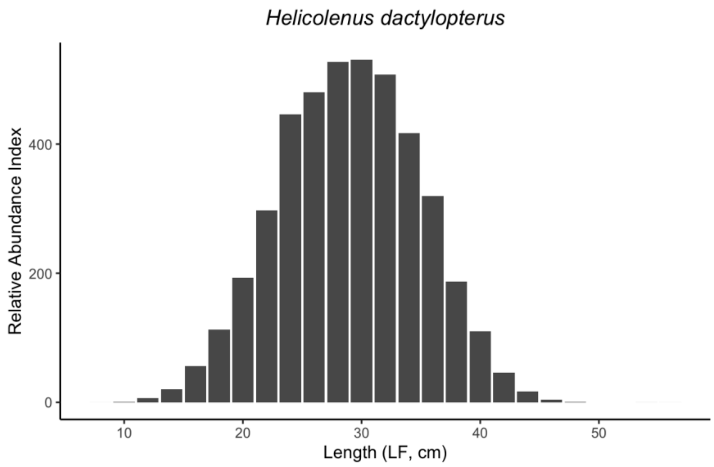

Figure 16.4. Mean length of Helicolenus dactylopterus in Azores bottom longline survey 1995–2023 (from Novoa-Pabon *et al*., WD 5 to the 2024 WGDEEP).

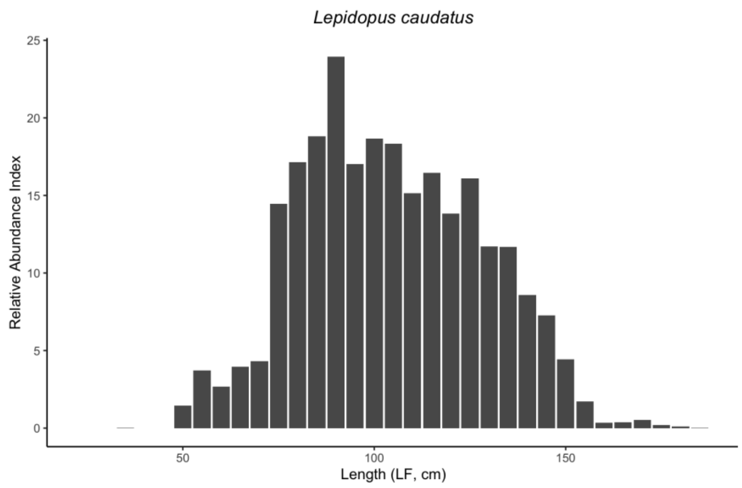

Figure 16.5. Mean length of *Lepidopus caudatus* in Azores bottom longline survey 1995–2023 (from Novoa-Pabon *et al.*, WD 5 to the 2024 WGDEEP).

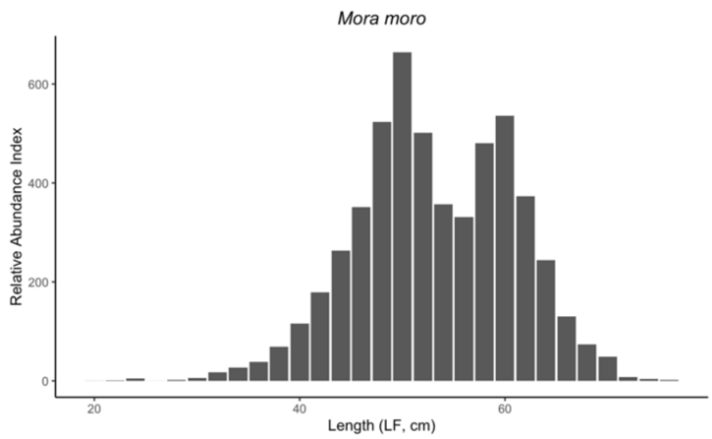

Figure 16.6. Mean length of *Mora moro* in Azores bottom longline survey 1995–2023 (from Novoa-Pabon *et al.*, WD 5 to the 2024 WGDEEP).

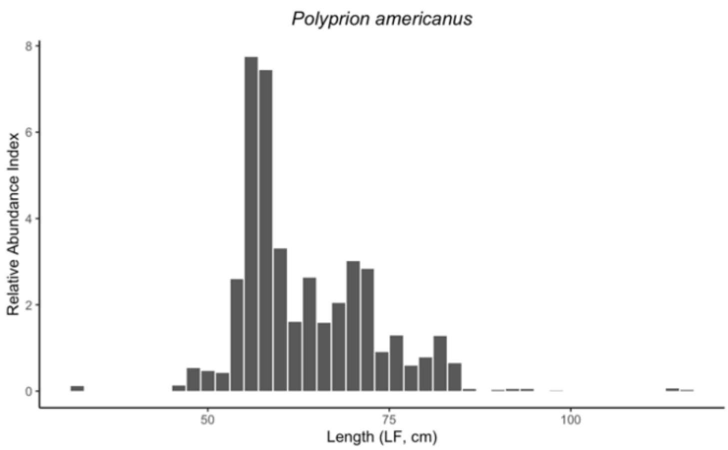

Figure 16.7. Mean length of *Polyprion americanus* in Azores bottom longline survey 1995–2023 (from Novoa-Pabon *et al.*, WD 5 to the 2024 WGDEEP).

16.3.3 Age compositions

No new information.

16.3.4 Weight-at-age

No new information.

16.3.5 Maturity and natural mortality

No new information.

16.3.6 Catch, effort and research vessel data

For blackbelly rosefish standardized indices from the Spanish Porcupine Bank Survey (abundance and biomass), the French EVHOE survey in the Celtic Sea and Bay of Biscay (biomass), the Spanish bottom-trawl survey (SP-NGFS) in Divisions 9.a and 8.c and the Portuguese longline survey in the Azores Islands (abundance) and are given in Figures 16.7–16.11.

Data from longline survey PALPROF (L4398) conducted annually on the Basque Coast (ICES 8c) since 2015 on a commercial longliner are presented. Historical series of Biomass and abundance index of the main deep-water teleost are shown in the table 16.13 and 16.14. The experimental design was implemented to estimate and assess the inter-annual variation of the abundance and biomass indices of the deep-water ichthyofauna. To get homogeneous and comparable data series, the six hauls were carried out every year in the same position and period, covering depths from 650 m to 2400 m. The stratification was based on 400 m intervals following the profile of the canyon valley (WD Diez *et al.*, 2024).

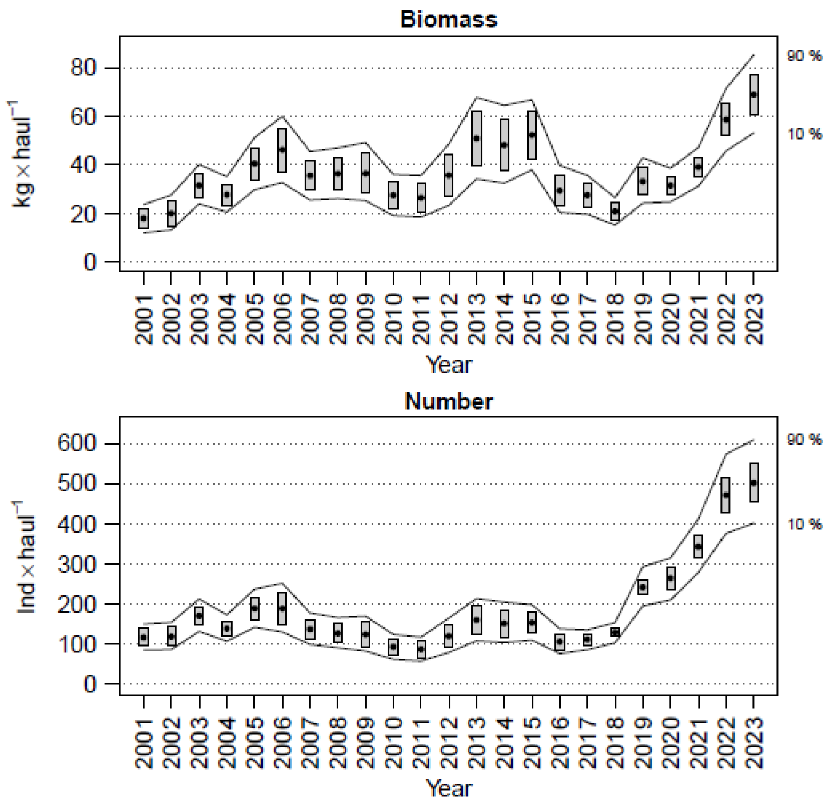

Figure 16.7. Evolution of biomass and abundance indices of *Helicolenus dactylopterus* in the Porcupine Surveys (2001–2023). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000) (from Ortiz et al., WD 07 to the 2024 WGDEEP).

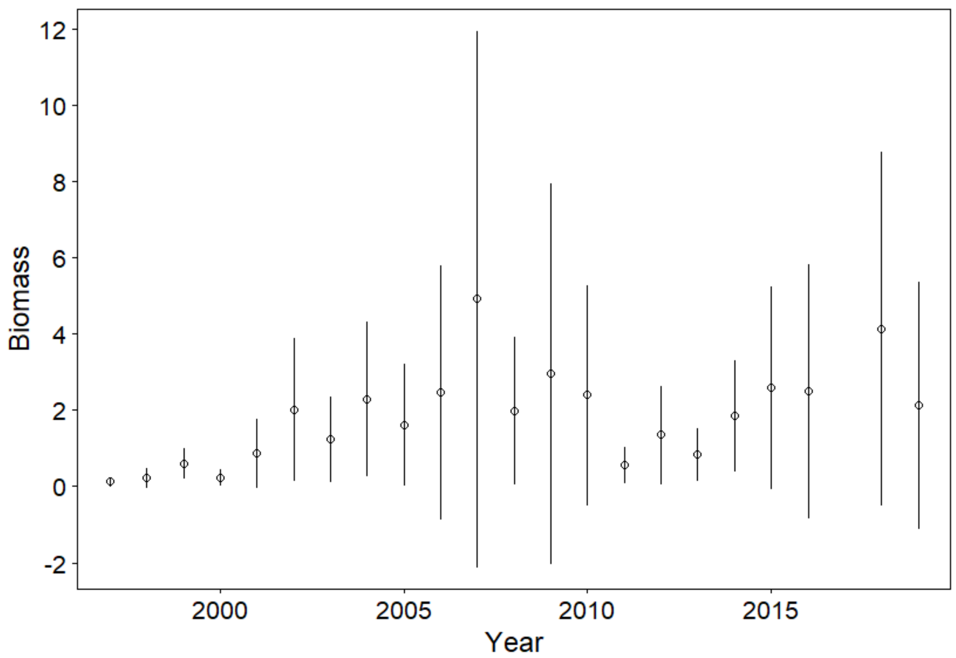

Figure 15.8. Survey biomass index from the French survey (EVHOE) for *Helicolenus dactylopterus*.

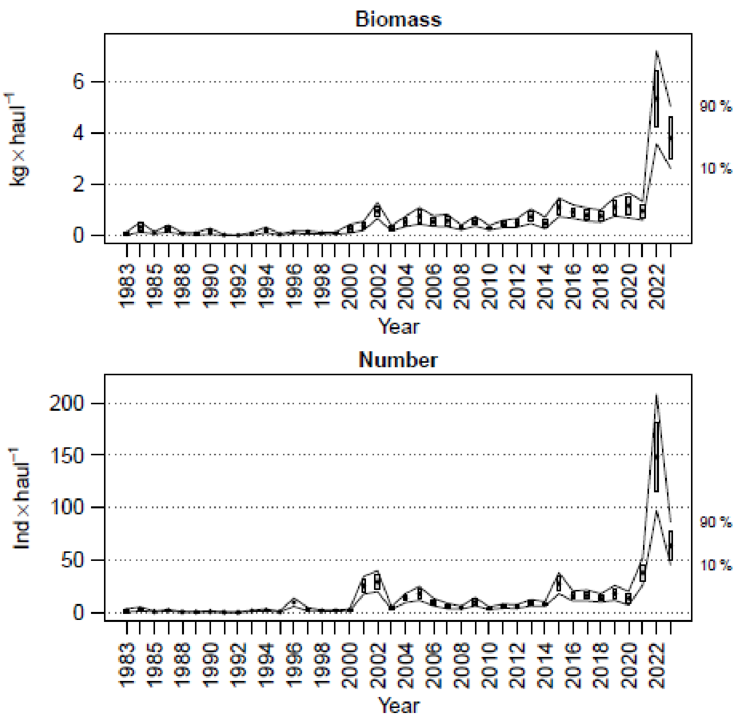

Figure 16.9. Evolution of *Helicolenus dactylopterus* mean stratified biomass and abundance in Northern Spanish Shelf surveys time-series (1983–2023). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000) (from Ruiz-Pico et al., WD 08 to the 2024 WGDEEP).

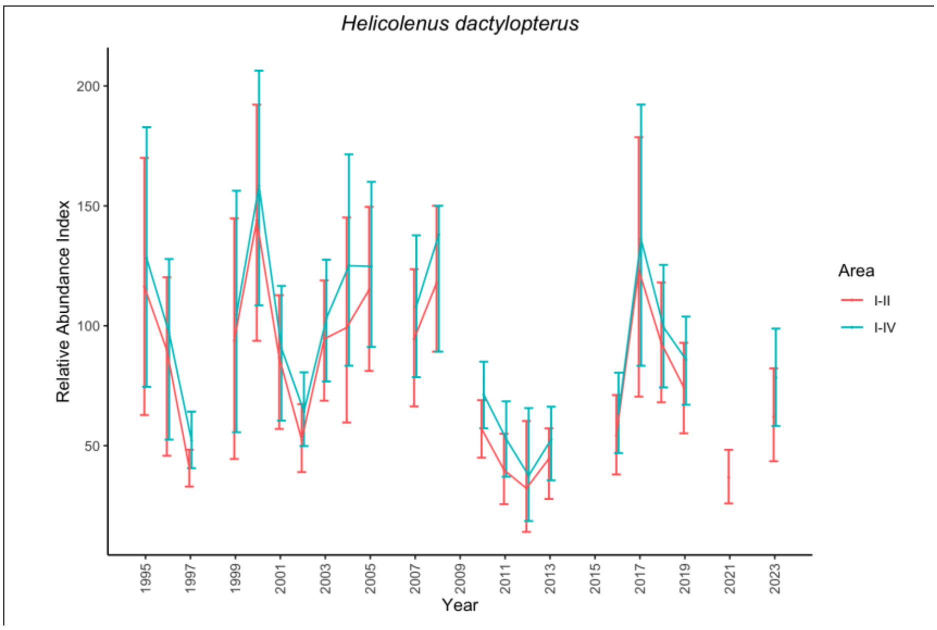

Figure 16.10. Annual bottom longline survey abundance index for *Helicolenus dactylopterus* in Azorean bottom longline surveys (from Novoa-Pabon *et al.*, WD 5 to the 2024 WGDEEP).

Abundance indices for silver scabbardfish, common mora and wreckfish from the Portuguese longline survey in the Azores Islands are given in Figures 16.11 to 16.13.

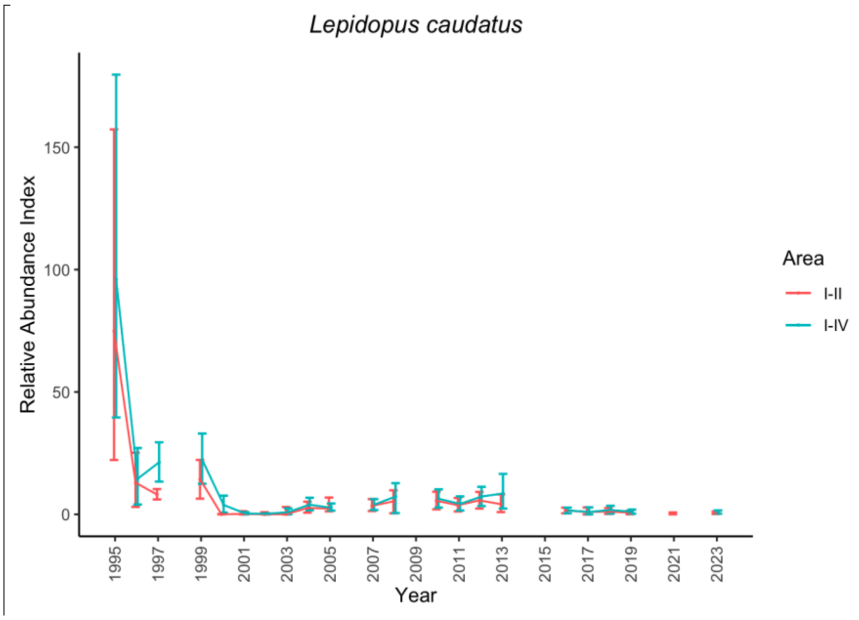

Figure 16.11 Annual bottom longline survey abundance index for *Lepidopus caudatus* in Azorean bottom longline surveys (from Novoa-Pabon *et al*., WD 5 to the 2024 WGDEEP).

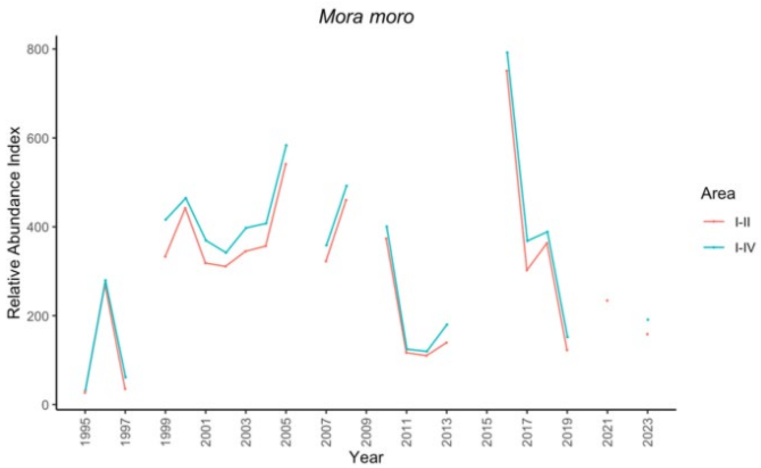

Figure 16.12. Annual bottom longline survey nominal cpue for *Mora moro* in Azorean bottom longline surveys (from Novoa-Pabon *et al*., WD 5 to the 2024 WGDEEP).

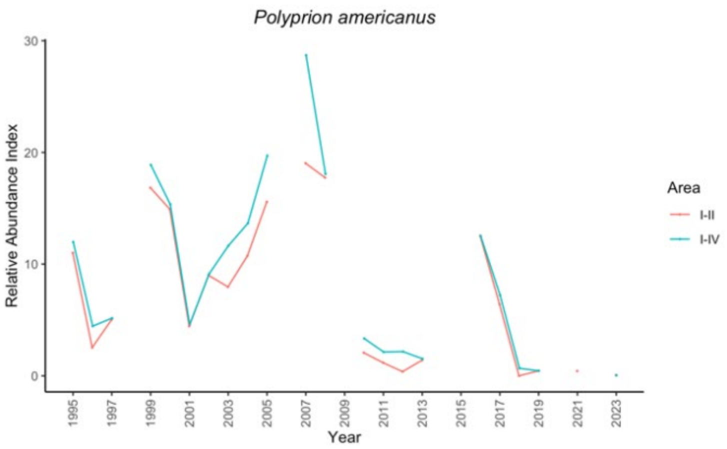

Figure 16.13. Annual bottom longline survey nominal cpue for *Polyprion americanus* in Azorean bottom longline surveys (from Novoa-Pabon *et al*., WD 5 to the 2024 WGDEEP).

16.3.7 Data analysis

No new analyses were carried out in 2024. Updated surveys series from several species are included in different working documents presented to the 2024 WGDEEP and to previous ones.

16.3.8 Comments on the assessment

No assessment was carried out in 2024.

16.3.9 Management considerations

Currently no advice is required for these stocks.

Table 16.1. Official landings of *Mora moro* and *Moridae* (t).

Year	2	5b	6 and 7	8 and 9	10	12	14b
1988							
1989							
1990					2		
1991		5	1		4		
1992			25				
1993			10				
1994			10				
1995				83			

Year	2	5b	6 and 7	8 and 9	10	12	14b
1996				52			
1997				88			
1998			41				
1999		1	20				
2000	8	3	159	25		1	
2001	1	100	194	25		87	
2002	1	19	159	10	100	13	
2003		8	327	12	125	15	7
2004		1	71	15	87	4	
2005		1	63	50	69		
2006	0	4	135	45	92*	0	
2007	0	5	100	15	86*	0	0
2008	0	10	72	14	53*	0	0
2009	0	10	80	9	68*	0	0
2010	0.04	14	84	4	55*	0	0
2011	0.02	6	87	3	57*	0	0
2012	0.04	5	71	2	31*	0	0
2013	0.06	1	103	7	52*	0	0
2014	0	1	65	20	62*	0	0
2015	0.43	2	77	54	92*	0	0
2016	0	1	54	56	191*	0	0
2017	0	3	30	62	169*	0	0
2018	0	5	59	28	165*	0	0
2019	0.13	15	59	19	124*	0	0.35
2020	0	5	78	15	60*	0	0

*** Only data from Azore**

Table 16.2 Official landings of rabbitfish (*Chimaera monstrosa* and *Hydrolagus* spp) (t).

Year	1 and 2	3 and 4	5a	5b	6 and 7	8	9	12	14	TOTAL
1991			499							499

Year	1 and 2	3 and 4	5a	5b	6 and 7	8	9	12	14	TOTAL
1992		122	106							228
1993		8	3							11
1994		167	60		2					229
1995			106	1						107
1996		14	32							46
1997		38	16					32		86
1998		56	32		2			42		132
1999		47	9	3	237	2		114		412
2000	6	34	6	54	404	2		48		554
2001	7	23	1	96	797	7		79		1010
2002	15	24		64	570	6		98	1	778
2003	57	25	1	61	469	2		80	4	699
2004	22	40		100	444	6		128	5	745
2005	77	171		63	571	14		249	1	1146
2006	29	17	1	62	325	10			5	449
2007	64	2	1	78	391	3				539
2008	81	12	1	49	370	3				516
2009	89	6	2	6	47			70		220
2010	197	21	7	5	31			25		286
2011	150	7	4	2	88					251
2012	104	17	4	29	475	2		434		1065
2013	103	40	2	30	160	1		56		392
2014		4		32	131	4		77		178
2015	79	14		25	30			1		149
2016	78	49		40	225	15	31	4		364
2017	69	32	0	103	144	<1	0	0	1	350
2018	131	21	0	60	146	<1	0	0	0	360
2019	220	24	0	70	145	<1	0	0	<1	461
2020	133	37	0	25	42	<1	0	0	0	238

Year	1 and 2	3 and 4	5a	5b	6 and 7	8	9	12	14	TOTAL
2021	0	0	0	0	0	0	0	0	0	0
2022	114	75	0	46	200	2	0	0	0	437

Table 16.3. Official 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
2013			342	351		693
2014			235 0+	228		463
2015			127 3+	91		218

Year	5a	5b	6 and 7	12	14	TOTAL
2016			131	258		389
2017	14	0	156	326	<1	496
2018	5	0	77*	323*	1	406*
2019	5	0	72	246	0	322
2020	6	0	46	193	0	245
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
* Only data from Spain						

Table 16.4. Official landings of wreckfish (*Polyprion americanus*) (t).

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
1998	12	238	140	390

Year	6 and 7	8 and 9	10	TOTAL
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
2018	6	70	89*	166*
2019	4	66	78*	149*
2020	5	101	79	185
2021	0	0	0	0
2022	0	0	0	0
* Only data from Azores				

Table 16.5. Official landings of blackbelly rosefish (*Helicolenus dactylopterus*) (t)

Year	3 and 4	5b	6	7	8 and 9	10
1980						18
1981						22

Year	3 and 4	5b	6	7	8 and 9	10
1982						42
1983						93
1984						101
1985						169
1986						212
1987						331
1988						439
1989			79	48	2	481
1990	4		69	31	5	480
1991	5		99	29	12	483
1992	3		112	47	11	575
1993	1		87	65	8	650
1994	2		62	55	4	708
1995	2		62	9		589
1996	2		77	10		483
1997	1		78	10	1	410
1998			53	92	3	381
1999	8	64	194	160	29	340
2000		16	213	119	33	441
2001			177	102	34	301
2002			81	115	18	280
2003			184	213	124	338
2004	2	3	142	291	135	282
2005			103	204	206	190
2006	0	1	195	839	328	209
2007	0	1	387	1968	519	277
2008	0	1	138	1175	527	287
2009	2	1	150	1321	651	317
2010	1	0	201	1681	1861	216

Year	3 and 4	5b	6	7	8 and 9	10
2011	1	3	178	2303	1821	239
2012	0	1	161	954	1402	192
2013	7	3	130	517	1326	236
2014	1	6	152	480	809	224
2015	0	1	112	496	665	258
2016	0	1	116	487	592	327
2017	0	3	135	647	595	344
2018	4	2	170	583	489	295
2019	9	2	219	543	434	192
2020	7	2	200	500	478	130

Table 16.6. Official landings of silver scabbardfish (*Lepidopus caudatus*) (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	42	81*	13	137
2019		48	66*		114
2020		94	91*		185
*Only data from Azores					

Table 16.7. Official landings of deep-water cardinal fish (*Epigonus telescopus*) (t)

Year	5b	6	7	8 and 9	10	12
1990					3	
1991					11	

Year	5b	6	7	8 and 9	10	12
1992						
1993		15	15			
1994	4	35	182			
1995	3	20	71			
1996	8	13	32			
1997	8	27	22			
1998		86	29			
1999	8	54	224	3		
2000	2	121	181	5	3	
2001	7	109	284	4		
2002		97	888	8	14	
2003	2	47	1031	5	16	1
2004	1	30	843	10	21	2
2005		50	637	8	4	
2006	0	27	66	26	10	0.1
2007	0	10	17	31	7	0
2008	0	5	12	11	7	0
2009	0	10	13	34	7	0
2010	0	7	11	30	5	0
2011	0	4	45	3	5	0
2012	0	16	4	4	4	0
2013	0.1	10	2	2	4	0
2014	0	5	1	1	4	0
2015	0	5	1	1	4	0
2016	0	13	11	1	11	0
2017	0.3	12	0.4	3	8	0
2018	0.3	32	0.3	1	5	0
2019	1	0	0	3	143	0
2020	2	19	1	3	5	0

Table 16.8. Official estimates of landings of deep-water red crab (*Chaceon affinis*) (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
2018						
2019						
2020						

Table 16.10. Official landings (t) of Mediterranean slimehead, also known as silver roughy (*Hoplostethus mediterraneus*) (t)

Year	27.7	27.8	27.9
2006	0	0	0.7
2007	0	0	0
2008	0	0	0.01
2009	0	0	0.01
2010	0	0	14
2011	0	0	3.38
2012	0	0	27.26
2013	0	0.82	34.93
2014	0	3.85	36.11
2015	0	6.9	14.98
2016	0	2.68	1.62
2017	0.25	2.33	1.06
2018	0.585	3.845	0.25
2019	0.701	1.277	0.29
2020	1.067	1.783	22.73

Table 16.11. Official landings of Atlantic thornyhead (*Trachyscorpia cristulata*) (t)

Year	27.4	27.6	27.7	27.8
2006	0	0	0.01	26
2007	0.01	4.6	13.73	1.41
2008	0	2.8	4.2	0.62
2009	0	1.6	4.61	0.6
2010	0	0	0	0
2011	0	0.38	2.59	0.4
2012	0	0.06	4.43	0.36
2013	0.01	0.07	2.05	0.48
2014	0	0	0.92	0.72
2015	0	0	0.75	0.58
2016	0	0.45	0.14	0.29

2017	0	0.02	0.26	0.04
2018	0	0.025	0.585	0.035
2019	0	0.485	0.542	0.397
2020	0	0.019	1.607	1.453

Table 16.12. Official landings of Norway redfish (*Sebastes viviparus*) (t)

Year	27.2	27.5	27.6	27.12	27.14
2006	13	0	0	0	0
2007	7.3	0	0	0	0
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	2600.7	0	0	0
2011	0	1415	0	0	10
2012	0	532	0	1	1
2013	0	532	0	0	0
2014	1	546	0	0	4
2015	0	468	0	0	0
2016	0	0	0.3	0	0
2017	0	170	0	0	0
2018	0.5	117	0	0	0
2019	0.6	142	0	0	0
2020	0	118	0	0	0

Table 16.13. Biomass Index (kg/h) of the main deep-water sharks caught in the survey in the period 2015-2022 all the depth stratum combined.

	Biomass Index (kg/h)								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii	0	0	0	0	0.08	0	0	0	0
Antimora rostrata	0.23	0.46	0.66	0.27	0.46	0.84	0.33	0.40	0.09
Aphanopus carbo	0.23	1.34	2.13	0.41	1.13	2.62	1.41	1.48	0.82
Molva dypterigia	0	0	0	0	0	0	0.22	0	0
Mora moro	1.21	5.66	5.02	3.60	3.63	5.01	2.67	1.70	1.79
Phycis blennoides	0.11	0.0	0.06	0.11	0.43	0.42	0.22	0.61	0.41

Synaphobranchus kaupii	0.02	0.02	0.04	0.03	0.05	0.02	0.02	0.02	0
Trachyrincus scabrus	0	0	0.02	0	0	0	0.01	0	0
TOTAL	1.8	7.48	7.93	4.42	5.78	8.91	4.88	4.21	3.11

Table 16.14. Abundance Index (No./h) of the main deep-water teleost caught in the survey in the period 2015-2023 all the depth stratum combined.

	Abundance Index (No./h)								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii	0	0	0	0	0.0003	0	0	0	0
Antimora rostrata	0.0015	0.0032	0.0054	0.0015	0.0038	0.0052	0.0023	0.0030	0.0007
Aphanopus carbo	0.0015	0.0085	0.0115	0.0031	0.0069	0.0139	0.0074	0.0082	0.0062
Molva dypterigia	0	0	0	0	0	0	0.0003	0	0
Mora moro	0.0046	0.0255	0.0172	0.0170	0.0144	0.0183	0.0113	0.0069	0.0135
Phycis blennoides	0.0004	0.0000	0.0004	0.0008	0.0021	0.0022	0.0013	0.0026	0.0031
Synaphobranchus kaupii	0.0004	0.0004	0.0011	0.0008	0.0014	0.0004	0.0006	0.0007	0.0000
Trachyrincus scabrus	0	0	0.0004	0	0	0	0.0003	0	0
TOTAL	0.0084	0.0376	0.036	0.0232	0.0289	0.04	0.0235	0.0214	0.0235

16.4 References

Diez, G., Basterretxea M., Oyarzabal, I., Cuende E., Mugerza, A., Horrach, L., Mendizabal, A. 2024. Abundance, biomass and CPUE of deep-water teleost species in the longline survey (PALPROF) in the Bay of Biscay (ICES 8c) from 2015 to 2023. Working Document presented to the Working Group on the biology and assessment of deep-sea fisheries resources. ICES WGDEEP,24th – 30th, April 2024, Copenhagen.

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Ortiz, P., Fernández-Zapico, O., Ruíz-Pico, S., Blanco, M., Velasco, F. and Baldó, F. 2024. Results on silver smelt (Argentina silus and A. sphyraena), bluemouth (Helicolenus dactylopterus), greater forkbeard (Phycis blennoides), roughsnout grenadier (Trachyrincus scabrus), Spanish ling and ling (Molva macrophthalma and Molva molva) from the 2023 Spanish Groundfish Survey on the Porcupine Bank (NE Atlantic). Working Document presented to the Working Group on the biology and assessment of deep-sea fisheries resources. ICES WGDEEP,24th – 30th, April 2024, Copenhagen.

Ruíz-Pico, S., Fernández-Zapico, O., Blanco, M., Ortiz, P., González-Irusta, J.M., Punzón and Velasco, F. 2024. Results on greater forkbeard (Phycis blennoides), Spanish ling (Molva macrophthalma), roughsnout grenadier (Trachyrincus scabrus), bluemouth (Helicolenus dactylopterus)and other scarce deep-sea fish species on the 2023 Northern Spanish Shelf Groundfish Survey. Working Document presented to the Working Group on the biology and assessment of deep-sea fisheries resources. ICES WGDEEP,24th – 30th, April 2024, Copenhagen.

Contents

Annex 1: List of Participants

Table .

Name	Institute	Country
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Bruno Almón Pazos	Spanish Institute of Ocean-ography	Spain
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Elvar H. Hall-fredsson	Institute of Marine Research	Norway
Erik Berg	Institute of Marine Research	Norway
Hannipoula Olsen	Faroe Ma-rine Re-search In-stitute	Faroe Islands
Hege Over-boe Hansen	Institute of Marine Research	Norway
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Guzmán Díez	Azti	Spain

Annex 2: Resolutions

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

Approved in Resolutions meeting on 31 October 2023

2023/AT/FRSG11 The **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** (WGDEEP), chaired by Elvar Hallfredsson, Norway and Juan Gil Herrera, Spain, will meet in Copenhagen, Denmark, 24–30 April 2024 to:

a) Address generic ToRs for Regional and Species Working Groups.
b) Update the description of deep-water fisheries in both the NEAFC regulatory areas 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 areas. In particular, describe and prepare a first advice draft of any new emerging deep-water fishery with the available data in the NEAFC regulatory areas.
c) Continue work on exploratory assessments for deep-water species.
d) Evaluate the status of stocks for the provision of advice in 2024.

The assessments will be carried out based on 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 2024 ICES data call.

WGDEEP will report by 20 May 2024 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: Working Documents

WD ICES WGDEEP, Copenhagen 2024

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)

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Abstract

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 40 years (1984-2024). 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 give an estimate of by-catch in the commercial shrimp fishery from Reference fleet data. 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 also include the years 2014-2024.

Material and Methods

Data was collected from the annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research in the years 1984-2024 (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 a10mm 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 were 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 where catches were subsampled, length distributions were raised to the total catch prior to pooling.

Age data from selected surveys in 1987 and 2007-2024 were calculated as cumulative age distributions. Age and length data from 2008-2024 were analyzed for growth parameters.

Standardized mean catches by number of small juveniles of PAFL ≤ 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.

Data from the Norwegian reference fleet (2013-2023) was collected to report bycatch on roundnose grenadier in the Norwegian shrimp fishery.

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 from 2018-2024 remained low, but with an increasing trend compared with 2017. The index in 2024 shows the highest value since 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 PAFL>15cm declined to less than 10% which contrasts with the pre-1990 distributions dominated by large fish. From 1992, a pronounced mode of small fish can be followed in subsequent years, with modal length increasing through the time series.

In 2018 there is another shift in the length distributions. The very recent distributions (2018-2024) contrast with earlier distributions by having very low proportions of large fish. The distributions are dominated by small fish but at low levels compared to the 1990's. The situation in 2024 is the same as in 2023 for large fish but there seems to be more small fish (fish 5-10 cm PAFL).

Age distributions and growth

The cumulative age distribution from the extracted data from 1987 (Bergstad, 1990) contrasts substantially with the distributions from 2007-2024 in terms of proportions of old fish (e.g. >20 years). 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 2023 now show 21% fish > 20 years (Table 4). In 2024, the distribution again show only 9% fish > 20 years.

Age at length was analyzed for the years 2008-2024 (Figure 5) and compared with data from 1987 (Bergstad, 1990) (Table 3). The growth rate coefficient (k) and the length infinity ($L\infty$) for females is in the same range as the data from 1987, but slightly lower for 2008-2024 data compared with data from 1987, especially for females.

Occurrence of juveniles <5cm PAFL

There are positive signs of recruitment in 2024. The occurrence of juveniles < 5cm in 2024 show the highest value since 2009. However. 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. 3).

Geographical distribution

The area sampled in one year and the corresponding geographical distribution of grenadier catches is presented in Figure 4. The overall distribution area does not seem to have changed considerably during the time series 1984-2024. Catches of roundnose grenadier are restricted to the Norwegian Deep north to 59°N and extend eastwards into the Skagerrak basin. The highest catches were always found in the eastern Skagerrak part of the Norwegian Deep.

Commercial by-catch

For a simplified assessment of the bycatch of roundnose grenadier in the Norwegian shrimp fishery, data from the Norwegian Reference fleet showed that < 10% of the tows with shrimp trawl caught roundnose grenadier (Table 5). The value for catch weights from the Reference fleet indicates that the low reported Norwegian landings are realistic and that the landings are the bycatch amount taken by the Norwegian shrimp fishery.

Discussion

Despite high inter annual variability, the catch rates in terms of biomass and abundance from the survey suggest long term pattern of variation through the time series 1984-2024. 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 2024 abundance and biomass estimates were still at low levels.

The survey catch rate declined in all areas, also where high survey catches were common, i.e. in the eastern part of the Skagerrak (Fig. 4).

The time-series of size distributions also suggest pronounced structural changes during the period 1984-2024. The distributions from the 1980s with a dominance of fish around 15 cm PAFL contrast with those from the early 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 2018, the older fish are almost disappeared and the distributions changed to younger fish primarily but still with low levels.

The difference in age distributions between 1987 and 2024 is primarily seen in the proportion of older fish, i.e. there are almost no fish older than 30 years in 2024 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 (Table 3).

High mean survey biomass coincided with very high commercial landings in 2004-05 (Figure 6). The fishery may have utilized a period of elevated abundance resulting from what appears to be the single large pulse in recruitment in the 41 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 three 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 tons (Figure 6) 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. The data from the Norwegian Reference fleet suggests that current levels are minor, probably reflecting low grenadier abundance at relevant depths and introduction of sorting grids to the fishery.
Norway reports only landings. However, Sweden and Denmark have reported both discards and landings since 2014 (Figure 7). Until 2022, the discards have been less than two tons in total. In 2022 and 2023 the discards from Sweden and Denmark were 23 and 19 tons, respectively. This was a rather large increase compared to earlier levels but in general still at low levels.

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 are 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 decades. 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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Knutsen, H., Jorde, P.E., Bergstad, O.A., and Skogen, M. 2012. Population genetic structure in a deepwater fish *Coryphaenoides rupestris*: patterns and processes. Marine Ecology Progress Series, 460: 233–246.

Table 1. Summary of data on the bottom trawl survey series, 1984-2024. 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, GS – G.O. Sars. Data from 2024 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
2019	JAN	KB	3296	Campelen 1800 20mm/40, Rg and strapping***	27	8	108
2020	JAN	KB	3296	"	26	7	106

Table 1. Continued

YEAR	Survey month	Vessel	IMR Gear code	Additional gear info.	No. trawls >300m	No. trawls >400m	No. trawls survey
2021	JAN	KB	3296	Campelen 1800 20mm/40, Rg and strapping***	27	8	113
2022	JAN	KB	3296	‘’	28	8	119
2023	JAN	KB	3296	‘’	29	8	116
2024	JAN	GS	3296	‘’	27	7	97

* 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 1984-2024. Missing data are from surveys that are not representable according to roundnose grenadier catches (few stations > 300 m). Data from 2016 is 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
2020	26	18.72	11.48	63.02	38.07
2021	27	9.59	5.03	26.14	14.19
2022	28	23.87	10.94	75.20	35.61
2023	29	19.24	8.89	38.81	19.10

Table 2 continued					
Year	n	(kg/h)	SE(kg/h)	(n/h)	SE(n/h)
2024	27	29.21	17.40	132.10	71.98

Table 3. Estimated parameters of von Bertalanffy growth function on data from Skagerrak shrimp survey 2008-2024 and Skagerrak survey in 1987 as reported by Bergstad 1990. k=growth coefficient, L_∞=asymptotic length, t_0=theoretical age when length is zero, SE=standard error

	Estimated parameter			
Parameter	**Shrimp survey 2008-2024**		**Skagerrak survey 1987**	
	Females (SE)	**Males (SE)**	**Females**	**Males**
k	0.090 (±0.003)	0.073 (±0.010)	0.100	0.105
L_∞	16.9 (±0.203)	15.1 (±0.547)	18.1	14.7
t_0	-2.2 (±0.207)	-5.8 (±0.980)	-0.9	-1.5

Table 4. Cumulative percentages (%) for selected ages from 1987 and 2007-2024.

	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
2019	8	37	64	92	100
2020	40	64	83	97	100
2021	20	55	83	97	100
2022	33	53	81	95	99
2023	22	50	79	92	100
2024	39	66	91	97	100

Table 5. Proportion of tows with shrimp trawl that caught roundnose grenadier. Data from Norwegian Reference Fleet.					
Year	Total number of shrimp trawl	Number of trawl hauls that caught roundnose grenadier	% of total trawls catching roundnose grenadier	Catch of roundnose grenadier (kg)	Total Norwegian landings (kg)
2013	19	0	0		0
2014	19	2	10,5		0
2015	111	14	12,6	47	0
2016	336	23	6,85	37	300
2017	296	20	6,76	29	0
2018	248	19	7,66		60
2019	101	4	3,96	80	90
2020	61	6	9,84		777
2021	176	10	5,68	50	535
2022	162	2	1,23		694
2023	220	5	2,27		

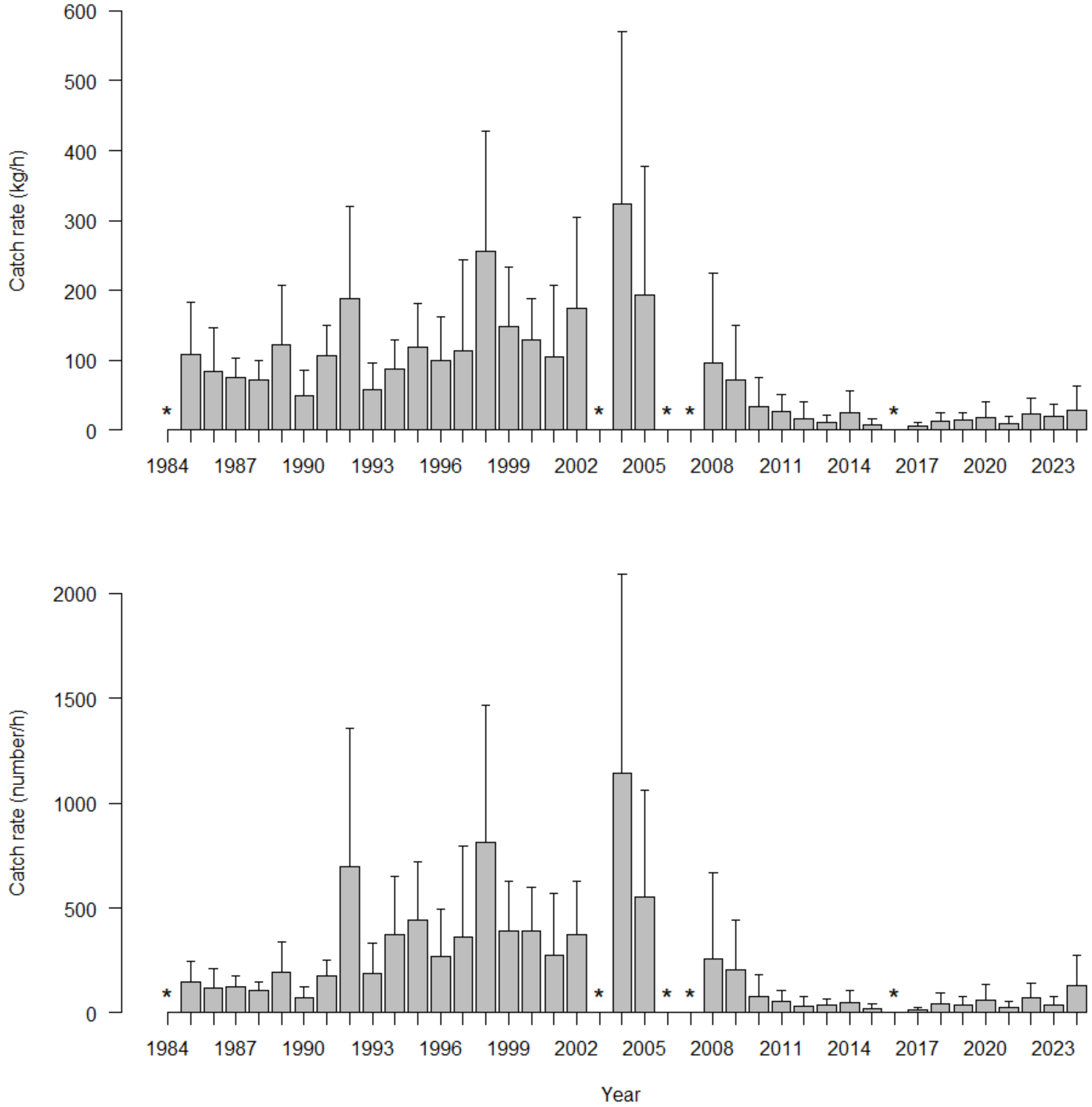


Figure 1. Standardized survey catch rates of roundnose grenadier, 1984-2024. Upper: Biomass (kg/h), Lower: Abundance (number/h). Standard error (2SE) shown by lines on top of bar. *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those years were excluded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.

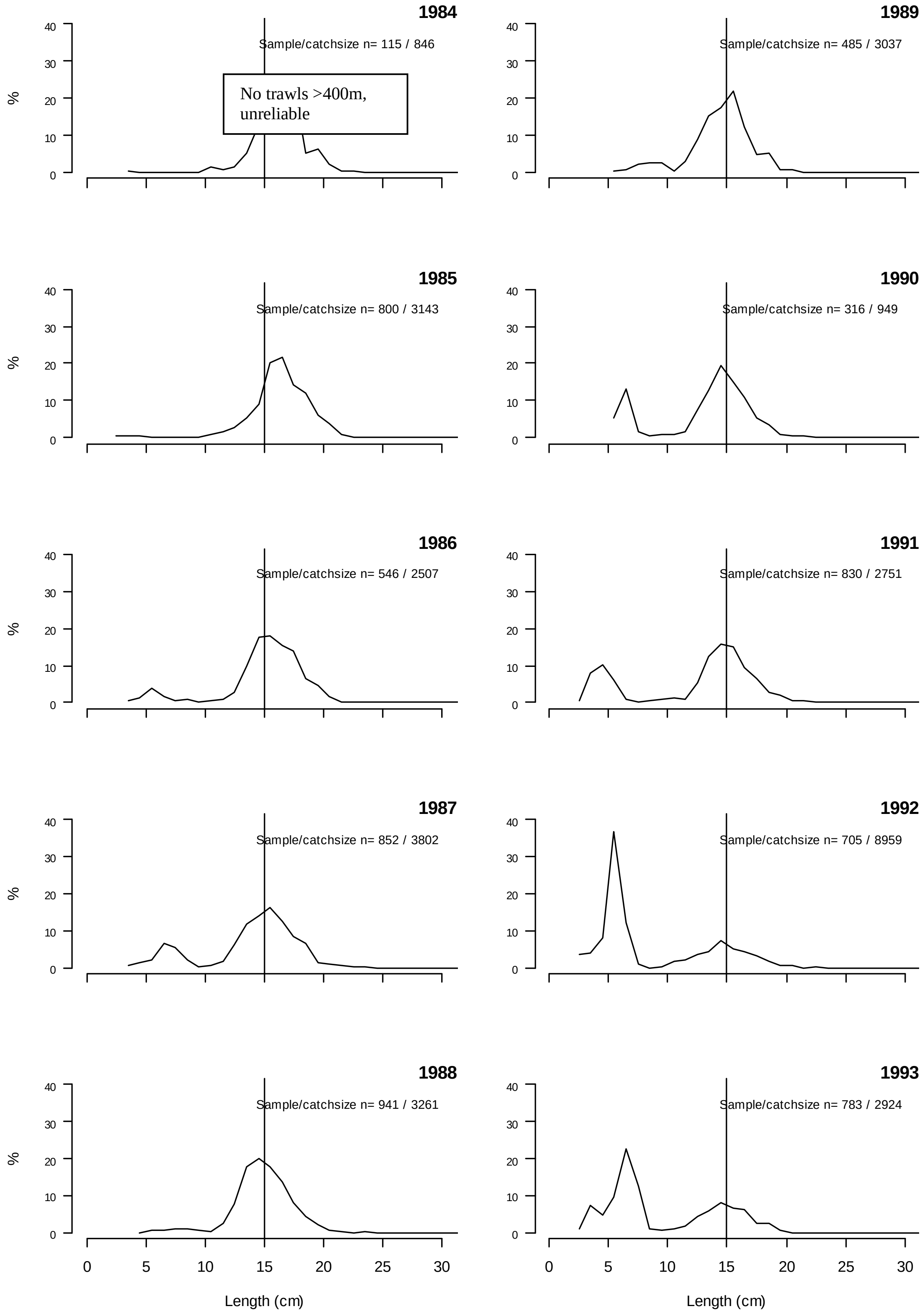
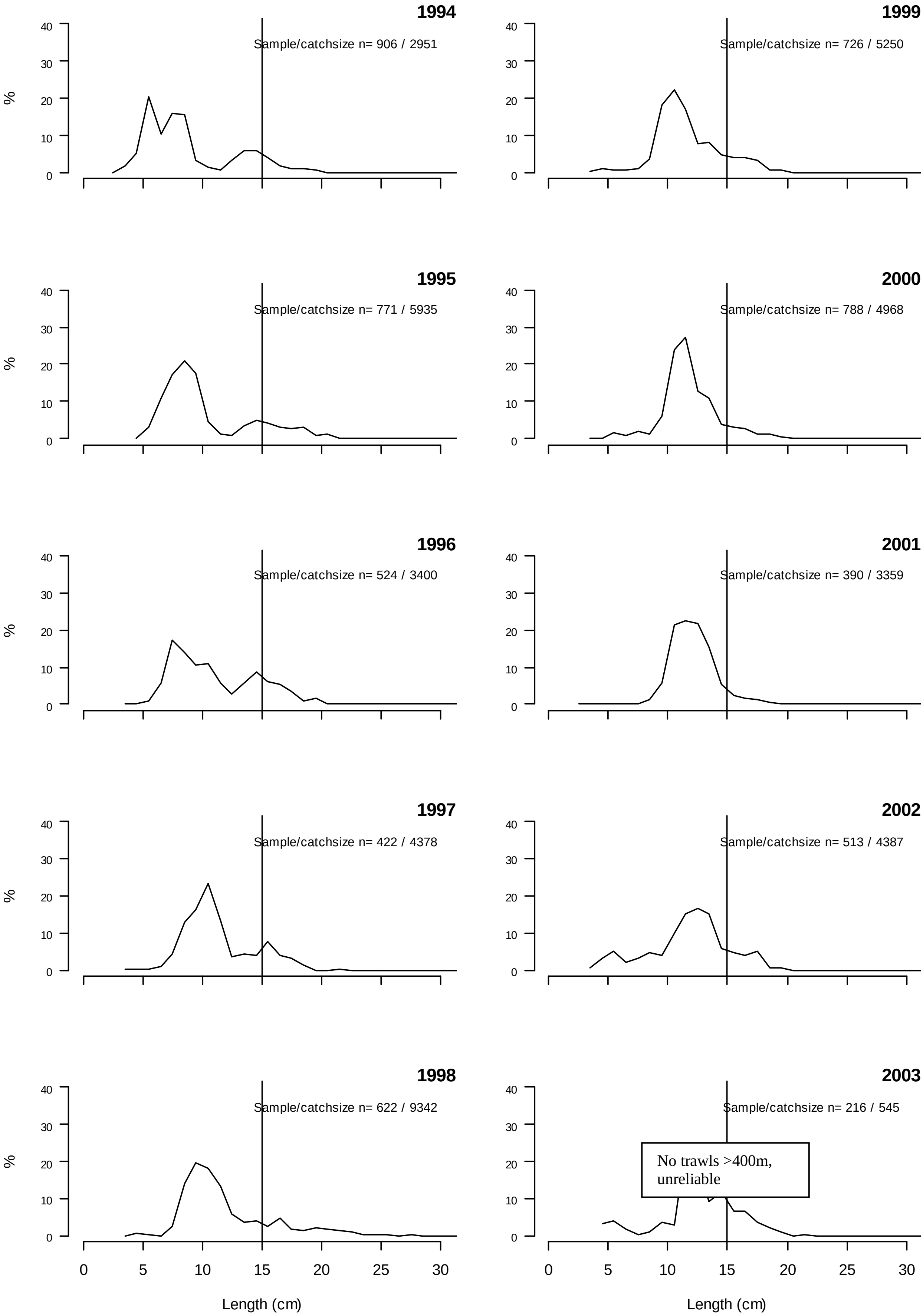


Figure 2. Length distributions of roundnose grenadier from annual *P. borealis* surveys, 1984-2024. Length is measured as PAFL (cm). The length distributions are calculated as percentage number of fish in each centimetre length interval standardized to total catch number and trawling distance for each 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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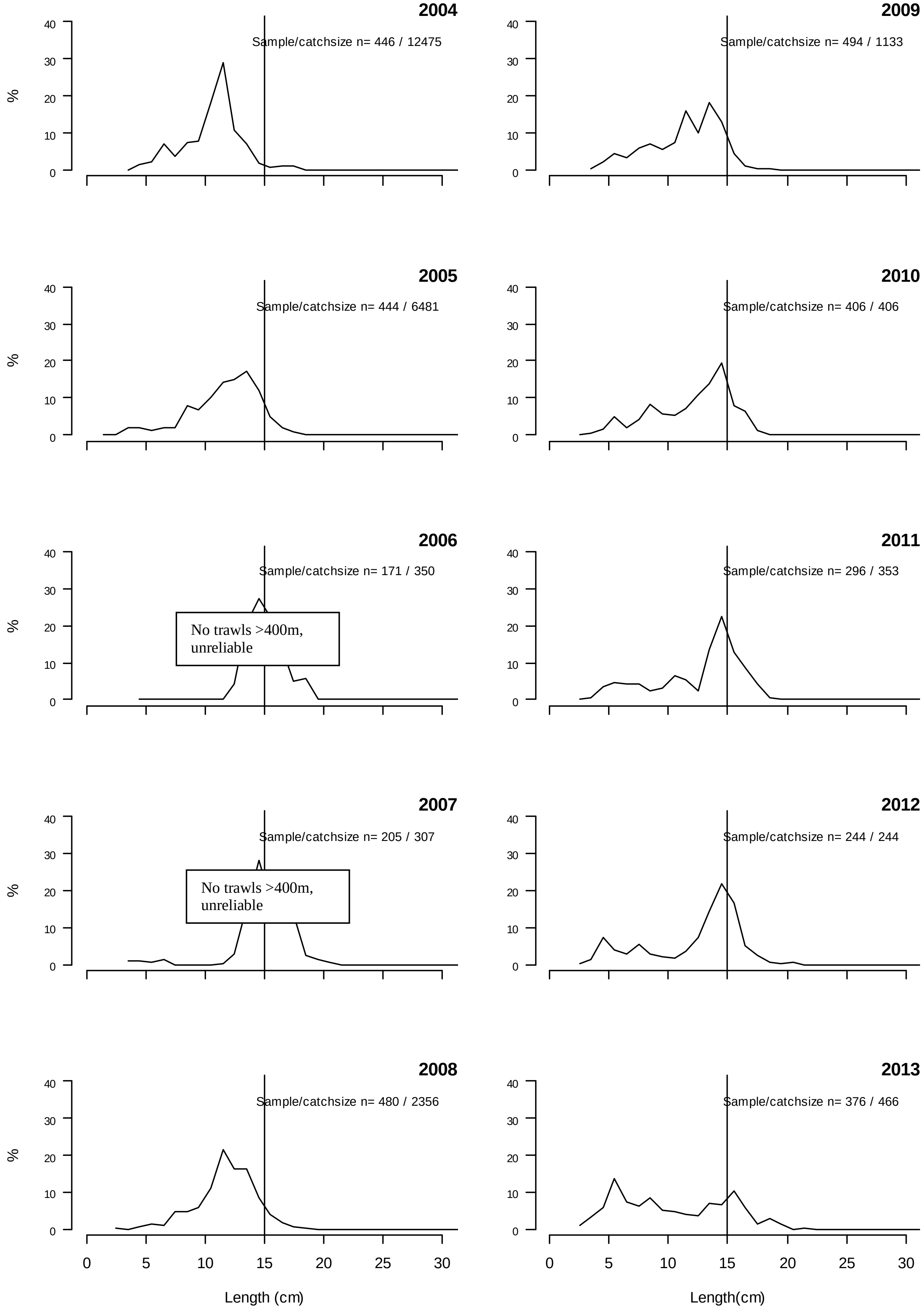

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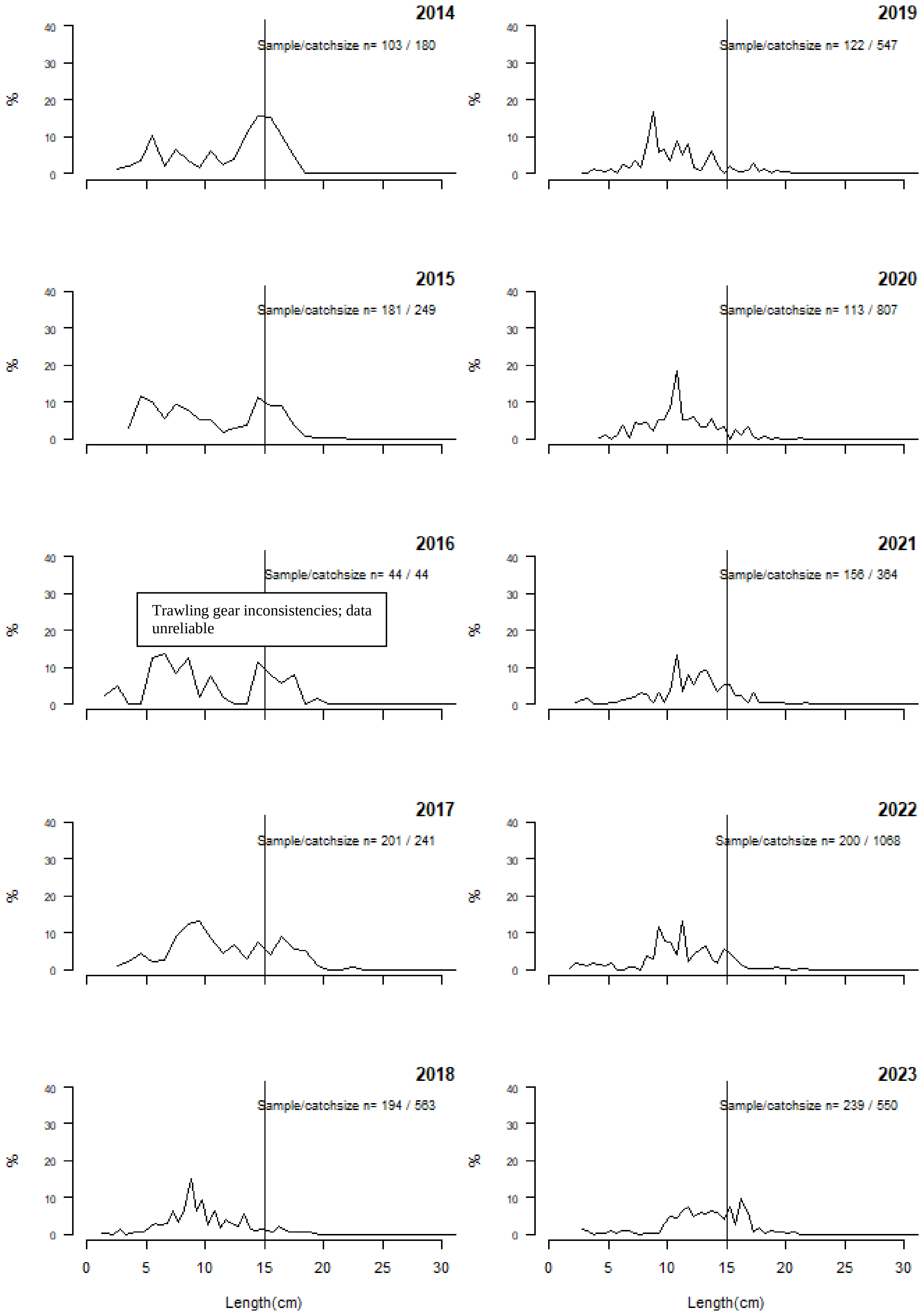

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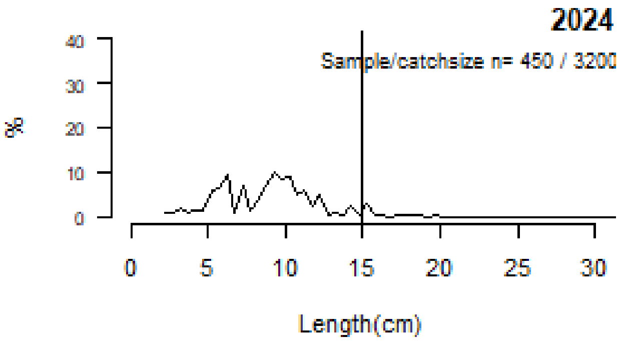

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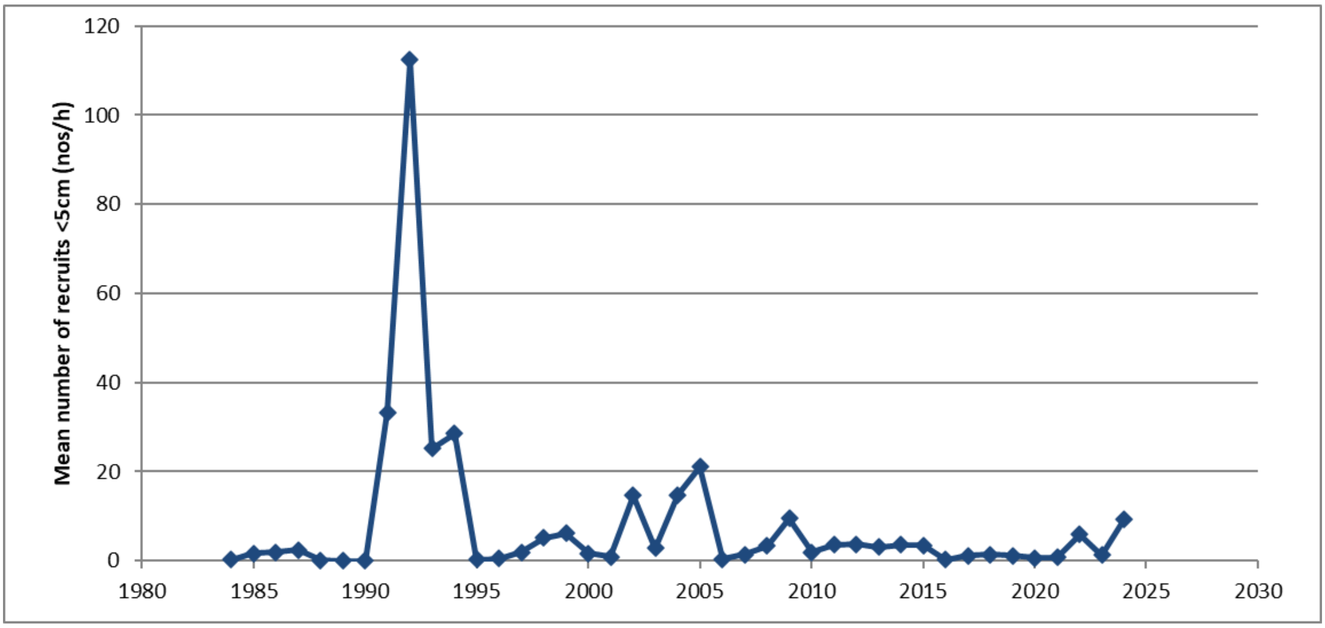


Figure 3. Mean catch rate of roundnose grenadier of PAFL ≤ 5 cm, 1984-2024. Data from shrimp survey, trawls deeper than 300 m. *In 1984,2003,2006 and 2007, no trawls were made deeper than 400 m, and data from these years should be disregarded; in 2016 data from shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded.

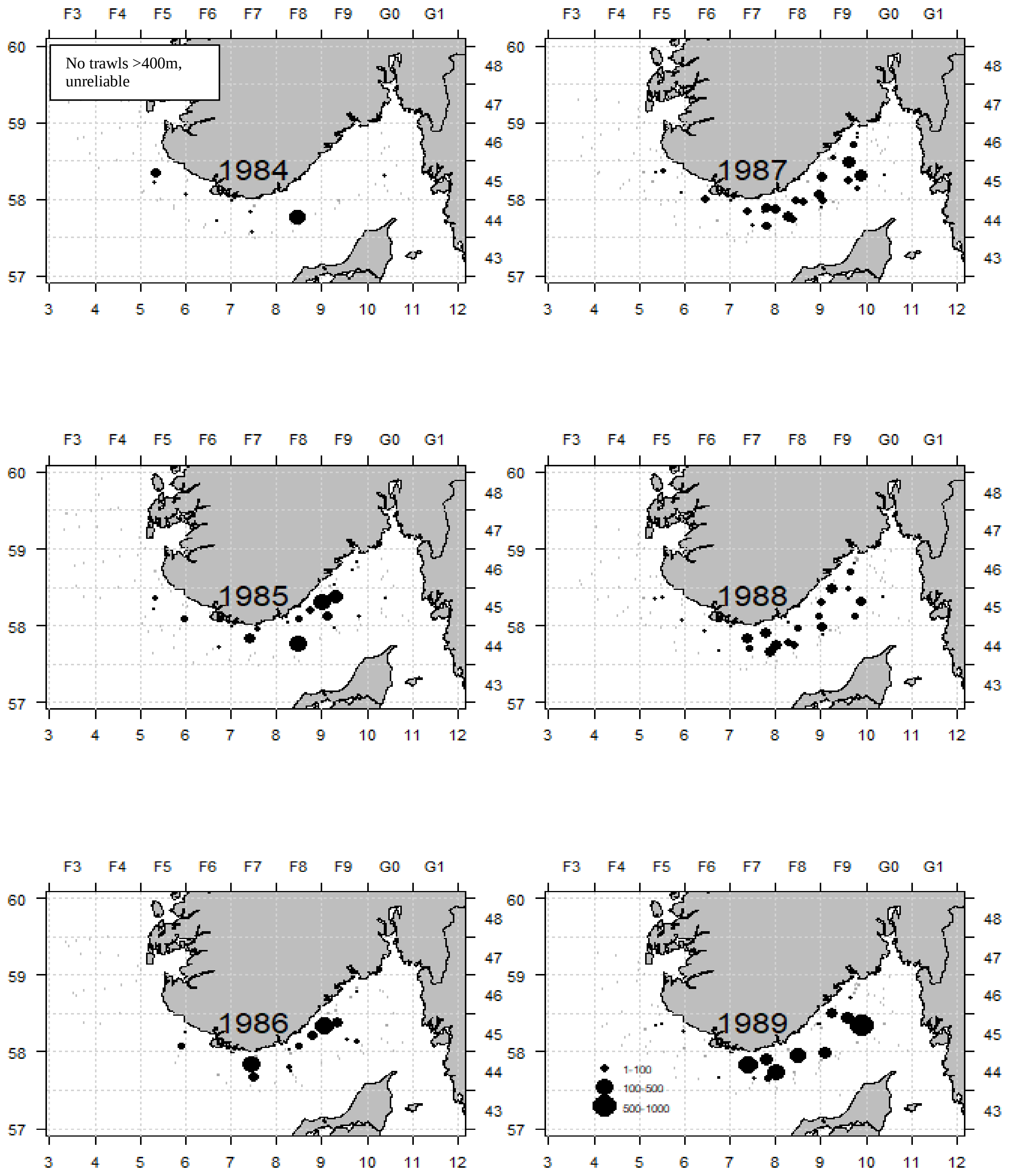
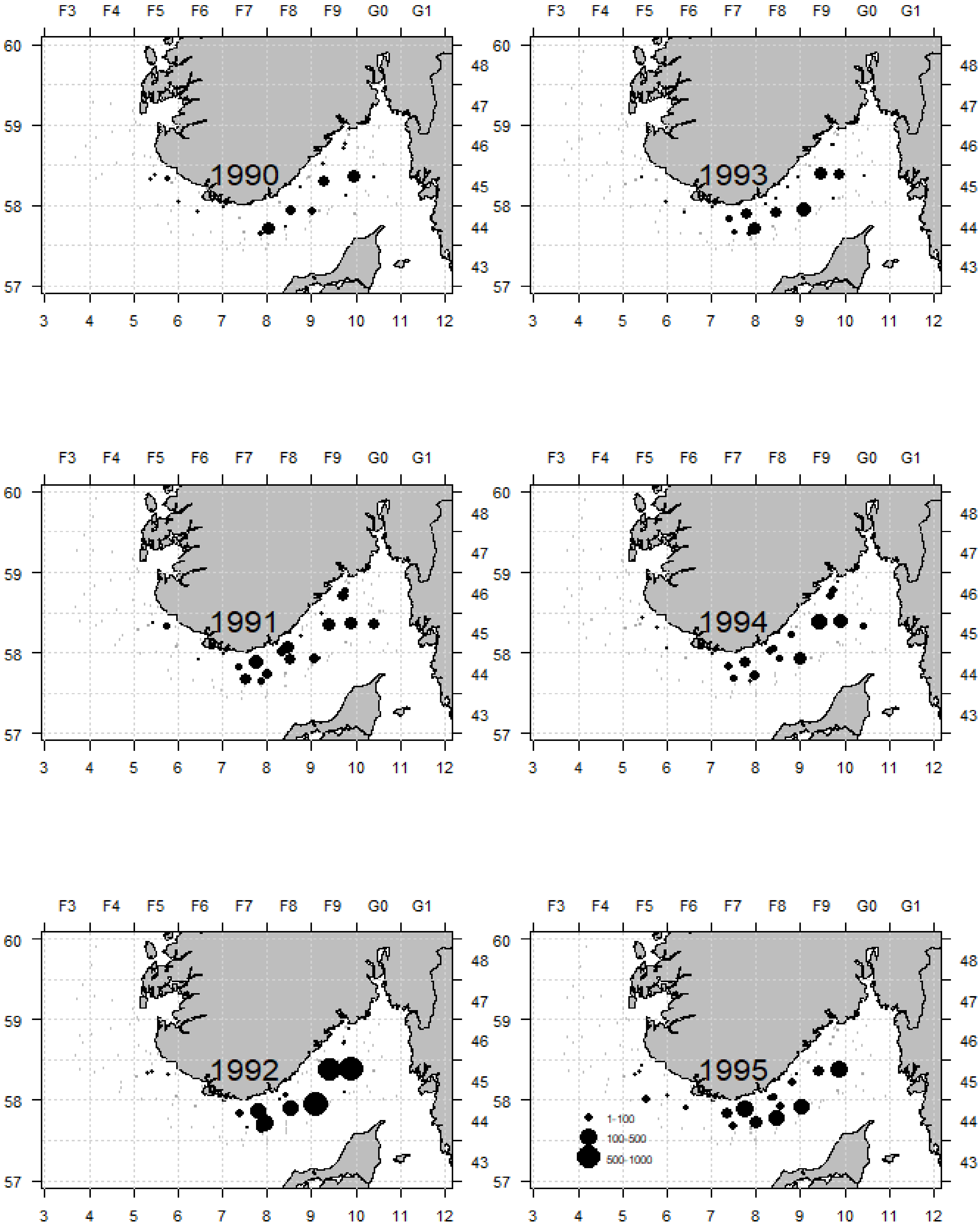


Figure 4. Geographical distribution of catches of roundnose grenadier (kg/h) from 1984-2023. Data from shrimp survey, trawls deeper than 300 m. Grey circles are trawls with no catch of grenadier. *In 1984, 2003, 2006 and 2007, only one single or no trawls were made deeper than 400 m, and data from those 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.



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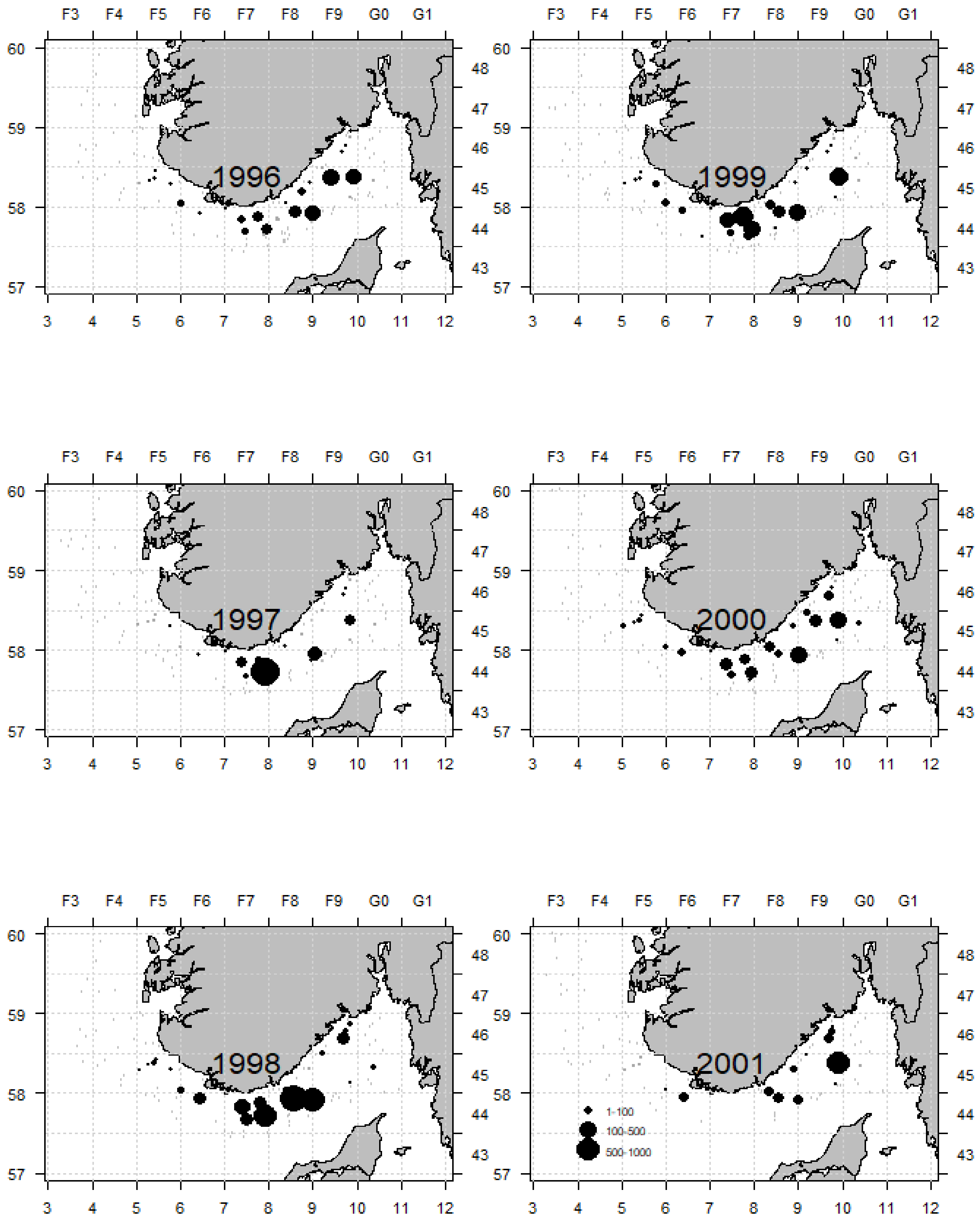

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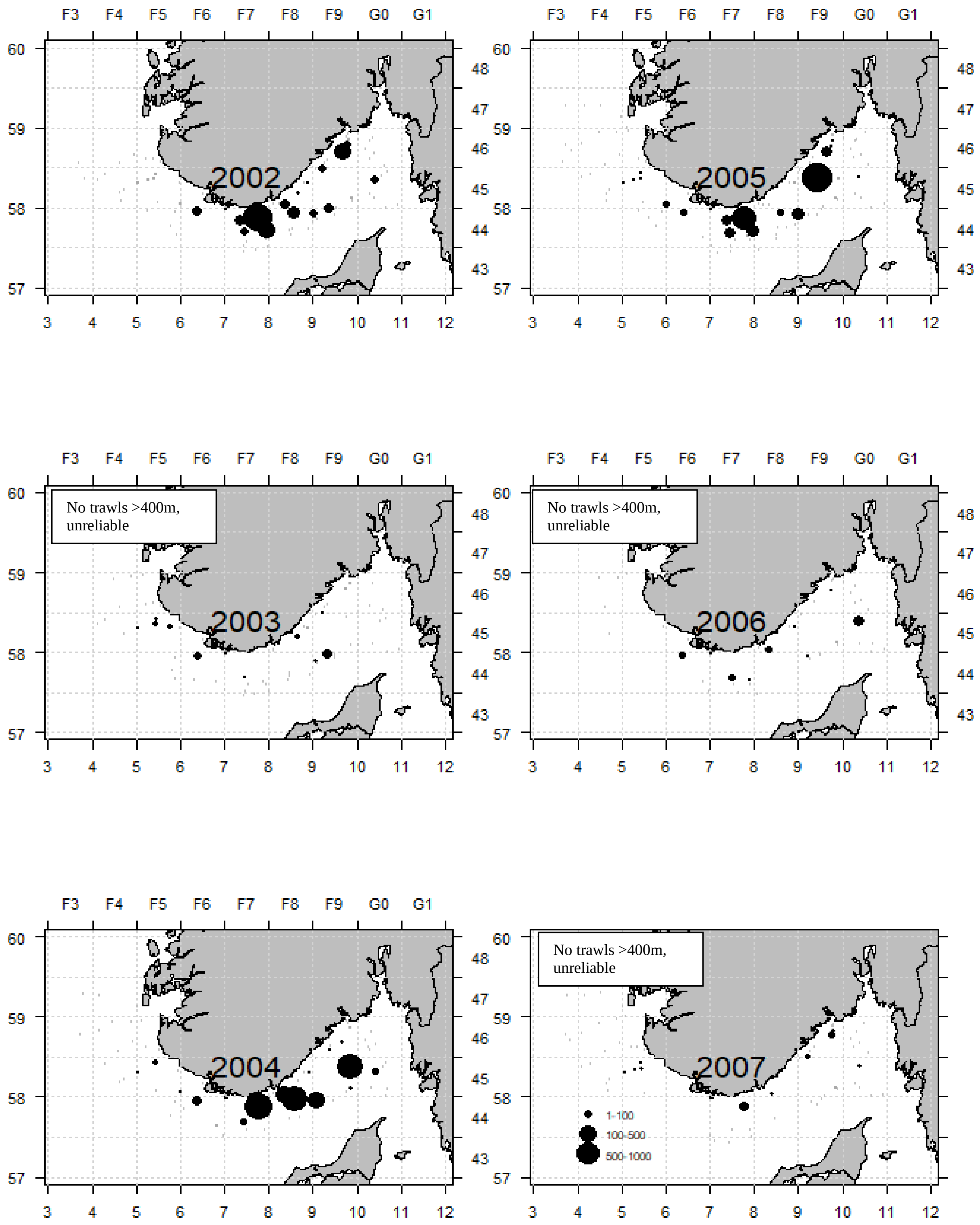

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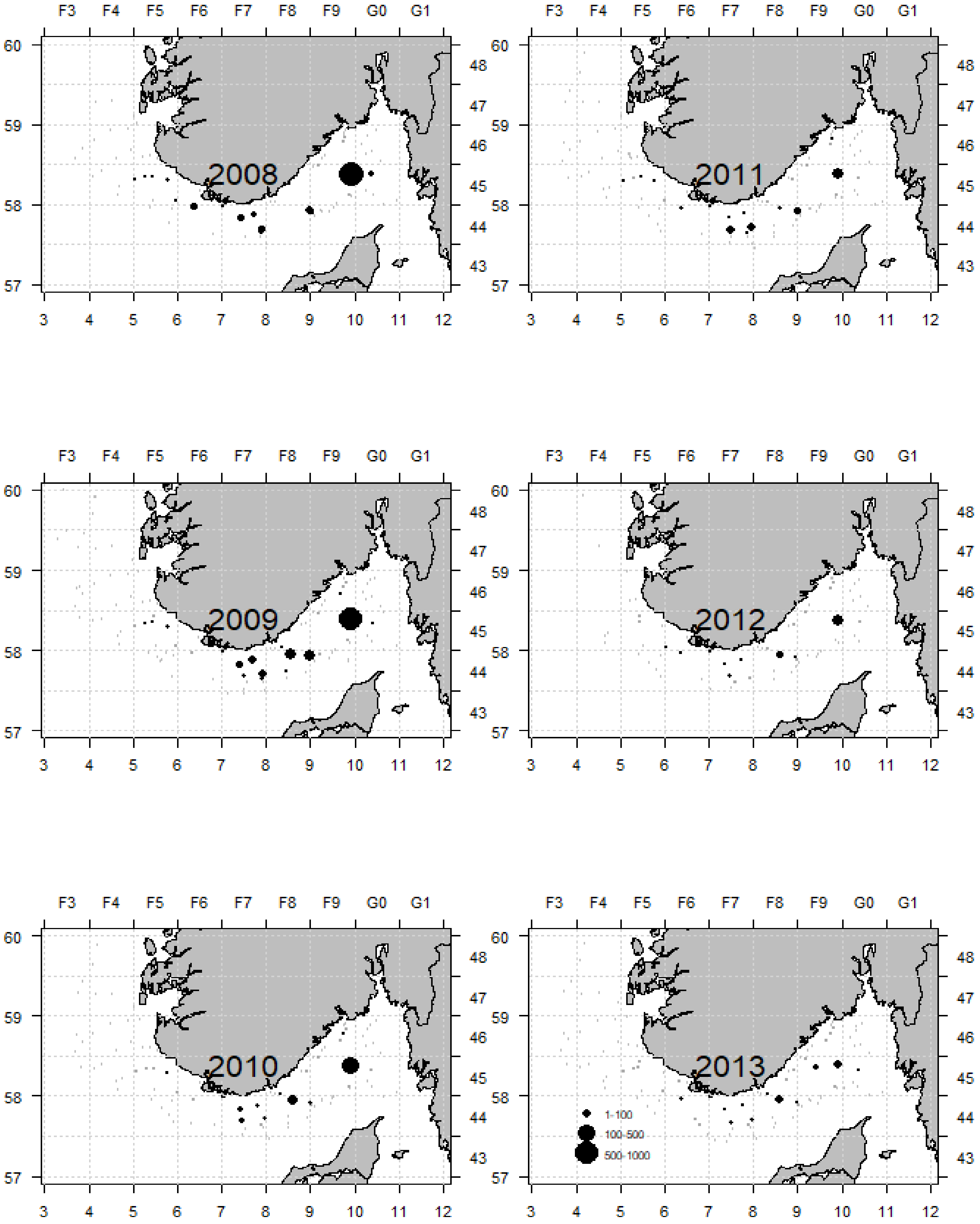

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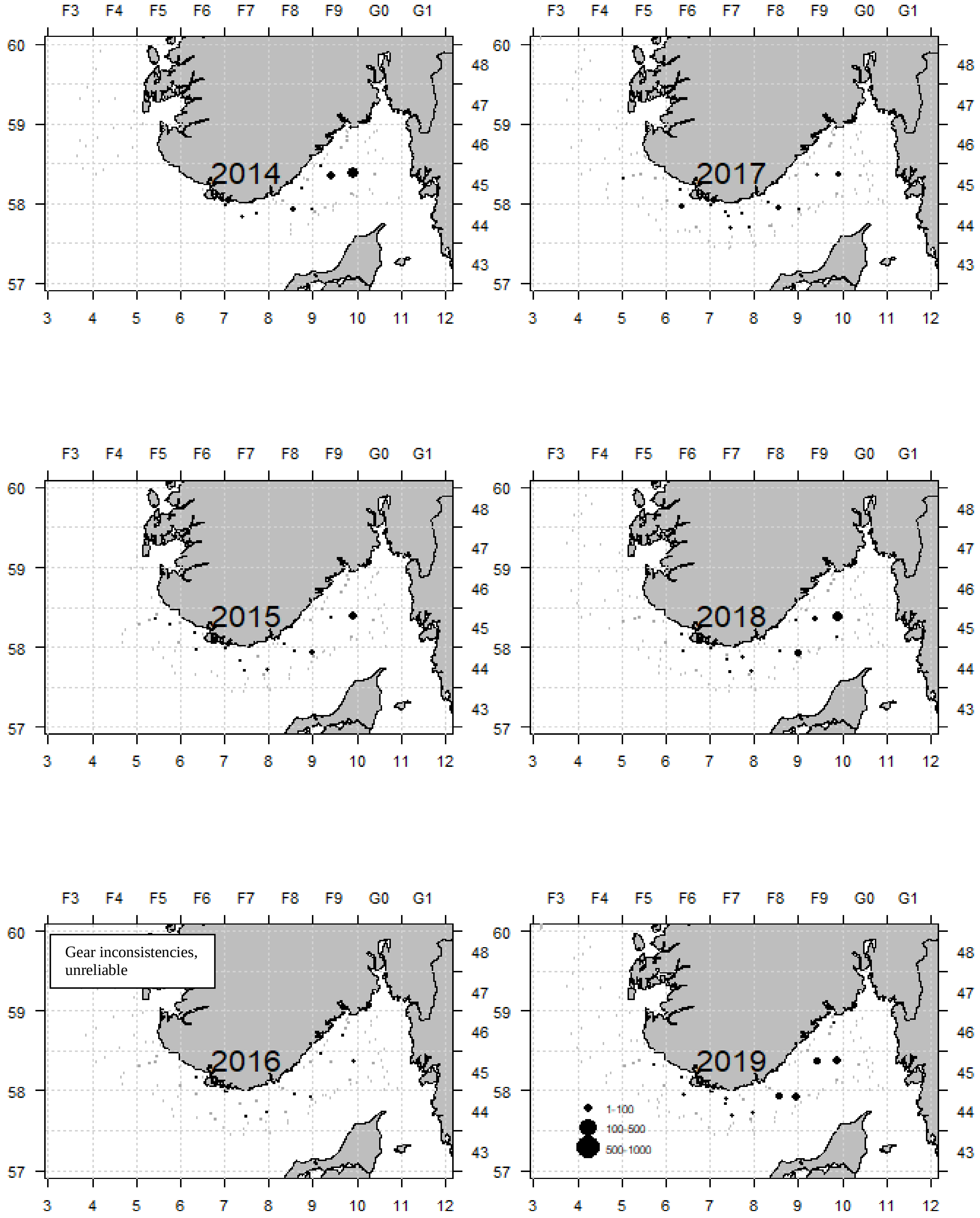

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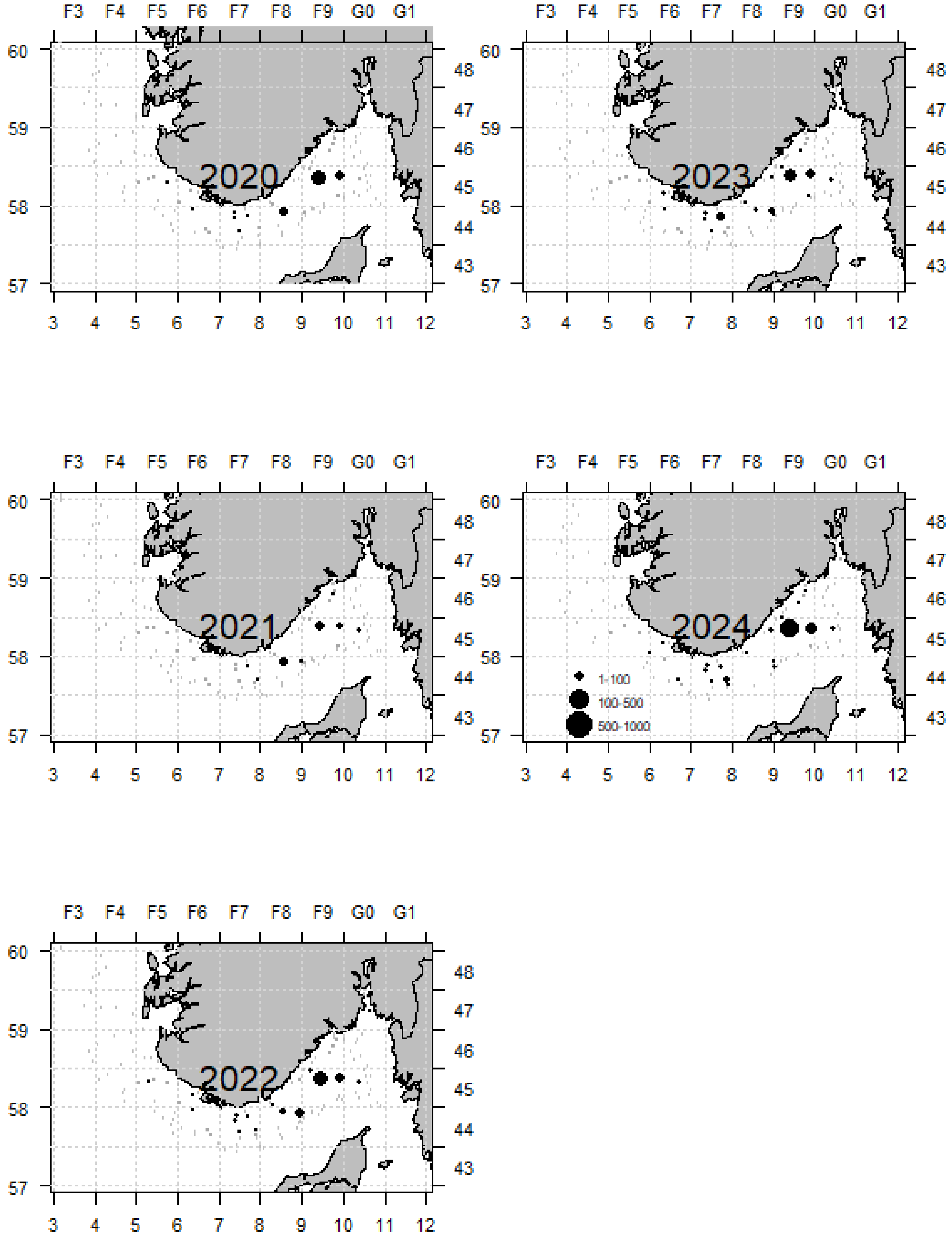

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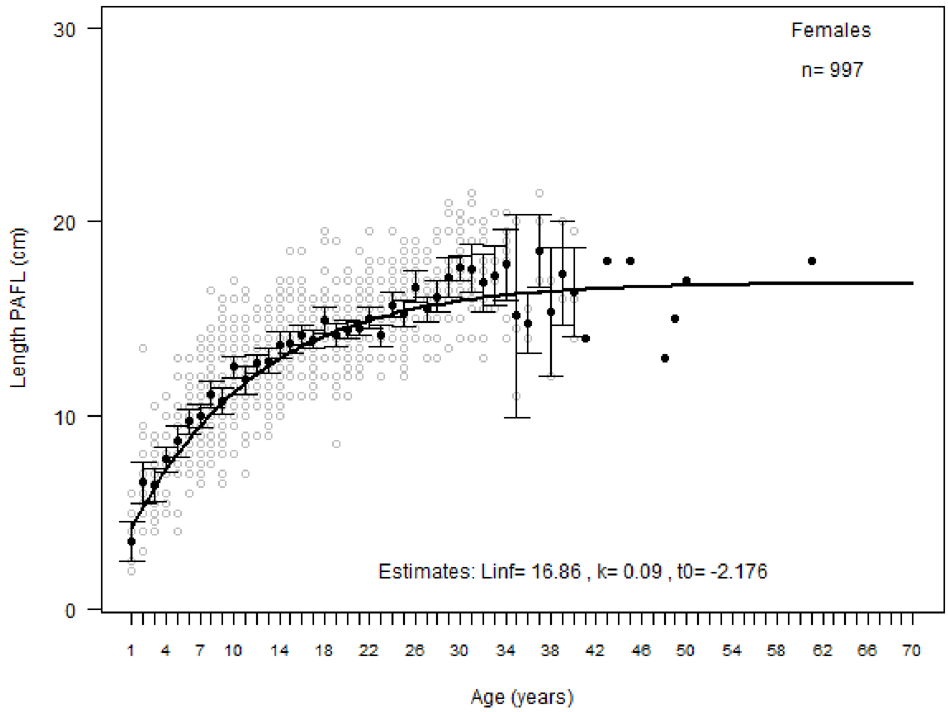


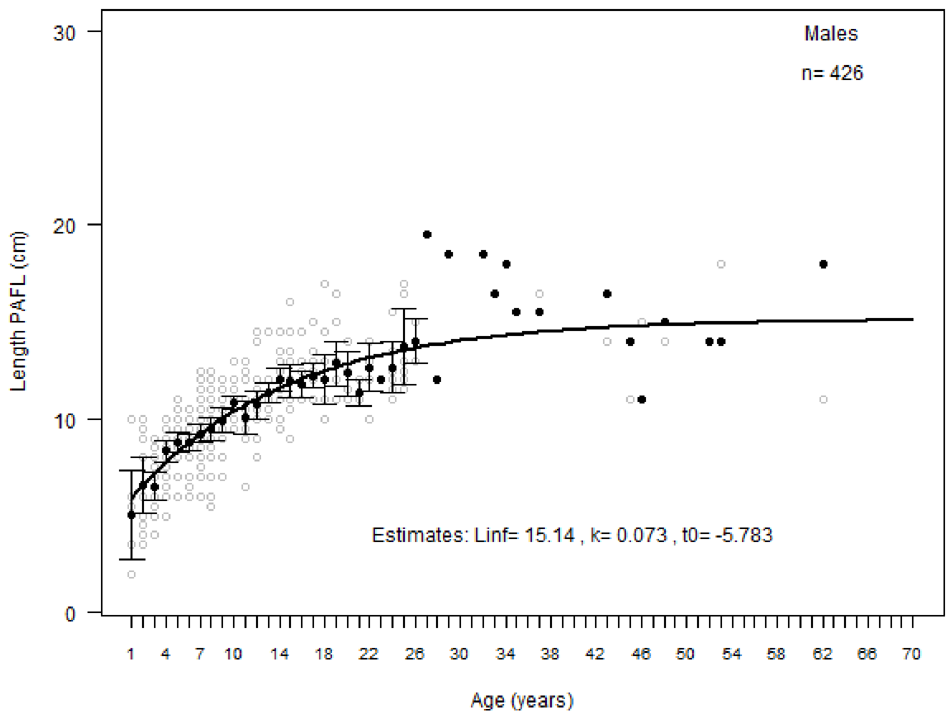


Figure 5. Length at age for female and male roundnose grenadier; data from Skagerrak 2008-2024. Mean values are estimated with ±2SE where there is more than one value. Estimated von Bertalanffy growth curves with parameters for females and males.

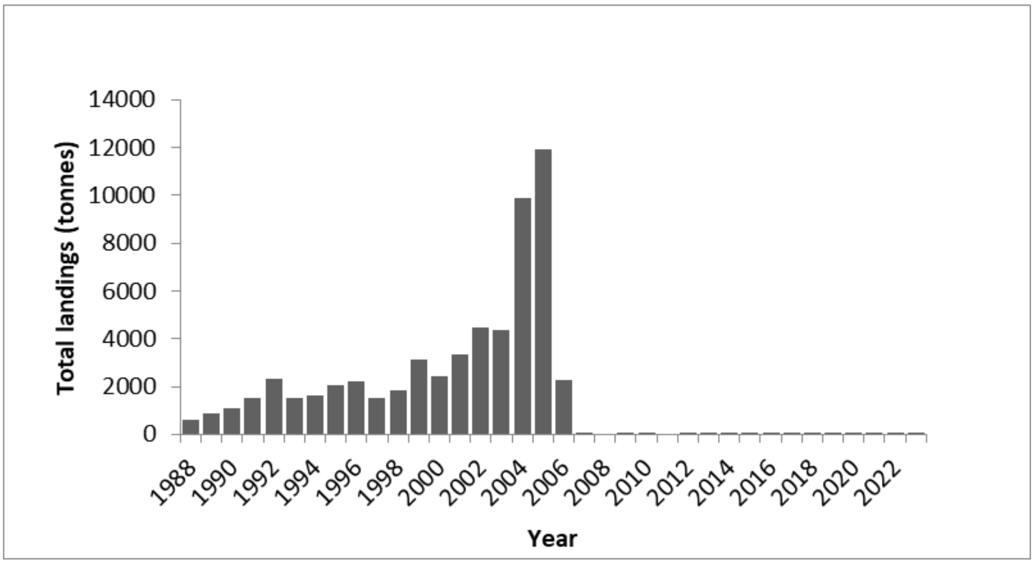
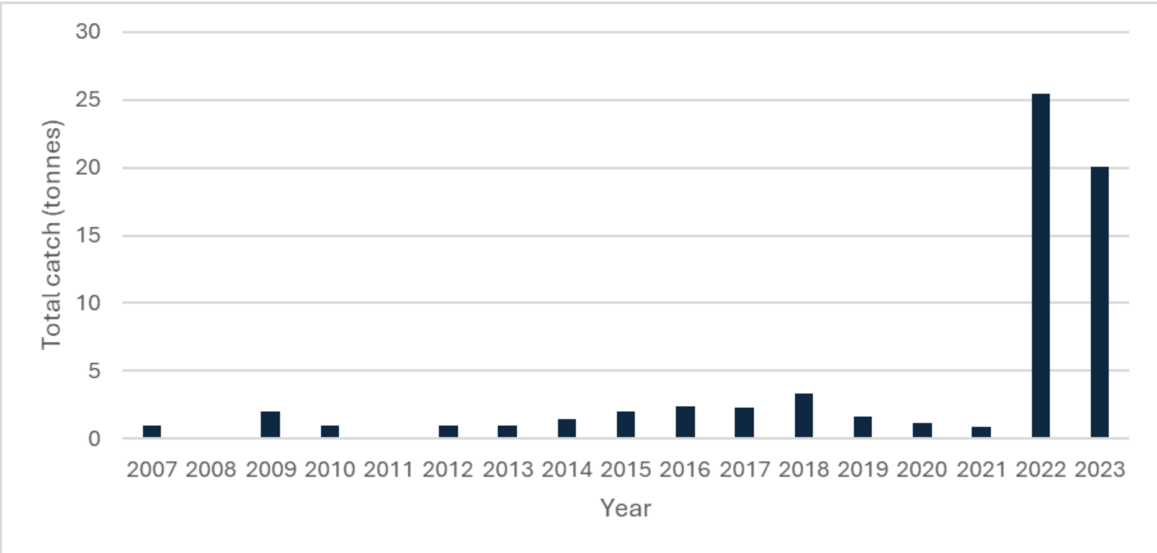


Figure 6. Total reported landings of roundnose grenadier in ICES Division 3a, 1988-2023. Landings from 2007 and later are very small and all less than 2 tons.



Figur 7. Total reported catches of roundnose grenadier in ICES Division 3a from 2007-2023. From 2014 discards are included in catches.

WGDEEP 2024, WD xx

CPUE Standardization of Silver smelt in 5b and 6a @ WGDEEP 2024

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10/04/2024

Abstract

At the WKGSS 2020 benchmark of Greater silver smelt in 5b and 6a, a combined and standardized CPUE series for the Faroe and EU fleets has been introduced (Quirijns and Pastoors 2020). In line with the 2023 calculation, a fleet effect was added to account for a mis-balance in data availability througout the time-series with almost an absence of PFA data in the early part of the time-series where Faroese data was availabe. Furthermore, the method applied in WGDEEP 2024 has been extended to cover the whole time series up to 2023.

It is noted that the signals in the two separate CPUE series are somewhat different in the most recent year, with a decline observed in the Faroese CPUE and an increase observed in the PFA CPUE.

1 Introduction

At the WKGSS 2020 benchmark of Greater silver smelt in 5b and 6a, a combined and standardized CPUE series for the Faroe and EU fleets has been introduced (Quirijns and Pastoors 2020).

2 Results

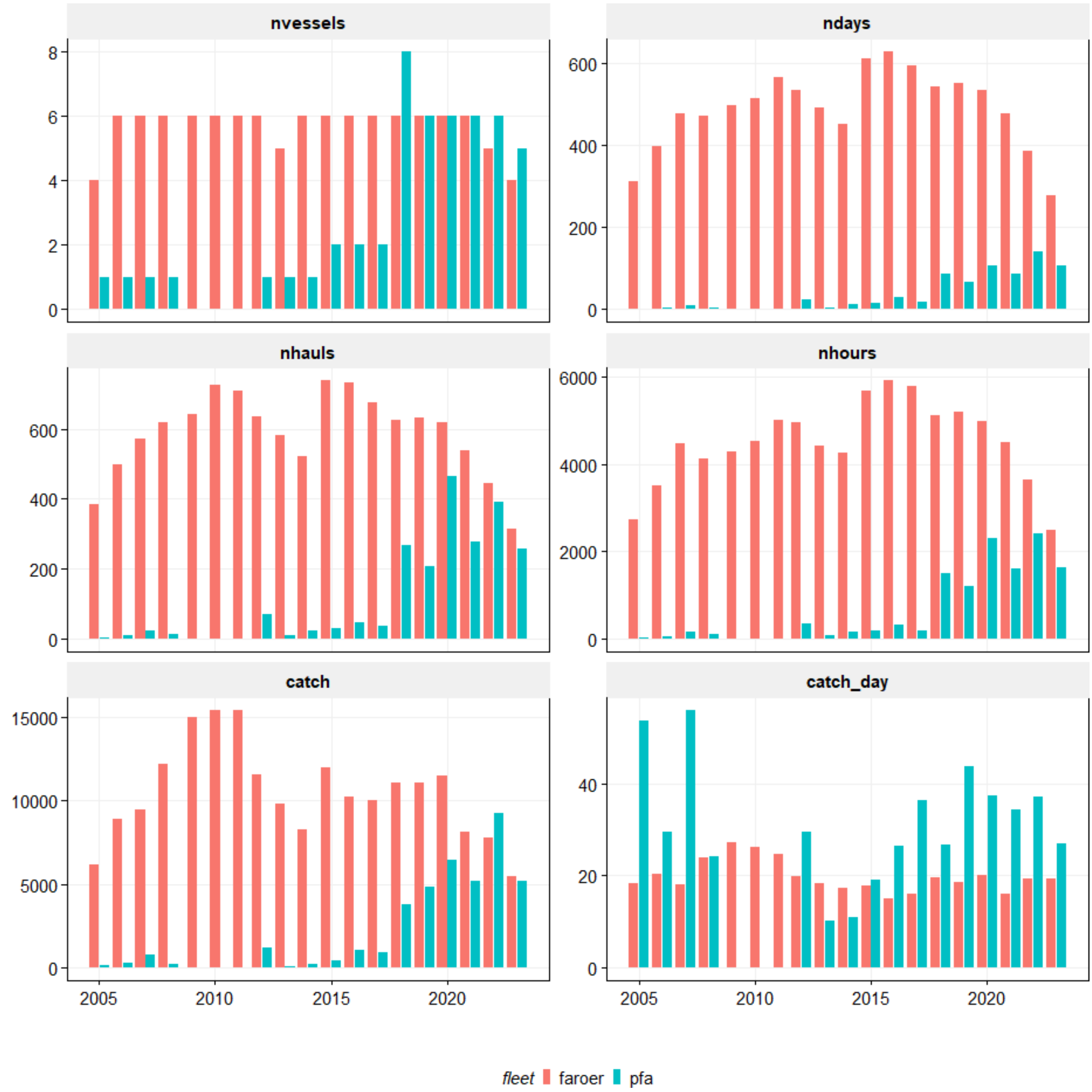


Figure 1: ARU.27.5b6a metrics describing the fisheries

The ‘raw’ (unstandardized) CPUE is based on the catch per day.

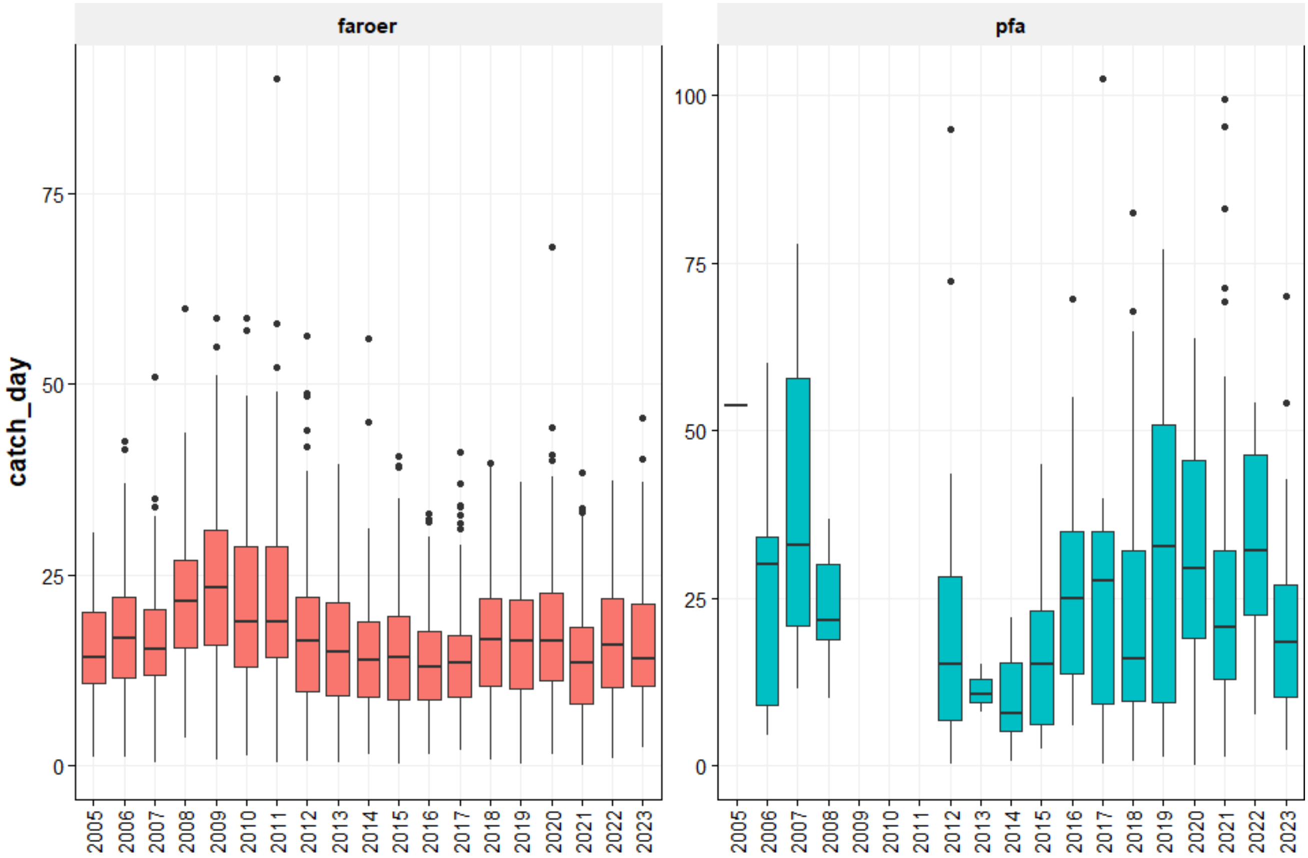


Figure 2: ARU.27.5b6a Catch per unit effort.

For the years 2005-2023, below are the spatial distributions of the used number of hauls by fleet.

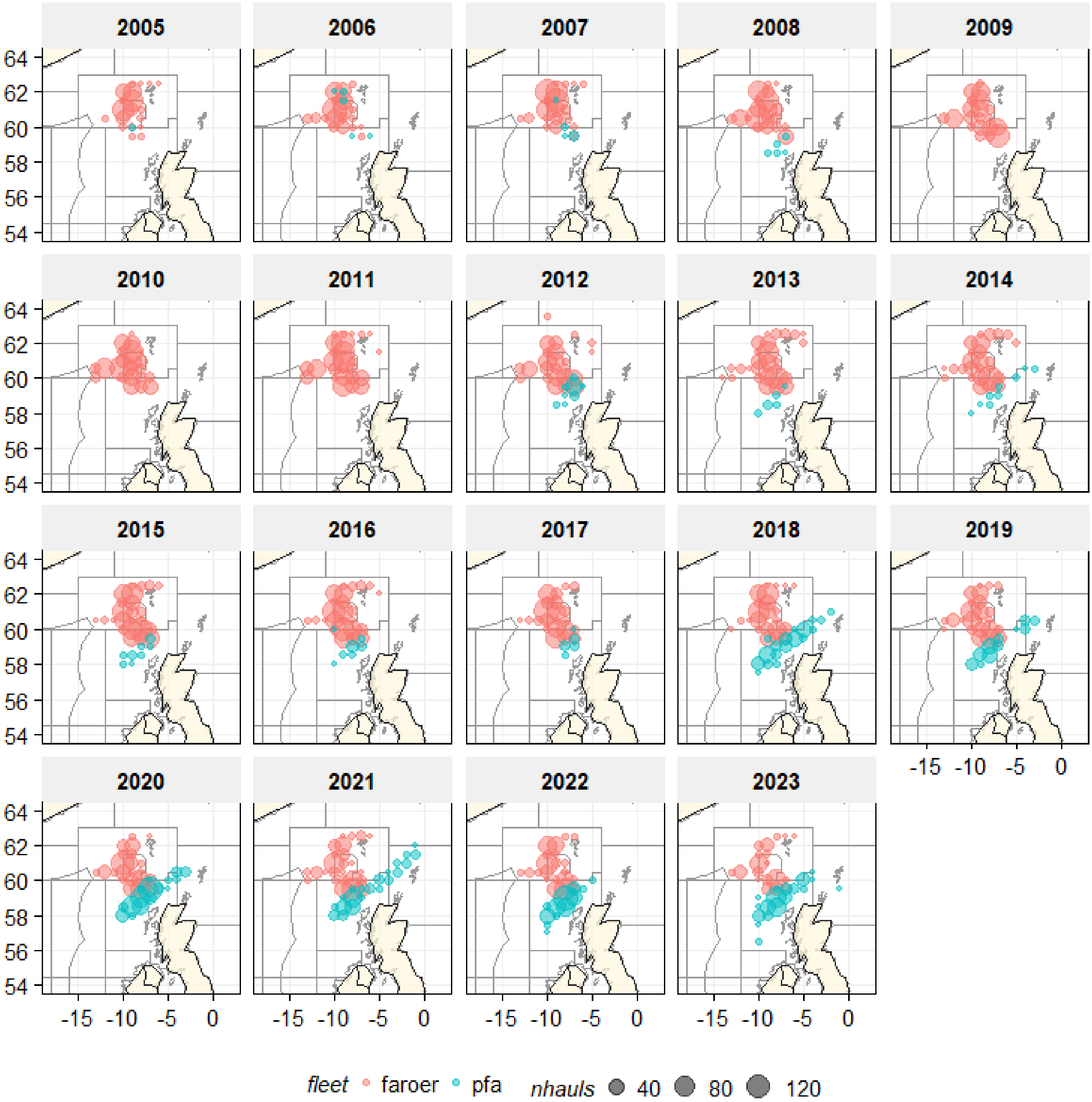


Figure 3: ARU.27.5b6a plot of the number of hauls by rectangle and day

Standardized CPUE index

We applied an updated model for standardization of of CPUE: CPUE ~ year + week + depth + fleet, where CPUE is expressed as catch per day and per rectangle. Catches have first been summed by vessel, year, week and rectangle and the number of hauls and fishing days have been calculated. Then the catches and effort (fishing days) have been summed over all vessels by year, week, fleet and the average depth has been calculated. CPUE was then calculated as the average catch per rectangle and per day by fleet.

The differences in modelling approach are shown below where we compare the model setup used in WGDEEP 2023 with the glm and gam approach.

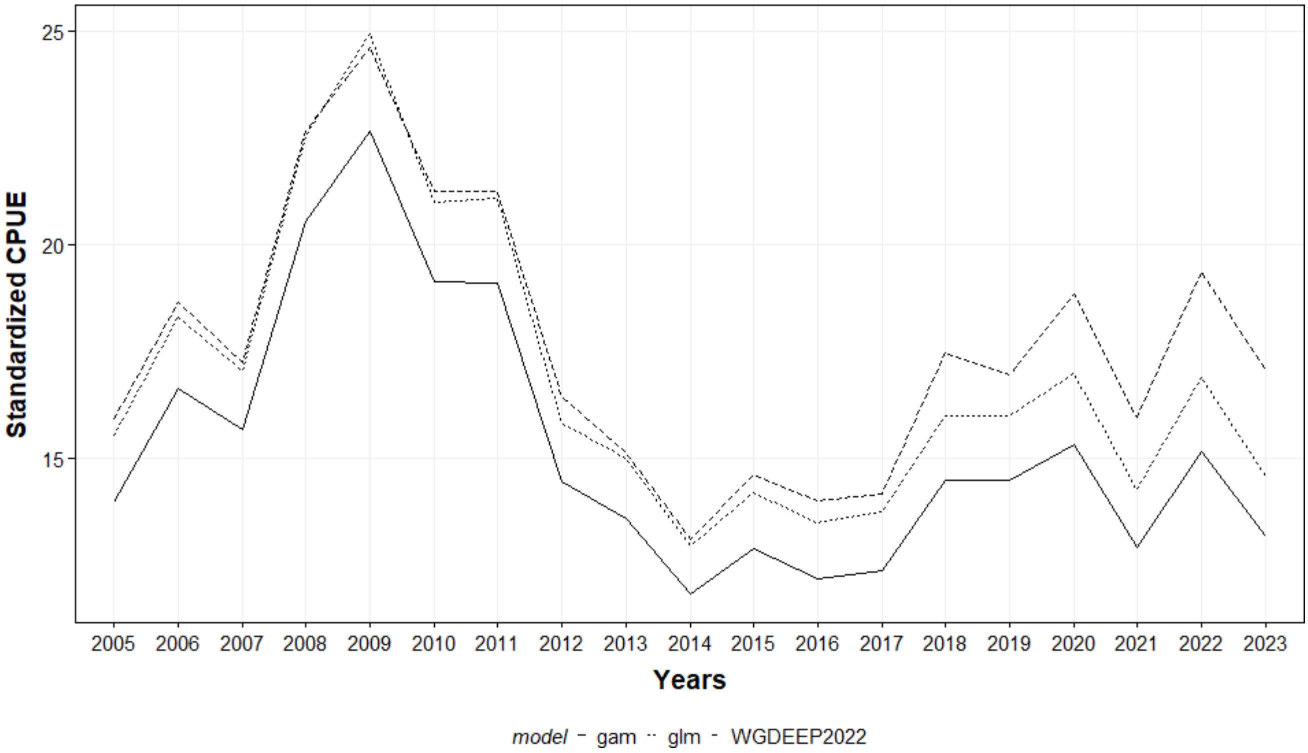


Figure 5: ARU.27.5b6a comparison of standardized CPUE between WGDEEP 2022 and updated model settings

Not only a scaling is visible, but also a change in trend from around 2015 onwards.

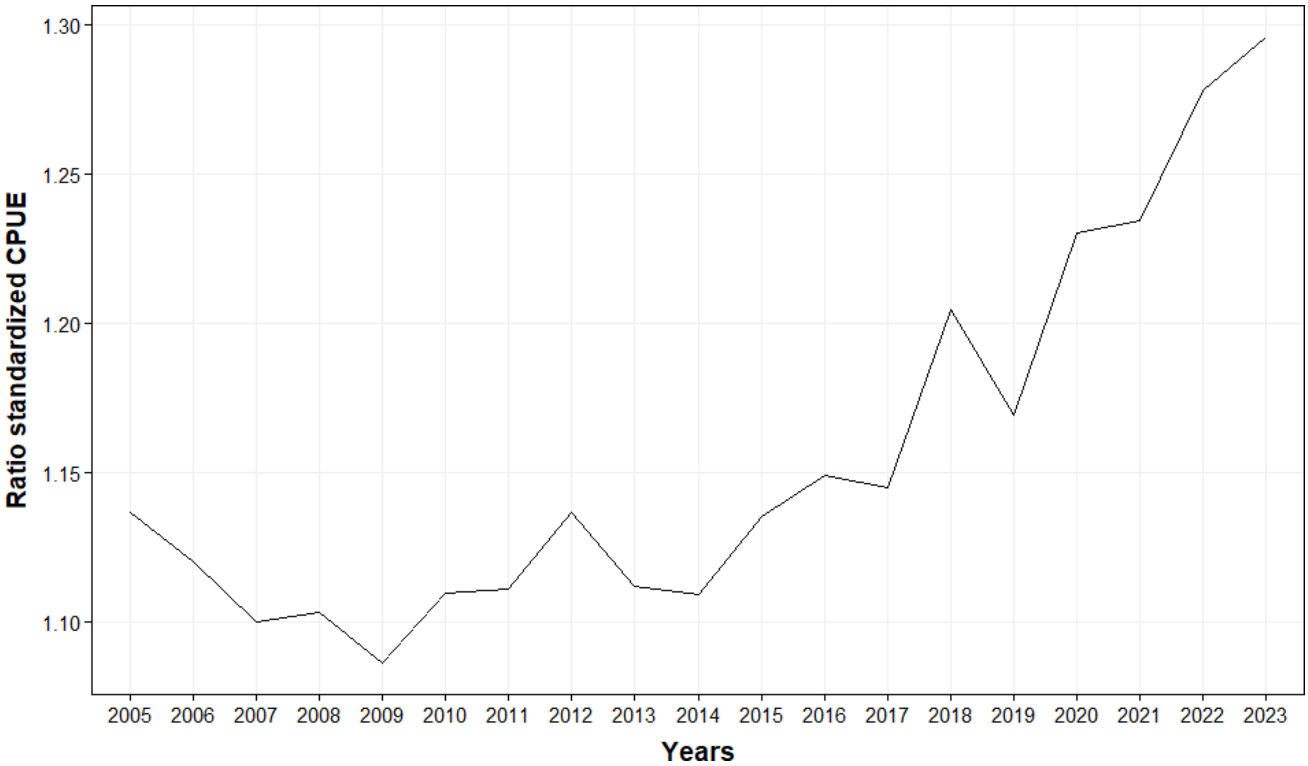


Figure 6: ARU.27.5b6a ratio between WGDEEP 2022 and updated standardized CPUE model settings

Finally, the comparison of the WGDEEP 2023 and WGDEEP 2024 time-series is presented. These time-series are very similar and given that these time series are fitted as relative indices in the assessment model, any up or downscaling of the absolute value is unimportant.

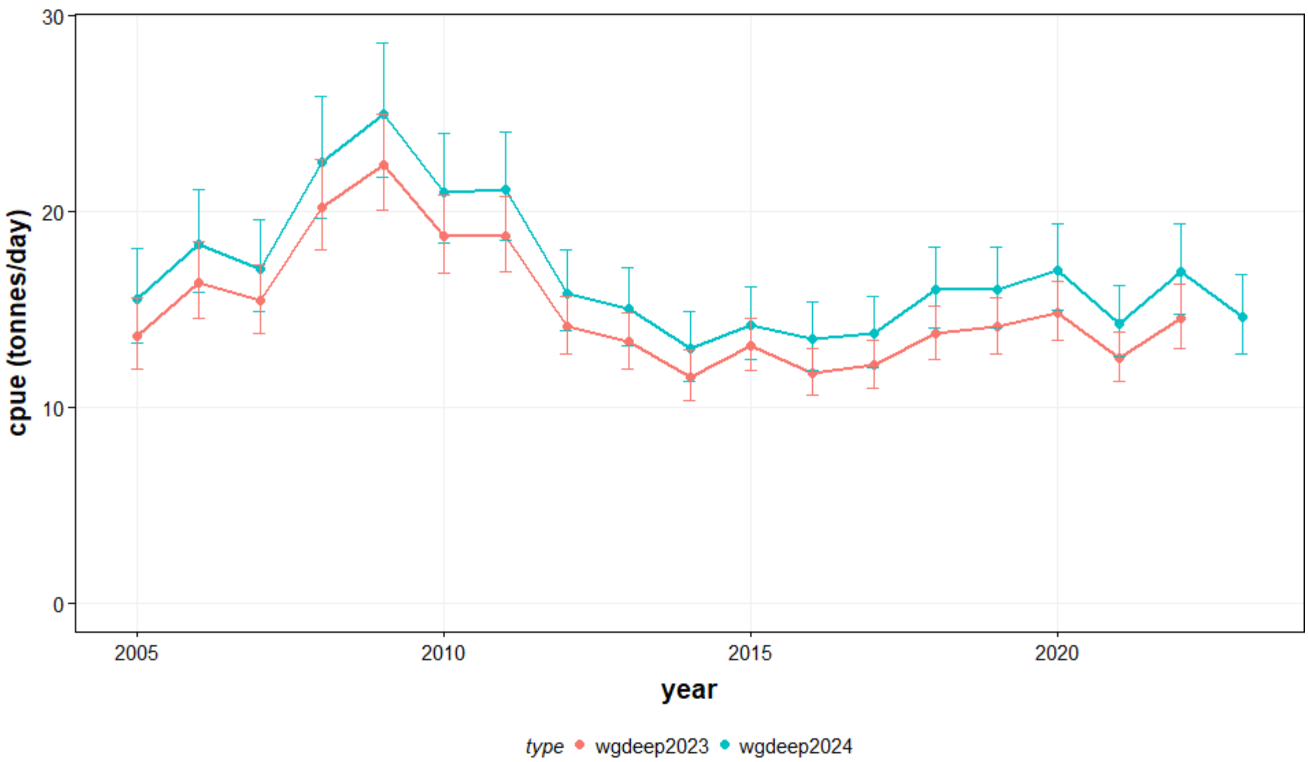
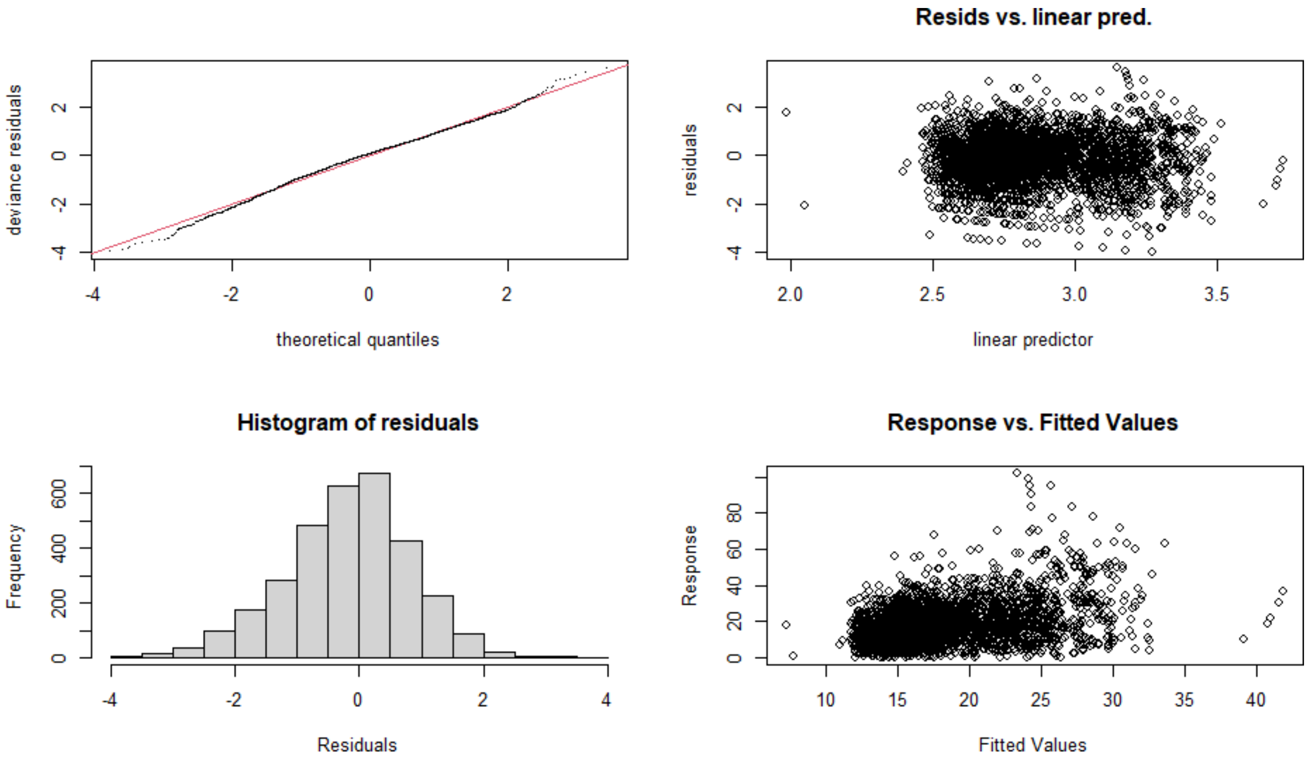


Figure 4: ARU.27.5b6a standardized CPUE (catch per rectangle and day), in comparison with WKGSS series

Model diagnostics




```
Method: UBRE   Optimizer: outer newton
full convergence after 5 iterations.
Gradient range [6.213142e-12,1.684888e-10]
(score 0.08107971 & scale 1).
Hessian positive definite, eigenvalue range [0.0003851978,0.0006646325].
Model rank =  38 / 38

Basis dimension (k) checking results. Low p-value (k-index<1) may
indicate that k is too low, especially if edf is close to k'.

           k'   edf k-index p-value
s(week)  9.00 6.38    0.83  <2e-16 ***
s(depth) 9.00 4.25    0.89  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 7: ARU.27.5b6a standardized CPUE model diagnostics

Evaluation of explanatory variables

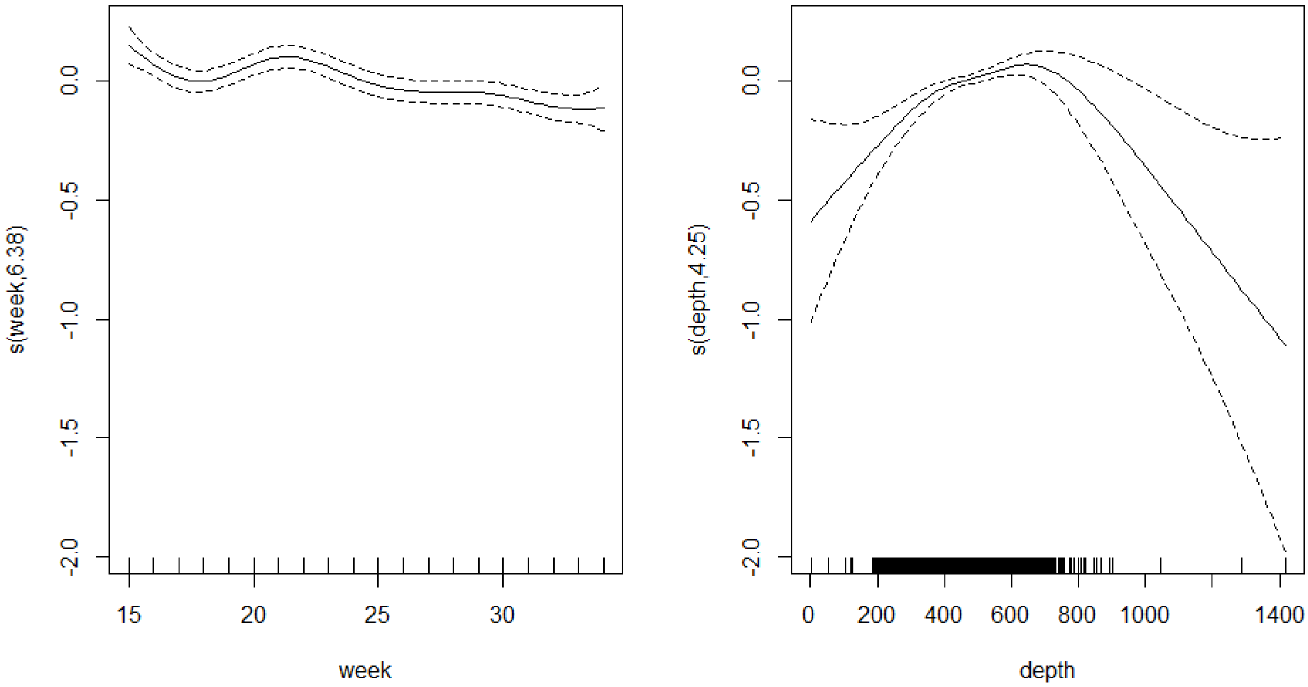


Figure 8: ARU.27.5b6a standardized CPUE explanatory variables

year	cpue	lwr	upr
2005	15.52	13.31	18.08
2006	18.3	15.86	21.12
2007	17.07	14.87	19.6
2008	22.54	19.62	25.89
2009	24.94	21.75	28.6
2010	21	18.38	24.01
2011	21.11	18.53	24.05
2012	15.84	13.91	18.03
2013	15.02	13.15	17.14
2014	12.98	11.32	14.88
2015	14.2	12.47	16.17
2016	13.5	11.87	15.35
2017	13.75	12.06	15.67
2018	16	14.09	18.17
2019	16.01	14.09	18.2
2020	17	14.94	19.35
2021	14.28	12.56	16.23
2022	16.9	14.72	19.39
2023	14.61	12.71	16.79

Table 1: ARU.27.5b6a standardized (GLM) commercial CPUE (tonnes/day) for greater silversmelt, with lower and upper values based on the standard error.

year	cpue	lwr	upr
2005	14	12.28	15.95
2006	16.65	14.82	18.71
2007	15.69	14.04	17.53
2008	20.54	18.37	22.97
2009	22.66	20.34	25.25
2010	19.15	17.22	21.29
2011	19.12	17.27	21.18
2012	14.48	13.07	16.05
2013	13.61	12.23	15.14
2014	11.83	10.59	13.23
2015	12.89	11.63	14.3
2016	12.2	11.03	13.49
2017	12.39	11.18	13.72
2018	14.5	13.16	15.98
2019	14.51	13.13	16.03
2020	15.34	13.87	16.97
2021	12.94	11.73	14.27
2022	15.16	13.55	16.97
2023	13.18	11.77	14.76

Table 2: ARU.27.5b6a standardized (GAM) commercial CPUE (tonnes/day) for greater silversmelt, with lower and upper values based on the standard error.

Single fleet analysis

A single fleet analysis was carried out by using the combined raw CPUE datasets and extracting the separate parts for the Faroese and PFA fleets. These data were then processed in a similar fashion as in the combined analysis. It is clear that the Faroese data is substantially more precise that the data from PFA as evident from the confidence intervals. This is likely due to the number of observations, where the dataset from Faroe Islands over all years is based on 10 times the number of hauls compared to the PFA data. In addition, the Faroese fishery is a targeted fishery for silver smelt, while the PFA fishery is a mixed fishery with blue whiting in the daytime and silver smelt in the nighttime.

It is noted that the signals in the two separate CPUE series are somewhat different in the most recent years where the faroer time series is mostly flat while the PFA time series shows more variability, an increase since 2015 but a steep drop in 2023. The silversmelt fishery started very late in 2023 for PFA vessels and probably by that time, they missed the main hotspots, resulting in a sharp decline.

Figure 9: ARU.27.5b6a standardized single fleet CPUE (catch per rectangle and day)

3 Discussion

CPUE standardization using GAM procedures is a common way of dealing with CPUE information. Here we used aggregated data (catch per day) as the main response variable and year, week, depth and fleet as explanatory variables. Both area and period cannot use attributes that are related to the hauls. The standardized CPUE for WGDEEP 2024 is in line with the one presented in 2023.

It is noted that the signals in the two separate CPUE series are somewhat different in the most recent years where the faroer time series is mostly flat while the PFA time series shows more variability, an increase since 2015 but a steep drop in 2023. The silversmelt fishery started very late in 2023 for PFA vessels and probably by that time, they missed the main hotspots, resulting in a sharp decline.

The data from the Faroese fisheries are generated from a targetted fishery on silver smelt, while the data from the PFA is from a mixed fishery with blue whiting (blue whiting in the daytime, silver smelt in the nighttime). This probably leads to the higher uncertainties in the CPUE estimates for the PFA compared to the Faroese fleet. It is also noted that the number of observations in the PFA fisheries prior to 2015 is much lower than after 2015, because the self-sampling program only started in 2015.

4 References

ICES (2020). Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). ICES Scientific Reports. Volume 2, Issue 38: 928 pp.

Pastoors, M. A. and F. J. Quirijns (2020). Correcting an error in the CPUE Standardizing of Greater silversmelt for WGDEEP 2020, WD05.

Quirijns, F. J. and M. A. Pastoors (2020). CPUE standardization for greater silversmelt in 5b6a. WKGSS 2020, WD03.

The development of the Norwegian longline fleet's fishery for ling, tusk and blue ling during the period 2000-2023

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Introduction

Ling, tusk and blue ling were fished by Norway for centuries, and the amount landed has been recorded since 1896 (Figure 1). The major catches of these species are taken by longliners, and the catches are to a large degree bycatches. The fishery for these species is influenced by the size of various quotas for other species, especially the quota for Arcto Norwegian cod. Therefore, total catch may not be a good indicator of the condition of these stocks (Figure 2).

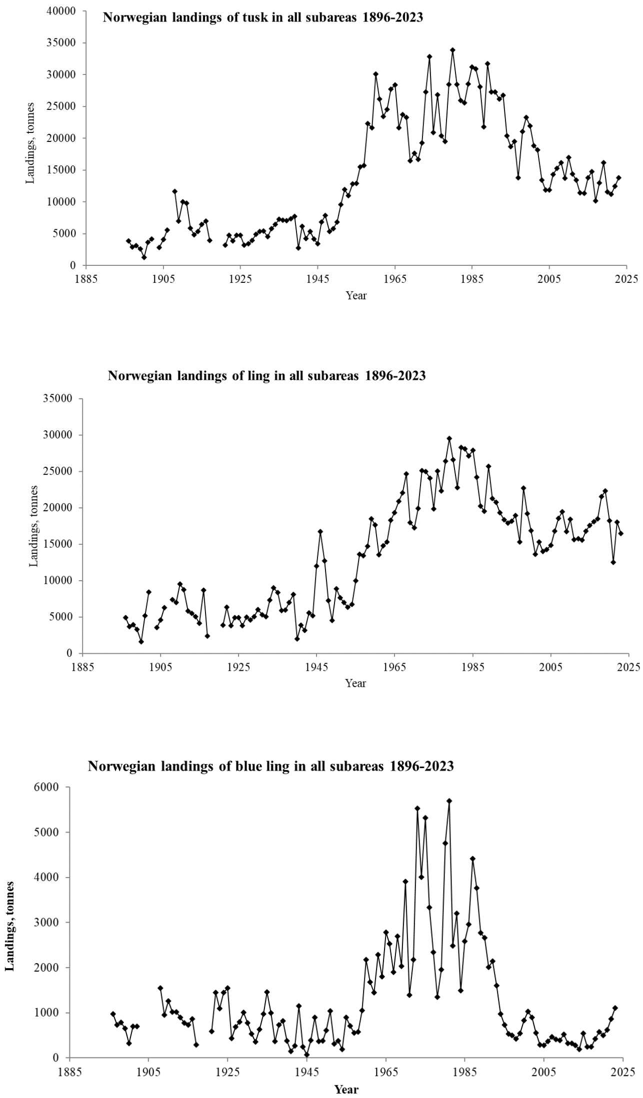


Figure 1. Reported Norwegian landings of tusk, ling and blue ling for the period 1896 -2023.

Scientific surveys do not cover the main habitats of ling, blue ling and tusk. Therefore, these stocks need to be monitored based on commercial data. One possible way to track their abundance, based only on commercial data, would be to develop a catch per unit of effort series for the fishery. But again, the major challenge for any cpue series: It is easy to generate a cpue series, and it is difficult to determine if the series track abundance.

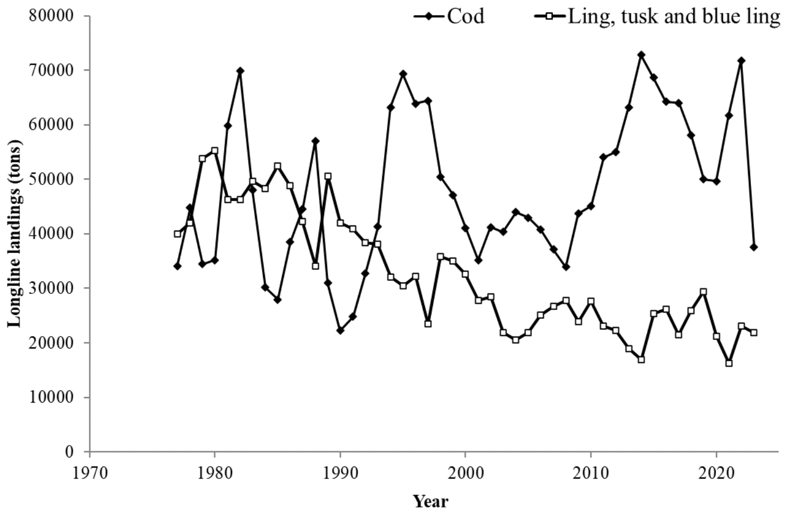


Figure 2. Total landings by longliners of cod (diamonds) and the combined total landings of ling, tusk and blue ling (open squares) for the period 1977- 2023.

Development of the Norwegian fleet of longliners, 1977- 2023

In addition to data on total landings*, the Norwegian Directorate of Fisheries (NDF) provides data on number of fishing vessels participated in the fishery, the gear employed, areas fished and changes in vessel ownership. In Table 1 are the number of long liners during the period 1977 to 2023, the total landed catch by the fleet, and the average annual catch per vessel. The number of vessels increased from 36 in 1977 to a peak of 72 in 2000, and after that the number decreased to 25 in 2014-2017, the last few years the number of vessels has stabilized at 26 vessels fishing more than 8 tons ling, tusk and blue ling.

The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The decrease in the number of vessels was accompanied by a decrease in total catches until 2004; afterwards, the landings have been varying but stable (Figure 3a). The catch-per-vessel was stable from 1980 until 2003. In the period 2003- 2019 there was a steady increase in catch-per-vessel with a sharp decrease in 2021 followed by an increase in 2022 (Figure 3b).

* The data provided by the NDF are the total landed catch, the logbook data, and the catch along with its location.

In 2012 new regulations were initiated and the number of cod quotas for each vessel increased from 3 to 5. This caused a further reduction in the number of long liners; from 36 in 2012, to 25 in 2015 to 2018. In 2023 there were 26 vessels.

a) b)

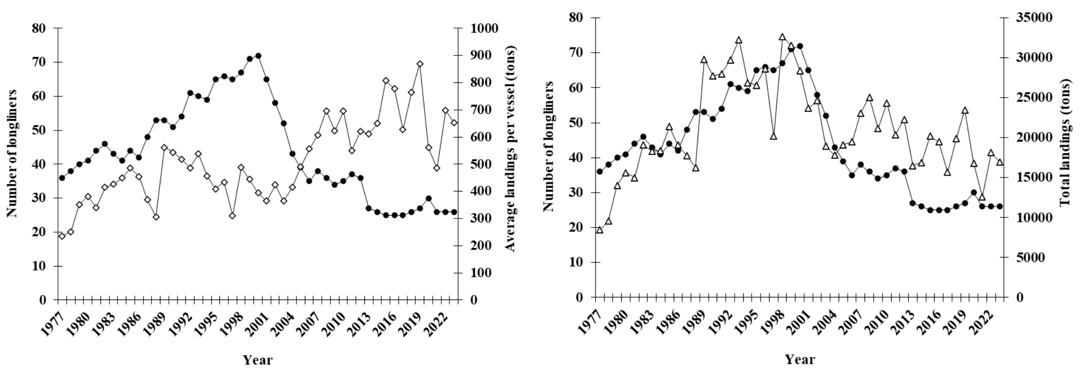


Figure 3. a) The number of long liners (filled circles) and the average landings per vessel of ling and tusk (open diamonds) in the period 1977-2023 and, b) the number of longliners and the total landings of ling and tusk (open triangles).

Logbooks

All available logbooks for the years 2000-2023 are now in the database, and the data have undergone extensive quality control procedures. The data for 2010 is incomplete because of problems getting some of the logbook data, both for the paper logbooks and for the electronic logbooks. In 2010, electronic logbooks were implemented for the longline fleet. The Norwegian Directorate of Fisheries has received the data, but because of lack of quality control, the 2010 data will not be released. Some fishers did not send paper logbooks because they had delivered the data electronically. Because of this, logbooks from only 11 of 35 vessels are available for 2010. The quality of the logbooks varies considerably, and a serious problem is that some lack information on the number of hooks used per day. The data from 2011 are almost complete with data from 35 of 37 vessels. In 2012 to 2023 all logbooks are available, though some days have been deleted due to punching errors.

Days in the fishery

The Norwegian longline logbooks provide information on the geographical distribution of the fleet. In Table 2 are the average number of days a vessel spent fishing for tusk, ling and blue ling, jointly or separately, for all ICES Subareas and Divisions. After 2000, when new quota regulations for cod were introduced, the number of days each vessel fished for three-deep-water species increased, and by 2005 the number of days in the fishery was twice that was in 2000. The data for 2006 show that the number of days in the fishery has decreased by more than 20 percent compared with 2005 and 2007. The data was checked for errors, but none were discovered. The number of fishing days has trended downward since 2007, most likely because of the record large stock of Arcto Norwegian cod. This trend changed dramatically in 2019 when the number of fishing days per vessel increased from 134 days in 2018 to 192 days in the tusk fishery and in the ling fishery it changed from 94 in 2018 to 125 in 2019. However, in 2023 the total number of fishing days had increased to 171.

Division 2a has been the main fishing grounds since 2000, followed by 4a and 5b (Table 2).

Average number of hooks per day

Table 3 are estimates of the average number of hooks used per day in each ICES area and in the total fishery for the years 2000-2023. For all areas combined, there was a steady increase in the number of hooks used from 2000 through 2009. This is also the general trend for subareas (Figure 4). The combined time series for 1972-1994 (Bergstad and Hareide, 1996) and the series based on data from 2000-2012 show that the average number of hooks has increased from 10 000 hooks per day in 1972 to around 39 000 in 2021 to 2023 (Figure 6).

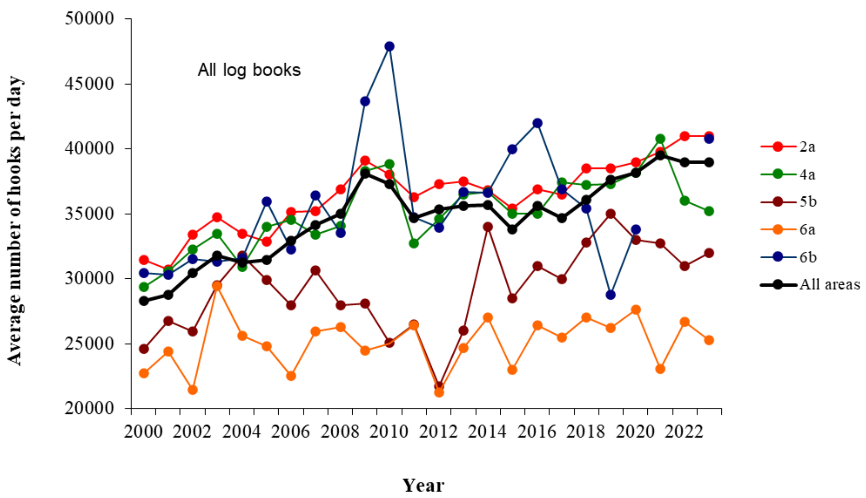


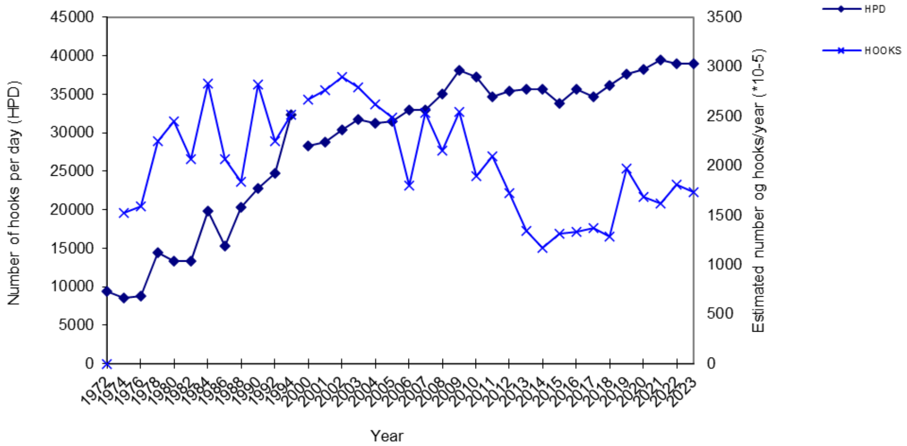
Figure 4. Average number of hooks the Norwegian longliner fleet used per day in each of the ICES subareas and in the total fishery for the years 2000-2023 for the fishery for tusk, ling and blue ling.

Total number of hooks per year

Based on the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, estimates of the total number of hooks used per year were generated (Tables 1, 2 and 3). Table 4 and Figure 5 show the estimated number of hooks (in thousands) set in each of the ICES subareas and in the total for all areas for the years 2000-2023 During the period 1974 to 2013 the total number of hooks per year has varied considerably, after this the number of hooks per year have been stable but with an increase in 2019. Since 2019 the number of hooks per year has been relatively stable (Figure 6).

The total number of hooks per year considers; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, may be a suitable measure of tracked applied effort. Based on this measure of effort, it appears that the average effort for the years 2011-2023 is 40% less than the average effort during the years 2000-2003.

a.



b.

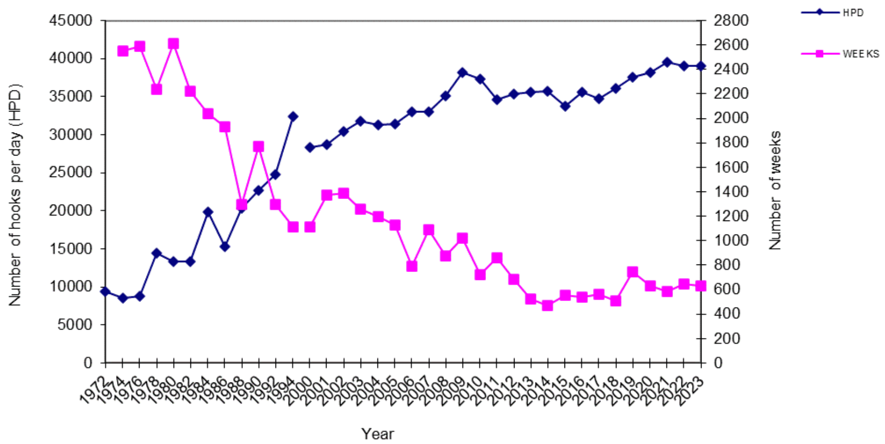


Figure 5. The combined time series for 1972-1994 (Bergstad and Hareide, 1996) and the series based on data from 2000-2023: a) The numbers of hooks used per day, and the total number of hooks used per year; b) The numbers of hooks used per day, and the total number of weeks the long liners participated in the fishery for ling and tusk.

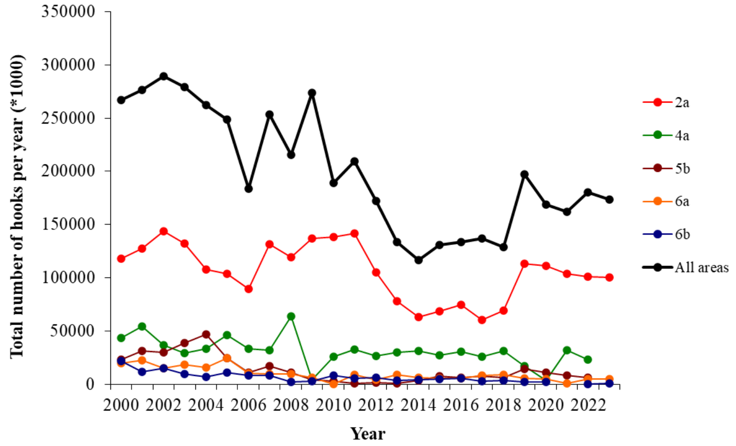


Figure 6. Estimated total number of hooks (in thousands) the Norwegian longliner fleet used in the ICES subareas with highest catches and in the total fishery for the years 2000-2023 for the fishery for tusk, ling and blue ling.

The size of the vessels

There was a steady increase in the average size of the vessels from 34 m in 1977 to 45.2 m in 2023. Figure 7 show the average size of the vessels and the smallest and the largest vessel in the fleet for the period 1977 to 2023.

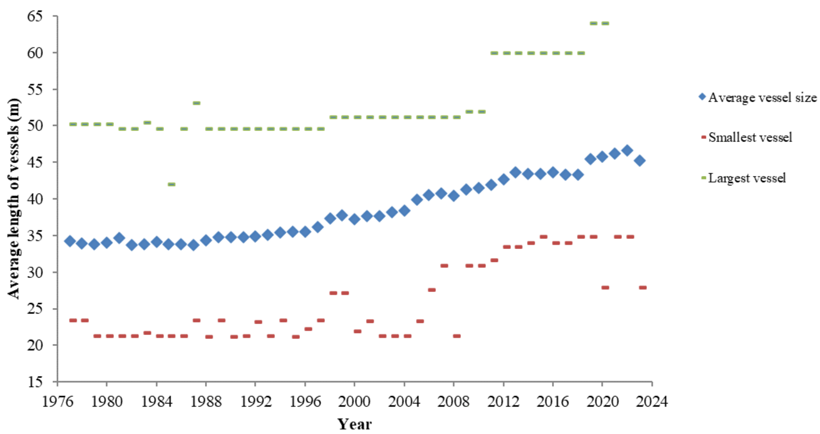


Figure 7. Average size of longliners >21 m for the period 1977-2023.

Fishing area

Approximately 65-70% of the commercial catches of ling are taken by vessels using demersal longlines, either target species or bycatch (Helle and Pennington, 2015), and the remains are taken mainly by gillnets but also some by trawlers. Although the tusk fishery takes place from Rockall to the southern Barents Sea (Helle and Pennington, 2004), between 70 to 80 percent of the catches by Norwegian vessels are from the Norwegian Economic Zone.

Figure 8 shows all the catches of ling registered in the electronic logbooks by longliners in 2013-2023 in areas 1 and 2.

Tusk are mainly caught by longliners (approximately 90 percent of the total catch). Figure 9 shows all catches of tusk registered in the electronic logbooks by longliners in Areas 1 and 2 during the period 2013 to 2023.

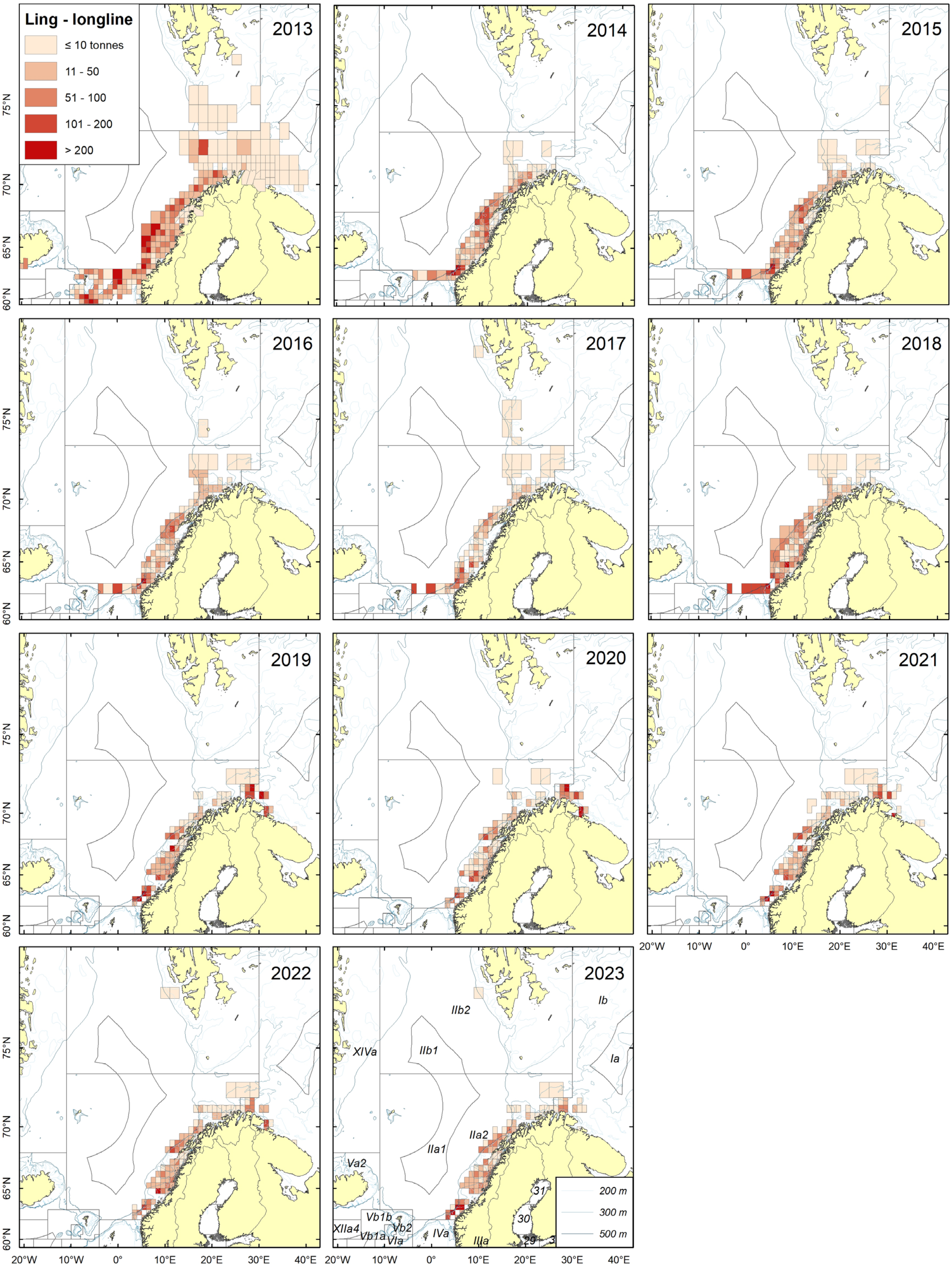


Figure 8. Distribution of the catches using longlines by the Norwegian fishery for ling in 2013 to 2023 in areas 1 and 2.

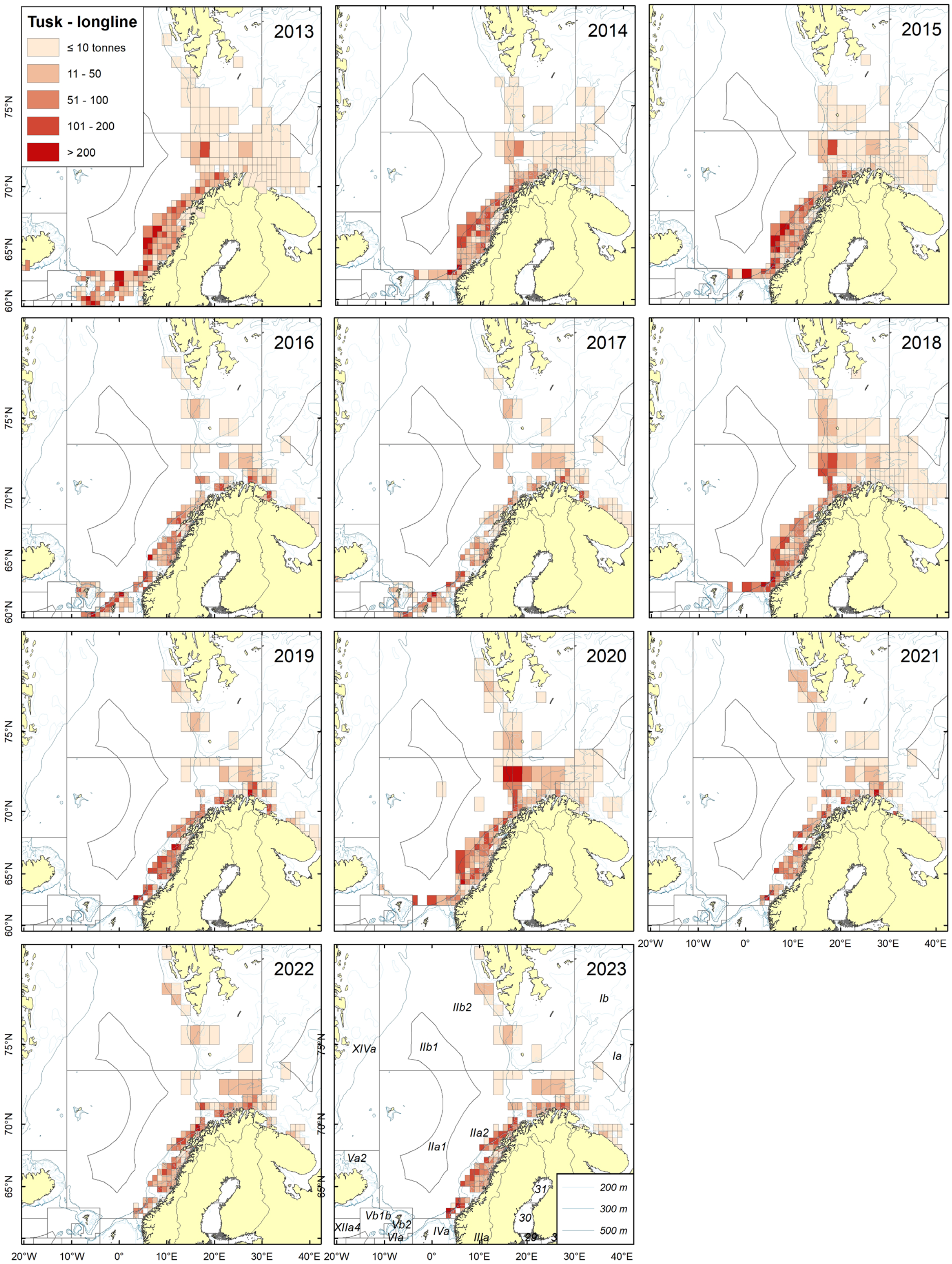


Figure 9. Distribution of the catches using longlines by the Norwegian fishery for tusk in 2013 to 2023 in areas 1 and 2.

CPUE

Based on methods described in Helle *et al*., 2015 to derive a cpue series were for ling and tusk calculated two ways; using all data available and catches for which ling and tusk were targeted (>30 percent of the daily total catch).

In Figures 11 and 13 are plots of the estimated cpue series for the most important ICES subareas for ling and tusk: based on all the available data, and a cpue series based on only those catches that ling or tusk appear to be targeted; included plots of estimated 95% confidence intervals.

Ling:

Both cpue series for ling in 2a have been relatively stable since 2011, but with a declining trend the last six years for the targeted fishery.

In Areas 4a there was a steady increase in cpue from 2002 until 2016 and were down in 2017 and 2018 but with a slight increase in 2019 and 2020. In 2021 there were little or no fishing in the traditional areas due to no agreement about the TAC in the area. The estimate is therefore based on very limited data and does not present a correct picture of the stock situation. In 2022 the index was at the same level as in 2020 but declined sharply in 2023.

In 6a and 6b there was also a positive trend from 2002 to 2016 with a varying but stable index until 2022. There was a sharp decline in 2023 The Norwegian fleet had limited access to the areas in 2021 and there was very little fishery in 2022. There was no fishing in area 6b in 2021 and 2022. One Norwegian vessel fished in the area in 2023.

When all ling data for Areas 3.a, 4, 6, are combined for a cpue series, and ling was targeted a cpue series, both indicate a steady increase since 2003 to 2017 and then a decline in 2018. In 2020 there were an increase. The estimates for 2021 do not represent the normal fishery in the areas and should not be considered valid. In 2022 the index was at the same level as in 2020, in 2023 there was a sharp decline almost to the 2021 level.

Tusk:
Both cpue series in Area 2a have been relatively stable since 2011.

The series in Area 4a based on all the catches indicates at first a stable series and then a slightly decreasing trend for the last six years, while the series based on the targeted fishery shows a clear and positive upward trend from 2002 until 2013, after this there was a declining trend, and this trend is especially clear for the targeted fishery.

However, the index has been relatively stable for the targeted fishery the last five years.

The series in Area 5b shows a stable trend from 2000 to 2008, afterwards it increased until 2012, then decreased until 2017 and a relatively large increase in 2018 and a decreasing trend after 2018.

In area 6a 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 and slightly increasing level when all data are used, and a sharp increase from 2018 to 2019 for the targeted fishery followed by a decrease in 2020 (Figure 13). In 2022 the index was at the same level as during the period 2011-2016.

The cpue series for Area 6b when all data were used, a catch from longliners show a decrease from 2000 to 2006. After 2006, the cpue was low but at a stable level. There was no direct fishery for tusk in the last years.

The combined cpue series for areas 4a, 5b and 6a. shows an increasing trend from 2000 to 2010, after 2010 cpue was at a high and stable level, declined in 2017. After 2017 the index has been varying but in 2022 the index was at the same level as during the period 2011-2016.

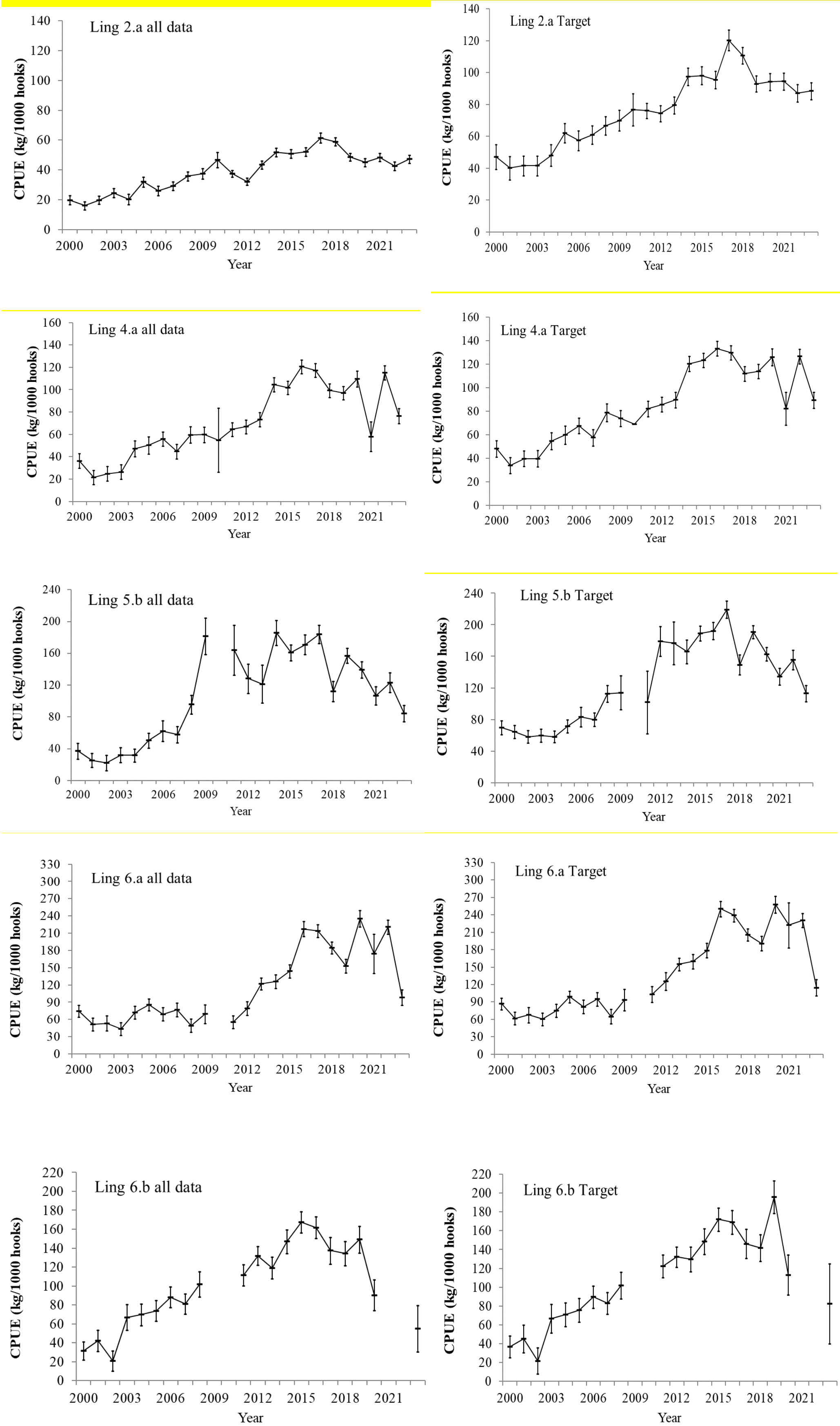
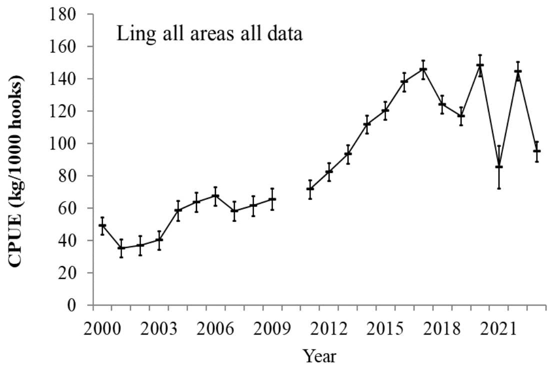


Figure 11. Estimated cpue (kg/1000 hooks) of ling in Subareas 2a, 4a, 5b, 6a and 6b based on skipper's logbooks during the period 2000-2023. The bars denote the 95% confidence intervals.



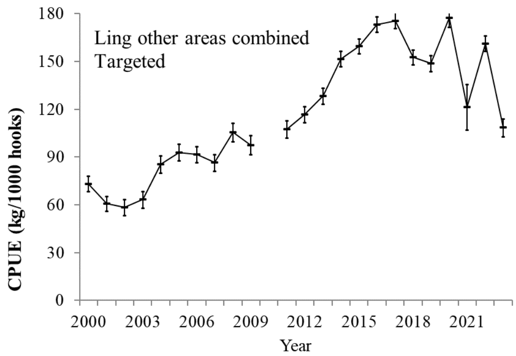


Figure 12. Ling areas combined (3, 4, 6) based on skipper's logbooks during the period 2000-2023. The bars denote the 95% confidence intervals.

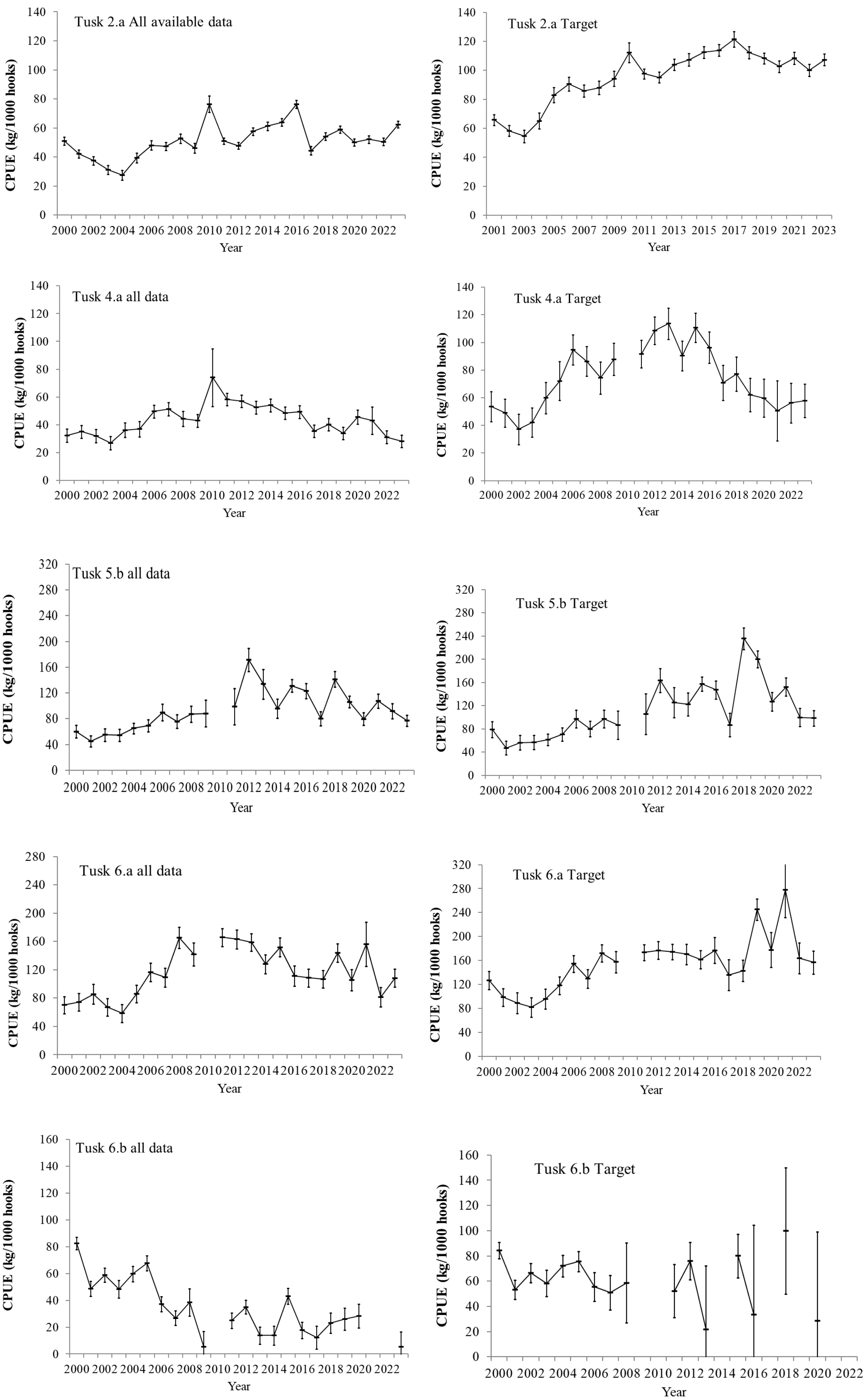


Figure 13. Estimated cpue (kg/1000 hooks) of tusk in Subareas 2a, 4a, 5b, 6a and 6b based on skipper's logbooks during the period 2000-2022. The bars denote the 95% confidence intervals.

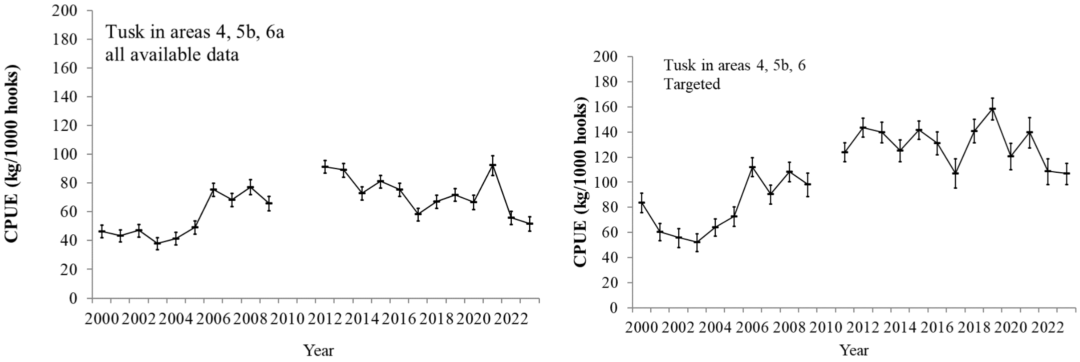


Figure 14. Tusk in other areas combined (4, 5b, 6a) based on skipper's logbooks during the period 2000-2021. The bars denote the 95% confidence intervals.

Blue ling

The cpue series for blue ling based on longline data shows a low and stable level for the Areas 1, 2, 3a and 4. Although there was no direct fishery in these areas, the stock does not seem to show any recovery.

A low and steady population for blue ling were in subareas 5a and 14 and in Areas 5b, 6 and 7. When only data from 6a, there was a positive trend from 2004 to 2015, after this the trend has been at a lower level until 2020. From 2021 there has been an increasing trend..

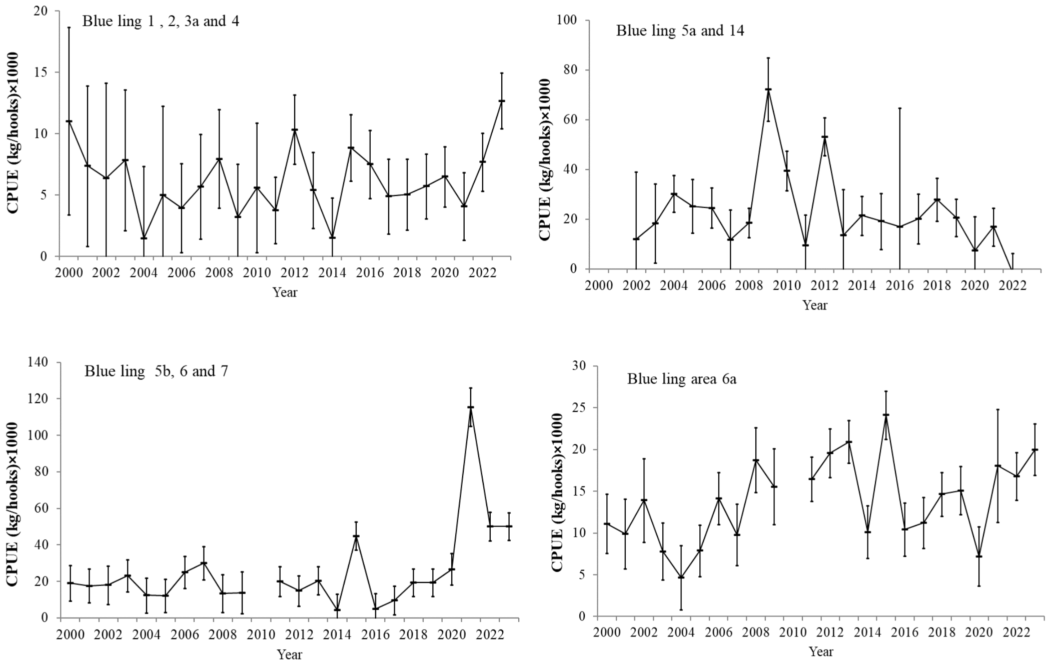


Figure 15. Estimated cpue (kg/1000 hooks) of blue ling in Subareas: 1, 2, 3.a; 4, 5.a; 14, 5.b, 6; 7; and in Subarea 6.a. All data from skipper's logbooks during the period 2000-2022. The bars denote the 95% confidence intervals.

Conclusions and discussion.

Legislation enacted since 2000 for regulating the cod fishery caused a continuous reduction in the number of longliners in the fishery for tusk, ling and blue ling, and by 2009, there were only 34 vessels above 21m in the fishery. Due to recent regulations, the number of vessels was 26 in 2021. Because of this decrease the number of vessels were 58 % fewer since 2000, the total number of hooks employed reduced, the total number of weeks fished, and until 2021, there were a significant reduction in effort. Compared with 2000, a decrease in total effort has occurred even though there was an increase in the number of hooks set per vessel/day until 2021. The large increase in effort in 2019 is probably due to a reduction in cod quotas. This fishery should be monitored and reported to prevent overfishing (Figures 5 and 6).

During the period 1998 through 2003, the total landings declined from 32 675 to 19 000 tons, while the catch-per-vessel remained relatively constant. The total catches were stable during the years 2004 through 2006, but after that, there was a sharp increase in 2007 and 2008. The average catch-per-vessel increased considerably during 2003- 2008, afterwards the catch has been relatively stable.

It should be noted that using the total landings as a measure of stock development can be very misleading. For example, there is a negative correlation between the landings of cod and the total landings of ling, blue ling and tusk (Figure 2), which is due to cod being the most valued species. Therefore, the decrease in total landings does not indicate a reduced stock size, but only an increase in cod quotas.

If a stock is not covered by a scientific survey, then a commercial cpue index is often used to track temporal trends in abundance. It is widely recognised that caution must be used when interpreting a cpue series based on commercial catch data. But by considering: the application and distribution of fishing effort; species specific knowledge, such as when a species is targeted or if it is a preferred species; patterns in the total catch by fleet and by vessel; etc., then based on all these factors, a reliable assessment of a stock's condition.

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Table 1. Summary statistics for the Norwegian longliner fleet during the period 1995-2023 (vessels exceeding 21m).

Year	Number of longliners	Total landed catch by fleet	Catch per vessel (Tons)
1977	36	8471	235
1978	38	9563	252
1979	40	14038	351
1980	41	15651	382
1981	44	15002	341
1982	46	19079	415
1983	43	18338	426
1984	41	18398	449
1985	44	21364	486
1986	42	19080	454
1987	48	17788	371
1988	53	16253	307
1989	53	29816	563
1990	51	27726	544
1991	54	27979	518
1992	61	29718	487
1993	60	32290	538
1994	59	26908	456
1995	65	26571	409
1996	66	28645	434
1997	65	20173	310
1998	67	32675	488
1999	71	31528	444
2000	72	28391	394
2001	65	23681	364
2002	58	24619	424
2003	52	18969	365
2004	43	17815	414
2005	39	19106	490
2006	35	19475	556
2007	38	23060	607
2008	36	25069	696
2009	34	21158	622
2010	35	24360	696
2011	37	20344	550
2012	36	22302	620
2013	27	16522	612
2014	26	16907	650
2015	25	20189	808
2016	25	19478	779
2017	25	15663	627
2018	26	19895	765
2019	27	23498	870
2020	30	16827	561
2021	26	12621	485
2022	26	18134	698
2023	26	16995	654

Table 2. Average number of days that each Norwegian longliner operated in an ICES subarea/division.

All species	1	2a	2b	3a	4a	4b	5a	5b	6a	6b	7c	12	14b	All areas
2000	9	54	2	+	24	2		13	12	10	2	+	6	131
2001	5	64	9		22		1	18	14	6	1	5	3	148
2002	10	74	2		29			20	12	8		1	8	164
2003	12	73	3	1	21	1	3	25	12	6		3	9	169
2004	20	75	11		22		2	34	14	5	1	1	9	195
2005	23	81	14		25		2	21	25	8	0,4		5	203
2006	11	73	3		38		3	11	13	7				159
2007	15	101	21		27	3	2	15	10	6	1			201
2008	7	90	18	1	26		4	11	10	2			2	171
2009	19	103	20	1	49	1	2	4	7	2			3	211
2010	8	104	13		3		1	3		5			5	145
2011	12	103	4		21	3	2	1	9	4				159
2012	9	78	4		26	1	2	2	5	5	1		2	135
2013	6	63	2		22	2	2	1	11	4			1	114
2014	5	66	2		31	1	2	4	9	4			2	126
2015	8	77	4		36	1	2	11	9	5			2	155
2016	4	81	7		31	1	2	8	8	5			3	150
2017	12	66	15		33		2	10	13	3			4	158
2018	4	69	6		27	1	2	7	13	4			4	137
2019	5	109	14		31	1	2	15	8	3			6	194
2020	6	95	7		15		2	11	6	2			3	147
2021	16	100	20		3		2	10	1	0			6	158
2022	9	95	18		34		2	8	7				5	178
2023	7	94	15		25		2	12	7	1			8	171

Tusk	1	2a	2b	4a	4b	5a	5b	6a	6b	7c	12	14b	All areas
2000	3	34	1	18	1		11	12	4	2	1	2	88
2001	1	57		22		1	18	14	6	1	3	1	124
2002	5	66	2	28			20	12	8			2	141
2003	5	58		19	2	3	25	12	5			1	130
2004	6	60	1	21		2	34	14	5	1		3	148
2005	5	69	2	25		2	21	23	8	0		3	158
2006	1	67	1	37		3	11	13	7				140
2007	5	89	3	26		2	15	10	6	0			157
2008	4	92	4	30		4	14	15	5				169
2009	6	87	2	56	2	2	4	7	2			1	159
2010	4	93	2	2		3			4			2	112
2011	12	103	4	21		2	1	9	4				155
2012	9	78	4	25		2	2	5	4	1		2	132
2013	6	63	2	22		2	1	11	3			1	111
2014	5	66	2	31		2	4	9	3			2	125
2015	8	77	4	36	1	2	11	9	5			2	154
2016	4	81	7	30		2	8	8	5			3	148
2017	12	66	15	31		2	10	13	2			3	154
2018	4	69	6	26		2	7	13	3			4	134
2019	5	109	14	30	1	2	15	8	2			6	192
2020	6	95	7	15		2	11	6	2			3	146
2021	16	99	20	3		2	10	1				6	157
2022	9	91	18	34		2	8	7				5	174
2023	6	86	15	24		2	12	7	1			7	160

Ling	2a	3a	4a	4b	5a	5b	6a	6b	7c	14b	All areas
2000	23	+	19	1		12	13	4	3		76
2001	40		22	+	1	17	13	5	1		100
2002	50		29			18	11	7			114
2003	40	1	20	1	3	24	12	4			104
2004	37		22		2	34	14	5	1		115
2005	51		25		2	21	23	8	+		126
2006	54		38		3	11	13	7			126
2007	65		27	3	2	15	10	6	1		128
2008	52	1	25		4	11	9	2			104
2009	65	1	49		2	4	7	2			130
2010	70		3		3			7			83
2011	73		21	3	4	2	8	4			113
2012	59		26	1	2	2	5	5	1		98
2013	44		22	1	2	1	11	4			85
2014	53		31	1	2	4	9	4		1	106
2015	54		37	1	2	11	9	5		1	122
2016	55		31	1	2	7	8	5		1	111
2017	27		33		2	10	13	3			88
2018	41		27	1	2	6	13	4			94
2019	66		31	1	2	14	8	3			125
2020	47		15		2	10	6	2			83
2021	53		3		1	9	1				67
2022	53		34		1	7	7				102
2023	58		25		2	11	7	1			104

Blue ling	2a	4a	5a	5b	6a	6b	12	14b	All areas
2000	1	1		4	9	1	2	+	18
2001	1	+	1	3	6	1	5		15
2002	1	1		4	4	2		+	11
2003	1		1	5	8	2	2	+	14
2004	+	1	2	5	6	+		+	14
2005	+	1	1	1	10			+	14
2006	1	2	2	4	8	+			18
2007	1	2	1	5	6	1			16
2008	2	4	3	4	10			1	25
2009	1	4	2	3	6			1	17
2010	2	1	2					2	7
2011	2	2		1	7				12
2012	1	2		2	5			1	12
2013	1	2		1	8				13
2014	1	3	1	2	5	1		1	12
2015	3	4	1	5	7				20
2016	1	4		3	6				15
2017	1	3		5	7			1	17
2018	1	3		4	8			1	17
2019	4	3		6	6			2	21
2020	6	4		3	4				17
2021	6		1	4	1			1	13
2022	5	9	1	4	6			1	26
2023	10	8	1	8	6			1	34

Table 3. Average number of hooks that the Norwegian longliner fleet used per day in each of the ICES subareas/divisions and in the total fishery for the years 2000-2022 in the fishery for tusk, ling and blue ling. n is the total number of days with hook information contained in the logbooks.

All		**1**	**2a**	**2b**	**3a**	**4a**	**4b**	**5a**	**5b**	**6a**	**6b**	**7c**	**12**	**14b**	**All areas**
2000	**Average**	31688	31439	35409	30250	29378	30263		24594	22763	30471	29600	18136	2815	28325
	n	353	1916	71	4	685	38		411	435	227	80	22	191	4429
2001	**Average**	33325	30703	34638		30553	33500		26760	24419	30340	33108	17548	2465	28743
	n	163	2196	315		727	10		613	447	140	37	175	135	4958
2002	**Average**	35432	33431	34756		32291	33867		25939	21484	31557			9458	30432
	n	263	2031	45		667	15		475	186	149			251	4083
2003	**Average**	35045	34766	34776	33037	33484	32559	22605	29513	29421	31325		13063	11515	31794
	n	376	1839	67	27	510	34	38	515	302	97		48	228	4081
2004	**Average**	32431	33475	31859		30934		25815	31804	25636	31559	25250		12474	31285
	n	433	1389	217		439		54	693	308	111	28		105	3777
2005	**Average**	32671	32861	35082		34039		23100	29885	24807	35949	33429		18960	31438
	n	316	1248	207		331		30	374	369	137	7		91	3110
2006	**Average**	33182	35140	39298		34561		21526	27943	22504	32273				32959
	n	187	1252	57		673		57	159	248	139				2711
2007	**Average**	34380	35207	37881	35000	33414	38086	25414	30681	25958	36400	31071			34110
	n	318	2103	328	8	587	58	58	355	249	145	14			4223
2008	**Average**	36833	36890	39650	36467	34056	31500	32704	27968	26319	33514			9464	35042
	n	96	1500	297	15	395	10	71	188	138	35			45	2790
2009	**Average**	39184	39142	43744	34636	38299	30167	26106	28123	24455	43645			7034	38127
	n	267	1419	281	11	680	6	33	57	99	31			38	2922
2010	**Average**	40519	38057	41607		38838		20182	25067		47904			7672	37296
	n	19	1089	135		37		11	30		52			58	1491
2011	**Average**	37205	36260	35280	35275	32737	37343	28062	26492	26424	34727			25750	34668
	n	411	3622	126	8	740	104	63	24	310	137			4	5549
2012	**Average**	36434	37298	38357		34639		33647	21702	21249	33934	39064		9091	35381
	n	307	2817	157		933		68	63	196	176	22		59	4765
2013	**Average**	39500	37500	42000		36500	43000	30900	26000	24700	36700	31000		27500	35600
	n	211	2073	81		710	34	69	34	351	132	10		36	3678
2014	**Average**	37699	36782	39660		36715	44614	35015	34000	26979	36551			22374	35676
	n	112	1501	44		707	22	46	101	214	97			65	2909
2015	**Average**	36100	35400	43500		35000	40800	31600	32400	30700	29000			29800	33800
	n	209	1902	91		908	33	54	276	222	130			53	3878

2016	**Average**	40000	36900	42000		35000	35000	37000	31000	26400	42000			31400	35600
	n	100	2025	175		775	25	50	200	200	125			75	3750
2017	**Average**	41700	36500	43000		37400	40300	33700	30000	25500	36900			25400	34700
	n	302	1660	374		815	11	54	260	320	78			89	3963
2018	**Average**	42800	38500	42000		37200	44500	42600	32800	27000	35400			35400	36100
	n	99	1776	142		692	34	51	148	295	96			105	3738
2019	**Average**	43000	38500	44300		37300	43800	38400	35000	26200	28800			26800	37600
	n	123	2956	381		842	31	63	393	218	79			172	5258
2020	**Average**	44600	39000	45900		38200		41400	33000	27600	33800			23300	38200
	n	168	2853	221		464		59	315	181	56			88	4405
2021	**Average**	43700	39800	46400		40800	47800	30000	32700	23100				34300	39500
	n	408	2600	524		80	6	42	250	17				150	4077
2022	**Average**	46900	41000	48600		36000		35000	31000	26700				31100	39000
	n	233	2353	459		900		45	200	191				120	4500
2023	**Average**	44800	41000	45700		35200		37400	32000	25300	40800			29600	39000
	n	169	2449	400		642		55	310	179	22			200	4426

Table 4. Estimated total number of hooks (in thousands) that the Norwegian longliner fishery for tusk, ling and blue ling used in each of the ICES subareas/divisions and in the total area for the years 2000-2022.

All	1	2a	2b	3a	4a	4b	5a	5b	6a	6b	7c	12	14b	All areas
2000	20534	117708	5099	218	50765	4358		23020	19667	21939	4262	1306	1216	267161
2001	10831	127724	20263		43691			31309	22221	11833	2152	5703	481	276508
2002	20551	143486	4032		54313			30089	14953	14642			4389	289469
2003	21868	131972	5425	1718	36565	1693	3526	38367	18359	9773		2038	5389	279406
2004	27891	107957	15069		29264		2220	46497	15433	6785	1086		4827	262325
2005	29306	103808	19155		33188		1802	24476	24187	11216	521		3697	248895
2006	12775	89783	4126		45966		2260	10758	10239	7907				183567
2007	19081	131569	29434		33381	4228	1881	17028	9604	8081	1150			253676
2008	9282	119524	25693	1313	31876		4709	11075	9475	2413			681	215719
2009	25313	137075	29746	1178	63806	1026	1775	3825	5820	2968			717	273523
2010	11345	138527	18931		4078		706	2632		8383			1343	189277
2011	16965	141922	5363		26124	4257	2133	1007	9037	5279				209464
2012	11805	104733	5523		32422	1230	2423	1566	3825	6108			655	171952
2013	7821	77963	2772		26500	1419	2039	858	8966	3633			1815	133752
2014	4901	63118	2062		29592	1160	1821	3536	6313	3801			1163	116875
2015	7220	68145	4350	0	31500	1020	1580	8910	6907,5	3625	0	0	1490	130975
2016	4000	74722	7350	0	27125	875	1850	6200	5280	5250	0	0	2355	133500
2017	12510	60225	16125	0	30855		1685	7500	8288	2768	0	0	2540	137065
2018	4451	69069	6552	0	26114	1157	2215	5970	9126	3682	0	0	3682	128588
2019	5805	113306	16745	0	31220	1183	2074	14175	5659	2333	0	0	4342	196949
2020	8028	111150	9639	0	17190	0	2484	10890	4968	2028	0	0	2097	168462
2021	18179	103480	24128	0	3182		1560	8502	601	0	0	0	5351	162266
2022	10975	101270	22745	0	31824		1820	6448	4859	0	0	0	4043	180492
2023	8154	100204	17823	0	22880	0	1945	9984	4605	1061	0	0	6157	173394

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2024).

Updating data from deep-water fishery of the Azores (ICES subdivision 27.10.a.2)

by

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Abstract

This document resumes and updates the information on the demersal/deep-water fishery from the Azores for the 2024 ICES working group WGDEEP. It presents a general summary description of the fishery, including information on landings, spatial distribution of effort, and catches.

1. Description of the Fishery

The Azores demersal/deep-water fisheries are a multispecies and multigear fishery with economically important and represent more than 70% of the annual total landed catch of the region (Menezes e Pinho, 2009; Santos et al., 2020). About 70 demersal species are landing in the Azores, from which around 24 are classified as deep-water, representing their landings in the last three years about 2200 tons in weight and around 13 million Euros in value at the first sale on the auctions (Fig. 1). The dynamic of the fishery seems to be dominated by the main target species *Pagellus bogaraveo*. However, other commercially important species are also caught (*Beryx* spp., *Polyprion americanus* and *Helicollenus dactylopterus*), and the target species seems to change seasonally according to abundance, species vulnerability and market (Pinho and Menezes, 2005; Pinho et al., 2014; Santos et al., 2019).

The fishery is clearly a typical small scale, where the small vessels (<12m; 90% of the total fleet) predominate, using mainly traditional bottom longlines and several types of hand lines.

The ecosystem is a seamount type, with fishing operations occurring in all available areas, from the island's coasts to the seamounts within the Azorean EEZ. Few seamounts are explored outside the EEZ, being the most frequently visited those of the south on the Fishery Committee for the Eastern Central Atlantic (CECAF) areas (WD Pinho, 2018). The fishery takes place at depths until 1000 m, catching species from different assemblages (shallow, intermediate, and deep), with a mode on the 200-700 m strata, the intermediate strata (slope) where the most commercially important species occur (Menezes et al., 2006; Santos et al., 2019). No major changes have been observed in the vessel's regime of operation and spatial distribution of effort, although in the recent five years, more vessels have changed from the longline to hand lines gear.

Since the end of the nineties, the landings of most of the commercially important species have decreased (Table 1, Fig. 2 and 3). This resulted from intensive fishing due to the development or entry of new and more technological vessels to fishing, expanding the fishing areas to offshore seamounts and increasing the catchability (Santos et al., 2021). Notably, the target species of the fishery, *Pagellus bogaraveo* seems to be the more resilient species, with landings starting to decrease a decade later with a significant decrease on landings observed during the last four years (see Fig. 2). The fishery is currently limited by the management rules to constrain the catches (TAC/quota).

To avoid species overexploitation, technical measures were introduced by the regional government in 1998 (including fishing restrictions by area, vessel type and gear, fishing licence based on landing threshold, minimum lengths, and closed areas for fishing; Santos et al., 2019). Under the E. C. Common Fisheries Policy, TACs were introduced for some species, namely blackspot seabream, black scabbardfish, alfonsinos, and deep-water sharks. During 2017 red seabream quotas were allocated by island, vessel and access conditions regulated by quater. In 2019, some techniques measures have been changed, as for example, a closed season (EC. Reg 74/2015) implemented in 2016 to reduce effort during the spawning period was revoked and the minimum lengths were revised by EC. Reg. 63/2019.

Since 2002, the use of bottom longlines in the coastal areas was significantly reduced, because the local authorities have banned the use of this gear in the coastal areas on a range of 6 miles for local vessels and coastal vessels with a length lower than 24m and 30 miles for larger vessels. Therefore, the smaller boats that operate in this area have changed their gears to several types of handlines, which may have increased the pressure on some species included the red seabream. The deep water bottom longline is currently a seamount fishery. Consequently, the fishery expanded to offshore seamounts areas, with a high concentration on the seamounts along the Mid Atlantic Ridge, including small vessels, targeting mainly red blackspot seabream (*Pagellus bogaraveo*), bluemouth (*Helicolenus dactylopterus*), alfonsinos (Beryx spp.) and wreckfish (*Polyprion americanus)* (Fig. and 2) (see Diogo et al, 2015). 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 (Table 1, Fig. 3). An important issue is the effect of the management measures on the dynamic of the fishery, which may difficult the interpretation of the landings or abundance trends due to spatiotemporal target effects (Santos et al., 2019). The alfonsinos fishery for example has a fishing season shorter and shorter during each year due to quota limitation and target effect from the offshore longline fishery.

2. Landings

Total landings in weight of deep-water species increased until 1994, decreasing thereafter with an abrupt decrease in 1999 due to a general decrease observed on landings by species with a particular crash observed for the silver scabbard fish (*Lepidopus caudatus*) (Fig. 2 and 3). Landings in value increased until 2007, decreasing thereafter. The landings of the major deep-water species caught by the Azores fleet for the period 1980 to 2023, are resumed in Table 1 and Figure 3. The fishery has expanded to more offshore areas, with high effort on the seamounts along the Mid Atlantic Ridge (WD Pinho, 2018). This area expansion is a consequence of the decrease in the abundance observed for almost all the demersal/deep water species in the coastal and nearby areas since 1994 (Fig. 2 and 3).

Disaggregated landing data by vessel has been available since 1985. Information by gear type and effort data are collected by shore-based samplers who inquire about fishing masters during the landing operations. The present reported annual catches in weight include only the official landings collected in the Azorean port auctions, since the discards and the frozen or transformed fish are not quantified on the landings.

The present accepted definition of "deep-water species" presents some conflicts with the case of the Azores fishery, since the local ecosystem is a natural deep-water one, the dynamics of some species cover both strata, shallow and deep, and literally all the Azorean fleet can be considered as a deep-water fishery. However, landings of some deep-water species as defined by ICES (Annex I species, EC Reg. 2347/2002) represents a minor fraction of total demersal landings because the exploitation of these species is not economically profitable under the actual framework of a small-scale fishery (see Table 1).

3. Discards

There is no new information available collected under DCF.

4. *Length compositions*

The histograms of the length composition distribution were plotted for 2019 – 2023. These are preliminary data from samples not extrapolated to the total landings collected through the national data collection framework (Figure 4).

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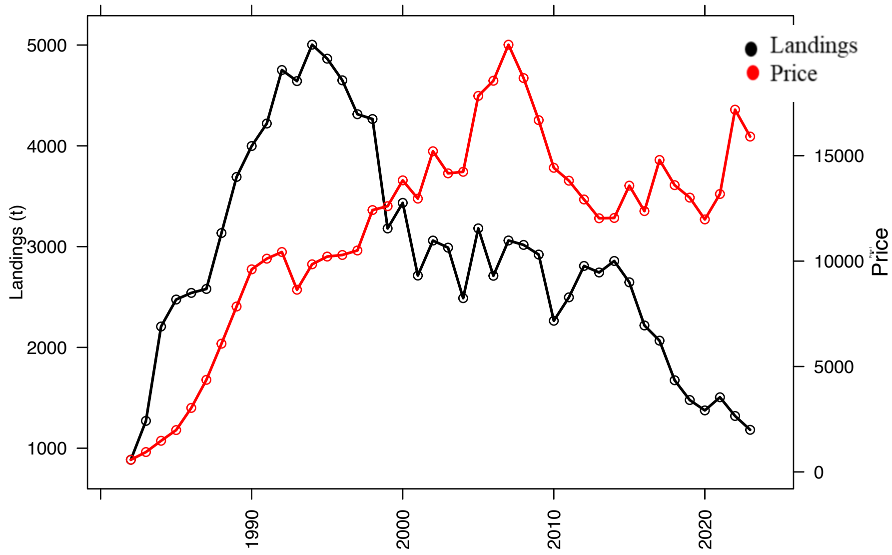

Figure 1. Total landings, in weight and value, of deep-water species from Azores (1982-2023). Important historical management events are also shown on the graph.

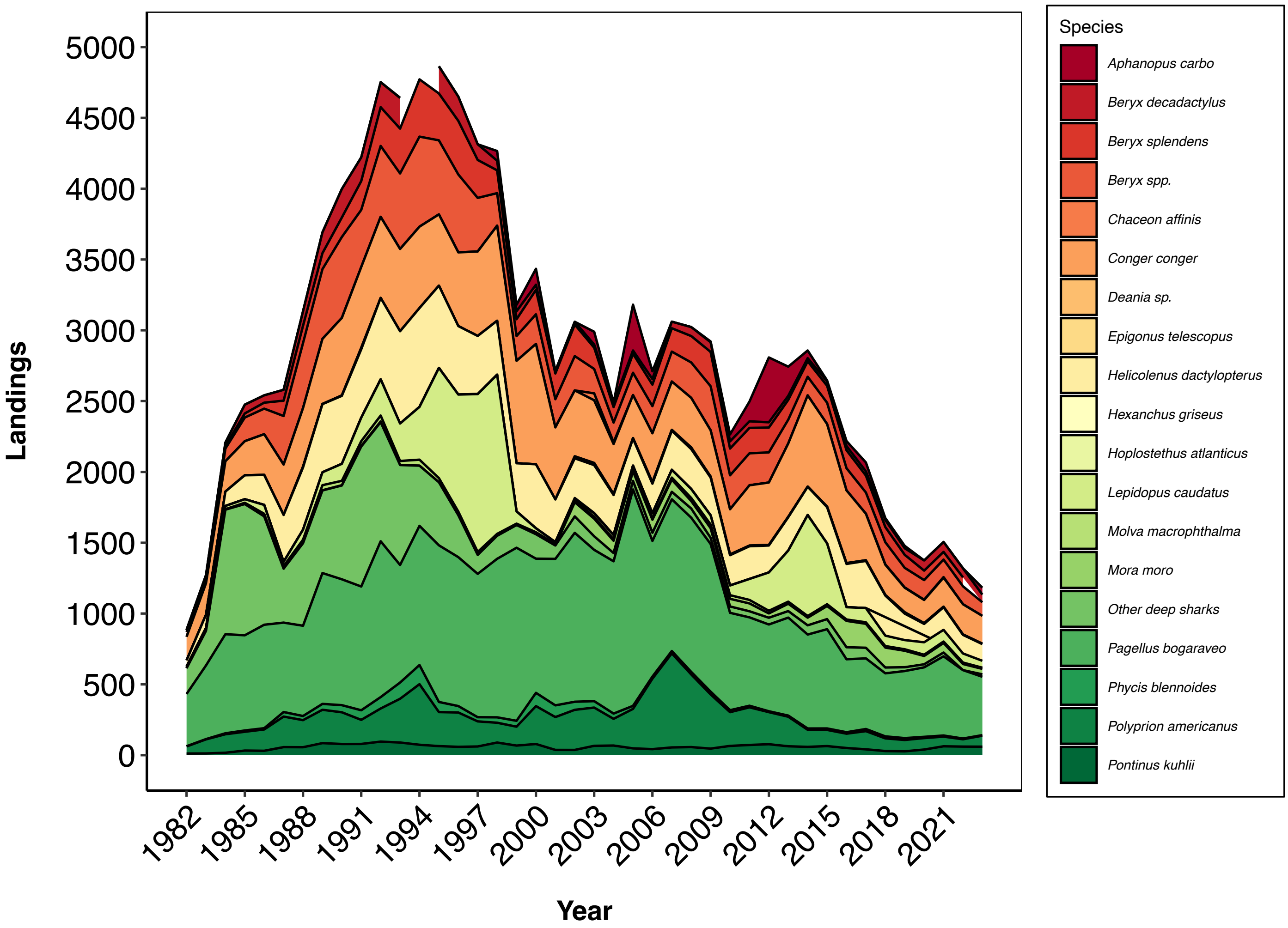

Figure 2. Overview (1980-2023) of the deep-water species landings from the Azores (ICES 10 a2).

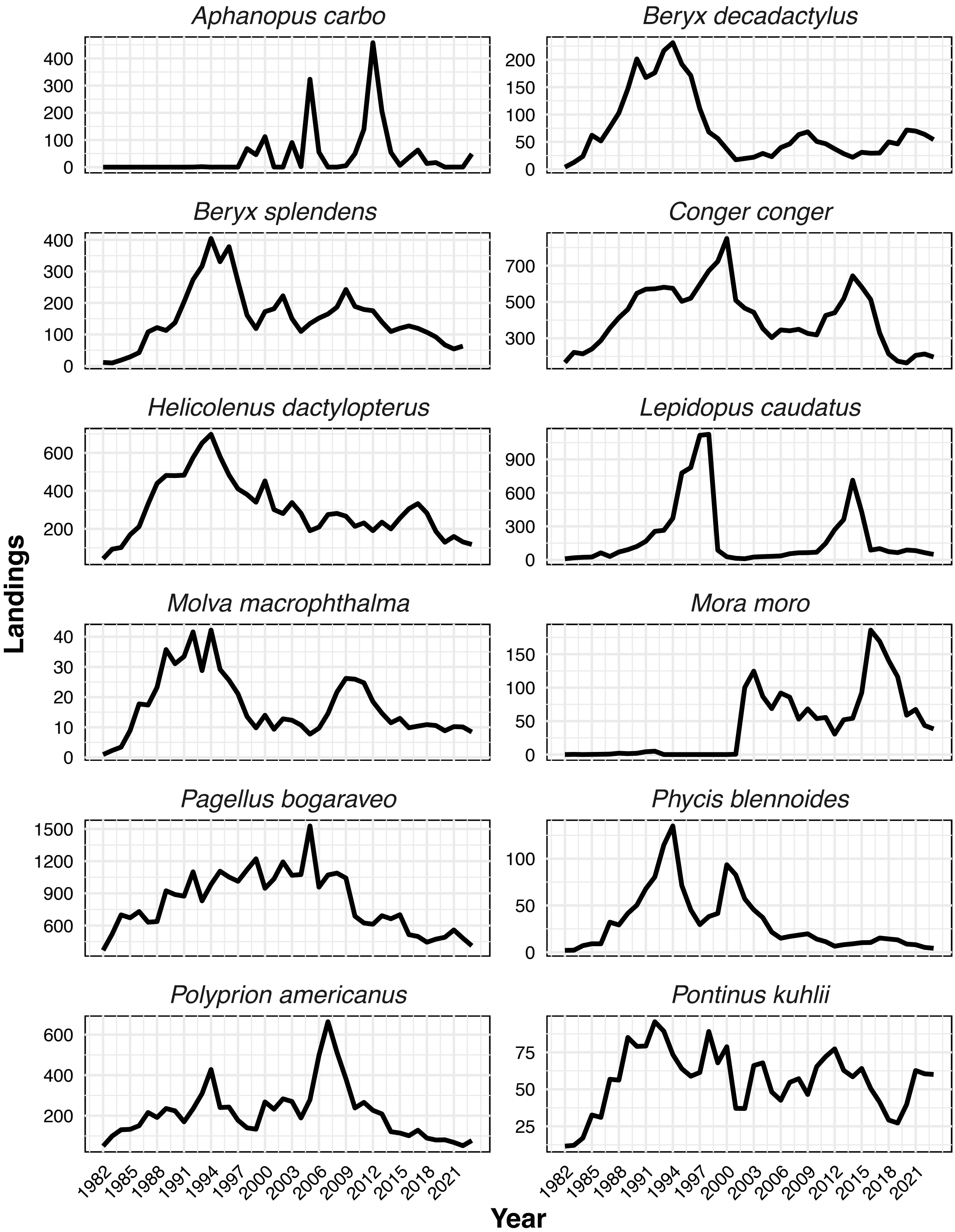

Figure 3. Annual landings of major demersal/deep-water species of the Azores (1982-2023).

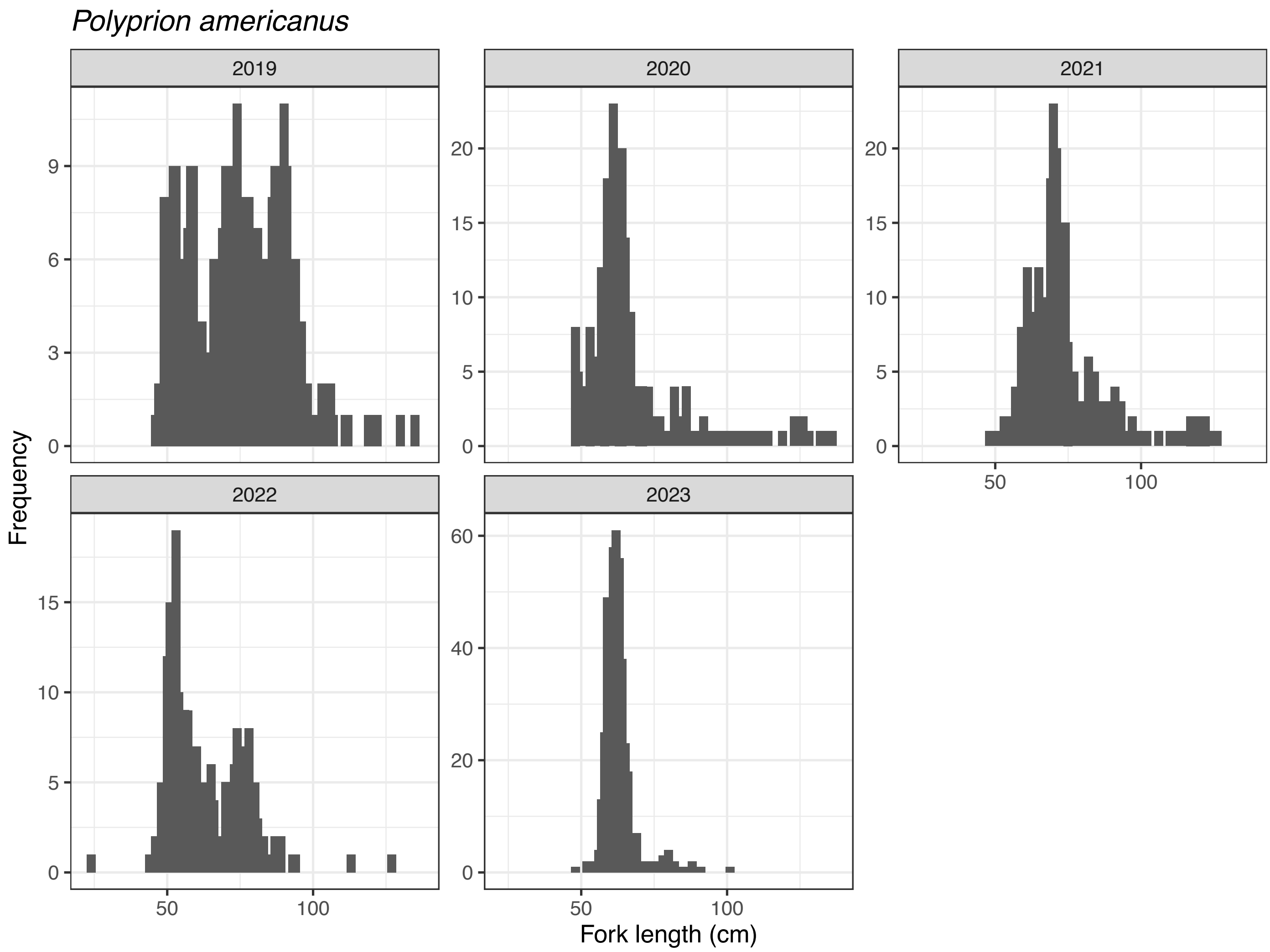

Figure 4: Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

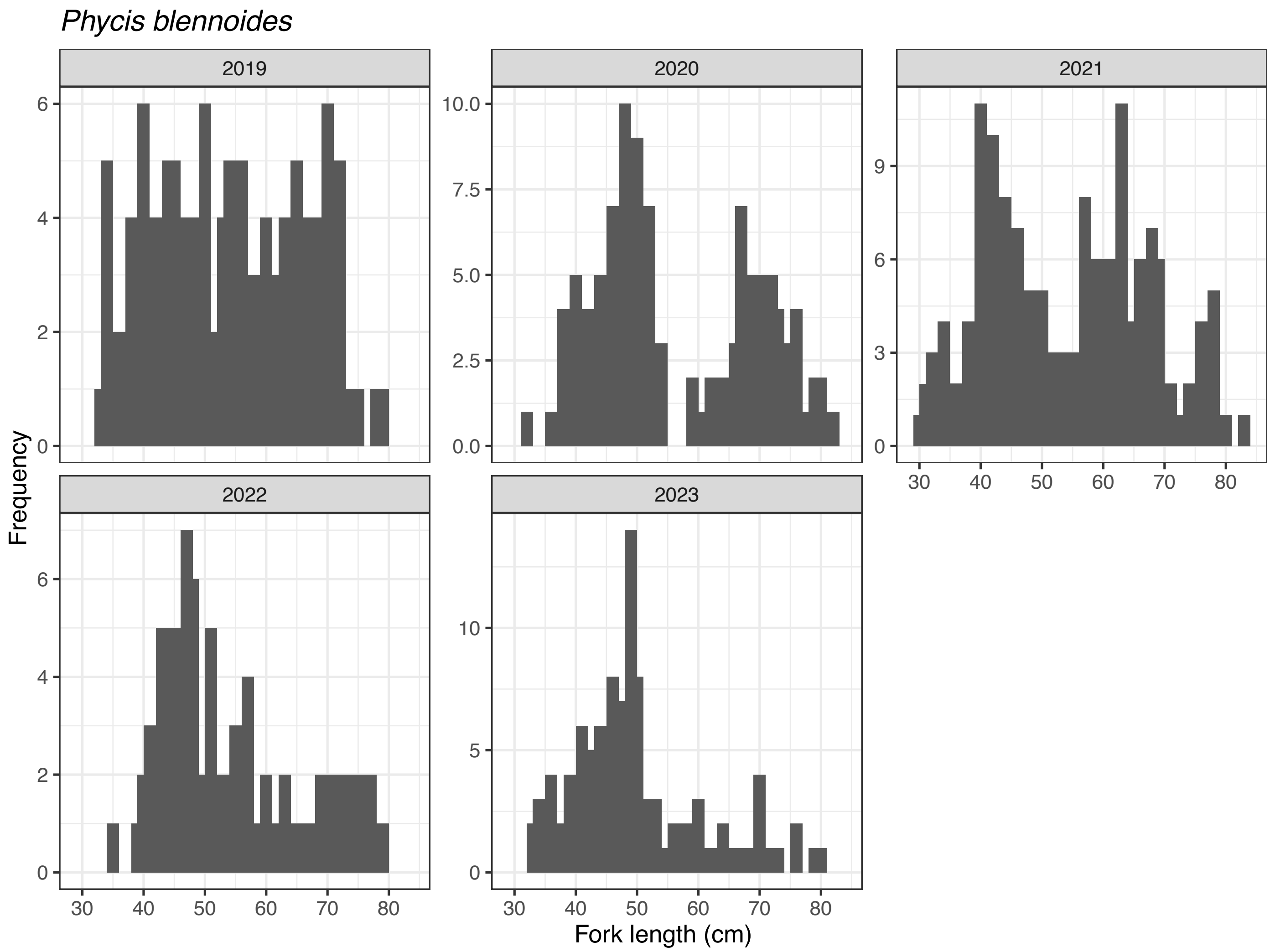

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

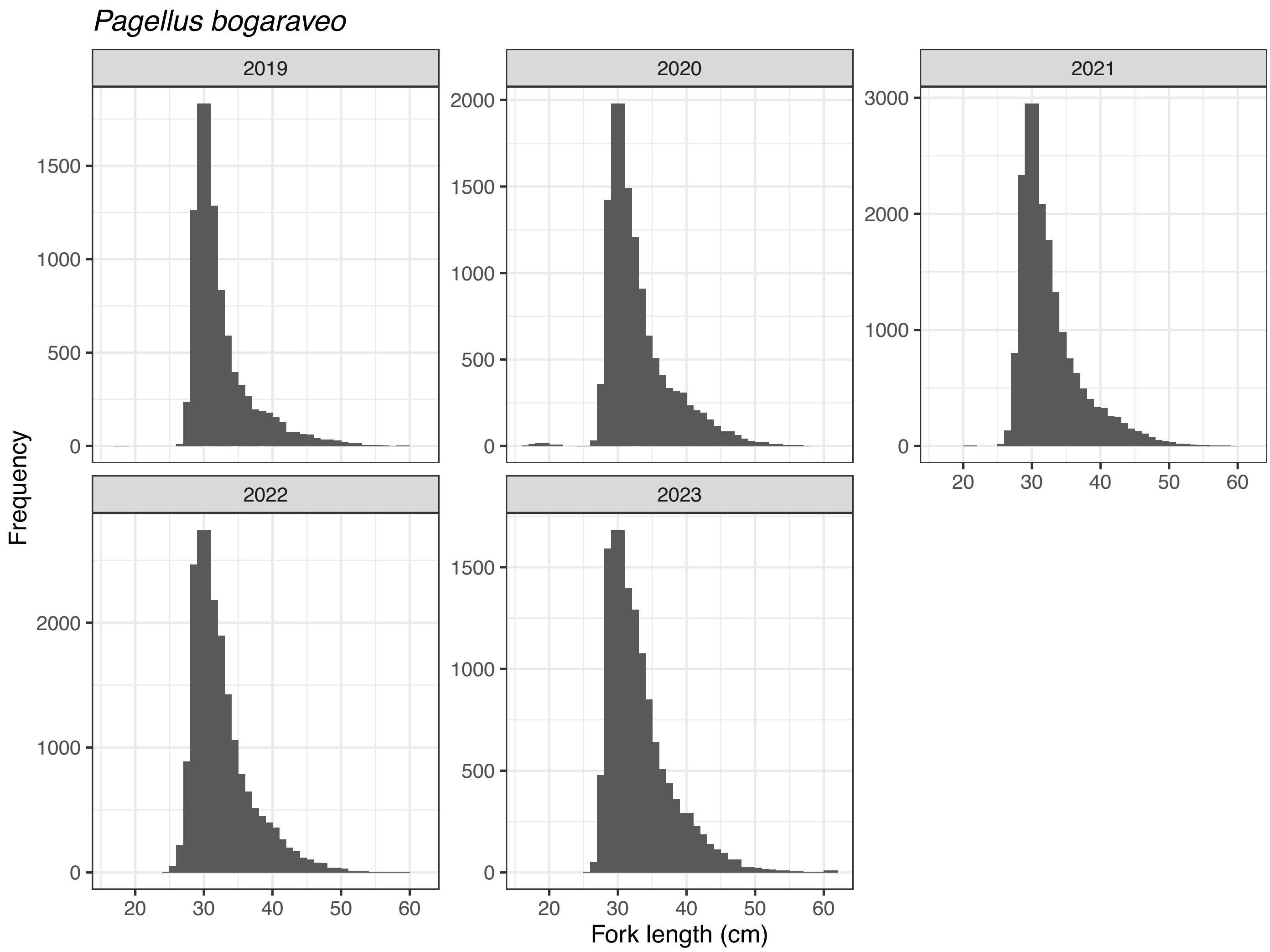

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

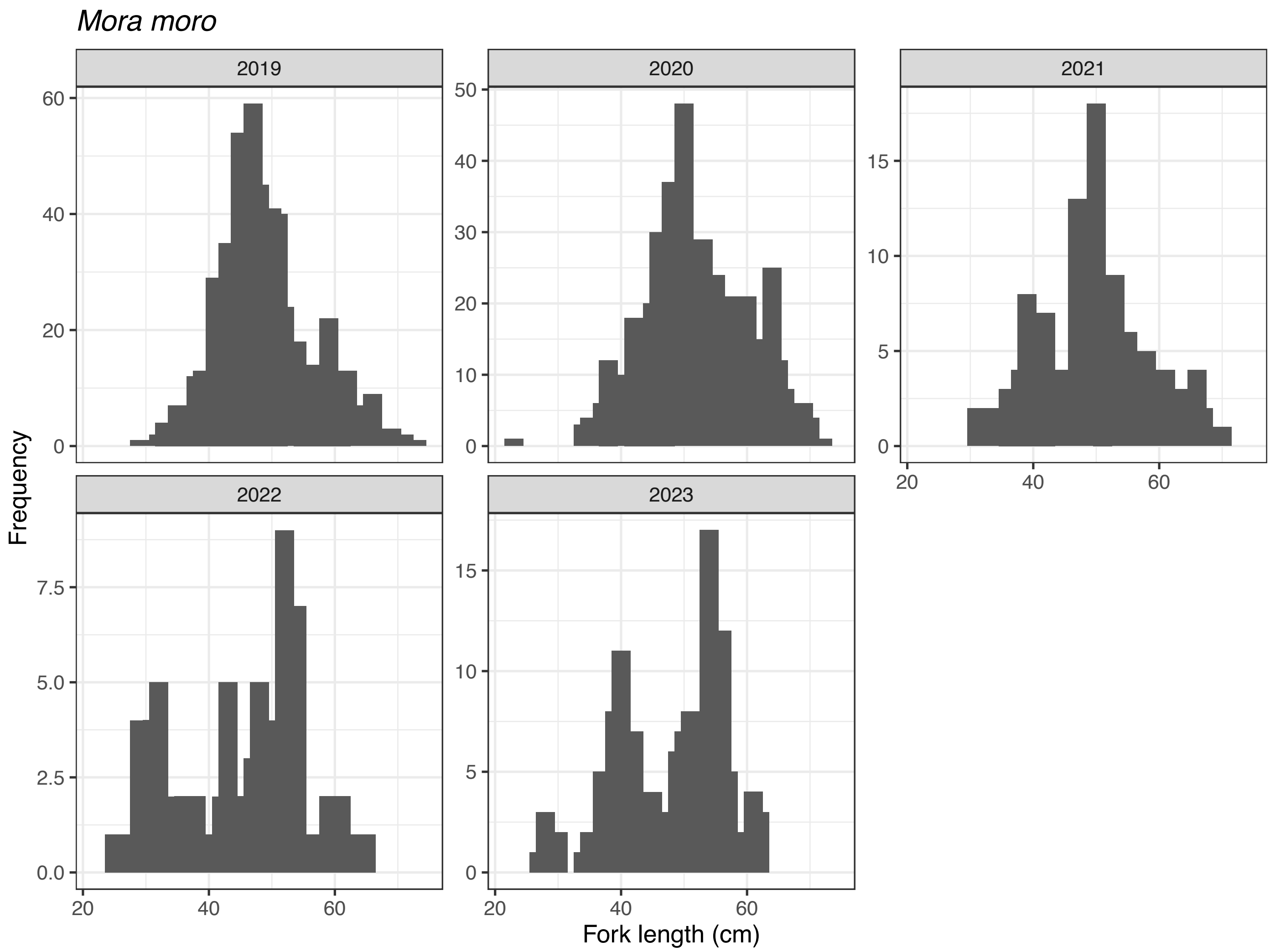

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

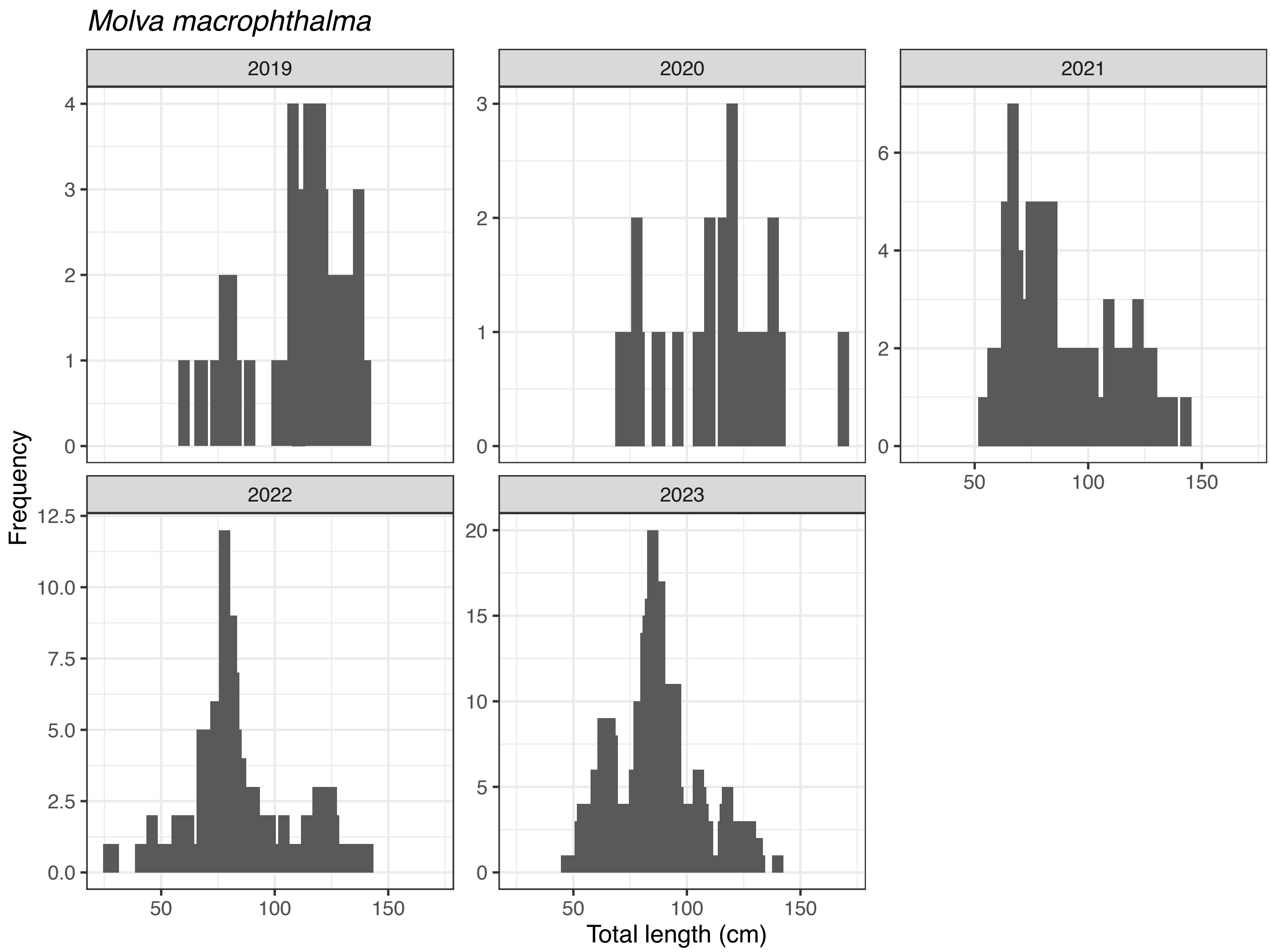

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

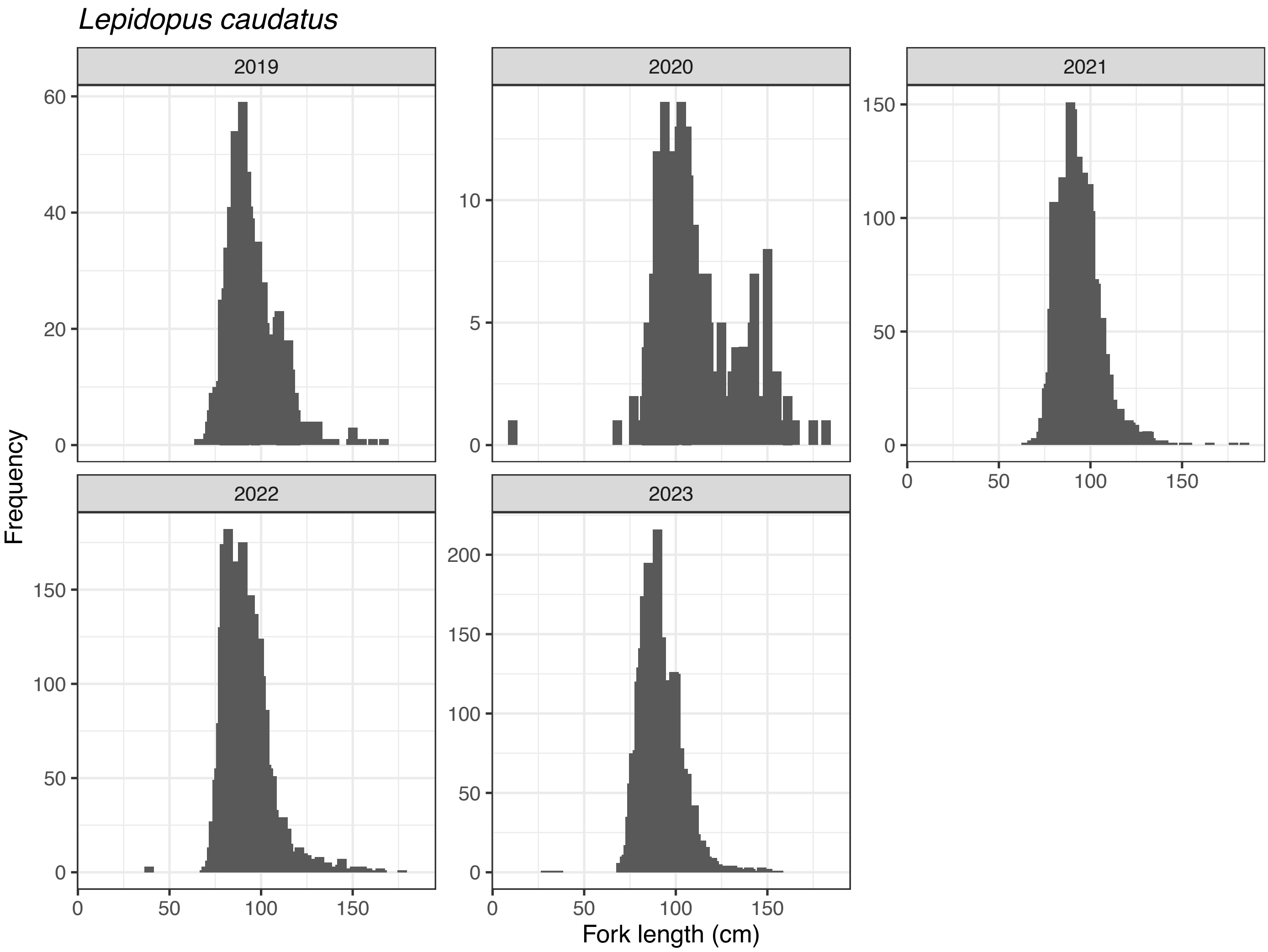

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

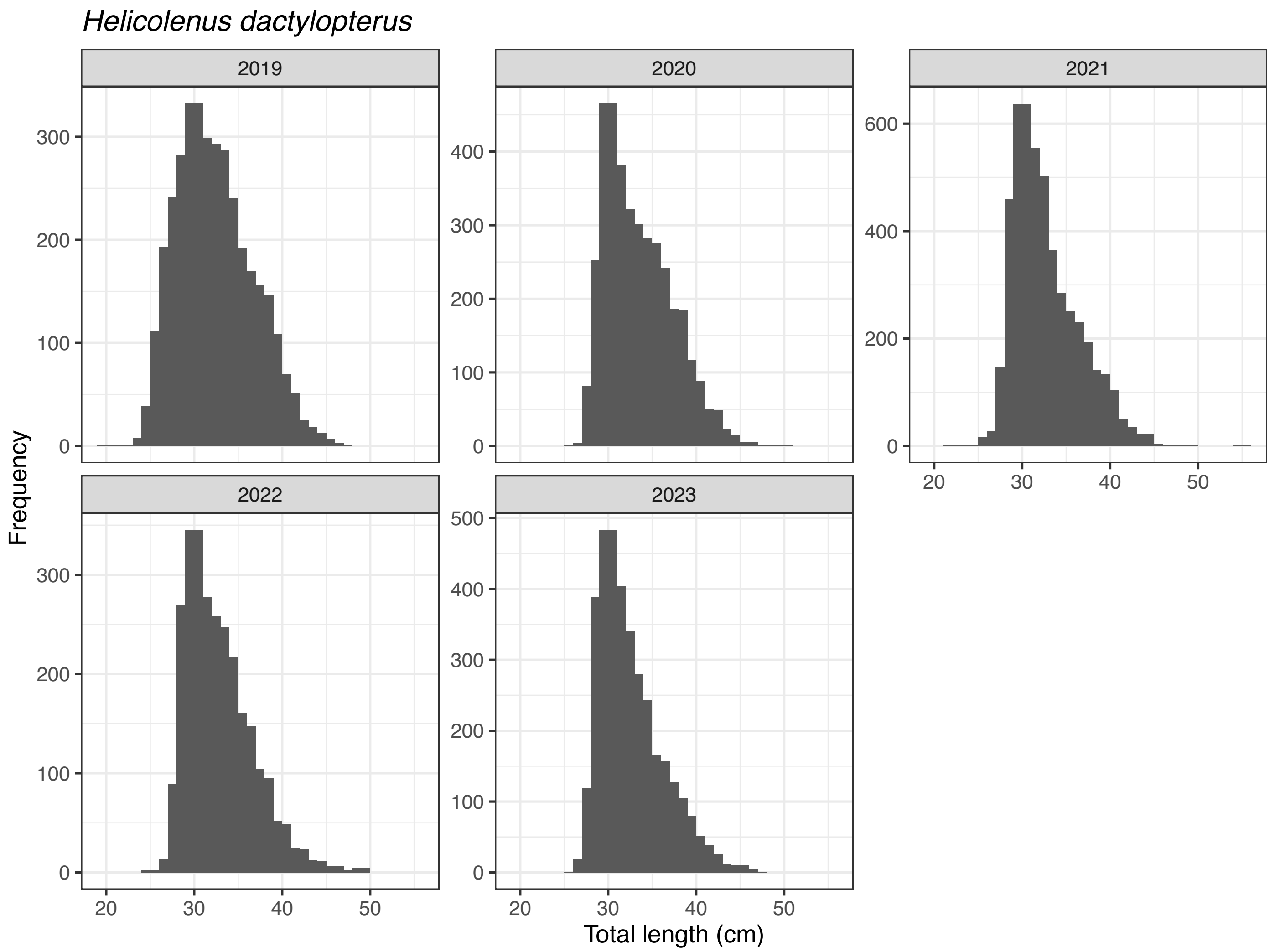

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

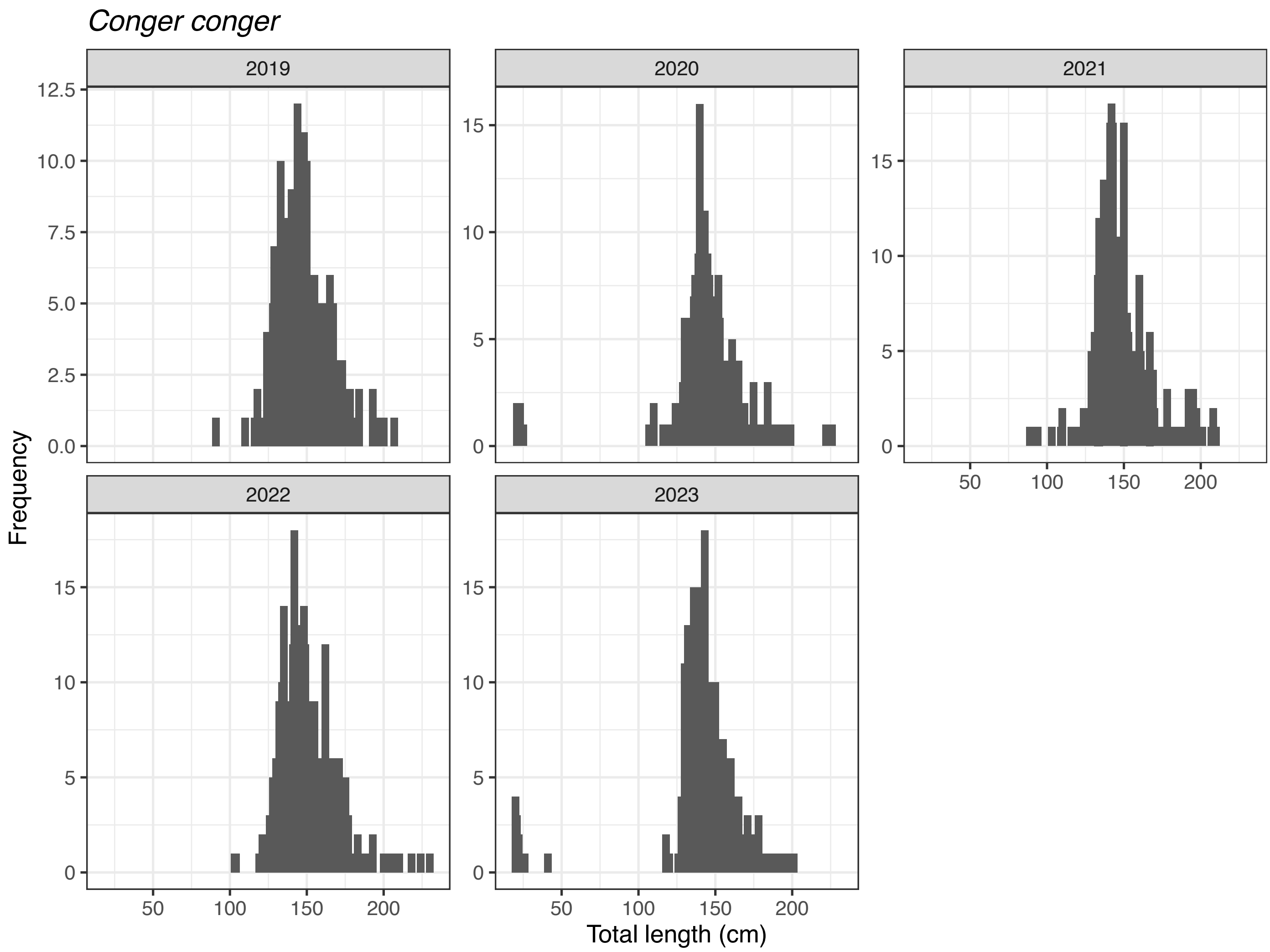

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

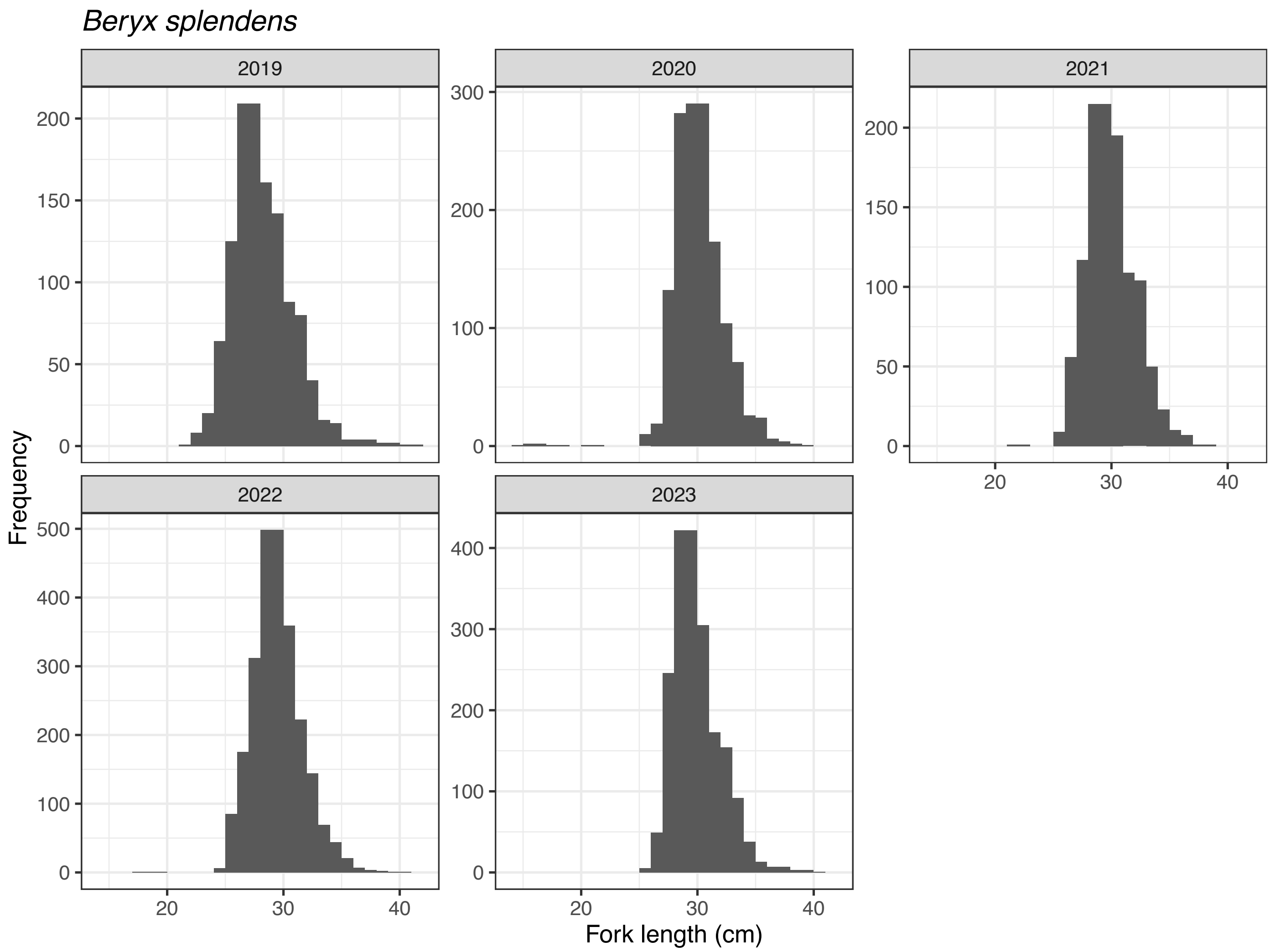

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

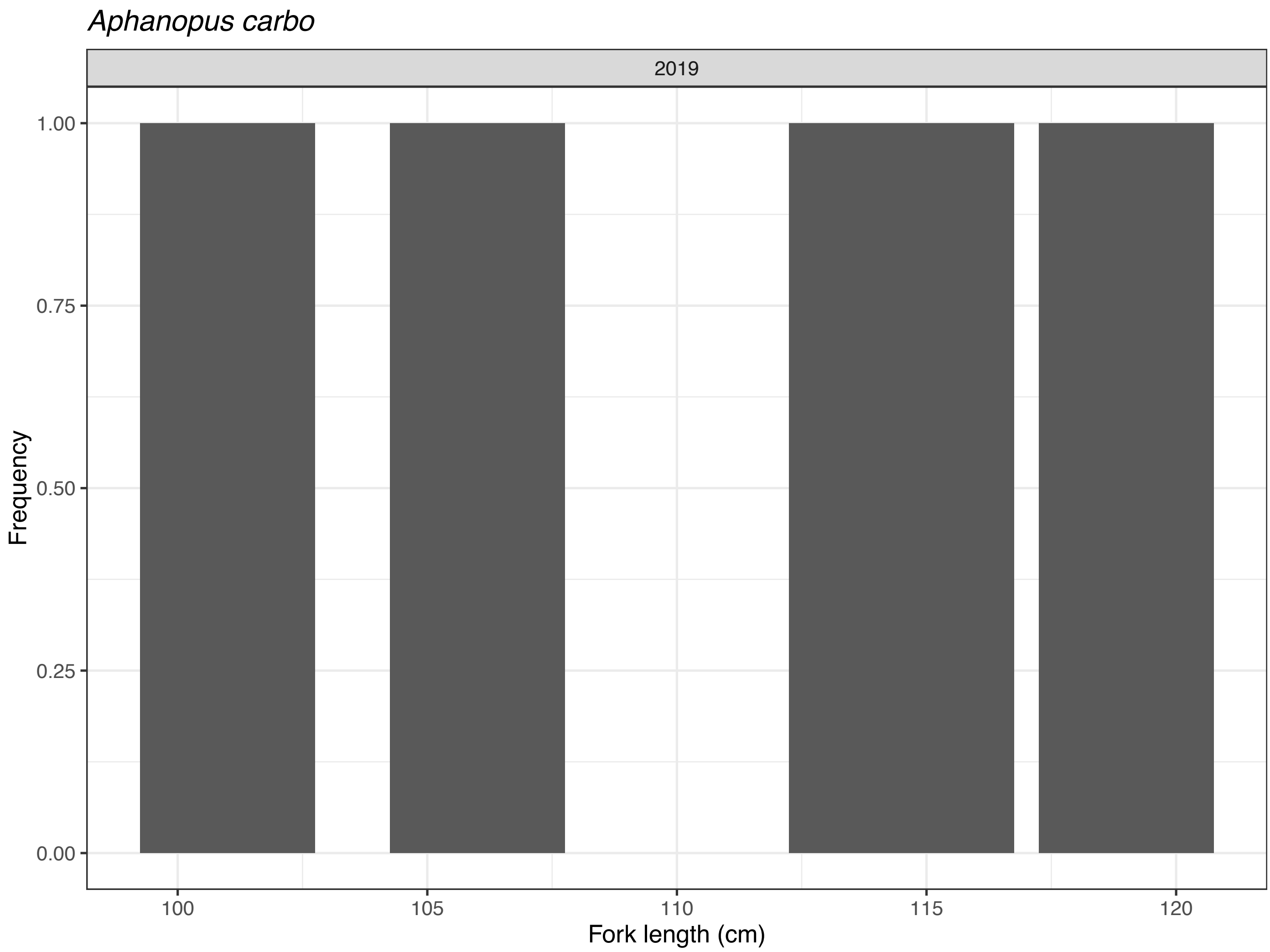

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

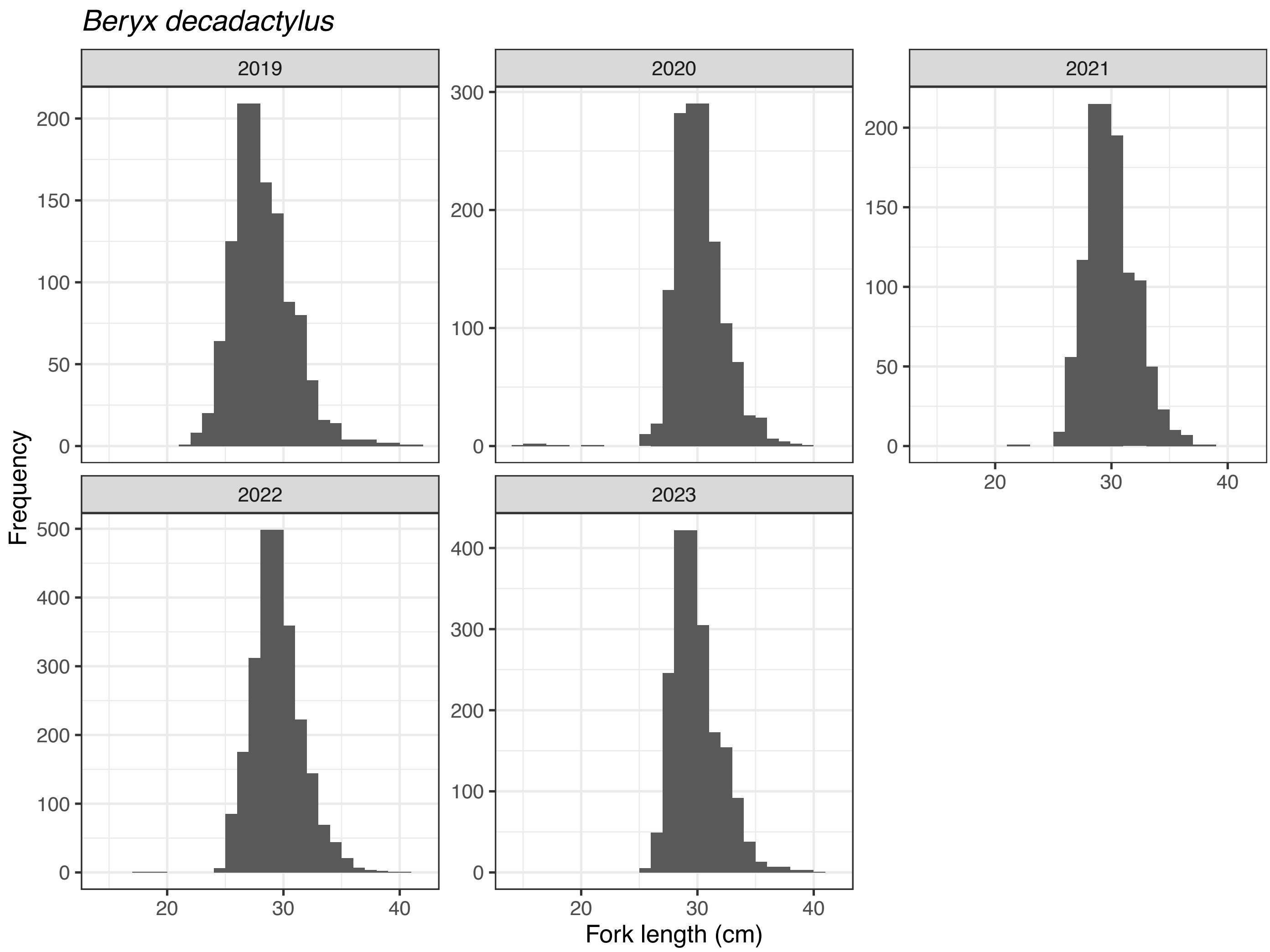

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

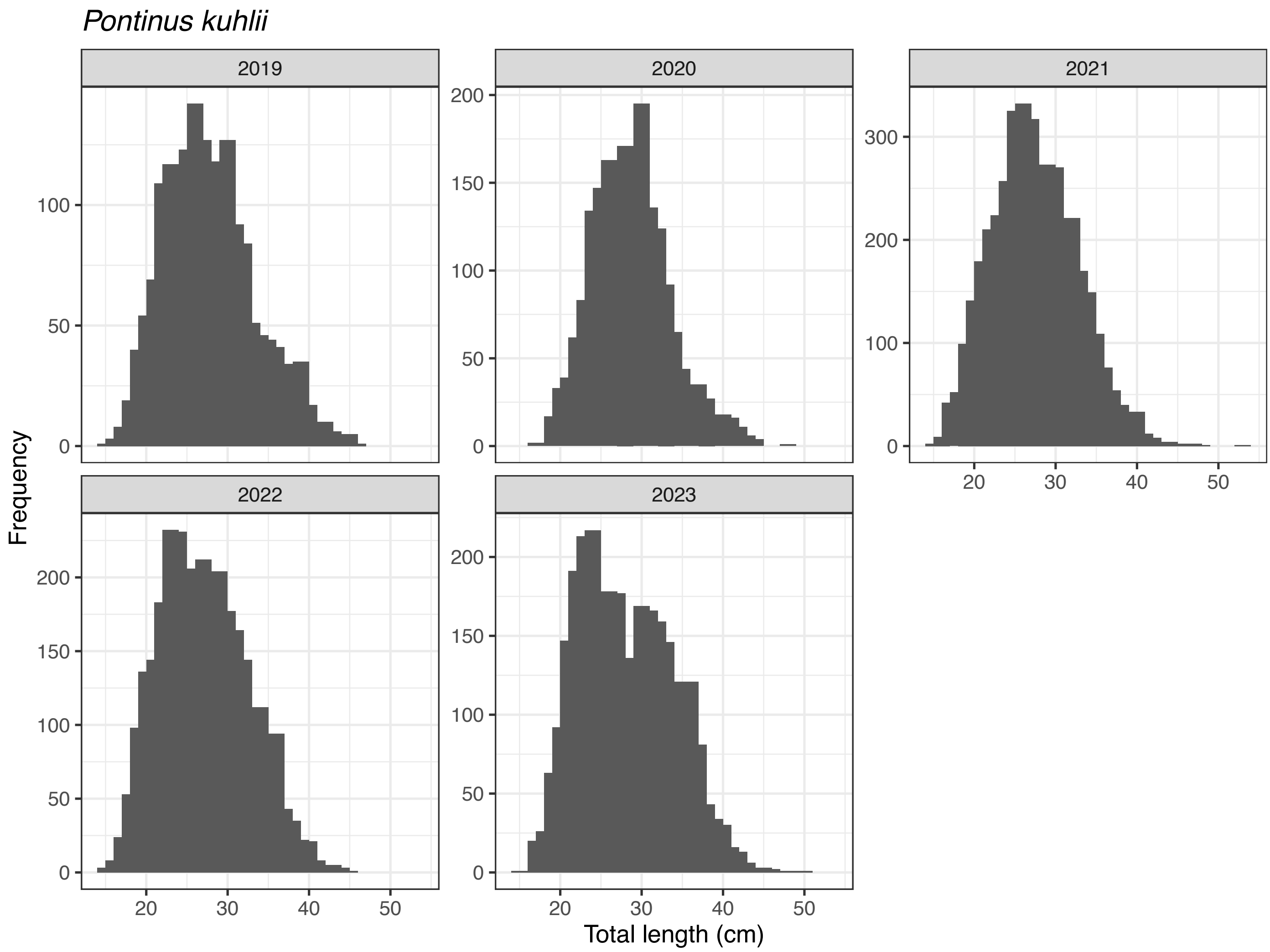

Figure 4 (cont.): Length–frequency distributions of deep-sea species of Azores (2019 – 2023) collected from national data collection framework.

Table 1. Landings (tons) of deep-water species from the Azores (ICES area X). + landed as mixed species; * Include 270t from CECAF 34.2.0.

Year	*Aphanopus carbo*	*Beryx decadactylus*	*Beryx splendens*	*Chaceon affinis*	*Conger conger*	*Daenia sp (+)*	*Dalatias licha*	*Epigonus telescopus*	*Helicolenus dactylopterus*	*Hexanchus griseus*	*Hoplostethus atlanticus*	*Lepidopus caudatus*	*Malva macrophtalma*	*Mora moro*	*Other deep sharks (+)*	*Pagellus bogaraveo*	*Phycis blennoides*	*Polyprion americanus*
1980		0	3		131				18			13				415	0	38
1981		0	4		143				22			6				407	2	40
1982		4	11		166				42			10	1			369	2	50
1983		13	10		222				93			18	2			520	2	99
1984		24	19		214				101			23	3			700	7	131
1985		62	29		241				169			25	9			672	9	133
1986		52	42		287				212			63	18			730	9	151
1987		77	108		356				331			30	17			631	32	216
1988		103	122		413				439			70	23			637	29	191
1989		147	113		459				481			91	36			924	42	235
1990		201	137		547			3	480			120	31	2		889	50	224
1991		168	203		570			11	483			166	33	4		874	68	170
1992		176	274		572			+	575			255	42	+		1100	81	234
1993		217	317		581			+	652			264	29	+		830	115	309
1994		231	404		575			+	698			373	42	+		983	135	428
1995		192	331		503		321	+	581			778	29	+		1106	71	240
1996		171	379		521		216	+	483			826	26	+		1052	45	243
1997		111	268		596		30	+	410			1115	21	+		1012	30	177
1998	68	68	161		672		34	+	381			1187	14	+		1119	38	140
1999	46	56	119		723		31	+	340			86	10	+		1222	41	133
2000	112	37	172		850		31	+	452			28	14	+		947	94	268
2001	+	17	182		509		13	+	301		343	14	9	+		1034	83	232
2002	+	20	223		465		35	14	280	7	+	10	13	100		1193	57	283
2003	91	22	150	49	443		25	15	338	2	+	25	12	125		1068	45	270
2004	2	29	110	13	354	1	6	6	282	1	+	29	11	87		1075	37	189
2005	323	23	134		304	1	14	4	190	1	+	31	8	69		1383*	22	279
2006	55	40	152		346	1	10	10	209	1	+	35	10	92		958	15	497
2007	0.2	46	165		341	0.3	7	7	275	1	+	55	15	86	1	1071	17	664
2008	0.2	63**	187**	0.1	349	6	10	7	281	0.4	+	63	22	53	0	1089	18	513
2009	5	68**	243**		326	0	6	7	267	0.3	+	64	26	68	0	1042	20	382
2010	49	51	189	0	318	3	2	5	213	1	+	68	26	54	2	687	14	238
2011	139	47	179	0	426	0	0	5	231	0	+	148	25	55	5	624	11	266
2012	458	37	175	0	441	0	0	4	190	0	+	271	19	31	31	613	6	226
2013	206	28	140	0	517	0	0	4	235	0	+	361	15	52	70	692	8	209
2014	54	22	109	0	644	0	0	2	200	0	+	713	11	54	0	663	9	121
2015	7	31	120	0	583	0	0	4	256	0	+	429	13	92	0	701	10	114
2016	36	29	127	0	513	0	0	6	306	0	+	87	10	186	0.1	515	10	101
2017	63	30	119	1	329	0	0	5	333	0	+	101	10	169	0	499	15	128
2018	14	50	107	2	214	0	0	4	283	0	+	74	11	141	0	455	14	89
2019	17	46	92	2	174	0	0	9	187	0	+	65	11	116	0	474	13	80
2020	0	72	67	2	164	0	0	5	130	0	0	88	9	59	0	491	9	81
2021	0	70	54	3	206	0	0	4	160	0	0	83	10	67	0	559	8	68
2022	0	64	63	0	213	0	0	18	131	0	0	64	10	43	0	483	5	52
2023	49	55	42	0	196	0	0	16	118	0	0	49	8	38	18	412	4	77

+ landed as mixed species
** includes 270t from CECAF 34.2.0

The ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP 2024).

Updating Survey-derived information for deep-water species from the Azores (ICES Subdivision 27.10.a.2).

by

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Abstract

This working document resumes the information for deep-water species (Annex I and II from the EC regulations) from the Azorean Spring Bottom Longline survey for the 2023 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 species in 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 the spring season, covering 5 statistical areas, according to the geographical characteristics and distribution of demersal species (coast of the islands and the main fishing seamounts), with the primary objective of estimating fish abundance for stock assessment. The statistical areas are I – banks “Azores and Pricesa Alice”; II – islands “Faial/Pico, Graciosa, São Jorge and Terceira”; III – islands “Santa Maria e São Miguel”; IV – bank “Mar da Prata”; VI – islands “Flores/Corvo” (Fig. 1). The survey is primarily directed for abundance estimation of red seabream (*Pagellus bogaraveo*). This is the principal target species of the multispecific and multigear demersal fishery in the Azores (ICES subdivision 27.10.a2) but information for other commercially important species is also collected.

The survey follows a random stratified design, based on transects covering the depth range from 50 to 1200m allocated proportionally to five statistical areas of the ICES subdivision 27.10.a.2 (ICES, 2010).

The objective of this working document is to resume the survey information of deep-water species to the WGDEEP 2023.

Methods

The Azorean spring bottom longline survey data from 1995 to 2023 was used to compute the annual abundance index, mean annual abundance by depth stratum, length composition, and annual mean length for the most important commercial species from the Azores: red seabream (*Pagellus bogaraveo*), blackbelly rosefish (*Helicolenus dactylopterus*), Alfonsinos (*Beryx splendens* and *Beryx decadactylus*), European conger (*Conger conger*) and Silver scabbardfish (*Lepidopus caudatus*). The survey follows a random stratified design covering the islands, banks, and main seamounts from 0 to 1200m. However, the survey is designed for abundance estimates of benthopelagic species from 0 to 600m. This depth range was extended to 800m since 2004. The deepest strata, 600-1200m until 2004 and 800-1200m thereafter, were covered without replicates being the information collected for exploratory and ecological proposes. To be comparable along all survey time series, the annual abundance index was computed for the depth strata 0-600m and was estimated at the 95% confidence interval. During 2021, the spring bottom longline survey covered only 50% of the total sampling area. The sampled area corresponds to areas I-II (Fig. 1). Thus, the entire historical series of the relative abundance index was reconstructed for these statistical areas sampled during the year 2021.

For less abundant deep-water species in the survey, such as Greater forkbeard (*Phycis blennoides*) and Wreckfish (*Polyprion americanus*), or species with broader depth distribution such as deep-water Common mora (*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 strata there were not replicates to estimate the variance.

Mean length composition for the period 1995-2023 and annual mean length were computed for all species mentioned in this working document.

Results

Abundance indices

An index of annual abundance estimated in biomass for the most important surveyed species is presented in Figure 2. High interannual variability is observed in the abundance indices. Trends of the annual abundance for other species caught in the survey are also presented in Annex I.

Data analyzed in this paper refers to the period between 1995 and 2023. There is no information for 1998, 2006, 2009, 2014, 2015, 2020, and 2022 because there was no survey. The abundance index from the surveys seems to confirm the trend observed in the landings time series (see WD Peixoto et al., 2024) for some species (e.g. *Beryx spp*., *M. moro*, *P. bogaraveo,* and *L. caudatus*) (Fig. 2). In general, the index of relative abundance during 2023 remains at a low or stable level for most species, except for the red seabream (*P. bogaraveo*), for which a high value is observed in line with last year. The increase observed for red seabream is consistent in Area I and Area VI, but contradictory to the trend in Area II, for the remaining statistical areas it remains stable (Fig. 3). The distribution of depth over time shows no significant changes for these species (Fig. 4).

For the deeper species, such as *M. moro* and *P. americanus*, there is a downward trend in the abundance index, in contrast to *P. blennoides*, which shows an increase in the abundance index (Annex I). It is important to highlight that the Azorean bottom longline survey is designed for abundance estimation considering the strata 50-600m (until 800 m after 2004) and originally targeting the red seabream (*P. bogaraveo*). The survey may not be effective in sampling some of these deep-water species because the range of the species distribution can be broader than the survey coverage for abundance estimation purposes and little is known about the species dynamic. Thus, survey-derived abundance indices for these species must be interpreted with caution. Besides that, ecological, environmental factors, and other factors associated with the fishery gear may affect the abundance estimation of the annual Azorean spring bottom longline survey. More detailed analyses are necessary to explore these relationships using for example GLM approaches.

Length composition and mean length

Mean length composition for some deep-water species, for the period 1995-2023, is presented in Figure 5. 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 decreased trend but with high variability over time for almost all species (Fig. 6).

Discussion

The depth distribution of most of the species reported here is relatively well sampled by the current survey design, except for *M. moro* and *L. caudatus*. However, survey sampling coverage by stratum is an issue because it is not homogeneous over time. Abundance is comparable for all-time series for depth strata 0-600m. The strata 600-1200m were covered without replication (only one transect) by stratum. Since 2004 the survey coverage broaded to 800m with at least two replicates by stratum. For the years 1996 and 2008, the statistical area for the 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 more stable and so replication may not change the trend in the abundance.

High interannual variability is observed in the abundance of some species, such as *P. bogaraveo*, which makes difficult the trend interpretation. Analysis done until now does not show evidence of problems related to gear saturation, competition, or soak time, which are variables that influence the catch rate dynamic of a longline. However, these issues should be better explored by GLM approach in future work, analyzing particularly the effect of the presence of other species.

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ICES, 2010. Report of the Working Group for North-east Atlantic Continental Slope Survey - WGNEACS. ICES CM 2010/SSGESST:16, REF. SCICOM, ACOM.

Peixoto et al., 2024. Updating from deep-water fishery of the Azores (ICES subdivision 27.10.a.2). Working Document (WD 04). ICES Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP).

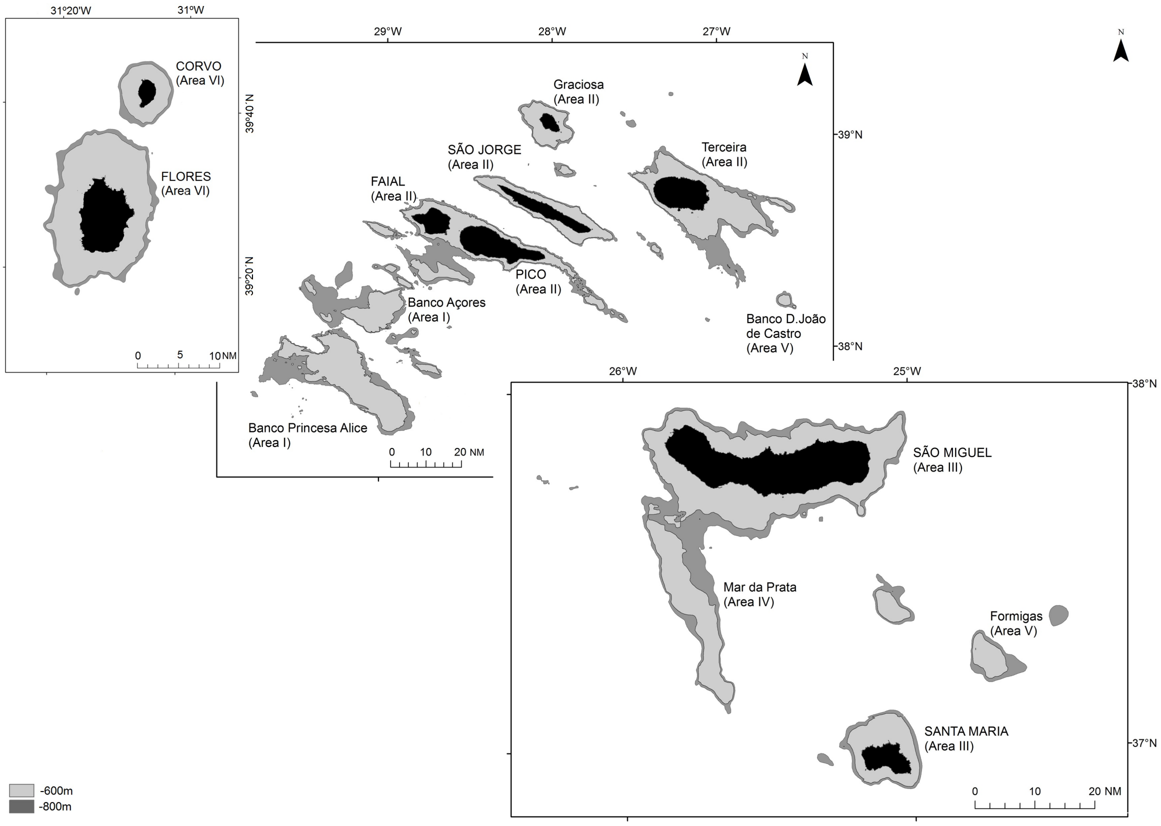


Figure 1. Statistical areas (I to VI) and sub-areas (I — banks “Azores” and “Princesa Alice”; II — islands “Faial/Pico”, “Graciosa”, “São Jorge”, and “Terceira”; III — islands “Santa Maria” and “São Miguel”; IV — bank “Mar da Prata”; V — banks “D. João Castro”, “Formigas” and other small seamounts; and VI — islands “Flores/Corvo”) defined for the Azorean demersal bottom longline survey. Shadowed areas represent the 600 and 800 m isobaths.

Abundance index

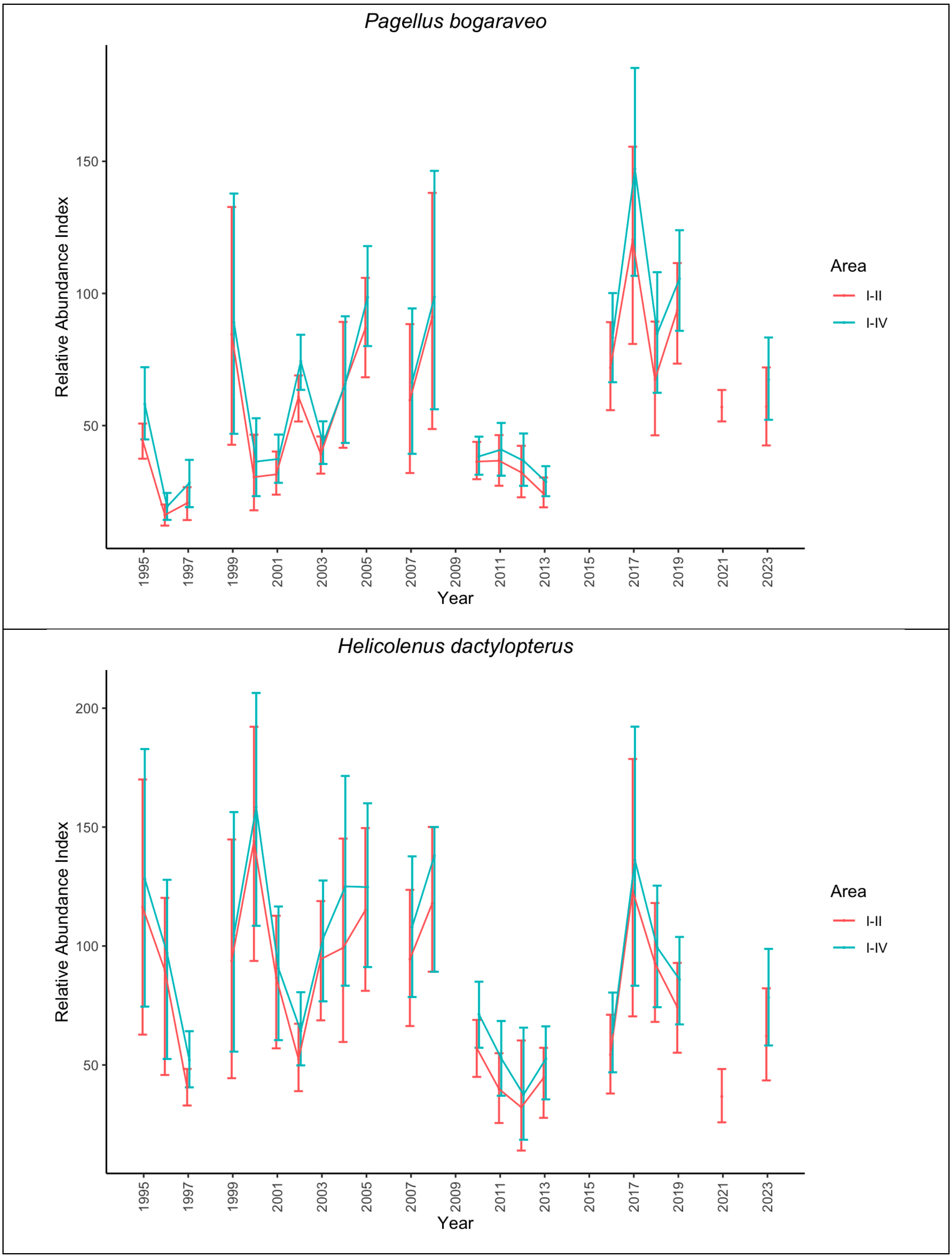


Figure 2. Annual bottom longline survey abundance index in biomass available for some of the Azorean deep-ware species (1995-2023).

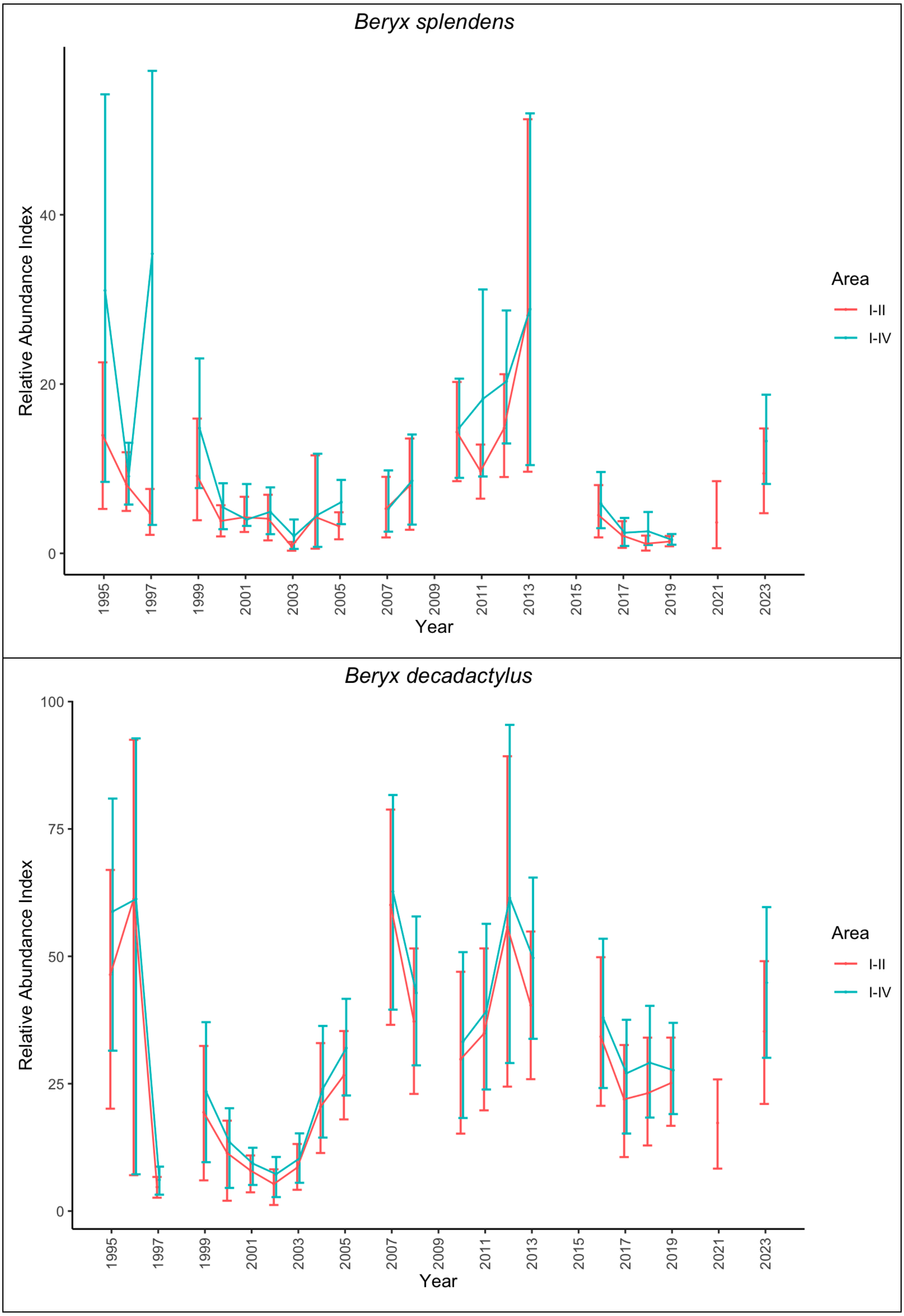
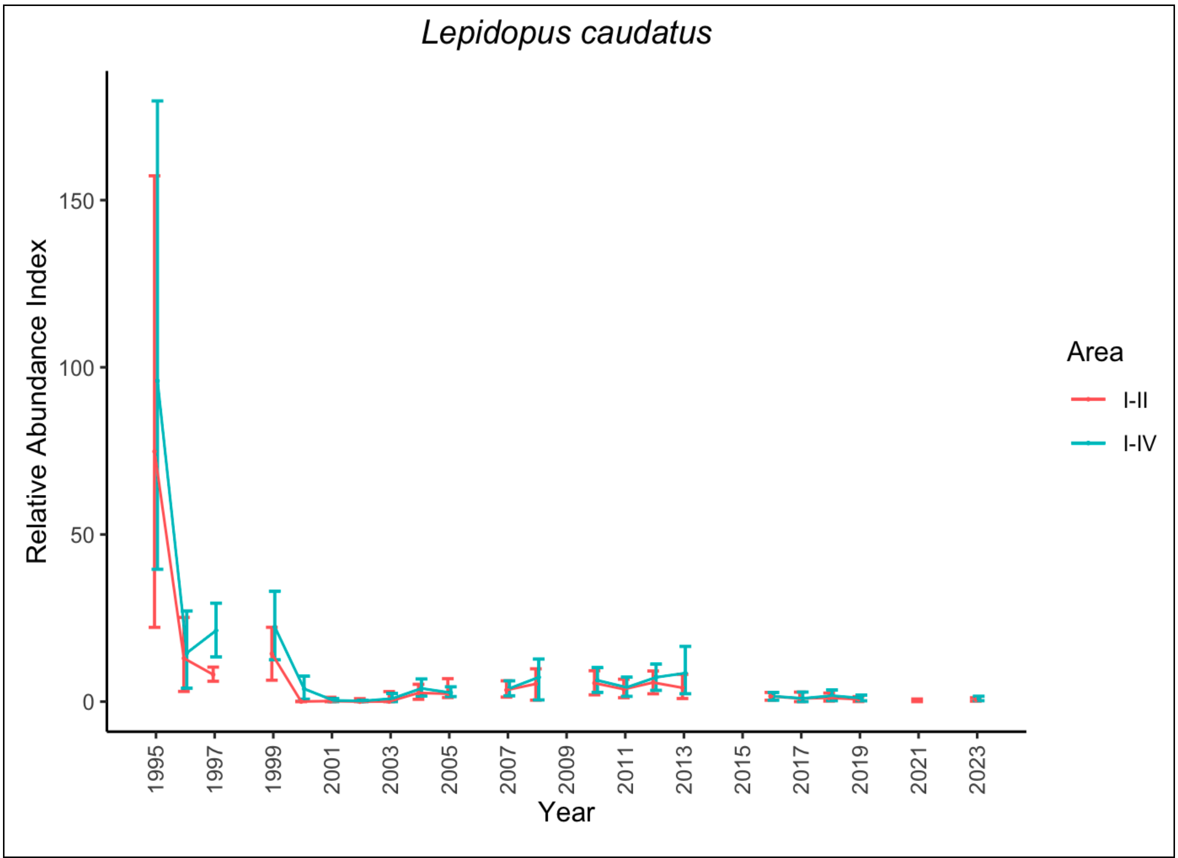


Figure 2 (Cont.). Annual bottom longline survey abundance index in biomass available for some of the Azorean deep-ware species (1995-2023).



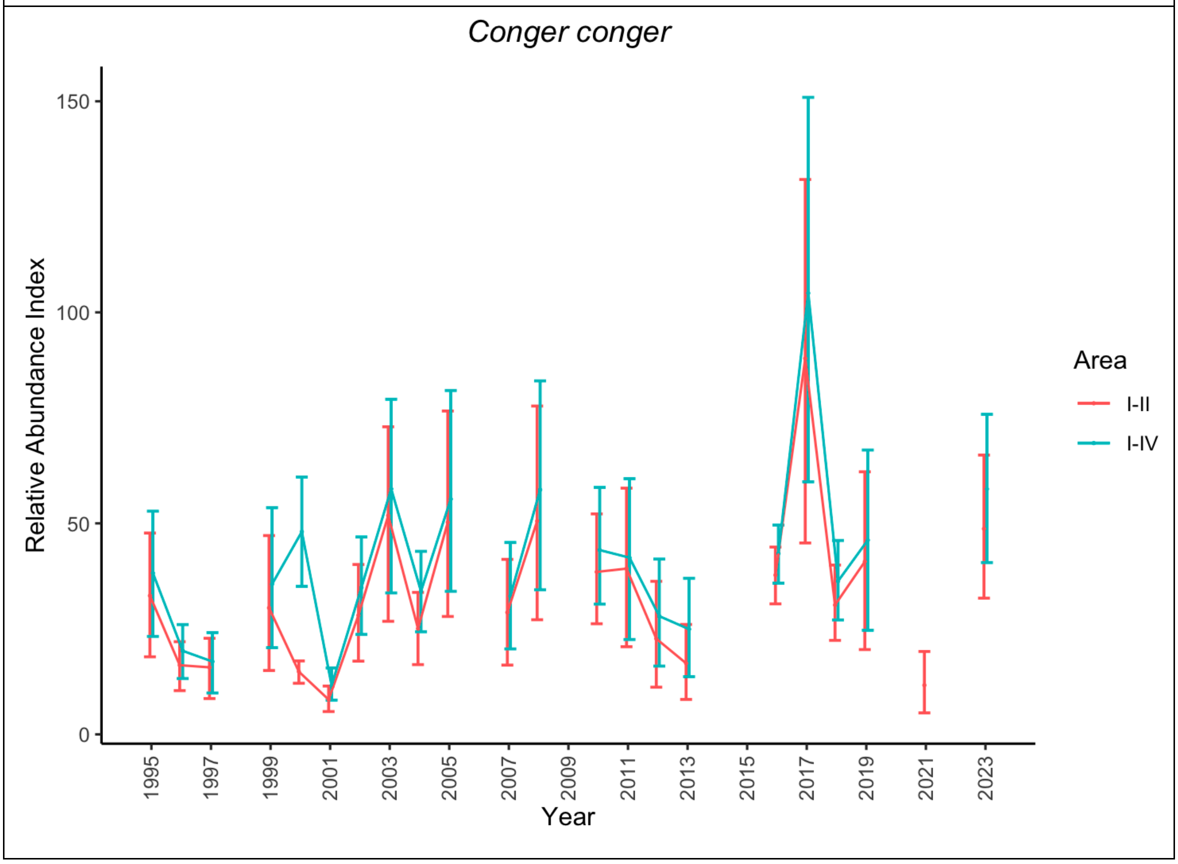


Figure 2 (Cont.). Annual bottom longline survey abundance index in biomass available for some of the Azorean deep-ware species (1995-2023).

Abundance index by statistical areas

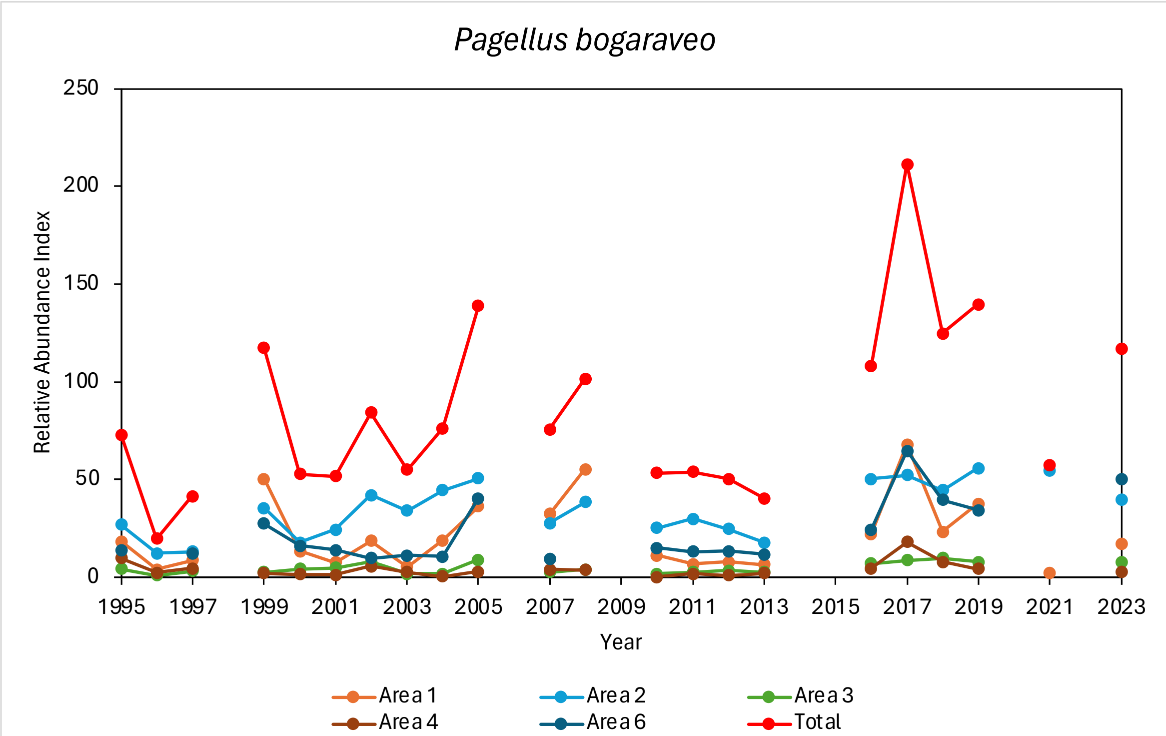


Figure 3. Annual bottom longline survey abundance in biomass available of Pagellus bogaraveo by statistical areas (1995-2023).

Distribution by depth

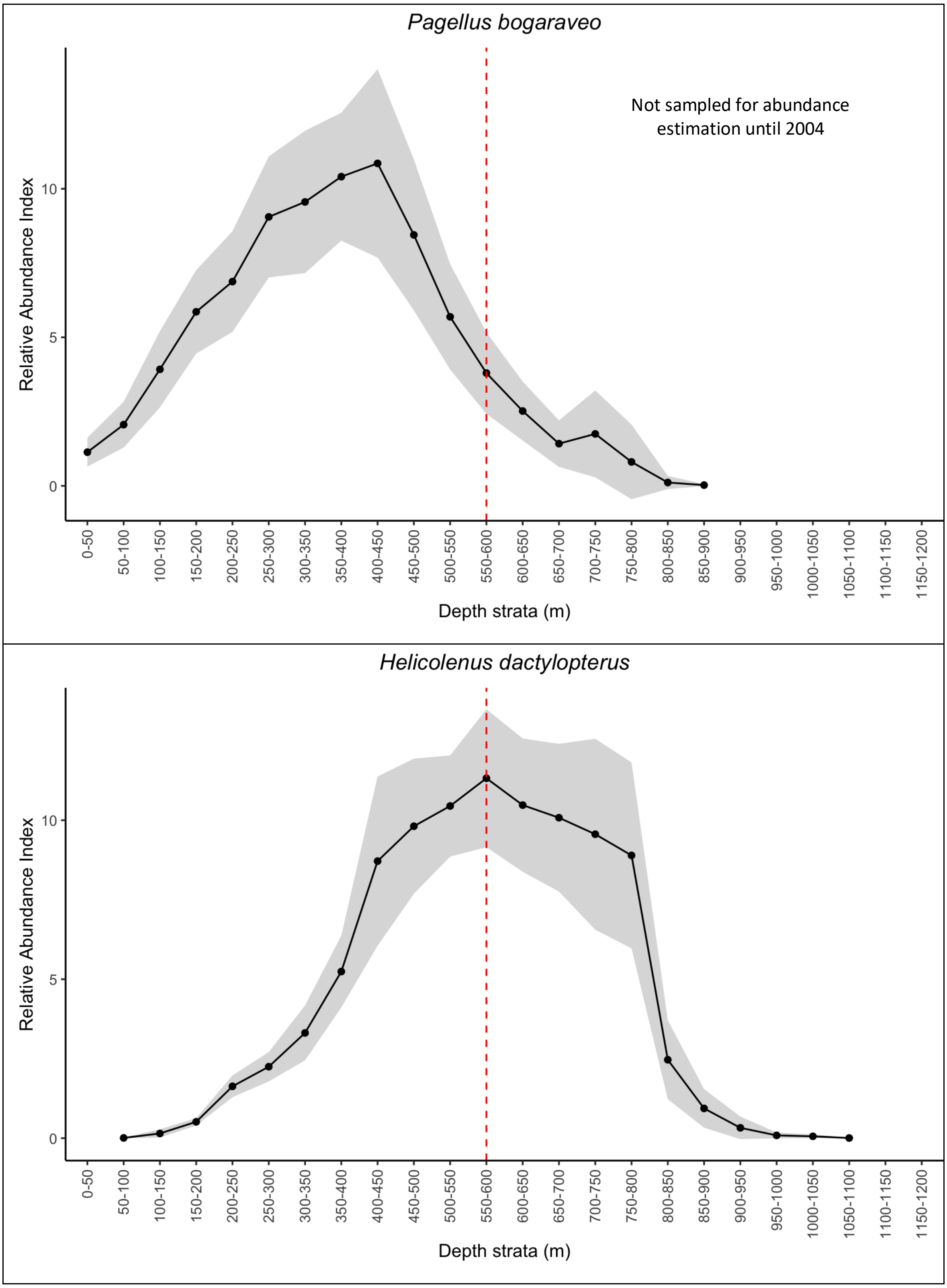


Figure 4. Mean abundance index by depth stratum for Areas I-IV and the period 1996 - 2023.

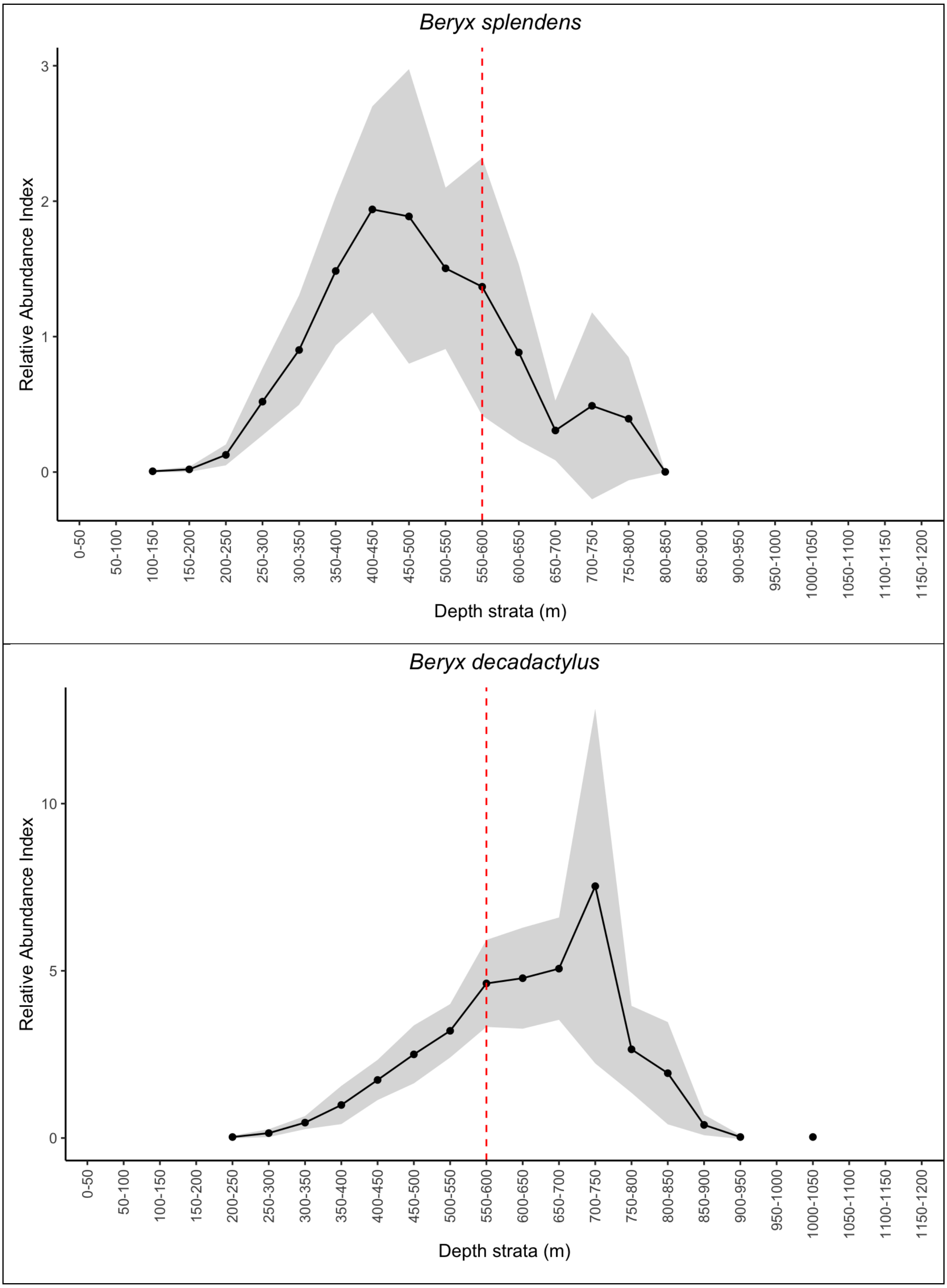


Figure 4 (Cont.). Mean abundance index by depth stratum for Areas I-IV and the period 1996 - 2023.

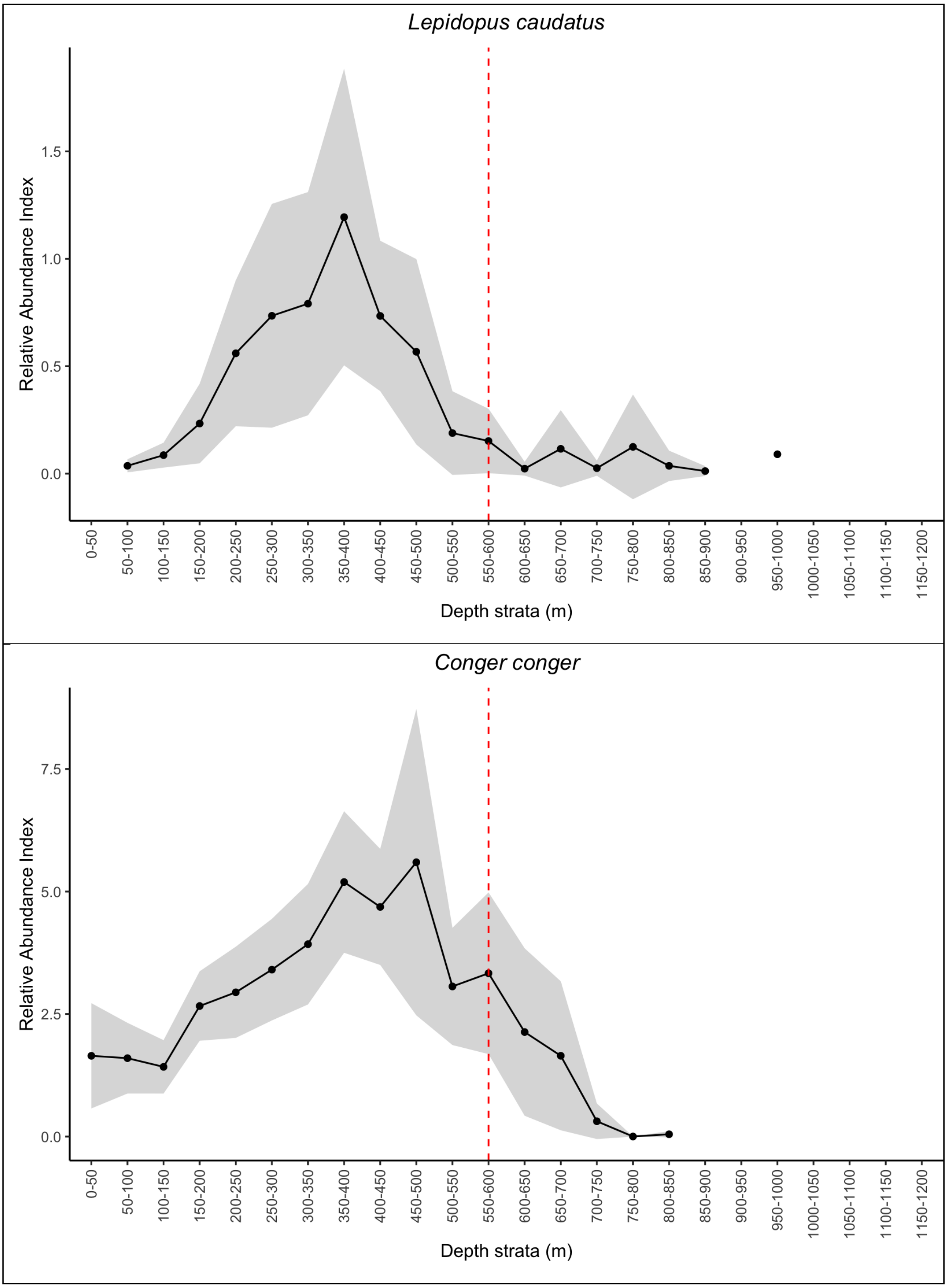
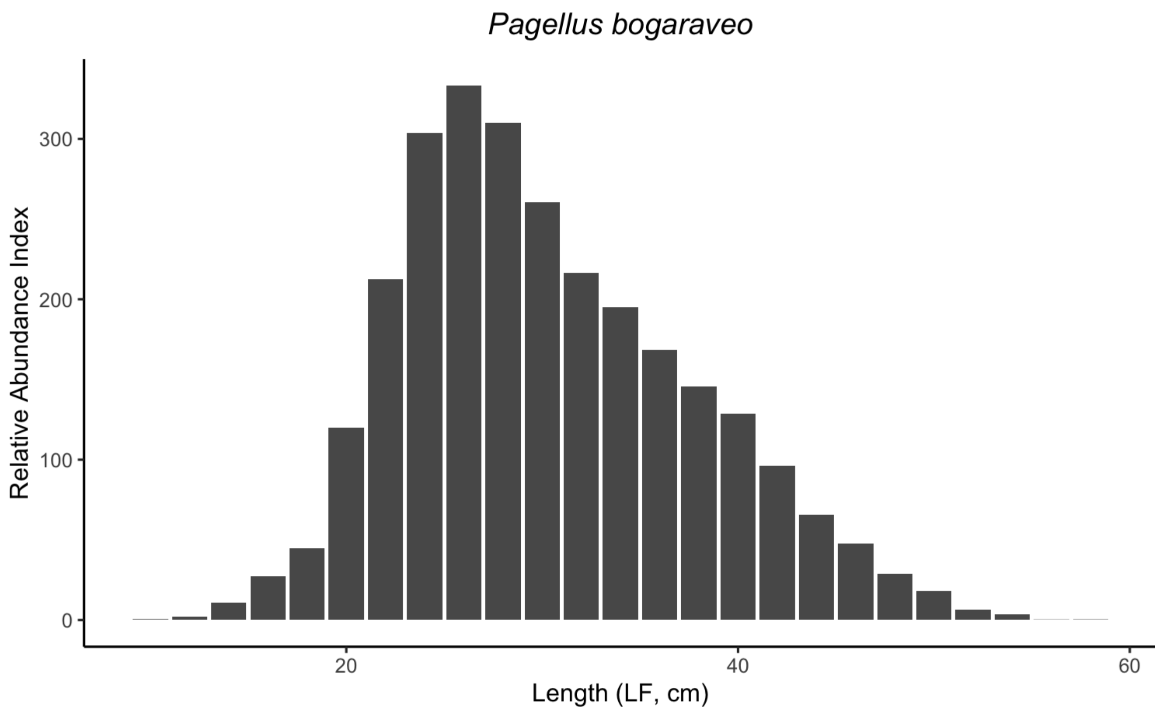


Figure 4 (Cont.). Mean abundance index by depth stratum for Areas I-IV and the period 1996 - 2023.

Length composition



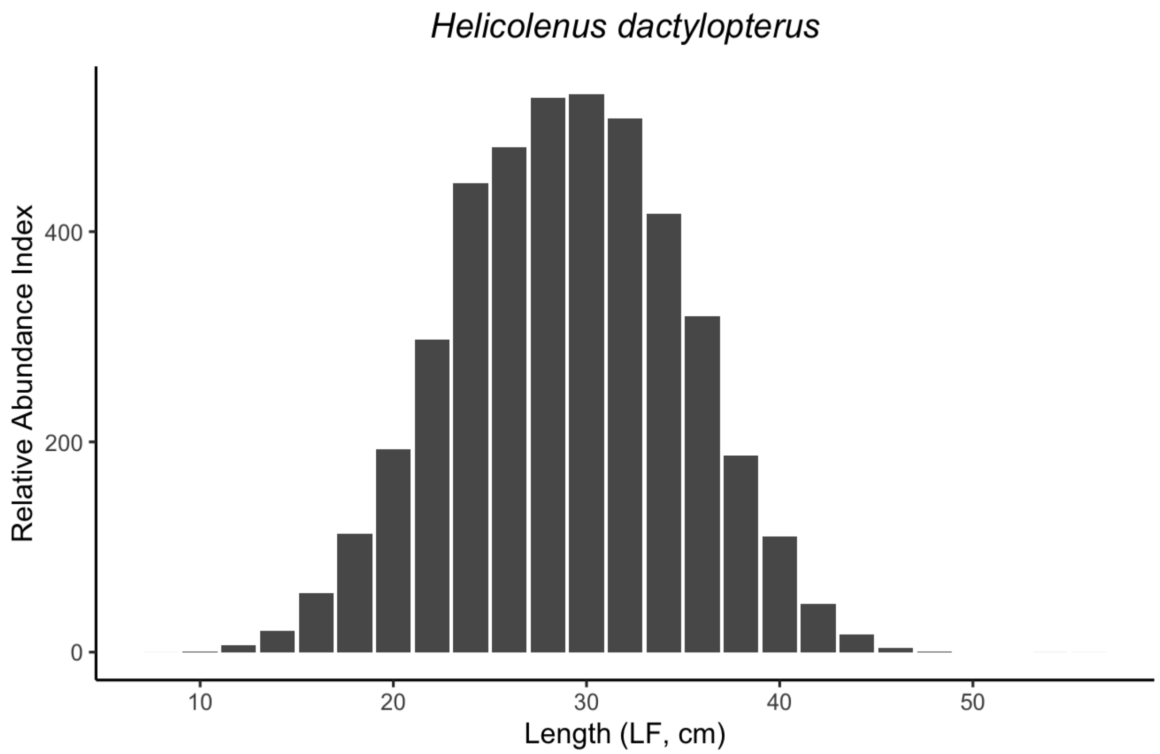
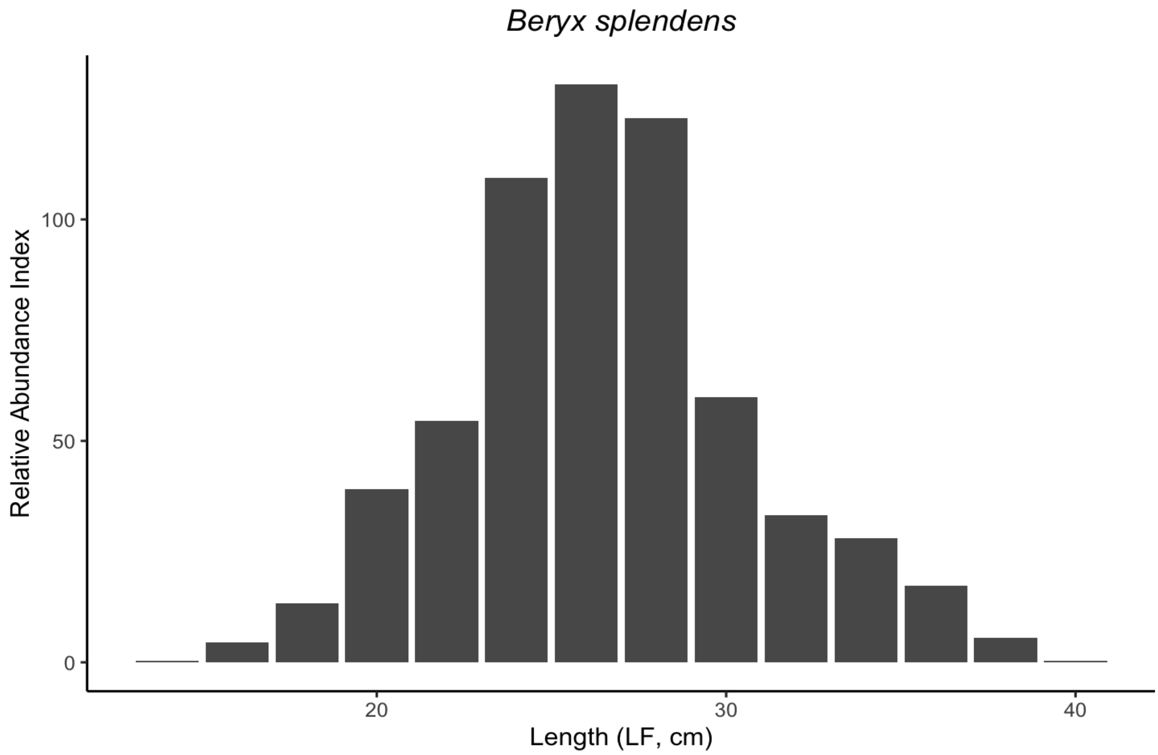


Figure 5. Mean length composition for the period 1995-2023 and Areas I-IV for some of the Azorean deep-water species.



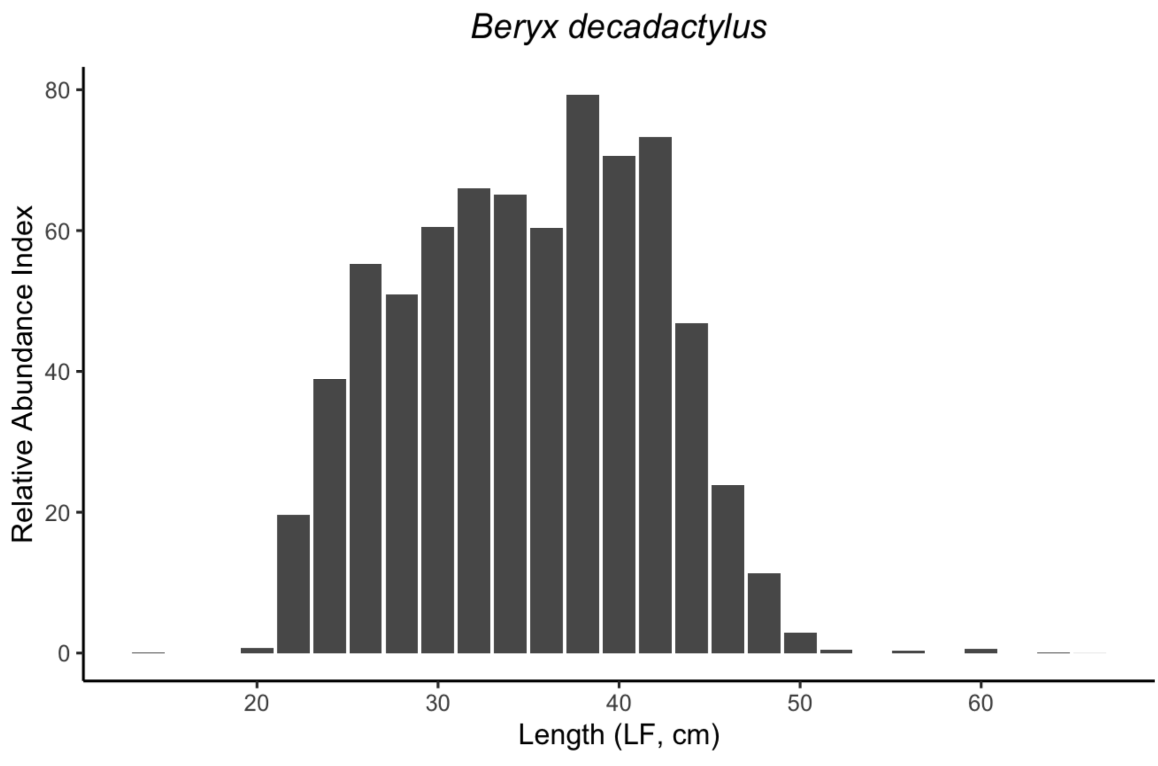


Figure 5 (Cont.). Mean length composition for the period 1995-2023 and Areas I-IV for some of the Azorean deep-water species.

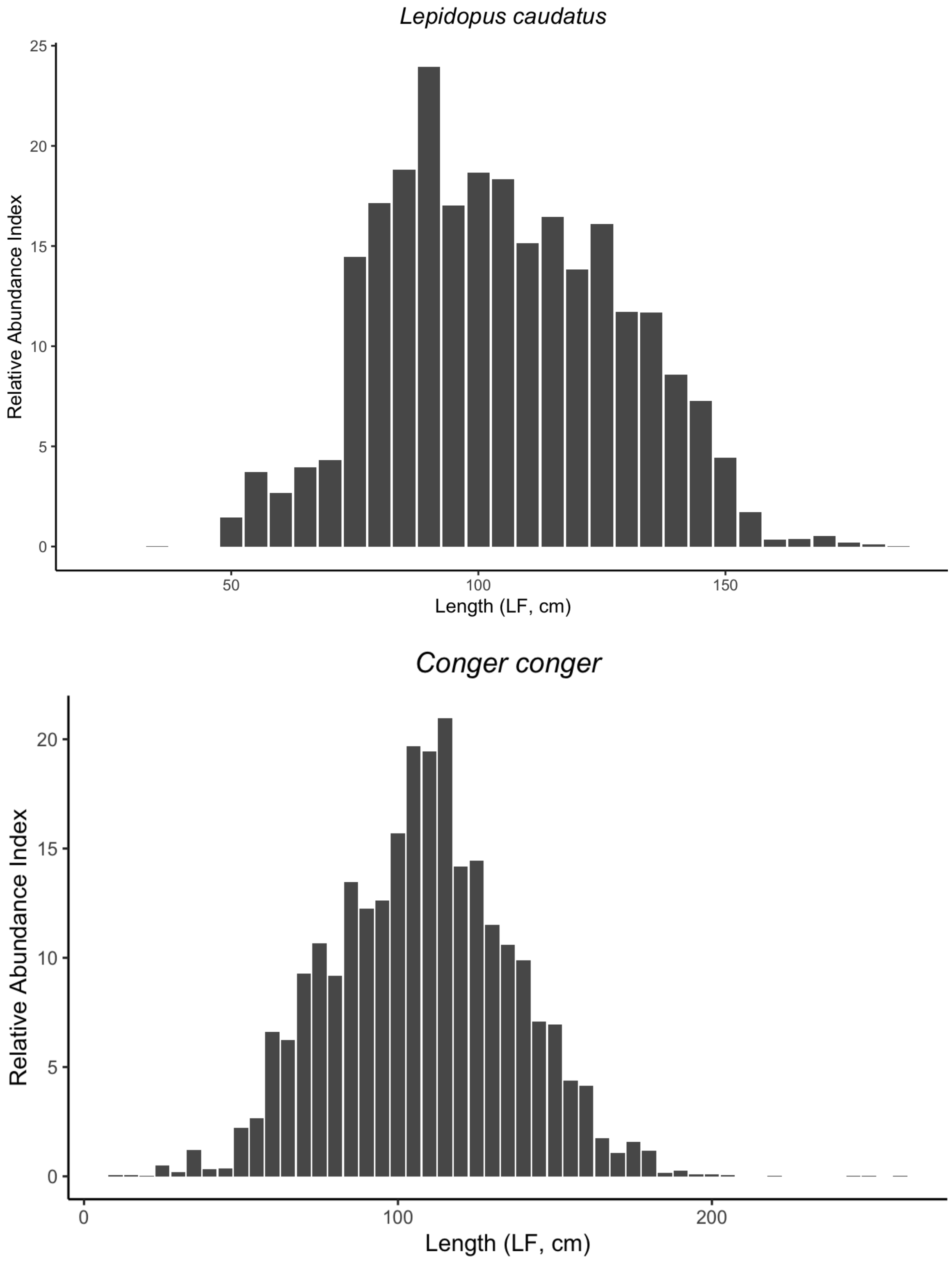
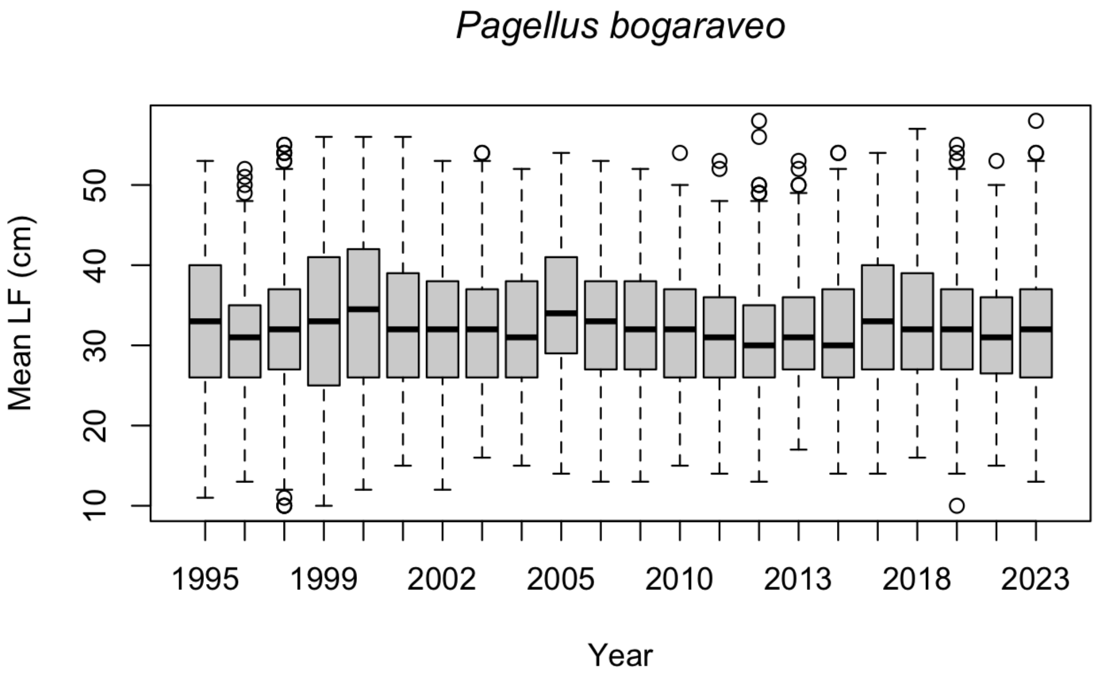


Figure 5 (Cont.). Mean length composition for the period 1995-2023 and Areas I-IV for some of the Azorean deep-water species.

Mean length



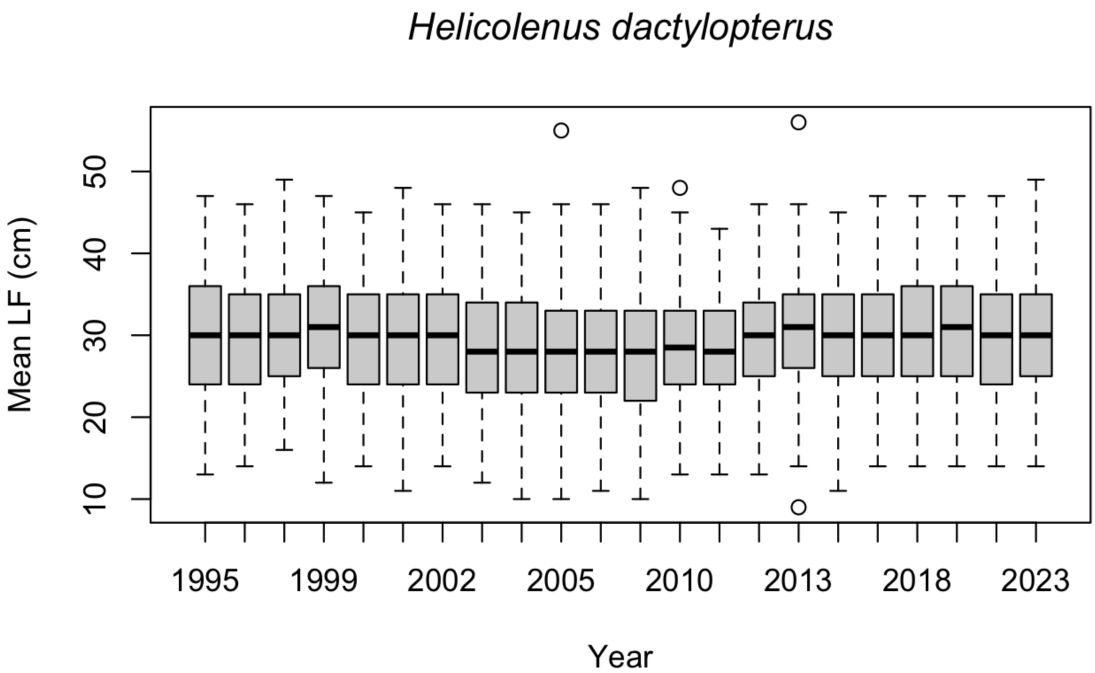
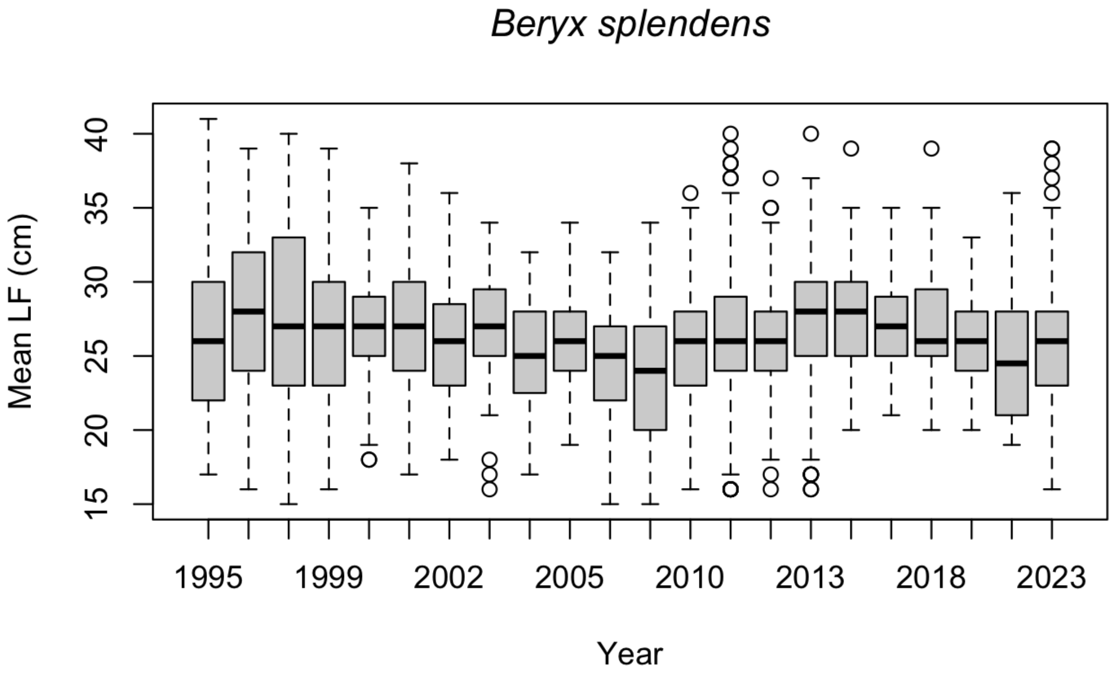


Figure 6. Annual mean length for some deep-water species for Areas I-IV.



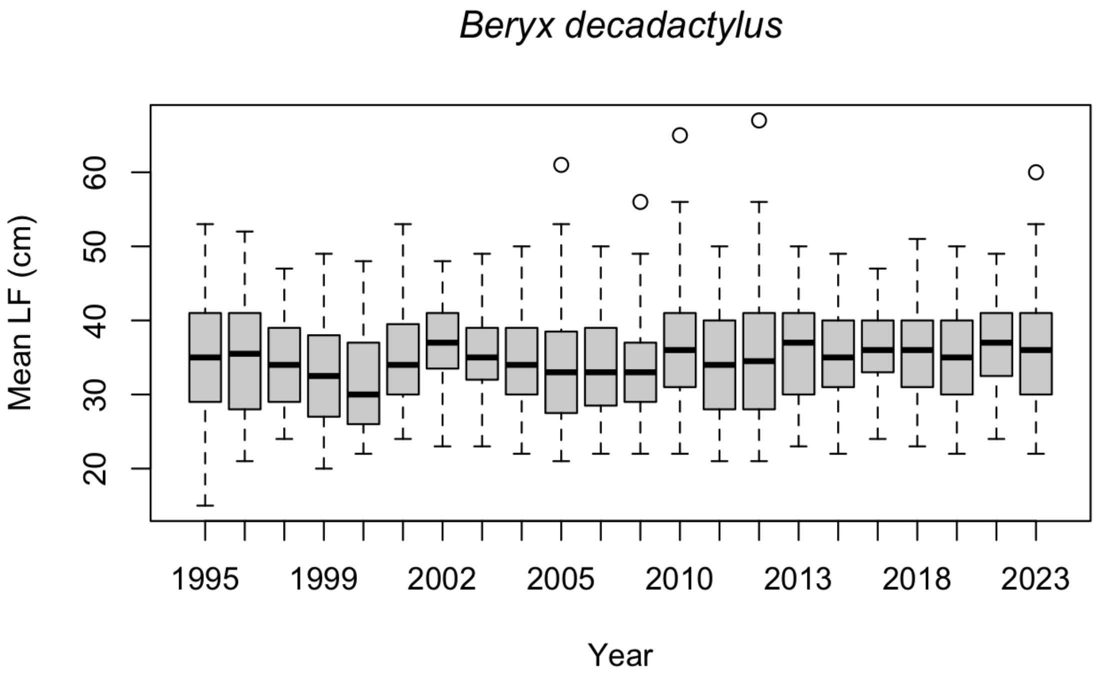
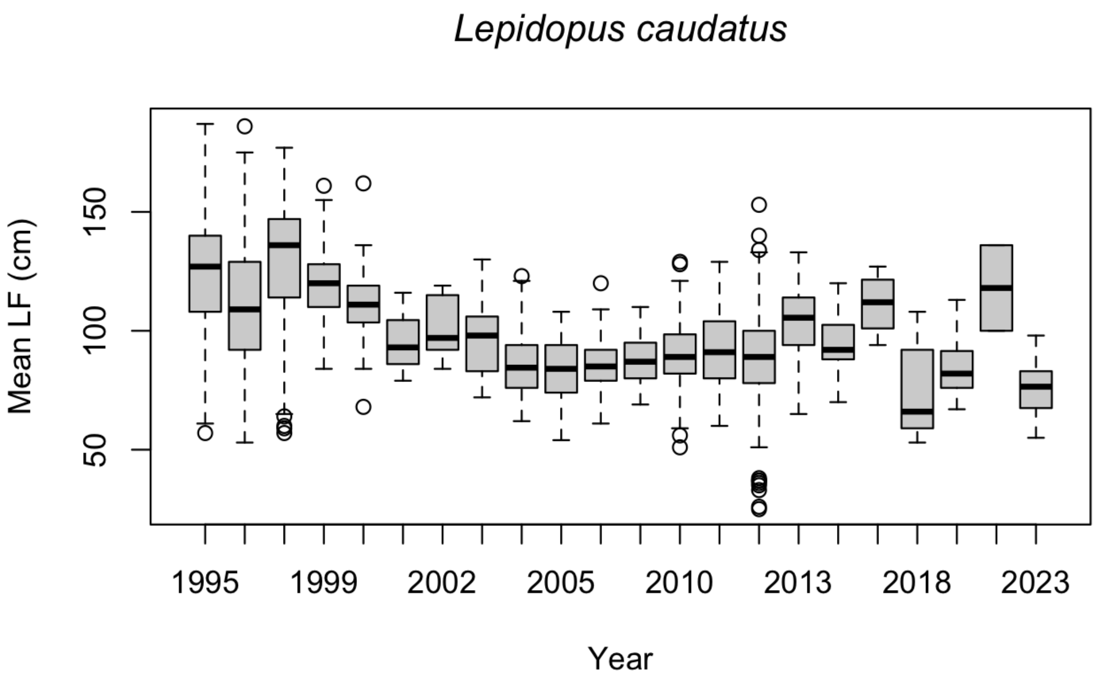


Figure 6 (Cont.). Annual mean length for some deep-water species for Areas I-IV.



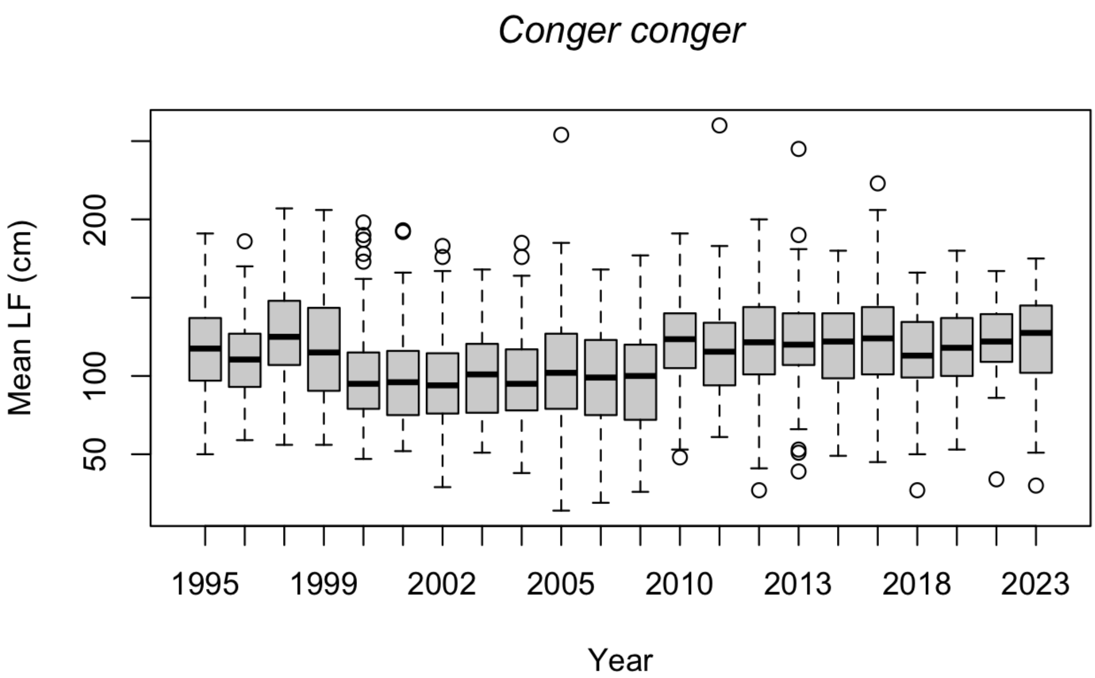


Figure 6 (Cont.). Annual mean length for some deep-water species for Areas I-IV.

Annex I: Other species.

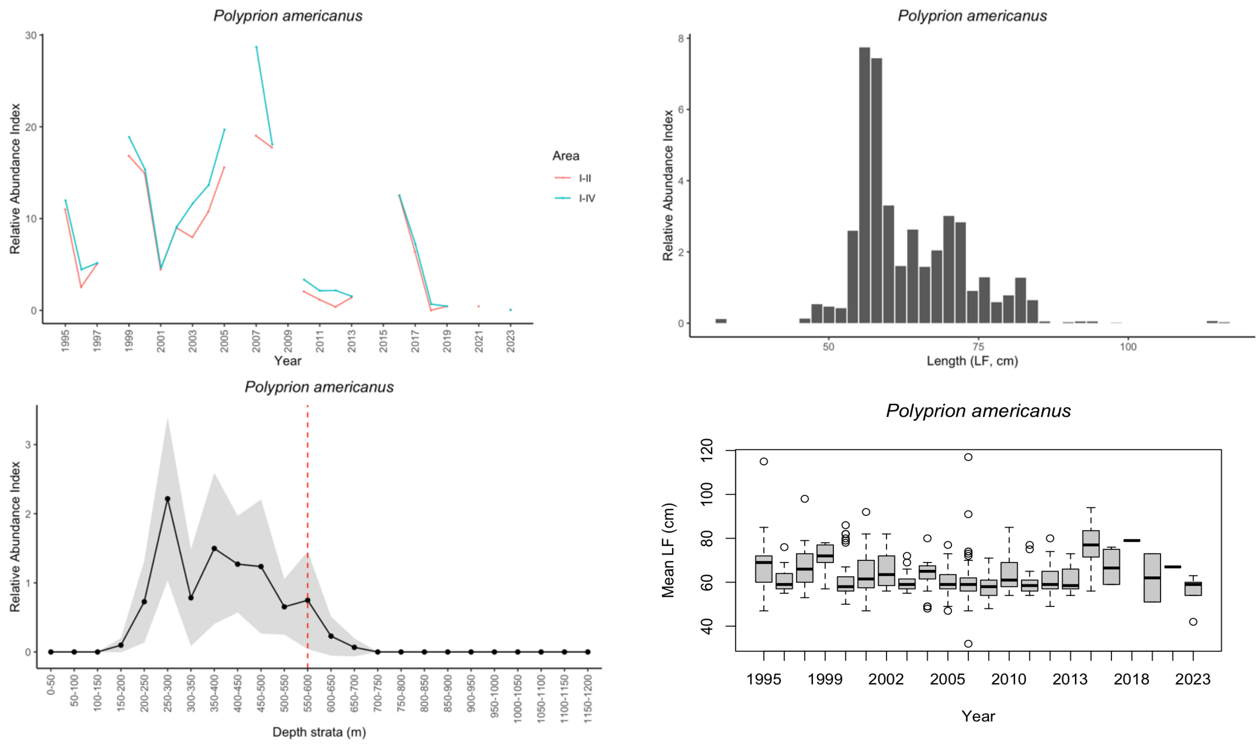


Figure I.1. Resumed survey information for *Polyprion americanus.*

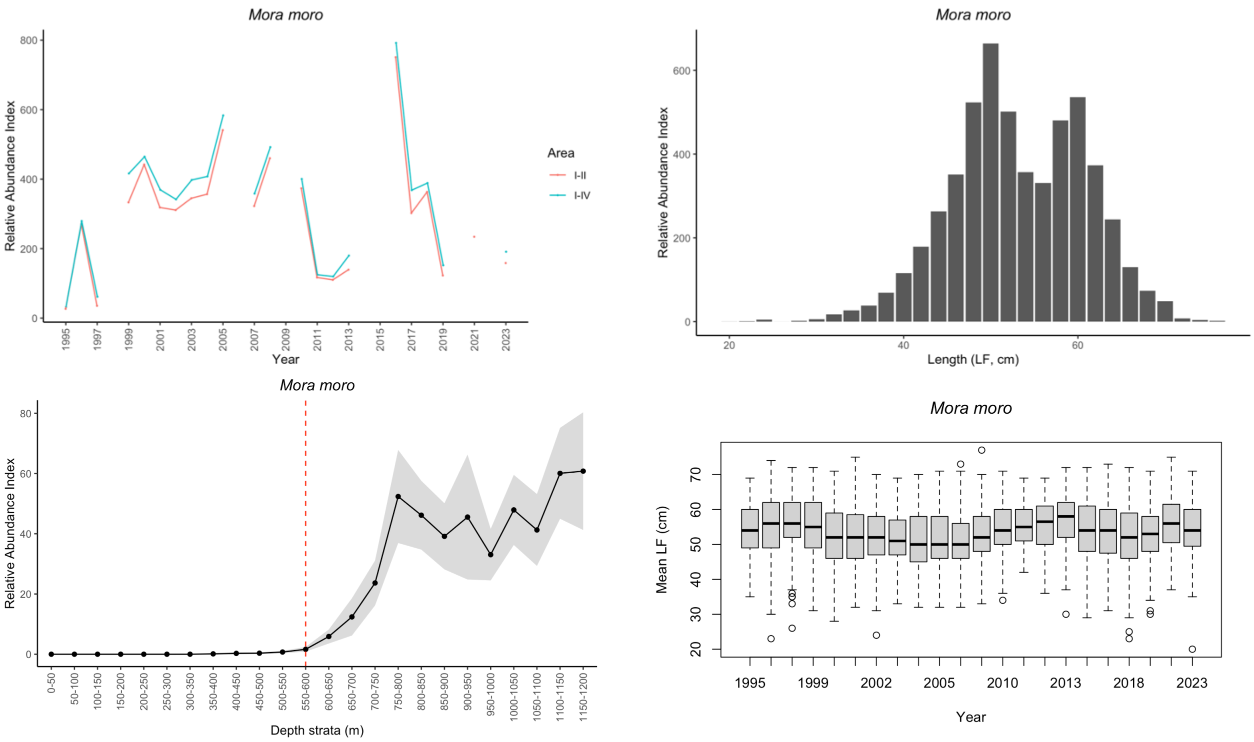


Figure I.2. Resumed survey information for *Mora moro.*

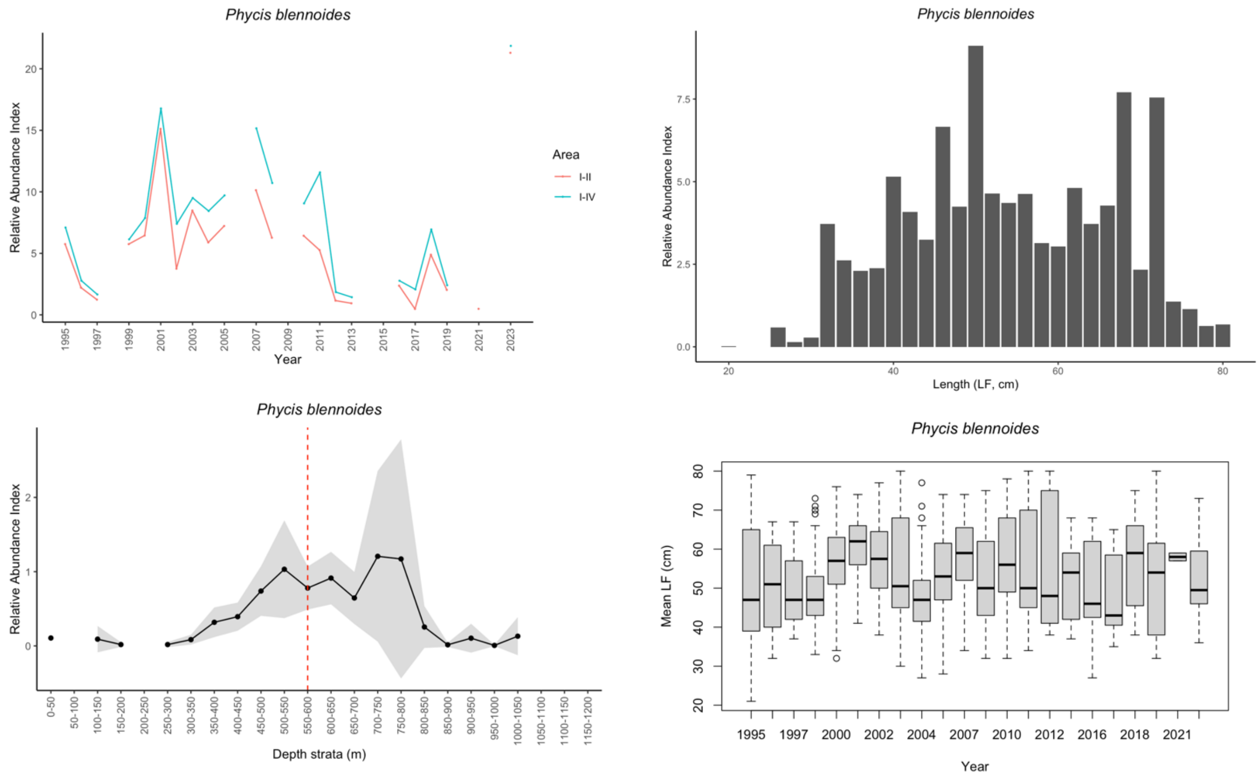


Figure I.3. Resumed survey information for *Phycis blennoides.*

Working Document to the ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP), 24-30 April 2024

Not to be cited without prior reference to the author

Distribution of red seabream and related species around the British Isles

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Summary: Red seabream (*Pagellus bogaraveo*), also known as western or blackspot seabream, has been subject to fisheries exploitation in Subareas 6, 7 and 8, where the landings and stock size showed a severe decline in the 1970s–80s. The stock is seriously depleted and a decade ago in 2014, ICES recommended the establishment of a recovery plan for the stock, including protective measures in areas where juveniles occur. There remains some uncertainty over the status of the stock and presence of the species in the wider Celtic Sea. Here, we review and assess existing information and data (biological and catch) held by ICES and UK national databases to contribute to a better understanding of the stock's status of red seabream. Initial results are suggestive that, while red seabream is still present in the Celtic Sea and Western Channel, the substantial reduction in the standing stock and difficulty in stock recovery since the 1980's may be linked to long-term effects of historic bottom trawling on red seabream habitats.

Species distribution in the Northeast Atlantic

Red seabream is distributed in the Northeast Atlantic, from southern Norway to Cape Blanc in Mauritania, including the NE Atlantic archipelagos of the Azores, Madeira, and Canary Islands, and in the Mediterranean Sea (Heessen *et al*., 2015; De Cubber *et al.*, 2023). The species occurs on the continental shelf break and slope, and seamounts (Morato *et al*., 2001; Santos *et al*., 2021), on mud and sand bottoms, and hard substrates (Bauchot and Hureau, 1986). They can be found at depths down to 700 m in the Atlantic but are found typically at 150–300 m depth (Froese and Pauly, 2023). Juveniles are mainly found in shallow waters, where it is thought to generally use coastal refuges as nursery areas, while adults are found in deeper and more offshore areas (Morato *et al*., 2001; Pinho *et al*., 2014).

The presence of red seabream around the British Isles is well documented, including Irish and Scottish Atlantic coasts, English Channel, and the Irish Sea (Desbrosses *et al*., 1932; Lorance, 2011; Heessen *et al*., 2015). Historical accounts suggest that the species has been caught in the North Sea (Desbrosses *et al*., 1932; ICES Catch Statistics[1]), but recent fisheries-independent surveys have not recorded the species in these waters.

Fishery overview

Red seabream (*Pagellus bogaraveo*) is a commercially valuable species, for which ICES provide advice for three stock units that are all managed through TACs (SBR/678-, SBR/09-, and SBR/10-). The species has been commercially exploited since the 1950s, with catches peaking for almost two decades during the 1960s and 1970s (ICES, 2022). For the purposes of this paper, we only consider the Celtic Seas and the English Channel, Bay of Biscay stock (sbr.27.6-8).

Along the European continental shelf, the stock was mainly exploited by French and Spanish bottom trawlers, by artisanal pelagic trawlers in the Bay of Biscay (Divisions 8.a, b), and by the Spanish longline fleet in the Cantabrian Sea (Division 8.c) (ICES, 2022). Between 1988–2021, the majority of landings have been reported by Spain (70%), France (18%), UK (10%) and Ireland (1%) (ICES, 2022). However, red seabream has been overexploited in Subareas 6–8, where the reported landings declined steeply in the 1980s (Lorance, 2011; Vieira *et al*., 2019).

The red seabream stock in Subareas 6–8 is considered by ICES to be seriously depleted even in the absence of biological reference points. It is a bycatch species in mainly longline, gillnet and otter trawl fisheries, with only landings data available (ICES, 2023). In 2014, ICES recommended the establishment of a recovery plan for the stock, including protective measures in areas where juveniles occur. The most recent ICES advice for red

[1] https://www.ices.dk/data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx

seabream in Subareas 6–8 is that "*when the precautionary approach is applied, there should be zero catch in each of the years 2023 and 2024"* (ICES, 2022[2]).

At present, reported landings of red seabream from Subareas 6–8 are almost all bycatch from longline, gillnet and otter trawl fleets from France and Spain. Most of these landings were reported from Subarea 8. In the UK, activity data is reported, via logbooks, by the skippers to Marine Management Organisation (MMO), as part of the existing monitoring and control of fishing activity framework. UK landings of red seabream for the period 2018-2022 in the ICES Divisions covered by the stock almost never exceeded 1 tonne in landed weight (expect in 2018). The majority of landings were caught using demersal trawls and gillnets (Figure 1).

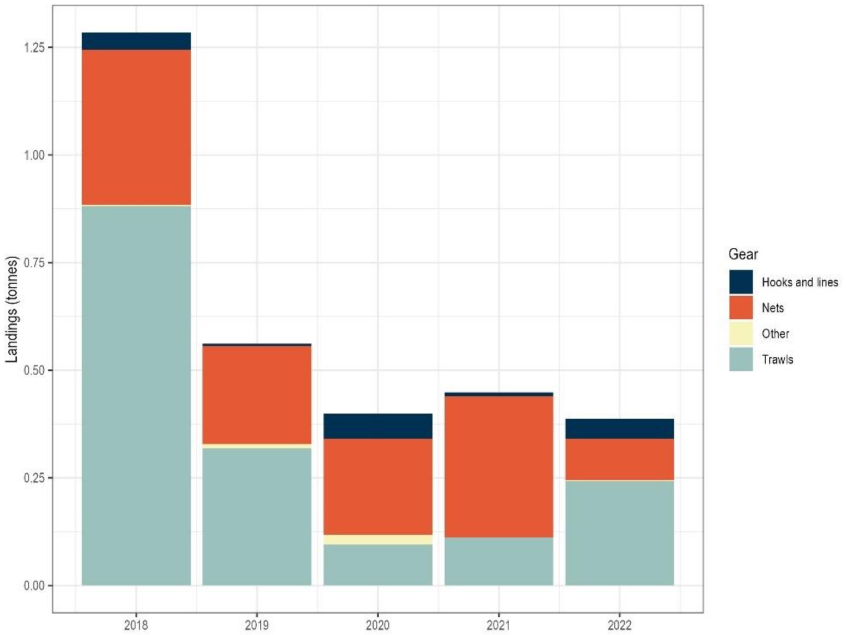

Figure 1. UK landings (tonnes) of red seabream, by gear, in ICES Subareas 4 and 7 from 2018 to 2022, based on data available from MMO. No landings were reported from ICES Subarea 6 for the same period.

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[2] ICES. 2022. Blackspot seabream (*Pagellus bogaraveo*) in subareas 6–8 (Celtic Seas, the English Channel, and Bay of Biscay). *In* Report of the ICES Advisory Committee, 2022. ICES Advice 2022, sbr.27.6-8. https://doi.org/10.17895/ices.advice.19453802

Current management

There are existing management measures relevant to red seabream. Fisheries on the stock of red seabream in Subareas 6-8 (SBR/678) is subject to management and TAC constraints. The Written Record of fisheries consultations between the United Kingdom and the European Union for 2021, 2022, 2023 and 2024[3] stated that the TAC would remain at 105 t, with the UK being allocated 10% (11 t) and the EU being allocated 90% (95 t). All the above state that the TAC is for bycatch only and that directed fisheries are not permitted for this stock.

Fisheries-dependent data

Reported landings (2018–2022) of red seabream by UK vessels, as extracted from the MMO fishing activity database (Table 1), shows that the majority of landings were recorded from Divisions 7.d, 7.e, and 7.j, were caught by beam, bottom trawl, and gillnets and are considered to be a small bycatch in fisheries targeting hake, monkfish and lemon sole. Minor landings were also reported from the central and southern North Sea.
For the period 2018–2022, there was some evidence of seasonality in red seabream landings, with a higher proportion landed in the summer and early autumn (June to October). Demersal trawls and gillnets were the main gears, contributing to 79% of the reported UK landings.

[3] Written Record of fisheries consultations between the United Kingdom and the European Union for 2024 (publishing.service.gov.uk)

Table 1. Reported annual landings (tonnes) of red seabream by UK vessels (2018–2022) by ICES Division. Shaded rows indicate those Divisions from where most of these landings originated.

ICES Division	2018	2019	2020	2021	2022
4.b	< 0.01				
4.c	0.01			0.01	
7.a	< 0.01	< 0.01			
7.b					
7.c					
7.d	0.05	0.04	0.07	0.19	0.07
7.e	1.08	0.37	0.21	0.18	0.28
7.f	0.01	< 0.01	0.01	0.01	
7.g		< 0.01	< 0.01	0.01	< 0.01
7.h	< 0.01	0.04	0.04	0.03	0.02
7.j	0.13	0.10	0.03	0.04	0.01
7.k			0.05		
Total	**1.28**	**0.56**	**0.4**	**0.45**	**0.39**

It is worth to note that the UK landings data might be affected by a change in the recording system for seabream. Between 2018–2022, around 89% of UK landings of seabreams were recorded under one code ‘SBX’ (seabreams nei[4]) rather than being separated by red (SBR) and black seabream (BRB). This change into recording seabreams’ landings as SBX has been occurring for UK vessels for the last five years. Most records of SBX are from areas where black seabream (BRB) is abundant (for example, Division 7.d). Landings of unidentified seabreams (SBX) from those areas where red seabream would be expected to be more abundant (for example, Divisions 7.h and 7.j) have been low. Other species of seabreams (for example, bogue *Boops boops*) occur occasionally in UK waters but landings are negligible.

The main area of uncertainty around SBX landings is from Division 7.e (Figure 2), which may comprise some red seabream although several other species of seabream are locally common in Division 7.e. Further studies of the species composition of seabreams in this area are required. The STECF FDI database indicates that other countries report under SBR and BRB, making little use of the SBX code.

[4] nei = not elsewhere identified.

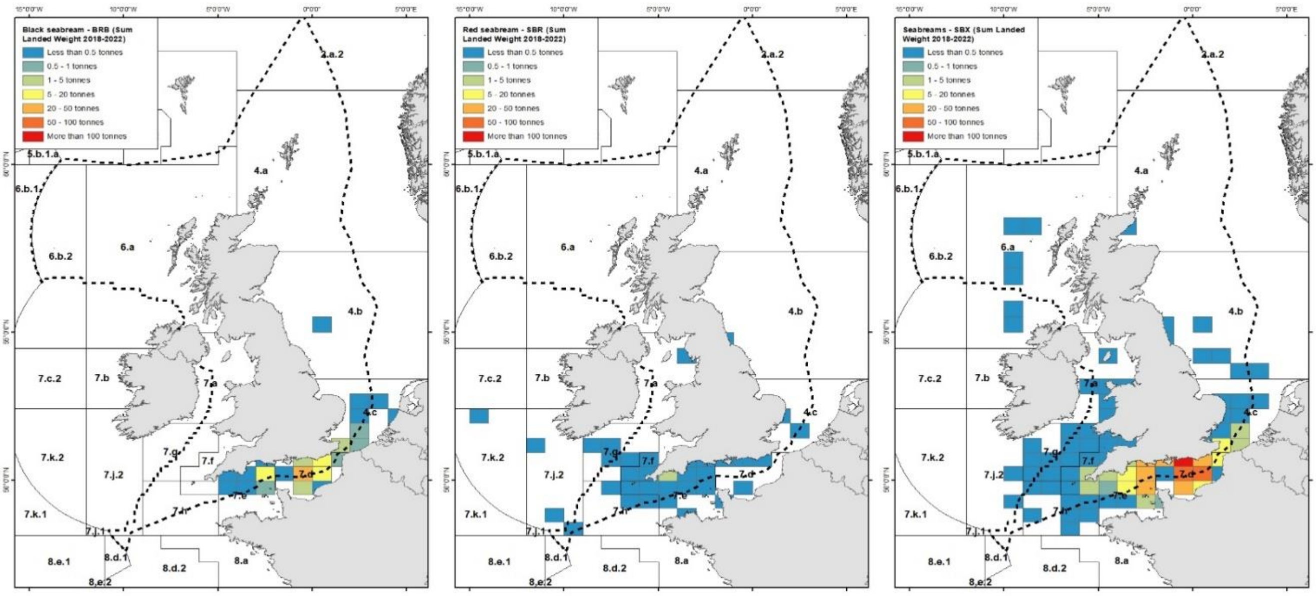

Figure 2. Reported landings (tonnes) of black seabream (BRB; left), red seabream (SBR; centre) and seabream nei (SBX; right) by UK vessels extracted from the fishing activity database (MMO). Reported landings of SBR were primarily from 7.d-e, 7.h-k, though some landings may relate to misidentifications of other seabreams or coding errors. Reported landings of SBX were primarily from 7.d-e, where black seabream is the main commercial seabream species.

Recreational fisheries may constitute a significant proportion of the mortality of juvenile red seabream in some areas, owing to the coastal distribution of juveniles, and this has been confirmed for the stock in Subarea 10 (Pinho *et al.*, 2014). In the UK (and Ireland), there are no regulations applicable to recreational catches of red seabream. However, available survey data shows no bycatch in UK recreational fisheries in recent years, and therefore is likely to be a minor source of fishing mortality at the present time (Hyder *et al*., 2021).

Fisheries-independent data

Data were extracted from ICES Datras[5], including all the International Bottom Trawl Surveys (IBTS) operating in the Northeast Atlantic and North Sea, and also the beam trawl surveys. Most of the catches of red seabream reported by fisheries-independent surveys come from the French trawl surveys FR-CGFS (Divisions 4.c and 7.d) and EVHOE

[5] ICES Database on Trawl Surveys (DATRAS), 2023, ICES, Copenhagen, Denmark. https://datras.ices.dk

(Divisions 7.f, 7.h, 7.j.2, and 8.a-c), and the Beam Trawl Survey (BTS, Divisions 4.c, 7.a, and 7.d-h). Bottom trawl surveys used a GOV trawl, with an average horizontal opening of 20 metres and a vertical opening of 4 metres. On the other hand, BTS were equipped with a 3 or 4 metres beam trawl to retrieve the catches. These surveys represent 98% of the total catches of seabreams in the study area.

These data confirmed the occurrence of seven seabream species around the British Isles (Figure 3), including axillary (or Spanish) seabream (*Pagellus acarne*), common pandora (*Pagellus erythrinus*), Couch's seabream (*Pagrus pagrus*), black seabream (*Spondyliosoma cantharus*) and gilthead seabream (*Sparus aurata*). No data was available for Common dentex (*Dentex dentex*), which could be expected given the preference of this species for more temperate habitats.

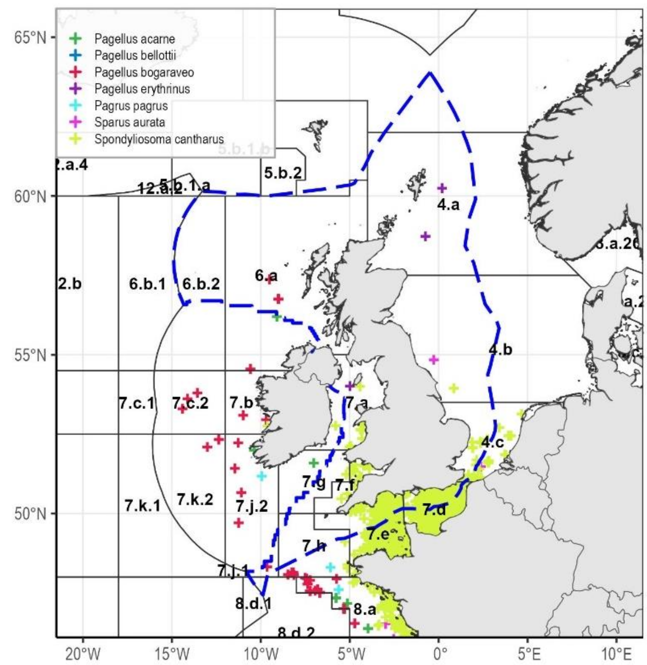

Figure 3. Distribution of red seabream and other seabreams around the British Isles, based on data available from ICES Database of Trawl Surveys (DATRAS, http://datras.ices.dk) for the period 1971–2022.

There are records dating back to 1971, however the distribution of catches by year varies significantly for all the species. For all seabream species, the depth of capture ranged from 7 to 705 metres. Red seabream is the species that was caught in deeper waters compared to other seabream species (Figure 4).

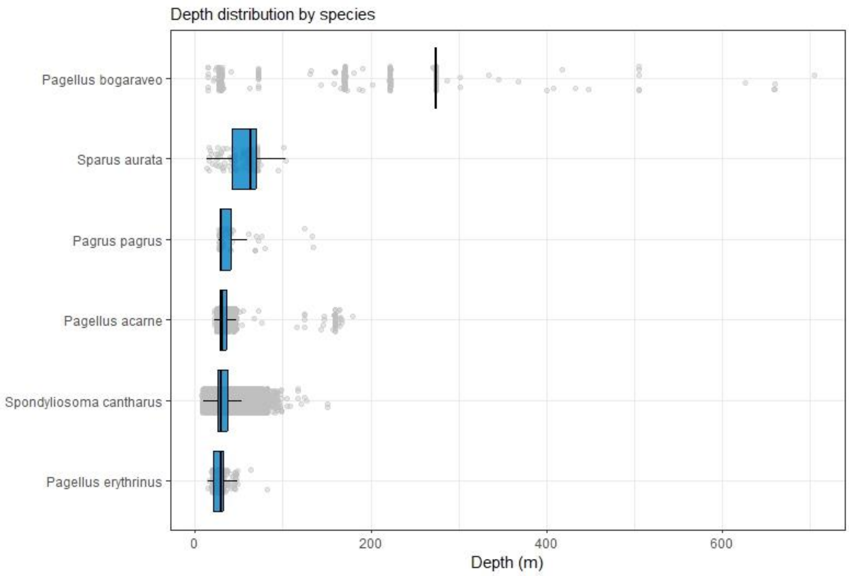

Figure 4. Depth distribution (in metres) by species, based on data available from ICES Database of Trawl Surveys (DATRAS, http://datras.ices.dk) for the period 1971–2022. Boxplots represent the 25th and 75th percentile and median, and jitter points show individual records across the bathymetric range.

Conclusion

Information presented here confirms that red seabream is still present in the Celtic Sea and Western Channel. The substantial reduction in the standing stock (Vieira *et al*., 2019) and difficulty in stock recovery since the 1980's may be linked to long-term effects of historic bottom trawling on red seabream habitats (cf. Pourtois *et al*., 2022; see also Jennings and Kaiser, 1998).

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Results on silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), roughsnout grenadier (*Trachyrincus scabrus*), Spanish ling and ling (*Molva macrophthalma* and *Molva molva*) from the 2023 Spanish Groundfish Survey on the Porcupine Bank (NE Atlantic)*

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Abstract

This working document presents the results of the most significant deep-sea fish species caught in 2023 on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3). Biomass, abundance, geographical distribution and length ranges were analysed for silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater fork-beard (*Phycis blennoides*), roughsnout grenadier (*Trachyrincus scabrus*), Spanish ling and ling (*Molva macrophthalma* and *Molva molva*) and other scarce deep sea species. Overall, the biomass of these target species decreased, except for *A. sphyraena* and *H. dactylopterus* reaching the highest values of the entire time series. The recruitment was poor.

Introduction

The Spanish bottom trawl survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been carried out annually on the third-quarter (September) since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in the area (Baldó 2023).

The aim of this working document is to update the results (abundance indices, length frequency and geographic distributions) of the most common deep-sea fish species on the 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, 2021, 2022, Ruiz-Pico et al. 2016, 2018, 2019, 2020, 2023). The species analysed were: *Argentina silus* (greater silver smelt), *Argentina sphyraena* (lesser silver smelt), *Helicolenus dactylopterus* (bluemouth), *Phycis blennoides* (greater forkbeard), *Trachyrincus scabrus* (roughsnout grenadier), *Molva molva* (ling) and *Molva macrophthalma* (Spanish ling) and some other scarce deep sea species as *Aphanopus carbo* (black scabbardfish), *Brosme brosme* (tusk), *Coryphaenoides rupestris* (roundnose grenadier), *Hoplostethus atlanticus* and *Beryx* spp.

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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 to avoid the selection of adjacent 5×5 mm rectangles (Kingsley et al. 2004). Extra hauls were performed within the standard stratification to improve coverage in gaps left by random sampling and outside the standard stratification to explore the continuity of the fish community in Porcupine Seabight.

More details on the survey design and methodology are presented in the Manual of the IBTS North Eastern Atlantic Surveys (ICES 2017).

The tow duration is 20 min since 2016, but the results were extrapolated to 30 min of trawling time to keep up the time series.

Results

In 2023, 80 valid standard hauls and 8 extra hauls were carried out. Among the additional hauls, 4 of them have been carried out into the standard stratification, to improve coverage in the gaps left by random sampling and 4 of them, between 911 and 1219 m, to explore the continuity of the fish community in Porcupine Seabight (Figure 1).

The total stratified catch per haul increased in 2023 reaching the highest value of the time series (Figure 2). Fish represented 95% of the total catch, and the selected deep water fish represented 12% of that total fish catch, with the following percentages per species: *Helicolenus dactylopterus* (37%), *Argentina silus* (32%), *Argentina sphyraena* (16%), *Trachyrincus scabrus* (9%), *Phycis blennoides* (5%), *Molva Macrophthalma* (0.2%) and *Molva molva* (0.03%).

Argentina silus **(greater silver smelt) and** ***Argentina sphyraena*** **(lesser silver smelt)**

In 2023, both, the biomass and abundance of *Argentina* spp. decreased slightly after the increment of the previous year, still remaining between the medium values of the time series. This specifically due to the decrease of *A. silus* which is the most contributing species in the overall percentage of silver smelt. However, the lowest contributing species, *A. sphyraena*, increased this last survey, following the trend of the previous year (Figure 3; Figure 4; Figure 5).

Both species were found in the north of the bank this last year. Specifically, most of the *A. sphyraena* spots were in that area, whereas *A. silus* silus was mainly found in the south of the study area, as usual, but mainly in the deeper southwest strata in this last survey (Figure 6 and Figure 7).

The abundance of small individuals of *A. silus* and *A. sphyraena* decreased compared to the previous years, *A. sphyraena* with a single mode around 24 cm and *A. silus* with a single mode around 25 cm (Figure 8).

***Helicolenus dactylopterus* (bluemouth)**

Although bluemouth is not requested in the ICES DCF Data Call, biomass and abundance are significant in the area and useful for the assessment of the species (ICES, 2015).

Biomass and abundance of *H. dactylopterus* followed the upward trend of the last four years reaching the highest value of the time series (Figure 9). However, recruitment has remained at the same low values as in previous year (Figure 10).

H. dactylopterus was found throughout the study area. As in previous years, hardly any recruits were found in their usual areas, the Irish shelf and the southeastern area of the bank, mostly between 200 and 600 m (Figure 11).

The size distribution of *H. dactylopterus* showed a well defined mode in 18 cm and a second small mode was found in 11 cm (Figure 12).

***Trachyrincus scabrus* (roughsnout grenadier)**

T. scabrus has decreased slightly in this last survey after reaching the highest value in the time series last year (Figure 13).

The species was found in the deepest southeastern and western area, as usual in the historical series (Figure 14).

The length distribution in 2023 was similar to the previous year, showed a mode at 18.5 cm. A decrease in the abundance of the smaller sizes can also be seen (Figure 15).

***Phycis blennoides* (greater fork-beard)**

Biomass and abundance of *P. blennoides* blennoides was similar to that of the previous year, the values remain among the lowest in the time series (Figure 16). Biomass patches were widely found in the south, west and east, but scarcely in the north, as in previous years (Figure 17).

Most specimens were from 29 cm to 32 cm in this last survey and the recruitment remained at low values similar to those of the previous year (Figure 18).

***Molva molva* (ling) and *Molva macrophthalma* (Spanish ling)**

These two species were analysed comparatively in this working document, as in previous reports.

M. molva was scarcer than *M. macrophthalma* in the area. Both species have been on a downward trend since 2014 and has not yet been reverted. In this last survey, the biomass and abundance decreased reaching the lowest value of the time series (0.05 kg/haul and 0.06 ind/haul in *M. molva* and 0.45 kg/haul and 0.97 ind/haul in *M. macrophtalma*) (Figure 19).

The few biomass patches of *M. molva* were found in the center of the bank whereas *M. macrophthalma* was found in the west and in the south of the study area, though scarcer than in previous years (Figure 20).

Only 3 specimens of *M. molva* were found, ranging from 51 to 64 cm. Specimens of *M. macrophthalma*, a few more than previous year, sized from 16 to 111 cm (Figure 21).

Other deep-sea fish species

The deep water species *Aphanopus carbo*, *Coryphaenoides rupestris*, *Hoplostethus atlanticus* and *Beryx* spp. were scarcely or not found in the standard stratification of the study area, but were found outside of it, except for *Beryx* spp. The species *Brosme brosme* was found in the previous year in two hauls, but in this last survey was not found again.

The species *C. rupestris* and *H. atlanticus* were found only in the deep hauls between 918 and 1219 m carried out to explore the continuity of the fish community in Porcupine Seabight, out of the standard stratification, in the southeast part of the bank. 119 specimens of *C. rupestris* were found, ranging from 4.5 to 25 cm. Only 2 specimens of *H. atlanticus* were found from 24 cm.

In 2023, the species *A. carbo* was found from 739 and 1219 m, in four hauls in the standard stratification (Figure 22), but mainly in deep hauls in the Porcupine Seabight (Figure 23).

Species of the genus *Beryx* were found in the standard stratification, the biomass and abundance increased in this last survey (Figure 24). Six specimens of *Beryx splendes* from 24 to 35 cm were found in six hauls in the south and in the east and three of *Beryx decadactylus* from 28 to 32 cm in two hauls in the east (Figure 25).

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Figures

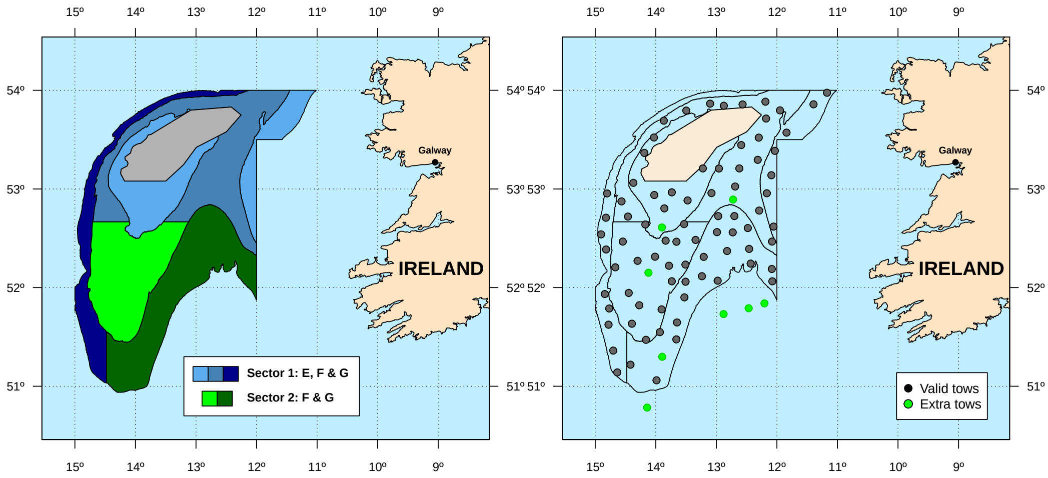

Figure 1: Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 - 450 m and G) 451 - 800 m. The grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: Distribution of hauls performed in 2023.

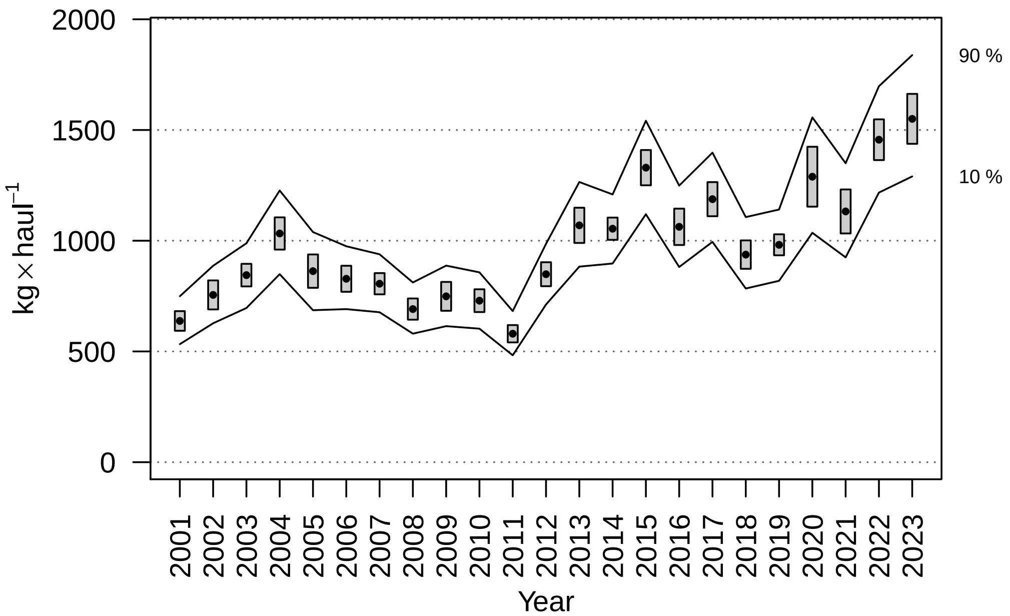

Figure 2: Evolution of the total fish catch in biomass in the Porcupine surveys.

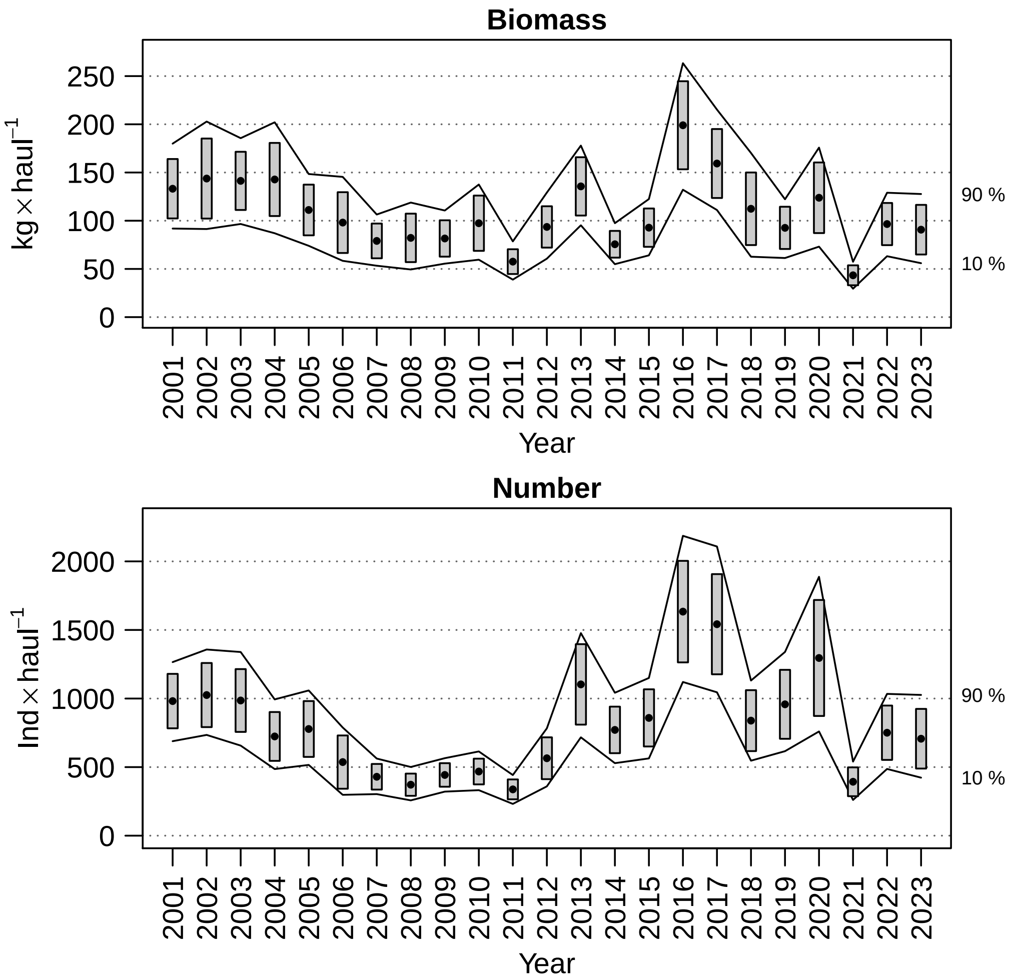

Figure 3: Evolution of biomass and abundance indices *Argentina* spp. (mainly *Argentina silus*) in the Porcupine surveys. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

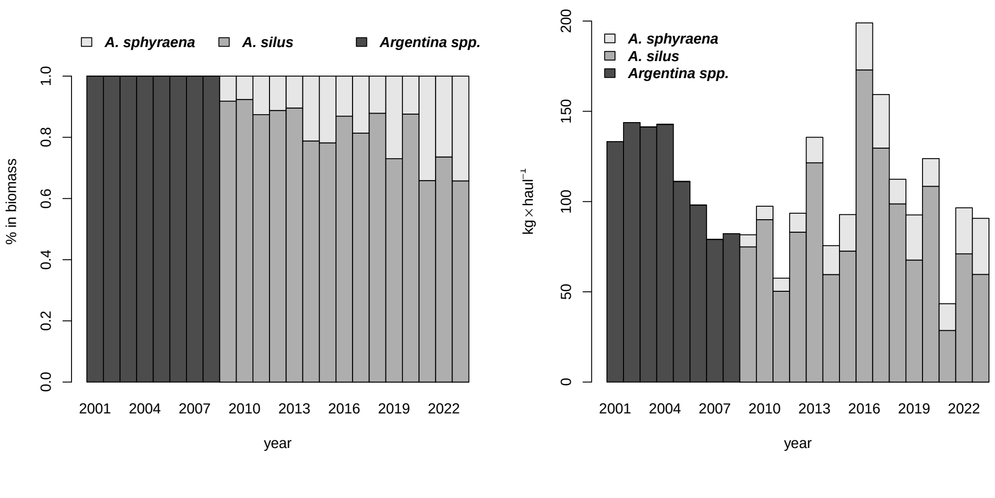

Figure 4: Share and abundance of Argentine species in the Porcupine surveys.

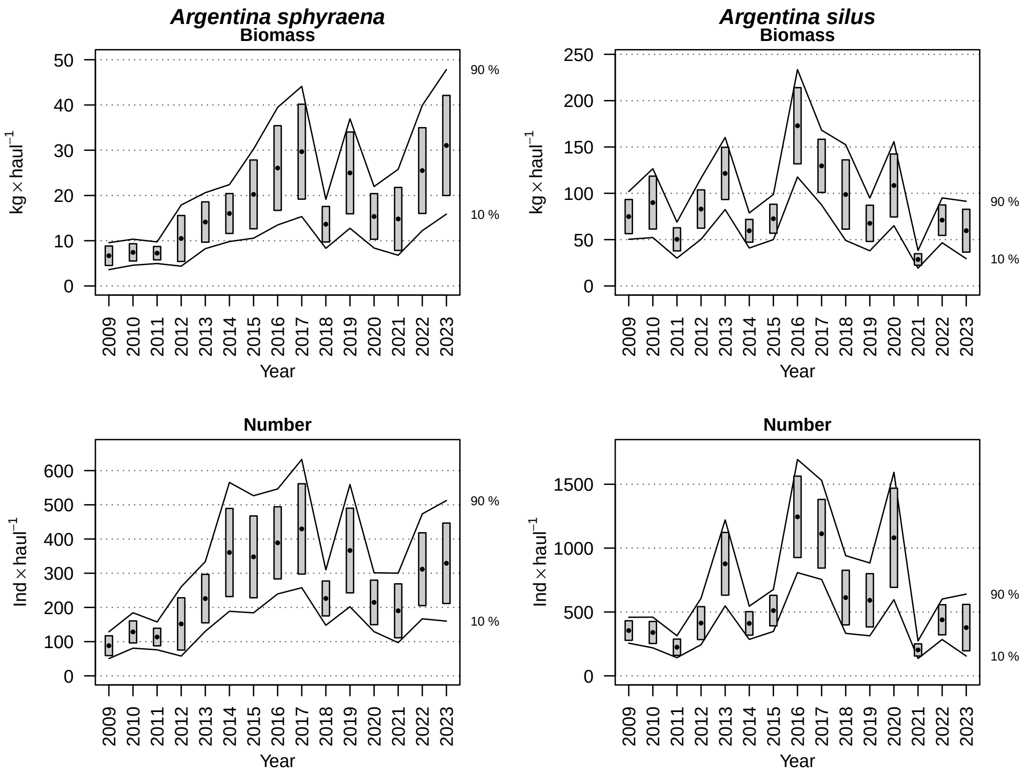

Figure 5: Evolution of biomass and abundance indices of *Argentina sphyraena* and *Argentina silus* in the Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

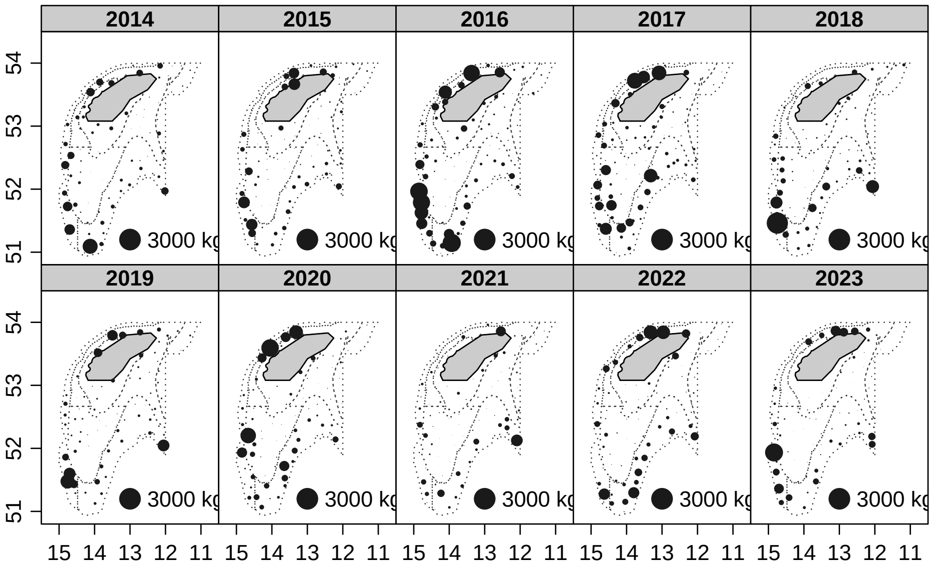

Figure 6: Geographic distribution of *Argentina* spp. catches (kg/30 min haul) in Porcupine surveys over the last decade.

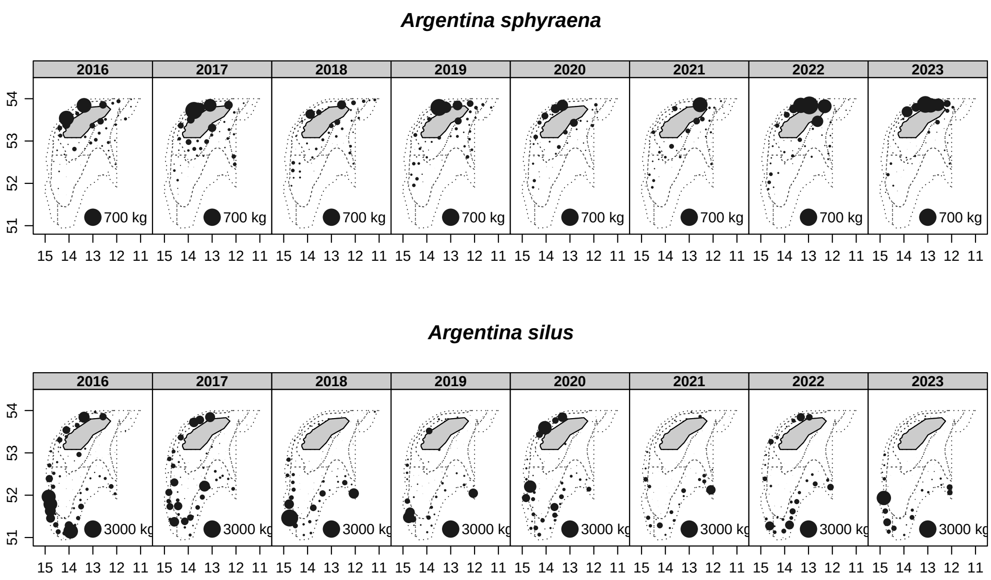

Figure 7: Geographic distribution of *Argentina sphyraena* and *Argentina silus* catches (kg/30 min haul) in Porcupine surveys (2016-2023).

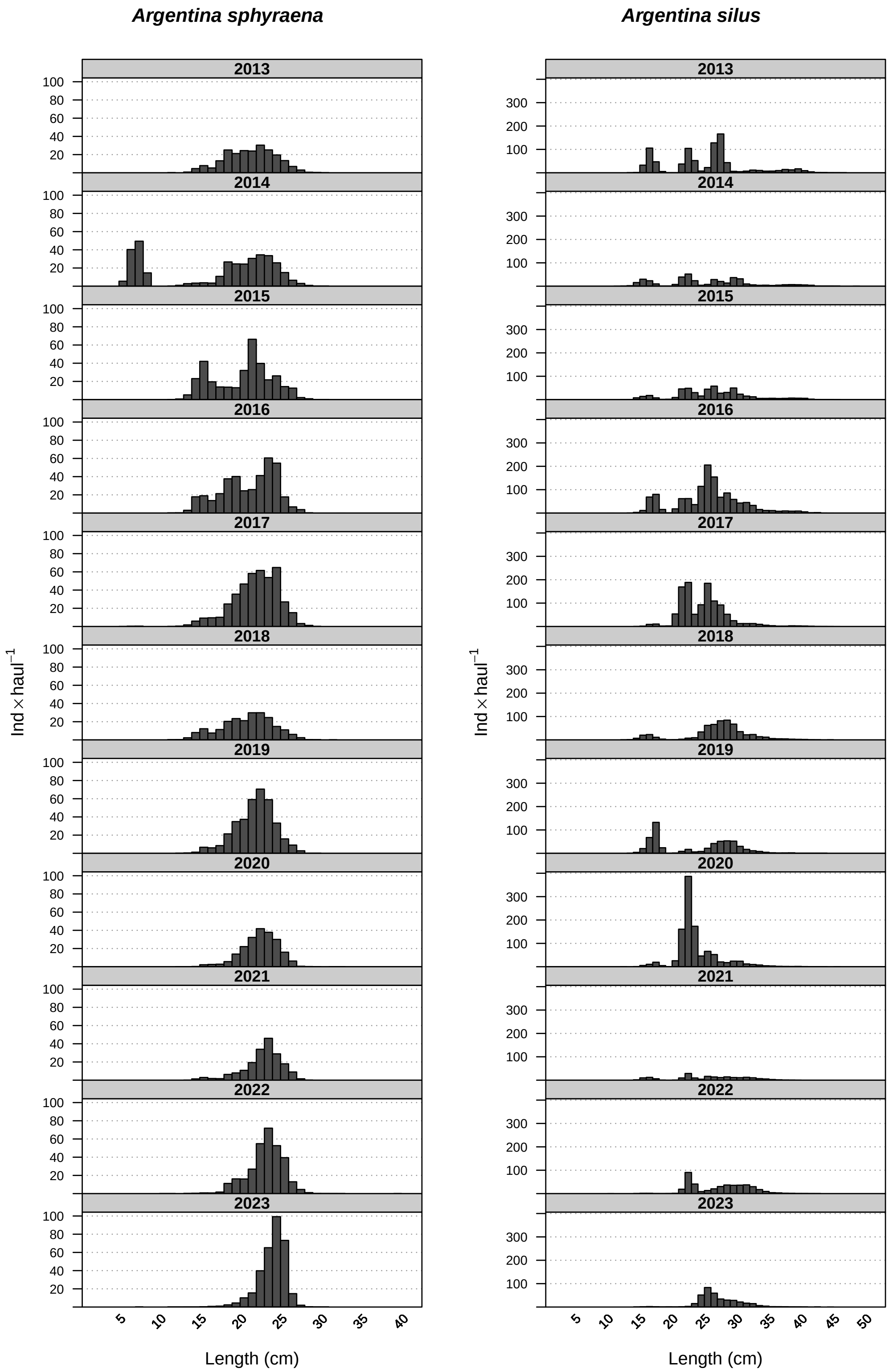

Figure 8: Mean stratified length distributions of *Argentina sphyraena* and *Argentina silus* in the Porcupine surveys (2013-2023).

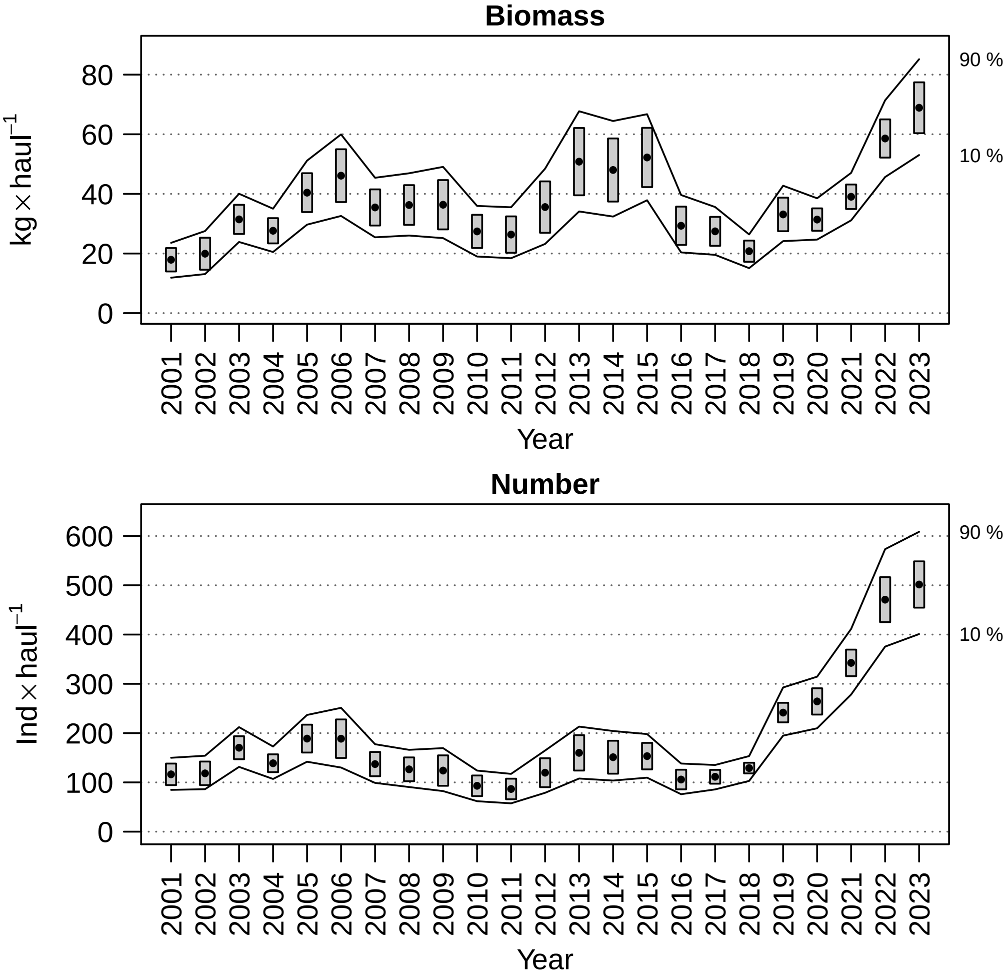

Figure 9: Evolution of biomass and abundance indices of *Helicolenus dactylopterus* in the Porcupine surveys. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

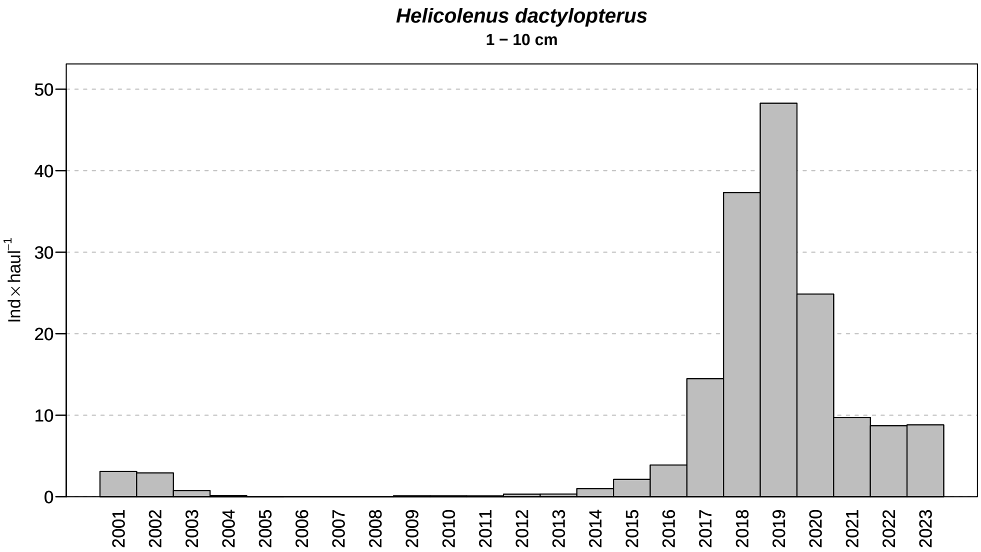

Figure 10: Mean stratified abundance of *Helicolenus dactylopterus* recruits (1-10 cm) in the Porcupine surveys.

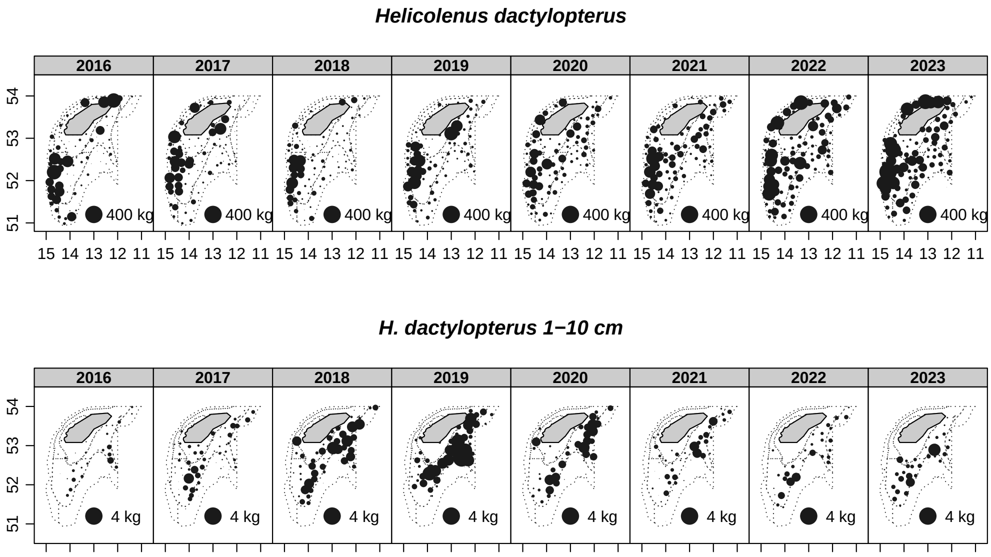

Figure 11: Geographic distribution of *Helicolenus dactylopterus* catches ($kg \times 30$ min haul-1) and recruits (1-10 cm) in the Porcupine surveys (2016-2023).

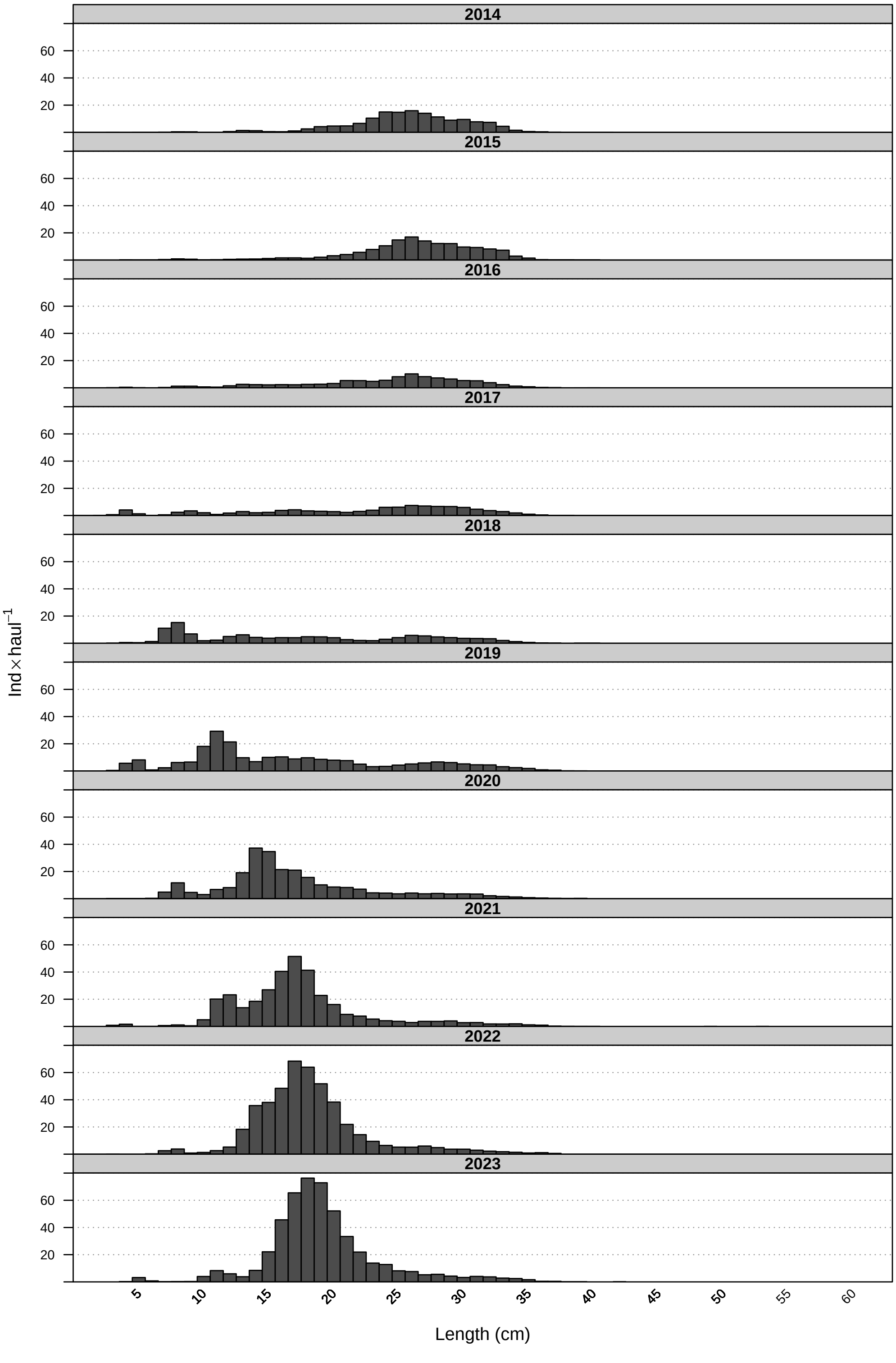

Figure 12: Mean stratified length distributions of *Helicolenus dactylopterus* in the Porcupine surveys (2014-2023).

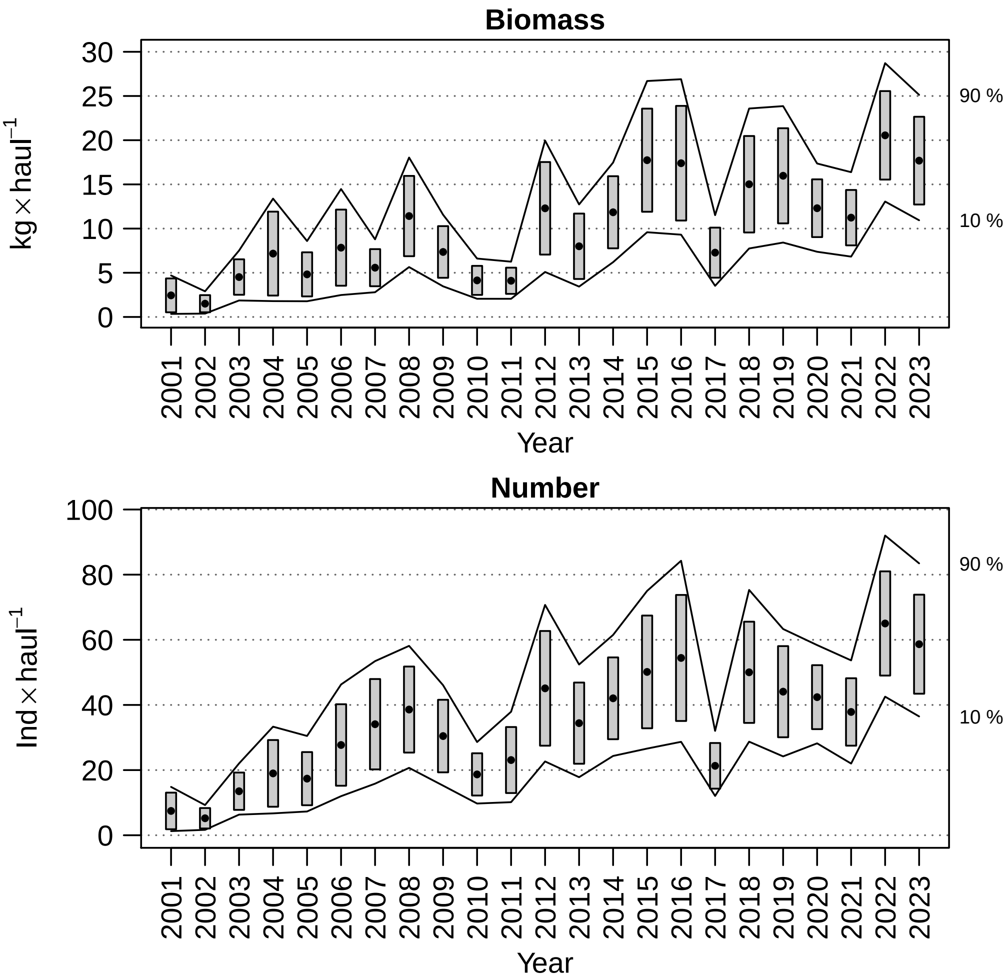

Figure 13: Evolution of biomass and abundance indices of *Trachyrincus scabrus* in the Porcupine surveys. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

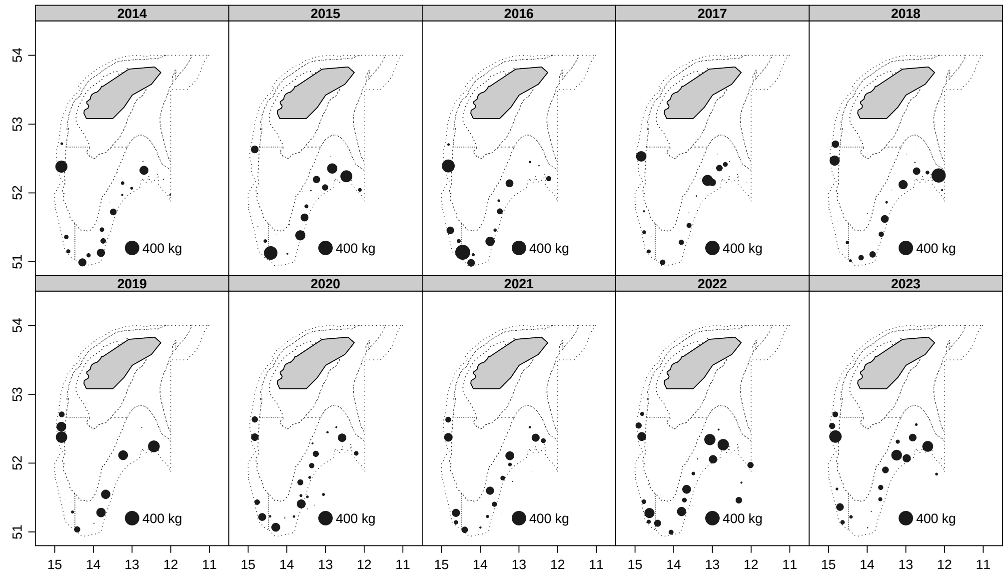

Figure 14: Geographic distribution of *Trachyrincus scabrus* catches (kg/30 min haul) in Porcupine surveys over the last decade.

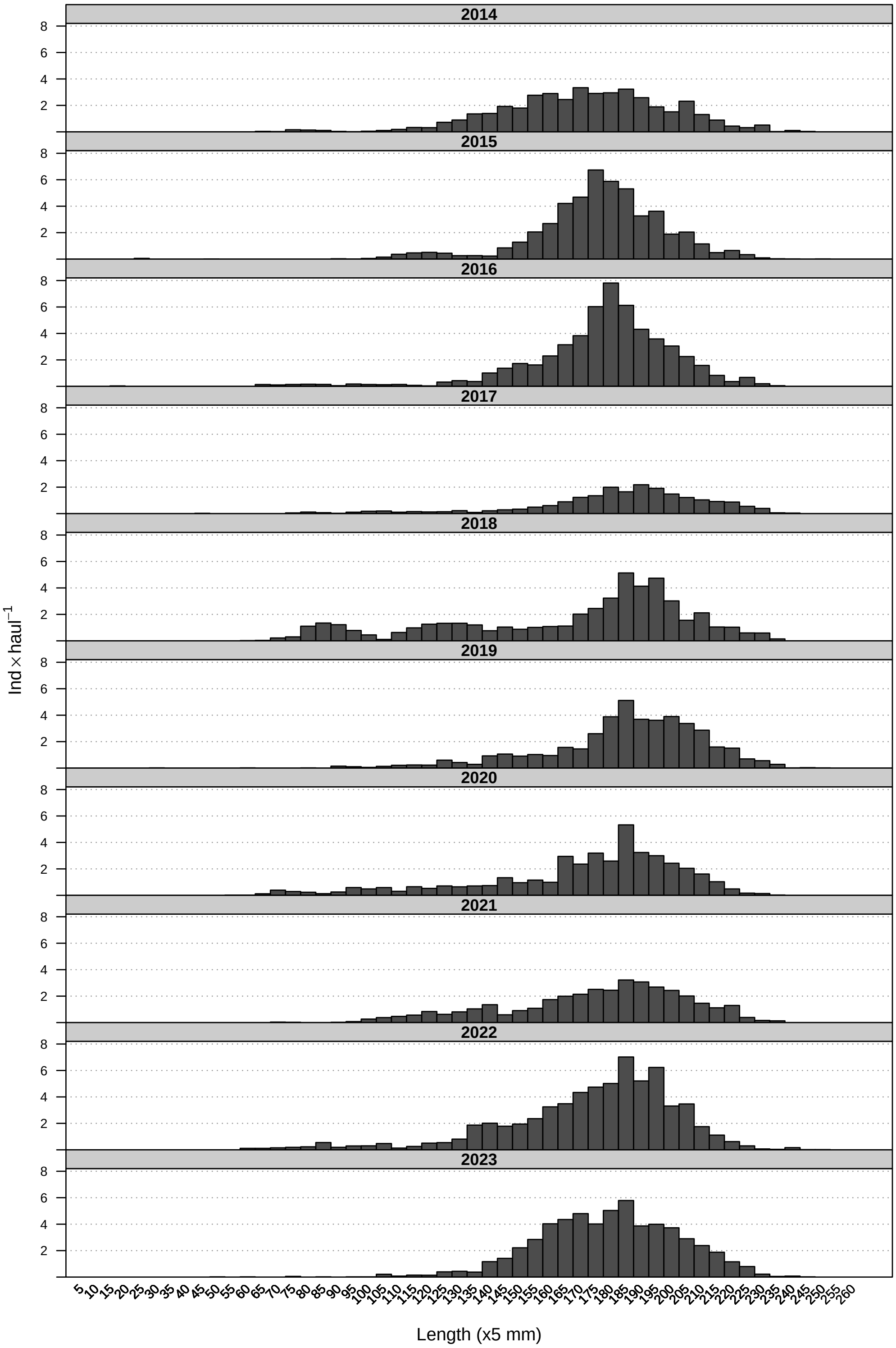

Figure 15: Mean stratified length distributions of *Trachyrincus scabrus* in the Porcupine surveys (2014-2023).

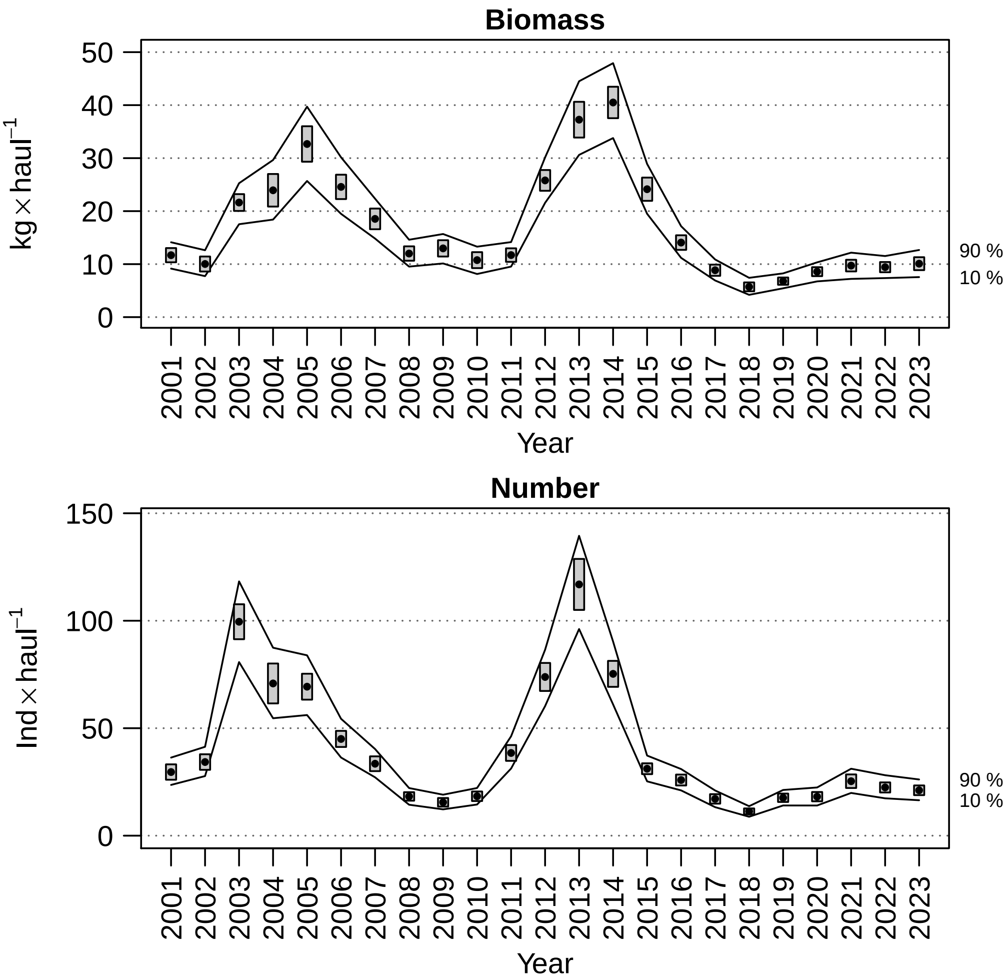

Figure 16: Evolution of biomass and abundance indices of *Phycis blennoides* in the Porcupine surveys. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

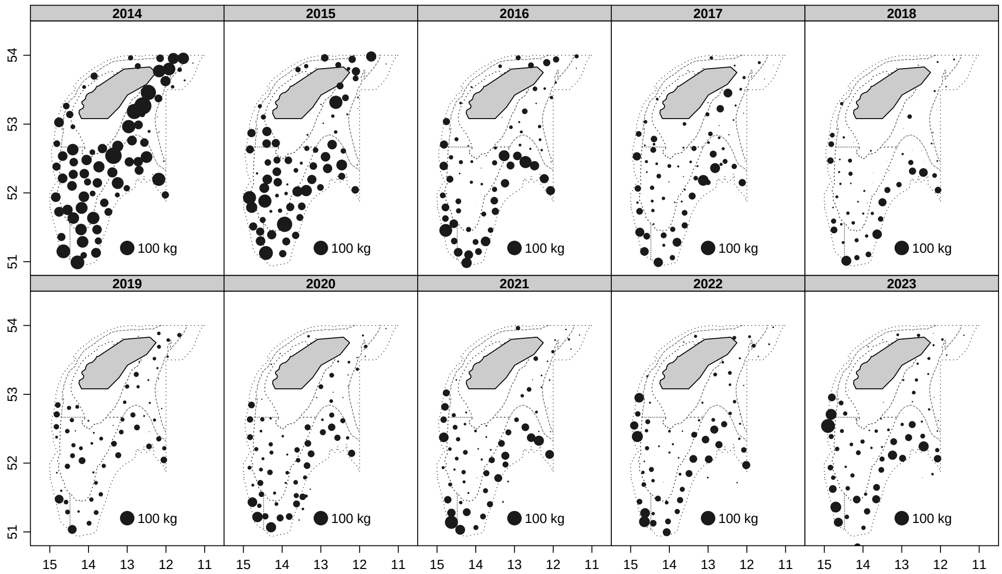

Figure 17: Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys over the last decade.

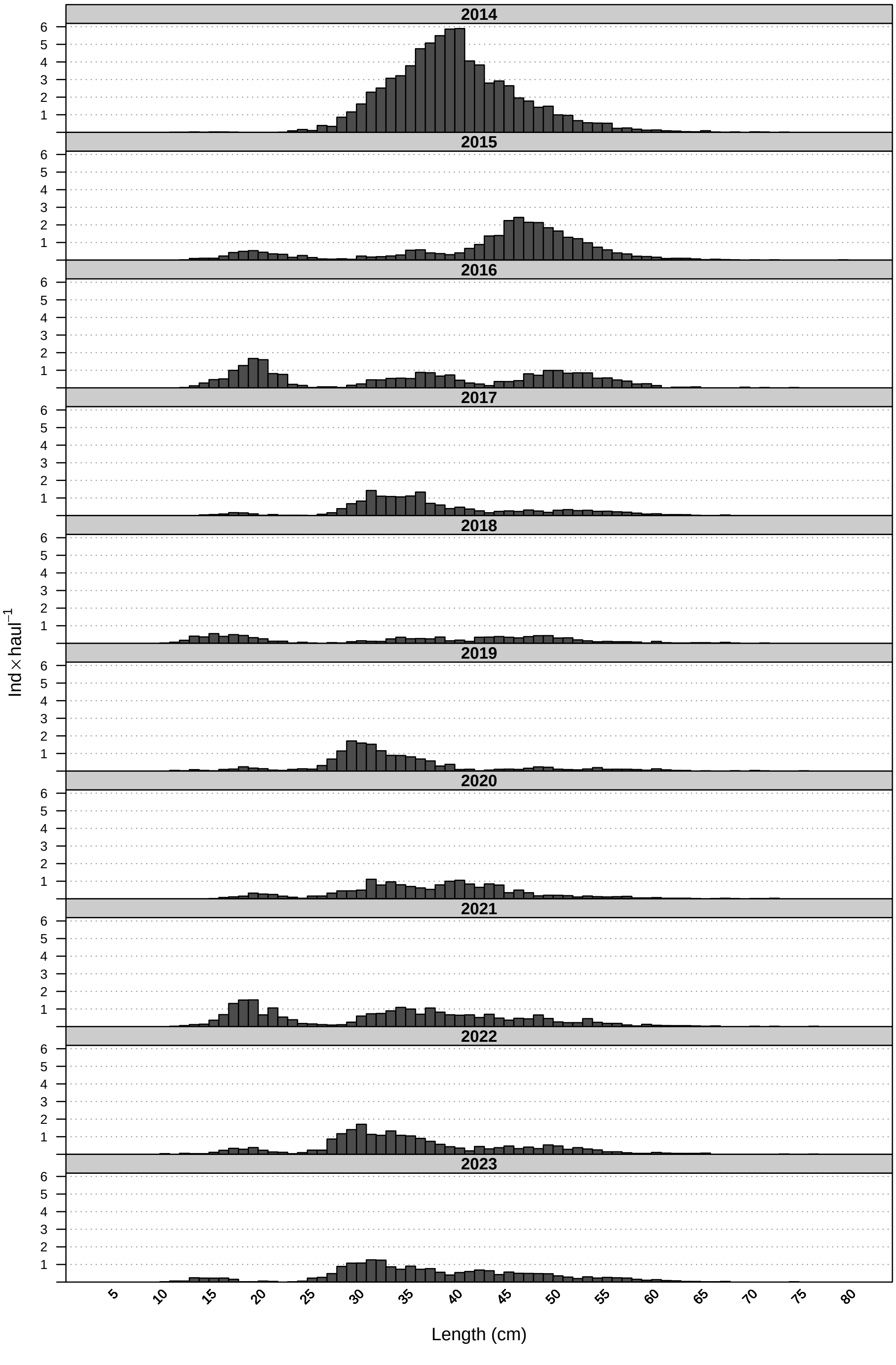

Figure 18: Mean stratified length distributions of *Phycis blennoides* in the Porcupine surveys (2014-2023).

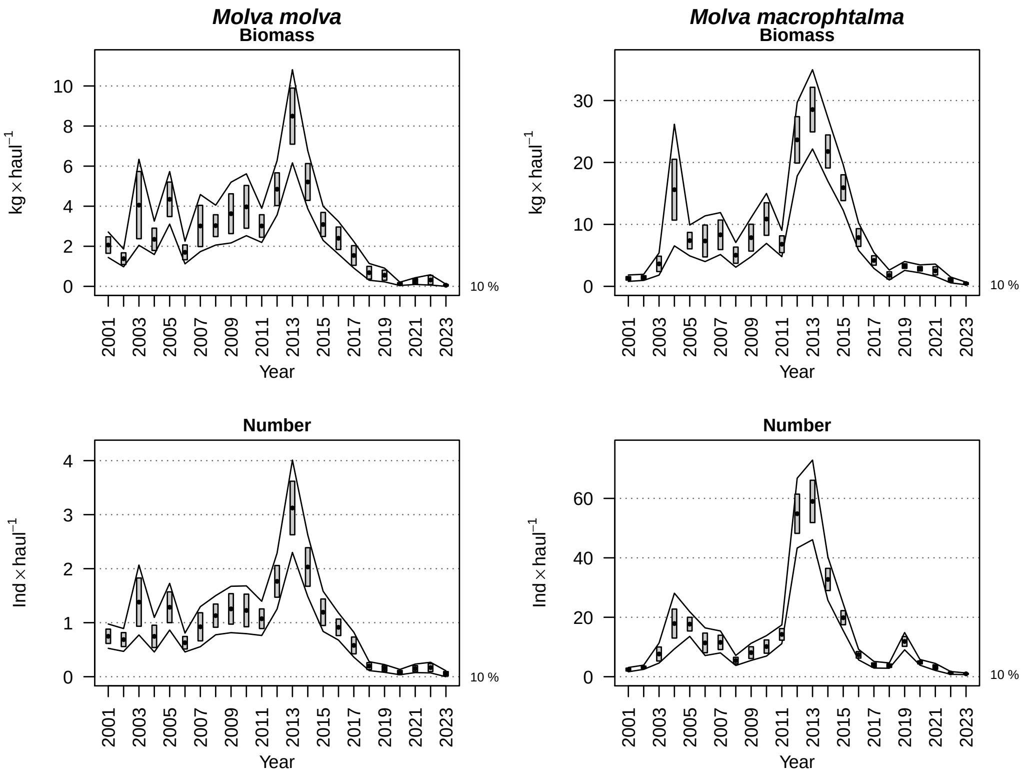

Figure 19: Evolution of biomass and abundance indices of *Molva molva* and *Molva macrophthalma* in the Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations =1000).

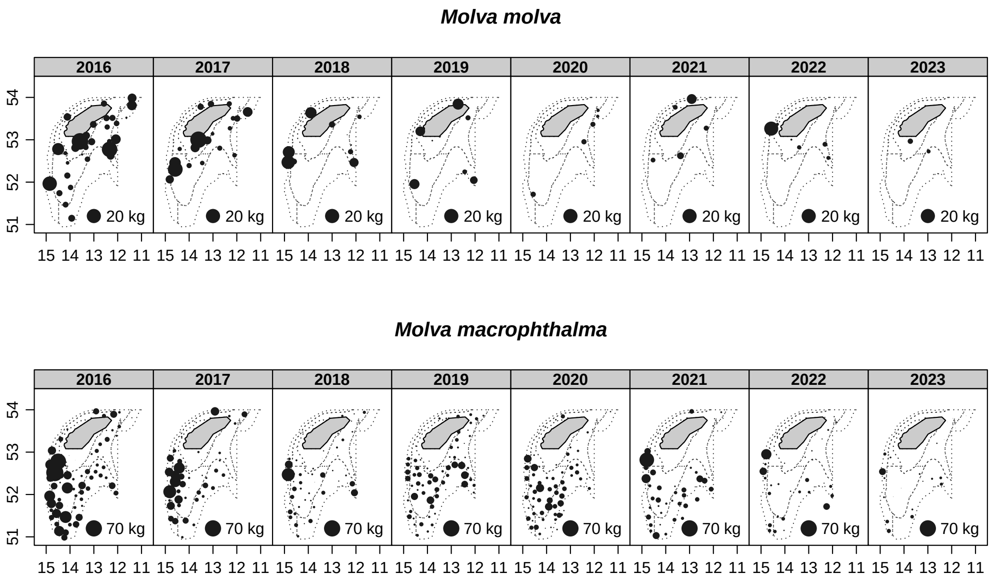

Figure 20: Geographic distribution of *Molva molva* and *Molva macrophthalma* catches (kg/30 min haul) in Porcupine surveys (2016-2023).

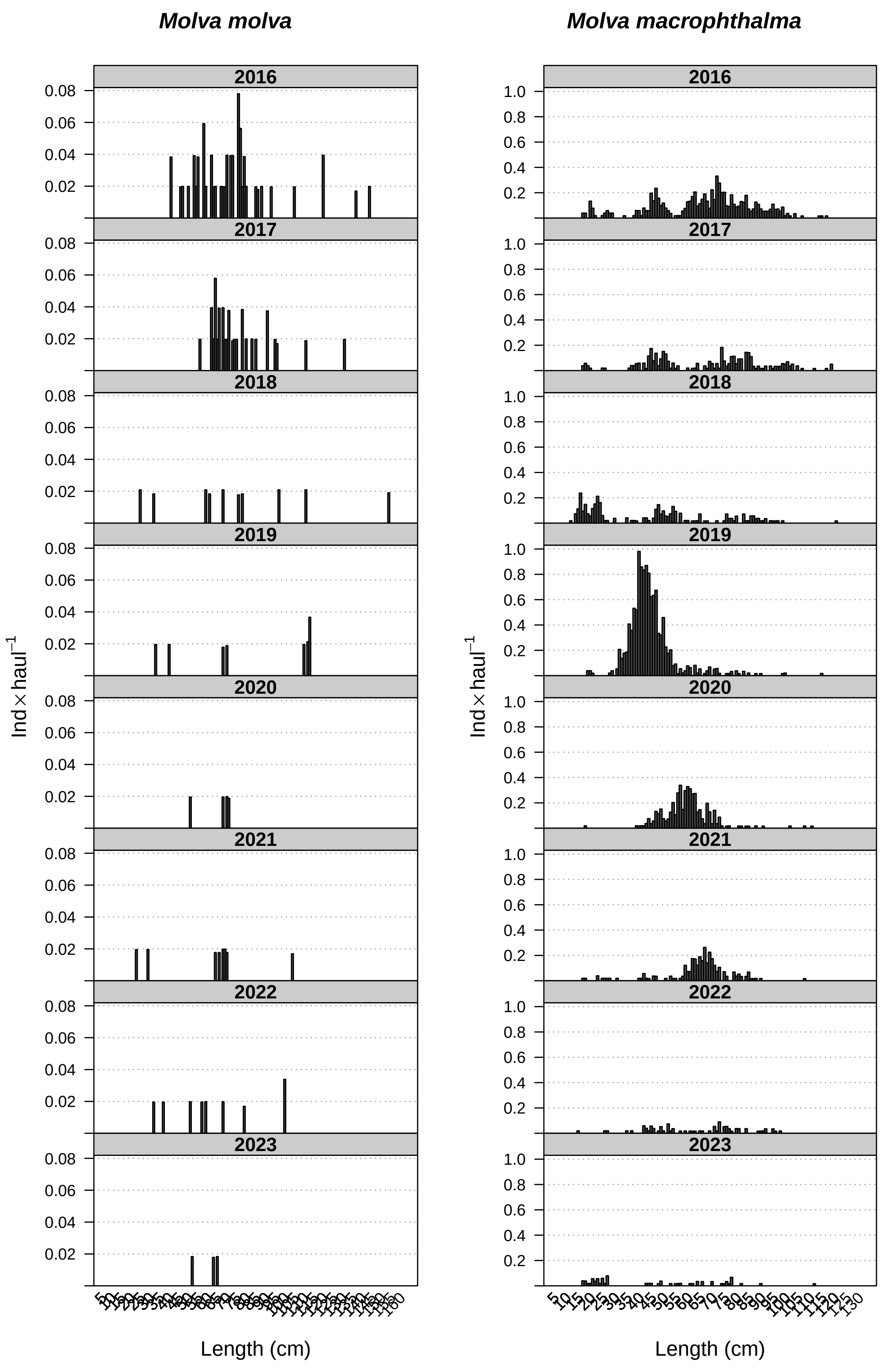

Figure 21: Mean stratified length distributions of *Molva molva* and *Molva macrophthalma* in the Porcupine surveys (2016-2023).

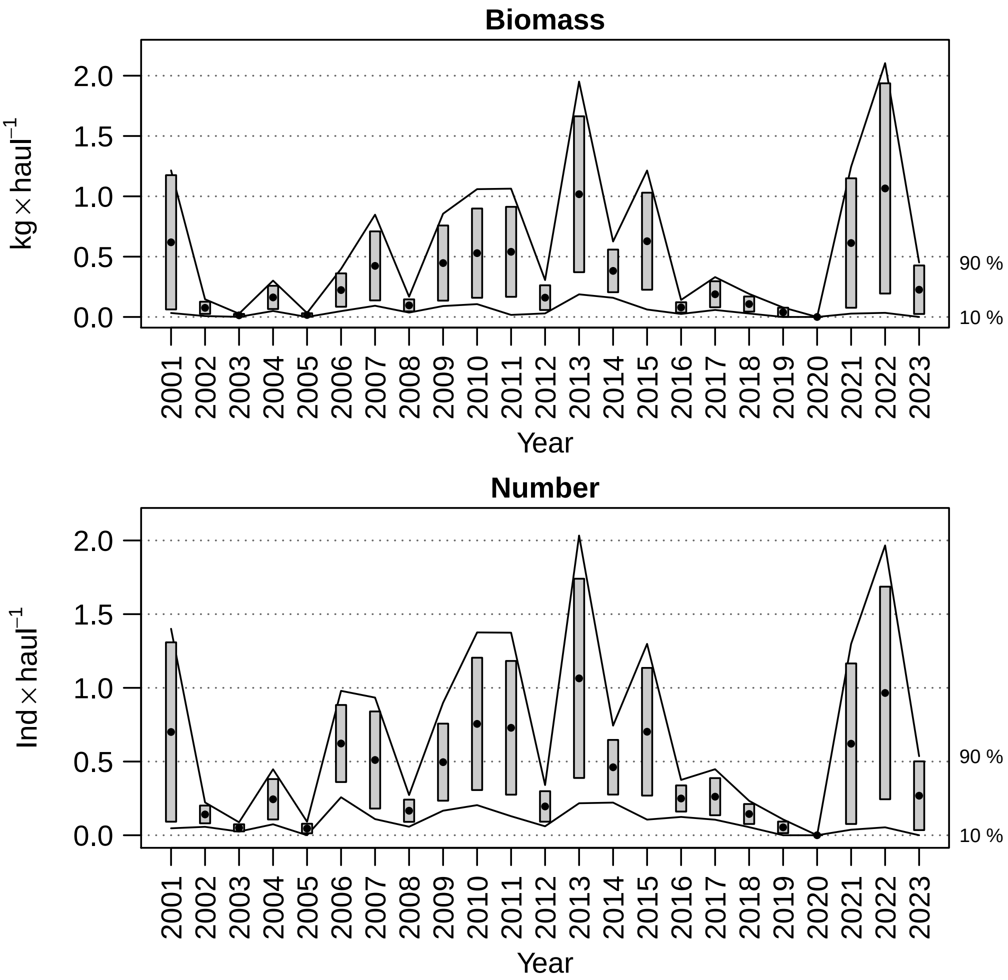

Figure 22: Evolution of biomass and abundance indices of *Aphanopus carbo* in the Porcupine surveys. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

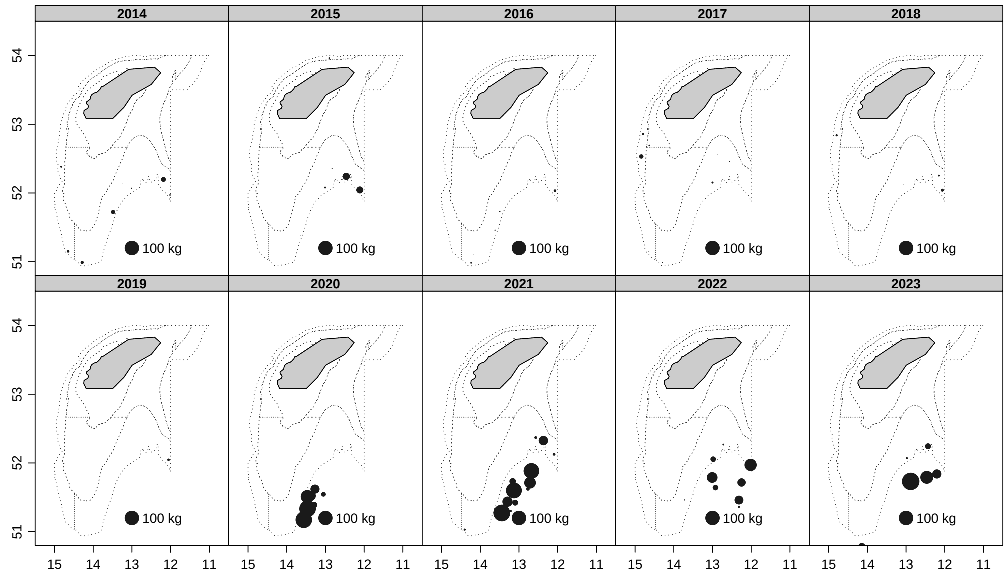

Figure 23: Geographic distribution of *Aphanopus carbo* catches (kg/30 min haul) in Porcupine surveys over the last decade.

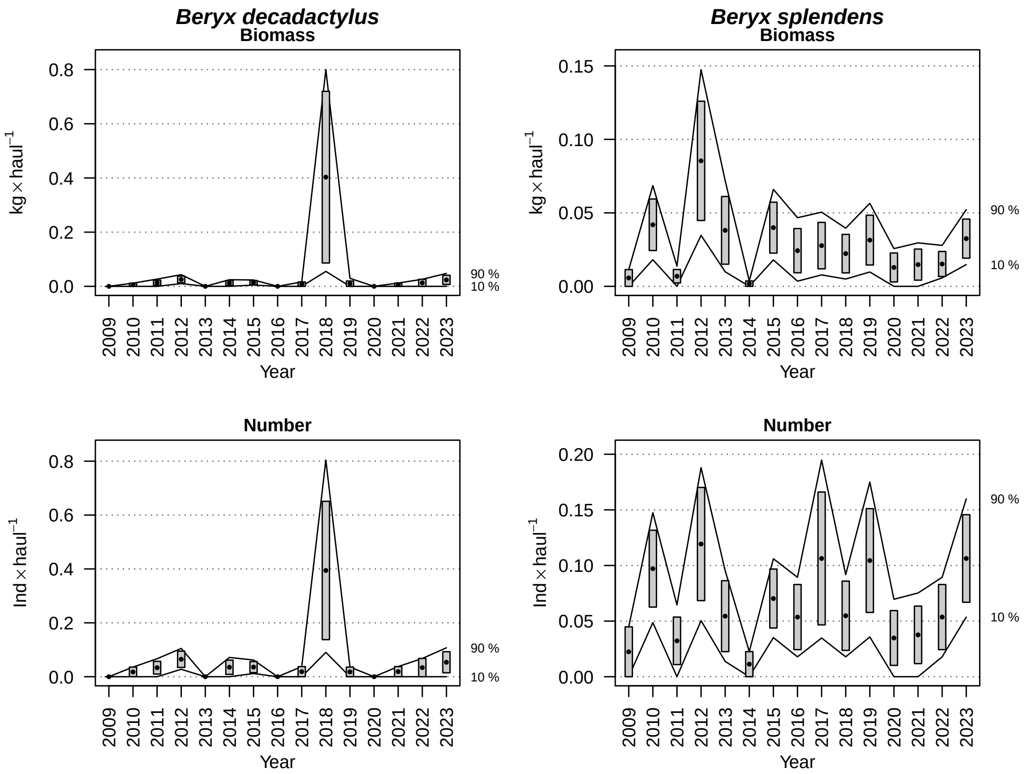

Figure 24: Evolution of biomass and abundance indices of *Beryx decadactylus* and *Beryx splendens* in the Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations=1000).

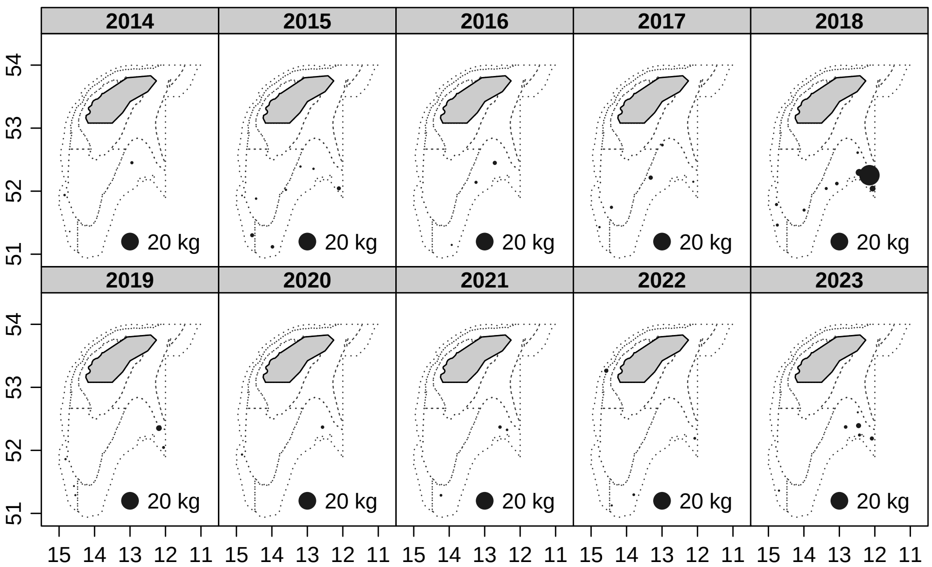

Figure 25: Geographic distribution of *Beryx* spp. catches (kg/30 min haul) in Porcupine surveys over the last decade.

Results on greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*), roughsnout grenadier (*Trachyrincus scabrus*), bluemouth (*Helicolenus dactylopterus*)and other scarce deep-sea fish species on the 2023 Northern Spanish Shelf Groundfish Survey*

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Abstract

This working document presents the results on the most significant deep-sea fish species on the Northern Spanish Shelf Groundfish Survey in 2023. Biomass, abundance, length distributions and geographic ranges were analysed for greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*), roughsnout grenadier (*Trachyrincus scabrus*), bluemouth (*Helicolenus dactylopterus*) and other scarce deep-sea fish species. Biomass of *M. macrophthalma* and *Pagellus bogaraveo* increased, whereas *P. blennoides*, *T. Scabrus*, and *H. dactylopterus* decreased. *Aphanopus carbo*, *Beryx* spp. were scarce as usual and *Coryphaenoides rupestris* was not found in this last survey. Recruitment was significant for *P. blennoides*.

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 frequencies and geographic distribution) of the most common deep-sea fish species on the bottom trawl surveys on the Northern Spanish Shelf after the results presented previously (Blanco et al. 2022, 2019, Fernández-Zapico et al. 2023, 2020, 2018, Ruiz-Pico et al. 2021). The species analyzed are *Phycis blennoides* (greater forkbeard), *Molva macrophthalma* (spanish ling), *Trachyrincus scabrus* (roughsnout grenadier), *Helicolenus dactylopterus* (bluemouth), and other scarce species as *Aphanopus carbo* (black scabbardfish), *Coryphaenoides rupestris* (roundnose grenadier), *Beryx* spp. (alfonsinos) 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 geographic 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.

***Citation**: Ruiz-Pico S, Fernández-Zapico O, Blanco M, Ortiz P, González-Irusta JM,Punzón A, Velasco F (2024) Results on greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*), roughsnout grenadier (*Trachyrincus scabrus*), bluemouth (*Helicolenus dactylopterus*)and other scarce deep-sea fish species on the 2023 Northern Spanish Shelf Groundfish Survey. ICES Working Group on the Biology and Assessment of Deep Sea Fisheries Resources, - May 2024, ICES HQ, Copenhagen, Denmark.

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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 geographic 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, due to the small area and scarcity of trawlable shallower grounds. 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. However, 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. The standardized indices of the deep water fishes analyzed in this report probably underestimate its real biomass due to the fact that most of its catches might happen out of the standard stratification area, in additional hauls deeper than 500 m. For this reason, the catches in standard and deeper additional hauls were plotted in this report.

Results

In this last survey 125 valid hauls were carried out, 112 of these were standard hauls and 13 additional hauls (1 of them shallower than 70 m and 12 of them between 500 m and 800 m) (Figure 1).
The total stratified fish catch in biomass per haul decreased this last survey, although remained among the high values of the time series (Figure 2).
In the study area, *P. blennoides*, *M. macrophthalma* and *T. scabrus* usually showed more than half of their biomass in the additional deep hauls (>500 m) whereas *P. bogaraveo* and *H. dactylopterus* were mainly found in standard hauls or even in shallower hauls (<70 m). In 2023, the biomass of *M. macrophthalma* remained among the high values of the time series. *P. blennoides*, *T. scabrus* and *H. dactylopterus* decreased sharply, whereas *P. bogaraveo* increased. Other deep-sea fish species like *A. carbo* and *Beryx* spp. were found as usual but scarcely, whereas *C. rupestris* has been not found since 2019. Recruitment of *P. blennoides* remained high despite the decrease whereas the recruitment of *H. dactylopterus* decreased markedly in contrast to the previous year.

Phycis blennoides (greater forkbeard)

In 2023, 23% of the hauls where *P. blennoides* was found were additional deep hauls (>500 m) and contained 69% of the biomass. This last year the biomass in standard and in those additional deep hauls decreased (Figure 3). The geographic distribution of *P. blennoides* remained similar to previous years, being widespread in the sampling area, although with smaller spots of biomass in the Galician area (Figure 4). The length distribution in standard hauls continue to show a clear, but smaller mode of recruits at 15-16 cm, (Figure 5). In the additional deeper hauls, larger specimens were found as usual, being more abundant specimens from 26 to 41 cm (Figure 6).

Molva macrophthalma (Spanish ling)

This last year, the biomass of *M. macrophtalma* increased even more in standard and additional hauls reaching the highest value of the time series (Figure 7). This last survey, as previous years, most of the biomass (65%) was found in standard hauls (70 - 500 m) which were 83% of the total hauls with *M. macrophtalma*. The species kept on being widespread in the study area although a big spot of biomass was found in the central area of the Cantabrian Sea in the last survey (Figure 8). Fewer recruits (mode around 24 cm) and larger specimens mainly from 36 to 70 cm were found in standard hauls this last year (Figure 9). In additional deeper hauls sizes ranged from 37 to 113 cm (Figure 10).

Trachyrincus scabrus (roughsnout grenadier)

T. scabrus has been mostly found in additional hauls (>500 m) in the last decade. Nevertheless, the biomass in those deep hauls decreased markedly in this last survey and any specimen was found in standard stratification (Figure 11). The species was only found in five hauls from 533 to 941 m throughout the study area (Figure 12). Specimens ranged from 45 mm to 255 mm, although more abundance of large specimens (120 to 220 mm) were found, with a mode in 140 mm (Figure 13).

Pagellus bogaraveo (blackspot seabream)

P. bogaraveo has been found in additional shallower hauls (<70 m) and standard hauls over the time series. In this last survey, the biomass in standard stratification increased sharply (Figure 14). Specimens were found in seven hauls from 52 to 132 m, just in one additional shallower hauls at 52 m. The haul with the highest biomass was in the north of the Galician waters at 81 m, and the other six spots of biomass in the Cantabrian Sea (Figure 15). The sizes ranged from 16 to 26 cm (Figure 16).

Helicolenus dactylopterus (bluemouth)

Although bluemouth is not requested for ICES DCF Data Call, the biomass and abundance are significant in the area and useful for the assessment of the stock (ICES, 2017). *H. dactylopterus* has been mainly found in standard hauls. In 2023, both the biomass and abundance decrease sharply, although they kept on being among the high values of the time series (Figure 17). The geographic distribution of *H. dactylopterus* remained similar to the previous year, with greater biomass in the Galician area, and the usual spot in the easternmost Ajo-Bidasoa sector (Figure 18). Length distribution showed a small signal of recruitment, in contrast to the previous year. A small mode in 5 cm was found and also a strong decrease of specimens around 12 cm. Nevertheless, a little mode around 16 cm was observed (Figure 19 and Figure 20).

Other deep-sea fish species

Other species scarcely caught in the survey were *Aphanopus carbo* and *Beryx* spp. They have been mainly found out of the standard stratification in deeper additional hauls (> 500 m).
In 2023, *A. carbo* was caught in two hauls at 940 in Galician area and at 540 m in easternmost Cantabrian sea (Figure 21 and Figure 22), with a total of seven specimens which ranged from 91 to 110 cm.
Beryx spp. were found in four hauls between 452 m and 606 m. Two specimens of *B. decadactylus*

in Galician waters of 23 and 24 cm and four specimens of *B. splendens* which ranged from 21 to 27 cm in the western part of the Cantabrian sea (Figure 23 and Figure 24).
The species*Coryphaenoides rupestris* has continued uncaught since 2019.

Acknowledgements

We would like to thank the R/V Miguel Oliver crew and the IEO scientific teams that made the SPNSGFS Survey possible. Included in the ERDEM5 project, the survey has been co-funded by the EU through the European Maritime and Fisheries Fund (EMFF) within the National Program of collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

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Figures

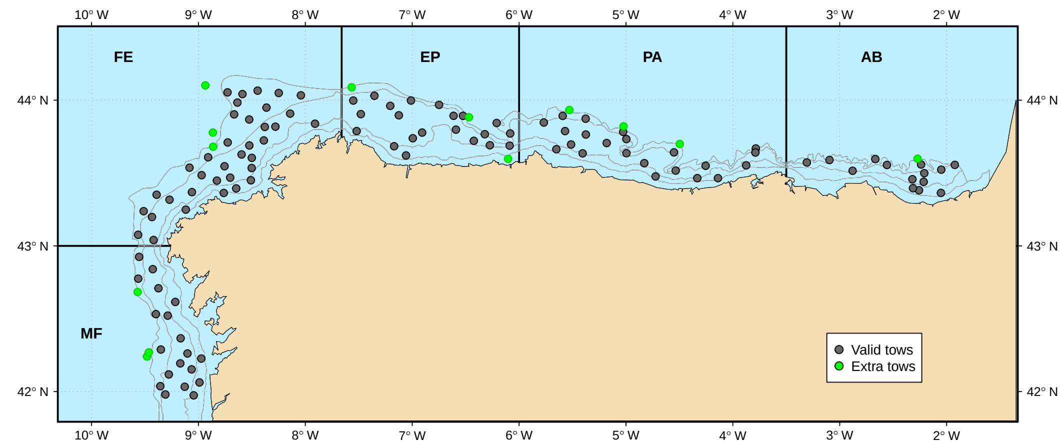


Figure 1: Stratification design and hauls on the Northern Spanish shelf groundfish survey in the last year; Depth strata are: A) 70-120 m, B) 121 - 200 m and C) 201 - 500 m. Geographic sectors are MF: Miño-Finisterre, FE: Finisterre-Estaca, EP: Estaca-cabo Peñas, PA: Peñas-cabo Ajo, and AB: Ajo-Bidasoa.

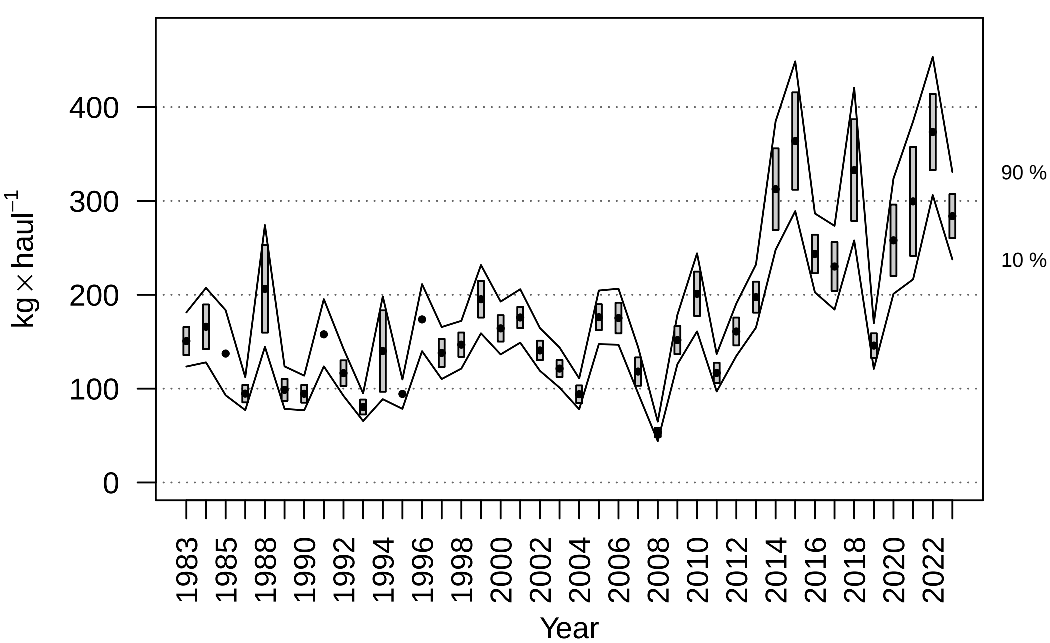


Figure 2: Evolution of the total fish catch in biomass on the Northern Spanish shelf groundfish survey.

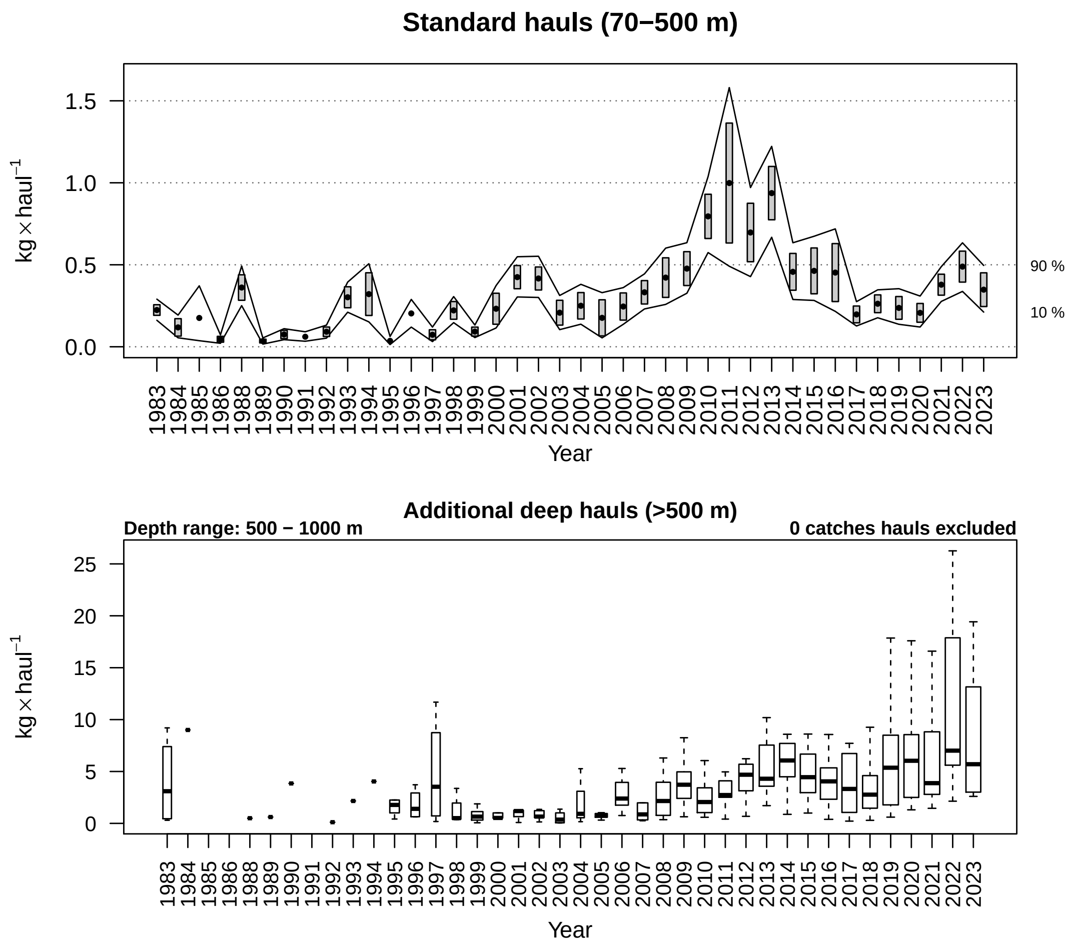


Figure 3: Evolution of *Phycis blennoides* stratified biomass index in standard hauls and additional deep hauls during the Northern Spanish shelf groundfish survey time series. For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a=0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartiles of the biomass catches in the deep hauls performed.

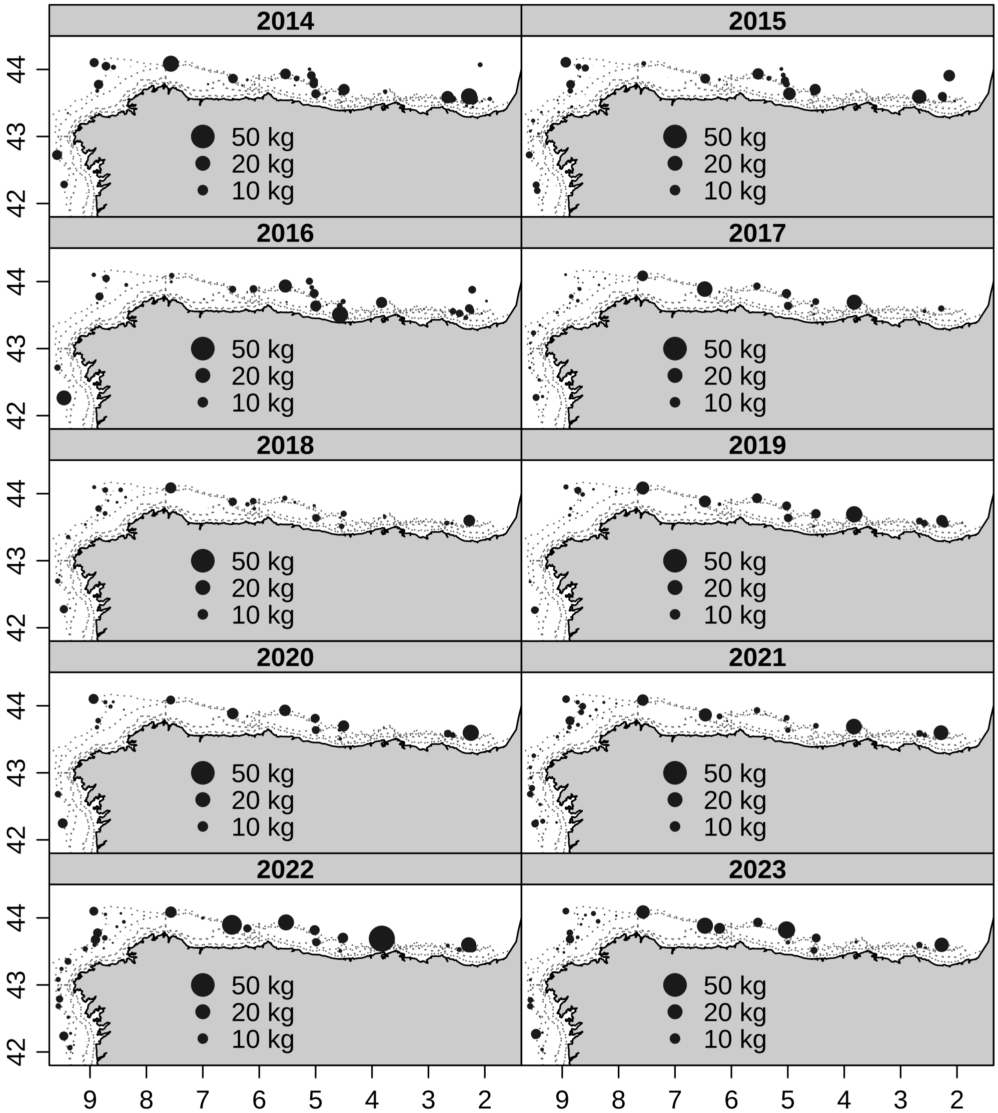


Figure 4: Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey in the last decade.

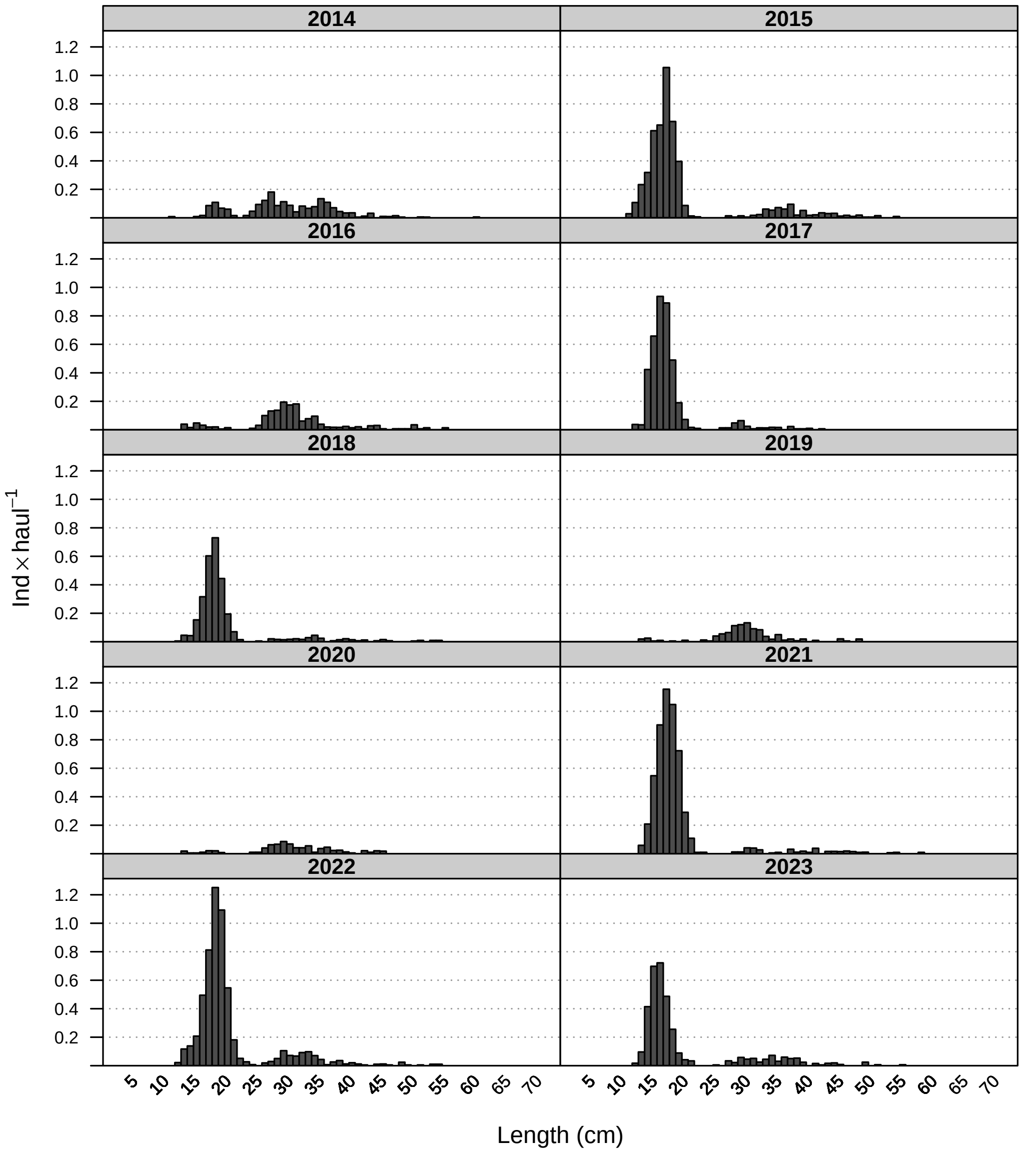


Figure 5: Mean stratified length distributions of *Phycis blennoides* in the Northern Spanish shelf groundfish survey in the last decade.

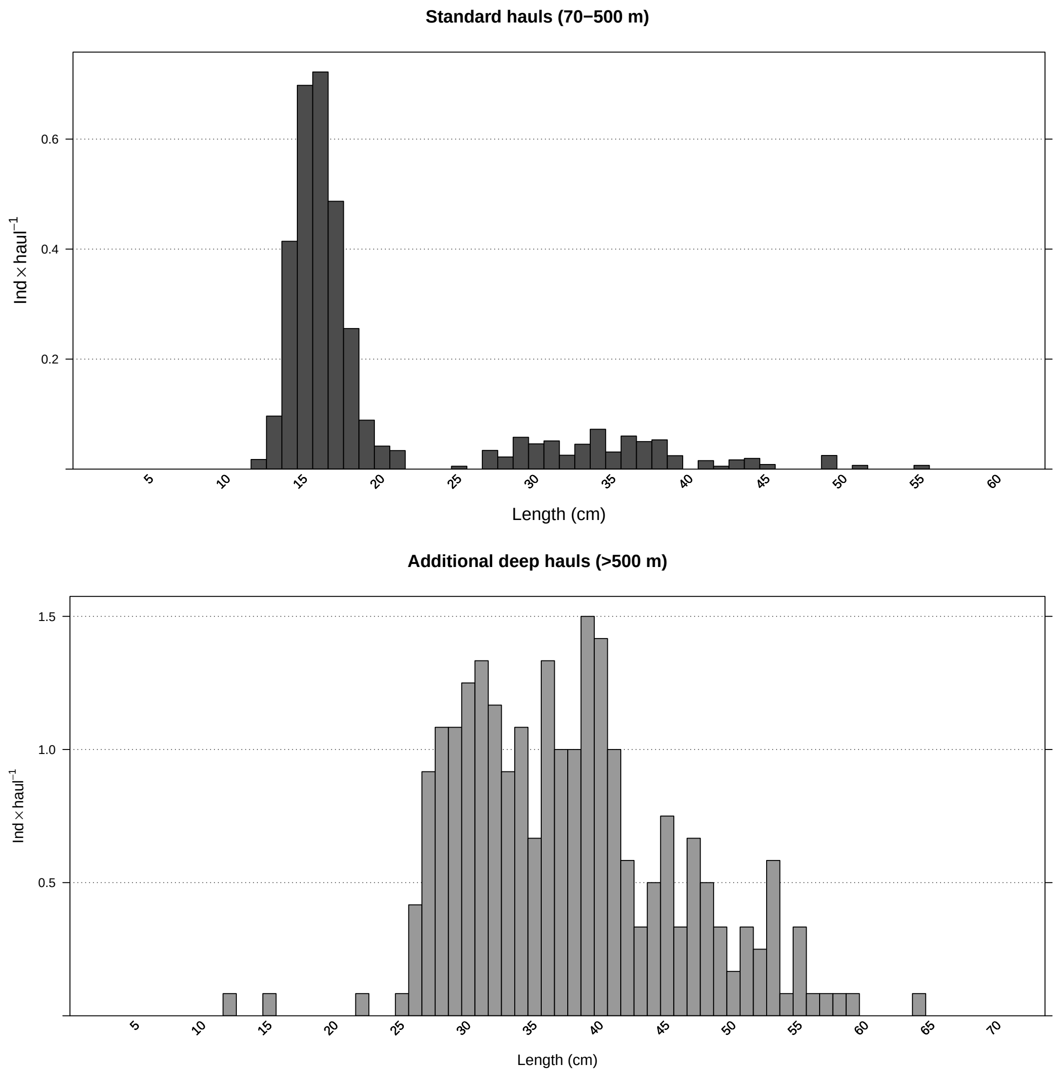


Figure 6: Mean length distributions of *Phycis blennoides* in additional hauls (>500 m) and in the standard hauls (70-500 m) in the Northern Spanish shelf groundfish survey 2023.

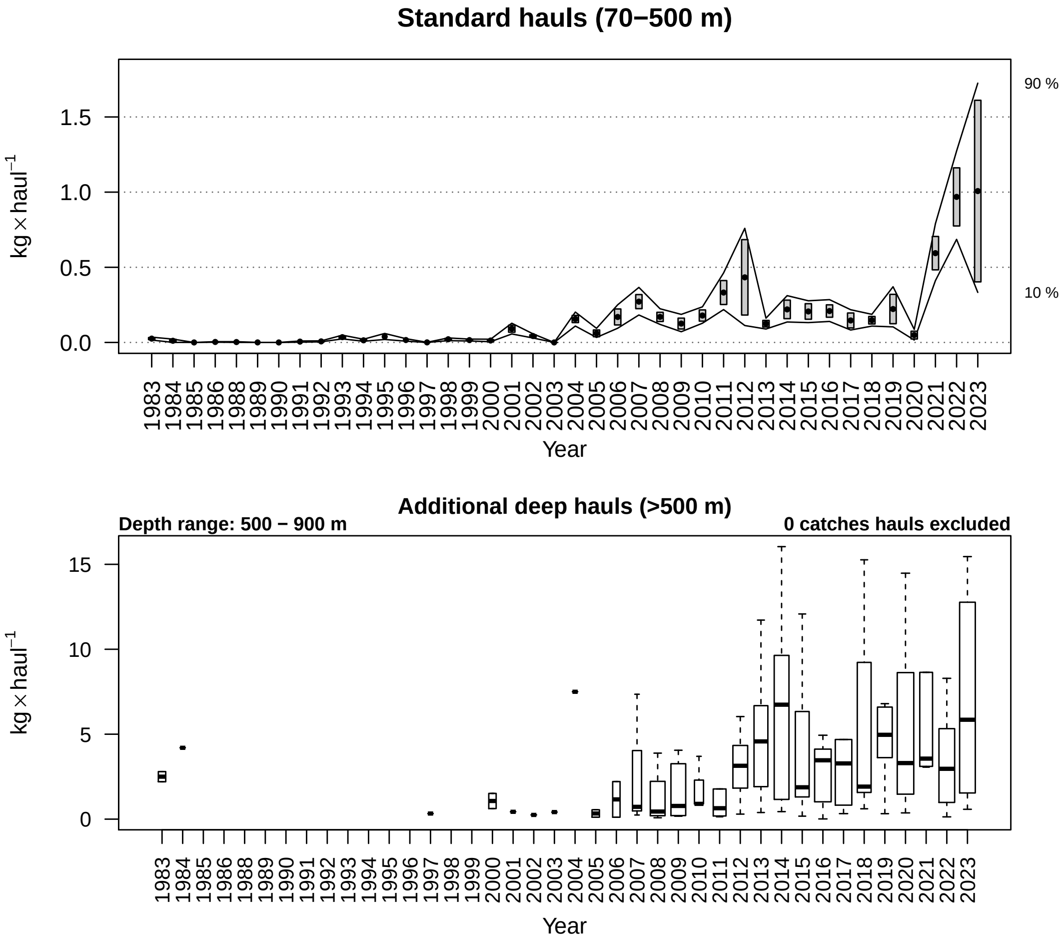


Figure 7: Evolution of *Molva macrophtalma* stratified biomass index in standard hauls and additional deep hauls during the Northern Spanish shelf groundfish survey time series. For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartiles of the biomass catches in the deep hauls performed.

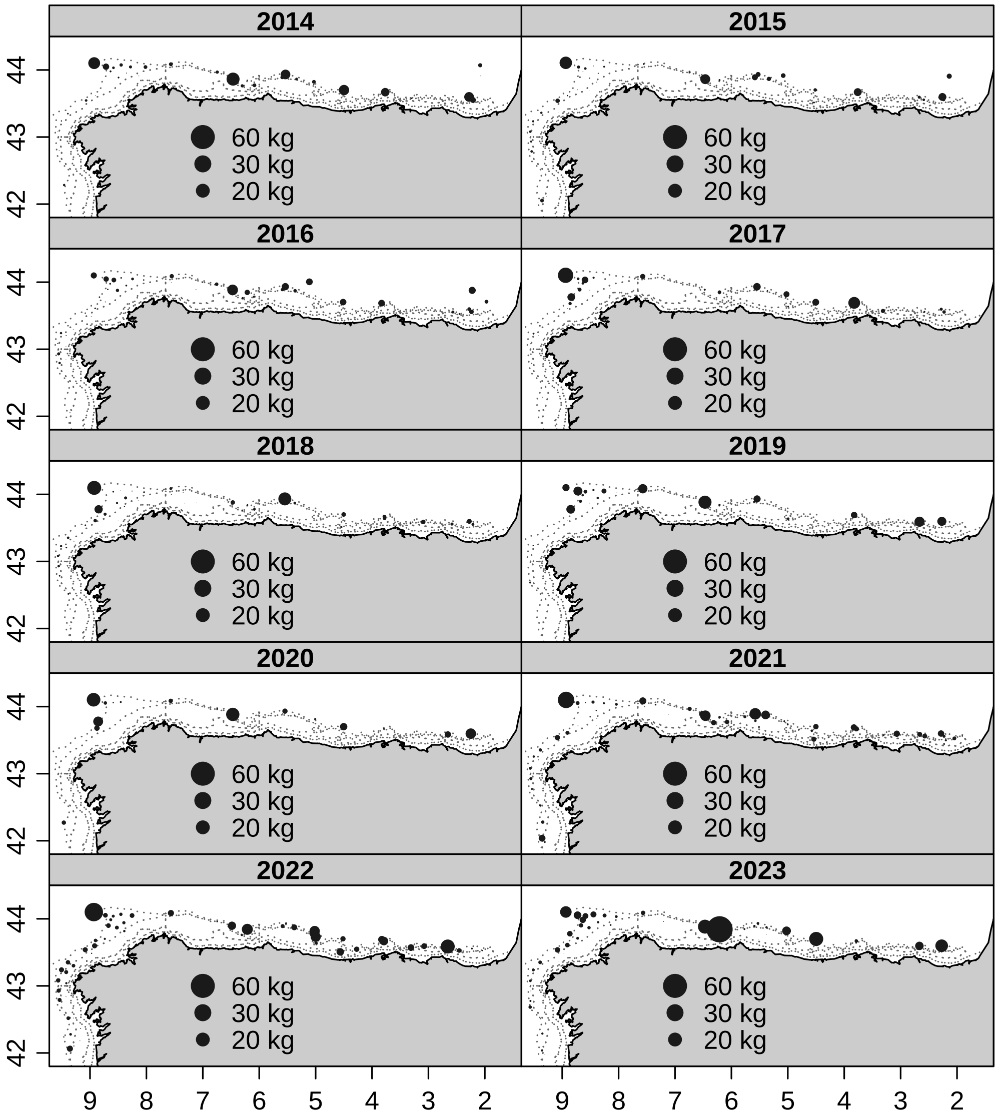


Figure 8: Geographic distribution of *Molva macrophtalma* catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey in the last decade.

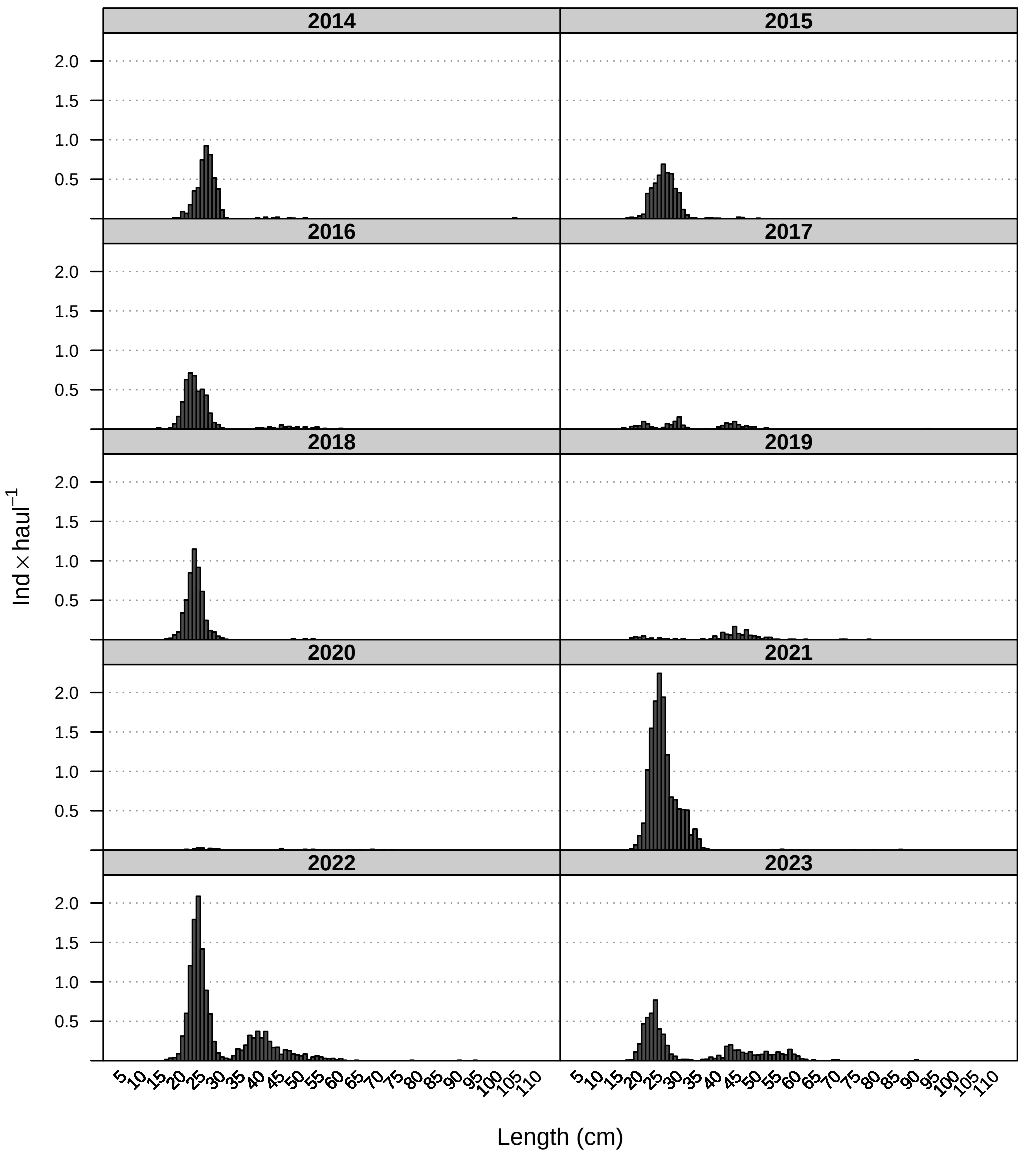
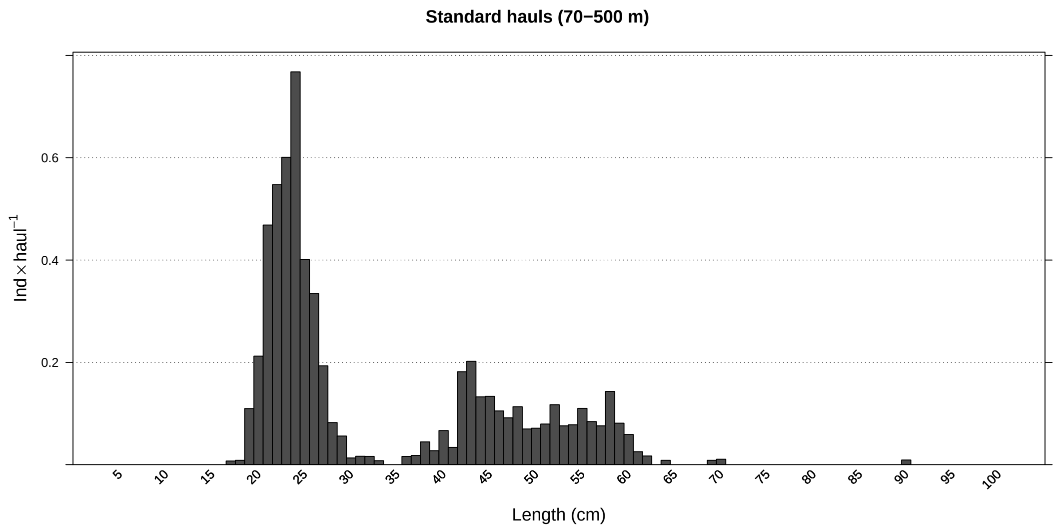


Figure 9: Mean stratified length distributions of *Molva macrophtalma* in the Northern Spanish shelf groundfish survey in the last decade.



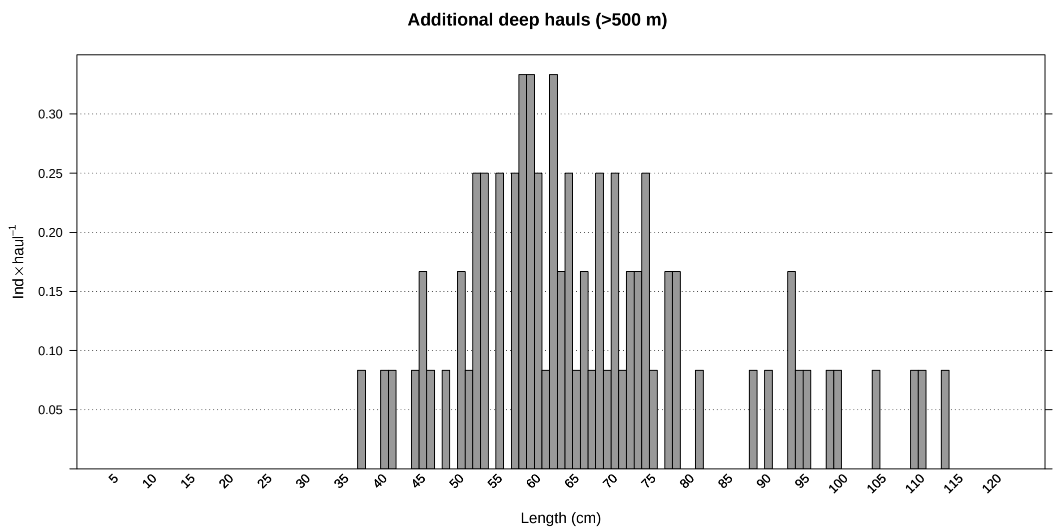


Figure 10: Mean length distributions of *Molva macrophtalma* in additional hauls (>500 m) and in the standard hauls (70-500 m) in the Northern Spanish shelf groundfish survey 2023.

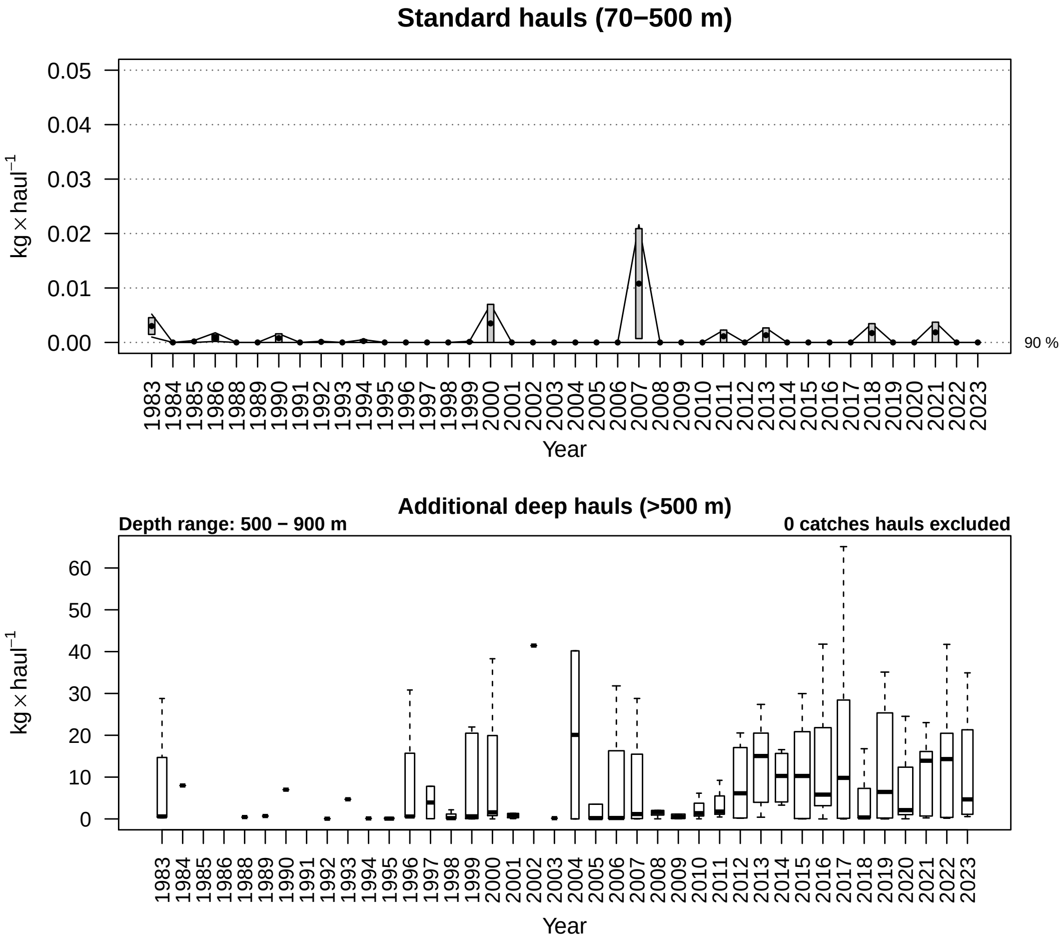
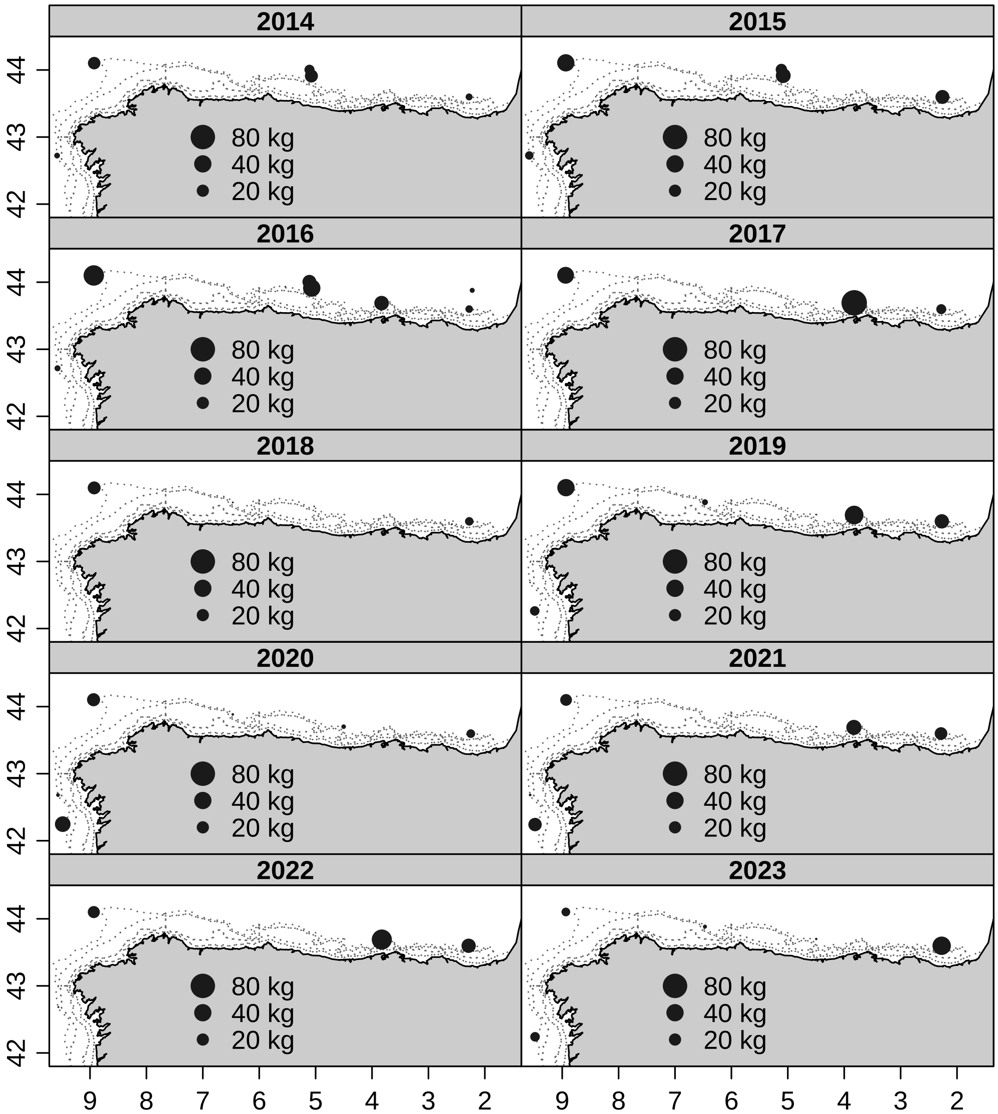


Figure 11: Evolution of *Trachyrincus scabrus* stratified biomass index in standard hauls and additional deep hauls during the Northern Spanish shelf groundfish survey time series. For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartiles of the biomass catches in the deep hauls performed.



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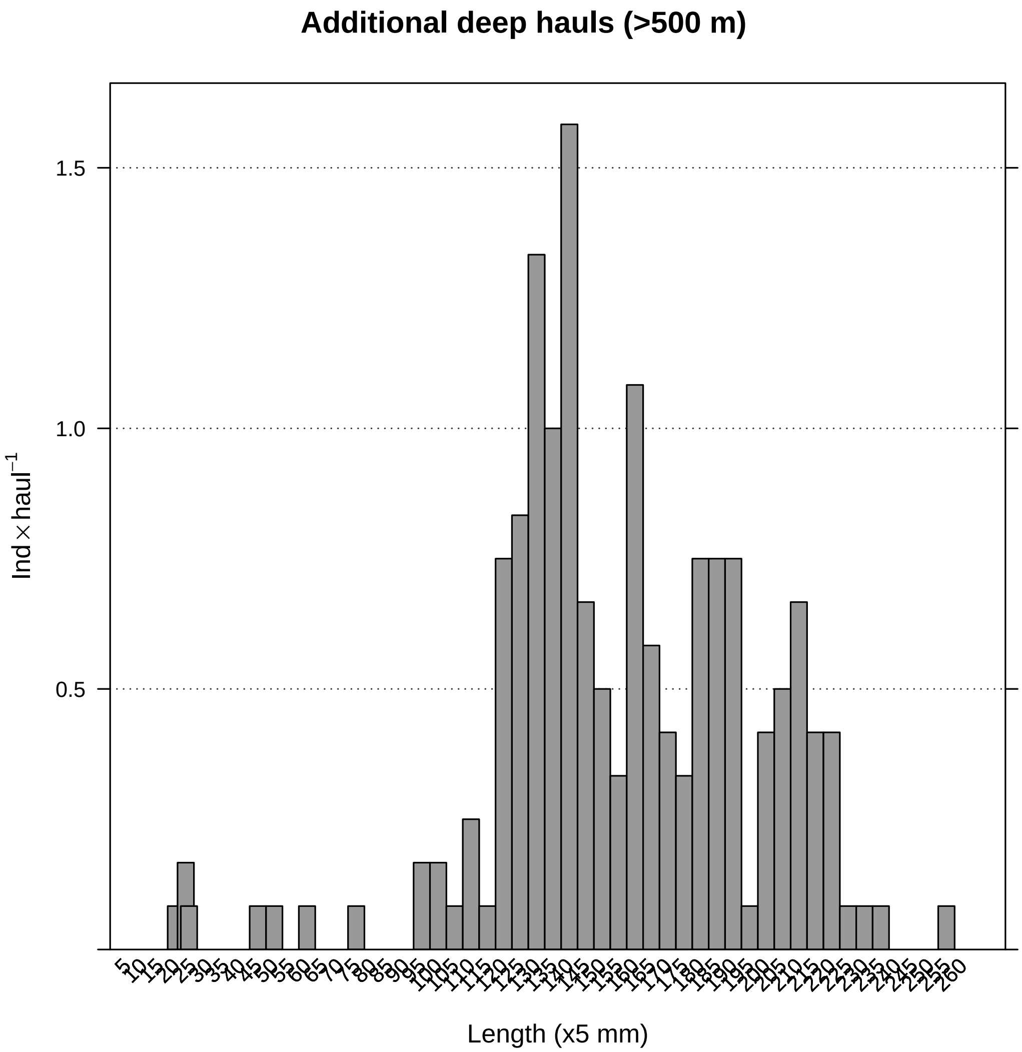

Figure 13: Mean length distributions of *Trachyrincus scabrus* in additional hauls (>500 m) in the Northern Spanish shelf groundfish survey 2023

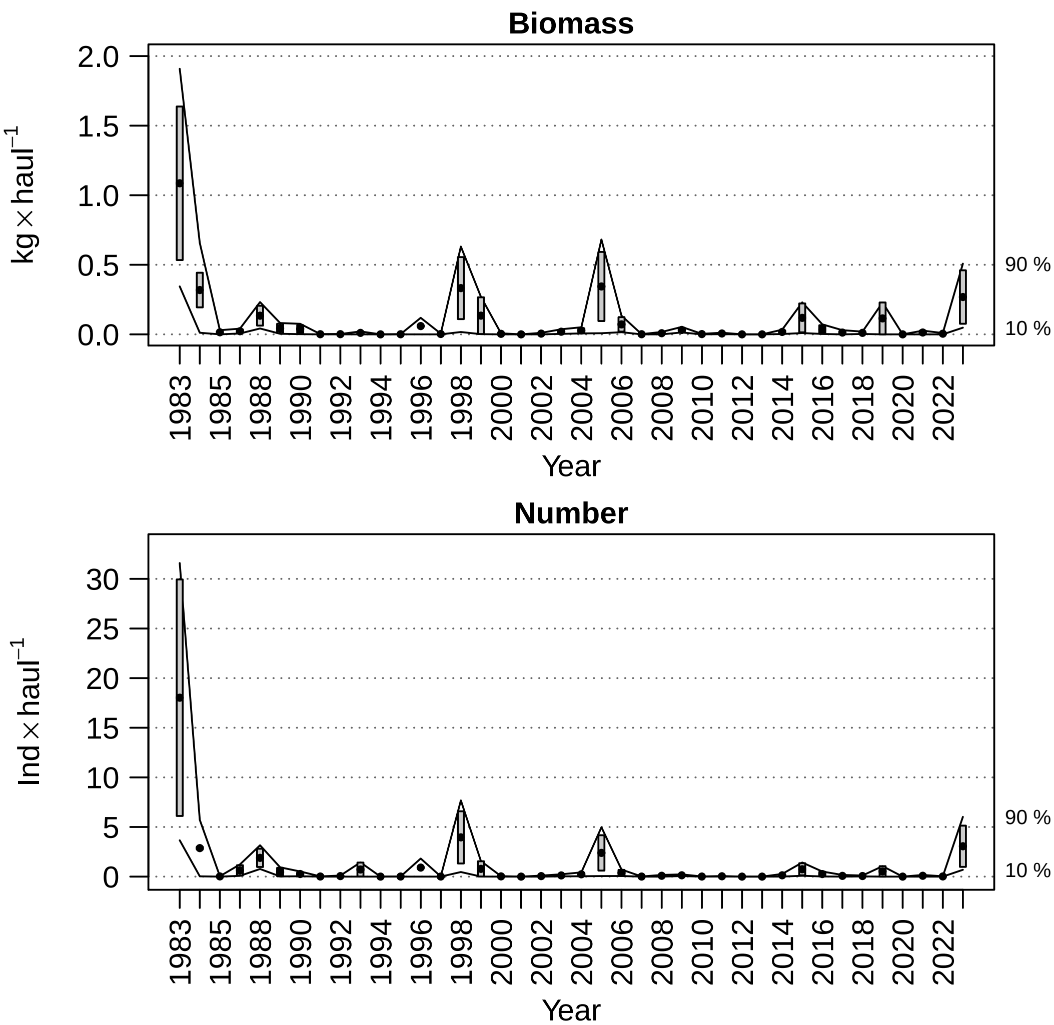

Figure 14: Evolution of *Pagellus bogaraveo* mean stratified biomass and abundance in the Northern Spanish shelf groundfish survey time series. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000).

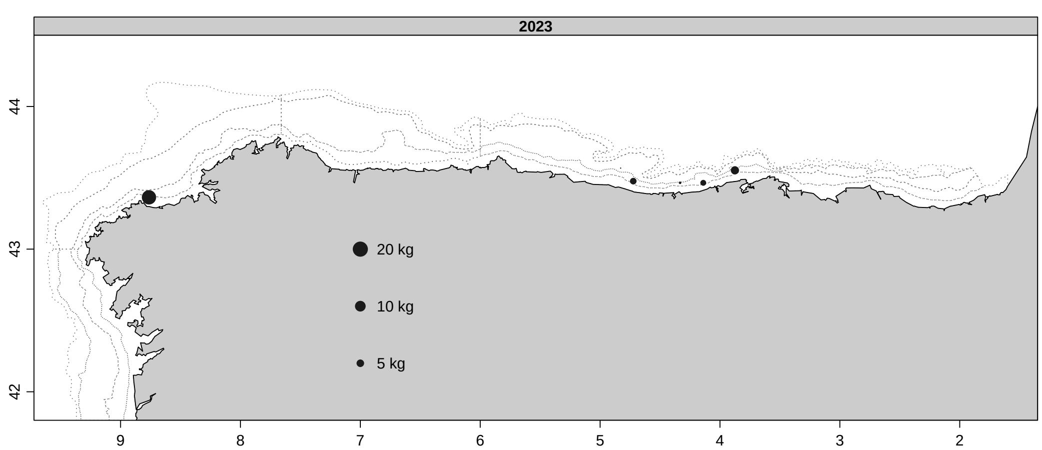

Figure 15: Geographic distribution of *Pagellus bogaraveo* catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey 2023.

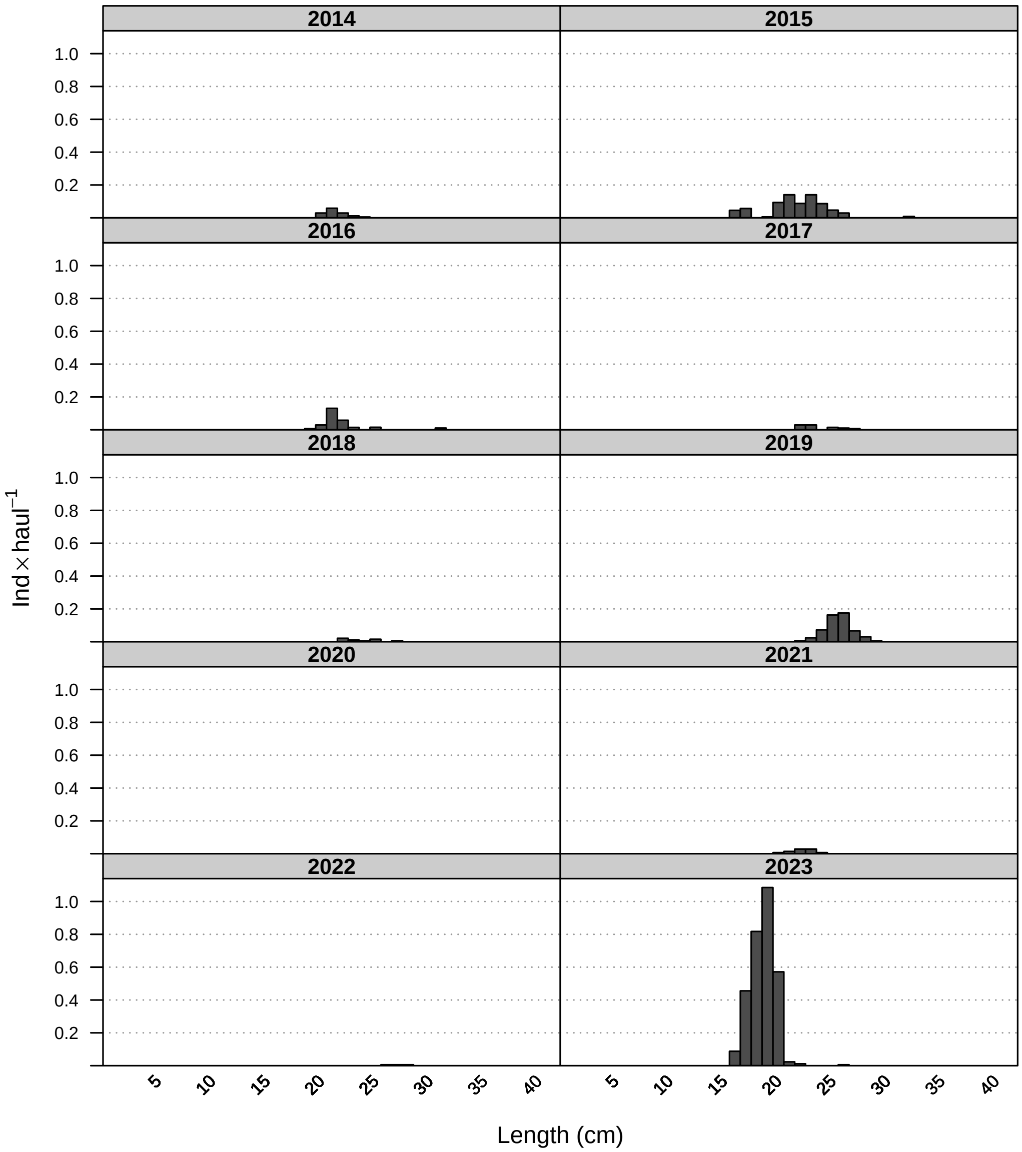

Figure 16: Mean stratified length distributions of *Pagellus bogaraveo* in the Northern Spanish shelf groundfish survey in the last decade.

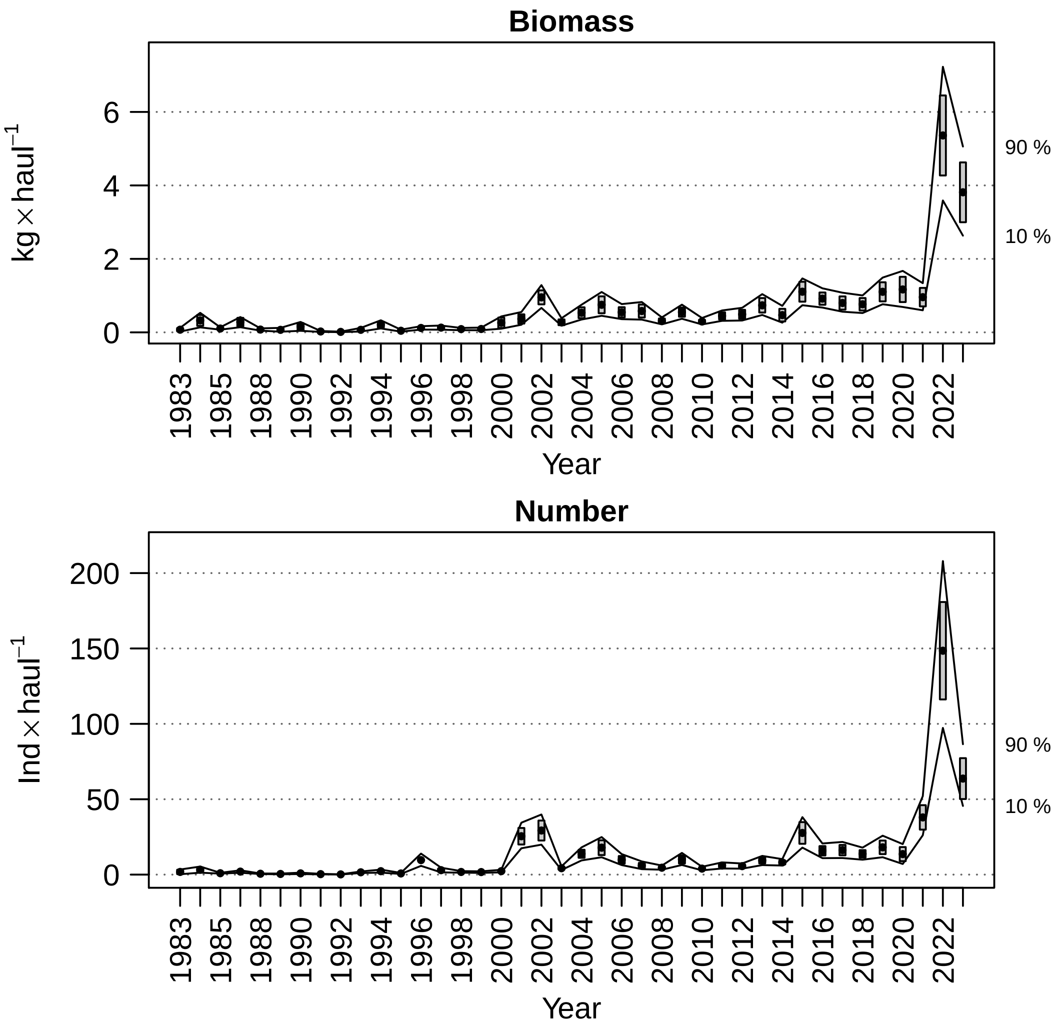

Figure 17: Evolution of *Helicolenus dactylopterus* mean stratified biomass and abundance in the Northern Spanish shelf groundfish survey time series. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000)

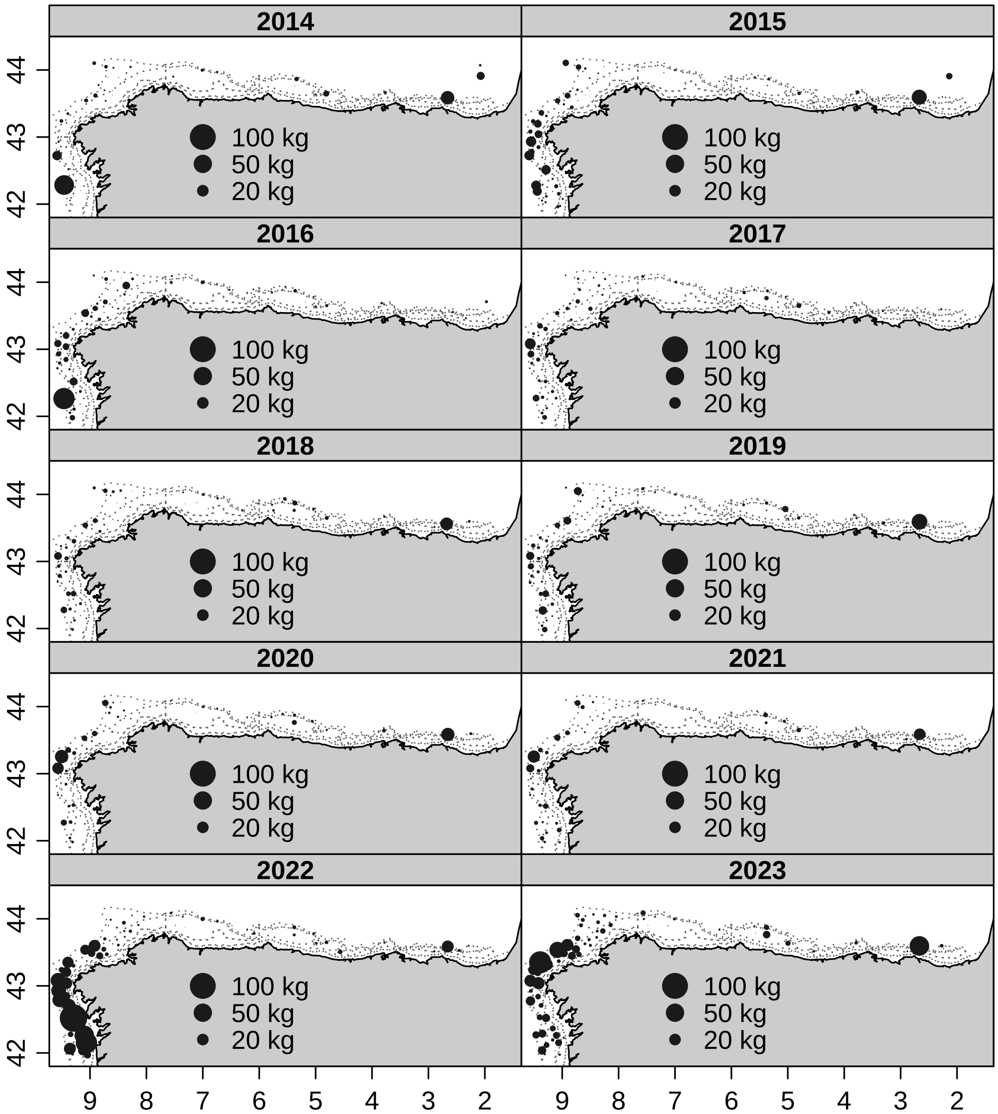

Figure 18: Geographic distribution of *Helicolenus dactylopterus* catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey in the last decade.

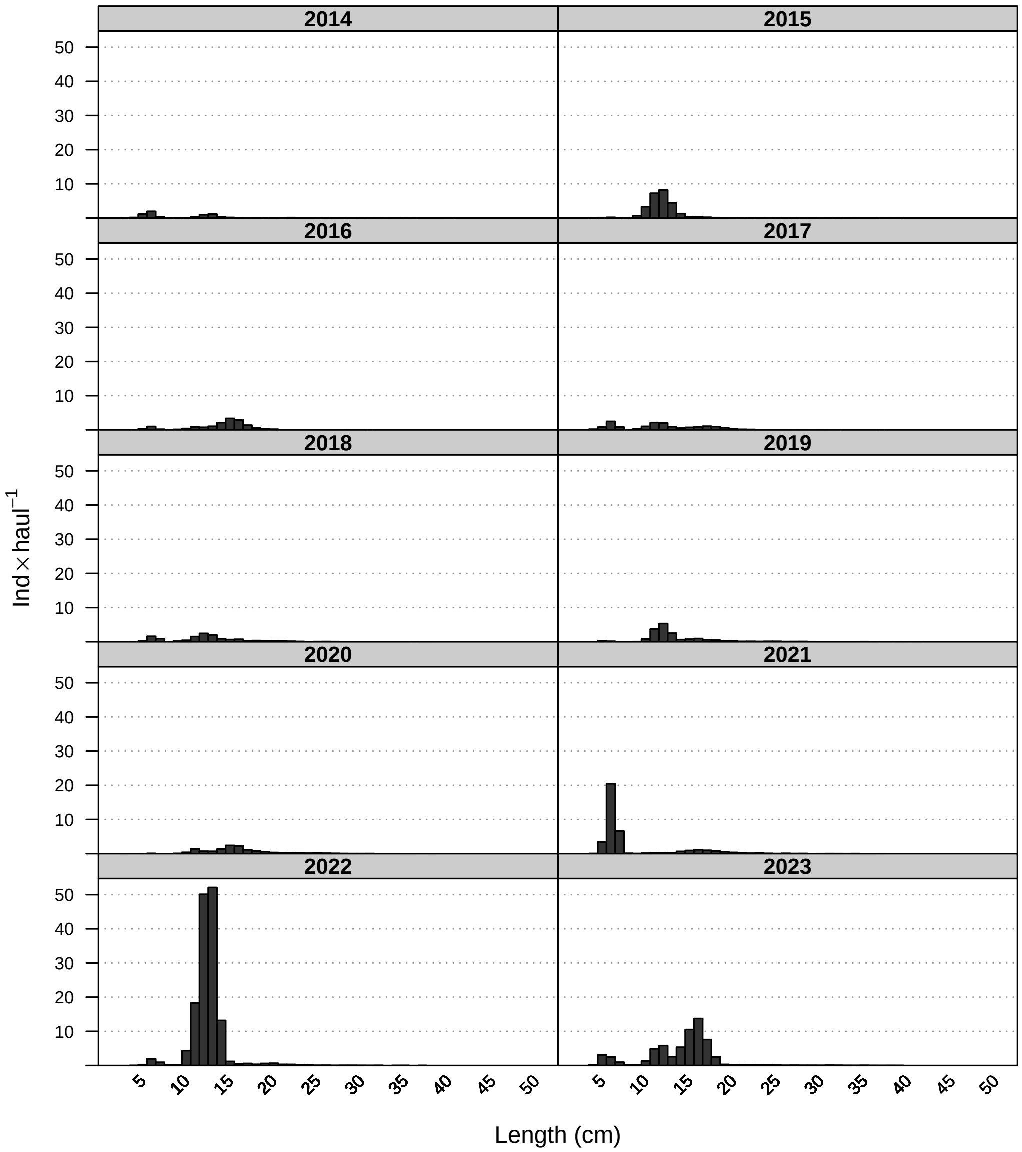

Figure 19: Mean stratified length distributions of *Helicolenus dactylopterus* in the Northern Spanish shelf groundfish survey in the last decade.

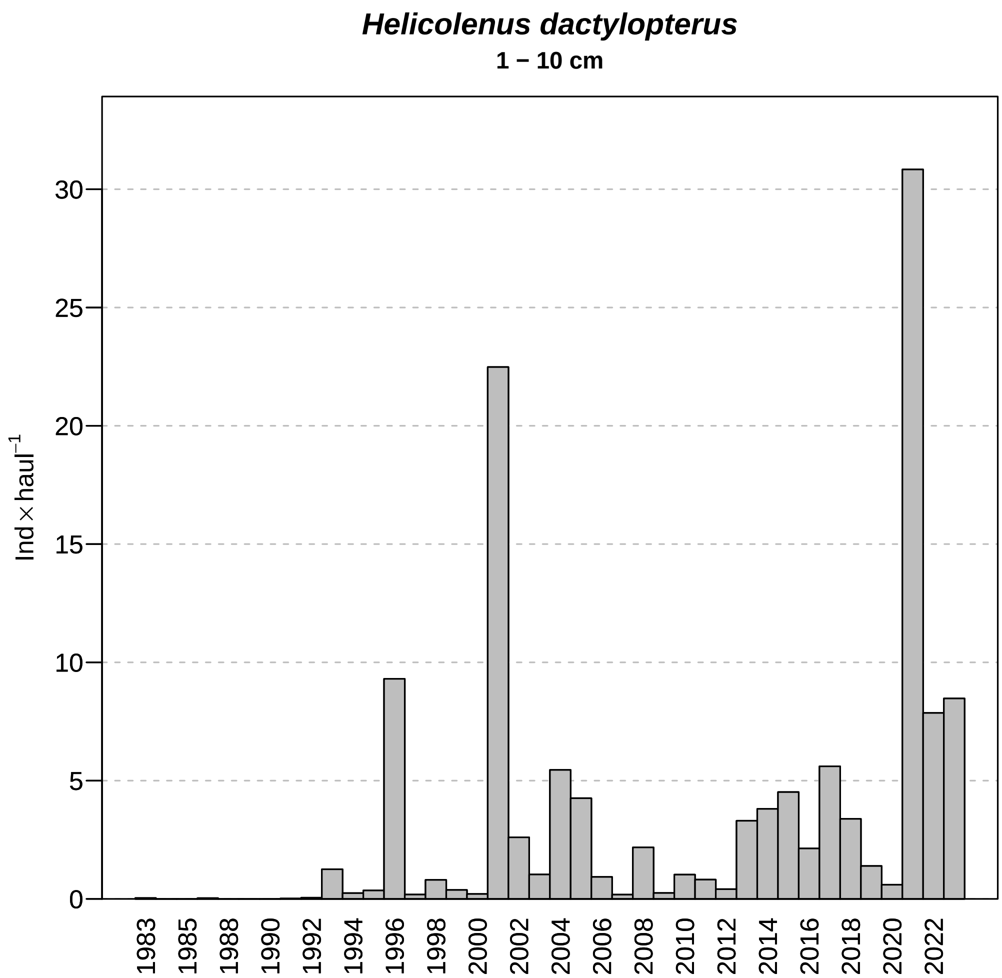

Figure 20: *H. dactylopterus* recruitment (< 10 cm) in the Northern Spanish shelf groundfish survey time series.

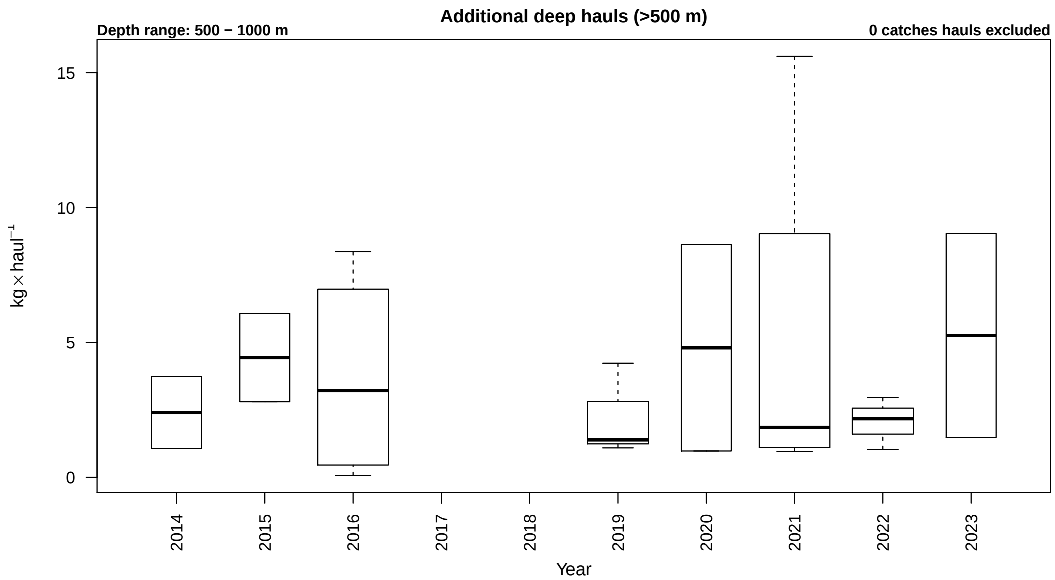

Figure 21: Evolution of *Aphanopus carbo* biomass and abundance in additional deep hauls in the Northern Spanish shelf groundfish survey time series. Boxplots represent the median and interquartiles of the biomass and abundance catches in the deep hauls performed.

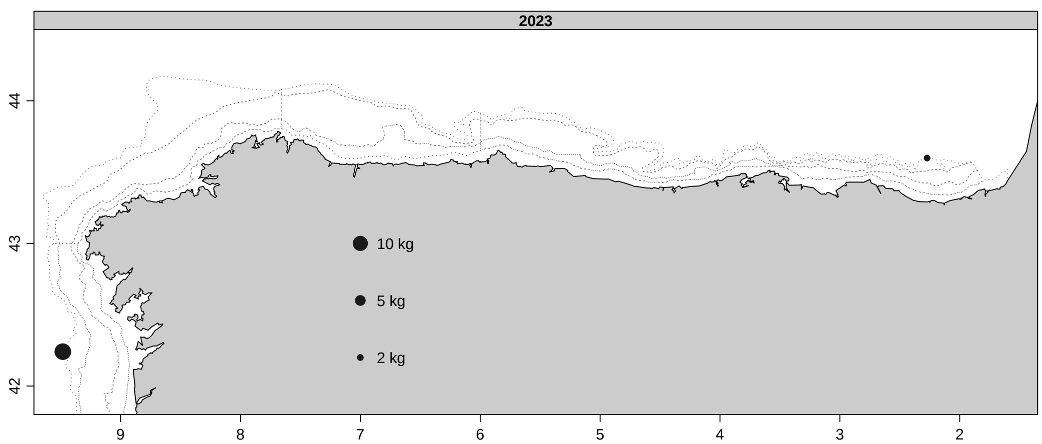

Figure 22: Geographic distribution of *Aphanopus carbo* catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey survey 2023.

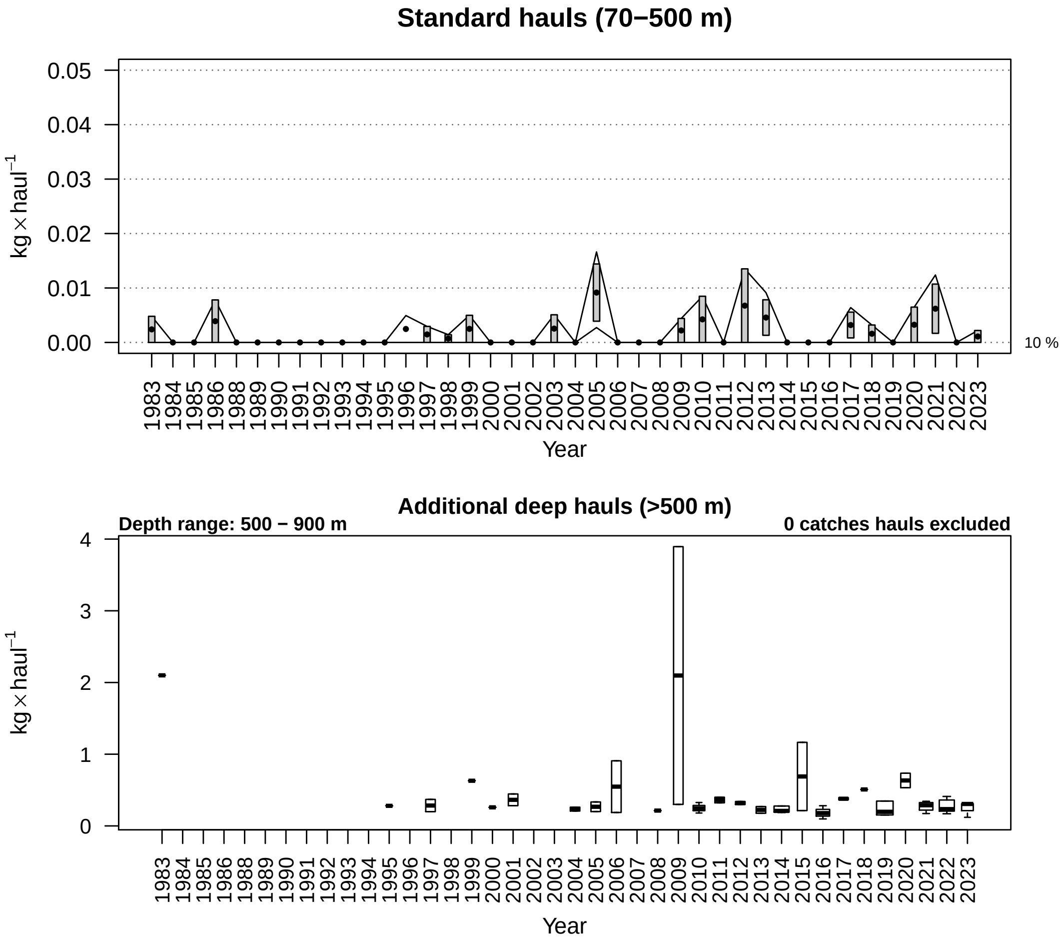

Figure 23: Evolution of *Beryx* spp. stratified biomass index in standard hauls and additional deep hauls in the Northern Spanish shelf groundfish survey time series. For the standard hauls boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a= 0.80, bootstrap iterations = 1000). For the additional deep water hauls boxplots represent the median and interquartiles of the biomass catches in the deep hauls performed.

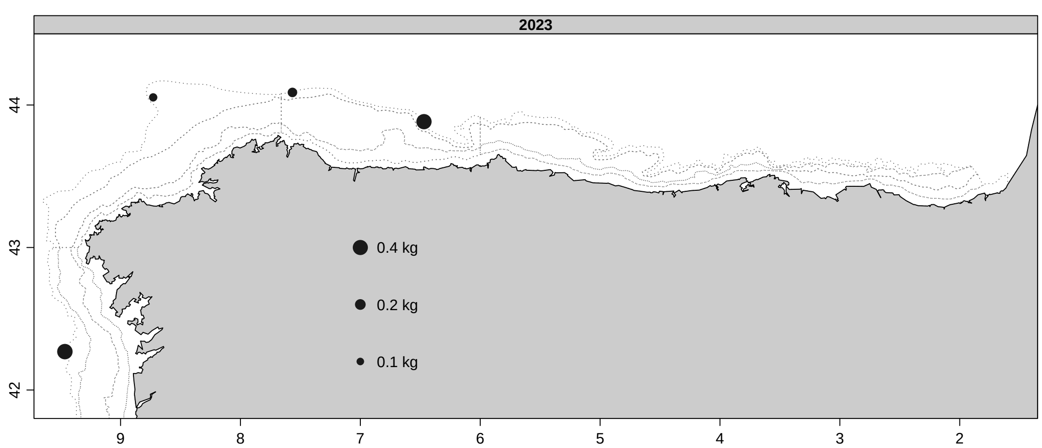

Figure 24: Geographic distribution of *Beryx* spp. catches (kg/30 min haul) in the Northern Spanish shelf groundfish survey 2023.

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Biology and Assessment of Deep Sea Fisheries Resources

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This Working Document has not been peer-reviewed by ICES WGDEEP and should not being interpreted as the view of the Group. The Working Document is appended for information only.

Strait of Gibraltar Blackspot seabream Spanish target fishery : last update?

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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 2023. So, data about landings, fishing effort, CPUEs and landings length frequencies are presented to its inclusion in the 2024 WGDEEP Report.

1. Introduction and fishery description

Since the earlies 1980´s a Spanish artisanal fishery targeting to Blackspot seabream (*Pagellus bogaraveo*, namely "*voraz*") have been 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, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022 and 2023). Blackspot seabream Spanish fishery in the Strait of Gibraltar is almost a mono-specific fishery with a clear target species which represents the 74% from the total landed species which constitutes a fleet component by itself (Silva *et al*., 2002).

In 2006, 2008, 2010, 2012 and 2016 different trials were attempted to assess this resource within the ICES WGDEEP (ICES, 2006, 2008, 2010, 2012, 2016 and 2018). Finally, 2018 scientific advice was based on abundance indexes (DLS category 3). All the available information from this target fishery (including the biomass index used as the basis for the assessment) were updated with the most recent (2022) data.

Thus, the main objective of this paper is to provide to the 2024 ICES WGDEEP a summary of the available information of this deep-water fishery located in a very narrow place of the ICES area 9. Hope that would be the last time!!

2. Material and methods

Fishery information from the sale sheets was gathered for the period 1983-2021: 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 was also estimated from the data collected by IEO monitoring programme (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 were more recently available (from 2009 onwards): this monitoring system, locally called "green boxes" (to differentiate them from the EU VMS "blue boxes"), send every three minutes to a control centre several information about the fishing boat: time, positions, course and speed. Data were filtered and analyzed, according to the protocols proposed by Burgos *et al*. in 2013, to estimate fishing effort and catch rates of the Blackspot seabream Spanish target fishery.

3. Results and discussion

- <u>Landings data</u>: Figure 1 shows a continuous increase of Spanish landings from the beginning of the time series to reach a maximum in 1994. Since then landings´ trend decreased till 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 since 2018 show the lowest values of the series, with a 2019-2023 mean of about 8 tons but about a 1 ton in the last two years (2022-2023) landed by 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 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 three different Advice bodies/Regional Fisheries Organizations (ICES, GCFM and CECAF) boundaries (Figure 2). In fact, since 2015 Spanish Blackspot seabream landings available at InterCatch tool comprise 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-SAC and SRC-WW) so, when possible, it is included in the WGDEEP landings estimates because Moroccan boats target the same population, sharing the main Strait of Gibraltar fishing grounds with Spain (ICES, 2016).

- <u>CPUEs</u>: Nominal biomass 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 does not consider the missing effort. So in the most recent years, when the resource is not quite abundant, the missing effort might increase substantially (fishing boats with no catches and no sale sheet records). Therefore, the LPUE trend since the first fishery´s decline (1997) should be interpreted with caution because it cannot be a real image of the resource abundance and might be overestimated. Anyway, a severe and continuous decreasing trend is observed since 2016, from CPUEs lower than 40 kilos till about 10 kilos per fishing trip in last two years (2022-2023).

Table 1 updates the available information from regional VMS (SLSEPA), following the data compilation and process described by Burgos *et al*. in 2013.

Table I. Estimates of fishing effort and CPUEs (2009-2023) from the "*voracera*" fleet targeting Blackspot seabream based on regional VMS (SLSEPA) and fishery statistics (sales sheets).

Data source		2009	2010	2011	2012	2013	2014	2015	2016
VMS	Landings (k)	459,010	274,882	190,786	79,163	37,799	94,261	137,444	73,508
	No. sales	7,200	5,863	4,711	2,946	2,086	2,989	3,079	1,873
	Fishing days (fishing trips)	8,373	7,238	6,160	3,686	2,695	4,191	4,234	2,724
	CPUE 1 (landings/no. sales)	64	47	40	27	18	32	45	39
	CPUE 2 (landings/fishing days)	55	38	31	21	14	22	32	27
TOTAL	Landings (k)	579,140	316,365	239,790	126,006	66,159	137,623	166,440	99,726
	No. sales	8,892	6,932	5,659	3,638	2,222	3,527	3,384	2,418
	CPUE 1 (landings/no. sales)	65	46	42	35	30	39	49	41

Data source		2017	2018	2019	2020	2021	2022	2023
VMS	Landings (k)	24,716	4,402	4,825	1,579	2,614	313	627
	No. sales	1,017	309	248	62	89	36	36
	Fishing days (fishing trips)	1,740	1,046	607	125	266	235	177
	CPUE 1 (landings/no. sales)	24	14	19	25	29	9	17
	CPUE 2 (landings/fishing days)	14	4	8	13	10	1	4
TOTAL	Landings (k)	42,991	7,633	18,693	12,838	8,412	488	1,251
	No. sales	1,308	429	794	525	404	72	101
	CPUE 1 (landings/no. sales)	33	18	24	24	21	7	12

CPUE 2 (landings/fishing days), where the effort is estimated from the VMS device also declined with lower values than CPUE 1 because the fact of the missing effort. So, as expected, CPUEs estimates from VMS analysis shows the same trend but lower values than the nominal one, from sale sheets (Figure 3).

- <u>Length frequencies</u>: The mean length of landings seems to have decreased in certain periods: from 1995 to 1998, from 2009 to 2013 and from 2021 till 2023 (Figure 4).

4. Main conclusions

The general trend for the time series of both, landings and CPUEs, continues showing a decreasing pattern over recent years, exhibiting the lowest values of the whole series. This might be a consequence of an overexploitation status of the stock, which is addressing the fishery into a critical situation.

It should be noted that GFCM establish a management plan for the Blackspot seabream fishery of the Strait of Gibraltar in 2022 (GFCM/45/2022/3 on a multiannual management plan for the sustainable exploitation of blackspot seabream in the Alboran Sea, geographical subareas 1 to 3). Last update assessment (2023) for Blackspot seabream in the Strait of Gibraltar was presented through the Subregional Committee of the Western Mediterranean to the Scientific Advisory Committee of the GFCM in 2022. Results indicated that the stock is depleted with unsustainable exploitation and low fishing mortality. The recommendation was to proceed with immediate reduction of fishing mortality, implementing also a recovery plan (GFCM, 2023).

Last January the stock was presented to the WKBMSYSPiCT3: the Group agreed to remove the Strait of Gibraltar information because the stock would be assessed based on representative data from the ICES Subarea 9. So, a historical landings reconstruction and CPUE standardization for the Portuguese polyvalent fleet were performed. It was agreed that this CPUE index is adequate and fulfill the requirements for the application of the rfb or 2 over 3 rule for the 2024 WGDEEP.

In summary, hopefully this would be the last time that the Stratit of Gibraltar target fioshery info is presented within the ICES WGDEEP.

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, CSIC), Consejería de Agricultura y Pesca de la Junta de Andalucía and Tarifa´s Fishermen Brotherhood.

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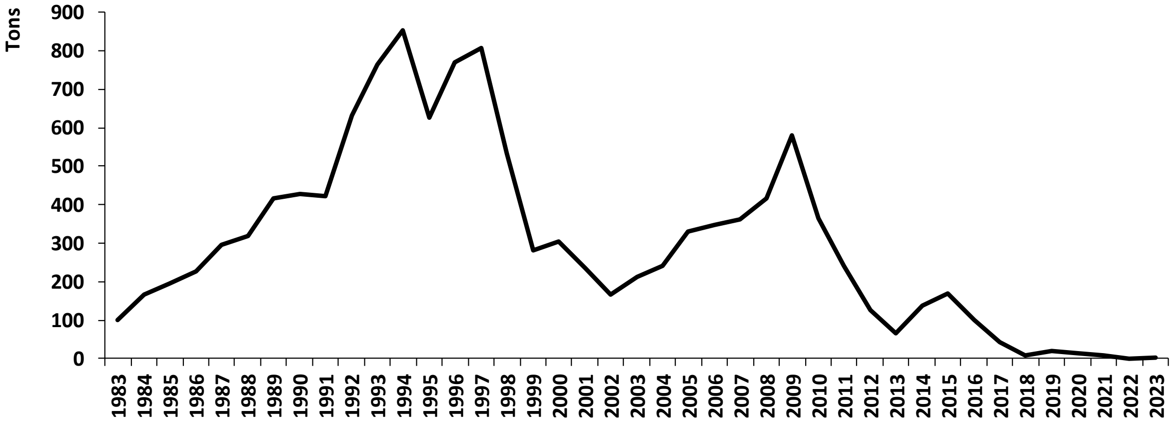

Figure 1. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: total landings (1983-2023).

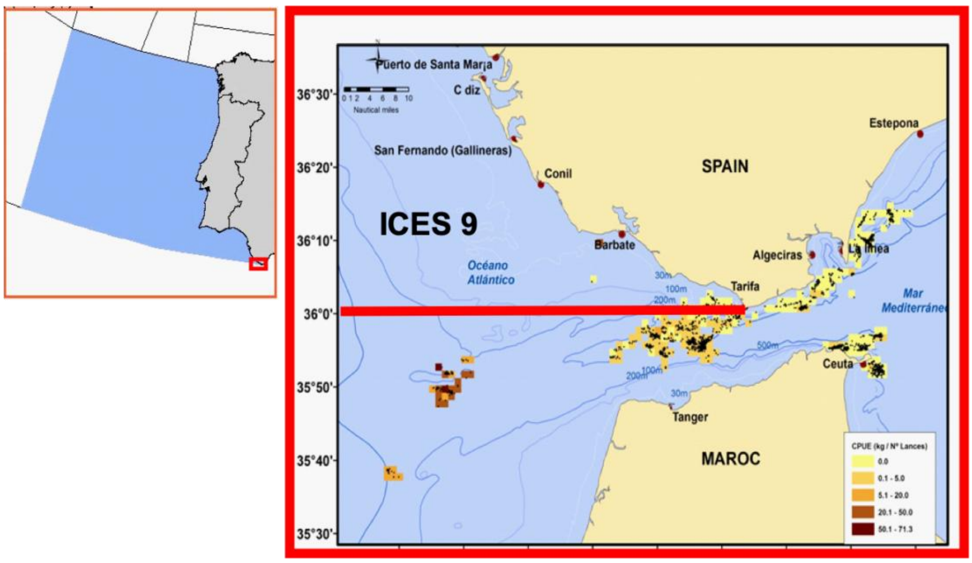

Figure 2. Spanish "*voracera*" fleet footprint of the Strait of Gibraltar.

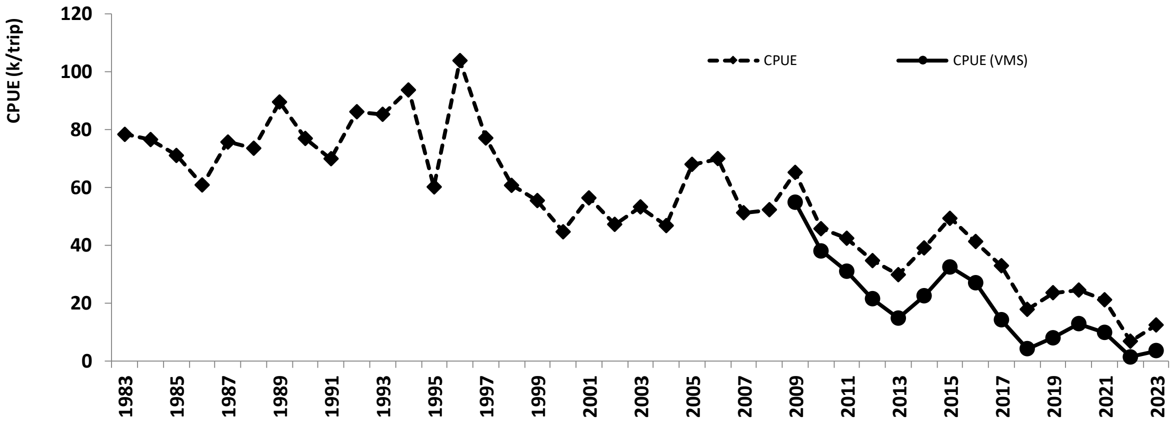

Figure 3. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: nominal (sale sheets) CPUE (1983-2023) and (VMS) CPUE (2009-2023).

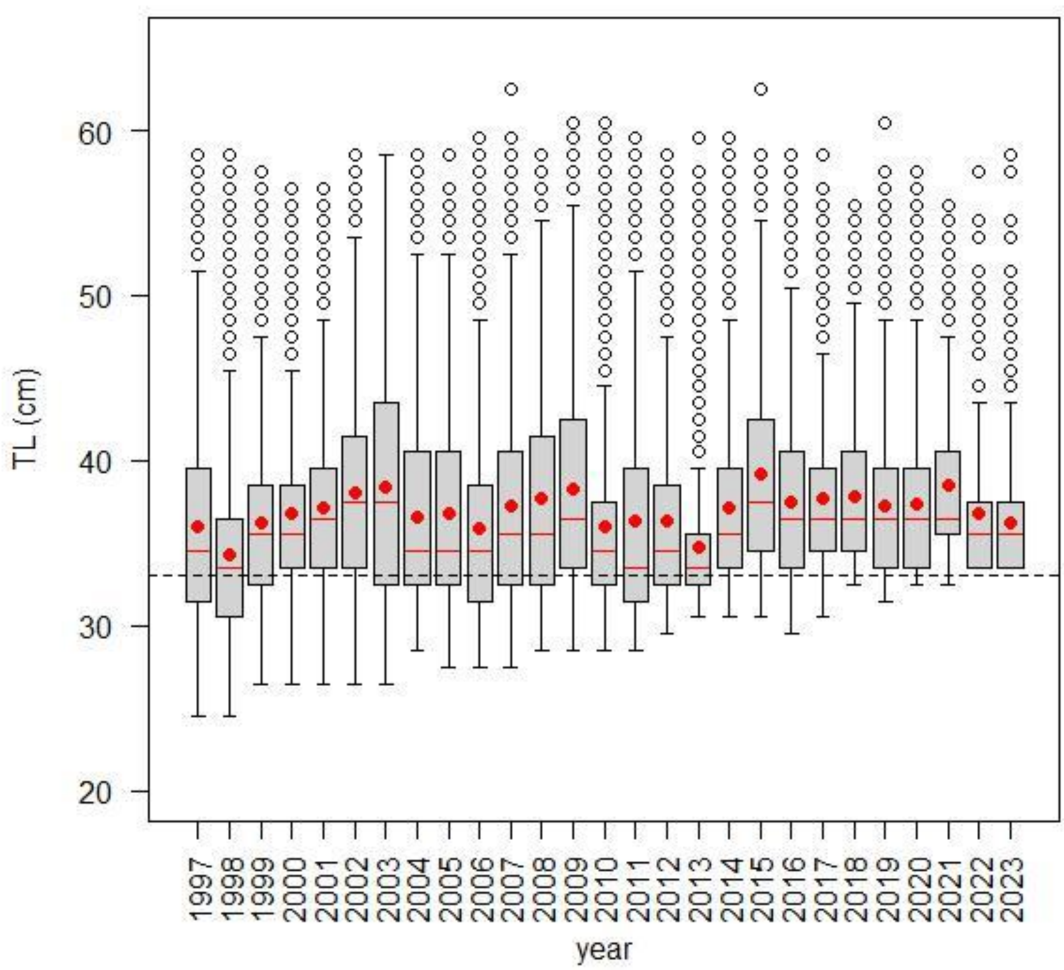

Figure 4. Blackspot seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: landings length distribution descriptive statistics (red dot: mean value, red line: median value, box and whiskers: Interquartile Range plus Q_1-3IQR and Q_3+3IQR, circles: outliers).

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Abundance, biomass and CPUE of deep-water teleost species in the longline survey (PALPROF) in the Bay of Biscay (ICES 8c) from 2015 to 2023.

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INTRODUCTION

Data from longline surveys conducted annually on the Basque Coast (ICES 8c) since 2015 on a commercial longliner are presented. The experimental design was implemented to estimate and assess the inter-annual variation of the abundance and biomass indices of the deep-water ichthyofauna in the area of study. To get homogeneous and comparable data series, the six hauls were carried out every year in the same position and period, covering depths from 650 m to 2400 m. The stratification was based on 400 m intervals following the profile of the canyon valley (Diez et al., 2021).

MATERIAL AND METHODS

Fishing gear and fishing operations

A modified former commercial bottom longline fishing gear, specific for deep-water sharks, was adapted for the survey. In this Working Document only the abundance and biomass indices of the deep-water teleost caught in survey from 2015 to 2023 are presented.

The commercial gear used 6 mother lines with 1800 hooks fishing overnight (soak time = 8 - 9 h), but in order to minimize the mortality of deep-water sharks in the scientific fishing gear, the number of hooks was reduced to 300, and the soak time was set at 4 h. The vessel was equipped with a specifically designed device for recovering fishing gear from deep waters at a depth of more than 2500 m. Several modifications to the fishing gear were tested during the 2015 pilot survey, and the final design was a double gear divided into two equal main line sections of 1750 m+1750 m, each with 150 hooks. Each hook was baited with a third of Atlantic mackerel (*Scomber scombrus*), and the main line was attached to the bottom by means of a 1.5 kg stone for every five hooks. In order to improve the catch efficiency of species that feed above the sea bottom, the stones of the main line were removed, resulting in two floating sections of 75 hooks. Therefore, the fishing gear consisted of 150 hooks in contact with the bottom, and 150 hooks in the floating sections (Figure1). The fishing gear was linked to the surface by two head ropes (without hooks) and two marker floats, placed at the beginning and end of the main line. For the continuous recording of depth, temperature and salinity, the longline was monitored every 30 s by means of five small DST CTD and DST-centi sensors (www.star-oddi.com), able to withstand 2400-3000 m in depth, respectively. Three of these sensor devices were attached to the beginning, mid-point and end of the main rope, and the remaining two at the top of each of the "floating" sections (Figure 1). To locate and monitor the fishing gear after each haul, two satellite buoys (https://zunibal.com/en/product/zunliner-longline-buoy/) were installed in the marker floats. One haul was accomplished per day; starting at 8 a.m. and ending in the evening after recovering the longline and the hauling data collected by the sensors.

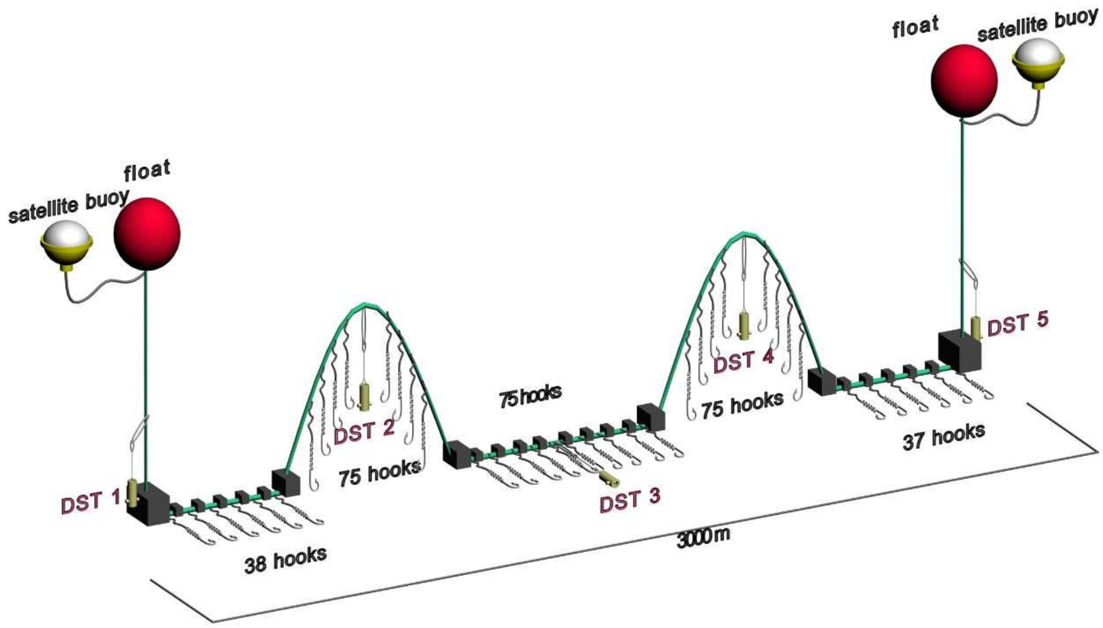

Figure 1. Scheme of the final design of the long-line fishing gear used in the pilot survey. The positions of DST 1, 3 and 5 correspond to the main line sections fishing at the bottom, and DST2 and 4 to the floating sections.

Survey area

The surveys were conducted annually from 2015 to 2022 between the 15th of September and the 15th of October. The sampling stations were located in an area 10.5 km north of Cape Matxitxako in a narrow canyon of about 28 km long that progressively decreases in depth from 500 to 2500 m. The six hauls covered the whole depth range along the canyon valley in four 400 m strata: 650-1050 m, 1051-1450 m, 1451-1850 m and 1851-2250 m (Figure 2).

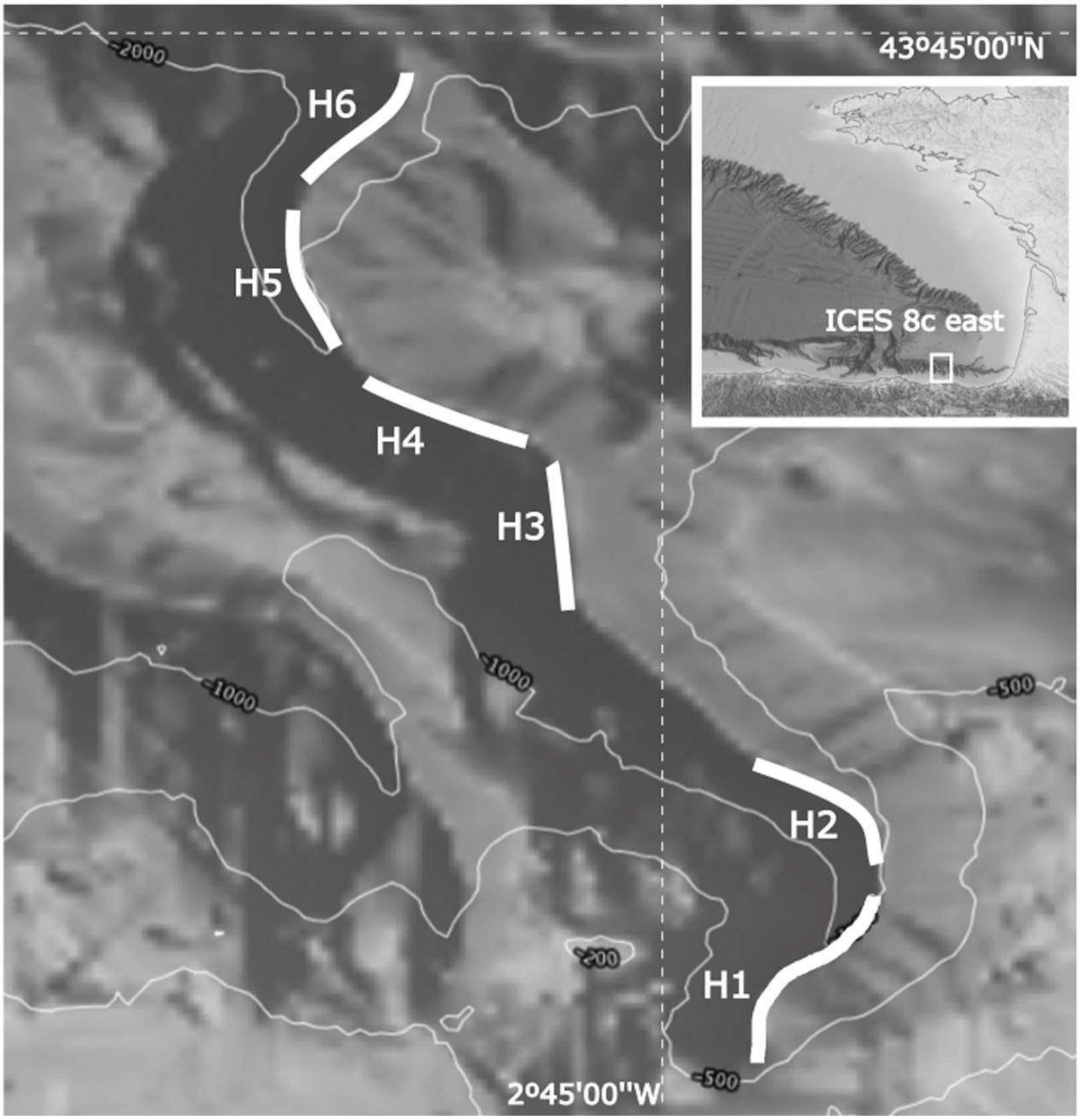

Figure 2. Bathymetric map showing the position of the six hauls in the Matxitxako Canyon in the southeast of the Bay of Biscay (ICES Division 8c). The correspondence of the hauls with the deep strata is: H1 (650-1050 m); H2 (1051-1450 m); H3 (1451-1850 m); H4 (1451-1850 m); H5 (1851-2250 m); H6 (1851-2250 m).

Biomass estimation: catch per unit effort (CPUE)

To calculate the fishing effort and CPUEs in each haul, the hooks were classified according to seven categories, both during the hauling and recovery of the longline (Table 1).

Table 1. Hook Status Categories

	during the hauling
N	Loss of bait during the hauling
N.O	Hook status Not Observed/recorded
	during the recovery
E	Hook with bait
C	Hook with bait partially eaten
R	Broken-Tangled hook
V	Empty hook (no catch, no bait)
P	Hook with catch

During the recovery of the longline, the hooks were numbered from 1 to 300 to identify the position of the catches and to identify whether the catches belonged to the floating or the bottom sections. Percentage of Ineffective Hooks (PIH) was defined as the number of hooks not able to fish divided by the total number of hooks:

PIH: (R + V +N) / (C+E+N+P+R+V).

Fishing Gear Catchability (FGC) was defined as the proportion of hooks that had fished (P) divided by the number of hooks able to fish (P + E + C):

FGC = P / (P + E + C).

Total Catchability (TC) was the proportion of hooks with catch in the total hooks hauled:

P / = N+ N.O. + E +C+R+V+P

Soak time was calculated from the time the first hook reached the bottom (indicated by sensor DST 1) until this hook was hauled back. Soak time was different in each haul strata, since the time it took for the first hook to reach the bottom became longer as the depth of the bottom increased.

To be able to compare the analysis of catches by haul, Effort and CPUE were standardized to the number of hooks and duration of soak time. Thus, Effort in each stratum (EFFORTst) was estimated as the number of hooks able to fish during the haul (P + E + C), divided by the total of hooks and multiplied by soak time (minutes) (1) and after raised to 60 min (1 hour) (2):

(1) EFFORTst: ((P + E + C) / (total hooks) x min soak time

(2) EFFORTst: ((P + E + C) / (total hooks) x 60 min

This year the Catch per Unit of Effort was adapted to the units usually used in the assessments based in survey trends. Therefore, the CPUE was raised to 60 min and the Biomass index was calculated in kg/h:

Biomass Index = kg / EFFORTst = kg/(hook x 60 min) = **kg/h**, and also, the

Abundance Index = **No/h**.

RESULTS

Temporal changes in the total Biomass and Abundance of deep-water teleost

The highest biomass was recorded in 2027 with 168 kg (Table 2) due in part to the catches of *M. moro* and *A. carbo* reaching 106 kg and 45 respectively. In 2023 the lowest biomass in the series was recorded (71 kg) with also the lowest catches of *M. moro* and *A. carbo.*

Table 2. Accumulated Biomass (kg) of the main deep-water teleost caught in the survey in the period 2015-2023 all the depth stratum combined.

	kg								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii					*2*				
Antimora rostrata	9	10	14	5	9	15	8	9	2
Aphanopus carbo	9	29	45	8	22	46	33	34	19
Conger conger	3	7						1	
Lophius piscatorius	18								
Molva dypterigia							5		
Mora moro	48	121	106	70	71	87	63	39	41
Phycis blennoides	4		1	2	8	7	5	14	9
Synaphobranchus kaupii	1	0.3	1	1	1	0.3	1	0.5	
Trachyrincus scabrus			0.5				0.2		
TOTAL	**92**	**166**	**168**	**86**	**113**	**155**	**114**	**97**	**71**

During the nine years of the survey, 10 different species of teleosts were caught. Among these species the most abundant species were *M. moro* with on average 41 individuals/year, *A. carbo* (21) and A. rostrata (9) (Table 3). The series average in the nine years showed that 66.7 % of the teleost species were found on the hooks in contact with the bottom.

Table 3. Accumulated Abundance (No.) of the main deep-water sharks caught in the survey in the period 215-2022, all the depth stratum combined.

	number								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii					1				
Antimora rostrata	8	9	15	4	11	12	7	9	2
Aphanopus carbo	8	24	32	8	20	32	23	25	19
Conger conger	1	1						1	
Lophius piscatorius	1								
Molva dypterigia							1		
Mora moro	24	72	48	44	42	42	35	21	41
Phycis blennoides	2		1	2	6	5	4	8	9
Synaphobranchus kaupii	2	1	3	2	4	1	2	2	
Trachyrincus scabrus			1				1		
TOTAL	**46**	**107**	**100**	**60**	**84**	**92**	**73**	**66**	**71**

Temporal changes in the Biomass index of deep-water teleost

Biomass (kg/h) and Abundance (No/h) index of the nine years of the survey of the five main deep-water teleost is shown in the Figure 3.

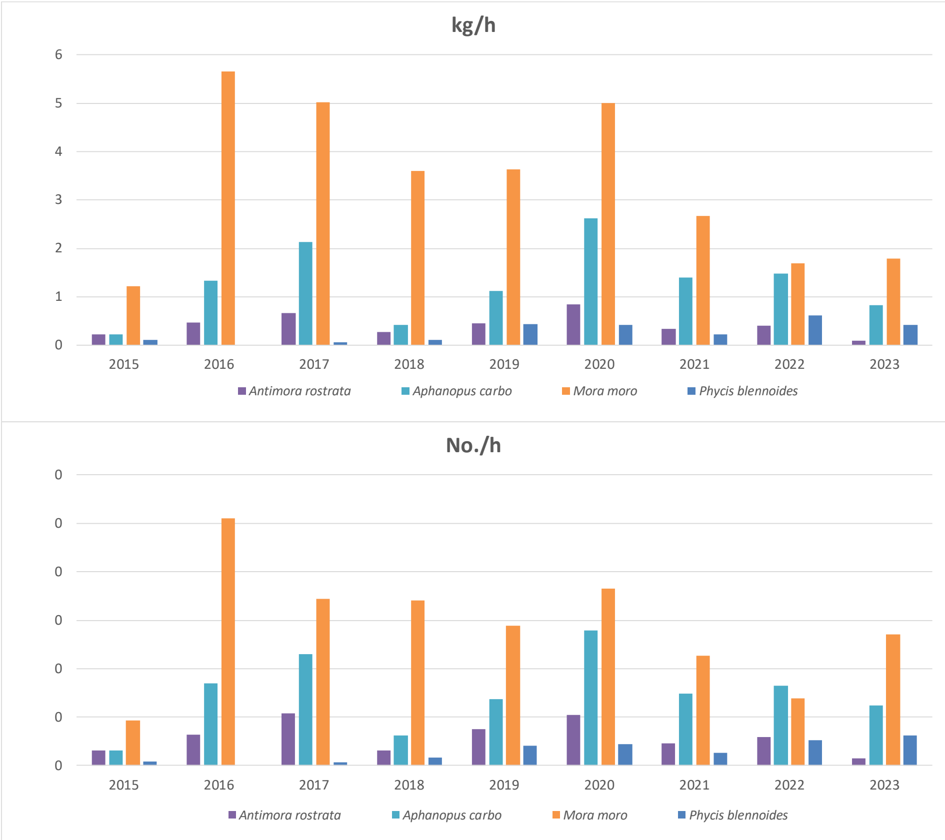

Figure 3. Annual variation of the Biomass (kg/h) and abundance (Nº/h) of the four main deep-water teleost in the period 2015-2023.

The Biomass Index showed the highest values in 2020 with 8.9 kg/h (Table 4) and a significant decrease observed in 2023 with only 3.1 kg/h the second lowest values after the year 2015.

Table 4. Biomass Index (kg/h) of the main deep-water sharks caught in the survey in the period 2015-2022 all the depth stratum combined.

	Biomass Index (kg/h)								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii	0	0	0	0	0.08	0	0	0	0
Antimora rostrata	0.23	0.46	0.66	0.27	0.46	0.84	0.33	0.40	0.09
Aphanopus carbo	0.23	1.34	2.13	0.41	1.13	2.62	1.41	1.48	0.82
Conger conger	0.08	0.31	0	0	0	0	0	0.04	0
Lophius piscatorius	0.45	0	0	0	0	0	0	0	0
Molva dypterigia	0	0	0	0	0	0	0.22	0	0
Mora moro	1.21	5.66	5.02	3.60	3.63	5.01	2.67	1.70	1.79
Phycis blennoides	0.11	0.0	0.06	0.11	0.43	0.42	0.22	0.61	0.41
Synaphobranchus kaupii	0.02	0.02	0.04	0.03	0.05	0.02	0.02	0.02	0
Trachyrincus scabrus	0	0	0.02	0	0	0	0.01	0	0
TOTAL	2.3	7.8	7.9	4.4	5.8	8.9	4.9	4.2	3.1

The overall Abundance index shows two peaks in 2016 and 2020, with lowest value observed in 2015 and with a stable trend since 2021 (Table 5).

Table 5. Abundance Index (No./h) of the main deep-water teleost caught in the survey in the period 2015-2023 all the depth stratum combined.

	Abundance Index (No./h)								
species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Alepocephalus bairdii	0	0	0	0	0.0003	0	0	0	0
Antimora rostrata	0.0015	0.0032	0.0054	0.0015	0.0038	0.0052	0.0023	0.0030	0.0007
Aphanopus carbo	0.0015	0.0085	0.0115	0.0031	0.0069	0.0139	0.0074	0.0082	0.0062
Conger conger	0.0002	0.0004	0	0	0	0	0	0.0003	0.0000
Lophius piscatorius	0.0002	0	0	0	0	0	0	0	0
Molva dypterigia	0	0	0	0	0	0	0.0003	0	0
Mora moro	0.0046	0.0255	0.0172	0.0170	0.0144	0.0183	0.0113	0.0069	0.0135
Phycis blennoides	0.0004	0.0000	0.0004	0.0008	0.0021	0.0022	0.0013	0.0026	0.0031
Synaphobranchus kaupii	0.0004	0.0004	0.0011	0.0008	0.0014	0.0004	0.0006	0.0007	0.0000
Trachyrincus scabrus	0	0	0.0004	0	0	0	0.0003	0	0
TOTAL	0.009	0.038	0.036	0.023	0.029	0.040	0.024	0.022	0.024

Regarding the catches by depth, the highest biomass per hour (kg/h) has been recorded historically in the stratum of 1051-1450 m and more specifically in 2021 with 21.42 kg/h and lowest catches per hour were recorded every year at the deepest strata (Figure 4).

Biomass (kg/h) stratum (m)	2015	2016	2017	2018	2019	2020	2021	2022	2023
650-1050	2.32	9.97	10.45	6.29	9.55	7.87	6.65	8.50	1.59
1051-1450	6.63	11.11	21.42	10.91	7.71	15.65	10.50	9.08	8.72
1451-1850	10.35	1.99	1.60	0.20	0.20	0.94	10.04	0.21	2.24
1851-2250	1.44	2.42	3.35	1.68	2.53	6.25	1.80	1.93	0.31

Figure 4. CPUE (kg/(hook x min) of deep-water sharks by depth stratum and year in the series 2015-2023.

On average the strata of 1051-1450 m recorded the highest values both in biomass and abundance with 11.3 kg/h and 6.07 No./h (Figure 5).

	650-1050	1051-1450	1451-1850	1851-2250
Biomass (kg/h)	7.02	11.30	3.08	2.41
Abundance (No./h)	4.41	6.07	0.82	2.40

Figure 5. Biomass (kg/h) abundance (No./h) by stratum of deep-water sharks in the period 2015-2023.

The abundance and biomass of sharks and teleost on the hooks attached to the bottom were between three and four times higher than in the floating sections (Figure 6).

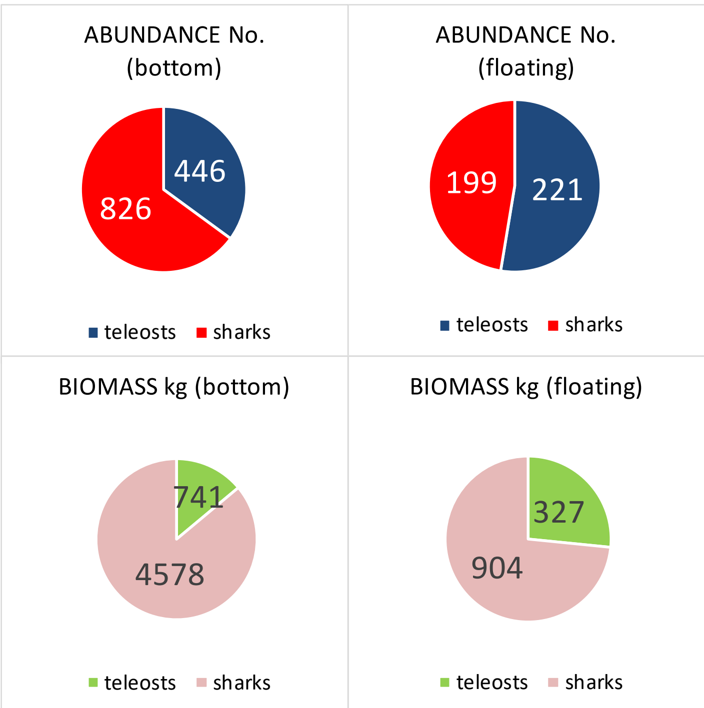

Figure 6. Comparison of the Total abundance (No.) and biomass (kg) between deep-water sharks and teleosts in the bottom and floating sections in the period 2015-2023.

In relation to the bathymetric distribution of the species *C. conger* and *M. dypterigia* were only caught in the first strata (650 to 1050 m), while *A. carbo* was found in the entire depth range and *A. rostrata* and *A. bairdii* only in the deepest strata (Figure 7).

	strata (m)			
SPECIES	**650-1050**	**1051-1450**	**1451-1850**	**1851-2250**
Conger conger	100%			
Molva dypterigia	100%			
Phycis blennoides	81%	19%		
Trachyrincus scabrus	50%	50%		
Aphanopus carbo	43%	30%	21%	5%
Mora moro	36%	64%		
Antimora rostrata				100%
Lophius piscatorius		100%		
Synaphobranchus kaupii			24%	76%
Alepocephalus bairdii				100%

Figure 7. Bathymetric distribution of the deep-water teleost. Bars indicate the percentage of abundance (No.) of each species in the entire depth range in the period 2015-2023.

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OVERVIEW OF CRUISE-SERIES FOR

GREATER SILVER SMELT IN ICES AREAS 1, 2, 3a AND 4.

Lise Heggebakken and Elvar H. Hallfredsson

A greater silver smelt stock unit is defined in ICES areas 1,2,3a and 4 (Barents Sea, Norwegian Sea and North Sea).

Before benchmark conducted in January 2024 (ICES 2024), all trawl surveys in the IMR Norway database with registrations of greater silver smelt within the stock distribution area were examined. This gave a good overview of the distribution of the species (Figure 1). Greater silver smelt in 1,2,3a and 4 are distributed from the North Sea and into the Barents Sea, but main densities are in division 2.a (Figure 2). The assessment uses acoustic biomass index from the Norwegian Continental Slope Deep Sea Survey in Spring in Subarea 2 (ICES code G5678), which is conducted biennially at the slope and deeper shelf areas between approximately 62-74 °N (Figure 3).

The purpose of the review of the trawl surveys was to decide if some of the surveys gave added information about the stock, and whether construction of indices based on some of the surveys may be further pursued in the future. A joint trawl index may also be attempted in the future, even though that might prove to be a difficult task as there are variations in time span, survey area, time of year and trawl gears.

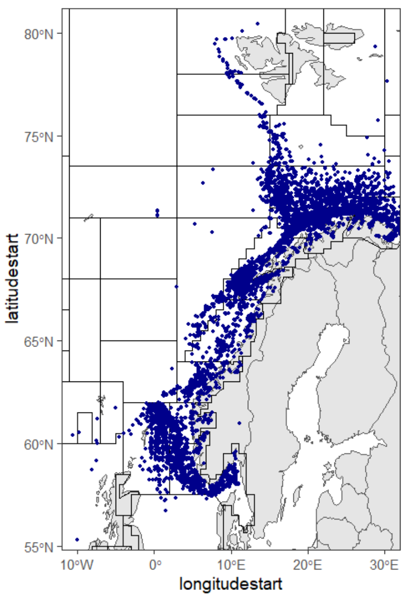

Figure 1: All trawl stations with recorded cathces of greater silver smelt in the database of IMR Norway 1971-2023.

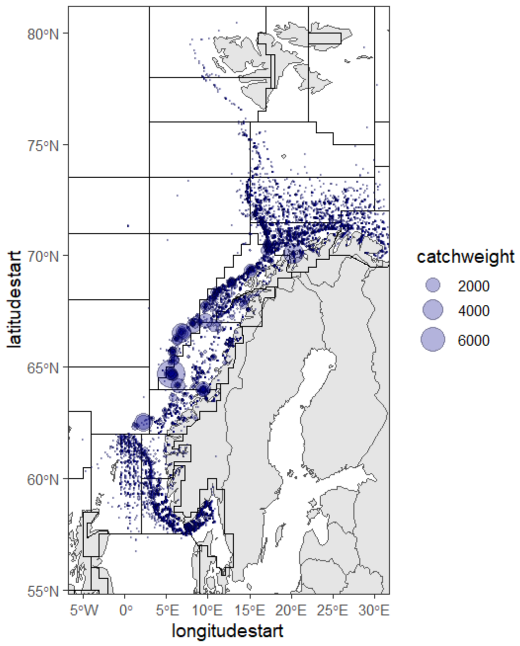

Figure 2: All trawl stations with recorded catches of greater silver smelt in the database of IMR Norway 1971-2023. Bubble size reflects catch weight in kilos.

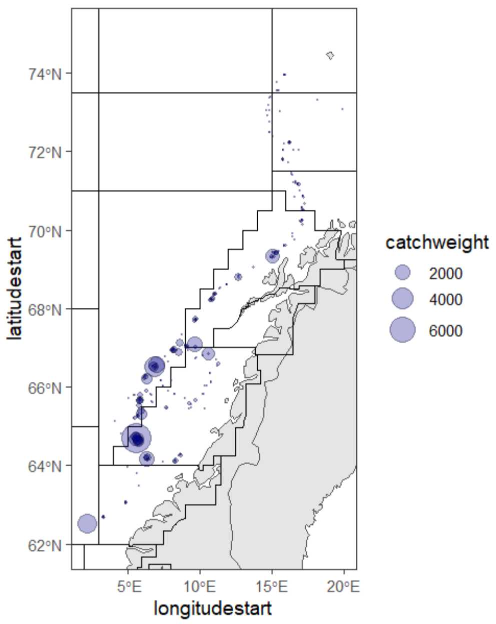

Figure 3: Amount of greater silver smelt for each bottom trawl station in the Norwegian Sea continental slope survey in spring. Bubble size reflects catch weight in kilos.

Comparing all the survey time-series, the Norwegian Sea continental slope survey in spring is the one with the highest amount of greater silver smelt caught per haul. However, some of the time-series shown below, can also be considered, either to be used as a separate index, or as a joint index for more coverage in time and space (Table 1).

Table 1: Overview of some possible surveys to be used as an index for greater silver smelt:

Suveyseries	**Surveynr**	**Start Yr**	**Stop Yr**	**Nr of Yrs**	**Mean catch (kg/Yr)**	**Max fish.dep(m)**	**Months**	**Comments**
Norw.sea cont.slope survey spring	25	2009	2022	7	7300	1170	Mar-Apr	Acoustic index is used in assessment.
North sea shrimp survey	15	1984	2023	40	856	678	Jan-Feb, May-Jun, Oct-Nov	Have been tired earlier, problem with change in season during time series.
Norw.sea cont.slope survey autumn	16	1995	2021	20	1700	1330	Jul-Dec	Suggestion to use as an index. Shift in survey timeseries, early years might be cut off.
Varanger Stad NOR costal cruise autumn	23	1985	2022	36	1140	613	Sep-Dec	Suggestion to use as an index.
BarentSea NOR-RUS ecosystem in autumn	6	2003	2023	21	140	1590	Aug-Oct	Low catches, might used?
NorthSea International .ecosystem Q2Q3	8	2016	2023	8	135	306	Jul-Aug	Only up to 62 North, might be used in joint index?
Barents Sea NOR-RUS demersal fish cruise Winter	5	1980	2023	44	130	791	Jan-Mar	Only Barents Sea
Lofoten NOR demersal fish cruise Mar-Apr	7	1985	2023	36	140	640	Mar-Apr	Located around Lofoten, close to shore.

The two trawl survey-series which stand out, and could be considered used as a joint index, are the Norwegian Sea continental slope survey in autumn and the Varanger Stad Norwegian costal cruise in autumn, and figure 4 shows catches of greater silver smelt in these surveys. At the Norwegian Sea continental slope survey a larger trawl is used (Alfredo trawl) than at the Varanger-Stad coastal survey (Campelen trawl). In attempt to make catches at these surveys comparable the catch in weight at each station was divided by approximate sweeping width, taking herding by sweeps into account (60 m for Alfredo and 25 for Campelen). It should be noted that this is a rough approximation for visualization purposes that should not be used in any analytical work without considerably closer scrutiny.

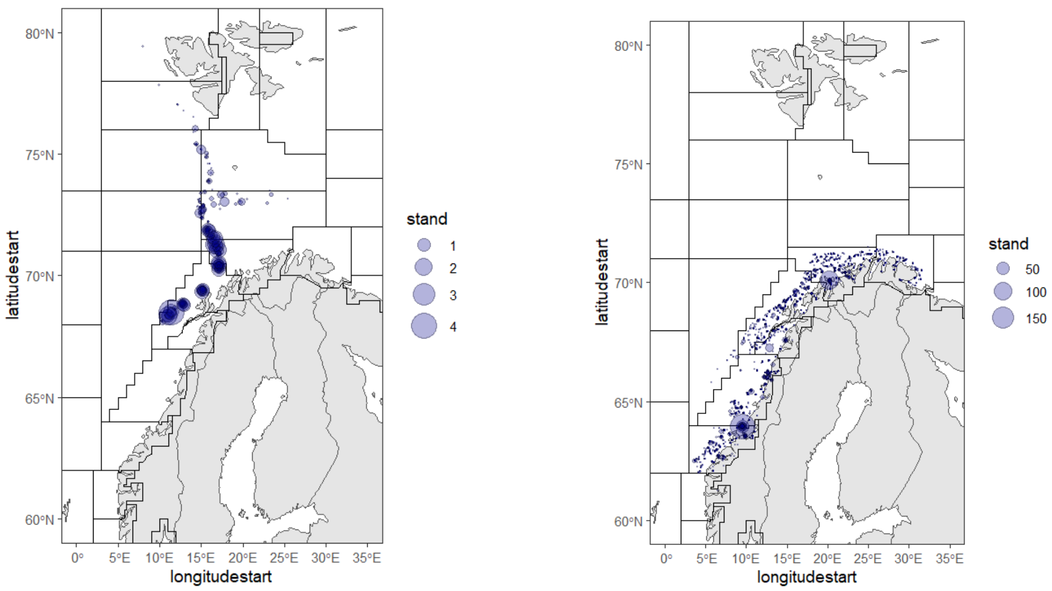

Figure 4: Catches of greater silver smelt in Norwegian Sea continental slope survey in autumn (left panel, years 2009-2022) and catches of greater silver smelt in the Varanger Stad Norwegian costal cruise in autumn (right panel, years 1985-2022). Bubble size reflects catchweight approximately standardized between the surveys (see text).

The southern part of the species distribution, ICES area 3a and 4, is not covered by the two surveys suggested for use in the last paragraph. The Norwegian North Sea Shrimp Survey is run in ICES 3a and 4 (Figure 5) and might be a foundation for a biomass index for the species in that area. However, this survey has been conducted during different times of the year through the timeseries and at the 2020 benchmark (ICES, 2021) it was considered not suitable as input in a SPiCT surplus production model assessment. However, the survey might be considered used together with other surveys in a joint index.

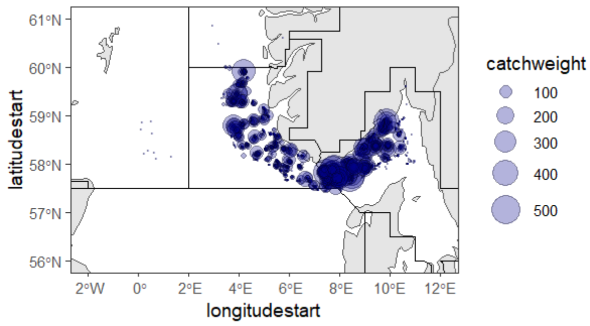

Figure 5: Catches for greater silver smelt in the North Sea Shrimp Survey, all years combined (1984-2023). Bubble size reflects catch per station in kg.

There are other cruise-series that might be considered included in a joint index. However, each of these cruise-series only cover small parts of the distribution area of greater silver smelt. Additionally total catch each year for each of the surveys is relatively minor (around 130-140 kg per year) (Figure 6, 7, 8 and 9).

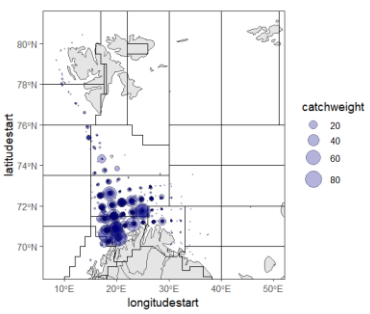

Figure 6: Catches in kilos per trawl station for greater silver smelt for all years combined (2003-2023) from Barents Sea Norwegian-Russian Ecosystem Survey in autumn. The survey is only conducted in the Barents Sea.

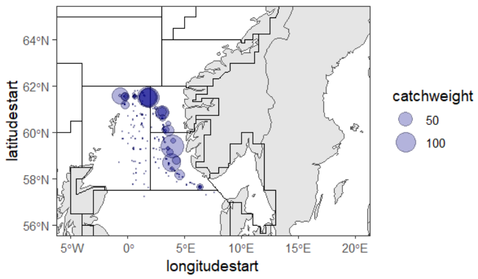

Figure 7: Catches in kilos per trawl station for greater silver smelt for all years combined (2016-2023) from North Sea International Ecosystem survey in quarter 2 and quarter 3. This survey only covers areas between 57-62 degrees north.

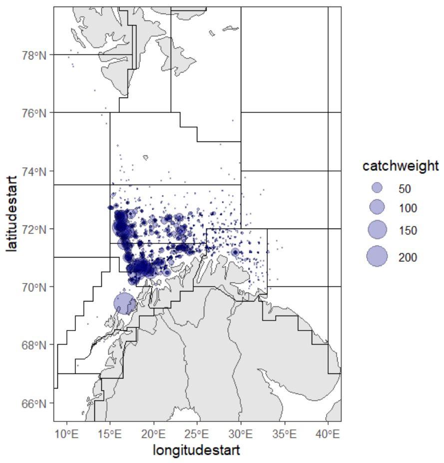

Figure 8: Catches in kilos per trawl station for greater silver smelt for all years combined (1980-2023) from Barents Sea Norwegian-Russian Demersal Fish Cruise in winter. This survey only covers the Barents Sea.

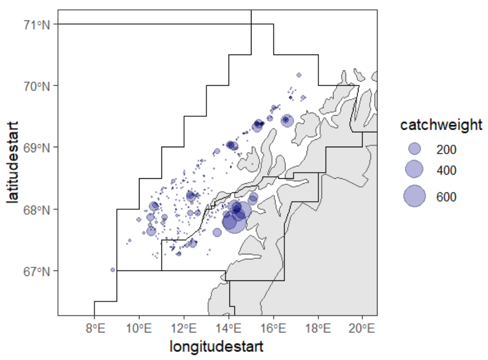

Figure 9: Catches in kilos per trawl station for greater silver smelt for all years combined (1985-2023) from Lofoten Norwegian Demersal Fish Cruise in March-April. This survey only covers the areas around Lofoten Island.

Considering the low catch per year of greater silver smelt for the cruise-series shown in Figure 6-9, these four cruise-series may not be well suited to be included in a joint index for greater silver smelt.

Based on our data examination, if other cruise-series are to be considered included in the assessment together with the acoustic index from Norwegian Sea continental slope survey in spring used presently, the most likely candidate is one of the three cruise-series; Norwegian Sea continental slope survey in autumn, the Varanger Stad Norwegian costal cruise in autumn or the North Sea shrimp survey. Or alternatively all three together in a joint index.

If these three cruise-series were combined into one joint index, the coverage would have be from Skagerrak and north to 80°N. Such joint index would thus cover a larger area than the index from Norwegian Sea continental slope survey in spring which covers the slope from around 62-74°N.

Combining cruise-series in a joint index for greater silver smelt in ICES areas 1, 2, 3a and 4 is not straight forward.The different surveys are conducted during different time of the year, different gears are used, and time span for the surveys varies. Another issue to keep in mind is that the index used for greater silver smelt in the assessment now is an acoustic index, while many of the surveys, like the North Sea shrimp survey, are bottom trawl and not acoustic surveys. Given the patchiness of greater silver smelt within the distribution area, a bottom trawl swept area index is considered less reliable than an acoustic index for estimating abundance/biomass for the species. Thus the most actual surveys for a joint index might be the Norwegian Sea continental slope survey in autumn and the Varanger Stad Norwegian costal cruise in autumn, as both include acoustic estimations.

In conclusion construction of a joint index can be something worth pursuing, preferably using acoustic cruise-series.

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NORWEGIAN SLOPE SURVEY GREATER SILVER SMELT ACOUSTIC INDEX UPDATE - COMPARISON WITH OLD INDEX AND EFFECT ON ASSESSMENT

Lise Heggebakken and Elvar Hallfredsson

Introduction

At the Institute of Marine Research (IMR), all indices used in assessment work are now preferably done in the StoX package (Johnsen *et. al.* 2019). StoX is an open-source software, developed at IMR, Norway, to analyze survey data and calculate survey estimates from acoustic and swept area surveys. The main purpose of StoX is, however, to host quality controlled standard programs for various types of stock abundance estimations.

The greater silver smelt (*Argentina silus*) in ICES areas 1, 2, 3a and 4 is categorized as a category 3 stock in ICES. Since the management unit was defined in 2015 trend-based assessment has been used, first by the ICES "2 over 3" rule (ICES, 2021) and then by the "rfb" rule (ICES 2023). For biomass trend an acoustic biomass index based on the Norwegian Continental Slope Deep Sea Survey in spring in Subarea 2 (ices code G5678, hereafter named "the Slope Survey") has been applied, calculated in StoX. This index was also used as input to SPiCT (Stochastic surplus Production model in Continuous Time, GitHub - DTUAqua/spict: Stochastic surplus Production model in Continuous Time) assessment for the stock during the WKBMSYSPICT3 benchmark in January 2024, where SPiCT was suggested to be used for advice for greater silver smelt in ICES areas 1, 2, 3a and 4 (ICES, 2024).

The currently used greater silver smelt acoustic biomass index was calculated in an earlier version of the StoX software. Here the latest StoX version is applied, and the resulting indices are compared to the earlier indices, and the effect of applying the recalculated biomass index in the SPiCT assessment is examined.

StoX

A key feature of StoX is the architecture which focuses on flexibility and modularity. Any program hosted by StoX is built up by functions performing a limited logic task. The functions that make up a program or model (in StoX terminology), are executed in a sequential order. The behavior of a function is governed by input parameters (Johnsen *et. al*. 2019).

Reuse of code between different applications is important for several reasons. It reduces development time for new applications and ensures that bugs and errors in the new application code are kept at a minimum level. Within StoX, code is reused by reusing the functions in different applications. A specific function solves a well-defined programming task and acts as a building block of a model. All available functions are available from StoX function libraries.

It is the aim of StoX development that all methods used to produce "official" abundance estimates should be based on published methods. It is also a goal that estimation methods in StoX should be based on sound statistical practices. This includes producing estimates that contain a measure of uncertainty. StoX has been designed to facilitate time series analysis of estimates as well as sensitivity analysis.

Survey strata-systems

Strata-system for greater silver smelt in the Slope Survey has been defined using the R-Package RStoxUtils by Mikko Vihtakari (https://github.com/MikkoVihtakari/RstoxUtils). The strata must be defined as spatial polygons (a GIS vector data class) for implementation in StoX. These polygons are then used to calculate the area and to define which stations and part of the acoustic track that lies inside each stratum for further abundance calculation. Changes in the area estimations may dramatically change abundance estimates, and it is important that the same strata-systems are used for the entire time series. The RStoxUtils package contains functions to define strata based on bottom topography and geographical limits. The bathymetry is adapted from the GEBCO 15-arcsecond bathymetry grid (https://www.gebco.net). The strata system is based on compromises between prior knowledge about vertical and horizontal distribution of the stock, and coverage of the surveys in terms of numbers of stations, acoustic track, and survey area (ICES, 2020).

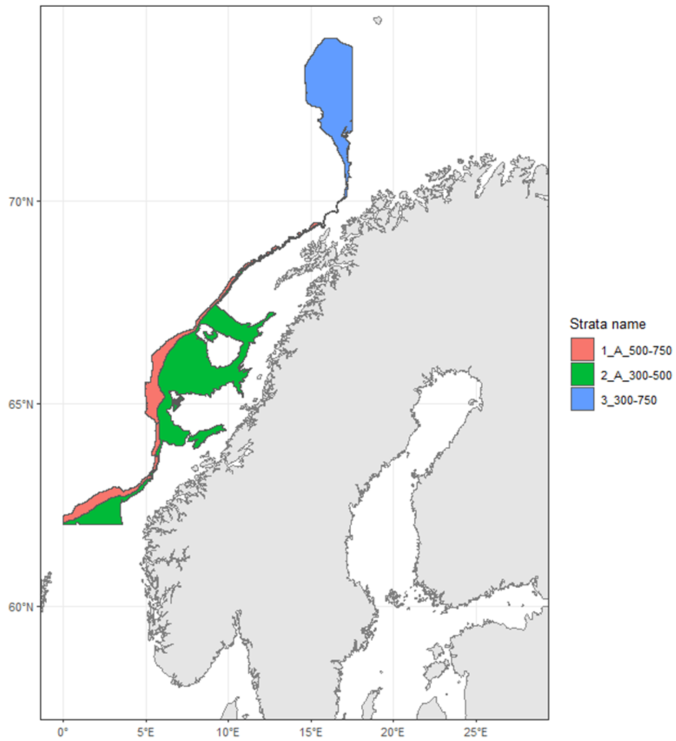

Figure 1. Strata-system for greater silver smelt in the Slope Survey.

Issues

Since StoX was launched in 2016, various versions have been developed. For greater silver smelt in ICES areas 1, 2, 3a and 4, index calculated in StoX version 2.7 has been used in the assessment since the benchmark in 2020, and this was also the approach for the biomass index used in the SPiCT model in the 2024 benchmark. However, the newest version of the software is StoX 3.6.2 and here this version is used to recalculate the biomass index. In table 1 and Figure 2, the index calculated in StoX 2.7 compared to StoX 3.6.2 in strata 1 and 2 is shown. Figure 3 shows the index divided by strata, and figure 4 shows the biomass estimates for each stratum with bootstrapped confidence intervals. Bootstrapping only worked in the 3.6.2 version for these data. It is only the calculated index from strata 1A and 2A which are used in the assessment, due to low coverage of strata 3 in some years, but strata 3 does not have a large impact on the index (Figure 3 and 5).

Table 1: Comparing the index calculated from different versions of StoX in strata 1A and 2A:

Year	StoX3.6.2	StoX2.7	Difference (%)
1990	239420	249218	4 %
1991	188706	193421	2 %
1992	167296	-	-
2009	432611	443886	3 %
2012	334332	333013	0 %
2014	525429	521049	1 %
2016	492644	494604	0 %
2018	466724	411335	12 %
2020	631096	600351	5 %
2022	407121	403275	1 %
2024	833919	811204	3 %

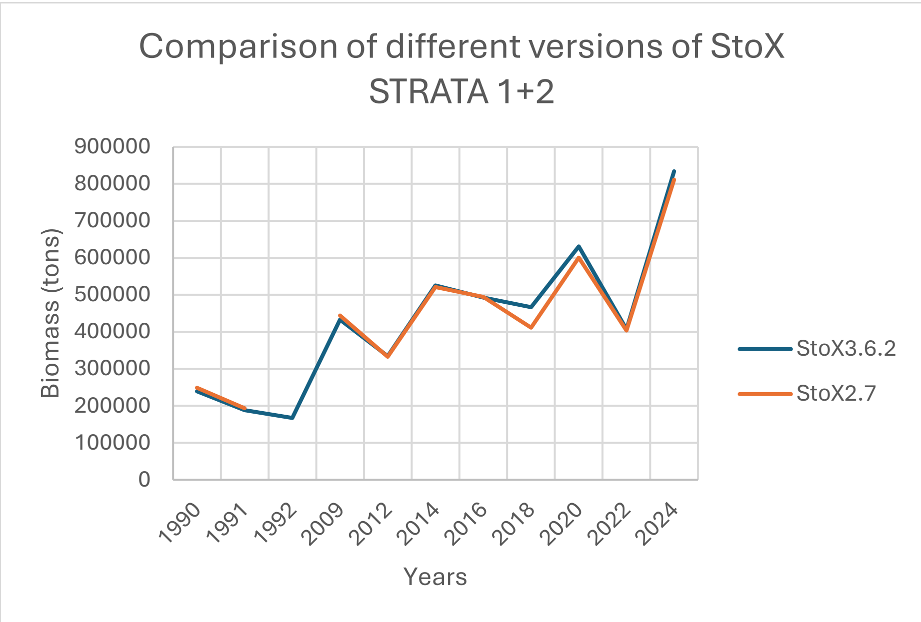

Figure 2: Comparing StoX 2.7 with StoX 3.6.2 for the years 1990-1992, and 2009-2024 in strata 1 and 2.

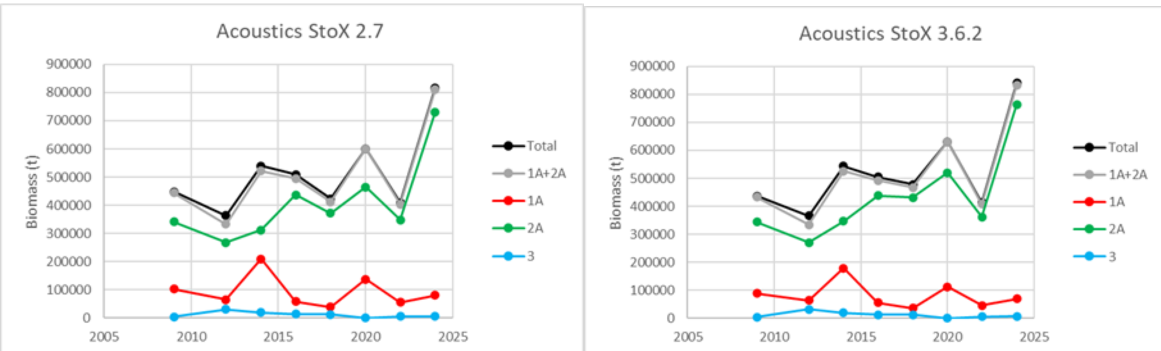

Figure 3: Acoustic biomass indices from the Norwegian Sea south-east slope survey; differences between strata in year 2009-2024 using StoX 2.7 (left) and StoX 3.6.2 (right).

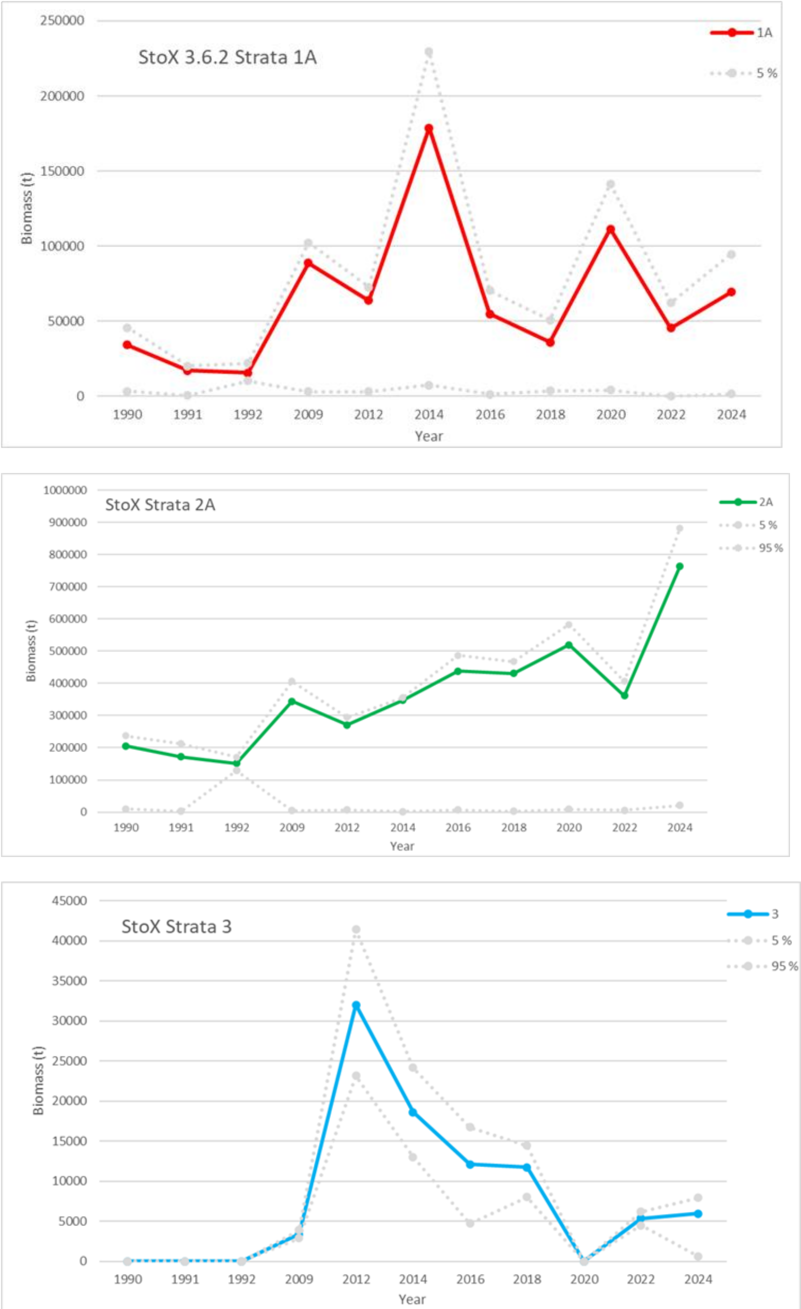

Figure 4: Acoustic biomass estimates in the Slope Survey by stratum, with bootstrapped confidence intervals as calculated in StoX 3.6.2.

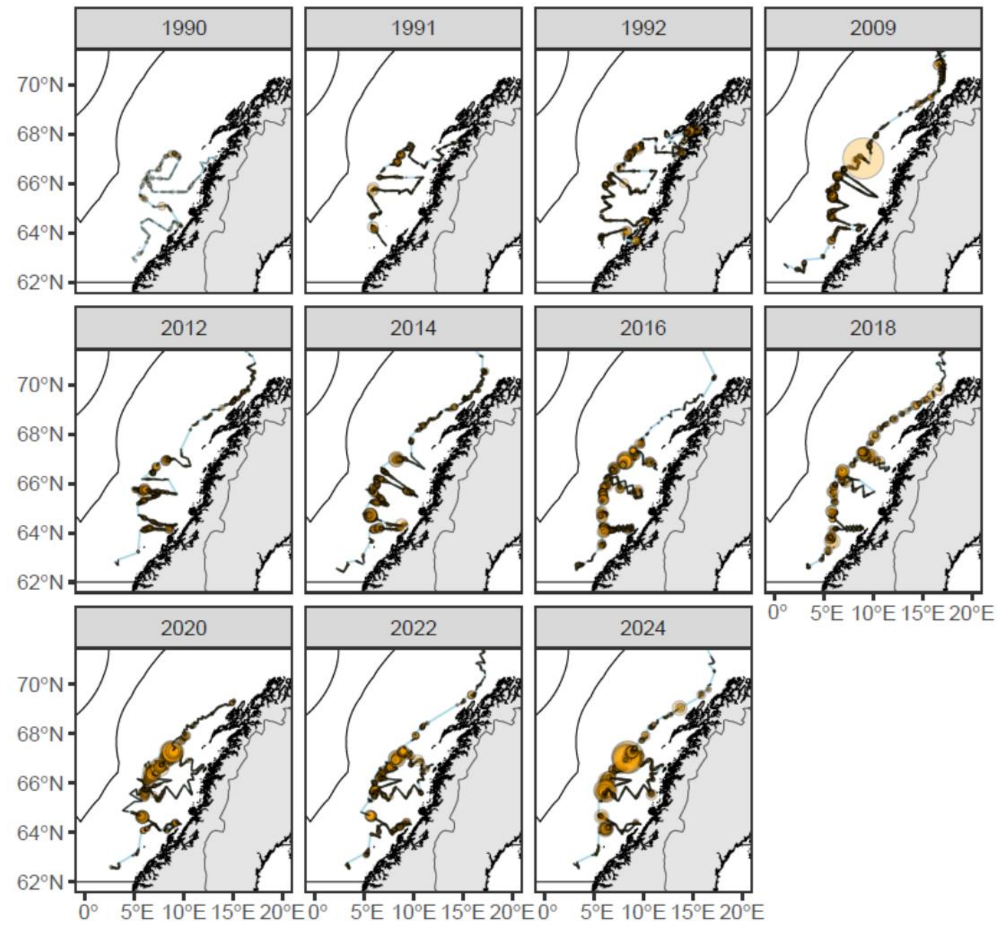

Figure 5: Acoustic track in the Slope Survey by year. Bubble size reflects NASC values per nmi assigned to greater silver smelt.

Overall, the discrepancy is minor between updated index calculated in StoX 3.6.2 compared to the 2.7 version. The most apparent difference is that in the StoX 3.6.2 an estimate for 1992 was achieved, where StoX 2.7 did not perform. Other vice for all years, apart from 2018, the index calculated from the different versions of StoX varies up to max 5%. For year 2018, however, the index differs by 12 % between the two versions of StoX. To investigate why the index differs between the two versions in the year 2018, all settings in StoX were reviewed. No immediate differences in settings were discovered that could explain the difference. One assumption might be that the new version of StoX uses the stations different that the old version, causing the index to differ. However, this seems unlikely since all the years using StoX 2.7 are calculated the same way and all years using StoX 3.6.2 are calculated using the same assumptions, but only year 2018 differs by 12%.

All input files were reconsidered, both acoustic and biotic, without finding any issues. The conducting of the survey throughout the years is shown in table 2. Comparing the survey conducted in 2018 with other years, it does not seem like year 2018 should give any major differences in index. The acoustic coverage was good, the number of stations were normal for this survey and the Bear Island trench was also carried out.

Table 2: Overview of survey Norwegian Sea south-east slope survey, years 2009-2024:

YEAR	NR OF STATIONS	BEAR ISLAND TRENCH COVERED	COMMENTS
2009	78	NO	Good acoustic coverage
2012	74	YES	Good acoustic coverage
2014	96	NO	Good acoustic coverage
2016	55	YES	Good acoustic coverage
2018	78	YES	Good acoustic coverage
2020	47	NO	Limited acoustic coverage in northernmost areas due to Covid
2022	79	YES	Good acoustic coverage
2024	68	YES	LImited acoustic coverage in Bear Island trench, good acoustic coverage rest of strata

Discussion

The SPiCT Benchmark conducted during January 2024 accepted the SPiCT model used in the advice of greater silver smelt in ICES areas 1, 2 3a and 4 (yet to be accepted by Benchmark Oversight Group (BOG) and The Advisory Committee (ACOM)). Given the differences between different versions of StoX, some scenarios are listed in table 3. Values given from Benchmark 2024 are the same as during the actual benchmark (StoX 2.7 was used). Values given for StoX 2.7 shows advice when adding one more year of survey index, in addition to catches from 2023, which was not available during the benchmark. Values for StoX 3.6.2 shows advice when the newest version of StoX-program is applied.

Table 3: Advice from SPiCT using different versions of StoX, in addition to one extra year in index and catches compared to the benchmark.

SPiCT	Benchmark 2024			StoX 2.7			StoX 3.6.2			StoX 3.6.2
	C	B/Bmsy	F/Fmsy	C	B/Bmsy	F/Fmsy	C	B/Bmsy	F/Fmsy	C without 1992
1.Keep current catch	13012.1	1.10	0.79	14437.8	1.26	0.70	14517.2	1.30	0.65	14590.5
2.Keep current F	13108.4	1.10	0.80	15535.3	1.25	0.75	15766.5	1.29	0.71	15886.9
3.Fish at Fmsy	16110.0	1.06	1.00	20231.1	1.20	1.00	21552.4	1.22	1.00	21000.7
4.No fishing	14.1	1.26	0.00	16.6	1.43	0.00	16.9	1.47	0.00	17.0
5.Reduce F by 25%	10002.3	1.14	0.60	11841.0	1.29	0.56	12027.3	1.33	0.53	12115.2
6.Increase F by 25%	16106.7	1.06	1.00	19109.7	1.21	0.94	19377.9	1.24	0.89	19532.1
7.MSY hockey-stick rule	16110.0	1.06	1.00	20231.1	1.20	1.00	21552.4	1.22	1.00	21000.7
8.ICES advice rule	14909.6	1.08	0.92	18359.9	1.22	0.90	19629.2	1.24	0.90	19061.7
9.ICES_2024_f25	14067.8	1.09	0.86	17070.2	1.23	0.83	18299.5	1.26	0.84	17725.0
10.ICES_2024_f15	13080.8	1.10	0.80	15582.8	1.25	0.75	16761.4	1.27	0.76	16183.3

Due to notion of general uncertainty in the assessment, the 2024 benchmark recommended to use lower fractile of F_{MSY} than in the ICES standard rule. The recommended fractile was 15th. In table 3 this is scenario 10 (ICES_2024_f15) which shows that the suggested TAC advice increased by 2502 tons (19%) when comparing the advice from benchmark in January 2024 with advice using index calculated in StoX 2.7 in April 2024. The reason for this increase is most likely that the April SPiCT run includes the survey conducted in February/March 2024, and the acoustic index doubled from 2022 to 2024.

Comparing the advice based on the index calculated in StoX 2.7 vs. StoX 3.6.2, the advice increased with 1179 tons (7.6%). However, comparing the advice using index calculated in StoX 3.6.2 without year 1992 (as done during the benchmark using StoX 2.7), the advice only increased with 600 tons (3.9%).

Conclusion

The difference in index in year 2018 between the 2.7 and 3.6.2 version of StoX is unfortunate. However, in general the difference between the biomass indices calculated in the two versions is minor in almost all years, and the effect on SPiCT based advice is not substantial. Thus, we consider that the 3.6.2 version can be used. There are two obvious benefits, the 3.6.2 version manages to estimate biomass for 1992 and it manages to provide bootstrapped uncertainty estimates. Additionally, StoX 2.7 is no longer supported by IMR.

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Assessment of blackspot seabream (*Pagellus bogaraveo*) in ICES Division 9.a stricto sensu (Atlantic Iberian waters) using the rfb rule

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1. Introduction

Pagellus bogaraveo (Brünnich, 1768), the blackspot seabream, distributes between southern Norway and Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1932; Pinho and Menezes, 2005).

In the Northeast Atlantic, the blackspot seabream stock structure is still unknown (ICES, 2023). Genetic studies showed a restricted gene flow among the populations located in the Azores (ICES Division 27.10.a.2) and other areas (Stockley *et al*., 2005; Piñera *et al*., 2013; Robalo *et al*., 2021; Cunha *et al*., 2024). Mitochondrial control region showed similar genetic diversity among sampling sites in the NE Atlantic and the Mediterranean (Robalo *et al*., 2021). More recently, a genotyping-by-sequencing approach revealed the existence of a genetic cluster in the Gulf of Cádiz that, combined with ocean circulation patterns, bathymetry, and the existence of local upwelling, may provide an explanation for the genetic differentiation between the specimens caught in that area and the western coast of continental Portugal (Cunha *et al*., 2024).

For management purposes, ICES adopts three management components: (a) Subareas 27.6, 27.7 and 27.8; (b) Subarea 27.9; and (c) Subarea 27.10 (ICES, 2007). These components were established to better record the available information and do not have implicit the existence of three different stocks of blackspot seabream. Blackspot seabream in ICES Subarea 27.9 is currently classified as category 3 stock.

The latest ICES advice for blackspot seabream in Subarea 27.9 was based on the CPUE from the Spanish mechanized handline fleet ("*voracera*"), operating in the Strait of Gibraltar area (ICES, 2022). Although the ICES Subarea 27.9 extends from 36° to 43°N, catches from the "*voracera*" fleet, occur south of 36° 20' N, so the biomass index is based on a fringe of the species distribution in this area.

In ICES Subarea 27.9, in addition to catches from the target fishery in the Strait of Gibraltar, there are catches from coastal areas of Northern Spain (Galicia) and Portugal, from fisheries not targeting the species (Table 1).

Table 1. Blackspot seabream landings by country in ICES Subarea 9 as considered by WGDEEP 2023 and in ICES Subarea 9 stricto sensu. (Adapted from ICES, 2024).

Year	Portugal	Spain	TOTAL	Portugal*	Spain**	TOTAL^
1988	370	319	689	116	N/A	116
1989	260	416	676	81	N/A	81
1990	166	428	594	52	N/A	52
1991	109	423	532	34	N/A	34
1992	166	631	797	52	N/A	52
1993	235	765	1000	74	N/A	74
1994	150	854	1004	47	N/A	47
1995	204	625	829	64	N/A	64
1996	209	769	978	65	N/A	65
1997	203	808	1011	64	N/A	64
1998	357	520	877	112	N/A	112
1999	265	278	543	83	N/A	83
2000	83	338	421	83	33	116
2001	97	277	374	97	41	138
2002	111	248	359	111	82	193
2003	142	329	471	142	117	259
2004	183	297	480	183	57	240
2005	129	365	494	129	35	164
2006	104	440	544	104	93	197
2007	185	407	592	185	45	230
2008	158	443	601	158	27	185
2009	124	594	718	124	36	160
2010	105	379	484	105	33	138
2011	74	259	333	74	34	109
2012	143	152	203	143	23	166
2013	90	91	180	90	40	130
2014	59	203	262	59	29	88
2015	66	87	295	66	17	83
2016	70	95	242	70	20	90
2017	69	61	147	69	12	81
2018	58	29	95	58	9	67
2019	36	20	60	36	4	39
2020	43	16	62	43	5	47
2021	29	16	49	29	5	34
2022	33	7	42	33	3	36
2023	38	10	48	38	7	45

*Landings estimates from Portugal mainland, removing those from Azores fishing grounds (1988 - 1999).

**Landings estimates from Spain, removing those from the Strait of Gibraltar (ICES Subarea 9N, Galician coast).

^Total landings estimates (ICES Subarea 27.9 stricto sensu)

In the last years, there has been a significant decrease in blackspot seabream Strait of Gibraltar landings (Table 1) as well as in the biomass index from the "*voracera*" fleet, leading to a progressive decline in the TACs and quotas (Table 3).

Table 2. Blackspot seabream in ICES Subarea 27.9. Total Allowable Catch (TAC) and Portuguese quota in ICES Subarea 27.9, between 2014 and 2024.

Year	TAC EU	Portugal quota
2014	780	166
2015	374	80
2016	183	39
2017	174	37
2018	165	35
2019	149	32
2020	149	32
2021	119	25
2022	119	25
2023	114	24
2024	114	24

It is also important to remark that the Strait of Gibraltar target fishery is assessed every year within the General Fisheries Commission for the Mediterranean (GFCM), who established a multiannual management plan for the sustainable exploitation of blackspot seabream in the Alboran Sea (geographical subareas 1 to 3) in 2022 (GFCM/45/2022/3).

Blackspot seabream in ICES Subarea 27.9 (sbr.27.9) stock was recently benchmarked by WKBMSYSPiCT3: based on the information above, the Group agreed to remove the Strait of Gibraltar information so that the stock would be assessed based on representative data from the ICES Subarea 27.9. (ICES, 2024).

For this year's advice, the suggestion was to use the rfb catch advice, which is a MSY advice for category 3 stocks based on the stock trend from a biomass index, the mean length in the catch relative to an MSY proxy length and a biomass safeguard to ensure compliance with ICES precautionary approach (ICES, 2017).

2. Data and application of the rule

Following the above considerations, an alternative advice for blackspot seabream in ICES Subarea 27.9 stricto sensu was presented to WGDEEP 2024, following the ICES rfb catch rule (ICES, 2021, 2022):

$$A_{y+1} = A_y \times r \times f \times b \times m$$

(× stability clause if the change in the advice is +20%/-30%; only applied if b≥1)

where A_y corresponds to the last catch advised value, *r* to the stock biomass trend, *b* to the biomass safeguard, *m* to a multiplier related to life history and *f* to a fishing mortality proxy.

Since the present advice proposal will not consider part of the stock biomass used in the previous advice, the latest catch advice can no longer be used. According to ICES guidelines if no previous catch advice (A_y) exists, the most recent catch (C_{y-1}), or the average of the last three years of catch should be used.

Following the ICES guidance on the parameter determination for the rfb rule (ICES, 2021, 2022), the input values for stock sbr.27.9 are presented in Table 3.

Table 3. Blackspot seabream in ICES Subarea 27.9. Estimates used in the rfb rule, with details.

Variable	Definition	Estimate	Detail
r: Stock biomass trend	*r* = Index A / Index B	0.87	Biomass index derived from commercial LPUE from Portuguese polyvalent fleet: Index A (2021, 2022) = 32.7 Index B (2018, 2019, 2020) = 37.6
f: Fishing proxy	$\frac{\bar{L}_{y-1}}{L_{F=M}}$	1.17	Length composition of Portuguese fishery raised to sbr.27.9 landings (without SoG) for the period 2014-2023. $\bar{L}_{y-1}$ =38.55 $L_{F=M} = 32.82$
b: Biomass safeguard	$b = \min\left(1, I_{y-1} / I_{\text{trigger}}\right)$ $I_{\text{trigger}} = I_{\text{loss}}\ \omega$, considering $\omega = 1.4$	1	Stock indicator; I_{loss}, = 24.18 (2001) $I_{trigger}$ = 33.85 $\frac{I_{y-1}}{I_{\text{trigger}}} = 1.2$
m: Tuning parameter	linked to von Bertalanffy k	0.95	k < 0.2 yr^{-1} for slow growing species such as deep-water stocks
C_{y-1}: *Catch*	average of the last three years of catch	38333	Since no previous catch advice (A_y) exists, the most recent catch (C_{y-1}), or the average of the last three years of catch should be used
A_y: Advice	$A_{y+1} = C_y \times r \times f \times b \times m$	42703	

Following the rfb rule, the advised landings in 2025 and 2026 should not exceed 42 tonnes. Previous advice (2023 and 2024) is not comparable with the proposed advice for 2025 and 2026 because a new assessment method and input data are being applied, and the stability clause was not applied either.

3. Stock detailed application

3.1. Stock indicator (for the definition of *r* and *b*)

The stock-size indicator corresponds to the standardized LPUE (landings per unit effort, in kg.trip^{-1}) from the Portuguese polyvalent fleet, considering only January and December, the months when the species is targeted by the fishery (presented, reviewed and accepted at WKBMSYSPiCT3; ICES, 2024). The biomass indicator is presented in Table 4 and Figure 1.

Table 4. Blackspot seabream in ICES Subarea 27.9. Nominal and standardized LPUE (landings per unit effort, in kg.trip^{-1}) from the Portuguese polyvalent fleet.

Year	Nominal LPUE kg.trip^{-1}	Standardized LPUE kg.trip^{-1}
2000	32.04	42.52
2001	29.97	24.18
2002	43.73	32.45
2003	45.54	41.87
2004	33.54	34.86
2005	32.67	45.01
2006	30.62	42.57
2007	29.79	41.91
2008	35.99	57.62
2009	17.06	36.01
2010	29.38	49.09
2011	38.88	51.99
2012	45.23	57.05
2013	31.87	58.46
2014	31.14	65.34
2015	46.85	45.66
2016	34.70	37.59
2017	35.75	30.77
2018	35.10	39.84
2019	35.03	35.62
2020	61.25	34.43
2021	49.59	34.63
2022	43.70	29.08
2023	30.16	40.57

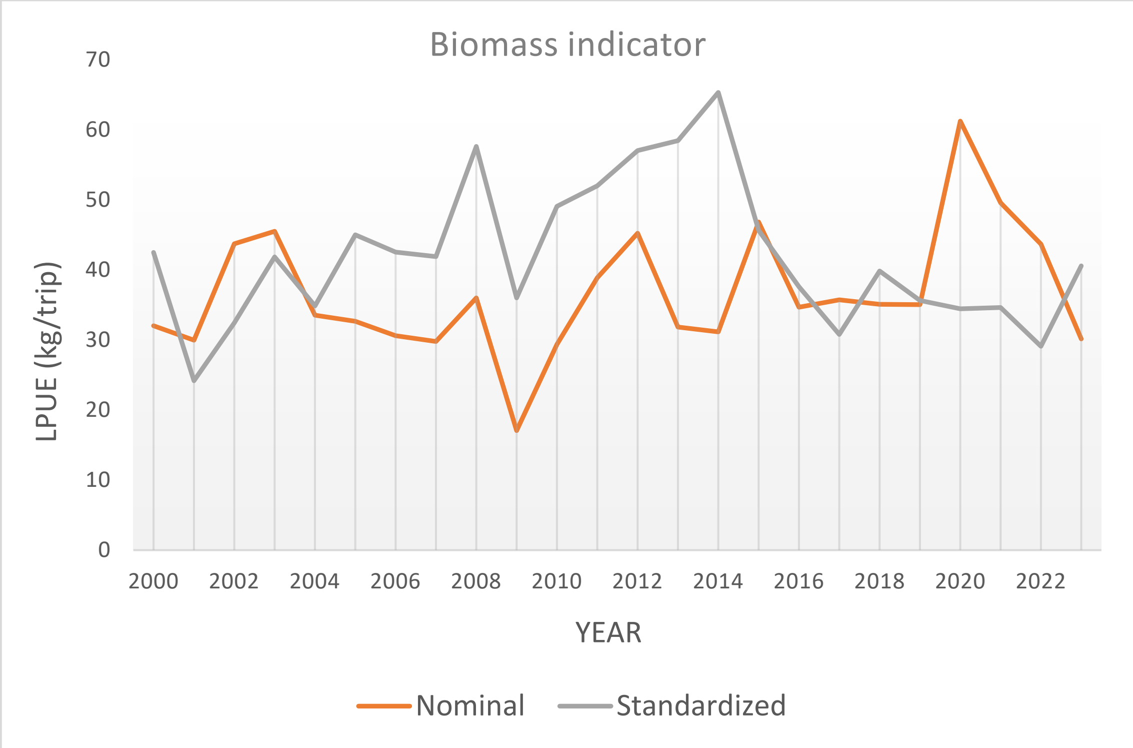

Figure 1. Blackspot seabream in ICES Subarea 27.9. Nominal and standardized LPUE (landings per unit effort, in kg.trip^{-1}) from the Portuguese polyvalent fleet.

3.2. Estimation of length-based indicators (*f* proxy)

Portuguese landings represent over 70% of the total stock landings in ICES Division 27.9 stricto sensu (excluding the Strait of Gibraltar), within which trawl and polyvalent fleets combined correspond to ~100% of the Portuguese landings since 2020 (Castellanos *et al.*, 2024 WD). Discards are considered negligible for this stock (ICES, 2023).

The length–frequency distribution for the period between 2014 and 2023 from length sampling of the Portuguese polyvalent and trawl fishing segments operating in ICES Subarea 27.9 raised to landings in ICES Subarea 27.9 stricto sensu (Portugal and northern Spain) is presented in Figure 2.

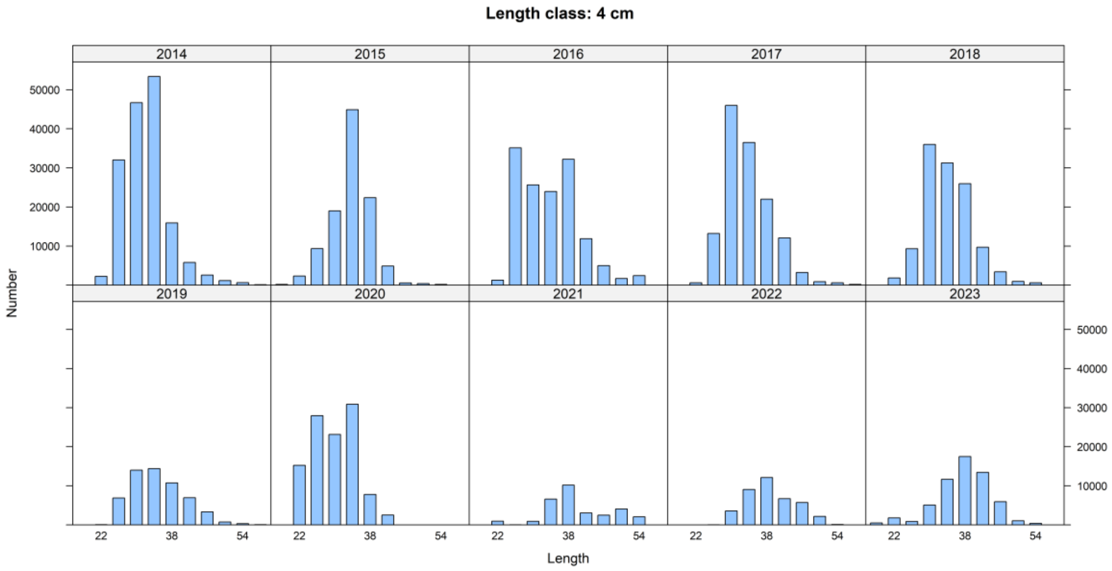

Figure 2. Blackspot seabream in ICES Subarea 27.9. Length–frequency distribution (4 cm classes) for Portuguese polyvalent and trawl fleets combined, raised to ICES Subarea 27.9 stricto sensu (Portuguese and northern Spain catches) for the period between 2014 and 2023.

f proxy for applying the rfb rule was determined using the length frequency distribution in 2023 from length sampling of the Portuguese polyvalent and trawl fishing segments operating in ICES Subarea 27.9 raised to landings in ICES Subarea 27.9 stricto sensu (Portugal and northern Spain) (Table 5 and Figure 2).

Table 5. Blackspot seabream in ICES Subarea 27.9. Length–frequency distribution for Portuguese polyvalent and trawl fleets combined. Numbers of individuals are raised to landings in ICES Subarea 27.9 stricto sensu (Portugal and northern Spain).

Total length (cm)	Number of individuals
20	488.3538
21	683.6954
22	403.5345
23	361.9725
24	336.6524
25	559.0093
26	224.435
27	112.2175
28	0
29	251.0128
30	508.863
31	1609.502
32	2718.699
33	3236.96
34	2512.566
35	3012.301
36	2881.86
37	4508.885

38	3967.678
39	4113.172
49	4888.755
41	4101.74
42	4592.433
43	2481.294
44	2278.787
45	1968.382
46	1290.238
47	1461.423
48	1205.073
49	388.4429
50	295.1357
51	319.5373
52	56.10874
53	181.1427
54	67.42613
55	135.848

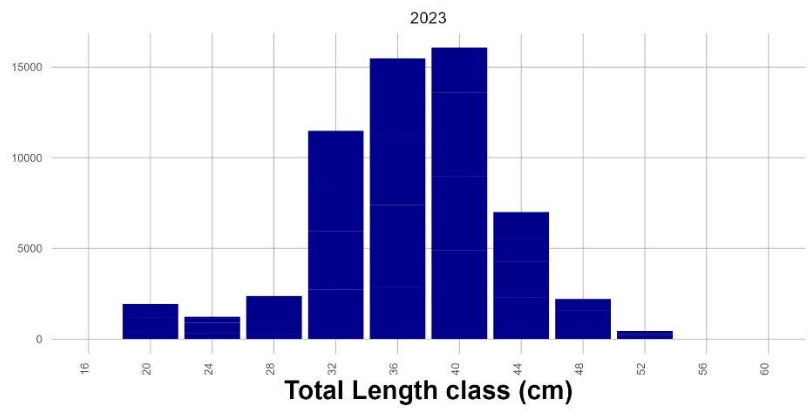

Figure 2. Blackspot seabream in ICES Subarea 27.9. Length–frequency distribution (4 cm classes) in 2023 for Portuguese polyvalent and trawl fleets combined, raised to ICES Subarea 27.9 stricto sensu (Portuguese and northern Spain catches).

To determine *f* proxy based on length-based indicators (LBI), estimates of L_{inf}, L_{50} and length-weight relationship parameters *a* and *b* were used. The L_{inf} and L_{50} estimates were adopted from CopeMed II (2019) and Gil *et al*. (2009), respectively. Since blackspot seabream is a protandric hermaphrodite, the L_{50} corresponding to females, which is above the minimum landing size (MLS, 33 cm), was adopted. The length-weight relationship parameters ($W = 1.17542e^{-05} \times L^{3.0366}$) were estimated based on biological sampling data collected in 2020 and following the procedure in fishR Vignette (Ogle, 2013). Parameters for blackspot seabream in ICES Subarea 27.9 are summarised in Table 6.

Table 6. Blackspot seabream in ICES Subarea 27.9. Biological parameters used for calculating the LBI parameters.

Parameter	Value	Definition	Source
L_{inf} (cm)	65.26	Asymptotic average maximum length	Gil et al. (2009)
L_{50} (cm)	35.1	Length at 50% maturity (females)	CopeMed II (2019)
a	$1.18x10^{-5}$	Condition factor parameter of length-weight relationship	Farias and Figueiredo (2023, WD)
b	3.04	Slope parameter of length-weight relationship	Farias and Figueiredo (2023, WD)

For estimating the LBI, 4 cm length classes were adopted to get a smooth and unimodal distribution. For 2023, the estimated LBI were: L_c = 22 cm, L_{mean} = 38.55 cm and $L_{F=M}$ = 32.82 cm.

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Pagellus bogaraveo Atlantic Iberian waters *stricto sensus* (ICES Division 27.9.a)

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1. Introduction

Blackspot seabream (*Pagellus bogaraveo*, Brünnich 1768) is a benthopelagic sparid distributed across the Eastern Atlantic: from Norway to Cape Blanc in Mauritania, Madeira, the Canary Islands, and the Azores. It is also frequent in the western Mediterranean, including the Strait of Gibraltar, becoming rare eastern of the Strait of Sicily and absent in the Black Sea (Mytilineou *et al*., 2013; Spedicato *et al*., 2002; Whitehead, 1986). Although, the species was recently recorded in Syrian waters (Saad *et al*., 2020).

As other Sparidae species, the blackspot seabream is a sequential protandric hermaphrodite, starting as males and then changing into females at 30–35 cm length and around 4 to 6 years age (Alcaraz *et al*., 1987; Gil, 2006; Krug, 1994). It grows relatively slow to a maximum size of 70 cm, weight of 4 kg and about 15 years age (Gil, 2006; Krug, 1994; Sánchez, 1983). The maximum age ever reported from annual ageing is 20 years (ICES, 2012). Juveniles inhabit inshore areas while adults have deeper distribution (Desbrosses, 1932). Olivier (1928) and Desbrosses (1932) also report species vertical movements during the night and in certain seasons, related to daylight and spawning.

Stock structure of the species in ICES Subarea 27.9 is still unknown. The species is not evenly distributed along the area, being more frequently caught at specific grounds, suggesting a patchy distribution (Farias and Figueiredo, 2019). Linkages between the Strait of Gibraltar exploited population and the populations in the northern and central area of Subarea 27.9 are unlikely, with no evidence of movements between them. Genetic studies using mitochondrial DNA were inconclusive, showing similar genetic diversity among sampling sites in the NE Atlantic and the Mediterranean (Robalo et al., 2021). More recently, a genotyping-by-sequencing approach revealed the existence of a genetic cluster in the Gulf of Cádiz that, combined with ocean circulation patterns, bathymetry, and the existence of local upwelling, may provide an explanation for the genetic differentiation between the specimens caught in that area and the western coast of continental Portugal (Cunha et al., 2024). Ferrari *et al.* in 2023 strengthened the hypothesis that egg and larval dispersal are fundamental in sustaining the genetic connectivity of the blackspot seabream to explain the absence of genetic population structuring in NE Atlantic and Mediterranean samples (from the Bay of Biscay till the Ionian Sea).

This species is one of the most important commercial demersal species in the Strait of Gibraltar area. The fishing hook gears used are known as "*voracera*" in both countries involved in the fishery (Morocco and Spain). Figure 1 shows the main fishing grounds of the Spanish target fishery ("*voracera*" fleet) in the Strait of Gibraltar: catches are less common in ICES Subarea 27.9 (stricto sensu) and fully represented to the south of 36°00' N.

In the Strait of Gibraltar area tagging surveys (56 days at sea in 2001, 2002, 2004, 2006 and 2008) have been conducted. A total of 4500 fish were tagged, of which 423 recaptures have been reported, also from the Moroccan fishery. Main results indicate the inexistence of significant movements, although strict movements 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).

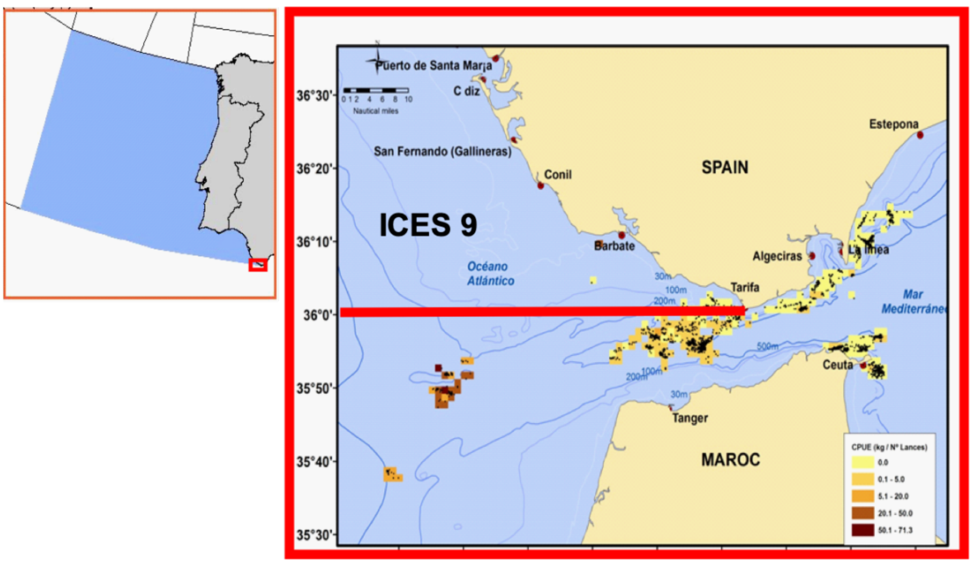

Figure 1. Blackspot seabream target fishery of the Strait of Gibraltar footprint (Spanish "*voracera*" fleet).

Besides, it should be noted that the Strait of Gibraltar target fishery is assessed every year within the General Fisheries Commission for the Mediterranean (GFCM). Also GFCM established a management plan for this fishery in 2022 (GFCM/45/2022/3 on a multiannual management plan for the sustainable exploitation of blackspot seabream in the Alboran Sea, geographical subareas 1 to 3).

In January 2024, this stock was benchmarked within WKMSYSPiCT 3 (ICES, 2024). For all the stated above, the Group agreed to remove the Strait of Gibraltar information because the stock would be assessed based on representative data from the ICES Subarea 27.9.

1.1.Fishery information

Pagellus bogaraveo is caught by Spanish and Portuguese fleets in ICES Subarea 27.9. Spanish landings data from this area are available from 1983, Portuguese data from 1988, and Moroccan information from 2001 (ICES, 2023). 2016–2022 European landings in Subarea 27.9, most of which are taken with lines, are from Portugal (~48%) and Spain (~52%). Important to note that these changes partially reflect restrictive TAC constrains in recent years. Last TAC for whole Subarea 27.9 was established for 2023 and 2024 (114 t). Although the advice aims to reduce total catch within the whole fishing area, it has been noted that the current TAC does not limit the whole fishery because it only applies to the mentioned Subarea, nevertheless catches in the GFCM area 37.1.1 and CECAF area 34.1.11 should be reported (Council Regulation (EU) 2016/2285).

The available data of commercial landings, as estimated by the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), extends from 1988 to 2022 (ICES, 2023). Table I and Figure 2 present these values and the new estimates from WKMSYSPiCT3, which exclude Strait of Gibraltar landings from the Spanish data to get only data from Subarea 9N (Galician coast) and also the landings in Portugal mainland from Azores fishing grounds in the early years of the series (1988-1999).

Table I. Blackspot seabream landings by country in ICES Subarea 9 as considered by WGDEEP 2023 and in ICES Subarea 9 stricto sensu.

Year	Portugal	Spain	TOTAL	Portugal*	Spain**	TOTAL^
1988	370	319	689	116	N/A	116
1989	260	416	676	81	N/A	81
1990	166	428	594	52	N/A	52
1991	109	423	532	34	N/A	34

Year	Portugal	Spain	TOTAL	Portugal*	Spain**	TOTAL^
1992	166	631	797	52	N/A	52
1993	235	765	1000	74	N/A	74
1994	150	854	1004	47	N/A	47
1995	204	625	829	64	N/A	64
1996	209	769	978	65	N/A	65
1997	203	808	1011	64	N/A	64
1998	357	520	877	112	N/A	112
1999	265	278	543	83	N/A	83
2000	83	338	421	83	33	116
2001	97	277	374	97	41	138
2002	111	248	359	111	82	193
2003	142	329	471	142	117	259
2004	183	297	480	183	57	240
2005	129	365	494	129	35	164
2006	104	440	544	104	93	197
2007	185	407	592	185	45	230
2008	158	443	601	158	27	185
2009	124	594	718	124	36	160
2010	105	379	484	105	33	138
2011	74	259	333	74	34	109
2012	143	152	203	143	23	166
2013	90	91	180	90	40	130
2014	59	203	262	59	29	88
2015	66	87	295	66	17	83
2016	70	95	242	70	20	90
2017	69	61	147	69	12	81
2018	58	29	95	58	9	67
2019	36	20	60	36	4	39
2020	43	16	62	43	5	47
2021	29	16	49	29	5	34
2022	33	7	42	33	3	36

*Landings estimates from Portugal mainland, removing those from Azores fishing grounds (1988 - 1999)

**Landings estimates from Spain, removing those from the Strait of Gibraltar (Subarea 9N, Galician coast)

^Total landings estimates (Subarea 9, *stricto senso*)

There is a minimum conservation reference size of 33 cm for this species in 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). Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). Given the low levels of discards, the discarded rate is admitted to be nearly zero for most assessment purposes and those that do occur are mainly related to catches of small individuals. Consequently all catches of blackspot seabream in management area 27.9 are assumed to be landed (ICES, 2023).

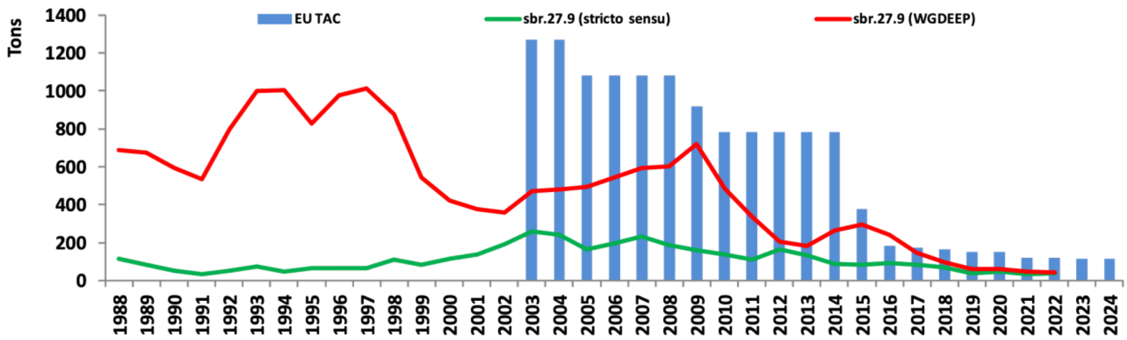

Figure 2. Blackspot seabream landings and TAC in Subarea 9 from ICES WGDEEP (red line) and Subarea 9 *stricto sensu* (green line).

1.2.Current assessment and advice

Currently, sbr.27.9 is considered a data-limited stock and it is classified as ICES Category 3.2 stock. Last scientific recommendation using Strait of Gibraltar biomass indicator trend was provided in 2022, and ICES advised that commercial landings should be no more than 114 tonnes in each of the years 2023 and 2024.

2. Methodology

2.1.Landings and discards

Landings data are available from mainland Portugal and Spain, these last including only landings in the northern part of ICES Subarea 9 (Galician coast) and excluding landings in the Strait of Gibraltar, hence in ICES Subarea 9 *stricto sensu* (Figure 3).

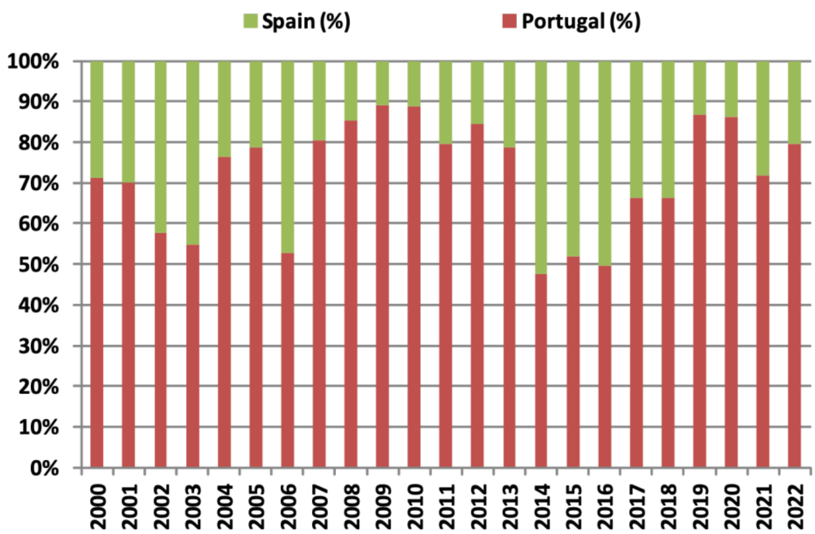

Figure 3. Blackspot seabream landings (in %) by country in ICES Subarea 9 *stricto sensu*.

It should be noted that removing Strait of Gibraltar landings the percentage of landings by country changes and Portugal almost accounts for 80% of the total in recent years.

Discards are considered negligible (less than 5%).

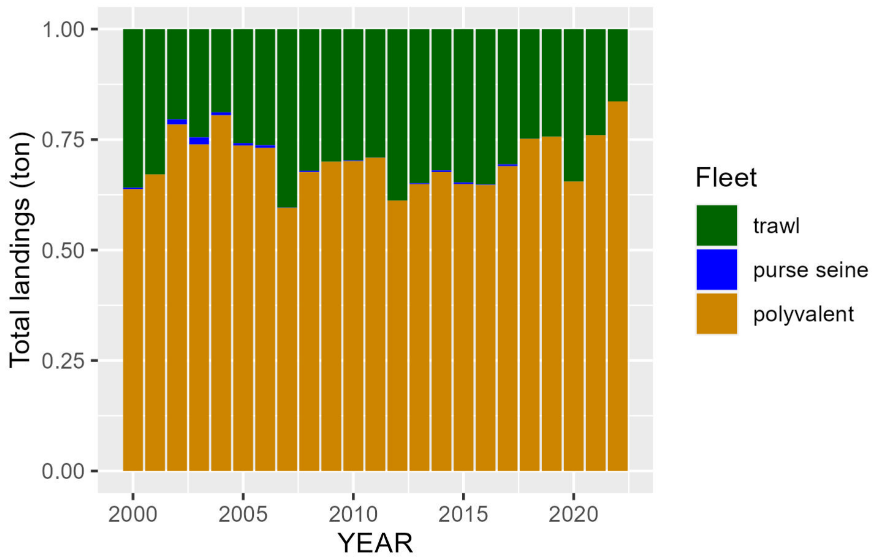

Figure 4. Blackspot seabream total landings in mainland Portugal by fishing segment between 2000 and 2022.

Between 2009 and 2023, the polyvalent fishing segment presented the highest landings of the species, followed by the trawl segment, with purse seine showing nearly negligible landings (Figure 4).

2.2. Standardized commercial biomass index

Catch-per-unit-effort (CPUE), was calculated as landings in kg per trip in mainland Portugal in the period between 2000 and 2022. Landings were analysed by fishing segment separately: polyvalent segment and trawl segment.

The nominal CPUE index was derived from yearly means of the raw CPUE data.

A protocol developed by Winker (2022) for the blackspot seabream target fishery of the Strait of Gibraltar (‘*voracera*’) was adapted for standardizing the CPUE indexes. CPUE was standardized using Generalized Additive Mixed Models (GAMMs), following the guidelines from Winker *et al*. (2013) and Winker *et al*. (2014).

2.3. Stock assessment

A first exploratory assessment was carried out with SPiCT using ICES Subarea 9 landing estimates in the strict sense and the standardized biomass index (see above), but tthe model did not converge, hence the assessment was not accepted. Furthermore, the Stock Synthesis (SS3) framework was applied to the Blackspot bream stock and the adjustment of the different analyzes revealed a potential use of this methodology to stock assessment of this species. More details can be found in Working Document (WD, Castellanos *et al*., 2024).

3. Results

3.1. Standardized commercial biomass index

To prepare data for CPUE standardization, considering daily landings in mainland Portugal between 2000 and 2022, vessels assigned to the polyvalent fleet with positive landings of blackspot seabream were identified and all trips in that period were selected. The vessels that most frequently landed the species, which cumulatively represented 25% of all recorded trips, were selected. This resulted in the selection of 44 fishing vessels. The monthly variation of the standardized CPUE was analysed and a seasonal effect was put in evidence, with December and January standing out. This confirms that fishermen are targeting the species in the months when the price is higher. Only landings during January and December was selected to proceed with the analysis

Next, the most commonly encountered species in the selected vessels landings, which cumulatively represented 50% of all recorded species records, were identified. This resulted in the selection of commonly recorded species, of which blackspot seabream was the most frequently encountered (Figure 5).

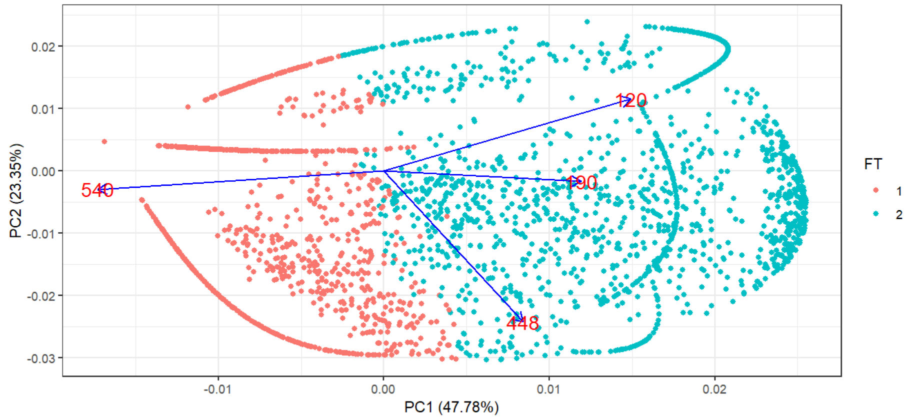

Figure 5. Graphical representation of the cluster analysis projectted over the first two Principal Components: "540" corresponds to *Pagellus bogaraveo*.

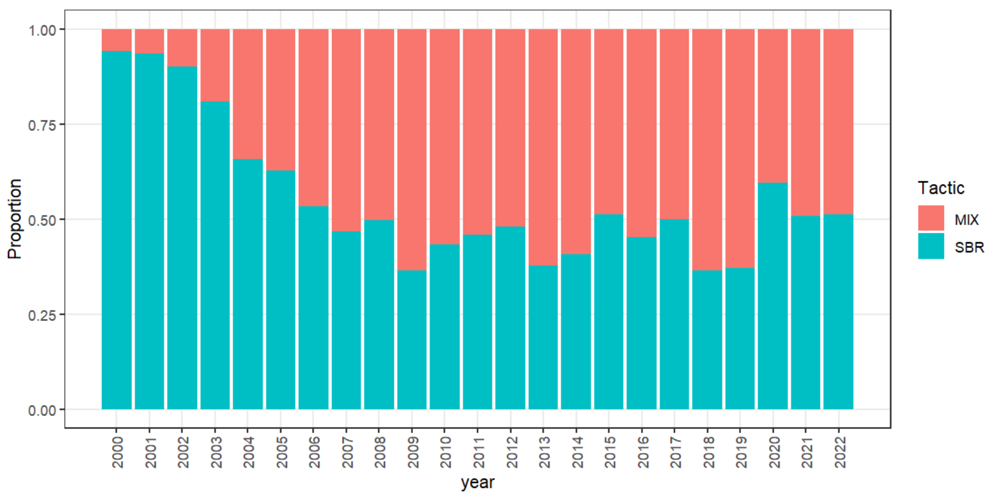

Figure 6. Annual change in proportions of clusters as a latent predictor for Fishing Tactic (FT).

To account for variation in targeting, the guidelines propose two approaches: (1) deriving an additional factor for targeting from a cluster analysis of the landings composition (He *et al*. 1997) and (2) using the Direct Principle Component (DPC) approach, which involves the principle components (PC) of the decomposed catch composition as predictor variable (Winker *et al*. 2013; Winker *et al*. 2014). Trips with zero catches of blackspot seabream (SBR) were only 0.41%. This includes trips where either the other common species, *Lepidopus caudatus* or *Trachurus* spp, but no SBR was caught, which indicates that “true” zero catches of SBR may be negligible for SBR.

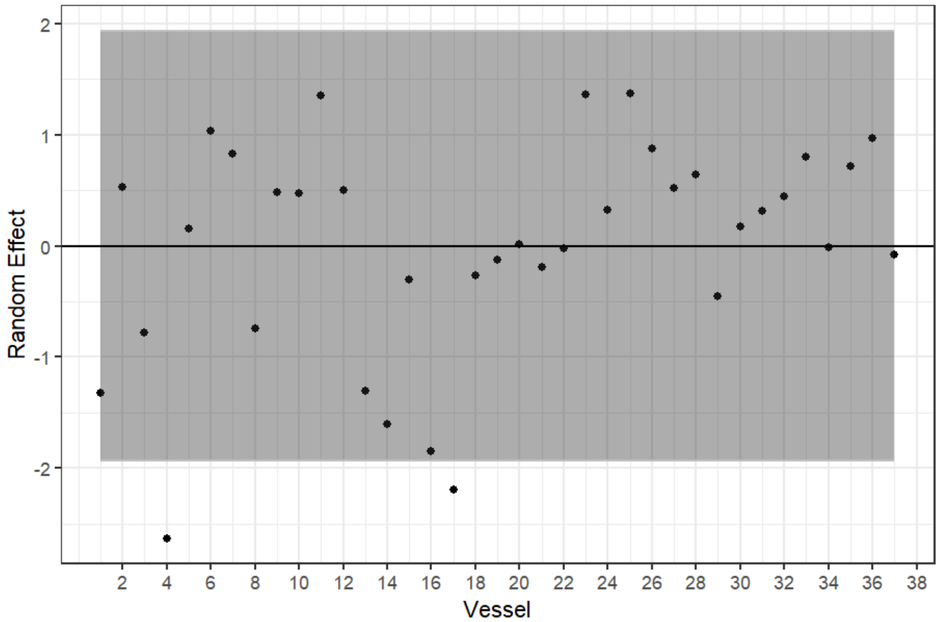

Figure 7. Random effects coefficients (dots). The dark grey shaded area denote the estimated standardivation from the mean, the ligth grey the 95% CIs.

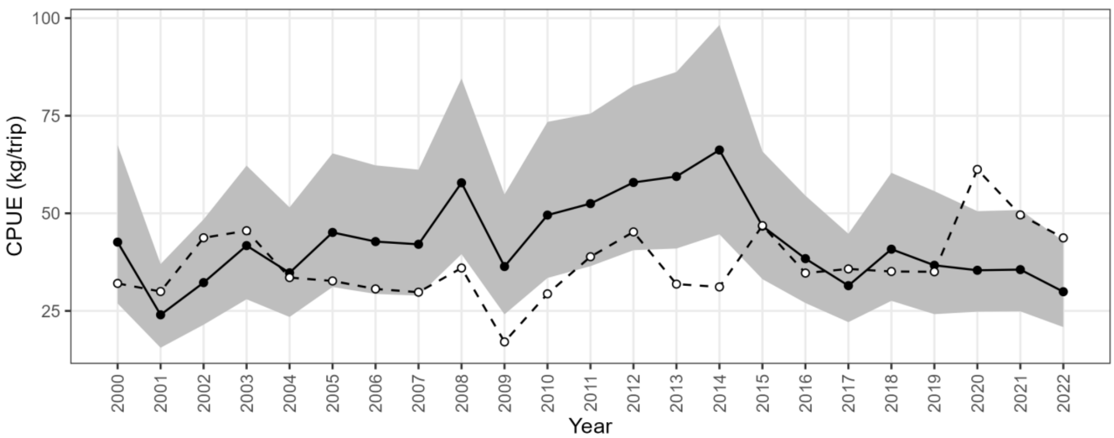

Figure 8. Nominal and standardised CPUE indices for blackspot seabream using the DPC-GAMM with 95% CIs.

The previous guidelines for CPUE standardization proved not to be adequate for the trawl fishing segment. This mainly derives from the fact that the species is a by-catch of trawlers whose fishing areas are extended and do not cover the preferential area for the species occurrence (seamounts). Applying the guidelines to trawl data (landings by fishing trip) for the identification of fishing trips targeting the species indicated that there are no fishing trips targeting the species. Therefore, for having a robust standardized CPUE for the trawl fishing segment, a new methodology should be developed.

3.2.Stock assessment

A simulation using the parameterization of run2 (Anex 1) was applied to Blackspot seabream stock in ICES subarea 9. For commercial landings and CPUE, the time series was extended from 2000 to 2022. The most significant results are listed in the figures below.

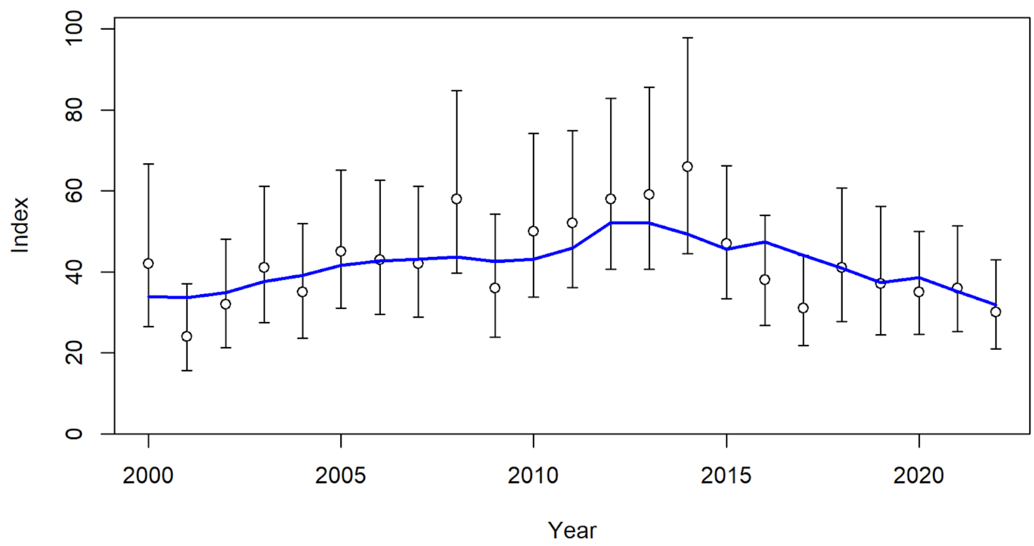

Figure 9. Fit to log index data on log scale for cpue_polyv. Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines (if present) indicate input uncertainty before addition of estimated additional uncertainty parameter.

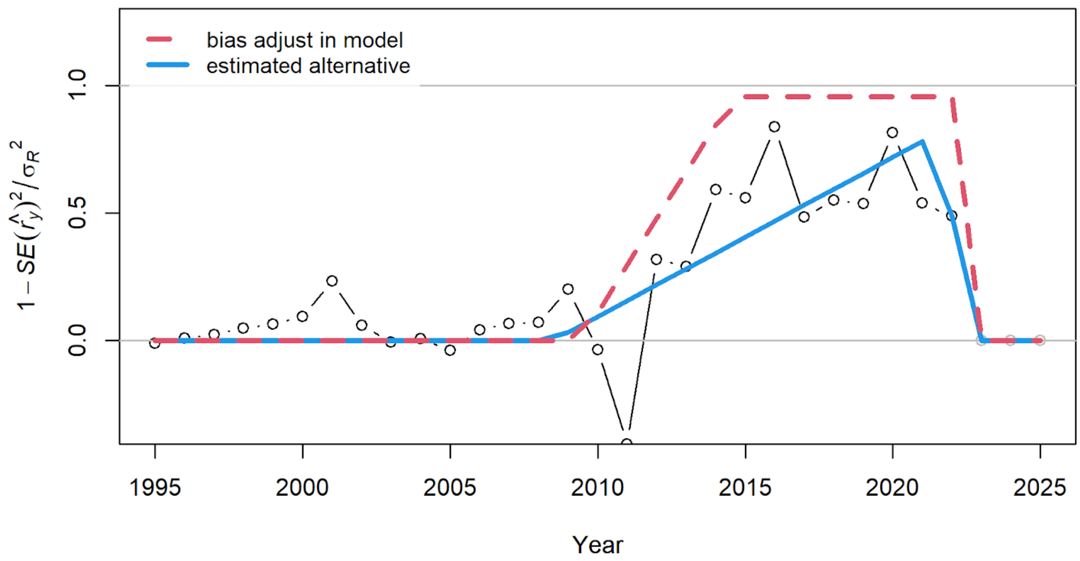

Figure 10. Red lines show current settings for bias adjustment. Blue line shows least squares estimate of alternative bias adjustment relationship for recruitment deviations.

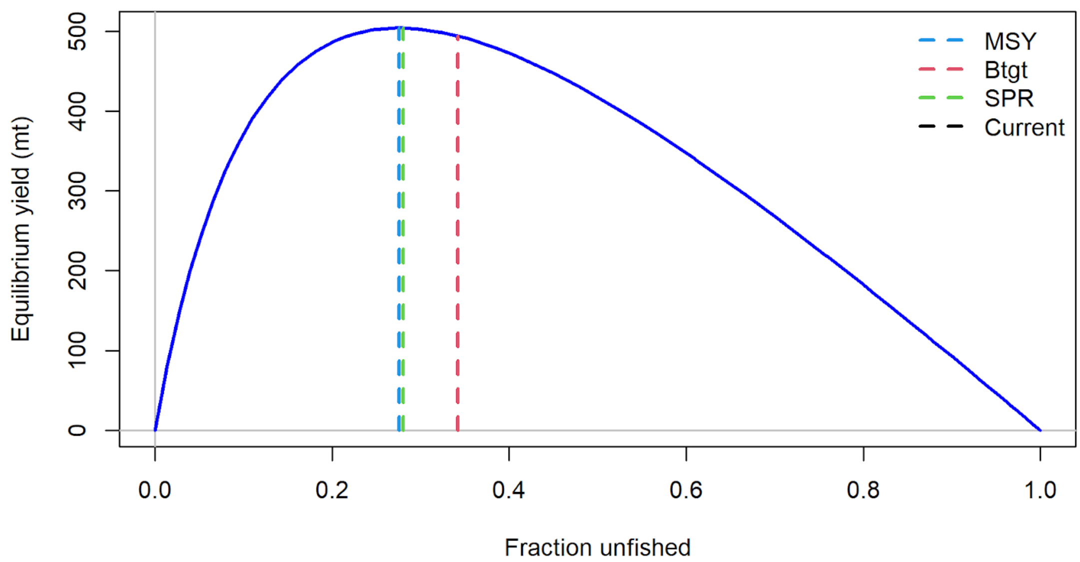

Figure 11. Yield curve with reference points.

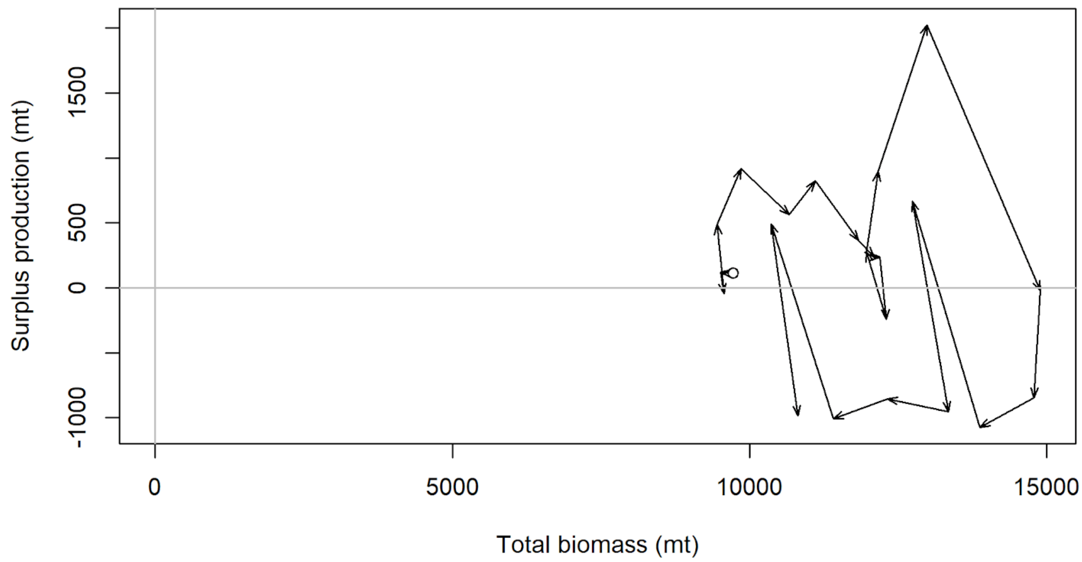

Figure 11. Surplus production vs biomass plot.

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ANNEX 1

Table A1 Parameters values and status (estimated or fixed)

Long Name	**Name**	**Low**	**High**	**Init**	**Phase run1**	**Phase run2**	**Phase run3**
Natural Mortality	#NatM	0.01	0.5	0.3	Fixed	Fixed	Fixed
Length at age min	#L_at_Amin	11	13	12	Fixed	Fixed	Fixed
Length at age max	#L_at_Amax	40	70	51.9	Fixed	Fixed	Fixed
Growth rate	#VonBert_K	0.1	0.2	0.18	Estimated	Fixed	Estimated
Parameter 1 of weigth/length relationship	#Wtlen_1	-1	1	1.9E-5	Fixed	Fixed	Fixed
Parameter 2 of weigth/length relationship	#Wtlen_2	1	4	3.015	Fixed	Fixed	Fixed
Maturity 50	#Mat50%	20	70	30	Fixed	Fixed	Fixed
Maturity slope	#Mat_slope	-2	1	-1.5	Fixed	Fixed	Fixed
Alpha parameter for fecundity equation	#alpha_fecundity	0.001	1	0.05140	Fixed	Fixed	Fixed
Beta parameter for fecundity equation	#beta_fecundity	3	5	4.2576	Fixed	Fixed	Fixed
Virgin recruitment	#SR_LN(R0)	1.5	23	12	Estimated	Estimated	Fixed
Steepness	#SR_BH_steep	0.2	0.999	0.6	Fixed	Fixed	Fixed
Recruitment deviation	#SR_sigmaR	0.1	5	0.6	Estimated	Estimated	Estimated
	LenSelex for each fleet :						
L50 for selectivity	#Value_at_50	10	40	20	Fixed	Fixed	Fixed
Difference between L95/L50 for selectivity	#Diff_50_95	10	40	10	Fixed	Fixed	Fixed

Survey results of roughhead grenadier, roundnose grenadier, greater argentine, tusk, blue ling, black scabbard fish, ling, and orange roughy in ICES Division 14.b in the period 1998-2016 and 2022-2023

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Abstract

A stratified bottom trawl survey in East Greenland (ICES 14.b) has been conducted by the Greenland Institute of Natural Resources (GINR) from 1998 to 2016 (no survey was conducted in 2001), at depths between 400 to 1500 m with RV Paamiut, using an Alfredo II bottom trawl gear. RV Paamiut was retired in 2017 and in 2022-2023 the survey was conducted with a new vessel owned by the GINR, RV Tarajoq, using also a new trawl gear, Bacalao 476. There was unfortunately not any comparative trawling between vessels. Survey results include biomass and abundance estimates and length frequency distributions, which are presented for roughhead grenadier (*Macrourus berglax*), roundnose grenadier (*Coryphaenoides rupestris*), greater argentine (*Argentina silus*), tusk (*Brosme brosme*), blue ling (*Molva dypterygia*), black scabbardfish (*Aphanopus carbo*), ling (*Molva molva*), and orange roughy (*Hoplostethus atlanticus*). Roughhead grenadier and roundnose grenadier results have already been reported to ICES NWWG (Christiansen et al. 2024).

1. Introduction

During the period 1987-1989 the Japan Marine Fishery Resources Research Centre and the Greenland Institute of Natural Resources (GINR) jointly conducted three bottom trawl surveys off East Greenland as part of a joint venture agreement on fisheries development and fisheries research in Greenland waters (Jørgensen and Akimoto 1990; Yatsu and Jørgensen 1988abc; Yatsu and Jørgensen 1989). The surveys were primarily aimed at Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* spp.) and covered various areas between Cape Farewell and 72°N at depths down to 1500 m. During the period 1989-1996 GINR conducted annual shrimp trawl surveys with RV Paamiut off East Greenland (Anon. 1997), but the surveys only covered depths down to 600 m with a poor coverage of depths > 400 m. In 1998, GINR initiated a bottom trawl surveys series with RV Paamiut, which has been rigged for deep sea trawling, using an Alfredo III bottom trawl. No comparative trawling between the RV Shinkai Maru and RV Paamiut was conducted, making comparisons between the surveys difficult, and there is little overlap in depth range between the shrimp trawl survey and the present deep-water survey. There was no survey off East Greenland in

2001. The vessel (RV Paamiut) used for the surveys from 1998-2016 was retired in 2018 before paired trawling experiments with a replacement vessel could be conducted. In 2022, the new vessel owned by GINR, RV Tarajoq began a new survey series using a Bacalao 476 trawl.

2. Materials and methods

Until 2008, the Greenland halibut deep-water survey was conducted in June and suffered in almost all years 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 and ice-induced problems have largely vanished. Also, in 2008 the survey was combined with the shallower Greenland shrimp and fish survey (which was previously only conducted off West Greenland), that uses a different gear and trawls in shallower waters than the Greenland halibut deep-water survey. The combination of the two surveys led to a change in trawling hours so that most of the stations were taken during night. Prior to the change in timing of the survey, a GLM analysis was performed on commercial catch rates and showed only minor effects of these changes. In 2023 the Greenland halibut survey was conducted between September 18 and October 4.

Stratification

The survey was planned to cover ICES division 14.b from 61°N to 67°N 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 originally stratified in five Subareas Q1-Q5 (Table 1). The stratification has been changed repeatedly in the past.

In 2004 the stratification was changed to reduce variance of the Greenland halibut biomass estimates and to increase strata size. Larger strata corresponds to fewer strata and should thereby reduce the amount of strata without observations due to bad weather, ice, or other complications. The "old" stratum Q1 was divided in two. The northern, shallow part of the stratum was separated from the rest of the stratum, primarily because the fish fauna here is different from the rest of the stratum and because Greenland halibut is generally smaller in this area. This northern shallow area is now stratum Q1 (Table 1, Fig. 1). The remaining part of the old Q1 was combined with Q2 as there was no difference in the catches of Greenland halibut in the two areas. The depth strata 1001-1200 m, 1201-1400 m, and 1401-1500 m was combined to one depth stratum, because the catches of Greenland halibut were generally small in these strata. Stratum Q3 was not changed. In Q5 the two small depth strata 801-1000 and 1001-1200 were combined because the catches of Greenland halibut were at the same level in the two strata throughout the years. The spatial extent of these new strata was measured using "MapInfo" v.4.0 and this stratification scheme is what is currently used for reporting in this working document (Table 1).

In addition, area Q6 off Southeast Greenland has been included in previous years' plans, but it was never possible to trawl in this area due to ice and rough bottom, and Q6 has been excluded from the survey area since 2004. In 2022-2023, plans were made to include new, previously not surveyed areas, because 1) the survey time series was altered through the introduction of a new vessel and new trawl anyway, 2) the new trawl enables deeper trawling/trawling over rougher bottom, and 3) commercial Greenland halibut fishery is taking place in the new areas. Areas Q4 and Q8 are tentatively included in the survey program since 2023, depending on available time during the survey. However, for this year's reporting they are not included here as only few stations were taken in these areas. If a longer time series becomes available for these areas (Q4 and Q8), the reporting will be updated.

Sampling design

From 1998 to 2016, the survey was planned as a stratified random bottom trawl survey with a total of 70 hauls, yielding an overall coverage of 527 km^2 per haul. Each stratum was allocated at least two hauls. The remaining hauls were allocated in order to minimize the variance in the estimation of the biomass of Greenland halibut; *i.e.* strata with great variation in the catches of Greenland halibut in the previous year's survey were assigned relatively more hauls than strata with little variation in the catches.

In 2004 a new method of choosing stations was introduced combining the use of a minimum between-stations-distance rule (buffer zone) with a random allocation scheme (Kingsley et al. 2004). In Q5 depth stratum 801-1200 m only 7 positions were suitable for trawling. The positions of the 3 hauls allocated to this stratum were chosen at random between the 7 trawlable positions. In 2022, the stratified random bottom trawl survey was changed to a fixed station allocation design due to many stations being moved and problems finding suitable fishing grounds because of rough sea bed.

Vessel and gear

From 1998 to 2017, the survey was conducted by the 1084 GT trawler RV Paamiut, using an Alfredo III trawl with a mesh size on 140 mm and a 30-mm mesh-liner in the cod-end. The ground gear was of the rock hopper type. The trawl doors were changed to “Injector" weighing 2700 kg, in 2004, but this has not affected the performance of the trawl. Figures of rigging and bobbins chain together with further information about the gear is given in Jørgensen (1998). A Furuno net sonde mounted on the head rope measured net height. Scanmar sensors measured the distance between the trawl doors. In 2022, RV Tarajoq (2896 GT) began a new survey series using a Bacalao 476 trawl with a mesh size on 136 mm and a 30-mm mesh-liner in the cod-end using the same trawl doors as on RV Paamiut (Table 2).

Swept area calculation

Nominal swept area for each tow was calculated as the straight-line distance between its GPS start and end positions multiplied by the wingspread. Trawl door distance was normally recorded 3-5 times per tow and the average value was used to calculate wingspread, provided at least 3 records are available. With the Alfredo trawl wingspread was calculated as:

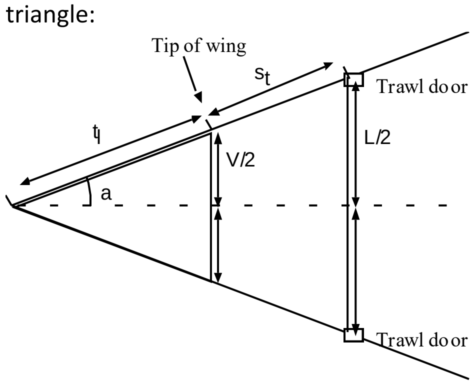
Distance between outer bobbins=10.122 + trawl door distance * 0.142

This relationship was estimated based on flume tank measurements of the trawl and rigging (Jørgensen 1998).

In 2022, the gear was changed to Bacalao 476 gear. For this trawl, wingspread is calculated as follows:

$V = (t_l * L) / (t_l + s_t)$

where V is wingspread; L is trawl door distance ; t are the trawl wings; and s are the bridles. The trawl wings are 26.83 m long and the bridles are 129 m long in this trawl. This calculation assumes that the trawl geometry is a triangle:



However, the actual shape of the Bacalao trawl is likely not a triangle, therefore a constant based on data from the Canadian survey was applied. Scanmar sensors measured wingspread during the Canadian survey in Subarea 0A at the same depths as the deep Greenland halibut survey of GINR. The difference between estimates presented here and the sensor measurements in each depth strata from the Canadian survey was added as a constant to the wingspread calculations presented here.

Trawling procedure

Towing time is usually 30 min, but towing times down to 15 min are accepted. Average towing speed is 3.0 kn. Towing speed is estimated from the start and end positions of the haul. Trawling takes place day and night. Near-bottom temperatures are measured at 0.1°C precision using a Seamon sensor mounted on a trawl door.

Catch handling

For each haul the catch was sorted by species, total weight was recorded, and individual length was measured (TL to 1.0 cm) easured. Subsets of Greenland halibut and redfish were additionally sexed, individual weight and maturity recorded, and otoliths sampled. Small redfish (<18 cm) were not determined to species and were instead recorded as juveniles (*Sebastes* sp.). In case of large catches subsamples of the catch were measured. Subsamples always comprise at least 200 specimens.

Biomass and abundance estimates are based on swept area calculations as outlined above with a catchability coefficient of 1.0. All catches are standardised to 1 km^2 swept area before further calculations. In strata with one haul only SE is estimated as: SE= biomass or abundance. As the survey was previously conducted in early June, when large amounts of ice flow southwards along the East Greenland coast, some areas were poorly sampled due to ice. To compensate for this the Greenland halibut biomass is run through a GLM model where logcpue = year + subdivision + depth. In 2011, age readings from otoliths were stopped as the results obtained seemed unreliable. After international agreement in 2016, the readings for this survey started again in 2023.

3. Results and discussion

In 2023 many stations were not taken due to bad weather. In total, 39 stations were taken, causing bad coverage especially in Q5 (Table 4). Therefore all results have to be interpreted with caution and keeping in mind that less data is available in 2023 to produce reliable biomass and abundance estimates in East Greenland from this survey. Thus, most total biomass estimates represent a decrease compared to 2022, which is likely due to the reduced amount of stations taken.

Roughhead grenadier (Macrourus berglax; RHG)

The 2023 total biomass estimate for roughhead grenadier was 6,321 t (SE 4,131 t, Table 5 & 6, Fig. 1), which is a strong reduction compared to 2022 where the total biomass estimate was 12,914 t (SE 3,861 t, Table 5). Correspondingly, the abundance decreased to 3,575,000 (Table 5 & 6, Fig. 2). The length distribution is bimodal with a mode around 20 cm and 36 cm, respectively (Fig. 4).

Roundnose grenadier (Coryphaenoides rupestris; RNG)

In total, only 37 t (SE 0 t) of roundnose grenadier were estimated to be present in the area in 2023, which is a strong decrease compared to 84 t (SE 17 t) in 2022 (Table 7, Fig. 5). This species is generally less abundant than roughhead grenadier in the area, but also seems to be in decline in recent years. However, the low estimate for 2023 is also a result of the species being taken in only one of all taken stations and it is important to consider that much fewer hauls were made in 2023 than in previous years. The corresponding abundance estimate for 2023 is also low at 2,839,000 (SE 0, Table 8, Fi.g 6). The length distribution indicates that only small roundnose grenadiers were sampled with a mode around 3 cm (Fig. 8).

Greater argentine (*Argentinus silus; ARU*)

In 2022, the vast majority of the biomass of greater argentine was caught in Q5 between 401-600 m (Table 10, Fig. 11). Biomass for greater argentine has been increasing from 1998 t (6.4 t) to 2016 (808.1 t), peaking in 2014 (2166.7 t) (Table 9, Fig. 9). In 2023, the biomass was 1131.87 t (SE = 395.11). Abundance was estimated to be 2,309,000 (SE = 713,000) in 2023 and generally follows the same patterns as biomass (Table 9, Fig. 10). 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. 12). In 2023, several modes approximately between 35-45 cm were apparent.

Tusk (*Brosme brosme*, USK)

In 2023, tusk was caught in relatively few hauls compared to previous years (Table 12, Fig. 15), which may, however, be a consequence of the (due to bad weather) shortened survey program. Biomass for tusk has been low until 2010 (mean biomass = 18.2 t), with no catches in 1998, 1999 and 2005. From 2010 until 2016, the biomass was distinctly higher (mean biomass = 275 t) ranging from 188.3 t (2014) to 504.1 t (2013) (Table 11, Fig. 13). In 2023, the biomass was 224.6 t (SE = 138.9 t). Abundance was estimated at 95,000 (SE = 57,000) in 2023 (Table 11 & 12, Fig. 14). The overall length distribution for all years are based on relatively low sample sizes (N<100), individual size ranged from 43 cm to 82 (Fig. 16). In 2023 a mode around 55 cm was present in the length frequency distribution, but the sample size is small (Fig. 16).

Blue ling (*Molva dypterygia*, BLI)

In 2022, blue ling was caught in Q2, Q3, and Q5, with the majority of the catch taken in Q5 between 801-1200 m (Table 14, Fig. 19). Biomass for blue ling has been low from 1998 to 2005 (mean biomass =138.4 t). From 2006 until 2016, the biomass has been distinctly higher (mean biomass = 786.5 t) ranging from 158 t (2007) to 1340 t (2012) (Table 13, Fig. 17). In 2023, the biomass was 262 t (SE = 94) (Table 13 & 14, Fig. 17). In 2023, the abundance was estimated at 131,000 (SE = 61,000) and generally follows biomass estimates (Table 13 & 14, Fig. 18). No mode can be observed in the length distribution (Fig. 20).

Black scabbardfish (*Aphanopus carbo*, BSF)

Black scabbardfish are rarely caught in this survey. There were no catches in the years 1998, 1999, 2000, 2002, 2003, 2006 and 2016, and neither in 2022 and 2023. In 2013 and 2015, the species was caught only at 1 station, 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 15, Fig. 23), where the majority of the biomass also has been observed in previous years (Fig. 23). In 2008 and 2010-2012, the biomass was estimated between 33.1 t and 56.4 t, whereas all other years the biomass was less than 7.9 t (Table 15). This is most likely because this pelagic and deep living pelagic fish is not targeted by the applied type of bottom trawl and hence biomass and abundance estimates (Fig. 21 & 22) are likely not truly representative of actual biomass and abundance in the investigated area. Overall length distributions from 2011 and 2012 show a wide mode between 70 cm and 110 cm.

Ling (*Molva molva*; LIN)

Ling are not commonly caught in this survey. There were no catches from 1998 to 2004, 2008, 2013-2014 and 2016, and neither in 2023 (Table 16). Except from 2011, where the estimated biomass was 267.6 t (SE = 251 t) (Table 16), yearly estimates are 10-fold less or zero evidencing that ling do not commonly occur in the investigated area (Table 16, Fig. 24 & 25).

Orange roughy (*Hoplostethus atlanticus*; ORY)

Orange roughy is not commonly caught in this survey. The species was only caught in 2008, 2013, 2014 and 2015 (Fig. 27). In 2014 and 2015, estimated biomass was 1.7 t and 1.1 t, respectively, and in all other years it was zero or very close to zero (Table 18, Fig. 27). In 2015, all fish were caught in Q3 at depths between 801-1200 m (Fig. 29). No length distributions are shown as too few specimens (N<20) were caught.

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Table 1. Areas (km^2) and their percentage distribution for subareas and depth strata (m). Q4 areas are not included.

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. General survey information and gear specifications for the surveys 1998-2016 on board R/V Paamiut and for the survey in 2022-2023 with R/V Tarajoq.

Procedure	**Specifications**	
Vessel	R/V Paamiut	R/V Tarajoq
TRB	1084 GT	2896 GT
Dimensions	LOA 58.61m, Beam 11.21 m	LOA 61.4 m, Beam 16.3 m
Main engine	2000BHP, Diesel 257, 1471KW	3943/4896 BHP, Diesel 475, 2900/3600 KW
Survey Area	14b (401- 1500 m)	14b (401- 1500 m)
Years	1998-2016 (no survey 2001)	2022-2023
Time of year	August/September	September/October
Number of days	15	15
Towing speed (knots)	3	3
Tow duration	30 min	30 min
Gear	Alfredo 3	Bacalao 476
Vertical trawl opening (m)	5.6	4.5*
Distance between doors	120 -145 m	151.8*
Wing spread	10.122 + distance between the doors * 0.142.	$V = (t_l * L) / (t_l + s_t)$ + constant
Mesh size (mm)	140	136
Door	until 2003:Greenland Perfect (370*250 cm) from 2004: Shark injector (353*273)	Shark injector (353*273)
Door type (kg)	2400 kg with extra 20 kg	2850
Mesh size (mm)	44	44
Mesh-line in the cod-end	30 mm	30
Sampling design	Buffered Random Stratified	Fixed stations
Number of Stations	100	74 fixed + 70 extra (min 80)
Number of strata	10	10
Trawling schedule	24 hours	
Criteria for rejecting a haul	Snag of the trawling gear in the bottom Damage in the cod-end or severe damages in large sections of the wings or belly Less than 15 minutes of effective trawling time Gear malfuntion	
Criteria for change haul position	Wrong depth interval Poor bottom conditions	
Sampling species	All fish species and invertebrates	
Target species	Greenland halibut	

Table 3. Number of valid hauls for the period 1998-2003. No survey was conducted in 2001.

Subarea	Depth stratum (m)	Area (km2)	1998	1999	2000	2002	2003
Q1	401-600	7444.1	6	4	3	1	4
Q1	601-800	622	3	3	3	3	3
Q1	801-1000	652.3	3	3	3	2	2
Q1	1001-1200	881.8	2	2	2	2	1
Q1	1201-1400	741.4	2	2	2	2	1
Q1	1401-1500	462.3	2	2	2	2	2
Q2	401-600	777	2	2	2	2	3
Q2	601-800	853.4	4	3	3	3	3
Q2	801-1000	1336	5	4	3	4	3
Q2	1001-1200	1699.3	2	2	2	2	2
Q2	1201-1400	1742	2	2	2	0	2
Q2	1401-1500	1162.6	1	2	2	2	1
Q3	401-600	9830.2	6	7	9	3	1
Q3	601-800	3788.1	3	4	4	1	5
Q3	801-1000	755.4	2	0	2	0	2
Q5	401-600	1819.4	2	2	1	0	0
Q5	601-800	257.1	0	2	2	2	1
Q5	801-1000	106.7	0	2	2	2	2
Q5	1001-1200	148.9	2	2	2	2	1
Q5	1201-1400	985.5	2	2	2	3	1
Q5	1401-1500	614.5	3	2	2	2	0
TOTAL			54	54	55	40	40

Table 4. Number of valid hauls for the period 2004-2016 with RV Paamiut and 2022-2023 with RV Tarajoq, after a new stratification scheme was introduced.

Subarea	Depth stratum (m)	Area (km2)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2022	2023	Total
Q1	401-600	6975	2	0	0	2	4	4	2	8	7	10	7	11	12	0	5	2	76
Q2	401-600	1246	4	4	5	3	5	4	4	2	4	5	5	5	5	0	7	2	64
Q2	601-800	1475.4	5	5	6	5	7	5	5	6	9	5	7	7	7	0	5	1	85
Q2	601-1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	3
Q2	801-1000	1988.3	8	9	12	9	3	9	8	8	9	8	7	8	10	0	8	7	123
Q2	1001-1500	6689.4	3	3	4	3	4	5	5	4	7	4	7	7	7	0	5	0	68
Q3	401-600	9830.2	9	1	2	2	2	5	5	6	4	9	7	8	11	0	4	7	82
Q3	601-800	3788.1	4	8	2	6	6	10	6	7	7	11	12	10	14	0	11	4	118
Q3	801-1000	755.4	0	2	0	0	2	3	3	5	4	4	5	5	6	0	5	5	49
Q4	801-1200	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Q5	401-600	1819.4	3	0	1	2	3	2	0	1	2	1	2	3	3	0	4	2	29
Q5	601-800	257.1	3	1	3	2	3	4	1	3	3	6	6	6	6	0	6	3	56
Q5	801-1000	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	4
Q5	801-1200	255.6	3	4	3	4	0	4	3	3	4	5	6	2	5	0	2	0	48
Q5	1201-1400	985.5	5	6	3	5	3	6	5	8	5	9	3	7	9	6	9	0	89
Q5	1401-1500	614.5	3	4	2	3	1	3	3	5	2	3	3	5	5	4	2	0	48
		TOTAL	52	47	43	46	47	64	50	66	67	80	78	84	100	10	73	36	

Table 5.Total biomass (tonnes) with SE, and abundance (10^3) with SE, of roughhead grenadier (*Macrourus berglax*, RHG) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	3480.9	546.2	4027.81	639.14
1999	PA	4741.67	803.82	5268.51	979.85
2000	PA	3434.36	351.12	3894.76	380.16
2001	PA	-	-	-	-
2002	PA	4523.51	2095.86	5409.19	3429.93
2003	PA	3100.01	609.13	3421.35	741.1
2004	PA	3150.55	532.5	2813.58	266.75
2005	PA	4237.93	872.42	5230.35	1225.6
2006	PA	3972.49	597.02	4600.06	620.9
2007	PA	3435.29	637.47	3590.22	445.99
2008	PA	6841.49	983.99	6590.11	818.97
2009	PA	7256.96	1425.21	6836.17	1173.32
2010	PA	9201.84	2292.12	7532.03	1162.02
2011	PA	5855.39	1032.07	5678.71	1055.34
2012	PA	7926.09	1330.41	7060.19	1030.43
2013	PA	7604.93	1765.46	5756.69	1212.99
2014	PA	6816.97	1043.22	5426.8	713.5
2015	PA	8751.71	2292.95	5647.58	1239.19
2016	PA	6953.35	1190.37	6004.64	1043.39
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	12913.87	3860.92	7338.93	1703.29
2023	TJ	6320.94	4130.93	3575.53	2300.02

Table 6. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE with SE of roughhead grenadier (RHG) by subarea and depth stratum in 2023.

Subarea	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	13.324	93	93	17	118	118
Q2	0401-0600	1246	2	425.35	530	174	389	485	193
Q2	0601-0800	1475	1	3100.53	4575	4117	1429	2108	2275
Q2	0801-1000	1988	2	381.336	758	223	250	496	192
Q3	0401-0600	9830	7	11.117	109	70	10	97	53
Q3	0601-0800	3788	4	20.914	79	46	14	54	32
Q3	0801-1000	755	5	39.398	30	11	45	34	6
Q5	0401-0600	1819	2	72.178	131	131	84	152	152
Q5	0601-0800	257	3	12.041	3	3	16	4	1
Q5	0801-1200	256	1	49.31	13	11	105	27	29
TOTAL		28389	29	145.5	6321	4131	81.01	3575	2300

Table 7.Total biomass (tonnes) with SE, and abundance (10^3) with SE, of roundnose grenadier (*Coryphaenoides rupestris*, RNG) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	2877.29	1299.84	6166.28	2654.39
1999	PA	4303.63	463.11	9661.55	1012.45
2000	PA	2294.69	1237.14	5630.96	2486.13
2001	PA	-	-	-	-
2002	PA	1771.06	1224.19	7065.28	4542.48
2003	PA	4459.12	2097	13593.18	4742.32
2004	PA	1151.83	792	4369.14	1841.27
2005	PA	1174	337.77	5883.41	1813.27
2006	PA	689.04	300.31	3781.2	967.65
2007	PA	878.79	250.81	8312.51	2493.72
2008	PA	772.93	242.56	4296.04	1277.88
2009	PA	215.67	52.05	1452.29	368.99
2010	PA	416.21	93.74	2525.65	478.99
2011	PA	3202.25	2821.1	9207.74	6687.45
2012	PA	5379.46	4774.44	15325.86	13521.71
2013	PA	294.99	151.77	1469.95	694.61
2014	PA	106.1	36.39	826.32	322.61
2015	PA	999.46	815.95	3065.97	2106.33
2016	PA	170.25	46.08	530.16	127.62
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	84.01	17.25	1501.97	640.44
2023	TJ	37.27	0	2838.93	0

Table 8. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE with SE of roundnose grenadier (*Coryphaenoides rupestris*, RNG) by subarea and depth stratum in 2023.

Div	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	0	0	0	0	0	0
Q2	0401-0600	1246	2	0	0	0	0	0	0
Q2	0601-0800	1475	1	0	0	-	0	0	-
Q2	0801-1000	1988	2	0	0	0	0	0	0
Q3	0401-0600	9830	7	0	0	0	0	0	0
Q3	0601-0800	3788	4	0	0	0	0	0	0
Q3	0801-1000	755	5	0	0	0	0	0	0
Q5	0401-0600	1819	2	0	0	0	0	0	0
Q5	0601-0800	257	3	0	0	0	0	0	0
Q5	0801-1200	256	1	145.812	37	-	11107	2839	-
TOTAL		28389	29	0	37	0	0	2839	0

Table 9. Total biomass (tonnes) with SE, and abundance (10^3) with SE, of greater silver smelt (*Argentinus silus*, ARU) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	5.39	3.14	11.69	7.73
1999	PA	2.13	2.13	5.32	5.32
2000	PA	6.5	3.54	18.2	9.49
2001	PA	-	-	-	-
2002	PA	53.79	36.23	197.17	141.11
2003	PA	162.26	93.46	493.99	293.54
2004	PA	96.91	36.05	302.86	116.52
2005	PA	55.11	19.63	186.41	67.75
2006	PA	167.25	58.48	471.75	176.95
2007	PA	126.62	45.78	384.07	143.34
2008	PA	240.62	105.47	608.6	279.75
2009	PA	347.48	155.47	747.82	343.53
2010	PA	370.78	100.95	753.41	206.27
2011	PA	432.1	145.02	1145.74	405.38
2012	PA	481.74	166.49	954.86	294.72
2013	PA	643.7	173.47	1239.71	309.73
2014	PA	2046.61	842.8	4127.26	1594.59
2015	PA	257.55	71.72	506.79	119.83
2016	PA	808.11	360.38	1609.62	889.75
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	1038.46	713.42	2221.33	1653.29
2023	TJ	1131.87	395.11	2309.42	713.15

Table 10. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE of of greater silver smelt (*Argentinus silus*, ARU) by subarea and depth stratum in 2023.

Div	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	0	0	0	0	0	0
Q2	0401-0600	1246	2	69.362	86	86	151	188	188
Q2	0601-0800	1475	1	0	0	0	0	0	0
Q2	0801-1000	1988	2	6.351	13	13	15	30	30
Q3	0401-0600	9830	7	0	0	0	0	0	0
Q3	0601-0800	3788	4	0	0	0	0	0	0
Q3	0801-1000	755	5	0.88	1	1	2	2	2
Q5	0401-0600	1819	2	538.318	979	385	1095	1993	686
Q5	0601-0800	257	3	158.073	41	16	287	74	27
Q5	0801-1200	256	1	47.332	12	10	87	22	18
TOTAL		28389	29	13.92	1132	395	25.12	2309	713

Table 11. Total biomass (tonnes) with SE, and abundance (10^3) with SE, of tusk (*Brosme brosme*, USK) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	0	0	0	0
1999	PA	0	0	0	0
2000	PA	3.75	3.75	0.99	0.99
2001	PA	-	-	-	-
2002	PA	61.06	34.27	194.13	108.82
2003	PA	2.21	1.6	8.82	4.41
2004	PA	4.36	4.36	9.69	9.69
2005	PA	0	0	0	0
2006	PA	16.47	7.74	19.3	7.93
2007	PA	18.42	14.94	11.95	7.28
2008	PA	69.25	29.48	166.13	93.72
2009	PA	47.4	22.34	112.41	54.81
2010	PA	225.8	113.64	369.05	206.85
2011	PA	113.62	48.34	92.71	39.91
2012	PA	349.74	261.82	138.21	67.2
2013	PA	504.06	159.77	286.14	68.41
2014	PA	188.3	111.11	126.96	50
2015	PA	277.94	87.08	186.26	47.79
2016	PA	371.81	92.08	325.44	81.58
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	296.16	77.86	152.86	53.66
2023	TJ	224.56	138.93	95.15	57.37

Table 12. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE of of tusk (*Brosme brosme*, USK) by subarea and depth stratum in 2023.

Div	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	11.761	82	82	6	39	39
Q2	0401-0600	1246	2	85.089	106	106	30	38	38
Q2	0601-0800	1475	1	0	0	0	0	0	0
Q2	0801-1000	1988	2	0	0	0	0	0	0
Q3	0401-0600	9830	7	3.714	37	37	2	18	18
Q3	0601-0800	3788	4	0	0	0	0	0	0
Q3	0801-1000	755	5	0	0	0	0	0	0
Q5	0401-0600	1819	2	0	0	0	0	0	0
Q5	0601-0800	257	3	0	0	0	0	0	0
Q5	0801-1200	256	1	0	0	0	0	0	0
TOTAL		28389	29	4.89	225	139	2.02	95	57

Table 13. Total biomass (tonnes) with SE, and abundance (10^3) with SE, of blue ling (*Molva dypterygia*, BLI) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	87.47	42.49	34.41	11.78
1999	PA	163.48	69.45	65.93	27.83
2000	PA	211.09	114.02	161.13	75.62
2001	PA	-	-	-	-
2002	PA	76.26	17.34	86.61	15.93
2003	PA	101.38	31.39	96.62	35.86
2004	PA	81.59	32.72	89.16	42.79
2005	PA	111.08	30.99	83.28	15.38
2006	PA	570.07	264.94	355.56	131.03
2007	PA	158.35	57.06	136.59	57.59
2008	PA	870.02	404.82	1013.83	574.84
2009	PA	1239.68	617.42	860.55	353.19
2010	PA	892.11	157.68	689.48	193.73
2011	PA	588.19	232.69	665.09	318.57
2012	PA	1339.72	194.16	976.82	369.4
2013	PA	1248.22	412.14	571.84	159.41
2014	PA	865.88	288.05	471.72	127.73
2015	PA	417.65	162.08	204.49	74.07
2016	PA	432.5	155.17	182.92	66.68
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	446.91	164.25	177.15	69.22
2023	TJ	262.36	94	130.58	61.48

Table 14. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE of of blue ling (*Molva dypterygia*, BLI) by subarea and depth stratum in 2023.

Div	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	0	0	0	0	0	0
Q2	0401-0600	1246	2	39.802	50	50	10	13	13
Q2	0601-0800	1475	1	65.85	97	54	22	33	18
Q2	0801-1000	1988	2	0	0	0	0	0	0
Q3	0401-0600	9830	7	4.935	49	49	2	16	16
Q3	0601-0800	3788	4	0	0	0	0	0	0
Q3	0801-1000	755	5	0	0	0	0	0	0
Q5	0401-0600	1819	2	13.131	24	24	30	54	54
Q5	0601-0800	257	3	4.891	1	1	3	1	1
Q5	0801-1200	256	1	164.132	42	23	52	13	7
TOTAL		28389	29	3.31	263	94	2.17	130	61

Table 15. Total biomass (tonnes) with SE, and abundance (10^3) with SE, of black scabbardfish (*Aphanopus carbo*, BSF) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	0	0	0	0
1999	PA	0	0	0	0
2000	PA	0	0	0	0
2001	PA	-	-	-	-
2002	PA	0	0	0	0
2003	PA	0	0	0	0
2004	PA	0.82	0.82	4.08	4.08
2005	PA	1.71	1.71	1.37	1.37
2006	PA	0	0	0	0
2007	PA	2.33	1.98	7.49	5.35
2008	PA	37.53	33.34	33.79	27.28
2009	PA	2.66	2.66	3.1	3.1
2010	PA	56.38	25.08	82.79	35.31
2011	PA	39.86	26.67	56.44	35.99
2012	PA	33.12	9.57	34.13	12.07
2013	PA	1.81	1.81	2.05	2.05
2014	PA	7.91	4.87	6.85	3.52
2015	PA	1.52	1.52	2.15	2.15
2016	PA	0	0	0	0
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	0	0	0	0
2023	TJ	0	0	0	0

Table 16.Total biomass (tonnes) with SE, and abundance (10^3) with SE, of ling (*Molva molva*, LIN) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	0	0	0	0
1999	PA	0	0	0	0
2000	PA	0	0	0	0
2001	PA	-	-	-	-
2002	PA	0	0	0	0
2003	PA	0	0	0	0
2004	PA	0	0	0	0
2005	PA	15.69	15.69	9.26	9.26
2006	PA	29.89	29.89	6.29	6.29
2007	PA	14.61	10.34	25.32	19.91
2008	PA	0	0	0	0
2009	PA	3.09	3.09	3.67	3.67
2010	PA	19.23	0	8.21	0
2011	PA	267.64	251.03	491.56	484.77
2012	PA	19.92	19.92	6.04	6.04
2013	PA	0	0	0	0
2014	PA	0	0	0	0
2015	PA	23.43	14.85	9.18	6.1
2016	PA	0	0	0	0
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	6.43	6.43	2.12	2.12
2023	TJ	0	0	0	0

Table 17. Mean Catch (kg/km2), biomass (tonnes) with SE, mean numbers (num/km2) and abundance (10^3) with SE of of ling (*Molva molva*, LIN) by subarea and depth stratum in 2023.

Div	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE	Mean Number	Abundance	SE
Q1	0401-0600	6975	2	0	0	0	0	0	0
Q2	0401-0600	1246	2	0	0	0	0	0	0
Q2	0601-0800	1475	1	0	0	0	0	0	0
Q2	0801-1000	1988	2	0	0	0	0	0	0
Q3	0401-0600	9830	7	0	0	0	0	0	0
Q3	0601-0800	3788	4	0	0	0	0	0	0
Q3	0801-1000	755	5	0	0	0	0	0	0
Q5	0401-0600	1819	2	0	0	0	0	0	0
Q5	0601-0800	257	3	0	0	0	0	0	0
Q5	0801-1200	256	1	0	0	0	0	0	0
TOTAL		28389	29	0	0	0	0	0	0

Table 18. Total biomass (tonnes) with SE, and abundance (10^3) with SE, of Orange roughy (*Hoplostethus atlanticus*, ORY) for the period 1998-2016 (no survey in 2001) on board RV Paamiut (PA) and for 2022-2023 on board RV Tarajoq (TJ).

Year	Vessel	Biomass	SE	Abundance	SE
1998	PA	0	0	0	0
1999	PA	0	0	0	0
2000	PA	0	0	0	0
2001	PA	-	-	-	-
2002	PA	0	0	0	0
2003	PA	0	0	0	0
2004	PA	0	0	0	0
2005	PA	0	0	0	0
2006	PA	0	0	0	0
2007	PA	0	0	0	0
2008	PA	0.16	0.16	0.92	0.92
2009	PA	0	0	0	0
2010	PA	0	0	0	0
2011	PA	0	0	0	0
2012	PA	0	0	0	0
2013	PA	0.02	0.02	0.69	0.69
2014	PA	1.74	1.74	2.33	2.33
2015	PA	1.09	1.09	2.15	2.15
2016	PA	0	0	0	0
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	TJ	0	0	0	0
2023	TJ	0	0	0	0

Figure 1. Roughhead grenadier (RHG) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

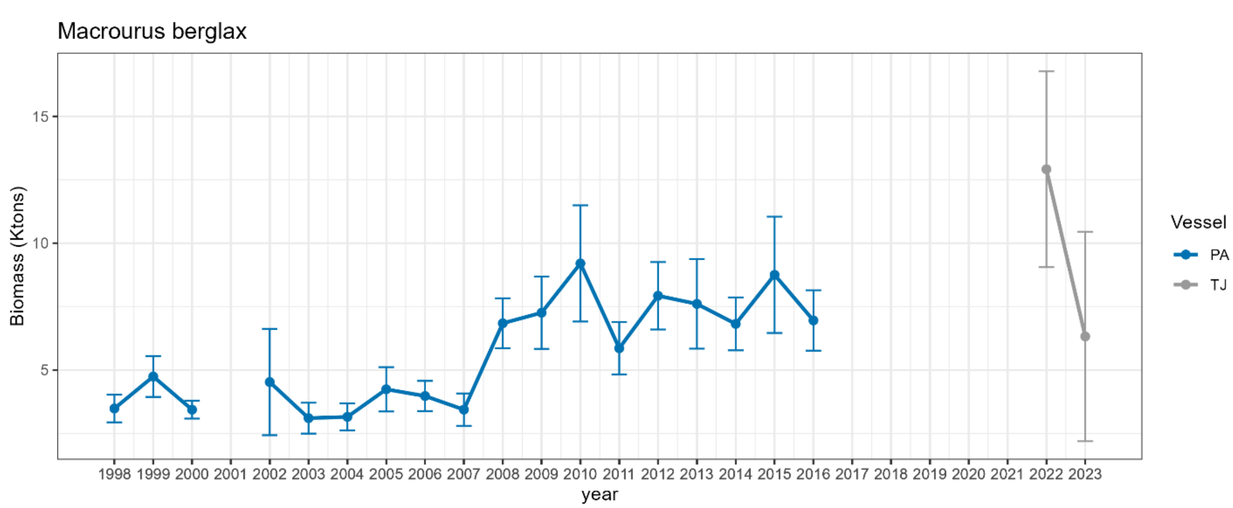


Figure 2. Roughhead grenadier (RHG) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

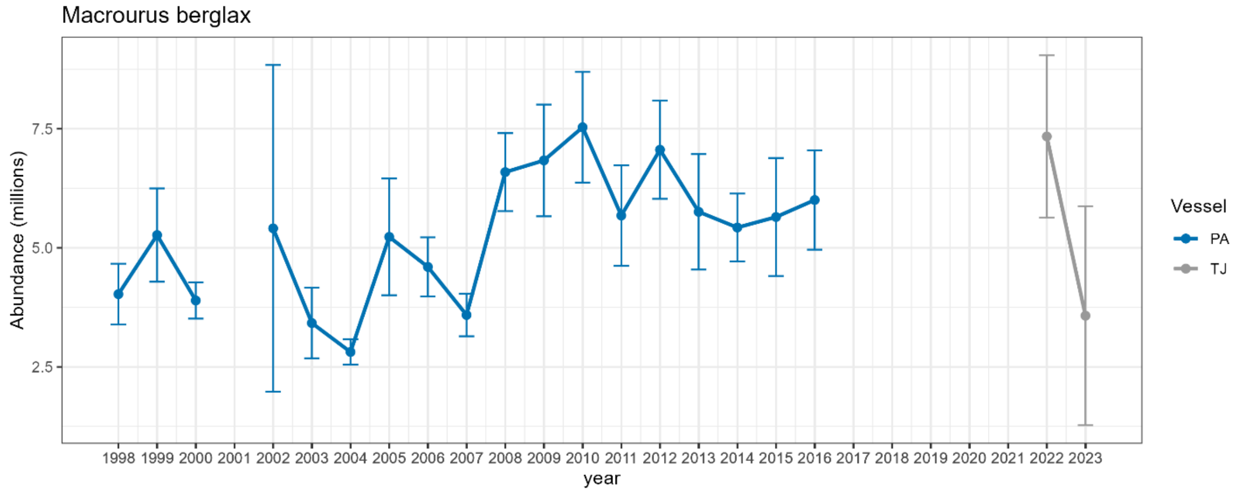


Figure 3. Distribution of survey catches of roughhead grenadier (RHG) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023.

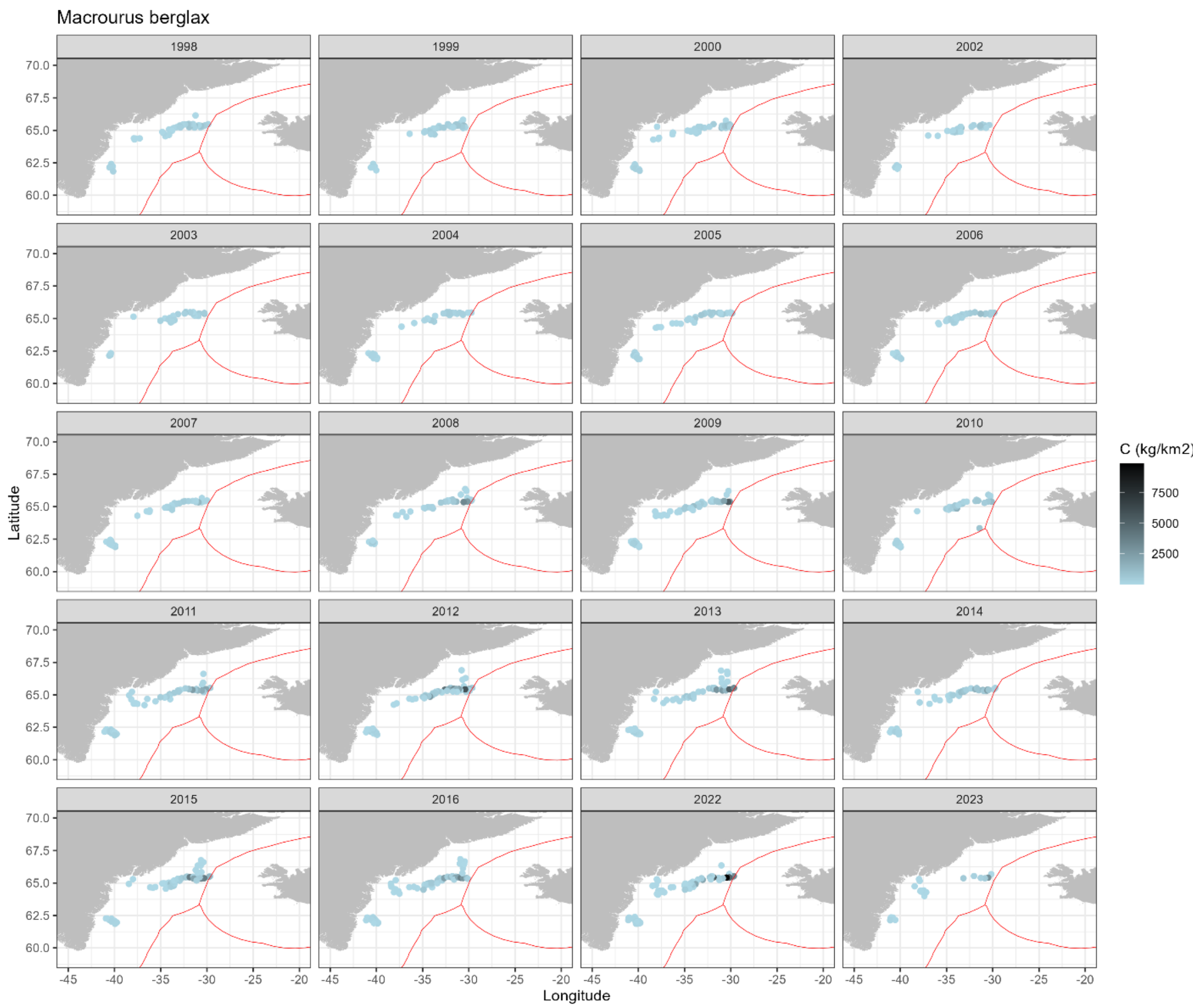


Figure 4. Length frequency distribution per swept area of roughhead grenadier (RHG) for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

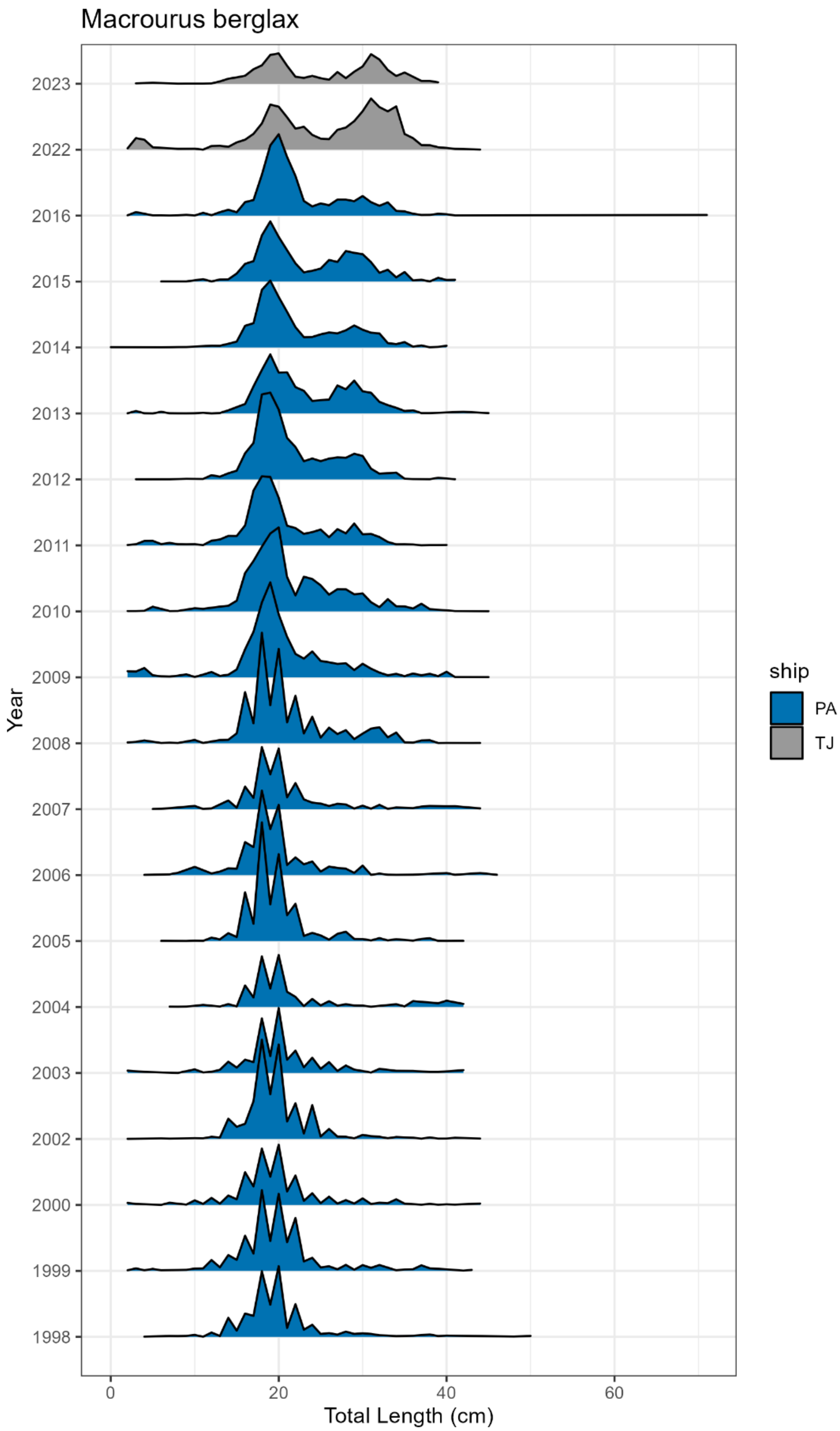


Figure 5. Roundnose grenadier (RNG) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

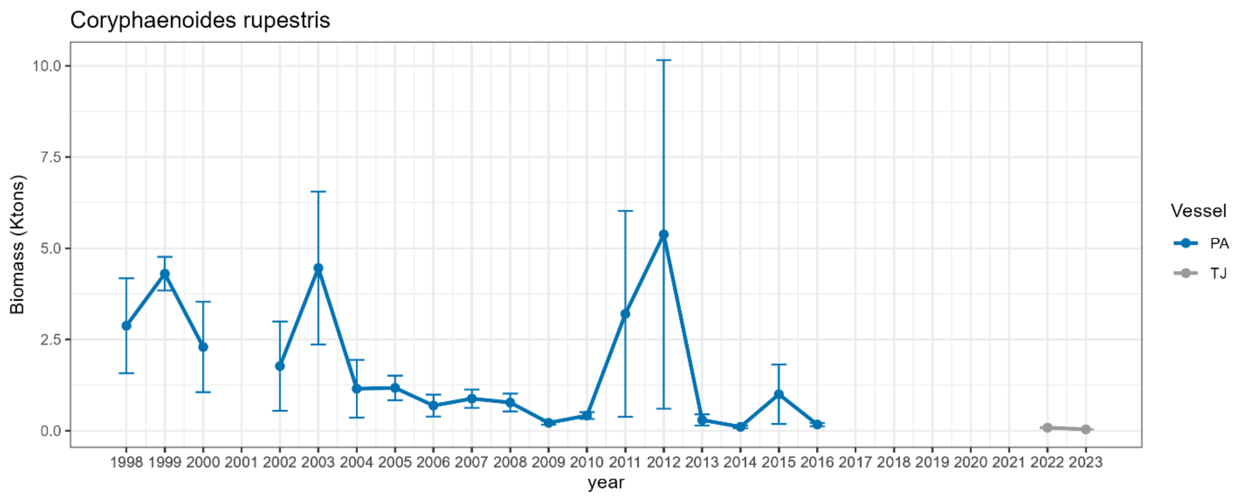


Figure 6. Roundnose grenadier (RNG) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

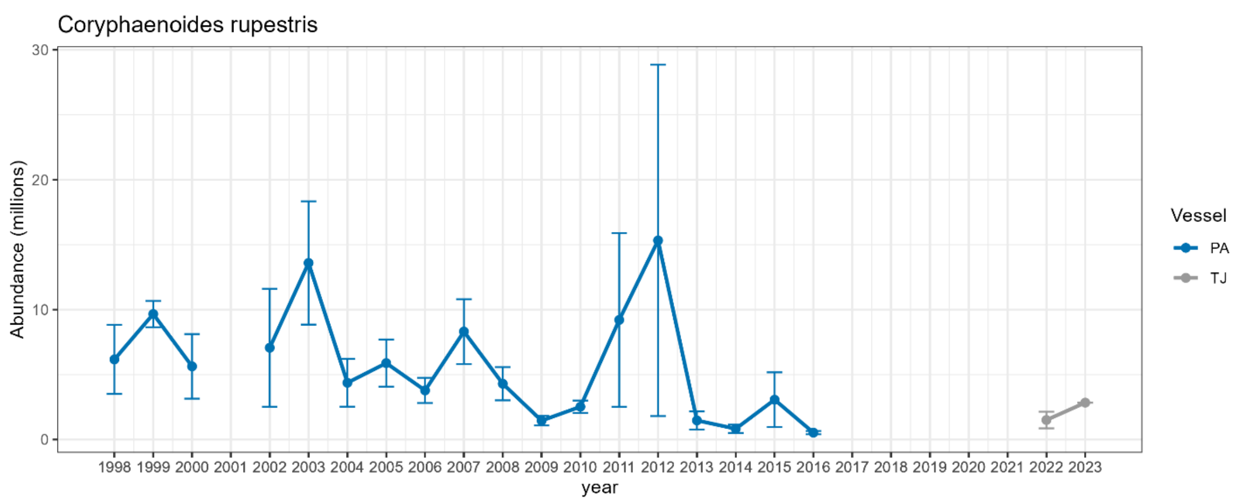


Figure 7. Distribution of survey catches of roundnose grenadier (RNG) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023.

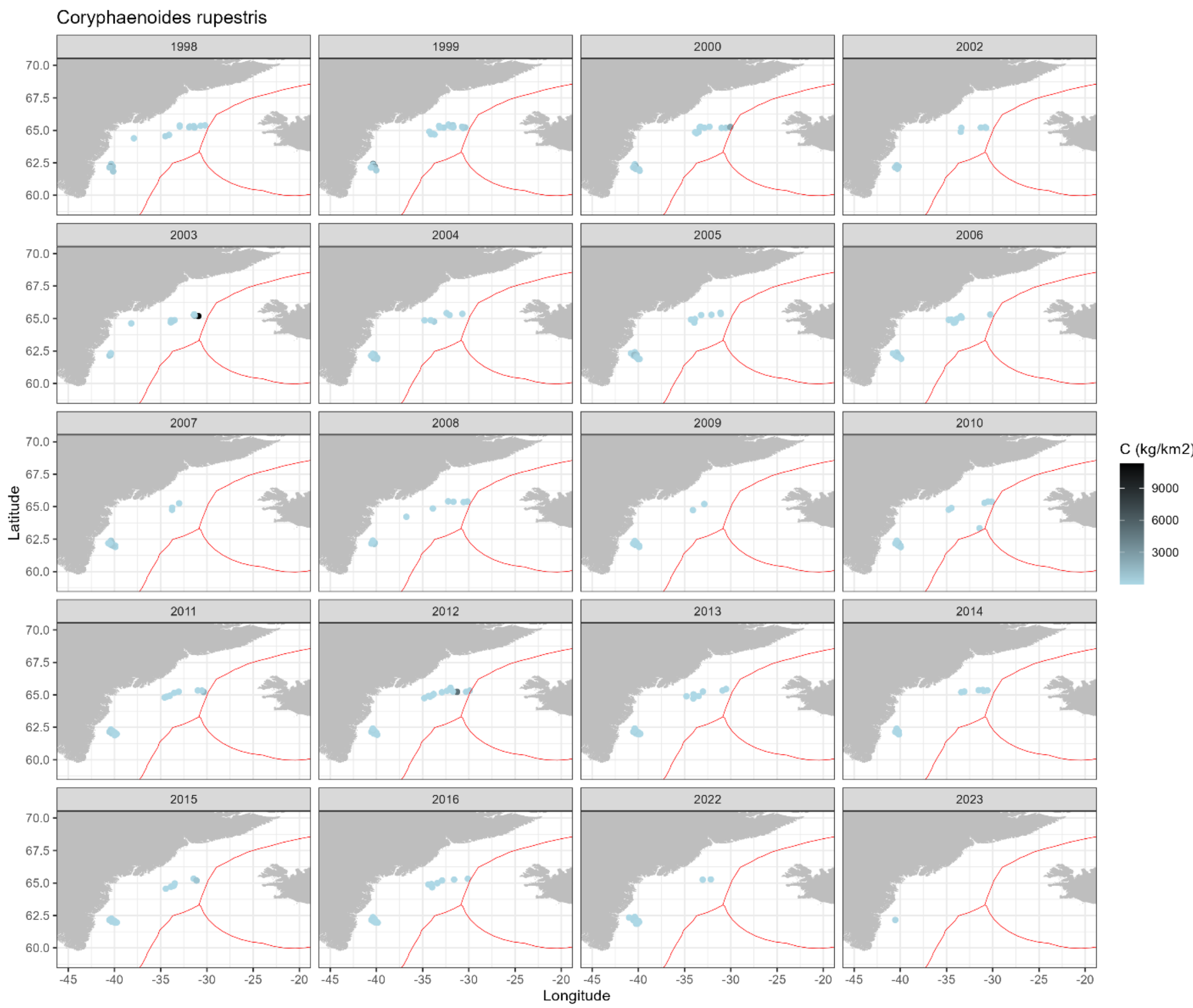


Figure 8. Length frequency distribution per swept area of roundnose grenadier (RNG) for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

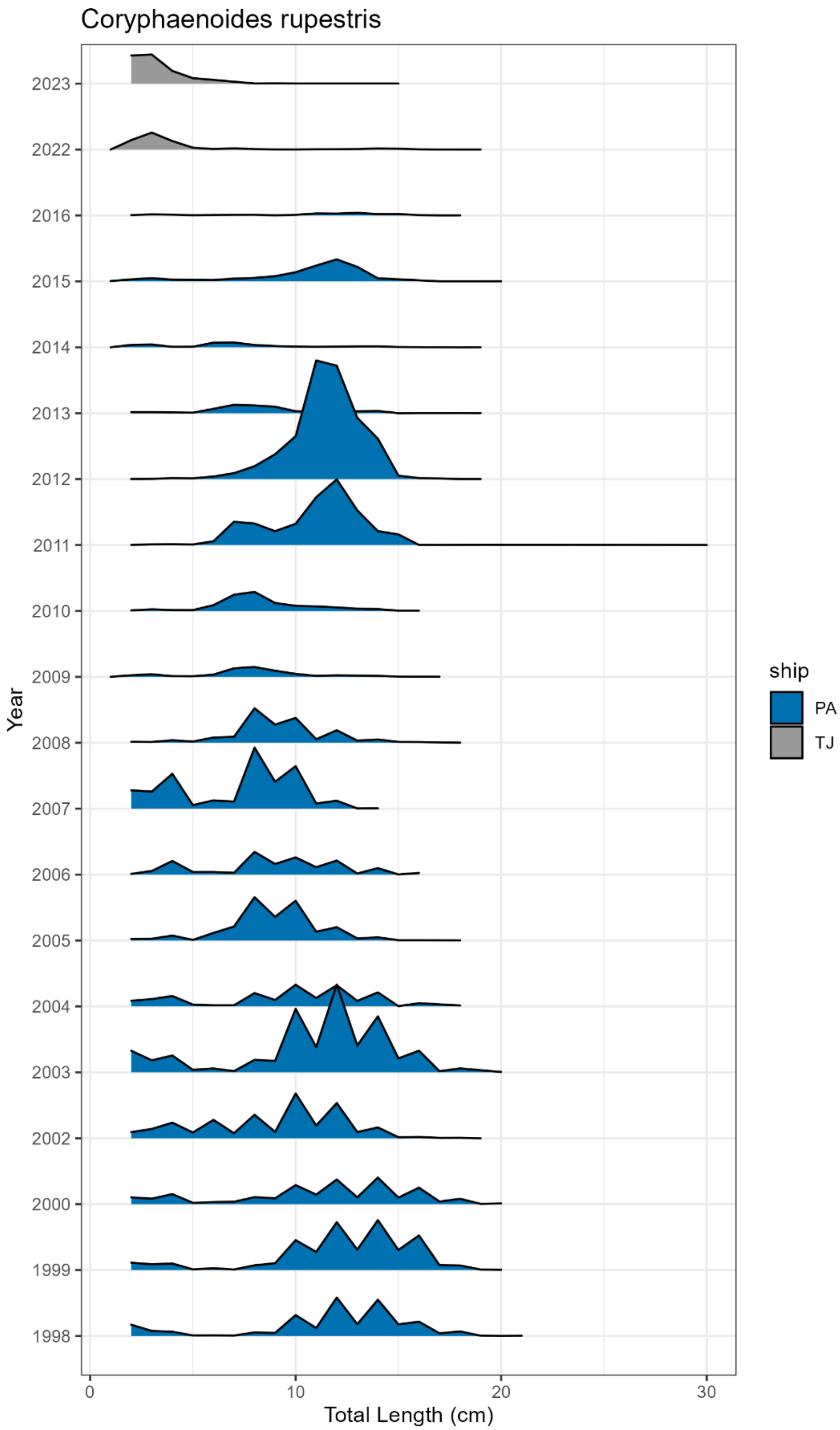


Figure 9. Greater argentine (ARU) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

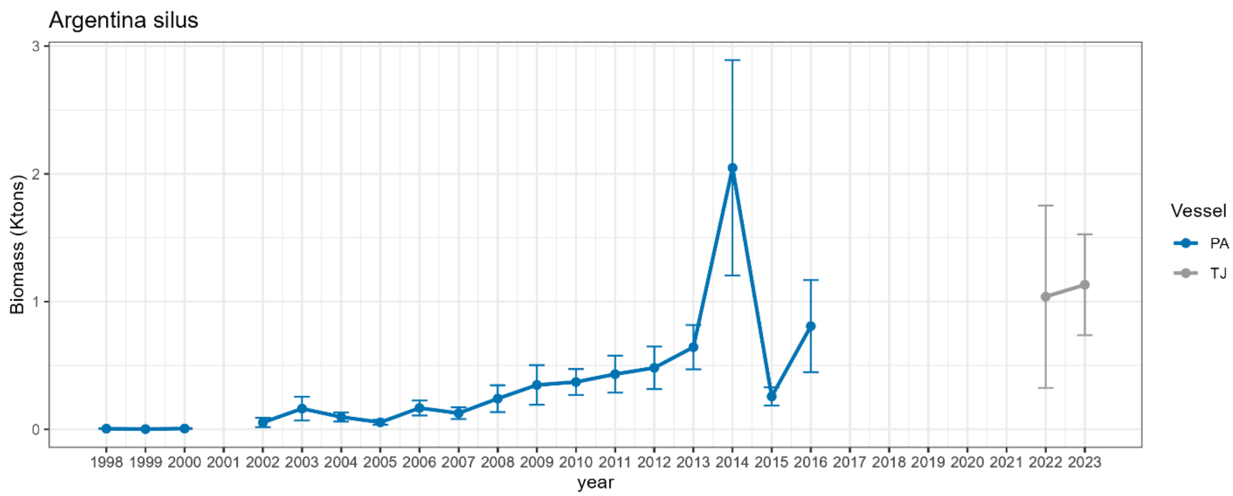


Figure 10. Greater argentine (ARU) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

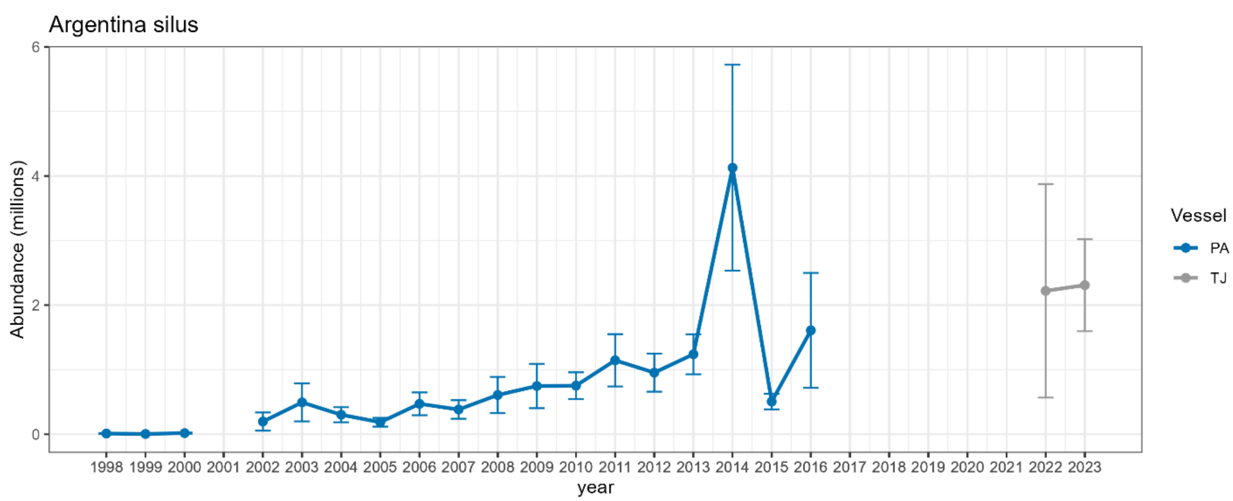


Figure 11. Distribution of survey catches of greater argentine (ARU) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023.

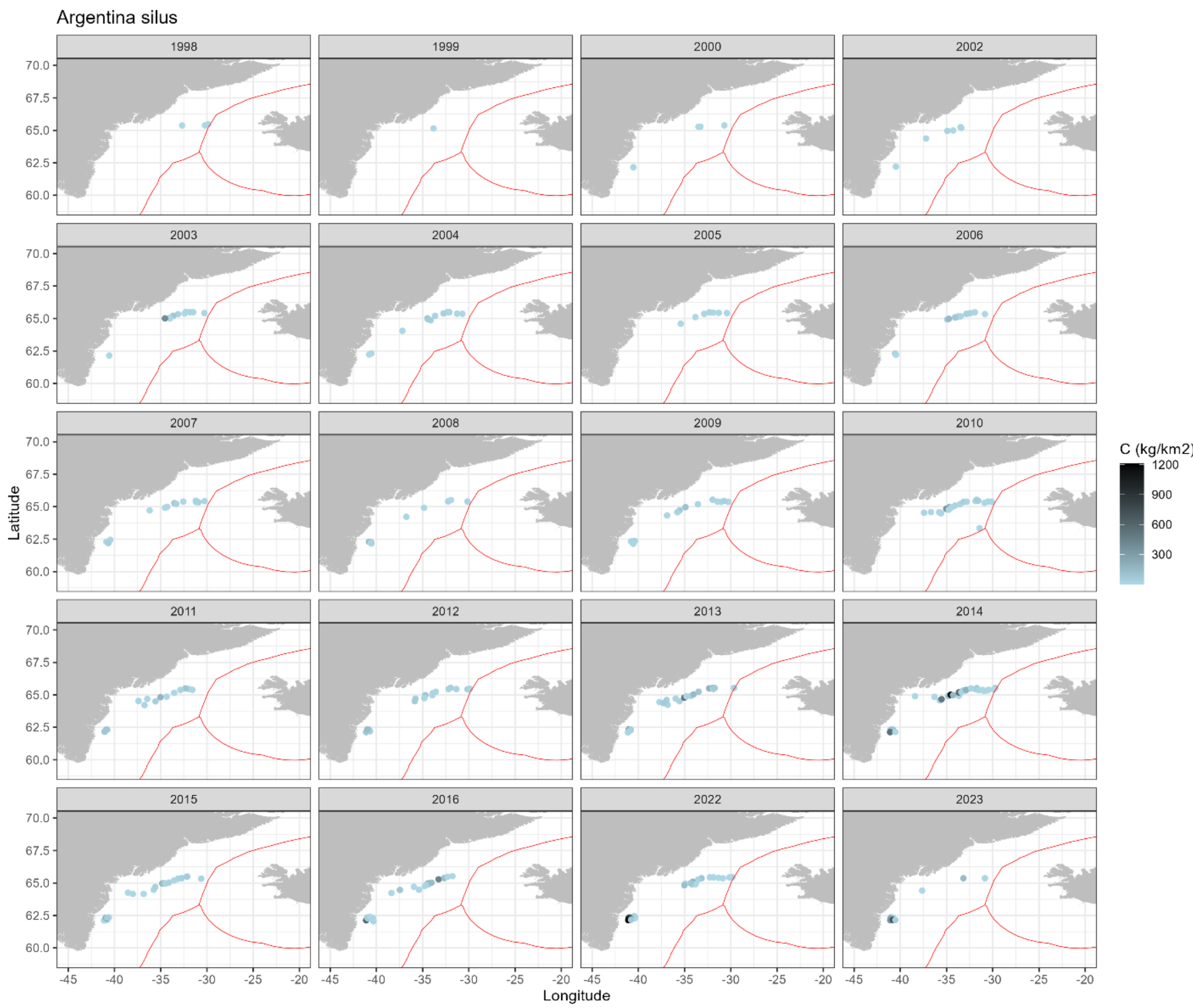


Figure 12. Length frequency distribution per swept area of greater argentine (ARU) for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

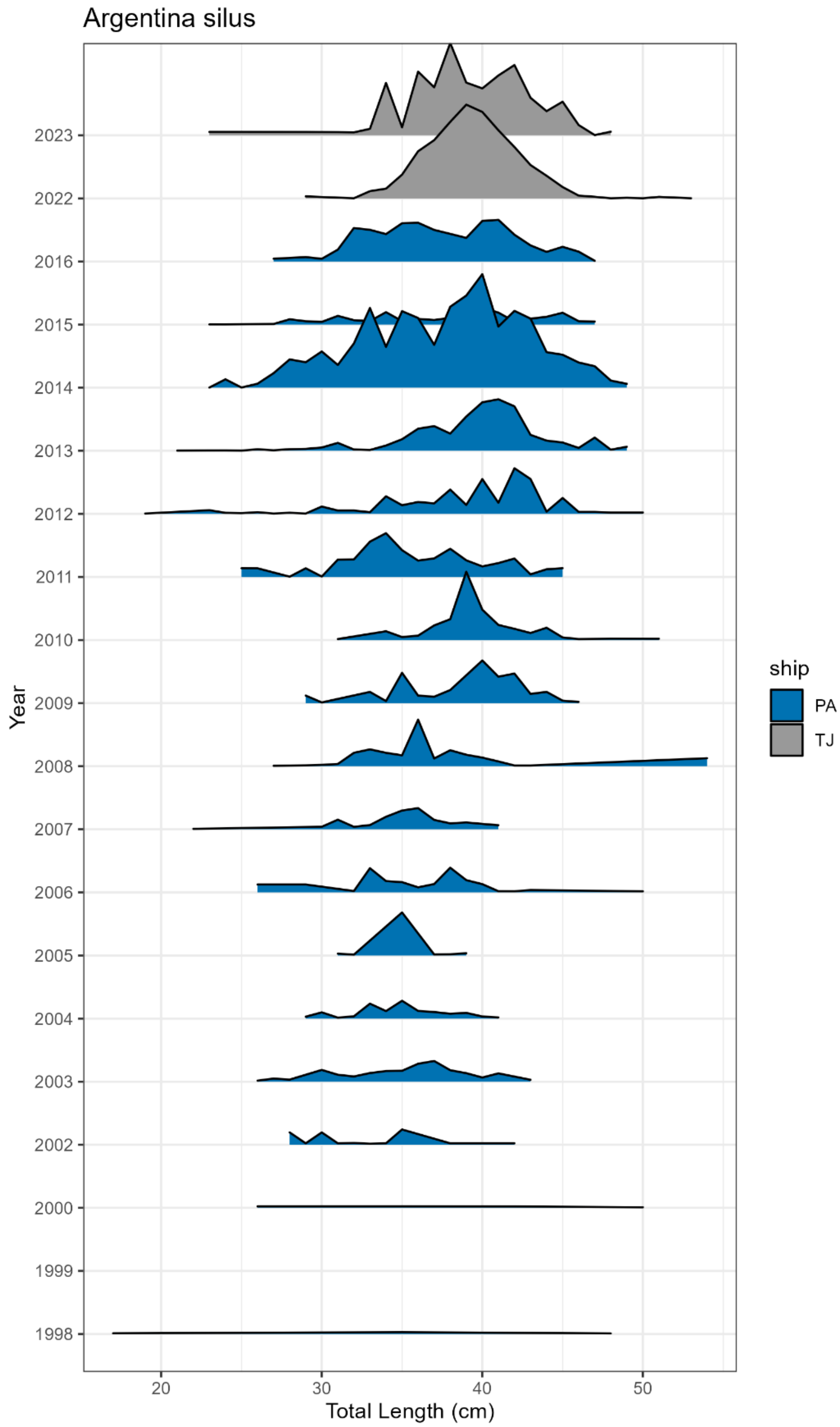


Figure 13. Tusk (USK) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

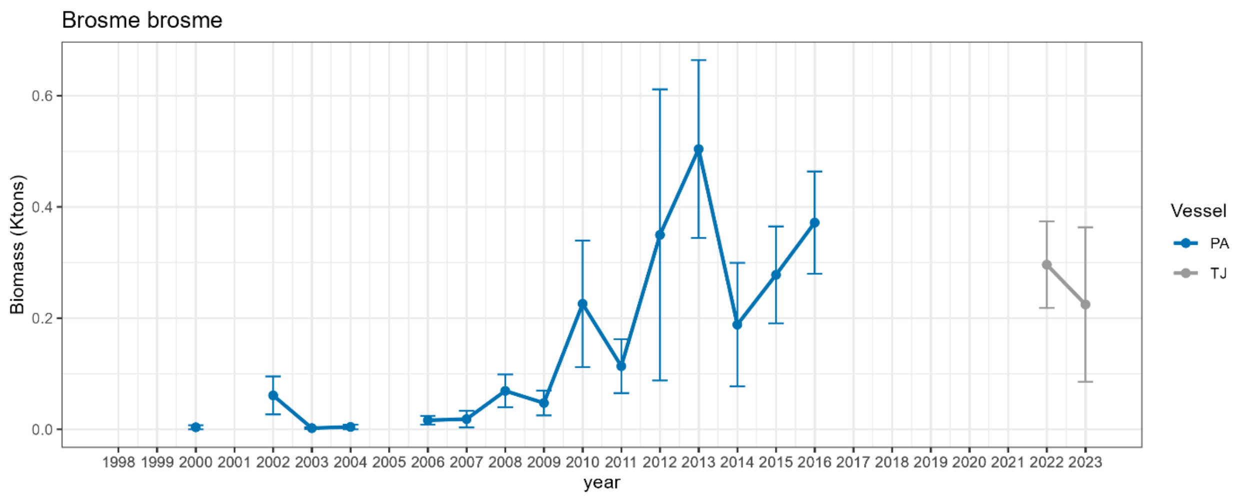


Figure 14. Tusk (USK) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

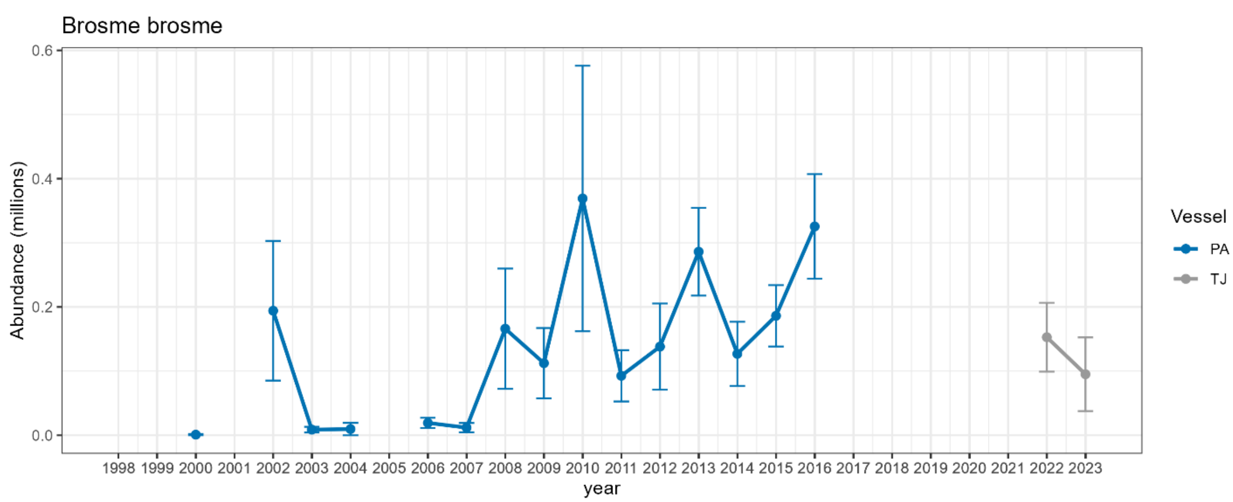


Figure 15. Distribution of survey catches of tusk (USK) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023 (no catch of this species in years that are not plotted).

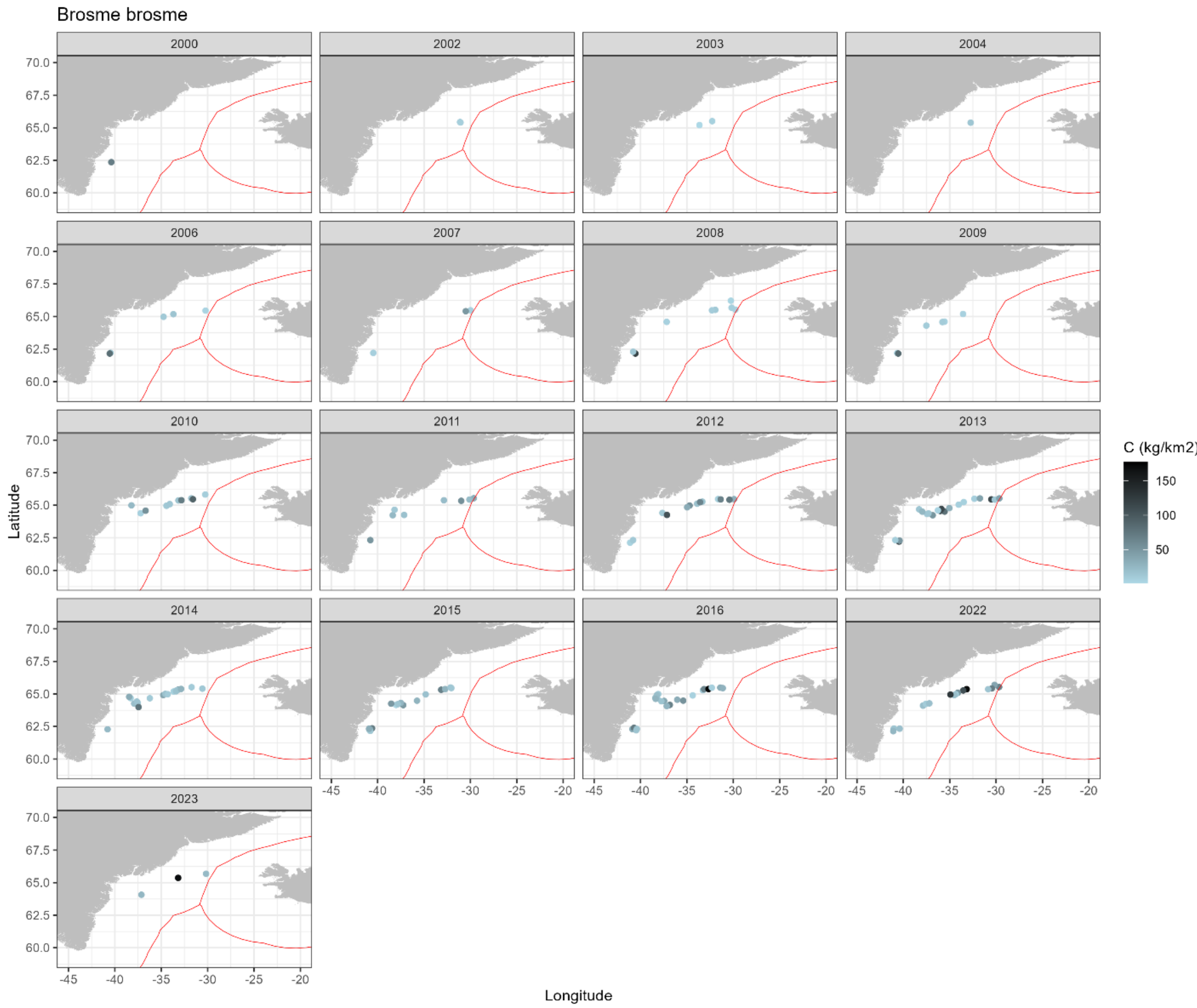


Figure 16. Length frequency distribution per swept area of tusk (USK) for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

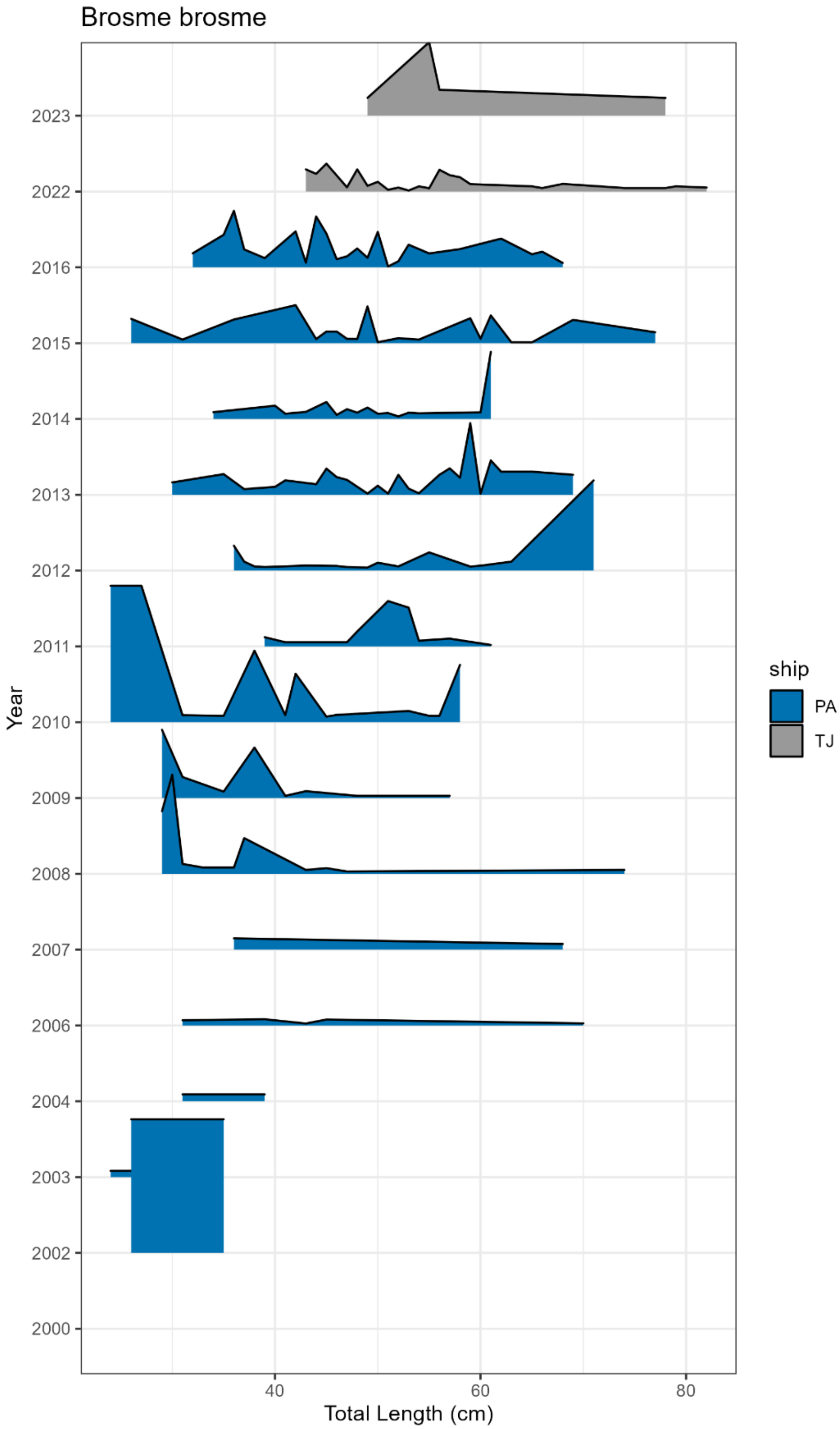


Figure 17. Blue ling (BLI) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

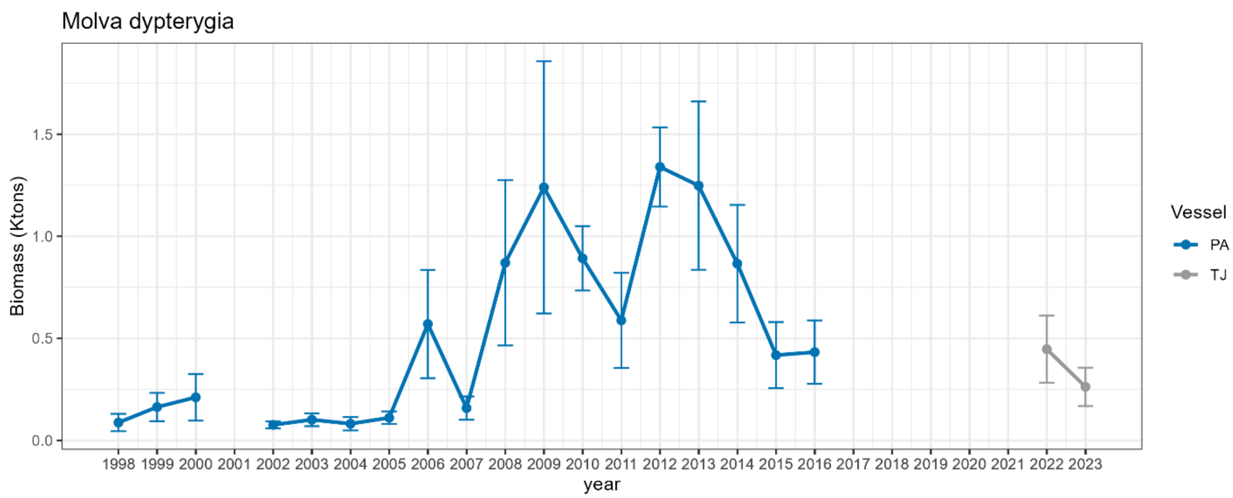


Figure 18. Blue ling (BLI) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

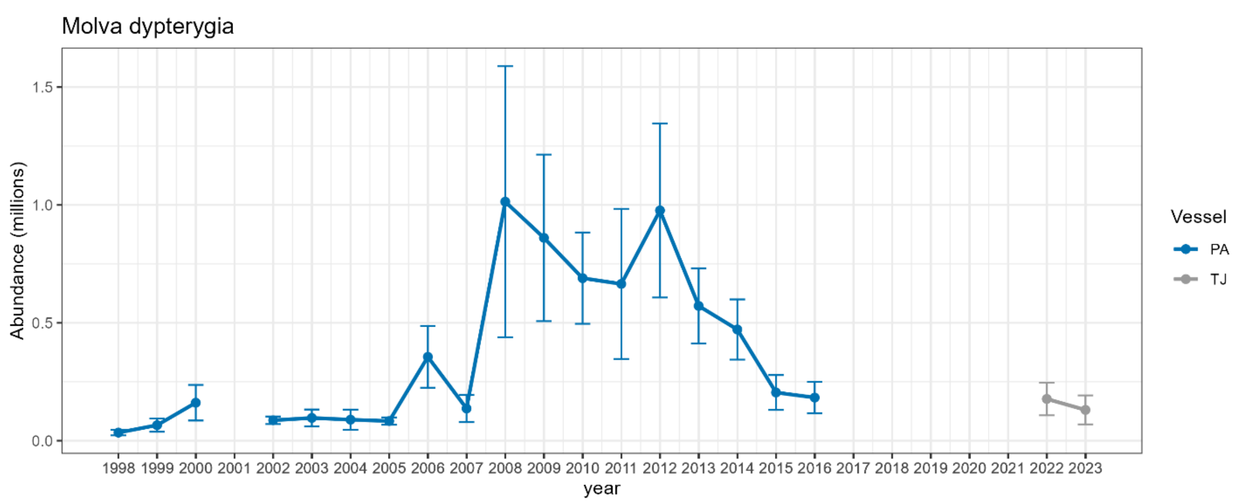


Figure 19. Distribution of survey catches of blue ling (BLI) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023.

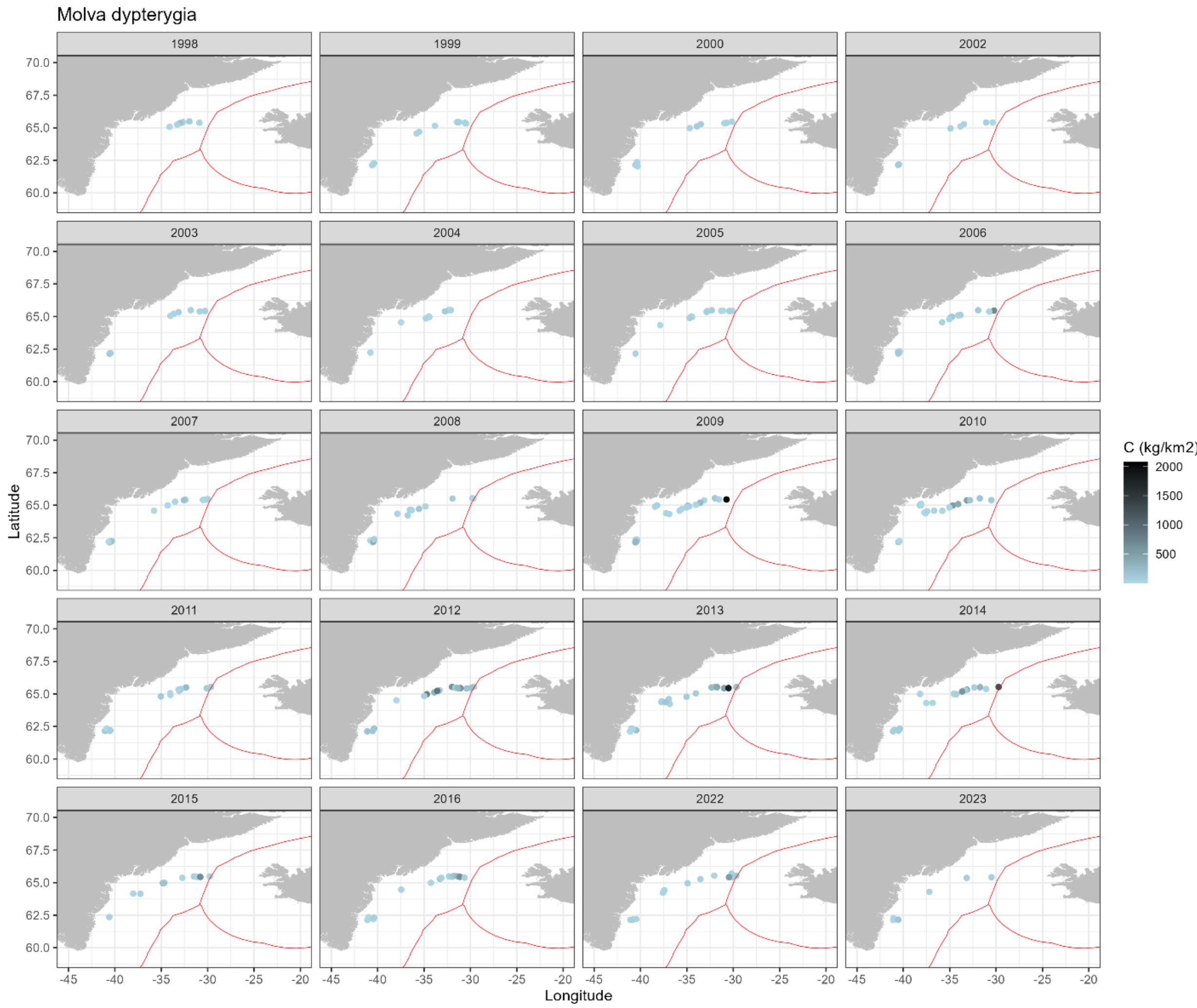


Figure 20. Length frequency distribution per swept area of blue ling (BLI) for the period 1998-2019 on board RV Paamiut and 2022-2023 on board RV Tarajoq.

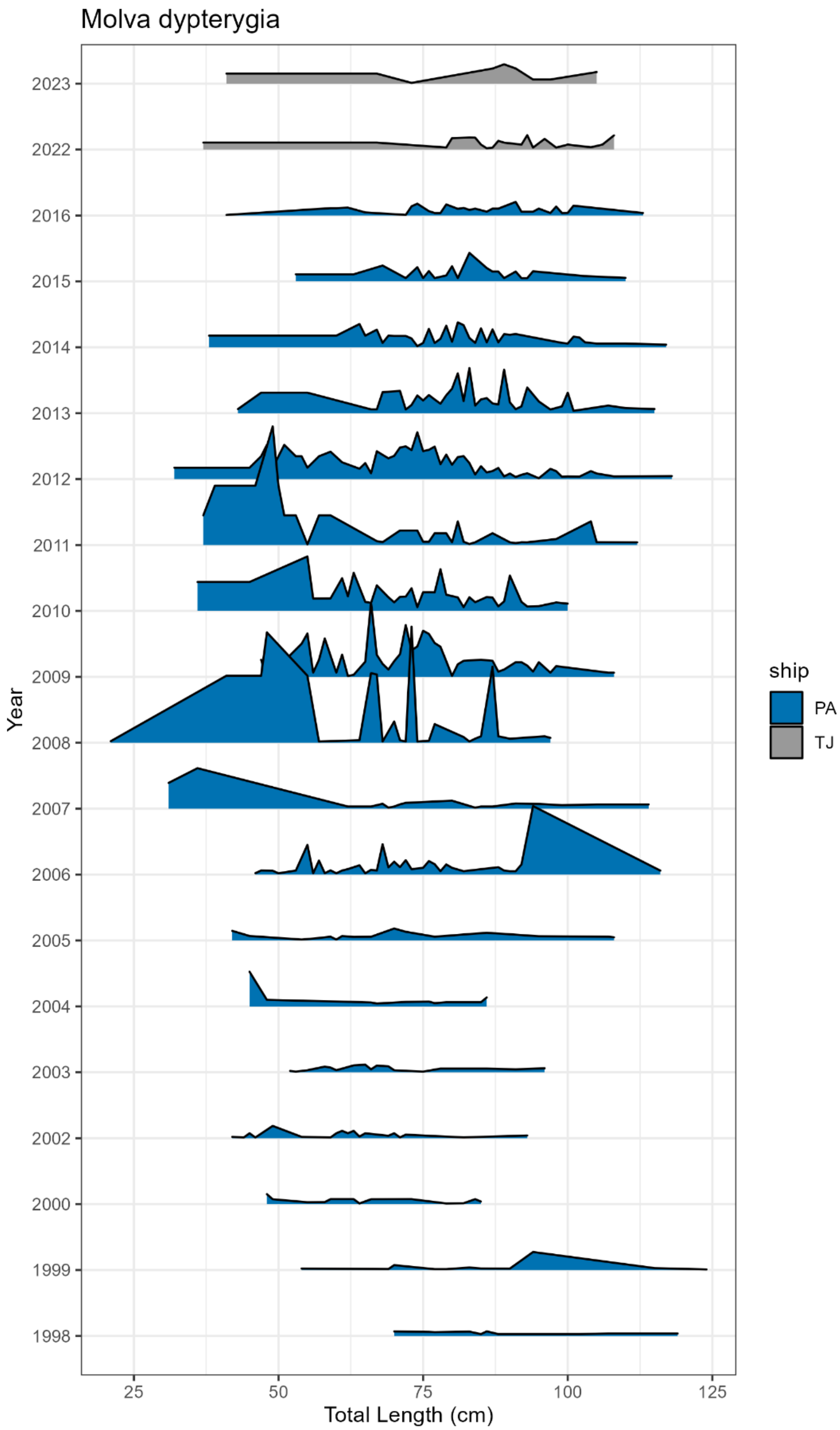


Figure 21. Black scabbardfish (BSF) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

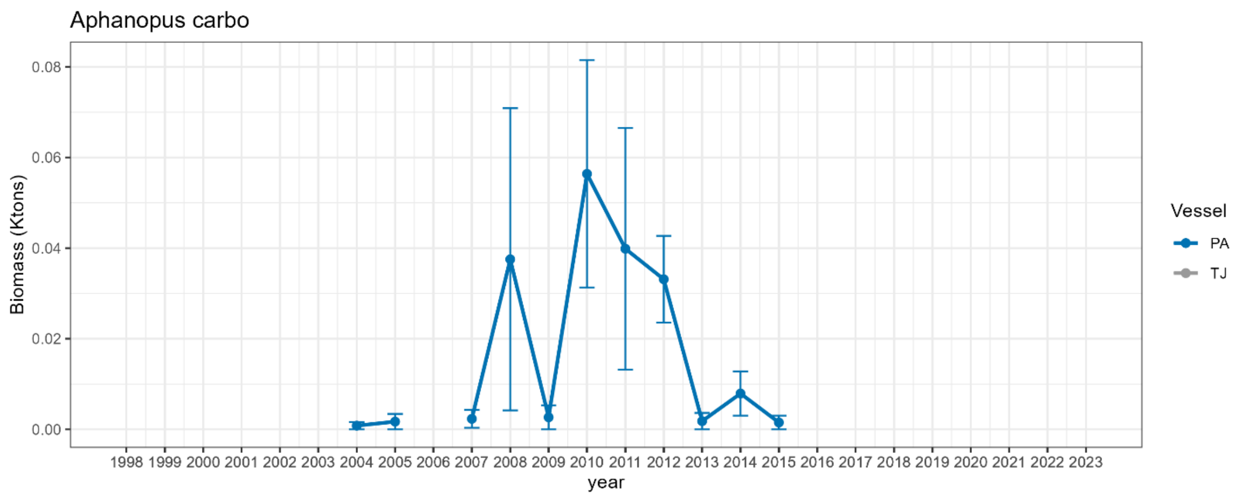


Figure 22. Black scabbardfish (BSF) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

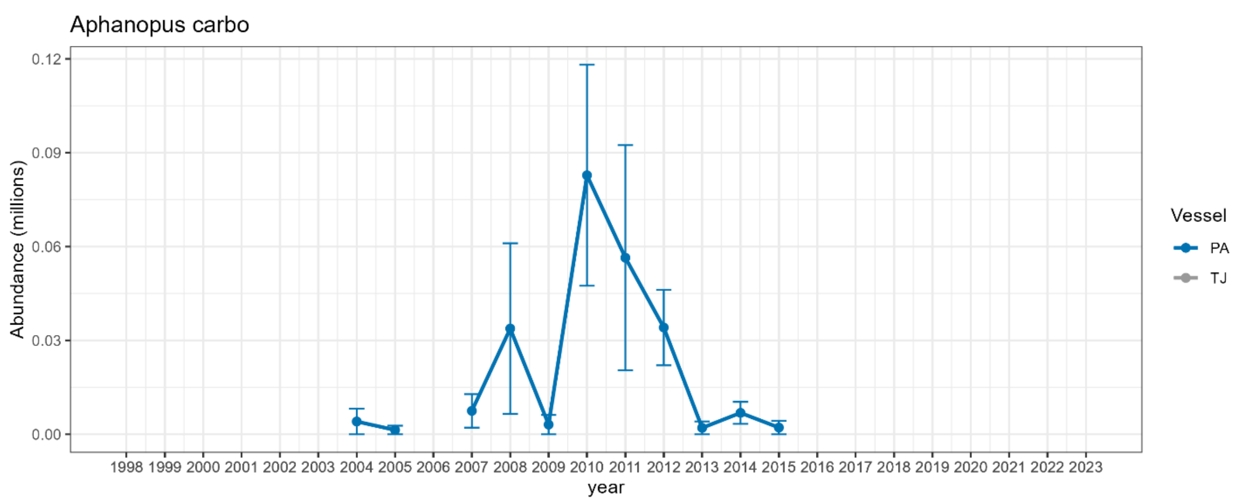


Figure 23. Distribution of survey catches of black scabbardfish (BSF) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023 (no catch of this species in years that are not plotted).

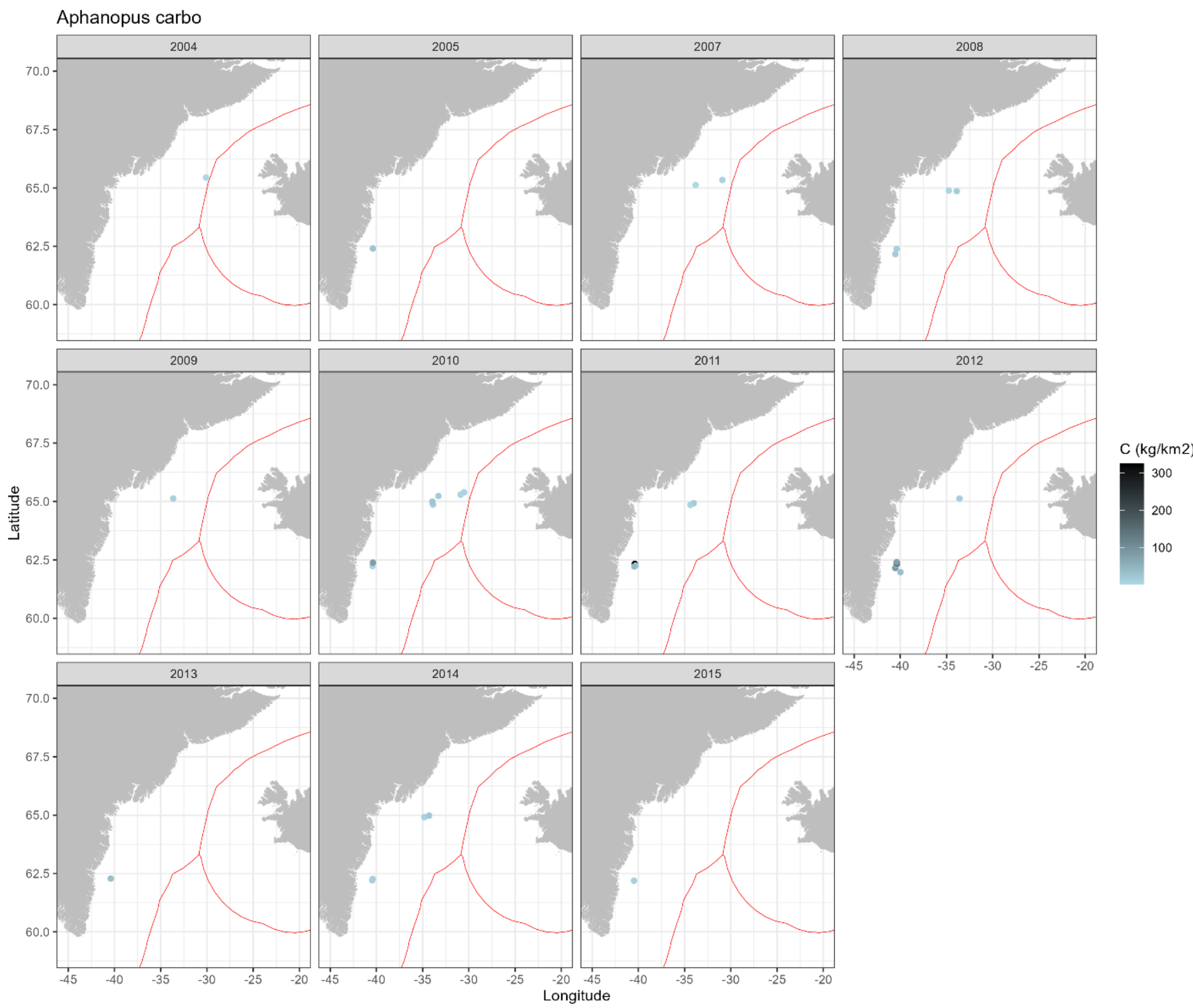


Figure 24. Ling (LIN) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

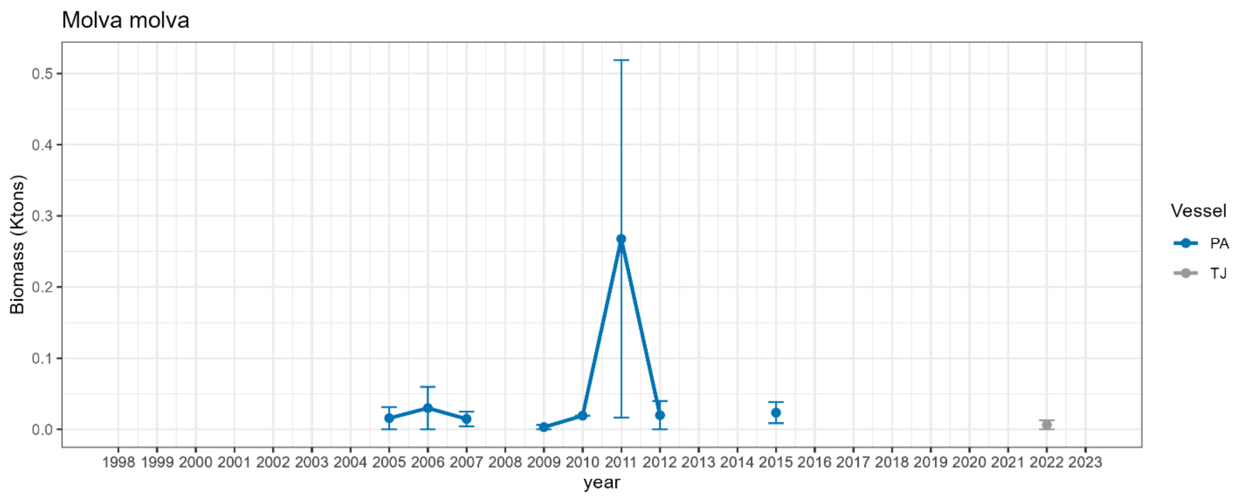


Figure 25. Ling (LIN) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

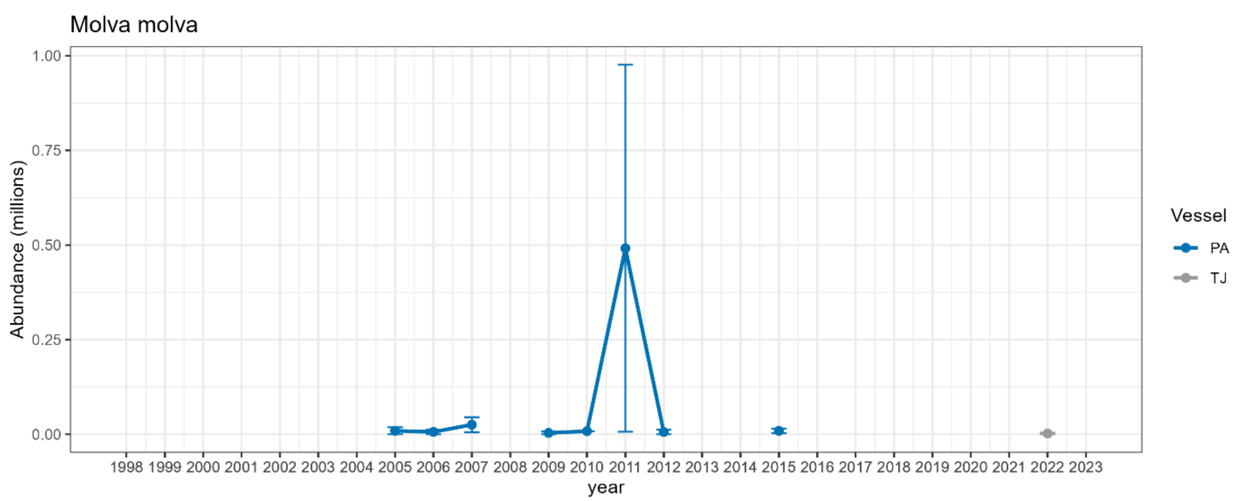


Figure 26. Distribution of survey catches of ling (LIN) off East Greenland (ICES 14.b) from 1998-2016 and 2022-2023 (no catch of this species in years that are not plotted)**.**

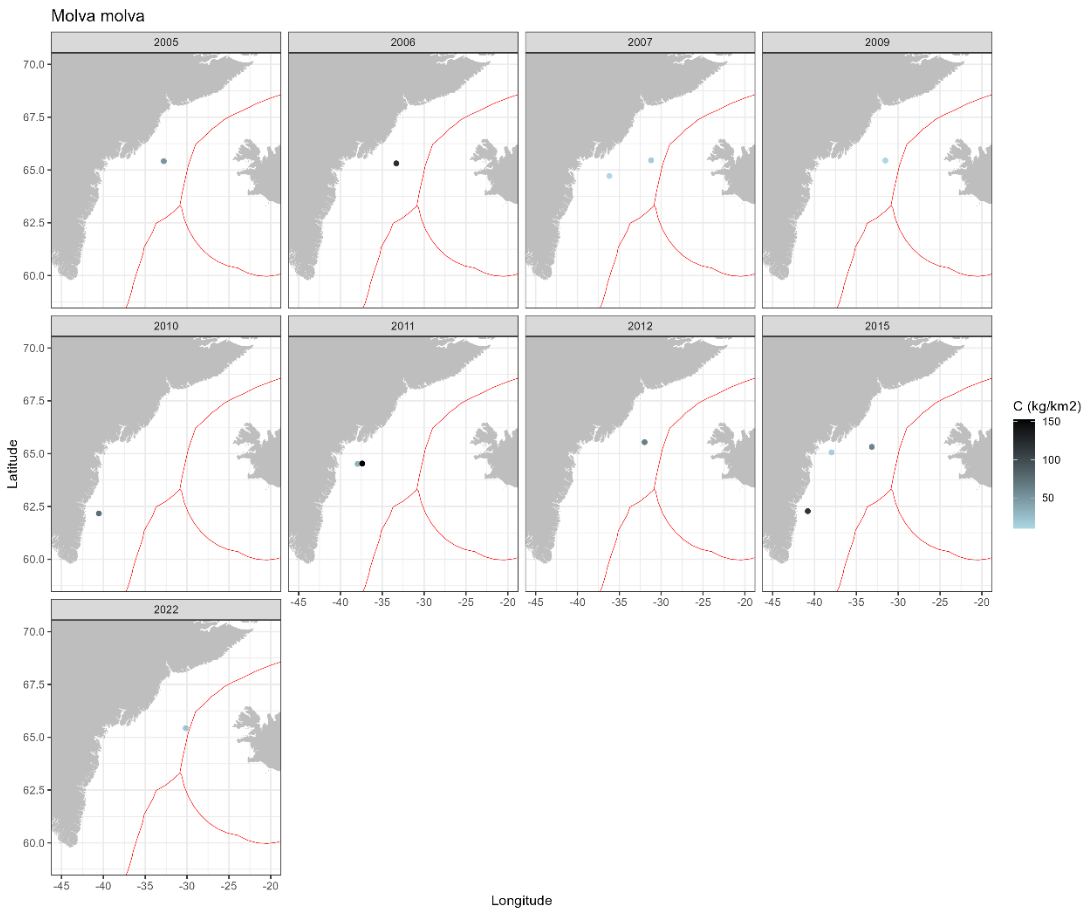


Figure 27. Orange roughy (ORY) biomass (tonnes) calculated by swept area method in tonnes and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

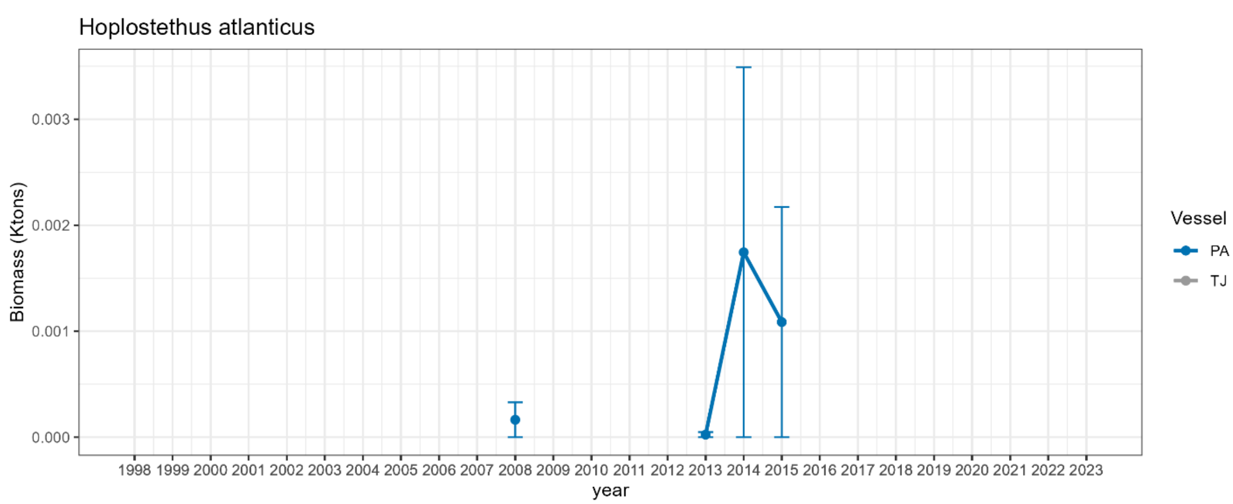


Figure 28. Orange roughy (ORY) abundance ('000s) calculated by swept area method and +/- S.E. by year for the period 1998-2016 on board RV Paamiut and 2022-2023 on board RV Tarajoq (no catch of this species in years that are not plotted).

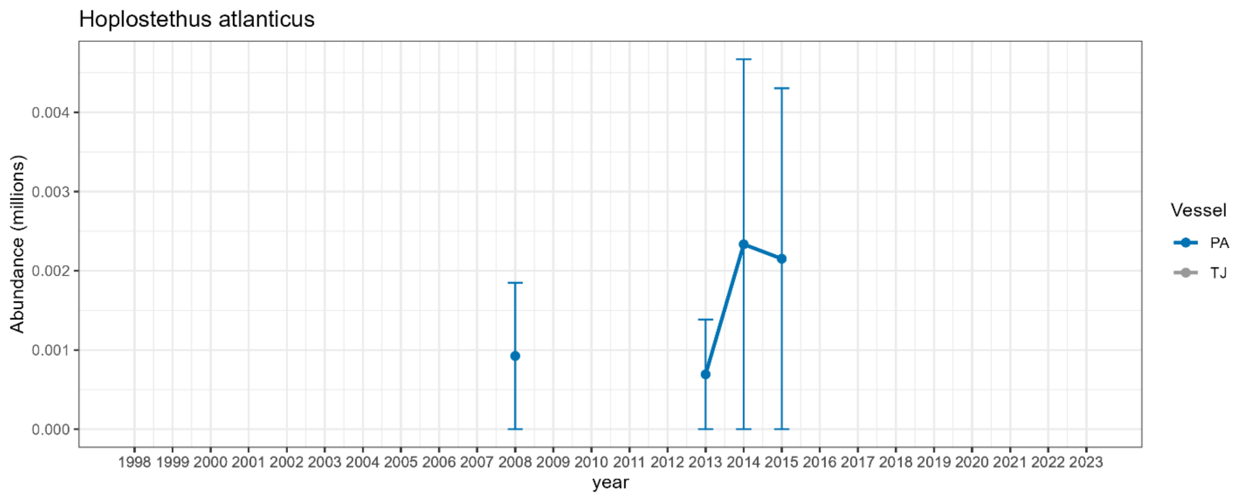
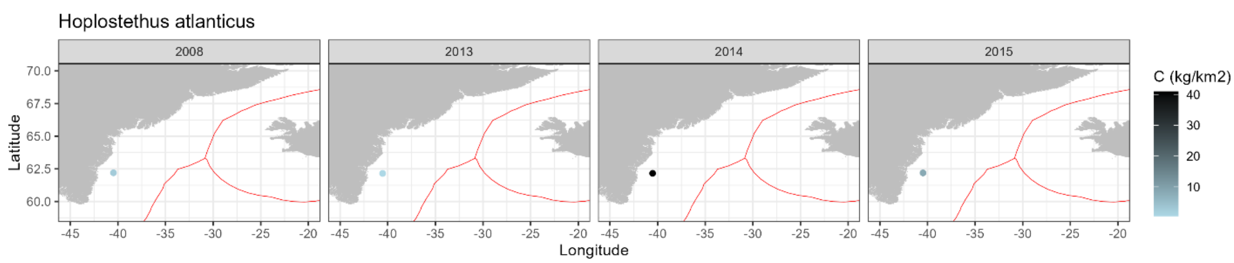


Figure 29. Distribution of survey catches of orange roughy (ORY) off East Greenland (ICES 14.b) in 1998-2016 and 2022-2023 (no catch of this species in years that are not plotted).



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Black scabbardfish in Northeastern Atlantic (Northern component)

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1. INTRODUCTION

Aphanopus carbo (black scabbardfish) is a bathypelagic species with a wide distribution along the North Atlantic. In the North Atlantic, the species occurs between 30ºN and 70ºN, from the strait of Denmark to Western Sahara, with greatest abundance to the South of the Faroe Islands, in the Rockall Trough, to the west of mainland Portugal, and around Madeira and the Canary archipelagos. It occurs only sporadically north of the Scotland-Iceland-Greenland ridges. The species which can be found at depths from 200 m, in the northern section of the NE Atlantic (Nakamura and Parin, 1993; Kelly et al., 1998), to 2300 m around the Canary Islands (Pajuelo et al., 2008). Despite this wide bathymetric range, it is more frequent between 800 and 1800 m in mainland Portugal (Martins et al., 1989), 800 and 1300 m in Madeira (Bordalo et al., 2009A & B), and 400 and 1400 m of the West of the British Isles (Morales-Nin et al., 2002; Allain et al., 2003).

Since 2003, the management of black scabbardfish fishery, adopted for EU vessels fishing in EU and international waters, includes a combination of TAC and licensing system (ICES, 2023). In 2016 the EU ban on bottom trawling in European waters at depths deeper than 800 m (Regulation (EU) 2016/2336) impacted the fishing activity of trawlers. This Regulation impacted the activity of French deep-water trawlers, as some of the fishing grounds traditionally exploited for catching black scabbardfish are now prohibited.

The black scabbardfish model accepted by ICES to monitor the stock and to provide scientific advice is fishery dependent and the major data contributor for the northern component derives from French trawlers.

The present document summarizes a preliminary data analysis on the impact of the EU Ban of Bottom trawling on the black scabbardfish data for the Northern component. In particular, it addresses the following aspects of fishing fleet behavior before and after the EU ban, spatial distribution of fishing effort through time.

1.1. Stock

For management purposes and scientific advice the International Council for the Exploration of the Sea (ICES) considers three assessment units (ICES, 2011, 2021):

i. Northern (divisions 27.5.a, 27.5.b and 27.12.b and subareas 27.6 and 27.7);
ii. Southern (subareas 27.8 and 27.9);
iii. Other areas (Division 27.3.a and subareas 27.1, 27.2, 27.4, 27.10, and 27.14).

These management units were defined according to the main fisheries catching black scabbardfish occuring at the time; the Northern component corresponds mainly to trawl fisheries while the southern component is dominated by longline fisheries.

1.2. ICES latest advice

In 2022, the advice was: “when the precautionary approach is applied, catches should be no more than 4214 tonnes in each of the years 2023 and 2024”.

2. FRENCH TRAWLER DATA

The fishery data used in the analysis refers to the period between 2002 and 2022, thus including years before and after the adoption of EU Ban.

These data include the following variables:

- VESSEL_FK: Vessel id (21 different vessels, one of which with only 12 observations)
- SEQ: Sequential number that represents each fishing operation
- BSF: black scabbardfish landings*
- allSP: total landings (all species)
- YEAR
- MONTH
- DAY
- ENGIN_FAO_COD : DCF gear CODE (OTB only)
- RECT: ICES rectangle
- depthClass: such that 450 means depth band 400-500
- FISHING_DURATION (FISHING_TIME): in hours
- Power.Main: vessel power

*given the low levels of discarding, it is admitted that landings of black scabbardfish correspond to catches.

For the following analysis purposes fishing operations performed by the same vessel on the same day are considered to belong to a fishing haul.

3. DATA ANALYSIS

The initial analysis of the number of the different bottom trawlers, total number of fishing operations and total catch of black scabbardfish by year (Figs. 1 - 3) suggest three different time periods of fishing activity

1. 2002-2010 - High number of fishing operation;
2. 2011-2016 - High total catch of black scabbardfish;
3. 2017-2022 - After the EU bottom trawl ban.

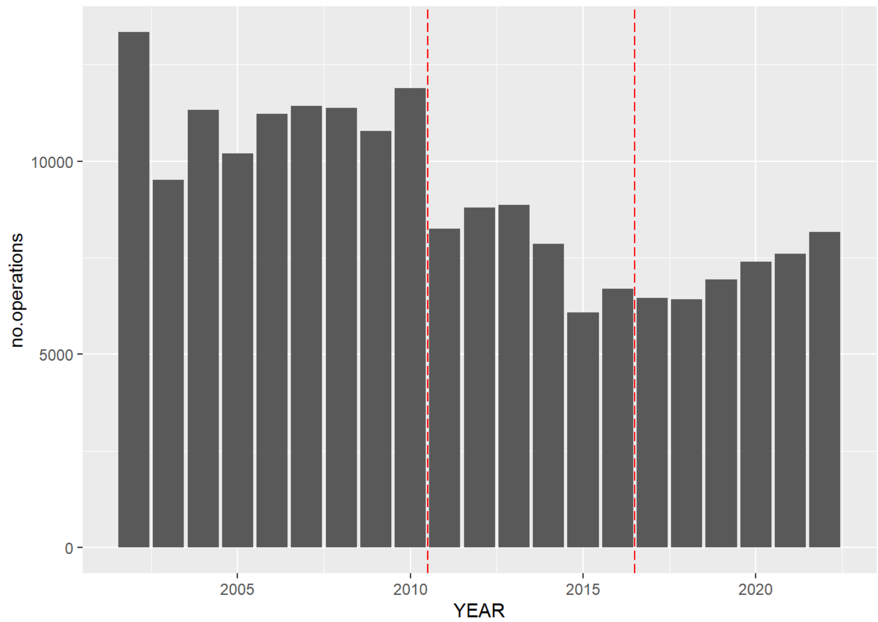

Figure 1. Black scabbardfish annual total number of fishing operations derived from fishing vessels that have had fishing operations with positive catches of black scabbardfish. Period 2002 - 2022. Vertical red lines show limits for the three different time periods.

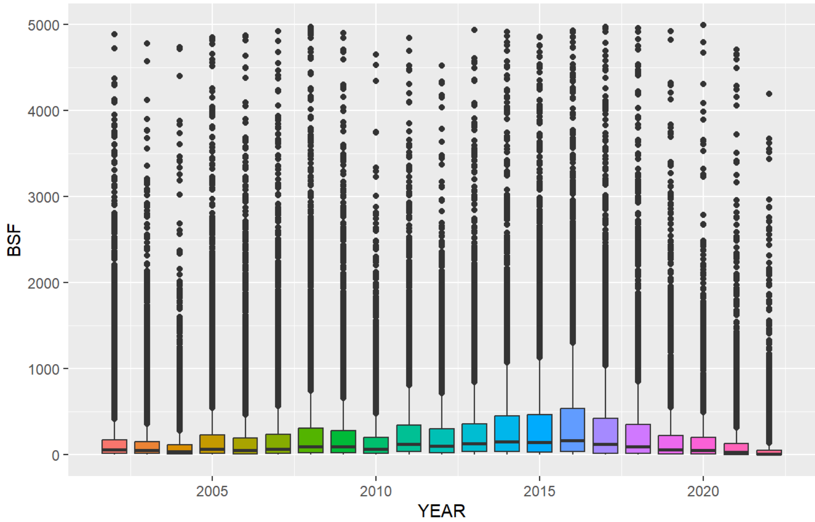

Figure 2. Annual total catch of black scabbardfish derived from fishing vessels that have had fishing operations with positive catches of black scabbardfish. Period 2002 - 2022.

Whilst the median catch per haul is small, large catches of 1 to 5 tonnes occur in few hauls (Figure 2).

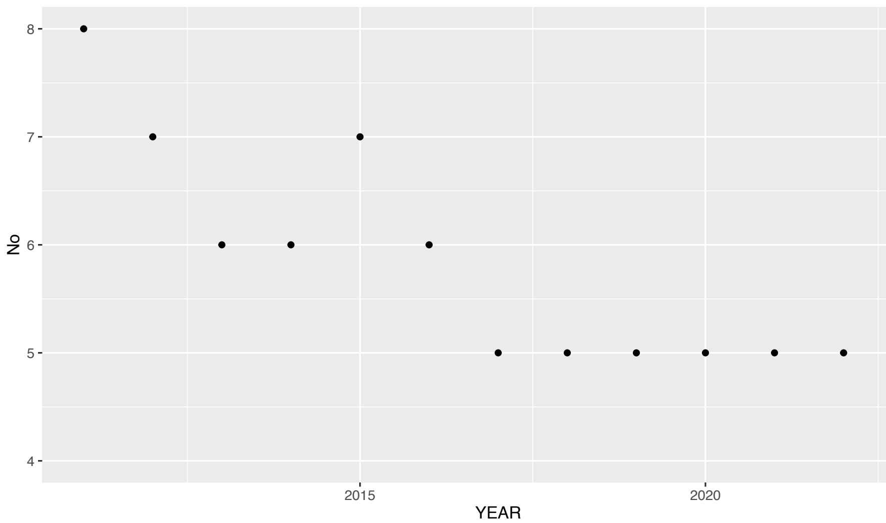

Figure 3. Black scabbardfish total number of vessels with catches of black scabbardfish by year.

The ICES rectangles visited by fishing vessels that have had fishing operations with positive catches of black scabbardfish by year and grouped by fishing period are presented in Figure 4. This figure reveals there was a spatial displacement of fishing effort over time particularly in the 3rd period. During this period fishing effort related to black scabbardfish catches is concentrated in the northern area.

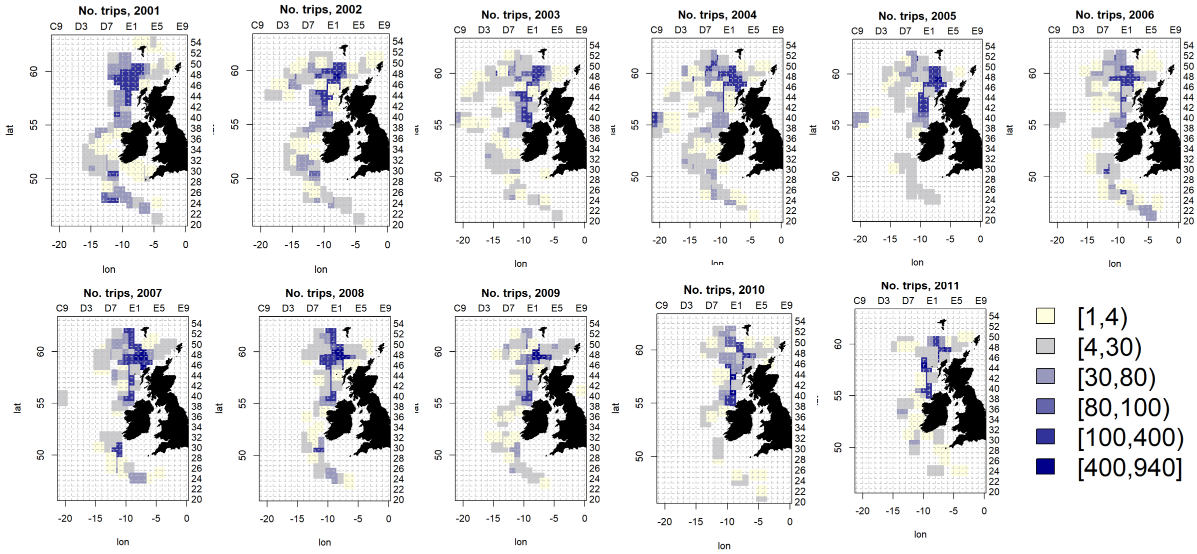

Figure 4a. Number of fishing operations by ICES statistical rectangle derived from fishing activity from trawlers with positive catches of black scabbardfish. Period: period 2002 - 2010, 1st period.

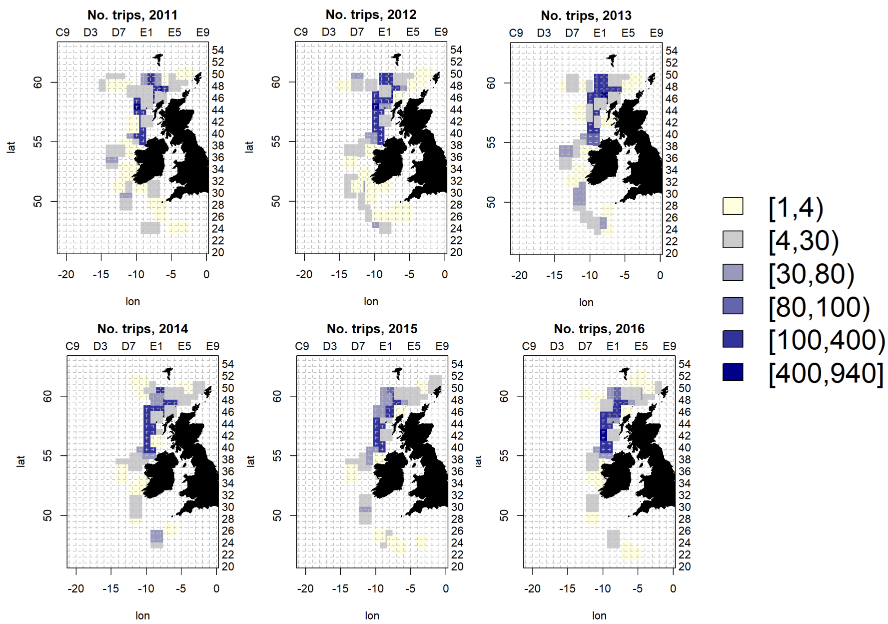

Figure 4b. Number of fishing operations by ICES statistical rectangle derived from fishing activity from trawlers with positive catches of black scabbardfish Period 2011 - 2016, 2nd period.

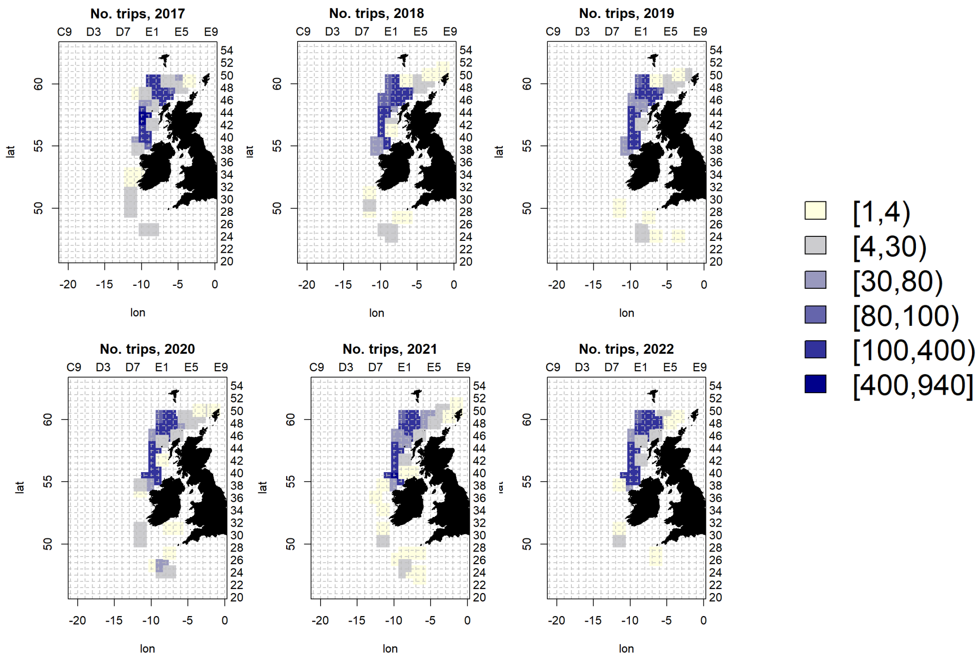

Figure 4c. Number of trips by ICES statistical rectangle derived from fishing activity from trawlers with positive catches of black scabbardfish period 2017 - 2022, 3rd period.

Figure 5 presents the total number of fishing operations for each period. The analysis of this figure clarifies the spatial displacement of the fishing effort, as well as, the fact that the fishing fleet that traditionally catches black scabbardfish moved its activity for shallower waters in areas where the species is unlikely to occur.

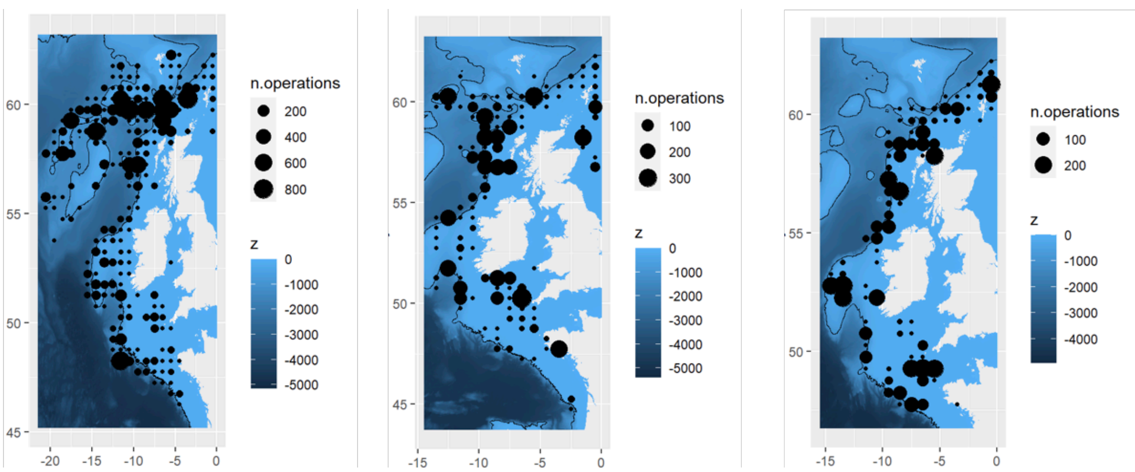

Figure 5. Number of fishing operations by ICES statistical rectangle during 1st period (left panel), 2nd period (middle panel) and 3rd period (right panel). The contour lines represent the 1000 meters bathymetry.

Note that the current CPUE excludes hauls out of the Scottish slope.

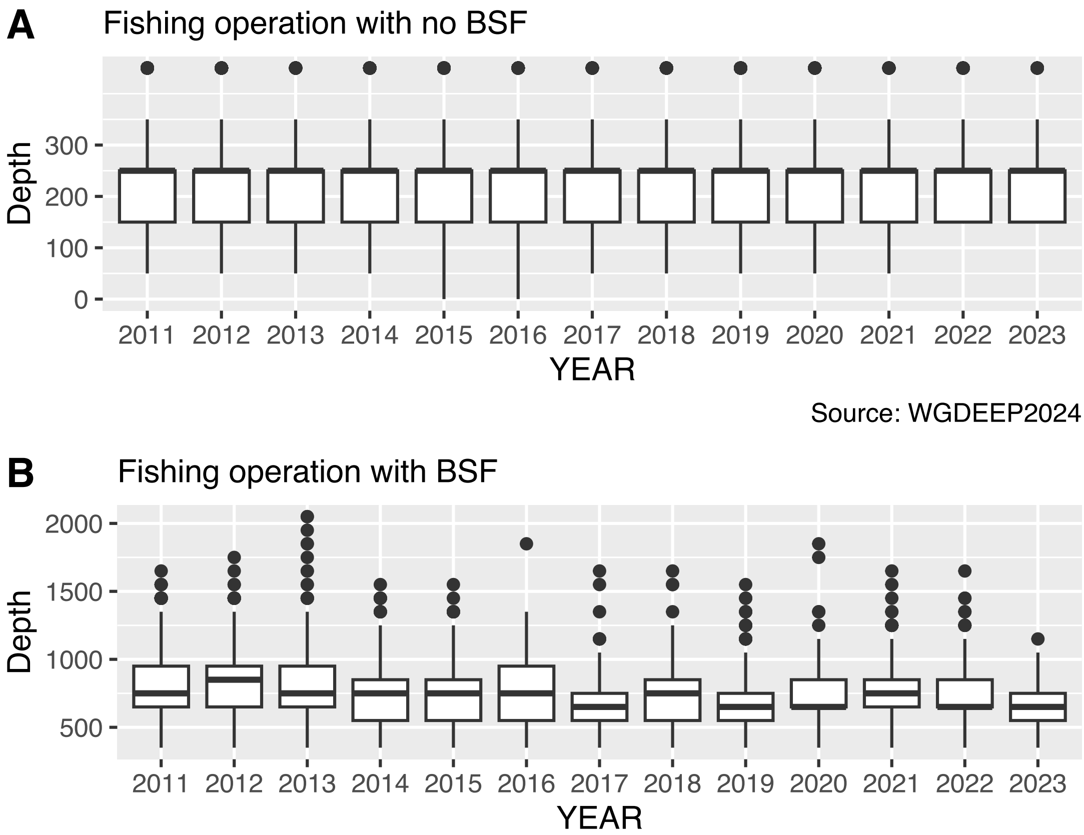

Figure 6. A) Number of fishing operations with zero catches of black scabbardfish (BSF). B) Number of fishing operations with BSF, by depth during the whole period.

The number of operations with zero catches of black scabbardfish (Figure 6) are mainly derived from areas shallower than 250 meters. The depth range corresponds to areas where the species is known not to occur. On the other hand, the fishing operations with positive catches of black scabbardfish are derived from areas with depth greater than 600 meters and in the 3rd period the depth range is narrower them in the previous periods. This difference may result from the costrains imposed by the EU regulation.

The rectangles visited annually and the corresponding number of fishing operations is presented in figure 7. The hovmoller diagram shows the spatial distribution of visited rectangles over time. From the previous analysis, fishing activity in recent years with catches of black scabbardfish is concentrated in the northeast area, an area of oceanographic interest due to its dynamics and complex bathymetry (Figure 5).

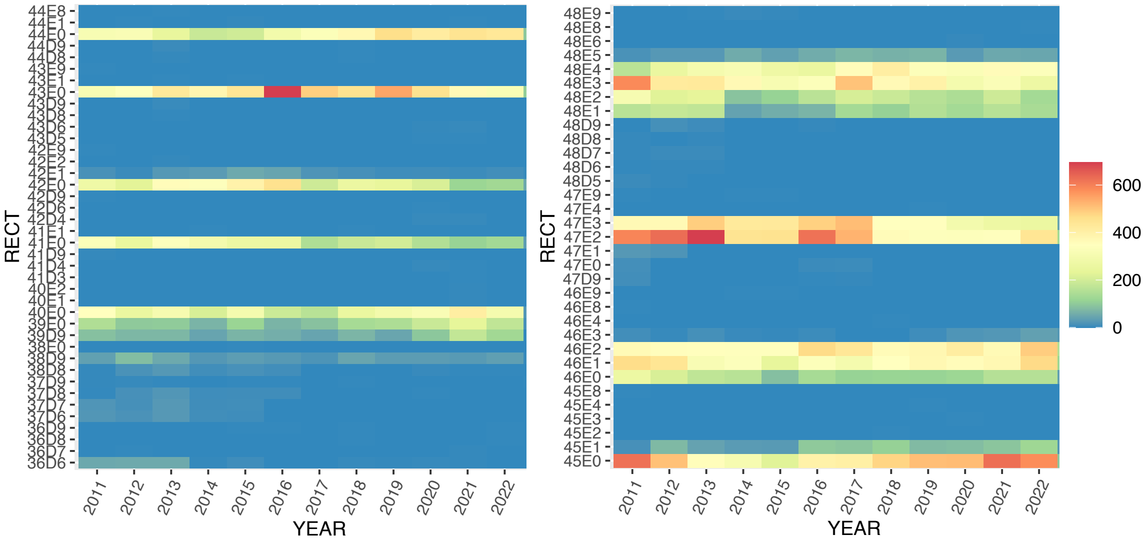

Figure 7. Hovmollers diagram of the annual total number of fishing operations derived from fishing vessels that have had fishing operations with positive catches of black scabbardfish by ICES rectangles. The RECT is the ID of each ICES rectangles during the whole period (2002 - 2022).

The following analysis focuses on the impact of the EU ban on the French deep-water bottom trawl fishery by considering the 2nd and 3rd period only. For this purpose fishing hauls are considered. Fishing haul correspond to a combination of vessel and date, i.e.,

fishing haul_i <> vessel_i xdate_i

The variables under study are:

- **Number of fishing hauls;**
- **Time duration of each fishing haul;**
- **Total catch** of black scabbardfish;
- **Mean the total catch** of black scabbardfish by fishing haul.

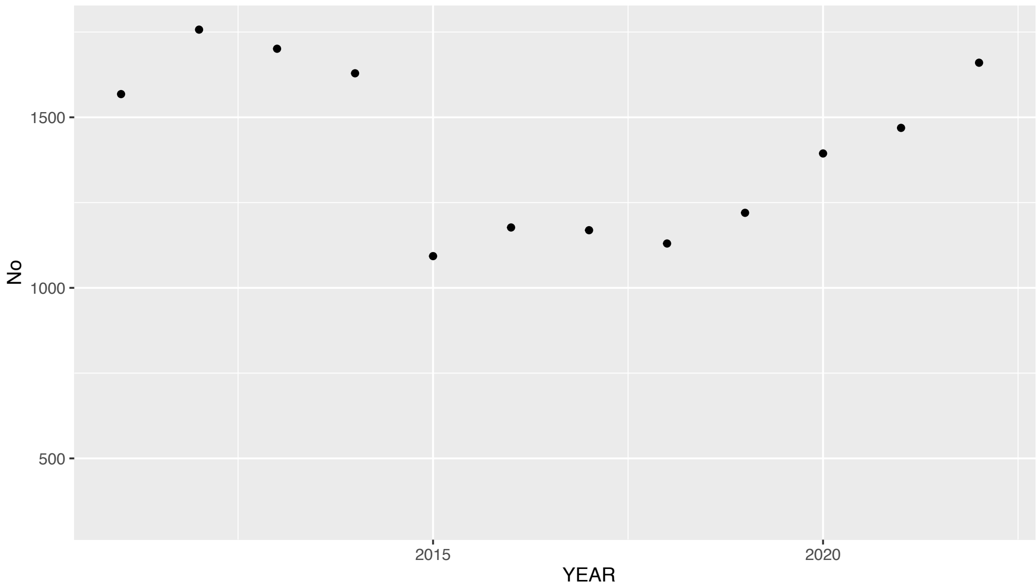

Figure 8. Number of fishing hauls by year for the at 2nd and 3rd period (2011 - 2022).

The number of **fishing hauls per year** has increased after 2016, the year of EU ban (Figure 8). However given the previous analyses this increase appears to be closely related to a displacement of the fishing activity to shallower waters, most of them areas where the black scabbardfish does not occur.

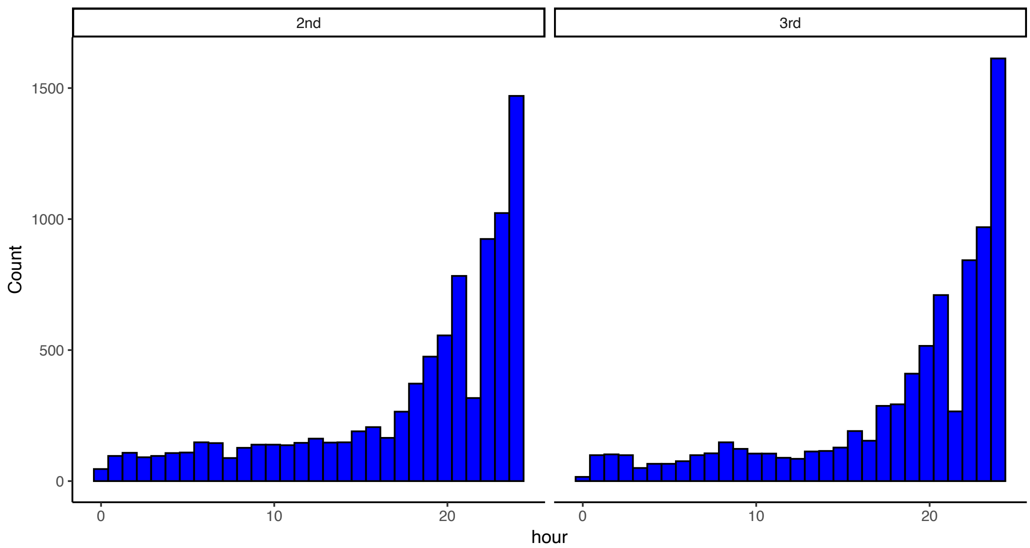

Figure 9. Distribution of the time duration of fishing haul per year. Left panel: 2nd period (2011 - 2016). Rigth panel: 3rd period (2017 - 2022).

The distribution of **time duration of fishing haul** changed from the 2nd to the 3rd. In the latter, the tail of the distribution is heavier at the left (i.e. shorter time) (Figure 9). This is likely to be related to an increase of fishing activity in shallower waters in areas where the black scabbardfish does not occur.

The decrease of the fishing effort from the 2nd to the 3rd reflects the reduction of fishing vessels that traditionally catch black scabbardfish (Figure 3), after the implementation of the the EU Ban regulation.

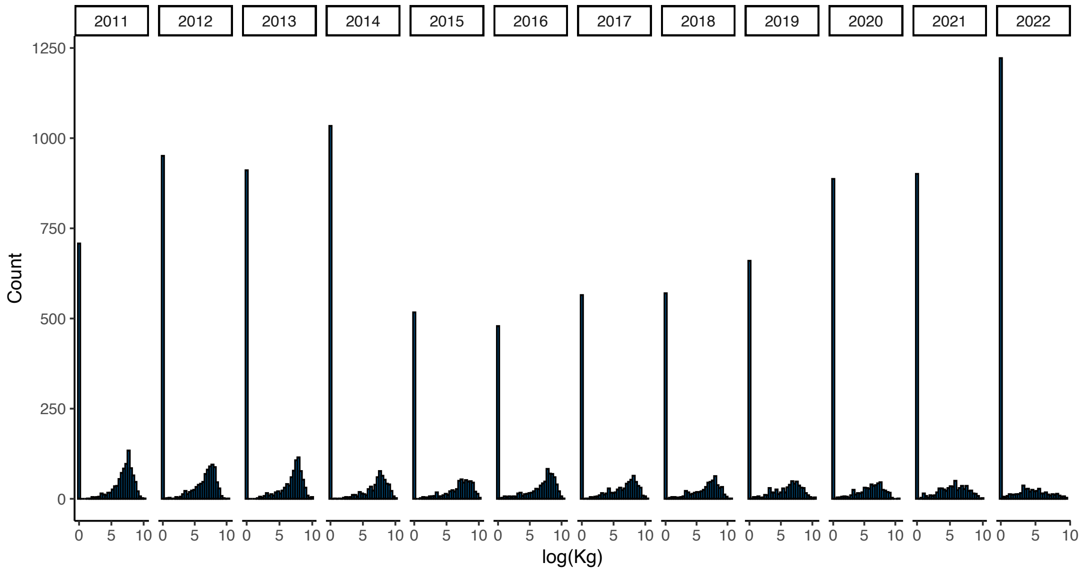

Figure 10. Distribution of the total catchesweigth of the black scabbardfish by fishing haul per year.

The **mean catch weight of black scabbardfish per fishing haul** has decreased after 2016 (Figure 10). Given the trends of previous variables this pattern is unlikely to be related to a potential decrease of black scabbardfish abundance but it appears to strongly reflect changes in fishing activity.

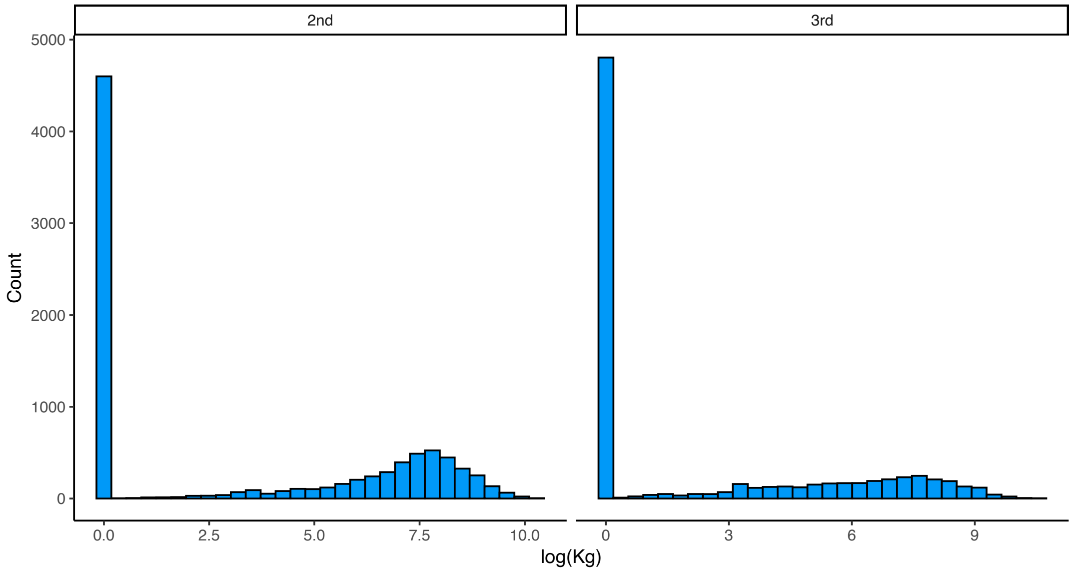

Figure 11. Distribution of the total landed weigth of the black scabbardfish by fishing haul per period. Left panel: 2nd period (2011-2016). Rigth panel: 3rd period (2017 - 2022).

The number of fishing haul with no catches of black scabbardfish has increased in recent years particularly after 2019 (Figure 10). The distribution of the logarithm of **total weight of black scabbardfish by fishing haul** changed during the 3rd period (Figure 11).

A deeper anaylsis of the environmental conditions in areas, where in recent years, black scabbardfish is caugth, provides information to the temporal and spatial evolution of black scabbardfish abundance.

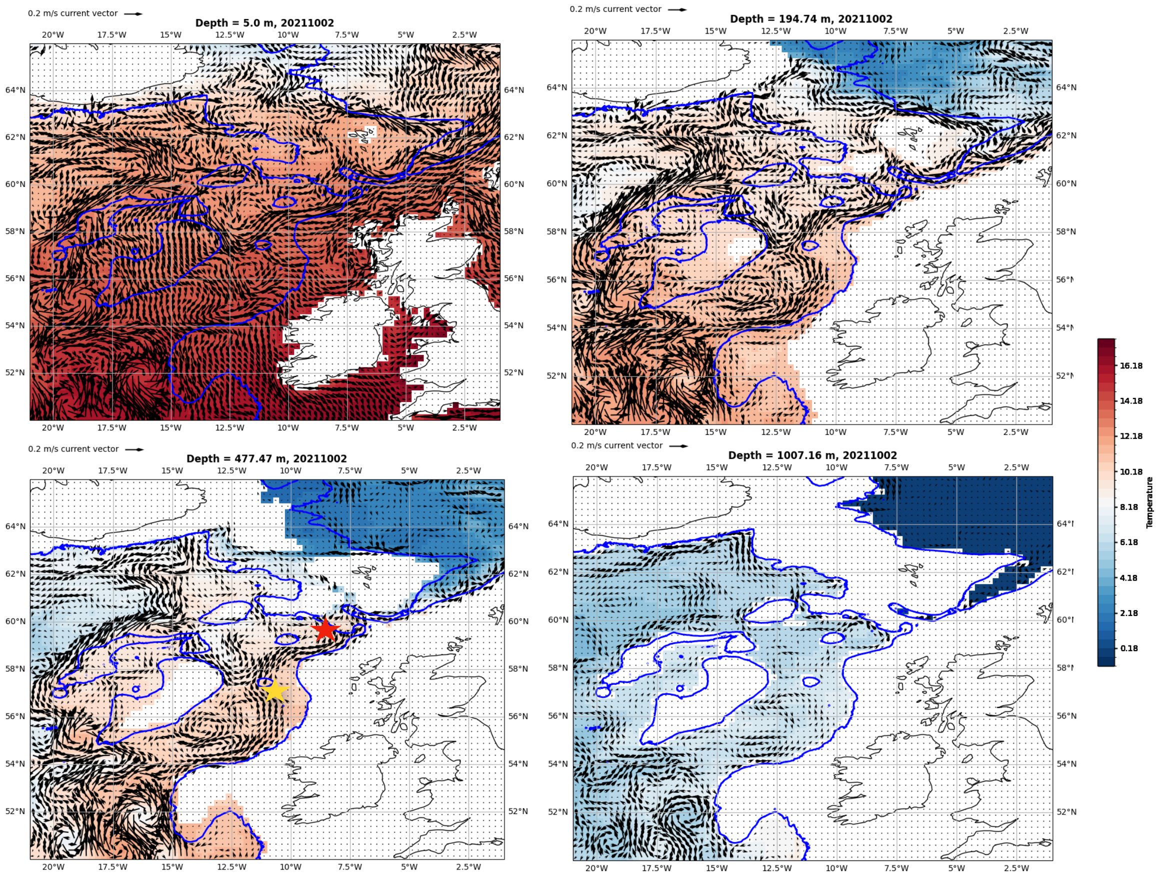

Figure 11a. Spatial distribution of the temperature at differentes depths from the ECCO model. The figure correspond at the 1st of October 2021. Top panel left: Depth at 5 meters. Top panel rigth: Depth at 194 meters. Bottom panel left: Depth at 447 meters. Bottom panel rigth: Depth at 1007 meters. The current vectors are represented as blue arrows. The blue contour lines represent the 1000 meter sbathymetry.

The areas where the fishing effort is concentrated in a region with a characteristic bathymetry, which causes an intense slope current on the margin of the continental shelf. A preliminary analysis of the oceanographic variables is presented in figures 11a-b. This analysis was made using the high resolution model, ECCO/*Estimating the Circulation and Climate of the Ocean* (Wunsch etal., 2009).

The temperature pattern reveals changes in depth that seem to respond to dynamic processes in the southern region and intrusions of cold water conditioned by the bathymetric characteristics are observed in the northeastern region.

To recognize changes in temperature at depth two vertical profiles were selected. These are represented during the months of January, June and October (Figure 11b). Seasonal variability is evident in the profiles in both regions, however what is most striking is seeing how during the month of October the surface stratification becomes more superficial.

Exploring anomalies in the vertical distribution in this region is of special interest to recognize their impact on the abundance of the species.

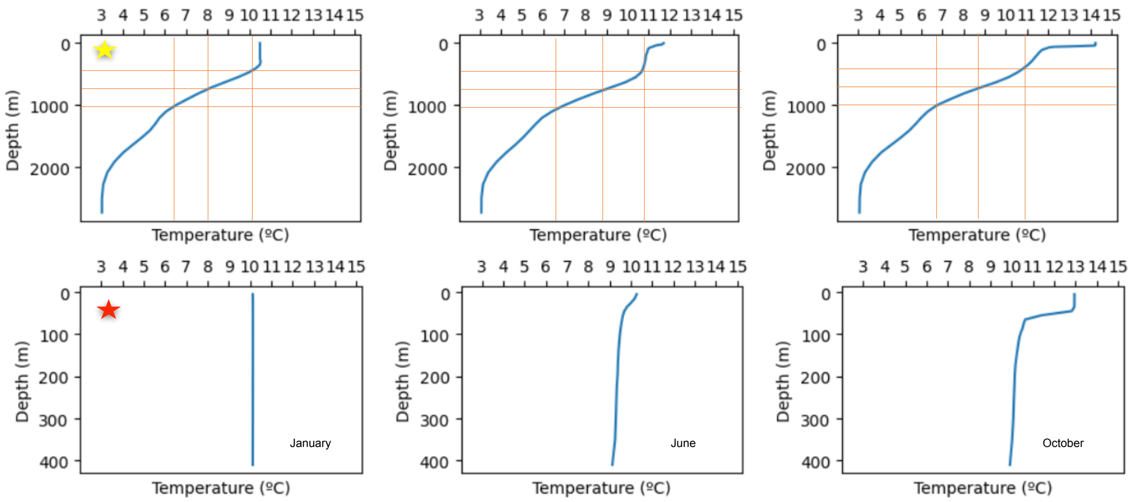

Figure 11b. Vertical profile of the temperature from the ECCO model. The star-shaped marks correspond to the locations of the profiles, previously identified in Figure 11a.

4. CONCLUSIONS

The spatio-temporal preliminary analysis of French data, particularly for the period immediately before and after the EU Ban of trawling deeper than 800m indicates a spatial displacement of the fishing activity of the vessels traditionally capturing black scabbardfish. Most of the vessels directed their activity towards species with a shallower distribution than black scabbardfish but a small group of 5 vessels continued to catch the species. In the later case, the species appears to be caught in fishing area shallower than 800m but with topographic and oceanographic conditions suitable for the occurrence of black scabbardfish species. These results encourage further analyses with the aim of monitoring abundance and of estimating fishing effort, required for the adjustment of the accepted assessment model. The recent information from the Scottish survey and the constraining imposed to deep water trawling appears to be appropriated with a delay on the provision of a scientific advice for the stock, i.e. until the benchmark that will take place by the end of 2024, as no detrimental impact on the northern component of the stock is expected to occur.

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Commercial catches of roughhead grenadier, roundnose grenadier, greater argentine, tusk, blue ling, black scabbardfish, ling, and orange roughy in ICES Division 14.b in the period 1999-2023

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Abstract
Yearly and monthly logbook information, and CPUE distribution from 1999 to 2023 for roughhead grenadier (*Macrourus berglax*; RHG), roundnose grenadier (*Coryphaenoides rupestris*; RNG), greater silver smelt (*Argentina silus*; ARU), tusk (*Brosme brosme*; USK), blue ling (*Molva dypterygia*; BLI), black scabbardfish (*Aphanopus carbo*; BSF), ling (*Molva molva*; LIN), and orange roughy (*Hoplostethus atlanticus*; ORY), in East Greenland, ICES 14.b, is presented in this document. Data presented are a mix of targeted catches and bycatch of the Greenland halibut fishery in East Greenland.

1. Introduction

Commercial trawl and longline fisheries operate in ICES Ddivision 14.b off East Greenland. This document presents information recorded in logbooks of these fisheries in the time period from 1999 to 2023. The species presented here are roughhead grenadier (*Macrourus berglax*; RHG), roundnose grenadier (*Coryphaenoides rupestris*; RNG), greater argentine (*Argentina silus*; ARU), tusk (*Brosme brosme*; USK), blue ling (*Molva dypterygia*; BLI), black scabbardfish (*Aphanopus carbo*; BSF), ling (*Molva molva*; LIN), and orange roughy (*Hoplostethus atlanticus*; ORY). The numbers presented in previous working documents have been updated.

Catch quotas have been set for the following of these species: grenadiers (RNG and RHG combined), tusk, blue ling, and greater argentine. The total allowable catch (TAC) for grenadiers was 3 000 tonnes (t) in 2007, 2 000 t in 2008-2009, and 1 000 tons in 2010-2023. For tusk the TAC was 500 t in 2014 and 1 500 t from 2015-2023. For blue ling the TAC was 500 t in 2014 and no quota has been set since. For greater argentine the TAC was 10 000 t in 2013-2015 and no quota has been set since.The TAC is set by the Government of Greenland.

2. Materials and Methods

Logbooks have been mandatory for vessels greater than 30 ft (9.4 m) since 2008. Data about all logbooks records are reported to the Greenland Fishery License Authority (GFLK). Trawlers and longliners gather information about their fishery, including effort and location for individual fishing events, and send the data to GFLK on a weekly basis. Data presented here is a mix of targeted catches (greater argentine fishery from 2015 and 2018 and tusk fishery from 2014) and bycatch during the fishery for Greenland halibut in ICES Division 14.b (from 1999). From 2005 (except 2006) small catches for grenadiers come from 14.a due to the expansion of the Greenland halibut fishery to a more northern fishing ground between 67°N and 68°30'N.

3. Results and discussion

Roughhead grenadier (Macrourus berglax; RHG)

Negligible amounts of roughhead grenadiers were caught between 1999 and 2004. From 2005 to 2013 catches remained very low (mean catches 2005-2013 = 7.8 t), whereas it increased to an average of 71.2 tons between 2014 and 2018. In 2019, catches dropped to only 1 t. Catches have been increasing from 2020 (23.17 t) to 2023 reaching the highest catch of the entire time series in 2023 (164.4 t) (Table 1, 2 & 4, Fig. 1 & 2). From 2014 reported catches of roughhead grenadier on long lines are much higher, which might be linked to the onset of targeted long line fishery after tusk in 2014 (Table 3). There are no explanations for the drastic drop to only 1.0 tons in 2019, which has been reported by only a single vessel. Possibly, this is due to misidentification. Most of the catches are from 14.b, few catches were taken in 2013, 2016-2017, and 2021 in 14.a, due to the expansion of the Greenland halibut fishery to a northern fishing ground (Table 2, Fig.2 and 3). From survey information (Christiansen & Nogueira, 2024), it was established that roughhead grenadier is much more common than roundnose grenadier in ICES 14.b. Therefore, it is likely that there is misidentification of grenadier 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 combined) is not reached any years.

Roundnose grenadier (Coryphaenoides rupestris; RNG)

Catches of roundnose grenadier have been relatively stable (annual mean catch=91.4 tons) throughout the evaluated time period (1999 to 2023) ranging from 30.6 tons (2008) to 167.4 tons (2021) (Table 1 & 5, Fig.1). Most of the catches are also from 14.b, few catches were taken sporadically in 14.a (Table 2, Fig. 4 & 5).The majority is caught as bycatch by trawlers, whereas longliners typically took a smaller portion of the total catch. Only in 2019 and 2021 catches with longliners were higher than the catch taken with trawlers (Table 3). As mentioned for roughhead grenadier, the catch of roudnose grenadier is possibly overestimated due to incorrect species identification.

Greater argentine (Argentina silus; ARU)

From 1990 to 2013, there are only reported catches in 2002 (0.5 t). From 2014 to 2023 catches have been very low except years 2017 and 2018 (666.8 t and 425.2 t), which is due to the onset of targeted pelagic trawl fishery for the species since 2015. This targeted fishery ceased in 2019 thus since then low catches are reported (Table 1, 3 & 6, Fig. 1 & 6).

Tusk (Brosme brosme; USK)

Catches of tusk between 1999 to 2013 were much lower (mean annual catch=30.1 tons) compared to catches from 2015 to 2023 (mean annual catch =571.3 tons) (Table 1, 3 & 7, Fig. 1 and 7). The catch was predominantly taken by longline throughout the time series (Table 3). The increase in catches corresponds with the initiation of a targeted fishery in 2014 with a TAC of 500 tons, which was increased by the Greenland government to 1500 tons, from 2015 to 2023.

Blue ling (Molva dypterygia; BLI)

Catches of blue ling have been low from 1999 to 2009 (annual mean catch = 3.2 t), increasing since then, and peaking in 2015 (65.4 t). Catches increased from 2010 (annual mean catch =22.6 tons, Table 1, 3 & 8, Fig. 1 & 8). Blue ling was mostly caught in trawl fisheries and the composition between longline and trawl catches remains relatively constant except in 2015, where the largest trawl catch of 65.5 tons was reported (Table 3).

Black scabbardfish (Aphanopus carbo; BSF)

Black scabbardfish was only caught in 2010 (30kg) and 2011 (180 kg) in the month of September (Table 1 & 9, Figure 1 & 9).

Ling (Molva molva; LIN)

Catches of ling were fluctuating between years with no apparent trend over time (Fig. 10). In 2005, 2006, 2015 and 2016 catches were above 15 tons, whereas catches were below 5 tons in 2000-2003, 2007, 2009-2013 and 2017-2022 (Table 1 , 3 & 10, Fig. 1 & 10). The majority of catches are from trawlers, expect in 2015 (Table 3).

Orange roughy (Hoplostethus antlanticus; ORY)

Orange roughy was caught only in 2007 and 2010 (0.4 and 0.8 t respectively, Table 1 & 11, Figure 1 & 11).

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Table 1. Total annual commercial catches (tonnes) of roughhead grenadier (*Macrourus berglax*; RHG), roundnose grenadier (*Coryphaenoides rupestris*; RNG), greater argentine (*Argentina silus*; ARU), tusk (*Brosme brosme*; USK), blue ling (*Molva dypterygia*; BLI), black scabbardfish (*Aphanopus carbo*; BSF), ling (*Molva molva*; LIN), and orange roughy (*Hoplostethus atlanticus*; ORY) in the Greenlandic EEZ zone of ICES Division 14.b from 1999 to 2023.

Year	RHG	RNG	ARU	USK	BLI	BSF	LIN	ORY
1999	0.0	129.4	0.0	5.2	0.2	0.0	8.1	0.0
2000	0.0	95.1	0.0	0.0	1.4	0.0	0.0	0.0
2001	0.0	84.5	0.0	23.3	0.6	0.0	0.7	0.0
2002	0.0	54.7	0.5	0.0	0.2	0.0	0.3	0.0
2003	0.0	54.2	0.0	2.2	2.6	0.0	0.2	0.0
2004	0.0	101.5	0.0	17.0	7.1	0.0	7.1	0.0
2005	20.0	61.7	0.0	39.3	5.6	0.0	17.7	0.0
2006	4.4	64.4	0.0	102.2	5.9	0.0	18.6	0.0
2007	3.9	43.0	0.0	18.7	1.3	0.0	1.5	0.4
2008	11.4	30.6	0.0	20.7	4.8	0.0	11.1	0.0
2009	3.5	44.2	0.0	15.9	5.4	0.0	4.6	0.0
2010	11.4	59.8	0.0	15.1	7.5	0.0	3.1	0.8
2011	2.2	136.4	0.0	91.1	8.0	0.2	4.8	0.0
2012	13.4	123.3	0.0	74.6	13.0	0.0	5.1	0.0
2013	0.3	128.0	0.0	27.6	15.7	0.0	2.4	0.0
2014	61.6	99.7	4.2	167.3	13.9	0.0	8.0	0.0
2015	38.2	139.7	12.2	878.8	65.4	0.0	20.5	0.0
2016	75.1	63.5	16.6	562.4	8.6	0.0	15.2	0.0
2017	92.8	93.1	666.8	763.2	11.9	0.0	4.5	0.0
2018	89.1	128.6	425.2	684.5	33.6	0.0	4.6	0.0
2019	0.9	157.1	3.4	386.7	45.4	0.0	1.9	0.0
2020	23.2	46.9	28.1	216.0	26.8	0.0	1.5	0.0
2021	55.5	167.4	15.4	720.1	17.0	0.0	1.4	0.0
2022	86.3	134.0	0.8	367.2	27.3	0.0	0.7	0.0
2023	164.4	80.7	0.0	562.8	15.3	0.0	2.2	0.0

Table 2. Total annual commercial catches (tonnes) of roughhead grenadier (*Macrourus berglax*; RHG), roundnose grenadier (*Coryphaenoides rupestris*; RNG), greater Argentine (*Argentina silus*; ARU), tusk (*Brosme brosme*; USK*)*, blue ling (*Molva dypterygia*; BLI), black scabbardfish (*Aphanopus carbo*; BSF), ling (*Molva molva*; LIN), and orange roughy (*Hoplostethus atlanticus*; ORY) in the Greenlandic EEZ zone of ICES Division 14.a and 14.b from 1999 to 2023 (when column for 14a is not available, no catches were recorded there).

	RHG		RNG		ARU	USK	BLI		BSF	LIN	ORY
Year	14a	14b	14a	14b	14b	14b	14a	14b	14b	14b	14b
1999	0.0	0.0	0.0	129.4	0.0	5.2	0.0	0.2	0.0	8.1	0.0
2000	0.0	0.0	0.0	95.1	0.0	0.0	0.0	1.4	0.0	0.0	0.0
2001	0.0	0.0	0.0	84.5	0.0	23.3	0.0	0.6	0.0	0.7	0.0
2002	0.0	0.0	0.0	54.7	0.5	0.0	0.0	0.2	0.0	0.3	0.0
2003	0.0	0.0	0.0	54.2	0.0	2.2	0.0	2.6	0.0	0.2	0.0
2004	0.0	0.0	0.0	101.5	0.0	17.0	0.0	7.1	0.0	7.1	0.0
2005	0.0	20.0	0.2	61.5	0.0	39.3	0.0	5.6	0.0	17.7	0.0
2006	0.0	4.4	0.0	64.4	0.0	102.2	0.0	5.9	0.0	18.6	0.0
2007	0.0	3.9	0.0	43.0	0.0	18.7	0.0	1.3	0.0	1.5	0.4
2008	0.0	11.4	0.0	30.6	0.0	20.7	0.0	4.8	0.0	11.1	0.0
2009	0.0	3.5	0.1	44.1	0.0	15.9	0.0	5.4	0.0	4.6	0.0
2010	0.0	11.4	0.0	59.8	0.0	15.1	0.0	7.5	0.0	3.1	0.8
2011	0.0	2.2	0.2	136.3	0.0	91.1	0.0	8.0	0.2	4.8	0.0
2012	0.0	13.4	0.5	122.8	0.0	74.6	0.0	13.0	0.0	5.1	0.0
2013	0.0	0.3	0.1	127.9	0.0	27.6	0.0	15.7	0.0	2.4	0.0
2014	0.0	61.6	0.9	98.8	4.2	167.3	0.0	13.9	0.0	8.0	0.0
2015	0.0	38.2	0.0	139.7	12.2	878.8	0.0	65.4	0.0	20.5	0.0
2016	0.6	74.5	0.0	63.5	16.6	562.4	0.0	8.6	0.0	15.2	0.0
2017	0.0	92.8	0.4	92.7	666.8	763.2	0.0	11.9	0.0	4.5	0.0
2018	0.0	89.1	1.7	126.9	425.2	684.5	0.0	33.6	0.0	4.6	0.0
2019	0.0	0.9	0.2	156.9	3.4	386.7	0.0	45.4	0.0	1.9	0.0
2020	0.0	23.2	0.5	46.5	28.1	216.0	0.0	26.8	0.0	1.5	0.0
2021	2.0	53.5	1.4	166.0	15.4	720.1	0.0	17.0	0.0	1.4	0.0
2022	1.0	85.3	22.7	111.3	0.8	367.2	0.0	27.3	0.0	0.7	0.0
2023	41.5	122.9	0.1	80.7	0.0	562.8	0.0	15.3	0.0	2.2	0.0

Table 3. Total annual commercial catches (tonnes) by gear of roughhead grenadier (*Macrourus berglax*; RHG), roundnose grenadier (*Coryphaenoides rupestris*; RNG), greater Argentine (*Argentina silus*; ARU), tusk (*Brosme brosme*; USK*),* blue ling (*Molva dypterygia*; BLI), black scabbardfish (*Aphanopus carbo*; BSF), ling (*Molva molva*; LIN), and orange roughy (*Hoplostethus atlanticus*; ORY) in the Greenlandic EEZ zone of ICES Divisions 14.a and 14.b from 1999 to 2023.

	RHG			RNG			ARU	USK				BLI				BSF	LIN			ORY
Year	BTM	LL	GN	BTM	LL	Other	BTM	BTM	GN	LL	Other	BTM	GN	LL	Other	BTM	BTM	LL	Other	BTM
1999	0.0	0.0	0.0	129.4	0.0	0.0	0.0	1.0	0.0	4.2	0.0	0.0	0.0	0.2	0.0	0.0	8.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	78.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	72.0	12.6	0.0	0.0	23.3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
2002	0.0	0.0	0.0	52.0	0.0	2.7	0.5	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
2003	0.0	0.0	0.0	54.2	0.0	0.0	0.0	2.2	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
2004	0.0	0.0	0.0	101.5	0.0	0.0	0.0	17.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0
2005	20.0	0.0	0.0	61.7	0.0	0.0	0.0	39.1	0.0	0.0	0.2	5.6	0.0	0.0	0.0	0.0	17.7	0.0	0.0	0.0
2006	4.4	0.0	0.0	64.4	0.0	0.0	0.0	100.3	0.0	1.9	0.0	5.9	0.0	0.0	0.0	0.0	18.6	0.0	0.0	0.0
2007	3.9	0.0	0.0	42.4	0.7	0.0	0.0	11.4	0.0	7.3	0.0	0.3	0.0	1.0	0.0	0.0	1.5	0.0	0.0	0.4
2008	11.4	0.0	0.0	28.9	1.7	0.0	0.0	12.7	0.0	8.0	0.0	3.6	0.0	1.2	0.0	0.0	10.9	0.1	0.0	0.0
2009	3.5	0.0	0.0	37.0	0.0	7.1	0.0	0.0	0.0	0.0	15.9	3.9	0.0	0.0	1.5	0.0	3.4	0.0	1.2	0.0
2010	11.4	0.0	0.0	53.5	6.3	0.0	0.0	0.0	0.0	13.9	1.2	2.3	0.0	5.2	0.0	0.0	3.1	0.0	0.0	0.8
2011	2.2	0.0	0.0	130.9	5.5	0.0	0.0	0.0	0.0	91.1	0.0	5.7	0.0	2.2	0.0	0.2	3.0	1.8	0.0	0.0
2012	13.3	0.1	0.0	115.7	7.7	0.0	0.0	0.0	0.0	59.5	15.1	4.9	0.0	7.8	0.3	0.0	4.5	0.6	0.0	0.0
2013	0.3	0.0	0.0	125.9	2.1	0.0	0.0	0.5	0.0	14.4	12.8	15.7	0.0	0.0	0.0	0.0	0.0	1.9	0.5	0.0
2014	16.0	21.2	24.4	94.0	5.7	0.0	4.2	0.0	4.1	163.2	0.0	8.8	0.7	4.4	0.0	0.0	5.4	2.6	0.0	0.0
2015	3.5	34.7	0.0	104.9	34.8	0.0	12.2	0.6	0.0	876.8	1.4	64.8	0.0	0.6	0.0	0.0	2.6	17.9	0.0	0.0
2016	4.7	70.4	0.0	55.1	8.4	0.0	16.6	2.5	0.0	559.9	0.0	7.1	0.0	1.5	0.0	0.0	2.1	13.1	0.0	0.0
2017	0.4	92.4	0.0	87.8	5.3	0.0	666.8	1.0	0.0	762.2	0.0	7.0	0.0	5.0	0.0	0.0	1.0	3.5	0.0	0.0
2018	0.6	88.5	0.0	123.1	5.6	0.0	425.2	101.4	0.0	583.1	0.0	31.9	0.0	1.7	0.0	0.0	4.1	0.5	0.0	0.0
2019	0.9	0.0	0.0	61.9	95.2	0.0	3.4	2.3	0.0	384.4	0.0	26.8	0.0	18.6	0.0	0.0	1.7	0.2	0.0	0.0
2020	8.6	14.6	0.0	43.4	3.5	0.0	28.1	2.8	0.0	213.2	0.0	24.9	0.0	1.9	0.0	0.0	1.3	0.2	0.0	0.0
2021	10.9	44.6	0.0	55.0	112.5	0.0	15.4	4.0	0.0	716.1	0.0	10.7	0.0	6.3	0.0	0.0	0.9	0.5	0.0	0.0
2022	17.0	69.3	0.0	82.0	52.0	0.0	0.8	1.5	0.0	365.8	0.0	21.7	0.0	5.6	0.0	0.0	0.7	0.0	0.0	0.0
2023	33.0	131.4	0.0	80.7	0.0	0.0	0.0	0.5	0.0	562.4	0.0	12.9	0.0	2.5	0.0	0.0	1.8	0.4	0.0	0.0

Table 4. Total monthly commercial catches (tonnes) of roughhead grenadier (RHG) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	0.2	5.7	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	1.3	1.8	0.2	1.1	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	1.7	1.5	0.6	0.0	0.1	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.4	1.9	1.5	2.7	2.7	1.4	0.8	0.0	0.0
2009	0.0	0.0	0.1	0.7	1.4	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	4.1	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	9.1	4.2	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	28.9	0.3	7.2	0.2	0.0	0.0	0.0	3.6
2015	0.0	0.0	17.1	17.7	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
2016	0.8	25.3	30.9	13.4	0.0	2.5	1.9	0.4	0.0	0.0	0.0	0.0
2017	0.0	0.0	51.1	41.3	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	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.0	0.0
2020	0.0	0.9	0.8	0.5	0.9	2.7	13.6	2.5	0.5	0.6	0.1	0.0
2021	0.0	0.0	0.0	0.0	3.9	12.6	27.2	8.0	0.9	1.0	1.3	0.5
2022	0.0	0.2	15.1	14.1	1.2	0.2	0.6	5.9	8.8	39.6	0.7	0.0
2023	0.0	1.2	2.2	11.6	3.2	0.0	2.0	14.0	45.6	47.1	37.5	0.1
Total	0.8	27.6	167.7	167.2	52.4	28.5	71.3	37.6	67.5	93.0	39.7	4.2

Table 5. Total monthly commercial catches (tonnes) of roundnose grenadier (RNG) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	1	2	3	4	5	6	7	8	9	10	11	12
1999	12.8	23.7	20.2	23.5	0.2	5.0	4.4	4.8	7.0	14.5	11.5	1.8
2000	0.2	21.3	13.4	9.6	5.7	11.8	8.1	10.8	8.3	1.1	3.8	1.3
2001	0.0	0.0	1.8	0.7	2.7	18.0	26.9	23.9	3.4	2.4	2.4	2.4
2002	0.0	0.0	2.3	5.0	3.6	16.3	18.5	4.7	0.9	0.3	2.3	0.7
2003	0.0	0.0	1.1	3.3	11.1	10.7	9.8	7.2	4.5	4.7	1.7	0.3
2004	0.0	0.0	0.1	7.5	6.3	19.2	31.0	20.4	7.6	3.8	3.3	2.3
2005	0.0	0.0	0.0	1.5	2.6	16.3	27.1	10.1	3.1	0.9	0.0	0.1
2006	0.0	0.0	0.1	3.5	14.6	8.5	6.5	25.4	2.9	0.4	2.2	0.4
2007	0.0	0.1	0.3	3.8	12.8	9.1	8.2	4.6	1.6	1.2	1.0	0.5
2008	1.5	0.1	0.2	5.6	6.6	6.3	3.3	3.7	1.4	1.6	0.3	0.0
2009	0.0	0.0	0.9	3.5	9.3	8.5	9.6	4.7	3.6	2.0	1.8	0.4
2010	0.0	0.0	0.5	7.4	12.1	8.9	10.3	9.4	7.0	1.4	3.0	0.0
2011	0.0	0.0	2.6	7.3	18.9	42.0	36.5	15.8	5.5	3.8	3.0	1.0
2012	0.0	0.0	2.2	9.2	35.6	29.3	19.6	19.9	4.0	3.2	0.3	0.0
2013	0.0	0.0	3.0	15.4	27.7	38.3	21.0	12.4	1.3	5.8	2.9	0.3
2014	0.0	0.5	4.2	12.0	16.6	19.4	16.3	5.5	8.5	12.1	1.5	3.1
2015	3.0	0.6	22.4	42.8	16.9	4.6	12.8	12.3	13.3	3.2	1.7	6.1
2016	0.0	0.8	4.6	10.5	14.4	10.7	15.8	4.5	1.7	0.4	0.0	0.0
2017	0.0	0.7	11.4	17.9	17.1	8.2	20.1	7.8	3.5	5.4	0.4	0.6
2018	0.0	1.7	17.4	23.3	9.4	11.1	46.8	16.5	1.2	1.3	0.0	0.0
2019	0.0	0.7	10.4	10.9	2.5	77.7	38.8	6.9	3.2	6.0	0.1	0.0
2020	0.0	0.3	4.0	2.2	4.9	6.1	6.5	8.3	11.3	0.1	1.3	2.0
2021	0.0	0.0	0.0	5.8	15.2	63.5	32.2	27.8	7.9	5.1	9.4	0.5
2022	0.0	0.5	2.7	3.5	6.5	30.8	49.2	13.0	24.6	1.0	0.6	1.6
2023	0.0	0.0	1.3	10.6	7.9	14.1	13.8	12.6	11.8	3.5	3.2	2.0
Total	17.6	50.9	126.7	246.2	281.0	494.3	493.2	293.0	148.8	85.2	57.7	27.2

Table 6. Total monthly commercial catches (tonnes) of greater argentine (ARU) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	0.5	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	0.1	0.0	0.0
2018	0.0	0.0	30.1	241.4	139.7	0.0	0.0	0.0	0.0	13.9	0.1	0.0
2019	0.0	0.0	3.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.1	2.3	0.0	0.0	0.0	0.0	3.5	0.2	0.0	22.1	0.0
2021	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.5	15.2	35.5	341.8	705.3	6.7	2.1	4.8	15.0	24.1	22.2	0.0

Table 7. Total monthly commercial catches (tonnes) of tusk (USK) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	4.7	0.5	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	4.7	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	2.3	1.2	4.5	2.4	5.4	1.1
2005	0.0	0.0	1.8	0.1	1.6	3.3	3.3	0.3	6.2	9.9	12.7	0.2
2006	0.0	0.0	2.5	2.6	4.1	0.8	0.5	6.8	1.1	1.6	3.1	79.4
2007	0.0	0.0	0.0	0.0	0.0	4.0	7.5	0.2	4.3	2.7	0.0	0.0
2008	12.7	0.0	0.0	0.0	1.5	0.6	0.0	3.7	0.0	2.2	0.0	0.0
2009	0.0	0.0	0.0	1.0	1.2	0.1	5.5	8.2	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.1	0.7	4.7	5.6	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	13.5	10.0	33.9	11.6	3.9	0.0	0.0
2013	0.0	0.0	1.3	16.0	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	1.5	53.2	29.2	49.7	29.3	0.4	0.0	0.0
2015	43.2	0.0	0.0	0.0	9.4	46.1	59.8	468.2	252.0	0.0	0.1	0.0
2016	0.0	0.0	1.4	24.2	49.0	95.1	180.4	34.1	147.6	13.7	3.6	13.3
2017	11.4	44.1	151.5	1.2	0.1	240.0	75.8	95.7	103.9	1.0	15.7	22.7
2018	0.8	0.0	107.6	52.7	8.0	296.1	44.3	23.5	113.4	9.3	5.3	23.5
2019	8.9	39.2	11.9	59.9	15.1	113.2	92.0	39.9	4.4	0.4	0.1	1.6
2020	7.6	9.2	5.9	86.3	34.5	4.8	45.9	10.6	2.7	3.3	0.5	4.9
2021	0.0	3.7	25.7	54.4	200.3	198.4	157.5	58.3	10.1	7.0	4.7	0.0
2022	0.2	0.1	18.2	48.9	28.8	16.9	8.2	4.2	68.8	156.3	3.3	13.5
2023	24.7	50.6	31.5	56.9	92.1	18.9	0.4	155.3	43.2	69.8	11.2	8.2
Total	109.5	146.9	359.2	408.3	453.2	1112.0	750.3	1011.3	835.7	340.1	67.1	168.4

Table 8. Total monthly commercial catches (tonnes) of blue ling (BLI) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	0.1	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	0.8	0.8	0.2	0.9
2005	0.0	0.0	0.0	1.0	0.1	1.3	2.1	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	0.4	0.0	0.5	1.4	3.7
2007	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.7	0.1	0.0	0.0
2008	2.8	0.0	0.0	0.0	0.2	0.1	0.0	0.8	0.1	0.7	0.1	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	1.6	4.7	0.3	0.2	0.1
2011	0.0	0.0	0.1	0.0	0.3	2.4	0.2	1.0	0.9	2.0	1.0	0.1
2012	0.0	0.0	0.7	2.1	1.8	1.3	0.1	1.9	3.3	1.9	0.0	0.0
2013	0.0	0.0	1.1	1.1	1.2	0.3	0.2	2.1	0.1	7.0	2.7	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	0.6	0.4	0.7	0.1	26.1	32.9	0.0	0.7
2016	0.0	1.0	0.9	0.4	1.4	0.1	0.3	0.0	4.4	0.0	0.0	0.0
2017	0.0	0.4	3.7	1.8	0.1	0.8	2.1	0.6	1.2	1.2	0.0	0.0
2018	1.7	0.6	3.3	8.8	1.8	0.2	0.5	0.1	0.7	15.0	0.9	0.0
2019	0.0	0.1	1.1	0.1	0.2	0.6	16.8	6.8	7.2	11.5	0.3	0.6
2020	0.0	0.3	1.0	0.1	0.2	1.0	4.5	3.5	5.2	5.6	5.4	0.0
2021	0.3	0.0	0.0	0.0	0.0	5.1	5.6	0.2	0.8	1.3	2.5	1.1
2022	0.6	0.1	0.8	0.0	0.1	0.6	0.0	0.1	4.0	16.8	2.9	1.4
2023	0.3	0.1	0.4	0.0	0.0	0.9	2.7	2.2	3.4	3.6	1.6	0.1
Total	5.6	4.7	16.6	17.5	14.2	19.7	40.0	27.2	67.2	103.6	19.2	8.9

Table 9. Total monthly commercial catches (tonnes) of black scabbardfish (BSF) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	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
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0

Table 10. Total monthly commercial catches (tonnes) of ling (LIN) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	1	2	3	4	5	6	7	8	9	10	11	12
1999	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.6	0.6	2.0	3.8	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	0.3	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	5.6	0.0	0.0
2005	0.0	0.0	0.1	0.0	2.7	0.1	0.0	4.1	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	10.1	0.0	0.0	0.0	0.1	0.0	0.0	0.8	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	0.5	0.7	0.1	0.1	0.0	0.0	0.0	1.6	0.0
2011	0.0	0.0	0.6	0.8	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	9.5	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	8.5	0.1	1.0	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
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	1.6	0.0
2020	0.0	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1
2021	0.0	0.1	0.1	0.2	0.5	0.1	0.0	0.0	0.0	0.0	0.4	0.0
2022	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0
2023	0.0	0.1	0.1	0.2	0.0	0.3	1.5	0.0	0.0	0.0	0.0	0.0
Total	20.2	1.4	1.4	4.5	8.4	11.7	20.8	22.3	7.4	17.7	9.4	20.7

Table 11. Total monthly commercial catches (tonnes) of orange roughy (ORY) in the Greenlandic EEZ zone of ICES 14 from 1999 to 2023.

Year	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	0.3	0.1	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	0.8	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	0.0	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
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0

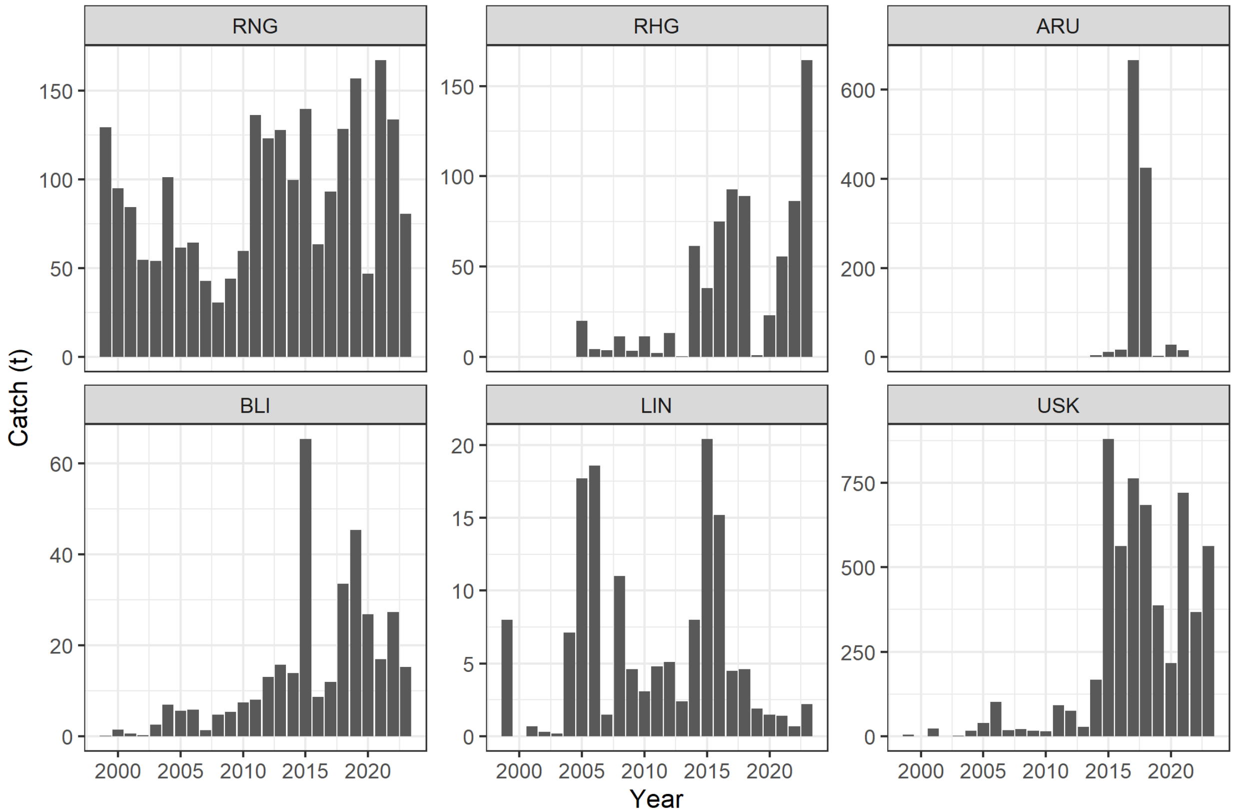

Figure 1. Total annual commercial catches by gear, in tonnes (t) of roughhead grenadier (RHG), roundnose grenadier (RNG), greater argentine (ARU), tusk (USK), blue ling (BLI), and ling (LIN) in the Greelandic EEZ zone of ICES 14 from 1999 to 2023. Note the different scales of the y axes. Catches for black scabbardfish and orange roughy were very low and can be seen in Table 1.

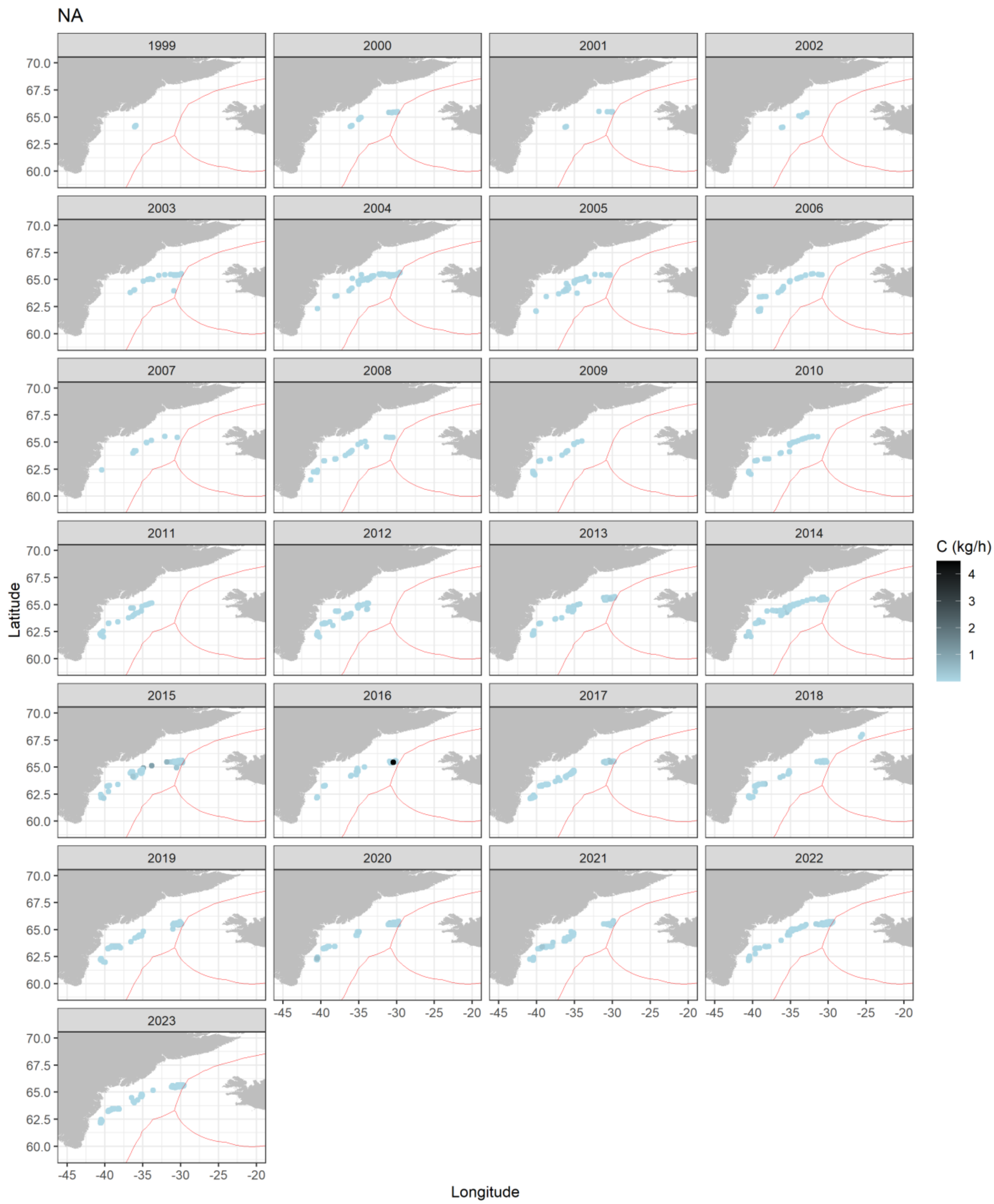

Figure 2. Roughhead grenadier (*Macrourus berglax*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

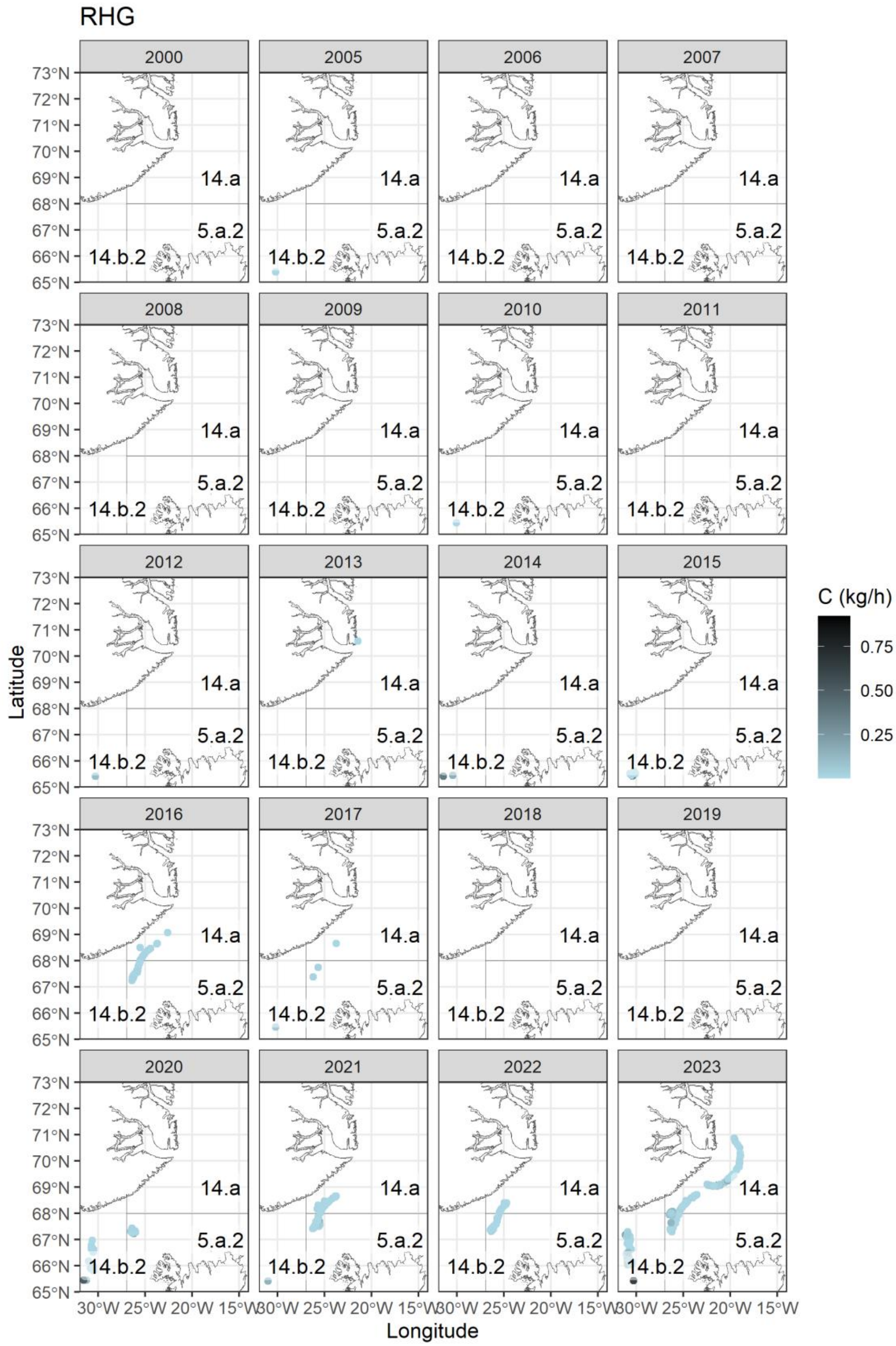

Figure 3. Roughhead grenadier (*Macrourus berglax*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.a.

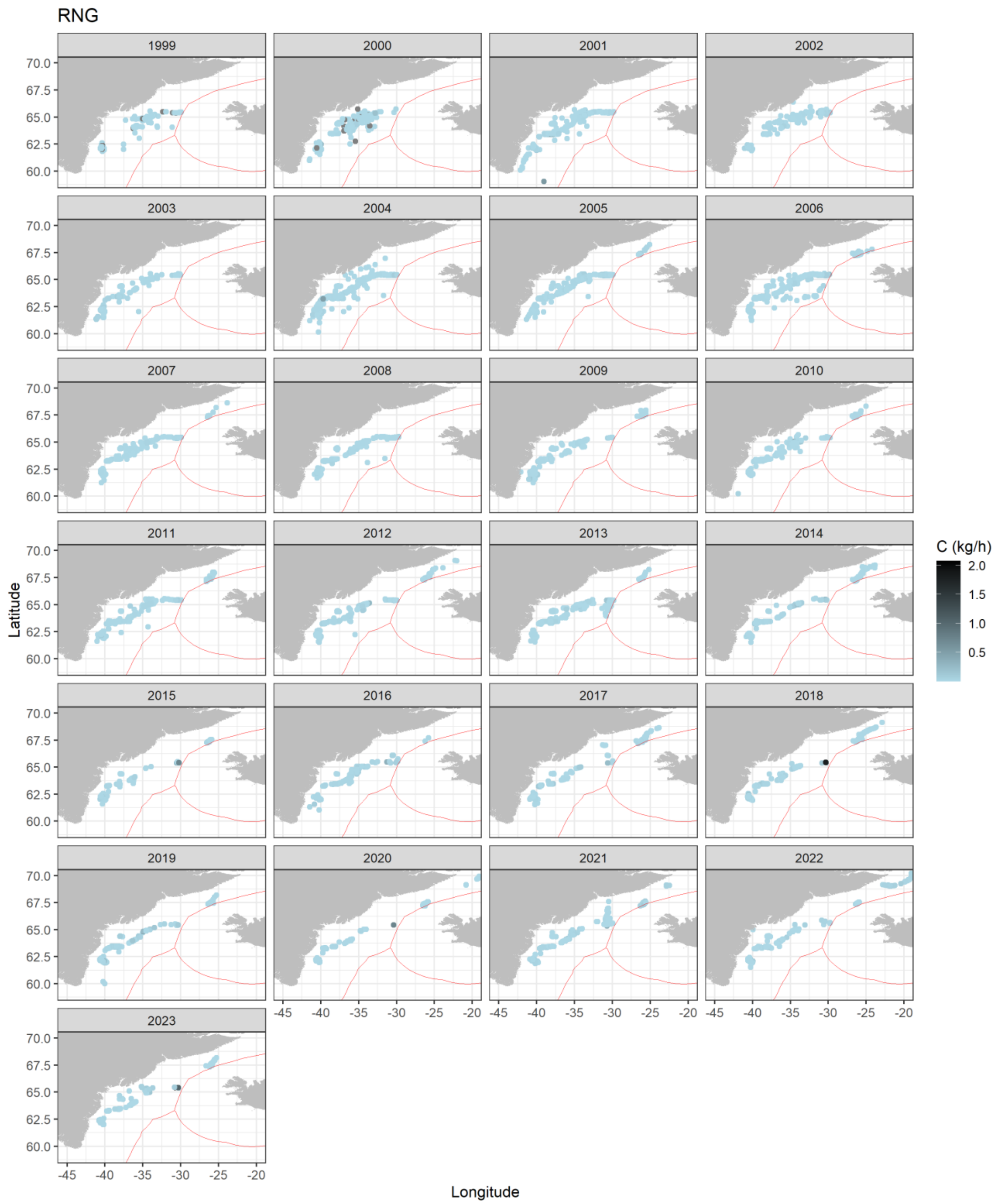

Figure 4. Roundnose grenadier (*Coryphaenoides rupestris*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

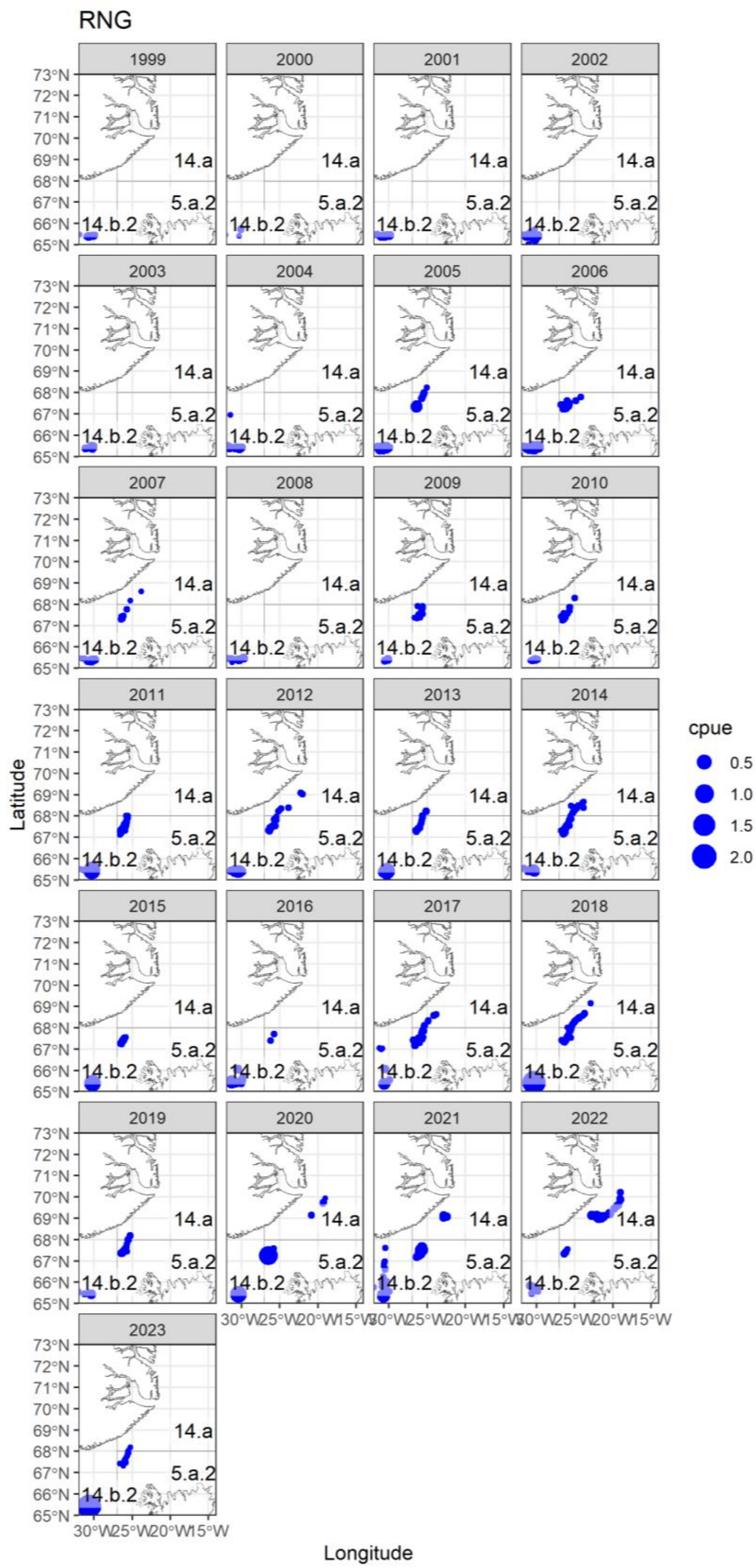

Figure 5. Roundnose grenadier (*Coryphaenoides rupestris*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.a.

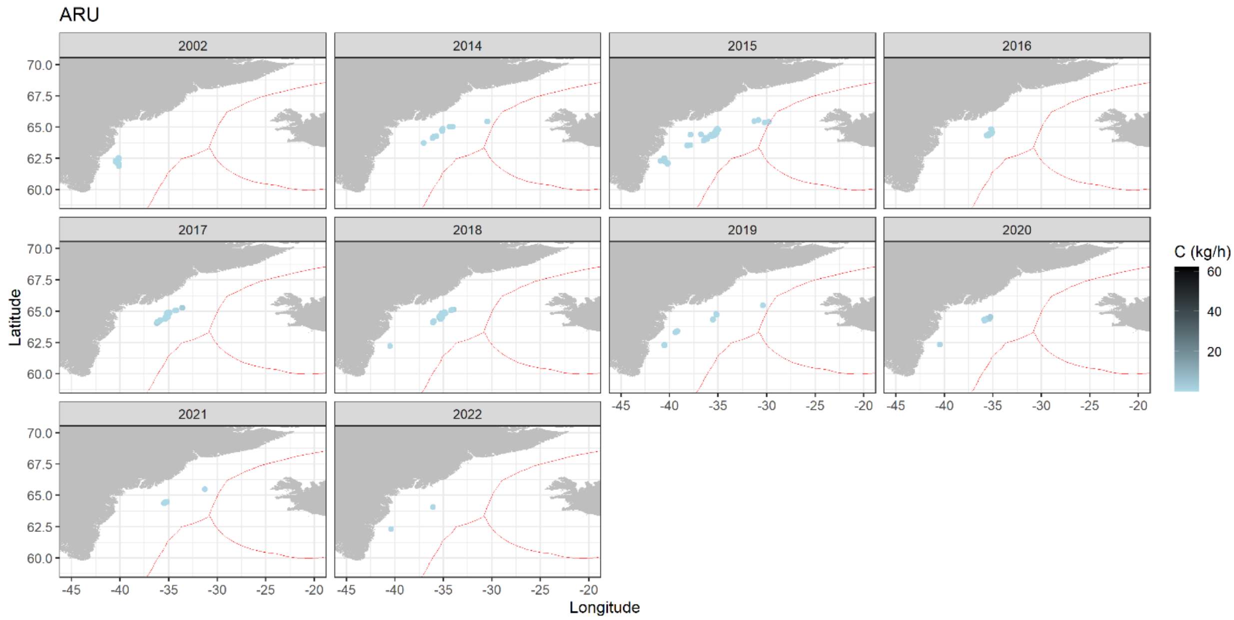

Figure 6. Greater argentine (*Argentina silus*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

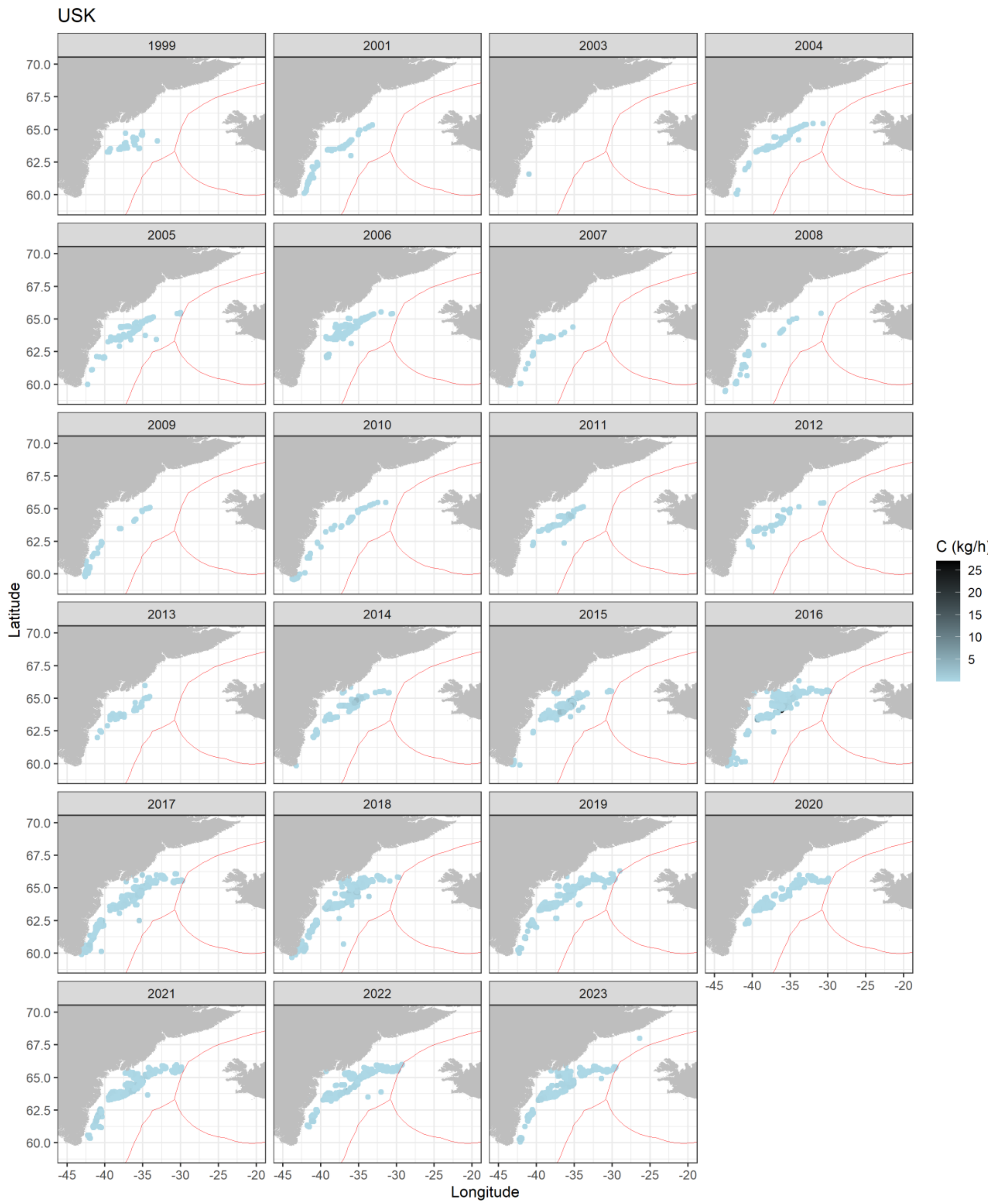

Figure 7. Tusk (*Brosme brosme*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

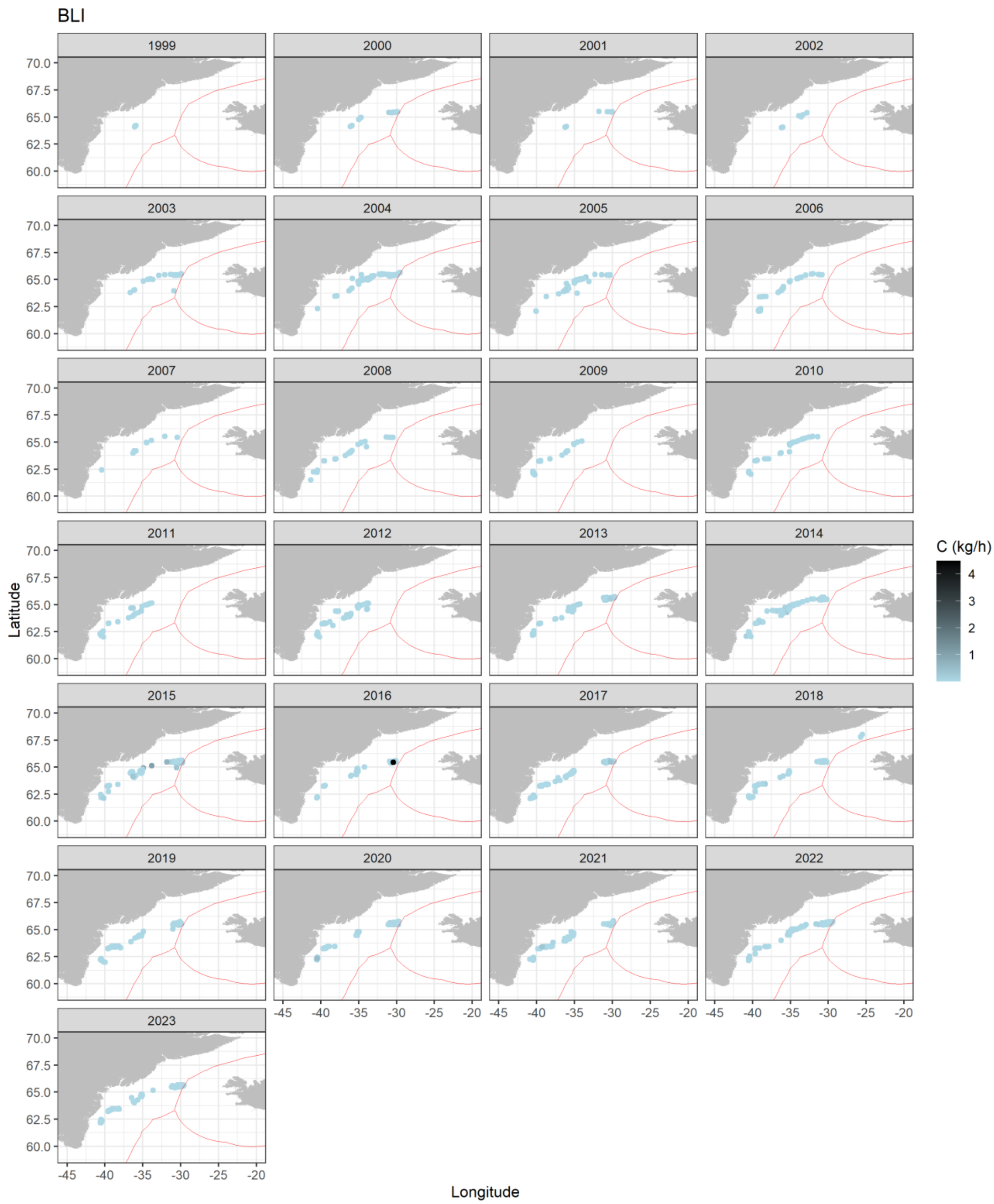

Figure 8. Blue ling (*Molva dypterygia*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

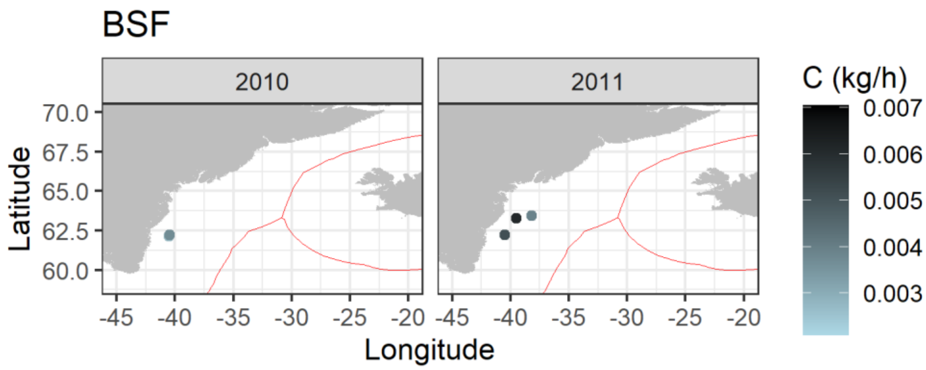

Figure 9. Black scabbardfish (*Aphanopus carbo*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

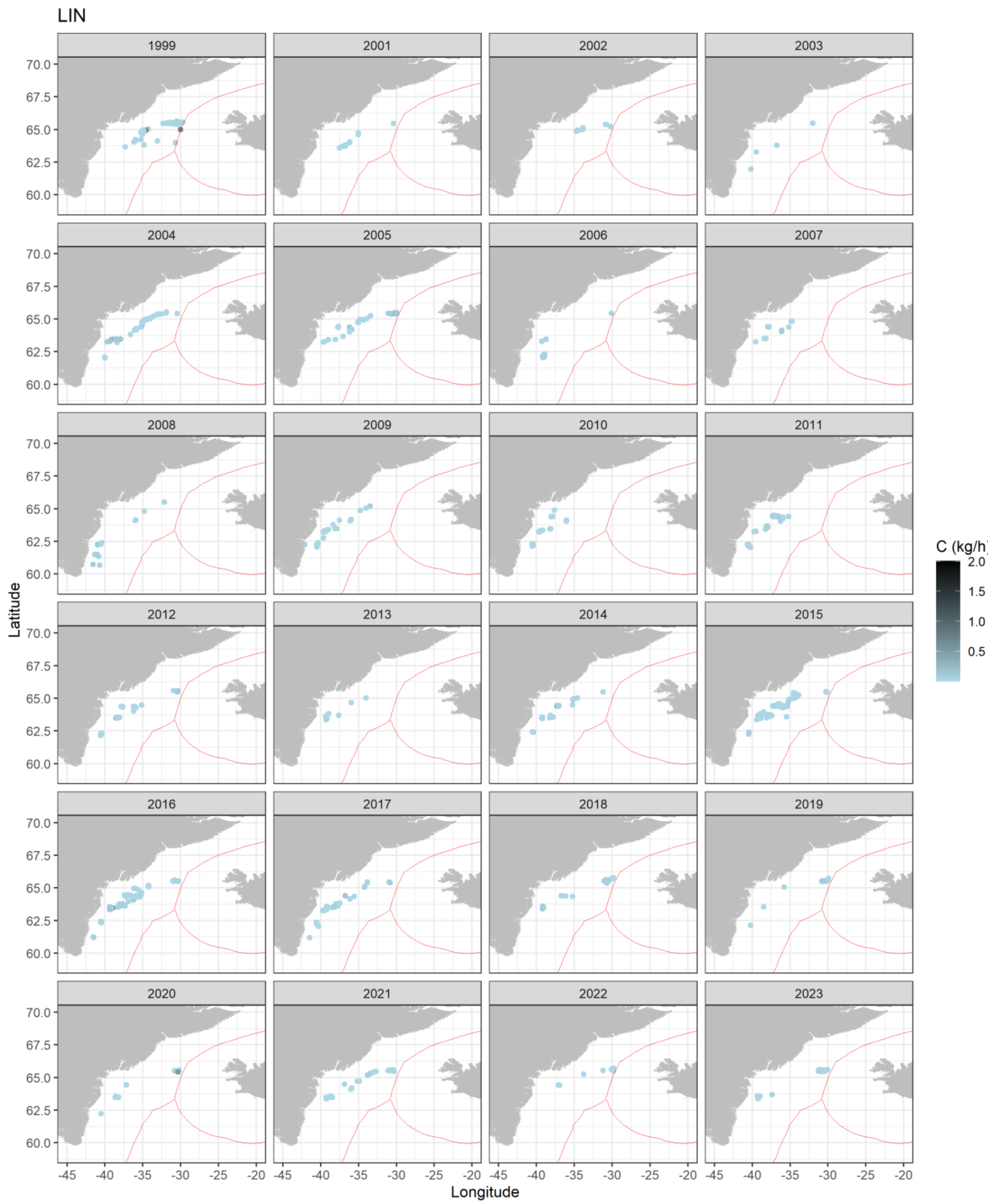

Figure 10. Ling (*Molva molva*) CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

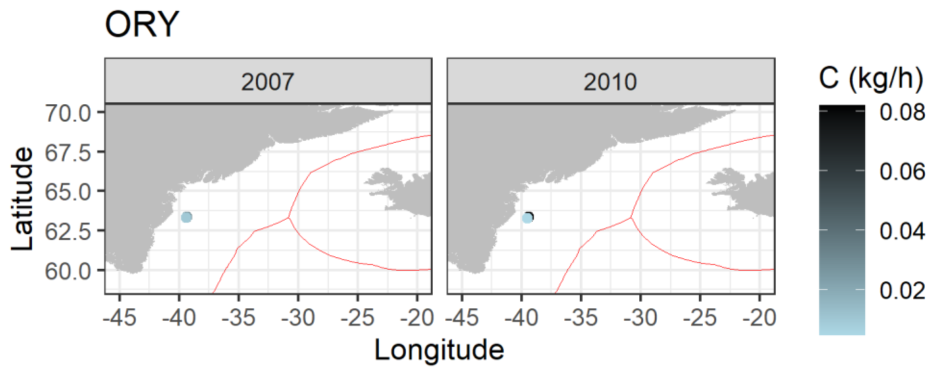

Figure 11. Orange roughy (*Hoplostethus antlanticus)* CPUE (kg/h) distribution in the Greenlandic EEZ of ICES 14.b.

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Not to be cited without prior refernce to the author(s)

Documentation of the standardisation method of the Greater Silver Smelt (*Argentina silus*) index used in assessment derrived from Scottish deep-water survey (1323S)

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Introduction

During the GSS2020 benchmark of Greater Silver Smelt, indices to be included in assessment model were explored, and decision was to include 4 indices, there amongs a fishery independant biomass index of Greater Silver Smelt (*Argentina silus*) derrived from the Scottish Deepwater survey. A process of backward selection revealed the optimal structure for a generalised linerar model as described by Campell in GSS2020 WD01.

The index usually is submitted to WGDEEP as part of standardised data request from ICES and normally has includes pre-calculated standardised index. For WGDEEP 2023 the index was submitted as averaged catches over the year (Figure *1*).

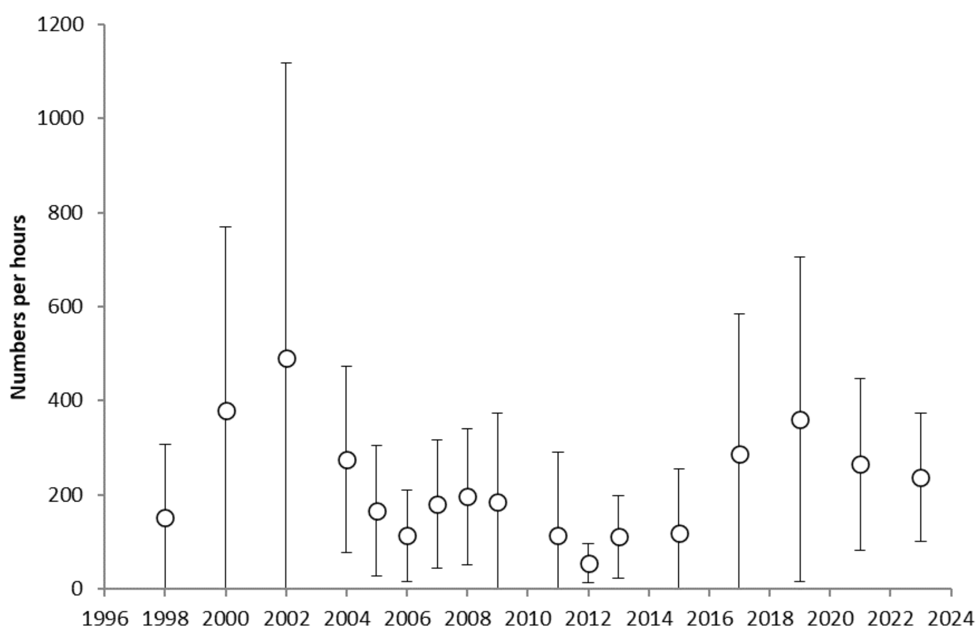

Figure 1 – Scottish Deepwater Survey CPUE index, catch averaged per year. Source: Scottish Marine

Since this index was explored, evaluated and approved during WKGSS202 as a glm standardisation, we here document the methodology for producing the glm standardisation of the index for future replication, compare an error found in the raising of catches done in 2021, and also compare glm standardisation to the averaged catch index received in 2024.

R.script

R-script for glm standardisation of index used for reproducing and replicating the Scottish Survey index.

```
rm(list=ls())
setwd("d:\\Arbeidi\\WGDEEP\\WGDEEP2024\\ScotDeepwater_2023\\")
# Load necessary libraries
library(tidyverse) # for data manipulation
library(broom)     # for tidy model output
# Load your data
#data <- read.csv("GARdata_1998_2021.csv")  #data for reproducing the index
data <- read.csv("GARdata_1998_2023.csv")     #data for replicating with additional data point (2023)
str(data)
# Fit a Poisson regression model
model <- glm(data$st.gar ~ 0 + as.factor(data$year) + as.numeric(data$depth) + data$shot.lat, family = "poisson")
# Summarize the model
model_summary <- summary(model)
# Optionally, you can use the broom package to tidy up the model output
tidy(model)
# Extract coefficients, standard errors, z-values, and p-values
coefficients <- coef(model_summary)
std_errors <- coef(summary(model))[, 2]
z_values <- coef(summary(model))[, 3]
p_values <- coef(summary(model))[, 4]
# Create a data frame with the extracted information
summary_df <- data.frame(
  "Coefficient" = coefficients,
  "Standard_Error" = std_errors,
  "Z_Value" = z_values,
  "P_Value" = p_values
)
# Save the summary to a CSV file
#write.csv(summary_df, "model_summary2021.csv", row.names = FALSE)
write.csv(summary_df, "model_summary2023.csv", row.names = FALSE)
```

Results

Comparison of averaged catch abundance index and the glm standardised index

Comparison of the index with averaged catched over years and the reproduced glm standardised index showed a noticeable discrepancy in 2021 which implies a variation in the independant variables of depth or latitude within the hauls (Figure *2*).

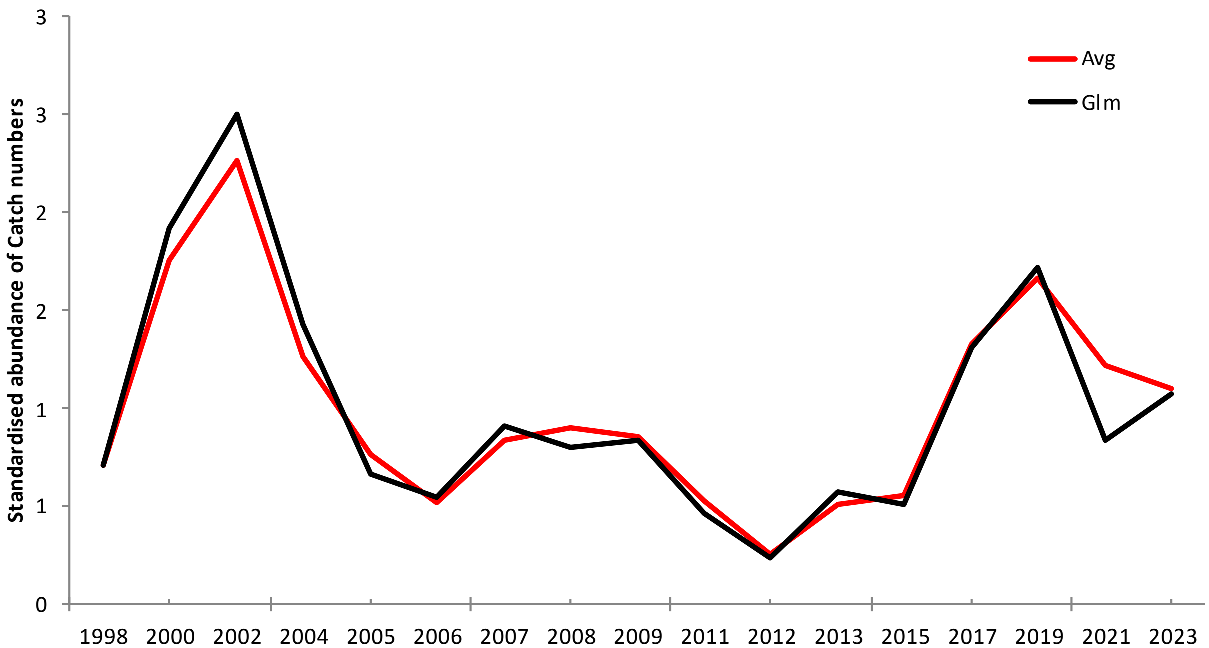

Figure 2 – Comparison of Scottish Deepwater survey Abundance index as averaged over years (red) and generalized linear model (black).

By comparing assessment results using both averaged and glm standardised indexes showed this to be negligible (Tabel 1). Results comparing this can also be viewed on stockassessment.org – ARU27.5b6a_WGDEEP_upgraded_baserun resulting in the glm standardisation being used in the assessment (Figure 3).

Tabel 1 – diagnostics from stockassessment.org comparing Averaged Catch index (current) and glm standardized index (base run).

Mohn's rho		**AIC**	
R(age5)	-0.0642	**Current**	-558.38
SSB	-0.0139	**Base**	-559.38
Fbar(6-14	0.0061		

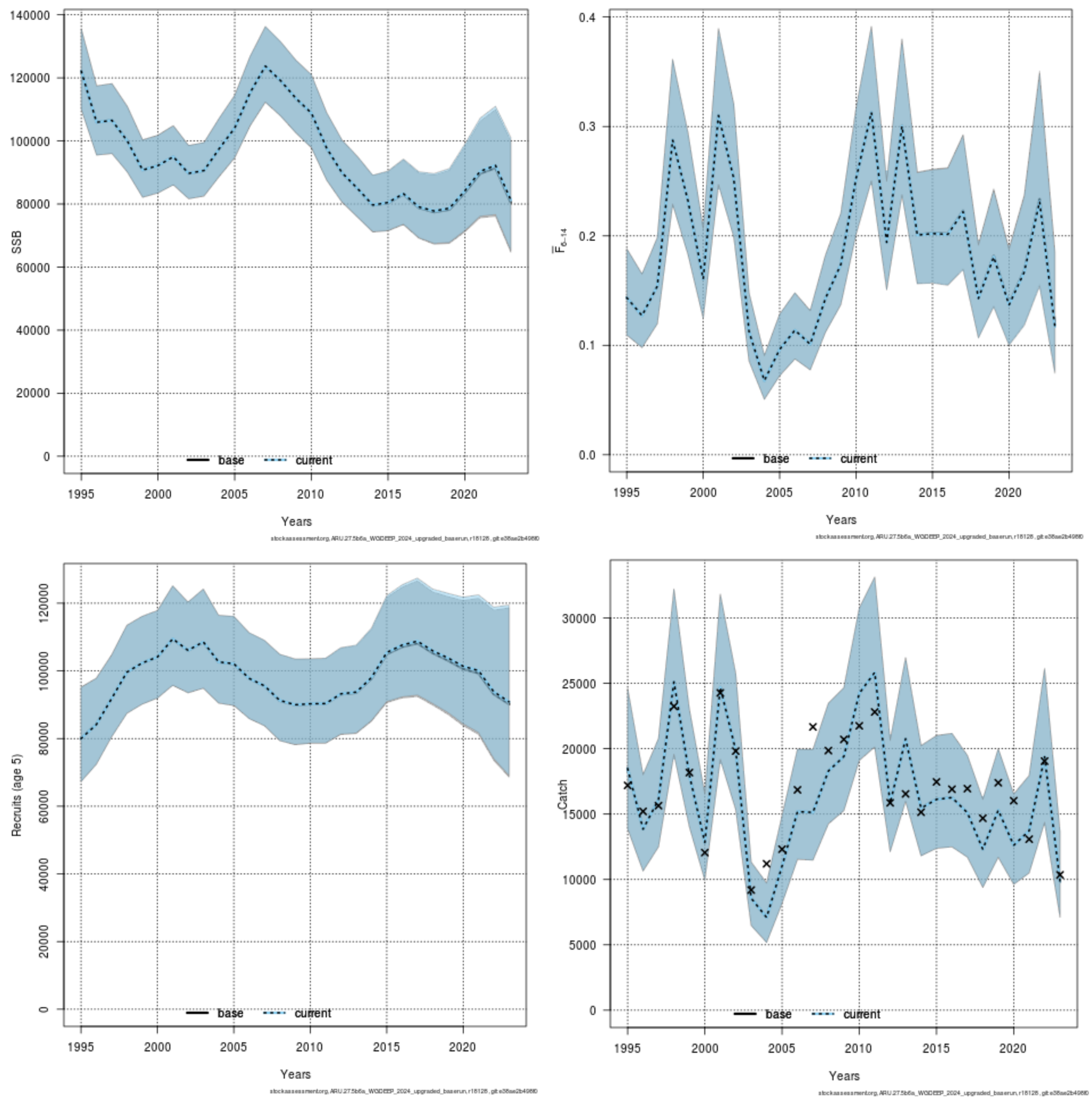

Figure 3 – Sam results from stockasssessment.org. Top left: SSB. Top right: F. Bottom left: recruitment. Bottom right: catch from model. Base-run includes glm standardized index (gray) whilst the averaged catch overlays this (blue).

Reproducing and replicating the glm standardisation

Upon reproducing the 2021 glm standardized index in 2024, an error was identified in the raising of catches in dataset for 2021 (Figure *4*; Annex 3). The corrected value is 0.86 compared with 1.22 used in WGDEEP2022 and WGDEEP2022. This error was corrected for the 2024 glm standardization index (Figure *4*).

Figure 4 – Comparison of standardization of Scottish Deepwater Survey index showing small discrepancy between glm index from 2021 (in red) and reproduced index in 2024 (in black) with standard errors. Grey line shows replicated glm index with the addition of last survey point (used in WGDEEP2023 assessment).

References

Campbell, N., 2021. WKGSS2020 WD01 – A Greater Silver Smelt abundance index for ICES Div. 6a derived from the Scottish Deepwater Survey data set.

Appendix List

1. GLM standardisation index
    a. 2021 GLM results and Index received for WGDEEP2022
    b. 2021 reproduced GLM results and index prior to WGDEEP2024
    c. Replicated GLM results and index with 2023 data for WGDEEP2024
2. GAR survey data received at WGDEEP2022
3. GAR survey data received at WGDEEP2023

1. Glm standardised index

Glm results received @wgdeep2022

Year	Coefficient	SE	Z	Prob	Signif.	e(Coefficient)	e(coefficient + se)	Rescaled SE	Standardised Abundance	Standardised SE
1998	-14.73	0.324	-45.517	2.00E-16	***	0.000000401	0.000000554	0.000000153	**0.67**	0.260
2000	-13.71	0.354	33.917	2.00E-16	***	0.000001110	0.000001581	0.000000471	**1.86**	0.800
2002	-13.46	0.352	44.291	2.00E-16	***	0.000001433	0.000002038	0.000000605	**2.40**	1.028
2004	-14.00	0.355	22.982	2.00E-16	***	0.000000828	0.000001182	0.000000353	**1.39**	0.600
2005	-14.78	0.367	-1.074	0.282912		0.000000383	0.000000552	0.000000170	**0.64**	0.288
2006	-14.96	0.362	-5.999	1.99E-09	***	0.000000318	0.000000457	0.000000139	**0.53**	0.236
2007	-14.45	0.364	7.106	1.20E-12	***	0.000000533	0.000000766	0.000000234	**0.89**	0.397
2008	-14.55	0.360	4.953	7.31E-07	***	0.000000481	0.000000689	0.000000209	**0.80**	0.354
2009	-14.52	0.360	5.7	1.20E-08	***	0.000000494	0.000000708	0.000000214	**0.83**	0.364
2011	-15.10	0.368	-8.482	2.00E-16	***	0.000000276	0.000000398	0.000000123	**0.46**	0.208
2012	-15.80	0.381	-18.539	2.00E-16	***	0.000000138	0.000000202	0.000000064	**0.23**	0.109
2013	-14.89	0.368	-3.516	0.000438	***	0.000000342	0.000000495	0.000000153	**0.57**	0.259
2015	-15.03	0.365	-7.224	5.06E-13	***	0.000000297	0.000000428	0.000000131	**0.50**	0.222
2017	-14.08	0.356	19.94	2.00E-16	***	0.000000766	0.000001093	0.000000328	**1.28**	0.556
2019	-13.78	0.358	27.724	2.00E-16	***	0.000001035	0.000001481	0.000000445	**1.73**	0.756
2021	-14.13	0.358	17.252	2.00E-16	***	0.000000728	0.000001042	0.000000314	**1.22**	0.533

Glm replicated for wgdeep2024 using 2021 data

- error found in dataset for 2021, replaced with datafile from 2024 excluding data 2023.

Year	Coefficient	SE	Z	Prob	Signif.	e(Coefficient)	e(coefficient + se)	Rescaled SE	Standardised Abundance	Standardised SE
1998	-13.3473	0.319924	-41.7202	0		0.000001597	0.000002199	0.000000602	**0.71**	0.266
2000	-12.3507	0.317667	-38.8794	2.85E-247		0.000004327	0.000005944	0.000001618	**1.91**	0.715
2002	-12.0871	0.318107	-37.997	0		0.000005632	0.000007741	0.000002109	**2.49**	0.932
2004	-12.6486	0.317439	-39.8458	5.62E-113		0.000003212	0.000004412	0.000001200	**1.42**	0.530
2005	-13.3992	0.322514	-41.5462	0.275855125		0.000001516	0.000002093	0.000000577	**0.67**	0.255
2006	-13.6056	0.319751	-42.5508	2.61E-10		0.000001234	0.000001698	0.000000465	**0.54**	0.205
2007	-13.1006	0.318391	-41.1464	2.39E-11		0.000002044	0.000002810	0.000000766	**0.90**	0.339
2008	-13.2042	0.321405	-41.0827	5.46E-06		0.000001843	0.000002541	0.000000699	**0.81**	0.309
2009	-13.1691	0.320005	-41.153	9.02E-08		0.000001909	0.000002628	0.000000720	**0.84**	0.318
2011	-13.7524	0.321756	-42.7417	1.98E-18		0.000001065	0.000001469	0.000000404	**0.47**	0.179
2012	-14.4462	0.323161	-44.7026	1.46E-78		0.000000532	0.000000735	0.000000203	**0.24**	0.090
2013	-13.557	0.318662	-42.5436	5.39E-05		0.000001295	0.000001781	0.000000486	**0.57**	0.215
2015	-13.6704	0.32149	-42.522	9.35E-14		0.000001156	0.000001595	0.000000438	**0.51**	0.194
2017	-12.7232	0.31935	-39.8408	6.62E-86		0.000002981	0.000004103	0.000001122	**1.32**	0.496
2019	-12.4502	0.318279	-39.1172	1.47E-161		0.000003917	0.000005385	0.000001468	**1.73**	0.649
2021	-13.1447	0.324975	-40.4483	7.95E-89		0.000001956	0.000002707	0.000000751	**0.86**	0.332

Glm results replicated with dataset 1998-2023.

Year	Coefficient	SE	Z	Prob	Signif.	e(Coefficient)	e(coefficient + se)	Rescaled SE	Standardised Abundance	Standardised SE
1998	-15.0315	0.306715	-49.0081	0		0.000000296	0.000000403	0.000000106	**0.71**	0.253
2000	-14.0316	0.304437	-46.0903	0		0.000000806	0.000001092	0.000000287	**1.92**	0.683
2002	-13.7692	0.304988	-45.1466	0		0.000001047	0.000001421	0.000000374	**2.50**	0.890
2004	-14.3286	0.304231	-47.0978	0		0.000000599	0.000000811	0.000000213	**1.43**	0.507
2005	-15.0966	0.309139	-48.8344	0		0.000000278	0.000000378	0.000000101	**0.66**	0.240
2006	-15.296	0.30658	-49.8922	0		0.000000228	0.000000309	0.000000082	**0.54**	0.194
2007	-14.7833	0.305114	-48.4517	0		0.000000380	0.000000515	0.000000136	**0.91**	0.323
2008	-14.9104	0.307982	-48.4133	0		0.000000335	0.000000455	0.000000121	**0.80**	0.288
2009	-14.8636	0.306689	-48.4647	0		0.000000351	0.000000476	0.000000126	**0.84**	0.300
2011	-15.4521	0.308316	-50.1178	0		0.000000195	0.000000265	0.000000070	**0.46**	0.167
2012	-16.1407	0.309866	-52.0892	0		0.000000098	0.000000133	0.000000036	**0.23**	0.085
2013	-15.2426	0.30546	-49.9004	0		0.000000240	0.000000326	0.000000086	**0.57**	0.204
2015	-15.3684	0.308151	-49.8728	0		0.000000212	0.000000288	0.000000076	**0.50**	0.182
2017	-14.4138	0.306036	-47.0983	0		0.000000550	0.000000747	0.000000197	**1.31**	0.469
2019	-14.1413	0.304907	-46.3792	0		0.000000722	0.000000979	0.000000257	**1.72**	0.613
2021	-14.8651	0.311348	-47.7442	0		0.000000350	0.000000478	0.000000128	**0.83**	0.305

2. GAR_data_1998_2021

	cruise	haul	gear	year	depth	shot.lat	shot.lon	duration	GAR	st.gar	gtype
1	1698S	1998-437	BT184_21	1998	597	58.7	-8.28	178	1708	575.7303	0
2	1698S	1998-438	BT184_21	1998	530	58.33	-9.33	141	1446	615.3191	0
5	1698S	1998-441	BT184_21	1998	626	57.93	-9.67	152	9	3.552632	0
8	1698S	1998-444	BT184_21	1998	650	57.57	-9.6	120	3	1.5	0
9	1698S	1998-445	BT184_21	1998	409	57.22	-9.35	105	522	298.2857	0
10	1698S	1998-446	BT184_21	1998	696	57.1	-9.42	135	10	4.444444	0
13	1698S	1998-449	BT184_21	1998	709	56.93	-9.17	70	2	1.714286	0
16	1698S	1998-452	BT184_21	1998	622	56.82	-9.13	150	0	0	0
18	1698S	1998-454	BT184_21	1998	700	56.28	-9.18	30	9	18	0
19	1698S	1998-455	BT184_21	1998	730	56.2	-9.25	175	26	8.914286	0
20	1400S	2000-382	BT184_21	2000	613	58.72	-8.23	52	1923	2218.846	0
22	1400S	2000-384	BT184_21	2000	638	58.3	-9.48	120	449	224.5	0
26	1400S	2000-388	BT184_21	2000	600	57.68	-9.62	120	602	301	0
29	1400S	2000-391	BT184_21	2000	416	57.32	-9.42	120	100	50	0
32	1400S	2000-394	BT184_21	2000	421	55.2	-10.03	120	253	126.5	0
35	1400S	2000-398	BT184_21	2000	428	55.95	-9.27	120	1	0.5	0

36	1400S	2000-399	BT184_21	2000	710	55.95	-9.32	120	1688	844	0
38	1400S	2000-401	BT184_21	2000	528	56.33	-9.15	120	52	26	0
42	1400S	2000-405	BT184_21	2000	592	56.7	-9.03	120	93	46.5	0
45	1400S	2000-409	BT184_21	2000	552	57.17	-9.35	120	663	331.5	0
48	1400S	2000-412	BT184_21	2000	750	56.63	-9.12	120	18	9	0
53	1402S	2002-451	BT184_21	2002	550	56.8	-9.05	120	86	43	0
57	1402S	2002-455	BT184_21	2002	430	55.92	-9.27	120	36	18	0
58	1402S	2002-456	BT184_21	2002	750	55.82	-9.4	120	1167	583.5	0
61	1402S	2002-459	BT184_21	2002	400	55.15	-10.05	120	1449	724.5	0
62	1402S	2002-460	BT184_21	2002	630	55.15	-10.08	120	158	79	0
68	1402S	2002-466	BT184_21	2002	500	56.25	-9.18	120	50	25	0
69	1402S	2002-467	BT184_21	2002	750	56.92	-9.17	120	3	1.5	0
72	1402S	2002-470	BT184_21	2002	750	56.62	-9.13	60	5	5	0
74	1402S	2002-472	BT184_21	2002	600	58.73	-8.15	60	380	380	0
76	1402S	2002-474	BT184_21	2002	650	57.58	-9.62	120	174	87	0
81	1402S	2002-479	BT184_21	2002	600	58.28	-9.45	120	7847	3923.5	0
84	1402S	2002-482	BT184_21	2002	500	58.77	-7.85	60	18	18	0

86	1304S	2004-340	BT184_21	2004	660	58.78	-7.95	120	297	148.5	0
87	1304S	2004-341	BT184_21	2004	425	57.35	-9.4	120	47	23.5	0
88	1304S	2004-342	BT184_21	2004	570	57.18	-9.35	120	1397	698.5	0
93	1304S	2004-348	BT184_21	2004	700	55.95	-9.32	120	2007	1003.5	0
96	1304S	2004-352	BT184_21	2004	600	55.27	-10.03	60	282	282	0
97	1304S	2004-353	BT184_21	2004	430	55.18	-10.03	60	574	574	0
98	1304S	2004-354	BT184_21	2004	400	55.82	-9.3	120	26	13	0
99	1304S	2004-355	BT184_21	2004	500	56.2	-9.22	120	112	56	0
100	1304S	2004-356	BT184_21	2004	550	56.72	-9.02	120	261	130.5	0
108	1304S	2004-365	BT184_21	2004	600	57.7	-9.62	60	81	81	0
110	1304S	2004-367	BT184_21	2004	640	58.22	-9.57	60	9	9	0
111	1205S	2005-378	BT184_21	2005	500	56.7	-9.02	120	146	73	0
116	1205S	2005-383	BT184_21	2005	525	57.08	-9.28	120	229	114.5	0
119	1205S	2005-386	BT184_21	2005	600	57.62	-9.6	120	73	36.5	0
123	1205S	2005-391	BT184_21	2005	650	58.25	-9.55	120	343	171.5	0
128	1205S	2005-396	BT184_21	2005	600	58.72	-8.22	120	866	433	0
135	1506S	2006-458	BT184_21	2006	550	56.8	-9.07	120	55	27.5	0

137	1506S	2006-460	BT184_21	2006	500	56.32	-9.15	120	23	11.5	0
138	1506S	2006-461	BT184_21	2006	500	55.24	-10.04	118	802	407.7966	0
141	1506S	2006-464	BT184_21	2006	750	55.29	-10.06	120	10	5	0
142	1506S	2006-465	BT184_21	2006	450	55.83	-9.31	120	66	33	0
143	1506S	2006-466	BT184_21	2006	750	55.96	-9.33	60	244	244	0
149	1506S	2006-472	BT184_21	2006	525	57.19	-9.36	120	36	18	0
154	1506S	2006-477	BT184_21	2006	540	57.59	-9.59	120	38	19	0
157	1506S	2006-480	BT184_21	2006	570	58.2	-9.57	120	74	37	0
160	1506S	2006-483	BT184_21	2006	550	58.73	-8.23	120	846	423	0
162	1506S	2006-485	BT184_21	2006	540	58.85	-7.73	120	32	16	0
164	1307S	2007-388	BT184_21	2007	580	57.68	-9.62	120	569	284.5	0
165	1307S	2007-391	BT184_21	2007	525	57.18	-9.36	120	436	218	0
171	1307S	2007-398	BT184_21	2007	500	55.2	-10.06	126	956	455.2381	0
174	1307S	2007-401	BT184_21	2007	500	56.33	-9.17	110	53	28.90909	0
175	1307S	2007-402	BT184_21	2007	500	56.83	-9.08	107	92	51.58879	0
180	1307S	2007-407	BT184_21	2007	600	58.15	-9.59	120	91	45.5	0
188	1108S	2008-380	BT184_21	2008	500	56.21	-9.32	120	6	3	0

192	1108S	2008-384	BT184_21	2008	500	55.14	-10.08	120	1225	612.5	0
197	1108S	2008-389	BT184_21	2008	500	56.69	-9.02	120	140	70	0
198	1108S	2008-390	BT184_21	2008	500	57.06	-9.27	120	93	46.5	0
202	1108S	2008-394	BT184_21	2008	600	58.29	-9.47	120	731	365.5	0
204	1108S	2008-396	BT184_21	2008	500	57.58	-9.57	60	136	136	0
213	1108S	2008-405	BT184_21	2008	500	58.72	-8.08	42	48	68.57143	0
216	1108S	2008-408	BT184_21	2008	500	58.85	-7.73	120	529	264.5	0
227	1209S	2009-376	BT184_16	2009	500	56.21	-9.21	36	1	1.666667	1
234	1209S	2009-383	BT184_16	2009	500	55.24	-10.04	60	192	192	1
238	1209S	2009-387	BT184_16	2009	500	56.72	-9.03	61	5	4.918033	1
241	1209S	2009-390	BT184_16	2009	500	57.18	-9.35	60	1	1	1
242	1209S	2009-391	BT184_16	2009	750	57.18	-9.42	30	2	4	1
243	1209S	2009-392	BT184_16	2009	500	57.69	-9.62	60	68	68	1
249	1209S	2009-398	BT184_16	2009	600	58.18	-9.57	66	748	680	1
254	1209S	2009-403	BT184_16	2009	500	58.86	-7.71	62	555	537.0968	1
255	1011S	2011-447	BT184_16	2011	500	56.26	-9.19	60	44	44	1
263	1011S	2011-455	BT184_16	2011	500	56.73	-9.04	64	57	53.4375	1

270	1011S	2011-462	BT184_16	2011	700	57.77	-9.68	60	2	2	1
271	1011S	2011-463	BT184_16	2011	500	57.64	-9.6	50	29	34.8	1
272	1011S	2011-464	BT184_16	2011	400	57.84	-9.55	61	4	3.934426	1
273	1011S	2011-465	BT184_16	2011	600	57.95	-9.66	63	1	0.952381	1
277	1011S	2011-469	BT184_16	2011	550	58.42	-9.24	60	654	654	1
286	1212S	2012-442	BT184_16	2012	500	56.26833	-9.18983	52	31	35.76923	1
294	1212S	2012-451	BT184_16	2012	500	56.8145	-9.06617	60	36	36	1
298	1212S	2012-455	BT184_16	2012	500	57.26533	-9.41017	60	33	33	1
303	1212S	2012-460	BT184_16	2012	500	57.6555	-9.606	60	27	27	1
307	1212S	2012-464	BT184_16	2012	700	57.70367	-9.66133	60	1	1	1
308	1212S	2012-465	BT184_16	2012	600	57.655	-9.62017	60	78	78	1
317	1212S	2012-474	BT184_16	2012	500	58.4245	-9.2265	30	84	168	1
319	1213S	2013-315	BT184_16	2013	487	56.24067	-9.19533	54	12	13.33333	1
326	1213S	2013-323	BT184_16	2013	614	55.2535	-10.0557	60	370	370	1
327	1213S	2013-324	BT184_16	2013	506	55.25433	-10.0182	60	86	86	1
335	1213S	2013-332	BT184_16	2013	521	56.75283	-9.045	60	115	115	1
340	1213S	2013-337	BT184_16	2013	496	57.24617	-9.39567	30	37	74	1

345	1213S	2013-342	BT184_16	2013	504	57.59017	-9.57667	30	17	34	1
350	1213S	2013-347	BT184_16	2013	511	58.413	-9.204	30	41	82	1
355	1215S	2015-362	BT184_16	2015	510	58.82833	-7.77333	60	183	183	1
366	1215S	2015-373	BT184_16	2015	530	58.4375	-9.1485	60	582	582	1
370	1215S	2015-377	BT184_16	2015	500	57.60567	-9.58217	60	91	91	1
374	1215S	2015-381	BT184_16	2015	500	57.2715	-9.4155	60	48	48	1
378	1215S	2015-385	BT184_16	2015	500	56.80367	-9.06283	61	25	24.59016	1
382	1215S	2015-389	BT184_16	2015	500	56.2715	-9.18767	60	9	9	1
383	1215S	2015-390	BT184_16	2015	750	56.2665	-9.25033	39	0	0	1
390	1215S	2015-397	BT184_16	2015	720	57.78717	-9.68167	60	19	19	1
393	1317S DEEPWATER	2017-308	BT184_16	2017	500	56.207	-9.215	60	13	13	1
403	1317S DEEPWATER	2017-318	BT184_16	2017	480	55.245	-10.029	30	590	1180	1
410	1317S DEEPWATER	2017-325	BT184_16	2017	743	56.799	-9.107	60	0	0	1
411	1317S DEEPWATER	2017-326	BT184_16	2017	528	56.819	-9.069	60	84	84	1
412	1317S DEEPWATER	2017-327	BT184_16	2017	514	57.219	-9.376	60	136	136	1
421	1317S DEEPWATER	2017-336	BT184_16	2017	740	57.66	-9.661	30	0	0	1
426	1317S DEEPWATER	2017-341	BT184_16	2017	502	57.616	-9.587	60	114	114	1

429	1317S DEEPWATER	2017-344	BT184_16	2017	515	58.437	-9.163	60	975	975	1
433	1317S DEEPWATER	2017-348	BT184_16	2017	545	58.595	-8.652	60	81	81	1
438	1419S DEEPWATER	2019-329	BT184_16	2019	528	58.432	-9.158	21	413	1180	1
447	1419S DEEPWATER	2019-338	BT184_16	2019	515	57.228	-9.382	60	197	197	1
450	1419S DEEPWATER	2019-341	BT184_16	2019	501	56.758	-9.049	48	65	81.25	1
455	1419S DEEPWATER	2019-346	BT184_16	2019	470	55.298	-10	30	68	136	1
461	1419S DEEPWATER	2019-352	BT184_16	2019	493	56.273	-9.187	60	76	76	1
465	1419S DEEPWATER	2019-356	BT184_16	2019	511	57.614	-9.582	60	493	493	1
753	1621S DEEPWATER	2021-522	BT184_16	2021	515	58.86	-7.69583	60	345.483	113.5	1
756	1621S DEEPWATER	2021-525	BT184_16	2021	544	58.58	-8.706	60	832.546	278.998	1
759	1621S DEEPWATER	2021-528	BT184_16	2021	525	58.43	-9.1645	60	328.896	111.2	1
770	1621S DEEPWATER	2021-539	BT184_16	2021	492	56.79	-9.05245	60	192	55.2	1
776	1621S DEEPWATER	2021-545	BT184_16	2021	504	57.25	-9.39537	60	109	28.6	1
779	1621S DEEPWATER	2021-548	BT184_16	2021	492	57.56	-9.5622	60	273	78.4	1
781	1621S DEEPWATER	2021-550	BT184_16	2021	634	59.38	-10.0847	24	15	11.7	1
782	1621S DEEPWATER	2021-551	BT184_16	2021	704	59.21	-9.89133	27	0	0	1

3. GAR_data_1998-2023

	cruise	haul	gear	year	depth	shot.lat	shot.lon	duration	GAR	st.gar	gtype
1	1698S	1998-437	BT184_21	1998	597	58.7	-8.28	178	1708	575.7303	0
2	1698S	1998-438	BT184_21	1998	530	58.33	-9.33	141	1446	615.3191	0
5	1698S	1998-441	BT184_21	1998	626	57.93	-9.67	152	9	3.552632	0
8	1698S	1998-444	BT184_21	1998	650	57.57	-9.6	120	3	1.5	0
9	1698S	1998-445	BT184_21	1998	409	57.22	-9.35	105	522	298.2857	0
10	1698S	1998-446	BT184_21	1998	696	57.1	-9.42	135	10	4.444444	0
13	1698S	1998-449	BT184_21	1998	709	56.93	-9.17	70	2	1.714286	0
16	1698S	1998-452	BT184_21	1998	622	56.82	-9.13	150	0	0	0
18	1698S	1998-454	BT184_21	1998	700	56.28	-9.18	30	9	18	0
19	1698S	1998-455	BT184_21	1998	730	56.2	-9.25	175	26	8.914286	0
20	1400S	2000-382	BT184_21	2000	613	58.72	-8.23	52	1923	2218.846	0
22	1400S	2000-384	BT184_21	2000	638	58.3	-9.48	120	449	224.5	0
26	1400S	2000-388	BT184_21	2000	600	57.68	-9.62	120	602	301	0
29	1400S	2000-391	BT184_21	2000	416	57.32	-9.42	120	100	50	0
32	1400S	2000-394	BT184_21	2000	421	55.2	-10.03	120	253	126.5	0

35	1400S	2000-398	BT184_21	2000	428	55.95	-9.27	120	1	0.5	0
36	1400S	2000-399	BT184_21	2000	710	55.95	-9.32	120	1688	844	0
38	1400S	2000-401	BT184_21	2000	528	56.33	-9.15	120	52	26	0
42	1400S	2000-405	BT184_21	2000	592	56.7	-9.03	120	93	46.5	0
45	1400S	2000-409	BT184_21	2000	552	57.17	-9.35	120	663	331.5	0
48	1400S	2000-412	BT184_21	2000	750	56.63	-9.12	120	18	9	0
53	1402S	2002-451	BT184_21	2002	550	56.8	-9.05	120	86	43	0
57	1402S	2002-455	BT184_21	2002	430	55.92	-9.27	120	36	18	0
58	1402S	2002-456	BT184_21	2002	750	55.82	-9.4	120	1167	583.5	0
61	1402S	2002-459	BT184_21	2002	400	55.15	-10.05	120	1449	724.5	0
62	1402S	2002-460	BT184_21	2002	630	55.15	-10.08	120	158	79	0
68	1402S	2002-466	BT184_21	2002	500	56.25	-9.18	120	50	25	0
69	1402S	2002-467	BT184_21	2002	750	56.92	-9.17	120	3	1.5	0
72	1402S	2002-470	BT184_21	2002	750	56.62	-9.13	60	5	5	0
74	1402S	2002-472	BT184_21	2002	600	58.73	-8.15	60	380	380	0
76	1402S	2002-474	BT184_21	2002	650	57.58	-9.62	120	174	87	0
81	1402S	2002-479	BT184_21	2002	600	58.28	-9.45	120	7847	3923.5	0

84	1402S	2002-482	BT184_21	2002	500	58.77	-7.85	60	18	18	0
86	1304S	2004-340	BT184_21	2004	660	58.78	-7.95	120	297	148.5	0
87	1304S	2004-341	BT184_21	2004	425	57.35	-9.4	120	47	23.5	0
88	1304S	2004-342	BT184_21	2004	570	57.18	-9.35	120	1397	698.5	0
93	1304S	2004-348	BT184_21	2004	700	55.95	-9.32	120	2007	1003.5	0
96	1304S	2004-352	BT184_21	2004	600	55.27	-10.03	60	282	282	0
97	1304S	2004-353	BT184_21	2004	430	55.18	-10.03	60	574	574	0
98	1304S	2004-354	BT184_21	2004	400	55.82	-9.3	120	26	13	0
99	1304S	2004-355	BT184_21	2004	500	56.2	-9.22	120	112	56	0
100	1304S	2004-356	BT184_21	2004	550	56.72	-9.02	120	261	130.5	0
108	1304S	2004-365	BT184_21	2004	600	57.7	-9.62	60	81	81	0
110	1304S	2004-367	BT184_21	2004	640	58.22	-9.57	60	9	9	0
111	1205S	2005-378	BT184_21	2005	500	56.7	-9.02	120	146	73	0
116	1205S	2005-383	BT184_21	2005	525	57.08	-9.28	120	229	114.5	0
119	1205S	2005-386	BT184_21	2005	600	57.62	-9.6	120	73	36.5	0
123	1205S	2005-391	BT184_21	2005	650	58.25	-9.55	120	343	171.5	0
128	1205S	2005-396	BT184_21	2005	600	58.72	-8.22	120	866	433	0

135	1506S	2006-458	BT184_21	2006	550	56.8	-9.07	120	55	27.5	0
137	1506S	2006-460	BT184_21	2006	500	56.32	-9.15	120	23	11.5	0
138	1506S	2006-461	BT184_21	2006	500	55.24	-10.04	118	802	407.7966	0
141	1506S	2006-464	BT184_21	2006	750	55.29	-10.06	120	10	5	0
142	1506S	2006-465	BT184_21	2006	450	55.83	-9.31	120	66	33	0
143	1506S	2006-466	BT184_21	2006	750	55.96	-9.33	60	244	244	0
149	1506S	2006-472	BT184_21	2006	525	57.19	-9.36	120	36	18	0
154	1506S	2006-477	BT184_21	2006	540	57.59	-9.59	120	38	19	0
157	1506S	2006-480	BT184_21	2006	570	58.2	-9.57	120	74	37	0
160	1506S	2006-483	BT184_21	2006	550	58.73	-8.23	120	846	423	0
162	1506S	2006-485	BT184_21	2006	540	58.85	-7.73	120	32	16	0
164	1307S	2007-388	BT184_21	2007	580	57.68	-9.62	120	569	284.5	0
165	1307S	2007-391	BT184_21	2007	525	57.18	-9.36	120	436	218	0
171	1307S	2007-398	BT184_21	2007	500	55.2	-10.06	126	956	455.2381	0
174	1307S	2007-401	BT184_21	2007	500	56.33	-9.17	110	53	28.90909	0
175	1307S	2007-402	BT184_21	2007	500	56.83	-9.08	107	92	51.58879	0
180	1307S	2007-407	BT184_21	2007	600	58.15	-9.59	120	91	45.5	0

188	1108S	2008-380	BT184_21	2008	500	56.21	-9.32	120	6	3	0
192	1108S	2008-384	BT184_21	2008	500	55.14	-10.08	120	1225	612.5	0
197	1108S	2008-389	BT184_21	2008	500	56.69	-9.02	120	140	70	0
198	1108S	2008-390	BT184_21	2008	500	57.06	-9.27	120	93	46.5	0
202	1108S	2008-394	BT184_21	2008	600	58.29	-9.47	120	731	365.5	0
204	1108S	2008-396	BT184_21	2008	500	57.58	-9.57	60	136	136	0
213	1108S	2008-405	BT184_21	2008	500	58.72	-8.08	42	48	68.57143	0
216	1108S	2008-408	BT184_21	2008	500	58.85	-7.73	120	529	264.5	0
227	1209S	2009-376	BT184_16	2009	500	56.21	-9.21	36	1	1.666667	1
234	1209S	2009-383	BT184_16	2009	500	55.24	-10.04	60	192	192	1
238	1209S	2009-387	BT184_16	2009	500	56.72	-9.03	61	5	4.918033	1
241	1209S	2009-390	BT184_16	2009	500	57.18	-9.35	60	1	1	1
242	1209S	2009-391	BT184_16	2009	750	57.18	-9.42	30	2	4	1
243	1209S	2009-392	BT184_16	2009	500	57.69	-9.62	60	68	68	1
249	1209S	2009-398	BT184_16	2009	600	58.18	-9.57	66	748	680	1
254	1209S	2009-403	BT184_16	2009	500	58.86	-7.71	62	555	537.0968	1
255	1011S	2011-447	BT184_16	2011	500	56.26	-9.19	60	44	44	1

263	1011S	2011-455	BT184_16	2011	500	56.73	-9.04	64	57	53.4375	1
270	1011S	2011-462	BT184_16	2011	700	57.77	-9.68	60	2	2	1
271	1011S	2011-463	BT184_16	2011	500	57.64	-9.6	50	29	34.8	1
272	1011S	2011-464	BT184_16	2011	400	57.84	-9.55	61	4	3.934426	1
273	1011S	2011-465	BT184_16	2011	600	57.95	-9.66	63	1	0.952381	1
277	1011S	2011-469	BT184_16	2011	550	58.42	-9.24	60	654	654	1
286	1212S	2012-442	BT184_16	2012	500	56.26833	-9.18983	52	31	35.76923	1
294	1212S	2012-451	BT184_16	2012	500	56.8145	-9.06617	60	36	36	1
298	1212S	2012-455	BT184_16	2012	500	57.26533	-9.41017	60	33	33	1
303	1212S	2012-460	BT184_16	2012	500	57.6555	-9.606	60	27	27	1
307	1212S	2012-464	BT184_16	2012	700	57.70367	-9.66133	60	1	1	1
308	1212S	2012-465	BT184_16	2012	600	57.655	-9.62017	60	78	78	1
317	1212S	2012-474	BT184_16	2012	500	58.4245	-9.2265	30	84	168	1
319	1213S	2013-315	BT184_16	2013	487	56.24067	-9.19533	54	12	13.33333	1
326	1213S	2013-323	BT184_16	2013	614	55.2535	-10.0557	60	370	370	1
327	1213S	2013-324	BT184_16	2013	506	55.25433	-10.0182	60	86	86	1
335	1213S	2013-332	BT184_16	2013	521	56.75283	-9.045	60	115	115	1

340	1213S	2013-337	BT184_16	2013	496	57.24617	-9.39567	30	37	74	1
345	1213S	2013-342	BT184_16	2013	504	57.59017	-9.57667	30	17	34	1
350	1213S	2013-347	BT184_16	2013	511	58.413	-9.204	30	41	82	1
355	1215S	2015-362	BT184_16	2015	510	58.82833	-7.77333	60	183	183	1
366	1215S	2015-373	BT184_16	2015	530	58.4375	-9.1485	60	582	582	1
370	1215S	2015-377	BT184_16	2015	500	57.60567	-9.58217	60	91	91	1
374	1215S	2015-381	BT184_16	2015	500	57.2715	-9.4155	60	48	48	1
378	1215S	2015-385	BT184_16	2015	500	56.80367	-9.06283	61	25	24.59016	1
382	1215S	2015-389	BT184_16	2015	500	56.2715	-9.18767	60	9	9	1
383	1215S	2015-390	BT184_16	2015	750	56.2665	-9.25033	39	0	0	1
390	1215S	2015-397	BT184_16	2015	720	57.78717	-9.68167	60	19	19	1
393	1317S DEEPWATER	2017-308	BT184_16	2017	500	56.207	-9.215	60	13	13	1
403	1317S DEEPWATER	2017-318	BT184_16	2017	480	55.245	-10.029	30	590	1180	1
410	1317S DEEPWATER	2017-325	BT184_16	2017	743	56.799	-9.107	60	0	0	1
411	1317S DEEPWATER	2017-326	BT184_16	2017	528	56.819	-9.069	60	84	84	1
412	1317S DEEPWATER	2017-327	BT184_16	2017	514	57.219	-9.376	60	136	136	1
421	1317S DEEPWATER	2017-336	BT184_16	2017	740	57.66	-9.661	30	0	0	1

426	1317S DEEPWATER	2017-341	BT184_16	2017	502	57.616	-9.587	60	114	114	1
429	1317S DEEPWATER	2017-344	BT184_16	2017	515	58.437	-9.163	60	975	975	1
433	1317S DEEPWATER	2017-348	BT184_16	2017	545	58.595	-8.652	60	81	81	1
438	1419S DEEPWATER	2019-329	BT184_16	2019	528	58.432	-9.158	21	413	1180	1
447	1419S DEEPWATER	2019-338	BT184_16	2019	515	57.228	-9.382	60	197	197	1
450	1419S DEEPWATER	2019-341	BT184_16	2019	501	56.758	-9.049	48	65	81.25	1
455	1419S DEEPWATER	2019-346	BT184_16	2019	470	55.298	-10	30	68	136	1
461	1419S DEEPWATER	2019-352	BT184_16	2019	493	56.273	-9.187	60	76	76	1
465	1419S DEEPWATER	2019-356	BT184_16	2019	511	57.614	-9.582	60	493	493	1
753	1621S	2021-522	BT184_16	2021	541	58.858	-7.695	60	345.483	345.483	1
756	1621S	2021-525	BT184_16	2021	533	58.579	-8.706	60	832.546	832.546	1
759	1621S	2021-528	BT184_16	2021	522	58.426	-9.164	60	328.896	328.896	1
770	1621S	2021-539	BT184_16	2021	480	56.785	-9.052	60	192	192	1
776	1621S	2021-545	BT184_16	2021	504	57.246	-9.395	60	109	109	1
779	1621S	2021-548	BT184_16	2021	525	57.562	-9.562	60	273	273	1
781	1621S	2021-550	BT184_16	2021	627	59.375	-10.084	24	15	37.5	1
782	1621S	2021-551	BT184_16	2021	721	59.207	-9.891	27	0	0	1

1	1323S	2023-307	BT184_16	2023	540	58.862	-7.693	50	274	328.8	1
4	1323S	2023-310	BT184_16	2023	542	58.612	-8.602	60	603.88	603.88	1
7	1323S	2023-313	BT184_16	2023	530	58.435	-9.149	30	304	608	1
11	1323S	2023-317	BT184_16	2023	505	55.298	-10.001	60	93	93	1
14	1323S	2023-320	BT184_16	2023	750	55.225	-10.095	60	1	1	1
20	1323S	2023-326	BT184_16	2023	460	56.263	-9.186	30	26	52	1
21	1323S	2023-327	BT184_16	2023	750	56.244	-9.258	60	81	81	1
24	1323S	2023-330	BT184_16	2023	530	56.763	-9.049	60	132	132	1
34	1323S	2023-340	BT184_16	2023	500	57.283	-9.422	60	162	162	1
40	1323S	2023-346	BT184_16	2023	510	57.619	-9.588	60	313.101	313.101	1

PFA self-sampling report for WGDEEP 2024 (v1)

Niels Hintzen, 22/04/2024 17:03:07

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 PFA fishery for argentines takes place in the months April and May, and sometimes into June. The predominant fishing area is ICES division 27.6.a with also some catches being taken in 2.a, 4.a and 5.b. The fishery is combined with the fishery for blue whiting, whereby the catches of blue whiting take place during the day and catch of argentines mostly in the night.

Overall, the self-sampling activities for the argentines fisheries during the years 2017 – 2024 covered 51 fishing trips with 1552 hauls, a total catch of 93688 tonnes and 88587 individual length measurements.

The length compositions of argentines are relatively stable over the years, varying between medians of 34 to 36 cm.

1 Introduction

The Pelagic Freezer-trawler Association (PFA) is an association that has nine member companies that together operate 18 freezer trawlers (in 2023) in six European countries (www.pelagicfish.eu). In 2015, the PFA has initiated a self-sampling program that expands the ongoing monitoring programs on board of pelagic freezer-trawlers by the specialized crew of the vessels. The primary objective of that monitoring program is to assess the quality of fish. The expansion in the self-sampling program 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 program is carried out by Niels Hintzen (PFA chief science officer) with support of Lina de Nijs (PFA) and Floor Quirijns (contractor).

2 Overview of self-sampling methodology

The PFA self-sampling program has been incrementally implemented on freezer-trawler vessels from the Netherlands, UK, Germany, France, Poland and Lithuania during the years 2015-2017. From 2018 onwards, all vessels in the association are covered by the self-sampling program. The program is designed in such a way that it follows as closely as possible the working practices on board of the different vessels and that it delivers the biological and fisheries information needed for the relevant scientific bodies (e.g. ICES, SPRFMO, CECAF), certification bodies (e.g. MSC) and as a mechanism of feedback for the participating companies.

The following main elements can be distinguished in the self-sampling protocol:

- haul information (date, time, position, weather conditions, environmental conditions, gear attributed, estimated catch, optionally: species composition)
- batch information (total catch per batch=production unit, including variables like species, average size, average weight, fat content, gonads y/n and stomach fill)
- linking batch and haul information (essentially a key of how much of a batch is caught in which of the hauls)
- length information (length frequency measurements, either by batch or by haul)
- biological information (measuring individual fish)

The self-sampling information was initially collected using standardized Excel worksheets. From 2018 onwards a transition is being made from Excel spreadsheet to dedicated data-recording software (M-Catch) with live synchronization to a shore-based system. The information collected during a trip will be sent for data processing by the end of the trip. The self-sampling data is being checked and added to the database by Lina de Nijs, who also generate standardized trip reports (using RMarkdown) which are being sent back to the vessel and company. 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 program.

For this report, the PFA self-sampling data has been filtered for vessel-trip-week combinations using the following criteria:

- hauls in divisions 27.6.a; 27.5.b; 27.4.a
- catch of arg by trip and week at least 10% of the total catch of that trip and week.
- catch of arg by trip and week at least 10 tonnes.

The selection resulted in 121 vessel-trip-week combinations over the years 2017-2023.

A particular challenge in the PFA self-sampling program is dealing with the different length metrics in use. Routinely, on freezer-trawlers, fish will be measured in standard length (SL, until the onset of the tail of the fish). However, for scientific purposes, length is required mostly in total length (TL), or, in the case of the South Pacific RFMO, in fork length (FL). The PFA self-sampling program aims to utilize the appropriate scientific length metric: TL in Europe and Africa, FL in the South Pacific. However, in some instances, the quality managers on board of the vessels have used the wrong length metric for the area they were fishing in. Until 2021, these situations were 'corrected' by applying a direct length-to-length conversion based on data from individual measurements of SL, FL and TL. It was recognized that this approach could lead to holes in the length distributions.

In 2022 a new method of converting length-to-length was implemented, based on the paper by Hansen et al (2018). The method consists of generating simulated length-length-keys similar to the often used age-length-keys. The implementation of the new method means to some differences may exist in length data compared to previous reports.

3 Results

3.1 General

An overview of all the self-sampled trips for arg in 27.6.a, 27.5.b, 27.4.a. The percentage non-target species is defined as the catch of non-pelagic species relative to the catch of pelagic species.

year	nvessels	ntrips	ndays	nhauls	catch	catch/day	nontarget	nlength	nbio
2017	3	3	33	90	7,464	226	1.23%	6,150	0
2018	7	8	79	215	10,446	132	1.61%	15,291	509
2019	6	7	48	118	10,792	225	0.06%	7,450	7
2020	7	9	104	288	15,342	148	0.53%	14,258	131
2021	5	6	59	139	10,704	181	0.74%	6,848	102
2022	6	8	148	382	21,855	148	1.58%	16,381	21
2023	5	10	131	320	17,084	130	1.11%	22,209	47
(all)		51	602	1,552	93,688			88,587	817

Table 3.1.1: PFA deepwater fisheries for argentines. Self-sampling Summary of number of vessels, trips, days, hauls, catch (tonnes), catch per day(tonnes/day), percentage non-target species, number of fish measured and number of biological samples

Catch and number of self-sampled hauls by year and division

division	2017	2018	2019	2020	2021	2022	2023	all	perc
27.6.a	7,464	10,446	10,792	15,342	10,704	21,855	17,084	93,688	100.0%
(all)	7,464	10,446	10,792	15,342	10,704	21,855	17,084	93,688	100.0%

division	2017	2018	2019	2020	2021	2022	2023	all	perc
27.6.a	90	215	118	288	139	382	320	1,552	100.0%
(all)	90	215	118	288	139	382	320	1,552	100.0%

*Table 3.1.2: PFA deepwater fisheries for argentines. Self-sampling Summary of catch (top) and number of hauls (bottom) per year and division. * denotes incomplete year*

Catch and number of self-sampled hauls by year and month

month	2017	2018	2019	2020	2021	2022	2023	all	perc
Mar	0	0	0	0	0	0	789	789	0.8%
Apr	596	2,316	3,557	9,600	3,669	14,048	5,163	38,949	41.6%
May	6,868	8,130	7,234	4,522	7,035	7,807	9,874	51,471	54.9%
Jun	0	0	0	1,146	0	0	0	1,146	1.2%
Jul	0	0	0	0	0	0	1,056	1,056	1.1%
Aug	0	0	0	0	0	0	203	203	0.2%
Oct	0	0	0	75	0	0	0	75	0.1%
(all)	7,464	10,446	10,792	15,342	10,704	21,855	17,084	93,688	100.0%

month	2017	2018	2019	2020	2021	2022	2023	all	perc
Mar	0	0	0	0	0	0	22	22	1.4%
Apr	4	50	33	143	39	247	111	627	40.4%
May	86	165	85	119	100	135	152	842	54.3%
Jun	0	0	0	19	0	0	0	19	1.2%
Jul	0	0	0	0	0	0	28	28	1.8%
Aug	0	0	0	0	0	0	7	7	0.5%
Oct	0	0	0	7	0	0	0	7	0.5%
(all)	90	215	118	288	139	382	320	1,552	100.0%

Table 3.1.3: PFA deepwater fisheries for argentines. Self-sampling summary of catch (top) and number of hauls (bottom) per year and month.

Catch and number of self-sampled hauls by year and country (flag)

flag	2017	2018	2019	2020	2021	2022	2023	all	perc
DEU	0	2,054	3,617	2,711	1,095	1,350	1,697	12,524	13.4%
LIT	0	0	0	75	0	0	0	75	0.1%
NL	7,464	8,392	7,175	12,556	9,610	20,504	15,387	81,089	86.6%
(all)	7,464	10,446	10,792	15,342	10,704	21,855	17,084	93,688	100.0%

flag	2017	2018	2019	2020	2021	2022	2023	all	perc
DEU	0	59	46	74	27	44	67	317	20.4%
LIT	0	0	0	7	0	0	0	7	0.5%
NL	90	156	72	207	112	338	253	1,228	79.1%
(all)	90	215	118	288	139	382	320	1,552	100.0%

Table 3.1.4: PFA deepwater fisheries for argentines. Self-sampling summary of catch (top) and number of hauls (bottom) per year and month.

Catch by species and year

species	english_name	scientific_name	2017	2018	2019	2020	2021	2022	2023	all	perc
whb	blue whiting	Micromesistius poutassou	5,030	6,659	6,792	9,116	6,093	11,963	10,946	56,600	60.4%
arg	argentines	Argentina spp	2,248	3,439	3,899	5,946	4,398	9,416	5,752	35,098	37.5%
mac	mackerel	Scomber scombrus	94	179	95	199	132	131	187	1,018	1.1%
hke	hake	Merluccius merluccius	89	142	3	39	50	277	132	732	0.8%
sqr	squid	Loligo vulgaris	0	4	0	15	5	47	20	92	0.1%
mcd	NA	Ceratoscopelus maderensis	0	0	0	11	18	2	14	45	0.0%
sqm	Broadtail shortfin squid	Illex coindetii	0	0	0	0	4	15	4	23	0.0%
squ	various squids nei	Loliginidae, Ommastrephidae	0	0	3	14	0	0	5	22	0.0%
mzz	other fish	Osteichthyes	0	19	0	0	0	0	0	19	0.0%
pok	saithe	Pollachius virens	3	2	0	0	3	0	10	17	0.0%
her	herring	Clupea harengus	0	0	0	0	0	0	10	10	0.0%
gfb	NA	Phycis blennoides	0	0	0	1	0	3	1	5	0.0%
bhg	NA	Benthosema glaciale	0	0	0	0	0	0	2	2	0.0%
hom	horse mackerel	Trachurus trachurus	0	1	0	0	1	0	0	2	0.0%
boc	boarfish	Capros aper	0	0	0	0	0	0	2	2	0.0%
oth	NA	NA	0	0	0	0	0	0	0	2	0.0%
(all)	(all)	(all)	7,464	10,446	10,792	15,342	10,704	21,855	17,084	93,688	100.0%

Table 3.1.5: PFA deepwater fisheries for argentines. Self-sampling Summary of total catch (tonnes) by species. OTH refers to all other species that are not the main target species

Haul positions

An overview of all self-sampled hauls in the PFA deepwater fisheries for argentines..

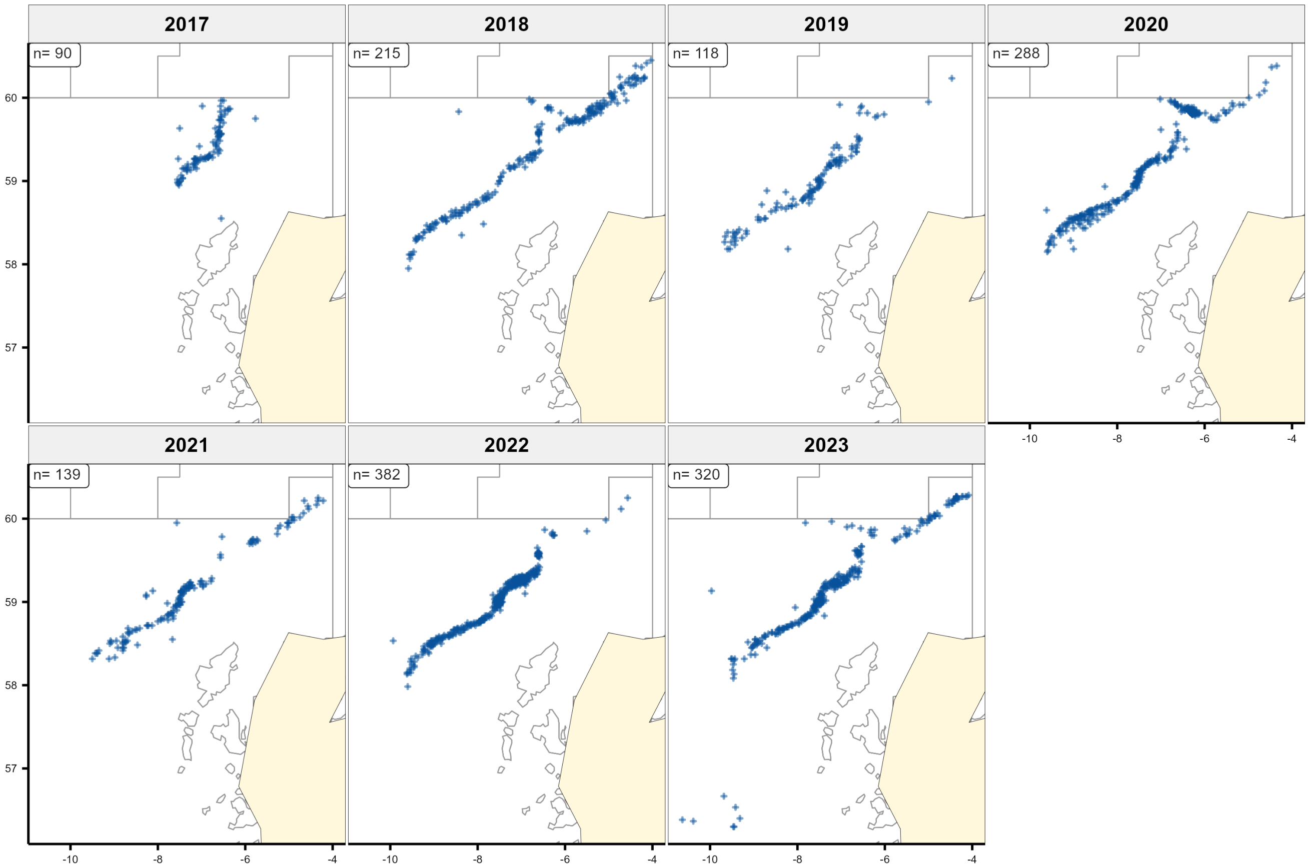

Figure 3.1.1: PFA deepwater fisheries for argentines. Self-sampling haul positions. N indicates the number of hauls.

Catches for the main target species

Summed catches (tonnes) of the main target species aggregated in rectangles.

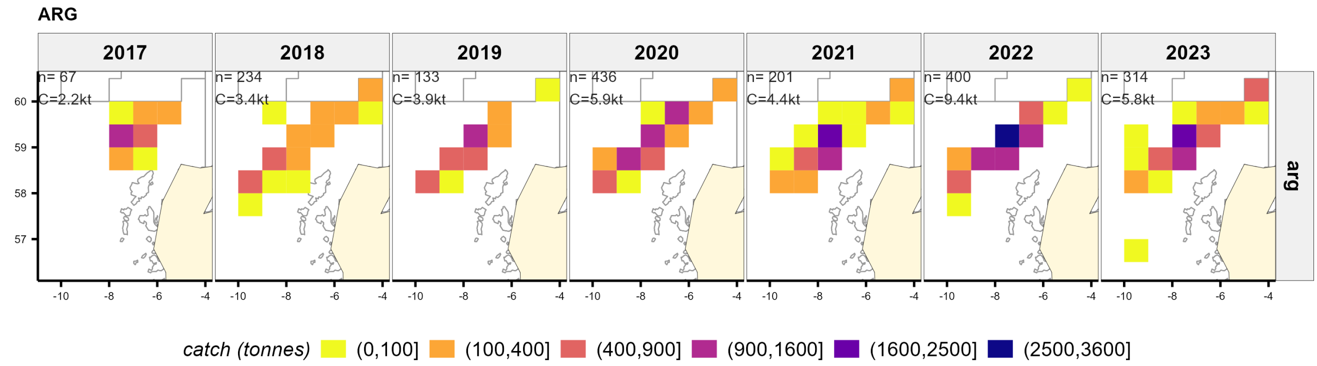

Figure 3.1.2: PFA deepwater fisheries for argentines. Self-sampling catch per species and per rectangle. N indicates the number of hauls. Catch refers to the total catch per year.

Catch rates (catch/day) for the main target species

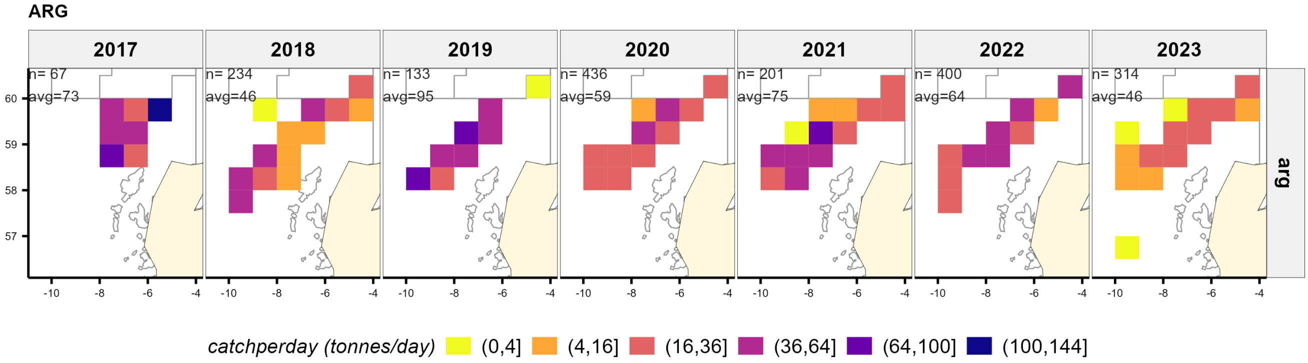

Figure 3.1.3: Average catch per day, per species and per rectangle. N indicates the number of hauls; avg refers to the average catch per day.

Average surface temperature by quarter and by rectangle.

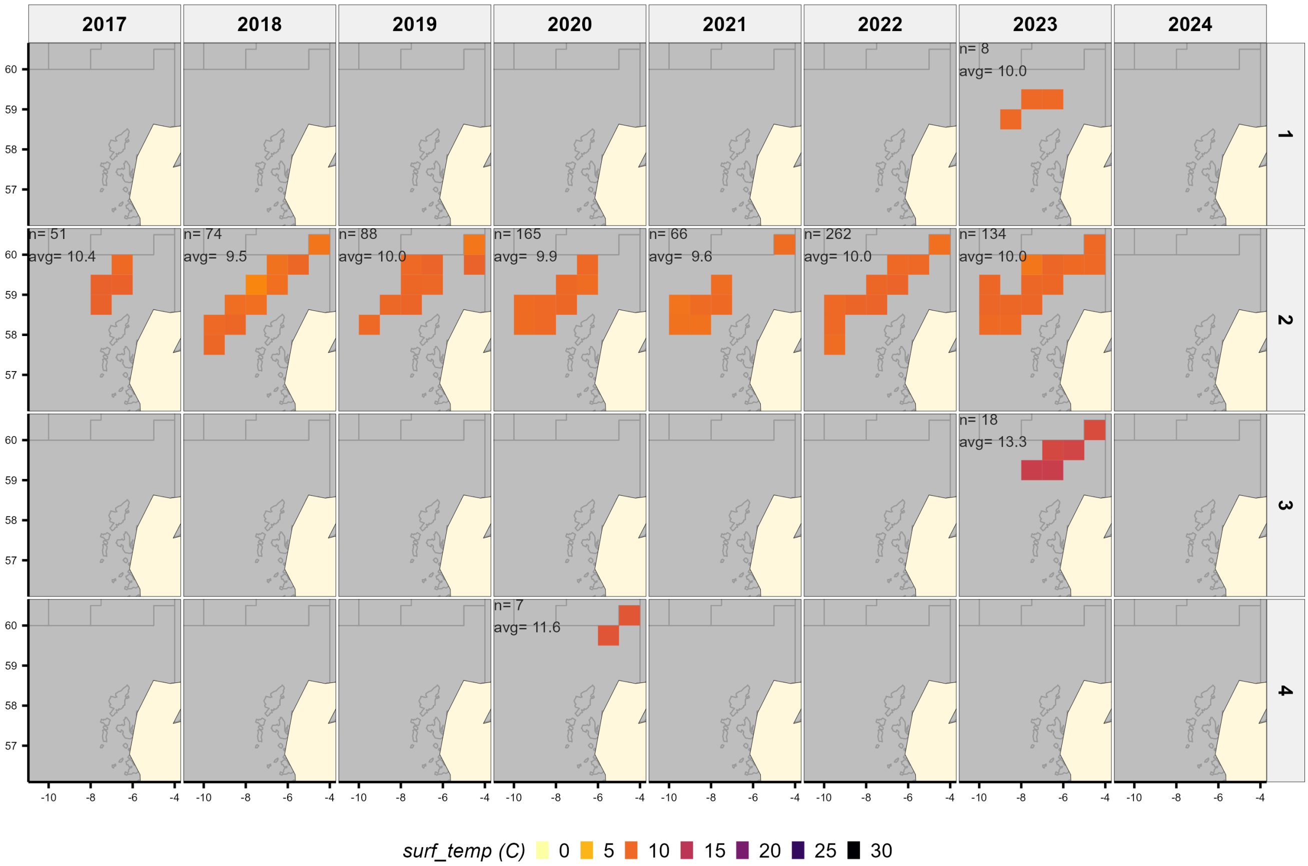

Figure 3.1.4: PFA deepwater fisheries for argentines. Average surface temperature (C) by year and quarter. N indicates the number of hauls. Avg refers to the average temperature.

Average fishing depth.

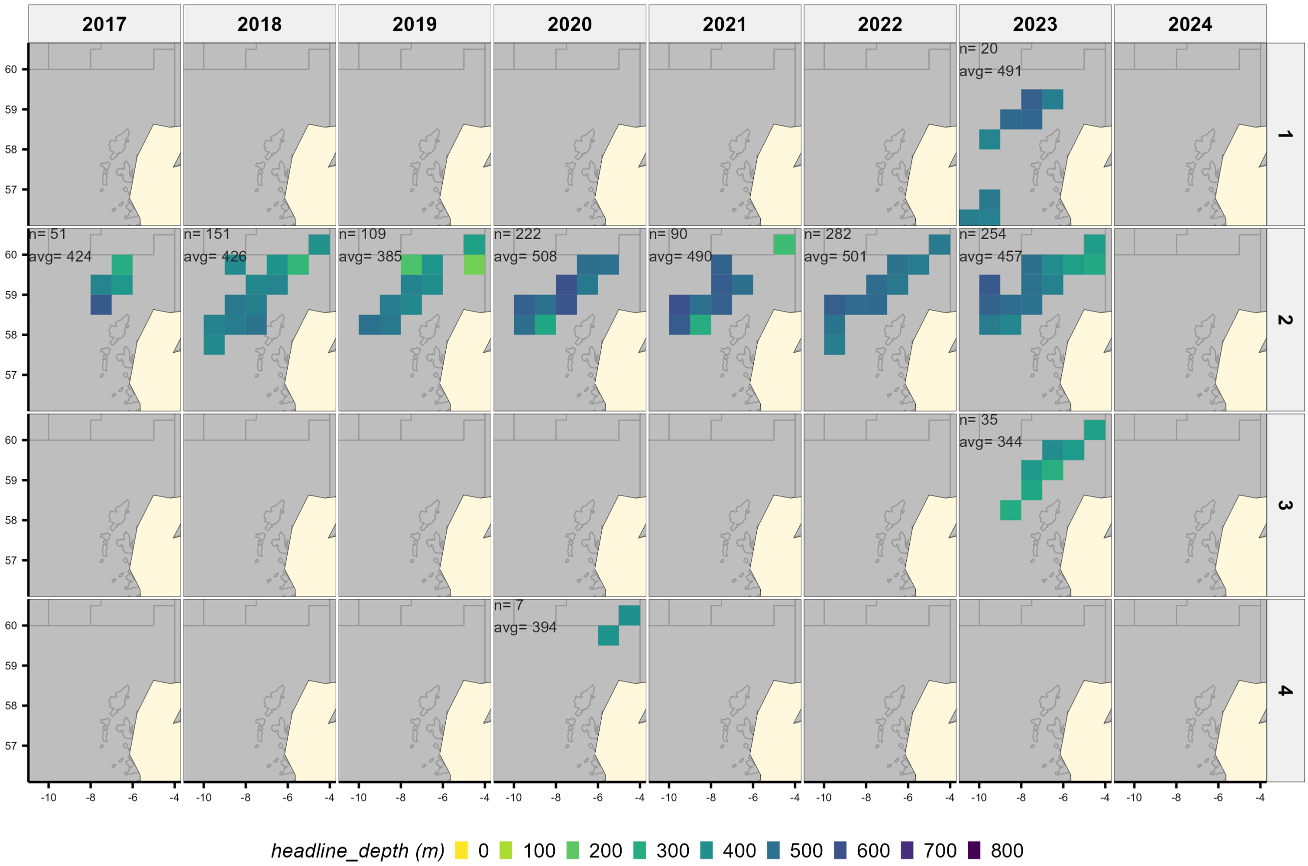

Figure 3.1.5: PFA deepwater fisheries for argentines. Average fishing depth (m) by year and quarter. N indicates the number of hauls. Avg refers to the average fishing depth.

Average wind force.

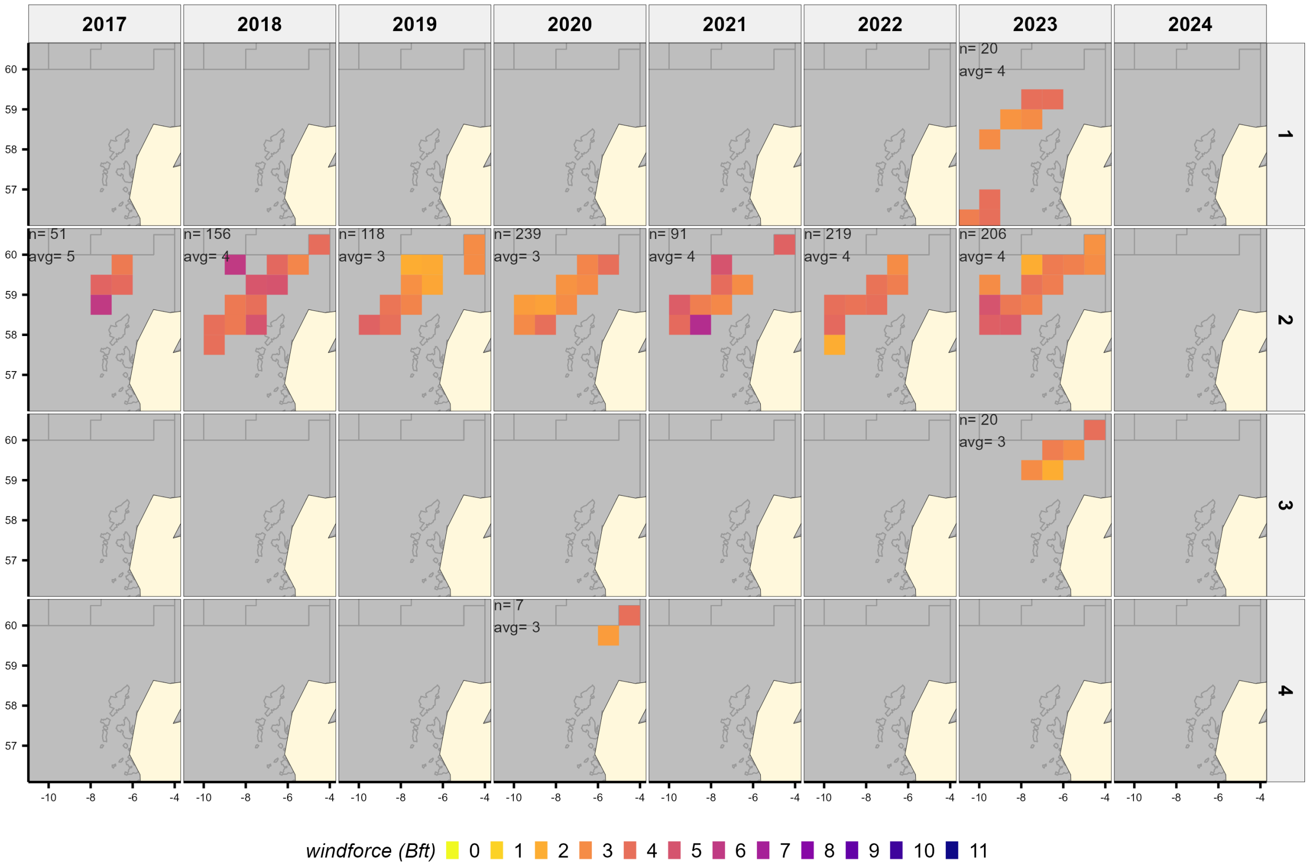

Figure 3.1.6: PFA deepwater fisheries for argentines. Average windforce (Bft) by year and quarter. N indicates the number of hauls. Avg refers to the average windforce.

3.2 Argentines (ARG, Argentinus sp.)

Argentines self-sampling summary.

species	year	nvessels	ntrips	ndays	nhauls	catch	catch/day	nlength	nbio
arg	2017	3	3	31	67	2,248	73	668	0
arg	2018	7	8	75	190	3,439	46	1,564	459
arg	2019	6	7	41	94	3,899	95	3,039	0
arg	2020	7	9	101	273	5,946	59	3,980	32
arg	2021	5	6	59	136	4,398	75	3,099	0
arg	2022	6	8	146	366	9,416	64	6,231	0
arg	2023	5	10	126	303	5,752	46	4,608	0
(all)	(all)		51	579	1,429	35,098		23,189	491

Table 3.2.1: Argentines. Self-sampling summary with the number of days, hauls, trips, vessels, catch (tonnes), catch rate (ton/day), number of fish measured, number of biological observations.

Argentines. Catch by division

species	division	2017	2018	2019	2020	2021	2022	2023	all	perc
arg	27.6.a	2,248	3,439	3,899	5,946	4,398	9,416	5,752	35,098	100.0%
(all)	(all)	2,248	3,439	3,899	5,946	4,398	9,416	5,752	35,098	100.0%

Table 3.2.2: Argentines. Self-sampling summary with the catch (tonnes) by year and division

Argentines. Catch by month

species	month	2017	2018	2019	2020	2021	2022	2023	all	perc
arg	Mar	0	0	0	0	0	0	209	209	0.6%
arg	Apr	38	811	720	3,201	1,289	5,739	1,336	13,135	37.4%
arg	May	2,210	2,628	3,179	2,276	3,110	3,677	3,635	20,715	59.0%
arg	Jun	0	0	0	452	0	0	0	452	1.3%
arg	Jul	0	0	0	0	0	0	534	534	1.5%
arg	Aug	0	0	0	0	0	0	38	38	0.1%
arg	Oct	0	0	0	16	0	0	0	16	0.0%
(all)	(all)	2,248	3,439	3,899	5,946	4,398	9,416	5,752	35,098	100.0%

Table 3.2.3: Argentines. Self-sampling summary with the catch (tonnes) by year and month

Argentines. Catch by rectangle

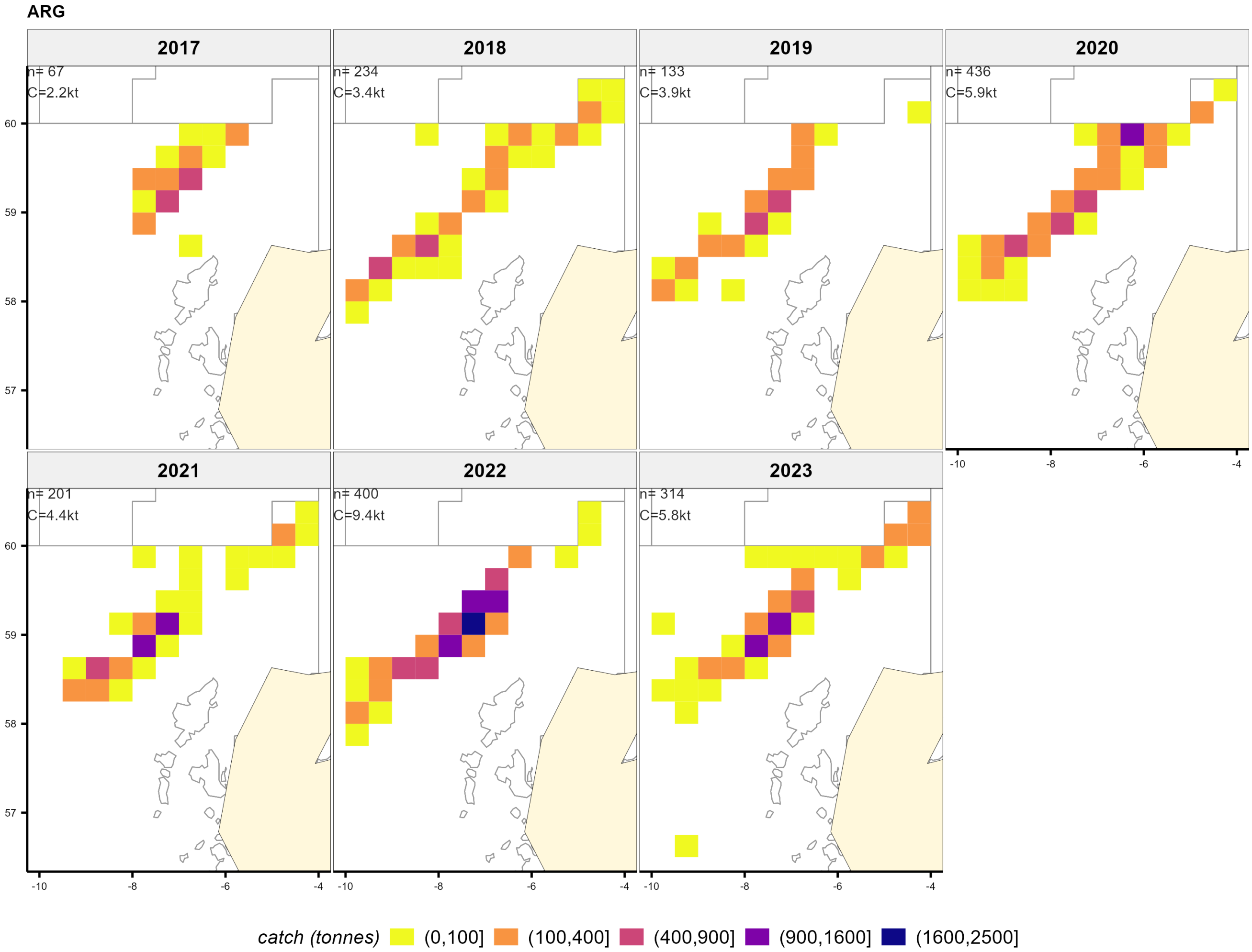

Figure 3.2.1: Argentines. Catch per rectangle. N indicates the number of hauls; Catch refers to the total catch per year.

Argentines. Catchrate (ton/day) by rectangle

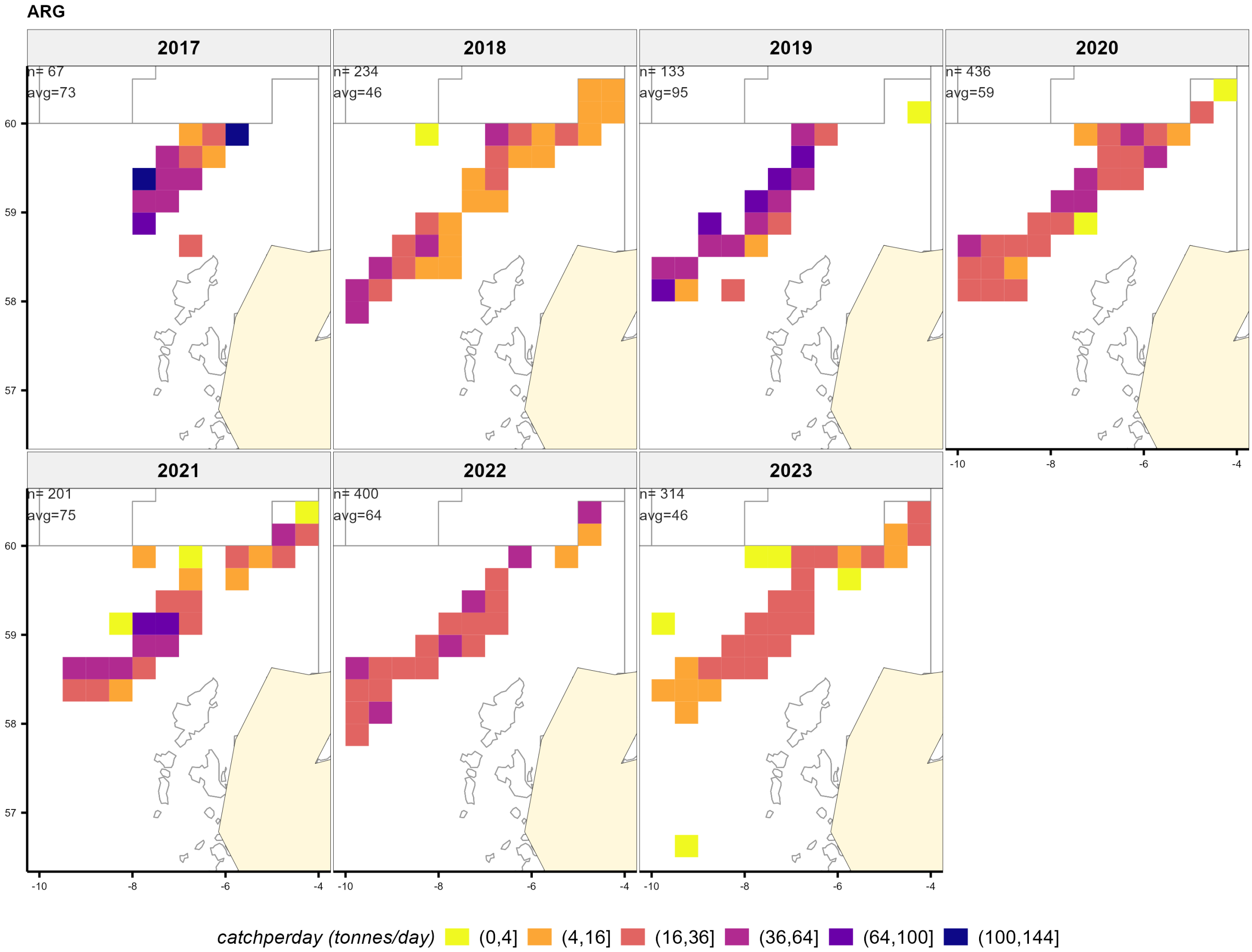

Figure 3.2.2: Argentines. Catchrate (ton/day) per rectangle. N indicates the number of hauls; Avg refers to the average catchrate per rect.

Argentines. Spatio-temporal evolution of catch by month and rectangle

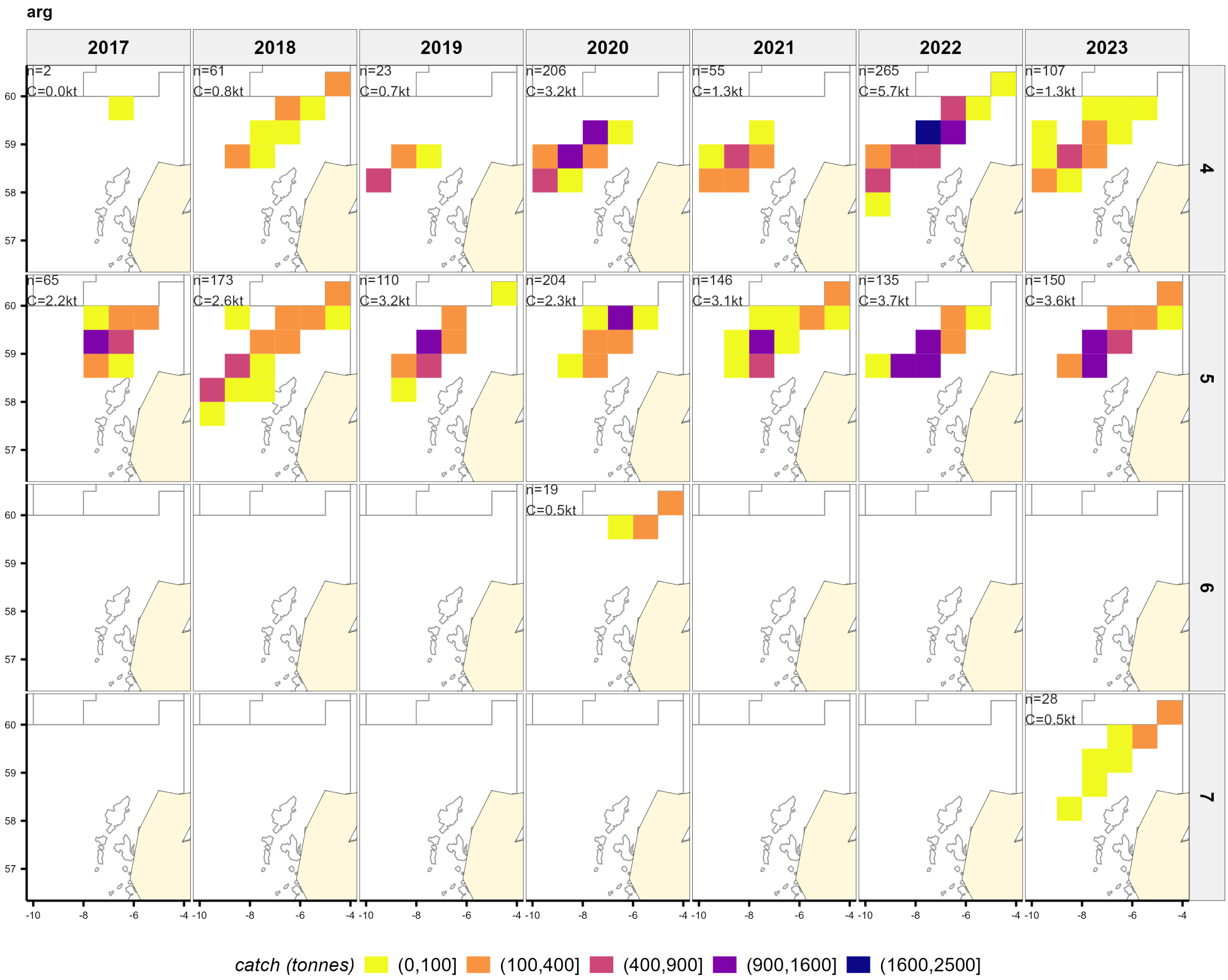

Figure 3.2.3: Argentines. Spatio-temporal evolution of the catches per rectangle and month. N indicates the number of hauls; C refers to the total catch by year and month.

Argentines. Catch proportion at depth

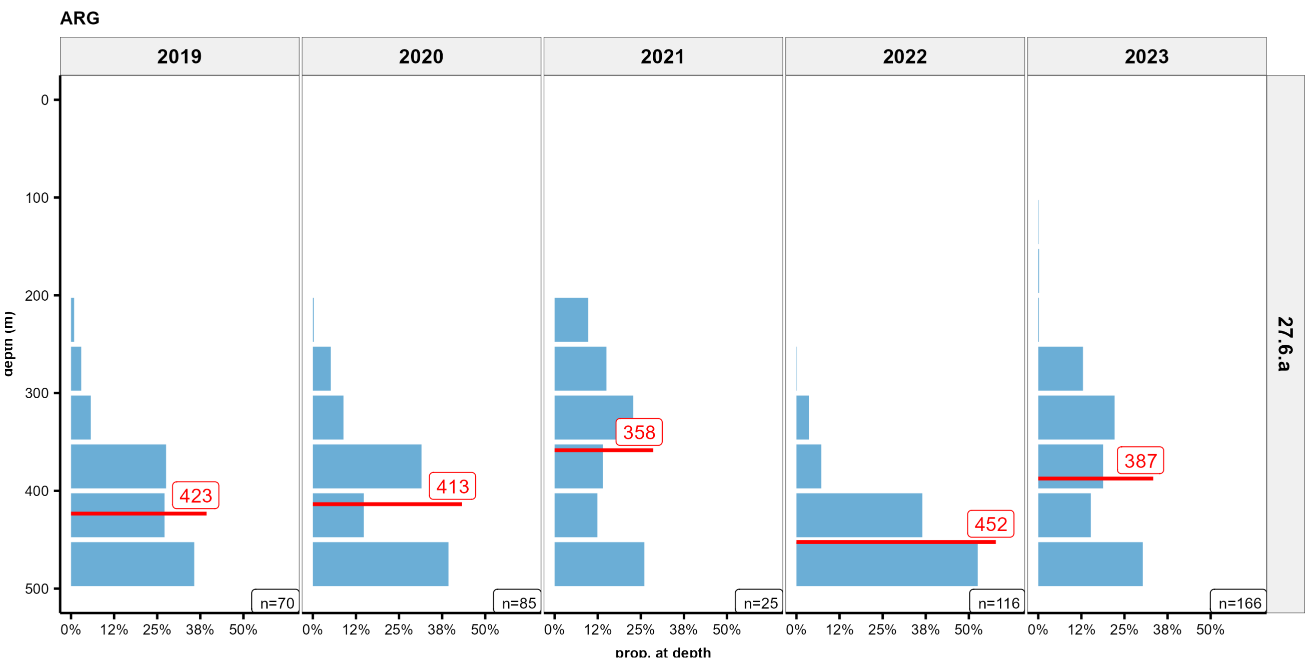

Figure 3.2.4: Argentines. Catch proportion at depth. N indicates the number of hauls.

Argentines. Length distributions of the catch

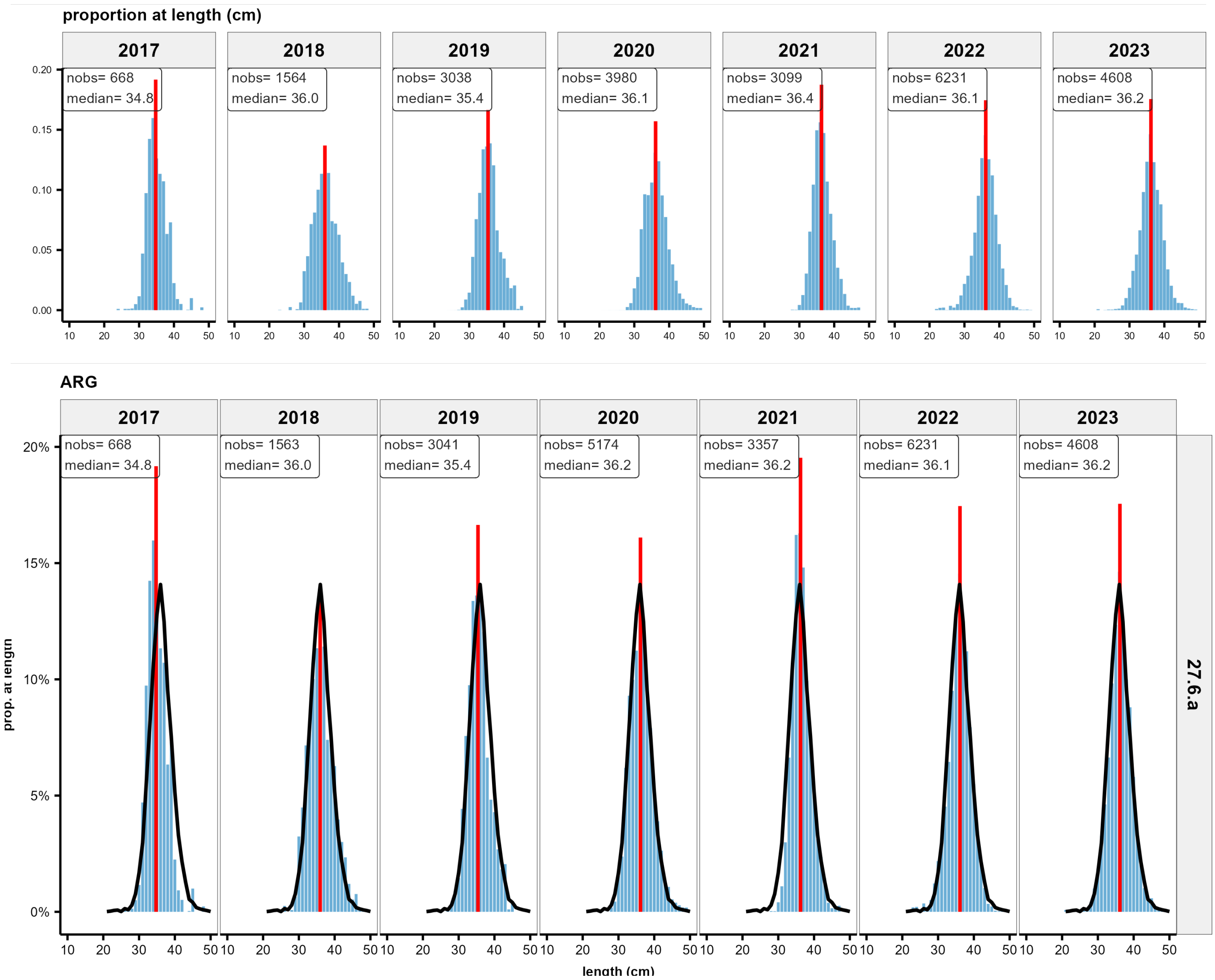

Figure 3.2.5: Argentines. Length distributions by year (top) and by year and division (bottom). Nobs refers to the number of observations; median denotes the median length.

Argentines. Length distributions as proportions by (large) rectangle

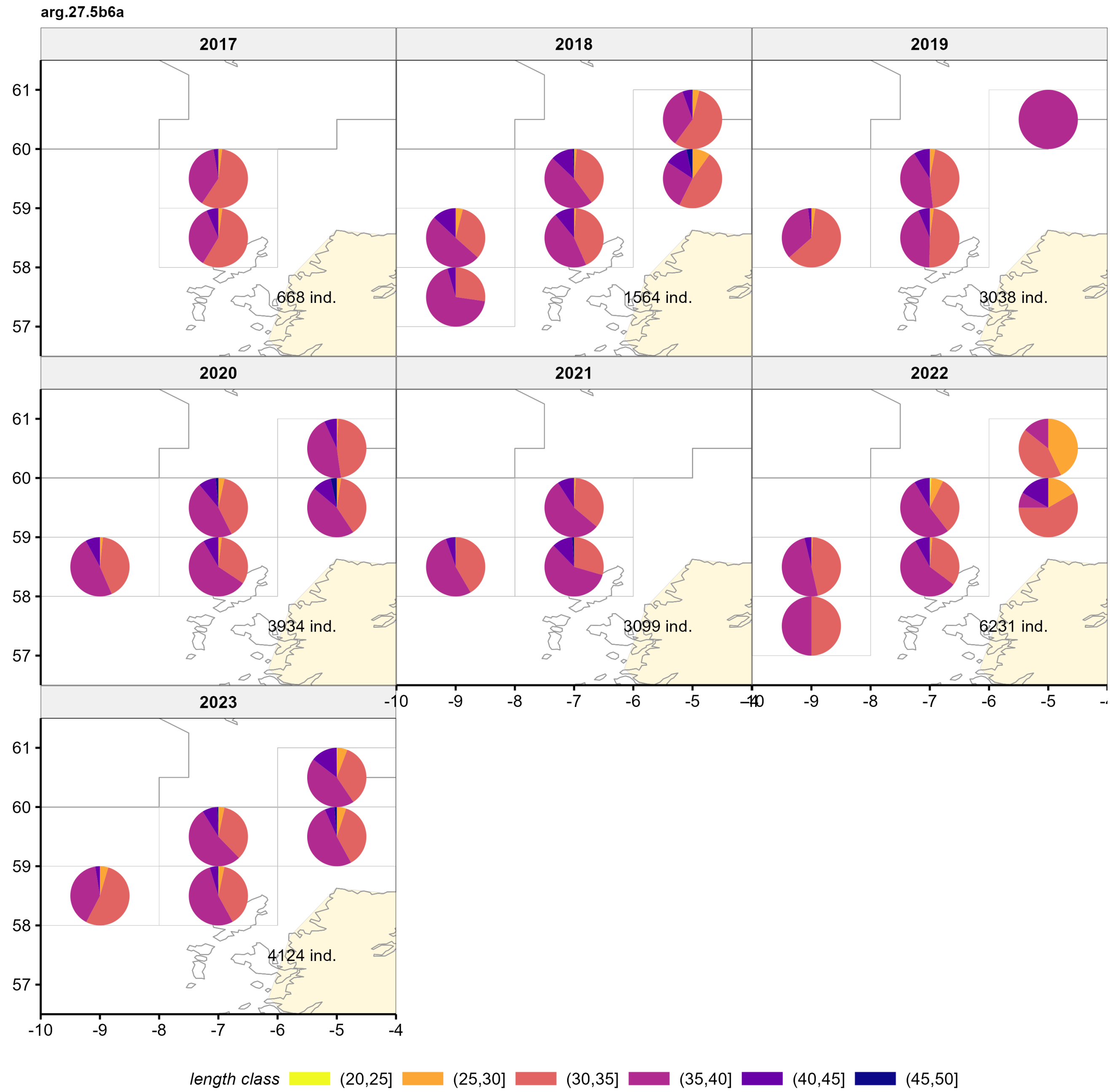

Figure 3.2.6: Argentines. Length distributions as proportions by large rectangle. Ind. refers to the number of length measurements

Argentines. Average length, weight and fat content by year and month

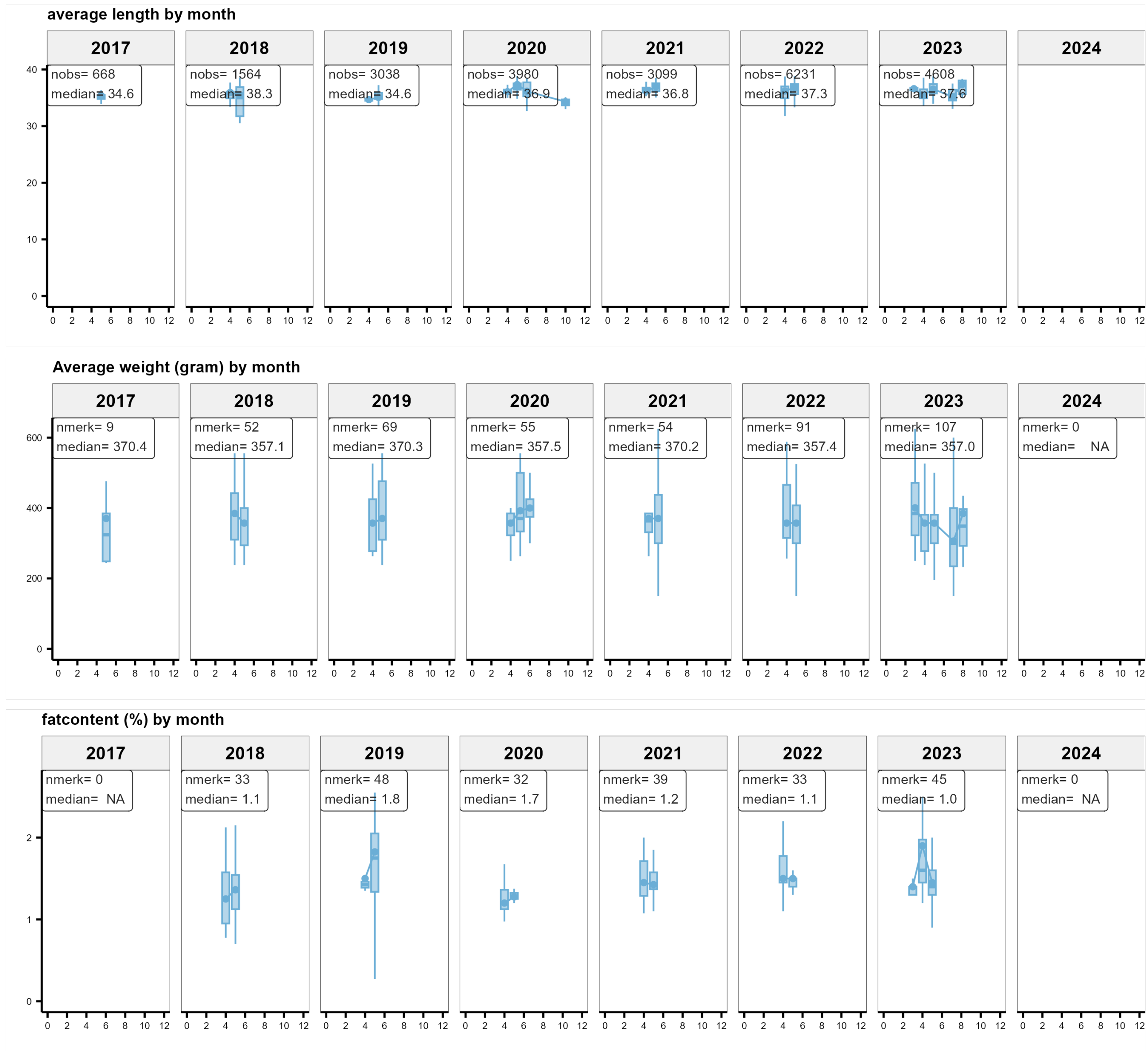

Figure 3.2.7: Argentines. Average length, average weight, and average fat content. Nobs indicates the number of measurements, median indicates the median values

4 Discussion and conclusions

From 2018 onwards, all PFA vessels were participating in the PFA self-sampling program.

The definition of what constitutes 'a fishery' for a certain species is not straightforward to resolve. In this report we selected all vessel-trip-week combinations with:

- hauls in divisions 27.6.a; 27.5.b; 27.4.a
- catch of arg by trip and week at least 10% of the total catch of that trip and week.
- catch of arg by trip and week at least 10 tonnes.

Since 2020, the measurements of average weight and fat content are included in the self-sampling report. Weights and fat content are routinely being collected for some of the target species (e.g. herring, mackerel) on the basis of production units (batches). The measurements are being carried out both when the species is the main target of the fishery and when it is a bycatch in other fisheries.

5 Acknowledgements

The skippers, officers and the quality managers of many of the PFA vessels are putting in a lot of effort to make the PFA the self-sampling work. Without their efforts, there would be no self-sampling.

6 References and publications

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7 More information

Please contact Niels Hintzen (nhintzen@pelagicfish.eu) if you would have any questions on the PFA self-sampling program or the specific results presented here.

Working Document for the ICES Working Group on Biology and Assessment of Deep-Sea Fisheries Resources

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Scabbard fish in the Madeira archipelago (CECAF 34.1.2)

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Abstract

This working document updates the information existing from the previous WGDEEP meeting of 2023 for the *Aphanopus* spp. in CECAF fishing area 34. Mainly an update on the time-series of annual Portuguese landings (by vessel segment), length distributions and CPUE at CECAF area. A standardized biomass index series based on daily landings of commercial horizontal mid-water drifting longline fishery in Madeira was also updated with data from 2023.

1. INTRODUCTION

The fishery for deep-water species carried out in the Madeira EEZ and international adjacent waters (CECAF 34.1.2. area), dates back to the 17th century (Merrett and Haedrich, 1997) and for several decades this was the only fishery targeting scabbard fish in the Northeast Atlantic (Bordalo-Machado and Figueiredo, 2009). This fishery as an important and irreplaceable economic and social value in the Madeira fisheries sector. In Madeira, exploited deep-water fish stocks are overwhelmingly dominated by two scabbard fish species: *Aphanopus carbo* Lowe 1839 and *Aphanopus intermedius* Parin, 1983, which represent about half of the overall landings throughout the year (Delgado et al., 2013, 2018; Hermida and Delgado, 2016). This deep-sea fishery targeting the black and intermediate scabbard fish, off the Madeira archipelago, is recognized as an artisanal and selective activity targeting predominantly adult individuals and presenting a low rate of bycatch (Severino et al., 2009).

Both scabbard fish species occur at a wide depth range, from 200 m in the northern part of the NE Atlantic (Nakamura and Parin, 1993) to 2300 m off the Canary Islands (Pajuelo et al., 2008) for *A. carbo*, although more frequent at 800-1300 m in Madeira (Morales-Nin and Sena-Carvalho, 1996) and to 1350 m for *A. intermedius* (Delgado et al., 2013). *Aphanopus carbo* and *A. intermedius* seem to be adapted to a strong activity of migrating upwards at night to feed on crustaceans, cephalopods and fishes (Tuset et al., 2010). Furthermore, these two sympatric species move to reproduction areas off Macaronesian archipelagos (i.e., Madeira and the Canary Islands) and the northwest coast of Africa (Figueiredo et al., 2003; Pajuelo et al., 2008; Perera 2008; Farias et al., 2013). The spawning season of both *Aphanopus* species has been reported to take place from October to December (Figueiredo et al., 2003; Delgado et al., 2013).

The black and intermediate scabbard fish fishery represents one of the most profitable commercial activities on small-scale fisheries in Madeira archipelago. In 2023, the commercial landings in weight of *Aphanopus* spp. reached annual catches of up to 2139 tonnes yielding a total first sale value of approximately 10.2 M€.

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 reliable CECAF data could provide a wider perception of the stock dynamics of these migratory species in the northeast Atlantic.

1.1. Fishery in Madeira

In compliance with the Multiannual Union Programme for Data Collection (EU-MAP), the Madeira fishing fleet targeting the deep-water species, *A. carbo* and *A. intermedius*, uses a specialized fishing gear with longlines (LLD_DWF_0_0_0). The fishing gear is a mid-water horizontal drifting longline, set in the water column usually at depths of between 800 and 1300 m (Figure 1).

The fishing gear used to catch the scabbardfishes is a drifting longline always set at least more than 100 m above the bottom of the sea. This is an important aspect of the fishery as, in normal circumstances, the gear does not contact the sea floor thus is not a menace to hypothetical Vulnerable Marine Ecosystems (VME).

This fishery is known by its highly selective nature, concerning the bycatches of non-target species and the length structure of the catches of the targeted species – constituted almost exclusively by adult specimens over 90 cm total length. The catches of sub adult individuals scarcely achieve around 0.5% of the total number of individuals captured.

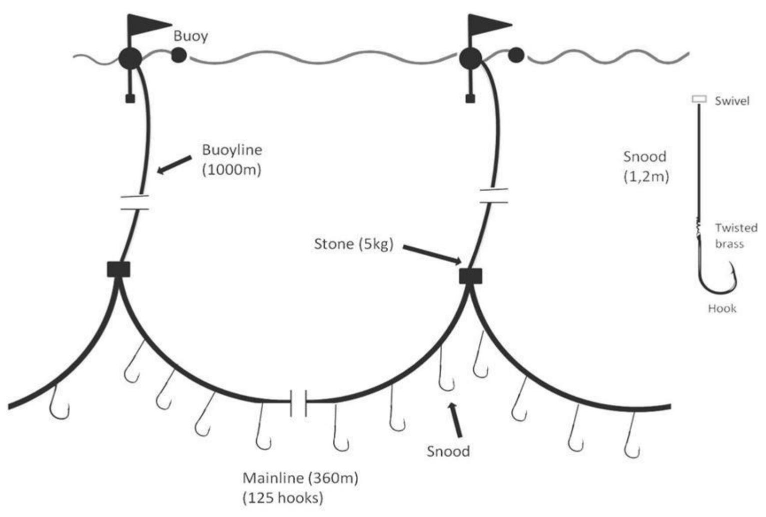


Figure 1 – Mid-water horizontal drifting longline used by the Madeira fishing fleet.

There is a combination of prevailing factors that result in a fishery with such unique features. Such factors are the geographical area of the fishery, where, according to the migratory model proposed by Farias et al. (2013), only adult specimens are available to this type of fishery and the highly selective nature of the fishing methodology itself, namely the fact that the passive fishing gear is operated strictly within a depth layer of the water column, between 800 and 1300 meters deep, without being anchored, and always well above the seafloor. The gear aims to catch the black scabbard fish in its daily vertical migration to feed, thus minimizing the probability of capture of benthic bycatch species.

This fishery, carried out by the fishing vessels targeting the black and intermediate scabbard fishes registered in Madeira, which was traditionally performed mostly around the islands of Madeira and Porto Santo and the seamounts inside the Madeira EEZ, has undergone considerable geographic expansion in recent decades in the Northeast Atlantic, mostly from 2005 onwards, and initiated a process of expansion looking for new fishing areas (Figure 2). Progressively, new fishing grounds located in international waters SE of the Azores, off the Canaries and the "rediscovery" of the seamounts within the Madeira EEZ became indispensable for this fishery and bilateral agreements with the Azores and the Canaries were made to allow the fleet access to those areas.

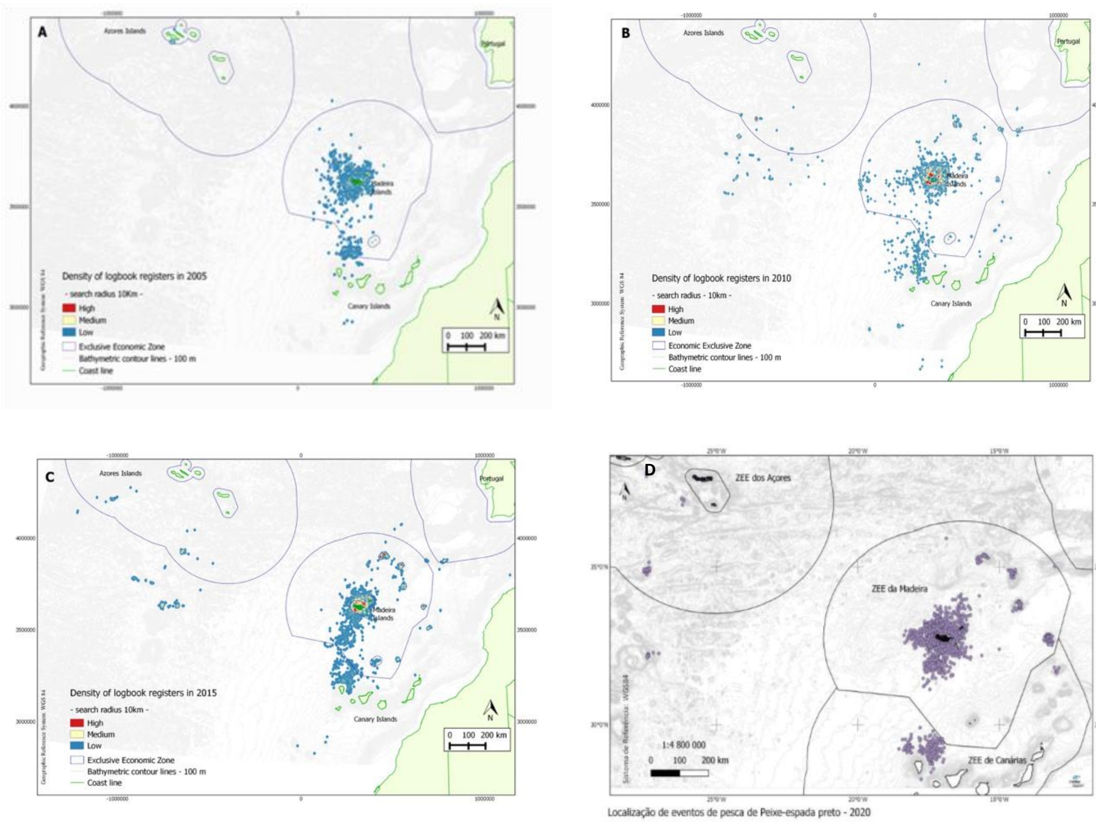


Figure 2 - Density plots illustrating the geographical distribution of the fishing sets with catches in 2005 (A), 2010 (B), 2015 (C) and 2020 (D): density maps estimated with the software Quantum GIS 2.2, module "heatmap" covering a search radius of 10 Km (Regional Directorate for Fisheries and Sea - Madeira).

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 and intermediate scabbard fish have moved to new fishing grounds, some of them located outside the EEZ of Madeira (SE of the Azores and off the NW of the Canaries) (Figure 2).

From 2019 to the present, most of fishery targeting the black and intermediate scabbard fish have been carried out within the Madeira EEZ. However, the fishing grounds off the Northwest of Canaries continues to be a relevant fishing area for the Madeira fishing fleet, due to the availability of black and intermediate scabbard fish and the lack of interest in these species by the Canary fishing fleet, which makes profitability the capture of them by the fishing fleet from Madeira. The capture of *Aphanopus* spp. in the Azores fishing grounds by the fishing fleet from Madeira has been decreasing since 2015. According to the fishermen fishing in Azores is not profitable due to the distance between Madeira and Azores.

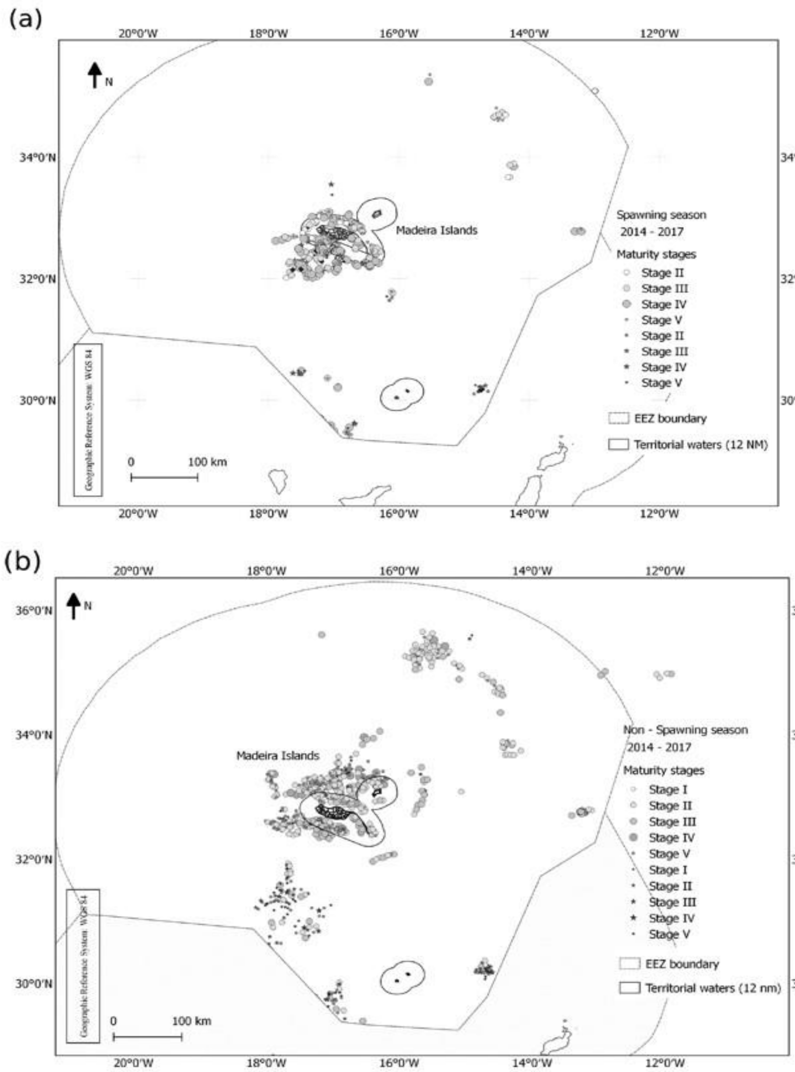


Figure 3 - Map showing both *Aphanopus* species distribution, *A. carbo* (grey circles) and *A. intermedius* (grey stars), during spawning (a) and non-spawning (b) seasons according to the distance from the coast (<12 and >12 nautical miles; 1 n.m. = 1.852 km) (Vasconcelos et al., 2020).

The enlargement of the maritime area covered by the fishing operations was prompted by the decrease of the abundance of the resource in the traditional fishing grounds, near the islands of Madeira and Porto Santo. And also due to the improvement of the fishing fleet of Madeira verified in the last years. This search for new fishing grounds was driven by the need to stabilise catches that suffered a severe decline from 2000 onwards. A relative stabilisation of the fishery was achieved in the last years but the enormous increase in the costs led several vessels to leave the activity.

Though, most of the *Aphanopus* spp. fishery still remains concentrated off the islands of Madeira and Porto Santo, especially during the spawning season from October to December, mainly the fishery operated by the small vessels (< 12 m). Migrations to areas less than 12 n.m. from the coast, were observed for *A. carbo* throughout the spawning season (Figure 3) (interannual database from 2014-2017; Vasconcelos et al., 2000). The mature stages IV and V were the ones that overwhelmingly dominated this migration pattern to shallower areas. This migration of mature adults towards areas near the coast, especially during spawning, occurs simultaneously with a noticeable increase of the proportion of fishing events inside the EEZ (<12 n.m.), making them more susceptible to mid-water drifting longline fishery (Vasconcelos et al., 2020).

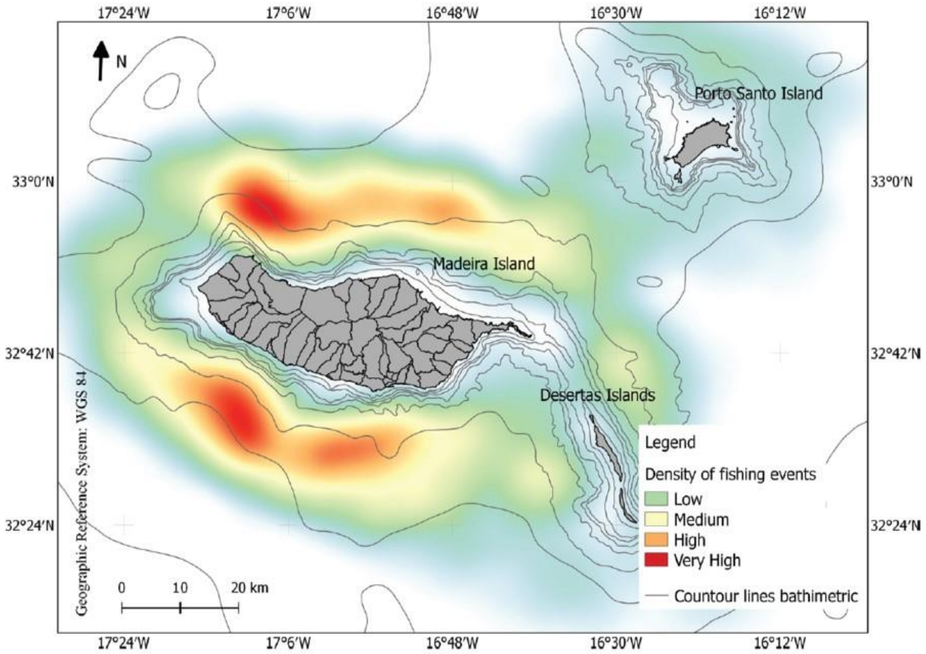


Figure 4 - Kernel density estimation plot showing the mean density values of the fishing events during the spawning season per compartment of 10 km × 10 km generated for the study area and for the period 2014–2017. Low: 1–10; Medium: 11–20; High: 21–30; and Very High: >31 fishing events (Vasconcelos et al., 2020).

There are three main aggregation areas identified off Madeira (Figure 4), where fishing events occurs during spawning, mainly the fishing grounds from Câmara de Lobos and Ribeira Brava at the south coast of Madeira and Porto do Moniz-Seixal at the north coast (Vasconcelos et al., 2020). The fishing grounds are located at an average distance of 2 to 4 n.m. offshore, although the same depths are found over a wider range of 3 to 6 n.m. offshore (Vasconcelos et al., 2020). Most likely, these areas correspond to areas with environmental and sea bottom topography that favour reproduction, as these areas generally correspond to canyons where there are prominent folds in the bathymetry towards the coast and its nearby steep slopes. These represent very closed geological formations with the dimension of extensive canyons, probably protected from strong currents and where high densities of spawning individuals aggregate, facilitating high probability of successful external fertilization (Vasconcelos et al., 2020).

2. METHODS

2.1. Fishery dependent data

2.1.1. Landings and mean price in Madeira archipelago

Portuguese total landings of *Aphanopus* spp. in CECAF area 34 (in weight, ton, and value, euro) were analysed by year. Fishery dependent data were collected from commercial landings for the period between 1990 and 2023.

2.1.2. Landings and mean price in Madeira archipelago by vessel length category

Portuguese landings of *Aphanopus* spp. in CECAF area 34 (in weight, tonnes, and value, euro) were analysed by year and by fishing vessel segment (vessel length category). Fishery dependent data were collected from commercial landings for the period between 2008 and 2023. The active fishing fleet at CECAF area is grouped into the following categories: VL0010 (vessel size less than 10 m), VL1012 (vessel size between 10 and 11.99 m), VL1218 (vessel size between 12 and 17.99 m) and VL1824 (vessel size between 18 and 23.99 m).

2.2. Length distribution

Aphanopus spp. length sampling data available for Madeira were analysed considering both species combined by year for the period between 2009 and 2023. Numbers-at-length were raised to the total landings.

2.3. CPUE

All landings from the commercial mid-water drifting longline fishery at all the fishing ports of Madeira (mainly port of Funchal), in the Northeast Atlantic (32°00'–33°30'N, 15°30'–18°00'W) were considered for this analysis, during the period between 2008 and 2023. From each fishing trip data on total weight landed of the species (in kg), vessel name and corresponding length category, engine power (KW), number of days at sea, number of fishing days and fishing operations, and the total number of hooks were examined. A trip was defined from the moment the vessel leaves the dock to when it gets back to the dock.

The standardized CPUE model based on daily landings of commercial mid-water horizontal drifting longline fishery in Madeira was updated with data from 2023.

3. RESULTS AND DISCUSSION

3.1. Fishery dependent data

3.1.1. Landings and mean price in Madeira archipelago

The annual landings of black and intermediate scabbard fish derived from Madeiran mid-water longliners for the period between 1990 and 2023 are presented in Figure 5.

Catches in CECAF 34 area were updated with fishery data from Madeiran mid-water longliners landings from 1990 to 2023. These catches are recorded by the Regional Fisheries Department of Madeira (Figure 5). CECAF catches have been decreasing after the 1998 peak, but an increase was observed from 2012 onwards. Between 2020 and 2021 a decrease was observed mainly due to the reduction in fishing days caused by the COVID-19 pandemic. In 2023, a decrease of 120 tonnes was observed when comparing with 2022, mainly due to the reduction of the fishing effort.

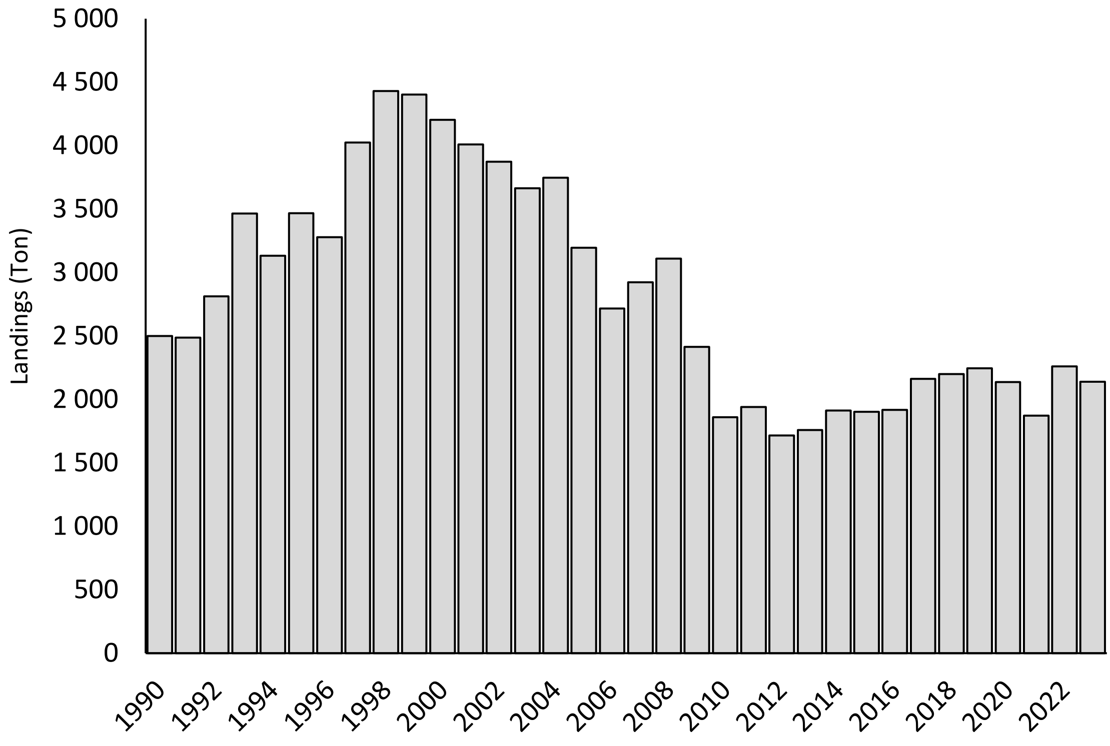


Figure 5 - Time-series of annual Portuguese landings of *Aphanopus* spp. at CECAF area (1990-2023).

The EU TAC and total catches for CECAF 34 area from 2005 to 2023 are presented in Table 1. It was observed a relevant decrease in the EU TAC for the *Aphanopus* spp. fishery in CECAF 34.1.2, from 4285 tons in 2005 to 2189 tons in 2023.

Table 1 - Black scabbard fish TACs and total landings in CECAF area 34 in tonnes, between 2010 and 2023, for both species (*Aphanopus carbo* and *Aphanopus intermedius*).

Year	EU TAC CECAF 34.1.2 area	Landings CECAF 34.1.2. Area
2005	4 285	3 195
2006	4 285	2 717
2007	4 285	2 922
2008	4 285	3 109
2009	4 285	2 413
2010	4 285	1 860
2011	4 071	1 941
2012	3 867	1 716
2013	3 674	1 758
2014	3 490	1 913
2015	3 141	1 902
2016	2 827	1 917
2017	2 488	2 163
2018	2 189	2 199
2019	2 189	2 246
2020	2 189	2 136
2021	2 189	1 873
2022	2 189	2 259
2023	2 189	2 139

Following the methodology adopted at WGDEEP 2016 (ICES, 2016), standardised annual catch estimates for the period from 1990 to 2023 of the nineteen fishing resources (ordered in terms of total weight catch) and grouped into four groups (1, large pelagics; 2, elasmobranchs; 3, small pelagics; and 4, demersals) were determined based on data extracted from DSEIMar/DRPM database (Figure 6).

The 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. 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, among others.

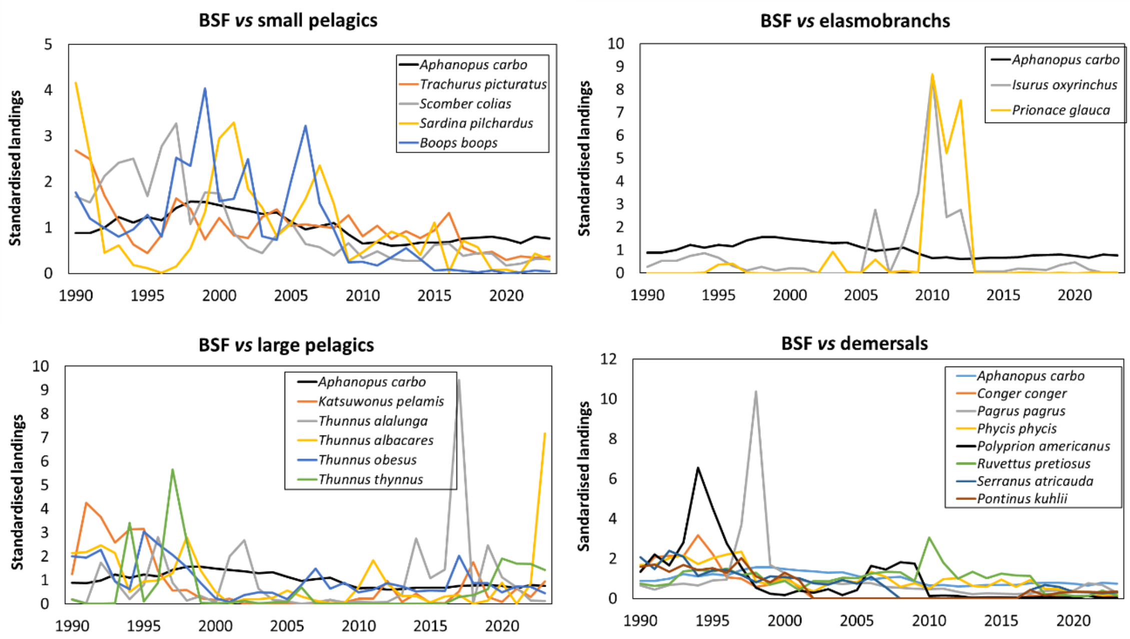


Figure 6 - Trends in standardised landings of scabbard fishes and the 19 other top ranked species in Madeiran landings.

The first sale value of *Aphanopus* spp., in millions of euros, for the period between 2008 and 2023 is presented in Figure 7. This value followed the same trend observed in the annual landings in terms of weight. The reduction in the economic value observed in 2020 and 2021 is related to the decrease in effort due to COVID 19 Pandemic. In 2023, the total economic value (10.2 M€) was higher than the value obtained in 2022 (7.6 M€).

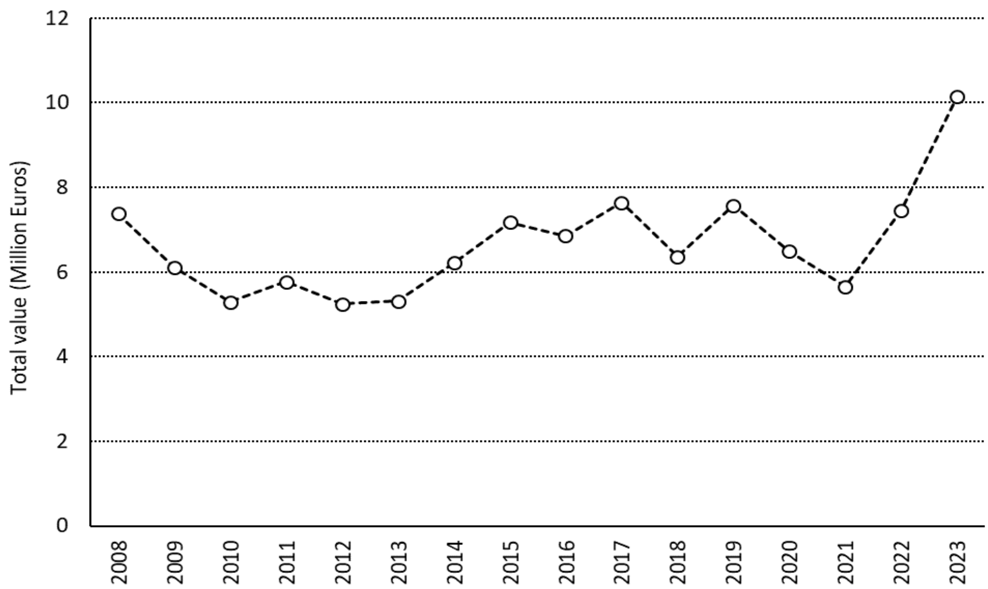


Figure 7 – Economic value of the catches of *Aphanopus* spp., in millions of euros, for CECAF 34.1.2., between 2008 and 2023.

3.1.2. Landings and mean price in Madeira archipelago by vessel length category

The number of vessels in activity in Madeiran longline fleet has steadily decreased during the last two decades (Figure 8). There was a decline of the number of vessels from 35 in 2002 to 20 in 2023.

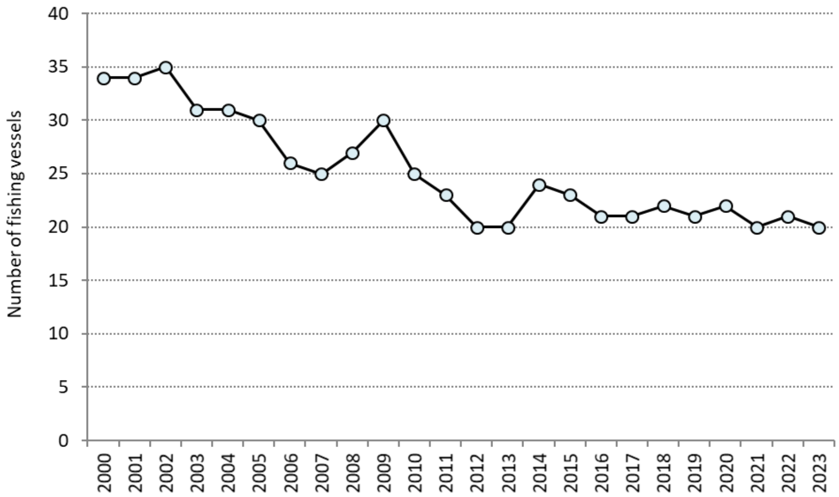


Figure 8 - Number of vessels active in the fishery of *Aphanopus* spp. at CECAF 34.1.2 area between 2000 and 2023.

Though, in the last years, the fishery has achieved a certain stability in the number of active vessels, as the small number of vessels remaining in the fishery are small artisanal vessels (Figure 9). In 2023, 50% of the active vessels were grouped between 12 and 18 m of overall length, thus hardly having operational conditions to make any significant increase in the present total number of hooks used in each fishing set.

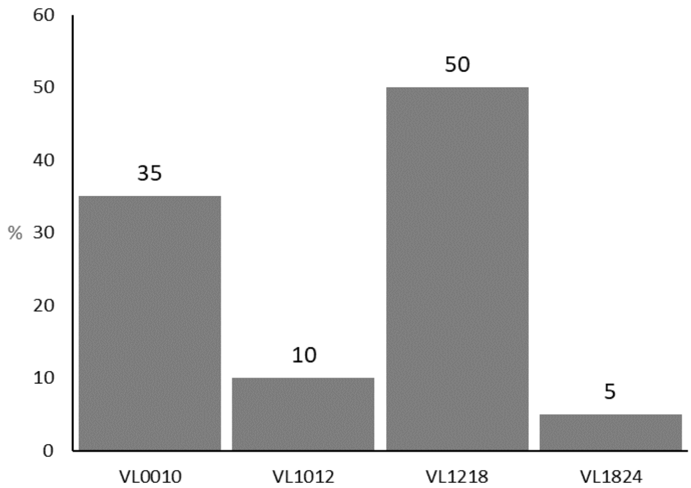


Figure 9 - Composition of the active fleet in the fishery of *Aphanopus* spp. at CECAF 34.1.2 area in 2023 per vessel length category (n=20 vessels).

A time-series of annual Portuguese landings at CECAF 34.1.2 area per vessel length is represented in Figure 10. The majority of the annual landings in Madeira are made by vessels of the length segments VL1218 and VL1824, wherein *ca.* 78.54% of the total landings in 2023 were performed by vessels belonging to VL1218 segment.

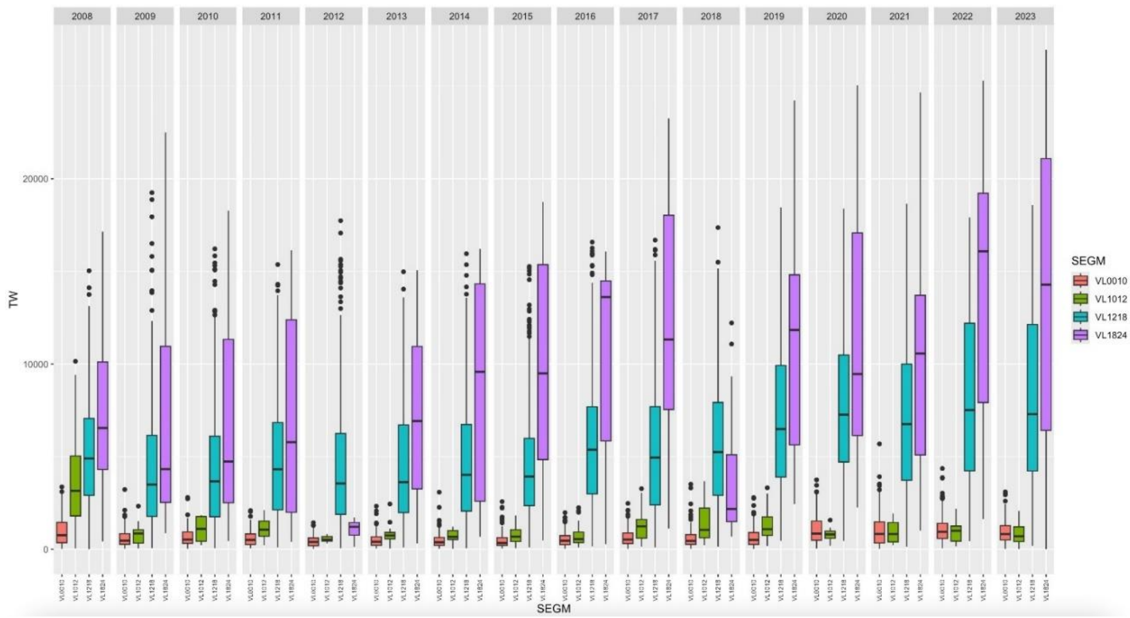


Figure 10 - Time-series of annual Portuguese landings of *Aphanopus* spp. at CECAF 34.1.2 area per vessel length category (SEGM), from 2008 to 2023.

The vessel length category VL1218 presented the highest landing and first sale values, followed by the vessel segment VL1824 (Figure 11). Though the number of vessels in the segment VL1824 represents only 5% of the total active fleet in Madeira, their contribution is higher (*ca.* 14.0%) than both vessel segments VL0010 and VL1012 together (*ca.* 6.3%). In 2023, it was observed an increase in the economic values for segments VL0012, VL1218 and VL1824, being more pronounced in the segment VL1218.

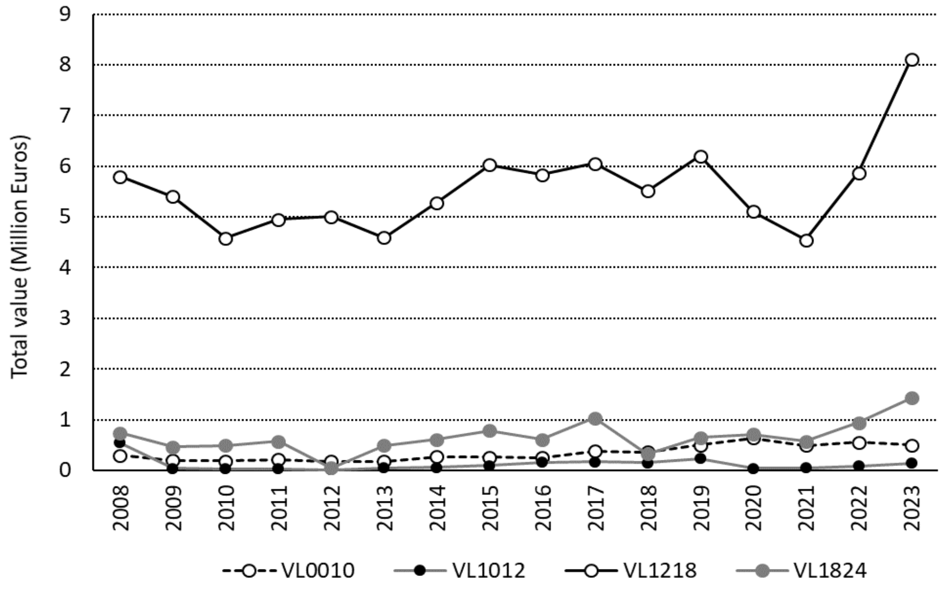


Figure 11 – Economic value of the catches of *Aphanopus* spp., in millions of euros per vessel category between 2008 and 2023.

3.2. Length distribution

The analysis of data indicates neither great changes on the length range between years nor on the mean length (around 114-118 cm total length, TL). From 2010 to 2018 the mean length was between 117 and 118 cm TL, occurring a slight decrease in 2019-2023 (115-116 cm TL).

Annual total length–frequency distributions of the exploited population caught by the Madeiran longline fleet in CECAF 34.1.2 area for the period 2010-2023 are presented in Figure 12. The range of scabbardfish total length varied between 87 cm and 155 cm.

Overall, between 2010 and 2023 there was verified a stability in the composition of lengths and average lengths for scabbardfish species caught by the Madeiran fleet.

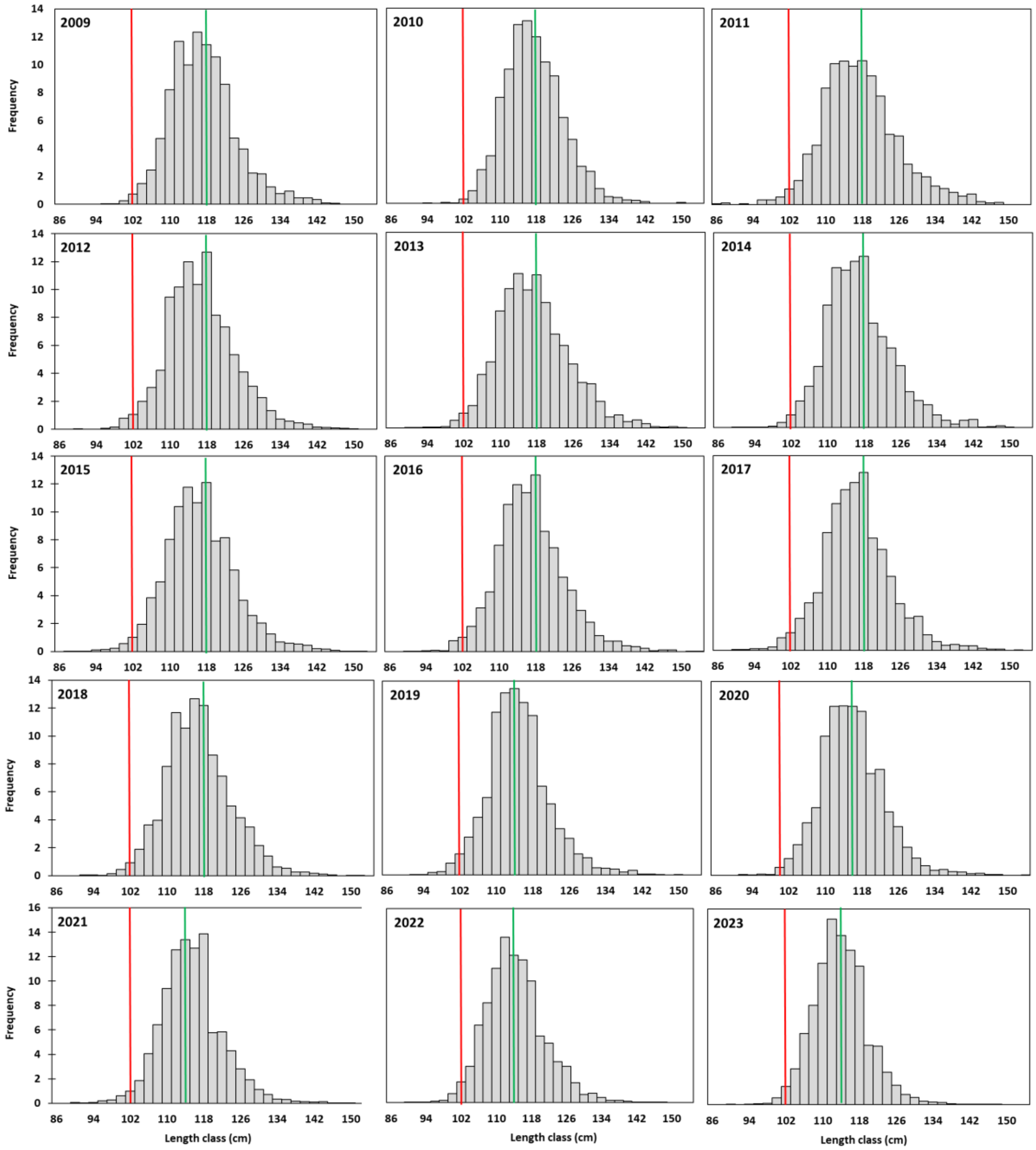


Figure 12 - Annual length–frequency distribution of specimens of *Aphanopus* spp. landed by the Portuguese middle-water longliners operating along CECAF area 34.1.2, from 2010 to 2023. Red line represents the length at first maturity according to Figueiredo et al. (2003) and green line represents the annual mean total length.

3.3. CPUE

Fishing effort in total number of hooks accumulated per year is represented in Figure 13. There was an overall decrease in the available period, reflecting the decline of the number of vessels. The year of 2004 stands for the highest total number of hooks (*ca.* 22.3 M) in the period available, since then effort has declined, and it is rather constant in the last years around 14-11 M hooks per year. In 2023, the total number of hooks was approximately 10.1 M.

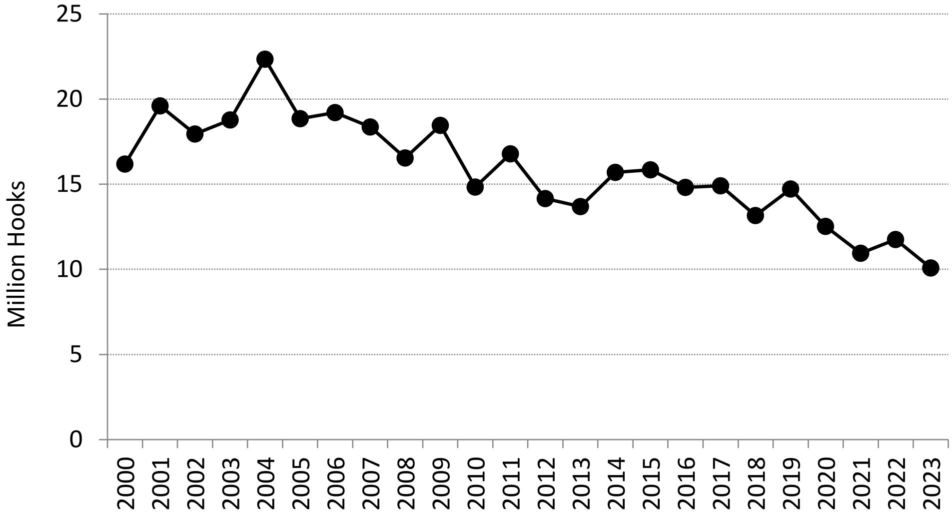


Figure 13 - Time-series of the total annual effort estimated for the CECAF 34.1.2 area (million hooks) for the *Aphanopus* spp. fishery, between 2000 and 2023.

The unstandardized CPUE had an overall decline along the analysed period (Figure 14). The variation observed in the years 2000-2006 was about -45% in CPUE, corresponding to an increase of 16% in the fishing effort. From 2006 to 2008 there was a slight recovery of the landings and of the unstandardized CPUE. The decreasing trend of landings restarted in 2008, but all indicators analysed reached a certain level of stability between 2010 and 2016, and even a recovery was observed since 2020, with an increase of 20 kg/1000 hooks from 2022 to 2023.

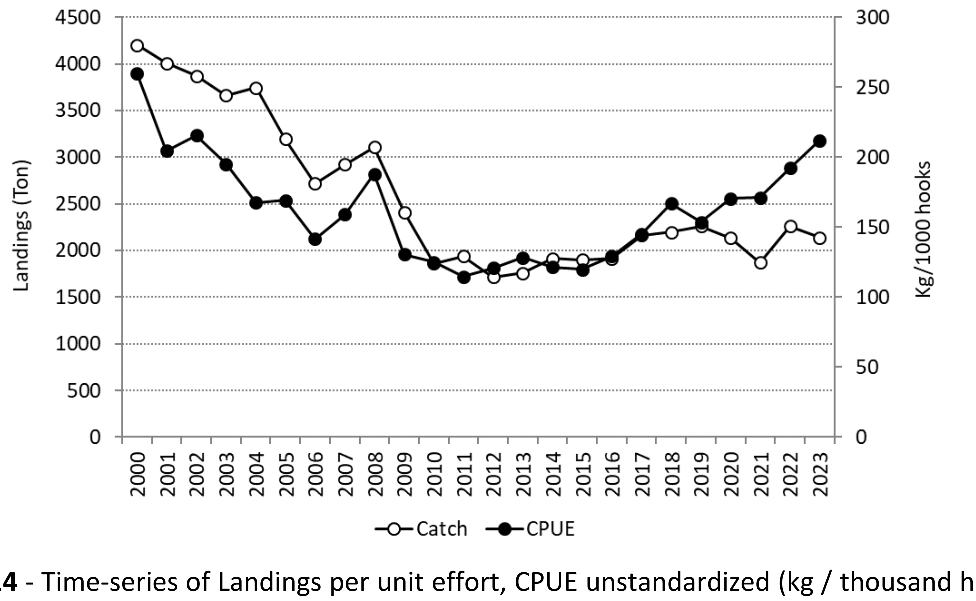


Figure 14 - Time-series of Landings per unit effort, CPUE unstandardized (kg / thousand hooks) of *Aphanopus* spp. in CECAF 34.1.2 area, between 2000 and 2023

A standardized CPUE model based on daily landings of commercial drifting longline fishery in CECAF 34.1.2 area is being developed for the period of 2008-2023. An exploratory data analysis showed a higher correlation between the number of hooks and the number of hauls (Figure 15).

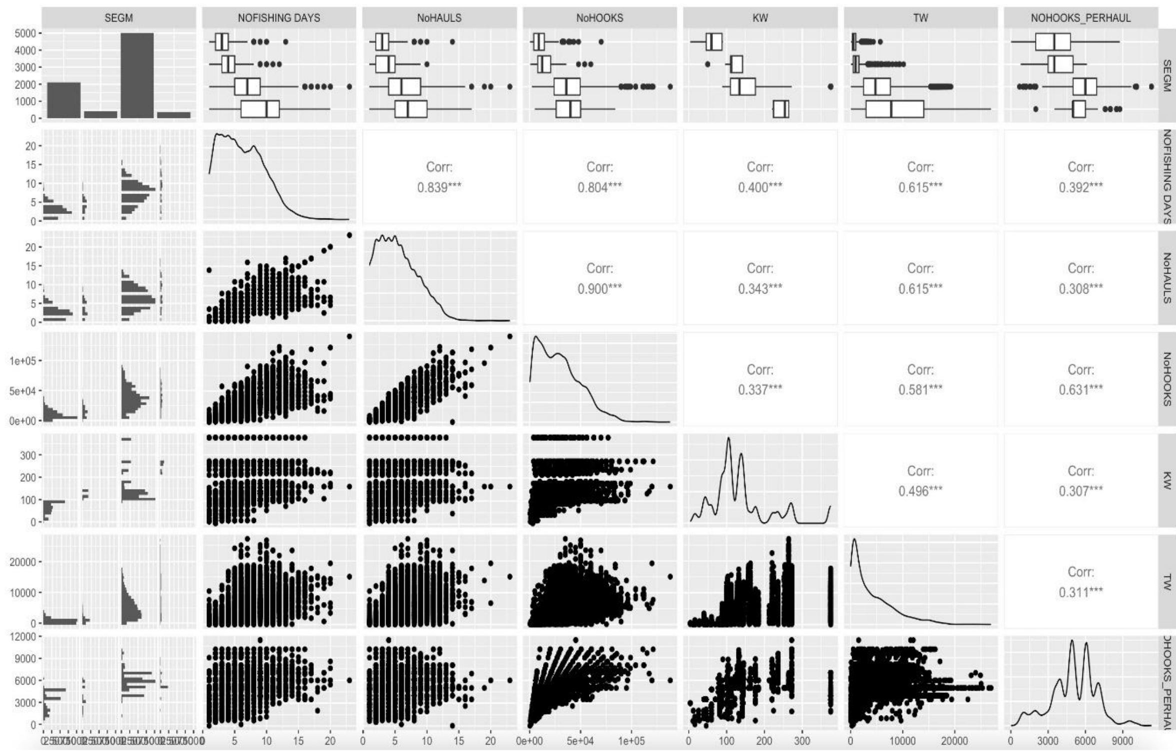
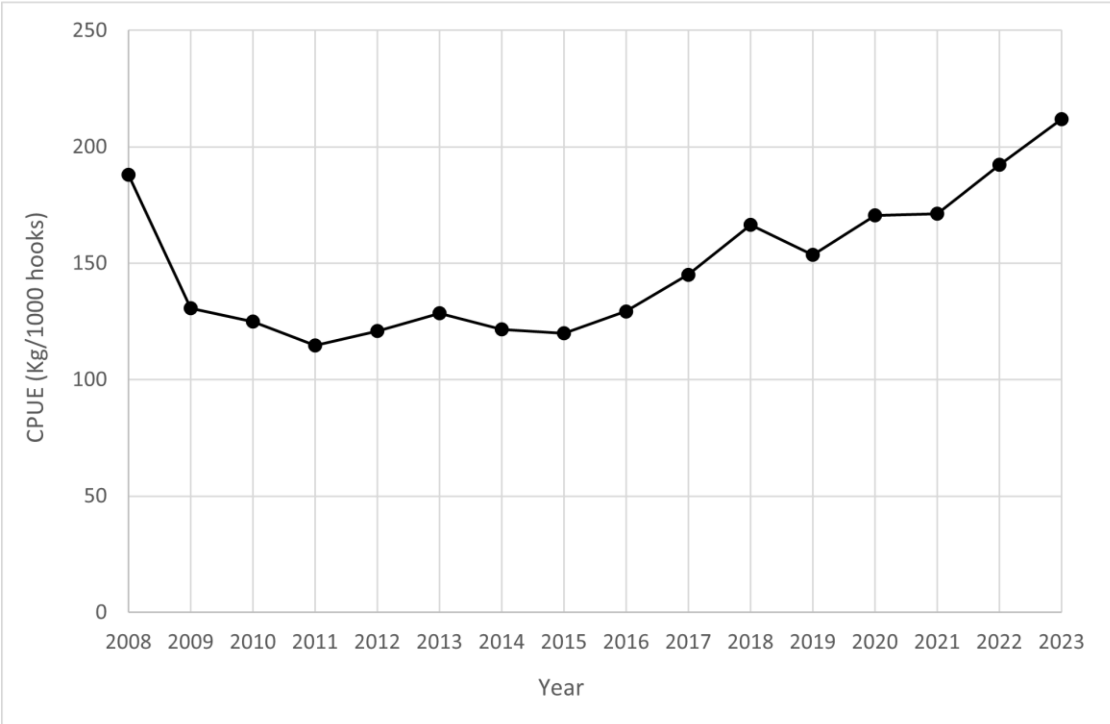


Figure 15 - Exploratory data analysis showing the correlation between the potential variables for the CPUE standardised model of *Aphanopus* spp.

For the period from 2008 to 2023, a standardised CPUE was obtained by adjusting a GLM model based on daily landings of commercial mid-water horizontal drifting longline fishery in CECAF 34.1.2 (Figure 16). The response variable (CPUE) was black and intermediate scabbard fish catches in weight per hook.

The exploratory standardised CPUE data analysis per year and by vessel segment (Figure 16) showed a recovery in the last five years, especially in the vessel segments smaller than 18 meters, which represents 95% of the Madeira mid-water drifting longline fleet. However, these are just preliminary results and further analysis will be performed.



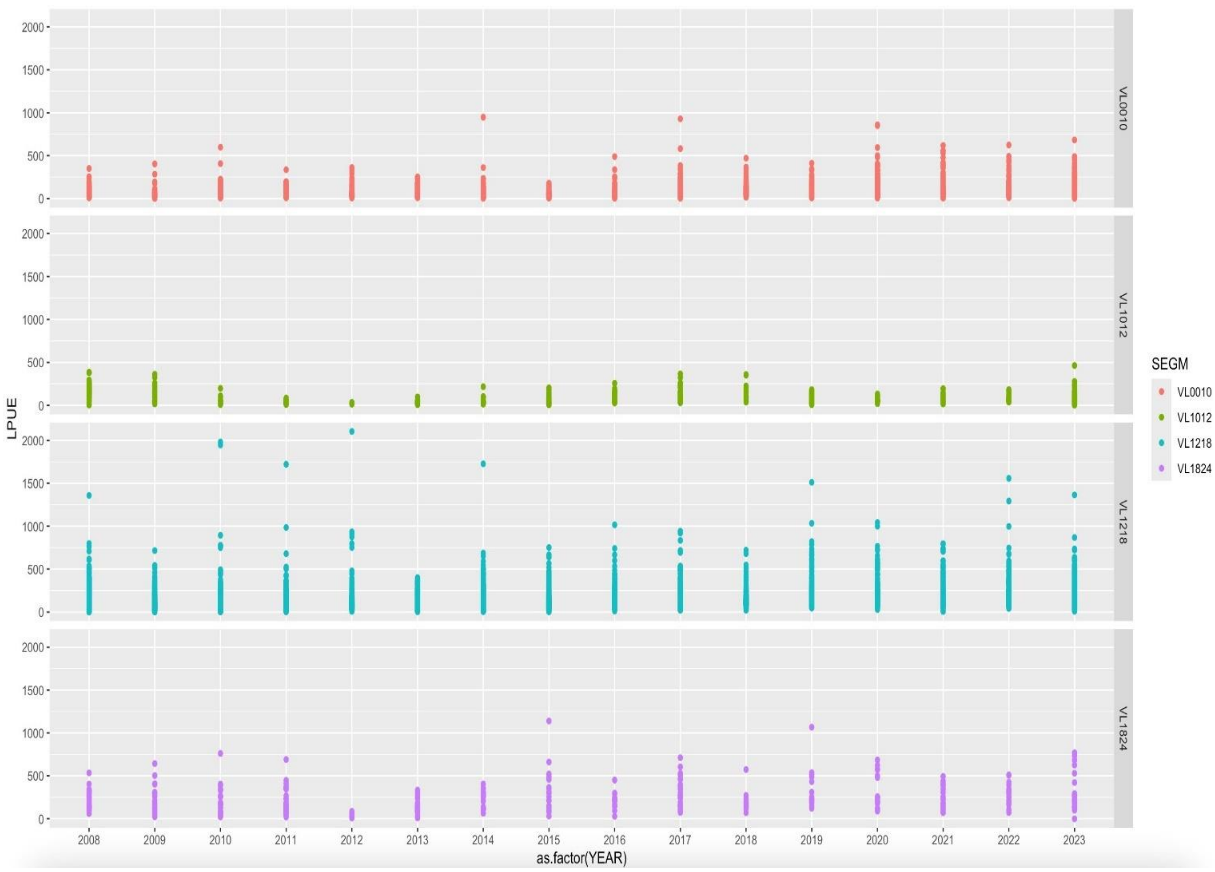


Figure 16 - Time-series of the standardized CPUE (kg/haul) of *Aphanopus* spp., per vessel segment (A) and all segments combined.

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Annex 4: Review Group reports

Four of the stocks assessed by WGDEEP in 2024 applied new DLS methods for the first time:

Stock code	Stock description
alf.27.nea	Alfonsinos (*Beryx* spp.) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)
bsf.27.nea	Black scabbardfish (*Aphanopus carbo*) in subareas 1, 2, 4-8, 10, and 14, and divisions 3.a, 9.a, and 12.b (Northeast Atlantic and Arctic Ocean)
gfb.27.nea	Greater forkbeard (*Phycis blennoides*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)
sbr.27.9	Blackspot seabream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)

An external review was conducted for each of these stocks by experts at the Virginia Institute of Marine Science (VIMS):

- John Hoenig, Ph.D.
- Julie M. Gross
- Abigail R. Sisti
- Madison Griffin

Review of Alfonsinos – alf.27.nea

General Summary:

Alfonsinos (*Beryx spp.*) is a multispecies stock that consists of two species, *Beryx splendens* and *Beryx decadactylus*, and is currently classified as an ICES Category 5 stock. For the 2024 assessment, the working group proposed that it was possible to apply the 'rfb' rule (for Category 3 stocks) to generate catch advice as there is now a sufficient amount of species-specific data available. Alternatively, the working group presented catch advice generated using the precautionary approach for Category 5 stocks. A precautionary reduction of catch was previously applied in 2022 assessment of Alfonsinos and, therefore, is not applied again in the 2024 assessment.

When the 'rfb' rule is applied to this stock ICES advises that landings should be no more than 234 tonnes in each of the years 2025 and 2026. This catch advice is a 23.5% increase in total allowable catch from previous advice. Alternatively, when the precautionary approach for Category 5 stocks is applied ICES advises that landings should be no more than 179 tonnes in each of the years 2025 and 2026; there is no change in catch advice if this rule is applied.

The major obstacle for applying the 'rfb' rule at this time is the absence of reliable abundance index data for recent years. Specifically, abundance indices for 2020, 2021, and 2022 are interpolated values, as surveys were either partially conducted (2021) or not conducted at all (2020 and 2022) in those years. This review group expresses concerns about the validity of these interpolated abundance values because residual diagnostics (Assessment Report: Figures 11.14 and 11.15) and retrospective analyses (Assessment Report: Figures 11.16 and 11.17) for interpolation models show concerning patterns that indicate subpar model performance (consistent over estimation of abundances relative to observed abundances). These interpolated abundance values are used to calculate parameters for the 'rfb' rule and, as such, may be overestimating the appropriate amount of total allowable catch.

The review group recommends not to accept the 'rfb' rule for this stock at this time and, therefore, recommends that the precautionary approach for Category 5 stocks be used to generate catch advice for 2025/2026. However, the review group recommends revisiting the application of the 'rfb' rule for this stock in future assessments (*i.e.*, 2026), once more observed (and reliable) abundance data is available for Alfonsinos.

Background:

Alfonsinos (*Beryx spp.*) are deep-water species, whose fishery in the Northeast Atlantic includes two species, *Beryx splendens* and *Beryx decadactylus*. Alfonsinos are predominantly caught by Portuguese, Spanish and French trawlers and longliners, but the Portuguese (Azores) fishery consistently accounts for the majority of Alfonsinos total landings. Both *B. splendens* and *B. decadactylus* are considered "bycatch species" in demersal trawl and longline mixed fisheries that target other deep-water species, and landings are often reported under a single category, *Beryx spp*. Species-specific landings are available only for the Portuguese (Azores) hook and line fishery. Historically, *B. splendens* has accounted for the majority of the catch in the Azores fishery (70%, on average) and *B. decadactylus* the remaining (30%, on average). However, in recent years the Azorean fleet appears to preferentially catch the more valuable of the two species, *B. decadactylus*, in response to repeated precautionary quota reductions.

Information about length compositions of catches, as well as biological information (ageing, weights, sex ratio, and maturity) for each *B. splendens* and *B. decadactylus* have been collected since 2002. Abundance indices for *B. splendens* and *B. decadactylus* have been estimated from both the Azorean commercial fishery and from an annual Azores survey (ARQDAÇO). Discard rates estimated for the Azores longline fishery are available from 2007-2020 (no discard information available for 2021-2023). Discard rates varied from 0.8% to 8.6% for *B. splendens* and 0.07% to

10.2% for the *B. decadactylus*. However, discards have increased in recent years (due to quota restrictions and minimum landing length regulations).

Technical Comments

'rfb' rule:

The working group attempted to apply the 'rfb' rule to the Alfonsinos stock in 2024, using length composition and abundance indices from the Azores commercial fishery, and life history parameters estimated for the species in the Azores derived from annual surveys. The working group expressed concerns about abundance indices derived from the Azores commercial fishery, as abundance data was not available in 2020 (due to COVID-19), only partially available in 2021, and was not available in 2022 (due to a vessel crew strike). The working group attempted to interpolate abundance indices for each *B. splendens* and *B. decadactylus* for these years using Generalized Additive Mixed Models (GAMMs). As presented in the assessment report, the data inputs for interpolation models are not clearly documented or explained. More concerningly, interpolation model diagnostics presented in the assessment report suggest that models are overestimating abundance indices for both *Beryx spp.* models (Assessment Report: figures 11.14, 11.15). This conclusion is also supported by patterns seen in the retrospective analyses of models; clear patterns of overestimation are evident in models for both *Beryx spp* (Assessment Report: figures 11.16, 11.17). The overestimation of abundance indices can have serious implications for the calculation of parameters of the 'rfb' rule. This issue was the primary concern of the working group and a key reason why the review group recommends not to accept the 'rfb' rule methodology (at this time).

This review group also expresses concerns about the traffic light indicators (Assessment Report: Table 11.4). Of the six traffic light indicators presented, three of these are cause for concern (red). The assessment reported that the population of large individuals is decreasing in recent years ($L_{max5\%} \leq L_{inf} = 0.73$), the amount of mega spawners is exceptionally low ($P_{mega} = 0.02$), and MSY proxy results show that exploitation is above MSY level ($L_{mean} < L_{F=M} = 0.9$). This evidence supports the review group's recommendation to proceed with precautionary catch advice for 2025/2026.

Additionally, the review group expresses some concern about the availability of recent discards information. Discard information has been made available for the Azores fishery since 2007, however, this data is stated to be not available for 2021, 2022, and 2023.The assessment report noted that discards have increased in recent years and, therefore, discard information is not negligible for this stock and needs to be considered.

Precautionary approach:

The working group also presented catch advice generated using the precautionary approach for Category 5 stocks, if the attempted 'rfb' rule is concluded to be an inapplicable method. Methods for the precautionary approach were applied appropriately for the Alfonsinos stock according to ICES guidelines. Because the precautionary buffer was applied during the previous 2022 assessment, the buffer should not be applied again for the 2024 assessment. Under this method, the catch advice would remain the same as previously advised; landings should be no more than 179 tonnes in each of the years 2025 and 2026. The review group supports the use of the precautionary approach for the Alfonsinos stock.

Additional Comments:

Background information on the fishery and the available data (and its sources) was well documented. However, the review group strongly recommends additional details concerning the interpolation of abundance indices. The assessment report presented results and model diagnostics for abundance index interpolation models but contained no discussion about the appropriateness of the model results, patterns seen in diagnostics plots of model fits, or the subsequent implications overestimation of abundance. The assessment report also contained no particular description of methodology for retrospective analyses and made no comments on the apparent (and concerning) trends seen in the results of these analyses. The assessment report would greatly benefit from the inclusion of discussion concerning the abundance interpolation and retrospective analysis results and, if possible, speculation about why the patterns may be occurring, and how these results might affect subsequent calculations for harvest control rules (*i.e.*, calculation of 'rfb' parameters).

Additionally, the working group presented questions about the potential difference in specific proportions of *Beryx spp.* in catches from areas other than Azores (i.e., France and Spain). The review group expects there would be differences in species-specific compositions of catches in these areas (as compared to the Azores fishery) but has no way to assess the significance of this assumption at this time.

Conclusions:

The review group recommends that the catch advice generated from the precautionary approach for Category 5 stocks be accepted for the 2024 assessment, out of abundance of caution. Additionally, the review group concludes that application of the 'rfb' rule is inappropriate at this time due to concerns about the validity of interpolated abundance indices (subsequently used in 'rfb' parameter calculations). The review group encourages the working group to revisit the application of the 'rfb' rule in future assessments, once more observed abundance data is made available which will support reliable calculations for 'rfb' parameters, namely the parameter 'r'.

Review of bsf.27.nea - Black Scabbardfish

General Summary:

Black scabbardfish (*Aphanopus carbo*) is assessed by ICES as a single stock, though the species is organized into four major components (northern, southern, central eastern Atlantic, and other areas). ICES provides scientific advice only for the northern and southern areas; ICES does not assess fisheries in the central eastern Atlantic and other areas but the assessment working group includes trends from these additional areas to provide a better understanding of the stock dynamics.

For the 2024 assessment, the working group attempted to apply the Bayesian dynamic population model (benchmarked at WKDEEP 2014 (ICES, 2015)) used in previous assessments. However, the model fit poorly and failed to produce appropriate catch estimates, particularly for the recent years of data. The model's failure (at this time) is speculated to be caused by major changes in the northern component of the fishery. The EU Regulation 2016/2336 banned bottom trawling (greater than 800 m depth), and greatly reduced the available fishing grounds for the French fishing fleet.

Because the previously applied model could not be fit for the 2024 assessment, the working group proposed two alternative approaches for scientific catch advice. The first proposal was a rollover of the advice given in 2022, such that catches should be no more than 4124 tonnes for each of 2025 and 2026. The second proposal was to apply the 'rfb' rule for each stock component (northern and southern) separately, as the working group remarked that there are differences in exploitation patterns between the northern and southern stock components. The 'rfb' rule advises that catches should be no more than 1868 tonnes in Subarea 8 and Division 9.a and no more than 1308 tonnes in Division 5.b, subareas 6–7, and Division 12.b in each of the years 2025 and 2026 (for a total of 3176 tonnes each year).

The review group recommends that implementing the rollover advice is sufficient (appropriate) at this time. Despite the unstable changes in the northern component's fishing effort and biomass index, the rollover advice is justifiable because:

1. Alternative abundance indices (derived from Scottish and Icelandic surveys) in the northern component are generally stable and not particularly low (relative to their time series).
2. Indices of abundance for stock components are above $I_{trigger}$, indicating that the stock status is relatively good and fishing pressure proxy shows that fishing pressure is on target in the South and somewhat too high (1.15) in the North.
3. Additionally, there is a benchmark assessment planned for 2024–2025 that will address and fix the issues for the previously applied model.
4. Alternative harvest control rules do not appear appropriate. 'rfb' is inappropriate because it assumes equilibrium conditions when the stock dynamics here are changing. 'rb' is unnecessarily conservative given the amount of data available.

Background:

Black scabbardfish are found on seamounts and ridges throughout the Northeast Atlantic, from 30°N to the Strait of Denmark. ICES considers one single assessment unit in the Northeast Atlantic. However, because of the different characteristics of fisheries and life stage occurring in each area, the species is organized into four components: northern, southern, central eastern Atlantic (referred to as CECAF), and other areas. ICES provides scientific advice only for the northern and southern areas; ICES does not assess fisheries in the central eastern Atlantic and other areas but the assessment working group includes trends from these additional areas to provide a better understanding of the stock dynamics.

In the northern component (subareas 27.5, 27.6 and 27.7 and Division 27.12.b), the predominant fishery is bottom trawl. In the southern region (subareas 27.8 and 27.9), the predominant fishery is longlining. In the CECAF and other areas, the fishery consists of longlining and trawling. The fishery is managed using TAC and limited licensing. Discards are assumed to be negligible. Most all biomass, abundance, and landing indices from survey catch indicate stable or decreasing trends in recent years for the fishery as a whole. However, changes are seen in the northern component of this stock. A recent regulation on bottom trawling in the EU (EU Regulation 2016/2336) banned bottom trawling at depths greater than 800 m. This regulation has notably reduced the available fishing grounds for the French fishing fleet and, subsequently, is reflected in changing trends in CPUE and biomass.

Technical Comments

State-space model:

The working group attempted to apply the previously used Bayesian state-space model to this stock and presented the results in the assessment. Results indicate poor model fit and the review group concurs with the decision to not apply the model for the 2024 assessment to generate advice.

Rollover advice:

Rollover catch advice (i.e., to reuse advice previously used for 2022/2023) is the working group's primary recommendation. ICES does not currently have an approved framework to apply rollover catch advice. In order for the review group to support the use of rollover catch advice for any existing stock, including the Black scabbardfish, we recommend the working group adopt a general framework. Given the lack of a rollover advice framework, the working group adopted the following guidelines in order to effectively review the catch advice for Black scabbardfish.

Arguments in support of rollover advice	Arguments against rollover advice
Assessment is deficient due to missing data not associated with changes in the fishery dynamics (due to circumstances beyond assessment control, *e.g.*, vessel breakdown)	Stock dynamics, fishery, or assessment methodology changes (*e.g.*, major shift in fishing location due to area closure)
Stability of catches, CPUE, survey index, etc.	Catches, CPUE, survey index are unstable
Abundance index is not near the lowest on record	Abundance index is near the lowest on record
Immediately preceding assessment showed f (or f proxy) below F_{MSY} or proxy; abundance index above index proxy for B_{MSY}	Previous assessment suggests f and biomass below or close to F_{MSY} and B_{MSY} (or their proxies)
Absence of alternative appropriate quota setting mechanisms	Appropriate quota setting mechanisms exist

We considered the above guidelines when evaluating the appropriateness of rollover advice for this stock. Despite the concerning changes in biomass index for the northern component (derived from the French fleet CPUE, noted by the working group that this data is no longer indicative of abundance), trends in abundance and fishing pressure from other surveys indicate stock stability. Alternative abundance indices (derived from Scottish and Icelandic surveys) in the northern component are generally stable and not particularly low (relative to their time series). Additionally, trends in fishing pressure and abundance in the southern component of the stock have remained stable over time. Calculated current biological reference points also indicate relative stable stock status. Indices of abundance are above $I_{trigger}$, indicating that the stock status is relatively good and fishing pressure proxy shows that fishing pressure is somewhat above F_{MSY}.

Additionally, the working group remarks that the previously applied model will undergo a benchmark process in 2024–2025 which should address the current issues with its application and alter data inputs where necessary.

'rfb' rule:

In addition to rollover advice, the working group examined the use of the 'rfb' rule to provide catch advice. The 'rfb' rule relies on the assumption that the stock is in equilibrium, which is required for the fishing parameter proxy (*f*) to be accurately estimated from the length frequency distribution. The length distribution may not be stable and indicative of stock status because 1) the change in fishing locations may result in a different component (size distribution) of the population being exploited, and 2) changing fishing patterns may result in changing fishing mortality which will be reflected in the size distribution of the catch with a time delay. Additionally, changes in fishing location and fishing effort may affect the interpretability of CPUE data. Due to trends seen in the northern component's CPUE due to EU regulation changes, the 'rfb' rule may not provide appropriate catch advice. The working group noted concerns that since catches were notably low in the northern component in recent years, these values had significant influence on the calculated catch advice. Additionally, length-based indicators are sometimes derived for the entire stock and other times for each component individually. The 'rfb' rule would decrease the catch advice by 19% and 30% respectively for the northern and southern component. Based on the above considerations, the review group rejects the use of the 'rfb' rule for the Black scabbardfish stock.

Additional Comments:

The report is well organized and well detailed with information. However, the review group recommends that an explicit list of justifications in favor of rollover catch advice be given.

Conclusions:

At this time, the review group concurs with the working group that rollover advice is justifiable for 2025/2026 catch advice. However, the review group cautions that should the state-space model prove unable to be properly adjusted, the working group should also consider alternative methods that are more appropriate than the 'rfb' rule.

Review of gfb.27.nea - Greater Forkbeard

General Summary:

ICES evaluates the Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic as a single stock, and requests review of the stock assessment as such. The Greater forkbeard is a bycatch species with landings reported in subareas 1–10 and 12. The assessment working group incorporates data from eleven surveys to capture this broad geographic range. In 2024, ICES advises that when the framework for category 3 stocks is applied ('rfb' rule), catches should not exceed 686 tonnes. With the assumption that discard rates will be maintained at the 10-year average (24%), the advice suggests that landings should not exceed 522 tonnes.

For the 2024 assessment, ICES' utilization of the 'rfb' rule is a departure from previous assessments, which applied the 'rb' rule. The review group recognizes that the repeated use of the 'rb' rule can severely limit catch advice due to the mechanics of the rule, rather than true stock depletion. As such, the review group acknowledges the 'rb' rule may provide overly conservative catch advice. However, in this assessment, use of the 'rfb' rule is not yet sufficiently justified. The sole use of length distribution data from 2023 should be more fully explained. Additionally, the review group recommends critical examination of the role of discards within the dataset, and the relative influence of discard data on fishing proxy indices. Given the relative stability of landings, abundance, and effort in recent years, the review group views application of the 'rfb' rule as reasonable if the working group can better justify the quality of the 2023 length distribution data and a value for the fishing proxy, *f*.

Background:

Greater forkbeard is found across the Northeastern Atlantic from Norway to Cape Blanc in West Africa. Greater forkbeard is a bycatch species for both trawl and longline fisheries. Due to limited information on the stock structure, ICES manages the species in a single stock assessment. No TAC is set for the stock in any area. Discards are substantial, variable, and poorly known for the stock. The average discard rate for Greater forkbeard over the last ten years is estimated to be 24%, but data from only select countries and subareas is available. Discard survival is unreported in the assessment document. Total landings and biomass have decreased substantially since 2013 and 2014, respectively, but have generally stabilized at a reduced level in some subareas since 2018.

Technical Comments:

Greater forkbeard is currently rated as a category 3 stock. In 2022, the working group applied the ICES category 3 framework using the 'rb' rule to advise catch for this stock. In the 2024 assessment, the working group applied the 'rfb' rule for this stock, incorporating a fishing pressure proxy (*f*) using length distribution data from 2023. According to the 2022 assessment document, "commercial length frequency data is only available from some countries and areas and the historical series is not considered robust to be conclusive on observed trends." Additionally, exploratory analysis from the 2022 assessment states "uncertainties in the input parameters" for the 'rfb' rule precluded the use of the 'rfb' rule for the stock assessment.

Length distribution for Greater forkbeard is highly variable from year to year. It is unclear from the data and reasoning presented why the 2023 commercial length frequencies were considered representative of the entire stock, while they were not considered robust in previous years. For a stock with substantial and not fully characterized discard rates, the fate of discards must be considered. Including or removing discards alters the length frequency data. The working group should state whether discards are included in the length data and justify their inclusion or exclusion. The review group recommends that more information be provided concerning discard survival, since discards make up a large portion of the catch. If all discards survive, they are irrelevant to the catch (it's as if they were not caught). However, if discard survival is low, they must be considered as part of the total catch and included in the length frequency distribution.

If the working group would like to apply the 'rfb' rule going forward, uncertainty around LBIs must be resolved. Given the lack of robust length frequency data, the working group should consider sensitivity analysis for the fishing proxy parameter (*f*), which relies on both $L_{F=M}$ and L_{y-1}. Specifically, we recommend repeating the analysis with values of $L_{F=M}$ and L_{y-1} using length frequency data from each previous year (before 2022) of length frequency data and comparing these results to those obtained using only 2023 length frequency data.

Standardized stock biomass is calculated as the average of six surveys, spanning the geographical distribution of the stock with some variation in survey length. While variation in peak catch is present across the surveys, an overall trend of decreasing biomass has been observed since approximately 2013. Recent years indicate that biomass and abundance may have stabilized, albeit at reduced levels compared to recent peaks. The stability in recent years justifies the adequacy of the 'rfb' rule, despite the variability in the length frequency data. The review group wonders if stability of biomass may replace the fishing proxy parameter (*f*), if stability of biomass suggests stability of fishing mortality for this stock.

Additional Recommendations:

The standardized CPUE was calculated from the Portuguese polyvalent fleet. Justification for only using this data is required, as the Greater forkbeard is also caught in other countries and with other gears.

Conclusions:

The Review Group believes the 'rb' rule is giving extremely conservative advice. The review group believes the 'rfb' rule may only be applied if the working group better justifies the input parameters. Use of the 'rfb' rule is not appropriate in a strict sense because of uncertainty in the length frequencies and thus in the *f* parameter. However, 'rfb' might be used if the uncertainty in *f* can be evaluated. The Review Group notes that the stability of the biomass, landings and effort in recent years suggests that the use of the 'rfb' rule in this case may provide reasonable advice.

References:

ICES. 2022. Section 10, Greater forkbeard (*Phycis blennoides*) in all ecoregions. *In* Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). ICES Scientific Reports. 4:40. 995 pp. http://doi.org/10.17895/ices.pub.20037233

Review of sbr.27.9 - Blackspot seabream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)

General Summary:

Blackspot seabream (*Pagellus bogaraveo*) is caught by Spanish and Portuguese fleets in ICES Subarea 27.9. Landings data for this species are available from Portuguese data from 1988 and Spanish data from 2000. However, for the most recent years (2019–2023), landings data for Subarea 27.9 "*strictu senso*" (referring to Portugal and northern Spain only) are taken from the Portuguese polyvalent fleet (>80%) and from Spain (<20%). Additionally, landings information from the Strait of Gibraltar target fishery (Spain and Morocco) are removed. Decisions to alter recent years' data were approved during the ICES workshop on development of MSY advice using SPiCT (WKBMSYSPiCT3: ICES, 2024), although SPiCT was not applied for the current assessment.

Overall, the analyses appear appropriate and there are methodological justifications provided in the supplementary material (ICES 2024, Farias *et al.*, 2024). The 'rfb' rule advises the catch for each 2025 and 2026 should be no more than 43 tonnes. However, current advice was not able to be compared to previous advice due to changes in methodology. To examine the effects of the changes to the methodology the review group recommends continuity runs or sensitivity analyses.

Background:

Blackspot seabream in ICES Subarea 27.9 is currently classified as a category 3 stock and its stock structure is still unknown. Blackspot seabream is targeted by Spanish and Portuguese fleets in ICES Subarea 27.9. Detailed information from Portuguese and Spanish fisheries has been updated in the 3rd Benchmark Workshop on development of MSY advice using SPiCT (WKBMSYSPiCT3, ICES 2024) and 2024 WGDEEP. Additionally, the species is caught in the Strait of Gibraltar target fishery (Spain and Morocco), however, this information is removed for the 2024 assessment. In ICES Subarea 27.9, in addition to catches from the target fishery in the Strait of Gibraltar, there are catches from coastal areas of Northern Spain (Galicia) and Portugal, from fisheries not targeting the species. It should also be noted that Portuguese landings in recent years partially reflect restrictive national quotas constraints.

Due to the uncertainty surrounding the stock structure, it is noted that the previous advice method was applied to data from the Spanish directed fishery. These data are concentrated in the southern portion and extend beyond the subarea boundaries and may not be representative of the subarea 9 stock as a whole.

Technical Comments:

Application of the 'rfb' rule to this stock appears appropriate. However, the review group did have some additional recommendations and reservations about the data used in the calculations. According to Farias et al. 2024, L_{50} and L_{∞} are calculated according to studies that concern the Strait of Gibraltar, though that region is excluded from this assessment. There is noted lack of mixing between Strait of Gibraltar and Portuguese populations. Uncertainty in L_{50} and L_{∞} were also noted as concerns in the 2022 review of the blackspot seabream assessment. The review group recommends recalculation of L_{∞} based on fishery-specific length composition, as well as sensitivity analyses to evaluate the effect of different L_{∞} values on catch advice.

Additionally, length distributions indicated that the polyvalent fleet longlines catch larger fish than the trawl. However, the variables used in the 'rfb' rule formula are strictly from Portuguese longlines data. By excluding the Portuguese trawl data, the advice resulting from the 'rfb' rule may be skewed or weighted inaccurately. We recommend providing details on why this decision was made or sensitivity analyses.

The CPUE from the Portuguese polyvalent fleet was standardized using Generalized Additive Mixed Models. However, the standardization of the CPUE indices excludes trawl data from the procedure. The working group noted in the WKBMSYSPiCT3 report (ICES, 2024) that inclusion of trawl data caused the standardized indices to be inadequate and that further work needs to be done to allow for trawl data to be included in standardized CPUE indices. The review group agrees with the conclusions made by the working group that improved CPUE standardization methodology should be developed, but the current indices are adequate at this time for the application of the 'rfb' rule.

The procedure for raising length frequency data by the landings in order to combine length data from two gears appears incorrect as described in the assessment document. Rather than raising the length frequencies by the landings, the proportions in each length bin should be raised by the landings. We are unable to verify if this was, in fact, done.

Finally, the review group recommends that the working group provides clear documentation of continuity runs to separate the effects of changing input data and temporal dynamics.

Additional Comments:

In Faria *et al*. (2023), the text names 42 tonnes as the catch advice recommendation, however, tables and text within the assessment documents show that the advice is ~42.7 or has been rounded up to 43.

Conclusions:

The methods used to provide advice are approved by ICES and appear to be applied appropriately. The review group recommends that the advice alternatives and a table of the catch advice be calculated using the different data inputs (*i.e.*, sensitivity analyses).

References:

Farias, I., Castellanos, P., Figueiredo, I., Gil, J., 2024. Assessment of blackspot seabream (*Pagellus bogaraveo*) in ICES Division 9.a stricto sensu (Atlantic Iberian waters) using the rfb rule. Working document presented to the ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP). Copenhagen, 23–30 April 2024.

ICES. 2024. Benchmark workshop 3 on the development of MSY advice using SPiCT (WKBMSYSPiCT3). ICES Scientific Reports. 6:6. 370 pp. https://doi.org/10.17895/ices.pub.24998858