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11–18 April 2018

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

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

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1 Executive Summary

WGDEEP met at ICES Headquarters in Copenhagen, Denmark on 11–18 of April. The group was chaired by Pascal Lorance from France and Gudmundur Thordarson from Iceland. Terms of Reference of the Working Group are given in Section 2.

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

In response to a special request from the EU on the added value of having small TAC for some species caught in a mixed fishery in some areas, the working group addressed the issue for those of deep-water stocks listed in the request. Depending on the species, these small TACs may correspond to a stock unit evaluated by ICES, e.g. for the blackspot seabream in subareas 6, 7 and 8 or to management units smaller than the ICES stock unit (e.g. for ling where ICES assesses the stock status in (1) Subareas 6-9, 12 and 14 and in Divisions 3a and 4a and (2) Division 5b but there are separated EU TAC in EU waters of Division 3a, Subarea 4 and Subarea 5 and a larger TAC in subareas 6–9, 12 and 14.

2 Introduction

The **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** (WGDEEP), chaired by Pascal Lorance from France and Gudmundur Thordarson, met at ICES Headquarters in Copenhagen, Denmark on 11th to 18th of April 2018.

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

2.1 Terms of Reference

2017/2/ACOM14 The **Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources** (WGDEEP), chaired by Pascal Lorance, France, and Gudmundur Thordarson, Iceland, will meet at ICES Headquarters, 11–18 April 2018 to:

a) Address generic ToRs for Regional and Species Working Groups.

b) Complete the development of Stock Annexes for all the stocks assessed by WGDEEP, based on the most recent agreed assessment.

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

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

e) Evaluate the stock status of stocks in Icelandic waters for the provision of annual advice in 2018.

f) Evaluate the stock status of all relevant stocks in EU waters for the provision of biennial advice in 2018.

g) Estimate MSY proxy reference points for the category 3 and 4 stocks in need of new advice in 2018:

a) Update the MSY proxy reference points for those category 3 and 4 stocks with existing proxy reference points using most recent data. For those stocks without reference points listed below, collate necessary data and information in order to estimate MSY proxy reference points prior to the Expert Group meeting. The official ICES data call included a call for length and life history parameters for each stock in the table below;

b) Propose appropriate MSY proxies for each of the stocks listed below by using methods provided in the ICES Technical Guidelines (ICES, 2017) along with available data and expert judgement.

Stock Code	Stock name description	EG	Data Category
aru.27.123a4	Greater silver smelt (*Argentina silus)* in subareas 1, 2, and 4, and in Division 3.a (Northeast Arctic, North Sea, Skagerrak and Kattegat)	WGDEEP	3.2
aru.27.6b7-1012	Greater silver smelt (*Argentina silus*) in Subareas 7–10 and 12, and Division 6.b (other areas)	WGDEEP	3.2
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)	WGDEEP	3.2
gfb.27.nea	Greater forkbeard (*Phycis blennoides*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	WGDEEP	3.2
sbr.27.9	Blackspot seabream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)	WGDEEP	3.2
usk.27.1-2	Tusk (*Brosme brosme*) in subareas 1 and 2 (Northeast Arctic)	WGDEEP	3.2

The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group on the dates specified in the 2018 ICES data call. WGDEEP will report by 8 May 2018 for the attention of ACOM.

To address these terms of reference, the activity by stock assessment unit of the expert group meeting was coordinated as indicated in the table below.

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
alf.27.nea	Alfonsinos/Golden eye perch (*Beryx* spp.) in the Northeast Atlantic	Mário Rui Rilho de Pinho	Mário Rui Rilho de Pinho	2018	Biennial
aru.27.5a14	Greater silver smelt (*Argentina silus*) in Division 5.a	Pamela Woods	Magnus Thorlacius	2018	Annual
aru.27.123a4	Greater silver smelt (*Argentina silus*) in Subareas 1 and 2	Elvar Halldor Hallferdsson	Elvar Halldor Hallferdsson	2019	Biennial
aru.27.5b6a	Greater silver smelt (*Argentina silus*) in Divisions 5.b and 6.a	Lise Helen Ofstad	Lise Helen Ofstad	2019	Biennial
aru.27.nea	Greater silver smelt (*Argentina silus*) in Subareas 4, 6.b, 7, 8, 9, 10, 12, and 14, and Divisions 3.a (other areas)	Hege Overboe Hansen	Elvar Halldor Hallferdsson	2019	Biennial
bli.27.5a14	Blue ling (*Molva dypterygia*) in Division 5.a and Subarea 14 (Iceland and Reykjanes Ridge)	Magnús Thorlacius	Pamela Woods	2018	Annual

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
bli.27.5b67	Blue ling (*Molva dypterygia*) in Subdivision 5.b, and Subareas 6 and 7	Pascal Lorance	Pascal Lorance	2018	Biennial
bli.27.nea	Blue ling (*Molva dypterygia*) in Divisions 3.a, and 4.a and Subareas 1, 2, 8, 9, and 12	Hege Overboe Hansen	Hege Overboe Hansen	2018	Biennial
bsf.27.nea	Black scabbardfish (*Aphanopus carbo*) in the Northeast Atlantic	Ivone Figueiredo	Ivone Figueiredo	2018	Biennial
gfb.27.nea	Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic	Guzmán Diez	Guzmán Diez	2018	Biennial
lin.27.1–2	Ling (*Molva molva*) in Subareas 1 and 2	Kristin Helle	Kristin Helle	2019	Biennial
lin.27.5a	Ling (*Molva molva*) in Division 5.a	Magnus Thorlacius	Pamela Woods	2018	Annual
lin.27.5b	Ling (*Molva molva*) in Division 5.b	Lise	Lise	2019	Biennial
lin.27.3a4a6–91214	Ling in (*Molva molva*) Divisions 3.a and 4.a, and in Subareas 6, 7, 8, 9, 12, and 14 (other areas)	Kristin Helle	Kristin Helle	2019	Biennial
ory.27.nea	Orange roughy (*Hoplostethus atlanticus*) in the Notheast Atlantic	Pascal Lorance	Pascal Lorance	2019	Every fifth year
rng.27.5a10b12ac14b	Roundnose grenadier (*Coryphaenoides rupenstris*) in in Mid-Atlantic Ridge (10., 12.c, 5.a1, 12.a1, 14.b1)	Dmitriy Aleksandrov	Dmitriy Aleksandrov	2019	Biennial
rng.27.3a	Roundnose grenadier (*Coryphaenoides rupenstris*) in Division 3.a	Hege Overboe Hansen	Hege Overboe Hansen	2018	Biennial
rng.27.5b6712b	Roundnose grenadier (*Coryphaenoides rupenstris*) in Subareas 6 and 7, and Divisions 5.b	Lionel Pawlowski	Lionel Pawlowski	2018	Biennial

Fish Stock	Stock name	Stock Coord.	Assess. Coord.	Next Advice year	Advice frequency
	and 12.b				
rng.27.1245a8914ab	Roundnose grenadier (*Coryphaenoides rupenstris*) in all other areas (1, 2, 4, 5.a2, 8, 9, 14.a, and 14.b2)	Dmitriy Aleksandrov	Dmitriy Aleksandrov	2019	Biennial
sbr.27.6–8	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subareas 6, 7 and 8	Guzmán Diez	Guzmán Diez	2018	Biennial
sbr.27.9	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea 9	Juan Gil	Juan Gil	2018	Biennial
sbr.27.10	Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea 10 (Azores region)	Mário Rui Rilho de Pinho	Mário Rui Rilho de Pinho	2018	Biennial
usk.27.1–2	Tusk in Subareas 1 and 2 (Arctic)	Kristin Helle	Kristin Helle	2019	Biennial
usk.27.5a14	Tusk in Division 5.a and Subarea 14	Pamela Woods	Magnus Thorlacius	2018	Annual
usk.27.12a	Tusk in Subarea 12, excluding 12.b (Mid-Atlantic Ridge)	Kristin Helle	Kristin Helle	2019	Biennial
usk.27.3a45b6a7–912b	Tusk in Divisions 3.a, 5.b, 6.a, and 12.b, and Subareas 4, 7, 8, and 9 (other areas)	Kristin Helle	Kristin Helle	2018	Biennial
usk.27.6b	Tusk in Division 6.b (Rockall)	Kristin Helle	Kristin Helle	2018	Biennial
tsu.27.nea	Roundsnout grenadier (*Trachiryncus scabrus*) in the Northeast Atltantic	Pascal Lorance	Pascal Lorance	2019	One-off advice
rhg.27.nea	Roughhead grenadier (*Macrourus berglax*) in NEAFC and 5.a (North Atlantic)	Pascal Lorance	Pascal Lorance	2019	Every fifth year
oth-comb	Other deep-sea species combined	Pascal Lorance	Pascal Lorance	No advice	Collated data

ToR a) Address the general ToRs

In regards to the general ToRs WGDEEP did address them for the stocks relevant.

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

Most stocks assessed by WGDEEP have stock annexes but some of them are old and have not gone through a benchmark procedure. The stock annex for blue ling north of the British Isles (bli.27.5b67) was updated (minor changes) before the meeting by the stock coordinator.

ToR c) NEAFC request on description of deep-water fishery

WGDEEP dealt with this request and the answer can be found in Section 17.

ToR d) Exploratory assessments

Exploratory assessments were presented for the following stocks:

- Greater silver smelt in 5.b and 6.a an XSA and SAM run were presented.
- Red sea bream in 9 a Gadget model was presented and results from a stock production model and VPA based growth method.

A more detailed description, diagnostic and results can be found in the corresponding stock sections.

ToR e), f) g) Assessment and advice of WGDEEP stocks

These ToRs were the main focus of WGDEEP-2018.

ToR h) Estimate MSY proxy reference points for the category 3 and 4 stocks in need of new advice in 2018

Length-based indicators (LBIs) were applied to observed length distributions of black scabbardfish. Two data sets were used (1) length distributions of all catches in the ICES area combined and (2) length distributions of all catches in the ICES and CECAF areas combined.

For greater forkbeard, new trials with SPiCT were carried out, following first attempts in 2017, but the results were not conclusive.

Both SPiCT and LBIs were explored for the blackspot seabream in Subarea 9 and tusk in subareas 1 and 2, without obtaining sufficiently robust results for the former while SPiCT produced robust outputs which indicated a stock status in line with experts' perception on the stock for the latter.

Benchmark of WGDEEP stocks

WGDEEP-2018 proposes that the following stocks be benchmarked in 2020: Three of the greater silver smelt stocks: 5b6a, 5a14 and 123a4, roundnose grenadier in subareas 6 and 7, and divisions 5.b and 12.b and finally ling in 5b.

An exploratory assessment has been presented for greater silver smelt in 5b and 6a for several years. First it was a XSA model but SAM for the last two years. There are still some modelling challenges that have to be dealt with and further incorporation of data from 6a into the assessment. Last year WGDEEP proposed to have this stock benchmarked in 2019 but now considers that an additional year for further evaluation of the input data and the model is needed and additionally it would be beneficial to have this stock benchmarked with the other two greater silver smelt stocks.

Greater silver smelt in 5a14 was benchmarked in 2010 and since then age structured data has become available, both from surveys and commercial catches. This along with more varied exploitation levels should make it possible to improve the assessment method. In terms of modelling an age structured model such as SAM or an age-length based model as Gadget could be possible candidates.

As with the other greater silver smelt stocks assessed by WGDEEP the stock in 123a4 was last benchmarked in 2010 but then the assessment unit included greater silver smelt from all other areas than 5a. Since the last benchmark additional data has become available such as a survey series and more length and age structured data from commercial catches. Assessment methods to be explored are further elaborations of DLS methods and possibly assessment models such as SAM or SPiCT. Roundnose grenadier in subareas 6 and 7, and divisions 5.b and 12.b was benchmarked in 2010 and the assessment methodology based on the surplus production model has not been revised since then. However, some issues have not been resolved since the 2010 benchmark. Stock area includes 12.b but the current assessment is only considered to be reliable for 5b, 6, 7 because 12.b landings are likely to include landings of roughhead grenadier (*Macrourus berglax*). Discards have not been included in the current assessment and the impact of this is unknown. The reconstruction of a time-series of discard rates is required for the whole time-series. An attempt to update the landings data in 6 and 12.b was done in 2018 with no revision of the data due to the lack of additional information. No new information has been available since then. Prior estimates of discards can only be addressed at the moment through assumptions to be tested.

Additionally, some issues have appeared since then such as parameter estimates from the assessment model are possibly too high in regards of stock dynamics. The French tallybooks, due to the decrease of effort and number of vessels in the deep-water French fisheries are no longer representative to derive abundance indices and now the Marine Scotland Science Deepwater Survey is long enough and used as an abundance index. Length distributions are available since 1990 and have not been used into the model. The SS3 model may be considered as a candidate replacement. This option will be investigated during the year.

An exploratory assessment has been presented for ling in 5b for several years. First it was a XSA model but for SAM for the last two years. Further work on the input data and modelling the stock dynamics of ling in 5a is expected to take place during the next two years. This stock has never been benchmarked.

TACMAN – request

WGDEEP discussed this request both in plenary and in sub-groups. The conclusions of the expert group by stock will be the basis for the two pieces of advice that will be published by ICES on the 2nd June and 20th of September 2018.

Transparent Assessment Framework (TAF)

TAF is a new framework, currently in development, to organize all ICES stock assessments. Using a standard sequence of R scripts, it makes the data, analysis, and results available online, and documents how the data were preprocessed. Among the key benefits of this structured and open approach are improved quality assurance and peer review of ICES stock assessments. Furthermore, a fully scripted TAF assessment is easy to update and rerun later, with a new year of data. As of spring 2018, the first assessments are being scripted in standard TAF scripts. See http://taf.ices.dk for more information.

During the WGDEEP 2018 meeting, a session about the Transparent Assessment Framework (TAF), where the practical and technical aspects of TAF were introduced to WGDEEP members. . Further, three stocks were moved into TAF:

1) Icelandic ling [lin.27.5a]. This is an extensive and complicated Gadget assessment, on which further intersessional work will be done before WGDEEP 2019 meeting. Some technical issues were identified. Progress towards getting the core assessment into TAF during the 2018 meeting is around 60%.
2) Greater forkbeard [gfb.27.nea]. DLS 3.2 stock, 100% in TAF.
3) Blackspot seabream [sbr.27.9]. DLS 3.2 stock, 100% in TAF.

3 Stocks and Fisheries of the Oceanic Northeast Atlantic

3.1 Area overviews

Stocks and fisheries of the Oceanic Northeast Atlantic (Mid-Atlantic Ridge and oceanic seamounts and the Azores archipelago). The Mid-Atlantic Ridge (MAR) is the spreading zone between the Eurasian and American plate. The ridge is continually being formed as the two plates spread at a rate of about two cm/year. In the ICES area it extends over 1500 nm from the Iceland to the Azores, crossing the Azores archipelago between the western and central islands groups. The subareas with hard substrata are characterized by a rough bottom topography comprising summits and upper slopes of seamounts and seamount complexes, the central rift valley slopes, and several fracture zones with steep slopes. However, the MAR is mainly sediment-covered and has generally gentle sloping bathymetry, and only about 5% of the lower bathyal area is hard substratum (Niedzielski *et al.* 2013).

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

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

3.2 Fisheries overview

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

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

3.2.1 Azores EEZ

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

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

3.2.2 Mid-Atlantic Ridge

The Northern MAR is a very extensive area located between Iceland and Azores, and comprises features such as the comparatively shallow Reykjanes Ridge extending from southern Iceland to the Charlie-Gibbs Fracture Zone, as well as prominent seamount complexes such as the Faraday Seamounts just south of that fracture zone. Trawl fisheries started on the MAR in 1973, and more than 40 seamounts have subsequently been explored, fished for shorter or longer periods, and regarded as commercially important in Soviet/Russian assessments (Table 3.7.1). Figure 3.7.1 illustrates subareas of the area beyond national jurisdiction (where the Northeast Atlantic Fisheries Commission regulates fisheries) with depths shallower than 2000 m. These are the subareas within the approximate maximum depth of deep-water fisheries in the ICES area (in reality few fisheries extend deeper than 1500 m).

The basis of the pioneer Soviet deep-water fishery was the discovery of concentrations of roundnose grenadier (*Coryphaenoides rupestris)* on multiple hills along the MAR. Later aggregations of alfonsino *(Beryx splendens)*, orange roughy *(Hoplostethus atlanticus)*, cardinal fish *(Epigonus telescopus)*, tusk (*Brosme brosme*), 'giant' redfish (*Sebastes marinus)* and blue ling (*Molva dypterigia)* were found during multi-nation exploratory and commercial operations in the 1970s–1990s. Trawl and longline fisheries were conducted in Subareas 10, 12, 14 and 5 (Figure 3.7.2) by Russian, Icelandic, Faroese, Polish, Latvian, Spanish and Norwegian vessels. However, few of these (often subsidized) efforts led to lasting regular fisheries. It has also been suspected that IUU fishing occurred by vessels from other areas, but the scale of such activity is unknown.

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

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

3.3 Details on the history and trends in fisheries

3.3.1 Azores EEZ

Since the mid-1990s the landings of deep-water species show a decreasing tendency (Figure 3.7.3 and Table 3.7.2), reflecting the change in the fleet behaviour towards targeting blackspot sea bream.

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

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

3.3.2 Mid-Atlantic Ridge

Grenadier (Macrouridae) fisheries: The greatest annual catch of roundnose grenadier (almost 30 000 t) on the MAR was taken by the Soviet Union in 1975, fluctuating in subsequent years between 2800 and 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 19 years, there has only been a sporadic fishery (Figure 3.7.2) by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (catch data are not available). During the entire fishing period to 2009, the catch of roundnose grenadier from the northern MAR amounted to more than 236 000 t, mostly from ICES Subarea 12.

Spain carried out five limited exploratory trawl surveys to seamounts on the MAR between 1997–2000 and a longline survey in 2004, but except for sporadic fisheries in the northern area (Division 14.b) there has been a decline in interest.

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

Blue ling fisheries: The deep-water fisheries off Iceland tend to be on the continental slopes although in 1979 a short-lived fishery on spawning blue ling (*Molva dypterygia*) was initiated on a “small steep hill” at the base of the slope near the Westman Islands. The fishery peaked at 8000 t in 1980 and subsequently declined rapidly. Later, in 1993, French trawlers found a small seamount in southerly areas of the Reykjanes Ridge at the border of the Icelandic EEZ and were fishing for blue ling there with 390 t of catch. The maximum Icelandic catch in that area was more 3000 t also in 1993. Catches declined sharply to 300 and 117 t for next two years and no fishery was reported later (Figure 3.7.2). A fishery on the seamount was resumed by Spanish trawlers in the 2000s with biggest catch about 1000 t, but this has ceased.

Orange roughy fisheries: In 1992 the Faroe Islands began a series of exploratory cruises for orange roughy beginning in their own waters and later extending into international waters. Exploitable concentrations were found in late 1994 and early 1995. Several vessels began a commercial fishery but only one vessel managed to maintain a viable fishery. Most of the fishery took place on five banks. In the northern area (ICES Subarea 12) catches peaked in 1995–1998 (570–802 t), and since then have generally been less than 300 t (Figure 3.7.2). Catches from 6 to 470 t per annum were also made in ICES Subarea 10 in 1996–1998, 2000–2001, 2004–2011, 2012, 2014, 2015 and 2016. The black scabbardfish was the main bycatch species and in recent years catches were 45–313 t for both Subareas (2009–2014).

Longline fisheries for redfish: In 1996 a small fleet of Norwegian longliners began a fishery for ‘giant’ redfish and tusk on the Reykjanes Ridge. The fishery was mainly conducted close to the summits of seamounts and vertical longlines were used in the fishery in rugged terrain. The fishery continued in 1997, but experienced an 84% decrease in cpue. Norway carried out two exploratory longline surveys in 1996 and 1997. A Russian longline fishery was conducted in the same area in 2005–2007 and 2009.

Alfonsino fisheries: The first commercial catches of alfonsino in this area were taken by pelagic trawling on the Spectre seamount in 1977 and this and other seamounts were exploited in 1978 and 1979. No commercial fishing took place during the 1980s but nine exploratory and research cruises yielded about 1000 t of mixed deep-water species, mostly alfonsino, but also commercial catches of cardinal fish, orange roughy, black scabbardfish and silver roughy (*Hoplostethus mediterrraneus*). A joint Norwegian-Russian survey in 1993 used a bottom trawl to survey three seamounts and a catch of 280 t, mainly alfonsino and cardinal fish, was taken from two of them. Orange roughy, black scabbard fish and wreckfish *(Polyprion americanus)* were also of potential commercial significance. Commercial fishing yielded more than 2800 t over the next seven years (Figure 3.7.2). In recent years there have been no indications of a target fishery for alfonsino. Since the discovery of the seamounts in the North Azores area Soviet and Russian, vessels have taken about 6000 t, mainly of alfonsino. Vessels from the Faroe Islands and the UK have also taken small catches of the species in the area. Faroe Islands reported landings of 141 t of alfonsinos and 82 t of orange roughy from area 10 (and 1.7 t from area 12) during 2015. During 2016 Faroes reported landings, from area 10, of 48 t of alfonsinos, 86 t of orange roughy (and 7 t from area 12) and 50 t of black scabbardfish (and 0.2 t from area 12).

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

3.4 Technical interactions

3.4.1 Azores EEZs

The fishery is multispecies and so technological interactions are observed. In the past the bycatch of this fishery was considered insignificant, according to a pilot study conducted in 2004 (ICES, 2006). However, reported discards from observers in the longline fishery from 2004–2010 shows that for some species, like deep-water sharks, the discards may be important. Actually, commercial value species like red blackspot sea bream and wreckfish, 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.

3.4.2 Mid-Atlantic Ridge

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

3.5 Ecosystem considerations

3.5.1 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.

3.5.2 Mid-Atlantic Ridge

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

The MAR is isolated from the continental slope except for the relatively continuous shallower connections via the Greenland and Scotland ridges, and some seamount chains, e.g. the New England seamounts provide other linkages to the continents. There is a substantial literature on biogeography of seamounts and the MAR, and also some recent studies of population genetics. Demersal fish assemblages on the MAR resemble those on adjacent slope areas on either side (Bergstad *et al.*, 2012), and for some important commercial species, e.g. roundnose grenadier, genetic studies suggest homogeneity across wide areas across the ocean basin (Knutsen *et al.*, 2012).

3.6 Management of fisheries

3.6.1 Azores EEZ

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

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

3.6.2 Mid-Atlantic Ridge

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

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

Current NEAFC measures also include regulations on bottom fishing aimed to protect VMEs. Regular fishing with bottom-touching fishing gear is only allowed in restricted subareas of the NEAFC Regulatory Area designated as 'existing fishing areas' (Figure 3.7.4). Other areas are either closed to bottom fishing or considered subareas only open to pre-assessed exploratory fisheries evaluated and accepted by the commission. In the event a possible VME is encountered in 'existing fishing areas' or during exploratory fishing, move-on rules apply and temporary closures established until it has been determined that a VME exists or not.

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

3.7 References

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3.8 Tables

Table 3.7.2. Overview of landings in Subareas 10 (a.1,a.2,b),12I (c, a.1) (does not include information from 12.b, Western Hatton Bank) and 14.b1).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
ALFONSINOS (*Beryx* spp.)	731	1510	384	229	725	484	199	243	172	139	161	192	211	252	312	245	232	222	168	131	292	156	149
ARGENTINES (*Argentina silus*)		1			2					4													0
BLUE LING (*Molva dypterigia*)	602	814	438	451	1363	607	675	1270	1069	644	35	65	1			72	0	16	9		0		0
BLACK SCABBARDFISH (*Aphanopus carbo*)	304	455	203	253	224	357	134	1062	502	384	198	73		80	162	240	163	16	206	85	7	86	63
BLUEMOUTH (*Helicolenus dactylopterus*)	589	483	410	381	340	452	301	280	338	282	190	209	275	281	267	213	231	190	235	200	256	306	333
DEEP WATER CARDINAL FISH (*Epigonus telescopus*)						3		14	16	21	4	10	7	7	7	5	5	4	4	2	4		5
GREATER FORKBEARD (*Phycis blennoides*)	75	47	32	39	41	100	91	63	56	46	22	134	201	18	26	14	11	6	8	9	10	10	15
LING (*Molva molva*)	50	2	9	2	2	7	59	8	19		2				1			0	0		1		0
MORIDAE						1	88	113	140	91	69	127	86	53	68	54	55						169
ORANGE ROUGHY (*Hoplostethus atlanticus*)	676	1289	814	806	441	447	839	28	201	711	324	104	20	108	26	74	112	139		47	84	93	<1
RABBITFISHES (*Chimaerids*)			32	42	115	48	79	98	81	128	193				22	0		2	6				0
ROUGHHEAD GRENADIER (*Macrourus berglax*)					3	7	10	7	2	28	8	8			6	0	0	2726	868	448			0
ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*)	644	1739	8622	11979	9696	8602	7926	11 468	10 805	10 748	513	86	2	13	5	1691	3366	2724	1907	2075	862	659,95	84
RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*)	1115	1052	1012	1119	1222	947	1034	1193	1068	1075	1383	958	1070	1089	1042	687	624	613	692	663	701	515	499
SHARKS, VARIOUS	1385	1264	891	1051	50	1069	1208	35	25	6	14	104	63	12	1	7	5	31	70				75
SILVER SCABBARDFISH (*Lepidopus caudatus*)	789	826	1115	1187	86	28	14	10	25	29	31	35	55	63	64	68	148	282	0	713	429	87	101
SMOOTHHEADS (*Alepocephalidae*)		230	3692	4643	6549	4146	3592	12538	6883	4368	6872							160	17				0
Trachipterus sp																		54					0
TUSK (*Brosme brosme*)	18	158	30	1	1	5	52	27	83	16	66	64	19		2	107	0	29			1		0
WRECKFISH (*Polyprion americanus*)	244	243	177	140	133	268	232	283	270	189	279	497	664	513	382	238	266	226	209	121	116	101	128
TOTAL	7222	10113	17861	22323	20993	17578	16533	17272	10950	8161	10364	2666	2674	2489	2393	3715	5218	7441	4398	4493	2 764	2 014	*1 621*

***- provisional data**

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

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

3.9 Figures

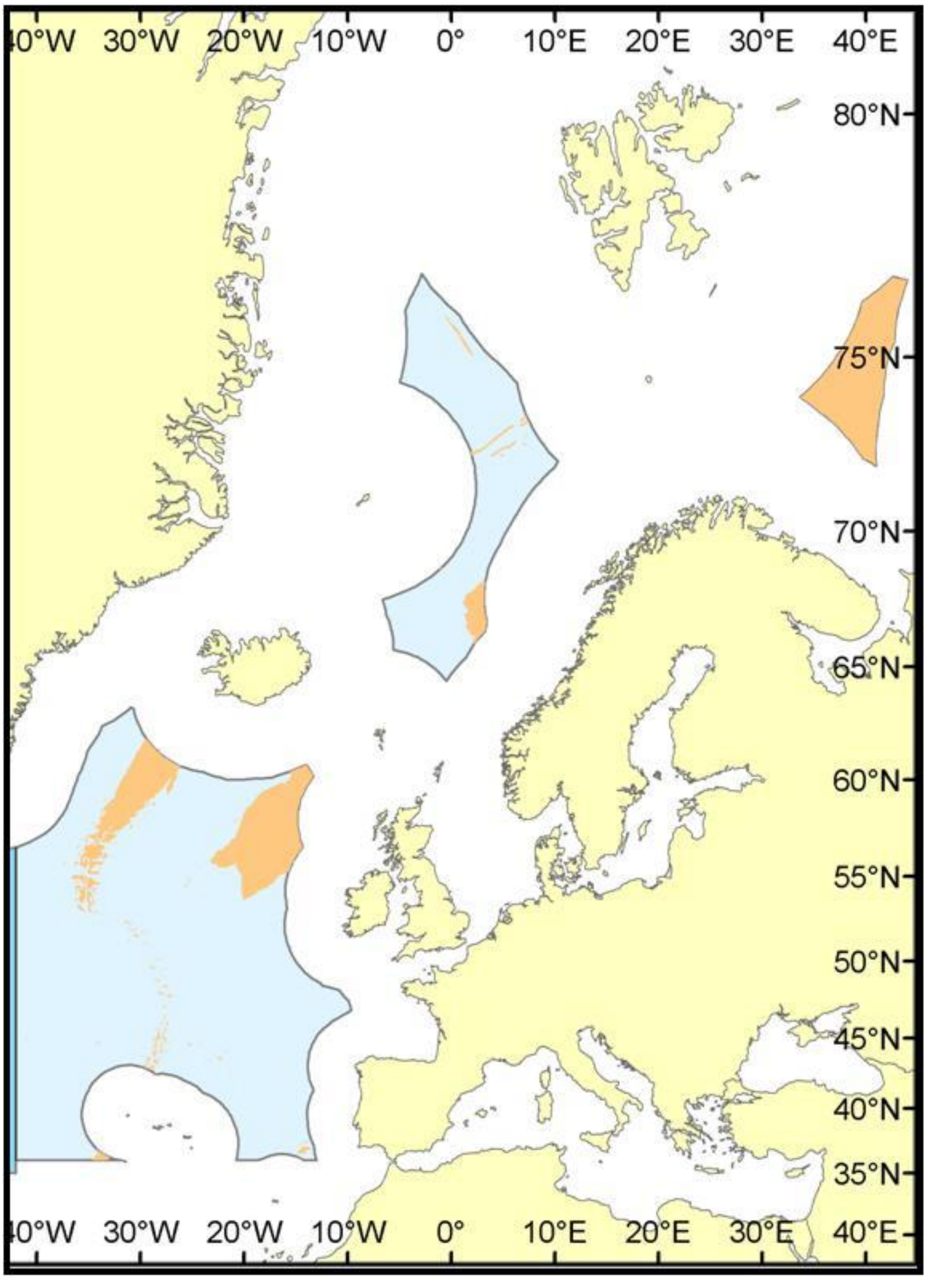


Figure 3.7.1. The NEAFC Regulatory Area (area beyond national jurisdiction) in the Northeast Atlantic (light blue polygons) with superimposed subareas shallower than 2000 m (light brown patches). Note that the NEAFC RA in the Barents Sea is entirely shallower than 2000 m, and that a high Arctic NEAFC RA (beyond 80°N) is not shown on the map.

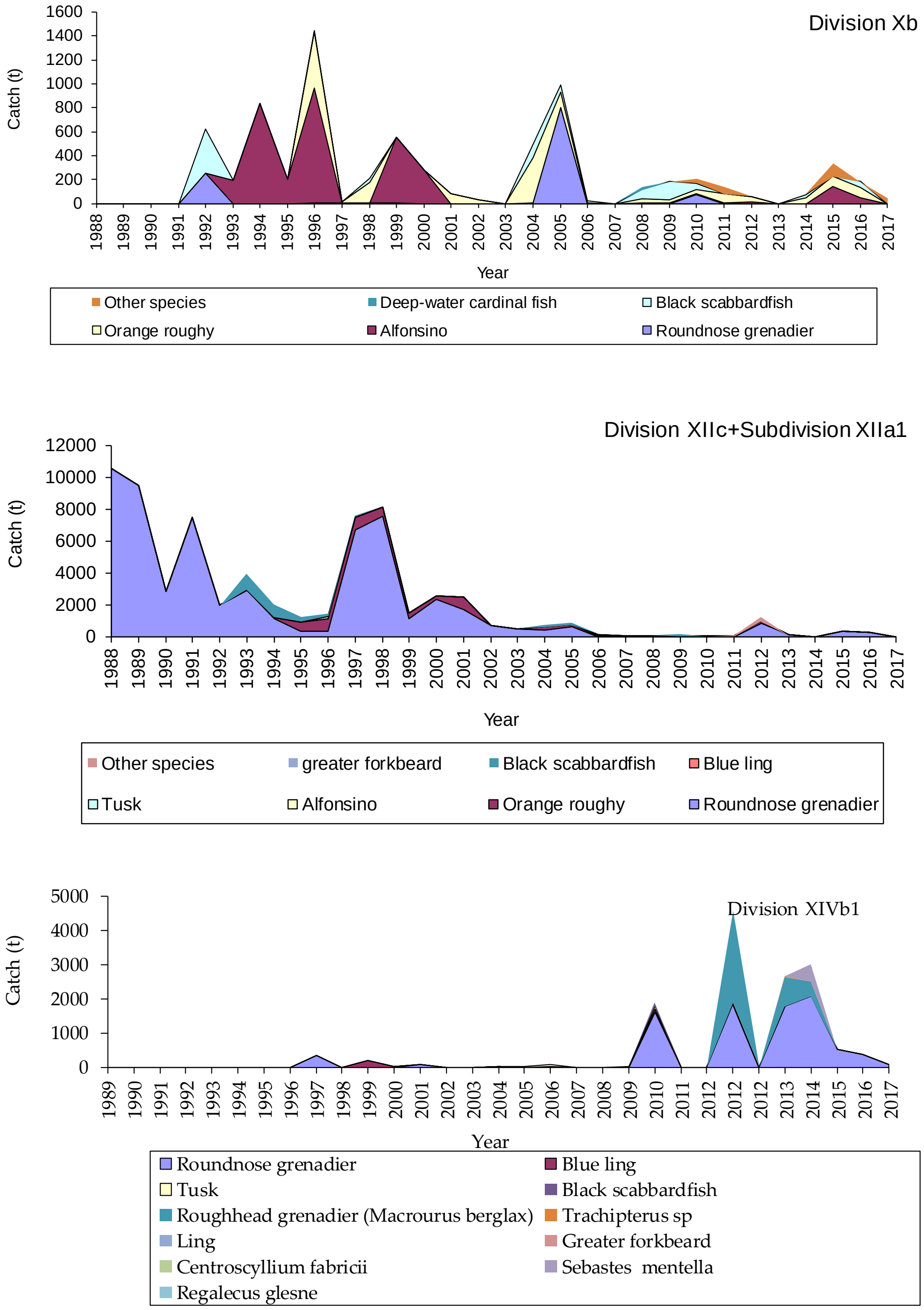


Figure 3.7.2.Annual catch of major deep-water species on MAR in 1988–2017.

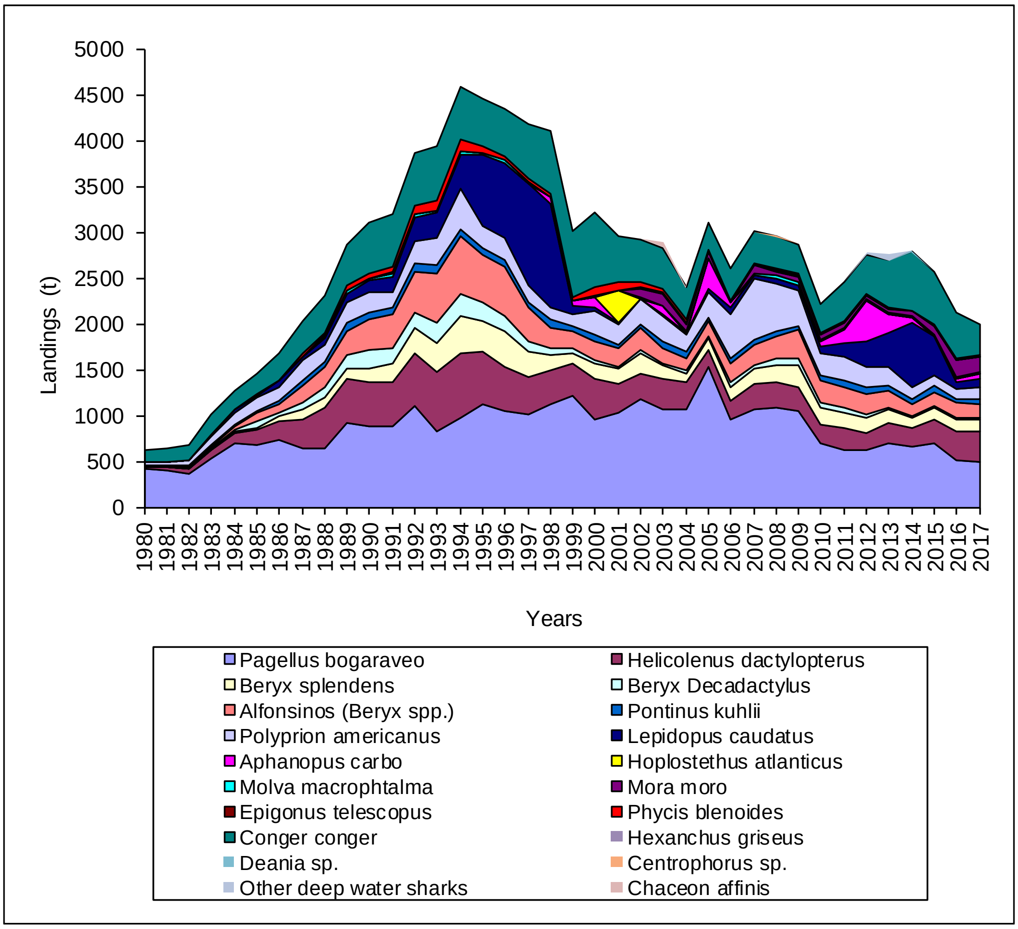


Figure 3.7.3. Annual landings of major deep-water species in Azores from hook and line fishery (1980–2017).

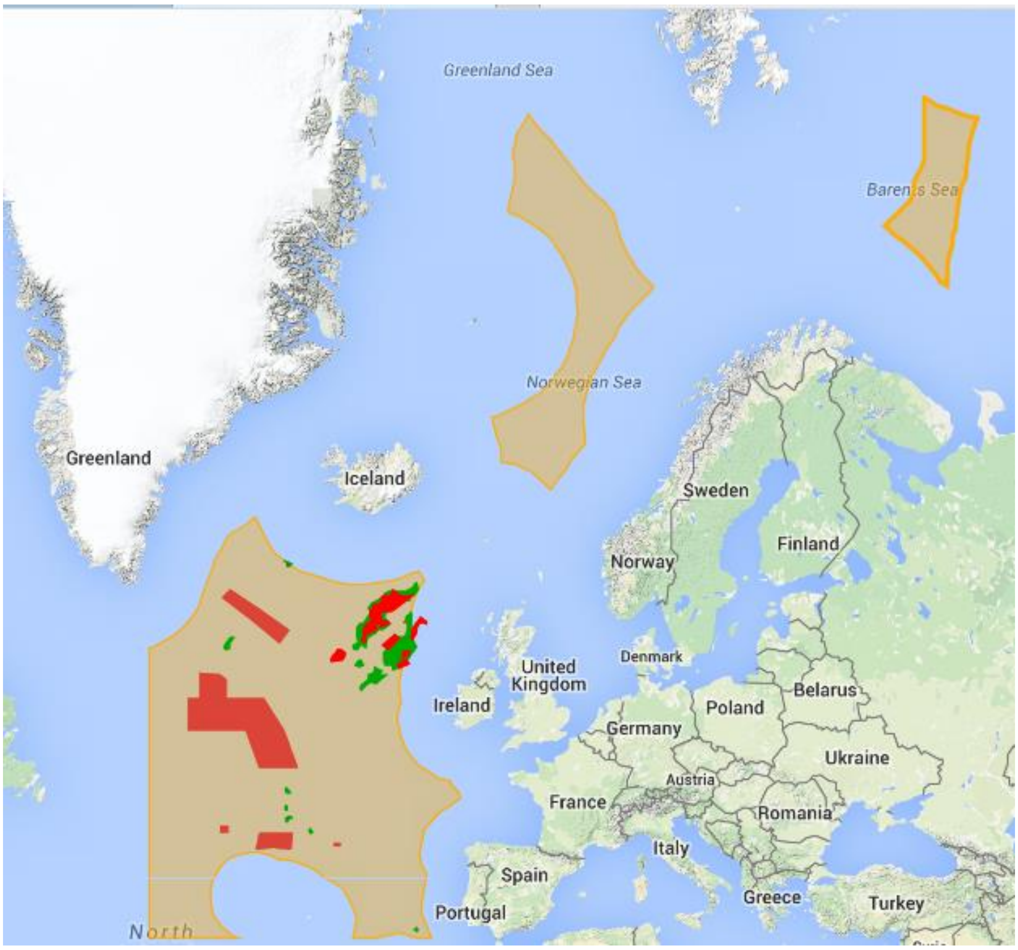


Figure 3.7.4. The regulatory area of NEAFC (light brown) and subareas of the Mid-Atlantic Ridge, seamounts and the Rockall-Hatton areas designated as bottom fishing closures (red), and 'existing fishing areas (green). Areas outside closures and 'existing fishing areas' are only open to pre-assessed exploratory bottom fishing. Source: www.neafc.org .

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

4.1 Stock description and management units

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

4.2.1 The fishery

The longline fisheries in Faroese waters were mainly on the slope on the Faroe Plateau and a small amount of it was on the bank areas and Wyville-Thomson Ridge (Figure 4.2.1). Ling was also caught as bycatch by trawlers fishing saithe on the Faroe Plateau (Figure 4.2.2). In the latest years, foreign catches was mainly by the Norwegian long-liners.

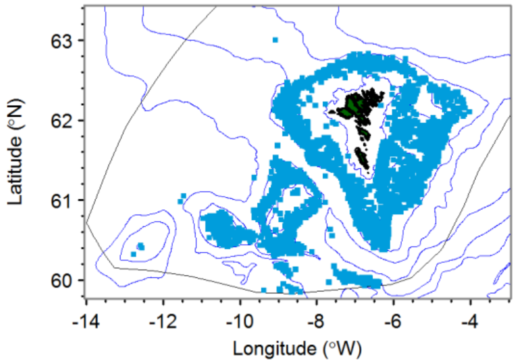


Figure 4.2.1. Ling in 5.b. Spatial distribution of the longline fishery 1985 to present, where ling was >30% of the total catches in the sets. These are the data behind the longliners cpue series of ling.

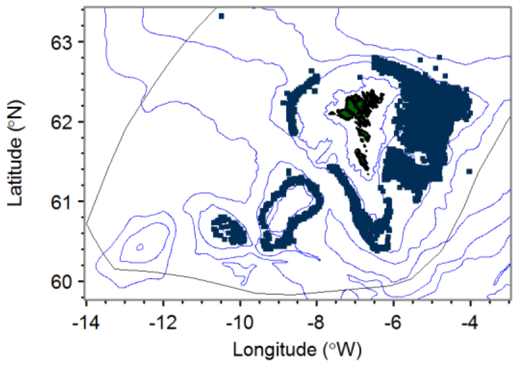


Figure 4.2.2. Ling in 5.b. Spatial distribution of pair trawler fishery 1994 to present, where ling was in the catch and saithe >60% of the total catch per haul. These are the data behind the pair trawler bycatch cpue series of ling.

4.2.2 Landings trends

Landings data for this stock are available from 1904 onwards (Figure 4.2.3). Landing statistics for ling by nation for the period 1988–2017 are given in Tables 4.2.1–4.2.3 and total landings data from 1904 onwards are shown in Figure 4.2.3. Total landings in Division 5.b have in general been very stable since the 1970s varying between around 4000 and 7000 tonnes. In the period from 1990–2005 around 20% of the catch was fished in area 5.b2, and in the period 2006–2017 this has decreased to around 10%. The preliminary landings of ling in 2017 were 6152 tons, of which the Faroes caught 76%. The reason for the low foreign catches in 2011–2013 was because of no bilateral agreement on fishing rights between the Faroes, Norway and EU.

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

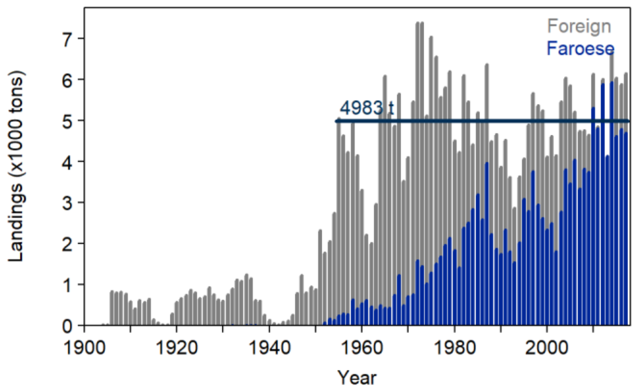


Figure 4.2.3. Ling in 5.b. Total international landings since 1904. The mean catches from 1955 to present were around 5000 tons.

4.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, effort should be adjusted such that catches should be no more than 5196tonnes in each of the years 2018 and 2019. All catches are assumed to be landed.

4.2.4 Management

For the Faroese fleets, there is no species-specific management of ling in 5.b, although there is a licensing scheme and effort limitations. The main fleets targeting ling are each year allocated a total allowable number of fishing days to be used in the demersal fishery in the area. The recommended minimum landing size for ling is 60 cm, but that is not enforced because of the discard ban. Mostly 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm. Other nations are regulated by TACs.

There is a bilateral agreed quota between Norway and Faroe Islands, but there was no such agreement in 2011–2013. In 2018, Norway can catch 2200 tons ling/blue ling, 1801 tons tusk, 150 tons saithe and 800 tons other species as by-catch in bottom fishery in Faroese waters.

In 2018, the Faroese Government will allow 5 Russian vessels to undertake experimental fishing in the Faroese Fishing Zone at depths deeper than 700 meters, provided that a Russian scientific observer is onboard. No more than 3 vessels can be operating simultaneously. Two of these vessels can undertake experimental fishery in deep waters around Outer Bailey and Bill Baileys Banks, at depth between 500 and 700 meters, provided that catches in this area do not exceed 500 tonnes of deep-sea species.

Quotas of blue ling/ling* and other species for European Union vessels fishing in the Faroese zone in 2018 is 2000 tonnes and 700 tonnes, respectively. *By-catch of maximum 665 tonnes of roundnose grenadier and black scabbardfish to be counted against this quota.

4.2.5 Data available

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

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

From the two annual Faroese groundfish surveys on the Faroe Plateau, especially designed for cod, haddock and saithe, biological data (mainly length and round weight, Table 4.2.4) as well as catch and effort data are available. Data of ling larvae from the annual 0-group survey on the Faroe Plateau was also used.

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

4.2.5.1 Landings and discards

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

4.2.5.2 Length compositions

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

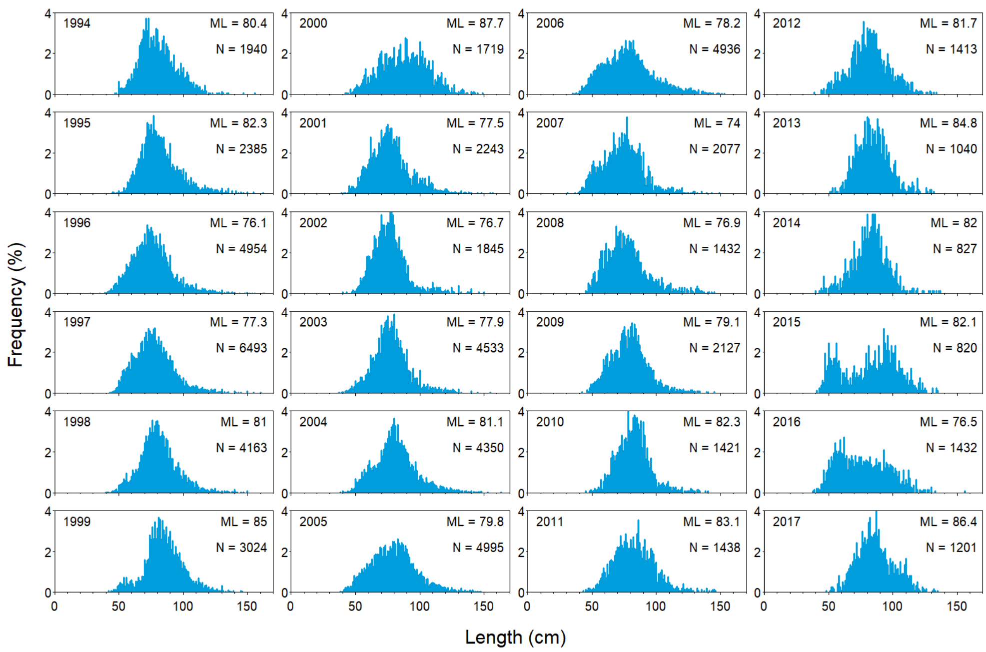


Figure 4.2.4. Ling in 5.b. Length distribution in the landings of ling from Faroese longliners (>110 GRT). ML-mean length and N-number of length measures.

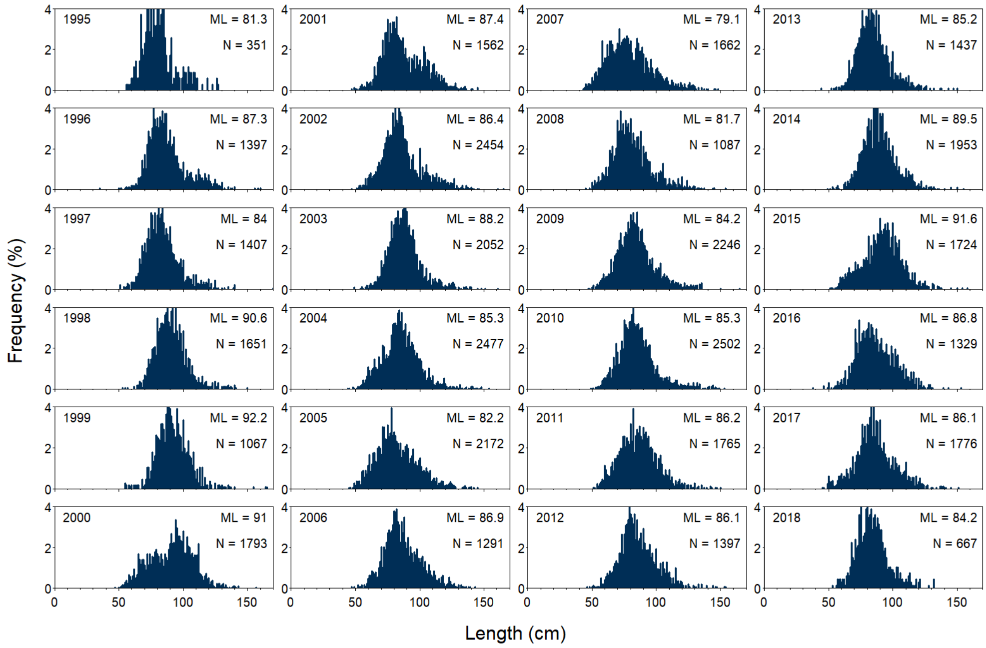


Figure 4.2.5. Ling in 5.b. Length distribution in the landings of ling from Faroese trawlers (>1000 HP). ML-mean length and N-number of length measures.

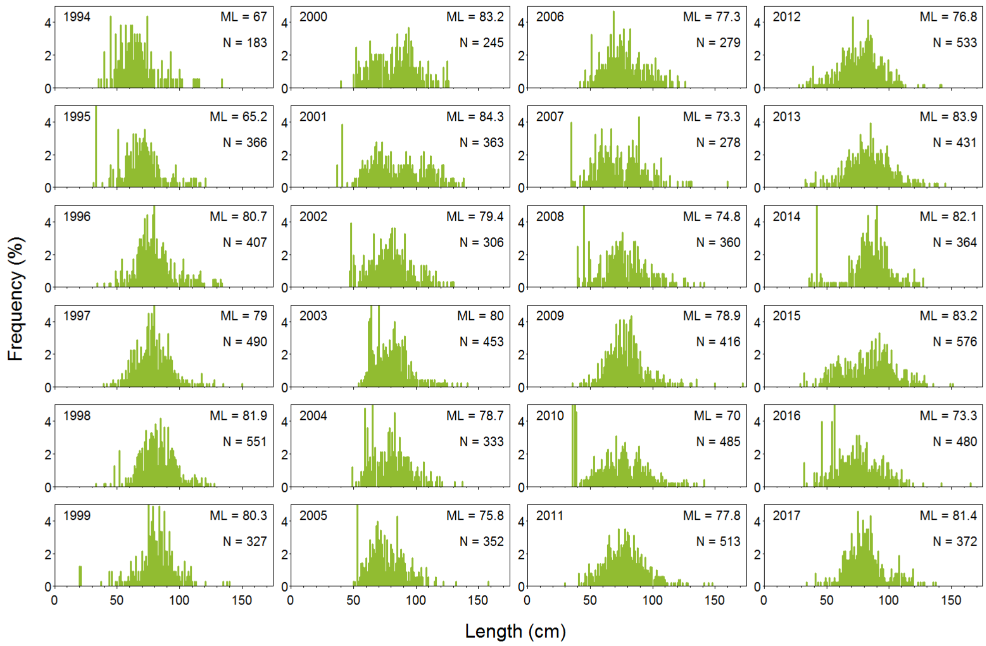


Figure 4.2.6. Ling in 5.b. Length distribution from the spring groundfish survey. ML- mean length, N–number of calculated length measures. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

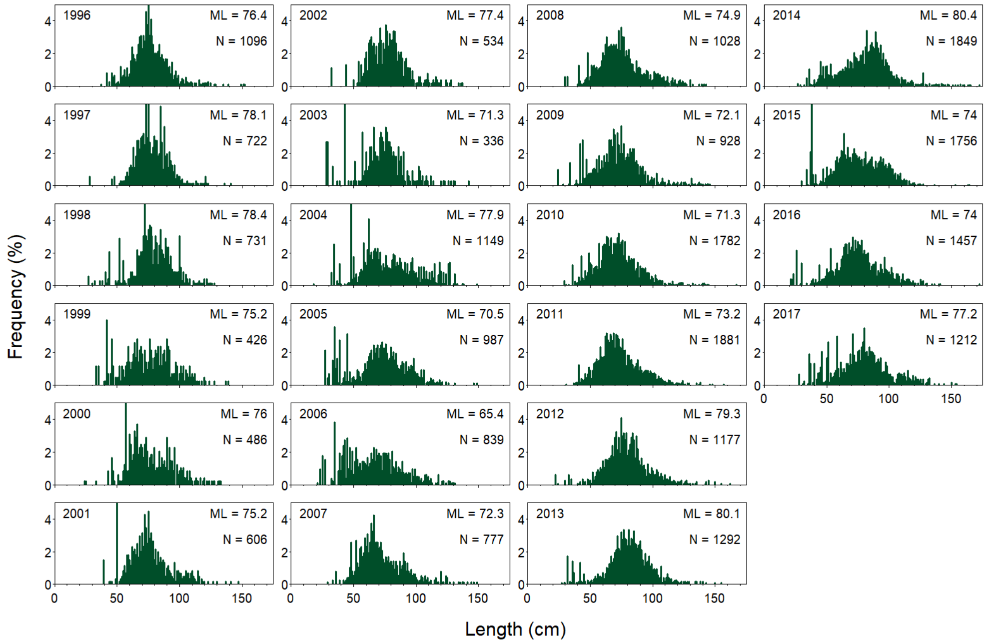


Figure 4.2.7. Ling in 5.b. Length distribution from the summer groundfish survey. ML- mean length, N–number of calculated length measures. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

4.2.5.3 Catch-at-age

Catch-at-age data were provided for Faroese landings in 5.b for the period 1996 to present. Due to few age data in the recent period were all ages from 1996 to present combined (the same age–length key for all these years in the exploratory assessment). Thereafter were the age–length data distributed on the lengths for the distinct years and fleets (longliners and trawlers) (Figure 4.2.8). The common ages in the landings are from five to nine years and the mean age is around 7–8 years.

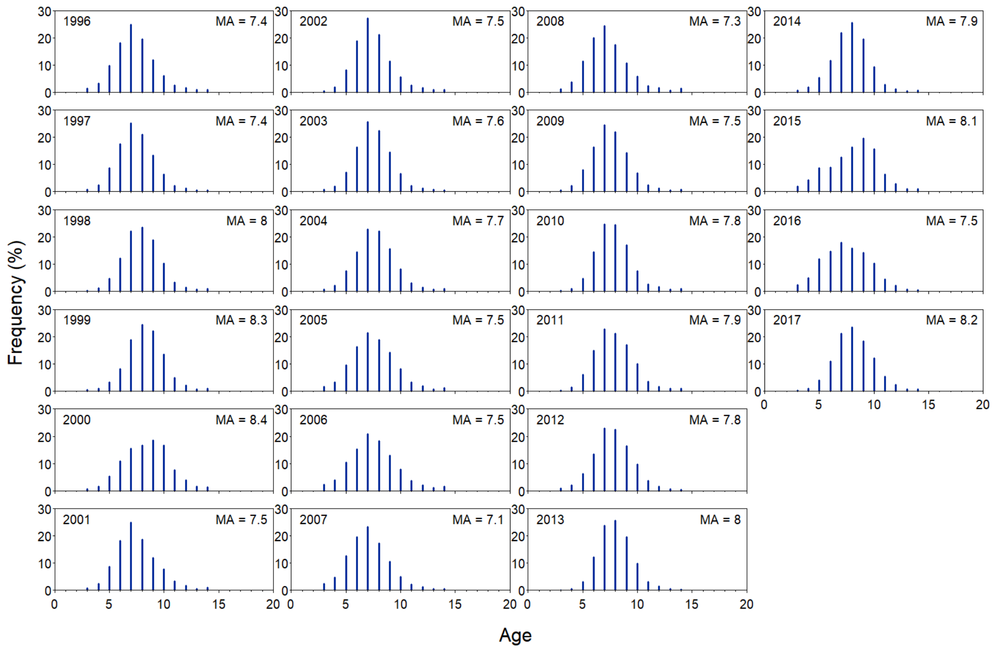


Figure 4.2.8. Ling 5.b. Catch-at-age composition used in the exploratory assessment. MA- mean age.

4.2.5.4 Weight-at-age

Mean weight-at-age data from the landings in 5.b were modelled by using all the age samples from landings (1996 to present) combined before they were distributed on the length distribution for the distinct year and fleet (longliners and trawlers). There is no particular decreasing trend in the mean weights over the period (Figure 4.2.9).

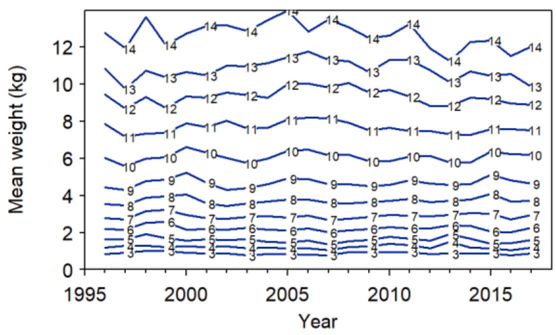


Figure 4.2.9. Ling in 5.b. Mean weight-at-age in the catches.

4.2.5.5 Maturity and natural mortality

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

Maturity parameters:

Area	Sex	A50	N	L50	N	RW50	N	GW50	N
Faroese waters	Combined	5.89	1677	68.86	1737	2069.5	1308	1435.2	295
Faroese waters	Female	6.21	846	71.81	871				
Faroese waters	Male	5.60	831	66.54	865				

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

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

4.2.5.6 Catch, effort and research vessel data

Commercial cpue series

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

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

Fisheries-independent cpue series

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

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

4.2.6 Data analyses

Mean length in the length distribution from commercial catches from Faroese longliners and trawlers showed an increase in mean length from 74–79 cm in 2007 to mainly around 83–86 cm since 2010 (Figure 4.2.4–4.2.5). The mean length in length distributions for the Norwegian longliners fishing in Faroese waters, in the period 2003–2009 were around 87 cm. The Faroese trawlers have a slightly higher mean length in the catches as the Faroese longliners.

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

Fluctuations in abundance

Information on abundance trends can be derived from the cpue data from the Faroese longliners (Figure 4.2.10), Norwegian longliners fishing in 5.b (Figure 4.2.11), bycatch from the Faroese pair trawlers fishing saithe (Figure 4.2.10) and from the Faroese groundfish surveys (Figure 4.2.12). Data from these series are presented in Table 4.2.5–4.2.6.

The Faroese longline cpue series and the Faroese trawl bycatch cpue series show an increasing trend since around 2001 (Figure 4.2.10). The Norwegian longline series show an increase since 2004 (Figure 4.2.11). It has to be noted that there are less than 100 fishing days from Norwegian longliners in Faroese waters in 2009–2014 (Table 4.2.6).

The two survey cpue series indicate a stable situation since the late 1990s and an increase in recent years (Figure 4.2.12). There were a small decrease in latest years, but the values were still well above the mean value.

A potential recruitment index was calculated from the two surveys as the number of ling smaller than 40 cm (Figure 4.2.13). This shows indications of increasing recruitment in recent years. In addition, a potential recruitment index was calculated of ling (2–3 cm in length) from the annual 0-group survey on the Faroe Plateau 1983 to present, which also showed indications of high recruitment (Figure 4.2.14). These recruitment indices support an indication of increasing recruitment in recent years.

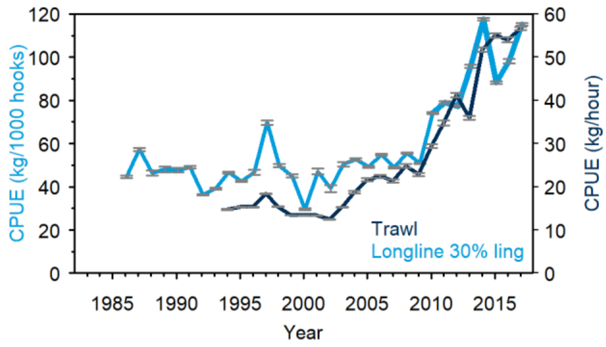


Figure 4.2.10. Ling in 5.b. Standardized cpue from Faroese longliners (turquoise line) and pair trawlers (bycatch, dark blue line) fishing in Faroese waters. Data from longliners (>110 GRT) are from sets where ling >30% of the total catch. Data from trawlers are from hauls where ling was caught and saithe >60% of the total catch. The error bars are SE.

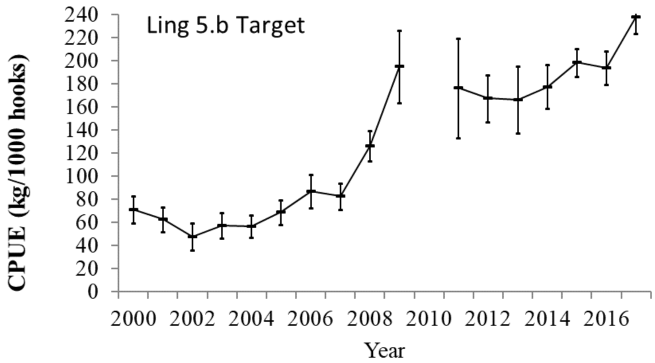


Figure 4.2.11. Ling in 5.b. Standardized cpue (kg/ 1000 hooks) of ling from Norwegian longliners fishing in 5.b. The bars denote the 95% confidence intervals. Note that there are very few data since 2006.

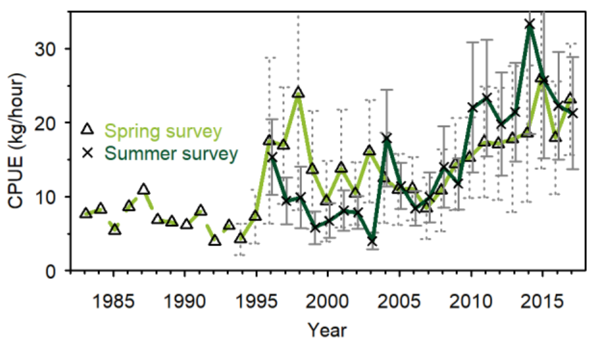


Figure 4.2.12. Ling in 5.b. Standardized cpue (kg/h) from the two annual Faroese groundfish surveys on the Faroe Plateau. The error bars are SE. The data for 1983–1993 were not standardized.

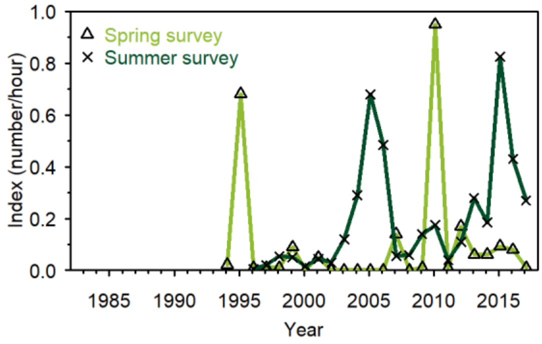


Figure 4.2.13. Ling in 5.b. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

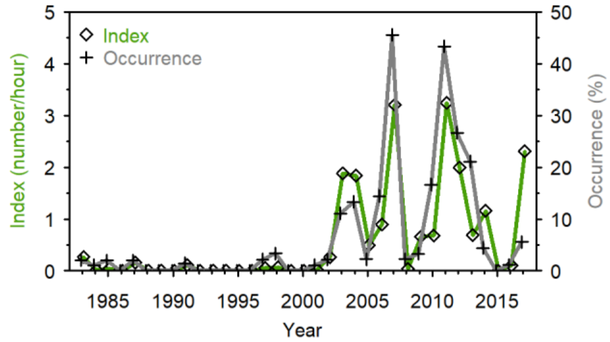


Figure 4.2.14. Ling in 5.b. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

Analytical assessment

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

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

The results from the SAM model supported that ling in Faroese waters is at a high level as both the recruitment and SSB were above long-term mean in the latest five years (Figure 4.2.15). The retrospective pattern showed that fishing mortality tended to be underestimated, whereas the recruitment and SSB tended to be overestimated.

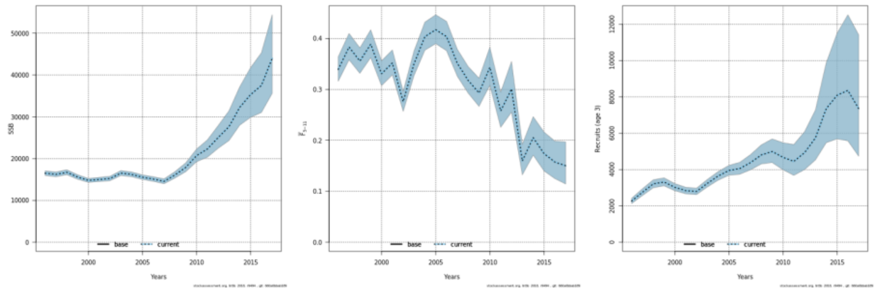


Figure 4.2.15. Ling in 5.b. Output from the age based assessment using SAM.

4.2.6.1 Reference points

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

Yield per recruit analysis in SAM from the exploratory assessment gave F_{MAX} = 0.21, $F_{0.1}$ =0.12 and $F_{0.35SPR}$ = 0.15.

4.2.7 Comments on assessment

All signs from commercial catches and surveys indicate that ling in Division 5.b is at present in a good state. This is confirmed in the exploratory assessment using the summer survey as tuning series.

There is a clear seasonal pattern in log q residuals and there need to be a closer look at the diagnostic to find the best settings. It is a need to look closer at the ALK for the whole period to try to solve the strong log q residual patterns. Still, the assessment shows that there is an increase in recruitment, stock biomass and spawning–stock biomass during the last year's period.

Ling in 5.b is a category 3 stock according to the ICES DLS approach proposed by the ADG in 2012. There are possibilities to increase ling in 5.b to a category 1 stock with the excising data.

In the advice a 3.2 rule was used on the summer survey.

4.2.8 Management consideration

Stability in landings and trends in abundance indices suggest that ling in Division 5.b has been stable since the middle of the 1980s, with an increasing trend in the last seven years. The available data series does not cover the entire period of the fishery (back to the early 1900s; see Figure 4.2.3) and no information is available on stock levels prior to 1986. There is evidence of increased recruitment in the last seven years compared to earlier levels.

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

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

4.2.9 Application of MSY proxy reference points

Conclusions from WKProxy review 2017 on lin.27.5b:

The RG believes that an acceptable proxy method (LBI) was used and concurs with the EG that the stock is not overfished and is not experiencing overfishing. Based on the analysis provided by the EG, the trends from SAM results and LBI indicators, the RG determined that the stock is in good health. The RG concluded that the stock was not experiencing overfishing due to the F trends, F_{2015} compared to F_{max}, and LBI values. These proxy values indicated that the stock was in good health.

Length-based indicator method (LBI)

The input parameters and the catch length composition for the period 1995–2017 are presented in the table below and in Figure 4.2.16. The length data used in the LBI model are data from the Faroese longliner and trawler fleets. The length data are not raised to total catch.

Input parameters for LBI.

Data type	Years/Value	Source	Notes
length–frequency distribution	1995–2017	Faroese long-liners and trawlers	
Length–weight relation	0.0033* length $^{3.1311}$	Faroese survey data	combined sex
L_{MAT}	69 cm	Faroese survey data	
L_{inf}	198 cm	Faroese survey data	

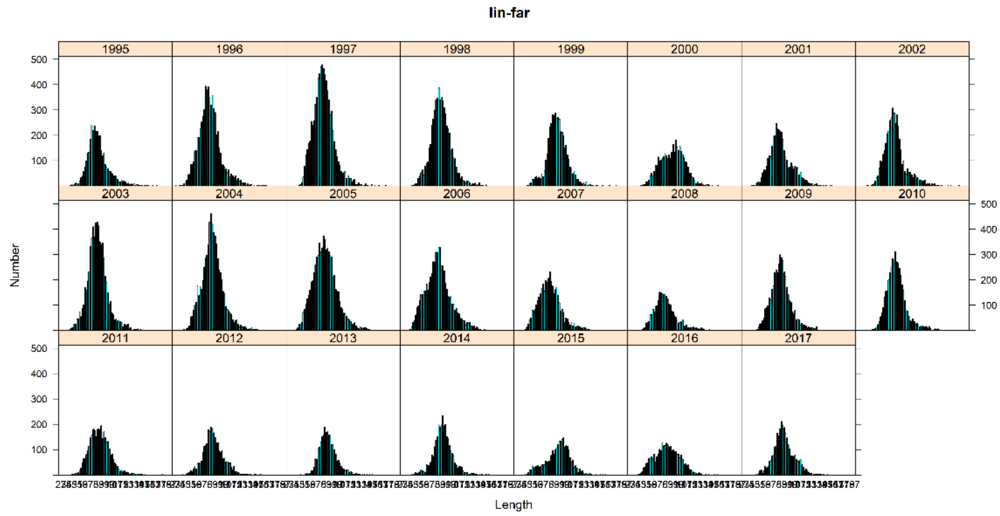


Figure 4.2.16. Ling in Faroese waters (5.b). Catch length distributions for the period 2001–2016 with 2 cm length bins (sex combined).

Output from the screening of length indicator ratios for combined sexes was conducted under three scenarios: (a) Conservation; (b) Optimal yield, and (c) maximum sustainable yield (Figure 4.2.17).

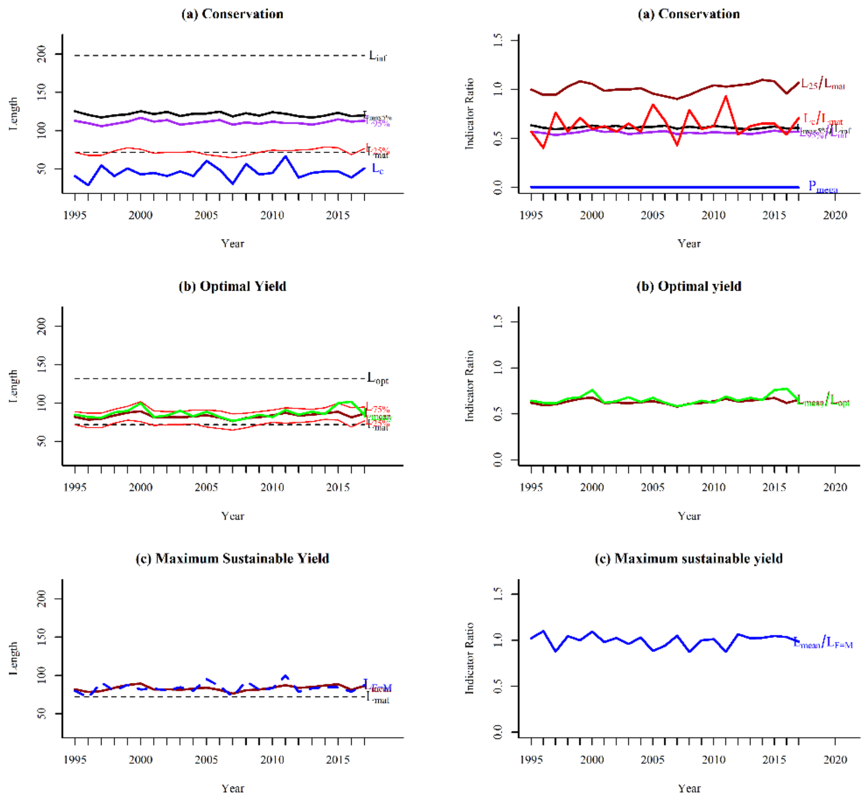


Figure 4.2.17. Ling in Faroese waters (5.b). Screening of length indicators ratios for sex combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysing the results showed that the conservation of immature ling indicator, L_c/L_{mat}, was usually less than one, while $L_{25\%}/L_{mat}$ was usually around 1 (Figure 4.2.17). In 2014-2017, $L_{25\%}/L_{mat}$, has been greater than 0.96 (Table below).

The conservation of large ling indicator, $L_{max5\%}/L_{inf}$, was around 0.6 for the entire period (Figure 4.2.17), and between 0.60 and 0.62 in 2014-2017 (Table below). The indicator was less than 0.8, which suggests that there were few mega-spawners in the catch. Since the VBF produced an unusually high L_{inf}, the value used in the model was L_{max}. This could be the reason that the indicator ratio was less than 0.8. If we would have used a lower L_{inf} value, the indicator ratio would have been higher! The catch was lower than the length of optimal yield.

The MSY indicator ($L_{mean}/L_{F=M}$) was greater than 1 for almost the whole period (Figure 4.2.17), which indicates that ling in Faroese waters are fished sustainably.

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

The final results from the LBI method.

	Conservation				Optimizing Yield	MSY
Ling 5.b	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	$L_{mean}/L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2014	0.65	1.10	0.61	0%	0.66	1.03
2015	0.65	1.08	0.62	0%	0.67	1.05
2016	0.54	0.96	0.60	0%	0.62	1.04
2017	0.71	1.07	0.61	0%	0.62	0.99

SPiCT

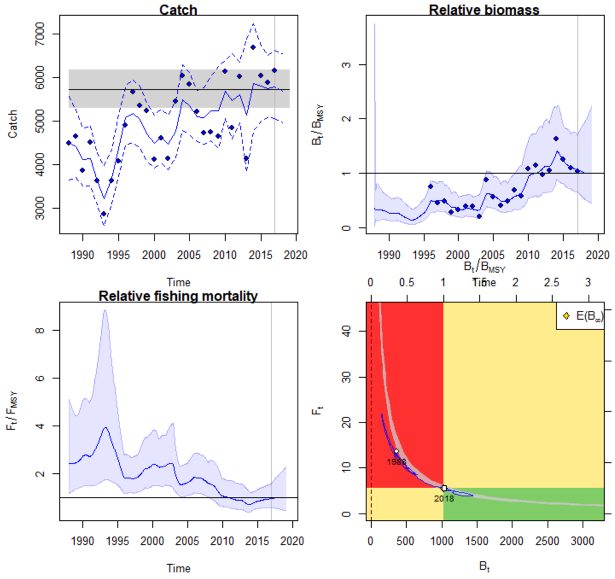
The input data for catch was a time-series of landings for area 27.5.b from 1988–2017. The abundance index was from the Faroese annual trawl summer survey (1996–2017).

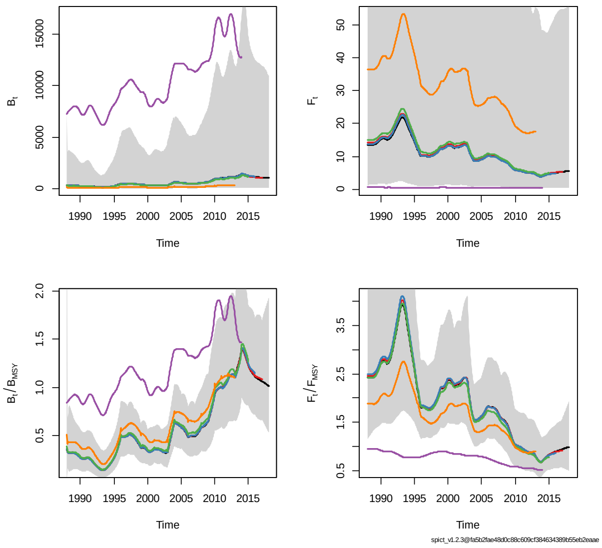
The model did not give any reliable results. A default run gave the warning message: "Model did not obtain proper convergence! Estimates and uncertainties are most likely invalid and cannot be trusted". Several different settings were tried (as suggested in the WKProxy review, WGDEEP report 2017). With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

The conclusion was that this model cannot be used for lin-27.5b assessment unit. Still, the results showed that the biomass has been above the biomass reference point ($B_{trigger}$=B_{MSY}/2) and the fishing mortality has been below the F_{MSY} proxy.

```
Stochastic reference points (Srp)
          estimate        cilow       ciupp  log.est rel.diff.Drp
 Bmsys 1026.005573   92.2407374 11412.39180 6.933428  0.002880195
 Fmsys    5.583232    0.5107966    61.02719 1.719768 -0.001788981
 MSYs  5728.456462 5318.7423499  6169.73173 8.653201  0.001101515

Predictions w 95% CI (inp$msytype: s)
                  prediction        cilow        ciupp    log.est
 B_2018.00      1035.8050777   97.8923587 10959.917339  6.9429343
 F_2018.00         5.5339937    0.5428487    56.415513  1.7109097
 B_2018.00/Bmsy    1.0095511    0.5290437     1.926482  0.0095058
 F_2018.00/Fmsy    0.9911811    0.5081669     1.933302 -0.0088580
 Catch_2018.00  5693.3685323 4956.6937312  6539.529574  8.6470574
 E(B_inf)       1028.0171624           NA           NA  6.9353871
```


Catch
Relative biomass
Relative fishing mortality
Catch
Time
E(B∞)
1988
2018
Time
Time
Time


Time
Time
Time
Time
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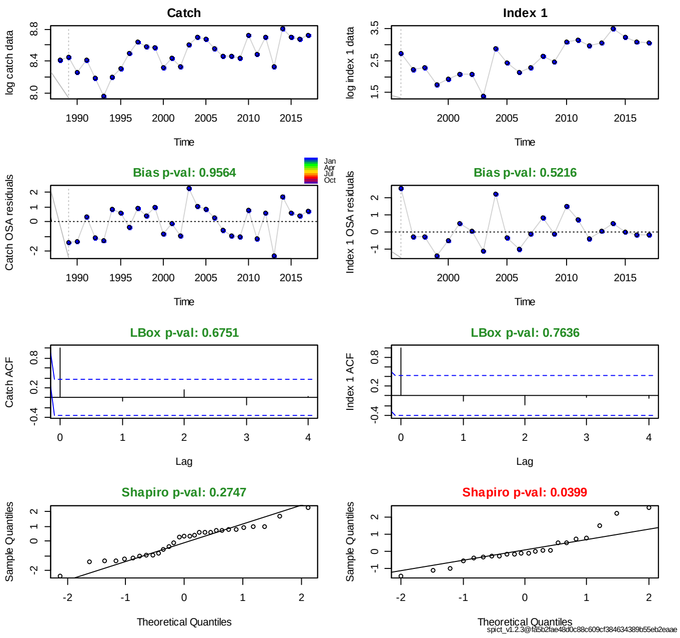
Catch
Index 1
log catch data
log index 1 data
Time
Time
Bias p-val: 0.9564
Bias p-val: 0.5216
Catch OSA residuals
Index 1 OSA residuals
LBox p-val: 0.6751
LBox p-val: 0.7636
Catch ACF
Index 1 ACF
Lag
Lag
Shapiro p-val: 0.2747
Shapiro p-val: 0.0399
Sample Quantiles
Theoretical Quantiles
Theoretical Quantiles
spict_v1.2.3@fa5b2fae48d0c88c609cf384634389b55eb2eeae

4.2.10 Tables

Table 4.2.1. Ling in 5.b1. Nominal landings (1988–present).

Year	Denmark (2)	Faroes	France	Germany	Norway	E&W (1)	Scotland (1)	Russia	Total
1988	42	1383	53	4	884	1	5		2372
1989		1498	44	2	1415		3		2962
1990		1575	36	1	1441		9		3062
1991		1828	37	2	1594		4		3465
1992		1218	3		1153	15	11		2400
1993		1242	5	1	921	62	11		2242
1994		1541	6	13	1047	30	20		2657
1995		2789	4	13	446	2	32		3286
1996		2672			1284	12	28		3996
1997		3224	7		1428	34	40		4733
1998		2422	6		1452	4	145		4029
1999		2446	17	3	2034	0	71		4571
2000		2103	7	1	1305	2	61		3479
2001		2069	14	3	1496	5	99		3686
2002		1638	6	2	1640	3	239		3528
2003		2139	12	2	1526	3	215		3897
2004		2733	15	1	1799	3	178	2	4731
2005		2886	3		1553	3	175		4620
2006	3	3563	6		850		136		4558
2007	2	3004	9		1071		6		4092
2008		3354	4		740	32	25	11	4166
2009	13	3471	2		419		270		4174
2010	28	4906	2		442		121		5500
2011	49	4270	2		0		0		4321
2012	117	5452	7		0		0		5576
2013	3	3734	7		0		0		3744
2014		5653	10		308		7	13	5990
2015		4375	15		993	1	3	6	5392
2016		4214	4		855	0	114		5187
2017*		4422	4		864		54		5345

***Preliminary.**

(1) Includes 5.b2.

(2) Greenland 2006–2013.

Table 4.2.2. Ling in 5.b2. Nominal landings (1988–present).

YEAR	FAROES	FRANCE	NORWAY	TOTAL
1988	832		1284	2116
1989	362		1328	1690
1990	162		633	795
1991	492		555	1047
1992	577		637	1214
1993	282		332	614
1994	479		486	965
1995	281		503	784
1996	102		798	900
1997	526		398	924
1998	511		819	1330
1999	164	4	498	666
2000	229	1	399	629
2001	420	6	497	923
2002	150	4	457	611
2003	624	4	927	1555
2004	1058	3	247	1308
2005	575	7	647	1229
2006	472	6	177	655
2007	327	4	309	640
2008	458	3	120	580
2009	270	1	198	469
2010	393	1	236	630
2011	522	0	0	522
2012	434	1	0	435
2013	387	1	0	388
2014	276		389	665
2015	244	1	337	582
2016	569	4	126	699
2017*	266		542	808

***Preliminary.**

Table 4.2.3. 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	5990	665	6655
2015	5392	582	5974
2016	5187	699	5886
2017*	5345	808	6153

***Preliminary.**

Table 4.2.4. Ling in 5.b. Overview of the sampling from commercial landings and different surveys since 1996.

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

Table 4.2.5. Ling in 5.b. Data on the cpue series from Faroese commercial fleets and groundfish surveys. Only the spring survey data from 1983–1993 was not standardized. N- number of sets/hauls behind the commercial cpues.

	Longline			Trawl (bycatch)			Spring survey		Summer survey	
Year	Mean	se	N	Mean	se	N	Mean	se	Mean	se
1983							7.7			
1984							8.3			
1985							5.5			
1986	44.6	0.6	47				8.6			
1987	57.2	0.8	91				10.9			
1988	46.4	1.1	26				6.9			
1989	48.0	1.2	28				6.6			
1990	47.6	1.1	39				6.2			
1991	48.9	0.6	110				8.0			
1992	36.3	0.4	139				4.0			
1993	39.2	0.5	130				6.1			
1994	46.6	0.4	182	14.8	0.2	69	4.3	2.1		
1995	42.6	0.4	150	15.3	0.1	244	7.3	3.6		
1996	46.7	1.3	22	15.3	0.1	216	17.5	11.2	15.3	5.1
1997	69.7	1.0	91	18.4	0.1	586	16.9	7.9	9.4	3.2
1998	49.7	0.7	77	15.4	0.1	597	23.9	15.8	9.9	4.1
1999	45.1	0.6	80	13.4	0.0	926	13.6	8.0	5.8	2.2
2000	29.6	0.5	68	13.3	0.0	851	9.4	5.4	6.8	2.3
2001	47.1	1.2	31	13.4	0.0	905	13.8	8.0	8.1	2.7
2002	39.2	1.8	9	12.5	0.0	792	10.4	4.2	7.9	2.2
2003	50.5	1.0	26	15.3	0.1	701	16.1	6.9	4.0	1.1
2004	52.6	0.7	73	18.9	0.3	591	12.5	6.1	17.9	6.5
2005	49.3	0.4	120	21.8	0.4	783	11.0	4.8	11.4	3.1
2006	54.8	0.5	135	22.6	0.5	666	11.1	4.3	8.4	2.4
2007	48.9	0.5	72	21.6	0.4	692	8.4	4.2	9.9	3.4
2008	55.6	0.4	175	25.1	0.5	612	10.8	5.6	14.0	5.5
2009	50.8	0.4	181	23.1	0.4	759	14.4	6.2	11.7	3.4
2010	74.3	0.4	823	29.7	0.4	968	15.2	5.4	22.1	8.8
2011	78.6	0.5	796	35.2	0.6	714	17.4	7.5	23.3	7.9
2012	77.5	0.5	679	41.7	0.6	1118	17.1	7.6	19.8	7.0
2013	96.1	0.8	368	36.3	0.5	928	17.8	9.9	21.4	6.7
2014	118.6	1.0	649	52.3	0.6	1275	18.5	9.2	33.4	14.9
2015	88.8	0.7	447	55.7	0.6	1614	26.0	12.3	25.7	10.5
2016	98.4	1.1	341	54.2	0.6	1257	17.9	7.6	22.3	7.3
2017	115.2	0.7	265	56.7	0.4	990	23.1	7.5	21.2	7.6

Table 4.2.6. Ling in 5.b. Data from the Norwegian longliners cpue series. Mean cpue is from longliners with more than 30% ling in the sets. SE- standard error, N- number of days that the Norwegian longliners operated in an ICES subarea/division (WD 2017, Helle and Pennington).

Year	Mean cpue	SE	N
2000	70.8	5.9	288
2001	62.6	5.4	371
2002	47.8	5.9	355
2003	57.2	5.6	391
2004	56.3	5.0	571
2005	68.6	5.4	335
2006	86.8	7.5	125
2007	82.4	5.9	294
2008	126.2	6.8	167
2009	194.7	15.9	39
2010			
2011	176.1	22.1	11
2012	167.3	10.4	50
2013	165.9	14.8	24
2014	177.4	9.6	83
2015	198.3	6.2	205
2016	193.6	7.3	163
2017	237.5	7.4	152

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

4.3.1 The fishery

Ling has been fished in Subareas 1 and 2 for centuries, and the historical development is described in Bergstad and Hareide (1996). In particular, the post-World War II increase in catch caused by a series of technical advances, is well documented. Currently the major fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries, but bycatches of ling are taken by other gears, such as trawls and handlines. Around 50% of the Norwegian landings are taken by longlines and 45% by gillnets, partly in the directed ling fisheries and in part as bycatch in fisheries for other ground fish. Other nations catch ling as bycatch in their trawl fisheries. Figure 4.3.1 shows the spatial distributions of the total catches for the Norwegian longline fishery in 2013 to 2017.

The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number stabilized at 25 in 2015 to 2017. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas 1 and 2 has declined since its peak in 2011. During the period 2000 to 2014 the main technological change in Subareas 1 and 2 was that the average number of hooks per day increased from 31 000 hooks to 35 000 hooks. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (for more information see Helle and Pennington, WD 2018).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2017 is 43% less than the average effort during the years 2000–2003. . It should be noted that the annual fishery covers the entire distribution of tusk in Subareas 1 and 2 (see Figure 4.3.1), so that the catch produced by the applied effort is likely proportional to the actual population.

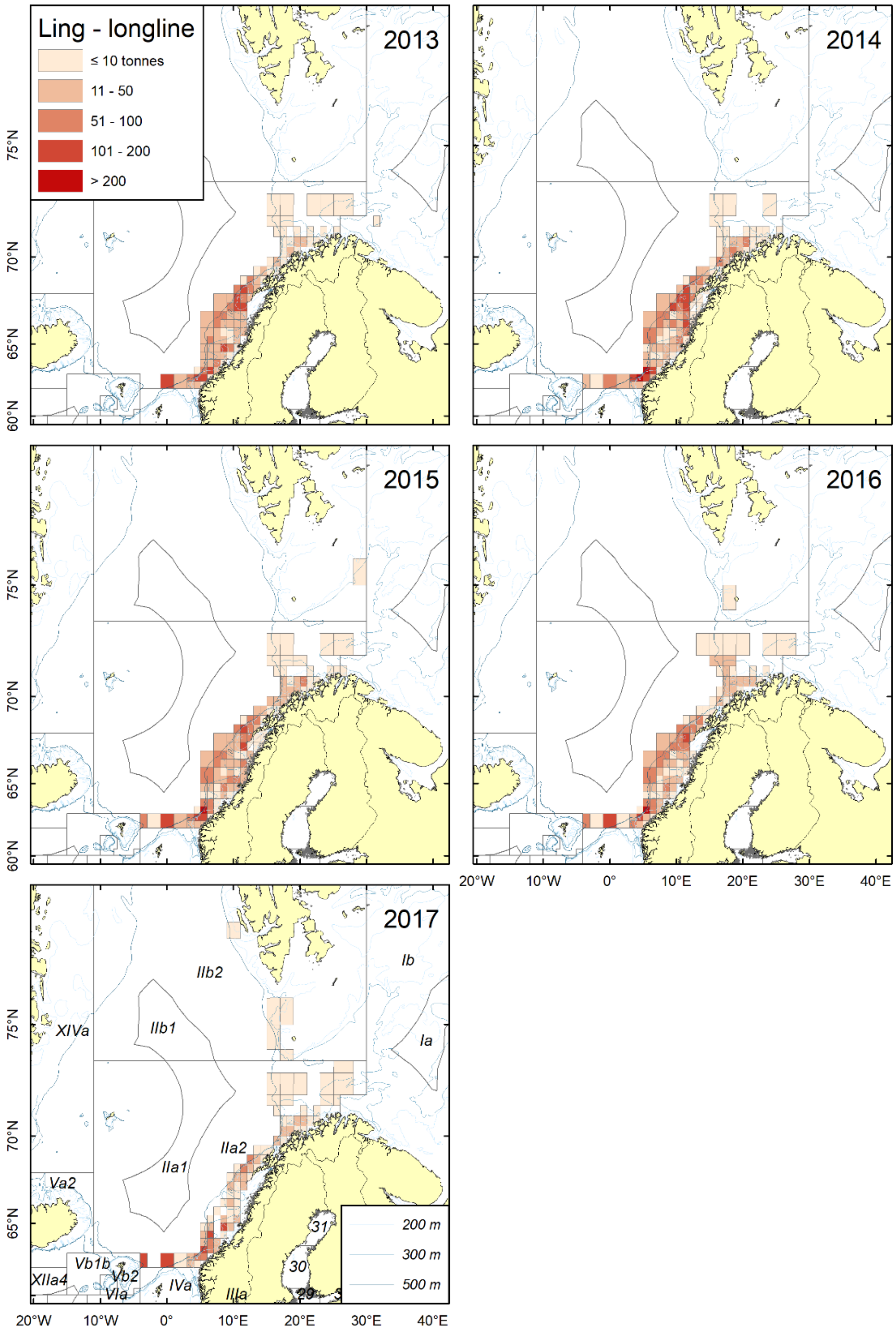

Figure 4.3.1. Distribution of the total catch of ling in Subareas 1 and 2 taken by the Norwegian longline fishery in 2013–2017.

4.3.2 Landings trends

Landing statistics by nation in the period 1988–2017 are in Tables 4.3.1a–d. During 2000–2005, the landings varied between 5000 and 7000 t, which was slightly lower than the landings in the preceding decade. In 2007, 2008 and 2010 the landings increased to over 10 000 t. The preliminary landings for 2017 is 7971 t. Total international landings in Areas 1 and 2 are given in Figure 4.3.2.

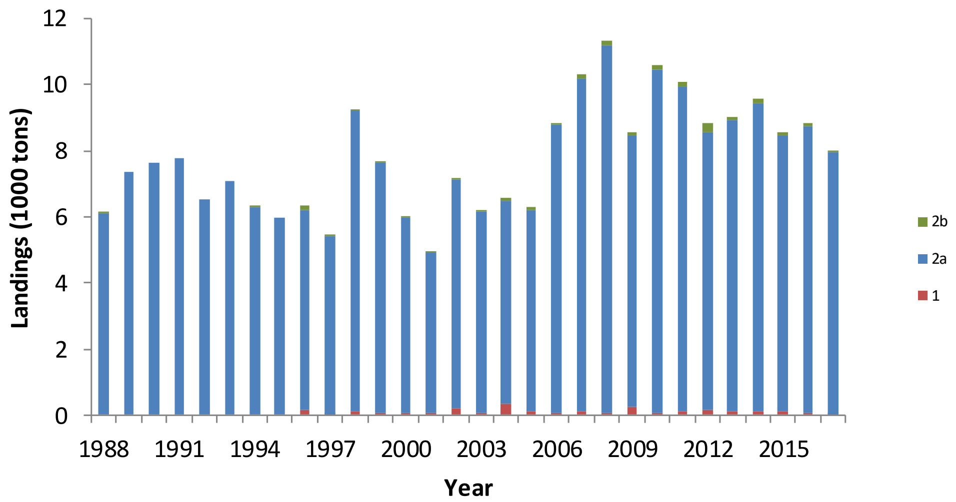

Figure 4.3.2. Total international landings of ling in Subareas 1 and 2.

4.3.3 ICES Advice

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

Management

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

The quota for ling in EU and international waters was set at 36 t for 2017.

4.3.4 Data available

4.3.4.1 Landings and discards

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

4.3.4.2 Length compositions

Length composition data are available for the longliners and gillnetters from the Norwegian Reference fleet. Figures 4.3.3 and 4.3.4 show the length distribution of ling in Areas 1 and 2 for the period 2001 to 2017. 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 4.3.5.

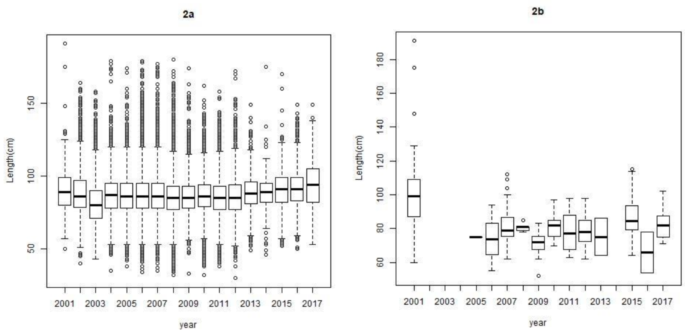

Figure 4.3.3. Box and whiskers plots for the length of ling in Areas 1, 2a and 2b for the period 2001 to 2017.

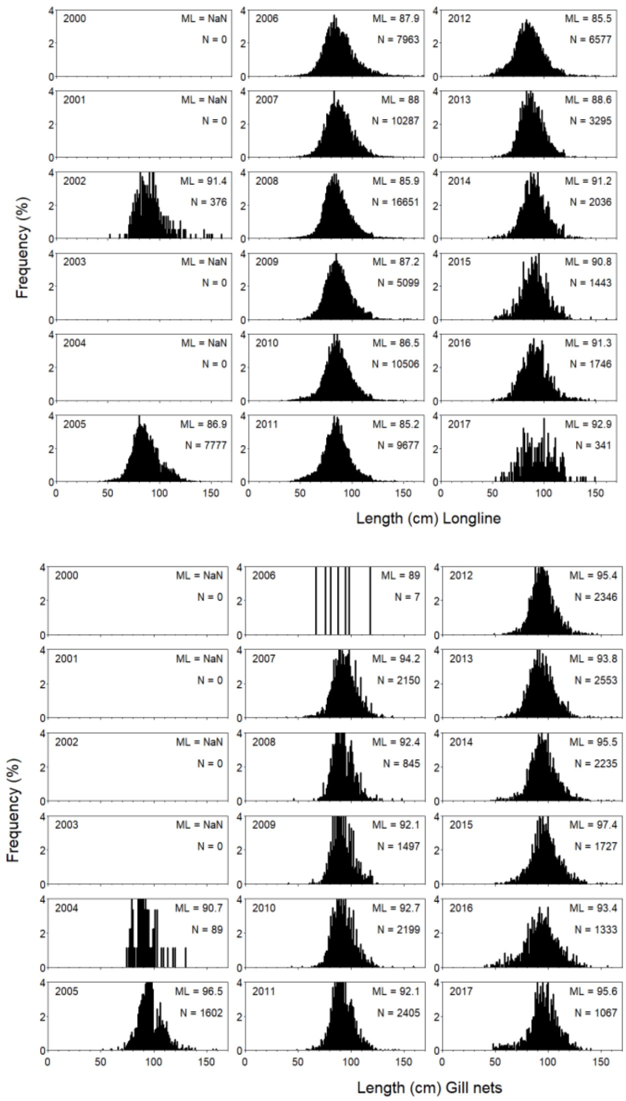

Figure 4.3.4. Plots of the length distributions of ling in Subareas 1 and 2 combined for the period 2001 to 2016.

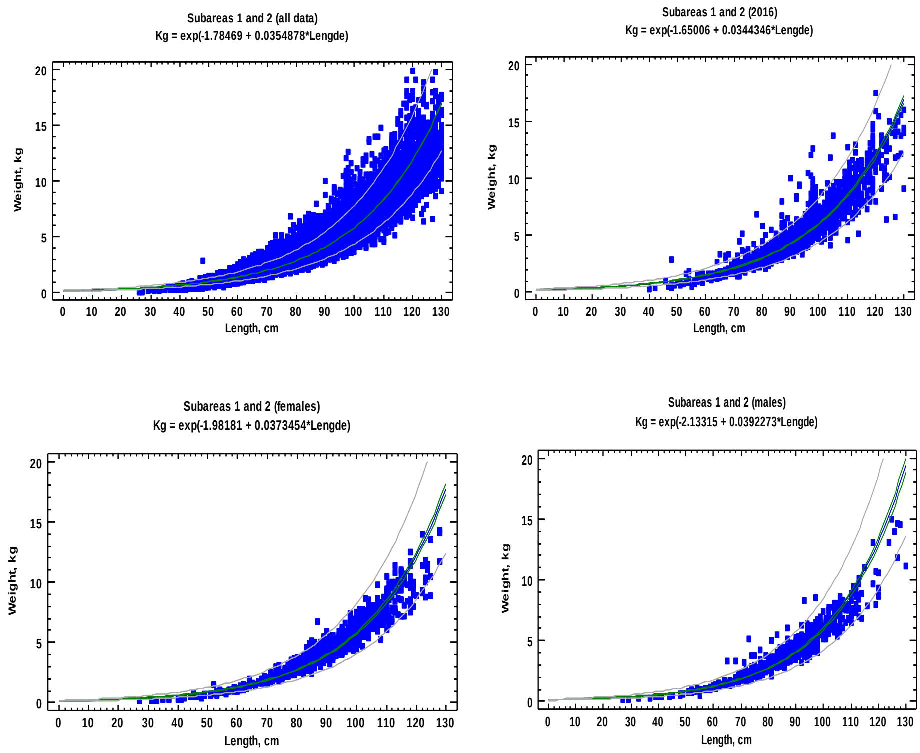

Figure 4.3.5. Weight–length relationship for the period 2008–2016, and only for 2016 (upper panel) and for females and for males, separately (lower panel). Data were collected by the Norwegian Reference Fleet.

4.3.4.3 Age compositions

The Catch-at-age composition for each year is in figure 4.3.6, and box and whiskers plots for the estimated age distribution of the catch for: the total catch; and separately for the longline fishery and for the gillnet fishery for 2010–2016 (Figure 4.3.7).

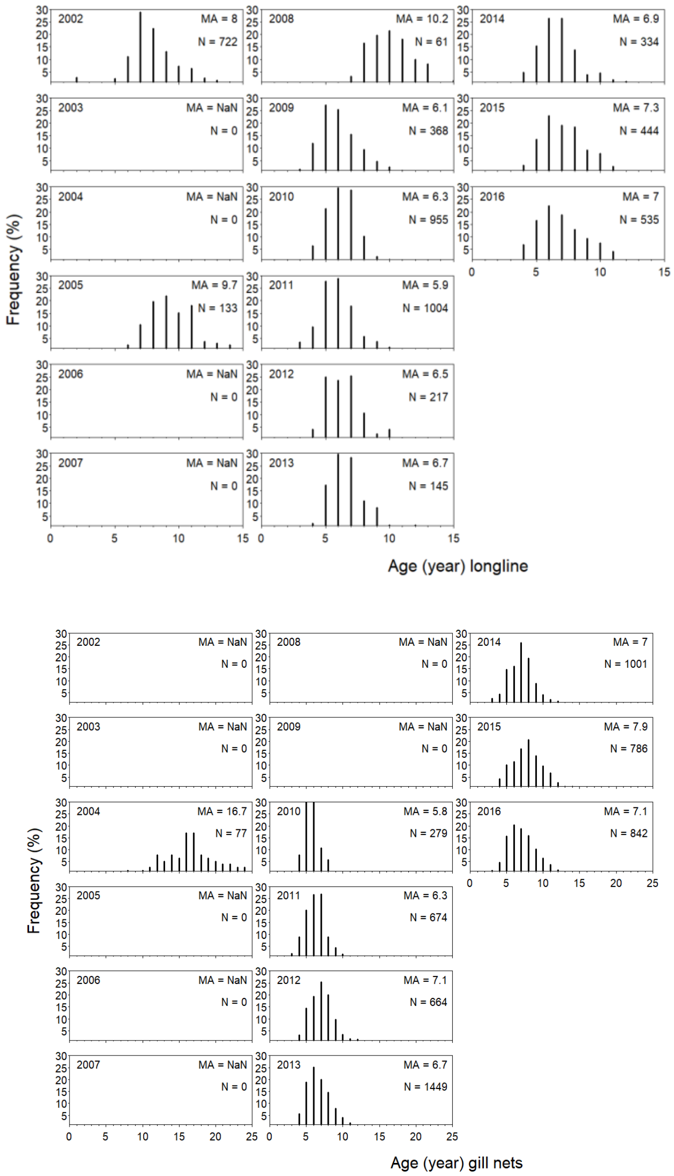

Figure 4.3.6. Ling in Areas 1 and 2, Catch-at-age composition. MA denotes mean age.

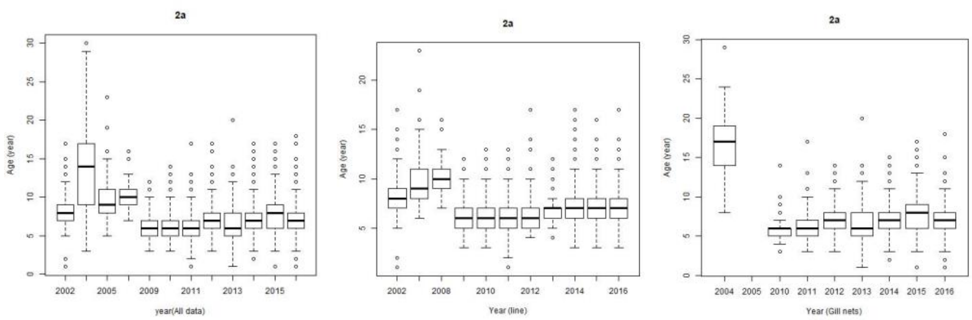

Figure 4.3.7. Age composition of the fish caught by longliners and gillnetters during the period 2002–2016.

4.3.4.4 Length and weight-at-age

Figure 4.3.8 shows the average mean length and mean weight-at-age for the years 2009–2017.

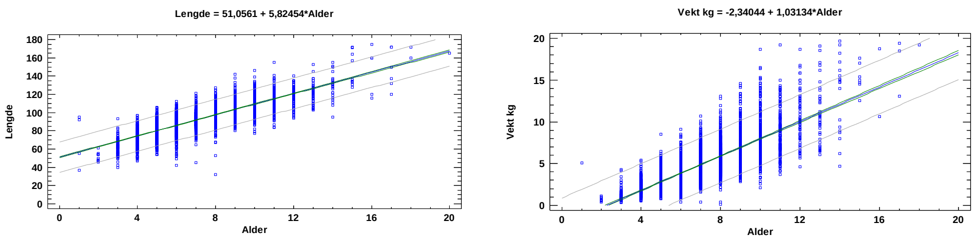

Figure. 4.3.8. Average mean length and mean weight versus age for the period 2010–2017.

4.3.4.5 Maturity and natural mortality

Maturity ogives for ling are in Figure 4.3.9 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

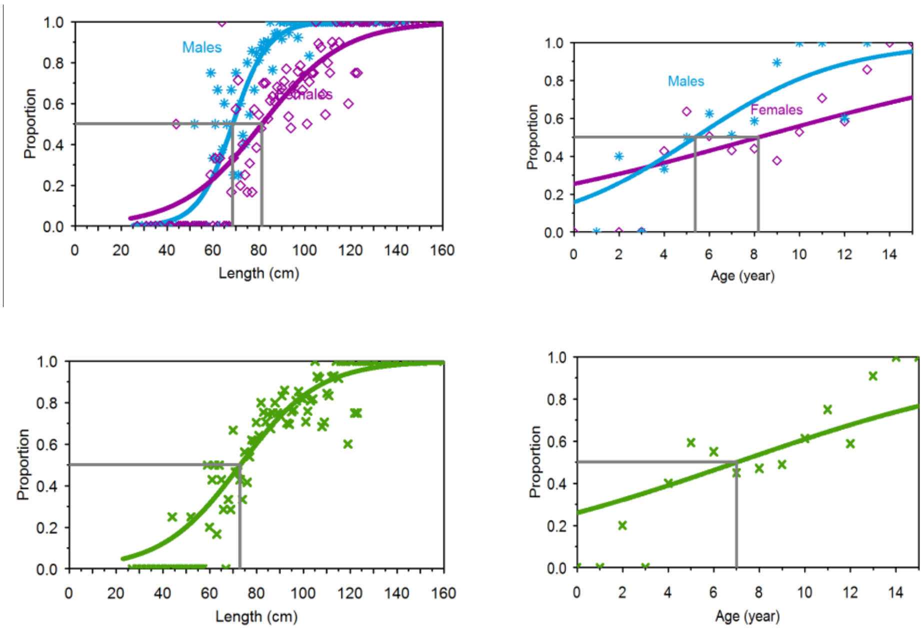

Figure 4.3.9. Maturity ogives for ling in Areas 1 and 2: males and females (upper panel) and for males and females combined (lower panel).

4.3.4.6 Catch and effort data

Two standardized cpue series for 2000–2017 for Norwegian longliners are in Figure 4.3.10. One series was based on all the catch data, and the other cpue series used only catches 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.

4.3.5 Data analyses

Length distribution

In Figures 4.3.3 and 4.3.5 are plots of the length distributions in Areas 2 and 3 for 2001 to 2016. It appears that the mean length in Area 1 has varied slightly, while the mean length in Area 2a and 2b has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery.

Cpue

Graphs of two standardized GLM-based cpue series estimated based on all the data and based on data for which ling made up more than 30% of the catch are shown in Figure 4.3.10. Both cpue series indicate an upward trend for the entire period. The method is described in Helle *et al.*, 2015.

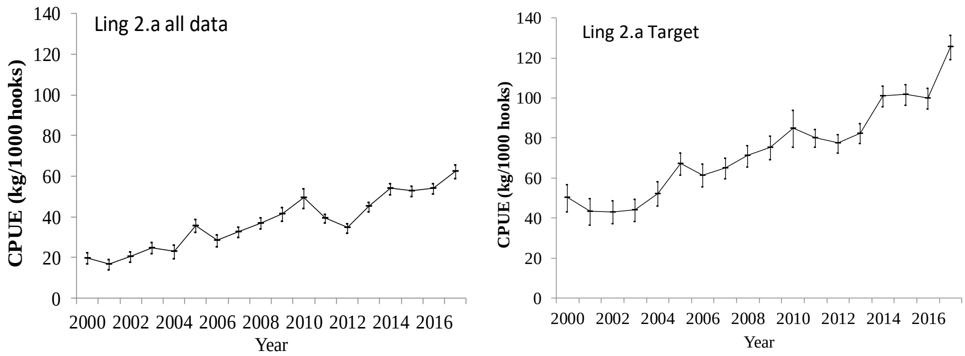

Figure 4.3.10. Estimate of cpue (kg/1000 hooks) for ling in Area 2a based; on all available data, and on catches when ling was considered the target species for 2000–2017. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

4.3.6 Comments on the assessment data analyses

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

4.3.7 Management considerations

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

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

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

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

4.3.8 Application of MSY proxy reference points

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

Length-based indicator method (LBI)

The input parameters and the length distributions of the catches for the period 2001–2017 are in Table 4.3.2 and Figure 4.3.11. The length data used in the LBI model are from the Norwegian longliner fleet.

Table 4.3.2. Ling in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

DATA TYPE	YEARS/VALUE	SOURCE	NOTES
Length–frequency distribution	2001–2016	Norwegian long-liners (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	

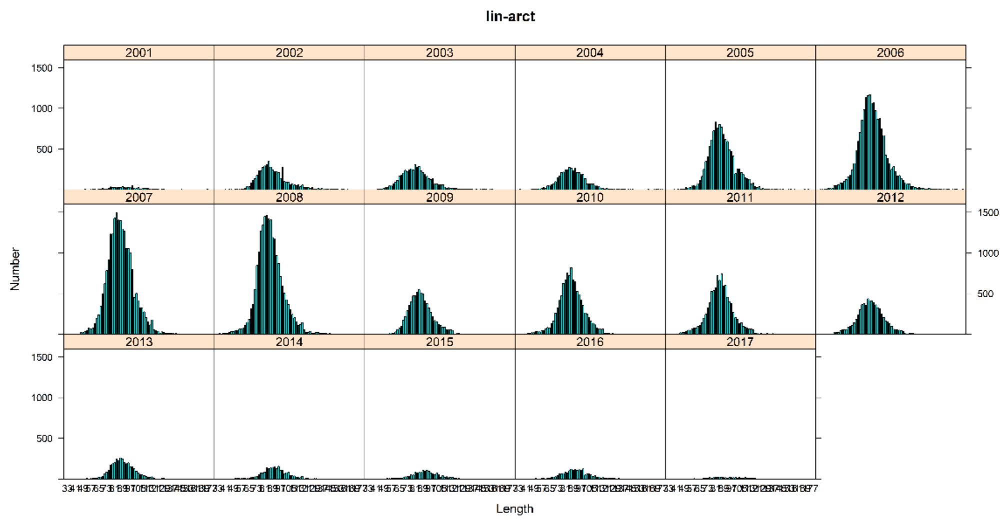

Figure 4.3.11. Ling in arctic waters (1, 2.a, 2.b). Catch length distributions, 2 cm length classes, for the period 2001–2017 (sex combined).

Outputs from the screening of length indicator ratios for combined sexes under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield, are in Figure4.3.12.

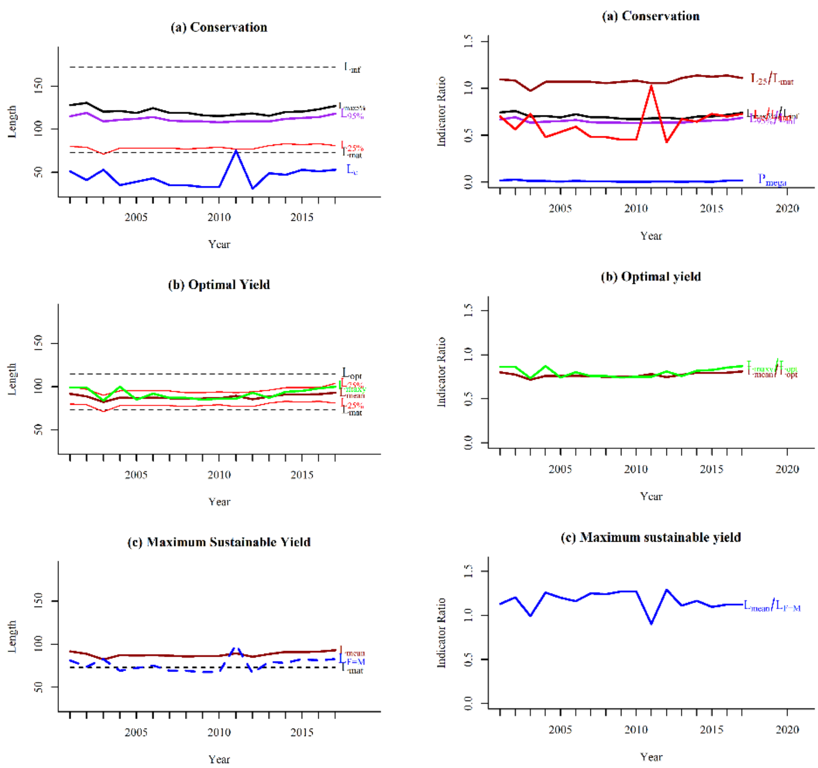

Figure 4.3.12. Ling in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

Analysis of results

The 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 4.3.12). In 2014–2017, $L_{25\%}/L_{mat}$ was also greater than 1 (Table 4.3.3), therefore there is no indication that immature ling are being overfished.

For the status for large ling, the model shows that the indicator ratio of $L_{max5\%}/L_{inf}$ is around 0.7 for the whole period (Figure 4.3.12) and between 0.68 and 0.74 in 2014–2017 (Table 4.3.3), which is less than the limit of 0.8 suggesting that there is a lack of mega-spawners in the catch, which indicates that there is a truncation point in the length distribution. The mean length of ling in the catch is lower than the mean length for optimizing yield.

The MSY indicator ($L_{mean}/L_{F=M}$) is greater than 1 for almost the whole period (Figure 4.3.12), which indicates that ling in arctic waters are fished sustainably. Regarding model sensitivity, the MSY value was always greater than 0.90.

Conclusion: The overall perception of the stock during the period 2014–2017 is that ling in arctic waters seems to be fished sustainably (Table 4.3.3). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 4.3.3. Ling in arctic waters (1, 2.a, 2.b). The final results from the LBI method.

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2014	0.64	1.12	0.70	1%	0.77	1.17
2015	0.73	1.12	0.70	0%	0.79	1.10
2016	0.70	1.14	0.72	2%	0.80	1.12
2017	0.73	1.11	0.74	2%	0.81	1.12

Results for the SPiCT model:

The input data were landings in 2000–2017, and the cpue index for the targeted fishery from 2000–2017 (Figure 4.3.13).

The model converges and both the deterministic and stochastic reference points are very similar, but the confidence intervals are very large.

Outputs from the model: B_{msy}=28126, F_{msy}= 0.399, MSY=11215, K=42675.

(Advice for 2018-2019 is 13103 tons and the total landings in 2017 was 7971 tons).

The results show wide confidence intervals for the absolute biomass and fishing mortality. The traffic light figure shows that the stock started in the red zone and are now in the green zone (Figure 4.3.14.) This corresponds to the present perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality (Figure 4.3.15).

The retrospective analysis shows that the model is not robust enough for ling in subareas 1 and 2 (Figure 4.3.16).

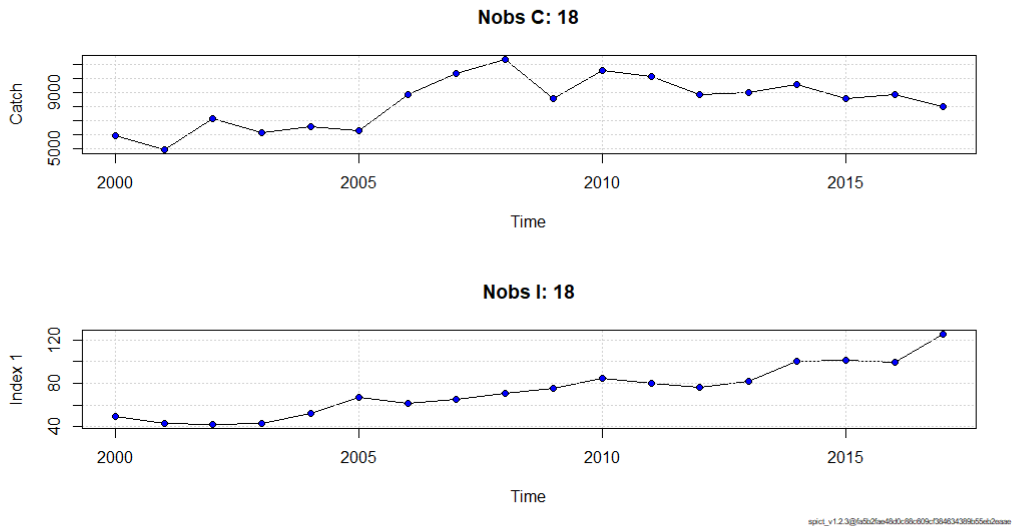

Figure. 4.3.13. Input data.

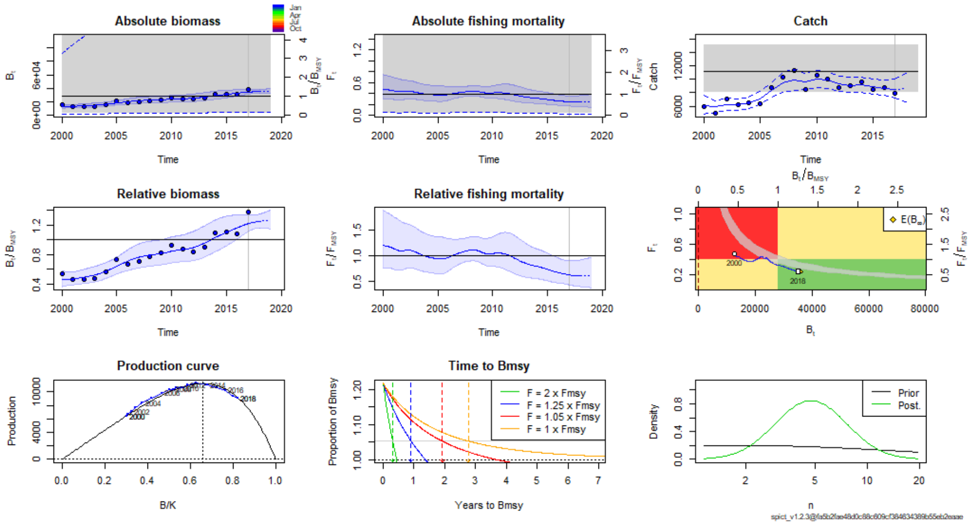

Figure. 4.3.14. Plots of the results.

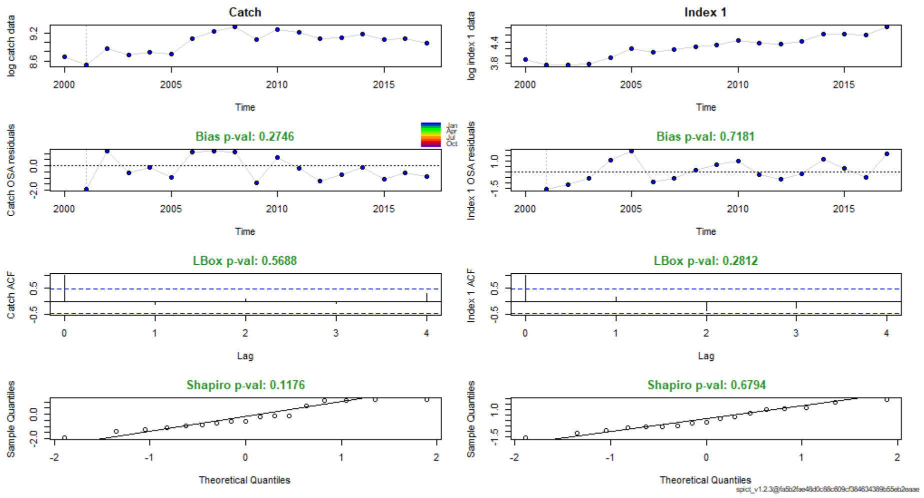

Figure 4.3.15. Diagnostic from SPiCT

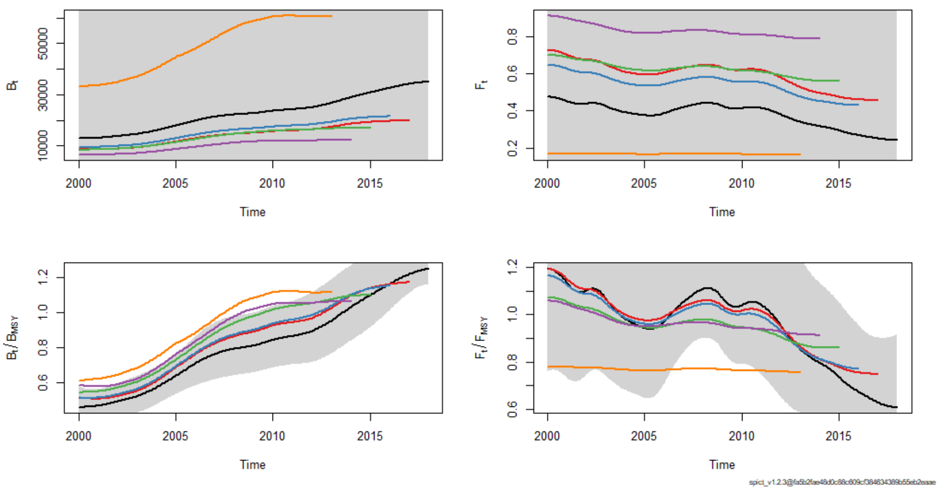

Figure 4.3.16. Retrospective analysis.

4.3.9 Tables

Table 4.3.1a. 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

***Preliminary.**

Table 4.3.1b. 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

YEAR	FAROES	FRANCE	GERMANY	NORWAY	E & W	SCOTLAND	RUSSIA	IRELAND	ICELAND	SPAIN	GREENLAND	POLAND	TOTAL
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

***Preliminary.**

Table 4.3.1c. Ling 2b. WG estimates of landings.

Year	Norway	E & W	Faroes	France	Total
1988		7			7
1989		-			
1990		-			
1991		-			
1992		-			
1993		-			
1994		13			13
1995		-			
1996	127	-			127
1997	5	-			5
1998	5	+			5
1999	6				6
2000	4	-			4
2001	33	0			33
2002	9	0			9
2003	6	0			6
2004	77				77
2005	93				93
2006	64				64
2007	180		0		180
2008	162	0	0		162
2009	84				84
2010	128				128
2011	164			7	171
2012	266				266
2013	76				76
2014	85	52			137
2015	95				95
2016	53				1
2017*	28				28

***Preliminary.**

Table 4.3.1d. Ling 1 and 2. Total landings by subarea or division.

Year	1	2.a	2.b	All areas
1988		6119	7	6126
1989		7368		7368
1990		7628		7628
1991		7793		7793
1992		6521		6521
1993		7093		7093
1994		6309	13	6322
1995		5954		5954
1996	136	6083	127	6346
1997	31	5373	5	5409
1998	123	9072	5	9200
1999	64	7581	6	7651
2000	69	5891	4	5964
2001	66	4858	33	4957
2002	206	6917	9	7132
2003	89	6062	6	6157
2004	345	6138	77	6560
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	161	11 346
2009	236	8244	84	8564
2010	57	10395	128	10580
2011	129	9798	171	10098
2012	158	8425	266	8849
2013	126	8819	76	9021
2014	123	9337	137	9606
2015	93	8362	95	8550
2016	65	8700	54	8819
2017*	43	7900	28	7971

***Preliminary.**

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

4.4.1 The fishery

The fishery for ling in 5.a has not changed substantially in recent years. Around 150 longliners annually report catches of ling, around 50 gillnetters, around 60 trawlers and ten *Nephrops* boats. Most of ling in 5.a is caught on longlines and the proportion caught by that gear has increased since 2000 to around 65% in 2009–2017. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2007 to around 6% in 2017. Catches in trawls have varied less and have been at around 20% of Icelandic catches of ling in 5.a (Table 4.4.1).

Table 4.4.1. Ling in 5.a. Number of Icelandic boats and catches by fleet segment participating in the ling fishery in 5.a.

YEAR	NUMBER OF BOATS			CATCHES IN TONNES				SUM
	Longliners	Gillnetters	Trawlers	Longline	Gillnet	Trawl	Others	
2000	165	88	68	1537	703	729	236	3526
2001	146	114	57	1086	1056	492	223	3174
2002	128	92	56	1277	649	661	248	3111
2003	137	73	54	2207	453	580	336	3840
2004	144	67	68	2011	548	656	506	4000
2005	152	60	72	1948	517	1081	766	4596
2006	167	51	81	3733	634	1242	669	6577
2007	155	59	76	4044	667	1396	492	6889
2008	138	43	78	5002	509	1509	714	7993
2009	141	46	67	6230	747	1540	1096	9867
2010	156	50	68	6531	390	1537	1411	10 143
2011	151	58	59	5595	241	1677	1279	9060
2012	156	48	58	7477	264	1398	1551	10 952
2013	163	45	57	6781	354	2805	254	10 194
2014	128	30	60	10 342	673	2722	228	13 965
2015	159	44	58	7765	655	1913	1218	11 551
2016	137	46	60	5242	689	1833	820.6	8581
2017	132	40	61	4901	560	1541	700.4	7703

Most of the ling caught in 5.a by Icelandic longliners is caught at depths less than 300m and by trawlers, less than 500 m (Figure 4.4.1). The main fishing grounds for ling in 5.a as observed from logbooks are in the south, southwestern and western part of the Icelandic shelf (Figure 4.4.2). The main trend in the spatial distribution of ling catches in 5.a according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 40% of ling catches are caught on the southwestern part of the shelf (Figure 4.4.3). In recent years the main fishing pressure has shifted towards shallower waters (Figure 4.4.1).

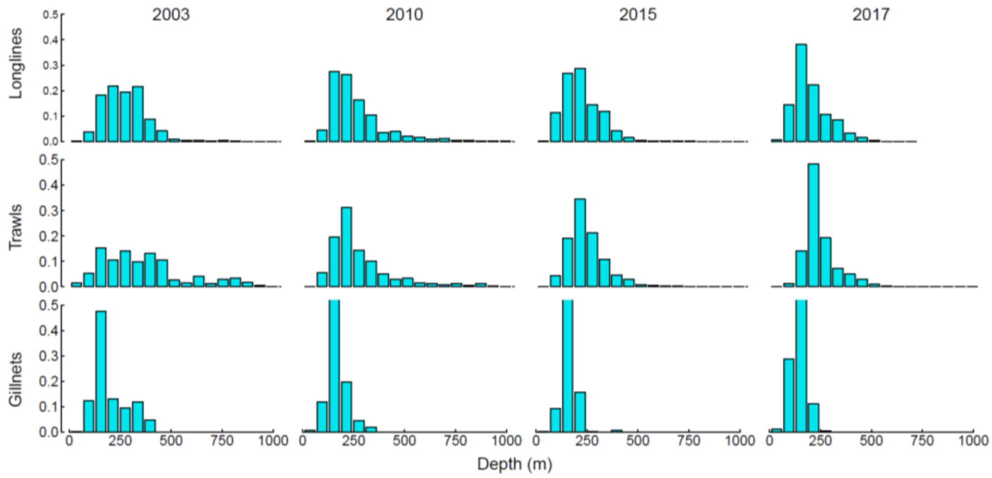

Figure 4.4.1. Ling in 5.a. Depth distribution of ling catches from longlines, trawls and gillnets from Icelandic logbooks.

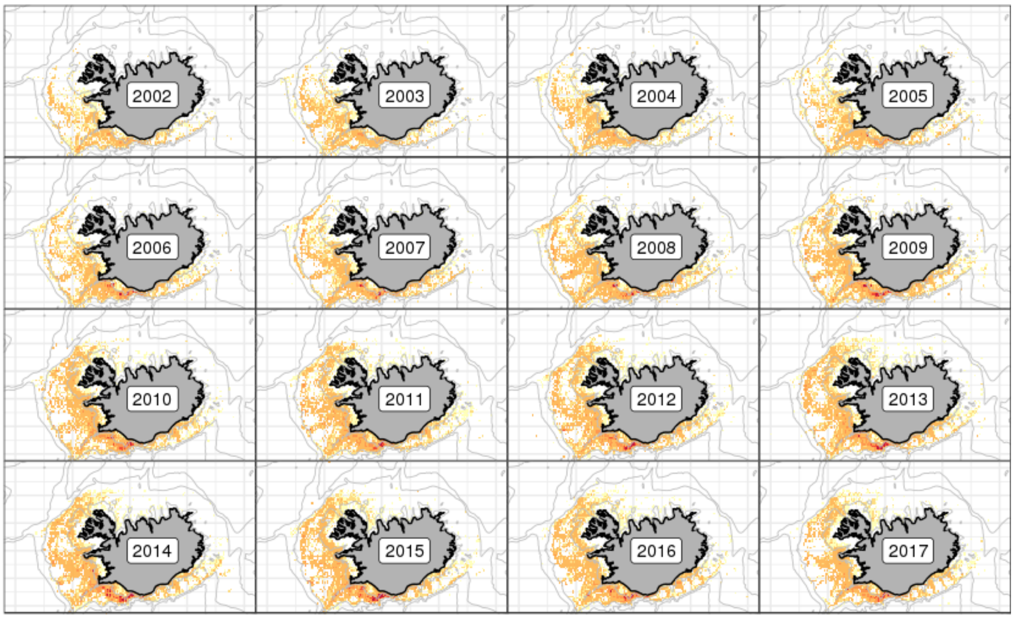

Figure 4.4.2. Ling in 5.a. Geographical distribution (tonnes/square mile) of the Icelandic longline ling fishery since 1998 as reported in logbooks by the Icelandic fleet.

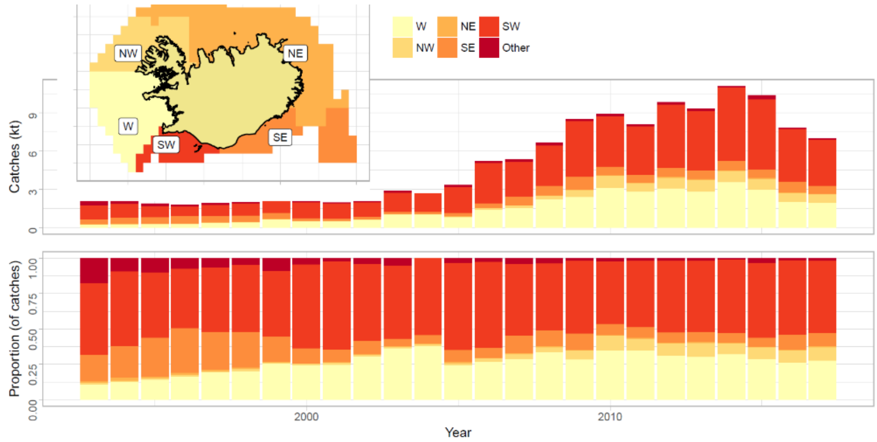

Figure 4.4.3. Ling in 5.a. Changes in spatial distribution of ling catches as recorded in Icelandic logbooks.

4.4.2 Landings trends

In 1950–1971 landings of ling in 5.a ranged between 7 kt to 15 kt. Landings decreased between 1972 and 2005 to between 3 kt to 7 kt as a result of foreign vessels being excluded from the Icelandic EEZ. In 2001 to 2010 catches increased substantially year on year and reached 11 kt in 2010 and remained at that level until 2014, apart from 2011 catches of 9.6 kt, when the catches increased to 16 kt. This catch level has not been reached since the early seventies. (Table 4.4.6 and Figure 4.4.4).

4.4.3 ICES Advice

The ICES advice for 2017 states: ICES advises on the basis of an MSY approach that catches should be no more than 9 343 t. All catches are assumed to be landed.

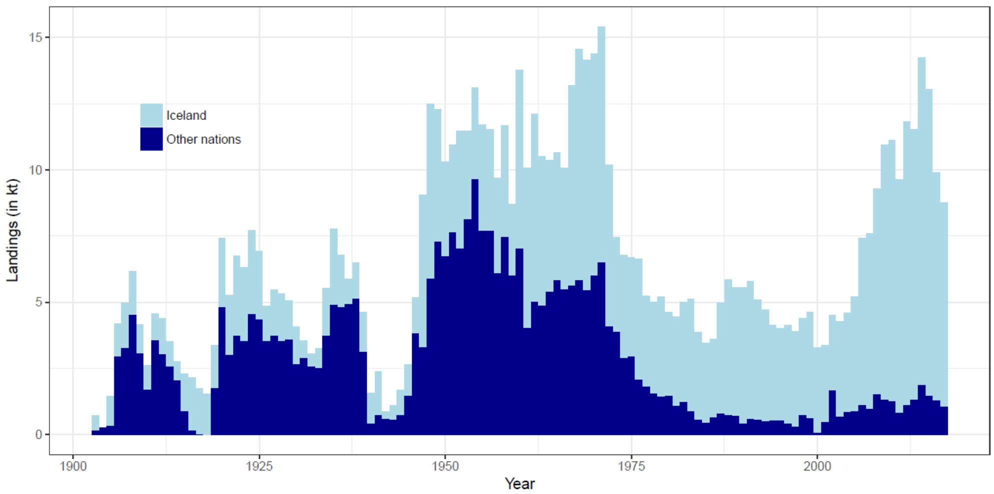

Figure 4.4.4. Ling in 5.a. Nominal landings.

4.4.4 Management

The Icelandic Ministry of Industries and Innovation (MII) is responsible for management of the Icelandic fisheries and implementation of legislation. The Ministry issues regulations for commercial fishing for each fishing year (1 September–31 August), including an allocation of the TAC for each stock subject to such limitations. Ling in 5.a has been managed by TAC since the 2001/2002 fishing year.

Landings have exceeded both the advice given by MRI and the set TAC from 2002/2003 to 2012/2013 but amounted to less than two thirds in 2015/2016 (Table 4.4.2). Overshoot in landings in relation to advice/TAC has been decreasing steadily since the 2009/2010 fishing year, with an overshoot of 53% to 35% in 20102011, 24% in 2011/2012 and 4% in 2012/2013. The reasons for the implementation errors are transfers of quota share between fishing years, conversion of TAC from one species to another and catches by Norway and the Faroe Islands by bilateral agreement. The level of those catches is known in advance but has until recently not been taken into consideration by the Ministry when allocating TAC to Icelandic vessels. There is no minimum landing size for ling in 5.a.

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

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

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

4.4.5 Data available

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

4.4.5.1 Landings and discards

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

4.4.5.2 Length compositions

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

Table 4.4.4. Ling in 5.a. Number of available length measurements from Icelandic commercial catches.

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

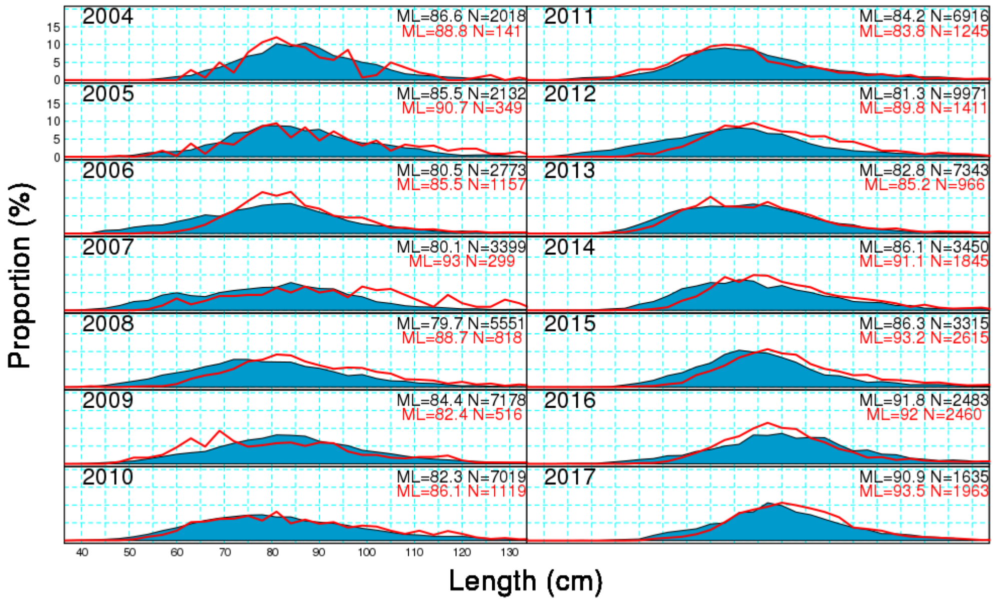

Figure 4.4.5. Ling in 5.a. Length distributions from the Icelandic longline fleet (blue area) and trawls (red lines).

4.4.5.3 Age compositions

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

Table. 4.4.5. Ling in 5.a. Number of available aged otoliths from the commercial catches.

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

4.4.5.4 Weight-at-age

No data available.

4.4.5.5 Maturity and natural mortality

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

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

4.4.5.6 Catch, effort and research vessel data

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

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

Icelandic survey data

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

Figure 4.4.5 shows both a recruitment index and the trends in biomass from both surveys. Length distributions from the spring survey are shown in Figure 4.4.6 (abundance) and changes in spatial distribution the spring survey are presented in Figure 4.4.7.

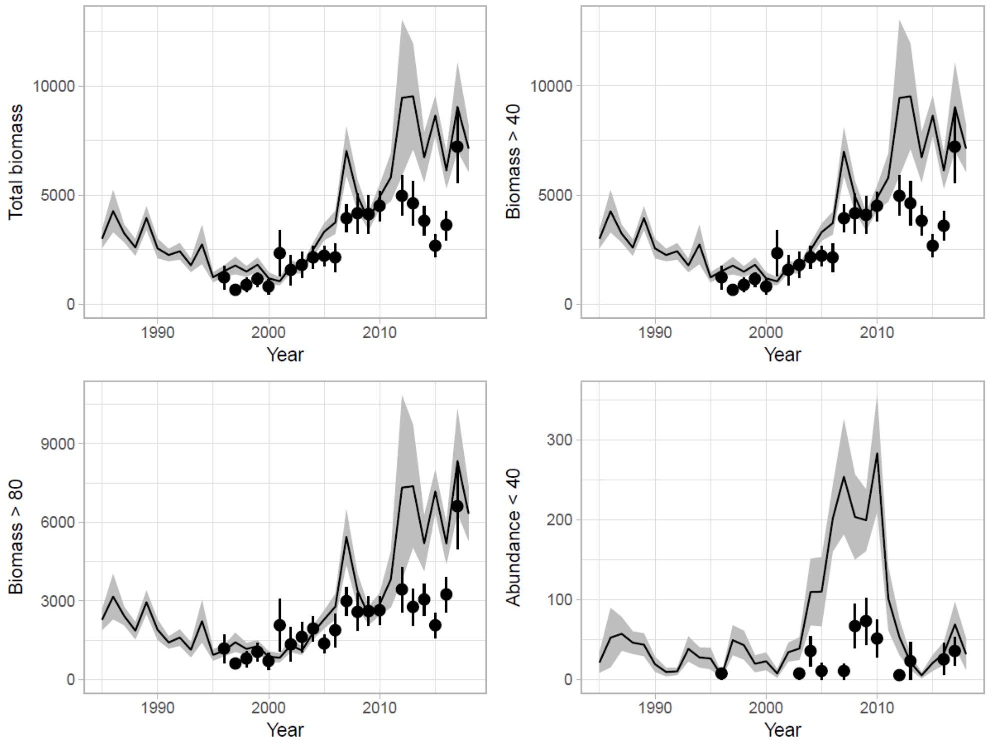

Figure 4.4.5. Ling in 5.a. Shown are a) Total biomass indices, b) biomass indices larger than 40 cm, c) biomass indices larger than 80 cm and d) abundance indices smaller than 40 cm. The lines with shades show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shades and vertical lines indicate +/- standard error.

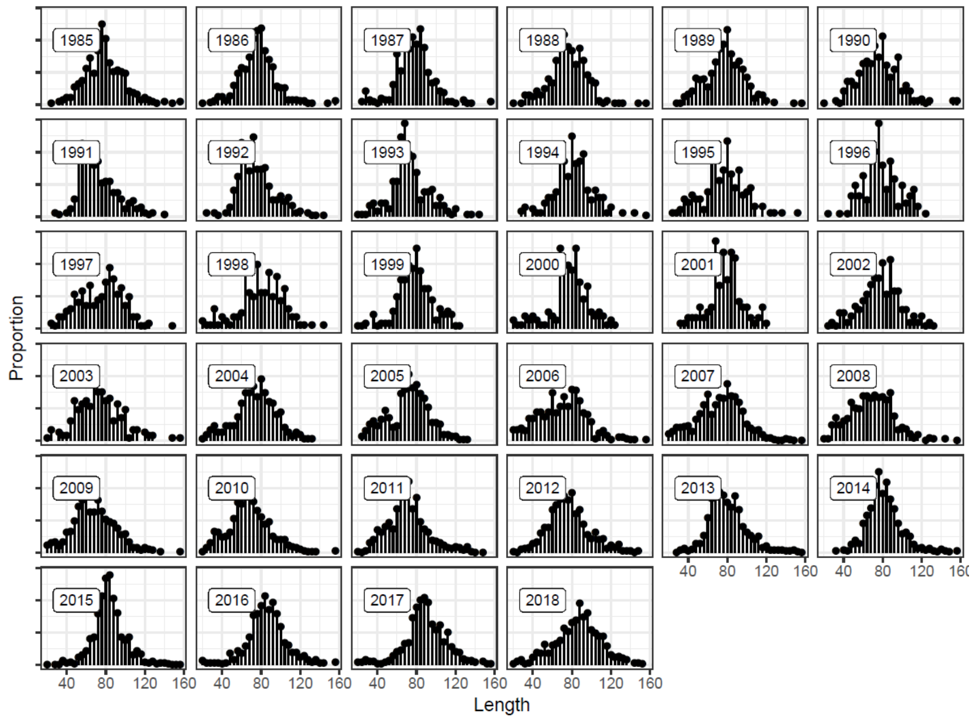

Figure 4.4.6. Ling in 5.a. Abundance indices by length (3 cm grouping) from the spring survey since 1985.

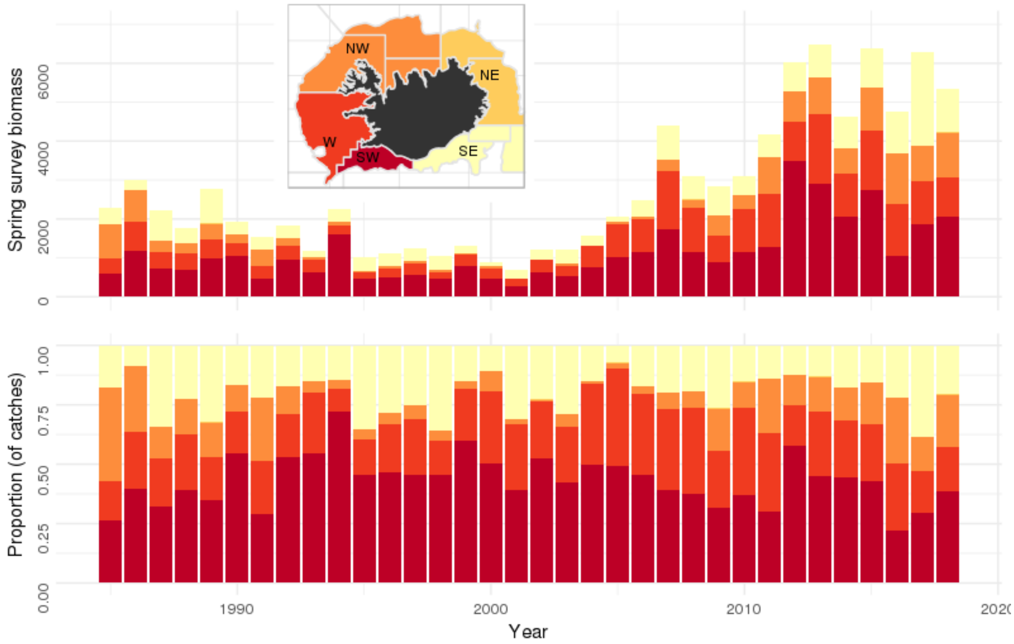

Figure 4.4.7. Ling in 5.a. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

4.4.6 Data analyses

There have been no marked changes in the number of boats participating in the ling fishery in 5.a. Most of ling catches are taken at depths less than 250 meters (Figure 4.4.1). Spatial distribution of catches has been similar since 2000 with around 80% of catches caught on the western and southwestern part of the shelf (Figures 4.4.2 and 4.4.3).

Sampling from commercial catches of ling is considered good; both in terms of spatial and temporal distribution of samples in relation to landings (WGDEEP 2012). Mean length as observed in length samples from longliners decreased from 2000 to 2008 from around 91 cm to 80 cm (Figure 4.4.5). This may be the result of increased recruitment in recent years rather than increased fishing effort. Mean length has varied in the period 2009 to 2016 between 82–92 cm with no clear trend. It is premature to draw conclusions from the limited age-structured data. It can only be stated that most of the ling caught in the Icelandic spring survey is between age 5 and 9; but from longlines the age is between the ages of 6 to 10.

Ling in both in the spring and autumn surveys are mainly found in the deeper waters south and west off Iceland. Both the total biomass index and the index of the fishable biomass (>40 cm) in the March survey gradually decreased until 1995 (Figure 4.4.5). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices increased and have been for the last five years the highest in the time-series. The index of the large ling (80 cm and larger) shows similar trend as the total biomass index (Figure 4.4.5). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003–2007 and but then decreased by around 25% and remained at that level until 2010. Then the juvenile index fell to a very low level in 2014 but has since then started showing signs of an upward trend (Figure 4.4.5). However, the increase in the juvenile index is very uncertain as it is simply some variation in the length distribution of the survey but not a distinct peak (Figure 4.4.6).

The shorter autumn survey shows that biomass indices were low from 1996 to 2000 but have increased since then (Figures 4.4.5). There is a consistency between the two survey series; the autumn survey biomass indices are however derived from substantially fewer ling caught. Also, there is an inconsistency in the recruitment indices (<40 cm), where the autumn survey shows much lower recruitment, in absolute terms compared with the spring survey (Figure 4.4.5). This discrepancy is likely a result of much lower catchability of small ling (due to different gears) in the autumn survey, where ling less than 40 cm has rarely been caught.

Changes in spatial distribution as observed in surveys: According to the spring survey most of the increase in recent years in ling abundance is in the western area, 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.

Analytical assessment on Ling using Gadget

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

Data used and model settings

Data used for tuning are given in the stock annex.

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

Diagnostics

Observed and predicted proportions by fleet

Overall fit to the predicted proportional length and age–length distributions is close to the observed distributions. (Figures 4.4.7 to 4.4.12). In the initial years of the spring the observed length proportions appear have greater noise in, however as the number of samples caught the noise level decreases. Similarly for gears where only a small portion of the ling catch is caught, such as the gillnet, the overall noise is greater than for those gears with greater number of samples.

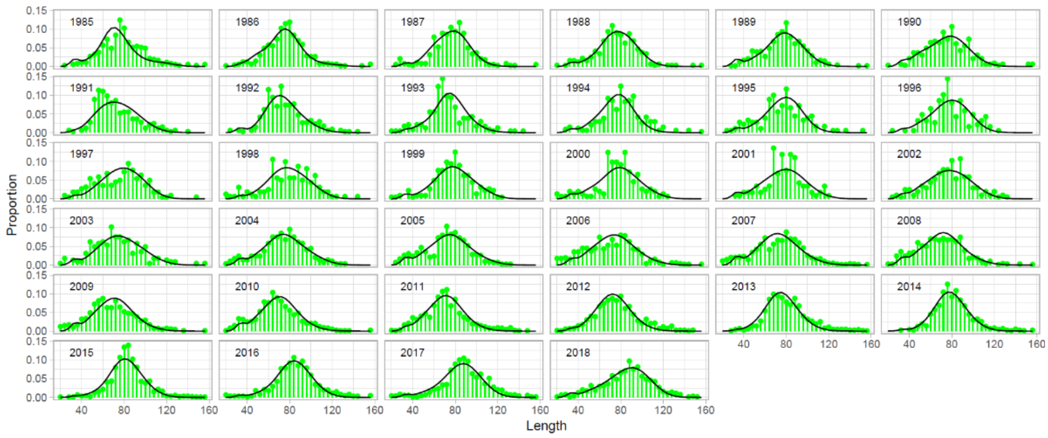

Figure 4.4.7. Ling in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions in the spring survey (green lines and points).

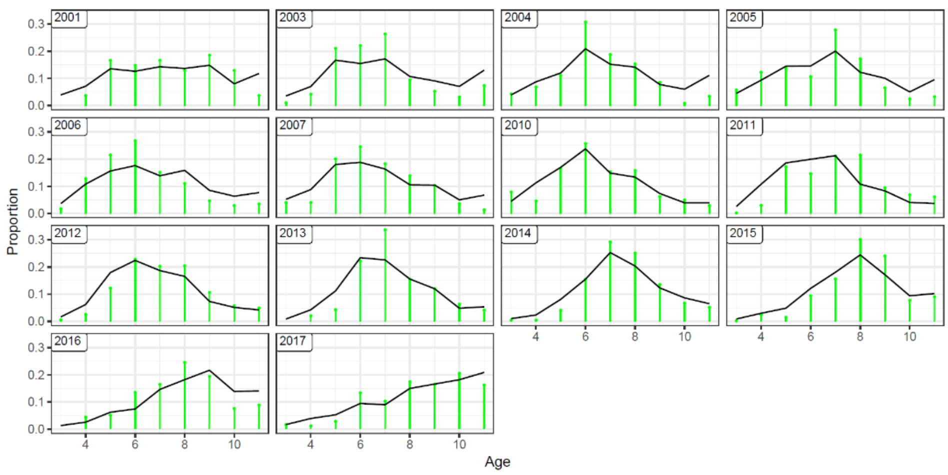

Figure 4.4.8. Ling in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in the spring survey catches (green lines and points).

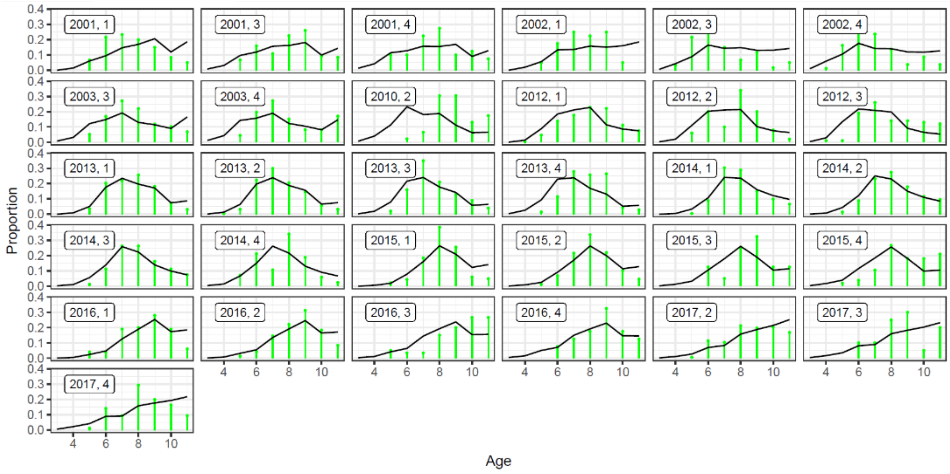

Figure 4.4.9. Ling in 5.a. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in longlines catches (blue lines and points).

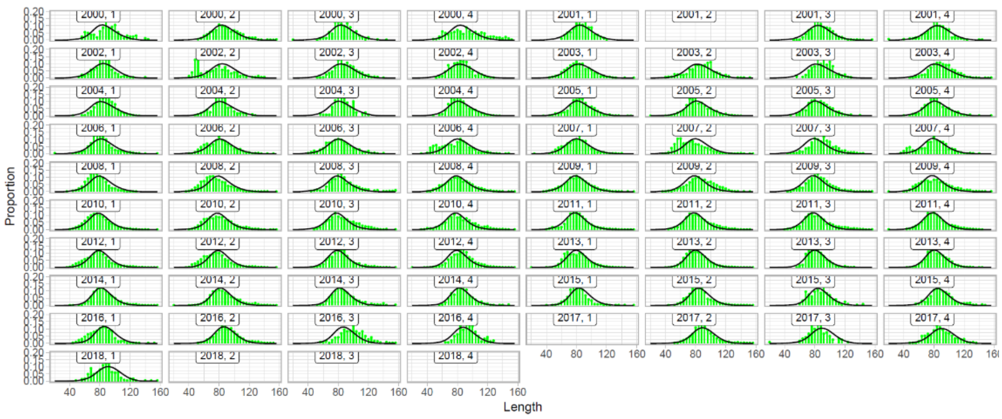

Figure 4.4.10. Ling in 5.a. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions from longline catches (green lines and dots).

Model fit

Figure 4.4.13 shows the overall fit to the survey indices described in the stock annex. In general, the model appears to follow the stock trends historically. Furthermore, the terminal estimate is not seen to deviate substantially from the observed value for most length groups, with model overestimating the abundance in the two largest length groups. Looking at the first three length groups (20–50, 50–60, 60–70) the model appears to discount the recruitment peak observed between 2005 and 2010 as the increase is not observed in the bigger length classes to the same degree. Summed up over survey biomass the model overestimates the biomass in the terminal years.

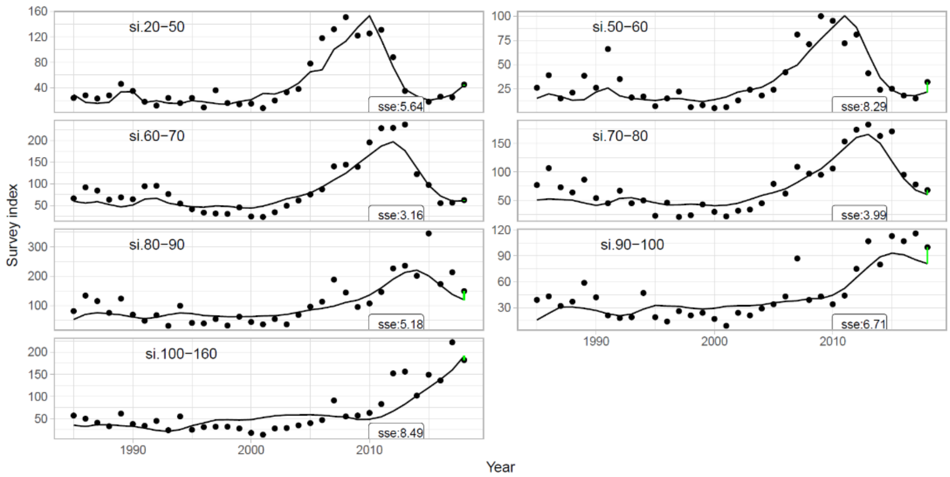

Figure 4.4.13. Fitted spring survey index by length group from the Gadget model (black line) and the observed number of ling caught in the survey (dotted line). The green line indicates the difference between the terminal fit and the observations.

Results

The results are presented in Table 4.4.7 and Figures 4.4.14 and 4.4.16. Recruitment peaked in 2009 to 2010 but has decreased and is estimated in 2013 to 2015 to be at low level. Spawning–stock biomass has increased since 2000 and is now estimated the highest SSB estimate in the time-series. Similarly, harvestable biomass is estimated at its highest level in the time-series. Fishing mortality for fully selected ling (age 14–19) has decreased from 0.66 in 2009 to 0.25 in 2015.

This year's assessment shows a downward revision of SSB and an upward revision of fishing mortality compared to the 2014 and 2015 assessments (Figure 4.4.15). The reason for this revision is the 'one-way trip' in the data and as the model is now getting closer to the terminal total survey index there is a downward revision of biomass. Therefore, when running an analytical retrospective analysis, a very similar pattern is observed (Figure 4.4.16). Nevertheless, some slight inconsistencies were found in input data and catches used in the model. The catches in the model have been updated with official ICES catches as presented in Table 4.4.6.

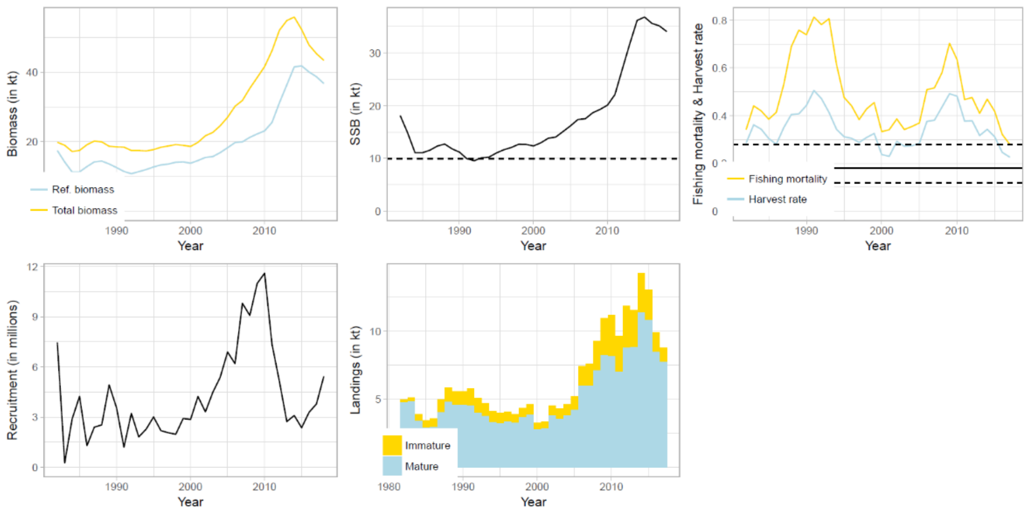

Figure 4.4.14. Ling in 5.a. Estimated biomass, fishing mortality, recruitment and total catches.

Reference points

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

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

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

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	9.93 kt	B_{pa}
	H_{msy}	0.24	The harvest rate that maximises the median long-term catch in stochastic simulations with recruitment drawn from a block bootstrap of historical recruitment scaled according to a hockey stick recruitment function with B_{loss} as defined below.
	F_{msy}	0.284	The median fishing mortality when an harvest rate of H_{msy} is applied.
Precautionary approach	B_{lim}	7.09 kt	$B_{pa}/e^{1.645\sigma}$ where $\sigma = 0.2$
	B_{pa}	9.93 kt	SSB(1992), corresponding to B_{loss}
	H_{lim}	0.56	H corresponding to 50% long-term probability of SSB $> B_{lim}$
	F_{lim}	0.70	F corresponding to H_{lim}
	F_{pa}	0.41	$F_{lim}/e^{1.645\sigma}$ where $\sigma = 0.33$
	H_{pa}	0.35	H corresponding to F_{pa}
Management plan	H_{mp}	0.18	H such that $P(SSB < B_{pa}$ |for any given year) < 0.05.

The management plan proposed by Iceland is:

> The spawning–stock biomass trigger (MGT $B_{trigger}$) is defined as 9.93 kt, the reference biomass is defined as the biomass of ling 70+ cm and the target harvest rate (HR_{MGT}) is set to 0.18. In the assessment year (Y) the TAC for the next fishing year (September 1 of year Y to August 31 of year Y+1) is calculated as follows:
>
> When SSB_Y is equal or above MGT $B_{trigger}$:
> $TAC_{Y/y+1} = HR_{MGT}*B_{Ref,y}$
>
> When SSB_Y is below MGT $B_{trigger}$:
> $TAC_{Y/y+1} = HR_{MGT}*(SSB_y/MGT\ B_{trigger})*B_{ref,y}$

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

4.4.7 Comments on the assessment

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

4.4.7.1 Management considerations

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

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

4.4.8 Tables

Table 4.4.6. Ling in 5.a. Catches by country (Source STATLANT).

Year	Belgium	Faroe	Germany	Iceland	Norway	UK	Total
1980	445	607	0	3149	423	0	4624
1981	196	489	0	3348	415	0	4448
1982	116	524	0	3733	612	0	4985
1983	128	644	0	4256	115	0	5143
1984	103	450	0	3304	21	0	3878
1985	59	384	0	2980	17	0	3440
1986	88	556	0	2946	4	0	3594
1987	157	657	0	4161	6	0	4981
1988	134	619	0	5098	10	0	5861
1989	95	614	0	4896	5	0	5610
1990	42	399	0	5153	0	0	5594
1991	69	530	0	5206	0	0	5805
1992	34	526	0	4556	0	0	5116
1993	20	501	0	4333	0	0	4854
1994	3	548	0	4049	0	0	4600
1995	0	463	0	3729	0	0	4192
1996	0	358	0	3670	20	0	4048
1997	0	299	0	3634	0	0	3933
1998	0	699	0	3603	0	0	4302
1999	0	500	0	3973	120	1	4594
2000	0	0	0	3196	67	3	3266
2001	0	362	2	2852	116	1	3333
2002	0	1629	0	2779	45	0	4453
2003	0	565	2	3855	108	5	4535
2004	0	739	1	3721	139	0	4600
2005	0	682	1	4311	180	20	5194
2006	0	960	1	6283	158	0	7402
2007	0	807	0	6592	185	0	7584
2008	0	1366	0	7736	176	0	9278
2009	0	1157	0	9610	172	0	10939
2010	0	1095	0	9867	168	0	11130
2011	0	588	0	8743	249	0	9580
2012	0	875	0	10706	248	0	11829
2013	0	1030	0	10212	294	0	11445
2014	0	1738	0	12450	158	0	13930
2015	0	1233	0	11553	250	0	12862
2016	0	1072	0	8582	230	0	9884
2017*	0	829	0	7703	243	0	8774

***Preliminary.**

Table 4.4.7. Ling in 5.a. Results from the Gadget assessment.

Year	Biomass	B75	SSB	Rec3	Catch	HR	F
1982	20,49	16,78	17,43	6,48	4,99	0,31	0,33
1983	19,52	13,26	14,63	0,87	5,12	0,40	0,42
1984	17,75	10,91	11,19	2,72	3,88	0,36	0,40
1985	17,97	11,09	11,17	4,05	3,45	0,31	0,36
1986	19,53	12,27	11,72	1,61	3,60	0,30	0,39
1987	20,57	13,52	12,50	2,13	4,97	0,38	0,51
1988	20,23	13,26	12,91	2,62	5,85	0,45	0,67
1989	18,95	12,74	12,06	4,62	5,55	0,45	0,74
1990	18,71	11,30	11,32	3,91	5,56	0,50	0,73
1991	18,71	10,12	10,11	1,20	5,79	0,58	0,79
1992	17,72	9,64	9,63	3,16	5,09	0,53	0,78
1993	17,72	10,30	10,24	1,82	4,71	0,47	0,79
1994	17,60	11,21	10,41	2,32	4,11	0,37	0,61
1995	18,01	11,96	11,21	3,01	3,97	0,33	0,47
1996	18,73	12,41	11,82	2,18	4,07	0,33	0,44
1997	19,11	12,94	12,25	2,11	3,91	0,30	0,38
1998	19,55	13,38	12,93	1,97	4,35	0,33	0,42
1999	19,34	12,93	12,92	2,91	4,62	0,36	0,45
2000	19,06	13,05	12,65	2,84	3,28	0,25	0,33
2001	20,28	13,85	13,28	4,23	3,36	0,24	0,33
2002	22,23	14,72	14,18	3,31	4,53	0,31	0,38
2003	23,22	15,02	14,41	4,42	4,28	0,28	0,33
2004	25,17	15,80	15,50	5,27	4,63	0,29	0,34
2005	27,62	17,13	16,60	6,84	5,20	0,30	0,36
2006	30,81	18,01	17,80	6,19	7,43	0,42	0,50
2007	32,49	18,16	17,93	9,72	7,62	0,42	0,50
2008	36,07	19,17	19,04	9,13	9,28	0,49	0,57
2009	39,25	19,37	19,67	10,83	10,95	0,57	0,69
2010	42,46	20,31	20,51	11,40	11,15	0,54	0,62
2011	47,02	22,92	22,56	7,55	9,65	0,41	0,46
2012	52,91	28,19	27,42	5,07	11,83	0,42	0,47
2013	55,55	32,78	32,15	2,80	11,54	0,35	0,40
2014	56,41	37,28	36,59	3,06	14,25	0,38	0,46
2015	52,68	38,03	37,14	2,55	13,04	0,35	0,42
2016	48,19	37,30	35,85	3,20	9,88	0,27	0,32
2017	45,69	36,76	35,29	3,85	8,77	0,24	0,28
2018	43,80	34,75	34,20	5,44			

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

4.5.1 The fishery

Significant fisheries for ling have been conducted in Subareas 3 and 4 at least since the 1870s, pioneered by Swedish longliners. Since the mid-1900s the major targeted ling fishery in 4.a is by Norwegian longliners conducted around Shetland and in the Norwegian Deep. There is little activity in 3.a. Of the total Norwegian 2016 landings in Subareas 3 and 4, 83% were taken by longlines, 9% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (4.b,c) are bycatches from various other fisheries.

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

When Areas 3–4 and 6–14 are pooled over 1988–2017, 42% of the total landings were in Area 4, 30% in Area 6.a, and 24% in Area 6.b.

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

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

The Norwegian fishery

The Norwegian longline fleet increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number of vessels decreased and then stabilized at 25 in 2015 to 2017. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that each Norwegian longliner operated in an ICES division was highly variable for 4.a, stable for 6.b and declining for 6.a. The average number of hooks has remained relatively stable in 4.a and 6.a. During the period 1974 to 2017 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2018).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2017 is 43% less than the average effort during the years 2000–2003.

The French fishery

French fleets operating in 6, 7.bck are mainly otter trawlers, gillnetters and longliners, which accounts for around 850 t of ling in 2017, mainly from otter trawlers (450t). Gillnetters landed 10 t and longliners around 390 t.

The number of otter trawlers operating in the region has decreased from around 70 in the beginning of the 2000s to 32 in 2017. Gillnetters have had a relatively stable number of boats involved, between 12 and 20 during the period 2000 to 2017. The number of longliners has increased from one in 2000 to 17 in 2017 (Table 4.5.3).

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

Landings of ling by otter trawlers have been increasing since 2004. For gillnetters and longliners, landings are closely related to changes in efforts. Since 2011 landings have been stable for gillnetters and increasing for longliners.

The Spanish fishery

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

4.5.2 Landings trends

Landing statistics by nation in the period 1988–2017 are in Tables 4.5.1 and 4.5.2 and Figures 4.5.1 and 4.5.2.

There was a decline in landings from 1988 to 2003, since then the amount landed has been stable and slightly increasing. When Areas 3–14 are pooled, the total landings averaged around 32 000 t in the period 1988–1998 and afterwards the average catch varied between 16 000 and 17 000 tons per year. The preliminary landings for 2017 is 20 276 t.

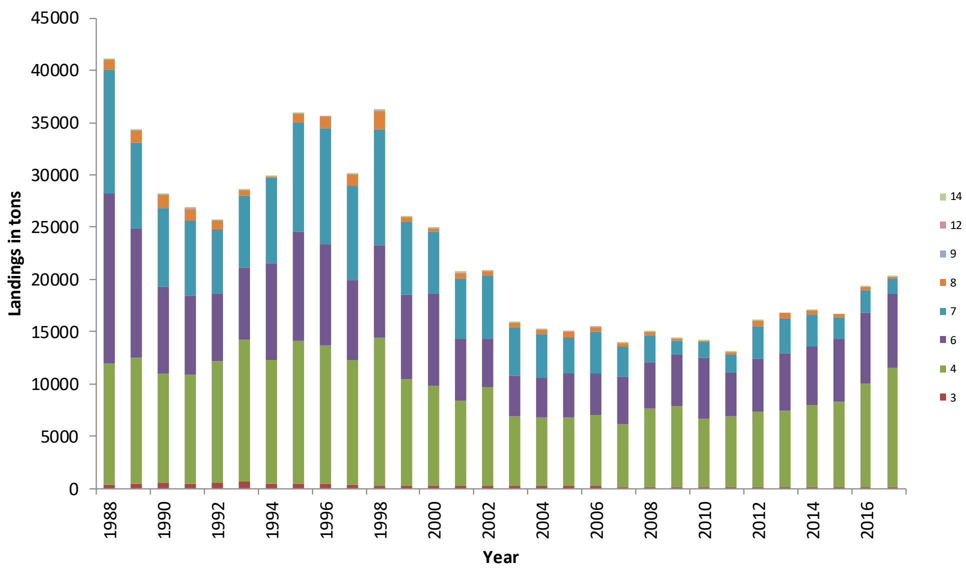

Figure 4.5.1. International landings. Ling in other areas.

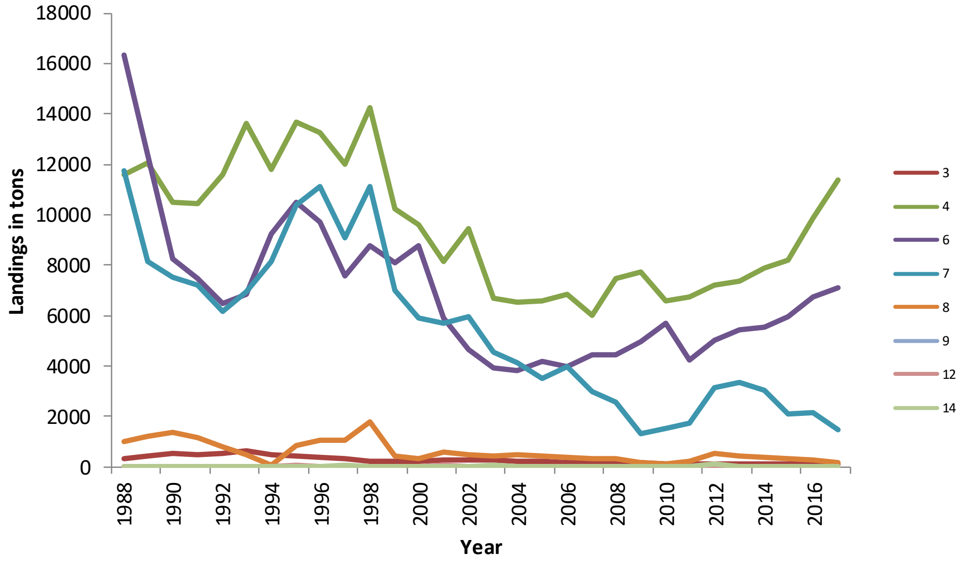

Figure 4.5.2. International landings ling in by years.

4.5.3 ICES Advice

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

4.5.4 Management

Norway has a licensing scheme in EU waters, and in 2018 the Norwegian quota in the EC zone is 7500 t. The Faroe Islands has a quota of 200t in 6.a and 6.b. The quota for the EU in the Norwegian zone (Area 4) is set at 1 350 t.

EU TACs for areas partially covered in this section are in 2016–2018

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

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

4.5.5 Data available

4.5.5.1 Landings and discards

Landings were available for all relevant fleets. Within the Norwegian EEZ and for Norwegian vessels fishing elsewhere discarding is prohibited and therefore there is no information if there were discards. Discards by Denmark, Sweden, Spain, Ireland, France, England and Scotland are given below for the years 2012 to 2017 (Table 4.5.4), and by area and countries for 2017 (Table 4.5.5). Discarding has been increasing over this period; in 2017 1147 tons of ling were discarded.

Table 4.5.4. Total discards by country for the years 2013 to 2017.

	2012	2013	2014	2015	2016	2017
Denmark						1
Spain	46	101	54	0	1	10
Ireland	176	160	435	0	220	105
France		29	15	131	72	71
Sweden				4		
UK (Scotland)				704	1302	959
UK (England)					22	
Sweden						2
Total	222	290	504	839	1598	1147

Reported discards by area and country:

Area	Country	Discards
27.4	Denmark	1
27.4	Sweden	2
27.4.a	France	23
27.6.a	France	25
27.7.h	France	6
27.7.j	France	1
27.8.a	France	14
27.6.a	Ireland	57
27.6.b	Ireland	27
27.7.g	Ireland	19
27.7.j	Ireland	2
27.6.a	Spain	10
27.4.a	UK(Scotland)	835
27.6.a	UK(Scotland)	66
27.6.b.2	UK(Scotland)	57
Total		1147

4.5.5.2 Length composition

Data from the Norwegian reference fleet

Average fish length, weight–length relationships and the length distribution for the Norwegian longline and gillnet fishery in Areas 4a, 6a, 6b are shown in Figures 4.5.3–4–5.7, respectively. Data are from the Norwegian longline reference fleet. Weight as a function of length for ling in Areas 6 and 7 are based on Spanish data (Figure 4.5.8).

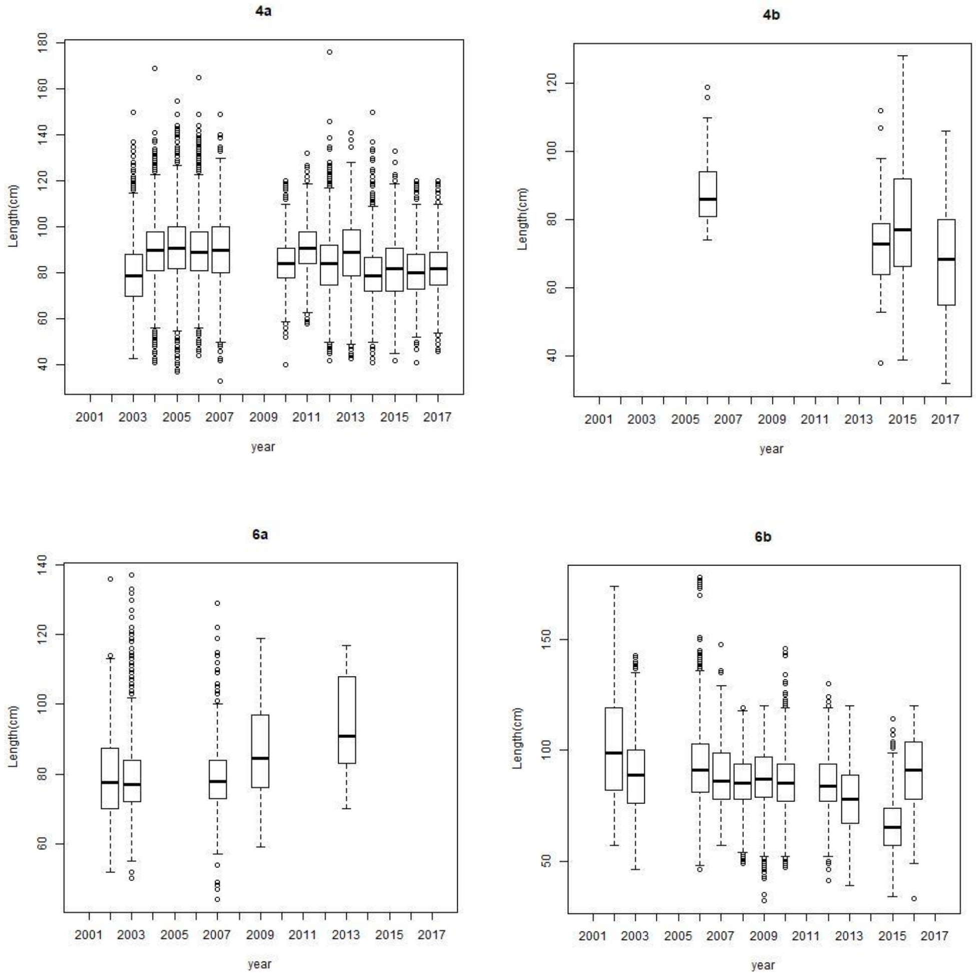

Figure 4.5.3. Box and whisker plots of the annual length distributions for the Norwegian longline reference fleet in 4.a, 4.b, 6.a and 6.b.

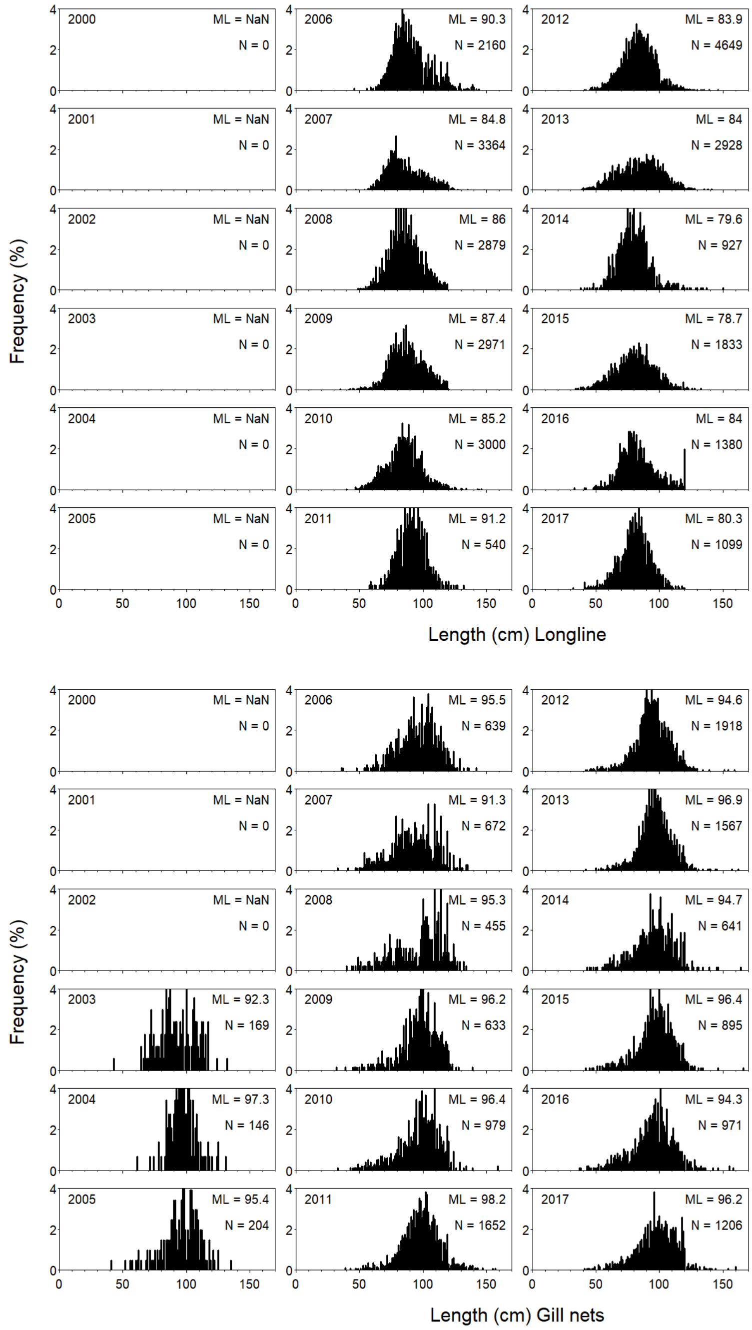

Figure 5.4.4. . Length distributions of ling in Areas 4.a, 6.a and 6.b for the Norwegian reference fleet.

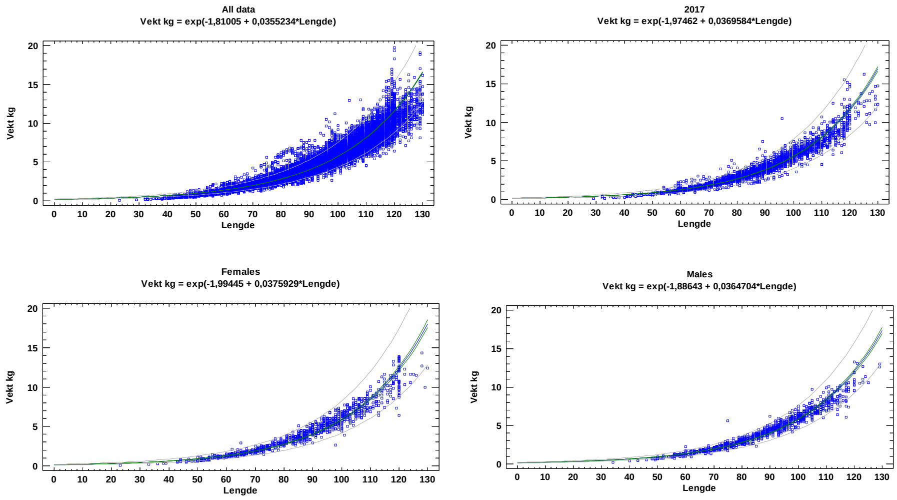

Figure 4.5.5. Weight as afunction of length for ling based on all available Norwegian data.

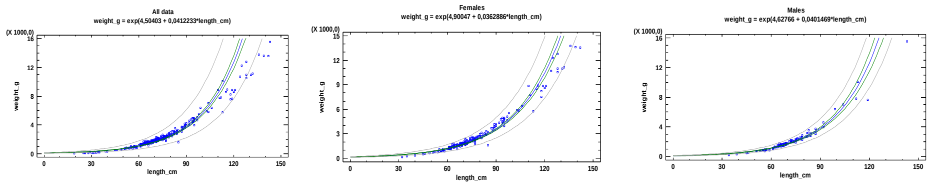

Figure 4.5.9. Weight as a function of length for ling in Areas 6 and 7 based on Spanish data from 2014 to 2017.

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

In Figure 4.5.10 are the estimated length distributions of ling for the years 2001–2017. (For more information see Fernández-Zapico *et al.*, WD 2018).

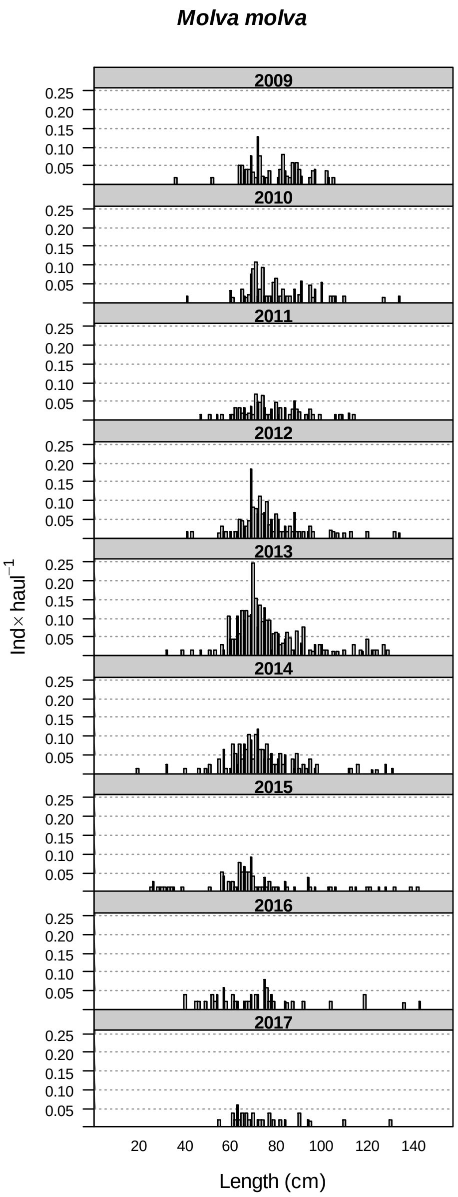

Figure 4.5.10. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey in the period 2001–2017.

4.5.5.3 Age compositions

Estimated age distributions for the years 2009–2016 based on data from the Norwegian Reference fleet for all areas combined (Figures 4.5.12) and box and whisker plots for the age composition of the fish taken by longliners and gillnetters in Area 4.a (Figure 4.5.13).

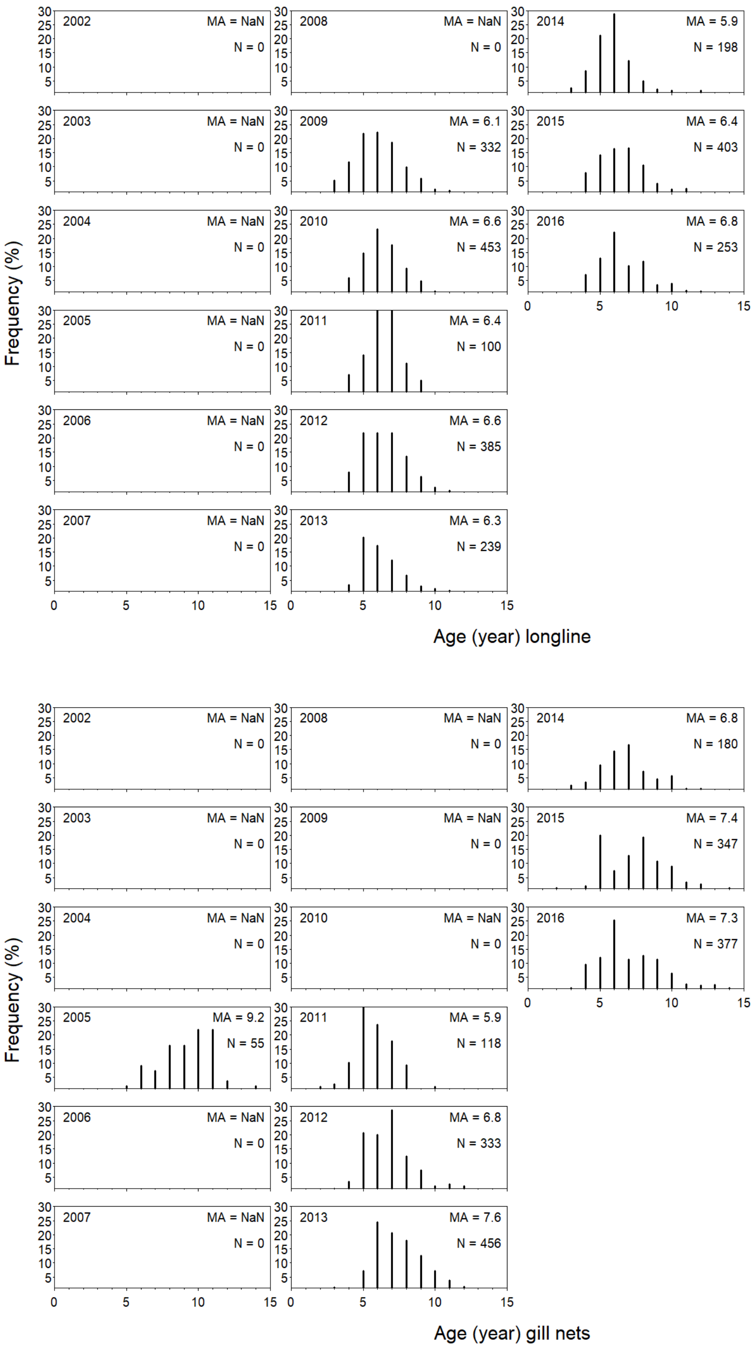

Figure 4.5.12. Age distributions for ling areas combined for all catches taken by longliners and by gill netters.

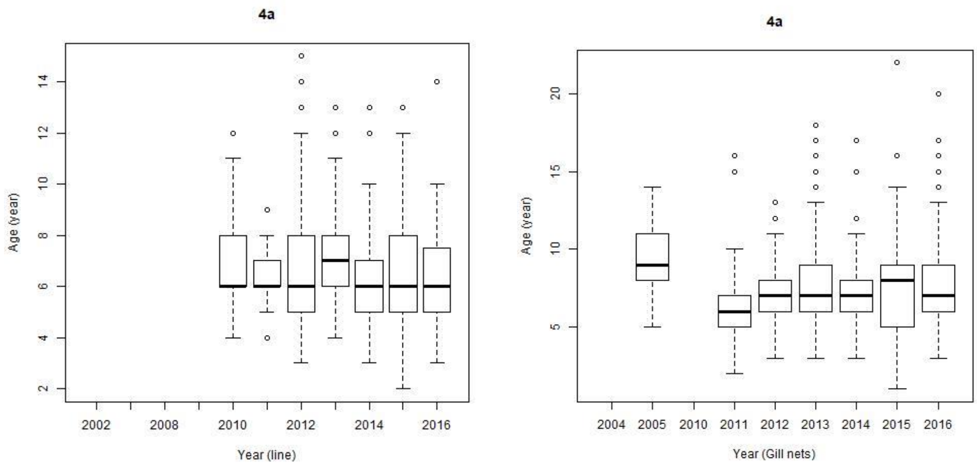

Figure 4.5.13. Age composition of the fish in area 4a taken by longliners and gillnetters.

4.5.5.4 Weight-at-age

Average weight- and length-at-age for 2009 to 2016 for Areas 4.a and 6.a based on data from the longliners in the Norwegian reference fleet Figure 4.5.13. and the average length-at-age and average weight-at-age for the Spanish ling fishery (2014–2017) on Porcupine Bank (Figures 4.5.14 and 4.5.15).

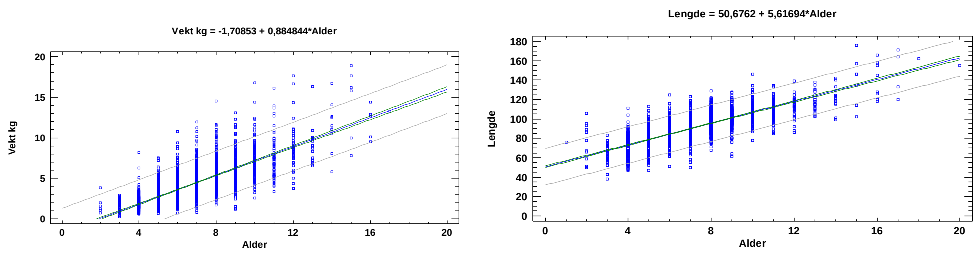

Figure 4.5.13. Average weight- and length-at-age for 2009 to 2017 for Areas 4.a and 6.a.

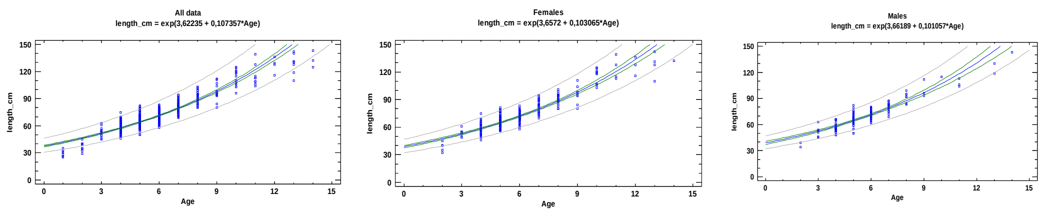

Figure 4.5.14. Average length-at-age based on Spanish data for areas 6 and 7 from 2014 to 2017.

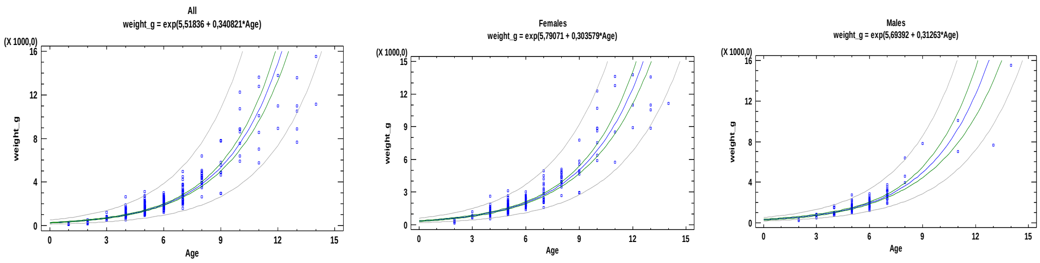

Figure 4.5.15. Average weight-at-age based on Spanish data for Areas 6 and 7 from 2014 to 2017.

4.5.5.5 Maturity and natural mortality

Maturity ogives for ling are in Figure 4.5.16 and in the Table below. The results fit well with the statement that ling becomes mature at-ages 5–7 (60–75 cm lengths) in most areas, with males maturing at a slightly lower age than females (Magnusson *et al.*, 1997).

Maturity parameters:

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

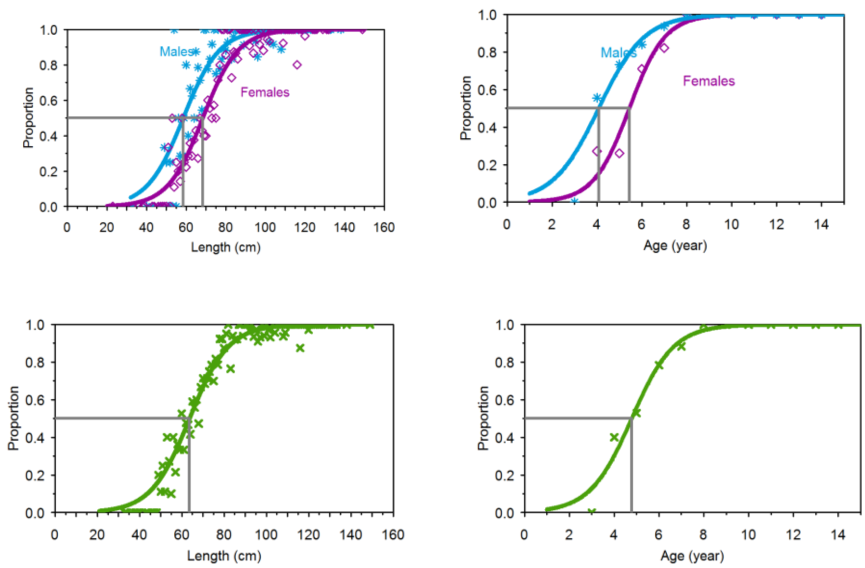

Figure 4.5.16. Ling lin.27.3a4a6-91214, Maturity ogives for age and length for males and females (top panel) and sexes combined (lower panel).

4.5.5.6 Catch, effort and research vessel data

Spanish Porcupine Bank survey

The Spanish bottom trawl survey on the Porcupine Bank (ICES divisions 7.c and 7.k) has been carried out annually since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in these areas (ICES, 2010a; 2010b). The survey provides estimates of biomass and abundance indices. Area covered by the survey is shown in Figure 4.5.17.

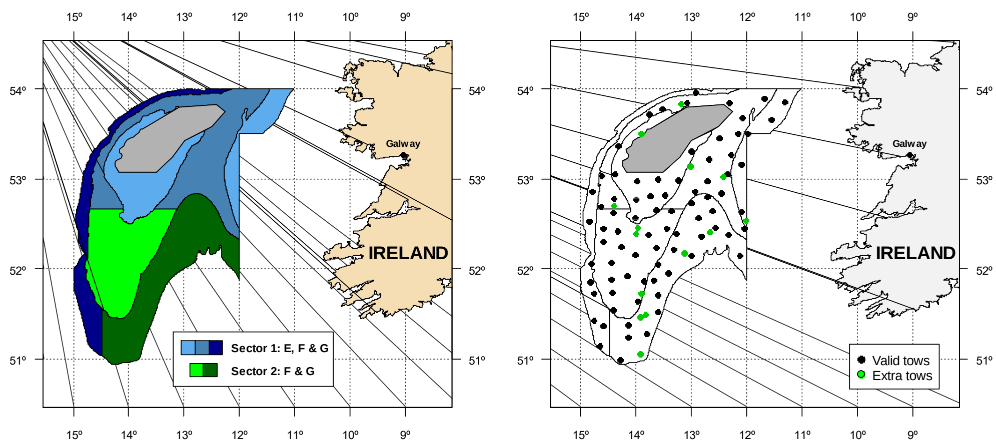

Figure 4.5.17. Left: Stratification design used in the Porcupine surveys starting in 2003: Previous years were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank denotes a large non-trawlable area. Right: distribution of hauls in 2017

French IBTS survey

The survey was cancelled in 2017 due to technical difficulties with the survey vessel and therefore no new data are available.

Commercial cpues

French lpue

Landing effort, measured in hours at sea, and landings per unit of effort (lpue) are provided by the French otter trawl, longline and gillnet fishery for areas 6 and 7.bck for the years 2000–2017.

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 2000–2017. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. The quality of the Norwegian logbook data is poor in 2010 due to changes from paper to electronic logbooks. Since 2011 data quality has improved considerably and data from the entire fleet were available.

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

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

4.5.6 Data analyses

Length data analysis

Mean length of the commercial catches by the Norwegian longlining reference fleet fluctuate and is approximately 90 cm for Areas 4 and 6.b and around 80 cm for Area 6.a. The series does not indicate any apparent time trends.

On Porcupine Bank the estimated length distributions appear to be quite stable with a length range of approximately 30–130 cm. The mode of the distributions tends to be around 70 cm, and there are no clear recruitment signals, which implies that Porcupine Bank is not a recruitment area for young ling (Figure 4.5.17). For more information, see Fernández-Zapico *et al.*, WD 2018.

French lpue

The landings of ling by otter trawlers increased from 2004–2014. During the last three years there has been a decrease in landings. For gillnetters and longliners, changes in landings are closely related to changes in effort (Figure 4.5.8).

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

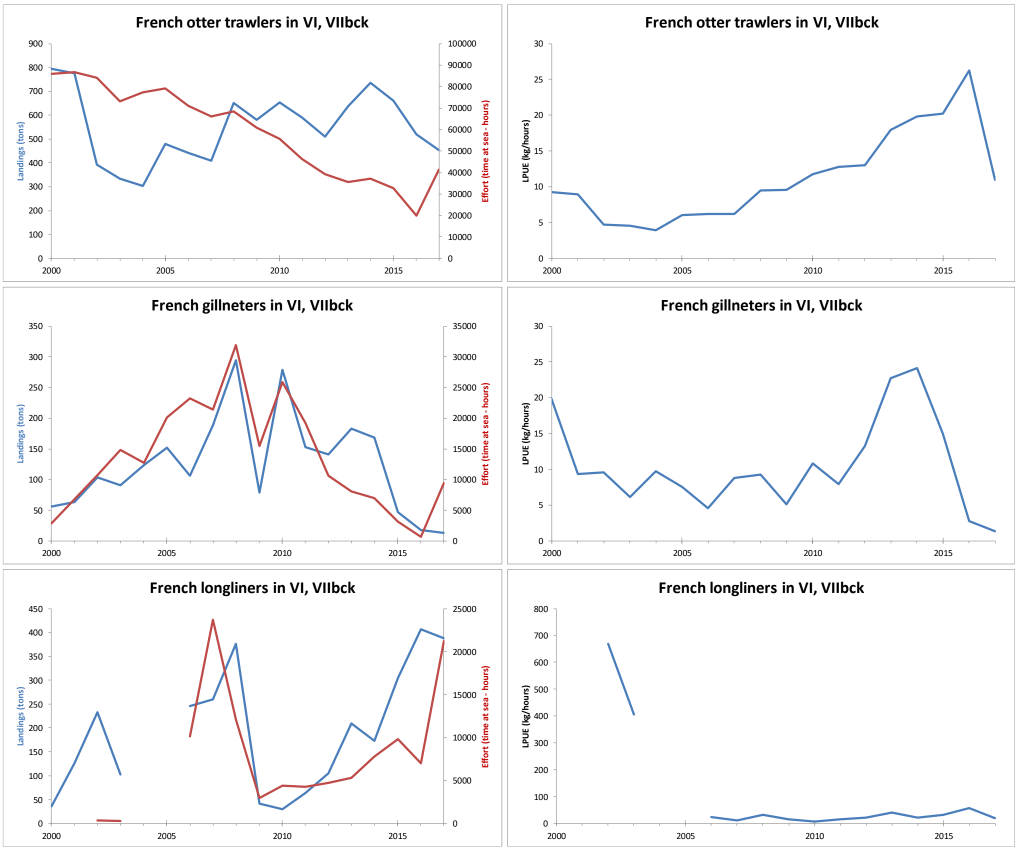

Figure 4.5.18. Lpue series for the main French fleet operating in 6, 7.b, c and k.

Spanish ling 2016 Porcupine Bank (NE Atlantic) survey

Estimated biomass and abundance indices based on data from the Porcupine Survey for the years 2001–2017 are in Figure 4.5.19. The abundance indices for ling based on the survey have been quite stable from 2001–2012. Taking into account the 80% confidence limits, except for the peak in 2013, the abundance indices for ling have been quite stable, for the years 2001–2016, however there is a downward trend after the peak in 2013.

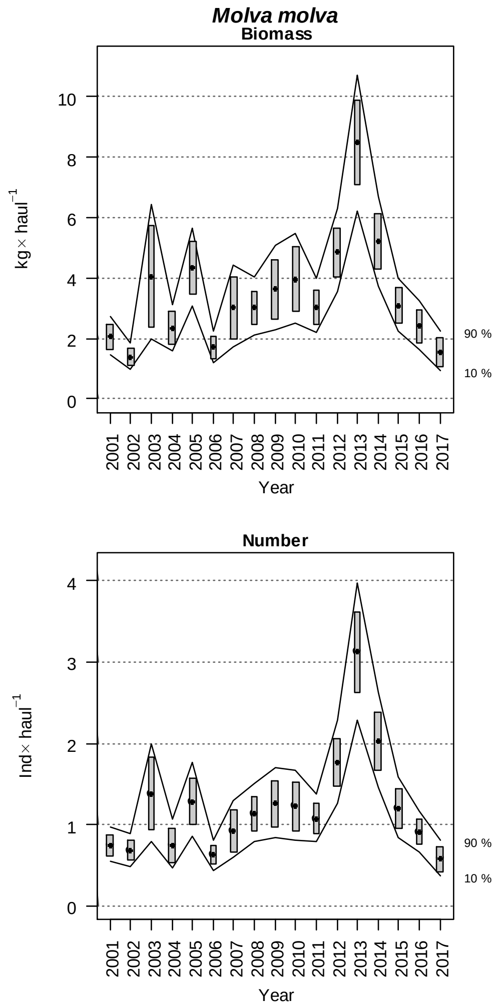

Figure 4.5.19. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2017. Boxes mark the parametric, based standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

Cpue series based on the Norwegian longline fleet

For ling, cpue has generally increased for all areas until 2017 when there was a decrease in all areas. A large part of Rockall (Area 6.b) was closed for fishing in the beginning of 2007. After 2007, the cpue for ling increased steadily until 2015, after this there have been a declining trend.

When all data for “ling other areas” are combined, the cpue series indicates a steady increase since 2003 to 2017 and the decline in 2017 is not apparent when all data are combined.

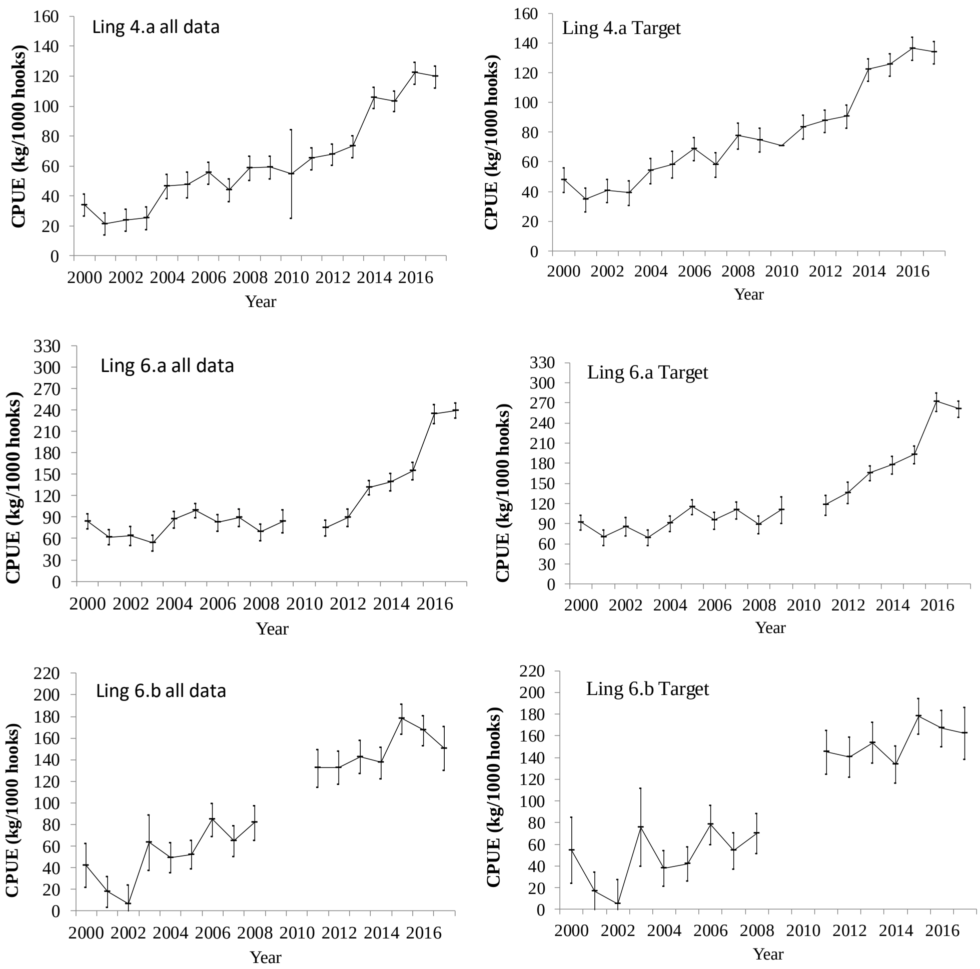

Figure 4.5.20. Cpue series for ling for the period 2000–2017 based on all available data and when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

The ling stocks in Areas (3.a, 4, 6, 7, 8, 9, 10, 12, 14) were best covered by the Norwegian longline fleet. It was therefore decided in plenary that a combined cpue series should be made in order to give advice for the entire area, and that the data from the targeted fishery should be used. The combined series is shown in Figure 4.5.21.

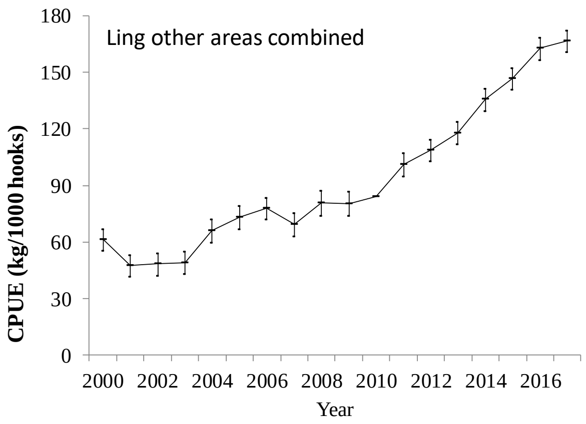

Figure 4.5.21. Cpue series for ling, areas combined, for the period 2000–2017 based on data when ling appeared to have been targeted. The bars denote the 95% confidence intervals.

Biological reference points

See Section 4.5.9.

4.5.7 Comments on the assessment

The standardised cpue time-series for the Norwegian longliners shows similar trends as the superpopulation model presented in 2012 and the the unstandardised time-series presented in 2011. The trend is either stable (4.a and 6.a) or increasing (6.b) during the last decade (Figure 4.5.21).

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

4.5.8 Management considerations

The cpues series based on commercial data either indicate a stable or an increasing trend, since the catches have been stable and the indicator series shows an increasing trend. There has been an increase in discarding of ling, in 2016 there was a peak when around 8% was discarded, in 2017 5% of the catches were discarded.

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

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

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

4.5.9 Application of MSY proxy reference points

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

Length-based indicator method (LBI)

The input parameters and the catch length composition for the period 2002–2017 are in the following tables and figures. The length data used in the LBI model are data from the Norwegian longline fleet. The length data are not weighted and therefore do not represent the length distribution of the entire catch.

Input parameters for LBI.

DATA TYPE	SOURCE	YEARS/VALUE	NOTES
Length–frequency distribution	Norwegian longliners (Reference fleet)	2002–2017	
Length–weight relation	Norwegian Reference fleet and survey data	$0.0055 * length^{3.0120}$	
L_{MAT}	Norwegian Reference fleet and survey data	64 cm	Combined sexes
L_{inf}	Norwegian Reference fleet and survey data	183 cm	

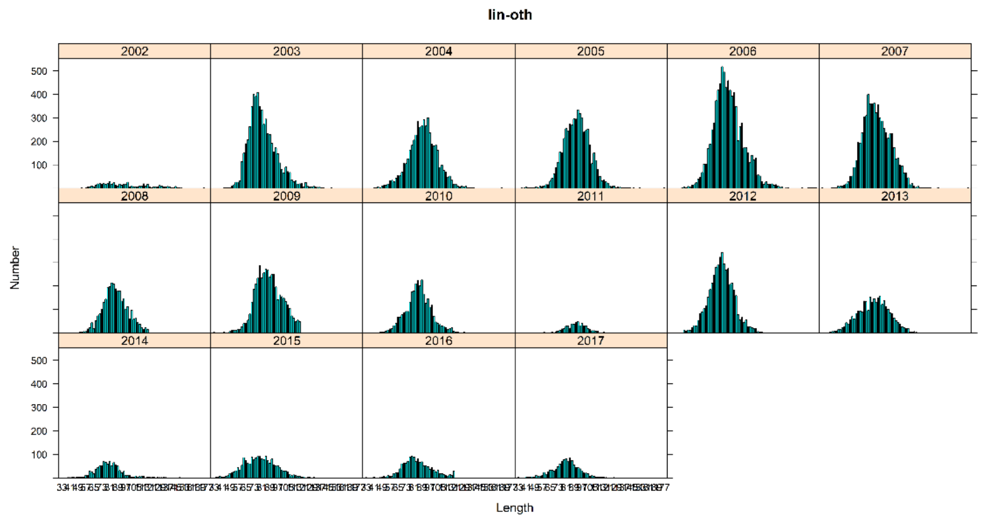

Figure 4.5.22. Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Catch length composition for the period 2001–2016 at 2 cm length classes (sex combined).

Outputs

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

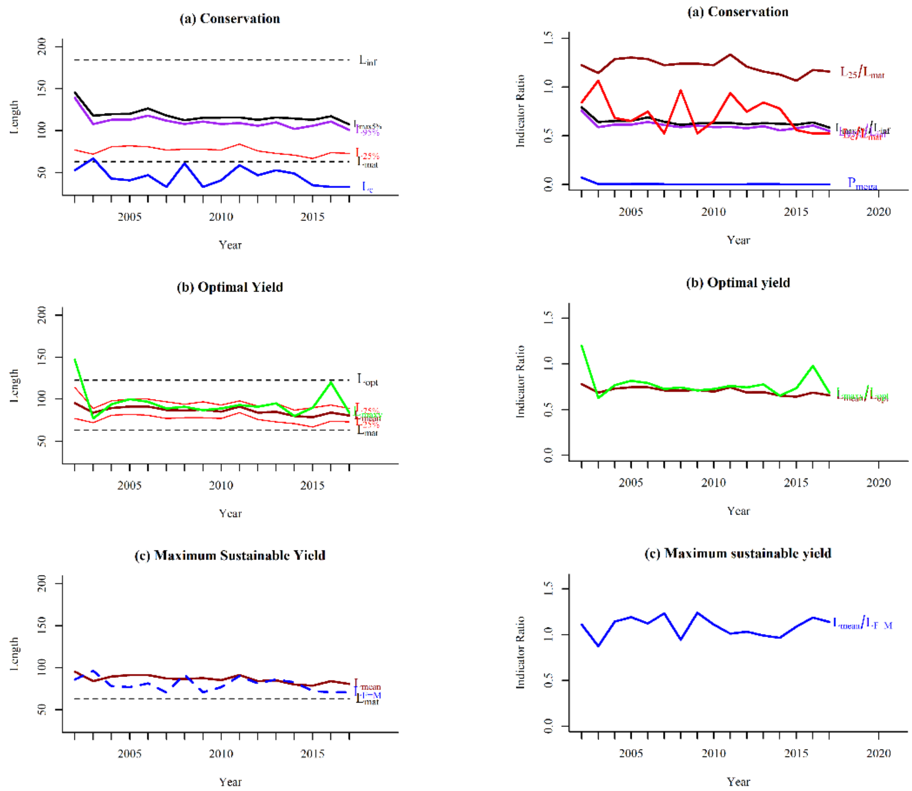

Figure 4.5.23. Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Screening of length indicator ratios for sex combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysis of results

For the conservation of immature ling the model shows that L_c/L_{mat} is usually less than one, but $L_{25\%}/L_{mat}$ is usually greater than 1 (Figure 4.5.23). In 2014–2017, $L_{25\%}/L_{mat}$ has been greater than 1. The sensitivity measure, L_{mat}, suggests that there is no overfishing of immature ling.

The conservation measure for large ling shows that the indicator ratio of $L_{max5\%}/L_{inf}$ is around 0.6 for the whole period (Figure 4.5.23) and between 0.58 and 0.64 in 2014–2017 (table under). Therefore, since the conservation indicator is less than 0.8, this implies that there are few of mega-spawners in the catch which indicates that there is a truncation point in the length distribution of the catch, i.e. the present catch levels are not optimal.

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

Conclusions

The overall perception of the stock during the period 2014–2017 is that ling in other areas seems to be fished sustainably. However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Traffic light indicators

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	>1	>1	>0.8	>30%	~1 (>0.9)	≥1
2014	0.78	1.13	0.62	0%	0.65	0.97
2015	0.56	1.06	0.61	0%	0.64	1.09
2016	0.52	1.17	0.64	0%	0.68	1.19
2017	0,52	1.16	0.58	0%	0.67	1.14

Plots for the SPiCT model:

The input data were landings 1988–2017, and the cpue index for the targeted fishery from 2000–2017 (Figure 4.5.24).

The model converges and both the deterministic and stochastic reference points are very similar, but the confidence intervals are very large.

Outputs from the model: B_{msy}=162920, F_{msy}= 0.155, MSY=25062, K= 667567

(Advice for 2018-2018 is 17695 tons and the total landings in 2017 was 20 276 tons).

The plots of the results show wide confidence intervals for the absolute biomass and fishing mortality. The traffic light figure shows that the stock started in the red zone and is now in the green zone. (Figure 4.5.25). The diagnostics do not show any patterns in the residuals and no signs of bias, auto correlation or normality. This corresponds to the present perception of the development of the stock (Figure 4.5.26).

The retrospective analysis shows that the model is not robust enough for ling in "other areas" (Figure 4.5.27).

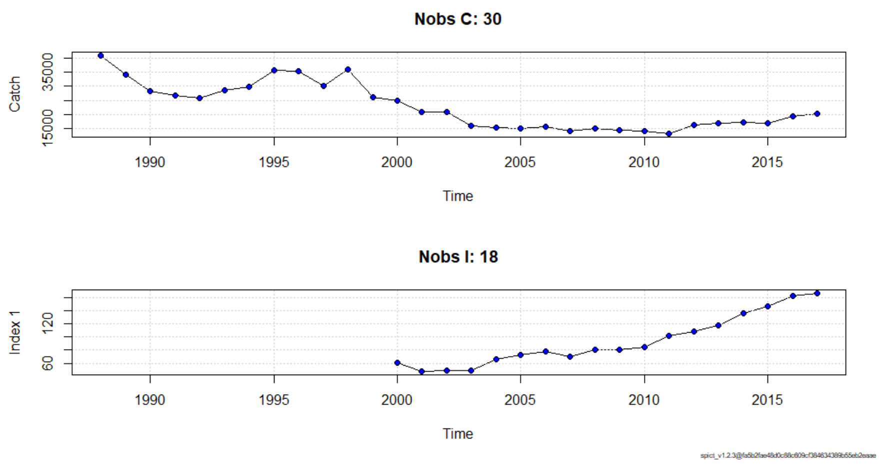

Figure 4.5.24. Input data

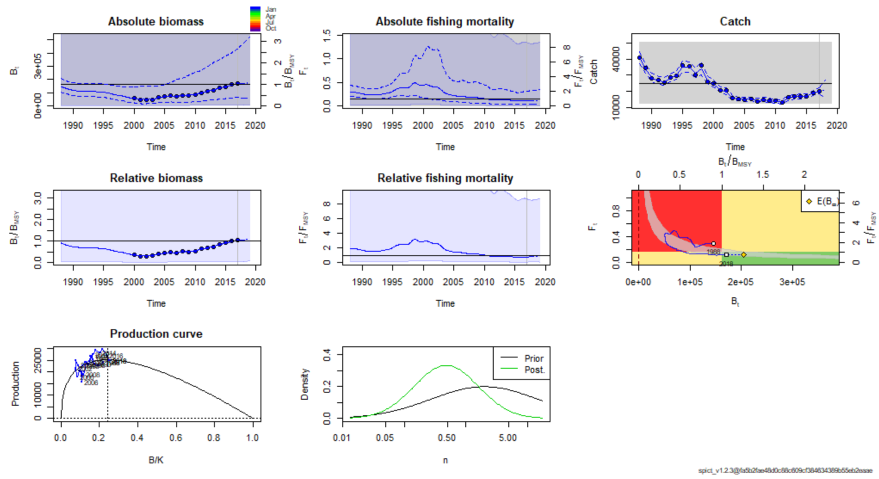

Figure 4.5.25. Plots of the results.

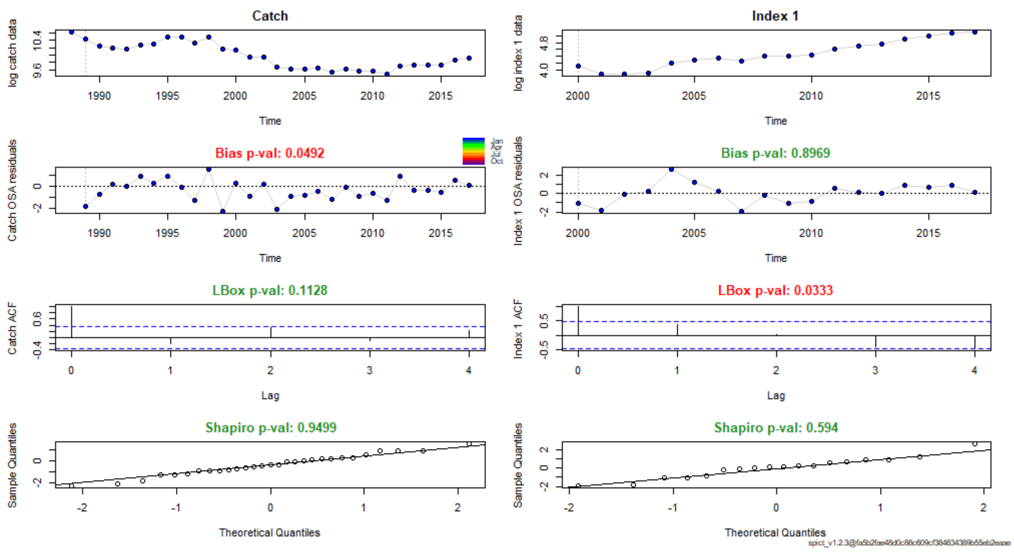

Figure 4.5.26. Diagnostics from SPiCT.

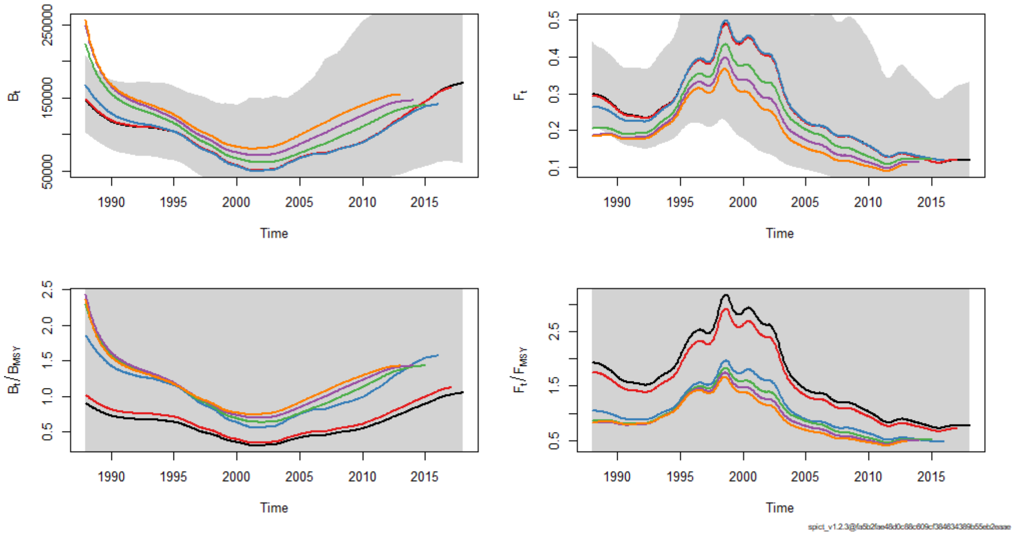

Figure 4.5.27. Retrospective analysis.

4.5.10 Tables

Table 4.5.1. Ling 3a, 4a, 6, 7, 8, 9, 12 and 14. WG estimates of landings.

Ling 3

Year	Belgium	Denmark	Germany	Norway	Sweden	E & W	Total
1988	2	165	-	135	29	-	331
1989	1	246	-	140	35	-	422
1990	4	375	3	131	30	-	543
1991	1	278	-	161	44	-	484
1992	4	325	-	120	100	-	549
1993	3	343	-	150	131	15	642
1994	2	239	+	116	112	-	469
1995	4	212	-	113	83	-	412
1996		212	1	124	65	-	402
1997		159	+	105	47	-	311
1998		103	-	111	-	-	214
1999		101	-	115	-	-	216
2000		101	+	96	31		228
2001		125	+	102	35		262
2002		157	1	68	37		263
2003		156		73	32		261
2004		130	1	70	31		232
2005		106	1	72	31		210
2006		95	2	62	29		188
2007		82	3	68	21		174
2008		59	1	88	20		168
2009		65	1	62	21		149
2010		58		64	20		142
2011		65		57	18		140
2012		66	<1	61	17		144
2013		56	1	62	11		130
2014		51	1	54	14		120
2015		58	1	50	16		125
2016		77	1	57	17		152
2017*		58	1	57	22		138

***Preliminary.**

Table 4.5.1. (continued).

Ling 4.a

Year	Belgium	Denmark	Faroes	France	Germany	Neth.	Norway	Sweden[1)]	E&W	N.I.	Scot.	Total
1988	3	408	13	1143	262	4	6473	5	55	1	2856	11 223
1989	1	578	3	751	217	16	7239	29	136	14	2693	11 677
1990	1	610	9	655	241	-	6290	13	213	-	1995	10 027
1991	4	609	6	847	223	-	5799	24	197	+	2260	9969
1992	9	623	2	414	200	-	5945	28	330	4	3208	10 763
1993	9	630	14	395	726	-	6522	13	363	-	4138	12 810
1994	20	530	25	n/a	770	-	5355	3	148	+	4645	11 496
1995	17	407	51	290	425	-	6148	5	181		5517	13 041
1996	8	514	25	241	448		6622	4	193		4650	12 705
1997	3	643	6	206	320		4715	5	242		5175	11 315
1998	8	558	19	175	176		7069	-	125		5501	13 631
1999	16	596	n.a.	293	141		5077		240		3447	9810
2000	20	538	2	147	103		4780	7	74		3576	9246
2001		702		128	54		3613	6	61		3290	7854
2002	6	578	24	117			4509		59		3779	9072
2003	4	779	6	121	62		3122	5	23		2311	6433
2004		575	11	64	34		3753	2	15		1852	6306
2005		698	18	47	55		4078	4	12		1537	6449
2006		637	2	73	51		4443	3	55		1455	6719
2007		412	-	100	60		4109	3	31		1143	5858
2008		446	1	182	52		4726	12	20		1820	7259
2009		427	7	90	27		4613	7	19		2218	7408
2010		433		62	40		3914		28		1921	6398
2011		541		90	62		3790	8	18		1999	6508
2012		419		105	47		4591	6	28		1822	7018
2013		548		104	83		4273	5	15		2169	7197
2014		404		182	53		5038	3	23		2046	7749
2015		424		127	53		5369	6	90		2018	8069
2016		797		304	71		6021	5	65		2477	**9740**
2017*		1036		300	111		6925	11	78		2761	**11222**

***Preliminary.**

(1) Includes 4b 1988–1993.

Table 4.5.1. (continued).

Ling 4.bc.

YEAR	BELGIUM	DENMARK	FRANCE	SWEDEN	NORWAY	E & W	SCOTLAND	GERMANY	NETHERLANDS	TOTAL
1988					100	173	106	-		379
1989					43	236	108	-		387
1990					59	268	128	-		455
1991					51	274	165	-		490
1992		261			56	392	133	-		842
1993		263			26	412	96	-		797
1994		177			42	40	64	-		323
1995		161			39	301	135	23		659
1996		131			100	187	106	45		569
1997	33	166	1	9	57	215	170	48		699
1998	47	164	5		129	128	136	18		627
1999	35	138	-		51	106	106	10		446
2000	59	101	0	8	45	77	90	4		384
2001	46	81	1	3	23	62	60	6	2	284
2002	38	91		4	61	58	43	12	2	309
2003	28	0		3	83	40	65	14	1	234
2004	48	71		1	54	23	24	19	1	241
2005	28	56		5	20	17	10	13		149
2006	26	53		8	16	20	8	13		144
2007	28	42	1	5	48	20	5	10		159
2008	15	40	2	5	87	25	15	11		200
2009	19	38	2	13	58	29	137	17	1	314
2010	23	55	1	13	56	26	10	17		201
2011	15	59	0		85	24	11	17		211
2012	12	45	1	10	84	25	7	8		192
2013	15	47	1	5	71	0	21	12	4	176
2014	16	46	0	6	34	7	14	15	3	141
2015	11	36		6	54	10	16	14		147
2016	14	42		6	50	7	9	21	1	150
2017*	9	36		9	74	4	9		2	143

***Preliminary.**

Table 4.5.1. (continued).

Ling 6.a update for Spain.

Year	Belgium	Denmark	Faroes	France (1)	Germany	Ireland	Norway	Spain(2)	E&W	IOM	N.I.	Scot.	Total
1988	4	+	-	5381	6	196	3392	3575	1075	-	53	874	14 556
1989	6	1	6	3417	11	138	3858		307	+	6	881	8631
1990	-	+	8	2568	1	41	3263		111	-	2	736	6730
1991	3	+	3	1777	2	57	2029		260	-	10	654	4795
1992	-	1	-	1297	2	38	2305		259	+	6	680	4588
1993	+	+	-	1513	92	171	1937		442	-	13	1133	5301
1994	1	1		1713	134	133	2034	1027	551	-	10	1126	6730
1995	-	2	0	1970	130	108	3156	927	560	n/a		1994	8847
1996			0	1762	370	106	2809	1064	269			2197	8577
1997			0	1631	135	113	2229	37	151			2450	6746
1998				1531	9	72	2910	292	154			2394	7362
1999				941	4	73	2997	468	152			2264	6899
2000	+	+		737	3	75	2956	708	143			2287	6909
2001				774	3	70	1869	142	106			2179	5143
2002				402	1	44	973	190	65			2452	4127
2003				315	1	88	1477	0	108			1257	3246
2004				252	1	96	791	2	8			1619	2769
2005			18	423		89	1389	0	1			1108	3028
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

Year	Belgium	Denmark	Faroes	France (1)	Germany	Ireland	Norway	Spain(2)	E&W	IOM	N.I.	Scot.	Total
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	868		156	1530	1500	3			2244	**6306**

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

Table 4.5.1. (continued).

Ling 6.b.

Year	Faroes	France (2)	Germany	Ireland	Norway	Spain (3)	E & W	N. I.	Scotland	Russia	Total
1988	196		-	-	1253		93	-	223		1765
1989	17		-	-	3616		26	-	84		3743
1990	3		-	26	1315		10	+	151		1505
1991	-		-	31	2489		29	2	111		2662
1992	35		+	23	1713		28	2	90		1891
1993	4		+	60	1179		43	4	232		1522
1994	104		-	44	2116		52	4	220		2540
1995	66		+	57	1308		84		123		1638
1996	0		124	70	679		150		101		1124
1997	0		46	29	504		103		132		814
1998		1	10	44	944		71		324		1394
1999		26	25	41	498		86		499		1175
2000	+	18	31	19	1172		157		475	7	1879
2001	+	16	3	18	328		116		307		788
2002		2	2	2	289		65		173		533
2003		2	3	25	485		34		111		660
2004	+	9	3	6	717		6		141	182	1064
2005		31	4	17	628		9		97	356	1142
2006	30	4	3	48	1171		19		130	6	1411
2007	4	10	35	54	971		7		183	50	1314
2008*	69	6	20	47	1021		1		135	214	1513
2009	249	5	6	39	1859		3		439	35	2635
2010	215	2		34	2042		0		394		2687
2011	12	5		16	957		1		268		1259
2012	60	7		13	1089	3			218		1390
2013		19		8	532	6			229	1	795
2014	60	7		10	435	2			258	2	774
2015	5	10	1	16	952	11	6		211	3	1215
2016	56			35	821	2	4		170		1088
2017*	5		2	59	498	7	2		219	1	793

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

Ling 7

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

***Preliminary.**

Table 4.5.1. (continued).

Ling 7.a.

Year	Belgium	France	Ireland	E & W	IOM	N.I.	Scotland	Total
1988	14	-1	100	49	-	38	10	211
1989	10	-1	138	112	1	43	7	311
1990	11	-1	8	63	1	59	27	169
1991	4	-1	10	31	2	60	18	125
1992	4	-1	7	43	1	40	10	105
1993	10	-1	51	81	2	60	15	219
1994	8	-1	136	46	2	76	16	284
1995	12	9	143	106	1	-2	34	305
1996	11	6	147	29	-	-2	17	210
1997	8	6	179	59	2	-2	10	264
1998	7	7	89	69	1	-2	25	198
1999	7	3	32	29		-2	13	84
2000	3	2	18	25			25	73
2001	6	3	33	20			31	87
2002	7	6	91	15			7	119
2003	4	4	75	18			11	112
2004	3	2	47	11			34	97
2005	4	2	28	12			15	61
2006	2	1	50	8			27	88
2007	2	0	32	1			8	43
2008	1	0	13	1			0	15
2009	1	36	9	2			0	48
2010		28	15	1			0	44
2011	1	2	23	1			1	28
2012	2		11	1			0	14
2013	1		6				23	30
2014	2	0	11				16	29
2015	1		8				10	19
2016	1		10				13	**24**
2017*			9				15	**24**

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

Table 4.5.1. (continued).

Ling 7.b, c.

Year	France (1)	Germany	Ireland	Norway	Spain (3)	E & W	N.I.	Scotland	Total
1988	-1	-	50	57		750	-	8	865
1989	-1	+	43	368		161	-	5	577
1990	-1	-	51	463		133	-	31	678
1991	-1	-	62	326		294	8	59	749
1992	-1	-	44	610		485	4	143	1286
1993	-1	97	224	145		550	9	409	1434
1994	-1	98	225	306		530	2	434	1595
1995	78	161	465	295		630	-2	315	1944
1996	57	234	283	168		1117	-2	342	2201
1997	65	252	184	418		635	-2	226	1780
1998	32	1	190	89		393		329	1034
1999	51	4	377	288		488		159	1366
2000	123	21	401	170		327		140	1182
2001	80	2	413	515		94		122	1226
2002	132	0	315	207		151		159	964
2003	128	0	270			74		52	524
2004	133	12	255	163		27		50	640
2005	145	11	208			17		48	429
2006	173	1	311	147		13		23	668
2007	173	5	62	27		71		20	358
2008	122	16	44	0		14		63	259
2009	42		71	0		17		1	131
2010	34		82	0		6		131	253
2011	29		58			28		93	208
2012	126	1	39	230	370	1		246	1013
2013	267	2	46		379	136		180	1010
2014	118		57		279	19		59	532
2015	101		53		184	144		78	560
2016	93		46	6	172	46		207	**570**
2017*	90		32		133	34		26	**315**

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

Table 4.5.1. (continued).

Ling 7.d, e.

Year	Belgium	Denmark	France (1)	Ireland	E & W	Scotland	Ch. Islands	Netherlands	Spain	Total
1988	36	+	-1	-	743	-				779
1989	52	-	-1	-	644	4				700
1990	31	-	-1	22	743	3				799
1991	7	-	-1	25	647	1				680
1992	10	+	-1	16	493	+				519
1993	15	-	-1	-	421	+				436
1994	14	+	-1	-	437	0				451
1995	10	-	885	2	492	0				1389
1996	15		960		499	3				1477
1997	12		1049	1	372	1	37			1472
1998	10		953		510	1	26			1500
1999	7		545	-	507	1				1060
2000	5		454	1	372		14			846
2001	6		402		399					807
2002	7		498		386	0				891
2003	5		531	1	250	0				787
2004	13		573	1	214					801
2005	11		539		236					786
2006	9		470		208					687
2007	15		428	0	267					710
2008*	5		348		214	2				569
2009	6		186		170			1		363
2010	4		144		138				8	294
2011	5		238		176				6	425
2012	7		255	1	164	2			7	436
2013	5		259		218					482
2014	4		338	1	262					605
2015	5		204		137			1		347
2016	3		141		149					**293**
2017*	4		105		94					**203**

***Preliminary.**

Table 4.5.1. (continued).

Ling 7.f.

YEAR	BELGIUM	FRANCE (1)	IRELAND	E & W	SCOTLAND	TOTAL
1988	77	-1	-	367	-	444
1989	42	-1	-	265	3	310
1990	23	-1	3	207	-	233
1991	34	-1	5	259	4	302
1992	9	-1	1	127	-	137
1993	8	-1	-	215	+	223
1994	21	-1	-	379	-	400
1995	36	110	-	456	0	602
1996	40	121	-	238	0	399
1997	30	204	-	313		547
1998	29	204	-	328		561
1999	16	108	-	188		312
2000	15	91	1	111		218
2001	14	114	-	92		220
2002	16	139	3	295		453
2003	15	79	1	81		176
2004	18	73	5	65		161
2005	36	59	7	82		184
2006	10	42	14	64		130
2007	16	52	2	55		125
2008	32	88	4	63		187
2009	10	69	1	26		106
2010	10	42	0	17	0	69
2011	20	39	2	94		155
2012	28	80	<1	59	<1	167
2013	22	68	1	93	40	224
2014	61	182	0	91		334
2015	15	54	2	17		88
2016	25	51	1	34	3	**114**
2017*	7	21	1	19		**48**

***Preliminary. (1) See Ling 7.**

Table 4.5.1. (continued).

Ling 7.g–k.

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain (2)	E&W	IOM	N.I.	Scot.	Total
1988	35	1	-1	-	286	-	2652	1439	-	-	2	4415
1989	23	-	-1	-	301	163		518	-	+	7	1012
1990	20	+	-1	-	356	260		434	+	-	7	1077
1991	10	+	-1	-	454	-		830	-	-	100	1394
1992	10	-	-1	-	323	-		1130	-	+	130	1593
1993	9	+	-1	35	374			1551	-	1	364	2334
1994	19	-	-1	10	620		184	2143	-	1	277	3254
1995	33	-	1597	40	766	-	195	3046		-3	454	6131
1996	45	-	1626	169	771		583	3209			447	6850
1997	37	-	1574	156	674		33	2112			459	5045
1998	18	-	1362	88	877		1669	3465			335	7814
1999	-	-	1220	49	554		455	1619			292	4189
2000	17		1062	12	624		639	921			303	3578
2001	16		1154	4	727	24	559	591			285	3360
2002	16		1025	2	951		568	862			102	3526
2003	12		1240	5	808		455	382			38	2940
2004	14		982		686		405	335			5	2427
2005	15		771	12	539		399	313			4	2053
2006	10		676		935		504	264			18	2407
2007	11		661	1	430		423	217			6	1749
2008	11		622	8	352		391	130			27	1541
2009	7		183	6	270		51	142			14	673
2010	10		108	1	279		301	135			14	848
2011	15		260		465		16	157			23	936
2012	23		584	2	516		201	138			56	1520
2013	24		622		495		190	74			203	1608
2014	13		535		445		177	185			202	1557
2015	11		391		366		153	131			13	1065
2016	10		383		549		107	114			9	**1172**
2017*	10		291		392		85	91			12	**881**

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

Table 4.5.1. (continued).

Ling 8.

Year	Belgium	France	Germany	Spain	E & W	Scot.	Total
1988		1018			10		1028
1989		1214			7		1221
1990		1371			1		1372
1991		1127			12		1139
1992		801			1		802
1993		508			2		510
1994		n/a		77	8		85
1995		693		106	46		845
1996		825	23	170	23		1041
1997	1	705	+	290	38		1034
1998	5	1220	-	543	29		1797
1999	22	234	-	188	8		452
2000	1	227		106	5		339
2001		245		341	6	2	594
2002		316		141	10	0	467
2003		333		67	36		436
2004		385		54	53		492
2005		339		92	19		450
2006		324		29	45		398
2007		282		20	10		312
2008		294		36	15	3	345
2009		150		29	7		186
2010		92		31	11		134
2011		148		47	6		201
2012		349		201	2		552
2013		281		139	35	4	459
2014		280		110	4	1	395
2015*		269		63	5		337
2016		207		77	3		**287**
2017*		154		43	2		**199**

Ling 9.

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

Table 4.5.1. (continued).

Ling 12.

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
1988				-				0
1989				-				0
1990				3				3
1991				10				10
1992				-				0
1993				-				0
1994				5				5
1995	5			45				50
1996	-		2					2
1997	-		+	9				9
1998	-	1	-	1				2
1999	-	0	-	-	+	2		2
2000		1	-		6			7
2001		0	29	2	24		4	59
2002		0	4	4	0			8
2003			17	2	0			19
2004								
2005				1				1
2006	1							1
2007								0
2008								0
2009		0	1					1
2010								0
2011		1						1
2012	3						1	4
2013								0
2014								0
2015								0
2016								0
2017*								0

Table 4.5.1. (continued).

Ling 14.

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	russia	Total
1988		3	-	-	-	-		3
1989		1	-	-	-	-		1
1990		1	-	2	6	-		9
1991		+	-	+	1	-		1
1992		9	-	7	1	-		17
1993		-	+	1	8	-		9
1994		+	-	4	1	1		6
1995	-	-		14	3	0		17
1996	-			0				0
1997	1			60				61
1998	-			6				6
1999	-			1				1
2000			26	-				26
2001	1			35				36
2002	3			20				23
2003				83				83
2004				10				10
2005								0
2006								0
2007				5				5
2008					1		1	2
2009	+	3						3
2010		3						3
2011	2			1				3
2012	1		105					106
2013								0
2014	1	1	6	1	1			9
2015								0
2016	9	1		10			**1**	**21**
2017*	1			1			**2**	**4**

***Preliminary.**

Table 4.5.2 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	1	26 013
2000	228	9246	384	6909	1879		73	1182	846	218	3578	339	1	7	26	24 916
2001	262	7854	284	5143	788		87	1226	807	220	3360	594	0	59	36	20 720
2002	263	9072	309	4127	533		119	964	891	453	3526	467	0	8	23	20 756
2003	261	6433	234	3246	660		112	524	787	176	2940	436		19	83	15 912
2004	232	6306	241	2769	1064		97	640	801	161	2427	492		0	10	15 240
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	0	14 942
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	0	15 414
2007	174	5858	159	3119	1314		43	358	710	125	1749	312		0	5	13 927
2008	168	7259	200	2950	1551		15	259	569	187	1541	345		0	1	15 045
2009	149	7408	314	2324	2635		48	131	363	106	673	186		1	3	14 341

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
2010	142	6398	201	3031	2687		44	253	294	69	848	134		0	3	14 104
2011	140	6508	211	2999	1259		28	208	425	155	936	201		0	3	13 073
2012	145	7018	192	3655	1390		14	1013	436	167	1520	552		0	106	16 208
2013	130	7197	176	4660	795		30	1010	482	224	1608	459		0	0	16 771
2014	120	7749	141	4761	774		29	532	605	334	1557	395		0	9	17 075
2015	125	8069	147	4764	1215		19	560	347	88	1065	337		0	0	16 736
2016	**152**	**9739**	**150**	**5659**	**1088**		**24**	**570**	**293**	**114**	**1172**	**287**			**21**	19269
2017	138	11222	143	6306	793		24	315	203	48	881	199		0	4	20276

***Preliminary.**

Table 4.5.3. Number of French fishing vessels (otter trawlers, gillnetters and longliners) during the period 2000–2016.

NUMBERS OF SHIPS	OTTER TRAWLERS	GILLNETTERS	LONGLINERS
2000	65	12	1
2001	77	13	2
2002	66	15	3
2003	61	19	2
2004	52	22	0
2005	46	24	1
2006	44	20	6
2007	42	20	7
2008	37	20	7
2009	38	20	6
2010	29	21	2
2011	32	18	3
2012	36	15	4
2013	33	14	8
2014	33	13	9
2015	31	9	11
2016	26	5	12
2017	28	11	17

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

5.1 Stock description and management units

Biological investigations in the early 1980s suggested that at least two adult stock components were found within the area, a northern stock in Subarea 14 and Division 5.a with a small component in 5.b, and a southern stock in Subarea 6 and adjacent waters in Division 5.b. This was supported by differences in length and age structures between areas as well as in growth and maturity. Egg and larvae data from early studies also suggested the existence of many spawning grounds in each of areas of the northern and southern stocks and this was considered as indications of stock separation. However, in most areas small blue ling below 60 cm do not occur and fish appear in survey and commercial catch at 60–80 cm suggesting scale large spatial migrations and therefore limited population structuring. The conclusion is that stock structure of blue ling in the ICES area is uncertain.

As in previous years, in addition to one stock in Division 5.b and Subareas 6 and 7 and one in Division 5.a and 14. All remaining areas are grouped together as “other areas". This latter unit includes Subareas 1 and 2 and Division 4.a and 3.a were historical landing have been significant and subareas, 8 and 9, where the species does not occur. Landings reported in 8 and 9 are ascribed to the related Spanish ling (*Molva macrophtalma*). The situation in Subarea 12 is different as this subarea includes part of the Mid-Atlantic Ridge (12.a1, 12.a2, 12.a4 and 12.c) and the western slope of the Hatton Bank (12.b). None of these have represented major landings in the 2000s. However, based upon the continuity of bathymetric features and lesser abundance, blue ling from the western Hatton Bank is likely to be similar to those from the northern Hatton Bank (6.b). Therefore, including ICES Division 12.b in the assessment unit for 5.b, 6 and 7 could be considered. Because of the much lesser abundance of blue ling on the Hatton Bank, this should not impact significantly on the assessed stock biomass and dynamics.

Historical total international landings show that blue ling have been exploited for long. Before the start of the time-series used by WGDEEP, Norway landed 1000–2000t per year in the 1950s and 1960s. These landings might have been mainly from Subareas1 and 2. German landings starting in the 1950s were mainly reported in Statlant from ICES Division 5.a and 5.b. Since 1966, the main fishing countries have been the Faroe Islands, France, Germany, Iceland and Norway (Figure 5.1.1). Except in a few recent years where large amount where caught in Division 5.a, the stock unit of Division 5.b and Subareas 6 and 7 have had the main contribution to total landings (Figure 5.1.2).

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

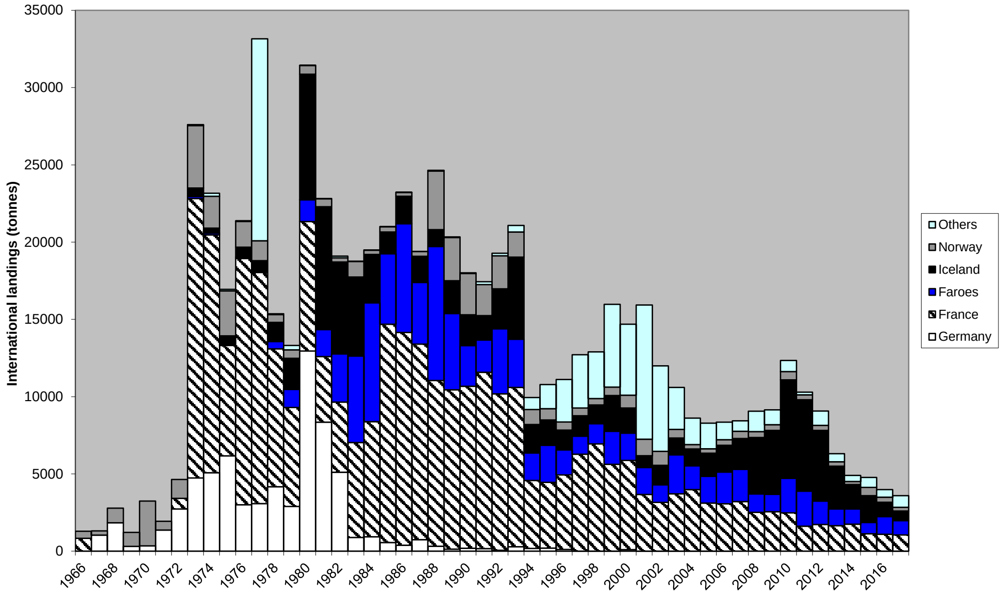

Figure 5.1.1. Total international landings of blue ling in the Northeast Atlantic, by country, 1966–2017.

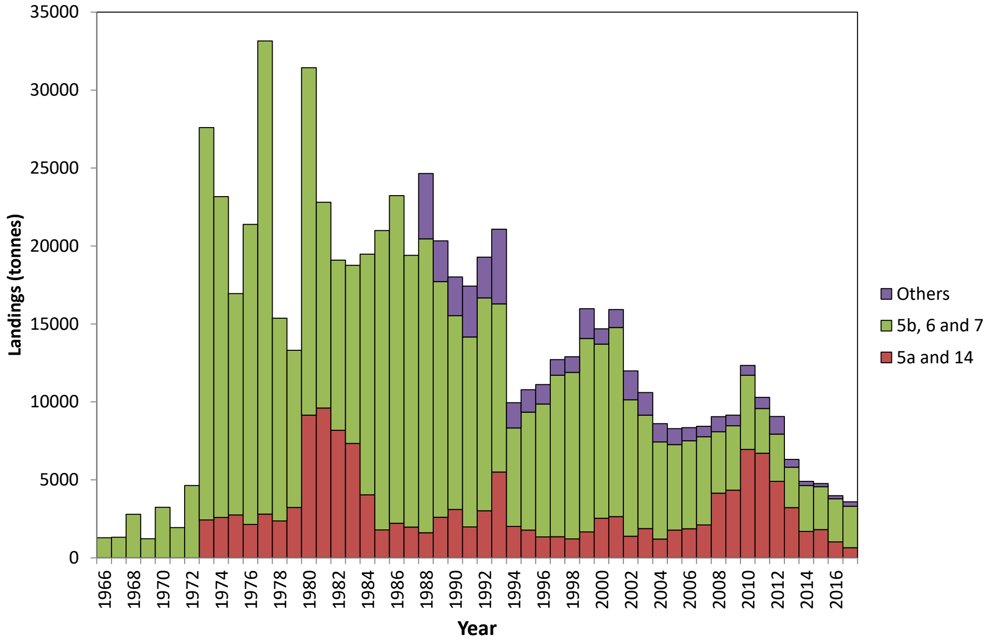

Figure 5.1.2. Total international landings of blue ling in the Northeast Atlantic, by stock unit, 1966–2017.

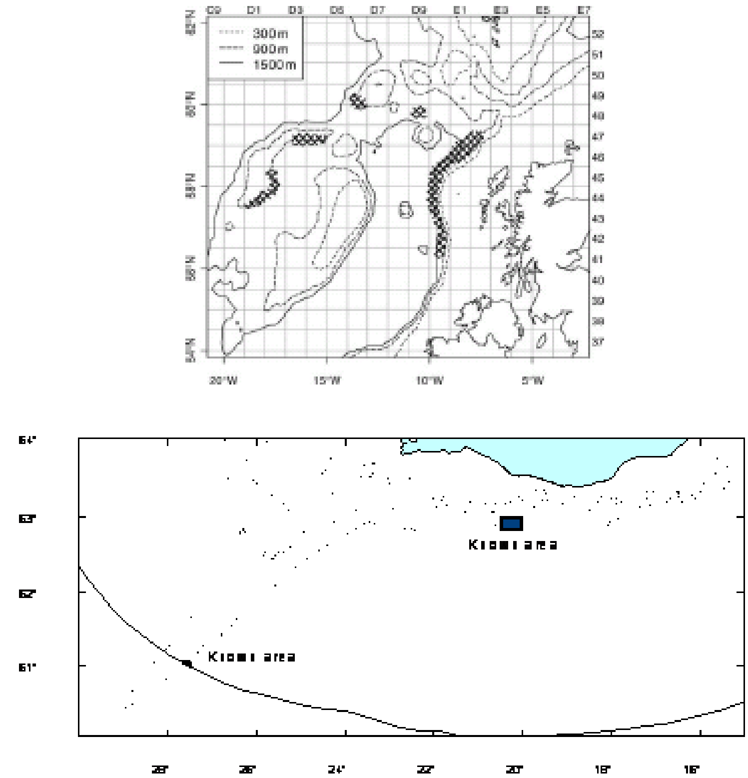

Figure 5.1.3. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b, from Large *et al.*, 2010).

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

5.2.1 The fishery

The change in geographical distribution of the Icelandic blue ling fisheries from 1999, to 2017 (Figures 5.2.1 and 5.2.2) indicates that there has been an expansion of the fishery of blue ling to northwestern waters. This increase may partly be the result of increased availability of blue ling in the north western area.

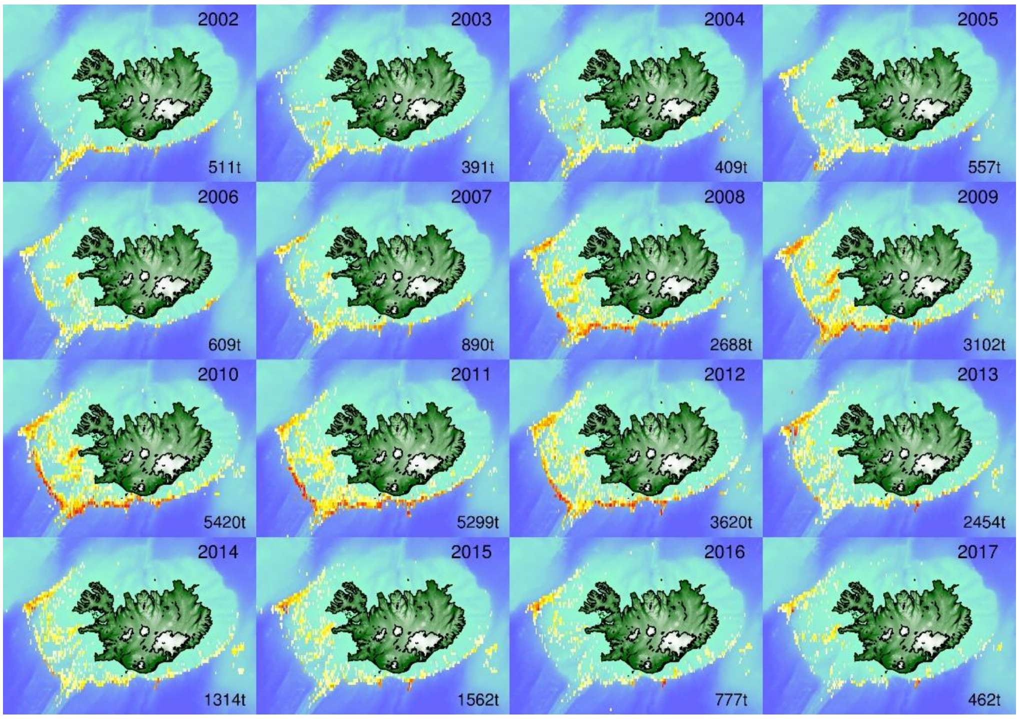

Figure 5.2.1. Blue ling in 5.a and 14. Geographical distribution of the Icelandic blue line fishery since 2002 as reported in logbooks. All gear types combined.

Before 2008 the majority of the catches of blue ling in 5.a were by trawlers, as bycatch in fisheries targeting Greenland halibut, redfish, cod and other demersal species (Table 5.2.3). Most of the catches by trawlers are taken in waters shallower than 700 m and by longliners until 2008 mostly at depths shallower than 600 m.

After 2007 there was a substantial change in the fishery for blue ling in 5.a (Table 5.2.3). The proportion of catches taken by longliners increased from 7–20% in 2001–2007 to around 70% in 2011 as longliners started targeting blue ling. The trend has reversed and in 2015–2017 the proportion of longline catches decreased to 20–30%. At the same time longliners have started fishing in deeper waters than before 2008 and since then the bulk of the longline catches have been taken at depths greater than 500 m (Figure 5.2.3).

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

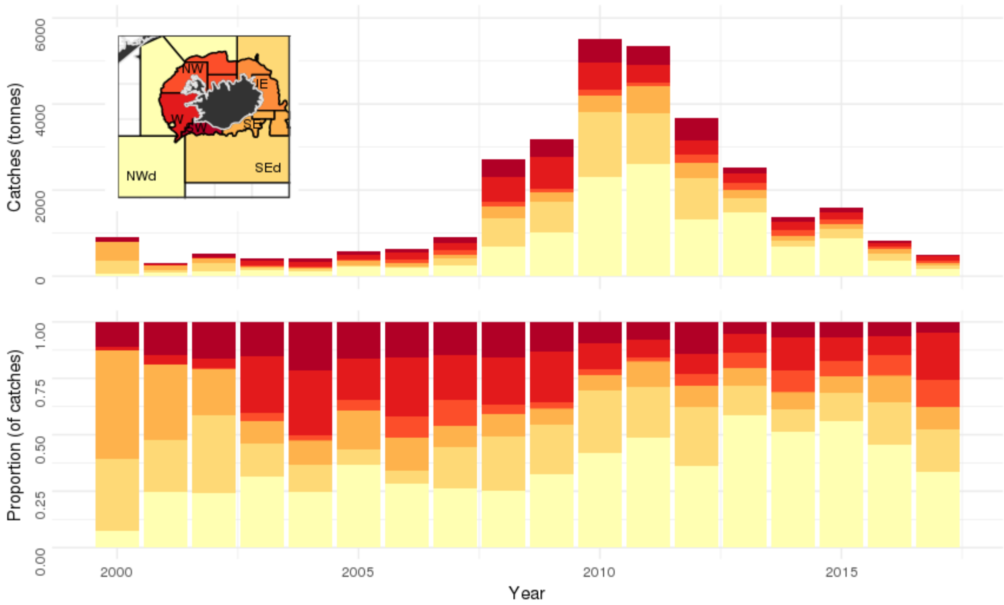

Figure 5.2.2. Blue ling in 5.a and 14. Spatial distribution of reported catches in 5.a in tonnes (upper) and as annual proportions (lower). The inserted map shows the area division and location of operations in 2013 (hauls and lines) as white points.

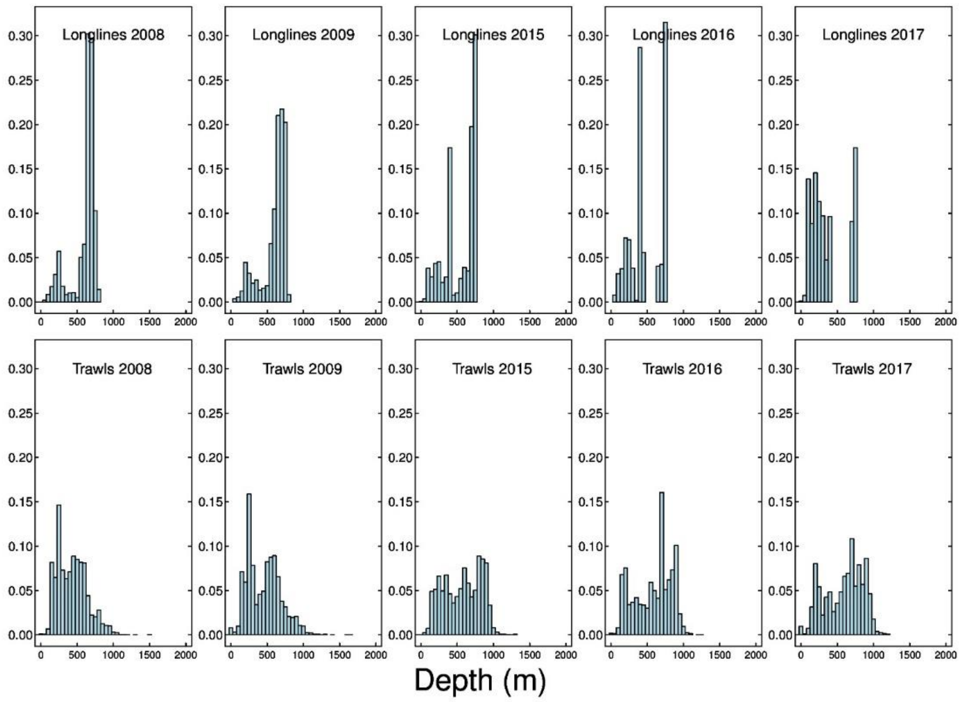

Figure 5.2.3. Blue ling in 5.a and 14. Depth distribution of longlines (upper row) and trawls (lower row) catches in 5.a according to logbook entries.

5.2.2 Landings trends

The preliminary total landings in 5.a 2017 were 636 t of which the Icelandic fleet caught 619 t. (Table 5.2.2 and Figure 5.2.4). Catches of blue ling in 5.a increased by more than 370% between 2006 and 2010, the main part of this increases can be attributed to increased targeting of blue ling by the longline fleet. Since then catches in 5.a decreased compared to 2010 or by around 4900 tonnes (Table 5.2.3).

Total international landings from 14 (Table 5.2.2) have been highly variable over the years, ranging from a few tonnes in some years to around 3700 t in 1993 and 950 t in 2003. Most of the landings in 2003 were taken by Spanish trawlers (390 t), but there is no further information available on this fishery. These larger landings are very occasional and, in most years, total international landings have been between 50 and 200 t. Preliminary landings in 2017 were 17 t.

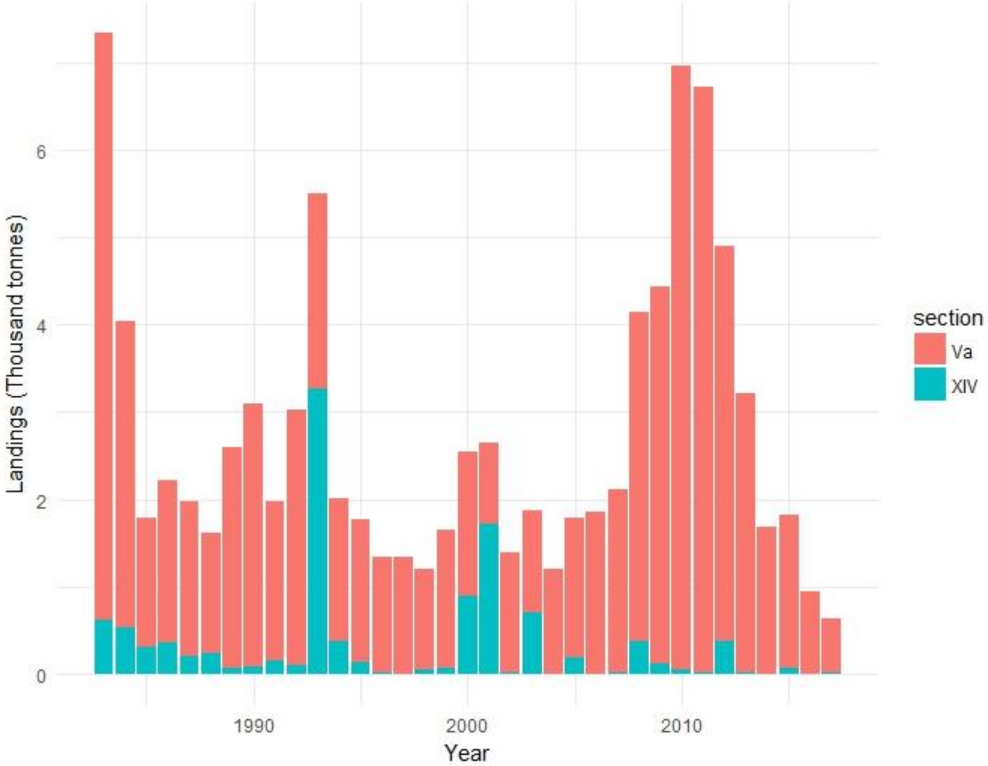

Figure 5.2.4. Blue ling in 5.a and 14. Nominal landings.

5.2.3 ICES Advice

The ICES advice for 2017 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1956 tonnes. Area closures to protect spawning aggregations should be maintained and expanded as appropriate.

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

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

5.2.4 Management

Before the 2013/2014 fishing year the Icelandic fishery was not regulated by a national TAC or ITQs. The only restrictions on the Icelandic fleet regarding the blue ling fishery were the introduction of closed areas in 2003 to protect known spawning locations of blue ling, which are in effect. As of the 2013/2014 fishing year, blue ling is regulated by the ITQ system (regulation 662/2013) used for many other Icelandic stocks such as cod, haddock, tusk and ling. The TAC for the 2016/2017 fishing year was set at 2032 based on the recommendations of MRI using the same advisory procedure as in 5.2.3.

Table 5.2.5. Blue ling in 5.a and 14. TAC recommended for tusk in 5.a by the Marine Research Institute, national TAC and total landings from the quota year 2013/2014.

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

5.2.5 Data available

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

5.2.5.1 Landings and discards

Landings data are given in Tables 5.2.1 and 5.2.2. Discarding is banned in the Icelandic fishery. There is no available information on discarding of blue ling in 5.a and 14. Being a relatively valuable species and not being subjected to TAC constraints before 2013/2014 fishing year nor minimum landing size there should be little incentive to discard blue ling in 5.a.

5.2.5.2 Length compositions

Length distributions from the Icelandic trawl and longline catches for the period 2001–2016 are shown in Figure 5.2.5. Due to a mistake, no length measures were called for from commercial catches in 2017. Mean length from trawls increased from 86 cm in 2012 to 94 cm in 2016. On average mean length from longlines is higher than from trawls.

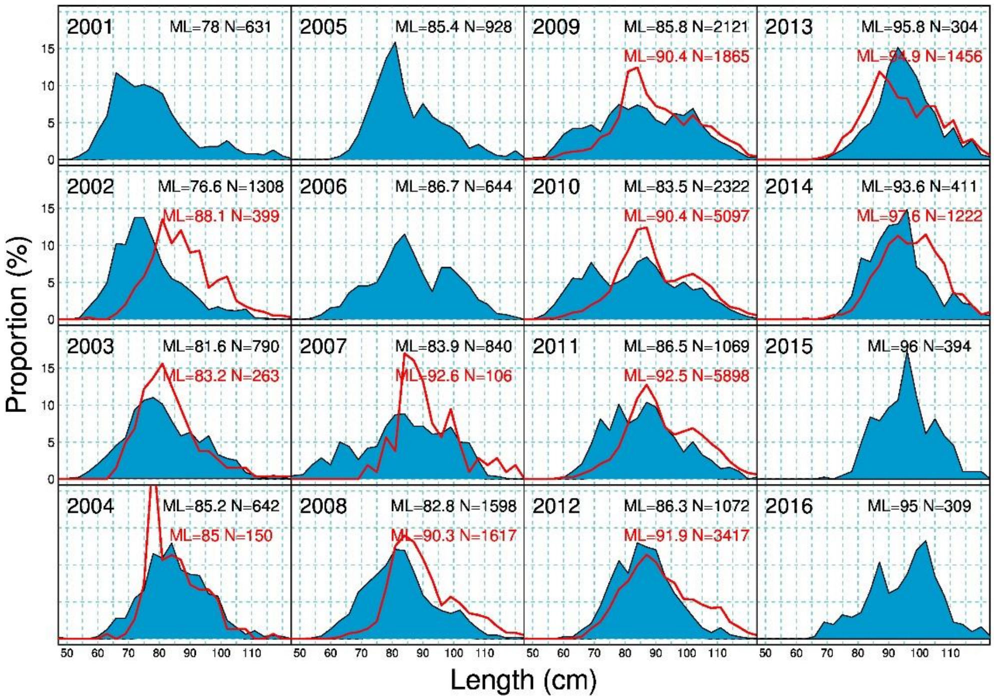

Figure 5.2.5. Blue ling in 5.a and 14. Length distribution of blue ling from trawls (blue area) and longlines (red lines) of the Icelandic fleet in 5.a since 2001, though 2017 is missing due to lack of data. The number of measured fish (N) and mean length (ML) is also given.

5.2.5.3 Age compositions

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

5.2.5.4 Weight-at-age

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

5.2.5.5 Maturity and natural mortality

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

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

5.2.5.6 Catch, effort and survey data

Effort and nominal cpue data from the Icelandic trawl and longline fleet are given in Figure 5.2.6. Due to changes in the fishery (expansion into new areas, fleet behaviour, etc.) and technical innovations cpue is not considered a reliable index of biomass abundance of blue ling in 5.a and therefore no attempt has been made to standardize the series. However, looking at fluctuations in cpue and effort may be informative regarding the development of the fishery. Cpue from longlines has remained high since 2008. No marked changes are observed from trawls since 2000.

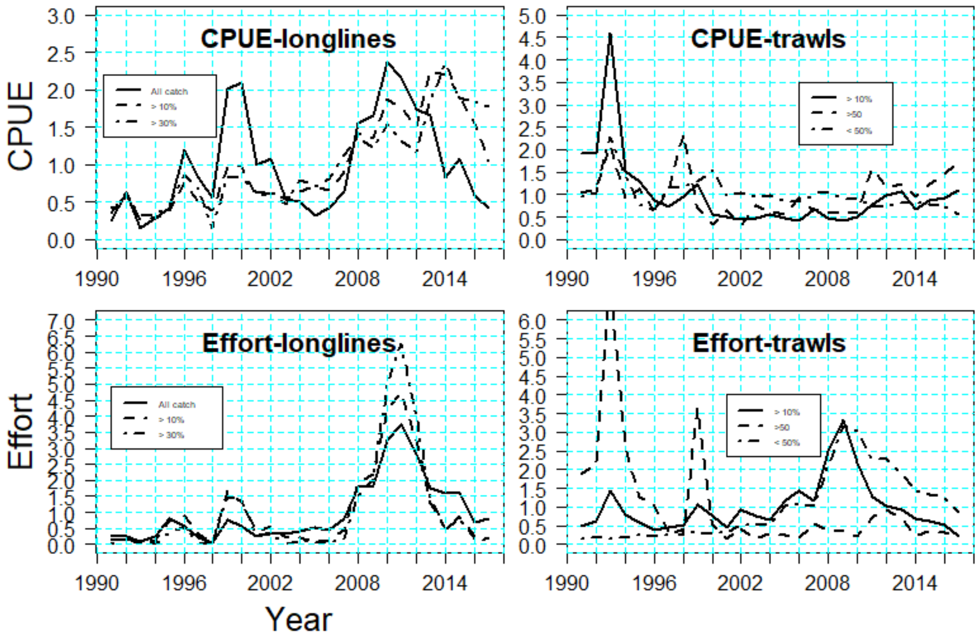

Figure 5.2.6. Blue ling in 5.a and 14. Nominal cpue and effort from longlines and trawls in 5.a based on logbook data where blue ling was either recorded in catches or above certain level.

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

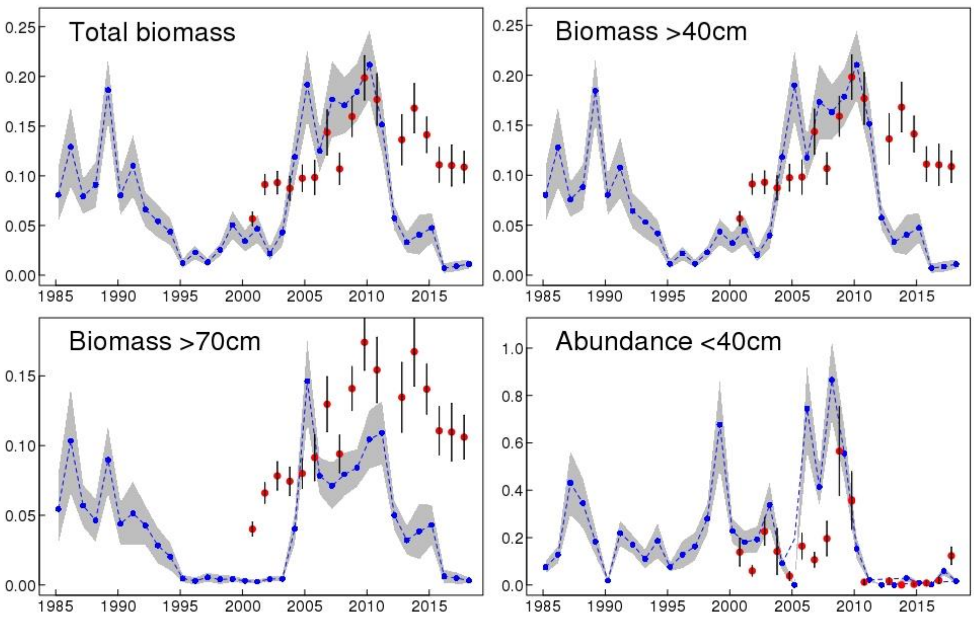

Figure 5.2.7. Blue ling in 5.a and 14. Abundance indices for blue ling in the Icelandic spring survey since 1985 (line and shaded area) and the autumn survey since 2000 (red points and vertical lines). A) total biomass index, b) biomass of 40 cm and larger c) biomass of 70 cm and larger, d) abundance index of <40 cm. The shaded area and the vertical bar show +/- standard error of the estimate.

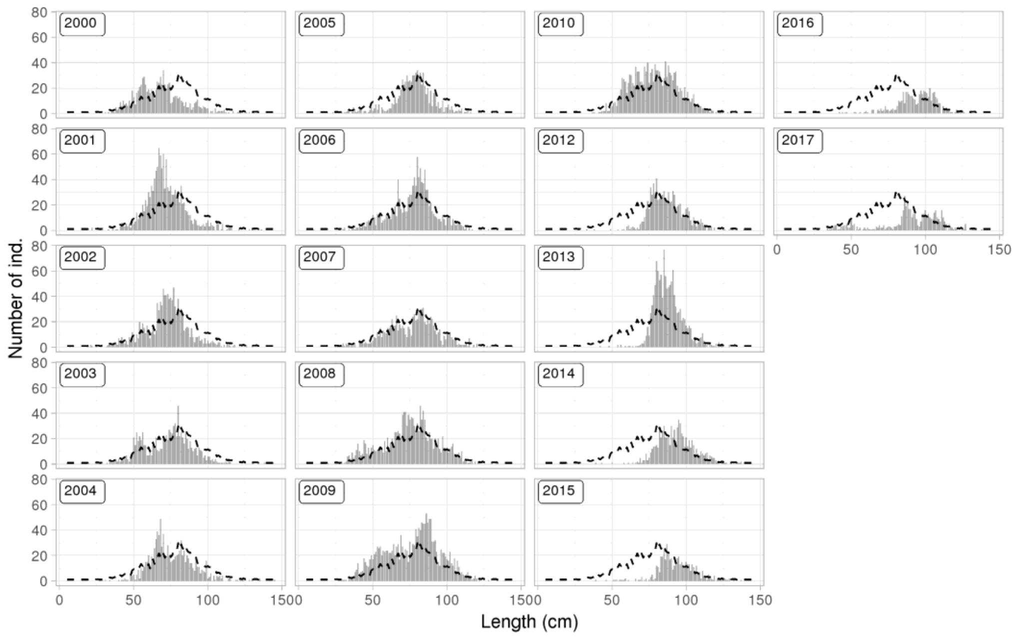

Figure 5.2.8. Blue ling in 5.a and 14. Length distributions from the Icelandic autumn survey since 2000. Black line is the average by length over the whole survey period.

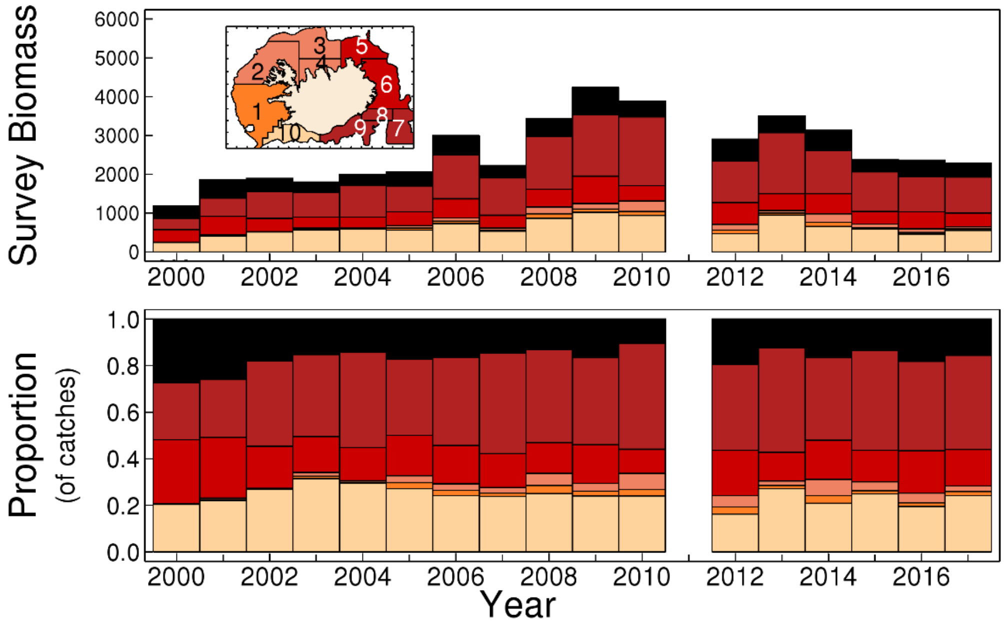

Figure 5.2.9. Blue ling in 5.a and 14. Spatial distribution from the Icelandic autumn survey.

5.2.6 Data analyses

Landings and sampling

Catches from the Icelandic longline fleet increased rapidly from 2007–2010 resulting in a rapid expansion of the fishing area and change in the selectivity of the fishery although there are now strong indications since 2012 that this may have reversed. This can be seen when looking at Table 5.2.3. In 2005 longliners caught 102 tonnes of blue ling when trawlers caught 1260 tonnes or 84% of the total catches (1505 tonnes). In 2011 trawlers caught 1618 tonnes, out of 5900 tonnes or 27%, but longliners 4138 tonnes or 70%. Since then the proportion taken by longliners has decreased and in 2017 longliners caught 27% of the catches, trawls 70% and other gear 3%.

As longliners take on average larger blue ling (Figure 5.2.5) 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 in 2011 but in longlines in 2012 and 2013. The expansion of the longline fleet to deeper waters (Figure 5.2.3) may be the result of decreased catch rates in shallower areas.

Cpue and effort

As stated above cpue indices from commercial catches are not considered a reliable index of stock abundance. Therefore, the rapid increase in cpue from longlines should not be viewed as an increase in stock biomass but rather as the result of increased interest by the longline fleet and its expansion into deeper waters (Figure 5.2.6). In 2011 to 2012 there was a slight decrease in cpue from longline but the cpue increased again in 2013 to its highest value in the time-series. Cpue from trawling has remained at low levels while effort increased until about 2009 after which it has decreased (Figure 5.2.6).

Surveys

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

The shorter autumn survey, which goes to greater depths and is therefore more likely to reflect the true biomass dynamics than the spring survey does indicate that there was an increase in blue ling biomass since 2007 (Figure 5.2.7). Since 2010 the biomass index has decreased to similar levels as observed in 2002–2005. A large increase of more than 200% in the recruitment index was observed in 2008 but in the 2010 it had decreased again to its lowest observed value and has not increased again (Figures 5.2.7 and 5.2.8). Due to industrial action, only part of the autumn survey was conducted in 2011.

F_{proxy}

Relative fishing mortality (F_{proxy} = Yield/Survey biomass) derived from the autumn survey (+40 cm) and the combined catches from 5.a and 14 indicates that fishing mortality may have increased by more than 150% between 2007–2010 (Figure 5.2.10 and Table 5.2.4). Since then there are indications that it has decreased by similar percentage between 2012 and 2014, to the same levels as observed in 2002 and 2009 but has decreased even further between 2015 and 2017. The reason for the decrease is because of proportionally greater decrease in landings than in the survey index.

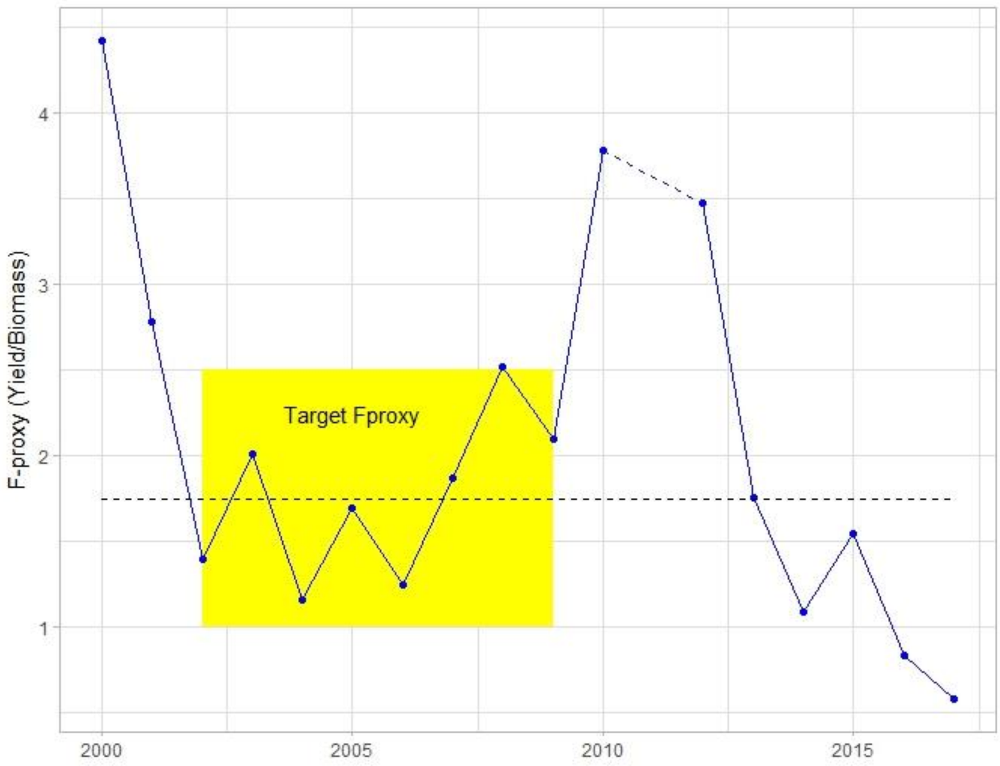

Figure 5.2.10. Blue ling in 5.a and 14. Changes in relative fishing mortality (Yield/Survey biomass >39 cm). The yellow box highlights the reference period used by ICES as basis for the 2012 advice and the blue dotted line is the target F_{proxy} of 1.75 (Mean of 2002–2009).

Analytical assessment

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

An exploratory stock assessment of blue ling in 5.a using the Gadget model was presented at WGDEEP 2012. Updated results of the model were not presented at WGDEEP 2017.

5.2.7 Comments on the assessment

The assessment presented above is based on the ICES DLS approach for category 3 stocks and was proposed by the ADG in 2012. In the 2012 advice the target F_{proxy} was set at 1.7 or the average F_{proxy} in 2002–2009, however the landings from 14 were not correct and using the revised landings the target should be 1.75.

The autumn survey index in 2016 was 1086.0. Using the same procedure as last year would result in the advice for 2018 to set the TAC at 1901 t (1086.0 * 1.75).

5.2.8 Management consideratio3ns

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

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

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

5.2.9 Application of MSY_{proxy} reference points (ToR h)

In the ICES response to the: EU request to provide a framework for the classification of stock status relative to MSY proxies for selected category 3 and category 4 stocks in ICES Subareas 5 to 10. ICES set the F_{MSY} proxy for blue ling in 5.a as 1.75 but did not set a B_{MSY} trigger proxy for the stock.

This year WGDEEP tried to re-run the SPiCT model on the index used for the assessment. The length-based indicator model however, uses the length distribution from commercial catches which are missing for 2017 and hence, running the model was not possible.

Conclusions

The analysis presented above indicates that the fishing pressure is below F_{MSY} and the stock biomass is above possible MSY $B_{trigger,proxy}$. This does not sound unlikely given that the biomass index is still rather high compared to its lowest values. The selection pattern from the fishery is good as only large blue ling are being caught but that is most likely because there is no recruitment coming into the stock at present.

The findings presented here support the general view of WGDEEP that the stock is at a sustainable level and that the selection pattern is good.

5.2.10 Tables

Table 5.2.1. Blue ling: Landing in ICES Division 5.a.

Year	Faroe	Germany	Iceland	Norway	UK	Total
1973	74	1678	548	6	61	2367
1974	34	1959	331	140	32	2496
1975	69	1418	434	366	89	2376
1976	29	1222	624	135	28	2038
1977	39	1253	700	317	0	2309
1978	38	0	1237	156	0	1431
1979	85	0	2019	98	0	2202
1980	183	0	8133	83	0	8399
1981	220	0	7952	229	0	8401
1982	224	0	5945	64	0	6233
1983	1195	0	5117	402	0	6714
1984	353	0	3122	31	0	3506
1985	59	0	1407	7	0	1473
1986	69	0	1774	8	0	1851
1987	75	0	1693	8	0	1776
1988	271	0	1093	7	0	1371
1989	403	0	2124	5	0	2532
1990	1029	0	1992	0	0	3021
1991	241	0	1582	0	0	1823
1992	321	0	2584	0	0	2905
1993	40	0	2193	0	0	2233
1994	89	1	1542	0	0	1632
1995	113	3	1519	0	0	1635
1996	36	3	1284	0	0	1323
1997	25	0	1319	0	0	1344
1998	59	9	1086	0	0	1154
1999	31	8	1525	8	11	1583
2000	0	7	1605	25	8	1645
2001	95	12	752	49	23	931
2002	28	4	1256	74	10	1372
2003	16	16	1098	6	24	1160
2004	38	9	1083	49	20	1199
2005	24	25	1497	20	26	1592
2006	63	22	1734	27	9	1855
2007	78	0	1999	4	10	2091
2008	88	0	3653	21	0	3763
2009	178	0	4132	5	0	4315
2010	515	0	6377	13	0	6905
2011	797	0	5903	2	0	6702
2012	312	0	4207	2	0	4521
2013	435	0	2769	2	0	3204
2014	71	0	1588	30	0	1689
2015	10	0	1734	4	0	1748
2016	6	0	925	84	0	1015

Year	Faroe	Germany	Iceland	Norway	UK	Total
2017[1)]	4	0	619	0	0	623

[1)] **Provisional figures.**

Table 5.2.2. Blue ling: Landing in ICES Division 14. Source: STATLANT database.

Year	Faroe	Germany	Greenland	Iceland	Norway	Russia	Spain	UK	Denmark	Total
1983	0	621	0	0	0	0	0	0	0	621
1984	0	537	0	0	0	0	0	0	0	537
1985	0	315	0	0	0	0	0	0	0	315
1986	214	149	0	0	0	0	0	0	0	363
1987	0	199	0	0	0	0	0	0	0	199
1988	21	218	3	0	0	0	0	0	0	242
1989	13	58	0	0	0	0	0	0	0	71
1990	0	64	5	0	0	0	0	10	0	79
1991	0	105	5	0	0	0	0	45	0	155
1992	0	27	2	0	50	0	0	32	0	111
1993	0	16	0	3124	103	0	0	22	0	3265
1994	1	15	0	300	11	0	0	57	0	384
1995	0	5	0	117	0	0	0	19	0	141
1996	0	12	0	0	0	0	0	2	0	14
1997	1	1	0	0	0	0	0	2	0	4
1998	48	1	0	0	1	0	0	6	0	56
1999	0	0	0	0	1	0	66	7	0	74
2000	0	1	0	4	0	0	889	2	0	896
2001	1	0	0	11	61	0	1631	6	0	1710
2002	0	0	0	11	1	0	0	0	0	12
2003	0	0	0	0	36	0	670	5	0	711
2004	0	0	0	0	1	0	0	7	0	8
2005	2	0	0	0	1	0	176	8	0	187
2006	0	0	0	0	3	1	0	0	0	4
2007	19	0	0	0	1	0	0	0	0	20
2008	1	0	0	0	2	0	381	0	1	385
2009	1	0	0	0	3	0	111	4	0	119
2010	1	0	0	0	9	0	34	0	3	47
2011	0	0	0	0	2	0	0	1	6	9
2012	0	0	0	367	9	0	0	0	3	379
2013	0	0	4	0	0	0	0	3	9	16
2014	0	0	0	0	3	0	0	0	0	3
2015	0,3	0	59	0	0,9	0	0	0	5	65
2016	0	0	0	0	0	0	0	0	7,2	7,2
2017[1)]	0,2	0	3,7	0	4	0	0	0	3,2	11,1

[1)] **Provisional figures.**

Table 5.2.3. Blue ling. Catches by gear type and numbers of boats participating in the blue ling fishery in 5.a.

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

Table 5.2.4. Blue ling in 5.a and 14. Catches in 5.a and 14 along with survey biomass index (larger than 40 cm) from the Icelandic Autumn survey and the calculated F_{proxy} (($C_{5.a}$ + C_{14})/I).

Year	5.a	14	Index	Fproxy
2000	1645	896	574.5	4.42
2001	931	1710	950.2	2.78
2002	1372	12	988.3	1.40
2003	1160	711	930.1	2.01
2004	1199	8	1039.7	1.16
2005	1592	187	1051.4	1.69
2006	1855	4	1492.9	1.25
2007	2091	20	1128.1	1.87
2008	3758	385	1645.2	2.52
2009	4233	119	2073.8	2.10
2010	6905	47	1836.8	3.78
2011	6702	9	*No survey*	
2012	4521	379	1411.5	3.47
2013	3082	16	1762.3	1.76
2014	1588	3	1455.8	1.09
2015	1734	65	1161.1	1.55
2016	925	7	1118.0	0.92
2017	623	11,1	1086.0	0.58

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

5.3.1 The fishery

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

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

5.3.2 Landings trends

Total international landings from Division 5.b (Tables 5.3.1a–f, Figure 5.3.1 and revised stock annex) peaked in the late 1970s at around 21 000 t and then decline until 2010. Thereafter landings have oscillated between 1000 and 1500 tonnes per year. Note that landings for years prior to 2000 were moved to the stock annex, in order to shorten report tables.

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

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

Landings data by country and ICES Division considered for 2016 were extracted from InterCatch for all countries, expect for the Faroe Islands where ICES preliminary landings where used.

5.3.3 ICES Advice

The ICES advices for 2017 and 2018 is "when the MSY approach is applied, catches should be no more than 11314 tonnes in 2017 and no more than 10 763 tonnes in 2018. All catches are assumed to be landed".

Following reference points development carried out in 2015 for stocks of ICES category 1, F_{MSY} for the stock was set to 0.12 in 2016, and this was the reason for the higher ICES catch Advice for 2017 and 2018 compared to previous years. The previous advice, delivered in 2014, was based on an F_{proxy} defined as $F_{50\%SPR}$=0.07.

5.3.4 Management

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

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

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

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

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

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

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

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

Since 2015, the EU TAC in EU and international waters has been set to the level of the ICES catch advice. Therefore international catch from the stock, which include catch in EU, international and Faroese waters, are legally allowed to exceed the ICES catch advice. To constrain catch to a level not exceeding the advice, the EU TAC should be reduced of an amount corresponding to catches in Faroese waters, therefore including the EU quota in Faroese waters and Faroese catch.

In 2009, the EU introduced protection areas of spawning aggregations of blue ling on the edge of the Scottish continental shelf and at the edge of Rosemary Bank (6.a). Entry/exit regulations apply and vessels cannot retain >6 t of blue ling from these areas per trip. On retaining 6 t vessels must exit and cannot re-enter these areas before landing. In 2013, NEAFC introduced a protection of the spawning area located near the southwest boundary of the Icelandic EEZ, this area was banned to bottom fishing gears from 15 February to 15 April from 2013 to 2016 (rec 5:2013, http://www.neafc.org/managing_fisheries/measures/current).

In ICES Division 27.6.b, areas closed to bottom fishing gears have been extended and these include some of the spawning areas identified by Large *et al.* (2009), see Figure 5.1.3b.

5.3.5 Data availability

5.3.5.1 Landings and discards

Landings data for 2015-16 were revised and data for 2017 were available for all countries. International landings have been smaller than 3000 tonnes in each of the four past years (2014-2017). In 2017 only about one quarter of the maximum catch advised by ICES was actually caught. Some EU fleet, in particular the French fleet of large trawlers, appear to be in a situation of under capacity. Although higher fishing opportunities for blue ling became available in 2015, vessels kept fishing mostly for saithe. This under capacity is the results of the reduction of the number of French trawlers >=30 m, based in harbours where deep-waters species are landed from 35 in 2005 to 16 in 2016 (Common Fleet Register data). Further the restriction of fishing at spawning time no longer allows for major target catch at the spawning season as in the 1980s and 1990s.

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

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

5.3.5.2 Length compositions

Annual length distribution of blue ling landings from Faroese trawlers was available from 1981 to 2017 (Figure 5.3.2).

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

Time-series of number and occurrence (percent of haul) of blue ling smaller than 80 cm in Faroese surveys was provided (Figure 5.3.6).

The length distribution of French landings was updated ((Figure 5.3.7).

5.3.5.3 Age compositions

Age estimation of blue ling sampled from 2009 to 2017 was available from France. In application of the DCF regulation about 250 age estimations have been carried out for every quarter since 2009.

5.3.5.4 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. Weight and length data were provided by Faroe Island and the parameters of the length–weight relationship from new data were similar to the previous estimates.

5.3.5.5 Maturity and natural mortality

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

5.3.5.6 Catch, effort and RV data

The standardized cpue time-series from the Faroese trawler fleet was updated (Ofstad, 2016 WD). This time-series was not used in assessment.

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

The Scottish deep-water research survey has been set to be biennial, the last survey was carried out in 2017; the available time-series is presented in Figure 5.3.8).

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

The standardized abundance index from the Norwegian longliner fleet operating in 6.a was updated (Table 5.3.3). The standardization method was the same as that developed for ling (Helle *et al.*, 2015) and is also used for stocks of ling and tusk (see chapters 4 and 6). This index shows large year-to-year variation probably in relation to the small size of the fleet and the small fishing effort and catch. This index is not used for assessment as it is not considered is representative of variation in abundance.

5.3.6 Data analyses

Length distribution of catches of Faroese fleets show that fish caught are mostly in the length range 70–120 cm (Figures 5.3.2). Recruitment inputs are visible in survey catches in some years, e.g. 2007–2009 and again in 2017 (Figure 5.3.3). Smaller and more variable numbers are caught in the Faroese spring survey (Figure 5.3.4). The time series from the Faroese deepwater survey in still short (4 years) and no standardised index is calculated yet.

Mean length in French trawl landings shows a decreasing trend from the mid-1980s to the mid 1995 (Figure 5.3.7). The mean length then remained small at less than 90 cm up to the late 2000s, afterward it increased and now oscillate around 95 cm. This is considered to reflect the overexploitation in the 1990s, followed by a rebuilding.

Surveys

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

Multiyear catch curve (MYCC) model

Results of the Multiyear catch curve (MYCC, see stock annex) model are presented in Figures 5.3.9 and 5.3.10. The total mortality was estimated to 0.14 in 2016 and 2017 and 0.15 during the two previous years, corresponding to fishing mortalities of 0.03 and 0.04 respectively. The fishing mortality has been smaller than 0.12 (FMSY) since 2004 and smaller the 0.07 (MSY F_{lower}) since 2008. The total number of individuals of age 9 and over was estimated to 23 million at the start of 2018.

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

SRA estimates were made using the natural mortality *M=0.11*, which, was chosen in 2014, because it resulted in the smallest difference in number-at-age estimated from the MYCC and SRA. This value is also similar to F=0.1 used for blue ling in 5.a and 14.b.

The cpue index from the Norwegian longline fleet was updated. This index shows large year-to-year variation probably in relation to the small size of the fleet and the small fishing effort and catch. It is reminded that the Irish index from the Irish deep-water survey 2006–2009 was no longer used in this model since 2015.

Trials were made to fit the model to available time-series of indices (the fishery independent indices for the Marine Scotland Science Deepwater Survey and from the Faroese summer survey) and the biomass index from the Norwegian longline fishery. Technical problems were met as the fit never converged when the three time-series of indices were used together, although the trend did not look conflicting. As a consequence one fit was made using the Faroe summer survey and the Norwegian longline index and another fit with the Scottish survey. These fits are further referred to as FIT1 and FIT2.

The estimates trends of stock biomass and fishing mortality were similar in these two fits and tables and figures are provided for the first only (Tables 5.3.5 and Figures 5.3.12 AND 5.3.).

Estimated biomass trajectories and fishing mortalities were similar to previous estimates. The exploitable biomass at the start of the time-series was estimated to 279 000 t and 269 000 t in FIT1 and FIT 2 respectively. The biomass at the start of 2018 was estimated to 119 000 t and 95 000 t in FIT1 and FIT 2 respectively, corresponding to 42% and 35 % of the biomass in the initial year (1966). In both fits, the fishing mortality in recent years was low, smaller than 0.05 since 2011 down to 0.02-0.03 in the last year. The estimated F in the past was high during 20 years or more from the mid-1980s to the mid-2000s. The exploitable biomass was at its lowest historical level, in 2002–2003 for both fits. It was then less than 20% of the initial biomass, i.e. close or below the precautionary approach B_{lim} level as expected, at the time, in assessment comments, although without quantification, at the time (ICES, 2002). For this stock the exploitable biomass and the spawning biomass (SSB) are equal because the fish recruit to the fishery and to the adult stock at the same time.

Reference points

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

Reference points for bli-5b67 estimated by WKMSYref4.

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

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

5.3.7 Comments on assessment

The assessment of blue ling in ICES Division 5.b and Subareas 6 and 7 is based on two models. A multiyear catch curve model (MYCC) is used to estimate the total annual mortality taking into account annual variations in recruitment, a stock reduction analysis (SRA) is used to predict the biomass dynamics of the stock. Although F_{MSY}=0.12 was estimated for the stock, WKMSYref4 reported that *"it seems most appropriate to use ' F_{MSY} lower with $B_{trigger}$* [=0.08] *as an interim F_{MSY} reference point for management purpose. This would allow increasing the catch and continuing the rebuilding of the stock biomass, while getting more years in the assessment"*. The advice delivered in 2016 was however based on F_{MSY}=0.12. Since 2014, the catch advice for the stock has been based upon the results from the MYCC model.

5.3.8 Management considerations

Blue ling is susceptible to sequential depletion of spawning aggregations. Maintaining the current closed areas will provide protection for the spawning aggregations. This may not be needed as far as a TAC management regime is effective in limiting fishing mortalities as intended and if highly aggregated fisheries in these areas do not cause local depletion. In Faroese waters, from which one third to half the catch has been taken in recent years, the catch is mainly taken in the spawning season. Spawning areas in Faroese waters were further identified in 2017 based upon analyses of past survey data (Ofstad, 2018, WD). Temporal closures on these areas could be considered.

5.3.9 References

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5.3.10 Tables

Table 5.3.1a. Landings of blue ling in Subdivision 5.b.1 (see stock annex for years before 2000).

YEAR	FAROES	FRANCE(1)	GERMANY(1)	NORWAY	UK (E & W) (1)	UK (Scot.)	IRELAND	RUSSIA(1)	TOTAL
2000	1677	575	1	163	33			1	2450
2001	1193	430	4	130	11		2		1770
2002	685	578		274	8				1545
2003	1079	1133		12	1				2225
2004	751	1132		20				13	1916
2005	1028	781		15	1				1825
2006	1276	839		21	1			16	2153
2007	1220	1166		212	8			36	2642
2008	642	865		35				110	1652
2009	523	325						0	848
2010	840	464		49			0	0	1353
2011	838	312		0			0	0	1150
2012	799	424		8			0	5	1236
2013	440	423		0			0	3	866
2014	730	609		29					1368
2015	621	142	0	140	0		0	0	9503
2016	1100	555	0	74	0		0	0	1730
2017	766	267	0	21	0	3	0	0	1057

(1) Includes 5.b.2.

Table 5.3.1b. Landings of Blue ling in Subdivision 5.b.2 (see stock annex for years before 2000).

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

(1) Includes 5.b.1.

Table 5.3.1c. Landings of blue ling in Division 6.a (see stock annex for years before 2000).

YEAR	FAROES	FRANCE	GERMANY	IRELAND	NORWAY	SPAIN(1)	E & W	SCOTLAND	LITHUANIA	TOTAL
2000		4544	94	9	102	108	24	1300		6181
2001		2877	6	179	117	797	116	2136	16	6244
2002		2172		125	61	285	16	2027	28	4714
2003	7	2010		2	106	3	3	428	29	2588
2004	10	2264		1	24	4	1	482	38	2824
2005	17	2019		2	33	88		390	1	2550
2006	13	1794		1	49	87	3	433	2	2382
2007	13	1814			31	47		113	1	2019
2008	14	1579			73	10		112	2	1790
2009	11	2202			74	165		178		2630
2010	43	1937			86	223		134		2423
2011	10	1136			93	10		74		1323
2012	5	1178			86	6		47		1322
2013	2	1168			132	11		203		1516
2014		1094			18			278		1390
2015	0	920	0	0	127	83	8	371	0	1509
2016	0	831			37	125	0	273	0	1266
2017	0	772	0	0	29	44	0	641	0	1486

. (1) Includes 5.b

Table 5.3.1d. Landings of blue ling in Division 6.b (see stock annex for years before 2000).

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

(1) Included in 6.a. (2) includes unallocated catch.

Table 5.3.1e. Landings of blue ling in Subarea 7 (see stock annex for years before 2000).

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

Table 5.3.1f. Blue ling landings in Division 5.b and Subareas 6 and 7 (see stock annex for years before 2000).

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

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

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

Table 5.3.3. Standardized cpue index (kg/1000 hooks) from the Norwegian longliners in ICES Division 6.a.

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

Table 5.3.4. Total and fishing mortality, stock number and recruitment estimates from the MYCC model under the assumption M=0.11.

YEAR	Z	Z STANDARD DEV.	RECRUITMENT NUMBER (MILLIONS)	RECRUIT. STANDARD DEV.	TOTAL NUMBERS AGES 9+ (MILLIONS)	NUMBER AGE 9+ SD	F
1995	0.22	0.01	3.50	0.31	17.04	1.74	0.11
1996	0.23	0.01	3.51	0.32	17.16	1.54	0.12
1997	0.27	0.01	3.56	0.33	17.24	1.37	0.16
1998	0.27	0.01	3.51	0.32	16.71	1.24	0.16
1999	0.31	0.02	3.59	0.33	16.37	1.13	0.20
2000	0.32	0.02	3.50	0.31	15.48	1.07	0.21
2001	0.33	0.02	3.53	0.30	14.83	1.02	0.22
2002	0.28	0.01	3.38	0.34	14.03	1.05	0.17
2003	0.25	0.01	3.41	0.32	14.06	1.11	0.14
2004	0.22	0.01	3.63	0.30	14.56	1.10	0.11
2005	0.21	0.01	3.76	0.34	15.47	1.09	0.10
2006	0.21	0.01	3.70	0.30	16.27	1.13	0.10
2007	0.20	0.01	3.64	0.29	16.82	1.19	0.09
2008	0.18	0.01	3.59	0.28	17.33	1.26	0.07
2009	0.18	0.01	3.49	0.29	18.01	1.33	0.07
2010	0.18	0.01	3.41	0.31	18.53	1.41	0.07
2011	0.15	0.00	3.42	0.31	18.88	1.49	0.04
2012	0.16	0.00	3.30	0.34	19.51	1.59	0.05
2013	0.15	0.00	3.20	0.40	19.90	1.72	0.04
2014	0.15	0.00	3.29	0.37	20.47	1.82	0.04
2015	0.15	0.00	3.61	0.32	21.23	1.82	0.04
2016	0.14	0.00	3.55	0.32	21.88	1.83	0.03
2017	0.14	0.00	3.60	0.33	22.53	1.82	0.03
2018				0.34	23.06	1.85	

Table 5.3.5. Time-series 1966–20116 of exploitable biomass (thousand tonnes), fishing mortality (*F*, year^{-1}) and Spawning–Stock Biomass relative to the Spawning–Stock Biomass in the first year (*SSB/SBB0*) from the stock reduction analysis (SRA), with *M*=0.11.

YEAR	EXPLOITABLE BIOMASS	F	SSB/(SSB0)	YEAR	EXPLOITABLE BIOMASS	F	SSB/(SSB0)
1966	278.8	0	1	1992	71.2	0.23	0.256
1967	277.5	0.01	0.995	1993	67.5	0.18	0.242
1968	276.2	0.01	0.991	1994	66.5	0.11	0.239
1969	273.5	0	0.981	1995	70.1	0.12	0.251
1970	272.6	0.01	0.978	1996	72.1	0.13	0.258
1971	269.7	0.01	0.967	1997	72.7	0.16	0.261
1972	268.2	0.02	0.962	1998	71.3	0.17	0.256
1973	264.1	0.11	0.947	1999	69.3	0.21	0.249
1974	239.6	0.09	0.859	2000	65.4	0.2	0.235
1975	220.9	0.07	0.792	2001	62.8	0.23	0.225
1976	209.6	0.1	0.752	2002	59.4	0.17	0.213
1977	194	0.18	0.696	2003	59.7	0.14	0.214
1978	168	0.09	0.603	2004	61.6	0.11	0.221
1979	161	0.07	0.577	2005	64.7	0.09	0.232
1980	157.5	0.16	0.565	2006	68.4	0.09	0.245
1981	141.9	0.1	0.509	2007	71.7	0.09	0.257
1982	136.3	0.09	0.489	2008	74.8	0.06	0.268
1983	133.4	0.09	0.478	2009	79.3	0.06	0.284
1984	130.1	0.13	0.467	2010	83.5	0.06	0.299
1985	122.8	0.18	0.44	2011	86.9	0.04	0.312
1986	111.8	0.22	0.401	2012	92.4	0.04	0.331
1987	99.4	0.2	0.357	2013	97.6	0.03	0.35
1988	90.9	0.25	0.326	2014	103.3	0.03	0.371
1989	81.3	0.22	0.292	2015	108.5	0.03	0.389
1990	75.8	0.19	0.272	2016	113.9	0.03	0.408
1991	73.4	0.19	0.263	2017	118.9	0.02	0.426

Table 5.3.6. Estimated SSB and yield in the long term (after stabilization) of the stock bli-5b67 under a range of fishing mortality. Projection initiated from the stock number-at-age in 2014 and run for 200 years, with a range of F value from the current F to ten times more.

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

5.3.11 Figures

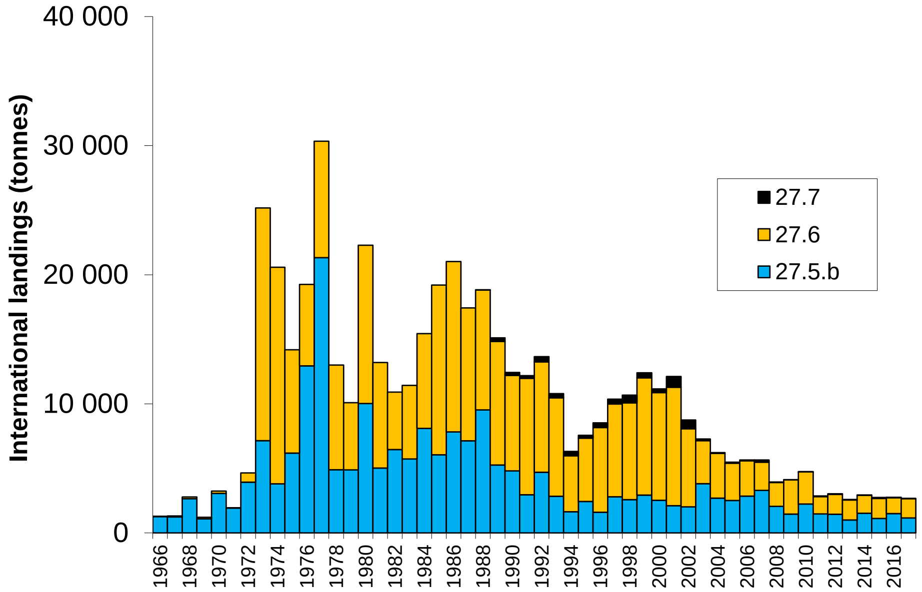


Figure 5.3.1. International landings for bli.27.5b67 in ICES subareas 6 and 7 and Division 5b.

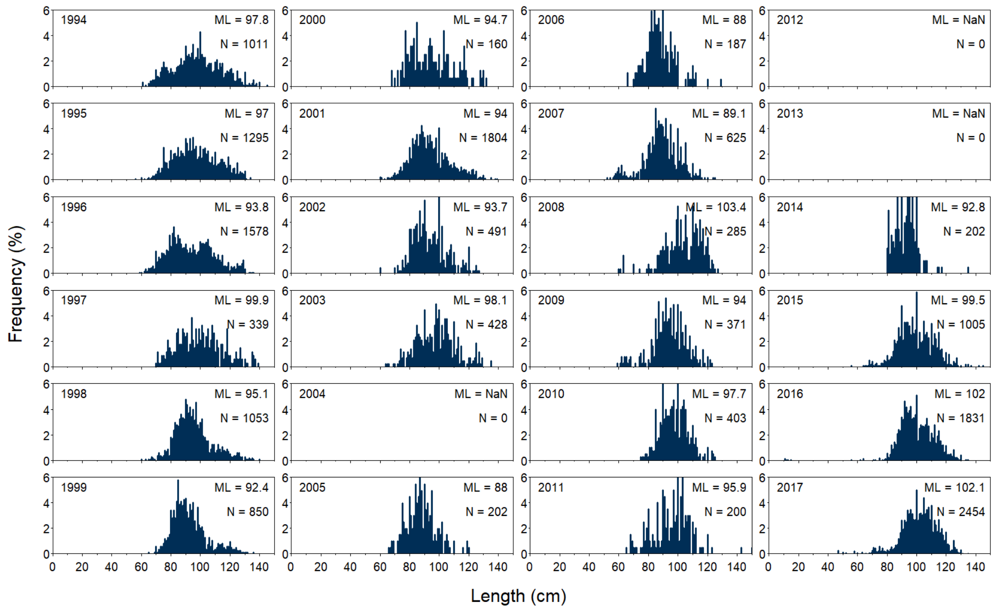


Figure 5.3.2. Length distribution of blue ling landings from Faroese otter-board trawlers >1000 HP in ICES 5.b.

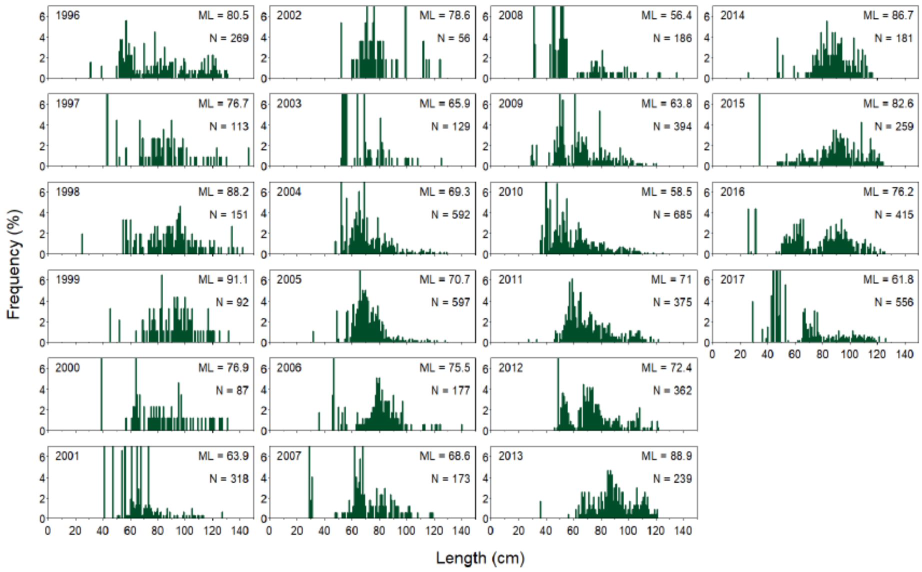


Figure 5.3.3. Length distribution of blue ling in the summer groundfish Faroese survey on the Faroe Plateau.

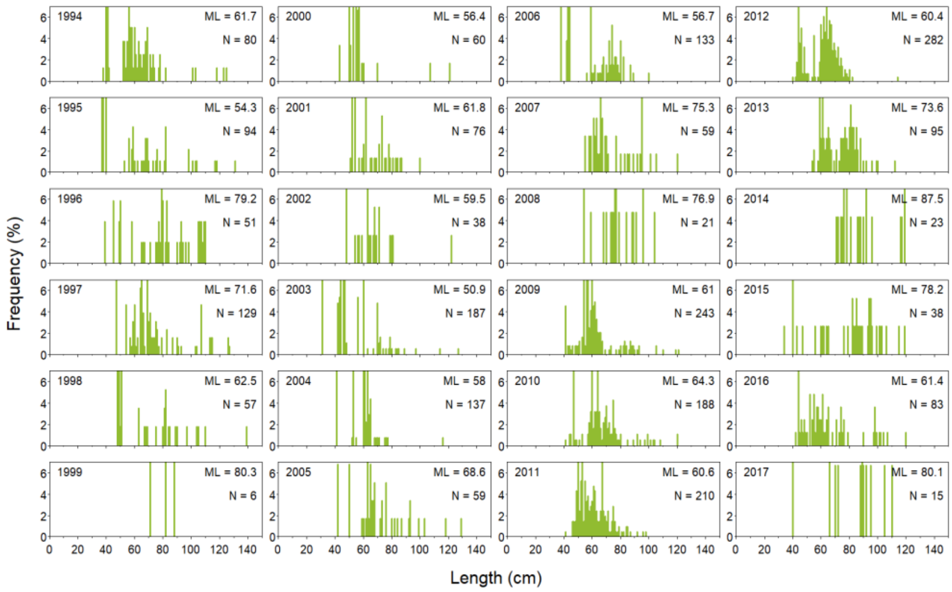


Figure 5.3.4. Length distribution of blue ling in the spring groundfish Faroese survey on the Faroe Plateau.

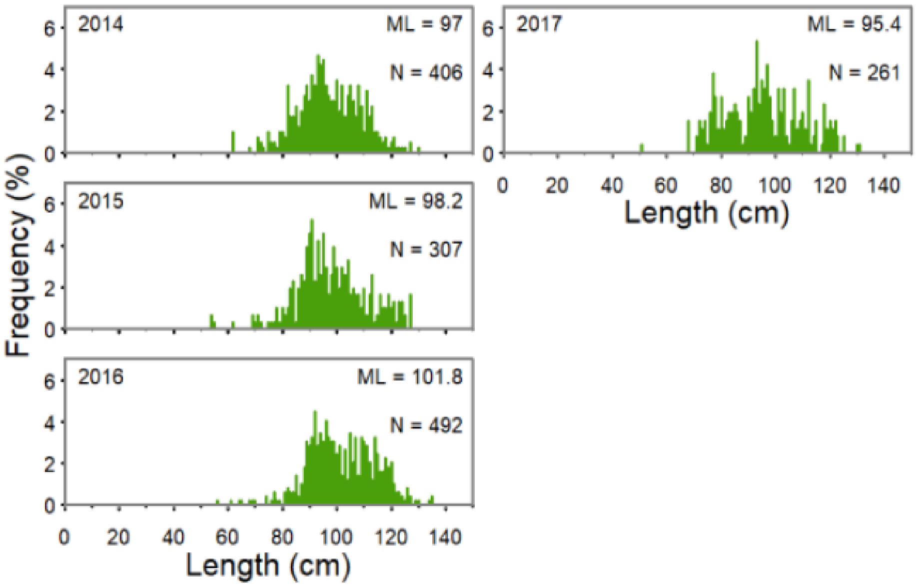


Figure 5.3.5. Length distribution of blue ling in the 2014 deep-water survey in Faroese waters and spatial distribution of catches of blue ling in the survey.

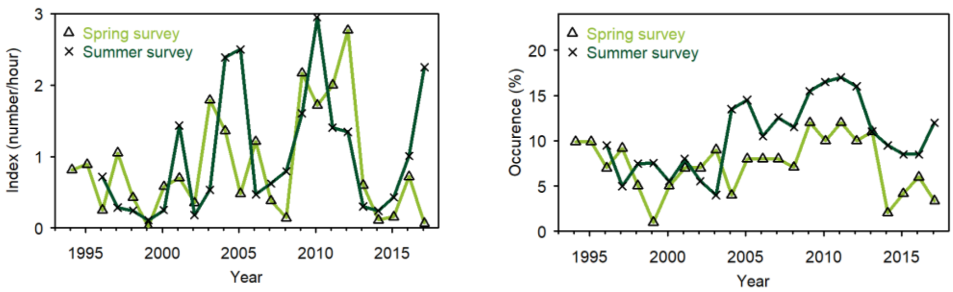


Figure 5.3.6. Juvenile (<80 cm) blue ling caught in groundfish surveys on the Faroe Plateau (left) number per hour and (right) occurrence.

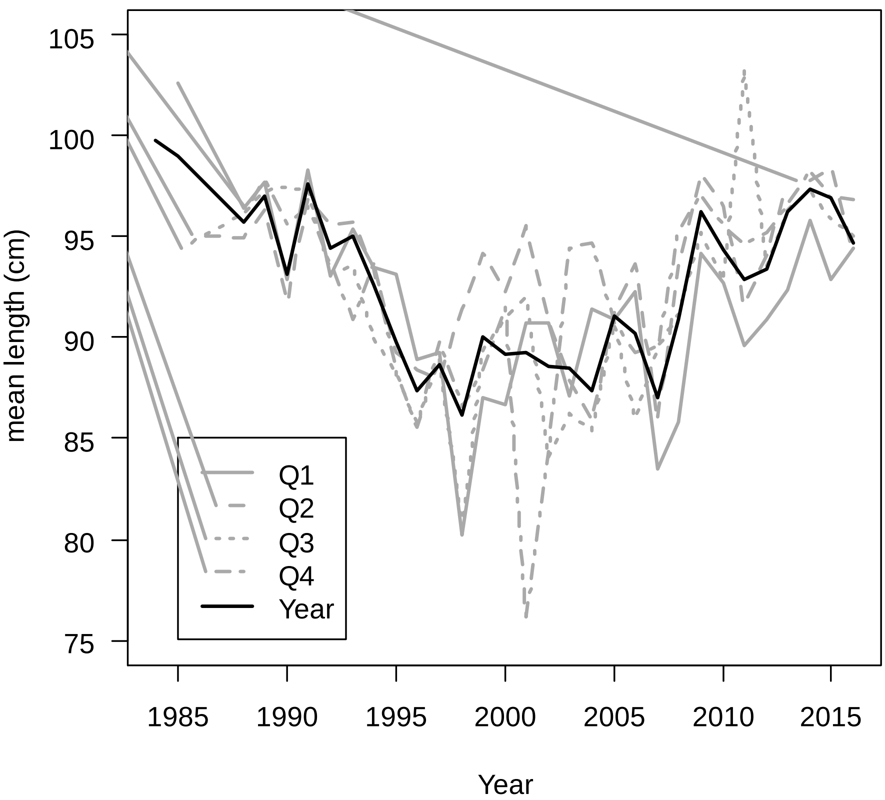


Figure 5.3.7. Quarterly mean length in French trawlers landings, 1984–2017.

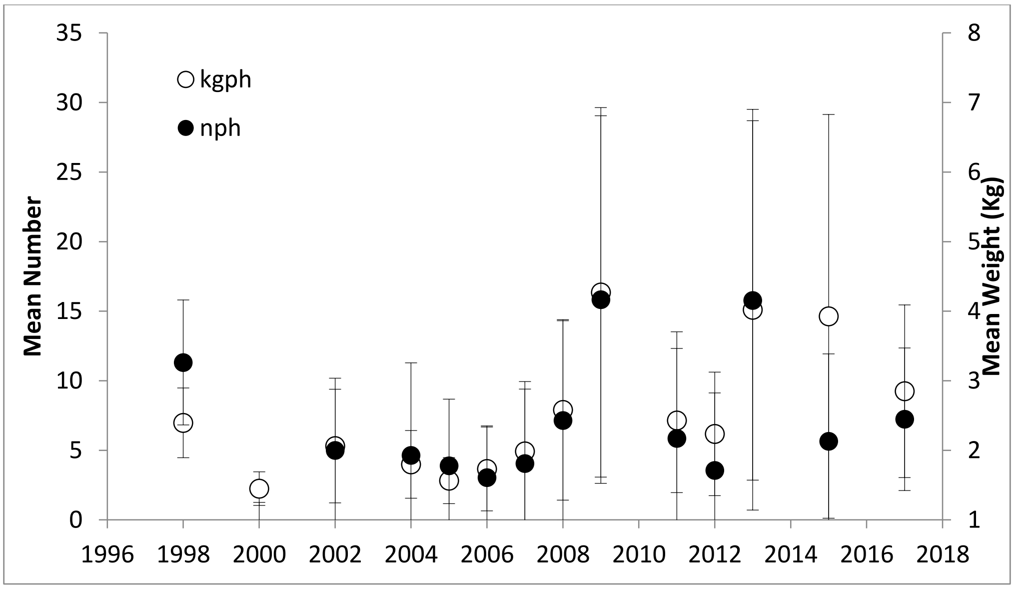


Figure 5. 3.8. Biomass index in the Scottish deep-water survey, based on haul carried out from 400 to 1600 m along the Scottish slope.

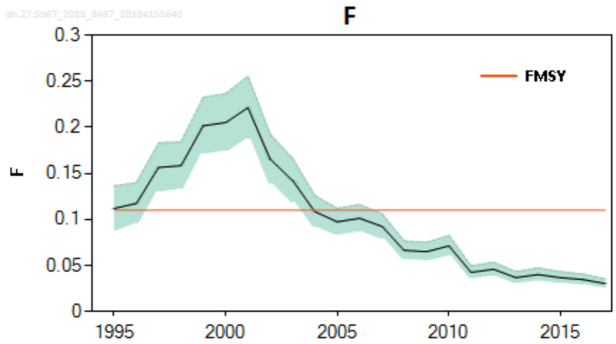


Figure 5.3.9. Estimated fishing mortality from the MYCC

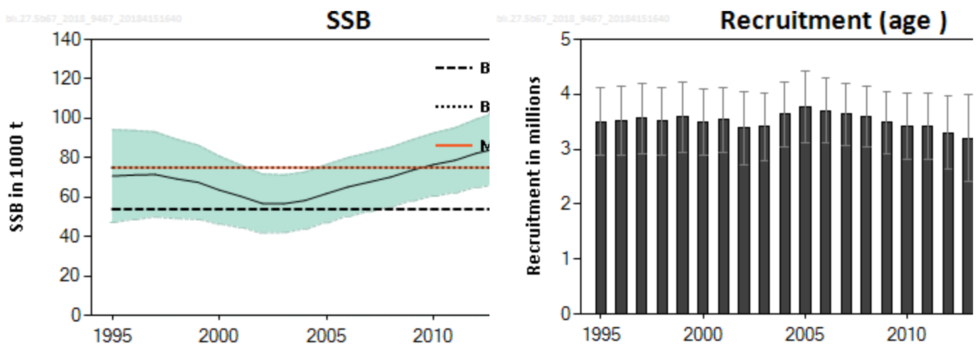


Figure 5.3.10. Estimated biomass of age 9+ and recruitment numbers-(at-age 9) from the MYCC.

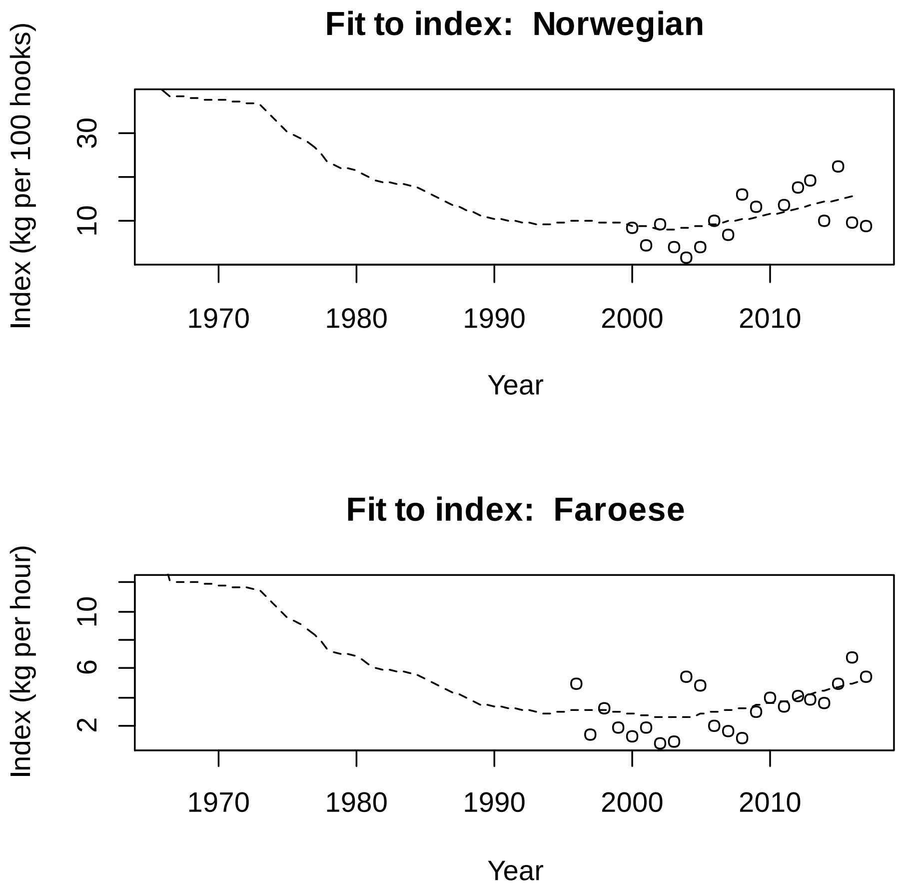


Figure 5.3.11. SRA model: fit of biomass indices to the estimated stock biomass: (top) Faroese summer surveys, (bottom) Norwegian longliner fleet cpue.

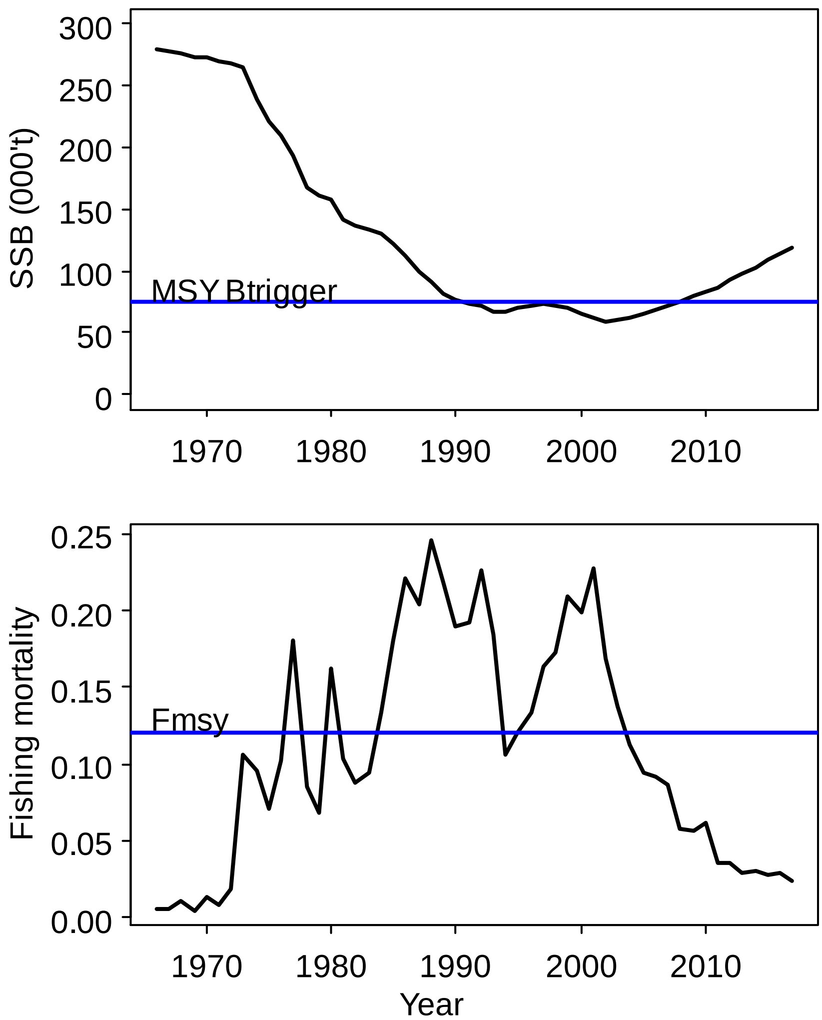


Figure 5.3.12. Spawning–stock biomass (SSB, thousand tonnes, top panel) and fishing mortality (bottom panel) from 1966 (onset of the fishery) to 2017 (fit to the Norwegian longline fleet index and the Faroese summer, FIT1).

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

5.4.1 The fishery

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

In Hatton Bank (Division 12.b) blue ling represents a significant bycatch of trawl fisheries for mixed deep-water species. In Division 2.a there is also a bycatch from the longline and gillnet fisheries.

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

5.4.2 Landings trends

Landing data are presented in Tables 5.4.0a–f. There are also historical landings from the Norwegian fishery, mainly from Division 2.a, back from 1896 (Figure 5.4.1). During the whole time-series, around 90% or more of the total landings were taken in Subareas 2, 4 and 12 combined. Landings from other areas are currently at a low level. In 2017, 89% of the landings came from Subarea 2 and 4.

For all areas, a continuous decline on landings has been observed after the higher landing levels in the 1988–1993 period. Landings from individual subareas and divisions have since the three last year been around 200 tonnes.

5.4.3 ICES Advice

The ICES advice for 2018 and 2019 is:

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

5.4.4 Management

A 2018 precautionary TAC for EU vessels in international waters of 12 was set to 286 tonnes and value for bycatches only. TACs for vessels in EU waters and international waters of 5.b, 6 and 7 were set to 10 763 tons; of this a quota for Norwegian and Faroese vessels was set to 150 tonnes each to be fished in Union waters of 2.a, 4, 5.b, 6 and 7. In Union and international waters of 2 and 4, a precautionary TAC for EU vessels was set to 53 tonnes. In Union and international waters of 3.a, a precautionary TAC for EU vessels was set to 8 tonnes.

5.4.5 Data availability

5.4.5.1 Landings and discards

Landings data are presented in Table 5.4.0a–f. Denmark and UK(Scotland) reported discards; 0,808 and 0,117 tonnes respectively

5.4.5.2 Length compositions

Length compositions from Spain (Figure 5.4.6) are available for area 12.b.

5.4.5.3 Age compositions

No age data are available.

5.4.5.4 Weight-at-age

No weight-at-age data are available.

5.4.5.5 Maturity and natural mortality

No data were available.

5.4.5.6 Catch, effort and research vessel data

For the Norwegian catches there was presented a cpue from Subarea 1, 2, 3.a and 4 combined (Figure 5.4.5.). The cpue series is calculated from 2000–2017 and is based on longline data from the Norwegian fishery.

5.4.6 Data analyses

The assessment for this stock is based on landing trends. The landings have declined and for all areas the mean landings are now less than 15% of the mean landings from the years 1988–1993 (the period with stable landings). The increase in landings seen for Subarea 4 in 2015 has stabilized at the same level in 2017. The 2015 increase was a result of increased Norwegian landings (Figures 5.4.2–5.4.4).

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

In Subarea 12 and after relative high levels for the period 2001–2005 landings have declined. This decline is a result of reductions in Spanish fishing activity in this area which for now is the only country reporting landings from this area.

In Subarea 4 an increase on French and Norwegian landings were registered in 2010 and 2011. The landings for 2017 are at the same level as in 2016 and landing levels are still at the low levels seen in mid-2000s.

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

The length compositions from Spanish landings show lengths from 69-129 cm (Figure 5.4.6). This is in the same range as seen in length compositions from Faroese catches from areas 5.b, 6 and 7.

The Norwegian cpue series show a low and stable level for the years 2000–2017 and although there is no directed fishery from this area there seems to be no recovery for this part of the stock.

5.4.6.1 Biological reference points

There are not yet suggested methods to estimate biological reference points for category 5 and 6 stocks. Therefore, no attempt was made to run SPiCT or LBI-method for this stock.

5.4.7 Comments on assessment

Not applicable.

5.4.1 Management considerations

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

The advice given in 2017 remains appropriate.

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

The bulk of current bycatches of blue ling from subareas and divisions treated in this section are taken within EEZs. The exception is the 12b catches from the Hatton Bank within the NEAFC Regulatory Area. The landings from 12b has decreased the recent years (Table 5.4.1)

5.4.2 Tables

Table 5.4.0a. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Sub-area 1. (* preliminary).

Year	Iceland	Norway	France	Faroes	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
2015					0
2016		0.84			1
2017*					0

Table 5.4.0b. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Divisions 2.a, b. (* preliminary).

Year	Faroes	France	Germany	Greenland	Norway	E & W	Scotland	Sweden	Russia	Total
1988	77	37	5		3416	2				3537
1989	126	42	5		1883	2				2058
1990	228	48	4		1128	4				1412
1991	47	23	1		1408					1479
1992	28	19		3	987	2				1039
1993		12	2	3	1003					1020
1994		9	2		399	9				419
1995	0	12	2	2	342	1				359
1996	0	8	1		254	2	2			267
1997	0	10	1		280					291
1998	0	3			272		3			278
1999	0	1	1		287		2			291
2000		2	4		240	1	2			249
2001	8	7			190	1	2			208
2002	1	1			129	1	17			149
2003	30				115		1	1		147
2004	28	1			144				1	174
2005	47	3			144	1			2	197
2006	49	4			149					202
2007	102	3			154		3			262
2008	105	9			208		11			333
2009	56	1			219		9			285
2010	183	1			234		4			422
2011	312	7			167					486
2012	188	7			142		1			338
2013	79	16			107					202
2014	29	16			73		9			127
2015	16	6			91					113
2016	22	7	0.059		57		1			87
2017*	57	5			112		3			177

Table 5.4.0c. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Sub-area 3. (* preliminary).

YEAR	DENMARK	NORWAY	SWEDEN	FRANCE	TOTAL
1988	10	11	1		22
1989	7	15	1		23
1990	8	12	1		21
1991	9	9	3		21
1992	29	8	1		38
1993	16	6	1		23
1994	14	4			18
1995	16	4			20
1996	9	3			12
1997	14	5	2		21
1998	4	2			6
1999	5	1			6
2000	13	1			14
2001	20	4			24
2002	8	1			9
2003	18	1			19
2004	18	1			19
2005	48	1			49
2006	42				42
2007					0
2008		2			2
2009		+			0
2010		+			0
2011					0
2012					0
2013		1			1
2014		+	+		0
2015	+	+			0
2016	0.154	0.64	0.005	0.307	1
2017		0,775			1

Table 5.4.0d. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Division 4.a. (* preliminary).

Year	Denmark	Faroes	France (IV)	Germany	Norway	E & W	Scotland	Ireland	Total
1988	1	13	223	6	116	2	2		363
1989	1		244	4	196	12			457
1990			321	8	162	4			495
1991	1	31	369	7	178	2	32		620
1992	1		236	9	263	8	36		553
1993	2	101	76	2	186	1	44		412
1994			144	3	241	14	19		421
1995		2	73		201	8	193		477
1996		0	52	4	67	4	52		179
1997		0	36		61	0	172		269
1998		1	31		55	2	191		280
1999	2		21		94	25	120	2	264
2000	2		15	1	53	10	46	2	129
2001	7		9		75	7	145	9	252
2002	6		11		58	4	292	5	376
2003	8		8		49	2	25		92
2004	7		17		45		14		83
2005	6		7		51		2		66
2006	6		6		82				94
2007	5		2		55				62
2008	2		9		63		+		74
2009	1		12		69		7		89
2010	1		24		109		21		155
2011			129		46		1		176
2012			96		70				166
2013			5		38				43
2014			4		34		12		50
2015	+		6		74	+	3		83
2016	0,48		6	0,041	74		6		87
2017*	0,499		3		65	+	5		73

Table 5.4.0e. Blue ling (*Molva dypterygia*). Working group estimates of landings (tonnes) in Subarea 12. (* preliminary).

YEAR	FAROES	FRANCE	GERMANY	SPAIN	E & W	SCOTLAND	NORWAY	ICELAND	POLAND	LITHUANIA	RUSSIA	UNALLOCATED	TOTAL
1988		263											263
1989		70											70
1990		5					547						552
1991		1147											1147
1992		971											971
1993	654	2591	90			1							3336
1994	382	345	25										752
1995	514	47			12								573
1996	445	60		264		19							788
1997	1	1		411	4								417
1998	36	26		375	1								438
1999	156	17		943	8	43		186					1353
2000	89	23		406	18	23	21	14					594
2001	6	26		415	32	91	103	2					675
2002	19			1234	8	48	9						1318
2003		7		1096			40		12	37			1192
2004		27		861		10					7		905
2005		10		657		35				8			710
2006		61		436							4		501
2007	1			353									354
2008				564									564

Year	Faroes	France	Germany	Spain	E & W	Scotland	Norway	Iceland	Poland	Lithuania	Russia	unallocated	Total
2009		+		312							+		312
2010				50									50
2011				55									55
2012				205								427	632
2013				178								76	254
2014				80									80
2015				12									12
2016				29									29
2017*				28									28

Table 5.4.0f. Blue ling (*Molva dypterygia*). Total landings by Subarea/Division (From 2010 landings from Areas 8, 9 and 10 given in previous reports are now considered to represent *Molva macropthalma*). (* preliminary data).

Year	1	2	3	4	12	Total
1988	10	3537	22	363	263	4195
1989	8	2058	23	457	70	2616
1990	4	1412	21	495	552	2484
1991	3	1479	21	620	1147	3270
1992	5	1039	38	553	971	2606
1993	1	1020	23	412	3336	4792
1994	3	419	18	421	752	1613
1995	5	359	20	477	573	1434
1996	2	267	12	179	788	1248
1997	1	291	21	269	417	999
1998	1	278	6	280	438	1003
1999	1	291	6	264	1353	1915
2000	3	249	14	129	594	989
2001	1	208	24	252	675	1160
2002	1	149	9	376	1318	1853
2003	0	147	19	92	1192	1450
2004	1	174	19	83	905	1182
2005	1	197	49	66	710	1023
2006	0	202	42	94	501	839
2007	0	262	0	62	354	678
2008	0	333	2	74	564	973
2009	1	285	0	89	312	687
2010	1	422	0	155	50	628
2011	3	486	0	176	55	720
2012	1	338	0	166	632	1137
2013	0	202	1	43	254	500
2014	4	127	0	50	80	261
2015	0	113	0	83	12	208
2016	0,84	87	1	87	29	205
2017*	0	177	1	73	28	279

Table 5.4.1 Blue ling in Subarea 27.nea. Landings inside and outside the NEAFC Regulatory Area (RA). Weights are in tonnes.

Year	Inside the NEAFC RA	Outside the NEAFC RA	Total landings
2014	80	181	261
2015	12	196	208
2016	29	176	205
2017	28	251	279

5.4.3 Figures

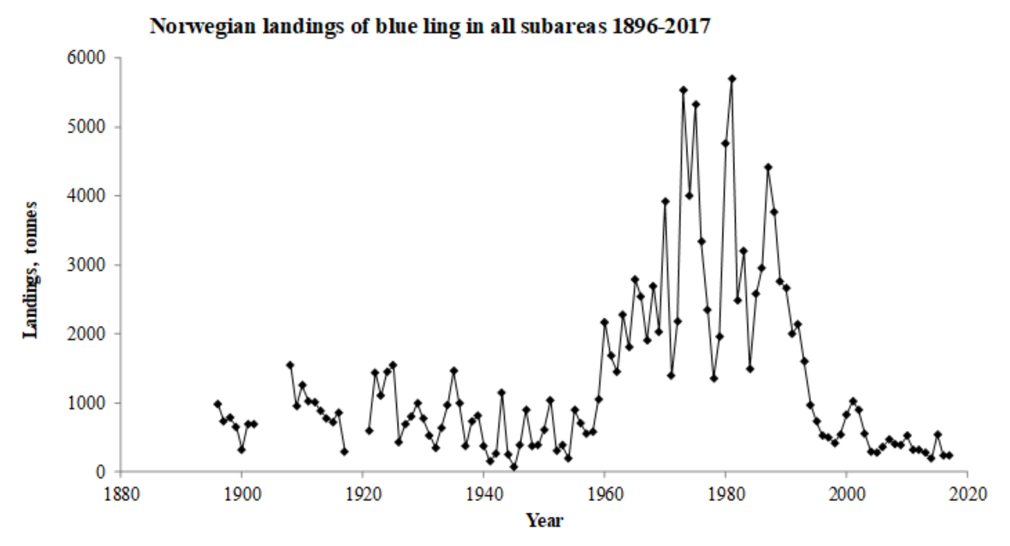


Figure 5.4.1. Reported Norwegian landings on blue ling from 1896–2017.

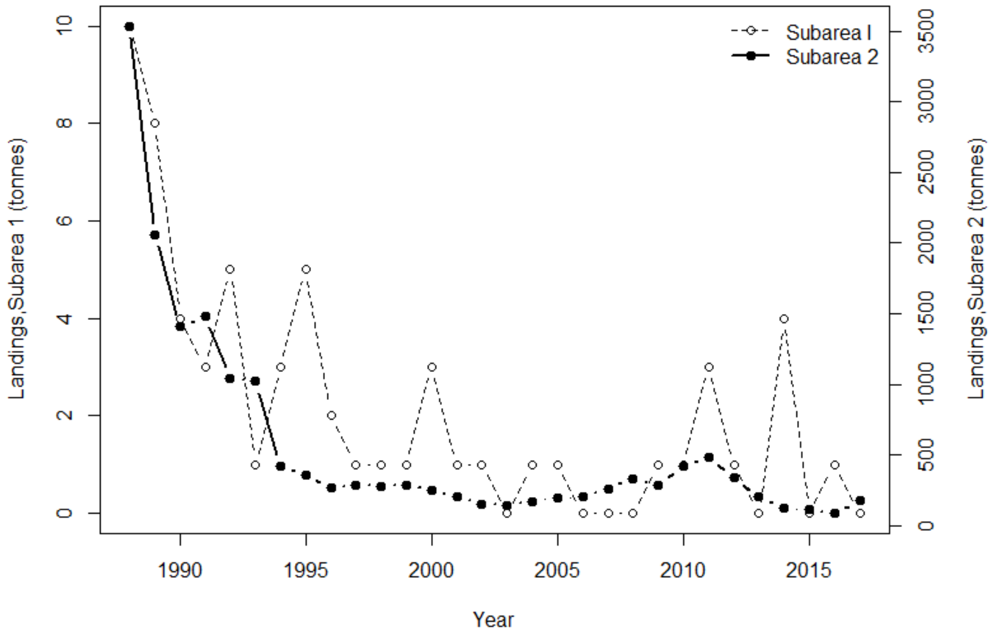


Figure 5.4.2. Landings of blue ling in Subareas 1 and 2.

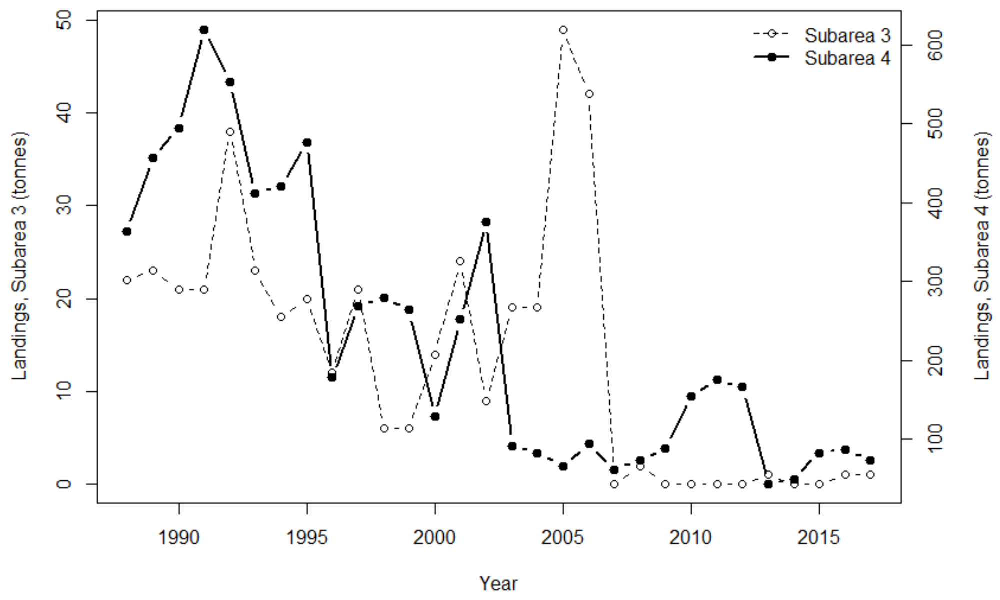


Figure 5.4.3. Landings of blue ling in Subareas 3 and 4.

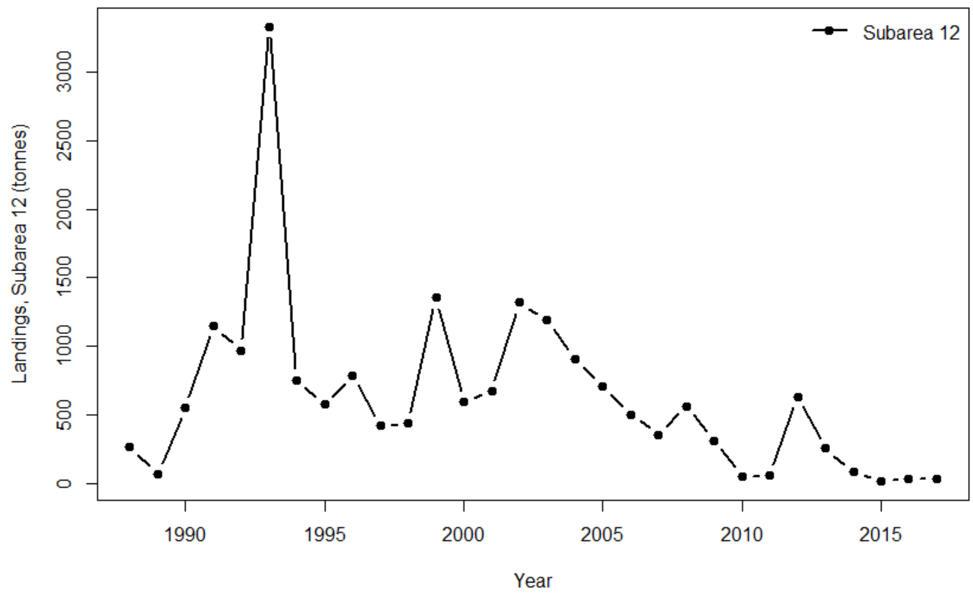


Figure 5.4.4. Landings of blue ling in Subarea 12.

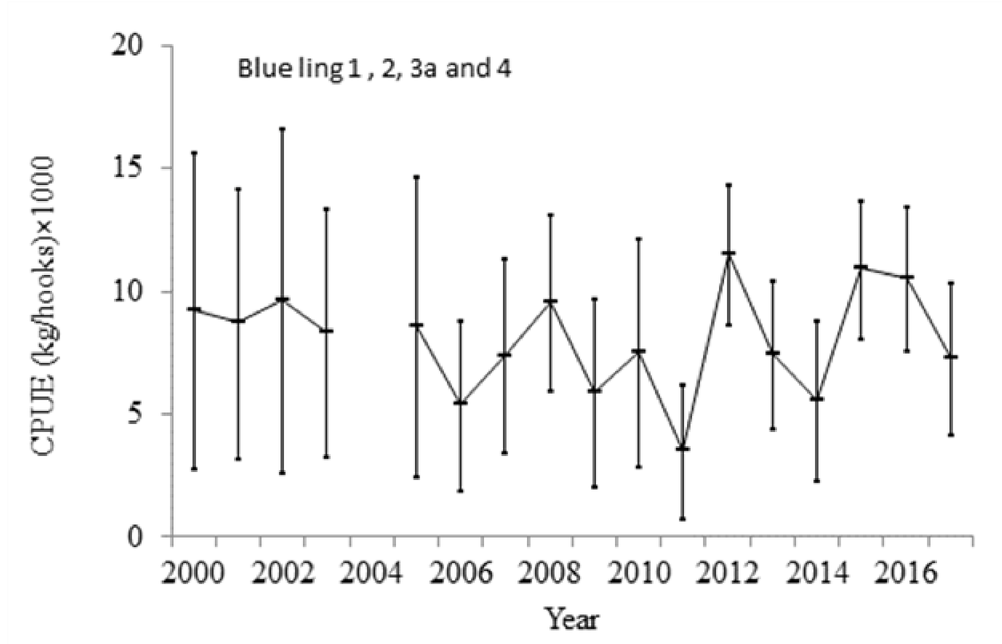


Figure 5.4.5. Norwegian cpue (kg/1000 hooks) from longlines catches in areas 1, 2, 3.a and 4 from 2000–2017.

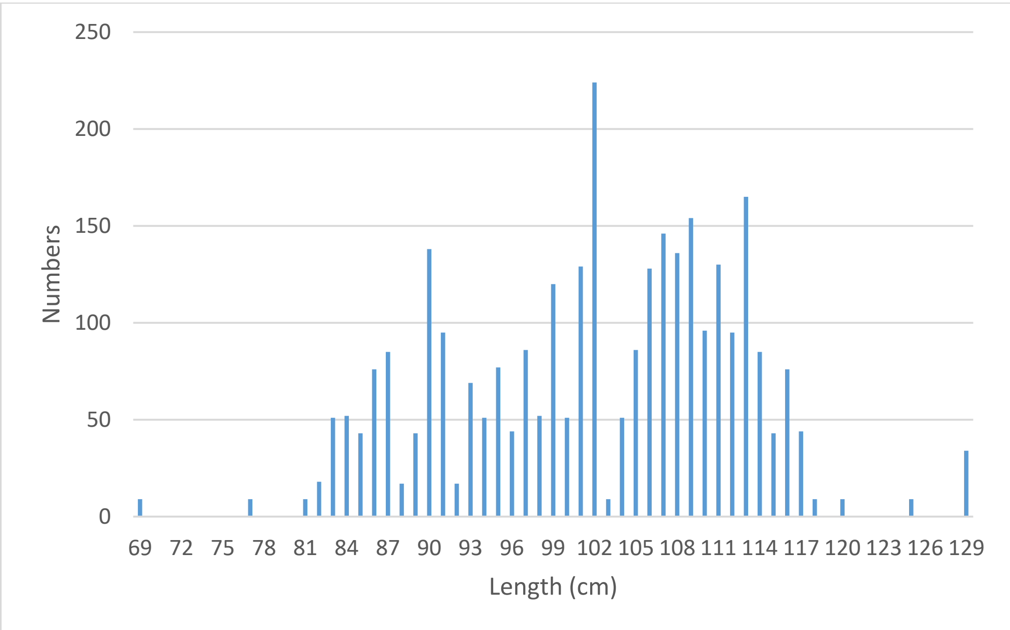


Figure 5.4.6. Length composition from Spanish landings from area 12b in 2017

6 Tusk (*Brosme brosme*).

6.1 Stock description and management units

In 2007, WGDEEP examined the available evidence of any stock discrimination for tusk. Based on genetic investigations (references), the group suggested the following stock units for tusk:

- Area5.a and 14;
- Mid-Atlantic Ridge;
- Rockall (6.b);
- Areas 1, 2.

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

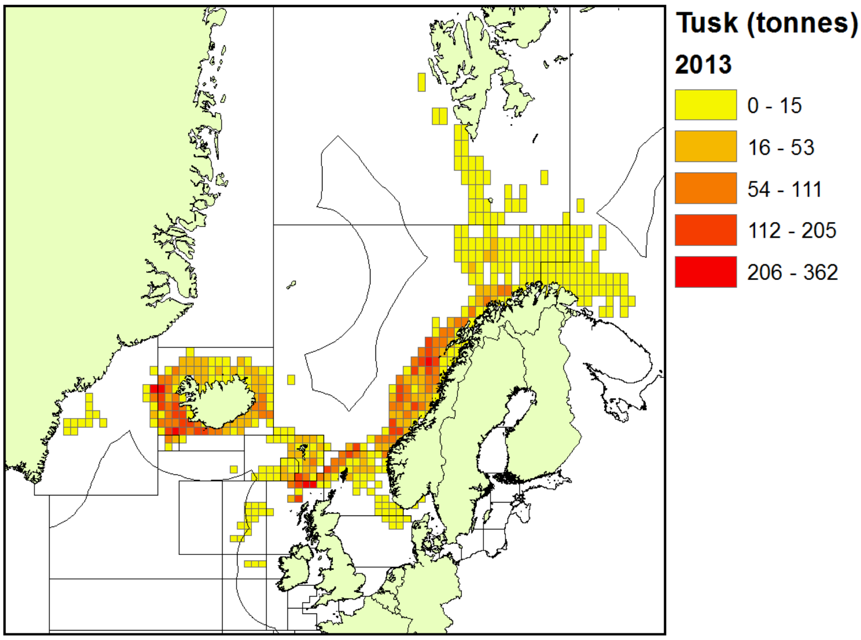


Figure 6.1. Reported landings of tusk in the ICES area by statistical rectangle, 2013. Data from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in this figure account for 99% of all reported landings in the ICES area.

6.2 Tusk (*Brosme Brosme*) in Division 5.a and Subarea 14

6.2.1 The fishery

Tusk in 5.a is caught in a mixed longline fishery, conducted in order of importance by Icelandic, Faroese and Norwegian boats. Between 150 and 240 Icelandic longliners report catches of tusk > 100 kg, but ~100 more vessels have small amounts of bycatch landings (Table 6.2.1). Far fewer gillnetters and trawlers participate in the fishery. The number of longliners reporting tusk catches in 2016 decreased to 138 from 163 the previous year (Table 6.2.1). Most of tusk in 5.a is caught on longlines or around 97% of catches in tonnes and this has been relatively stable proportion since 1992 (Table 6.2.1).

Table 6.2.1. Tusk in 5.a. Number of Icelandic boats with tusk landings and their total landings.

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

Most of the tusk caught in 5.a by Icelandic longliners is caught at depths less than 300 meters (Figure 6.2.1). The main fishing grounds for tusk in 5.a as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf (Figures 6.2.2 and 6.2.3).

The main trend in the spatial distribution of tusk catches in 5.a according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 50–60% of tusk is caught on the south and western part of the shelf (Figure 6.2.3).

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.

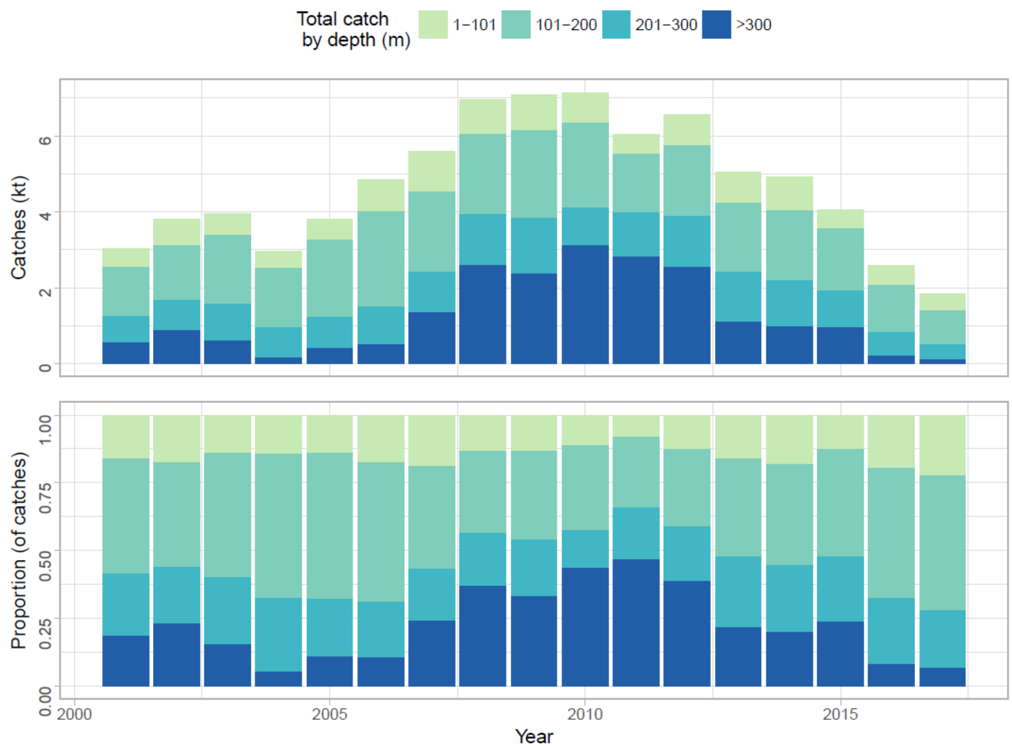


Figure 6.2.1. Tusk in 5.a and 14. Depth distribution of catches in 5.a according to logbooks.

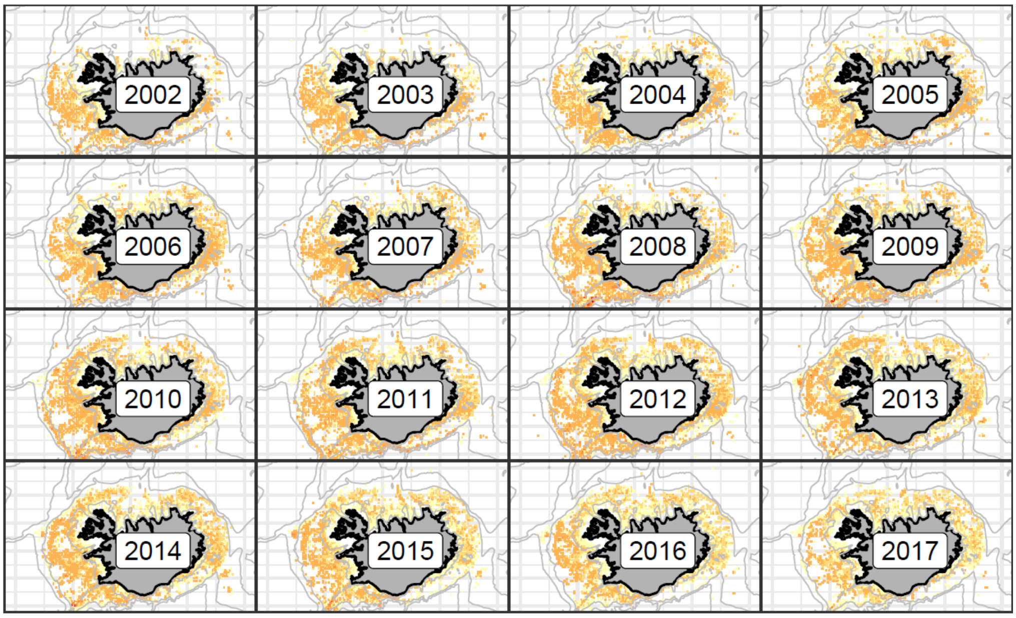


Figure 6.2.2. Tusk in 5.a and 14. Geographical distribution of the Icelandic fishery since 1999 as reported in logbooks. All gears combined.

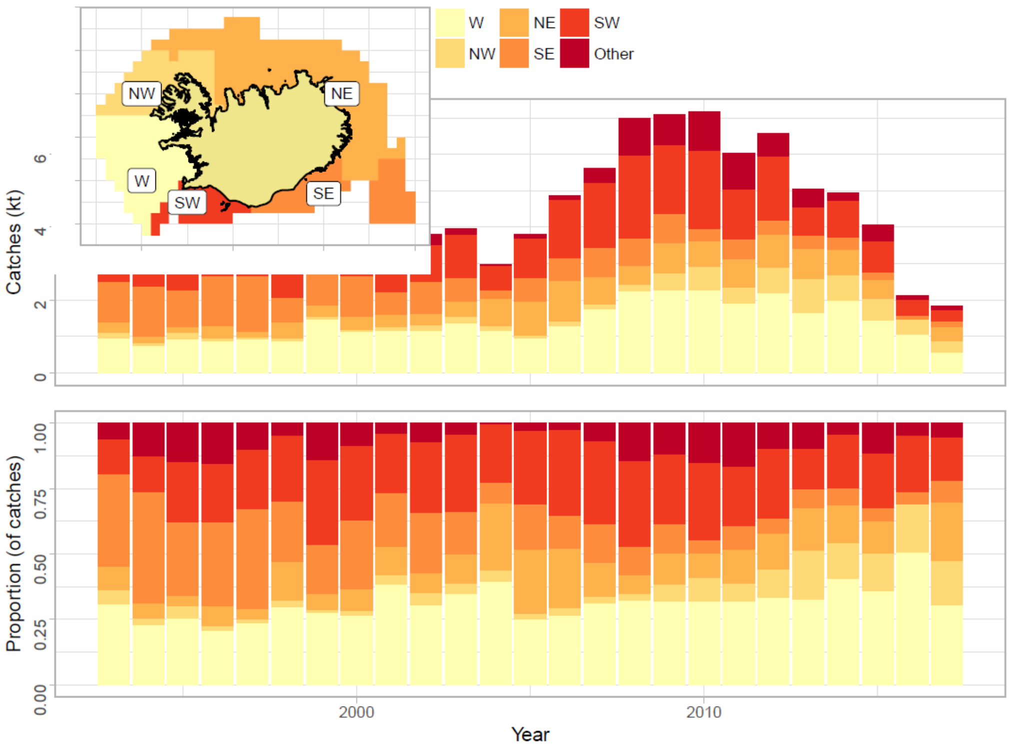


Figure 6.2.3. Tusk in 5.a and 14. Changes in spatial distribution of the Icelandic fishery from 1996 as reported in logbooks. All gears combined.

6.2.1.1 Landings trends

The total annual landings from ICES Division 5.a were around 2540 tonnes in 2017 (Table 6.2.7), signifying a continuous decrease in landings from 2010. This is contrary to the trend in landings from 2000 in which the annual landings gradually increased in 5.a to around 9000 tonnes in 2010 (Figure 6.2.4).

The foreign catch (mostly from the Faroe Islands, but also from Norway) of tusk in Icelandic waters has always been considerable. Until 1990, between 40–70% of the total annual catch from ICES Division 5.a was caught by foreign vessels but has since then been between 15–25%, mainly from the Faroe Islands (Table 6.2.7).

Landings in 14.b have always been low compared to 5.a, rarely exceeding 100 t. However around 900 tonnes in 2015 and around 418 tonnes in 2017 were caught in the 14.b mainly by Faroese and Greenlandic vessels (Table 6.2.8). The spatial distribution of longline operations in 14.b in 2015 is shown in Figure 6.2.3b.

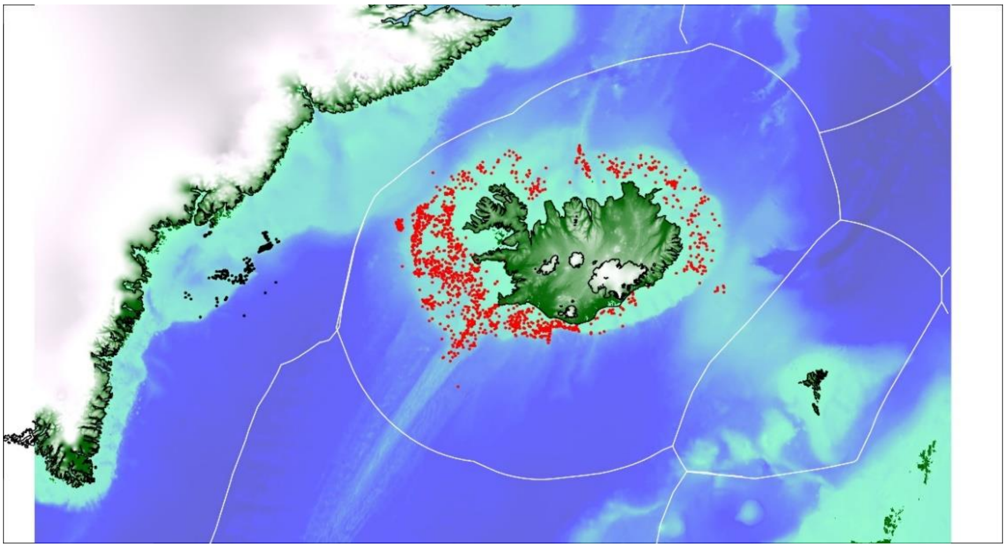


Figure 6.2.3b. Position of longline operations in 14.b and 5.a where tusk was recorded in 2015.

6.2.1.2 ICES Advice

The latest Advice from ICES in May 2016 states: ICES advises that, based on the MSY approach, catches should be no more than 3780 t.

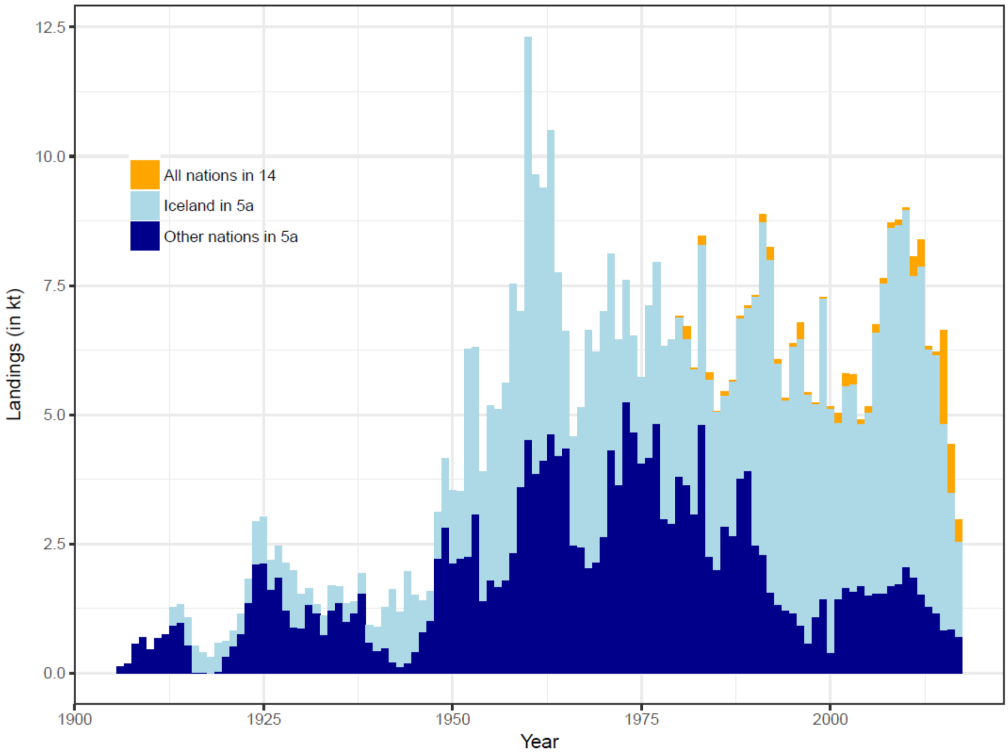


Figure 6.2.4. Tusk in 5.a and 14. Landings in 5.a and 14 (source for 14: STATLANT).

6.2.1.3 Management

The Icelandic Ministry of Industries and Innovation (MII) is responsible for management of the Icelandic fisheries and implementation of legislation. Tusk was included in the ITQ system in the 2001/2002 quota year and as such subjected to TAC limitations.

At the beginning the TAC was set as recommended by MRI but has often been set higher than advice. One reason is that no formal harvest rule exists for this stock. The landings, by quota year, have always exceeded the advised and set TAC but the overshot in landings has decreased from 30–40%. However, since the 2011/2012 fishing year the overshoot in landings has decreased to 6–16% apart from 2014/2015 when it was 34% (Table 6.2.2).

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

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

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

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

However, for the last three fishing years, managers have to some extent taken into account the foreign catches (see below). The tusk advice given by MRI and ICES for each quota year is, however, for all catches, including foreign catches. Figure 6.2.5 shows the net transfers in the Icelandic ITQ-system. During the 2005/2006–2010/2011 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 net transfer of other species being changed to tusk quota.

Table 6.2.2. Tusk in 5.a and 14. TAC recommended for tusk in 5.a by the Marine Research Institute, national TAC and total landings from the quota year 2001/2002.

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

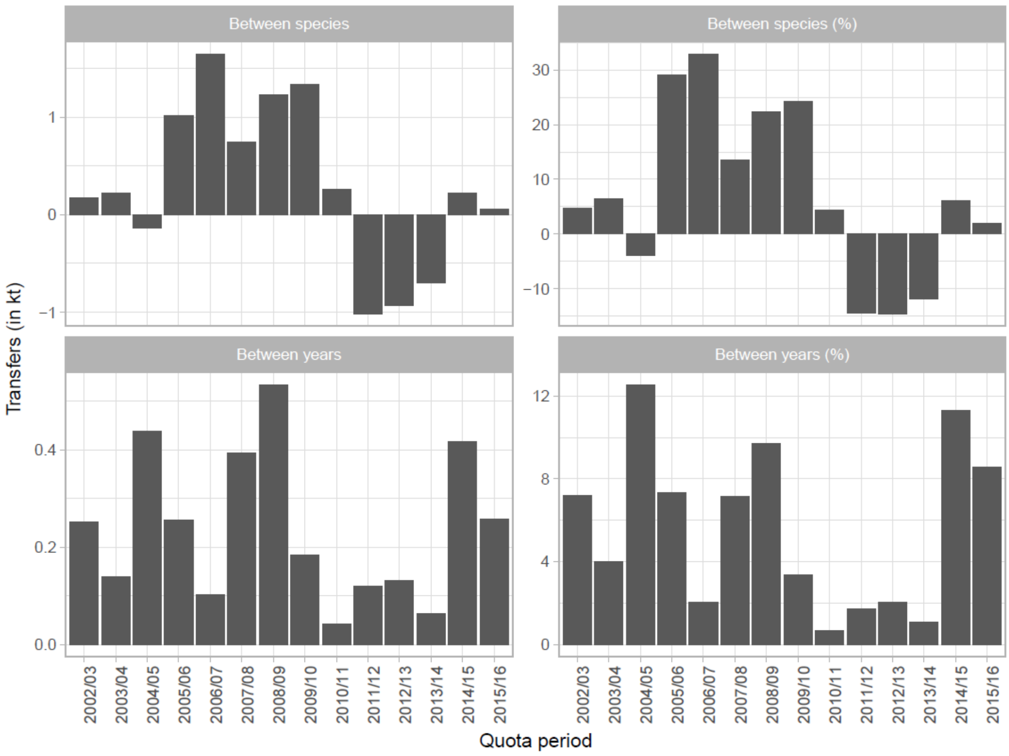


Figure 6.2.5. Tusk in 5.a and 14. Net transfers of tusk quota to other species in the Icelandic ITQ system by fishing year. Positive values indicate that other species are being changed to tusk but negative mean that tusk quota is being converted to other species.

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. Further description of the Icelandic management system can be found in the stock annex.

6.2.2 Data available

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

6.2.2.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discarding is banned by law in the Icelandic demersal fishery, as well as in Norway. Based on limited data, discard rates in the Icelandic longline fishery for tusk are estimated very low (<1% in either numbers or weight) (WGDEEP, 2011:WD02). Measures in the Icelandic management system such as converting quota share from one species to another are used by the Icelandic fleet to a large extent, and this is thought to discourage discards in mixed fisheries. A description of the management system is given in the stock annex for tusk in 5.a and 14.

Landings for tusk in 14 are obtained from the STATLANT database. No information is available on discards in 14.

6.2.2.2 Length compositions

An overview of available length measurements from 5.a is given in Table 6.2.3. Most of the measurements are from longlines, number of available length measurements increased in 2007 from around 2500 to around 4000 and were close to that until 2016 when they decreased to around 1700 and remained there.

Length distributions from the spring survey data and longline fishery are shown in Figures 6.2.6 and 6.2.7 respectively. In the figures, numbers-at-length are multiplied by the expected proportion mature at that length to split catch numbers into mature and immature components.

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

Table 6.2.3. Tusk in 5.a and 14. Number of available length measurements from Icelandic (5.a) commercial catches.

Year	Longline		Gillnets		Trawls	
	Samples	**Measured**	**Samples**	**Measured**	**Samples**	**Measured**
2005	12	1775	0	0	0	0
2006	15	2225	0	0	3	450
2007	22	3154	2	167	1	150
2008	32	4722	0	0	0	0
2009	27	3945	0	0	0	0

2010	29	4354	0	0	0	0
2011	28	4141	0	0	0	0
2012	35	5105	0	0	1	150
2013	22	3278	0	0	0	0
2014	28	3384	0	0	0	0
2015	26	3115	0	0	0	0
2016	14	1671	0	0	0	0
2017	8	1710	0	0	0	0

Figure 6.2.6. Tusk in 5.a and 14. Length distributions from Icelandic spring survey catches. Red areas are immature tusk and green represent mature tusk. Small numbers to the right refer to mean length (ML).

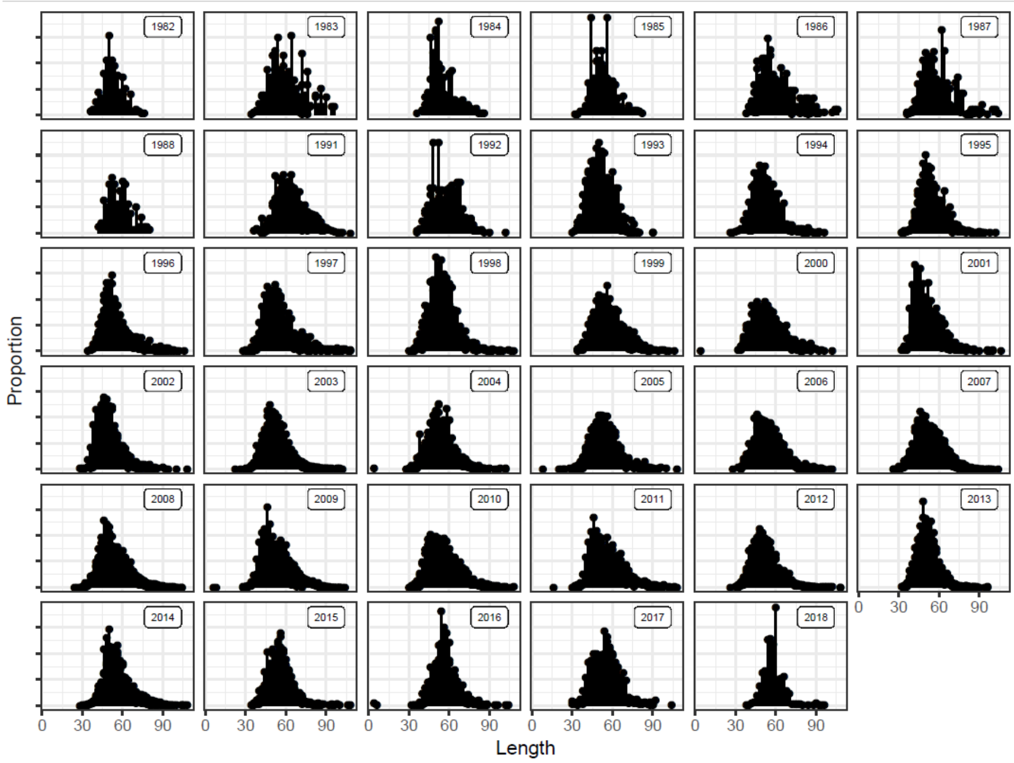


Figure 6.2.7. Tusk in 5.a and 14. Length distributions from Icelandic commercial longline catches.

Age compositions

Table 6.2.4 gives an overview of otolith sampling intensity by gear types from 2000 to 2017 in 5.a. Since 2010 considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2008–2016. The age data are used as input for the Gadget assessment. It is expected that the effort in ageing of tusk will continue. Age distributions are shown from the spring survey and commercial longline samples in Figures 6.2.8 and 6.2.9 respectively.

No data are available from 14.

Table 6.2.4. Tusk in 5.a and 14. Number of available otoliths from Icelandic (5.a) commercial catches and the Icelandic Spring survey and the number of aged otoliths.

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

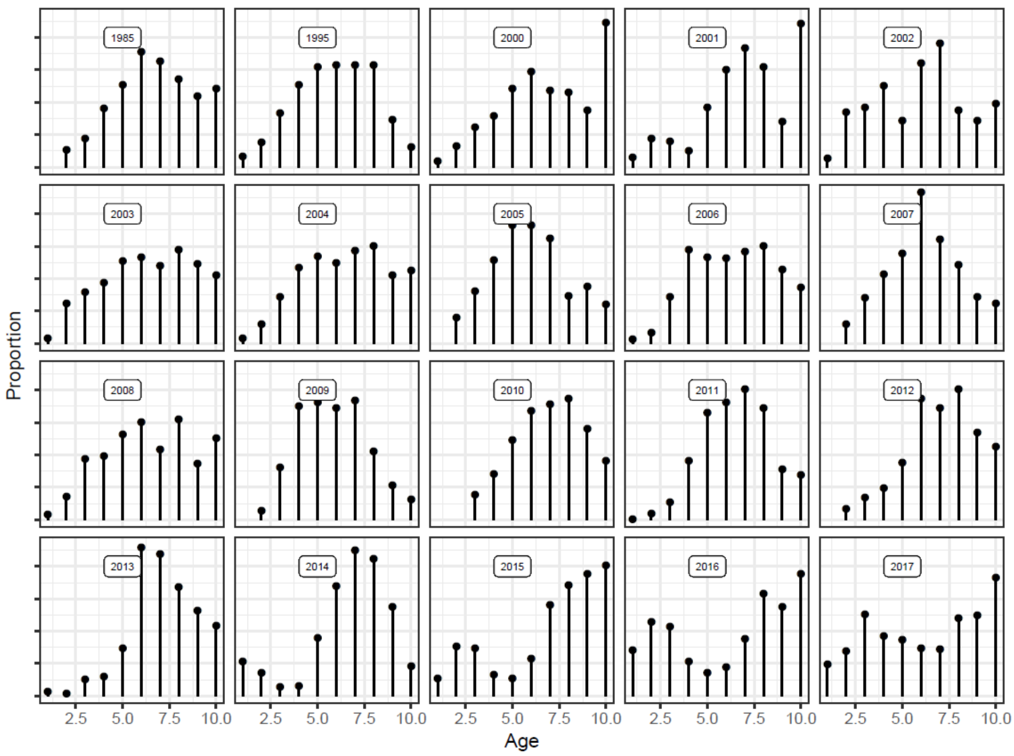


Figure 6.2.8. Tusk in 5.a and 14. Age distributions in proportions in 5.a (From the Iceland spring survey).

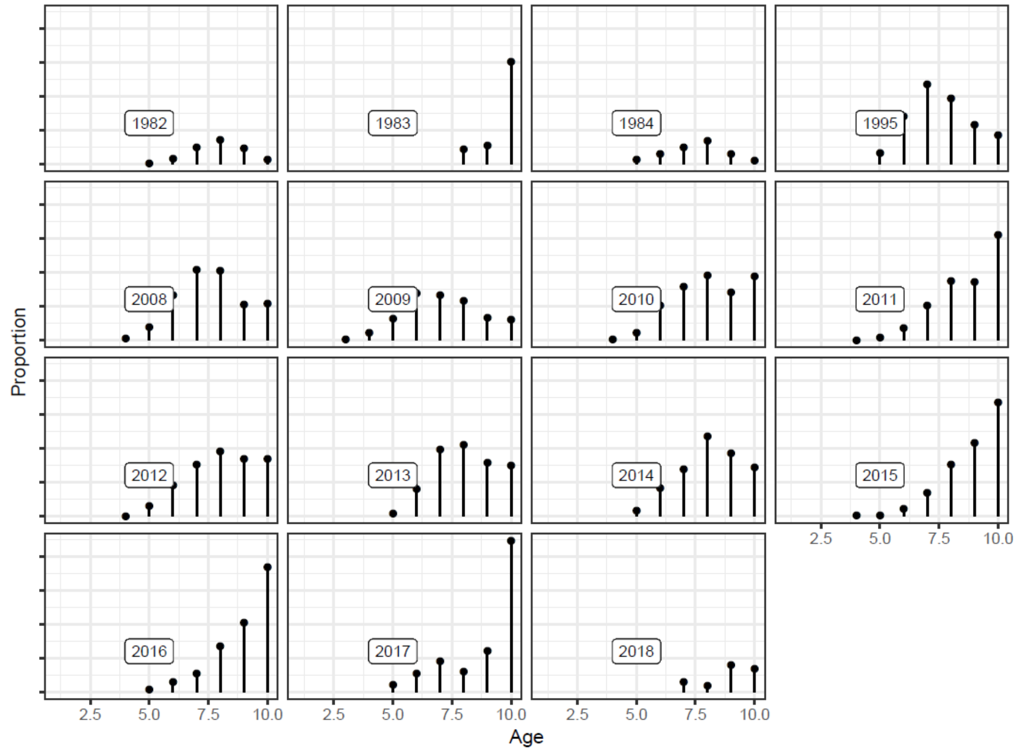


Figure 6.2.9. Tusk in 5.a and 14. Age distributions in proportions in 5.a (From longlines). Samples for 2018 are only from January – March.

6.2.2.3 Weight-at-age

Weight-at-age data from 5.a are limited to 2008–2017.

No data are available from 14.

6.2.2.4 Maturity and natural mortality

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

No information is available on natural mortality of tusk in 5.a.

No data are available for 14.

6.2.2.5 Catch, effort and research vessel data

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

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

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

Icelandic survey data (ICES Division 27.5.a)

Indices: The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the tusk fishery. Detailed description of the spring groundfish survey is given in the stock annex for tusk in 5.a. In 2011 the 'Faroe Ridge' survey area was included into the estimation of survey indices.

In addition, the autumn survey was commenced in 1996 and expanded in 2000 however a full autumn survey was not conducted in 2011 and therefore the results for 2011 are not presented. A detailed description of the Icelandic spring and autumn groundfish surveys is given in the Stock Annex. Figure 6.2.10 shows both a recruitment index and the trends in various biomass indices. Changes in spatial distribution are shown in Figures 6.2.11 and 6.2.12.

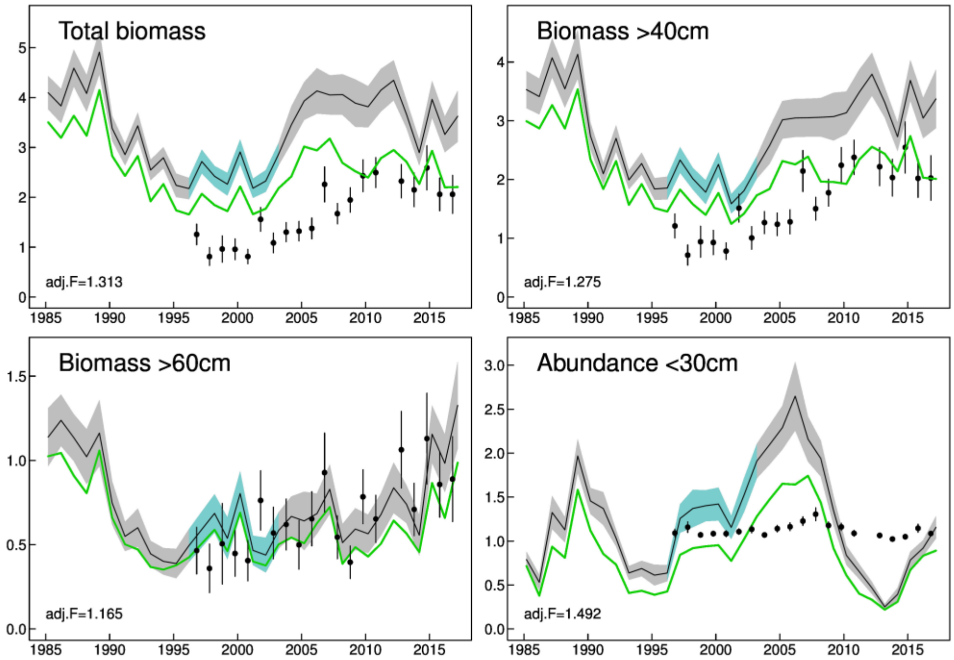


Figure 6.2.10. Tusk in 5.a and 14. Indices in the Spring Survey (March) 1985 and onwards (line shaded area) and the autumn survey (October) 1996 and onwards (No autumn survey in 2011). Green line is the index excluding the Faroe-Iceland Ridge.

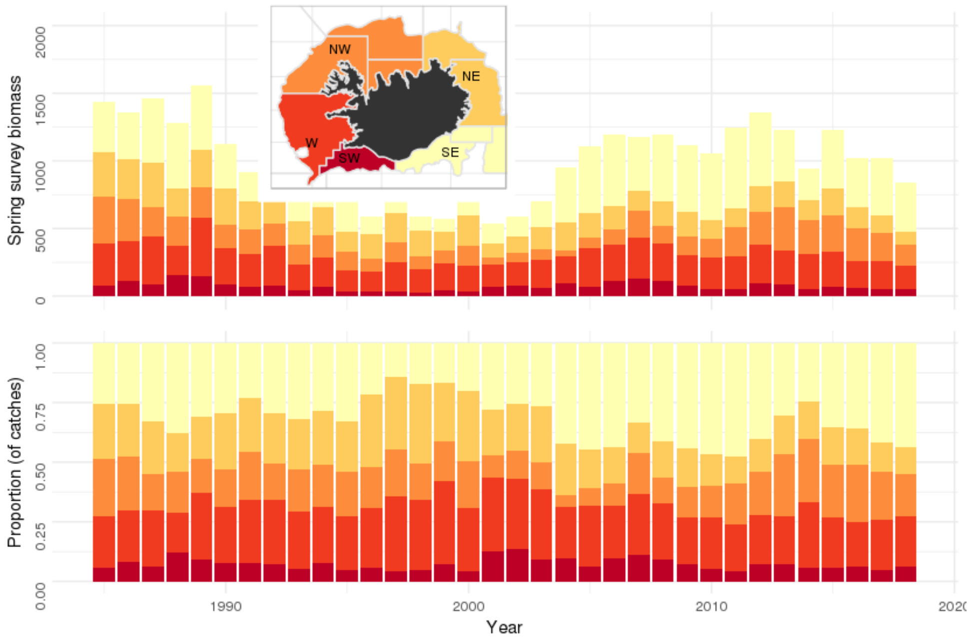


Figure 6.2.11. Tusk in 5.a and 14. Estimated survey biomass in the spring survey (March) by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

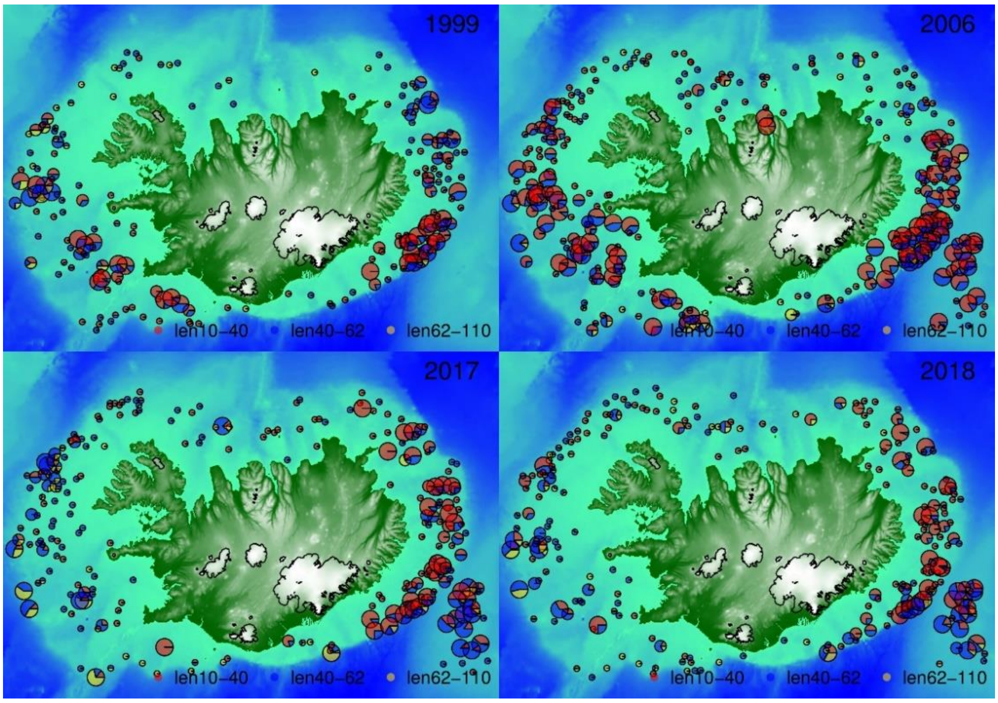


Figure 6.2.12. Tusk in 5.a and 14. Changes in spatial distribution divided by size. Size of pie is indicative of numbers of specimens caught at the tow-station.

German survey data (ICES Subarea 27.14)

Indices: 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 is 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 6.2.13 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 6.2.14.

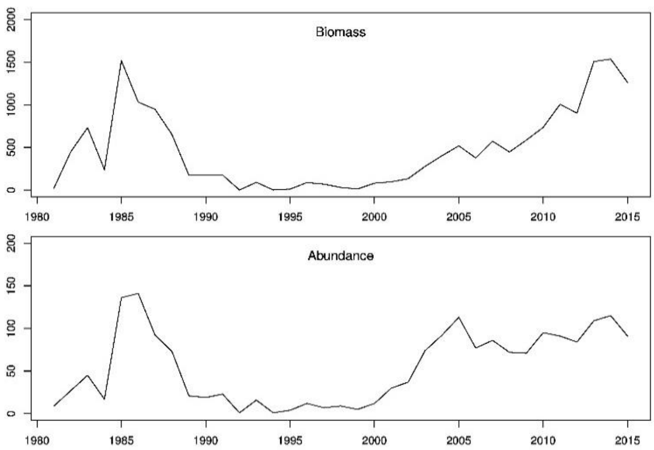


Figure 6.2.13. Biomass and abundance estimates from the Walter Herwig survey in 14. The data are just the total number caught and then converted to weight.

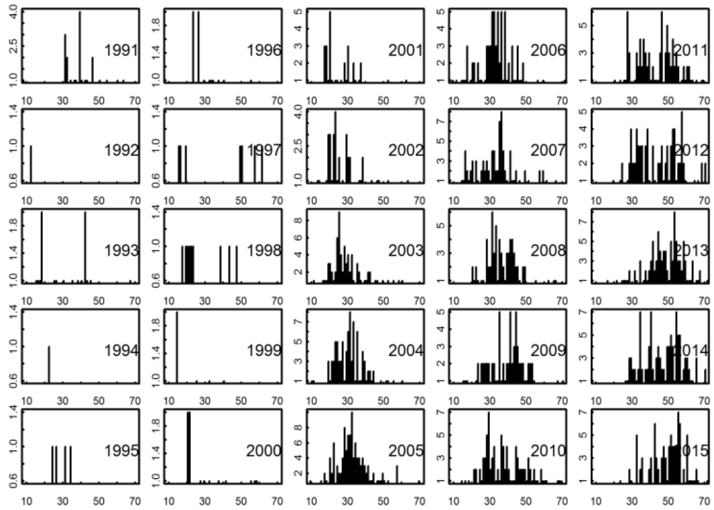


Figure 6.2.14. Length distributions from the Walter Herwig survey in 14.

6.2.3 Data analyses

There have been no marked changes in the number of boats nor the composition of the fleet participating in the tusk fishery in 5.a (Table 6.2.1). Catches decreased from around 9000 tonnes in 2010 to 2540 tonnes in 2017. This decrease is mainly because of reductions in landings by the Icelandic longline fleet and to a lesser extend Faroese and Norwegian landings (Table 6.2.6). This has resulted in less overshoot of landings relative to set TAC (Table 6.2.2) but species conversions in the ITQ system show that other species were converted to tusk last year compared to tusk being converted to other species in previous fishing years.

There are no marked changes in the length compositions since 2004, mean length in the catches ranges between 52.7 and 54.1 (Figure 6.2.6). According to the available length distributions and information on maturity only around 29% of catches in abundance and 44% in biomass are mature (Figure 6.2.6). There does seem to be a gradual increase in mean age of the age distribution from commercial catches from roughly 7 to 9 (Figure 6.2.9). The reason for this is unknown, but given they lack of distinctive cohort structure in the data the first explanation might be a lack of consistency in ageing. Also, tusk have experienced a reduction in fishing mortality over the latter half of this range. Reasons such as difference in sampling, temporal or spatial are highly unlikely.

At WGDEEP 2011 the Faroe-Iceland Ridge was included in the survey index when presenting the results from the Icelandic spring survey for tusk in 5.a. Total biomass index and the biomass index for tusk larger than 40 cm (harvestable part of the stock) has remained at similar level as in since 2011 at a relatively high level (Figure 6.2.10). The same holds for the index of tusk larger than 60 cm (spawning–stock biomass index) but that index didn't increase by similar factors as the other two biomass indices. The index of juvenile abundance (<30 cm) decreased by a factor of six between the 2005 survey when it peaked and the 2013 survey when it was at its lowest observed value. Since 2013 juvenile index has increased year on year in the 2014–2017 surveys. The index excluding the Faroe-Iceland Ridge shows similar trends as described above. The result from the shorter autumn survey are by and large similar to those observed from the spring survey except for the juvenile abundance index that is more or less at a constant level compared to the spring survey juvenile index. Due to industrial action the autumn survey did not take place in 2011.

When looking at the spatial distribution from the spring survey around half of the index is from the SE area (Figure 6.2.11). However only around 20 to 25% of the catches are caught in this area (Figures 6.2.2 and 6.2.3). The change in juvenile abundance between 2006 and recent years can be clearly seen in Figures 6.2.11 and 6.2.12 where in 2006 juveniles (<40 cm) were all over the southern part of the shelf but can hardly be seen in recent years.

Stock assessment on Tusk in 5.a using Gadget

Since 2010 the Gadget model (**G**lobally applicable **A**rea **D**isaggregated **G**eneral **E**cosystem **T**oolbox, see www.hafro.is/gadget) has been used for the assessment of tusk in 5.a (See stock annex for details). As part of a Harvest Control Evaluation requested by Iceland this stock was benchmarked in 2017 (WKICEMSE 2017). Several changes were made to the model setup and settings which are described in the stock annex.

Data used and model settings

Data used for tuning are given in the stock annex.

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

Diagnostics

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

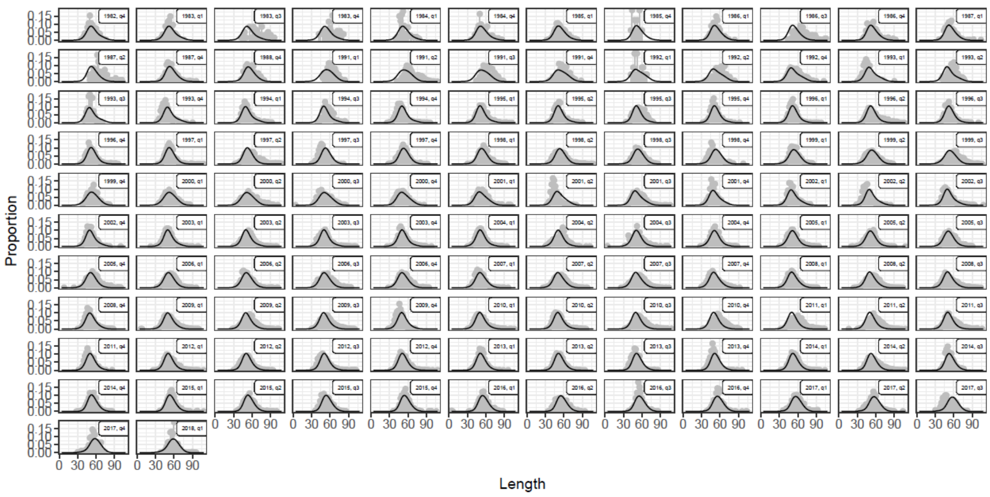


Figure 6.2.15. Tusk in 5.a and 14. Proportional fit (black line) to observed length distributions (grey points and bars) from commercial catches (longlines) by year and quarter from Gadget.

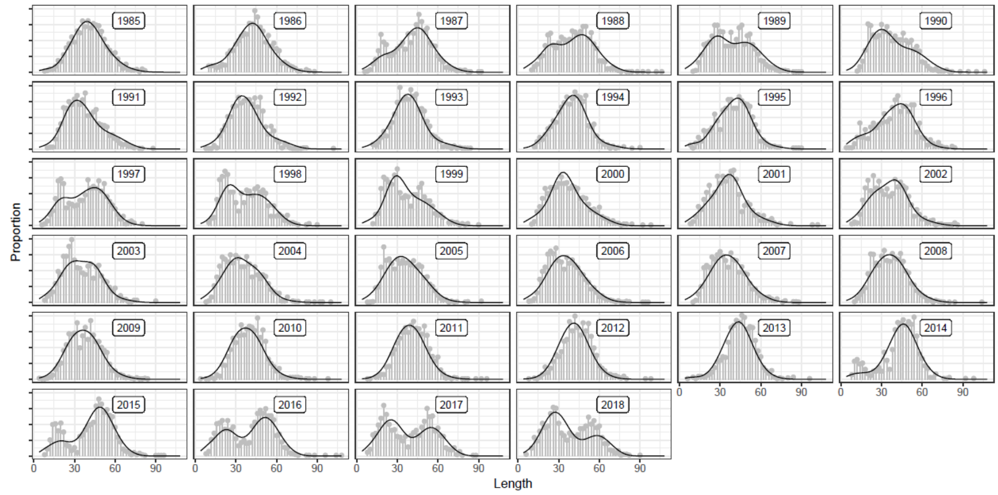


Figure 6.2.16. Tusk in 5.a and 14 Fit (red line) to observed length distributions (points and blue bars) from the Icelandic spring survey by year from Gadget.

Model fit: In Figure 6.2.17 the length disaggregated indices are plotted against the predicted numbers in the stock as a time-series. The correlation between observed and predicted is good for the first five length groups (10–19, 20–29, 30–39, 40–49, 50–59 and 60–69) which the first three to four are the main length groups of tusk caught in the spring survey. In the two larger length groups the fit gets progressively worse. Overall fit, when the disaggregated abundance indices and predictions are converted to biomass and summed over the length intervals is good, however the model is predicting lower biomass than the survey indicates in the terminal year (Figure 6.2.17).

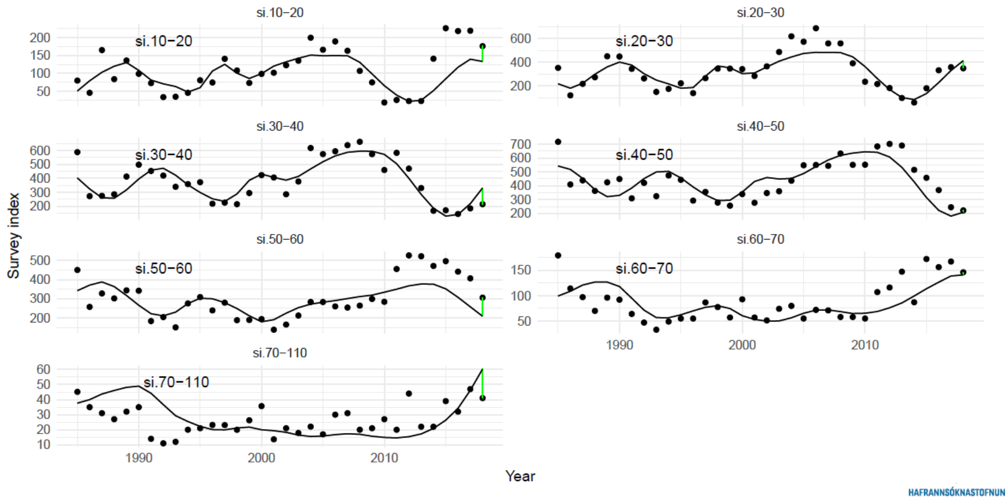


Figure 6.2.17. Tusk in 5.a and 14. Gadget fit to indices from disaggregated abundance by length indices from the spring survey.

Results

The results are presented in Table 6.2.8 and Figure 6.2.18. In comparison with last year, there has been a slight downward revision of biomass levels. Recruitment peaked in 2005 to 2006 but has decreased and is estimated in 2013 to have been the lowest observed. Recruitment in 2014–2016 is estimated to be considerably higher than in 2013. Spawning–stock biomass has increased slowly since 2005. Harvestable biomass is estimated at a fairly high level compared to the rest of the time-series. Harvest rate has decreased from 0.29 in 2008 to 0.12 in 2016. Estimates reference biomass (B40+) have been stable for the last three years.

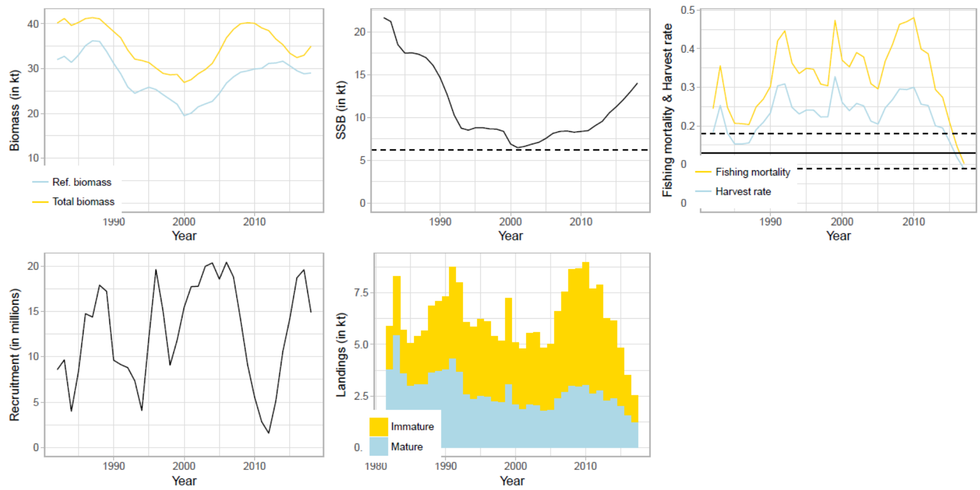


Figure 6.2.16. Tusk in 5.a and 14. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for tusk for the age groups most important in the fishery i.e. ages 7 to 10 (solid line).

Reference points

In the past Yield-per-recruit based reference points estimated as described in the stock annex were used as proxies for F_{MSY}. F_{MAX} from a Y/R analysis is 0.24 and $F_{0.1}$ is 0.15.

WGDEEP 2014 recommended using F_{MSY}=0.2 as the target fishing mortality rather than F_{max}. This was subsequently used as the basis for the advice in 2014 by ICES. (See stock annex for details).

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

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

The management plan proposed by Iceland is:

> The spawning–stock biomass trigger (MGT $B_{trigger}$) is defined as 6.24 kt, the reference biomass is defined as the biomass of tusk 40+ cm and the target harvest rate (HR_{MGT}) 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 SSB_Y is equal or above MGT $B_{trigger}$:
>
> $TAC_{Y/y+1} = HR_{MGT}*B_{Ref,y}$
>
> When SSB_Y is below MGT $B_{trigger}$:
>
> $TAC_{Y/y+1} = HR_{MGT}* (SSB_y/MGT\ B_{trigger}) * B_{ref,y}$

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

6.2.4 Comments on the assessment

This is the second year that the assessment is conducted in a different manner than previous to the benchmark in 2017, which was done as part of Harvest Control Rule evaluation request to ICES from Iceland.

WKICEMSE 2017 noted:

> "Catches of tusk in Greenland, within ICES Subarea 14, were discussed. Minor catches (representing <5% of the total catch of tusk in 5.a+14) have always occurred in the Greenland area and were never included in the stock assessment of tusk. However, these catches increased in 2015 and 2016, representing around 10%–15% of the total catches in those years. None of the work presented to WKICEMSE included these catches, which seem to occur well away from the area where the catches included in the stock assessment take place (i.e. in or around ICES Division 5.a). Information about these catches in the Greenland area is somewhat limited and no biological samples are available; doubts related to population structure, movement and connectivity were also noted during the discussion. It was then decided to conduct a stock assessment run incorporating those catches (just the tonnage), to gain understanding on

their potential impact on stock assessment results. Their inclusion in the assessment resulted in minor revisions upwards of the estimated stock biomass (around 1%–4% revision, on average throughout the years in the stock assessment) and downwards of the estimated harvest rate (around 0%–3% revision, on average throughout the years in the stock assessment, although with an increase of the harvest rates estimated for 2015 and 2016); the results of this run are available at the end of Section 2.2. As there are some doubts in relation to these catch data and population structure of tusk in the area, WKICEMSE did not feel that a decision to include these catches in the stock assessment at this point was appropriate before conducting additional explorations and having a better understanding. It is recommended that appropriate stock experts in WGDEEP should explore this issue further."

This was discussed at WGDEEP-2017 and the following points were raised:

- Stock structure is generally unclear when it comes to deep-water stocks and many of the stock units assessed by WGDEEP are defined based on very limited scientific knowledge.
- The current advice units of tusk are not based on genetic studies except for tusk in Rockall and on the Mid Atlantic Ridge.
- The fishing areas for tusk in 5.a and 14 are widely separated (see Section 6.1). However survey data do show continuous distribution between Greenland, Iceland and the Faroe Islands.
- Genetic studies do not detect difference in tusk populations from the Barents Sea down to the Faroe Islands and over to Iceland and Greenland (Knutsen *et al.*, 2009).
- Knutsen *et al.* (2009) proposed that the bathymetry over the NE-Atlantic could form a "bridge" between Norway and Greenland. However, they point out that tusk is not believed make extensive migrations and actually to be a sedentary species. Larval dispersal could account for the lack of genetic difference in tusk.
- It is highly plausible that the increased abundance of tusk seen in the Walter Herwig survey is of Icelandic origin that might have been dispersed as larvae to Greenland, similar as has been reported for cod in 5.a. However, unlike cod it is unlikely that tusk would migrate back to Iceland.
- The tusk population in Greenland is likely to be a "sink" from the Icelandic population and as such should not affect the productivity of tusk in Iceland.

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

6.2.5 Management considerations

Increased catches in 14.b from less than 100 tonnes in previous year to 980 tonnes in 2015, and about 419 tonnes in 2017 are of concern (See Section 6.1.4).

The signs from commercial catch data and surveys indicate that the total biomass of tusk in 5.a is stable. This is confirmed in the Gadget assessment. Recruitment in 5.a is on the increase again after a low in 2013. However due to reduction in fishing mortality harvestable biomass and SSB 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.

Table 6.2.6. Tusk in 5.a and 14. Nominal landings by nations in 5.a.

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

Table 6.2.7. Tusk in 5.a and 14. Nominal landings by nations in 14.

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

Year	Faroe	Denmark	Greenland	Germany	Iceland	Norway	Russia	Spain	UK	Total
2002	4	0	0	0	86	30	0	0	0	120
2003	0	0	0	0	2	88	0	0	0	90
2004	0	0	0	0	0	40	0	0	0	40
2005	7	0	0	0	0	41	8	0	0	56
2006	3	0	0	0	0	19	51	0	0	73
2007	0	0	0	0	0	40	6	0	0	46
2008	0	0	33	0	0	7	0	0	0	40
2009	12	0	15	0	0	5	11	0	0	43
2010	7	0	0	0	0	5	0	0	0	12
2011	20	0	0	0	131	24	0	0	0	175
2012	33	0	0	0	174	46	0	0	0	253
2013	1.9	0.3	0	0	0	23.8	0	0	0	26
2014	2	0	0	0	0	26	0	0	0	28
2015	670	0.1	166	0	0	62	0	0	0	898
2016	111	0	182	0	0	178	0	0	0	471
2017	83	0.38	335	0	0	141	0	0	0	419

Table 6.2.8. Tusk in 5.a and 14. Estimates of biomass, biomass 40+ cm, spawning–stock biomass (SSB) in thousands of tonnes and recruitment (millions), harvest rate (HR) and fishing mortality from Gadget.

YEAR	BIOMASS	B_{40+}	SSB	REC3	CATCH	HR	F
1982	40.18	32.02	21.65	12.23	5.88	0.18	0.24
1983	41.19	32.75	21.20	8.57	8.29	0.26	0.36
1984	39.64	31.40	18.50	7.53	5.69	0.18	0.25
1985	40.30	33.00	17.51	7.15	5.06	0.15	0.21
1986	41.17	35.13	17.55	2.96	5.38	0.15	0.21
1987	41.38	36.22	17.36	6.19	5.64	0.15	0.20
1988	41.13	36.07	16.98	10.92	6.86	0.19	0.25
1989	39.68	33.83	16.08	10.64	7.08	0.21	0.27
1990	38.28	31.19	14.64	13.24	7.30	0.24	0.30
1991	36.89	28.86	12.66	12.73	8.76	0.31	0.42
1992	34.15	25.91	10.27	7.12	8.00	0.31	0.45
1993	32.12	24.49	8.74	6.77	6.07	0.24	0.36
1994	31.82	25.23	8.52	6.52	5.83	0.22	0.34
1995	31.36	25.85	8.79	5.44	6.23	0.24	0.35
1996	30.14	25.34	8.80	3.03	6.10	0.24	0.35
1997	28.95	24.20	8.67	8.97	5.40	0.22	0.31
1998	28.62	23.14	8.63	14.52	5.17	0.23	0.30
1999	28.70	22.06	8.37	11.15	7.23	0.34	0.47
2000	26.92	19.49	6.89	6.71	5.08	0.26	0.37
2001	27.56	20.07	6.46	8.75	4.81	0.23	0.35
2002	28.85	21.49	6.62	11.44	5.55	0.25	0.39
2003	29.80	22.12	6.88	13.12	5.57	0.25	0.38
2004	31.19	22.71	7.09	13.15	4.82	0.21	0.31
2005	33.86	24.47	7.55	14.78	5.01	0.20	0.30
2006	36.89	26.76	8.14	15.05	6.60	0.24	0.37
2007	38.77	28.17	8.37	13.73	7.54	0.27	0.41
2008	40.02	29.20	8.42	15.11	8.63	0.29	0.46
2009	40.24	29.51	8.27	13.90	8.68	0.30	0.47
2010	40.12	29.92	8.36	10.46	8.98	0.30	0.48
2011	39.09	30.06	8.46	6.76	7.70	0.25	0.40
2012	38.48	31.17	9.04	4.11	7.87	0.25	0.39
2013	36.63	31.27	9.54	2.11	6.26	0.20	0.29
2014	35.35	31.65	10.53	1.18	6.16	0.20	0.27
2015	33.43	30.63	11.26	3.79	4.84	0.16	0.21
2016	32.47	29.53	12.09	7.84	3.49	0.12	0.15
2017	32.98	28.85	13.01	10.55	2.54		

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

6.3.1 The fishery

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

6.3.2 Landings trends

Landing statistics by nation in the period 1988–2017 are shown in Table 6.3.1.

The reported landings are generally very low in these areas. Russia reported some landings of tusk in 2005–2007 and 2009 and no landings were reported for 2010 and 2011. In 2012 Norway reported 17 tonnes in Area 14.b1 and the Faroe Islands, 1 tonne No landings have been reported in 2013, 2014, 2016 and 2017, while in 2015 Greenland reported 2 tonnes.

6.3.3 ICES Advice

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

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

6.3.4 Data available

6.3.4.1 Landings and discards

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

6.3.4.2 Length compositions

No length compositions were available.

6.3.4.3 Age compositions

No age compositions were available.

6.3.4.4 Weight-at-age

No data were available.

6.3.4.5 Maturity and natural mortality

No data were available.

6.3.4.6 Catch, effort and research vessel data

No data were available.

6.3.5 Data analyses

There are insufficient data to assess this stock.

6.3.5.1 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.

6.3.6 Comments on the assessment

No assessment was carried out this year.

6.3.7 Management considerations

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

6.3.8 Tables

Table 6.3.1. Tusk 12. WG estimate of landings.

Tusk 12

Year	Faroes	France	Iceland	Norway	Scotland	Russia	Total
1988		1					1
1989		1					1
1990		0					0
1991							0
1992							0
1993	29	1	+				30
1994	27	1	+				28
1995	12	-	10				18
1996	7	-	9	142			158
1997	11	-	+	19			30
1998				-			1
1999				+	1		1
2000				5	+		5
2001		1		51	+		52
2002				27			27
2003				83			83
2004		2		7		5	14
2005	2	1					3
2006						64	64
2007						19	19
2008						0	0
2009						2	2
2010							0
2011							0
2012	1						1
2013							0
2014							0
2015							0
2016							0
2017*							0

***Preliminary.**

Tusk 14.b1

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

Table 6.3.1. (Continued).Tusk, total landings by subareas or division.

Year	12	14.b1	All areas
1988	1		1
1989	1		1
1990	0		0
1991	0		0
1992	0		0
1993	30		30
1994	28		28
1995	18		18
1996	158		158
1997	30		30
1998	1		1
1999	1		1
2000	5		5
2001	52		52
2002	27		27
2003	83		83
2004	14		14
2005	3		3
2006	64		64
2007	19		19
2008	0		0
2009	2		2
2010	0		0
2011	0		0
2012	1	17	18
2013	0		0
2014	0		0
2015	0	2	2
2016	0		0
2017*			0

***Preliminary.**

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

6.4.1 The fishery

Tusk is a bycatch species in the trawl, gillnet and longline fisheries in Subarea 6.b. Norway has traditionally landed the largest percentage of the total catch and is hence the most important fleet in the area. During the period 1988–2017 Norwegian vessels have reported over 80 percent of the total landings. Small bycatches of tusk were also taken in 6.b by trawlers in the haddock fishery. Since January 2007 parts of the Rockall Bank has been closed to fishing. The areas closed are 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 at 25 in 2015 to 2017. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. With the decreasing size of the flee; because of closed areas, increasing fuel costs and larger quotas of Arcto Norwegian cod, the total numer of days the fleet has been fishing in area 6.b per year has decreased from a maximun in 2002 of 464 fishing days to 50 days in 2017 (Figure 6.4.1). The number of hooks set per day increased from an average of 30 000 in 2000 to 35 000 in 2017.

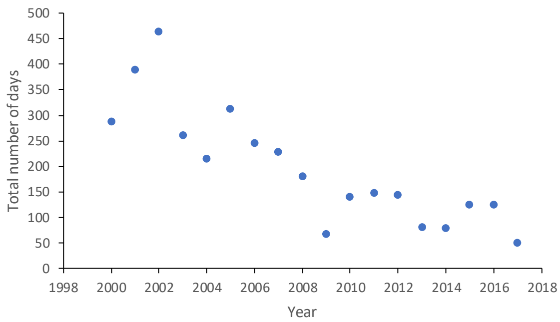


Figure 6.4.1. Estimated total number of days the Norwegian longline fleet fished for tusk during the period 2000 to 2017 based on logbooks.

6.4.2 Landings trends

Landing statistics by nation in the period 1988–2017 are in Table 6.4.1.

Landings varied considerably between 1988 and 2000; peaked at 2344 t in 2000, and since then have been low with a declining trend. In 2014 the catch was 38 tons, an all-time low during this period, while in 2015 the total catch increased to 226 tons but in 2017 the landings decreased to 47 tons (Figure 6.4.1).

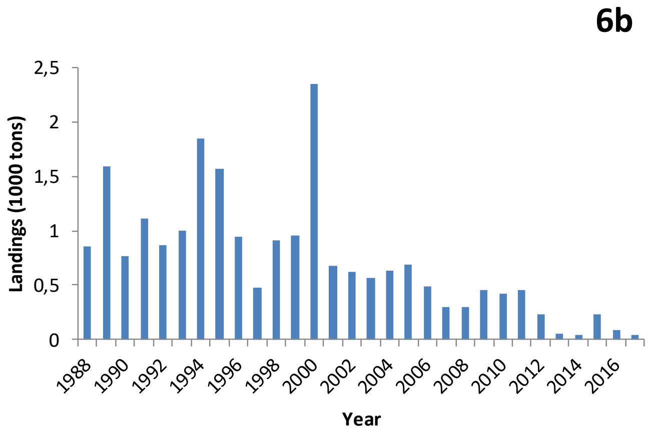


Figure 6.4.1. The international total landings of tusk from Subarea 6.b.

6.4.3 ICES Advice

Advice for 2017 to 2018: ICES advises that when the precautionary approach is applied, catches should be no more than 350 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed.

6.4.4 Management

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

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

EU TACs cover Subareas 5, 6, 7 (EU and international waters) and in 2018 is set at 1207 t.

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

6.4.5 Data available

6.4.5.1 Landings and discards

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

6.4.5.2 Length compositions

The length distributions of tusk based on data provided by the Norwegian reference fleet for the period 2002–2017 are in Figures 6.4.3 and 6.4.4. The average length during this period fluctuated without any obvious trends (no data were available for 2004, 2011, 2014 and 2017).

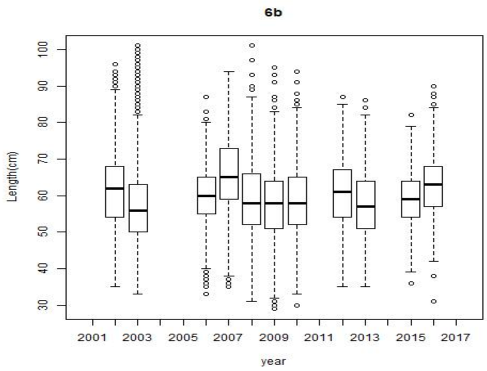


Figure 6.4.3. The length distribution of tusk based on data provided by the Norwegian reference fleet for 2002–2016 (no data were available for 2004, 2011, 2014 and 2017).

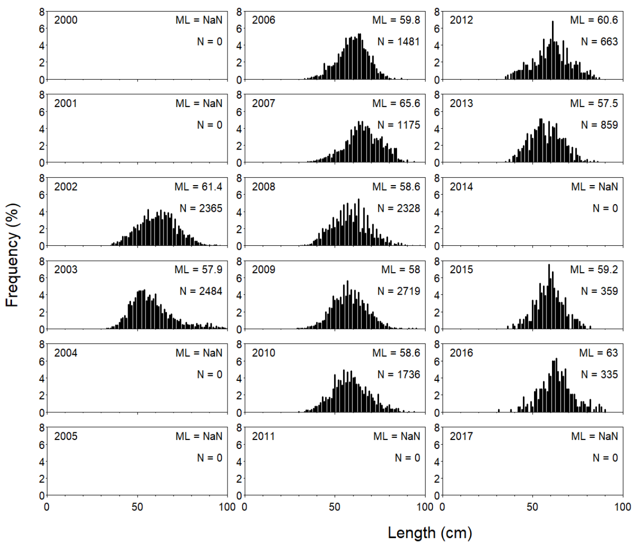


Figure 6.4.4. The length distribution of tusk based on data provided by the Norwegian reference fleet for 2002–2016 (no data were available for 2004, 2005, 2011, 2014 and 2017).

6.4.5.3 Age compositions

No new age composition data were available.

6.4.5.4 Weight-at-age

No new data were presented.

6.4.5.5 Maturity and natural mortality

No new data were presented.

6.4.5.6 Catch, effort and research vessel data

Norway began in 2003 collecting and entering data from official logbooks into an electronic database, and data are now available for 2000–2017. 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.

6.4.6 Data analyses

No analytical assessments were carried out.

Norwegian longline cpue

When using all available data, the standardized cpue series showed a declining trend from 2000–2007, after 2007 the cpue has been at a stable but a low level. When only data from the targeted fishery are, used, the cpue appears to be stable, although there were no new data for 2016 and 2017 (Figure 6.4.5).

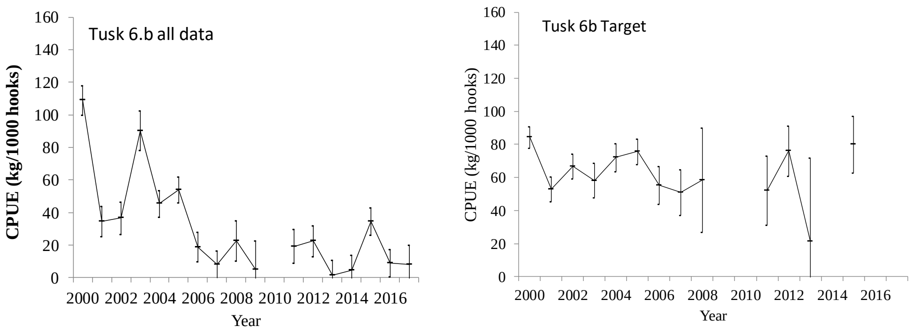


Figure 6.4.5. Estimated cpue (kg/1000 hooks) series for tusk in Subarea 6.b based on skipper's log-books (during the period 2000–2017). The bars denote the 95% confidence intervals.

6.4.6.1 Biological reference points

See Section 6.4.9.

6.4.7 Comments on the assessment

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

6.4.8 Management considerations

The landings since 2001 have been low with a decreasing trend. The landings were especially low in 2013 and 2014. During these two years the fishing activities were also very low with an average fishing activity of two days per longliner. In 2015 the average number of fishing days increased to five and the total landings increased considerable compared to the previous two years. When all available data are combined, the cpue series also shows a decreasing trend until 2007 after this it has been at a stable but low level. The cpue series for the targeted fishery for tusk shows a stable level.

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

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

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

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

6.4.9 Application of MSY proxy reference points

Length-based indicator method (LBI)

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

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

SPiCT

The SPiCT model was run based on the cpue and catch data for tusk in 6.b using the default settings. Due to time constrains various model settings were not tested and further work is needed before it can be concluded whether or not SPiCT is appropriate method for this stock.

Table 6.4.1. Tusk 6.b. WG estimate of landings.

Year	Faroes	France	Germany	Ireland	Iceland	Norway	E & W	N.I.	Scot.	Russia	Total
1988	217		-	-		601	8	-	34		860
1989	41	1	-	-		1537	2	-	12		1593
1990	6	3	-	-		738	2	+	19		768
1991	-	7	+	5		1068	3	-	25		1108
1992	63	2	+	5		763	3	1	30		867
1993	12	3	+	32		899	3	+	54		1003
1994	70	1	+	30		1673	6	-	66		1846
1995	79	1	+	33		1415	1		35		1564
1996	0	1		30		836	3		69		939
1997	1	1		23		359	2		90		476
1998		1		24	18	630	9		233		915
1999				26	-	591	5		331		953
2000		2		22		1933	14		372	1	2344
2001	1	1		31		476	10		157	6	681
2002		8		3		515	8		88		622
2003		7		18		452	11		72	1	561
2004		9		1		508	4		45	60	627
2005		5		9		503	5		33	137	692
2006	10	1		16		431	2		25	2	487
2007	4	0		8		231	1		30	25	299
2008	41	0		2		190	0		16	44	293
2009	70			4		358			17	3	452
2010	57			1		348			13		419
2011	3					433			14		450
2012	15					209			9		233
2013		1				46			11		57
2014	6					26			6		38
2015	1					218	7		7		226
2016				1		80			9		90
2017*				2		37			8		47

*Preliminary.

Table 6.4.1. (Continued).

Tusk, total landings in Subarea 6.b.

Year	6.b	All areas
1988	860	860
1989	1593	1593
1990	768	768
1991	1108	1108
1992	867	867
1993	1003	1003
1994	1846	1846
1995	1564	1564
1996	939	939
1997	476	476
1998	915	915
1999	953	953
2000	2344	2344
2001	681	681
2002	622	622
2003	561	561
2004	627	627
2005	692	692
2006	487	487
2007	299	299
2008	293	293
2009	452	469
2010	419	419
2011	450	450
2012	233	233
2013	57	57
2014	38	38
2015	226	226
2016	90	90
2017*	47	47

***Preliminary.**

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

6.5.1 The fishery

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

Figure 6.5.1 shows the spatial distribution of the total catch by the Norwegian longline fishery in 2013 to 2017. The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number decreased to 25 in 2017. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas 1 and 2 has declined since the peak in 2011. During the period 1974 to 2016 the total number of hooks per year has varied considerably, but with a downward trend since 2002 (For more information see Helle and Pennington, WD 2018).

Since the total number of hooks per year takes into account; the number of vessels, the number of hooks per day, and the number of days each vessel participated in the fishery, it follows that it may be a suitable measure of changes in applied effort. Based on this gauge, it appears that the average effort for the years 2011–2017 is 43% less than the average effort during the years 2000–2003. It should be noted that the annual fishery covers the entire distribution of tusk in Subareas 1 and 2 (see Figure 6.5.1), so that the catch produced by the applied effort is likely proportional to the actual population.

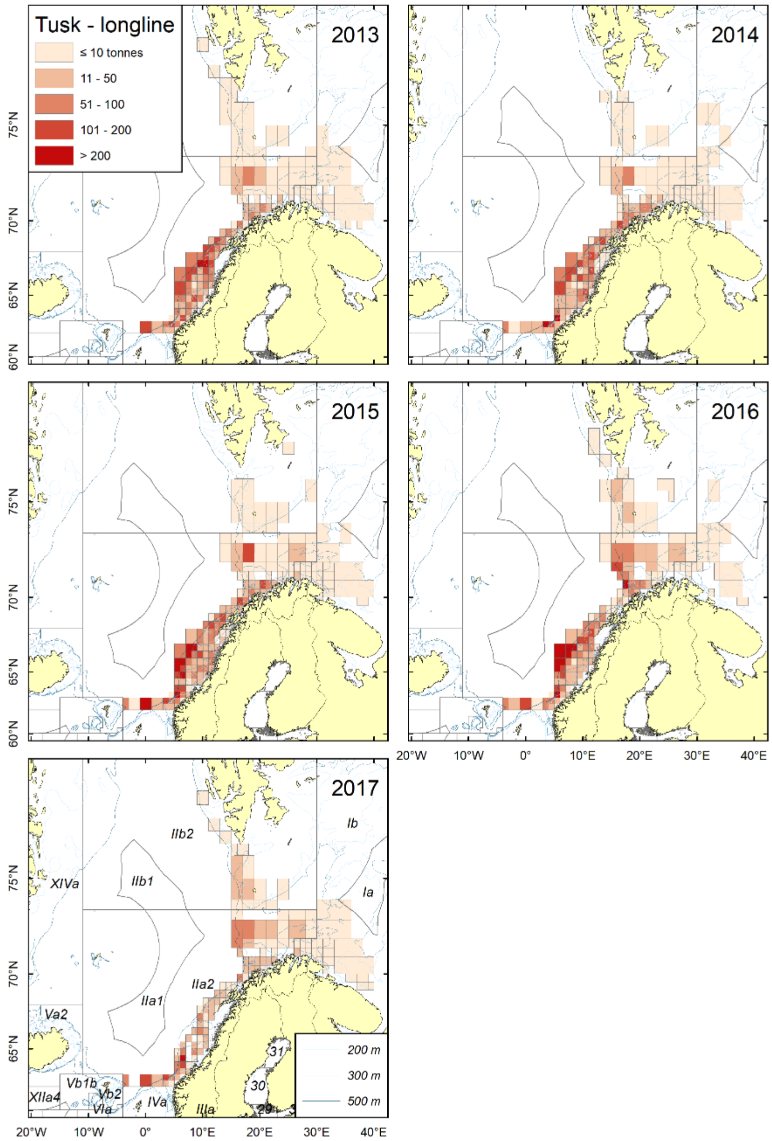


Figure 6. 5.1. Distribution of catches for the Norwegian longline fishery in Subareas 1 and 2 in 2013 to 2017.

6.5.2 Landings trends

Landing statistics by nation in 1988–2017 are given in Table 6.5.1a–d. Landings declined from 1989 to 2005, afterwards the landings increased (Figures 6.5.2 and 6.5.3). The preliminary landings for 2017 are 7 926 t.

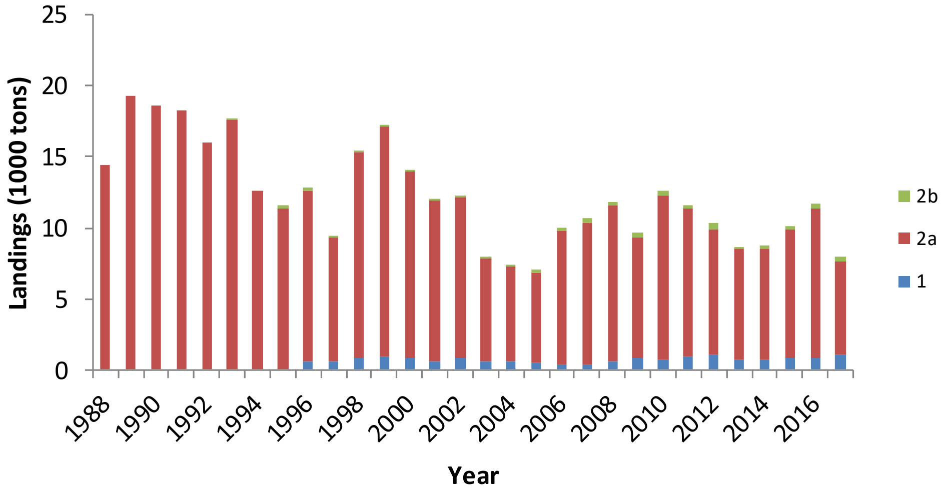


Figure 6.5.2. Total yearly landings of tusk in Areas 1 and 2 for 1988–2017.

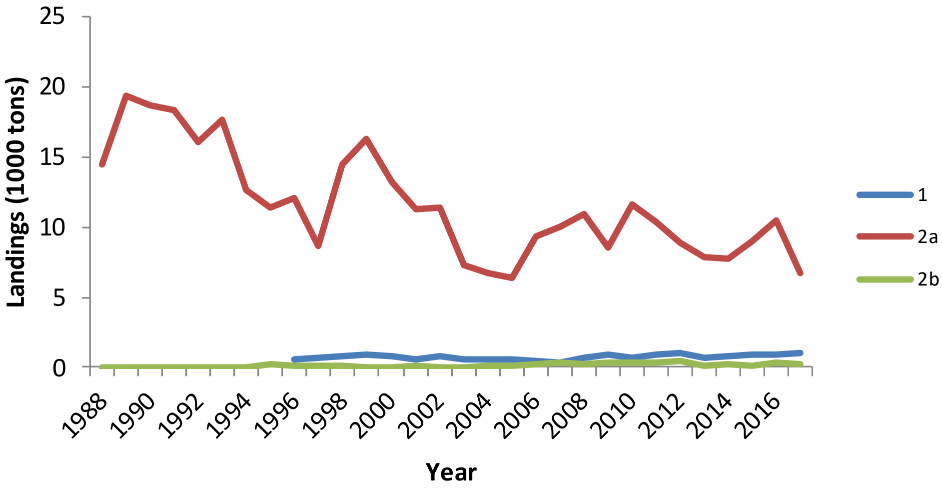


Figure 6.5.3. Total yearly landings of tusk in Areas 1 and 2 for 1988–2017.

6.5.3 ICES Advice

Advice for 2018 to 2019: ICES advises that if the precautionary approach is applied, then the yearly catch should be no more than 10451 tonnes for 2018 and 2019. All catches are assumed to be landed.

Management:

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

The EU TAC (for community vessels fishing in community waters and waters not under the sovereignty or jurisdiction of third countries in 1, 2 and 14) was set to 21 t in 2018.

6.5.4 Data available

6.5.4.1 Landings and discards

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

6.5.4.2 Length compositions

Figures 6.5.4 and 6.5.5 show the length distributions and Figure 6.5.6 shows the length–weight relationship for tusk based on data provided by the Norwegian reference fleet for the period 2001–2017.

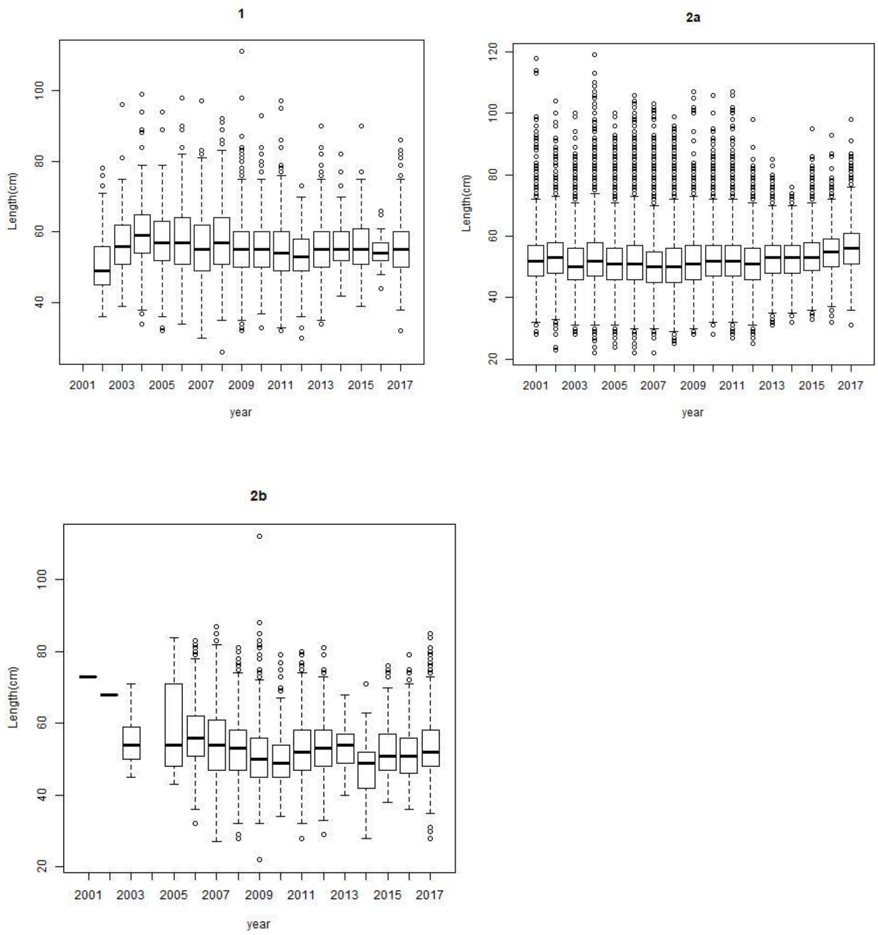


Figure 6.5.4. Box and whisker plots showing the length distribution of tusk. The data were provided by the Norwegian reference fleet for the period 2001–2017.

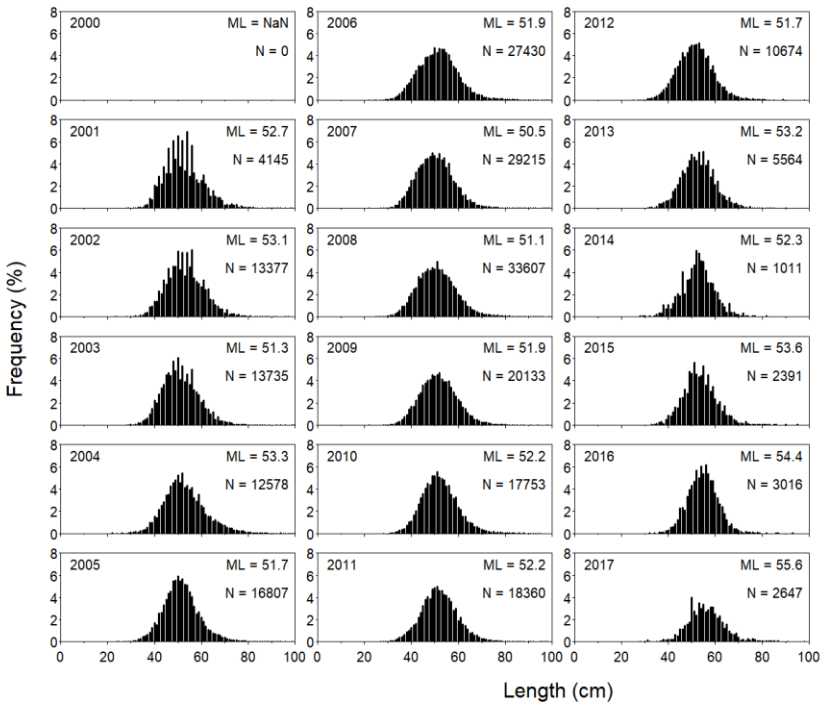


Figure 6.5.5. The estimated length distributions of the catch of tusk by Norwegian longliners combined for the Areas 1, 2.a and 2.b.

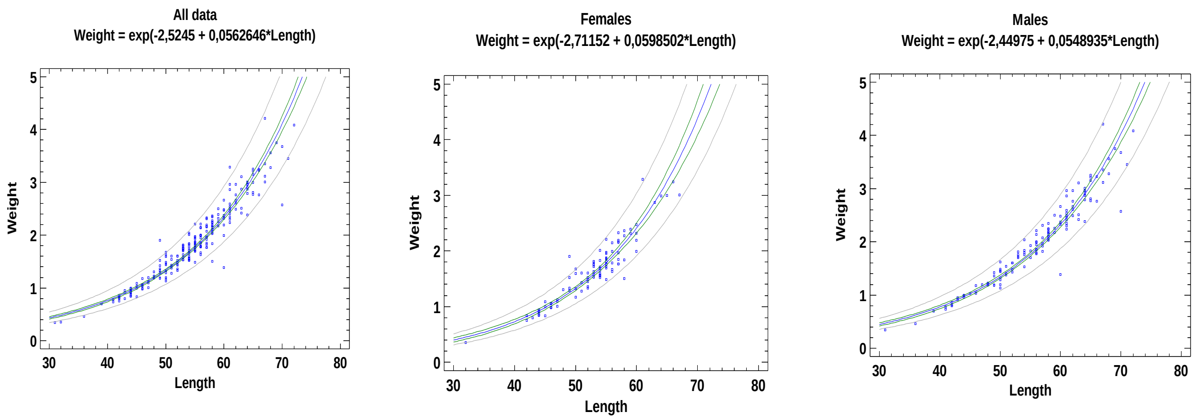


Figure 6.5.6. Length–weight relationship for tusk.

6.5.4.3 Age compositions

The average length and weight-at-age for males and females based on all available data for the years 2000–2002, 2004, 2005, 2010, 2011, 2013-2016 are shown in Figure 6.5.7 and the catch-at- age composition from the longline fishery in areas 1 and 2 is shown in Figure 6.5.8.

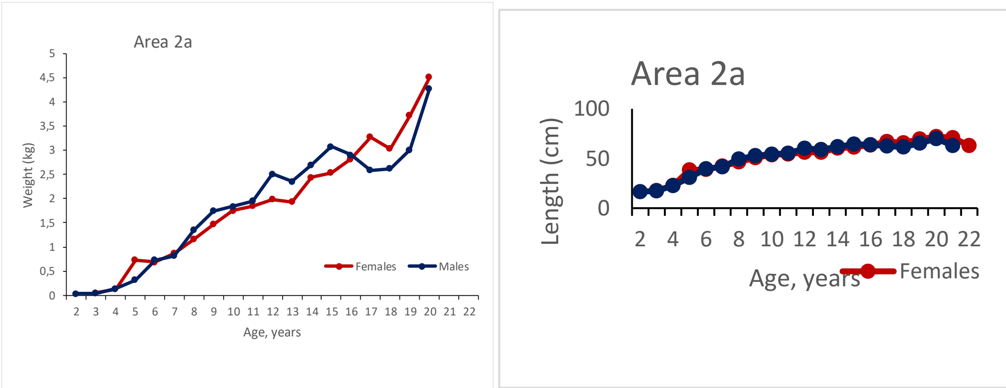


Figure 6.5.7. Average length and weight-at-age for all available data for the years 2000–2002, 2004, 2005, 2010, 2011, 2013-2016.

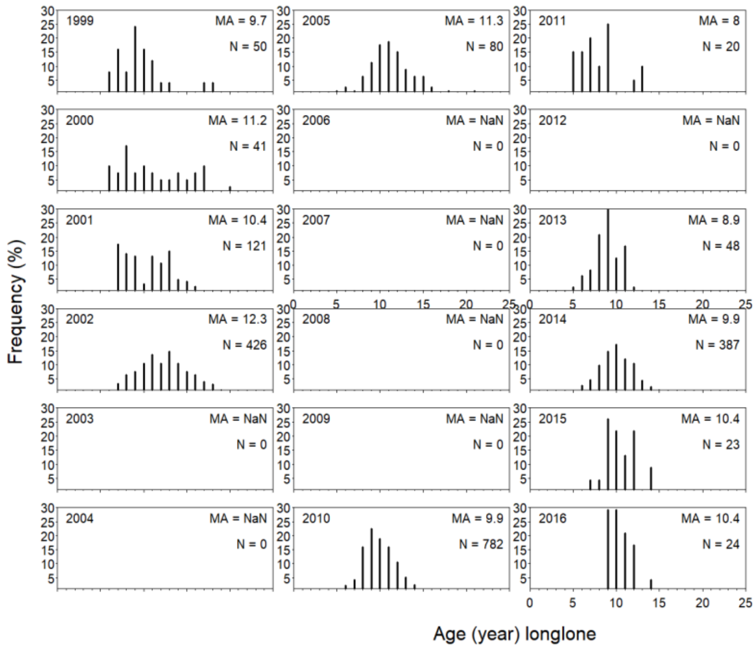


Figure 6.5.8. Catch-at- age composition from the longline fishery in areas 1 and 2.

6.5.4.4 Maturity and natural mortality

Maturity ogives of tusk are in Figure 6.5.9 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

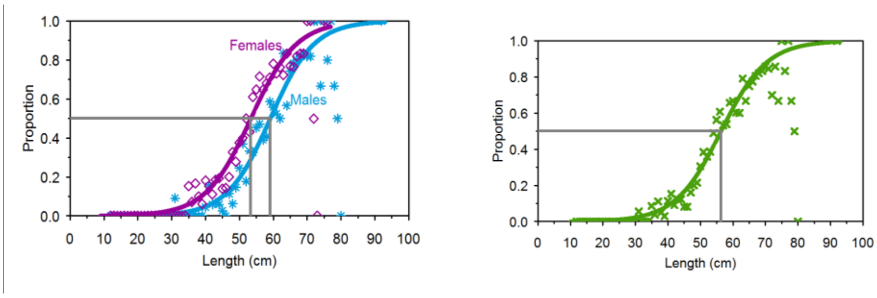


Figure 6.5.9. Tusk 1 and 2, Maturity ogive on length for males and females, and all data combined.

6.5.4.5 Catch, effort and research vessel data

Norway started in 2003 to collect and enter data from official logbooks into an electronic database, and these data are now available for the period 2000–2017. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 t in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day.

The method for estimating cpue for tusk is given in Helle *et al*., 2015. An analysis based on these data is in the WD Helle and Pennington, 2018. Two cpue series, one based on all data and one when tusk was targeted were presented (Figure 6.5.9). No research vessel data were available.

6.5.5 Data analyses

Length distribution

The mean length fluctuated without any obvious trends.

Assessment

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

CPUE

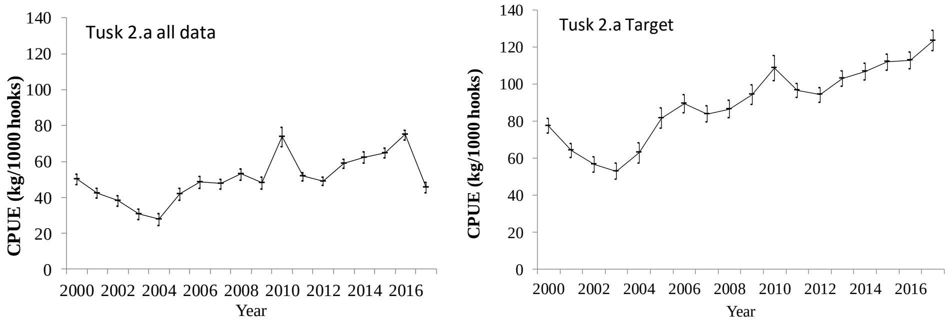


Figure 6.5.9. Estimates of cpue (kg/1000 hooks) of tusk based on skipper's logbook data for 2000–2017. The bars denote the 95% confidence interval.

Two standardized GLM-based cpue series using all the data and based only when tusk made up more than 30% of the catches are in Figure 6.5.9. Both cpue series show an upward trend from 2004 until 2016, while for 2017, the estimates diverge (Figure 6.5.9).

Biological reference points

Biological reference points are in Table 6.5.2.

Table 6.5.2. Life history parameters

Data type	Years/Value	Source	Notes
Length–frequency distribution	2001–2016	Norwegian longliners (Reference fleet)	
Length–weight relationship	0.0106* length $^{3.0168}$	Norwegian longliners (Reference fleet) and survey data.	combined sex
L_{MAT}	56 cm	Norwegian longliners (Reference fleet) and survey data.	
L_{inf}	119 cm (L_{max})	Norwegian longliners (Reference fleet) and survey data.	

6.5.6 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.

6.5.7 Management considerations

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

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.

6.5.8 Application of MSY proxy reference points

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

Results for the LBI

The results for the LBI are very sensitive to the assumed values of L_{inf} and L_{mat}. The background data for Linf and Lmat are limited and hence very unreliable. The ageing of tusk is very difficult and A_{50} was not estimated.

More reliable data must is needed to get more precise measurements for the life history parameters. The LBI method was run with the new length data from 2017 and the conclusion was similar to last year. However, with the uncertainty about the input parameters new results will not be presented until more reliable input values are available.

Results for the SPiCT model:

The SPiCT model was run on the cpue and catch data for tusk in arctic waters (1, 2.a, 2.b) using the default settings.The input data was landings 2000–2017, and the cpue index for the targeted fishery from 2000–2017 (Figure 6.5.10.)

The model converges and both the deterministic and stochastic reference points are very similar, and the confidence intervals are relatively narrow which makes the model, perhaps, more plausible.

Outputs from the model: B_{msy}=28779, F_{msy}= 0.394, MSY=11347, K=98556

(Advice for 2018-2018 is 11659 tons and the total landings in 2017 was 7926 tons).

The plots of the results show narrow confidence intervals for the absolute biomass and fishing mortality (Figure 6.5.11.) The traffic light figure shows that the stock started in the red zone and are now in the green zone. This corresponds to the present perception of the development of the stock. The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality (Figure 6.5.12.). The retrospective plot showed that the test is robust (Figure 6.5.13.).

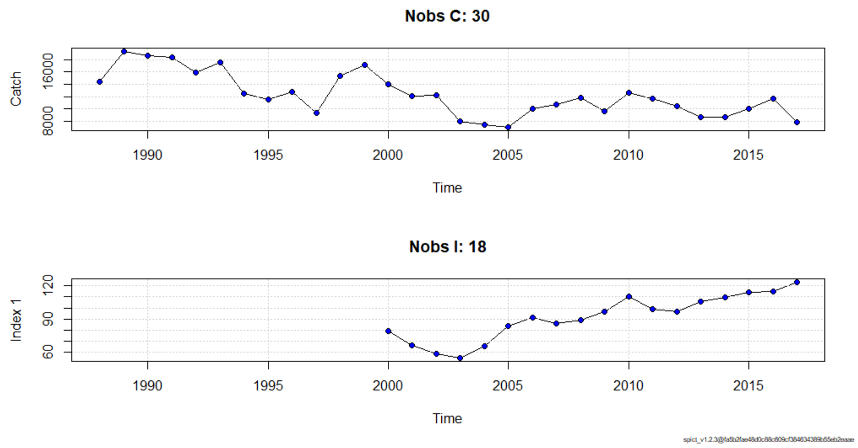


Figure 6.5.10. Input data

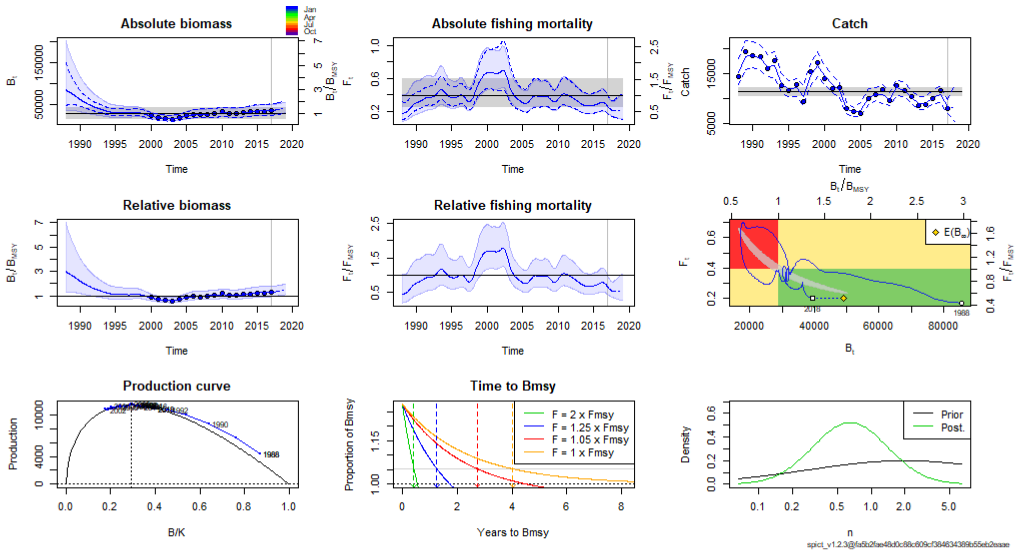


Figure 6.5.11. Plots of the results

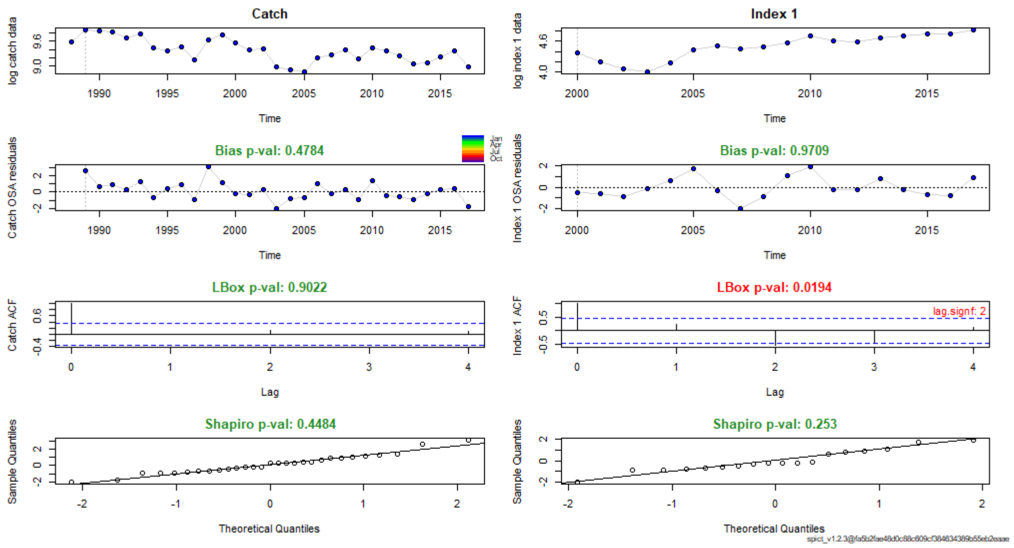


Figure 6.5.12. Diagnostics from SPiCT

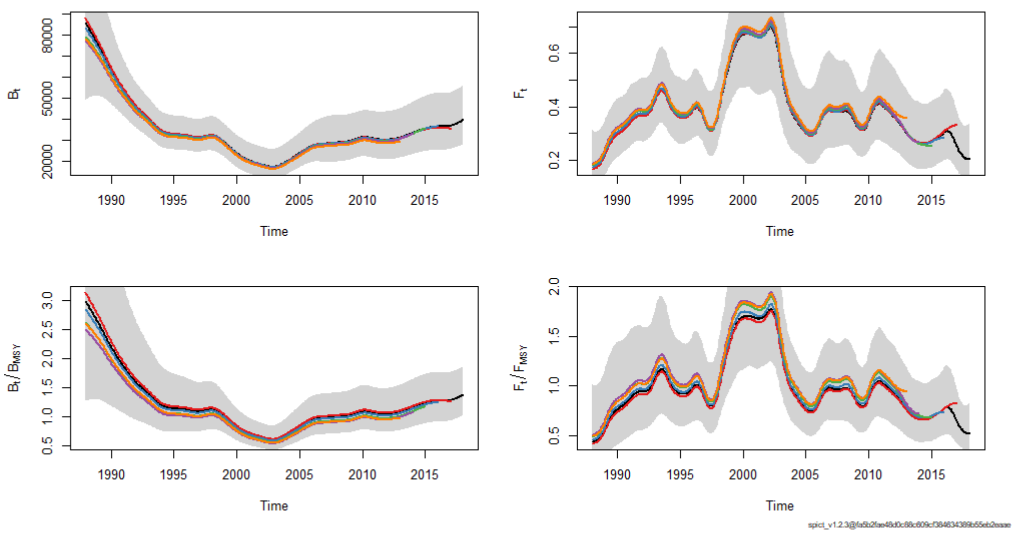


Figure 6.5.13. Retrospective analysis.

6.5.9 Tables

Table 6.5.1a. Tusk 1. WG estimates of landings.

Year	Norway	Russia	Faroes	Iceland	Ireland	France	Total
1996	587						587
1997	665						665
1998	805						805
1999	907						907
2000	738	43	1	16			798
2001	595	6		13			614
2002	791	8	n/a	0			799
2003	571	5			5		581
2004	620	2			1		623
2005	562						562
2006	442	4					446
2007	355	2					357
2008	627	7					634
2009	869	1					870
2010	725	1				1	727
2011	941						941
2012	1024						1024
2013	692						692
2014	766	5					771
2015	904						904
2016	890	2					892
2017*	1036	1					1037

***Preliminary.**

Table 6.5.1b. Tusk 2.a. WG estimates of landings.

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

***Preliminary.**

(1)Includes 2.b.

Table 6.5.1c. Tusk 2.b. WG estimates of landings.

Year	Norway	E & W	Russia	Ireland	France	Total
1988		-				0
1989		-				0
1990		-				0
1991		-				0
1992		-				0
1993		1				1
1994		-				0
1995	229	-				229
1996	161					161
1997	92	2				94
1998	73	+	-			73
1999	26		4			26
2000	15	-	3			18
2001	141	-	5			146
2002	30	-	7			37
2003	43					43
2004	114		5			119
2005	148		16			164
2006	168		23			191
2007	350		17	1		368
2008	271		11	0		282
2009	249		39			288
2010	334		57			391
2011	299		20		5	324
2012	453		40			493
2013	121	3	16			140
2014	185		41			226
2015	97		69			166
2016	165		144			309
2017*	153		81			234

Table 6.5.1d. Tusk 1 and 2. WG estimates of total landings by subareas or divisions.

Year	1	2a	2b	All areas
1988		14 403	0	14 403
1989		19 350	0	19 350
1990		18 628	0	18 628
1991		18 306	0	18 306
1992		15 974	0	15 974
1993		17 584	1	17 585
1994		12 566	0	12 566
1995		11 388	229	11 617
1996	587	12 047	161	12 795
1997	665	8667	94	9426
1998	805	14 475	73	15 353
1999	907	16 250	26	17 183
2000	798	13 192	18	14 008
2001	614	11 301	146	12 061
2002	799	11 355	37	12 191
2003	581	7316	43	7940
2004	623	6684	119	7426
2005	562	6324	164	7050
2006	446	9351	191	9988
2007	357	10 019	368	10 744
2008	634	10 966	282	11 882
2009	870	8499	288	9657
2010	727	11 540	391	12 658
2011	941	10 386	319	11 646
2012	1024	8862	493	10 394
2013	692	7830	140	8662
2014	771	7745	226	8742
2015	904	9021	166	10 091
2016	892	10459	309	11660
2017*	1037	6655	234	7926

***Preliminary.**

6.6 Tusk (*Brosme brosme*) in areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9 and other areas of 12

6.6.1 The fishery

A summary of the fisheries is in the Overview Sections: 3.3., 3.4, 3.5 and 3.6.

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

When landings from Areas 3–4 and 6.a–12 are pooled over the period 1988–2017, 35% of the landings have been in Area 4, 47% in Area 5.b, and 16% in Area 6.a.

In Area 5.b, tusk was mainly fished by longliners (about 90% of the catch), and the rest of the catch of tusk was taken by large trawlers. The main fishing ground for tusk is on the slope around the Faroes Plateau and the Faroe Bank deeper than approximately 200 m. The Norwegian longliners were not allowed to fish inside the Faroese EEZ in 2011–2013, and the Faroese longliners fish in the area where the Norwegian longliners used to fish. Since 2014 Norwegian longliners have quotas in 5.b.

6.6.2 Landings trends

Landing statistics by nation during 1988–2017 are in Table 6.6.1 and are shown by year in Figure 6.6.1.

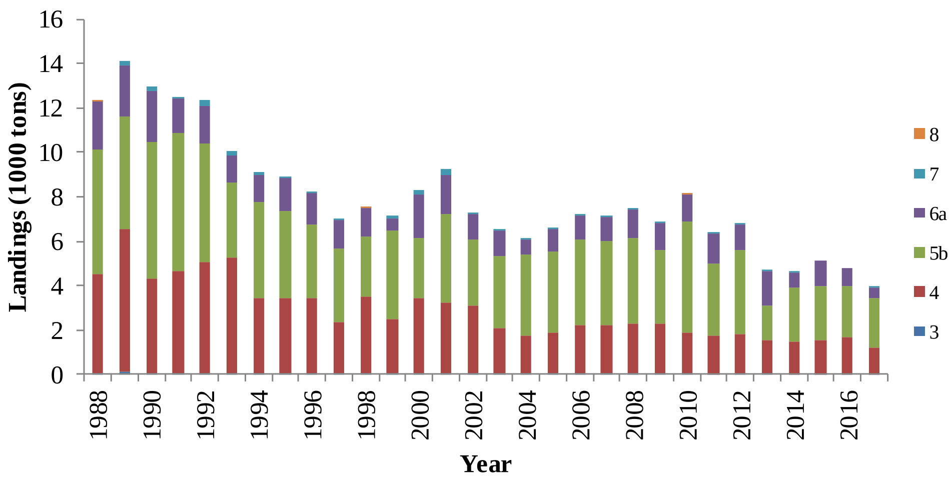


Figure 6.6.1. Landings of tusk per year for 1988–2017.

For all subareas/divisions, the catches were relatively stable from 2002 to 2012, afterwards the total catch declined, especially in Area 5.b. The total catch was 3916tons in 2017 (Figures 6.6.1 and 6.6.2).

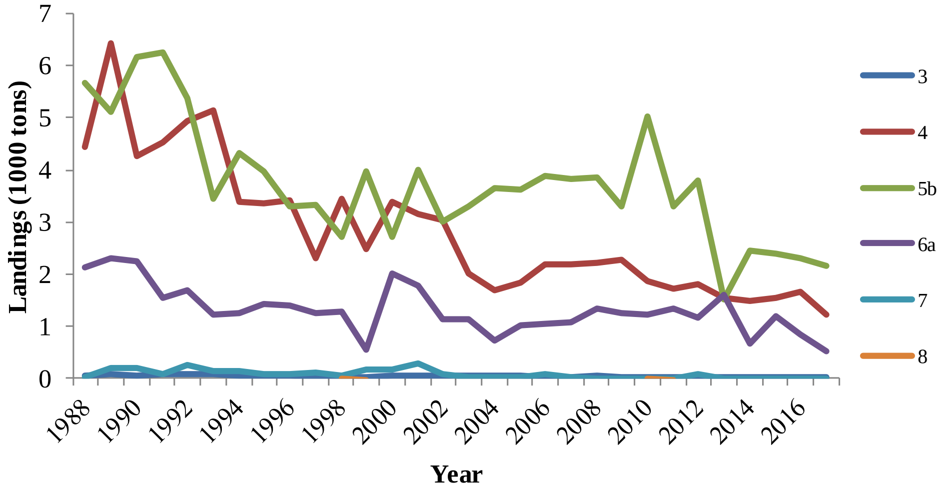


Figure 6.6.2. Landings of tusk by area for 1988–2017.

6.6.3 ICES Advice

Advice for 2018 to 2019: *ICES advises that when the precautionary approach is applied, catches should be no more than 8984 tonnes in each of the years 2018 and 2019. Discarding is considered to be negligible.*

6.6.4 Management

There is a licensing scheme and also effort limitation in area 5.b. The minimum landing length for tusk in Division 5.b is 40 cm. Norway has a bilaterally agreed quota with the Faeroes in 5.b, which is 1801 t for 2018. Norway also has a licensing scheme in EU waters, and in 2018 the Norwegian quota in the EC

In 2018, the Faroese Government will allow five Russian vessels to conduct experimental fishing in the Faroese Fishing Zone at depths deeper than 700 meters if a Russian scientific observer is on board, however no more than 2923 t can be fished. The quota for the EU in the Norwegian zone (Area 4) is set at 170 t, but only three vessels can be operating simultaneously. Two of these vessels can do 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.

EU TACs for areas partially covered in this section are in 2018:

Subarea 3: 31 t

Subarea 4: 251 t

Subarea 5, 6, 7 (EU and international waters): 1 207 t

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

6.6.5 Data available

6.6.5.1 Landings and discards

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

Discards by Spain, Ireland, France and Scotland are given for the years 2013–2017 (Table 6.6.2), and by area and countries for 2017 (Table 6.6.3).

Table 6.6.2 Total discards by country for 2013 to 2017.

	2013	2014	2015	2016	2017
Spain	40	0			
Ireland	12	0			
France			6	1	8
UK (Scotland)			12	152	130
Denmark					5
Total	52	0	18	153	143

Table 6.6.3. Discards in 2017 by area on country.

Area	Country	Discards
27.3.a	Denmark	1
27.4	Denmark	4
27.4.a	France	4
27.6.a	France	4
27.4	UK(Scotland)	58
27.6.a	UK(Scotland)	72
Total		143

6.6.5.2 Length compositions

Figure 6.6.3 show the estimated length distributions of tusk in Areas 4.b, 5.b and 6.a based on data provided by the Norwegian reference fleet for 2001–2017, and Figure 6.6.4 shows the estimated length distributions of the catch of tusk by Norwegian longliners, combined, for Areas 4.a, 5.b and 6.a.

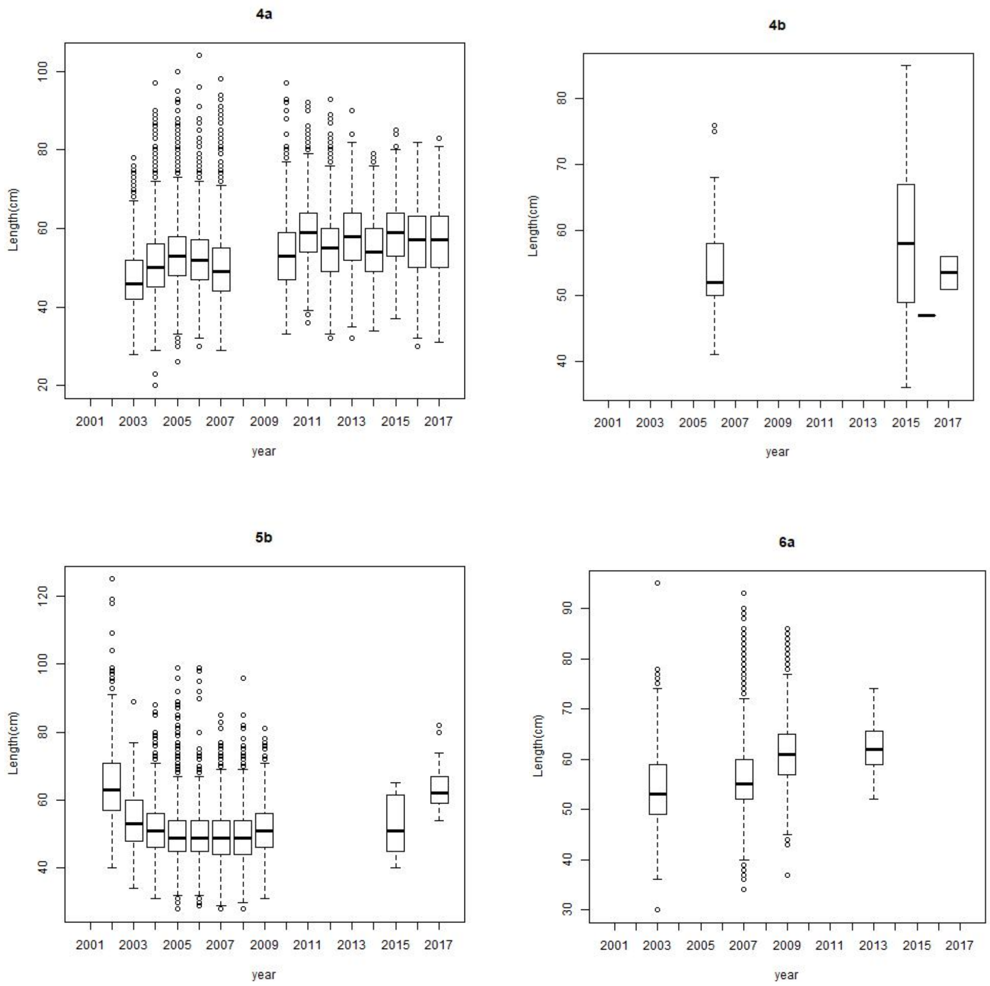


Figure 6.6.3. The length distribution in Areas 4.a, 4.b, 5.b and 6.a for 2001–2017, based on length data from the Norwegian reference fleet.

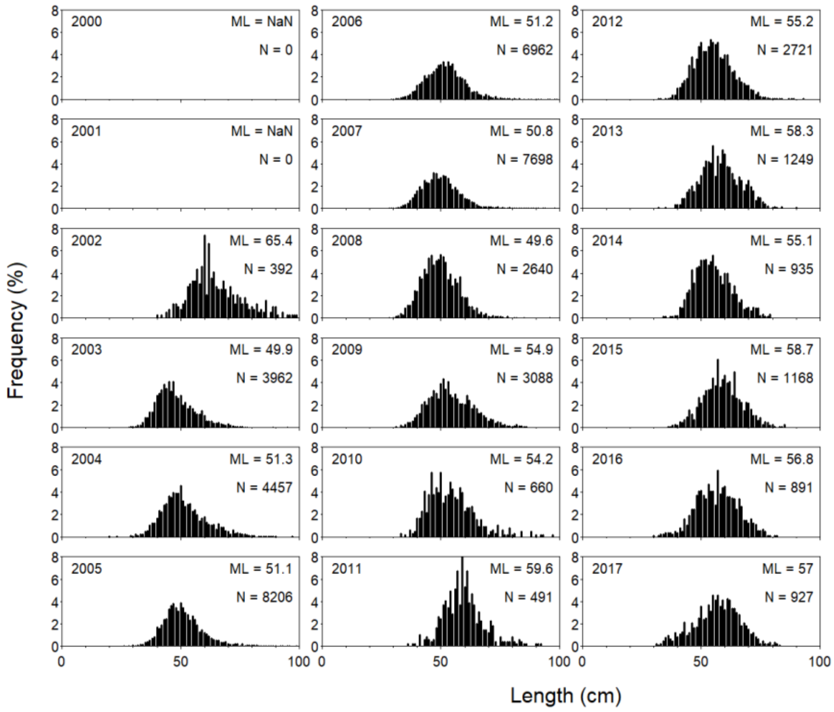


Figure 6.6.4. The estimated length distributions of the catch of tusk by Norwegian longliners, combined, for Areas 4.a, 5.b and 6.a.

The length distribution based on the commercial catches by Faroese longliners since 1994 are in Figure 6.6.5. The estimated mean length varied from 46–56 cm, and there was no downward trend. In 2017, the mean length was 62 cm and the maximum was 80 cm and most of the landings were between 40 and 60 cm (Figure 6.6.5).

The length data are from trawl surveys conducted in Faroese waters that are: the annual Faroese spring (1994-present, Figure 6.6.6) and summer surveys (1996-present, Figure 6.6.7), deep-water surveys (2014–2016, Figure 6.6.8), the annual Greenland halibut surveys (1995-present, Figure6.6.9), redfish trawl surveys (2003–2011, Figure 6.6.10) and the blue ling surveys (2000-2003, Figure 6.6.11).

The mean length for the spring and summer groundfish surveys varied between 43 and 55 cm (Figure 6.6.5 and 6.6.6). The length distributions from these surveys are noisy and some lengths seem to be overestimated (especially small fish). The reason behind the overestimation is probably that small tusk, below commercial landing size, are sampled as a subsample from the catch and thereafter multiplied up to the total catch weight. Few tusks smaller than 30 cm are caught in these surveys. The mean length of tusk caught in the deep-water survey was around 56-61 cm (Figure 6.6.8). The annual mean length of tusk in the Greenland halibut-, redfish- and blue ling surveys, which used commercial trawl, varied around 55-60 cm (Figure 6.6.9–6.6.11).

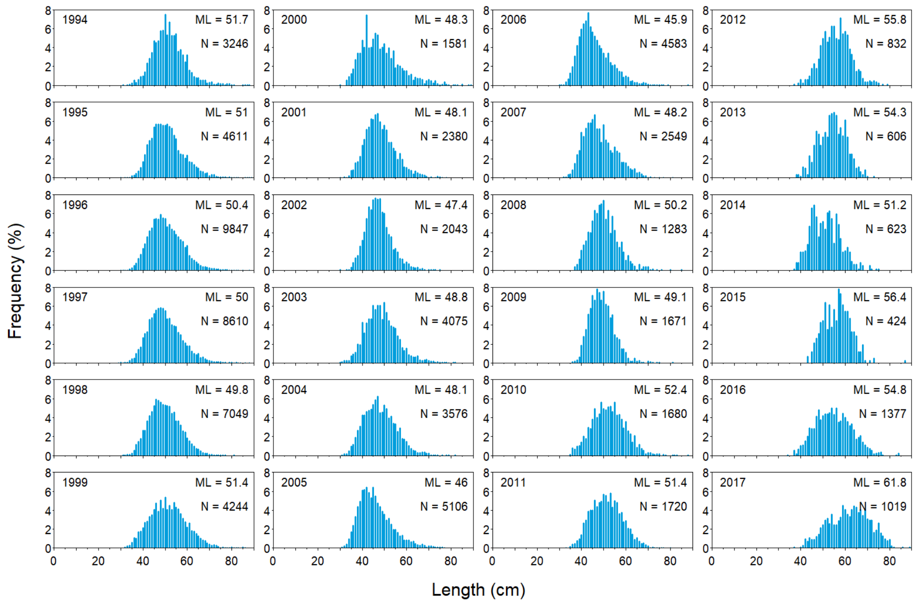


Figure 6.6.5. The estimated length distributions of the catch of tusk by Faroese longliners (>100 BRT) in Area 5.b.

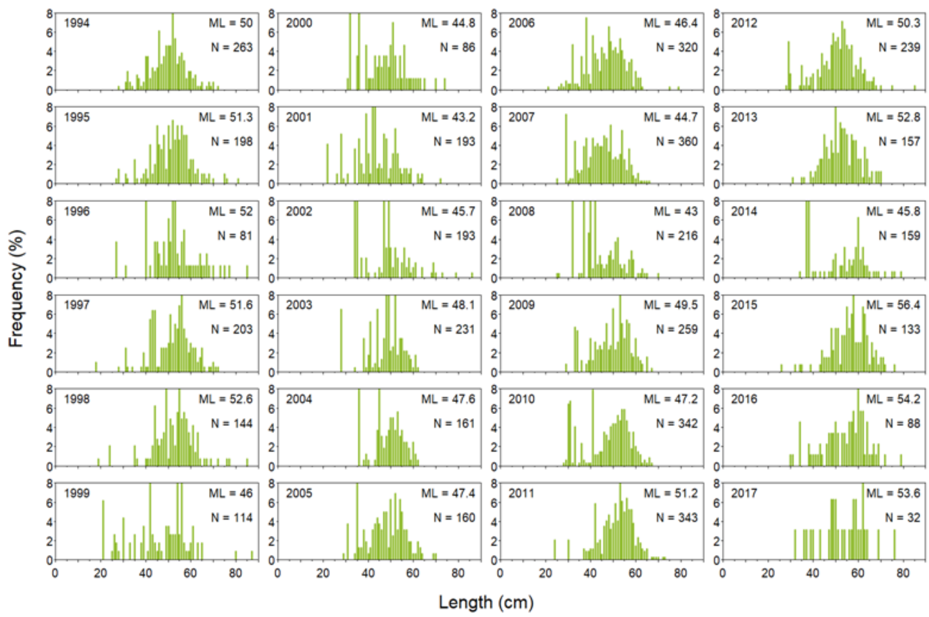


Figure 6.6.6. Estimated length distributions of tusk in Area 5.b based on data from the Faroese spring groundfish surveys.

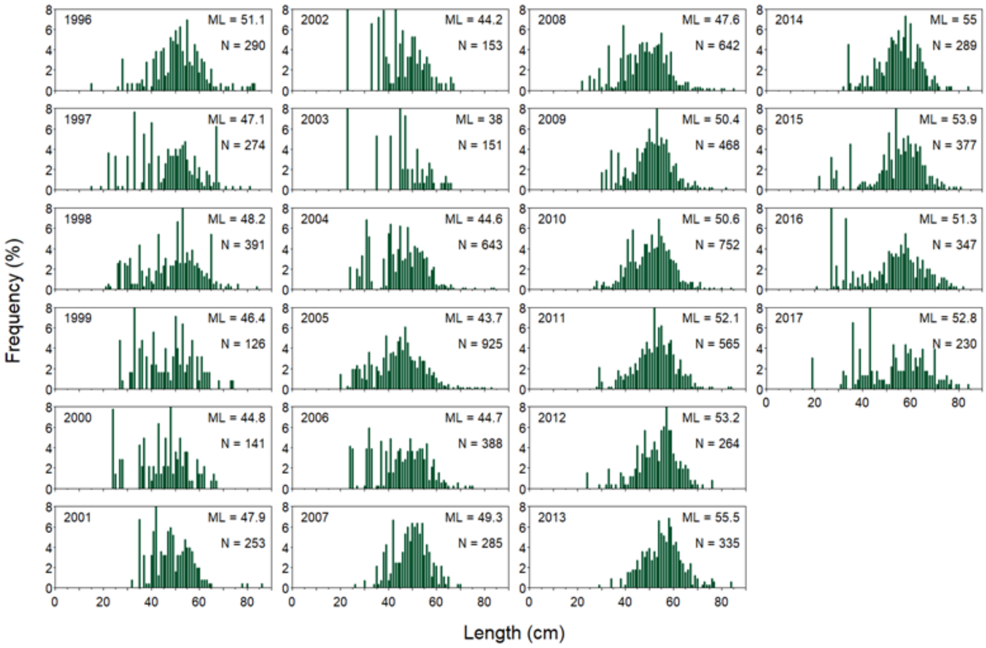


Figure 6.6.7. Estimated length distributions of tusk in Area 5.b based on data from the Faroese summer groundfish surveys.

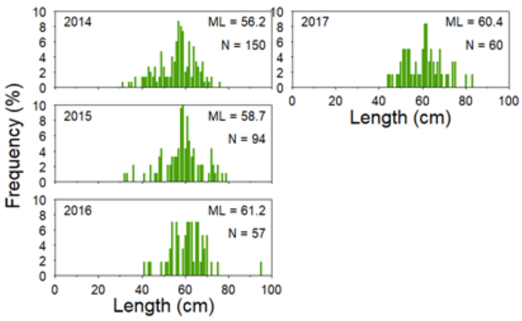


Figure 6.6.8. Tusk 5.b. Length distribution for the deep-water survey in 2014–2017.

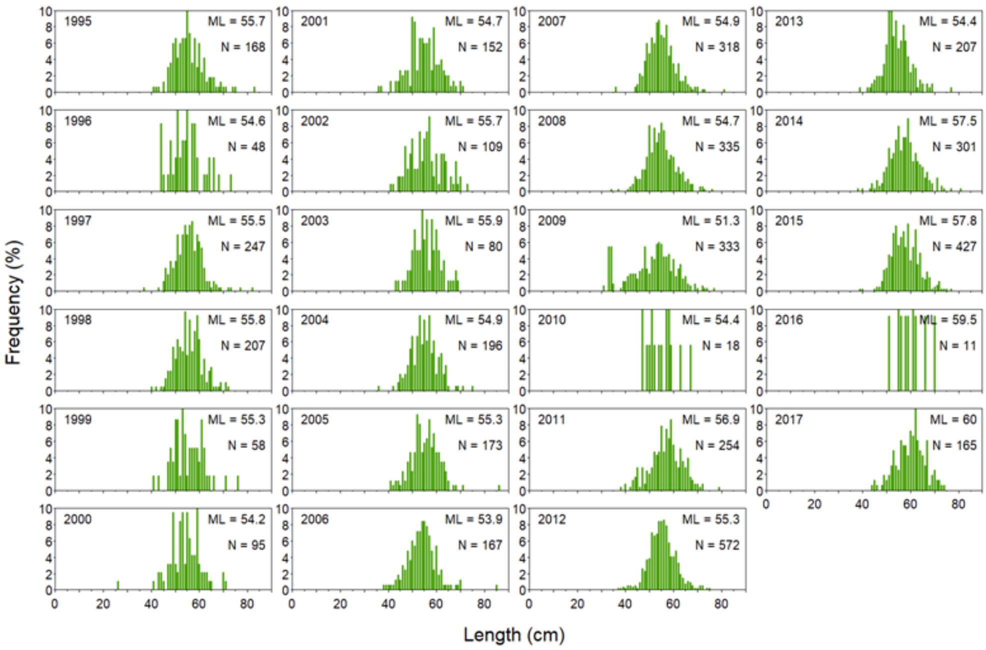


Figure 6.6.9. Tusk 5.b. Length distributions for the annual Faroese Greenland halibut trawl survey.

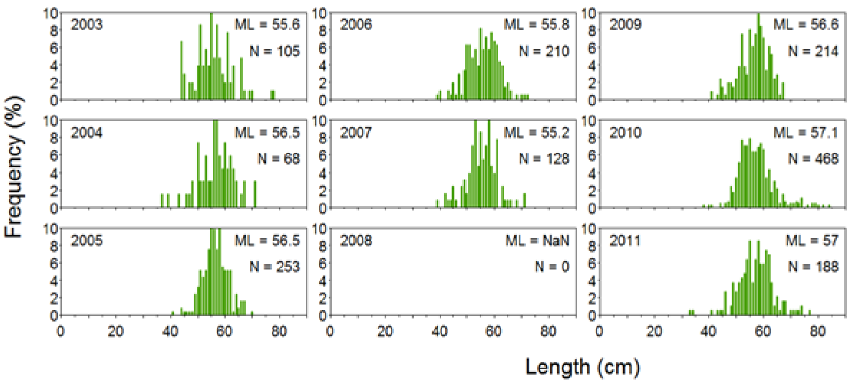


Figure 6.6.10. Tusk 5.b. Length distribution for the redfish trawl survey 2003–2007, 2009–2011.

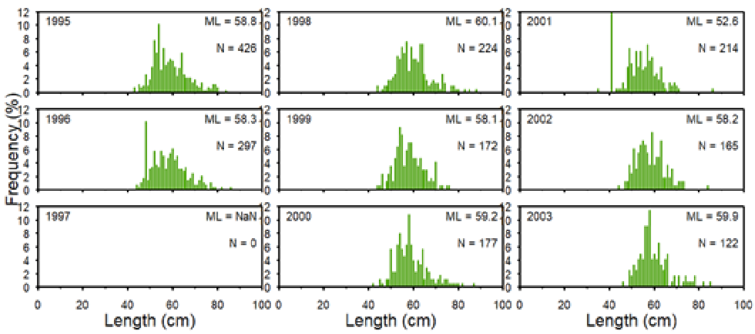


Figure 6.6.11. Tusk 5.b. Length distribution for the blue ling survey in 2000–2003.

6.6.5.3 Age and growth compositions

Mean length-at-age, mean gutted weight-at-length and mean round weight-at-age of tusk in Faroese waters are in Tables 6.6.4 and 6.6.5 and Figures 6.6.12–6.6.14.

The mean growth of tusk was only 2.5-3 cm per year (WD 2017). One year old tusk were around 9-15 cm, 5 years old around 43 cm and 10 year old fish were around 59 cm. The mean gutted weight of a 40 cm and 60 cm long tusk was around 0.7 kg and 2.2 kg, respectively (Figure 6.6.13).(WD 2017). There is almost no difference in female and male growth rates (Figures 6.6.12 and 6.6.14). The gutted-round weight relation is showed in Figure 6.6.15.

An age–length key using all data from the last three years was used as to estimate the catch-at-age (age composition) for the longline fishery (Figure 6.6.16). These preliminary results show that the longline landings are mainly six to ten-year-old fish and the mean age was around eight to nine years.

Table 6.6.4. Tusk 5.b. Growth parameters.

Area	Sex	L_∞ (cm)	SE	K (year^{-1})	SE	T_0	SE	N	Age range	Max observed size (cm)
Faroese waters	Combined	109.632	15.410	0.060	0.018	-3.414	1.129	1287	2–18	
Faroese waters	Female	84.430	3.230	0.109	0.012	-1.434	0.444	667	2–17	
Faroese waters	Male	76.207	2.555	0.144	0.017	-0.675	0.463	618	3–18	

Table .6.6.5. Tusk 5.b. Weight–length relation: Weight = a * Length^b.

Area	Sex	a	b	N	Length range (cm)	Weight range (g)	Weight	Source
Faroese waters	Combined	0.0098	3.023	15160			Round	Surveys
Faroese waters	Female	0.0150	2.9185				Round	Surveys
Faroese waters	Male	0.0085	3.0582				Round	Surveys
Faroese waters	Combined	0.0126	2.952	6657			Gutted	Landings

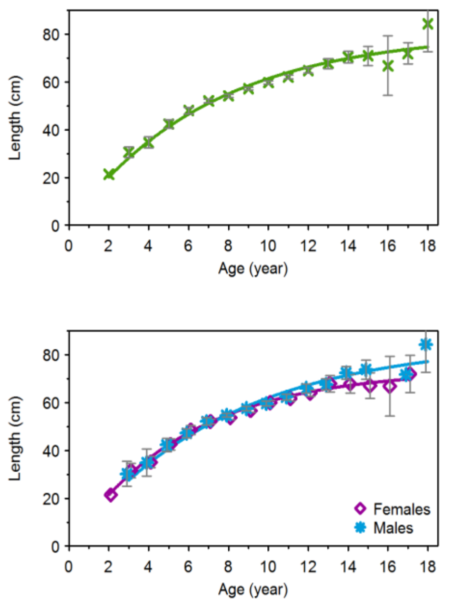


Figure 6.6.12. Tusk 5.b. Mean length-at-age for tusk: males and females combined (top panel), and separately (bottom panel).

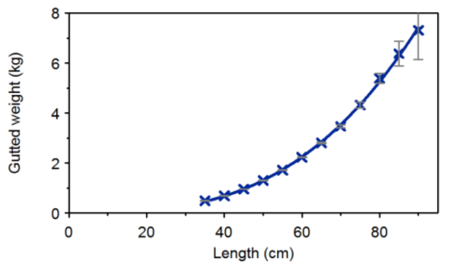


Figure 6.6.13. Tusk 5.b. Mean gutted weight-at-length for tusk.

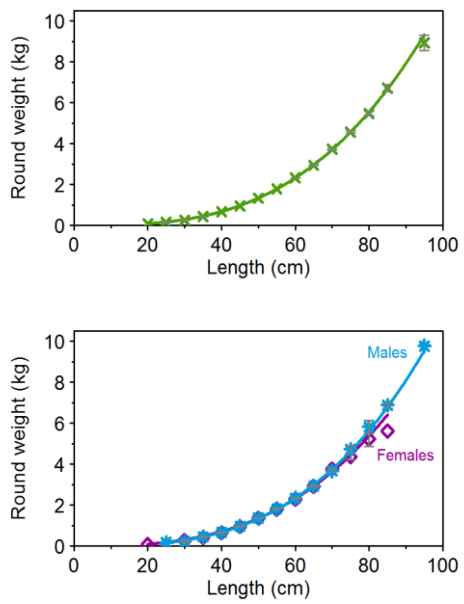


Figure 6.6.14. Tusk 5.b. Mean round weight at length for tusk.

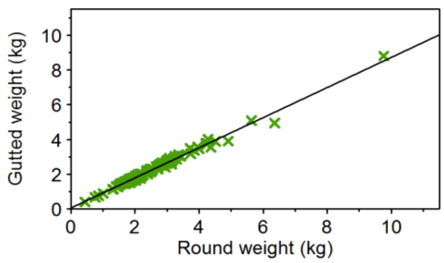


Figure 6.6.15. Tusk 5.b. Gutted-round weight relation. Gutted weight = 0.87×(round weight) + 0.07, R^2 = 0.99, N=148.

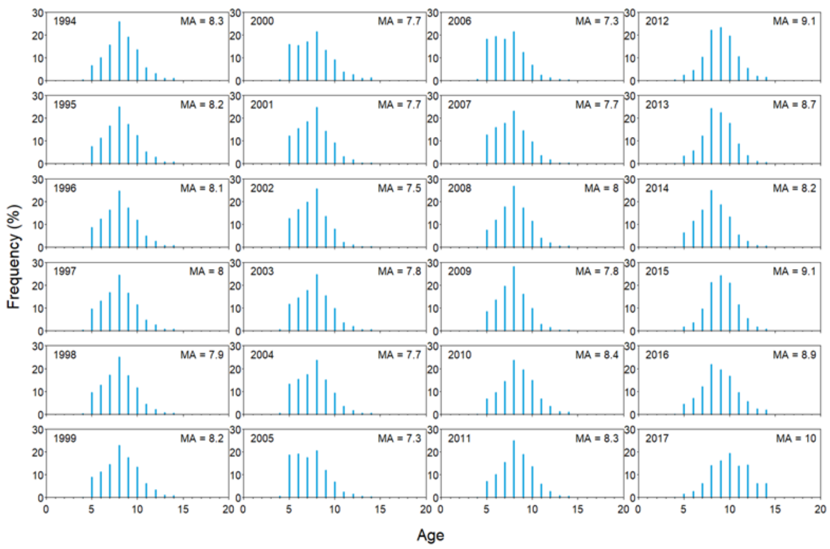


Figure 6.6.16. Tusk 5.b. Age distributions of the tusk catch by the Faroese longline fishery. Age 14 is a plus group.

6.6.5.4 Weight-at-age

The mean weight at age of tusk in the commercial catches from Faroese waters are in Figure 6.6.17. The mean weight at age was relatively stable from 1994 to 2017. There were very few samples containing four-year-old tusk.

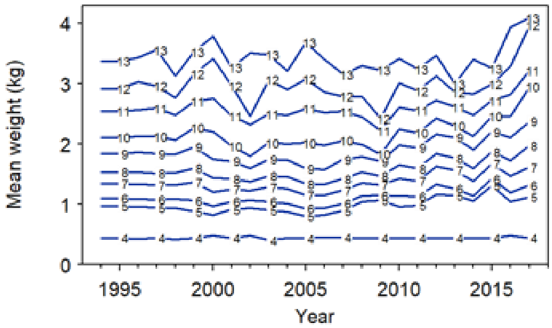


Figure 6.6.17. Tusk 5.b. Mean weight-at-age of tusk catch.

6.6.5.5 Maturity and natural mortality

The maturity ogives for females and males were different: the females tended to mature younger than males. (Table 6.6.6, Figure 6.6.8). Most of the maturity samples are collected outside the spawning season, so it is a bit difficult to see if the individuals are immature or resting. Females and males seem to be equally distributed by length (Figure 6.6.19).

No information is available on the natural mortality of tusk in 5.b.

Table 6.6.6. Tusk 5.b. Maturity parameters.

Area	Sex	A_{50}	N	L_{50}	N
Faroese waters	Combined	6.75	1267	50.50	1292
Faroese waters	Female	6.01	653	48.35	665
Faroese waters	Male	7.77	614	53.33	627

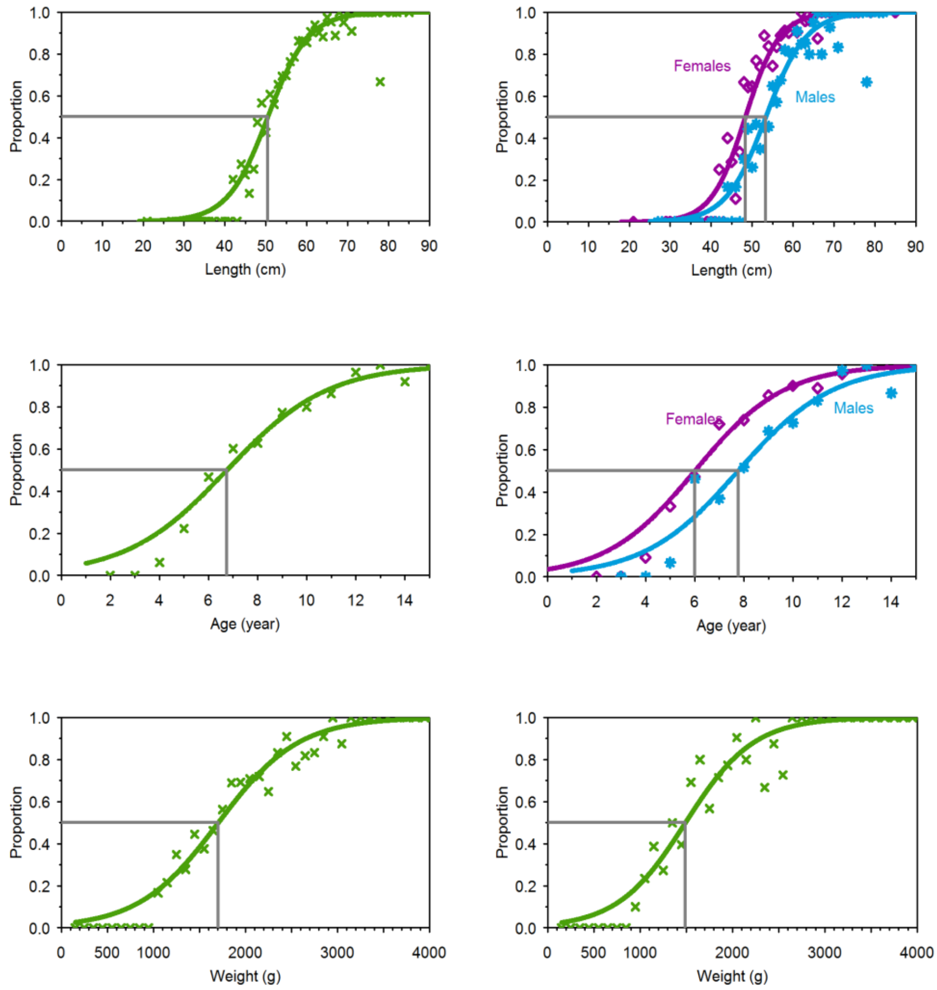


Figure 6.6.18. Tusk 5.b. Maturity ogive on length (upper left), age (upper right), round weight (bottom left) and gutted weight (bottom right).

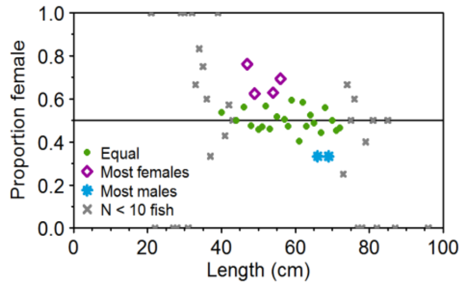


Figure 6.6.19. Tusk 5.b. Proportion of females.

6.6.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch per unit of effort (cpue) series for three commercial fleets: the Faroese longliners, the Faroese pair trawlers (bycatch) and the Norwegian longliners fishing in Division 5.b. The Faroese cpue data are from five longliners (GRT >110) and 6–10 pair trawlers (HP >1000). The effort units based on logbook data were: 1000 hooks for the longliners, and trawling hours for the trawlers. The selection of data and standardization are described in the stock annex for tusk in "other areas". The data selected in the longliner series were sets where ling was more than 30% of the catch which is the same target as used for the Norwegian longliner series.

Norway started in 2003 to collect and enter data from official logbooks into an electronic database, and data are now available for 2000–2017. 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. 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 standardized cpue data 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 were used. The Norwegian and Faroese longliners both have ling and tusk as target species.

Fisheries independent cpue series

Cpue estimates (kg/hour) for tusk are available from two annual groundfish trawl surveys on the Faroe Plateau that were designed for cod, haddock and saithe. The annual survey on the Faroe Plateau covers the main fishing areas and mainly the larger part of the spatial distribution area (Ofstad, WD WGDEEP 2017). Information on the surveys and standardization of the data are described in the stock annex.

6.6.6 Data analyses

Length distributions

Norwegian length distributions, based on data provided by the longline reference fleet from Areas 4.a, 5.b and 6.a, have varied slightly with no obvious trends (Figures 6.6.3 and 6.6.4). The average length of the catch of tusk by Norwegian longliners combined for areas 4.a, 5.b and 6.a was 57 cm in 2017.

The mean length of tusk sampled in the spring and summer groundfish surveys varied between 43 and 55 cm (Figures 6.6.6 and 6.6.7). The length distributions are noisy and some mean lengths seem to high (especially for small fish). The reason behind the overestimation is probably that small tusk, below commercial landing size, are a subsample from the catch and thereafter multiplied up to the total catch weight. Few tusk smaller than 30 cm are caught in these surveys. The mean length of tusk caught in the deepwater survey was around 56–58 cm (Figure 6.6.8). The mean length of tusk in the Greenland halibut-, redfish- and blue ling surveys, which used a commercial trawl, varied around 55 cm (Figure 6.6.9–6.6.11).

Cpue trends

4.a

Two cpue series for tusk in Area 4.a based on Norwegian longline data were; one based on all the catches, and one based on when tusk appeared to be the target species. The series based on all the catches indicates at first a stable cpue and then a slightly decreasing trend for the last four years, while the series based on the targeted fishery shows a clear and positive upward trend from 2002 until 2013, and then a declining trend (Figure 6.6.20).

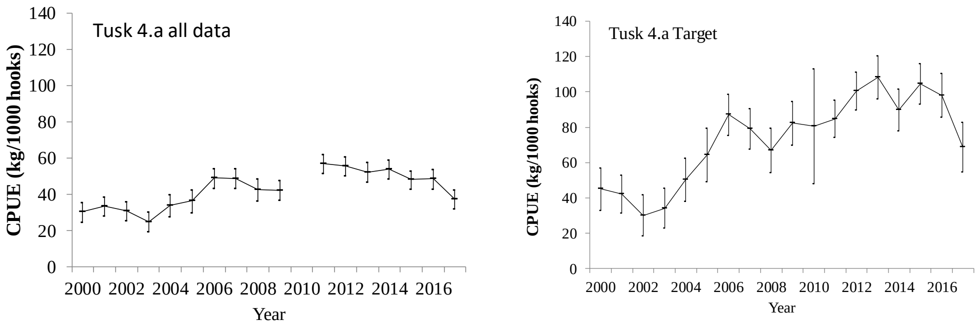


Figure 6.6.20. Tusk cpue series in 4.a for 2000–2017 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

5.b

A standardized commercial CPUE series for longliners fishing in Faroese waters is in Table 6.6.7, and Figure 6.6.21. The cpue data were mainly from the logbooks of five longliners. The data selected were only from sets where tusk was more than 30% of the total catch. This new series was suggested during WGDEEP 2015 so that the series would be comparable with the Norwegian series. The mean CPUE from 2008 to 2017 was 84 kg/1000 hooks and 88 kg/1000 hooks in 2017.

The standardized CPUE from the annual Faroese groundfish surveys in spring (1994-present) and summer (1996-present) are in Figure 6.6.22. In addition, a CPUE series for the spring survey, 1983-1993, based on non-stratified data, are in Figure 6.6.22. The CPUE series for the annual groundfish surveys show a downward trend during the last two years. These surveys are only conducted in waters less than 530 m, so these estimates are not covering the whole distribution area of tusk.

Abundance indices for tusk caught by the Faroese 0-group survey on the Plateau were at a low level from 1983-2011, whereas the indices have increased in 2012-2013, but decreased in 2014-2017 (Figure 6.6.23). In 2015-2017, no tusk was caught by the 0-group survey on the Faroe Plateau.

Abundance indices for tusk < 40 cm, generated by the Faroese groundfish survey on the Plateau, also were low in 2015, with a slight increase in 2016 and a decrease in 2017 (Figure 6.6.23).

Table 6.6.7. Tusk 5.b. Standardized cpue for Faroese longliners in Faroese waters.

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CPUE	**83.6**	**84.8**	65.2	60.7	**70.4**	**59.1**	**48.5**	**48.0**	**53.0**	**52.3**	46.1	79.6	55.6	**48.8**	**40.4**	**56.8**
SE	0.27	0.25	0.42	0.29	0.22	0.17	0.12	0.16	0.13	0.15	0.37	0.23	0.25	0.18	0.26	0.23
N	112	125	58	67	147	274	301	246	305	214	26	54	57	77	71	77

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CPUE	49.6	70.8	47.2	61.4	**69.3**	**61.9**	**67.3**	**68.8**	**90.9**	**93.0**	**94.8**	**78.6**	**81.1**	**73.5**	**100.6**	**87.8**
SE	0.58	0.46	0.99	0.74	0.51	0.88	0.81	0.83	0.52	0.66	0.68	0.84	0.67	0.86	2.11	1.96
N	22	23	26	53	103	76	145	135	651	634	509	169	194	119	119	73

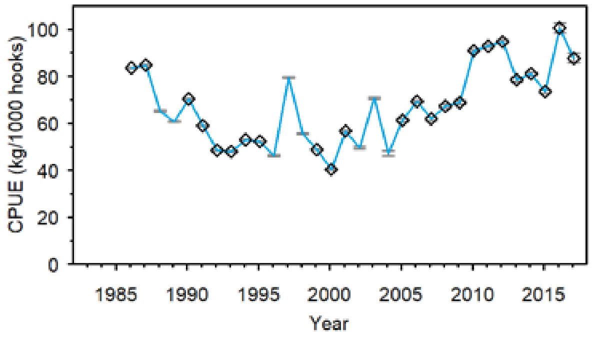


Figure 6.6.21. Tusk 5.b. Standardized cpue for longliners (<110 GRT) fishing in Faroese waters. The diamond points show when the estimated cpue is based on more than 100 sets.

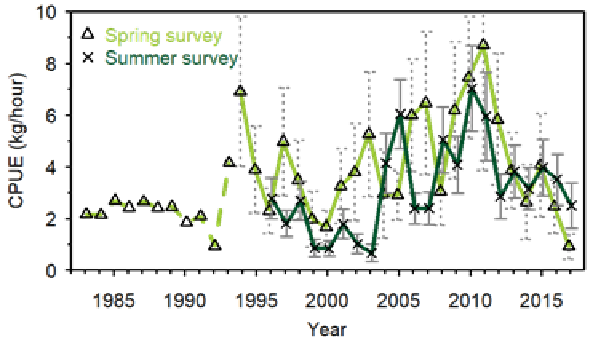


Figure 6.6.22. Tusk 5.b. Standardized cpue from the annual trawl groundfish surveys. The spring survey data from 1983–1993 are not stratified.

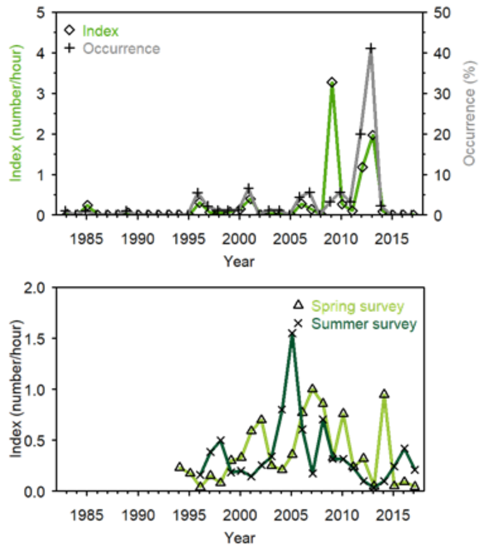


Figure 6.6.23. Tusk 5.b. Abundance index for tusk (2–3 cm in length in number/hour) on the Faroe Plateau based on the 0-group survey (upper figure) and abundance index for tusk <40 cm from the annual spring and summer trawl survey on the Faroe Plateau (lower figure).

The cpue series based on the Norwegian longline data shows a stable trend from 2000 to 2008, afterwards it increased until 2012 and then decreased until 2017 (Figure 6.6.24).

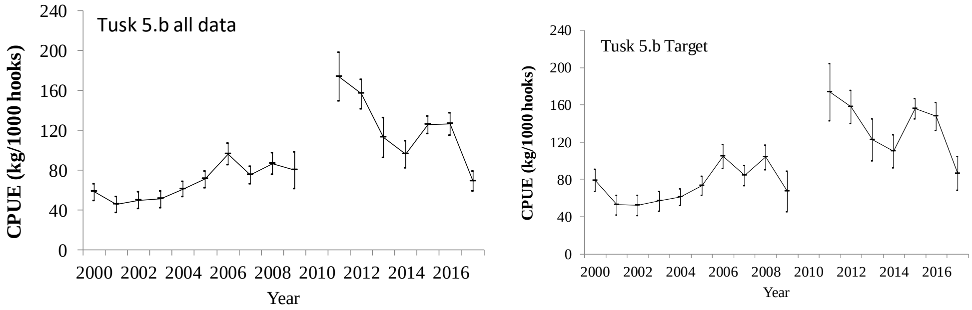


Figure 6.6.24. Tusk cpue series in 5.b for 2000–2016 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

6.a

In 6.a a cpue series based on the Norwegian longline data shows an increase in cpue from 2004 to 2008, afterwards it has remained at a high, but slightly declining level (Figure 6.6.25).

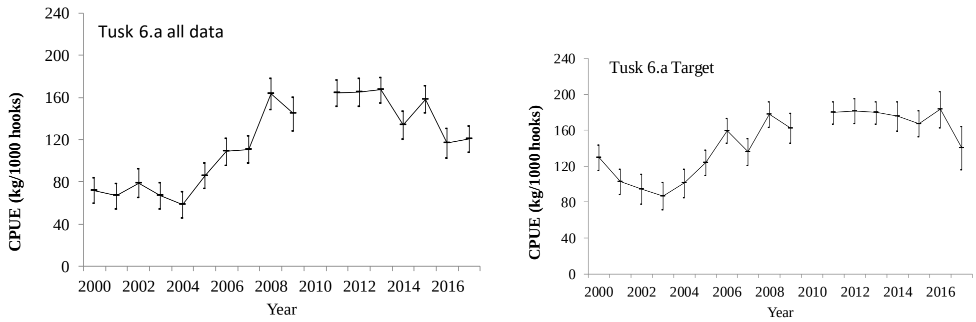


Figure 6.6.25. Tusk in area 6.a. Two cpue series for the period 2000–2016 based on all available data and when tusk appeared to be targeted. The bars denote the 95% confidence intervals.

Combined cpue series for "Tusk areas 4, 5b and 6a"

To produce one cpue series for all areas, all the data from the Norwegian longline fleet was combined (Areas 4.a, 4.b, 5.b and 6.a). Data from the targeted fishery were used (daily catches when tusk made up more than 30% of the total catch, Figure 6.6.26).

The combined Norwegian longline cpue series shows an increasing trend from 2000 to 2010, after 2010 cpue was at a high and stable level but declined in 2017 (Figure 6.6.22).

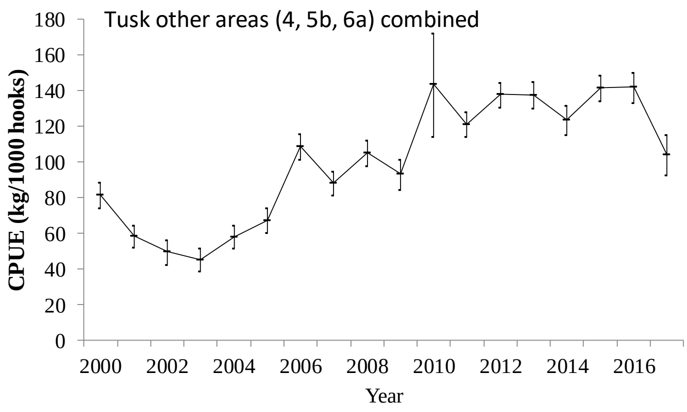


Figure 6.6.26. A combined cpue series for all "other tusk" areas for the period 2000–2016 based on data from the Norwegian longline fleet when tusk was targeted (>30% of total catch). The bars denote the 95% confidence intervals.

6.6.6.1 Biological reference points

See Section 6.6.9.

6.6.7 Comments on the assessment

The Norwegian longline cpue series for tusk based on the logbooks has now been standardized. The new cpue series shows the same trends as the unstandardized cpue series and the series based on a super-population model that was presented in 2012.

6.6.8 Management considerations

Landings of tusk in all subareas have been declining since 2002. The cpue series, for the Faroes longline fishery in 5.b and for the Norwegian longline fisheries show a stable or positive trend since 2003 with a decrease during the last few years. In 4.a and 6.b the cpue series indicate a positive development of the stocks until the last year. As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the tusk cpue series tracks the 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.

6.6.9 Application of MSY proxy reference points

Two different methods were tested for tusk in other areas, the Length-based indicator method (LBI) and SPiCT.

Length-based indicator method (LBI)

The input parameters and the catch length composition for the period 2002–2017 are in the Table 6.6.8. and Figure 6.6.27. 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. 6.6.8. Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length–frequency distribution	2002–2016	Faroese longliners fishing in Division 5.b	Data combined from both sources
	2002–2017	Norwegian longliners 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 longliners (Reference fleet) and survey data.	combined sexes
L_{MAT}	51 cm	Faroese survey data	
L_{inf}	125 cm (L_{max})	Norwegian longliners (Reference fleet)	

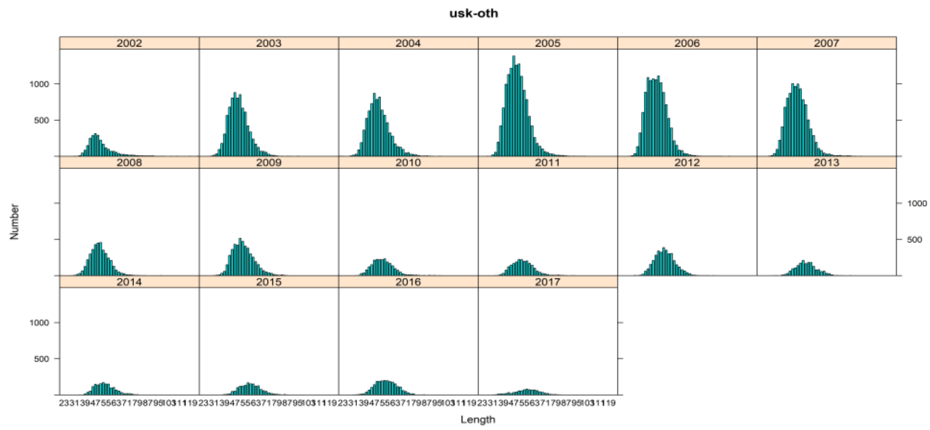


Figure 6.6.27. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Catch length distributions (2 cm bins) have not been raised to total catch for the period 2002–2017 (combined sexes).

Outputs

The length indicator ratios for combined sexes were examined for three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield are in the Figure 6.6.28.

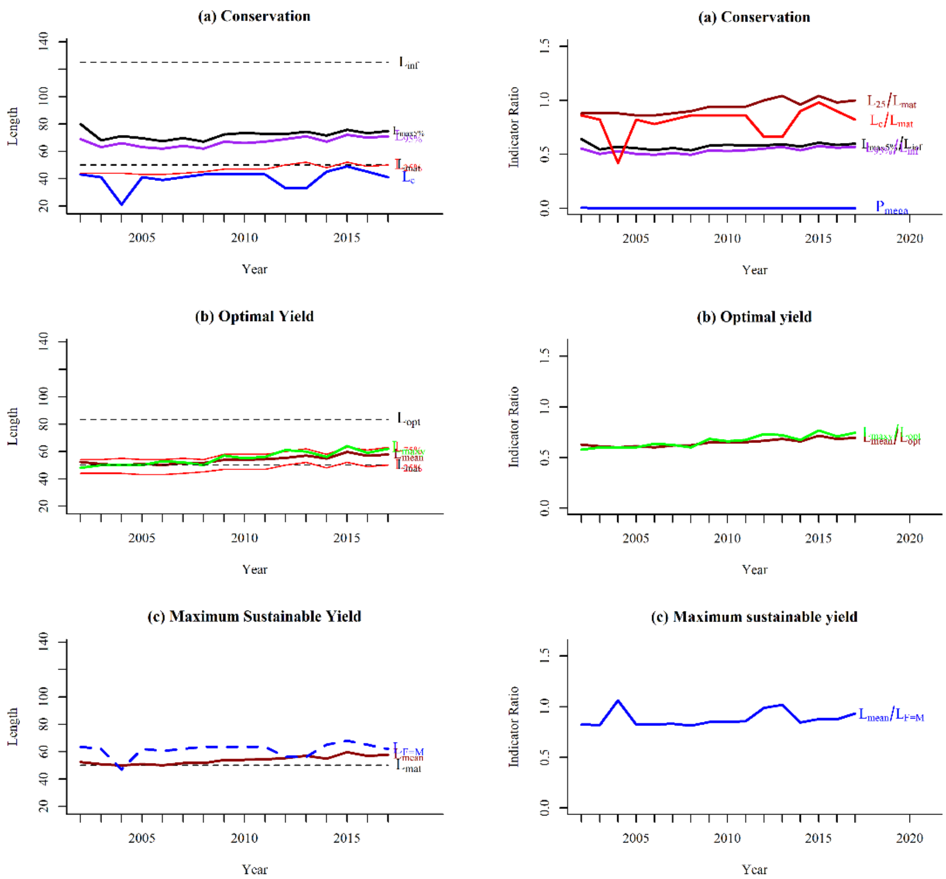


Figure 6.6.28. Tusk in other areas (3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12). Screening of length indicators ratios for sexes combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

Analysis of results

The conservation model for immature tusk shows that both L_c/L_{mat} and $L_{25\%}/L_{mat}$ are usually less than 1, but usually greater than 0.8 (Figure 6.6.28). In 2014–2017, the ratios were greater than 0.9 (Table 6.6.9.). 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 0.60 for the whole period (Figure 6.6.28), and between 0.57 and 0.61 during the period 2014–2017 (Table 6.6.9), which is less than the baseline, 0.8. The reason that the VBF results gave unusually low values of L_{inf}, was because the value used in the model was L_{max}. If we had used a smaller value of L_{inf}, then the indicator ratio would be higher. Since tusk is a deep-water and slow-growing species, the P_{mega} and L_{mean}/L_{opt} values used were probably incorrect.

The MSY indicator, $L_{mean}/L_{F=M}$, was less than 1 for almost the entire period (Figure 5.2), which indicates that tusk in other areas were fished unsustainably. It should be noted that if L_{inf} were set equal to L_{max}, then MSY would always have been greater than 0.8.

Table 6.6.9. Tusk in areas 3.a, 4.a, 5.b, 6.a, 7, 8, 9, 12. The final results based on the LBI method.

Traffic light indicators

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	>1	>1	>0.8	>30%	~1 (>0.9)	≥1
2014	0.90	0.96	0.57	0%	0.66	0.84
2015	0.98	1.04	0.61	0%	0.72	0.88
2016	0.90	0.98	0.59	0%	0.68	0.88
2017	0.82	1.0	0.60	0%	0.69	0.93

Conclusions

The overall perception of the tusk stock in these areas during the period 2014–2017, based on the LBI results, is that tusk seems to be overexploited and fished unsustainably (Table 5.3). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

The results for the LBI are very sensitive to the assumed values of L_{inf} and L_{mat}. In the combined areas, such as tusk other areas, the values used for L_{inf} and L_{mat} are sometimes based on data from only one of the subareas and not from the entire area combined. The value of L_{max} is often used for L_{inf}. For tusk, it is because the ageing of tusk is very difficult, so the background values are not very reliable. Tusk is a deep-water species, so P_{mega} and L_{mean}/L_{opt} are not used for tusk.

SPiCT

The input data were landings in 1988–2017, and the cpue index for the targeted fishery from 2000–2017 (Figure 6.6.29).

The model converged and both the deterministic and stochastic reference points are very similar, but the confidence intervals are relatively large.

Outputs from the model: B_{msy}=24375, F_{msy}= 0.126, MSY=10252, K= 37423

(Advice for 2018-2019 is 8984 tons and the total landings in 2017 was 3916 tons).

The results show wide confidence intervals for the absolute biomass and fishing mortality. The traffic light figure shows that the stock is now in the green zone. (Figure 6.6.30). The diagnostics do not show any patterns in the residuals and no significance for bias, auto correlation or normality (Figure **6.6.31)**.

The retrospective analysis shows that the model is not robust for tusk in "other areas" (Figure 6.6.32).

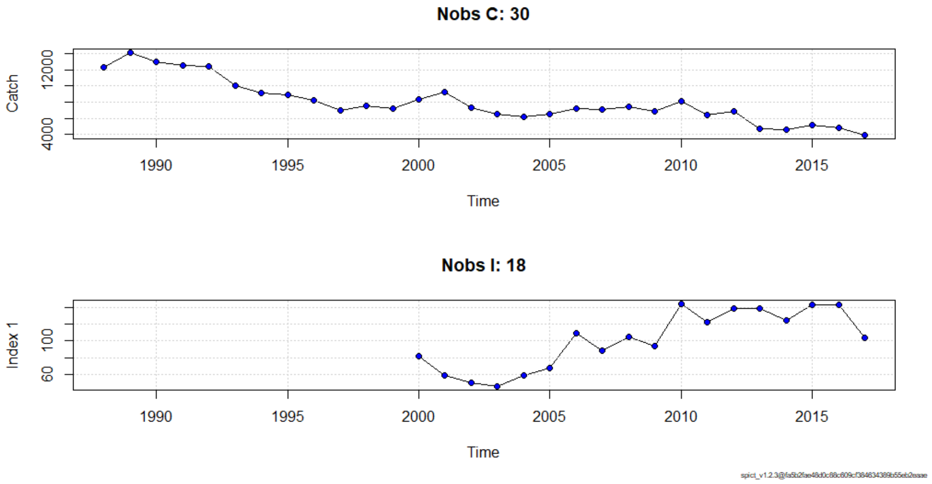


Figure 6.6.29. Input data

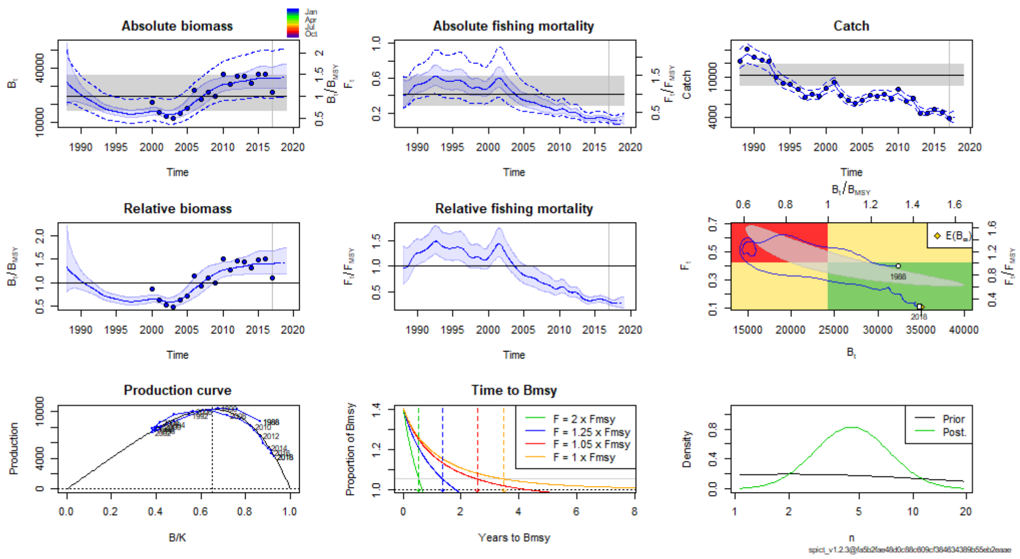


Figure 6.6.30. Plots of the results.

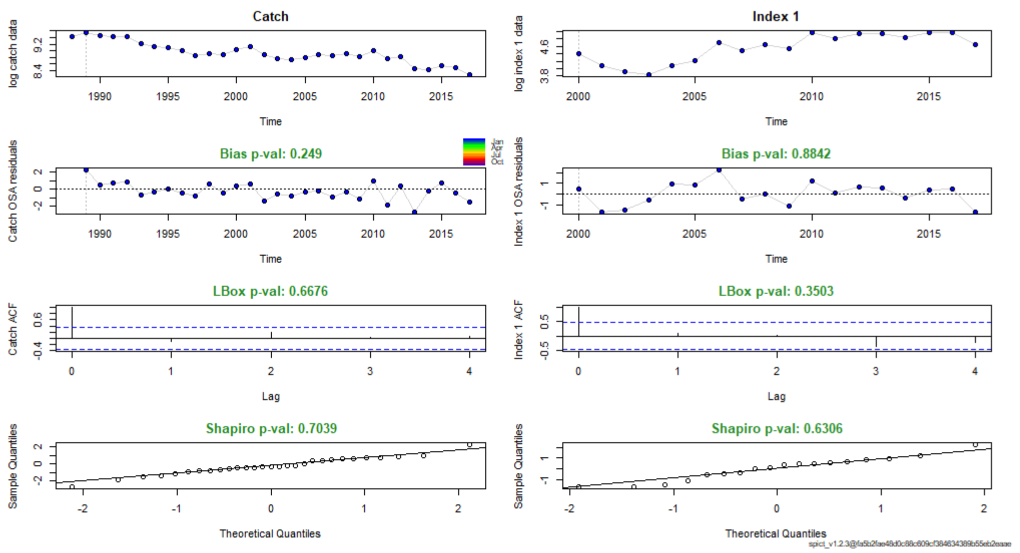


Figure 6.6.31. Diagnostics from SPiCT.

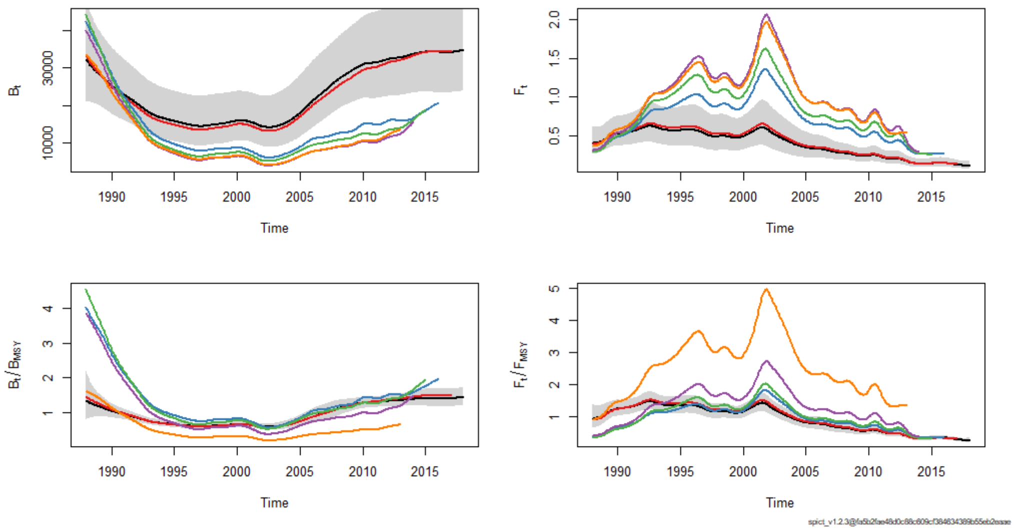


Figure 6.6.32. Retrospective analysis.

6.6.10 Tables

Table 6.6.1. 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
2014	1	7	1	9
2015	1	7	1	9
2016	1	12	1	14
2017*	1	8	1	10

***Preliminary.**

Tusk 4.a

Year	Denmark	Faroes	France	Germany	Norway	Sweden[(1)]	E & W	N.I.	Scotland	Ireland	Total
1988	83	1	201	62	3998	-	12	-	72		4429
1989	86	1	148	53	6050	+	18	+	62		6418
1990	136	1	144	48	3838	1	29	-	57		4254
1991	142	12	212	47	4008	1	26	-	89		4537
1992	169	-	119	42	4435	2	34	-	131		4932
1993	102	4	82	29	4768	+	9	-	147		5141
1994	82	4	86	27	3001	+	24	-	151		3375
1995	81	6	68	24	2988		10		171		3348
1996	120	8	49	47	2970		11		164		3369
1997	189	0	47	19	1763	+	16		238	-	2272
1998	114	3	38	12	2943		11		266	-	3387
1999	165	7	44	10	1983		12		213	1	2435
2000	208	+	32	10	2651	2	12		343	1	3259
2001	258		30	8	2443	1	11		343	1	3095
2002	199		21		2438	1	8		294		2961
2003	217		19	6	1560		4		191		1997
2004	137	+	14	3	1370	+	2		140		1666
2005	123	17	11	4	1561	1	2		107		1826
2006	155	8	14	3	1854		5		120		2159
2007	95	0	22	4	1975	1	6		74	3	2180
2008	57	0	16	2	1975		3		85	1	2139
2009	48		8	1	2108	7	3		93		2268
2010	36		10	2	1734		8		71		1861
2011	52		24		1482	1	6		72		1636
2012	28		14	1	1635	1	3		67		1749
2013	42		11	3	1375		3		76		1510
2014	21		13	3	1365		3		58		1463
2015	24		6	2	1448	1	5		44		1530
2016	33		5	3	1565	1	4		39		1650
2017*	37		5	2	1121				41		1206

[(1)] Includes 4.b 1988–1993.

***Preliminary.**

Table 6.6.1. (Continued).

Tusk 4.b

Year	Denmark	France	Norway	Germany	E & W	Scotland	Ireland	sweden	Total
1988		n.a.		-	-				
1989		3		-	1				4
1990		5		-	-				5
1991		2		-	-				2
1992	10	1		-	1				12
1993	13	1		-	-				14
1994	4	1		-	2				7
1995	4	-	5	1	3	2			15
1996	4	-	21	4	3	1			33
1997	6	1	24	2	2	3			38
1998	4	0	55	1	3	3			66
1999	8	-	21	1	1	3			34
2000	8		106	+	-	2			116
2001	6		45(1)	1	1	3			56
2002	6		61	1	1	2			71
2003	2		5	1					8
2004	2		19	1		1			23
2005	2		4	1					7
2006	2		30						32
2007	1		6				8		15
2008	0		69			0	2		71
2009	1		3			0	0	13	17
2010	1		13						15
2011	1		95						96
2012	2		43					2	47
2013	3		28						31
2014	2		9						11
2015	3		14	1					18
2016	2		5		2				9
2017*	1		16					1	18

(1) Includes 4.c.

***Preliminary.**

TUSK 5.b1

Year	Denmark	Faroes(4)	France	Germany	Norway	E & W	Scotland (1)	Russia	Total
1988	+	2827	81	8	1143	-			4059
1989	-	1828	64	2	1828	-			3722
1990	-	3065	66	26	2045	-			5202
1991	-	3829	19	1	1321	-			5170
1992	-	2796	11	2	1590	-			4399
1993	-	1647	9	2	1202	2			2862
1994	-	2649	8	1 (2)	747	2			3407
1995		3059	16	1 (2)	270	1			3347
1996		1636	8	1	1083				2728
1997		1849	11	+	869		13		2742
1998		1272	20	-	753	1	27		2073
1999		1956	27	1	1522		11(3)		3517
2000		1150	12	1	1191	1	11(3)		2367
2001		1916	16	1	1572	1	20		3526
2002		1033	10		1642	1	36		2722
2003		1200	11		1504	1	17		2733
2004		1705	13		1798	1	19		3536
2005		1838	12		1398		24		3272
2006		2736	21		778		24	1	3559
2007		2291	28		1108	2	2	37	3431
2008		2824	18		816	18	13	109	3689
2009		2553	14		499	4	31	34	3135
2010		3949	16		866		58		4889
2011		3288	3		1		1		3293
2012		3668	23		102				3793
2013		1464	36		0				1500
2014		1764	32		511		3		2310
2015		1338	26		717				2081
2016		1494	17		747		3		2261
2017*		1472	18		544		1		2035

1) Included in 5.b2 until 1996.

(2) Includes 5.b2.

(3) Reported as 5.b.

(4) 2000–2003 5.b1 and 5.b2 combined.

*** Preliminary.**

Table 6.6.1. (Continued).

Tusk 5.b2

Year	Faroe	Norway	E & W	Scotland [(1)]	France	Total
1988	545	1061	-	+		1606
1989	163	1237	-	+		1400
1990	128	851	-	+		979
1991	375	721	-	+		1096
1992	541	450	-	1		992
1993	292	285	-	+		577
1994	445	462	+	2		909
1995	225	404	-2	2		631
1996	46	536				582
1997	157	420				577
1998	107	530				637
1999	132	315				447
2000		333				333
2001		469				469
2002		281				281
2003		559				559
2004		107				107
2005		360				360
2006		317				317
2007		344				344
2008		61				61
2009		164				164
2010		127				127
2011		0				0
2012		0				0
2013					12	12
2014		123			6	129
2015		323			1	324
2016		42				42
2017*		135				135

(1)Includes 5.b1.

(2)See 5.b1.

(3)Included in 5.b1.

***Preliminary.**

Tusk 6a

Year	Denmark	Faroes	France [1]	Germany	Ireland	Norway	E & W	N.I.	Scot.	Spain	netherlands	Total
1988	-	-	766	1	-	1310	30	-	13			2120
1989	+	6	694	3	2	1583	3	-	6			2297
1990	-	9	723	+	-	1506	7	+	11			2256
1991	-	5	514	+	-	998	9	+	17			1543
1992	-	-	532	+	-	1124	5	-	21			1682
1993	-	-	400	4	3	783	2	+	31			1223
1994	+		345	6	1	865	5	-	40			1262
1995		0	332	+	33	990	1		79			1435
1996		0	368	1	5	890	1		126			1391
1997		0	359	+	3	750	1		137	11		1261
1998			395	+		715	-		163	8		1281
1999			193	+	3	113	1		182	47		539
2000			267	+	20	1327	8		231	158		2011
2001			211	+	31	1201	8		279	37		1767
2002			137		8	636	5		274	64		1124
2003			112		4	905	3		104	0		1128
2004		1	140		22	470			93	0		726
2005		10	204		7	702			96	0		1019
2006		5	239		10	674	16		115	0		1059
2007		39	261		3	703	9		70	0		1085
2008		30	307		1	964	0		44	0		1346
2009		33	217		4	898	0		88	2		1242
2010		41	183		5	939			48			1216
2011		87	173		1	1060			25			1337
2012		106	166		1	860			41			1174
2013		46	191		1	1204			66	86		1594
2014		0	193			393			60	16		662
2015			200			866	1		63	62	1	1193
2016		41	178		1	499			42	82	1	844
2017*		5	136			274			59	37		511

Not allocated by divisions before 1993.

*** Preliminary.**

Table 6.6.1. (Continued).

Tusk 7.a

Year	France	E & W	Scotland	Total
1988	n.a.	-	+	+
1989	2	-	+	2
1990	4	+	+	4
1991	1	-	1	2
1992	1	+	2	3
1993	-	+	+	+
1994	-	-	+	+
1995	-	-	1	1
1996	-	-		
1997	-	-	1	1
1998	-	-	1	1
1999	-	-	+	+
2000		-	+	+
2001		-	1	1
2002	n/a	-	-	-
2003		-	-	-
2004				
2005				
2006				
2007				
2008				
2009				
2010				
2011				
2012				
2013				
2014				
2015				
2016				
2017*				0

***Preliminary.**

Tusk 7.b,c

Year	France	Ireland	Norway	E & W	N.I.	Scotland	Total
1988	n.a.	-	12	5	-	+	17
1989	17	-	91	-	-	-	108
1990	11	3	138	1	-	2	155
1991	11	7	30	2	1	1	52
1992	6	8	167	33	1	3	218
1993	6	15	70	17	+	12	120
1994	5	9	63	9	-	8	94
1995	3	20	18	6		1	48
1996	4	11	38	4		1	58
1997	4	8	61	1		1	75
1998	3		28	-		2	33
1999	-	16	130	-		1	147
2000	3	58	88	12		3	164
2001	4	54	177	4		25	263
2002	1	31	30	1		3	66
2003	1	19		1			21
2004	2	19					21
2005	4	18				1	23
2006	4	23	63			0	90
2007	2	4	7				13
2008	2	2	0				4
2009	0	4	0				4
2010		5					5
2011		1					1
2012			63				63
2013	3	1					4
2014		1					1
2015							0
2016							0
2017*						1	01

***Preliminary.**

Table 6.6.1. (Continued).

Tusk 7.g–k

Year	France	Germany	Ireland	Norway	E & W	Scotland	Spain	Total
1988	n.a.		-	-	5	-		5
1989	3		-	82	1	-		86
1990	6		-	27	0	+		33
1991	4		-	-	8	2		14
1992	9		-	-	38	-		47
1993	5		17	-	7	3		32
1994	4		12	-	12	3		31
1995	3		8	-	18	8		37
1996	3		20	-	3	3		29
1997	4	4	11	-		+	0	19
1998	2	3	4	-		1	0	10
1999	2	1	-	-		+	6	8
2000	2		5	-	-	+	6	13
2001	3		-	9	-	+	2	14
2002	1				1		3	5
2003	1		1				1	3
2004	1						0	1
2005	1						1	2
2006	1		1				1	3
2007	1						1	1
2008	0						0	0
2009	0		0		0	0	0	0
2010	0							0
2011	0							0
2012	0					2		2
2013	0							0
2014								0
2015								0
2016								0
2017*								0

***Preliminary.**

Tusk 8.a

Year	E & W	France	Total
1988	1	n.a.	1
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	-	-
1997	+	+	+
1998	-	1	1
1999	-	-	0
2000	-		-
2001	-		-
2002	-	+	+
2003	-	-	-
2004		1	
2005			
2006			
2007			
2008			
2009			
2010		4	4
2011		0	0
2012			0
2013			0
2014			0
2015			0
2016			0
2017*			0

***Preliminary.**

Table 6.6.1. (Continued).

Tusk, total landings by subareas or division.

Year	3	4.a	4.b	5.b1	5.b2	6.a	7.a	7.b,c	7.g-k	8.a	All areas
1988	61	4429		4059	1606	2120		17	5	1	12 298
1989	93	6418	4	3722	1400	2297	2	108	86		14 130
1990	60	4254	5	5202	979	2256	4	155	33		12 948
1991	84	4537	2	5170	1096	1543	2	52	14		12 500
1992	85	4932	12	4399	992	1682	3	218	47		12 370
1993	79	5141	14	2862	577	1223		120	32		10 048
1994	51	3375	7	3407	909	1262		94	31		9136
1995	42	3348	15	3347	631	1435	1	48	37		8904
1996	44	3369	33	2728	582	1391		58	29		8234
1997	31	2272	38	2742	577	1261	1	75	19		7016
1998	21	3387	66	2073	637	1281	1	33	10	1	7510
1999	29	2435	34	3517	447	539		147	8	0	7156
2000	36	3260	116	2367	333	2011		164	13		8300
2001	57	3095	56	3526	469	1767	1	263	14		9248
2002	50	2961	71	2722	281	1124		66	5		7280
2003	51	1997	8	2733	559	1128		21	3		6500
2004	45	1666	23	3536	107	726		21	1		6125
2005	44	1826	7	3272	360	1019		23	2		6553
2006	29	2159	32	3560	317	1059		90	3		7249
2007	21	2180	15	3468	344	1077		13	1		7119
2008	46	2139	71	3798	61	1347		4	0		7466
2009	19	2268	17	3135	164	1242		4	0		6849
2010	21	1861	15	4889	127	1216		3	0	4	8136
2011	17	1623	96	3287	0	1337		5	0	0	6361
2012	20	1749	47	3793	0	1174		63	2		6848
2013	22	1510	31	1500	12	1594		4	0		4673
2014	9	1463	11	2310	129	662		1			4585
2015	9	1530	18	2081	324	1193		0			5155
2016	14	1650	9	2261	42	844		0			4820
2017*	10	1206	18	2035	135	511		1			3916

***Preliminary.**

7 Greater silver smelt (*Argentina silus*)

7.1 Stock description and management units

At the WGDEEP 2014 it was suggested that unit arg-oth was split further into advisory units as fishing grounds are sufficiently isolated (WD, WGDEEP2014, figure 7.1.1). It was also suggested that further division may be adequate. This change was implemented at the WGDEEP meeting in 2015. Greater silver smelt is now divided into four management units by ICES areas; in 1, 2, 3a and 4 (aru.27.123a4), in 5a and 14 (aru.27, aru.27.5a14), in 5b and 6a (aru.27.5b6a), and 6b, 7-10 and 12 (aru.27.6b7–1012).

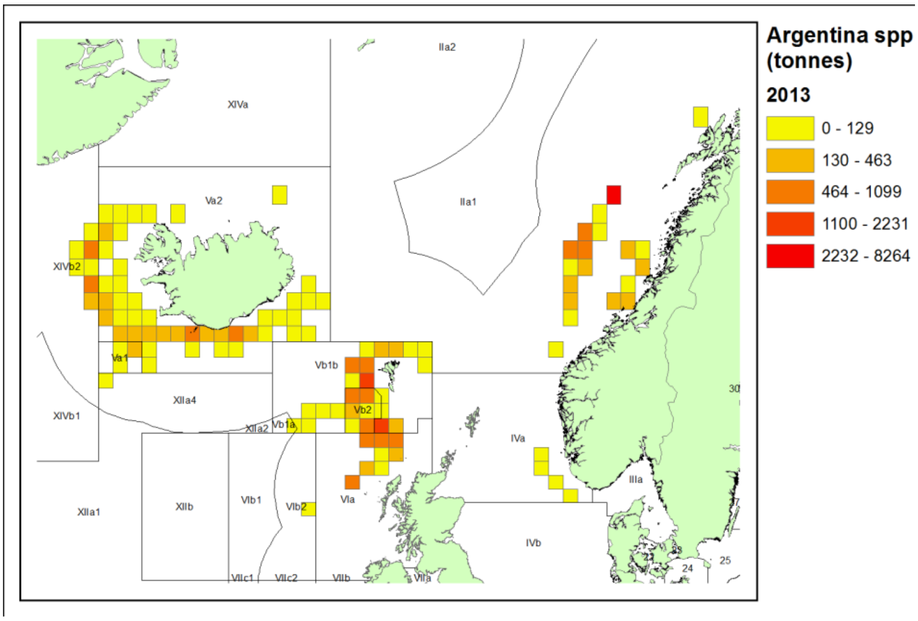


Figure 7.1.1. Catches of greater silver smelt by Iceland, Norway, Faroes and the Netherlands in 2013. Some catches of *A. Sphyraena* and *Argentina* unidentified may be included in the Norwegian and Dutch landings.

7.2 Greater silver smelt (*Argentina silus*) in 1, 2, 3.a and 4

7.2.1 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.

7.2.2 Landing trends

International landings are summarised in Tables 7.2.1–72.4. The variation through the time-series primarily reflects the developments in the Norwegian target fisheries in Subarea 2. The landings from 4.a were estimated based on sampling of mixed-species catches at the fishmeal factories, and the quality of the process may have varied somewhat through the time-series.

From peak levels of 10000 t to 11000 t in the 1980s when the targeted fishery developed, the landings (primarily by Norway) from Subareas (1 and) 2 declined in the 1990s. Except for in 2001, when landings were 14369 t, the landings remained relatively stable at 6–8000 t until 2003. In 2004 to 2006 landings increased sharply to reach 21685t in 2006. The monitoring of abundance was not satisfactory in that period, but the increase in landings did probably not reflect increased abundance. Since the fishery was not restricted by a TAC, it is thought that temporal variation in landings primarily reflected variation in the market demand. In 2007–2017 the Norwegian catches in targeted fisheries were around 12000t per year in accordance with annual TAC regulations reintroduced in 2007.

Since 2014 marked increase is observed in catches in area 3 and 4, and these have in 2017 risen to substantial 5969. Mostly they are bycatch taken at the southern slope of Norwegian trench, and the bulk of them are reported as lesser silver smelt. There are uncertainties on how well these landings are estimated and about species identification, and this should be addressed with better sampling in cooperation with the industry (Table 7.5.6). In this report, all registered landings are assumed to be greater silver smelt.

In 2017 total landings were 18295 t (Table 7.2.1–7.2.3). Landings from Subarea 2 were 12322 t and the remainder was reported from 4 and 3.a.

7.2.3 ICES Advice

In 2017 ICES advised that, when the precautionary approach is applied, catches should be no more than 15 656 tonnes in each of the years 2018 and 2019. All catches are assumed to be landed.

7.2.4 Management

For a period after 1983 a Norwegian precautionary unilateral annual TAC applied in 2.a which was always the main fishing area. The landings never exceeded the quota and this regulation was abandoned in 1992. As landings increased substantially in the mid-2000s, a 12 000 t unilateral Norwegian TAC was introduced in 2007 and this TAC was maintained until 2015 when for 2016 it was increased to 13 047 t, which also was the TAC for 2016. In 2018 the TAC is 13770 t. The Norwegian target fishery is further regulated by a licensing system that limits the number of trawlers that can take part and specifies gear restrictions, bycatch restrictions, and an area- and time restriction. In 2016 there are 31 licences, but in recent years 21–26 actually took part in the fishery.

In 2016 a RTC-regime (Real Time Closures) was implemented to the direct fisheries in area 2, aimed to limit bycatch of redfish, saithe and haddock. Closing criteria was sat to 1000 kg in combined weight of redfish, saithe and haddock in single catches.

In 2017 a minimum landing size (MLS) in the direct fisheries of 27 cm was implemented in the direct fisheries, with access to 20% mixture of greater silver smelt in numbers under the MLS in single catches. Also, ban on landing greater silver smelt to be processed to fishmeal was repealed in 2017.

In Norway vessels that are not licensed to greeter silver smelt fisheries can have up to 10% in weight bycatch of greater silver smelt in single catches and landings. This also applies to vessels that are licenced, but those must subtract the bycatch from their quota.

There is no Norwegian TAC for fisheries in 4.a and 3.a where targeted fisheries are prohibited, but bycatch restrictions apply. The EU introduced TAC management in 2003 applying to EU vessels fishing in the EU EEZ and international waters. For 2018 the EU TAC for 1+2 =90 t, and for 4 + 3 the TAC was 1234 t.

This management unit is not distributed in international waters, hence the 2016 TACs described above totalling 13 770 t (Norway) and 90 (EU;area 1 and 2) +1234 t (EU; 3 and 4) apply to Norwegian and EU waters, respectively.

7.2.5 Data available

7.2.5.1 Landings and discards

Landings data are presented by ICES Subareas and Divisions and countries (Tables 7.2.1–7.2.4, Figure 7.2.1–7.2.3). (Data from 2014–2017 were obtained from national official statistics (Norway) and InterCatch. From earlier years data are WG estimates based on national submissions to ICES which are not fully included in InterCatch.)

Discarding is banned in Norway and all catches are assumed to be landed. There is information in InterCatch on very minor discards from non-Norwegian fisheries on this management unit, but bycatches are assumed generally to be landed.

7.2.5.2 Length compositions

Length distributions are presented for target fishery catches from 2.a for the period 2009–2016 and for bycatches by Norwegian vessels in 4.a for the years 2011, 2013, 2014 and 2016 (Figure 7.2.4–7.2.7). For each year these distributions are derived by pooling multiple samples from landing sites and samples provided by commercial vessels (WD by Hallfredsson *et al.*, 2016).

Length information is available from the Norwegian slope survey in 2.a in March biennially 2009–2016 (Figure 7.2.8) (WD by Hallfredsson *et al.*, 2017).

Length information is available from the annual Norwegian shrimp survey in 3.a–4.a, 1984–2016 (Figure 7.2.9).

These numbers will be updated for 2017 at WGDEEP 2019, which is an advice year.

7.2.5.3 Age compositions

Age compositions from Norwegian catches in 2015 are presented in Figures 7.2.10.

Age distributions by depth from the Norwegian slope survey in 2 in March 2016 are shown in Figure 7.2.11.

These figures will be updated for 2017 at WGDEEP 2019, which is an advice year.

7.2.5.4 Weight-at-age

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

7.2.5.5 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

7.2.5.6 Catch, effort and research vessel data

A trawl acoustic survey was conducted in 2016 along the continental slope in Norwegian EEZ from 62–74°N (WD16 Hallfredsson *et al.*, 2017). This survey was the fourth in a biennial series. Highest densities of greater silver smelt in 2016 were found in similar areas as in previous surveys, i.e. on the shelf break and in shelf troughs off central Norway (Figure 7.2.12). Additionally, trawl surveys were conducted in 2.a in 2003–2005. Biomass estimates based on the acoustic observations and trawl swept area estimates show increasing trend since 2012 (Table 7.2.5, Figure 7.2.13). Greater silver smelt has been distributed rather evenly from 300–500 m depth in the surveys according to acoustics, which is in contrast to the catches that are mostly conducted at depths around 300–400 m (Figure 7.2.14).

The 2018 survey ended while the 2018 WGDEEP meeting was ongoing, and will be reported next year.

Incidence and abundance indices for greater silver smelt from the annual Norwegian shrimp survey in 3.a and southeastern parts of 4.a are shown in Figure 7.2.15.

The results for the 2018 shrimp survey will be reported at WGDEEP 2019, which is an advice year.

7.2.6 Data analyses

Length and age distributions

In Division 2.a size and age distributions from target fisheries (Figures 7.2.5 and 7.2.10) continue to consist of rather smaller and younger fish than catches in the 1980s during the initial years of the target fisheries (Bergstad, 1993; Monstad and Johannessen, 2003; Johannessen and Monstad, 2003). There are, however, no changes in the size and age composition in the recent seven years when the target fishery has been regulated with TACs and other measures. Length and age distributions in the Norwegian survey sampling the entire geographical and depth range show higher length and age ranges, however, with deeper than 400 m samples having proportion of old fish closer to those observed in the 1980s (Figure 7.2.11). The fishery is mainly conducted shallower than 400 m (Figure 7.2.14).

In Division 3.a there has been a declining trend in the length distributions throughout the 1984–2016 shrimp survey time-series, but with some reappearance of large fish in the most recent years (Figure 7.2.9).

In Division 4.a size distributions from the bycatch (Figures 7.2.6 and 7.2.7) suggest that the catches comprise rather variable but smaller fish than those in the target fishery landings in 2.a. This probably reflects that the slope of the Norwegian Deep in 4.a is comparatively shallow and is mainly a juvenile area and feeding area for dispersed large fish out with the winter-spring aggregatory phase (Bergstad, 1993).

Commercial and survey cpue series

For Division 2.a fisheries, both acoustic and trawl indices show similar upward trend in recent years (Table 7.2.5, Figure 7.2.13). The geographical distribution and pattern of aggregations in 2016 appeared similar to those observed in earlier surveys (Figure 7.2.12). There is a rather high CV in the trawl estimates, and the acoustic biomass estimates are considerably higher than the trawl indices. It is possible that this reflects that the trawl indices don’t show the more pelagic part of the vertical distribution of this bento-pelagic fish. One should however be careful in the interpretation of absolute biomass values from different methods, and the comparison might thus not be fully appropriate. It is reassuring that both methods show similar trends.

The catch rates in terms of numbers and weight from the Norwegian shrimp survey (1984–2016) in 3.a and 4.a suggest pronounced variation and trends (Figure 7.2.15). The survey catch rates first declined steadily and then rather abruptly to unprecedented low levels in 2005. Since 2005, indices have increased steadily and they are now at similar levels to the start of the series in 1985. The decline in abundance until 2005 was also reflected in a decrease in incidence and size.

Exploratory assessment

An exploratory assessment was conducted and presented at the 2017 meeting, using the SPiCT model. Exploratory assessment surveying different DLM assessments was presented at the current meeting (Hallfredsson, WD). The stock is suggested for Benchmark in 2020.

Existing abundance, length and age dataseries for this stock are rather short in time. However, if the time-series are maintained they may support more analytical assessment in near future.

7.2.7 Comments on the assessment

The ICES framework for category 3 stocks was applied (ICES, 2012) in 2017, for a two years advice (2018 and 2019). For draft advice, the Norwegian acoustic survey in Subarea 2 was applied as an index for the stock development. The advice is based on a comparison of the two latest index values with the three preceding values, combined with average catches in recent years. For years where index values are not available the values are obtained by interpolation). The index is estimated to have increased by more than 20% which means that the uncertainty cap was applied to calculate the catch advice. The stock status relative to candidate reference points is unknown. The precautionary buffer was applied in 2015 therefore it is not applied again. Discarding is considered negligible.

7.2.8 Management considerations

Advice is given every second year for this stock and the 2017 advice applies for 2018 and 2019.

The size and age distributions of landings in the major fishery, i.e. the target fishery in the Norwegian EEZ, remains stable, suggesting that the prior decline in the proportions of large fish in the catches observed during the first decades of the fishery has halted. Furthermore, corresponding data from Norwegian surveys show that larger and older fish occur in adjacent and deeper areas than the areas being used by the fishery. The fishing areas (both for the target fishery and bycatch fisheries) have remained the same since the early 1980s. The exception is the 3.a where a target fishery was conducted until the mid-1990s but not since.

Acoustical biomass estimates for Division 2.a in 2012 showed some reduction compared to 2009, but a marked upward trend again since then, as does the trawl index.

The Norwegian shrimp survey data from Division 3.a suggest that the abundance in that area has increased in recent years after an abrupt decline in 2004–2005. The apparently rather rapid increase in the abundance index in recent years may suggest that immigration from northern areas (in 4.a or 2.a) may have happened. The abrupt decline in 2005 may partly have resulted from high incidental mortality due to greater silver smelt being a bycatch in the roundnose grenadier fishery which peaked in 2003–2005.

The bycatch in area 4 has increased rapidly since 2012, and was 5969 tonnes in 2017. This is an alarming level. There are uncertainties in how this bycatch is estimated in this, as it is an industry fishery for reduction. Additionally, most of these catches are registered as lesser silver smelt, but there are strong reasons to assume that these for the most are greater silver smelt catches. These matters need to be more thoroughly investigated.

7.2.9 Tables and Figures

Table 7.2.1. Greater Silver Smelt in 1, 2, 3.a and 4 by countries. WG estimates of landings in tonnes. ICES official statistics.

YEAR	DENMARK	SWEDEN	IRELAND	GERMANY	NETHERLANDS	NORWAY	POLAND	RUSSIA/USSR	SCOTLAND	FRANCE	FAROES	ICELAND	SUM
1966	0	0		0		156							156
1967	0	0		0		3							3
1968	0	0		0		0							0
1969	0	0		0		0							0
1970	0	0	0	0	0	339			0	0			339
1971	0	0	0	0	0	116			0	0			116
1972	0	0	0	0	0	77			0	0			77
1973	0	0	0	21	0	110			0	0			131
1974	0	0	0	0	0	0			0	0			0
1975	0	0	0	0	0	500			0	0			500
1976	0	0	0	0	0	1034			0	0			1034
1977	0	0	0	0	0	478			0	0			478
1978	0	0	0	428	0	1500			0	0			1928
1979	0	0	0	64	0	640			0	0			704
1980	0	0	0	22	0	156			0	0			178
1981	0	0	0	18	0	183			0	0			201
1982	4654	0	0	0	0	610			0	0			5264
1983	8539	0	0	0	0	671			0	0			9210
1984	6293	0	0	0	0	442			0	0			6735
1985	996	0	0	0	0	1070			0	0			2066
1986	0	0	0	0	0	762			0	0			762
1987	190	0	0	2	0	1141			0	0			1333
1988	1062	0	0	1	0	13014	5	14	0	0	0	0	14096
1989	1322	0	0	0	335	10495	0	23	1	0	0	0	12176
1990	737	0	0	13	5	10686	0	0	0	0	0	0	11441
1991	1421	0	0	0	3	8864	0	0	6	1	0	0	10295

YEAR	DENMARK	SWEDEN	IRELAND	GERMANY	NETHERLANDS	NORWAY	POLAND	RUSSIA/USSR	SCOTLAND	FRANCE	FAROES	ICELAND	SUM
1992	3564	0	0	1	70	8932	0	0	101	0	0	0	12668
1993	2353	0	0	0	298	8481	0	0	56	0	0	0	11188
1994	1118	0	0	0	0	6221	0	0	614	0	0	0	7953
1995	1061	0	0	357	0	6419	0	0	20	0	0	0	7857
1996	1446	0	0	0	0	6817	0	0	0	0	0	0	8263
1997	1455	542	0	1	0	5167	0	0	0	0	0	0	7165
1998	748	428	0	169	277	8655	0	0	0	0	0	0	10277
1999	1420	0	0	0	7	7151	0	0	18	0	0	0	8596
2000	1039	273	10	0	3	6107	0	195	18	9	0	0	7654
2001	907	1011	3	0	0	14360	0	7	233	28	0	0	16549
2002	614	484	4	0	0	7406	0	0	164	0	0	0	8672
2003	918	42	0	4	617	8351	0	7	22	4	4	0	9969
2004	910	0	36	4	4277	11574	0	4	12	0	0	0	16817
2005	470	0	0	1	28	17066	0	16	0	0	14	0	17595
2006	335	0	0	6	0	25149	0	4	2	0	0	0	25496
2007	0	0	0	0	0	16373	0	1	0	0	0	0	16374
2008	0	0	0	0	0	13424	0	0	0	0	0	0	13424
2009	0	0	0	0	0	13495	0	0	0	0	0	0	13495
2010	0	0	0	0	0	12865	0	0	33	0	0	0	12898
2011	0	0	0	0	0	12060	0	0	0.4	4	0	0	12064
2012	0	0	0	0	0	12352	0	0	0	1.2	114	18	12485
2013	0	0	0	0	0	13227	0	0	0	2.3	0	0	13229
2014	40	1	0	204	345	14471	0	0	0	1	0	0	15062
2015	0	1	0	0	0	15235	0	0	0	0	0	0	15236
2016	0	1	0	38	11	18835	0	7	0	1.4	0	0	18893
2017	69	1	0	0	10	17792	0	35	0	0	0	0	18295

Table 7.2.2. Greater Silver Smelt in 1 and 2. WG estimates of landings in tonnes.

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
1988			11332	5	14					11351
1989			8367		23					8390
1990		5	9115							9120
1991			7741							7741
1992			8234							8234
1993			7913							7913
1994			6217			590				6807
1995	357		6418							6775
1996			6604							6604
1997			4463							4463
1998	40		8221							8261
1999			7145			18				7163
2000		3	6075		195	18	2			6293
2001			14357		7	5				14369
2002			7405			2				7407
2003		575	8345		7	2	4	4		8937
2004		4235	11557		4					15796
2005			17063		16			14		17093
2006			21681		4					21685
2007			13272		1					13273
2008			11876							11876
2009			11929							11929

Year	Germany	Netherlands	Norway	Poland	Russia/USSR	Scotland	France	Faroes	Iceland	TOTAL
2010			11831			23				11854
2011			11476			0.4				11476
2012			12002				0.2	114	18	12134
2013			11978				0.3			11979
2014			11752							11752
2015			12049							12049
2016			13115		7		0.4			13122
2017		10	12277		35					12322

Table 7.2.3. Greater Silver Smelt in 3. WG estimates of landings in tonnes. Figures in parentheses are discards as recorded in InterCatch.

Year	Denmark	Germany	Norway	Sweden	TOTAL
1966			156		156
1967			3		3
1968					
1969					
1970			106		106
1971			26		26
1972					
1973		20			20
1974					
1975			496		496
1976			1034		1034
1977			273		273
1978		25	1435		1460
1979			640		640
1980			156		156
1981			173		173
1982	4376		140		4516
1983	7733		221		7954
1984	5588		317		5905
1985	10		281		291
1986			676		676
1987	190		768		958
1988	1062		27		1089
1989	938		236		1174
1990	732		1150		1882
1991	1421		800		2221
1992	3564		634		4198
1993	2343		487		2830
1994	1108				1108
1995	1061				1061
1996	1389		159		1548
1997	1455		703	542	2700
1998	748		413	428	1589
1999	1420		2		1422
2000	1039		4	273	1316
2001	907			1011	1918
2002	614			484	1098
2003	918			42	960
2004	910		1		911
2005	470				470
2006	324				324
2007					0

Year	Denmark	Germany	Norway	Sweden	TOTAL
2008					0
2009					0
2010					0
2011					0
2012					0
2013					0
2014			2	1	3
2015			22	1	23
2016			101	1	102
2017			3	1	4

Table 7.2.4. Greater Silver Smelt in 4. WG estimates of landings in tonnes. Figures in parentheses are discards as recorded in InterCatch.

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	TOTAL
1970					233			233
1971					90			90
1972					77			77
1973			1		110			111
1974								
1975					4			4
1976								
1977					205			343
1978			403		65			493
1979			64					64
1980			22					22
1981			18		10			28
1982	278				470			748
1983	806				450			1256
1984	705				125			830
1985	986				789			1775
1986					86			86
1987			2		373			375
1988			1		1655			1656
1989	384			335	1892	1		2612
1990	5		13		421			439
1991		1		3	323	6		333
1992			1	70	64	101		236
1993	10			298	81	56		445
1994	10				4	24		38
1995					1	20		21
1996	57				54			111
1997			1		1			2
1998			129	277	21			427
1999				7	4			11
2000		7			28		10	45
2001		28			3	228	3	262
2002					1	162	4	167
2003			4	42	6	20		72
2004			4	42	16	12	36	110
2005			1	28	3			32
2006	11		6		3468	2		3487
2007					3101			3101
2008					1548			1548
2009					1566			1566
2010					1034	10		1044
2011		4			584			588

Year	Denmark	France	Germany	Netherlands	Norway	Scotland	Ireland	TOTAL
2012		1			350			351
2013		2			1249			1251
2014	40 (7)	1	204	345	2717			3307(7)
2015*					3164			3164
2016		1	38	11	5619			5669
2017	69				5512	388		5969

Table 7.2.5. GSS in 2.a. Biomass estimates (t) for greater silver smelt in Norwegian slope surveys conducted in March 2009, 2012 and 2014. For acousic methods see Harbitz, WD ICES, WKDEEP 2010.

	Swetp-area, bottom trawl							Acoustics				
Area	SW	SE	NW	NE	Total	std	CV	SW	SE	NW	NE	Total
2004					43978	20366	0.46					
2005					114644	39648	0.35					
2009	24171	44961	484	997	70613	18952	0.27	122026	91901	1069	1787	216783
2012	4505	28778	1053	155	34491	12996	0.38	66961	96643	10941	3352	177897
2014*	104726	18818	2769	0	126313	98011	0.78	209771	111156	7216		328143
2016	53868	118059	4256	47	176230	81894	0.46	113942	456046		1573	571561

SW = Latitude < 70°N, depth 500–750 m.

SE = Latitude < 70°N, depth 300–500 m.

NW = Latitude > 70°N, depth 500–750 m.

NE = Latitude > 70°N, depth 300–500.

***In 2014 the survey was conducted without the use of a midwater trawl. This might reduce accuracy and precision of the estimates because the allocation of backscattering strength to species categories in the pelagic zone could not be supported by catch information from targeted trawl tows.**

Table 7.2.6. Catches (t) registered as greater silver smelt (GSS), lesser silver smelt (LSS) and mix of both spcies (LSS/GSS) as registered in Norwegian fisheries in logbooks (upper table) and port landings (lower table).

ICES area	LSS	LSS/GSS	GSS	Total
1.b				0
2.a2	32	664	12325	13021
3.a	6	3	0	9
4.a	4463	776	21	5260
4.b	1	0	0	1
Total	4501	1443	12346	18290

ICES area	LSS	LSS/GSS	GSS	Total
1.b		1		1
2.a2	42	12232	2	12276
3.a	3			3
4.a	5321	180	7	5508
4.b	5			5
Total	5370	12413	9	17792

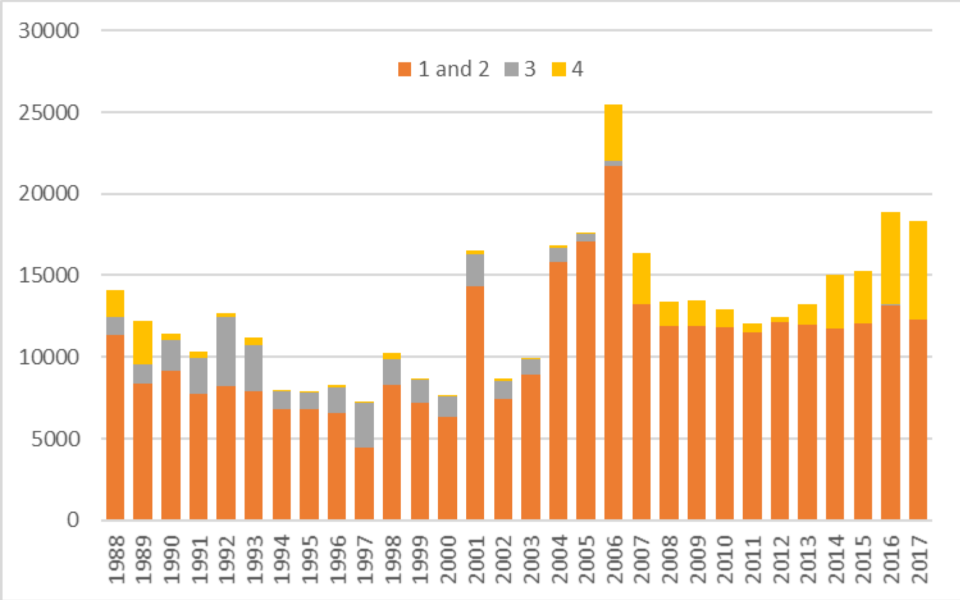


Figure 7.2.1. Total landings of greater silver smelt in Subareas 1, 2, 3 and 4.

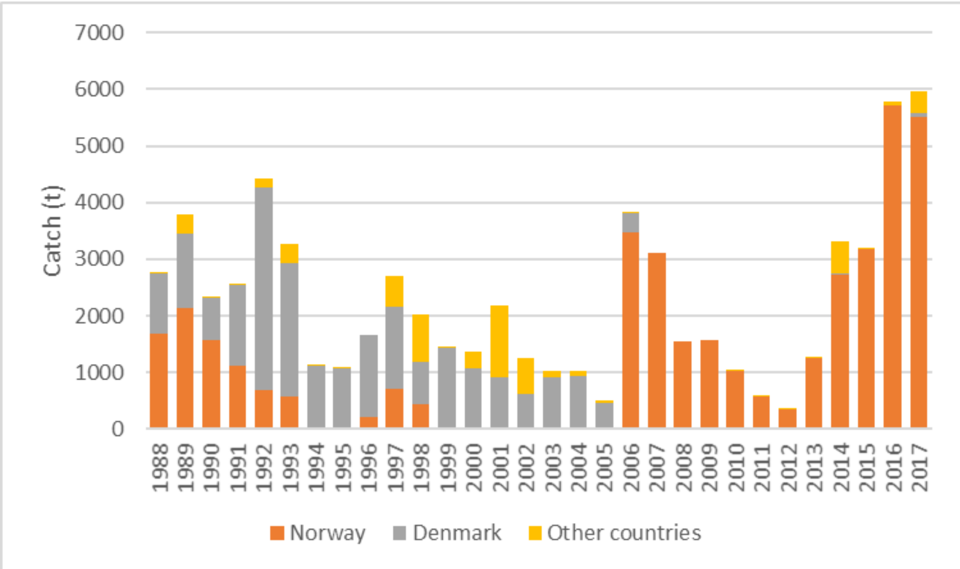


Figure 7.2.2. Total landings of greater silver smelt in Subareas 3 and 4, by countries.

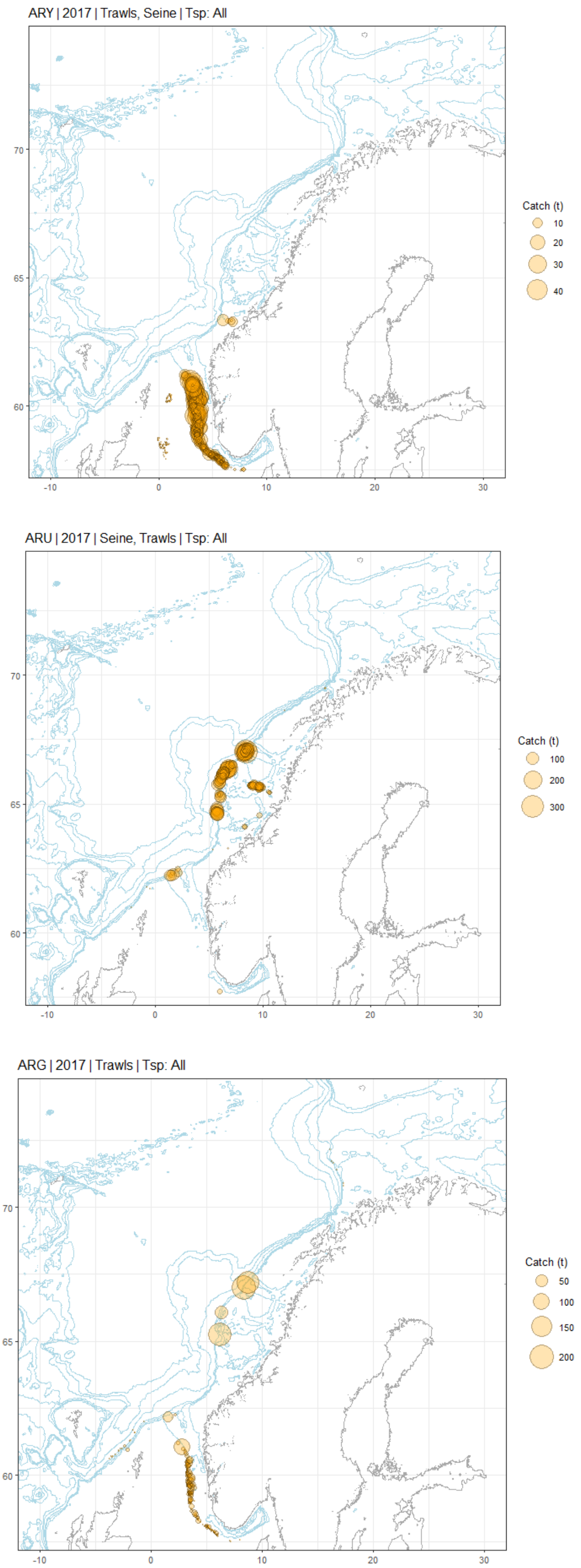


Figure 7.2.3. Norwegian catches in 2016 based on logbooks, included bycatch. Uppermost, middle and lowermost panels show catches registered as lesser silver smelt, greater silver smelt and mix of both species, respectively. Bubble sizes reflect sizes of single catches. NB: Catch representing max bubble size varies between panels.

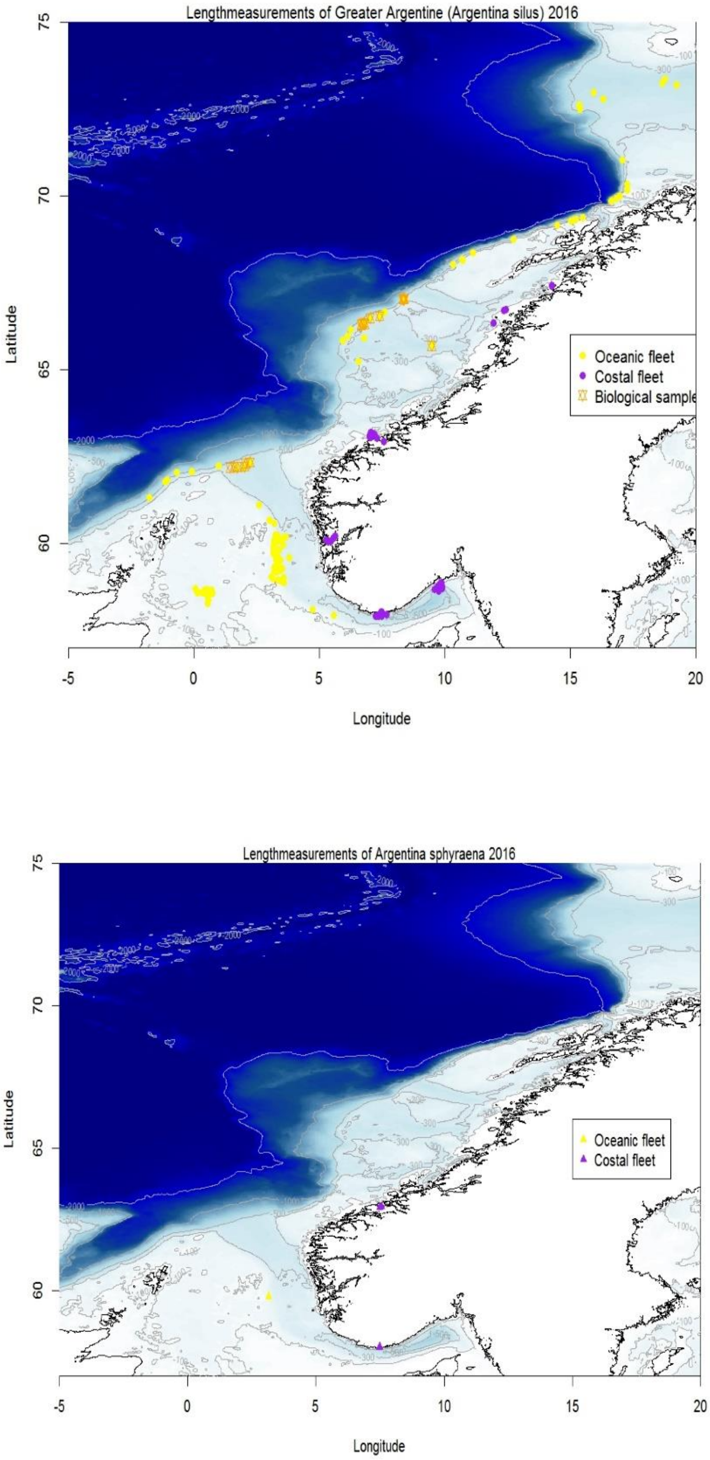


Figure 7.2.4. Positions for the greater silver smelt (upper panel) and lesser silver smelt (lower panel) catches that samples were taken from in 2016.

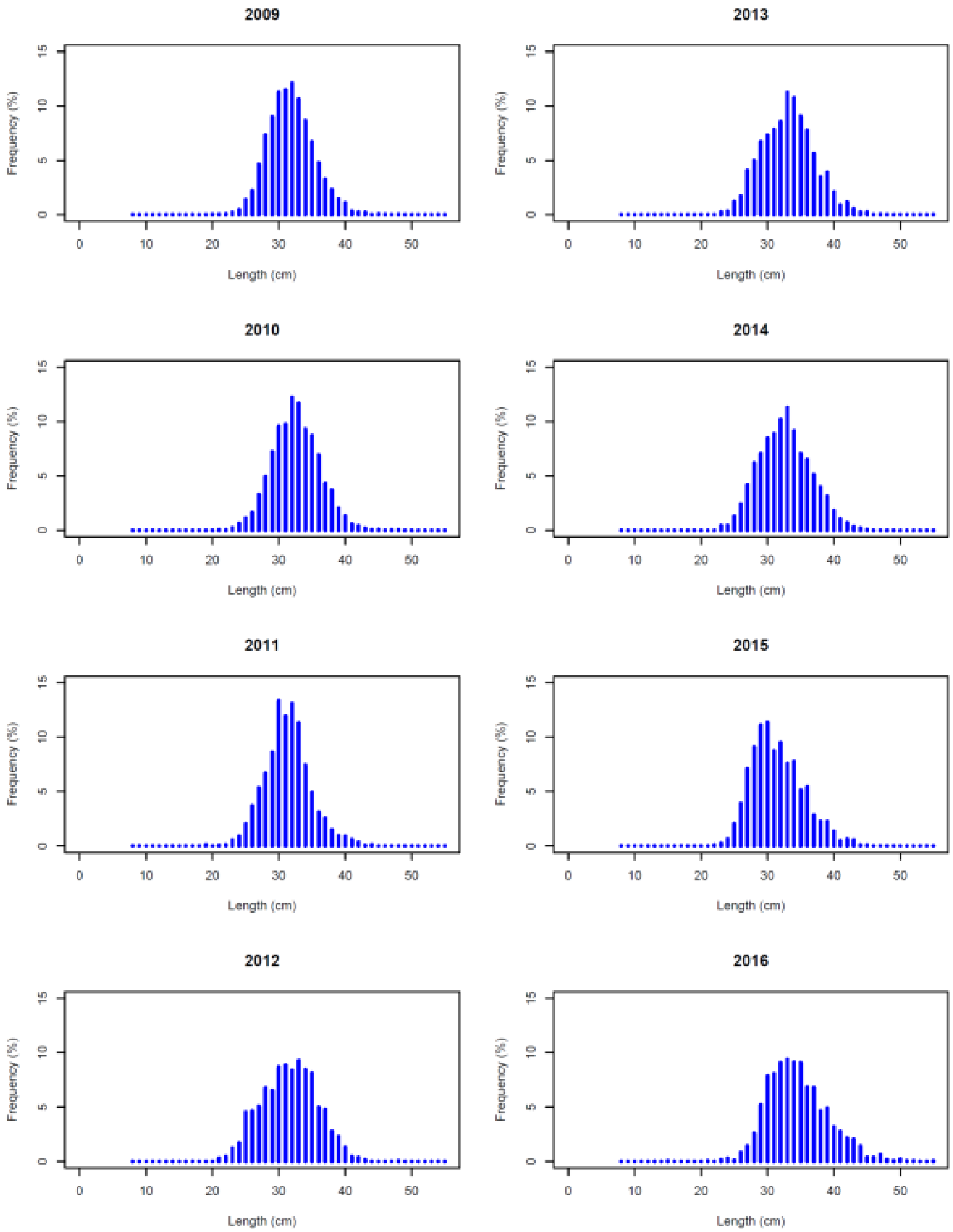


Figure 7.2.5. Greater silver smelt in 1, 2, 4 and 3.a. Length distributions from the target fisheries in 2009–2016 north of 62°N (approximately area 1 and 2). For each year, the distributions were derived by pooling samples from all fishing grounds in (WD Hallfredsson *et al.*, 2017).

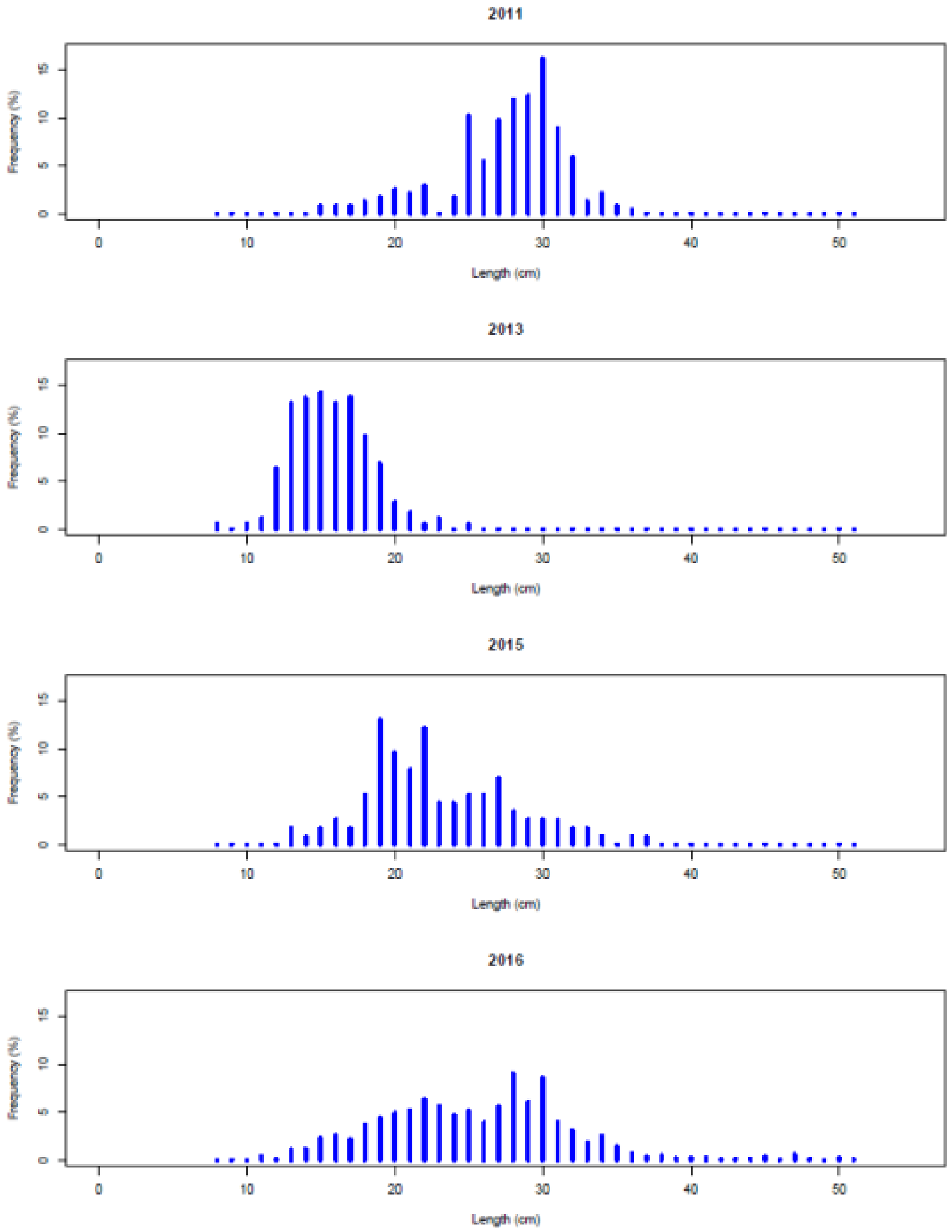


Figure 7.2.6. Greater silver smelt in 1, 2, 3.a and 4. Length distributions in annual samples from Norwegian bycatches south of 62°N (approximately area 3 and 4.). For each year, the distributions were derived by pooling samples from all fishing grounds in (WD Hallfredsson *et al.*, 2017).

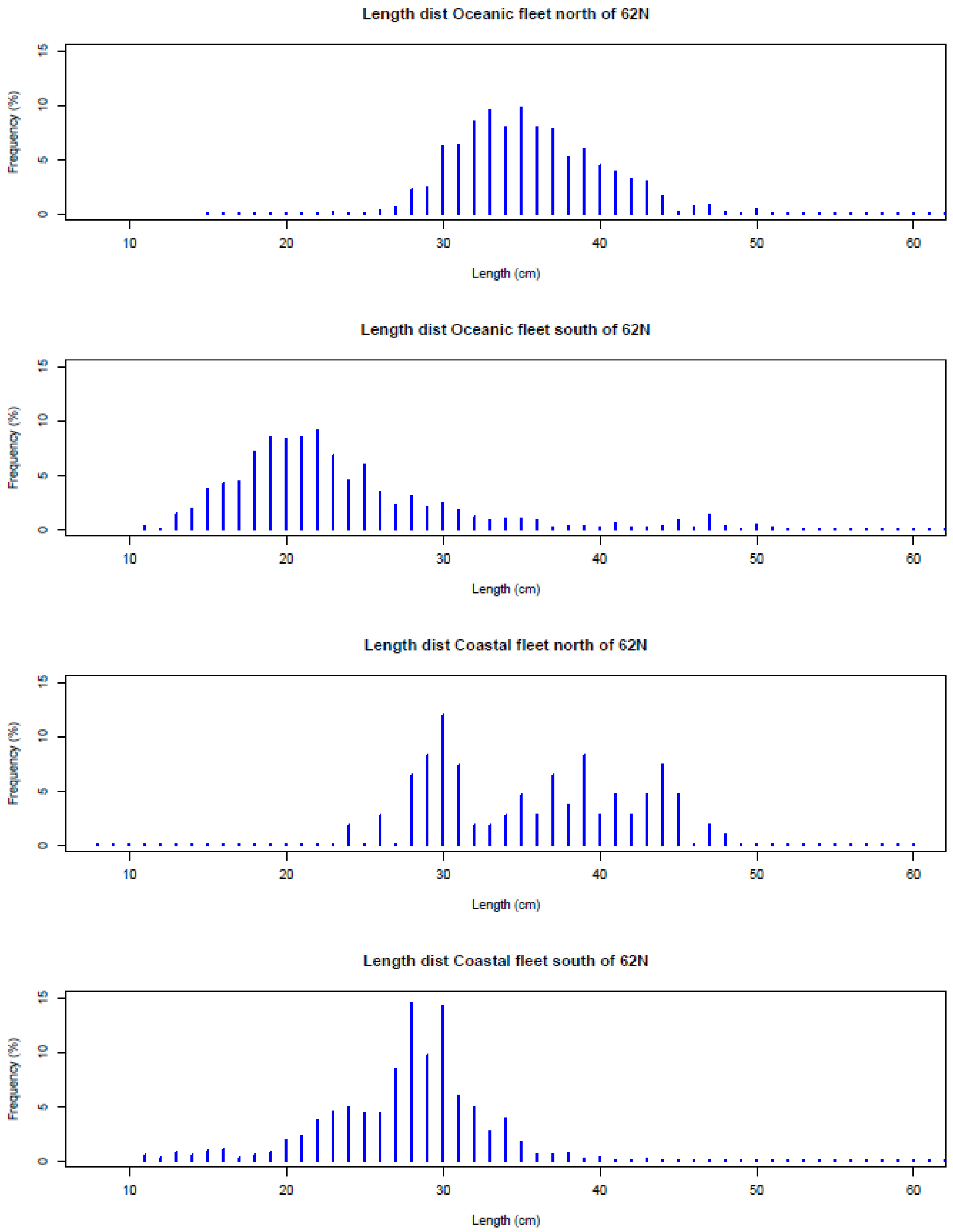


Figure 7.2.7. Length distributions from the fisheries north and south of 62°N, devided by if samples came from ocanic vs. coastal fleeds. The distribution were derived by pooling all samples from all fishing areas. The distributions were derived by pooling samples from all fishing grounds in (WD Hallfredsson *et al.*, 2017).

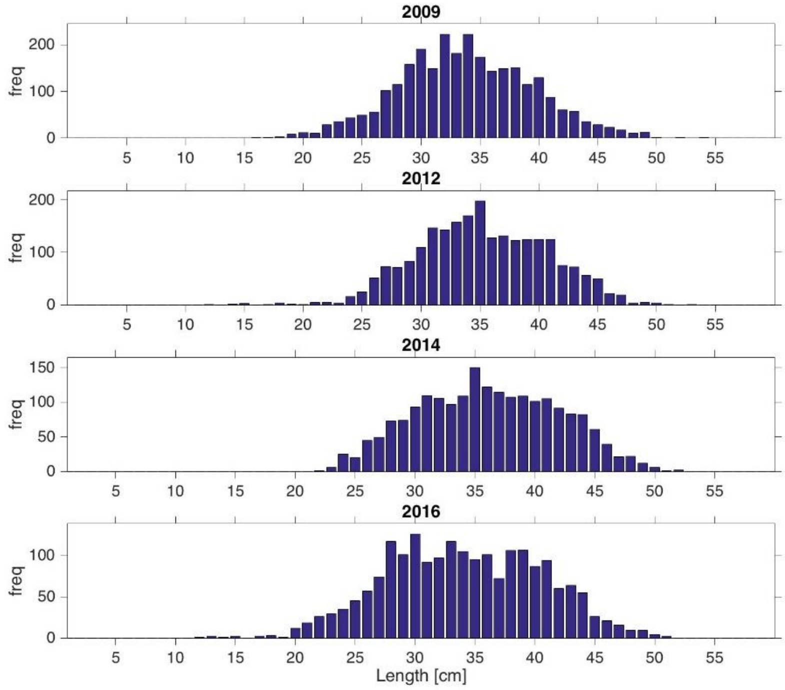


Figure 7.2.8. Length frequencies for Argentine in Norwegian slope survey in 2009, 2012, 2014 and 2016. No apparent substantial difference between years is seen, and few individuals have lengths outside the range 20–50 cm.

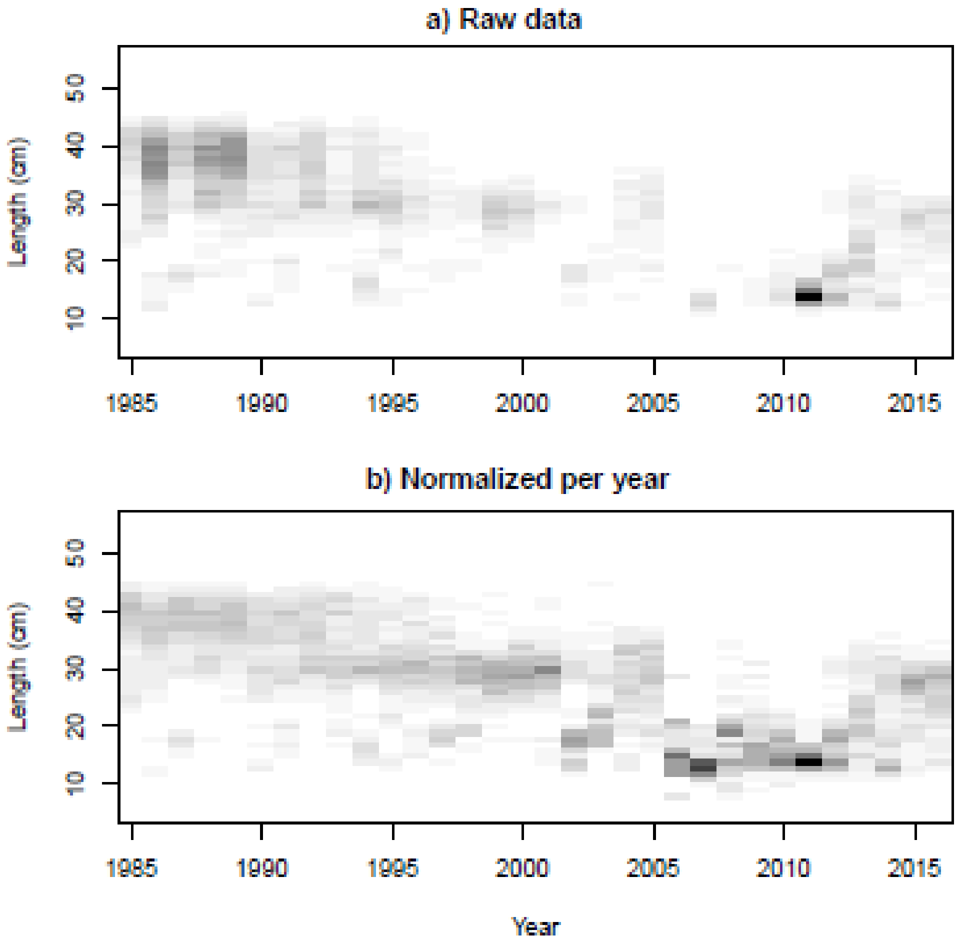


Figure 7.2.9. Greater silver smelt in 1, 2, 3, and 4. Length distributions from the annual Norwegian shrimp survey in 3.a and eastern parts of 4.a, 1985–2016 (from Hallfredsson *et al*., 2016, WD for WGDEEP).

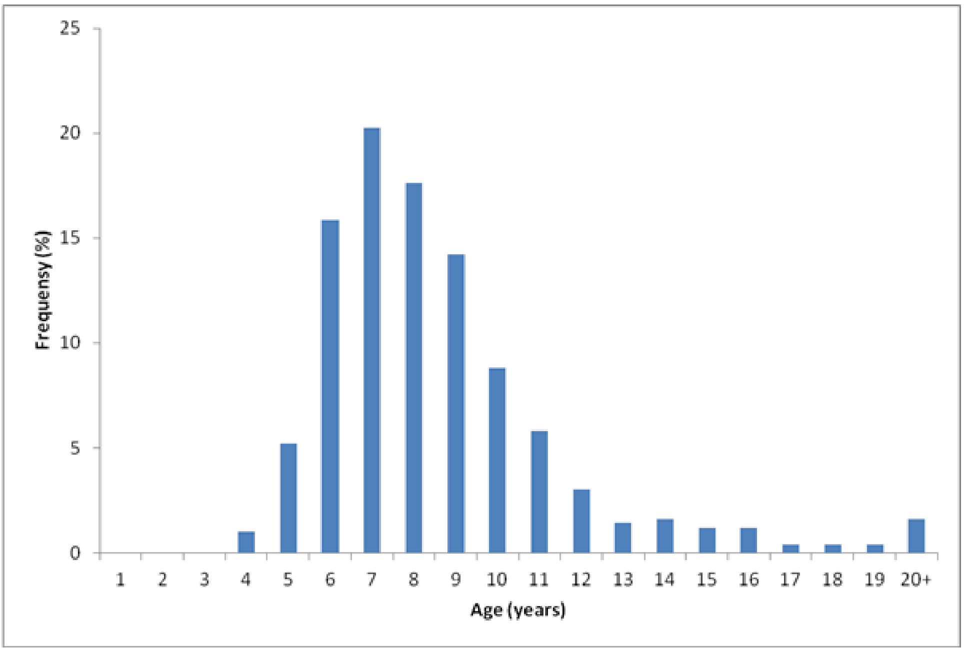


Figure 7.2.10. Greater silver smelt in 1, 2, 3, and 4. Age composition of pooled Norwegian landings samples, 2015. (Hallfredsson *et al*., 2016, WD to WGDEEP).

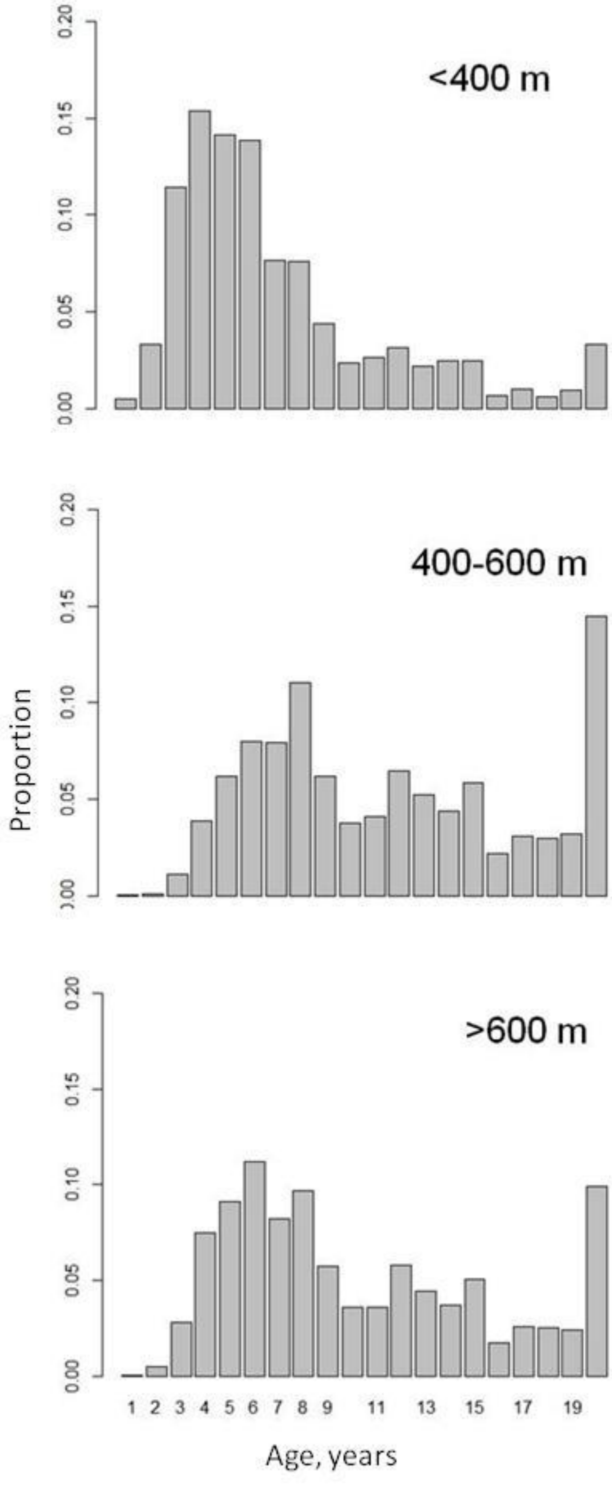


Figure 7.2.11. Greater silver smelt in 1, 2, 3, and 4. Age compositions by depth zones in the Norwegian slope survey in March–April 2016.

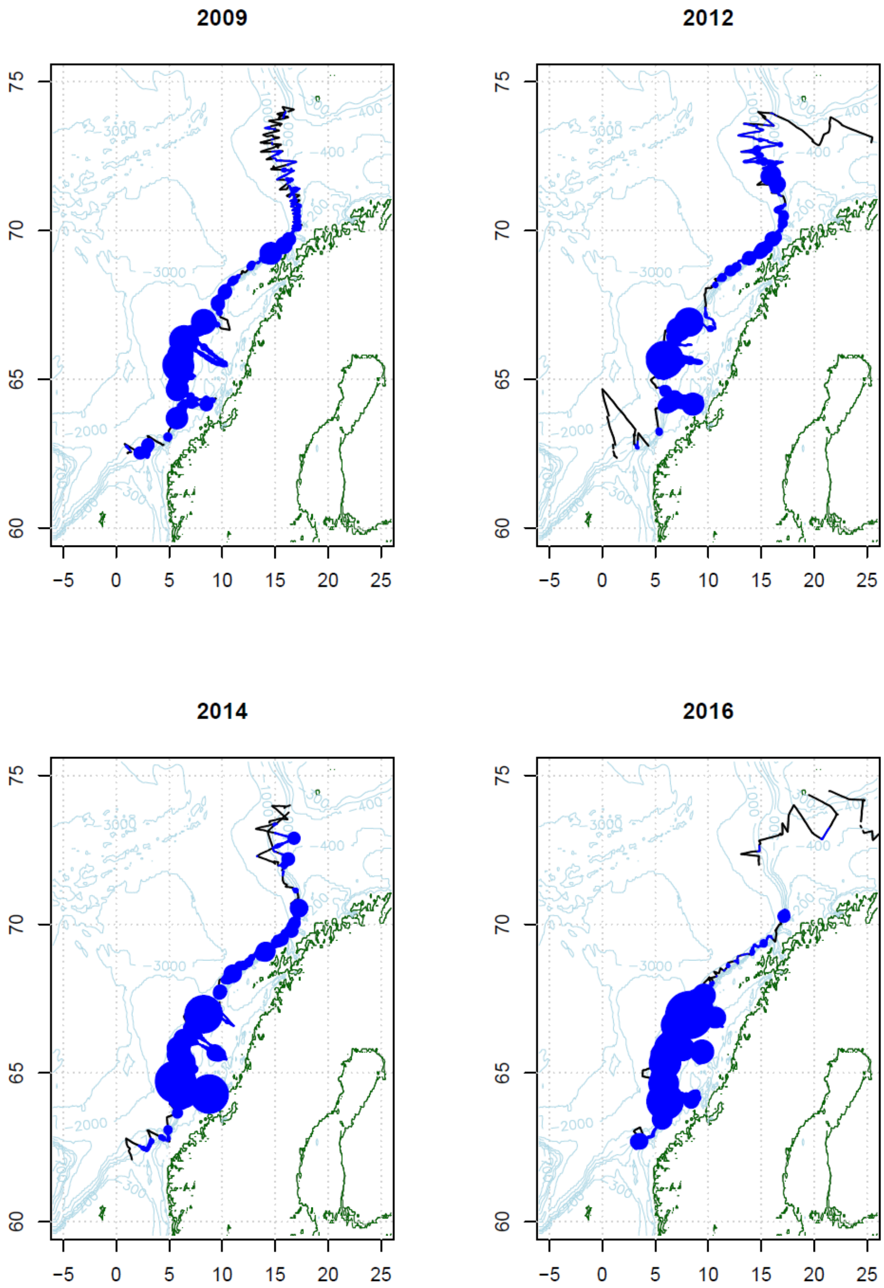


Figure 7.2.12. Greater silver smelt in 2.a. Acoustic backscattering strength estimates SA-values) in Norwegian continental shelf and slope surveys March–April 2009, 2012, 2014, and 2016.

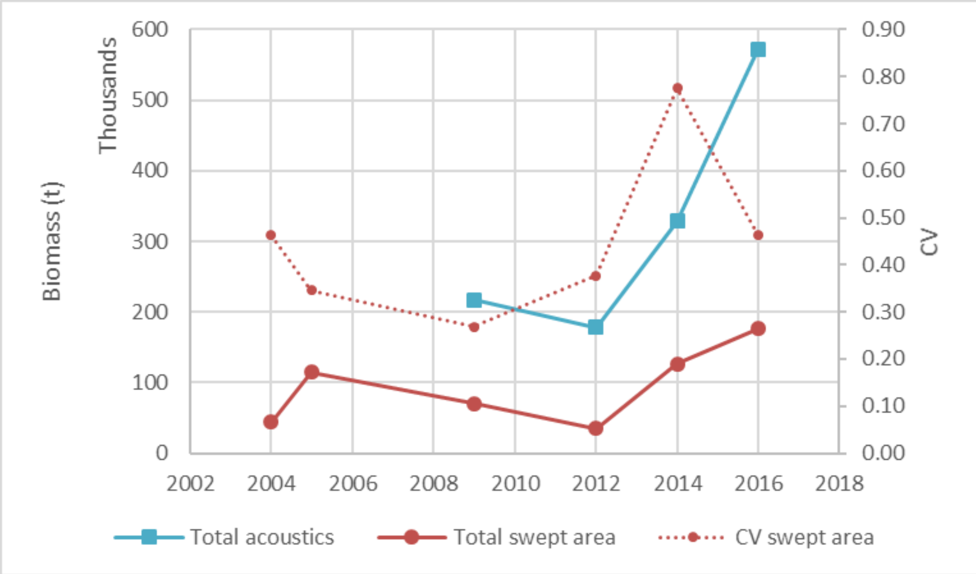


Figure 7.2.13. Estimated biomass for greater silver smelt for acoustic surveys in March–April 2009, 2012, 2014 and 2016 (for method see Harbitz, 2010), and bottom trawl swept area estimates from the same surveys and 2004 and 2005 in addition. Also shown is CV for the trawl estimates.

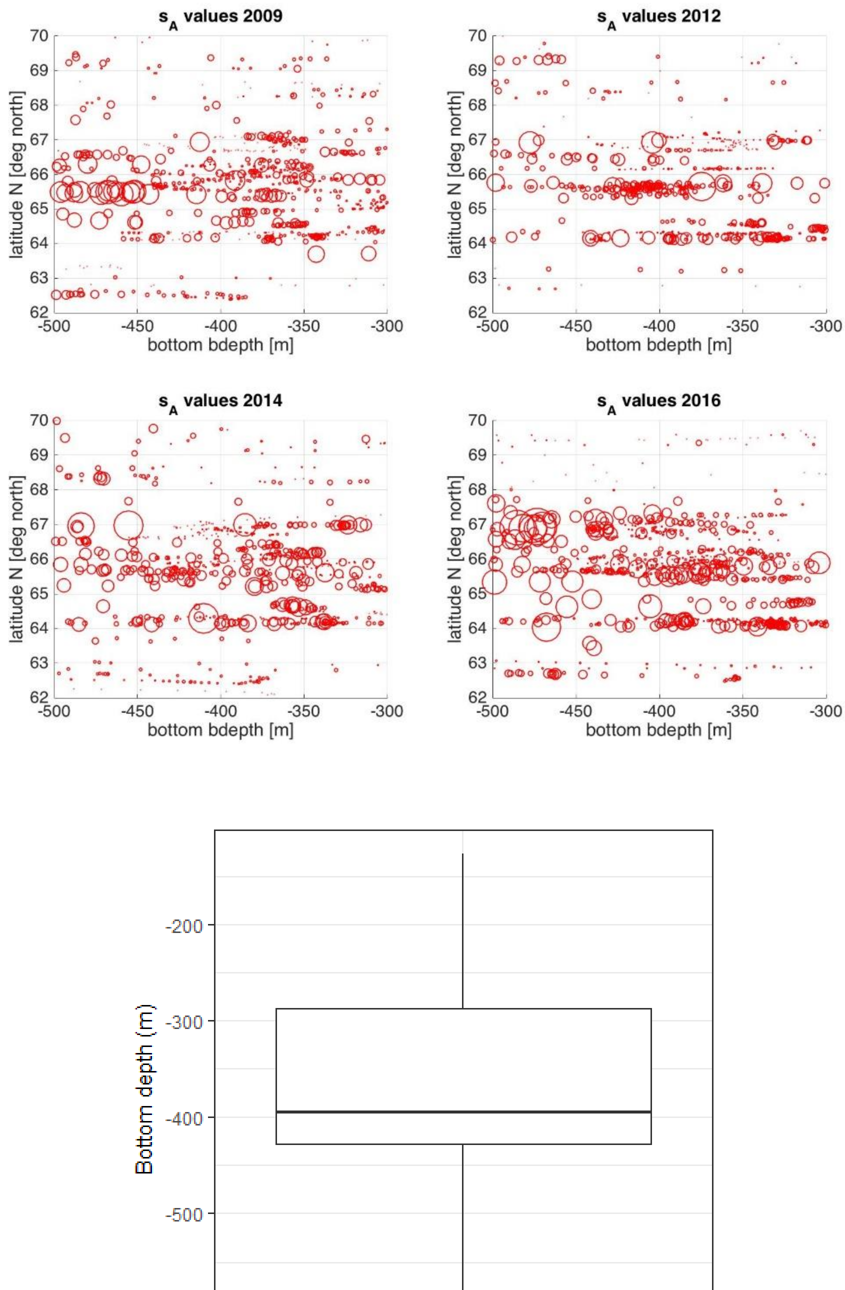


Figure 7.2.14. Upper panels: sA (1 nm. resolution) plots of acoustic Argentine registrations from the most abundant stratum in Egga South (southeast) during the scientific IMR cruises in 2009, 2012, 2014 and 2016. All circles are scaled equally with area proportional to the square root of sA-value. A considerably larger mean sA-value (180) was found in 2016 compared to 2009, 2012 and 2014 (107, 104 and 118, respectively). Lower panel: Boxplot showing depth at stations where catches were registered in 2016 according to logbooks.

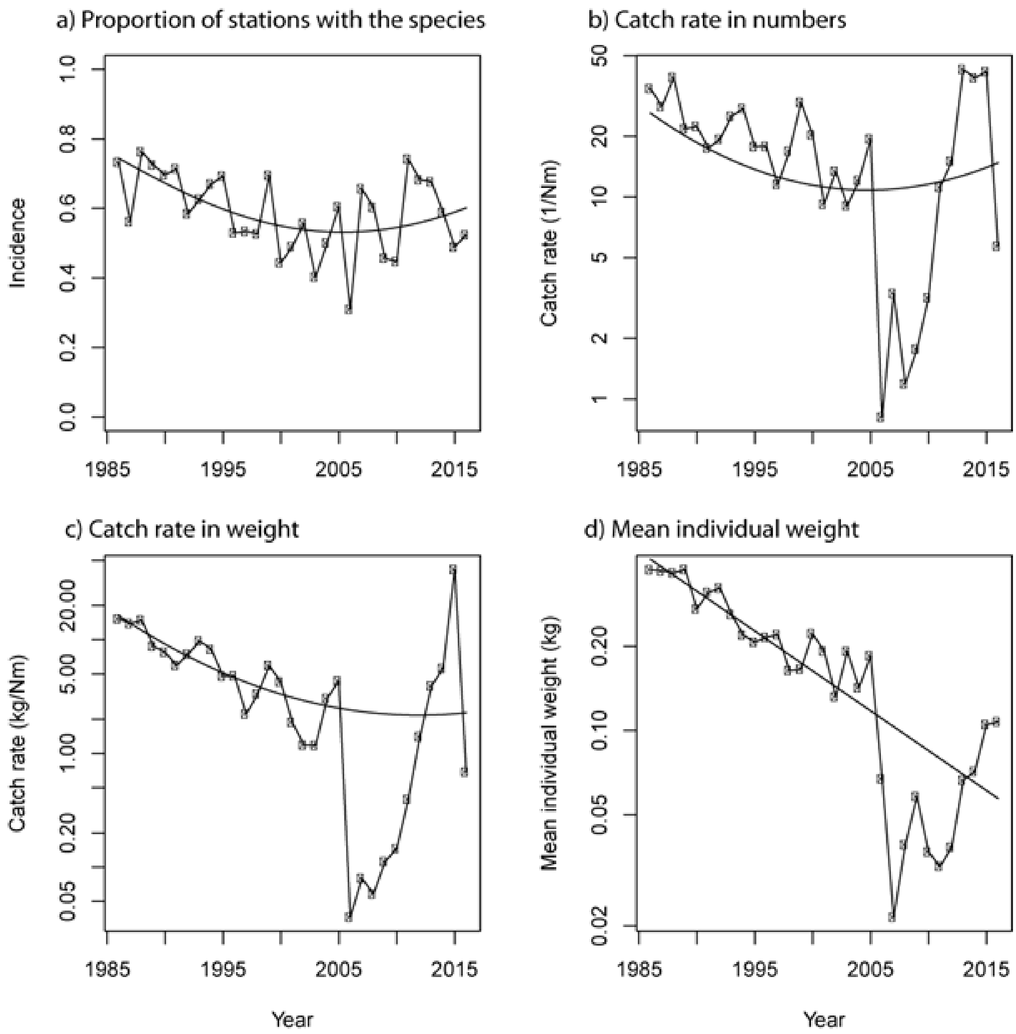


Figure 7.2.15. Greater silver smelt in 1, 2, 3 and 4. Annual estimates of incidence, mean catches in numbers and weight, and mean lengths derived from the annual Norwegian shrimp survey in 3.a and eastern parts of 4.a, 1985–2016 (note logarithmic scales). Superimposed on the means are fitted trend lines, allowing for linear and quadratic effects, using quasi-Poisson regression. (from Hallfredsson *et al.*, 2017, WD16 WGDEEP).

7.3 Greater silver smelt (*Argentina silus*) in Division 5.a

7.3.1 The fishery

Greater silver smelt is mostly fished along the south and southwest coast of Iceland, at depths between 500 and 800 m. Greater silver smelt has been caught in bottom trawls for years as a bycatch in the redfish fishery. Only small amounts were reported prior to 1996 as most of the greater silver smelt was discarded. However, discarding is not considered significant because of the relatively large mesh size used in the redfish fishery. Since 1997, a directed fishery for greater silver smelt has been ongoing and the landings have increased significantly (Table. 7.3.1).

7.3.1.1 Fleets

Since 1996 between 20 and 39 trawlers have annually reported catches of greater silver smelt in 5.a (Table 7.3.1). The trawlers participating in the greater silver smelt fishery also target redfish (*Sebastes marinus* and *S. mentella*) and to lesser extent Greenland halibut and blue ling.

Number of hauls peaked in 2010, but the number of hauls have decreased since then in line with lower total catches. In most years between 70–90% of the greater silver smelt catches are taken in hauls were the species is more than 50% of the catch (Table 7.3.2).

Table 7.3.1. Greater silver smelt in 5.a. Information on the fleet reporting catches of greater silver smelt.

YEAR	NUMBER TRAWLERS	NUMBER HAULS	REPORTED CATCH	NO. HAULS WHICH GSS >50% OF CATCH	PROPORTION OF REPORTED CATCH IN HAULS WERE GSS >50%
1997	26	854	2257	384	0,846
1998	39	2587	11132	1968	0,955
1999	24	1451	4456	824	0,865
2000	23	1263	3491	643	0,827
2001	26	767	1577	255	0,715
2002	32	1134	3127	504	0,777
2003	30	1127	1965	253	0,538
2004	27	1017	2688	340	0,705
2005	30	1368	3520	361	0,732
2006	31	1542	3725	395	0,715
2007	26	1259	3440	461	0,759
2008	31	3143	8428	863	0,663
2009	34	3434	10233	1010	0,694
2010	36	4724	16280	1836	0,740
2011	34	3244	10155	973	0,723
2012	31	3334	9732	985	0,713
2013	31	2704	7192	618	0,651
2014	24	2336	6157	487	0,614
2015	24	1836	5312	334	0,600
2016	26	2090	5708	387	0,596
2017	21	1347	3878	241	0.593

7.3.1.2 Targeting and mixed fisheries issues in the Greater Silver Smelt fishery in 5.a

Mixed fisheries issues: species composition in the fishery

Redfish spp. (*Sebastus marinus* and *S. mentella*) are the main species when it comes to the mixed fishery encompassing greater silver smelt. Other species of lesser importance are Greenland halibut, blue ling and ling. Other species than these rarely exceed 10% of the bycatch in the greater silver smelt fishery in 5.a (Table 7.3.2).

Table 7.3.2. Greater silver smelt in 5.a. Proportional bycatch species composition where greater silver smelt was more than 50% of the total catch in a haul.

Year	Redfish		Greenland halibut	Ling	Blue ling	Other
	S. marinus	*S. mentella*				
1997	1,4	79	0,0	6,9	7,2	5,5
1998	5,3	77,9	0,0	3,6	6,4	6,8
1999	4	79,9	0,0	2,5	5,9	7,6
2000	4,8	71	0,2	0,3	9,7	14,1
2001	22,4	55,4	4,5	0,5	0,9	16,3
2002	16,9	74,2	0,4	1,2	4,0	3,2
2003	37,7	52	0,4	0,1	5,1	4,7
2004	25,1	68,4	0,7	0,1	0,9	4,8
2005	15,6	69,5	4,3	1,4	3,0	6,2
2006	28,8	59,8	1,4	0,9	1,0	8,1
2007	12,1	70,9	5,9	0,3	6,1	4,6
2008	26,7	60,8	2,8	1,2	5,0	3,4
2009	20,9	63,7	3,3	0,2	7,9	4,1
2010	16	63,7	2,0	0,9	6,4	11,1
2011	13,4	66,3	2,2	0,4	4,8	12,9
2012	8,9	67,5	1,3	0,2	7,5	14,5
2013	9,6	63,8	4,7	0,2	9	12,8
2014	2,4	78,3	2,8	0,3	5,5	10,7
2015	13,8	67,1	3,1	0,3	4,2	11,7
2016	10,9	73,5	5,5	0,2	2,8	7,1
2017	2.9	85.6	1.6	0.2	2.9	6.8

Spatial distribution of catches through time

Spatial distribution of catches in 1996–2017 is presented in Figures 7.3.1 and 7.3.2. With the exception of 1996, most of the catches have been from the southern edge of the Icelandic shelf. However, in recent years there has been a gradual increase in the proportion caught in the western area and even in the northwestern area. The reason for this is that the fleet focusing on redfish and Greenland halibut in more northern regions also takes a few hauls of greater silver smelt in the area (Figures 7.3.1 and 7.3.2).

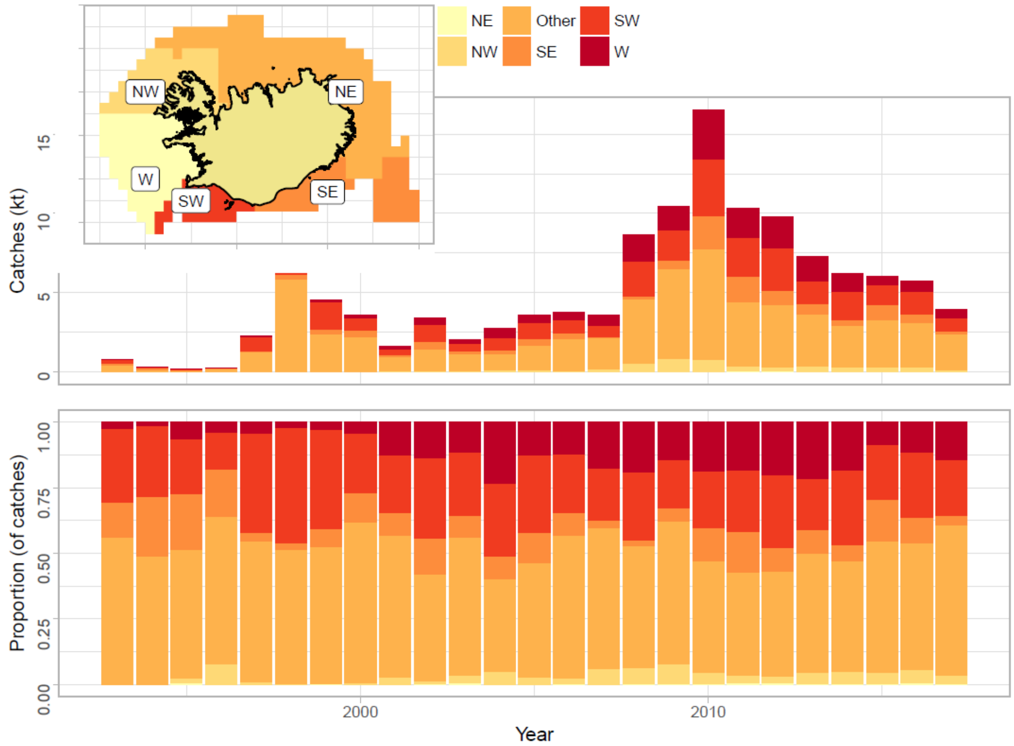


Figure 7.3.1. Greater silver smelt in 5.a. Catches defined by regions deeper than 400 m by year (See stock annex for details). Above are the catches on absolute scale and below in proportions.

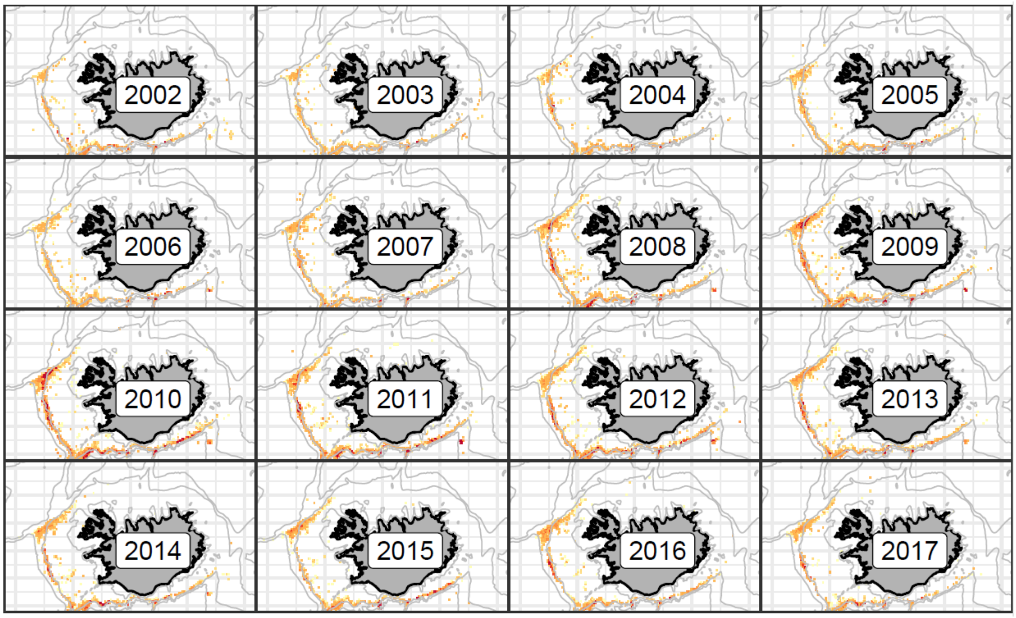


Figure 7.3.2. Greater silver smelt in 5.a. Spatial distribution of catches as reported in logbooks.

7.3.2 Landings trends

Landings of Greater Silver Smelt are presented in Table 7.3.1 and Figure 7.3.3. Since directed fishery started in 1997–1998, the landings increased from 800 t in 1996 to 13 000 t in 1998. Between 1999 and 2007 catches varied between 2 600 to 6 700 t. Since 2008 landings have increased substantially, from 4 200 t in 2007 to almost 16 500 t in 2010. In 2011 landings started to decrease due to increased management actions, and landings in 2017 amounted to approximately 4 300 tonnes.

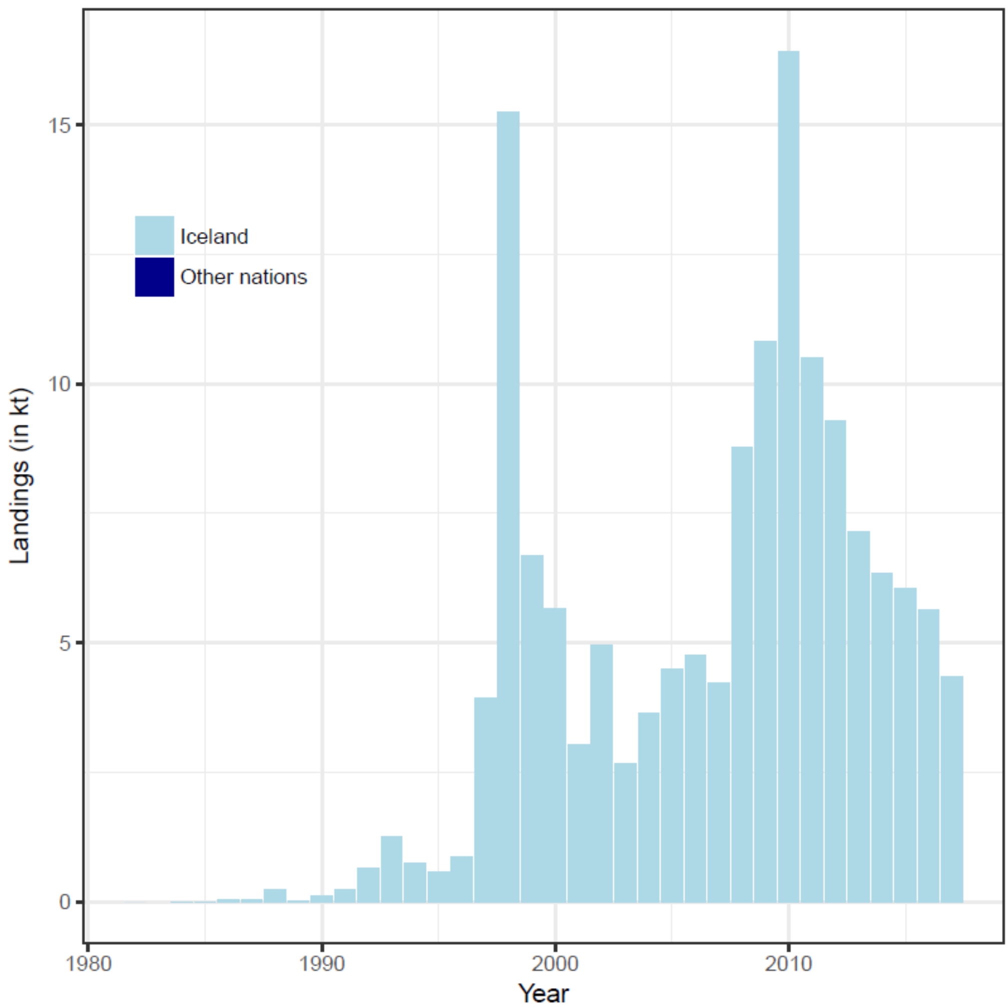


Figure 7.3.3. Greater silver smelt in 5.a. Nominal landings. 23 tonnes were landed by foreign vessels (England and Wales) in 1999, which is the only year of reported by foreign vessels.

7.3.3 ICES Advice

The ICES advice for 2018 is: Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 7 603 tonnes.

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

For this stock the F_{proxy} of 0.171 is applied (with no uncertainty cap) as a factor to the 2017 survey index biomass estimate of 44 462, resulting in catch advice of no more than 7 603 t. ICES does not implement the default rule as used for other data-limited stocks because the fishing mortality has changed significantly in the last two years.

7.3.4 Management

Before the 2013/2014 fishing year the Icelandic fishery was managed as an exploratory fishery subject to licensing since 1997. A detailed description of regulations on the fishery of greater silver smelt in 5.a is given in the stock annex.

The TAC for the 2013/2014 fishing year was set at 8 000 based on the recommendations of MRI using a preliminary Gadget model and the 2014/2015 fishing year the recommendation was to maintain the catches at 8 000 t. For the fishing year 2015/2016 it was also maintained at 8 000 t, but was 7 885 t for 2016/2017 and 9 310 t for 2017/2018.

7.3.5 Data available

7.3.5.1 Landings and discards

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

7.3.5.2 Length compositions

Table 7.3.3 gives the number of samples and measurements available for calculations of catch in numbers of Greater Silver Smelt in 5.a. Length distributions are presented in Figure 7.3.4.

7.3.5.3 Age compositions

Table 7.3.3 gives the number of samples and measurements available for calculations of catch in numbers of greater silver smelt in 5.a. Estimates of catch in numbers are given in Figure 7.3.5.

Table 7.3.3. 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. aged otoliths
1997	45	4863	28	1319	985
1998	141	14911	102	6018	890
1999	58	4163	44	2180	82
2000	27	2967	18	1011	113
2001	10	489	6	245	17
2002	21	2270	10	360	127
2003	63	5095	13	425	0
2004	34	996	7	225	84
2005	49	3708	14	772	0
2006	29	4186	13	616	465
2007	14	2158	8	285	272
2008	44	3726	39	1768	1387
2009	53	5701	36	1746	1387
2010	134	16351	68	3370	3120
2011	63	6866	40	1953	1774
2012	35	3891	23	1094	405
2013	47	4925	34	710	704
2014	32	4709	16	350	340
2015	11	1275	8	221	217
2016	45	5880	13	285	184
2017	20	2927	12	250	206

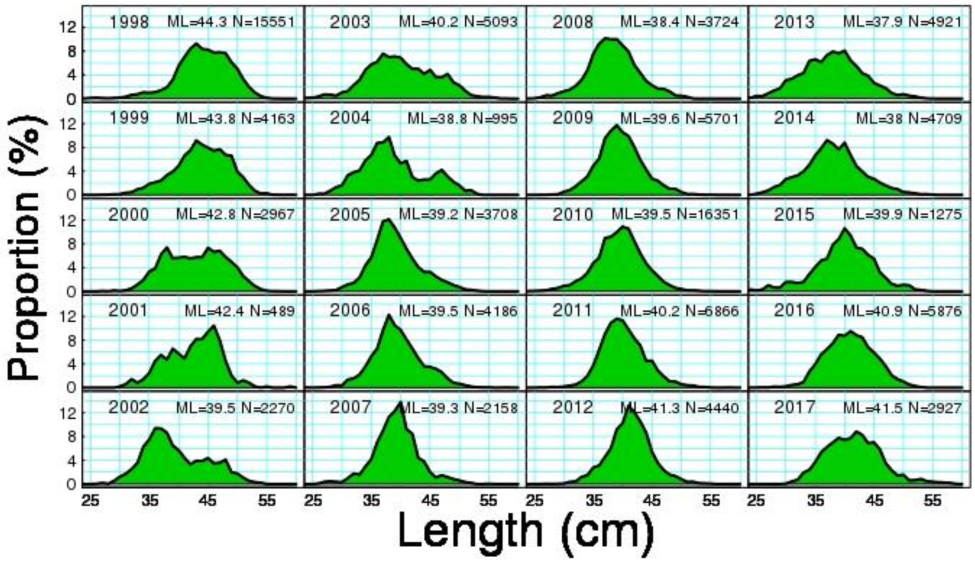


Figure 7.3.4. Greater silver smelt in 5.a. Length distributions from commercial catches.

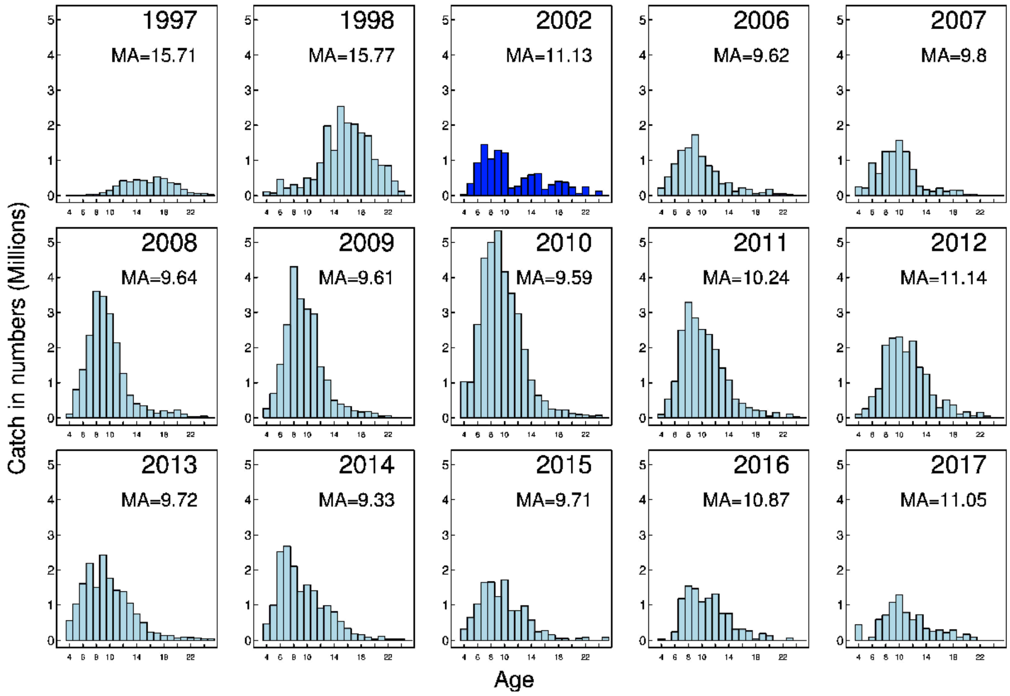


Figure. 7.3.5. Greater silver smelt in 5.a. Catch in numbers. Estimates for 2002 are based on limited number of aged otoliths (See Table 7.3.3).

7.3.5.4 Weight-at-age

No marked changes can be observed in mean weight-at-age from commercial catches between 1997–1998 and 2006–2013.

7.3.5.5 Maturity and natural mortality

Estimates of maturity ogives of greater silver smelt in 5.a were presented at the WKDEEP 2010 meeting for both age and length (WKDEEP 2010, GSS-04) using data collected in the Icelandic autumn survey (See stock annex for details). Males tend on average to mature at a slightly higher age or at 6.5 compared to 5.6 for females but at a similar length as females 35.3 cm. Most of the greater silver smelt caught in commercial catches in 5.a are mature.

No information exists on natural mortality of greater silver smelt in 5.a.

7.3.5.6 Catch, effort and research vessel data

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

At WKDEEP 2010 a glm cpue series was presented (WKDEEP 2010, GSS-05), however because of strong residual patterns the group concluded that the glm-cpue series was not suitable to use as an indicator of stock trends.

The cpue is not considered to represent changes in stock abundance as the fishery is mostly controlled by market factors, oil prices and quota status in other species, mainly redfish.

Icelandic survey data

Indices

The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, gives trends on fishable biomass of many exploited stocks on the Icelandic fishing grounds. In total, about 550 stations are taken annually at depths down to 500 m. The survey area does not cover the most important distribution area of the greater silver smelt fishery in 5.a and is therefore not considered representative of stock biomass. The survey may be indicative of recruitment; however, the data have not been explored in sufficient detail to be used for this purpose. In addition, the autumn survey was commenced in 1996 and expanded in 2000. A detailed description of the autumn groundfish survey is given in the stock annex for greater silver smelt in 5.a. The survey is considered representative of stock biomass of greater silver smelt since it was expanded in 2000. Figure 7.3.6 gives trend in biomass and juvenile abundance for the spring survey in 1985 to 2017 and for the autumn survey in 2000 to 2016. Due to industrial action in 2011 the autumn survey was cancelled after about one week of survey time. Greater Silver Smelt is among the most difficult demersal fish stocks to get reliable information on from bottom-trawl surveys. This is in large part due to the fact that most of the greater silver smelt caught in the survey is taken in few but relatively large hauls. This can result in very high indices with large variances particularly if the tow-station in question happens to be in a large stratum with relatively few tow-stations. Therefore, the index is winsorized when used in the advisory procedure (See stock annex for details). A comparison of indices, with or without winsorization are shown in Figure 7.3.7.

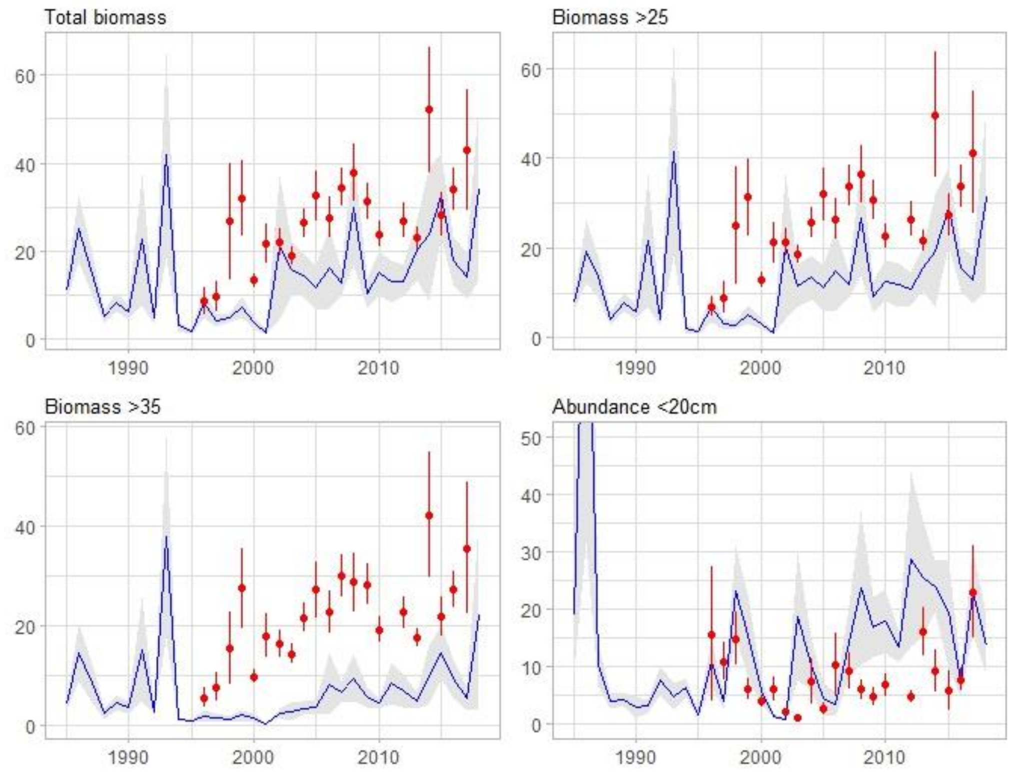


Figure 7.3.6. Greater silver smelt in 5.a. Indices from the Icelandic spring survey (black lines and shaded area) and from the autumn survey (dots and vertical lines). Vertical lines and shaded area represent +/- 1 standard error.

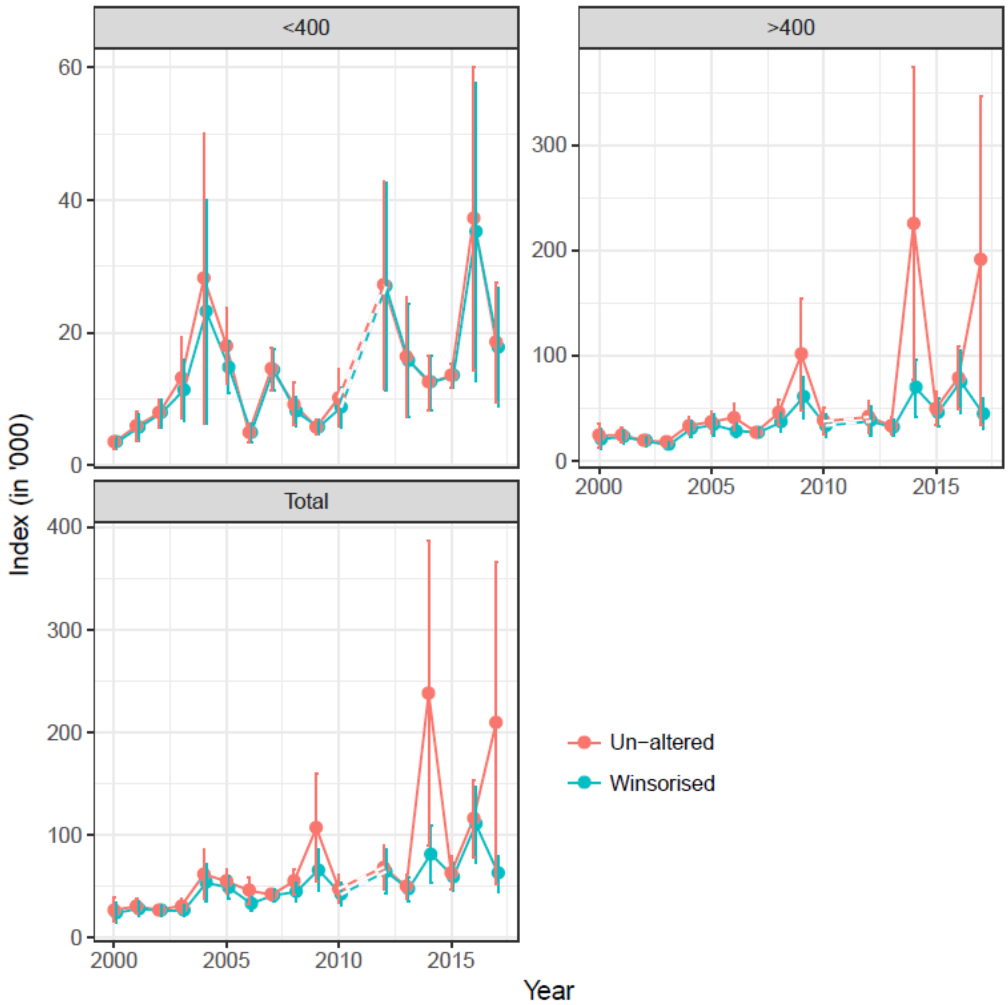


Figure 7.3.7. Greater silver smelt in 5.a. Index from the Icelandic autumn survey, divided by depth. The line colour indicates the biomass index used, either un-altered or Winsorized (see text for further details).

7.3.6 Data analyses

Landings and sampling

Spatial distribution of catches did not change markedly between 2015 and 2016 and fishing for greater silver smelt in the NW area seems to have stopped (Figures 7.3.1 and 7.3.2). Landings of greater silver smelt increased rapidly from 2007 to 2010 when they peaked at around 16 000 tonnes, since then they have decreased to around 5646 tonnes in 2016 (Figure 7.3.3 and Table 7.3.4). The decrease in catches is the result of increased vigilance by the managers to constrain catches to those advised and also lesser interest by the fleet in the stock. At the same time mean length in catches decreased from around 44 cm in 1998 to 38–40 in 2008 to 2011. However, there is a slight increase in mean length in 2012 which can also be seen in recent years (Figure 7.3.4). A similar continuous downward trend in mean age in the commercial catches is also observed. Mean age in the fishery has decreased since the late nineties from around 16 to around 10 in 2006 to 2011. 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 7.3.5). The reason for this change is not known as there is no marked difference in the spatial distribution of the fishery.

Surveys

As mentioned above, greater silver smelt is a difficult species to survey in trawl surveys and the indices derived from the both the spring and autumn surveys have high CVs. Occasional spikes in the indices without any clear trend characterize the spring survey biomass indices. The only thing that can be derived from the spring survey is that the biomass indices (total and >25 cm), in 1985–1993 and again from 2002 to 2017 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 with the 2012 estimate at the highest level since 1986 (Figure 7.3.6).

The observed trends in the biomass indices from the autumn survey have a considerably different trend than those observed in the spring survey (Figure 7.3.6). According to the autumn survey, biomass increased more or less year on year from 2000 to 2008 but then decreased in 2009 and 2010. The total biomass index in the autumn survey showed slight variations until 2014 when the index increased to the highest value observed.

There is a clear gradient in mean length of greater silver smelt with depth, larger fish being in deeper water. Also, 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. As noted in the section above the Winsorized index appears to be less sensitive to the few large hauls in the 2009 and 2014 survey years (Figure 7.3.7).

F_{proxy}

Changes in relative fishing mortality (F_{proxy} = Yield / Survey biomass at depths greater than 400 m) are presented in Figure 7.3.8 and Table 7.3.5. According to the graph, F_{proxy} was relatively stable in 2004 to 2006 but then increased slowly from 2006 to 2008. This was mainly driven by increases in catches. The decrease in 2009 is the result of a very high value of the index in that year but the decrease between 2010 and 2012 is due to decrease in catches as the index was at similar levels between the two years (Figure 7.3.7).

Figure 7.3.8. Greater silver smelt in 5.a. Changes in relative fishing mortality (F_{proxy}). The index used is the >400 m Winsorized index from the Icelandic autumn survey (see text for further details).

Analytical assessment

No analytical assessment presented this year, but it was planned to present an exploratory analytical assessment next year in preparation for a benchmark proposed for 2020.

7.3.7 Comments on the assessment

The assessment was conducted according to the stock annex.

7.3.8 Management considerations

Exploitation of greater silver smelt has been reduced in recent years, coming down from a relatively high level in 2010, to levels lower than the average exploitation rate in the reference period.

7.3.9 Application of MSY proxy reference points (ToR h)

In the ICES response to the: EU request to provide a framework for the classification of stock status relative to MSY proxies for selected category 3 and category 4 stocks in ICES Subareas 5 to 10. ICES set the F_{MSY} proxy for greater silver smelt in 5.a as 0.171 but did not set a B_{MSY} trigger proxy for the stock. This year WGDEEP re-ran the length-based indicator model used to answer the request.

Length-Based Indicator (LBI)

Data and settings

In the LBI-model model run presented here length-at-maturity (L_{mat}) was set at 35.95 cm and Linf at 42.68. These values were obtained from data collected in the Icelandic autumn survey. The length distributions came from commercial catches from 2004 to 2017. Mean weight at length was estimated from a length–weight relationship from the Icelandic autumn survey (Figure 7.3.9). The length bin used was 2 cm.

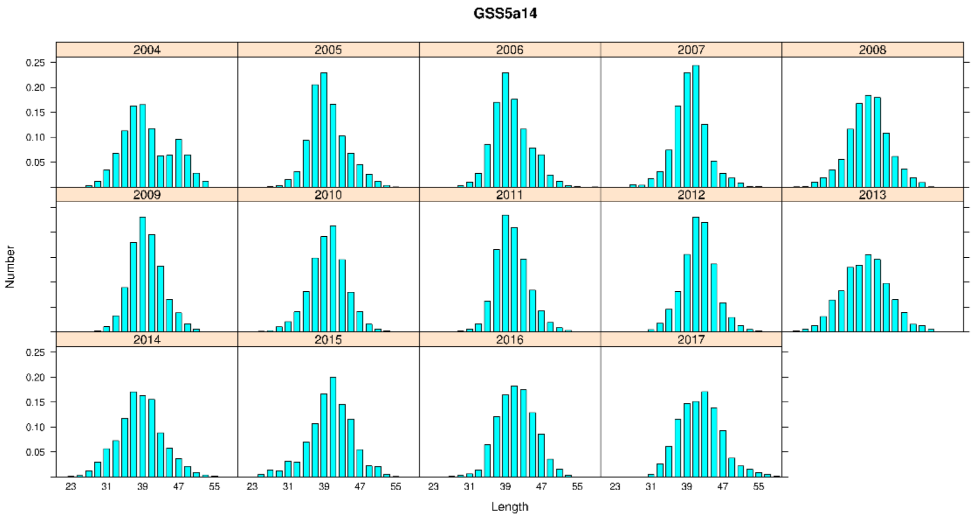


Figure 7.3.9. Length distributions used for estimating LBI.

Results

According to the results, greater silver smelt in 5.a is being harvested at a sustainable level in the period as $L_{mean}/L_{F=M}$ is always larger than 1 (Table 7.3.6 and Figure 7.3.10).

Table 7.3.6. LBI results for 2015 to 2017.

Traffic Light Indicators

	Conservation				Optimum Yield	MSY
	L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	$L_{mean}/L_{F=M}$
	>1	>1	>0.8	>30%	~1(>0.9)	≥ 1
2015	0.75	1.03	1.02	84%	1.23	1.23
2016	1.03	1.06	1.01	91%	1.29	1.05
2017	1.03	1.06	1.08	91%	1.31	1.07

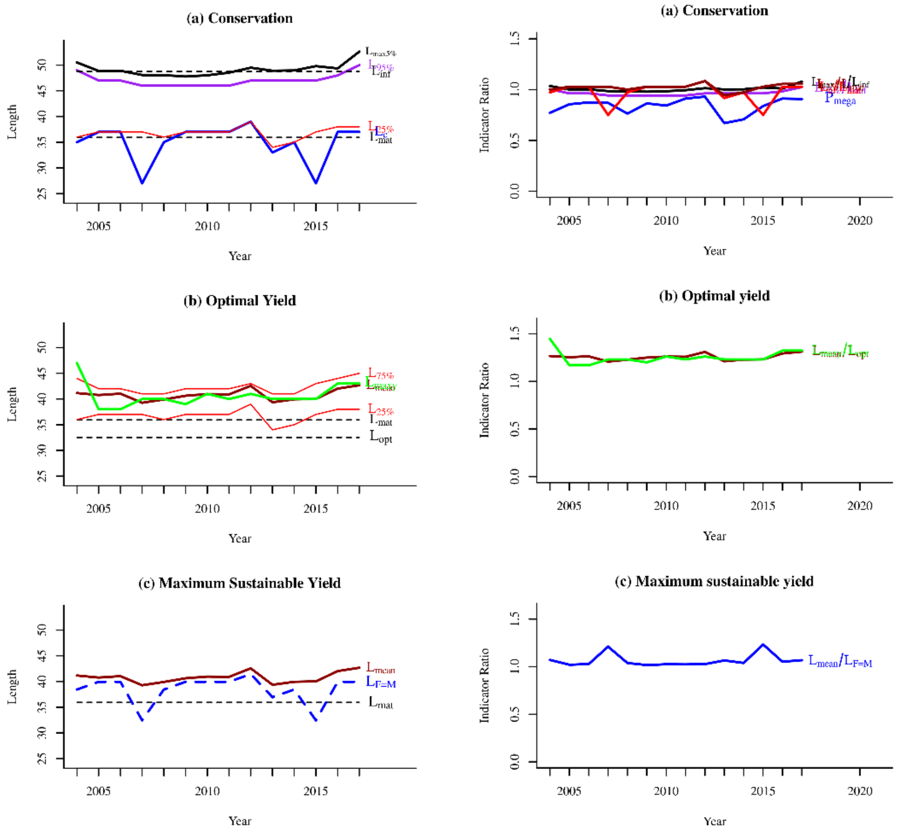


Figure 7.3.10. Results of LBI for commercial length distributions from 5.a.

7.4 Greater silver smelt (*Argentina silus*) in 5.b and 6.a

7.4.1 The fishery

The target fisheries for the Divisions 5.b and 6.a management unit are mainly conducted by Faroese and European trawlers. In 2017, the catches in 5.b were mostly taken by Faroese trawlers (99%) while the catches in 6.a were mostly taken by European trawlers (72%) and the remainder by Faroese trawlers (28%, inside the Faroese EEZ). In earlier years (2015–2016) Iceland, and Russia also caught some quantities of silver smelt in division 5.b (Table 7.4.1).

Historically, greater silver smelt were only taken as bycatch in shelf-edge deep-water fisheries and either discarded or landed in small quantities. Targeted fisheries for greater silver smelt in Faroese waters did not develop until the mid-1990s and the early 2000s for division 6.a.

In 2017 the (preliminary) landings in Faroese waters in 5.b and 6.a were mainly taken by three pairs pair trawlers deploying bentho-pelagic trawls (9799 t in 5.b and 1934 t in 6.a, total 11 733 t) (Table 7.4.1 and Figure 7.4.1).

The greater silver smelt fishing grounds in Faroese waters from the mid-1990s to 2007 were located north and west on the Faroe Plateau and around Faroe Bank/Lousy Bank at depths between 300 and 700 meters. Since 2008, the Faroese fishery has extended the fishing grounds to include the area around the Wyville-Thomson Ridge south of the islands (Figure 7.4.2). Since 2012 around 50% of the Faroese catches were fished on the Wyville-Thomson Ridge (in Divisions 5.b and 6.a, inside the Faroese EEZ).

The European fisheries on silver smelt mostly takes place on the shelf edge within divisions 6a, 5.b and 4.a. New information from the self-sampling program carried out by the European fisheries (Pelagic Freezer-trawler Association, PFA) has this year been presented to the Working Group (Pastoors, 2018). The self-sampling program consists of historical information derived from skipper's notes (2002-2016) and new information collected as part of the research program within the PFA. A preliminary overview of catch rates of silver smelt (both *Argentina silus* and *Argentina Sphyraena*) from these fisheries is shown in Figure 7.4.3.

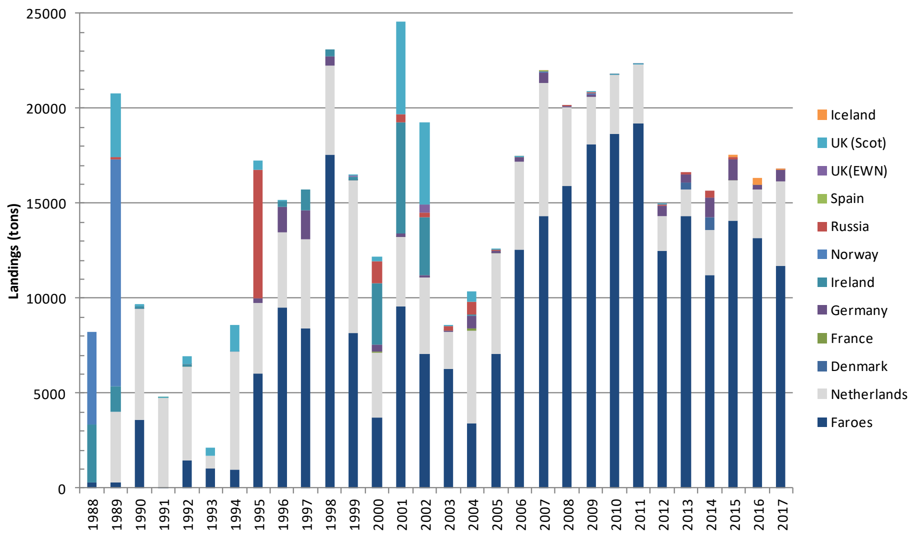


Figure 7.4.1. Greater silver smelt in 5.b and 6.a. Total landings of greater silver smelt in 5.b and 6.a by countries.

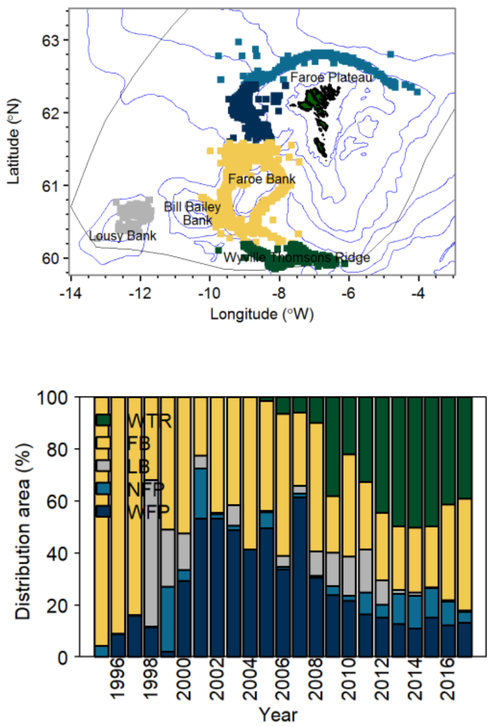


Figure7.4.2. Greater silver smelt in 5.b. Spatial distribution of the Faroese directed trawl fishery of greater silver smelt (upper Figure) and distribution of the greater silver smelt catch divided into five main areas in Faroese waters (lower Figure). WFP- west of the Faroe Plateau, NFP- north of the Faroe Plateau, LB- Lousy Bank, FB- Faroe Bank, WTR- Wyville Thomson Ridge.

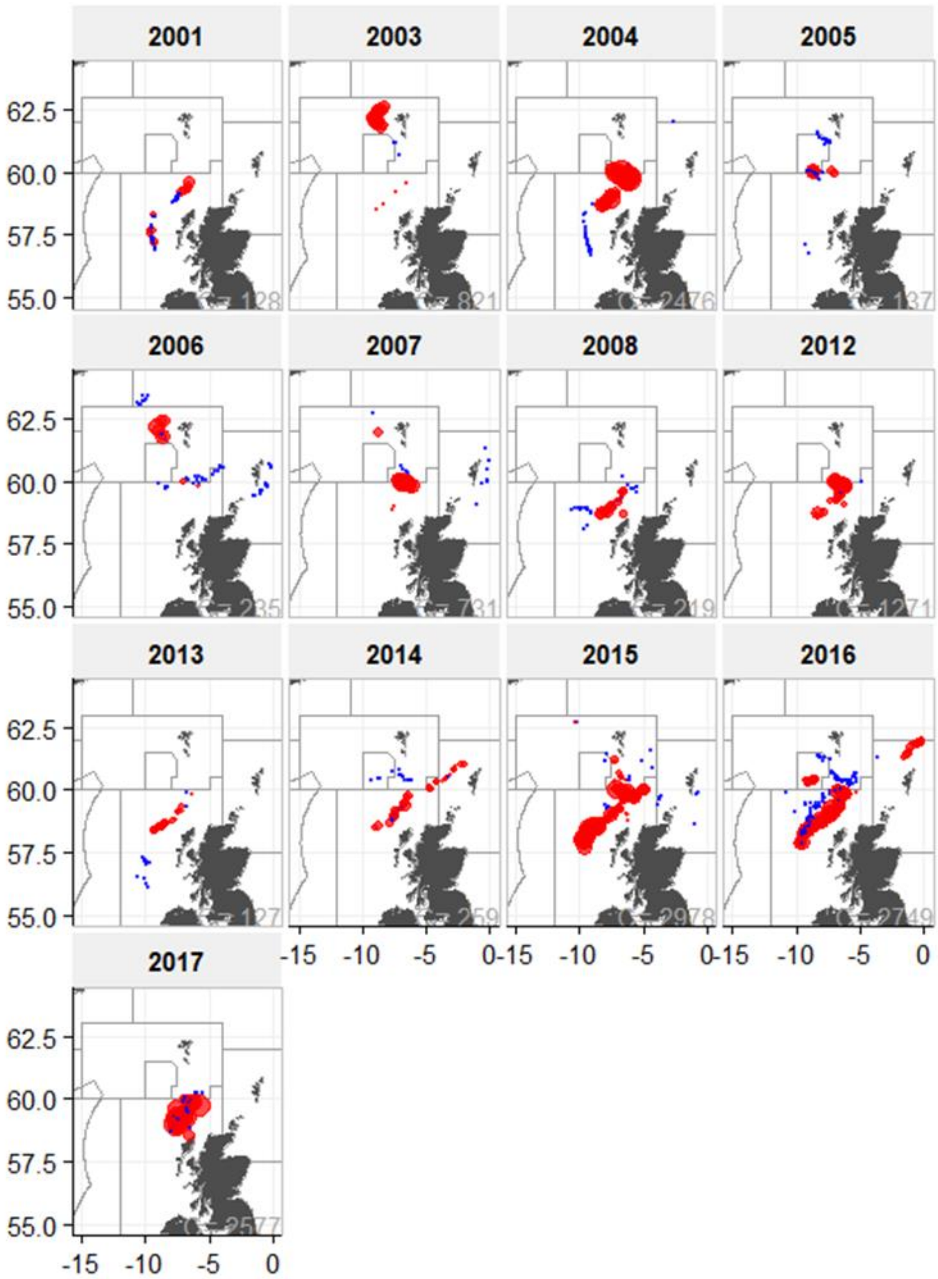


Figure 7.4.3. Greater silver smelt in 5.b and 6.a. Catch rates of Argentines in PFA self-sampled fisheries. Total self-sampled catch (C) in tonnes. Blue dots are zero catches for argentines (targeted to other species, mostly blue whiting)

7.4.2 Landing trends

Landings in Division 5.b increased rapidly from 2004 (5300 t) to 2006 (12 500 t) and further increased with landings in 2011 being 15 600 t (Table 7.4.2). Since then landings have been around 10–13 thousand tonnes, in 2017 the preliminary catch was 9871 t. The recent reduction in greater silver smelt catches in 5.b is a combined effect of the vessels targeting mackerel rather than greater silver smelt, the introduction of Faroese quotas, and a shift in fishing area to include areas in 6.a inside the Faroese EEZ.

The landings in 6.a increased and reached a maximum of 14 466 t in 2001; then decreased again and have been between 5000 and 7500 t since 2004. Preliminary landings in 2017 were 6940 t.

7.4.3 ICES Advice

ICES advises that when the precautionary approach is applied, landings should be no more than 12 036 tonnes in each of the years 2018 and 2019. Discarding is known to take place, but ICES cannot quantify the corresponding catches.

7.4.4 Management

The EU introduced TAC management for silver smelt in 2003 and sets a TAC for the EU fishery in areas 5, 6 and 7 (Separate EU TACs exist for silver smelt in areas 1 and 2, and in areas 3a and 4). For 2015 and 2016 the EU TAC was set to the same as in previous years (5, 6, 7 = 4316 tons). In 2017, the EU TAC was 3884 tons in areas 5, 6 and 7. In 2018, the EU TAC is 4661 tons in areas 5, 6 and 7.

In the period from 2010–2013, the Faroese greater silver smelt fishery was managed by an agreement between the Faroese fleet that were licensed to conduct direct greater silver smelt fishery and the Faroese authorities, guided by the stock assessment and scientific advice of Faroe Marine Research Institute. The agreement was that total annual landings should not exceed 18 000 tonnes in the Faroese EEZ. There was no advice from ICES that was specific for the Faroese greater silver smelt component. Regulation was through a general regulation of fishing days for the trawler group. There were also limitations in e.g. minimum size, bycatch, mesh size and fishing area restrictions.

In 2014, the Faroese authorities introduced species-specific TAC for greater silver smelt applicable for Faroese trawlers fishing inside the Faroese EEZ. Six trawlers had licences to target greater silver smelt, the technical measures continued to apply and the TAC are presented in the table below. The reason for this reduction in TAC was the decrease in the biomass index as estimated by the exploratory assessment of greater silver smelt in Faroese waters.

The text table below summarizes the ICES advice for silver smelt and the TACs that have been set by the Faroese authorities and the European Union. The summed TACs of the Faroe Islands and EU exceed the ICES advice for the years where advice has been provided for this stock.

Year	Area	2014	2015	2016	2017	2018	2019
ICES advice	5b, 6a	*	*	10030	10030	12036	12036
TAC Faroe Islands	5b, 6a	16000	14400	13000	11500	11700	
TAC EU	5,6,7 1)	4316	4316	4316	3884	4661	
Summed TACs		20316	18716	17316	15384	16361	

1) The EU TAC applies to all of areas 5, 6 and 7. However, only minor catches have been taken outside of divisions 5.b and 6.a.

7.4.5 Data available

Data on length, round weight and age were available for greater silver smelt from the Faroese and European landings. There were also catch and effort data from logbooks for the Faroese trawlers.

From the two annual Faroese groundfish surveys on the Faroe Plateau, especially designed for cod, haddock and saithe, biological data (mainly length and round weight) as well as catch and effort data were available for greater silver smelt. In addition, a deepwater survey has been conducted since 2014 which cover the greater silver smelt fishery areas.

7.4.5.1 Landings and discards

Landings data were presented by area and countries (Tables 7.4.1 and 7.4.2, Figure 7.4.1). Landings were available for all relevant fleets.

Discarding is banned inside the Faroese EEZ and all catches are assumed to be landed. In the European Union, the landing obligation for pelagic fisheries entered into force from 2015 onwards. Catches of all species caught during pelagic fisheries are to be landed, except for protected species which need to be discarded. The landing obligation will apply to EU demersal fisheries from 2019 onwards.

There was information in InterCatch and from other sources on discards from non-Faroese fisheries on this management unit (Table below), but bycatches are assumed generally to be landed.

However, in Subareas 6 and 7 greater silver smelt can be a very significant discard of the trawl fisheries on the continental slope, particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004). New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain, so in 2014–2015 there appears to have been no Spanish discards of this species in Subarea 6 (only in 7).

Based upon on-board observations from EU data collection framework (DCF) sampling, the catch composition of the French mixed trawl fisheries in 5.b, 6 and 7 include 5.3% of greater silver smelt, based upon data for year 2011 (Dubé *et al.*, 2012). This species were discarded in that fishery; it represents 25.3% of the discards. Raised to the total landings from that fishery an estimate of 280 t of discarded greater silver smelt was estimated for 2011. Based upon similar level of the fishery in 2010–2012 this figure was considered to apply also to recent years. The discards in 2014–2016 were mainly in Division 6.a and it was from the French and Scottish deep-water fisheries (data from WGDEEP and InterCatch) (table below).

The landings statistics are regarded as being adequate for assessment purposes.

	Area 5.b		Area 6.a			5.b and 6.a	
Year	Germany	France	Germany	Scotland	France	Total	% landings
2014	28		92	653	808	1581	10.1
2015				109	161	270	1.5
2016		12		1451	200	1663	10.2
2017		31		14	217	262	1.6

7.4.5.2 Length compositions

There are length distributions of commercial catches from Faroese commercial trawl catches in 5.b (Figure 7.4.4) and from the Russian commercial bottom trawl catches in the Faroese Fishing Zone (Figure 7.4.5). In addition, length measurements from the Dutch fishery in 6.a were available (Figure 7.4.6).

Length distributions from the Faroese spring- and summer groundfish surveys on the Faroe Plateau in 5.b are presented in Figures 7.4.7 and 7.4.8.

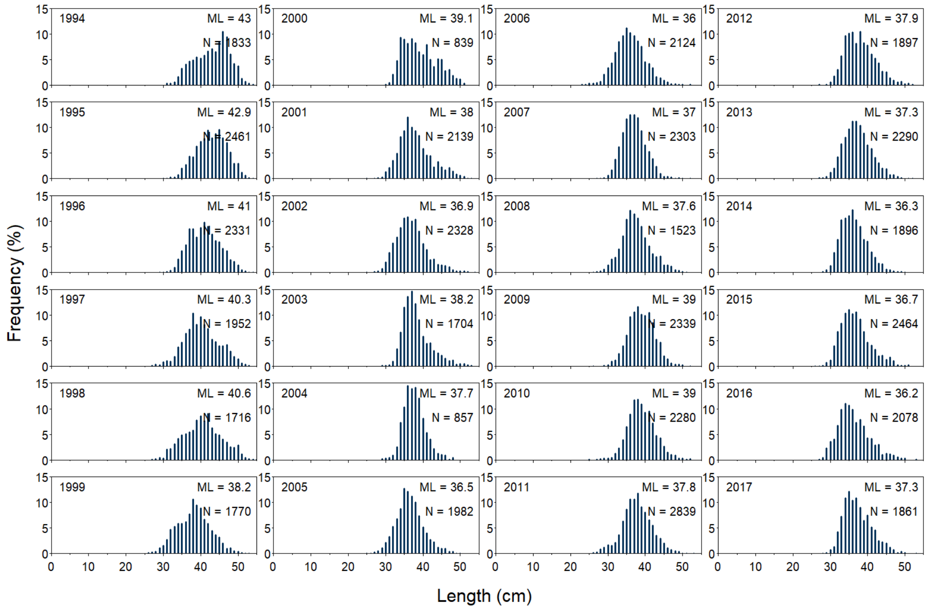


Figure 7.4.4. Grater silver smelt in 5.b. Length distributions of greater silver smelt in the Faroese landings. ML= mean length (cm).

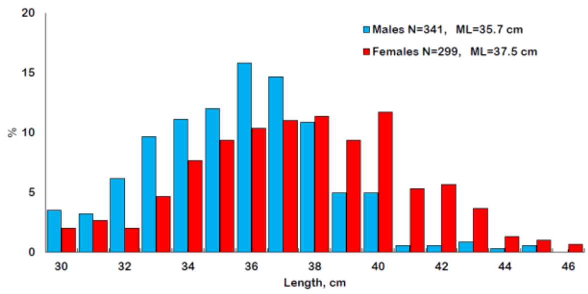


Figure 7.4.5. Greater silver smelt in 5.b. Length composition of greater silver smelt from Russian commercial trawl catches in the Faroese EEZ in April 2017 (Aleksandrov, WD WGDEEP 2018). ML= mean length (cm).

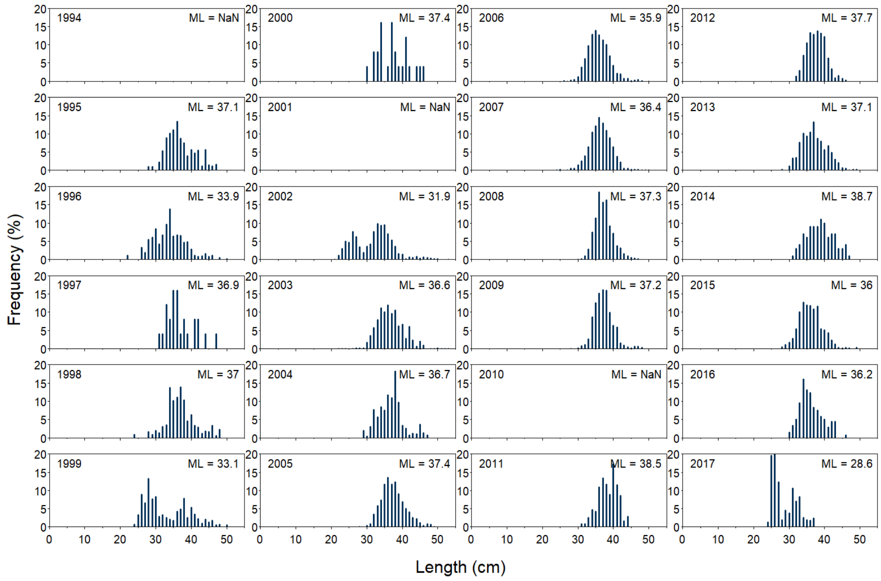


Figure 7.4.6. Greater silver smelt in 6.a. Length composition of greater silver smelt from the Dutch trawl catches in Division 6.a (data from InterCatch). ML= mean length (cm).

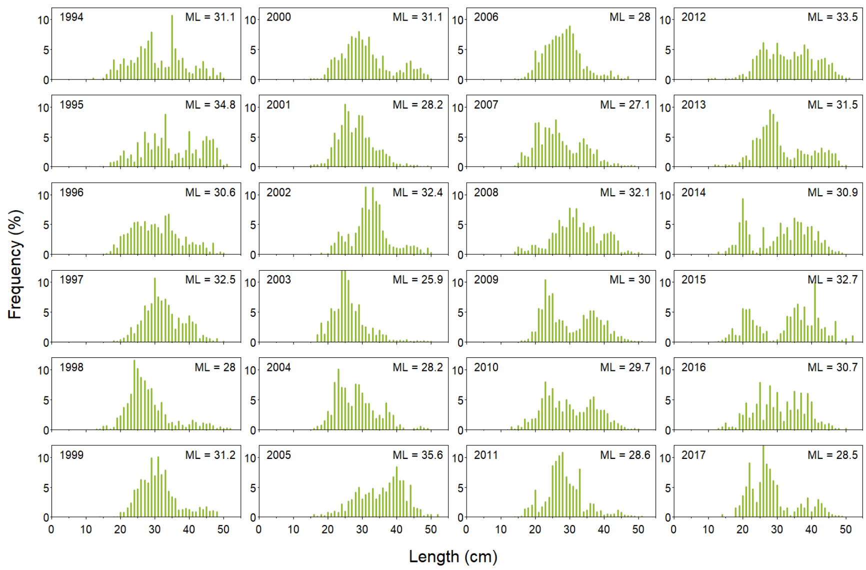


Figure 7.4.7. Greater silver smelt in 5.b. Length distribution from the Faroese spring survey with mean length (ML) and number of calculated length measures (N). Greater silver smelt is sampled from a subsample of the total catch, so the values are multiplied to total catch.

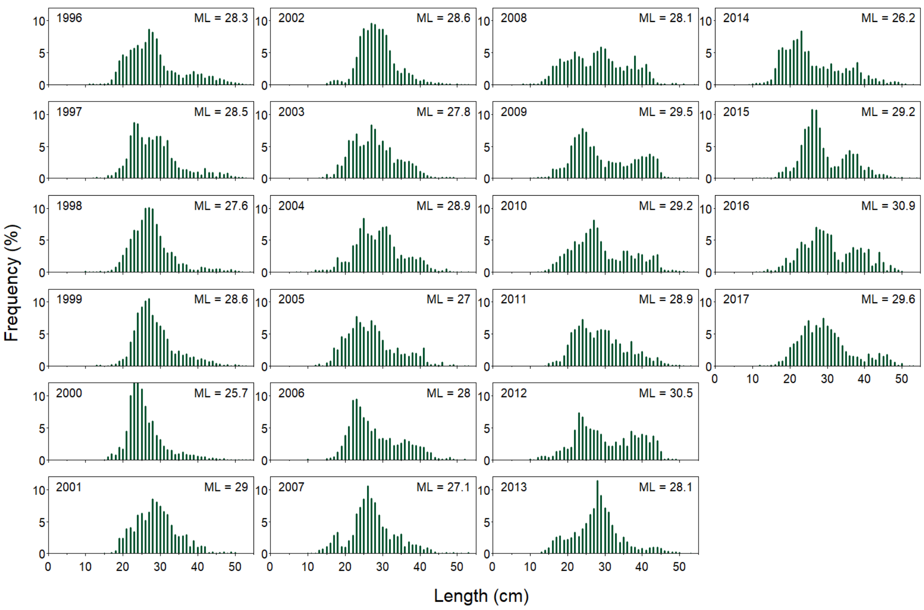


Figure 7.4.8. Greater silver smelt in 5.b. Length distribution from Faroese summer survey with mean length (ML) and number of calculated length measures (N). GSS is sampled from a subsample of the total catch, so the values are multiplied to total catch.

7.4.5.3 Age compositions

Age compositions from Faroese landings in Faroese waters are presented in Figure 7.4.9 and these were used in the exploratory assessment. In addition, age data are available from the Dutch fishery in Division 6.a in some years.

There are also age data of greater silver smelt from the Faroese groundfish surveys in Division 5.b.

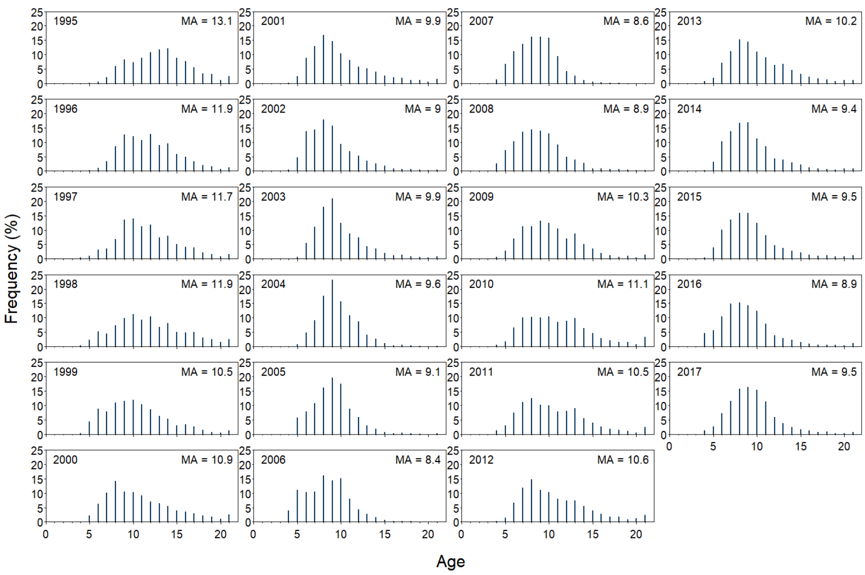


Figure 7.4.9. Greater silver smelt in 5.b. Age distribution used in the exploratory assessment in 5.b from commercial pair trawlers with mean age (MA) 1995–2017.

7.4.5.4 Weight-at-age

Weight-at-age data of greater silver smelt from the Faroese commercial trawl fisheries are presented in Figure 7.4.10 and these were used in the exploratory assessment. In addition, data were also available from the Dutch fishery in Division 6.a in some years (Figure 7.4.17).

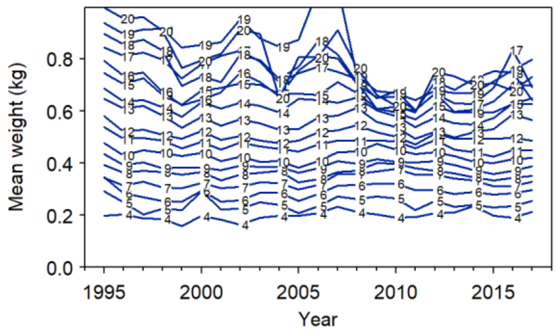


Figure 7.4.10. Greater silver smelt 5.b. Mean weight-at-ages 4–21+ of greater silver smelt in the commercial catch.

7.4.5.5 Maturity and natural mortality

Maturity of greater silver smelt from Russian commercial trawl catches in the Faroese Fishing Zone in April 2017 are shown in Figures 7.4.11. Most of the greater silver smelt caught in commercial catches in Division 5.b is mature (Ofstad, WD14 WGDEEP 2017).

No new data on natural mortality were presented. Natural mortality was set to 0.1 in the exploratory assessment (stock annex).

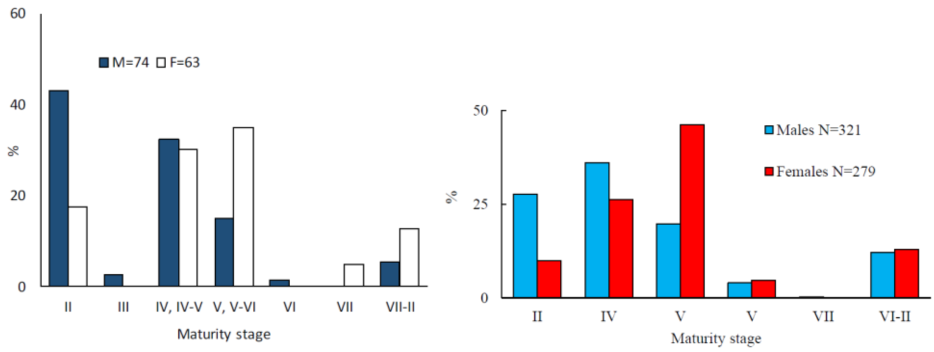


Figure 7.4.11. Greater silver smelt in 5.b. Maturity of Greater silver smelt from commercial trawl catches in the Faroese EEZ in April 2017 (Aleksandrov, WD WGDEEP 2018).

7.4.5.6 Catch, effort and research vessel data

A standardized cpue series from commercial trawlers targeting greater silver smelt in Faroese waters (Division 5.b) is shown in Figure 7.4.12. In addition, to investigate sequential depletion the cpue series for the five main fishing areas in Faroese EEZ are compared in Figure 7.4.12.

Cpue indices for greater silver smelt from the annual Faroese groundfish surveys for cod, haddock and saithe in Division 5.b are shown in Figure 7.4.13. Comparison of the cpue from the commercial fishery and the summer groundfish survey are shown in

Figure 7.4.13. Density (mean kg/h for the whole survey period) and spatial distribution from the same survey is shown in Figure 7.4.14. It has to be noted that these surveys have very few stations (<5) deeper than 500 m and are therefore only likely to cover the juveniles adequately. The adult part of the population is not fully covered by these surveys and they may not necessarily reflect correctly the temporal variation of the biomass of the stock.

A new cpue series is under development for the European pelagic fisheries (Pastoors, 2018) based on the skippers logbooks and self-sampling data. Work is ongoing to provide appropriate standardization of the cpue. The series is expected to be available for the upcoming benchmark for silver smelt in 2020.

A deep-water trawl survey was introduced in 2014 and repeated annually since, covering the slope and banks around the Faroes. This deep-water survey covers the fishing area for greater silver smelt in Faroese EEZ (Figure 7.4.15).

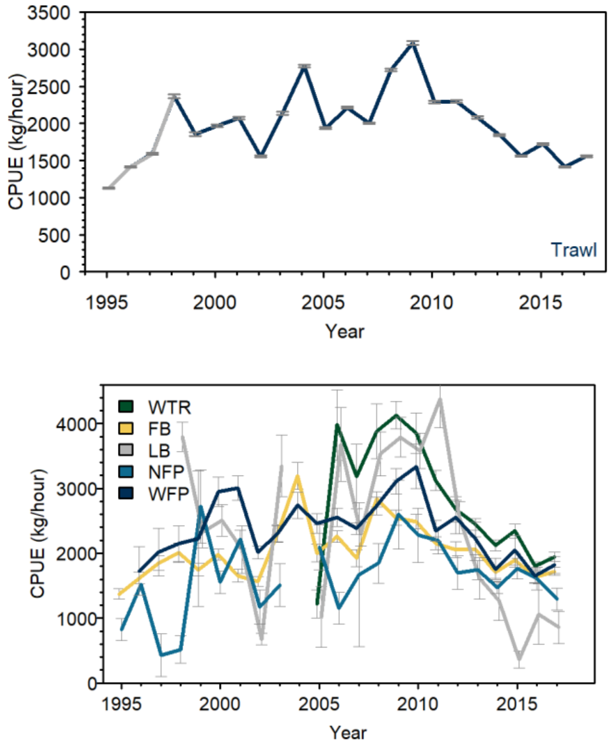


Figure 7.4.12. Greater silver smelt in 5.b. Standardized cpue from pair trawlers fishing greater silver smelt where catch of greater silver smelt is more than 50% of total catch in each haul (upper). Comparison of the commercial Faroese greater silver smelt cpue (kg/hour) from the five main fishing areas. WFP- west of the Faroe Plateau, NFP- north of the Faroe Plateau, LB- Lousy Bank, FB- Faroe Bank, WTR- Wyville-Thomson Ridge (lower).

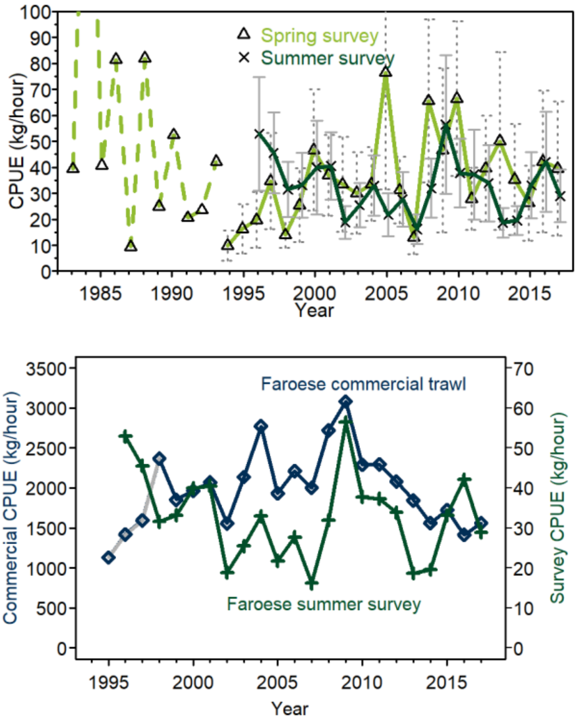


Figure 7.4.13. Greater silver smelt in 5.b. Standardized cpue from Faroese groundfish surveys on the Faroe Plateau (upper). Arrows +- SE and the data from 1983–1993 was not standardized. Comparisons between the cpue from the summer groundfish survey and the commercial trawler series (lower).

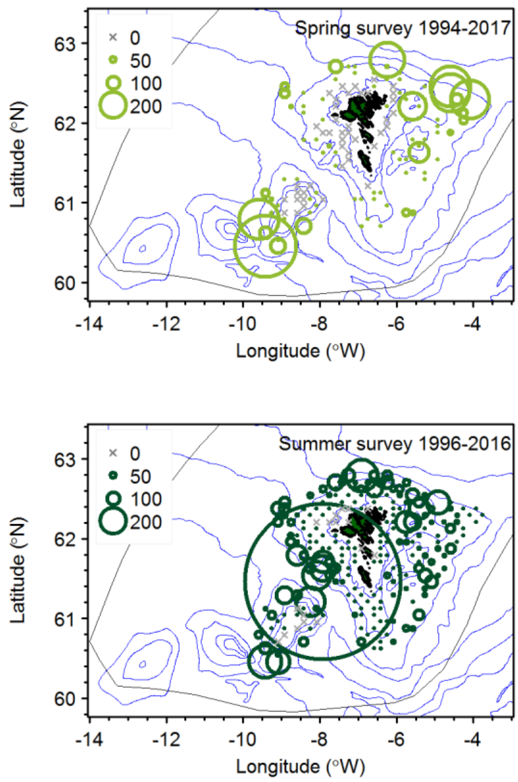


Figure 7.4.14. Greater silver smelt in 5.b. Density and spatial distribution of greater silver smelt in the annual spring (upper) - and summer (lower) groundfish surveys on the Faroe Plateau and the Faroe Bank as average (kg/hour, 1994–2016). Depth contour line is for 100, 200 and 500 m.

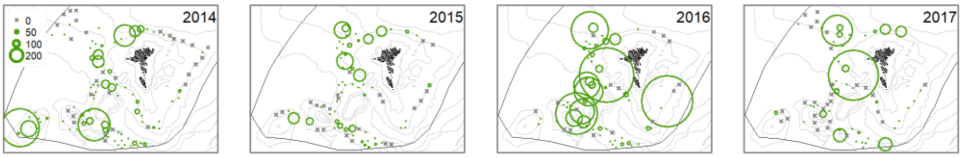


Figure 7.4.15. Greater silver smelt in 5.b. Density and spatial distribution of greater silver smelt in the deep-water surveys in 2014-2017 (kg/hour). Depth contour line is for 100, 200 and 500 m.

Explorations on silver smelt abundance in Scottish deepwater survey have been initiated and are expected to be available for the upcoming benchmark meeting.

7.4.6 Data analyses

Landings have increased from the whole management unit since 1994–2007 (Figure 7.4.1). The landings have been stable at a level between 20 000 and 22 000 tonnes since 2007 to 2011 and decreased to a level around 15 000–17 000 in 2012–2016 in Divisions 5.b and 6.a (Table 7.4.2, Figure 7.4.1).

Length and age distributions

Mean length and age in the Faroese landings in Division 5.b decreased from 1994 to 2000 and have been stable since then (Figures 7.4.4, 7.4.9, 7.4.16), probably reflecting a gradual change during and following the first years of exploitation of a virgin stock (Ofstad, WD WKDEEP 2010). The variation in mean length during the latest years could be due to sampling from different depths in the various areas, as the size of greater silver smelt is increasing with increasing depth (Figure 7.4.16). Generally, the Faroese bottom surveys catch individuals less than 30 cm in length at depths shallower than 350 m whereas larger individuals (35–40 cm) were found deeper.

Mean lengths in the Dutch landings were mainly between 36 to 38 cm for the whole period 1995–2016 (Figure 7.4.6). The mean length of greater silver smelt in Faroese and Dutch trawlers was very similar, around 36–39 cm after 2003 except in 2017 (Figure 7.4.16). The low mean lengths observed in the Dutch fishery (1996, 1999, 2002, 2017) are probably caused by the catch being a mixture of *Argentina silus* and *Argentina spyraena* or that the Dutch trawlers in these years fished shallower waters than in other years or that the data are from discard not landings. The Dutch data are from the ICES InterCatch database.

The mean lengths by age of greater silver smelt sampled in the Faroese and Dutch fishery were quite comparable (Figure 7.4.17), allowing the use of Faroese age–length data in an exploratory age-based assessment.

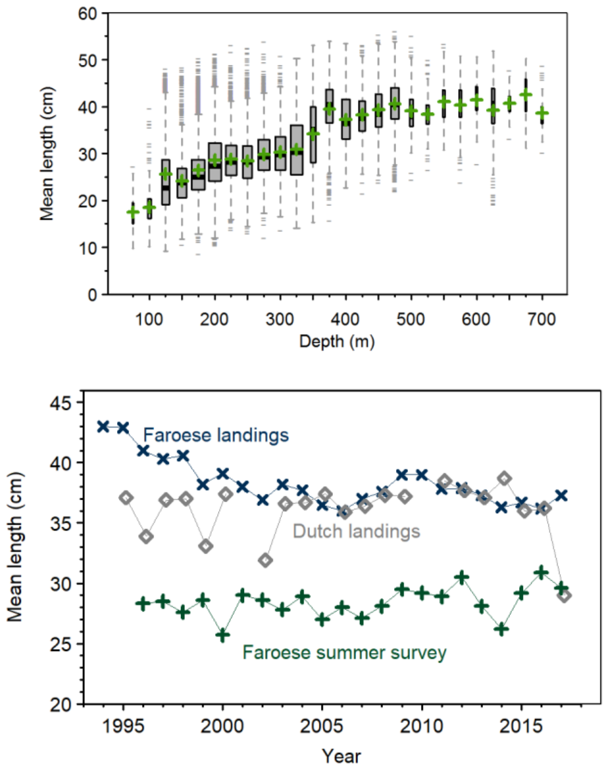


Figure 7.4.16. Grater silver smelt in 5.b and 6.a. Mean length at different depth interval (e.g. 100 is 100–124 m) from various surveys in Faroese area (upper). Comparison of mean length at year from Faroese- and Dutch landings and from the Faroese summer survey (lower).

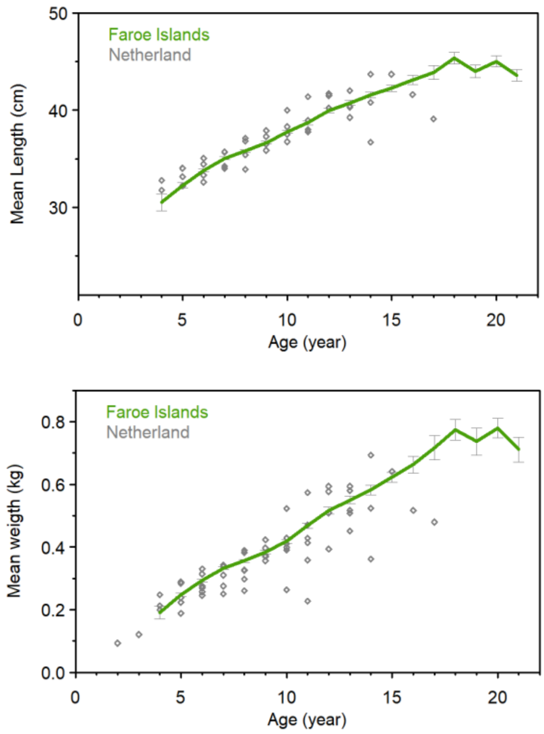


Figure 7.4.17. Grater silver smelt in 5.b and 6.a. Comparisons of greater silver smelt mean length-at-age (left) and mean weight-at-age (right) in the commercial Faroese fisheries (green line) and Dutch fisheries (grey symbols). Dutch data from InterCatch.

Commercial and survey cpue series.

The Faroese commercial cpue (Division 5.b) increased until 2010 and has decreased slightly until 2014. It was a slight increase in 2015, small decrease in 2016 and a small increase again in 2017 (Figure 7.4.12). The period from 1995 to 1997 is believed to be a "learning" period, i.e. the cpue is not believed to be proportional to abundance in those years.

There were concerns about that the commercial Faroese trawl cpue as the distribution of fishing amongst fishing grounds within the Faroes EEZ changed after 2008 (Figure 7.4.2). This has also been mentioned in an earlier WD (Ofstad, WD 2015). There was suspicion that the commercial cpue might be maintained by sequential fishing on different aggregations inhabiting different fishing ground. To investigate this a calculation of the cpue for each of the five different areas was conducted (Figure 7.4.12). The cpue for the "new" fishing area primarily used after 2008 were slightly higher for the period 2005–2011. Even so, the cpues still appear to show the same temporal pattern.

The Faroese summer survey biomass index showed actually the same main trends as in the Faroese commercial cpue, except in 2016 (Figure 7.4.13). Given the low turnover rate (high turnover time) in this species one would not expect to see large changes in abundance by year, indicating that short-term fluctuations may be caused by random events and inadequate sampling. The shallow depth range sampled by the survey (very few stations deeper than 500 m) covers the juveniles adequately but not necessarily the adults since large individuals are generally found at greater depths.

Exploratory assessment

An exploratory age-based stock assessment of greater silver smelt in Faroese waters was presented to the group. It was an update from last year's SAM.

The data basis for the age-based assessment was catch data for all countries fishing greater silver smelt particularly Faroe Islands and Netherlands, age compositions representing the Faroese fishery and growth data for both the Faroese fleet as well as the Dutch fleet. As showed earlier in this report, the Dutch length and age data were comparable with the Faroese data. There are two tuning series in the assessment 1) the Faroese summer survey used as a recruitment index (ages 4 to 6, as suggested by the WGDEEP group in 2016) and 2) the commercial cpue series from the Faroese commercial trawlers logbooks. Unfortunately, there is no corresponding commercial cpue series for the Dutch fishery. Such a series would have facilitated investigations of the patterns in 6.a and comparisons with the Faroese data.

The results of the exploratory SAM assessment are summarised Figure 7.4.18. The output level from SAM was very unstable and it was difficult to find input and settings so the model converged. The WG suggested investigating different mortality (0.1, 0.15 and 0.2), try with age 5 as recruitment and use ages 6-21 in the commercial tuning series.

Although the exploratory age-based stock assessment has not been benchmarked, it seems to indicate the trend in stock size and fishing mortality and may provide a valid perception of the temporal variation of the stock. Greater silver smelt in 5.b and 6.a was suggested for a benchmark in 2020.

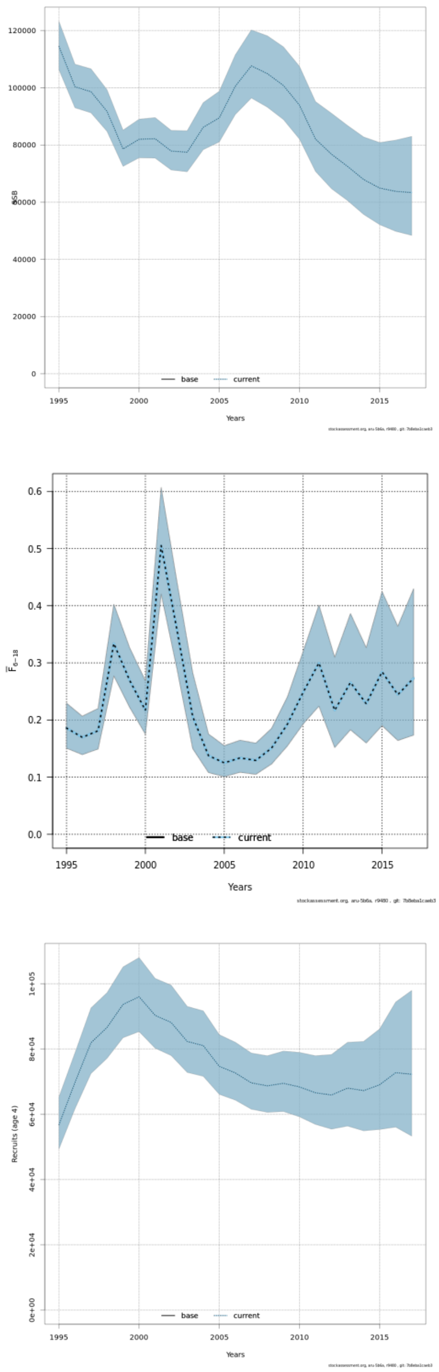


Figure 7.4.18. Grater silver smelt in 5.b and 6.a. Spawning biomass, fishing mortality and recruitment of greater silver smelt in Division 5b and 6a, output from the exploratory age-based assessments done in SAM.

7.4.6.1 Reference points

There are no accepted reference points for this management unit.

7.4.7 Comments on the assessment

Advice is given every second year for this stock, so the advice for 2018 also applies for 2019. The advice is based on trends in the cpue (kg/hour) from the Faroese summer survey on the Faroe Plateau (DLS method 3.2). The advice for 2016–2017 was, for the first time, given for the new advisory unit (Divisions 5.b and 6.a).

Unfortunately there is no agreed cpue series for the European fishery yet, which could be compared with the Faroese commercial cpue series. Work is ongoing in this direction, and results are expected to be available for the next WG meeting and for the benchmark of silver smelt.

A benchmark of silver smelt stocks in the Northeast Atlantic is foreseen for the spring of 2020. The benchmark will focus on new (genetic) information on the stock structure, new data series that have been made available and the application of appropriate quantitative methods to assess the state of the stocks.

7.4.8 Management considerations

The greater silver smelt fishery in Faroese waters is managed by Faroese authorities and the quota for 2018 was set at the F_{01} catch from the exploratory age-based assessment (SAM). The quota of greater silver smelt in the Faroese EEZ has been reduced from 16 000 t (for 2014) to 11 700 in 2018 (Table in 7.4.4). The reason for this was the decrease in the spawning–stock biomass index from the exploratory assessment.

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 5.b and 6.a where the bulk of the catches are taken.

There appears to be no agreement between the Faroe Islands and EU on the setting of an overall TAC for silver smelt in 5.b and 6.a. As a consequence, the sum of the TACs of the Faroe Islands and EU has exceeded the scientific advice from ICES from 2016 onwards.

7.4.9 Application of MSY proxy reference points

Conclusions from WKProxy review 2017 on aru.27.5b6a:

While considering all proxy reference points presented by the EG, in general the F2016 from SAM indicated that fishing is occurring around MSY, indicating a healthy stock.

The time series of LBI indicator ratio also indicates a healthy stock.

The RG finds these methods and this conclusion acceptable, but in future would like further exploration of other category 3 methods (MLZ, LB-YPR and SPiCT through fixing parameters if the EG has confidence in CPUE indices) to have a more consistent picture of the stock status.

LBI

At the ICES WKPROXY meeting in November 2015 a screening method (Length-based indicators and reference points) was tried on greater silver smelt in Division 5.b and 6.a (ICES, WKPROXY 2015). These input data are updated with the latest values. The input data were the length distribution from Faroese commercial trawlers fishing in the Faroese EEZ 1994–2016 or length distribution from Dutch trawlers fishing in 6.a, mean weight-at-length per year was the same as used in the exploratory XSA assessment, L_{mat} = 34.8 cm, L_{inf} = 44.7 cm, combined sex.

The results show that greater silver smelt in Divisions 5.b and 6.a was fished sustainably at levels close to optimum yield and with exploitation at MSY levels based on the length-based indicator model (Tables below and Figure 7.4.18).

Area 5.b	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2012	1.01	1.01	1.05	95%	1.32	1.05
2013	1.01	1.01	1.02	92%	1.30	1.03
2014	0.95	0.98	0.99	88%	1.24	1.03
2015	0.95	0.98	1.04	87%	1.26	1.04
2016	0.95	0.95	1.04	83%	1.25	1.04
2017	1.01	1.01	1.03	94%	1.30	1.03

Area 6.a	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2013	1.01	0.98	1.00	92%	1.29	1.03
2014	1.01	1.03	1.03	96%	1.33	1.06
2015	0.95	0.98	0.97	89%	1.23	1.02
2016	1.01	0.98	0.97	90%	1.27	1.01

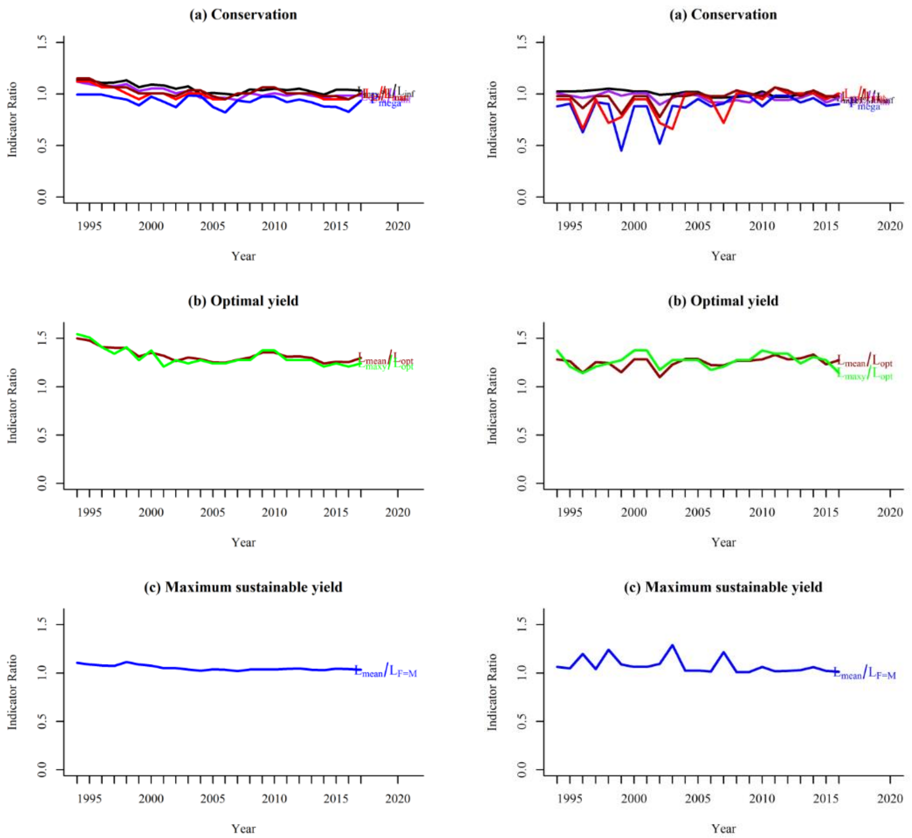


Figure 7.4.18. Grater silver smelt in 5.b and 6.a. Output figures for 5.b (left) and 6.a (right) from LBI.

The conclusion of the screening method was that the results shows that the stock seems to be harvested in a suitable way as it was not exploited above the length-based indicator of MSY.

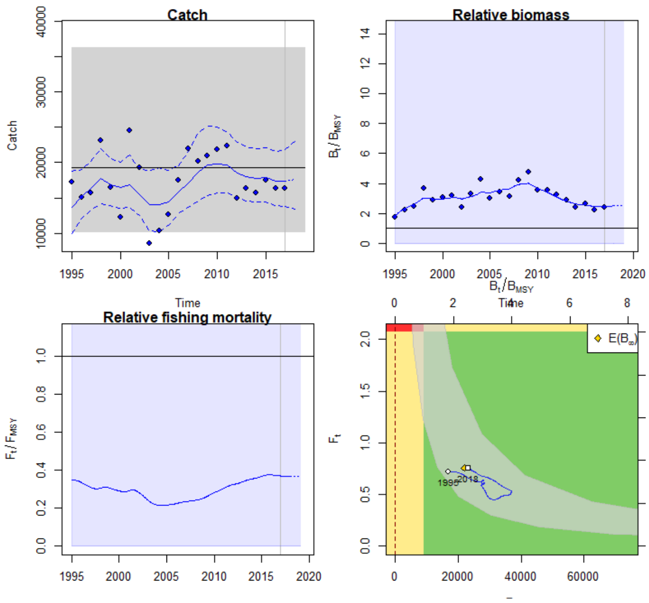
SPiCT

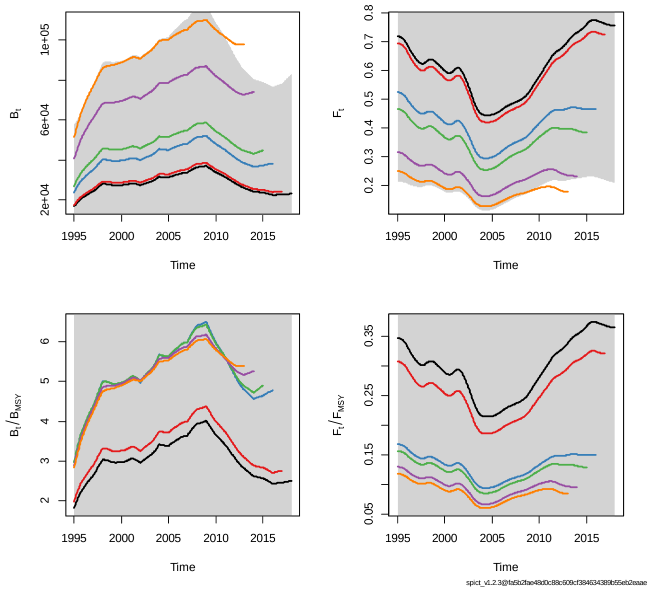
The input data for catch was a time-series of landings and discards for area 27.5.b and 27.6.a together from 1995-2017. The abundance index was from the Faroese annual trawl summer survey. In addition, the Faroese commercial trawl series was also used as a more representative series of the exploited biomass as the Faroese summer survey do not cover the fishery distribution for greater silver smelt.

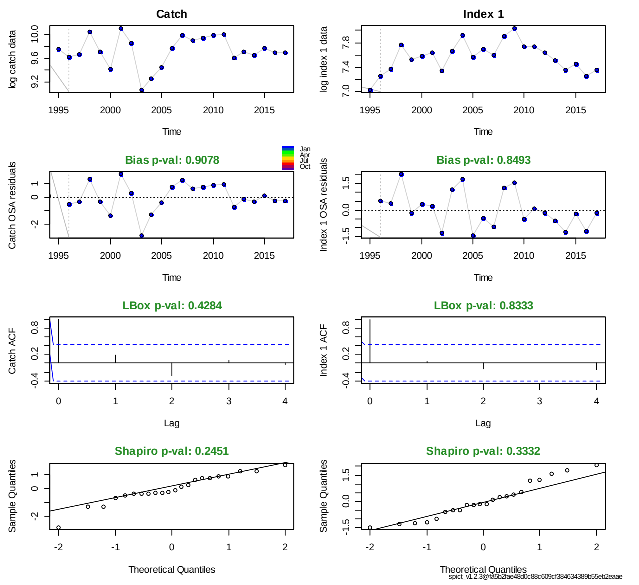
The model did not give any reliable results using the Faroese annual trawl summer survey as abundance index, even if several different settings were tried such as α=1, β=1 and n=2 (as suggested in the WKProxy review, WGDEEP report 2017). There was a warning message: "Model did not obtain proper convergence! Estimates and uncertainties are most likely invalid and cannot be trusted". The results had in common a very wide confidence interval and very different output numbers each time a parameter was changed.

The model was also tried with the Faroese commercial trawl series, with almost the same results. There is too little contrast in the input data, but the model converged with settings α=1, β=1 and n=2. The results showed that the biomass has been above the biomass reference point (Btrigger=BMSY/2) and the fishing mortality has been below the FMSY proxy. Example of the output figures is showed below.

The conclusion was still that the SPiCT model cannot be used for aru-5b6a assessment unit.


Catch
Relative biomass
Relative fishing mortality
Time


Time


Catch
Index 1
Bias p-val: 0.9078
Bias p-val: 0.8493
LBox p-val: 0.4284
LBox p-val: 0.8333
Shapiro p-val: 0.2451
Shapiro p-val: 0.3332
Theoretical Quantiles

7.4.10 Tables

Table 7.4.1. Greater Silver Smelt 5.b and 6.a. WG estimates of landings in tonnes. *) landings in 2016 are preliminary.

Greater silver smelt (*Argentina silus*) 5.b

YEAR	FAROES	RUSSIA/USSR	UK (SCOT)	UK(EWN)	ICELAND	IRELAND	FRANCE	NETHERLANDS	NORWAY	GERMANY	TOTAL
1988	287										287
1989	111	116									227
1990	2885	3									2888
1991	59		1								60
1992	1439	4									1443
1993	1063										1063
1994	960										960
1995	5534	6752									12 286
1996	9495		3								9498
1997	8433										8433
1998	17 570										17 570
1999	8186		15	23			5				8229
2000	3713	1185	247				64				5209
2001	9572	414	94			1					10 081
2002	7058	264	144					5			7471
2003	6261	245	1					51			6558
2004	3441	702	42					1125			5310
2005	6939	59						15			7013
2006	12 524	35									12 559

Year	Faroes	Russia/USSR	UK (Scot)	UK(EWN)	Iceland	Ireland	France	Netherlands	Norway	Germany	TOTAL
2007	14 085	8						0.4	32		14 126
2008	14 930	19							3		14 952
2009	14 200	28									14 228
2010	15 567	2	40								15 609
2011	15 071	8									15 079
2012	9744	110									9854
2013	11 109	114									11 223
2014	9747	339								110	10 196
2015	13 025	115			132		0.3			40	13 312
2016	11 129	13	0.2		345			31		38	11 557
2017*	9799	6			63			2		1	9871

Table 7.4.1. (Continued).

Greater silver smelt (*Argentina silus*) 6.a

Year	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	E&W	Scotland	Russia	Spain	TOTAL
1988					3040		4884					7924
1989		188			1325	3715	11984		3369			20581
1990		689		14	110	5870			112			6795
1991			7			4709			10			4726
1992			1		100	4964			466			5531
1993						663			406			1069
1994				43		6217			1375			7635
1995		483		284		3706			465			4938
1996				1384	295	3953						5632
1997				1496	1089	4684						7269
1998				464	405	4687						5556
1999				24	168	8026		5				8223
2000			19	403	3178	3389						6989
2001			7	189	5838	3655			4777			14466
2002			1	150	3035	4020		424	4136			11766
2003				126	1	1932			80			2039
2004			147	652	46	3707			507			5059
2005		103	10	125	18	5317			61			5634
2006		53		213		4628			3		1	4897
2007		254		589		6969	3				2	7817

Year	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	E&W	Scotland	Russia	Spain	TOTAL
2008		991		10		4156	3					5160
2009		3923		115	0.5	2488	83		6	36		6651
2010		3060				3143	7		20	11		6241
2011		3655			0.1	3050		2	2			6709
2012		2781	2	538	0.2	1785		5	5	1		5115
2013	125	3197		417	0.1	1430				13	0.2	5182
2014	711	1495		908		2332				21		5467
2015		1055		1027		2154	0					4236
2016		2050	0	228		2495						4773
2017*		1934		599		4405	2					6940

Table 7.4.2. Greater silver smelt (*Argentina silus*) (5.b and 6.a).

Year	5.b	6.a	Total
1988	287	7924	8211
1989	227	20581	20808
1990	2888	6795	9683
1991	60	4726	4786
1992	1443	5531	6974
1993	1063	1069	2132
1994	960	7635	8595
1995	12286	4938	17224
1996	9498	5632	15130
1997	8433	7269	15702
1998	17570	5556	23126
1999	8229	8223	16452
2000	5209	6989	12198
2001	10081	14466	24547
2002	7471	11766	19237
2003	6558	2039	8597
2004	5310	5059	10369
2005	7013	5634	12647
2006	12559	4897	17456
2007	14126	7817	21943
2008	14952	5160	20112
2009	14228	6651	20879
2010	15609	6241	21850
2011	15586	6709	22295
2012	9854	5115	14969
2013	11223	5182	16405
2014	10196	5462	15662
2015	13312	4236	17548
2016	11557	4773	16330
2017*	9871	6940	16811

7.5 Greater silver smelt (*Argentina silus*) in 6.b, 7, 8, 9,10 and 12

7.5.1 The fishery

The fisheries from this area is very minor and there are no directed fisheries.

7.5.2 Landing trends

Landings from this area are reported from 1966–2017. Landings increased until 2002 to 4662 tons then declined again to low levels of less than a ton in 2017. Landings from the twelve last years have been less than 50 tons. The main landings have been from Subareas 6b and 7 where Ireland were fishing for some years between 2000 and 2003.

7.5.3 ICES Advice

Advice is given every other year. The 2017 advice was from area 6b, 7, 8, 9, 10 and 12, and stated "ICES advises that when the precautionary approach is applied, landings should be no more than 14 tonnes in each of the years 2018 and 2019. Discarding is known to take place, but ICES cannot quantify the corresponding catches.".

7.5.4 Management

The EU introduced TAC management in 2003. For 2018 the EU TAC in Subareas 5, 6 and 7 was 4551 tonnes, however this applies predominantly to fisheries in 6a.

7.5.5 Data available

7.5.5.1 Landings and discards

Landings data are presented by area and countries (Tables 7.5.1–7.5.5, Figure 7.5.1). Discards data from the three last years are presented in Table 7.5.6. Discards are mainly from the Spanish fishery and from Subarea 7. The discards were very high compared to the landings. However, the discards since 2014 were reduced compared to the years before.

Argentina silus can be a very significant discard of the trawl fisheries of the continental slope of Subareas 6 and 7 particularly at depths 300–700 m (e.g. Girard and Biseau, WD 2004) (table 7.5.7). Information have been available on discards in 2009 and 2012 in Basque country and Spanish fisheries in Subareas 6–7, and Divisions 5.3.abcd and northern 9.a. These estimates have been in the range 1000–4000 t since 2003. In 2010 and 2011 they were around 2000 t. New calculation of the estimates for 2012 and 2013 reduce strongly the discards reported by Spain. Same applies for discards registered by the Netherlands. Based upon on-board observations from DCF sampling, the catch composition of the French mixed trawl fisheries in 5.b, 6 and 7 include 5.3% of greater silver smelt, based upon data for year 2011 (Dubé *et al.*, 2012). This species is discarded in that fishery; it represents 25.3% of the discards. Raised to the total landings from that fishery an estimated 280 t of discarded greater silver smelt was estimated for 2011. It should be noted that after redefinition of stock structure in 2015 area 6.a is not included in this stock.

7.5.5.2 Length compositions

The size compositions of *Argentinas* spp. from Porcupine survey since 2001 is presented in Figure 7.5.2.

7.5.5.3 Age compositions

No new data on age composition were presented.

7.5.5.4 Weight-at-age

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

7.5.5.1 Maturity and natural mortality

No new data on maturity and natural mortality were presented.

7.5.5.2 Catch, effort and research vessel data

Spanish bottom-trawl surveys have been carried out in Subarea 7 (Porcupine) since 2001. Recent investigations have revealed that survey catches from the Spanish Porcupine survey contain both *A. Silus* and *A. Sphyraena* (Figures 7.5.2, 7.5.3 and 7.5.4). Abundance and biomass indices from survey catches of mixed *A. silus* and *A. sphyraena* is presented in Figure 7.5.3. The Spanish survey only goes to 400 m and is unlikely to fully cover the depth range of greater silver smelt.

7.5.6 Data analyses

Length and age distributions

The size compositions from Porcupine Bank in Subarea 7 have no obvious trend towards smaller fish but these data may by disturbed by the relative species composition *A. silus* and *A. sphyreana* (Figure 7.5.2).

Commercial and survey cpue series

For Subarea 7, abundances and biomass indices from the Spanish porcupine survey have been showing a decreasing trend from 2002 until 2011 but have been rising since then (Figure 7.5.3). The index has a slightly down in 2017 compared to 2016. However the survey is unlikely to cover all the exploitable biomass of the stock as it only goes down to 400 meters.

Exploratory assessment

No exploratory assessment was presented.

Biological reference points

SPiCT was run on the landings dataseries (1973–2016) and the biomass index series from Porcupine bank (2001–2016) at WGDEEP 2017, but it did not converge.

7.5.7 Comments on the assessment

Advice is given every second year for this stock and this year is not an advice year.

It should be noted that lesser silver smelt (*Argentina sphyraena*) may in some southerly areas have been included in the landing figures. According to research on the Spanish Porcupine survey where both species appear lesser silver smelt are smaller and occupies shallower areas than greater silver smelt (Figures 7.5.2, 7.5.3 and 7.5.4). The proportion of lesser silver smelt in the fisheries is not believed to be large but further investigations should be undertaken.

The biomass index is only from the Porcupine bank and is therefore not covering the total stock area.

7.5.8 Management considerations

The trends for Porcupine bank survey biomass indices have increased in 2015 and 2016, but are slightly down in 2017.

7.5.9 Tables and Figures

Table 7.5.1. Greater Silver Smelt in 6.b. WG estimates of landings in tonnes. * landings in 2017 are preliminary.

Year	Faroes	Germany	Ireland	Netherlands	Scotland	Russia	Spain	TOTAL
1979								
1980		13						13
1981		525						525
1982								
1983		4						4
1984								
1985								
1986								
1987								
1988								
1989								
1990			300					300
1991				5				5
1992			220		1			221
1993					3			3
1994					20			20
1995	1114							1114
1996								
1997								
1998								
1999			178					178
2000			1355			29		1384
2001					62	68		130
2002					1	29		30
2003					6	120		126
2004				11		12		23
2005						4		4
2006								
2007								
2008						1	8	9
2009								
2010								
2011								
2012								
2013								
2014						20.5		20.5
2015								0
2016								0
2017*								0

Table 7.5.2. Greater Silver Smelt in 7. WG estimates of landings in tonnes. * landings in 2016 are preliminary.

YEAR	FRANCE	GERMANY	IRELAND	NETHERLANDS	SCOTLAND	NORWAY	POLAND	SPAIN	UK E/W	TOTAL
1972										
1973	40									103
1974							63			
1975										
1976										
1977			1							1
1978		404					5			409
1979		103								103
1980										
1981										
1982						666				666
1983						595				595
1984						163				163
1985										
1986						258				258
1987						50				50
1988						100				100
1989						200				200
1990		23		1						24
1991				9						9
1992				254						254
1993				505						505
1994				39						39
1995		73	6	431						510
1996		10								10
1997				12						12
1998										
1999			50							50
2000		79	166	244				34		523
2001	5		1592	2	2782			34		4415
2002			4433		2			2		4437
2003			95	19				5		119
2004				13	19			15		47
2005		26	1		14			17		58
2006								40		40
2007								35		35
2008										
2009	13		1					6		20
2010	10			8				2	3	23
2011		4			8					12
2012		2			1					3
2013				1						1
2014				1						1
2015				5						5
2016	0			0				0		0
2017*				8						8

Table 7.5.3. Greater Silver Smelt in 8. WG estimates of landings in tonnes. *landings in 2016 are preliminary.

Year	Netherlands	Spain	TOTAL
2002	195		194.61
2003	43		42.525
2004	23		22.722
2005	202		202.29
2006			0
2007			0
2008		10	10
2009			0
2010			0
2011	1		1
2012			0
2013			0
2014	1.1		1.1
2015			0
2016		0	0
2017*		1	1

Table 7.5.4. Greater Silver Smelt 9. WG estimates of landings in tonnes. *) landings in 2016 are preliminary.

Year	Netherlands	Portugal	TOTAL
2006			0
2007	1		1
2008		0.5	0.5
2009		1.9	1.9
2010		1.9	1.9
2011		0.9	0.9
2012		1.9	1.9
2013*			0
2014			0
2015			0
2016			0
2017*			0

Table 7.5.5. Greater Silver Smelt 12. WG estimates of landings in tonnes. * landings in 2016 are preliminary.

Year	Faroes	Iceland	Russia	Netherlands	TOTAL
1988					0
1989					0
1990					0
1991					0
1992					0
1993	6				6
1994					0
1995					0
1996	1				1
1997					0
1998					0
1999					0
2000		2			2
2001					0
2002					0
2003					0
2004			4	625	629
2005				362	362
2006					0
2007					0
2008					0
2009					0
2010					0
2011					0
2012		31			31
2013					0
2014					0
2015					0
2016					0
2017*					0

Table 7.5.6. Discard data from 2015 and 2017 from Subarea 6b, 7-1012.

YEAR	Spain				France
	6b	7	8	9	6b+7
2015	7	28	0		
2016		237	2	1	19
2017		151			

Table 7.5.7. Discards by Spain and Netherlands from before the redefinition of the stock area (Subarea 6,7 and 8) from 2003–2014.

Year	Spain	Netherland	Total
2003	2806	1246	4053
2004	3075	299	3374
2005	2437	0	2437
2006	1249	149	1398
2007	2037	44	2082
2008	3060	57	3118
2009	4108	73	4182
2010	2005	23	2029
2011	2050	5	2056
2012	177	25	202
2013	91	20	132
2014	159	111	1365

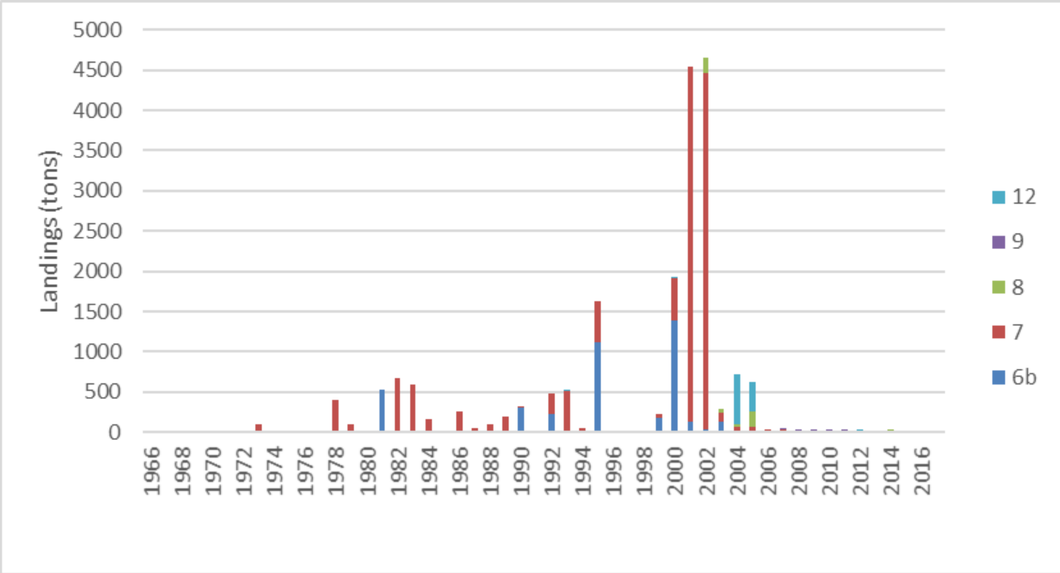


Figure 7.5.1. Total landings from 1966–2017 of greater silver smelt in 6.b, 7, 8, 9, 10 and 12.

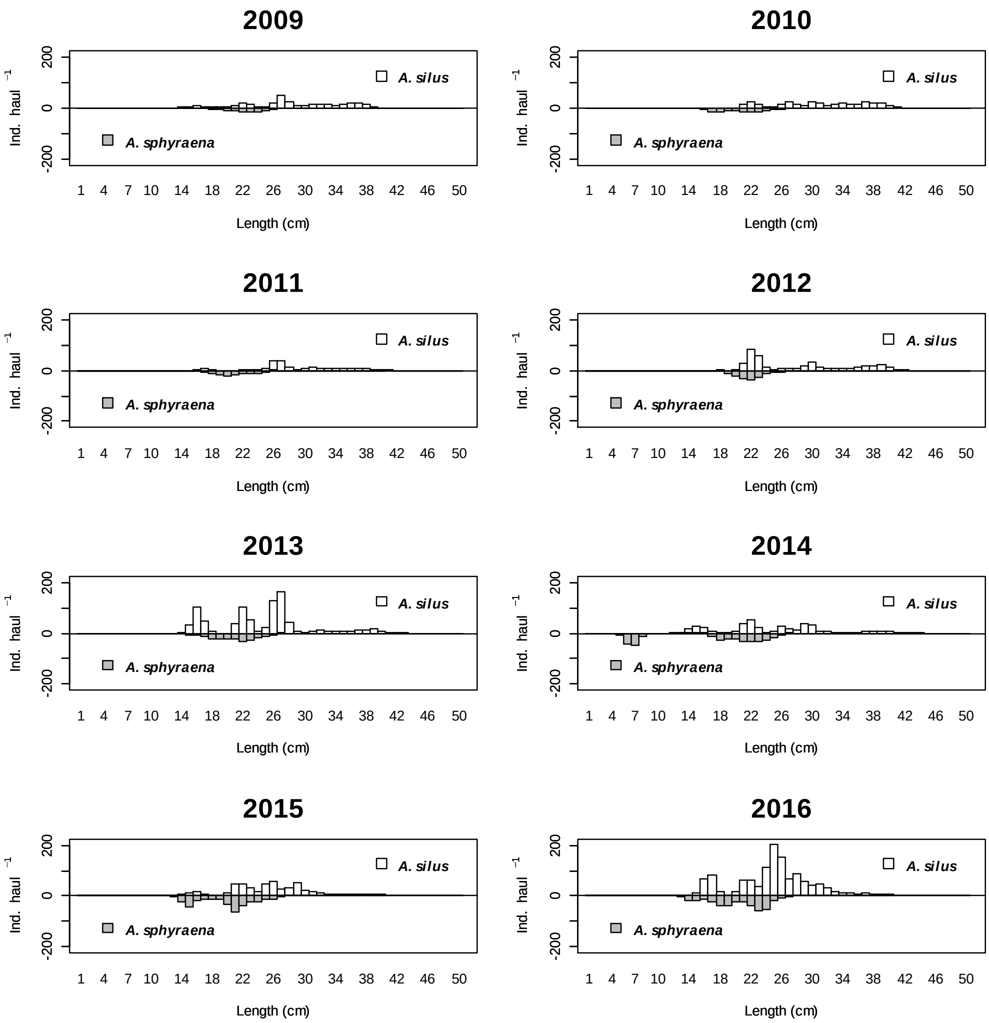


Figure 7.5.2. Mean stratified length distributions of *Argentina* spp. in Spanish Porcupine surveys from Subarea 7.

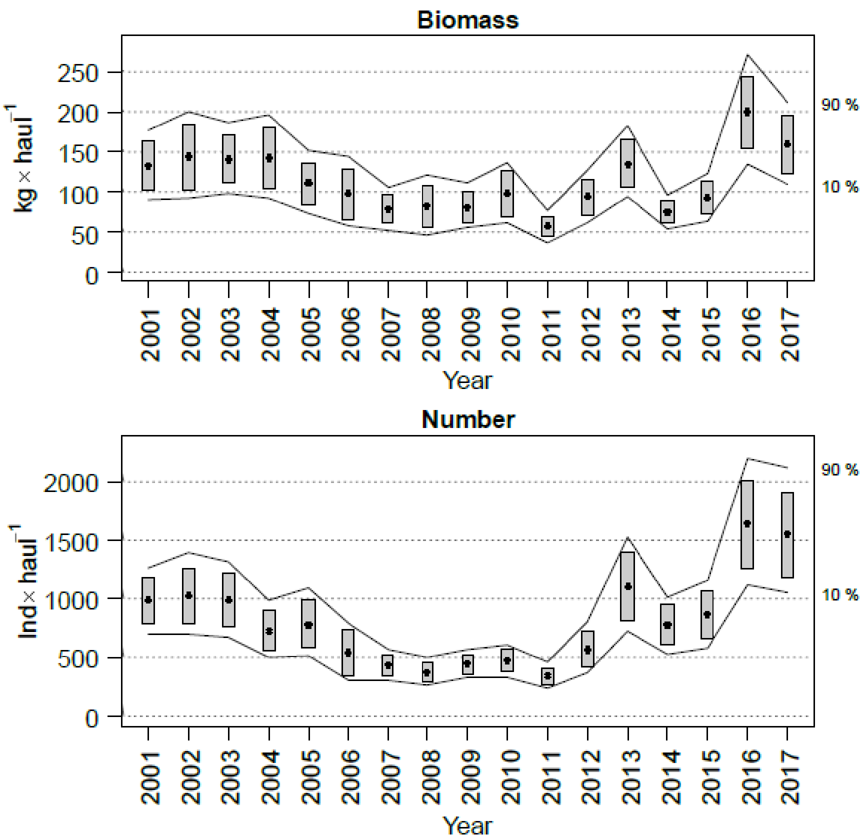


Figure 7.5.3. Greater silver smelt in 7. Changes in *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time-series. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

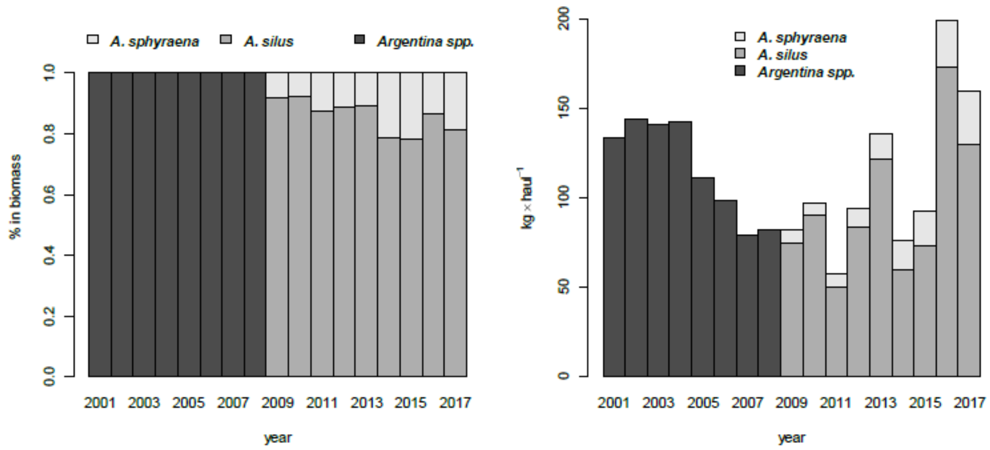


Figure 7.5.4. Share and abundance of Argentine species in Porcupine Bank surveys (2001–2017).

8 Orange roughy (*Hoplostethus atlanticus*) in the Northeast Atlantic

8.1 Stock description and management units

There is no information to determine the existence of separate populations of orange roughy in the North Atlantic.

The current ICES practice is to assume three assessment units:

- Subarea 6;
- Subarea 7;
- Orange roughy in all other areas.

Given the scarcity of spatial fisheries data, biological and genetics data, WGDEEP saw no reason to change this.

Orange roughy is an aggregating species and the spatial scale of current management units would not prevent sequential depletion of local aggregations. ICES recommended that where the small-scale distribution is known, this be used to define smaller and more meaningful management units.

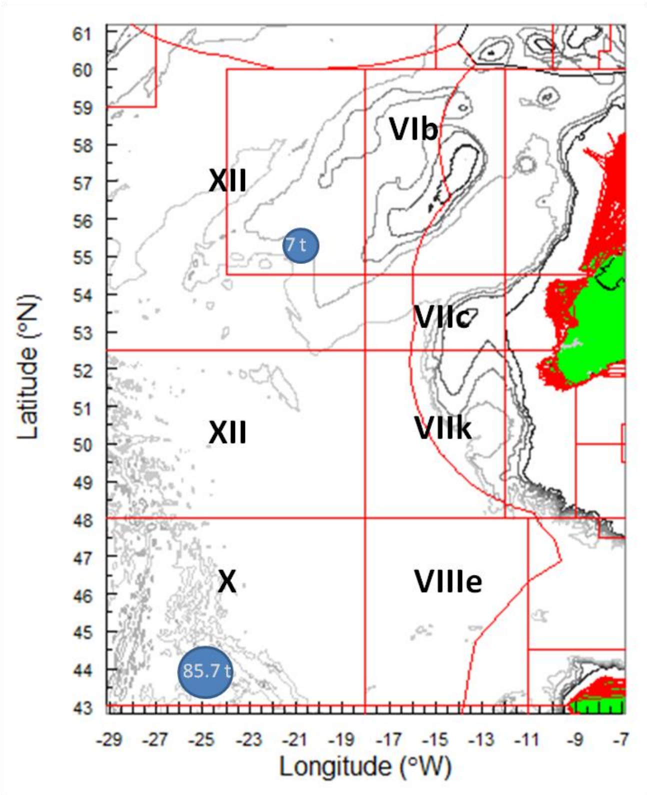


Figure 8.1.1. Faroese catches for orange roughy by ICES areas in Northeast Atlantic in 2016.

8.2 Orange roughy (*Hoplostethus Atlanticus*) in Subarea 6

8.2.1 The fishery

There was a French target fishery, centred on spawning aggregations around the Hebrides Terrace Seamount. Irish vessels fished there for two years starting in 2001, but directed fisheries had ceased by 2006. No fishing and no catch was reported for the year 2017.

8.2.2 Landings trends

Table 8.2.1 and Figure 8.2.1 show the landings data for orange roughy for ICES Subarea 6 as reported to ICES or as reported to the Working Group. In recent years, only a small landing, 700 kg rounded to 1 tonne in Table 8.2.1 was landed by the Faroe Islands in 2016. The cumulative landings in Area 6 since 1988 were 7188 tonnes.

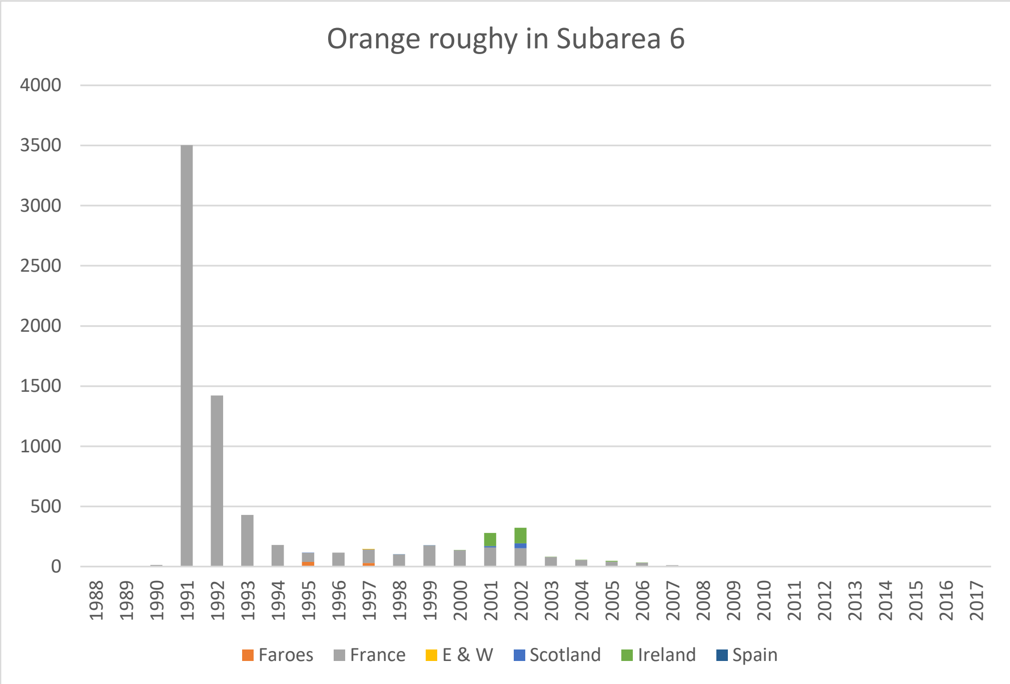


Figure 8.2.1. Time-series of orange roughy landings by country in ICES Subarea 6.

8.2.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

8.2.4 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 EC vessels in Area 6 was reduced annually between 2007 and 2009. A zero TAC has been set for orange roughy in Subarea 6 since 2010.

Landings in relation to TAC are displayed in Table 8.2.2.

Table 8.2.2. EU TACs and landings in EU and international waters of 6.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	88	81	81
2004	88	56	56
2005	88	45	45
2006	88	33	33
2007	51	12	12
2008	34	5	5
2009	17	2	2
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	1
2017	0	0	0

8.2.5 Data available

8.2.5.1 Landings and discards

Landings are in Table 8.2.1.

Raised discard weights were not available for 2014 and 2015.For 2016 and 2017, discards were estimated to 0 -zero).

8.2.5.2 Length compositions

Length distributions are available from historical observer programmes and current deep-water surveys. Available information can be found in the stock annex.

8.2.5.3 Age compositions

No new information. Available information can be found in the stock annex.

8.2.5.4 Weight-at-age

No information.

8.2.5.5 Maturity and natural mortality

No new information. Available information can be found in the stock annex.

8.2.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

8.2.6 Data analyses

No new analysis was performed in 2017.

8.2.7 Management considerations

The fisheries for orange roughy in Subareas 6 and 7 have now ceased and a zero TAC has been implemented since 2010. A zero TAC without allowing a bycatch can potentially lead to discarding if existing fisheries overlap with the distribution of orange roughy. Previous examination of French observer data suggested that bycatch and discarding of orange roughy is currently not significant (<1 tonne).

Due to the closure of the fishery in Subareas 6 and 7 there are limited fishery-dependant data to evaluate the status of the stocks. Also, current fisheries limited monitoring programmes are insufficient to monitor the recovery of the stocks in Subareas 6 and 7.

Assessment of the susceptibility of orange roughy populations in Subareas 6 and 7 to recent and current deep-water trawl fisheries (see WGDEEP 2014, Section 8.3) has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remains, such as on the "flat" fishing grounds in Subarea 6 on the continental slope to the northwest of Ireland extending to the west of Scotland. The overlap between orange roughy distribution and current fishery seems to generate a small bycatch. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in Subareas 6 and 7, the impact of current fisheries is considered sustainable.

The zero EU TAC implies that no EU fishing for the species is allowed. The application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the 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.

Table 8.2.1. Orange roughy catch in Subarea 6.

Year	Faroes	France	E & W	Scotland	Ireland	Spain	Total
1988	-	-	-	-	-	-	0
1989	-	5	-	-	-	-	5
1990	-	15	-	-	-	-	15
1991	-	3,502	-	-	-	-	3502
1992	-	1,422	-	-	-	-	1422
1993	-	429	-	-	-	-	429
1994	-	179	-	-	-	-	179
1995	40	74	-	2	-	-	116
1996	0	116	-	0	-	-	116
1997	29	116	1	-	-	-	146
1998	-	100	-	-	-	2	102
1999	-	175	-	-	0	1	176
2000	-	136	-	-	2	-	138
2001	-	159	-	11	110	-	280
2002	n/a	152	-	41	130	-	323
2003	-	79	-	-	2	-	81
2004	-	54	-	-	2	-	56
2005	-	41	-	-	6	-	47
2006		32			1		33
2007		12					12
2008		5					5
2009		3					3
2010		0					0
2011		0					0
2012		0					0
2013		1(1)					3**
2014		0					0
2015							0
2016	1						1
2017							0

8.3 Orange roughy (*Hoplostethus Atlanticus*) in Subarea 7

8.3.1 The fishery

After the collapse of the fishery in Subarea 6, the main fishery for orange roughy in the northern hemisphere moved to this subarea. This fishery peaked in 2002 and rapidly declined thereafter. Some targeted fishing from a few or even one single 20–24 m trawlers was carried out until 2008 while the remaining catches were a bycatch from the mixed deep-water trawl fishery operating on the slopes.

8.3.2 Landings trends

Table 8.3.1 and Figure 8.3.1 show the landings data for orange roughy as reported to ICES or as reported to the Working Group.

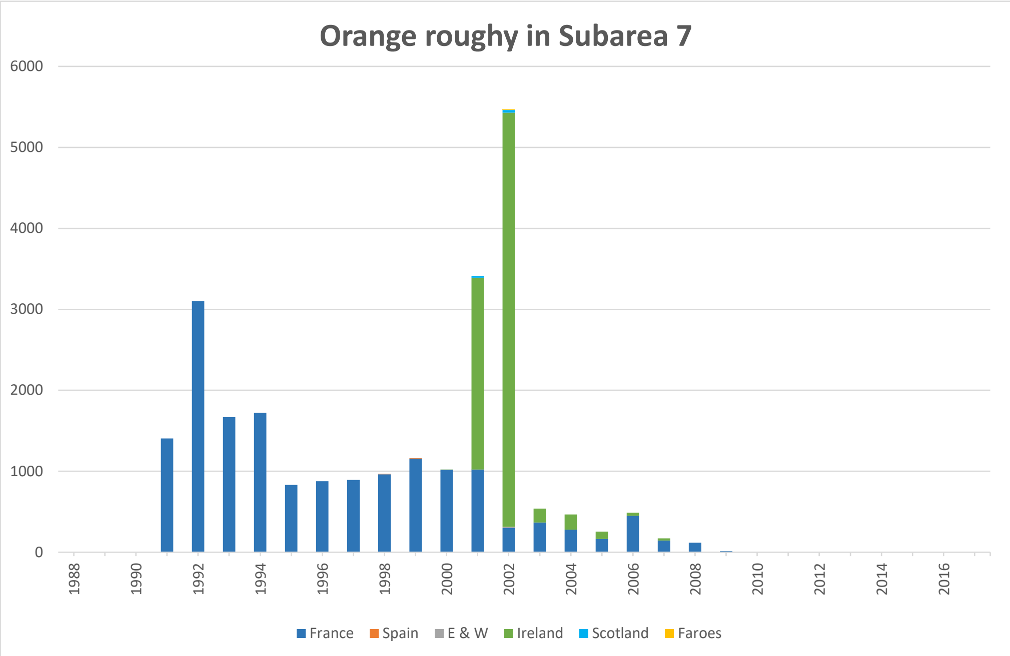


Figure 8.3.1. Time-series of orange roughy landings by country in ICES Subarea 7.

8.3.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

8.3.4 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 8.3.2. EU TACs and landings in EU and international waters of Subarea 7.

		Landing (t)	
Year	TAC (t)	EC vessels	Total
2003	1349	541	541
2004	1349	467	467
2005	1149	255	255
2006	1149	489	489
2007	193	172	172
2008	130	118	118
2009	65	15	15
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0

The TAC for orange roughy in Subarea 7 was set to 0 t for 2016 and 2017. No catch was reported.

8.3.5 Data available

8.3.5.1 Landings and discards

Landings are shown are in Table 8.3.1.

There was no landings since 2010. Discards of Orange roughy from the French mixed deep-water fishery in Subareas 6 and 7 were estimated from observer data. In recent years, discards estimated at fleet level have been calculated for total discards and by species. In 2012, the estimated discards of orange roughy was 400 kg.

In 2017 a reported discard in Intercatch of 30 kg in Division 7.d from France was clearly the results of a coding error in the fisheries statistic system.

8.3.5.2 Length compositions

No new information available. Historic information can be found in the stock annex.

8.3.5.3 Age compositions

No new information available. Historic information can be found in the stock annex.

8.3.5.4 Weight-at-age

No data.

8.3.5.5 Maturity and natural mortality

No new information available. Historic information can be found in the stock annex.

8.3.5.6 Catch, effort and research vessel data

No new information. Available information can be found in the stock annex.

8.3.6 Management considerations

The fisheries for orange roughy in Subareas 6 and 7 have now ceased and a zero TAC has been implemented since 2010. A zero TAC without allowing a bycatch can potentially lead to discarding if existing fisheries overlap with the distribution of orange roughy. Examination of French observer data suggests that bycatch and discarding of orange roughy in 2010-2016 was not significant (<1 tonne). Due to the closure of the fishery in Subareas 6 and 7 there are limited fishery-dependant data to evaluate the status of the stocks. Also, current fisheries-independent monitoring programmes are insufficient to monitor the recovery of the stocks in Subareas 6 and 7.

PSA Assessment of the susceptibility of orange roughy populations in Subareas 6 and 7 to recent and current deep-water trawl fisheries has shown a strong reduction in risk over time when fisheries stopped directed targeting practices and continued with mixed deep-water trawl fisheries. Some spatial overlap between the species and current fisheries remained, such as the northern slope of the Porcupine Bank. Fishing effort ceased in this location in 2009 but returned from 2010 onwards. In the same area, scientific trawl surveys have confirmed the presence of orange roughy including juveniles (see ICES, 2012). The overlap between orange roughy distribution and current fishery seemed to generate small bycatch before 2016. Owing to previous estimates of sustainable catch of a few hundred tonnes per year in Subareas 6 and 7, the impacts of fisheries in 2010-16 was considered sustainable.

The zero EU TAC implies that no EU fishing for the species is allowed. For 2017, the application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic implies that bycatch in EU trawl fisheries might be minor as a consequence of the ban of fishing deeper than 800 m with trawls in this regulation. Possible bycatch should be minor or inexistent because the fraction of orange rough biomass occurring shallower than 800.

Table 8.3.1. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus,* by country in Subarea 7. Reported landings after 2012 have been 0 and the table was not expanded for these years

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

***Preliminary.**

8.4 Orange Roughy (*Hoplostethus atlanticus*) In Subareas 1, 2, 4, 5, 8, 9, 10, 12 and 14 and Division 3.a

8.4.1 The fishery

Fisheries have been conducted in Divisions 5.a–b and Subareas 8, 10 and 12. Most started in the early 1990s, the exception being Subarea 10 which started in 1996. Since 2010, fisheries are mainly occurring in subareas 10 and 12, with sporadic catches in 5.a, 5.b and 9. In recent years, one Faroese vessel operated a small directed fishery in ICES Subareas 10 and 12. Information on this fishery is presented in WD Ofstad, 2018.

8.4.2 Landing trends

Table 8.4.0 and Figure 8.4.1 show the landings data for orange roughy for the ICES areas as reported to ICES or as reported to the Working Group.

Landings from the single vessel fishing in subareas 10 and 12 have been between 50 and 150 tonnes per year since 2014. They amounted to 150 tonnes in 2017. During the two last years, these landings were from subarea 10 only.

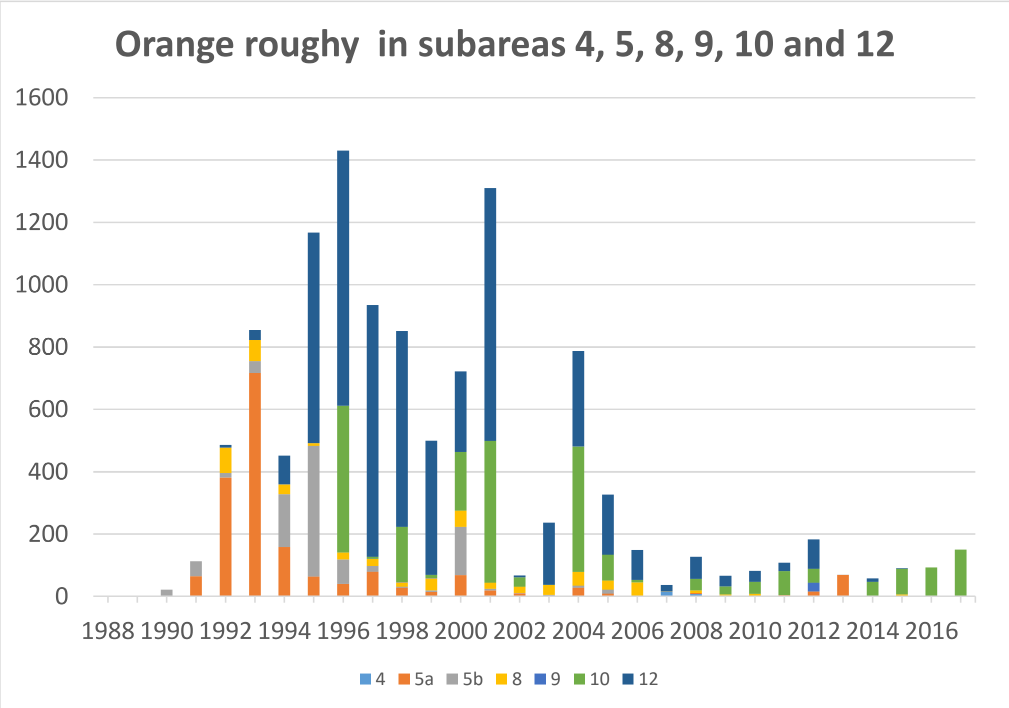


Figure 8.4.1. Time-series of orange roughy landings by subarea in all ICES areas (except subareas 6 and 7).

8.4.3 ICES Advice

The ICES advice was published in 2016 for 2017–2020. It applies to orange roughy in the Northeast Atlantic and states that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020.

8.4.4 Management measures

The EU TAC is set to for 0. The TAC applies to Community waters and EC vessels in international waters. Landings in relation to EU TAC are shown in Table 8.4.1.

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 8.4.1. 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	TAC (t)	EC vessels	Total
2005	102	71	278
2006	102	58	149
2007	44	16	36
2008	30	8	112
2009	15	5	62
2010	0	<1	83
2011	0	4	124
2012	0	28	167
2013	0	0	57
2014	0	0	58
2015	0	0	84
2016	0	0	0
2017	0	0	0

8.4.5 Data available

8.4.5.1 Landings and discards

Landings are in Table 8.4.0. In recent years, Faroe Islands continued the fishery for orange roughy. The Faroese catches were 93 and 150 tonnes in area 10, respectively in 2016 and 2017. In 2016 and 2017, small discards were reported by Spain in Division 8.c and 9.a, 500 and 225 kg respectively in 2016 and 2017.

8.4.5.2 Length composition

Sampling of lengths, weight and gender of orange roughy was carried out by trained crew members on board the single Faroese fishing vessel operating in this fishery. Samples were taken randomly from the catch. The length distribution of the catch is between 50–70 cm total length (Figure 8.4.1), 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 2011–2017 compared with the results from the experimental fishery in 1992–1998 (Thomsen, 1998) (Table 8.4.2).

Table 8.4.2. Mean length and weight by sex. From sampling by trained crew members on board the single Faroese fishing vessel targeting orange roughy.

Year	Area	Average length (cm)		Average weight (kg)		
		Female	Male	Female	Male	
1992–1998	Faroe Islands	61.4	58.6	4.4	3.7	Thomsen, 1998
	Hatton Bank	64.6	62.8	4.9	4.3	Thomsen, 1998
	Reykjanes Ridge	58.9	56.4	3.6	3	Thomsen, 1998
	North of Azores	60.6	59.7	3.9	3.7	Thomsen, 1998
2011		61.4	60.5	3.5	3.2	
2012		61.4	60.8	3.5	3.2	
2013		60.9	57.7	4.3	3.8	
2014		62.1	58.4	4.2	3.7	
2015		59.0	58.3	3.7	3.5	
2016		61.4	58.7	4.3	3.7	
2017		60.6	57.5	3.9	3.4	

8.4.5.3 Age composition

No data.

8.4.5.4 Weight-at-age

No data.

8.4.5.5 Maturity and natural mortality

No data.

8.4.5.6 Catch, effort and research vessel data

Catch and effort data were collected on a haul-by-haul basis in the Faroese fishery.

8.4.6 Data analysis

No data analysis was carried out in 2017

8.4.7 Management considerations

Due to its very low productivity, orange roughy can only sustain very low rates of exploitation. Currently, it is not possible to manage a sustainable fishery for this species. ICES recommends no directed fisheries for this species. Bycatches in mixed fisheries should be as low as possible.

The zero EU TAC implies that no EU fishing for the species is allowed. The application of the EU regulation 2016/2336, establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic implies that bycatch in EU trawl fisheries might be minor as a consequence of the ban of fishing deeper than 800 m with trawls in this regulation. Possible bycatch should be minor because the fraction of orange rough biomass occurring shallower than 800 m is minor or inexistent. With the exception of the black scabbardfish fishery in 9.a, where bycatch of orange roughy are not known to occur, there are no EU longline fishery at depth where orange roughy occurs.

In 2015–2017 all landings from the stock were caught in the NEACF RA.

8.4.8 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.

Ofstad, L.H. 2018. Faroese fishery of orange roughy in ICES areas 10 and 12. WD02 WGDEEP 2018.

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8.4.9 Tables

Table 8.4.0a. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division 5.a.

Year	Iceland	Total
1988	-	0
1989	-	0
1990	-	0
1991	65	65
1992	382	382
1993	717	717
1994	158	158
1995	64	64
1996	40	40
1997	79	79
1998	28	28
1999	14	14
2000	68	68
2001	19	19
2002	10	10
2003	0	0
2004	28	28
2005	9	9
2006	2	2
2007	0	0
2008	4	4
2009	<1	<1
2010	<1	<1
2011	4	4
2012	16	16
2013	54	54
2014	0	0
2015	0	0
2016	0	0
2017	0	0

Table 8.4.0b. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Division 5.b.

Year	Faroes	France	Total
1988	-	-	0
1989	-	-	0
1990	-	22	22
1991	-	48	48
1992	1	12	13
1993	36	1	37
1994	170	+	170
1995	419	1	420
1996	77	2	79
1997	17	1	18
1998	-	3	3
1999	4	1	5
2000	155	0	155
2001	1	4	5
2002	1	0	1
2003	2	3	5
2004		7	7
2005	3	10	13
2006	0	0	0
2007	0	1	1
2008	0	<1	<1
2009	<1	2	2
2010	<1	<1	<1
2011	0	0	0
2012	0	0	0
2013	1		1
2014	0		0
2015	0		0
2016	0	0	0
2017	0	0	0

Table 8.4.0c. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 8.

Year	France	Spain	E & W	Total
1988	-	-	-	0
1989	0	-	-	0
1990	0	-	-	0
1991	0	-	-	0
1992	83	-	-	83
1993	68	-	-	68
1994	31	-	-	31
1995	7	-	-	7
1996	22	-	-	22
1997	1	22	-	23
1998	4	10	-	14
1999	33	6	-	39
2000	47	-	5	52
2001	20	-	-	20
2002	20	-	-	20
2003	31			31
2004	43			43
2005	29			29
2006	43			43
2007	1			1
2008	8			8
2009	13			13
2010	8			8
2011	0			0
2012	0			0
2013	0			0
2014				0
2015	6			6
2016	0			0
2017	0	0	0	0

Table 8.4.0d. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 9.

Year	Portugal	Spain(1)	Total
1990	0	-	0
1991	0	-	0
1992	0	-	0
1993	0	-	0
1994	0	-	0
1995	0	-	0
1996	0	-	0
1997	0	1	1
1998	0	1	1
1999	0	1	1
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	4	0	4
2012	28		28
2013	0		0
2014			0
2015			0
2016			0
2017			0

Included in landings from Subarea 9 until 2002

Table 8.4.0e. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 10.

Year	Faroes	France	Norway	E & W	Portugal	Ireland	Total
1989	-	-	-	-	-		0
1990	-	-	-	-	-		0
1991	-	-	-	-	-		0
1992	-	-	-	-	-		0
1993	-	-	1	-	-		1
1994	-	-	-	-	-		0
1995	-	-	-	-	-		0
1996	470	1	-	-	-		471
1997	6	-	-	-	-		6
1998	177	-	-	-	-		177
1999	-	10	-	-	-		10
2000	-	3	-	28	157		188
2001	84	-	-	28	343		455
2002	30	-	-	-	-		30
2003		1					1
2004	384					19	403
2005	128	2					130
2006	8						8
2007	0						0
2008	37						37
2009	26						26
2010	39						39
2011	77						77
2012	45						45
2013	0						0
2014	47 (1)						47
2015	83 (1)						83
2016	93 (1)						93
2017	150 (1)						150

Landings 2014–2017 were from Division 10.b

Table 8.4.0f. Working Group estimates of landings of orange roughy, *Hoplostethus atlanticus*, in Subarea 12.

Year	Faroes	France	Iceland	Spain	E & W	Ireland	New Zealand	Russia	Total
1989	-	0	-	-	-			-	0
1990	-	0	-	-	-			-	0
1991	-	0	-	-	-			-	0
1992	-	8	-	-	-			-	8
1993	24	8	-	-	-			-	32
1994	89	4	-	-	-			-	93
1995	580	96	-	-	-			-	676
1996	779	36	3	-	-			-	818
1997	802	6	-	-	-			-	808
1998	570	59	-	-	-			-	629
1999	345	43	-	43	-			-	431
2000	224	21	-	-	2			12	259
2001	345	14	-	-	2		450	-	811
2002	+	6	-	-	-		0	-	6
2003		64				136	0	-	200
2004	176	131					0		307
2005	158	36					0		193
2006	81	15							96
2007	20								20
2008	71								71
2009	34								34
2010	35								35
2011	27								27
2012	94								94
2013	2								2
2014	11								11
2015	1								1
2016	0								0
2017	0								0

Table 8.4.0g. Orange roughy total international landings in the ICES area, excluding Subareas 6 and 7.

Year	4	5.a	5.b	8	9	10	12	All areas
1988		0	0	0	0	0	0	0
1989		0	0	0	0	0	0	0
1990		0	22	0	0	0	0	22
1991		65	48	0	0	0	0	113
1992		382	13	83	0	0	8	486
1993		717	37	68	0	1	32	855
1994		158	170	31	0	0	93	452
1995		64	420	7	0	0	676	1167
1996		40	79	22	0	471	818	1430
1997		79	18	23	1	6	808	935
1998		28	3	14	1	177	629	852
1999		14	5	39	1	10	431	500
2000		68	155	52	0	188	259	722
2001		19	5	20	0	455	811	1310
2002		10	1	20	0	30	6	67
2003		+	5	31	0	1	200	237
2004		28	7	43	0	403	307	788
2005		9	13	29	0	83	193	327
2006		2	0	43	0	8	96	149
2007	14		1	1	0	0	20	36
2008	7	4	<1	8	0	37	71	127
2009	0	1	2	3	0	26	34	66
2010	0	<1	<1	8	0	39	35	82
2011	0	4	0	0	<1	77	27	108
2012		16	0	0	28	45	94	183
2013		54	1	0	0	0	2	57
2014						47	11	58
2015				6		83	1	90
2016						93		93
2017						150		150

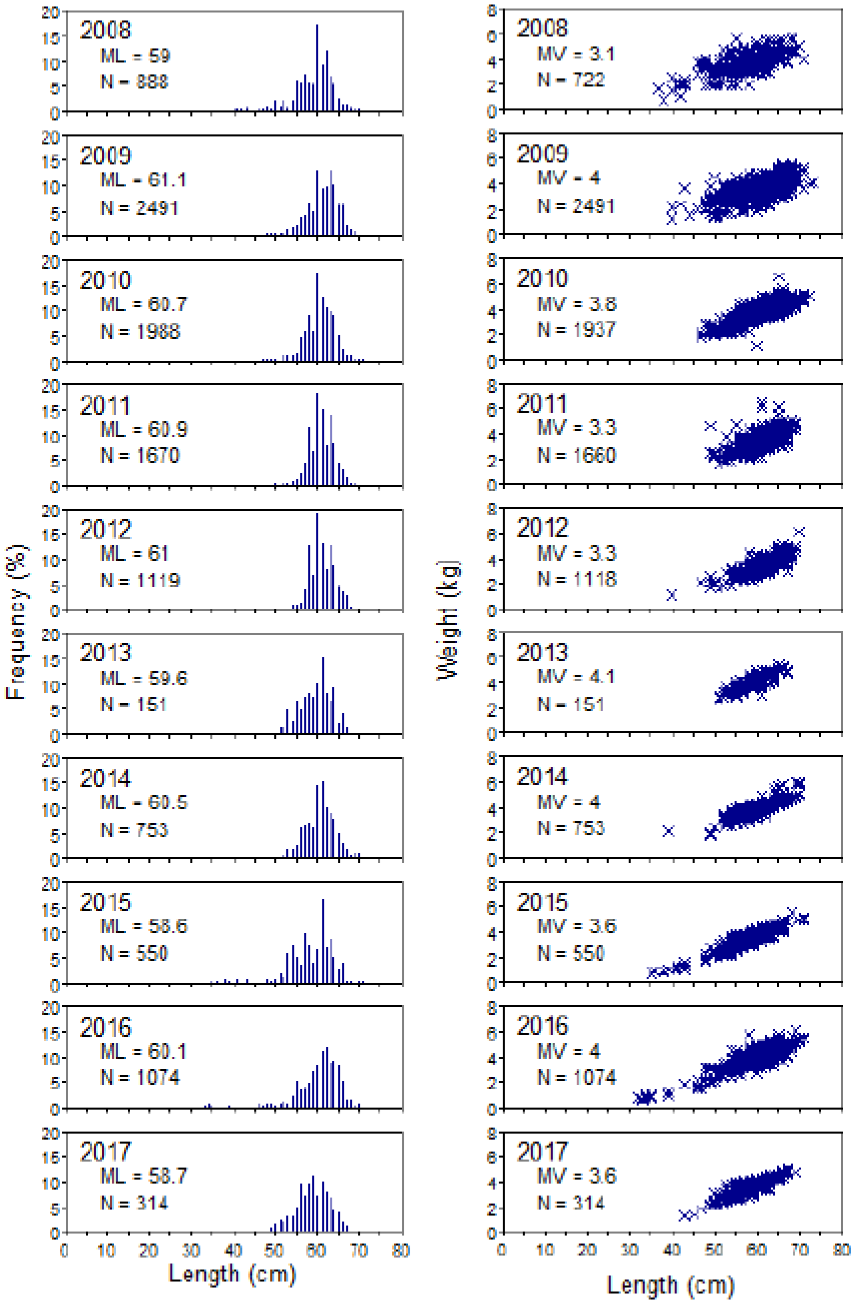


Figure 8.4.1. Length distribution and length–weight relation of orange roughy in Faroese catches 2008–2017.

9 Roundnose grenadier (*Coryphaenoides rupestris*)

9.1 Stock description and management units

ICES WGDEEP has in the past proposed four assessment units of roundnose grenadier in the NE Atlantic (Figure A.1):

- Skagerrak (3.a);
- The Faroe-Hatton area, Celtic sea (Divisions 5.b and 12.b, Subareas 5, 7);
- the Mid-Atlantic Ridge 'MAR' (Divisions 5.b, 12.c, Subdivisions 5.a1, 12.a.1, 14.b.1);
- All other areas (Subareas 1, 2, 4, 8, 9, Division 14.a, Subdivisions 5.a.2, 14.b.2).

This current perception is based on what are believed to be natural restrictions to the dispersal of all life stages. The Wyville-Thomson Ridge may separate populations further south on the banks and slopes off the British Isles and Europe from those distributed to the north along Norway and in the Skagerrak. Considering the general water circulation in the North Atlantic, populations from the Icelandic slope may be separated from those distributed to the west of the British Isles. It has been postulated that a single population occurs in all the areas south of the Faroese slopes, including also the slopes around the Rockall Trough and the Rockall and Hatton Banks but the biological basis for this remains hypothetical.

In 2007, WGDEEP examined the available evidence of stock discrimination in this species but, on the available evidence, was not able to make further progress in discriminating stocks. On this basis WGDEEP concluded there was no basis on which to change current practice.

Recent genetic analyses have brought forward new information regarding the issue of stock discrimination in the roundnose grenadier. White *et al*. (2010), investigating a limited geographic area in the central and eastern North Atlantic, found evidence of population substructure and local adaptation to depth. A study by Knutsen *et al*. (in press and summarized by Bergstad (WGDEEP 2012, WD 03)), covered a larger geographic range and significant genetic structure was observed. Parts of this structure, notably in peripheral (Canada) and bathymetrically isolated basins (Skaggerak and Trondheimsleia (off Norway)), obviously represent distinct biological populations with limited present connectivity. In other areas, off the British Isles (Irish slope, Rockall, and Rosemary Bank), the magnitude of genetic structure is weaker and less clearly defined. This lack of definition could reflect that samples from this area represent a single, widespread population. On the other hand, a recent study of coastal Atlantic cod (Knutsen *et al*., 2011) reported highly restricted connectivity (less than 0.5% adult fish exchanged per year) among two populations that were only weakly differentiated at microsatellite loci. This level is similar to that found between Greenland, Mid-Atlantic Ridge, Rockall, and Rosemary Bank, and the possibility that some of these sites represent distinct biological populations cannot be excluded.

9.2 Roundnose Grenadier (*Coryphaenoides rupestris*) in Division 5.b and 12.b, Subareas 6 and 7

9.2.1 The fishery

The majority of landings of roundnose grenadier from this area are taken by bottom trawlers. To the west of the British Isles, in Divisions 5.b, 6.a, 5.b.2 and Subareas 7, French trawlers catch roundnose grenadier in a multispecies deep-water fishery. The Spanish trawling fleet operates further offshore along the western slope of the Hatton Bank in ICES Divisions 6.b.1 and 12.b.

9.2.2 Landings trends

Official French landings have been revised for 2015 and are preliminary for 2016.

Evidence of substantial mismatches between observer and official Spanish data of landings in Subarea 6 and Division 12.b were presented at WGDEEP in 2010. This has raised some concerns regarding possible misreporting between the different species of grenadiers (*Coryphaenoidesrupestris*, *Macrourusberglax* and *Trachyrincusscabrus*). This issue is still present for 12.b and 6.b landings but according to official Spanish catch data it concerns a much smaller proportion of grenadier catch. Catches of *Macrourus berglax* and *Trachyrincus scabrus* were almost absent from the catches over the 2009–2011 period. In 2012, 6 t of *Trachyrincus scabrus* were reported in 6, 188 t in 12.b. 2013 landings data show around 179 t and 195 t of *Macrourus berglax* reported in 6.b and 12.b respectively. No landings were reported for *Trachyrincus scabrus* since 2014.

Over the past two decades, landings from Division 5.b, have reached more than 3800 t in 1991 and more than 2000 t in 2001. Between these two periods, the landings were low (less than 700 t in 1994). After 2001, landings decreased to about 1000 t in 2002 but increased further to about 1840 t in 2005 and then decreased to 74 t in 2011. In 2017, the provisional landings in 5.b are 30 t. These landings are exclusively from French and Faroese trawlers (Table 9.2.0a–f).

In Subarea 6, the highest landings were observed in 2001 (close to 15 000 t) and have decreased to around 1060 t in 2014. Provisional landings are 631 t in 2017. Most of these landings are caught by French and Spanish trawlers.

In Subarea 7, landings close to 2000 t were recorded in 1993–1994, recent annual landings are much lower (from 200400 t/year in 2005–2007, 34 t in 2011). No landings were reported in 2017.

In ICES Division 12.b, the recent fishery is exclusively from Spanish trawlers. After a peak to more than 12 200 t in 2004, reported landings have decreased to about 5335 t in 2009, 1580 t in 2011 and 832 t in 2014. Provisional landings were 599 t in 2016 and 1001 tons in 2017. There were significant Faroese landings in the mid-1990s, but this fishery disappeared in the 2000s and now amounts for a few tons some years. French fisheries have landed up to 1700 t in 2004 but to almost no landings since 2007.

The landings data are considered uncertain in Division 12.b, because of the possibility of unreported landings in international waters, which is a serious issue for assessment. In addition to this, none of the national landings data were reported by new ICES divisions and some landings were allocated to divisions according to working group knowledge of the fisheries.

9.2.3 ICES Advice

The ICES advice for 2017 and 2018 is: “ICES advises for Subareas 6 and 7 and Division 5.b that when the MSY approach is applied, catches should be no more than 3325 tonnes in 2017 and 3399 tonnes in 2018.If discard rates do not change from the average of the last three years (2013–2015), this implies landings of no more than 3052 tonnes in 2017 and no more than 3120 tonnes in 2018.

ICES advises for Division 12.b that when the precautionary approach is applied, catches should be no more than 572 tonnes in each the years 2017 and 2018. If discard rates do not change this implies annual landings of no more than 526 tonnes for each year."

9.2.4 Management

TACs for EU vessels for deep-water species have been set since year 2003. These TACs are revised every second year. The EU TAC and national quotas from member countries apply to all vessels in EU EEZ and to EU vessels in international waters.

For Division 5.b and Subareas 6 and 7, a TAC was set at 3052 t for 2017 and 3120 t for 2018. The TAC since EC regulation 1367/2014 was a combined value for roundnose grenadier and roughhead grenadier (*Macrourus berglax*). For 2017 and 2018, this TAC set by EC regulation 2016/2285 is only for roundnose grenadier but with the following rule that "any bycatches for roughhead grenadier should be limited to 1% of each Member State's quota of roundnose grenadier and counted against that quota, in line with the scientific advice".

The rationale for this change is explained in the EC regulation: "According to the advice provided by ICES, limited on-board observations show that the percentage of roughhead grenadier has been less than 1% of the reported catches of roundnose grenadier. On the basis of those considerations, ICES advises that there should be no directed fisheries for roughhead grenadier and that bycatches should be counted against the TAC for roundnose grenadier in order to minimise the potential for species misreporting. ICES indicates that there are considerable differences, of more than an order of magnitude (more than ten times), between the relative proportions of roundnose and roughhead grenadier reported in the official landings and the observed catches and scientific surveys in the areas where the fishery for roughhead grenadier currently occurs. There are very limited data available for this species, and some of the reported landing data are considered by ICES to be species misreporting. As a consequence, it is not possible to establish an accurate historical record of catches of roughhead grenadier".

In Subareas 8, 9, 10, 12 and 14 the TAC was set at 2623 t in 2017 and 2099 t for 2018. This TAC covers areas with minor roundnose grenadier catches (8, 9 and 10), part of this assessment area (Division 12.b, the western slope of the Hatton bank) and the Mid-Atlantic Ridge (Divisions 12.a,c and Subarea 14). The main countries having quotas allocations under this TAC are Spain and Poland. Therefore these quota allocations are based upon historical landings in 12.b for Spain and in 12.a,c (Mid-Atlantic Ridge) for Poland.

The table below summarizes the TACs in the two management areas and landings in the assessment area.

	5.b, 6, 7		8, 9, 10, 12, 14		Total international Landings 5.b, 6, 7, 12.b
	EU TAC	EU Landings	EU TAC	EU Landings 12.b	
2005	5253	5777	7190	8782	14558
2006	5253	4676	7190	4361	9037
2007	4600	3778	6114	4258	8036
2008	4600	3102	6114	2432	5534
2009	3910	4046	5197	5335	9381
2010	3324	3461	5197	2759	6220
2011	2924	1577	4573	1578	3155
2012	2546	1440	3979	666	9103
2013	4297	1517	3581	796	3841
2014	4297	1147	3223	832	2072
2015	4010	701	3644	314	1015
2016	4078	767	3279	599	1366
2017**	3052	661	2623	1001	1662
2018**	3120		2099		

*** provisional.**

**** combined TAC for roundnose grenadier and roughhead grenadier.**

[1]: official + unallocated catches.

After the introduction of TACs in 2003 and 2005, the reported landings have decreased. However, the observed decrease may be confounded by problems related to species reporting particularly in 12.b.

In addition to TACs, further management measures applicable to EU fleets are a licensing system, fishing effort limits, the obligation to land the fish in designated harbours and a regulation for on-board observations according to Council Regulation (EC) No 2347/2002 of 16 December 2002. In the Faroes waters, the catch of roundnose grenadier is subject to a minimum size of 40 cm total length, other regulations that may apply to roundnose grenadier are detailed in the overview section.

9.2.5 Data available

9.2.5.1 Landings and discards

Landings time-series data per ICES areas are presented in Table 9.2.0.

Landings data by new ICES areas were available from France, Norway and UK (England and Wales and Scotland) from 2005. No other country provided data by new ICES area. Catch in Subarea 12 were allocated to Division 12.b (western Hatton bank) or 12.a,c (Mid-Atlantic Ridge) according to knowledge of the fisheries from WG members.

Catch and discards by haul were available from observer programmes from France and Spain.

French observer programme: Discards data are available routinely from France since 2008 through the Obsmer (observers at sea) program. The length distributions of discards from all these observations has been consistent and stable for the period 2004–2010 with about 30% of the weight and 50% of the number of roundnose grenadier caught being discarded, because of small size. This figure is higher than from previous sampling programme where the discarding rate in the French fisheries was estimated slightly above 20% in 1997–1998 (Allain *et al*., 2003). These differences may have come from a combination of changes in the depth distribution of the fishing effort and a decrease in the abundance of larger fish as visible in the landings. Since then, the discard rate has been reduced to 12% of the weight of the catch (29% in number of individuals) in 2011 and 6% in weight in 2012 (24% in numbers). In 2013, discards accounts for 15% of the catch in weight and 32% in number. In 2014, discards accounts for 6% of the catch in weight and 16% in number. In 2015 and 2016, discards accounted for 5% of the catch in weight and 15 to 17% in number. In 2017, discards were 6% in weight and 15% in number.

The reduction of discards is related to:

1) a change of depth of the French fleet towards shallower waters; and
2) attempts to avoid areas where discards are high.

Spanish Observer programme (Hatton Bank): discard data are available from the Spanish Observer Programme. For the period 2004–2015,observers have covered on average 15±10% (range 3–39%) of the fleet fishing days in Division 6.b, and 12±8% (range 2–33%) in Division 12.b. Although occasionally the discards reached 26% of the total observed weight catch in the period 1996–2015, they are negligible in most sampled months. Annual average discards are 7% (range 0–21%) in weight in both Divisions 6.b and 12.b (range 0–26%). These discards, however, correspond to undersized individuals. Discards data for 2011 were not presented as they are considered to be inaccurate but provided again for 2012 and onwards. In 2017, in area 6.b and 12.b, the discard rate is around 4.7% in weight (5.05% in 6.b and 4.6% in 12.b).

9.2.5.2 Length composition of the landings and discards

Length composition of landings and discards were available from France and Spain covering different periods and areas (Figures 9.2.1–9.2.3).

9.2.5.3 Age composition

No new data.

9.2.5.4 Weight-at-age

No new data.

9.2.5.5 Maturity and natural mortality

No new data.

9.2.5.6 Research vessel survey and cpue

Research vessel survey

Data were available from the Marine Scotland deep-water survey since the years 1998 and from stats squares 41E0 through 45E0. This survey operates now on a biannual basis therefore no survey was carried out in 2016. Last survey occurred in 2015.

Lpues from the French trawl fishery to the west of the British Isles

Haul by haul data from French skipper's personal tallybooks were updated for 2014 and 2015. In 2015, data from only one boat were available therefore the value this year was not included into the assessment. Discards are not available from those datasets therefore only lpues are calculated and provided for roundnose grenadier. Owing to the decreasing of quotas in recent years, the fishery now operates on a smaller area. Further, in 2012 data for only two vessels were available at the time of the working group. As a result, the data only covered two of the five small areas previously considered for this lpue series. The time-series should then be interpreted with caution. The observed lpue is unlikely to represent properly the trend in the stock because the change in abundance in unfished areas are not considered. Indices have not been compiled since 2016 due to the very low number of boats.

Lpue from the Faroese commercial fleet

The commercial cpue series is from trawlers, where the criteria were that grenadier contributed more than 30% of the total catch.

Logbook data for the period 1985–2009 have been quality controlled. The cpue are from a subset of the commercial ships: all available logbooks from 6–8 otterboard trawlers mainly fishing in deep water, 4–8 pairtrawlers fishing on the slope from about 150 m and 4–5 longliners (GRT >110). The data for 2010–present are selected directly from the database at the Faroese Coastal Guard and all available logbooks have been available. For comparison the same ships were selected as used previously in the WG.

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

Roundnose grenadier is only fished by large trawlers and the main fishing area is on the slope around the Faroe Bank.

The cpue data were available in 2014 but the figure is not accurate because of a very small number of hauls with more than 30% of grenadier since 2011 (one in 2014).

Lpue from the Spanish commercial fleet in 12.b

Some basic lpue indices were estimated for the Spanish fleet in order to include the 12.b landings into the assessment. The level of aggregation (month by month total landings and horsepower units) did not permit to estimate a proper standard deviation. The time-series was updated for 2016 and 2017.

9.2.6 Data analyses

9.2.6.1 Benchmark assessments

Trends from length distribution and individual weight

For France, the modal discarded length has remained constant (Figures 9.2.1–9.2.2) at around 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 17cm in 2017 (Figure 9.2.4).

Size–frequency data provided by Spain for the period 2002–2015 in 6 and 12.b shows the modal length (PAFL) of landings to be closely similar between divisions with female being larger than male by around 2 cm (Figure 9.2.5). The modal length of discards is around 9.5 cm. Over the period 2002–2017, 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 2009–2017, in both 6 and 12.b, the mean length in landings has increased by two centimetres for both males and females in 2010–2011. Few discards data were available by the time of the working group. No new information is available on Spanish discards.

The difference of modes of the length distributions of landed catch between the Spanish fleet in Divisions 6 and 12.b and the French fleet is possibly because of different sorting habits in relation to different markets.

It is therefore important that length distribution of the landings and discards are provided to the working group by all fleets exploiting the stock.

Time-series of mean individual weight from the Marine Scotland Deepwater Science survey shows no clear trends because of big confidence intervals. Average weight is around 0.42 kg in 2016 and 0.73 kg in 2017 but with very wide confidence intervals (Figure 9.2.6).

Trends in abundance indices

Marine Scotland Deep-water Science survey (MSDSS)

The working group was provided this year with an update of the survey indices. There is an increasing trend of abundance over the period 2011–2013. Since 2015, there is however a decrease and the index was close to the long term average of the series. (Figure 9.2.7).

Lpue from the Faroese commercial fleet

The cpue is stable for the period 2009–2010 although it is above average in 2011. After that period, the small number of hauls carrying more than 30% of grenadier makes cpue estimates highly inaccurate (Figure 9.2.8). No new data has been available since 2014.

Lpue from the Spanish commercial fleet in 12.b

The lpue has declined over the time-series stable with a peak in 2003 followed by a decline until 2005. A second peak occurred in 2008. The lpue has been declining since then (Figure 9.2.9).

Lpue from the French tallybooks

The overall trend in abundance (Figure 9.2.10–9.2.11) shows a decline from 2000 to 2003 and has been stable until 2015 when the series stops. Due to the low number of boats, the time series is no longer usable for assessment.

Bayesian surplus production model

A Bayesian surplus production model is used for this stock and results are used as indicators of trends (see stock annex).

Based upon what is believed to be natural restrictions to the dispersal of all life stages, the area of this stock is considered to include Division 5.b and 12.b and Subareas 6 and 7 but due to uncertainties in the catch in Division 12.b, assessment has been restrained to 5.b, 6, 7 in 2008 and 2009. The WKDEEP benchmark agreed in 2010 that "landings and effort data in Division 12.b should be included into the assessment if they become reliable. A separate assessment for Division 12.b should be carried out separately from the one for Division 5.b, and Subareas 6, 7." The reference assessment ("Ref") is therefore restrained to 5.b, 6, 7 while a full exploratory assessment including 12.b is presented further in this section.

The following datasets were used for the benchmark assessment:

- Landings in 5.b, 6, 7 (1988–2016);
- Life-history parameters to provide initial estimates for the model (Figure 9.2.12).

The benchmark assessment also used to use French tallybooks in 6. Due to the decline of activity of this fleet and the low number of boats now involved, the series is no longer usable for the assessment. Therefore, the assessment uses overall standardized abundances indices from Marine Scotland Science Deepwater Survey (2000–2017); this series replaces the French tallybooks in 6. It is considered a suitable replacement because the data selection is made for the same area than for the French tallybook and the survey sampling is considered to be an independent source of information. This index was not available when the assessment was initially benchmarked in 2010.

The various time-series used for those benchmark and exploratory runs are listed in Table 9.2.1.The summary of each assessment output is on Table 9.2.2.

Diagnostics plot are available on Figures 9.2.13–9.2.14 and indicates an average fit of the model. The predicted LPUE is used as an indicator of the fit of the distribution of r estimates based on the available data and indices and show a rather smoothed signal in comparison with the high contrast of the indices. Moreover, the decreasing of observed abundance in the MSDSS survey is translated in a nearly flat CPUE for the same period.

Outputs of the assessments are presented on Figure 9.2.15.

Harvest rate H_y can be seen as a proxy of fishing mortality as it is the ratio between landings and stock biomass B_y on year *y*. The surplus production model provides also B_{MSY} and H_{MSY} indicators. B_{MSY} is assumed by the model to be half of K, the carrying capacity, considered here by the model to be equal to stock biomass estimates in 1988. H_{MSY} is the ratio between a sustainable catch C_{MSY} and $B_{MSY.}$ C_{MSY} is equal to r*K/4, *r* being the intrinsic growth rate of the population. For this particular value of catch, the stock biomass is expected to reach a theoretical equilibrium.

The shape of the harvest rates is driven by the shape of the landings time-series and has been over H_{MSY} since 1992 until 2007, peaking over the period 2000–2004 at around 0.25. Since then, the median of the harvest rate distribution has been close or below H_{MSY} which is around 0.09+/-0.01. Stock biomass has been continuously below B_{MSY} since 2002 with lowest value reached in 2006. Since 2013, the median biomass has been above $B_{MSY.}$In comparison to previous assessment, the use of the MSDSS indices results in a more vigorous state of the stock than what has been previously seen with the tallybooks indices. However, in both cases, the trends are strictly the same.

Virgin biomass was estimated to be around 135 kt (+/-2 kt). The magnitude of this number is in line with estimates from previous working groups. Stock biomass in 2017 is around 88 kt (+/-14 kt) which a slight increase of 9kt in comparison of the similar run carried out at WGDEEP 2017 based on the MSDSS indices stronger than in previous year as a consequence . B_{MSY} is estimated to be 68 kt (+/-1 kt). MSY $B_{trigger}$ is set at 34 kt (half of BMSY value).

In 2017, the probability of this stock (5.b, 6, 7) to be above MSY $B_{trigger}$ is 100%, 85% to be above B_{MSY}, 100% to be below H_{MSY} (Table 9.2.2). Model outputs suggest that any TAC set below C_{MSY} (6115 t +/- 613 t) will allow the stock to converge to B_{MSY}.

This assessment does not change the perception that biomass is recovering after a low historical level in 2006 however at a faster pace than what has been estimated in previous years. This is directly related to the change of indices. The exploitation rate appears to be below MSY limits and biomass estimates show an upwards trend.

9.2.6.2 Exploratory assessments in 5.b, 6, 7 and 12.b

The benchmarked assessment methodology uses data only from 5.b, 6 and 7.

An additional exploratory assessment is always carried out to take account of landings in 12.b.Run "5.b-6-7-12.b" is the standard run using 12.b landings data. MSSDS data and Spanish standardized lpues are combined with a weighting corresponding to the amount of landings in 12.b and 5.b, 6, 7.

The inclusion of landings of 12.b requires a combined abundance indices from the landings and efforts of the Spanish fleet 12.b and the indices from the Marine Scotland Deepwater Science Survey (Figure 9.2.16). The weighting between indices relies on proportion of landings between the 5.b,6,7 regions and 12.b (Table 9.2.1).

Figure 9.2.17 shows the estimates of biomass and harvest rates. Harvest rates have been over H_{MSY} since 1999 with a peak in 2004 before declining to levels slightly above H_{MSY} since 2008. Harvest rates were below H_{MSY} in 2011 and then since 2013.

Biomass has been continuously below B_{MSY} since 2003 with 2006 as the lowest level and has slowly increased since then to close or slightly above B_{MSY} since 2016. The carrying capacity was estimated to be around 228 kt+/-9.8 kt. Stock biomass in 2017 is 122 kt (+/- 24 kt). B_{MSY} is estimated to be 114 kt +/- 4.9 kt. From this run, the probability of this stock to be above MSY $B_{trigger}$ (57 kt) is 100%, 49% to be above B_{MSY} and 100% to be below H_{MSY}. Median C_{MSY} is estimated to be 9088 t +/- 906 t. Any catch below this level should lead to an increase of stock biomass. Those values are close to those in previous year despite the change of indices. The major change is in stock biomass estimates which has sharply increased by around 30kt in 2016 as a likely consequence of the use of the MSDSS survey rather than the French tallybooks.

It is important to note that the confidence over this assessment including 12.b is lower than for the one restricted to areas 5.b, 6, 7 because of the uncertainty of the landings in 12.b linked to species reporting and evidence of reporting from other areas. Landings in 12.b contributes strongly therefore it should be emphasized that Member States should provide accurate landings and effort information regarding the fishing activity in 12.b as uncertainties associated with the high level of landings in 12.b strongly impact any assessment.

Short-term forecasts

Short-term forecast were carried out this year.

The Bayesian context allows introducing the notion of risk into the assessment through catch options and probabilities to be above or below limits such as MSY indicators. Several stocks at ICES provide probabilities with catch options (e.g. Bay of Biscay anchovy, Greenland halibut).

With this stock on a rebuilt trajectory, several catch options were tested to provide projections of the potential catches in the next years and the probability to reach B_{MSY}.

Several runs were considered forecasting the period 2018–2026. For 2018, as the TACs are not taken in the stock area, the catches were assumed to be equal to the harvest rate of 2017. For the following years, several catch options were considered.

- Run 1: *Status quo* landings: catches remains constant over time according to the TAC set by EU for 2016. TAC in 2016 is then used each following years.
- Run 2: TAC_y gradually decreases every two years by 15%.
- Run 3: TAC_y follows the ICES WKFRAME3 approach.
- Run 4: Closure of the fishery (TAC_y=0).
- Run 5: TAC so that harvest rate stays at H_{MSY} levels.
- Additional runs for a range of constant TAC between 500t to 8000t in 5b, 6, 7 and 11000t in 12b.
- Additional runs based on CMSY, upper and lower H_{MSY} levels

Run 3 is based on the ICES WKFRAME3 approach. The following rules are applied:

- If B_y is below B_{MSY},

$$H_y = H_{MSY} \cdot \frac{B_{y-1}}{B_{MSY}}$$

As catch level C_y is simply H_y*B_y, recommended TAC_y would be expected to be:

$$TAC_y = H_{MSY} \cdot \frac{{B_{y-1}}^2}{B_{MSY}}$$

- If B_y is above or equal to B_{MSY},

$$TAC_y = H_{MSY} \cdot B_{y-1}$$

Run 6 has constant harvest rates set at H_{MSY}. In order to keep H at HMSY, it is necessary to project the available biomass B_y the upcoming year using the surplus production model equation. This gives the following harvest control rule:

$$TAC_y = H_{MSY} \cdot \frac{B_{y-1} + r \cdot B_{y-1} \cdot \left(\frac{1 - B_{y-1}}{K}\right)}{1 + H_{MSY}}$$

The corresponding TACs are shown in the table below. As the median biomass is mainly above B_{MSY}, for many catch options, the convergence toward MSY target is likely to reduce stock biomass year after year compared to actual level.

In regards to reference points, the results of the different scenarios are discussed below for both reference and survey based runs. Results are expressed as probabilities to reach a given threshold (BMSY, MSY Btrigger, HMSY).

Results have to be considered carefully especially considering the EU TAC because the catch option here refers to catch opportunities for roundnose grenadier only. EU TAC is combined for roughhead and roundnose grenadier.

Probability of being above MSY Btrigger

Contrary to previous years, MSY Btrigger is no longer equal to B_{loss} (biomass in 2006) but is half of B_{MSY}. In all scenarios, biomass will stay well above MSY Btrigger. In the whole 5b-6-7-12b area, any global TAC in the range tested will maintain the probability above 93% over the period 2018–2028.

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Run 5b.6.7	Closure	661	0	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	661	500	500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	85% TAC	661	562	562	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Hsq = H2017	661	698	732	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2017 Catch	661	767	767	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	661	1000	1000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	661	2000	2000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	661	3000	3000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=4000t	661	4000	4000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=5000t	661	5000	5000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=6000t	661	6000	6000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cmsy	661	6115	6115	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Lower Hmsy	661	6352	6285	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=7000t	661	7000	7000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	TAC=8000t	661	8000	8000	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.97
	Hmsy TAC	661	8144	7921	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	WKFRAME3	661	8402	8121	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97
	TAC=9000t	661	9000	9000	1.00	1.00	1.00	1.00	1.00	0.99	0.97	0.97	0.96	0.94
	Upper Hmsy	661	9935	9496	1.00	1.00	1.00	1.00	1.00	0.99	0.97	0.97	0.96	0.95
	TAC=10000t	661	10000	10000	1.00	1.00	1.00	1.00	0.99	0.97	0.96	0.94	0.92	0.86
	TAC=11000t	661	11000	11000	1.00	1.00	1.00	1.00	0.98	0.96	0.94	0.91	0.83	0.75

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Exploratory Run 5b.6.7.12b	Closure	1662	0	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	1662	500	500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	1662	1000	1000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2016 Catch	1662	1366	1366	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	85% TAC	1662	1413	1413	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Hsq	1662	1762	1859	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	1662	2000	2000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	1662	3000	3000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=4000t	1662	4000	4000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=5000t	1662	5000	5000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=6000t	1662	6000	6000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=7000t	1662	7000	7000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=8000t	1662	8000	8000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Lower Hmsy	1662	8004	8055	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=9000t	1662	9000	9000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
	Cmsy	1662	9088	9088	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
	TAC=10000t	1662	10000	10000	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
	Hmsy TAC	1662	10262	10164	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	WKFRAME3	1662	10369	10253	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
	TAC=11000t	1662	11000	11000	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.96
	Upper Hmsy	1662	12519	12201	1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.95	0.94

Probability of being above B_{MSY}

For any scenarios with catch below 6000t, the probability to be above B_{MSY} will increase in the 5.b,6,7 run. Values above will lead to a slow decrease of probability, the lowest one being 75%. For the whole 5.b,6,7,12.b run, any catch below 9000t will increase the probability to reach B_{MSY}.

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Closure	661	0	0	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	661	500	500	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	85% TAC	661	562	562	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Hsq = H2017	661	698	732	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2017 Catch	661	767	767	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	661	1000	1000	0.95	0.97	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	661	2000	2000	0.95	0.96	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	661	3000	3000	0.95	0.96	0.97	0.97	0.97	0.98	0.99	1.00	1.00	1.00
	TAC=4000t	661	4000	4000	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.98
Run 5b.6.7	TAC=5000t	661	5000	5000	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
	TAC=6000t	661	6000	6000	0.95	0.94	0.94	0.93	0.93	0.93	0.93	0.92	0.92	0.92
	Cmsy	661	6115	6115	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.91
	Lower Hmsy	661	6352	6285	0.95	0.94	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.91
	TAC=7000t	661	7000	7000	0.95	0.94	0.93	0.92	0.91	0.90	0.86	0.85	0.83	0.81
	TAC=8000t	661	8000	8000	0.95	0.93	0.92	0.90	0.85	0.82	0.78	0.73	0.68	0.62
	Hmsy TAC	661	8144	7921	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	WKFRAME3	661	8402	8121	0.95	0.93	0.92	0.89	0.85	0.83	0.80	0.77	0.74	0.70
	TAC=9000t	661	9000	9000	0.95	0.93	0.91	0.85	0.79	0.72	0.63	0.58	0.49	0.43
	Upper Hmsy	661	9935	9496	0.95	0.92	0.88	0.83	0.76	0.69	0.63	0.59	0.56	0.51
	TAC=10000t	661	10000	10000	0.95	0.92	0.86	0.80	0.70	0.60	0.50	0.41	0.30	0.20
	TAC=11000t	661	11000	11000	0.95	0.92	0.84	0.74	0.60	0.47	0.33	0.23	0.13	0.07

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Closure	1662	0	0	0.77	0.86	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00
	TAC=500t	1662	500	500	0.77	0.86	0.93	0.97	0.98	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	1662	1000	1000	0.77	0.85	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00
	TAC=2016 Catch	1662	1366	1366	0.77	0.85	0.92	0.95	0.98	0.99	1.00	1.00	1.00	1.00
	85% TAC	1662	1413	1413	0.77	0.85	0.92	0.95	0.98	0.99	1.00	1.00	1.00	1.00
	Hsq	1662	1762	1859	0.77	0.85	0.91	0.95	0.97	0.98	0.99	1.00	1.00	1.00
	TAC=2000t	1662	2000	2000	0.77	0.85	0.90	0.94	0.97	0.98	0.99	1.00	1.00	1.00
	TAC=3000t	1662	3000	3000	0.77	0.84	0.89	0.93	0.95	0.97	0.98	0.99	0.99	1.00
Exploratory	TAC=4000t	1662	4000	4000	0.77	0.83	0.86	0.91	0.93	0.95	0.97	0.98	0.98	0.99
Run 5b.6.7.12b	TAC=5000t	1662	5000	5000	0.77	0.81	0.85	0.88	0.91	0.93	0.94	0.95	0.97	0.97
	TAC=6000t	1662	6000	6000	0.77	0.80	0.83	0.85	0.88	0.89	0.91	0.92	0.93	0.94
	TAC=7000t	1662	7000	7000	0.77	0.78	0.80	0.83	0.84	0.85	0.86	0.88	0.88	0.89
	TAC=8000t	1662	8000	8000	0.77	0.78	0.78	0.78	0.79	0.79	0.80	0.81	0.82	0.82
	Lower Hmsy	1662	8004	8055	0.77	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.80	0.80
	TAC=9000t	1662	9000	9000	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.71
	Cmsy	1662	9088	9088	0.77	0.76	0.74	0.73	0.73	0.72	0.71	0.71	0.70	0.70
	TAC=10000t	1662	10000	10000	0.77	0.73	0.71	0.68	0.67	0.66	0.63	0.61	0.59	0.58
	Hmsy TAC	1662	10262	10164	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
	WKFRAME3	1662	10369	10253	0.77	0.72	0.70	0.68	0.66	0.64	0.62	0.60	0.59	0.58
	TAC=11000t	1662	11000	11000	0.77	0.72	0.68	0.64	0.60	0.57	0.55	0.52	0.49	0.46
	Upper Hmsy	1662	12519	12201	0.77	0.69	0.64	0.58	0.54	0.51	0.47	0.45	0.44	0.42

Probability of being below HMSY

In 5b,6,7, the probability of being below H_{MSY} will remain at 100% for any catch below 5000t. It will then decrease and be below 50% for catches higher than 8000t. In 5b,6,7 and 12.b, the probability will remain above 95% for any catches below 7000t.

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Closure	661	0	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	661	500	500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	85% TAC	661	562	562	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Hsq = H2017	661	698	732	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2017 Catch	661	767	767	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	661	1000	1000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	661	2000	2000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	661	3000	3000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=4000t	661	4000	4000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Run 5b.6.7	TAC=5000t	661	5000	5000	1.00	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97
	TAC=6000t	661	6000	6000	1.00	0.90	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.85
	Cmsy	661	6115	6115	1.00	0.88	0.87	0.86	0.85	0.85	0.85	0.85	0.84	0.83
	Lower Hmsy	661	6352	6285	1.00	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	TAC=7000t	661	7000	7000	1.00	0.74	0.70	0.69	0.65	0.63	0.61	0.59	0.59	0.57
	TAC=8000t	661	8000	8000	1.00	0.53	0.49	0.45	0.41	0.35	0.31	0.29	0.26	0.22
	Hmsy TAC	661	8144	7921	1.00	0.24	0.23	0.23	0.21	0.25	0.21	0.22	0.26	0.24
	WKFRAME3	661	8402	8121	1.00	0.45	0.45	0.46	0.46	0.46	0.46	0.47	0.48	0.48
	TAC=9000t	661	9000	9000	1.00	0.32	0.26	0.21	0.17	0.14	0.12	0.10	0.05	0.04
	Upper Hmsy	661	9935	9496	1.00	0.17	0.17	0.17	0.17	0.18	0.19	0.19	0.20	0.22
	TAC=10000t	661	10000	10000	1.00	0.16	0.13	0.09	0.04	0.03	0.03	0.02	0.01	0.03
	TAC=11000t	661	11000	11000	1.00	0.08	0.03	0.02	0.01	0.01	0.00	0.00	0.02	0.04

	Scenario	Catch 2018	Catch option 2019	Catch option 2020	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	Closure	1662	0	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=500t	1662	500	500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=1000t	1662	1000	1000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2016 Catch	1662	1366	1366	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	85% TAC	1662	1413	1413	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Hsq	1662	1762	1859	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=2000t	1662	2000	2000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=3000t	1662	3000	3000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exploratory	TAC=4000t	1662	4000	4000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Run 5b.6.7.12b	TAC=5000t	1662	5000	5000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	TAC=6000t	1662	6000	6000	1.00	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99
	TAC=7000t	1662	7000	7000	1.00	0.93	0.94	0.94	0.94	0.94	0.94	0.95	0.95	0.95
	TAC=8000t	1662	8000	8000	1.00	0.84	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.86
	Lower Hmsy	1662	8004	8055	1.00	0.84	0.84	0.84	0.84	0.84	0.83	0.83	0.83	0.83
	TAC=9000t	1662	9000	9000	1.00	0.69	0.69	0.68	0.68	0.68	0.67	0.67	0.67	0.66
	Cmsy	1662	9088	9088	1.00	0.67	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65
	TAC=10000t	1662	10000	10000	1.00	0.53	0.52	0.51	0.51	0.49	0.48	0.47	0.46	0.44
	Hmsy TAC	1662	10262	10164	1.00	0.22	0.20	0.24	0.20	0.22	0.18	0.21	0.21	0.20
	WKFRAME3	1662	10369	10253	1.00	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	TAC=11000t	1662	11000	11000	1.00	0.39	0.38	0.36	0.33	0.32	0.30	0.30	0.28	0.27
	Upper Hmsy	1662	12519	12201	1.00	0.24	0.24	0.25	0.25	0.25	0.26	0.26	0.26	0.27

9.2.7 Management considerations

The harvest rate for roundnose grenadier appears to be below H_{MSY} in 5.b, 6, 7 and also for runs in 12.b. SSB is below B_{MSY} in all regions and at low levels. For 5.b, 6, 7, the assessment suggests a slow recovery of the stock while the inclusion of 12.b landings suggests a more stable situation.

9.2.8 Benchmark preparation

This stock has been benchmarked in 2010 and the assessment methodology based on the surplus production model has not been revised since then. At that time it was considered the assessment was considered to be of category 3. In 2012, this stock assessment was classified as category 1 due to development of short-term forecast.

Yet, some issues have not been resolved since the 2010 benchmark.

- Stock area includes 12.b but the current assessment is only considered to be reliable for 5b, 6, 7 because 12.b landings are likely to include landings of roughhead grenadier (*Macrourus berglax*). Therefore the assessment for the whole area has only be exploratory since 2010. Some work is needed to clean out this time-series if accurate catch data for the different grenadier species are available or if the composition of species is known from observers at sea. An attempt to update the landings data in 6 and 12.b was done in 2018 with no revision to the data due to the lack of additional information. Discard time-series is available since 1996 and properly quantified since then. It is supposed from various exploratory runs that discard rates might have been higher at the beginning of the fishery. Because of this, discards have not been included in the current assessment and the impact of this is unknown. The reconstruction of a time-series of discard rates is required for the whole time-series. No new information has been available since then. Prior estimates of discards can only be addressed at the moment through assumptions to be tested.

Additionally, some issues have appeared since then:

- Estimates of r (intrinsic growth rates of the surplus production model) are possibly too high in regards of stock dynamics. This should be explored from modelling and data exploration. The lack of contrast between indices from observation and those predicted using estimates of r is a concern as trends from the model seem to increasingly differ over the years.
- A workaround to the problem above would be to use another model taking account additional information that are not currently taken account by the model such as length distributions and giving more value to recent information from survey indices.
- The French tallybooks, due to the decrease of effort and number of vessels in the deep-water French fisheries are no longer representative to derive abundance indices. The Marine Scotland Science Deep-water survey is available on a biannual basis in line with advisory years and a sufficient time-series and has been integrated into the assessment over the last 3 years. However, comparisons with the French tallybooks show some strong differences of biomass which leaves some doubt on biomass estimates. The reason for those differences have to be investigated.
- Multi Year Catch Curves are no longer available. Other indicator of stock status may be considered using for example, length or individual weight.

9.2.9 Table and Figures

Table 9.2.0a. Working Group estimates of landings of roundnose grenadier from Division 5.b.

Year	Faroes	France	Nor way	Germ any	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
1988				1				1
1989	20	181		5	52			258
1990	75	1470		4				1549
1991	22	2281	7	1				2311
1992	551	3259	1	6				3817
1993	339	1328		14				1681
1994	286	381		1				668
1995	405	818						1223
1996	93	983		2				1078
1997	53	1059						1112
1998	50	1617						1667
1999	104	1861	2			29		1996
2000	48	1699		1		43		1791
2001	84	1932						2016
2002	176	774				81		1031
2003	490	1032				10		1532
2004	508	985	0	0	6	0	76	1575
2005	903	884	1	0	1	0	48	1837

Year	Faroes	France	Norway	Germany	Russia/ USSR	UK (E+W)	UK (Scot)	TOTAL
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

***Provisional.**

Table 9.2.0b. Working Group estimates of landings of roundnose grenadier from Subarea 6.

Year	Estonia	Faroes	France	Germany	Ireland	Lithuania	Norway	Poland	Russia	Spain	UK (E+W)	UK (Scot)	TOTAL
1988		27		4							1		32
1989		2	2211	3								2	2218
1990		29	5484	2									5515
1991			7297	7									7304
1992		99	6422	142			5				2	112	6782
1993		263	7940	1								1	8205
1994			5898	15	14							11	5938
1995			6329	2	59							82	6472
1996			5888									156	6044
1997		15	5795		4							218	6032
1998		13	5170				21			3			5207
1999			5637	3	1					1			5642
2000			7478		41		1			1002	1	433	8956
2001	680	11	5897	6	31	137	32	58	3	6942	21	955	14773
2002	821		7209		12	1817		932			6	741	11538
2003	52	32	4924		11	939		452	3			185	6598
2004	26	12	4574	0	8	961	0	13	72	1991	0	72	7729
2005	80	24	2897	0	17	92	1	0	71	468	0	44	3694
2006	34	25	1931	0	5	112	0	0	0	252	0	15	2374
2007	0	10	1552	0	2	31	0	0	0	354	0	4	1953
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

Year	Estonia	Faroes	France	Germany	Ireland	Lithuania	Norway	Poland	Russia	Spain	UK (E+W)	UK (Scot)	TOTAL
2010	0	13	1271	0	0	0	2	0	0	189	1.2	23	1500
2011	0	4	1112	0	0	0	0	0	0	335.89	0	8	1460
2012	0	0	1088	0	0	0	0	0	0	257.87	2	0	1348
2013	0	0	934	0	0	0	0	0	0	475.89	6.2032	0	1416
2014	0	0	630	0	0	0	0	0	0	429.4	0	0	1060
2015	0	0	364	0	0	0	0	0	0	274.51	0	0	638
2016	0	0	422	0	0	0	0	0	0	298.4	0	5.368	725
2017*	0	0	99	0	0.5	0	0	0	0	523.32	0	8	631

*** Provisional.**

Table 9.2.0c. Working Group estimates of landings of roundnose grenadier from Subarea 7.

Year	Faroes	France	Ireland	Spain	UK (Scot)	TOTAL
1988						0
1989		222				222
1990		215				215
1991		489				489
1992		1556				1556
1993		1916				1916
1994		1922				1922
1995		1295				1295
1996		1051				1051
1997		1033		5		1038
1998		1146		11		1157
1999		892		4		896
2000		859				859
2001		938	416			1354
2002	1	449	605		3	1058
2003		373	213		1	587
2004	0	248	320	0	0	568
2005	0	191	55	0	0	246
2006		248	138	0	0	386
2007		207	20	0	0	227
2008		27				27
2009		59				59
2010		41				41
2011		34				34
2012		48		0.18		48
2013		40				40
2014		11				11
2015		10				10
2016		4				4
2017*		0				0

*** provisional.**

Table 9.2.0d. Working Group estimates of landings of roundnose grenadier from Subarea 12.b

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
1988													0
1989			0						52				52
1990			0										0
1991			14						158				172
1992			13										13
1993		263	26	39									328
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

Year	Estonia	Faroes	France**	Germany	Iceland	Ireland	Lithuania	Spain	USSR/Russia	UK (E+W)	UK (Scotl.)	Norway	Total
2008		0	0				3	2416	13				2432
2009								5335					5335
2010			1					2758					2759
2011		3						1575					1578
2012		9						657					666
2013								796					796
2014		3.6						828.72					832
2015								313.99					314
2016								599.48					599
2017*								1001					1001

*** Preliminary.**

**** French landings reported in former ICES Subarea 12 allocated to 12.b.**

Table 9.2.0e. Working Group estimates of landings of roundnose grenadier unallocated landings in 5.b, 6 and 12.

Year	Unallocated
1988	
1989	
1990	
1991	
1992	
1993	
1994	
1995	
1996	
1997	
1998	
1999	
2000	
2001	208
2002	504
2003	952
2004	0
2005	0
2006	0
2007	0
2008	0
2009	
2010	
2011	
2012	6997.0
2013	1522.0
2014	92.0
2015	
2016	
2017*	

*** Provisional.**

Table 9.2.0f. Working Group estimates of landings of roundnose grenadier 5.b, 6, 7 and 12.b.

Year	5.b	6	7	8.b	Unallocated	5.b,6,7	Overall total
1988	1	32	0	0	0	33	33
1989	258	2218	222	52	0	2698	2750
1990	1549	5515	215	0	0	7279	7279
1991	2311	7304	489	172	0	10104	10276
1992	3817	6782	1556	13	0	12155	12168
1993	1681	8205	1916	328	0	11802	12130
1994	668	5938	1922	486	0	8528	9014
1995	1223	6472	1295	644	0	8990	9634
1996	1078	6044	1051	1528	0	8173	9701
1997	1112	6032	1038	2049	0	8182	10231
1998	1667	5207	1157	4397	0	8031	12428
1999	1996	5642	896	8573	0	8534	17107
2000	1791	8956	859	6195	0	11606	17801
2001	2016	14773	1354	6094	208	18143	24445
2002	1031	11538	1058	10080	504	13627	24210
2003	1532	6598	587	12235	952	8717	21904
2004	1575	7729	568	12796	0	9872	22668
2005	1837	3694	246	8782	0	5777	14559
2006	1775	2374	386	4361	0	4535	8896
2007	1700	1953	227	4258	0	3880	8138
2008	1112	1841	27	2432	0	2980	5411
2009	446	1391	59	5335	0	4046	9381
2010	611	1500	41	2759	0	2152	4911
2011	74	1460	34	1578	0	1568	3146
2012	44	1348	48	666	6997	1440	9103
2013	60	1416	40	796	1522	1517	3835
2014	77	1060	11	832	92	1147	2072
2015	52	638	10	314	0	701	1015
2016	38	725	4	599	0	767	1366
2017*	30	631	0	1001	0	661	1662

*** Preliminary.**

Table 9.2.1. Time-series of landings and lpues used for the reference and exploratory assessments.

	Landings 1988–2017		Abundance indices		
Simulations	Reference, 567–DS survey	5b–6–7–12b	French tallybooks (discontinuated)	Mar. Scot. Survey (Reference)	5b–6–7–12b (combined index)
				survey indices	
1988	33	33	-	-	-
1989	2698	2750	-	-	-
1990	7279	7279	-	-	-
1991	10104	10276	-	-	-
1992	12155	12168	-	-	-
1993	11802	12130	-	-	-
1994	8528	9014	-	-	-
1995	8990	9634	-	-	-
1996	8173	9701	-	-	-
1997	8182	10231	-	-	-
1998	8031	12428	-	-	-
1999	8534	17107	-	-	-
2000	11606	17801	1.000	1.000	-
2001	18143	24445	1.093	1.135*	-
2002	13627	24210	1.809	1.269	1.000
2003	8717	21904	0.399	1.258*	1.377
2004	9872	22668	0.424	1.247	1.233
2005	5777	14559	0.387	1.140	0.858
2006	4535	8896	0.332	0.887	0.653
2007	3880	8138	0.465	1.251	0.821
2008	2980	5411	0.546	1.471	0.933
2009	4046	9381	0.493	1.288	1.000
2010	2152	4911	0.429	1.260*	0.861
2011	1568	3146	0.403	1.233	0.739
2012	1440	9103	0.462	1.612	1.031
2013	1517	3835	0.497	1.798	1.322
2014	1147	2072	0.399	1.621*	0.932
2015	701	1015	-	1.445	0.913
2016	767	1366	-	1.289*	1.289
2017**	661	1662	-	1.133	0.996

*** index is interpolated with the immediate neighbouring years.**

**** Preliminary landings.**

Table 9.2.2. Summary of results from the exploratory assessments.

			Simulations					
	Simulation	Year	Areas 5.b–6–7 – DS			Areas 5.b–6–7–12.b		
			Mar. Scotland Survey			Exploratory run		
	Median biomass	1988	135035	+/-	1784	228017	+/-	9805
	+/- std dev	2017	87875	+/-	13966	122016	+/-	2367 5
	(tons)							
Standard	Average biomass	1988	135298			226309		
outputs	(tons)	2017	87442			121975		
	Med. Harvest rate	1988	0	+/-	0	0	+/-	0
	+/- std dev	2017	**0.01**	**+/-**	**0**	**0.01**	**+/-**	**0**
	Median Bmsy	all	67517	+/-	892	114009	+/-	4903
	(tons)							
MSY	MSY Btrigger	Bmsy/2	33759	+/-	446	57005	+/-	2452
reference	(tons)							
points	Median Hmsy	all	0.09	+/-	0.01	0.08	+/-	0.01
	Target Cmsy	all	6115	+/-	613	9088	+/-	906
	(tons)							
	P(B>Bmsy)	2017	0.85			0.49		
Risks	P(H<Hmsy)	2017	1.00			1.00		
	P(B>Btrig)	2017	1.00			1.00		

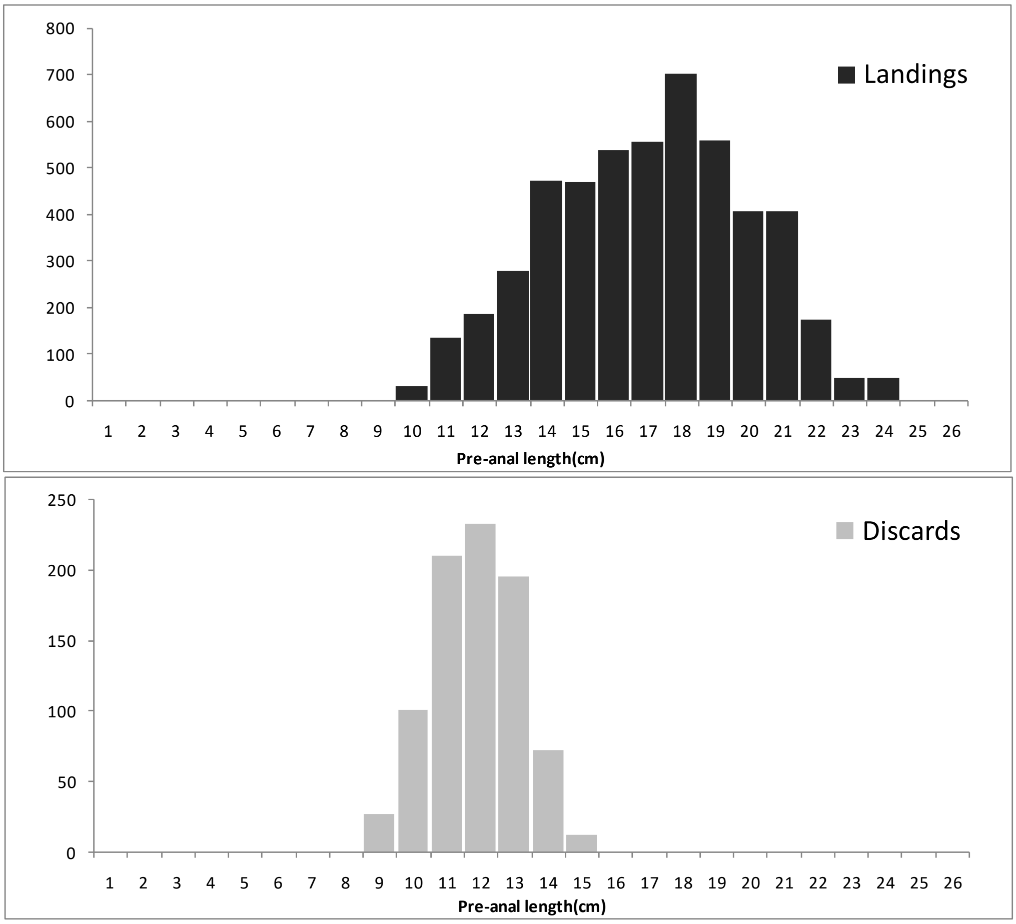


Figure 9.2.1. Length distribution of the landings and discards of the French fleet in Division 5.b, 6, 7 based from on-board observations in 2017.

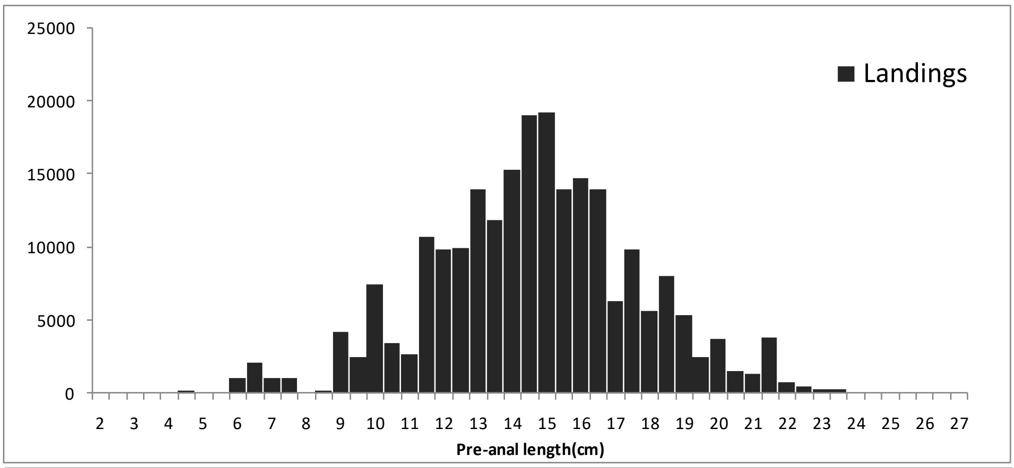


Figure 9.2.2. Length distribution of the landings of the Spanish fleet in Division 6.b based from on-board observations in 2017.

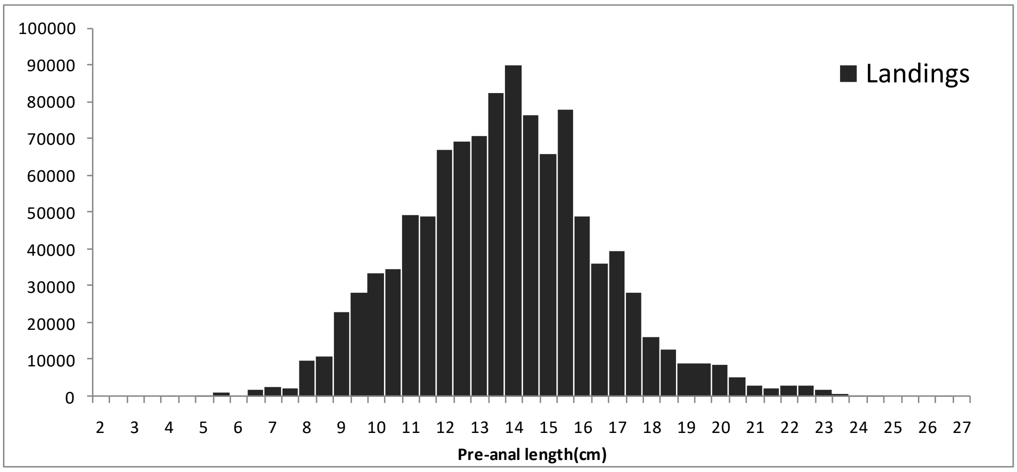


Figure 9.2.3. Length distribution of the landings of the Spanish fleet in Division 12.b based from on-board observations in 2017.

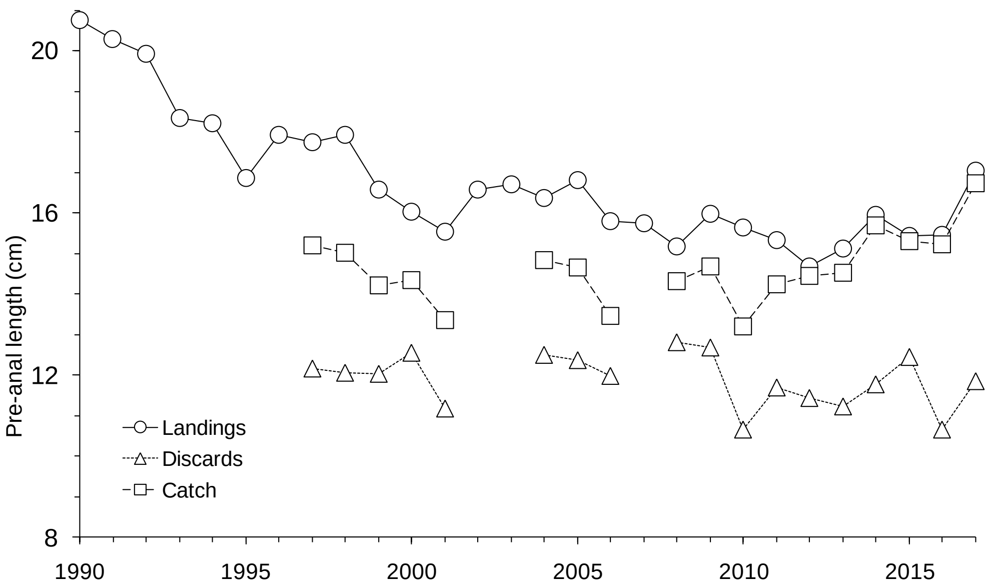


Figure 9.2.4. Evolution of the pre-anal length of roundnose grenadier in the French landings, catch and discards, 1990–2017.

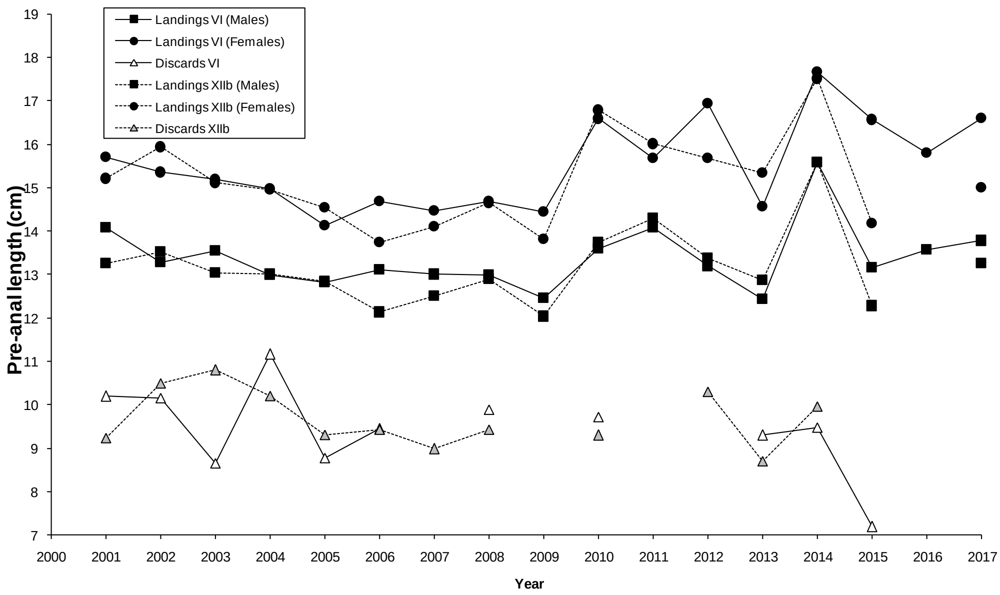


Figure 9.2.5.Evolution of the pre-anal length of roundnose grenadier in the Spanish landings and discards in Divisions 6.b and 12.b, 2001–2017.

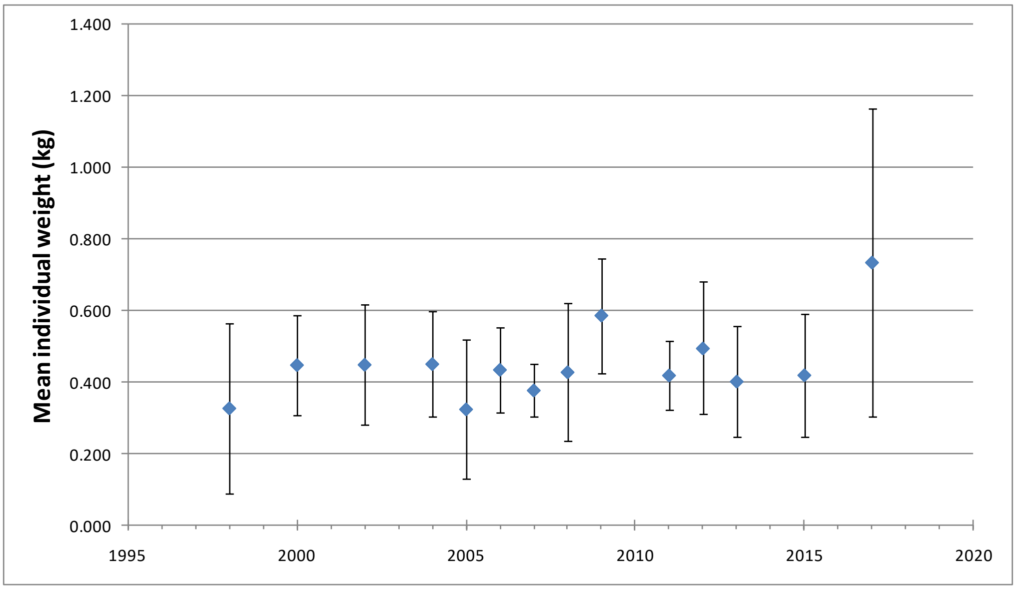


Figure 9.2.6. Mean individual weight of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

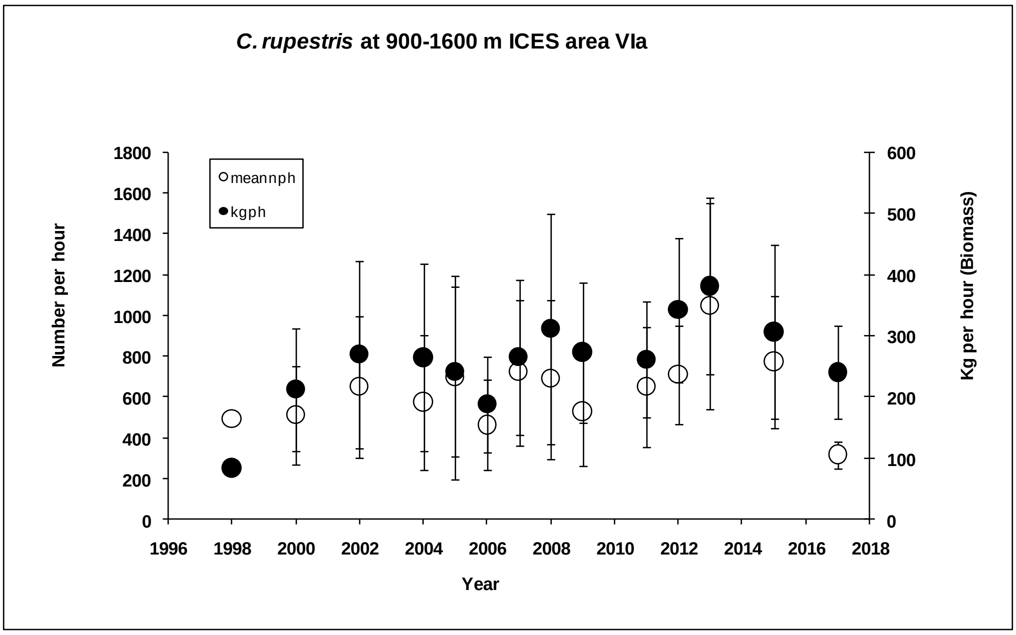


Figure 9.2.7. Abundance indices of roundnose grenadier according to Marine Scotland deep-water science survey in 6.a.

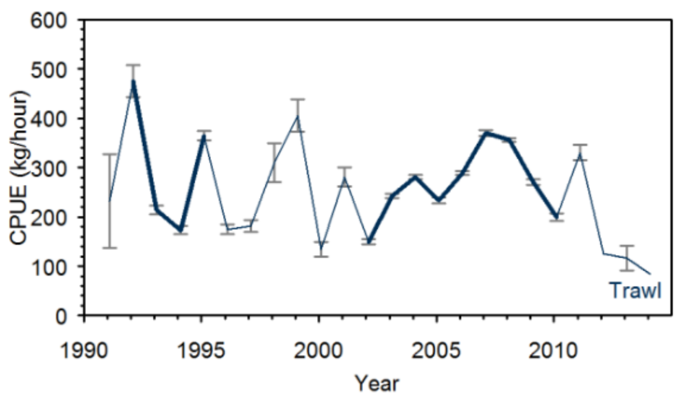


Figure 9.2.8.Roundnose grenadier in 5.b. Cpue from otter-board trawlers. Criteria: >30% of roundnose grenadier in the catch.

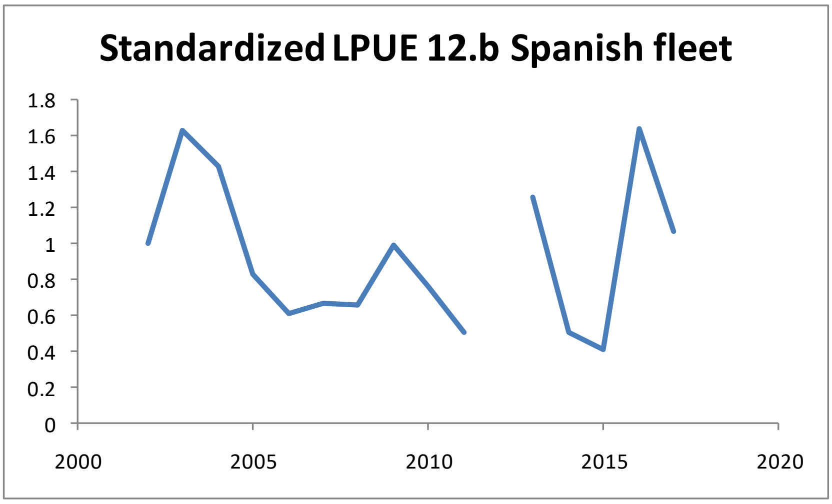


Figure 9.2.9. Lpue from the Spanish commercial fleet operating in 12.b.

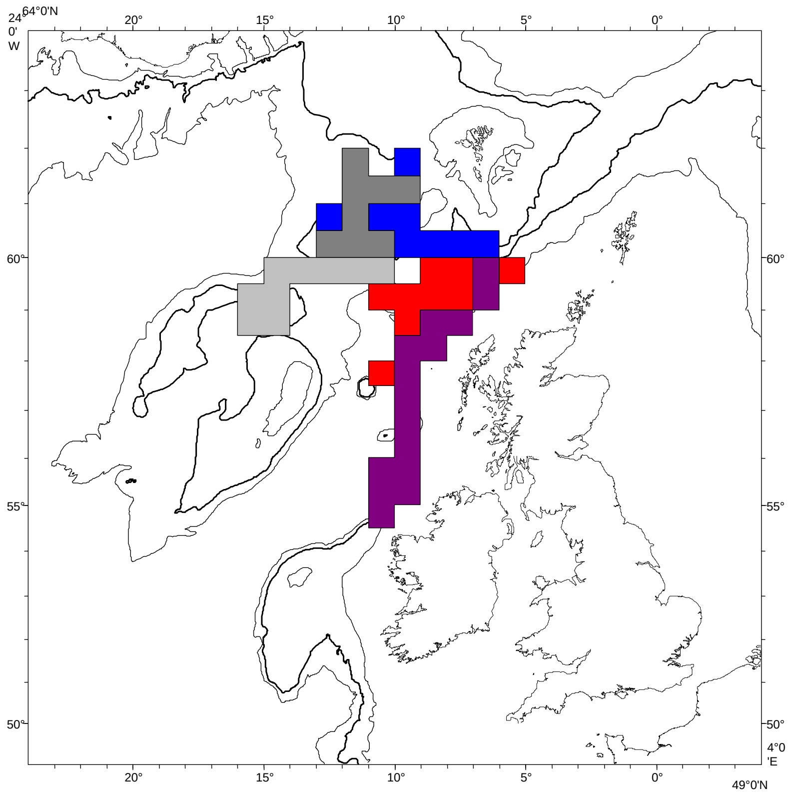


Figure 9.2.10. Reference areas (set of statistical rectangles) used to calculate French lpues (brown: New grounds in 5 (new5), grey new grounds in 6 (new6); red: others in 6 (other6); purple: edge in 6 (edge6); blue: all grounds in 7 (ref7). Depth contours are 200, 1000 and 2000 m.

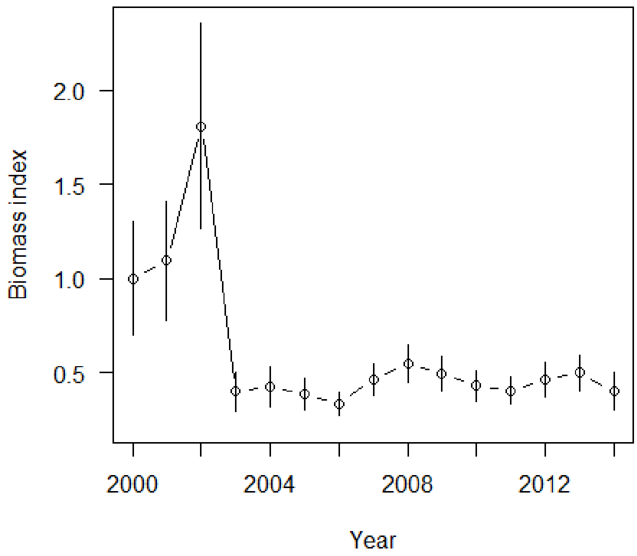


Figure 9.2.11. Time-series of abundance indices (calculated based upon the tallybook data). The grenadier abundance was predicted for the mean length of all tow carried out in every rectangle of the two small areas (edge6, other6) and averaged across rectangle.

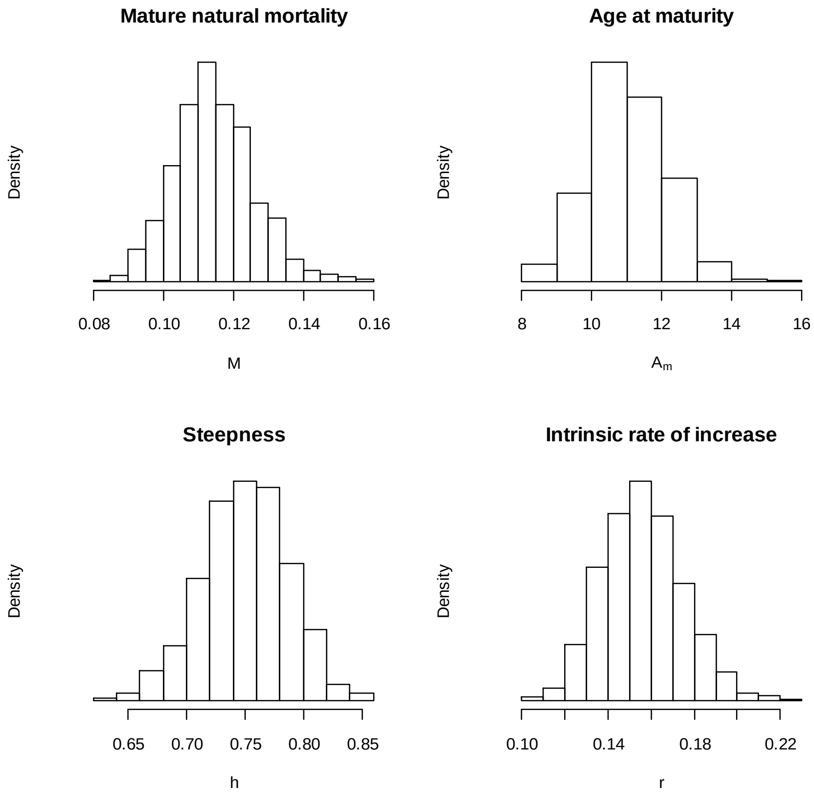


Figure 9.2.12. Distribution of initial life-history parameters used in the surplus production model.

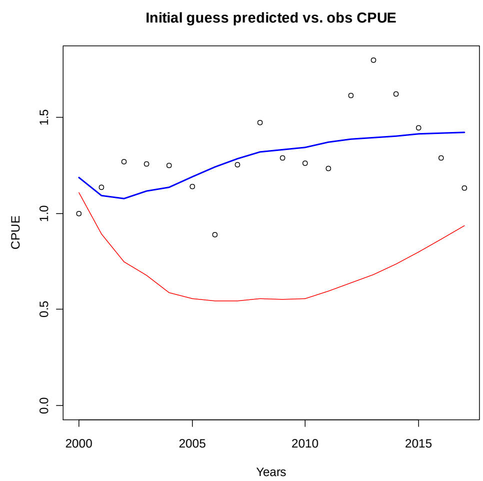


Figure 9.2.13. Predicted vs. initial guess vs. estimates of lpue for roundnose grenadier in 5.b, 6, 7, based on commercial data.

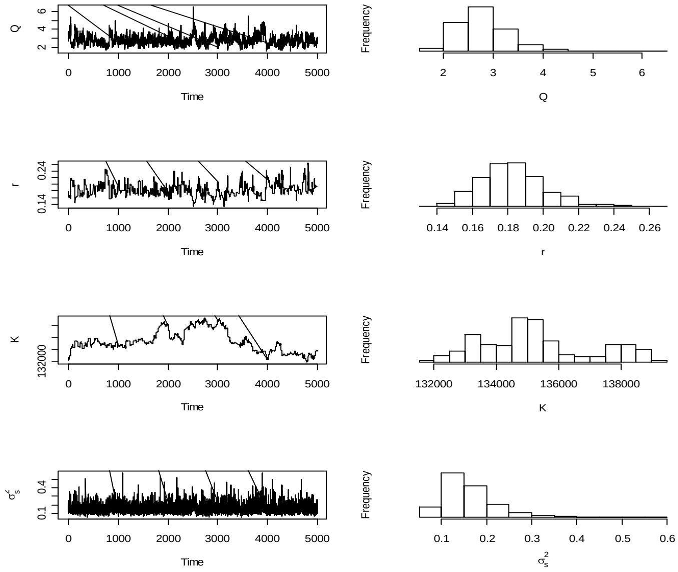


Figure 9.2.14. Diagnostic plots of the reference assessment on roundnose grenadier in 5.b, 6, 7.

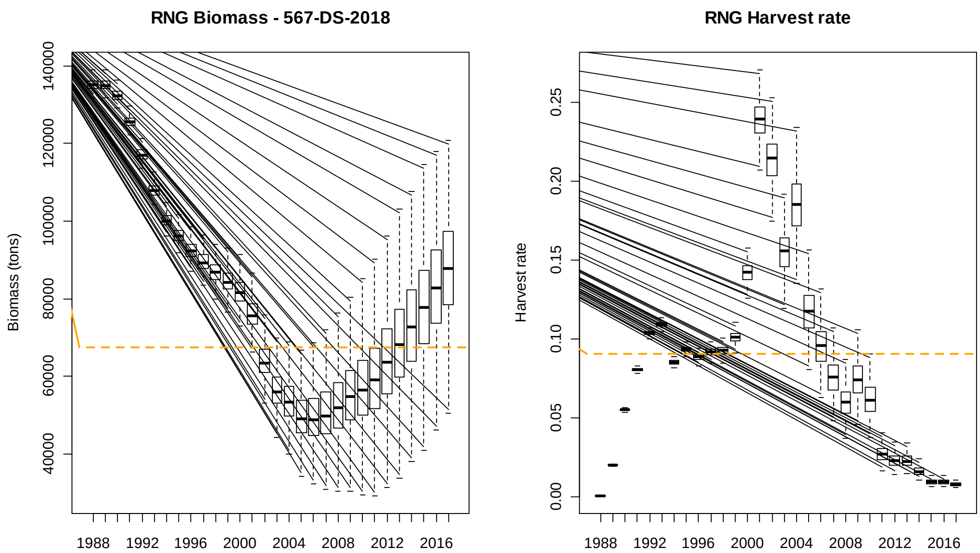


Figure 9.2.15. Estimated biomass and harvest rates from the reference simulation (5.b, 6, 7). Dotted lines are respectively B_{MSY} (left panel) and H_{MSY} levels (right panels).

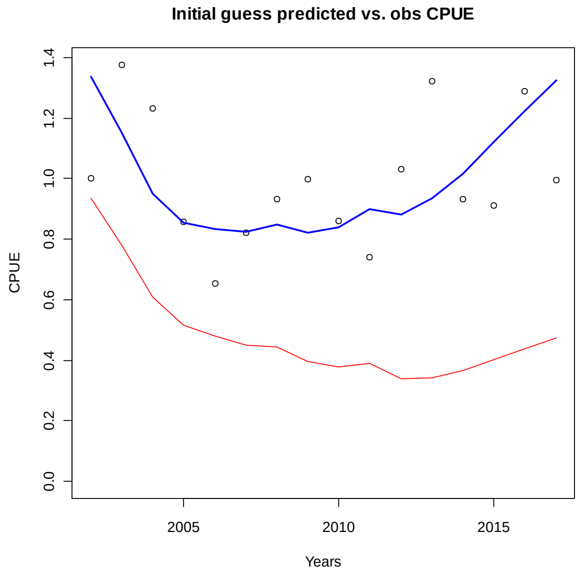


Figure 9.2.16. Predicted vs. initial guess vs. estimates of lpue for roundnose grenadier in 5.b, 6,7, 12.b based on combined commercial LPUE (12.b) and survey (6).

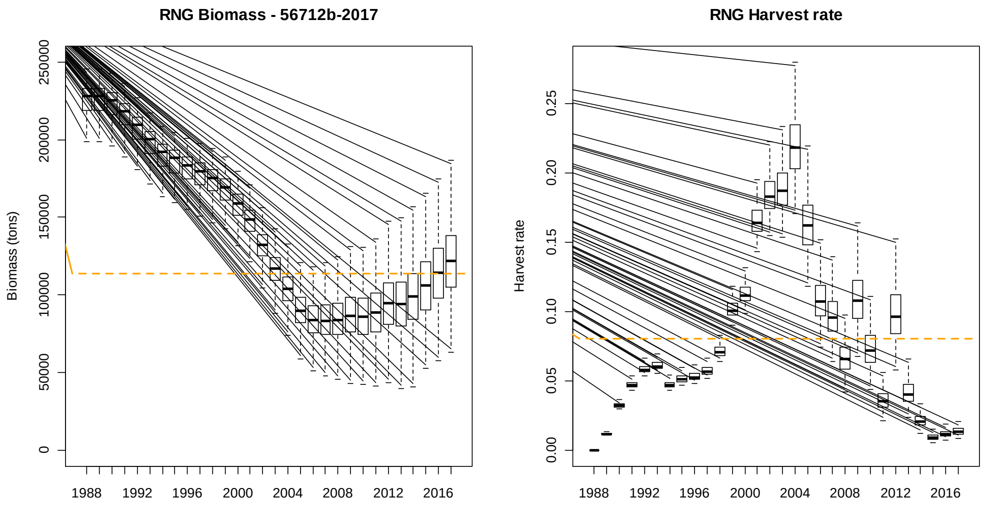


Figure 9.2.17. Estimated biomass and harvest rates using landings in 5.b, 6, 7 and 12.b.

9.3 Roundnose grenadier (*Coryphaenoides rupestris*) in Division 3.a

9.3.1 The fishery

From the late 1980s until 2006 a Danish directed fishery for roundnose grenadier was conducted in the deeper part of Division 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.

9.3.2 Landing trends

The total landings by all countries from 1988–2017 are shown in Table 9.3.0 and Figure 9.3.0.

The landings from the directed fishery ceased in 2007 and the total landings have since been minor (<2 tonnes). The landings are now bycatches from other fisheries.

9.3.3 ICES Advice

The Advice for 2017 and 2018 is: "ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017 and 2018".

9.3.4 Management

The directed fishery for roundnose grenadier was stopped in April 2006 based on agreements between Norway and the EU, and has been prohibited since. Norway and the EU has introduced a mandatory use of sorting grids in shrimp fisheries in order to minimize the bycatch of fish.

In Council Regulation (EU) No 2016/2285, fixing for 2017 and 2018 the fishing opportunities for EU vessels for fish stocks of certain deep-sea fish species, a TAC was set to 278 and 223 tons, respectively, 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.

9.3.5 Data available

9.3.5.1 Landings and discards

Landings data are presented in Table 9.3.0. Discards are reported from both the Swedish and Danish fishery but only Swedish discards are noticeable; Swedish discard were 1.6 t in 2017.

9.3.5.2 Length compositions

Since the directed fishery has stopped there is no new information on size compositions from commercial catches other than the data given for the period 1996–2006 in the stock annex.

Updated information on size distribution from the Norwegian shrimp survey is provided in Figure 9.3.1.

9.3.5.3 Age composition

Age data are available from 1987 and from 2007–2017 (Figure 9.3.4).

These age data (until 2013) are presented in Bergstad *et al*., 2014.

9.3.5.4 Bycatch effort and cpue

There is no new information on bycatch on this species.

Earlier, there has been estimated bycatch of roundnose grenadier in Norwegian shrimp fishery in ICES Division 4.a and 3.a (Figure 9.3.2). These bycatch estimates were not obtained by sampling of the commercial catches but derived using the mean annual Norwegian shrimp trawl survey catches of grenadier at depths <400 m and annual effort in the shrimp trawl fishery. The shrimp fishery in this area is mainly conducted shallower than the primary depth range of roundnose grenadier. It should be noted that commercial vessels fishing in the relevant areas use sorting grids to reduce bycatch, a device not used in the survey, hence survey-based estimates are likely to be overestimates.

9.3.5.5 Survey indices

There is updated information on the survey indices from the shrimp survey (Figure 9.3.3). The indices are given as biomass (kg/h) and abundance (number/h). The Norwegian annual shrimp survey conducted since 1984 samples deeper parts of the Skagerrak and northeastern North Sea (3.a and 4.a), including the depth range where the roundnose grenadier occurs (mainly 300–600 m) (Bergstad, 1990b). The minor area >600 m is an ammunition and warship dumping ground with warning against fishing. The survey is considered to adequately sample the main distribution area of roundnose grenadier, and the sample sizes by year (no. of tows at depths >300 m and >400 m) are presented in Table 9.3.1.

9.3.6 Data analyses

An earlier study analysed the time-series of abundance of roundose grenadier through the time-series (Bergstad *et al*., 2014). Catch rates in terms of biomass (kg/h) and abundance (nos/h) were calculated for stations 300 m and deeper (Figure 9.3.3). Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration. The published analysis also includes a time-series of small grenadier, i.e. <5 cm PAFL, illustrating variation in recruitment.

9.3.6.1 Trends in landings, effort and estimated bycatches

Collated information on landings and survey-based estimates of bycatch suggest that the removals of roundnose grenadier are now at low levels in Division 4.a and 3.a. Although the discards from the fishery in this area now is reported to be at the same level as the landings, the level on reported total catch is still low and in the range of what it has been since 2007.

There is no longer a directed fishery for grenadier in this area and data on effort and cpue is therefore not available from the commercial catches. The earlier evaluation of the Danish cpue data were presented in ICES (2007) but these cpue data do not provide any clear indications of stock development and status for the time of the directed fishery which ceased in mid-2006.

Landings are now insignificant and represent bycatches from other fisheries. The estimated bycatch of roundnose grenadier from the Norwegian shrimp fishery is shown to be at low levels (less than 100 tonnes /year) but since both the landings and survey catches are at very low levels now and the stock does not seem to recover, there is some concern that mortality from reported current bycatch levels are not fully accounted for. The application of sorting grids most probably reduces retained bycatch, but there is some uncertainty with regards to survival rates during passage of the grids for this species.

9.3.6.2 Size compositions

The recent length distributions from the Norwegian survey data contrasts with the 1991–2004 distributions by their small proportions of small fish (Bergstad *et al*., 2014). The pulse of juveniles appearing in the early 1990s appears to have represented the only major recruitment event through the time-series 1984–present. Recently some small juveniles appear every year in the survey, but there is no indication of a pronounced recruitment pulse as observed in the early 1990s.

The Danish and Norwegian length distributions, sampled from commercial landings and survey catches, respectively, agree well for those years covered by samples from both countries (1987 and 2004–2006) (See stock annex for information on the Danish length distributions from the directed fishery). Note that both in 1987 and 2004 there appear to be two clearly distinguishable components in the Danish length compositions. In the Norwegian data, several years show two modes and it is possible to follow the more abundant occurrence of juveniles<5 cm (PAL) through several years.

9.3.6.3 Biomass and abundances indices from survey

The survey catch rates in terms of biomass (kg/h) and abundance (nos/h) varied strongly through the time-series, but elevated levels were observed from 1998 to 2005. The indices have declined since 2004 with both biomass and abundance being lowest on record in 2017, but show a small increase for 2018. 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.

9.3.6.4 Age data

The age distributions from recent years contrasts with distributions from the 1980s (Bergstad, 1990b) in terms of proportions of old fish (e.g. >20 years) (Figure 9.3.4). After the exploitation pulse in 2003–2005, the proportion of old fish has declined to very low levels (Bergstad *et al*., 2014). In recent years, i.e. after 2006 the mean age in the catches has increased somewhat, but the proportion of fish >20 years remains low.

Analyses of size distributions and the time-series of survey abundance of small juveniles by Bergstad *et al*. (2014) suggested that only a single very abundant recruitment event occurred during the period 1984–2018, perhaps only a single major year class. This event rejuvenated the stock and enhanced abundance in subsequent years.

9.3.6.5 Biological reference points

SPiCT was run on the landings data series (1988-2017) and the roundnose biomass index series from the Norwegian shrimp survey (1985-2017) but it did not converged (Table 9.3.2)

9.3.7 Comments on assessment

The working group decided to upgrade this stock to a 3.2 category using the biomass index from the Norwegian shrimp survey, derived from the relevant depth range of the species in this area.

9.3.8 Management considerations

The decline in abundance after 2005–2006 suggested by the Norwegian shrimp survey catch rates probably reflect the combined effect of the enhanced targeted exploitation in 2003–2005 and low recruitment in the years following the single recruitment pulse in the early 1990s. The percentage of fish >15 cm is at a lower level as in the late 1980s and early 1990s, and there is no suggestion of a new recruitment pulse as seen in the 1990s. Recent age distributions almost lack the >20 years old component which was prominent in the 1980s.

Since the targeted fishery has stopped and the bycatch in the shrimp fishery seems low, the potential for recovery of the roundnose grenadier in Skagerrak may be good. Abundance levels has declined since 2004 and in 2017 it was the lowest recorded during the survey period 1984–2018. However, this year indices show a small increase but still as low levels. Rejuvenation and growth of the population would at present seem unlikely due to low recruitment during the recent decade. Additionally, there is some uncertainty regarding the effect of the sorting grid in the shrimp fishery and this could be the source of an unknown mortality.

9.3.9 Tables and Figures

Table 9.3.0. Roundnose grenadier in Division 3.a. WG estimates of landings.

YEAR	DENMARK	NORWAY	SWEDEN	TOTAL
1988	612		5	617
1989	884		1	885
1990	785	280	2	1067
1991	1214	304	10	1528
1992	1362	211	755	2328
1993	1455	55		1510
1994	1591		42	1633
1995	2080		1	2081
1996	2213			2213
1997	1356	124	42	1522
1998	1490	329		1819
1999	3113	13		3126
2000	2400	4		2404
2001	3067	35		3102
2002	4196	24		4220
2003	4302			4302
2004	9874	16		9890
2005	11 922			11 922
2006	2261	4		2265
2007	+	1		1
2008	+	+		+
2009	2	+	+	2
2010	1	+	+	1
2011		0		0
2012	1	0		1
2013	1	0		1
2014	0,6	0	0,4	1
2015	0,6	+	+	0.6
2016	1,1	0,3	+	1,4
2017*	0,7	+	+	0,7

*** Preliminary data.**

Table 9.3.1. Summary of data on the bottom-trawl survey series, 19842016. Rg- rock-hopper groundgear. 'Strapping'maximum width of trawl constrained by rope connecting warps in front of otter doors. MS-RV Michael Sars, HM-RV Håkon Mosby. Data from 2016 survey are included. All trawls were fitted with a 6mm mesh codend liner.

YEAR	SURVEY MONTH	VESSEL	IMR GEAR CODE	ADDITIONAL GEAR INFO.	NO. TRAWLS >300M	NO. TRAWLS >400M	NO. TRAWLS SURVEY
1984	OCT	MS	3230	Shrimp trawl (see text)	10	1	67
1985	OCT	MS	3230	"	21	5	107
1986	OCT/NOV	MS	3230	"	24	9	74
1987	OCT/NOV	MS	3230	"	35	14	120
1988	OCT/NOV	MS	3230	"	31	11	122
1989	OCT	MS	3236	Campelen 1800 35mm/40, Rg	31	7	106
1990	OCT	MS	3236	"	26	5	89
1991	OCT	MS	3236	"	28	9	123
1992	OCT	MS	3236	"	27	10	101
1993	OCT	MS	3236	"	30	10	125
1994	OCT/NOV	MS	3236	"	27	10	109
1995	OCT	MS	3236	"	29	12	103
1996	OCT	MS	3236	"	27	11	105
1997	OCT	MS	3236	"	25	6	97
1998	OCT	MS	3270	Campelen 1800 20mm/40, Rg	23	6	97
1999	OCT	MS	3270	"	27	8	99
2000	OCT	MS	3270	"	25	10	109
2001	OCT	MS	3270	"	18	4	87
2002	OCT	MS	3270	"	24	6	82
2003	OCT/NOV	HM	3230	Shrimp trawl (as in 1984–1988)	13	0	68
2004	MAY	HM	3270	Campelen 1800 20mm/40, Rg	17	6	65
2005	MAY	HM	3270	"	23	8	98
2006	FEB	HM	3270	"	10	0	45
2007	FEB	HM	3270	"	11	1	66
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	"	27	8	111

*** Path width of the tow constrained by a 10 m rope connecting the warps, 200 m in front of otter boards.**

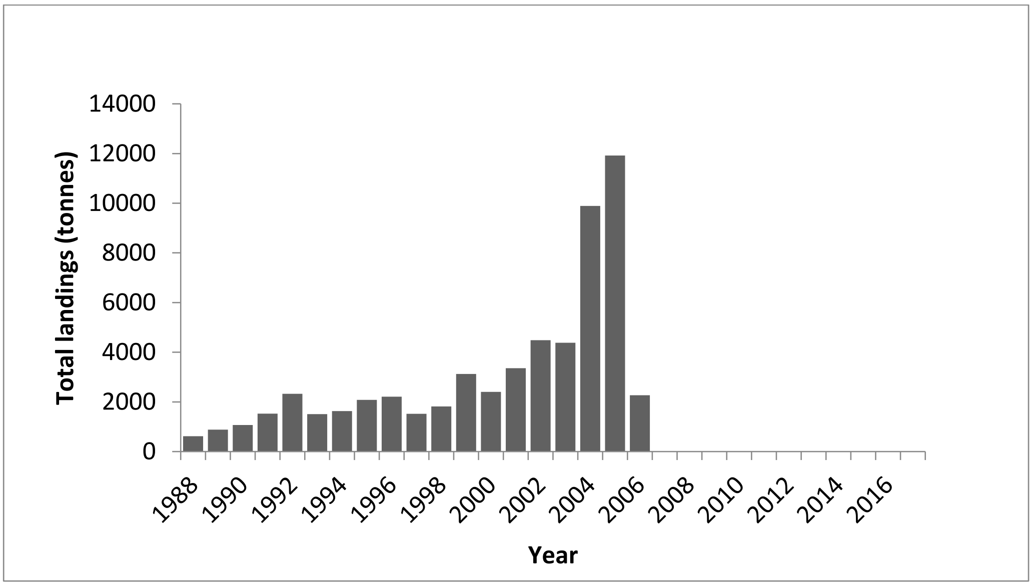


Figure 9.3.0. Landings of roundnose grenadier from Division 3.a. Landings from 2007–2017 are insignificant.

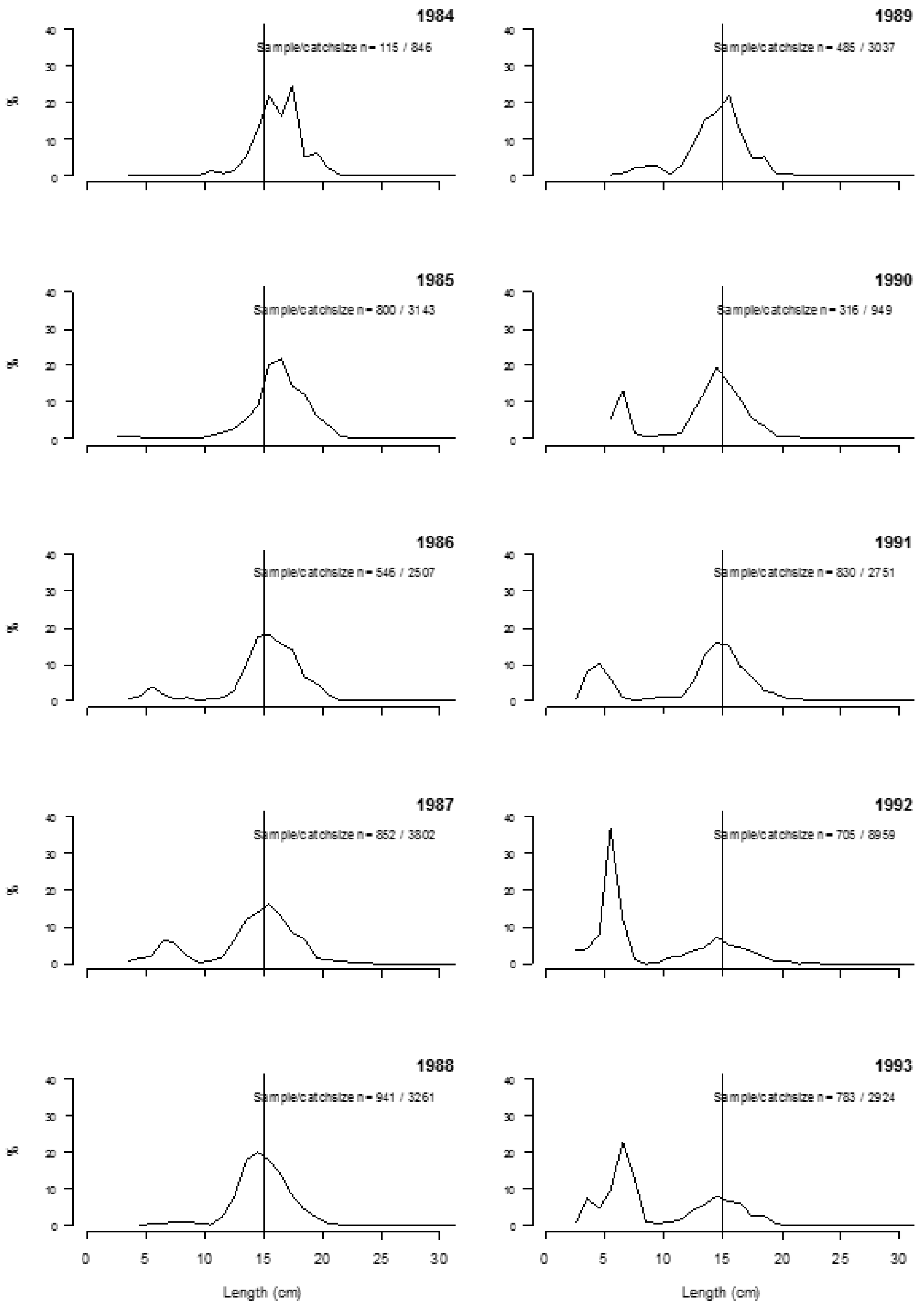


Figure 9.3.1. Length–frequency distributions for roundnose grenadier, 1984–2018. Data from Norwegian shrimp survey, all catches deeper than 300 m. Length is measured as pre-anal fin length in cm. The distributions are calculated as percent number of fish in each cm length interval standardized to total catch number and trawling distance for each station each year.

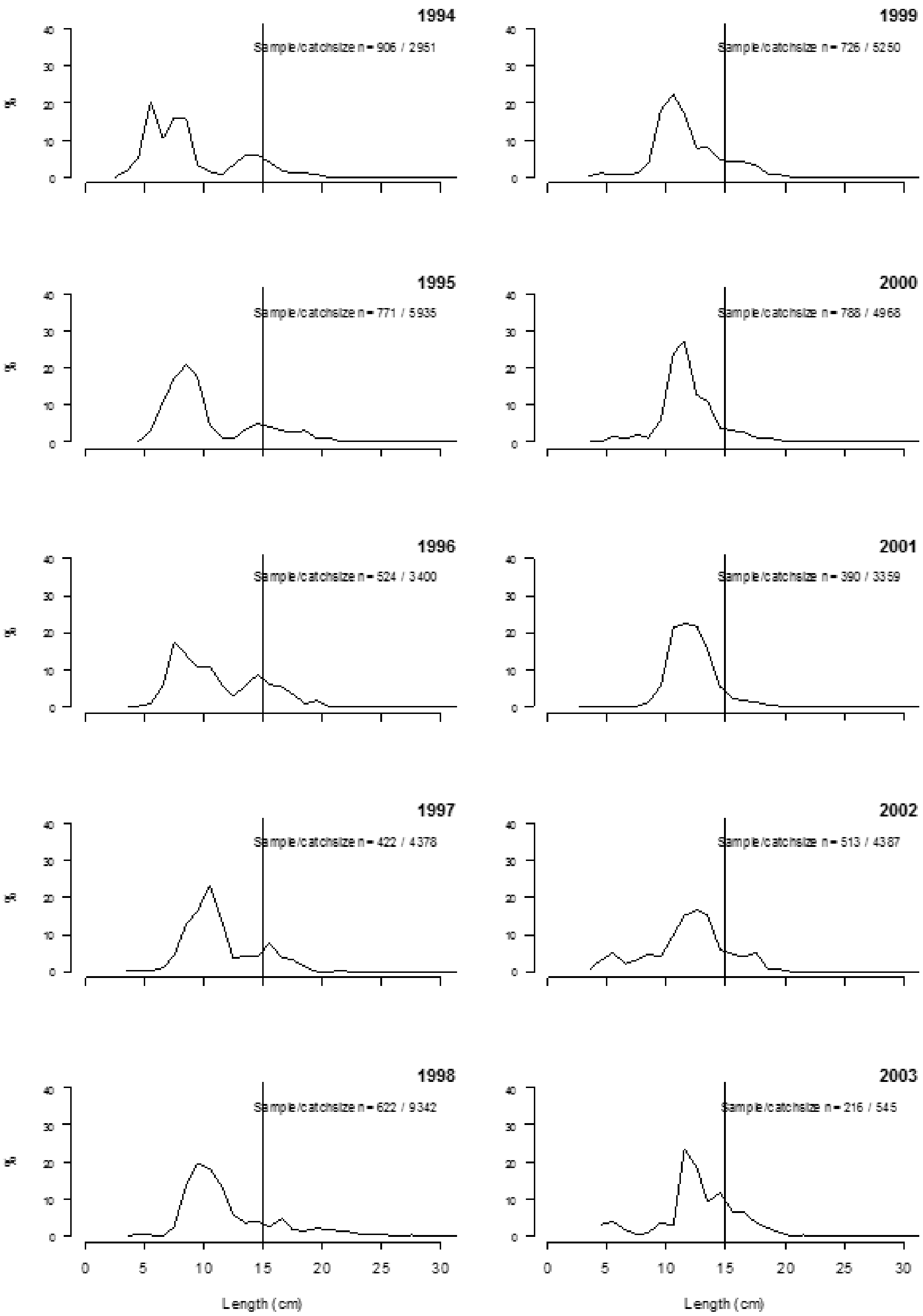


Figure 9.3.1. (Con't).

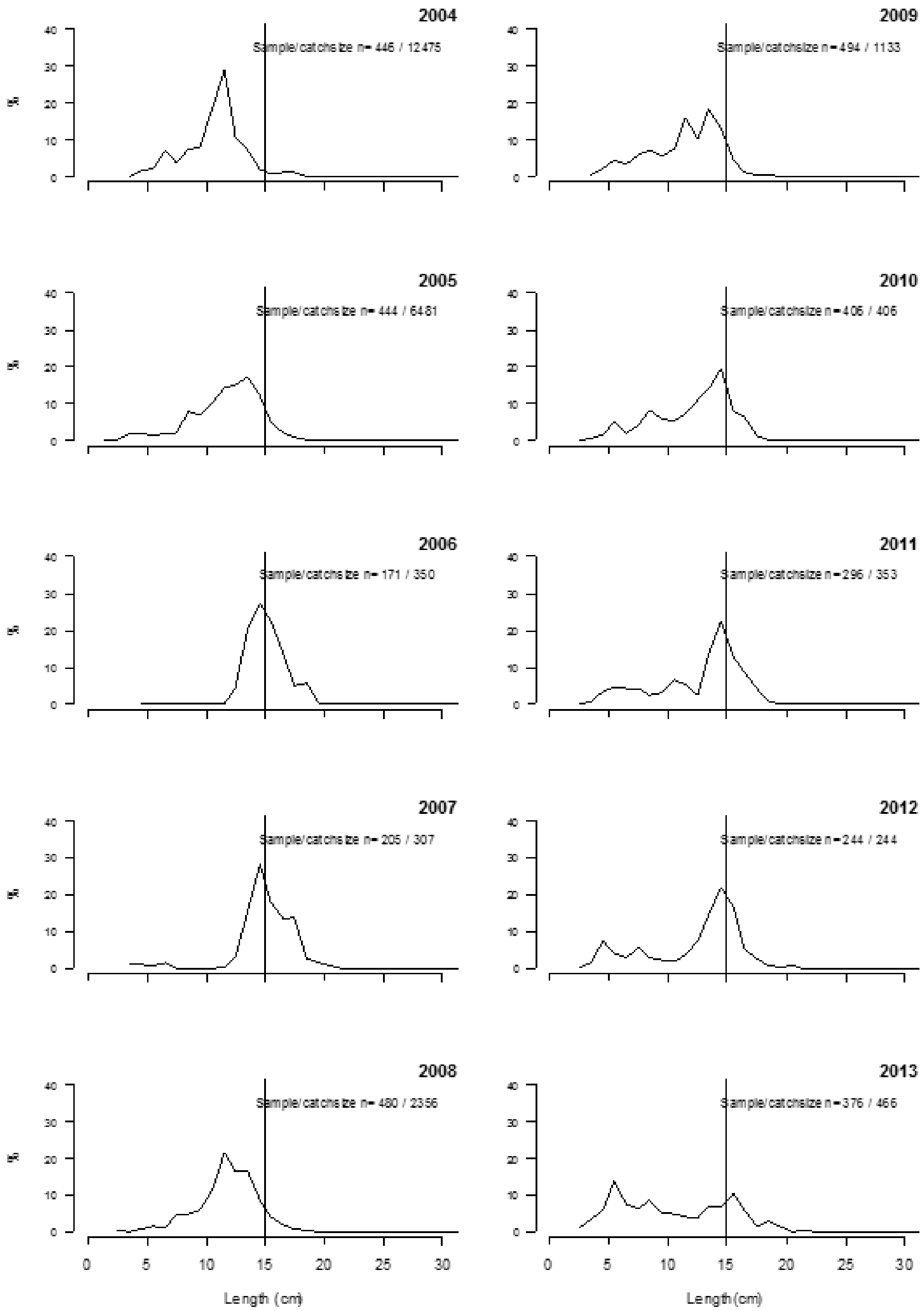
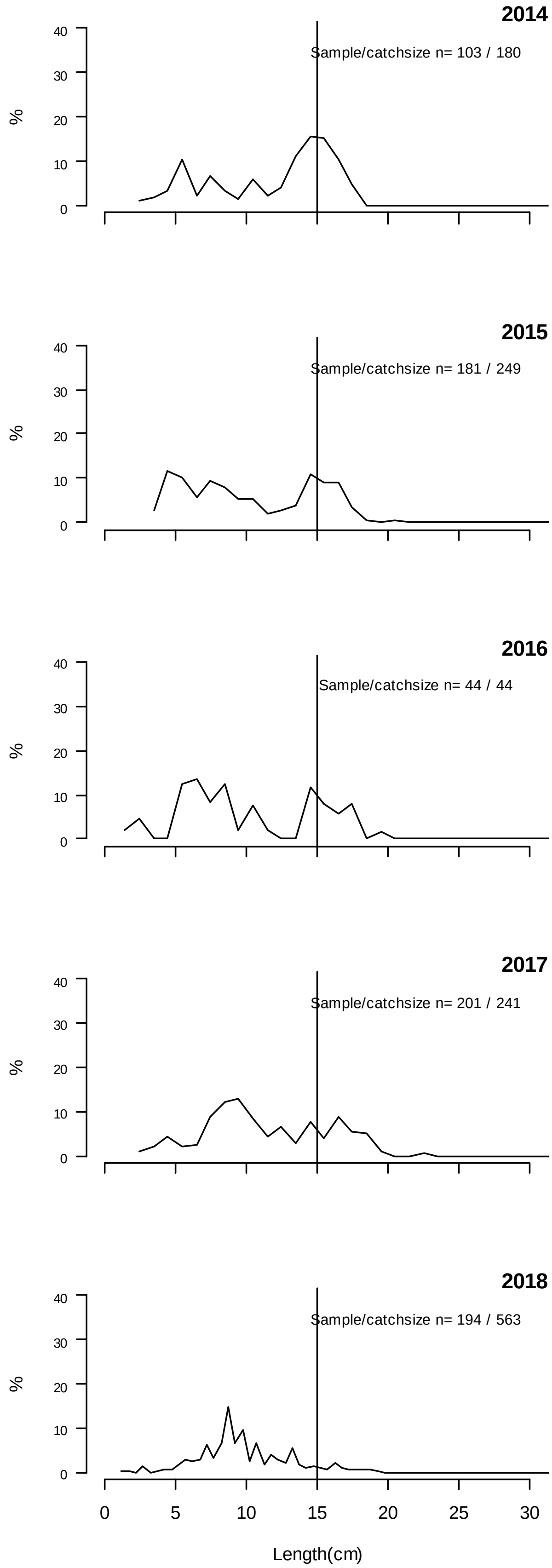


Figure 9.3.1. (Con't).



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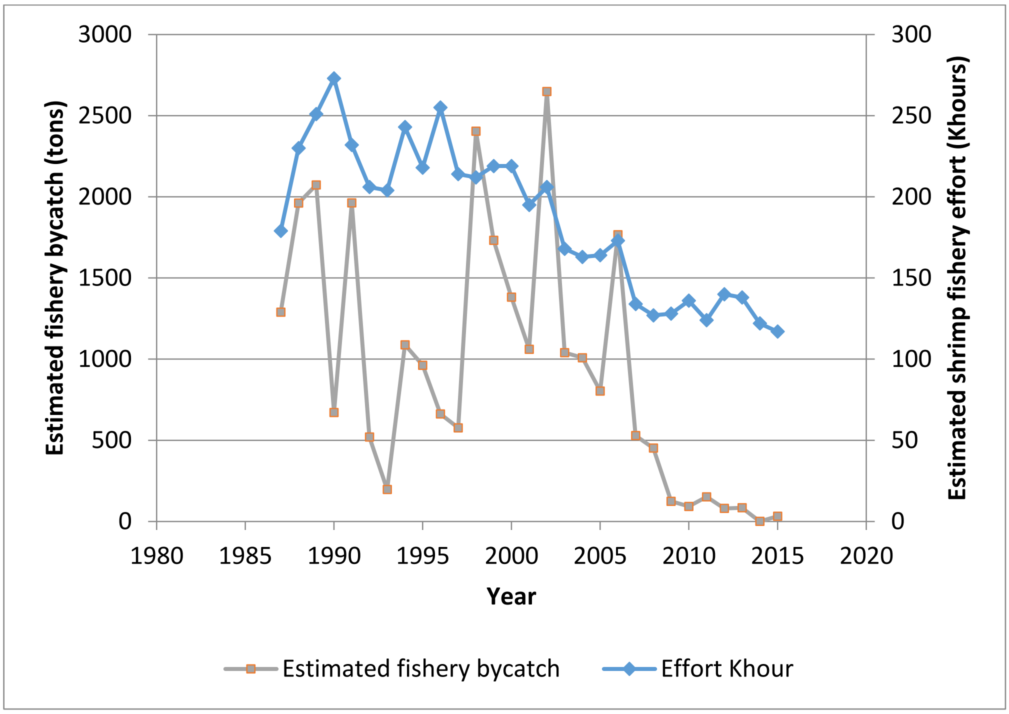

Figure 9.3.2. Estimated bycatch of roundnose grenadier in the Norwegian shrimp fishery in ICES Division 4.a and 3.a, and the estimated commercial shrimp fishery effort in the same area. See text for explanation.

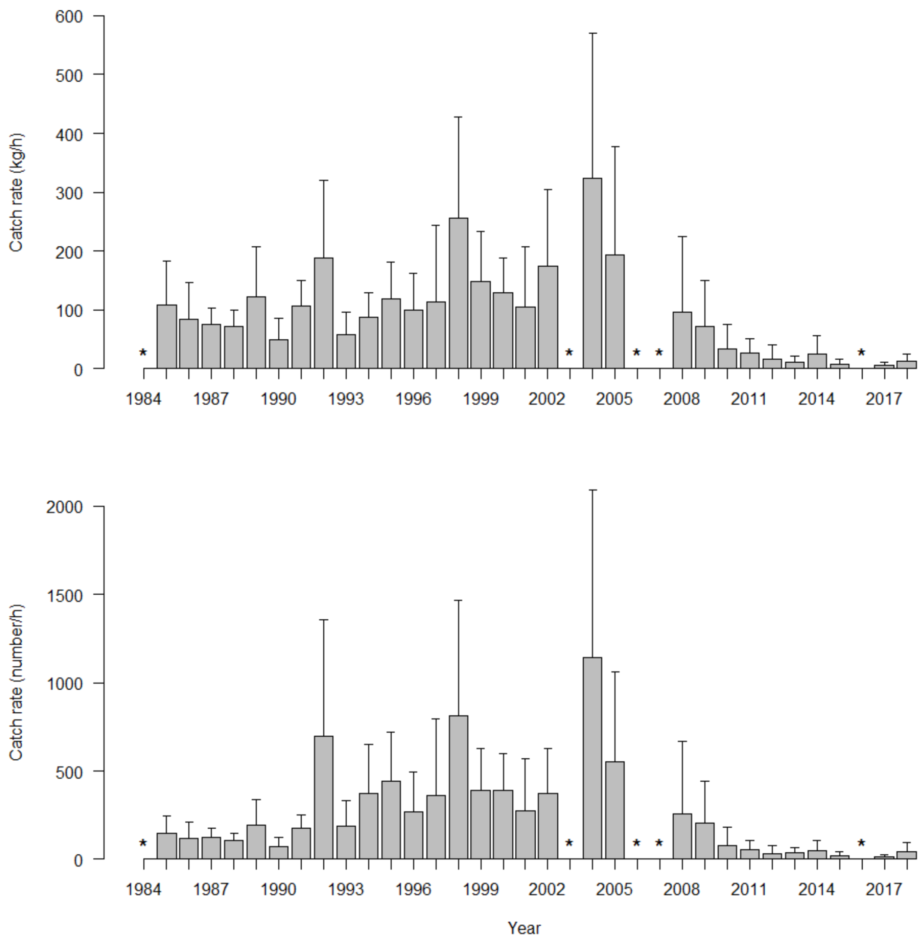

Figure 9.3.3. Survey catch rates in biomass (kg/h) and abundance (nos/h) of grenadier 1984–2018. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m, thus the primary grenadier habitat was not sampled for those years. For 2016 data from the shrimp survey is regarded as unreliable due to inconsistencies with trawling gear and data from that year should be excluded. For the other years the survey is thought to cover the distribution area of roundnose grenadier Lines indicate estimates of 2SE (Updated from Bergstad *et al.*, 2014).

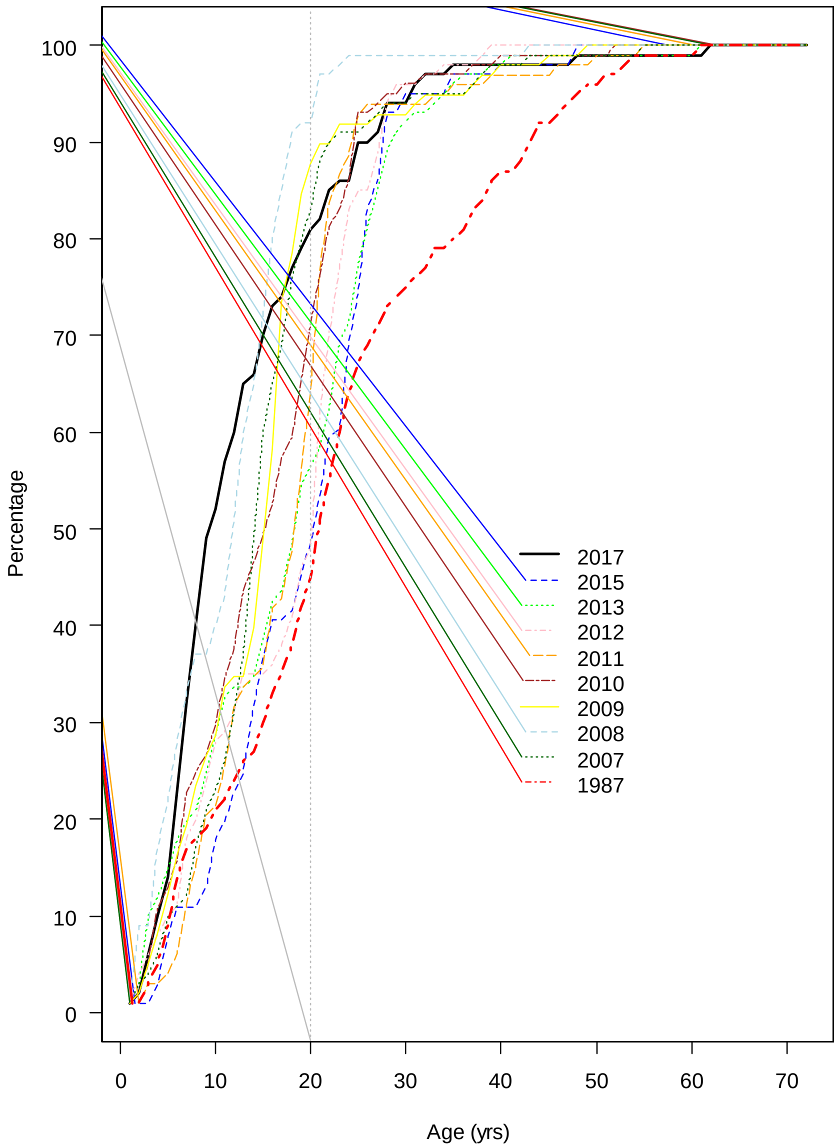

Figure 9.3.4. Cumulative age distributions of roundnose grenadier in the Skagerrak. Data from survey catches in the Skagerrak in 1987 and 2007–2013, 2015 and 2017. The distribution from 1987 was modified from Bergstad (1990). Data from 2007 were collected on the deep-water fish survey in April.

Table 9.3.2. Results and summary from SPiCT

```
Convergence: 0  MSG: relative convergence (4)
Objective function at optimum: 85.4882808
Euler time step (years):  1/16 or 0.0625
Nobs C: 28,  Nobs I1: 29

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

Model parameter estimates w 95% CI
          estimate       cilow        ciupp    log.est
 alpha  8.276756e-01   0.3339662 2.051247e+00 -0.1891340
 beta   1.313415e-01   0.0202843 8.504420e-01 -2.0299542
 r      4.484150e-02   0.0000004 4.821094e+03 -3.1046221
 rc     2.481810e-02   0.0000002 3.378209e+03 -3.6961813
 rold   1.715690e-02   0.0000001 2.741431e+03 -4.0653533
 m      3.374306e+03   0.0003976 2.863465e+10  8.1239450
 K      4.445504e+05 192.0868518 1.028832e+09 13.0048188
 q      2.437000e-04   0.0000001 4.201196e-01 -8.3195373
 n      3.613607e+00   0.6007630 2.173595e+01  1.2847064
 sdb    3.678015e-01   0.2147984 6.297905e-01 -1.0002118
 sdf    1.628186e+00   1.2224870 2.168521e+00  0.4874664
 sdi    3.044204e-01   0.1805302 5.133311e-01 -1.1893458
 sdc    2.138484e-01   0.0349584 1.308160e+00 -1.5424879

Deterministic reference points (Drp)
         estimate       cilow        ciupp   log.est
 Bmsyd 2.719228e+05 109.9115858 6.727407e+08 12.513273
 Fmsyd 1.240910e-02   0.0000001 1.689104e+03 -4.389329
 MSYd  3.374306e+03   0.0003976 2.863465e+10  8.123945
Stochastic reference points (Srp)
      estimate cilow ciupp log.est rel.diff.Drp
 Bmsys      NaN   NaN   NaN     NaN          NaN
 Fmsys      NaN   NaN   NaN     NaN          NaN
 MSYs       NaN   NaN   NaN     NaN          NaN

States w 95% CI (inp$msytype: s)
                 estimate    cilow        ciupp   log.est
 B_2017.00       2.91453e+04 16.62979 5.107993e+07  10.28005
 F_2017.00       3.37000e-05  0.00000 6.606390e-02 -10.29873
 B_2017.00/Bmsy          NaN       NaN          NaN       NaN
 F_2017.00/Fmsy          NaN       NaN          NaN       NaN

Predictions w 95% CI (inp$msytype: s)
                 prediction      cilow        ciupp    log.est
 B_2018.00       2.779298e+04 15.5905175 4.954612e+07  10.2325387
 F_2018.00       3.570000e-05  0.0000000 7.974910e-02 -10.2395458
 B_2018.00/Bmsy           NaN        NaN          NaN        NaN
```

F_2018.00/Fmsy	NaN	NaN	NaN	NaN
Catch_2018.00	9.718939e-01	0.0697733	1.353782e+01	-0.0285086
E(B_inf)	NaN	NA	NA	NaN

9.3.10 References

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9.4 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)

9.4.1 The fishery

The fishery on the Northern Mid-Atlantic Ridge (MAR) started in 1973, when dense concentrations of roundnose grenadier were discovered by USSR exploratory trawlers. Roundnose grenadier aggregations may have occurred on 70 seamount peaks between 46–62°N, but only 30 of them were commercially important and subsequently exploited. Since the early 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. Last decades the main countries participating in the fishery are Spain (since 2010) and Russia (since 2000).

9.4.1.1 Landings trends

The greatest annual catch (almost 30 000 t) was taken by the Soviet Union in 1975 (Tables 9.4.1–9.4.5, Figure 9.4.1) and in subsequent years the Soviet catch varied from 2800 to 22 800 t. The fishery for grenadier declined after the dissolution of the Soviet Union in 1992. In the last 15 years, there has been a sporadic fishery by vessels from Russia (annual catch estimated at 200–3200 t), Poland (500–6700 t), Latvia (700–4300 t) and Lithuania (data on catch are not available). Grenadier has also been taken as bycatch in the Faroese orange roughy fishery and Spanish demersal multispecific fishery.

There is no information about target fishery of roundnose grenadier on the MAR in 2006 and 2007. In 2008 and 2009 Russian trawlers made attempts at fishing with pelagic and bottom trawls in the southern part of the Division 12.c. Total catches were 30 t and 12 t respectively including 13 t and 5 t of roundnose grenadier. In 2010, Russian trawler caught 73 t roundnose grenadier during a short-term fishery (two days) in the southern part of the Division 10.b.

Also in 2007, the Spanish fleet targeting redfish on the MAR reported landings of roundnose grenadier in 14.b.1 totalling 1722 tonnes. The following years, roundnose grenadier became a target species. In 2011 official landings in 14.b.1 increased to 2239 t. In subsequent years total estimated landings amounted to of 1860, 1790 and 2065 t in 2012, 2013 and 2014 respectively. To these figures an unallocated catch in 14.b.1 of 1015 t must be added. The total estimated preliminary catch in 2014 consists of 3466 t including Spanish catch in 14.b.1, negligible Faroese and French bycatches in 10.a, 12.a and 14.b.1 and discards. In 2015 total Spanish catch was declared as 862 t (533 and 329 tonnes in 14.b.1 and 12.a.1 respectively). In 2016 the landings were estimated as 660 t. No catches were reported by other countries.

The information on fishery in 2017 was presented only by Spain. The preliminary official landings for 2017 are 84 t including 68 t in 14.b.1 and 16 t in 12.a.1 (Table 9.4.4).

The landings data is very uncertain for last years. There are differences between catch data reported to the ICES and to NEAFC, and information presented to WG also.

9.4.1.2 ICES Advice

ICES advice applicable to 2016 and 2017

"ICES advises that when the precautionary approach is applied, landings should be no more than 717 tonnes in each of the years 2016 and 2017. ICES cannot quantify the corresponding catches." In the advice for 2016 and 2017, the stock status was presented as follows:

		Fishing pressure					Stock size			
		2012	2013	2014			2013	2014	2015	
Maximum Sustainable Yield	F_{MSY}	?	?	?	Undefined	MSY $B_{trigger}$	?	?	?	Undefined
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Undefined	B_{pa}, B_{lim}	?	?	?	Undefined
Management Plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-	-	-	Not applicable
Qualitative evaluation	-	?	?	?	Unknown	-	?	?	?	Undefined

ICES advice applicable to 2018 and 2019

"ICES advises that when the precautionary approach is applied, landings should be no more than 717 tonnes in each of the years 2018 and 2019. ICES cannot quantify the corresponding catches." In the advice for 2016 and 2017, the stock status was presented as follows:

		Fishing pressure					Stock size			
		2014	2015	2016			2014	2015	2016	
Maximum sustainable yield	F_{MSY}	?	?	?	Unknown	MSY $B_{trigger}$	?	?	?	Unknown
Precautionary approach	F_{pa},F_{lim}	?	?	?	Unknown	B_{pa},B_{lim}	?	?	?	Unknown
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable
Qualitative evaluation	-	?	?	?	Unknown	-	?	?	?	Unknown

9.4.1.3 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. On the 35th Annual session of NEAFC the recommendation (Rec. 8:2017) on the Conservation and Management of Roundnose Grenadier (*Coryphaenoides rupestris*), Roughhead Grenadier (*Macrourus berglax*), and Roughsnout Grenadier (*Trachyrinchus scabrus*) and other Grenadiers (*Macrouridae*) in the NEAFC Regulatory Area (Divisions 10.b and 12.c, and Subdivisions 12.a.1 and 14.b.1) was adopted for 2018. It specifies:

3) A total allowable catch limitation of 717 tonnes of roundnose grenadier.

4) 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.

5) Contracting Parties shall submit all data on the relevant fishery to ICES, including catches, bycatches, discards and activity information.

9.4.2 Data available

9.4.2.1 Landings and discards

Landings are given in Tables 9.4.1–9.4.5. The information on landings is very uncertain for last years. There were no discards of roundnose grenadier on Russian trawlers where smallest fish and waste were used for fishmeal processing. The information on discards rate is very poor. The studies of discards were conducted only in 2014, when the discards on Spanish target fishery estimated by scientific observers was at level of 386 t (Tables 9.4.4).

9.4.2.2 Length compositions

According to last Russian research data (October 2010) large mature specimens of grenadier of 60–85 cm in total length prevailed in catches taken on the MAR between 46–50°N (Figure 9.4.2). The retrospective data analysis demonstrates that the length of fish caught in 2003–2010 in the surveyed area decreased as compared to 1980s. The length distributions in 2003 and 2010 are generally similar, however, in 2010 the number of small immature grenadier up to 50 cm in length was lower.

In 2013 juvenile individuals were occasionally caught by pelagic trawl during Redfish survey in the Irminger Sea at a depth 500–900 m. Total length of 28 specimens varied from 7 to 32 cm.

The pelagic trawl Spanish fishery in 2012–2014 caught individuals from 6 to 23 cm preanal length, the mean length comprised 12.2–13.5 cm and 13,3–15.0 cm for males and females respectively. The observed length data on Spanish fishery in 2016 showed, that the length composition of catches has substantially changed. The mean length of males was 10,7 cm and mean length of females 12.0 cm. The cause of such significant reduction of fish size could be either overfishing or abundant recruitment. The length compositions of landings and discards of this fishery are presented in Figure 9.4.3.

9.4.2.3 Age compositions

No new data on age compositions were presented.

9.4.2.4 Weight-at-age

No new weight-at-age data are available.

9.4.2.5 Maturity and natural mortality

No new data on natural mortality are available. According to Russian research data in October 2010, gonads of roundnose grenadier were mostly at the stage of maturation. The total proportion of females at pre-spawning and spawning states constituted 25%, which is comparable with the results observed in May–June 2003 (21%). In the both cases a small number of juvenile specimens were observed in catches (2.3% and 3.4%respectively).

9.4.2.6 Catch, effort and research vessel data

Catch and cpue data are given in Tables 9.4.1–9.4.6 and Figures 9.4.1 and 9.4.4–9.4.6. There are gaps in the cpue time-series due to lack of catch statistics for 1973 and 1982 and absence of target fishery in 1994–1995 and 2006–2009 (data for some years cannot be used owing to short fishing periods). Effort data separated by subareas and divisions are available for Russian fleet in 2003–2009 (Table 9.4.6). Effort data for Spanish fleet are available for 2010–2017 (Table 9.4.7). The information on effort is very uncertain for last years.

Data on biology and distribution of juvenile roundnose grenadier was collected in May–July 2003, 2005, 2007, 2011, 2013 during the international trawl-acoustic survey (ITAS) of redfish *Sebastes mentella* in the Irminger and Labrador Seas, as well as during investigations under the Russian national programme of investigations on the West Iceland and East Greenland slopes. Russian, Icelandic and German research vessels participated in ITAS. In 2015 the survey also was conducted but the information on the distribution of juvenile roundnose grenadier was not available for WGDEEP. Trawl stations were carried out by pelagic trawl (78,7/416) with vertical opening of 43 m and Gloria 896 pelagic trawl with vertical opening of 46 m. In 2003 for the first time, data suggesting a wide distribution of young fish in the high seas pelagic are obtained (Vinnicchenko V. and Khlivnoy V., 2008). Investigation results are evidence of the long passive migrations of this species at early life stages. Outside the island slopes, juvenile roundnose grenadier was registered in most parts of the investigated area between 52°54'–63°41'N, 26°00'–51°06'W above 1200–3200 m depth (Figure 9.4.4). Juveniles were caught in pelagic layer at depths of 120–840. Maximum catches (up to ten individuals per one trawling hour) were registered over the MAR in the layer 500–700 m. Pre-anal length of specimens varied from 2 to 7 cm, age varied from 0+–3. The collected materials indicate a possibility to use ITAS for studies of abundance dynamics in roundnose grenadier. This objective requires more detailed analysis on distribution and abundance of young grenadier.

9.4.3 Data analyses

The source of information on abundance trends was only the cpue series from the Soviet/Russian official data (Table 9.4.6, Figure 9.4.5). The cpue varied strongly, but generally declined in the 1970s, then the level appears to have remained comparatively stable till to 1990. Further decline occurred in 1991–1993 and 1998–2000. There is some increasing of cpue in 2004–2005 but it remained at a low level, almost half that observed in the early 1970s when a virgin stock was exploited. These data must be treated with caution because the fishery on MAR is very difficult and its effectiveness depends on many factors (distribution of pelagic concentrations, experience of vessel crew, environmental conditions, etc.) that could not be taken in account during current analysis of cpue dynamics.

Since 2010 the official Spanish cpue and effort data are available. The current effort is low compared to the effort developed by USSR vessels in the 1970s and the cpue seems also low, long-term comparison is however undermined by the absence of standardisation of fleet and vessel type. The Spanish cpue in Subdivisions 14.b.1 were on maximal level in 2011. In 2012–2013 the cpue declined and was stability in 2014–2015 (Figure 9.4.6). The time-series of the cpue for Subdivisions 12.a.1 is very short (Figure 9.4.7).

The most recent trawl acoustic survey was carried out by Russian RV “Atlantida” in October 2010 in the southern part of fishing area (44–50°N), where 17 seamounts were surveyed (Figure 9.4.8). The typical echo-indications of grenadier were obtained over 13 seamounts located to the north of 46°N. Similar to 2003, considerable increase of the grenadier distribution depths (mainly 1200–1350 m, sometimes up to 1500 m) was observed (Figure 9.4.9) as compared to 1970s–1980s, when it was mainly from 600 to 1200 m (Chuksin and Sirotin, 1975). The biomass of the pelagic component of the grenadier on the 13 seamounts amounted to about 59 400 t. In 2003 the biomass was estimated 35 100 t on the nine seamounts of this area. The biomass values were higher in 2010 than in 2003 at the most seamounts (Table 9.4.8). The average biomass per one seamount increased from 3900 t in 2003 to 4600 t in 2010.

9.4.4 Biological reference points

No attempt was made to propose reference points for this stock.

9.4.5 Comments on the assessment

No analytical assessments were carried out.

9.4.6 Management considerations

The fishery was resumed in recent years after the long break. The landings series is too short now. In fact, active fishery was resumed in 2010. The recent landings and the cpue data are very uncertain. The cpue can be use as indicator of the state of stock in future.

9.4.7 References

Vinnichenko V., Khlivnoy V. 2008. New data on distribution of young roundnose grenadier (*Coryphaenoides rupestris*) in the North Atlantic Grenadiers of the world oceans: Biology, stock assessment and fisheries. American Fisheries Society, 2008. 119–124 pp.

9.4.8 Tables and Figures

Table 9.4.1. Working group estimates of catch of roundnose grenadier from Subdivision 5.a.1.

Year	USSR/ Russia	Total
1973	820	820
1974	12 561	12 561

Table 9.4.2. Working group estimates of catch of roundnose grenadier from Subarea 10.b.

Year	USSR/ Russia	Faroes1	Total
1976	170		170
1993		249	249

1994			
1995			
1996		3	3
1997		1	1
1998		1	1
1999		3	3
2000			
2001			
2002			
2003			
2004		1	1
2005	799		799
2006			
2007			
2008			
2009			
2010	73		73
2011			
2012			
2013			
2014			
2015			
2016			
2017			

Table 9.4.3.Working group estimates of catch of roundnose grenadier from Subareas 12.a.1 and 12.c.

Year	USSR/ Russia	Poland2	Latvia2	Faroes2	Spain	Lithuanian	Total
1973	226						226
1974	5874						5874
1975	29894						29894
1976	4545						4545
1977	9347						9347
1978	12310						12310
1979	6145						6145
1980	17 419						17419
1981	2954						2954
1982	12472						12472
1983	10300						10300
1984	6637						6637
1985	5793						5793
1986	22842						22842
1987	10893						10893
1988	10606						10606
1989	9495						9495
1990	2838						2838
1991	3214		4296				7510
1992	295		1684				1979
1993	473		2176	263			2912
1994			675	457			1132
1995				359			359
1996	208			136			344
1997	705	5867		138			6710
1998	812	6769		19			7600
1999	576	546		29			1151
2000	2325						2325
2001	1714			2			1716
2002	737						737
2003	510						510
2004	436			8			444
2005	600						600
2006				1			1
2007				2			2
2008	13						13
2009	5						5
2010							
2011							
2012					864	4	868
2013					118		118
2014				4			4
2015					329		329

Year	USSR/ Russia	Poland2	Latvia2	Faroes2	Spain	Lithuanian	Total
2016					289		289
2017[3]					16		16

[1]–revised catch data

[2]– official ICES data

[3]– preliminary data.

Table 9.4.4. Working group estimates of catch of roundnose grenadier from Subdivision 14.b.1.

Year	USSR/ Russia	Spain	Unallocated	Discards	Total
1976	11				11

1982	153				153

1997	3361				3361
1998					
1999					
2000	5				5
2001	69				69
2002	4	235[2]			239
2003		272[2]			272
2004	201				201
2005					
2006					
2007		57			57
2008		1722			1722
2009					
2010		753			753
2011		2239			2239
2012		1860	1098		2958
2013		1790			1790
2014		2065	1015	386	3466
2015		533			533
2016		371			371
2017[3]		69			69

[1]–revised catch data [2]– official ICES data [3]—preliminary statistics.

Table 9.4.5. Working group estimates of catch of roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1, by area.

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
1973	820	0	226	0	1046
1974	12561	0	5874	0	18435
1975	0	0	29894	0	29894
1976	0	170	4545	11	4726
1977	0	0	9347	0	9347
1978	0	0	12310	0	12310
1979	0	0	6145	0	6145
1980	0	0	17419	0	17419
1981	0	0	2954	0	2954
1982	0	0	12472	153	12625
1983	0	0	10300	0	10300
1984	0	0	6637	0	6637
1985	0	0	5793	0	5793
1986	0	0	22842	0	22842
1987	0	0	10893	0	10893
1988	0	0	10606	0	10606
1989	0	0	9495	0	9495
1990	0	0	2838	0	2838
1991	0	0	7510	0	7510
1992	0	0	1979	0	1979
1993	0	249	2912	0	3161
1994	0	0	1132	0	1132
1995	0	0	359	0	359
1996	0	3	344	0	347
1997	0	1	6710	3361	10072
1998	0	1	7600	0	7601
1999	0	3	1151	0	1154
2000	0	0	2325	5	2330
2001	0	0	1716	69	1785
2002	0	0	737	239	976
2003	0	0	510	272	782
2004	0	1	444	201	646
2005	0	799	600	0	1399
2006	0	0	1	0	1
2007	0	0	2	57	59
2008	0	0	13	1722	1735
2009	0	0	5	0	5
2010	0	73	0	753	826
2011	0	0	0	2239	2239
2012	0	0	868	2958	3826
2013	0	0	118	1790	1908
2014	0	0	4	3466	3470

Year	5.a.1	10.b	12.a.1 and 12.c	14.b.1	Total
2015	0	0	329	533	862
2016	0	0	289	371	660
2017[1]	0	0	16	68	84

[1]—preliminary statistics.

Table 9.4.6. Soviet/Russian fishing effort and cpue on the roundnose grenadier fishery on the MAR.

Year	ICES Subarea and Division	Number of fishing days	Catch per fishing day, t
1974	12.a.1+12.c, 5.a.1		35.2
1975	12.a.1+12.c		36.6
1976	12.a.1+12.c, 14.b.1, 10.b		24.0
1977	12.a.1+12.c		17.3
1978	12.a.1+12.c		17.0
1979	12.a.1+12.c		19.6
1980	12.a.1+12.c		17.3
1981	12.a.1+12.c		18.4
1982	12.a.1+12.c		
1983	12.a.1+12.c		17.3
1984	12.a.1+12.c		18
1985	12.a.1+12.c		18.5
1986	12.a.1+12.c		21
1987	12.a.1+12.c		17.3
1988	12.a.1+12.c		21.8
1989	12.a.1+12.c		15.6
1990	12.a.1+12.c		18.4
1991	12.a.1+12.c		14.5
1992	12.a.1+12.c		12.9
1993	12.a.1+12.c, 10.b		10.7
1994	12.a.1+12.c, 14.b.1, 10.b		
1995	12.a.1+12.c, 14.b.1, 10.b		
1996	12.a.1+12.c, 10.b		22.2
1997	12.a.1+12.c, 14.b.1, 10.b		20.3
1998	12.a.1+12.c, 10.b		6.8
1999	12.a.1+12.c, 10.b		8.8
2000	12.a.1+12.c, 14.b.1		9.1
2001	12.a.1+12.c		15.8
	14.b.1		
2002	12.a.1+12.c		13.2
	14.b.1		
2003	12.a.1+12.c	51	10.1
2004	12.a.1+12.c	25	16.1
2005	12.a.1+12.c	42	17.7
	10.b	37	
2006	12.a.1+12.c, 14.b.1, 10.b		

2007	12.a.1+12.c, 14.b.1, 10.b		
2008	12.c	7	
2009	12.c	1	

Table 9.4.7. Spanish fishing effort on roundnose grenadier fishery on the MAR.

Year	ICES Subarea and Division	Number of fishing days	Effort, kwd	Number of fishing bots
2010	14.b	19		3
2011	14.b	98		4
2012	12.a.1	60		7
2012	14.b	140		7
2013	12.a.1	18		3
2013	14.b	147		6
2014	14.b	150		3
2015	12.a.1	21	25400[1]	1
2015	14.b	38	54693[1]	2
2016	12.a.1	2		2
2016	14.b	24		2
2017	12.a.1	2	2419[1]	1
2017	14.b1	5	26394[1]	2

[1]—preliminary statistics.

Table 9.4.8. Biomass of roundnose grenadier (t) according results of the Russian acoustic surveys on the MAR in 2003 and 2010.

Seamount number	2003	2010
462	Not surveyed	2188
473-A	1662	10 259
473-B	7016	6417
476-A	3159	4357
485-A	971	6350
485-B	Not surveyed	2097
491-B	3228	2203
493-A	Fish records are weak	1828
494-A	18 086*	12 274
494-B		8227
495	977	1350
495-B	Not surveyed	241
496-A	Fish records are weak	1573
TOTAL	35 099	59 364

*** – total for two seamounts.**

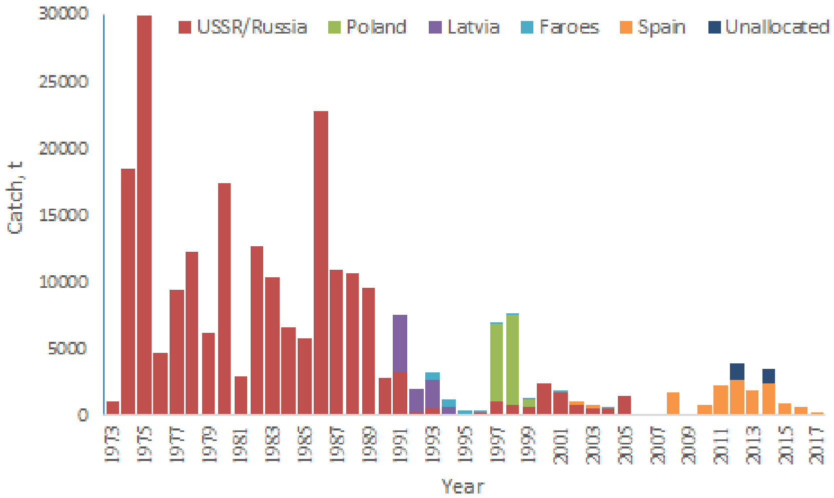


Figure 9.4.1. International catch of roundnose grenadier on the MAR in 1973–2017.

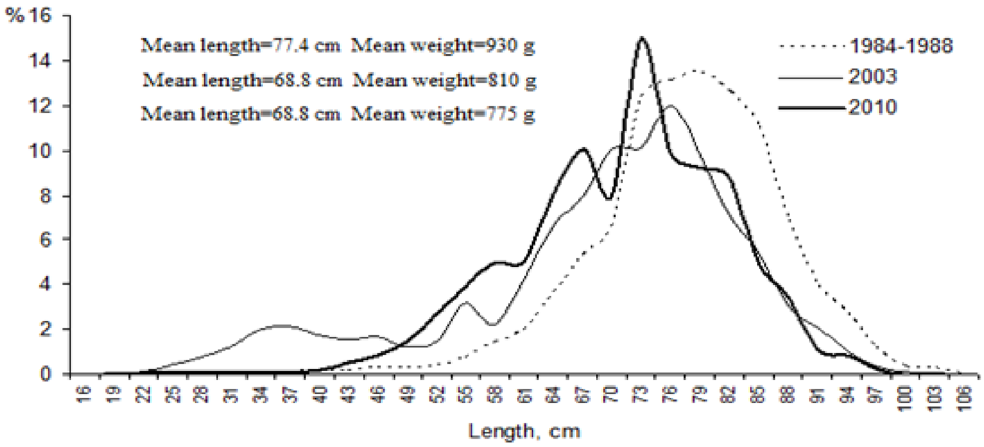


Figure 9.4.2. Total length composition of roundnose grenadier on the MAR in 1984–1988 (47–51°N), in 2003 (47–51°N) and in 2010 (47–50°N).

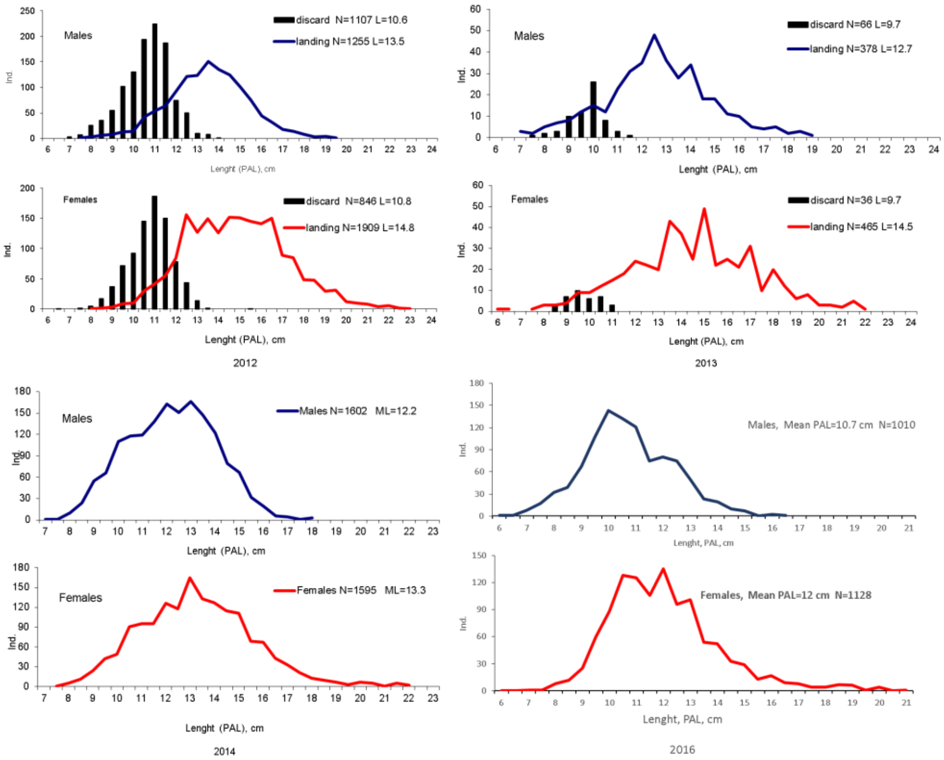


Figure 9.4.3. Length composition (PAL) of landings and discards of roundnose grenadier on Spanish commercial trawl fishery.

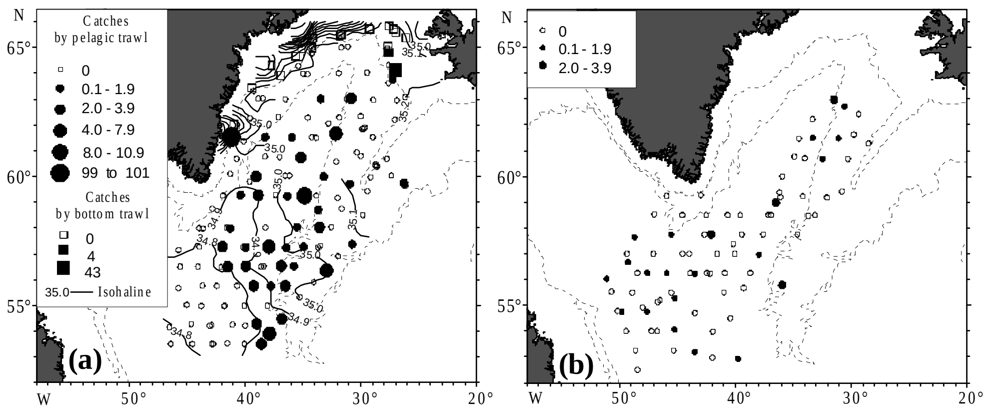


Figure 9.4.4. Catches of young roundnose grenadier (indiv./1 trawling hour) and water salinity at 50 m depth in the North Atlantic in May–July 2003 (a) and in June–July 2005 (b) (Vinnicchenko V., Khlivnoy V. 2008).

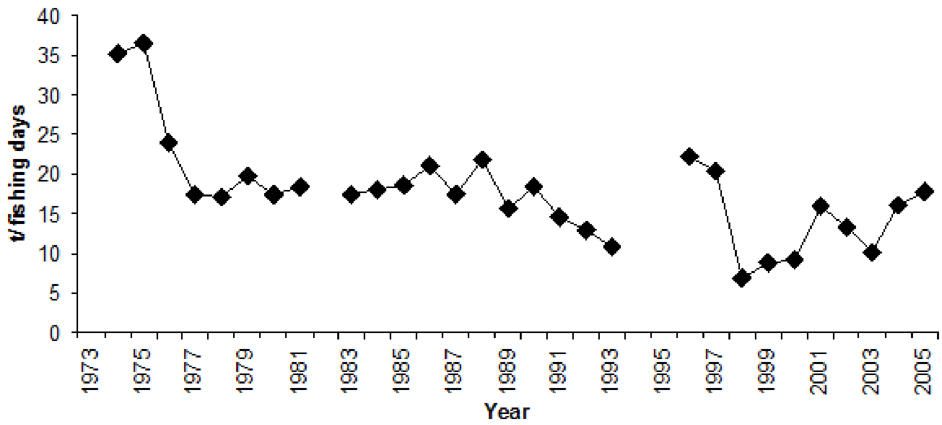


Figure 9.4.54. Soviet/Russian cpue of roundnose grenadier on the MAR in 1973–2005.

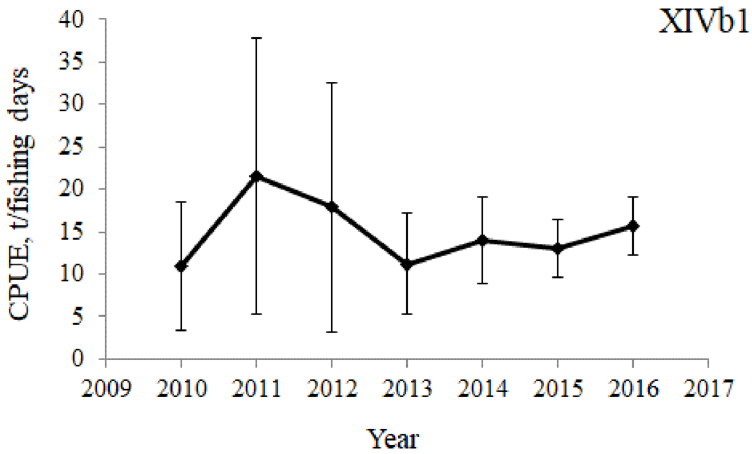


Figure 9.4.6. Spanish cpue of roundnose grenadier on the MAR in Subdivision 14.b.1 in 2010–2016. The cpue 2017 is not representative.

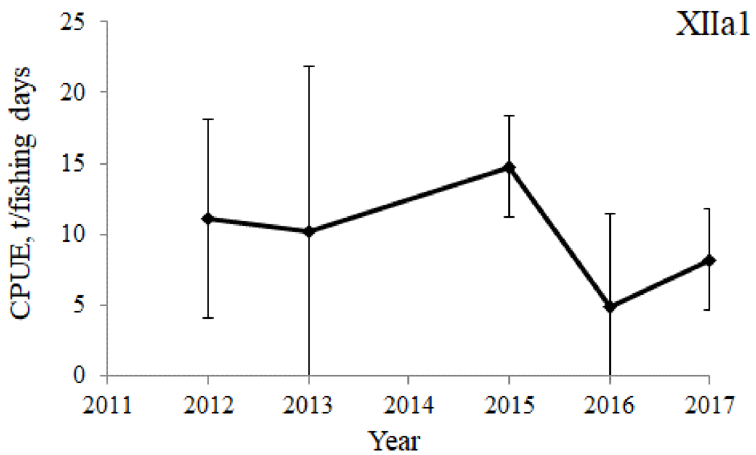


Figure 9.4.7. Spanish cpue of roundnose grenadier on the MAR in Subdivision 12.a.1 in 2012–2013 and 2015-2017.

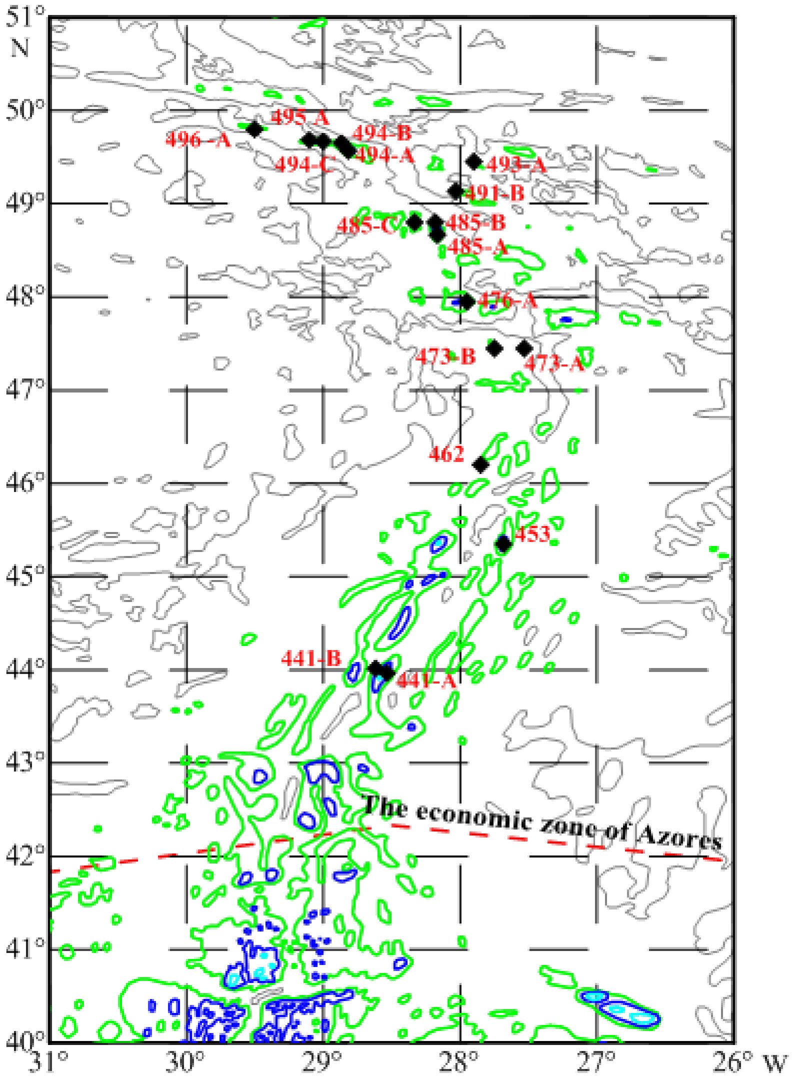


Figure 9.4.7. Location of seamounts surveyed at RV "Atlantida" on the MAR in October 2010.

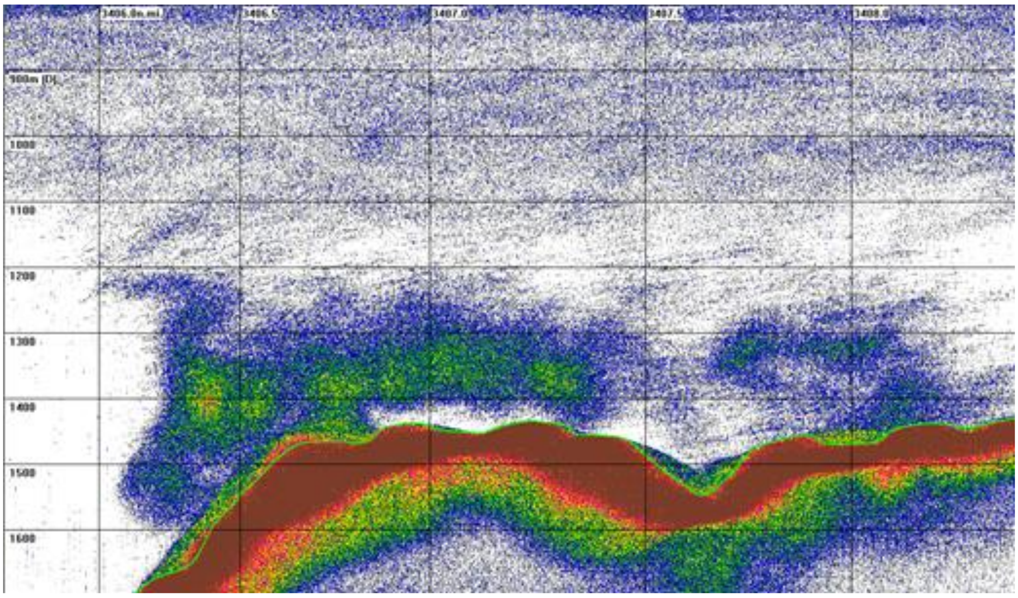


Figure 9.4.8. Echo-records of roundnose grenadier at the MAR seamount 494-A in October 2010.

9.5 Roundnose grenadier (*Coryphaenoides rupestris*) in subareas 1, 2, 4, 8, and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2 (Northeast Atlantic and Arctic Ocean)

9.5.1 The fishery

Outside of the main fisheries covered in other sections, landings of roundnose grenadier were insignificant.

9.5.1.1 Landings trends

Landing statistics by countries in the period 1990–2016 are presented in Tables 9.5.1–9.5.5.

In the Subareas 1 and 2 the catch of roundnose grenadier in 2016 comprised 4 t and was mainly taken as bycatch by Norwegian fleet. Moreover, insignificant catch of species was declared by France, from 1990 landings varied from 0 to 101 t (Figure 9.5.1). The major contribution to the total catch was made by Norway. Roundnose grenadier was partly taken in mixed deep-water fisheries; directed local fisheries in Norwegian fjords for this species also exist. Earlier French landings, that reached 41 t, were assigned to this species however a recent revision of the data indicates that previous landings are more likely to correspond to roughhead grenadier, so there is no French landings for roundnose grenadier in Subareas 1 and 2.

In Subarea 4, the catch of roundnose grenadier in 2016 was mainly taken by the French fleet and comprised 2 t. The vessels of Norway and Scotland also had negligible catches. During 1990–2012 total landings in this area varied between 0 and 372 t (Figure 9.5.2). The main contribution to the total catch was made by the Danish fleet in 2004. Roundnose grenadier is caught as incidental bycatch in this area by Scottish and Norwegian vessels in insignificant amount as well. As detected for French landings of this species in Subareas 1 and 2, earlier landings of roundnose grenadier in Subarea 4 are likely to correspond to roughhead grenadier but 2014 landings are well assigned. Four tons in 2014 may correspond to catch of roundnose close to the Norwegian deep or to misreported roughhead along the slope of the northern North Sea.

During 1990–2016, the landings of roundnose grenadier within Icelandic waters (Division 5.a) varied 2 to 398 t and were made by Iceland (Figure 9.5.3). Maximum landings were registered in 1992–1997 when 198–398 t were caught annually as bycatch in mixed deep-water fisheries, but it should be noted that it can include other grenadier species till 1990 (Table 9.5.3). In recent years, roundnose grenadier landings from 16 to 81 t were taken in Icelandic waters as bycatch in trawl fisheries for Greenland halibut and redfish. In 2016 catch in 5.a amounted 52 t.

Roundnose grenadier landings in Subareas 8 and 9 during 1990–2014 were minor and amounted 0 to 28 t annually (Figure 9.5.4). The main contribution to the total catch was made by France (Table 9.5.4). In 2015 landings from the subareas were 1 t. In 2016 were negligible bycatches and discards on French and Spanish fishery. Total amount was less 0.02 t.

Total catch in Greenland waters (Subdivision 14.b.2) in 1990–2016 varied from 1 to 126 t (Table 9.5.5). There is no directed fishery for roundnose grenadier in these areas. The majority of landings is taken as bycatch by Greenland, Germany and Norway during Greenland halibut bottom-trawl fisheries (Table 9.5.5). In 2015 catch was 38 t that mainly was taken by Greenland. In 2016 was no catches declared (Figure 9.5.5).

In the period 2003–2005 the unallocated landings were assigned to Subareas 1, 2, 4,8, 9 and Division 5.a.2 and 14.b.2, the values were 208, 504, and 952 t respectively (Table 9.5.6, Figure 9.5.6).

9.5.1.2 ICES advice

ICES advice applicable to 2015

"The 2012 advice for this stock is biennial and valid for 2013 and 2014 (ICES, 2012). New data available do not change the perception of the stock. Therefore, the advice for this fishery in 2015 is the same as the advice for 2013: Based on the ICES approach for data-limited stocks, ICES advises that fisheries should not be allowed to expand from 120 t until there is evidence that this is sustainable."

ICES advice applicable to 2016 and 2017

"ICES advises that when the precautionary approach is applied, landings should be no more than 65 tonnes in each of the years 2016–2017. ICES cannot quantify the corresponding catches."

In the advice for 2016 and 2017, the stock status was presented as follows:

		Fishing pressure					Stock size			
		2012	2013	2014			2013	2014	2015	
Maximum Sustainable Yield	F_{MSY}	?	?	?	Undefined	MSY $B_{trigger}$	?	?	?	Undefined
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Undefined	B_{pa}, B_{lim}	?	?	?	Undefined
Management Plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-	-	-	Not applicable
Qualitative evaluation	-	?	?	?	Unknown	-	?	?	?	Undefined

ICES advice applicable to 2018 and 2019

"ICES advises that when the precautionary approach is applied, landings should be no more than 65 tonnes in each of the years 2018 and 2019. ICES cannot quantify the corresponding catches."

In the advice for 2018 and 2019, the stock status was presented as follows:

		Fishing pressure					Stock size			
		2014	2015	2016			2014	2015	2016	
Maximum sustainable yield	F_{MSY}	?	?	?	Unknown	MSY $B_{trigger}$	?	?	?	Unknown
Precautionary approach	F_{pa},F_{lim}	?	?	?	Unknown	B_{pa},B_{lim}	?	?	?	Unknown
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable
Qualitative evaluation	-	?	?	?	Unknown	-	?	?	?	Unknown

9.5.1.3 Management

There is a TAC management of the roundnose grenadier fisheries in Subareas 1, 2, 4, 8, 9, Division 5.a and Subdivision 14.b.1 for European Community vessels. In international waters there are NEAFC regulation of efforts in the fisheries for deep-water species.

9.5.2 Data available

9.5.2.1 Landings and discards

Landings are given in Table 9.5.1–9.5.5. Estimated discards owing to bycatch in Spanish fisheries for demersal fish in 8 and 9 did not exceed 2 t in 2012, and did not reached to 1 t in subsequent years.

9.5.2.2 Length compositions

No data.

9.5.2.3 Age compositions

No data.

9.5.2.4 Weight-at-age

No data.

9.5.2.5 Maturity and natural mortality

No data.

9.5.2.6 Catch, effort and research vessel data

No data.

9.5.3 Data analyses

No assessment was carried out for this stock in 2016.

Biological reference points

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

9.5.4 Comments on the assessment

No assessment was carried out for this stock in 2016.

9.5.5 Management considerations

This is a bycatch fishery and advice should take into account advice for other stocks.

9.5.6 Tables and Figures

Table 9.5.1. Working group estimates of landings of roundnose grenadier from Subareas 1 and 2.

Year	Faroes	Denmark	Germany	Norway	Russia/USSR	Germany	UK (E+W)	France	TOTAL
1990			2		12	3			17
1991			3	28					31
1992		1		29					30
1993				2					2
1994			12						12
1995									0
1996									0
1997	1			100					101
1998				87	13				100
1999				44	2				46
2000									0
2001							2		2
2002				11	1				12
2003				4					4
2004				27					27
2005				12					12
2006				6	2				8
2007				11	1				12
2008				10					10
2009				8					8
2010				17	6				23
2011				16					16
2012				5					5
2013				17					17
2014				4					4
2015				11					11
2016				2				0	2
2017*				4				<1	4

*** Preliminary data.**

Table 9.5.2. Working group estimates of landings of roundnose grenadier from Subarea 4.

Year	Germany	Norway	UK (Scot)	Denmark	France	TOTAL
1990	2					2
1991	4					4
1992			4	1		5
1993	4					4
1994	2			25		27
1995	1		15			16
1996			5	7		12
1997			10			10
1998						0
1999		5				5
2000						0
2001				17		17
2002		1	26			27
2003		1	11			12
2004			1	371		372
2005		2				2
2006		4				4
2007		1				1
2008						0
2009						0
2010		2	0			2
2011		0	0			0
2012		1				1
2013						0
2014					3	3
2015		1	<1		1	2
2016		0	0		1	1
2017*		<1			<1	<1

***Preliminary data.**

Table 9.5.3. Working group estimates of landings of roundnose grenadier from Division Va.

Year	Faroes	Iceland**	Norway	UK (E+W)	Denmarck	Greenland	TOTAL
1990		7					7
1991		48					48
1992		210					210
1993		276					276
1994		210					210
1995		398					398
1996	1	139					140
1997		198					198
1998		120					120
1999		129					129
2000		54					54
2001		40					40
2002		60					60
2003		57					57
2004		181					181
2005		76					76
2006		62					62
2007	1	13	2				16
2008		29					29
2009		46					46
2010		59					59
2011		62					62
2012	0	80					81
2013		84					84
2014		36					36
2015		22			2		24
2016		52					52
2017*						2	2

*** Preliminary data. ** includes other grenadiers from 1990 to 1996.**

Table 9.5.4. Working group estimates of landings of roundnose grenadier from Subareas 8 and 9.

Year	France	Spain	TOTAL
1990	5		5
1991	1		1
1992	12		12
1993	18		18
1994	5		5
1995			0
1996	1		1
1997			0
1998	1	19	20
1999	9	7	16
2000	4		4
2001	7		7
2002	3		3
2003	2		2
2004	2		2
2005	8		8
2006	27	1	28
2007	10		10
2008	8		8
2009	1		1
2010	1		1
2011	1		1
2012	0		0
2013	0		0
2014	0		0
2015	1		1
2016	0	0	0
2017*	0	0	0

*** Preliminary data.**

Table 9.5.5. Working group estimates of landings of roundnose grenadier from Division 14.b.2.

Year	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	Estonia**	TOTAL
1990		45	1			1				47
1991		23	4			2				29
1992		19	1	4	6		1			31
1993		4	18	4						26
1994		10	5							15
1995		13	14							27
1996		6	19							25
1997	6	34	12		7					59
1998	1	116	3		6					126
1999		105	0		19					124
2000		41	11		5					57
2001		11	5		7	2	72			97
2002		25	5		15	1	1			47
2003			15		5	1				21
2004		27	3							30
2005			7		6	1				14
2006		35	0		17					53
2007	1				1					2
2008								12		12
2009					2					2
2010		33			7					40
2011		32			4					36
2012					1					1
2013					2					2
2014	0				7				4	11
2015			38							38
2016			15							15
2017*			26							26

*** Preliminary data.**

**** Estonian landings in 2014 not reflected in ICES catch statistic.**

Table 9.5.6. Working group estimates of landings of roundnose grenadier from 1, 2, 4, 5.a.2, 8, 9, 14.a and 14.b.2.

Year	1+2	4	Va	8+9	14.b.2	14.a	Unallocated	Total
1990	17	2	7	5	47		0	78
1991	31	4	48	1	29		0	113
1992	30	5	210	12	31		0	288
1993	2	4	276	18	26		0	326
1994	12	27	210	5	15		0	269
1995	0	16	398	0	27		0	441
1996	0	12	140	1	25		0	178
1997	101	10	198	0	57		0	366
1998	100	0	120	20	126		0	366
1999	46	5	129	16	124		0	320
2000	0	0	54	5	57		0	116
2001	2	17	40	7	97		208	163
2002	12	27	60	3	47		504	149
2003	4	12	57	2	21		952	96
2004	27	372	181	2	30		0	612
2005	12	2	76	7	14		0	111
2006	8	4	62	28	53		0	155
2007	12	1	16	10	2		0	41
2008	10	0	29	8	12		0	59
2009	8	0	46	1	2			57
2010	23	2	59	1	40			125
2011	16	0	62	1	36			115
2012	5	1	81	1	1			89
2013	17	0	84	0	2			103
2014	4	4	36	0	11			55
2015	11	3	0	1	38			53
2016	2	1	0**	0	15	2		20
2017*	4	<1	2**		26			32

*** Preliminary data.**

**** catch in subdivision 5.a.2**

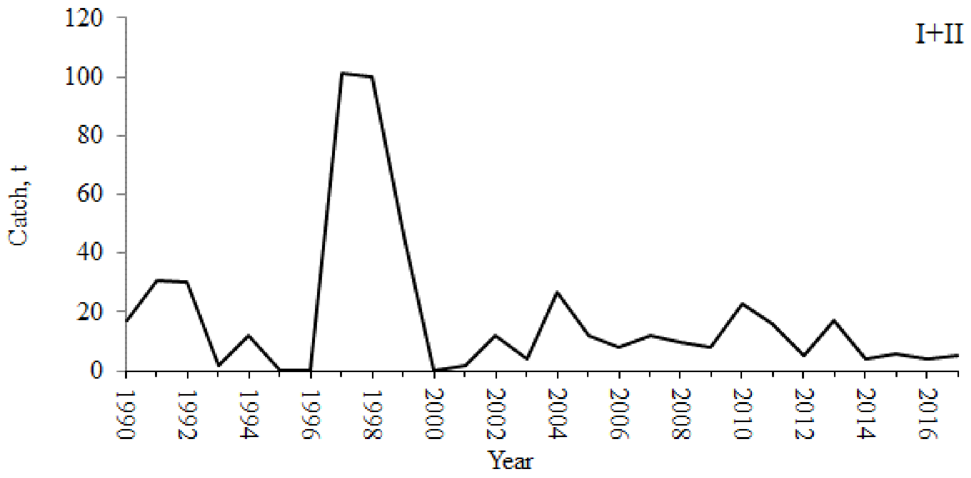


Figure 9.5.1. Roundnose grenadier landings in Subareas 1 and 2, 1990–2017 (data for 2017 are preliminary).

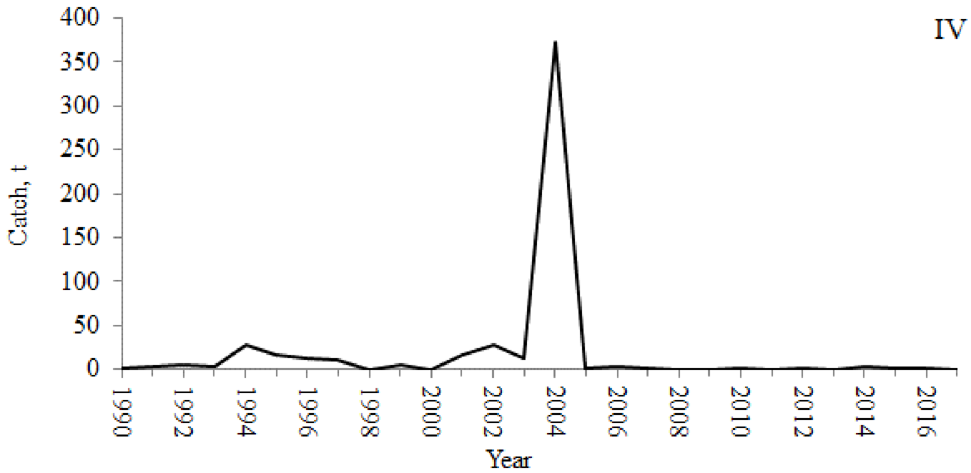


Figure 9.5.2. Roundnose grenadier landings in Subareas 4, 1990–2017 (data for 2017 are preliminary).

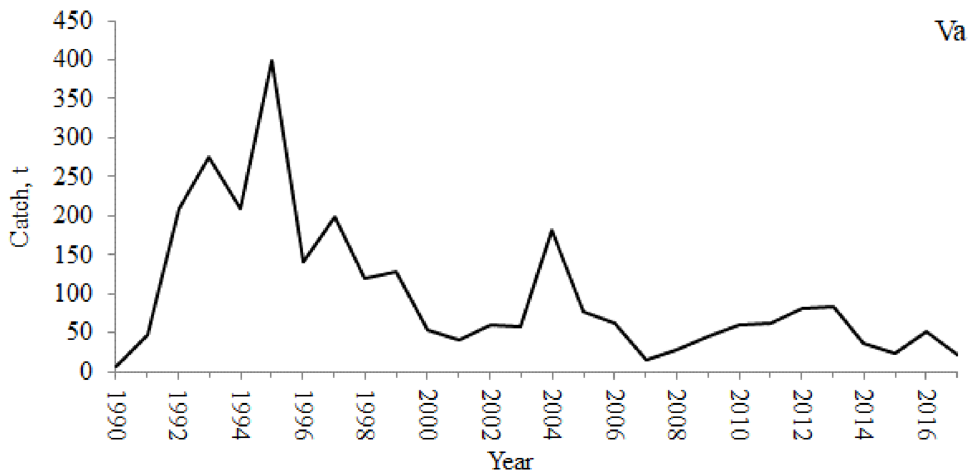


Figure 9.5.3. Roundnose grenadier landings in Division 5.a, 1990–2017 (data for 2017 are preliminary).

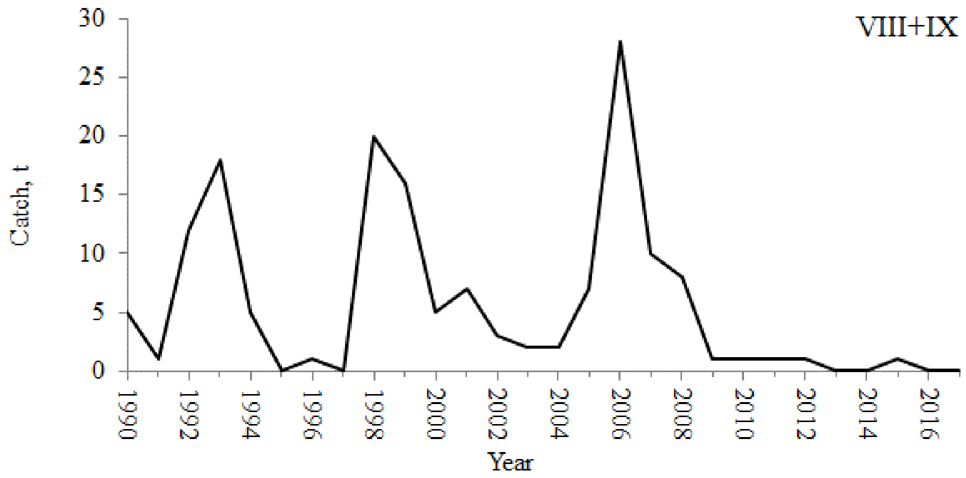


Figure 9.5.4. Roundnose grenadier landings in Subareas 8–9, 1990–2017 (data for 2017 are preliminary).

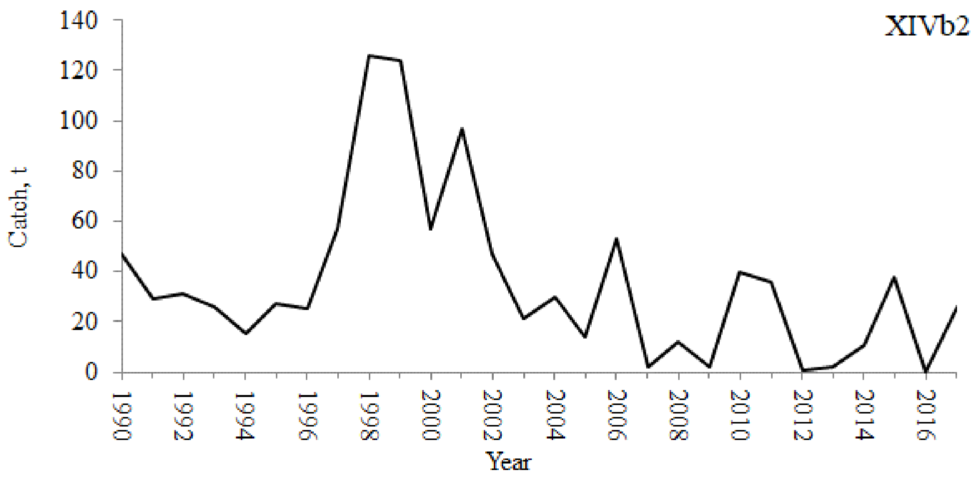


Figure 9.5.5. Roundnose grenadier landings in Subarea 14.b.2, 1990–2017 (data for 2017 are preliminary).

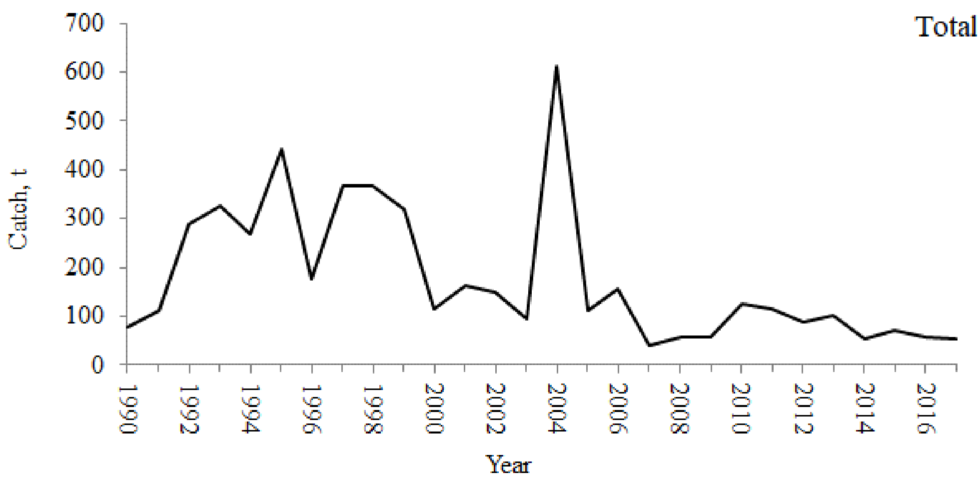


Figure 9.5.5. Roundnose grenadier landings in Subarea 14.b.2, 1990–2017 (data for 2017 are preliminary).

10 Black scabbard fish (*Aphanopus carbo*) in the Northeast Atlantic

10.1 Stock description and management units

The species is distributed on both sides of the North Atlantic and on seamounts and ridges south to about 30°N. It occurs only sporadically at the north of the Scotland-Iceland-Greenland ridges. Juveniles are mesopelagic and adults are benthopelagic. The life cycle is completed in just one area and either small or large scale migrations occur seasonally.

The stock structure in the whole Northeast Atlantic is still uncertain. Nevertheless, all the available information supports the assumption of a single stock from Faroese waters and the west of the British Isles down to Portugal (Farias *et al.*, 2013). The links with other areas such as ICES Subarea 10 is less clear, as in this Subarea two different species *A. carbo* and *A. intermedius* coexist (Besugo *et al.*, 2014 WD).

Prior to the 2014 benchmark meeting (WKDEEP, 2014), WGDEEP has considered three assessment units for black scabbardfish (ICES, 2011):

i) Northern (Divisions 5.b. and 12.b and Subareas 6 and 7);

ii) Southern (Subareas 8 and 9);

iii) Other areas (Divisions 3.a and 5.a Subareas 1, 2, 4, 10, and 14).

The Northern component comprises fish exploited mainly by trawlers while the Southern component by deep-water longliners from Subarea 9.a. In the other areas, the species is exploited by both longliners and trawlers, but till 2010 the overall landings from those areas were globally much lower than at the other two management units. However, in recent years, fishing activity in ICES Division 5.a has been regular, with landings rounding about 300 ton *per* year. To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, in 2016, WGDEEP agreed to include ICES Division 5.a in the Northern component.

Furthermore based on the linkage between the Northern and Southern management units, WKDEEP 2014 concluded that despite the management advice is provided for each of the two management units, the advice should be given by considering the status of bsf-nea stock as a whole. The reason for the maintenance of two distinct units when management purposes are considered is related to the fact that the stock is subjected to two main distinct different exploitation regimes (different fishing gears and exploited size ranges of the species).

All evidences available support the existence of one single stock doing a clockwise migration within these areas. A dynamic population model was developed for assessing the stock by considering the two components: the Northern and the Southern. The model was benchmarked at WKDEEP 2014.

The link between the Northern and Southern components and the other areas, excluding ICES Division 5.a, is less clear. The component "Other areas" is treated separately from Northern and Southern components.

The present report is structured maintaining the initial separation between units, except for topics related with the stock assessment and the advice.

10.2 Black scabbard fish in Divisions 5.b and 12.b and Subareas 6 and 7

In this section, fisheries, landings trends, and applicable management are presented for Divisions 5.b and 12.b and Subareas 6 and 7, but the stock assessment data analyses and management considerations apply to these areas combined with ICES Subareas 8 and Divisions 9.a and 5.a.

ICES Division 5.a has previously been included in "Other areas", however, in 2016, WGDEEP decided to include ICES Division 5.a in the Northern Component both for stock assessment analyses and for management considerations.

10.2.1 The fishery

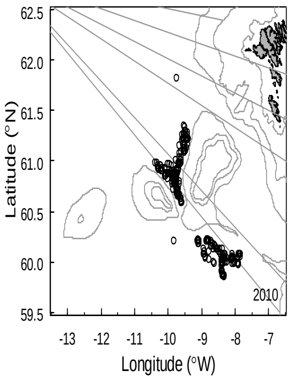


Figure10.2.1. Faroese main fishing grounds of black scabbardfish in Subarea 5.b (fishing hauls in which the species contributed with more than 50% of the total catch).

In Subarea 5.b, black scabbardfish is fished by large trawlers and the main fishing area is on the slope around the Faroe Bank (Figure 10.2.1).

In 2018, there was no updated information on the fisheries taking place in the Northern Component area.

10.2.2 Landings trends

The historic landings trends on this assessment unit are described in the stock annex.

Total landings from the ICES Division 5.b and Subareas 6, 7 and 12 show a markedly increasing trend from 1999 to 2002 followed by a decreasing trend till 2005 (Figure 10.2.1). In 2006, there was a peak in landings and since then landings decreased, particularly in ICES Divisions 6 and 7. This was majorly driven by the EU TAC management adopted (Figure 10.2.1). From 2009 till 2016, landings have been stable, fluctuating around about 3000 Ton per year. In 2017, there was a slight decrease.

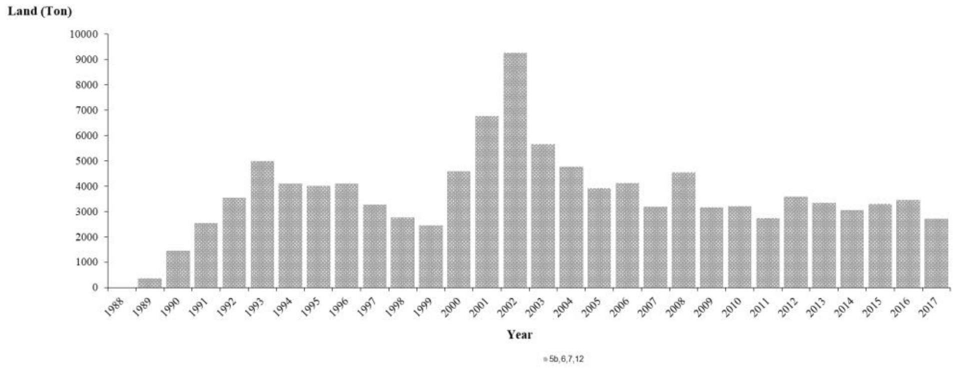


Figure10.2.1. bsfnea Northern component annual landings time-series for ICES Division 5.b and Subareas 6 plus 7 and 12 (2017 provisional data).

In earlier years, French landings represented more than 75% of the Northern Component total landings, but in 2000 and 2006 they just represented about 50%. During that period, both Faroese and Spanish landings increased determining an increase in their relative contribution (Figure 10.2.2). However, after 2010, the relative importance of French landings, particularly at ICES Subarea 6, augmented.

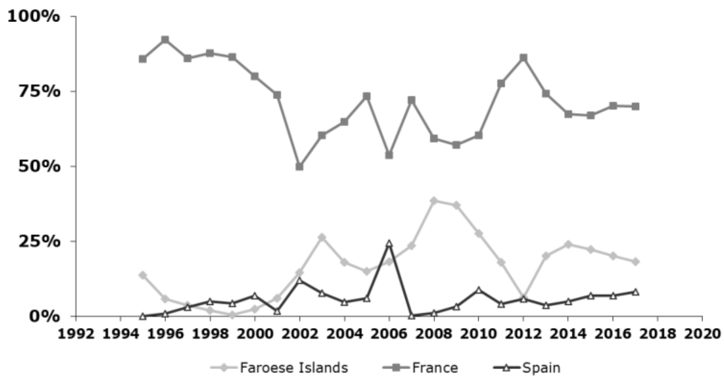


Figure 10.2.2. bsfnea Northern component French, Spanish and Faroese relative contribution to the annual landings for the Northern component.

10.2.2.1 ICES Advice

The latest ICES advice for 2017 and 2018 was: "*ICES advises that when the precautionary approach is applied, catches should be no more than 5894 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed.*

Distributed by area this corresponds to annual catches of no more than 2802 tonnes in subareas 6 and 7 and divisions 5.b *and* 12.b, *annual catches of no more than 2726 tonnes in Subarea* 8 *and Division* 9.a, *and annual catches of no more than 366 tonnes in subareas* 1, 2, 4, *and* 10 *and divisions* 3.a *and* 5.a.".

10.2.3 Management

Since 2003, the management of black scabbardfish adopted for EU vessels fishing in EU and international waters, includes a combination of TAC and licensing system. TACs and total landings of EU vessels in Subareas 27.5, 6, 7, and 12, since 2006 to 2015, are presented in the Table below. The difference between the TAC and landings may not necessarily be regarded as TAC overshoot as some catches occur in waters under the jurisdiction of third countries and are therefore not covered by the TAC.

Year	EU TAC 27.5, 27.6, 27.7 & 27.12	Landinds 27.5.b, 27.6, 27.7 and 27.12
2006	3042	7455
2007	3042	4885
2008	3042	3722
2009	2738	3082
2010	2547	2582
2011	2356	2350
2012	2179	2155
2013	3051	2772
2014	3966	3048
2015	3649	3291
2016	3357	3452
2017*	2 954	2709

*** preliminary.**

10.2.4 Data available

10.2.4.1 Landings and discards

In 2016, updated landing data were made available for the major fishing countries operating in the ICES Division 27.5b and Subareas 6, 7 and 12 (Table 10.2.1) and for ICES Division 5.a (Table 10.4.1c).

Update discard data were also provided for major fishing countries operating at the Northern component area. The level of black scabbardfish discards, as previously observed, is low. Based on the discard data available for the Northern component, it is concluded that discards of black scabbardfish are negligible.

10.2.4.2 Length compositions

Length frequency distributions based on French on-board observer data are presented in Figure 10.2.3. For the period under analysis and although no major differences on length frequency distributions are noted, a slight increase in the mean length is observed in the latter 4–5 years.

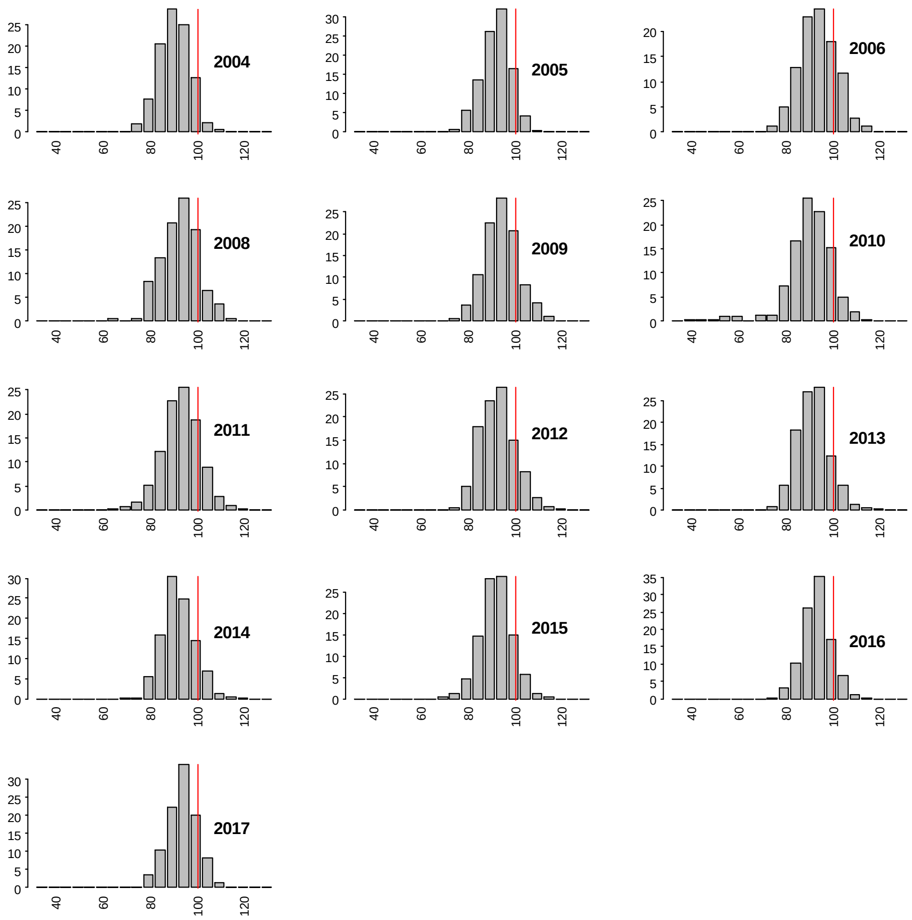


Figure 10.2.3. bsfnea Northern component - Annual frequency length distribution of black scabbardfish based on French observer data collected on-board commercial vessels (2008–2017). The red vertical line indicates the length of 1st maturity of the species.

The temporal evolution of the mean length by quarter and for the whole year shows no marked trend (Figure 10.2.4), suggesting stability on the length structure of the exploited population.

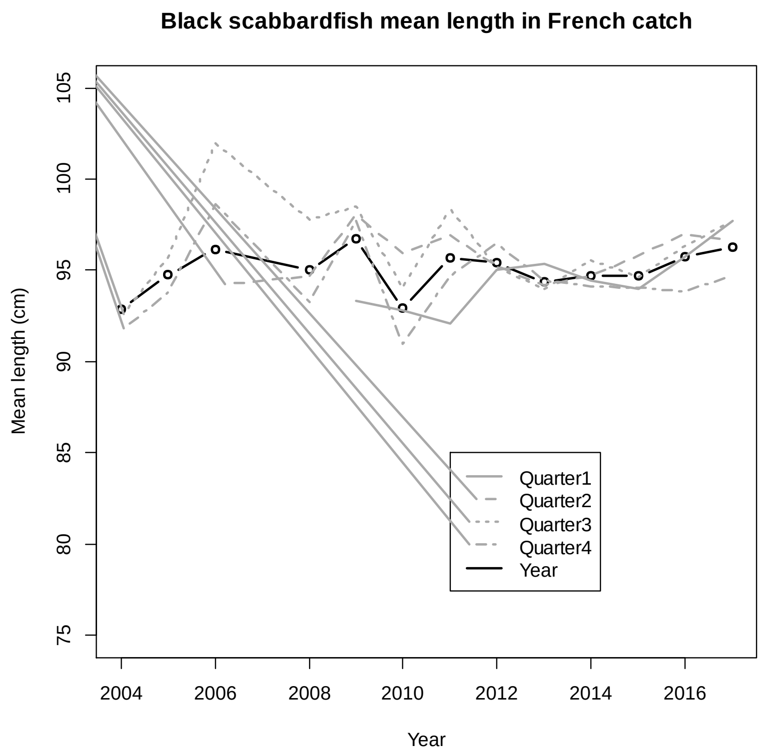


Figure 10.2.4. bsfnea Northern component – Mean length estimates of black scabbardfish by quarter for the period 2008-2017. Data were collected under the French on-board observer program.

The length frequency distributions of the Faroese landing data for the years between 2014 and 2017 are presented in Figure 10.2.5. The mean length of landed black scabbardfish is around 90-92 cm (Figure 10.2.5).

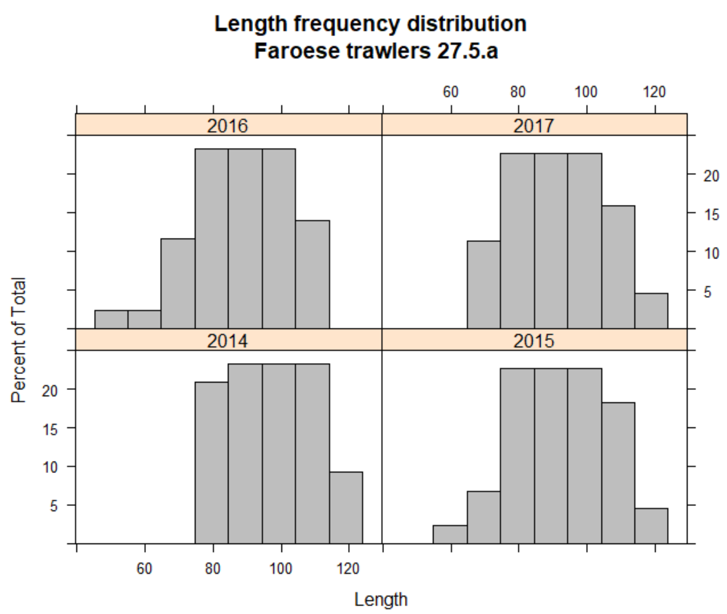
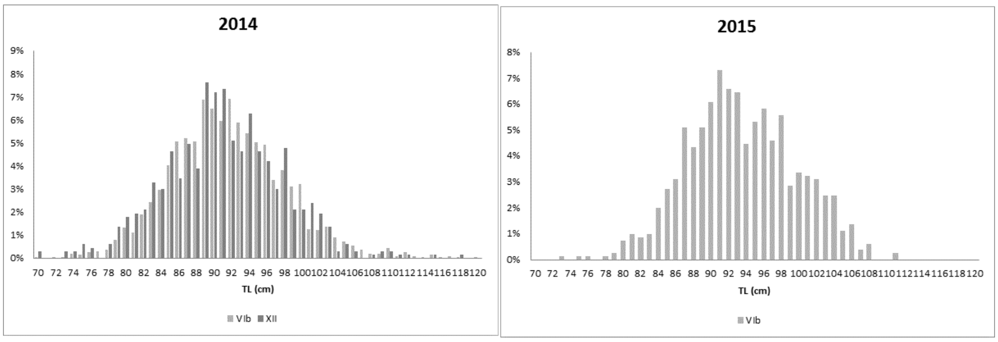


Figure 10.2.5. bsfnea Northern component – Black scabbardfish 5.b. Length frequency distribution based on Faroese landing data (2014–2017).



a) b)

Figure 10.2.6. bsfnea Northern component – Length frequency distribution based on Spanish on-board observed in 2014 (a) and in 2015 (b) in Division 6.b and Subarea 12.

Spanish length data from on-board observer program were available for 2014 and 2015. Figure 10.2.6 presents the annual length frequency distributions for ICES Division 6.b and ICES Subarea 12.

The length frequency distributions ranges are similar both between geographical areas and fishing fleets and, overall, specimens with lengths smaller than 103 cm predominate.

The length data available suggests a similar length structure of the exploited population between the different fishing fleets operating at the Northern component. The French length data series is the longest and because of that French data were used to calculate the total catches, in number, grouped in the two length classes considered in the assessment model (the two length classes are: C2, which includes specimens from 70 to 103 cm TL(total length), and C3, which are specimens larger than 130 cm TL.

Table 10.2.1. bsfnea Northern component Total catch estimates (in Ton) and total catch estimates (in number) in length group C2 and C3 by SEM1 (3-8 of the year) and SEM 2 (month 9-12 of the year plus months 1 and 2 of the following year) for the years 1999–2017.

	Catch (in ton)		Catch (in number) C2		Catch (in number) C3	
Year	Sem 1	Sem 2	Sem 1	Sem 2	Sem 1	Sem 2
1999		1553		1264092		197321
2000	2044	3053	1555358	2485582	242786	387991
2001	2759	3758	2098661	3059087	327594	477514
2002	3720	4362	2830256	3550670	441794	554248
2003	2442	2775	1857504	2258718	289950	352578
2004	2143	2119	1740128	1928011	153435	95913
2005	1860	2040	1406337	1582422	182697	161474
2006	2801	1919	2152433	1512990	243934	172945
2007	1682	1930	1164611	1527070	209447	174555
2008	1874	2616	1160752	2069458	301462	236553
2009	2202	1740	1357278	1159152	352502	263009
2010	1843	1569	1327905	1166053	186787	167764
2011	1671	1653	965970	1135256	287668	167927
2012	1475	1283	985407	631463	189141	155895
2013	1879	1651	1382488	1056923	174340	138409
2014	2134	1726	1454066	1181859	233393	147308
2015	2048	1549	1455544	1222845	193143	127742
2016	2267	1462	1530274	1117978	291048	131779
2017*	1601		1046235		229587	

***incomplete since catches January and February 2018 were not available**

***incomplete since catches in January and February 2018 were not available for most countries, except France.**

Table 10.2.1. presents the total catch in weight, in Ton, and in number by length class, C2 and C3, for the period 1999-2017 by six-month time period, adopted as the time unit in the model and defined as: SEM1= months 3-8 of the year; SEM2=month 9–12 of the year plus months 1 and 2 of the following year.

10.2.4.3 Age compositions

The exploited population was not structured by age because the stock assessment approach followed to assess the stock is a stage-based model, with stages defined according to length.

10.2.4.4 Weight-at-age

No data on weight-at-age are available.

10.2.4.5 Maturity and natural mortality

The information available for ICES Subareas 5.b, 6, 7 and 12 consistently points out to the predominance of small and immature specimens.

10.2.4.6 Catch, effort and research vessel data

Standardized French CPUE series covering the period 1998-–017 are presented in Figure (10.2.7). Estimates were made for one vessel in each ICES rectangle, for the mean fishing depth by rectangle, and determined by averaging over rectangles by area. CPUE was estimated by six-month time periods as: SEM1= months 3–8 of the year; SEM 2=month 9–12 of the year, plus months 1 and 2 of the next year. The use of an index by semester instead of a yearly index was driven by a clear seasonal pattern in CPUE with higher catch rates in autumn-winter.

Since no French CPUE data were available for 2015, WGDEEP agreed to use the 2014 data in the assessment model. There are no evidences of great changes on the abundance or biomass in recent years. This assumption is consistent with both the Scottish and Iceland surveys.

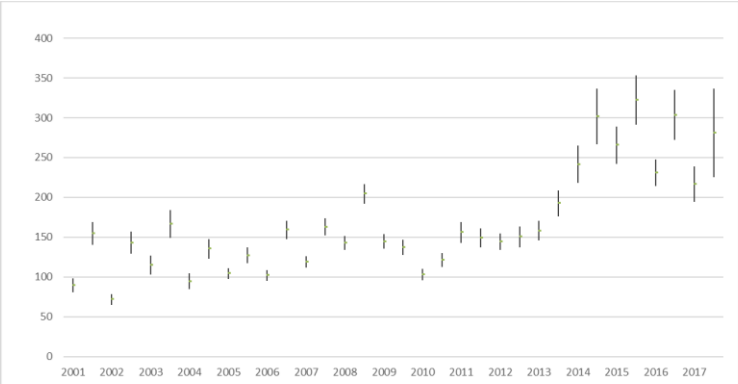


Figure 10.2.7. bsfnea Northern component CPUE by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

Scottish research survey data have been provided to WGDEEP. The annual biomass and abundance indices estimates obtained for hauls deeper than 500 and shallower than 1600 m are presented in Figure 10.2.8. After 2012, both the annual biomass and annual abundance indices are at higher levels, indicating that the population at the Northern component has been increasing.

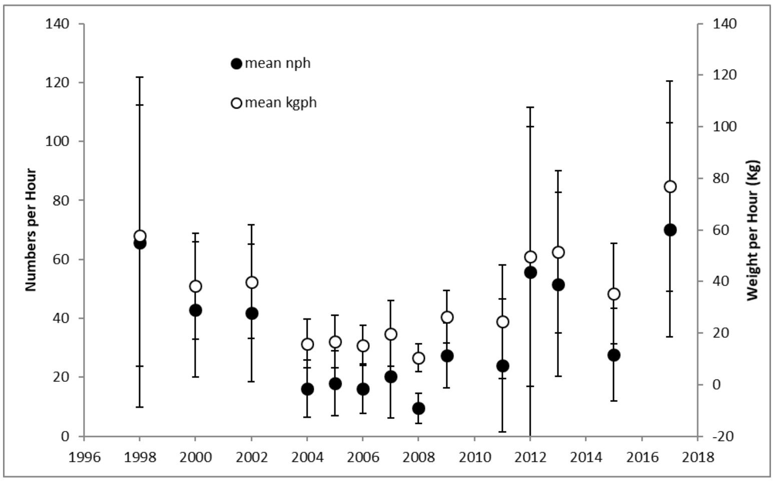


Figure 10.2.8. bsfnea Northern component. Annual biomass and abundance indices of black scabbardfish estimated for depths deeper than 500 m and shallower than 1600 m.

In ICES Division 9.a a new series of biomass indices for all sizes (Total biomass) and for specimens larger than 90 cm and 110 cm are shown along with abundance of black scabbardfish smaller than 80 cm from the Icelandic Autumn survey.

The time series of biomass indices for all sizes (Total biomass) and for specimens larger than 90 cm and 110 cm estimated based on Icelandic Autumn surveys show some variability although consistent increasing trends are observed for the latter years of the time-series. The abundance of black scabbard fish smaller than 80 cm shows a decreasing trend by the end of the time series (Fig. 10.2.9.).

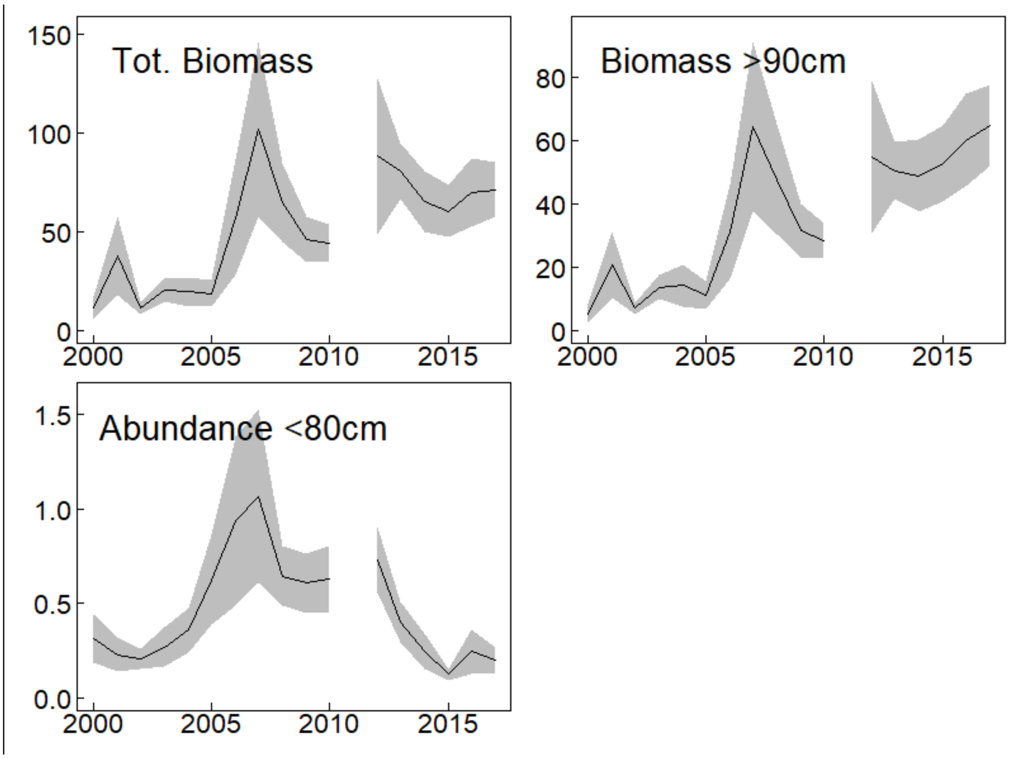


Figure 10.2.9. bsfnea Northern component. 95% Confidence interval of the biomass indices for all sizes (Tot. Biomass) and for specimens larger than 90 cm (Biomass >90 cm) and 110 cm (Biomass >110 cm) along with abundance of black scabbardfish smaller than 80 cm (Abundance <80 cm) from the 2015 Icelandic Autumn survey.

10.2.5 Data analyses

For the major fishing countries exploiting the northern and southern stock components in the ICES area, the landing data are considered reliable and discards are considered minor. For stock assessment purposes the 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. Worth to remark that the adopted assessment model includes a parameter that accommodates for the uncertainty on the input catch data.

In the model, the standardized French CPUE series is adopted for the Northern component and the standardized Portuguese CPUE series is used for the Southern component.

The CPUE series and the catch weights from each component are used to derive the standardized fishing effort. Standardized fishing effort for the Northern and Southern components are calculated for each time periods, i.e., SEM1 and SEM2. These estimates are obtained by dividing the catch weight data by the corresponding standardized

CPUE. Within the assessment model a full recruitment model with log-normal error linking the fishing effort estimate by SEM with the catchability coefficient is used to define the prior distribution of the parameter - survivorship to fishing.

Furthermore, the distribution of the parameter related to emigration to the Northern component is unknown since survey data available is insufficient to derive a prior distribution for this parameter. The Scottish survey is held every two years and at a time period out of the migration season. So, the information available does not allow inferring the index of C2 elements entering in the Northern area in SEM2 each year. Due to the lack of a reliable recruitment index, a non-informative prior distribution is adopted in the model.

Stock assessment and 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.

In each model an observational process is included. The observation processes consist of the Catch in number by semester.

Model adequacy

The quality of the 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.

The evaluation of the model's adequacy based on the expected deviance estimates (Northern component 1646.72 and Southern component 1384.33) together and the credible intervals (intervals in the domain of the posterior probability distributions) indicate a good fitting (Fig 10.2.10).

The catch estimates (posterior medians) of C2 and C3 length classes combined and the corresponding observed catch in Northern and Southern components show a good adjustment. For both components the ranges of the 95% credible intervals are relatively narrow, particularly for the semesters at the end of the studied period (Fig. 10.2.10)

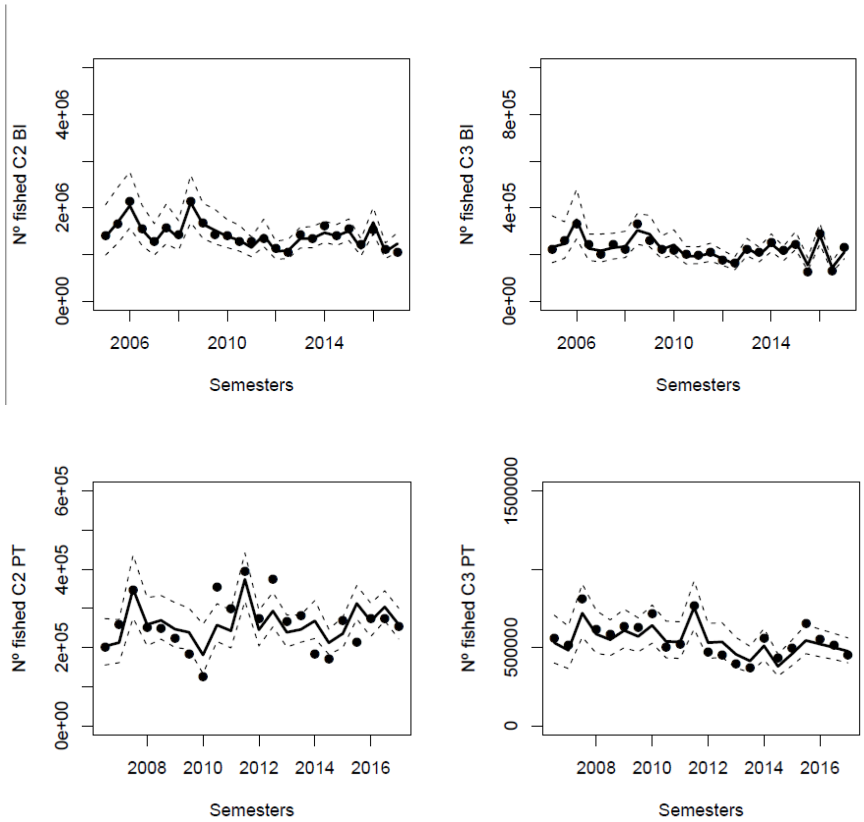


Figure 10.2.10. Estimated catches (solid line) and 95% credible intervals (dashed lines), for Northern component C2 length group (upper left), C3 length group (upper right) and Southern component C2 length group (lower left) and C3 length group (low right). Observed catches are represented by black dots.

The time-series of the estimates of the total abundance in the Northern component for the C2 and C3 length groups show a steady increasing trend. For the two length groups the credible intervals are relatively wide (Fig. 10.2.11).

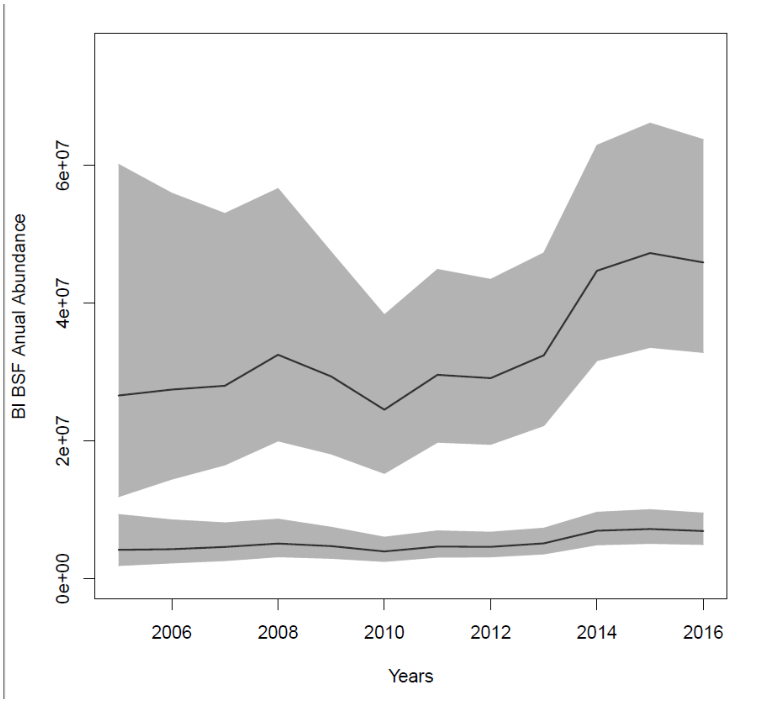


Figure 10.2.11. Northern component -Estimated BSF annual abundances for C2 (upper) and C3 (lower) length groups with the 95% credible intervals.

The temporal evolution of the total abundance in the Southern component for the C2 and C3 length group is presented in Figure 10.2.12.

For the two stock components and for both C2 and C3 length groups the credible intervals are wider at the beginning of the time series (Figs. 10.2.11 and 10.2.12 narrowing by the end of the time series.

For the two stock components, the temporal evolution of the estimates of the total abundance of black scabbardfish suggest an upward or downward trend in the more recent years (Figure 10.2.13).

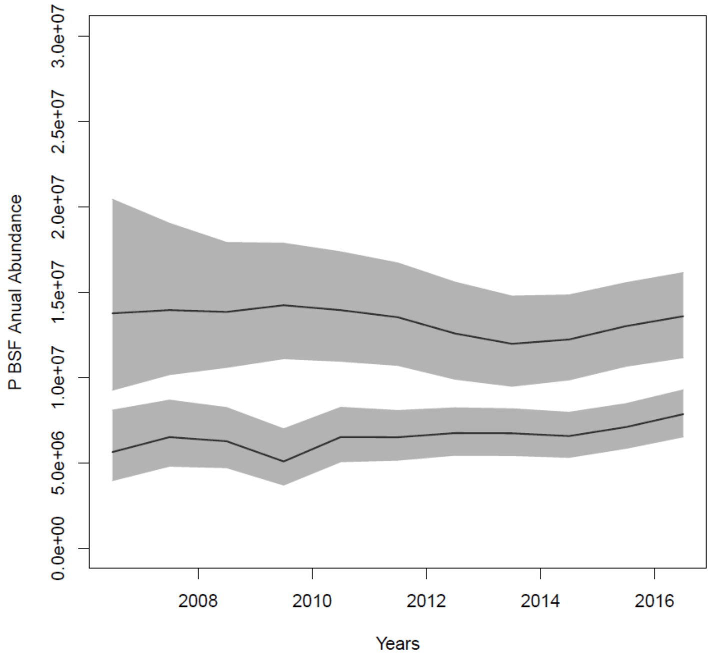


Figure 10.2.12. Southern component -Estimated BSF abundances for C2 (lower) and C3 (upper) length groups with 95% credible intervals.

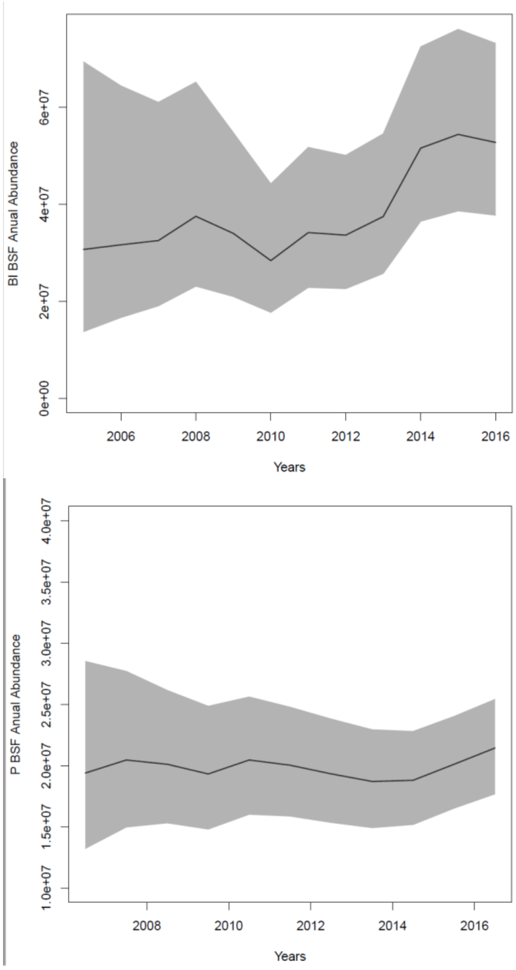


Figure 10.2.13 Northern (upper) and Southern (lower) component - Estimated BSF annual abundances with 95% credible intervals.

The posterior distributions for all the parameters of the Northern and Southern components are presented in Figures 10.2.14. and 10.2.14, respectively.

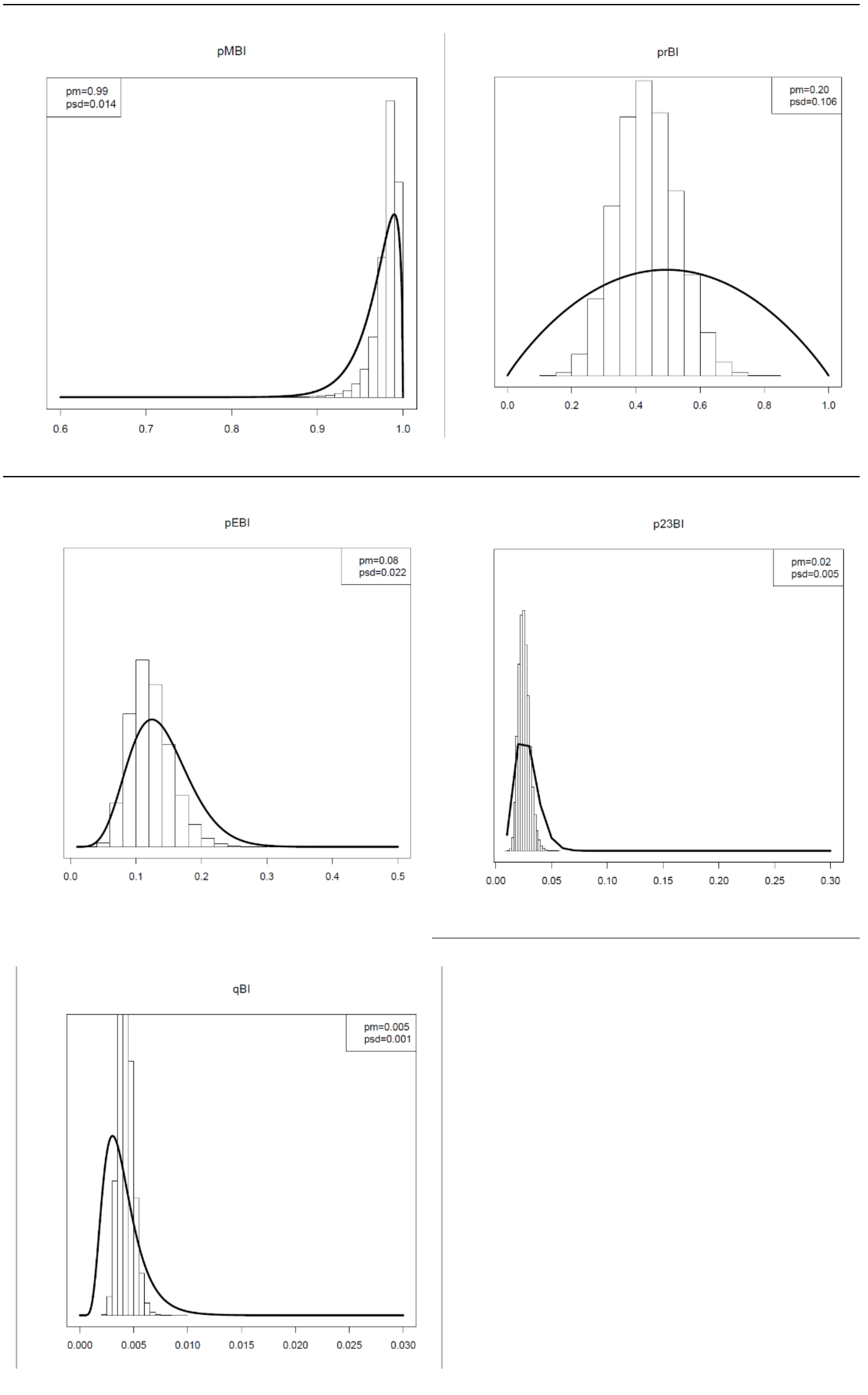


Figure 10.2.14 Prior (thick line) and posterior distributions (histogram) for parameters of the Northern component. pMBI is probability of surviving to natural mortality; p23BI is the probability that a specimen from the Northern component transits from C2 to C3 during one semester. prBI is the probability of a specimen entering the length group C2 in the Northern component during the second semester; pEBI is the probability of a specimen belonging to length group C2 or C3 leaving the Northern component in the first semester; qBI is the probability of catchability in the Northern component in the Northern component.

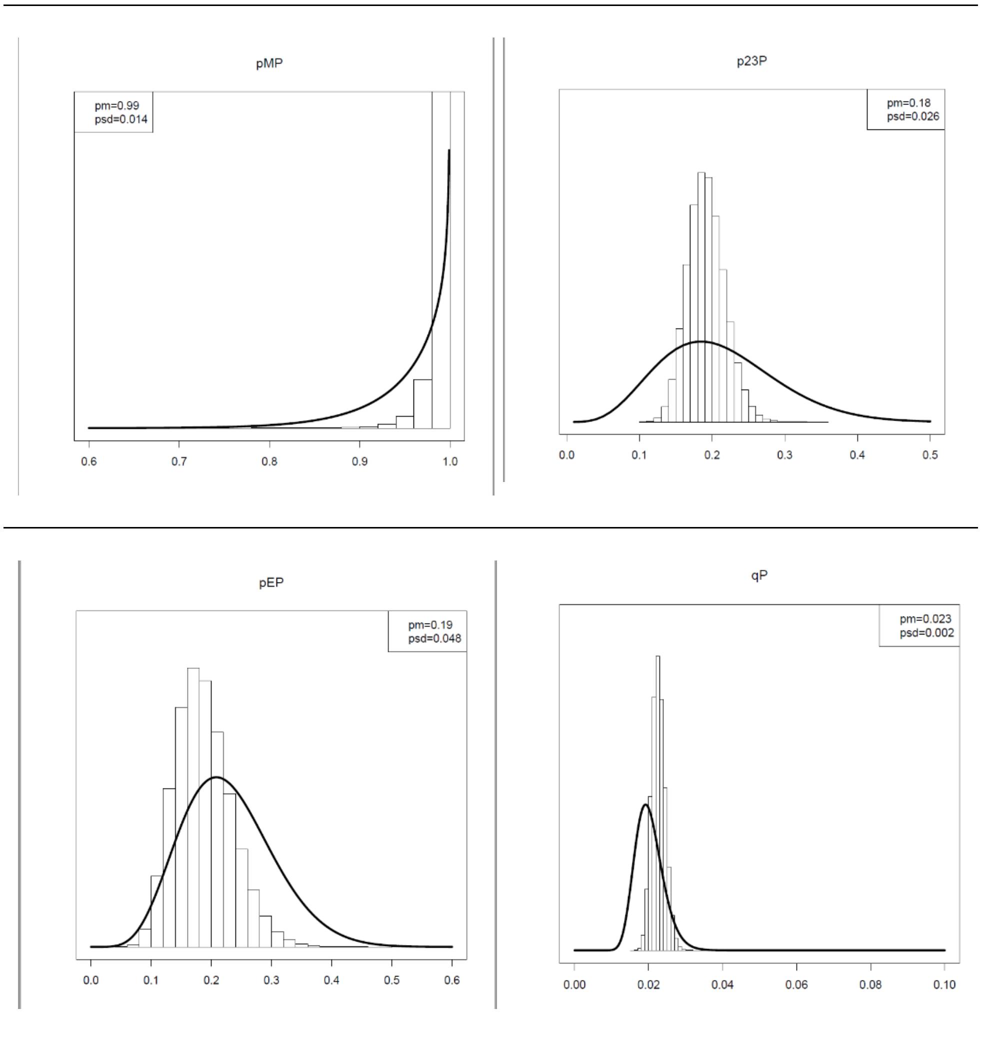


Figure 10.2.15. Prior (thick line) and posterior distributions (histogram) for parameters of the Southern component. pMP is the probability of surviving to natural mortality; p23P is the probability that a specimen from the Southern component transits from C2 to C3 during one semester. pE;P is the probability that a specimen belonging to length group C3 leaves the Southern component in the first semester; qP is the probability of catchability in the Southern component in the Southern component.

All the priori distributions adopted for the parameters had a quite large coefficient of variation. These high values were included as precautionary measures to guarantee the introduction of uncertainty on their values. For most of the parameters posterior distributions (Figures. 10.2.13 and 10.2.14) it is evident that the observational data provided information to update the priori distributions. In addition, the posterior distribution means are not, in general, far apart from the initial guess.

HCR from WKDEEP 2014

At the WKDEEP 2014 and in view of the admitted linkage between the Northern and Southern components, it was agreed that the status of the stock as a whole in the NE Atlantic should be considered when giving management advice for either fishery component. However, it was also been agreed that given the presumed sequential nature of the exploitation pattern, management should also take into consideration trends occurring in the separate areas.

A harvest control rule was adopted in WKDEEP 2014 so that the catches in the two components are updated based on recent trends of total abundance in each component. Trends are measured as the estimates of the linear model slope which are fitted to the posterior median estimates of abundance of the most recent five years from each component. The harvest control rule simply specifies that catch advice should only increase when the abundance trends for the two components are increasing. If either is stable or decreasing, the advised catch for each of the two components should be adjusted according to the rate of change in the one showing the decrease.

In the two components, the abundance does not show a clear upward or downward trend. The estimates of slope obtained for the regressions of posterior median estimate of year y *versus* posterior median estimate at the previous year (y-1) for semesters SEM 1 and SEM 2 for the last five year are around 1 (Table 10.2.2.). Thus according to harvest control rule the catches should be kept at the same level as last year.

Table 10.2.2. Slope estimates of the regressions of posterior median estimate of year y versus posterior median estimate at the previous year (y-1) for semester Sem 1 and Sem 2 for the last five years.

	Northern component	Southern component
Annual	1.0745	1.0034

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 overall length frequency distribution of black scabbardfish catches in the northern component of ICES area (5.b, 6.a, and 6.b.1) and the southern component (9.a) combined for 2016 and 2017. LBIs were also estimated for the exploited population in ICES area and in CECAF (Madeira) combined. The length frequency distributions of 1cm interval class and 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 results obtained are presented in Tables 10.2.3 and 10.2.4.

In both cases the MSY indicator ($L_{mean}/L_{F=M}$) and optimizing yield indicator (L_{mean}/L_{opt}) are above the reference point1 both in 2016 and in 2017. Other indicators were below their reference points.

Table 10.2.3. LBI estimates for the exploited population of bs.27.fnea stock in ICES area in 2016 and 2017

	Conservation				Optimizing Yield	MSY
	L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	L_{mean}/LF=M
Ref	>1	>1	>0.8	>30%	~1 (>0.9)	?1
2016	0.66	0.89	0.67	0.01%	0.90	1.06
2017	0.68	0.92	0.68	0.01%	0.92	1.06

For the ICES area (Table 10.2.3) the ratio between length of first catch (L_c) and the length at first maturity is smaller than 1. The estimated value of L_c is considered rather low for the perception of the exploited population. The unusual frequencies of small size specimens appear to have a major influence in the L_c estimation. Other estimators need to be explored particularly for cases where the level of sampling may be considered insufficient. A similar problem has also arisen with $L_{25\%}$. Regarding the ratio $L_{max5\%}/L_{inf}$ the estimated value clearly reflects the underlying length structure of the bsfnea in ICES area.

Both the MSY indicator ($L_{mean}/L_{F=M}$) and optimizing yield indicator (L_{mean}/L_{opt}) are close to 1 in 2016 and in 2017.

Table 10.2.3. LBI estimates the exploited population of bsf.27.nea stock in ICES area and CECAF (Madeira) in 2016 and 2017

	Conservation				Optimizing Yield	MSY
	L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	L_{mean}/LF=M
Ref	>1	>1	>0.8	>30%	~1 (>0.9)	?1
2016	0.66	0.89	0.67	0.01%	0.90	1.06
2017	0.68	0.92	0.69	0.01%	0.93	1.06

For the ICES area plus CECAF (Table 10.2.3) the results are similar to those obtained for the ICES area alone. The estimate of the Lc appears to be more consistence with what is known for the population but the estimates of $L_{max5\%}/L_{inf}$ and P_{mega} are considered deficiently estimated, being particularly influenced by the spatial structure of black scabbardfish length structure.

LBI results show that the stock is at a desirable status as the exploitation level is above the length-based indicator of MSY. However, for the indicators related with conservation state of the stock the values are considered less informative given the available knowledge on species length structure probably because these are dependent on the tail of the frequency distribution.

10.2.6 Management considerations

Available information does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, however most available evidences support it. In face of these evidences catches from ICES Division 5.a were included in the Northern component in the assessment of the stock.

Management advice is given based on the harvest control rule adopted at the WKDEEP 2014 (see the Stock annex for further details).

WGDEEP did not assess fisheries in Madeira (Eastern Central Atlantic area, CECAF) or in other areas outside the ICES area. Nonetheless, it is admitted that the incorporation of CECAF data could provide a global perception of the whole dynamics of the stock.

In 2015, STECF provided an exploratory assessment of the status of the species around Madeira (STECF-14–15). It was mentioned that, for the period 2000–2013, there was a general decline in fishing capacity and fishing effort. The number of vessels has also declined by 41% (34 to 20 vessels). Furthermore, in the second half of the last decade, some Madeiran vessels targeting the black scabbardfish have moved to new fishing grounds, some of them located outside the EEZ of Madeira (SE of the Azores and off the Canaries), although most of the fishery still remains concentrated off the islands of Madeira and Porto Santo (Figure 10.2.14).

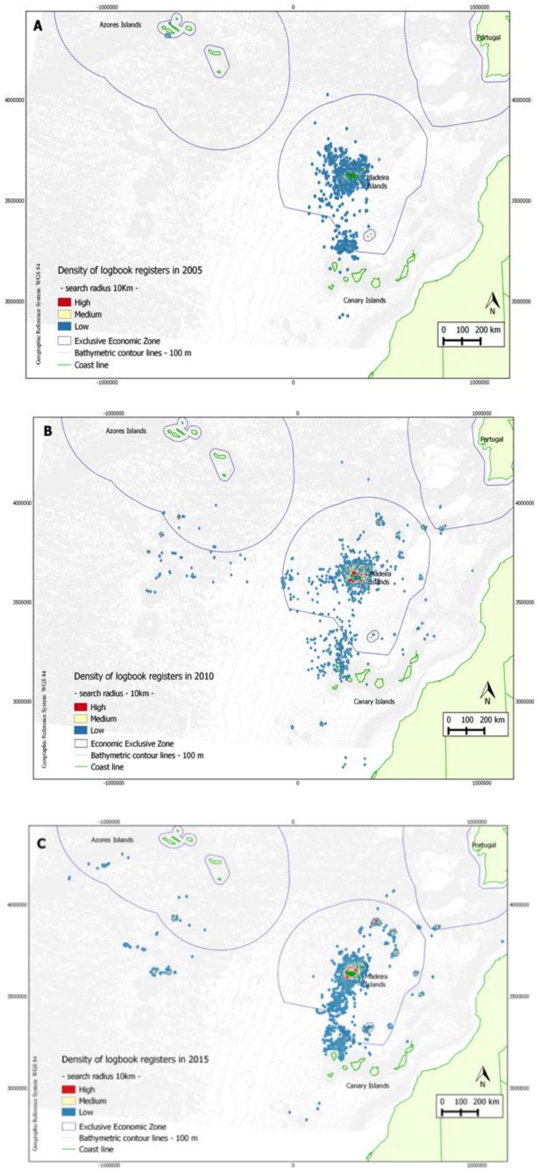


Figure 10.2.14 bsf.27.nea. CECAF area. Density plots illustrating the geographical distribution of the fishing sets with catches in 2005 (A), 2010 (B) and 2015 (C) (Delgado et al., submitted).

According to the STECF report the decline in fishing capacity has not resulted in a commensurate reduction in fishing effort, as the number of hooks deployed has only decreased by 14%. That is because of improvements on individual vessel efficiency that determined that the average number of hooks deployed per vessel increased from 470

000 in 2000 to 700 000 in 2013. Such reasoning does not, however, reflect the impact of spatial displacement of the fleet to new offshore areas outside Madeiran EEZ on the total fishing effort, as the total number of hooks is estimated by integrating the number of days at sea per trip and those had also increased. It should also be noted that a reasonable stabilisation of the yields, fishing effort and CPUE of the fishery in Madeira was achieved in the last years (Delgado et al., submitted).

The previous WGDEEP analysis of Portuguese catches in CECAF 34 area, where Madeira fleet operates and recorded at the FAO global catch statistics (WGDEEP 2016) was updated. Information on Madeiran landings from 1990 to 2017 recorded at the Regional Fisheries Department of Madeira (DSI/DRP) database was used for updating. The annual landings of black scabbardfish derived from Madeiran longliners for the period between 2000 and 2017 are presented in Figure 10.2.15. Annual landings have been decreasing since the 1998 peak, with a slight but constant recovery in the last six years, wherein around 2163 tons were landed in 2017. EU has set TACs for 2017 and 2018 for EU and international waters of CECAF 34.1.2 (BSF/C3412-) of 2488 and 2189 ton, respectively.

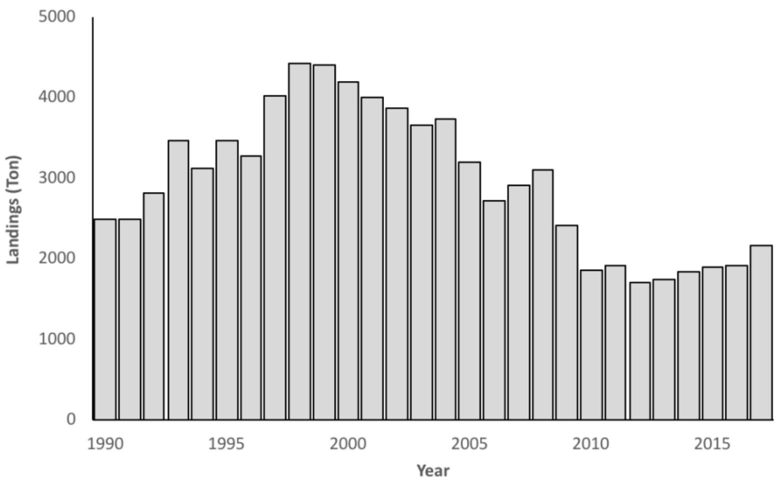


Figure10.2.15. bsf.27.nea Time-series of annual Portuguese landings at CECAF area.

Following the methodology used at WGDEEP 2016, standardized annual catch estimates for the period from 1990 to 2017 of the nineteen resources (ordered in terms of total weight catch) and grouped into four groups (1, large pelagics; 2, elasmobranchs; 3, small pelagic; and 4, demersals) were determined based on data extracted from DSI/DRP database.

The updated results support previous conclusions, namely that, given the diversity of species under analysis (Figure 10.2.16), which includes different taxonomic groups (*chondrichthyans* and *teleosts*), lifestyles (benthic, demersal and pelagic), and both short- and long-lived organisms, to admit that declining trends are reflecting changes on resources abundance which may imply that Madeiran waters are subject to severe overexploitation. However, further studies and a careful interpretation of the variations of the trends in some resources are needed to highlight this conclusion. In some cases the landing trends are not only related to the resources abundance in Madeiran waters, but subject to other factors like variations on the market regulation (e.g. small pelagic fishery), environmental, application of TAC's and quotas, etc.

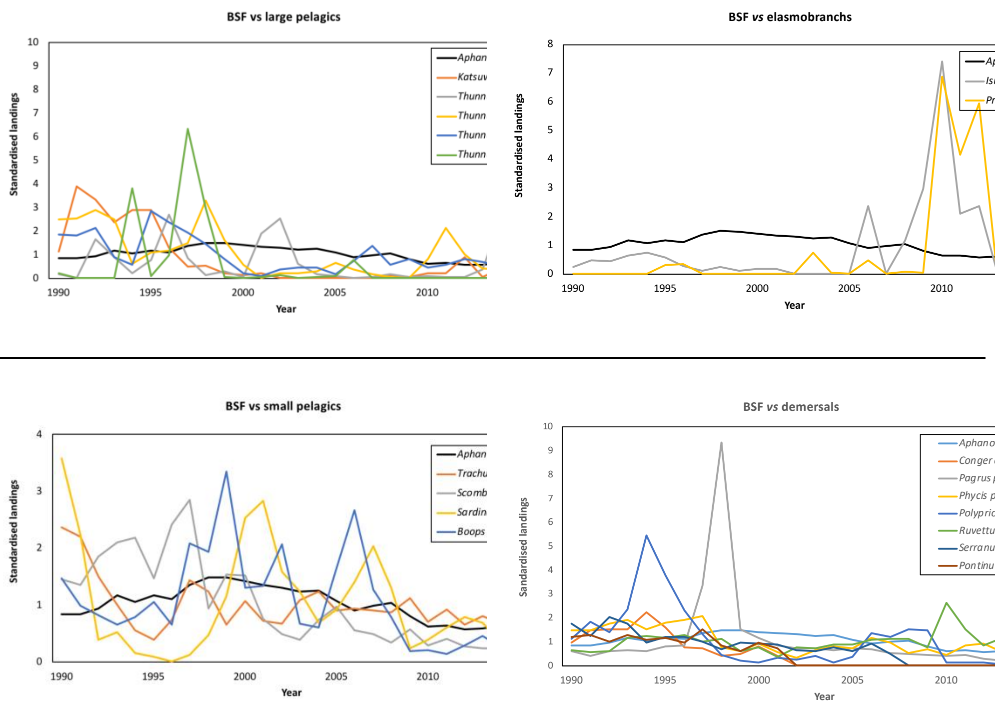


Figure 10.2.16 bsf.27.nea. CECAF area. Trends in standardised landings of black scabbardfish and the 19-other top ranked species in Madeiran landings.

Annual total length–frequency distributions of the exploited population caught by the Madeiran longline fleet in CECAF area for the period 2009–2017 are presented in Figure 10.2.17. The analysis of this figure indicates neither changes on the length range between years nor on the mean length (Figure 10.2.17). The average estimates of the annual total length mean for the period were about 118 cm and did not vary between years.

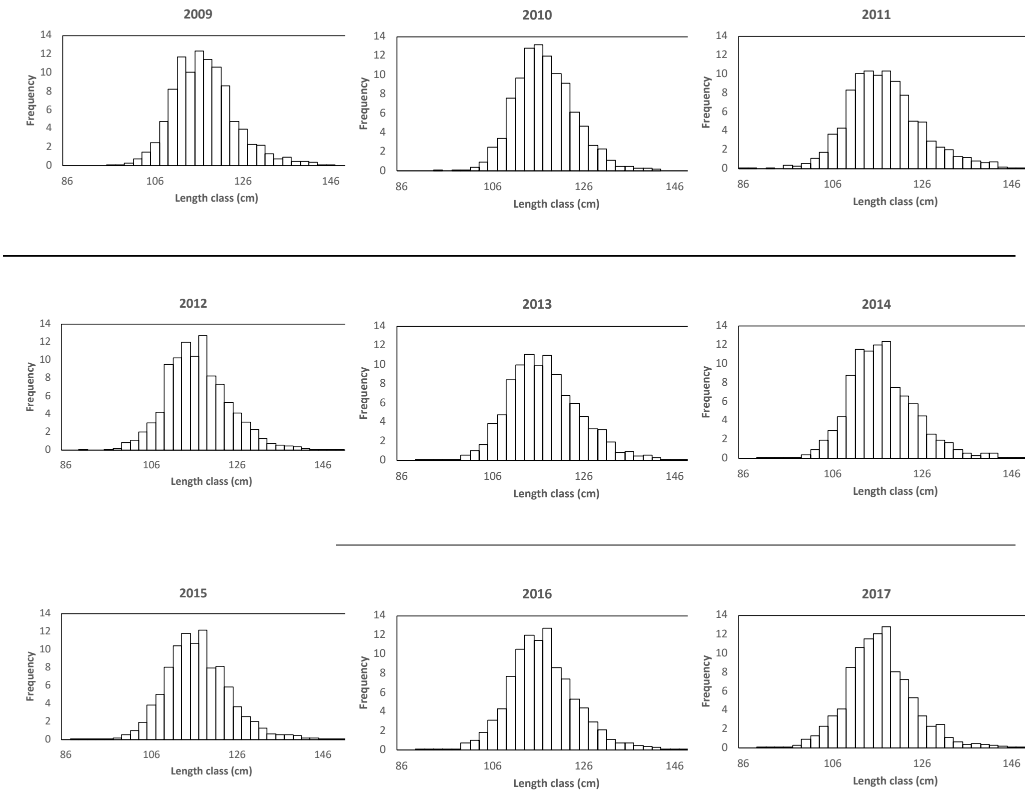


Figure 10.2.17. bsf.27.nea CECAF. Annual length–frequency distribution of specimens landed by the Portuguese longliners operating along CECAF area.

WGDEEP considers that temporal and spatial changes of Madeiran fishing activity should be further investigated. It is expected that this analysis will contribute to clarify the uncertainties regarding species abundance trend inside the Madeira EEZ and its relation with the ICES components.

10.2.7 Tables

Table 10.2.1a. Landings of black scabbard fish from Division 5.b. Working group estimates.

Year	Faroese Islands			France	Germany*		Scotland	E&W&NI	Russia	Total
	5.b.1	5.b.2	5.b	5.b	5.b.1	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
2014	400	181	143	0	0	0	0	0	1	725
2015	549	181	0	211			1			941
2016			712	52						765
2017			427	112			0			540

Table 10.2.1b. Landings of black scabbard fish from Division 12. Working group estimates.

Year	France	Spain	Scotland	Russia(7.c)**	Poland*	Faroes	Unallocated	Total
1988				.	-			0
1989	0			.	-			0
1990	0			.	-			0
1991	2			.	-			2
1992	7			.	-			7
1993	24			.	-			24
1994	9			.	-			9
1995	8			.	-			8
1996	7	41		.	-			48
1997	1	98		.	-			99
1998	324	134		.	-			458
1999	1	109	0	.	-			109
2000	5	237		.	-			242
2001	3	115		.	-			118
2002	0	1117	1	.	-			1119
2003	7	444		.	1			452
2004	10	230	1	.	-			242
2005	14	239		.	-			253
2006	0	1009		.	-			1009
2007	-	9	0	.	-			9
2008	-	53	0	4	.			57
2009	-	103		-	.			103
2010	1	180	-	-	.			181
2011	1	113	-	-				114
2012	-	47	-	-			907	954
2013	-	50	-				289	339
2014	-	149	-					149
2015	-	51	-			0		51
2016		82						82
2017		68						68

***STATLAND data.**

***STATLAND data from 1988 to 2011.**

Table 10.2.1b. Continued.

Year	Faroes	Germany	Ireland	E&W&NI	Iceland*	Lituania*	Estonia	Total
1988		.				.	.	0
1989		.				.	.	0
1990		.				.	.	0
1991		-				.	-	0
1992		-				-	-	0
1993	1051	93				-	-	1144
1994	779	45				-	-	824
1995	301	-				-	-	301
1996	187	-			0	-	-	187
1997	102	-				-	-	102
1998	20	-				-	-	20
1999		-				-	-	0
2000	1	-				-	-	1
2001		-				-	-	0
2002		-		0		-	-	0
2003		-	1			1	-	2
2004	95	-				1	-	96
2005	127	-	0			-	1	128
2006	8	-				-	2	10
2007	0	-	0			-	7	7
2008	1	.	0			-	.	1
2009	156	-	0	0		.	.	156
2010	27	-	0	0			.	27
2011	24	-	-	-			.	24
2012								0
2013	1	-	-	-			.	1
2014							.	0
2015								0
2016								0
2017	0							0

***STATLAND data.**

Table 10.2.1c. Landings of black scabbard fish from subarea 6. Working group estimates.

Year	France			Faroes		Germany*		Ireland	Scotland		Netherlands *			Lituania*	Estonia *	Poland*	Russia*	Spain	Spain	Unallocated	Total
	6	6.a	6.b	6.a	6.b	6.a	6.b	6.a	6.a	6.b	6.a	6.b	6	6.a	6.b	6.b	6.b	6.a	6.b		
1988						.	.				-	-		.	.		.				
1989		138	0	46		.	.		-	-	-	-		.	.	-	.				184
1990		971	53			.	.		-	-	-	-		.	.	-	.				1023
1991		2244	62			-	-		-	-	-	-		.	-	-	-				2307
1992		2998	113	3		-	-		-	-	-	-		-	-	-	-				3113
1993		2857	87		62	48	-		-	-	-	-		-	-	-	-				3054
1994		2331	55			30	15		2	-	-	-		-	-	-	-				2433
1995		2598	15			-	3		14	4	-	-		-	-	-	-				2634
1996		2980	1			-	2		36	<0.5	-	-		-	-	-	-				3019
1997		2278	16		3	-	-		147	88	-	-		-	-	-	-				2533
1998		1553	7			-	-		142	6	-	-		-	-	-	-				1708
1999	-	1610	8			-	-		133	58	11	-		-	-	-	-				1820
2000	-	2971	27			-	-		333	41	7	-		-	-	-	-				3378
2001	-	3791	29		3	-	-		486	145	-	-		3	225	-	226				4908
2002	-	3833	156	2		-	-		603	300	21	2		9	-	2	-				4928
2003	-	2934	67	45		-	-		78	9	-	2		12	7	2	7				3162
2004	-	2637	99	59		-	-		100	24	-	-		85	5	-	5				3014
2005	3	2533	59	38		-	-		18	62	-	-		5	11	-	11				2741
2006	-	1713	36	59		-	-	1	63	0	-	-		1	3	-	3				1879
2007	-	1991	4	44	37	-	-	0	53	0	-	-		-	-	-	-				2129
2008	-	2348	0	37	0	.	.	0	26	0	14	.		-	.	.	1				2427
2009	15	1609	1	39	0	.	.	0	80	0	.	.		.	.	.	-				1744
2010	-	1778	1	72		.	.	0	73	0	.	.				.	-				1923
2011	5	1791	3	31		-	-		1	0	.	.					-				1830
2012	-	1509	0	3		-	-	.	34	0							-			690	2236

2013		1799	9	6	-			-	57	.										189	2060
2014	0	1902	0	4	2	0	0	-	110	.	3	0		0	0	0	0			0	2021
2015		1870		1				-	124				5					10	172		2181
2016		2336						-	96				1					9	163		2606
2017		1714		64				-	101				0					3	153		2035

Table 10.2.1d. Landings of black scabbard fish from Division 7. Working group estimates.

Year	France								Ireland			Scotland	E&W&NI	Spain	
	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	Total
1988															
1989		0	-	-	-		-	-				-			0
1990		0	2	8	0		0	-				-			10
1991		0	14	17	7		7	49				-			94
1992		0	9	69	11		49	183				-			322
1993		0	24	149	16		170	109				-			468
1994		0	32	165	8		120	336				-			662
1995		0	52	121	9		74	385				-			641
1996		0	104	130	2		60	360				-			658
1997		0	24	200	1		33	202				-		1	462
1998		0	15	104	6		52	211				-		2	390
1999	-	-	7	97	0	2	70	177				-		0	355
2000	-	-	25	173	1	4	100	253				3		0	559
2001	-	-	40	237	0	3	180	267				41		0	768
2002	-	0	33	105	2	7	138	49				53			386
2003	-	-	15	29	1	3	159	36				1			245
2004	-	-	31	28	8	9	115	63				0			253
2005	0	5	6	11	1	17	105	23				-			169
2006	-	-	3	10	1	24	315	20	1	32	37	0	2		445
2007	-	-	2	7	0	4	168	7	0	52	17	-	-		257

2008	-	-	2	19	0	6	148	4	-	-	-	0	-		179
2009	-	-	-	29	1	2	53	4	-	-	-	-	-		90
2010	-	-	2	40	0	2	36	-	-	-	-	-	-		81
2011	-	-	0	81	0	2	129	-	-	-	-	-	-		212
2012	-	-	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
2016			6	0	52	3	30	0	-	-	-			1	
2017			1	0	55	1	9	0	-	-	-	0		0	66

Table 10.2.1e. Landings of black scabbard fish from Division 6 and 7. Working group estimates.

Year	Ireland	E&W&NI	Total
1988			
1989			0
1990			0
1991			0
1992			0
1993	8		8
1994	3		3
1995			0
1996		1	1
1997	0	2	2
1998	0	1	1
1999	1	1	2
2000	59	40	99
2001	68	37	105
2002	1050	43	1093
2003	159	5	164
2004	293	2	295
2005	79	-	79
2006	-	-	0
2007	-	-	0
2008	-	-	0
2009	-	-	0
2010	-	-	0
2011	-	-	0
2012	-	-	0
2013	-	-	0
2014	-	-	0
2015	-	-	0
2016	-	-	0
2017	-	-	0

10.3 Black scabbard fish in Subareas 8, 9

10.3.1 The fishery

The main fishery taking place in these subareas is derived from the Portuguese longliners. This fishery was described in 2007 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 8. In 2014 and 2015, Spain has also reported catches of black scabbardfish in Subareas 8 and 9 but they are relatively low.

10.3.2 Landings trends

Landings in Subareas 8 and 9 are almost all from the Portuguese longline fishery that takes place in Subarea 9.a, representing more than 99% of the total landings (Figure 10.3.1).

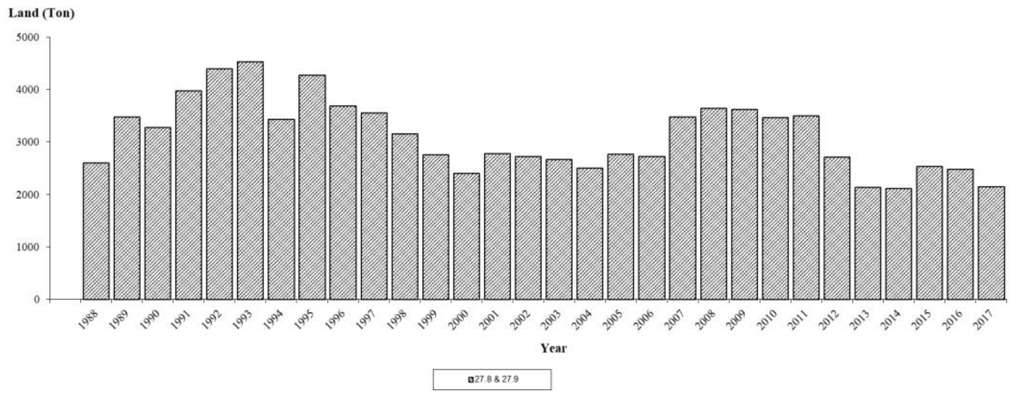


Figure 10.3.1. bsfnea. Southern Component. Annual landings for ICES Subareas 8 and Division 9.a (2017 provisional data).

10.3.3 ICES Advice

The latest ICES advice for 2017 and 2018 was: "ICES advises that when the precautionary approach is applied, catches should be no more than 5894 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed.

Distributed by area this corresponds to annual catches of no more than 2802 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2726 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 366 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.".

10.3.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2006 till 2015, as well as, the total landings in Subareas 8, 9 and 10 are next presented.

Year	EU TAC 27.8,27.0,27.10	EU Landinds in 27.8 and 27.9	EU Landinds in 27.10**
2006	3042	2791	65
2007	4000	3556	
2008	4000	3719	75
2009	3600	3601	162
2010	3348	3453	102
2011	3348	3476	164
2012	3348	2726	462
2013	3700	2147	206
2014	3700	2128	30
2015	3700	2537	240
2016	3700	2479	86
2017	3 330	2154	70

*** 2017 landing estimates are preliminary.**

**** the proportion of *A. intermedius* in the catches is considered high but it is not quantified**

10.3.5 Data available

10.3.5.1 Landings and discards

New information on the discards of deep-water species produced by the Portuguese on-board sampling programme (EU DCR/NP) was presented.

Discards of most species carried out by Portuguese vessels operating deepwater set longlines (targeting black scabbardfish) within the Portuguese ICES Division 9.a were not quantified at fleet level. However, the low frequency of occurrence (and number of specimens) registered in the sampled hauls and sets indicates discards can be assumed null or negligible for most assessment purposes. The black scabbardfish discard mortality is mainly caused by shark and cetacean predation on hooked black scabbardfish and is relatively low when compared to landings. Consequently, discards are not likely to play a significant role in the assessment of this species.

10.3.5.2 Length compositions

Length–frequency distribution of the black scabbardfish landed at Sesimbra landing port (ICES 9.a) by the Portuguese longline fleet obtained under the DCF/EU landing sampling program were used to separate the southern component into the two length groups (TL (total length): 70 cm C2 < 103 and C3 > 130 cm) defined by the assessment approach adopted by the WKDEEP 2014.

Table 10.3.1. bsfnea. Southern component. Total catch estimates (in ton)) for the years 1999 to 2015 and total catch estimates (in number) in length group C2 and C3 by Six month time period (Sem1 and Sem 2) for the years 2001 to 2017.

	Catch (in ton)		Catch (in number) C2		Catch (in number) C3	
Year	Sem 1	Sem 2	Sem 1	Sem 2	Sem 1	Sem 2
2001	1025	1162	166255	224512	454294	494926
2002	994	1205	242627	281845	394790	486076
2003	1001	1038	246200	326925	391912	369658
2004	939	1087	319954	289114	326133	421767
2005	1001	1068	173811	191031	441320	470265
2006	970	1229	154077	200083	447828	561937
2007	1162	1713	258842	348131	512897	808791
2008	1392	1335	252886	248574	617378	582175
2009	1390	1346	225098	183532	633817	627814
2010	1464	1287	126636	353994	720474	501186
2011	1257	1808	299508	395972	520973	768757
2012	1188	1245	273648	374823	470397	454947
2013	1011	991	266160	282208	393448	369904
2014	1218	968	182502	170497	559315	433302
2015	1184	1397	268942	214209	497101	655433
2016	1278	1203	274784	273498	554148	515061
2017*	1065		255404		452883	

***incomplete since catches January and February 2018 were not available**

10.3.5.3 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).

10.3.5.4 Weight-at-age

No new information on age was presented.

10.3.5.5 Maturity and natural mortality

In ICES Subarea 9.a only immature and early developing specimens have been observed (Figueiredo, 2009, WGDEEP WD). Mature individuals only occurred in Madeira (Figueiredo *et al.*, 2003), in Canary Islands (Pajuelo *et al.*, 2008), and the northwest coast of Africa although it is possible that two different species may occur in these areas.

Black scabbardfish has a determinate fecundity strategy; the relative fecundity estimates ranged from 73 to 373 oocytes/female weight (g). Skipped spawning was also considered to occur; the percentages of non-reproductive females between 21% and 37% (Vieira *et al.*, 2009).

10.3.5.6 Catch, effort and research vessel data

Standardized Portuguese CPUE series covering the period 1998- 2017 are presented Figure (10.3.2) by 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 next year. Estimates of CPUE obtained through the adjustment of a GLM model, in which monthly CPUE is the response variable and Year, Month and Vessel are the factors. The monthly CPUE was calculated for each vessel as the ratio of the total landed weight (Kg) and the number of fishing trips. Only vessels having total annual landings ≥ 1000 Kg and more than one year of landings were considered.

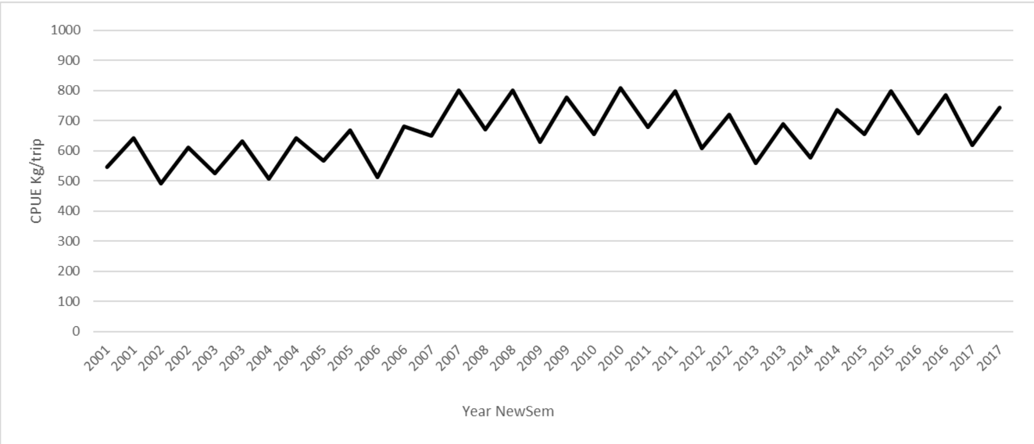


Figure 10.3.2. bsfnea Southern Component. Standardized Portuguese CPUE by semester time-series.

10.3.6 Data analyses

Data analyses are described in section 10.1.5. One single assessment is admitted for the stock, which combines data from the two fisheries areas, in 5.b, 6, 7 and 27-.12.b and 5.a on one hand and 8 and 9 on the other hand. The same migrating stock is exploited in the two fishery areas.

10.3.7 Management considerations

Management considerations are described in section 10.1.6.

Table 10.3.1a. Black scabbard fish from Subarea 9; Working group estimates of landings.

Year	Portugal	France	Spain	Total
1988	2602			2602
1989	3473			3473
1990	3274			3274
1991	3978			3978
1992	4389			4389
1993	4513			4513
1994	3429			3429
1995	4272			4272
1996	3686			3686
1997	3553		0	3553
1998	3147		0	3147
1999	2741		0	2741
2000	2371		0	2371
2001	2744		0	2744
2002	2692			2692
2003	2630	0		2630
2004	2463			2463
2005	2746			2746
2006	2674			2674
2007	3453			3453
2008	3602			3602
2009	3601			3601
2010	3453		0	3453
2011	3476			3476
2012	2668		12	2680
2013	2130			2130
2014	2109			2109
2015	2527		0	2527
2016	2456		0	2456
2017	2117		0	2117

Table 10.3.1b. Black scabbard fish from Subarea 8; Working group estimates of landings.

Year	France						Spain	
	8	8.a	8.b	8.c	8.d	8.e		Total
1988								0
1989								0
1990					0			0
1991		1			0			1
1992		4			4			9
1993		5			7			11
1994		3			2			5
1995		0						0
1996		0			0		3	3
1997		1			0		1	2
1998		2			0		3	6
1999		7			4		0	12
2000		15	0		20	0	1	36
2001		16	0		12	0	1	29
2002		17	2		16		1	36
2003		25			8		1	34
2004	0	25	0		14		1	40
2005		19	0		6		1	26
2006		30	2	0	19		0	52
2007		14	1		13		1	29
2008		10	0		35		1	45
2009		15	1	0	3		1	19
2010	0	13	1	0	3			17
2011		4	0	0	14			18
2012		10	0		3		18	32
2013		5	0	0	2		3	10
2014		7	0	0	3			9
2015		5	0				0	5
2016		2	0		1		16	19
2017		2	0		0		32	35

10.4 Black scabbard fish other areas (1, 2, 3.a, 4, 10, 5.a, 14)

10.4.1 The fishery

This assessment unit is made up of diverse areas. In some of these areas fisheries have occurred sporadically or at very low levels, such as in 1–4. Those levels may just indicate that the species has a low occurrence in those areas. On the contrary, landings from other areas, particularly in 10, indicate that the level of abundance of the species appears to be significant.

In recent years, fishing activity on black scabbardfish in ICES Division 5.a has been regular, with landings rounding about 300 ton *per* year. To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, WGDEEP2016 agreed to include ICES Division 5.a in the Northern component.

No further information is available on the Faroese exploratory trawl fishery that was taking place in the Mid-Atlantic Ridge area, starting from 2008.

10.4.2 Landings trends

In ICES Subarea 10 landings have been variable but in recent years landings have increased, reaching 464 tonnes in 2012. Since 2010, Icelandic landings in ICES Subarea 5.a have significantly increased, being stable around 300 t in recent years. The 111 tonnes reported in 2010 in ICES Division 14 are considered to be misreported.

10.4.3 ICES Advice

The latest ICES advice for 2017 and 2018 was: "ICES advises that when the precautionary approach is applied, catches should be no more than 5894 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed.

Distributed by area this corresponds to annual catches of no more than 2802 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2726 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 366 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a."

10.4.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2007 to 2017 by subarea are presented next.

In 2010, 2013, and 2014, the TACs have been exceeded, particularly in 2010. More information is needed to track the situation.

Year	EU TAC 27.1 , 27.2, 27.3 and 27.4	EU Landings
2007	15	2
2008	15	0
2009	12	5
2010	12	127
2011	12	1
2012	9	0
2013	9	51
2014	9	10
2015	9	2
2016	9	9
2017	9	0

*** 2017 landing estimates are preliminary. TACs and landings for subarea X are included in Table 10.3.4**

Figure 10.4.1. Annual landings for black scabbardfish by ICES Subareas 2, 4, 5.a, 10 and 14.

10.4.5 Data available

10.4.5.1 Landings and discards

Landings are given in Tables 10.4.1a–e and in Figure 10.4.1. In Subareas 2, 4 and 14 reported landings are considered to be misreported although it is not know to what extent.

10.4.5.2 Length compositions

Length frequency distributions based on the Icelandic Autumn surveys for the period 2000–2017 are presented in Figure 10.4.2.

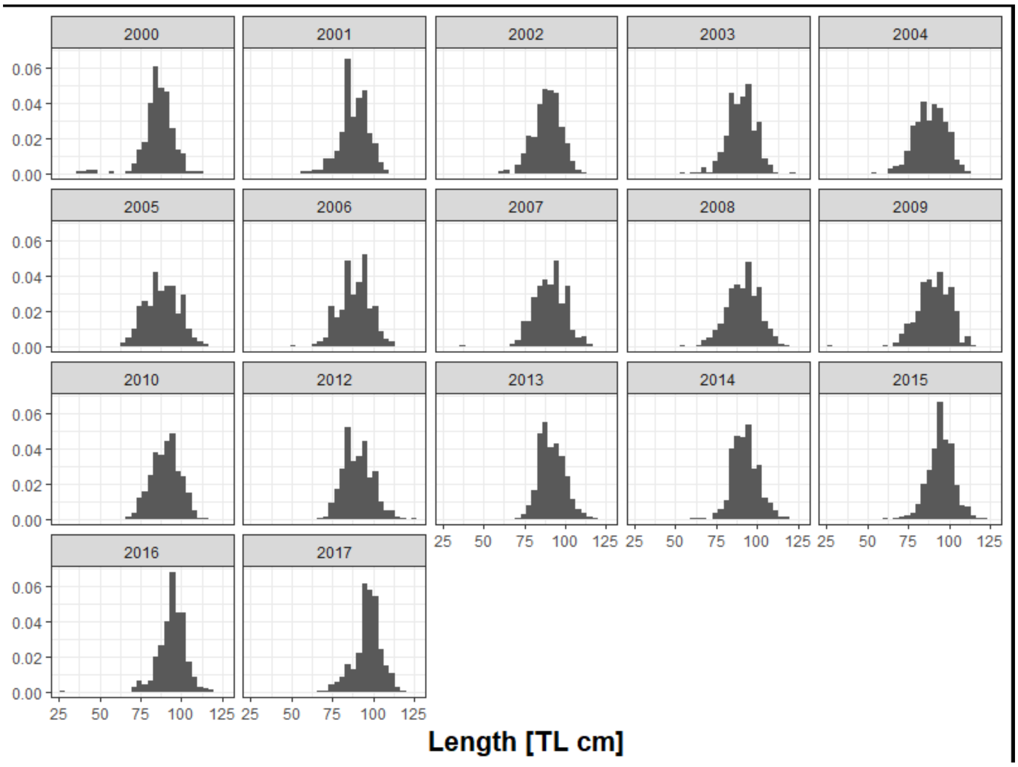


Figure 10.4.2. bsfnea Black scabbard fish in 5.a: length distribution from the Icelandic Autumn survey, from 2000–2015.

10.4.5.3 Age compositions

No data were available.

10.4.5.4 Weight-at-age

No data were available.

10.4.5.5 Maturity and natural mortality

No new data were available.

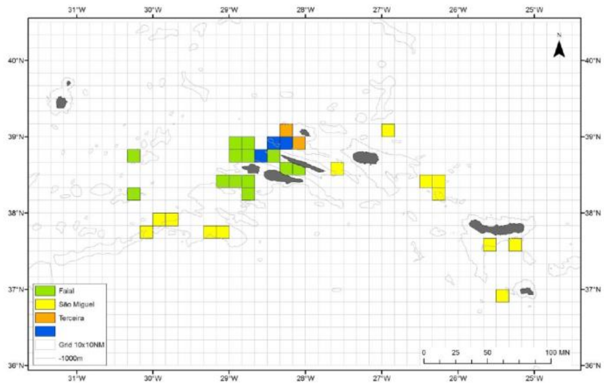
10.4.5.6 Catch, effort and research vessel data

See section 10.2.4.6 where the new Icelandic (ICES 5.a) series of biomass indices for all sizes (Total biomass) and for specimens larger than 90 cm and 110 cm are shown along with abundance of black scabbard fish smaller than 80 cm from the Icelandic Autumn survey were provided by Iceland.

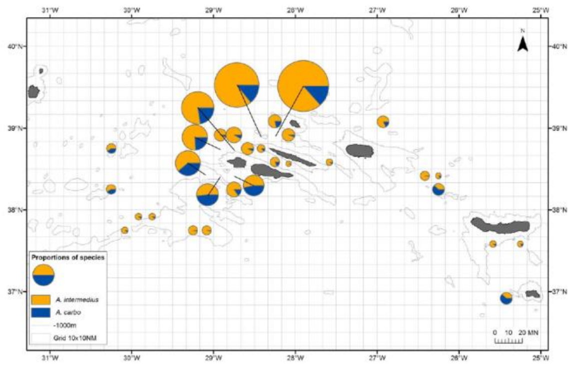
10.4.6 Data analyses

In Subarea 10, the commercial interest for the exploitation of black scabbardfish has been increasing over time, but apart from the data presented for 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 the in ICES Division 10.a, *A.carbo* and *A. intermedius* (Besugo *et al.*, 2014 WD). Spatial estimates of the proportion of co-occurrence of the two species are presented in Figure 10.4.3, showing that the overall proportion of *A. intermedius* in relation to the overall catches of *Aphanopus* species is about 0.75. It is however important to remark that the proportion can vary according to the sampling location.



(a)



(b)

Figure 10.4.3 – bsfnea. Other areas. Map of the sampling locations (a) and estimates of the proportion of each *A. carbo* and *A. intermedius* at different sampling points (b).

10.4.7 Comments on the assessment

Excluding ICES Division 5.a, and despite the variability on the overall landings along years, data available suggest that ICES Division 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 area 10 (Besugo *et al.*, 2014 WD) needs to be, in the future, taken into consideration to provide advice for this stock.

10.4.8 Management considerations

The information available does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, although most of the evidence available does support it. In face of this evidence ICES Division 5.a data was included in the Northern component.

The co-occurrence of two different species *A. carbo* and *A. intermedius* in ICES area 10 needs to be, in the future, considered providing advice for this stock.

10.4.9 Tables

Table 10.4.1a. Black scabbard fish other Areas 2 and 3. Working group estimates of landings.

YEAR	FRANCE	FAROES 2.A	FRANCE 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
2014	-	-		0
2015	-	-		0
2016	-	-	0	0
2017	-	-	-	0

Table 10.4.1b. Black scabbard fish other Areas 4. Working group estimates of landings.

Year	France				Scotland			Germany *	E&W&NI	Total
	4	4.a	4.b	4.c	4.a	4.b	4.c	4.a	4.a	
1988					-			.	-	0
1989	3				-			.	-	3
1990	70				-			.	-	70
1991	107				-			-	-	107
1992	219				-			-	-	219
1993	34				-			-	-	34
1994	45				-			3	-	48
1995	6				2			-	-	8
1996	6				1			-	-	7
1997	0				2			-	-	2
1998	2				9			-	-	11
1999		4			3			-	-	7
2000		2			3			-	-	5
2001		1			10			-	1	12
2002		0			24			-		24
2003		0			4			-		4
2004		4	1		0			-		5
2005		1	1		0			-		2
2006		13			0	0	0	-		13
2007		1	0		-			-		1
2008		0			0			-		0
2009		5	0		-	-	-	-	-	5
2010		13	2		-	-	-	-	-	15
2011		-	1		-	-	-	-	-	1
2012		0			-	-	-	-	-	0
2013		1	0	0	-	-	-			1
2014		10	0	0	0	0	0	0	0	10
2015		2	0	0	0	0	0	0	0	2
2016		9	-	-						
2017		0	-	0	0	0	0			

Table 10.4.1c. Black scabbard fish other Areas 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	1		1
1995	+		0
1996	0		0
1997	1		1
1998	0		0
1999	6		6
2000	10		10
2001	5		5
2002	13		13
2003	14		14
2004	19		19
2005	19		19
2006	23		23
2007	1		1
2008	0		0
2009	15		15
2010	109		109
2011	172		172
2012	365		365
2013	325	0	325
2014	360	-	360
2015	265	0	265
2016	346		
2017	294		294

Table 10.4.1d. Black scabbard fish other Areas 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
2016	50	36		-	86
2017	7	63		-	70

Table 10.4.1f. Black scabbard fish other Areas 14. Working group estimates of landings.

YEAR	FAROES	SPAIN	UNALLOCATED	TOTAL
	14.b			
1988	-			0
1989	-			0
1990	-			0
1991	-			0
1992	-			0
1993	-			0
1994	-			0
1995	-			0
1996	-			0
1997	-			0
1998	2			2
1999	-			0
2000	-	90		90
2001	-	0		0
2002		8		8
2003		2		2
2004				0
2005	0			0
2006	-			0
2007	0			0
2008	0			0
2009	0			0
2010		111		111
2011	0			0
2012	-	39	49	88
2013		50	40	90
2014	0	0	0	0
2015	0	0	0	0
2016				0
2017	0	0	0	0

10.4.10 References

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

11.1 The fishery

Greater forkbeard is as a bycatch species in the traditional demersal longline and trawl mixed fisheries targeting species such as hake, megrim, monkfish, ling, and blue ling in Subareas 6, 7, 8 and 9.

Spanish, French, Norwegian and UK trawl and longline are the main fleets involved in this fishery. Since 2008, 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. Russian, Swedish, Faroese and the Icelandic fisheries in the Northeast Atlantic land small and occasional quantities of greater forkbeard as bycatch of the trawler fleet targeting roundnose grenadier, tusk and ling on Hatton and Rockall Banks.

A further 13% of landings in this period come from the French and Spanish trawl and longline fleets in Subareas 8 and 9 (mainly from 8). In Subarea 9 since 2001 small amounts of *Phycis* spp (probably *Phycis phycis*) have been landed in ports of the Strait of Gibraltar by the longliner fleet targeting scabbardfish in Algeciras, Barbate and Conil. Portuguese landings of *P. blennoides* are scarce, but important amounts of *Phycis* spp and *Phycis* species are reported every year in Subarea 9. Portuguese landings of *P. blennoides* present a marked seasonal pattern, being particularly higher between March and July. Reasons for this marked seasonality are unknown, but may be related to abundance variations of this species or to seasonality patterns in other fisheries where this species is taken as bycatch (Lagarto *et al*., 2016).

Minor quantities of *Phycis blennoides* are landed by Portugal in Subarea 10 and by Norwegian and in recent years Faroese vessels in Divisions 5.a and 5.b. The Azores deep-water fishery is a multispecies and multigear fishery dominated by the main target species *Pagellus bogaraveo*. Target species can change seasonally according to abundance and market prices, but *P. blennoides,* representing less than 0.5% of total deep-water landings in the last five years, can be considered as bycatch.

11.2 Landings trends

Tables 11.0a–h and Figure 11.1 show landings of greater forkbeard by country and subarea.

In Subareas 1, 2, 3 and 4 only Norwegian landings are significant reaching 219 t in 2016 in these combined subareas. The Norwegian longliners which fish in these areas catch *P. blennoides* as a bycatch in the ling fishery. The quantity of this bycatch depends on market price. After eight years without *P. blennoides* records, in 2002 the Norwegian fleet reported 315 t in Subareas 1 and 2 and 561 t in Subareas 3 and 4, since then the landings of this country have been significant but lower than in 2002.

Historically in 5.b the main landings come from France and Norway. However in 2011 and 2012 the landings reached the highest values because Faroes reported 310 t and 145 t respectively. After these years, combined landings in this subdivision dropped to low levels as before because the Faroese fleet did report only 0.15 t in the period from

2013 to 2017. Landings reported in 2017 by all countries were 9, the lowest value of the series in this Division.

Traditionally the most important landings in the Northeast Atlantic are recorded in 6 and 7 from Spain, France, Norway, UK and Ireland. Historical landings decreased since the peak of 4967 t in 2000 and they are especially low in 2009 and 2010 due to the low landings reported by Spain in those years. In 2017 the international reported landings were 1073 t, mainly by France (431 t) and Spain (399 t)

The main landings from Subareas 8 and 9 come from Spanish fleets. The average combined landings in the last ten years is 254 t. In 2010 landings were the lowest of the series mainly due to the reduction of landings reported by Spain.

Historically in Subarea 10 landings come only from Portugal although in 2107 for first time this country didn't reported any landing. After a peak to 136 t in 1994 and 91t in 2000 the average in the last ten years is 10 t. In 2014 for first time France reported 0.2 t in this subarea.

Although since 1991 many countries were involved in the fishery in Subarea 12 only in the period 2002–2009 Spain reported significant landings. From 2013 onwards no country reported landings in this subarea.

11.3 ICES Advice

For 2017 and 2018 ICES advised on "the basis on the precautionary approach that landings should be no more than 1682 tonnes".

11.4 Management

Biannual EU TACs for 2016 and 2017 and landings in in the same years by ICES subarea are shown below. Landings in Subareas 1, 2, 3 and 4 include Norwegian landings while only EU TACs are shown. In all subareas landings were lower than the EU TAC in this period.

PHYCIS BLENNOIDES	EU TAC		TOTAL INTERNATIONAL LANDINGS	
Subarea	**2016**	**2017**	**2016**	**2017**
1, 2, 3, 4	37	33	336	235
5, 6, 7	2434	2166	1505	1082
8, 9	320	285	323	186
10, 12	65	58	10	0
Total	2856	2542	2174	1503

11.5 Stock identity

ICES currently considers greater forkbeard as a single-stock for the entire ICES area. It is considered probable that the stocks structure is more complex; however further study would be required to justify change to the current assumption.

11.6 Data available

11.6.1 Landings and discard

Landings are presented in Table 11.0a–h and in Figure 11.1. Landings by fishing gear in 2015 are shown in the Table 11.1. The discards estimates from 2013–2017 accounted

36%, 34%, 49%, 25% 25% of the total catches respectively (Table 11.2a). In 2017 the main reported discards come from Subarea 4 (54%), 7 (26%) and 6 (10%). Length frequencies of commercial fleets available indicate that discards in 2015 affected specially to individuals smaller than 17 cm of which the 100% were discarded. In 2016 and 2017 the range of discarded greater forkbeard increased affected in high proportion also to individuals smaller than 36 cm and 45 cm respectively (Figure 11.2).

Series of Effort data (kWd) since 2014 of the Spanish, French, Swedish, UK (Scotland) and Irish fleets (OTB, LLS and GTR) have been provided by subarea (Table 11.3). The effort for a given year is calculated as the sum of kWd of those fleets/countries reported information in Intercatch.

11.6.2 Length compositions

Figures 11.3, 11.4, 11.5, and 11.6 present the length–frequency distributions of Spanish Groundfish Survey in the Porcupine bank, Northern Spanish Shelf bottom-trawl and Portuguese Crustacean Surveys/*Nephrops* TV Surveys (PT-CTS (UWTV (FU 28–29) until 2017, and French IBTS until 2016.

11.6.3 Age compositions

No new data available.

11.6.4 Weight-at-age

This year there is presented the accumulated mean weight-at-length of the international commercial landings and discards reported to InterCatch in 2016 and 2017 (Figure 11.7).

11.6.5 Maturity and natural mortality

New information of L_{mat}, L_{inf} and K was provided for the Spanish Data Call to the WG.

	Value	Reference	Comments
L_{mat}	53.89	CV=3.4%	both sex, n=960, years: 2015+2016+2017
L_{inf}	91.46	CV=6.3%	both sex, n=1045, years: 2015+2016+2017
K	0.142	CV=10%	both sex, n=1045, years: 2015+2016+2017

11.6.6 Catch, effort and research vessel data

In 2017 the following surveys covering the continental slope of Subareas, 3, 4, 6, 7, 8, and 9.a have been included in the analysis of biomass and abundance indices (Figure 11.8):

- Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS) in Divisions 7.c and 7.k. Biomass and abundance of greater forkbeard from 2001 to 2017 are presented in Figure 11.9.
- French EVHOE IBTS (FR-EVHOE) in Divisions 7.f,g,h,j; and 8.a,b,d). Although the French survey didn't was carry out in 2017 the data of abundance and biomass raised to the total subarea have been provided for a series from 1997 to 2016. (Figures 11.10).
- Irish Groundfish survey (IGFS) in Divisions 6.a South and 7.b. Abundance and biomass Indices (nº per hour and kg per hour) from the period 2005 to

2017. This survey provides abundance indices for the total catches and for individuals <32 cm by shelf and slope strata (Figure 11.11).

- Northern Spanish Shelf bottom-trawl survey (SP-NGFS) in Divisions 9.a and 8.c. Biomass and abundance (kg/30 min tow and No/30 min tow) of greater forkbeard in the Cantabrian Sea from 1990 to 2017 are presented in Figure 11.12.
- North Sea IBTS survey (NS-IBTS) in Divisions 4.abc, 3.a and 3.c. No new data are available for this survey in 2017. Abundance in number per hour from 1975 to 2016 is presented in Figure 11.13.
- Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) in Divisions 5.b, 6.ab, 7.ab. No new information is available since 2015. Abundance in number per hour from 1986 to 2014 is presented in Figure 11.14.
- Scottish Deep-water trawler survey in Divisions 6.a. Biomass and abundance of greater forkbeard until 2017 are presented in the Figure 11.15.
- Portuguese crustacean surveys/*Nephrops* TV Survey (PT-CTS (UWTV (FU 28–29) in Division 9.a South, Biomass in kg per hour from 1997 to 2016 is presented in Figure 11.16.

11.7 Data analyses

In the Spanish Groundfish Survey in the Porcupine bank the biomass of *Phycis blennoides* decreased still more this last year, reaching the lowest value of the time series (8.8 ± 1.1 kg haul $^{-1}$). The biomass and abundance have been going down for four years in a row (Figure 11.9). The species was similarly distributed in the study area in last two years but with lower presence, being in 2017 even less abundant in the northern area of the bank (Figure 11.7). *P. blennoides* was found between 198 and 754 m this last survey mainly in 450-800 m depth strata as previous years. Regarding length distribution, the few specimens caught of *P. blennoides* ranged from 14 cm to 67 cm. There were hardly any signs of recruits and adults around 50 cm unlike the previous year, just one mode of individuals around 31 cm (Figure 11.3) (Ruiz-Pico *et al.* 2018).

The EVHOE IBTS survey in Divisions 7.f,g,h,j and 8.a,b,d indicates an increase in biomass since 1996, with peaks in 2004, 2007 and 2012 and a decrease since 2013. However landings have decreased from 2012 onwards since the most important peak in 2011. Similarly, the abundance shows no clear trend in the series, but has also peaks in 2002, 2007 and 2012. An important decrease was also observed since this year, with a slight peak in 2015. (Figure 11.10). The mean length has increased since the beginning of the series reaching the highest value in 2014 (Figure 11.5).

Iris GFS indicates an increase in the abundance and biomass from 2009 to 2012 and 2013 respectively. From these years onwards a decrease is shown to 2017 to the lowest value of the series. (Figure 11.11).

In Northern Spanish Shelf bottom-trawl survey in 2017 the biomass of Phycis blennoides in standard hauls (0.2 ± 0.05 Kg·haul-1) fell sharply to levels similar to those reached between 2003 and 2006, while the abundance (4.00 ± 0.95 ind·haul-1) increased following the fluctuations (ups and downs) of recruitment over the last decade (Figure 11.12). A note to highlight is that 77.59% of the biomass of Phycis blennoides catch in the survey was found deeper than 500 m, with 23.53% of the hauls with this species carried out at that depth. In these additional hauls deeper than 500 m, the species followed the decreasing trend from 2014 in terms of biomass whereas a slight increasing can be observed in terms of number, what is clearly related with the rise of juveniles in the present survey. In 2017, *P. blennoides* was caught between 134 m and 700 m and it was widespread in the sampling area, although most of the biomass was found in the central area of the Cantabrian Sea, as usually (Figure 11.18). Regarding length distribution, large individuals (>25 cm) show a decrease compared with the last ten years, whereas the recruitment has risen this last year. Length distribution is shown to be similar for the individuals catch in additional hauls deeper than 500m and those catch in standard hauls. Nevertheless, for larger individuals length distribution was wider in deeper hauls (Fernández-Zapico *et al*., 2018).

The NS-IBTS recorded in 2012 (40.2 individuals/hour) the most important abundance years of the series although the trend shows a decrease since this year to 2016 (Figure 11.13).

No data for 2015 and 2016 have been updated in the DATRAS system for the SWC-IBTS. The trend series of abundance until 2014 is shown in the Figure 11.14.

The Scottish Deep-water trawler survey covers a core area of the continental slope of the Rockall Trough (6.a) from between 55 to 59°N long with the slope stratified by depth at 500, 1000, 1500 and 1800 m. Historical series of biomass index show a tooth saw profile since 1998, with a minimum of 5.9 kg/hour in 2009 to a maximum 14.8 kg/hour in 2013. In 2017 an important increase of the biomass was recorded reaching the peak of the series with 46.1 kg/hour. The abundance shows also an increase in 2017 with similar levels to those recorded in 2012 and 2013 (Figure 11.15)

In the Portuguese survey in 9.a south the series of biomass and abundance show a decrease trend since 1997 to 2004 but with significant peaks in 1999 and 2002. After this, the abundance and biomass recorded the highest values in 2008 and 2010 respectively, and dropped to 2013 and increases significantly again up to 2016. Values biomass are in the range of 0 kg/hour to 2.33 kg/hour (Figure 11.16). 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 year 2008 (Figure 11.6). The size range observed in the Portuguese continental coast, indicating that the species is able to complete the life cycle in this area. In recent years the *P. blennoides* standardized biomass index estimates are above the overall mean, showing an increasing trend, particularly from 2013 to 2016 (a slight decrease was observed in 2017 in relation to 2016). A similar trend was observed between 1997 and 2016 for the juvenile component of the population, suggesting that the fishing pressure has not seriously impaired the recruitment (Lagarto et al., 2017).

WGDEEP reiterates its previous view that although the data provided by the surveys have increased the area covered in the ecoregion, neither the available surveys nor discard data cover yet the entire distributional stock, especially in Subareas 1 and 2.

11.7.1 Exploratory assessment

No analytical assessment was presented in WGDEEP 2018.

11.7.2 Comments on the assessment

No analytical assessment was presented in WGDEEP 2018.

11.8 Management considerations

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

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 2012, and in biomass since 2013. 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 perhaps due to the high abundance recorded in 2011 to 2013. The trend in Subarea 8 shows an increase in biomass and abundance until 2012 and a decrease in biomass from 2014 to 2016 although abundance recovers slightly in 2015 and 2017. In Division 9.a south annual standardized biomass and abundance indexes suggest an increase of biomass and abundance in 2013 to 2017.

On the other hand, landings in all ecoregions were stable from 2011 to 2014 from between 2000–2600 t near the total TAC established. In the last years and , although the TAC was increased in 2015 and 2016 to 2856 t landings reported have been of this figure especially in 2017 in which landings consumed only 59% of TAC As greater forkbeard is a bycatch of the traditional demersal trawl and longline mixed fisheries, discards of this species are considered high. Due to the species is a bycatch and not all the countries involved in the fishery report data to InterCatch the discard cannot be quantified for the whole stock and are very variable from year to year. In the same sense, the commercial length frequencies are only partially available from some countries and areas and the historical series is short. According to the information available, reported discards are high but very variable among years represented 51%, 55%, 95%, 34% and 34 of the annual landings from the period 2013–2017. That means none of the EU member countries landed the quota assigned, and the quota has been not reached even if we consider the discards reported. These landings of greater forkbeard are mainly bycatches, however, this species are locally important for certain fleets fishing in subareas 6 and 7 with base port mainly in the North West of Spain (and France??). It can be supposed that if the TAC for this stock is removed these fleets could increase the both landings and discards of greater forkbeard.

11.9 Application of MSY proxy reference points

A Stochastic Production Model in Continuous Time (SPiCT) was applied in 2017 to The GFB stock using the historical series of landings since 1998 and the standardized biomass indicator (average) from six surveys: IGFS-WIBTS-Q4, EVHOE-WIBTS-Q4F, SpGFS-WIBTS-Q4, SpGFS-WIBTS-Q4, SDS, PT-CTS (UWTV (FU 28–29) from the period 2005–2016.

Residuals could not be calculated because estimation did not converge, so a new input was performed shortening the series of landings to the same period of the Index series (from 2005 to 2016), but again the estimation did not converge.

The inputs and results of the first attempt are shown in the Figures 11.19 and 11.20.

11.10 Tables and Figures

Table 11.0a. Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic. Working group estimates of landings.

YEAR	1+2	3+4	5B	6+7	8+9	10	12	TOTAL
1988	0	15	2	1898	533	29	0	2477
1989	0	12	1	1815	663	42	0	2533
1990	23	115	38	1921	814	50	0	2961
1991	39	181	53	1574	681	68	0	2596
1992	33	145	49	1640	702	91	1	2661
1993	1	34	27	1462	828	115	1	2468
1994	0	12	4	1571	742	136	3	2468
1995	0	3	9	2138	747	71	4	2972
1996	0	18	7	3590	814	45	2	4476
1997	0	7	7	2335	753	30	2	3134
1998	0	12	8	3040	1081	38	1	4180
1999	0	31	34	3455	673	41	0	4234
2000	0	11	32	4967	724	91	6	5831
2001	8	27	102	4405	727	83	8	5360
2002	318	585	149	3417	715	57	81	5321
2003	155	233	73	3287	661	45	82	4536
2004	75	143	50	2606	720	37	54	3685
2005	51	83	46	2290	519	22	77	3087
2006	49	139	39	2081	560	15	42	2925
2007	47	239	56	1995	586	17	37	2978
2008	117	245	45	1418	446	18	17	2307
2009	82	149	22	796	203	13	44	1309
2010	132	186	61	824	69	14	0	1287
2011	113	179	319	1257	321	11	0	2201
2012	98	199	169	1802	366	6	0	2641
2013	83	179	11	1588	275	8	0	2143
2014	97	214	24	1566	360	9	0	2269
2015	121	215	34	1471	323	10	0	2174
2016	187	273	13	1265	263	10	0	2012
2017	80	155	9	1073	186	0	0	1503

Table 11.0b. Greater forkbeard *(Phycis blennoides)* in Subareas 1 and 2. Working group estimates of landings.

YEAR	NORWAY	FRANCE	RUSSIA	UK (SCOT)	UK (EWNI)	GERMANY	FAROE ISLANDS	TOTAL
1988	0							0
1989	0							0
1990	23							23
1991	39							39
1992	33							33
1993	1							1
1994	0							0
1995	0							0
1996	0							0
1997	0							0
1998	0							0
1999	0	0						0
2000	0	0						0
2001	0	1	7					8
2002	315	0		1		2		318
2003	153	0				2		155
2004	72	0	3	0				75
2005	51	0						51
2006	46	0	3					49
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

Table 11.0c. Greater forkbeard (*Phycis blennoides*) in Subareas 3 and 4. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK (EWNI)	UK (SCOT)(1)	GERMANY	DENMARK	SWEDEN	TOTAL
1988	12	0	3	0				15
1989	12	0	0	0				12
1990	18	92	5	0				115
1991	20	161	0	0				181
1992	13	130	0	2				145
1993	6	28	0	0				34
1994	11			1				12
1995	2			1				3
1996	2	10		6				18
1997	2			5				7
1998	1		0	11				12
1999	3		5	23				31
2000	4		0	7				11
2001	6		1	19	2			27
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

(1) Includes Moridae, in 2005 only data from January to June.

Table 11.0d. Greater forkbeard (*Phycis blennoides*) in Division 5b. Working group estimates of landings.

YEAR	FRANCE	NORWAY	UK(SCOT)[1]	UK(EWNI)	FAROE ISLANDS	RUSSIA	ICELAND	TOTAL
1988	2	0						2
1989	1	0						1
1990	10	28						38
1991	9	44						53
1992	16	33						49
1993	5	22						27
1994	4							4
1995	9							9
1996	7							7
1997	7	0						7
1998	4	4						8
1999	6	28	0					34
2000	4	26	1	0				32
2001	9	92	1	0				102
2002	10	133	5	0				149
2003	11	55	7	0				73
2004	9	37	2	2				50
2005	7	39		0,3				46
2006	8	26			6			39
2007	11	34	0	0	9	2	0	58
2008	10	20	0		4	11	1	46
2009	0	13	3		3	2	0	24
2010	2	45	3	1	11		2	62
2011	7				310		1	319
2012	6	5			145	7	7	169
2013	7	3	0				0	11
2014	7	14	0		0		2	24
2015	5	27					2	34
2016	7	3	0				3	13
2016	7	3	0				3	13
2017	9		0					9

[1] Includes Moridae in 2005 only data from January to June.

Table 11.0e. Greater forkbeard (*Phycis blennoides*) in Subareas 6 and 7. Working group estimates of landings.

YEAR	FRANCE	IRELAND	NORWAY	SPAIN(1)	UK (EWNI)	UK (SCOT) (2)	GERMANY	RUSSIA	FAROE ISLANDS	TOTAL
1988	252	0	0	1584	62	0				1898
1989	342	14	0	1446	13	0				1815
1990	454	0	88	1372	6	1				1921
1991	476	1	126	953	13	5				1574
1992	646	4	244	745	0	1				1640
1993	582	0	53	824	0	3				1462
1994	451	111		1002	0	7				1571
1995	430	163		722	808	15				2138
1996	519	154		1428	1434	55				3590
1997	512	131	5	46	1460	181				2335
1998	357	530	162	530	1364	97				3040
1999	314	686	183	824	929	518	1			3455
2000	671	743	380	1613	731	820	8	2		4967
2001	683	663	536	1332	538	640	10	4		4405
2002	613	481	300	1049	421	545	9	0		3417
2003	469	319	492	1100	245	661	1	1		3287
2004	441	183	165	1131	288	397		1		2606
2005	598	237	128	979	179	164		5		2290
2006	625	68	162	1075	148			2	0	2081
2007	578	56	188	875	117	179		2		1995
2008	711	43	174	236	31	196		27	0	1418
2009	304	7	222	48	31	184		1		796
2010	383	8	219	23	14	173		3	1	824
2011	378	6	309	326	27	210				1257
2012	381	9	225	992	1	194				1802
2013*	451	16	289	583	3.4	246		0		1588
2014	468	25	159	769	9	135				1566
2015	451	37	135	716	26	105				1471
2016	412	13	97	641	13	90				1265
2017	431	6	134	399	14	88				1073

(1) Landings of *Phycis* spp Included from 1988 to 2012.

(2)Includes Moridae in 2005 only data from January to June.

*** Preliminary.**

Table 11.0f. Greater forkbeard (*Phycis blennoides*) in Subareas 8 and 9. Working group estimates of landings.

YEAR	FRANCE	PORTUGAL	SPAIN[1]	UK(EWNI)	UK (SCOT)	TOTAL
1988	7	29	74			110
1989	7	42	138			187
1990	16	50	218			284
1991	18	68	108			194
1992	9	91	162			262
1993	0	115	387			502
1994		136	320			456
1995	54	71	330			455
1996	25	45	429			499
1997	4	30	356			390
1998	3	38	656			697
1999	8	41	361			410
2000	36	91	375			502
2001	36	83	453			573
2002	67	57	418			542
2003	28	45	387			461
2004	44	37	446			527
2005	58	22	312	0		392
2006	54	10	257			321
2007	32	14	510	0		556
2008	41	13	123			178
2009	8	13	183	0		203
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

(1) **Landings of *Phycis spp* Included from 1988 to 2012.**

Table 11.0g. 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
2010	14		14
2011	11		11
2012	6		6
2013	8		8
2014	9	0	9
2015	10		10
2016	10		10
2017			0

Table 11.0h. Greater forkbeard (*Phycis blennoides*) in Subarea 12. Working group estimates of landings.

YEAR	FRANCE	UK(SCOT)[1]	NORWAY	UK(EWNI)	SPAIN[2]	RUSSIA	TOTAL
1988							0
1989							0
1990							0
1991							0
1992	1						1
1993	1						1
1994	3						3
1995	4						4
1996	2						2
1997	2						2
1998	1						1
1999	0	0					0
2000	2	4					6
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

[1]Includes Moridae in 2005 only data from January to June.

[2] Landings of *Phycis spp* Included from 1988 to 2012.

Table 11.1. ***Phycis*** **spp. European landings (t) by métier in 2016.**

LANDINGS (T)	2017
Denmark	
OTB_CRU	0.1
OTB_DEF	4.2
SDN_DEF	0.0
SSC_DEF	0.6
France	**459.7**
GNS_DEF_>=100_0_0	14.1
LLS_DEF_0_0_0_all	13.0
MIS_MIS_0_0_0_HC	1.7
OTB_DEF_>=120_0_0_all	115.4
OTB_DEF_100-119_0_0	122.1
OTB_DEF_70-99_0_0	6.8
OTB_DWS_>=120_0_0_all	90.1
OTT_DEF_>=70_0_0	8.6
OTT_DEF_100-119_0_0_all	81.0
OTT-CRU	2.9
OTT-DEF	4.0
Ireland	**6.3**
OTB_DEF_100-119_0_0_all	3.6
OTB_DEF_70-99_0_0_all	2.7
Norway	**134.2**
LLS_FIF_0_0_0_all	134.2
Portugal	**9.1**
MIS_MIS_0_0_0	8.9
OTB	0.2
Spain	**558.0**
GNS_DEF_>=100_0_0	2.3
GNS_DEF_120-219_0_0	0.2
GNS_DEF_60-79_0_0	0.4
GNS_DEF_80-99_0_0	3.7
GTR_DEF_60-79_0_0	0.9
LHM_DEF_0_0_0	0.0
LLS_DEF_0_0_0	380.7
MIS_MIS_0_0_0_HC	0.5
OTB_DEF_>=55_0_0	49.6
OTB_DEF_>=70_0_0	5.9
OTB_DEF_100-119_0_0	92.9
OTB_DEF_70-99_0_0	14.2
OTB_DWS_100-129_0_0	0.0
OTB_MCD_>=55_0_0	2.6
OTB_MPD_>=55_0_0	3.8
PTB_DEF_>=70_0_0	0.0
PTB_MPD_>=55_0_0	0.2
Sweden	**0.0**

OTB_CRU_32-69_0_0_all	0.0
UK (England)	**14.4**
GNS_DEF	0.0
LLS_DEF	0.1
MIS_MIS_0_0_0_HC	0.7
OTB_CRU	0.1
OTB_DEF	13.5
UK(Scotland)	**97.7**
LLS_DEF_0_0_0_all	16.2
MIS_MIS_0_0_0_HC	1.6
OTB_CRU_70-99_0_0_all	0.8
OTB_DEF_>=120_0_0_all	79.1
Total general	**1284.2**

Table 11.2a. Reported discards (ton) of *P. blennoides* from 2013 to 2017.

TON	2013	2014	2015	2016	2017
DISCARDS	1185	1166	2068	677	513
LANDINGS	2143	2269	2175	2012	1503
CATCHES	3328	3435	4243	2689	2016

Table 11.3. Effort (kWd) of *P. blennoides*, *P. Phycis* and *Phycis* spp by the Spanish, Swedish and Irish fleets from 2014 to 2107.

2014	2	3	4	5	6	7	8	9	12
Spain					500 409	534 570	4 676 906	1 330 671	
Sweden		6 908 723	1 666 360						
Ireland			1 019		754 232	9 955 488	619		1 756
2015									
Spain					544 731	6 497 141	15 584 384	12 579 168	
Sweden		6 252 366	2 103 825						
2016									
Spain					567188	4775689	14675183	6589323	
Sweden		881							
UK(Scotland)			11779125	36663		68448	221		
France	548084	213152	3863520	590412	6498055	45211426	46962821		
2017									
Spain	634609	7400	4477482	370400	4837947	52468986	49011507		
France					599343	5277665	10744748	6355509	

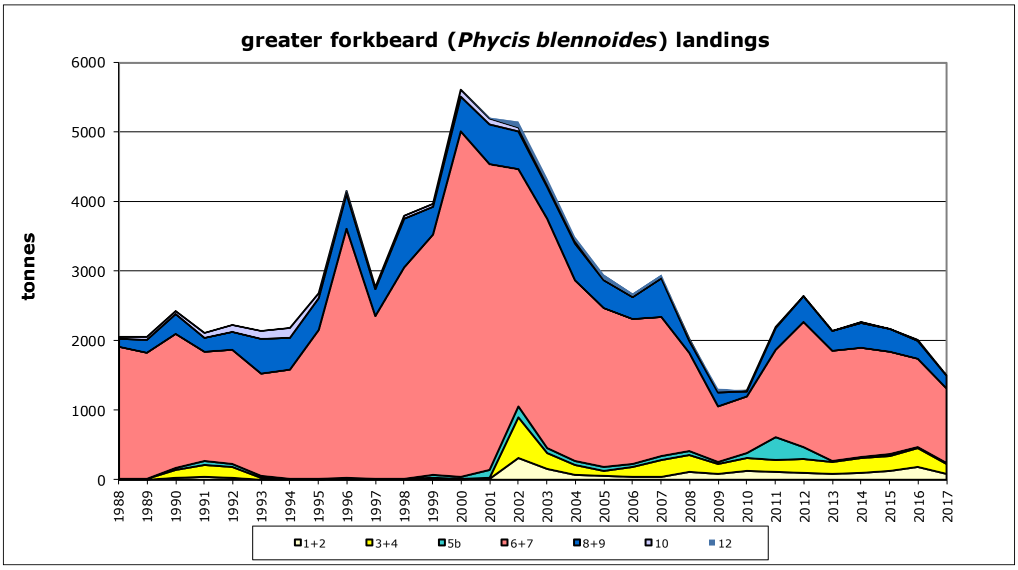

Figure 11.1. Greater forkbeard landing trends in all ICES subareas since 1988.

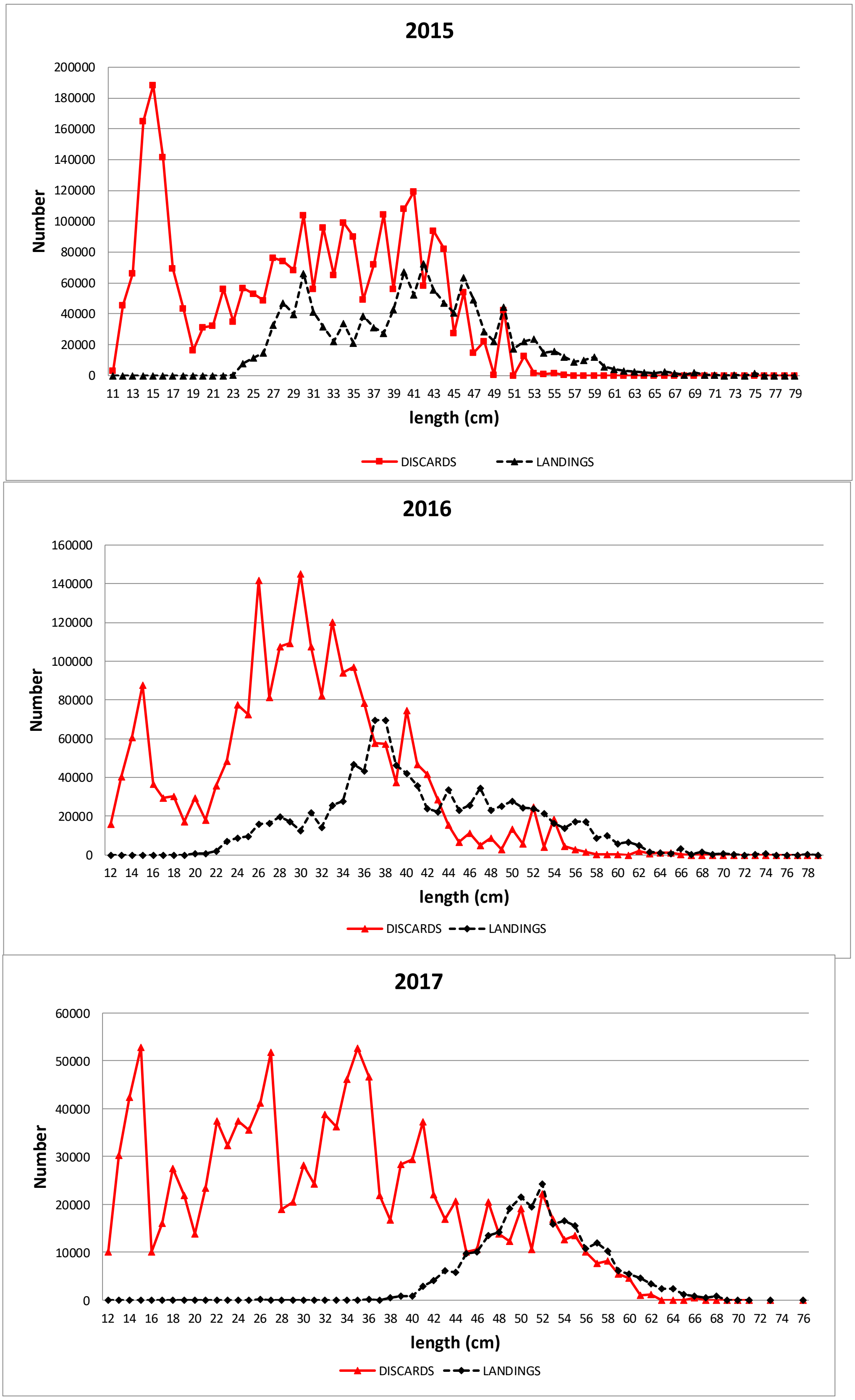

Figure 11.2. Commercial length frequencies of the greater forkbeard landings and discards in 2015 and 2016 from the France, Spain, Ireland, Portugal UK (England) and UK (Scotland).

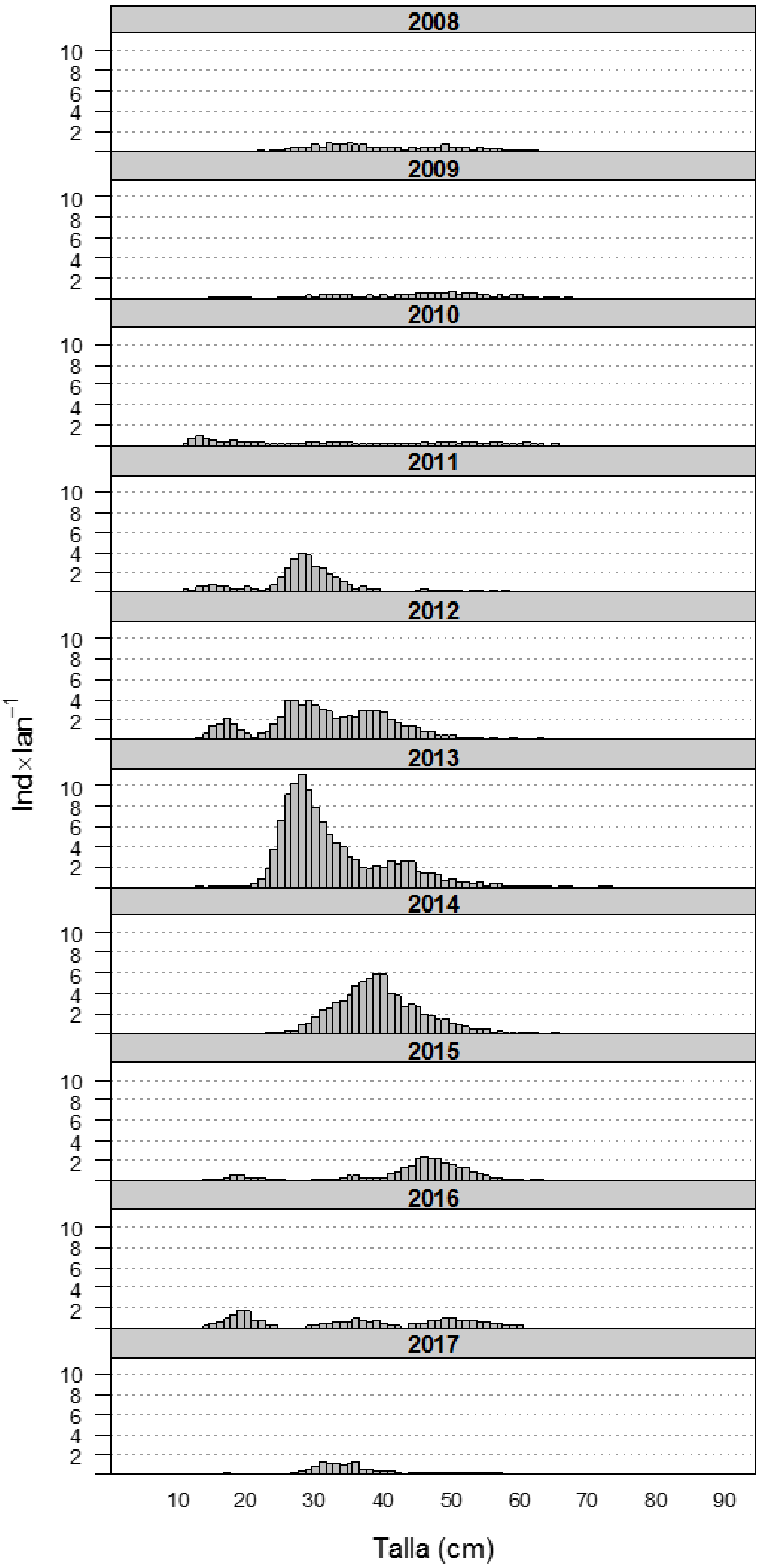

Figure 11.3. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Porcupine survey (Divisions 7.c and 7.k) time-series (2010–2017).

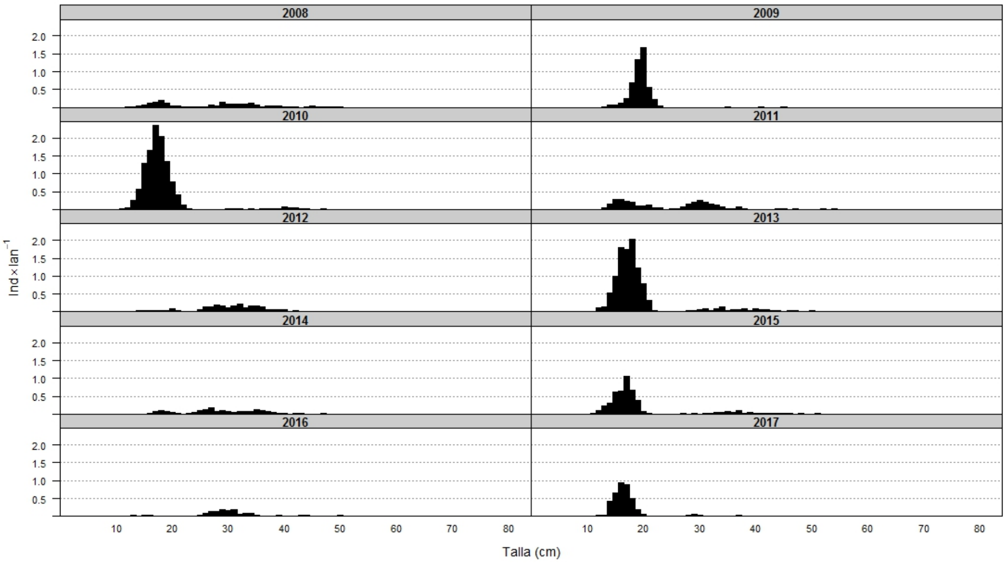

Figure 11. 4. Mean stratified length distributions of greater forkbeard (*P. blennoides*) in Northern Spanish Shelf survey (8.c and 9.a) in the period 2007–2017.

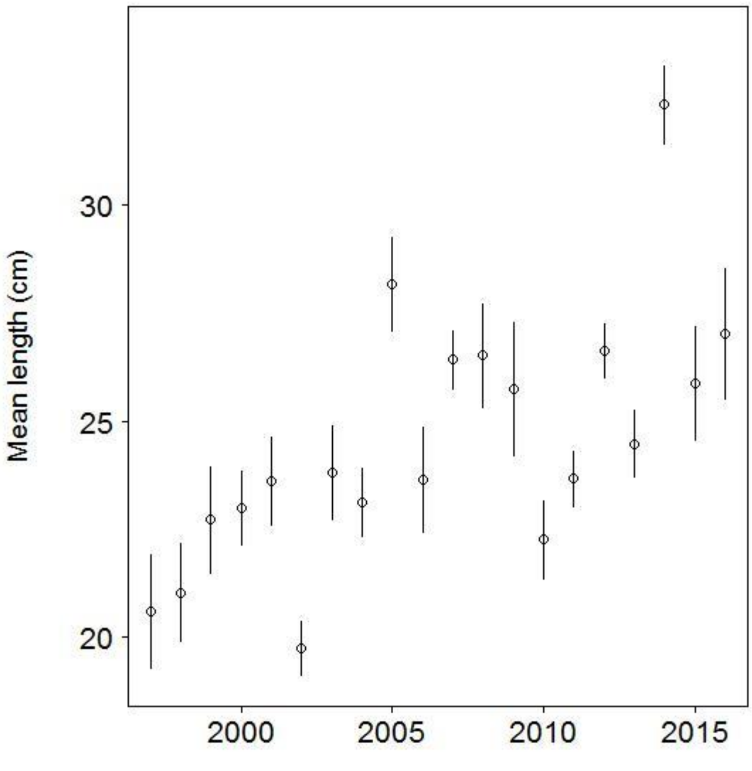

Figure 11. 5. Greater forkbeard series of mean length from the French IBTS survey Divisions 7.fghj and 8.abd until 2016.

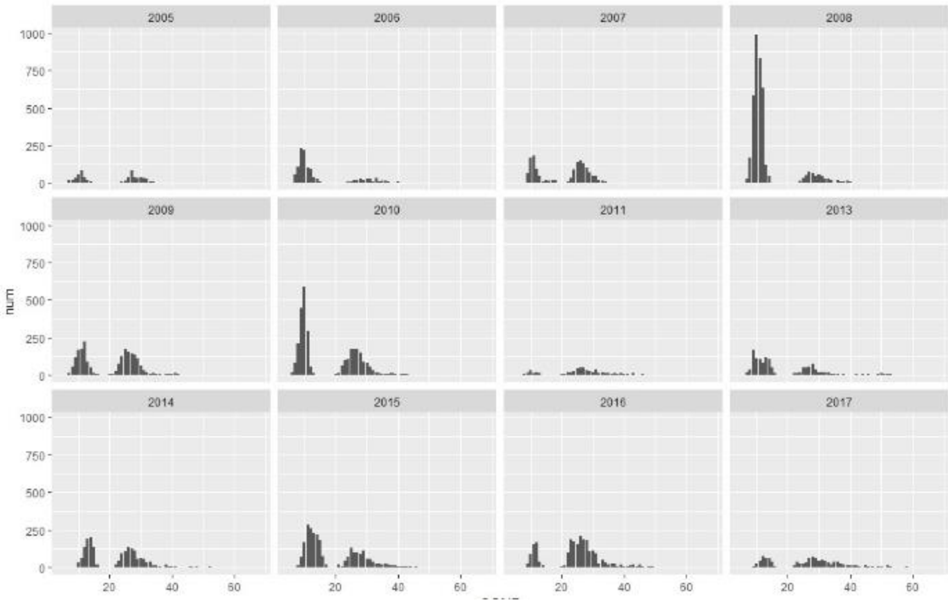

Figure 11.. Length distribution by year of *P. blennoides* specimens caught during the Portuguese Crustacean Surveys/*Nephrops* TV Surveys (PT-CTS (UWTV (FU 28–29)) undertaken between 2005 and 2017 in Subdivision 9.a. No survey was conducted in 2012.

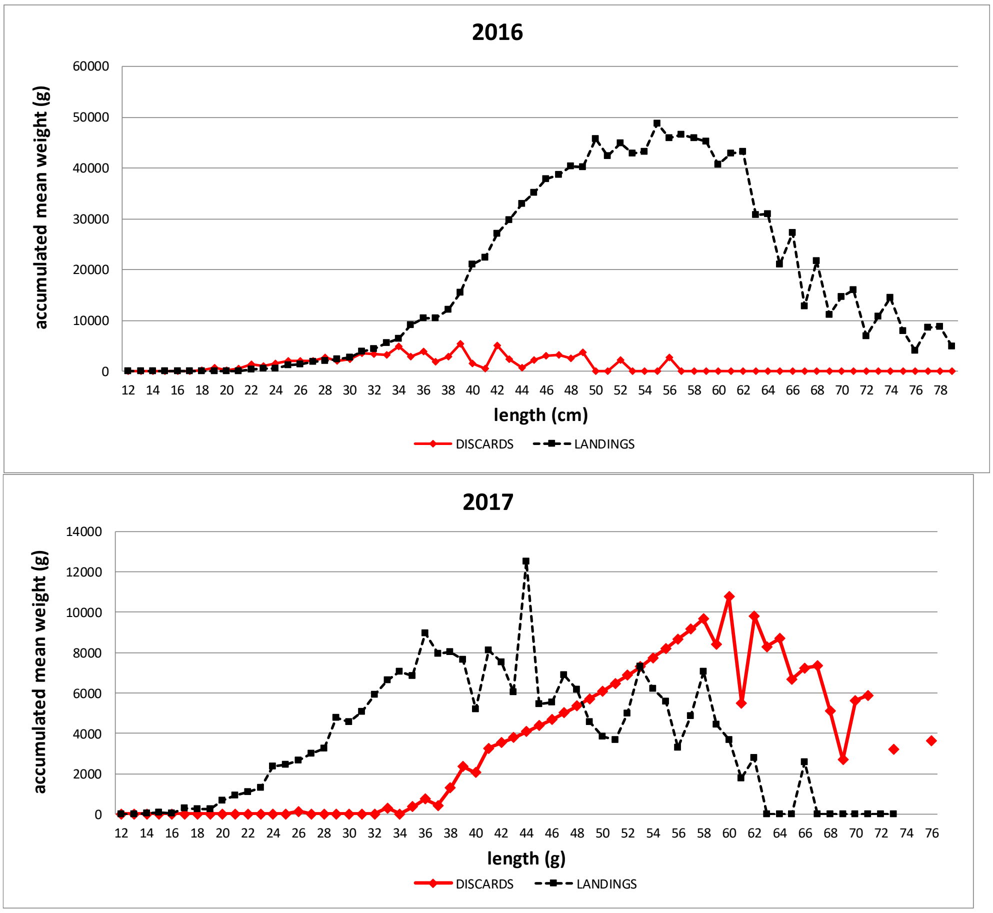

Figure 11.7 Accumulated mean weight at length of the international commercial landings and discards reported to intercatch in 2016 and 2017

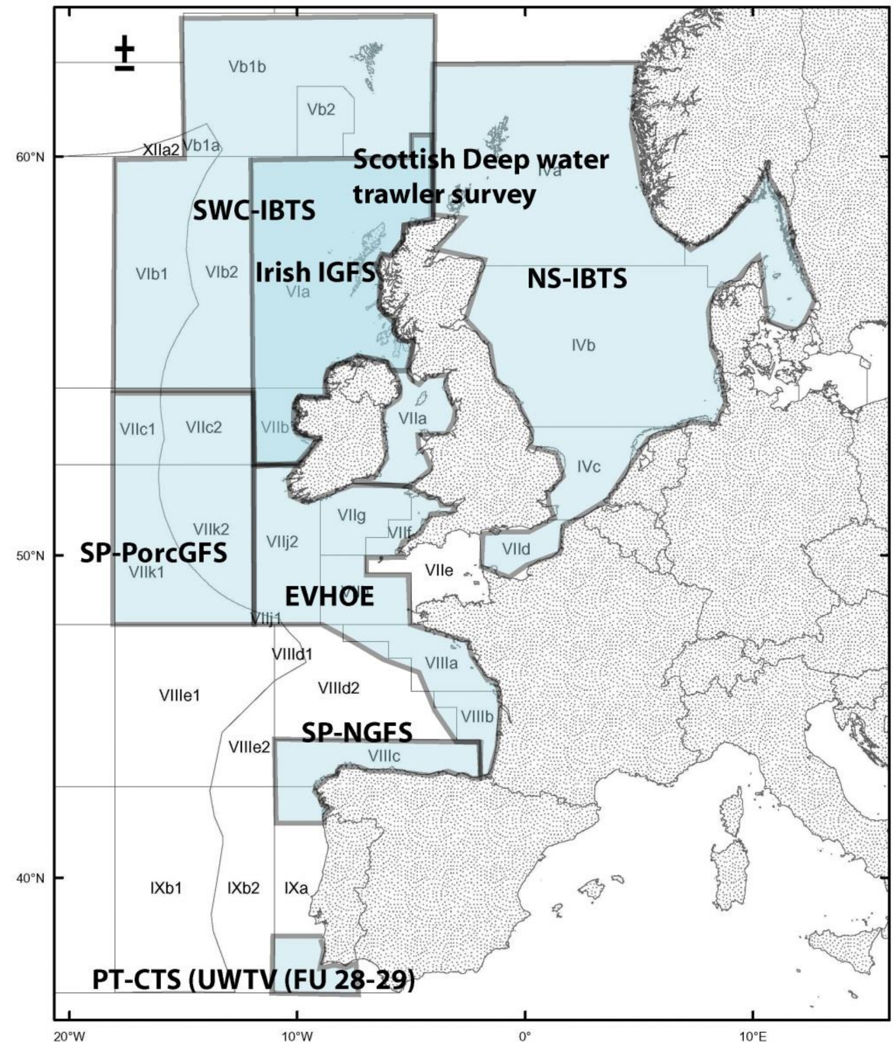

Figure 11.8. Map of the Divisions covered by the eight surveys used in the trend analysis of abundance and biomass of GFB.

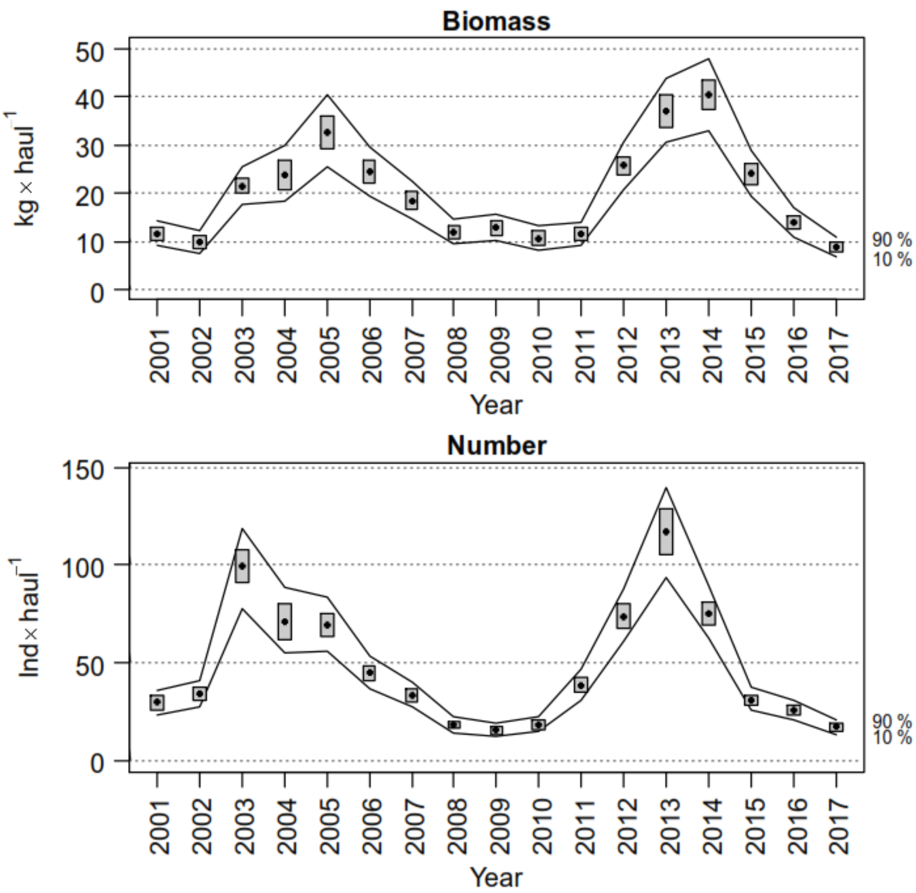

Figure 11.9. Evolution of *Phycis blennoides* biomass and abundance indices during Porcupine Survey time-series (2001–2017) in Divisions 7.c and 7.k. Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (⚜ = 0.80, bootstrap iterations = 1000).

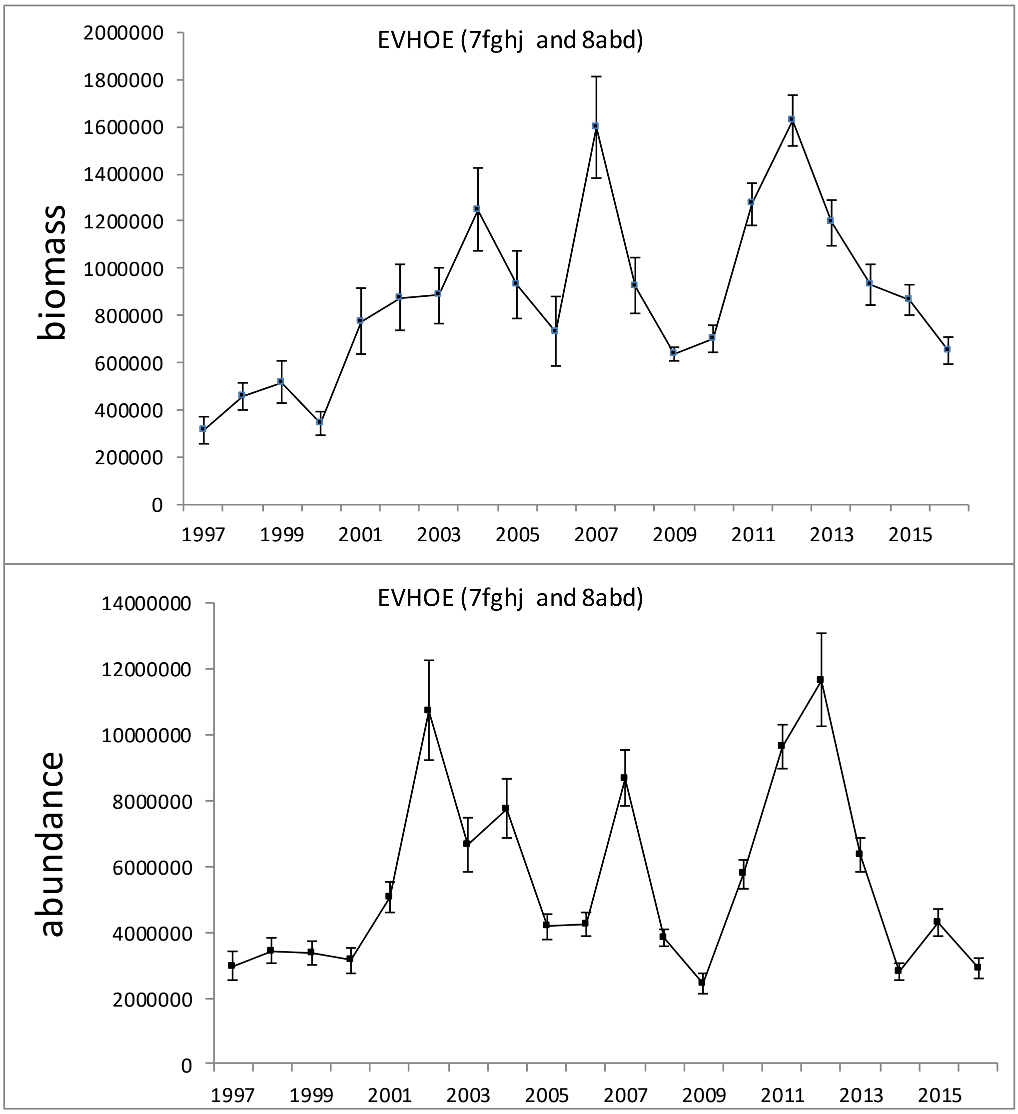

Figure 11.10. Greater forkbeard series of abundance and biomass of the French EVHOE IBTS survey in the Divisions 7.fghj and 8.abd combined until 2016.

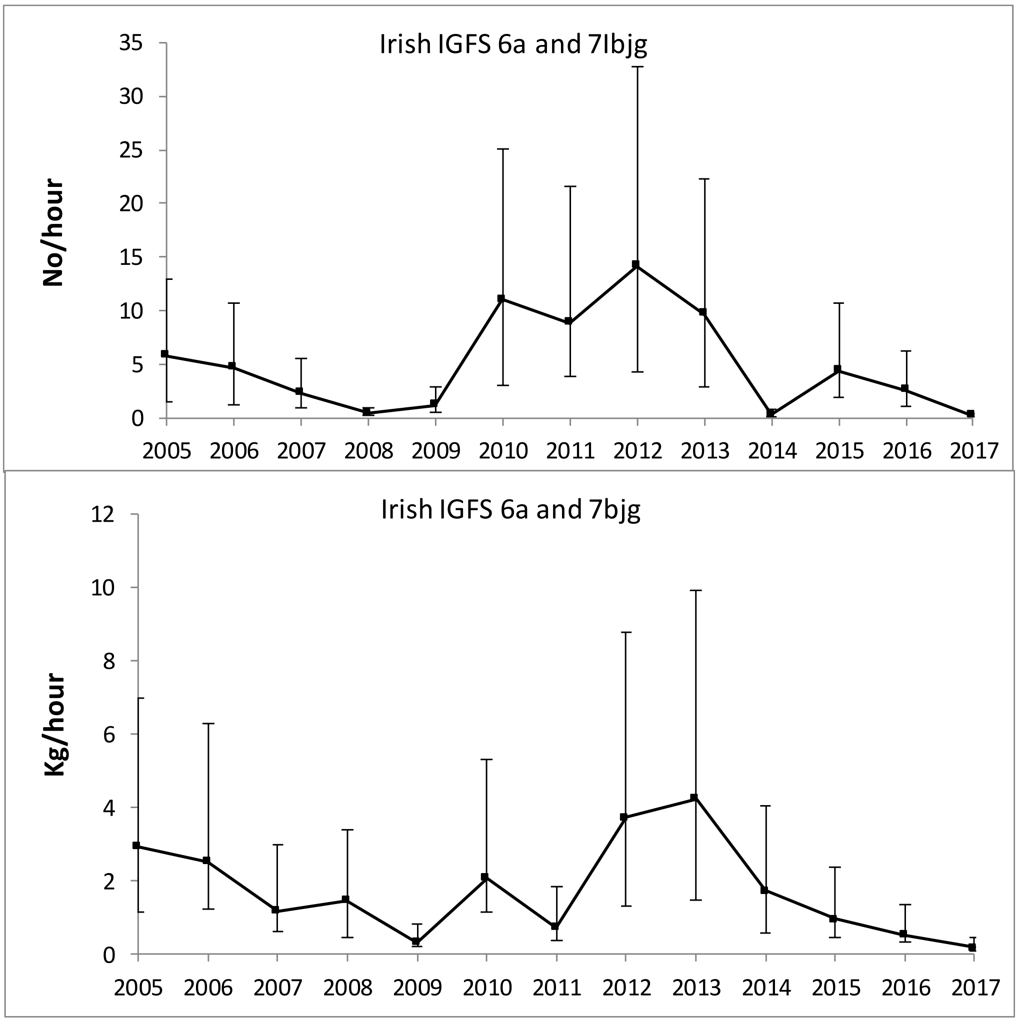

Figure 11.11. Abundance and biomass Indices (nº per hour and kg per hour) of Greater forkbeard total catches of the Irish IGFS Survey in the slope and shelf strata, 2005–2017.

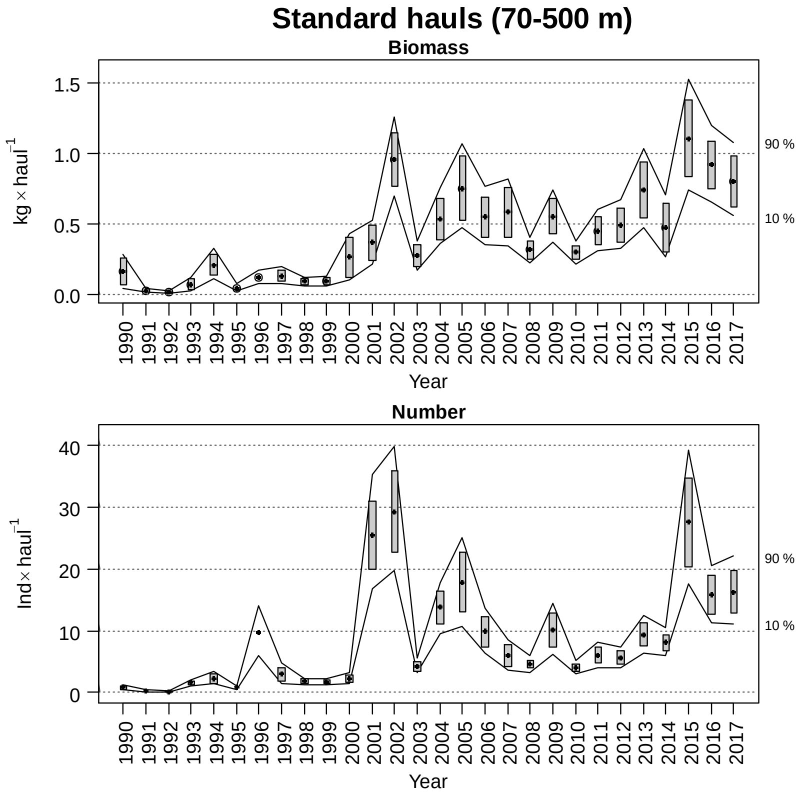

Figure 11.12. Changes in *Phycis blennoides* abundance index (kg/tow and No/tow) during northern Spanish Shelf bottom-trawl survey time-series (1990–2017) in Divisions 9.a and 8.c.

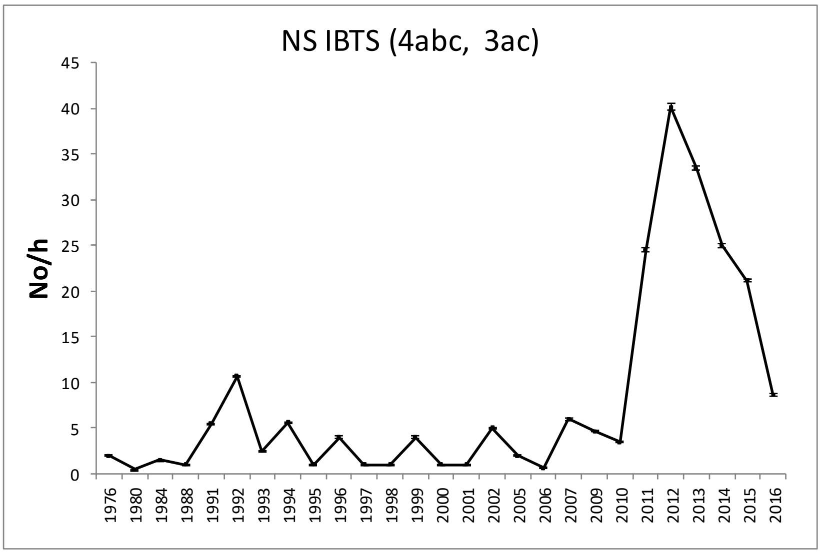

Figure 11.13. Greater forkbeard series of abundance (No/hour of the North Sea IBTS survey (NS-IBTS) until 2016 in Divisions 4.abc and 3.ac.

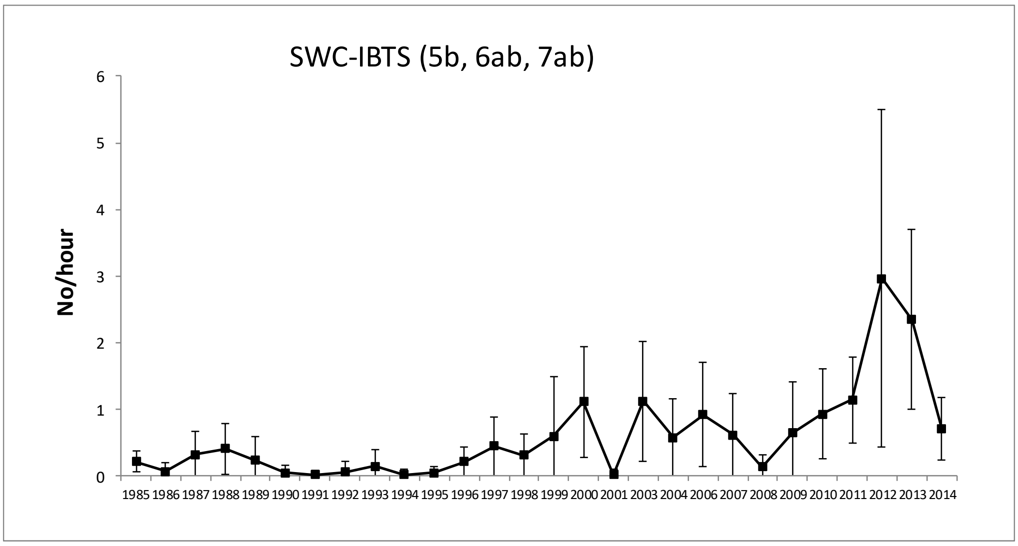

Figure 11.14. Greater forkbeard series of abundance (No/hour) of the Scottish Western Coast Groundfish IBTS survey (SWC-IBTS) until 2014 in Divisions 5.b, 6.ab and 7.ab.

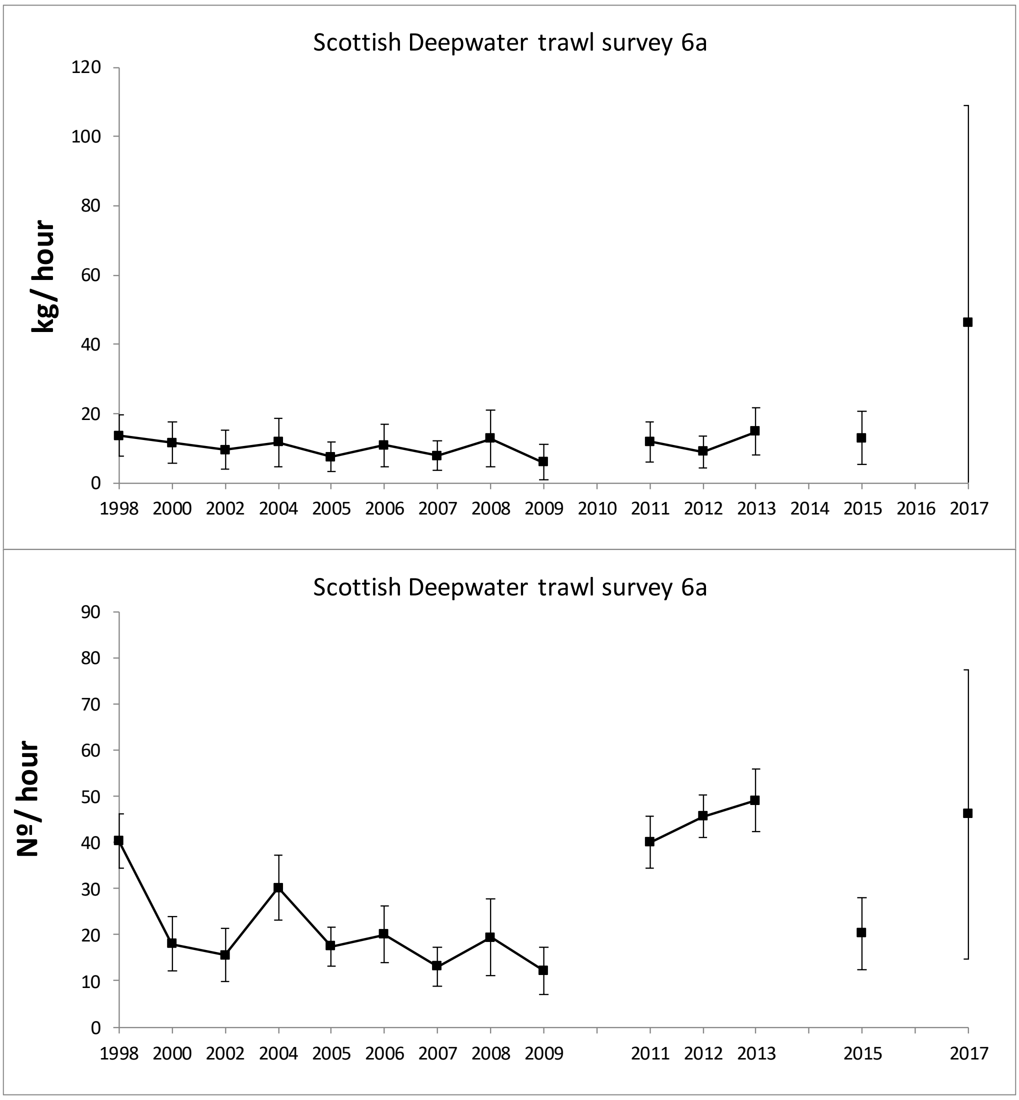

Figure 11.15. Greater forkbeard series of biomass (kg/hour) and abundance (Nº/hour) of the Scottish Deep-water trawl survey until 2017 in Division 6.a.

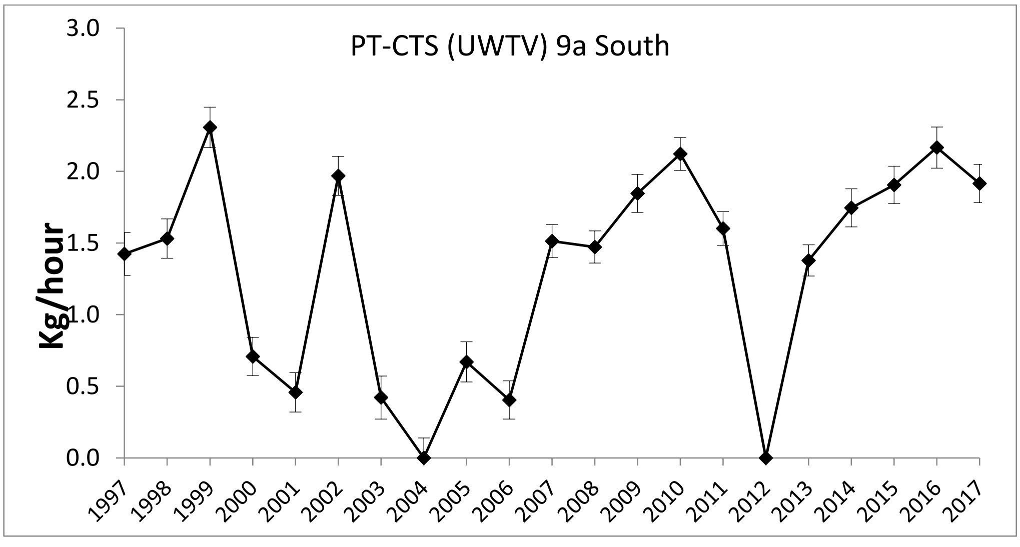

Figure 11.16. Greater forkbeard series of biomass of the Portuguese PT-CTS (UWTV (FU 28–29) survey until 2017 in the Division 9.a South.

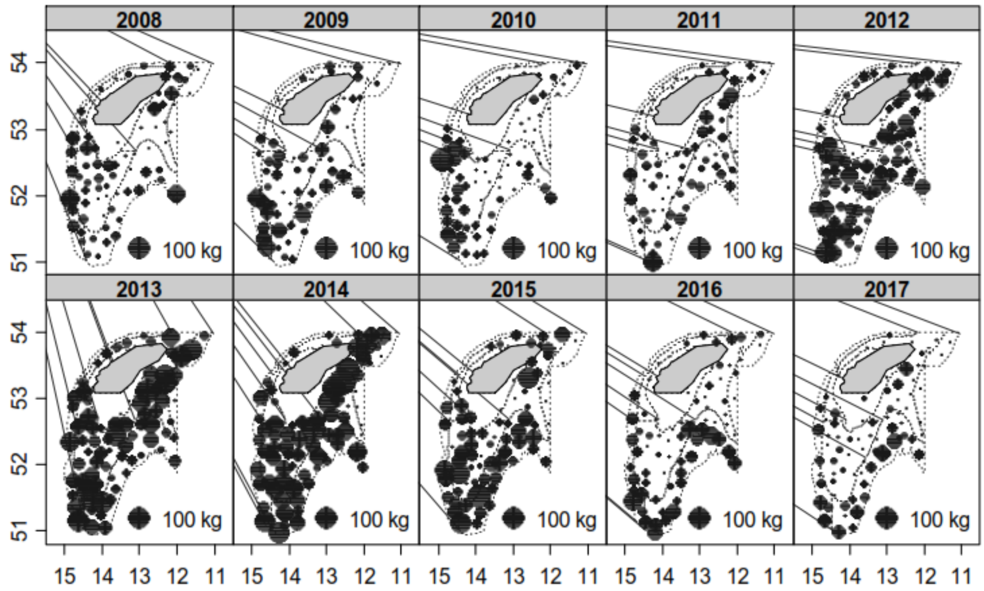

Figure 11.17. Geographic distribution of *Phycis blennoides* catches (kg/30 min haul) in Porcupine surveys between 2007 and 2017.

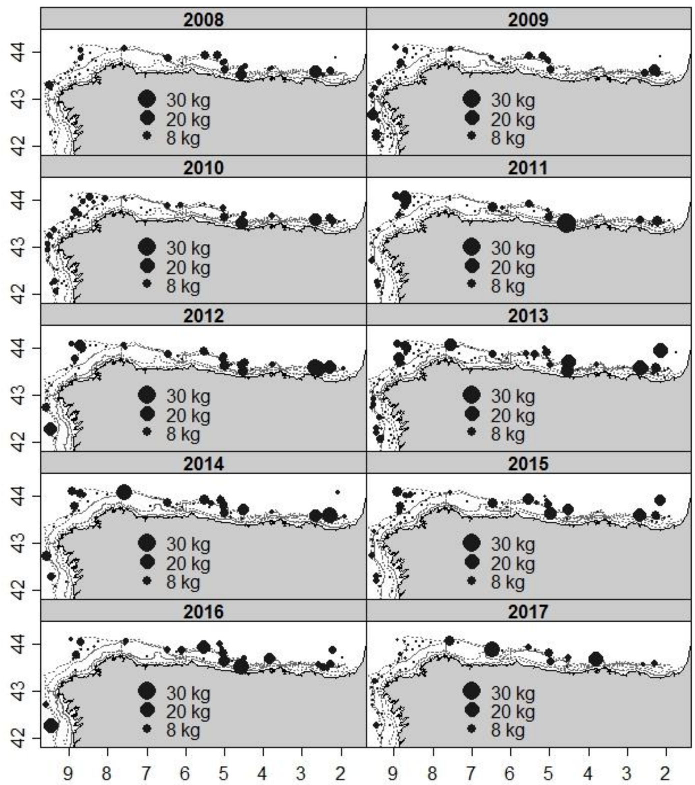

Figure 11.18. Catches in biomass of greater forkbeard on the Northern Spanish Shelf bottom-trawl surveys during the period: 2005–2016.

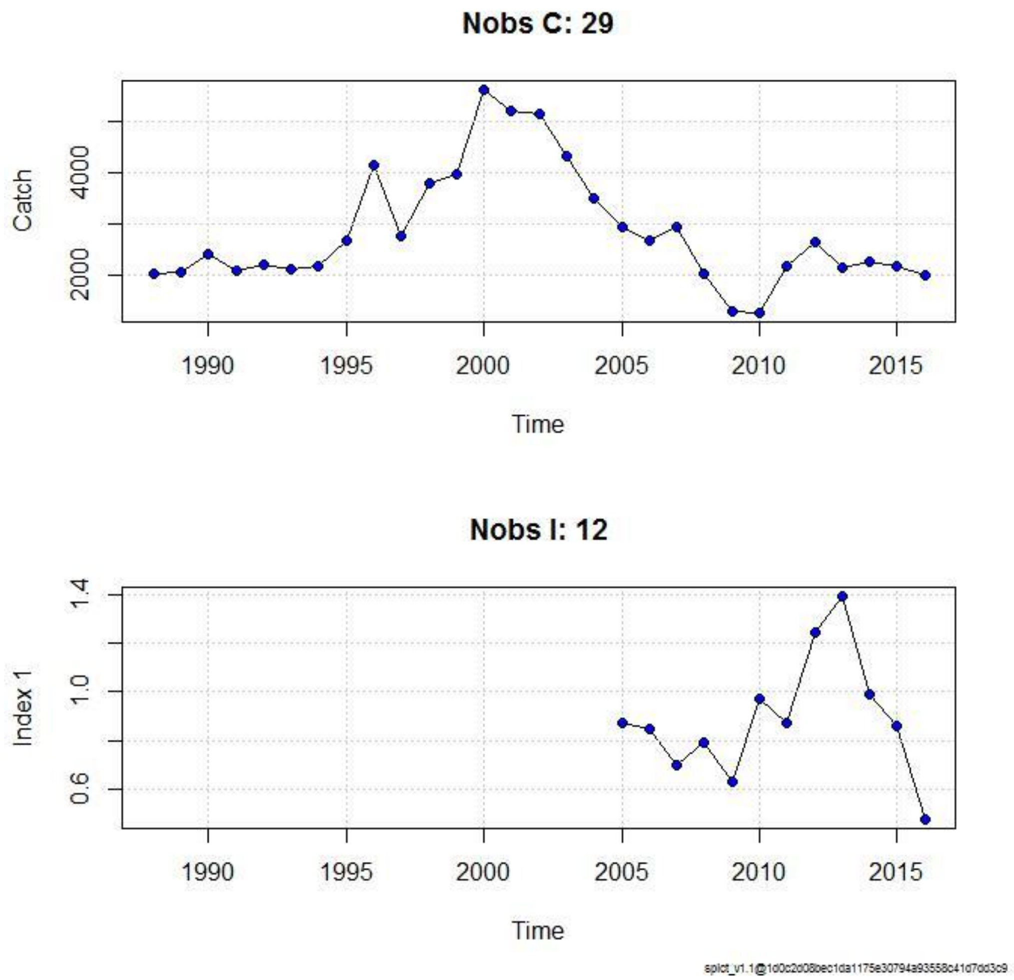

Figure 11.19. Inputs of the SPICT model used in the Greater Forkbeard stock.

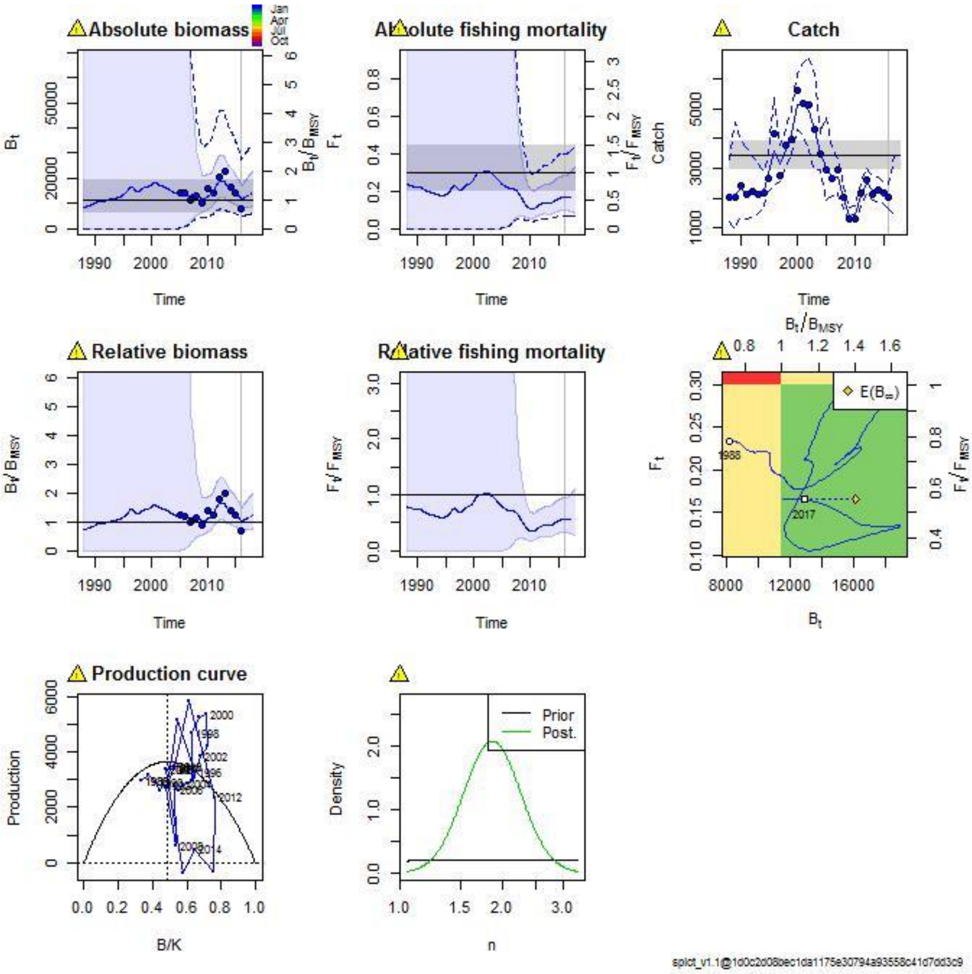

Figure 11.20. Results of the SPICT model for the Greater Forkbeard stock.

11.11 References

Lagarto N., Moura, T., Figueiredo I. 2017. Greater forkbeard *Phycis blennoides* in Portuguese waters (ICES Division 9.a). Working Document for the ICES Working Group on Biology and Assessment of Deep-sea Fisheries Resources Copenhagen, 24 April–1 May 2017. 16 pp.

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12 Alfonsinos/Golden eye perch (*Beryx* spp.) in all ecoregions

12.1 The fishery

Alfonsinos, *Beryx splendens* and *Beryx decadactylus*, are generally considered as bycatch species in the demersal trawl and longline mixed fisheries targeting deep-water species. For most of the fisheries, the catches of alfonsinos are reported under a single category, as *Beryx* spp.

The proportions of each species in the catches are not well known. Detailed landings data by species are available only for the Portuguese (Azores) hook and line fishery in Division 10.a, where the landings of *B. decadactylus* averaged 20% of the catches of both species in the last twenty years, and for the Russian trawl fishery that targeted *B. splendens*.

Portuguese, Spanish and French trawlers and longliners are the main fleets involved in this fishery.

There were landings from a targeted fishery by Russian vessels in the NEAFC area (10.b) between 1993 and 2000 and some minor landings as bycatch in fisheries targeting other species since 2000. There are no target fisheries currently occurring in Mid-Atlantic Ridge (NEAFC) area since 2000 (see Section 4). Currently landings are reported from bycatch fisheries occurring in the NEAFC regulatory area (RA) of ICES Division 10.b from Faroese vessels and in the EEZ of Portugal (Subarea 9), Spain (6, 7, 8 and 9), France (6, 7 and 8), and from a small-scale target fishery based in the Azores operation in Division 10.a (See Table 12.1 c, d and e).

12.2 Landings trends

The available landings data for Alfonsinos, (*Beryx* spp), by ICES subarea/division as officially reported to ICES or to the working group, are presented in Tables 12.1(a–g), 12.2 and 12.3 and Figures 12.1–12.5. Total landings are stabilized since 2005, due to management measures introduced (TAC/quotas and effort regulation), being around 360 t between 2005 and 2017, with high landings during 2012 (605 t). Current catches are 240 t. Faroes reported a landing of 141 t for 2015 and 48 t for 2016 from area 10.b.

12.3 ICES Advice

Based on ICES approach to data-limited stocks, ICES advises that *annual catches should be no more than 280 tonnes. All catches are assumed to be landed.*

12.4 Management

Fishing with trawl gears is forbidden in the Azores region (EC. Reg. 1568/2005). A box of 100 miles limiting the deep-water fishing to vessels registered in the Azores was created in 2003 under the management of fishing effort of the CFP for deep-water species (EC. Reg. 1954/2003). An EU TAC of 296 t for EC vessels is in force since 2014, being reduced to 280 t for the period 2017–2018.

Technical measures have been introduced in the Azores since 1998. During 2009 new measures were introduced, particularly to control the effort of longliners through restrictions on fishing area, minimum length, gear and effort. These measures were updated during 2015-2017. A network of MPAs were implemented on the Azores with closed access to deep-water fisheries (including Sedlo, D. J Castro and Formigas seamounts). The seamount (Condor) was closed to the fishery. There are NEAFC regulations of effort in the fisheries for deep-water species and closed areas to protect vulnerable habitats on the RA. (http://neafc.org/managing_fisheries/measures/current).

Regulation	Species	Year	ICES Area	TAC	Landings
Reg 2270/2004	*Beryx* sp	2005	3, 4, 5, 6, 7, 8, 9, 10, 12	328	422
	Beryx sp	2006	3, 4, 5, 6, 7, 8, 9, 10, 12	328	367
Reg 2015/2006	*Beryx* sp	2007	3, 4, 5, 6, 7, 8, 9, 10, 12	328	396
	Beryx sp	2008	3, 4, 5, 6, 7, 8, 9, 10, 12	328	405
Reg 1359/2008	*Beryx* sp	2009	3, 4, 5, 6, 7, 8, 9, 10, 12	328	382
	Beryx sp	2010	3, 4, 5, 6, 7, 8, 9, 10, 12	328	296
Reg 1225/2010	*Beryx* sp	2011	3, 4, 5, 6, 7, 8, 9, 10, 12	328	331
	Beryx sp	2012	3, 4, 5, 6, 7, 8, 9, 10, 12	328	596
Reg 1262/2012	*Beryx* sp	2013	3, 4, 5, 6, 7, 8, 9, 10, 12	312	272
	Beryx sp	2014	3, 4, 5, 6, 7, 8, 9, 10, 12	296	282
Reg. 1367/2014	*Beryx* sp	2015	3, 4, 5, 6, 7, 8, 9, 10, 12	296	224
	Beryx sp	2016	3, 4, 5, 6, 7, 8, 9, 10, 12	296	252
Reg. 2285/2016	*Beryx* sp	2017	3, 4, 5, 6, 7, 8, 9, 10, 12	280	240
	Beryx sp	2018	3, 4, 5, 6, 7, 8, 9, 10, 12	280	

12.5 Stock identity

No new information.

12.6 Data available

12.6.1 Landings and discards

Tables 12.1a–g, describe the alfonsinos landings by subarea and country. Discards results for the Azorean longliners were reported during 2014 (WD, Pinho, 2014) and were not updated. Annual longline discard estimates by year for the sampled trip vessels with alfonsinos catches during the period 2004–2011 range from 0.8% to 8.6% for *B splendens* and 0.07% to 10.2% for the *B. decadactylus* (Table 12.2). These discards are mostly a result of the management measures such as TAC and minimum length.

12.6.2 Length compositions

Fishery length compositions from the Azores are summarized for both species in Figures 12.6 and 12.7 for the period 1991–2016. This information was not updated for the 2017 because data was not available (WD Pinho, 2018).

Azorean survey length compositions were updated (WD Pinho and Silva, 2018) and are resumed for both species in Figures 12.8 and 12.9.

Annual mean length from the Azorean fishery and survey for both species are presented in Figures 12.10 to 12.13. Fishery information was not updated.

12.6.3 Age compositions

No new information about age compositions of *Beryx* species was available during the WGDEEP meeting. This information was already reported to the working group but there are not relevant changes on the growth of the species.

12.6.4 Weight-at-age

No new information.

12.6.5 Maturity, sex-ratio, length-weight and natural mortality

No new information was available to the working group. The DCF information was summarized in the 2010 report and there are no relevant changes on the biology of the species.

12.6.6 Catch, effort and research vessel data

Standardized fishery cpue was updated, by species and for combined species, for the period 1990-2016 (WD Santos et al, 2018a, b, c) (Figure 12.14 and Table 12.3). A Generalized Linear Modeling approach using a hurdle (delta) model was applied. The standardization protocols assumed a hurdle model (zero-altered lognormal) with a binomial error distribution and logit link function for modeling the probability that a null or positive observation occurs (proportion of positive catches), and a lognormal error distribution with an identity link function for modeling the positive catch rates on successful trips. For *beryx splendens* the index trends showed an oscillation over time, with a general decreasing behavior from the year 2009. For *Beryx decadactylus* the index trends showed a peak in 1991, followed by a decreasing trend until 1997, and a more stable trend afterwards. For the species combined the index trends showed an oscillation over time, with an increase up to 1996, followed by a decreasing trend overall with some recovery between 2003 and 2012, and a rapid decrease afterwards.

Abundance indices from the Azorean longline survey were updated (WD Pinho *et al*., 2017) and are presented for the alfonsino (*Beryx splendens*) (Figure 12.15) and golden eye perch (*Beryx decadactylus*) (Figure 12.16).

12.7 Data analyses

Total landings declined in the late 1990s and have since stabilized at about 370 tonnes (for the two species combined), with a peak of 605 t in 2012 due to the landings reported by Spain for Areas 6–7. Species-specific landings trends in the Azores fishery showed similar trends for both species (Figure 12.4 and 12.5).

A reduction on the small fish (<20 cm) is observed on the landings for *B splendens* since 2005 due to the minimum length regulations. Length compositions present in general a mode around 30 cm with the exception of the period 2004–2007 (Figure 12.6). Considering a length of first maturity around 35 cm fork length (FL), it appears that the Azorean fishery have caught mainly immature fish. However, this may be a selective effect of the hook and line fisheries or an uncertainty on the maturity estimates.

Fishery length compositions for *B decadatylus* show a bimodal or trimodal distribution. A well-defined mode is observed annually around 24 cm. The other two modes vary annually being centred on 32 cm and 42 cm during the last five years (Figure 12.7).

Survey length compositions for *B splendens* and *B decadactylus* show that relatively small numbers of *B decadactylus* are caught on the survey on the sampled depth strata (50–600 m) (Figures 12.8 and 12.9). For *B splendens* a mode around 25–30 cm is observed and *B decadactylus* show a bimodal or trimodal distribution.

Fishery mean length of *B. splendens* presents a slight decrease a long time (Figure 12.10) and for *B. decadactylus* is stable around 35 cm (Figure 12.11).

Survey mean length for *B splendens*, shows an increase from 1995 (27 cm) to 1997 (32 cm) and maintained since 1999 around 27 cm fork length (Figure 12.12). For *B decadactylus* a decrease is observed from 1995 (37 cm) to 1997 (34 cm), with a peak in 1996 (39 cm) and maintained since 1999 around 35 cm (Figure 12.13).

Survey abundance index for *B splendens*, declined significantly between 1995 and 1997 and has since remained at very low levels until 2007. An increasing trend on the abundance has been observed during the last four years followed by a decrease in 2016 and 2017 (Figure 12.15). For *B. decadactylus* a decrease is observed from 1995 to 1996, maintained thereafter until 2003 at low levels. It increased then from 2003 to 2007 and maintained thereafter at high levels until 2011 decreasing thereafter (Figure 12.15).

The working group express concerns on the reliability of these indices as an indicator of abundance index due to the relatively small numbers of individuals caught each year particularly for *B. decadactylus*. The survey may not be designed for these highly mobile and aggregative species particularly for *B. decadactylus*. Therefore the working group thinks the approach taken in 2012, i.e. to base advice on catch history to be appropriate.

12.7.1 Exploratory analysis

12.7.1.1 Length-based indicators

Length-based indicators were re-explored using refined code developed at WKSHARK4 that helped improve the reliability of calculations of L_C and improved usability. For this exercise, length compositions of *Beryx splendens* for both sexes were combined from 1995 – to 2016 from the Azores (ICES Subarea 10.a and assumes negligible discard from the fisheries.

The life history parameters used to inform the LBI assessment are given in Table 12.2. Two values for L_{mat} were run separately due to large differences from the literature.

PARAMETERS	VALUE	REFERENCE
L_∞	46.1	Anibal et al., 1998
L_{mat}	24.7	Isidro (1996)
	35.5	Pereira and Pinho, 2012
M	0.2	Silva, 2016
k	0.12	Anibal and Krug, 1998
a	0.0178	Pereira and Pinho, 2012
b	3.0755	Pereira and Pinho, 2012

Results using the most recent LBI assessments methods produced results (Figure 12.4 and 12.5 and Table 12.17 and 12.18) similar to those observed in previous assessments (ICES 2017). Varying the value of L_{mat}, only influenced the LBIs that were associated with conservation of juvenile fishes. For L_{mat} = 24.5 cm, the indicator L_C/L_{mat} was below the threshold value of one between 1995 and 2001, and then again for 2005 and 2006, but was otherwise above one, indicating a good status. Despite 1998, L_{25}/L_{mat} gave a good status throughout. Combined, it could be inferred that most fishing was occurring on fish above maturity. For the larger estimation of L_{mat} (35.5 cm), both indicators for the conservation of juveniles (L_C/L_{mat} and L_{25}/L_{mat}) gave a poor status (<1) across the fishing period.

For the remaining LBIs, most displayed gradual declines in status with time. L_{max5}/L_∞ and $L_{mean}/L_{F=M}$ provided good, albeit decreasing, statuses from 1995 until 2011, and then indicated a poor status until 2016. A similar decreasing trend was observed in P_{mega}, although the switch from good status to poor status occurred earlier in 2005.

12.8 Comments on the assessment

Overall it is observed from the length base indicators a generally decreasing status, but difficult to distinguish due to the imposition of fishery regulations that could result in the under reporting of less abundant but present larger or smaller individuals.

12.9 Management considerations

As a consequence of their spatial distribution associated with seamounts, their life history and their aggregating behaviour, alfonsinos are considered to be easily overexploited by trawl fishing; they can only sustain low rates of exploitation. Population dynamics are uncertain with recent estimates suggesting high longevity (>50 years), while other estimates suggest a longevity of ~15 years. Fisheries on such species should not be allowed to expand above current levels unless it can be demonstrated that such expansion is sustainable. To prevent wiping out entire subpopulations that have not yet been mapped and assessed the exploitation of new seamounts should not be allowed.

12.10 References

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12.11 Tables and Figures

Table 12.1a. 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
2015	0	0
2016	0	0
2017	0	0

***Preliminary.**

Table 12.1b. Alfonsinos (*Beryx* spp.) from Division 5.b.

YEAR	FAROES	FRANCE	TOTAL
988			0
1989			0
1990		5	5
1991		0	0
1992		4	4
1993		0	0
1994		0	0
1995	1	0	1
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0

***Preliminary.**

Table 12.1c. Alfonsinos (*Beryx* spp.) from Subareas 6 and 7.

YEAR	FRANCE	E & W	SPAIN	IRELAND	SCOTLAND	TOTAL
1988						0
1989	12					12
1990	8					8
1991						0
1992	3					3
1993	0		1			1
1994	0		5			5
1995	0		3			3
1996	0		178			178
1997	17	4	5			26
1998	10	0	71			81
1999	55	0	20			75
2000	31	2	100			133
2001	51	13	116			180
2002	35	15	45			95
2003	20	5	55	4		84
2004	15	3	46			64
2005	15	0	55	0		70
2006	27	0	51	0		78
2007	17	1	47	0		65
2008	22	0	32	0		54
2009	9	0	0	0	1	10
2010	4	0	0	0	1	5
2011	7	0	33	0	0	40
2012	4	0	337	0	0	341
2013	14	1	33	0	0	77
2014	10	0	38	0	0	49
2015	6	0		6	0	12
2016	5	0.45	13	0	1	20
2017	7	0	11	0	0	18

***Preliminary.**

Table 12.1d. Alfonsinos (*Beryx* spp.) from Subareas 8 and 9.

YEAR	FRANCE	PORTUGAL	SPAIN	E & W	TOTAL
1988					0
1989					0
1990	1				1
1991					0
1992	1				1
1993	0				0
1994	0		2		2
1995	0	75	7		82
1996	0	43	45		88
1997	69	35	31		135
1998	1	9	258		268
1999	11	29	161		201
2000	7	40	117	4	168
2001	6	43	179	0	228
2002	13	60	151	14	238
2003	10	0	95	0	105
2004	21	53	209	0	283
2005	9	45	141	0	195
2006	8	20	64	3	97
2007	8	45	67	0	120
2008	5	42	54	0	101
2009	1	42	18	0	61
2010	12	27	1	0	41
2011	4	21	40	0	65
2012	4	11	27	0	42
2013	5	17	4	0	26
2014	3	18	81	0	102
2015	3	0	59		61
2016	3	1	71	0	76
2017	3	2	67	0	73

*** Preliminary.**

Table 12.1e. Alfonsinos (*Beryx* spp.) from Subarea 10.

	10.a	10.b				
YEAR	PORTUGAL	FAROES	NORWAY	RUSSIA**	E & W	TOTAL
1988	225					225
1989	260					260
1990	338					338
1991	371					371
1992	450					450
1993	533		195			728
1994	644		0	837		1481
1995	529	0	0	200		729
1996	550	0	0	960		1510
1997	379	5	0			384
1998	229	0	0			229
1999	175	0	0	550		725
2000	203	0	0	266	15	484
2001	199	0	0	0	0	199
2002	243	0	0	0	0	243
2003	172	0	0	0	0	172
2004	139	0	0	0	0	139
2005	157	0	0	0	0	157
2006	192	0	0	0	0	192
2007	211	0	0	0	0	211
2008	250	2	0	0	0	252
2009	311	1	0	0	0	312
2010	240	0	0	5	0	245
2011	226	4	0	5	0	235
2012	213	10	0	0	0	222
2013	168	0	0	0	0	168
2014	131	0	0	0	0	131
2015	151	141	0	0	0	292
2016	156	48	0	0	0	204
2017	149	0	0	0	0	149

*** Preliminary.**

**** Not official data from ICES Area 10.b.**

Table 12.1f. Alfonsinos (*Beryx* spp.) from Subarea 12.

YEAR	FAROES	TOTAL
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995	2	2
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	2	2
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0
2017	0	0

*** Preliminary.**

Table 12.1g. Landings of Alfonsinos (*Beryx* spp.) from Madeira (Portugal) outside the ICES area.

YEAR	PORTUGAL	TOTAL
1988		0
1989		0
1990		0
1991		0
1992		0
1993		0
1994		0
1995	1	1
1996	11	11
1997	4	4
1998	3	3
1999	2	2
2000*		
2001*		
2002*		
2003*		
2004*		
2005*		
2006*		
2007*		
2008*		
2009*		
2010*		
2011*		
2012*		
2013*		
2014*		
2015*		
2016		
2017		

*** No information.**

Table 12.2. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subarea/division.

YEAR	4	5.b	6+7	8+9	10.a	10.b	12	TOTAL
1988			0	0	225	0		225
1989			12	0	260	0		272
1990	1	5	8	1	338	0		353
1991			0	0	371	0		371
1992	2	4	3	1	450	0		460
1993			1	0	533	195		729
1994			5	2	644	837		1488
1995		1	3	82	529	200	2	817
1996			178	88	550	960	0	1776
1997			26	135	379	5	0	545
1998			81	268	229	0	0	579
1999			75	201	175	550	0	1001
2000			133	168	203	281	0	785
2001			180	228	199	0	0	607
2002			95	238	243	0	0	577
2003			84	105	172	0	0	361
2004			64	283	139	0	0	485
2005			70	195	157	0	0	422
2006			78	97	192	0	0	367
2007			65	120	211	0	0	396
2008	0	0	54	101	250	2	0	407
2009	0	0	10	61	311	1	0	383
2010	0	0	5	41	240	5	0	291
2011	0	0	40	65	226	9	2	342
2012	0	0	341	42	213	10	0	605
2013	0	0	77	26	168	0	0	272
2014	0	0	49	102	131	0	0	282
2015	0	0	12	61	151	141	0	365
2016	0	0	20	76	156	48	0	300
2017	0	0	18	73	149	0	0	240

***Preliminary.**

Table 12.3. Reported landings of *Beryx splendens* and *B. decadactylus* in the Azores (ICES Division 10.a).

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
	119	30	149

***Preliminary.**

Table 12.2. Annual percentage of *Beryx* spp. discarded by year in the Azores (ICES Division 10.a) 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 12.3. Nominal and standardized CPUE series (kg 10^{-3} hooks scaled to the mean) for alfonsino *Beryx splendens*, Beryx decadactylus and species combined from the Azorean bottom longline fishery. LCI and UCI indicate estimated 95% confidence bounds.

	Beryx comb				*B. splendens*				*B. decadactylus*			
Year	Nominal	Standardized	LCI	UCI	Nominal	Standardized	LCI	UCI	Nominal	Standardized	LCI	UCI
1990	0.86	1.01	0.77	1.25	0.01	0.02	0	0.04	0.18	1.02	0.75	1.29
1991	1.24	1.36	1.03	1.7	1.05	1.29	0.63	1.96	1.49	2.88	1.41	4.35
1992	0.19	1.07	0.76	1.38	0.04	0.18	-0.02	0.37	0.07	2.08	1.47	2.7
1993	1.26	1.38	1.02	1.75	1.11	2.22	1.25	3.2	2.06	1.87	0.85	2.89
1994	1.51	1.3	0.93	1.67	1.28	1.24	0.52	1.95	2.68	1.37	0.67	2.06
1995	0.78	1.32	1	1.65	0.7	0.79	0.3	1.27	1.24	1.68	0.92	2.43
1996	2.59	1.61	1.13	2.1	2.74	2.51	1.3	3.72	2.58	1.65	0.73	2.57
1997	0.48	1.04	0.75	1.32	0.49	0.97	0.45	1.48	0.56	0.8	0.44	1.17
1998	0.74	0.94	0.71	1.17	0.79	0.9	0.49	1.32	0.67	0.83	0.41	1.25
1999	0.98	0.91	0.7	1.13	1.19	1.31	0.82	1.81	0.4	0.51	0.22	0.79
2000	0.96	0.82	0.63	1.01	1.1	1.47	0.93	2	0.63	0.71	0.29	1.14
2001	1.4	0.78	0.58	0.99	1.72	1.34	0.75	1.92	0.52	0.5	0.19	0.81
2002	1.46	0.87	0.63	1.12	1.74	1.12	0.61	1.63	0.7	0.69	0.23	1.15
2003	0.7	0.5	0.38	0.62	0.8	0.46	0.25	0.67	0.46	0.46	0.18	0.74
2004	0.84	0.62	0.46	0.78	0.98	0.85	0.49	1.21	0.49	0.57	0.23	0.92
2005	0.91	0.81	0.63	1	1.1	0.87	0.5	1.25	0.41	0.44	0.2	0.69
2006	1.12	0.86	0.65	1.07	1.18	1.03	0.6	1.46	1.13	0.7	0.27	1.12
2007	1.1	0.78	0.57	0.99	1.2	1.2	0.7	1.7	0.96	0.58	0.19	0.97
2008	1.07	1.08	0.81	1.35	1.12	1.05	0.6	1.5	1.11	0.84	0.33	1.35
2009	1.31	1.21	0.91	1.5	1.34	1.4	0.82	1.99	1.45	0.86	0.34	1.38
2010	1.06	1.13	0.89	1.37	1.03	0.95	0.54	1.36	1.4	1.05	0.54	1.56
2011	0.89	1.3	1.04	1.56	0.91	1.03	0.59	1.46	1	1.03	0.57	1.49
2012	1.29	1.35	1.08	1.62	1.33	1.02	0.56	1.48	1.4	0.86	0.48	1.24
2013	0.74	1.07	0.86	1.28	0.75	0.67	0.36	0.99	0.87	0.74	0.43	1.05
2014	0.43	0.56	0.46	0.67	0.38	0.35	0.17	0.54	0.68	0.72	0.42	1.02
2015	0.64	0.62	0.5	0.73	0.61	0.45	0.22	0.68	0.88	0.84	0.45	1.23
2016	0.44	0.69	0.55	0.83	0.32	0.3	0.15	0.45	0.98	0.72	0.34	1.1

Table 12.4. Length base indicators results for splendid alfonsino (*Beryx splendens*) (ICES 27.10a) and assuming L_{mat} 24.7 cm.

	Lc_Lmat	L25_Lmat	Lmax5_Linf	Pmega	Lmean_Lopt	Lmean_LFeM
	>1	>1	>0.8	>0.3	≈1	≥1
Year	Conservation (Immatures)		Conservation (Large)		Optimal Yield	MSY
1995	0.91	1.07	0.92	0.42	1.08	1.14
1996	0.99	1.11	0.89	0.45	1.1	1.1
1997	0.99	1.11	0.91	0.42	1.09	1.09
1998	0.83	0.99	0.92	0.35	1.02	1.14
1999	0.95	1.03	0.86	0.37	1.07	1.1
2000	0.91	1.07	0.89	0.4	1.07	1.14
2001	0.91	1.03	0.88	0.37	1.06	1.12
2002	1.11	1.11	0.87	0.32	1.09	1.02
2003	1.11	1.19	0.88	0.43	1.12	1.04
2004	1.07	1.11	0.85	0.37	1.09	1.04
2005	0.95	1.03	0.83	0.15	0.98	1.01
2006	0.95	1.03	0.87	0.2	0.99	1.02
2007	1.03	1.07	0.85	0.17	1.02	1
2008	1.11	1.11	0.84	0.24	1.07	1
2009	1.03	1.11	0.83	0.25	1.05	1.02
2010	1.03	1.15	0.82	0.35	1.06	1.04
2011	1.07	1.11	0.79	0.18	1.03	0.98
2012	1.07	1.11	0.78	0.19	1.04	0.99
2013	1.07	1.11	0.77	0.12	1.01	0.97
2014	1.11	1.11	0.8	0.18	1.05	0.98
2015	1.03	1.11	0.84	0.27	1.05	1.03
2016	1.07	1.11	0.81	0.18	1.03	0.98

Table 12.5. . Length base indicators results for splendid alfonsino (Beryx splendens) from Azores (ICES 27.10a) and assuming L_{mat} 35.5 cm.

	Lc_Lmat	L25_Lmat	Lmax5_Linf	Pmega	Lmean_Lopt	Lmean_LFeM
	>1	>1	>0.8	>0.3	≈1	≥1
Year	Conservation (Immatures)		Conservation (Large)		Optimal Yield	MSY
1995	0.63	0.75	0.92	0.42	1.08	1.14
1996	0.69	0.77	0.89	0.45	1.1	1.1
1997	0.69	0.77	0.91	0.42	1.09	1.09
1998	0.58	0.69	0.92	0.35	1.02	1.14
1999	0.66	0.72	0.86	0.37	1.07	1.1
2000	0.63	0.75	0.89	0.4	1.07	1.14
2001	0.63	0.72	0.88	0.37	1.06	1.12
2002	0.77	0.77	0.87	0.32	1.09	1.02
2003	0.77	0.83	0.88	0.43	1.12	1.04
2004	0.75	0.77	0.85	0.37	1.09	1.04
2005	0.66	0.72	0.83	0.15	0.98	1.01
2006	0.66	0.72	0.87	0.2	0.99	1.02
2007	0.72	0.75	0.85	0.17	1.02	1
2008	0.77	0.77	0.84	0.24	1.07	1
2009	0.72	0.77	0.83	0.25	1.05	1.02
2010	0.72	0.8	0.82	0.35	1.06	1.04
2011	0.75	0.77	0.79	0.18	1.03	0.98
2012	0.75	0.77	0.78	0.19	1.04	0.99
2013	0.75	0.77	0.77	0.12	1.01	0.97
2014	0.77	0.77	0.8	0.18	1.05	0.98
2015	0.72	0.77	0.84	0.27	1.05	1.03
2016	0.75	0.77	0.81	0.18	1.03	0.98

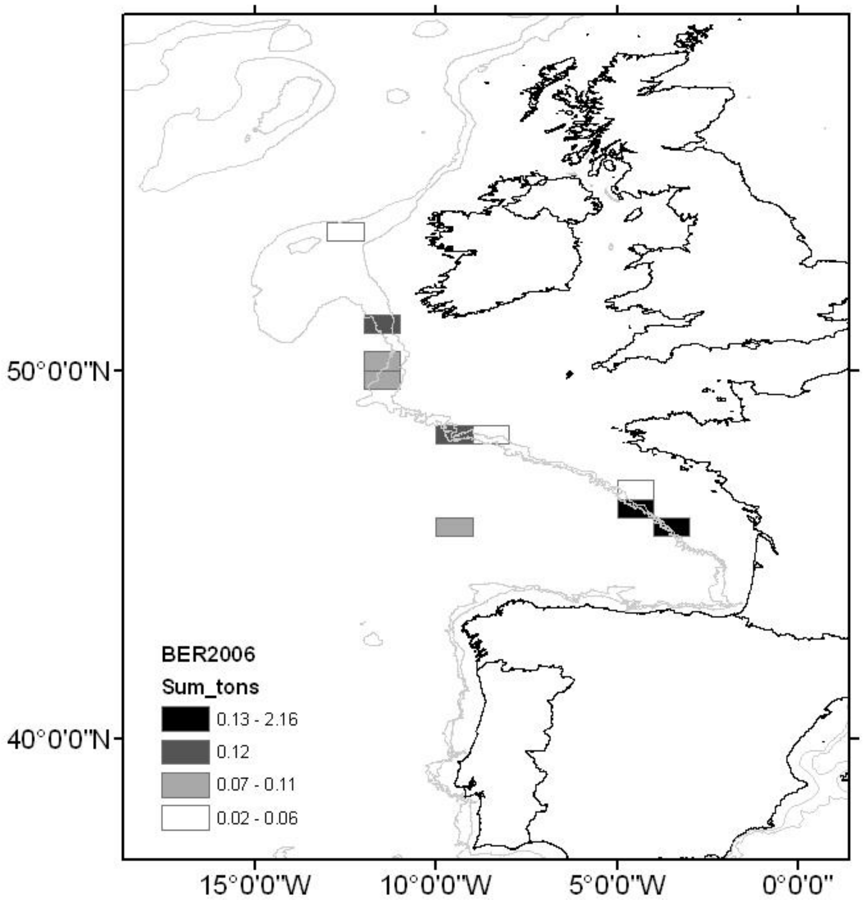


Figure 12.1. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2006.

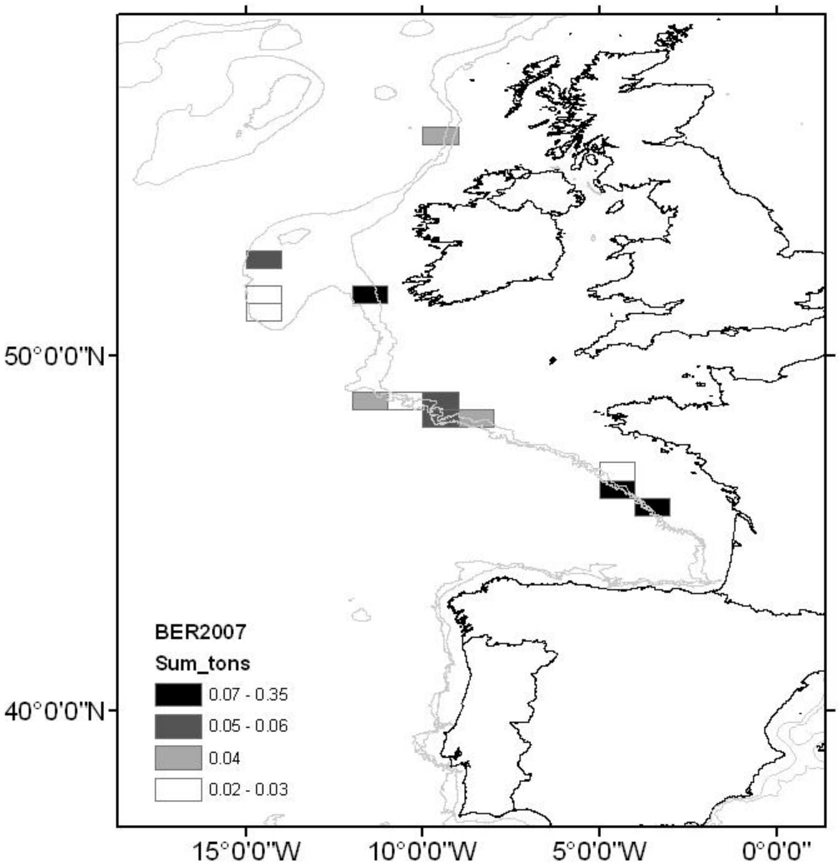


Figure 12.2. Catches of alfonsinos by French, Irish, UK (England and Wales and Scotland) and Icelandic vessels, 2007.

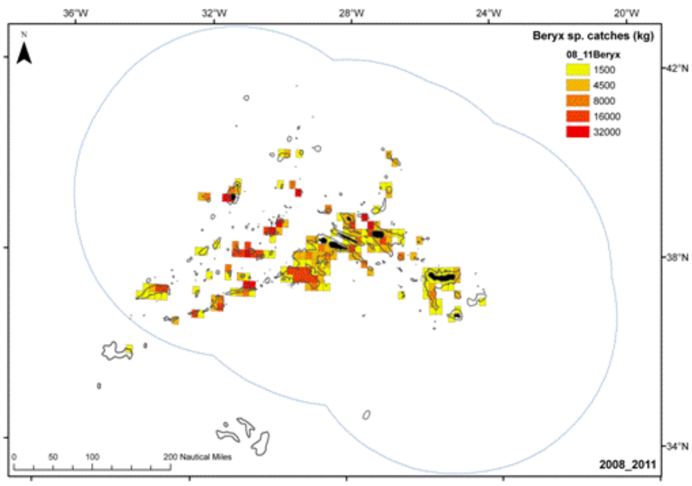


Figure 12.3. Catches of alfonsinos by Azores vessels, 2008–2011 (ICES, 10.a.2).

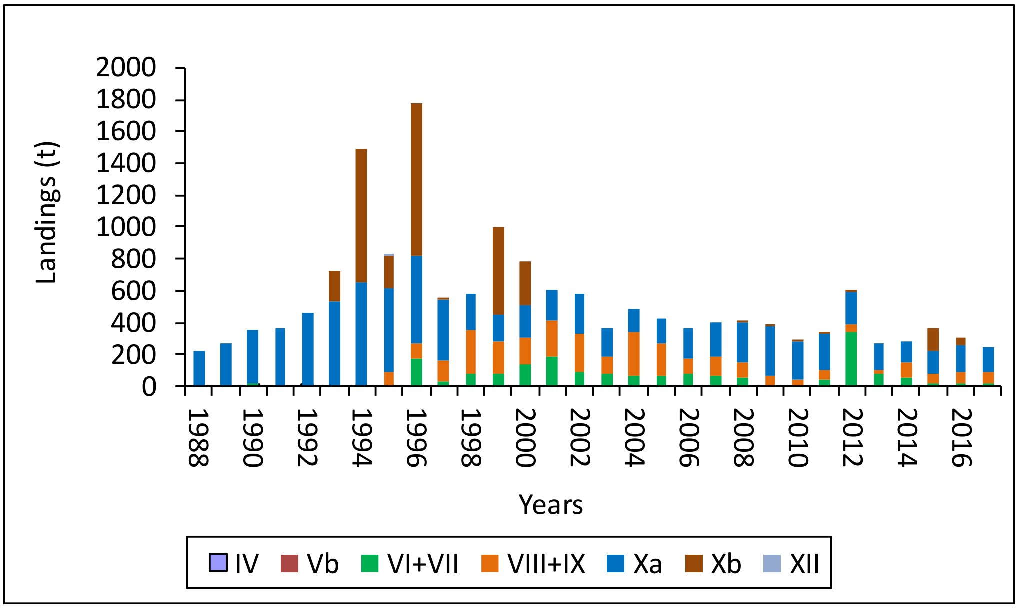


Figure 12.4. Reported landings for the alfonsinos, (*Beryx* spp), by ICES subarea/division.

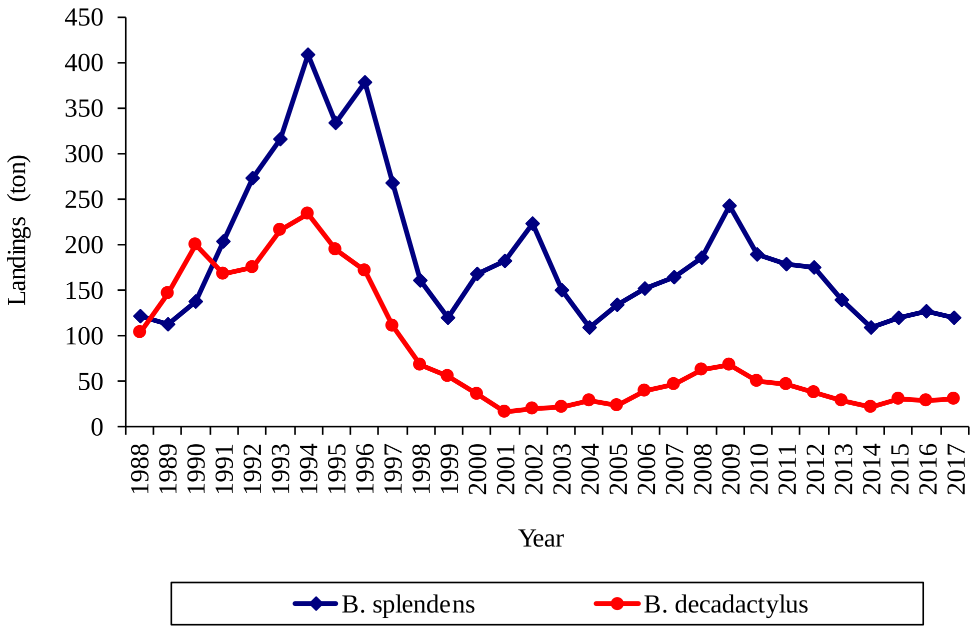


Figure 12.5. Landings of *Beryx splendens* and *B. decadactylus* in Azores (ICES Subarea 10).

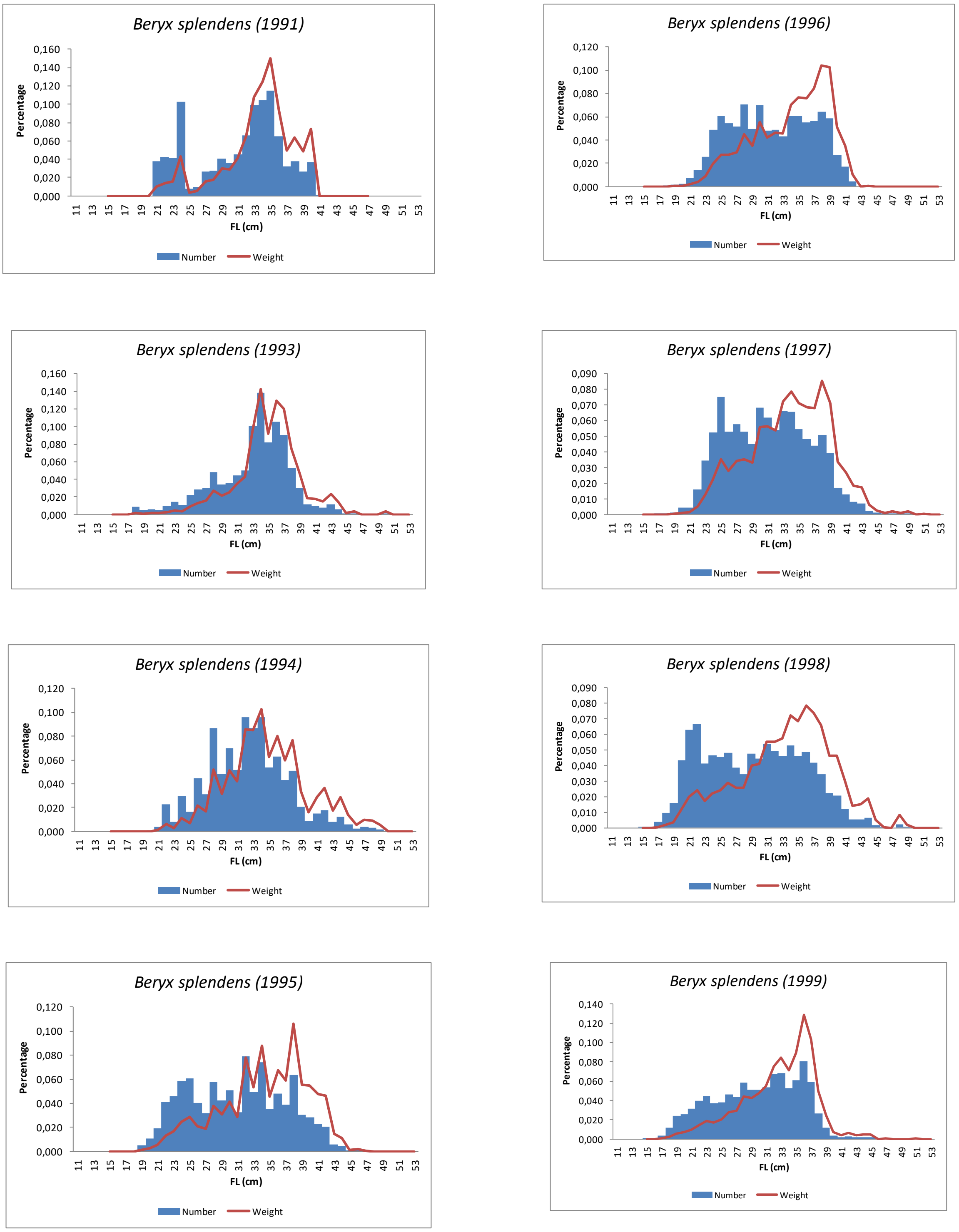


Figure 12.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea 10). Bars represent the proportion in number of every size class and the red line represents the proportion in weight.**

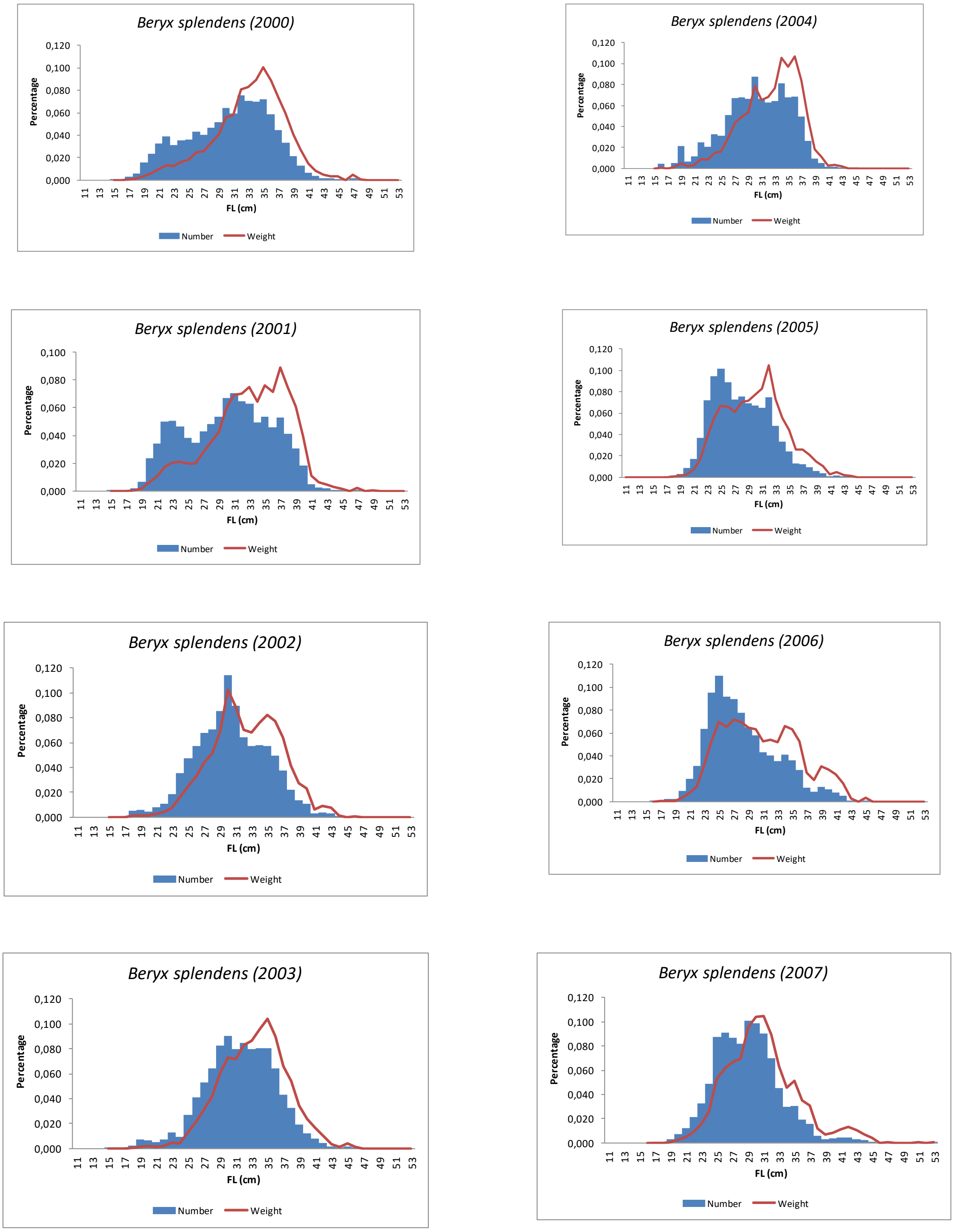
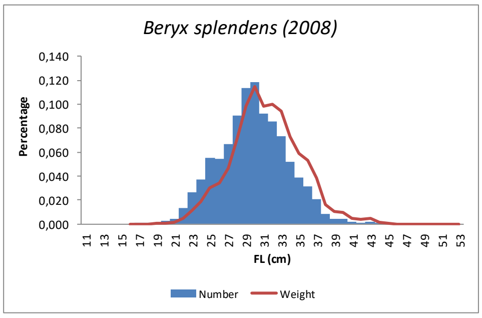
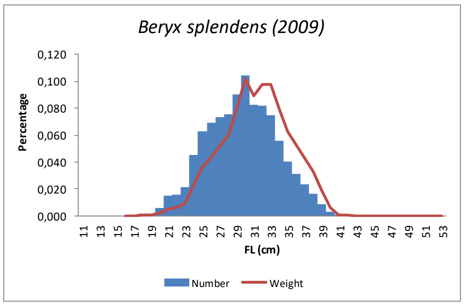
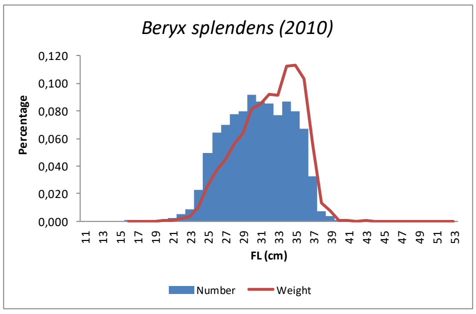
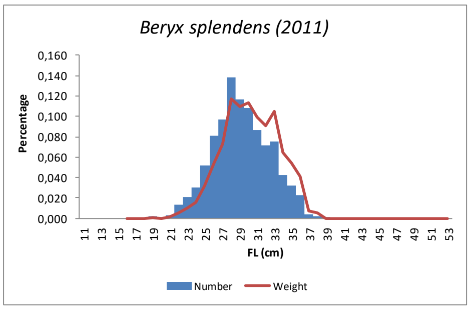


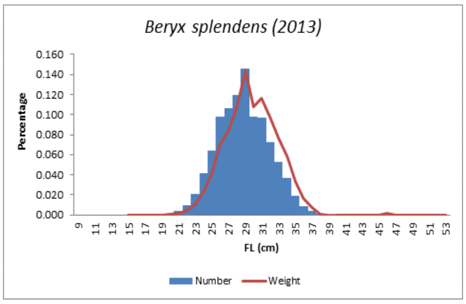
Figure 12.6. ***Beryx splendens*** **Length distribution of the catch from the Azores (ICES Subarea 10). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

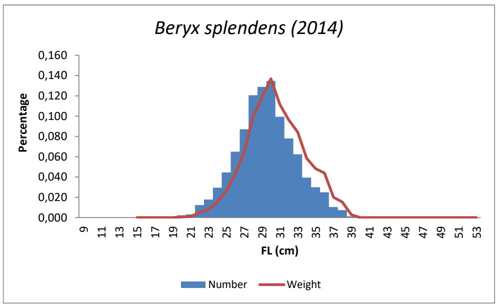

Beryx splendens (2008)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
0,140
FL (cm)
Number
Weight

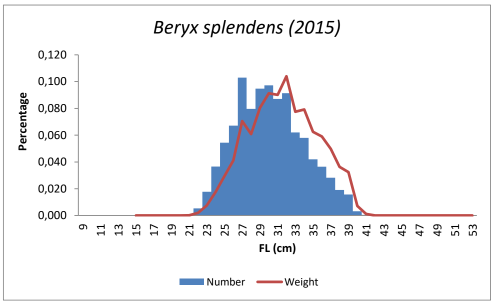

Beryx splendens (2009)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
FL (cm)
Number
Weight

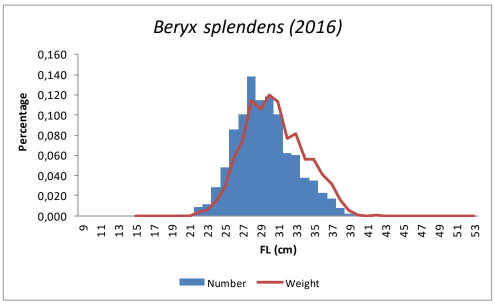

Beryx splendens (2010)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
FL (cm)
Number
Weight


Beryx splendens (2011)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
0,140
0,160
FL (cm)
Number
Weight


Beryx splendens (2013)
Percentage
0.000
0.020
0.040
0.060
0.080
0.100
0.120
0.140
0.160
FL (cm)
Number
Weight


Beryx splendens (2014)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
0,140
0,160
FL (cm)
Number
Weight


Beryx splendens (2015)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
FL (cm)
Number
Weight


Beryx splendens (2016)
Percentage
0,000
0,020
0,040
0,060
0,080
0,100
0,120
0,140
0,160
FL (cm)
Number
Weight

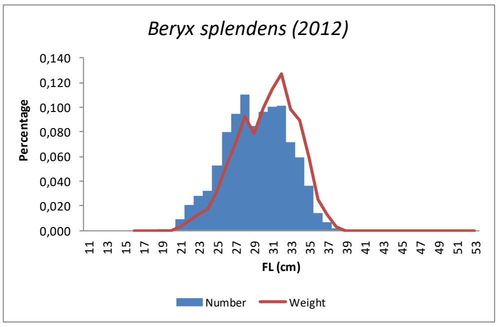


Figure 12.6. *Beryx splendens* Length distribution of the catch from the Azores (ICES Subarea 10). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.

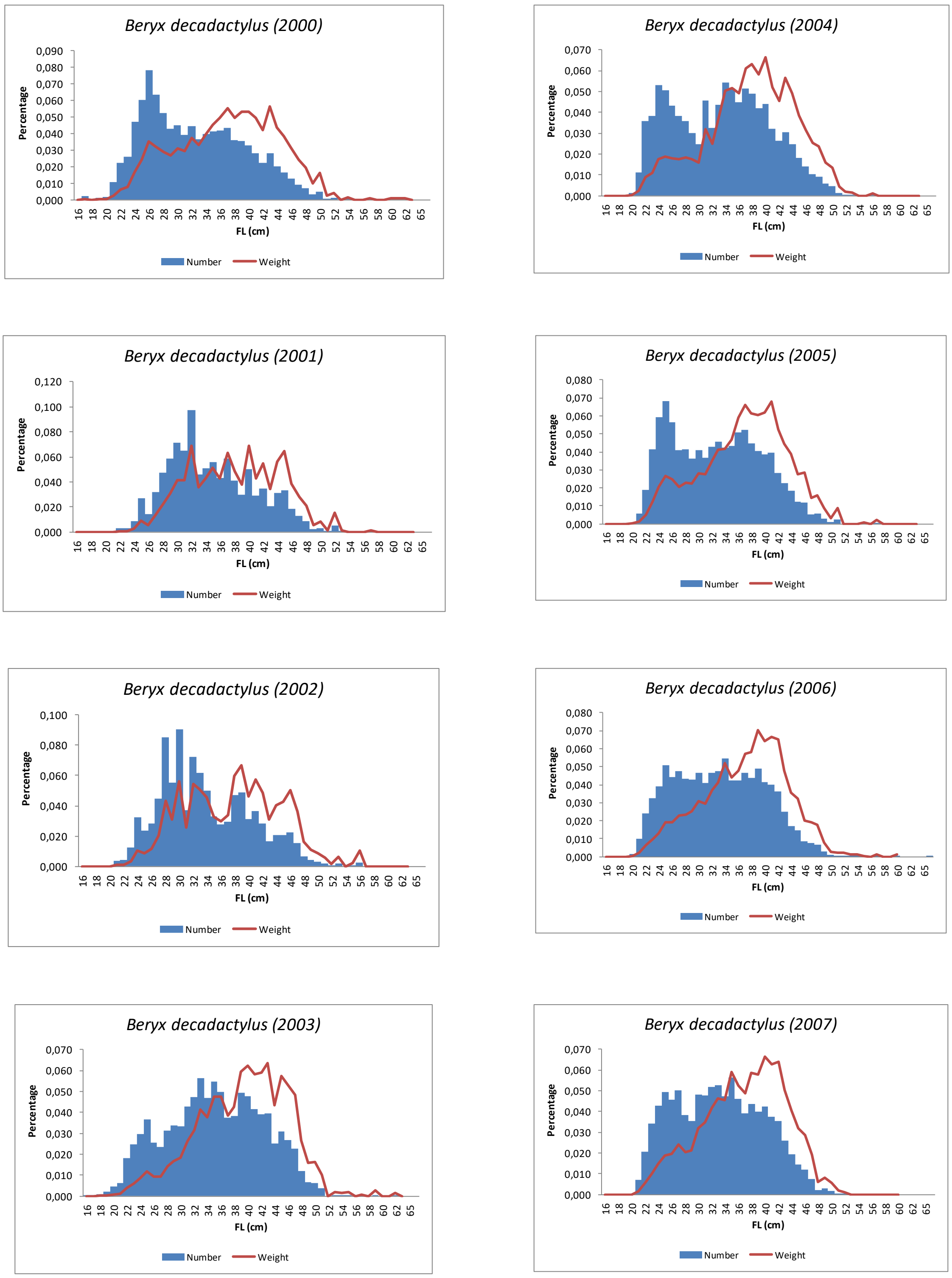
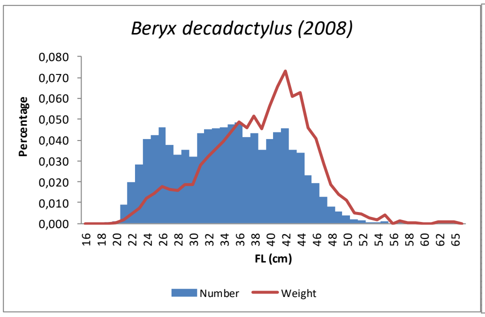
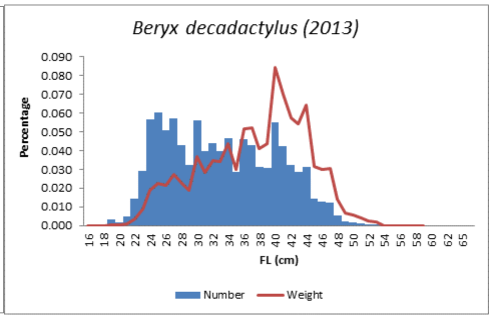
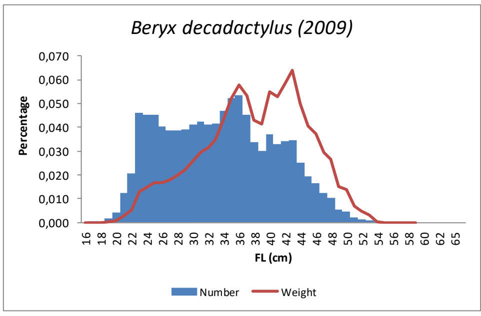
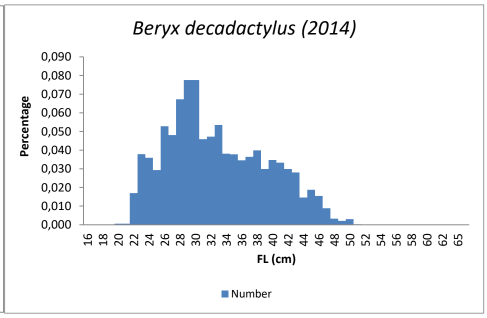


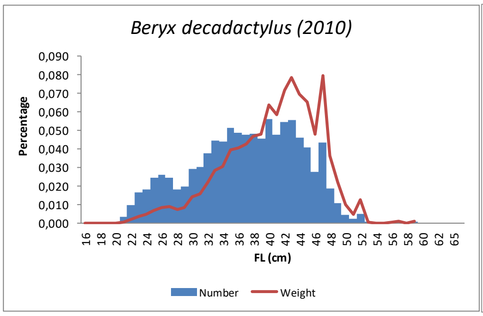
Figure 12.7. *Beryx decadactylus* Length distribution of the catch from the Azores (ICES Subarea 10). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.

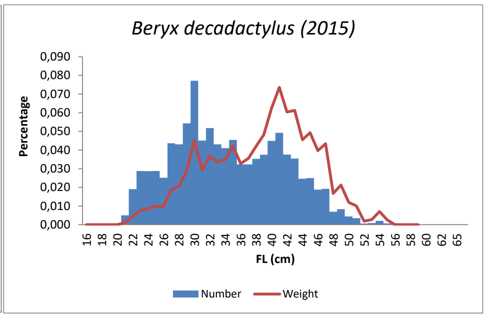

Beryx decadactylus (2008)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight

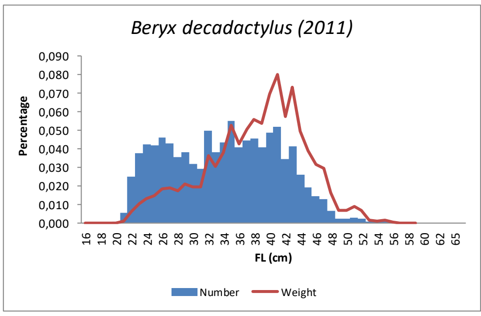

Beryx decadactylus (2013)
0.000 0.010 0.020 0.030 0.040 0.050 0.060 0.070 0.080 0.090
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight

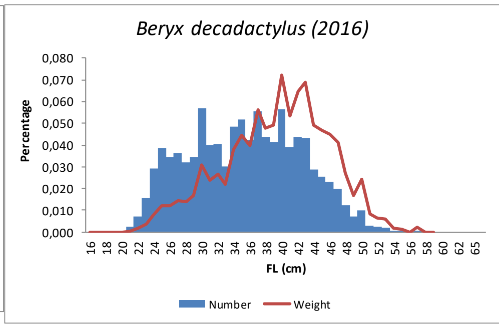

Beryx decadactylus (2009)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight


Beryx decadactylus (2014)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080 0,090
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number


Beryx decadactylus (2010)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080 0,090
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight


Beryx decadactylus (2015)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080 0,090
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight


Beryx decadactylus (2011)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080 0,090
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight


Beryx decadactylus (2016)
0,000 0,010 0,020 0,030 0,040 0,050 0,060 0,070 0,080
Percentage
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 65
FL (cm)
Number
Weight

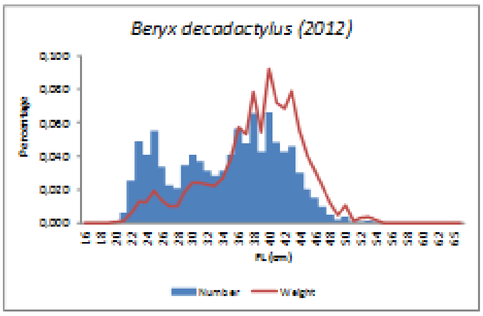


Figure 12.7. ***Beryx decadactylus*** **Length distribution of the catch from the Azores (ICES Subarea 10). Bars represent the proportion in number of every size class and the red line represents the proportion in the weight.**

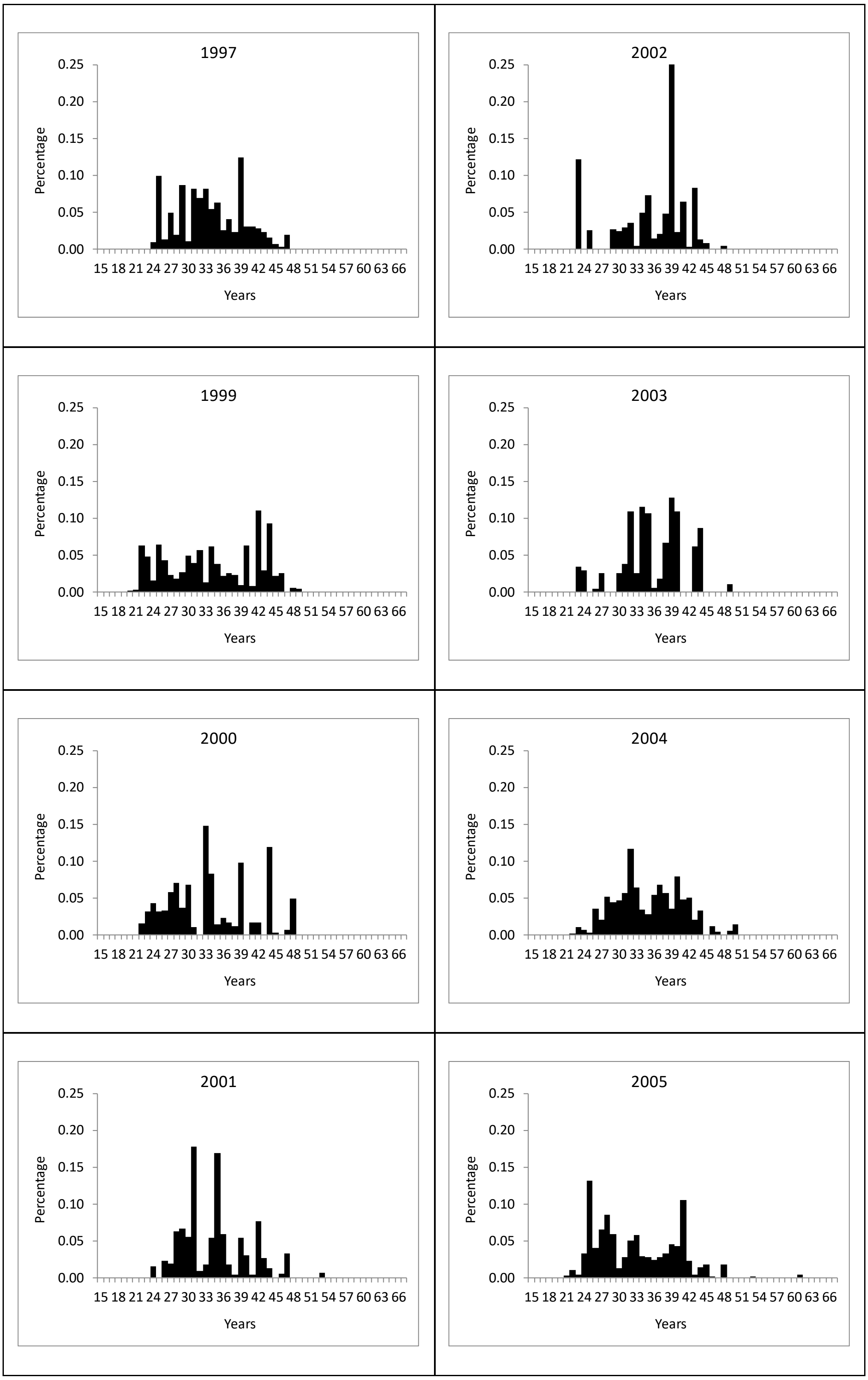


Figure 12.8. ***Beryx decadactylus*** **survey length compositions by year from the Azores (ICES Subarea 10).**

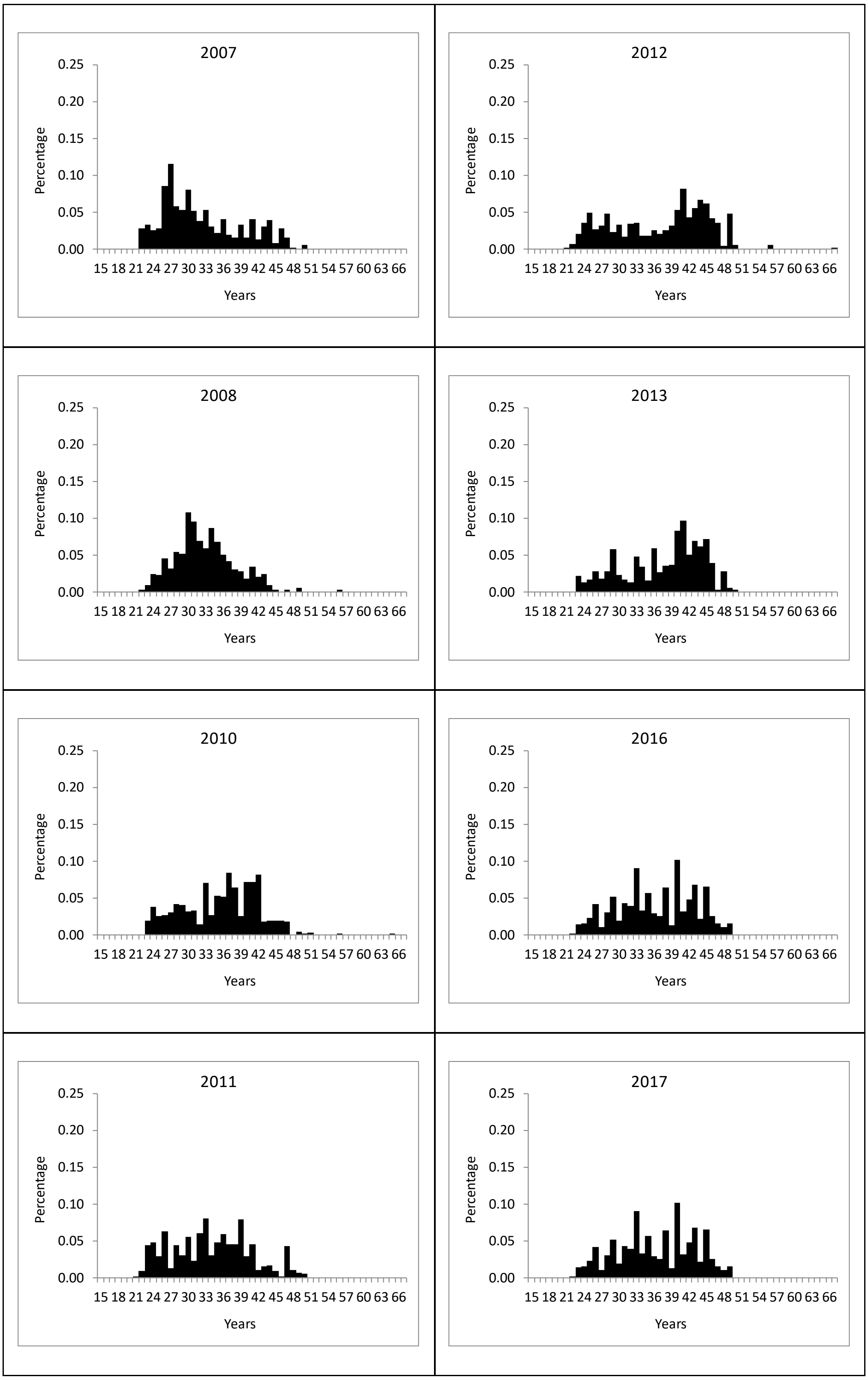


Figure 12.8. ***Beryx decadactylus*** **survey length compositions by year from the Azores (ICES Subarea 10).**

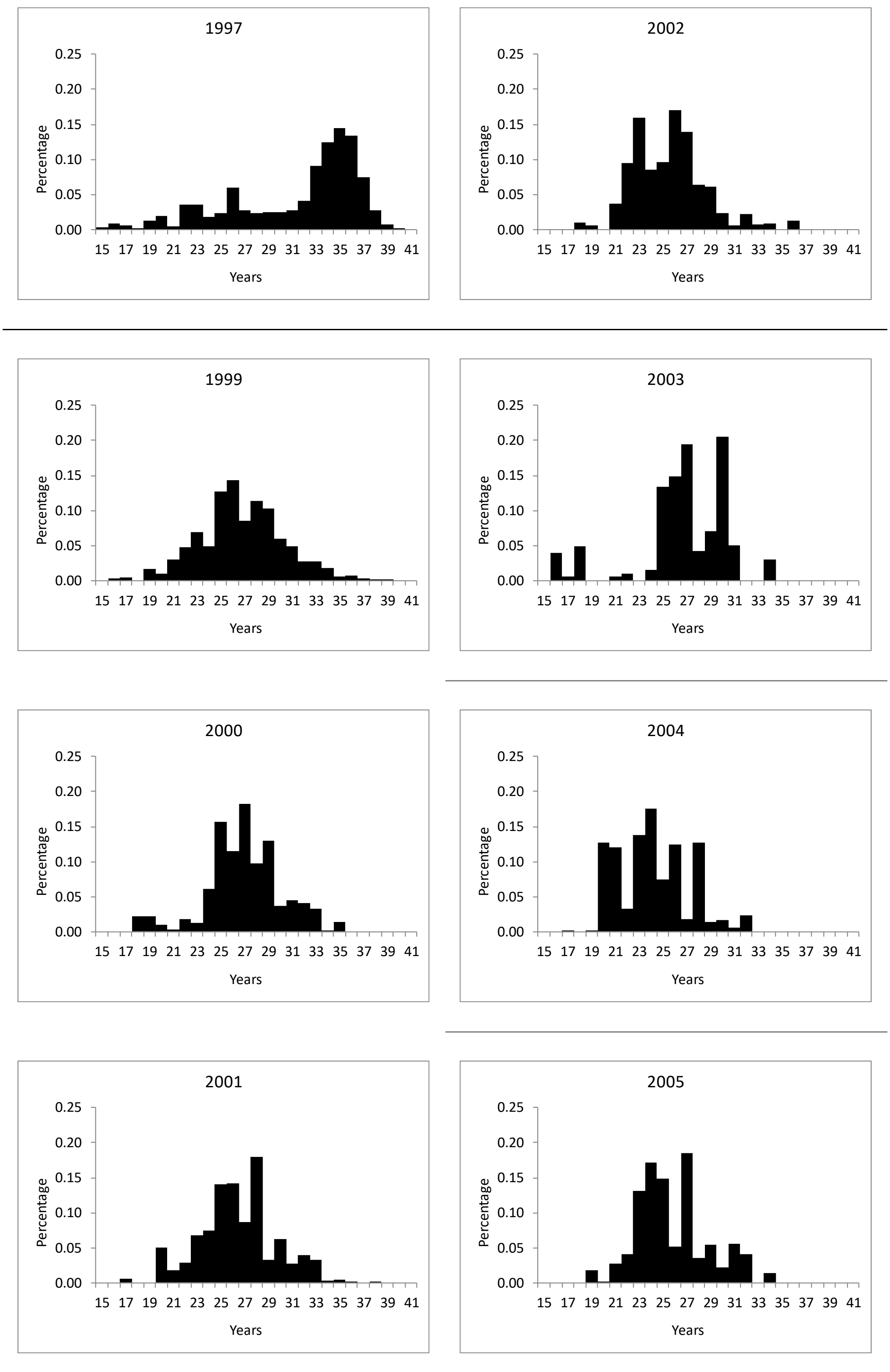


Figure 12.9. ***Beryx splendens*** **survey length compositions, by year from the Azores (ICES Subarea 10).**

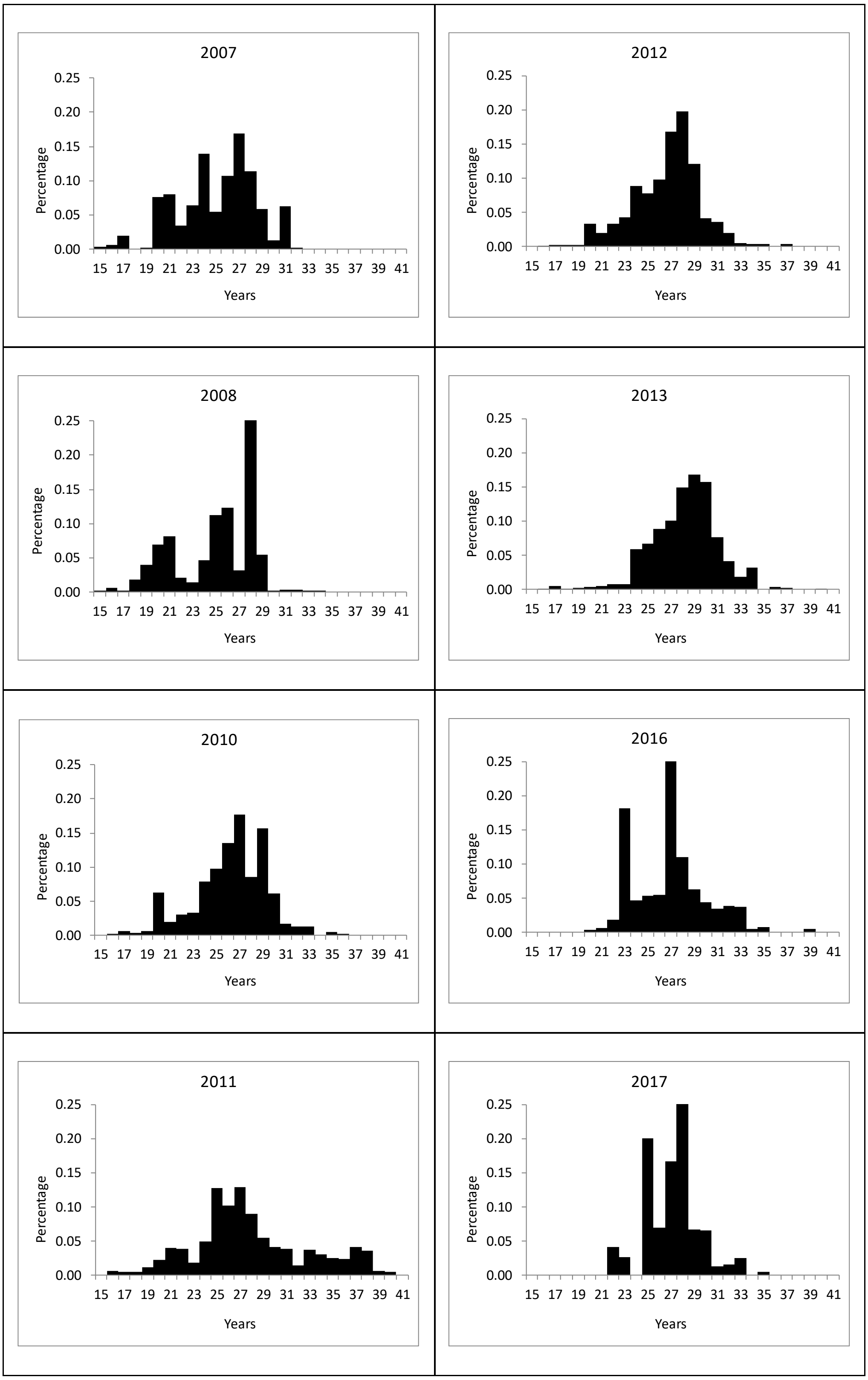


Figure 12.9. ***Beryx splendens*** **survey length compositions, by year from the Azores (ICES Subarea 10).**

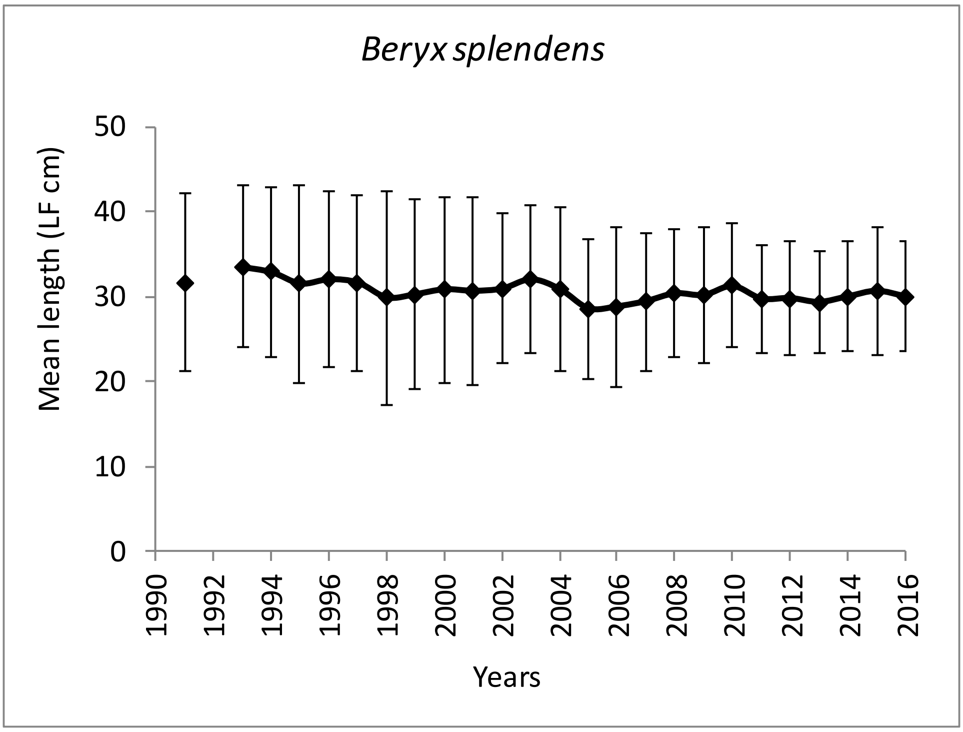


Figure 12.10. Annual mean length of *Beryx splendens* from the Azorean fishery (ICES Subarea 10).Bars are 95% confidence interval.

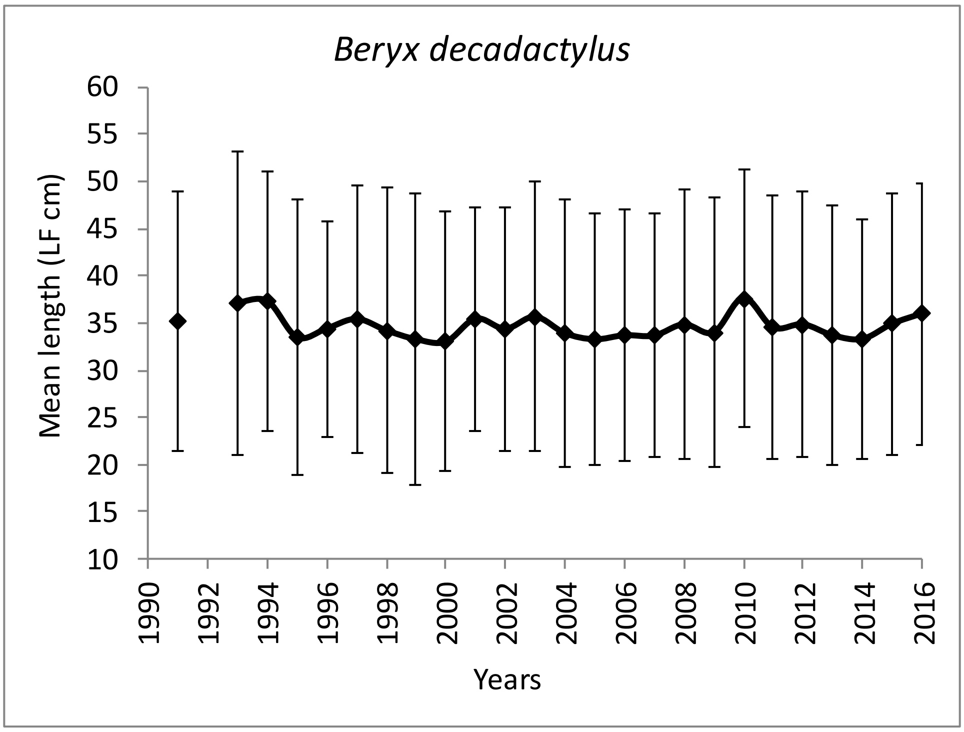


Figure 12.11. Annual mean length of *Beryx decadactylus* from the Azorean fishery (ICES Subarea 10).Bars are 95% confidence interval.

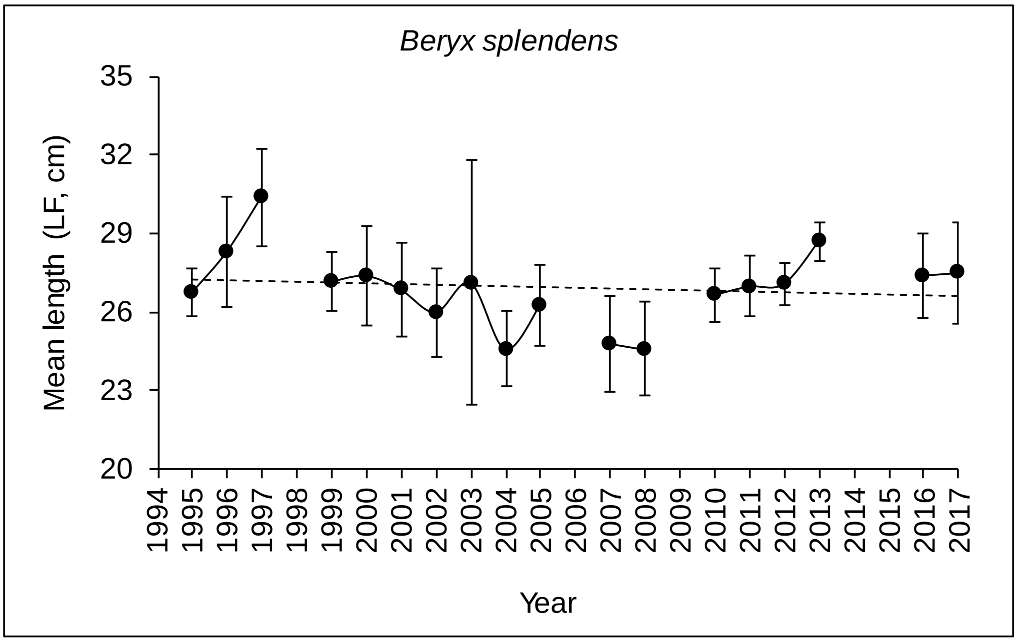


Figure 12.12. Annual mean length of *Beryx splendens* from the bottom longline survey (ICES Subarea 10).Bars are 95% confidence interval.

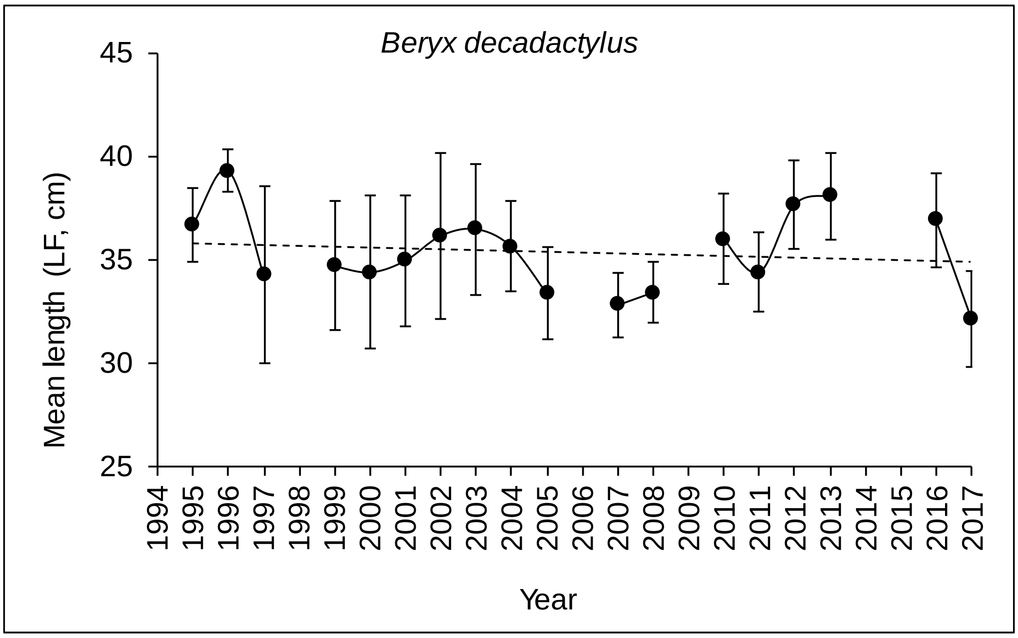


Figure 12.13. Annual mean length of *Beryx decadactylus* from the bottom longline survey (ICES Subarea 10). Bars are 95% confidence interval.

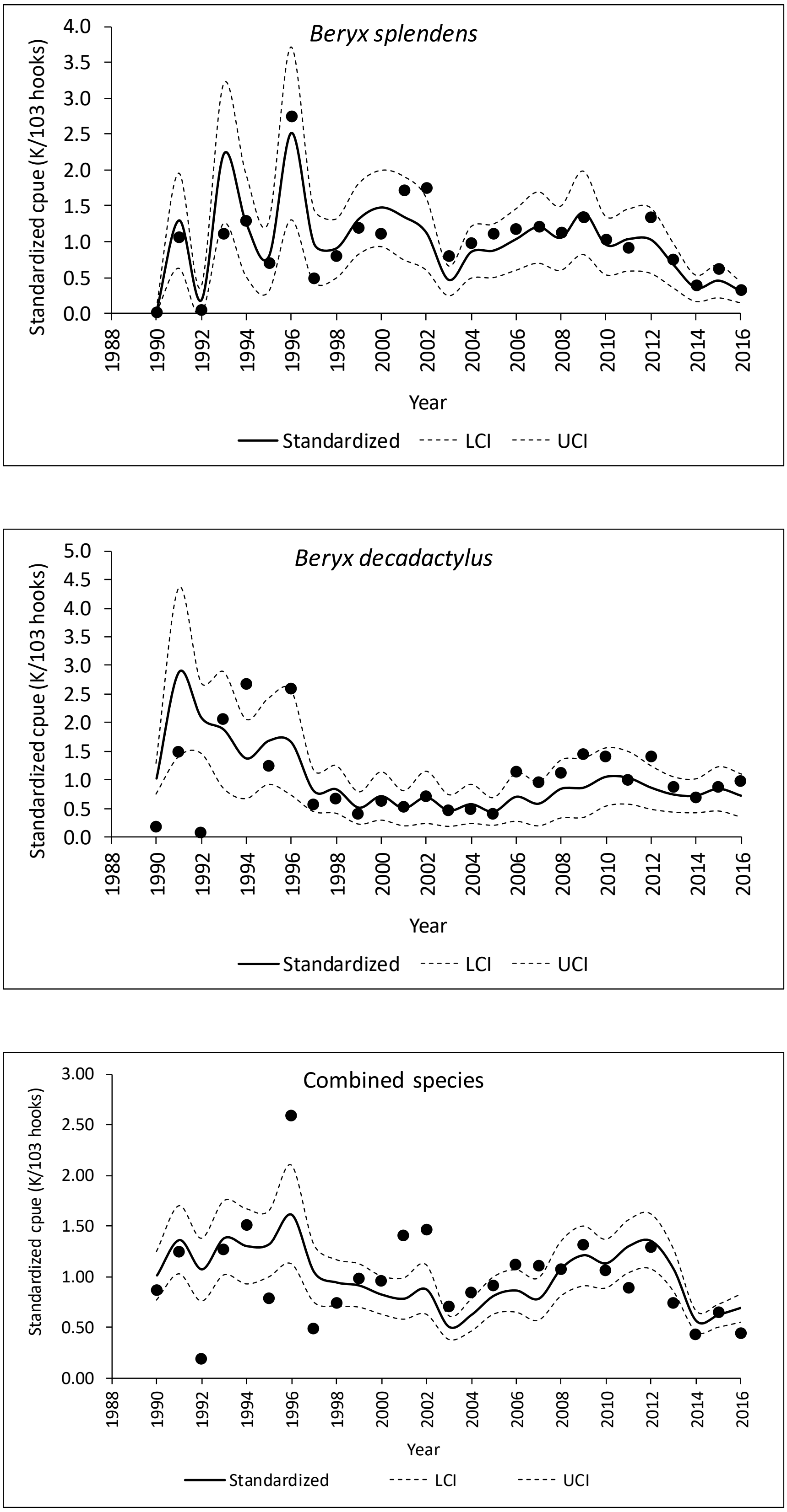


Figure 12.14. Standardized fishery cpue for alfonsinos by species and species combined from the Azorean bottom longline fishery (ICES Subarea 10).

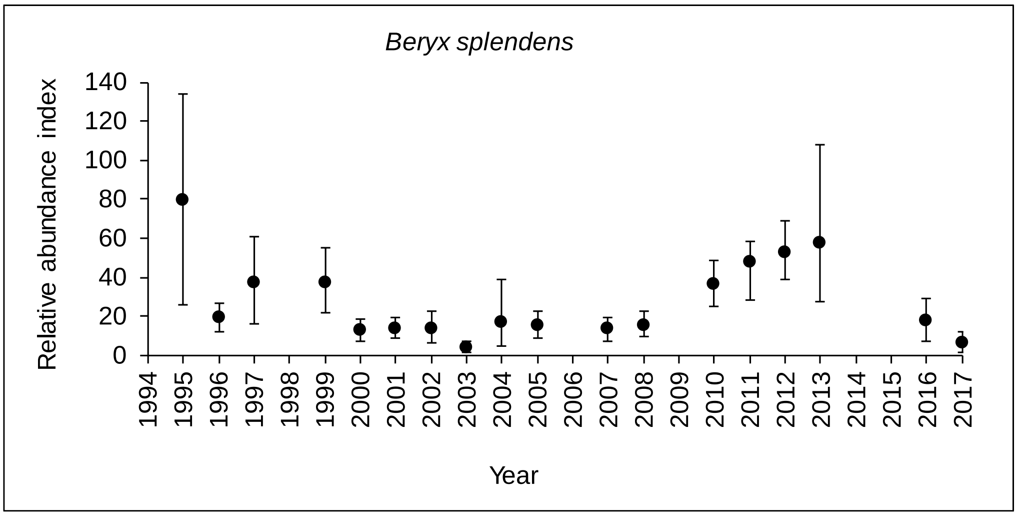


Figure 12.15. Annual bottom longline survey abundance index in number available for the alfonsinos (*Beryx splendens*) from the Azorean deep-water species surveys (ICES Subarea 10).

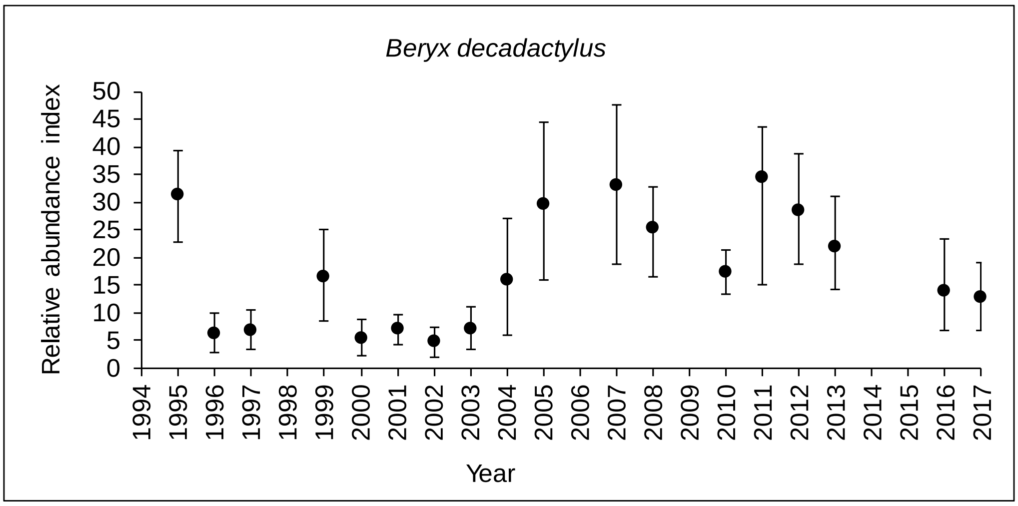


Figure 12.16. Annual bottom longline survey abundance index in number available for the golden eye perch (*B. decadactylus*) from the Azorean deep-water species surveys (ICES Subarea 10).

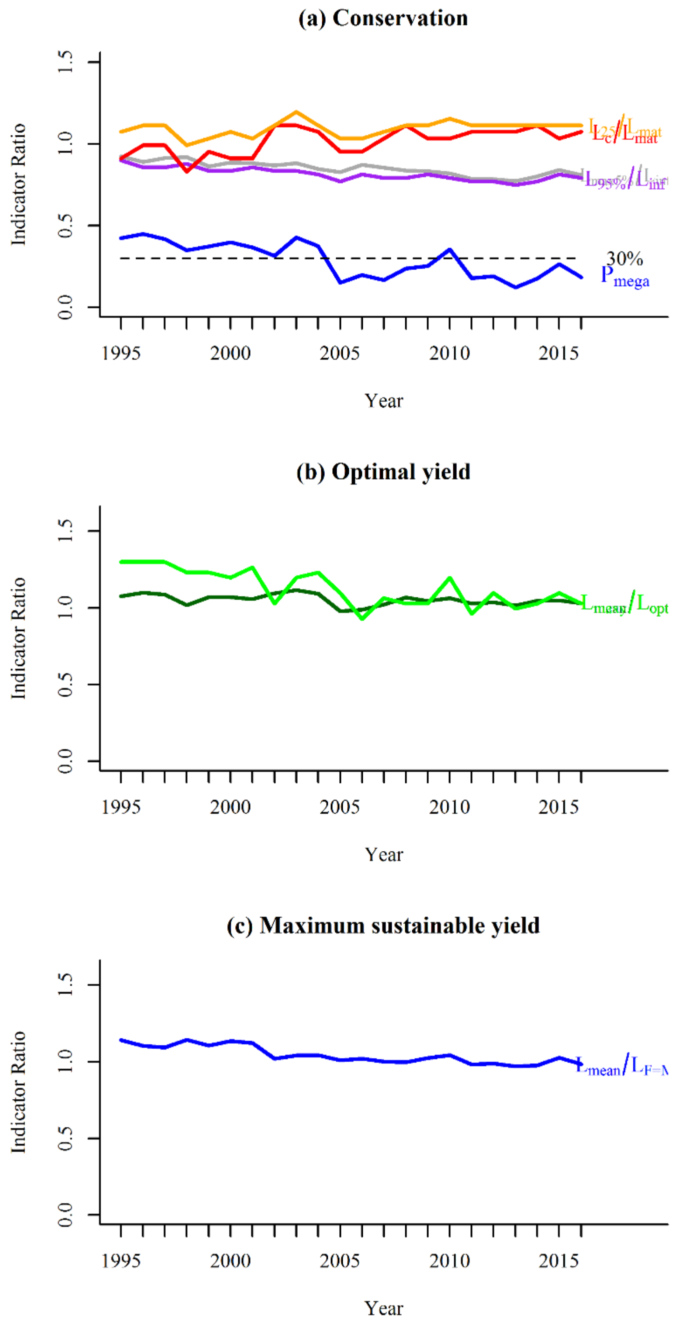


Figure 12.17. Indicator ratios and proxies of reference points (asssuming L_{mat} = 24.7 cm) for the alfonsinos (*B.* splendens) from ICES Division 10.a.

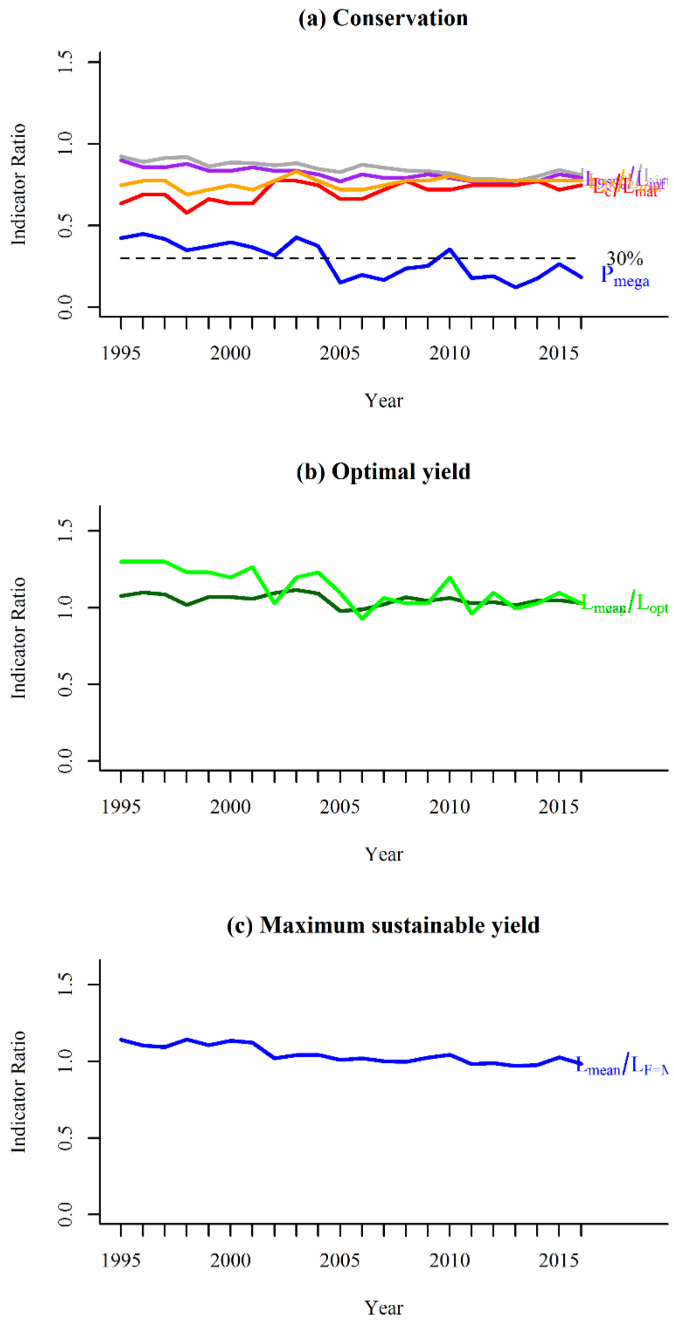


Figure 12.18. Indicator ratios and proxies of reference points (asssuming L_{mat} = 35.5 cm) for the alfonsinos (*B. splendens*) from ICES Division 10.a.

13 Blackspot sea bream (*Pagellus bogaraveo*)

13.1 Stocks description and management units

ICES considered three different components for this species: a) Subareas 6, 7, and 8; b) Subarea 9, and c) Subarea 10 (Azores region), (ICES, 1996; 1998a).

The interrelationships of the blackspot sea bream from Areas 6, 7, and 8, and the northern part of Area 9.a, and their migratory movements within these areas have been observed by tagging methods (Gueguen, 1974). However, there is no evidence of movement to the southern part of 9.a where the main current fishery currently occurs.

Studies show that there are no genetic differentiation between populations from different locations within the Azores region (east, central and west group of Islands, and Princesa Alice Bank) but there are genetic differences between Azores (ICES Area 10.a.2) and mainland Portugal (ICES Area 9.a) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth, suggest that Area 10 component of this stock can effectively be considered as a separate assessment unit.

Available information, particularly genetics and tagging, seems to support the current assumption of three assessment units (6–8, 9 and 10).

13.2 Blackspot sea bream in Subareas 6, 7 & 8

13.2.1 The fishery

From the 1950s to the 1970s, the blackspot sea bream was exploited mainly by French and Spanish bottom offshore trawlers, by artisanal pelagic trawlers in the eastern Bay of Biscay (ICES Divisions 8.a,b), and by Spanish longliners in the Cantabrian Sea (ICES Division 8.c), with smaller contributions from other fisheries (Lorance, 2011). Currently, EU Regulations state that no directed fisheries are permitted under the quota, therefore catches should be only bycatches.

In the period considered (1988–2015), most of the estimated landings from the Subareas 6, 7 and 8 were taken by Spain (69%), followed by France (18%), UK (11%) and Ireland (2%).

The fishery in Subareas 6, 7 and 8 strongly declined in the mid-1970s, and the stock is seriously depleted. Since the 1980s, it has been mainly a bycatch of otter trawl, longline and gillnet fleets and only a few small-scale handliners have been targeting the species. Since 1988 the landings from Subarea 8 represent 67% and Subareas 6 and 7 33% of total accumulated landings. At present the blackspot sea bream catches in these areas are almost all bycatches of longline and otter trawl fleets from France, Ireland and Spain.

13.2.2 Landings trends

Landings data by ICES Subareas reported to the working group are shown in Table 13.2.1a–c. Figure 13.2.1a presents an overview of the historical series of landings in Subareas 6, 7 and 8 since the middle of the last century. Figure 13.2.1b shows, in greater detail, landings of the same subareas since 1988. In 2014 UK (Scotland) reported landings for first time in 7.j, and Netherlands in 2017 in Subarea 7This ICES division is however part of the historical area of distribution of the species (Olivier, 1928; Desbrosses, 1932).

For these three subareas combined, landings decreased from 461 t in 1989 to 52 t in 1996, increased again to a peak in 2007 (324 t) and then decreased in parallel to the reduction of the TAC in following years from 256 t in 2014 and to 124 ton in 2017.

13.2.3 ICES Advice

ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017 and 2018.

13.2.4 Management

The EU TAC for the Subareas 6, 7 and 8 was set for fish time in 2003 and has been reduced since this year from 350 t to 144 t in 2017 Landings in 2007, 2010, 2012, 2015 and 2016 were slightly above the TAC. A minimum landing size of 35 cm was applied from 2010 to 2012.

Pagellus bogaraveo		
Year	TAC	Landings
2003	350	129
2004	350	183
2005	298	158
2006	298	139
2007	298	324
2008	298	159
2009	253	203
2010	215	281
2011	215	177
2012	215	257
2013	196	295
2014	178	256
2015	169	177
2016	160	164
2017	144	124

13.2.5 Data available

13.2.5.1 Landings and discards

The Spanish, French and UK extended landing-series of *P. bogaraveo* in Northeast Atlantic were updated (Figure 13.2.1b). Landings in 2016 and 2017 dropped significantly to 164 t, and 126 t respectively, mainly due to the decrease of landings reported in subareas 6 and 7 since 2013.

Historically, discards are considered negligible and since estimates are available in 2014 they were reported an average of 1.7 t/in all subareas representing between 0.6%–1.3% of the annual catches. Discards resulting from low quotas are compulsory as the fishery for the species was closed. In 2015 and 2016, discards in French fisheries may have resulted from legal closures of quota (MEDDE, 2015; MEEM, 2016). As the blackspot sea bream 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 onboard observation and discards related to low quotas.

Misidentification in on-board observation may occur as the species occurs at low abundance and three similar sparids species occur (*P. acarne, P. erythrinus, P. bellotii* and *Pagrus pagrus*). Length compositions

Length–frequency distribution of commercial landings and discards in 2015 and 2016 are presented (Figure 13.2.2). Length frequencies available from 2017 come from the discards and were very scarce, reporting only sized for four length categories, therefore any figure for this years is presented.

13.2.5.2 Age compositions

No age data were available to the working group. No age estimations are carried out for this stock.

13.2.5.3 Weight-at-age

Mean size and weight-at-age (Table 13.2.2) derived from Guéguen (1969) and Krug (1998) were used by Lorance (2011) in a yield-per-recruit model to simulate the effect of fishing mortality on the blackspot sea bream stock of Bay of Biscay.

13.2.5.4 Maturity and natural mortality

Natural mortality of 0.2 was estimated by Lorance (2011). M was derived from the presumed longevity in the population according the rule M ¼ 4.22/t_{max}, where t is the maximum age in the population derived from data from many populations (Hewitt and Hoenig (2005)).

13.2.5.5 Catch, effort and research vessel data

At the current level of abundance, the black spot sea bream is rarely caught in the northern surveys by French EVHOE IBTS (Divisions 8.f,g,h,j; 8.a,b, and 7.d), Irish IGFS (Divisions 6.a South and 7.b), by Spanish Groundfish Survey in the Porcupine bank (SP-PorcGFS) in Divisions 7.c and 7.k and in the Northern Spanish Shelf Groundfish Survey (SP-NGFS in Divisions 8c and 9a). In French surveys, similar to the current western IBTS, from early 1980s when the stocks were already low it was still in 40–60% of the hauls. This proportion dropped to close to zero by 1985 (Lorance, 2011). This observation indicates that the current survey is appropriate to detect and monitor a recovery of the stock if ever it happens.

P. bogaraveo is a scarce species in the Northern Spanish Shelf Groundfish Survey (Divisions 8c and 9a), on average since 1990 this species appeared only in the 2,2% of the total hauls (Figure 13.2.3). In 2014 for first time in last three years the Northern Spanish Shelf bottom-trawl survey (SP-NGFS) reported catches of only 0.02 kg/hour (juveniles from 21 cm to 24 cm). In 2015 this species reached a high abundance value compared to the mean values of the time-series, both in biomass and number, except the values of 1998 and 2005, unusually high. In 2016, this species was only found in three hauls and the stratified biomass was 0.031 Kg·haul^{-1}. This last survey the biomass and abundance dropped after the slight increase of 2015. In 2017, both biomass (0.01 ± 0.01 Kg·haul^{-1}) and abundance (0.07 ± 0.07 ind·haul^{-1}) kept the decreasing trend after the peak in 2015 (Figure 13.2.4). The few specimens found this last year ranged from 22 cm to 27 cm, similar to 2016 but with the absence of the smallest individuals between 19 cm and 21 cm and also those largest ones of 31 cm. (Figure 13.2.5). In 2017 the geographic distribution of *P. bogaraveo* remained similar to 2016, basically captured in the central area of the Cantabrian Sea (**Error! Reference source not found.**

Catch of blackspot seabream in the EVHOE survey have been too rare to allow the calculation of a survey indicator. However, data from the survey are in accordance with a possible recent increase. In particular, a large catch of more than 1000 individuals occurred in the 2016 survey. Although, one single event is not significant, it is noteworthy that it occurred in the area where on-board observations of the species occur and fishers report an increase occurrence. These indications do not allow revising the stock status which should still be considered to lag below any possible reference point. They however imply that a rebuilding has probably started. A quick appraisal of the level of occurrence that would be expected if the stock rebuilt to past levels can be found from two surveys carried out in the Bay of Biscay only in 1973 and 1976 with the same protocol and gear as the current EVHOE survey, but covering only strata of Bay of Biscay shelf up to 200 m (Figure 13.2.7).

In 1973 and 1976, blackspot seabream was caught in 25% and 55 % of the hauls respectively (Figure 13.2.8). Since the start of the current survey series in 1987, it has always been caught in less than 5% of the hauls in the same strata, some years not at all. In the same strata, it was caught in one out of more than 60 in each of 2015 and 2016. Therefore a ten to thirty-fold increase in occurrence might occur to consider that the stock rebuilt to level from the 1960s and 1970s, where catch amounted to 15 000 t/year.

The current monitoring with on-board observations and the EVHOE survey is insufficient to monitor this rebuilding accurately, while the stock is still low. The increase occurrence in on-board observations is however consistent with fishers reporting more encounter. If the increase persists, which is likely under the current management, occurrences in on-board observations and the survey might become significant in the next few years.

13.2.6 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 13.2.1a). Catches recorded in the surveys are very scarce and are mainly juveniles smaller than 30 cm.

There are reports from fishers that the abundance of the blackspot seabream is increasing to the north of the Bay of Biscay, between 47 and 48°N. This latitude range is the main area where small catch of blackspot seabream have occurred in the 2000. When TACs were set from 2003, there were some conflicts between métiers in this area mainly with small artisanal handliners requesting vessels targeting pelagic species, mostly sardine with trawls and seine, to avoid any bycatch of blackspot seabream. The introduction of the TAC and national quota had an impact on fishing practices.

In the same area, fishers report to encounter more frequently the species in recent years. This was investigated using on-board observations in French fisheries (Figure 13.2.9). The method used consisted in estimating the proportion of fishing operations where the species was caught (landings and discards combined) in French on-board observations to the south of 49°N. The limit at 49°N north was set to include the south of the Celtic Sea to the West of Brittany, where the species was historically abundant. This was made for all bottom trawls types combined and all bottom nets combined for years 2010 to 2016. Some increasing trend in the proportion of hauls with catch of the species can actually be seen for bottom trawls, although the proportion of positive hauls is still small (Figure 13.2.10).

13.2.7 Biological reference points

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

13.2.8 Management considerations

In the 2014 advice, ICES recommends the establishment of a recovery plan for the stock. This stock is collapsed and the advice is to reduce mortality by all means to allow the stock to rebuild, however nor a recovery plan nor scientific studies to support this recommendation have been ever applied in these subareas, only a minimum landing size of 35 cm was applied but only for the period from 2010–2012.

Measures should include protection for areas where juveniles occur. Recreational fisheries may be a significant proportion of the mortality of those juveniles owing to their coastal distribution. This was confirmed for the stock in Subarea 10 (Pinho, 2015).

The TAC was exceeded in 2007, 2010, 2012, 2013, 2014, 2015and 2016.

13.2.9 References

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13.2.10 Tables and Figures

Table 13.2.1a. Red blackspot sea bream in Subareas 6 and 7; WG estimates of landings by country.

YEAR	FRANCE*	IRELAND	SPAIN	UK (E & W)	UK (SCOT)	CH. ISLANDS	NETHERLANDS	TOTAL
1988	52	0	47	153		0		252
1989	44	0	69	76		0		189
1990	22	3	73	36		0		134
1991	13	10	30	56		14		123
1992	6	16	18	0		0		40
1993	5	7	10	0		0		22
1994	0	0	9	0		1		10
1995	0	6	5	0		0		11
1996	0	4	24	1		0		29
1997	0	20	0	36				56
1998	0	4	7	6				17
1999	2	8	0	15				25
2000	4	n.a.	3	13				20
2001	2	11	2	37				52
2002	4	0	9	13				25
2003	13	0	7	20				40
2004	33		4	18				55
2005	29		4	7				41
2006	36	0	8	19				63
2007	46	0	27	57				130
2008	39	0	2	22				63
2009	34	1	16	10				61
2010	22	0	40	1				62
2011	21		11	4				37
2012	38		118					156
2013	28		146	4				178
2014	15		35	9	0			60
2015	13	0	21					34
2016	24	0	15	1	0			40
2017	15	1	19	1		0	0	37

Table 13.2.1b. Red blackspot sea bream in Subarea 8; WG estimates of landings by country.

YEAR	FRANCE*	SPAIN	UK (E & W))	TOTAL
1988	37	91	9	137
1989	31	234	7	272
1990	15	280	17	312
1991	10	124	0	134
1992	5	119	0	124
1993	3	172	0	175
1994	0	131	0	131
1995	0	110	0	110
1996	0	23	0	23
1997	18	7	0	25
1998	18	86	0	104
1999	13	84	0	97
2000	11	189	0	200
2001	8	168	0	176
2002	10	111	0	121
2003	6	83	0	89
2004	37	82	8	128
2005	28	90	0	118
2006	20	57	0	77
2007	44	149	1	193
2008	55	40	0	95
2009	5	137	0	142
2010	61	157	0	218
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

Table 13.2.1c Red blackspot sea bream in Subareas 6, 7 and 8; WG estimates of landings by subarea.

YEAR	6 AND 7*	8*	TOTAL
1988	252	137	389
1989	189	272	461
1990	134	312	446
1991	123	134	257
1992	40	124	164
1993	22	175	197
1994	10	131	141
1995	11	110	121
1996	29	23	52
1997	56	25	81
1998	17	104	121
1999	25	97	122
2000	20	200	220
2001	52	176	227
2002	25	121	147
2003	40	89	129
2004	55	128	183
2005	41	118	158
2006	63	77	139
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

Table 13.2.2 Mean size and weight-at-age of Red blackspot sea bream in Bay of Biscay. From Lorance (2010), derived from Guéguen (1969b) and Krug (1998).

Age group	Mean size (total length, cm)	Mean weight (g)	Proportion of females mature
0			0
1	11.2	18	0
2	17.6	72	0
3	22.3	149	0
4	26	239	0
5	29.2	342	0
6	31.9	449	0.007
7	34.3	562	0.05
8	36.1	658	0.15
9	37.9	765	0.31
10	39.5	870	0.45
11	40.9	969	0.54
12	42.3	1076	0.62
13	43.7	1190	0.68
14	44.8	1285	0.73
15	45.9	1386	0.77
16	46.7	1462	0.80
17	47.8	1572	0.83
18	49.2	1719	0.86
19	49.9	1796	0.88
20	50.2	1830	0.89

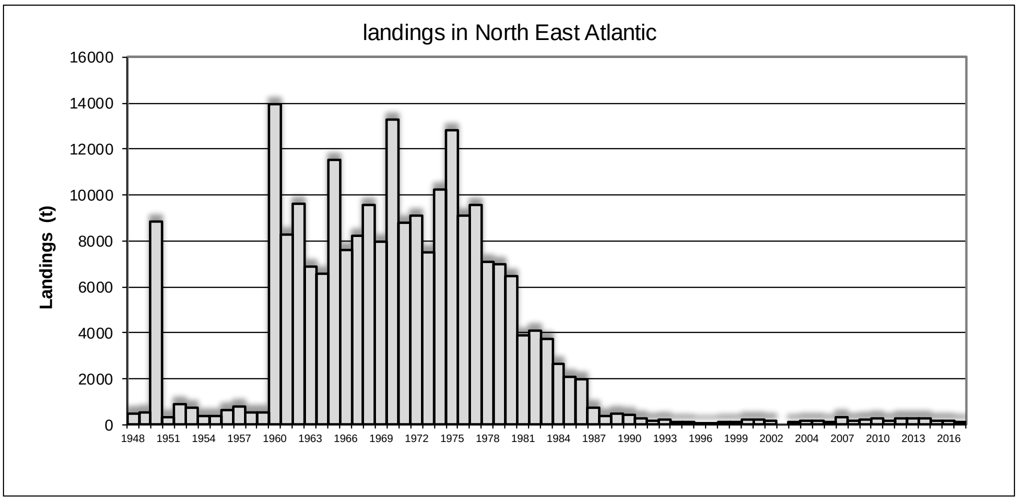


Figure 13.2.1a. Time-series of Red blackspot sea bream landings from 1948–2017 in Northeast Atlantic (Subareas 6, 7 and 8).

Reference/Source (1) of reconstructed landings data for blackspot sea bream in the Bay of Biscay	
France	-Years 1977–1987: Landings of *P.bogaraveo* (*sic*?) from the Northeast Atlantic. M. Pinho, pers. com. Source: SGDeep 1995. -Years 1950–1984: Landings of *Pagellus* sp. ("sea breams") from the Northeast Atlantic. Source: Dardignac (1988), quoted by Castro (1990). SGDeep
Portugal	-Years 1948–1987 Subarea 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. ("sea breams") from the Northeast Atlantic. Source: Anuarios de Pesca maritima. Castro (1990). SGDeep 1996.Table 13.2.3. -Years 1983–1987: Landings of *P.bogaraveo* (*sic*) from Division 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 13.2.4. -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 1988–2017 WGDeep official data

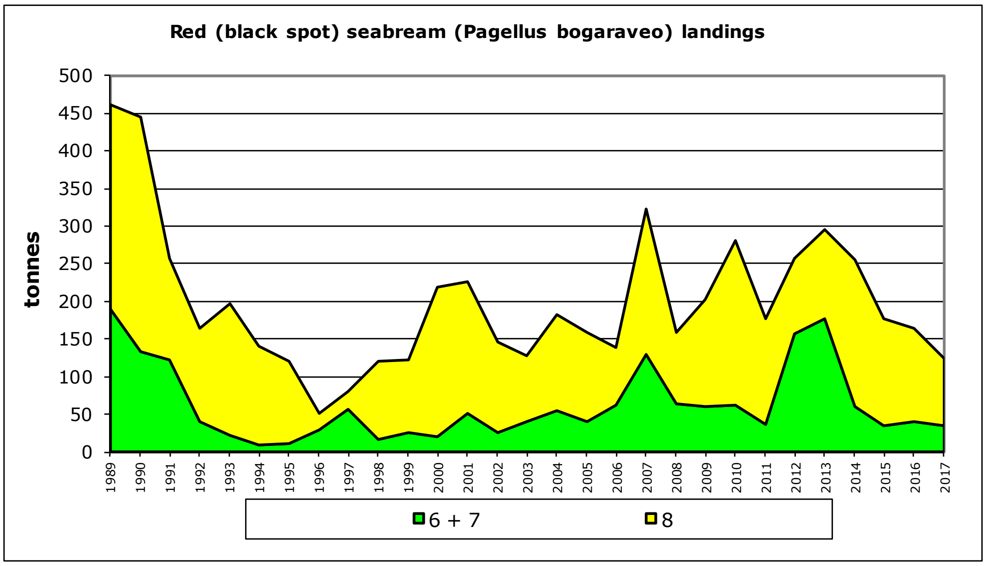
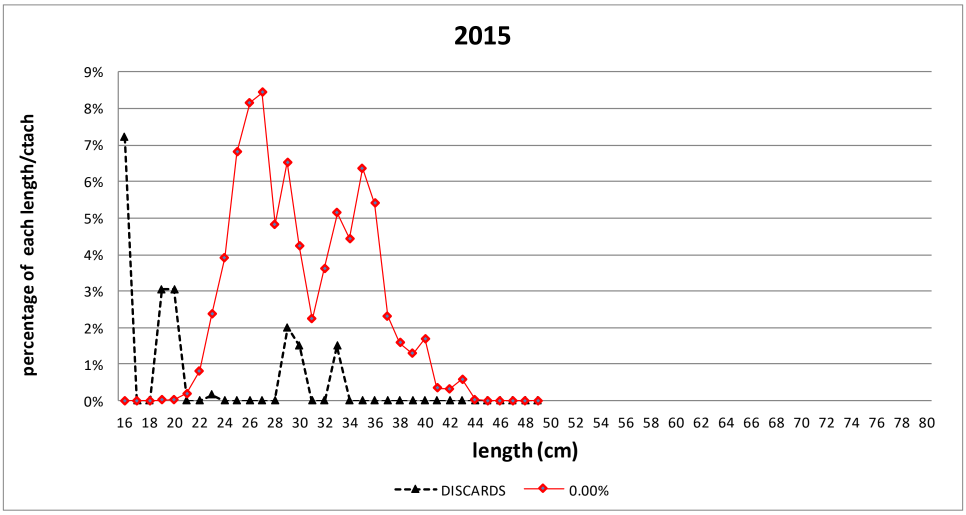


Figure 13.2.1b. Red blackspot sea bream landing trends in ICES Subareas 6 and 7 since 1988.



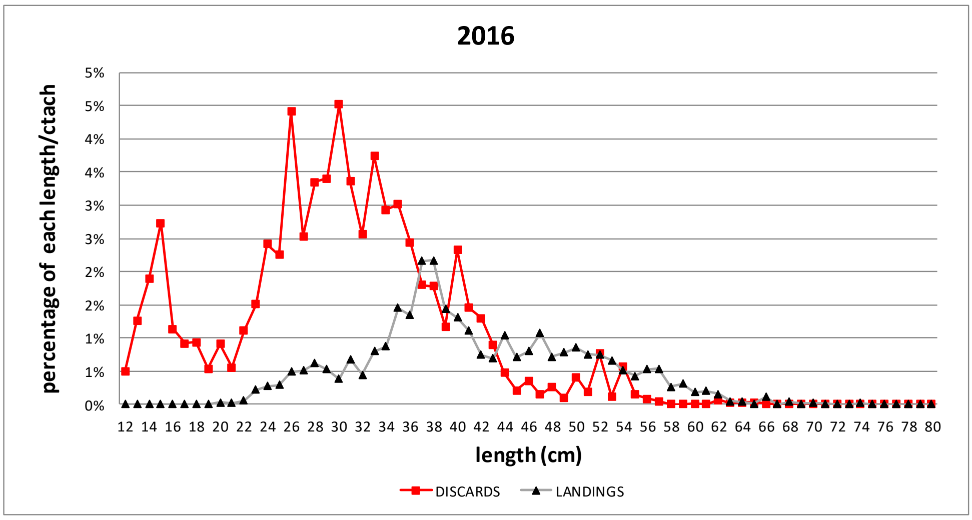


Figure 13.2.2. Length frequencies of the Red blackspot sea bream in commercial catches, landings and discards in 2015 and 2016 in Subareas 6, 7 and 8.

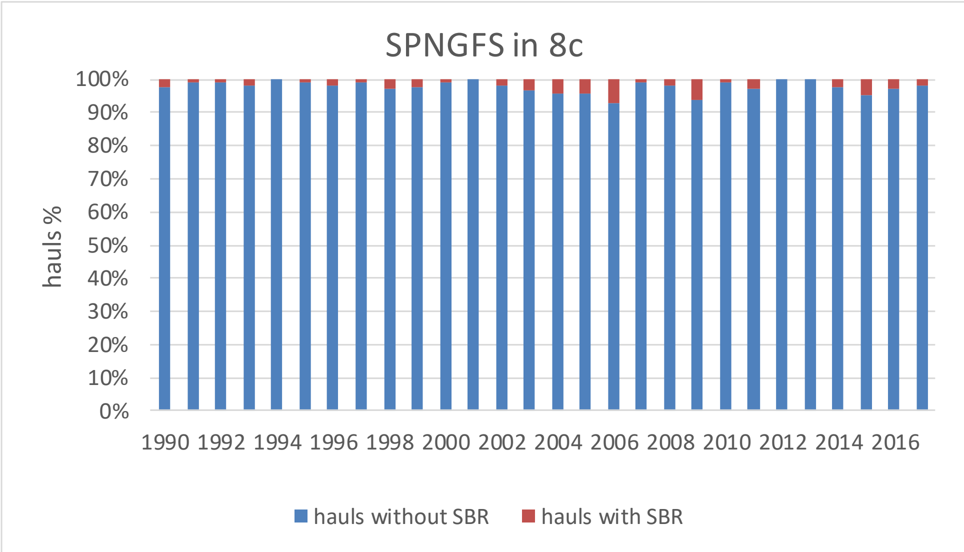


Figure 13.2.3. Occurrence (%) of the Red blackspot sea bream (P. bogaraveo) in Northern Spanish Shelf survey time-series (1990–2017).

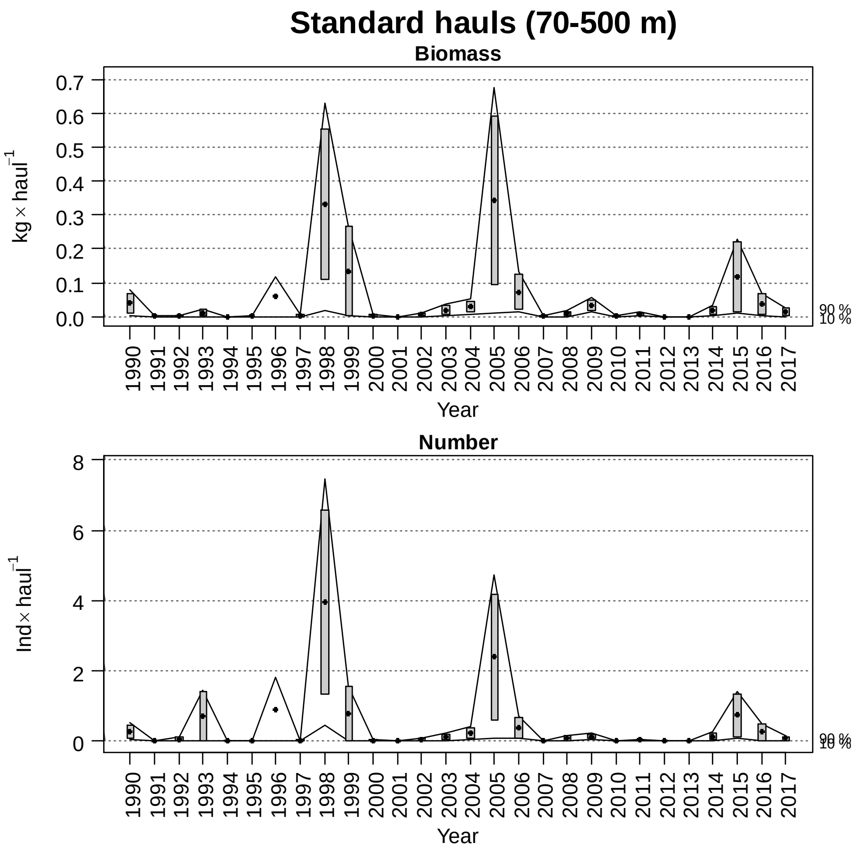


Figure 13.2.4. Evolution of Red blackspot sea bream (*P. bogaraveo*) mean stratified abundance in Northern Spanish Shelf survey time-series (1990–2017).

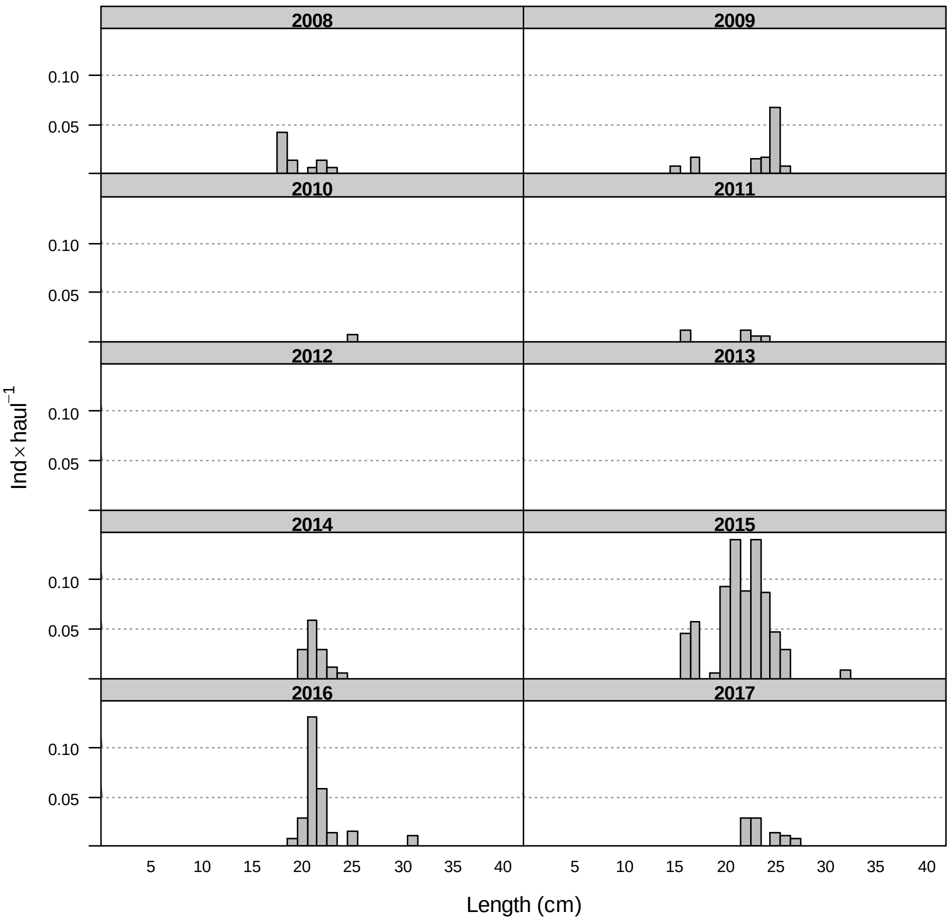


Figure 13.2.5. Mean stratified length distributions of Red blackspot sea bream (*P. bogaraveo*) in Northern Spanish Shelf surveys (2003–2017).

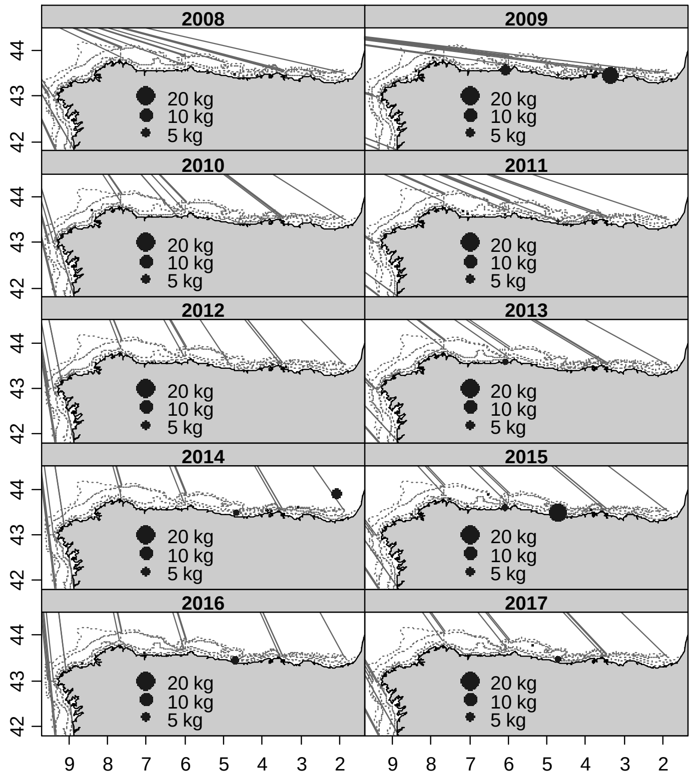


Figure 13.2.6. Catches in biomass of Red blackspot sea bream on the Northern Spanish Shelf bottom-trawl surveys, 2003–2016.

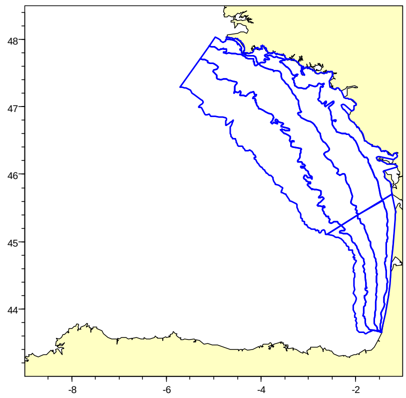


Figure 13.2.7. Strata covering the Bay of Biscay shelf, sampled in the current EVHOE survey and in two previous surveys in 1973 and 1976.

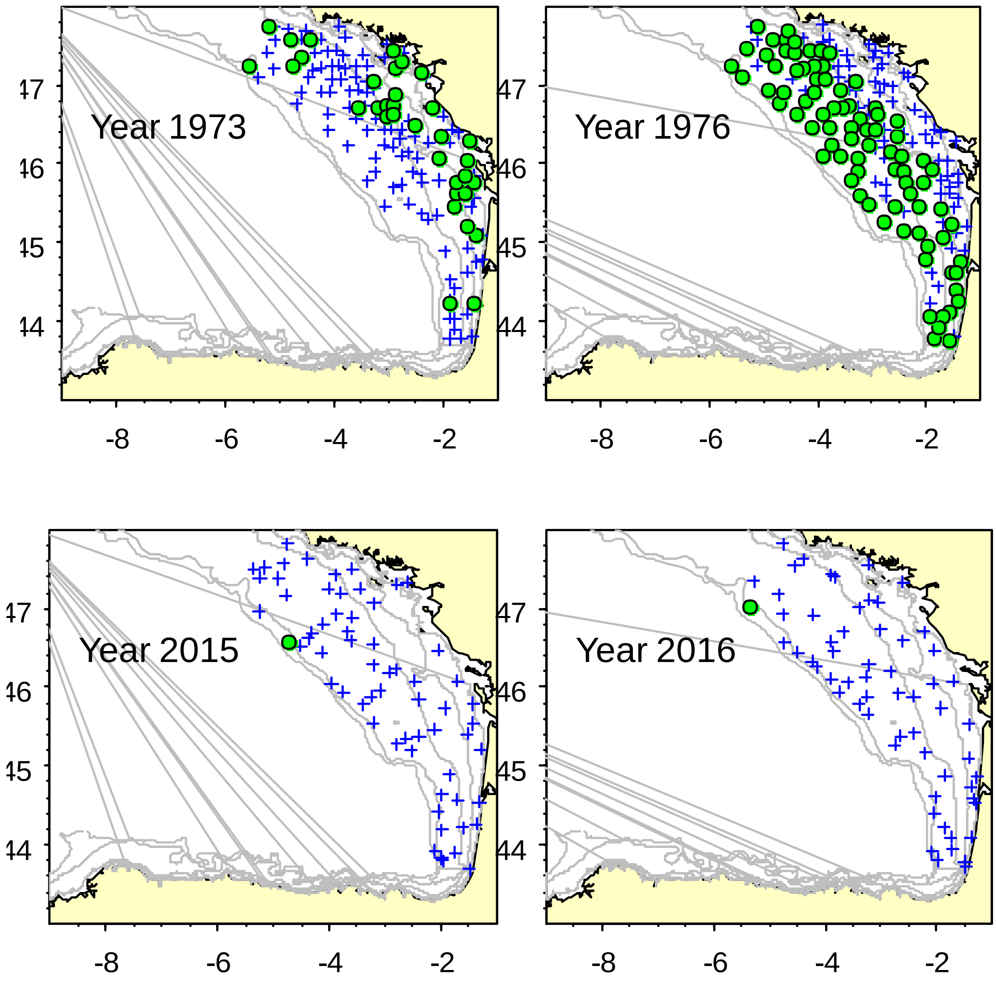


Figure 13.2.8. Occurrences of Red blackspot sea bream in surveys carried out in 1973 and 1976 and in the EVHOE survey in 2015 and 2016.

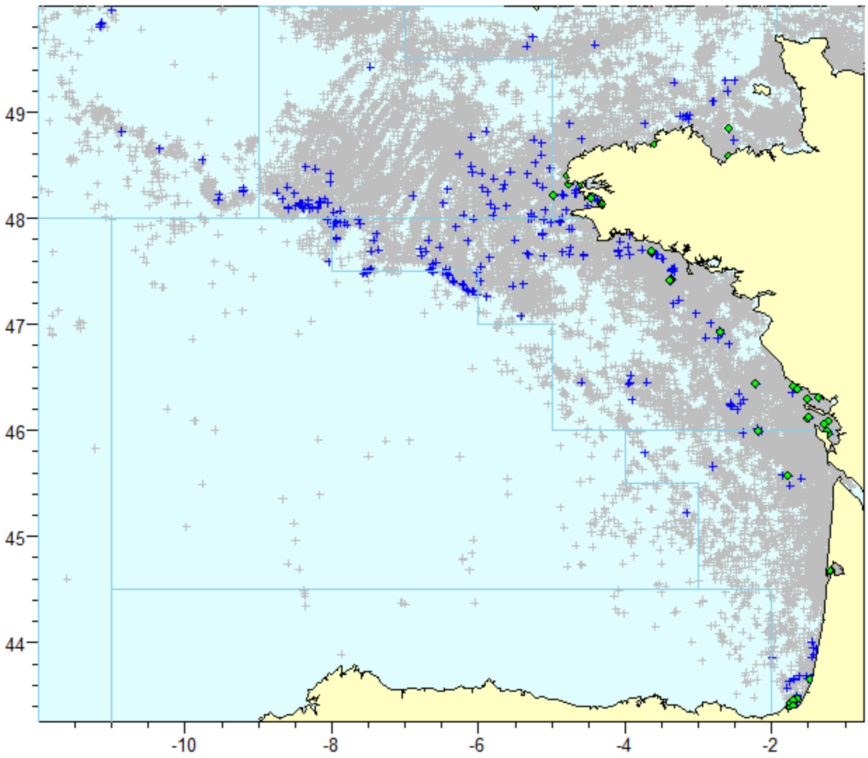


Figure 13.2.9. Geographical distribution on catch of the Red blackspot sea bream in French on-board observations 2010–2016 in the Bay of Biscay and southern Celtic Sea, all métiers. (Grey) all haul/sets observed, (Blue crosses) hauls with catch of blackspot seabream, (Green dots) hauls with catch of blackspot seabream<20 cm which species identification may be uncertain.

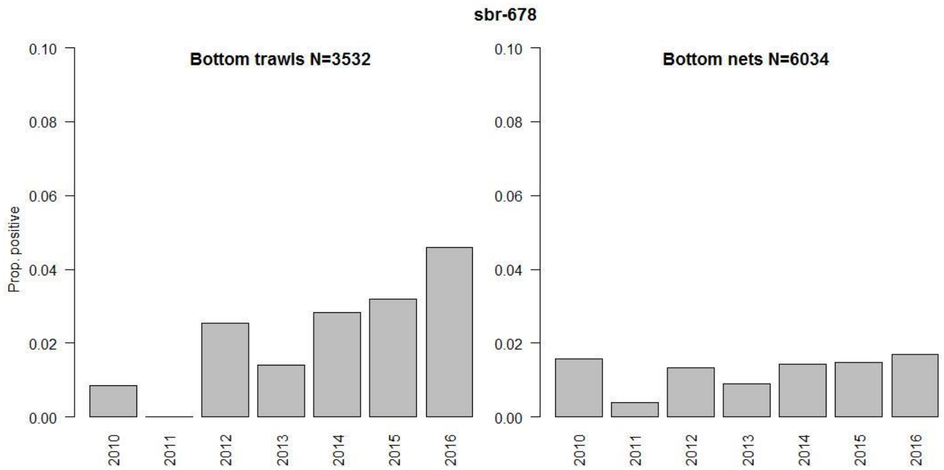


Figure 13.2.10. Proportion of fishing operations with catch of Red blackspot sea bream in bottom trawls (left) and bottom net (right) in French fisheries to the south of 49°N (ICES Divisions 8.a–d and the southern part of 7.d and 7.h–k).

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

13.3.1 The fishery

Pagellus bogaraveo is caught by Spanish and Portuguese fleets in Subarea 9. Spanish landings data from this area are available from 1983, Portuguese data from 1988 and Moroccan information from 2001. European landings in Subarea 9, most of which are taken with lines, are from Spain (>60%) and Portugal (<40%) 2012–2017.

An update of the available information on the Spanish target fishery, from the southern part of Subarea 9, Strait of Gibraltar area, has been provided to the Working Group (Gil *et al.*, WD to the WGDEEP 2018). Currently, less than 60 Spanish boats are involved in the fishery. The fishing grounds of the Spanish fleet are on both sides of the Strait of Gibraltar and near, i.e. mostly less than 20 nautical miles, the main ports (Tarifa and Algeciras). It should be noted that not all the catches/landings come exclusively from ICES Subarea 9: however it was considered from the same stock although the fishing grounds encompass areas of different Regional Organizations/Commissions (ICES, GCFM and CECAF). Fishing takes advantage of the fluctuation of the tide at depths from 350 to 700 m with "*voracera*" gear, a mechanized handline. Since 2002 other artisanal boats have joined the blackspot sea bream fishery from Conil port, although they operate in other fishing grounds and use longlines. This section of the fleet counts currently about six boats. Landings are aggregated into commercial categories due to the wide size range of the catch and size varying prices. Historically these categories have varied with time but from 1999 onwards have remained the same in all ports.

In addition, Moroccan longliners have been fishing in the Strait of Gibraltar area since 2001. These are about 102 boats that are mainly based in Tangier. The average technical characteristics of these boats are: 20 GRT and 160 HP. Moreover, 435 artisanal boats (±15 CV, ≤2 GRT and 4–6 m length) also target this species in the Strait of Gibraltar area (COPEMED II, 2015). The WG considers the account of Moroccan data appropriate as the fishery operates in the same area as the Spanish fishery and obviously targets the same stock. Landings information was also available from GFCM Subregional Committee on the Western Mediterranean meeting (2018).

Detailed information from Portuguese fisheries has been provided to the Working Group by Farias *et al.* (WD to the WGDEEP 2018). As well as in other Spanish places in Subarea 9, it is admitted that there is no target fishery towards blackspot sea bream in Portugal mainland: the species is usually caught as bycatch of fisheries targeting other species. The majority of deep-water species landings as fresh fish in mainland Portugal correspond to the polyvalent fleet, which uses mainly longlines, while landings from trawlers are the second more relevant. The main landing ports (≈89% of the species mainland Portugal total landings) from North to South are: Matosinhos, Aveiro, Nazaré, Peniche, Sesimbra and Sagres.

Peniche (Portuguese central western coast) is the most important landing port (landings between 1999 and 2017 represented nearly 50% of the Portuguese landings of the species in ICES 9a. The species is mainly landed between December and March: this pattern could reflect differences on the species' availability (coinciding with the spawning season) or differences dues to skippers' seasonal fishing grounds preferences (Farias *et al.*, WD to the WGDEEP 2018).

13.3.1.1 Landing trends

Since 1990, the maximum catch was reached in 1993–1994 and 1997 (about 1000 t) whereas the minimum (272 t) in 2013 (Figure and Table 13.3.1). After a slight increase, landings decreased again in 2017. It should be noted that not every Spanish landings from the Strait of Gibraltar come only from ICES Subarea 9. Moroccan landings are supposed to be outside ICES Subarea 9.

13.3.2 Advice

The ICES advice for 2017 and 2018 was: "that when the precautionary approach is applied, catches should be no more than 138 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed. ICES notes that the distribution of the stock extends outside Subarea 9 and catch statistics are incomplete. ICES recommends the establishment of a management plan that covers the entire stock distribution area."

13.3.3 Management

Since 2003, TAC and Quotas have been applied to the blackspot sea bream fishery in Subarea 9. The following table shows a summary of *P. bogaraveo* recent years TACs and European countries landings in this Subarea:

P. BOGARAVEO	2011–2012		2013–2014		2015–2016		2017–2018	
ICES Subarea	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings
9	780–780	333–295	780–780	180–262	374–183	153 (142*)–165 (77*)	174-165	130 (18*) -

***from InterCatch info: landings from adjacent waters of the Strait of Gibraltar (FAO 34.1.11 and FAO 37.1.1).**

In addition to the TAC for 2011–2012 a minimum landing size of 35 cm (total length) shall be respected. However, 15% of fish landed may have a minimum landing size of at least 30 cm (total length). Furthermore, a maximum of 8% of each quota may be fished in EU and international waters of 6, 7 and 8.

There is a minimum conservation reference size of 33 cm for this species in the Regions 1–5 (as defined in Article 2 of Regulation (EC) No 850/98) since 11 May 2017 (Commission Implementing Regulation (EU) 2017/787 of 8 May 2017). This size coincides with the previously applied in the Mediterranean Sea.

European landings have always been far below the adopted TACs although these have been reduced over the years. However, in the year 2016, considering other areas such as FAO 34.1.11 and FAO 37.1.1, European countries landings (242 t) is above the 2016 TAC (183 t) for ICES Subarea 9 (Figure 13.3.1).

13.3.4 Stock identity

Stock structure of the species in ICES Subarea 9 still unknown.

Several tagging surveys (56 days at sea in 2001, 2002, 2004, 2006 and 2008) have been conducted in the Strait of Gibraltar area. A total of 4500 fish were tagged of which 404 recaptures have been reported. No significant movements have been observed, although local migrations were noted: feeding grounds are distributed along the entire

Strait of Gibraltar and the species seems to remain within this area as a resident population (Gil, 2006). Recaptures of tagged fish have also been reported by the Moroccan fishery.

Farias *et al*. (WD to the WGDEEP 2018) presents information of blackspot sea bream spatial distribution from Portuguese research surveys, from the relative frequency of fishing hauls with species catch rates higher than 5 specimens in the 1990-2017 surveys. It is concluded that the species is not evenly distributed along the surveyed area, being more frequently caught at specific grounds, suggesting a patchy distribution. In the northern coast of Portugal, the species is caught down to 100 m deep, whereas preferred habitats are between 200 and 400 m deep in the southwestern coast (Figure 13.1.2).

13.3.5 Data available

13.3.5.1 Landings and discards

Historical landing dataseries available to the Working Group are described in Section 13.1.1 and detailed in Table 13.1.1. It should be noted that 2015, 2016 and 2017 Spanish landings includes adjacent areas, not only ICES Subarea 9 (data are not separated in earlier years). Besides, Morocco landings from the Strait of Gibraltar area are available since 2001 and it supposed to take place outside ICES Subarea 9.

Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). For this species discards can be assumed to be zero or negligible for most assessment purposes and those that do occur are mainly related to catches of small individuals: therefore, for this stock, all catches are assumed to be landed at this moment.

13.3.5.2 Length compositions

Length frequencies of landings are available for the Spanish "*voracera*" blackspot sea bream target fishery in the Strait of Gibraltar (1983–2017). Figure 13.3.3 show the updated length distribution data (from Gil *et al*., WD to the WGDEEP 2018). The table below shows the mean and median landed size since 1990:

YEAR	MEAN	STD. DEV.	MEDIAN	YEAR	MEAN	STD. DEV.	MEDIAN
1990	38.39	5.61	39	2004	36.56	5.69	35
1991	39.94	6.20	40	2005	36.79	6.02	35
1992	40.10	6.61	40	2006	35.87	5.58	35
1993	39.98	6.65	40	2007	37.26	5.95	36
1994	39.92	6.33	40	2008	37.76	6.22	36
1995	36.70	6.49	36	2009	38.29	6.23	37
1996	36.72	6.52	35	2010	36.06	5.29	35
1997	35.98	6.38	35	2011	36.31	6.37	34
1998	34.33	5.07	34	2012	36.39	5.90	35
1999	36.23	5.30	36	2013	34.76	3.59	34
2000	36.79	4.81	36	2014	37.11	5.14	36
2001	37.11	5.45	37	2015	39.08	6.27	38
2002	38.10	5.93	38	2016	37.47	5.28	37
2003	38.35	6.27	38	2017	37.72	4.37	37

Only one mean value (in 1998) is lower than the 2013 year´s mean landing size. Median values are well below the mean in recent years. However, changes are small and gradual. There seem to be a long-term decline, despite the mean length ups and downs over the last decade (Figure 13.3.3).

13.3.5.3 Age compositions

Age and growth, based on otolith readings, were revised at the ICES, WKAMDEEP meeting (October, 2013): The maximum age was estimated at ten years of age based on otolith readings in the Strait of Gibraltar area. However two tags from the tag–recapture programme were recaptured after ten years (J. Gil, *pers. com*.). Moreover, growth estimates from tag–recapture experiments suggest that otolith readings may underestimate age and that some hyaline rings are uncounted and/or missing. The use of these biased age estimates may have substantial consequences.

13.3.5.4 Weight-at-age

No new information was presented to the group.

13.3.5.5 Maturity and natural mortality

No new information was presented to the group.

13.3.5.6 Catch, effort and research vessel data

Figure 13.1.4 present cpue information, restricted to the Strait of Gibraltar fishery (Gil *et al*., WD to the WGDEEP 2018). Effort, as indicated, from sales sheets is not standardized and is potentially an underestimate in some years as the effort unit chosen may be inappropriate while standardized cpue estimated from VMS analysis shows the same trend. Figure 13.3.5 and Table 13.3.3 presents the summary statistics of the VMS index: In 2013 and 2017 the median value is 0: in other words, at least the 50% of the target fishing trips got zero blackspot sea bream catches.

While, Figure 13.3.6 present mean catch rates from the two main gears, polyvalent (longlines) and trawl, at Peniche port (Portugal coast): standardization procedures to these reference fleets are detailed in Farias *et al*. (WD to the WGDEEP 2018). Catch rates derived from longliners are higher than those from trawl: this probably reflects difference on the species length range between the two fleets (trawlers mainly catch small size specimens while longlines catch larger ones).

13.3.5.7 Data analyses

The trend is fairly clear in the target fishery of the Strait of Gibraltar. Landings have declined significantly till 2013 which may be considered as an indication of a substantial reduction in exploitable biomass. Mean length distribution and cpue decreasing trends throughout these years may also be consistent with an overexploited population. However, in the most recent years (2014 and 2015) all signals from the target fishery (landings, cpue and length distribution) showed increasing signs but without any evidence of its sustainability and, therefore in 2016 and 2017 drops again.

Analysis of CPUE for the Portuguese reference fleet is not in accordance with the abundance trend from the Strait of Gibraltar target fishery: after 2006 the longlines and bottom trawl catch rates are relatively stable and less variable than in precedent years.

13.3.6 Exploratory assessments (ToR d)

Gil *et al*. (WD to the WGDEEP 2018) summarizes the assessment trials on the target fishery of the blackspot sea bream in the Strait of Gibraltar area presented to the GFCM 2018 WGSAD: these include several joint assessments (Spain and Morocco data) but the gadget model was only accepted in terms of "qualitative advice" within the WGSAD. Input data and main results are described in the Working Document.

Anyway, fishery sustainability could be compromise at current levels because $F_{CURRENT}$ seems to be about 0.3 in both analytical approaches (LCA/VPA and gadget), far above from the reference point $F_{0.1}$ estimated value (0.14 and 0.17, in YpR respectively models). Figures 13.3.7 and 13.3.8 presents the comparison of biomass and F estimates from these two approaches.

13.3.7 Management considerations

A TAC regime (174 and 165 t) was established for 2017 and 2018 for whole Subarea 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 9, nevertheless catches in the GFCM area 37.1.1 and CECAF area 34.1.11 shall be reported (Council Regulation (EU) 2016/2285). Recent landings are far below to previous TAC levels but in 2016, European landings (including other areas such as FAO 34.1.11 and FAO 37.1.1) are above the 2016 TAC.

The combination of the minimum size of 33 cm for this species and the landing obligation (EU Regulation 2013/1380) might have an effect on this fishery.

WGDEEP reiterates its advice of a need for a recovery plan for the Strait of Gibraltar fisheries: vital to its success is the involvement of non-EU countries (primarily Morocco). The reduction of fishing effort towards fishing mortality sustainability levels is desirable: it should be noted that GCFM started a work plan to establish a management plan for this target fishery in 2019 (Recommendation GFCM/41/2017/2 on the management of blackspot sea bream fisheries in the Alboran Sea, geographical subareas 1 to 3, for a two-year transition period).

As well as in other ICES Subareas (6, 7, 8 and 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.

Besides, it may be considered not appropriate to infer the population status of the blackspot sea bream from the Strait of Gibraltar data, where an intense target fishery is known to take place to the whole ICES Subarea 9. Alternates such as the definition of functional units for assessment and management purposes, like in the Norway lobster (*Nephrops norvegicus*) case, appears to be a more reasonable solution (Farias *et al*., WD to the WGDEEP 2018).

13.3.8 Application of MSY proxy reference points (ToR g)

Input data and codes used in these exploratory assessments are available at the WGDEEP SharePoint (Data/sbr.27.9).

Figures 13.3.9 and 13.3.10 presents the preliminary results of the SPiCT model attempted within the WGDEEP 2018. The model do not converge when blackspot sea bream total (including Morocco) landings (1983–2017) and cpue from VMS (2009–2017) were used as data inputs (Figure 13.3.9). Another run using two CPUEs (nominal and VMS) from the Spanish target fishery in the Strait of Gibraltar as abundance indices reach the convergence. However, the WG considers that the estimates (with wide confidence intervals) are not in conformity with the current perception of the stock status.

The length data used in the LBI model come from the Spanish target fishery of the Strait of Gibraltar. 33 cm are used as an input for L at maturity (taking into account that is a hermaphrodite species and 33 cm is the estimated length at sex, male to females, change) while 62 cm (largest observed sample) was the value for L infinite. Length distribution data (1 cm bin) are raised to total landings from the target "*voracera*" fleet.

Output from the screening of length indicator ratios for combined sexes was conducted under three scenarios: (a) Conservation; (b) Optimal yield, and (c) maximum sustainable yield (Figure 13.3.11). Conclusion: Overall perception of the stock during the period 1997–2017 is presented in the traffic lights Table 13.3.4. However, values are nearby the reference indicator ratios and sensitivity to Lmat and Linf estimates was not explored, so the WG considered it quite prelaminar. Further work should be done for the application of MSY proxy reference points in order to produce relevant results.

13.3.9 Tables and Figures

Table 13.3.1. Blackspot sea bream (*Pagellus bogaraveo*) in Subarea 9: Working Group estimates of landings (in tonnes). Spanish landings from 2012 are official statistics.

YEAR	PORTUGAL	SPAIN	MOROCCO*	UNALLOCATED	TOTAL
1983		101			101
1984		166			166
1985		196			196
1986		225			225
1987		296			296
1988	370	319			689
1989	260	416			676
1990	166	428			594
1991	109	423			532
1992	166	631			797
1993	235	765			1000
1994	150	854			1004
1995	204	625			829
1996	209	769			978
1997	203	808			1011
1998	357	520			877
1999	265	278			543
2000	83	338			421
2001	97	277	19		374 (19*)
2002	111	248	37		259 (37*)

YEAR	PORTUGAL	SPAIN	MOROCCO*	UNALLOCATED	TOTAL
2003	142	329	24		471 (24*)
2004	183	297	34		480 (34*)
2005	129	365	39		494 (39*)
2006	104	440	74		544 (74*)
2007	185	407	90		592 (90*)
2008	158	443	77		601 (77*)
2009	124	594	99		718 (99*)
2010	105	379	107		484 (107*)
2011	74	259	136		333 (136*)
2012	143	60	122	92	295 (122*)
2013	90	91	92		181 (92*)
2014	59	203	118		262 (118*)
2015	66	87 (142**)	219		295 (219*)
2016	70	95 (77**)	159		242 (159*)
2017	69	61 (18**)	188		148 (188*)

***Morocco landings are available from the Subregional Committee on the Western Mediterranean 2018 meeting, which includes a technical session on blackspot sea bream (GFCM SCR-WM)**

****Figures in brackets includes blackspot sea bream from other areas (FAO 34.1.11. and FAO 37.1.1).**

Table 13.3.2. Spanish "*voracera*" blackspot sea bream fishery of the Strait of Gibraltar (ICES Subarea 9): Estimated cpue using sales sheets or VMS data as effort unit (adapted from Gil *et al.*, WD to the 2018 WGDEP).

YEAR	CPUE	VMS CPUE
1983	78	
1984	76	
1985	71	
1986	61	
1987	76	
1988	73	
1989	89	
1990	77	
1991	70	
1992	86	
1993	85	
1994	94	
1995	60	
1996	104	
1997	77	
1998	61	
1999	55	
2000	45	
2001	56	
2002	47	
2003	53	
2004	47	
2005	68	
2006	70	
2007	51	
2008	52	
2009	67	55
2010	46	38
2011	42	31
2012	35	21
2013	30	14
2014	39	22
2015	49	32
2016	41	27
2017	33	14

Table 13.3.3. Spanish "*voracera*" blackspot sea bream fishery of the Strait of Gibraltar: Summary statistics from VMS CPUEs (adapted from Gil *et al.*, WD to the 2018 WGDEP).

Year	#Fishing trips	Mean	Median	25%percentile	75%percentile
2009	8373	54.82	48.8	17.85	82.34
2010	7238	37.98	28.34	5.417	54.32
2011	6160	30.97	24.52	0	46.86
2012	3685	21.48	15.01	0	34.38
2013	2695	14.77	0	0	24.36
2014	4191	22.49	12.27	0	38.01
2015	4234	32.44	20.12	0	50.65
2016	2724	26.99	11.58	0	39.78
2017	1740	14.20	0	0	20.58

Table 13.3.4. Blackspot sea bream in ICES Subarea 9: LBI output table.

		Conservation				Opt. Yield	MSY
		Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Year	Stock/Sex	>1	>1	>0.8	>30%	~1 (>0.9)	?1
1997	sbr9/N	0.86	0.94	0.81	0.11	0.88	0.99
1998	sbr9/N	0.86	0.91	0.77	0.04	0.84	0.94
1999	sbr9/N	0.92	0.97	0.79	0.07	0.89	0.96
2000	sbr9/N	0.98	1.00	0.79	0.06	0.91	0.94
2001	sbr9/N	0.89	1.00	0.81	0.09	0.90	0.99
2002	sbr9/N	0.89	1.00	0.83	0.11	0.92	1.01
2003	sbr9/N	0.89	0.97	0.82	0.13	0.93	1.02
2004	sbr9/N	0.92	0.97	0.81	0.08	0.89	0.96
2005	sbr9/N	0.92	0.97	0.81	0.11	0.90	0.97
2006	sbr9/N	0.89	0.94	0.80	0.07	0.87	0.96
2007	sbr9/N	0.92	0.97	0.83	0.11	0.91	0.98
2008	sbr9/N	0.92	0.97	0.83	0.14	0.92	0.99
2009	sbr9/N	0.92	1.00	0.84	0.16	0.93	1.00
2010	sbr9/N	0.92	0.97	0.81	0.08	0.88	0.95
2011	sbr9/N	0.92	0.94	0.83	0.12	0.90	0.97
2012	sbr9/N	0.92	0.97	0.83	0.11	0.88	0.95
2013	sbr9/N	0.95	0.97	0.74	0.02	0.84	0.89
2014	sbr9/N	0.98	1.00	0.82	0.08	0.91	0.95
2015	sbr9/N	0.98	1.03	0.84	0.15	0.96	0.99
2016	sbr9/N	0.95	1.00	0.81	0.09	0.91	0.96
2017	sbr9/N	1.02	1.03	0.79	0.06	0.93	0.94

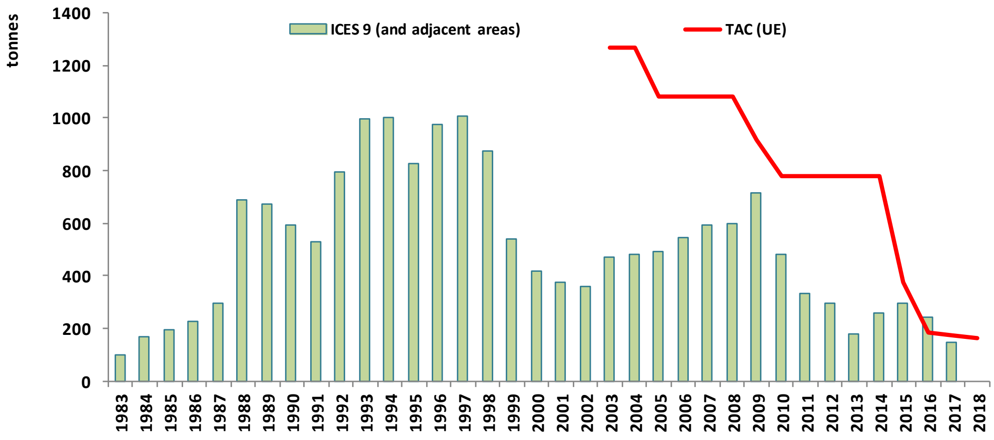


Figure 13.3.1. Blackspot sea bream in ICES Subarea 9 (and adjacent waters): Total European landings (Morocco landings are not included) and EU TACs. Since 2015 landings from Strait of Gibraltar includes other areas (FAO 34.1.11 and FAO 37.1.1).

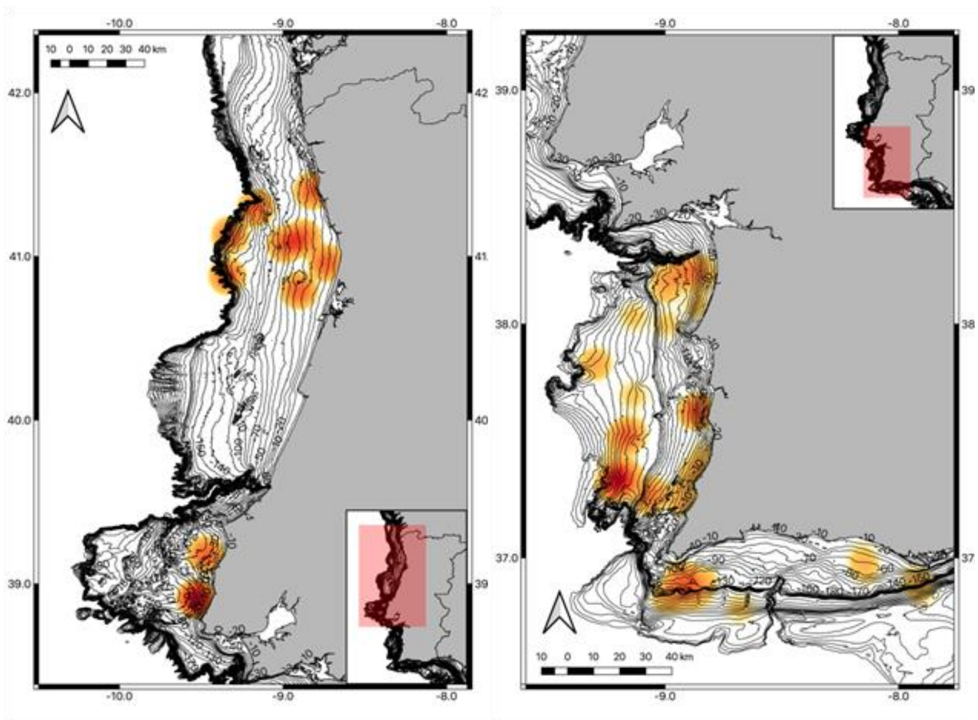


Figure 13.3.2. Blackspot sea bream in ICES Subarea 9: Distribution *of Pagellus bogaraveo* along the Portuguese coast based on Portuguese surveys from the period between 1997-2011 and 2013-2017. The coloured blotches are hauls with Pagellus bogaraveo catches over 5 n.h-1. The colour intensity of the blotches reflects species occurrence. (from Farias *et al.*, WD to the 2018 WGDEEP).

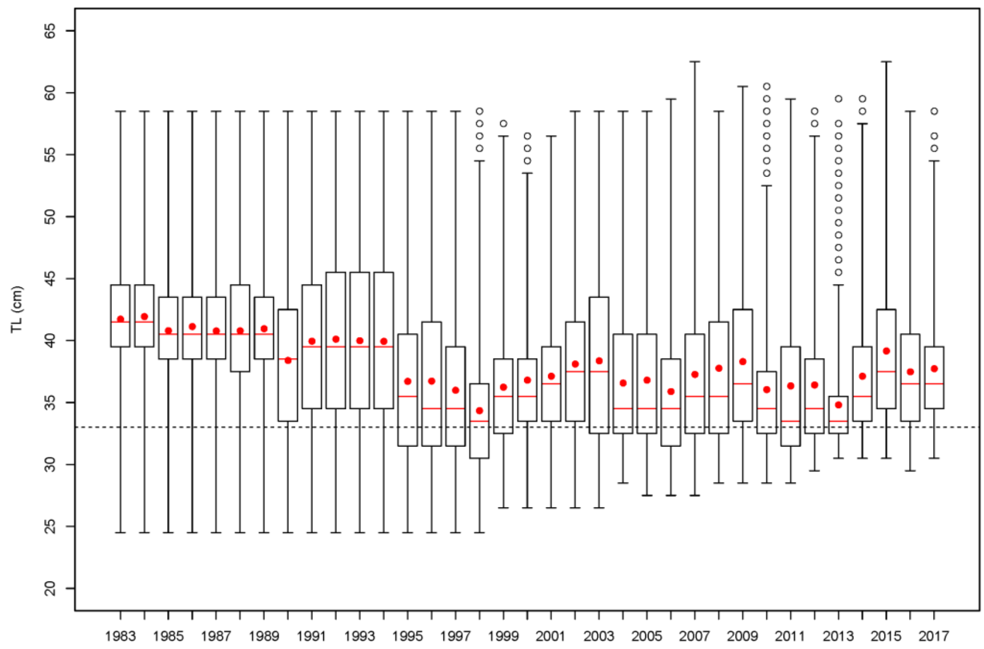


Figure 13.3.3. Spanish "*voracera*" blackspot sea bream fishery of the Strait of Gibraltar: 1983–2017 (from Gil *et al.*, WD to the 2018 WGDEEP). Dashed line (at 33 cm) represents the current minimum landing size for the species in Atlantic NE and Mediterranean.

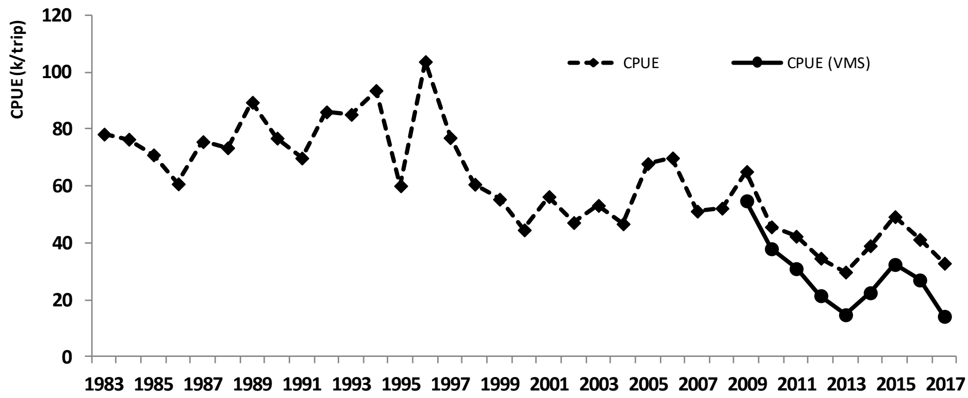


Figure 13.3.4. Blackspot sea bream in ICES Subarea 9: Spanish "*voracera*" target fishery of the Strait of Gibraltar estimated cpue using sales sheets (dashed line) and VMS data as unit of effort (solid line) (from Gil *et al.*, WD to the 2018 WGDEEP).

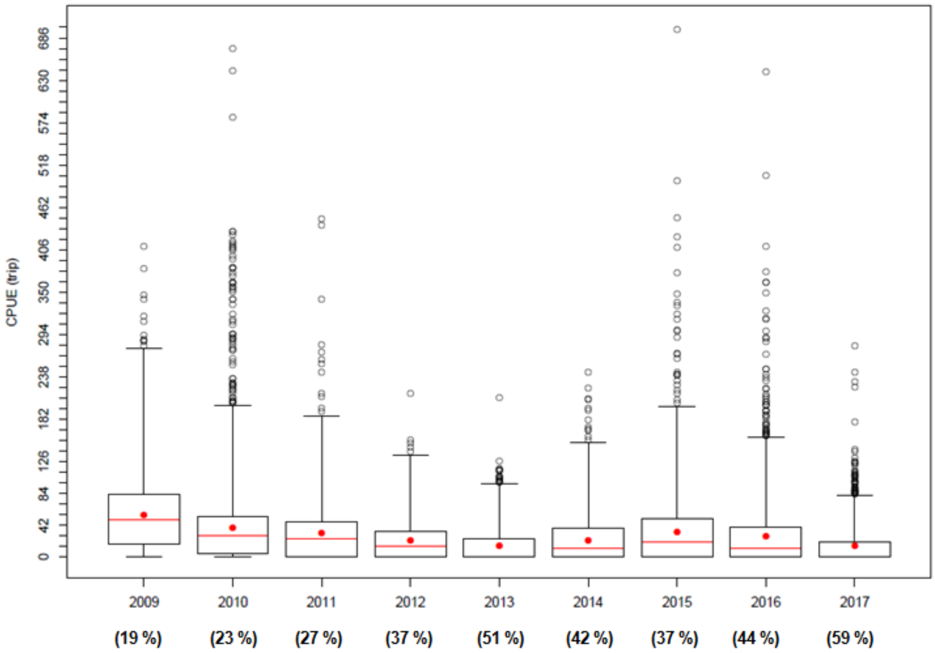


Figure 13.3.5. Blackspot sea bream in ICES Subarea 9: Summary statistics from VMS index: mean value (red dot), median value (red line), Interquartile Range plus Q1-3IQR and Q3+3IQR (box and whiskers) and outliers (circles). Percentage below every year are related to missing effort (percentage of fishing trips with CPUE=0) (from Gil *et al.*, WD to the 2018 WGDEEP).

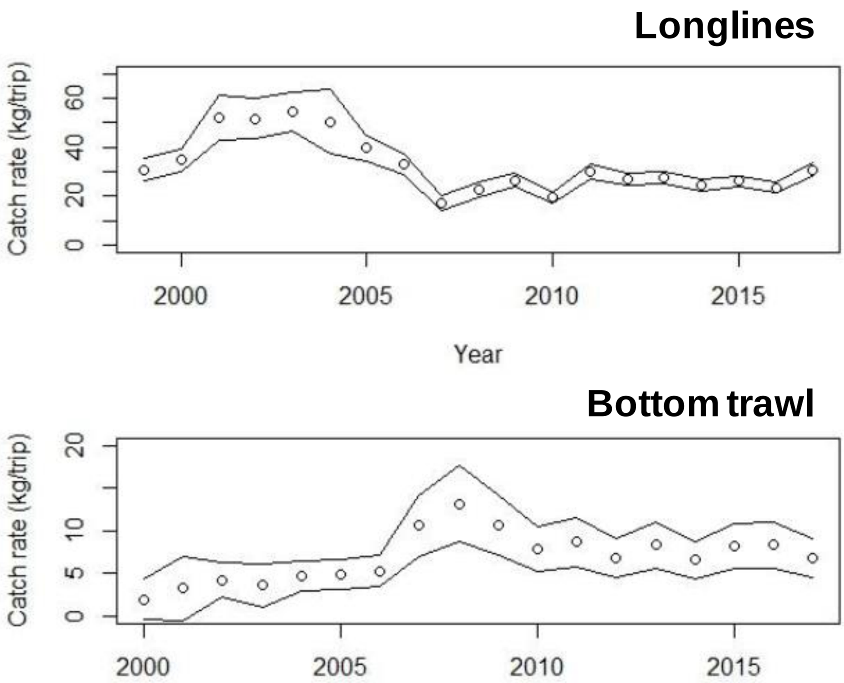


Figure 13.3.6. Blackspot sea bream in ICES Subarea 9: catch rate (kg*trip-1) in Peniche port. Above, bottom longline fleet from 1999 to 2017; Below, trawl fleet from 2000 to 2017 (from Farias *et al.*, WD to the 2018 WGDEEP).

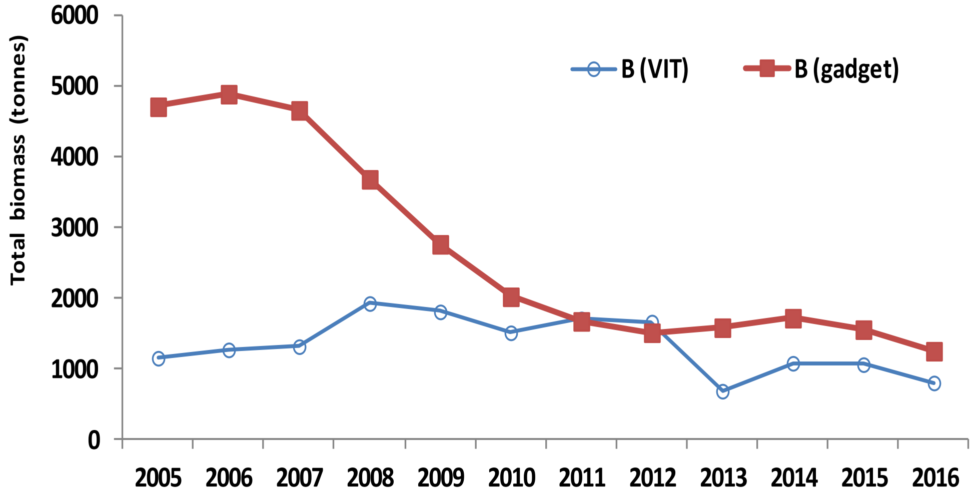


Figure 13.3.7. Blackspot sea bream in ICES Subarea 9: comparison between biomass estimates from LCA/VPA (VIT software) and gadget assessment trials for the Strait of Gibraltar target fishery (from Gil *et al.*, WD to the 2018 WGDEEP).

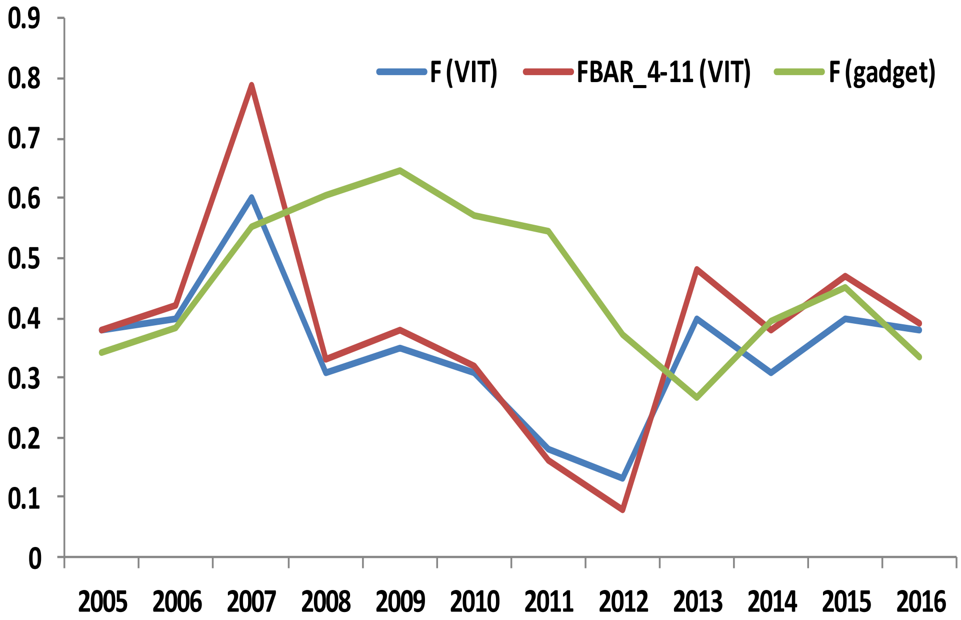


Figure 13.3.8. Blackspot sea bream in ICES Subarea 9: comparison between F estimates from LCA/VPA (VIT software) and gadget assessment trials for the Strait of Gibraltar target fishery (from Gil *et al.*, WD to the 2018 WGDEEP).

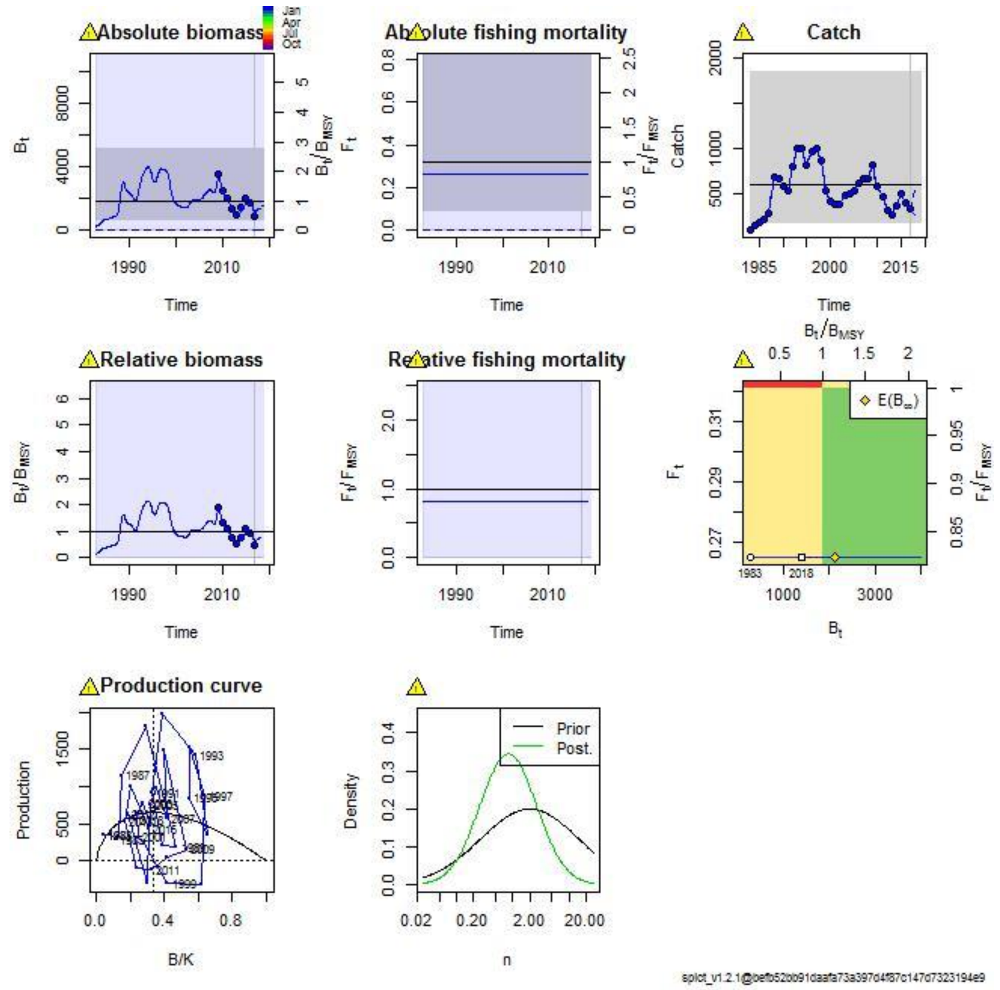


Figure 13.3.9. Blackspot sea bream in ICES Subarea 9: SpiCT summary results (only VMS index).

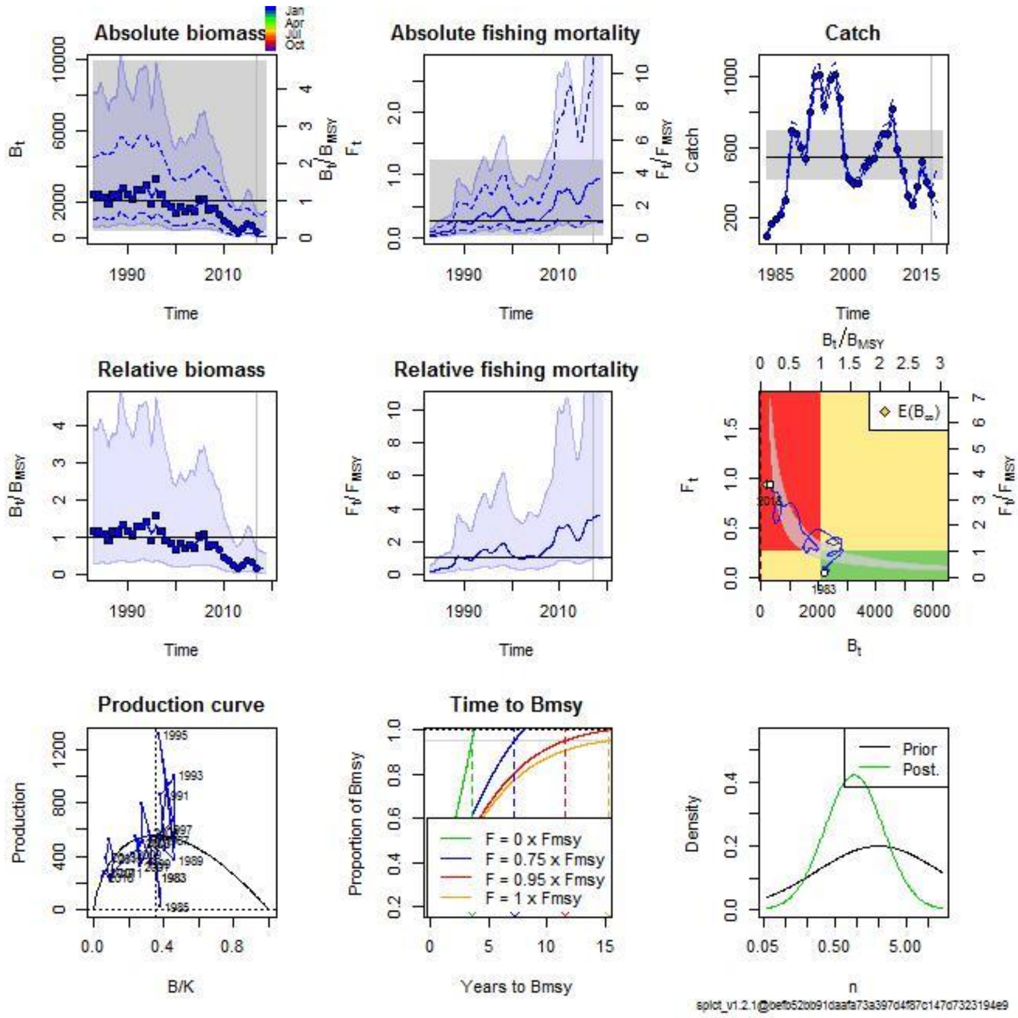


Figure 13.3.10. Blackspot sea bream in ICES Subarea 9: SpiCT summary results (nominal and VMS indices)

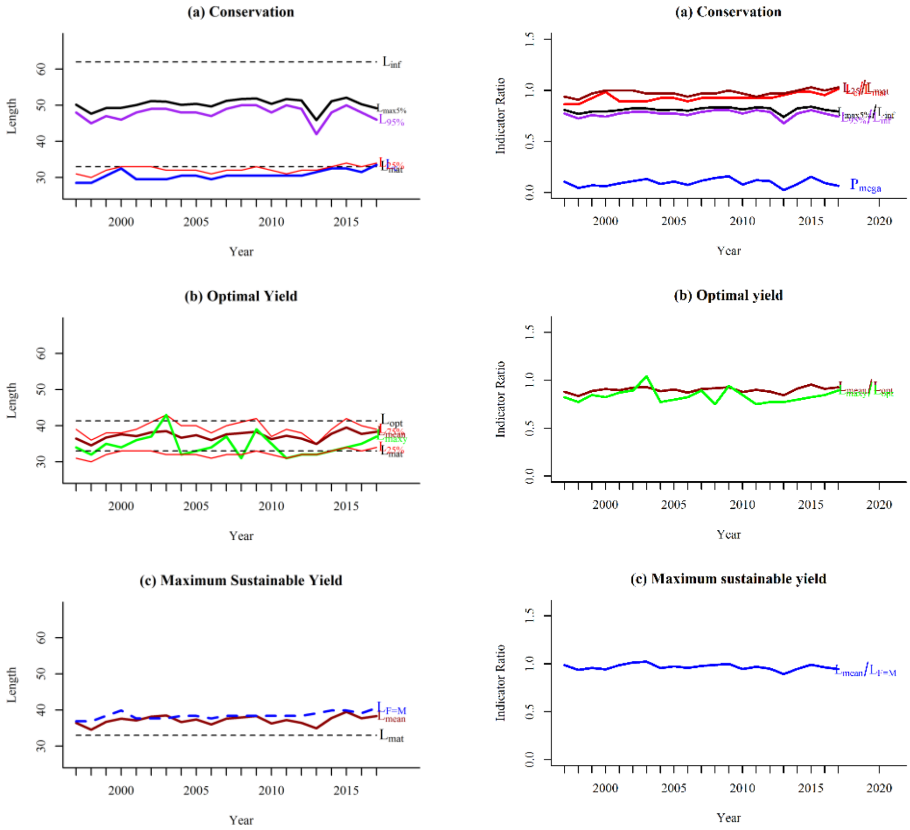


Figure 13.3.11. Blackspot sea bream in ICES Subarea 9: LBI outputs.

13.3.10 References

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13.4 Blackspot sea bream (*Pagellus bogaraveo*) in Division 10.a

13.4.1 The fishery

Blackspot sea bream has been exploited in the Azores (Area 10.a.2), at least since the XVI century as part of the demersal fishery. The directed fishery is a hook and line fishery where two components of the fleet can be defined: the artisanal (handlines) and the longliners (Pinho, 2003; Pinho *et al*., 2009; Pinho *et al.,* 2014). The artisanal fleet is composed of small open deck boats (<12 m) that operate in local areas near the coast of the islands using several types of handlines. Longliners are closed deck boats (>12 m) that operate in all areas but during the last years the fishery are only authorized to operate on offshore (>6 nm) banks and seamounts (Pinho *et al.,* 2014; Diogo *et al.,* 2015). The tuna fishery caught, until the end of the nineties, juveniles (age 0) of blackspot sea bream as live bait, but in a seasonal and irregular way because these catches depend on tuna abundance and on the occurrence of other preferred bait species like *Trachurus picturactus* (Pinho *et al*., 2014).

The Azorean demersal fishery is a multispecies and multigear fishery where *P. bogaraveo* is considered the target species. The effect of these characteristics on the dynamics of the target fishery is not well understood.

13.4.2 Landings trends

Historically, landings increased from 400 t at the start of the eighties to approximately 1000 t at the start of the nineties (Figure 13.4.1), due to the development of new markets, increased fish value, entry of new and modern boats, better professional education of the fisher and introduction of bottom longline gear, permitting the expansion of the exploitable area to deeper waters, banks, and seamounts as well as the expansion of the fishing season (ICES, 2006). Between 1990 and 2009 the annual landings have fluctuated around 1000 t, with a peak in 2005. Important expansion of the fishery to offshore seamounts occurred during this period, particularly made by the longline fleet as a consequence of spatial management measures introduced. During the period 2010–2012 the landings decreased significantly to an average of 641 t, which correspond to about 57% of the TAC during that period, maintaining thereafter around this value due to the TAC introduced. In general a continuous decrease has been observed since 2005. Currently the fishery is highly constrained by management measures.

Landings of 2016 are 515 t and 499t in 2017.

13.4.3 ICES Advice

ICES advises that when the precautionary approach is applied, catches should be no more than 480 tonnes in each of the years 2017 and 2018. All catches are assumed to be landed.

13.4.4 Management

Under the European Union Common Fisheries policy a TAC was introduced in 2003 (EC. Reg. 2340/2002). TACs and landings are given below.

	Reg (CE) Nº. 2015/2006				Reg (CE) Nº. 1359/2008			
P. bogaraveo	**2007**		**2008**		**2009**		**2010**	
ICES Sub-Area	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**
X	**1136**	**1070**	**1136**	**1089**	**1136**	**1042**	**1136**	**687**
	Reg (CE) Nº. 1225/2010				Reg (CE) Nº. 1262/2012			
P. bogaraveo	**2011**		**2012**		**2013**		**2014**	
ICES Sub-Area	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**	**TAC**	**Landings**
X	1136	624	1136	613	1122	692	920	663
	Reg (CE) Nº. 1367/2014				Reg (CE) Nº. 2285/2016			
P. bogaraveo	**2015**		**2016**		**2017**		**2018**	
ICES Sub-Area	**TAC**	**Landing**	**TAC**	**Landing**	**TAC**	**Landing**	**TAC**	**Landing**
X	**690**	**701**	**517**	**515**	**507**	**499**	**507**	

Since 2003 deep-water fishing within 100 miles of the Azores baseline is restricted to vessels registered in the Azores under the management of fishing effort of the common fishery policy for deep-water species (EC. Reg. 1954/2003). For the 2006 the Regional Government introduced a quota system by Island and vessel. Specific access requirements and conditions applicable to fishing for deep-water stocks were established (EC. Reg 2347/2002). Fishing with trawl gears and bottom gillnets was forbidden in the Azores region.

For 2009, the Regional Government introduce new technical measures, including the minimum landing size (30 cm total length), area restrictions by vessel size and gear, and gear restrictions (hook size and maximum number of hooks on the longline gear). A seamount (Condor) was also closed to fisheries to allow a multidisciplinary research (ecological, oceanography and geological). During 2015, 2016 and 2017 additional technical measures were introduced limiting the fishing area for longliners, updated the minimum landing size to 33cm and introducing marine protected areas for coastal and oceanic areas. Undersize proportion of fish permitted on board of fishing levels was updated introducing a lower tolerance limited. A close season to reduce effort on the spawning aggregations was introduce (covering the period January 15 and end of February) and implemented in 2016. During 2017 new license limitations were introduced for littoral hook and line fisheries.

13.4.5 Data available

13.4.5.1 Landings and discards

Total annual landings data are available since 1980. However, detailed and precise landing data are available for the assessment since 1990 (WD Pinho *et al*., 2018a). Landings from Area 10.a.2 are presented in the Table 13.4.1 and Figure 13.4.1.

Information on the discards in the longline fishery has been collected in the Azores by a team of observers on board the longline fleet. This information was presented during the 2012 meeting and was not updated (WD, Pinho, 2015). On average about 0.6% of blackspot sea bream was discarded annually on sampled trips between 2004 and 2012.

13.4.5.2 Length compositions

Length composition data of the catch of the fishery is available for the period 1990 to 2016. However data from 1990–1994 is based on low sampling coverage and so are not presented here. Data for subsequent years are presented in Figure 13.4.2. Length data for 2017 was not available.

Length compositions are similar to those from surveys (Figure 13.4.3) with a mode around 25–28 cm. Large quantities of adult individuals greater than 40 cm are observed in the fishery for the years 1999, 2002 and 2005 decreasing thereafter. This increase may be relate to catchability factors. The length distributions present some sort of truncation for the last five years because the reduction of juveniles due to minimum size measures and a reduction of large individuals.

13.4.5.3 Age compositions

The information is available from the fishery and surveys until 2016 but are not presented here because it is not relevant to the current assessment.

13.4.5.4 Weight-at-age

No new information was presented to the group because there are no relevant changes on the biology of the species.

13.4.5.5 Maturity, sex-ratio and natural mortality

Maturity and sex-ratio data were updated in accordance with the methods outlined in the stock annex. Natural mortality was reviewed in 2015 (WD Silva *et al*., 2015) exploring several empirical methods for the M estimation. A mean value of M=0.3 was estimated but with a considerable uncertainty.

13.4.5.6 Catch, effort and research vessel data

Standardized fishery cpue was updated for the period 1990–2016 (WD Pabon et al 2018) (Figure 13.4.4 Table 13.4.2). A Generalized Linear Modelling approach using a hurdle (delta) model was applied. The standardization protocols assumed a hurdle model (zero-altered lognormal) with a binomial error distribution and logit link function for modelling the probability that a null or positive observation occurs (proportion of positive catches), and a lognormal error distribution with an identity link function for modelling the positive catch rates on successful trips. The index trends showed an oscillation over time, with a general increasing trend until 1996, and a general decreasing behaviour after this period (Figure 13.4.4). The trends from the nominal and standardized index differed markedly from 2002 onwards; indeed, the nominal CPUE showed a rather increasing trend until 2005, while the standardized index presented a less pronounced trend. However, it is not necessary that the nominal and standardized trends follow the same trend. The standardized index for the *year* factor show in theory the trend of the population, while the nominal catch rates should represent the combined trends of all other factors and its interactions.

Survey data were updated (WD Pinho, 2018b) and are resumed on Figure 13.4.5 and Table 13.4.3.

13.4.6 Data analyses

The standardised fishery cpue has been variable but shows no overall trend (Table 13.4.2; Figure no. 13.4.4). In recent years, the cpue appears to have shown a declining trend from a high point in 2005 with current cpue around the lowest observed level. This coincides with a declining trend in landings (Figure 13.4.1) and survey abundance indices (Figure 13.4.5) over the same period, except for the last two year for the survey case.

The Azorean bottom longline survey targeting *Pagellus bogaraveo* is reliable for abundance estimates, since the survey design is adapted to the stock behaviour covering most of the species habitat (with exception of seamounts around Mid-Atlantic Ridge) (Table 13.4.3). The survey time-series is not continuous because in some years there was no survey. The annual values were computed using statistical areas I-IV because area VI was not sampled in some years. Survey indices from 1995 to 2017 show no trend with a high value every three years until 2005 and for the years of 2016 and 2017 (Figure 13.4.5). The 2017 year correspond to the highest index value observed on the time series. These high values may be related with some sort of catchability variability (fish are more available to the gear in some years) as a function of the feeding behaviour (bentho-pelagic), reproduction (protandric forming spawning aggregations) of the species or due to environmental effects. However, the survey abundance indices from 2010–2013 are on the range of lowest values with a decrease trend. This period correspond to the lowest catch observed during the last 19 years being on average 60% of the precedent years (1995–2009) (Figure 13.4.1). Survey abundance indices of mature and immature follows the same trend of the total abundance estimates (Figure 13.4.6).

Annual mean length data from the fishery and from the survey follow a similar trend (Figure 13.4.7). An overall increase trend is observed on the annual mean length but with interannual variability.

Mean length of mature stock for the entire period (1995–2017) is around 37 cm (Figure 13.4.8) and immature about 26 cm (Figure 13.4.9) Mature fish mean length increased from 36 cm in 1995 to 41 cm in 2000 and decreased thereafter until 36 cm in 2013, with an increase for the last two years. Variance of the estimates is high.

No analytical assessment was carried out this year.

Exploratory analysis

Length-based indicators

Length-based indicators were explored and updated using refined code developed at WKSHARK4 that have helped improve the reliability of the calculations of L_C and improved usability. The life history parameters used in this exercise are given in Table 13.4.4. Combined sex data were used (ignoring hermaphroditic demographic structuring) from 1995–2016 and assuming negligible discards.

The overall results from LBI (Table 13.4.5 and Figure 13.4.10) were similar to those from previous assessments (ICES, 2016). Results show that most indicators show a consistently poor status across the survey period. From 1997 through to 2005 however, the indicator L_{max5}/ L_{∞} was above the threshold of 0.8 and provided a good status. This was similarly observed in $L_{mean}/ L_{F=M}$, albeit it with slightly "poor" status values (<0.05 below "good") from 2001 – 2004.

The results consistently suggest that harvesting occurs below the size at maturity and therefore conservation of juvenile fish is poor (L_C and $L_{25\%} << L_{mat}$ (30 cm). This was expected since the current relative exploitation pattern corresponds with an $L_{50\%}$ of around L_{mat}. This L_{mat} value is already considered low having declined from 34 cm to 30 cm in recent years, likely due to a response to fishing pressure. This indicator has been generally steady over the survey period.

For the mature fraction of the populations, the results suggest that the large individuals are present but scarce ($L_{max}<L_{\infty}$). L_{mat} of 30 cm is considered lower than L_{opt} (37 cm) and the indicator of P_{mega} is consistently lower than the expected threshold of 0.3. There were no increasing or decreasing trends across the survey period, with all indicators remaining relatively steady. The years where $L_{mean}/ L_{F=M}$ (an MSY proxy)

demonstrated a "good" status (1992, 1998–2000 and 2005), all correspond to years of relatively higher P_{mega} values (≥ 0.1), which indicate the presence of larger fish in the catches (Table 13.4.5).

Overall the updated LBI assessments suggests that the stock has been exploited unsustainably at levels above optimal and MSY, with no evidence to suggest improving conditions.

Comments on the explanatory analysis

The recommendation to standardize the fishery cpue was fulfilled. There are conflicts between the fishery cpue and survey trend for the last two years. However, the fishery is highly constrained by the management measures (TAC/quotas and technical measures) introduced in the last years, which may explain the fishery cpue trend.

13.4.7 References

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Silva et al. 2015

13.4.8 Tables and Figures

Table 13.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2).

Year	Azores (10.a.2)	Total
1980	415	415
1981	407	407
1982	369	369
1983	520	520
1984	700	700
1985	672	672
1986	730	730
1987	631	631
1988	637	637
1989	924	924
1990	889	889
1991	874	874
1992	1090	1090
1993	830	830
1994	989	989
1995	1115	1115
1996	1052	1052
1997	1012	1012
1998	1119	1119
1999	1222	1222
2000	947	924
2001	1034	1034
2002	1193	1193
2003	1068	1068
2004	1075	1075
2005	1113	1113
2006	958	958
2007	1063	1070
2008	1089	1089
2009	1042	1042
2010	687	687
2011	624	624
2012	613	613
2013	692	692
2014	663	663
2015	701	701
2016	515	515
2017	499	499

Table 13.4.2. Nominal and standardized bottom longline fishery abundance index (scaled cpue to the mean) of the blackspot sea bream (*Pagellus bogaraveo)* in Subarea 10.

YEAR	NOMINAL CPUE	STANDARDIZED CPUE	LOWER CI	UPPER CI
1990	0.92	0.97	0.87	1.08
1991	0.92	0.94	0.81	1.07
1992	0.96	0.98	0.78	1.17
1993	0.79	1.01	0.87	1.15
1994	0.97	1.01	0.84	1.18
1995	1.09	1.08	0.92	1.23
1996	1.24	1.5	1.25	1.75
1997	1.63	1.32	1.1	1.53
1998	1.03	1.21	1.06	1.35
1999	1.1	1.3	1.16	1.44
2000	0.82	0.82	0.75	0.9
2001	1.12	0.96	0.84	1.07
2002	1.24	1.02	0.9	1.15
2003	0.98	1	0.91	1.1
2004	1.42	1.08	0.96	1.19
2005	1.71	1.16	1.06	1.27
2006	1.26	0.95	0.86	1.04
2007	1.34	1.22	1.09	1.36
2008	1.21	1.13	1.02	1.24
2009	1.18	0.96	0.88	1.05
2010	0.62	0.72	0.66	0.78
2011	0.59	0.76	0.69	0.82
2012	0.62	0.81	0.74	0.88
2013	0.64	0.91	0.83	0.99
2014	0.67	0.83	0.76	0.90
2015	0.56	0.74	0.68	0.80
2016	0.39	0.61	0.56	0.67

Table 13.4.3. Survey relative abundance index in number of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2).

Year	Lower	Index	Upper
1995	88	105	125
1996	33	42	49
1997	33	48	58
1998	na	na	na
1999	80	112	143
2000	38	52	67
2001	58	67	78
2002	126	138	150
2003	66	86	103
2004	69	94	120
2005	118	143	166
2006	na	na	na
2007	54	79	106
2008	84	102	119
2009	na	na	na
2010	53	67	83
2011	52	70	87
2012	49	60	69
2013	38	47	55
2014	na	na	na
2015	na	na	na
2016	114	135	158
2017	125	155	182

na = Not available.

Table 13.4.4: Life history parameters used the length-based indicator (LBI) assessment.

Parameters	Value	Definition	Obs.
L_{oo} (cm)	56,72	Asymptotic average maximum length	ICES, 2012
K (year-1)	0,13	Growth coefficient of the von Bertalanffy growth model	ICES, 2012
a=	0,0172	Condition factor parameter of length-weight relationship	Rosa *et al.*, 2006
b=	3,0273	Slope parameter of length–weight relationship	Rosa *et al.*, 2006
M	0,2	Natural mortality	ICES, 2006
L_{mat}	30,0	Length at maturity taken from female fish	ICES, 2016

Table 13.4.5. Length-based indicator (LBI) status for *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2). Red values indicated value lower than threshold (poor status), and green values indicate a value higher than the threshold (good status).

Year	Lc_Lmat >1	L25_Lmat >1	Lmax5_Linf >0.8	Pmega >0.3	Lmean_Lopt ≈1	Lmean_LFeM ≥1
	Conservation (Immatures)		Conservation (Large)		Optimal Yield	MSY
1990	0.65	0.75	0.76	0.04	0.76	0.99
1991	0.65	0.72	0.75	0.03	0.72	0.95
1992	0.98	1.02	0.79	0.13	0.97	1
1993	0.68	0.78	0.77	0.04	0.75	0.95
1994	0.88	0.88	0.79	0.06	0.86	0.95
1995	0.82	0.85	0.77	0.05	0.81	0.94
1996	0.82	0.88	0.73	0.03	0.81	0.94
1997	0.75	0.85	0.83	0.07	0.8	0.97
1998	0.72	0.82	0.89	0.12	0.82	1.02
1999	0.75	0.82	0.9	0.17	0.88	1.07
2000	0.72	0.85	0.87	0.13	0.85	1.06
2001	0.75	0.82	0.85	0.09	0.81	0.99
2002	0.78	0.88	0.84	0.09	0.84	0.99
2003	0.78	0.85	0.82	0.07	0.8	0.95
2004	0.82	0.85	0.81	0.06	0.82	0.95
2005	0.75	0.85	0.83	0.1	0.83	1
2006	0.85	0.92	0.8	0.08	0.86	0.97
2007	0.82	0.88	0.79	0.06	0.84	0.97
2008	0.78	0.88	0.8	0.07	0.83	0.98
2009	0.85	0.92	0.81	0.08	0.86	0.98
2010	0.92	0.98	0.81	0.07	0.88	0.95
2011	0.85	0.92	0.79	0.05	0.83	0.94
2012	0.88	0.92	0.78	0.05	0.84	0.93
2013	0.92	0.95	0.8	0.05	0.85	0.92
2014	0.82	0.88	0.78	0.04	0.8	0.93
2015	0.88	0.92	0.8	0.06	0.84	0.93
2016	0.88	0.95	0.84	0.1	0.87	0.97

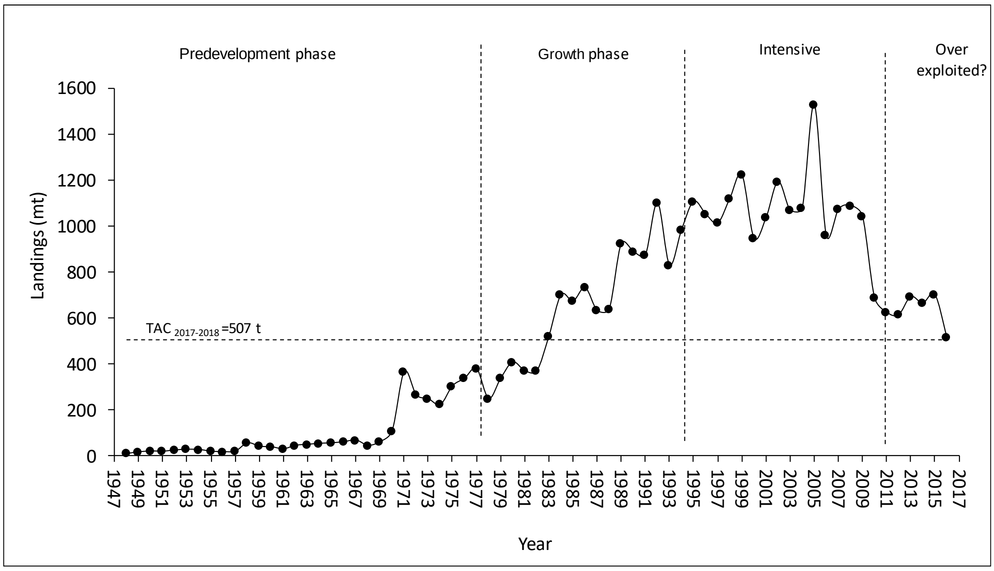

Figure 13.4.1. Historical landings of *Pagellus bogaraveo* from the Azores (ICES Area 10.a.2). Main technical management measures introduced to the fishery are also shown on the graph.

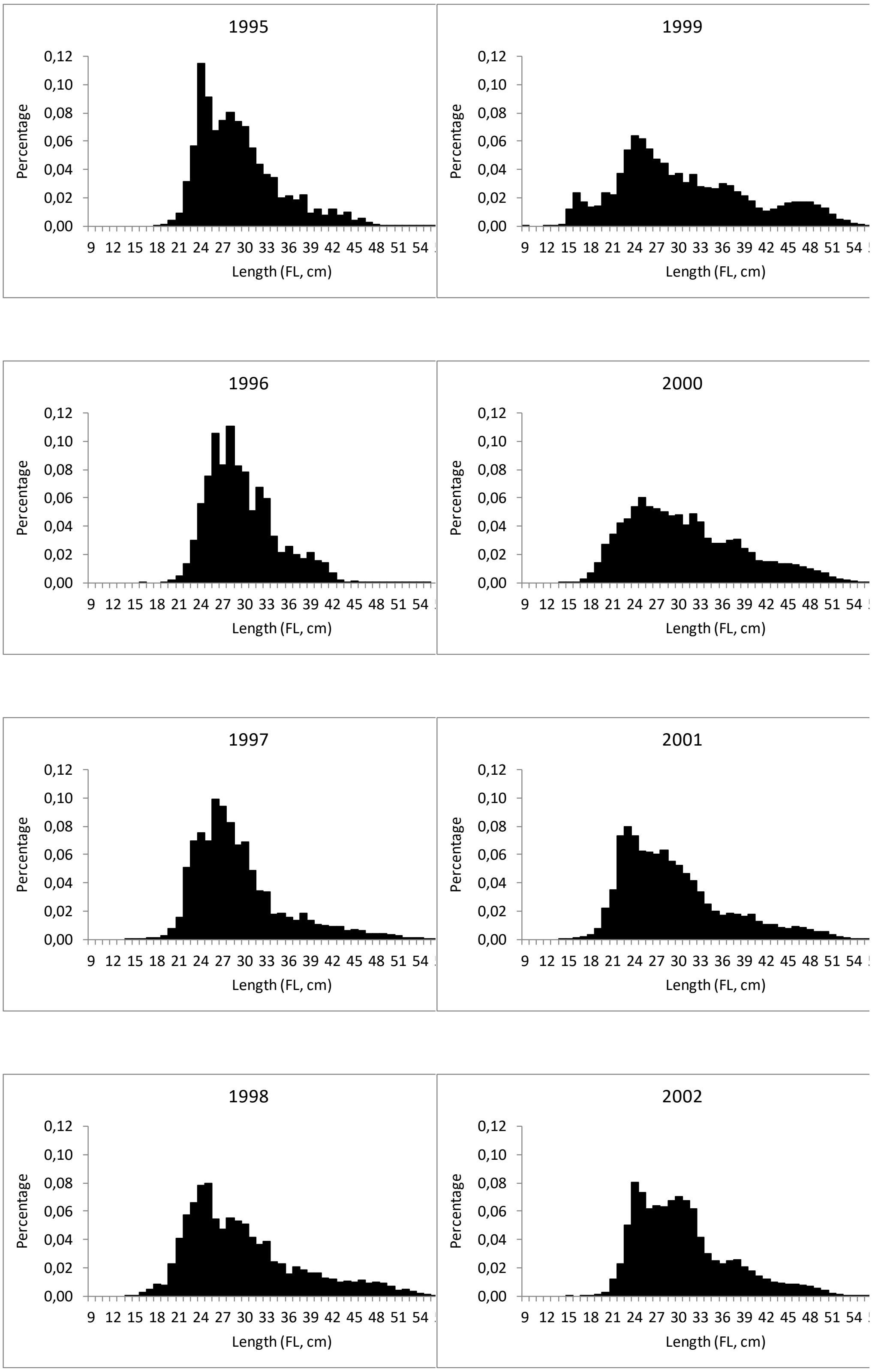

Figure 13.4.2. Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area 10.a.2).

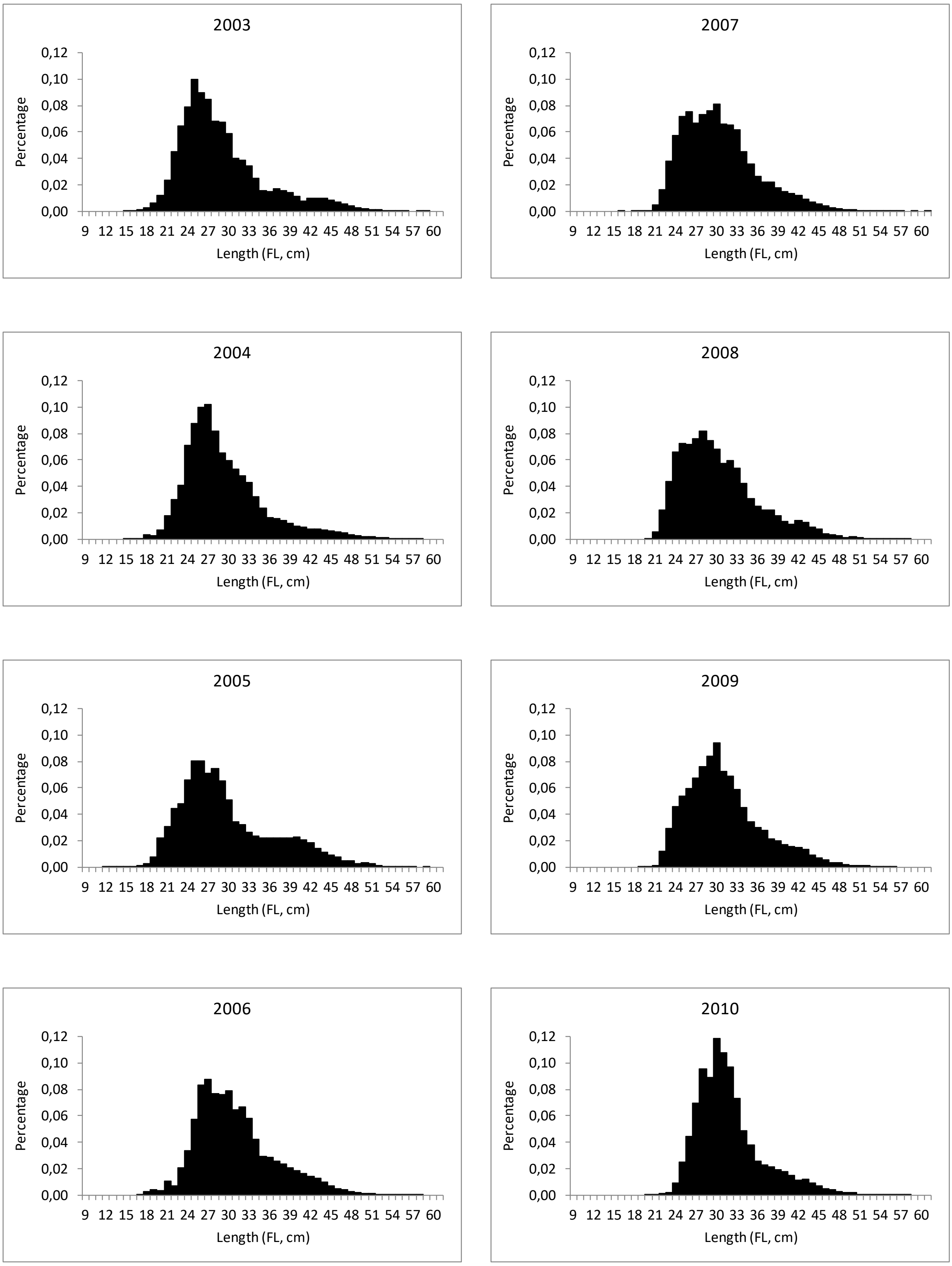

Figure 13.4.2. (Cont.). Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area 10.a.2).

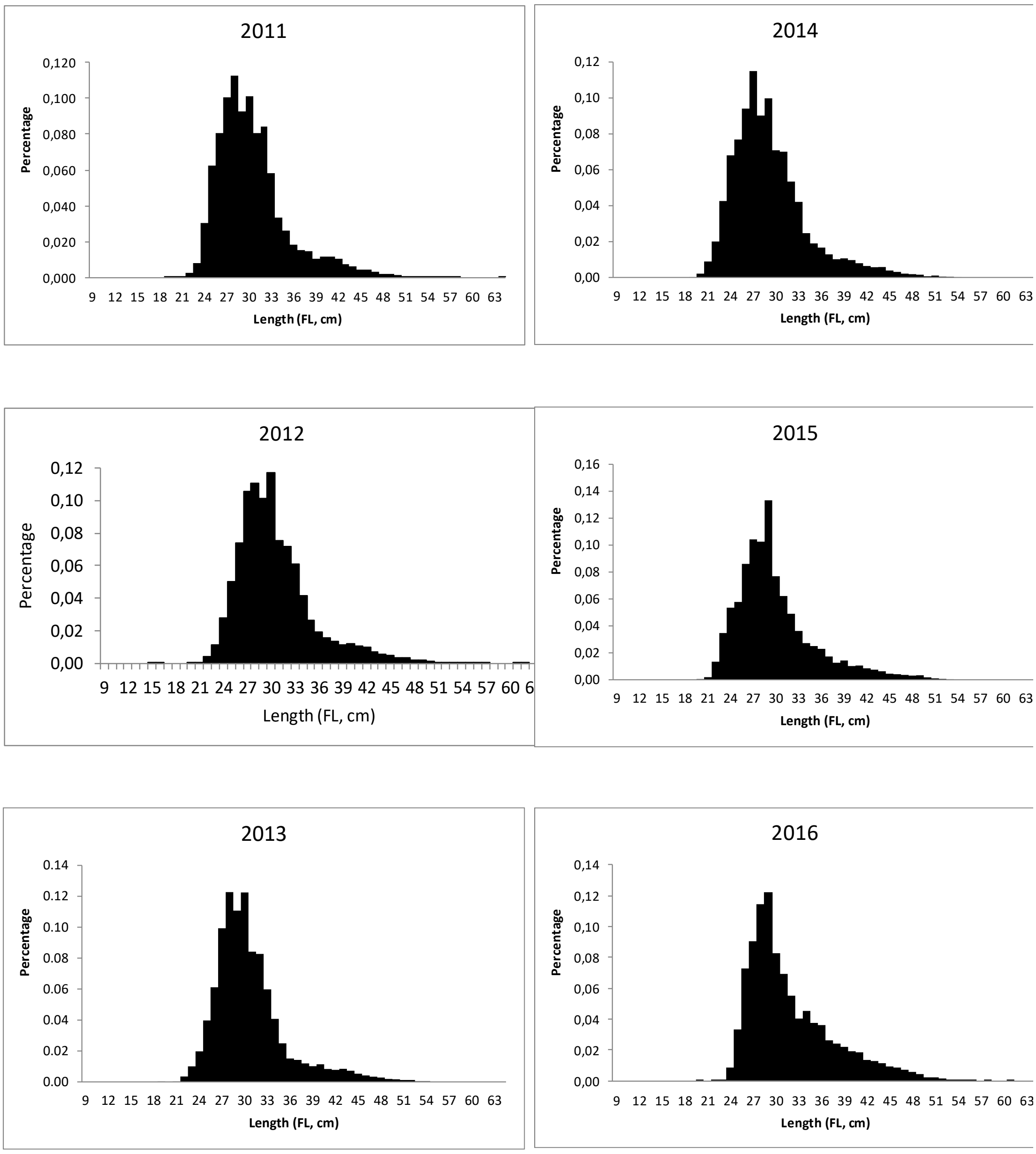

Figure 13.4.2. (Cont.) Annual length composition of *Pagellus bogaraveo* from the fishery for the period 1995–2013 (ICES Area 10.a.2).

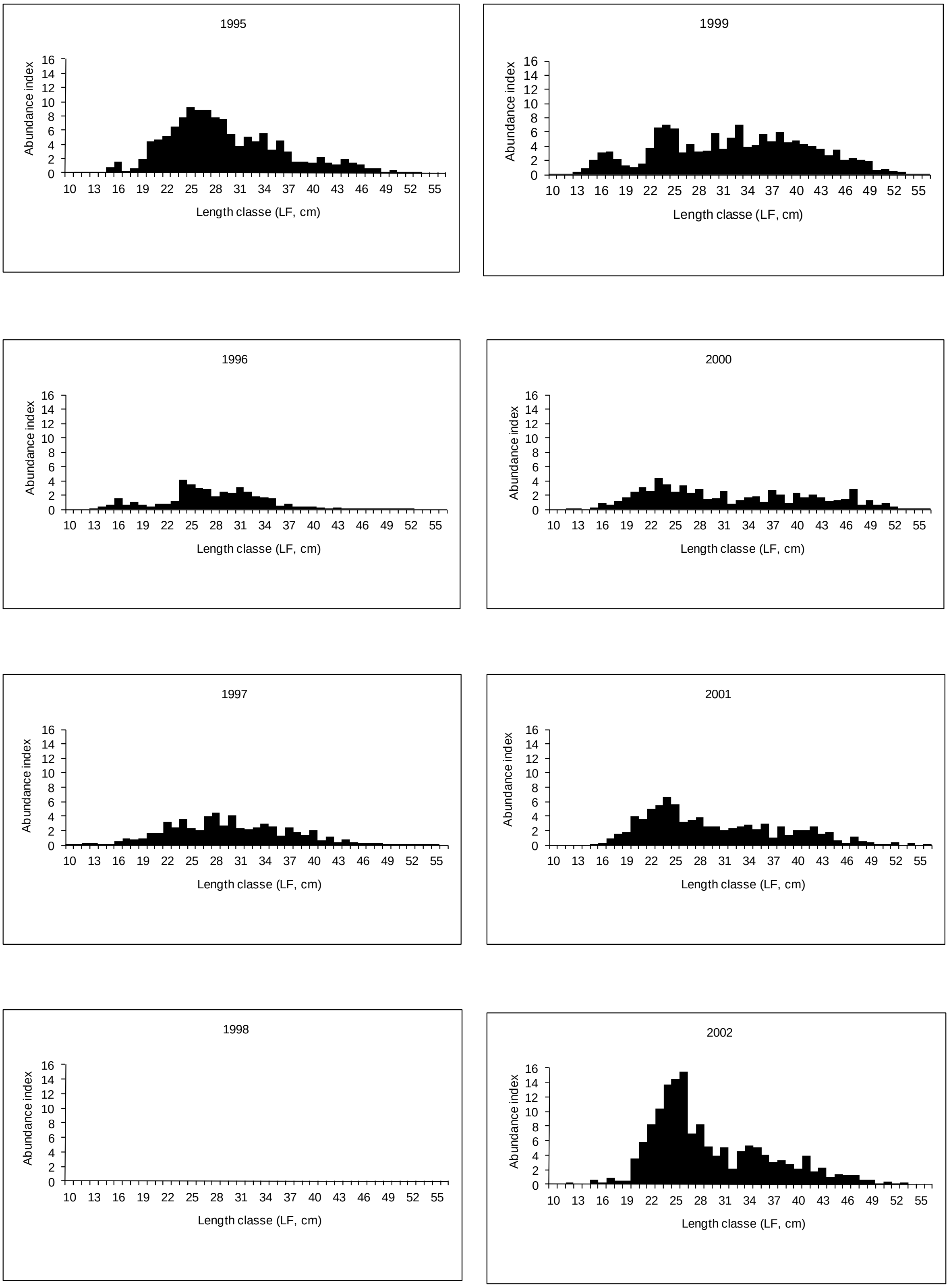

Figure 13.4.3. Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2003 (ICES Area 10.a.2).

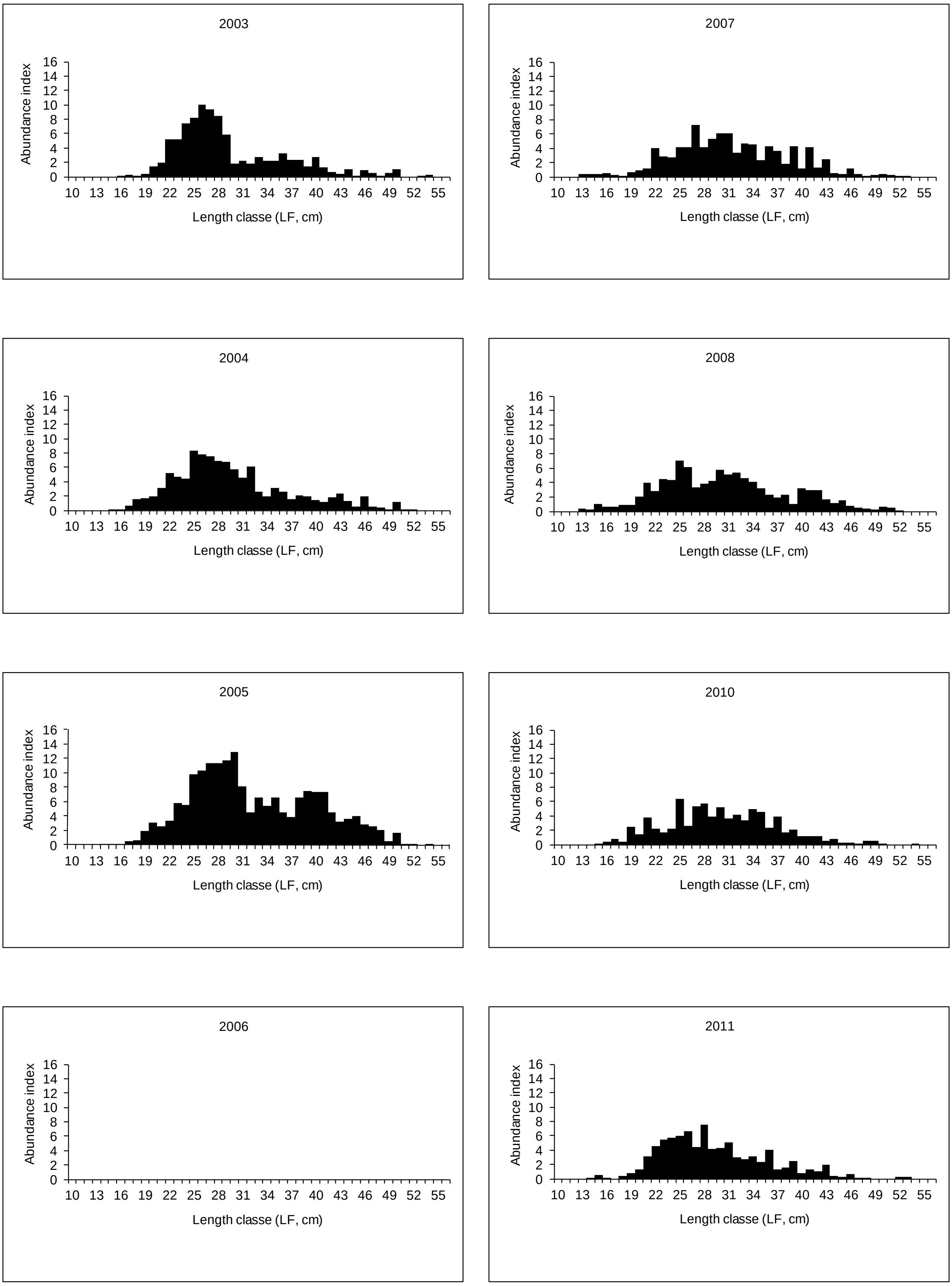

Figure 13.4.3. (Con't). Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2013 (ICES Area 10.a.2).

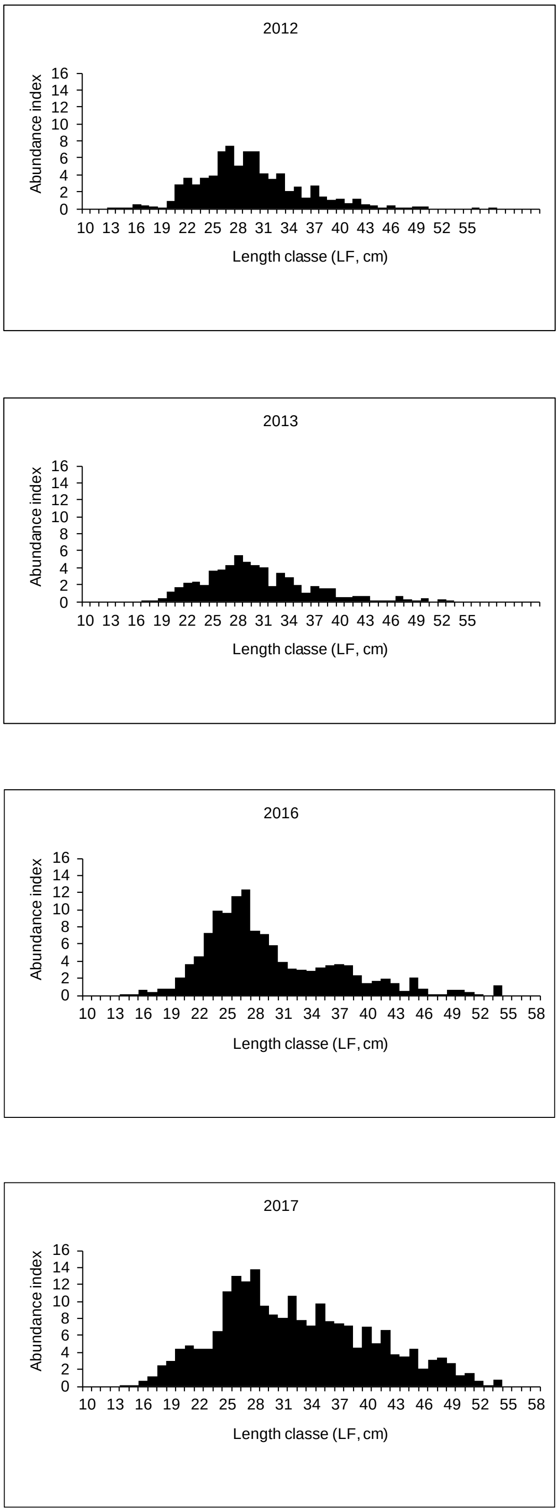

Figure 13.4.3. (Con't) Annual length composition of *Pagellus bogaraveo* from the Azorean spring bottom longline survey for the period 1995–2013 (ICES Area 10.a.2).

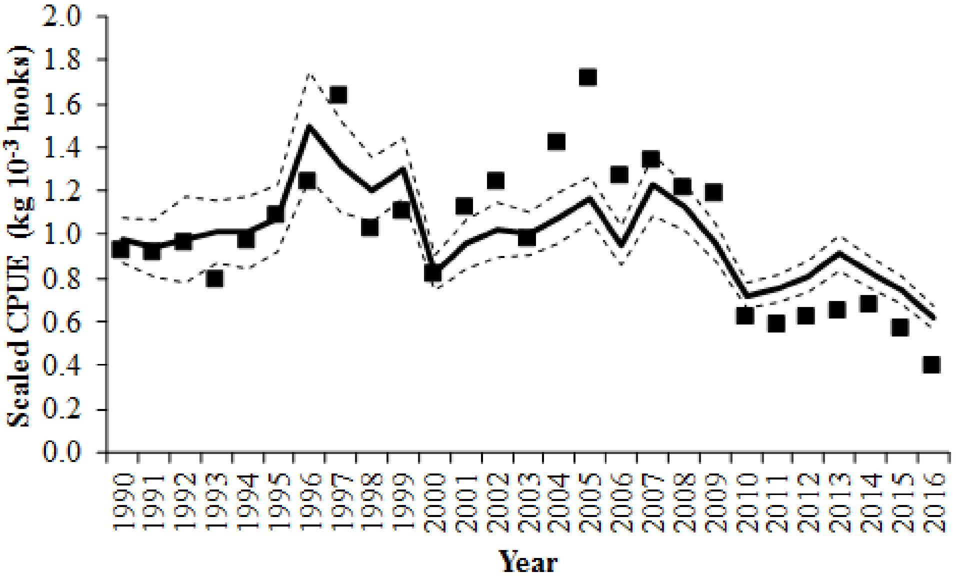

Figure 13.4.4. Standardized fishery catch rates of *Pagellus bogaraveo* from ICES Area 10.a.2. In the graph are shown the nominal cpue (squares), standardized cpue (solid line) and confidence intervals (dashed line).

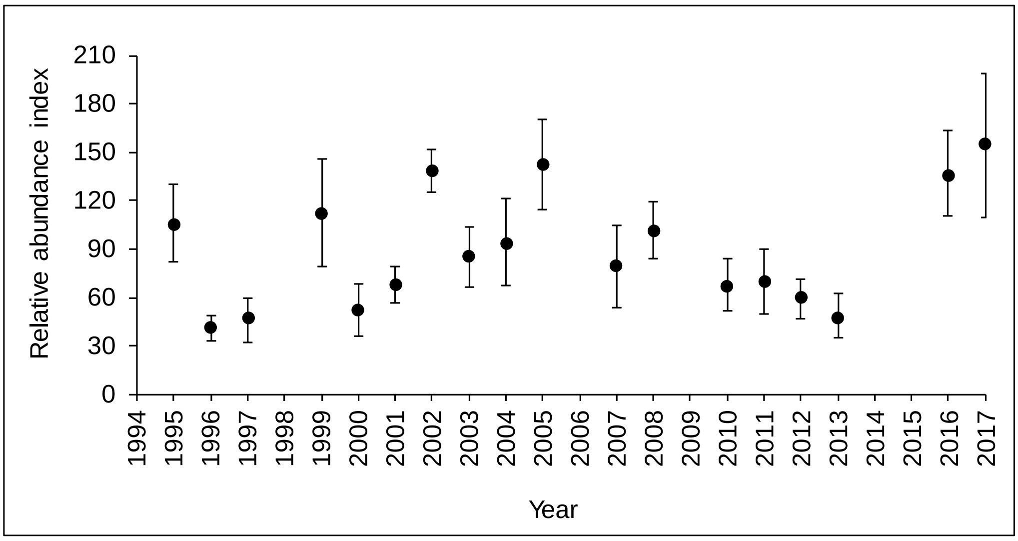

Figure 13.4.5. Annual abundance in number (Relative Population Number) and in weight (Relative Population Weight) of *Pagellus bogaraveo* from surveys for ICES Area 10.a.2.

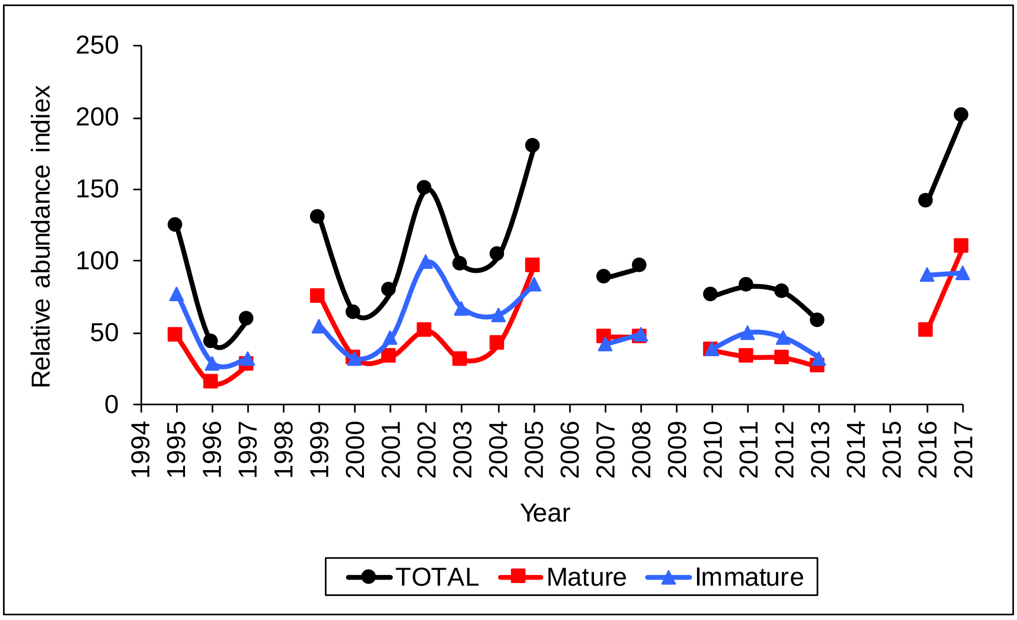

Figure 13.4.6. Survey abundance indices for mature and immature stock.

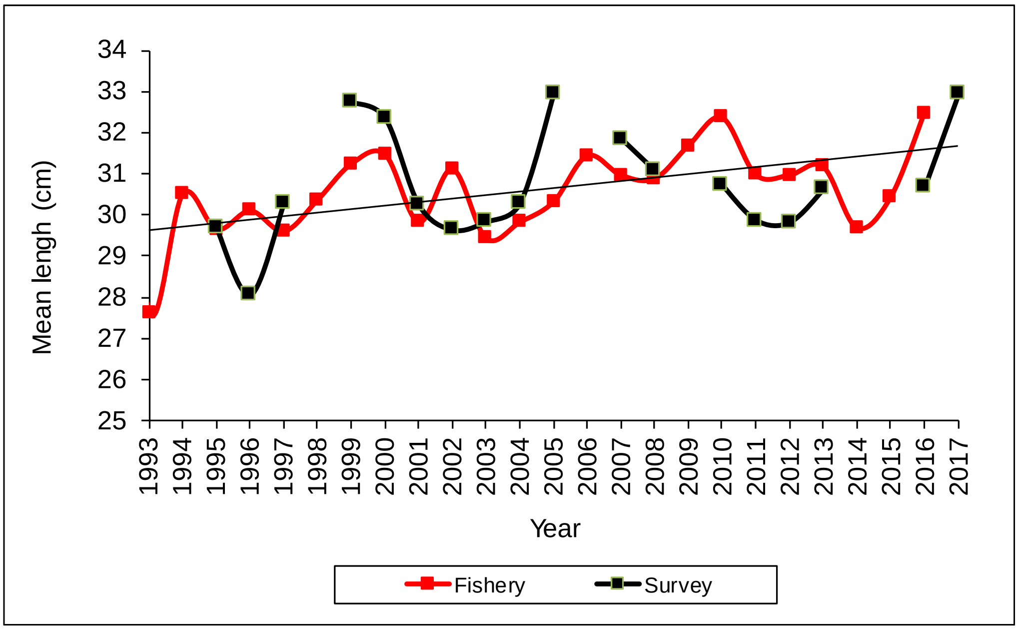

Figure 13.4.7. Annual mean length from the fishery (1990–2010) and from survey length compositions (1995–2008).

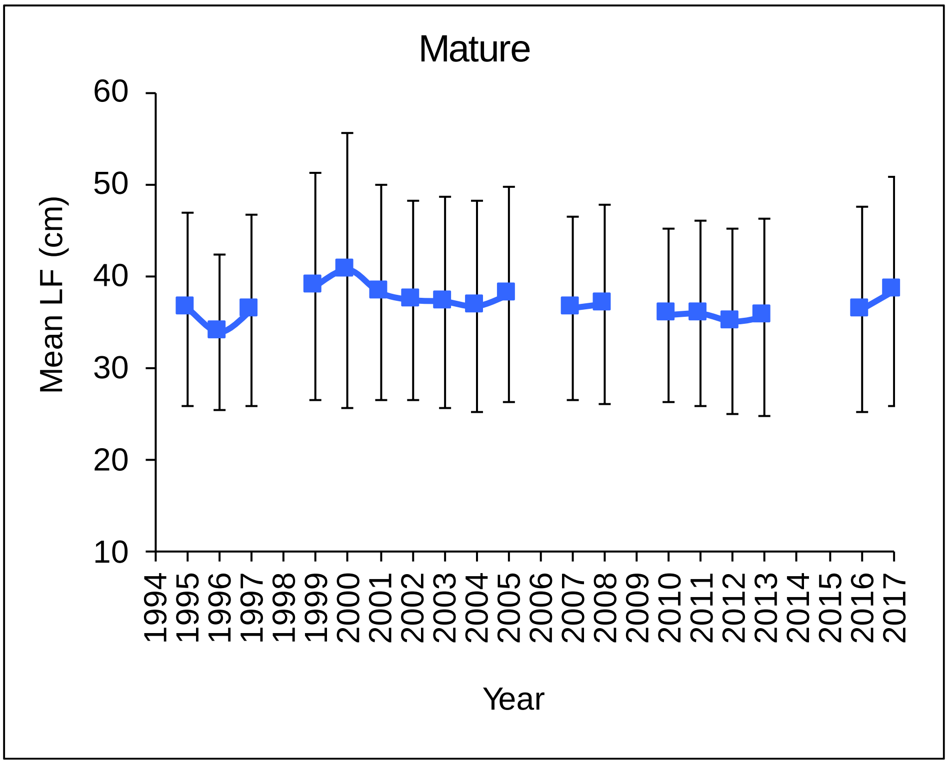

Figure 13.4.8. Annual mean length of mature individuals from the Azorean longline survey.

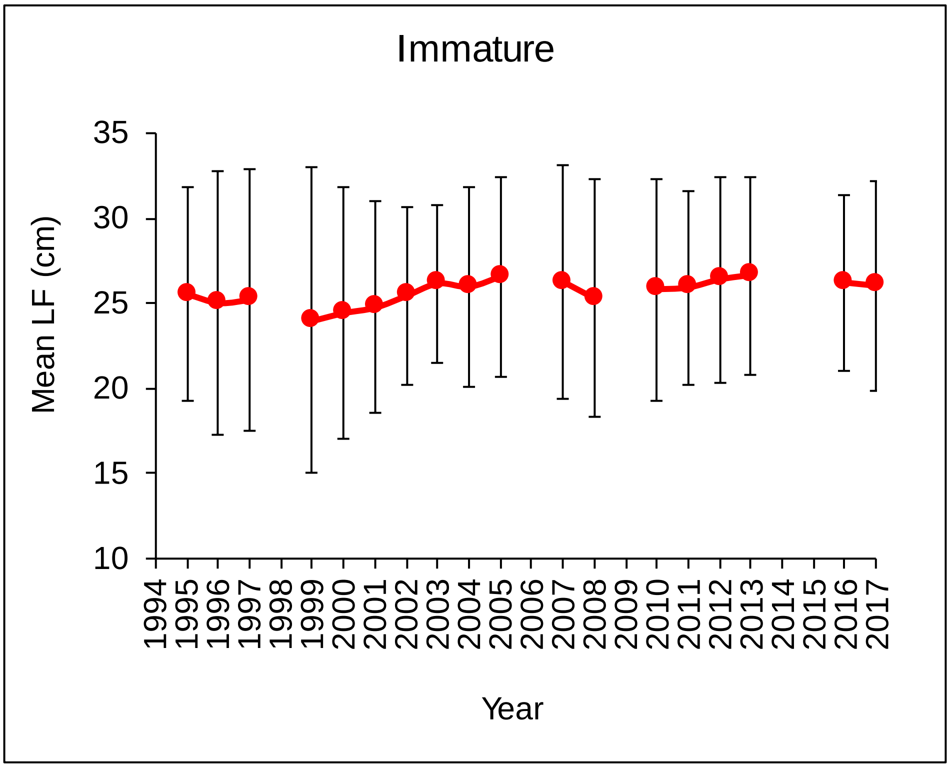

Figure 13.4.9. Annual mean length of immature individuals from the Azorean longline survey.

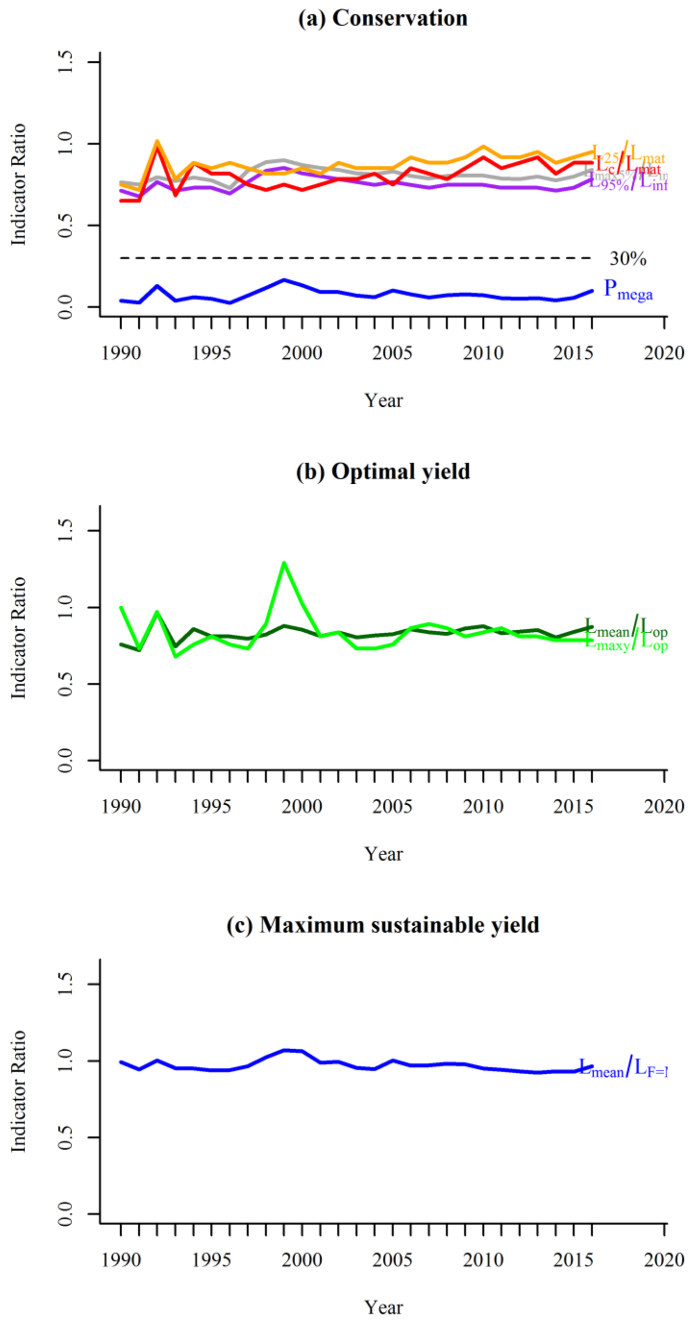

Figure 13.4.10: Indicator ratios and reference points for red sea bream in the Azores (ICES 10.a) for the period 1993–2015.

14 Roughhead grenadier (*Macrourus berglax*) in the Northeast Atlantic

14.1 Stock description and management units

The population structure of roughhead grenadier in the Northeast Atlantic in unknown. The species occurs at small abundance in some areas, mostly to the North of 60°N. The assessment unit considered by ICES is the whole Northeast Atlantic, this does not postulate anything about the population structure.

14.2 The fishery

Roughhead grenadier has a low commercial value and the scarce landing data available correspond mostly to landed bycatch. However, unusually large catches (> 500 t) in Subarea 6 from 2005–2007, in Subarea 12 from 2002–006 and 2012 as well as in Subarea 14 from 2012–2014 were reported. Afterwards in2015–2017, the level of reported landings returned to past levels.

Roughhead grenadier is mostly caught with bottom trawl but catches in 14 and 12.a are from the Spanish fleet targeting redfish and were taken with pelagic trawl, a GLORIA type in the first year (2010) and a modified alfonsinos pelagic trawl in the following years.

The Spanish fleet fishing grenadiers on the Mid-Atlantic ridge (MAR) consists of ten trawlers with an average length of 62 m and average GRT of roughly 1000 t, although the maximum number of ships present in the fishing ground in any given year is seven. This fleet alternates the redfish and grenadier fisheries. Most landings are taken in 14.b.1, where the fishing season lasts between three and seven months. Effort and catches peak in late spring and early summer.

14.3 Landings trends

Because there is no stock defined or management units, this section describes the landings data available for the different ICES divisions.

In Subareas 1 and 2 there are landing records since 1990, year with the highest catch, about 600 t. Landings have declined significantly and since 2005 they are in the range of 30 to 50 t, expect a higher level to 100 tonnes in 2016. Most landings are from Norway with a smaller contribution from Russia. Landings from France are occasional and negligible, below 0.5 t in most years (Table 14.1).

Landing records from Subareas 3 and 4 also started in 1990 and have been very low, peaking in 2005 at 39 t. The remaining years landings oscillated between 0 and 10 t, mostly to Norway, France, UK (Scotland) and Ireland have also reported landings in a few years (Table 14.2).

In Division 5.a, roughhead grenadier is occasionally caught but since 2010 the average landings reported have increased to 19 t/year a (Table 14.3).

Landings have been reported in 5.b since 1997. The highest catch was 99 t in 1999, but in other years landings were <12 t and in the last three years only 1 t/year was (Table 14.4).

Landings from Subareas 6 and 7 were mostly caught by the Spanish demersal multispecies fishery in Hatton Bank operated by freezer trawlers. The series starts in 1992, with official landings peaking during the period 2011–2013, when they reached 632 t in 2012 due to an exceptional report of 436 t by Lithuania. France has taken part in the fishery for a longer period but with much lower landings. Other minor participants in the fishery are Norway, UK, Ireland and Russia (Table 14.5).

Occasional landings of less than 0.5 tonne have been occasionally reported from Subarea 8. These should be considered as coding errors or area misreporting as the species is not known to occur in Subarea 8.

Official landings in Subarea 12 include landings from both the demersal multispecies fishery in Hatton Bank (12.b) and the pelagic redfish and grenadier fishery on the MAR (12.a). The series starts in 2000, and peaks in 2005 at 2200 t and in 2009 at 2832 t. Thereafter reported landings have decreased to 0 in 2017 (Table 14.6).

Low landings have been reported from Subarea 14 have been reported since 1993. In 2010–2014, Spain reported landings of 500–2700 tonnes/years (Table 14.7). Norway and Russia reported landings earlier that other countries, and Greenland and the UK have occasionally also recorded very small catches. Landings decreased since 2013 but more strongly in 2014 and 2015 to less than 85 t.

14.4 ICES Advice

The only ICES advice on roughhead grenadier was published in 2015 and states that *"for the years 2016–2020 there should be no directed fisheries for roughhead grenadier, and bycatch should be counted against the TAC for roundnose grenadier to minimise the potential for species misreporting."*

14.5 Management

There is no management plan for roughhead grenadier in NEAFC and 5.a. There has been no species-specific EU TAC for this species nor other species-specific management measure. Since 2015, bycatch of the species should be reported under the roundnose grenadier quota for the same area and may not exceed 1% of the quota. No directed fisheries of roughhead grenadier are permitted. This accounting of roughhead grenadier landings under quotas for roundnose grenadier was subject to an action for annulment at the EU court of justice and was rejected (http://curia.europa.eu/juris/liste.jsf?language=en&num=C-128/15).

14.6 Data available

14.6.1 Landings and discards

Official landing data are available from Subareas 1 and 2 since 1990, from Subareas 3 and 4 since 1992, from Division 5.a since 1996, from Division 5.b since 1997, from Subareas 6 and 7 since 1993, from Subarea 8 for 2002 and 2006, from Subarea 12 since 2000, and from Subarea 14 since 1993.

Discard data for most years from 1996 to 2015 from Subareas 6, 12 and 14, collected by Spanish scientific observers, on-board commercial Spanish trawlers were used to estimate discard rates. Discard rates, estimated as the discarded catch divided by retained catch of the species, are high, averaging 0.77 ± 0.42 (mean $\pm$ standard deviation) for Subarea 6, 0.68 ± 0.23 for Subarea 12 and 0.53 ± 0.50 for Subarea 14.b (Table 14.8).

14.7 Length composition of the landings and discards

No data available.

14.8 Age composition

No data available.

14.9 Weight-at-age

No data available.

14.10 Maturity and natural mortality

No data available.

14.11 Research vessel survey and cpue

14.11.1 Research vessel survey

The Icelandic autumn groundfish survey IS-SMH is the main source of fishery-independent data for *M. berglax* in Icelandic waters. Further, data can be compiled from several other older surveys of exploratory nature.

The IS-SMH survey covers Icelandic shelf and slope at depths from 20–1500 m. It is a stratified systematic survey with standardized fishing methods. Small-meshed bottom trawls (40 mm in the codend) equipped with rock-hopper are towed at a speed of 3.8 knots for a predetermined distance of 3 nautical miles (See the stock annex for greater silver smelt for a detailed description of methodology).

14.11.2 Cpue

The data available to WGDEEP only allow an estimation of non-standardised cpue for the Spanish fleet operating in Subareas 6, 12 and 14 in 1996–2015.

14.12 Data analyses

No data analysis was carried out.

14.13 Benchmark assessments

There has been no benchmark for this stock.

14.14 Management considerations

Only landings are available and the time-series considered reliable is restricted to 1992–2001. Years 2002–2015 are not considered because catches reported in some divisions are significantly larger than the historical landings and there are major doubts about the reality of these catch (ICES, 2014). Information from scientific on-board observers and exploratory surveys in Subareas 6, 12 and 14 indicates that the species occurs at low density over these fishing grounds, making it unlikely that such quantities can have been caught.

There are no biological data (length or age composition, weight-at-age, maturity, mortality) that could be used to assess changes in stock status.

Literature based mostly on survey data from Canadian waters indicates that this is a long-lived, slow-growing species, of low fecundity and vulnerable to overfishing (see Devine and Haedrich, 2008 and references therein; Gonzalez-Costas, 2010). Age estimations from otoliths have found specimens of up to 23 years (Savvatimsky, 1984) and the species has been classified as of concern due to a decline of >90% of the survey index within Canadian waters over a period of 15 years (COSEWIC, 2007).

Thus, no expansion of the actual fisheries should be permitted until enough data are collected from the exploited population to identify the stock and conduct an appropriate assessment.

14.15 References

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14.16 Tables and Figures

Table 14.1. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subareas 1 and 2.

Year	Germany	Norway	Russia	France	Spain	TOTAL
1988						
1989						
1990	9	580				589
1991		829				829
1992		424				424
1993		136				136
1994						0
1995				1		1
1996				3		3
1997		17		4		21
1998		55				55
1999				<0.5		0
2000		35	13	<0.5		48
2001		74	20	<0.5		94
2002		28	1	<0.5		29
2003		47	30			77
2004		78	1			79
2005		64	13	<0.5		77
2006		74	4	<0.5		78
2007		44	5			49
2008		49	6			55
2009		51	2			53
2010		39	6			45
2011		29				29
2012		54				54
2013		34	1	1		36
2014						
2015	0	26	17	0	+	43
2016		38	62			100
2017	0	41	9	+	0	50

Table 14.2. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subareas 3 and 4.

Year	France	Ireland	Norway	UK (Scot.)	TOTAL
1991					
1992			7		7
1993					
1994					
1995					
1996	4				4
1997	5				5
1998	1				1
1999	< 0.5				
2000	< 0.5	1	3	< 0.5	4
2001	< 0.5	1	9		10
2002	< 0.5		3	< 0.5	3
2003	< 0.5		2		2
2004	< 0.5		< 0.5	1	1
2005	1		38	< 0.5	39
2006	< 0.5				
2007					
2008					
2009					
2010				< 0.5	
2011	2				2
2012	1			< 0.5	1
2013	1				1
2014					
2015	+	0	+	0	+
2016	< 0.5		< 0.5		< 1
2017	< 0.5		< 0.5		< 1

Table 14.3. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in 5.a.

Year	Iceland	TOTAL
1995		
1996	15	15
1997	4	4
1998	1	1
1999		
2000	2	2
2001	1	1
2002	4	4
2003	33	33
2004	3	3
2005	5	5
2006	7	7
2007	2	2
2008	< 0.5	
2009	5	5
2010	22	22
2011	21	21
2012	16	16
2013	16	16
2014		
2015	20	20
2016	20	20
2017	34	34

Table 14.4. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Division 5.b.

Year	France	Norway	UK (Scot.)	Russia	TOTAL
1997	6				6
1998	9				9
1999	99				99
2000	1				1
2001	2	2			4
2002	3		< 0.5		3
2003	12				12
2004	9		1		10
2005	6				6
2006	10				10
2007	3			2	5
2008	1			2	3
2009					
2010		1			1
2011					
2012	2		1		3
2013	2				2
2014	< 0.5				
2015	1	+	0	0	1
2016					
2017	<0.5	<0.5			0.5

Table 14.5. Official landings (t) roughhead grenadier (*Macrourus berglax*) in Subareas 6 and 7.

Year	UK (E+W)	France	Norway	UK (SCO)	Spain	Ireland	Russia	Lithuania	TOTAL
1988									
1989									
1990									
1991									
1992									
1993	18								18
1994	5								5
1995	2	2							4
1996		13							13
1997		12							12
1998		10							10
1999		38							38
2000	< 0.5	3		8					11
2001		2	27	16					45
2002		4	2	6					12
2003		8	2		1				11
2004		6		5	0				11
2005		6		2	0				8
2006		10		< 0.5	0	75			85
2007		21			0	18			39
2008		2			222		4		228
2009		12		< 0.5	0				12
2010		8		1	51		1		61
2011		3			346				349
2012		1		4	191			436	632
2013		2			179				181
2014					42				42
2015		11	+		21				32
2016		35			32				67
2017		3	1		1	<0.5			5

Table 14.6. Official landings (t) roughhead grenadier (*Macrourus berglax*) in Subarea 12.

Country	Norway	France	Spain	Russia	Lithuania	TOTAL
1999						
2000	7	< 0.5				7
2001	10	< 0.5				10
2002	7		1136			1143
2003	2	< 0.5	223			225
2004	27	< 0.5	725			752
2005		< 0.5	2200	5		2205
2006		< 0.5	968	8		976
2007			420			420
2008			252			252
2009	6		2826			2832
2010			580			580
2011			441			441
2012			526		4	530
2013			210			210
2014			164			164
2015			53			53
2016	<0.5		31			31
2017						0

Table 14.7. Official landings (t) of roughhead grenadier (*Macrourus berglax*) in Subarea 14.

Country	Greenland	Norway	Russia	Spain	UK (E+W)	TOTAL
1992						
1993	18	34				52
1994	5					5
1995	2					2
1996						
1997						
1998		6				6
1999		14				14
2000						
2001		26				26
2002		49	4			53
2003		33				33
2004		46	9			55
2005		30	10			40
2006		1	3			4
2007		6	9			15
2008			3			3
2009		3			1	4
2010		1	13	1500	1	1515
2011			27	1516		1543
2012		16	18	2687		2721
2013			32	803		835
2014			11	450		461
2015*	3	68	0	12		83
2016		73	8	4		85
2017		87	17			104

(*) Preliminary data.

Table 14.8. Average discard rate (discarded catch / total catch) 1996–2015, estimated from data collected by scientific observers on board commercial trawlers.

Year	6.b	12.a	12.b	14.b
1996			0.00	0.00
1997				
1998	0.42		0.56	
1999				
2000		1.00	0.41	0.12
2001	0.94		0.40	0.00
2002	0.79		0.50	1.00
2003	0.65		0.00	0.00
2004	1.00		0.97	
2005				
2006	0.33		0.00	
2007				
2008	0.00		0.04	
2009			0.00	
2010			0.17	
2011				0.13
2012				
2013	1.00		1.00	1.00
2014				
2015	NA	NA	NA	NA
Mean	0.79	1.00	0.37	0.51

15 Roughsnout grenadier (*Trachyrincus scabrus*) in the Northeast Atlantic

15.1 Stock description and management units

There are taxonomic issues with this stock. The roughsnout grenadier (*Trachyrincus scabrus*) was formerly *Trachyrincus trachyrincus,* with various spellings. The roughnose grenadier (*Trachyrincus murrayi*) is a closely related species that is abundant throughout the north of Northeast Atlantic (Jonsson, 1992). The scientific names and spelling of these species changed over time. The similarity of the English names (roughsnout grenadier and roughnose grenadier) can only add more to the confusion.

Along the slope to the west of Scotland in ICES Division 6.a, only *Trachyrincus murrayi* was caught in surveys spanning depths from 500–2000 m and that took place in the 1970s and 1980s (Gordon and Duncan, 1984). In recent years, *Trachyrincus murrayi* is caught by the Marine Scotland deep-water research surveys in sufficient numbers to allow the estimation of population indicators (Neat and Burns, 2010).

Published literature does not report the occurrence of *Trachyrincus scabrus* at significant level in northern areas of the Northeast Atlantic. In particular, there are no records of the species in surveys held along the Mid-Atlantic Ridge (Fossen *et al*., 2008). *Trachyrincus scabrus* is not caught in Icelandic surveys where *Trachyrincus murrayi* is caught in large numbers.

T. scabrus has been reported in the Porcupine Seabight (ICES Division 7.j,k) at depths 500–1300 m. The species was also recorded further south in the Cantabrian Sea (ICES Division 8.c). In the latter area, *T. scabrus* was report to occur at a high abundance on the Le Danois Bank (ICES Division 8.b) at depths from 500–800 m (Sanchez *et al*., 2008).

Unlike in the Atlantic Ocean, *Trachyrincus scabrus* occurs in most of the Mediterranean Sea, along the Spanish slope to the Ionian Sea (D'Onghia *et al*., 2004; Moranta *et al*., 2006). In the Mediterranean Sea high abundances were reported at depths ranging from 800–1300 m. In the Mediterranean Sea, *T. scabrus* reaches larger size than the other macrourid species occurring at the same depth range.

Therefore, *T. scabrus* is a species occurring in the Mediterranean Sea and in the Atlantic and does not seem to occur at levels susceptible to support commercial fisheries in most areas north of 52°N.

The other *Trachyrincus* species (*T. murrayi*) occurs in Subareas 5, 6 and 12. There is no known fishery for this species, it does not reach sufficient sizes to be of commercial interest. It is only a bycatch of deep-water fisheries in Subareas 5, 6 and 7 and probably 12.

As *T. scabrus* and *T. murrayi* can be misidentified in fisheries catches this chapter addresses the two species.

Landings of *T. scabrus* were reported for ICES Subareas 6, 12 and 14. In these areas the species is considered to be at most a minor bycatch. The occurrence of the species is even not confirmed in Subareas 12 and 14. It may be that only *T. murrayi*, occurs in these Subareas. Therefore the species identity of commercial landings reported as *T scabrus* needs to be confirmed. The reporting of 0 landings in response to the data call for landings and discards in 2016 and 2017, tends to confirm that landings reported in previous years were misidentification or coding errors.

15.2 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 15.1a)

In 2006-2008, Lithuania reported significant landings for subareas 6 and 12 (Table 15.1b, source ICES catch statistics 2006-2015). Landings reported by Spain in 2012-14 are not included in ICES catch statistics 2006-2015. No landings were reported in preliminary catch statistics for 2016 and 2017.

15.3 ICES Advice

The ICES advice for the years 2016–2020 is that "*there should be no directed fisheries for roughsnout grenadier, and bycatch should be counted against the TAC for roundnose grenadier to minimize the potential for species misreporting*."

In the future, *Trachyrincus scabrus* and *T. murrayi*, should be considered non-commercial species and should not be subject to ICES advice any more. Reported landings should be considered as species misreporting.

15.4 Management

There is no current species-specific management measure for the roughsnout grenadier. Despite the advice for years 2016–2020, the EU regulation for TACs of deep-water species in 2017–2018 makes no mention of the roughsnout grenadier (Council regulation (EU) 2016/2285). There is no regulation for this species in other countries (Norway, Iceland, Faroe Islands) where these species should be landed when caught.

The EU regulation 2016/2336 establishing specific conditions for fishing for deep-sea stocks, make no mention of *Trachyrincus* species.

15.5 Data availability

15.5.1 Landings and discards

Landings data are presented in Table 15.1a and 15.1.b.

T. murrayi is discarded by the French deep-water fishery. Both *T. murrayi* and *T. scabrus* are recorded in on-board observation but the identification of these species may be uncertain. The total discards of the two combined have been less than of 0.2% of total catch in deep-water fishing hauls since 2010 (Table 15.2). These species have not been landed at all by the French fishery. It can be concluded that *T. scabrus* and *T. murrayi* have a minor contribution to the total catch in weight in ICES Divisions 5.b and 6.a and Subarea 7, where the French fishery operates.

Discards of *Trachyrincus* spp. are expected to occur in all deep-water fisheries and also in the other fisheries along the upper slope such as fisheries targeting hake, monkfish and megrims, which may operate down to 800 m.

The stock was included in the data call for 2017 and data were delivered to WGDEEP through InterCatch and file provided by members. France, Spain and Portugal reported through InterCatch and no landings and discards were uploaded. The absence of landings matches expert knowledge that the species is not commercial. The absence of discards from InterCatch may come from the absence of landings so the standard raising variable being absent discards were raised to 0. Faroe Islands, Iceland and Norway, reported landings of deep-water species on the WGDEEP SharePoint and there were no landings of *Trachyrincus* spp. included. As the fisheries from these countries make no discards, there was no catch of roughsnout grenadier or these catch were not identified to species level.

15.6 Length compositions

No length data are available.

In the Icelandic autumn survey specimens of *T. murrayi* with sizes up to 40 cm total length have been recorded. Nevertheless the bulk of the catch is made of specimens with a length range from 5 to 20 cm.

T. murrayi of 45 cm total length would weigh less than 300 g using the following weight–length relationship estimated Length–weight relationship for *T. murrayi*: W=0.00129 LT^3.232 (Borges *et al.*, 2003).

15.6.1 Age compositions and longevity

No age composition is available. There are, however some studies on growth and longevity.

In the Mediterranean *T. scabrus* has a maximum age of eleven years (Massutti *et al.*, 1995).

Swan and Gordon (2001) analysed otoliths from 218 specimens of *T. murrayi*, with head length ranging from 2.1–11.7 cm and found up to nine growth bands on otolith. Converting the head length (HL) to total length (TL)by using the conversion estimated by the Swan and Gordon (2001): HL=3.630*HL0.402 (n=488), the largest fish in the sample had 42 cm total length, which seems to be at or close to the maximum length of the species in the area.

It can be concluded that the two *Trachyrincus* species appear to have similar longevities, of around ten years. Similar lifespans have been estimated for other small macrourids (Coggan *et al.*, 1999).

15.6.2 Weight-at-age

No weight-at-age data are available.

15.6.3 Maturity and natural mortality

No data were available.

15.6.4 Catch, effort and research vessel data

Population indicators of *T. murrayi* were estimated from data collected during deepwater research surveys held by the Marine Scotland. The abundance and length distribution varied along the period under analysis (2000–2008) and no trend was observed (Neat and Burns, 2008). Scottish survey data for this species were not requested to Marine Scotland in 2018 because the species is not of commercial interest.

15.7 Data analyses

Available data on *T. murrayi* suggest that the species is too small to have commercial interest. In fact, the weight of the largest specimen caught in Icelandic survey (45 cm TL) was not more than 500 g. Available data on *T. scabrus* suggest that the species occurs at too level in the Northeast Atlantic to support any commercial fishery.

15.7.1 Biological reference points

Not applicable.

15.8 Comments on assessment

Not applicable.

15.9 Management considerations

The roughsnout and roughnose grenadiers are small bycatch in some deep-water fisheries (see example in Table 14.2).

Owing to the smaller size and shorter longevity of *T. murrayi* and *T. scabrus* compared to the target species of deep-water fisheries, levels of fishing mortality that are sustainable to the target species are most likely to be also sustainable for these smaller species.

The only, management that can be proposed is to include minor landings of any macrourid species in the TAC of the main grenadier species, the roundnose grenadier. This should not imply any increase of the TAC of roundnose grenadier, because catches of *Trachyrincus* spp. and all other macrourids are small compared to that of the roundnose grenadier in all ICES divisions.

15.10 Recommendation

As the roughsnout and roughnose grenadiers are non-commercial species and are not likely to become of commercial interest in the foreseeable future, it is recommended that these species are no longer considered by ICES in terms of stock assessment.

Reported landings of bycatch of these species should be considered misreporting of other species, most probably of the roundnose grenadier.

Roughsnout and roughnose grenadiers should not be subject of catch advice.

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15.12 Tables

Table 15.1a. Official landings of roughsnout grenadier by ICES Subarea reported by Spain.

Year	Spain 6.b	Spain 12.a	Spain 12.b	Spain 14.b	Total
2012		54		3	57
2013					0
2014	42	4	155	448	649
2015	0	0	0	0	0
2016	0	0	0	0	0

Table 15.1b. Official landings of roughsnout grenadier by ICES Subarea reported by Lithuania.

Year	Lithuania 6	Lithuania 12	Total
2006	506	67	573
2007	442	101	543
2008	49	50	99

Table 15.2. Discards of *T. murrayi* and *T. scabrus* in the French deep-water trawl fishery compared to the catch of the target species and the total landings and discards from 2010 to 2016. Raw observation data, no raising applied.

	2010	2011	2012	2013	2014	2015	2016
Total catch in observed hauls (tonnes)	530	846	652	551	533	377	317
Landings (tonnes)	451	694	526	440	477	334	290
Discards (tonnes)	79	151	126	111	56	43	27
Catch (landings+ discards) of roundnose grenadier, black scabbardfish and blue ling (tonnes)	387	616	456	373	388	257	225
Discards of *T. murrayi* and *T. scabrus* (tonnes)	0.10	0.42	1.16	0.55	0.52	0.12	0.10

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

ToR

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

16.1 Landings in the NEAFC regulatory area

16.1.1 Data availability

Landings data were available to ICES from InterCatch and preliminary landings and data provided by experts. In recent years, both allow separating landings from EEZs from landings from the NEAFC RA. In particular catch from the subdivisions of ICES divisions that are inside and outside EEZs, e.g. 6.b.2 and 6.b.1 inside and outside EEZs respectively for the Division 6.b, were available from both data sources. Some landings reported by larger Subareas, e.g. 27.10 could be allocated to either EEZs or the RA based on knowledge of the fisheries from WGDEEP.

Landings by stock in 2015-2017 are presented in Table 17.1. It was not possible to update maps of landings/catches by statistical rectangle, thus Figures 17.1–17.6 show data from 2013.

16.1.2 Characterisation of fisheries in the NEAFC RA

Deep-water fisheries in the NEAFC Regulatory Area occurred predominantly in two regions; the Mid-Atlantic ridge (ICES Divisions 27.10.b, 27.12.a;1, 27.12.c and 27.14.b.1) and the Rockall-Hatton area (Divisions 27.6.b.1 and 27.12.b). Descriptions of fisheries on the Mid-Atlantic ridge are given in the area overviews for the Oceanic Northeast Atlantic (Section 3). In 2015–2017, there were also minor landings from Subdivision 27.5.b.1 which is an extension of the longline fishery that occurs in the Faroese EEZ into Areas Beyond National Jurisdiction (ABNJ). No landings of deep-water species was reported in the preliminary catch for this area in 2016. This fishery is described in Section 3.1.

Figures 17.1–17.6 show reported landings of roundnose grenadier, black scabbardfish, blue ling, ling tusk and alfonsino in the ICES area in 2013 by statistical rectangle. Since 2014, equivalent data have not been available to update these figures. Landings were not available at this spatial resolution for all countries: the percentage of landings available by statistical rectangle and the countries for which these data were available are given in the figure captions. In particular, landings data from the Spanish fleet working in Division 6.b.1, 12.b, and 14.b.1 were incomplete (between 5% and 55% of reported landings available by statistical rectangle, depending on species). In some cases, observer estimates of catches in this fishery differed from official landings data. Where this was the case, additional catches estimated by observers were included in Working Group's estimates of catches as "unallocated landings". This no longer occurred for 2016 landings. These landings were not available by statistical rectangle for 2013 and so are not included in the maps. Landings of deep-water species from the NEAFC RA are therefore considerably underestimated in Figures 17.1–17.6.

The Working Group noted that high landings of roughhead grenadier on the mid-Atlantic Ridge in 2012, 2013 and 2014 reaching 2726 tonnes, 868 tonnes and 448 tonnes respectively were no reported in subsequent years. Landings of these species returned to previous levels of a few hundreds of tonnes in all the northeast Atlantic and about 100 tonnes in Subarea 12. However, the working met difficulties in separating landings of this species between the NEAFc RA and EEZs, so that data are not provided for this species.

Table 17.2 provides an overview of the fisheries and ICES advice by stock fished in the NEAFC area.

16.2 Spawning aggregations and areas of local depletion in the NEAFC Regulatory Area

No new information was available in 2017. The information compiled in 2014 is presented below.

Little information is available regarding the location of spawning aggregations in the NEAFC Regulatory area. There are many records of captures of fish of various species in spawning condition but these cannot be assumed to constitute aggregations as the species in question may be widespread spawners.

Blue ling is known to form discrete and predictable spawning aggregations including some in the NEAFC area. Available information on the location of blue ling spawning in the Northeast Atlantic was collated by Large *et al*., 2010 and a separate piece of ICES advice to the European commission in 2009. From 1970 to 1990, the bulk of the fishery for blue ling was seasonal fisheries targeting these aggregations which were subject to sequential depletion. Known spawning areas are shown in Figure 16.1. In Iceland, the depletion of the spawning aggregation in a few years was documented two decades ago (Magnússon and Magnússon, 1995) and blue ling is an aggregating species at spawning time. To prevent depletion of adult populations temporal closures have been set both in the Icelandic and EU EEZs.

Known spawning areas in the NEAFC RA are located on the northeastern margins of Hatton Bank (ICES Division 6.b) and along the eastern and southern margins of Hatton Bank (6.b). NEAFC has had a seasonal closure in force since 2010 (http://neafc.org/managing_fisheries/measures/current; latest regulation: *Recommendation on Regulatory Measures for the Protection of Blue Ling in the NEAFC Regulatory Area (ICES Division XIV) from 2017–2020*, valid until 31 December 2020).

ICES does not have any information relating to areas of recent local depletion of deep-water fish stocks in the NEAFC Regulatory Area. Russian reports from the late 1990s suggested that alfonsino on seamounts north of the Azores remained depleted at that time. The spatial resolution of information provided currently does not facilitate assessment of the current state or recovery rates of locally depleted stocks.

ICES does not have sufficient information to evaluate the abundance of orange roughy associated with the seamounts of the Mid-Atlantic Ridge where a fishery has continued in recent years under a NEAFC regulation. Landings have increase from 83 tonnes in 2015 to 150 tonnes in 2017.

16.3 Tables and Figures

Table 16.1. Landings from fisheries in the NEAFC regulatory area (RA) in 2015–2017.

StockKeyLabel	year	Inside NEAFC RA				Outside NEAFC RA			
		Landings official	Discards	catches	unallocated landings	Landings official	Discards	catches	unallocated landings
alf.27.nea	2015	141	0	141	0	224	0	224	0
	2016	48	0	48	0	252	0	252	0
	2017	0	0	0	0	240	0	240	0
aru.27.123a4	2015	0	0	0	0	17548	270	17818	0
	2016	0	0	0	0	16330	1663	17993	0
	2017	0	0	0	0	16811	262	17073	0
aru.27.5a14	2015	0	0	0	0	6056	0	6056	0
	2016	0	0	0	0	5646	0	5646	0
	2017	0	0	0	0	3946	0	3946	0
aru.27.5b6a	2015	0	0	0	0	17548	NA	NA	0
	2016	0	0	0	0	16330	NA	NA	0
	2017	0	0	0	0	16811	NA	NA	0
aru.27.6b7-1012	2015	0	*	*	0	6	*	*	0
	2016	0	*	*	0	0	*	*	0
	2017	0	*	*	0	15	*	*	0
bli.27.5a14	2015	0	0	0	0	1823	0	1823	0
	2016	0	0	0	0	932	0	932	0
	2017	0	0	0	0	634	0	634	0

StockKeyLabel	year	Inside NEAFC RA				Outside NEAFC RA			
		Landings official	Discards	catches	unallocated landings	Landings official	Discards	catches	unallocated landings
bli.27.5b67	2015	33	0	33	0	2725	0	2725	0
	2016	18	0	18	0	3041	0	3041	0
	2017	20	0	20	0	2649	0	2649	0
bli.27.nea	2015	12	0	12	0	196	0	196	0
	2016	29	0	29	0	176	0	176	0
	2017	28	0	28	0	251	0	251	0
bsf.27.nea	2015	292	0	292	0	6063	0	6063	0
	2016	305	0	305	0	3231	0	3231	0
	2017	334	0	334	0	2372	0	2372	0
gfb.27.nea	2015	0	0	0	0	2175	0	2175	0
	2016	0	0	0	0	2012	0	2012	0
	2017	0	0	0	0	1503	0	1503	0
lin.27.1-2	2015	0	0	0	0	8550	0	8550	0
	2016	0	0	0	0	8819	0	8819	0
	2017	0	0	0	0	7971	0	7971	0
lin.27.3a4a6-91214	2015	123	0	123	0	16613	839	17452	0
	2016	133	0	133	0	19123	1598	20721	0
	2017	35	0	35	0	20241	1146	21387	0
lin.27.5a	2015	0	0	0	0	13036	0	13036	0
	2016	0	0	0	0	9884	0	9884	0
	2017	0	0	0	0	8766	0	8766	0
lin.27.5b	2015	0	0	0	0	5974	0	5974	0

StockKeyLabel	year	Inside NEAFC RA				Outside NEAFC RA			
		Landings official	Discards	catches	unallocated landings	Landings official	Discards	catches	unallocated landings
	2016	0	0	0	0	5886	0	5886	0
	2017	0	0	0	0	6152	0	6152	0
ory.27.nea	2015	83	0	0	0	6	0	0	0
	2016	93	0	0	0	0	0	0	0
	2017	150	0	0	0	0	0	0	0
rhg.27.nea	2015	**	**	**	**	**	**	**	**
	2016	**	**	**	**	**	**	**	**
	2017	**	**	**	**	**	**	**	**
rng.27.1245a8914ab	2015	0				53			
	2016	0				20			
	2017	0				32			
rng.27.3a	2015	0	0	0		1	1	2	0
	2016	0	0	0		1.4	1	2.4	0
	2017	0	0	0		0.7	1.6	2.3	0
rng.27.5a10b12ac14b	2015	778			61	23			
	2016	381			279	0			
	2017	84				0			
rng.27.5b6712b	2015	602	*	*	0	413	*	*	0
	2016	923	*	*	0	443	*	*	0
	2017	1497	*	*	0	164	*	*	0
sbr.27.10	2015	0	0	0	0	701	0	0	0
	2016	0	0	0	0	515	0	0	0

StockKeyLabel	year	Inside NEAFC RA				Outside NEAFC RA			
		Landings official	Discards	catches	unallocated landings	Landings official	Discards	catches	unallocated landings
	2017	0	0	0	0	499	0	0	0
sbr.27.6-8	2015	0	0	0	0	177	0	0	0
	2016	0	0	0	0	164	0	0	0
	2017	0	0	0	0	126	0	0	0
sbr.27.9	2015	0	0	0	0	514	0	0	0
	2016	0	0	0	0	401	0	0	0
	2017	0	0	0	0	336	0	0	0
tsu.27.nea	2015	NA				NA			
	2016	0	*	*	0	0	*	*	0
	2017	0	*	*	0	0	*	*	0
usk.27.1-2	2015	0	0	0	0	10091	0	10091	0
	2016	0	0	0	0	11660	0	11660	0
	2017	0	0	0	0	7926	0	7926	0
usk.27.12ac	2015	0	0	0	0	2	0	0	0
	2016	0	0	0	0	0	0	0	0
	2017	0	0	0	0	0	0	0	0
usk.27.3a45b6a7-912b	2015	0	0	0	0	5155	18	5173	0
	2016	0	0	0	0	4820	153	4973	0
	2017	0	0	0	0	3916	159	4075	0
usk.27.5a14	2015	0	0	0	0	5734	0	0	0
	2016	0	0	0	0	3965	0	0	0
	2017	0	0	0	0	3100	0	0	0

StockKeyLabel	year	Inside NEAFC RA				Outside NEAFC RA			
		Landings official	Discards	catches	unallocated landings	Landings official	Discards	catches	unallocated landings
usk.27.6b	2015	43	0	43	0	183	0	183	0
	2016	20	0	20	0	70	8	78	0
	2017	3	0	3	0	44	14	58	0

*** discards not estimated separately for the NEAFC RA and inside EEZs**

**** separated landings inside and outside EEZ not compiled by WGDEEP**

Table 16.2. Description of fisheries in the NEAFC area and ICES advice applicable in 2017 (issued in 2016 or before).

ICES stock code	Stock	NEAFC Deep Sea Stock Category	location of NEAFC fisheries	description of NEAFC fisheries	ICES advice applicable
lin.27.3a4a6-91214	Ling (*Molva molva*) in Subareas 6–9, 12, and 14, and in in Divisions 3.a and 4.a (Northeast Atlantic and Arctic Ocean)	4	Rockall Bank (see Figure 17.4)	longline fisheries on Rockall bank. The majority of the fishery occurs within the EU EEZ, but it extends very slightly into the NEAFC Regulatory Area.	ICES advises that when the precautionary approach is applied, catches should be no more than 17 695 tonnes in each of the years 2018 and 2019. If discard rates do not change from the average of the last three years (2014–2016) this implies landings of no more than 16 793 tonnes.
bli.27.5b67	Blue ling (*Molva dypterygia*) in Subareas 6–7 and Division 5.b (Celtic Seas, English Channel, and Faroes grounds)	4	Rockall, Hatton and Lousy Banks (see Figure 17.3)	Mixed deep-water trawl fisheries on Rockall and Hatton Banks. Longline fishery on Lousy Bank	Based on the ICES MSY approach ICES advises that catches should be no more than 11 314 and 10 763 tonnes in 2017 and 2018.
bli.27.nea	Blue ling (*Molva dypterygia*) in Subareas 1, 2, 8, 9, and 12, and in Divisions 3.a and 4.a (other areas)	2	Hatton Bank. (see Figure 17.3)	Landings in 12.b come from the same fishery and assessment unit as those in 6.b. WGDEEP has recommended that the stock definition be reviewed and 12.b included in the bli.27.5b67 assessment unit.	ICES advises that when the precautionary approach is applied, there should be zero catches in each of the years 2018 and 2019. This advice is unlikely to change until the scientific information is sufficient to assess the status of the stock. Closed areas to protect spawning should be maintained.

ICES stock code	Stock	NEAFC Deep Sea Stock Category	location of NEAFC fisheries	description of NEAFC fisheries	ICES advice applicable
usk.27.12ac	Tusk (*Brosme brosme*) in Subarea 12, excluding Division 12.b (southern Mid-Atlantic Ridge)	4	Mid-Atlantic Ridge	Sporadic small catches have occurred in the past.	ICES advises that when the precautionary approach is applied, there should be zero catches in each of the years 2018 and 2019 unless there is evidence that this is sustainable. Measures should be taken to limit occasional high levels of bycatch.
usk.27.6b	Tusk (*Brosme brosme*) in Division 6.b (Rockall)	4	Rockall (See Figure 17.5)	longline fisheries on Rockall bank. The majority of the fishery occurs within the EU fishing zone, but it extends very slightly into NEAFC waters	When the precautionary approach is applied, catches should be no more than 350 tonnes in each of the years 2017 and 2018 t.
usk.27.3a45b6a7-912b	Tusk (*Brosme brosme*) in Subareas 4 and 7–9, and in Divisions 3.a, 5.b, 6.a, and 12.b (Northeast Atlantic)	4	Lousy Bank (see Figure 17.5)	Longline fisheries in 5.b1a. The majority of the fishery occurs within the Faroes EEZ, but it extends very slightly into NEAFC waters	I CES advises that when the precautionary approach is applied, catches should be no more than 8984 tonnes in each of the years 2018 and 2019.
ory.27.nea	Orange roughy (*Hoplostethus atlanticus*) in Subareas 1–10, 12 and 14 (Northeast Atlantic and adjacent waters)	Subarea 10 = 1; Subareas 6+7 = 2	Mid-Atlantic Ridge	Directed fisheries occurred on the Mid-Atlantic Ridge and a seamount in Subarea 6.b	ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017–2020

ICES stock code	Stock	NEAFC Deep Sea Stock Category	location of NEAFC fisheries	description of NEAFC fisheries	ICES advice applicable
rng.27.5b6712b	Roundnose grenadier (*Coryphaenoides rupestris*) in Subareas 6–7, and in Divisions 5.b and 12.b (Celtic Seas and English Channel, Faroes grounds, and western Hatton Bank)	1	Rockall and Hatton Bank	Mixed deep-water trawl fisheries on Rockall and Hatton Banks.	Catches should be no more than 3325 tonnes in 2017 and 3399 tonnes in 2018 in Subareas 6 and 7 and Division 5.b. For Division 12.b catches should be no more than 572 tonnes in each the years 2017 and 2018.
rng.27.5a10b12ac14b	Roundnose grenadier (*Coryphaenoides rupestris*) in Divisions 10.b and 12.c, and in Subdivisions 12.a.1, 14.b.1, and 5.a.1 (Oceanic Northeast Atlantic and northern Reykjanes	1	Mid-Atlantic Ridge	Recently developed deep-water trawl fishery on the Mid-Atlantic Ridge. For 2014–2015, landings figures presented here include official landings data and "unallocated" landings derived from observer data. In 2015, 1015 tonnes were unallocated.	ICES advises that when the precautionary approach is applied, landings should be no more than 717 tonnes in each of the years 2018 and 2019. ICES cannot quantify the corresponding catches.
bsf.27.nea	Black scabbardfish (*Aphanopus carbo*) in Subareas 1, 2, 4, 6–8, 10, and 14, and in Divisions 3.a, 5.a–b, 9.a, and 12.b (Northeast Atlantic and Arctic Ocean)	4	Rockall Bank, Hatton Bank (see Figure 17.2) and Mid-Atlantic Ridge	Mixed deep-water trawl fisheries on Rockall and Hatton Banks. Catches on the Mid-Atlantic Ridge have been about 300 tonnes in recent years.	Catches should be no more than 5894 tonnes in each of the years 2017 and 2018. Distributed by area, annual catches of no more than 2802 tonnes in Subareas 6 and 7 and Divisions 5.b and 12.b; no more than 2726 tonnes in Subarea 8 and Division 9.a, and no more than 366 tonnes in Subareas 1, 2, 4, and 10 and Divisions 3.a and 5.a.

ICES stock code	Stock	NEAFC Deep Sea Stock Category	location of NEAFC fisheries	description of NEAFC fisheries	ICES advice applicable
alf.27.nea	Alfonsinos (*Beryx* spp.) in Subareas 1–10, 12 and 14 (Northeast Atlantic and adjacent waters)	Subareas 6-9 = 4; Seamounts and ridges in RA = 3	Mid-Atlantic Ridge	Directed trawl fisheries existed in this area in the past, landings were small in recent years.	Landings should be no more than 280 tonnes in each of the years 2017 and 2018.
rhg.27.nea	Roughhead grenadier (*Macrourus berglax*) in Subareas 5–8, 10, 12 and 14 (Northeast Atlantic and Arctic Ocean)	Subareas 4, 12 and 14 = 2; other areas = 4	Mid-Atlantic Ridge, Hatton Bank	High landings reported in 2012-2014. Returned to lower level in 2015-2017.	For the years 2016 to 2020 there should be no directed fisheries for roughhead grenadier, and bycatch should be counted against the TAC for roundnose grenadier to minimise the potential for species misreporting

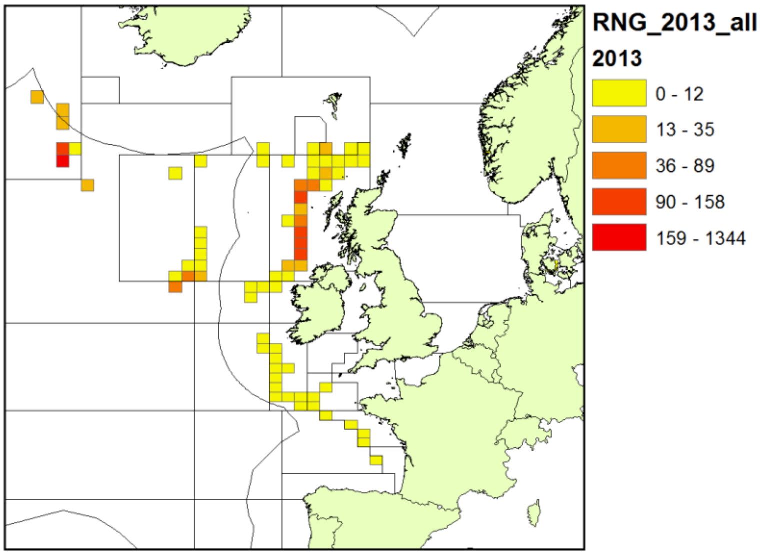


Figure 16.1. Reported landings of roundnose grenadier in the ICES area by statistical rectangle, 2013. Data from the France, UK (England and Wales), and Spain. Landings shown in this figure account for 84% of all reported landings in the ICES area. Landings data by statistical rectangle in the NEAFC area (Subareas 6.b, 12.b and 14.b) are incomplete with only 1740 tonnes (55% of reported landings) reported by statistical rectangle. Data on unallocated landings in the NEAFC area of 6.b and 12.b (1403 tonnes) were not reported to the working group by statistical rectangles and hence not included in this figure.

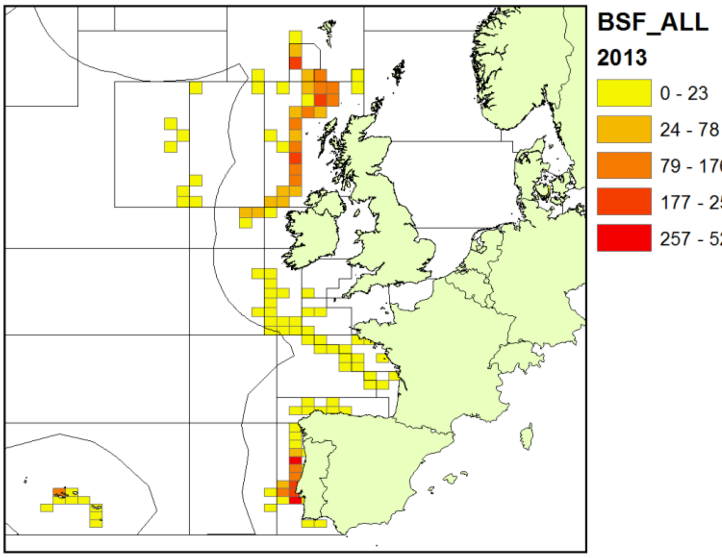


Figure 16.2. Reported landings of black scabbardfish in the ICES area by statistical rectangle, 2013. Data from the Faroes, France, UK (England and Wales), Spain and Portugal. Landings shown in this figure account for 92% of all reported landings in the ICES area. Landings data by statistical rectangle in the NEAFC area (Subareas 6.b and 12.b) are incomplete with only 4.9 tonnes (5% of reported landings) reported by statistical rectangle. Data on unallocated landings in the NEAFC area of 6.b and 12.b (455 tonnes) were not reported to the working group by statistical rectangles and hence not included in this figure.

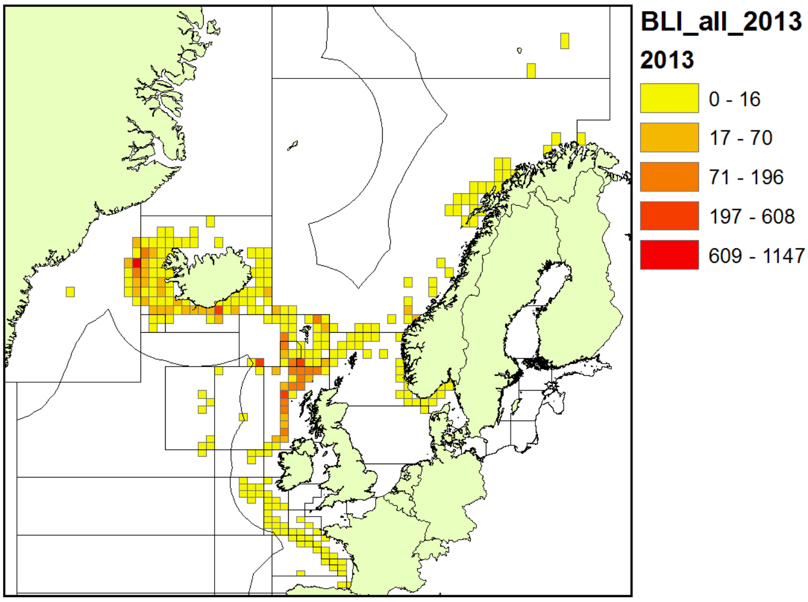


Figure 16.3. Reported landings of blue ling in the ICES area by statistical rectangle, 2013. Data from the Faroes, Norway, France, UK (England and Wales), and Spain. Landings shown in this figure account for 96% of all reported landings in the ICES area. Landings data by statistical rectangle in the NEAFC area (Subareas 6.b and 12.b) are incomplete with only 27 tonnes (15% of reported landings) reported by statistical rectangle. Data on unallocated landings in the NEAFC area of Division 12.b (86 tonnes) were not reported to the working group by statistical rectangles and hence not included in this figure.

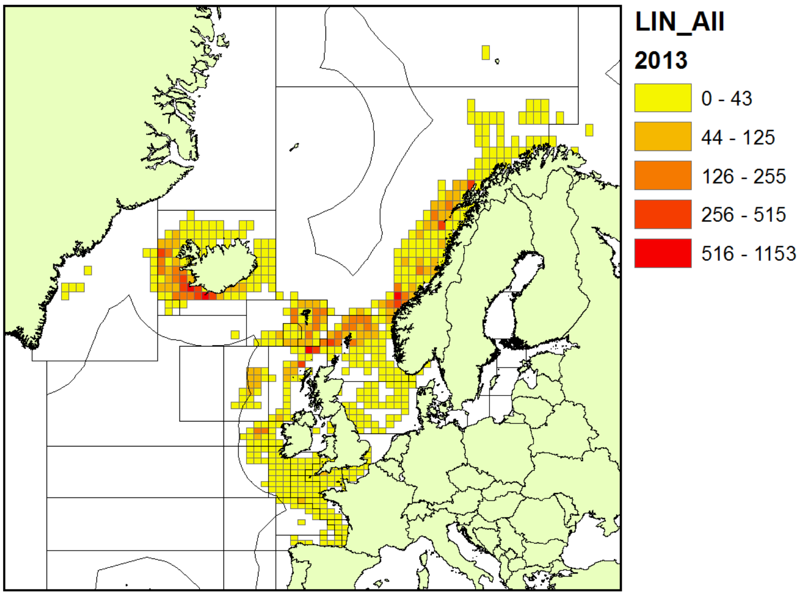


Figure 16.4. Reported landings of Ling in the ICES area by statistical rectangle, 2013. Data from Norway, Faroes, Iceland, UK (England and Wales) and Spain. Landings shown in this figure account for 53% of all reported landings in the ICES area.

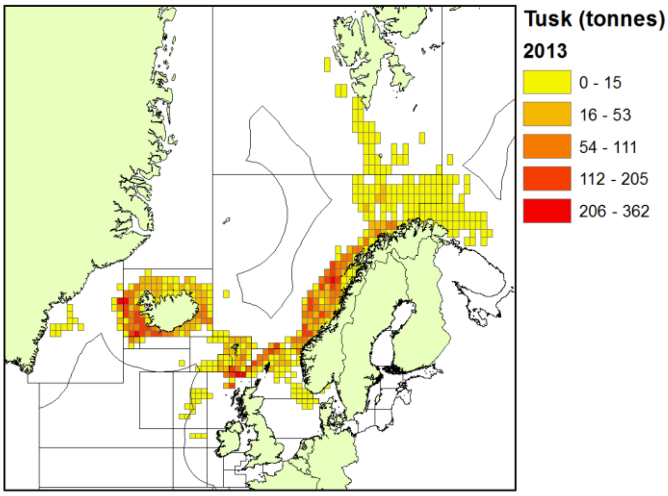


Figure 16.5. Reported landings of tusk in the ICES area by statistical rectangle, 2013. Data from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in this figure account for 99% of all reported landings in the ICES area.

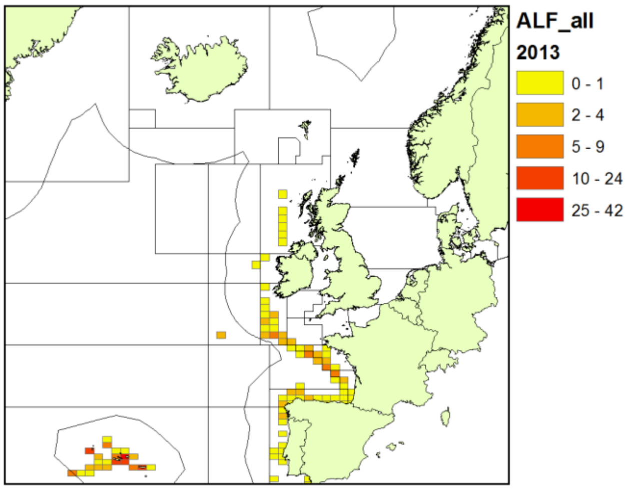


Figure 16.6. Reported landings of *Beryx* spp in the ICES area by statistical rectangle, 2013. Data from Portugal, France, and Spain. Landings shown in this figure account for 97% of all reported landings in the ICES area.

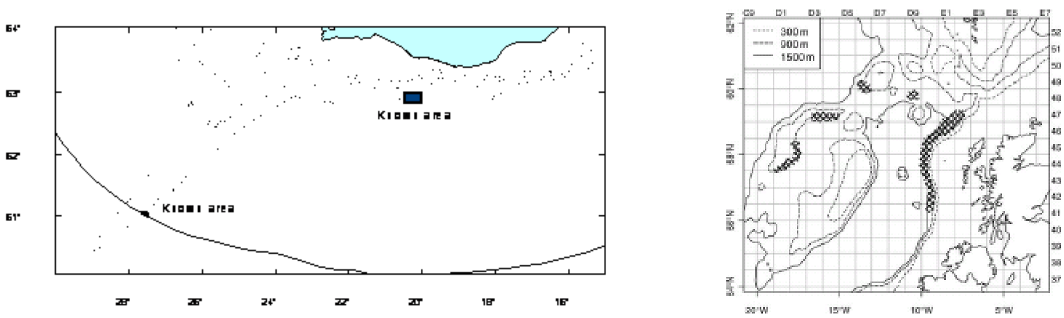


Figure 16.8. Known spawning areas of blue ling in Icelandic water (a) and to the West of Scotland (b), from Large *et al.*, 2010.

Annex 1: List of participants

Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)

11–18 April 2018

MEMBER	INSTITUTE	EMAIL	COUNTRY
Christopher Bird	Centre for Environment Fisheries and Aquaculture Science (Cefas) Lowestoft Laboratory	christo-pher.bird@cefas.co.uk	United Kingdom
Elvar Halldor Hallfredsson	Institute of Marine Research Tromsø	elvar.hallfreds-son@hi.no	Norway
Gudmundur Thordarson	Marine and Freshwater Research Institute	gudmundur.thordar-son@hafogvatn.is	Iceland
Guzmán Diez	AZTI-Tecnalia Sukarrieta	gdiez@azti.es	Spain
Hege Øverbø Hansen	Institute of Marine Research Flødevigen Station	hegeha@hi.no	Norway
Inês Farias	Portuguese Institute for the Sea and the Atmosphere (IPMA)	ifarias@ipma.pt	Portugal
Iñígo Martinez	International Council for the Exploration of the Sea	inigo@ices.dk	Denmark
Ivone Figueiredo	Portuguese Institute for the Sea and the Atmosphere (IPMA)	ifigueiredo@ipma.pt	Portugal
Juan Gil Herrera	Instituto Español de Oceanografía Centro Oceanografico de Cádiz	juan.gil@ieo.es	Spain
Kristin Helle	Institute of Marine Research	kristin.helle@hi.no	Norway
Lionel Pawlowski	Ifremer	lionel.paw-lowski@ifremer.fr	France
Lise Helen Ofstad	Faroe Marine Research Institute	liseo@hav.fo	Faroe Is-lands
Magnus Thorlacius	Marine and Freshwater Research Institute	magnus.thor-lacius@hafogvatn.is	Iceland
Mário Rui Rilho de Pinho	University of the Azores Department of Oceanography and Fisheries	mario.rr.pinho@uac.pt	Portugal
Martin Pastoors	Pelagic Freezer-Trawler Association	mpastoors@pe-lagicfish.eu	Nether-lands
Pamela Woods	Marine and Freshwater Research Institute	pamela.woods@hafog-vatn.is	Iceland
Pascal Lorance	Ifremer	pascal.lo-rance@ifremer.fr	France
Stefano Mariani	University of Salford School of Environment & Life Sciences	s.mariani@sal-ford.ac.uk	United Kingdom
Vladimir Khlivnoy	Knipovich Polar Research Institute of Marine Fisheries and Oceanography(PINRO)	khlivn@pinro.ru	Russian Federation

Annex 2: Recommendations

All recommendations are available from the ICES Recommendation database (http://community.ices.dk/admin/Recomendations/SitePages/Home.aspx).

RECOMMENDATION	TO
Assessement of roughsnout and roughnose grenadiers by WGDEEP As the roughsnout and roughnose grenadiers (Trachyrincus scabrus and T. murrayi) are non-commercial species and are not likely to become of commercial interest in the foreseeable future, it is recommended that these species are no longer considered by ICES in terms of stock assessment. Reported landings of bycatch of these species should be considered misreporting of other species, most probably of the roundnose grenadier. Roughsnout and roughnose grenadiers should not be subject of catch advice. For management purposes, primarily to prevent species misreporting, it is recommended that landings ascribed to roughsnout and roughnose grenadiers are counted against the national quotas, EU TAC and/or NEAFC TACs for roundnose grenadier.	ACOM

Annex 3: WGDEEP Stock Annexes

The table below provides an overview of the WGDEEP stock annexes updated at the WGDEEP 2018 meeting. Stock annexes for other stocks are available on the ICES web-site Library under the Publication type "Stock Annexes". Use the search facility to find a particular stock annex, refining your search in the left-hand column to include *year*, *ecoregion*, *species* and *acronym* of the relevant ICES expert group.

STOCK ID	STOCK NAME	LAST UPDATED	LINK
gfb.27.nea	Greater forkbeard (*Phycis blennoides*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	April 2018	gfb.27.nea
rng_3a	Roundnose grenadier (*Coryphaenoides rupestris*) in Di-vision 3.a (Skagerrak and Kattegat)	April 2018	rng_3a
rng_5b67	Roundnose grenadier (*Coryphaenoides rupestris*) in subare-as 6-7, and in Divisions 5.b and 12.b (Celtic Seas and the English Channel, Faroes grounds, and western Hatton Bank)	April 2018	rng_5b67
usk.27.3a45b6a7-912	Tusk (*Brosme brosme*) in subareas 4 and 7–9, and in divi-sions 3.a, 5.b, 6.a, and 12.b (Northeast Atlantic)	April 2018	usk.27.3a45b6a7-912

Annex 4: List of Working documents

Russian Fisheries and Investigations of Deep-Water Fish in The Northeast Atlantic In 2017, Dmitrii I. Aleksandrov, Vladimir N.Khlivnoi, Polar Research Institute of Marine Fisheries and Oceanography (PINRO)

Pastoors, M.A. 2018 PFA self-sampling report for WGDEEP 2018. PFA report 2018_08. © 2018 Pelagic Freezer-trawler Association

Updating Survey data from the Azores for deep-water species, Mário Rui Pinho and Helder Silva, Department of Oceanography and Fisheries (DOP) 9901-862 -Azores

Data from deep water fishery of the Azores, Mário Rui Pinho

Update on Norwegian fishery independent information on abundance, recruitment, size distributions, and exploitation of roundnose grenadier (Coryphaenoides rupestris) in the Skagerrak and north-eastern North Sea (ICES Division IIIa and IVa), Hege Øverbø Hansen, Odd Aksel Bergstad and Terje Jørgensen

Standardized Catch Rates for *Beryx decadactylus* (alf.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016), Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Standardized Catch Rates for *Beryx* spp. (alf-comb.27.nea) from the Azorean Bottom Longline Fleet (1990-2016), Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Standardized Catch Rates for Bluemouth Rockfish (brf.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016) Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Standardized Catch Rates for Conger Eel (coe.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016) Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Exploratory assessment on greater silver smelt in ICES areas 1,2,3a and 4 using different data limited methods, Elvar H. Hallfredsson

Standardized Catch Rates for Red Seabream (sbr.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016) Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Standardized Catch Rates for *Beryx splendens* (fin.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016) Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Standardized Catch Rates for Wreckfish (wrf.27.10a2) from the Azorean Bottom Longline Fleet (1990-2016) Régis V. S. Santos, Ana M. Novoa-Pabon, Helder M. da Silva1, João G. Pereira, Mario R. Pinho

Greater forkbeard Phycis blennoides in Portuguese waters (ICES Division 9.a), Teresa Moura, Neide Lagarto, Ivone Figueiredo, Instituto Português do Mar e da Atmosfera.

Summary of assessment trials on the Blackspot seabream fishery of the Strait of Gibraltar, Juan Gil, Said Benchoucha, José Luis Pérez, Sana El Arraf, Bjarki Thor Elvarsson

The Blackspot seabream Spanish target fishery of the Strait of Gibraltar: an update of the available information, Juan Gil, Candelaria Burgos, Carlos Farias, Juan José Acosta and Mar Soriano

Results on Greater forkbeard (*Phycis blennoides*), Bluemouth (*Helicolenus dactylopterus*), Spanish ling (*Molva macrophthalma*) and Red seabream (*Pagellus bogaraveo*) of the Northern Spanish Shelf Groundfish Survey O. Fernández-Zapico, M. Blanco, S. Ruiz-Pico, I. Preciado, A. Punzón, F. Velasco

Black scabbard fish in Faroese waters (27.5.b), Lise H. Ofstad

Roundnose grenadier in Faroese waters (27.5.b), Lise H. Ofstad

Faroese fishery of orange roughy in ICES area 10 and 12, Lise H. Ofstad

Tusk in Faroese waters (Division 27.5.b), Lise H. Ofstad

Blue ling in Faroese waters (Division 5.b), Lise H. Ofstad

Notes on *Pagellus bogaraveo* in the Portuguese continental waters (ICES Division 9.a), Inês Farias, Gonçalo Araújo, Teresa Moura, and Ivone Figueiredo

Results on silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*) and ling (*Molva molva*) from the Porcupine Bank Survey (NE Atlantic), S. Ruiz-Pico, O. Fernández-Zapico, M. Blanco, F. Velasco & F. Baldó

Annex 5: Audits

Advice sheet audit report and check list

Working Group: WGDEEP **rng27.3a** **Stock Name:** Choose an item.

Date:
Auditor: Vladimir Khlivnoi

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
    - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
    - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type:** update
2) **Assessment**: Survey trend based assessment
3) **Forecast**: not presented
4) **Assessment model**: none
5) **Data issues:** The biomass indices from the Norwegian shrimp survey are available. The landings information is available but recently reported landings are very low.
6) **Consistency**: same as last year
7) **Stock status**: ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.
8) **Management Plan**: ICES is not aware of any agreed precautionary management plan

General comments

This was a well documented, well ordered and considered section. It was easy to follow and interpret.

Technical comments

(Include comments on points where the draft report contains errors, is unclear and if the assessment is done according to the stock annex)

Conclusions

The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Is the assessment according to the stock annex description?

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

Have the data been used as specified in the stock annex?

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

Is there any **major** reason to deviate from the standard procedure for this stock?
Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☐ Compare the status table with the F and SSB plots they should show the same information.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct and

☒ The sources are correct.

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☐ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☒ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☐ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☐ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☐ If there is no change from the previous year the table should be the same.

☐ Ensure there is no typos wrong acronyms for the surveys.

☐ Assessment type- check that the standard text is used.

Information from stakeholders

☐ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☐ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☐ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☒ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☐ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: sbr.27.6-8**

Date: 18th of April
Auditor: Hege Øverbø Hansen

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
    - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
    - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type: update**
2) **Assessment**: Catch trend assessment, category 6 stock
3) **Forecast**: not presented
4) **Assessment model**:
5) **Data issues:** The catch data are available and according to the stock annex. There are additional data from surveys on abundance and length compositions.
6) **Consistency**:
7) **Stock status**: The stock is depleted.
8) **Management Plan**: No management plan for this stock.

General comments

This is a well documented and considered section. It is easy to follow and interpret.

Technical comments

The assessment is done according to the stock assessment**.**

Conclusions

The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice? YES

Is the assessment according to the stock annex description? YES

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary? No management plan.

Have the data been used as specified in the stock annex? YES

Has the assessment, recruitment and forecast model been applied as specified in the stock annex? YES

Is there any **major** reason to deviate from the standard procedure for this stock? NO

Does the update assessment give a valid basis for advice? YES
If not, suggested what other basis should be sought for the advice?

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables. YES

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☐ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☐ Check if the labels for the years are correct.

☐ Compare the status table with the F and SSB plots they should show the same information.

☒ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct and

☒ The sources are correct.

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☐ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☒ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☐ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be “There is no available information”

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☒ Ensure that the forecast year “predicted landings or catch corres. to advice” column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☒ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☐ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☐ Check if the column names are correct mainly recruitment age and age range for F.

☒ If the stock is category 5 or 6 then it should read “There is no assessment for this stock”

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: bli.27.5a14**

Date: 17/04/2018
Auditor: Guzman Diez

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type: update**
2) **Assessment**: trends
3) **Forecast**: not presented
4) **Assessment model**: The ICES framework for category 3 stocks (
5) **Data issues:** Only the Icelandic autumn survey is used and covers the full depth range and geographical distribution of the stock
6) **Consistency**: annual advice. Last year (2017) was accepted
7) **Stock status**: ICES assesses that fishing pressure on the stock is below FMSY proxy (status compared to Bpa not known but likely above candidate)
8) **Management Plan**: ICES is not aware of any agreed precautionary management plan for 2017 in this area.

General comments

It was a well documented. It was easy to follow using the the description of the assessment in the Stock annex and in the Report

Technical comments

The last version of the Sock annex is in 2016. Since the assessment is annual and the same method has been used in 2017 and 2018, only the sections A1-A4 need to be updated

Conclusions

The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

yes

Is the assessment according to the stock annex description?

yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

There is no management plan for this stock

Have the data been used as specified in the stock annex?

yes

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

No analytical assessment

Is there any **major** reason to deviate from the standard procedure for this stock?

no

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? The update assessment has been considered valid for advice for the EG. As bli4-14 is a data limited stock the precautionary approach is considered as the most convenient

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

No correct- 2015-2016-2017

☒ Check if the labels for the years are correct.

No correct- 2015-2016-2017

☐ Compare the status table with the F and SSB plots they should show the same information.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

<u>Basis of catch options table</u>:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct and

☒ The sources are correct.

<u>Catch options table:</u>

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☒ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☒ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☐ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☐ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☐ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☐ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☐ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☐ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: bsf.27.nea**

Date: 30.April.2018
Auditor: Pamela Woods

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

For single stock summary sheet advice:

1) **Assessment type: SALY**
2) **Assessment**: *analytical*
3) **Forecast**: *not presented*
4) **Assessment model**: *stage-structured state-space model with two life history stages and two spatial stock components, including unidirectional migration (southwards). Used to analyse trends in total abundance across data sources for a trends-based assessment, not to provide biomass estimates or reference points.*
5) **Data issues:** *Stock is so widespread that data likely only reflect small glimpses of stock dynamics in locations where species is fished.*
6) **Consistency**: *Results consistent and similar to last year's assessment; very little change in abundance trends.*
7) **Stock status**: *Unknown, but likely to be B<Blim based on expert judgement, F<Fpa based on LBI, R unobserved.*
8) **Management Plan**: *ICES is not aware of a management plan.*

General comments

Although the model of stock dynamics is complex, the assessment is clearly communicated as a category 3 stock.

Technical comments

Evaluating stock dynamics of this species is complicated by a large spatial gradient in life history – the youngest fish are found in the northernmost samples and mature individuals are only found in the southernmost samples. The analytical model is therefore used as a tool to evaluate dynamics of the entire stock by combining data sources from two distant fisheries (north – British Isles and south – Portugal) that differ in life history stage, and by incorporating unidirectional southwards migration with northwards recruitment. From this model, abundance trends are inferred and used in a trends-based assessment. Auxiliary data (Icelandic and Scottish surveys) are used qualitatively.

Conclusions

The assessment has been performed correctly – trends in biomass were inferred from the analytical model, which were then translated via a category 3 framework into a change in advised catch.

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Yes

Is the assessment according to the stock annex description?

Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

No management plan.

Have the data been used as specified in the stock annex?

Yes.

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

Yes.

Is there any **major** reason to deviate from the standard procedure for this stock?

No.

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

No.

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

Ok.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☒ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☒ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☒ Compare the status table with the F and SSB plots they should show the same information.

☒ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

<u>Basis of catch options table</u>:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct and

☒ The sources are correct.

<u>Catch options table:</u>

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☒ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☒ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☒ For all the options given in the table calculate the percentage of change in SSB and TAC.

☒ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under "Other options".

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Those not checked are not relevant.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☒ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☒ Are the units in plots correct?

☒ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Those not checked are not relevant.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☒ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☒ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☐ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☐ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☐ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read “There is no assessment for this stock”

None relevant.

Sources and references

☐ Ensure all references are correct.

☐ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: gfb.27.nea**

Date: 17 April 2018
Auditor: Elvar H. Hallfredsson

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type:** update
2) **Assessment**: trends
3) **Forecast**: not presented
4) **Assessment model**: The ICES framework for category 3 stocks (3.2)
5) **Data issues:** The French EVHOE survey didn't take place in 2017, however the biomass series of this survey was maintained in the analysis (one of 6 surveys in a combined index)
6) **Consistency**: biennial advice. Last advice accepted.
7) **Stock status**: No reference points.
8) **Management Plan**: No management plan

General comments

This was a well-documented, well ordered and considered section. It was easy to follow and interpret

Technical comments

In section "G. Biological reference points" in the Stock Annex it is says "WKLIFE Gislason spreadsheet was applied using values for L_{MAX} and AFC derived from Casas and Pineiro, 2000 and Muus and Nielsen, 1999. Some of the parameters estimated by the model (L_{inf}, k,) were different from those derived by those authors. Notwithstanding, if $F_{40\%SPR}$ is adopted as a proxy for FMSY the values obtained do not seem unrealistic.". This is somewhat unclear and not consistent with the 3.2 assessment. No reference point is applied. The Stock Annex needs to be updated.

Conclusions

The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice? Yes

Is the assessment according to the stock annex description? Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary? No management plan

Have the data been used as specified in the stock annex? Yes

Has the assessment, recruitment and forecast model been applied as specified in the stock annex? No analytical assessment

Is there any **major** reason to deviate from the standard procedure for this stock? NO

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? The update assessment is valid, given this data limited stock.

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☐ Compare the status table with the F and SSB plots they should show the same information.

☒ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is correct,

☒ The notes are correct and

☒ The sources are correct.

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☒ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☒ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☐ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☐ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☐ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☒ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☐ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☐ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: lin.27.5a**

Date: 20/04/2018
Auditor: Juan Gil Herrera

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

1) **Assessment type:** update
2) **Assessment**: analytical (ICES category 1)
3) **Forecast**: not presented
4) **Assessment model**: gadget model
5) **Data issues:** Only the Icelandic autumn survey is used. Covers the full depth range and geographical distribution of the stock
6) **Consistency**: Annual advice under a management plan (from 1st September till the next year end of August). Last year (2017) was benchmarked and accepted.
7) **Stock status**: ICES assesses that fishing pressure on the stock is below FMSY proxy (status compared to Bpa not known but likely above candidate)
8) **Management Plan**: ICES is not aware of any agreed precautionary management plan for 2017 in this area.

General comments

It so well documented, the Stock Annex is a really good example. So, it was quite easy to follow using the assessment description of the in the Stock annex (as well as the Report). Finnally, comparison with previous Advice Sheet was really quick.

Technical comments

Last update of the Sock annex was in May 2017. Since the assessment is annual and the same method has been used in 2017 and 2018, only minor details (historical series in Table 2 and 2018/2019 instead of 2017/2018 as "advice year" in the H section) needs to be updated.

Conclusions

The assessment has been performed correct and consistently with previous (and benchmarked) year (2017). Minor details should be corrected.

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Absolutely YES

Is the assessment according to the stock annex description?

Yes

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

There is a benchmarked (Icelandic) management plan for this stock

Have the data been used as specified in the stock annex?

For sure

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

A short term forecast (according to the benchmark) to the end of 2019 is provided to evaluate the impact on the SSB of the 2019 catches

Is there any **major** reason to deviate from the standard procedure for this stock?

None

Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

The update assessment has been considered valid for advice for the EG.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☒ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☒ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☒ Compare the status table with the F and SSB plots they should show the same information.

☒ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☒ The value is almost correct, in table 23 TAC and Advice change should be -27% instead of -29%

☒ The notes are correct but In the recruitment row (Table 2) should be specified that are in thousands (and may be use the 5440 instead of 5.44. The same for the SSB in Table 3 (32690 instead of 32.69)

☒ The sources are correct. As far as I understand the source column can be deleted

Catch options table:

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☒ The wanted catch and SSB values should be given in tonnes (t); correct the SSB value in Table 3 (32690 instead of 32.69)

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☐ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☒ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☒ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.) Yes, it was benchmarked by ICES in 2017

Quality of the assessment

☒ Are the units in plots correct? Yes

☒ Are the titles in the plots correct including F (age range) recruitment (age). There is something that should be corrected in the Figure 2 legend: HR shows only.... “current assessment” that should be changed to “two last assessments”, or something similar!!

☒ The red line correspond to the year of assessment (except F which is year of assessment -1)

☒ Each plot should have five lines. There are some lines missing in the Recruitment plot while in the case of HR plot is right (just 2 lines) because before 2017 fishing pressure was estimated as F instead of HR.

☒ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots. Looks fine; Reference points lines (SSB and HR) fits to the Table values

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information" But according to the single stock guidelines the default should be There is no additional available information. I don´t really know if this additional matters or not!!

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☐ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown. 8336 tons in 2017 come from Icelandic fishing year (from 1st September 2016 till 31 August 2017) according to Table 7. So it should be specified (I mean 2016/2017) or replace by 8655 (value for 2017 calendar year) which includes non Icelandic catches (I don´t know if can be splitted by gear).

History of commercial landings table:

☒ Ensure that the values for the last row are correct check against the preliminary landings (link to be added).

Summary of the assessment

☒ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F. According to that it should be included in the R column “at age 3”, but it was not included also in 2017 Advice Sheet. Again, I don´t really know if (similarly) Harvest rate column should be related (and included) to B(75+).

☐ If the stock is category 5 or 6 then it should read “There is no assessment for this stock”

Sources and references

☒ Ensure all references are correct.

☒ Ensure all references in the advice sheet are referenced in this section. Guess that the ICES Secretariat includes later the 2018 Report reference (hope so, in all the Advice Sheets!!)

Advice sheet audit report and check list

Working Group: WGDEEP rng.27.5b6712b **Stock Name:** Choose an item.

Date: 20. April 2018
Auditor: Lise H. Ofstad

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General
Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:
Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type: update**
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: *Bayesiansurplus production model for 27.5b67, ICES cat. 5 for 27.12b*
5) **Data issues:** *Uses Marine Scotland Deepwater surveys abundance index instead of LPUE from French trawlers*
6) **Consistency**: *see above*
7) **Stock status**: *B<Blim for a while, Flim<F<Fpa*
8) **Management Plan**: ICES is not aware of any agreed precautionary management plan for roundnose grenadier in this area.

General comments
This was ok documented, well ordered and considered section. It was easy to follow and interpret

Technical comments
I have read true the report and stock annex. My suggestions are reported to the stock coordinator.
The assessment is done according to the stock annex.

Conclusions
The assessment has been performed correctly

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?

Is the assessment according to the stock annex description?

If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?

Have the data been used as specified in the stock annex?

Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

Is there any **major** reason to deviate from the standard procedure for this stock?
Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

∨ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

∨ The advised value of catches should be the same as presented in the catch options table.

∨ Check the years for which the advice is given.

Stock development over time

∨ Ensure all units used in the plots are correct (compare with previous year advice sheet).

∨ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

∨ Check if the legend of the plots is consistent with what is shown in the plots.

∨ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

∨ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

∨ Check if the labels for the years are correct.

☐ Compare the status table with the F and SSB plots they should show the same information.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

<u>Basis of catch options table</u>:

For each of the rows in the table ensure that:

∨ The year is correct,

∨ The value is correct,

∨ The notes are correct and

∨ The sources are correct.

<u>Catch options table:</u>

☐ The forecast should be re-run to ensure all values are correct.

☐ Compare the input data with previous year run (previous year should be in the share point under the data folder)

∨ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

∨ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

∨ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

∨ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☐ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☐ Are the units in plots correct?

☐ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

∨ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

∨ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☐ If there is no change from the previous year the table should be the same.

☐ Ensure there is no typos wrong acronyms for the surveys.

☐ Assessment type- check that the standard text is used.

Information from stakeholders

∨ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☐ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☐ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☐ Ensure the legend of the table reflects the year for the data given in the table.

∨ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

∨ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☐ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

∨ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☐ Check if the column names are correct mainly recruitment age and age range for F.

☐ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

∨ Ensure all references are correct.

∨ Ensure all references in the advice sheet are referenced in this section.

Advice sheet audit report and check list

Working Group: WGDEEP **Stock Name: sbr.27.9**

Date: 23/04/2018
Auditor: Magnús Thorlacius

- *Audience to write for: ADG, ACOM, benchmark groups and EG next year.*
- *Aim is to audit (check if correct):*
  - *the stock assessment– concentrate on the input data, settings and output data from the assessment*
  - *the correct use of the assessment output in the forecast, and check if forecast settings are applied correctly*
- *Any deviations from the stock annex should be described sufficiently.*
- *By the conclusion of the working group, all update assessments should be audited successfully.*
- *Store all audits on SharePoint for future reference.*

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM.

1) **Assessment type: update**
2) **Assessment**: trends
3) **Forecast**: not presented
4) **Assessment model**: none
5) **Data issues:** data available as described in the stock annex
6) **Consistency**: same as last year
7) **Stock status**: ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined
8) **Management Plan**: *Plan is* ***not*** *evaluated by ICES*

General comments

This was a well-documented, well ordered and considered section. It was easy to follow and interpret.

Technical comments

When calculating the advice, the average for the years 2013-2015 don't match the values in table 9 for the index. Are those not the values used?

Conclusions

The assessment has been performed correctly apart from the comment above.

Checklist for audit process

General aspects

Has the EG answered those TORs relevant to providing advice?
Yes
Is the assessment according to the stock annex description?
Yes
If a management plan is used as the basis of the advice, has been agreed to by the relevant parties and has the plan been evaluated by ICES to be precautionary?
No management plan.
Have the data been used as specified in the stock annex?
Yes
Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
Yes
Is there any **major** reason to deviate from the standard procedure for this stock?
No
Does the update assessment give a valid basis for advice?

Yes

If not, suggested what other basis should be sought for the advice?

It is useful to print previous year advice sheet for comparison purposes it will make it easier to find potential errors and or inconsistencies.

Along with the spelling and structure of the text ensure that any values referenced in the text match the values or percentages shown in the tables.

All the values presented in the advice sheet should not be rounded at the WG. All rounded will be done at the ADG.

The check list below is given by section and it results from a compilation of the most frequent errors but by no means is it a complete list.

ICES stock advice

☒ Ensure the basis of the advice used is the correct one i.e Management plan; MSY approach; precautionary approach. The same as stated in the basis of advice table and history of advice table.

☒ The advised value of catches should be the same as presented in the catch options table.

☒ Check the years for which the advice is given.

Stock development over time

☒ Ensure all units used in the plots are correct (compare with previous year advice sheet).

☒ Ensure all titles of the plots are correct i.e caches; landings, recruitment age (0, 1, 2…); relative index

☐ Recruitment plot: if the intermediate years is an outcome of a model the value should be unshaded.

☐ Ensure the F and SSB reference points (RP) in the plots are the same as in the reference points table. Also, check the respective labels if they correspond with the RP.

☒ Check if the legend of the plots is consistent with what is shown in the plots.

☒ Check that the graphs match the data in table of stock assessment results.

Stock and exploitation status

☒ Compare with the previous year's advice sheet. The years in common should have the same status (symbol).

☒ Check if the labels for the years are correct.

☒ Compare the status table with the F and SSB plots they should show the same information.

☐ Does the stock have a management plan? If yes than the row for the management plan should be filled as well otherwise will read not applicable.

Catch options

Basis of catch options table:

For each of the rows in the table ensure that:

☒ The year is correct,

☐ The value is correct, the value for the average index 2013-2015 is 23,23 according to table 9, not 22,95 as it says in table 2.

☒ The notes are correct and

☒ The sources are correct.

Catch options table:

☒ The forecast should be re-run to ensure all values are correct.

☒ Compare the input data with previous year run (previous year should be in the share point under the data folder)

☐ The wanted catch and SSB values should be given in tonnes (t);

☐ Confirm if the F values for the options F_{lim}; F_{pa}; are correct.

☐ For the options where the value of F will take SSB of the forecast year to be equal to B_{lim}; B_{pa}; $MSY_{Btrigger}$ confirm if the SSB value for the forecast year is equal or close to the reference points.

☒ For the options where a percentage is added or taken (i.e +10%; 15%, etc.) from the current TAC. Ensure that the calculated values are correct.

☐ For all the options given in the table calculate the percentage of change in SSB and TAC.

☐ In the first column (Rationale) ensure the rational of the first line is the correct basis for the advice. All other options should be under “Other options”.

☐ Compare different catch options; higher F should result in lower SSB

☐ Check if SSB change is in line with F.

Basis of the advice

☒ Ensure the basis of the advice is correct and if the same is used in the catch option table and in the ICES stock advice section.

☒ Is there a management plan? If there is one it should be stated if it has been evaluated by ICES and considered precautionary or not and also if it has been sign off by the clients(EU; Norway, Faroe Islands, etc.)

Quality of the assessment

☒ Are the units in plots correct?

☒ Are the titles in the plots correct including F (age range) recruitment (age).

☐ The red line correspond to the year of assessment (except F which is year of assessment -1)

☐ Each plot should have five lines.

☐ Ensure the reference points lines (in the SSB and F plots) are correct and match with the values in the reference point table and summary plots.

Issues relevant for the advice

☒ Along with the spelling and structure in the text ensure that any values referenced in the text match the values or percentages in the tables within the advice sheet.

Reference points

☒ Ensure all the values, technical basis and sources are correct. If new values were not calculated the table should be the same as previous year.

Basis of the assessment

☒ If there is no change from the previous year the table should be the same.

☒ Ensure there is no typos wrong acronyms for the surveys.

☒ Assessment type- check that the standard text is used.

Information from stakeholders

☒ If no information is available the standard sentence should be "There is no available information"

History of advice, and management

☒ This table should only be updated for the assessment year and forecast year except if there was revision to the previous years.

☒ Ensure that the forecast year "predicted landings or catch corres. to advice" column match the advice given in the ICES stock advice section (usually given in thousand tonnes).

History of catch and landings

Catch distribution by fleet table:

☒ Ensure the legend of the table reflects the year for the data given in the table.

☒ Ensure that the sum of the percentage values in each of the components (landings and discards) amount to 100%

☒ Ensure that the sum of the values for discards and landings are equal to the value in the catch column. However, if only landings or discards components are shown, then total catch should be unknown.

History of commercial landings table:

☐ Ensure that the values for the last row are correct check against the preliminary landings (link to be added)

Summary of the assessment

☒ This table is an output from the standard graphs. If there was any errors picked up with any of the plots, then this table should be replaced by a new version once the errors are corrected.

☒ Check if the column names are correct mainly recruitment age and age range for F.

☒ If the stock is category 5 or 6 then it should read "There is no assessment for this stock"

Sources and references

☐ Ensure all references are correct. The reference is missing for ACOM 2014 advice and the link to 2018 WGDEEP report as it is for all summary sheets.

☐ Ensure all references in the advice sheet are referenced in this section.

Annex 6: EU-Special Request on TAC Management

Stocks/species included in the deep sea regulation.

Introduction

ICES was requested to analyse for a ***list*** of stocks under the deep water regulation the role of the Total Allowable Catch instrument. ICES was asked to assess the ***risks*** of removing TACs for each case analysed in light of the requirement to ensure that the stock concerned remains within safe biological limits in the short and middle term. ICES was further requested to assess the potential contribution of the application of other conservation tools in absence of TACs to the requirement that the stock concerned remains within safe biological limits.

In cases where the uses of TAC should be continued, ICES was asked to analyse a possible approach to contribute to inter-annual stability of TACs.

This request applies to a number of WGDEEP stocks some of which being under the EU regulation for certain deep-sea fish stocks and some others being under the general EU TAC regulation. WGDEEP followed a similar approach to that taken by in 2017 to address an EU special request on risk to the stock of dab and flounder of having no catch limits for the stock. In the responding advice, ICES defined the six following questions to evaluate this 2017 request:

1. Was the TAC restrictive in the past?
2. Is there a targeted fishery for the stock or are the species mainly discarded?
3. Is the stock of large economic importance or are the species of high value?
4. How are the most important fisheries for the stock managed?
5. What are the fishing effort and stock trends over time?
6. What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?

For stocks evaluated by WGDEEP, not all these questions could be answered, in particular Questions 5 and 6 could be treated only partly, primarily because in some areas TACs are applied to WGDEEP stocks that are only small bycatch on other species fisheries.

The TACs included in the request are mostly small TACs of a few tonnes or tens of tonnes and they may not correspond to ICES assessment units. WGDEEP considered that some of these differences between assessment and management units have a sound rationale and should in no way be considered as mismatch between assessment and management. The rationale for the differences between assessment and management units may be:

- For some species ICES considers large assessment units because there is no robust data to define stock structure. In this situation, it may be useful to split the ICES recommended catch between TAC for smaller areas in order to avoid local/regional depletion. For example ICES considers all the Northeast Atlantic as one assessment units for greater forkbeard (gfb.27.nea) while the EU sets four TACs for this species. Some of these TACs are low in areas where the species is caught as a small bycatch with no data allowing for an assessment, e.g. Azorean waters.

- When TACs for deep-water species were set it may have been recommended to set small TACs or zero TACs in areas where species occur at low level or do not occur at all in order to prevent either unmonitored development of new fisheries or area/species misreporting. The possibility of such issues may be reduced in recent years compared to the early 2000s when TACs where set.
- Some small EU TACs may apply to EU waters located at the fringe of EEZ of non-EU countries or at the fringe of international waters. This applies for example to the EU TAC of ling in community waters of 5.b, where the ICES assessment unit is ling in 5.b (lin.27.5b) while the bulk of ling from 5.b are caught in Faroese waters.

WGDEEP suggested that the effect of removing TACs may be hard to predict. In some stocks/TACs this may allowed for unsustainable catch to be landed while for some other the fishing activity and catch of the considered species may not change, like it was assessed for dab and flounder (ICES, 2017). For a few TACs, WGDEEP could suggest some alternative measures, in particular it was suggested that the TAC for a small area could be merged with a wider adjacent area.

ICES, 2017. EU request on a combined dab and flounder TAC and potential management measures besides catch limits http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.04.pdf

Stocks with TACs cutting across North Western and South Western Waters

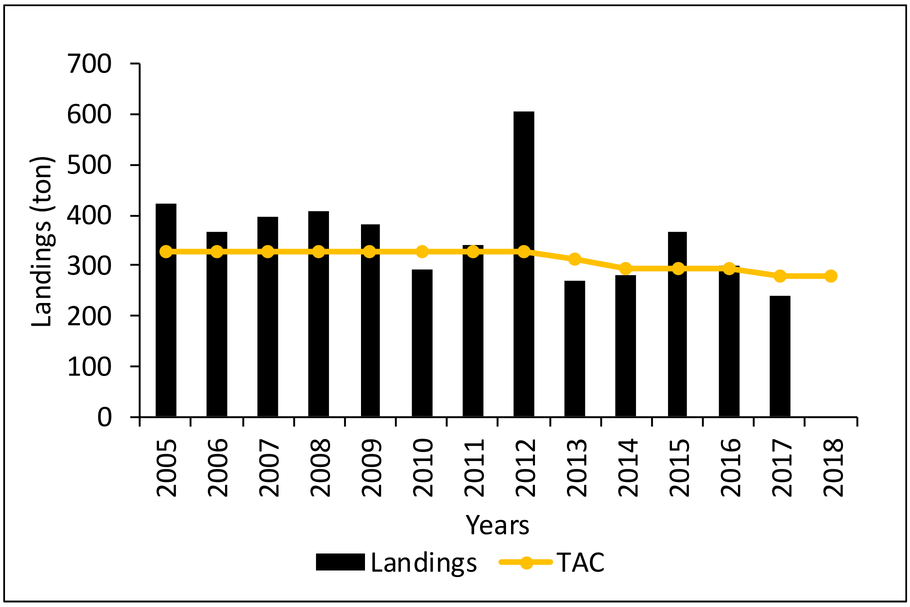
Beryx spp.

1. *Was the TAC restrictive in the past?*

According the analysis of the last fourteen years the TAC has been restrictive being the landings above the TAC almost along all the period, except for the years 2010, 2014 and 2017 (Table 1 and Figure 1). For some areas, like Portugal-Azores, the resultant quota has been restrictive in some recent years being the fishery closed usually until November. It should also be noted that TACs are only applied for the EU fisheries and in the NEAFC area the fishery for alfonsinos is regulated based on effort only.

Table 1. Annual TAC and Landings of Beryx spp reported to ICES area.

Regulation	Species	Year	ICES Area	TAC	Landings
Reg 2270/2004	*Beryx sp*	2005	II, IV, V, VI, VII, VIII, IX, X, XI	328	422
	Beryx sp	2006	II, IV, V, VI, VII, VIII, IX, X, XI	328	367
Reg 2015/2006	*Beryx sp*	2007	II, IV, V, VI, VII, VIII, IX, X, XI	328	396
	Beryx sp	2008	II, IV, V, VI, VII, VIII, IX, X, XI	328	407
Reg 1359/2008	*Beryx sp*	2009	II, IV, V, VI, VII, VIII, IX, X, XI	328	383
	Beryx sp	2010	II, IV, V, VI, VII, VIII, IX, X, XI	328	291
Reg 1225/2010	*Beryx sp*	2011	II, IV, V, VI, VII, VIII, IX, X, XI	328	340
	Beryx sp	2012	II, IV, V, VI, VII, VIII, IX, X, XI	328	605
Reg 1262/22012	*Beryx sp*	2013	II, IV, V, VI, VII, VIII, IX, X, XI	312	272
	Beryx sp	2014	II, IV, V, VI, VII, VIII, IX, X, XI	296	282
Reg. 1367/2014	*Beryx sp*	2015	II, IV, V, VI, VII, VIII, IX, X, XI	296	365
	Beryx sp	2016	II, IV, V, VI, VII, VIII, IX, X, XI	296	300
Reg 2285/2016	*Beryx sp*	2017	II, IV, V, VI, VII, VIII, IX, X, XI	280	240
	Beryx sp	2018	II, IV, V, VI, VII, VIII, IX, X, XI	280	



2. *Is there a targeted fishery for the stock or are the species mainly discarded?*

Historically there was a punctual target fishery on the Mid Atlantic Ridge (MAR) made by Russia and in the Azores with hook and line gears (under a multispecies context). The decrease of target fisheries were related with depletion on MAR and intense fishing and management measures in the Azores. Currently the landings come from by-catches fisheries including trawl, hook and line and gillnets gears. There are no fisheries on the recent years at MAR. For the Azores case the fisheries is a multispecies where the alfonsinos are one of the important target species among other species like wreckfish and red seabream. There are no information on discards for the recent years. Discards from the Azorean longliners was between 1%-10% by year due to the management effects (TAC and technical measures including hook size, minimum size for both species, zoning the fishing by area and by vessel size, marine protected areas,). There are also some sort of target fishery from sprain and main land Portugal.

3. *Is the stock of large economic importance or are the species of high value?*

These are valuable species particularly Beryx decadactylus. Average recent prices by year for the first sale at the Azores auctions are around 5 euros for Beryx splendens and 15 euros for Beryx decadactylus. However, the value of the species varies seasonally by island and year according the market. More than 90% of the fish is exported in fresh. The Azorean alfonsinos landings in value are around 1 million euros per year on the landings during the last 10 years, representing a high revenue for the local fisheries.

4. *How are the most important fisheries for the stock managed?*

Alfonsinos are managed through TAC and quotas under the Common Fisheries Policy of the EU and through effort regulations in the NEAFC areas. TAC advice from ICES is for species combined and for the entire NE Atlantic. The level of interaction between subareas or subdivisions is unknown however, available data suggests that at least for Beryx decadactylus it is very probable to occur because individuals in mature stages are not caught at the Azores subdivision Xa2. The lack of a TAC in NEAFC areas may be an incentive to pulse target fisheries on MAR seamounts (NEAFC existing fishing areas).

5. *What are the fishing effort and stock trends over time,*

There are not reliable estimates of the commercial trend effort for this stock. The stock (species combined) was in the past highly exploited in the Mid Atlantic Ridge (MAR) areas with the local depletion of some target seamounts. Nowadays there are no target fisheries occurring in MAR (because it is not economical under the present management limitations) and there are only by-catch fisheries in the European EEZs, although with some sort of target on alfonsinos. The most important fishery nowadays is the Azorean demersal hook and line fishery, representing around 56% of the landings in the last 10 years. The fishery is however, highly constrained by management measures, including TAC/Quotas, technical measures and closed areas to fishing. The information available are only landings. More detailed data is only available from the Azores (27.10.a2). The stock is accessed based on category 5 (landings base). The relative abundance indices from the Azores are not considered reliable because the stock unit is unknown (survey design cover a very small fraction of the stock distribution) and the fishery is highly constrained by the management measures.

There are no reliable estimates of the stock status.

6. What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?

Because alfonsinos are a bycatch species, the expected effort depends of the effort over the target species which includes alfonsino. These species are also highly aggregative around seamounts and so highly vulnerable to target fishing. TACs constrain the amount of effort that can be target to this resource. The species are highly valuable. With the remove of the TACs there are no upper limits in how much effort can be direct to alfonsinos and most probably the use of selective gears to target the resource will be developed.

Overall conclusion

It is not recommended to remove the TACs because it is expected the development of target fisheries due to the high value of the resources. Given the aggregative characteristics of the stock this scenario it is an incentive to stock depletion.

Deep sea sharks

Several species of deep-water sharks have been commercially exploited in the ICES area, but the leafscale gulper shark, *Centrophorus squamosus,* and the Portuguese dogfish, *Centroscymnus coelolepis*, were the two species of greatest importance to fisheries. Historically, in Portuguese and some Spanish fisheries, deep-water shark species have been recorded separately in landings data. However, in other fisheries, it has been a common practice to record landings of all species collectively under generalised categories such as "various sharks not elsewhere identified", "siki sharks", "dogfish sharks not elsewhere identified" etc. Also the same categories were often used to report other species such as pelagic sharks or spurdog. These misreporting problems has difficult the quantification of landings of deep-water sharks by species.

ICES has formerly provided combined advice on the two species under the generic term "siki". After 2014 and given the biology and spatial dynamics of the leafscale gulper shark and Portuguese dogfish, ICES provided advice on the species separately (ICES WKDEEP 2014).

Given the very low population productivity of both leafscale gulper shark and Portuguese dogfish and despite the rates of exploitation and stock sizes having not been quantified, it was considered that the two stocks could only sustain very low rates of exploitation. Based on that, ICES has routinely advised against targeted fisheries on leafscale gulper shark and Portuguese dogfish.

The ICES advice provided in 2015 for each of these species was:

- when the precautionary approach is applied for leafscale gulper shark in the Northeast Atlantic, fishing mortality should be minimized and no targeted fisheries should be permitted". This advice was valid for 2016 to 2019.
- when the precautionary approach is applied for Portuguese dogfish shark in the Northeast Atlantic, fishing mortality should be minimized and no targeted fisheries should be permitted". This advice was valid for 2016 to 2019.

Leafscale gulper shark has a wide distribution in the NE Atlantic from Iceland and Atlantic slopes southerly to Senegal, Madeira and the Canary Islands. Available information suggests that the species is highly migratory (Clarke *et al*., 2001; 2002; Moura e*t al*., 2014). In the NE Atlantic, the distribution pattern formerly assumed for the species considered the existence of a large-scale migration, where females would give birth off the Madeira Archipelago, from which there were reports of pregnant females (Severino et al., 2009). Recent data showed that pregnant females also occur off Iceland, indicating another potentially important reproductive area in the northern part of the NE Atlantic (Moura et al., 2014). Segregation by sex, size and maturity are probably linked to factors such as depth and temperature. Pregnant females tend to occur at waters warmer than those of the remaining maturity stages, particularly immature females are usually found at greater depths and lower temperatures (Moura *et al.*, 2014). Based on a molecular study it was showed that females are less dispersive than males being possibly philopatric. In the absence of more clear information on stock identity, a single assessment unit off the Northeast Atlantic has been adopted by ICES.

Portuguese dogfish is widely distributed along the NE Atlantic, but its spatial dynamics is not fully understood. The species lives near the bottom of the continental slopes at depths ranging from 230 to 2400 m (Compagno et al. 2004). At the NE Atlantic, the species depth ranges recorded are shallower than 933 m off Iceland (Magnússon et al. 2000); 1400-1900 m along the Reykjanes Ridge, west of Norway (Hareide and Garnes 2000); 600-1200 m and down to 1950 m on the Hatton Bank (Duran Muñoz *et al*. 2000); 458-1019 m in the Rockall Trough (Gordon 1999); 600–1400 m west of Ireland (Girard 2000); 750-1500 m in the Porcupine Seabight (Merret et al. 1991); and 800-1500 m off Portugal (Veríssimo et al. 2003). The species size ranges are similar between the northern and southern European continental slopes and all the maturity stages are found in the two areas. The absence of small specimens in the NE Atlantic has been interpreted to a different preferential habitat or to a more benthic behaviour of juveniles (Moura et al., 2014). The occurrence of all adult reproductive stages within the same geographical area and, in many cases, in similar proportions provide support to the hypothesis that the species can complete its life cycle in those areas of occurrence (Moura et al., 2014). Genetic studies on Portuguese dogfish developed so far were inconclusive about its stock structure (Moura et al., 2008 WD; Veríssimo et al., 2011). In the absence of more clear information, a single assessment unit in the Northeast Atlantic has been adopted by ICES.

1) Was the TAC restrictive in the past?

The first EU TAC for deep-water sharks was adopted in 2005 and in 2010 the EU TAC for deep-sea sharks was reduced to zero. Since then the EU TAC has remained at zero (Table 1).

Table 1. EU TAC for deep-water sharks 2005-2016

Fishing opportunities	Subarea 5, 6, 7, 8, 9	Subarea10	Subarea 12 (includes also *Deania histricosa* and *Deania profondorum*)
2005 and 2006	6763	14	243
2007	2472(1)	20	99
2008	1646(1)	20	49
2009	824(1)	10(1)	25(1)
2010	0(2)	0(2)	0(2)
2011	0(3)	0(3)	0(3)
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0

(1) Bycatches only. No directed fisheries for deep-sea sharks are permitted.

(2) Bycatches of up to 10% of 2009 quotas are permitted.

(3) Bycatches of up to 3% of 2009 quotas are permitted.

Initially the EU's deep-water shark category included a group of species, but it has been updated and new species have been included. The more recent list (Council regulation (EC) No 1182/2013) includes the following taxa: deep-water catsharks *Apristurus* spp., frilled shark *Chlamydoselachus anguineus*,), gulper sharks *Centrophorus* spp., Portuguese dogfish *Centroscymnus coelolepis*, longnose velvet dogfish *Centroscymnus crepidater*, black dogfish *Centroscyllium fabricii*; birdbeak dogfish *Deania calcea*; kitefin shark *Dalatias licha*; greater lantern shark *Etmopterus princeps*; velvet belly *Etmopterus spinax*; mouse catshark *Galeus murinus*; six-gilled shark *Hexanchus griseus*; sailfin roughshark *Oxynotus paradoxus*; knifetooth dog-fish *Scymnodon ringens*, and Greenland shark *Somniosus microcephalus*.

Table 2 presents the WGEF landings estimates for the two main species, leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic. Figure 1 presents the total landings and the corresponding adopted TAC by EU management area.

Table 2 Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (Subareas 27.4–14). Working Group estimate of combined landings of Portuguese dogfish and leafscale gulper shark (t) by ICES area. Landings are combined until 2009; from 2010 onwards landings are presented by species (leafscale gulper shark - Portuguese dogfish).

ICES	27.4.a	27.5.a	27.5.b	27.6	27.7	27.8	27.9	27.10	27.12	27.14	Unknown Area	TOTAL
1988	0	0	0	0	0	0	560	0	0	0	0	560
1989	12	0	0	8	0	0	507	0	0	0	0	527
1990	8	0	140	6	0	6	475	0	0	0	0	635
1991	10	0	75	1013	265	70	1075	0	1	0	0	2509
1992	140	1	123	2013	1171	62	1114	0	2	0	0	4626
1993	63	1	97	2781	1232	25	946	0	7	0	0	5152
1994	98	0	198	2872	2087	36	1155	0	9	0	0	6455
1995	78	0	272	2824	1800	45	1354	0	139	0	0	6512
1996	298	0	391	3639	1168	336	1189	0	147	0	0	7168
1997	227	0	328	4135	1637	503	1311	0	32	9	0	8182
1998	81	5	552	4133	1038	605	1220	0	56	15	0	7705
1999	55	0	469	3471	895	531	972	0	91	0	0	6484
2000	1	1	410	3455	892	361	1049	0	890	0	0	7059
2001	3	0	475	4459	2685	634	1130	0	719	0	0	10105
2002	10	0	215	3086	1487	669	1198	0	1416	12	0	8093
2003	16	0	300	3855	3926	746	1180	0	849	4	0	10876
2004	5	0	229	2754	3477	674	1125	0	767	0	0	9031
2005	4	0	239	1102	842	376	1033	1	134	0	1323	5054
2006	4	0	195	638	323	208	1325	0	0	0	34	2727
2007	3	0	590	737	94	23	517	0	1	61	0	2025
2008	1	0	171	621	111	27	463	0	0	0	0	1393
2009	1	0	24	54	4	105	33	0	0	0	0	220
2010	1 - 0	0 – 0	38 - 8	21 - 22	4 - 0	4 - 1	4 - 1	0 - 0	0 - 0	0 - 0	0 - 0	71 - 33
2011	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	1 - 0	1 - 1	0 - 0	0 - 0	0 - 0	0 - 0	2 - 1
2012	0 - 0	0 - 0	51 - 0	0 - 0	0 - 0	0 - 0	1 - 0	0 - 0	0 - 0	0 - 0	0 - 0	52 - 1
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

ICES	27.4.a	27. 5.a	27.5 .b	27.6	27. 7	27. 8	27. 9	27. 10	27.1 2	27.14	Unknown Area	TOTA L
2014	0 - 0	0 - 0	32 - 5	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	33 - 5

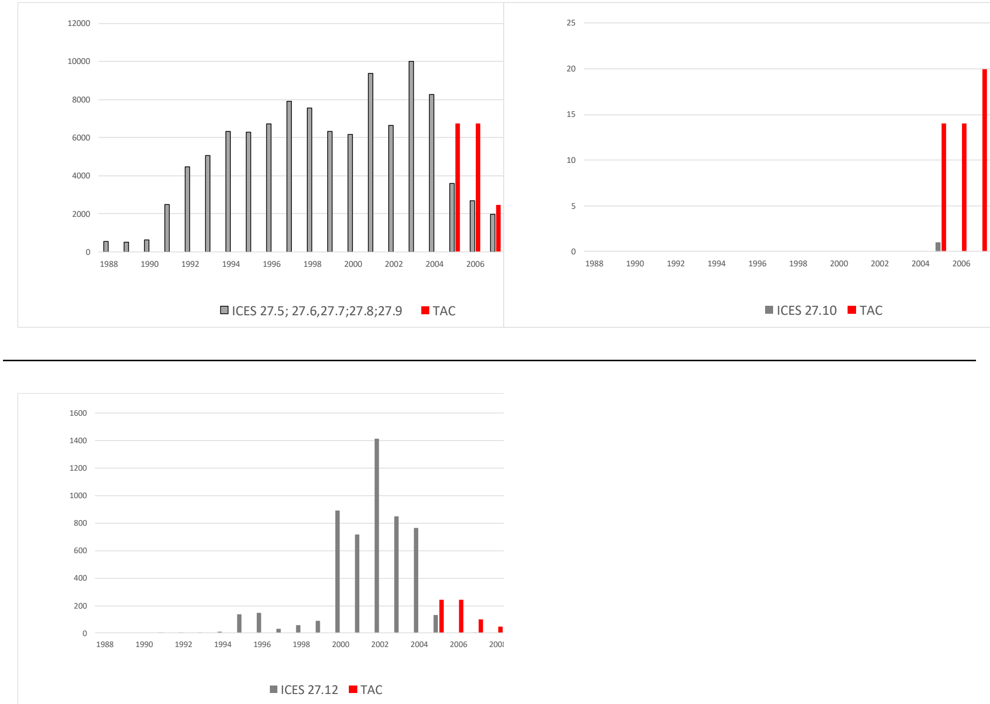


Figure1. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic. WGEF estimate of combined landings of Portuguese dogfish and leafscale gulper shark (t) by ICES area and the adopted by EU management area.

2) *Is there a targeted fishery for the stock or are the species mainly discarded?*

The adopted EU zero TAC for deep-water sharks is considered to have successfully prevented targeted fisheries for deep-water sharks in ICES areas. After 0 EU TAC, landings of these species have become bycatches of deep-sea fisheries which has led to an increase in discards. The estimates of deep-water shark discards for those fisheries have a considerable level of uncertainty. The onboard sampling information has not been used to estimate catch, as appropriate estimators need to be developed for that purpose.

Based on the onboard sampling data, discard information is presented for the Spanish and French fisheries (Tables 3 and 4) (2005–2014).

Important to remark that for both leafscale gulper shark and Portuguese dogfish the survivorship of specimens after catch is extremely low. However, in a recent scientific study leafscale gulper sharks caught by longline at depths of 900–1100 m were tagged, indicating that they might be capable of surviving capture by that fishing gear

(Rodríguez-Cabello and Sánchez, 2014). However, in this study soaking times were restricted to 2–3 hours and the lines were hauled back at a very slower speeds (0.4–0.5 m.s–1) than those used under normal fishing practices.

Table 3 Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (Subareas 27.4–14). Spanish discard data for *Centrophorus* spp. Numbers of sampled trips and total trips are not yet available for the years 2010 onward.

Year	Celtic Sea (Subareas (27.6-8))			Iberian Waters (Divisions (27.8c–9.a))		
	Sampled trips	Total trips	Raised discards (t)	Sampled trips	Total trips	Raised discards (t)
2003	9	1172	0	51	18 036	0
2004	11	1222	0	53	20 819	0
2005	10	1194	0	97	11 693	4.5
2006	13	1152	3.2	75	18 352	4.1
2007	12	1233	0	95	17 750	0
2008	11	1206	67.3	103	15 114	0
2009	15	1304	61.1	116	14 486	85.9
2010			0			29.2
2011			0			0.9
2012			173.4			0.7
2013			0			0

Table 4. Deep-water sharks - Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (Subareas 27.4–14). Total number of fishing trips observed, number of hauls and number of hauls with catch of Portuguese dogfish and leafscale gulper shark in French on-board observations (2005–2014).

		Total number of		Portuguese dogfish (positive hauls)		Leafscale gulper shark (positive hauls)	
Year	Country	Trips	Hauls	Number	Proportion	Number	Proportion
2005	France	18	212	26	0.12	9	0.04
2006	France	9	106	18	0.17	1	0.01
2007	France	6	15	1	0.07	35	0.14
2008	France	18	245	12	0.05	143	0.24
2009	France	42	605	89	0.15	120	0.24
2010	France	48	504	93	0.18	71	0.16
2011	France	29	443	67	0.15	93	0.21
2012	France	32	449	35	0.08	79	0.18
2013	France	36	447	27	0.06	72	0.20
2014	France	31	365	34	0.09	9	0.04

3) *Is the stock of large economic importance or are the species of high value?*

Deep-water shark species are of high value all over the world. Shark meat and fins and liver oil are marketed in many geographic areas. Shark meat is also utilized as fishmeal, dried and salted for human consumption. Current usage of deep-water sharks' meat, from world areas where landings are legal are poorly known. There are use of oil in the cosmetic industry, and before the reduction of the TAC to 0, livers from EU catch were fully used. ICES has no data on the price of liver oil.

In the early 1990s, livers of deep-water sharks were landed and sold separately. Such practice is currently banned in application of the 0 TAC for deep-water shark.

4) *How are the most important fisheries for the stock managed?*

In parallel to the 0 EU TAC adopted for the deep-water sharks, target species of main fisheries that have deep-water sharks as bycatches are also managed.

However, before the adoption of the EU TAC for deep-sea sharks, several species were commercially exploited in the ICES area by both mixed trawl fisheries and in mixed and directed longline fisheries. Before the EU ban on fishing with gillnets in depths greater than 600 m, there were important gillnet fisheries directed to deep-sea sharks in some areas.

A brief description of those fisheries is next included.

Norway: Norwegian longliners target blue ling (*Molva dypterygia*), mora (*Mora moro*) and leafscale gulper shark (*Centrophorus squamosus*) on the continental slope between 800 and 1100 m. In 2000 and 2001, a longline fishery for Greenland halibut with a by-catch of Portuguese dogfish operated on Hatton Bank at depths ranging from 1300 and 1600 m.

Faroes: A directed longline fishery on deep-water sharks was carried out in the southern and western slopes of Faroes Island from 1995 to 1999. No detailed information on this fishery is available although anecdotal information suggests that fishing was developed at depths between 800 and 1200 m in the slopes west of the Wyville Thompson Ridge and south of the Faroe Bank Plateau.

Germany: in the early 2000s, two German vessels conducted a deep-sea gillnet fishery (Hareide et al., 2004). The main fishing area was on the southern part of area 27.7 (Porcupine Seabight), around area 27.6 (Rockall) and in area 27.12. Deep-water sharks were landed in Spain under the commercial category 'various sharks'. This fishery ceased in 2006 as a result of the EU ban on fishing with gillnets in depths greater than 600 m.

France: *C. squamosus* and *C. coelolepis* and, lately, *Centroscyllium fabricii* were caught by the French trawl fishery for mixed deep-water species. Initially this fishery was conducted in ICES Subareas 27.6.a and 27.7c,k but in 2001 when the Irish deep-water trawl fishery started to operate in Subarea 27.7 most of the French fishing fleet restricted to Division 27.6.a. In Subarea 27.12 there were French landings of deep-water sharks, but it is not possible to detect any trends in shark biomass from the available data.

Ireland: An Irish longline fishery targeting ling and tusk in the upper slope and deep-water sharks started in 2000 and ceased in 2003. Mainly two species of deep-water sharks, *C. coelolepis* and *C. squamosus* were marketed but there were some landings of birdbeak dogfish and longnose velvet dogfish.

UK: Between the mid 1980s and 2006, UK registered longliners and gillnetters operating a directed fishery for deep-water sharks in Subareas 27.6, 27.7, and 27.12. The fleet was mostly composed of vessels based in Spain but registered in the UK, Germany, and other countries outside the EU, such as Panama.

C. squamosus and *C. coelolepis* were caught by a Scottish deep-water mixed-species trawl fishery operating mainly in Subarea 27.6. Since the introduction of TACs for a number of deep-water species, in 2003, effort in this fishery has greatly reduced.

Spain: A fleet of large freezer trawlers (initially composed by around 24 vessels) have been conducting a mixed deep-sea fishery in international waters off the Hatton Bank, mainly in ICES Subarea 27.12 and partially in Division 27.6.b. Only a small fraction of the fleet works full-time in this fishery (e.g. 2 vessels in 2000 and 4 vessels in 2001). The main commercial fish species caught are smoothheads, roundnose grenadier, blue ling and *C. coelolepis*.

The Basque "baka" trawl fishery operates in Subareas 27.6 and 27.7 and Divisions 27.7.a,b,d, but deep-water species including deep-water sharks are mainly caught in Subarea 27.6. For the period 1997–2002, a small deep-water longline fleet targeting deep-water sharks annually landed in Basque ports about 150 t in "trunk" weight (i.e. gutted and without head, skin and fins) of deep-water sharks (Lucio et al., 2004).

Portugal: In Sesimbra (Division 27.9.a), the longline fishery targeting black scabbard-fish *Aphanopus carbo* has a bycatch of deep-water sharks, particularly Portuguese dog-fish and the leafscale gulper shark. Deep-water sharks may be also caught by the Portuguese deep-sea bottom-trawl fishery that targets the rose shrimp *Parapenaeus longirostris* and *Nephrops* mainly south and southwest of the Portuguese mainland. Deep-water shark species caught in this fishery are: birdbeak dogfish, blackmouth cat-shark, gulper shark, kitefin shark, leaf-scale gulper shark, smooth lanternshark *Etmopterus pusillus*, and velvet belly.

From 1983– 2001, there was a directed longline fishery for deep-water sharks, based at Viana do Castelo in northern Portugal. Landings from this fishery predominantly con-sisted of leafscale gulper shark, Portuguese dogfish, and gulper shark.

5) What are the fishing effort and stock trends over time?

No reliable data on fishing effort to deep-water shark stocks is available. Also, there is no robust data available to follow their stock trends over time. Since 2009 the 0 TAC adopted for the two stocks render the fishery-dependent data unavailable for monitor-ing the status of the stocks.

Abundance indices are exclusively derived from the Scottish deep-water survey, the only deep-water survey taking place in ICES area. Scottish data are available for the period after the development of the deep-water fisheries in the area. The updated time series of the Scottish survey abundance index for leafscale gulper shark (left) and for the Portuguese dogfish (right) in Scottish deep-water surveys (2000–2017) is presented in Figure 2.

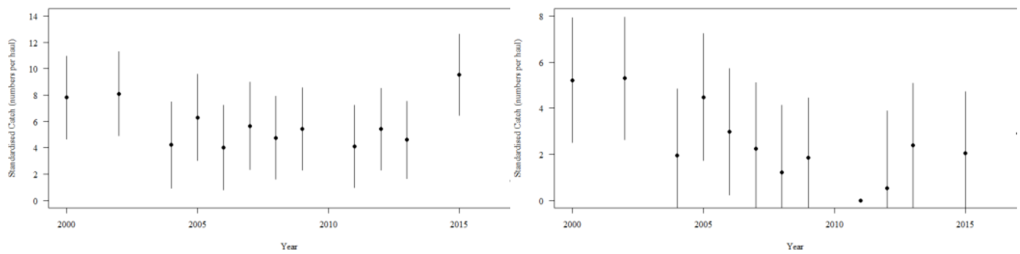


Figure 2 Deep-water sharks - and Portuguese dogfish in the Northeast Atlantic (Subareas 4–14). Standardized abundance index for leafscale gulper shark (left) and for the Portuguese dogfish (right) in Scottish deepwater surveys 2000 to 2017 (error bars = ± 2 standard error).

The abundance indices obtained for each deep-water shark species are considered inappropriate for inferring stock trend, as data are representative of an insignificant part of the stock management area. No other fishery-independent abundance indices are available thus preventing the understanding stock abundance temporal evolution at the major fraction of its distribution area and in particularly, on the stock response as a result of 0 EU TAC adopted for the deep-water shark.

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

The information available is insufficient to address this question. Given the highly commercial value of the species, removing the TAC for deep-water sharks may constitute an incentive for the development of directed fisheries, as it has occurred in the past.

Overall conclusion

Catch in the 1990s and 2000s show that high landings of deep-water sharks are achievable. In this decade unsustainable levels of catch were achieved. At least in some specific areas catches from longlines and gillnet set in the deep water may be dominated by deep-water sharks with a very small contribution of other deep-water species. In other words, targeting deep-waters sharks is achievable in some areas and gears. For trawl fisheries, option for targeting are reduced (although probably not inexistent) owing to the 800 m depth limit now applied to these fisheries. Current restriction of fishing depth make catch of deep-water sharks almost impossible for nets, although data suggest some deep-water shark bycatches in monkfish fisheries. The TAC for deep-water sharks has been efficient at reducing past catches which were unsustainable. If this TAC is halted alternative measures to constraint deep-water fisheries to their current level is required. Then, without a TAC, measures to spatially limit fisheries and fishing effort are absolutely necessary. It is however difficult to design which measures would be efficient in addition to current EU regulations were both trawling and netting are restricted in terms of fishing depth, which results in protecting deep-water sharks in a fraction of their depth distribution.

Conclusion suggesting that freezing fishing grounds and fishing effort of DW fisheries to current level could allow catch of sharks to be sustainable.

Blackspot seabream in subareas 6, 7 and 8

History of the stock

This stock collapsed in the early 1980s, with strongly declining landings from the mid-1970s to the mid 1980s (Lorance 2011). From the collapse to 2003 the fishery remained unregulated with no quota or technical measures to limit the fishing mortality of the residual population. From 2003 the TAC regulation restricted the catch and only by-catch were allowed.

Blackspot seabream is a male-first sex-changing species, it is also aggregating and forms shoals that can be targeted by fisheries at least in some seasons and areas.

1) *Was the TAC restrictive in the past?*

Restrictive effect seen from legal regulation and fisheries certification

The TAC was first introduced in 2003, for French fisheries it was restrictive at least from 2005. The two first years, in 2003-2004 the TAC may not have been constraining as the stock was most probably lower at the time than now after 15 years of strict regulation. Every year, a national French regulation divides the French quota in subquotas attributed to Producers Organisations (POs). From 2006, one or several national regulations for quota closure of blackspot seabream were issued every year and these closed the fishery for part of all POs. In other words from 2006, the species was subject to legal prohibition of landings by part or all French vessels susceptible to catch it during part of the year. In addition to national regulation, other rules designed to comply the TAC regulation have been set by POs or CNPMEM (Committees for Maritime Fisheries and Fish Farming, http://www.comite-peches.fr/en/about-us/the-cnpmem/) could not be fully traced back for all year because there is no database of all rules at POs and industry representative committees' level.

From 2005 landings were banned to artisanal purse seiners, by the Brittany CRPMEM (Regional Committee for Maritime Fisheries and Fish Farming). Since 2009 this ban has been included in the MSC certification of the sardine fishery by purse seiners of south Brittany (MSC 210). From 2002 to 2004, the French landings statistics included 23 landings events of more than 1 tonne of blackspot seabream by these artisanal purse seiners. No such event was recorded in 2005-2017, which reflects that these vessels could avoid these catches. The MSC assessment report one catch event in 2009, which is not in landings statistics, possibly because it was confiscated as MSC reported that "*One occasional landing of red sea bream in early 2009 has conduct authorities to remove license to the fishing boat during several months preventing for further commercial catches. The measure is now strictly applied. These measures are supposed to maintain these species at levels that will enable recovery or restocking*" (MSC 2010). The ban to seiners was only included in the French regulation in 2015 (JORF, 2015). The same regulation sets a catch limit of 300 kg per year for all type of trawls, which was applied based on CRPMEM rules.

For 2017, the PO "*Les pêcheurs de Bretagne*", to which most vessels fishing in 7.e-k and 8.a are registered took the following decisions:

- Landings of blackspot seabream smaller than 500g grams were ban throughout the year,
- All landings were banned from 01/01/2017 to 05/07/2017
- From 05/07/2017 to 31/12/2017, 8 artisanal handliners were allowed a bycatch of 80 kg/day, all other handliners and longliners were allowed a bycatch of 40kg/day and 300 kg/year, landings from all other métiers were banned

Therefore, French fisheries complied with the reducing TAC mainly by banning or restricting catch for towed gears and setting catch limits to hooks and lines métiers.

Fisheries catch statistics

Catch statistics should be considered uncertain, primarily because their total amount is small. Additionally, in Division 8c the recreational fisheries often catch adult blackspot seabreams and sell them outside official markets. These landings could be significant but cannot be quantified and are not accounted for in official landings. The species is also subject to recreational catches in French waters.

Historically, discards are considered negligible, since 2014 discards reported in all subareas represent between 0.6% and 1.3% of the annual catches. However, discards sampling (from on-board observations) is likely to be unreliable for species rarely caught, in particular for an aggregating species were a small number of big catches may represent the bulk of discards. Raising protocols are also problematic for species which are not landed by the same fleet (e.g. French trawlers and seiners which landings were banned at national level). For recent years, these low discard level is in contradiction with information reported by stakeholders.

Comparing TAC and landings suggest that the TAC may not have been strongly restrictive overall before 2009-2011, as the TAC was larger than the total catch up to 2010 with the exception of 2007. However, catches of small artisanal fleets (deep water longlines) might not have been fully reported to official landings in some areas and small bycatch may not have been fully reported in logbook at least in earlier years. In more recent years there is a decrease in catches concomitant to the decreasing TAC, which suggest that the TAC was a constraint (Table 1 and figure 1). French POs further reported that they could no longer exchange quotas with Spanish POs, implying that French catches had to be reduced much and Spanish fleets became constrained.

Table 1. Time-series of TAC and landings of blackspot seabream in subareas 6, 7 and 8 (mostly caught from subareas 8).

YEAR	TAC	LANDINGS	TAC-LANDINGS
2003	350	129	221
2004	350	183	167
2005	298	158	140
2006	298	139	159
2007	298	324	-26
2008	298	159	139
2009	253	203	50
2010	215	281	-66
2011	215	177	38
2012	215	257	-42
2013	196	295	-99
2014	178	256	-78
2015	169	177	-8
2016	160	164	-4
2017	144	124	20

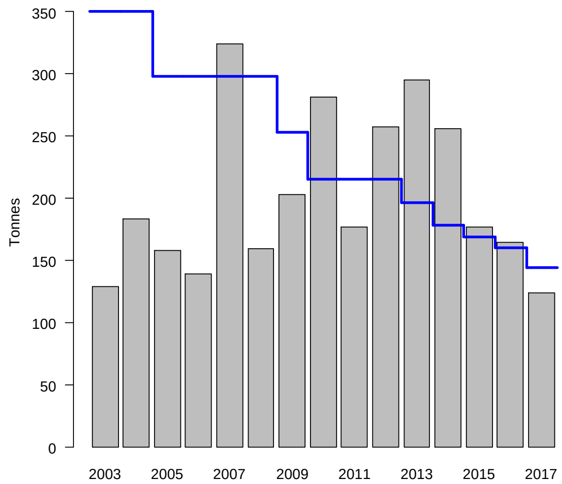


Figure. Landings (grey bars) and TAC of blackspot seabream in ICES subareas 6, 7 and 8.

French landings have been reducing over time (Figure 1). It is not known whether the increase landings in 2004, reflects increasing abundance, changes in fishing activity targeting or misreporting in earlier years. Changes in fishing targeting may have resulted from change in availability of other species including seabass. Misreporting may simply result from error because the same vessels fish for a several sparids species with similar 3 letters codes. For example, catches of the much more abundant black seabream, which annual catch are over 2000 t and catches of the gilthead seabream may include a bycatch of blackspot seabream. Minor miscoding errors of catches of black and gilthead seabreams (coded BRB and SBG respectively) to blackspot seabream (SBR) may have a large impact on reported landings of the latter. This is however unlikely to have happened after 2007-2008 as blackspot seabream became subject to more attention

The total catch of blackspot seabream from French artisanal purse seiners amounted to 85 tonnes in 2002–2004, i.e. 28 t/year on average, four times the 2018 French quota. Small catch by seines after 2005 may be bycatch for demersal seines.

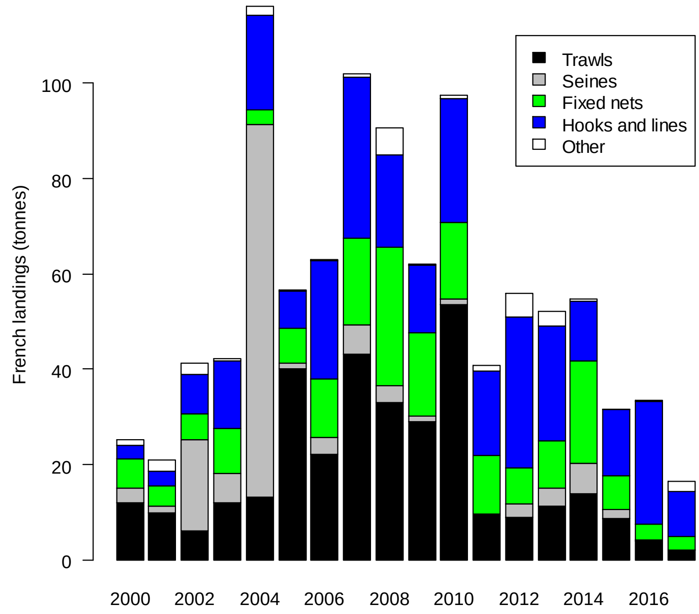


Figure 1. French landings of blackspot seabream by fishing gear, 2000-2017

2) Is there a targeted fishery for the stock?

Blackspot seabream used to be a major species in the landings from the Bay of Biscay up to the early 1980s. Up to the mid-1970s, more than 15 000 t of blackspot sea bream were landed annually in Spanish and French ports. About two third of these landings were from Spain and one third from France. Up to the 1970s, 95% of French landings were from bottom trawls but in 1984, 18% of French landings were from pelagic trawls (Dardignac, 1984).

In Spanish waters landings come mainly from longline vessels (50-70 %) followed by trawl gears. Gillnet and purseine represent only a minor component of landings (<15 %).

Currently, no directed fisheries are permitted under the quota, therefore catches should be only bycatches.

A target fishery would surely develop without a TAC, because of the high price and the aggregating behaviour of the species (Figure 2).

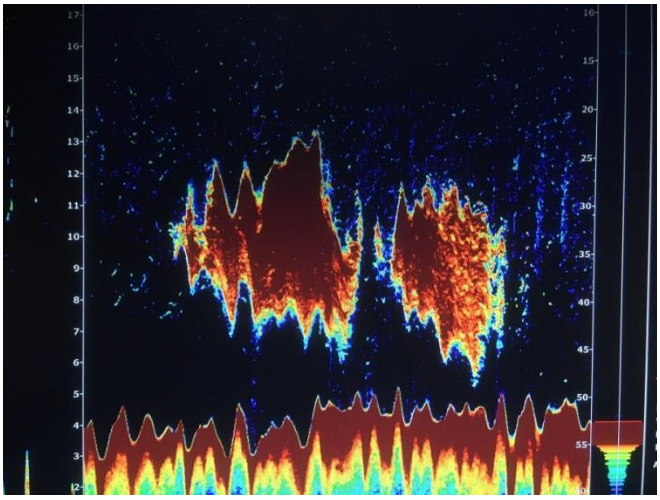


Figure 2 Shoal of > 30 T of blackspot seabream. Fishers have reported that such shoals have been found more frequently in recent years

3) *Is the stock of large economic value and the species or high price*

At the current low level of the stock the value is small, the historic value was high. The species is one of the highest priced species in European waters.

The mean price in Spanish fish auction markets of blackspot seabream caught in ICES Division 8.c have been over 10 euros per kg for more than 10 years (Figure 3). Prices have increased from 2007 to 2014 (no data for more recent years), with mean price in 2012-2014 close to 15 euros and reaching 20 euros in December.

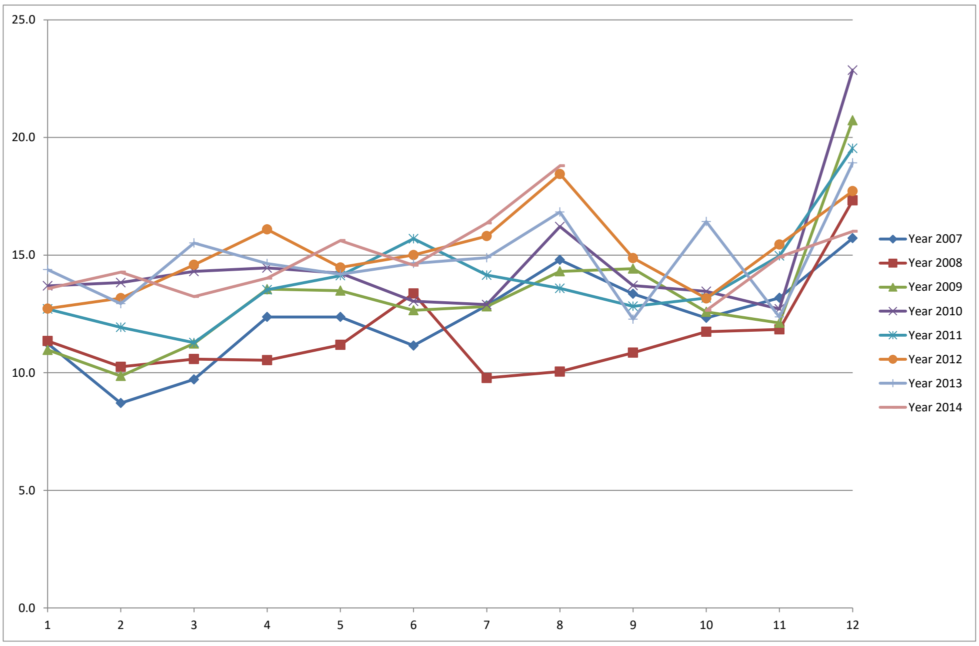


Figure 3. Mean price per year and month of blackspot seabream landings from Division 8.c

Similarly the mean price at French first sale increased over time and was around 15 euros/kg in 2016 and 2017 (Figure 4).

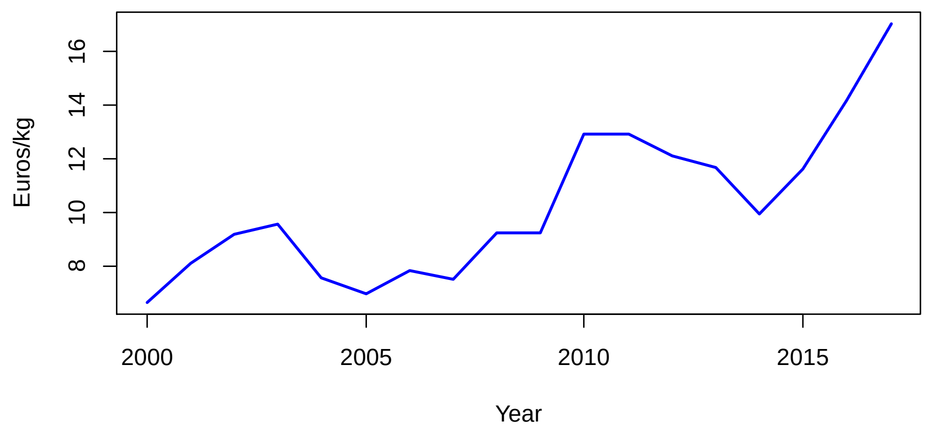


Figure 4. Mean price per year of blackspot seabream landed by French vessels.

The level of annual yield that could have been sustainable before the stock collapse was estimated between 5 000 and 10 000 tonnes per years based on various assumptions using the DCAC model (MacCall 2009, ICES 2012). Assuming that the price above would be lower at higher stock abundance by similar to that of seabass (13 € per kg, mean 2015-17, at first sale in France) the stock to be rebuilt represents a landed fish value of more than 60 million euros per year.

4) *How is the most important fishery for the stock managed?*

The main current management is by a biannual TAC and national quotas. The TAC is for bycatch only, no targeted catch are allowed.

5) *What are the fishing effort and stock trends over time?*

As the stock is currently a small bycatch, fishing effort relevant to the stock cannot be estimated.

Recent stock trends are not estimated by ICES. The stock is assessed as category 6 and catches are not informative in terms of stock trends because catch are constrained by the TAC.

The stock collapsed in the early 1980s, with strongly declining landings from the mid-1970s to the mid 1980s (Lorance 2011). The decline occurred in the total absence of management so that the decreasing catch from 15 000 to 20 000 tonnes per year down to less than 1000 tonnes per year reflected the declining biomass. The overexploitation induced a recruitment failure. Before the collapse, the total stock biomass was likely more than 100 000 tonnes and it declined to a few percent of this after the collapse (Lorance 2011). Catches declined sharply from 1975 to 1985 and have stayed at low levels ever since.

Information from surveys

In two surveys carried out in the Bay of Biscay in 1973 and 1976 with the same trawl and fishing protocol as the current EVHOE survey, but with more hauls in the Bay of Biscay (ICES divisions 8ab) blackspot seabream was caught in 32 out of 134 (26%) and 83 out of 155 (54%) hauls respectively in May 1973 and October 1976. In the last ten years (from 2007 to 2016 as the 2017 coverage was very incomplete) of the EVHOE survey in the same area, the species was caught in 15 out of 796 hauls (2%). In 1973 and

1976, the fish was found all over the shelf (Figure 5). There was less than 5 individuals in half of hauls with catch of the species, a few hauls included up to 200 individuals reflecting the aggregative behaviour were the species from shoals and at sufficient abundance a few individuals are observed dispersed everywhere, making a very skewed distribution of numbers per haul (Figure 6).

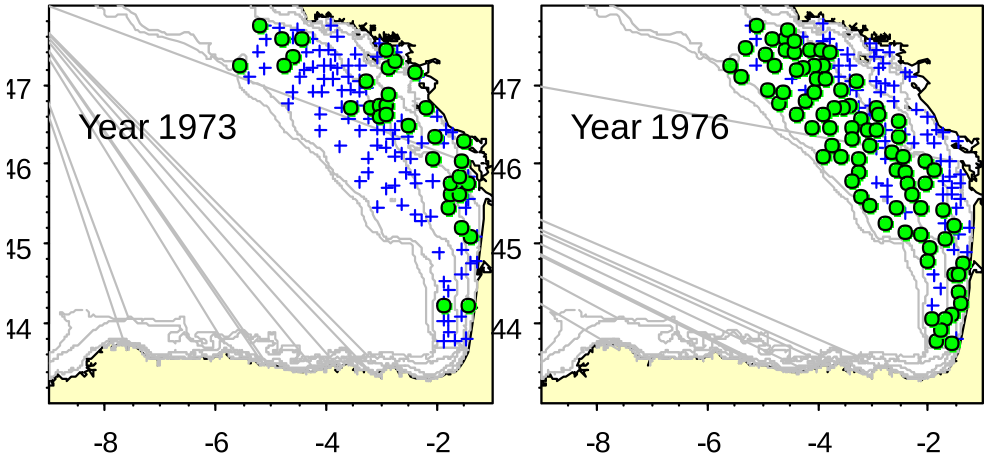


Figure 5. Spatial distribution of the blackspot seabream in two surveys carried out in May 1973 and October 1976 in the Bay of Biscay, blue crosses: hauls with no catch of the species, green dots: hauls with catch.

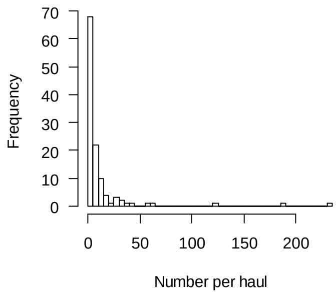


Figure 6. Number of blackspot seabream caught per hauls during surveys in 1973 and 1976.

Nowadays, blackspot seabream is a scarce species in the Northern Spanish Shelf Groundfish Survey (SP-NGFS) (Divisions 8c and 9a). On average since 1990 this species was only caught in 2.2% of the total number of hauls. The full survey time-series started in 1983. They followed a stratified sampling with three depth strata (ranging from 70 to 500 m) and five geographical sectors .An average of 130 hauls are performed each year during autumn season (September-October). The number of hauls with catches of blackspot seabream is on average low and varied without trend (Figure 7). However, the highest number of hauls with catches occurred in 1983 (23 positive hauls), at that time the stock was collapsing under overexploitation. The number of positive hauls was overall smaller in the 1990s than in the two past decades.

The number and mean weight of individuals caught have fluctuated (Figure 8). With the exception of the high catch and bigger specimens at the beginning of the time series, mostly juveniles (mean weight of 100–200 g) were caught. A large number of small blackspot seabream was caught in one haul (90 m depth) during the 1999 survey, reflecting again the aggregative behaviour of the species.

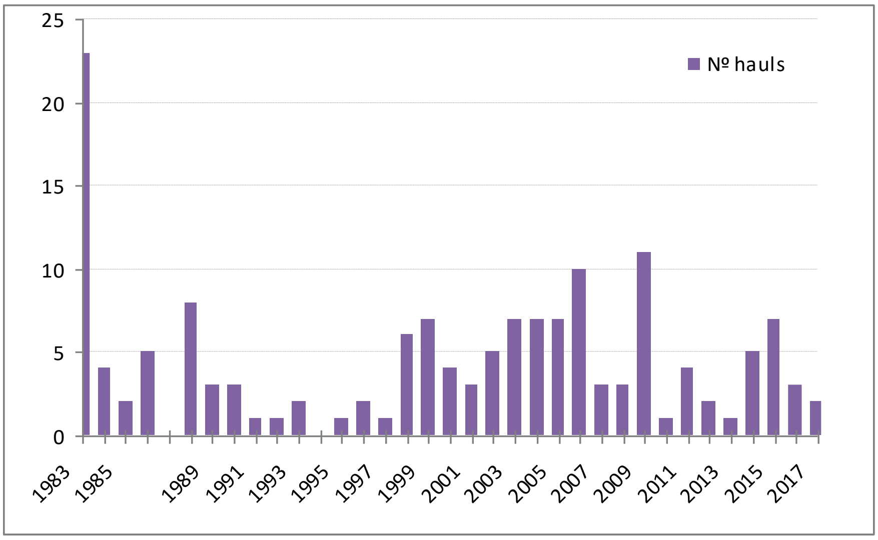


Figure 7. Number of hauls in the annual Spanish (IEO) surveys with catches of blackspot seabream.

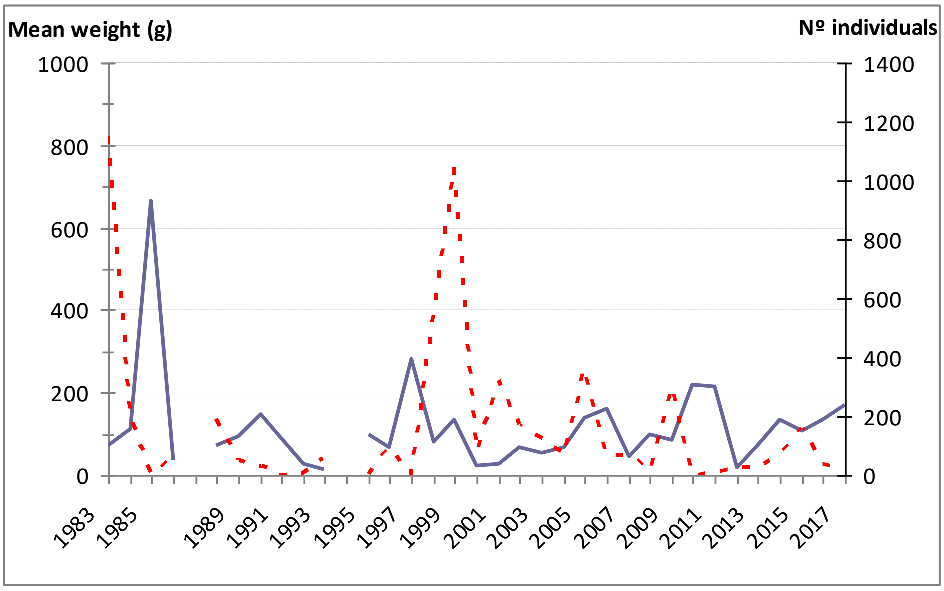


Figure 8. Mean weight (blue continued line) and number of blackspot seabream (red dashed line) caught during annual bottom trawl surveys in ICES Division 8.c (Spain, IEO).

From 2017, the PO Les Pêcheurs de Bretagne reported frequent encountered detected from echo-sounders in Iroise sea (west of Brittany in 7.e and 7.h) and sporadic bycatch in all 7.e and 8.a.

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

Because the species is aggregating and shoals are detectable acoustically, a moderate targeted effort would result in catch much higher than the current TAC. Because of the high price of the species, it is certain that some effort would be redirected to targeting if is the TAC is removed.

Overall conclusion

Blackspot seabream can be easily targeted and national quotas have been restrictive since 2005 in France and later, probably 2012 in Spain. The historic targeted fishery generated the collapse of the stock. The TAC allowed to deter targeted catch from metiers able to land big catch when shoals are detected (trawls and seines).

In terms of dynamics of the stock, it is most likely that leaving the shoals encountered by trawlers and seiners in the sea allowed a rebuilding of the stock to begin. Although no quantitative data is available, fishing vessels have reported more frequent encounter of shoals attributed to the species in recent years. The catch of 400 kg in one single haul during the EVHOE survey in 2016 is consistent with the known aggregative behaviour, and may be a first sign of reappearance in fisheries surveys. Unfortunately, the survey was not carried out in 2017.

It is a strongly expected result of catch limitation that a small residual stock would increase under small fishing pressure. Although, there is not data to assess the stock, which is in ICES assessment category 6, the abundance has almost certainly increased under the TAC constrain since 2003. It should be considered that from the collapse in the mid-1980s to 2003, the fishery remained fully unregulated and therefore any detected shoal of blackspot might have been fished. This was no longer done, or only illegally, in the past 10 years or more.

Because of the moderate productivity of the species, which may not mature as female before age 8 (Lorance 2011), the effect of the protection provided by the TAC does not appear yet in available data. The stock should be understood as having been driven well below any possible level of MSY B trigger, so that several years might be necessary for the biomass of mature females to increase to levels able to produce historic recruitment levels again.

Since it is one of the most valuable species in the Bay of Biscay the presumed increase in stock biomass following 15 years of TAC management since 2003 would be destroyed in one or two years in the absence of a TAC and the stock would return to the very low levels of the 1990s and early 2000s, where it was not managed at all. It that situation the conservation of the stock would probably be at risk.

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Greater forkbeard

1) *Was the TAC restrictive in the past?*

According the analysis of the last ten years the TAC has not been restrictive in the past since in six of the years the catches has been well above the TAC (table 1).

From 2007-2011 only discards estimates were available for Spain and Basque Country, and therefore it is probably that the catches were much higher than TAC in this period.

Official Reported discards from Intercatch are only available for a short series (2013-2017) but not for all the countries report discards all the years, so discards are only partially estimated for this period.

Table 1. Discards, landings and TAC of greater forkbeard

YEAR	TAC	LANDINGS	DISCARDS	CATCH	TAC-LANDINGS	TAC-CATCH
2007	2394	2949	887	3836	-555	-1442
2008	2394	2038	1731	3769	356	-1375
2009	2380	1311	701	2012	1069	368
2010	2380	1288	609	1897	1092	483
2011	2380	2201	63	2263	179	117
2012	2380	2641	58	2699	-261	-319
2013	2380	2143	1185	3328	237	-948
2014	2380	2269	1166	3435	111	-1055
2015	2856	2174	2068	4242	682	-1386
2016	2856	2012	677	2689	844	167
2017	2542	1503	513	2016	1039	526

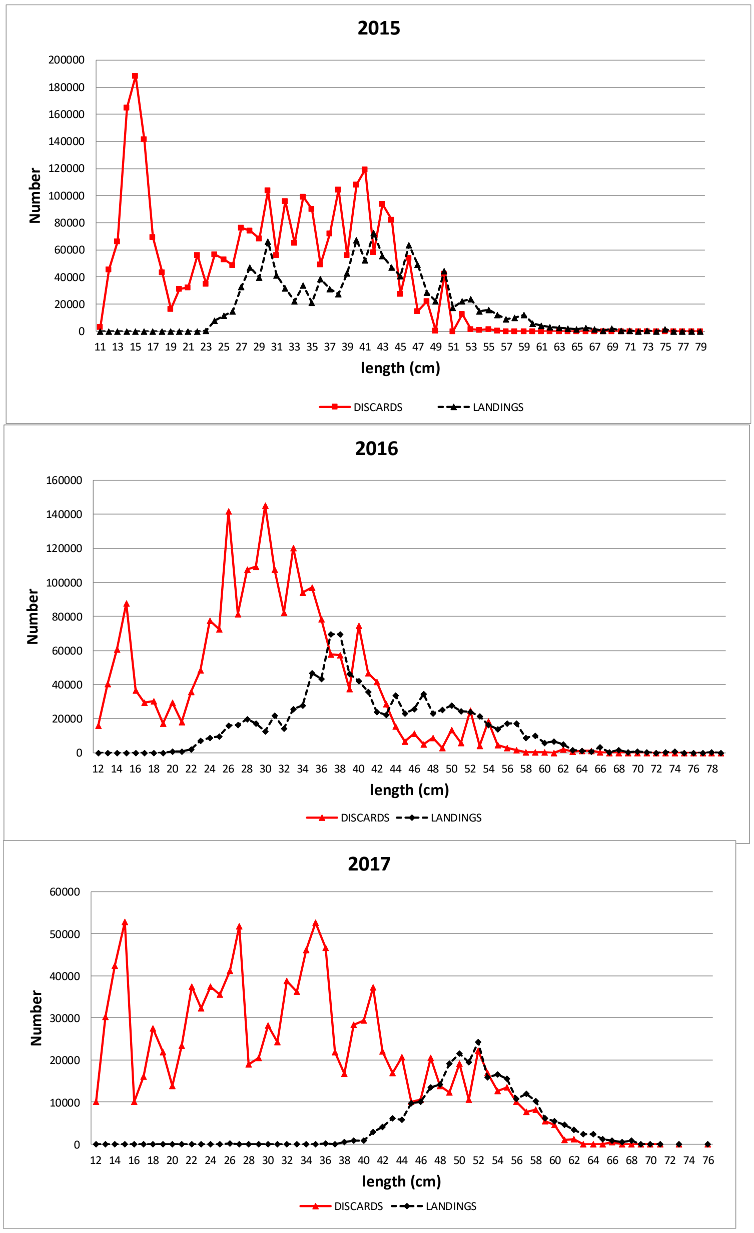
2) *Is there a targeted fishery for the stock or are the species mainly discarded?*

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.

As it is mention in the previous question discards in the first six years of the series are underestimated and very variable.

Discards in Intercatch are only available for a short series (2013–2017) and not for all the countries all the years. Since 2013 reported discard varies between 25-49% of the total reported catches in Intercatch.

Available Length frequencies of commercial fleets indicate that discards in 2015 affected specially to individuals smaller than 17 cm of which the 100% were dis-carded in 2015. In 2016 and 2017 the size range of discarded greater forkbeard increased, and affects in high proportion also to individuals smaller than 36 cm and 45 cm respectively



Commercial length frequencies of the greater forkbeard landings and discards in 2015 and 2017

3) *Is the stock of large economic importance or are the species of high value?*

Greater forkbeard is not a species of high economic species in the all Northeast Atlantic, however, the GFB 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. For instance, the price of GFB at first sale in the port of Vigo (North West of Spain) is rather high among the deep-water species and gadoids (Table 3).

Portuguese GFB reported landing data in 27.9.a are mainly from the polyvalent fleet. Landings of GFB by the otter trawl fleet represented less than 1% of total reported landings from both the polyvalent and trawl fleets.

Landings od GFB reported by the polyvalent fleet, are mainly of the largest size commercial category of this species. In fact, 47% of total reported landings of GFB for the polyvalent fleet are of the largest size category. Furthermore, the price per kg of specimens on the largest size category are about ten times the price of the two smallest size categories (Table 2). Given these differences in price per Kg and reported landed weight by size category, it is concluded that GFB discard rates might be high for the small-sized specimens caught by the polyvalent fleet.

Finally, comparing the polyvalent and the otter trawl reported landings, it can be concluded that specimens from otter trawlers have very little economic value (15% of the average price of the largest-size category from the polyvalent fleet) and specimens are mainly discarded.

Table 2. Average price at first sale of greater forkbeard by size category from Portuguese landings in 2017. Size categories are ordered from largest (1) to smallest (5).

FLEET	SIZE CATEGORY	€/KG
Polyvalent	1	4.78
Polyvalent	2	3.19
Polyvalent	3	1.88
Polyvalent	4	0.76
Polyvalent	5	0.44
Otter trawl	1	3.28
Otter trawl	2	2.06
Otter trawl	3	1.36
Otter trawl	4	0.50

Table 3. Average Price at first sale from December 2016 to October 2017 of Spanish landings in the port of Vigo (North West of Spain) of greater forkbeard compared to other deep-water species and shelf gadoid fish.

SPECIES	€/KG
Pollack	5.36
Mora moro	3.08
Greater Forkbeard	2.62
Blue ling	2.49
Saithe	1.84
Ling	1.76
Haddock	1.50

Compared to other gadoids from the shelf and the slope, greater forkbeard is a species with low price in France (Table 4). Only saithe, which is caught in much larger quantities has a lower price. Because of the usually small catch rate and no strong aggregative behaviour it is unlikely that fishing effort may be targeted to greater forkbeard at a profit.

Table 4. Price at first sale of French landings of greater forkbeard compared to 8 other species of deep-water and shelf gadoid fish.

	DEEP-WATER SPECIES	OTHER GADOIDS							
	GREATER FORKBEARD	BLUE LING	ROUNDNOSE GRENADIER	LING	COD	HADDOCK	HAKE	SAITHE	POLLACK
2008	1.64	2.15	1.88	2.04	2.94	1.46	2.92	0.99	3.68
2009	1.49	1.77	1.67	1.83	2.56	1.24	2.61	1.03	3.59
2010	1.60	1.81	1.78	1.97	2.95	1.22	3.15	1.39	3.64
2011	1.74	2.05	1.95	2.15	2.81	1.08	2.98	1.44	3.71
2012	1.59	1.93	1.64	2.04	2.65	1.09	2.69	1.38	3.87
2013	1.82	1.88	1.58	2.06	2.83	1.50	2.70	1.25	3.74
2014	1.50	1.65	1.54	1.80	2.60	1.56	2.60	1.42	3.55
2015	1.56	2.04	1.70	2.19	2.69	1.81	3.05	1.47	4.57
2016	1.55	1.70	1.75	2.16	3.12	1.98	2.79	1.56	4.71
2017	1.87	2.17	2.32	2.15	3.64	2.00	2.91	1.27	5.38

Overall, the species seems to have an overall low value with a large range between the smaller and the larger size category. Locally, large individuals may have a good economic value for some fleets, in particular some Spanish and Portuguese fleets. Elsewhere, the species is mainly a bycatch of minor economic value because of moderate price and small quantities compared to other species. As a consequence, some fleets could target large individuals of large economic value, while the species would remain a bycatch for some other whatever is the management regime.

4) *How are the most important fisheries for the stock managed?*

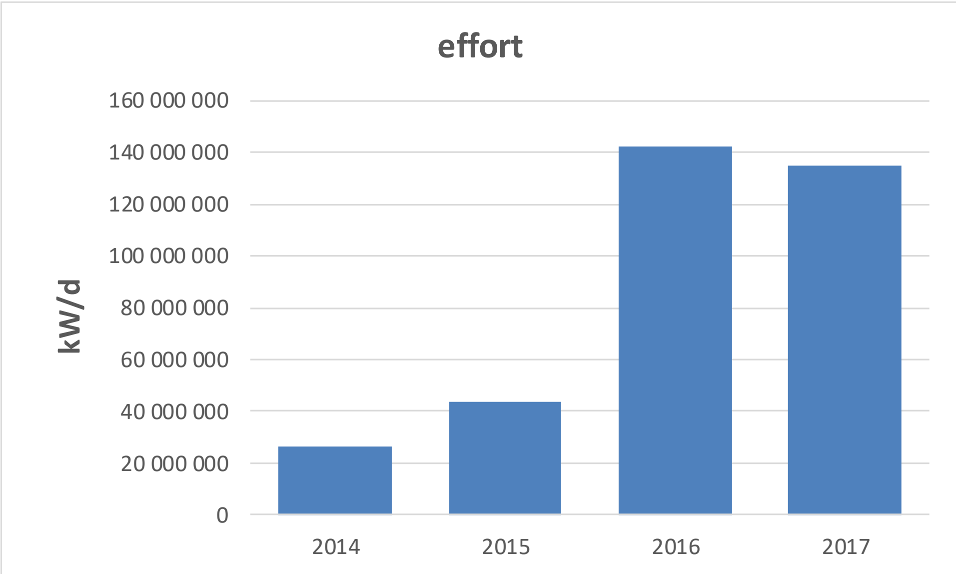
The stock of greater forkbeard in Northeast Atlantic is managed by a biannual TACs dividing the total TAC in four groups of subareas according a constant proportion every year:

SUBAREAS	% OF THE TOTAL TAC
1, 2, 3, 4	1%
5, 6, 7	85%
8, 9	11%
10, 12	2%

5) *What are the fishing effort and stock trends over time,*

There is a short series of effort (kWd) since 2014. The effort for a given year is calculated as the sum of kWd of all the fleets/countries reported information in Intercatch. The series of effort data in this period come from the Spanish, French Swedish, and Irish fleets, but not all the countries report effort data every year.

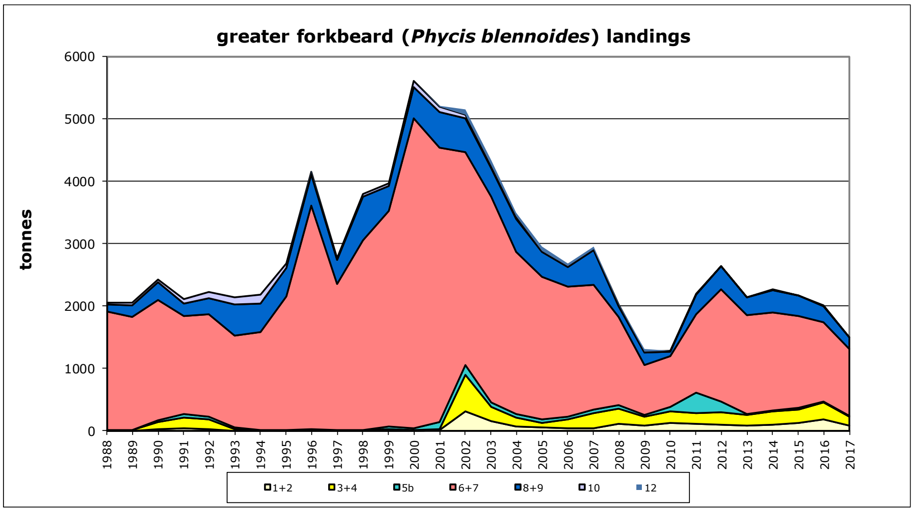
Taking into account that the data available are incomplete for each year, what means that are not fully comparable, the analysis indicates that the effort of these was increased in 2016 and 2017 from 3.0 to 5.4 times compared with the values in 2014 and 2015



6) What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?

Because GFB is a bycatch species, the expected effort depends of the effort of the main fleets over the target species. Although in recent years international landings indicates that the TAC is not consumed, and bearing in mind that this species is locally important for certain fleets from the North West of Spain and France fishing in subareas 6 and 7, if the TAC is removed it could be expected that this fleets could increase the effort in these subareas.

As it is mentioned in question 5, there are not reliable effort data before 2014, and those 2014 onwards are incomplete, but historical series indicates that this stock experienced in the past much higher landings than in recent years, especially in the period 1995-2004 in which the effort on deep-water species was especially high (see figure).



Stocks from North Sea: areas 2-4, to be regulated under the Precautionary Approach

Roundnose grenadier in 3.a

1) *Was the TAC restrictive in the past?*

The stock was fished until 2006 under an agreement between the three countries (Sweden, Denmark and Norway) in Skagerrak that gave each country mutually possibilities to fish on unregulated stocks in the Skagerrak. In 2005 the targeted fishery was stopped according to very high landings (Table 1). In 2006, an agreement between EU and Norway was made and the directed fishery for roundnose grenadier stopped. Since 2007, EU has set a quota for this stock in Subarea 3a.

Table 1. Total landings and landings divided into EU landing and non-EU landing and TAC for the years 2005–2017.

YEAR	TAC	TOTAL LANDINGS	EU LANDINGS	NON-EU LANDINGS
2005		11923	11923	0
2006		2265	2261	4
2007	850	1	0	1
2008	850	0	0	0
2009	850	2	2	0
2010	850	1	1	0
2011	850	0	0	0
2012	850	1	1	0
2013	680	1	1	0
2014	544	1	1	0
2015	435	1	1	0
2016	348	1	1	0
2017	278	1	1	0

2) *Is there a targeted fishery for the stock?*

There is now no targeted fishery for roundnose grenadier in Subarea 3a. The species is caught as bycatch in the shrimp fishery and of a total catch of 2,3 tons the 1,6 tons are discarded in 2017.

3) *Is the stock of large economic value?*

The roundnose bycatch from the Skagerrak fisheries is of low economic value; the landings are for reduction purposes.

How is the most important fishery for the stock managed?

The shrimp fishery is managed by a TAC; the roundnose is a small bycatch in this fishery; directed fishery for roundnose grenadier is prohibited in Norwegian zone and managed by a EU TAC for bycatch only.

4) *What are the fishing effort and stock trends over time?*

The stock trend is declined over time (Figure 1)

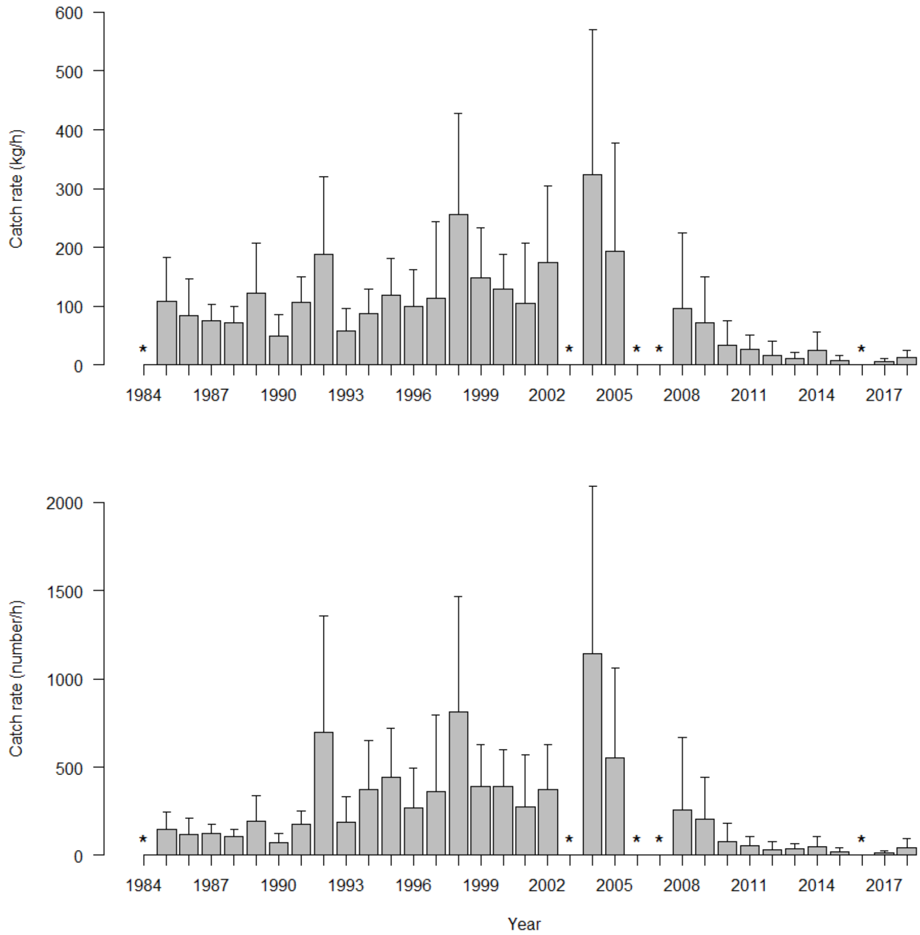


Figure 1. Survey catch rates in biomass (kg/h) and abundance (nos/h) of grenadier 1984–2018. Note: in 1984, 2003, 2006, and 2007 only a single or no trawls were made deeper than 400 m, thus the primary grenadier habitat was not sampled for those years. For 2016 data from the shrimp survey is regarded 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

5) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

No information on this for this stock

Overall conclusion

The TAC introduced from 2007 stopped the fishery. The purpose of setting this TCA was indeed of halting an unsustainable fishery. There is now no directed fishery for roundnose grenadier in Division 3a and the species is only taken as bycatch in the shrimp fishery. The landings are now much lower than the TAC. The stock level is considered very low. Catch before 2007 show that high targeted catch of the species in that area are feasible so that some regulation to prevent this to happen again is recommended.

Stocks from South Western waters: area 8-10 and the CECAF areas, to be regulated under the Precautionary Approach

Roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1

1) *Was the TAC restrictive in the past?*

Regulating the fishery of roundnose grenadier with a NEAFC TAC's in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 (Oceanic Northeast Atlantic and northern Reykjanes Ridge) started in 2013. Before this there were only the NEAFC effort regulation measures.

The EU TAC for Subareas 8, 9,10,12 and 14 was set in 2005. In 2017 and 2018, the EU TAC was 2623 and 2099 tonnes respectively. The NEAFC TAC was based on the ICES advice for divisions 10.b and 12.c, subdivisions 12.a.1, 14.b.1, and 5.a.1 and set at the level recommended by ICES (717 tonnes). 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.

Under the EU TAC in 8,9,10,12,14 catch come mainly from subareas 12 and 14. In recent years these catch were from Spain.

The fishery on the Mid-Atlantic Ridge started in 1973, when dense concentrations of roundnose grenadier were discovered by USSR exploratory trawlers. USSR/Russian fleet has the maximum length of the history of fishery and took the greatest volume of landings (Figure 1). Since the early 1990s fisheries on MAR have been sporadic and much smaller in scale. Last decades the main countries participating in the fishery are Spain (since 2010) and Russia (since 2000). EU countries had a minor participation to catch in this area.

For most years the landings are smaller than the set TAC (Figure 1). (Table 1). In subarea 4 the landings have always been lower than the TAC (Table 2).

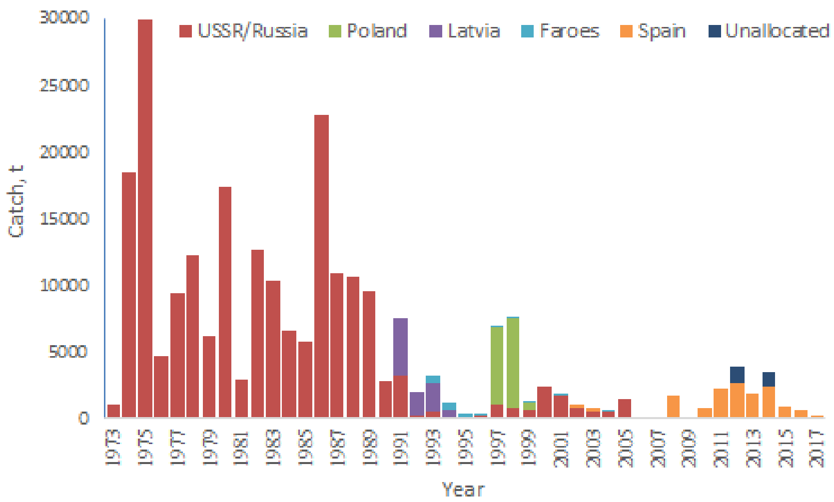


Figure 1. International catch of roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1 in 1973–2017.

Table 1. Roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1, landings and TAC

YEAR	TAC EU *	NEAFC TAC	NON EU LANDINGS	EU LANDINGS	ADD CATCH IN 12.B	CATCH IN 14.B.2
1973			1046	0		
1974			18435	0		
1975			29894	0		
1976			4726	0		
1977			9347	0		
1978			12310	0		
1979			6145	0		
1980			17419	0		
1981			2954	0		
1982			12625	0		
1983			10300	0		
1984			6637	0		
1985			5793	0		
1986			22842	0		
1987			10893	0		
1988			10606	0		
1989			9495	0		
1990			2838	0		
1991			3214	4296		
1992			295	1684		
1993			985	2176		
1994			457	675		
1995			359	0		
1996			347	0		
1997			4205	5867		
1998			832	6769		
1999			608	546		
2000			2330	0		
2001			1785	0		
2002			741	235		
2003			510	272		
2004			646	0		
2005			1399	0		
2006			1	0		
2007			2	57		
2008			13	1722		
2009			5	0		
2010			73	753		
2011			0	2239		
2012			0	3826		
2013		1350	0	1908		

YEAR	TAC EU *	NEAFC TAC	NON EU LANDINGS	EU LANDINGS	ADD CATCH IN 12.B	CATCH IN 14.B.2
2014		1350	4	3466		
2015		717	0	862		
2016	3279	717	0	660		
2017	2623	717	0	85		

*** the EU TAC is combined for 2 ICES 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.**

landings in Subareas 12 and 14

Subareas 8 and 9			Subdivision 14.b.2										
France	Spain	Total	Faroes	Germany	Greenland	Iceland	Norway	UK (E+ W)	UK (Scot)	Russia	Total	Unallocated	TOTAL
5		5		45	1			1			47		78
1		1		23	4			2			29		113
12		12		19	1	4	6		1		31		288
18		18		4	18	4					26		326
5		5		10	5						15		269
		0		13	14						27		441
1		1		6	19						25		178
		0	6	34	12		7				59		366
1	19	20	1	116	3		6				126		366
9	7	16		105	0		19				124		320
4		5		41	11		5				57		116
7		7		11	5		7	2	72		97	208	163
3		3		25	5		15	1	1		47	504	149
2		2			15		5	1			21	952	96
2		2		27	3						30		612
8		7			7		6	1			14		111
27	1	28		35	0		17				52		155
10		10	1				1				2		41
8		5								12	12		59
1		11					1	1			2		57
1		1		33			7				40		125
1		1		32			4				36		115
0		0					1				1		89
0		0					2				2		103
0		0					7				7		51
	1	2			38		38						70
		0					0						58

2) *Is there a targeted fishery for the stock?*

The roundnose grenadier fishery is a targeted trawl fishery. Most landings reported from Subdivisions 12.a.1, and 14.b.1 were targeted catch.

3) *Is the stock of large economic value?*

The grenadier fishery is very important for Spanish fleet and some non EU fleets (Russia).

Prices per kg are smaller for grenadier than for cod.

4) *How is the most important fishery for the stock managed?*

TAC set for NEAFC regulatory area. Additionally the TAC set for EU vessels combines for 2 ICES stocks.

5) *What are the fishing effort and stock trends over time?*

The landings and data is very uncertain for last years. There are differences between catch data reported to the ICES and to NEAFC

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

Conclusion

Because the combined TAC allows for the realization of the full amount of TAC in any of these areas need set separated TAC for each stock. TAC repeated two time in the NEAFC and for EU fleet.

Review of WGDEEP for TACMAN

The document provided outlines the key catches, discards, indices of abundance (where available), and other key information needed for advice for each of the deep-water stocks. The key question is whether the current total allowable catches (TACs) can be removed for any of the stocks, or a TAC should be retained for all of the stocks. The document needs some smoothing for grammar, and efforts to ensure that the figures, tables, and wording are similar for each stock. In addition, perhaps the intended readers are well aware of the different areas in question, but it would be good to add a map to each summary to show the boundaries of each region being assessed.

One suggestion would be to provide the available data upfront for each stock, and then discuss the six questions in context of all of the information. A possible format would be: (1) Map of stock structure and areas, (2) Table and plot of all known catches (not just most recent 10-15 years), showing TACs, (3) Table or plot of fish prices, with an indication of whether these are high or low compared to other species, (4) Plots of all survey or CPUE trends. Then go into the text. Another way of structuring the reports would be to follow the method used by New Zealand for each of its species, e.g. http://www.mpi.govt.nz/dmsdocument/18334/loggedIn

One overall impression I have reading through the reports of each stock is that I am skeptical that removing TACs on any stock is a good idea, as this risks allowing unlimited catches on any stocks, in an area that has a large amount of latent fishing effort, and ready markets. The fishing out of orange roughy on St Helens in Australia in a short number of years, for example, stands as a warning of how quickly a slow-growing and long-lived species can be reduced by a sudden inrush of fishing effort. Indeed, a classic case is listed here where Roundnose Grenadier in 3a had catches of 11,923 t in 2005, only 2,261 in 2006, and then a TAC of 850 t was imposed starting in 2007, but essentially no catches were recorded from 2007 onwards, as the stock declined continuously. If the current TACs are too precautionary, it would be better to raise the TAC to higher levels rather than abolishing them altogether. Indeed an interim TAC might be set high enough that a small pilot fishery would be economically viable, but low enough that it is unlikely that the stock would be substantially depleted.

A stock-by-stock review follows.

Beryx spp.

More information could be given about the catch levels prior to 2005: were they considerably higher than the TACs and catch levels from 2005 on presented in the document? Minor point: “from sprain” probably should be “from Spain”.

I concur with the recommendation here to maintain TACs. Given a developed market, catches that usually reach or exceed the TAC, high prices for at least *Beryx decadactylus*, and the possibility of serial depletion of seamounts where they aggregate and are amenable to targeted fisheries, TAC management should be continued.

Deep-sea sharks

Management advice for this group is to minimize the total catch since these are long-lived species with low reproductive rates. In this context, zero TACs for both targets and bycatch appears to have achieved the objective of halting any possibility of directed fisheries. Total landings and discards have been reduced to low levels compared to historical catches.

Removing TACs would run contrary to the intent to reduce bycatch and directed fisheries of these species, and likely lead to high catches from directed fisheries given their high value and past high levels of landings (up to 11,000 t per year). Continuing the TAC is advised, although the zero TAC could be increased to a higher level if sustainable fisheries on these species are considered warranted. However, given the wide range of species involved in this group, of which two have been substantially commercially harvested in the past (leafscale gulper shark and Portuguese dogfish), it would be a good idea to implement separate nominal TACs on each species (e.g. 50-200 t per species for all other species). This would avert the possibility that a fishery could develop on a currently untargeted species with a small population size, that would be large enough to deplete that species despite remaining within the TAC for all deep-sea sharks combined. If the TAC were to be lifted altogether, it is of critical importance that the ban on deep water gillnets (deeper than 600 m) be maintained, together with the ban on fishing in waters deeper than 800 m, and a careful check maintained to ensure that new fishing gear are not able to target deep-sea sharks, as well as annual species-specific catch+discard reports be examined for evidence of targeting on particular species that may warrant imposition of TACs.

Blackspot seabream

A substantial piece of missing information here is a plot of total catches for each year from the 1960s onward, to put the current catches and TAC into perspective. Notably the text notes that catches were more than 15,000 t annual up to the mid-1970s, which puts the current TACs of 350 t declining to 150 t, and corresponding similar catches in perspective, especially given that original declines in catches happened in the absence of TACs. Given the aggregating nature of blackspot seabream, and the apparent ease with which it could be avoided or targeted by artisanal purse seiners, it is clear than a targeted fishery could develop quickly and reach substantial levels. Rebuilding the stock could likely yield 5,000-10,000 t per yr.

Recommendation: keep the TAC in place and indeed reduce the TAC, given the clear depletion of the stock to just a few percent of original levels, its aggregating behavior, high prices (€10-20/kg), and the ability to target this stock. In addition, only bycatch should be allowed, not targeted catch. The reasoning behind continuing to reduce the TAC is that surveys show little sign of rebuilding to date under past TAC levels, suggesting that TACs are currently too high.

Greater forkbeard

In 6 of 11 years (2007-2017), the reported catch exceeded the TAC, and given the likely unreported discards from countries other than Spain and the Basque Country, it seems that TACs may have been exceeded for more years, and by a greater amount, than in this report. Discards are high, especially for smaller individuals, following the low prices for smaller fish, indeed prices are not particularly high even for the larger fish. The low catch rates and lack of aggregative behavior, together with the low prices, imply that greater forkbeard likely will not be subject to a large influx of targeted effort, compared to many of the other groups outlined in this report. However the data on effort suggests (in contradiction to these expectations) that effort on this species went up 3-5.4 times in the Intercatch database. There is a market, and landings have been higher in the past than at present, suggesting that should effort increase again in deep waters, catches may again increase on this species.

Recommendation: maintain TAC, could possibly be increased since this is a bycatch species, provided this is revisited if effort continues to rise.

Roundnose grenadier 3.a

A lack of regulation up to 2006 led to massive catches, which swiftly declined from 11,923 t in 2005 to 2,265 t in 2006. The imposition of TACs of 850 t in 2007 essentially completely ended the fishery, with subsequent catches of < 2 t thereafter.

Recommendation: maintain the TAC. The lesson from the past is that very large catches are possibly with directed effort, and surveys show that current biomass is substantially depleted from the levels of the 1980s and 1990s.

Roundnose grenadier in Divisions 10.b, 12.c and Subdivisions 5.a.1, 12.a.1, 14.b.1

The data here are much more limited than for the other stocks. In particular, an indication of effort would help clarify whether the sharp declines in catches over time are due to stock collapse (which seems likely) or a lack of markets. The main fishery is a targeted fishery but it operates in many different areas.

A suggestion here would be to maintain the combined EU TAC, but also impose lower maximum TACs for each of the individual areas, since the stock occurs across so many different areas. Here a map would be useful, but assuming there are 5 areas, catches could, for example, be allowed to be no more than half the combined TAC in any one area.

Recommendation: maintain a TAC, since the pattern of a long-term decline in catches in the absence of TACs suggest long-term decline in stock biomass.

REVIEW REPORT OF PROVISION OF ADVICE ON A REVISION OF THE CONTRIBUTION OF TACs TO FISHERIES MANAGEMENT AND STOCK CONSERVATION: DEEP-WATER SPECIES

Cathy Dichmont Consulting
cathydichmont@gmail.com

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Disclaimer

Contact Details

Name: Dr Catherine Dichmont
Address: 47 Pioneer Rd, Sheldon, Redlands, Queensland, Australia, 4157
Email: cathydichmont@gmail.com

1 CONTENTS

2 Executive Summary

ICES requested that a list of species be analysed in terms of the risk (whether it is biologically safe in the short and medium term) of removing TACs for each case and to assess the potential use of other conservation tools in the place of TACs. This review investigates whether these issues have been addressed for *Beryx* spp., deep sea sharks, blackspot seabream, greater forkbeard and roundnose grenadier. Specific questions to be addressed were:

- A general impression of the evaluation method (questions asked, data looked at)
- Stock by stock impression of whether the summary of the questions and data provide a solid background to say y/n to lifting TAC
- Any thoughts on additional comments from experts (valid concerns, etc.)
- The EC have set which species are target/bycatch; is this definition critical to the outcome of the evaluation?

The review report follows the above structure and addressed each question below.

3 RESPONSE

3.1 A GENERAL IMPRESSION OF THE EVALUATION METHOD (QUESTIONS ASKED, DATA LOOKED AT)

The following questions were addressed for each stock:

1. Was the TAC restrictive in the past?
2. Is there a targeted fishery for the stock or are the species mainly discarded?
3. Is the stock of large economic importance or are the species of high value?
4. How are the most important fisheries for the stock managed?
5. What are the fishing effort and stock trends over time?
6. What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?

Although these questions are very important and informative, how these questions link to the key issue at hand (removing the TAC) is important. Therefore, for this review, a few high-level queries to synthesise the conclusions were added to provide a consistent process and summary approach:

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?
    - In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem importance
    - In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted
2. Is the present TAC/management influenced by past unsustainable practices?
    - If yes, are those fisheries still active?
    - Was the stock targeted?
3. Can these or new unsustainable practices return if the TAC is removed?
    - Can they be targeted with present fleet?
    - Are they heavily discarded?
    - Is the stock valuable?
4. Are there alternatives to a TAC to manage this stock?
    - Can they be managed as companion species through target TACs (if applicable)?
    - Can they be spatially managed?
    - Any other mechanism? E.g. Multi-Year TACs (MYTAC).
5. Comment on the conclusions

As can be seen from these points, most of the questions posed within the report inform the high-level queries well, except for the companion species component.

The report addressed the removal of TACs on a single species case-by-case basis. In reality, the issue of removing a TAC can be much more complex. For example, there is a distinction between a low or zero TAC being removed to reduce administrative overheads compared to its removal to avoid choke TACs. In

Klaer and Smith (2011), they investigate an Australian multi-species and fleet fishery, and divide species into several components based on their interactions with others in their respective métiers, being target and non-target catch, primary species, companion species, associated species and discards. Of interest is whether a species is truly a companion species (i.e. a "species that should also be considered when setting the TAC of the primary species, because a considerable proportion of the primary species catch is taken with the companion species as non-target catch."). In Pascoe et al (2010), this companion species concept was used as an approach to only setting the TAC of one species which would then automatically control the catch of several others through the catch control on the primary species. This information was not available to the reviewer. If such work has been undertaken in the fishery, it would be of value to take this into consideration.

Most of the species in the report have not really addressed the possible alternative (to TACs) management approaches well. As stated in the report, this is probably due to the lack of knowledge on effort and effort related measures.

There may be value in sequencing the questions a bit differently. This may reflect a non-ICES reviewer needing more background information than may be the case for a reviewer more familiar with ICES history. However, the question of how the stocks are managed is perhaps more important to state up front as question 1.

Similarly, adding a web link to the latest ICES advice (if available) would be useful.

The conclusions per stock are often not clear (this is variable per stock) and may would be more appropriate to link the conclusions directly to the ultimate question, if even as a sub-heading. This was not asked of the authors but would be useful. If the answer is not known, then that can be clearly stated as well as the reasons why. This would crystallise the information provided to ICES (and help the reviewer).

The "riskiness" of a stock should be an additional question considered, as shown in the high-level queries above. This is a key to the potential impact of this decision. Although, this may be in part captured by Q2 on stock status, it is recommended that it be considered as an additional question.

In general, these stocks do present difficulty with Q6 for both the authors and reviewer. This is perhaps partly because of the lack of good effort data for most of the stocks, but also due to lack of information provided to the reviewer on the interaction of this species with others in the fishery. As stated above, this would be important information, if available. Either it could be subsumed into Q6 or added as another question, likely mostly not answered.

Another factor that may be worth considering is the option of MYTACs. This would be useful if the wish to remove a TAC is about administrative load rather than to avoid choke species issues. These MYTACs could then me monitored within the MYTAC cycle with simple break-out rules.

3.2 Stock by stock impression of whether the summary of the questions and data provide a solid background to say Y/N to lifting TAC.

The review follows the by species/stock approach as requested in the request.

3.2.1 Beryx spp.

1. Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

The key species aggregates on seamounts, has high catchability and can be easily targeted. They are a slow-growing long, lived species. Therefore; YES

2. Is the present TAC/management influenced by past unsustainable practices?

- If yes, are those fisheries still active?
- Was the stock targeted?

This group has no reliable estimate of stock status nor commercial effort over time. The basis of evaluation is therefore mainly from commercial landings, value and historical targeting.

The key species aggregates on seamounts and can be targeted. Several lines of evidence that targeting has occurred are provided, of which the most compelling is that there is a history of localised depletion of seamounts in the Mid Atlantic Ridge (MAR), given alfonsino's (the most valuable species in the group) aggregating behaviour.

3. Can these or new unsustainable practices return if the TAC is removed?

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

The landings have generally exceeded the TAC over time, it is an important part of the catches in some fisheries and it is a valuable species making it likely to be further targeted if a TAC is removed and not replaced with another mechanism.

4. Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

In terms of alternative mechanisms, this issue is not addressed. As stated at the start of the report, this is difficult to do for some species including this group. There are no reliable effort data over time, which means investigating effort related approaches is hard to do.

5. Conclusion

This section provides valuable information and a clear recommendation. As stated above, alternative measures are not addressed. Removal from the TAC system is not recommended in the report. Without a clear alternative, this review supports the view that removal of a TAC could increase the risk to the resource, at least locally and may not be sustainable in the medium term.

3.2.2 Deep sea sharks

It should be noted that much of the information addressing question 4 for this group, is more about past targeting than management. Most of the content should be moved to question 2 as it is more informative there. The management section requires more directed focus on the management that is presently on the longline fisheries, which seemed to have targeted deep sea sharks in the past, the 800 m depth limit for trawling (only first mentioned in the overall conclusion) and the 600m depth limit on gillnets.

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

Yes: This is a very large group of species that include deep-water catsharks, gulper sharks, dogfish etc. The group consists of species with low productivity. Based on the information provided, there is high overlap with past deep-sea fisheries especially the longline and gillnet fisheries. Refugia to the trawl and gillnet fishery exist through present depth limits.

2. Is the present TAC/management influenced by past unsustainable practices?

- If yes, are those fisheries still active?
- Was the stock targeted?

Unknown as this information was not provided directly in the report as this information is unknown in the past as well as the present, as is assumed in this review. Landings have not been separated for these species and the groupings in which they fall were various. Since 2009, ICES has set the TACs at or close to zero with no targeting permitted. What is provided is information that past high catches could have been influential on the resource. The 0 TAC since 2009 should have been beneficial, but this is analytically unknown.

Targeting has been undertaken in the past, but present measures have prevented this.

3. Can these or new unsustainable practices return if the TAC is removed?

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

The level of discarding is uncertain, with survival for some key species after discarding low. Deepwater sharks are very valuable. Evidence for past targeting is provided, but the 0 TAC has been effective at reducing targeting of this species. There are no reliable effort data. The zero TAC also means that stock status from commercial data cannot be derived in recent years. Scottish survey data are available, but do not represent a large enough area of the stocks range to infer population trends.

4. Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

Information about the depth range of the species shows it extends beyond the management depth limits of the trawl and gillnet fisheries (as stated in the report as well), thus providing a natural refuge for the stock.

5. Conclusions

The report conclusion is unclear. From the report, it is inferred that the TAC could be replaced with a freeze of fishing effort on deep sea fisheries to current levels and maintaining the depth limits on the trawl and gillnet fleets, and that these measures would be sustainable for this group of sharks.

The conclusion is valid based on the present fisheries and management. However, it is unclear if the directed longline fisheries could start again with the TAC removed. If this is the case, then this issue would have to be addressed.

Pertinent to this species group is the management in Australia of gulper shark and dogfish, the suite of species listed under the EPBC Act (ref) have been managed by an extensive set of spatial closures, move-on provisions, 100% observer coverage in some area, zero catch of gulper sharks and handling procedures. Under Australian Policy, targeting is not allowed on species that are below the limit reference point and as such an implicit zero TAC is in place. This management system may well be worth considering.

3.2.3 Blackspot bream in subarea 6, 7 and 8

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

This species has higher relative biological risk as it is a protandrous (male-first sex changing) species that shoals and aggregates in some seasons and areas.

2. Is the present TAC/management influenced by past unsustainable practices?
   - If yes, are those fisheries still active?
   - Was the stock targeted?

This stock had collapsed in the early 1980s, with management measures to restrict the catch to bycatch only started in 2003.

3. Can these or new unsustainable practices return if the TAC is removed?
   - Can they be targeted with present fleet?
   - Are they heavily discarded?
   - Is the stock valuable?

A series of management measures aimed at restricting bycatch through, for example, gear bans and annual catch limits have been effective. There is an important but unknown recreational catch, making the total catch uncertain. Reported discards are low, but may be unreliable. The TAC has only been restrictive since 2010. There is some interaction with the landings statistics misreporting with gilthead seabream prior to 2009. Catches prior to the quota restrictions; there were large catches of blackspot bream from the Bay of Biscay. The species is valuable, with the recent value increasing based on data of landings from French vessels. Present stock status cannot be determined from commercial data as it is a bycatch species. Surveys support that the species are aggregating with skewed distribution of numbers per haul.

4. Are there alternatives to a TAC to manage this stock?
   - Can they be managed as companion species through target TACs (if applicable)?
   - Can they be spatially managed?
   - Any other mechanism? E.g. Multi-Year TACs (MYTAC).

Alternatives to TACs were not clearly addressed.

5. Conclusions

The report conclusions are well set out and the removal of the TAC is not recommended. Again, it would be clearer if a statement at the end of the conclusions were made. The review supports this conclusion based on:

- *The historical catches have been large and the capacity to increase present catch still remains in part;*
- *The species aggregates, making them targetable;*
- *The biology of the species is such that it has naturally higher relative risk than many species;*

- *The stock collapsed due to overfishing and the resource was in poor condition, but may be recovering;*
- *These unsustainable catches continued when management was weaker, and only changed when restrictive management was put into place;*
- *If past catches are applied to present values, then it would be a very valuable fishery making it likely that fishing would increase if no TAC management was in place.*
- *Alternative measures are not clear.*

3.2.4 Greater forkbeard

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?
   - In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
   - In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

Based on previous ICES reports, this species is less vulnerable to fishing than other deep water species. It would probably be helpful to include this information in the report.

2. Is the present TAC/management influenced by past unsustainable practices?
   - If yes, are those fisheries still active?
   - Was the stock targeted?

This species is a bycatch species of the traditional demersal longline and trawl mixed fisheries. The TAC was not restrictive of the landings, despite discard information being incomplete. Discards can be almost as high as landings. Effort, although incomplete, has recently increased. Stock size is not known.

3. Can these or new unsustainable practices return if the TAC is removed?
   - Can they be targeted with present fleet?
   - Are they heavily discarded?
   - Is the stock valuable?

Discards are an important contribution to the total catch of this species, but are uncertain. Smaller fish tend to be in the discards compared to the commercial catch, but these data were only shown for 2015-2017. This is likely driven by the differential price between small and larger size categories, especially for the polyvalent fleet. The total catch has not been restrictive over most of the past decades. The species is generally not valuable, except for certain fleets.

The fishery is managed through biannual TACs, which are then regionally divided. Effort is only available from 2014, but is not complete. Landings in the past have been much higher than present.

Based on the information provided, this question is difficult to answer.

4. Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

No information was provided on this matter, beyond that the stock is caught as a bycatch in multi-species fisheries. It is unclear whether there could be target species TACs that would help indirectly control the catch of this stock.

5. Conclusion

There is no overall conclusion in this section at all and it would be helpful if it was added. The reviewer has inferred from the report that removal of a TAC would result in an increase in effort in sub-area 6 and 7, but not likely in other areas.

An argument is made that because, catch rates are small for this species, the species is not strongly aggregatory and its value is low compared to other gadoids it is unlikely that fishing effort may be targeted to greater forkbeard at a profit. This is difficult to judge as no catch rate data (or other anecdotal evidence of catch rates) are provided. However, given the price data provided, large animals may have good value for some fleets. Consequently, as also stated in the report, some fleets could target large individuals while it remains a bycatch in other regions.

The lack of effort data or anecdotal references on catch rates makes it hard to agree (or not) with the conclusion that lack of profitability over most of the stocks would prevent increased effort on this species, except where it is locally important. There is already a high degree of discarding, which seems to be the result of grading against smaller, less valuable individuals.

3.2.5 Roundnose grenadier 1,2,4 (missing)

This section was not presented for review.

3.2.6 Roundnose grenadier 3

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

This information is not provided in the report and would be valuable. In some regions, they are shoaling species and have medium productivity, but this would need to be confirmed by the authors.

2. Is the present TAC/management influenced by past unsustainable practices?

- If yes, are those fisheries still active?
- Was the stock targeted?

The targeted fishery, which consisted of very high landings, was stopped from 2006 onwards and managed under quota from 2007 thus likely stopping an unsustainable fishery. Since these restrictions have been in place, there is presently not a targeted fishery for this species. The value is low. Catch rates in recent years are low, although the effort definition of a bycatch species is not discussed.

3. Can these or new unsustainable practices return if the TAC is removed?

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

There is no information available and provided to answer question 6 about the potential for expansion. However, there was a large directed fishery on this stock. Catch rate data show a decline, even in recent years.

4. Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

This is not discussed.

5. Conclusion

The inference of the report conclusion (not stated directly) is to maintain the TAC, unless some alternative approach (though not defined) is used. TACs effectively stopped targeting from unsustainable fishing, while catch rates are still low. Based on the information provided, this conclusion is supported.

3.2.7 Roundnose grenadier in Division 10.b, 12.c and Sub-Divisions 5.a.1, 12.a.1, 14.b.1

This section is incomplete and has a table in portrait that is much more complete in landscape.

1. Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

This information is not provided in the report and would be valuable. In some regions, they are shoaling species and have medium productivity, but this would need to be confirmed by the authors.

2. Is the present TAC/management influenced by past unsustainable practices?
- If yes, are those fisheries still active?
- Was the stock targeted?

The stock is presently targeted and important for several fleets. Catches in the past have been much higher than those presently.

3. Can these or new unsustainable practices return if the TAC is removed?
- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

Most of the landings come from targeted catch. The species is valuable. Landings and effort data are uncertain. Question 6 is not answered.

4. Are there alternatives to a TAC to manage this stock?
- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

No information is provided on this aspect.

5. Conclusions

The conclusion needs a little rewriting as it was not clear, but the recommendation seems to be that the TAC should be separated for each stock (and by inference maintained). Given the information provided, it is not possible to review the conclusions of separating the TACs, but the reviewer does support retaining the TAC.

3.3 ANY THOUGHTS ON ADDITIONAL COMMENTS FROM EXPERTS (VALID CONCERNS, ETC.)

Most of these comments are provided in the first section, however, it is worth pointing out that a species by species approach does tend to preclude the consideration of species interactions and ecosystem considerations. Some overview of the species cluster being considered as a whole may provide benefit in informing the question of alternative management measures.

The quality of information required for Question 6 is quite high in that stock status and reference points are required. However, some information on past trends and how these could influence the future may be beneficial – the ability to add this information was variably interpreted for each stock.

3.4 THE EC HAVE SET WHICH SPECIES ARE TARGET/BYCATCH; IS THIS DEFINITION CRITICAL TO THE OUTCOME OF THE EVALUATION?

This was in part influential. The reason is that a) this definition did not seem to be very influential in the report conclusions and b) the ability to discard, fish illegally or target did not seem to be entirely enshrined by this definition.

4 References

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2. Sean Pascoe, André E. Punt, Catherine M. Dichmont. 2010. Targeting ability and output controls in Australia's multi-species Northern Prawn Fishery. European Review of Agricultural Economics, Volume 37, Issue 3, 1 September 2010, Pages 313–334, https://doi.org/10.1093/erae/jbq022

3. Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). 1999. http://www.environment.gov.au/epbc

Annex 7: EU-special request on TAC management - Stocks/species not included in the deep sea regulation.

ICES was requested to analyse for a list of stocks the role of the Total Allowable Catch instrument. It was asked to assess the ***risks*** of removing TAC for each case analysed in light of the requirement to ensure that the stock concerned remains within safe biological limits in the short and middle term. ICES was further requested to assess the potential contribution of the application of other conservation tools in absence of TACs to the requirement that the stock concerned remains within safe biological limits.

In cases where the uses of TAC should be continued, ICES was asked to analyse a possible approach to contribute to inter-annual stability of TACs.

This request applies to a number of WGDEEP stocks some of which being under the EU regulation for certain deep-sea fish stocks and some others being under the general EU TAC regulation. WGDEEP followed a similar approach to that taken by in 2017 to address an EU special request on risk to the stock of dab and flounder of having no catch limits for the stock. In the responding advice, ICES defined the six following questions to evaluate this 2017 request:

1) *Was the TAC restrictive in the past?*
2) *Is there a targeted fishery for the stock or are the species mainly discarded?*
3) *Is the stock of large economic importance or are the species of high value?*
4) *How are the most important fisheries for the stock managed?*
5) *What are the fishing effort and stock trends over time?*
6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

For stocks evaluated by WGDEEP, not all these questions could be answered, in particular Questions 5 and 6 could be treated only partly, primarily because in some areas TACs are applied to WGDEEP stocks that are only small bycatch.

The TACs included in the request are mostly small TACs of a few tonnes or tens of tonnes and they may not correspond to ICES assessment units. WGDEEP considered that some of these differences between assessment and management units have a sound rationale and should in no way be considered as mismatch between assessment and management. The rationale for the differences between assessment and management units may be:

- For some species ICES consider large assessment units because there is no robust data on which to rely to define stock structure. In this situation, it may be useful to split the ICES recommended catch between TAC for smaller areas in order to avoid local/regional depletion. For example ICES considers all the Northeast Atlantic as one assessment units for greater forkbeard (gfb.27.nea) while the EU sets four TACs for this species, some of which being very small in areas where the species is caught as a small bycatch with no data allowing for an assessment, e.g. Azorean waters,

- When TAC for deep-water species were set it may have been recommended to set small TACs or zero TACs in area where species occur at low level or do not occur at all in order to prevent either unmonitored development of new fisheries or area/species misreporting. The possibility of such issues may be reduced in recent years compared to the early 2000s when TACs where set,
- Some small EU TACs may apply to EU waters located at the fringe of EEZ of non-EU countries or at the fringe of international waters. This applies for example to the EU TAC of ling in community waters of 5.b, where the ICES assessment unit is ling in 5.b (lin.27.5b) while the bulk of ling from 5.b are caught in Faroese waters.

WGDEEP suggested that the effect of removing TACs may be hard to predict. In some stocks/TACs this may allowed for unsustainable catch to be landed while for some other the fishing activity and catch of the considered species may not change, like it was assessed for dab and flounder (ICES, 20147). For a few TACs, WGDEEP could suggest some alternative measures, in particular in some case it was suggested that the TAC for a small area could be merged with a wider adjacent area.

ICES, 2017. EU request on a combined dab and flounder TAC and potential management measures besides catch limits (http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.04.pdf)

LING 5.b (Faroe ground)

EU and Norway have quotas for ling/blue ling in ICES Division 5.b. 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 Faroese fleets catch around 75-85% of the ling landings in ICES Division 5.b.

The EU TAC in Union and International waters of 5 is 33 tons of ling/blue ling in 2018, which is around 1% of the quotas for EU+Norway in Faroese EEZ.

Ling in ICES Division 5.b are mainly distributed on the Faroe Plateau and on the bank areas south-west of the Faroe Islands. Very small amounts are caught on Wyville-Thomson ridge at the southernmost part in the Faroese EEZ.

Ling caught in the Union and International waters just outside the southernmost border of Faroese EEZ in 5.b is probably more connected to the ling stock in 6.a (lin.27.3a4a6-91214) than the stock on the Faroe Plateau in 5.b.

1) *Was the TAC restrictive in the past?*

It is difficult validate if the TAC was restrictive of catches supported by the stock in the past because TACs in faroese waters are for ling/blue ling together (Table 1). The TAC for ling in union and International waters of 5.b is for ling only.

Table 1. TAC for the years 2007-2018 and total landings (in tons), landings divided into EU and non-EU landings and ICES advice.

	Inside Faroese EEZ in 5.b		Union and International waters in 5.b	Landings of ling			ICES advice
	Norwegian TAC	EU TAC	EU TAC				
Year	Ling/Blue ling	Ling/Blue ling	Ling	Total	EU	Norway/Faroes	
2007	2406	3065	34	4731	20	4711	
2008	2525	3065	34	4736	63	4672	
2009	2525	3065	34	4643	286	4357	
2010	2425	2700	34	6129	152	5977	
2011	-	-	33	4843	51	4792	
2012	-	-	33	6011	125	5886	
2013	-	-	33	4132	11	4121	
2014	1250	1500	33	6643	16	6626	
2015	1900	1500	33	5968	20	5948	6730
2016	2000	2000	33	5886	122	5764	6730
2017	2000	2000	33	6152	58	6094	5196
2018	2200	2000					5196

2) *Is there a targeted fishery for the stock?*

Yes, there is targeted fishery for ling in 5b.

3) *Is the stock of large economic value?*

Yes, ling catch in 5.b is of economic value for the Faroe Islands.

4) *How is the most important fishery for the stock managed?*

For the Faroese fleets fishing in 5.b there is a licensing scheme and effort limitations. In 2019, it is likely that ling caught by Faroese vessels will be managed by a combination of licensing scheme and quotas in Faroese EEZ.

5) *What are the fishing effort and stock trends over time?*

No available data for fishing effort on stock level. The exploratory assessment shows that the fishing mortality is slightly decreasing and the spawning stock size is increasing.

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

The WG has no data to answer this question.

Overall conclusion

The 33 tons EU TAC in Union and International waters of 5 correspond to a small fraction of the total catch of ling in 5.b.

The Union and International waters are just outside the southernmost border of Faroese EEZ in 5.b so the ling caught in this areas is probably more connected to the ling stock in 6.a (lin.27.3a4a6-91214) than ling caught on the Faroe Plateau in 5.b, based on bathymetry features. Therefore, instead of removing this TAC, a measure, which effect is unknown, it could be considered combining this mall TAC to the larger TAC for ling in Union and international waters of 6, 7, 8, 9, 10, 12 and 14 into a TAC for Union and international waters of 5-10, 12 and 14.

Ling (*Molva molva*) in division 3a and subarea 4

1) *Was the TAC restrictive in the past?*

Regulating the fishery with TAC's in subareas 3a and 4 started in 2003. Before this there were larger landings in area 3a, but the landings have decreased to the present level before as 2003 (Figure 1). For most years the landings are smaller than the set TAC (Table 1). In subarea 4 the landings have always been lower than the TAC (Table 2).

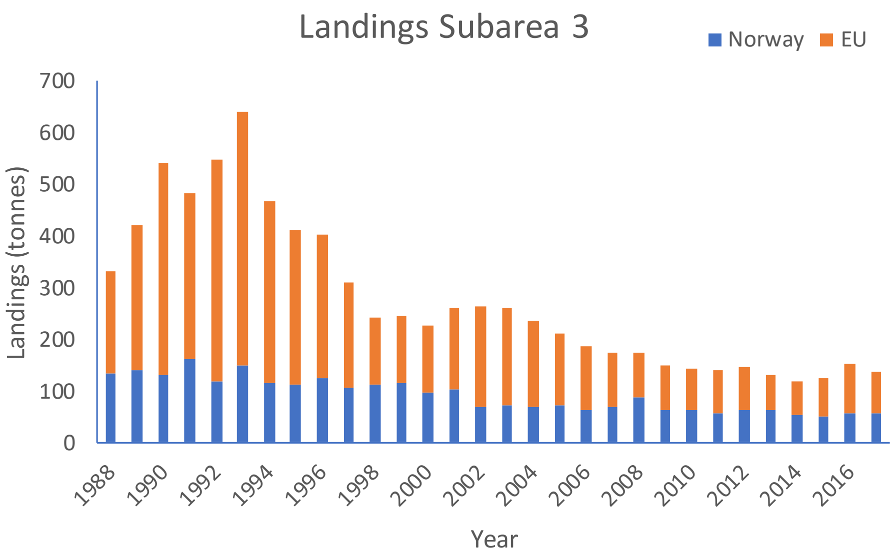


Figure 1. Landings by the Norwegian and EU fleet in subarea 3 for the period 1988-2017.

Table 1. Division 3a, landings TAC and % utilization of the TAC 2003-2017

Year	TAC EU subarea 3	EU landings	% utilized
2003	136	188	1,38
2004	136	166	1,22
2005	136	138	1,01
2006	136	126	0,93
2007	109	106	0,97
2008	100	87	0,87
2009	100	87	0,87
2010	90	78	0,87
2011	92	83	0,90
2012	92	83	0,90
2013		68	
2014	87	66	0,76
2015	87	75	0,86
2016	87	95	1,09
2017	87	81	0,93

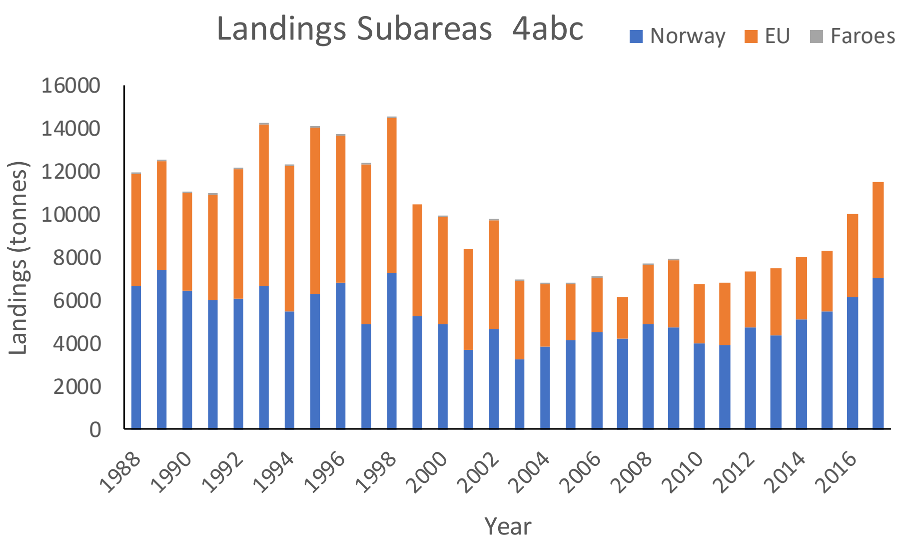


Figure 2. Landings by the Norwegian and EU fleet in subarea 4 for the period 1988-2017.

Table 2. Subarea 4, TAC, landings and % utilization of the TAC 2003-2017

Year	TAC EU subarea 4 (EU waters)	TAC EU subarea 4 (Norwegian waters)	Total TAC	EU landings 4	% utilized
2003	4666		4666	3456	0.74
2004	4666		4666	2729	0.58
2005	3966	1000	4966	2482	0.50
2006	3966	1000	4966	2402	0.48
2007	3173	1000	4173	1860	0.45
2008	2856	850	3706	2645	0.71
2009	2856	850	3706	3044	0.82
2010	2428	850	3278	2629	0.80
2011	2428	850	3278	2844	0.87
2012	2428	850	3278	2535	0.77
2013	2428	850	3278	3029	0.92
2014	1942	950	2892	2818	0.97
2015	2428	950	3378	2793	0.83
2016	2912	950	3862	3819	0.99
2017	3494	1350	4844	4366	0.90

2) *Is there a targeted fishery for the stock?*

The Norwegian longline fishery in area 4a is a targeted fishery. In Subarea 3 it is mainly a bycatch fishery and other than the longline fishery in subarea 4 ling is a bycatch species. Table 3 shows the proportion of the catches in percent between the main fishing gears in Subareas 3 and 4

Table 3. Catches in percent for the main fishing gears in Subareas 3 and 4.

SUBAREA	GILLNETS	LONGLINES	TRAWLS
3	22%	6%	71%
4	7%	44%	47%

3) *Is the stock of large economic value?*

Not for the EU fleet, for the Norwegian longline fleet it is relatively valuable. (compared to the cod fishery it has no commercial value). Total landings divided between EU and Norway in subareas 3 and 4 are given in Figures 1 and 2.

Prices per kg are slightly smaller for ling than for cod.

4) How is the most important fishery for the stock managed?

No TAC for Norwegian vessels in the Norwegian EEZ in 3 and 4. TAC set for EU vessels.

5) What are the fishing effort and stock trends over time?

The Norwegian longline fleet fishing for ling and tusk have declined from 72 vessels in 2000 to 25 in 2017, which has reduced the total fishing effort by this fleet with about 43%. A CPUE series based on data from the Norwegian longline fishery show a positive development of the stock.

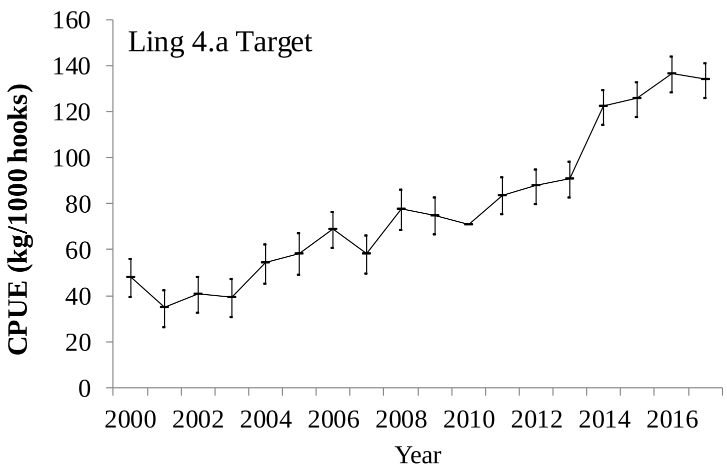


Figure 3. Estimates of CPUE (kg/1000 hooks) of ling based on skipper's logbook data from 2000 to 2017. The bars denote the 95% confidence interval.

6) What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?

Overall Conclusion

The EU TAC was never fully caught suggesting that the interest for the fish is unlikely to generate higher catch in the near future. However what would happen in a situation of limiting catch opportunities for other species in particular other gadoids in the North Sea and Skagerrak is unknown.

Although this could not be analyzed in may be that the TAC contributed to avoid species and/area misreporting.

Tusk (*Brosme brosme*) in in division 3a and subarea 4

1) *Was the TAC restrictive in the past?*

Regulating the fishery with TAC's in Subareas 3a and 4 began in 2003. The history of the landings is shown in Figures 1 and 2. For every year the landings are smaller than the set TAC in Subarea 3 (Table 1). In subarea 4 the landings have been considerably lower than the TAC for all years except in 2003 (Table 2).

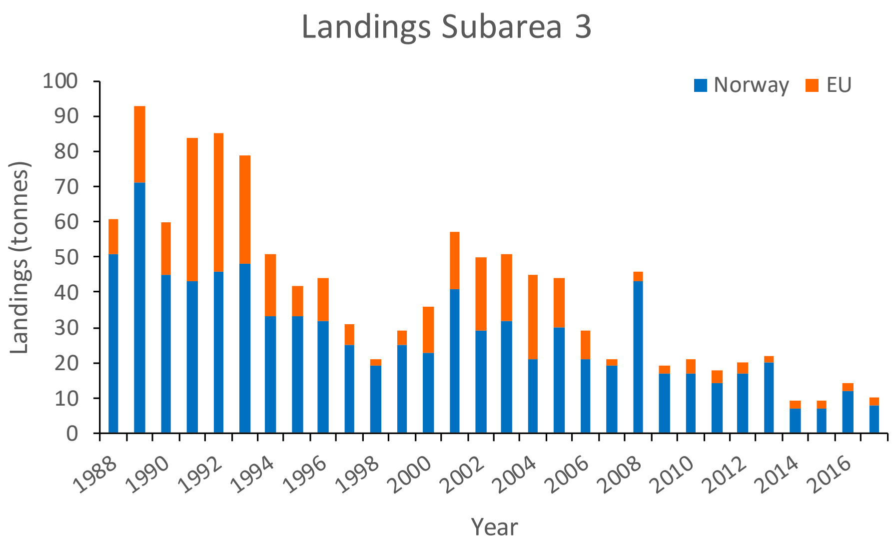


Figure 1. Landings by the Norwegian and EU fleet in Subarea 3 for the period 1988-2017.

Table 1. Area3a, landings TAC and % of the TAC 2003-2017

Year	TAC EU subarea 3	EU landings	% utilized
2003	40	19	0.48
2004	40	24	0.60
2005	40	14	0.35
2006	40	8	0.20
2007	28	2	0.07
2008	28	3	0.11
2009	28	2	0.07
2010	24	4	0.17
2011	24	4	0.17
2012	24	3	0.13
2013	24	2	0.08
2014	29	2	0.07
2015	29	2	0.07
2016	29	2	0.07
2017	29	2	0.07

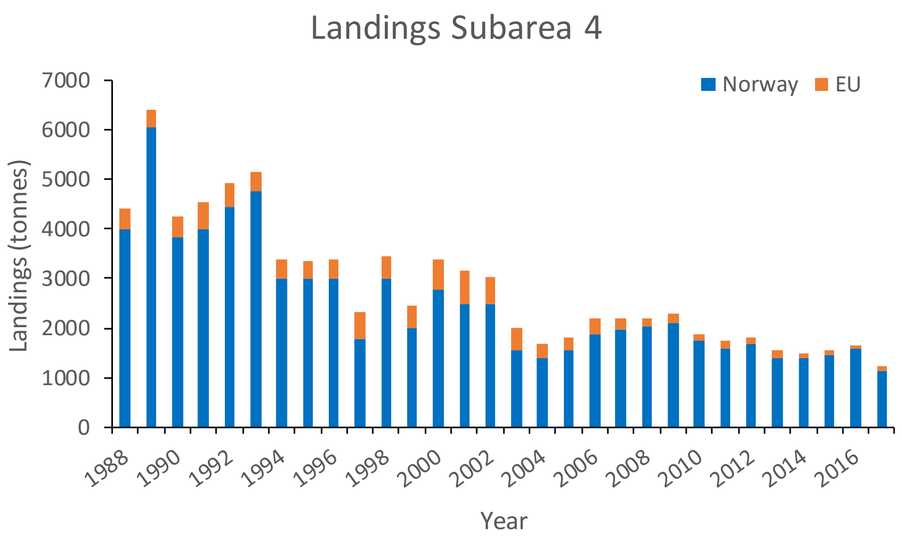


Figure 2. Landings by the Norwegian and EU fleet in Subarea 4 for the period 1988-2017.

Table 2. Subarea 4, TAC, landings and % of the TAC 2003-2017

Year	TAC EU subarea 4 (EU waters)	TAC EU subarea 4 (Norwegian waters)	Total TAC	EU landings 4	%
2003	370	70	440	440	1.00
2004	370	710	1080	300	0.28
2005	317	604	921	251	0.27
2006	317	604	921	299	0.32
2007	231	170	401	214	0.53
2008	231	170	401	166	0.41
2009	231	170	401	174	0.43
2010	196	170	366	128	0.35
2011	196	170	366	156	0.43
2012	196	170	366	120	0.33
2013	235	170	405	138	0.34
2014	235	170	405	100	0.25
2015	235	170	405	86	0.21
2016	235	170	405	89	0.22
2017	235	170	405	87	0.21

2) *Is there a targeted fishery for the stock?*

No, not in areas 3 and 4. Table 3 shows the proportion of the catches in percent between the main fishing gears in Subareas 3 and 4

Table 3. Catches in percent for the main fishing gears in Subareas 3 and 4.

Subarea	Gillnets	Longlines	Trawls
3	21%	24%	52%
4	4%	80%	15%

3) *Is the stock of large economic value?*

No.

4) *How is the most important fishery for the stock managed?*

No TAC for Norwegian vessels in the Norwegian EZ in 3 and 4. TAC set for EU vessels.

5) *What are the fishing effort and stock trends over time?*

The Norwegian longline fleet fishing for ling and tusk has declined from 72 vessels in 2000 to 25 in 2017, which has reduced total fishing effort by the fleet about 43%. A CPUE series, based on data from the Norwegian longline fishery, shows a positive development of the stock until 2013, after this there has been a negative trend.

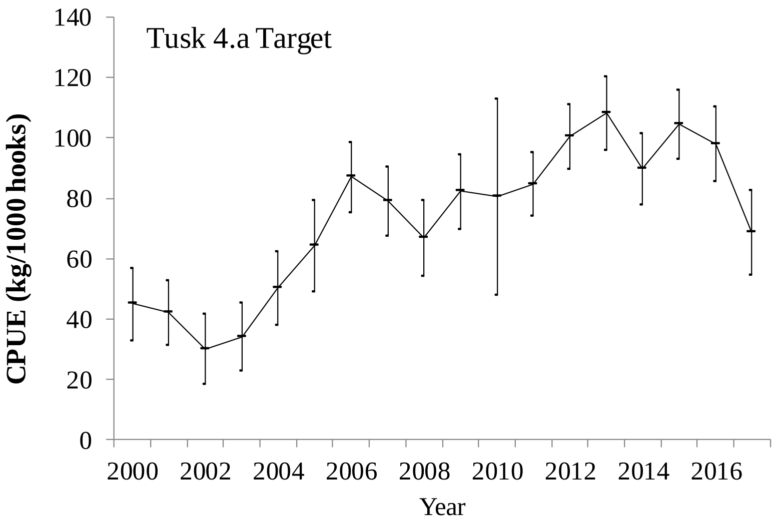


Figure 3. Estimates of CPUE (kg/1000 hooks) for tusk in Area 4a based on skipper's logbook data from 2000 to 2017. The bars denote the 95% confidence interval.

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

The EU TAC was never fully caught suggesting that the fishery is unlikely to generate higher catches in the near future.

Overall conclusion

Catch of tusk by EU vessels in Subarea 4 and Division 3a might have been mostly by-catch and the TAC was not caught since it was set in 2003. It seems unlikely that the fishery will generate higher catches in the near future. One reason for setting this TAC in the early 2000s may have been to prevent species and area misreporting.

Blue ling (*Molva dypterygia*) in subarea 12

1) *Was the TAC restrictive in the past?*

The landings are now below the TAC and for 2017 the landings were only 8% of the TAC. Before the TAC was set, the landings were above the TAC set for the recent years (Table 1). The landings are not restricted by the TAC now.

Table 1. Total landings and landings divided into EU landing and non-EU landing and TAC for the years 1988–2017.

		Landings (t)		
Year	TAC	Total landings	EU landings	Non-EU landings
1988		263	263	0
1989		70	70	0
1990		5	5	0
1991		1147	1147	0
1992		971	971	0
1993		3335	2681	654
1994		752	370	382
1995		573	59	514
1996		788	343	445
1997		417	416	1
1998		438	402	36
1999		1353	1011	342
2000		594	470	124
2001		693	582	111
2002		1271	1243	28
2003		1234	1194	40
2004		899	899	0
2005		682	682	0
2006		508	508	0
2007		362	361	1
2008		566	566	0
2009		312	312	0
2010		50	50	0
2011	815	55	55	0

2012	815	632	632	0
2013	774	254	254	0
2014	697	80	80	0
2015	558	12	12	0
2016	446	29	29	0
2017	357	28	28	0

2) *Is there a targeted fishery for the stock?*

There is no targeted fishery for blue ling in this area. The blue ling is only caught in a Spanish mixed trawl fishery for other species. The situation in the past, before TAC was set is unknown. There may have been directed fishing trips.

3) *Is the stock of large economic value?*

The landings are very small (28 tonnes in 2017) and the fishery is not of large economic value.

The species value is smaller than that of cod. In EU countries blue ling is sold as fish fillets, while outside the EU there are human consumption markets for fish product.

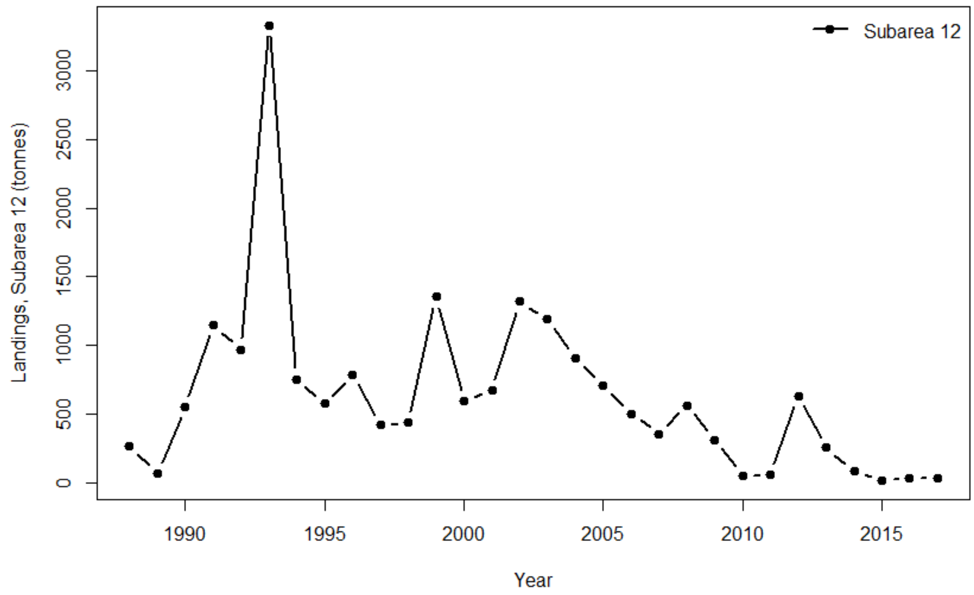
Blue ling in Subarea 12 is not considered a separate stock by ICES. Juveniles blue ling (younger than age 6) is not known to occur to any significant level in Subarea 12. Subarea 12 includes part of the Mid-Atlantic Ridge (12.a1, 12.a2, 12.a4 and 12.c) and the western slope of the Hatton Bank (12.b). None of these have represented major landings in the 2000s. Based upon the continuity of bathymetric features and lesser abundance, blue ling from the western Hatton Bank is likely to be similar to those from the northern Hatton Bank (6.b). Therefore, including ICES Division 12.b in the assessment unit for 5.b, 6 and 7 could be considered (ICES, 2018). The same might be true for blue ling occurring of the Mid-Atlantic part of Subarea 12, which could be considered likely to be related to blue ling in Division 5.a. In both cases, considering recent catches appending blue ling catches in Subarea 12 partly to the stocks in 5b, 6 and 7 and to that in 5.a would have no impact on the assessment because catches in Subarea 12 are minor compared to catches included in assessments of these two stocks.

4) *How is the most important fishery for the stock managed?*

The mixed trawl fishery for deep water species is managed by TAC for the different species.

5) *What are the fishing effort and stock trends over time?*

Landings are declining over time, the underlying population trend is unknown.



6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

There are no data on effort available for this stock.

Overall conclusion

The TAC has not been restrictive for this stock since the landings has been much below the set TAC. Blue ling is a bycatch in a Spanish mixed demersal trawl fishery in this area and the economic value of the fishery is regarded to be low. Since this is a bycatch species it is thought that this stock is indirectly regulated by other TAC`s in the area.

However, what would occur without a TAC is unknown. It has been widely reported that because of the aggregative behaviour of blue ling, targeted catch are possible. Therefore, instead of removing the TAC in Subarea 12, appending Division 12b to the TAC in 5b, 6 and 7 could be suitable. Allowing only bycatch (e.g. < 10% of total catch per trip) in Divisions 12.a.1 and 12.a.2, which are included in the NEACF RA could be considered. In Icelandic waters (Division 12.a.4) Icelandic regulation applies.

Review 1:

Review report of provision of advice on a revision of the contribution of TACS to fisheries management and stock conservation:

Executive Summary

ICES requested that a list of species be analysed in terms of the risk (whether it is biologically safe in the short and medium term) of removing TACs for each case and to assess the potential use of other conservation tools in the place of TACs.

- A general impression of the evaluation method (questions asked, data looked at)
- Stock by stock impression of whether the summary of the questions and data provide a solid background to say y/n to lifting TAC
- Any thoughts on additional comments from experts (valid concerns, etc.)
- The EC have set which species are target/bycatch; is this definition critical to the outcome of the evaluation?

The review report follows the above structure and addressed each question below.

A General Impression of the Evaluation Method (Questions Asked, Data Looked At)

The following questions were addressed for each stock:

1) *Was the TAC restrictive in the past?*

2) *Is there a targeted fishery for the stock or are the species mainly discarded?*

3) *Is the stock of large economic importance or are the species of high value?*

4) *How are the most important fisheries for the stock managed?*

5) *What are the fishing effort and stock trends over time?*

6) *What maximum effort of the main fleets can be expected under management based on FMSY (ranges) for the target stocks, and has the stock experienced similar levels of fishing effort before?*

Although these questions are very informative, how these questions link to the key issue at hand (removing the TAC) is important. Therefore, for this review, a few high-level queries to synthesise the conclusions were added to provide a consistent process and summary approach:

1) *Has the species/stock/group (hereafter just called stock) got characteristics that places it at high relative risk?*

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem importance
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

2) *Is the present TAC/management influenced by past unsustainable practices?*

- If yes, are those fisheries still active?
- Was the stock targeted?

3) *Can these or new unsustainable practices return if the TAC is removed?*

- Can they be targeted with the present fleet?
- Are they heavily discarded?
- Is the stock valuable?

4) Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

Comment on the conclusions

As can be seen from these points, most of the questions posed within the report inform the high-level queries well, except for the companion species component. To help the reviewer, the information from the 6 question was added to the 5 questions above to see whether the information provided could address the issues therein.

The report addressed the removal of TACs on a single species case-by-case basis. In reality, the issue of removing a TAC can be much more complex. For example, there is a distinction between a low or zero TAC being removed to reduce administrative overheads compared to its removal to avoid choke TACs. It was not clear to this reviewer why this particular list was chosen on a species by species basis. There may be value in sequencing the questions a bit differently. This may reflect a non-ICES reviewer needing more background information than may be the case for a reviewer more familiar with ICES history.

Similarly, adding a web link to the latest ICES advice (if available) would be useful. Many of the reports added more information, including figures and tables that comprehensively addressed this question. This approach did not assume a certain level of knowledge from the reader.

On the other hand, few reports provided biological information and the overall relative riskiness of the species and their interactions with the fisheries. This would have helped place the riskiness of making a potentially incorrect decision to keep a TAC or not in context.

The authors struggled with question 6. This question did get placed in the form of reference points which would be difficult for several to address. Several of the species provided an analysis comparing fishing effort on the key target species with the catch on the stock of concern. This was very useful, but there would be several caveats to this work (also presented in many of the reports). The key one being that the relationship between target effort and associated stock landings were linear (in most cases) and would remain the same if the TAC is lifted. Without a full assessment and fleet dynamics models it would be difficult to suggest more sophisticated approaches. On the other hand, looking at alternative management approaches and their pros and cons (as was done for skates and rays, for example) would be useful here, so perhaps the question was more complicated than it needed to be.

Finally, there is a policy issue highlighted by some small inconsistencies in the final recommendations that should be discussed. As an example, two overfished and overfishing stocks had opposite recommendations (keep the TAC, and no risk to removing TAC). The difference was that the landings for the one species was being restricted by the TAC whereas for the other, landings were well below the TAC. In both cases, discarding was large and not prohibited. Superficially one would agree that the one TAC is restrictive but not the other. However, in terms of total catch neither are restrictive and therefore nor is fishing mortality (F). Is the difference not therefore about the relative value of the stock concerned rather than the effectiveness of the TAC? i.e. the one stock is worth keeping at least until the TAC is met and then it is discarded, whereas the other is not worth keeping at all. In the case where the TAC was recommended not to be kept, alternative input control measures were not successful, yet F did need to be reduced on the species to ensure recovery. In this case, therefore, one would want to discuss adding effective management measures either by making the TAC work through restricting discarding (and allowing the stock to become a potential choke species) or clearly articulating workable alternatives.

On a related point, most of the MSY reference points provided were based on single species assessments. It is now becoming clear that not all stocks in an ecosystem can reach their single species MSY together and at the same time, so another question not addressed one species at a time is the ecosystem interactions between these species and whether all species in the present system can be sustainably managed at single species MSY levels. Although it was pleasing to see the inclusion of more companion species work and analyses attempting to address how useful the management of one bycatch stock is through the management of the target stock, this work needs much further research.

Species: Stock by Stock Impression of Whether the Summary of the Questions and Data Provide a Solid Background to Say Y/N To Lifting Tac.

Ling 5.b (Faroe ground)

1) *Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?*

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

No information is provided on the biology of the stock, nor its catchability beyond targeting. There is some discussion on the stock distribution and possible boundaries which is important to the conclusions and recommendation.

2) *Is the present TAC/management influenced by past unsustainable practices?*

- If yes, are those fisheries still active?
- Was the stock targeted?

No evidence is provided that the stock is targeted beyond a single statement that ling is targeted in 5b. Similarly, a single statement that initial analyses (based on what?) show the spawning stock is increasing and F slightly decreasing.

3) *Can these or new unsustainable practices return if the TAC is removed?*

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

Yes, in terms of targeting. No information is provided on discarding. For the input-controlled part of the fishery one would infer this is low (perhaps), but is unclear for the other component where a TAC is set. No evidence on price is provided for ling, but for a statement that the ling catch is of economic value for the Faroe Islands.

4) *Are there alternatives to a TAC to manage this stock?*

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

The bulk of the catch is not within the TAC for this region i.e. 75-85% of the ling landings are from the Faroese fleets that are managed by input controls.

Conclusion

More detail should be provided when answering the key questions. This would be beneficial, however the text does address the questions. An alternative to removing the TAC for ling in Area 5 for the Union and internationals waters is to combine this with the larger TAC for ling in the Union and international waters of 6, 7, 8, 9, 10, 12 and 14.

Ling (*Molva molva*) in division 3a and subarea 4

1) *Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?*

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

No information was provided on the biology. The stock is mainly retained as bycatch, except for targeting by the longline fishery in Subarea 4. No direct evidence in terms of metier or technical interaction information was provided. In that regard, Table 3 is informative in terms of the proportion caught by gear in each area, but not informative in terms of targeting.

2) *Is the present TAC/management influenced by past unsustainable practices?*

- If yes, are those fisheries still active?
- Was the stock targeted?

There is no TAC for Norwegian vessels in the Norwegian EEZ in 3 and 4. A TAC is set for EU vessels. Total effort of the Norwegian longline fleet for ling and tusk decreased, accompanied by a reduction of vessels over time. Commercial CPUE has increased since 2000. The consequence of the absence of a TAC for Norwegian vessels is not articulated. The TAC was not fully utilised.

3) *Can these or new unsustainable practices return if the TAC is removed?*

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

Present Norwegian fleet is 25 compared to 72 in 2000. Present longline Norwegian fleet can target the stock, but it is a bycatch for other gear types.
No information on discarding is provided.
The stock is relatively valuable for the Norwegian longline fleet only.
This part of the report (what maximum effort of the main fleet can be expected ..) was not answered in the report.

4) *Are there alternatives to a TAC to manage this stock?*

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

This part was also not answered in the report so difficult to answer.

Conclusion

The conclusion is hard to support or not support, given little evidence or even anecdotal evidence was provided in the main part of the report to lead one to the conclusions provided.

Tusk (Brosme brosme) in division 3a and subarea 4

1) *Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?*

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

No information about the biology of the stock is provided. Targeting information is also not provided.

2) *Is the present TAC/management influenced by past unsustainable practices?*

- If yes, are those fisheries still active?
- Was the stock targeted?

Commercial CPUE was low in the 2000, increased thereafter, but has recently shown declining trends. The EU TAC was underutilised especially in recent years (average of 18% and 34% for areas 3 and 4 respectively).

3) *Can these or new unsustainable practices return if the TAC is removed?*

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

There is no TAC for the Norwegian vessels in the Norwegian EZ in 3 and 4. A TAC is set for the EU vessels. The stock is not targeted and not valuable.
No information on discarding was provided.

4) *Are there alternatives to a TAC to manage this stock?*

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

Since the EU TAC was not caught especially in more recent years and no TAC on Norwegian vessels in EZ implied other mechanisms e.g. its low value, is already in place.

Conclusion

The conclusion, although not giving direct recommendations, provides a clear direction for decision makers, which follows from the information provided.

Blue ling (Molva dypterygia) in subarea 12

1) *Has the species/stock/group (hereafter referred to as stock) got characteristics that places it at high relative risk?*

- In terms of its general biology e.g. aggregating, sex change, long lived, low productivity, forage fish, ecosystem important
- In terms of its catchability e.g. degree of population overlap with key fisheries, presence of refuges, ability to be directly targeted

Presently not targeted in this area and is only caught by the Spanish mixed trawl fishery targeting other species. However, prior to TACs targeting is stated as unknown. Blue ling show aggregating behaviour, which implies that targeting is possible.

2) *Is the present TAC/management influenced by past unsustainable practices?*

- If yes, are those fisheries still active?
- Was the stock targeted?

The underlying stock trend is unknown, other than that recent landings have declined. No effort information is available for this stock – it is a bycatch species.

3) *Can these or new unsustainable practices return if the TAC is removed?*

- Can they be targeted with present fleet?
- Are they heavily discarded?
- Is the stock valuable?

Catches have been variable in the past (maximum of 3335t in 1993; minimum of 5t in 1990). The TAC has never been fully caught and has been very underutilised since 2014 (average of 7% since 2014). However, the catch under TAC was still variable (maximum of 632t in 2012, minimum of 12t in 2015). The stock is not valuable.

4) Are there alternatives to a TAC to manage this stock?

- Can they be managed as companion species through target TACs (if applicable)?
- Can they be spatially managed?
- Any other mechanism? E.g. Multi-Year TACs (MYTAC).

Statements are made in terms of boundaries for the assessments of the stocks and suggestions are made for potential changes. The low recent catches relative to the TAC support the statement that the mixed trawl fishery for deep water species is managed by the TAC for other species.

Conclusion

The overall conclusion is clear and suggests that the TAC could be removed. However, it recommends, to avoid potential targeting, adding the TAC to another TAC combined with by-catch limits in Divisions 12.a.1. and 12.a.2.

Review 2

The key question here is whether total allowable catches (TACs) can be removed for any of the stocks in question, or should be retained for all stocks. The disparate documents would be improved by an overall grammar check, and efforts to ensure that the data provided are in similar formats to allow decisions to be made fairly across stocks. I first make some overall points, and then summarize my thoughts on individual stocks.

1) Overall, I am skeptical that removing TACs for any stock is a good idea. Any stock with no TAC can be targeted with unlimited catches, and the EU has a large amount of latent fishing effort combined with ready markets. In such circumstances, a new market, technology, or stock can lead to rapid deployment of latent effort, leading to stock collapses in a short period of time. If the current TACs are too precautionary, TACs should be increased rather than abolished. For pilot fisheries, TACs could be set at levels that are economically viable but low enough to avoid substantial and rapid depletion.

2) TACs should be set separately for each species. TACs set on species complexes (such as "skates") risk targeting on the most valuable species within the complex, resulting in overfishing of that species even as TACs are not exceeded.

3) TACs should be set for management areas that correspond to stock boundaries. In a few instances, the TACs are set for areas that include portions of two stocks, rather than separate TACs being set for each stock. It is, of course, reasonable to set TACs for subareas of a single stock to ensure that catches are not concentrated in a single part of the stock range.

4) A major weakness in the current approach is that TACs are applied only to landings, not to total catch (landings + discards). In a multispecies fishery managed by TACs on individual species, some species will become choke species that constrain landings of other species. When discards are not accounted for in TAC advice, and are not measured, this provides incentives to discard catches that are over the TAC (or over individual quotas), and this is especially true for those stocks at lowest levels that currently have a "zero" TAC. A key part of management should be measuring and holding fishers accountable for discards, and then setting TACs for total catches instead of just for landings.

5) In a few cases, the bulk of catches, biomass, and habitat is outside EU waters, but TACs are still set at very low levels inside EU waters. These nominal TACs could be increased for stocks that are not targeted, have little EU commercial value, and are currently managed by TACs that are so low as to have a negligible impact on stock status. Increasing TACs would ensure that bycatch does not constrain catches of more valuable target species.

6) In cases where choke species are healthy, and current catches do not constitute overfishing, but catches are close to TACs, the TACs could be increased so that fewer fishers are constrained by catches of these choke species.

A stock-by-stock review follows.

Ling 5.b (Faroe ground)

The bulk of catches (75-85%) are in non-EU waters (Faroese EEZ). The EU TAC of 33 tons is 1% of the quotas in Faroese EEZ waters. Landings have ranged from 11 to 286 tons. For this stock, the TAC could be increased, or perhaps a better idea as suggested in the document, this small TAC could be merged with the larger TAC for EU and international waters in areas 5-10, 12, and 14.

Ling in 3a and subarea 4

Catches have been close to the TAC (70-100%) in recent years; the fishery is valuable and a target; and CPUE is increasing over time. Given the apparent increase in abundance, which has not been followed by similar substantial increases in TACs and catches, this stock is likely to become more of a constraining species over time unless the TAC is raised substantially in the future.

Recommendation: retain TACs, monitor frequently to see if TAC increases are warranted given biomass growth.

Tusk in 3a and subarea 4

Catches are far below TACs in almost all years, and there is no targeting or value associated with this stock; CPUE trends show no worrying signs. The current TAC can be retained into the future.

Blue ling subarea 12

Given that this is not considered to be a separate stock, and that catches have not been close to TACs in recent years, it makes sense to combine the TAC with the TACs for contiguous areas (5.b, 6, 7), as recommended.