

9 Black scabbardfish (*Aphanopus carbo*) in the North-east Atlantic

9.1 Stock description and management units

The species is distributed on both sides of the North Atlantic and on seamounts and ridges, from the Strait of Denmark, southwards to about 30°N (Nakamura & Parin, 1993). Juveniles are mesopelagic and adults benthopelagic. The life cycle of the species is not completed in just one area and large-scale migrations occur seasonally.

All available evidences suggest one single stock doing a clockwise migration between Northern European waters (ICES subareas 5, 6 and 7 and Division 27.12.b) and southern European waters (subareas 8 and 9) down to Madeira in the CECAF area, where spawning occurs (Farias *et al.*, 2013). The connexions between the Northern and Southern components and other areas, in particular Azorean waters and the mid-Atlantic Ridge is less clear. However, ICES considers one single assessment unit in the Northeast Atlantic.

Two different species, the black scabbardfish (*Aphanopus carbo*) and the intermediate scabbardfish (*A. intermedius*), coexist in Azorean waters (Subarea 10), Madeira, and the Canaries (Stefanni & Knutsen, 2007; Stefanni *et al.*, 2009; Biscoito *et al.*, 2011; Besugo *et al.*, 2014 WD). This latter species is not subject to assessment by ICES.

Because of the different characteristics of fisheries and life stage occurring in each area, the report is organised in four sections treating fisheries in northern, southern, other areas, and CECAF. WGDEEP does not assess fisheries in Madeira (Eastern Central Atlantic area, CECAF) or in other areas outside the ICES area.

Section 9.2 "Black scabbardfish (*Aphanopus carbo*) in subareas 27.5, 27.6 and 27.7 and Division 27.12.b" presents data and analyses on fisheries and catches in the Northern component of the ICES areas. In these areas the bulk of the catch is by trawlers.

Section 9.3 "Black scabbardfish (*Aphanopus carbo*) in subareas 27.8 and 27.9" presents data and analyses where the main fishery is from deep-water longliners in Division 27.9.a, which represents the Southern component of the ICES areas, as well as results of the model for the overall stock. The modelling relies on a state-space dynamic population model benchmarked at WKDEEP 2014 (ICES, 2015).

Section 9.4 "Black scabbardfish (*Aphanopus carbo*) in other areas" presents data and analyses for other areas, namely Division 27.3.a and subareas 27.1, 27.2, 27.4, 27.10, and 27.14. Data are mostly about longline fisheries. Since, 2010 the overall landings from those areas were globally much lower than at the other two management units.

Section 9.5 "Black scabbardfish (*Aphanopus carbo*) in CECAF area" presents data and analysis of fisheries and landings in CECAF area 34.1.2, where a directed bottom longline fishery operates. Although ICES does not assess this fishery, it is admitted that the incorporation of reliable CECAF data could provide a wider perception of the stock dynamics.

9.2 Black scabbardfish (*Aphanopus carbo*) in subareas 27.5, 27.6 and 27.7 and Division 27.12.b

In this section, fisheries, landings trends, and applicable management are presented for divisions 27.5.a, 27.5.b, and 27.12.b and subareas 27.6 and 27.7, but the stock assessment data analyses and management considerations apply to these areas and ICES subareas 27.8 and divisions 27.9.a.

ICES Division 27.5.a, initially included in “Other areas”, has been included in the Northern Component since 2016, both for stock assessment analyses and for management considerations.

9.2.1 The fishery

The fishing effort from EU vessels in the Northern Component area has been greatly reduced due to the EU Regulation 2016/2336 of 14 December 2016 (EU, 2016) that bans fishing with bottom trawls at a depth below 800 metres, with impacts on the French bottom deep-water fishery that catches the black scabbardfish.

In Division 27.5.b, black scabbardfish was initially fished by large trawlers that operated on the slope around the Faroe Bank and on the Wyville-Thomsen ridge close to the southernmost Faroese EEZ boarder. In Faroese waters, the black scabbardfish fishery is managed through a fishing licencing scheme and since 2013, only one trawler has had licence to fish black scabbardfish as a targeted species.

Faroese commercial trawlers use a star trawl with 486 meshes, 160 mm with a net mesh size of 80 mm. Black scabbardfish is usually fished at depths from 600 to 1000 m and the haul duration varies from 6 to 8h, but may last less in case of large catch (Ofstad, 2019 WD).

9.2.2 Landings trends

The historic landing trends on this assessment unit are described in the stock annex.

Total landings from the ICES Division 27.12.b and subareas 27.5, 27.6, and 27.7 show a markedly increasing trend from 1999 to 2002 followed by a decreasing until 2005 (Figure 9.2.1). The peak in landings was registered in 2002 and came mainly from landings in ICES subareas 27.6 and 27.7. The 2002 peak appears to be mainly driven as a response to the EU TAC management (Figure 9.2.1). From 2009 until 2016, landings have been stable, fluctuating around about 3000 tonnes per year. Since 2017, there was a slight decrease.

Since 2010, Icelandic landings in ICES Division 27.5.a have increased, remaining stable around 300 t between 2012 and 2017, and decreasing in more recent years.

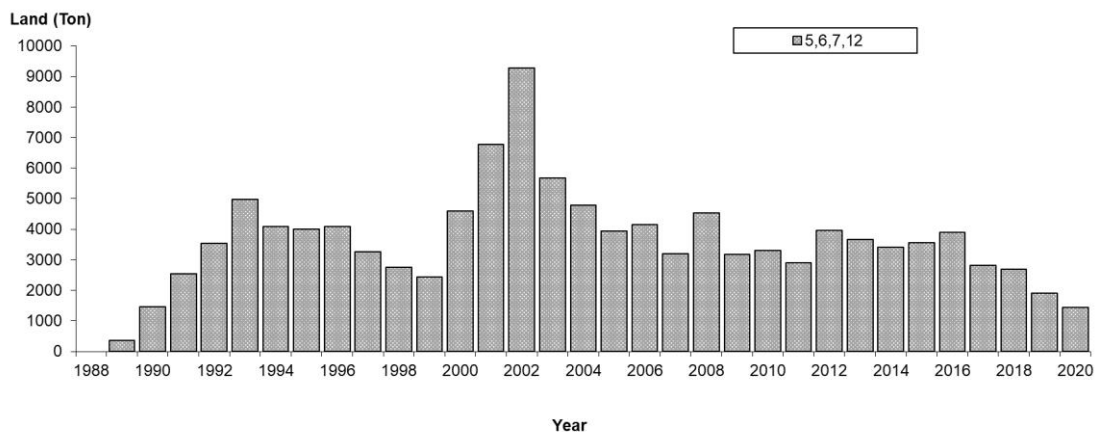


Figure 9.2.1. bsf.27.nea Northern component annual landings time-series for ICES subareas 27.5, 27.6, 27.7, and 27.12.

In early years, French landings represented more than 75% of the Northern component total landings, but in 2002 and 2006 they just represented about 50%. The relative importance of French landings, particularly at ICES Subarea 27.6, augmented from 2009 to 2012, decreased until 2015 and increased until 2017 to decrease again from 2017 to 2020. From 2013 to 2018, Spanish landings of black scabbardfish showed a slight increase, also decreasing in 2019, whereas Faroese landings increased from 2017 to 2020, which resulted on a rise in their relative contribution (Figure 9.2.2).

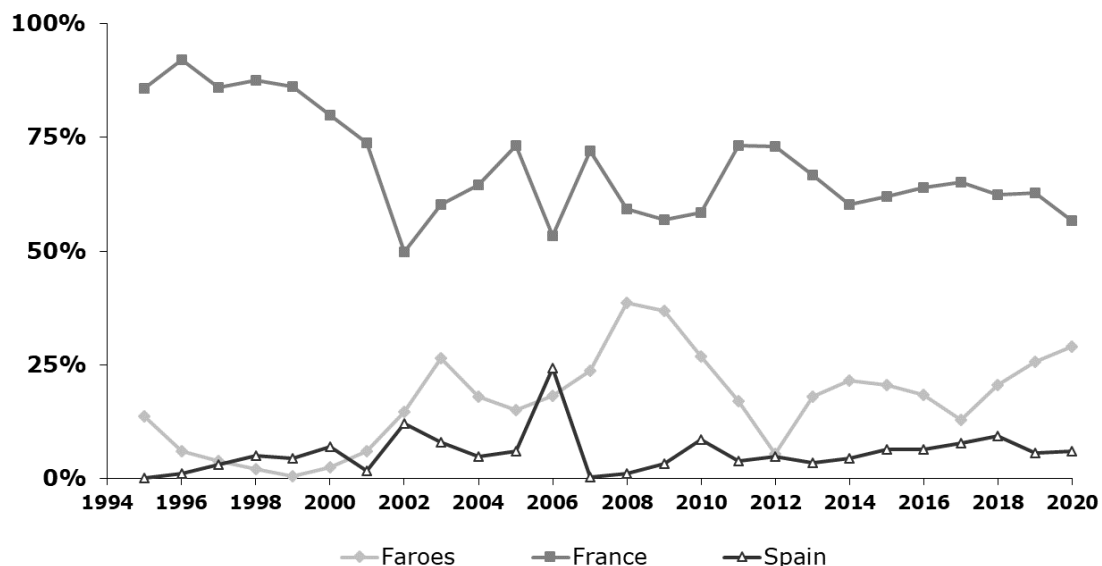


Figure 9.2.2 bsf.27.nea Northern component French, Spanish and Faroese relative contribution to the annual landings for the Northern component.

9.2.3 ICES Advice

The latest ICES advice, in 2020, was: “ICES advises that when the precautionary approach is applied, catches should be no more than 4506 tonnes in each of the years 2021 and 2022.

Distributed by area, this corresponds to annual catches of no more than 2143 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2084 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 280 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.”

9.2.4 Management

Since 2003, the management of black scabbardfish, adopted for EU vessels fishing in EU and international waters, includes a combination of TAC and licensing system. TACs and total landings of EU vessels in subareas 27.5, 27.6, 27.7, and 27.12, from 2006 to 2020, are presented in Table 9.2.1. The difference between the TAC and landings may not necessarily be regarded as TAC overshoot as some catches occur in waters under the jurisdiction of third countries and are therefore not covered by the EU TAC.

Given the EU Regulation 2016/2336 of the European Parliament and of the Council of 14 December 2016 (EU, 2016), “No fishing authorisation shall be issued for the purpose of fishing with bottom trawls at a depth below 800 metres”, black scabbardfish catches from trawl fishing grounds deeper than 800 meters are null for EU vessels since 2017.

Table 9.2.1. Black scabbardfish TACs and total landings of EU vessels in ICES subareas 27.5, 27.6, 27.7, and 27.12 from 2006 to 2021.

Year	EU TAC 27.5, 27.6, 27.7 & 27.12	Landings 27.5, 27.6, 27.7 and 27.12
2006	3042	4150
2007	3042	3194
2008	3042	4533
2009	2738	3159
2010	2547	3421
2011	2356	2900
2012	2179	2399
2013	3051	3229
2014	3966	3408
2015	3649	3546
2016	3357	3882
2017	2954	2821
2018	2600	2686
2019	2470	1903
2020	2470	1450
2021	583	

9.2.5 Data available

9.2.5.1 Landings and discards

In 2021, updated landing data were made available for the major fishing countries operating in ICES subareas 27.5, 27.6, 27.7, and 27.12 (Table 9.2.4).

Updated discard data were also provided for major fishing countries operating at the Northern component area. Based on the discard data available for this component, it is concluded that discards of black scabbardfish are negligible.

9.2.5.2 Research vessel data

Since September 2014, a Faroese deep-water survey has been conducted to investigate bottom fishes at deep waters and other areas than those the annual Faroese groundfish surveys covers (Ofstad, 2019 WD). The main species studied are tusk, blue ling, greater silver smelt, black scabbardfish, roundnose grenadier, deep-water redfish and Greenland halibut.

Faroese deep-water surveys are held onboard the research vessel “Magnus Heinason”. The trawl gear used is a star trawl with 40 mm mesh size in the cod-end. Rockhopper ground gear, 120 m bridles and Thyborøn-trawl doors. Fishing hauls have a mean duration of one hour, but the fishing haul duration (i.e. the time interval between the time when the gear reaches the bottom till it is hauled up from the bottom) may vary. The adopted sampling procedure is the same as those adopted for Faroese annual groundfish surveys. After each fishing haul the total catch is sorted by species and total weight is determined for each species. Further samples are also collected with the aim of obtaining data on specimens’ length and weight. For the main species, subsamples are also collected to determination of sex, maturity and age.

In Faroese waters, black scabbardfish is mainly distributed on the slope north of the Faroe Bank and on the Wyville-Thomsen ridge (Figure 9.2.3), which correspond to the main Faroese fishing areas. A closer look shows that the black scabbardfish is only caught in the area north-west of the Faroes and never caught on the Faroe Plateau (Figure 9.2.4). In 2020, only 31 out of the 75 hauls planned for the survey were performed due to the weather conditions and problems with the vessel.

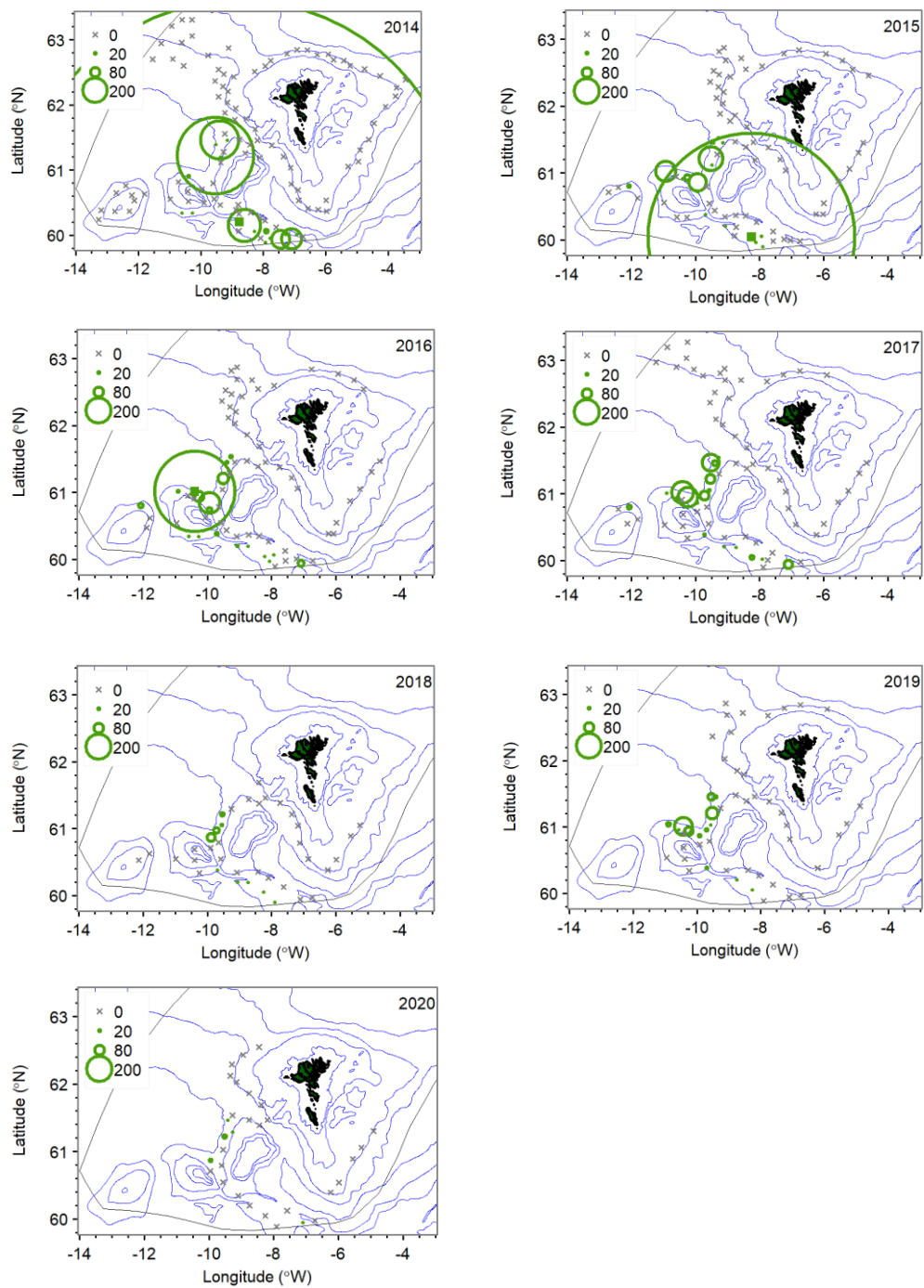


Figure 9.2.3. bsf.27.nea Northern component. Spatial distribution of CPUE (kg/h) from the deep-water surveys in 2014-2020. The green squares show the position of the largest catch. (Source: Ofstad, 2019, WD; Ofstad, L., 2020, 2021, pers. comm.).

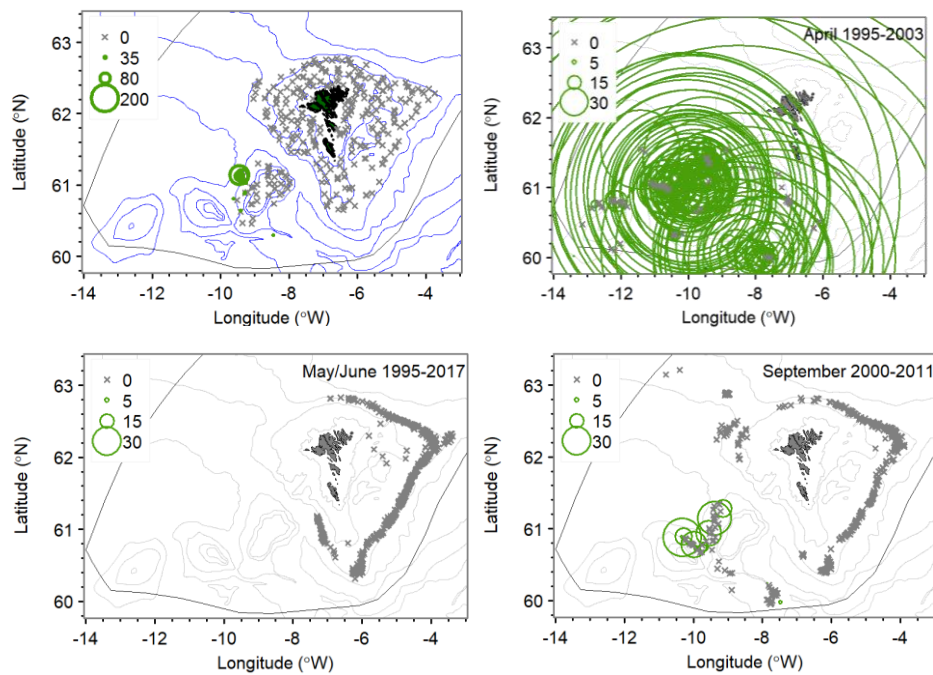


Figure 9.2.4. bsf.27.nea Northern component. Spatial distribution, CPUE (kg/h), from different surveys. Annual ground-fish surveys, August 1996-2017 (upper left), Blue ling surveys, April 1995-2003 (upper right), Greenland halibut surveys, May/June 1995-2017 (lower left) and Redfish surveys, September 2000-2011 (lower right). (Source: Ofstad, 2019, WD)

Oceanographic data collected in Faroese surveys indicate that the species occurs at depths below 500 m, in waters with temperature higher than 6°C (Figure 9.2.5). These two conditions are registered at the oceanic Faroese waters (Figure 9.2.6).

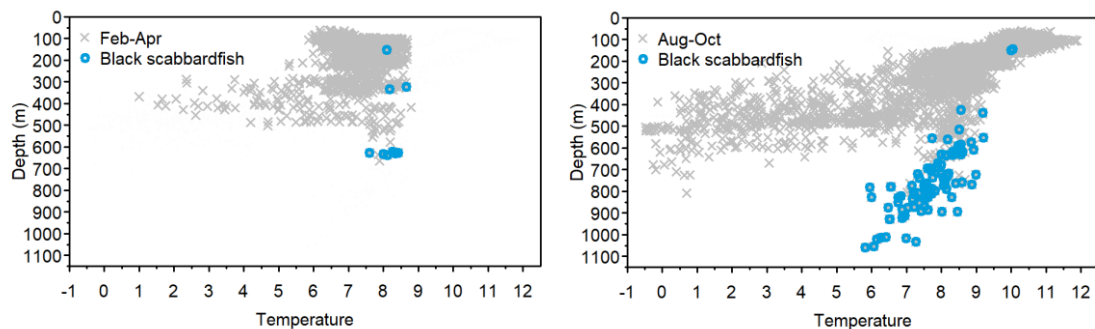


Figure 9.2.5. bsf.27.nea Northern component. Temperature and depth distribution of black scabbardfish (blue dots) and catch with no black scabbardfish (grey crosses) in February-April (left) and August-October (right). (Source: Ofstad, 2019, WD)

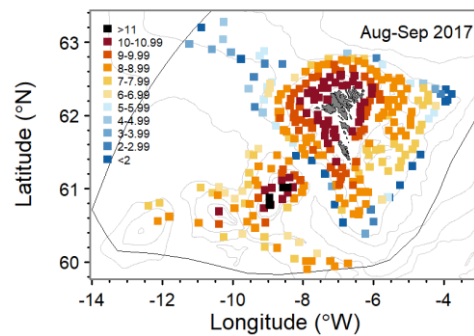


Figure 9.2.6. Temperature and depth distribution in Faroese waters August-September 2017. (Source: Ofstad, 2019, WD)

9.2.5.3 Length compositions

The annual length frequency distributions, based on French on-board observer data, for the period 2004-2020 are presented in Figure 9.2.7. The length frequency distribution is similar between years and reflects a predominance of immature individuals, i.e. specimens with less than 103 cm total length.

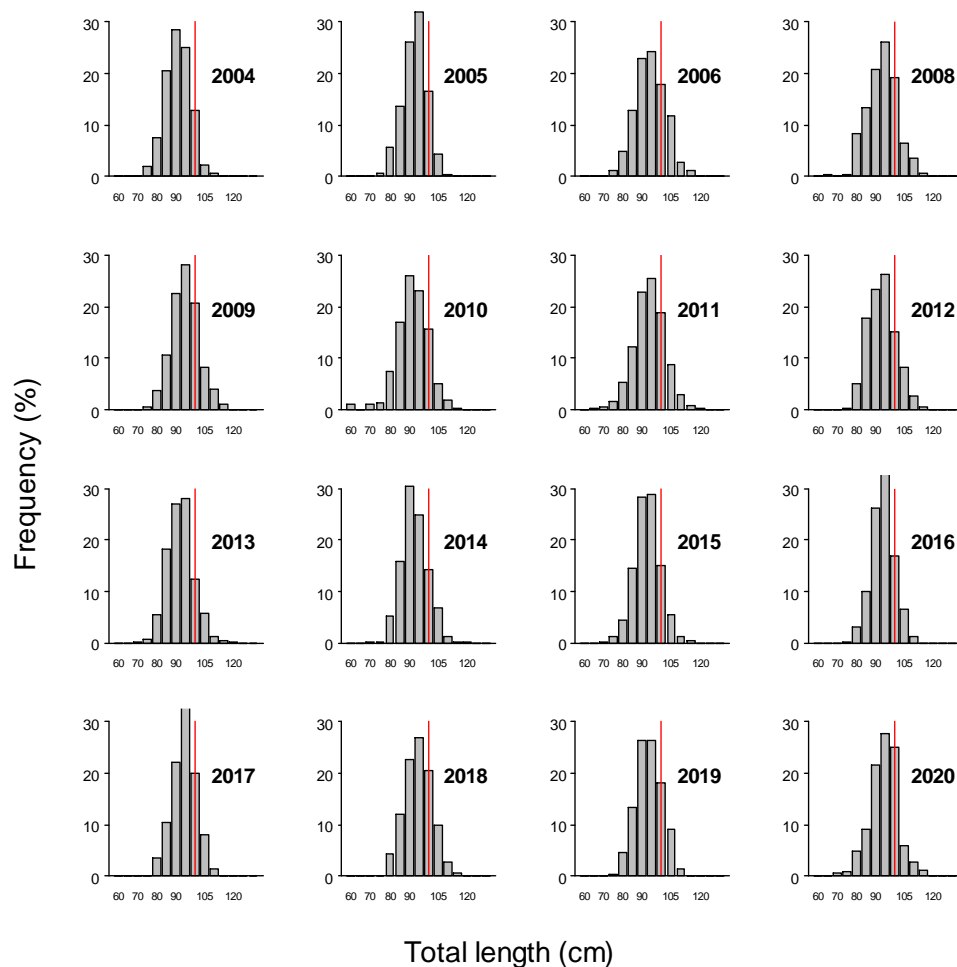


Figure 9.2.7. bsf.27.nea Northern component. Annual frequency length distribution of black scabbardfish based on French observer data collected on-board commercial vessels (2004–2020). The red vertical line indicates the length of 1st maturity of the species.

For the period 2004–2020, the temporal evolution of the mean length shows no trend (Figure 9.2.8), reflecting a stability on the length structure of the exploited population. In quarter 4, the lower mean length values were registered in 2010 and 2020, which may be associated with a high recruitment signal.

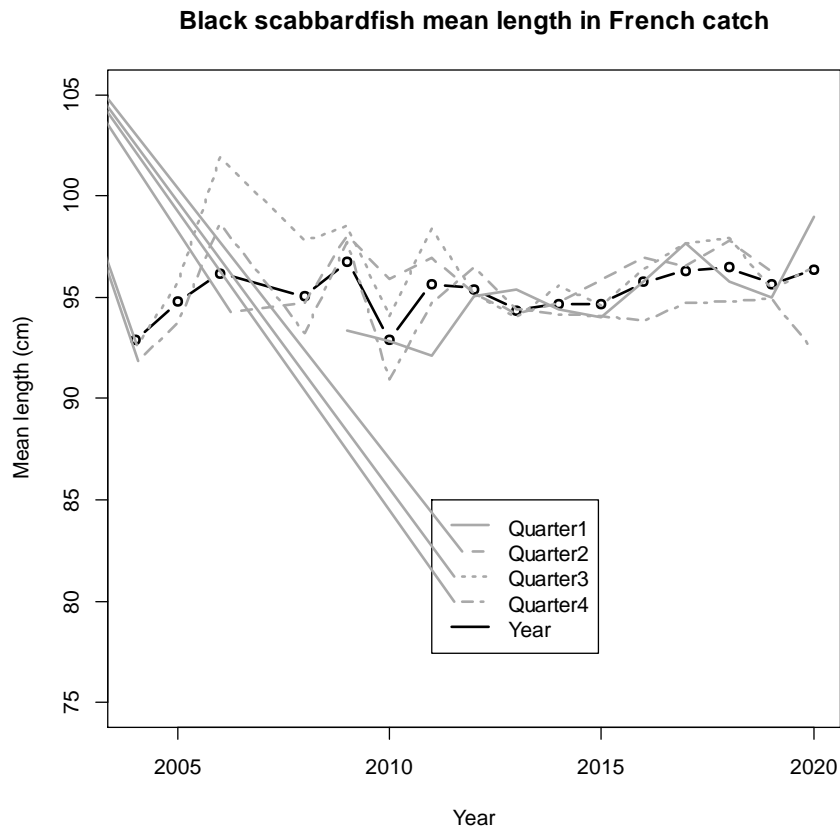


Figure 9.2.8. bsf.27.nea Northern component. Mean length estimates of black scabbardfish by quarter for the period 2004-2019. Data were collected under the French on-board observer program.

For the period 2014–2020, the annual length-frequency distributions based on samples collected at Faroese landings and Faroese deep-water surveys are presented in Figure 9.2.9. The mean length of the exploited population is around 90-92 cm, which is about the same mean length registered at the deep-water survey. In 2020, the Faroese survey length distribution includes specimens with length between 20 and 40 cm which were not registered before. Also, in 2020, the upper limit of the length range is lower than those from the previous years. The length frequency distribution for 2020 is not considered representative as it is based on 91 specimens and in the survey only 31 out of the 75 hauls planned were performed, due to the weather conditions and problems with the vessel.

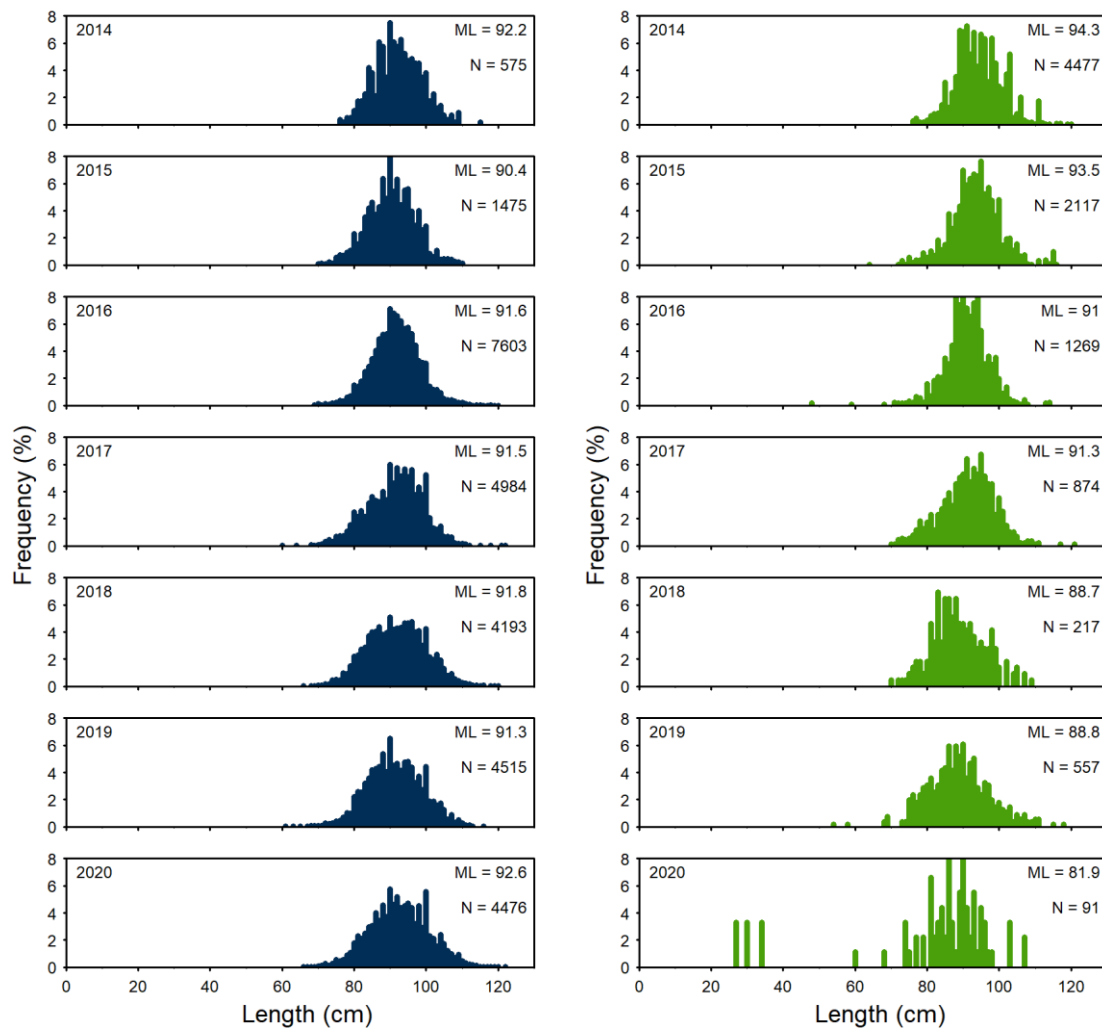


Figure 9.2.9. bsf.27.nea Northern component. Length-frequency distribution from the landings (left) and the deep-water survey (right) in 2014-2020. (Source: Ofstad, 2019 WD; Ofstad, L., 2020, 2021, pers. comm.)

In 2020, no new length information was provided by Spain for ICES Division 27.6.b and ICES Subarea 27.12. For 2014 and 2015, the annual length frequency distributions for ICES Division 27.6.b and ICES Subarea 27.12 were constructed based on the length data collected under Spanish on-board observer program (Figure 9.2.10).

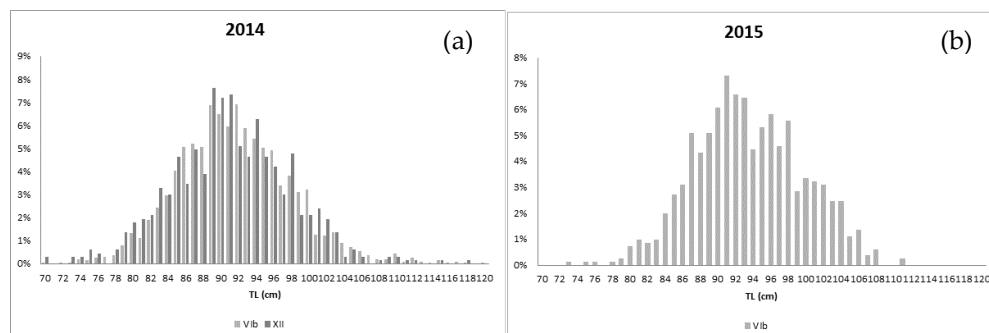


Figure 9.2.10. bsf.27.nea Northern component. Length frequency distribution based on Spanish on-board observations in 2014 (a) and in 2015 (b) in Division 6.b and Subarea 12.

Length frequency distributions for ICES Division 27.5.a based on the Icelandic Autumn surveys for the period 2000–2020 are presented in Figure 9.2.11.

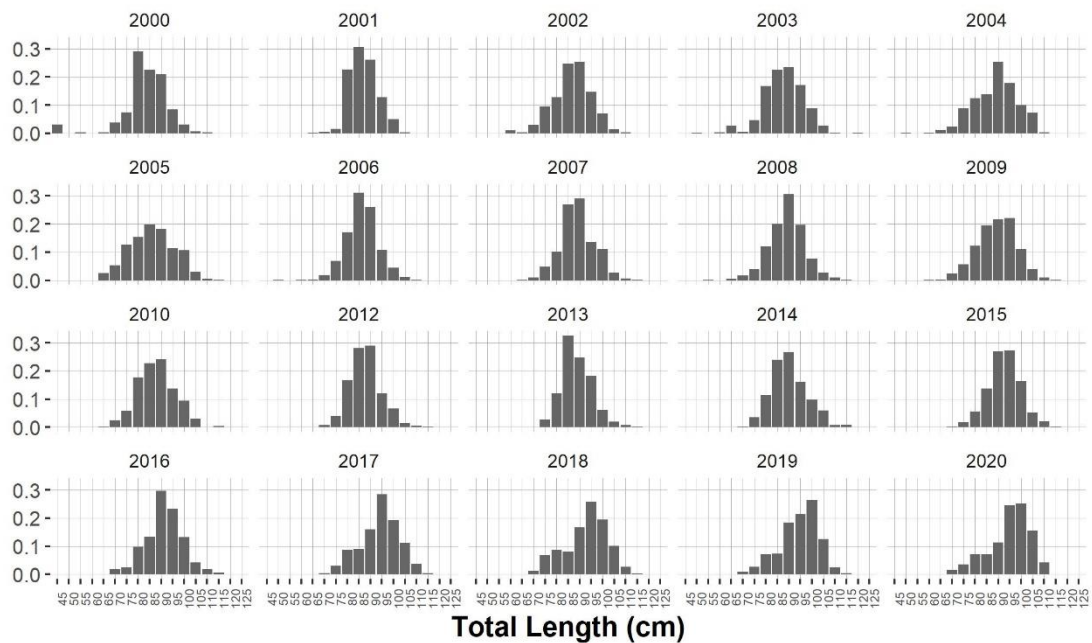


Figure 9.2.11. bsf.27.nea Northern component. Black scabbardfish in Division 27.5.a: length distribution from the Icelandic Autumn survey, from 2000 to 2019.

The length data available for the Northern component suggests a similar length structure of the exploited population between the different fishing fleets and specimens with total length smaller than 103 cm predominate.

The longest length data time series is from France and because of that French data is used to calculate the total catches, in number, grouped by the two length classes considered in the assessment model (the two length classes are: C2, which includes specimens from 70 to 103 cm TL (total length), and C3, which are specimens larger than 103 cm TL).

The total catch in weight (ton) and in number by length class, C2 and C3, for the period 1999–2019 used in the last advice in 2020 is presented in Table 9.2.2. A six-month time period is 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.

Table 9.2.2. bsf.27.nea 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 1999–2019.

Year	Catch (in ton)		Catch (in number) C2		Catch (in number) C3	
	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	1301	1046235	977682	229587	116252
2018	1574	961	992597	703734	232860	96849
2019*	1097		792651		124663	

* incomplete SEM 2 since January and February 2020 were not available

9.2.5.4 Age compositions

The exploited population is not structured by age because the assessment approach followed to assess the stock is a stage-based model, with stages defined according to length.

9.2.5.5 Weight-at-age

No data on weight-at-age are available.

9.2.5.6 Maturity and natural mortality

The information available for ICES Subareas 27.5.b, 27.6, 27.7, and 27.12 consistently points out to the predominance of small and immature specimens.

9.2.5.7 Catch, effort and research vessel data

The standardised French CPUE series covering the period 1998–2020 is presented in Figure 9.2.12. 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.

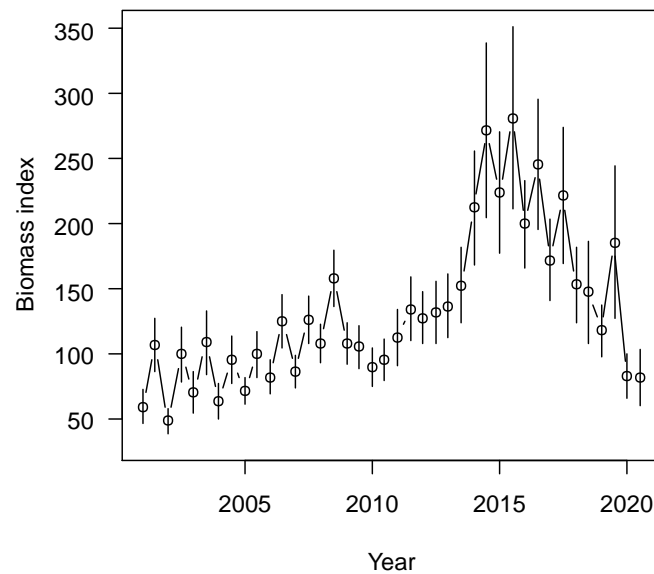


Figure 9.2.12. bsf.27.nea Northern component. CPUE by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

For the period from 2006 to 2020, the monotonic trend in the standardised fishing effort time series for the Northern component was tested using the Kendall rank correlation test. The time series plot with LOWESS smooth indicates a downward trend (Figure 9.2.13) and the autocorrelation in this data is not significant (Fig 10.2.14). The Mann-Kendall trend test ($\tau = -0.717$; 2-sided $p\text{-value} = 3.1601e-07$) confirms the downward trend in fishing effort for the Northern component.

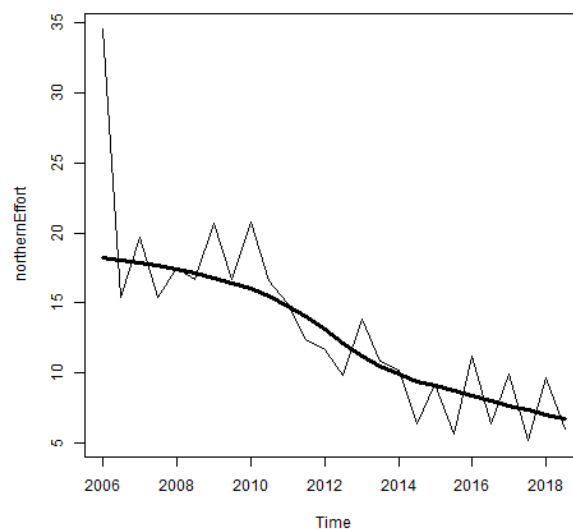


Figure 9.2.13. bsf.27.nea Northern component. Standardised effort by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

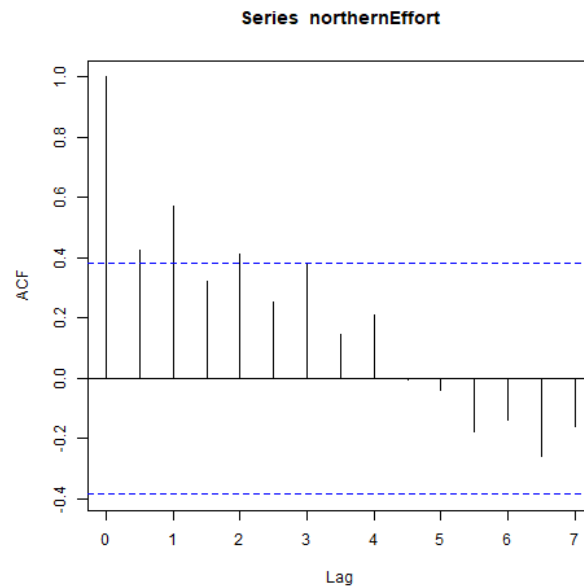


Figure 9.2.14. bsf.27.nea Northern component. Standardised fishing effort time series autocorrelation.

Scottish research survey data have been provided to WGDEEP. The survey takes place every two years. The annual biomass and abundance index estimates (kg per hour and mean numbers per hour of trawling for each haul with 95 % confidence intervals) obtained for hauls deeper than 500 and shallower than 1600 m are presented in Figure 9.2.15 (Campbell, 2020, pers. comm.). After 2012, both the annual biomass and annual abundance indices are at higher levels, indicating that the population at the Northern component has been increasing.

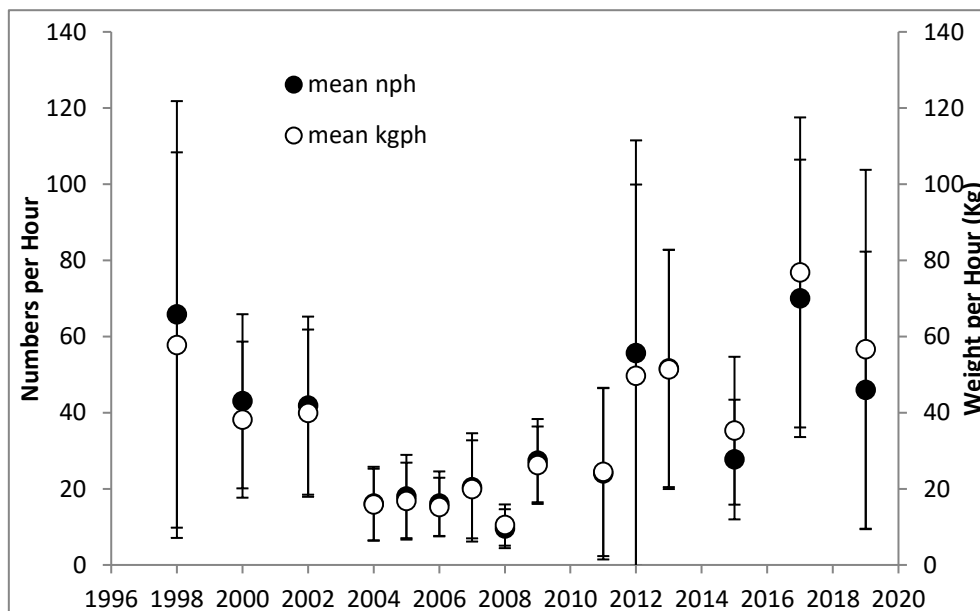


Figure 9.2.15. bsf.27.nea Northern component. Annual biomass and abundance indices of black scabbardfish estimated for depths deeper than 500 m and shallower than 1600 m, from 1998 to 2019. Seamounts/Rockall not included. (Source: Campbell, N., 2020, pers. comm.)

In ICES Division 27.5.a, the Icelandic Autumn survey biomass index series for all sizes (Total biomass) and specimens larger than 90 cm are at the higher level of the whole series are presented for the period between 2000 and 2019 (Figure 9.2.16). Black scabbardfish abundance index from

Icelandic Autumn survey shows an overall decreasing trend since 2013 however it is at higher levels than those registered at the beginning of the series (Figure 9.2.17).

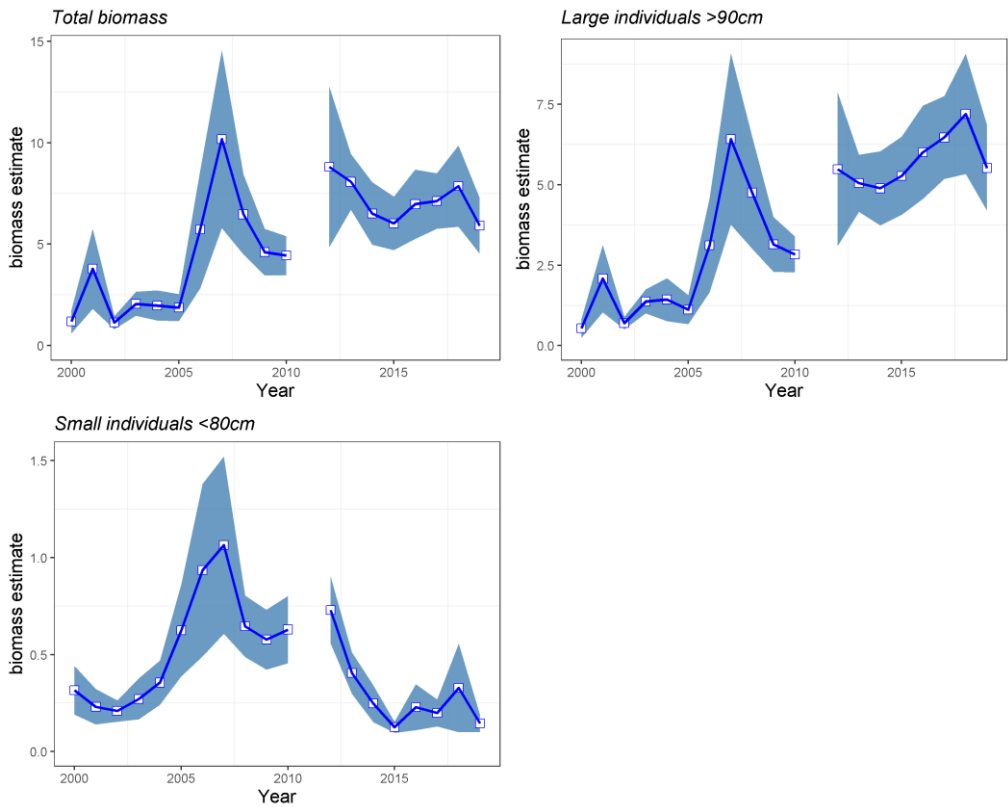


Figure 9.2.16. bsf.27.nea Northern component. Black scabbardfish biomass index with 95% confidence interval from the Icelandic Autumn survey from 2000 to 2019 for all sizes (Total biomass, upper left); specimens larger than 90 cm (Large individuals >90 cm, upper right); specimens smaller than 80 cm (Small individuals <80 cm, lower left).

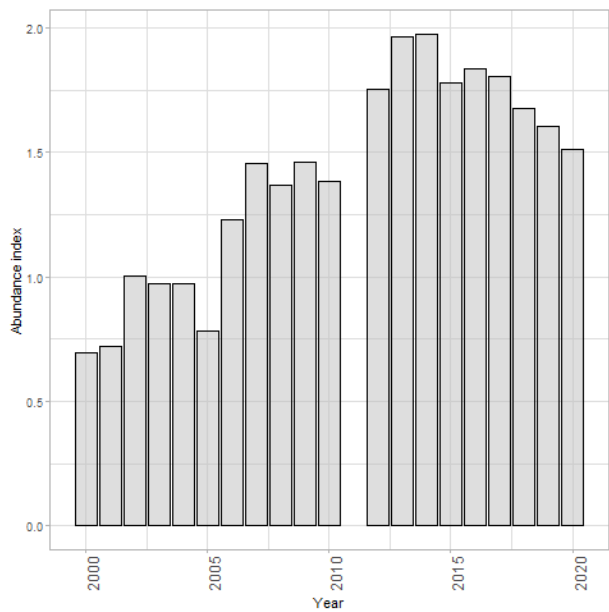


Figure 9.2.17. bsf.27.nea Northern component. Abundance of black scabbardfish from Icelandic Autumn survey from 2000 to 2020.

Regarding the Scottish survey data, the recent abundance and biomass indices are at similar levels when comparing with the beginning of the time-series (1998) and higher than in the mid-2000's, whereas for the Icelandic survey the abundance and biomass indices are at higher levels than at the beginning of the time-series (2000).

The trends in the abundance or biomass in recent years for the French fleet are different from both the Scottish and the Icelandic surveys. The lower French CPUE values in recent years reflect the spatial displacement of fishing effort to lower depths as a consequence of the bottom trawl ban for waters deeper than 800 m. In fact, based on Scottish surveys, black scabbardfish in Northern areas appear to be more frequent at depths between 800 and 1000 m.

Faroese commercial CPUE, between 2000 and 2020, calculated using fishery data from large Faroese trawlers and restricted to fishing hauls where black scabbardfish represents more than 30% of the total catch and for fishing haul with a duration larger than 2 hours is presented in Figure 9.2.18. The mean CPUE for the whole period was 250 kg/h and from 2013 to 2015 the CPUE was twice the overall mean value, about 508 kg/hour. Since 2016, the CPUE has been slightly decreasing probably related with an increased targeting of the fishery for blue ling.

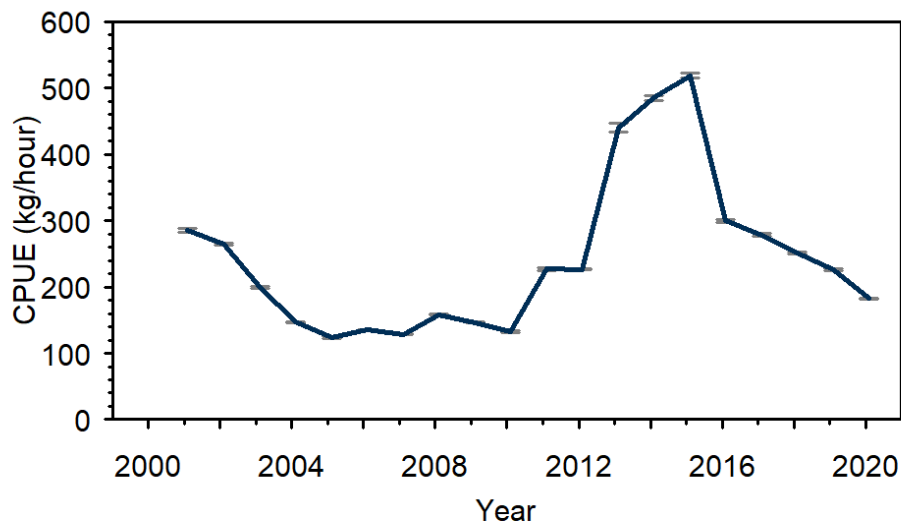


Figure 9.2.18. bsf.27.nea Northern component. Standardised CPUE (kg/hour) from Faroese commercial trawlers (> 1000 HK). Criteria: black scabbardfish >30% of total catch and effort > 2 hours per haul. (Source: Ofstad, L., 2021, pers. comm.).

9.2.6 Data analyses

For the major fishing countries exploiting the northern and southern stock components in the ICES area, the landing data are considered reliable and discards are 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 standardised French CPUE series is adopted for the Northern component and the standardised Portuguese CPUE series is used for the Southern component.

The CPUE series and the catch weights from each component are used to derive the standardised fishing effort. Standardised 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 standardised 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 (recruitment) 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.

As 2020 is not an assessment year for this stock, the model subsequent analyses were not performed.

MSY proxy reference points

Length-based indicators (LBIs) proposed by ICES for stocks in categories 3 and 6 were applied to the exploited population in the whole ICES area, that corresponds to the combined overall length frequency distribution of black scabbardfish from French length sampling in the Northern component (divisions 27.5.b, 27.6.a, and 27.6.b.1) and Portuguese length sampling in the Southern component (Division 27.9.a) for the period between 2014 and 2020. The length frequency distributions of 1 cm interval class were used. The life history parameters used for calculating the reference points, were $L_{mat} = 103$ cm (Figueiredo et al, 2003) and $L_{inf} = 159$ cm (Vieira et al., 2009).

The following traffic light table presents the final results from the combined length distribution of black scabbardfish in the Northern and Southern components for the period from 2014 to 2020 (Table 9.2.3).

Table 9.2.3. bsf.27.nea Northern and Southern components. LBI screening method ratios between 2014 and 2020.

	Conservation					Optimizing Yield	MSY	
	L _c /L _{mat}	L _{25%} /L _{mat}	L _{95%} /L _{inf}	L _{maxy} /L _{Opt}	L _{max5%} /L _{inf}	P _{mega}	L _{mean} /L _{Opt}	L _{mean} /L _{F=M}
Ref.	> 1	> 1	> 0.8	≈ 1	> 0.8	>30%	≈ 1 (>0.9)	≥ 1
2014	0.62	0.89	0.73	0.99	0.75	4%	0.94	1.14
2015	0.65	0.91	0.72	0.92	0.75	4%	0.94	1.12
2016	0.75	0.92	0.72	0.96	0.74	3%	0.95	1.03
2017	0.61	0.92	0.71	0.96	0.73	2%	0.95	1.16
2018	0.67	0.91	0.72	1.02	0.74	3%	0.95	1.10
2019	0.73	0.94	0.73	1.01	0.75	4%	0.97	1.07
2020	0.64	0.99	0.74	1.03	0.76	6%	1.00	1.19

The length at first catch was smaller than the length at first maturity in all years.

The MSY indicator ($L_{mean}/L_{F=M}$) was above 1 in all years, and the optimizing yield indicator (L_{mean}/L_{opt}) is close to 1 in all analysed years.

Analysis of results

LBI results show that the stock is at an adequate status as the exploitation levels are above the length-based indicator of MSY.

Most indicators of conservation state of the stock are below the desirable levels because they are based on length frequency analysis, which is shunt to lower lengths in the Northern component. These indicators are considered less informative given the available knowledge on species length-structure which are closely related to the tail of the frequency distribution. For this species, it should be possible to provide stock status by expert judgement, using indicators based on scientific knowledge on the species and the fishery.

9.2.7 Management considerations

Available information does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, however most available evidences support it. In face of these evidences, catches from ICES Division 27.5.a were included in the Northern component in the assessment of the stock.

The analysis of the annual relative fishing effort by depth strata (Figure 9.2.19, in relation to total fishing effort) indicates changes on the fishing depth by the French trawlers. This change might have an impact on catchability and a deeper scrutiny on depth of the French fishing grounds by year is required to incorporate those changes in the assessment model. In recent years the fishing effort on black scabbardfish indicates that the fishing operations are mainly performed at depth strata shallower than 800m, possible as a response to the EU Regulation trawl ban (EU, 2016).

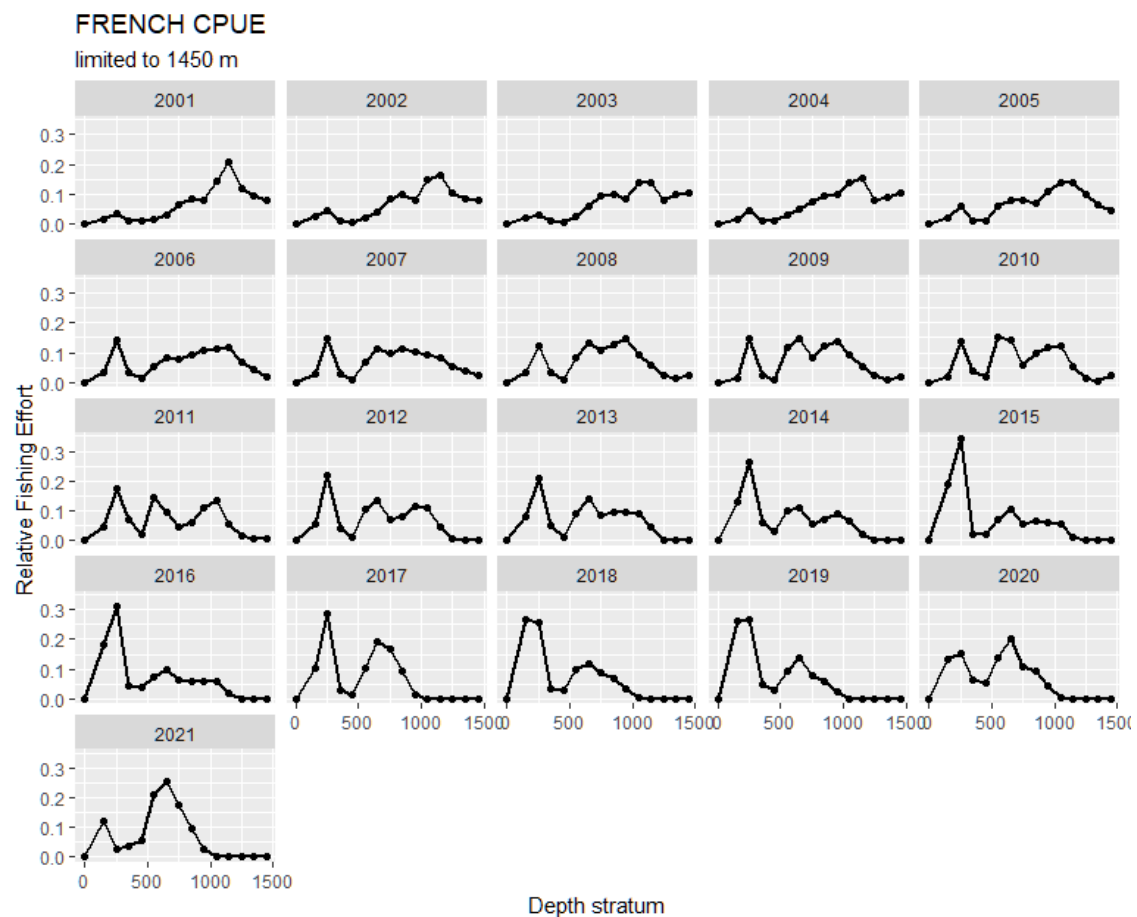


Figure 9.2.19. bsf.27.nea Northern component. French fleet annual relative fishing effort by depth strata, in relation to total fishing effort).

9.2.8 Tables

Table 9.2.4a. Landings of black scabbardfish from Division 27.5.b. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	Faroes			France	Germany*		Scotland	E&W&NI	Russia**	Total
	27.5.b.1	27.5.b.2	27.5.b	27.5.b	27.5.b.1	27.5.b	27.5.b			
1988					.	.	-			
1989	-	-		170	.	.	-			170
1990	2	10		415	.	.	-			427
1991	-	1		134	-	-	-			135
1992	1	3		101	-	-	-			105
1993	202	-		75	9	-	-			286
1994	114	-		45		1	-			160
1995	164	85		175			-			424
1996	56	1		129			-			186
1997	15	3		50			-			68
1998	36	-		144			-			180
1999	13	-		135			6			154
2000			116	186			9			311
2001	122	281		457			20			880
2002	222	1138		304			80			1744
2003	222	1230		172			11			1635
2004	80	625		94			70			869
2005	65	363		106			20			553
2006	54	637		93						784
2007	78	596		116						790
2008	94	787	828	159						1868
2009	117	852		96			1			1067
2010	102	715		142			31			990
2011	67	371		115						553
2012	84	43		115						242
2013	38	379	159	160						735

Year	Faroes			France	Germany*		Scotland	E&W&NI	Russia**	Total
	27.5.b.1	27.5.b.2	27.5.b	27.5.b	27.5.b.1	27.5.b	27.5.b			
2014	400	181	143	0	0	0	0	0	1	725
2015	549	181	0	211			1			941
2016			712	52						765
2017	285	14		112			0			412
2018	324	229		41			-			594
2019	395	93		52						540
2020	317	102		21			0			440

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.4b. Landings of black scabbardfish from Division 27.12. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	Faroes	France	Scotland	Spain	Germany*	E&W&NI	Ireland	Total
1988					.			0
1989		0			.			0
1990		0			.			0
1991		2			-			2
1992		7			-			7
1993	1051	24			93			1168
1994	779	9			45			833
1995	301	8						309
1996	187	7		41				235
1997	102	1		98				201
1998	20	324		134				478
1999		1	0	109				109
2000	1	5		237				243
2001		3		115				118
2002		0	1	1117		0		1119
2003		7		444			1	452
2004	95	10	1	230				337
2005	127	14		239			0	380

Year	Faroes	France	Scotland	Spain	Germany*	E&W&NI	Ireland	Total
2006	8	0		1009				1017
2007	0		0	9			0	9
2008	1		0	53			0	54
2009	156			103		0	0	259
2010	27	1		180		0	0	208
2011	24	1		113				138
2012				47				47
2013	1			50				51
2014				149				149
2015				51				51
2016				82				82
2017	0			68				68
2018				125				125
2019	0			46				46
2020				25				25

*STATLAND data from 1988 to 2011.

Table 9.2.4b. Continued.

Year	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
1988		-	.	.	.		0
1989		-	.	.	.		0
1990		-	.	.	.		0
1991		-	.	.	-		0
1992		-	.	-	-		0
1993		-	.	-	-		0
1994		-	.	-	-		0
1995		-	.	-			0
1996	0	-	.				0
1997							0
1998							0
1999							0

Year	Iceland*	Poland*	Russia**	Lithuania*	Estonia	Unallocated	Total
2000							0
2001							0
2002							0
2003		1		1			2
2004				1			1
2005					1		1
2006					2		2
2007					7		7
2008			4				4
2009							0
2010							0
2011							0
2012						907	907
2013						289	289
2014							0
2015							0
2016							0
2017							0
2018							0
2019							0
2020							0

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.4c. Landings of black scabbardfish from Subarea 27.6. Working group estimates.

Year	France		Faroes		Ireland		Scotland		Spain		Total
	27.6	27.6.a	27.6.b	27.6.a	27	27.6.a	27.6.a	27.6.b	27.6.a	27.6.b	
1988											0
1989		138	0	46			-	-			184
1990		971	53				-	-			1023
1991		2244	62				-	-			2307

Year	France			Faroes		Ireland	Scotland		Spain		Total
	27.6	27.6.a	27.6.b	27.6.a	27	27.6.a	27.6.a	27.6.b	27.6.a	27.6.b	
1992		2998	113	3			-	-			3113
1993		2857	87		62		-	-			3006
1994		2331	55				2	-			2403
1995		2598	15				14	4			2634
1996		2980	1				36	<0.5			3019
1997		2278	16		3		147	88			2533
1998		1553	7				142	6			1708
1999		1610	8				133	58			1809
2000		2971	27				333	41			3371
2001		3791	29		3		486	145			4454
2002		3833	156	2			603	300			4894
2003		2934	67	45			78	9			3132
2004		2637	99	59			100	24			2919
2005	3	2533	59	38			18	62			2714
2006	-	1713	36	59		1	63	0			1872
2007	-	1991	4	44	37	0	53	0			2129
2008	-	2348	0	37	0	0	26	0			2412
2009	15	1609	1	39	0	0	80	0			1744
2010	-	1778	1	72		0	73	0			1923
2011	5	1791	3	31			1	0			1830
2012	-	1509	0	3			34	0			1546
2013		1799	9	6			57				1871
2014	0	1902	0	4	2		110				2018
2015		1870		1			124		10	172	2176
2016		2336					96		9	163	2604
2017		1714		64			101		3	153	2035
2018		1601		-	-		65	0	0	124	1791
2019		1124					45		1	52	1222
2020	0	769	0	0	0	0	20	0	0	57	846

Table 9.2.4c. Continued.

Year	Germany*		Netherlands **		27.6	Lithuania**		Estonia**	Poland**	Russia**	Unallocated	Total
	27.6.a	27.6.b	27.6.a	27.6.b		27.6.a	27.6.b					
1988	.	.	-	-		.	.			.		0
1989	.	.	-	-		.	.		-	.		0
1990	.	.	-	-		.	.		-	.		0
1991	-	-	-	-		.	-		-	-		0
1992	-	-	-	-		-	-		-	-		0
1993	48	-	-	-		-	-		-	-		48
1994	30	15	-	-		-	-		-	-		30
1995	-	3	-	-		-	-		-	-		0
1996	-	2	-	-		-	-		-	-		0
1997			-	-		-	-		-	-		0
1998			-	-		-	-		-	-		0
1999			11	-		-	-		-	-		11
2000			7	-		-	-		-	-		7
2001			-	-		3	225		-	226		454
2002			21	2		9			2			34
2003				2		12	7		2	7		30
2004						85	5			5		95
2005						5	11			11		27
2006						1	3			3		7
2007												0
2008			14							1		15
2009												0
2010												0
2011												0
2012											690	690
2013											189	189
2014	0		3	0		0	0		0	0	0	3
2015					5							5

Year	Germany*		Netherlands **		Lithuania**		Estonia**	Poland**	Russia**	Unallocated	Total
	27.6.a	27.6.b	27.6.a	27.6.b	27.6	27.6.a	27.6.b	27.6.b	27.6.b		
2016					1						1
2017					0						0
2018											0
2019											0
2020											0

*STATLAND data from 1988 to 2011.

**STATLAND data.

Table 9.2.4d. Landings of black scabbardfish from Division 27.7. Working group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	France							Ireland			Scotland	E&W&NI	Spain	Total
	7	7.a	7.b	7.c	7.d-g	7.h	7.j	7.k	7.b,j	7.c	7.k	7.b,c,j,e,k	7.j,k	7
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

Year	France							Ireland			Scotland	E&W&NI	Spain	Total
	7	7.a	7.b	7.c	7.d-g	7.h	7.j	7.k	7.b,j	7.c	7.k	7.b,c,j,e,k	7.j,k	7
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 92
2017			1	0	4	1	9	0	-	-	-	0		0 15
2018			0	0	0	6	29	0		0				0 35
2019			0	0	0	6	15	0		0				10 30
2020			1	0	0	16	15	0		0				5 37

Table 9.2.4e. Landings of black scabbardfish from Divisions 27.6 and 27.7. Working Group estimates. E&W&NI is England, Wales and Northern Ireland.

Year	Ireland	E&W&NI	Total
1988			
1989			0
1990			0
1991			0
1992			0
1993	8		8
1994	3		3
1995			0
1996		1	1
1997	0	2	2
1998	0	1	1
1999	1	1	2

Year	Ireland	E&W&NI	Total
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
2018		0	0
2019			0
2020	0	0	0

Table 9.2.4f. Landings of black scabbardfish from Subarea 27.5.a. Working group estimates of landings.

Year	Iceland	Faroes	Total
1988	-		0
1989	-		0
1990	-		0
1991	-		0
1992	-		0
1993	0		0

Year	Iceland	Faroes	Total
1994	0		0
1995	0		0
1996	0		0
1997	1		1
1998	0		0
1999	6		6
2000	10		10
2001	5		5
2002	13		13
2003	14		14
2004	19		19
2005	19		19
2006	23		23
2007	1		1
2008	0		0
2009	15		15
2010	109		109
2011	172		172
2012	365		365
2013	325	0	325
2014	360	-	360
2015	265	0	265
2016	346		346
2017	294		294
2018	142		142
2019	65		65
2020	102		102

9.3 Black scabbardfish (*Aphanopus carbo*) in subareas 27.8 and 27.9

9.3.1 The fishery

The main fishery taking place in these subareas is derived from Portuguese longliners. This fishery was described in 2007 WGDEEP report (Bordalo-Machado and Figueiredo, 2007 WD) and updated later by Bordalo-Machado and Figueiredo (2009).

The French bottom trawlers operating mainly in Subareas 6 and 7 have a small marginal fishing activity in Subarea 27.8. In 2014 and 2015, Spain has also reported catches of black scabbardfish in Subareas 27.8 and 27.9 but these are also relatively low.

9.3.2 Landings trends

Landings in subareas 27.8 and 27.9 are mostly from the Portuguese longline fishery that takes place in Division 27.9.a, which represents more than 96% of the total landings (Figure 9.3.1).

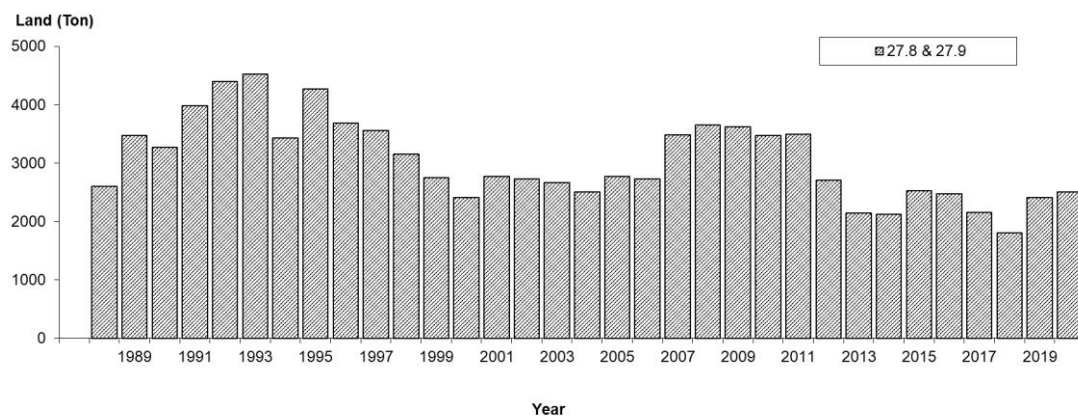


Figure 9.3.1. bsf.27.nea Southern component. Annual landings for ICES Subarea 27.8 and Division 27.9.a.

9.3.3 ICES Advice

The latest ICES advice, in 2020, was: “ICES advises that when the precautionary approach is applied, catches should be no more than 4506 tonnes in each of the years 2021 and 2022.

Distributed by area, this corresponds to annual catches of no more than 2143 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2084 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 280 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.”

9.3.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2006 until 2020, as well as the total landings in subareas 27.8, 27.9, and 27.10 are presented in Table 9.3.1.

Table 9.3.1. Black scabbardfish TACs and total landings of EU vessels in subareas 27.8, 27.9, and 27.10 from 2006 to 2020.

Year	EU TAC 27.8,27.9,27.10	EU Landings in 27.8 and 27.9	EU Landings in 27.10*
2006	3042	2726	65
2007	4000	3481	0
2008	4000	3647	75
2009	3600	3620	162
2010	3348	3470	102
2011	3348	3494	164
2012	3348	2711	462
2013	3700	2140	206
2014	3700	2118	30
2015	3700	2532	240
2016	3700	2476	86
2017	3330	2151	70
2018	2997	1801	14
2019	2832	2409	0
2020	2832	2509	0
2021	2266		

* The proportion of *A. intermedius* in the catches is considered high but is not quantified.

9.3.5 Data available

9.3.5.1 Landings and discards

New information on the discards of deep-water species produced by the Portuguese on-board sampling programme (EU DCR/NP) was presented (Fernandes, 2021, WD).

Discards of most species carried out by Portuguese vessels operating deep-water set longlines (targeting black scabbardfish) within the Portuguese part of ICES Division 27.9.a were not quantified at fleet level. The black scabbardfish discards are mainly due to shark and cetacean predation on hooked specimens and are relatively low when compared to catches.

The low frequency of occurrence of discarding and the low number of discarded specimens registered in the sampled hauls and sets lead to assume that discards in the Southern component are negligible.

9.3.5.2 Length compositions

Length–frequency distributions of the black scabbardfish landed at the main landing port for the species in ICES Division 27.9.a (Sesimbra port) by the Portuguese longline fleet derived from the DCF/EU landing sampling program from 2014 to 2020 are presented in Figure 9.3.2.

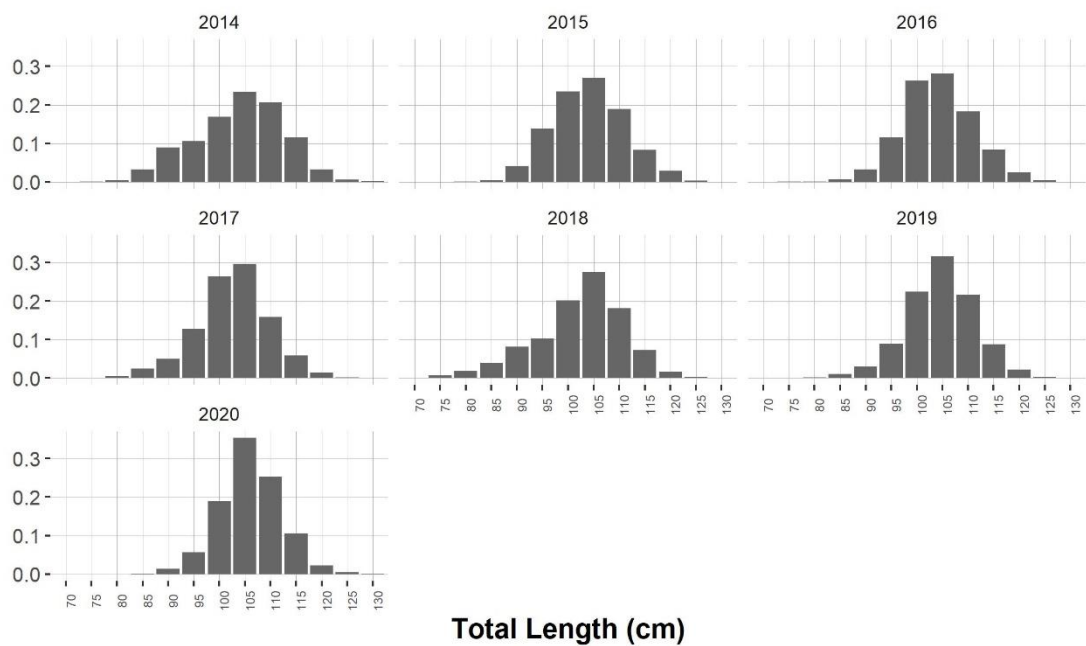


Figure 9.3.2. bsf.27.nea Southern component. Length–frequency distribution of black scabbardfish exploited by the deep-water longline fishery for ICES Division 27.9.a, from 2014 to 2020.

In the last assessment, in 2020, length–frequency distributions of the black scabbardfish from 2001 to 2019 were used, to separate the Southern component into the two length groups (TL (total length): 70 cm < C2 < 103 cm; C3: TL > 103 cm) defined by the assessment approach adopted by WKDEEP 2014.

Table 9.3.1. bsf.27.nea Southern component. Total catch estimates (in ton), and total catch estimates (in number) in length groups C2 and C3 by six-month time period (Sem 1 and Sem 2) for the years 2001 to 2019.

Year	Catch (in ton)		Catch (in number)		Catch (in number)	
	Sem 1	Sem 2	C2		C3	
			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	1079	266160	307426	393448	402958
2014	1233	970	184774	170893	566277	434309
2015	1188	1408	269689	234314	498482	716949
2016	1265	1219	276593	184425	557797	347314
2017	1067	1027	260837	291527	461092	420569
2018	797	1056	170683	185786	361261	514079
2019*	1163		222580		635079	

* incomplete SEM 2 since January and February 2020 were not available

9.3.5.3 Age compositions

The black scabbardfish population is not structured by ages because the approach followed to assess the stock is a stage-based model. The age growth parameters are used to construct the prior distribution for the probability a specimen transits from C2 to C3 length group during one semester taking into account the length structure of the population inhabiting the Southern area (for further details see the Stock Annex).

9.3.5.4 Weight-at-age

No new information on age was presented.

9.3.5.5 Maturity and natural mortality

In ICES Division 27.9.a, only immature and early developing specimens have been observed (Figueiredo, 2009, WGDEEP WD; Neves *et al.*, 2009). Mature individuals have only been reported in Madeira (Figueiredo *et al.*, 2003), Canary Islands (Pajuelo *et al.*, 2008), and the Northwestern coast of Africa (Perera, 2008). In those areas, spawners of two congener species (*Aphanopus carbo* and *A. intermedius*) coexist (Stefanni and Knutsen, 2007; Biscoito *et al.*, 2011; Besugo *et al.*, 2014, WD).

Black scabbardfish has a determinate fecundity strategy; the relative fecundity estimates ranged from 73 to 373 oocytes/female weight (g). Skipped spawning was also considered to occur; the percentages of non-reproductive females between 21% and 37% (Neves *et al.*, 2009).

9.3.5.6 Catch, effort and research vessel data

Standardised Portuguese CPUE series covering the period 1998-2019 are presented by a six-month time period, as: SEM1=months 3-8 of the year; SEM2=month 9-12 of the year plus months 1 and 2 of the following year (Figure 9.3.3). Estimates of CPUE were obtained through the adjustment of a GLM model, in which monthly CPUE is the response variable and Year, Month, and Vessel are the factors. The monthly CPUE was calculated for each vessel as the ratio of the total landed weight (Kg) and the number of fishing trips. Only vessels having total annual landings ≥ 1000 Kg and more than one year of landings were considered.

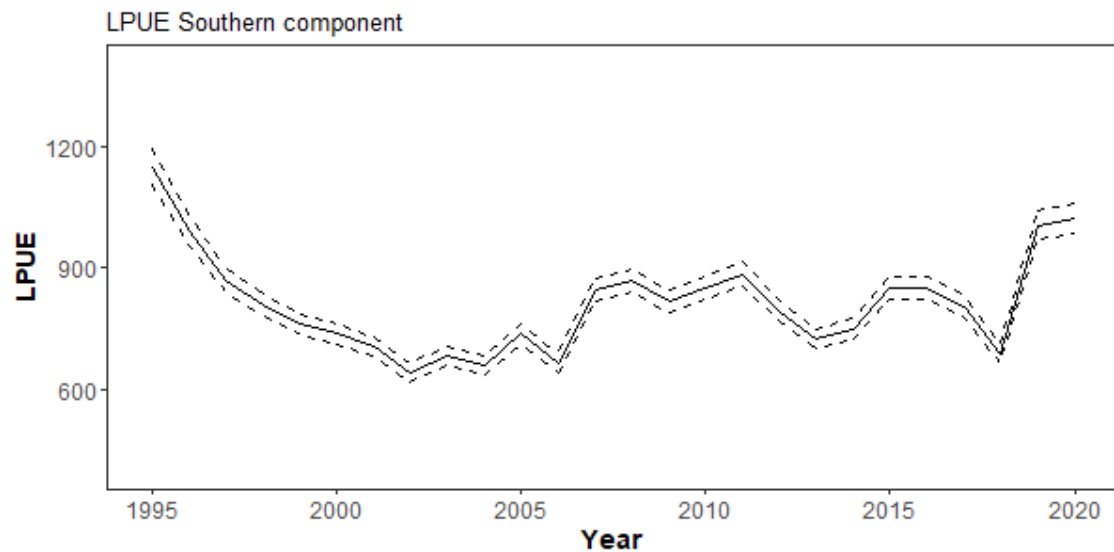


Figure 9.3.3. bsf.27.nea Southern component. Standardised Portuguese CPUE.

For the period 2006 to 2019, the monotonic trend in the standardised fishing effort time series for the Southern component was tested using the Kendall rank correlation. The time series plot with LOWESS smooth indicates a downward trend (Figure 9.3.4) and the autocorrelation in this data is not significant (Figure 9.3.5). The Mann-Kendall trend test ($\tau = -0.391$; 2-sided p -value = 0.0054823) confirms the downward trend in fishing effort for the Southern component.

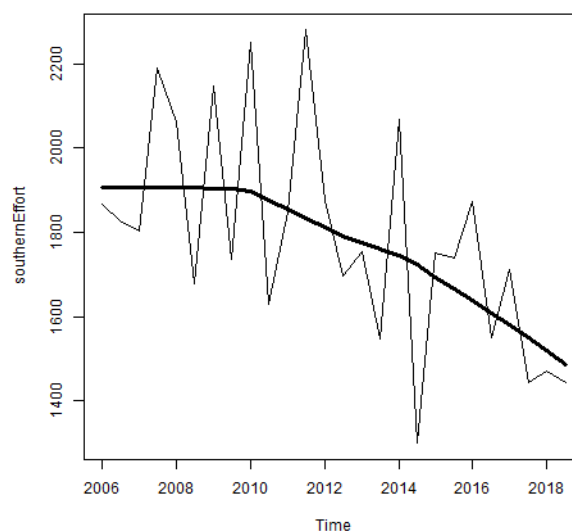


Figure 9.3.4. bsf.27.nea Southern component. Standardised effort by new semesters, i.e., SEM1= months 3-8 of the year and SEM2=month 9-12 of the year, plus months 1 and 2 of the next year.

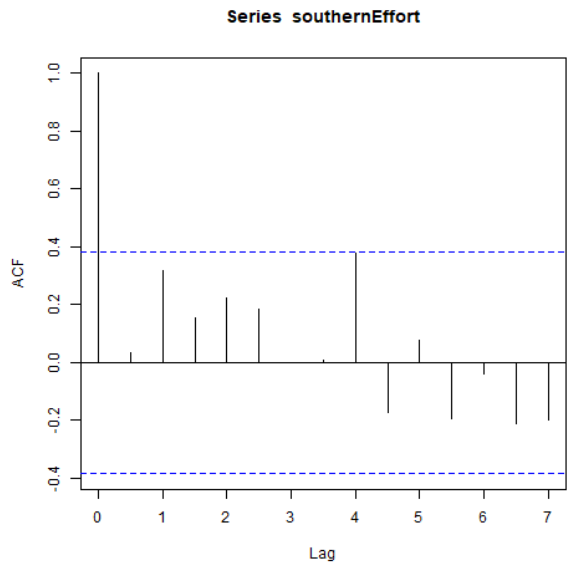


Figure 9.3.5. bsf.27.nea Southern component. Standardised fishing effort time series autocorrelation.

9.3.6 Data analyses

Data analyses are described in section 9.2.5. One single assessment is admitted for the stock, which combines data from the two fisheries areas: subareas 27.5, 27.6 and 27.7 and Division 27.12.b; and divisions 27.8 and 27.9 on the other hand.

9.3.7 Management considerations

Management considerations are described in section 9.2.6.

9.3.8 Tables

Table 9.3.2a. Black scabbardfish from Subarea 27.9. Working Group estimates of landings.

Year	Portugal	France	Spain	Total
1988	2602			2602
1989	3473			3473
1990	3274			3274
1991	3978			3978
1992	4389			4389
1993	4513			4513
1994	3429			3429
1995	4272			4272
1996	3686			3686
1997	3553		0	3553

Year	Portugal	France	Spain	Total
1998	3147		0	3147
1999	2741		0	2741
2000	2371		0	2371
2001	2744		0	2744
2002	2692			2692
2003	2630	0		2630
2004	2463			2463
2005	2746			2746
2006	2674			2674
2007	3453			3453
2008	3602			3602
2009	3601			3601
2010	3453		0	3453
2011	3476			3476
2012	2668		12	2680
2013	2130			2130
2014	2109			2109
2015	2527		0	2527
2016	2456		0	2456
2017	2117		0	2117
2018	1727		0	1727
2019	2302			2302
2020	2369	0	0	2370

Table 9.3.2b. Black scabbardfish from Subarea 27.8. Working group estimates of landings.

Year	France							Spain				Total
	8	8.a	8.b	8.c	8.d	8.e	8.a	8.b	8.c	8.d.2	8	
1988												0
1989												0
1990					0							0

Year	France					Spain					Total	
	8	8.a	8.b	8.c	8.d	8.e	8.a	8.b	8.c	8.d.2		8
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
2018		4	2	0	4		34	12	1	18		74

Year	France						Spain				Total	
	8	8.a	8.b	8.c	8.d	8.e	8.a	8.b	8.c	8.d.2		8
2019		12	5		8		45	15	0	22		108
2020		19	5	0	14	0	55	23	1	20	0	139

9.4 Black scabbardfish (*Aphanopus carbo*) in other areas (27.1, 27.2, 27.3.a, 27.4, 27.10, and 27.14)

9.4.1 The fishery

This assessment unit is made up of diverse areas. In some of these areas, fisheries have occurred sporadically or at extremely low levels, such as in subareas 27.1–4. Those levels may just indicate that the species has a low occurrence in those areas. On the contrary, landings from other areas, particularly in Subarea 27.10, indicate that the level of abundance of the species appears to be significant.

To guarantee the consistency of the underlying assumption of a unique stock in NE Atlantic and since there are no evidences against this assumption, WGDEEP 2016 agreed to include ICES Division 27.5.a in the Northern component (ICES, 2016). Consequently, landings information from ICES Division 27.5.a, which was formerly included in the present section, has been moved to section 9.2 of this Report.

No further information is available on the Faroese exploratory trawl fishery that was taking place in the Mid-Atlantic Ridge area, starting from 2008.

9.4.2 Landings trends

In ICES Subarea 27.10 landings have been variable but in for the period 2012-2016 landings increased, decreasing to less than 100 kg in 2020. The 111 tonnes reported in 2010 in ICES Subarea 27.14 are considered as misreporting.

9.4.3 ICES Advice

The latest ICES advice, in 2020, was: *“ICES advises that when the precautionary approach is applied, catches should be no more than 4506 tonnes in each of the years 2021 and 2022.*

Distributed by area, this corresponds to annual catches of no more than 2143 tonnes in subareas 6 and 7 and divisions 5.b and 12.b, annual catches of no more than 2084 tonnes in Subarea 8 and Division 9.a, and annual catches of no more than 280 tonnes in subareas 1, 2, 4, and 10 and divisions 3.a and 5.a.”

9.4.4 Management

Since 2003, management of black scabbardfish by EU vessels fishing in EU and international waters includes a combination of TAC and licensing system. The TAC adopted from 2007 to 2020 by subarea are presented in Table 9.4.1.

In 2010, between 2012 and 2014, and in 2016, the TACs have been exceeded, particularly in 2010. More information is needed to track the situation.

Table 9.4.1. Black scabbardfish TACs in subareas 27.1, 27.2, 27.3, and 27.4 and total landings of EU vessels in subareas 27.2, 27.3, 27.4, and 27.14 and Division 27.5a, from 2007 to 2020.

YEAR	EU TAC 27.1, 27.2, 27.3, and 27.4	EU Landings 27.2, 27.3, 27.4, and 27.14
2007	15	1
2008	15	0
2009	12	5
2010	12	127
2011	12	1
2012	9	39
2013	9	51
2014	9	10
2015	9	2
2016	9	10
2017	9	0
2018	9	1
2019	-	1
2020	-	4

* TACs and landings for subarea 27.10 are included in Table 9.3.1.

9.4.5 Data available

9.4.5.1 Landings and discards

Landings are given in Tables 9.4.2a–e and in Figure 9.4.1. In subareas 27.2, 27.4, and 27.14 reported landings are considered to be misreported, although it is not known to what extent.

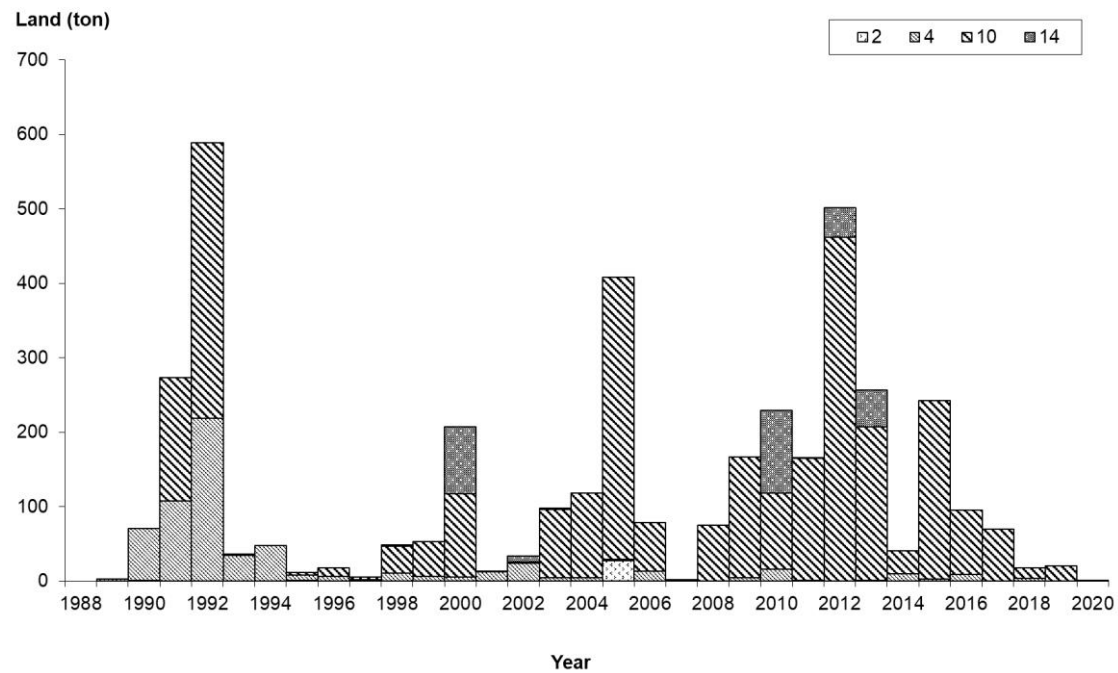


Figure 9.4.1. Annual landings for black scabbardfish in ICES subareas 27.2, 27.4, 27.10, and 27.14, between 1988 and 2020.

Greenland catches of black scabbardfish have been null in years between 1998 and 2020 except 2010 and 2011 (Nielsen, 2020 WD). For these two later years, 100 and 300 kg were reported from trawl bycatch, both in September (Figure 9.4.2).

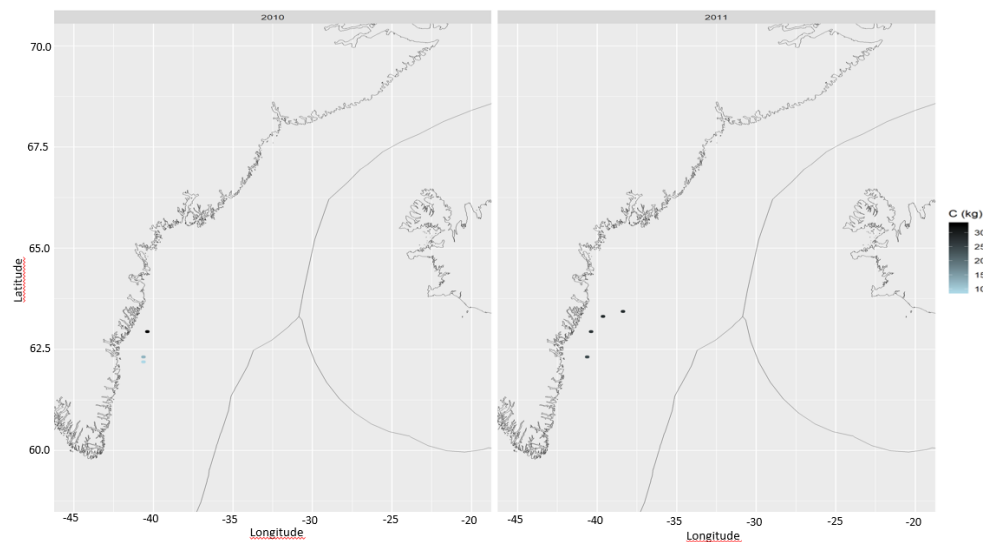


Figure 9.4.2. bsf.27.nea Black scabbardfish in 14. Distribution of commercial catches of black scabbard fish (in Kg) in East Greenland from 2010 and 2011. (Source: Nielsen *et al.*, 2019b WD)

9.4.5.2 Length compositions

No new information has been reported, except for ICES Division 27.5.a, which was included in the Northern component Section 9.2.4.3.

9.4.5.3 Age compositions

No data were available.

9.4.5.4 Weight-at-age

No data were available.

9.4.5.5 Maturity and natural mortality

No new data were available.

9.4.5.6 Catch, effort and research vessel data

In ICES Division 27.14.b, catches of black scabbard fish have been zero all years except 2010 and 2011 when 100 and 300 kg were reported from trawl bycatch from the fishery for Greenland halibut (*Reinhardtius hippoglossoides*) (Nielsen, 2021 WD).

From 1998 to 2016, the Greenland Institute of Natural Resources conducted stratified bottom trawl surveys in East Greenland (ICES Subarea 27.14.b). The survey is held onboard R/V Pâmiut. The depth of surveyed area ranged from 400 to 1500 m (Nielsen *et al.*, 2019a WD).

Until 2008, the survey took place in June but for almost all years it was affected by the ice covering the east coast of Greenland during early summer. From 2008 onwards, surveys have been held in August/September and the ice problems were eliminated. The 2008 survey was combined with a new shrimp/fish survey that uses a different trawl gear and operates at more shallow waters than the Greenland halibut survey. The combination of the two surveys led to a change in trawling hours so that most of the stations since 2008 were taken during night-time. Details on the survey namely information on survey design, vessel and trawling gear and handling of the catch see NWWG working document for Greenland halibut (Christensen & Hedeholm, 2016).

Black scabbardfish was rarely caught in the survey; the species did not occur in 1998, 1999, 2000, 2002, 2003, 2006, and 2016 surveys. In 2013 and 2015, the species was caught in one station out of an average number of 78 stations, whereas it was found in 4-6 stations in 2011, 2012 and 2014. For these years, catches ranged from 0.7 kg to 21.7 kg. In 2015, the species was only registered in Q5 at depths between 801-1200 m, where most of the biomass has also been observed in previous years (Figure 9.4.3)

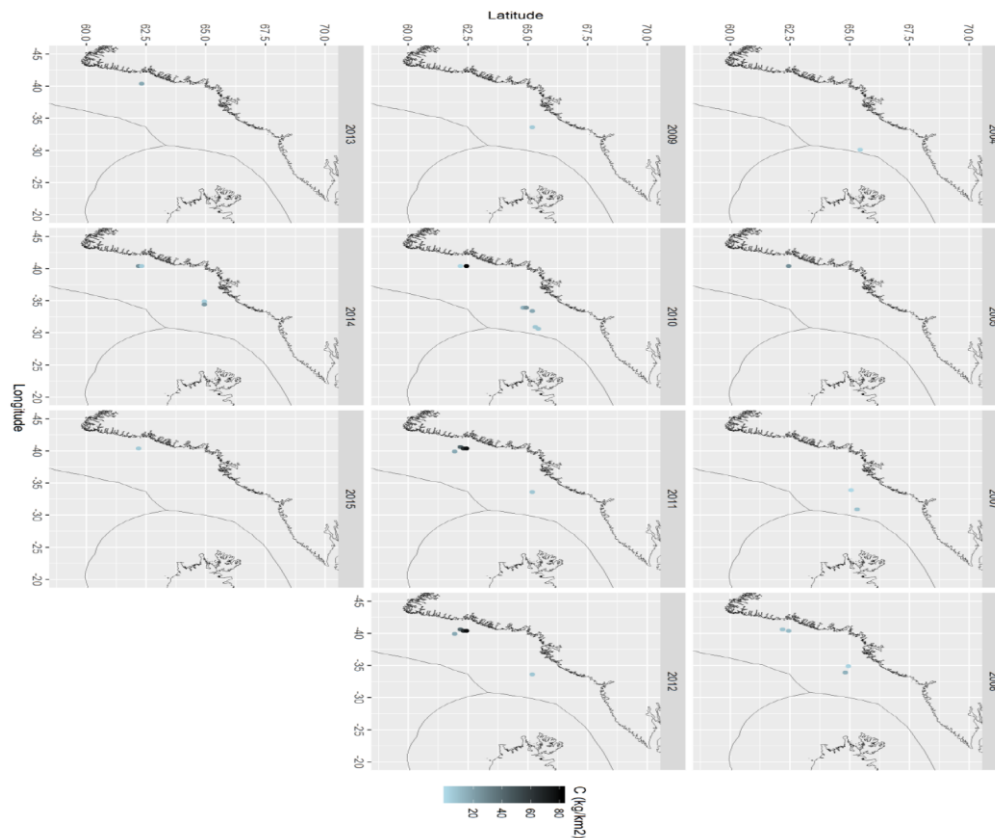


Figure 9.4.3. bsf.27.nea Black scabbardfish in Subarea 27.14. Distribution of survey catches of black scabbard fish at East Greenland (ICES Division 27.14.b) in 1998-2016. No survey in 2001, 2017, and 2018. (Source: Nielsen *et al.*, 2019a WD)

In 2008 and 2010-2012, the estimated biomass varied between 32.8 t and 56.4 t, whereas in all the other years the biomass was less than 7.9 t. This is most likely because black scabbardfish is benthopelagic and deep living, hence it is not fully fished by the fishing gear (bottom trawl). Hence the biomass estimates are considered not to reflect the actual biomasses in the surveyed area. The length frequency distributions based on 2011 and 2012 surveys show a wide mode between 70 cm and 110 cm (Figure 9.4.4).

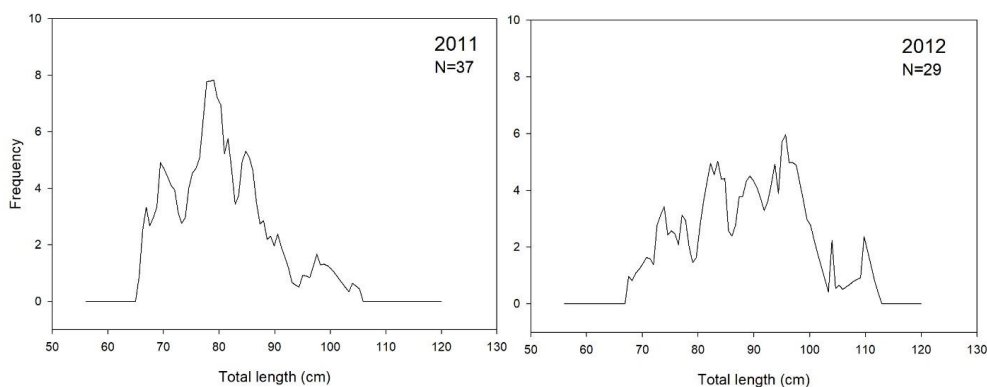


Figure 9.4.4 bsf.27.nea Black scabbardfish in Subarea 27.14. Length distribution of black scabbardfish at East Greenland (ICES Division 27.14.b) for 2011 and 2012. Survey years with $n < 20$ are not shown. No survey in 2001, 2017 and 2018. (Source: Nielsen *et al.*, 2019a WD)

9.4.6 Data analyses

In Subarea 27.10, the commercial interest for the exploitation of black scabbardfish has varied over time, but apart from the data presented from the Faroese exploratory survey in 2008, the data available are only landings.

Results from the Azores (MARPROF project, unpublished data), based on counting of the vertebrae indicate that two species of *Aphanopus* coexist in ICES Division 27.10.a, *A. carbo* and *A. intermedius* (Besugo *et al.*, 2014 WD).

The spatial distribution of the proportion of co-occurrence of the two species, presented in Figure 9.4.5, shows that the overall proportion of *A. intermedius* in relation to the overall catches of *Aphanopus* species is about 0.75. It is important to note that the proportion can vary according to the sampling location.

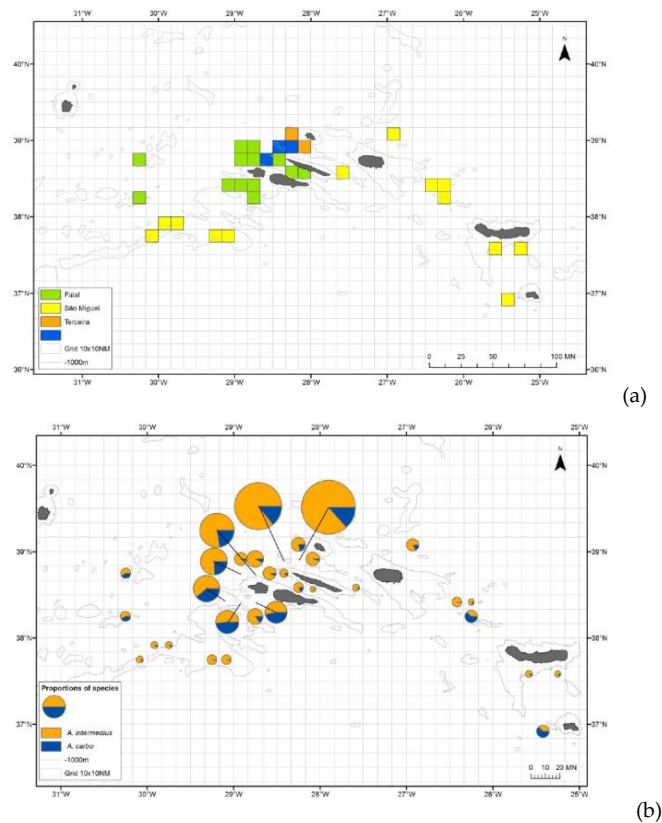


Figure 9.4.5. bsf.27.nea. Other areas. Map of the sampling locations (a) and estimates of the proportion of each *A. carbo* and *A. intermedius* at different sampling points (b) in Division 27.10.a.

9.4.7 Comments on the assessment

Despite the variability on the overall landings along the years, data available suggest that ICES Subarea 27.10 is an area of major concentration of the species. This spatial aspect is consistent with the current perception on the spatial distribution of the species at NE Atlantic. However, the co-occurrence of two different species, *A. carbo* and *A. intermedius*, in ICES Subarea 27.10 (Besugo *et al.*, 2014 WD) needs to be, in the future, taken into consideration to provide advice for this stock.

9.4.8 Management considerations

The information available does not unequivocally support the assumption of a single stock for the whole NE Atlantic area, although the evidence is in line with it.

The co-occurrence of two different species, *A. carbo* and *A. intermedius*, in ICES Subarea 27.10 needs to be considered when providing advice for this stock.

9.4.9 Tables

Table 9.4.2a. Black scabbardfish other areas: subareas 27.2 and 27.3. Working Group estimates of landings.

Year	France	Faroes	Iceland*	France	Total
		27.2.a	27.2.a.2	27.3.a	
1988					0
1989	0				0
1990	1				1
1991	0				0
1992	0				0
1993	0				0
1994	0				0
1995	1				1
1996	0				0
1997	0				0
1998	0				0
1999	-				0
2000	-				0
2001	-				0
2002	-				0
2003	-				0
2004	-				0
2005	0	27			27
2006	-	-			0
2007	-	0			0
2008	-	-			0
2009	-	-			0

Year	France	Faroes	Iceland*	France	Total
		27.2.a	27.2.a.2	27.3.a	
2010	0	-			0
2011	-	-			0
2012					0
2013	-	-			0
2014	-	-			0
2015	-	-			0
2016	-	-		0	0
2017	-	-		-	0
2018	-	.	13	-	13
2019					0
2020	0				0

* Preliminary catch statistics

Table 9.4.2b. Black scabbardfish other areas: Subarea 27.4. Working Group estimates of landings. E is England, W is Wales, NI is Northern Ireland.

Year	France				Scotland				Germany *		E&W&NI	Netherlands**	Total
	27.4	27.4.a	27.4.b	27.4.c	27.4	27.4.a	27.4.b	27.4.c	27.4.a		27.4.a	27.4.c	
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

Year	France				Scotland				Germany *	E&W&NI	Netherlands**	Total
	27.4	27.4.a	27.4.b	27.4.c	27.4	27.4.a	27.4.b	27.4.c	27.4.c	27.4	27.4.a	
2004		4	1			0			-			5
2005		1	1			0			-			2
2006		13				0	0	0	-			13
2007		1	0			-			-			1
2008		0				0			-			0
2009		5	0			-	-	-	-	-		5
2010		13	2			-	-	-	-	-		15
2011		-	1			-	-	-	-	-		1
2012		0				-	-	-	-	-		0
2013		1	0	0		-	-	-				1
2014		10	0	0		0	0	0	0	0		10
2015		2	0	0		0	0	0	0	0		2
2016		9	-	-								9
2017		0	-	0		0	0	0				0
2018	-	1	-	0	0	-	-	-		0	0	1
2019		1										1
2020		0	3			0					0	4

*STATLAND data

**Preliminary catch statistics.

Table 9.4.2c. Black scabbardfish other areas: Subarea 27.10. Working group estimates of landings.

Year	Faroes	Portugal	France	Ireland	Total
1988	-	-			0
1989	-	-	0		0
1990	-	-	0		0
1991	-	166	0		166
1992	370	-	0		370
1993	-	2	0		2
1994	-	-	0		0
1995	-	3	0		3
1996	11	0	0		11
1997	3	0	0		3
1998	31	5	0		36
1999	-	46	-		46
2000	-	112			112
2001		+			0
2002	2	+			2
2003		91	0		91
2004	111	2			113
2005	56	323		0	379
2006	10	55			65
2007	0	0		0	0
2008	75	0		0	75
2009	157	5		0	162
2010	53	49		0	102
2011	25	139			164
2012	4	458			462
2013		206			206
2014	30	-			30
2015	234	7			240

Year	Faroes	Portugal	France	Ireland	Total
2016	50	36			86
2017	7	63			70
2018	-	14			14
2019	3	17			20
2020		0	0	0	0

Table 9.4.2d. Black scabbardfish other areas: Subarea 27.14. Working Group estimates of landings.

Year	Faroes 27.14	Spain	Greenland 27.14.b	Unallocated	Total
1988	-				0
1989	-				0
1990	-				0
1991	-				0
1992	-				0
1993	-				0
1994	-				0
1995	-				0
1996	-				0
1997	-				0
1998	2				2
1999	-		0		0
2000		90	0		90
2001		0	0		0
2002		8	0		8
2003		2	0		2
2004			0		0
2005	0		0		0
2006			0		0
2007	0		0		0
2008	0		0		0

Year	Faroes	Spain	Greenland	Unallocated	Total
	27.14		27.14.b		
2009	0		0		0
2010		111	0		111
2011	0		0		0
2012		39	0	49	88
2013		50	0	40	90
2014	0	0	0	0	0
2015	0	0	0	0	0
2016			0		0
2017	0	0	0	0	0
2018	0		0		0
2019					0
2020		0			0

9.5 Black scabbardfish in CECAF area

WGDEEP does not assess fisheries in Madeira (Eastern Central Atlantic area, CECAF) or in other areas outside the ICES area. Nonetheless, it is admitted that the incorporation of reliable CECAF data could provide a wider perception of the stock dynamics. Updated information on the black scabbardfish fishery in Madeira (CECAF 34.1.2) has been presented to WGDEEP (Sousa *et al.*, 2021 WD).

In 2015, STECF provided an exploratory assessment of the status of the species around Madeira (STECF-14–15). It was mentioned that, for the period 2000–2013, there was a general decline in fishing capacity and fishing effort. The number of vessels has also declined by 41% (34 to 20 vessels). Furthermore, in the second half of the last decade, some Madeiran vessels targeting the black scabbardfish have moved to new fishing grounds, some of them located outside the EEZ of Madeira (SE of the Azores and off the Canaries) (Figure 9.5.1).

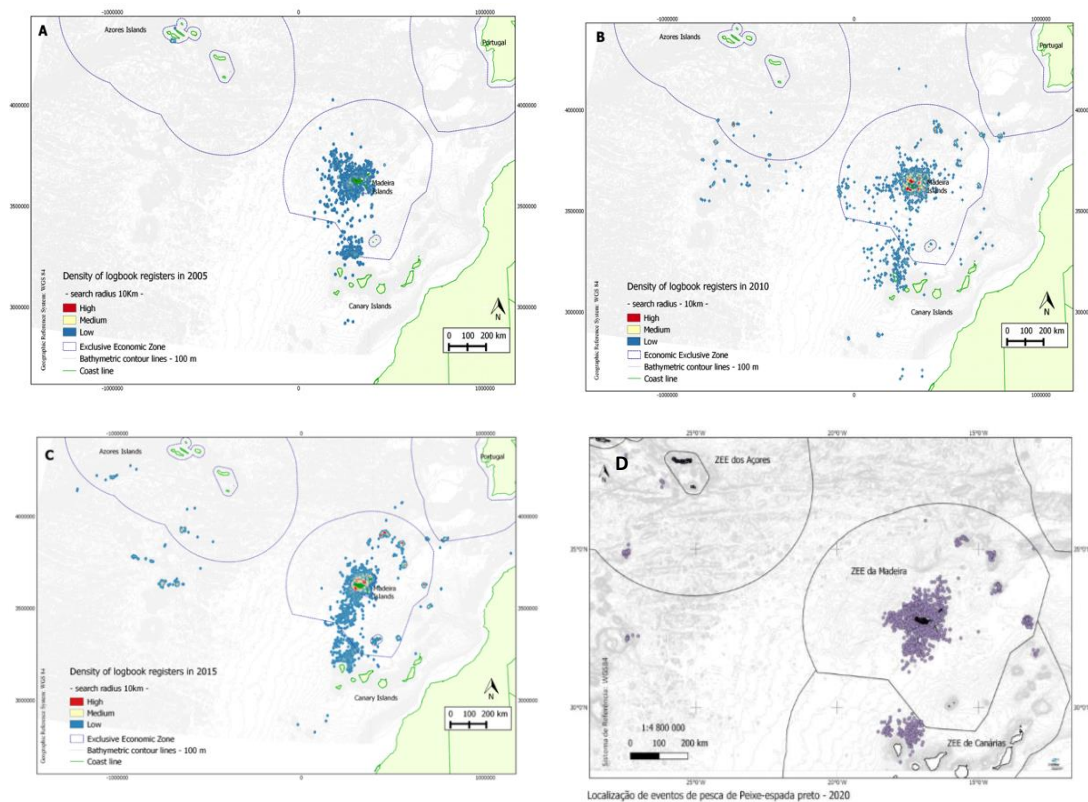


Figure 9.5.1. bsf CECAF area. Density plots illustrating the geographical distribution of the fishing sets with catches in 2005 (A), 2010 (B), 2015 (C) (Delgado *et al.*, 2018) and (D) 2020 (Sousa *et al.*, 2021 WD).

Catches in CECAF 34 area were updated with fishery data from Madeiran longliners landings from 1990 to 2020 (Figure 9.5.1). These catches are recorded by the Regional Fisheries Department of Madeira. CECAF catches have been decreasing after the 1998 peak, but a slight increase was observed from 2012 to 2019 (Figure 9.5.2 and Table 9.5.1).

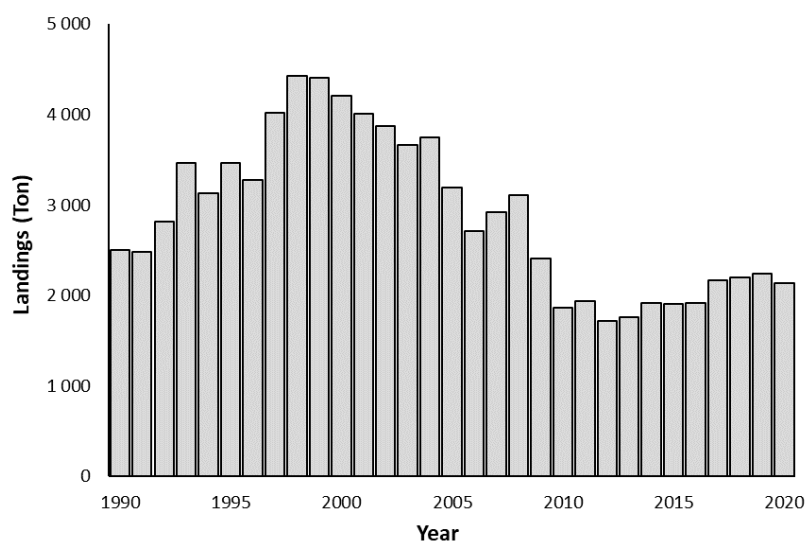


Figure 9.5.2. bsf CECAF 34. Time-series of annual Portuguese landings at CECAF area.

The EU TAC and total catches for CECAF 34 area from 2005 to 2020 are presented in Table 9.5.1.

Table 9.5.1. bsf. Black scabbardfish TACs and total landings in CECAF 34 area between 2005 and 2020.

Year	EU TAC CECAF 34.1.2 area	Landings CECAF 34.1.2. Area
2005	4 285	3 195
2006	4 285	2 717
2007	4 285	2 922
2008	4 285	3 109
2009	4 285	2 413
2010	4 285	1 860
2011	4 071	1 941
2012	3 867	1 716
2013	3 674	1 758
2014	3 490	1 913
2015	3 141	1 902
2016	2 827	1 917
2017	2 488	2 163
2018	2 189	2 199
2019	2 189	2 246
2020	2 189	2 136

Following the methodology adopted at WGDEEP 2016 (ICES, 2016), standardised annual catch estimates for the period from 1990 to 2020 of the nineteen resources (ordered in terms of total weight catch) and grouped into four groups (1, large pelagics; 2, elasmobranchs; 3, small pelagics; and 4, demersals) were determined based on data extracted from DSI/DRM database (Figure 9.5.3). The results do not support that given the diversity of species, which includes different taxonomic groups, lifestyles and both short- and long-lived organisms, the declining trends are reflecting changes on resources abundance which may imply that Madeiran waters are subject to severe over-exploitation. Further studies and a careful interpretation of trend variations of some resources are still required. It may happen that in some cases landing trends are not only related to the resources' abundance in Madeiran waters, but subject to other factors like variations on the market regulation (e.g. small pelagic fishery), environmental, application of TAC's and quotas, among others.

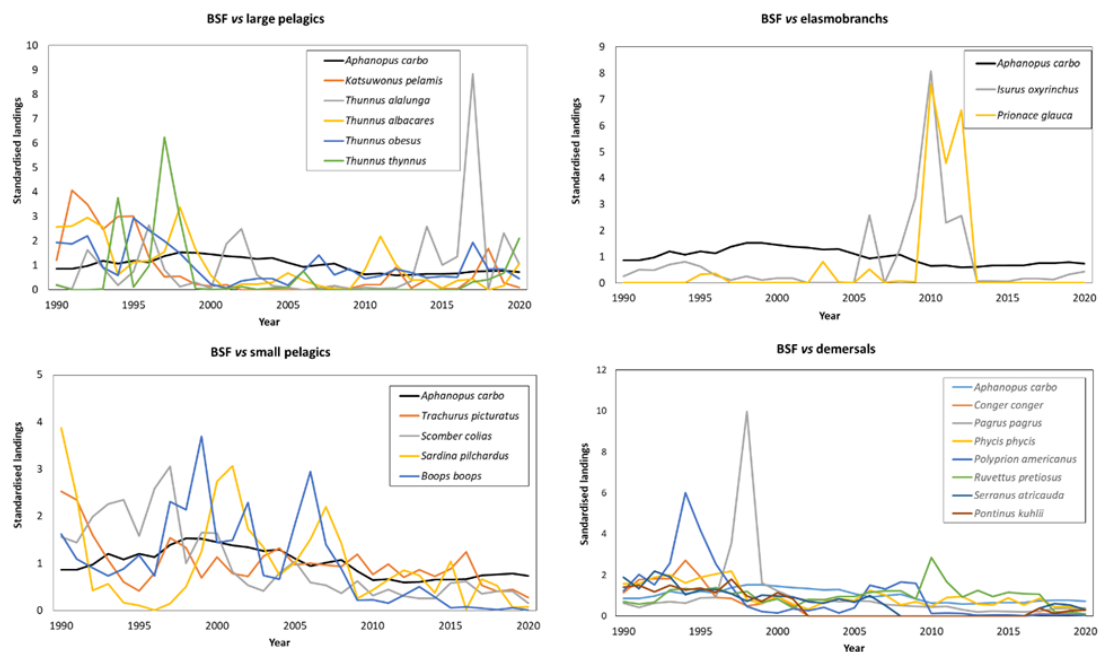


Figure 9.5.3. bsf CECAF area. Trends in standardised landings of black scabbardfish and the 19 other top ranked species in Madeiran landings.

For the period 2009–2020, the total length frequency distributions of the exploited population caught by the Madeiran longline fleet shows slight changes on the mean length throughout time (Figure 9.5.4). From 2011 to 2017 the mean length was constant at 118 cm TL, occurring a slight decrease in 2019 and 2020 (114 cm TL). The smaller number of vessels sampled in 2020 for length frequency distribution analysis, may have influenced the decrease in the estimated mean value.

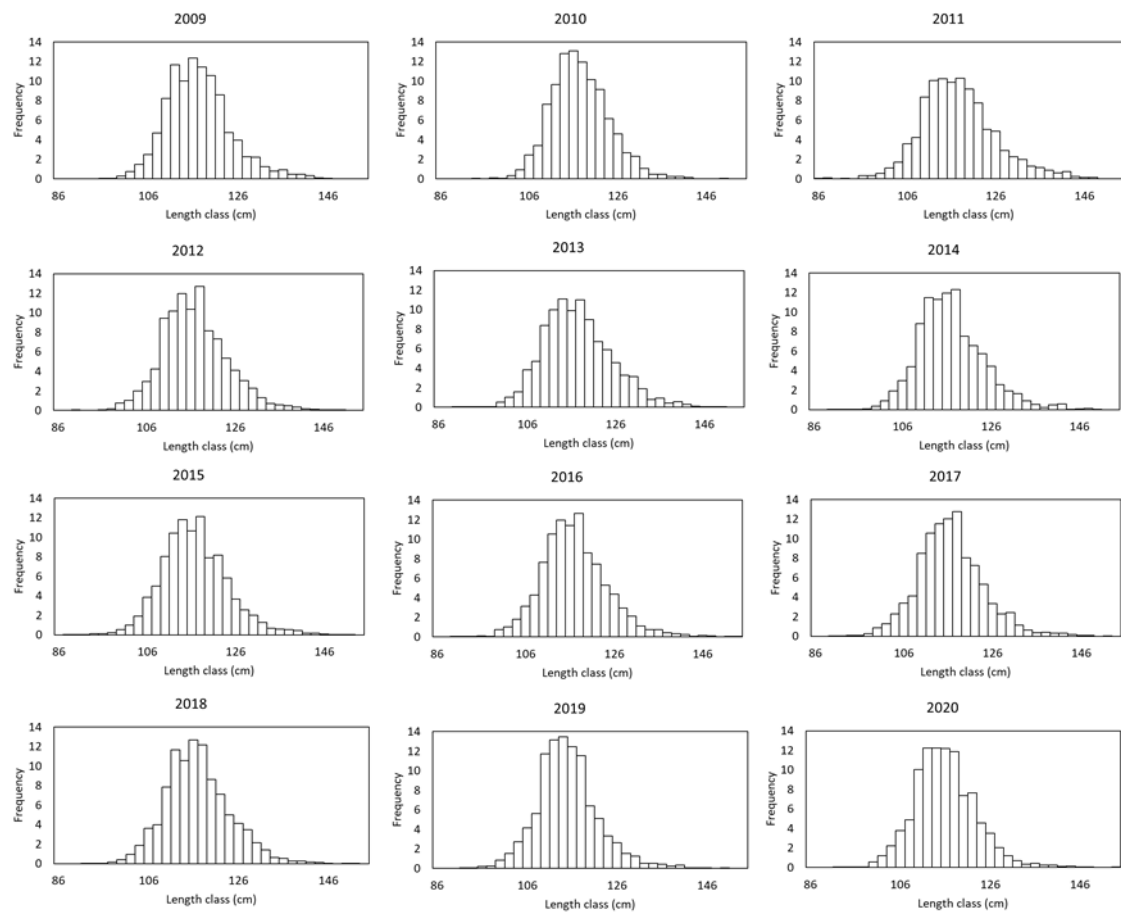


Figure 9.5.4. bsf CECAF. Annual length–frequency distribution of specimens landed by the Portuguese longliners operating along CECAF area.

In CECAF 34 area, the fishing effort that corresponds to the total number of hooks per year shows a continuous decrease from 2000 to 2020. Such decreasing trend is in line with the reduction in the number of active vessels (Figure 9.5.5).

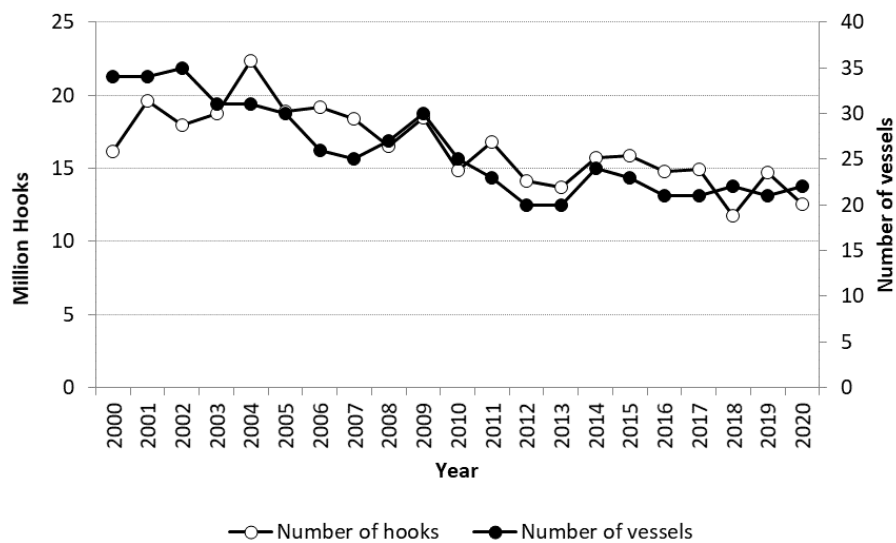


Figure 9.5.5. bsf CECAF 34 area. Time-series of the total annual effort estimated for the CECAF area (million hooks).

The nominal CPUE (Figure 9.5.6) shows an initial decreasing trend followed by a stable period (2010–2016) and a slight increase since 2017.

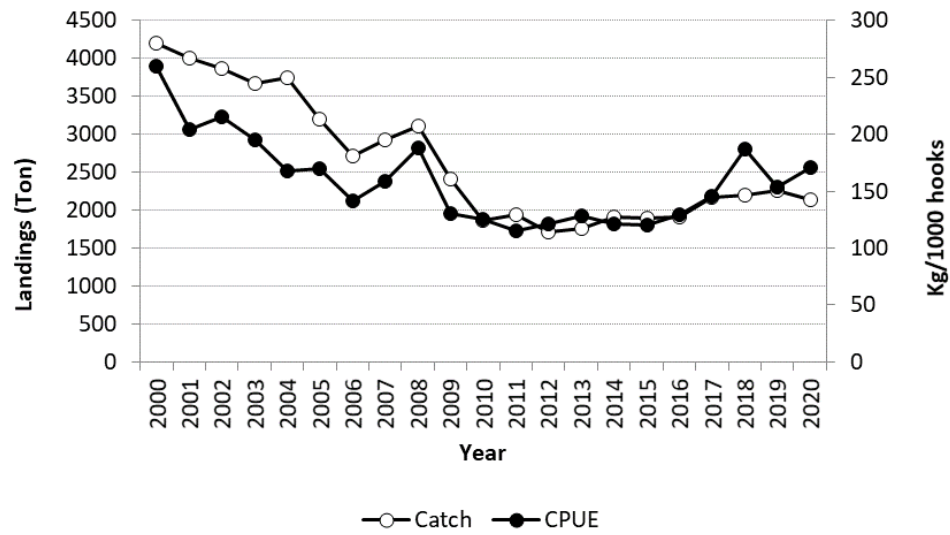


Figure 9.5.6. bsf CECAF 34 area. Time-series of landings per unit effort, nominal CPUE (kg/thousand hooks), in CECAF area.

For the period from 2008 to 2020, a standardised CPUE was obtained by adjusting a GLM model based on daily landings of commercial drifting longline fishery in CECAF 34 (Figure 9.5.7). The response variable (CPUE) was black scabbardfish catch in weight per fishing haul.

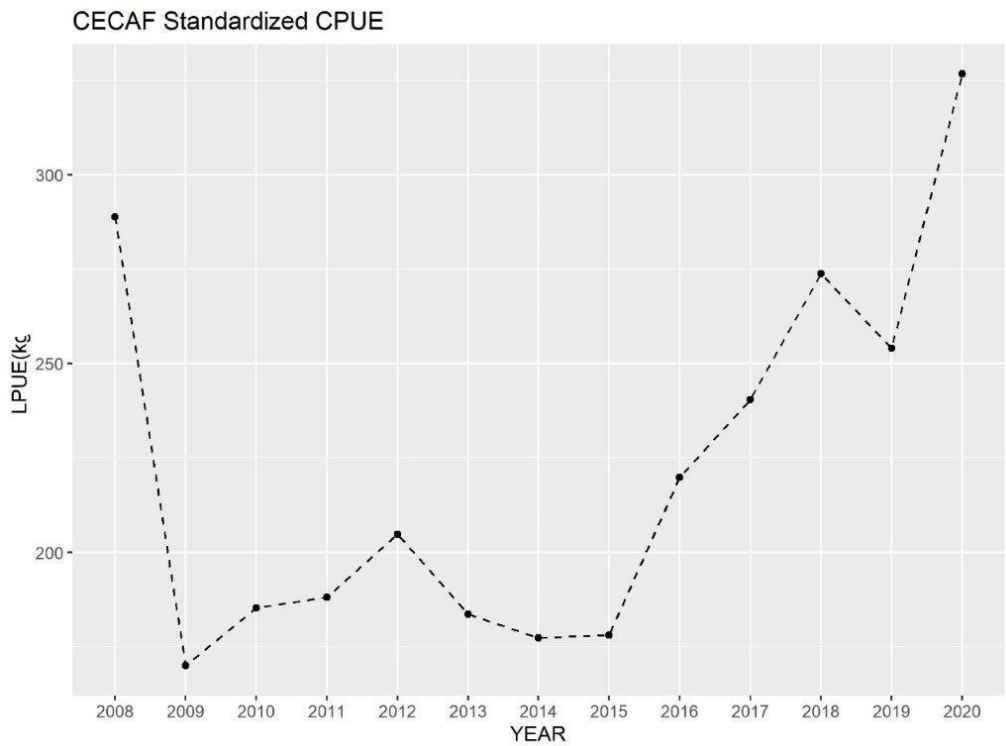


Figure 9.5.7. bsf.27.nea CECAF 34 area. Standardised CPUE (catch weight per fishing haul) from 2008 to 2020.

9.6 References

- Besugo, A., Menezes G. and Silva, H. 2014. Genetic differentiation of black scabbard fish *Aphanopus carbo* and *Aphanopus intermedius* at the 2012 and 2013 Azorean commercial landings. Working Document to the 2014 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Biscoito M., Delgado J., González J.A., Sefanni S., Tuset V.M., Isidro E., García-Mederos A., Carvalho D., 2011. Morphological identification of two sympatric species of Trichiuridae, *Aphanopus carbo* and *A. intermedius*, in NE Atlantic. *Cybius* 35, 19-32.
- Bordalo-Machado, P., and Figueiredo, I. 2007. A description of the black scabbardfish (*Aphanopus carbo* Lowe, 1839) fishery in the Portuguese continental slope. Working Document WD8 to the 2014 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Bordalo-Machado, P. and Figueiredo, I. 2009. The fishery for black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the Portuguese continental slope. *Reviews in Fish Biology and Fisheries* 19(1): 49-67. DOI: 10.1007/s11160-008-9089-7
- Christensen HT, and Hedeolm, R. 2016. Survey for Greenland halibut in ICES Area 14B, August/September 2015. Working Paper for ICES Northwestern Working Group April-May, 2016.
- Delgado, J, Amorim, A., Gouveia, L., and Gouveia, N. 2018. An Atlantic journey: the distribution and fishing pattern of the Madeira deep sea fishery. *Regional Studies in Marine Science*. doi.org/10.1016/j.rsma.2018.05.001.
- EU. 2016. Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002.
- Farias, I., Morales-Nin, B., Lorange, P. and Figueiredo, I. 2013. Black scabbardfish, *Aphanopus carbo*, in the northeast Atlantic: distribution and hypothetical migratory cycle. *Aquatic Living Resources* 26, 333–342.
- Figueiredo, I. 2009. APHACARBO project. Working Document 5 to the 2009 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Figueiredo, I., Bordalo-Machado, P., Reis, S., Sena-Carvalho, D., Blasdale, T., Newton, A., and Gordo, L.S. 2003. Observations on the reproductive cycle of the black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the NE Atlantic. *ICES J. Mar. Sci.* 60, 774-779.
- ICES. 2011. Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 2–8 March 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:17. 889 pp.
- ICES. 2015. Report of the Benchmark Workshop on Deep-sea Stocks (WKDEEP), 3–7 February 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:44. 119 pp.
- ICES. 2016. Report of the Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 20–27 April 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:18. 648 pp.
- ICES. 2018. Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 11–18 April 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:14. 771 pp.
- Nakamura I., Parin N.V., 1993. Snake mackerels and cutlassfishes of the world (families Gempylidae and Trichiuridae). *FAO Fish. Synop.* 125, Vol. 15.
- Neves, A., Vieira, A. R., Farias, I., Figueiredo, I., Sequeira, V., Serrano Gordo, L. 2009. Reproductive strategies in black scabbardfish (*Aphanopus carbo* Lowe, 1839) from the NE Atlantic. *Scientia Marina*, 73(S2), 19–31. <https://doi.org/10.3989/scimar.2009.73s2019>
- Nielsen, J. 2020. Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES division 14b in the period 1999–

2019. Working Document 02 to WGDEEP 2020 (Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources).
- Nielsen, J. 2021. Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES division 14b in the period 1999-2020. Working Document 04 to the ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Nielsen, J., Nogueira, A. and Christensen, H.T. 2019a. Survey results of roughhead grenadier, roundnose grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling, and orange roughy in ICES division 14b in the period 1998-2016. Working Document 05 to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Nielsen, J., Nogueira, A. and Christensen, H.T. 2019b. Commercial catches of roundnose grenadier, roughhead grenadier, greater silver smelt, blue ling, tusk, black scabbard fish, ling and orange roughy in ICES division 14b in the period 1999-2018. Working Document 06 to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Ofstad, L.H. 2019. Black scabbard fish in Faroese waters (27.5.b). Working Document 01 to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).
- Pajuelo, J.G., González, J.A., Santana, J.I., Lorenzo J.M., García-Mederos, A., and Tuset, V. 2008. Biological parameters of the bathyal fish black scabbardfish (*Aphanopus carbo* Lowe, 1839) off the Canary Islands, Central-east Atlantic. Fish. Res. 92, 140-147.
- Perera C.B., 2008. Distribution and biology of Black scabbardfish (*Aphanopus carbo* Lowe, 1839) in the North-west of Africa. Master Thesis in Biology and Management of Marine Resources. Faculty of Sciences, University of Lisbon.
- Sousa, R., Figueiredo, I., Farias, I., and Vasconcelos, J. 2021. Scabbard fish in the Madeira archipelago (CE-CAF 34.1.2). Working Document for the ICES Working Group on Biology and Assessment of Deep-Sea Fisheries Resources. Copenhagen, 22th April - 28th May 2021.
- Stefanni S., Bettencourt R., Knutsen H., and Menezes G. 2009. Rapid polymerase chain reaction–restriction fragment length polymorphism method for discrimination of the two Atlantic cryptic deep-sea species of scabbardfish. Mol. Ecol. Resour. 9, 528-530.
- Stefanni S., and Knutsen H., 2007. Phylogeography and demographic history of the deep-sea fish, *Aphanopus carbo* (Lowe, 1839), in the NE Atlantic: vicariance followed by secondary contact or speciation? Mol. Phylogen. Evol. 42, 38-46.