

4 Black-bellied and white anglerfish in Cantabrian Sea and Atlantic Iberian waters

ank.27.8c9a and mon.27.8c9a – *Lophius budegassa* and *L. piscatorius* in divisions 8.c and 9.a

4.1 General

Update assessment for *Lophius piscatorius* and *L. budegassa* in 2022. Software used: Stock Synthesis (SS; Merthot Jr. and Wetzel, 2013) for *L. piscatorius* and SPiCT (Pedersen and Berg, 2017) for *L. budegassa*. No data revisions this year.

4.1.1 Introduction

Two species of anglerfish, *L. piscatorius* and *L. budegassa* are found in ICES divisions 8.c and 9.a. Both species are caught in mixed bottom-trawl fisheries and artisanal fisheries using mainly fixed nets.

The two species have been landed together for the majority of the commercial categories and being recorded together in the ports' statistics. Therefore, estimates of each species in Spanish landings from divisions 8.c and 9.a and Portuguese landings of Division 9.a have been derived from their relative proportions in market samples. However, sampling data from Portugal suggests that species identification greatly improved in recent years with potential significant misidentification issues at a smaller number of landing ports. Consequently, since 2021 that Portuguese landings correspond to the official landings of each species with corrections for a reduced number of ports.

The total anglerfish landings are given in Table 4.1.1 by ICES Division, country and fishing gear. Landings increased in the early eighties reaching a maximum level in 1986 (9 433 t) and 1988 (10 021 t), and decreased after that to a minimum of 1801 t in 2001. In 2002–2005 period landings increased reaching 4 757 t. This period was followed by another one where landings gradually declined and in 2011 landings were less than half of the 2005 amount (2105 t). From 2011 to 2014, landings slightly increased to 3030 t. Annual values then progressively decreased again in the next eight years to 1 195 t in 2022, the lowest value recorded in the stocks' historical time-series.

The species proportion in the landings has changed since 1986. At the beginning of the time-series (1980–1986), *L. piscatorius* represented more than 70% of the total anglerfish landings. After 1986, the proportion of *L. piscatorius* decreased in the annual landings but in 1999–2002 both species showed approximately the same weight. In 2003, the proportion of *L. piscatorius* started to increase again, with a mean proportion of 66% in total landings from 2003 to 2019. Since 2021 the proportion of *L. budegassa* represents between 52 to 54% of total anglerfish landings.

ICES performs assessments for each species separately. The latest benchmark assessment for *L. piscatorius* in divisions 8.c and 9.a was carried out in 2018 (ICES, 2018) when new settings and data were incorporated into the existing Stock Synthesis (SS) model (Merthot Jr. and Wetzel, 2013). A benchmark assessment using SPiCT (Pedersen and Berg, 2017) for *L. budegassa* was conducted during WKMSYSPiCT (ICES, 2021). The time-series of available CPUE data were revised and several tests were conducted.

The ageing estimation problems detected during the previous benchmark (see WKFLAT report; ICES, 2012) continued unsolved for *L. piscatorius* (ICES, 2018) and no new studies were carried out for *L. budegassa*. The growth pattern inferred from mark-recapture and length composition data analyses (Landa *et al.*, 2008) was used in the assessment of *L. piscatorius*.

4.1.2 Summary of ICES advice for 2023 and management for 2022 and 2023

4.1.2.1 ICES advice for 2023

ICES gave separate advice for each of these species in 2022. ICES advises for *L. piscatorius* that when the EU multiannual plan (MAP) for Western waters and adjacent waters (EU, 2019) is applied, catches in 2022 that correspond to the F ranges are between 1 613 and 2 986 t. Catches higher than those corresponding to F_{MSY} (2 271 t) can only be taken under conditions specified in the MAP. For *L. budegassa*, ICES advises that when the precautionary approach is applied, catches in 2023 should be no more than 2 064 t.

4.1.2.2 Management applicable for 2022 and 2023

The two species are managed under a common TAC that was set at 3 868 t for 2022 and 4 335 t (EU, 2023) for 2023. The reported landings in 2022 were 31% of the established TAC.

There is no minimum landing size for anglerfish. However, the Council Regulation (EC) No. 2406/96, laying down common marketing standards for certain fishery products, fixes a minimum weight of 500 g for anglerfish (EU, 1996). In Spain, this minimum weight was implemented in 2000.

4.1.2.3 Management considerations

L. piscatorius and *L. budegassa* are subject to a common TAC. Both species of anglerfish are reported together because of their similarity but they are assessed and their advice is provided separately.

It should be noted that both anglerfish are essentially caught in mixed fisheries. Hence, management measures applied to these species may have implications for other stocks and vice versa. Although these stocks are assessed separately, they are managed together. Due to the differences in the current status of the individual stocks the advice is given separately.

4.1.3 References

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Table 4.1.1. White-bellied and black-bellied anglerfish (*L. piscatorius* and *L. budegassa*) in divisions 8.c and 9.a. Landings (in tonnes) by the main fishing fleets from 1978–2022 as estimated by the WGBIE.

Year	Div. 8c						Div. 9a					Div. 8c+9a		Unallocated/ Non- reported	Div. 8c+9a
	SPAIN			FRANCE			SPAIN			PORTUGAL		TOTAL	SUBTOTAL		
	Trawl	Gillnet	Others	Trawl	Gillnet	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal				
1978	n/a	n/a				n/a	506				n/a	222	728	728	
1979	n/a	n/a				n/a	625				n/a	435	1 060	1 060	
1980	4 008	1 477				5 485	786				n/a	654	1 440	6 926	6926
1981	3 909	2 240				6 149	1 040				n/a	679	1 719	7 867	7867
1982	2 742	3 095				5 837	1 716				n/a	598	2 314	8 151	8151
1983	4 269	1 911				6 180	1 426				n/a	888	2 314	8 494	8494
1984	3 600	1 866				5 466	1 136				409	950	2 495	7 961	7961
1985	2 679	2 495				5 174	977				466	1 355	2 798	7 972	7972
1986	3 052	3 209				6 261	1 049				367	1 757	3 172	9 433	9433
1987	3 174	2 571				5 745	1 133				426	1 668	3 227	8 973	8973
1988	3 583	3 263				6 846	1 254				344	1 577	3 175	10 021	10021
1989	2 291	2 498				4 789	1 111				531	1 142	2 785	7 574	7574
1990	1 930	1 127				3 057	1 124				713	1 231	3 068	6 124	6124
1991	1 993	854				2 847	878				533	1 545	2 956	5 802	5802
1992	1 668	1 068				2 736	786				363	1 610	2 758	5 493	5493
1993	1 360	959				2 319	699				306	1 231	2 237	4 556	4556
1994	1 232	1 028				2 260	629				149	549	1 327	3 587	3587
1995	1 755	677				2 432	814				134	297	1 245	3 677	3677
1996	2 146	850				2 995	749				265	574	1 589	4 584	4584
1997	2 249	1 389				3 638	838				191	860	1 889	5 527	5527
1998	1 660	1 507				3 167	865				209	829	1 903	5 070	5070
1999	1 110	1 140				2 250	750				119	692	1 561	3 811	3811
2000	710	612				1 322	485				146	675	1 306	2 628	2628
2001	614	364				978	247				117	459	823	1 801	1801
2002	587	415		61	8	1 072	344				104	380	828	1 901	1901
2003	1 190	771		55	0	2 016	617				96	529	1 242	3 258	3258
2004	1 513	1 389		87	32	3 021	549				77	602	1 229	4 250	4250
2005	1 651	1 719		160	55	3 586	653				60	458	1 171	4 757	4757
2006	1 490	1 371		72	6	2 938	801				68	351	1 220	4 158	4158
2007	1 327	1 076		26	7	2 437	866				78	303	1 247	3 683	3683
2008	1 280	1 238		31	9	2 558	473				50	246	770	3 328	3328
2009	1 151	1 207		20	10	2 389	386				43	262	691	3 080	3080
2010	689	1 036		14	3	1 742	355				72	203	630	2 372	2372
2011	458	598	105	18	2	1 180	216	88	146	122	199	770	1 951	154	2105
2012	432	610	89	14	2	1 148	163	60	132	161	533	1 049	2 197	339	2536
2013	495	853	52	23	7	1 430	142	85	140	114	412	893	2 323	288	2612
2014	545	1 073	35	30	11	1 694	211	93	8	143	408	863	2 557	474	3030
2015	557	943	5	13	14	1 532	190	114	3	161	422	890	2 422	395	2818
2016	579	964	9	12	10	1 573	179	146	3	127	377	832	2 405	419	2824
2017	410	879	1	4	11	1 305	215	128	2	98	440	883	2 188	119	2307
2018	414	770	34	12	15	1 245	244	72	2	58	280	656	1 901	16	1916
2019	299	553	0	2	2	856	183	81	1	65	239	570	1 426	152	1577
2020	302	320	2	12	5	641	222	45	5	157	445	874	1 515	0	1515
2021	300	257	1	5	0	563	204	30	4	113	411	763	1 326	0	1326
2022	332	220	1	0	0	553	207	14	2	96	323	641	1 195	0	1195

n/a: not available

4.2 White anglerfish (*Lophius piscatorius*) in divisions 8.c and 9.a

4.2.1 General

4.2.1.1 Ecosystem aspects

The ecosystem aspects of the stock are common with *L. budegassa* and are described in the Stock Annex.

4.2.1.2 Fishery description

L. piscatorius is mainly caught by Spanish and Portuguese bottom trawlers and gillnet fisheries. For some gillnet fishery, it is an important target species, while it is also bycatch of trawl fishery targeting hake or crustaceans (see Stock Annex). Since 2010, Spanish landings were on average 79% of total landings of the stock.

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to those landed by trawls. From 2010 to 2022, the Spanish landings were on average 37% from the trawl fleet (in 2022, mean lengths of 54 cm and 56 cm in divisions 8.c and 9.a, respectively were observed) and 51% from the gillnet fishery (mean length of 64 cm in Division 8.c was observed in 2022). For the same period, Portuguese landings were on average 15% from bottom trawlers (mean length of 54 cm in 2022) and 85% from the artisanal fleet (mean length of 72 cm in 2022).

4.2.2 Data

4.2.2.1 Commercial catches and discards

Total landings by country and gear for the period 1978–2022, as estimated by the WG, are given in Table 4.3.1. Unallocated and non-reported landings for this stock are available from 2011 to 2019. The unallocated and non-reported values are considered realistic and are taken into account for the assessment. Unallocated or non-reported landings were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort of each *métier* and quarter. Landings have been decreasing from 2005 (3 824 t) until 2022 (574 t), the historical minimum.

Spanish discards estimates and landings below minimum size of *L. piscatorius* in weight are shown in Table 4.3.2. No discards were reported in logbooks by any country. For the available time-series, anglerfish discards represent less than 16% of trawl catches. The maximum value observed from the time-series occurred in 2006 (99 t). Discards from the Spanish gillnet fleet are only available from 2013 to 2021 with quantities between 0 t and 144 t. The occasional high and zero values of discards reported for the gillnet fleet could be related to a very low sampling level. *L. piscatorius* discards in the Portuguese trawl fisheries are considered negligible (Fernandes and Prista, 2012; Prista *et al.*, 2014). Based on the Spanish and Portuguese discards information, the WG concluded that discards could be considered negligible.

4.2.2.2 Biological sampling

The procedure for sampling this species is the same as for *L. budegassa* (see Stock Annex).

The sampling levels for Portugal in 2022 are shown in Table 1.4. Following the requirement of the EU Data Collection Framework (DCF), the *métier* sampling adopted in Spain and Portugal in 2009 can affect the provided data. Spanish sampling levels are similar to previous years but a significant reduction in Portuguese samplings was observed in 2009–2011. Despite Portugal having increased their sampling effort, the number of samples and length measured are still low.

Since 2009, the length composition of trawl and artisanal Portuguese fisheries is not used in the assessment.

Length composition

The annual length compositions for all combined fleets for the period 1986–2022 are presented in Figure 4.3.1. Landings in number, the mean length and mean weight in the landings between 1986 and 2022 are shown in Table 4.3.4. The lowest total number of landings (year 2001) is 4% of the maximum value (year 1988). After 2001, values increased up to 2006 followed by a decreasing annual trend in 2007 to 2012. Since 2016, there is a strong downward trend in total landings number reaching 135 thousand in 2021 (value almost similar to the smallest number, 127 thousand in 2001, observed for the whole time-series). Mean lengths and mean weights in the landings increased sharply between 1995 and 2000. In 2002, low values of mean lengths and mean weights were observed, around the minimum of the time-series, due to the increase in smaller individuals. After that, increases in mean length were observed reaching 71 cm in 2010. Since 2018, the mean length and mean weight in landings have decreased from 77 cm to 55 cm and from 7 163 g to 3 711 g, respectively.

Biological information

The growth pattern used in the assessment follows a von Bertalanffy model with fixed $K = 0.11$ and L_{inf} is estimated by the model. Length-weight relationship, updated during the benchmark (ICES, 2018), maturity ogive and natural mortality (M) used in the assessment are described in the Stock Annex.

4.2.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period of 1983 to 2022 are summarized in Table 4.3.5.

The abundance index from the Spanish SpGFS-WIBTS-Q4 (G2784) survey is shown in Figure 4.3.2. Since 2000, the highest abundance values were detected in 2001 and 2006, following this year a downward trend was observed. In 2016, 2017, 2018 and 2019, the abundance indices were the lowest of the series (Figure 4.3.2) and almost no individuals < 20 cm were recorded (Figure 4.3.3). In 2021, slight increases in abundance were observed.

Since 2013, the Spanish SpGFS-WIBTS-Q4 (G2784) survey is conducted using a different vessel. The results of two inter-calibration experiments carried out between the two oceanographic vessels in 2012 and 2014 indicated that catches of white anglerfish have not been affected by the change of the vessel. Although in 2021, the Spanish SpGFS-WIBTS-Q4 (G2784) survey was partially carried out with a different vessel, it is considered that this change had no effect on abundance estimates.

4.2.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 4.3.6 and Figure 4.3.4. Values for Spanish trawlers (Division 8.c) from the ports of Santander and Avilés have been collected since 1986, for A Coruña since 1982, and for the Portuguese trawlers (Division 9.a) since 1989. A Coruña fleet series (landings, effort and LPUE) were updated to incorporate years at the beginning of the series (1982–1985). Three series are presented for A Coruña fleet: (1) A Coruña port for trips that are exclusively landed in the port; (2) A Coruña trucks for trips that are landed in other ports; and (3) A Coruña fleet that takes into account all the trips of the fleet. For 2020, no information for A Coruña port was provided. Although the abundance series from A Coruña port can be potentially used in the assessment, a previous analysis of the whole time-series must be done before taking this into account. The A Coruña fleet index, used in the assessment as an abundance index from 1982–2012, is not available since 2013.

Until 2011, most logbooks of Portuguese fleets were filled in paper but have been progressively replaced thereafter by electronic logbooks. In 2013, more than 90% of the logbooks were completed in the electronic version. The LPUEs series were revised from 2012 onwards. To revise the series backwards, further refinement of the algorithm is required.

For each fleet, the proportion of the landings in the stock is also given in Table 4.3.6. In 2007, a data series from the artisanal fleet from the port of Cedeira in Division 8.c was provided. This LPUE series is annually standardized to incorporate a new year of data and the latest available standardized series, from 1999–2011, is presented. Due to the reduction in the number of vessels of Cedeira fleet, this tuning series could not be considered a representative abundance index of the stock and it is no longer recorded. Standardized effort provided for Portuguese trawl fleets (1989–2008) and their corresponding LPUEs are also given in Table 4.3.6, but not represented in Figure 4.3.4.

All fleets show a general decrease in landings during the eighties and early nineties. From 2000 to 2005, Spanish fleets of A Coruña, Avilés and Cedeira showed an increase in landings while those landed by the Portuguese fleets remained at low levels. Since 2005–2009, landings from A Coruña and Cedeira fleets showed an overall decreasing trend. Proportion in total landings per fleet is higher for the Cedeira and A Coruña. Landings for both Portuguese fleets increased in 2014 and 2015 then decreased afterwards.

Effort trends show a general decline since the mid-nineties in all trawl fleets. In the last five years, low effort values were observed despite some slight fluctuations. Despite these variations along the time-series, the Cedeira artisanal fleet shows an overall increasing trend until 2008. After this year, the effort sharply declined to the minimum value of the series in 2011. From 2007–2011, the effort from A Coruña fleet was reduced by 47%, showing the lowest values of the series in 2011. The Portuguese Crustacean fleet shows high effort values in 2001 and 2002 that might be related to a change in the target species due to the very high abundance of rose shrimps during that period.

LPUEs (Table 4.3.6 and Figure 4.3.4) from all available fleets show a general decline during the eighties and early nineties followed by some increases. From 2002 to 2005, LPUEs increased for all fleets. This general LPUE trend is consistent between fleets including the artisanal fleet. In 2010 and 2011, an important increase in the Cedeira LPUE was observed. After 2012, only sub-division 9a was tracked. The LPUE was quite noisy these years although it shows a decreasing trend in recent years (since 2019). Portuguese fleets showed a one-off increase in 2011. Then in 2017 and 2019, Portuguese trawl fleet targeting crustaceans showed the highest LPUE value of the time-series with 2 kg/hour.

4.2.3 Assessment

This is an update assessment in relation to the model assessment adopted in the 2018 WKANGLER benchmark (ICES, 2018). Last year's assessment (ICES, 2022) was updated with the inclusion of the 2022 data.

4.2.3.1 Input data

Input data used in the assessment are presented in the Stock Annex.

Due to the problems described in the previous section (see section 4.3.2.4 on commercial catch-effort data), the A Coruña-fleet and Cedeira-fleet abundance indices from 2013 to 2022 were not included in the assessment. Length composition of landings for the Spanish artisanal fleet in ICES Division 8.c (SPART8C) for the 1st and 4th quarters are the only length composition used as input data for the year 2020. In 2021 and 2022, the length composition of landings for both

Spanish commercial fleets and the length composition from the Spanish SpGFS-WIBTS-Q4 (G2784) survey were the only length composition used in the assessment.

4.2.3.2 Model

The Stock Synthesis (SS; Merthot Jr. et al., 2018) software was selected to be used in the assessment of this stock and has been implemented since 2012 (ICES, 2012). The description of the model including the structure, settings, and parameter assumptions are presented below:

- **Model used:** Stock Synthesis (SS) (Methot Jr, 2000; Methot Jr. and Wetzel, 2013).
- **Software used:** Stock Synthesis v3.30.10 (Methot Jr. et al., 2018).

Stock Synthesis is an integrated assessment model. SS has been used for stock assessment all around the world. The area of highest use is on the US Pacific Coast. SS is coded in C++ using an Auto-Differentiation Model Builder¹ and available at the NOAA Virtual Laboratory². SS has three main characteristics that differentiate it from classical assessment models:

1. SS model structure allows for the building of simple to complex models depending upon the data available. Models can be built using age, length and/or both and spatial structure;
2. It is capable of integrating different sources of information;
3. All parameters have a set of controls to allow prior constraints, time-varying flexibility, and linkages to environmental data.

The overall SS model is subdivided into three submodels. The first submodel simulates the population dynamics, where the basic abundance, mortality and growth functions create a synthetic representation of the true population. The second submodel is the observation submodel. It contains the processes and filters designed to derive expected values for the various types of data. The last submodel is the statistical model that quantifies the magnitude of the difference between observed and expected data and employs an algorithm to find the set of parameters that maximizes the goodness-of-fit.

The SS model developed for the southern white anglerfish during the WKANGLER (ICES, 2018) has been designed for a particular set of data and specifications. This stock is harvested by four fleets, and two commercial LPUE series and one fishery-independent survey provide information about its relative abundance. No discards information is considered. Length composition data are available from both the fisheries and surveys. No age information is available for this stock.

Input data

Years: 1980–2022.

Model structure

- Temporal unit: quarterly-based data (landings, LPUE and length–frequency data; LFD) were used in SS calculations.
- Spatial structure: one area.
- Sex: both sexes combined.

Fleet definition

Four fleets were defined based on the gear type and country:

- Spanish trawlers in ICES divisions 8.c–9.a (SPTR8C9A);
- Spanish artisanal in ICES Division 8.c (SPART8C);

¹ <http://www.admb-project.org>

² <https://vlab.ncep.noaa.gov/>

- Portuguese trawlers in ICES Division 9.a (PTTR9A);
- Portuguese artisanal in ICES Division 9.a (PTART9A).

Landed catches

Quarterly landings are used as biomass (in weight) input in the model for the four fleets. Landings data for January 1980 to December 2022 were used to conduct the stock assessment.

From 1980 to 1988, quarterly landings were estimated using the average proportion for the years 1989–1993 by fleet. In the case of SPART8C, quarterly landings were estimated from 1980 to 1993 using the average proportion of the consecutive five years (1994–1998).

Abundance indices

- A Coruña trawlers (SPCORT8C): Quarterly LPUEs in weight from 1982 to 2012. It is considered in the model as four separate indices, one index per quarter.
- Cedeira gillnetters (SPCEDGN8C): Quarterly LPUE in weight from 1999 to 2011. It is considered in the model as four separate indices, one index per quarter.
- Spanish Groundfish Survey (SPGFS): Abundance index in numbers from 1983 to 2022, except for 1987.

Length composition of data

The length bin was set by 2 cm, from 4 to 100 cm, by 10 cm from 100 to 160 cm and by 40 cm from 160 to 200 cm. Length composition for the four fishing fleets and the three abundance indices were used. The available length data and their disaggregated level differ among fleets:

Length composition of fleets

- SPTR8C9A: 1986–2022, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach available in SS.
- SPART8C: 1986–2022, quarterly basis. From 1986 to 1994 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach available in SS.
- PTTR9A: 1986–2009, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach presented in SS.
- PTART9A: 1986–2009, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach present in SS.

Length composition of abundance indices

- SPCORT8C: 1982–2012, quarterly basis, with gaps in each of the years 1982, 1984, 1985 and 1986.
- SPCEDGN8C: 1999–2011, quarterly basis.
- SPGFS: length composition for the 4th quarter, from 1983–2022. The 1987 length composition is missing.

Model assumptions and parameters

Natural mortality: $M = 0.2$ for all ages and years.

Growth: von Bertalanffy function: $K = 0.11$ fixed, L_{\max} and mean length-at-age of 0.75 are estimated.

Maturity ogive: length-based logistic, $L_{50} = 61.84$ and slope = -0.1001 , constant over time.

Weight-at-length: $a = 2.5 \times 10^{-5}$; $b = 2.853$, not estimated.

Recruitment allocation in Quarter 3.

Stock–recruitment relationship: Beverton–Holt model: steepness $h = 0.999$, $\sigma_R = 0.4$, R_0 estimated.

Selectivity: For all fleets selectivity was only length-based and was modelled as a double normal function. Selectivity for fishery PTART9A was set to be flattop (asymptotic). Selectivity varies among fleets but is assumed to be time-invariant.

Sample size of length composition: The sample size of length composition of landings for the two Spanish fleets is set at 125, as only information with a good sampling level was included in the model. However, in 2022 the length composition of landings for the SPART8C Fleet seems to indicate a change in the selectivity to smaller sizes (Figure 4.3.5). Two different métiers, GNS_DEF_≥ 100_0_0 and GTR_DEF_60-79_0_0, with different selectivity are included in this fleet. In recent years, both gears are used in the same trip. Due to this, the *métier* is not well identified in the length sampling. Therefore, the fleet length composition aggregated was not properly representing the overall fleet catches and caused changes in the fishery selectivity estimates (Figure 4.3.6). For these reasons, it was decided to set the sample size in the year 2022 at 25 for the SPART8C Fleet.

4.2.3.3 Assessment results

The model diagnosis is carried out employing the residual analysis of the abundance indices. Residual plots of the fits to the abundance indices are shown in Figure 4.3.7. Although some minor trends have been detected, as was observed for A Coruña indices from 1996 to 2002, it can be considered that the model follows the abundance indices trends used in the model (A Coruña and Cedeira). For the SpGFS-WIBTS-Q4 survey (G2784), the model is overestimating the index from 2014 to 2022. Pearson residual plots are presented for the model fits to the length-composition data of the abundance indices (Figure 4.3.8). No specific pattern was detected in any of the abundance indices. However, some high positive residuals are evident for the SpGFS-WIBTS-Q4 survey (G2784) index. Nevertheless, the model fits reasonably well.

The model estimates size-based selectivity functions for commercial fleets (Figure 4.3.9) and abundance indices (Figure 4.3.10). All the selection patterns was assumed constant over time. The selection pattern for the Spanish trawl fleet is efficient for a wide range of lengths, from smaller to very large individuals. The Spanish artisanal fleet is most efficient at a narrow length range of large-sized fish, mainly from 75 to 90 cm. The Portuguese trawl fleet selection pattern indicates that this fishery is most efficient for individuals with size ranging between 30 and 60 cm. This selection pattern shows a strange selection pattern over larger fish, possibly due to insufficient length sampling. The Portuguese artisanal fleet has an asymptotic selection pattern, which is modelled to be asymptotic, that retains all fish measuring above 60 cm.

The selection patterns are equal for all quarters in A Coruña and Cedeira indices. For the A Coruña index, the selection pattern has a wide length range while Cedeira index shows more selectivity directed to larger individuals. The SpGFS-WIBTS-Q4 survey (G2784) index shows a well-defined selectivity for smaller individuals.

A variance-covariance matrix (Hessian calculation) was calculated to represent uncertainty in the spawning biomass and recruitment. The annual F summary reported in the standard SS output files (with both point estimate and standard deviation) does not correspond to the F summary used here (the average of lengths over 30 to 130 cm). The uncertainty of F could not be calculated from the variance-covariance matrix.

4.2.3.4 Historic trends in biomass, fishing mortality and recruitment

Table 4.3.7 and Figure 4.3.11 provide the summary of results from the assessment model and observed landings. Maximum values of recruitment are recorded at the beginning of the time-

series (1982, 1986, 1987 and 1989) with values over 3 million individuals. Along the time-series, other high recruitment values were detected such as in 1994 and 2001. Since 2014, the recruitment has been below 1 million individuals except for the years 2019 and 2021. The abundance estimates of age-0 from 2015 to 2017 were very low, and are considered as the minimum values of the whole time-series. Landings steadily decreased from 3.8 kt in 2005 to 1.1 kt in 2011, coinciding with the decrease in F , from 0.380 in 2005 to 0.135 in 2011. Compared to 2021, landings and F decreased in 2022 by 6% and 17%, respectively. Since 2005, SSB was above 6 kt and it steadily increased to 11.3 kt, value estimated at the beginning of 2023.

The very low recruitment values estimated by the model for the years 2015 to 2018 have not been reflected in the SSB. In fact, the SSB has been stable or increasing slightly from 2015 to 2019. Taking into account that white anglerfish reaches its maturity at 62 cm, which corresponds approximately to 4 years, the potential impact of low recruitments on SSB will only be detected after 4 or 5 years. In 2023, the SSB values increased slightly relative to the previous year's estimates. However, the progressive decline in landings detected from 2017 to 2022 may reflect the low exploitation abundance of ages 2, 3 and 4 in the fishery. The moderate recruitment level observed in 2019 and 2021 could be related to the increase of smaller individuals detected in the length composition of landings in 2021 and 2022, and the decrease of the mean length of landings from 77 cm in 2018 to 58 cm in 2022.

4.2.3.5 Retrospective pattern for SSB, fishing mortality, yield and recruitment

In order to assess the consistency of the assessment from year to year, a retrospective analysis was carried out. It was conducted by removing one year (2022), two years (2022 and 2021), three years (2022–2020), four years (2022–2019) and five years (2022–2018) of data while using the same model configuration (Figure 4.3.12). All the retrospective analysis runs was similar to the recruitment estimates. Although there are some uncertainties in recent recruitment estimates, no consistent bias was observed. Retrospective analysis showed an overestimation of the SSB in the final years and an underestimation of F . Nevertheless, there was no strong retrospective pattern observed and the assessment was accepted for projections. The Mohn's rho index (Mohn, 1999) for the last five years was estimated for recruitment (0.19), F (–0.10) and SSB (0.15).

4.2.4 Catch options and prognosis

4.2.4.1 Short-term projections

This year's projections were performed on the basis of the present assessment.

For fishing mortality, the F *status quo* (F_{sq}) is equal to 0.081, estimated as the average of $F_{2020-2022}$ over lengths 30–130 cm, was used for the intermediate year (2023). Although there is a decreasing trend in F , it was decided not to scale the F_{sq} to the final year because of the uncertainty of SSB estimates. Unscaled F_{sq} was considered more precautionary as a higher value of F is closer to F_{MSY} .

The recruitment used for projections in this WG is the geometric mean (GM) calculated from 2003 to the final assessment year (2022), following the option indicated in the Stock Annex when a trend in the time-series was detected. Recruitment short-term projection assumption value is given in Table 4.3.8. Projected landings for 2024 and SSB at the beginning of 2025 for different management options in 2024 are presented in Table 4.3.8. Under F_{sq} scenario in 2024, a 13% increase in landings with respect to 2023 as well as an 8% of increase in SSB in 2025 with respect to 2024 are expected.

4.2.4.2 Yield and biomass per recruit analyses

The summary table of Yield- and SSB-per-recruit analyses is given in the table below:

	SPR level	F _{mult}	F(30-130cm)	YPR(land)	SSB/R
F _{max}	0.14	3.13	0.255	1.92	6.80
F _{0.1}	0.26	2.02	0.165	1.82	12.45
F _{40%}	0.40	1.33	0.108	1.58	19.00
F _{35%}	0.35	1.54	0.125	1.67	16.64
F _{30%}	0.30	1.79	0.146	1.76	14.27

The F that maximizes the yield-per-recruit, F_{max}, is estimated at 0.255 which is well above F_{sq} (0.068) and which corresponds to a SPR level of 14%. The F_{0.1}, rate of F at which the slope of the YPR curve falls to 10% of its value of origin is equal to 0.165 and it corresponds to a SPR level of 26%. Fishing mortalities at F_{30%}, F_{35%} and F_{40%} were estimated at 0.146, 0.125 and 0.108, respectively. The F_{sq} is below F_{max}, F_{0.1}, F_{30%}, F_{35%} and F_{40%}.

4.2.5 Biological reference points of stock biomass and yield

Biological reference points for the southern white anglerfish stock were calculated in WKANGLER (ICES, 2018). In 2021, WGBIE followed the ACOM guidelines (ICES, 2020) where the value of F_{pa} was revised according to the new definition “F_{p0.5}, the F that leads to SSB ≥ B_{lim} with 95% probability” (calculated with B_{trigger}). Since the new F_{pa} value was higher than the F_{lim}, the F_{lim} value was discarded and has not been defined yet (ICES, 2021b). The reference points in use for the stock are presented in the following table:

Framework	Reference points	Value	Rational
Precautionary approach	B _{lim}	1993 t	B _{loss}
	B _{pa}	2769 t	B _{lim} * exp (1.645*0.2).
	F _{lim}	not defined	
	F _{pa}	0.87	F _{p0.5} ; the F that leads to SSB ≥ B _{lim} with 95% probability, calculated using B _{trigger} .
MSY approach	F _{MSY}	0.24	Stochastic simulation, F maximizes median equilibrium yield.
	F _{MSY-lower}	0.164	Stochastic simulations, 5% reduction in long-term yield compared with MSY.
	F _{MSY-upper}	0.33	
	MSY B _{trigger}	6283 t	5 th percentile of SSB when fishing at F _{MSY} .

4.2.6 Comments on the assessment

The spawning-stock biomass (SSB) values increased from 2007 to 2019, decreased in 2020 and 2021, then increased again in 2022 and 2023. SSB in 2023 is estimated at 11.3 kt which is well above B_{pa} (2 769 t) and MSY B_{trigger} (6 283 t). SSB have been corrected downwards every year as showed by the retrospective plot (Figure 4.3.12). F in 2022 has decreased by 17% relative to 2021. F in 2022 is estimated to be at a value of 0.068, below F_{pa} (0.87) and F_{MSY} (0.24). An increase in

landings occurred from 1.1 kt in 2011 to 2.0 kt in 2014 but declined to 0.6 kt in 2022. For the period 2015–2018, recruitments were extremely low, being the main concern about the status of the stock. In 2019 and 2021, the estimated recruitment values indicate a moderate increase in the abundance of age-0 individuals.

Since 2017, the catches for the two *Lophius* species in 8c and 9a are considerably lower than the agreed combined TAC for *Lophius* spp. for the same area. Although the combined TAC has been increasing in line with the ICES advice, landings of the two species have been decreasing. The reasons for this mismatch are not totally understood. The partial fishing effort information available until 2020 indicates that effort has decreased for some fleets (Figure 4.3.4). In the case of white anglerfish, the information from the Northern Spanish Shelf Groundfish Survey (SpGFS-WIBTS-Q4, G2784) is representative of small individuals (< 40 cm) revealing a very low levels of recruitment for the period 2015–2018 (Figure 4.3.2). On the other hand, the series of abundance indices for commercial sizes ended in 2012 and no other fishery-dependent information is available. Although the assessment model results are indicating high levels of SSB since 2015 (Table 4.3.7), the low catches represent an opposite perception of the stock size. The dynamics of the Spanish fleets targeting anglerfishes (trawlers and gillnetters) could have changed to catching other species in recent years. Thus, reducing the fishing effort towards the anglerfish species and, consequently, reducing their catches.

4.2.7 Quality considerations

The available unallocated and non-reported landing information for the period 2011–2019 are included in the stock assessment since the estimates were considered as realistic information. Uncertainty of the assessment model may have increased due to the absence of commercial abundance indices since 2012. For the last 11 years, the model lacks an abundance indicator for larger individuals which might have an effect on the F and SSB calculations for larger individuals.

4.2.8 Management considerations

Management considerations for both southern anglerfish stocks are included in section 4.2.

4.2.9 Recommendations for next benchmark

Given the uncertain results, WGBIE recommends for this stock to go to a benchmark as soon as possible. Intersessional works should be made and results presented on next WGBIE to evaluate progress to support the benchmark recommendation and, at the same time, improve the quality of the current assessment model for next year's advice. During the WKTADSA (ICES, 2021c), a number of issues to improve the current assessment model of the stock (mon.27.8.c9.a) was identified. The following tasks are proposed for the next benchmark:

- Simplify the current model by changing the structure from a quarter to an annual time-step.
- Reduce the number of fishing fleets included in the model. The four fleets defined in the current model could be reduced to 2 fleets: Gillnet Fleet and Trawler Fleet.
- Explore the selectivity pattern of the fleets. Although Stock Synthesis experts indicated that there are reasons against and for selecting a specific selectivity pattern, but disagreements occur with regards to the rule that should be considered such as “at least one fleet-selectivity must be asymptotic”. A specific residual analysis should be carried out to identify the potential impact of the different selectivity patterns on F and SSB estimates.
- Use an age-variant natural mortality (M). The differential sex growth (females reach larger sizes than males) should also be taken into account to define an M for older ages.

- Inclusion of a standardized abundance index for larger individuals by considering the potential of using a standardized commercial abundance index from the Spanish gillnet fleet targeting anglerfish.
- The model-based estimates of effective sample size should be updated every year using the Dirichlet-Multinomial method.
- Create a protocol for model diagnostics to ease model development and selection using the functions included in the R library *ss3diags* (Winker *et al.*, 2021).

4.2.10 References

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4.3 Tables and figures

Table 4.3.1. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Landings (in tonnes) by the main fishing fleets from 1978–2022 as estimated by the WGBIE.

Year	Div. 8c						Div. 9a						Div. 8c+9a		Div. 8c+9a	
	SPAIN			FRANCE			SPAIN			PORTUGAL			SUBTOTAL	Unallocated / Non-reported	TOTAL	
	Trawl	Gillnet	Others	Trawl	Gillnet	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL				
1978	n/a	n/a				n/a	258				115	373				
1979	n/a	n/a				n/a	319				225	544				
1980	2 806	1 270				4 076	401				339	740	4 816	0	4 816	
1981	2 750	1 931				4 681	535				352	887	5 568	0	5 568	
1982	1 915	2 682				4 597	875				310	1 185	5 782	0	5 782	
1983	3 205	1 723				4 928	726				460	1 186	6 114	0	6 114	
1984	3 086	1 690				4 776	578			186	492	1 256	6 032	0	6 032	
1985	2 313	2 372				4 685	540			212	702	1 454	6 139	0	6 139	
1986	2 499	2 624				5 123	670			167	910	1 747	6 870	0	6 870	
1987	2 080	1 683				3 763	320			194	864	1 378	5 141	0	5 141	
1988	2 525	2 253				4 778	570			157	817	1 543	6 321	0	6 321	
1989	1 643	2 147				3 790	347			259	600	1 206	4 996	0	4 996	
1990	1 439	985				2 424	435			326	606	1 366	3 790	0	3 790	
1991	1 490	778				2 268	319			224	829	1 372	3 640	0	3 640	
1992	1 217	1 011				2 228	301			76	778	1 154	3 382	0	3 382	
1993	844	666				1 510	72			111	636	819	2 329	0	2 329	
1994	690	827				1 517	154			70	266	490	2 007	0	2 007	
1995	830	572				1 403	199			66	166	431	1 834	0	1 834	
1996	1 306	745				2 050	407			133	365	905	2 955	0	2 955	
1997	1 449	1 191				2 640	315			110	650	1 075	3 714	0	3 714	
1998	912	1 359				2 271	184			28	497	710	2 981	0	2 981	
1999	545	1 013				1 558	79			9	285	374	1 932	0	1 932	
2000	269	538				808	107			4	340	451	1 259	0	1 259	
2001	231	294				525	57			16	190	263	788	0	788	
2002	385	341		51	7	784	110			29	168	307	1 090	0	1 090	
2003	911	722		46	0	1 679	312			29	305	645	2 324	0	2 324	
2004	1 262	1 269		73	27	2 631	264			27	335	626	3 257	0	3 257	
2005	1 378	1 622		134	46	3 180	371			29	244	643	3 824	0	3 824	
2006	1 166	1 247		60	5	2 478	260			29	230	519	2 997	0	2 997	
2007	955	1 009		22	6	1 992	181			13	192	386	2 378	0	2 378	
2008	894	1 168		26	8	2 096	138			11	127	275	2 371	0	2 371	
2009	850	1 058		17	9	1 935	213			10	148	371	2 306	0	2 306	
2010	370	955		12	2	1 339	158			2	119	279	1 618	0	1 618	
2011	243	483	73	15	2	816	59	28	48	46	80	260	1 077	80	1 157	
2012	271	527	67	12	2	880	54	20	42	6	163	285	1 165	230	1 395	
2013	274	718	38	19	6	1 054	47	30	50	15	154	296	1 350	190	1 541	
2014	358	947	28	25	9	1 368	91	47	4	27	122	291	1 659	374	2 032	
2015	324	802		11	12	1 149	86	53	2	34	200	375	1 524	244	1 767	
2016	376	846	3	10	8	1 243	76	67	1	8	120	273	1 516	294	1 809	
2017	248	726	1	3	8	986	106	66	1	30	138	341	1 327	119	1 446	
2018	227	614	34	5	6	886	117	35	1	6	94	253	1 139	4	1 144	
2019	161	435	0	0	0	597	74	33	1	22	104	233	830	78	909	
2020	175	256	1	8	3	443	84	40	2	28	125	279	722	0	722	
2021	178	233	1	3	0	415	88	7	2	16	80	193	608	0	608	
2022	221	197	1	0	0	419	67	7	1	19	61	154	574	0	574	
n/a: not available																

n/a: not available

Table 4.3.2. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Weights and proportions of unwanted catches for Spanish fleets.

Discards Recorded in Logbooks		Gillnet		
Year	Weight (t)	Weight (t)		
2019	0	0		
2020	0	0		
2021	0	0		
2022	0	0		

Landings Below Minimum Size		Gillnet		
Year	Weight (t)	Weight (t)		
2018	0.027	0.111		
2019	0	0		
2020*	0.001	0		
2021	0	0		
2022	0	0		

Discards Estimates: Trawl				
Year	Weight (t)	CV	% Trawl Catches	% Total Catches
1994	20.9	34.05	2.2	1.0
1995	n/a	n/a	n/a	n/a
1996	n/a	"	n/a	n/a
1997	5.4	68.13	0.3	0.1
1998	n/a	n/a	n/a	n/a
1999	0.7	"	0.1	0.0
2000	6.2	"	1.6	0.5
2001	n/a	"	n/a	n/a
2002	n/a	"	n/a	n/a
2003	26.2	"	2.0	1.1
2004	64.9	"	3.8	2.0
2005	56.2	"	2.9	1.4
2006	99.3	"	6.2	3.2
2007	17.2	"	1.4	0.7
2008	5.1	"	0.5	0.2
2009	24.5	"	2.2	1.1
2010	12.5	"	2.3	0.8
2011	30.1	"	7.7	2.5
2012	66.7	"	16.3	4.6
2013	65.8	"	15.7	3.8
2014	24.4	"	4.6	1.2
2015	20.8	"	4.4	1.2
2016	0.03	"	0.0	0.0
2017	13.3	"	3.3	0.9
2018	4.1	"	1.2	0.4
2019	1.9	"	0.7	0.2
2020*	2.2	"	0.7	0.3
2021	13.1	"	4.4	2.1
2022	5.9	"	1.9	1.0

Discards Estimates: Gillnet			
Year	Weight (t)	% Gillnet Catches	% Total Catches
2013	143.8	13.7	8.2
2014	0.0	0.0	0.0
2015	7.6	0.7	0.4
2016	24.2	2.3	1.3
2017	17.0	1.8	1.2
2018	1.8	0.2	0.2
2019	16.7	2.8	1.8
2020*	3.8	0.9	0.5
2021	0.0	0.0	0.0
2022	n/a	n/a	n/a

n/a: not available
CV: coefficient of variation
* only for 3rd and 4th quarter

Table 4.3.3. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Length composition by fleet and adjusted length composition for total landings (in thousands) in 2022. Adjusted total: adjusted landings including fleets without length composition.

Length (cm)	Div. 8c			Div. 9a				Div. 8c+9a	
	SPAIN			SPAIN		PORTUGAL		TOTAL	Adjusted TOTAL
	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL		
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.05	0.00	0.00	0.06	0.06	0.06
23	0.00	0.00	0.00	0.07	0.00	0.00	0.07	0.07	0.07
24	0.00	0.00	0.00	0.05	0.00	0.00	0.06	0.06	0.06
25	0.00	0.00	0.00	0.05	0.00	0.00	0.06	0.06	0.06
26	0.00	0.00	0.00	0.12	0.02	0.00	0.14	0.14	0.14
27	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.04
28	0.00	0.00	0.00	0.11	0.02	0.00	0.13	0.13	0.13
29	0.18	0.00	0.18	0.20	0.01	0.00	0.21	0.39	0.40
30	0.79	0.00	0.79	0.26	0.02	0.00	0.28	1.06	1.07
31	1.05	0.00	1.05	0.29	0.02	0.00	0.31	1.36	1.37
32	1.51	0.00	1.51	0.53	0.06	0.00	0.59	2.10	2.11
33	2.31	0.00	2.31	0.40	0.07	0.00	0.47	2.78	2.80
34	2.67	0.00	2.67	0.57	0.08	0.01	0.67	3.34	3.37
35	2.90	0.13	3.03	0.45	0.04	0.01	0.50	3.53	3.56
36	2.69	0.05	2.74	0.49	0.08	0.12	0.68	3.43	3.45
37	1.95	0.10	2.05	0.29	0.17	0.09	0.56	2.61	2.63
38	3.39	0.31	3.70	0.80	0.35	0.08	1.22	4.92	4.95
39	2.20	0.12	2.32	0.35	0.11	0.14	0.60	2.92	2.93
40	2.18	1.05	3.23	0.67	0.77	0.16	1.60	4.84	4.90
41	2.18	0.17	2.35	0.19	0.16	0.10	0.45	2.80	2.81
42	1.99	0.98	2.97	0.40	0.14	0.23	0.77	3.74	3.80
43	1.41	0.42	1.84	0.26	0.08	0.19	0.52	2.36	2.39
44	1.73	0.88	2.61	0.72	0.16	0.28	1.16	3.77	3.82
45	1.79	1.27	3.06	0.30	0.37	0.32	1.00	4.06	4.14
46	1.43	0.65	2.08	0.33	0.04	0.19	0.56	2.64	2.67
47	0.96	1.29	2.24	0.52	0.20	0.29	1.00	3.25	3.31
48	1.35	1.60	2.96	0.15	0.12	0.09	0.35	3.31	3.39
49	1.13	0.90	2.03	0.19	0.15	0.22	0.57	2.60	2.64
50	1.21	0.98	2.19	0.65	0.30	0.20	1.16	3.34	3.39
51	1.30	1.66	2.96	0.15	0.12	0.18	0.45	3.41	3.50
52	1.23	2.01	3.25	0.55	0.10	0.08	0.73	3.98	4.08
53	1.21	2.15	3.36	0.35	0.07	0.10	0.52	3.88	3.99
54	1.73	1.78	3.51	0.33	0.11	0.12	0.56	4.06	4.16
55	1.28	2.37	3.65	0.37	0.15	0.08	0.59	4.24	4.36
56	1.29	1.01	2.30	0.16	0.17	0.17	0.51	2.80	2.85
57	1.65	0.58	2.23	0.72	0.20	0.11	1.03	3.26	3.30
58	0.90	1.53	2.43	0.45	0.07	0.08	0.60	3.03	3.10
59	1.38	0.42	1.80	0.25	0.02	0.07	0.35	2.15	2.18
60	0.97	0.87	1.84	0.12	0.03	0.11	0.27	2.11	2.15
61	1.12	0.74	1.86	0.15	0.04	0.16	0.35	2.20	2.24
62	1.20	0.73	1.93	0.30	0.02	0.21	0.54	2.46	2.51
63	0.94	0.27	1.20	0.07	0.01	0.00	0.08	1.28	1.30
64	0.92	0.60	1.52	0.27	0.05	0.00	0.32	1.85	1.88
65	0.57	0.61	1.18	0.22	0.01	0.11	0.33	1.51	1.54
66	1.03	0.83	1.86	0.12	0.02	0.00	0.13	2.00	2.04
67	0.98	0.64	1.61	0.21	0.02	0.00	0.24	1.85	1.88
68	0.91	0.91	1.82	0.16	0.00	0.00	0.16	1.98	2.02
69	1.02	0.59	1.61	0.20	0.02	0.00	0.22	1.83	1.86
70	0.95	0.55	1.49	0.00	0.00	0.08	0.08	1.58	1.59
71	0.83	0.37	1.20	0.08	0.12	0.06	0.26	1.46	1.48
72	0.83	0.76	1.59	0.54	0.09	0.00	0.63	2.22	2.26
73	0.55	0.61	1.16	0.22	0.02	0.10	0.34	1.50	1.53
74	0.78	0.69	1.47	0.05	0.00	0.00	0.05	1.52	1.54
75	0.43	1.12	1.55	0.15	0.00	0.16	0.31	1.87	1.90
76	0.64	0.22	0.86	0.06	0.01	0.00	0.07	0.93	0.94
77	0.62	0.42	1.05	0.09	0.00	0.00	0.09	1.14	1.16
78	0.63	0.65	1.28	0.05	0.00	0.02	0.07	1.35	1.38
79	0.38	0.61	0.99	0.20	0.05	0.00	0.25	1.24	1.26
80	0.30	0.56	0.86	0.05	0.00	0.10	0.15	1.01	1.03
81	0.70	0.36	1.05	0.07	0.01	0.06	0.14	1.20	1.21
82	0.28	0.58	0.86	0.14	0.02	0.00	0.16	1.02	1.05
83	0.17	0.35	0.52	0.18	0.00	0.02	0.19	0.72	0.73
84	0.73	0.15	0.89	0.11	0.00	0.00	0.11	1.00	1.01
85	0.47	0.52	0.99	0.07	0.02	0.00	0.08	1.07	1.09
86	0.06	0.46	0.52	0.13	0.00	0.06	0.20	0.72	0.73
87	0.33	0.64	0.97	0.04	0.00	0.07	0.11	1.08	1.10
88	0.34	0.07	0.41	0.00	0.04	0.01	0.05	0.46	0.46
89	0.54	0.27	0.81	0.16	0.13	0.00	0.29	1.10	1.11
90	0.07	0.21	0.29	0.15	0.01	0.00	0.16	0.45	0.45
91	0.21	0.26	0.47	0.28	0.03	0.10	0.40	0.87	0.89
92	0.41	0.30	0.71	0.00	0.00	0.06	0.06	0.77	0.78
93	0.25	0.17	0.42	0.05	0.00	0.02	0.06	0.49	0.50
94	0.24	0.27	0.51	0.00	0.00	0.01	0.01	0.52	0.53
95	0.04	0.04	0.09	0.10	0.04	0.00	0.14	0.22	0.23
96	0.32	0.09	0.40	0.00	0.00	0.08	0.08	0.49	0.49
97	0.17	0.23	0.39	0.03	0.01	0.06	0.10	0.50	0.51
98	0.35	0.22	0.57	0.05	0.00	0.02	0.08	0.64	0.65
99	0.17	0.28	0.46	0.41	0.19	0.00	0.60	1.06	1.08
100+	1.51	2.35	3.87	0.80	0.22	1.56	2.58	6.45	6.54
TOTAL	75.0	45.6	120.6	18.9	5.8	7.0	31.7	152.2	154.6
Tonnes	220.9	197.3	418.1	67.3	18.7	60.7	146.7	564.9	573.7
Mean Weight (g)	2945	4329	3468	3566	3239	8681	4636	3711	3711
Mean length (cm)	54.0	63.9	57.8	56.1	54.2	72.4	59.4	58.1	58.1

Table 4.3.4. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Numbers, mean weights and lengths of landings between 1986 and 2022.

Year	Total (thousands)	Mean Weight (g)	Mean Length (cm)
1986	1 872	3 670	61
1987	2 806	1 832	44
1988	2 853	2 216	50
1989	1 821	2 744	54
1990	1 677	2 261	49
1991	1 657	2 197	50
1992	1 256	2 692	54
1993	857	2 719	54
1994	704	2 850	54
1995	876	2 093	48
1996	1 153	2 564	52
1997	1 043	3 560	60
1998	583	5 113	68
1999	290	6 674	71
2000	190	6 885	72
2001	127	6 189	64
2002	381	2 766	50
2003	784	2 907	54
2004	809	3 456	61
2005	856	4 259	63
2006	923	3 211	58
2007	553	4 251	62
2008	540	4 327	63
2009	492	4 630	64
2010	288	5 569	71
2011	249	4 252	62
2012	244	4 711	65
2013	269	4 929	66
2014	289	5 630	70
2015	307	4 902	66
2016	327	5 485	69
2017	233	6 205	73
2018	161	7 163	77
2019	139	6 519	73
2020	na	na	na
2021	135	4 500	64
2022	155	3 711	58

na: not available

Table 4.3.5 White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Abundance indices from Spanish and Portuguese surveys.

Year	SP-NORTH-Q4 (G2784)					PT-IBTS-Q4 (G8899)				
	September-October (total area Miño-Bidasoa)					October				
	Hauls	kg/30 min		n°/30 min		Hauls	kg/60 min		n°/60 min	
		Yst	se	Yst	se		Yst	se	Yst	se
1983	145	2.03	0.29	3.50	0.46	117	n/a		n/a	
1984	111	2.60	0.47	2.90	0.55	na	n/a		n/a	
1985	97	1.33	0.36	1.90	0.26	150	n/a		n/a	
1986	92	4.28	0.80	10.70	1.40	117	n/a		n/a	
1987	ns	ns	ns	ns	ns	81	n/a		n/a	
1988	101	3.33	0.70	1.50	0.25	98	n/a		n/a	
1989	91	0.44	0.08	2.40	0.30	138	0.09		0.07	
1990	120	1.19	0.22	1.20	0.22	123	0.46		0.05	
1991	107	0.71	0.22	0.50	0.09	99	+		+	
1992	116	0.76	0.15	1.18	0.16	59	0.09		0.01	
1993	109	0.88	0.16	1.20	0.14	65	0.08		0.01	
1994	118	1.66	0.62	3.70	0.49	94	+		0.02	
1995	116	2.19	0.32	5.70	0.69	88	0.05		0.03	
1996*	114	1.54	0.26	1.40	0.16	71	0.27		0.18	
1997	116	1.69	0.39	0.67	0.11	58	0.49		0.03	
1998	114	1.40	0.37	0.39	0.08	96	+		+	
1999*	116	0.75	0.23	0.36	0.06	79	+		+	
2000	113	0.57	0.19	0.88	0.18	78	+		+	
2001	113	1.09	0.24	2.88	0.28	58	+		+	
2002	110	1.34	0.21	2.76	0.29	67	0.06		0.04	
2003*	112	1.67	0.40	1.41	0.16	80	0.29		0.15	
2004*	114	2.09	0.32	2.71	0.32	79	0.16		0.12	
2005	116	3.05	0.54	2.04	0.19	87	0.12		0.04	
2006	115	1.88	0.40	2.86	0.30	88	+		+	
2007	117	1.65	0.25	2.56	0.25	96	+		+	
2008	115	1.85	0.37	1.96	0.35	87	+		+	
2009	117	1.07	0.17	1.91	0.17	93	+		+	
2010	114	1.29	0.25	1.95	0.28	87	+		+	
2011	114	0.77	0.16	1.09	0.18	86	+		+	
2012	115	1.11	0.27	1.06	0.14	ns	ns		ns	
2013**	114	2.09	0.64	2.30	0.30	93	0.34		0.02	
2014**	116	1.56	0.36	1.24	0.17	81	0.00		0.00	
2015**	114	1.14	0.25	0.58	0.10	90	0.00		0.00	
2016**	114	0.76	0.28	0.30	0.06	85	0.00		0.00	
2017**	112	0.53	0.30	0.18	0.07	89	0.00		0.00	
2018**	113	0.64	0.25	0.13	0.03	53	0.00		0.00	
2019**	113	0.53	0.21	0.31	0.07	n/a	n/a		n/a	
2020**	109	0.73	0.22	0.37	0.07	n/a	n/a		n/a	
2021***	113	0.90	0.23	0.78	0.11	93	0.002		0.0215	
2022****	114	1.53	0.33	0.88	0.10	61	0.00		0.00	

Yst = stratified mean

se = standard error

ns = no survey

n/a = not available

+ = less than 0.01

* For Portuguese Surveys - R/V Capricornio, other years R/V Noruega

** For Spanish Surveys - R/V Miguel Oliver, other years R/V Coornide de Saavedra

*** For Spanish Surveys - R/V Miguel Oliver and R/V Vizconde de Eza

**** For Spanish Survey - R/V Miguel Oliver and Portugal R/V Mário Ruivo

Table 4.3.6. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Landings (in thousands), fishing effort and LPUEs for trawl and gillnet fleets. For the landings, the proportion relative to the total annual stock landings is given.

Year	SP-AWTR8C			SP-SANTR8C			STAND-SP-CEDGNS8C		
	LANDINGS	% EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	% EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	% EFFORT (soaking days) (kg/soaking day)	LPUE
1985	500	7	10 845	516	8	18 153	28.4		
1987	500	10	8 309	529	10	14 995	35.3		
1988	401	6	9 047	387	6	16 660	23.3		
1989	214	4	8 063	305	6	17 607	17.3		
1990	260	7	8 497	278	7	20 469	13.6		
1991	245	7	7 681	281	8	22 391	12.6		
1992	198	6	--	222	7	22 833	9.7		
1993	76	3	7 635	186	8	21 370	8.7		
1994	116	6	9 620	188	9	22 772	8.2		
1995	192	10	6 146	186	10	14 046	13.2		
1996	322	11	4 525	270	9	12 071	22.4		
1997	345	9	5 061	381	10	11 776	32.3		
1998	286	10	5 929	316	11	10 646	29.7		
1999	108	6	6 829	182	9	10 349	17.6	342	18 4 582 74.5
2000	28	2	4 453	75	6	8 779	8.6	140	11 2 981 46.8
2001	23	3	1 838	54	7	3 053	17.6	87	11 1 932 44.8
2002	75	7	2 748	57	6	3 975	14.3	130	13 2 398 54.3
2003	111	5	2 526	85	4	3 837	22.1	159	7 2 703 59.0
2004	216	7	--	106	3	3 776	28.1	382	12 4 677 81.6
2005	278	8	--	59	2	1 404	41.9	434	12 3 325 130.4
2006	148	5	--	89	3	2 718	32.7	415	14 3 911 106.2
2007	101	4	--	103	4	4 334	23.8	233	10 3 976 58.6
2008	99	4	--	--	--	--	--	228	10 5 133 44.3
2009	69	3	--	35	2	1 125	31.3	183	8 2 300 79.5
2010	--	--	--	44	3	1 628	27.1	231	15 1 880 122.7
2011	--	--	--	44	4	--	--	60	6 522 115.9
2012	--	--	--	22	2	--	--	63	5 -- --

Year	SP-CORT8C-PORT			SP-CORT8C-TRUCKS			SP-CORT8C-FLEET		
	LANDINGS	% EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	% EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	% EFFORT (days*100hp)	LPUE (kg/day*100hp)
1982	1618	28	63 313				1618	28	63 313 25.6
1983	1490	24	51 008				1490	24	51 008 29.2
1984	1560	26	48 665				1560	26	48 665 32.1
1985	1134	18	45 157				1134	18	45 157 25.1
1986	825	12	40 420				825	12	40 420 20.4
1987	618	12	34 651				618	12	34 651 17.8
1988	656	10	41 481				656	10	41 481 15.8
1989	508	10	44 410				508	10	44 410 11.4
1990	550	15	44 403				550	15	44 403 12.4
1991	491	13	40 429				491	13	40 429 12.1
1992	432	13	38 899				432	13	38 899 11.1
1993	385	17	44 478				385	17	44 478 8.7
1994	245	12	39 602	63	3	12 795	5	309	15 52 397 5.9
1995	260	14	41 476	57	3	10 232	6	316	17 51 708 6.1
1996	413	14	35 709	83	3	8 791	9	496	17 44 501 11.2
1997	411	11	35 494	59	2	9 108	6	470	13 44 602 10.5
1998	138	5	29 508	30	1	--	--	168	6 -- --
1999	168	9	30 131	--	--	--	--	--	--
2000	85	7	30 079	2	0	--	--	88	7 -- --
2001	84	11	29 935	--	--	--	--	--	--
2002	130	12	21 948	61	6	6 747	9	191	18 28 695 6.7
2003	228	10	18 519	115	5	7 608	15	342	15 26 127 13.1
2004	277	9	19 198	162	5	10 342	16	439	13 29 540 14.9
2005	391	10	20 663	248	6	10 302	24	639	17 30 965 20.6
2006	242	8	19 264	273	9	12 886	21	515	17 32 130 16.0
2007	222	9	21 651	233	10	13 187	18	455	19 34 838 13.1
2008	274	12	20 212	153	6	9 812	16	428	18 30 024 14.2
2009	165	7	16 152	152	7	12 930	12	317	14 29 092 10.9
2010	129	8	16 680	70	4	9 003	8	165	10 22 746 7.3
2011	92	8	12 835	--	--	--	--	146	13 18 617 7.9
2012	132	9	14 446	--	--	--	--	142	10 21 110 6.7
2013	122	8	14 736	--	--	--	--	--	--
2014	114	6	18 060	--	--	--	--	--	--
2015	88	5	13 309	--	--	--	--	--	--
2016	138	8	13 718	--	--	--	--	--	--
2017	76	5	12 449	--	--	--	--	--	--
2018	95	8	13 247	--	--	--	--	--	--
2019	42	5	12 824	--	--	--	--	--	--
2020	--	--	--	--	--	--	--	--	--
2021	56	9	13 496	--	--	--	--	--	--
2022	49	8	13 478	--	--	--	--	--	--

Year	PT-CRUST						PT-FISH					
	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)
1989	85	2	76	23	1.1	3.7	175	3	52	18	3.3	9.9
1990	106	3	90	20	1.2	5.2	219	6	61	17	3.6	12.8
1991	73	2	83	17	0.9	4.4	151	4	57	15	2.6	9.8
1992	25	1	71	15	0.3	1.6	51	2	49	14	1.0	3.7
1993	36	2	75	13	0.5	2.7	75	3	56	13	1.3	5.7
1994	23	1	41	8	0.6	3.0	47	2	36	10	1.3	4.9
1995	22	1	38	8	0.6	2.8	45	2	41	9	1.1	4.9
1996	45	2	64	14	0.7	3.1	88	3	54	12	1.6	7.1
1997	51	1	43	11	1.2	4.5	59	2	27	9	2.2	6.7
1998	11	<1	48	11	0.2	1.0	17	1	35	10	0.5	1.8
1999	3	<1	24	8	0.1	0.4	6	<1	18	6	0.3	1.0
2000	2	<1	42	10	0.0	0.2	2	<1	19	6	0.1	0.4
2001	9	1	85	18	0.1	0.5	7	1	19	5	0.4	1.4
2002	18	2	62	10	0.3	1.9	11	1	14	4	0.8	2.4
2003	13	1	42	10	0.3	1.3	16	1	17	6	0.9	2.8
2004	12	<1	21	7	0.6	1.9	14	<1	14	4	1.0	3.3
2005	12	<1	20	5	0.6	2.2	17	<1	13	4	1.3	4.7
2006	13	<1	22	5	0.6	2.4	16	1	12	4	1.3	4.2
2007	7	<1	22	6	0.3	1.1	6	<1	8	3	0.8	2.1
2008	6	<1	14	4	0.4	1.5	5	<1	5	2	1.0	2.9
2009	5	<1	15	--	0.3	--	5	<1	6	--	0.8	--
2010	1	<1	21	--	0.0	--	1	<1	14	--	0.1	--
2011	24	2	18	--	1.3	--	22	2	9	--	2.4	--
2012	3	<1	36	--	0.1	--	3	<1	16	--	0.2	--
2013	8	<1	27	--	0.3	--	7	<1	12	--	0.6	--
2014	16	1	32	--	0.5	--	13	1	16	--	0.8	--
2015	18	1	17	--	1.1	--	16	1	14	--	1.2	--
2016	4	<1	12	--	0.3	--	4	<1	11	--	0.3	--
2017	16	1	8	--	2.0	--	15	1	11	--	1.3	--
2018	3	<1	5	--	0.6	--	3	<1	6	--	0.4	--
2019	12	1	6	--	1.9	--	11	1	5	--	2.0	--
2020	15	2	13	--	0.6	--	14	2	7	--	0.9	--
2021	8	1	11	--	0.4	--	7	1	8	--	0.4	--
2022	12	2	11	--	0.7	--	7	1	11	--	0.2	--

Table 4.3.7. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Summary of the assessment results.

	Recruit Age0 (thousands)	Total Biomass (t)	Total SSB (t)	Landings (t)	Yield/SSB	F (30-130 cm)
1980	671	15 440	9 760	4 817	0.49	0.30
1981	1 918	16 488	11 341	5 566	0.49	0.33
1982	7 353	15 556	11 893	5 782	0.49	0.38
1983	1 968	14 348	10 639	6 113	0.58	0.49
1984	767	14 050	8 821	6 031	0.68	0.51
1985	1 811	13 061	8 449	6 139	0.73	0.53
1986	6 488	10 828	7 821	6 870	0.88	0.80
1987	3 695	7 463	4 859	5 139	1.06	0.92
1988	1 080	7 353	3 201	6 321	1.98	1.37
1989	3 313	5 992	2 524	4 995	1.98	1.08
1990	2 237	4 958	2 437	3 790	1.56	0.81
1991	1 066	4 818	2 231	3 640	1.63	0.83
1992	1 329	4 526	2 131	3 382	1.59	0.86
1993	1 686	3 810	1 991	2 329	1.17	0.62
1994	3 098	3 861	2 090	2 007	0.96	0.50
1995	1 831	4 675	2 370	1 835	0.77	0.33
1996	336	6 625	3 342	2 956	0.89	0.38
1997	283	7 586	4 413	3 715	0.84	0.45
1998	223	6 871	4 802	2 981	0.62	0.38
1999	741	5 847	4 645	1 933	0.42	0.29
2000	642	5 160	4 311	1 256	0.29	0.24
2001	3 687	5 007	4 056	788	0.194	0.16
2002	1 629	5 890	4 262	1 093	0.26	0.188
2003	346	8 027	4 887	2 326	0.48	0.29
2004	2 144	9 440	5 960	3 258	0.55	0.33
2005	1 365	9 652	6 896	3 827	0.56	0.38
2006	1 269	9 077	6 605	2 998	0.45	0.34
2007	703	8 866	6 380	2 377	0.37	0.28
2008	759	9 125	6 723	2 372	0.35	0.26
2009	851	9 150	7 076	2 307	0.33	0.26
2010	1 444	8 907	7 141	1 620	0.23	0.185
2011	1 119	9 265	7 426	1 156	0.156	0.135
2012	501	10 370	8 136	1 396	0.172	0.143
2013	760	11 404	8 989	1 540	0.171	0.142
2014	1 416	12 143	9 942	2 033	0.204	0.179
2015	225	12 236	10 253	1 771	0.173	0.158
2016	191	12 536	10 456	1 809	0.173	0.170
2017	184	12 334	10 551	1 447	0.137	0.139
2018	401	12 063	10 762	1 144	0.106	0.119
2019	1 409	11 689	10 744	908	0.085	0.106
2020	399	11 456	10 454	720	0.069	0.094
2021	1 390	11 742	10 260	608	0.059	0.082
2022	756	12 350	10 539	574	0.05	0.07
2023*	706	13 488	11 324			

*geometric.mean(2003-2022)

Table 4.3.8. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Catch option table.

SSB(2023)	Rec proj	F(30-130cm)	Land(2023)	SSB(2024)
11 324	706	0.081	827	12 239

Fmult	Fland (30-130cm)	Landings (2024)	SSB (2025)
0	0	0	14 220
0.1	0.0081	98	14 121
0.2	0.0163	194	14 022
0.3	0.024	290	13 923
0.4	0.033	385	13 826
0.5	0.041	479	13 730
0.6	0.049	572	13 634
0.7	0.057	665	13 539
0.8	0.065	757	13 445
0.9	0.073	847	13 352
1	0.082	937	13 259
1.1	0.090	1027	13 168
1.2	0.098	1115	13 077
1.3	0.106	1203	12 986
1.4	0.114	1290	12 897
1.5	0.122	1376	12 808
1.6	0.130	1461	12 720
1.7	0.139	1546	12 633
1.8	0.147	1630	12 547
1.9	0.155	1713	12 461
2	0.163	1795	12 376
2.1	0.171	1877	12 292
2.2	0.179	1958	12 208
2.3	0.187	2038	12 125
2.4	0.196	2117	12 043
2.5	0.204	2196	11 962
2.6	0.212	2274	11 881
2.7	0.220	2352	11 801
2.8	0.228	2429	11 721
2.9	0.236	2505	11 642
3	0.244	2580	11 564

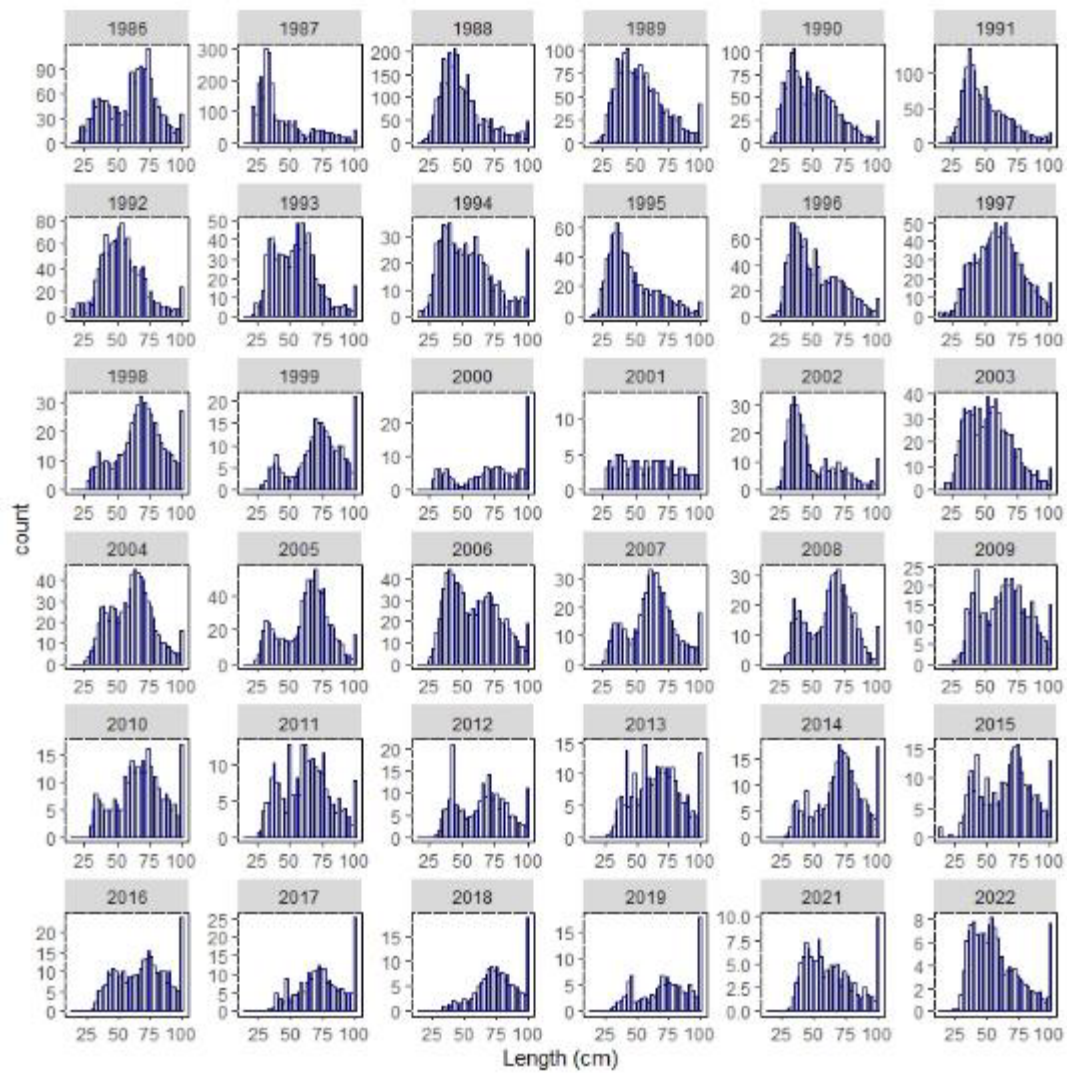


Figure 4.3.1. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Length distributions of landings (in thousands) from 1986 to 2022.

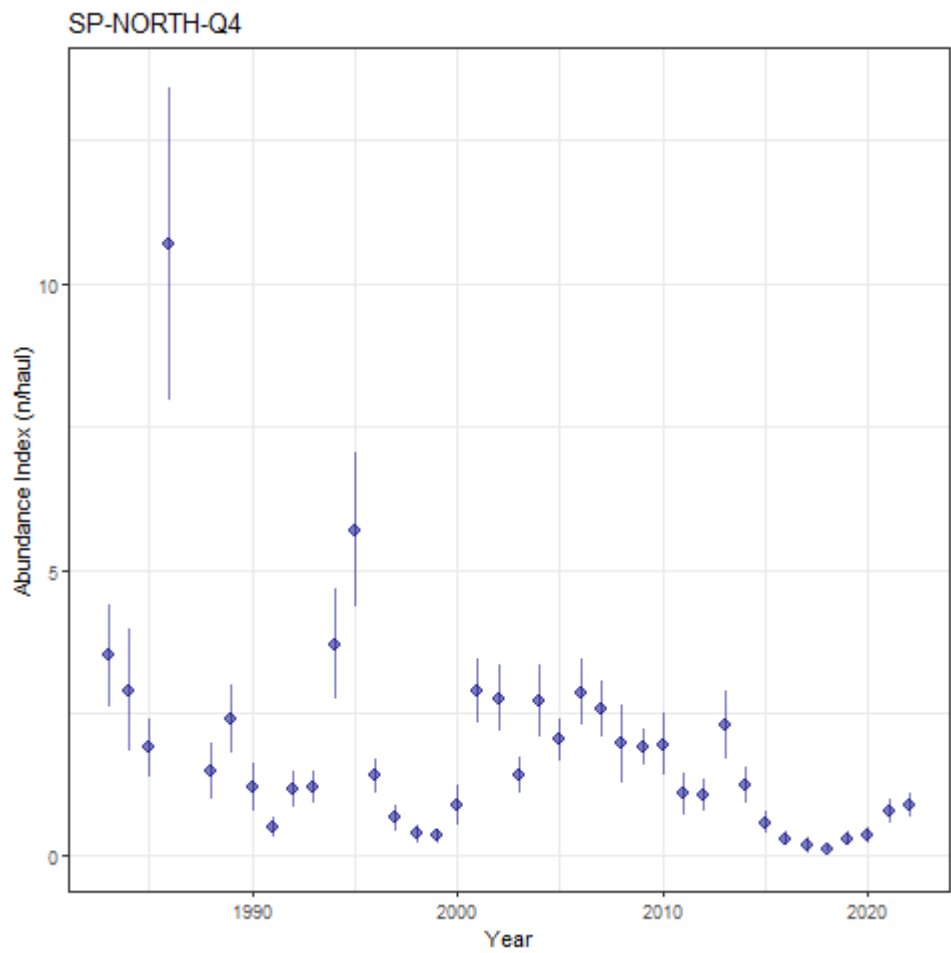


Figure 4.3.2. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Abundance index (in numbers/haul) from the SpGFS-WIBTS-Q4 (G2784) survey. Bars represent 95% confidence intervals.

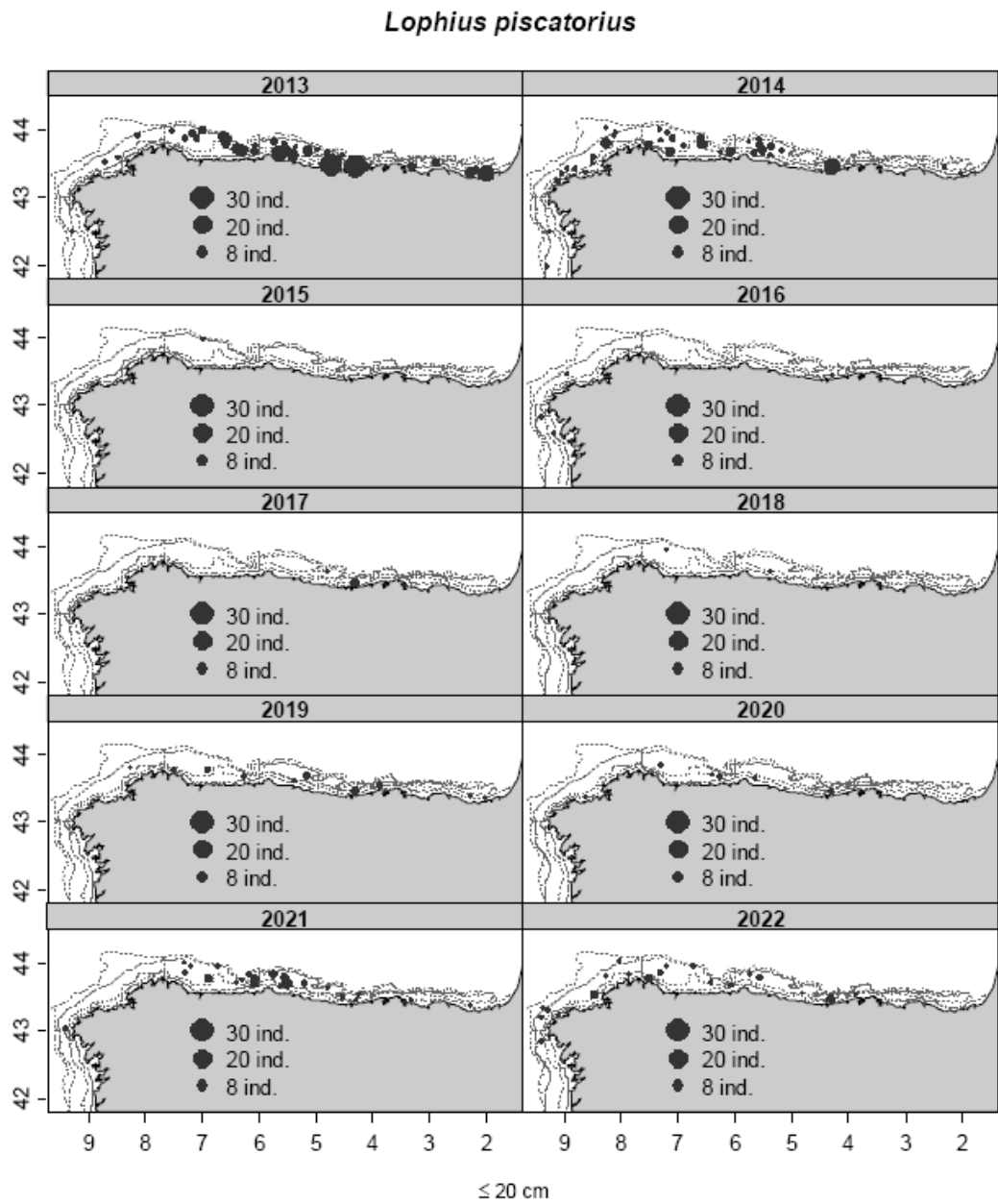


Figure 4.3.3. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Spatial distribution of juveniles (length 0–20 cm) in North Spanish Coast demersal survey (G2784) between 2012 and 2022.

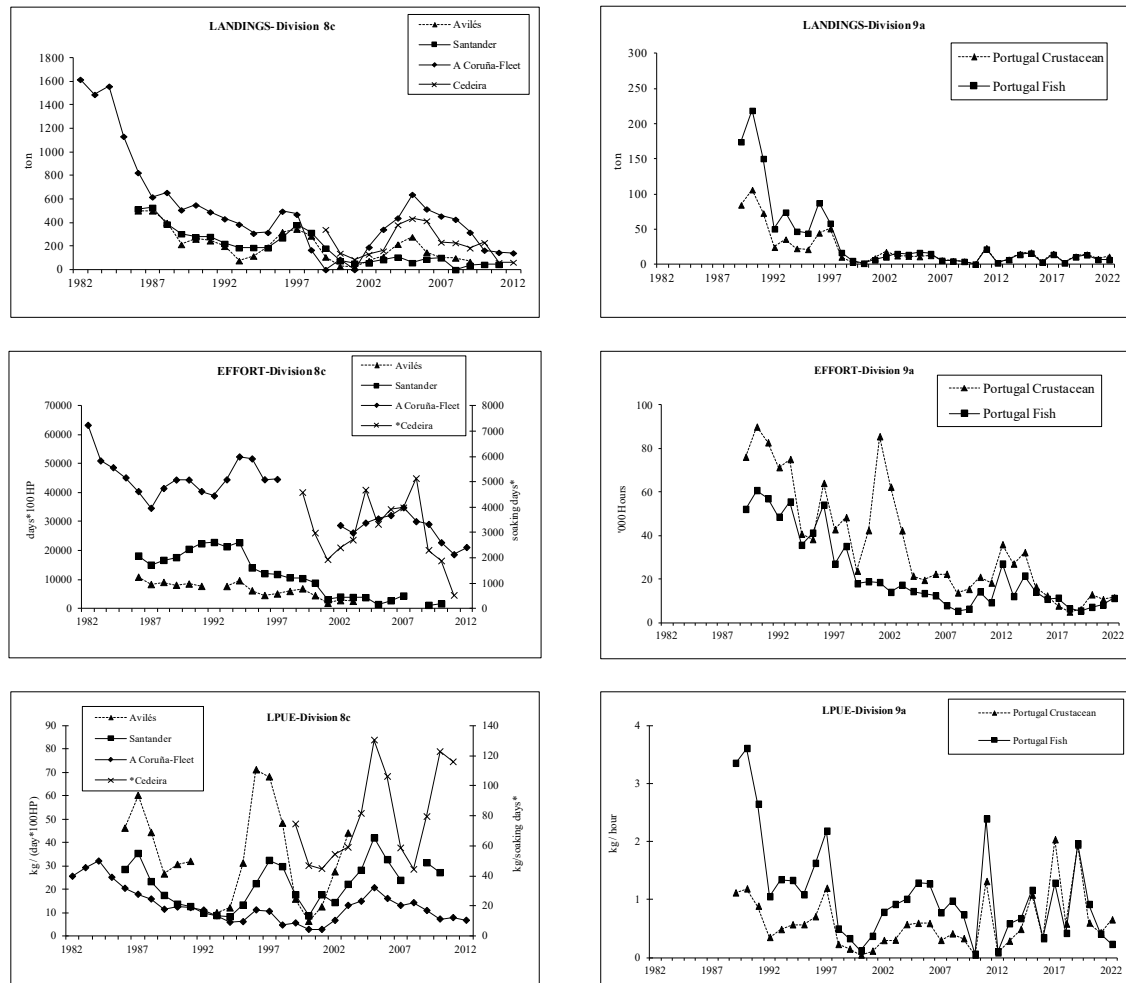


Figure 4.3.4. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Trawl (left) and gillnet (right) landings (in tonnes), effort (in day*100 HP in division 8c and '000 hours in division 9a) and LPUE (in kg/(day*100 HP in division 8c and kg/hr in division 9c) data between 1982–2022.

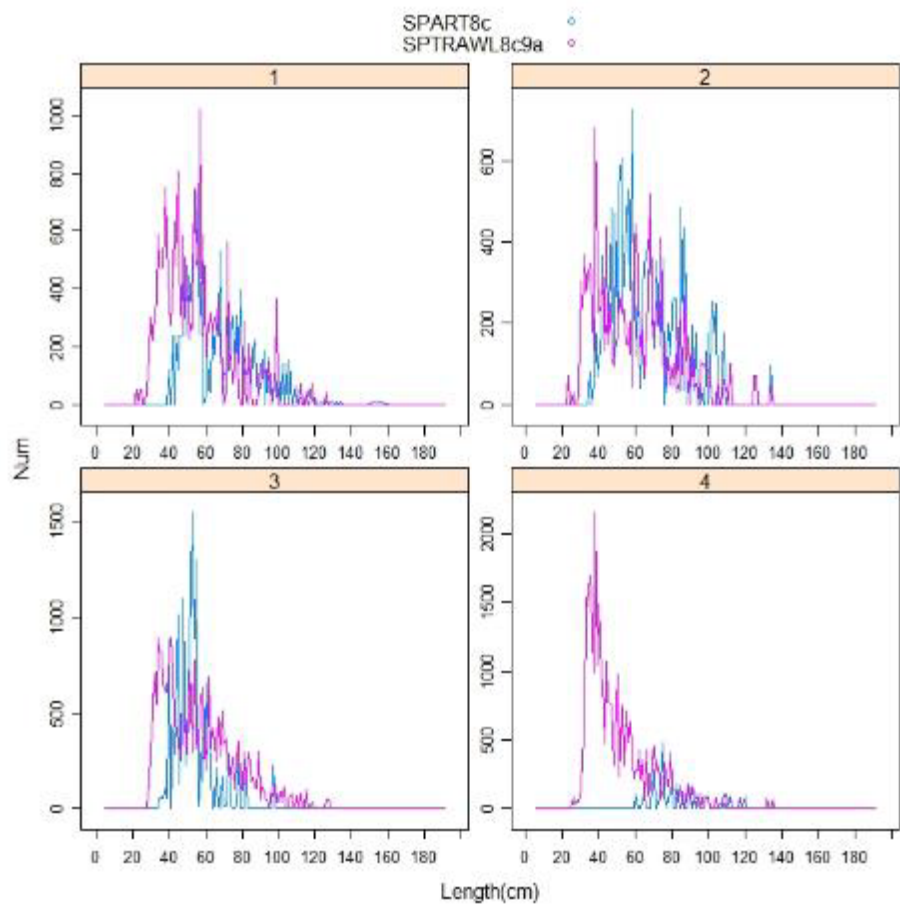


Figure 4.3.5. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Length composition by quarter in 2022 for the two Spanish fleets included in the SS model.

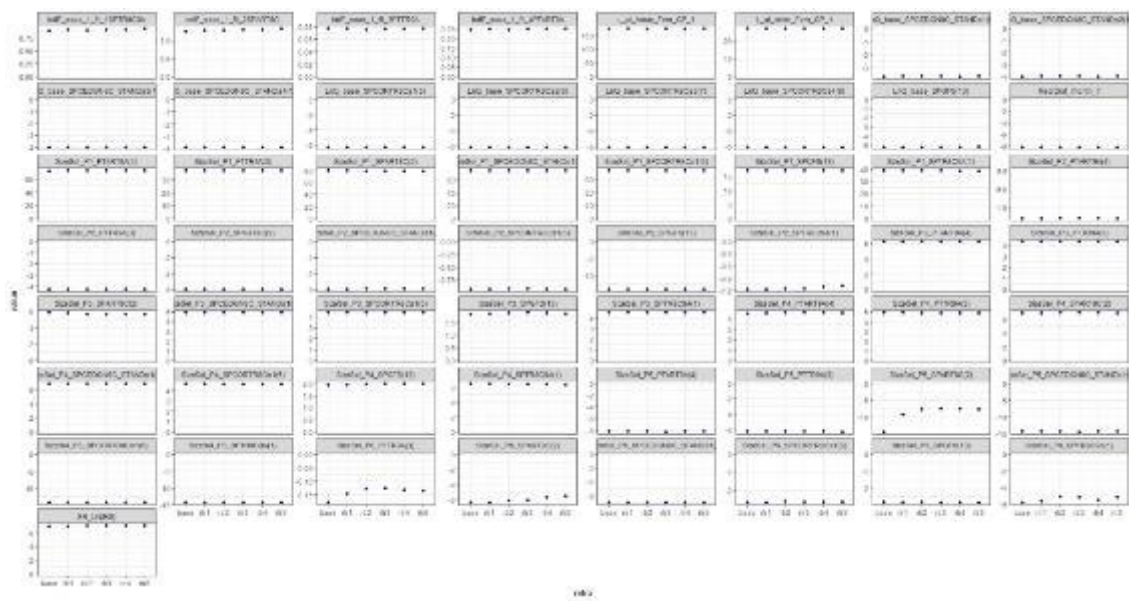


Figure 4.3.6. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Values of the estimated model parameters for a preliminary base model, that includes the 2022 length composition from a number of sample size of 125, and for 5 retrospective models.

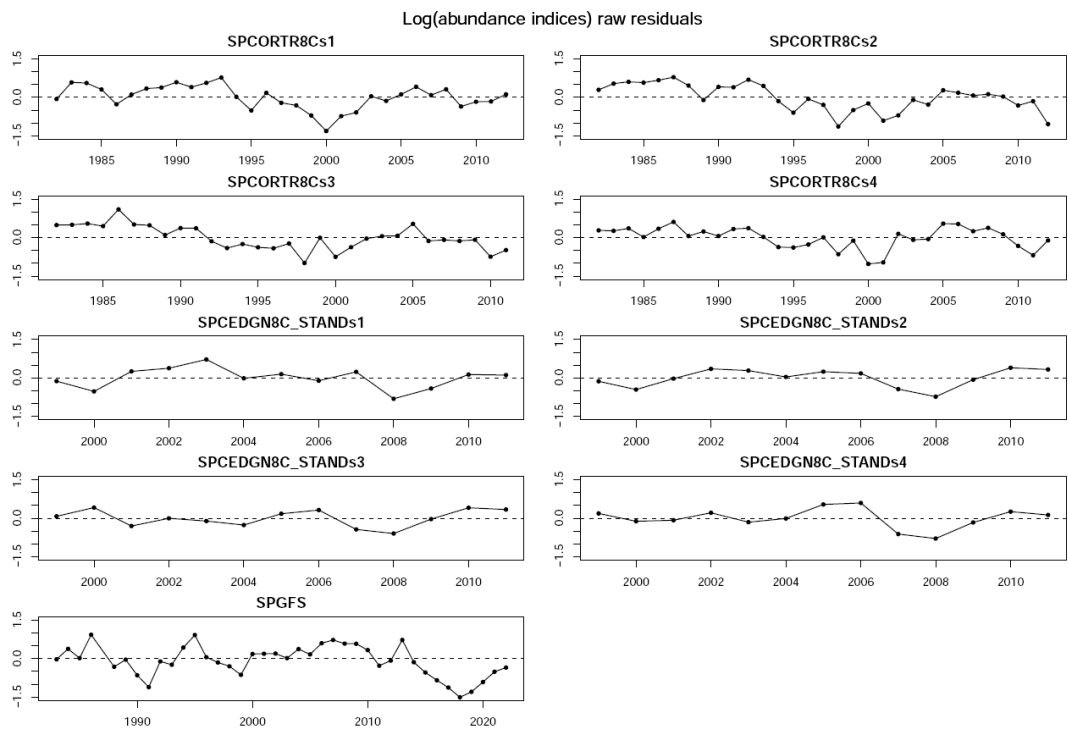
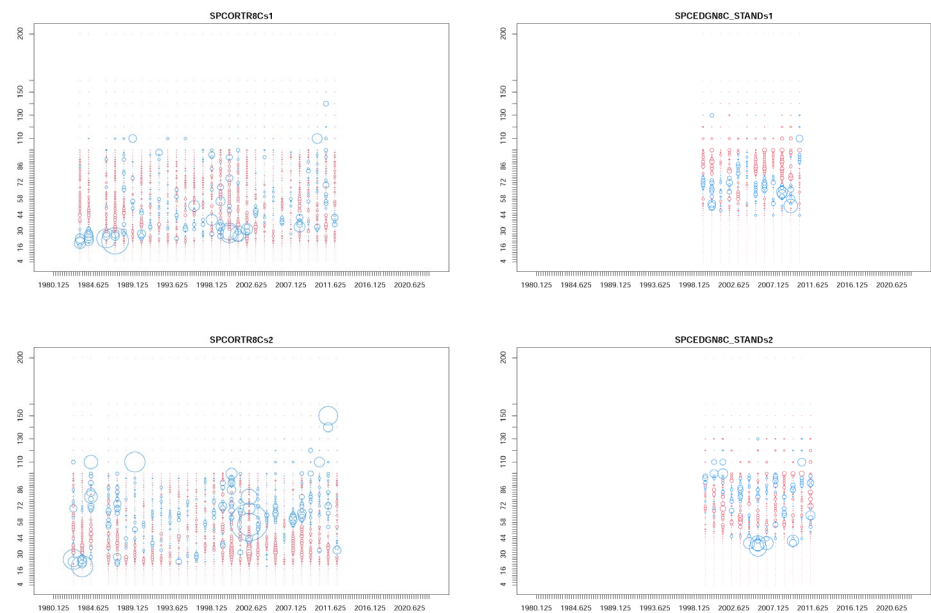


Figure 4.3.7. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Residuals of the fits to the surveys in log (abundance indices). A Coruña and Cedeira values are by quarters.



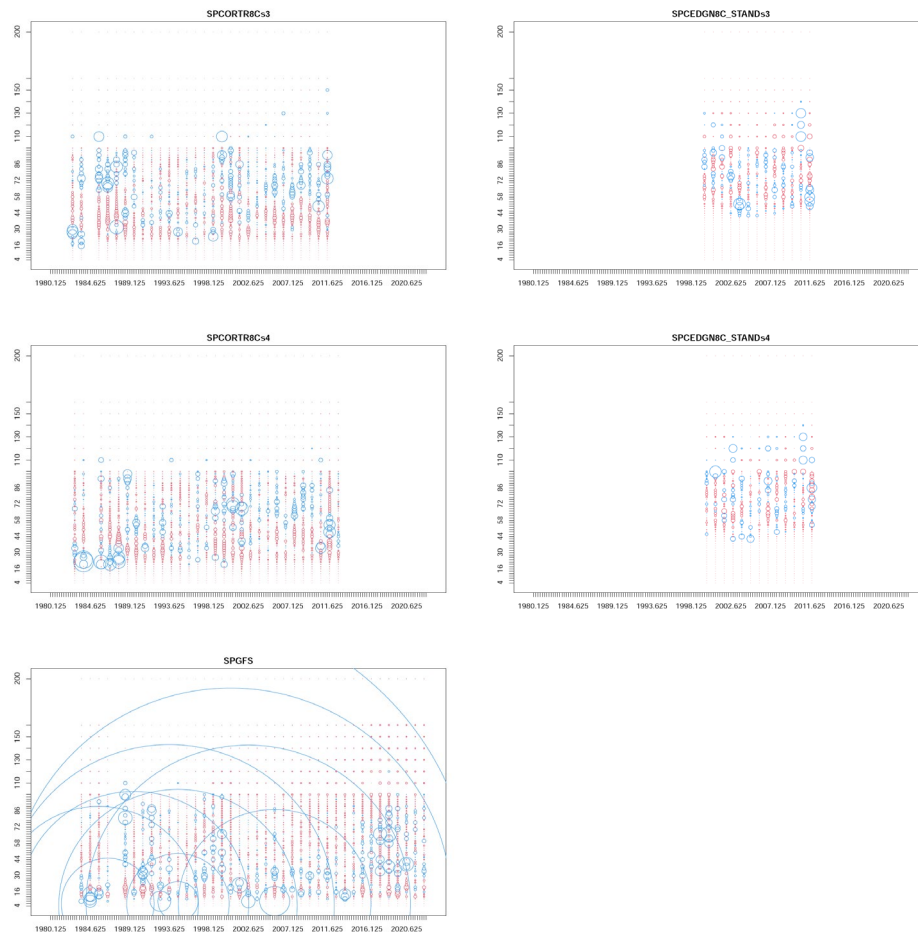


Figure 4.3.8. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Pearson residuals of the fit to the length distributions of the abundance indices. Blue=positive residuals and red=negative residuals.

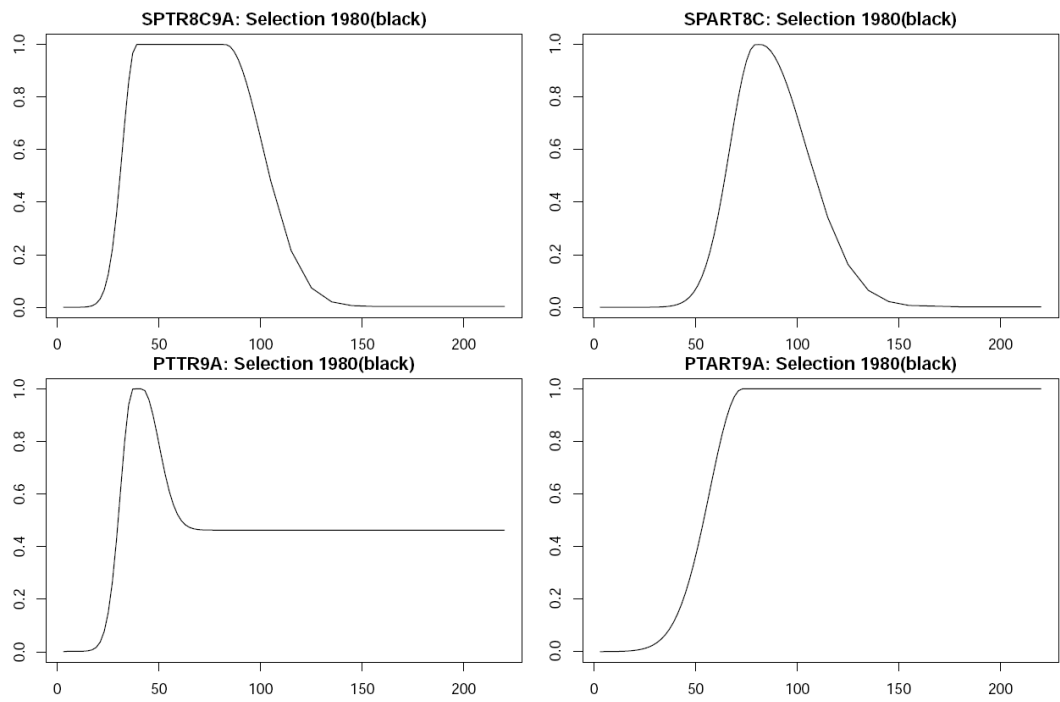


Figure 4.3.9. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Relative selection patterns at length by fishery estimated by the SS model.

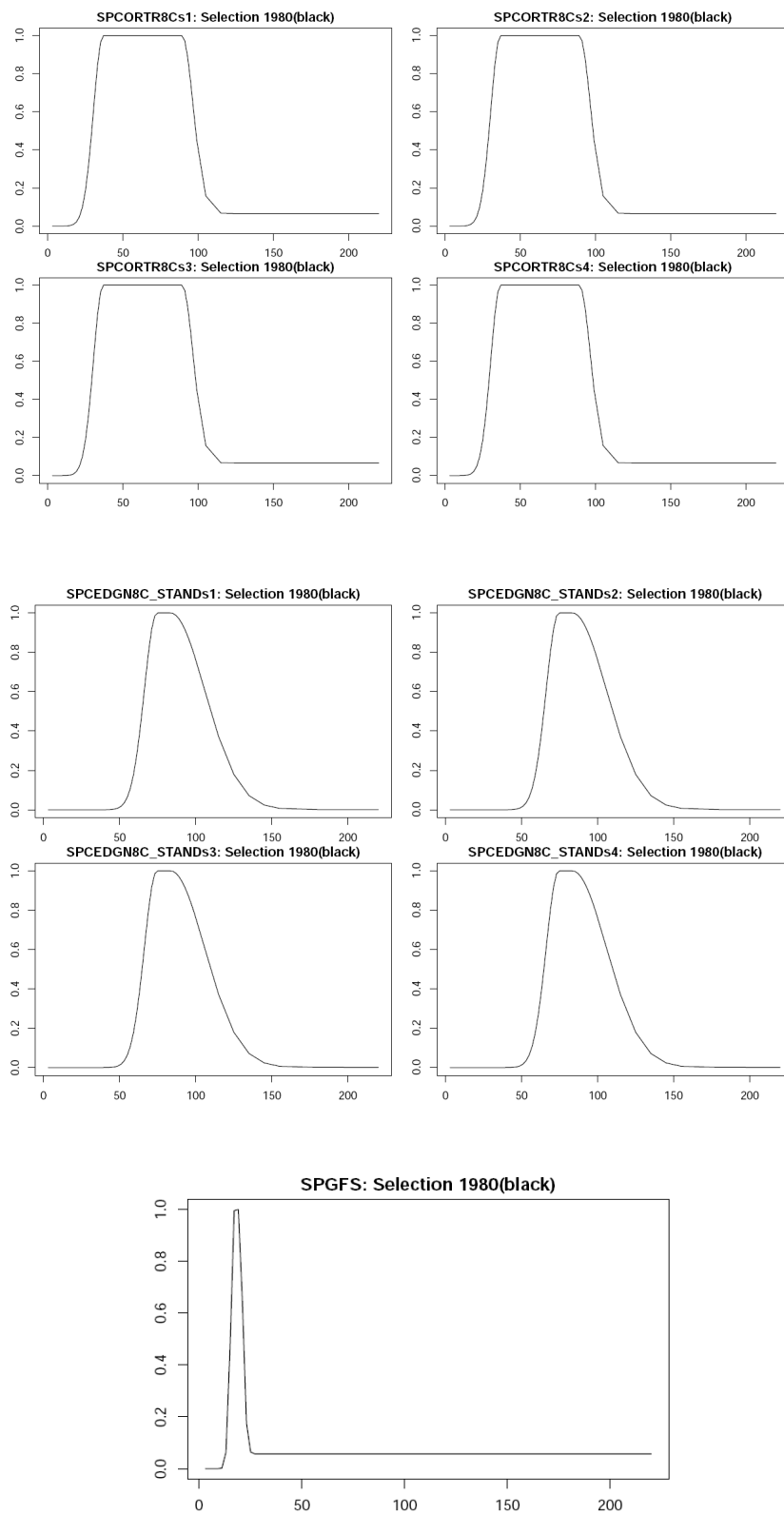


Figure 4.3.10. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Relative selection patterns at length by abundance index estimated by the SS model. A Coruña and Cedeira indices are by quarter.

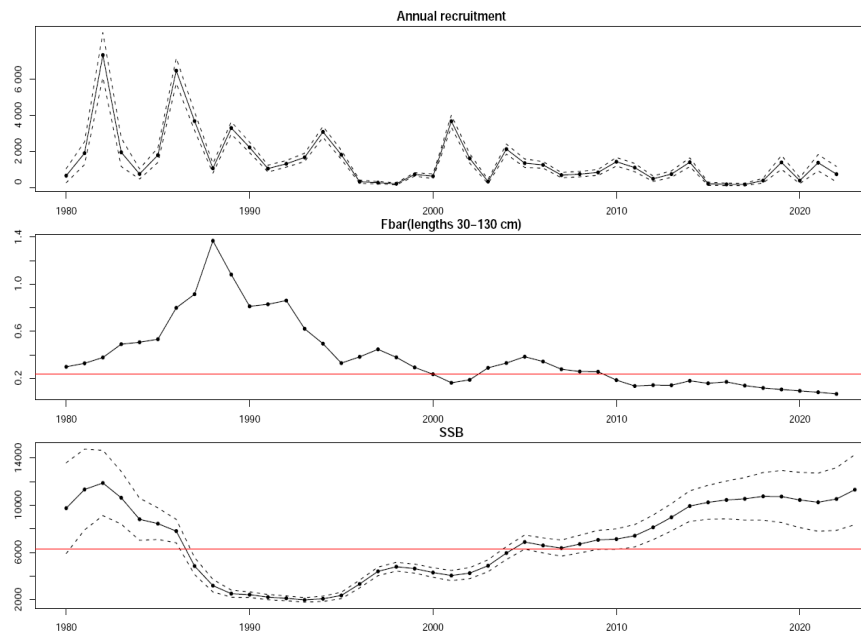


Figure 4.3.11. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Summary plots of stock trends with 95% intervals only for recruitment and SSB.

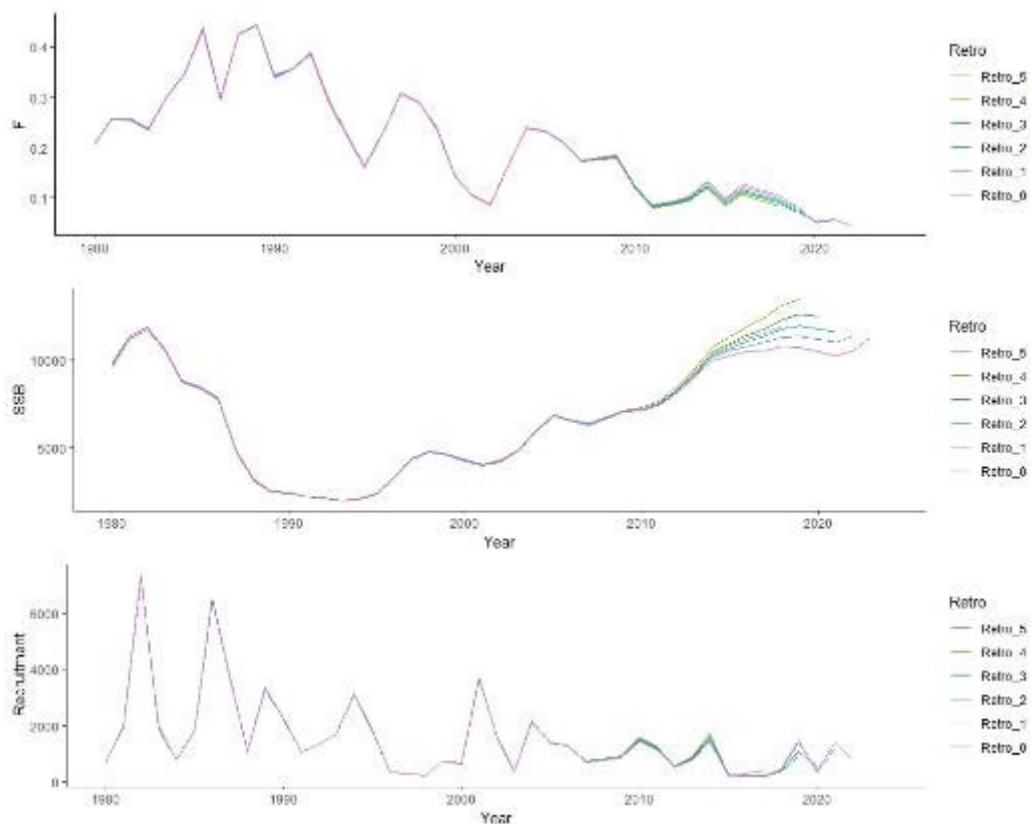


Figure 4.3.12. White-bellied anglerfish (*L. piscatorius*) in divisions 8.c and 9.a. Retrospective plots from the SS model.

4.4 Black-bellied anglerfish (*Lophius budegassa*) in divisions 8.c and 9.a

4.4.1 General

4.4.1.1 Ecosystem aspects

Biological/ecosystem aspects are common with *L. piscatorius* and are described in the Stock Annex.

4.4.1.2 Fishery description

L. budegassa is mainly caught by Spanish and Portuguese bottom trawlers and net fisheries (gillnet and trammelnets). As with *L. piscatorius*, *L. budegassa* is an important target species for the artisanal fleets and is a bycatch for the trawl fleets targeting other fishes or crustaceans (see Stock Annex). French trawl, gillnet and trammelnet fisheries also catch *L. budegassa*, but reported values represent <1% (on average) of the total stock landings.

The length distribution of the landings varies among fisheries, with gillnet and artisanal landings showing higher mean lengths compared to the trawl landings, except in 2017, when the mean lengths of the trawl and artisanal fisheries were similar. Since 2008, the Spanish landings were mostly allocated to the trawl fleet (89% in 2022; mean lengths in 2022 of 32.3 cm in division 9.a), followed by the gillnet fishery (11% in 2022; mean length in 2022 of 63 cm in Division 8.c) and other fleets (<1%). Portuguese landings, for the same period, were mainly from the artisanal fleet (77% in 2022; mean length of 53.3 cm in 2022), followed by the trawl fleet (23% in 2022; mean length of 49 cm in 2022). French landings since 2008 correspond, on average, to 67% from the trawl fleet, 32% from the gillnet fleet and 1% from other fleets.

4.4.2 Data

4.4.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2022, as estimated by WGBIE, are given in Table 4.4.1. Portuguese and Spanish landings and discards data were revised during the WKANGLER benchmark (ICES, 2018a). French landings data are available to WGBIE since 2002. Analysis of historical landings is presented in the Stock Annex. Unallocated/non-reported landings for this stock were available from 2011 to 2016 and again in 2018–2019. Estimates of unallocated or non-reported landings were based on the sampled vessels (Spanish concurrent sampling) and raised to the total effort for each *métier* and quarter. The unallocated/non-reported values were considered realistic and are, thus, included in the assessment.

From 2002 to 2007, landings increased to 1 306 t, decreasing afterwards to levels between 754–774 t in 2009–2010. From 2011 to 2016, landings fluctuated between 948 and 1 141 t and between 669 to 861 t for the period of 2017–2021. In 2022, landings were estimated at 621 t.

Spanish trawl and gillnet discard estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in Table 4.4.2. The estimated Spanish trawl discards observed from 1994–2022 shows two peaks: first in 2006 (114 t) and second in 2010 (64 t), followed by relatively lower levels since then. The estimated Spanish gillnet discards are available since 2011 and varied between 0 and 14.3 t. In total, Spanish discards represented ~ 4.6% of total catches of the stock in 2022.

Sampling effort and frequency of occurrence of *L. budegassa* discards in the Portuguese trawl fisheries were presented for the 2004–2013 period (Prista *et al.* 2014, WD03 in ICES, 2014). The

maximum frequency of occurrence in discards in the trawl fleet targeting fishes is 2% (sampling effort varies between 50 and 194 hauls per year). The maximum occurrence of discards in the trawl fleet targeting crustaceans is 8% (sampling effort varies between 28 and 111 hauls per year). Due to the low frequency of occurrence of anglerfish in the discards, it is not possible to apply the algorithm used for the hake (presented in Prista *et al.* 2014; WD03 in ICES, 2014). For this reason, discards estimates have not been calculated. In 2021 and 2022, at-sea sampling in Portuguese waters was implemented with limitations in sampling effort due to issues related with subcontracting services.

Partial information on the Spanish and Portuguese discards was available and the WG concluded that discards could be considered negligible.

4.4.2.2 Biological sampling

The procedure for sampling this species is the same as for *L. piscatorius* (see both *L. piscatorius* and *L. budegassa* Stock Annexes).

The *métier* sampling adopted in Spain and Portugal in 2009, following the requirement of the EU Data Collection Framework (DCF), can affect the data provided. Excluding 2020, Spanish sampling levels are similar to previous years. Portuguese sampling levels declined significantly in 2009–2011, but increased since then. In 2021 and 2022, the Portuguese sampling effort was intentionally increased in comparison to previous years to improve information on species identification in landing ports and collect more length data.

Length composition

Table 4.4.3 gives the annual length compositions by ICES Division, country and gear and the adjusted length composition for the 2022 total stock landings. However, these new data should be interpreted with caution given the low sampling levels for some fleets. Length composition is not used in the assessment of *L. budegassa* but provides ancillary information.

The annual length compositions for the years between 2002 and 2022 are presented in Figure 4.4.1. The total annual landings in numbers (in thousands), the annual mean length (in cm) and the mean weight (in g) are presented in Table 4.4.4. In 2022, landings (in numbers) were dominated by individuals < 30 cm and the mean length was estimated as 37 cm, smaller than the previous year.

The estimated total number of landed individuals shows a remarkable decrease in the year 2000 when compared to previous years. Since 2001, and excluding 2006 and 2007, estimated number of landed individuals oscillated between 230 and 531 thousands. The estimated mean weight is relatively high since 2012 (> 2 kg) with exception of the year 2022 where it reached a lower value.

4.4.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2022 are summarized in Table 4.4.5. The Portuguese survey was not performed in 2012, 2019, and 2020. Considering the very small number of black anglerfish caught in the SpGFS-WIBTS-Q4 (G2784) and PtGFS-WIBTS-Q4 (G8899) surveys, these indices were considered unsuitable to evaluate the change in abundance of this species. However, they can provide some incilliary information about recruitment. On the contrary, data from SpGFS-caut-WIBTS-Q4 (Gulf of Cádiz, G4309) are regular and its usefulness has been considered promising (ICES, 2018a, 2021a) but more studies on species distribution are needed to better interpret results from this survey. The biomass index from this survey increased since the beginning of the time-series, reaching a maximum value in 2022. No survey was conducted in 2021.

The small number of specimens < 20 cm in the Spanish bottom trawl surveys on the Northern Spanish Shelf suggests a lack of recruitment data for the surveyed area during the period 2017–

2019 (Figure 4.4.2; Blanco *et al.* 2023). The peak of individuals < 20 cm observed in 2020 is the first signal of recruitment since 2016. In 2021 and 2022, individuals < 20 cm were also recorded although at smaller levels than in 2020.

4.4.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 4.4.6 and Figure 4.4.3 for Spanish trawlers from ports of Santander, Avilés and A Coruña (all in Division 8.c) since 1986, and for Portuguese trawlers (Division 9.a) since 1989. Data are also available for the standardized Cedeira gillnet fleet from 1999 to 2012. For each fleet, the proportion in relation to the total landings is given. Landed values for each of the Portuguese trawl fleets were updated from 2012 onwards.

Since 2013, Spain has only provided information for A Coruña port series. Effort data for this tuning fleet in 2013 were calculated using the information from electronic logbooks and following different criteria than those established for previous years. In order to check the consistency of the Spanish data time-series, a backward revision of the time-series is needed to compare the different estimation methods and information sources used. The standardization of the series should be also conducted.

Three LPUE series were presented in the past for the A Coruña trawler fleet: (a) “A Coruña port” for trips that are exclusively landed in the port; (b) “A Coruña trucks” for trips that are landed in other ports; (c) and “A Coruña fleet” that considers all the trips of the A Coruña trawler fleet. The LPUE series previously used in the assessment (A Coruña fleet) was not updated since 2012.

Until 2011, for the Portuguese trawl fleets targeting fishes and crustaceans, most logbooks were filled in paper but have thereafter been progressively replaced by electronic logbooks. Since 2013, > 90% of the logbooks were reported in the electronic version. Generalized linear mixed models (GLMMs) were used to standardize both LPUE data, considering Year, Quarter and Area as independent variables and Vessel as a random variable. Details can be found in the Benchmark Workshop on the development of MSY advice for category 3 stocks using the Surplus Production Model in Continuous Time report (WKMSYSPiCT; ICES, 2021a).

Logbook data from the Portuguese artisanal fleet, particularly from vessels targeting *Lophius* spp. are also available since 2008 (electronic and paper). An LPUE series for the fleet targeting anglerfish with trammelnets was presented to WKMSYSPiCT (ICES, 2021a). However, more work is needed particularly to accommodate targeting effects using more adequate methodologies (e.g. clustering methods) as well as higher spatial resolution (ICES, 2021a).

Excluding the Avilés and Santander fleets, the overall trend in landings for all fleets was decreasing from the late eighties to mid-1990s (Figure 4.4.4). A slight increase was observed from 1995 to 1998. The A Coruña fleet showed the most important drop in landings and relative proportion of total landings in 2002. LPUEs of Spanish Avilés and Santander fleets show high values during the second half of the 1990s. Despite the variability observed, a decreasing trend was observed for all fleets from 2000 to 2005 which was then followed by a slightly increasing trend. The LPUE time-series from the Portuguese trawl fleet targeting crustaceans shows an increasing trend reaching a maximum value in 2018. The value in 2022 is still among the highest in the time-series. The LPUE time-series from the Portuguese trawl fleet targeting fish is variable but also shows an increasing trend from 2001 to 2012. Similarly, to the crustacean fleet, the value in 2022 is among the highest of the time-series.

Effort trend analysis was presented in section 4.3.4.4.

4.4.3 Assessment

4.4.3.1 History of the assessment

In WKANGLER 2018 (ICES, 2018a), a new model, SPiCT (Pedersen and Berg, 2017), was proposed for the assessment of *L. budegassa*, a stochastic production model in continuous time. This model was considered more reliable than the previous model used, ASPIC (Prager, 1992; 1994). The benchmarked approach gave comparable trends, but the estimates of stock biomass were notably higher, and fishing mortality was lower compared with the previous assessment method. A stepwise approach was proposed by WGBIE 2018 but was rejected by ACOM. Given the uncertainties regarding the absolute levels of biomass and fishing pressure, the assessment was considered indicative of trends only and it was decided to present the advice as a category 3.2 stock with proxy reference points, based on SPiCT results (ICES, 2018b).

A new benchmark was proposed for this stock in 2021 using SPiCT. CPUE data available for the stock were revised and several tests were conducted. Results and discussion of the results are available in the WKMSYSPiCT report (ICES, 2021a). The stock was upgraded to category 2.

4.4.3.2 Exploratory assessment with Stock Synthesis

Tests with the Stock Synthesis model (SS; Methot Jr. and Wetzel, 2013) were conducted during the Workshop on Tools and Development of Stock Assessment Models Using a4a and Stock Synthesis (WKTADSA, ICES, 2021b). A length-based model was developed assuming one area, one season, catch data from nets fleets (gillnets and trammelnets) and from trawl fleets (data from Portugal and Spain combined), two commercial LPUE indices and one biomass series from SpGFS-WIBTS-Q4 (G2784) to inform about recruitment. Several model configurations were tested but more work is required to reach a base model. The workshop was conducted before WKMSYSPiCT and conclusions from this benchmark should be considered in future. However, results from the SS model were promising and are available in the WKTADSA report (ICES, 2021b). Some comments are also available in the WKMSYSPiCT report (see reviewers' comments in ICES, 2021a).

4.4.3.3 SPiCT Model

The SPiCT model was revised during the WKMSYSPiCT (ICES, 2021a). The new model assumes the Schaefer population growth model (fixed parameter) and the default biomass and catches observed/process error ratios (alpha and beta, respectively).

The SPiCT input data:

- Total landings from 1980–2022 (discards are considered negligible).
- Portuguese trawl fleet targeting fish (1989–2022; Index 1).

The input data are presented in Tables 4.4.1 (Landings) and 4.4.6. (CPUE index for the Portuguese trawl fleet targeting fish) and Figure 4.4.4.

SPiCT settings:

- Euler time-step (years): 1/16 (default).
- CPUE at the middle of the year.
- Production curve shape: assume Schaefer ($n = 2$).
- B/K prior: assume initial depletion rate of 0.5 ($\log\text{bkratio} = c(\log(0.5), 0.5, 1)$).
- Other parameters: default (estimated by the model).

From the LPUE tuning indices previously used, only the PT-TRF9a, now standardized, was maintained. The other two indices were not considered due to uncertainty around the trends in the last years of the series in the case of PT-TRC9 and autocorrelation issues with the SP-CORT8c (fleet series; not updated since 2012). PT-TRC9 was driving the stock to a very

optimistic status which is not in agreement with the historical landings trajectory and the low landings obtained in 2019. In this model, a prior for B/K of 0.5 was assumed, as exploitation was likely to occur before the beginning of the available time-series. Despite target fisheries development in the late 1970s, previously, the species was likely to be caught and discarded in other fisheries.

4.4.3.4 Assessment diagnostics

No significant bias or autocorrelation was found and both QQ-plot and the Shapiro test show normality in the residuals (Figure 4.4.5.). Confidence intervals for F/F_{MSY} and B/B_{MSY} do not extend more than 1 order of magnitude, as proposed by Mildenerberger *et al.* (2021).

No strong retrospective pattern was observed (Figure 4.4.6.). Mohn’s rho statistics (Mohn, 1999) were estimated as -0.036 and 0.039 for B/B_{MSY} and F/F_{MSY} , respectively.

When checking the model robustness to different initial parameter values, results point to the existence of two local optima in the likelihood function. However, most of the runs agree in the final value, which corresponds to the best fit (the objective functions of both models were compared). The model will be consistent in the results as SPiCT always uses the same initial parameters.

4.4.3.5 Assessment results

SPiCT results are presented in Tables 4.4.7. and 4.4.8 and in Figure 4.4.7. The stock biomass (B) has been increasing since 2002. B/B_{MSY} is estimated to be above $MSY B_{trigger}$ proxy over the whole time-series. Fishing mortality (F) has decreased since 1998 and is estimated to have been below F_{MSY} proxy since 2002 (with exception of 2006).

4.4.4 Short-term projections

Short-term projections consider the F in the intermediate year as the estimated F at the time-step of the last observation and the estimated seasonal F process. Results for each scenario discussed in WKMSYSPiCT (ICES, 2021a) are presented in Table 4.4.9. All the scenarios considered for F are expected to keep the stock above B_{MSY} in 2024. Although the stock is included in the EU MAP for stocks fished in the Western Waters and adjacent waters (EU, 2019), F_{MSY} ranges were not defined.

4.4.5 Biological reference points

WKMSYSPiCT (ICES, 2021a) reiterated the basis for MSY reference points previously assumed by ICES. Those reference points are considered proxies. See section 4.4.4. for further details.

Framework	Reference point	Relative value	Technical basis	Source
MSY approach	$MSY B_{trigger}$	0.5^*	Relative value (B/B_{MSY}) from the SPiCT assessment model. B_{MSY} is estimated directly from the SPiCT model and changes when the assessment is updated.	ICES (2021a)
	F_{MSY}	1^*	Relative value (F/F_{MSY}) from the SPiCT assessment model. F_{MSY} is estimated directly from the SPiCT model and changes when the assessment is updated.	ICES (2021a)
Precautionary approach	$B_{lim proxy}$	$0.3 \times B_{MSY}^*$	Relative value (equilibrium yield at this biomass is 50% of the MSY proxy).	ICES (2021a)

Framework	Reference point	Relative value	Technical basis	Source
	B_{pa}	Not defined		
	$F_{lim\ proxy}$	$1.7 \times F_{MSY}^*$	Relative value (the F that drives the stock to the proxy of B_{lim}).	ICES (2021a)
	F_{pa}	Not defined		
Management plan	SSB_{mgt}	Not applicable		
	F_{mgt}	Not applicable		

*No reference points are defined for this stock in terms of absolute values. The SPiCT-estimated values of the ratios F/F_{MSY} and B/B_{MSY} are used to estimate stock status relative to the MSY reference points.

4.4.6 Comments on the assessment

This stock was last benchmarked in 2021 during the WKMSYSPiCT (ICES, 2021a) and advice is now given under the MSY approach for a category 2 stock (ICES, 2023).

The stock is included in the EU MAP for stocks fished in the Western Waters and adjacent waters (EU, 2019) but reference points for F_{MSY} ranges are still not defined for this stock under the new assessment model.

Since 2017 that advised catches combined for the two *Lophius* species in 8c and 9a are considerably lower than the agreed TAC for *Lophius* spp. for the same area. Although TAC has been increasing in line with the ICES advice, landings of the two species have been decreasing. Spanish industry in the North of Spain notes they are not able to find and catch their corresponding quota for anglerfish (both black and white anglerfish)". The reasons for this mismatch are not totally understood. Data currently available until 2020 indicates that fishing effort has decreased for some fleets (Figure 4.4.3). However, it is acknowledged that this information needs to be revised. In addition, and particularly in the case of ank.27.8c9a, stock size indicators (Portuguese CPUE from commercial trawl fleets and Spanish Gulf of Cadiz Bottom Trawl Survey - G4309) suggest that biomass is at high values (Tables 4.4.5, 4.4.6 and Figure 4.4.3). Information from the Northern Spanish Shelf Groundfish Survey (SpGFS-WIBTS-Q4, G2784) reveals no trend in the biomass index (Table 4.4.5). The length distribution from this survey suggests relatively good levels of small fish in the last three years (Figure 4.4.2). Total length frequency data (LFD) from landings show that in 2022 landings were dominated by small-sized individuals, which may also indicate good recruitment in previous years. Data available for this stock thus support the model output. It should also be noted that the three mentioned stock size indicators of the southern black anglerfish reflect the biomass in the Portuguese southwest coast and in the Gulf of Cádiz and that reliable information for the northern waters of the stock is missing.

Current model is considered good to provide a category 2 advice for this stock. WGBIE recommends for this stock to go to benchmark together with the southern white anglerfish to explore the possibility of implementing the Stock Synthesis (SS; Methot Jr. and Wetzel, 2013) framework for potential upgrade to a category 1 stock. Intersessional work should be addressed this year for possible presentation on the next WGBIE meeting to determine the feasibility of proceeding to a benchmark.

Artisanal vessels can operate with different gears to target different species and their efforts regularly shifts toward other important commercial species both of which are commonly observed to occur particularly in Portuguese waters. Changes in the fishing pattern of the Spanish northern trawl fisheries were also known to take place, which can affect the catches of *Lophius* spp. This points out the need to revise the CPUE commercial indices during the future benchmark in order to take into account the targeting effects, as noted during the WKMSYSPiCT (ICES, 2021a).

4.4.7 Quality considerations

Until 2011, most logbooks were filled in paper for the Portuguese fleets but have thereafter been progressively replaced by e-logbooks. Since 2013, more than 90% of the logbooks are being completed in the electronic version. The Portuguese LPUE series from the trawl fleets were standardized using the data previously used in the assessment. However, data revision and improvement in the standardization methods should be considered to accommodate targeting effects using more adequate methodologies (e.g. clustering methods) as well as higher spatial resolution. Standardized LPUEs are also required from fleets operating in other areas where the stock distributes. In addition, more accurate information on stock biology, ecology and distribution as well as on the fisheries behaviour are desirable to understand and validate some biomass indicators available for the stock (ICES, 2021a).

4.4.8 Management considerations

Management considerations are in section 4.2.

4.4.9 References

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4.5 Tables and figures

Table 4.4.1. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Tonnes landed by the main fishing fleets for 1978–2022 as determined by WGBIE (n/a: not available).

Year	Div. 8c						Div. 9a						Div. 8c+9a				
	SPAIN			FRANCE			TOTAL	SPAIN			PORTUGAL		TOTAL	SUBTOTAL	Unallocated/ Non reported	TOTAL	
	Trawl	Gillnet	Others	Trawl	Gillnet	Others		Trawl	Gillnet	Others	Trawl	Artisanal					
1978	n/a	n/a					n/a	248				n/a	107	355	355		355
1979	n/a	n/a					n/a	306				n/a	210	516	516		516
1980	1203	207					1409	385				n/a	315	700	2110		2110
1981	1159	309					1468	505				n/a	327	832	2300		2300
1982	827	413					1240	841				n/a	288	1129	2369		2369
1983	1064	188					1252	699				n/a	428	1127	2379		2379
1984	514	176					690	558				223	458	1239	1929		1929
1985	366	123					489	437				254	653	1344	1833		1833
1986	553	585					1138	379				200	847	1425	2563		2563
1987	1094	888					1982	813				232	804	1849	3832		3832
1988	1058	1010					2068	684				188	760	1632	3700		3700
1989	648	351					999	764				272	542	1579	2578		2578
1990	491	142					633	689				387	625	1701	2334		2334
1991	503	76					579	559				309	716	1584	2162		2162
1992	451	57					508	485				287	832	1603	2111		2111
1993	516	292					809	627				196	596	1418	2227		2227
1994	542	201					743	475				79	283	837	1580		1580
1995	924	104					1029	615				68	131	814	1843		1843
1996	840	105					945	342				133	210	684	1629		1629
1997	800	198					998	524				81	210	815	1813		1813
1998	748	148					896	681				181	332	1194	2089		2089
1999	565	127					692	671				110	406	1187	1879		1879
2000	441	73					514	377				142	336	855	1369		1369

Table 4.4.1. continued.

Year	Div. 8c							Div. 9a							Div. 8c+9a	
	SPAIN			FRANCE			TOTAL	SPAIN			PORTUGAL		TOTAL	SUBTOTAL	Unallocated/ Non reported	TOTAL
	Trawl	Gillnet	Others	Trawl	Gillnet	Others		Trawl	Gillnet	Others	Trawl	Artisanal				
2001	383	69					452	190			101	269	560	1013		1013
2002	202	74		10	1	0	288	234	0	0	75	213	522	810		810
2003	279	49		9	0	0	338	305	0	0	68	224	597	934		934
2004	251	120		14	5	0	391	285	0	0	50	267	603	993		993
2005	273	97		26	9	0	405	283	0	0	31	214	527	933		933
2006	323	124		12	1	0	460	541	0	0	39	121	701	1161		1161
2007	372	68		4	1	0	444	684	0	0	66	111	861	1306		1306
2008	386	70		5	1	0	462	336	0	0	40	119	495	957		957
2009	301	148		3	1	0	454	172	0	0	34	114	320	774		774
2010	319	81		2	1	0	403	197	0	0	70	84	351	754		754
2011	214	115	32	3	0	0	364	157	60	98	75	119	510	874	74	948
2012	161	83	22	2	0	0	268	109	40	90	156	370	765	1033	109	1141
2013	221	135	14	4	1	0	375	95	55	90	100	258	598	973	98	1071
2014	187	126	7	5	2	0	326	120	47	4	116	286	572	898	100	998
2015	233	141	1	2	2	0	380	103	62	2	126	222	515	895	152	1047
2016	203	118	5	2	2	0	330	103	79	2	120	257	560	889	125	1014
2017	163	153	0	1	3	0	319	109	62	1	68	302	542	861		861
2018	186	156	1	7	9	0	359	126	37	1	52	185	402	761	11	773
2019	137	117	0	1	2	0	259	109	49	1	43	135	337	595	73	669
2020	126	65	0	4	2	0	198	138	5	3	128	321	596	793		793
2021	122	24	0	2	0	0	148	116	23	2	97	331	570	718		718
2022	111	23	0	0	0	0	135	139	7	1	78	262	487	621		621

n/a: not available

Table 4.4.2. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Weight and percentage of discards for Spanish trawl and gillnet fleets.

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
TRAWL				
1994	6.1	24.4	0.6	0.4
1995	n/a	n/a	n/a	n/a
1996	n/a	n/a	n/a	n/a
1997	21.3	35.2	1.6	1.2
1998	n/a	n/a	n/a	n/a
1999	19.7	43.7	1.6	1.0
2000	8.7	35.1	1.1	0.6
2001	n/a	n/a	n/a	n/a
2002	n/a	n/a	n/a	n/a
2003	1.4	n/a	0.2	0.1
2004	10.9	n/a	2.0	1.1
2005	9.3	n/a	1.7	1.0
2006	114.0	n/a	11.7	9.8
2007	4.2	n/a	0.4	0.3
2008	4.9	n/a	0.7	0.5
2009	23.3	n/a	4.7	3.0
2010	63.5	n/a	11.0	8.4

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
2011	19.7	n/a	5.0	2.1
2012	5.9	n/a	2.1	0.5
2013	22.3	n/a	6.6	2.1
2014	27.8	n/a	8.3	2.8
2015	0.5	n/a	0.2	0.0
2016	0.4	n/a	0.1	0.0
2017	3.7	n/a	1.3	0.4
2018	1.1	n/a	0.3	0.1
2019	2.2	n/a	0.9	0.3
2020	2.2	n/a	0.8	0.3
2021	10.1	n/a	4.1	1.4
2022	28.7	n/a	10.3	4.6
GILLNETS				
2011	10.6	n/a		
2012	14.3	n/a		
2013	0	n/a		
2014	0.1	n/a	0.03	0.01
2015	0.4	n/a	0.18	0.04

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
2016	5.0	n/a	2.47	0.49
2017	10.9	n/a	4.82	1.26
2018	2.6	n/a	1.33	0.34
2019	13.3	n/a	7.40	1.98
2020	0.9	n/a	1.33	0.12
2021	0.8	n/a	1.60	0.11
2022	0	n/a	0	0

n/a: not available.

CV: coefficient of variation.

Table 4.4.3. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Length composition by fleet for landings (thousands) in 2022. Unreported catches excluded. Adjusted Total: adjusted to landings from fleets without length composition. n/a: not available.

Length (cm)	Div. 8c			Div. 9a				Div. 8c+9a	
	SPAIN		TOTAL	SPAIN	PORTUGAL		TOTAL	TOTAL	Adjusted TOTAL
	Trawl	Gillnet		Trawl	Trawl	Artisanal			
15				0,522			0,522	0,522	0,906
16									0,000
17				1,414			1,414	1,414	2,454
18				0,799			0,799	0,799	1,387
19				2,644			2,644	2,644	4,589
20				3,247			3,247	3,247	5,635
21				4,744			4,744	4,744	8,233
22				4,117			4,117	4,117	7,145
23				6,423			6,423	6,423	11,147
24				9,176		0,104	9,280	9,280	16,029
25				12,307		0,209	12,516	12,516	21,567
26				16,365	0,042		16,407	16,407	28,443
27				16,961		0,209	17,170	17,170	29,644
28				15,081			15,081	15,081	26,172
29				14,211		0,197	14,408	14,408	24,859
30				14,079	0,037	0,209	14,325	14,325	24,679
31				13,198	0,178	0,104	13,481	13,481	23,187
32				9,252	0,245	0,037	9,534	9,534	16,338
33				7,088	0,443	0,936	8,467	8,467	13,680
34		0,006	0,006	7,278	1,065	4,250	12,593	12,599	17,956
35		0,018	0,018	4,026	0,676	2,415	7,117	7,135	10,109
36		0,029	0,029	6,058	0,340	1,941	8,339	8,368	12,844
37		0,030	0,030	3,853	1,879	1,230	6,962	6,992	9,848
38		0,059	0,059	2,926	1,683	0,657	5,265	5,324	7,520
39		0,029	0,029	2,952	2,342	0,357	5,651	5,680	7,872
40		0,084	0,084	3,227	1,600	1,403	6,230	6,314	8,749
41		0,090	0,090	1,262	1,837	2,921	6,020	6,111	7,105
42		0,043	0,043	2,701	1,664	6,805	11,169	11,212	13,230
43		0,052	0,052	2,512	1,245	0,582	4,339	4,391	6,277
44		0,086	0,086	4,388	1,195	1,802	7,385	7,471	10,762

Table 4.4.3. continued

Length (cm)	Div.8c			Div.9a				Div. 8c+9a	
	SPAIN		TOTAL	SPAIN	PORTUGAL		TOTAL	TOTAL	Adjusted TOTAL
	Trawl	Gillnet		Trawl	Trawl	Artisanal			
45		0,077	0,077	1,354	1,929	10,802	14,085	14,162	15,214
46		0,045	0,045	2,502	1,089	3,479	7,071	7,116	8,989
47		0,036	0,036	1,632	0,893	2,013	4,538	4,574	5,801
48		0,049	0,049	1,358	0,786	1,953	4,096	4,146	5,180
49		0,016	0,016	0,620	0,782	1,844	3,246	3,261	3,729
50		0,040	0,040	0,891	0,686	1,467	3,043	3,083	3,767
51		0,016	0,016	0,697	0,442	2,215	3,354	3,370	3,894
52		0,015	0,015	0,985	1,181	0,860	3,026	3,041	3,776
53		0,062	0,062	0,545	0,172	1,893	2,610	2,672	3,118
54		0,056	0,056	0,907	0,299	0,215	1,421	1,477	2,185
55		0,048	0,048	0,658	0,859	1,693	3,210	3,258	3,777
56		0,044	0,044	0,997	0,390	0,682	2,070	2,114	2,879
57		0,065	0,065	0,197	0,221	0,680	1,098	1,164	1,356
58		0,025	0,025	0,683	0,180	0,742	1,605	1,630	2,150
59		0,049	0,049	0,375	0,238	0,769	1,382	1,432	1,744
60		0,017	0,017	0,190	0,116	0,315	0,622	0,638	0,790
61		0,107	0,107	0,112	0,315	1,844	2,271	2,378	2,540
62		0,078	0,078	0,574	0,494	1,114	2,183	2,260	2,740
63		0,077	0,077	0,486	0,307	0,951	1,743	1,820	2,234
64		0,091	0,091	0,191	0,345	1,712	2,247	2,338	2,545
65		0,108	0,108	0,238	0,552	1,827	2,618	2,725	2,980
66		0,112	0,112	0,730	0,315	1,346	2,391	2,502	3,121
67		0,064	0,064	0,188	0,323	2,187	2,698	2,762	2,948
68		0,064	0,064	0,225	0,342	2,319	2,886	2,950	3,163
69		0,120	0,120	0,170	0,258	1,017	1,445	1,565	1,778
70		0,128	0,128	0,263	0,060	0,830	1,153	1,280	1,568
71		0,056	0,056	0,170	0,167	1,033	1,370	1,425	1,591
72		0,073	0,073	0,094	0,139	0,907	1,140	1,213	1,336
73		0,180	0,180	0,080	0,176	1,654	1,910	2,090	2,281
74		0,190	0,190	0,118	0,137	1,108	1,363	1,553	1,779

Length (cm)	Div.8c			Div.9a				Div. 8c+9a	
	SPAIN		TOTAL	SPAIN	PORTUGAL		TOTAL	TOTAL	Adjusted TOTAL
	Trawl	Gillnet		Trawl	Trawl	Artisanal			
75		0,108	0,108	0,138	0,163	0,930	1,231	1,339	1,520
76		0,134	0,134	0,186	0,565	0,900	1,651	1,785	2,021
77		0,025	0,025	0,132	0,055	0,500	0,687	0,712	0,827
78		0,073	0,073	0,252	0,085	0,562	0,899	0,972	1,211
79		0,102	0,102	0,191	0,000	0,559	0,750	0,852	1,068
80		0,092	0,092	0,367	0,115	0,687	1,169	1,260	1,597
81		0,040	0,040	0,108		0,378	0,486	0,525	0,634
82		0,051	0,051	0,340	0,011	0,074	0,425	0,476	0,764
83		0,044	0,044	0,247	0,022	0,918	1,187	1,231	1,445
84		0,022	0,022	0,170	0,399	0,307	0,876	0,898	1,039
85				0,117		0,188	0,305	0,305	0,391
86		0,022	0,022	0,134	0,030	0,591	0,755	0,777	0,891
87		0,017	0,017	0,088	0,450	0,631	1,169	1,186	1,263
88				0,242		0,069	0,311	0,311	0,489
89				0,102	0,011	0,134	0,247	0,247	0,322
90				0,060		0,097	0,157	0,157	0,201
91				0,034		0,149	0,183	0,183	0,208
92				0,054	0,011	0,155	0,221	0,221	0,260
93				0,101			0,101	0,101	0,175
94				0,036	0,011	0,030	0,077	0,077	0,104
95				0,000	0,000	0,159	0,159	0,159	0,159
96				0,034	0,566	0,030	0,630	0,630	0,655
97				0,015		0,060	0,075	0,075	0,086
98						0,129	0,129	0,129	0,129
99						0,726	0,726	0,726	0,726
100+				0,033		0,189	0,222	0,222	0,246
TOTAL		1	1	3	2	9	15	16	18
Landings (t)		23	23	139	78	262	479	502	621
Mean Weight (g)		31749	31749	43765	31092	28622	32287	32261	33715
Mean Length (cm)		78,9	78,9	81,9	84,4	81,5	82,1	81,9	81,8
Measured weight (t)		n/a	n/a	n/a	1171,3	738,8	1910,1	n/a	n/a

n/a: not available

Table 4.4.4. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Number, mean weight and mean length of landings between 1986 and 2022.

Year	Total (thousands)	Mean Weight (g)	Mean Length (cm)
1986	1704	1504	43
1987	4673	820	34
1988	2653	1395	43
1989	1815	1420	44
1990	1590	1468	44
1991	1672	1294	42
1992	1497	1410	45
1993	1238	1799	48
1994	1063	1486	44
1995	1583	1157	40
1996	1146	1422	44
1997	1452	1248	41
1998	1554	1380	42
1999	1268	1487	42
2000	680	2010	47
2001	435	2329	49
2002	514	1497	41
2003	507	1826	46
2004	468	1974	47
2005	408	2198	49
2006	1030	1115	37
2007	1036	1255	39
2008	503	1889	48
2009	298	2585	51
2010	387	1940	45
2011	531	1641	43
2012	435	2366	49
2013	361	2678	50

Year	Total (thousands)	Mean Weight (g)	Mean Length (cm)
2014	442	2011	43
2015	406	2195	49
2016	340	2602	52
2017	324	2662	50
2018	295	2015	51
2019	230	2591	50
2020	334	2377	42
2021	309	2325	47
2022	498	1248	37

Year	SpGFS-WIBTS-Q4					PtGFS-WIBTS-Q4					SPGFS-caut-WIBTS-Q4				
	September-October (total area Miño-Bidasoa)					October					Gulf of Cádiz				
	Hauls	kg/30 min	se	n/30 min	se	Hauls	kg/h	se	n/h	se	Hauls	g/h	se	n/h	se
1983	145	0,68	0,17	0,50	0,09	117	n/a		n/a						
1984	111	0,60	0,17	0,60	0,11	na	n/a		n/a						
1985	97	0,46	0,11	0,50	0,07	150	n/a		n/a						
1986	92	1,42	0,32	2,50	0,33	117	n/a		n/a						
1987	ns	ns	ns	ns	ns	81	n/a		n/a						
1988	101	2,27	0,38	1,50	0,21	98	n/a		n/a						
1989	91	0,45	0,10	0,90	0,21	138	0,19		0,23						
1990	120	1,52	0,47	1,50	0,22	123	0,17		0,11						
1991	107	0,83	0,14	0,60	0,10	99	0,02		+						
1992	116	1,16	0,19	0,80	0,11	59	+		+						
1993	109	0,90	0,20	0,90	0,13	65	0,04		0,02		29	215	20,95	0,22	0,02
1994	118	0,75	0,17	1,00	0,12	94	0,09		0,06		ns	ns	ns	ns	ns
1995	116	0,72	0,12	1,00	0,11	88	0,08		0,02		ns	ns	ns	ns	ns
1996*	114	0,95	0,17	1,30	0,18	71	0,50		0,27		ns	ns	ns	ns	ns
1997	116	1,16	0,20	0,97	0,11	58	0,01		0,03		27	267	28,94	0,24	0,02
1998	114	0,88	0,18	0,57	0,09	96	0,13	1,28	0,02	0,01	34	139	10,18	0,17	0,01
1999*	116	0,43	0,12	0,26	0,06	79	0,08	0,14	0,10	0,05	38	89	8,21	0,27	0,02
2000	113	0,66	0,18	0,40	0,08	78	0,34	5,93	0,28	0,12	30	514	29,84	0,92	0,04
2001	113	0,19	0,06	0,52	0,10	58	0,02	0,02	0,02	0,02	39	298	24,36	0,41	0,04
2002	110	0,26	0,09	0,33	0,07	67	0	0	0	0	39	224	22,58	0,33	0,02
2003*	112	0,36	0,11	0,35	0,10	80	0,39	2,57	0,35	0,15	41	370	30,20	0,30	0,02
2004*	114	0,76	0,23	0,44	0,12	79	0,21	0,83	0,15	0,07	40	509	37,94	0,26	0,02
2005	116	0,64	0,20	1,62	0,30	87	0,01	0,01	0,07	0,07	42	990	43,43	2,60	0,08
2006	115	1,08	0,22	1,16	0,19	88	0,00	0,00	0,00	0,00	41	465	37,91	0,22	0,01
2007	117	0,59	0,12	0,48	0,08	96	0,03	0,06	0,02	0,02	37	703	54,25	0,40	0,03
2008	115	0,35	0,09	0,29	0,05	87	0,36	4,67	0,07	0,04	41	449	25,49	0,24	0,01
2009	117	0,30	0,08	0,35	0,08	93	0,00	0,00	0,02	0,02	43	561	35,11	0,43	0,02
2010	127	0,35	0,09	0,53	0,09	87	0,18	1,75	0,09	0,05	44	726	60,01	0,73	0,04
2011	111	0,63	0,15	0,52	0,08	86	0,06	0,28	0,02	0,02	40	806	43,58	0,57	0,03
2012	115	0,61	0,10	0,74	0,11	ns	ns	ns	ns	ns	37	723	53,73	0,77	0,03
2013^	114	1,27	0,36	1,40	0,35	93	0,03	0,10	0,02	0,02	43	1572	69,91	1,29	0,07
2014^	116	1,11	0,27	0,87	0,15	81	0,00	0,00	0,00	0,00	45	531	28,31	0,38	0,02
2015^	114	0,55	0,13	0,36	0,08	90	0,00	0,00	0,00	0,00	43	2058	96,93	1,45	0,05
2016^	114	0,51	0,10	0,40	0,06	85	0,30	7,51	0,02	0,02	45	1196	51,70	1,16	0,05
2017^	112	0,55	0,15	0,35	0,08	89	0,05	0,16	0,09	0,05	44	1085	49,24	0,76	0,03
2018^	113	0,76	0,23	0,29	0,07	53	0,10	0,50	0,08	0,08	45	1645	82,01	1,85	0,05
2019^	113	0,41	0,15	0,17	0,04	ns	ns		ns	ns	43	1252	50,62	0,68	0,02
2020^	109	0,29	0,12	0,27	0,07	ns	ns		ns	ns	44	1296	65,29	1,23	0,03
2021**,^^	113	0,47	0,15	0,47	0,13	93	0,33	3,20	0,53	0,17	ns	ns	ns	ns	ns
2022^	114	0,46	0,09	0,71	0,12	61	0,37	0,94	0,59	0,18	45	2578	71,53	8,53	0,40

Table 4.4.6. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Landings (in tonnes), fishing effort, standardized fishing effort, LPUE and standardized LPUE for trawl (all except the STAND-SP-CEDGNS8C) and gillnet fleets (STAND-SP-CEDGNS8C). For the landings, the percentage relative to the total annual stock landings is given.

Year	Avilés, SP-AVITR8C				Santander, SP-SANTR8C				Standardized Cedeira, STAND-SP-CEDGNS8C			
	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (soaking days)	LPUE (kg/soaking day)
1986	64	3	10845	5,9	21	1	18153	1,1	--	--	--	--
1987	85	2	8309	10,3	16	0	14995	1,1	--	--	--	--
1988	125	3	9047	13,9	30	1	16660	1,8	--	--	--	--
1989	119	5	8063	14,7	32	1	17607	1,8	--	--	--	--
1990	58	2	8497	6,8	40	2	20469	1,9	--	--	--	--
1991	52	2	7681	6,7	62	3	22391	2,8	--	--	--	--
1992	33	2	--	--	107	5	22833,0	4,7	--	--	--	--
1993	53	2	7635	7,0	143	6	21370	6,7	--	--	--	--
1994	65	4	9620	6,7	196	12	22772	8,6	--	--	--	--
1995	141	8	6146	23,0	126	7	14046	9,0	--	--	--	--
1996	162	10	4525	35,8	89	5	12071	7,4	--	--	--	--
1997	143	8	5061	28,3	122	7	11776	10,4	--	--	--	--
1998	91	4	5929	15,3	114	5	10646	10,7	--	--	--	--
1999	41	2	6829	5,9	67	4	10349	6,5	14	1	4 582	3,0
2000	23	2	4453	5,1	44	3	8779	5,0	4	<1	2 981	1,3
2001	12	1	1838	6,7	28	3	3053	9,3	6	1	1 932	3,0
2002	11	1	2748	4,1	16	2	3975	4,1	7	1	2 398	3,0
2003	9	1	2526	3,6	15	2	3837	4,0	3	<1	2 703	0,9
2004	32	3	--	--	23	2	3776,0	6,0	5	1	4 677	1,1
2005	54	6	--	--	7	1	1404,0	4,9	2	<1	3 325	0,7
2006	16	1	--	--	18	2	2717,5	6,8	4	<1	3 911	1,0
2007	11	1	--	--	19	1	4333,7	4,5	2	<1	3 976	0,6
2008	10	1	--	--	--	--	--	--	0	<1	5 133	0,1
2009	5	1	--	--	8	1	1124,8	6,8	4	1	2 300	1,7
2010	--	--	--	--	19,4	3	1627,8	11,9	4	1	1 880	2,1
2011	--	--	--	--	36,4	4	--	--	1	<1	522	1,3
2012	--	--	--	--	21,8	2	--	--	4	<1	--	--

Table 4.4.6. continued

Year	A Coruña-Port, SP-CORTR8C-PORT				A Coruña-Trucks, SP-CORTR8C-TRUCKS				A Coruña-Fleet, SP-CORTR8C-FLEET			
	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)
1982	655	28	63 313	10,3	--	--	--	--	655	28	63 313	10,3
1983	765	32	51 008	15,0	--	--	--	--	765	32	51 008	15,0
1984	574	30	48 665	11,8	--	--	--	--	574	30	48 665	11,8
1985	253	14	45 157	5,6	--	--	--	--	253	14	45 157	5,6
1986	352	14	40 420	8,7	--	--	--	--	352	14	40 420	8,7
1987	673	18	34 651	19,4	--	--	--	--	673	18	34 651	19,4
1988	570	15	41 481	13,7	--	--	--	--	570	15	41 481	13,7
1989	344	13	44 410	7,7	--	--	--	--	344	13	44 410	7,7
1990	288	12	44 403	6,5	--	--	--	--	288	12	44 403	6,5
1991	225	10	40 429	5,6	--	--	--	--	225	10	40 429	5,6
1992	211	10	38 899	5,4	--	--	--	--	211	10	38 899	5,4
1993	199	9	44 478	4,5	--	--	--	--	199	9	44 478	4,5
1994	166	11	39 602	4,2	37	2	12 795	2,9	204	13	52 397	3,9
1995	353	19	41 476	8,5	75	4	10 232	7,3	428	23	51 708	8,3
1996	334	21	35 709	9,4	68	4	8 791	7,8	403	25	44 501	9,0
1997	298	16	35 494	8,4	43	2	9 108	4,8	341	19	44 602	7,7
1998	323	15	29 508	10,9	72	3	--	--	394	19	--	--
1999	374	20	30 131	12,4	--	--	--	--	--	--	--	--
2000	287	21	30 079	9,6	6	0	--	--	293	21	--	--
2001	281	28	29 935	9,4	--	--	--	--	--	--	--	--
2002	76	9	21 948	3,5	31	4	6 747	4,6	107	13	28 695	3,7
2003	85	9	18 519	4,6	43	5	7 608	5,6	128	14	26 127	4,9
2004	68	7	19 198	3,5	40	4	10 342	3,8	107	11	29 540	3,6
2005	54	6	20 663	2,6	32	3	10 302	3,1	86	9	30 965	2,8
2006	70	6	19 264	3,6	81	7	12 866	6,3	151	13	32 130	4,7
2007	109	8	21 651	5,1	113	9	13 187	8,6	223	17	34 838	6,4
2008	163	17	20 212	8,1	98	10	9 812	10,0	261	27	30 024	8,7
2009	80	10	16 152	5,0	67	9	12 930	5,2	147	19	29 092	5,1
2010	74	10	16 680	4,4	87	12	9 003	9,7	199	26	22 746	8,7
2011	64	7	12 835	5,0	--	--	--	--	144	15	18 617	7,7
2012	102	9	14 446	7,0	--	--	--	--	172	15	21 110	8,2
2013	88	8	14 736	6,0	--	--	--	--	--	--	--	--
2014	79	8	18 060	4,4	--	--	--	--	--	--	--	--
2015	67	6	13 309	5,0	--	--	--	--	--	--	--	--
2016	89	9	13 718	6,5	--	--	--	--	--	--	--	--
2017	64	7	12 449	5,2	--	--	--	--	--	--	--	--
2018	79	10	13 247	6,0	--	--	--	--	--	--	--	--
2019	75	11	12 824	5,9	--	--	--	--	--	--	--	--
2020	--	--	--	--	--	--	--	--	--	--	--	--
2021	56,8	8	13498	4,2	--	--	--	--	--	--	--	--
2022	55,3	8,9	13478	4,1	--	--	--	--	--	--	--	--

Year	Portugal Crustacean, PT-TRC9A						Portugal Fish, PT-TRF9A					
	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)
1989	89	3	76	23	--	3,92	183	7	52	18	3,1	10,4
1990	127	5	90	20	0,8	6,2	261	11	61	17	4,9	15,2
1991	101	5	83	17	--	6,1	208	10	57	15	3,5	13,5
1992	94	4	71	15	1,1	6,2	193	9	49	14	2,3	14,1
1993	64	3	75	13	0,9	4,8	132	6	56	13	2,2	10,1
1994	26	2	41	8	0,6	3,4	53	3	36	10	1,2	5,5
1995	22	1	38	8	0,7	2,8	46	2	41	9	1,4	5,0
1996	45	3	64	14	0,8	3,1	88	5	54	12	2,1	7,1
1997	38	2	43	11	1,0	3,3	43	2	27	9	1,3	4,9
1998	70	3	48	11	1,3	6,3	111	5	35	10	1,1	11,5
1999	41	2	24	8	0,9	5,0	69	4	18	6	1,5	12,2
2000	66	5	42	10	2,7	6,5	76	6	19	6	2,0	12,6
2001	59	6	85	18	0,8	3,2	42	4	19	5	1,0	8,5
2002	47	6	62	10	--	4,8	28	3	14	4	2,7	6,2
2003	30	3	42	10	0,7	3,1	38	4	17	6	2,2	6,7
2004	23	2	21	7	0,9	3,5	27	3	14	4	1,8	6,2
2005	12	1	20	5	0,7	2,4	19	2	13	4	1,1	5,0
2006	18	2	22	5	0,9	3,3	22	2	12	4	1,3	5,6
2007	34	3	22	6	1,3	5,6	31	2	8	3	2,4	10,5
2008	21	2	14	4	1,3	5,4	19	2	5	2	1,9	10,6
2009	18	2	15	--	1,0	--	16	2	6	--	1,7	--
2010	37	5	21	--	1,6	--	34	4	14	--	2,7	--
2011	39	4	18	--	2,4	--	36	4	9	--	2,6	--
2012	66	6	36	--	2,8	--	90	8	16	--	4,8	--
2013	37	3	27	--	2,6	--	62	6	12	--	3,6	--
2014	50	5	17	--	2,9	--	66	7	16	--	2,9	--
2015	48	5	17	--	3,4	--	78	7	14	--	2,6	--
2016	52	5	12	--	4,6	--	67	7	11	--	3,4	--
2017	42	5	9	--	4,0	--	26	3	11	--	2,4	--
2018	36	5	5	--	5,1	--	16	2	6	--	2,8	--
2019	27	4	6	--	3,7	--	16	2	5	--	2,6	--
2020	52	7	--	--	4,4	--	76	10	--	--	4,1	--
2021	52	7	--	--	4,1	--	45	6	--	--	4,0	--
2022	49	7	--	--	3,9	--	29	4	--	--	4,1	--

Table 4.4.7. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. SPiCT summary results.

Model parameter estimates w 95% CI				
	estimate	cilow	ciupp	log.est
alpha	3.183	0.442	22.918	1.158
beta	0.134	0.024	0.768	-2.006
r	0.245	0.115	0.521	-1.408
rc	0.245	0.115	0.521	-1.408
rold	0.245	0.115	0.521	-1.408
m	1735	1276	2358	7.460
K	28378	13977	57617	10.250
q	0.000	0.000	0.000	-8.510
sdb	0.091	0.016	0.529	-2.401
sdf	0.201	0.137	0.293	-1.606
sdi	0.289	0.207	0.403	-1.243
sdC	0.027	0.005	0.145	-3.613

Deterministic reference points (Drp)				
	estimate	cilow	ciupp	log.est
B_{MSYd}	14189	6988	28808	9.560
F_{MSYd}	0.122	0.057	0.260	-2.102
MSYd	1735	1276	2358	7.460

Stochastic reference points (Srp)					
	estimate	cilow	ciupp	log.est	rel.diff.Drp
B_{MSYs}	13918	6790	28531	9.540	-0.019
F_{MSYs}	0.120	0.057	0.252	-2.118	-0.017
MSYs	1673	1290	2169	7.420	-0.037
*					

Model parameter estimates w 95% CI				
	estimate	cilow	ciupp	log.est
States w 95% CI				
	estimate	cilow	ciupp	log.est
B_2022.94	19045	9990	36309	9.850
F_2022.94	0.032	0.016	0.064	-3.436
B_2022.94/B_{MSY}	1.368	0.853	2.195	0.314
F_2022.94/F_{MSY}	0.268	0.152	0.472	-1.317
Predictions w 95% CI				
	prediction	cilow	ciupp	log.est
B_2024.00	19885	10528	37559	9.900
F_2024.00	0.032	0.015	0.071	-3.436
B_2024.00/B_{MSY}	1.429	0.905	2.254	0.357
F_2024.00/F_{MSY}	0.268	0.134	0.537	-1.317
Catch_2023.00	627	445	884	6.44
E(B_{inf})	23607	NA	NA	10.07

Table 4.4.8. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. SPiCT estimates for B/B_{MSY} and F/F_{MSY} . The 95% confidence intervals (CIs) are also provided.

Year	B/B_{MSY}			F/F_{MSY}		
	Estimate	CI high	CI Low	Estimate	CI high	CI Low
1980	1.42	2.90	0.69	0.93	1.69	0.52
1981	1.40	2.66	0.74	1.02	1.75	0.59
1982	1.38	2.49	0.76	1.07	1.81	0.64
1983	1.35	2.35	0.77	1.01	1.67	0.61
1984	1.29	2.19	0.76	0.86	1.40	0.53
1985	1.24	2.07	0.74	0.96	1.53	0.60
1986	1.27	2.05	0.79	1.42	2.55	0.79
1987	1.33	2.36	0.75	1.92	4.14	0.89
1988	1.26	2.63	0.60	1.68	3.57	0.79
1989	1.09	2.21	0.54	1.41	2.89	0.69
1990	1.01	1.97	0.51	1.43	2.93	0.69
1991	0.94	1.85	0.48	1.45	2.76	0.76
1992	0.86	1.56	0.47	1.69	3.10	0.93
1993	0.79	1.41	0.44	1.62	2.72	0.97
1994	0.68	1.12	0.42	1.52	2.46	0.94
1995	0.65	1.05	0.40	1.69	2.76	1.03
1996	0.63	1.02	0.39	1.62	2.63	1.00
1997	0.61	0.98	0.37	1.97	3.28	1.18
1998	0.60	1.00	0.36	2.15	3.87	1.19
1999	0.57	1.02	0.32	1.81	3.40	0.96
2000	0.54	0.98	0.29	1.36	2.51	0.74
2001	0.52	0.93	0.29	1.00	1.81	0.55
2002	0.52	0.93	0.29	0.89	1.64	0.48
2003	0.57	1.02	0.31	0.99	1.85	0.52
2004	0.60	1.10	0.33	0.94	1.69	0.52
2005	0.61	1.07	0.34	0.94	1.69	0.53
2006	0.64	1.13	0.36	1.11	2.14	0.57

Year	B/B _{MSY}			F/F _{MSY}		
	Estimate	CI high	CI Low	Estimate	CI high	CI Low
2007	0.70	1.32	0.37	0.97	1.91	0.49
2008	0.72	1.36	0.38	0.69	1.29	0.37
2009	0.73	1.33	0.40	0.56	1.04	0.30
2010	0.79	1.42	0.44	0.56	1.07	0.29
2011	0.89	1.65	0.47	0.64	1.38	0.30
2012	1.00	2.06	0.48	0.64	1.45	0.29
2013	1.05	2.23	0.50	0.58	1.20	0.28
2014	1.06	2.07	0.54	0.57	1.12	0.29
2015	1.07	2.03	0.57	0.57	1.13	0.29
2016	1.10	2.05	0.59	0.51	0.96	0.27
2017	1.10	1.96	0.61	0.44	0.80	0.25
2018	1.11	1.92	0.64	0.37	0.66	0.21
2019	1.13	1.92	0.67	0.35	0.62	0.20
2020	1.22	2.06	0.72	0.36	0.66	0.20
2021	1.31	2.23	0.76	0.30	0.52	0.17
2022	1.33	2.19	0.81	0.27	0.47	0.15
2023	1.37	2.20	0.86			

Table 4.4.9. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Estimates of catch, B/B_{msy} and F/F_{msy} for the scenarios proposed.

Scenario	Catch (t)	B/B _{MSY}	F/F _{MSY}
F = 0	0	1.52	0.00
F = F _{sq}	651	1.48	0.27
F = F _{MSY}	2337	1.36	1.00
F = F _{MSY_c_fractile}	2111	1.38	0.90

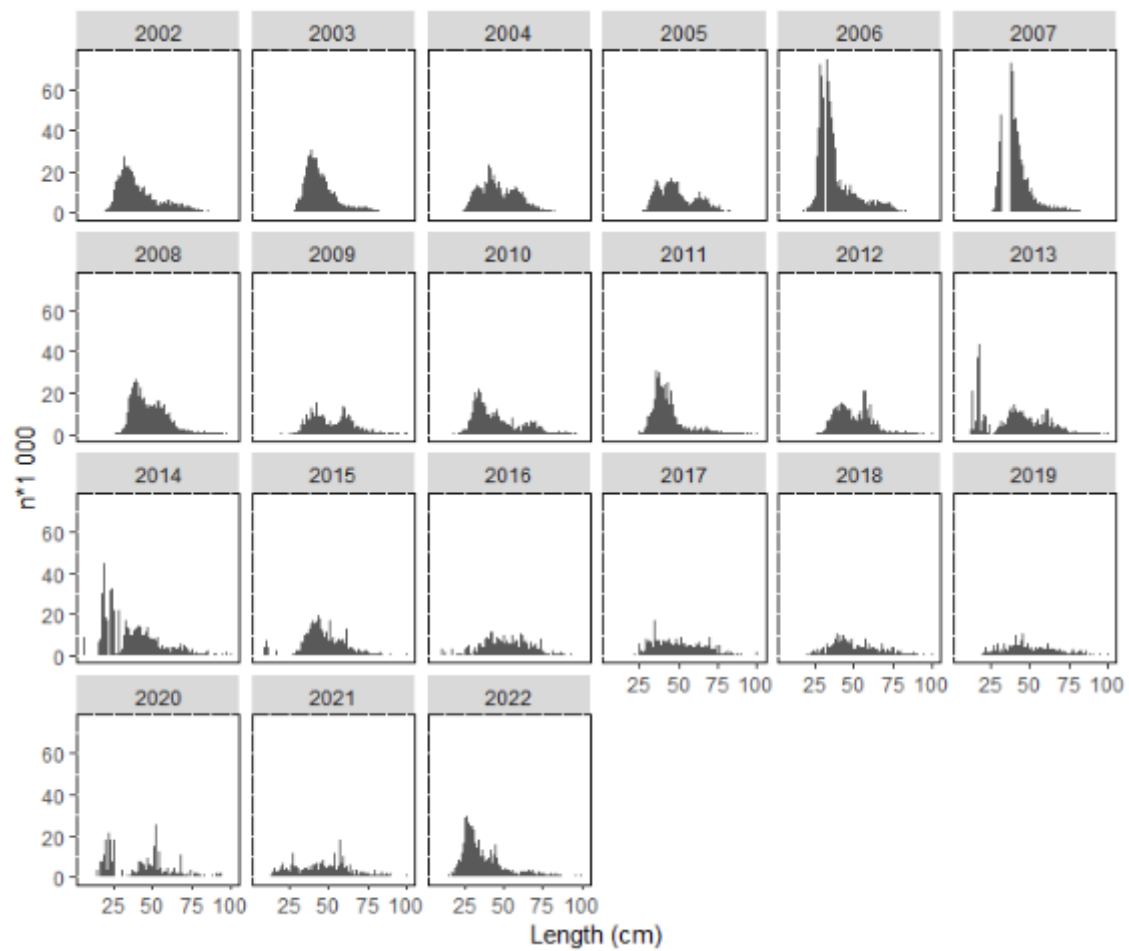


Figure 4.4.1. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Length distributions of commercial landings (in thousands) for the period 2002–2022.

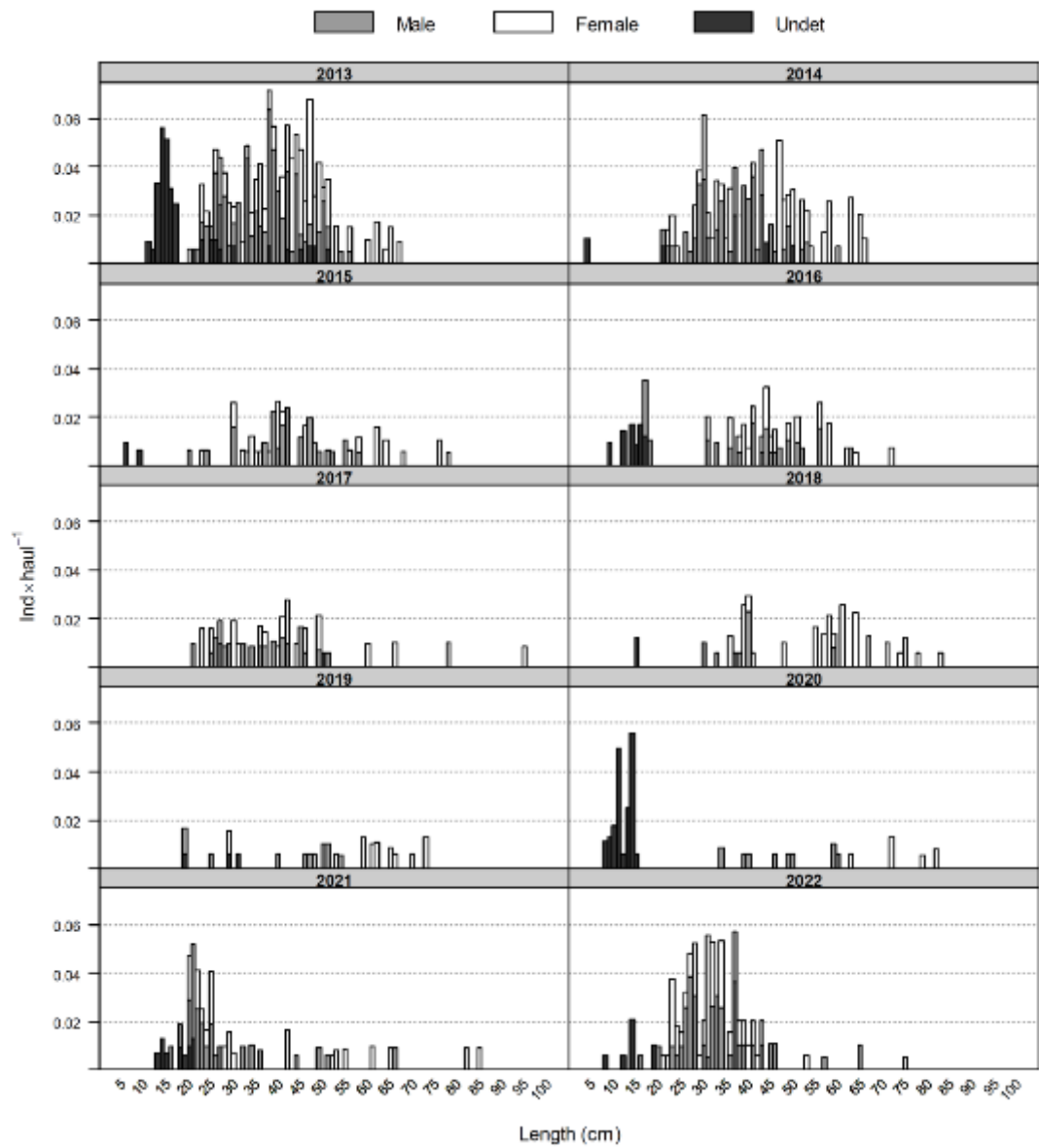


Figure 4.4.2. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Mean stratified length distributions in the Northern Spanish Shelf Groundfish Survey (SpGFS-WIBTS-Q4, G2784) for the period 2011–2022 (from Blanco *et al.*, 2023).

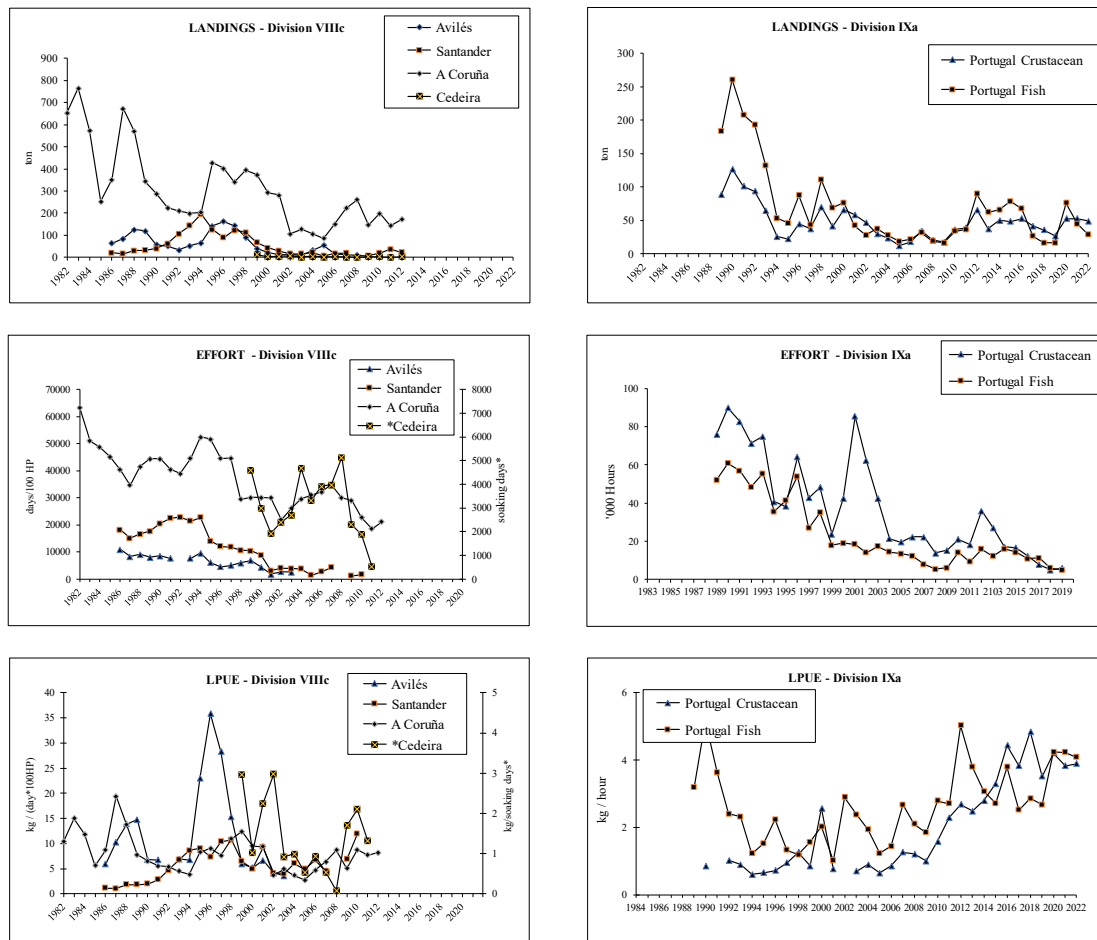


Figure 4.4.3. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Trawl (left) and gillnet (right) landings (in tonnes), effort (in days/100 HP in division 8c and '000 hours in division 9a) and LPUE (in kd/(day*100 HP) in division 8c and kg/hr in division 9a) data between 1986 and 2022.

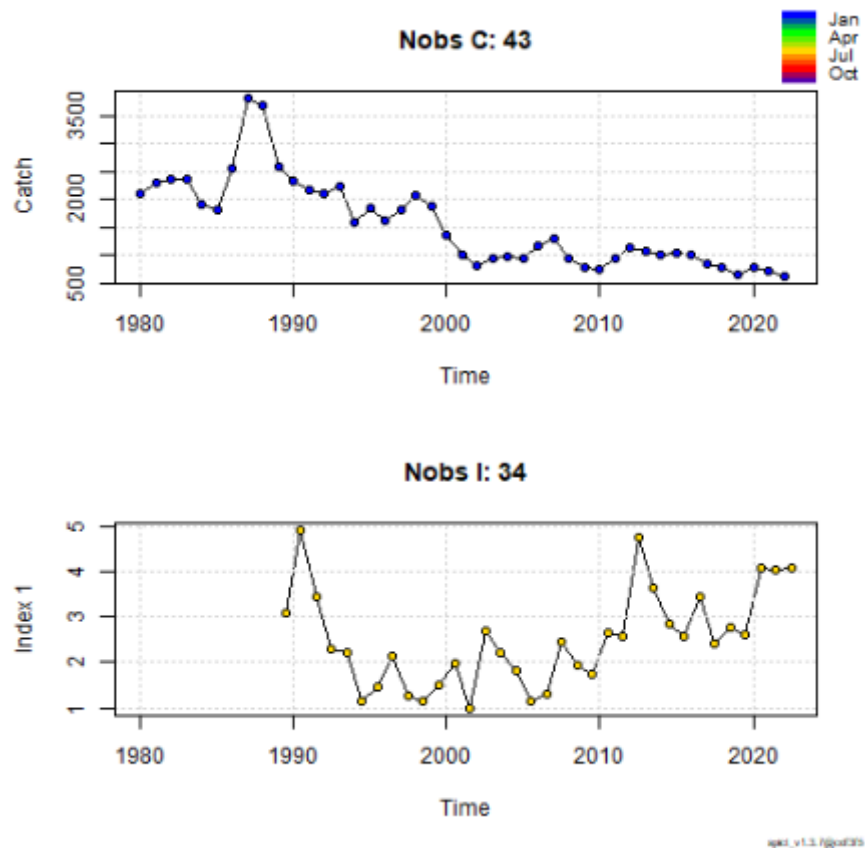


Figure 4.4.4. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. SPiCT input data. Catch data (upper panel) and Portuguese trawl fleet (PT-TRF9a) targeting fish LPUE index for the period of 1989 to 2022 (lower panel).

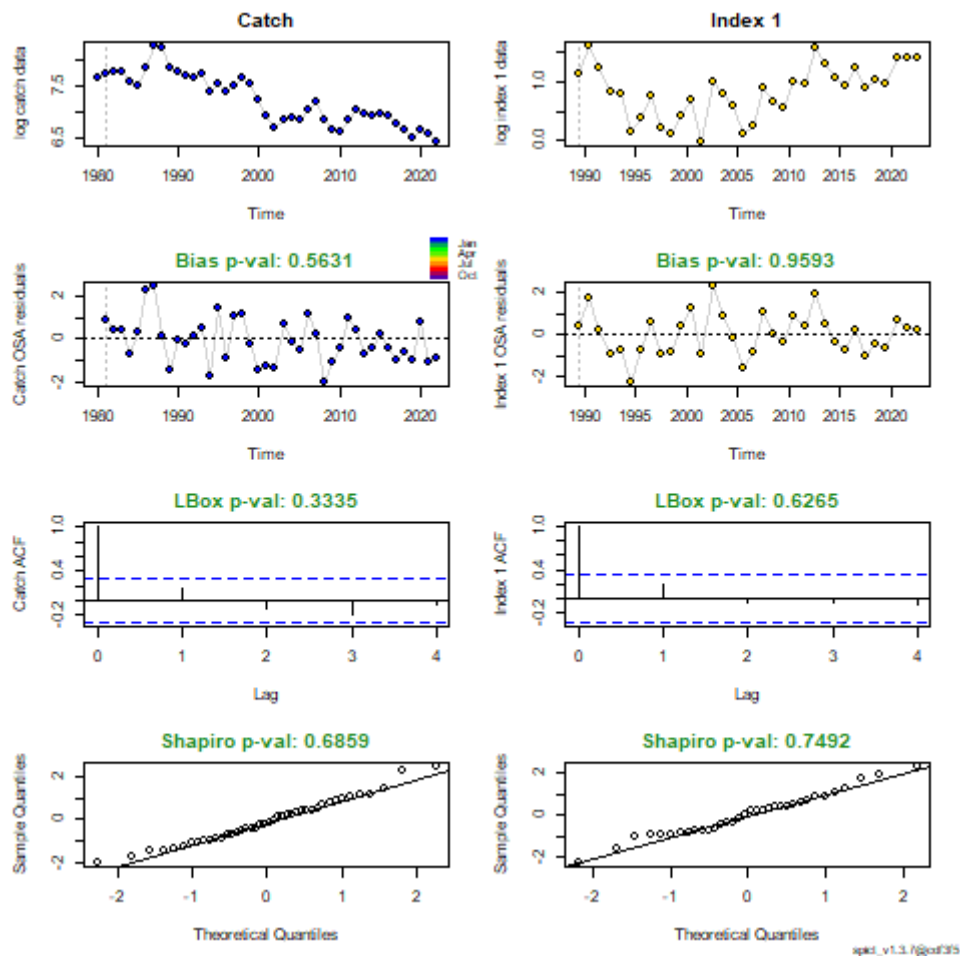


Figure 4.4.5. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. SPiCT diagnostics. Row1: Log of the input datasets. Row 2: OSA residuals with the p-value of a test for bias. Row 3: Empirical autocorrelation of the residuals with tests for significant autocorrelation. Row 4: Tests for normality of the residuals, QQ-plot and Shapiro test.

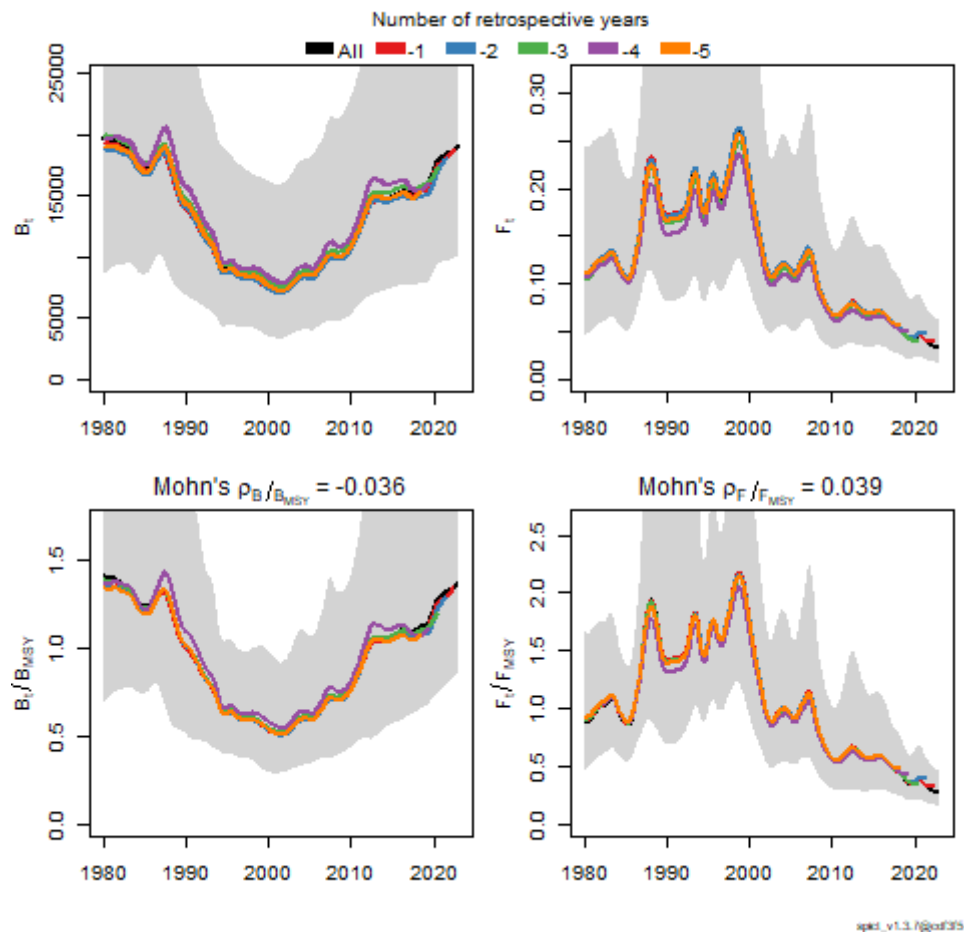


Figure 4.4.6. Anglerfish (*L. budegassa*) in divisions 8.c and 9.a. Five years retrospective analysis. Upper panel: absolute biomass and fishing mortality. Lower panel: relative biomass and fishing mortality. Grey regions represent the 95% CIs.

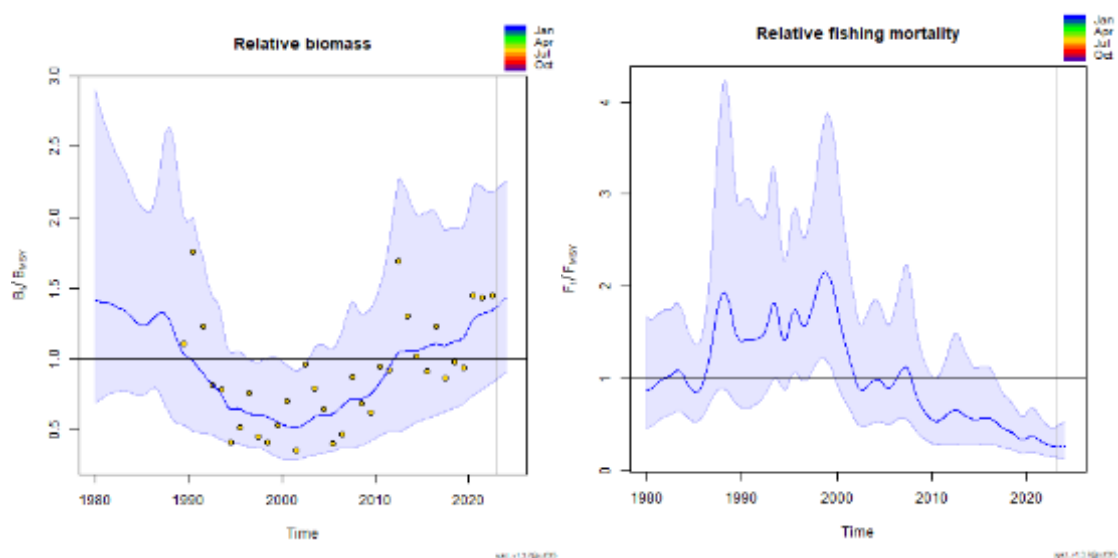


Figure 4.4.7. Black-bellied anglerfish (*L. budegassa*) in divisions 8.c and 9.a. SPiCT results: Left panel is the relative biomass and the right panel is the relative fishing mortality. Solid blue lines are estimated values; vertical grey lines indicate the time of the last observation beyond which dotted lines indicate forecasts; shaded blue regions are the 95% CIs for relative estimates; solid circles correspond to the Portuguese fish fleet (PT-TRF9a) index.

Contents

4	Black-bellied and white anglerfish in Cantabrian Sea and Atlantic Iberian waters	132
4.1	General.....	132
4.1.1	Introduction	132
4.1.2	Summary of ICES advice for 2023 and management for 2022 and 2023	133
4.1.3	References	133
4.2	White anglerfish (<i>Lophius piscatorius</i>) in divisions 8.c and 9.a.....	136
4.2.1	General.....	136
4.2.2	Data.....	136
4.2.3	Assessment	138
4.2.4	Catch options and prognosis.....	142
4.2.5	Biological reference points of stock biomass and yield	143
4.2.6	Comments on the assessment.....	143
4.2.7	Quality considerations	144
4.2.8	Management considerations	144
4.2.9	Recommendations for next benchmark	144
4.2.10	References	145
4.3	Tables and figures	146
4.4	Black-bellied anglerfish (<i>Lophius budegassa</i>) in divisions 8.c and 9.a	164
4.4.1	General.....	164
4.4.2	Data.....	164
4.4.3	Assessment	167
4.4.4	Short-term projections	168
4.4.5	Biological reference points	168
4.4.6	Comments on the assessment.....	169
4.4.7	Quality considerations	170
4.4.8	Management considerations	170
4.4.9	References	170
4.5	Tables and figures	172