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Section contents

7 Sole in divisions 8.a–b (northern and central Bay of Biscay)

Solea solea – sol.27.8ab

Type of assessment in 2021

Update. Age-structured XSA model. Category 1 stock (ICES, 2021).

Data revisions in 2021

Compared to last year's assessment, there is only very limited change in the ORAGHO (B1706) survey cpue.

7.1 General

7.1.1 Ecosystem aspects

See Stock Annex.

7.1.2 Fishery description

See Stock Annex.

7.1.3 Summary of ICES advice for 2021 and management applicable to 2020

ICES advice for 2021

ICES advises that when the EU multiannual plan (MAP; European Parliament and Council Regulation; EU, 2019) for Western waters and adjacent waters is applied, catches in 2021 that correspond to the F ranges in the MAP are between 2036 t and 4814 t. According to the MAP, catches higher than those corresponding to F_{MSY} (3483 t) can only be taken under the conditions specified in the MAP, whereas the entire range is considered precautionary when applying the ICES advice rule.

Management applicable to 2020 and 2021

The sole landings in the Bay of Biscay are subject to a TAC regulation. The TAC was set at 3666 t and 3483 t for 2020 and 2021, respectively.

The minimum landing size is 24 cm and the minimum mesh size is 70 mm for trawls and 100 mm for fixed nets when directed at sole. Since 2002, the hake recovery plan has increased the minimum mesh size for trawls to 100 mm in a large part of the Bay of Biscay (EU, 2002). However, since 2006, trawlers using a square mesh panel were allowed to use 70 mm mesh size in this area.

Since the end of 2006, the French vessels must have a European Fishing Authorization when their sole annual landing is above 2 t or be allowed to have more than 100 kg onboard. The Belgian vessel owners get a monthly non-transferable individual quota for sole and the amount is related to the capacity of the vessel.

A regulation establishing a multiannual plan (MAP) for Western waters and adjacent waters was adopted in March 2019 (EU, 2019). One of the objectives is to maintain or restore populations of harvested species at levels that can produce the maximum sustainable yield (MSY) in the context of mixed fisheries. The target fishing mortality (F) corresponds to the objective of reaching and maintaining MSY as ranges of values that are consistent with achieving MSY (F_{MSY}). The F_{MSY} upper limit is set that the probability of the stock falling below B_{lim} is no more than 5%. ICES considers that the F_{MSY} range for this stock used in the MAP is precautionary.

In addition to this MAP, the industry implemented a mesh size restriction of > = 80 mm for the bottom-trawls for the periods from 1 January to 31 May and from 1 October to 31 December. A seasonal closure was also applied during the spawning period, 1 January to 31 March, for the directed fishery for common sole. This closure consists of three periods of seven consecutive days for a total of 21 days of closure.

Since 2015, the French sole fishery in the Bay of Biscay (ICES divisions 8.a and 8.b) has been subjected to additional management measures aimed at reducing F and improving the recruitment level of the stock. Since 2016, these measures have concerned at least a 15-day fishing activity suspension during the first quarter for netters and a reinforcement of the trawl selectivity for at least 8 months of the year (including the first quarter).

7.1.4 Data

7.1.4.1 Commercial catches and discards

The working group (WG) estimates of landings and catches are shown in Table 7.1. Over 90% of the total landings are caught by France while Belgium catches amount to less than 10%. There are some incidental landings by other countries such as Spain (less than 1% of the total landings).

The official landings are lower than the WG landings estimates before 2008 but became higher from 2009. This discrepancy in estimates before 2009 and 2009–2010 was due to a new method that has been implemented to calculate the French official landings. This important discrepancy in 2009–2010 values was likely caused by some assumptions in the algorithm implemented to calculate French official landings for these 2 years, which was again modified in 2011. Consequently, the official and the WG landing estimates are closely similar since 2011. This latest WG method for evaluating landings is considered appropriate in providing the best available estimates of the landing series.

In 2002, landings increased to 5486 t due to very favourable weather conditions for the fixed nets fishery (frequent strong swell periods in the first quarter).

The 2020 landings (3221 t) is 12% below the landings constraint set at 3666 t for 2020.

Discards estimates were provided for the French offshore trawler fleet from 1984 to 2003 using the RESSGASC programme. The monitoring halted in 2004 and the discards are no longer used in the assessment. However, these surveys showed that discards from offshore trawlers are low at age 2 and above.

These low discard rates were confirmed by observations at sea in recent years. These observations have also shown that discards of beam trawlers and gillnetters are generally low but that the inshore trawler fleets may have occasionally high discards of sole. Unfortunately, these are difficult to estimate because the effort data of inshore trawlers are not precise enough to allow estimation by relevant areas.

The analysis of discards with data from OBSMER (SIH Harmonie, 2003) shows that the overall discard rate for sole in the Bay of Biscay is less than 5% (2.4% average discard ratio over 2015–2020).

7.1.4.2 Biological sampling

The quarterly French samplings for length composition are by gear (trawl or fixed net) and by boat length (below or over 12 m long). The split of the French landings by *métier* and length class is described in the Stock Annex. The observed split between fleets is presented in Table 7.2.

French and Belgian data were extracted from InterCatch for 2020.

Although age reading from otoliths now uses the same method in France and Belgium (see Stock Annex), the discrepancy between French and Belgian mean weight-at-age observed during the preceding WGs are still present. Work was carried out at the beginning of 2012 by the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS) to compare the age reading methods (ICES, 2012). The conclusion was the absence of bias between readers from the two countries using otoliths prepared with the same staining technique. All readers produced the same age estimates (i.e. no bias) of otoliths with or without staining. However, a likely effect of the weight-at-age determination process may also be presumed (weight-length relationship used in France and direct estimates in Belgium) and should be investigated. International age compositions are estimated using the same procedure as in previous years, as described in the Stock Annex. International mean weights-at-age of the catch are French-Belgian quarterly weighted mean weights. The catch and landings numbers-at-age are shown in Table 7.3 and Figure 7.1, respectively, and the mean catch weight-at-age in Table 7.4. The COVID-19 restrictions had a negligible impact on the biological sampling because most of the French catches occurred outside the period of the 2020 French spring lockdown.

7.1.5 Abundance indices from surveys

Since 2007, a beam trawl survey (ORHAGO, B1706) is carried out by Ifremer (France) to provide a sole abundance index in the Bay of Biscay. This survey is coordinated by the ICES WGBEAM. During the 2013 WGBEAM meeting, several cpue series were compared (ICES, 2013a). The index found to be the most appropriate was the one based on all the reference stations and carried out during the daytime. This was used to provide the abundance index for sole in divisions 8.a and 8.b. The 2013 WGHMM assessment was carried out according to the 2013 revised Stock Annex, which adds the ORHAGO (B1706) survey to the tuning files. This was a consequence of the IBP during the WGHMM 2013 which considered that the addition of the survey tuning fleet appears to be useful to the assessment (ICES, 2013b). In 2015, the survey vessel was changed. However, the gear configuration and method remained the same as in the previous years and the conclusion of the WGBEAM 2016 was: "*This change has had no consequence on the gear configuration*" (ICES, 2016c). On this basis, the WG agreed to retain the ORHAGO (B1706) abundance index for the assessment. Figure 7.2 shows the tuning fleets' time-series and their internal consistency. The ORHAGO survey (B1706) was not affected by the COVID-19 restrictions.

7.1.6 Commercial catch-effort data

The French La Rochelle and Les Sables trawler series of commercial fishing effort data and LPUE indices were completely revised in 2005. A selection of fishing days (or trips before 1999) was implemented with a double threshold (sole landings > 10% and *Nephrops* landings < = 10%) for a group of vessels. The process is described in the Stock Annex.

The risk that the sole 10% threshold may lead to an underestimation of the decrease in stock abundance was pointed out by RG in 2010 (M. Lissardy, Ifremer, pers. comm.). This general point is acknowledged by this WG. However, in this particular case and by using the knowledge of the fishery, this threshold was set to avoid the effect of changing target species which may also affect the LPUE trend. Indeed, the choice of target species may affect effort repartition between

the stock's major habitats and peripheral areas where sole abundance is lower. According to fishers, a minimum of 10% in catch for sole was implemented when carrying out mixed-species trawling on sole grounds in order to ensure that sole LPUEs are not driven by a fishing strategy evolution (i.e. the targeting of cephalopods more particularly).

The La Rochelle LPUE series (FR-ROCHELLE) shows a decreasing trend from 1990 to 2001 followed by the absence of any clear trend, only some up and down variations (Figure 7.2). The Les Sables d'Olonne LPUE series (FR-SABLES) also shows a declining trend up to 2003. Thereafter, a short increase in 2004–2005 was observed followed by a flat trend from 2005 onwards.

Two new tuning series were added to the assessment according to the WKFLAT 2011 (ICES, 2011): the Bay of Biscay offshore trawler fleet (14–18 m) in the second quarter (FR-BB-OFF-Q2) and the Bay of Biscay inshore trawler fleet (10–12 m) in the fourth quarter (FR-BB-IN-Q4) for 2000 to the last year. A selection of fishing days was made by a double threshold (sole landings > 6% and *Nephrops* landings <= 10%). The process is described in the Stock Annex.

Unfortunately, the fishing effort for the FR-BB-OFF-Q2 is no longer available since 2013. This is due to the use of electronic logbooks, for which the fishing effort is not a required value. Since 2013, these data are not well exported in the official database, and the majority of the fishing effort value is equal to 1. Therefore, the commercial LPUE could not be calculated for this fleet.

However, LPUE for the FR-BB-IN-Q4 fleet is still available from paper logbooks which are still used by this fleet. The computation of the FR-BB-IN-Q4 was not affected by the COVID-19 restrictions, because in the fourth quarter of 2020, the inshore trawler was not affected by COVID-19 restrictions.

For the ORHAGO (B1706) survey, the trend of the cpue shows an increase since 2008 despite some annual fluctuations which stabilized from 2013 onwards.

ORHAGO (B1706) shows a slight decrease in numbers-at-age 2 (Figure 7.2) in the last 5 years but the index is about the average of the whole time-series. It is worth noting that an important decrease of the ORHAGO (B1706) and FR-BB-IN-Q4 tuning fleet indices were observed in 2019 for age 2. Both also showed a decrease of the age 3 indices for the same year and in 2020, with a slight decrease for the FR-BB-IN-Q4 and a significant decrease for the ORHAGO (B1706) survey. A subsequent decrease in ages 2 and 3 indices was observed in 2020 where indices for both ages are lower than the 2019 values for the ORHAGO (B1706) survey and the FR-BB-IN-Q4 fleet. In general, these two fleets ORHAGO (B1706) and FR-BB-IN-Q4, are consistent among ages and allow for cohorts tracking.

7.2 Assessment

7.2.1 Input data

See Stock Annex.

7.2.2 Model

The model used in 2021 to assess the sole in the Bay of Biscay is the R FLXSA package (Kell, 2020) in R (R Core Team, 2020). The age range in the assessment is 2–8+, similar to last year's assessment. The year range used is 1984–2020.

Result of XSA runs

The final XSA model used the same settings as in last year's assessment run. Figure 7.1 shows the landings-at-age distribution and, similar to last year's landings which consist mainly of ages 3 and 4-year-old individuals.

			2020 XSA		2021 XSA
Catch data range			84–19		84–20
Catch age range			2–8+		2–8+
Fleets	FR – SABLES	91–09	2–7	91–09	2–7
	FR – ROCHELLE	91–09	2–7	91–09	2–7
	FR-BB-IN-Q4	00–19	3–7	00–20	3–7
	FR-BB-OFF-Q2	00–12	2–6	00–12	2–6
	FR-ORHAGO	07–19	2–8	07–20	2–8
Taper			No		No
Ages catch dep. stock size			No		No
Q plateau			6		6
F shrinkage se			1.5		1.5
Year range			5		5
Age range			3		3
Fleet se threshold			0.2		0.2
F bar range			3–6		3–6

The log-catchability residuals are shown in Figure 7.3 and retrospective results in Figure 7.4. The retrospective pattern shows a good estimation of F, SSB for 2018 data. Table 7.5 gives the results of Mohn's rho calculation from the most recent assessments and five retrospective assessments with terminal years (2016–2020). Mohn's rho value is −0.00042 for recruitment, 0.13000 for SSB and 0.04900 for F.

Because of the lack of FR-BB-OFF-Q2 abundance indices in the tuning data, the estimated survivors at age 2 are only based on the ORHAGO (B1706) survey. Recruits at age 2 were not well estimated for 2019.

Fs and stock numbers-at-age are given in Table 7.6 and Table 7.7, respectively. The results are summarized in Table 7.8. Trends in yield, F, SSB and recruitment are plotted in Figure 7.5. F in 2020 is estimated by XSA (Shepherd, 1999) at 0.38. F was 0.36 in 2019 and 0.34 in 2018.

7.2.2.1 Estimating year-class abundance

In this year's assessment, the retrospective analyses show that the recruitment was well estimated by the XSA model. The recruitment assumed for projections is computed as the geometric mean of the estimated recruitment over the period 2016–2020, which is equal to 12 688 thousand recruits.

7.2.2.2 Historic trends in biomass, fishing mortality, and recruitment

A full summary of the XSA time-series results are given in Table 7.8 and illustrated in Figure 7.6. Since 1984, F gradually increased, peaked in 2002 and decreased substantially in the following two years. It increased since 2005 then was stable at around F = 0.4. In 2017, the value was below F_{MSY} but increased since 2018 to be above F_{MSY}. The SSB trend in earlier years increased from 12 300 t in 1984 to 16 300 t in 1993. Afterwards, it showed a continuous decline to 9600 t in 2003. After an increase in SSB was observed between 2004 and 2006, then the values remained close to 11 000 t from 2007 to 2009. Although above the MSY $B_{brigger}$ (10 600 t) from 2004, SSB has been decreasing since 2012. SSB values for 2014 and 2015 were below the $B_{pa,}$ then was above since 2016 and for the last year (2020) estimated SSB is below MSY $B_{trigger}$ and B_{pa} (both equal to 10 600 t). The recruitment values were decreasing since 1993. Between 2004 and 2008, the series was stable at around 17 or 18 million then increased in 2009 to the highest value since 1992. After a short increase, the recruitment declined again since 2015, with the lowest values of 9101 and7986 observed in 2019 and 2020, respectively.

7.2.3 Catch options and prognosis

The exploitation pattern is the mean throughout 2018–2020 scaled at the last year. As the take up of TAC is less than 80%, a F-*status quo* for the intermediate year is used and set at 0.38. The recruits at age 2 from 2020 to 2021 are assumed equal to the geometric mean of 2016–2020 (GM_{16-20}). Stock numbers-at-age 3 and above are the XSA survivor estimates. Weights-at-age in the landings are the 2018–2020 means using the old fresh/gutted transformation coefficient of French landings (1.11). The fresh/gutted transformation coefficient of French landings was not computed in 2021. The predicted spawning biomass is consequently still comparable to the biomass reference point.

7.2.3.1 Short-term predictions

Input values for the catch forecast are given in Table 7.10. For the intermediate year (2021), the F-*status quo* was used to perform the short-term predictions ($F_{2021} = 0.38$).

In 2020, the WGBIE was concerned by the decrease in recruitment over the past two decades. The time-series used to compute the recruitment as a geometric mean was shortened to account for the low recruitment observed in the past 10 years using the mean of 2004 to 2017. In 2021, the retrospective analysis indicates that recruitment is well estimated in recent years, but still decreasing. In order to account for the lower recruitment in recent years, the geometric mean of the recruitment was again shortened and computed over the period 2016–2020, giving the value of 12 688 thousand recruits. The shorter period to compute the GM of the recruitment is more precautionary than the longer period used in previous stock assessments.

Assuming recruitment at GM_{16-20}, the SSB is predicted to decrease to 8934 t in 2022, and will decrease compared with 2021 at $F = F_{MSY} \times SSB_{2022}/MSYB_{trigger}$, to reach 9372 t in 2023 and will remain under B_{pa} and $MSYB_{trigger}$ (Table 7.10 and Table 7.11).

7.2.4 Biological reference points

ICES (2016a) and WKMSYRef4 for MSY approach reference points (ICES, 2016b) are given below as a technical basis with the values adopted for the precautionary approach reference points:

The F pattern is known, with low uncertainty, because of the limited discards and the satisfactory sampling level of the catches.

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	10 600 t	B_{pa}
	FMSY	0.33	F_{MSY} without $B_{trigger}$
	B_{lim}	7600 t	$B_{lim} = B_{pa} / \exp(\sigma \times 1.645)$
Precautionary Approach	B_{pa}	10 600 t	The third lowest value
	F_{lim}	Undefined	
	F_{pa}	0.88	F_{pa} = FP.05 (5% risk to B_{lim} with $B_{trigger}$)

7.2.5 Comments on the assessment

Sampling

The sampling level for this stock is considered to be satisfactory. The ORHAGO (B1706) survey provides information on several year-classes from age 2. At other ages, it is particularly useful to have a tuning fleet in the tuning file because the recent use of electronic logbooks has caused some obvious misreporting of effort which limits the available commercial tuning data in 2012 and 2013 coupled with the lack of FR-BB-OFF-Q2 abundance indices since 2013. Stopping the use of fleets of La Rochelle and Les Sables tuning series led to a paucity of information at age 2 in 2013, which were only provided by the Offshore Q2 tuning fleet (when data were available). That is no longer the case with the incorporation of the ORHAGO (B1706) survey in the assessment. The same age reading method is now adopted by France and Belgium. However, a discrepancy still exists between French and Belgian weights-at-age which requires further investigation.

Discarding

Available data on discards have shown that discards may be important at age 1 for some trawlers. Discards at age 2 were assumed to be low in the past due to the high commercial value of the sole catches. Recently, there are some reports of highgrading practices due to the landing limits adopted by some producers' organizations. Overall, discards remain low in recent years and are used to produce catch advice. Discards could be included in the assessment during the next benchmark.

Consistency

Since the 2013 assessment, the ORHAGO (B1706) survey has been included in the tuning fleets. This survey is the only tuning fleet that provides a recruitment index series for the more recent period. A GM is only used for recruitment predictions (2020–2023). It is worth noting that the variability of the recruitment series has increased in the period 2001 to 2019. The retrospective pattern in F shows that F_{2016} is well estimated (Figure 7.5). The definition of reference groups of vessels and the use of thresholds on species percentage to build the French series of commercial fishing effort data and LPUE indices are considered to provide LPUE representative of changes in stock abundance by limiting the effect of long-term change in fishing power (technological creep) and change in fishing practices in the sole fishery.

Misreporting

Misreporting is likely to be limited for this stock but it may have occurred for fish of the smallest market size category for some years. There are some reports of highgrading practices due to the landing limits adopted by some producers' organizations.

Industry input

The traditional meeting with representatives of the fishing industry was organized in France prior to the WG to present the data used during the WGBIE 2021 to assess the state of stock in the Bay of Biscay (ICES, 2021).

Since 2015, the French sole fishery in the Bay of Biscay (ICES divisions 8.a and 8.b) has been subjected to additional management measures aimed at reducing F and improving the stock's recruitment level. Since 2016, these measures include a fishing closure of at least 15 days during the first quarter for netters and a reinforcement of the selectivity for at least 8 months of the year (including the first quarter) for trawlers.

In addition to the European measures of the management plan of the Bay of Biscay sole stock (EU, 2006) and the harvest control rules defined in the framework of the South West Waters Advisory Council, France has set up from 2015 a national management regime towards the French sole fishery in the Bay of Biscay. In 2019, this management regime provides for:

- A 15-day fishing activity suspension per period of 5 consecutive days during the first quarter of the year, for netters holding a European fishing authorization for sole in the Bay of Biscay. From 2016 to 2018, these vessels were subjected to a 21-day fishing activity suspension per period of 7 consecutive days during the first quarter;
- The obligation to use a mesh size greater than or equal to 80 mm (the regulatory mesh size being 70 mm) from 1 January to 31 May and for at least 3 consecutive months from 1 June to 31 December, for bottom-trawlers holding a European fishing authorization for sole in the Bay of Biscay. The actual effectiveness of these management measures is not fully assessed;
- Suspension of netters from fishing during the months with the highest yields should significantly reduce landings. A study made by Ifremer (Ifremer, 2015) quantified that closing the fishery 5 days per month during the first quarter corresponds to a reduction of 16% of the annual landings of the netters compared to identical conditions of activity elsewhere;
- The increase in the mesh size of the bottom-trawls should also limit catches of sole that have not reached maturity (26 cm). A study made by AGLIA (AGLIA 2009) showed that size compositions of trawl catches differed between 70 and 80 mm mesh sizes and catches of sole less than 28 cm are considerably reduced.

Management considerations

The assessment indicates that SSB has decreased continuously to 9600 t in 2003, reached a peak in 1993 (16 308 t), then decreased to 14 446 t in 2011. After another decrease from 2012 to 2015, SSB increased from 2016 to 2017 followed by a decreasing trend since 2018 to 10 355 t in 2020. The SSB in 2019 was above B_{pa} and $MSYB_{trigger}$ (10 600 t), but is now under B_{pa} and $MSYB_{trigger}$, assuming a 12 688 recruitment value for 2021. A slight decrease of SBB is predicted by the short-term forecast in 2023 (9372 t), a value still under B_{pa} and $MSYB_{trigger}$ (Table 7.11). In 2006, a management plan (EU, 2006) was agreed for the Bay of Biscay sole but a long-term target for F was not set. This plan was not evaluated by ICES.

7.2.6 References

AGLIA, 2009. Etude d'impact à court terme d'une augmentation du maillage pour la flottille chalutière de la Côtinière.

EU. 2002. Council Regulation (EC) No. 2431/2002 fixing for 2003 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where catch limitations are required.

EU, 2006. Regulation (EC) No 389/2006 of 27 February 2006 establishing an instrument of financial support for encouraging the economic development of the Turkish Cypriot community and amending Council Regulation (EC) No 2667/2000 on the European Agency for Reconstruction.

EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83: 1–17. http://data.europa.eu/eli/reg/2019/472/oj.

ICES. 2011. Report of the Benchmark Workshop on Flatfish (WKFLAT), 1–8 February 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:39. 257 pp.

ICES. 2013a. Report of the Working Group on Beam Trawl Surveys (WGBEAM), 23–26 April 2013, Ancona, Italy. ICES CM 2013/SSGESST: 12, 260 pp.

ICES. 2013b. Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM), 10–16 May 2013, ICES Headquarters, Copenhagen. ICES CM 2013/ACOM:11A. 11 pp.

ICES. 2016a. EU request to ICES to provide FMSY ranges for selected stocks in ICES subareas 5 to 10. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.4.1. 13 pp. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/Special_Requests/EU_FMSY_ranges_for_selected_Western_Waters_Stocks.pdf.

ICES. 2016b. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 187 pp. ICES. 2016c. Report of the Working Group on Beam Trawl Surveys (WGBEAM), 14–17 April 2015, Leuven, Belgium. ICES CM 2015/SSGIEOM: 20, 148 pp.

ICES. 2021a. Advice on fishing opportunities. *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Section 1.1.1. https://doi.org/10.17895/ices.advice.7720.

Ifremer. 2015. Évaluation de mesures de gestion pour le stock de sole (*Solea solea*) du Golfe de Gascogne. Saisine DPMA n°15-8690.

Kell, L. 2020. "Flr/Flxsa: EXtended Survivor Analysis for Flr." Flr. URL: http://flr-project.org/FLXSA.

OBSMER. 2003. OBServations à la MER à bord des navires de pêche professionnels sur les côtes françaises de métropole. URL: https://sextant.ifremer.fr/record/24538369-ea5a-48d7-a89b-0c9530247ed2/.

R Core Team, 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Shepherd, J. G. 1999. Extended survivors analysis: An improved method for the analysis of catch-at-age data and abundance indices. ICES Journal of Marine Science, 56: 584–591.

SIH Harmonie. 2003. ObsMer (Observations à la Mer à bord des navires de pêche professionnelle sur les côtes françaises de métropole). https://sextant.ifremer.fr/record/24538369-ea5a-48d7-a89b-0c9530247ed2/.

7.2.7 Tables and figures

Table 7.1. Bay of Biscay sole in divisions 8.a and 8.b. International landings and catches used by WGBIE (in tonnes).

Year	Belgium	France	Spain	Total	ICES landings	discards	ICES catches
1979	0	2376	62	2443	2619	-	-
1980	33	2549	107	2689	2986	-	-
1981	4	2581	96	2694	2936	-	-
1982	19	1618	57	1746	3813	-	-
1983	9	2590	38	2669	3628	-	-
1984	0	2968	40	3183	4038	99	4137
1985	25	3424	308	3925	4251	64	4315
1986	52	4228	75	4567	4805	27	4832
1987	124	4009	101	4379	5086	198	5284
1988	135	4308	0	4443	5382	254	5636
1989	311	5471	0	5782	5845	356	6201
1990	301	5231	0	5532	5916	303	6219
1991	389	4315	3	4707	5569	198	5767
1992	440	5928	0	6359	6550	123	6673
1993	400	6096	13	6496	6420	104	6524
1994	466	6627	2	7095	7229	184	7413
1995	546	5326	0	5872	6205	130	6335
1996	460	3842	0	4302	5854	142	5996
1997	435	4526	0	4961	6259	118	6377
1998	469	3821	0	4334	6027	127	6154
1999	504	3280	0	3784	5249	110	5359
2000	451	5293	5	5749	5760	51	5811
2001	361	4350	0	4912	4836	39	4875
2002	303	3680	2	3985	5486	22	5508
2003	296	3805	4	4105	4108	21	4129
2004	324	3739	9	4072	4002	-	-
2005	358	4003	10	4371	4539	-	-

Year	Belgium	France	Spain	Total	ICES landings	discards	ICES catches
2006	393	4030	9	4432	4793	-	-
2007	401	3707	9	4117	4363	-	-
2008	305	3018	11	3336	4299	-	-
2009	364	4391	0	4755	3650	-	-
2010	451	4248	0	4699	3966	-	-
2011	386	4259	0	4645	4632	-	-
2012	385	3819	0	4204	4321	-	-
2013	312	4181	0	4492	4235	-	-
2014	307	3793	10	4110	3928	-	-
2015	302	3465	8	3775	3644	62	3706
2016	288	3054	4	3346	3232	134	3366
2017	274	2953	8	3236	3249	55	3304
2018	295	3165	8	3468	3308	79	3332
2019	322	3032	24	3351	3376	88	3464
2020	299	2091	21	3221	3219	74	3293

Table 7.2. Bay of Biscay sole in divisions 8.a and 8.b. Total landings by different fleets (in tonnes).

Year	Offshore trawlers	Inshore trawlers	Offshore gillnetters	Inshore gillnetters	Belgian Beam trawlers
1997	1874	667	1927	1356	435
1998	1826	605	1674	1414	463
1999	1261	289	2094	1105	499
2000	1197	474	2510	1114	459
2001	994	411	1947	913	368
2002	968	373	2760	1054	311
2003	992	329	1736	749	296
2004	898	369	1710	686	319
2005	923	326	2053	788	365
2006	923	373	2117	896	393
2007	920	392	1768	870	401
2008	813	238	2085	856	305
2009	745	235	1615	692	363
2010	792	323	1733	667	451
2011	807	327	2197	915	386
2012	744	365	1938	889	385
2013	744	313	2052	814	312
2014	716	345	1811	748	307
2015	537	263	1786	748	302
2016	471	259	1522	687	288
2017	514	245	1545	663	274
2018	470	230	1667	725	295
2019	457	227	1589	759	322
2020	437	226	1520	723	299

Table 7.3. Bay of Biscay sole in divisions 8.a and 8.b, catch number-at-age.

Year	2	3	4	5	6	7	8
1984	5901	3164	2786	2034	1164	880	1181
1985	8493	4606	2479	1962	906	708	729
1986	5901	3164	2786	2034	1164	880	1181
1987	8493	4606	2479	1962	906	708	729
1988	6126	4208	2673	2301	1512	1044	1235
1989	3794	5634	3578	2005	1482	690	714
1990	4962	5928	4191	2293	1388	874	766
1991	4918	6551	3802	3147	2046	967	499
1992	7122	6312	4423	2833	972	1018	870
1993	4562	6302	4512	2083	1113	1063	981
1994	4640	7279	4920	2991	2236	1124	951
1995	1897	7816	6879	3661	1625	566	708
1996	2603	5502	8803	5040	1968	970	696
1997	3249	5663	6356	3644	1795	843	986
1998	3027	5180	5409	2343	1697	1366	1319
1999	3801	9079	5380	3063	1578	692	877
2000	4096	5550	6351	2306	1237	785	1188
2001	2851	5113	4870	2764	1314	902	977
2002	5677	7015	5143	2542	955	421	444
2003	3180	6528	4948	1776	899	513	486
2004	5198	4777	4932	3095	1269	615	432
2005	4274	6309	2236	1220	729	377	250
2006	3411	5415	3291	917	661	272	333
2007	3976	3464	3738	2309	991	461	508
2008	3535	4436	2747	2012	1030	530	1537
2009	3885	5181	2615	1419	1262	686	946
2010	3173	4794	2886	1353	938	892	1193
2011	2860	3986	2233	1501	946	541	960
2012	2084	7707	3758	1272	484	269	284

Year	2	3	4	5	6	7	8
2013	1516	5222	8347	1019	570	275	516
2014	1302	4680	4264	3787	1008	225	517
2015	2312	2939	3777	3205	1450	286	635
2016	3767	3198	1769	2426	1810	791	522
2017	2531	3365	1742	2057	1305	939	636
2018	1144	3368	2682	1193	762	759	867
2019	1492	3608	2199	1023	606	587	949
2020	1736	3497	2448	1823	885	484	933

Table 7.4. Bay of Biscay sole in divisions 8.a and 8.b, catch weight-at-age (in kg).

Year	2	3	4	5	6	7	8
1984	0.13	0.18	0.228	0.288	0.352	0.394	0.614
1985	0.109	0.179	0.26	0.322	0.402	0.471	0.719
1986	0.104	0.176	0.25	0.334	0.417	0.508	0.67
1987	0.144	0.206	0.292	0.385	0.479	0.509	0.699
1988	0.135	0.192	0.274	0.36	0.499	0.507	0.609
1989	0.137	0.189	0.259	0.356	0.439	0.546	0.803
1990	0.132	0.18	0.242	0.349	0.438	0.603	0.857
1991	0.146	0.196	0.265	0.331	0.445	0.545	0.728
1992	0.146	0.196	0.262	0.341	0.404	0.49	0.715
1993	0.145	0.197	0.267	0.341	0.439	0.569	0.678
1994	0.147	0.195	0.251	0.325	0.422	0.57	0.775
1995	0.16	0.206	0.253	0.309	0.404	0.485	0.66
1996	0.159	0.204	0.268	0.319	0.399	0.453	0.625
1997	0.143	0.194	0.257	0.321	0.408	0.504	0.681
1998	0.162	0.214	0.259	0.338	0.414	0.506	0.706
1999	0.177	0.219	0.246	0.305	0.404	0.533	0.582
2000	0.172	0.208	0.278	0.345	0.455	0.577	0.76
2001	0.154	0.222	0.268	0.344	0.432	0.524	0.625
2002	0.173	0.211	0.266	0.324	0.472	0.599	0.689
2003	0.181	0.227	0.309	0.363	0.49	0.661	0.646
2004	0.192	0.229	0.293	0.395	0.498	0.65	0.818
2005	0.192	0.229	0.303	0.373	0.437	0.475	0.666
2006	0.198	0.245	0.286	0.352	0.426	0.461	0.54
2007	0.176	0.226	0.299	0.327	0.389	0.42	0.512
2008	0.174	0.229	0.287	0.352	0.392	0.401	0.519
2009	0.173	0.218	0.279	0.322	0.367	0.454	0.61
2010	0.179	0.206	0.273	0.338	0.415	0.478	0.769
2011	0.194	0.224	0.254	0.344	0.434	0.491	0.609
2012	0.182	0.225	0.258	0.308	0.37	0.415	0.586

Year	2	3	4	5	6	7	8
2013	0.21	0.242	0.274	0.306	0.371	0.522	0.525
2014	0.179	0.243	0.283	0.299	0.351	0.397	0.581
2015	0.198	0.226	0.318	0.314	0.389	0.367	0.52
2016	0.188	0.238	0.286	0.352	0.372	0.382	0.526
2017	0.219	0.239	0.301	0.376	0.434	0.427	0.523
2018	0.191	0.251	0.285	0.357	0.407	0.382	0.444
2019	0.2	0.248	0.288	0.334	0.332	0.372	0.424
2020	0.205	0.245	0.296	0.314	0.353	0.376	0.456

Table 7.5. Mohn's rho for R, SSB and R.

Variable	Mohn's rho
SSB	−0.00042
Mean F	0.04900
Recruits	0.13000

Table 7.6. Fishing mortality-at-age.

	2	3	4	5	6	7	8
1984	0.297	0.243	0.336	0.348	0.320	0.336	0.336
1985	0.360	0.354	0.272	0.372	0.229	0.292	0.292
1986	0.258	0.271	0.318	0.388	0.485	0.398	0.398
1987	0.175	0.356	0.347	0.372	0.411	0.378	0.378
1988	0.217	0.400	0.433	0.347	0.423	0.402	0.402
1989	0.203	0.437	0.429	0.598	0.526	0.519	0.519
1990	0.266	0.385	0.526	0.581	0.327	0.480	0.480
1991	0.144	0.354	0.464	0.446	0.419	0.631	0.631
1992	0.149	0.320	0.456	0.566	1.101	0.868	0.868
1993	0.0804	0.354	0.501	0.644	0.611	0.824	0.824
1994	0.110	0.328	0.754	0.747	0.771	0.812	0.812
1995	0.157	0.330	0.684	0.723	0.575	0.800	0.800
1996	0.115	0.355	0.531	0.510	0.790	1.059	1.059
1997	0.185	0.516	0.673	0.577	0.685	0.782	0.782
1998	0.212	0.396	0.738	0.606	0.429	0.778	0.778
1999	0.131	0.393	0.638	0.746	0.744	0.565	0.565
2000	0.273	0.480	0.767	0.723	0.550	0.496	0.496
2001	0.220	0.509	0.654	0.579	0.535	0.571	0.571
2002	0.249	0.526	0.809	1.018	0.968	0.765	0.765
2003	0.204	0.478	0.443	0.416	0.616	0.767	0.767
2004	0.237	0.381	0.436	0.292	0.370	0.433	0.433
2005	0.263	0.356	0.438	0.551	0.518	0.423	0.423
2006	0.228	0.464	0.471	0.395	0.450	0.513	0.513
2007	0.265	0.535	0.485	0.420	0.410	0.542	0.542
2008	0.201	0.535	0.572	0.442	0.480	0.503	0.503
2009	0.093	0.369	0.452	0.586	0.562	0.500	0.500
2010	0.094	0.344	0.625	0.447	0.334	0.270	0.270
2011	0.081	0.317	0.677	0.302	0.327	0.286	0.286
2012	0.104	0.338	0.411	0.664	0.486	0.185	0.185

	2	3	4	5	6	7	8
2013	0.193	0.32	0.444	0.548	0.509	0.218	0.218
2014	0.260	0.394	0.289	0.506	0.607	0.511	0.511
2015	0.161	0.347	0.344	0.562	0.496	0.652	0.652
2016	0.074	0.297	0.454	0.372	0.370	0.533	0.533
2017	0.098	0.309	0.287	0.278	0.292	0.479	0.479
2018	0.122	0.311	0.317	0.364	0.365	0.355	0.355
2019	0.135	0.347	0.391	0.326	0.362	0.381	0.381
2020	0.22	0.38	0.51	0.35	0.28	0.24	0.24

Table 7.7. Bay of Biscay sole in divisions 8.a and 8.b, stock number-at-age (start of year). Numbers*10 –3.**

	2	3	4	5	6	7	8
1984	24146	15402	10263	7273	4471	3246	4342
1985	29505	16235	10927	6636	4646	2939	3017
1986	28293	18619	10309	7529	4139	3342	3939
1987	24882	19774	12844	6785	4624	2307	2378
1988	26717	18905	12533	8218	4232	2774	2422
1989	28114	19455	11467	7353	5255	2509	1289
1990	32062	20761	11372	6759	3660	2809	2390
1991	35677	22236	12781	6083	3421	2387	2191
1992	35306	27942	14126	7273	3522	2037	1710
1993	24865	27532	18359	8101	3736	1060	1317
1994	26171	20694	17477	10069	3848	1834	1307
1995	23542	21204	13491	7441	4316	1610	1870
1996	29349	18211	13800	6161	3266	2198	2103
1997	23707	23676	11551	7341	3346	1341	1688
1998	22581	17836	12787	5334	3729	1527	2295
1999	24379	16536	10859	5529	2633	2197	2368
2000	24968	19347	10098	5193	2374	1132	1189
2001	16909	17192	10833	4245	2281	1239	1168
2002	24755	12275	9346	5095	2152	1209	843

	2	3	4	5	6	7	8
2003	24329	17455	6563	3765	1666	740	487
2004	17007	17949	9792	3812	2246	814	993
2005	18064	12144	11090	5730	2577	1404	1541
2006	18247	12563	7693	6479	2988	1389	4009
2007	17533	13148	7148	4348	3948	1724	2366
2008	18346	12169	6969	3980	2585	2372	3158
2009	33751	13582	6451	3560	2314	1446	2555
2010	24517	27818	8498	3713	1794	1194	1258
2011	20557	20202	17840	4114	2149	1162	2175
2012	13840	17158	13312	8202	2753	1403	3217
2013	13833	11285	11074	7989	3820	1533	3395
2014	17300	10317	7415	6427	4180	2077	1364
2015	17880	12070	6293	5027	3508	2061	1388
2016	16967	13771	7721	4038	2592	1933	2197
2017	16758	14264	9256	4435	2518	1620	2608
2018	15900	13744	9474	6284	3039	1702	3270
2019	9109	12735	9110	6245	3952	1908	2714
2020	7986	7204	8143	5577	4077	2489	4789

Table 7.8. Summary of sole in the Bay of Biscay.

Year	Recruits (in thousands)	SSB (in t)	Landings (in t)	Mean F (age 3–6)
1984	24146	12313	4038	0.31
1985	29505	13355	4251	0.31
1986	28293	14462	4805	0.37
1987	24882	15451	5086	0.37
1988	26717	15321	5382	0.4
1989	28114	14421	5845	0.5
1990	32062	14764	5916	0.45
1991	35677	14715	5569	0.42
1992	35306	15909	6550	0.61

Year	Recruits (in thousands)	SSB (in t)	Landings (in t)	Mean F (age 3–6)
1993	24865	16308	6420	0.53
1994	26171	15773	7229	0.65
1995	23542	14169	6205	0.58
1996	29349	13743	5854	0.55
1997	23707	13256	6259	0.61
1998	22581	13176	6027	0.54
1999	24379	12277	5249	0.63
2000	24968	11794	5760	0.63
2001	16909	10536	4836	0.57
2002	24755	9781	5486	0.83
2003	24329	9600	4108	0.49
2004	17007	11096	4002	0.37
2005	18064	11455	4539	0.47
2006	18247	12038	4793	0.44
2007	17533	11031	4363	0.46
2008	18346	10922	4299	0.51
2009	33751	10734	3650	0.49
2010	24517	12633	3966	0.44
2011	20557	14446	4632	0.41
2012	13840	14107	4321	0.47
2013	13833	13245	4235	0.46
2014	17300	10645	3928	0.45
2015	17880	10308	3644	0.44
2016	16967	10757	3232	0.37
2017	16758	13034	3244	0.29
2018	15900	12360	3517	0.34
2019	9109	11564	3400	0.36
2020	7986	10355	3219	0.38

Table 7.9: XSA tuning diagnostics

Fleet = FR-SABLES

Catchability residuals:

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	-0.23	-0.14	-0.38	-0.41	-0.09	-0.21	-0.13	-0.04	-0.18	0.19	-0.17	0.22	-0.13
3	0.10	-0.19	0.15	-0.11	-0.18	-0.03	0.20	-0.02	-0.43	0.39	0.06	0.25	0.01
4	0.12	-0.28	-0.10	0.36	0.13	0.01	0.01	0.44	-0.24	0.12	-0.06	0.12	-0.31
5	0.07	-0.17	-0.12	0.22	-0.02	-0.13	-0.25	0.15	0.27	-0.10	-0.29	0.33	-0.19
6	-0.20	0.16	-0.40	0.02	-0.25	0.23	-0.03	-0.40	0.43	-0.03	-0.24	0.34	0.04
7	-0.06	-0.15	-0.26	0.19	0.07	0.49	0.00	0.11	0.54	0.11	-0.19	0.06	0.07

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	0.30	0.49	0.82	0.26	0.15	-0.31	NA	NA	NA	NA	NA	NA	NA	NA
3	-0.30	-0.18	0.00	-0.02	0.16	0.14	NA	NA	NA	NA	NA	NA	NA	NA
4	-0.19	-0.16	-0.47	0.07	0.36	0.06	NA	NA	NA	NA	NA	NA	NA	NA
5	-0.51	0.24	-0.74	0.34	0.34	0.57	NA	NA	NA	NA	NA	NA	NA	NA
6	-0.36	0.14	-0.53	0.27	0.34	0.46	NA	NA	NA	NA	NA	NA	NA	NA
7	-0.12	0.05	-0.17	0.69	0.37	0.34	NA	NA	NA	NA	NA	NA	NA	NA

Mean log catchability and standard error of ages with independant of year class strength and constant w.r.t time:

	2	3	4	5	6	7
Mean log q	-15.0660	-14.5115	-14.4653	-14.6451	-14.6388	-14.6388
S.E. log q	0.3169	0.2008	0.2415	0.3276	0.3067	0.2896

Regression Statistics:

	Model used?	slope	Intercept	RSquare	Num Pts	Reg s.e	Mean Q
2	"No"	"5.74"	"38.76"	"0.03"	"19"	"1.46"	"-15.07"
3	"No"	"1.04"	"14.68"	"0.63"	"19"	"0.21"	"-14.51"
4	"No"	"0.87"	"13.81"	"0.7"	"19"	"0.21"	"-14.47"
5	"No"	"1.23"	"16.03"	"0.35"	"19"	"0.41"	"-14.65"
6	"No"	"1.45"	"17.64"	"0.27"	"19"	"0.44"	"-14.64"
7	"No"	"0.73"	"12.57"	"0.8"	"19"	"0.18"	"-14.53"

Fleet = FR-ROCHELLE

Catchability residuals:

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	-0.09	-0.18	-0.46	-0.40	-0.04	0.32	-0.06	0.19	-0.03	0.19	-0.24	0.70	0.16
3	0.19	-0.05	-0.02	-0.22	-0.12	0.05	0.11	-0.11	-0.50	-0.28	-0.09	0.18	0.23
4	0.44	0.12	-0.22	0.29	0.30	-0.15	-0.08	0.47	-0.26	-0.12	0.13	-0.33	-0.08
5	0.45	0.16	-0.09	0.18	0.21	-0.36	-0.36	0.00	0.18	-0.18	-0.07	-0.07	-0.08
6	0.11	0.33	-0.26	0.11	-0.36	-0.12	-0.02	-0.54	0.52	-0.29	0.08	-0.02	0.10
7	0.01	0.07	-0.02	0.00	-0.05	-0.08	-0.09	0.03	0.23	-0.19	0.15	-0.10	-0.24

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	0.37	0.13	0.00	0.07	0.21	-0.83	NA	NA	NA	NA	NA	NA	NA	NA
3	-0.09	-0.38	-0.24	0.59	0.59	0.15	NA	NA	NA	NA	NA	NA	NA	NA
4	-0.23	-0.21	-0.29	-0.17	0.38	0.02	NA	NA	NA	NA	NA	NA	NA	NA
5	-0.49	0.32	-0.29	-0.27	0.29	0.46	NA	NA	NA	NA	NA	NA	NA	NA
6	-0.22	0.39	-0.04	-0.24	0.15	0.32	NA	NA	NA	NA	NA	NA	NA	NA
7	-0.02	0.18	-0.02	-0.17	0.24	0.20	NA	NA	NA	NA	NA	NA	NA	NA

Mean log catchability and standard error of ages with independant of year class strength and constant w.r.t time:

	2	3	4	5	6	7
Mean log q	-15.0003	-14.5528	-14.7682	-15.1189	-15.1756	-15.1756
S.E. log q	0.3381	0.2867	0.2634	0.2836	0.2781	0.1418

Regression Statistics:

	Model used?	slope	Intercept	RSquare	Num Pts	Reg s.e	Mean Q
2	"No"	"1.98"	"19.84"	"0.13"	"19"	"0.64"	"-15"
3	"No"	"1.27"	"15.84"	"0.36"	"19"	"0.37"	"-14.55"
4	"No"	"0.84"	"13.91"	"0.68"	"19"	"0.22"	"-14.77"

```
5 "No"        "0.96" "14.86"   "0.53"  "19"    "0.28"  "-15.12"
6 "No"        "1.62" "19.65"   "0.28"  "19"    "0.43"  "-15.18"
7 "No"        "0.84" "13.89"   "0.91"  "19"    "0.11"  "-15.17"



Fleet =  FR-BB-IN-Q4

 Catchability residuals:

   2000  2001  2002  2003 2004  2005  2006  2007  2008  2009  2010  2011 2012
3  0.40 -0.25  0.40  0.82 0.38 -0.14  0.08  0.12  0.27 -0.02 -0.11 -0.37 0.26
4  0.46 -0.45 -0.63  0.19 0.40  0.17 -0.44  0.27  0.62 -0.30  0.44 -0.06 0.55
5  0.08 -0.35 -0.13 -0.73 0.50  0.23 -0.51  0.24  0.21 -0.01  0.16 -0.06 0.81
6 -0.46 -0.02  0.58 -0.34 0.83 -0.02  0.04  0.04 -0.01  0.13 -0.47 -0.18 0.03
7 -0.19 -0.10  0.55  0.28 0.23 -0.14  0.46 -0.52 -0.20 -0.32 -0.86 -0.42 0.02
   2013  2014  2015  2016  2017  2018  2019  2020
3 -0.33  0.09 -0.20 -0.10  0.09 -0.85 -0.55  0.00
4  0.13 -0.48 -0.27 -0.32 -0.21 -0.40  0.03  0.31
5 -0.15 -0.24  0.15  0.10 -0.55 -0.02  0.05  0.22
6  0.33 -0.12 -0.12  0.00 -0.03  0.02 -0.13 -0.13
7 -0.01 -0.66  0.16 -0.38  0.15 -0.05  0.27 -0.12


 Mean log catchability and standard error of ages with
 independant of year class strength and constant w.r.t time:

                  3        4        5        6        7
Mean log q -14.5909 -14.9661 -15.1649 -15.0662 -15.0662
S.E. log q   0.3694   0.3873   0.3532   0.3000   0.3714


 Regression Statistics:

  Model used? slope  Intercept RSquare Num Pts Reg s.e Mean Q
3 "No"        "0.86" "13.89"   "0.44"  "21"    "0.32"  "-14.59"
4 "No"        "0.84" "14.01"   "0.39"  "21"    "0.33"  "-14.97"
5 "No"        "0.83" "14.04"   "0.43"  "21"    "0.3"   "-15.16"
6 "No"        "0.93" "14.58"   "0.48"  "21"    "0.29"  "-15.07"
7 "No"        "1.36" "18.01"   "0.3"   "21"    "0.49"  "-15.15"



Fleet =  FR-BB-OFF-Q2

 Catchability residuals:

   2000  2001 2002  2003  2004  2005  2006  2007  2008  2009  2010  2011  2012
2  0.42  0.46 0.89  0.94  0.44  0.39 -0.25  0.56  0.93 -1.68 -1.43 -1.96  0.28
3 -0.44 -0.14 0.21  0.16  0.19 -0.18 -0.18  0.79  0.41 -0.10  0.00 -0.71 -0.01
4  0.35  0.23 0.13 -0.02 -0.07 -0.02 -0.65 -0.37  0.05 -0.19  0.29  0.44 -0.18
5  0.72  0.45 0.79 -0.20 -0.93  0.26 -0.56 -0.98  0.02 -0.10  0.36 -0.33  0.52
6  0.70  1.13 1.35  0.39 -0.52 -0.76  0.32 -0.01 -0.77 -0.35 -1.31  0.18 -0.34
  2013 2014 2015 2016 2017
2   NA   NA   NA   NA   NA
3   NA   NA   NA   NA   NA
4   NA   NA   NA   NA   NA
5   NA   NA   NA   NA   NA
6   NA   NA   NA   NA   NA


 Mean log catchability and standard error of ages with
 independant of year class strength and constant w.r.t time:

                  2        3        4        5        6
Mean log q -15.9002 -14.4985 -14.7267 -15.3321 -15.8530
S.E. log q   1.0181   0.3753   0.3036   0.5853   0.7784


 Regression Statistics:

  Model used? slope   Intercept RSquare Num Pts Reg s.e Mean Q
2 "No"        "-1.33" "1.95"    "0.04"  "13"    "1.3"   "-15.9"
3 "No"        "2.29"  "20.7"    "0.09"  "13"    "0.82"  "-14.5"
4 "No"        "0.67"  "12.86"   "0.74"  "13"    "0.18"  "-14.73"
```

```
5 "No"         "0.58"  "12.43"   "0.38"  "13"    "0.34"  "-15.33"
6 "No"         "1.07"  "16.4"    "0.06"  "13"    "0.87"  "-15.85"



Fleet =  FR-ORHAGO

 Catchability residuals:

   2007  2008  2009  2010  2011  2012  2013  2014  2015  2016  2017  2018  2019
2  0.06 -0.29  0.34 -0.24 -0.01 -0.43 -0.41  0.42  0.13  0.08 -0.01  0.15  0.24
3  0.11  0.20  0.27  0.04 -0.40  0.08 -0.22 -0.06 -0.17  0.36  0.19 -0.15 -0.10
4  0.13  0.01 -0.18 -0.23 -0.52  0.15  0.48 -0.06 -0.04 -0.01  0.00  0.02  0.23
5  0.40 -0.80 -0.46 -1.26 -1.30  0.38  0.38  0.51  0.53  0.64  0.18  0.51  0.24
6  0.29 -0.61 -0.67 -3.51 -0.92  0.19  0.96  1.12  0.96  0.59  0.97  0.54  0.22
7 -1.20 -0.34 -2.04 -0.96 -0.12  0.10  0.40  0.82  0.90  0.47  0.99  1.02  0.48
   2020
2 -0.03
3 -0.14
4  0.04
5  0.04
6 -0.14
7 -0.14


 Mean log catchability and standard error of ages with
 independant of year class strength and constant w.r.t time:

                2       3       4        5        6        7
Mean log q -9.0337 -9.4154 -9.7797 -10.1951 -10.4993 -10.4993
S.E. log q  0.2624  0.2133  0.2297   0.6726   1.2043   0.9113


 Regression Statistics:

  Model used? slope  Intercept RSquare Num Pts Reg s.e Mean Q
2 "No"        "0.91" "9.1"     "0.7"   "14"    "0.25"  "-9.03"
3 "No"        "0.97" "9.42"    "0.7"   "14"    "0.21"  "-9.42"
4 "No"        "1.14" "9.88"    "0.56"  "14"    "0.27"  "-9.78"
5 "No"        "0.41" "9.22"    "0.6"   "14"    "0.24"  "-10.2"
6 "No"        "0.25" "8.61"    "0.62"  "14"    "0.22"  "-10.5"
      7 "No"        "0.45" "8.8"     "0.27"  "14"    "0.4"   "-10.47"
```

Table 7.10. Short-term forecasts input parameters.

Variable	Value	Notes
$F_{age\ 3–6}$ (2021)	0.38	Average selection pattern from 2018 to 2020, scaled to the F of 2020.
SSB (2022)	8 934	Assessment forecast; in tonnes.
$R_{age\ 2}$ (2021–2022)	12 688	Geometric mean (2016–2020); in thousands.
Landings (2021)	3 219	Total catch in 2020 without discards; in tonnes.
Discards (2021)	77	Computed using the average discard ratio (2.4%) over 2015–2020 but not used in the assessment; in tonnes.

Table 7.11. Management options table. Annual catch scenarios (all weights are in tonnes).

Basis	Total catch* (2022)	Wanted catch** (2022)	Unwanted catch** (2022)	F_{wanted} (2022)	SSB (2023)	% SSB change ^	% TAC change ^^	% Advice change^ ^^
ICES advice basis								
EU MAP # : $F = F_{MSY} \times SSB_{2022}/MSY\ B_{trigger}$	2233	2180	53	0.28	9372	+5%	−36%	−36%
F = MAP F = F_{MSY} lower × $SSB_{2022}/MSY\ B_{trigger}$	1265	1235	30	0.15	10359	+16%	−38%	−38%
F = MAP F = F_{MSY} upper × $SSB_{2022}/MSY\ B_{trigger}$	3097	3023	74	0.41	8493	−5%	−36%	−36%
Other scenarios								
MSY approach = F_{MSY}	2578	2516	62	0.33	9022	+1%	−26%	−26%
F = 0	0	0	0	0	11647	+30%	−100%	−100%
F_{pa}	5522	5390	132	0.88	6046	−32%	+59%	+59%
F_{lim} (not applicable)								
$SSB_{2023} = B_{lim}$	3979	3884	95	0.56	7600	−15%	+14%	+14%
$SSB_{2023} = B_{pa} = MSY\ B_{trigger}$	1028	1004	24	0.12	10600	+18%	−70%	−70%
$SSB_{2023} = SSB_{2022}$	2663	2600	63	0.34	8934	0%	−24%	−24%
$F = F_{2021}$	2907	2837	70	0.38	8687	−3%	−17%	−17%
Projected landings ** = TAC_{2021}	3569	3483	86	0.49	8016	−10%	+2%	+2%
Total catch equal to TAC_{2021}	3483	3399	84	0.47	8098	−9%	0%	0%

*** Total catch is calculated based on projected landings and the assumed projected discard ratio (2.4%).**

**** "Projected landings" and "projected discards" are used to describe fish that would be landed and discarded based on the average discard rate estimate of 2015–2019 (2.4%).**

 # The EU multiannual plan (MAP; EU, 2019).

^ SSB_{2023} relative to SSB_{2022}.

^^ Total catch in 2022 relative to TAC in 2021 (3483 t).

^^^ Advice values for 2022 relative to the corresponding 2021 values (MAP advice of 3483, 2036, and 4814 t, respectively; other values are relative to F_{MSY}).

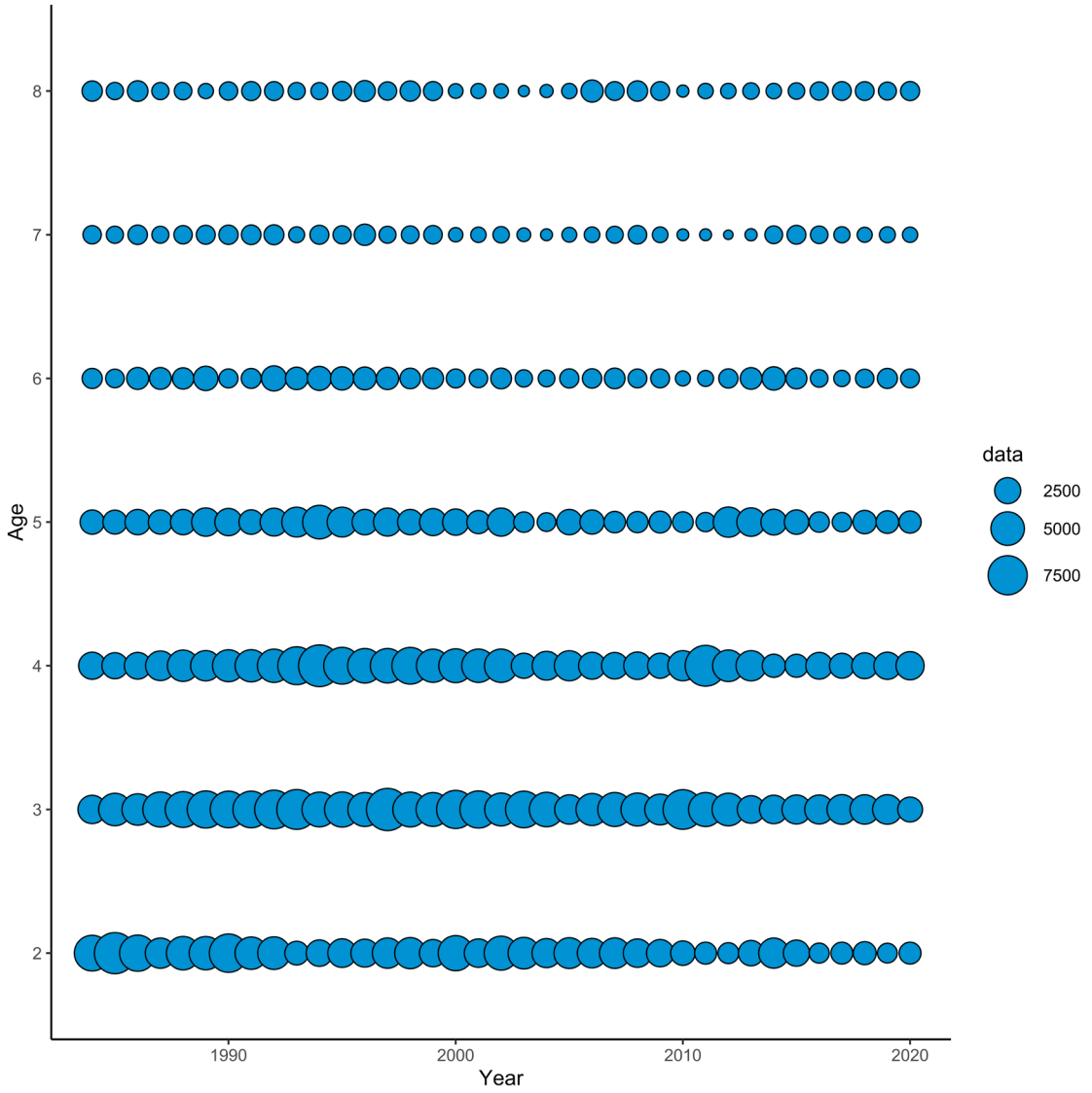

Figure 7.1.Bay of Biscay sole in divisions 8.a and 8.b, landings-at-age distributions.

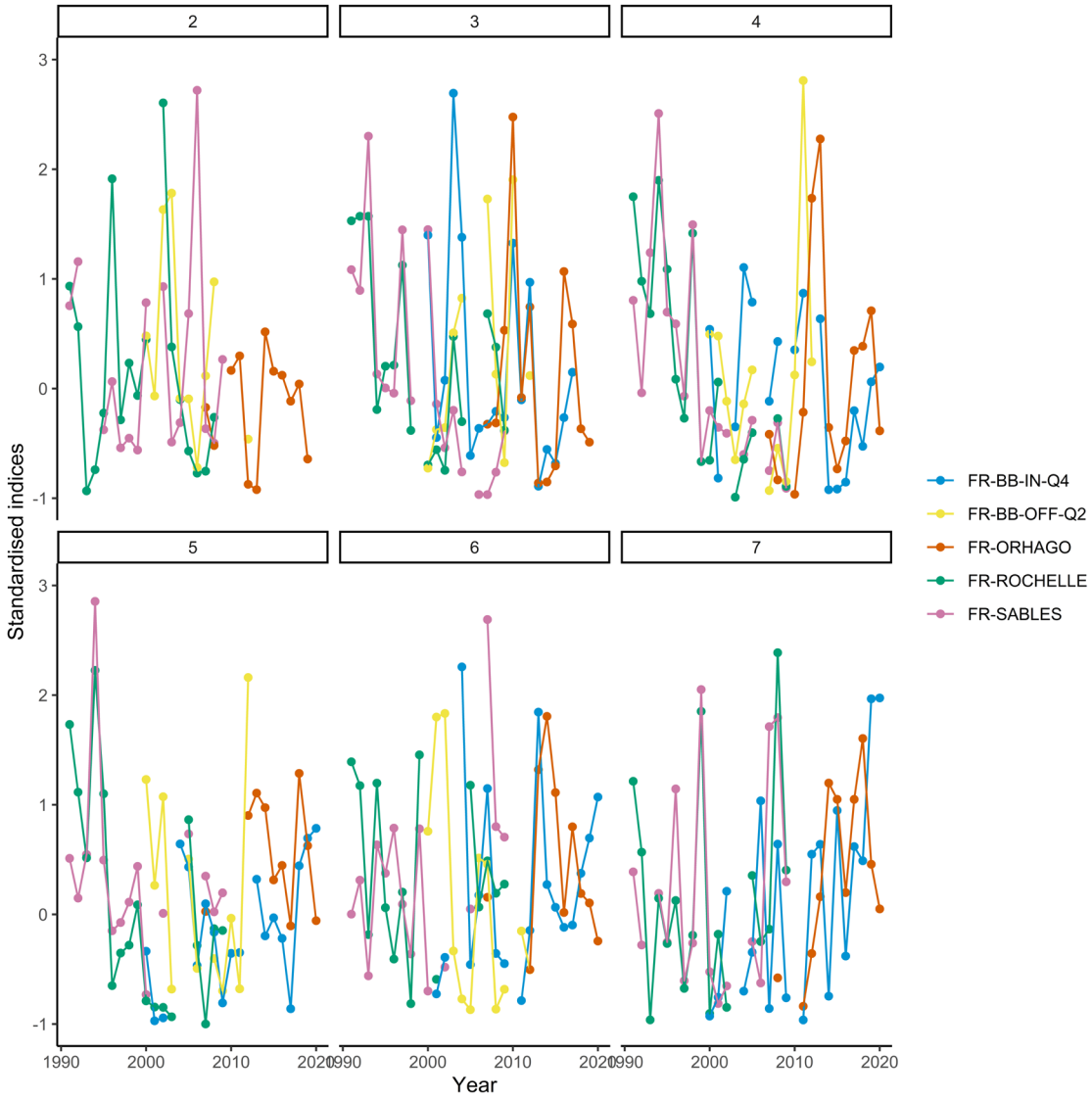

Figure 7.2.Time-series of standardized indices per age-classes. Colours represent tuning fleets.

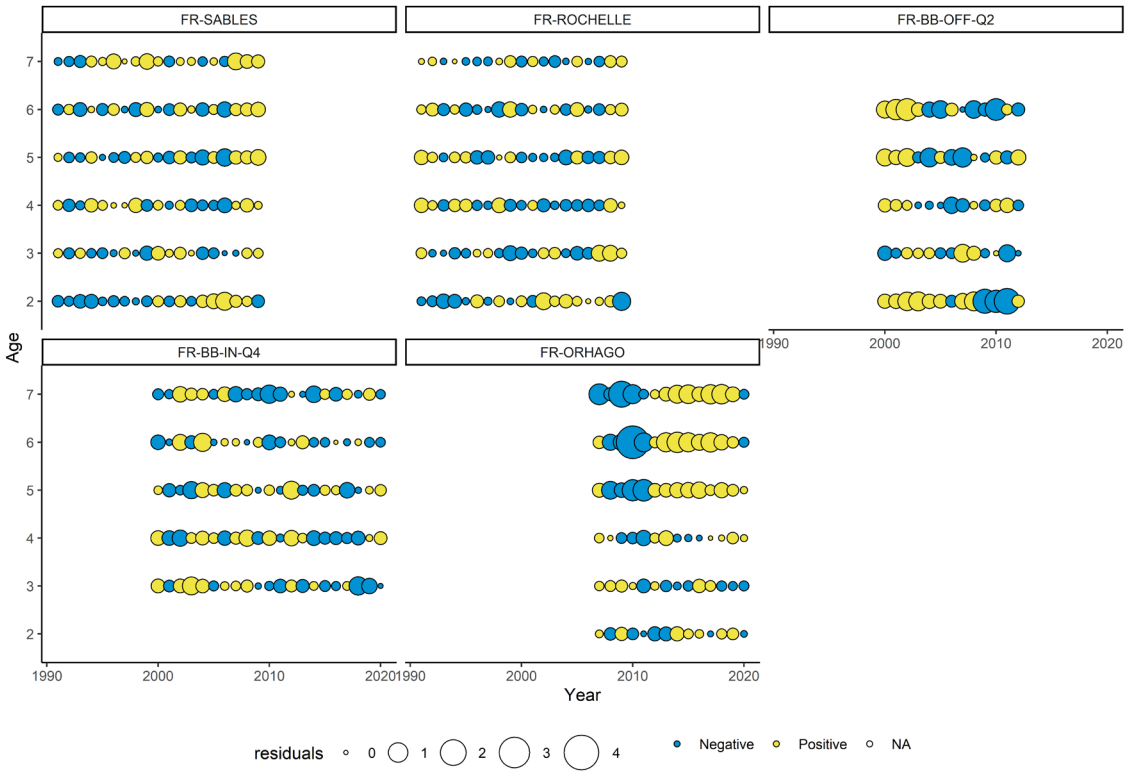

Figure 7.3.Bay of Biscay sole in divisions 8.a and 8.b, XSA assessment residuals (No Taper, mean q, s.e. shrink = 2.5, s.e. min = 2).

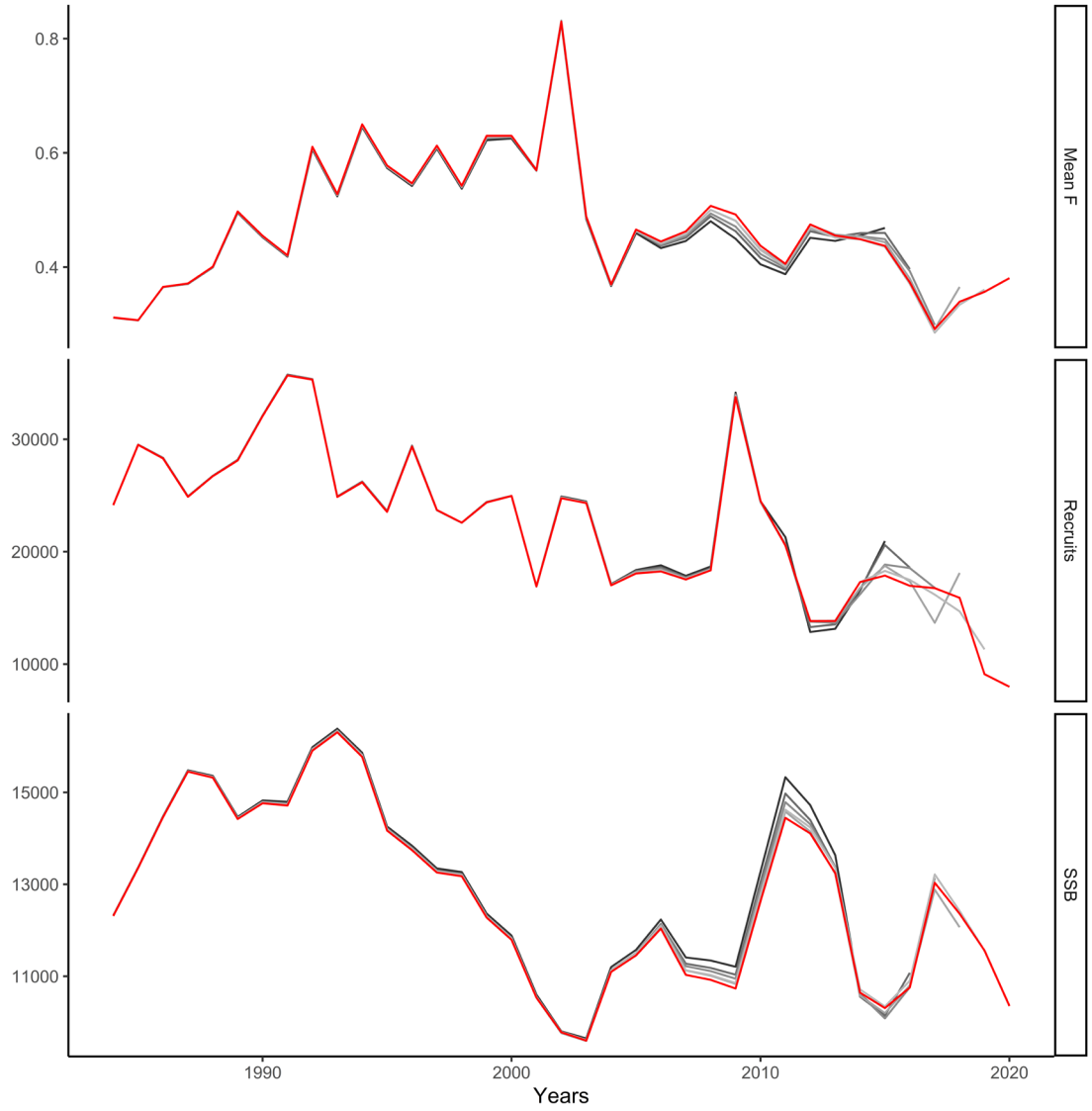

Figure 7.4. Bay of Biscay sole in divisions 8.a and 8.b. Retrospective patterns (No taper, q indep. stock size all ages, q indep. of age > = 6, shr. = 1.5).

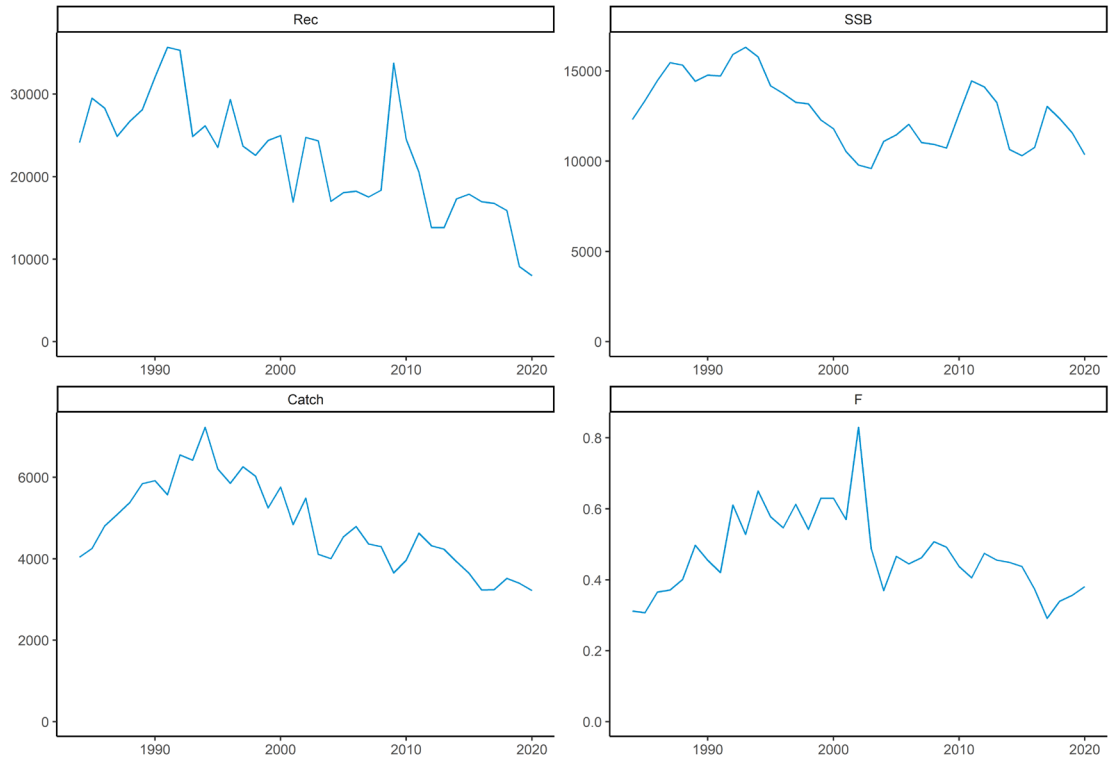

Figure 7.5. Bay of Biscay sole in divisions 8.a and 8.b. Trends for landings, F, recruitment, SSB and total catch data.