# 10 Hake in Cantabrian Sea and Atlantic Iberian waters

## hke.27.8c9a – *Merluccius merluccius* in divisions 8.c and 9.a, Southern stock

## 10.1 General

The assessment is carried out with the Stock Synthesis (SS) model developed in the most recent benchmark (ICES, 2023).

The assessment includes the 2022 data and minor revisions of surveys length frequency distribution or how these had been imputed in the SS model data file. More precisely, the 2020 length frequency distribution of the SPGFS-caut-WIBTS-Q4 (G4309) and SPGFS-cspr-WIBTS-Q1 surveys has been corrected after detecting some inconsistencies in the data. On the other hand, some inconsistencies in the SS data file length frequency distributions of the PtGFS-WIBTS-Q4 (G8899) and SpGFS-WIBTS-Q4 (G2784) have been detected too. More precisely, we noticed that the frequencies of the lengths smaller than 20 cm were the number of undetermined individuals instead of the sum of females, males and undetermined individuals. Hence, in our updated SS model this inconsistency has been corrected. Additionally, we also corrected an inconsistency in the females length distribution of SpGFS-WIBTS-Q4 (G2784) which consisted in a 2 positions displacement in length distribution frequencies, that is the frequency value assigned to 1cm was actually the one that corresponded to 3cm and so on. Finally, an inconsistency was also detected in the *nsamp* SS parameter (numbers of hauls) associated to the PtGFS-WIBTS-Q4 (G8899), specifically, the *nsamp* for years 2016, 2018 and 2021 have been revised from 86, 65, 102 to 85, 53 and 93, respectively.

### 10.1.1 Fishery description

The fishery description is available in the Stock Annex. Some minor inconsistencies in writing up the Stock Annex with respect to what was agreed upon in the WKANGHAKE benchmark (ICES, 2023) have been identified. These minor errors have now been corrected so that the Stock Annex exactly follows WKANGHAKE (modifications have been documented with track changes).

### 10.1.2 ICES advice for 2023 and management applicable to 2022 and 2023

#### 10.1.2.1 ICES advice for 2023

ICES advises that when the EU multiannual plan (MAP) for the Western Waters and adjacent waters is applied, catches in 2023 that correspond to the F ranges in the plan are between 8322 tonnes and 15 925 tonnes. According to the MAP, catches higher than those corresponding to FMSY (11 791 tonnes) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying ICES advice rules.

#### 10.1.2.2 Management applicable for 2022 and 2023

Hake is managed by a TAC, effort control and by technical measures. The agreed TAC for Southern Hake in 2022 was 7836 t but ICES received a special request from the European Commission to update the catch advice for 2022 based on the most recent data available for the stock

assessment conducted in 2022. The last available Stock Synthesis (SS) model that was applied to give the 2023 southern hake advice using catch data until 2021 (ICES, 2023) was used to project catch scenarios for 2022. The settings for these projections are the same as those used for the 2023 advice, as described in the Stock Annex (ICES, 2023), with the exception of those related with the intermediate year F and the recruitment in 2023, which in this case are not needed, since there is no intermediate year. The updated TAC of 14429 was only published at the end of 2022 (ICES, 2022b) and therefore there was not enough time for the new TAC to have an impact on 2022 catches. The agreed TAC for Southern Hake in 2023 is 15925.

Southern hake is included in the EU MAP for Western Waters and adjacent waters (EU, 2019a). The target fishing mortality (F), in line with $F_{MSY}$ ranges, should have been achieved by 2020.

This stock is under the landing obligation since 2016 with a *de minimis* exemption (a regulation establishing the exceptions of the landing obligation). Ongoing studies to evaluate the impact of *de minimis* exemption for the southern hake stock are being carried out by regional scientific and administration bodies with the collaboration of the SWWAC (South Western Waters Advisory Council).

Technical measures applied to this stock include: (i) a minimum conservation reference size (MCRS) of 27 cm, (ii) protected areas (seasonal or closed to some gears), and (iii) a minimum mesh size. These measures are set, depending on areas and gears, by several national regulations (EU, 2019b).

According to the Spanish Regulations progressively implemented after 2011 AAA/1307/2013, the Spanish quota is shared by individual vessels. This regulation was updated in 2015 (AAA/2534/2015) including a fishing plan for trawlers. Between 2007 and until 2018, Portuguese regulations also determined the distribution of the Portuguese hake quota by individual vessels.

## 10.2 Data

### 10.2.1 Commercial catch: landings and discards

Southern hake catches by country and gear for the period 1972–2022, as estimated by WGBIE, are given in Table 10.1. Since 2011, estimates of unallocated or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) multiplied by the total effort for each *métier*. Given the small differences between official and estimated amounts, in 2022 no unallocated values were assumed.

Overall landings decreased from 8 214 t in 2021 to 6 986 t in 2022. Portuguese official landings decreased from 1 963 t in 2021 to 1 583 t in 2022. Spanish official landings decreased from 6 161 t in 2021 to 5 270 t in 2022. Non-reported landings were estimated as 0 t in 2022, as in 2021. Total discards in 2021 were 851 t and decreased to 595 t in 2022. Total catches were 9 065 t in 2021 and decreased to 7 582 in 2022. The TAC for 2021 was 8517 t.

In the Portuguese on-board sampling program, no trips were sampled from the OTB_DEF and OTB_CRU fleets. For this reason, Portuguese discards were estimated based on the average discard per unit effort (DPUE in Kg/hour) of the most recent 3 data collection years (2017–2019) (Fernandes, 2021; WD 7 in ICES, 2021). In this approach, the estimated average of DPUE obtained is then multiplied by the fishing effort (in hours) of each fleet in 2022 to obtain the annual discard estimate.

Length distributions for 2021 landings and discards are presented in Figure 10.1 and in Table 10.2. Mean size in the landings has been stable from 35.3 in 2020 to 35.0 in 2021 and 36.5 in 2022. Mean size in the catch is quite stable too with 29.8 cm in 2020, 28.5 in 2021 and 29.2 in 2022.

### 10.2.2 Growth, length-weight relationship, maturity, and M

All these parameters were revised in the benchmark (ICES, 2023) and presented in Figure 10.2. New growth parameters and M are now sex-specific, and only female maturity is used. All biological parameters are now time invariant.

Growth is estimated as a von Bertalanffy model with female $L_{inf}$ = 110 cm and male $L_{inf}$ = 73.73 cm and the same k (0.14 $year^{-1}$) for males and females. The first year (age 0) is modelled linearly with a parameter (size at age 1) estimated by the model equally for males and females. All parameters are constant in time.

The length-weight relationship is estimated as a power model following $W = a * L^b$, where a = 0.00000377 and b = 3.16826. All parameters are constant in time.

Maturity at length is estimated as a time-invariant logistic with $L_{50}$ = 42.36 cm and slope = −0.265.

Natural mortality is variable at age, with breakpoints at ages 0, 1, 5 and 15, with different values for females (1.19, 0.64, 0.34 and 0.2) and males (1.19, 0.64, 0.4 and 0.27). All parameters are constant in time.

### 10.2.3 Abundance indices from surveys

Biomass, abundance and recruitment indices for the Portuguese and Spanish surveys are presented in Table 10.3 and Table 10.4, respectively. Recruitment and biomass indices are shown in Figure 10.3 for the Spanish SpGFS-WIBTS-Q4 (G2784), SPGFS-caut-WIBTS-Q4 (G4309) and for the Portuguese PtGFS-WIBTS-Q4 (G8899). These three surveys together cover the whole geographic area of the stock and are conducted simultaneously in autumn to minimize sources of variability. They are part of the IBTS survey group (ICES, 2017c), which further ensures the use of the same methodology.

The Portuguese Autumn survey (PtGFS-WIBTS-Q4-G8899) was not carried out in 2019 or 2020. The time-series showed variable abundance indices with maximum historical values observed in 2008–2010, 2013 and 2015 and a minimum in 1993. Low values for biomass and abundance were observed in the early 2000s and then increased after 2004. Values in 2016, 2017, 2018, 2021 and 2022 were rather stable and near the historical mean. The Spanish groundfish survey SpGFS-WIBTS-Q4 (G2784) shows a similar trend with low values for biomass and abundance in the early 2000s. These values increased after 2004 reaching a maximum in 2009–2012, 2015 and 2022. The estimates for 2020 and 2021 are very similar and around the historical mean whereas the value at 2022 is around the historical maximum. The Spanish SPGFS-caut-WIBTS-Q4 (G4309) was not carried out in 2021. The biomass time shows a similar trend to that observed in the PtGFS-WIBTS-Q4-G8899 and SpGFS-WIBTS-Q4 (G2784) with low values for biomass and abundance in the early 2000s. These values increased after 2004 reaching maximum values in 2013 and 2015. The estimates for 2020 and 2022 are almost the same and around the historical average.

Figure 10.3 shows that the recruitment indices of the SpGFS-WIBTS-Q4 (G2784), SPGFS-caut-WIBTS-Q4 (G4309) and PtGFS-WIBTS-Q4 (G8899) were highly variable in the past. In 2014, the 3 surveys decreased below historical means, but in 2015 the PtGFS-WIBTS-Q4 reached a historical maximum, while both SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4 returned to above-average values. In the latest years, all surveys show the same trends with a peak in 2015 followed by a decreasing trend afterwards, except for SPGFS-caut-WIBTS-Q4 which reached a historical maximum in 2019. In 2022, the value from SPGFS-caut-WIBTS-Q4 (G4309) was below the historical mean, PtGFS-WIBTS-Q4 (G8899) and SpGFS-WIBTS-Q4 (G2784) were a little above the historical mean.

Recruitment indices values of SPGFS-caut-WIBTS-Q4 (G4309) and SPGFS-cspr-WIBTS-Q1 (G7511) in 2020 were updated in Table 10.3 after detecting and correcting their length frequency distributions. More precisely, SPGFS-caut-WIBTS-Q4 (G4309) recruitment value of 34.7 has been changed to 32.8 whereas the SPGFS-cspr-WIBTS-Q1 (G7511) recruitment value has been changed from 42.1 to 34.6 according to the correction made in the corresponding length frequency distributions for 2020.

### 10.2.4 Commercial catch-effort data

Catch per unit effort indices were reviewed in the benchmark process (ICES, 2023). Two new standardized indices were accepted and incorporated in the assessment model, one from three different Spanish trawl métiers targeting medium size fish (SpTrawl) and other for large fish combining gillnetters and longliners (SpVolpal). These are presented in Figure 10.4 and Table 10.5. A Portuguese CPUE was also proposed but some technical problems precluded its use for assessment purposes.

The combined CPUE for trawlers (SpTrawl) shows the evolution of biomass from 2003 to 2022.

The index increases from the beginning of the series, peaking in 2010 and 2011 and decreasing thereafter with figures slightly below the mean in 2022. The combined CPUE VolPal (SpVolpal, 2009–2022) peaks at the beginning of the series (2009 and 2010) and decreases thereafter with a value softly below the mean in 2022.

## 10.3 Assessment

### 10.3.1 Preliminary model considerations

Hake in divisions 8.c and 9.a is caught in a mixed fishery mainly by the Spanish and Portuguese fleets (although there is a small percentage of French catches). In the SS model, the different fleets presented in Table 10.1 are grouped according to similar selectivity patterns:

1. Trawls (Spanish baka, pairtrawlers and Portuguese trawlers).
2. Volpal (Spanish gillnets and longliners).
3. Artisanal (Spanish, Portuguese and French artisanal fleets).
4. CdTrw (Cádiz trawlers).

### 10.3.2 Model diagnostics

Availability of input data time-series (catches, abundance indices, length compositions, size compositions and discards by year for each fleet) is summarized in Figure 10.5 providing an overview of the data considered in the model and hence of the required model diagnostics.

Convergence is a main issue for the southern hake SS model. The final model in WKANGHAKE (ICES, 2023) was chosen as the best one (minimum likelihood, convergence level, and positive definite hessian) among those performed in the jitters (model runs with different starting values). Therefore, after updating the model by adding 2022 data, jittering was again carried out to ensure that our final updated model reports the minimum likelihood.

Figure 10.6 shows the likelihood values of those jittered runs with a positive definite hessian. In total, the plot shows 25 valid runs from a total of 50 runs. The likelihood of our final model (blue line) coincides with the minimum likelihood attained by 8 of the 25 runs, supporting then the correct convergence of our updated proposed model. Its likelihood value is 2444.26 and the convergence level (final gradient) is 0.000921514.

Figure 10.7 shows the different comparisons among the observed and modelled values.

Quality of the landings and discards estimates along the years can be analysed in Figure 10.7a which reports the observed and estimated landings and discards along the years. Landings time-series are well estimated by the SS model whereas the discards are systematically underestimated by the model although in the last years (2019, 2021-2022) the underestimation is less marked.

Residuals for surveys (CdSurv, PtSurv and SpSurv are abbreviations of SPGFS-caut-WIBTS-Q4, ptGFS-WIBTS-Q4 (G8899), and SpGFS-WIBTS-Q4 (G2784)) and abundance indices (SpCPUE_trawlers and SpCPUE_volpal) are presented in log scale in Figure 10.7b. In general, the residuals do not show any pattern or trend. Additionally, their magnitude is lower than one which means that the observed and estimated values differ in less than one standard deviation.

Length distribution fit (all years together) is reported in Figure 10.7c. The fit of the commercial fleets (trawlers, volpal, artisanal and cdTrw) can be considered appropriate. On the other hand, the fit of SpSurv (separated length distributions by sex) is also quite accurate, whereas the PtSurv (sex separated) and CdSurv length distributions (sexes combined) fits show some inaccuracies.

In addition to this global overview of the length distributions adjustment grouping all years together, Figures 10.7d–10.7i report the expected and observed length distributions over the years (for commercial fleets the information is also provided by each quarter).

Figure 10.7d reports the observed and expected length distributions for trawlers' landings by year and season. The fit is quite good for all the years and seasons, except in 2020 when the model expected more large fish than those observed. Figure 10.7e reports the same information for the trawlers' discards. In this case, the length distributions are not well fitted and improvements must be addressed in the future.

Figure 10.f reports the observed and expected length distributions for volpal fleet. The fit is quite good, particularly in recent years. The year 2005 has a strange pattern with an excess of small fish in the observed data. This should be deleted from the input data in future uses of the model.

Figure 10.g reports the observed and expected length distributions for the artisanal fleet, and the fit can be considered quite good. On the other hand, Figure 10.h reports the observed and expected length distributions for cdTrw fleet. The fit is poor for some years and seasons, in particular, it seems to have a common pattern in seasons 2 and 4 in which the model expects more small fish than those observed.

Finally, Figure 10.i reports the observed and expected length distributions for the three surveys. The Spanish one (SpSurv) is well fitted over the years, whereas the Portuguese and Cádiz ones (PtSurv and CdSurv) are not well fitted for all the years. This may be because while the Spanish survey has a stable behaviour throughout the years, Cádiz and Portugal surveys are very variable (see Tables 10.3 and 10.4, the data is noisy without a clear explanation for Portugal surveys whereas variable behaviour in Cádiz one is related to the variable behaviour of this area along the years), perhaps time-varying parameters must be explored in future to solve these problems.

## 10.3.3 Assessment results

### 10.3.3.1 Estimated parameters

The model estimates selectivity parameters for each fleet, as double normal for all fleets and survey indices, except for volpal fleet (mixture of gillnetters and longliners targeting larger fish) with an assumed logistic selectivity. CPUE selectivity was mirrored to the corresponding fleet selectivity. Selectivity details can be seen in Figure 10.8. According to these estimated selectivity

curves, maximum selectivity for SpSurv and CdSurv is attained at 4 cm which is the first length class. This is questionable, and further work is required to better understand the causes.

#### 10.3.3.2 Historic trends in biomass, fishing mortality, yield, and recruitment

Table 10.6 and Figure 10.9 present summary results with estimated annual values and corresponding confidence intervals for fishing mortality (averaged over ages 1–7), recruitment (age 0) and SSB, as well as observed landings and discards for the years 1982–2022. The model was developed starting in 1960, although the reported values in the plots correspond to the years with good information (length distributions and calibration surveys).

Catches range from a minimum of 7 582 t in 2022 to a maximum of 22 950 t in 1983 with a mean of 13 664 if we focus on the period 1982–2022 presented in Figure 10.6. The two more recent years' values are close being 9 065 t and 7 582 t in 2021 and 2022, respectively.

Recruitment (age 0) is highly variable with a minimum of 111 million (2012) and a maximum of 566 million (2005) whereas its mean is around 239 million for the years 1982–2022. Despite these, the last 4 years are quite constant. However, all of the observed values are within the confidence intervals of the previous and following years.

Fishing mortality increased from the beginning of the time-series (F = 0.26 in 1982) peaking in 1995–1997 to around 0.85–0.90; then declining to 0.30 in 2006 and remaining relatively stable until 2016 (F = 0.42). Fishing mortality in the last years has been decreasing reaching 0.16 in 2022, below $F_{MSY}$ (0.221)

The SSB (described period: 1982–2022) was very high at the beginning of the time-series with values around 41 100 t, then decreased to a minimum of 3 036 t in 1998. Since 1998, the biomass has been steadily increasing, peaking in 2011 (20 834 t) and then slightly decreasing until 2017 after which it to increased once again, attaining 21 905 t in 2023.

#### 10.3.3.3 Retrospective pattern for SSB, fishing mortality, yield, and recruitment

Figure 10.10 presents the results of the assessments performed using the retrospective data series from 2021–2017. F estimates for the time-series from 1960 to 2020–2021 are inside the corresponding confidence interval of the time-series estimates of the base model whereas the estimates from 1960 to 2017-2019 are outside of this interval. SSB estimates for the time-series from 1960 to 2021 are inside the corresponding confidence interval of the time-series estimates of the base model whereas the estimates from 1960 to 2017-2020 are outside of this interval. The F and SSB Mohn rho are in line with this behaviour with values of −0.215 and 0.326 for F and SSB, respectively. There is a trend to down-correct the estimated SSBs and to up-correct F. On the other hand, recruitment estimates for series from 1960 to 2017–2019 are not inside the corresponding confidence intervals of the time-series estimates of the base model, contrary to those corresponding to recent years. However, according to the decision tree for handling assessments with retrospective patterns advice can be given (ICES, 2020). Even though, interseasonal work is required to improve these patters next year.

## 10.4 Catch options and prognosis

### 10.4.1 Short-term projections

Short-term projections are presented in Figure 10.11 and Table 10.7. The methodology used was developed during the latest benchmark (WKANGHAKE; ICES, 2023), and is also described in the Stock Annex. Recruitment estimates for last year (2022) are accepted as such (due to the small magnitude of the recruitment deviations at last years and the residuals of the surveys indices). Recruitment is then estimated in the projection years by the model, based on its stock–

recruitment relationship (Figure 10.12). The model shows a decreasing trend in F in recent years, although there is a retrospective pattern showing a correction of F upwards every year. For this reason, $F_{sq}$ (the F value assumed for the intermediate year) is determined by the average of the F of commercial fleets in the last three years (2020–2022).

$F_{sq}$ for the intermediate year (2023) is 0.21 with an expected catch of 10 793 t which corresponds to 9 913 t landings and 880 t discards. Recruitment for 2023–2024 is 357 754 and 367 914 thousand, respectively. In 2024 the expected SSB is 24 301 t.

Different 2024 F multipliers have been applied over the average F established in the intermediate year providing management alternatives according to different scenarios included in Table 10.11b.

Under the Multiannual Plan (MAP), with $F_{MSY}$ (F = 0.221) the catches would be 12 919.3 t, landings 11 783.2 t, and discards 1 136.1 t, whereas the SSB would be 26 726 t. The MAP also includes F equal to the lower and upper limits of $F_{MSY}$ for which catches would be 9 119.4 t and 17 445.5 t, respectively.

Additional scenarios over F include F = 0, F = $F_{lim}$, F = $F_{pa}$ and F equal to F in 2023for which the catches would be 0, 32 757.2 t, 28 044.2 t and 12 221.2 t, respectively. Table 10.7 also includes settings over SSB, in particular, SSB equal to SSB in 2024, $B_{lim}$, $B_{pa}$ and MSY $B_{trigger}$ for which the catches would be 17 463 t, 54 090.4 t, 50 719.4 t and 50 719.4 t, respectively. Note that the reference point values are specified in the next Section 10.5.

## 10.5 Biological reference points

Reference points were estimated during WKANGHAKE (ICES, 2023) and the process is described in the stock annex. It is worth noting that the ICES procedure to check whether $F_{MSY}$ and ranges are precautionary cannot be implemented easily in the SS framework. Furthermore, the quarterly length-based dynamic with fleets and sexes separated, and recruitment in different periods cannot be reproduced accurately in the EqSim framework. For this reason, WKANGHAKE (ICES, 2023) decided to transform the model results to EqSim to check only if $F_{MSY}$ and ranges are precautionary and afterwards use $F_{MSY}$ and ranges from SS as reference points.

| Framework | Reference point | Value | Technical basis | Source |
|---|---|---|---|---|
| MSY approach | MSY $B_{trigger}$ | 7556 t | $B_{pa}$; females only, in tonnes. | ICES (2023) |
| | $F_{msy}$ | 0.221 | SS estimates. | ICES (2023) |
| Precautionary approach | $B_{lim}$ | 6011 t | The breakpoint of the segmented regression stock–recruitment relationship; females only, in tonnes. | ICES (2023) |
| | $B_{pa}$ | 7556 t | exp(1.654 ×σ) × $B_{lim}$, $\sigma$ = 0.139; females only, in tonnes. | ICES (2023) |
| | $F_{lim}$ | 0.694 | The F that provides a 50% probability for SSB to be above $B_{lim}$. | ICES (2023) |
| | $F_{pa}$ | 0.558 | $F_{p.05}$ with ICES MSY AR: The F that provides a 95% probability for SSB to be above $B_{lim}$. | ICES (2023) |

| Framework | Reference point | Value | Technical basis | Source |
|---|---|---|---|---|
| Management plan | $F_{MGT}$ | Not defined | | |
| | $SSB_{MGT}$ | Not defined | | |
| | MAP MSY $B_{trigger}$ | 7556 t | MSY $B_{trigger}$; females only, in tonnes. | ICES (2023) |
| | MAP $B_{lim}$ | 6011 t | $B_{lim}$; females only, in tonnes. | ICES (2023) |
| | MAP $F_{msy}$ | 0.221 | $F_{msy}$ | ICES (2023) |
| | MAP range $F_{lower}$ | 0.151 | Consistent with ranges resulting in no more than 5% reduction in long-term yield compared to MSY. | ICES (2023) |
| | MAP range $F_{upper}$ | 0.311 | Consistent with ranges resulting in no more than 5% reduction in long-term yield compared to MSY. | ICES (2023) |

## 10.6 Comments on the assessment

The current model is quite unstable in terms of its ability to find a global optimum. An additional computation effort was undertaken to ensure the best possible solution. Current results are considered valid in terms of convergence.

Given the quality of catch data as well as the lack of abundance indices and length distributions at the beginning of the time-series, before 1982, the SSB and F estimates for that period should be considered with caution.

The model estimates landings and discards by fleet. Observed and modelled landings are quite similar. The model has a tendency to underestimate discards although they are well fitted in the last three years.

The SS model presents SSB for females only, which is an advance since egg production is considered a good metric of reproductive potential and female SSB, and is a better proxy for egg production than total mature biomass.

## 10.7 Future work

Future work should focus on the three problems mentioned in the previous section: convergence, old time-series estimation and discards underestimation. In addition to this, further work should be performed to improve the current biological parameters.

## 10.8 Management considerations

Southern hake is included in the Multiannual Management Plan for Western Waters (EU, 2019a). The target fishing mortality, in line with the ranges of $F_{MSY}$, should have been achieved by 2020. The current model already provides an F in 2022 that is slightly below $F_{MSY}$.

The retrospective pattern shows a general trend to correct SSB downwards and F upwards. The causes of this pattern are not yet well understood and should be further explored.

Hake is a top predator eating mainly blue whiting, horse mackerel, and other hake (cannibalism, particularly of juveniles by adults). There may be some impact of this on the rate of recovery of the population, particularly in areas of greater aggregations. The main hake predators in the area are the common and bottlenose dolphins.

## 10.9 References

EU. 2019a. 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.

EU. 2019b. Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005.

ICES. 2020. Workshop on Catch Forecast from Biased Assessments (WKFORBIAS; outputs from 2019 meeting). ICES Scientific Reports. 2:28. 38 pp. http://doi.org/10.17895/ices.pub.5997

ICES. 2022a. Stock annex: Hake (*Merluccius merluccius*) in divisions 8.c and 9.a, Southern stock (Cantabrian Sea and Atlantic Iberian waters). ICES Stock Annex. https://doi.org/10.17895/ices.pub.21316506

ICES. 2022b. EU request for an updated advice for hake (*Merluccius merluccius*) in divisions 8.c and 9.a, Southern stock (Cantabrian Sea and Atlantic Iberian waters) for catches in 2022. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022, sr.2022.14, https://doi.org/10.17895/ices.advice.21

ICES. 2023. Benchmark workshop on anglerfish and hake (WKANGHAKE). ICES Scientific Reports. 4:21. http://doi.org/10.17895/ices.pub.20068997

Methot Jr., R.D. and Wetzel, C.C. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142: 86–99

## 10.1 Tables and figures

**Table 10.1. Catch estimates (000' t) by country and gear. ART means Artisanal fleet, Cd-Trw refers to the Cádiz trawler fleet, Gillnet and Longline are the fleets combined in the SS model into one series named volpal. Pa-Ba Trw is a fleet which combines Pa-Trw and Ba-Trw, respectively pairtrawlers and baka (otter) trawlers. DISC and LAND are abbreviations for discards and landings.**

| | SPAIN | | | | | | | | | PORTUGAL | | | | FRANCE | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | ART | GILLNET | LONGLINE | Cd-Trw | Pa-Ba Trw | Pa-Trw | Ba-Trw | DISC | LAND | ART | Trw | DISC | LAND | TOTAL | UNALLOCATED | DISC | LAND | CATCH |
| 1972 | 7.10 | - | - | - | 10.20 | | | | 17.3 | 4.70 | 4.10 | - | 8.8 | | | - | **26.1** | **26.1** |
| 1973 | 8.50 | - | - | - | 12.30 | | | | 20.8 | 6.50 | 7.30 | - | 13.8 | 0.20 | | - | **34.8** | **34.8** |
| 1974 | 1.00 | 2.60 | 2.20 | - | 8.30 | | | | 14.1 | 5.10 | 3.50 | - | 8.6 | 0.10 | | - | **22.8** | **22.8** |
| 1975 | 1.30 | 3.50 | 3.00 | - | 11.20 | | | | 19.0 | 6.10 | 4.30 | - | 10.4 | 0.10 | | - | **29.5** | **29.5** |
| 1976 | 1.20 | 3.10 | 2.60 | - | 10.00 | | | | 16.9 | 6.00 | 3.10 | - | 9.1 | 0.10 | | - | **26.1** | **26.1** |
| 1977 | 0.60 | 1.50 | 1.30 | - | 5.80 | | | | 9.2 | 4.50 | 1.60 | - | 6.1 | 0.20 | | - | **15.5** | **15.5** |
| 1978 | 0.10 | 1.40 | 2.10 | - | 4.90 | | | | 8.5 | 3.40 | 1.40 | - | 4.8 | 0.10 | | - | **13.4** | **13.4** |
| 1979 | 0.20 | 1.70 | 2.10 | - | 7.20 | | | | 11.2 | 3.90 | 1.90 | - | 5.8 | - | | - | **17.0** | **17.0** |
| 1980 | 0.20 | 2.20 | 5.00 | - | 5.30 | | | | 12.7 | 4.50 | 2.30 | - | 6.8 | - | | - | **19.5** | **19.5** |
| 1981 | 0.30 | 1.50 | 4.60 | - | 4.10 | | | | 10.5 | 4.10 | 1.90 | - | 6.0 | - | | - | **16.5** | **16.5** |
| 1982 | 0.27 | 1.25 | 4.18 | 0.49 | 3.92 | | | | 10.1 | 5.01 | 2.49 | - | 7.5 | - | | - | **17.6** | **17.6** |
| 1983 | 0.37 | 2.10 | 6.57 | 0.57 | 5.29 | | | | 14.9 | 5.19 | 2.86 | - | 8.0 | - | | - | **22.9** | **22.9** |
| 1984 | 0.33 | 2.27 | 7.52 | 0.69 | 5.84 | | | | 16.7 | 4.30 | 1.22 | - | 5.5 | - | | - | **22.2** | **22.2** |
| 1985 | 0.77 | 1.81 | 4.42 | 0.79 | 5.33 | | | | 13.1 | 3.77 | 2.05 | - | 5.8 | - | | - | **18.9** | **18.9** |
| 1986 | 0.83 | 2.07 | 3.46 | 0.98 | 4.86 | | | | 12.2 | 3.16 | 1.79 | - | 4.9 | 0.01 | | - | **17.2** | **17.2** |

| | SPAIN | | | | | | | | | PORTUGAL | | | | FRANCE | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | ART | GILLNET | LONGLINE | Cd-Trw | Pa-Ba Trw | Pa-Trw | Ba-Trw | DISC | LAND | ART | Trw | DISC | LAND | TOTAL | UNALLOCATED | DISC | LAND | CATCH |
| 1987 | 0.53 | 1.97 | 4.41 | 0.95 | 3.50 | | | | 11.4 | 3.47 | 1.33 | - | 4.8 | 0.03 | | - | **16.2** | **16.2** |
| 1988 | 0.70 | 1.99 | 2.97 | 0.99 | 3.98 | | | | 10.6 | 4.30 | 1.71 | - | 6.0 | 0.02 | | - | **16.7** | **16.7** |
| 1989 | 0.56 | 1.86 | 1.95 | 0.90 | 3.92 | | | | 9.2 | 2.74 | 1.85 | - | 4.6 | 0.02 | | - | **13.8** | **13.8** |
| 1990 | 0.59 | 1.72 | 2.13 | 1.20 | 4.13 | | | | 9.8 | 2.26 | 1.14 | - | 3.4 | 0.03 | | - | **13.2** | **13.2** |
| 1991 | 0.42 | 1.41 | 2.20 | 1.21 | 3.63 | | | | 8.9 | 2.71 | 1.25 | - | 4.0 | 0.01 | | - | **12.8** | **12.8** |
| 1992 | 0.40 | 1.48 | 2.05 | 0.98 | 3.79 | | | 0.14 | 8.7 | 3.77 | 1.33 | 0.33 | 5.1 | - | | | **13.8** | **13.8** |
| 1993 | 0.37 | 1.26 | 2.74 | 0.54 | 2.67 | | | 0.24 | 7.6 | 3.04 | 0.87 | 0.44 | 3.9 | - | | | **11.5** | **11.5** |
| 1994 | 0.37 | 1.90 | 1.47 | 0.32 | | 0.82 | 1.90 | 0.29 | 6.8 | 2.30 | 0.79 | 0.71 | 3.1 | - | | **1.0** | **9.9** | **10.9** |
| 1995 | 0.37 | 1.59 | 0.96 | 0.46 | | 2.34 | 2.94 | 0.93 | 8.6 | 2.56 | 1.03 | 1.18 | 3.6 | - | | **2.1** | **12.2** | **14.3** |
| 1996 | 0.23 | 1.15 | 0.98 | 0.98 | | 1.46 | 2.17 | 0.91 | 7.0 | 2.01 | 0.76 | 0.99 | 2.8 | - | | **1.9** | **9.7** | **11.6** |
| 1997 | 0.30 | 1.04 | 0.76 | 0.88 | | 1.32 | 1.78 | 1.07 | 6.1 | 1.52 | 0.90 | 1.20 | 2.4 | - | | **2.3** | **8.5** | **10.8** |
| 1998 | 0.32 | 0.75 | 0.62 | 0.53 | | 0.88 | 1.95 | 0.57 | 5.0 | 1.67 | 0.97 | 1.11 | 2.6 | - | | **1.7** | **7.7** | **9.4** |
| 1999 | 0.33 | 0.60 | 0.00 | 0.57 | | 0.87 | 1.59 | 0.35 | 4.0 | 2.12 | 1.09 | 1.17 | 3.2 | - | | **1.5** | **7.2** | **8.7** |
| 2000 | 0.26 | 0.85 | 0.15 | 0.58 | | 0.83 | 1.98 | 0.62 | 4.7 | 2.09 | 1.16 | 1.21 | 3.3 | - | | **1.83** | **7.90** | **9.7** |
| 2001 | 0.32 | 0.55 | 0.11 | 1.20 | | 1.06 | 1.12 | 0.37 | 4.4 | 2.02 | 1.20 | 1.29 | 3.2 | - | | **1.66** | **7.58** | **9.2** |
| 2002 | 0.22 | 0.58 | 0.12 | 0.88 | | 1.37 | 0.75 | 0.38 | 3.9 | 1.81 | 0.97 | 1.11 | 2.8 | - | | **1.49** | **6.70** | **8.2** |
| 2003 | 0.37 | 0.43 | 0.17 | 1.25 | | 1.36 | 1.07 | 0.41 | 4.7 | 1.13 | 0.96 | 1.05 | 2.1 | - | | **1.46** | **6.74** | **8.2** |

| | SPAIN | | | | | | | | | PORTUGAL | | | | FRANCE | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | ART | GILLNET | LONGLINE | Cd-Trw | Pa-Ba Trw | Pa-Trw | Ba-Trw | DISC | LAND | ART | Trw | DISC | LAND | TOTAL | UNALLOCATED | DISC | LAND | CATCH |
| 2004 | 0.45 | 0.42 | 0.13 | 1.06 | | 1.66 | 1.13 | 0.22 | 4.8 | 1.27 | 0.80 | 0.69 | 2.1 | - | | **0.91** | **6.91** | **7.8** |
| 2005 | 0.72 | 0.63 | 0.09 | 0.88 | | 2.77 | 1.14 | 0.38 | 6.2 | 1.10 | 0.96 | 1.60 | 2.1 | - | | **1.98** | **8.30** | **10.3** |
| 2006 | 0.48 | 0.71 | 0.35 | 0.63 | | 4.70 | 1.81 | 2.65 | 8.7 | 1.22 | 0.91 | 0.61 | 2.1 | - | | **3.26** | **10.80** | **14.1** |
| 2007 | 0.83 | 1.80 | 0.89 | 0.50 | | 6.71 | 2.07 | 1.19 | 12.8 | 1.41 | 0.72 | 1.31 | 2.1 | - | | **2.50** | **14.93** | **17.4** |
| 2008 | 1.12 | 2.64 | 1.51 | 0.53 | | 6.32 | 2.44 | 1.45 | 14.6 | 1.27 | 0.94 | 0.86 | 2.2 | - | | **2.31** | **16.77** | **19.1** |
| 2009 | 1.41 | 2.92 | 2.10 | 0.55 | | 7.37 | 2.54 | 0.98 | 16.9 | 1.39 | 0.96 | 1.96 | 2.4 | - | | **2.93** | **19.24** | **22.2** |
| 2010 | 0.72 | 1.70 | 1.88 | 0.68 | | 6.33 | 1.71 | 1.00 | 13.0 | 1.61 | 0.73 | 0.58 | 2.3 | 0.36 | | **1.580** | **15.729** | **17.3** |
| 2011 | 0.41 | 1.09 | 0.76 | 0.53 | | 2.18 | 1.48 | 1.21 | 6.5 | 1.72 | 0.49 | 0.74 | 2.2 | | 8.40 | **1.95** | **17.06** | **19.0** |
| 2012 | 0.34 | 0.85 | 1.08 | 0.50 | | 1.64 | 1.42 | 1.35 | 5.8 | 1.79 | 0.81 | 0.47 | 2.6 | | 6.14 | **1.82** | **14.57** | **16.4** |
| 2013 | 0.64 | 1.75 | 1.11 | 0.62 | | 1.86 | 1.16 | 2.22 | 7.2 | 1.93 | 0.81 | 0.33 | 2.7 | 0.31 | 1.46 | **2.55** | **11.66** | **14.2** |
| 2014 | 0.75 | 1.46 | 1.60 | 0.54 | | 1.72 | 1.18 | 2.02 | 7.3 | 1.71 | 0.66 | 0.58 | 2.4 | 0.14 | 2.25 | **2.60** | **12.01** | **14.6** |
| 2015 | 0.90 | 1.11 | 1.23 | 0.36 | | 2.01 | 1.13 | 2.06 | 6.8 | 1.24 | 0.76 | 0.23 | 2.0 | 0.24 | 2.8 | **2.29** | **11.79** | **14.1** |
| 2016 | 0.91 | 1.64 | 1.30 | 0.42 | | 2.28 | 1.51 | 2.15 | 8.06 | 1.22 | 0.75 | 0.16 | 1.97 | 0.23 | 2.17 | **2.31** | **12.44** | **14.8** |
| 2017 | 0.69 | 1.51 | 1.71 | 0.27 | | 1.60 | 1.08 | 1.43 | 6.86 | 0.91 | 0.57 | 0.24 | 1.48 | 0.07 | 0.76 | **1.68** | **9.17** | **10.8** |
| 2018 | 0.76 | 1.64 | 1.00 | 0.39 | | 1.54 | 1.10 | 1.77 | 6.44 | 0.79 | 0.70 | 0.18 | 1.49 | 0.06 | 2.19 | **1.94** | **10.18** | **12.1** |
| 2019 | 0.78 | 1.65 | 1.12 | 0.43 | | 1.81 | 1.49 | 0.75 | 7.27 | 1.11 | 0.80 | 0.31 | 1.92 | 0.01 | 2.61 | **1.06** | **11.80** | **12.9** |
| 2020 | 0.73 | 1.54 | 1.16 | 0.44 | | 1.55 | 1.15 | 0.21 | 6.57 | 1.21 | 0.70 | 0.23 | 1.90 | 0.05 | 0.21 | **0.44** | **8.73** | **9.17** |

| | SPAIN | | | | | | | | | PORTUGAL | | | | FRANCE | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | ART | GILLNET | LONGLINE | Cd-Trw | Pa-Ba Trw | Pa-Trw | Ba-Trw | DISC | LAND | ART | Trw | DISC | LAND | TOTAL | UNALLOCATED | DISC | LAND | CATCH |
| 2021 | 0.58 | 1.55 | 1.35 | 0.25 | | 1.31 | 1.10 | 0.57 | 6.16 | 1.14 | 0.82 | 0.28 | 1.96 | 0.09 | 0.00 | **0.85** | **8.21** | **9.06** |
| 2022 | 0.50 | 1.50 | 1.14 | 0.28 | | 0.93 | 0.93 | 0.36 | 5.27 | 0.98 | 0.60 | 0.24 | 1.58 | 0.13 | 0.00 | **0.60** | **6.99** | **7.58** |

**Table 10.2. Catch, landings and discards length compositions (thousands). SOP is the sum of products, i.e. the sum of the products of number of fishes by the mean weight of the corresponding length using the *a* and *b* parameters of the weight-length relationship. NW means nominal weight.**

| Length (2 cm classes) | Land | Disc | Catch |
|---|---|---|---|
| 4 | 0 | 0 | 0 |
| 6 | 0 | 52 | 52 |
| 8 | 1 | 533 | 534 |
| 10 | 5 | 903 | 907 |
| 12 | 16 | 1216 | 1232 |
| 14 | 33 | 802 | 836 |
| 16 | 31 | 836 | 867 |
| 18 | 38 | 1274 | 1312 |
| 20 | 43 | 1733 | 1776 |
| 22 | 78 | 1466 | 1544 |
| 24 | 761 | 773 | 1534 |
| 26 | 1465 | 272 | 1736 |
| 28 | 1981 | 125 | 2106 |
| 30 | 1934 | 95 | 2029 |
| 32 | 1720 | 125 | 1845 |
| 34 | 1324 | 95 | 1419 |
| 36 | 1001 | 29 | 1030 |
| 38 | 751 | 6 | 757 |
| 40 | 517 | 1 | 518 |
| 42 | 407 | 1 | 408 |
| 44 | 306 | 1 | 307 |
| 46 | 273 | 1 | 274 |
| 48 | 217 | 9 | 226 |
| 50 | 208 | 0 | 209 |
| 52 | 210 | 0 | 210 |
| 54 | 215 | 0 | 215 |
| 56 | 208 | 0 | 208 |

| Length (2 cm classes) | Land | Disc | Catch |
|---|---|---|---|
| 58 | 189 | 0 | 189 |
| 60 | 170 | 0 | 170 |
| 62 | 147 | 0 | 147 |
| 64 | 107 | 0 | 107 |
| 66 | 91 | 0 | 91 |
| 68 | 72 | 0 | 72 |
| 70 | 57 | 0 | 57 |
| 72 | 53 | 0 | 53 |
| 74 | 30 | 0 | 30 |
| 76 | 22 | 0 | 22 |
| 78 | 15 | 0 | 15 |
| 80 | 12 | 0 | 12 |
| 82 | 15 | 0 | 15 |
| 84 | 6 | 0 | 6 |
| 86 | 7 | 0 | 7 |
| 88 | 4 | 0 | 4 |
| 90 | 3 | 0 | 3 |
| 92 | 2 | 0 | 2 |
| 94 | 2 | 0 | 2 |
| 96 | 1 | 0 | 1 |
| 98 | 8 | 0 | 8 |
| **TOTAL** | **14755** | **10349** | **25104** |
| **Nominal Weight (000' tons)** | **6.99** | **0.60** | **7.58** |
| **SOP** | **6.86** | **0.57** | **7.42** |
| **SOP / NW** | **1.02** | **1.05** | **1.02** |
| **Mean length (cm)** | **36.5** | **18.8** | **29.2** |

**Table 10.3. Portuguese groundfish surveys: biomass, abundance and recruitment indices. Autumn ptGFS-WIBTS-Q4 (G8899) is an input survey in the SS model and termed PtSurv.**

| Year | Winter (ptGFS-WIBTS-Q1) | | | | | Summer | | | | | Autumn ptGFS-WIBTS-Q4 (G8899) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | n/h < 20 cm (1) | hauls |
| | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | |
| 1979 * | | | | | | 11.7 | | 80.4 | | 55 | 9.5 | | na | | | 55 |
| 1980 * (**) | 11.3 | | 178.1 | | 36 | 15.4 | | 153.0 | | 63 | 12.5 | | 108.7 | | | 62 |
| 1981 ( Autumn **) | 10.7 | 0.7 | 122.4 | 15.5 | 67 | 9.9 | 1.3 | 87.8 | 15.5 | 69 | 24.4 | 0.5 | 734.8 | 29.3 | | 111 |
| 1982 | 18.1 | 2.5 | 265.6 | 37.5 | 69 | 11.0 | 2.7 | 93.0 | 32.8 | 70 | 10.6 | 1.8 | 119.5 | 34.7 | | 190 |
| 1983 ( Autumn **) | 27.0 | 6.0 | 530.5 | 151.0 | 69 | 15.1 | 2.3 | 120.5 | 20.8 | 98 | 13.4 | 0.5 | 121.8 | 4.8 | | 117 |
| 1984 | | | | | | | | | | | | | | | | |
| 1985 | | | | | | 14.3 | 0.8 | 170.7 | 15.6 | 101 | 11.0 | 0.7 | 128.7 | 8.4 | 86.7 | 150 |
| 1986 | | | | | | 27.4 | 1.8 | 249.4 | 15.1 | 118 | 17.7 | 1.2 | 165.6 | 28.4 | 90.2 | 117 |
| 1987 | | | | | | | | | | | 8.6 | 0.9 | 37.4 | 3.7 | 7.3 | 81 |
| 1988 | | | | | | | | | | | 15.3 | 1.7 | 177.8 | 30.8 | 111.7 | 98 |
| 1989 | | | | | | 11.9 | 0.9 | 80.8 | 8.6 | 114 | 8.4 | 0.5 | 59.6 | 4.6 | 19.8 | 130 |
| 1990 | | | | | | 9.8 | 1.0 | 95.6 | 13.5 | 98 | 11.8 | 1.0 | 157.2 | 26.3 | 97.2 | 107 |
| 1991 | | | | | | 14.2 | 1.2 | 104.2 | 11.3 | 119 | 20.9 | 4.3 | 195.3 | 41.5 | 92.3 | 80 |
| 1992 | 14.5 | 1.2 | 176.4 | 32.3 | 88 | 10.9 | 1.1 | 74.1 | 11.4 | 81 | 11.7 | 1.7 | 65.2 | 11.1 | 18.8 | 51 |
| 1993 | 9.0 | 0.7 | 78.7 | 16.8 | 75 | 11.3 | 1.7 | 105.0 | 34.7 | 66 | 5.5 | 0.8 | 54.4 | 12.9 | 28.4 | 58 |

| Year | Winter (ptGFS-WIBTS-Q1) | | | | | Summer | | | | | Autumn ptGFS-WIBTS-Q4 (G8899) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | n/h < 20 cm (1) | hauls |
| | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | |
| 1994 | | | | | | | | | | | 9.9 | 1.0 | 98.9 | 12.1 | 52.9 | 77 |
| 1995 | | | | | | 15.0 | 1.4 | 129.3 | 16.3 | 81 | 14.8 | 1.7 | 85.8 | 10.7 | 7.9 | 80 |
| 1996*** | | | | | | | | | | | 9.2 | 1.1 | 109.9 | 17.8 | 18.2 | 63 |
| 1997 | | | | | | 19.0 | 1.4 | 206.5 | 16.9 | 86 | 24.6 | 9.3 | 208.0 | 92.5 | 62.1 | 51 |
| 1998 | | | | | | 10.5 | 0.8 | 71.6 | 8.6 | 87 | 15.6 | 2.0 | 140.6 | 21.7 | 75.9 | 64 |
| 1999*** | | | | | | 11.8 | 0.7 | 116.2 | 10.1 | 65 | 11.6 | 1.5 | 118.3 | 17.1 | 14.4 | 71 |
| 2000 | | | | | | 16.4 | 1.6 | 123.0 | 15.2 | 88 | 11.8 | 1.8 | 102.7 | 19.9 | 49.2 | 66 |
| 2001 | | | | | | 16.6 | 1.7 | 132.5 | 14.2 | 83 | 15.6 | 2.8 | 164.2 | 38.5 | 89.9 | 58 |
| 2002 | | | | | | | | | | | 13.0 | 2.1 | 117.6 | 26.9 | 60.6 | 66 |
| 2003 *** | | | | | | | | | | | 9.8 | 1.0 | 94.2 | 8.0 | 11.9 | 71 |
| 2004 *** | | | | | | | | | | | 18.4 | 3.3 | 402.3 | 85.2 | 78.2 | 79 |
| 2005 | 17.7 | 2.6 | 384.0 | 53.8 | 68 | | | | | | 19.0 | 1.9 | 214.2 | 23.5 | 131.7 | 87 |
| 2006 | 16.0 | 2.0 | 377.5 | 55.4 | 66 | | | | | | 16.5 | 1.8 | 126.2 | 11.0 | 54.7 | 88 |
| 2007 | 22.4 | 3.4 | 609.1 | 114.1 | 63 | | | | | | 25.8 | 2.8 | 370.2 | 46.7 | 240.0 | 96 |
| 2008 | 31.1 | 4.8 | 700.6 | 170.8 | 67 | | | | | | 34.6 | 4.3 | 293.6 | 33.9 | 87.7 | 87 |
| 2009 | | | | | | | | | | | 37.5 | 4.4 | 476.4 | 75.9 | 318.6 | 93 |

| Year | Winter (ptGFS-WIBTS-Q1) | | | | | Summer | | | | | Autumn ptGFS-WIBTS-Q4 (G8899) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | hauls | Biomass (kg/h) | | Abundance (N/h) | | n/h < 20 cm (1) | hauls |
| | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | Mean | s.e. | Mean | s.e. | | |
| 2010 | | | | | | | | | | | 38.2 | 4.3 | 418.0 | 49.8 | 249.8 | 87 |
| 2011 | | | | | | | | | | | 18.7 | 1.5 | 272.9 | 25.2 | 179.4 | 86 |
| 2012 | | | | | | | | | | | | | | | | |
| 2013 | | | | | | | | | | | 35.2 | 3.4 | 473.1 | 62.1 | 289.0 | 93 |
| 2014 | | | | | | | | | | | 17.1 | 1.5 | 195.7 | 23.9 | 93.9 | 81 |
| 2015 | | | | | | | | | | | 37.2 | 4.3 | 602.1 | 65.0 | 393.2 | 90 |
| 2016 | | | | | | | | | | | 18.7 | 1.5 | 272.9 | 25.2 | 179.4 | 86 |
| 2017 | | | | | | | | | | | 19.7 | 2.6 | 256.1 | 57.9 | 136.6 | 89 |
| 2018 | | | | | | | | | | | 24.0 | 4.7 | 275.4 | 60.4 | 165.2 | 53 |
| 2019 | | | | | | | | | | | | | | | | |
| 2020 | | | | | | | | | | | | | | | | |
| 2021 | | | | | | | | | | | 21.3 | 2.7 | 272.5 | 35.2 | 161.0 | 93 |
| 2022 | | | | | | | | | | | 20.2 | 6.9 | 253.8 | 104.6 | 141.2 | 61 |

**Note: There are no survey data in 2012, 2019 and 2020. Data marked with * relate to 40 mm cod end mesh size, else 20 mm; ** whole area not covered; *** R/V Capricórnio, other years R/V Noruega; and (1) n/hour <20 cm converted to Noruega and NCT. Since 2002, tow duration is 30 min for autumn survey. Depth strata: from 1979 to 1988 covers 20–500 m depth; from 1989 to 2004 covers 20–750 m depth; since 2005 covers 20–500 m depth. In 2021, the survey was conducted with a new vessel (R/V Mário Ruivo).**

**Table 10.4. Spanish groundfish surveys: biomass, abundances and recruitment indices.**

| Year | SpGFS-WIBTS-Q4 (G2784) (/30 min) | | | | | | SPGFS-caut-WIBTS-Q4 (G4309) (/hour) | | | | SPGFS-cspr-WIBTS-Q1 (G7511) (/hour) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass index (Kg) | | Hauls | Abundance Index (nº) | | Recruits ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) |
| | Mean | s.e. | | Mean | s.e. | Mean | Mean | s.e. | | Mean | Mean | s.e. | | mean |
| 1983 | 7.04 | 0.65 | 107 | 192.4 | 25.0 | 177 | | | | | | | | |
| 1984 | 6.33 | 0.60 | 94 | 410.4 | 53.5 | 398 | | | | | | | | |
| 1985 | 3.83 | 0.39 | 97 | 108.5 | 14.0 | 98 | | | | | | | | |
| 1986 | 4.16 | 0.50 | 92 | 247.8 | 46.5 | 239 | | | | | | | | |
| 1987 | | | | | | | | | | | | | | |
| 1988 | 5.59 | 0.69 | 101 | 390.0 | 67.4 | 382 | | | | | | | | |
| 1989 | 7.14 | 0.75 | 91 | 487.9 | 73.1 | 477 | | | | | | | | |
| 1990 | 3.34 | 0.32 | 120 | 85.9 | 9.1 | 78 | | | | | | | | |
| 1991 | 3.37 | 0.39 | 107 | 166.8 | 15.8 | 161 | | | | | | | | |
| 1992 | 2.14 | 0.19 | 116 | 59.3 | 5.4 | 52 | | | | | | | | |
| 1993 | 2.49 | 0.21 | 109 | 80.0 | 8.0 | 73 | | | | | 3.04 | 0.53 | 30 | |
| 1994 | 3.98 | 0.33 | 118 | 245.0 | 24.9 | 240 | | | | | 2.68 | 0.33 | 30 | |
| 1995 | 4.58 | 0.44 | 116 | 80.9 | 8.4 | 68 | | | | | 4.66 | 1.28 | 30 | 71.5 |
| 1996 | 6.54 | 0.59 | 114 | 345.2 | 40.5 | 335 | | | | | 7.66 | 1.14 | 31 | 72.7 |
| 1997 | 7.27 | 0.78 | 119 | 421.4 | 56.5 | 410 | 5.28 | 2.77 | 27 | 26.7 | 3.34 | 0.52 | 30 | 72.5 |
| 1998 | 3.36 | 0.28 | 114 | 75.9 | 8.7 | 65 | 2.66 | 0.42 | 34 | 6.6 | 2.93 | 0.67 | 31 | 18.6 |

| Year | SpGFS-WIBTS-Q4 (G2784) (/30 min) | | | | | | SPGFS-caut-WIBTS-Q4 (G4309) (/hour) | | | | SPGFS-cspr-WIBTS-Q1 (G7511) (/hour) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass index (Kg) | | Hauls | Abundance Index (nº) | | Recruits ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) |
| | Mean | s.e. | | Mean | s.e. | Mean | Mean | s.e. | | Mean | Mean | s.e. | | mean |
| 1999 | 3.35 | 0.25 | 116 | 95.3 | 10.6 | 89 | 2.71 | 0.44 | 38 | 23.9 | 3.03 | 0.37 | 38 | 44.6 |
| 2000 | 3.01 | 0.43 | 113 | 66.9 | 7.4 | 59 | 2.03 | 0.61 | 30 | 18.6 | 3.02 | 0.47 | 41 | 39.7 |
| 2001 | 1.73 | 0.29 | 113 | 42.0 | 7.6 | 37 | 2.57 | 0.45 | 39 | 22.7 | 6.01 | 0.79 | 40 | 72.4 |
| 2002 | 1.91 | 0.23 | 110 | 57.1 | 8.8 | 53 | 3.39 | 0.78 | 39 | 118.6 | 2.74 | 0.25 | 41 | 22.4 |
| 2003 | 2.61 | 0.27 | 112 | 92.8 | 11.6 | 86 | 1.61 | 0.28 | 41 | 17.5 | | | | |
| 2004 | 3.94 | 0.40 | 114 | 177.0 | 23.5 | 170 | 2.72 | 0.69 | 40 | 85.8 | 3.65 | 0.47 | 40 | 92.7 |
| 2005 | 6.46 | 0.53 | 116 | 344.8 | 32.2 | 335 | 6.68 | 1.29 | 42 | 100.6 | 10.77 | 5.65 | 40 | 184.3 |
| 2006 | 5.50 | 0.39 | 115 | 224.5 | 21.9 | 211 | 4.99 | 2.00 | 41 | 212.3 | 2.15 | 0.40 | 41 | 3.7 |
| 2007 | 4.97 | 0.43 | 117 | 158.2 | 15.0 | 150 | 6.92 | 1.43 | 37 | 200.3 | 3.22 | 0.68 | 41 | 51.1 |
| 2008 | 4.93 | 0.46 | 115 | 99.3 | 11.5 | 81 | 4.33 | 0.60 | 41 | 64.4 | 3.48 | 0.67 | 41 | 50.5 |
| 2009 | 9.32 | 0.94 | 117 | 559.7 | 93.9 | 789 | 7.35 | 0.97 | 43 | 95.0 | 4.24 | 0.06 | 40 | 65.6 |
| 2010 | 8.36 | 0.65 | 114 | 201.0 | 14.9 | 175 | 5.82 | 0.83 | 44 | 46.0 | 6.91 | 1.09 | 36 | 202.5 |
| 2011 | 8.98 | 0.68 | 111 | 241.5 | 21.0 | 216 | 2.97 | 0.38 | 40 | 48.2 | 3.75 | 0.50 | 42 | 32.2 |
| 2012 | 8.44 | 0.75 | 115 | 297.3 | 39.5 | 280 | 5.38 | 0.90 | 37 | 44.0 | 3.49 | 0.65 | 33 | 62.9 |
| 2013 | 5.59 | 0.78 | 114 | 136.9 | 13.6 | 118 | 12.52 | 2.04 | 43 | 285.6 | 5.50 | 0.56 | 40 | 76.5 |
| 2014 | 3.72 | 0.44 | 116 | 78.0 | 9.6 | 68 | 9.33 | 1.38 | 45 | 63.0 | 6.01 | 0.65 | 40 | 60.4 |

| Year | SpGFS-WIBTS-Q4 (G2784) (/30 min) | | | | | | SPGFS-caut-WIBTS-Q4 (G4309) (/hour) | | | | SPGFS-cspr-WIBTS-Q1 (G7511) (/hour) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biomass index (Kg) | | Hauls | Abundance Index (nº) | | Recruits ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) | Biomass index (Kg) | | hauls | Rec ( < 20 cm) |
| | Mean | s.e. | | Mean | s.e. | Mean | Mean | s.e. | | Mean | Mean | s.e. | | mean |
| 2015 | 9.87 | 0.85 | 114 | 316.8 | 33.7 | 296 | 13.67 | 2.61 | 43 | 186.8 | 6.01 | 0.69 | 43 | 165.3 |
| 2016 | 7.67 | 0.65 | 114 | 211.3 | 18.3 | 185 | 5.90 | 0.92 | 45 | 87.6 | 6.50 | 0.76 | 44 | 118.5 |
| 2017 | 6.58 | 0.57 | 112 | 158.8 | 14.5 | 140 | 4.74 | 0.89 | 44 | 151.1 | 3.39 | 0.52 | 45 | 38.0 |
| 2018 | 6.48 | 0.52 | 113 | 300.8 | 34.8 | 291 | 8.00 | 1.22 | 45 | 34.4 | 5.78 | 1.48 | 41 | 134.6 |
| 2019 | 5.71 | 0.39 | 113 | 166.1 | 18.4 | 151 | 8.03 | 1.17 | 43 | 364.4 | 5.13 | 0.90 | 46 | 109.7 |
| 2020 | 5.45 | 0.47 | 109 | 131.2 | 13.2 | 123 | 4.54 | 0.63 | 44 | 32.8 | 5.82 | 0.93 | 45 | 34.6 |
| 2021 | 5.21 | 0.53 | 113 | 142.9 | 14.9 | 133 | | | | | | | | |
| 2022 | 9.56 | 0.76 | 114 | 246.3 | 28.1 | 223 | 5.44 | 1.11 | 45 | 43.0 | 4.37 | 0.83 | 45 | 104.4 |

**Note: Since 1997 new depth stratification is considered: 70–120 m, 121–200 m and 201–500 m, previous one was 30–100 m, 101–200 m and 201–500 m. The surveys SpGFS-WIBTS-Q4 (G2784) and SPGFS-caut-WIBTS-Q4 (G4309) are an input in the SS model and named as SpSurv and CdSurv, respectively**

**Table 10.5. Catch per unit effort and standard error (s.e). Trw CPUE is a weighted mean of 3 Spanish trawlers métiers (pairtrawlers – PTB_MPD_> = 55_0_0, and two otter (baka) trawlers in which the baka fleet of Table 10.1 can be split ("OTB_DEF_> = 55_0_0" and "OTB_MPD_> = 55_0_0"). VolPal CPUE is a weighted mean of Spanish gillnetters and long-liners.**

| YEAR | Trw CPUE (standardized) | s.e. | VolPal CPUE (standardized) | s.e. |
|---|---|---|---|---|
| 2003 | 0.506 | 0.090 | | |
| 2004 | 0.332 | 0.058 | | |
| 2005 | 0.546 | 0.090 | | |
| 2006 | 0.788 | 0.135 | | |
| 2007 | 0.885 | 0.149 | | |
| 2008 | 0.919 | 0.158 | | |
| 2009 | 1.018 | 0.171 | 1.171 | 0.120 |
| 2010 | 1.326 | 0.221 | 1.174 | 0.121 |
| 2011 | 1.475 | 0.238 | 1.073 | 0.111 |
| 2012 | 0.898 | 0.148 | 0.838 | 0.086 |
| 2013 | 1.106 | 0.181 | 0.769 | 0.084 |
| 2014 | 0.925 | 0.154 | 1.071 | 0.108 |
| 2015 | 0.932 | 0.153 | 0.882 | 0.088 |
| 2016 | 1.204 | 0.205 | 0.897 | 0.090 |
| 2017 | 0.864 | 0.142 | 0.900 | 0.091 |
| 2018 | 0.736 | 0.130 | 0.917 | 0.092 |
| 2019 | 1.312 | 0.246 | 0.865 | 0.091 |
| 2020 | 0.804 | 0.205 | 1.045 | 0.107 |
| 2021 | 0.847 | 0.151 | 1.038 | 0.105 |
| 2022 | 0.887 | 0.151 | 0.907 | 0.092 |

**Table 10.6. Assessment summary. Recruitment values and corresponding confidence intervals of plus minus 2 standard deviations (rec_value, rec_low, and rec_upp), SSB values and corresponding confidence intervals (ssb val, ssb_low and ssb_upp) and F values and corresponding confidence intervals (F_val, F_low and F_upp). Finally, catch, landings and discards time-series estimates.**

| Years | rec_low | rec_value | rec_upp | ssb_low | ssb_val | ssb_upp | F_low | F_val | F_upp | catch | landings | discards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | 429475 | 474632 | 519789 | 156058 | 181154 | 206250 | 0.048 | 0.060 | 0.071 | 16073 | 16073 | 0 |
| 1961 | 428907 | 474094 | 519281 | 151997 | 176692 | 201387 | 0.054 | 0.068 | 0.081 | 17655 | 17655 | 0 |
| 1962 | 428136 | 473374 | 518612 | 146687 | 171043 | 195399 | 0.056 | 0.069 | 0.083 | 17553 | 17553 | 0 |
| 1963 | 427316 | 472617 | 517918 | 141351 | 165458 | 189565 | 0.062 | 0.078 | 0.094 | 19139 | 19139 | 0 |
| 1964 | 426298 | 471688 | 517078 | 135130 | 159060 | 182990 | 0.083 | 0.105 | 0.126 | 24658 | 24658 | 0 |
| 1965 | 424576 | 470133 | 515690 | 125548 | 149349 | 173150 | 0.101 | 0.129 | 0.156 | 28516 | 28516 | 0 |
| 1966 | 422112 | 467952 | 513792 | 113736 | 137483 | 161230 | 0.085 | 0.110 | 0.134 | 23074 | 23074 | 0 |
| 1967 | 420238 | 466343 | 512448 | 105989 | 129810 | 153631 | 0.079 | 0.102 | 0.125 | 20771 | 20771 | 0 |
| 1968 | 418789 | 465131 | 511473 | 100594 | 124546 | 148498 | 0.076 | 0.099 | 0.121 | 19769 | 19769 | 0 |
| 1969 | 417672 | 464219 | 510766 | 96733 | 120837 | 144941 | 0.071 | 0.092 | 0.113 | 18254 | 18254 | 0 |
| 1970 | 417017 | 463706 | 510395 | 94570 | 118842 | 143114 | 0.045 | 0.058 | 0.072 | 11707 | 11707 | 0 |
| 1971 | 417839 | 464440 | 511041 | 97228 | 121718 | 146208 | 0.042 | 0.054 | 0.066 | 11267 | 11267 | 0 |
| 1972 | 418879 | 465349 | 511819 | 100823 | 125460 | 150097 | 0.099 | 0.127 | 0.155 | 26100 | 26100 | 0 |
| 1973 | 8451 | 269433 | 530415 | 95065 | 119647 | 144229 | 0.141 | 0.184 | 0.227 | 34800 | 34800 | 0 |
| 1974 | 11355 | 258661 | 505967 | 83016 | 107526 | 132036 | 0.101 | 0.135 | 0.169 | 22800 | 22800 | 0 |
| 1975 | 13678 | 249728 | 485778 | 76983 | 101204 | 125425 | 0.143 | 0.200 | 0.256 | 29500 | 29500 | 0 |
| 1976 | 15806 | 239094 | 462382 | 63566 | 86932 | 110297 | 0.142 | 0.210 | 0.278 | 26100 | 26100 | 0 |

| Years | rec_low | rec_value | rec_upp | ssb_low | ssb_val | ssb_upp | F_low | F_val | F_upp | catch | landings | discards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 17291 | 232573 | 447855 | 50292 | 73046 | 95801 | 0.092 | 0.143 | 0.193 | 15500 | 15500 | 0 |
| 1978 | 18358 | 237310 | 456262 | 43785 | 66039 | 88293 | 0.086 | 0.133 | 0.180 | 13400 | 13400 | 0 |
| 1979 | 20781 | 250445 | 480109 | 39403 | 60843 | 82282 | 0.118 | 0.182 | 0.245 | 17000 | 17000 | 0 |
| 1980 | 24449 | 258257 | 492065 | 33790 | 53919 | 74048 | 0.151 | 0.230 | 0.309 | 19500 | 19500 | 0 |
| 1981 | 63587 | 313335 | 563083 | 27692 | 46108 | 64525 | 0.143 | 0.211 | 0.280 | 16500 | 16500 | 0 |
| 1982 | 98538 | 266061 | 433584 | 24586 | 41100 | 57614 | 0.188 | 0.258 | 0.329 | 17592 | 17592 | 0 |
| 1983 | 108432 | 224315 | 340198 | 23367 | 37318 | 51268 | 0.268 | 0.362 | 0.456 | 22950 | 22950 | 0 |
| 1984 | 114698 | 231035 | 347372 | 19580 | 30862 | 42145 | 0.295 | 0.409 | 0.523 | 22179 | 22179 | 0 |
| 1985 | 99731 | 209495 | 319259 | 14644 | 24126 | 33609 | 0.311 | 0.430 | 0.548 | 18941 | 18941 | 0 |
| 1986 | 105038 | 263612 | 422186 | 11321 | 19477 | 27632 | 0.331 | 0.459 | 0.587 | 17161 | 17161 | 0 |
| 1987 | 32214 | 159855 | 287496 | 8642 | 15643 | 22643 | 0.349 | 0.497 | 0.644 | 16185 | 16185 | 0 |
| 1988 | 155254 | 296976 | 438698 | 6727 | 12400 | 18073 | 0.432 | 0.611 | 0.790 | 16653 | 16653 | 0 |
| 1989 | 100534 | 193242 | 285950 | 5086 | 9671 | 14257 | 0.396 | 0.549 | 0.702 | 13786 | 13786 | 0 |
| 1990 | 159293 | 249043 | 338793 | 4673 | 8509 | 12345 | 0.410 | 0.560 | 0.710 | 13190 | 13190 | 0 |
| 1991 | 125910 | 199547 | 273184 | 5167 | 8301 | 11436 | 0.426 | 0.547 | 0.668 | 12827 | 12827 | 0 |
| 1992 | 72880 | 124017 | 175154 | 5523 | 8132 | 10742 | 0.517 | 0.628 | 0.739 | 13798 | 13798 | 0 |
| 1993 | 109250 | 142638 | 176026 | 5422 | 7394 | 9366 | 0.532 | 0.641 | 0.751 | 11489 | 11489 | 0 |
| 1994 | 252909 | 293734 | 334559 | 4746 | 6199 | 7652 | 0.573 | 0.677 | 0.780 | 10859 | 9865 | 994 |

| Years | rec_low | rec_value | rec_upp | ssb_low | ssb_val | ssb_upp | F_low | F_val | F_upp | catch | landings | discards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 82407 | 118419 | 154431 | 3772 | 4868 | 5964 | 0.772 | 0.888 | 1.005 | 14341 | 12239 | 2102 |
| 1996 | 210438 | 252276 | 294114 | 3092 | 3887 | 4681 | 0.771 | 0.903 | 1.035 | 11640 | 9730 | 1910 |
| 1997 | 145181 | 185803 | 226425 | 2706 | 3416 | 4127 | 0.721 | 0.846 | 0.972 | 10769 | 8499 | 2270 |
| 1998 | 148576 | 190288 | 232000 | 2386 | 3036 | 3687 | 0.621 | 0.736 | 0.851 | 9364 | 7683 | 1681 |
| 1999 | 134910 | 175473 | 216036 | 2774 | 3486 | 4197 | 0.468 | 0.549 | 0.630 | 8690 | 7171 | 1519 |
| 2000 | 146896 | 190110 | 233324 | 3526 | 4392 | 5258 | 0.510 | 0.607 | 0.704 | 9737 | 7902 | 1835 |
| 2001 | 142854 | 190763 | 238672 | 3625 | 4639 | 5654 | 0.435 | 0.521 | 0.608 | 9243 | 7581 | 1662 |
| 2002 | 183329 | 234153 | 284977 | 3900 | 5091 | 6281 | 0.355 | 0.432 | 0.509 | 8189 | 6697 | 1492 |
| 2003 | 139671 | 182971 | 226271 | 4547 | 5978 | 7409 | 0.290 | 0.349 | 0.408 | 8206 | 6745 | 1461 |
| 2004 | 239091 | 296429 | 353767 | 5816 | 7532 | 9248 | 0.256 | 0.308 | 0.361 | 7824 | 6910 | 913 |
| 2005 | 474331 | 565741 | 657151 | 7387 | 9490 | 11592 | 0.260 | 0.314 | 0.368 | 10279 | 8301 | 1978 |
| 2006 | 177850 | 238182 | 298514 | 8670 | 11232 | 13793 | 0.250 | 0.296 | 0.343 | 14061 | 10799 | 3262 |
| 2007 | 339330 | 419608 | 499886 | 12169 | 15244 | 18319 | 0.304 | 0.361 | 0.418 | 17438 | 14934 | 2504 |
| 2008 | 297755 | 374164 | 450573 | 15181 | 18773 | 22364 | 0.318 | 0.376 | 0.435 | 19084 | 16773 | 2311 |
| 2009 | 244512 | 310686 | 376860 | 15952 | 19958 | 23963 | 0.363 | 0.430 | 0.498 | 22175 | 19240 | 2935 |
| 2010 | 150635 | 198509 | 246383 | 15831 | 20149 | 24468 | 0.300 | 0.354 | 0.408 | 17310 | 15730 | 1580 |
| 2011 | 278656 | 333727 | 388798 | 16306 | 20834 | 25362 | 0.362 | 0.430 | 0.498 | 19010 | 17062 | 1948 |
| 2012 | 78130 | 111237 | 144344 | 13873 | 18424 | 22975 | 0.332 | 0.392 | 0.452 | 16396 | 14573 | 1823 |

| Years | rec_low | rec_value | rec_upp | ssb_low | ssb_val | ssb_upp | F_low | F_val | F_upp | catch | landings | discards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 247367 | 301080 | 354793 | 12755 | 17191 | 21627 | 0.294 | 0.349 | 0.404 | 14214 | 11661 | 2553 |
| 2014 | 155270 | 203797 | 252324 | 11997 | 16299 | 20600 | 0.317 | 0.380 | 0.444 | 14614 | 12011 | 2602 |
| 2015 | 202350 | 251452 | 300554 | 10708 | 14784 | 18860 | 0.317 | 0.384 | 0.451 | 14077 | 11786 | 2292 |
| 2016 | 180724 | 233527 | 286330 | 10232 | 14156 | 18080 | 0.341 | 0.420 | 0.498 | 14756 | 12443 | 2313 |
| 2017 | 249455 | 310726 | 371997 | 9485 | 13366 | 17246 | 0.244 | 0.309 | 0.375 | 10847 | 9171 | 1676 |
| 2018 | 155824 | 211420 | 267016 | 10152 | 14161 | 18169 | 0.242 | 0.304 | 0.365 | 12125 | 10183 | 1942 |
| 2019 | 107004 | 151609 | 196214 | 11341 | 15624 | 19908 | 0.261 | 0.331 | 0.400 | 12861 | 11800 | 1061 |
| 2020 | 162523 | 224920 | 287317 | 12177 | 16954 | 21731 | 0.190 | 0.244 | 0.298 | 8732 | 8732 | 670* |
| 2021 | 178840 | 245718 | 312596 | 12818 | 18185 | 23551 | 0.165 | 0.215 | 0.266 | 9065 | 8214 | 851 |
| 2022 | 147959 | 254527 | 361095 | 13192 | 19089 | 24986 | 0.123 | 0.164 | 0.204 | 7582 | 6986 | 595 |
| 2023 | | | | 15228 | 21905 | 28583 | | | | | | |

**Table 10.7. Short-term projections. All weights are in tonnes.**

a) Intermediate years values.

| Variable | Value | Notes |
|---|---|---|
| F (2023) | 0.21 | $F_{sq}$ = Average F (2020–2022). |
| SSB (2024) | 24301 | Short-term forecast fishing at status quo ($F_{sq}$); tonnes. |
| $R_{age0}$ (2023) | 357754 | Estimated by the model based on the stock–recruitment relationship; thousands |
| $R_{age0}$ (2024) | 367914 | Estimated by the model based on the stock–recruitment relationship; thousands |
| Total catch (2023) | 10793 | Short-term forecast using $F_{sq}$ ; tonnes. |
| Projected landings (2023) | 9913 | Short-term forecast using $F_{sq}$ ; landings estimated by the model. |
| Projected discards (2023) | 880 | Short-term forecast using $F_{sq}$ ; discards estimated by the model. |

b) Annual catch scenarios.

| Basis | Total catch (2024) | Projected landings (2024) | Projected discards (2024) | $F_{total}$ (2024) | $F_{projected\ landings}$ ^^ (2024) | $F_{projected\ discards}$ ^^ (2024) | SSB (2025) | % SSB change* | % advice change** |
|---|---|---|---|---|---|---|---|---|---|
| ICES advice basis | | | | | | | | | |
| EU MAP F = $F_{MSY}$ ^ | 12919.3 | 11783.2 | 1136.1 | 0.221 | 0.202 | 0.019 | 26726 | 10 % | 10 % |
| EU MAP F = $F_{MSY}$ lower | 9119.4 | 8329.2 | 790.2 | 0.151 | 0.138 | 0.013 | 28771 | 18 % | 10 % |
| EU MAP F = $F_{MSY}$ upper | 17445.5 | 15882.6 | 1562.9 | 0.311 | 0.283 | 0.028 | 24311 | 0 % | 10 % |
| Other scenarios | | | | | | | | | |
| MSY approach = $F_{MSY}$ | 12919.3 | 11783.2 | 1136.1 | 0.221 | 0.202 | 0.019 | 26726 | 10 % | 10 % |
| F = 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33740 | 39 % | -100 % |
| F = $F_{lim}$ | 32757.2 | 29590.8 | 3166.4 | 0.694 | 0.627 | 0.067 | 16349 | -33 % | 178 % |
| F = $F_{pa}$ | 28044.2 | 25406.2 | 2638 | 0.558 | 0.506 | 0.052 | 18756 | -23 % | 138 % |
| SSB (2025) = $B_{lim}$ | 54090.4 | 47993.5 | 6096.9 | 1.651 | 1.465 | 0.186 | 6011 | -75 % | 359 % |
| SSB (2025) = $B_{pa}$ | 50719.4 | 45181.8 | 5537.6 | 1.432 | 1.276 | 0.156 | 7556 | -69 % | 330 % |
| SSB (2025) = MSY $B_{trigger}$ | 50719.4 | 45181.8 | 5537.6 | 1.432 | 1.276 | 0.156 | 7556 | -69 % | 330 % |
| SSB (2025) = SSB(2024) | 17463.2 | 15898.7 | 1564.5 | 0.311 | 0.283 | 0.028 | 24301 | 0 % | 48 % |
| F = F (2023) | 12221.2 | 11149.5 | 1071.7 | 0.208 | 0.19 | 0.018 | 27101 | 12 % | 4 % |

**Note: * means SSB 2025 relative to SSB 2024, ** Advice values for 2024 relative to the corresponding 2023 values**

**^ The EU multiannual plan (MAP; EU, 2019a), ^^ F landings and F discards were calculated using the ratios of the projected landings and discards ($Fl_{and}$ = $F_{tot}$ * Land / Catch; $F_{disc}$ = $F_{tot}$ * Disc / Catch).**

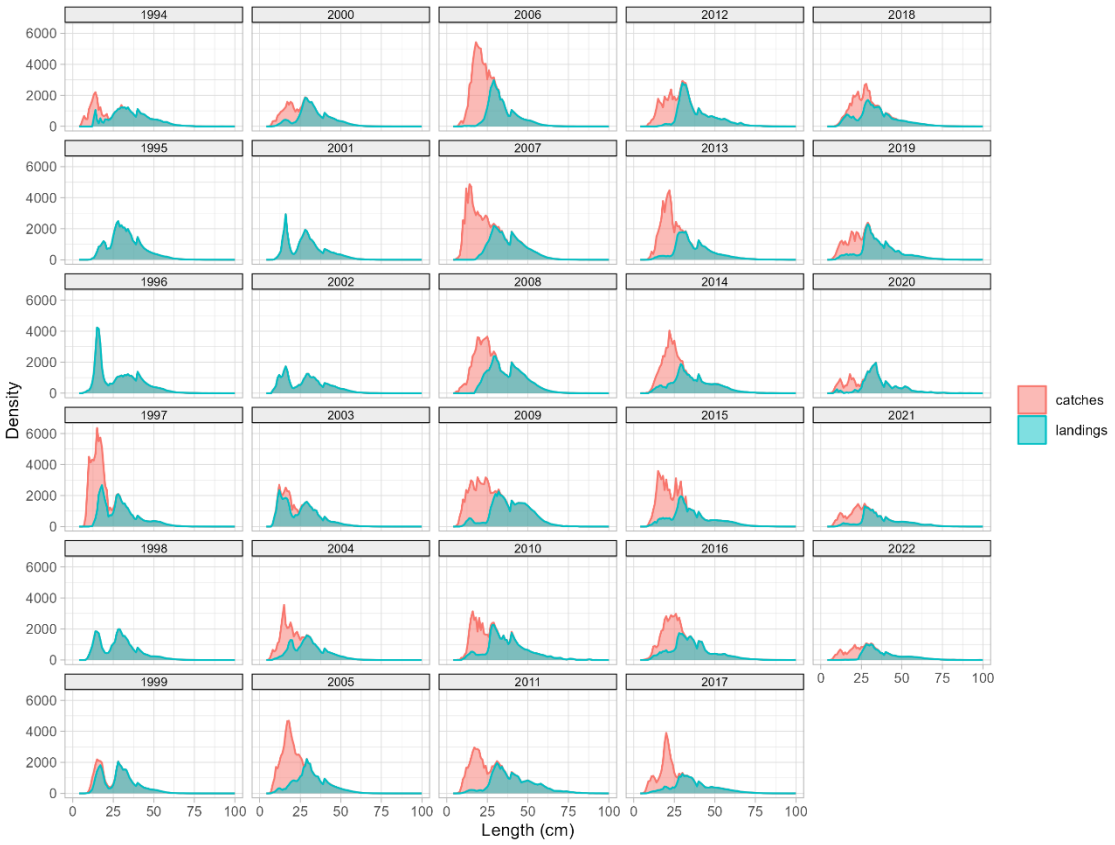



**Figure 10.1. Length distribution of catches used in the assessment (1994–latest year). Note that discards length distribution is missing in some years.**

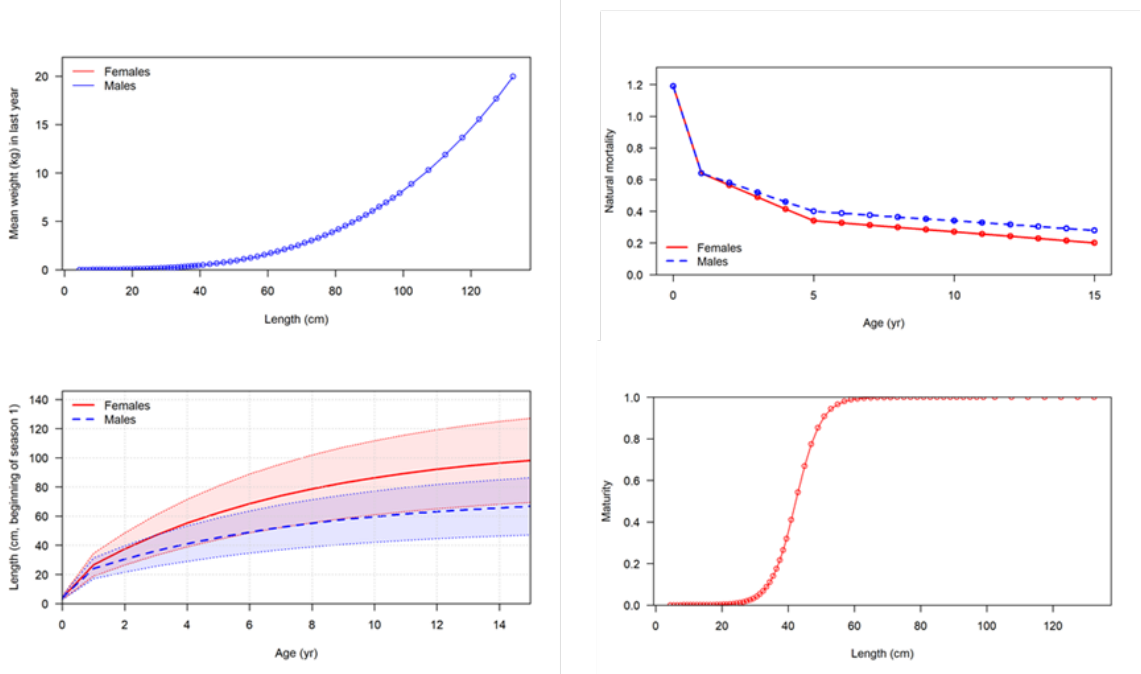



**Figure 10.2. Biological plots. Length-weight relationship (upper left), growth by sex (lower left); natural mortality by sex (upper right); and maturity ogive (lower right).**

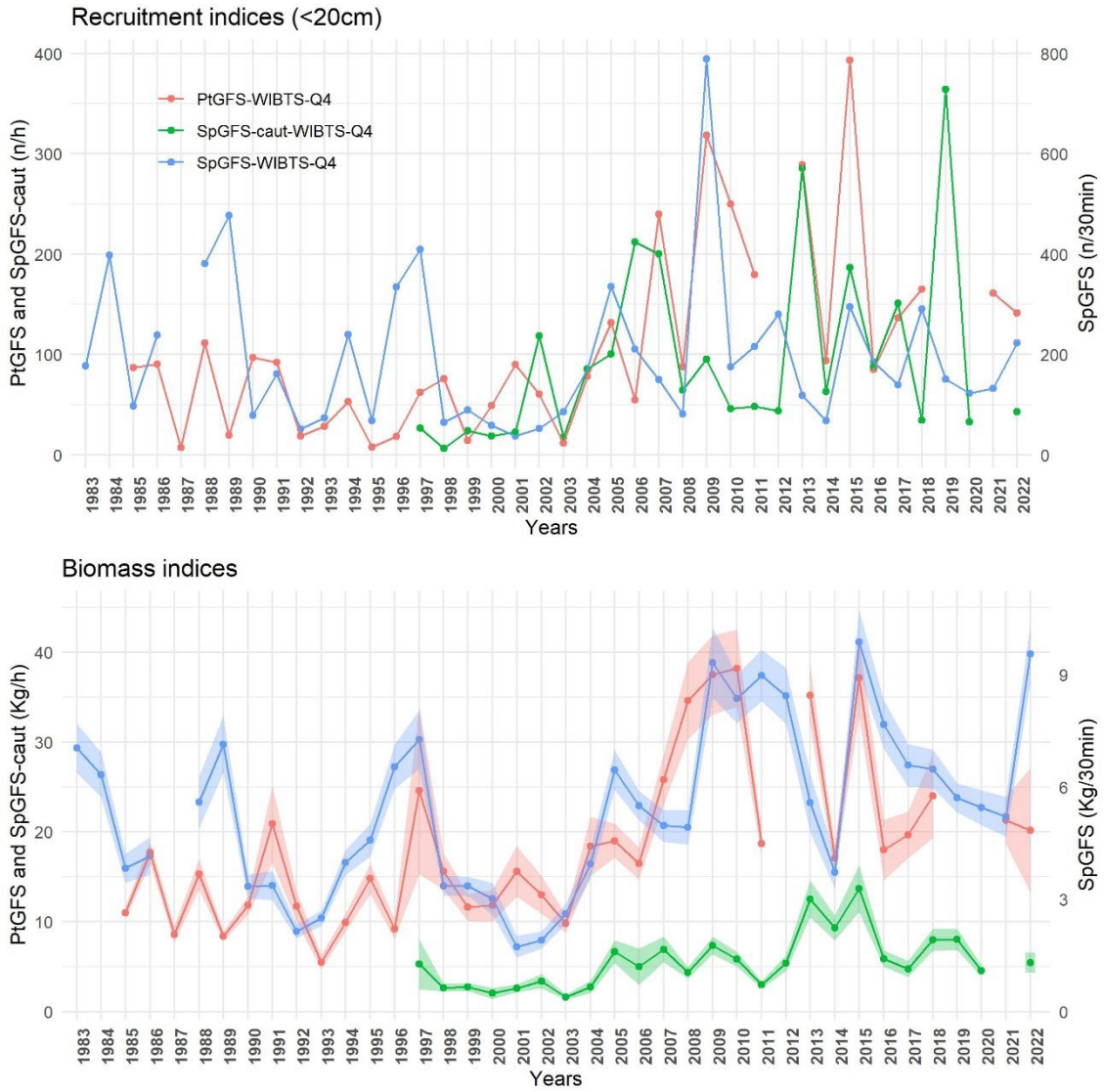
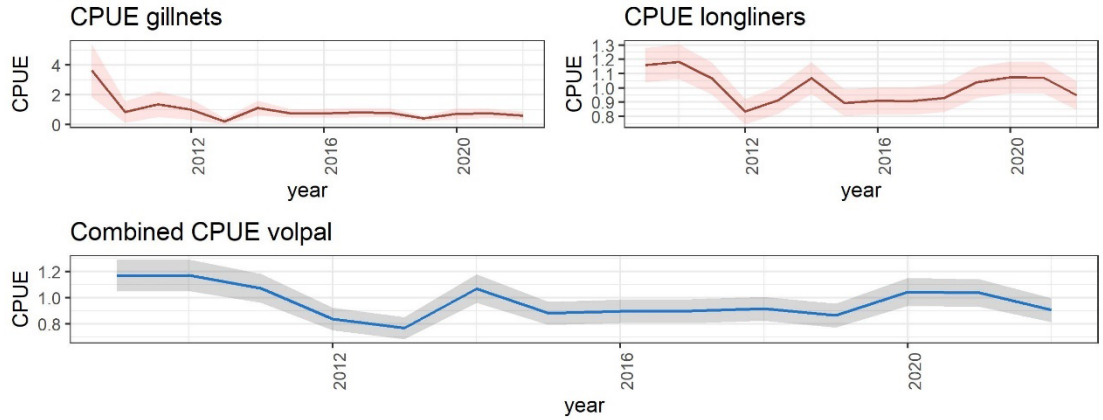



**Figure 10.3. Recruitment and biomass indices from groundfish surveys. The surveys SpGFS-WIBTS-Q4 (G2784) and SPGFS-caut-WIBTS-Q4 (G4309) are an input in the SS model and termed SpSurv and CdSurv, respectively. Autumn ptGFS-WIBTS-Q4 (G8899) is an input survey in the SS model and termed PtSurv. Shaded regions are 90% confidence intervals.**



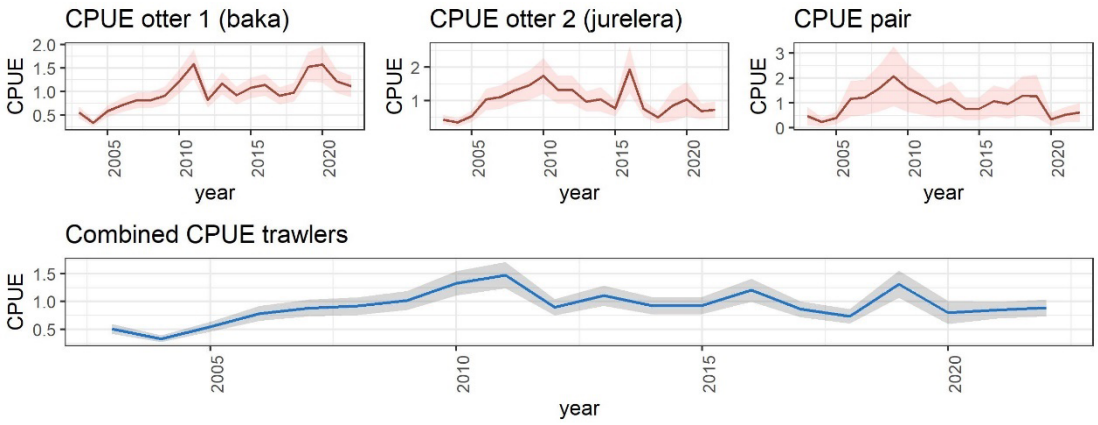



**Figure 10.4. CPUE trends for trawlers and volpal. Trawlers CPUE is a weighted mean of 3 Spanish trawlers métiers (pairtrawlers, and two otter (baka) trawlers in which baka fleet of Table 10.1 can be split ("baka" and "jurelera"). VolPal CPUE is a weighted mean of Spanish gillnetters and longliners. Shaded regions are 90% confidence intervals.**

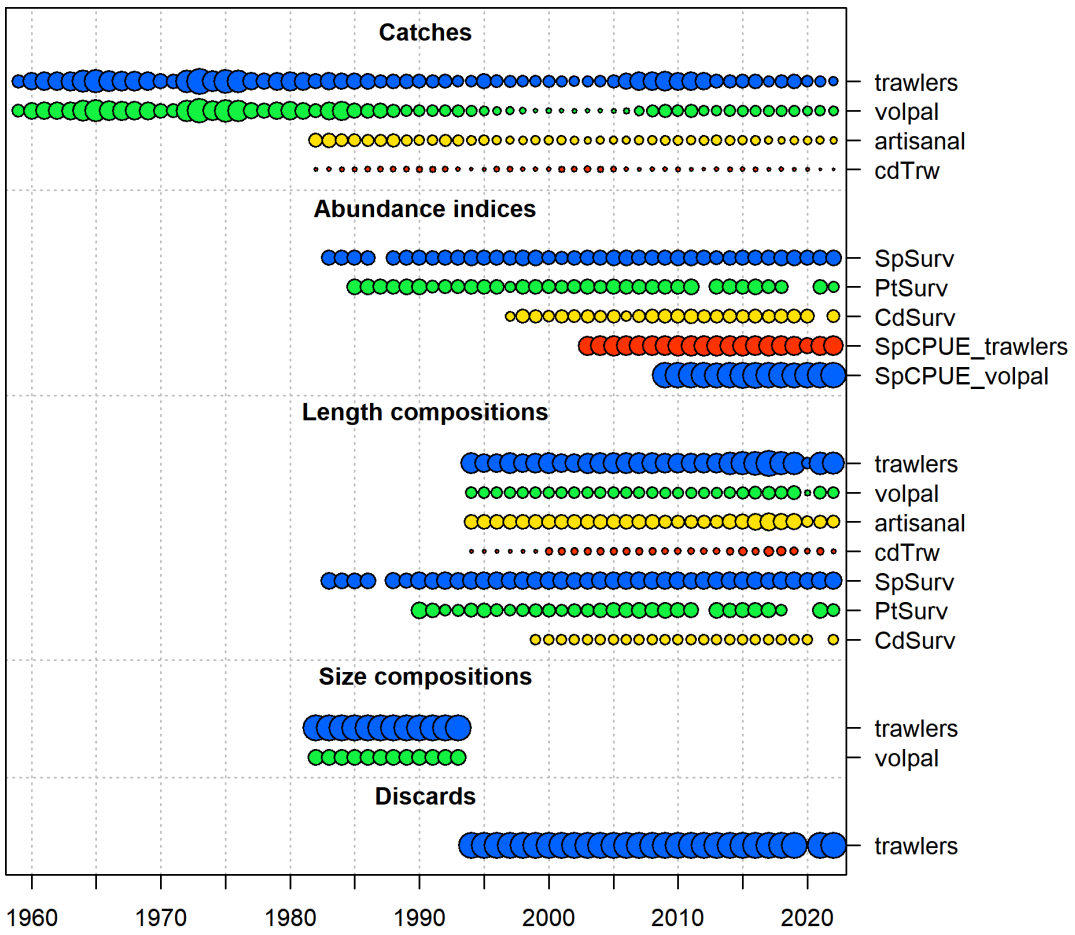



**Figure 10.5. Data presence by year for each fleet, where circle area is relative within a data type. Circles are proportional to total catch for catches; to precision for indices, discards, and mean body weight observations; and to total sample size for compositions and mean weight- or length-at-age observations. Note that since the circles are scaled relative to maximum within each type, the scaling within separate plots should not be compared. This is a seasonal model, so scaling is based on either the sum of samples within each year (for things like comps) or the average among observations within a year (for things like index uncertainty).**

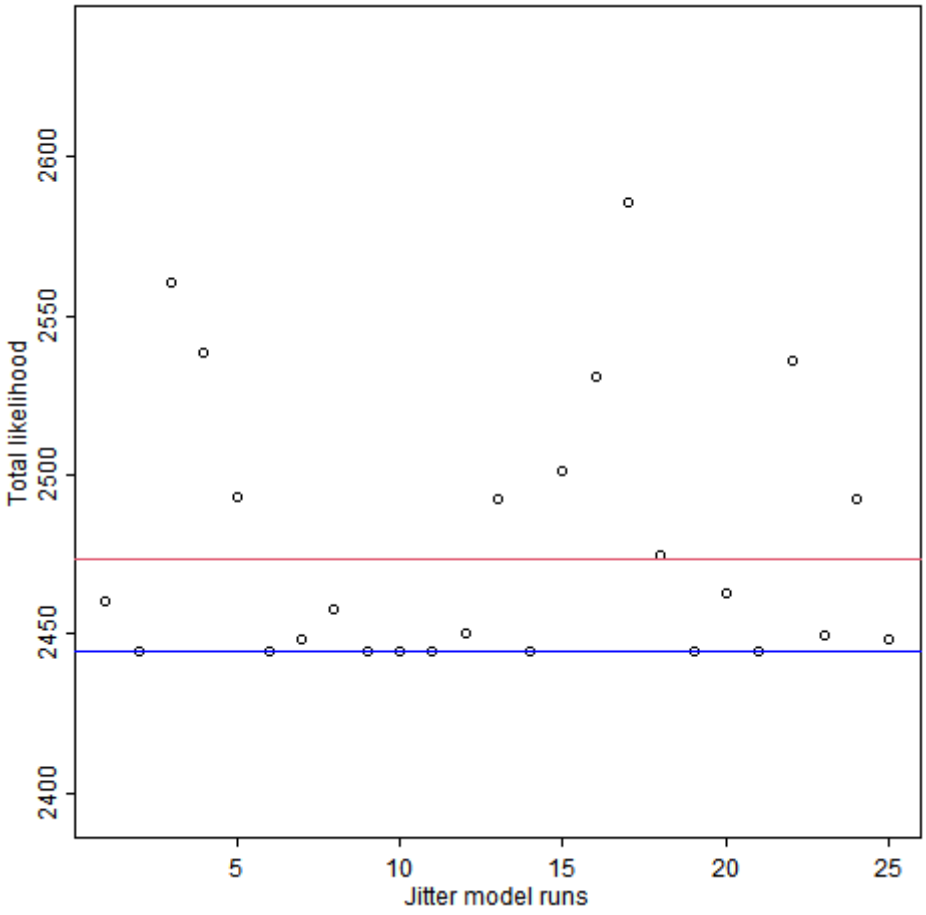



**Figure 10.6. Jitter convergence analysis. Blue line represents the final run likelihood. The graph shows the likelihood of those jittered runs that can invert the hessian (25 out of 50). 8 out of 25 got to the same minimum likelihood than the final run. The likelihood of our first run model is in red, after the jitter analysis such model has been changed to one of the jitter model runs in the blue line improving in this way the likelihood.**

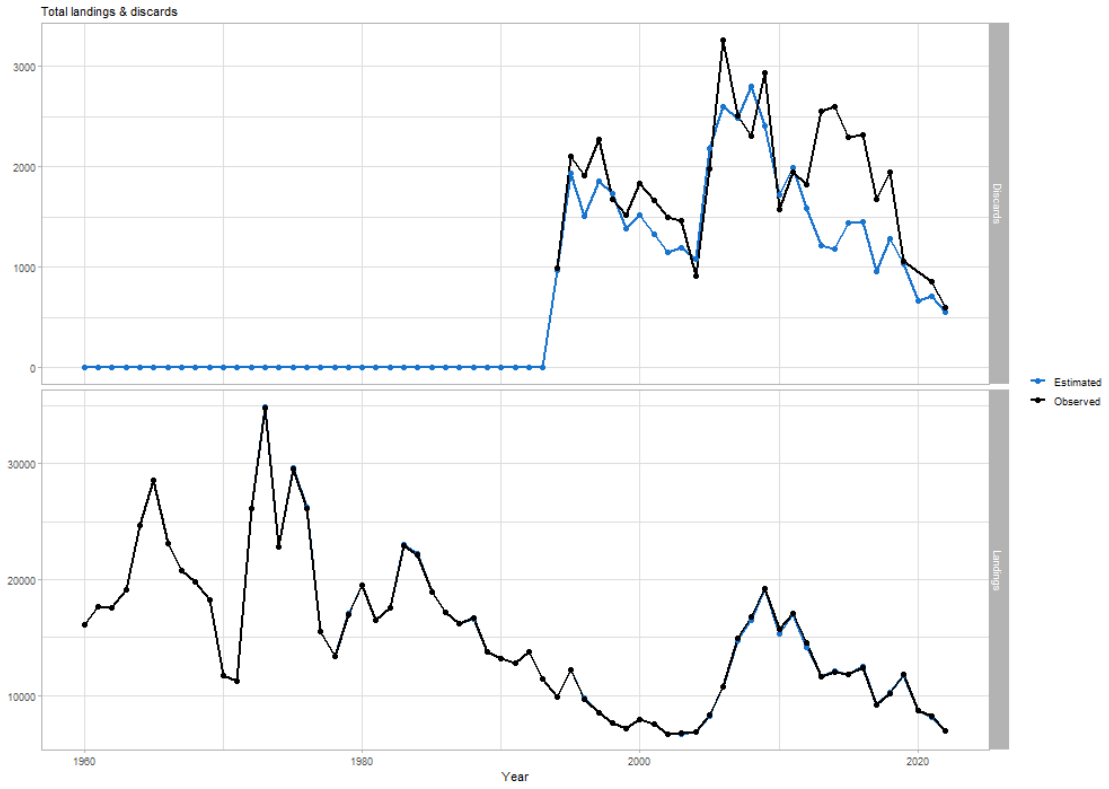



**Figure 10.7a. Observed and estimated landings and discards by year.**

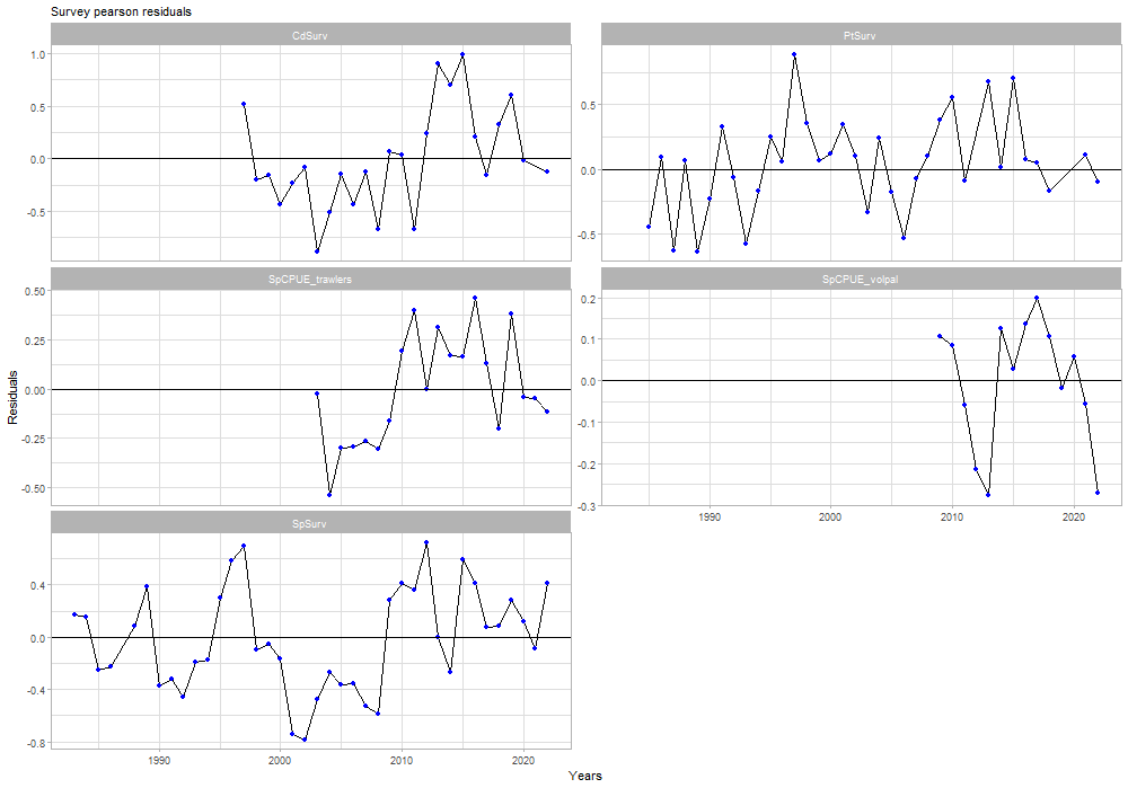



**Figure 10.7b. Survey (biomass) and CPUE model residuals in log scale.**


**Figure 10.7c. Length distribution fit for all years together. SpSurv and PtSurv provide a separated fit for males and females.**

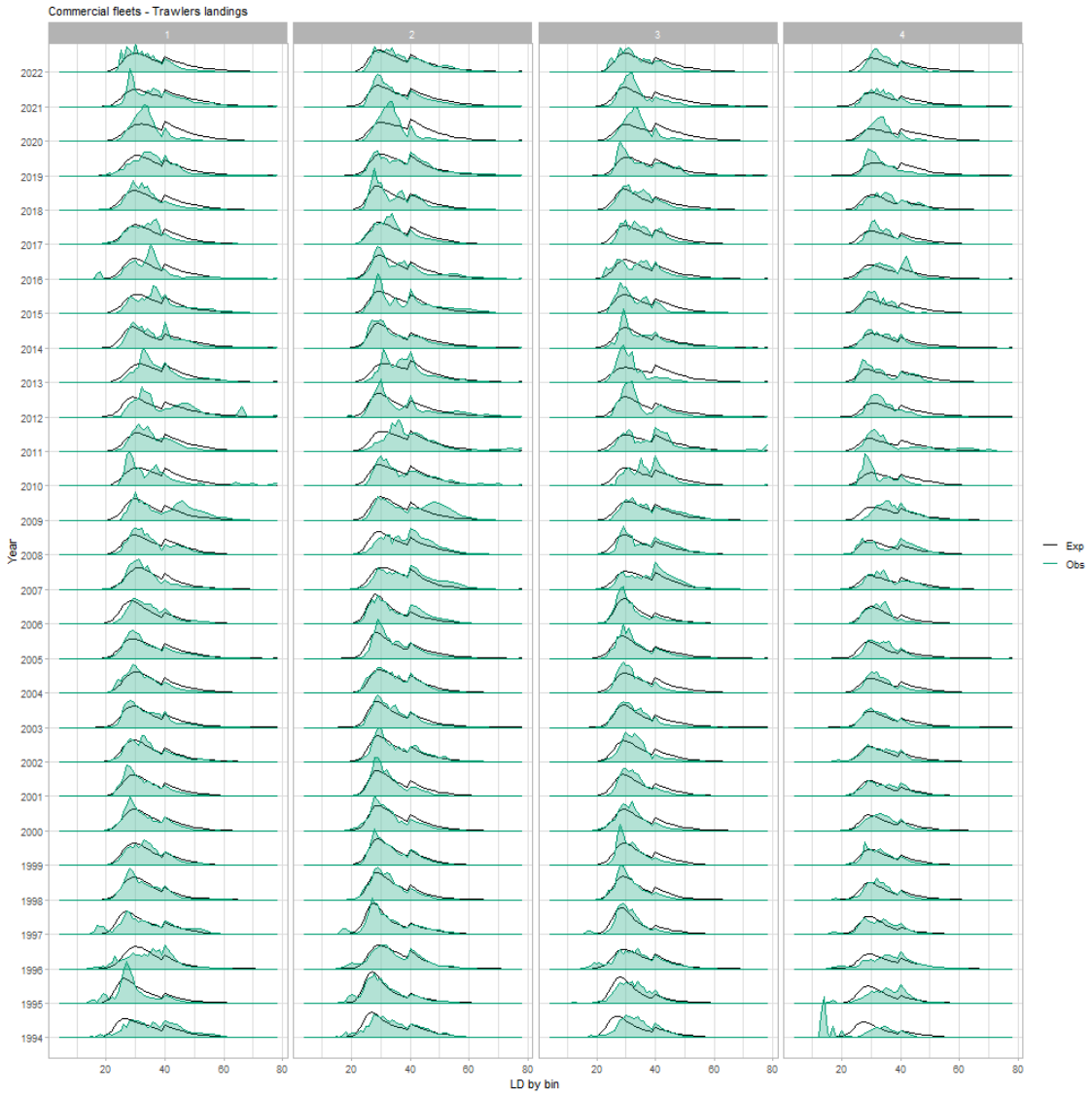



**Figure 10.7d. Observed and expected length distribution of trawler landings by year and season.**

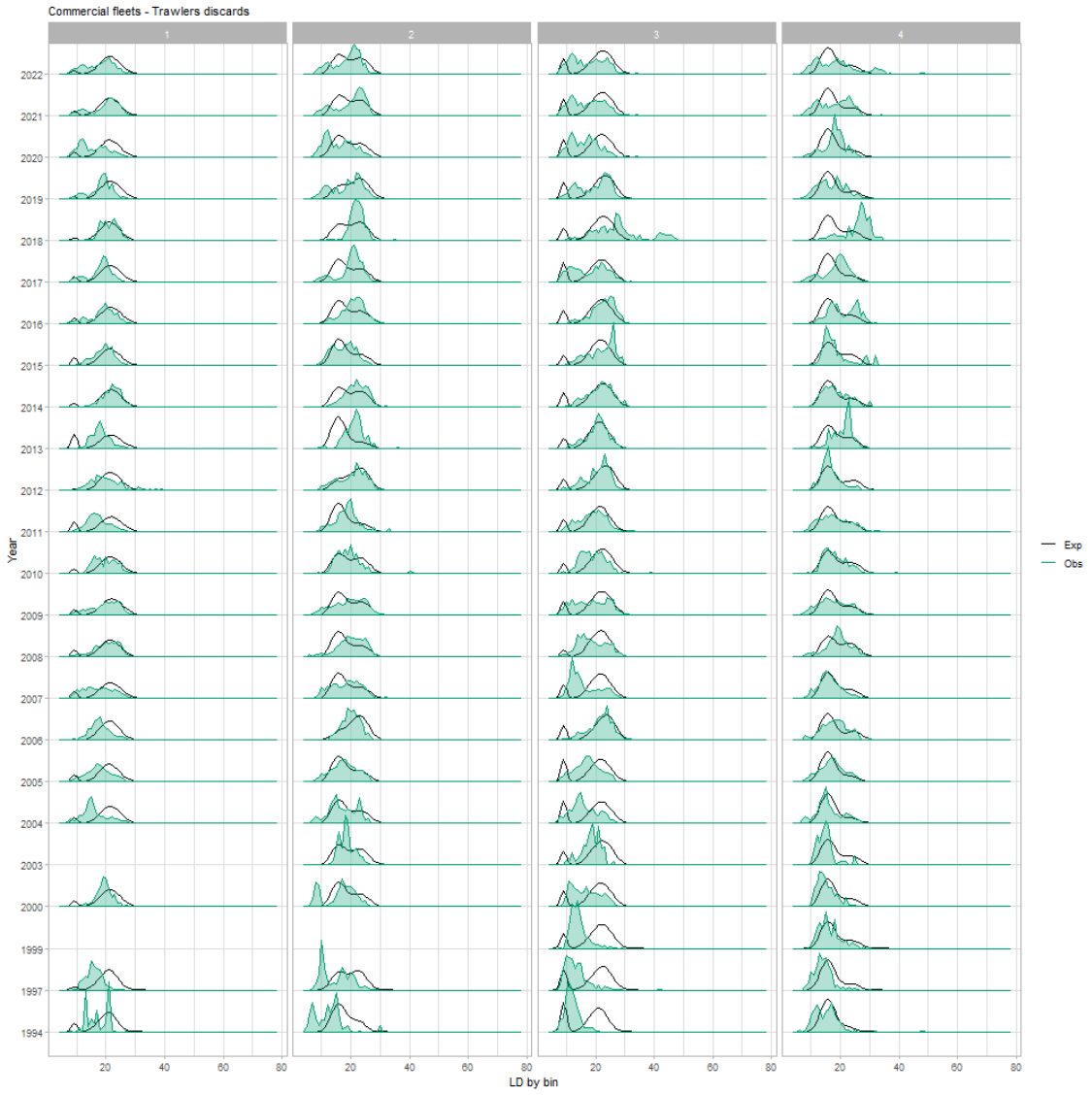



**Figure 10.7e. Observed and expected length distribution of trawler discards by year and season.**

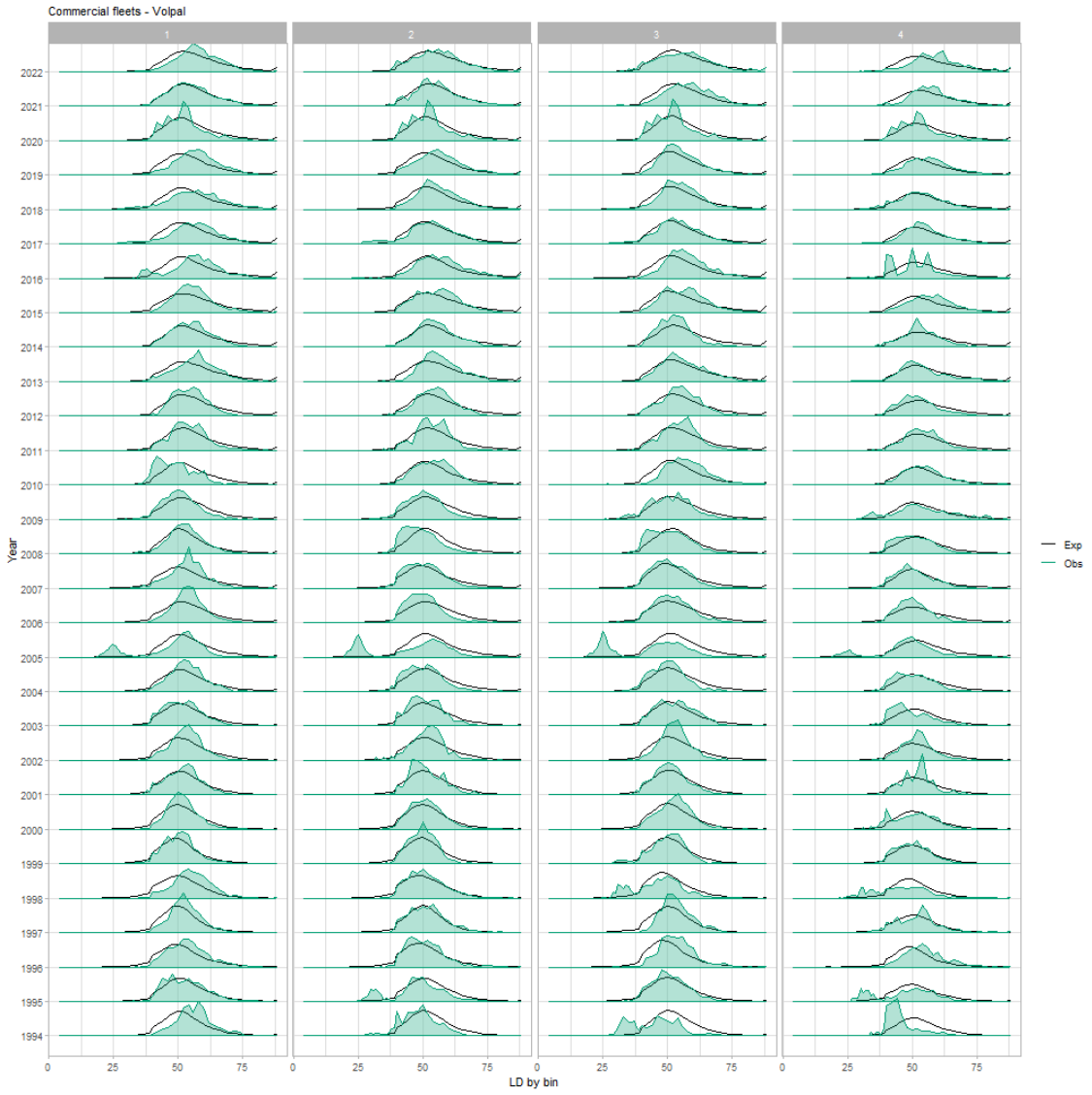



**Figure 10.7f. Observed and expected landings length distribution of volpal fleet by year and season.**

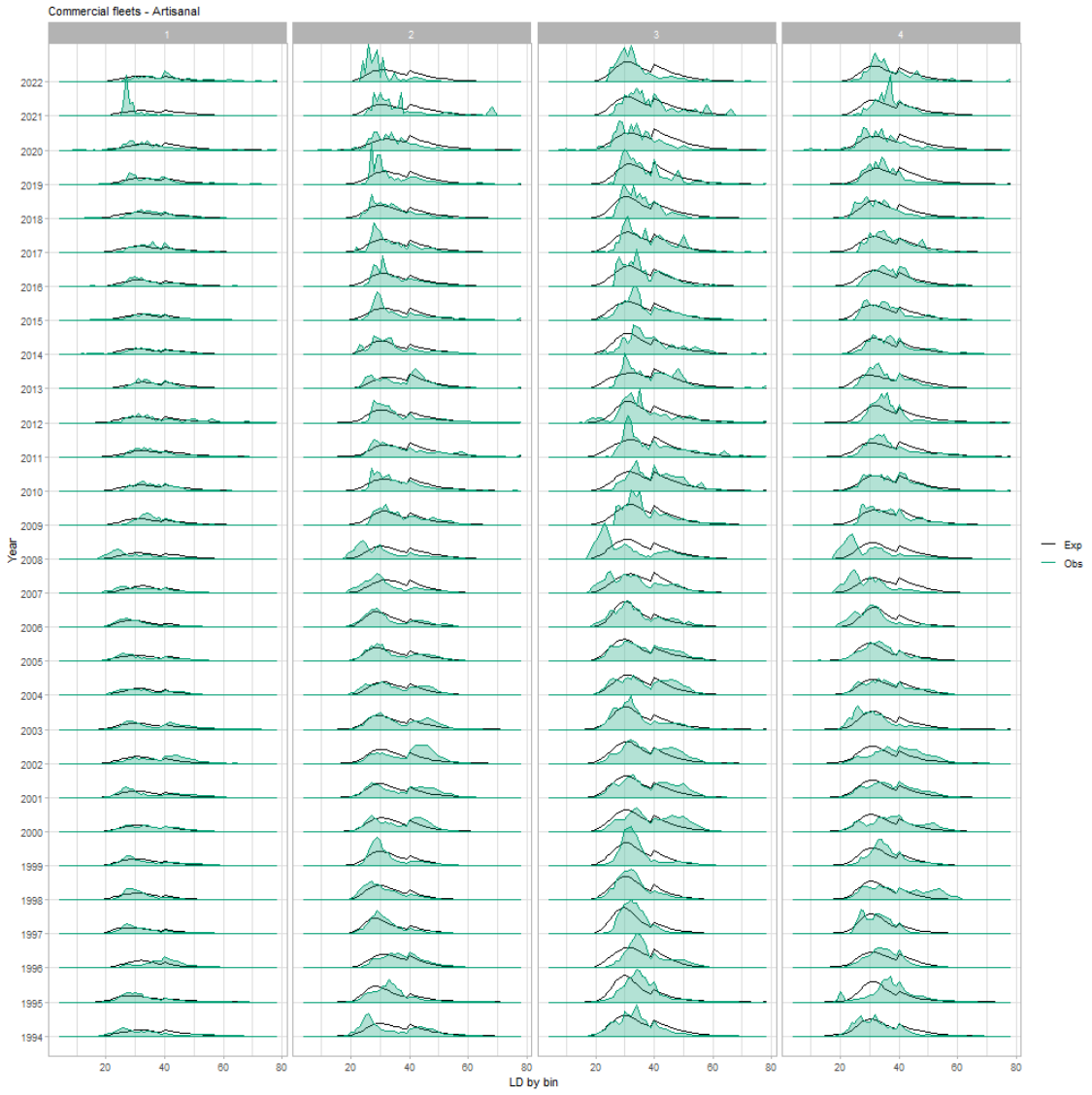



**Figure 10.7g. Observed and expected landings length distribution of artisanal fleet by year and season.**

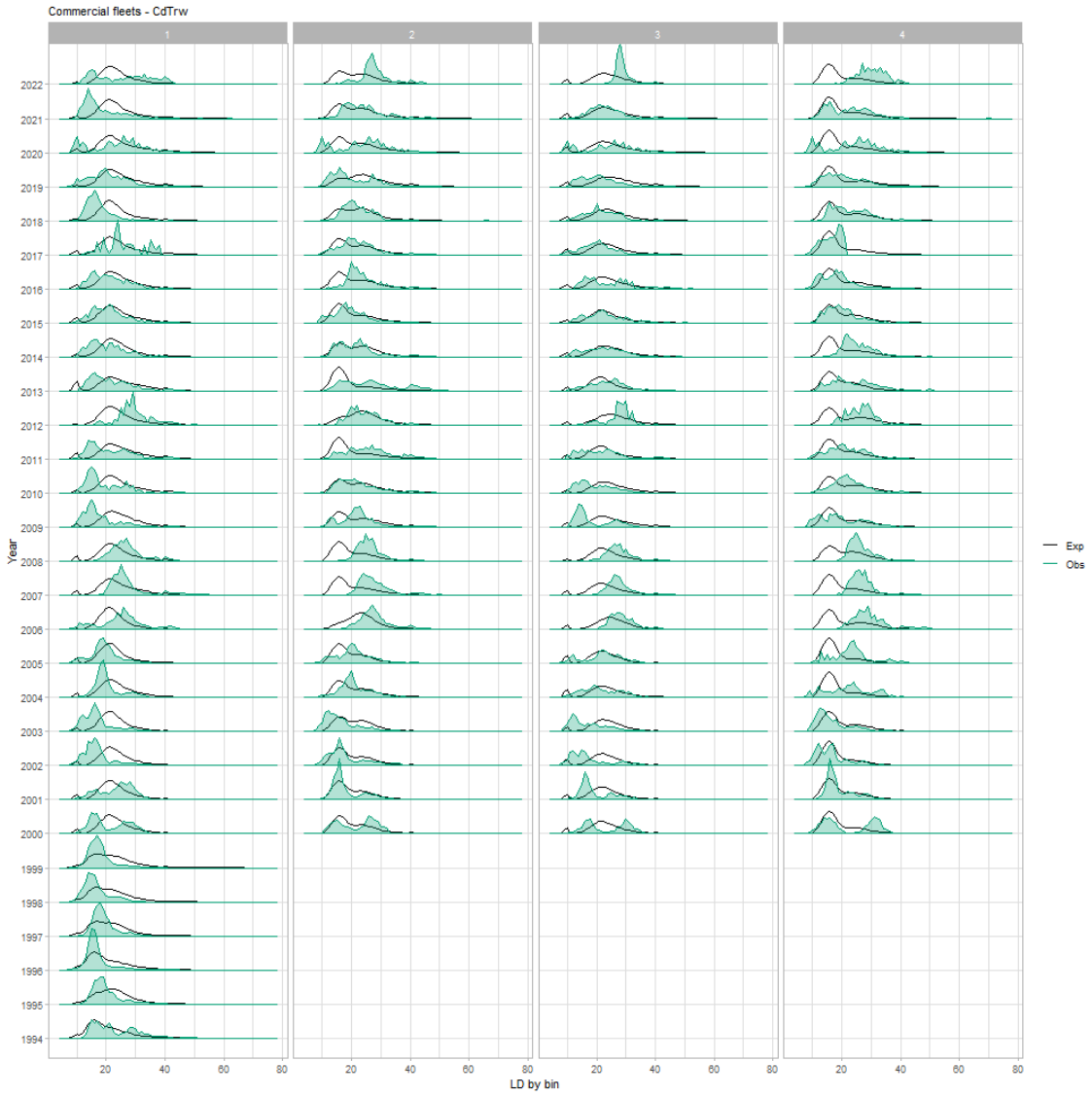



**Figure 10.7h. Observed and expected landings length distribution of cdTrw fleet by year and season.**

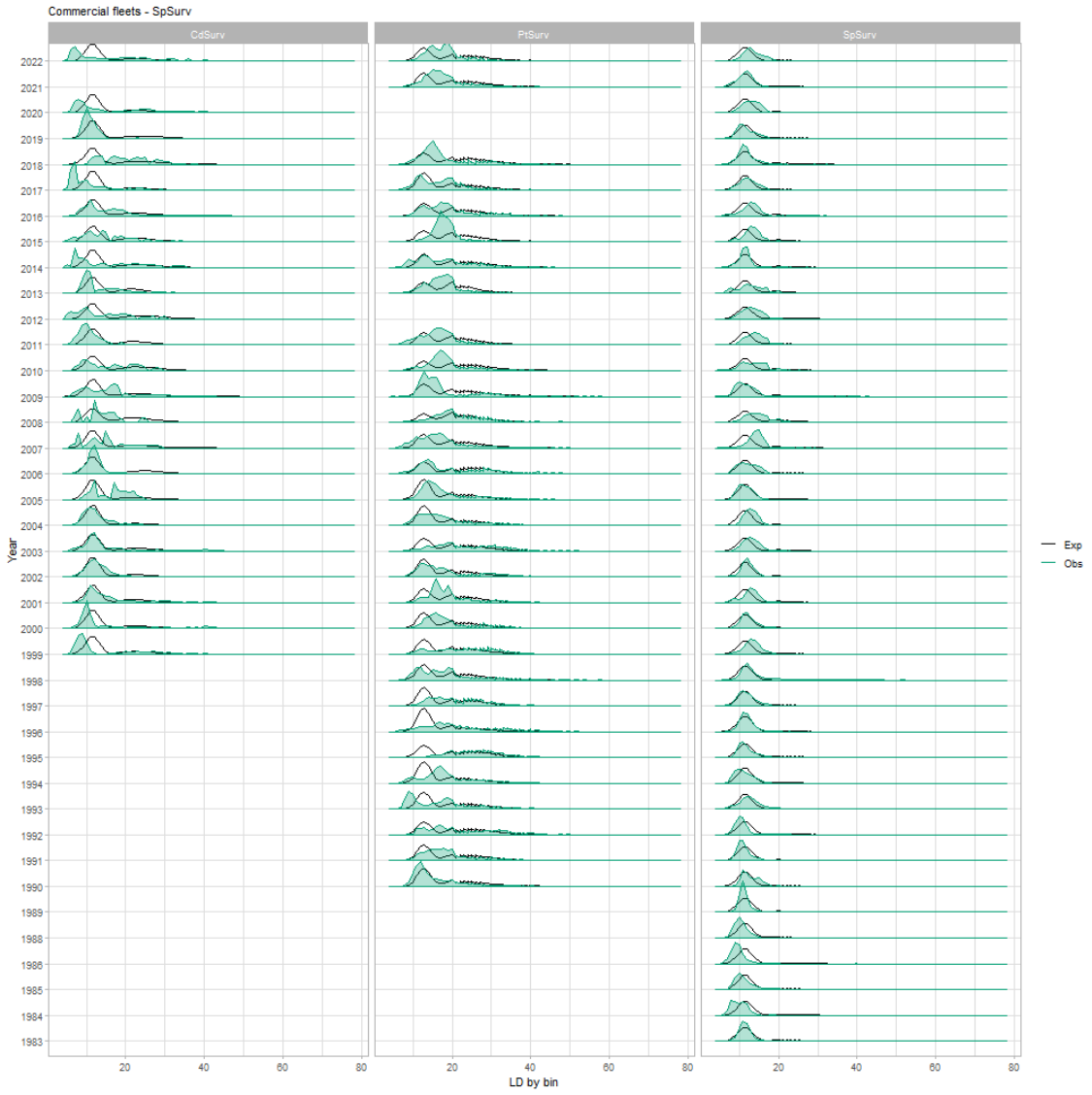



**Figure 10.7i. Observed and expected survey length distribution of Cádiz demersal survey (spGFS-caut-WIBTS-Q4), - left; Portuguese demersal survey (PtGFS-WIBTS-Q4 (G8899)), - centre; and North Spain demersal survey (SpGFS-WIBTS-Q4 (G2784)), - right.**

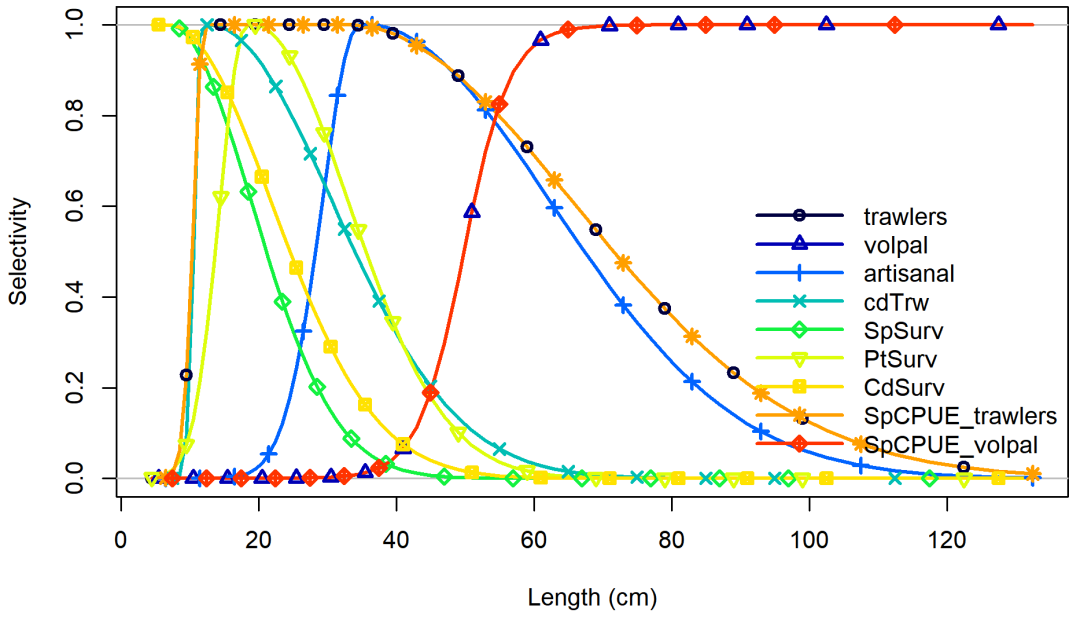



**Figure 10.8. Selection pattern for commercial fleets, surveys and abundance indices.**

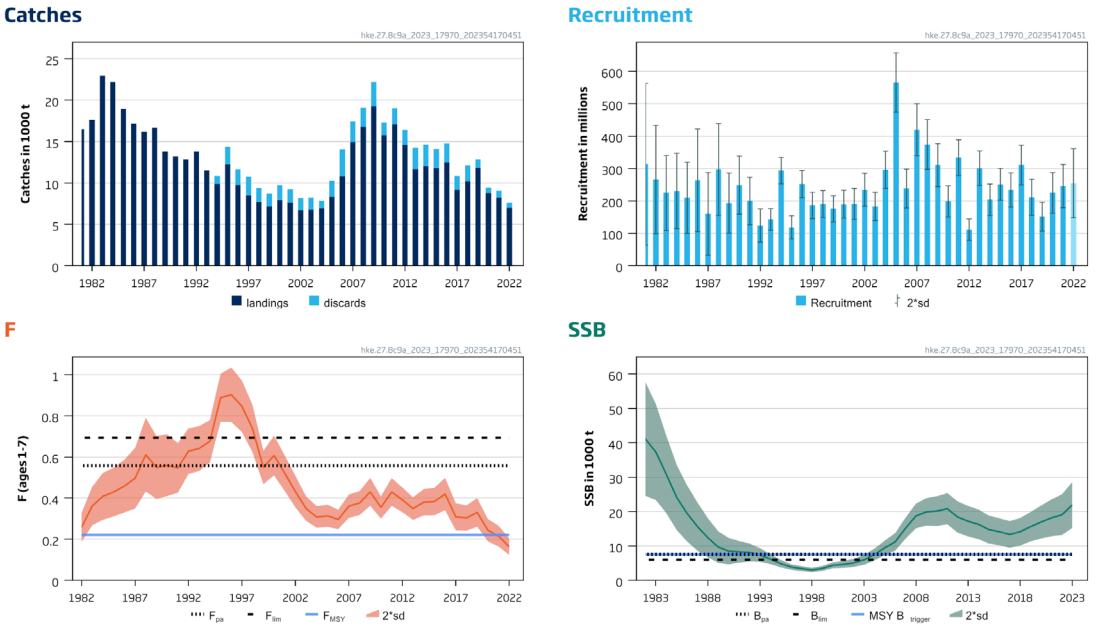



**Figure 10.9. Summary plot. SSB (females only) and removals (catch, landings, and discards). Fishing mortality (F) for ages 1–7.**

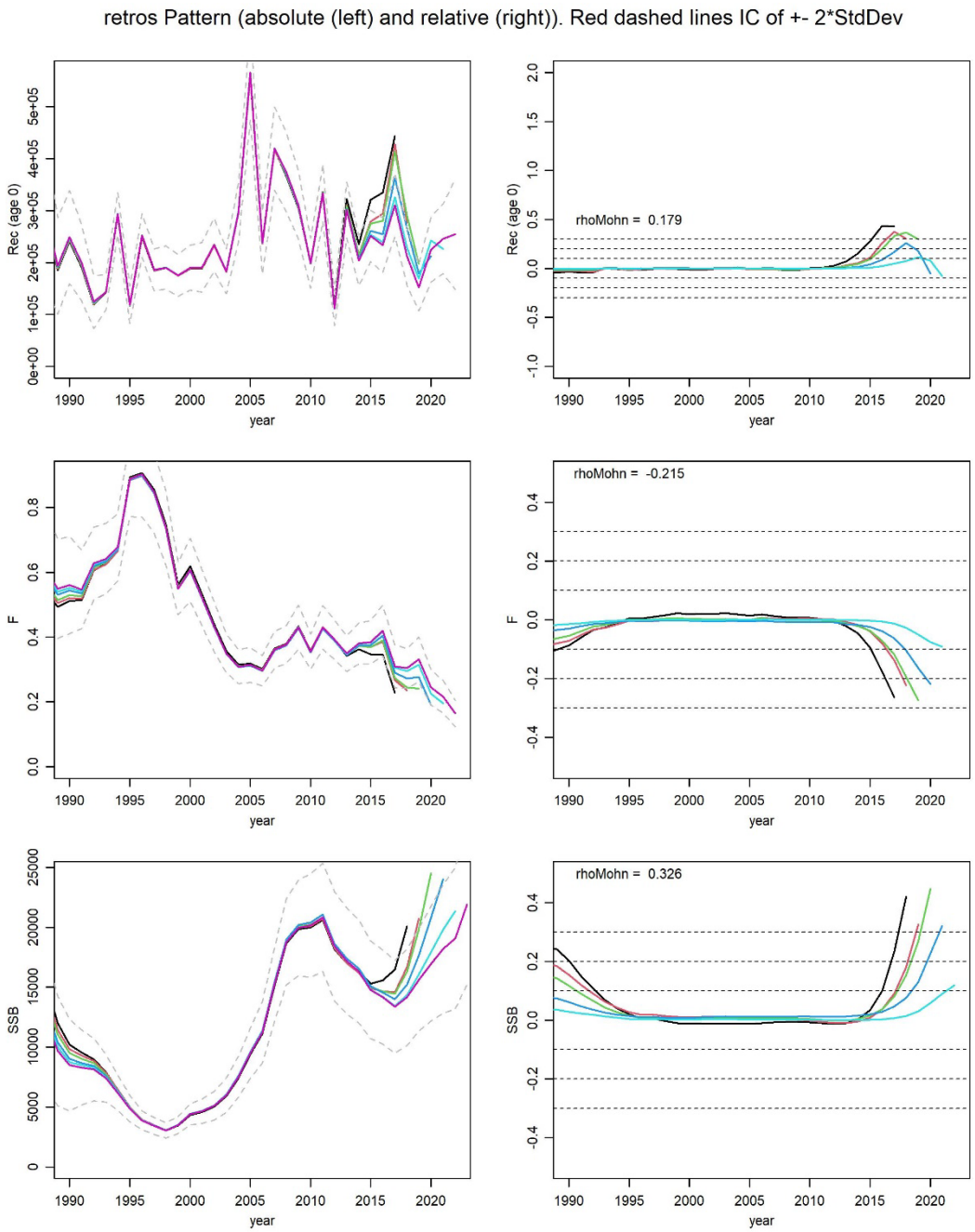



**Figure 10.10. Retrospective plots (absolute and relative).**

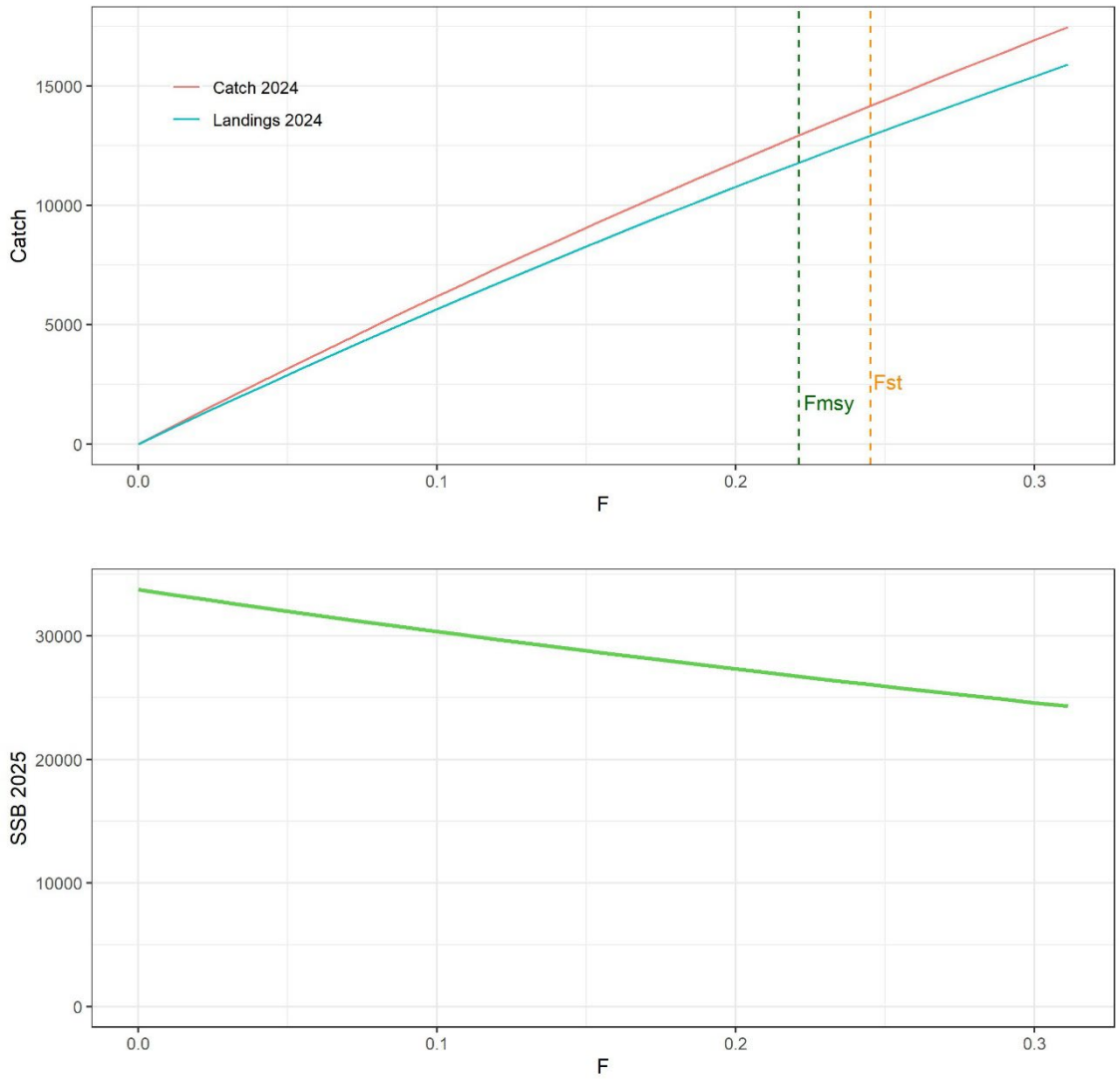



**Figure 10.11. Short-term projections for yield and SSB. The vertical red line is the $F_{MSY}$ and the green one is the assumed $F_{sq}$ (F status quo).**

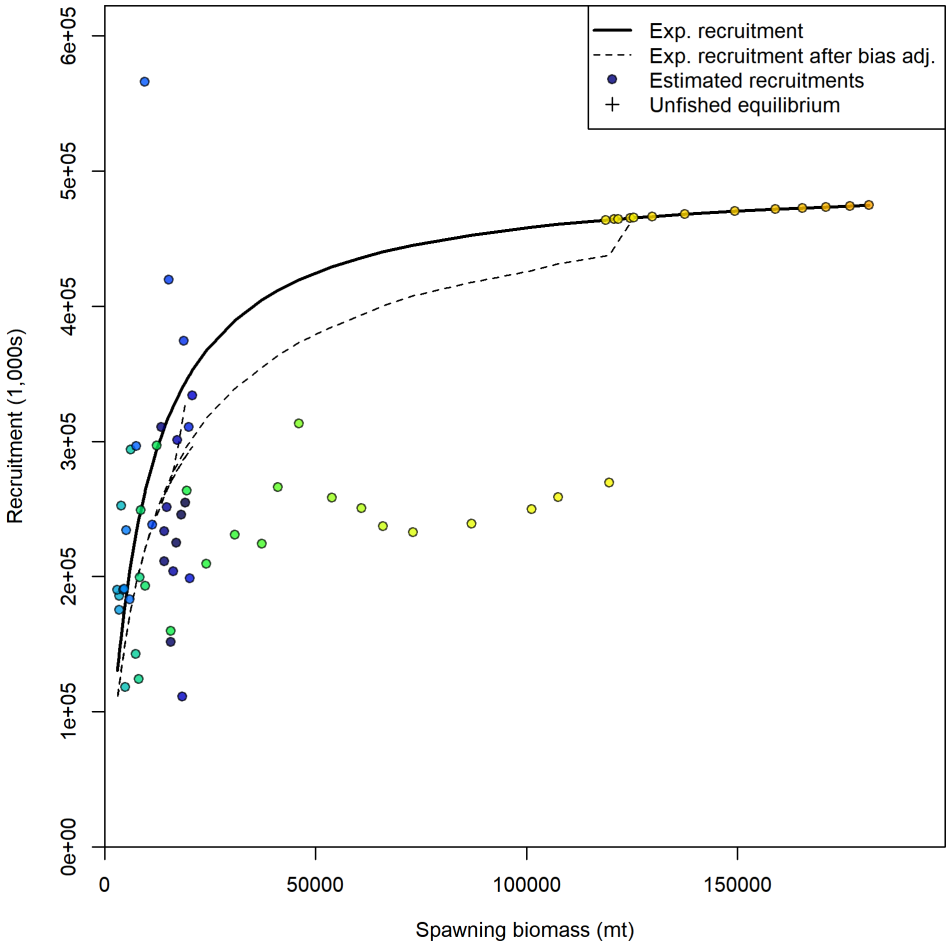



**Figure 10.12. Stock-recruitment relationship. Black line shows the Beverton and Holt model. Point colors indicate year, with warmer colors indicating earlier years and cooler colors in showing later years**

# Contents