Report of the 2026 ICCAT Swordfish Stock Assessment Meeting

(Hybrid, Madrid, Spain, 13–17 July 2026)

The results, conclusions and recommendations contained in this Report only reflect the view of the Swordfish Species Group. Therefore, these should be considered preliminary until the SCRS adopts them at its annual Plenary meeting and the Commission considers them at its annual meeting. Accordingly, ICCAT reserves the right to comment on, object to and endorse this Report until it is formally adopted by the Commission.

1. Opening, adoption of agenda and meeting arrangements

The meeting was held from 13 to 17 July 2026. The Swordfish Coordinator, Dr Kyle Gillespie (Canada), opened the meeting with the Swordfish Species Group (the Group) and the Rapporteurs for the southern Atlantic and Mediterranean stocks, Dr Luis Gustavo Cardoso (Brazil) and Dr George Tserpes (European Union (EU)), respectively. The ICCAT Assistant Executive Secretary welcomed the participants and emphasized the importance of the meeting. The Chair of the SCRS also welcomed the participants. The Chair of the Swordfish Species Group proceeded to review the agenda, which was adopted without changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of documents and presentations provided at the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents and presentations provided at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	***Rapporteur***
Item 1, 10, 11	N.G. Taylor
Item 2	R. Coelho, D. Rosa
Item 3.1	G. Liniers, L. Rueda
Item 3.2	G. Tserpes, D. Mantopoulou-Palouka
Item 3.3	G. Liniers, L. Rueda, N.G. Taylor, A. Kimoto
Item 3.4	G. Tserpes, G. Liniers, A. Kimoto
Item 4.1-4.3	B. Mourato, L.G. Cardoso, E. Kikuchi
Item 5.1, 5.2	M. Ortiz, K. Gillespie, A. Kimoto
Item 6	R. Coelho, L. Rueda
Item 7, 9	K. Gillespie, G. Tserpes, L.G. Cardoso
Item 8	K. Gillespie, G. Tserpes, L.G. Cardoso, C. Brown

2. Review of updates to data inputs (limited to updates since the data preparatory meeting)

SCRS/2026/090 estimated unreported dead discards of undersized Mediterranean swordfish during 2019-2024 using Task 2 size samples from the principal longline fleets and the applicable minimum-size limits, finding that estimated dead discards currently average approximately 8% of total catch in weight while reported discards remain low for several major fleets.

The Group acknowledged the presentation of this analysis. Comments highlighted the importance of knowing if the information regarding undersized swordfish in the ICCAT form T2SZ is also being reported in the nominal catch as landings or dead discards. This information should be submitted by CPCs using official statistical forms as the Secretariat is unable to determine whether the submitted data also includes dead discards. The Group decided to include these estimates in the stock assessment, as it was done in 2022, noting that CPCs could submit their own estimations, and that those should be supported by a SCRS document that should include a description of the methodology used for the estimation.

SCRS/2026/168 presented the analysis of catch-at-size (CAS) during the 1990–2024 period in the Ligurian Sea, describing long-term changes in length-frequency distributions (LFDs) associated with the evolution of fishing gears and fishing strategies, with consistently larger fish in the mesopelagic longline. The study shows that Ligurian CAS are broadly representative of the regional stock.

The Group noted the importance of understanding the effect that different fishing gear has on the size composition of the catch. Scientists present at the meeting were asked if those same differences observed, with larger fishes in the catches, for the mesopelagic longline were noted in other areas of the Mediterranean Sea. Spanish scientists mentioned similar observations in their fisheries, mainly on captures during summer and while fishing deeper.

SCRS/2026/167 analysed swordfish age and growth using spine and otolith samples from the Atlantic and Mediterranean stocks, finding good agreement between structures at younger ages but a tendency for spines to underestimate the ages of older fish, and developed an otolith-based and spine based, sex-specific von Bertalanffy growth model for the South Atlantic stock and a combined-sex growth curve for the Mediterranean stock.

It was suggested that the authors apply statistical methods to identify outliers in the spines length-age dataset, and to test for growth model sensitivity to these observations. There was a discussion on the protocol for ageing, and it was clarified that the methodology for annulus identification discussed during the 2023 ageing workshop was applied. It was noted that if the fastest growing individuals were the ones that presented more vascularization, and therefore were aged and included in the analysis, this could bias the results as these would be excluded. It was questioned if the differences between otoliths and spines could be due to vascularization. It was noted that spines are subject to vascularization but also remodelling of bone, while otoliths undergo no remobilization of materials once they are deposited. Therefore, otolith readings are considered to be more reliable due to these issues, and these differences have been observed in other swordfish stocks, as well as in other species such as tunas.

The author was asked to elaborate on the use of the highly informative priors on L_{inf}. It was indicated that Bayesian inference was applied as it was considered that estimated L_{inf} using frequentist statistics was low when compared to the maximum lengths present in catches. The use of priors allows for the introduction of previous knowledge in parameter estimation which is an advantage of applying Bayesian statistics.

3. Mediterranean assessment models

3.1 JABBA

'Just Another Bayesian Biomass Assessment' (JABBA) is a fully documented, open-source R package (www.github.com/JABBAmodel) that has been formally included in the ICCAT stock catalogue (https://github.com/ICCAT/software/wiki/2.8-JABBA) and management advice for the 2022 Swordfish Stock Assessment (Anon., 2022) was derived from the JABBA model results.

SCRS/2026/171 assessed Mediterranean swordfish stock status using three JABBA Bayesian state-space surplus-production models fit to updated catch and catch per unit effort (CPUE) data through 2024, finding broadly similar trends but differences in scale among models, with fishing mortality below F_{MSY} in all three models and biomass below B_{MSY} only in the Schaefer model.

The Group discussed the differences in B/B_{MSY} and F/F_{MSY} trajectories between the 2020 Mediterranean Swordfish Stock Assessment (Anon., 2020), and the 2026 analysis. Several sensitivity analyses in both continuity runs and main runs showed that these differences were mainly driven by the updated Greek index of abundance. This index differed from the 2020 version, showing a milder decline between the initial and the most recent period. This seems to have had an effect on the B/B_{MSY} and F/F_{MSY} trajectories estimated.

The Group asked about the decision to fix the process error during the initial years of the time series. It asked whether a sensitivity analysis had been conducted allowing the model to estimate process error from the beginning of the series. The modelers clarified that allowing process error throughout the entire series had very little effect on the results and did not improve diagnostics like the retrospective patterns observed. In addition, the Group asked about the negative pattern in the process error deviations in the last years of the series. It was noted that this negative trend in the process error was also observed during the 2020 Mediterranean Swordfish Stock Assessment (Anon., 2020), and it could be caused by different reasons, nevertheless allowing the model to estimate the process error since the beginning of the catch series did not change the negative pattern observed for the latest years.

The Group asked for further clarification on the continuity runs' model configuration. The modellers clarified that in the continuity runs the model configuration was exactly the same as the one used in the 2020 Mediterranean Swordfish Stock Assessment (Anon., 2020), the only changes were in the input data, i.e., update in the catch series, updated indices of abundance and their standard error configuration.

The Group agreed that the differences observed between the Schaefer and Pella models were expected, as they arise from the different assumption(s) underlying the surplus production function. Nevertheless, they suggested continuing the work on both the Schaefer and the Pella-ASEM model. The Group recommended dismissing the Pella model where the shape parameter is estimated within JABBA (Pella-m).

The Group commented on the sensitivity analyses, specifically suggested removing the historical catch sensitivity scenarios (historical under-reporting of catches), as this test had already been explored in 2020; moreover, the historical catch inflation seemed unrealistic.

The use of historical indices of abundance (Sicilian gillnet (SIC_GN) and early Ligurian longlines (LIG_LL)) was discussed. The Group proposed using them in the main model configuration. The inclusion of the historical indices had little effect on the biomass and fishing mortality trajectories. The Group discussed the value of the coefficient of variation (CV) on catches that was used: this was 0.2 instead of the default 0.1. The Group asked for a sensitivity test using the default configuration value (0.1). The use of a CV equal to 0.1 had also minor influence on the main model outputs.

The prior distribution for the initial depletion parameter was also discussed. The Group asked for a sensitivity test changing the default prior from lognormal to beta distribution, as well as a modification of the CV on the lognormal prior from 0.1 to 0.3. These modifications had again minor effects on the main model's outcome.

3.1.1 Model settings

The Group reviewed the JABBA model configuration presented by SCRS/2026/171. It used the R (R Core Team 2026) package 'JABBA' v.2.3.5 (Winker *et al.*, 2026). The default configuration estimated the following parameters: a) a lognormal prior on unfished biomass (K) as with mean equal to eight times the maximum historical catch, and a CV of 1; b) the initial depletion (B_1950/K), had a lognormal prior with mean 0.95 and CV equal to 0.1 (10%); and c) the random catch variability on log scale was set to 0.2. Catchability parameters associated with each one to the CPUE indices were formulated as uniform priors and observation variances were estimated by index assuming inverse-gamma priors. A minimum fixed observation error equal to 0.001 was used. The state-space formulation allows annual process error deviations around the deterministic surplus production. The process error variance was estimated using a non-informative inverse-gamma prior with both scaling parameters set to 0.001.

Catch data from series 1950 to 2024 (**Figure 1**) included estimates of dead discards (Rueda *et al.*, 2026; and SCRS/2026/090) as agreed during the 2026 Atlantic Swordfish Data Preparatory meeting (Anon.,2026).

Standardized CPUE (in weight) series were used as relative indices of abundance. Four longline standardized CPUE abundance indices were provided (**Figure 2**): Greek (GRC_LL) index (from 1987 to 2024; Tserpes and Peristeraki, 2026), Spanish (SPA_LL) index (from 1988 to 2024; Saber *et al.*, 2026), Ligurian (Italy, LIG_LL) index (from 2010 to 2023; Garibaldi *et al.*, 2026) and Morocco (MOR_LL) index (from 2012 to 2024; Layachi *et al.*, 2026). In addition, other abundance indices were provided for inclusion in sensitivity analyses: a Sicilian gillnet (SIC_GN) index (from 1990 to 2009; Tserpes *et al.*, 2011) and a historical Ligurian longline index (from 1991 to 2009; Garibaldi and Tserpes, 2015).

Coefficients of variation for each year from the standardized CPUEs were adjusted for each index to have a minimum value of 0.25 while keeping the inter-annual variability from the original CVs reported by the index providers. Specifically, for each CPUE series, a non-negative constant value was added to the whole series so that its minimum value was 0.25. This modification was agreed-to by the Swordfish Species Group during the 2026 Atlantic Swordfish Data Preparatory meeting (Anon., 2026).

Preliminary JABBA analyses included the continuity run, and three different categories of model runs based on alternative Schaefer and Pella-Tomlinson surplus production functions:

- *Continuity runs*: two continuity runs were conducted using updated catch and CPUE series up to the year 2024. One for the 2020 Schaefer Reference run and another for the 2020 Pella-Tomlinson run. The values of the parameters and model specifications are found in Winker *et al.* (2020b) and Anon. (2020).
- *Main runs*: three Main runs were conducted using both Schaefer and Pella-Tomlinson production functions:
  - *Schaefer*: with a prior distribution on *r* from the 2020 assessment was used (Winker *et al.*, 2020b; Anon, 2020).
  - *Pella-ASEM*: with an *r* prior distribution and the associated parameter (*m*) calculated using an Age-Structured Equilibrium Model (ASEM) approach (Winker *et al.*, 2020a). The values of the parameters used to run the ASEM are shown in **Table 1**. In addition to the updated L_{50} value with respect to the 2020 ASEM run, the following ASEM parameters were updated: (i) slope parameter of L_{50} (dLm) equal to 1/0.2; (ii) maximum age equal to 15 years; (iii) sequence of range of F values for iterative maximum sustainable yield (MSY) estimation from 0.01 to 0.9 each 0.002; (iv) length at 50% retention (SL_{50}) equal to 100 cm based on the analysis from the cumulative frequency distribution from the Spanish measured lengths. The *r* prior specification and the B_{MSY}/K value that were obtained from the ASEM simulations are shown in **Table 2,** following the same criterion used in the 2020 stock assessment, the final value for the CV of the prior of *r* was set to 0.2.
  - *Pella-m*: The third main model is an adaptation of the Pella ASEM model where the shape parameter *m* is estimated within the JABBA model. The prior specification for *r* was the same median as the *Pella-Tomlinson* model with a CV on the shape parameter equal to 0.3.

Sensitivity runs were also presented, including adding the historical indices, alternative catch scenarios assuming underreporting in the whole time series, and alternative initial biomass depletion level (SCRS/2026/171).

3.1.2 Diagnostics

The Group reviewed the complete suite of diagnostic analyses presented in SCRS/2026/171. The supporting figures and detailed diagnostic results, including model fits, residual analyses, posterior parameter distributions, process-error estimates, retrospective analyses, hindcast cross-validation, leave-one-index-out jackknife analyses, and the comparative diagnostic summary across scenarios, are provided in the document and are not reproduced in this report.

The authors reported satisfactory convergence for most of the model configurations, with stable Markov Chain Monte Carlo (MCMC) chains, well-defined posterior distributions, and adequate effective sample sizes. Model fits closely reproduced the main temporal patterns observed in the standardized CPUE series with the exception of the Moroccan index (MOR_LL). Residual analyses, runs tests, and process-error estimates indicated generally good model performance. Overall, the diagnostic results demonstrated that model performance was acceptable for both the alternative surplus production model functions.

The retrospective analyses, however, indicated directional trends of biomass and fishing mortality particularly for the Schaefer model (SCRS/2026/171, Figure 16). All the main runs display a notable retrospective pattern indicating either a strong influence of the final years of data or model instability associated to model misspecification or conflicting data sources. Hindcast cross-validation indicators were reviewed and the Mean Absolute Scaled Error (MASE) scores indicated poor predictivity performance for the MOR_LL and Greek longline (GRC_LL) indices (SCRS/2026/171 Figure 17). Leave-one-index-out Jackknife analyses indicated that the GRC_LL index had the greatest influence on the assessment results. Overall, the diagnostic analyses indicated that the assessment results were sensitive to the abundance-index configuration indicating conflicting trends or model misspecification(s).

The Group extensively reviewed the continuity run results.

The 2026 index standardization update for the Greek index included more carefully revised catch and effort data and more explanatory factors (SCRS/2026/039). For the main JABBA runs, the primary differences among the 2026 JABBA model results were associated with Schaefer versus Pella-Tomlinson assumptions. However, the results show large uncertainty in the stock estimates as reflected by the large credibility intervals particularly in the most-recent years. The diagnostics indicated unsatisfactory model performance with retrospective patterns, poor predictivity capacity of indices, and overall conflicts in data or model misspecification.

3.1.3 Stock status results

The Group reviewed the stock trajectories, management quantities, and Kobe phase plots presented for the initial JABBA scenarios. Estimated biomass and fishing mortality trajectories were in general similar in trend but varied in absolute values across the three JABBA scenarios. Biomass declined from relatively high levels during the early assessment period and subsequently stabilized around 1990s, while fishing mortality increased through the 1990s and early 2000s before declining in recent years. Differences among the alternative surplus production function assumptions were large, whereas the abundance-index had a greater influence on the estimated uncertainty.

Posterior estimates of the main management quantities are summarized in **Table 3**. For the terminal year, median B/B_{MSY} estimates were above and below 1, while the median F/F_{MSY} estimates remained below 1 under nearly all scenarios (**Figure 3**).

The Group reviewed the corresponding Kobe phase plots obtained from the Schaefer and Pella ASEM models (**Figure 4**). The Schaefer scenario results indicated that the stock is overfished at the terminal year (2024) but not subject to overfishing (i.e., the yellow quadrant of the Kobe plot), while the Pella-ASEM model indicated that the stock is not overfished and not subject to overfishing (i.e., the green quadrant of the Kobe plot). However, there was large uncertainty in both scenario results, and in the case of the Pella-ASEM model the stock appears never to have been overfished or subject to overfishing in the whole time series.

3.2 a4a

The Mediterranean swordfish stock was assessed using a statistical catch-at-age model developed under the Assessment for All (a4a) initiative of the European Commission Joint Research Centre (Jardim *et al.*, 2015). The a4a framework uses catch-at-age data to estimate historical population size and fishing mortality, allowing for flexible modelling of structural components through smooth functions (splines). The a4a is a non-linear statistical catch-at-age model and is defined by sub-models, which are the different parts that require structural assumptions. There are 5 sub-models in operation: $F_{at\text{-}age}$, abundance indices, catchability-at-age, recruitment, observation variance of catch and abundance indices and population's age structure in the first year. Modelling assumptions include Baranov's equation for the catches, exponential decay of the population numbers, and lognormality of catch, as well as abundance indices errors.

SCRS/2026/169 updated the 2020 Mediterranean swordfish a4a model with revised catch-at-age data and standardised abundance indices through 2024. The model results indicated higher spawning biomass and lower fishing mortality compared to the 2020 run. Sensitivity runs suggested that the change was driven primarily by revisions to the catch-at-age data rather than by the updated abundance indices. It should be noted that the continuity run maintained the same structural settings and biological assumptions as the 2020 assessment and should not be treated as an updated run since the method used to produce the catch–at-age data was different than the one used in 2020.

A revised model updated catch at age data but maintained structural assumptions. Results indicated that modified sub-model configuration could improve model diagnostics and biological realism. In particular, the assumption of a constant natural mortality rate across all ages may not accurately reflect the higher mortality experienced by younger, smaller individuals. Furthermore, changes in fleet dynamics and targeting over the assessment period suggest that a separable age-year effect, which assumes constant selectivity over time for fishing mortality, might be overly restrictive.

Document SCRS/2026/170 presented stock assessment results using a newly developed a4a model that included updated sub-model settings and age 9 plus group (instead of age 5 which was previously used).

3.2.1 Model settings

The Group reviewed the a4a model configuration and assumptions presented by Mantopoulou *et al.* (SCRS/2026/170). The Group requested an additional run using only the 4 CPUEs agreed during the 2026 Atlantic Swordfish Data Preparatory meeting (Anon., 2026) and this run was completed during the meeting.

The key model settings for the candidate runs included in SCRS/2026/170 were as follows:

- Catch-at-age data, including dead discards 1985-2024
- Five CPUEs (Greek, Moroccan, Spanish, Sicilian and Ligurian) considered to be representative of the 1-4 age-group.
- An age 9 plus group
- Maturity: 15%, 65%, 100% at ages 2, 3 and over 4
- Mortality: two different mortality assumptions, a constant M of 0.2 and a Lorenzen mortality by age
- Specific sub-model configuration settings are shown in **Table 4.** Input data and model assumptions used for the a4a runs are shown in **Figure 5**, and the standardized CPUE indices used are shown in **Figure 6**.

Two candidate models and two sensitivity runs were presented in the SCRS/2026/170 while an additional run was requested by the Group, namely:

1. Candidate Run 1: Constant M, 5 CPUEs
2. Candidate Run 2: Lorenzen M, 5 CPUEs
3. Sensitivity Run 1: Time series beginning in 1978, Constant M and 5 CPUEs
4. Sensitivity Run 2: Constant M, 7 CPUEs
5. Group proposal: Constant M, 4 CPUE indices

The document presented the fits to indices, estimated recruitment, biomass, spawning stock biomass (SSB), and fishing mortality, and retrospective analysis for each run.

The Group indicated that Candidate Run 1 had acceptable residuals and was the best-performing model from the a4a platform for this assessment. While residual patterns were similar between Runs 1 and 2, the retrospective pattern for the SSB was much more stable in Run 1.

The stock assessment results as shown in **Figure 7** show an increasing trend in SSB since around 2010, with a slight drop since 2020 and an increasing trend in F since 2018.

3.2.2 Diagnostics

Diagnostics across all runs were largely similar and, in this report, only the final run is presented. Any additional runs requested during the meeting are included in SCRS/2026/170. In order to choose the degrees of freedom specified by the k parameter (in a4a the parameter k represents the number of nodes used in the spline/smoother functions) in the sub-model settings, after deciding on the structural formulation (separable model/interaction to account for changes in selectivity along the years) an exploration was performed on the number of k's and the different fits. From the ones that maintain the desirable assumptions and plausible population dynamics the one with the lowest Generalized Cross-Validation (GCV)and Bayesian Information Criterion (BIC) is chosen. The exploration of the number of knots in the smoother of the fishing mortality sub-model is shown in **Figure 8**.

Figures 9 to **11** depict the residuals for the catch-at-age, biomass indices and the aggregated catch residuals, respectively. There are no obvious residual patterns except in the early period of the catch residuals for age 3.

A 5-year retrospective analysis was conducted to evaluate the stability of the model's terminal estimates. The retrospective trajectories for the final run (**Figure 12**) show tight alignment across the peels. Mohn's rho (ρ) was calculated for both SSB and Fishing Mortality (F_{bar} corresponding to ages 1-4). The resulting rho values fall well within the acceptable bounds, indicating that the model's terminal estimates are stable and not prone to severe retrospective errors.

3.2.3 Stock status results

Model results were broadly robust to alternative natural-mortality assumptions and sensitivity runs, with both candidate models indicating that the stock remained overfished and subject to overfishing in 2024. **Table 5** and **Figure 7** present the stock status for the final a4a run.

3.3 Stock Synthesis

3.3.1 Model settings

SCRS/P/2026/078 presented preliminary stock assessment results for Mediterranean swordfish using Stock Synthesis (SS3). Following the recommendations at the 2026 Swordfish Data Preparatory Meeting (Anon., 2026), the configurations were aligned as closely as possible with the JABBA and a4a models. The assessment incorporated fishery-dependent data covering the period 1950–2024, including total catches with estimates of dead discards, standardized biomass indices, and length-composition data. The model was configured as a single-area, one-sex assessment with annual time steps and a Beverton-Holt stock-recruitment relationship.

The assessment represented the principal fisheries exploiting the Mediterranean stock through nine fishing fleets, including longline fleets from Spain, Greece, Italy Liguria, Morocco, and an aggregated "other longline" fleet, in addition to Italy gillnet fleet, “other” gillnet, a harpoon fleet and an all "other" fleet. Standardized abundance indices were available for the four principal longline fleets. Length-composition data were incorporated for all fleets using 5 cm lower-jaw fork length (LJFL) intervals. To balance the relative influence of length-composition data among fleets in the likelihood, raw sample sizes were transformed using the base-10 logarithm to derive effective sample sizes.

The growth model followed a von Bertalanffy formulation, and the stock-recruitment steepness value and sigmaR were set as 0.83 and 0.284, respectively. A constant natural mortality value (M = 0.206) was used across all ages (0-25 years). A complete detail on model configurations is available in **Appendix 5**.

Based on the Group discussions and recommendations on the preliminary runs reviewed, a set of additional runs were conducted to investigate alternative model configurations. The following list provided a step-by-step modification to the base model to identify major changes and/or improvements in model performance and diagnostics that the Group was evaluating progressively during the meeting.

- Run 2: Correct/Update growth curve, with 54.57 cm LJFL at age 0 and larger CV for early ages, to allow more flexibility to the model and to improve fits to length composition data.
- Run 3: Based on run 2, estimate both parameters of a logistic parameterization of the selectivity curve for the harpoon fishery (FL6), because it is biologically appropriate, and this fishery historically targeted medium- to large-sized fish.
- Run 4: Based on run 3, use the selectivity of Morocco longline (FL4) for the ‘others’ fleet (FL9). In addition, the ‘others’ fleet length composition data is removed after confirming a negative effect on the length fits for FL4.
- Based on run 4, some technical adjustments were incorporated:
    - Run 5: The catchabilities associated with the CPUE series were computed analytically, instead of numerically. This is generally considered a good practice in Stock Synthesis models.
    - Run 6: The plus-group growth exponential decay option was changed from -998 to -999 to account for growth within the plus group in the initial equilibrium.
    - Run 7: The bias adjustment configuration for recruitment deviations was updated, using the recommendation by Stock Synthesis that is based on the previous configuration.
- Run 8a: Based on run 7, apply a dome shaped selectivity on the harpoon fishery (FL6) and a logistic selectivity on the ‘other gillnet’ fishery (FL8).
- Run 8c: Based on run 7, included age-dependent Lorenzen M natural mortality (MAA): age 8 as reference M=0.206.

- Run 8e: Based on run 7, lower the initial F prior mean value as well as the initial equilibrium catch to a value equivalent to the average of the three first years (1950-1952) of the Spanish catch series (100 t instead of 120).
- Run alt_1_tmblk_HP: Based on run 4, introduce a time block in the harpoon fishery (FL6) size data from 1950 to 1994 and 1996 to 2024 (eliminating 1995 data). Estimate selectivity as a double normal selectivity for the first period and maintain logistic selectivity (double normal fixing upper selectivity to 0.98) for the second period.
- Run alt_2_tmblk_CPUE_SPN: Based on run 4, include a time block in the Spanish longline index in 2007 to account for the development of the meso-pelagic fishery, which catches larger size individuals.
- Run alt_3_rmv_HP_lencomp: Based on run 4, remove length composition data from the harpoon fishery (FL6).
- Run 9: Based on run 7, apply both modifications in runs 8a and 8c: apply a dome shaped selectivity on the harpoon fishery (FL6), a logistic selectivity on the 'other gillnet' fishery (FL8), and age-dependent Lorenzen M natural mortality (MAA): age 8 as reference M=0.206.

The Group recommended run 9 as the Stock Synthesis reference model for the Mediterranean swordfish. Run 9 assumed a Lorenzen age-dependent natural mortality relationship rather than a constant natural mortality rate across ages. This relationship was implemented by specifying (M = 0.206) at age 8 and allowing Stock Synthesis to calculate the corresponding vector of natural mortality at age (**Figure 13**). This assumption is consistent with those used in the assessment for North and South Atlantic swordfish.

The Group also recommended applying flat-topped selectivity to at least one fleet to avoid the potential accumulation of "cryptic" biomass at older ages that would never be available to the fisheries. Logistic selectivity was initially assigned to the harpoon fishery because its overall contribution to total catches was relatively small (<2%), while the available size-composition data indicated that it primarily caught medium to large Mediterranean swordfish. However, because the model fit to the size composition for this fleet poorly, the Group ultimately decided to model its selectivity using a double-normal function and to assign logistic selectivity to the "other gillnet" fleet. These changes improved the fit to the length-composition data and eliminated the strong residual patterns observed previously.

Regarding the length-composition data, the Group also agreed to remove the size information for the "other" fleet because it represents a combination of several diverse but sporadic fleets, corresponding to FL7 in the historical period, and is based on a comparatively small number of size samples. The Group therefore decided to link the selectivity of the "other" fleet (FL9) to that of the Moroccan longline fleet (FL4).

Finally, the Group explored alternative scenarios in which the SPA_LL index was split into two periods, one from the first model year, with the second period beginning in 2007. The Group considered that the standardization of this index may not have fully accounted for the introduction of the so-called mesopelagic longline gear, which targets larger swordfish at greater depths than traditional surface longline gear. In the sensitivity run, alt_2_tmblk_CPUE_SPN, the estimated catchability coefficients (q) were very similar between the two periods, with overlapping credibility intervals. It should be noted that selectivity was held constant through time. Nevertheless, the resulting biomass and fishing-mortality trends differed from those of the reference model.

The Group recommended that national scientists further investigate how the CPUE standardization procedure could better account for this change in gear or métier. This issue may be analogous to effects of modifications associated with "trapline" longline gear that have recently been reported in Rueda *et al.* (2026). Pending further investigation, the Group agreed to retain the SPA_LL index as a single continuous series for the present assessment.

3.3.2 Diagnostics

The Group reviewed a suite of diagnostics for the preliminary run, including convergence statistics, fits to abundance indices and length-composition data, residual analyses, runs tests, hindcast cross-validation, retrospective analyses, likelihood profiles, Age-Structured Production Model (ASPM) diagnostics, and jitter analyses. The diagnostics did not show any strong retrospective pattern in the estimated historical population dynamics (**Figure 14**). However, the jitter analysis diagnostic showed that this preliminary run was not stable because most of the jitter runs failed to converge (**Figure 14**). Run 2 produced results consistent with those of the first run, with similar biomass and fishing mortality trajectories and slightly greater uncertainty in the estimates for the early years of the time series. Nevertheless, the fit of the length-composition data remained problematic for some fleets.

Run 3 did not improve the fit to the length-composition data for either the harpoon fishery (FL6) or the “other” fleet (FL9). **Figure 15** shows the fits to the length-composition data, aggregated across years, for each catch fleet included in the model.

Fixing the selectivity of the “other” fleet (FL9) to that of the Moroccan longline fleet (FL4) in Run 4 improved the fit for FL9 but worsened the fit for FL4. Removing the length-composition data for FL9 did not affect the other diagnostics from Run 4. The Group therefore agreed to retain the selectivity assumption introduced in Run 4 and remove the length-composition data for the “other” fleet (FL9), as the fit to these data was problematic and the model results were similar with and without them.

Run 5 improved model performance by deriving catchability analytically rather than estimating it numerically, thereby reducing the number of parameters estimated by the model. Runs 6 and 7 did not materially affect the diagnostics but were considered to provide more robust model settings.

In run 8a, the use of the logistic selectivity in the ‘other gillnet’ fishery showed similar results to those previously obtained and provided a better fit for the size data. However, it had a higher impact on the fishing mortality trajectory and produced a less well-defined likelihood profile.

Run 8c, which incorporated age-dependent natural mortality based on the Lorenzen relationship, produced results broadly similar to those of the other runs. However, this assumption had a greater influence on the biomass trajectory during the early years of the time series. It also affected the absolute scale of the recruitment estimates.

The modification in the $F_{initial}$ and the initial equilibrium catch in run 8e did not show notable improvement with respect to previous runs model configurations.

The introduction of the time block for the selectivity of the ‘harpoon’ fleet (run alt_1_tmblk_HP) improved the fit to the associated length composition data.

The introduction of a time block in the SPA_LL index (Run alt_2_tmblk_CPUE_SPN) produced biomass and fishing mortality trajectories that differed markedly from those of the other runs, with lower estimated biomass and higher estimated fishing mortality. In addition, the estimated catchability coefficients were very similar between the two time periods, providing little support for the time block. The Group recommended that future work focus on improving the SPA_LL index by incorporating fishing métier into the standardization.

The removal of the length composition data from the harpoon fishery (FL6) (run alt_3_rmv_HP_lencomp) was not considered a necessary modification of the model, as using the dome-shaped selectivity provided an adequate fit to these data while allowing them to be retained in the model.

Overall, the diagnostics for these runs were improved relative to those of the preliminary runs, with the exception of the ASPM diagnostic.

Diagnostics for Run 9 (Mediterranean swordfish reference model)

Model fits to the four longline CPUE indices showed residuals scattered around zero with no strong systematic trend (**Figure 16**, Loess RMSE = 19.9%), and mean length residuals were similarly centred on zero across fleets (RMSE = 6.8%), aside from an isolated deviation in the early SIC_GN series. Runs tests (**Figure 17**) on the CPUE residuals passed for all four indices, indicating no significant non-random patterns, though MOR_LL contained a single residual outlier around 2013. Runs tests on the mean length (**Figure 17**) residuals were less consistent: SPN_LL, LIG_LL, GRC_LL, HP, and Other_LL failed the test, indicating non-random residual patterns in these length-composition series, while MOR_LL, SIC_GN, and Other_GN passed.

Likelihood profiles over log(R_0) (**Figure 18**) showed a well-defined minimum in total likelihood consistent with the estimated value, driven primarily by the recruitment and length-composition likelihood components; the aggregate index likelihood contributed comparatively little curvature to the profile. Profiling the index likelihood by fleet revealed conflicting signals among the abundance indices: the Spanish CPUE series favoured lower values of R_0 while the Moroccan series favoured higher values, indicating some tension in the information content across indices. Retrospective analysis, based on sequential removal of up to five years of terminal data, showed peeled trajectories for both relative depletion and F/F_{MSY} tracking closely with the base run, with no marked retrospective pattern evident and the estimated Mohn's rho within the acceptable range (**Figure 19**).

The jitter analysis (**Figure 20**) indicated that the model consistently converged to the same optimum from alternative starting values, providing no evidence of convergence to competing local minima.

3.3.3 Stock status results

The Group reviewed a suite of diagnostics for run 9 and concluded that run 9 was accepted as the Stock Synthesis reference model for the Mediterranean swordfish stock given better fits to the length composition data compared to the other sensitivity scenarios.

Estimated virgin spawning biomass was approximately 228,900 t, while recent spawning biomass was approximately 28,000 t (**Figure 21**). Estimated relative spawning biomass in 2024 (SSB_{2024}/SSB_{MSY}) was 0.64 (95% confidence interval: 0.34 - 1.18) based on the multi-variate lognormal approach, whereas relative fishing mortality (F_{2024}/F_{MSY}) was 1.11 (0.66-1.87). MSY estimates were 12,225 t.

Run 9 estimated that spawning biomass was well above SSB_{MSY} (SSB/SSB_{MSY} of 4.5–5) from 1950 through the mid-1960s, then declined steadily from the 1970s, falling below SSB_{MSY} by the early 1990s and remaining near or slightly below 1 thereafter. Fishing mortality followed the inverse pattern: F/F_{MSY} stayed low through the 1970s, rose sharply through the late 1980s, and fluctuated around or above 1 from the early 1990s onward, with the most recent estimate near the F_{MSY} reference. Recruitment was stable and precisely estimated before 1990, then became more variable with a modest recent decline. Catches rose from negligible levels in the 1950s to a peak of 20,000 t in the late 1980s, then fluctuated between 8,000 and 15,000 t, generally below MSY in the last decade. The equilibrium yield curve indicated MSY of approximately 12,000 t at a depletion of about 0.15–0.20.

3.4 Synthesis of Mediterranean assessment results

The Group reviewed a series of JABBA (SCRS/2026/171), a4a (SCRS/2026/169, SCRS/2026/170) and SS3 model runs (SCRS/P/2026/078), that aimed to provide estimates of stock status. An important difference between the models was that in JABBA and SS3 the whole catch series from 1950 to 2024 was used as input, whereas a4a could only be initiated in 1985, thus omitting the catch information for the earlier period.

With regards to the JABBA model, the Group considered the updated model's stock status to be implausible, given known historical exploitation.

The Group noted that the various a4a runs gave consistent results, with the model assuming constant M and considering five CPUE series (SPA_LL, GRC_LL, MOR_LL, LIG_LL and SIC_LL) providing the overall best diagnostics. Findings indicate that the high catches observed in the beginning of the period (middle 1980s) had resulted in relatively low biomass levels, while the quota introduction favoured stock biomass increase and its stabilization at relatively higher levels in the most recent years. However, stock biomass remains below MSY levels.

A series of SS3 runs with different configurations were accomplished. Following discussions within the group a final model has been selected that provided acceptable overall diagnostics. The model structure considered nine fleet segments and four CPUE series (SPA_LL, GRC_LL, MOR_LL and LIG_LL). The model indicated that stock biomass had dropped in relation to the early period and remains below levels corresponding to MSY, following a period of catches that were well above MSY.

The Group decided to provide scientific advice for the Mediterranean swordfish stock using the final SS3 model. This approach was chosen for its ability to integrate diverse fishery data and adjust for selectivity by fleet segment and time period, offering a comprehensive overview of the historical evolution of both the stock and the fisheries. The trajectory of SSB/SSB_{MSY} showed a relatively stable pattern between 1950 and 1970 followed by a sharp decrease until the early-1990s to an overfished status (**Table 6** and **Figure 22**). Since then, the relative biomass has shown minor fluctuations remaining at levels below SSB_{MSY}. The SSB in 2024 was estimated to be 0.64 relative to SSB_{MSY}, with 95% credibility intervals (CI): 0.34 - 1.18. The F/F_{MSY} trajectory showed an increasing trend from the beginning of the time series as the fishery has been developed, crossing F_{MSY} in the middle of the 1980s. Since the early 1990s after the sharp increase, the estimated fishing mortality has fluctuated above MSY level (**Table 6** and **Figure 22**). The fishing mortality in 2024 was estimated to be 1.11 relative to F_{MSY}, with 95% credibility intervals (CI): 0.66 - 1.87). MSY estimate was 12,225 metric tons (11,702 – 12,748 t). It was noted that SS3 and a4a models provided broadly comparable results regarding stock status and trends for the most recent period.

Finally, a Kobe phase plot is presented (**Figure 23**), which predicts with 92.4% probability that stock biomass remains below levels that can produce MSY in 2024, with a 65.9% probability that the stock is overfished and overfishing is still occurring (red) and a 26.5% probability that the stock is overfished but overfishing is not occurring (yellow). In summary, the current Mediterranean swordfish SSB (SSB_{2024}) remained below SSB_{MSY}, while the current fishing mortality rate is slightly above the sustainable level (F_{MSY}) that would allow rebuilding to biomass levels that support MSY in the short-to-medium term.

4. South Atlantic assessment models

4.1 JABBA

JABBA was applied in the 2026 South Atlantic Swordfish Stock Assessment.

4.1.1 Model settings

The Group reviewed the JABBA model configuration presented in SCRS/2026/173. The assessment was conducted using the JABBA with the Pella-Tomlinson production function. The carrying capacity (K) was assigned a lognormal prior with a mean equal to six times the maximum observed catch and a coefficient of variation of 100%, while the initial depletion parameter (ψ) was specified using a beta prior with a mean of 0.95 and a CV of 5%. Observation error associated with the abundance indices was fixed at 0.25, whereas process error was estimated internally by the model and annual process deviations were estimated throughout the time series.

Informative priors for the intrinsic rate of population increase (r) and the relative biomass at MSY (B_{MSY}/K) were objectively derived from ASEM. Alternative biological hypotheses were generated by combining two growth models (VBF and GPZ) with two stock-recruitment steepness assumptions (h = 0.7 and 0.8). For each biological scenario, 1,000 Monte Carlo simulations incorporating uncertainty in natural mortality (M = 0.20; CV = 30%) were used to estimate the prior distributions of r and B_{MSY}/K that were subsequently incorporated into the JABBA analyses (**Tables 7** and **8**).

Input data consisted of the catch series (1950–2024) adopted during the 2026 Swordfish Data Preparatory Meeting (Anon., 2026) together with standardized longline CPUE indices (**Figure 24**). Two alternative abundance-index configurations were evaluated to investigate the sensitivity of model results to index composition.

Joint_CPUE configuration

- Joint LL (1994–2024)
- w_SPN LL (1989–2024)
- JPN LL1 (1962–1975)
- JPN LL2 (1976–1990)
- JPN LL3 (1991–2024)
- CTP LL1 (1968–1990)

All_CPUEs configuration

- w_SPN LL (1989–2024)
- JPN LL1 (1962–1975)
- JPN LL2 (1976–1990)
- JPN LL3 (1991–2024)
- CTP LL1 (1968–1990)
- CTP LL2 (1991–2024)
- BRA-URY LL (1978–2024)
- ZAF LL (2000–2024)

The Group noted that the alternative All_CPUEs configuration was developed to evaluate the influence of incorporating additional abundance information on stock status estimates. Each abundance-index configuration was combined with the four alternative biological prior scenarios, resulting in eight assessment models.

The standardized CPUE series exhibited contrasting temporal patterns reflecting differences among fleets, fishing areas and periods of operation. To improve comparability among abundance indices, all coefficients of variation lower than 0.25 were replaced by 0.25, while larger values were retained unchanged. Each of the four biological prior scenarios was evaluated under both abundance-index configurations, resulting in eight assessment models that were subsequently compared using a comprehensive suite of diagnostic analyses.

The Group discussed the treatment of the w_SPN_LL index adopted in the 2022 Swordfish Stock Assessment (Anon., 2022) in which the series was divided into two-time blocks (1989–1999 and 2000–2020) to account for a potential change in catchability. An additional sensitivity run (BC02-TB) was therefore developed using the same time-block approach, updated to 1989–1999 and 2000–2024, to allow direct comparison with the previous assessment and to evaluate its influence on the current assessment results.

4.1.2 Diagnostics

The Group reviewed the complete suite of diagnostic analyses presented in SCRS/2026/173. The supporting figures and detailed diagnostic results, including model fits, residual analyses, posterior parameter distributions, process-error estimates, retrospective analyses, hindcast cross-validation, leave-one-index-out jackknife analyses, and the comparative diagnostic summary across scenarios, are provided in the document and were not reproduced in this report.

The authors reported satisfactory convergence for all eight model configurations, with stable MCMC chains, well-defined posterior distributions, and adequate effective sample sizes. Model fits closely reproduced the main temporal patterns observed in the standardized CPUE series under both the Joint_CPUE and All_CPUEs configurations. Residual analyses, runs tests, posterior predictive checks (PPC), and process-error estimates indicated generally good model performance, with only minor differences among biological prior scenarios and abundance-index configurations. Overall, the diagnostic results demonstrated that model performance was robust to both the alternative biological priors and the composition of the abundance-index datasets.

The Group further noted that retrospective analyses showed low Mohn's rho values and satisfactory agreement among retrospective peels, indicating limited retrospective bias across all biological scenarios and CPUE configurations. Hindcast analyses showed generally consistent predictive performance among scenarios, although predictive skill varied among abundance indices and no biological prior consistently outperformed the others. Leave-one-index-out jackknife analyses indicated that the w_SPN_LL index had the greatest influence on the assessment, with its exclusion producing the largest changes in biomass trajectories and stock status estimates relative to the reference models. Overall, the diagnostic analyses indicated that the assessment results were robust to the alternative biological priors and abundance-index configurations considered.

The Group reviewed the diagnostic results for the BC02-TB sensitivity run, which included MCMC convergence, model fits, residual analyses, posterior predictive checks, retrospective analyses, hindcast cross-validation and jackknife analyses. The diagnostics indicated satisfactory model performance and were broadly comparable with those of the remaining scenarios, providing confidence that the incorporation of the time-block structure for the SPN_LL index did not compromise model fit or overall assessment performance.

4.1.3 Stock status results

The Group reviewed the stock trajectories, management quantities, and Kobe phase plots presented in SCRS/2026/173 (**Figures 25** and **26**). Estimated biomass and fishing mortality trajectories were generally consistent across the eight JABBA scenarios. Biomass declined from relatively high levels during the early assessment period and subsequently stabilized, while fishing mortality increased through the 1990s and early 2000s before declining in recent years. Differences among the alternative growth and steepness assumptions were relatively small, whereas the abundance-index configuration had a greater influence on the estimated uncertainty.

Posterior estimates of the main management quantities are summarized in **Table 9**. Median B/B_{MSY} estimates remained above 1 and median F/F_{MSY} estimates remained below 1 under all scenarios, indicating that the stock was most likely not overfished and that overfishing was not occurring in the terminal year. The Joint_CPUE configurations generally produced slightly higher biomass and lower exploitation estimates than the All_CPUEs configurations, although the overall stock-status interpretation remained unchanged.

The Group reviewed the stock status results obtained from the BC02-TB sensitivity run. Compared with the initial model configurations, the BC02-TB scenarios produced biomass and fishing mortality trajectories that were generally more consistent with those obtained in the previous assessment. In particular, the BC02-TB models estimated lower recent biomass, higher relative fishing mortality, and a stock status closer to the biological reference points than the initial runs, thereby reducing the differences between the 2022 and 2026 assessments. Despite these changes, the alternative biological prior scenarios continued to produce very similar stock trajectories and management quantities, indicating that the treatment of the Spanish longline index had a greater influence on the assessment results than the alternative growth and steepness assumptions (**Figure 27**).

The Group also reviewed the corresponding Kobe phase plots. Relative to the initial model configurations, the BC02-TB scenarios resulted in lower probabilities of the stock occurring in the Kobe green quadrant and higher probabilities in the yellow quadrants. Nevertheless, the posterior median estimates remained within the green quadrant for all four biological scenarios, indicating that the stock was most likely not overfished and that overfishing was not occurring. Overall, the Group noted that the BC02-TB sensitivity reconciled much of the difference between the 2022 and 2026 assessments while preserving the general conclusion regarding stock status (**Figure 28**).

4.2 Stock Synthesis

4.2.1 Model settings

Document SCRS/2026/166 presented the integrated stock assessment for South Atlantic swordfish using the Stock Synthesis (SS3) framework. The assessment incorporated fishery-dependent data covering the period 1950–2024, including total catches, standardized abundance indices, and length-composition data. The model was configured as a single-area, two-sex assessment with annual time steps and a Beverton-Holt stock-recruitment relationship. Equilibrium recruitment (R_0) was estimated internally by the model, while steepness (h) and recruitment variability (σR) were fixed according to the recommendations adopted during the 2026 Atlantic Swordfish Data Preparatory meeting (Anon., 2026).

The assessment represented the principal fisheries exploiting the South Atlantic stock through seven fishing fleets, including longline fleets from the European Union (Spain), Brazil–Uruguay, Japan, Chinese Taipei, South Africa, an aggregated "other longline" fleet, and an "other gears" fleet. Standardized abundance indices were available for the principal longline fleets, while length-composition data were incorporated for all fleets using 5-cm lower-jaw fork length intervals. Effective sample sizes for length compositions followed the Francis (2011) weighting approach to reduce the influence of pseudo-replication in the likelihood.

Life-history uncertainty was represented through an uncertainty grid combining alternative assumptions for growth, stock-recruitment steepness, and natural mortality. Two alternative growth models, a Gompertz and a Bayesian von Bertalanffy formulation, were combined with two fixed steepness values (0.7 and 0.8). Natural mortality was represented using two alternative formulations: a constant value of M = 0.2 across all ages, as decided in the 2026 Atlantic Swordfish Data Preparatory meeting (Anon., 2026), and an age-dependent Lorenzen formulation in which the agreed adult value of M = 0.2 corresponded to fish of approximately 14 years of age. These combinations resulted in eight alternative Stock Synthesis configurations representing the initial uncertainty grid considered during the assessment.

The Group noted that preliminary likelihood profile analyses indicated limited information in the available data to estimate several biological parameters directly within the assessment model. Consequently, the alternative biological assumptions were treated as fixed hypotheses defining the uncertainty grid rather than estimated quantities. Additional sensitivity analyses evaluating alternative abundance-index configurations and catch uncertainty were also presented in the working document.

After presenting the preliminary model runs, the Group requested additional analyses to investigate alternative model parameterizations before defining the final uncertainty grid. These analyses included: (1) restricting the assessment to age-dependent Lorenzen natural mortality; (2) reducing the minimum CPUE coefficient of variation from 0.25 to 0.20; (3) evaluating an alternative double-normal selectivity formulation allowing a small percentage of larger individuals to be retained for the terminal Chinese Taipei longline; and (4) introducing a time block in the Spanish longline CPUE series from 1989 to 1999 and 2000 to 2024. These additional runs were presented and discussed during the meeting prior to the selection of the final assessment scenarios and those decisions are presented in section 4.2.3.

4.2.2 Diagnostics

The Group reviewed a comprehensive suite of diagnostics including convergence statistics, fits to abundance indices and length-composition data, residual analyses, runs tests, hindcast cross-validation, retrospective analyses, likelihood profiles, ASPM diagnostics, and a series of additional sensitivity analyses requested during the meeting (SCRS/2026/166). Overall, all eight Stock Synthesis configurations converged successfully, with positive-definite Hessian matrices and small final gradients, indicating stable numerical performance across the entire uncertainty grid. Retrospective analyses showed negligible retrospective patterns, and all scenarios produced broadly comparable fits to the available abundance indices and length-composition data.

The Group noted that differences among the eight biological scenarios were generally modest from a diagnostic perspective. Residual analyses, hindcast evaluations, retrospective diagnostics, and likelihood profiles produced similar overall conclusions regardless of the alternative growth model or steepness assumption considered. Nevertheless, when scenarios differing only in the natural mortality formulation were compared, the Lorenzen configurations consistently showed slightly improved diagnostic performance relative to the corresponding constant natural mortality models. These improvements included marginally lower residual errors, improved length-composition hindcast performance, fewer conflicts in likelihood profiles, and better agreement between the integrated assessment and the ASPM diagnostic. Although these improvements were generally small, they were consistently observed across multiple diagnostic criteria.

The Group also reviewed leave-one-out analyses conducted for the reference model. Most abundance indices produced only minor changes in biomass trajectories when individually excluded. However, the Spanish longline CPUE and the most recent Japanese longline series generated noticeably different terminal biomass trajectories when omitted, suggesting that these indices contained contrasting information regarding recent stock dynamics. Despite these differences, the overall diagnostic results did not indicate sufficient evidence to exclude any individual abundance index from the assessment.

Following the presentation of the initial assessment, the Group requested a series of additional runs to evaluate whether alternative model parameterizations could improve model performance or reduce structural uncertainty. Four additional analyses were subsequently presented.

First, the minimum coefficient of variation applied to the standardized CPUE series was reduced from 0.25 to 0.20. Although this modification produced minor changes in model diagnostics, the resulting assessment outcomes remained very similar to those obtained under the original configuration (**Figure 29**). Considering that the minimum value of 0.25 had previously been agreed during the 2026 Atlantic Swordfish Data Preparatory meeting (Anon., 2026), the Group concluded that the results did not justify modifying this assumption.

Second, an alternative selectivity formulation was evaluated for the terminal Chinese Taipei longline fishery by replacing the logistic descending limb with a double-normal formulation allowing a small percentage of larger individuals to be retained. The Group noted that this modification produced a slight improvement in some goodness-of-fit diagnostics. However, the assessment results showed substantially higher biomass estimates and stock status. When these results were contrasted with the historical catch trajectory, the Group considered the resulting dynamics biologically implausible because catches exceeded the estimated MSY for approximately two decades (1988–2008) without producing the expected decline in biomass and with an F always smaller than the F_{MSY} value (**Figure 30**). Consequently, the original logistic selectivity formulation was retained.

Third, a time block was introduced into the Spain longline CPUE series as a sensitivity analysis. This modification produced modest improvements in several likelihood profiles (**Figure 31**) but simultaneously resulted in poorer runs-test performance (**Figure 33**), reducing the number of abundance and length-composition series satisfying the randomness criteria. Furthermore, the resulting stock trajectories differed little from those obtained under the original configuration (**Figure 32**). Considering the limited effect on assessment outcomes (**Figure 33**), together with the fact that previous applications of time blocks had been developed under biomass dynamic models rather than the integrated Stock Synthesis framework, the Group agreed to retain the original CPUE configuration without time blocks.

Finally, the Group discussed whether uncertainty associated with alternative growth hypotheses remained necessary after reviewing the initial assessment results. Although differences between the Gompertz and Bayesian von Bertalanffy growth models were relatively small, both parameterizations produced slightly different biomass trajectories and stock status estimates. The Group therefore concluded that both growth hypotheses remained biologically plausible and should continue to be represented within the uncertainty grid.

Based on the complete set of diagnostics and additional analyses, the Group concluded that the age-dependent Lorenzen natural mortality formulation consistently provided the most satisfactory representation of the available data. Given the large body size attained by swordfish and the expected decline in natural mortality with age and size, the age-dependent formulation was considered more biologically realistic and better aligned with the species' life history characteristics and growth pattern. Consequently, the Group agreed to retain only the scenarios assuming Lorenzen natural mortality for subsequent evaluation of stock status, while preserving the alternative growth models and steepness assumptions as the remaining sources of biological uncertainty represented in the final uncertainty grid.

4.2.3 Stock status results

Across the four Stock Synthesis scenarios selected by the Group, estimates of virgin spawning biomass ranged from approximately 85,600 t to 104,700 t, while recent spawning biomass ranged from approximately 21,400 t to 27,800 t (SCRS/2026/166, **Figure 34**). Relative spawning biomass in 2024 (SSB_{2024}/SSB_{MSY}) ranged from 0.97 to 1.33, whereas relative fishing mortality (F_{2024}/F_{MSY}) ranged from 0.60 to 0.79. MSY estimates were highly consistent across scenarios, varying only between approximately 11,200 t and 12,100 t. These results indicate that uncertainty associated with the remaining biological assumptions primarily affected estimates of current stock status rather than the productive capacity of the stock.

The selected scenarios consistently indicated that the stock was experiencing fishing mortality below F_{MSY}, while estimates of spawning biomass ranged from values close to SSB_{MSY} to levels moderately above this reference point, depending on the assumed steepness and growth hypotheses. Overall, the assessment suggested that the South Atlantic swordfish stock in 2024 was close to or above the biomass level capable of producing MSY and was not subject to overfishing under the biological assumptions retained by the Group.

The Group agreed that the four scenarios adequately represented the remaining uncertainty associated with the biological parameterization of the assessment. These scenarios were therefore selected as the basis for subsequent projections, Kobe analyses, management advice, and future Management Strategy Evaluation activities.

4.3 Synthesis of South Atlantic assessment results

Based on the review of model diagnostics and sensitivity analyses, the Group selected the original Stock Synthesis configuration and the Lorenzen age-dependent natural mortality formulation. The final uncertainty grid consisted of four scenarios combining alternative growth models and steepness assumptions (**Table 10** and **Figure 35**). Within the uncertainty grid steepness had a clearer effect on stock status indicators than the choice of growth model. Scenarios with h = 0.8 consistently produced higher SSB_{2024}/SSB_{MSY} and lower F_{2024}/F_{MSY} than the corresponding h = 0.7 scenarios. The effect of growth was more evident in the absolute scale of biomass and recruitment, with the von Bertalanffy growth function (VBF) generally producing higher recent spawning biomass than the Gompertz growth model (GPZ) under the same steepness assumptions (**Table 10** and **Figure 35**).

The combined results from the four Stock Synthesis scenarios (**Table 11** and **Figure 36**) indicated that relative spawning biomass declined substantially during the expansion of the fishery, decreasing from levels well above SSB_{MSY} during the early years of the fishery to values near or below SSB_{MSY} during periods of elevated exploitation. Since the early 2000s, spawning biomass has shown a gradual rebuilding trend, with all scenarios indicating continued improvement in stock condition during the most recent decade (**Table 11** and **Figure 36**). The joint distribution of the scenarios estimated a terminal spawning biomass in 2024 of SSB_{2024}/SSB_{MSY} = 1.19 (95% confidence interval: 0.90–1.57), indicating that current biomass is likely above the biomass level capable of producing MSY.

Fishing mortality increased progressively during the development of the fishery and exceeded F_{MSY} during several periods of the historical trajectory. However, fishing mortality has generally declined during the last decade, and the joint distribution of the scenarios estimated a terminal fishing mortality in 2024 of F_{2024}/F_{MSY} = 0.69 (95% confidence interval: 0.52–0.90) (**Table 11** and **Figure 36**), indicating that the stock is currently being exploited at levels below those associated with MSY.

The Kobe posterior distribution based on the joint results from the four Stock Synthesis scenarios (**Figure 37**) indicated an 84.2% probability that the South Atlantic swordfish stock is currently neither overfished nor subject to overfishing (green quadrant). The probability that the stock is overfished but not subject to overfishing (yellow quadrant) was estimated at 15.6%, while the probabilities associated with ongoing overfishing were negligible (0.08% in the orange quadrant and 0.13% in the red quadrant). The joint estimate of current stock status was SSB_{2024}/SSB_{MSY} = 1.19 (0.90–1.57) and F_{2024}/F_{MSY} = 0.69 (0.52-0.90), indicating that current biomass is likely above SSB_{MSY} while fishing mortality remains below F_{MSY}. The estimated MSY values from the four Stock Synthesis scenarios ranged from approximately 11,200 t to 12,100 t.

Overall, the selected assessment scenarios consistently indicate that the South Atlantic swordfish stock is currently not overfished and is not subject to overfishing. Although uncertainty remains regarding the precise magnitude of spawning biomass relative to SSB_{MSY}, all selected scenarios indicate fishing mortality below F_{MSY} and a high probability that the stock is in the green quadrant of the Kobe plot.

The Group noted that the current assessment indicates a substantial change in stock status relative to the previous assessment. The 2022 Swordfish Stock Assessment (Anon., 2022) (that estimated the stock status in 2020) concluded that the stock was likely overfished and experiencing overfishing, with a 91.5% probability of being overfished and a 55.6% probability of overfishing. In contrast, the current assessment estimated a 15.7% probability that the stock is overfished and a combined probability of overfishing of <1%, indicating a high likelihood that the stock is currently in the green Kobe quadrant.

Several factors were identified as contributing to these differences. First, considerable progress has been made in understanding South Atlantic swordfish life-history characteristics through the Swordfish Year Program (SWOYP) and studies conducted by CPC scientists. Updated estimates of growth, maturity, and natural mortality indicated faster growth and earlier maturation than previously assumed. The Group noted that these findings highlight the importance of continuing life-history research for ICCAT-managed stocks, as improvements in biological knowledge greatly improve stock assessment.

The Group also noted that the change from a biomass dynamic assessment framework (JABBA) to the integrated age-structured Stock Synthesis platform contributed to the differences observed between assessments. While JABBA estimates exploitable biomass dynamics, Stock Synthesis explicitly incorporates age, size, sex structure, recruitment, growth, maturation, and selectivity, and estimates spawning biomass dynamics.

The Group noted that the current assessment represents an advancement relative to previous assessments due to the incorporation of updated fisheries statistics through 2024, revised biological information on growth and maturity, age-dependent natural mortality assumptions, and the application of an integrated age-structured Stock Synthesis framework. These developments provide a more comprehensive representation of population dynamics and offer an improved basis for future projections, management advice, and any potential future development of management strategy evaluation (MSE) activities.

5. Projections

5.1 Mediterranean assessment

The Group agreed that projections for the Mediterranean swordfish stock would be conducted based on the final Stock Synthesis model selected for the stock status.

The Group discussed and agreed to the following settings for the stock projections:

- Assume a catch value of 8,360 t for the 2025 and 2026 projection years. This value is the 3-year average (2022-2024) of total catch used in the stock assessment, which included the estimates of dead discards.
- Use a 3-year average of the catch distribution by fleet (2022-2024) and its corresponding selectivities for the projection period.
- Constant catch projection scenarios are suggested as follows: zero catch; 6,000 to 15,000 t in 500/250 t increments and include scenario at MSY (12,225 t). However, it will be at the discretion of the modelers to optimise the projections around the current stock status so they are sufficiently informative.
- The projection period for constant catch scenarios will be from 2027 to 2039 which corresponds to two generation times (6 years) for this stock.
- Apply the Multivariate Lognormal (MVLN) approach for the stochastic projections and run 10,000 iterations.
- Future recruitment starting in 2025 will be predicted from the stock recruitment relationship estimated for this model with zero annual recruitment deviation.

The stochastic projection analyses will be completed intersessionally and provided to the Group as an SCRS document at least a week before the 2026 SCRS Species Group meeting.

5.2 South Atlantic assessment

The Group agreed that projections for the South Atlantic swordfish stock would be conducted based on the four Stock Synthesis scenarios selected for the stock status:

- 2 growth models (GPZ and VBF), and
- 2 steepness levels (0.7 and 0.8).

The Group discussed and agreed to the following settings for the stock projections:

- Assume a catch value of 8,802 t for the 2025 and 2026 projection years. This value is the 3-year average (2022-2024) of total catch used in the stock assessment.
- Use a 3-year average of the catch distribution by fleet (2022-2024) and its corresponding selectivities for the projection period.
- 20 constant catch projection scenarios as follows: zero catch; 8,000 t to 11,000 t in 500 t increments; 11,000 to 13,000 t in 250 t increments; and 13,000 t to 15,000 t in 500 t increments.
- The projection period for constant catch scenarios will be from 2027 to 2043 which corresponds with 2 generation times (8.5 years) for this stock.
- Apply the MVLN approach for the stochastic projections and run 10,000 iterations per scenario.
- Future recruitment starting in 2025 will be predicted from the stock recruitment relationship estimated for this model with zero annual recruitment deviation.

The projection analyses were completed during the meeting. The trends of projected relative SSB and fishing mortality for the joint scenarios are provided in **Figure 38**.

The Group noted that the stock has the constant-catch projections beginning in 2027 with relative spawning-stock biomass above the MSY level in 2026 (SSB_{2026}/SSB_{MSY}=1.39). The projections assume catches of 8,802 t in both 2025 and 2026, equal to the 2022–2024 average. These are below both the 10,000 t total allowable catch (TAC) and the estimated MSY range of approximately 11,200–12,100 t. Consequently, the stock enters the projection period with surplus biomass, which initially supports constant catches above the estimated MSY values.

The Kobe 2 matrix was produced for the catch scenarios between 0 t and 15,000 t. The percentage of joint models that resulted in SSB levels ≤20% of SSB_{MSY} were provided in **Table 12**. Among scenarios and projection years, percentages were observed for catch scenarios more than 14,000 t. Especially, the percentages exceeded 20% for the 15,000 t catch scenario in 2043. **Figure 39** shows histograms of SSB/SSB_{MSY} and F/F_{MSY} with some constant catch scenarios (0 t, 9,000 t, 10,000 t, 12,000 t, and 14,000 t) by year (2026, 2028, 2030, 2034, 2038, and 2043) from the joint Stock Synthesis projections.

6. North Atlantic MSE updates

The Chair presented a general overview of what was presented to the Panel 4 (PA4) intersessional meeting and a summary of the main points raised by PA4 and any specific requests.

The Group noted the main PA4 preferences with regards to the minimum landing size (MLS) simulations, namely that: 1) the main priority is simulating impacts of eliminating MLS; 2) the Group can consider and potentially evaluate a range of alternative MLS; 3) it is important to evaluate whether the adopted management procedure (MP) is robust to elimination/adjustments of the MLS; and 4) that analyses should consider changing fleet behaviour when eliminating the MLS.

The Group also noted that PA4 did not show a preference on the indicator metrics to be used when evaluating the performance of alternative MLS strategies. Some possibilities presented were: 1) higher MSY; 2) a reduction in juvenile mortality; and 3) higher reproductive output. At this stage, the Group could consider and explore all those, as well as other metrics that they consider adequate.

The Group raised a specific question about the Climate Test approach used in the climate change robustness testing. They asked specifically about the range of the parameter values tested for climate change (i.e., example on declines in somatic growth due to climate change) and the SSB thresholds reached under these scenarios. The Group noted that PA4 requested to be involved in defining acceptable risk thresholds for the purpose of testing MPs that are robust to climate scenarios. It was clarified that robustness tests vary one parameter at a time (e.g., decreasing somatic growth) to evaluate how each candidate management procedure (CMP) responds in terms of SSB.

SCRS/2026/172 explored the trade-offs between selectivity, retention and discard mortality for North Atlantic swordfish. The North Atlantic swordfish stock has had a minimum size limit (MSL) since 1991 but also has a very high discard mortality that has led to questions about the effectiveness of this MSL measure. The paper shows that a full retention policy (i.e., removing the MSL) produces higher yields than the current or higher MSL, without a corresponding loss in reproductive potential. Only if fishing and discard mortality on small sized fish were substantially reduced would maintaining or increasing the minimum size limit outperform full retention.

The Group asked for a clarification on which mortality components were used. The author clarified that the term discard mortality should include both at-haulback and post-release mortality, but that for North Atlantic swordfish only at-haulback mortality was included, which was already very high (88%). As such, the values shown can be interpreted as minimum discard mortality values, that still need to consider addition of post-release mortality.

The Group discussed the size selectivity that has been considered in the simulations and took note of experiences by some CPCs in their fleets. It was noted that the new trapline terminal gear modification seems to slightly shift selectivity towards larger swordfish specimens, although the work on traplines is still largely preliminary and this shift may be dependent on the size of the loops in use. At present, the selectivity values still need to be maintained using mostly longline data, as that is the gear that captures the majority of swordfish in the Atlantic.

The Group noted on the assumption of the North Atlantic swordfish MSE constant natural mortality (M) across ages, while typically younger fish experience higher natural mortality. Incorporating age-dependent M could potentially reduce the apparent impact of dead discarding because small fish would have a relatively high natural mortality rate under this new assumption. The results could therefore differ if age-specific mortality were included.

The Group discussed the point asked by PA4 on if those analyses should assume changing fleet behaviour, i.e., a change in size selectivity so fleets are no longer avoiding catching small fish. The Group commented that some of the initial work showed shifts in the spatial operation areas of the fleets that captured smaller-sized swordfish, like in the Gulf of Mexico. However, at the same time there was also the establishment of domestic regulations prohibiting fishing in those areas. So, it is not clear if the vessels avoided those areas in order to avoid capturing small sized swordfish once the minimum size was established, or if the vessels stopped fishing because of the spatial regulations. The Group also recalled an analysis carried out during the 2022 Swordfish Stock Assessment (Anon., 2022) showing that there were no major differences in swordfish size distribution for most fleets in Atlantic when comparing the pre and post size limit implementation. The Group recalled work that used detailed CPC size data collected by fishery observers and conducted collaboratively within the Group, which showed Atlantic areas where small swordfish are captured. The Group considered it important to note that the spatial areas containing small swordfish predicted by Rosa *et al.* (2025) are very large which may limit their application for guiding closed areas for protection of small swordfish.

The Group further discussed the difficulties and challenges of modelling fisheries behaviour, which can take into account multiple factors and variables (e.g., fuel price, weather conditions, targeting of secondary species such as blue shark in the case of swordfish longline fisheries, etc).

The Group noted that, although removing the MLS could theoretically encourage targeting of smaller fish if they were economically valuable, there is the perception that this shift to smaller fish may not be likely in the Atlantic, given that larger swordfish tend to be more valuable. It is therefore possible that even without an MLS established, fleets may continue to discard undersize swordfish due to their low market value.

Finally, the Group noted that the projected increase in MSY after removing the MLS is relatively small, suggesting that any benefits of removing the MLS should be weighed against any associated risks and uncertainties.

7. Recommendations

The Group reviewed recommendations developed during the 2026 Swordfish Data Preparatory Meeting (Anon., 2026). Recommendations with financial implications developed in 2025 were reviewed. It was noted that given the Commission's two-year budget cycle, there is limited scope for revisions to recommendations with financial implications for the 2027 budget year.

A recommendation related to use of SmartDots in ICCAT ageing programs would be developed in advance of the September Species Groups Meetings.

During this meeting, the following recommendations were developed:

To the Swordfish Species Group:

- Noting significant catch in the equatorial region near the current stock boundary, the Group recommended that the SWOYP program develop additional analysis and advice regarding this stock boundary and mixing among the three stocks.

- The Group recommended that a review of conversion factors be completed along with specific recommendations for revisions.

- The Group recommended the discard estimation checklist developed by the Working Group on Stock Assessment Methods (WGSAM) be tested and applied against estimation procedures previously presented to this Group.

To CPCs

- The Group recommended that development of discard estimation analyses from CPCs be treated as high priority, particularly for the Mediterranean, where few CPC developed estimations are currently available.

- The Group recommended that Mediterranean longline métiers and their treatment within catch rate standardizations be reviewed by CPC scientists in advance of the next assessment.

- The Group recommended that CPCs develop studies on trapline gear in advance of the next assessment.

8. Responses to the Commission

The Group reviewed requests for advice from the Commission and identified responses to be completed in 2026. The Group noted that some requests are more closely aligned with compliance issues and there was a suggestion that these requests should be taken up by that Committee.

The Group discussed the Commission request from Rec. 25-09 with respect to the draft reporting template that has been prepared by the Secretariat and the information included in Annex 2 of Rec. 25-09. In this regard, the Group was in general agreement with the requirements of the information that CPCs need to collect when conducting trapline pilot projects. However, there were some details and items that are not very clear or could be improved, so a detailed answer will be prepared for the September Species Group meeting.

With regard to the current draft ST-13 form, the Group recognizes that the current draft form contains all the elements required in Annex 2 of Rec. 25-09 but discussed if detailed raw set-by-set data submission is required or if some form of aggregated data is sufficient to assure that CPCs are complying with harmonized data collection (as requested in paragraph 6 of Rec. 25-09). The Group agreed that some type of either meta-data or aggregated data are sufficient to assure harmonized data collection.

The Group noted the need for coordination on this work with the Secretariat Statistics Department. A small group will work intersessionally with the Secretariat to present an updated draft ST-13 form to the September Species Group meeting. This draft will more closely align with data aggregation types already in place for observer data in form ST-09.

9. Review of the workplan

9.1 Intersessional work in 2026

Final stock status results and projections for the Mediterranean swordfish stock will be prepared intersessionally in advance of the September Species Group Meeting.

Noting the Commission's request for input on trapline gear data collection and reporting, a small group will develop feedback on the existing data collection and reporting requirements.

9.2 Workplan for 2027

The Group reviewed the 2027 workplan which includes items on swordfish life history, North Atlantic MSE, pop-up satellite archival tag (PSAT) deployment and analysis, environment effects, and studies on discard estimation from trapline gear.

It was noted that there are significant catches of swordfish in the equatorial region near the current stock boundary. It was suggested that new genetics results from this region may warrant the development of a new workplan item on the analysis of Atlantic swordfish stock boundaries and possible advice on revisions to these boundaries.

The Group emphasized the need for continued work on discard estimation. Noting the considerable estimation work the Secretariat completed to support the Mediterranean assessment in 2026, it was suggested that CPC at-sea-observer data should now be used to support estimation studies from national scientists. The SCRS Chair noted that estimation procedures for some CPCs have been reviewed and that additional guidance on review procedures would be forthcoming from the WGSAM. The Group noted that it has received alternative programs and methods for monitoring and estimating discards at sea for swordfish and other species from several CPCs (Serghini *et al.*, 2024; Akia *et al.*, 2025; Coelho *et al.*, 2025; Fernández-Costa and Ramos-Cartelle, 2025; Serghini *et al.*, 2025; Rueda *et al.*, 2026). The Group acknowledged the priority to review and provide feedback to the SCRS and national scientists following the recommendations from WGSAM on the evaluation of methodology provided in 2027.

It was noted that the workplan item related to updating conversion factors requires a review of existing conversions before further action is taken, as specific advice is needed on where revisions may be needed.

The 2027 workplan will be finalized during the Swordfish Species Group meeting in September 2026.

10. Other matters

SCRS/2026/174 developed the first standardised CPUE index for the Tunisian swordfish longline fleet operating in the east of Tunisia using generalized linear models (GLMs) fitted to data from 387 fishing trips during 2018–2025, finding a significant annual effect, with relatively high CPUE in 2022–2023 and a decline in 2024–2025, while noting that the index could be expanded with environmental covariates, additional ports and a longer time series for future stock assessments.

The Group discussed the presentation and requested clarification on the type of longline gear used by the fleet. The authors clarified that the fleet uses surface longlines. The Group further noted that, in the absence of additional explanatory variables, the analysis did not yet constitute an effective index of abundance standardization. Relevant variables could include month, season, bait type, vessel, and any other factors considered likely to influence catch rates. The unit of fishing effort should also be more clearly defined and evaluated. The next step should be to derive standardized annual catch-rate estimates by predicting the year effects while controlling for, or appropriately averaging over, the other explanatory variables. The Group concluded that the analysis was worth continuing.

The SCRS Chair noted that the ICCAT webpage includes a Science section containing stock-assessment and data-preparatory meeting reports. Previously, this page also listed planned assessments; however, the timing of the next assessment is currently shown as "To be determined." He expressed a desire to provide more specific dates for proposed assessments.

The Group noted that, for swordfish, several studies related to traplines could be important for the next assessment. Because these studies may have consequential implications for the assessment itself, including how to address non-continuous CPUE series, it may be preferable to delay the next assessment until the studies are complete and reported to the Group. The Group also noted that the quality of the available data will determine how informative the studies are.

Given the uncertainty surrounding the timing of the trapline studies and the quality of the data that will emerge from them, the Group concluded that it may be difficult to predict when the next assessment should take place. The Group further noted that the Commission had requested an update on traplines in 2028, and that several ongoing national programmes would need to be completed before the timing and scope of the next stock assessment could be determined.

11. Adoption of the report and closure

The report was adopted and the meeting was closed.

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Table 1. Biological parameter inputs used in the equilibrium biomass analysis to derive informative priors for JABBA and the model input settings for Mediterranean swordfish.

Parameter	***Mean***	***CV***	***Distribution***	***Description***	***Source***
M	0.206	0.25	lognormal	Natural mortality (1/year)	McAllister (2014)
Linf	238.58	0.1	lognormal	Von Bertalanffy asymptotic length	Mean: ICCAT Manual CV: Working Group
K	0.185	0.1	normal	Von Bertalanffy growth parameter	Mean: ICCAT Manual CV: Working Group
t0	-1.404	0.2	normal	Von Bertalanffy age at zero length	Mean: ICCAT Manual CV: Working Group
a	9.61E-06	-	exponential	Weight at length parameter (GG-LJFL)	Tserpes et al. (2017)
b	3.059	-	non lognormal	Weight at length parameter (GG-LJFL)	Tserpes et al. (2017)
L_{50}	136.5	0.2	lognormal	Length at 50% maturity	Mean: SCRS/2026/055 Manual CV: McAllister (2014)
d	0.2	0.2	lognormal	Parameter of the logistic maturity ogive	Working Group
h	0.83	0.14	beta	Steepness h=0.2 + 0.8 Beta (5.86. 1.59)	McAllister (2014)

Table 2. Results of the Age-structured Equilibrium Model (ASEM) model parameter values for Mediterranean swordfish.

Parameter	***Value***
mu r	0.154
CV r	0.096
B_{MSY} / K	0.35

Table 3. Median estimates of key management quantities obtained from the initial JABBA scenarios evaluated for Mediterranean swordfish. Results are presented for the three surplus production model scenarios.

Model	*quant*	*K*	B_{MSY}	F_{MSY}	*MSY*
Schaefer	median	168,509	84,254	0.1695	13,723
Pella ASEM	median	226,319	79,229	0.1672	13,081
Pella-Est_m	median	239,562	84,495	0.1655	13,414

Table 4. Sub-models settings applied to a4a for the Mediterranean swordfish.

Parameters	***Settings***
Initial age structure N1	a smoother (N: ~s(age, k = 3))
Recruitment R	a smoother (R:~s(year, k = 20)
Smoothers for year and age effect with a tensor for the interaction of year and age	with age and year effect modelled using splines (~s(year, k =18 or 20 or 25) + s(age, k=8) + ti(year, age, k = c(6,5))
Catchability of the surveys *q*	a constant model (~1) was assumed for the Greek, Spanish and Sicilian longline indices, while a smoothing effect on the year was assumed for Moroccan and Ligurian longlines, due to the trend in the residuals.
Variance model	An age smoother (~s(age, k = 3) and a constant variance (~1) for the CPUEs

Table 5. Stock status results for the final a4a run (Constant M) for the Mediterranean swordfish.

Metric	***Final a4a Run (Constant M)***
F/F_{MSY}	1.436
B/B_{MSY}	0.8
MSY(t)	11465

Table 6. Annual median estimates of relative spawning biomass (SSB/SSB_{MSY}) and relative fishing mortality (F/F_{MSY}) from the Stock Synthesis scenario (run 9) with 95% credibility intervals using the multivariate lognormal (MVLN) approximation for the Mediterranean swordfish stock. Trajectories were produced with SSB at the end of each year.

Scenario	Run9					
	SSB/SSB_{MSY}			F/F_{MSY}		
	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI
1951	5.05	4.77	5.34	0.01	0.01	0.01
1952	5.04	4.77	5.33	0.01	0.01	0.01
1953	5.03	4.76	5.32	0.01	0.01	0.01
1954	5.02	4.75	5.31	0.01	0.01	0.01
1955	5.02	4.74	5.30	0.01	0.01	0.01
1956	5.01	4.74	5.30	0.01	0.01	0.01
1957	5.00	4.73	5.29	0.01	0.01	0.01
1958	4.99	4.72	5.27	0.02	0.02	0.02
1959	4.98	4.71	5.27	0.01	0.01	0.01
1960	4.98	4.71	5.26	0.01	0.01	0.01
1961	4.97	4.70	5.26	0.01	0.01	0.01
1962	4.96	4.69	5.25	0.01	0.01	0.02
1963	4.96	4.69	5.24	0.02	0.01	0.02
1964	4.95	4.68	5.24	0.02	0.02	0.02
1965	4.92	4.65	5.20	0.04	0.04	0.04
1966	4.89	4.62	5.17	0.04	0.04	0.04
1967	4.86	4.60	5.15	0.03	0.03	0.03
1968	4.79	4.53	5.07	0.07	0.07	0.08
1969	4.72	4.46	4.98	0.08	0.08	0.09
1970	4.65	4.40	4.91	0.07	0.07	0.08
1971	4.55	4.30	4.81	0.11	0.10	0.12
1972	4.29	4.00	4.59	0.26	0.24	0.28
1973	4.10	3.75	4.47	0.21	0.19	0.23
1974	3.90	3.49	4.35	0.25	0.22	0.27
1975	3.75	3.30	4.26	0.23	0.20	0.25
1976	3.59	3.10	4.16	0.26	0.23	0.30
1977	3.43	2.92	4.04	0.29	0.25	0.33
1978	3.25	2.72	3.88	0.34	0.29	0.39
1979	3.09	2.55	3.74	0.33	0.28	0.39
1980	2.90	2.36	3.56	0.39	0.33	0.46
1981	2.73	2.20	3.40	0.41	0.34	0.49
1982	2.62	2.08	3.29	0.37	0.31	0.45
1983	2.52	1.98	3.19	0.40	0.33	0.49
1984	2.35	1.83	3.03	0.53	0.43	0.66
1985	2.16	1.65	2.84	0.63	0.51	0.79
1986	1.94	1.45	2.60	0.75	0.59	0.95
1987	1.70	1.23	2.34	0.90	0.70	1.16
1988	1.43	0.99	2.05	1.12	0.85	1.46
1989	1.23	0.83	1.83	1.13	0.84	1.53
1990	1.08	0.70	1.67	1.16	0.84	1.60
1991	0.94	0.59	1.51	1.27	0.90	1.81
1992	0.82	0.49	1.38	1.32	0.89	1.96
1993	0.78	0.46	1.32	1.27	0.84	1.91
1994	0.73	0.42	1.25	1.57	1.05	2.33
1995	0.71	0.41	1.23	1.35	0.88	2.07
1996	0.72	0.42	1.24	1.26	0.82	1.93
1997	0.72	0.42	1.23	1.48	0.98	2.24
1998	0.73	0.43	1.25	1.45	0.96	2.18
1999	0.74	0.44	1.26	1.38	0.91	2.09
2000	0.72	0.41	1.24	1.55	1.03	2.33
2001	0.69	0.40	1.21	1.54	1.00	2.35
2002	0.72	0.42	1.23	1.34	0.88	2.04
2003	0.69	0.40	1.19	1.60	1.06	2.42
2004	0.67	0.38	1.17	1.53	1.00	2.34
2005	0.65	0.37	1.15	1.55	1.01	2.38
2006	0.66	0.38	1.15	1.56	1.03	2.37
2007	0.69	0.40	1.19	1.46	0.96	2.22
2008	0.74	0.43	1.25	1.37	0.91	2.07
2009	0.77	0.45	1.30	1.30	0.86	1.98
2010	0.75	0.43	1.29	1.45	0.96	2.20
2011	0.74	0.42	1.29	1.29	0.83	2.02
2012	0.76	0.43	1.32	1.15	0.73	1.80
2013	0.78	0.45	1.36	1.04	0.66	1.64
2014	0.77	0.44	1.35	1.13	0.72	1.77
2015	0.72	0.40	1.30	1.27	0.80	2.01
2016	0.66	0.35	1.22	1.38	0.85	2.24
2017	0.62	0.32	1.17	1.28	0.77	2.13
2018	0.61	0.32	1.16	1.12	0.66	1.89
2019	0.60	0.32	1.14	1.13	0.67	1.91
2020	0.60	0.32	1.13	1.10	0.65	1.85
2021	0.61	0.32	1.14	1.04	0.61	1.77
2022	0.62	0.33	1.15	1.01	0.60	1.71
2023	0.63	0.34	1.16	1.03	0.61	1.72
2024	0.64	0.34	1.18	1.11	0.66	1.87

Table 7. Biological inputs used in the equilibrium biomass analysis to derive informative priors for JABBA for the South Atlantic swordfish stock. Growth parameters were obtained from alternative von Bertalanffy (VBGF) and Gompertz growth models, while remaining biological assumptions were common to all scenarios.

Parameter	Female VBGF	Male VBGF	Female Gompertz	Male Gompertz
L∞ (cm LJFL)	304.43	207.37	318.31	220.80
$K\ (yr^{-1})$	0.090	0.170	0.116	0.250
t_0	-3.14	-1.68	2.34	0.50
Weight-length a	1.69×10^{-6}	4.61×10^{-6}	1.69×10^{-6}	4.61×10^{-6}
Weight-length b	3.32	3.12	3.32	3.12
M	0.20	0.20	0.20	0.20
CV(M)	0.30	0.30	0.30	0.30
Female L50 maturity (cm)	150.7	–	150.7	–
Male L50 maturity (cm)	–	138.5	–	138.5
Selectivity L50 (cm)	119	119	119	119
Maximum age (yr)	25	25	25	25
Steepness (h)	0.7 / 0.8	0.7 / 0.8	0.7 / 0.8	0.7 / 0.8

Table 8. Informative priors for r and B_{MSY}/K used in the JABBA analyses for the South Atlantic swordfish stock. Priors were derived from age-structured model outputs under alternative growth (Gompertz and VBGF) and steepness (h = 0.7 and 0.8) assumptions using 1,000 Monte Carlo simulations incorporating uncertainty in natural mortality.

Scenario	Growth model	h	Mean r	CV(r)	Mean B_{MSY}/K
Gompertz_h0.7	Gompertz	0.7	0.111	0.196	0.367
Gompertz_h0.8	Gompertz	0.8	0.116	0.202	0.340
VBGF_h0.7	VBGF	0.7	0.116	0.209	0.362
VBGF_h0.8	VBGF	0.8	0.122	0.215	0.333

Table 9. Posterior estimates of key management quantities obtained from the JABBA scenarios evaluated for South Atlantic swordfish. Results are presented for the four biological prior combinations derived from the Age Structured Estimation Model (ASEM) under the Joint_CPUE, All_CPUEs, and BC02-TB configurations. For each scenario, posterior median estimates and 95% credibility intervals are shown for intrinsic population growth rate (r), carrying capacity (K), biomass at MSY (B_{MSY}), fishing mortality at MSY (F_{MSY}), current biomass relative to B_{MSY} (B/B_{MSY}), current fishing mortality relative to F_{MSY} (F/F_{MSY}), and management reference points.

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	All_CPUEs - All_CPUEs_Gptz_h0.7			All_CPUEs - All_CPUEs_Gptz_h0.8			All_CPUEs - All_CPUEs_VBGF_h0.7			All_CPUEs - All_CPUEs_VBGF_h0.8		
	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%
K	241926.836	175063.751	355384.909	227164.003	163609.818	337755.803	246664.522	172367.402	359328.734	218669.262	153246.235	330201.930
r	0.122	0.083	0.177	0.127	0.087	0.183	0.123	0.083	0.183	0.134	0.089	0.199
sigma_proc	0.010	0.003	0.025	0.009	0.003	0.026	0.010	0.002	0.026	0.009	0.003	0.026
F_MSY	0.123	0.084	0.178	0.149	0.101	0.214	0.127	0.085	0.189	0.162	0.108	0.240
B_MSY	88821.612	64273.335	130476.887	77115.256	55540.547	114657.802	89271.248	62382.109	130045.959	72888.930	51081.501	110066.066
MSY	10976.484	8298.939	14305.051	11526.305	8771.146	15578.419	11386.418	8577.656	15261.994	11885.026	9090.121	15813.513
B1950/K	0.946	0.741	1.162	0.950	0.746	1.160	0.949	0.744	1.163	0.949	0.743	1.158
B2024/K	0.422	0.260	0.627	0.428	0.245	0.649	0.428	0.246	0.653	0.453	0.256	0.653
B2024/BMSY	1.149	0.709	1.707	1.260	0.723	1.911	1.182	0.679	1.804	1.358	0.767	1.958
F2024/FMSY	0.753	0.427	1.269	0.651	0.335	1.209	0.705	0.363	1.276	0.582	0.325	1.109

	Joint_CPUE - Joint_CPUE_Gptz_h0.7			Joint_CPUE - Joint_CPUE_Gptz_h0.8			Joint_CPUE - Joint_CPUE_VBGF_h0.7			Joint_CPUE - Joint_CPUE_VBGF_h0.8		
	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%
K	270037.158	185402.209	419778.454	252989.636	176883.577	375241.017	253167.420	180977.081	390030.330	240813.997	164822.715	379152.635
r	0.120	0.082	0.173	0.121	0.083	0.177	0.123	0.082	0.179	0.128	0.084	0.193
sigma_proc	0.007	0.002	0.023	0.009	0.002	0.026	0.009	0.003	0.024	0.008	0.003	0.023
F_MSY	0.120	0.083	0.174	0.141	0.097	0.207	0.127	0.084	0.185	0.155	0.101	0.234
B_MSY	99142.105	68069.022	154118.492	85882.271	60046.584	127382.889	91624.735	65498.069	141157.285	80270.425	54940.284	126382.783
MSY	11895.729	8655.871	17014.636	12069.441	8935.616	17066.085	11710.830	8750.730	15866.370	12430.669	9287.546	17943.521
B1950/K	0.954	0.755	1.149	0.951	0.741	1.159	0.952	0.746	1.160	0.951	0.746	1.159
B2024/K	0.534	0.306	0.753	0.496	0.275	0.735	0.488	0.291	0.692	0.512	0.320	0.765
B2024/BMSY	1.454	0.834	2.051	1.461	0.811	2.165	1.348	0.805	1.912	1.535	0.961	2.296
F2024/FMSY	0.547	0.294	1.075	0.535	0.275	1.056	0.597	0.335	1.068	0.491	0.245	0.889

	BC02-TB - BC02TB_Gptz_h0.7			BC02-TB - BC02TB_Gptz_h0.8			BC02-TB - BC02TB_VBGF_h0.7			BC02-TB - BC02TB_VBGF_h0.8		
	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%
K	245725.510	172830.167	392342.543	228489.698	167670.407	328321.435	235838.521	165654.334	358526.946	221505.237	159625.906	318216.241
r	0.123	0.082	0.177	0.126	0.087	0.176	0.128	0.086	0.185	0.129	0.089	0.183
sigma_proc	0.008	0.002	0.023	0.008	0.002	0.025	0.008	0.002	0.023	0.008	0.003	0.024
F_MSY	0.123	0.083	0.178	0.147	0.102	0.206	0.132	0.089	0.191	0.156	0.107	0.222
B_MSY	90216.267	63453.292	144045.604	77565.289	56918.993	111455.121	85353.171	59952.558	129755.782	73834.244	53208.034	106070.881
MSY	11221.871	8874.597	14177.876	11441.330	9216.114	14079.479	11353.233	9135.104	14121.395	11604.865	9480.223	14334.074
B1950/K	0.953	0.751	1.156	0.954	0.757	1.159	0.955	0.752	1.152	0.951	0.751	1.152
B2024/K	0.368	0.214	0.546	0.356	0.201	0.536	0.359	0.206	0.538	0.356	0.215	0.560
B2024/BMSY	1.001	0.583	1.487	1.047	0.593	1.578	0.992	0.569	1.487	1.068	0.644	1.681
F2024/FMSY	0.841	0.518	1.394	0.787	0.468	1.362	0.841	0.503	1.417	0.760	0.427	1.288

Table 10. Annual median estimates of relative spawning biomass (SSB/SSB_{MSY}) and relative fishing mortality (F/F_{MSY}) from the four Stock Synthesis scenarios with 95% credibility intervals using the multivariate lognormal (MVLN) approximation for the South Atlantic swordfish stock. Trajectories were produced with SSB at the end of each year.

Scenarios	S01_GPZ_h0.7_M-Lorenzen						S02_GPZ_h0.8_M-Lorenzen						S03_VBF_h0.7_M-Lorenzen						S04_VBF_h0.8_M-Lorenzen					
	SSB/SSB_{MSY}			F/F_{MSY}			SSB/SSB_{MSY}			F/F_{MSY}			SSB/SSB_{MSY}			F/F_{MSY}			SSB/SSB_{MSY}			F/F_{MSY}		
	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI
1951	3.97	3.93	3.98	0.00	0.01	0.01	4.94	4.89	4.97	0.00	0.01	0.01	3.90	3.86	3.93	0.00	0.01	0.01	4.79	4.72	4.83	0.00	0.00	0.01
1952	3.96	3.93	3.98	0.01	0.01	0.01	4.93	4.89	4.97	0.01	0.01	0.01	3.89	3.86	3.93	0.01	0.01	0.01	4.78	4.72	4.83	0.00	0.00	0.01
1953	3.96	3.93	3.98	0.01	0.01	0.01	4.93	4.89	4.97	0.01	0.01	0.01	3.89	3.85	3.92	0.01	0.01	0.01	4.77	4.72	4.83	0.00	0.00	0.01
1954	3.95	3.93	3.98	0.00	0.00	0.00	4.93	4.88	4.97	0.00	0.00	0.00	3.89	3.85	3.92	0.00	0.00	0.00	4.77	4.71	4.83	0.00	0.00	0.00
1955	3.95	3.93	3.98	0.00	0.00	0.00	4.93	4.88	4.97	0.00	0.00	0.00	3.89	3.85	3.92	0.00	0.00	0.00	4.77	4.71	4.82	0.00	0.00	0.00
1956	3.95	3.93	3.98	0.00	0.00	0.00	4.93	4.88	4.97	0.00	0.00	0.00	3.89	3.85	3.92	0.00	0.00	0.00	4.77	4.71	4.83	0.00	0.00	0.00
1957	3.95	3.93	3.98	0.01	0.01	0.01	4.92	4.88	4.96	0.01	0.01	0.01	3.88	3.85	3.92	0.01	0.01	0.01	4.77	4.71	4.82	0.01	0.01	0.01
1958	3.95	3.93	3.98	0.00	0.00	0.00	4.92	4.88	4.96	0.00	0.00	0.00	3.88	3.85	3.92	0.00	0.00	0.00	4.77	4.71	4.82	0.00	0.00	0.00
1959	3.95	3.92	3.97	0.01	0.01	0.01	4.92	4.88	4.96	0.00	0.00	0.00	3.88	3.85	3.92	0.01	0.00	0.01	4.76	4.71	4.82	0.00	0.00	0.00
1960	3.94	3.92	3.97	0.01	0.01	0.02	4.91	4.87	4.95	0.01	0.01	0.01	3.88	3.84	3.91	0.01	0.01	0.01	4.76	4.70	4.81	0.01	0.01	0.01
1961	3.93	3.90	3.95	0.03	0.03	0.03	4.89	4.85	4.93	0.03	0.03	0.03	3.86	3.83	3.90	0.03	0.03	0.03	4.73	4.68	4.79	0.03	0.02	0.03
1962	3.92	3.89	3.94	0.02	0.02	0.03	4.88	4.84	4.92	0.02	0.02	0.02	3.85	3.82	3.89	0.02	0.02	0.02	4.72	4.67	4.78	0.02	0.02	0.02
1963	3.90	3.87	3.92	0.05	0.04	0.05	4.85	4.81	4.89	0.04	0.04	0.04	3.83	3.80	3.87	0.04	0.04	0.04	4.69	4.64	4.75	0.04	0.03	0.04
1964	3.87	3.85	3.90	0.07	0.06	0.07	4.81	4.77	4.85	0.06	0.05	0.06	3.80	3.77	3.84	0.06	0.06	0.06	4.65	4.60	4.71	0.05	0.05	0.05
1965	3.84	3.81	3.86	0.08	0.08	0.09	4.76	4.72	4.80	0.07	0.07	0.08	3.77	3.73	3.80	0.08	0.07	0.08	4.61	4.55	4.66	0.07	0.06	0.07
1966	3.81	3.79	3.84	0.06	0.06	0.07	4.73	4.69	4.77	0.06	0.05	0.06	3.74	3.71	3.78	0.06	0.06	0.06	4.58	4.52	4.63	0.05	0.05	0.05
1967	3.80	3.77	3.82	0.05	0.05	0.05	4.71	4.67	4.75	0.04	0.04	0.05	3.73	3.69	3.77	0.05	0.05	0.05	4.56	4.50	4.61	0.04	0.04	0.04
1968	3.77	3.74	3.80	0.08	0.08	0.08	4.67	4.63	4.71	0.07	0.07	0.07	3.70	3.67	3.74	0.07	0.07	0.08	4.52	4.47	4.58	0.06	0.06	0.07
1969	3.71	3.69	3.74	0.15	0.14	0.15	4.59	4.55	4.63	0.13	0.12	0.13	3.64	3.61	3.68	0.14	0.13	0.14	4.44	4.39	4.50	0.12	0.11	0.12
1970	3.64	3.62	3.67	0.18	0.18	0.19	4.50	4.45	4.54	0.16	0.15	0.17	3.57	3.54	3.61	0.17	0.16	0.17	4.35	4.29	4.40	0.14	0.14	0.15
1971	3.63	3.60	3.66	0.07	0.07	0.08	4.48	4.43	4.52	0.06	0.06	0.07	3.55	3.48	3.61	0.07	0.07	0.07	4.32	4.23	4.41	0.06	0.06	0.06
1972	3.61	3.56	3.65	0.09	0.09	0.09	4.45	4.39	4.51	0.08	0.07	0.08	3.53	3.42	3.65	0.08	0.08	0.09	4.30	4.16	4.45	0.07	0.07	0.07
1973	3.57	3.49	3.64	0.11	0.10	0.12	4.40	4.30	4.50	0.10	0.09	0.10	3.50	3.35	3.65	0.10	0.09	0.11	4.26	4.08	4.45	0.09	0.08	0.09
1974	3.51	3.40	3.62	0.10	0.10	0.11	4.33	4.20	4.47	0.09	0.08	0.09	3.43	3.26	3.61	0.09	0.09	0.10	4.18	3.97	4.41	0.08	0.07	0.08
1975	3.42	3.30	3.56	0.12	0.11	0.12	4.22	4.06	4.39	0.10	0.09	0.11	3.33	3.14	3.52	0.11	0.10	0.11	4.06	3.83	4.30	0.09	0.08	0.10
1976	3.32	3.17	3.47	0.11	0.10	0.12	4.10	3.91	4.29	0.10	0.09	0.10	3.20	3.01	3.41	0.10	0.09	0.11	3.91	3.67	4.17	0.09	0.08	0.09
1977	3.20	3.05	3.36	0.12	0.11	0.12	3.95	3.75	4.16	0.10	0.09	0.11	3.07	2.88	3.28	0.11	0.10	0.12	3.75	3.51	4.01	0.09	0.08	0.10
1978	3.09	2.92	3.26	0.12	0.11	0.13	3.81	3.60	4.02	0.10	0.10	0.11	2.95	2.75	3.16	0.11	0.10	0.12	3.60	3.36	3.87	0.09	0.09	0.10
1979	2.97	2.80	3.15	0.15	0.14	0.16	3.66	3.45	3.89	0.13	0.12	0.14	2.84	2.64	3.05	0.14	0.13	0.15	3.47	3.22	3.73	0.12	0.11	0.13
1980	2.84	2.67	3.02	0.24	0.22	0.26	3.50	3.28	3.73	0.20	0.19	0.22	2.71	2.51	2.92	0.22	0.21	0.24	3.31	3.06	3.57	0.19	0.17	0.21
1981	2.76	2.58	2.94	0.18	0.17	0.20	3.39	3.17	3.63	0.16	0.14	0.17	2.63	2.42	2.84	0.17	0.16	0.19	3.21	2.96	3.47	0.15	0.13	0.16
1982	2.67	2.49	2.86	0.29	0.27	0.32	3.28	3.05	3.53	0.25	0.23	0.28	2.56	2.36	2.78	0.28	0.25	0.30	3.13	2.88	3.40	0.23	0.21	0.26
1983	2.61	2.43	2.81	0.26	0.23	0.28	3.22	2.98	3.47	0.22	0.20	0.24	2.53	2.32	2.75	0.24	0.22	0.27	3.09	2.84	3.37	0.20	0.18	0.23
1984	2.51	2.32	2.72	0.43	0.40	0.47	3.09	2.84	3.35	0.37	0.34	0.41	2.43	2.22	2.65	0.41	0.37	0.45	2.97	2.71	3.25	0.34	0.31	0.38
1985	2.41	2.22	2.62	0.46	0.42	0.51	2.96	2.71	3.22	0.40	0.36	0.44	2.34	2.13	2.56	0.44	0.39	0.49	2.85	2.59	3.14	0.37	0.33	0.41
1986	2.38	2.19	2.59	0.29	0.26	0.32	2.92	2.68	3.19	0.25	0.22	0.28	2.32	2.12	2.55	0.28	0.25	0.31	2.84	2.59	3.13	0.23	0.21	0.26
1987	2.36	2.17	2.57	0.29	0.26	0.32	2.90	2.66	3.17	0.25	0.22	0.28	2.31	2.11	2.53	0.28	0.25	0.31	2.83	2.58	3.11	0.24	0.21	0.27
1988	2.26	2.07	2.47	0.61	0.55	0.67	2.78	2.54	3.05	0.52	0.47	0.58	2.20	2.00	2.42	0.60	0.53	0.67	2.70	2.45	2.98	0.50	0.44	0.56
1989	2.16	1.97	2.37	0.81	0.74	0.89	2.66	2.41	2.92	0.69	0.62	0.76	2.12	1.92	2.34	0.76	0.68	0.86	2.59	2.34	2.87	0.63	0.56	0.72
1990	2.09	1.90	2.30	0.86	0.78	0.95	2.57	2.32	2.83	0.73	0.66	0.81	2.12	1.92	2.33	0.80	0.72	0.89	2.60	2.35	2.87	0.67	0.59	0.75
1991	2.06	1.87	2.27	0.73	0.66	0.81	2.54	2.29	2.80	0.62	0.55	0.69	2.07	1.88	2.29	0.67	0.60	0.75	2.56	2.31	2.83	0.56	0.50	0.63
1992	2.00	1.81	2.20	0.73	0.66	0.81	2.47	2.23	2.73	0.62	0.55	0.69	2.00	1.81	2.21	0.69	0.62	0.77	2.47	2.23	2.73	0.57	0.50	0.64
1993	1.89	1.71	2.09	0.87	0.79	0.96	2.33	2.10	2.59	0.73	0.65	0.82	1.88	1.69	2.09	0.82	0.73	0.92	2.32	2.09	2.58	0.67	0.59	0.76
1994	1.76	1.58	1.95	1.07	0.97	1.18	2.16	1.94	2.41	0.90	0.81	1.00	1.77	1.59	1.97	1.00	0.89	1.12	2.19	1.96	2.44	0.82	0.72	0.92
1995	1.60	1.43	1.79	1.32	1.20	1.47	1.96	1.74	2.21	1.11	1.00	1.24	1.61	1.44	1.80	1.23	1.10	1.38	1.98	1.76	2.22	1.01	0.90	1.15
1996	1.48	1.32	1.67	1.20	1.08	1.34	1.81	1.60	2.05	1.01	0.90	1.13	1.47	1.31	1.66	1.13	1.00	1.28	1.81	1.60	2.04	0.93	0.82	1.06
1997	1.35	1.19	1.52	1.32	1.18	1.47	1.64	1.44	1.87	1.11	0.99	1.24	1.34	1.18	1.52	1.24	1.09	1.40	1.64	1.44	1.87	1.02	0.89	1.16
1998	1.28	1.13	1.45	1.09	0.97	1.22	1.56	1.37	1.77	0.91	0.81	1.03	1.27	1.12	1.44	1.03	0.91	1.17	1.56	1.37	1.78	0.85	0.74	0.97
1999	1.18	1.04	1.35	1.22	1.08	1.38	1.44	1.26	1.65	1.02	0.90	1.16	1.16	1.02	1.33	1.19	1.04	1.36	1.43	1.25	1.63	0.98	0.85	1.13
2000	1.09	0.95	1.25	1.29	1.15	1.45	1.32	1.15	1.52	1.08	0.96	1.22	1.07	0.93	1.23	1.26	1.09	1.45	1.31	1.14	1.51	1.03	0.89	1.20
2001	1.02	0.89	1.17	1.31	1.17	1.48	1.24	1.08	1.44	1.10	0.97	1.24	1.03	0.89	1.18	1.27	1.11	1.46	1.26	1.09	1.45	1.04	0.90	1.21
2002	0.98	0.85	1.13	1.28	1.13	1.44	1.20	1.04	1.38	1.07	0.94	1.21	0.98	0.85	1.14	1.25	1.09	1.44	1.21	1.04	1.39	1.03	0.89	1.19
2003	0.96	0.83	1.10	1.15	1.01	1.30	1.17	1.01	1.35	0.96	0.84	1.09	0.94	0.81	1.09	1.16	1.00	1.34	1.15	0.99	1.34	0.95	0.81	1.11
2004	0.93	0.80	1.07	1.20	1.06	1.35	1.14	0.98	1.31	1.00	0.88	1.13	0.92	0.79	1.06	1.19	1.02	1.38	1.13	0.97	1.31	0.97	0.83	1.14
2005	0.92	0.80	1.06	1.21	1.07	1.36	1.13	0.98	1.30	1.00	0.88	1.13	0.93	0.80	1.07	1.18	1.02	1.37	1.15	0.99	1.32	0.96	0.83	1.12
2006	0.90	0.78	1.04	1.31	1.16	1.47	1.11	0.96	1.28	1.08	0.96	1.22	0.93	0.80	1.07	1.27	1.11	1.46	1.15	0.99	1.33	1.04	0.90	1.20
2007	0.86	0.74	0.99	1.47	1.30	1.66	1.06	0.91	1.23	1.21	1.07	1.38	0.89	0.76	1.03	1.42	1.23	1.64	1.10	0.94	1.28	1.15	0.99	1.34
2008	0.86	0.74	0.99	1.20	1.05	1.37	1.06	0.91	1.23	0.99	0.87	1.14	0.89	0.76	1.03	1.16	1.00	1.35	1.10	0.94	1.28	0.95	0.81	1.11
2009	0.85	0.73	0.99	1.23	1.07	1.40	1.06	0.91	1.23	1.02	0.89	1.16	0.88	0.75	1.03	1.20	1.03	1.39	1.10	0.94	1.28	0.97	0.83	1.14
2010	0.85	0.73	0.99	1.21	1.06	1.39	1.05	0.90	1.23	1.00	0.87	1.15	0.87	0.74	1.02	1.19	1.02	1.40	1.09	0.92	1.27	0.97	0.82	1.14
2011	0.86	0.74	1.01	1.07	0.93	1.23	1.07	0.92	1.25	0.88	0.77	1.02	0.89	0.75	1.04	1.05	0.89	1.23	1.11	0.94	1.30	0.85	0.72	1.01
2012	0.89	0.77	1.04	1.02	0.89	1.17	1.12	0.96	1.30	0.84	0.73	0.97	0.94	0.80	1.10	0.97	0.83	1.14	1.18	1.01	1.37	0.79	0.67	0.93
2013	0.95	0.81	1.10	0.88	0.77	1.01	1.19	1.03	1.37	0.73	0.63	0.83	1.00	0.86	1.16	0.83	0.71	0.96	1.26	1.08	1.46	0.67	0.57	0.78
2014	0.97	0.84	1.13	0.95	0.82	1.08	1.22	1.06	1.41	0.78	0.68	0.89	1.02	0.87	1.18	0.89	0.76	1.03	1.29	1.11	1.49	0.72	0.61	0.84
2015	0.97	0.83	1.12	0.99	0.86	1.14	1.22	1.05	1.41	0.82	0.71	0.94	1.00	0.86	1.16	0.93	0.79	1.08	1.27	1.09	1.47	0.75	0.64	0.88
2016	0.94	0.80	1.10	1.03	0.90	1.19	1.18	1.02	1.38	0.85	0.74	0.98	0.97	0.82	1.13	0.98	0.84	1.14	1.22	1.05	1.43	0.79	0.67	0.93
2017	0.91	0.77	1.07	1.04	0.90	1.21	1.14	0.97	1.34	0.86	0.74	1.00	0.93	0.79	1.09	0.99	0.84	1.17	1.18	1.00	1.38	0.80	0.68	0.95
2018	0.88	0.75	1.04	1.04	0.90	1.21	1.11	0.94	1.31	0.86	0.74	1.00	0.91	0.77	1.08	0.99	0.84	1.17	1.16	0.98	1.36	0.80	0.68	0.95
2019	0.87	0.73	1.03	1.02	0.87	1.19	1.09	0.93	1.29	0.84	0.72	0.98	0.90	0.77	1.07	0.98	0.82	1.16	1.14	0.97	1.35	0.79	0.66	0.94
2020	0.88	0.74	1.04	0.90	0.77	1.05	1.11	0.94	1.31	0.74	0.63	0.87	0.92	0.77	1.08	0.86	0.72	1.02	1.16	0.98	1.37	0.70	0.58	0.83
2021	0.89	0.75	1.05	0.93	0.79	1.09	1.12	0.95	1.33	0.76	0.65	0.90	0.94	0.79	1.11	0.89	0.75	1.06	1.19	1.01	1.40	0.72	0.60	0.86
2022	0.92	0.78	1.09	0.83	0.70	0.98	1.17	0.99	1.38	0.68	0.57	0.80	0.98	0.83	1.15	0.79	0.66	0.95	1.24	1.05	1.46	0.64	0.53	0.77
2023	0.97	0.82	1.14	0.75	0.63	0.89	1.24	1.05	1.46	0.61	0.51	0.72	1.04	0.88	1.22	0.73	0.61	0.87	1.32	1.13	1.56	0.58	0.49	0.70
2024	1.02	0.86	1.21	0.78	0.66	0.94	1.31	1.11	1.55	0.63	0.53	0.76	1.08	0.91	1.29	0.75	0.62	0.91	1.39	1.17	1.65	0.60	0.49	0.73

Table 11. Annual median estimates of relative spawning biomass (SSB/SSB_{MSY}) and relative fishing mortality (F/F_{MSY}) from the joint four Stock Synthesis scenarios with 95% credibility intervals using the multivariate lognormal (MVLN) approximation for the South Atlantic swordfish stock. Trajectories were produced with SSB at the end of each year.

Scenario	Joint					
	SSB/SSB_{MSY}			F/F_{MSY}		
	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI
1951	4.40	3.87	4.96	0.00	0.00	0.01
1952	4.34	3.87	4.96	0.01	0.00	0.01
1953	4.34	3.86	4.96	0.01	0.00	0.01
1954	4.34	3.86	4.95	0.00	0.00	0.00
1955	4.34	3.86	4.95	0.00	0.00	0.00
1956	4.34	3.86	4.95	0.00	0.00	0.00
1957	4.34	3.86	4.95	0.01	0.01	0.01
1958	4.34	3.86	4.95	0.00	0.00	0.00
1959	4.33	3.86	4.95	0.00	0.00	0.01
1960	4.33	3.85	4.94	0.01	0.01	0.01
1961	4.31	3.84	4.92	0.03	0.02	0.03
1962	4.30	3.83	4.91	0.02	0.02	0.03
1963	4.27	3.81	4.88	0.04	0.03	0.05
1964	4.24	3.78	4.84	0.06	0.05	0.07
1965	4.20	3.74	4.79	0.07	0.06	0.09
1966	4.17	3.72	4.76	0.06	0.05	0.07
1967	4.15	3.71	4.74	0.05	0.04	0.05
1968	4.12	3.68	4.70	0.07	0.06	0.08
1969	4.05	3.62	4.62	0.13	0.11	0.15
1970	3.97	3.55	4.53	0.16	0.14	0.19
1971	3.92	3.51	4.51	0.07	0.06	0.08
1972	3.90	3.46	4.49	0.08	0.07	0.09
1973	3.86	3.40	4.47	0.10	0.08	0.11
1974	3.79	3.32	4.43	0.09	0.07	0.10
1975	3.68	3.21	4.34	0.10	0.09	0.12
1976	3.56	3.08	4.22	0.10	0.08	0.11
1977	3.43	2.94	4.09	0.10	0.09	0.12
1978	3.30	2.82	3.95	0.11	0.09	0.12
1979	3.18	2.71	3.81	0.13	0.11	0.15
1980	3.04	2.58	3.65	0.21	0.18	0.25
1981	2.95	2.49	3.55	0.16	0.14	0.19
1982	2.87	2.42	3.45	0.26	0.22	0.31
1983	2.83	2.39	3.39	0.23	0.19	0.27
1984	2.72	2.29	3.27	0.39	0.32	0.46
1985	2.61	2.19	3.14	0.42	0.34	0.49
1986	2.59	2.18	3.12	0.26	0.21	0.31
1987	2.58	2.16	3.10	0.26	0.22	0.31
1988	2.47	2.06	2.97	0.56	0.46	0.66
1989	2.36	1.97	2.85	0.72	0.58	0.87
1990	2.33	1.94	2.81	0.77	0.62	0.92
1991	2.29	1.90	2.77	0.64	0.52	0.78
1992	2.22	1.84	2.69	0.65	0.53	0.79
1993	2.09	1.73	2.54	0.77	0.62	0.93
1994	1.96	1.62	2.39	0.94	0.76	1.14
1995	1.78	1.46	2.18	1.17	0.94	1.42
1996	1.63	1.34	2.01	1.07	0.86	1.30
1997	1.48	1.21	1.83	1.17	0.93	1.42
1998	1.41	1.15	1.74	0.97	0.78	1.18
1999	1.30	1.05	1.61	1.10	0.89	1.34
2000	1.19	0.96	1.48	1.16	0.94	1.42
2001	1.13	0.91	1.41	1.18	0.95	1.44
2002	1.09	0.87	1.36	1.15	0.93	1.41
2003	1.05	0.84	1.32	1.05	0.84	1.29
2004	1.02	0.82	1.28	1.09	0.87	1.34
2005	1.02	0.82	1.28	1.08	0.87	1.34
2006	1.02	0.81	1.28	1.17	0.94	1.44
2007	0.97	0.77	1.23	1.31	1.04	1.61
2008	0.97	0.77	1.23	1.07	0.85	1.33
2009	0.97	0.76	1.23	1.10	0.87	1.36
2010	0.96	0.75	1.22	1.09	0.86	1.36
2011	0.98	0.77	1.25	0.96	0.76	1.20
2012	1.02	0.80	1.31	0.90	0.71	1.13
2013	1.09	0.85	1.40	0.77	0.60	0.97
2014	1.12	0.87	1.43	0.83	0.65	1.04
2015	1.11	0.86	1.41	0.87	0.67	1.09
2016	1.07	0.83	1.37	0.91	0.71	1.15
2017	1.03	0.80	1.33	0.92	0.71	1.16
2018	1.01	0.78	1.30	0.92	0.72	1.16
2019	1.00	0.77	1.29	0.90	0.70	1.14
2020	1.01	0.78	1.31	0.79	0.61	1.01
2021	1.03	0.79	1.34	0.82	0.63	1.05
2022	1.07	0.82	1.40	0.73	0.56	0.94
2023	1.13	0.86	1.49	0.66	0.51	0.86
2024	1.19	0.90	1.57	0.69	0.52	0.90

Table 12. Percent of the model runs that resulted in spawning stock biomass levels <= 20% of SSB_{MSY} during the projection period for a given catch level for the South Atlantic swordfish stock.

Probability of Stock Depletion (SSB < 20% of SSB_{MSY})

TAC (t)	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11250	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11750	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12250	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12750	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
13000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
13500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
14000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
14500	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	3%	6%
15000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	6%	13%	21%

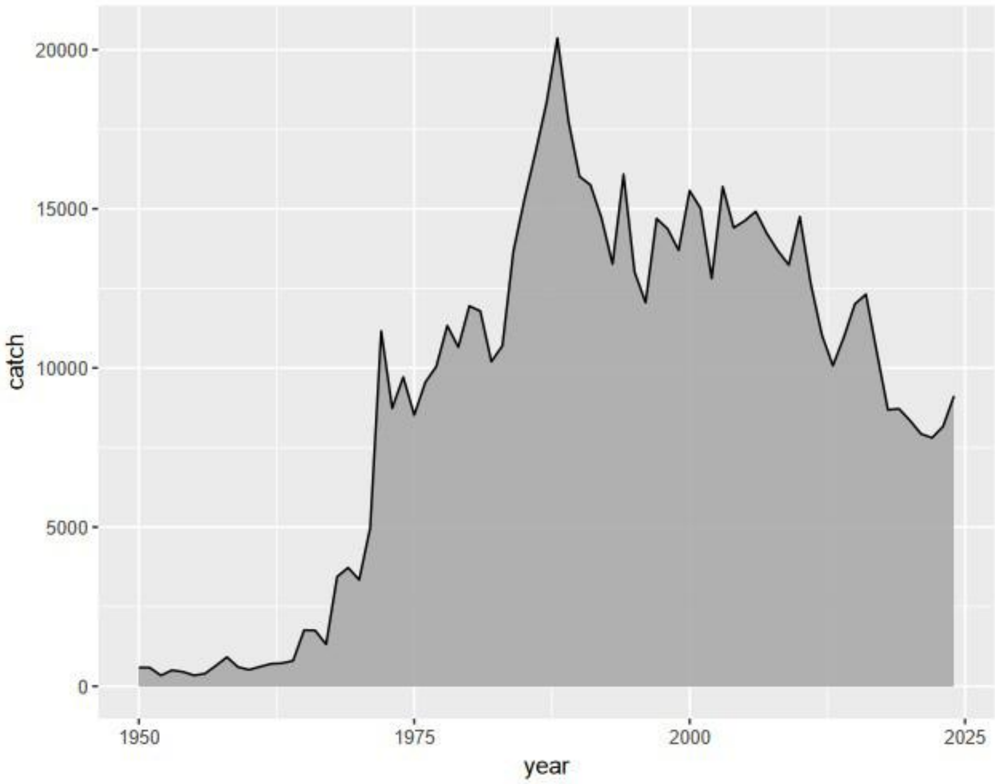


Figure 1. Total catches (including estimated dead discards) (tons) of swordfish in the Mediterranean from 1950 to 2024.

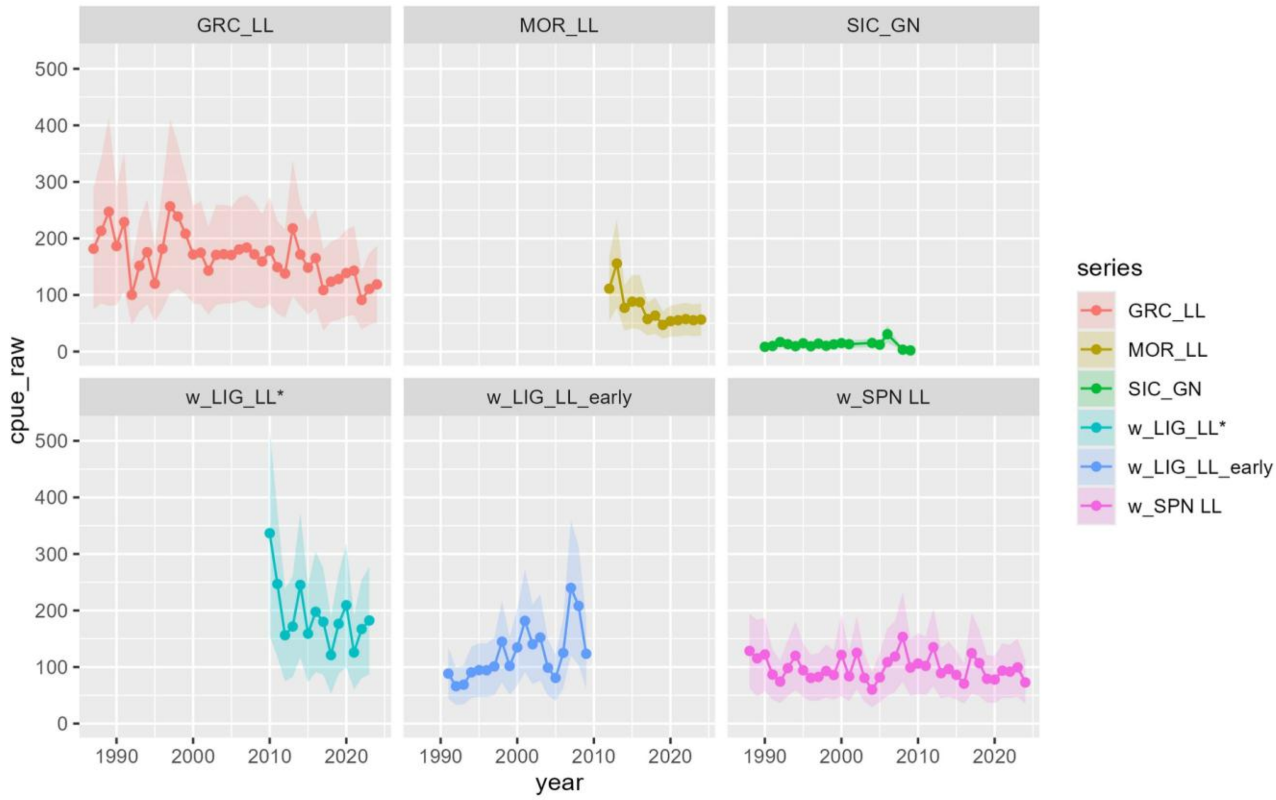


Figure 2. Time series of relative indices of abundance. GRC_LL: Greece longline; MOR_LL: Morocco longline; SIC_GN: Sicilian gillnet; w_LIG_LL: Ligurian longline; w_LIG_LL_early: historical Liguria longline; w_SPN_LL: Spain longline.

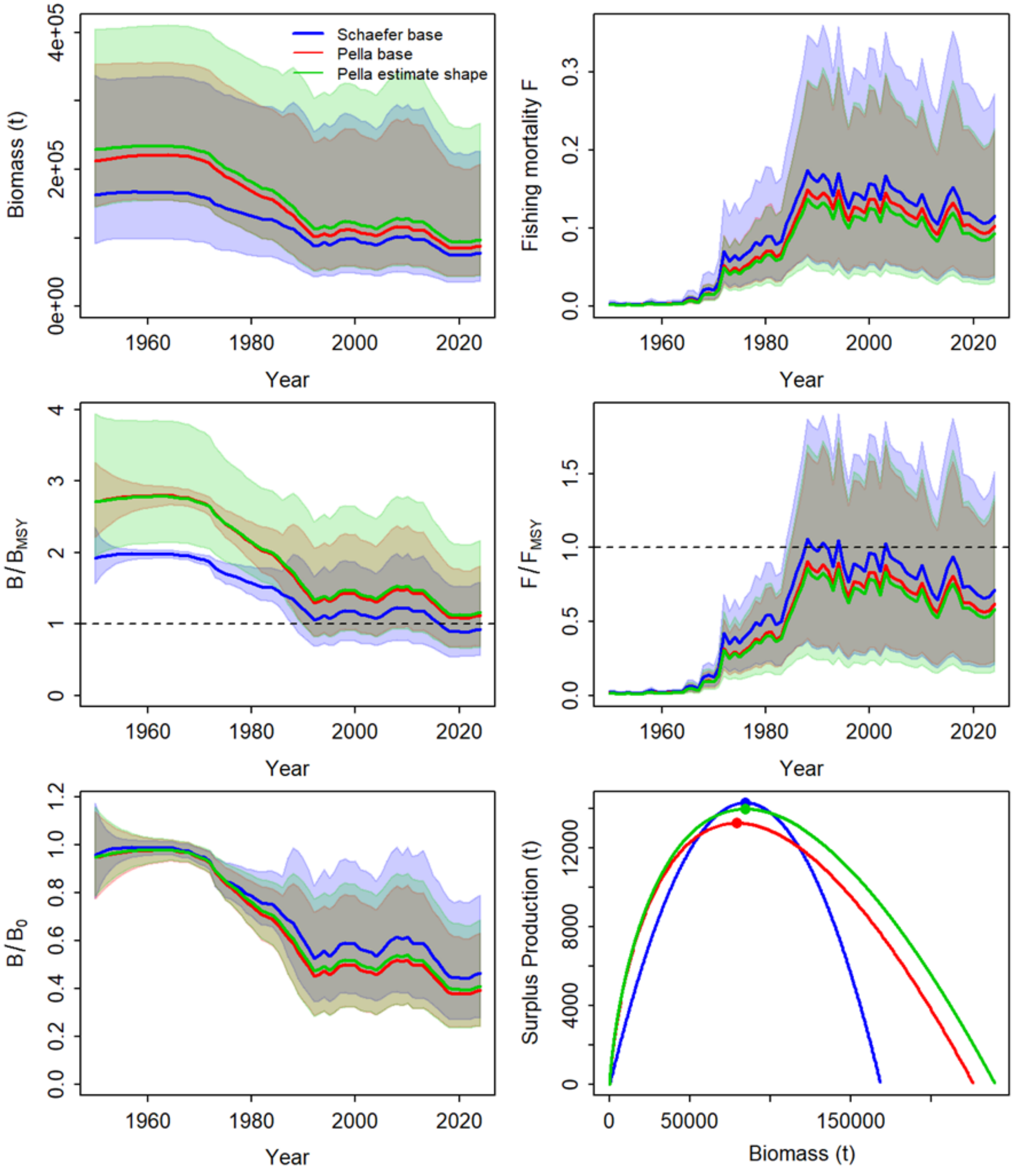


Figure 3. JABBA historical trajectories of stock biomass, fishing mortality, relative biomass and fishing mortality, and surplus production estimated under alternative scenarios for surplus production function configurations for the Mediterranean swordfish stock. Panels show trajectories of B/B_0, B/B_{MSY}, biomass, F/F_{MSY}, and fishing mortality through time. Dashed horizontal lines indicate B_{MSY} and F_{MSY} reference levels. The lower panels show surplus-production curves and associated estimates of B_{MSY}.

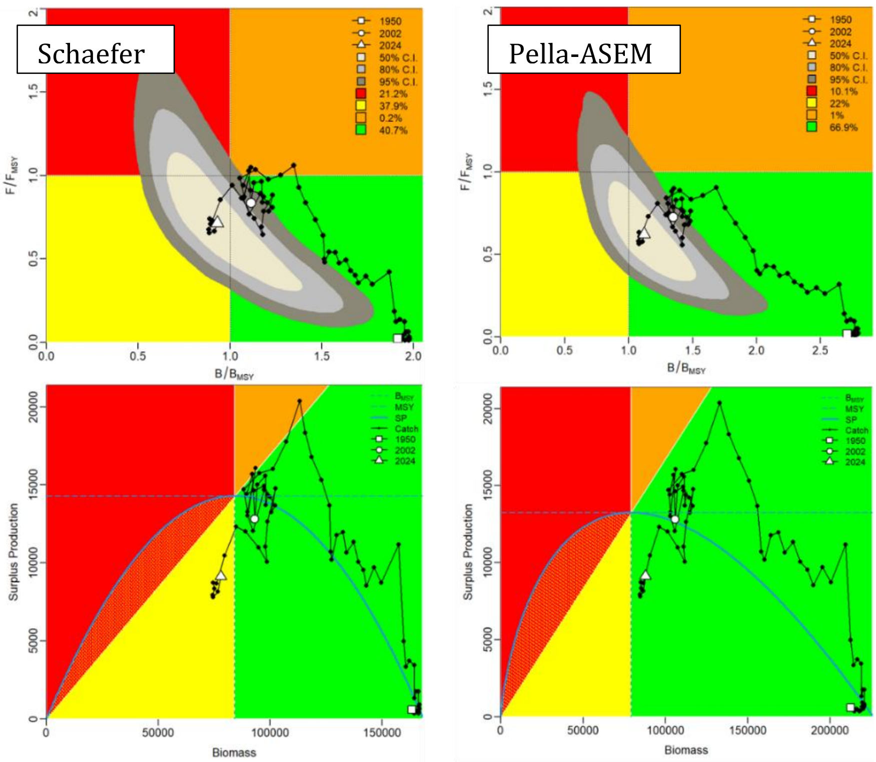


Figure 4. Kobe phase plots showing the joint posterior distributions of stock status (B/B_{MSY} and F/F_{MSY}) estimated by JABBA for Mediterranean swordfish under two alternative SPM model configurations Schaefer (left column) and Pella-Tomlinson ASEM (right column). The upper row corresponds to the Kobe plots, whereas the lower row shows the Surplus production trend. Shaded areas represent posterior Markov chain Monte Carlo (MCMC) sample confidence bounds, the white point indicates the posterior median estimate, and percentages indicate the posterior probability associated with each Kobe quadrant.

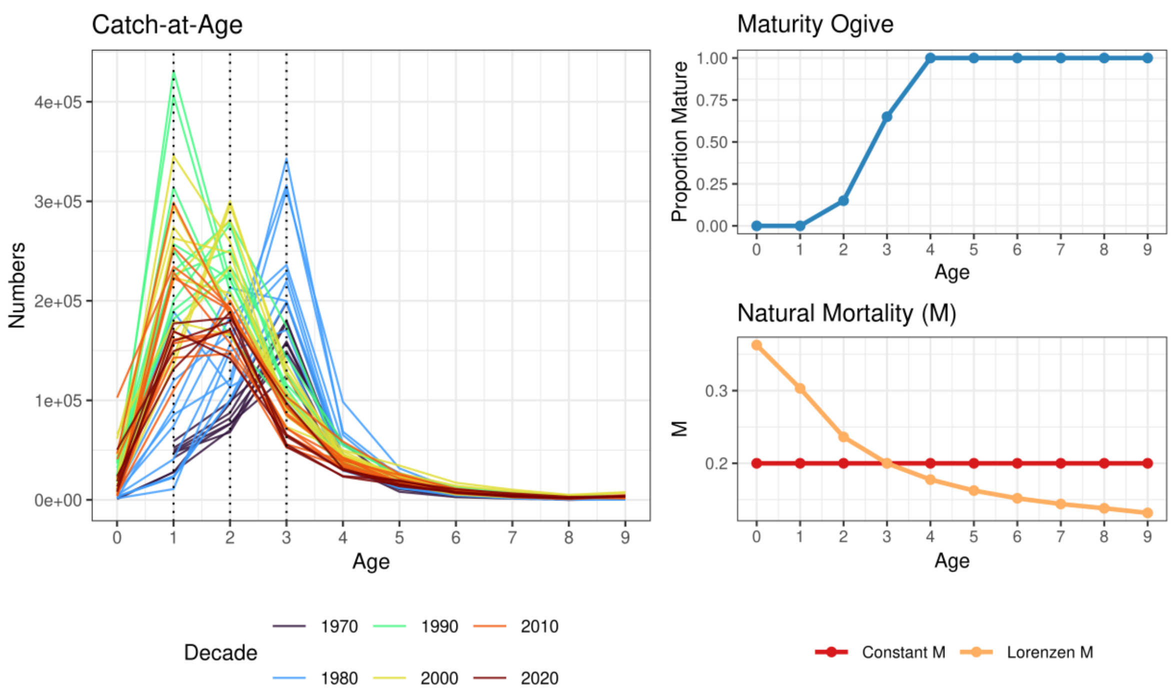


Figure 5. Input data and assumptions for the a4a model for the Mediterranean swordfish stock. Catch by age plot for every year from 1972-2024. Colours represent different decades. Maturity ogive and the two different natural mortality assumptions.

Figure 6. CPUE indices used in the a4a model for the Mediterranean swordfish stock.

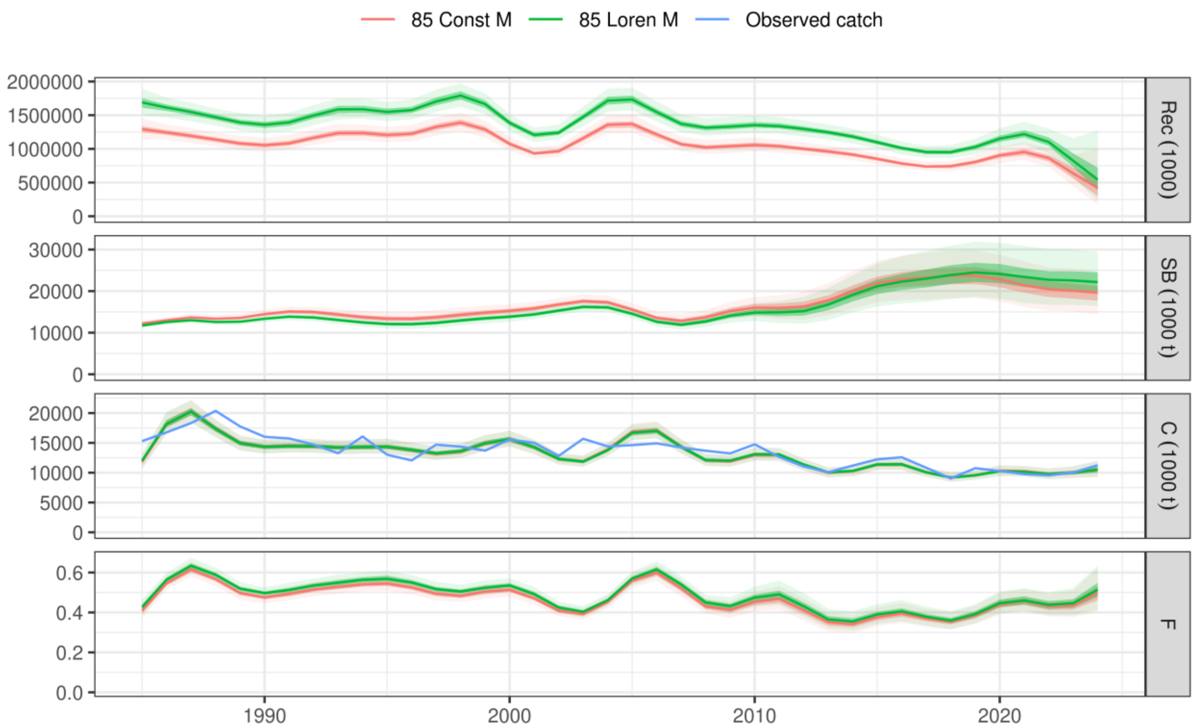


Figure 7. Stock assessment results for both for final a4a run (Constant M) for the Mediterranean swordfish stock and Lorenzen M runs.

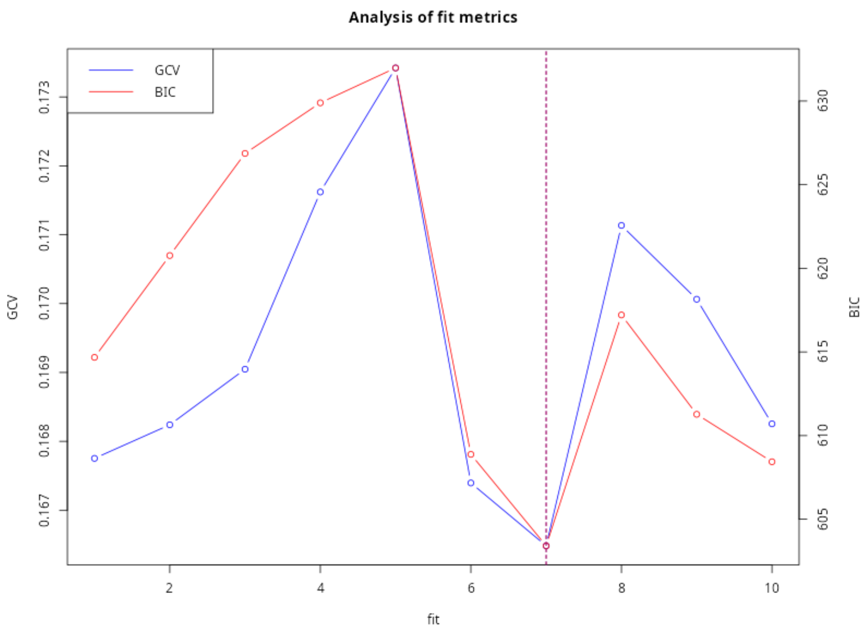


Figure 8. Exploration of the number of k's in the smoother of the fishing mortality sub-model in the A4A model for the Mediterranean swordfish stock, and more specifically on the year effect (~s(year, k = 18)) BIC: Bayesian Information Criterion, GCV: Generalized Cross Validation.

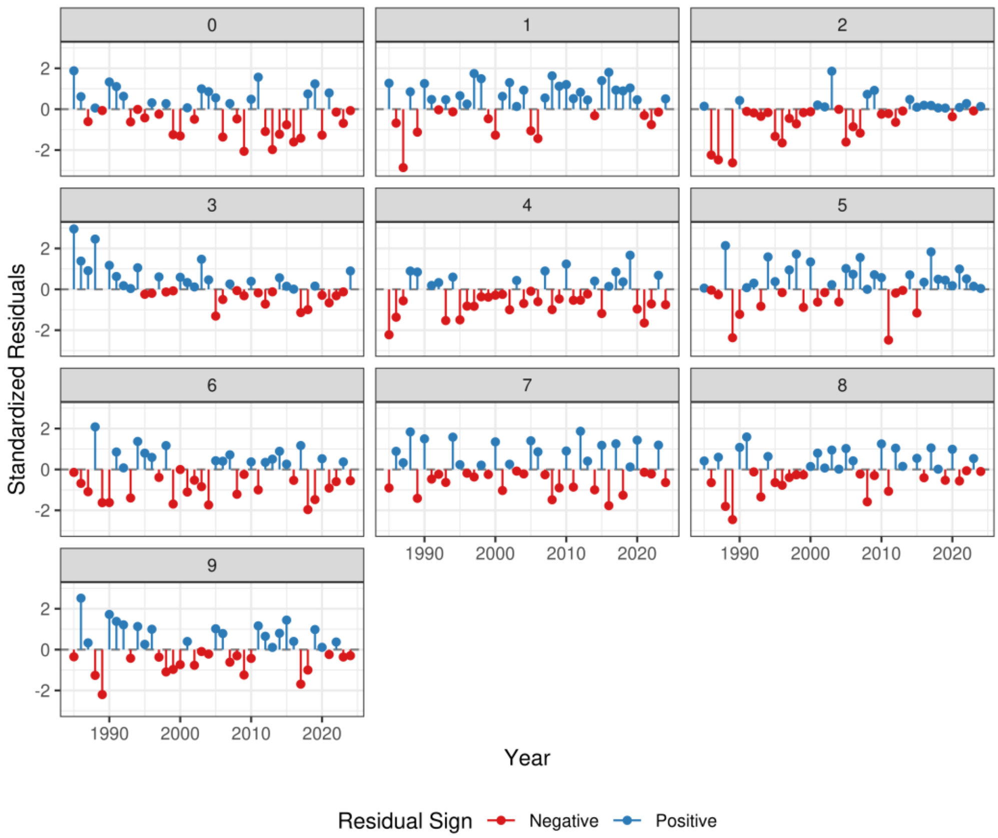


Figure 9. Catch standardized residuals by year and age for the final a4a run for the Mediterranean swordfish stock.

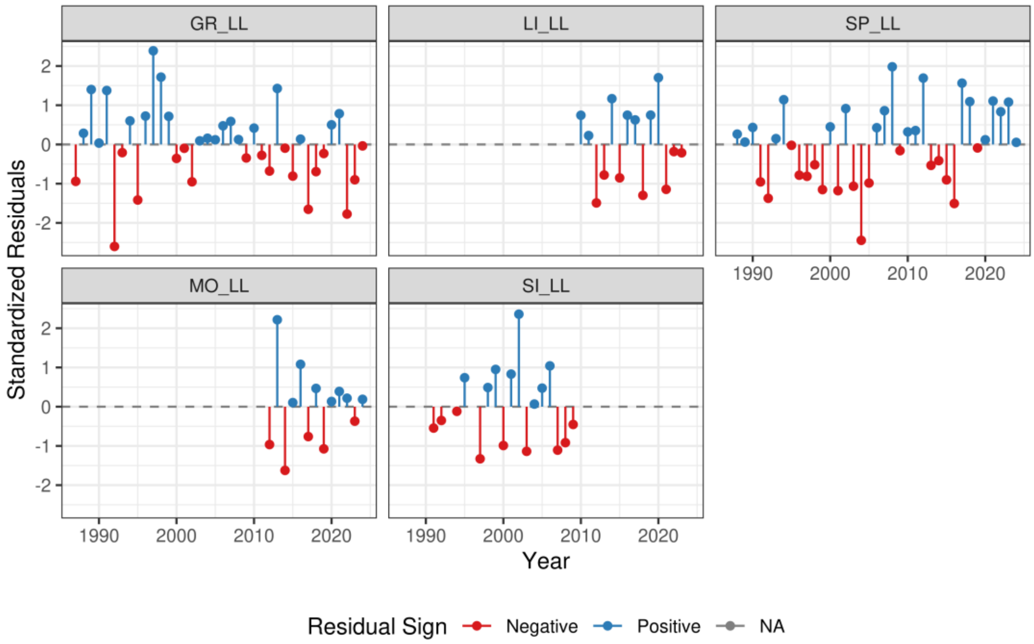


Figure 10. CPUEs standardized residuals by year for the final a4a run for the Mediterranean swordfish stock.

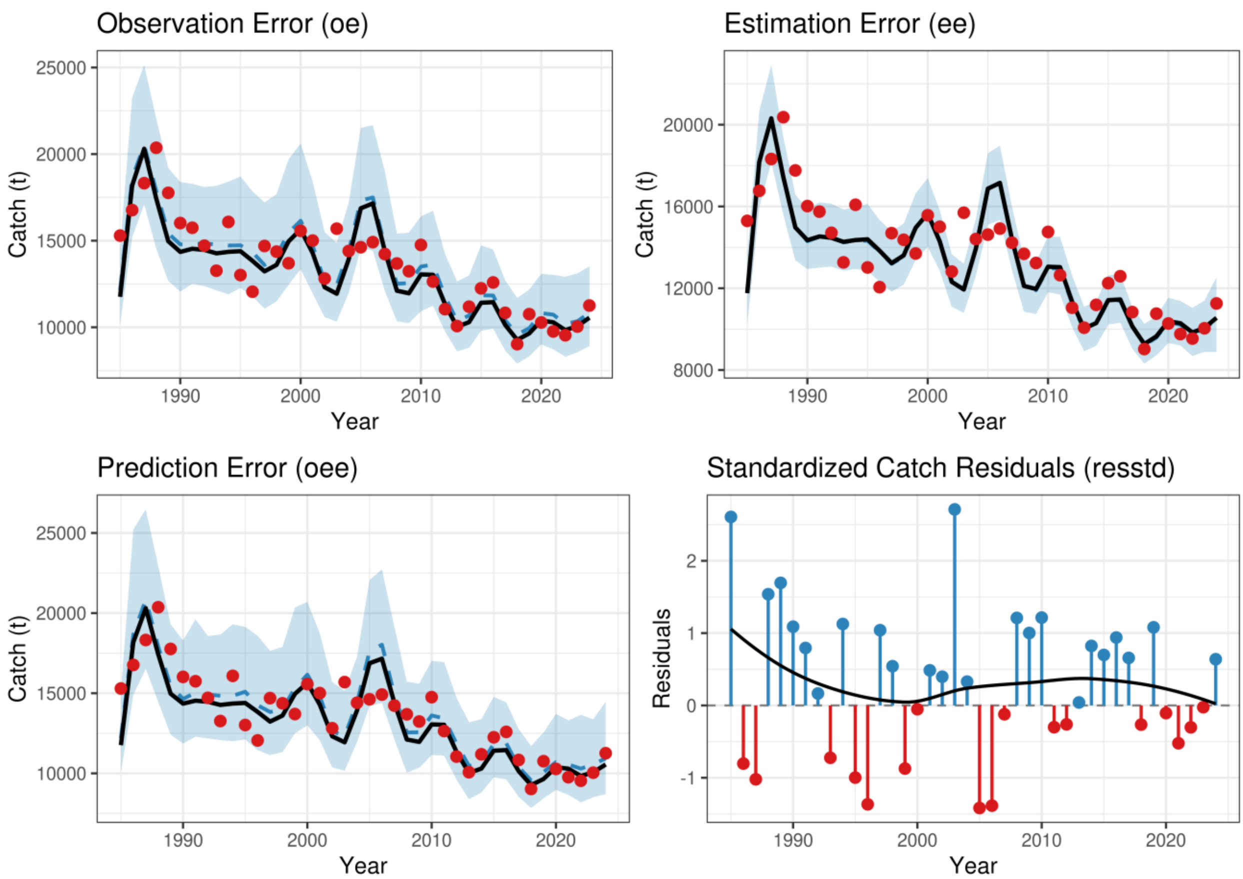
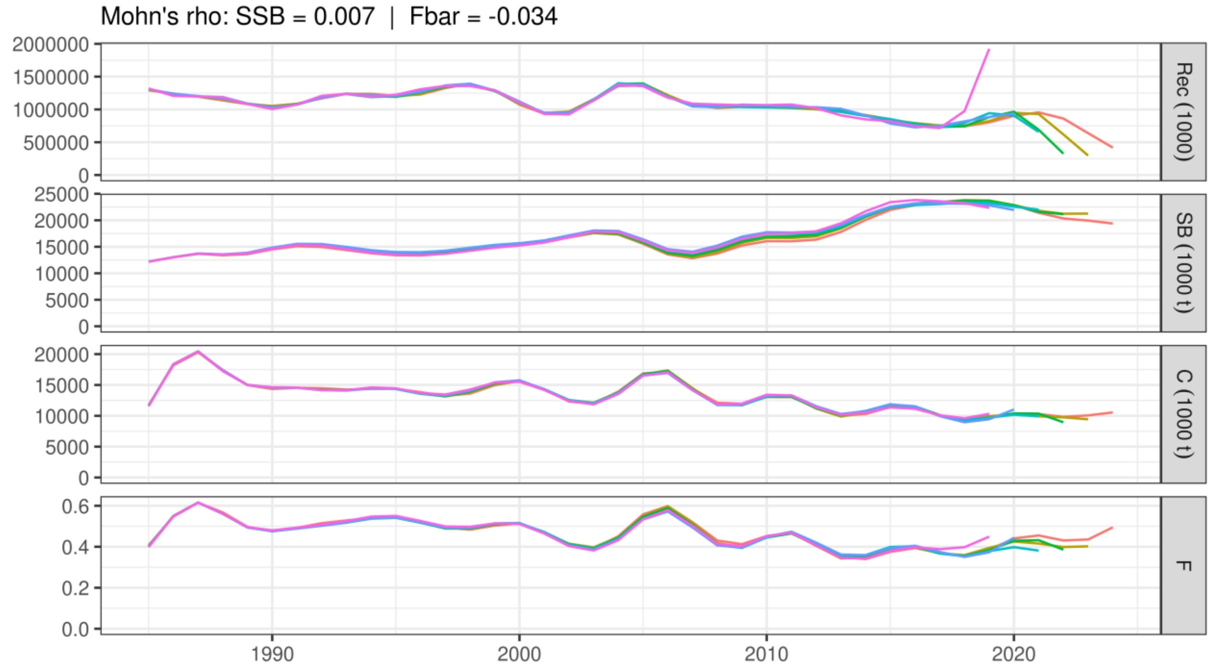


Figure 11. Aggregated catch diagnostics for the final A4A run for the Mediterranean swordfish stock, detailing the separated variance components (observation, estimation, and prediction errors) and the standardized aggregated residuals.



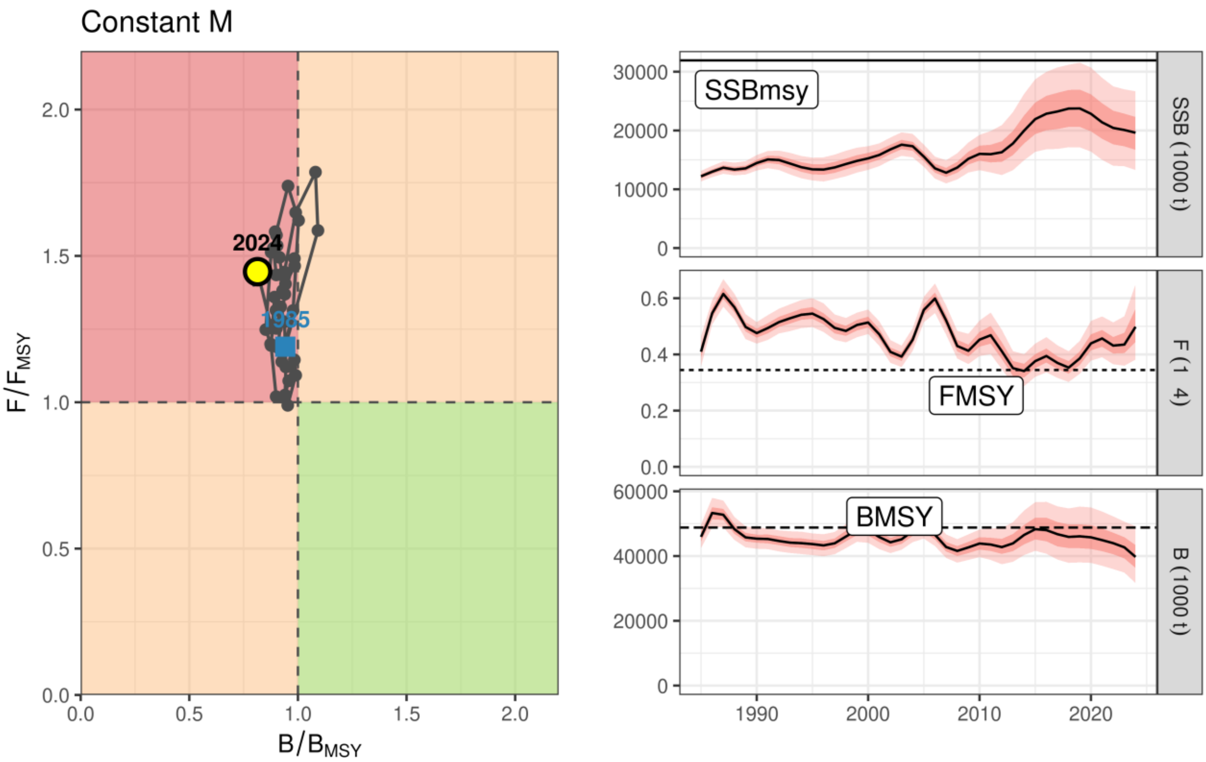


Figure 12. 5-year retrospective plot of final A4A run (constant M) for the Mediterranean swordfish stock, from top to bottom: Recruitment, Stock Spawning Biomass (SSB), Catch and Fishing mortality (F). The Mohn's rho values are also reported for SSB and F.

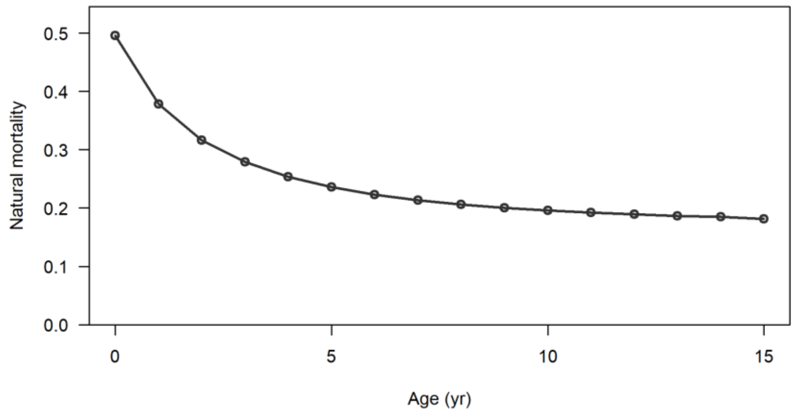


Figure 13. Estimated Lorenzen functional natural mortality by age (MAA) from the Stock Synthesis run 9 for the Mediterranean swordfish stock.

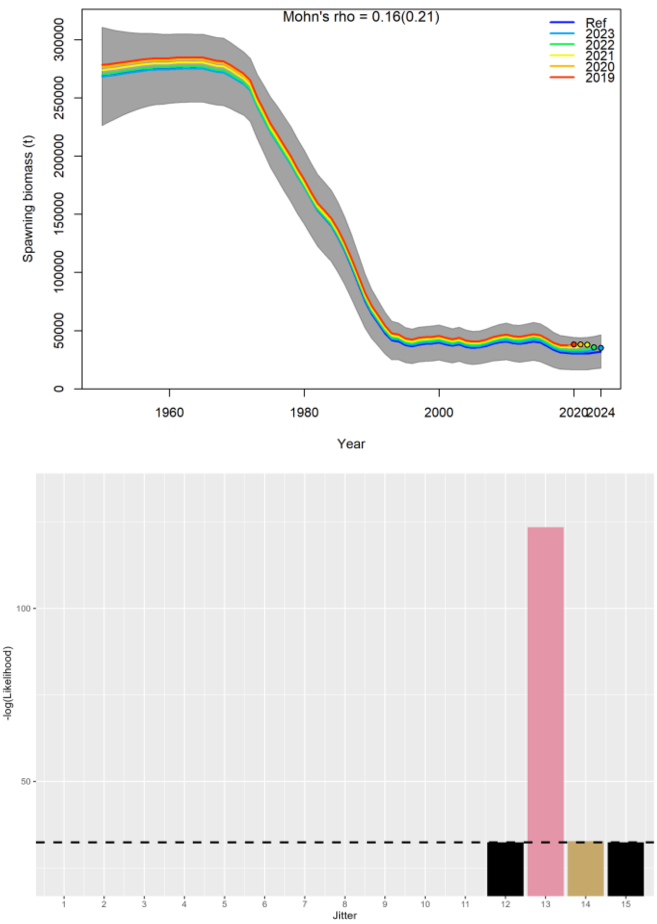


Figure 14. A 5-year retrospective plot for SSB and jitter analysis from SS3 preliminary for the Mediterranean swordfish stock.

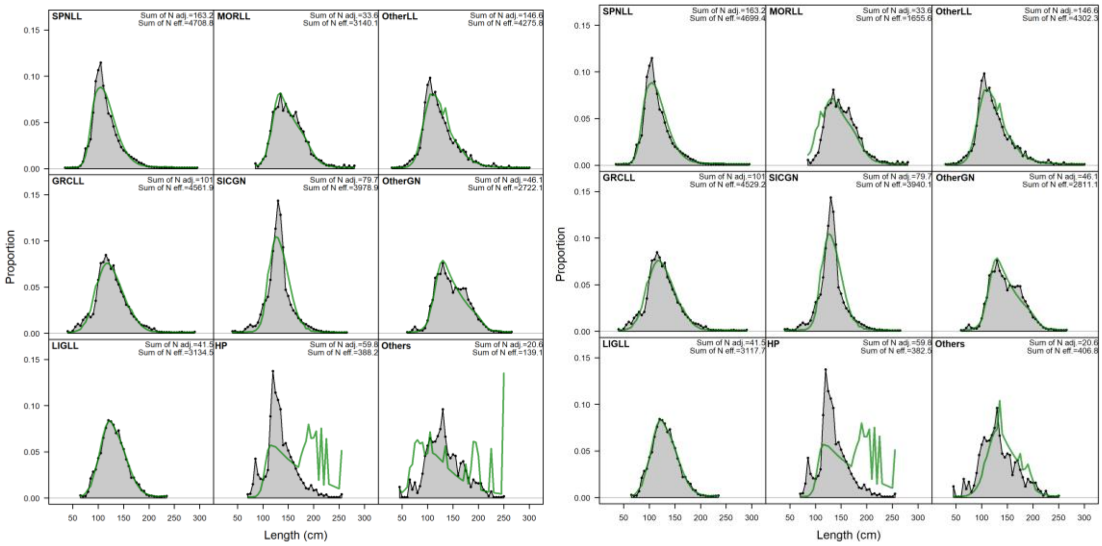


Figure 15. Fits to length composition data aggregated over the years, for each of the catch fleets in the model, from SS3 run 3 (left panels) and run 4 (right panels) for the Mediterranean swordfish stock.

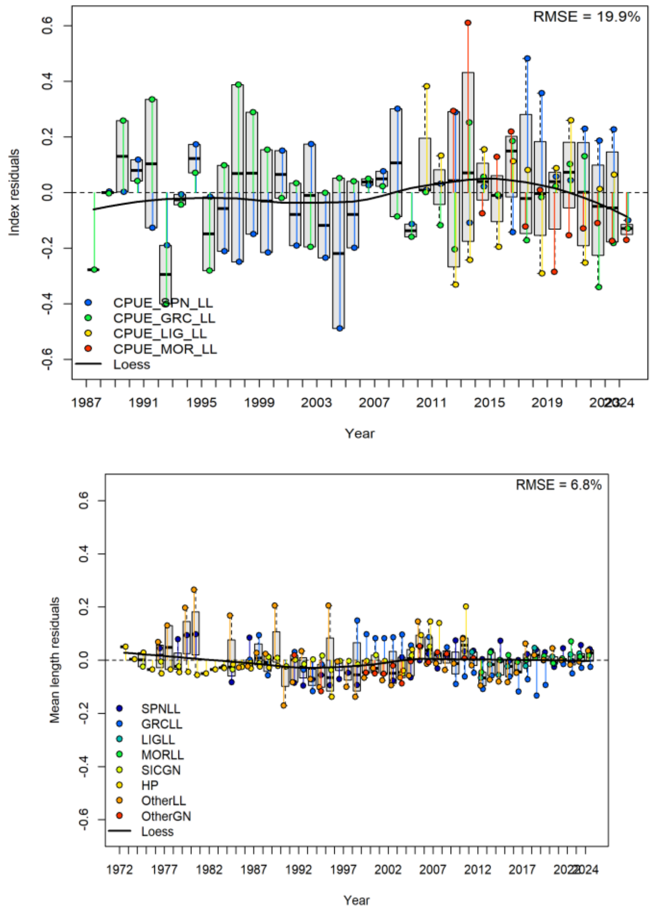


Figure 16. Residual plots for CPUE and mean length from SS3 run 9 for the Mediterranean swordfish stock.

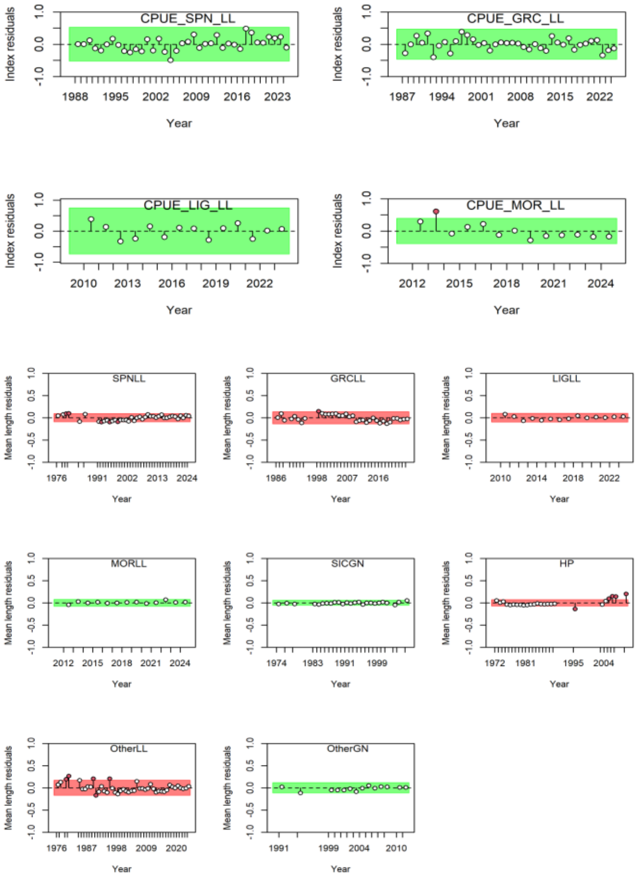


Figure 17. Runs test on the residuals of the CPUE indices (left panels) and mean length residuals by fleet (right panels) from SS3 run 9 for the Mediterranean swordfish stock. Green panels indicate runs tests consistent with random residual patterns, whereas red panels indicate significant departures from randomness.

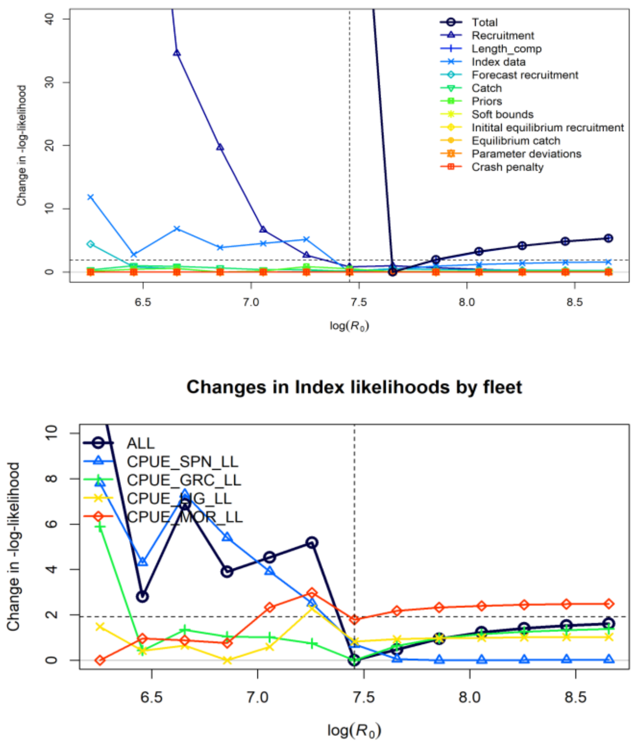


Figure 18. Likelihood profiles for log(R0) from SS3 run 9 for the Mediterranean swordfish stock. The left panel showed the contributions of the total, recruitment, length-composition, and abundance-index likelihoods. The right panel showed fleet-specific contributions from abundance-index data. The vertical dashed line indicates the estimated value of log(R0).

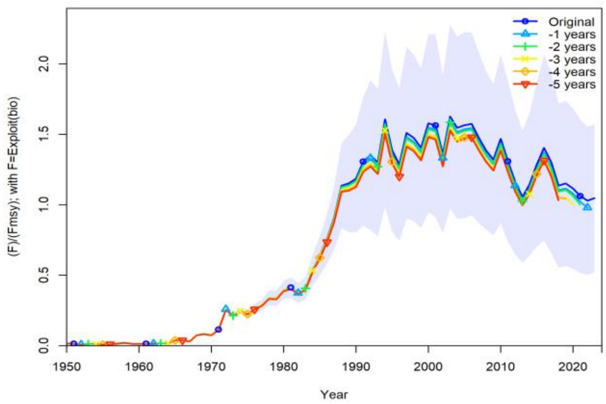


Figure 19. Five-year retrospective analysis on F/F_{MSY} from SS3 run 9 for the Mediterranean swordfish stock.

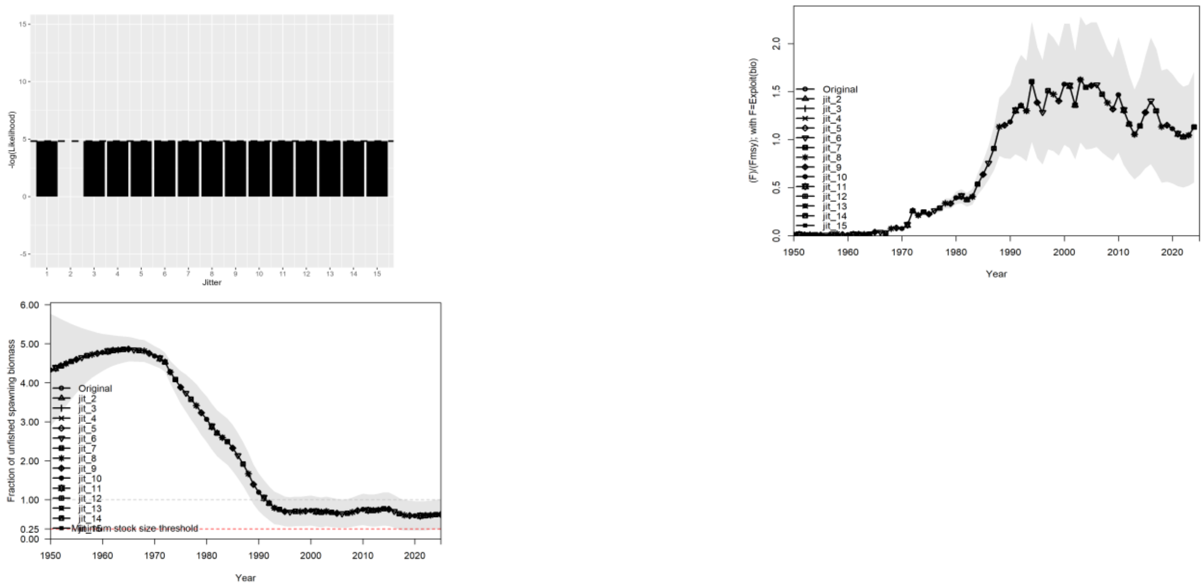


Figure 20. Jitter analysis from SS3 run 9 for the Mediterranean swordfish stock: negative loglikelihood, F/F_{MSY}, and SSB/SSB_{MSY}.

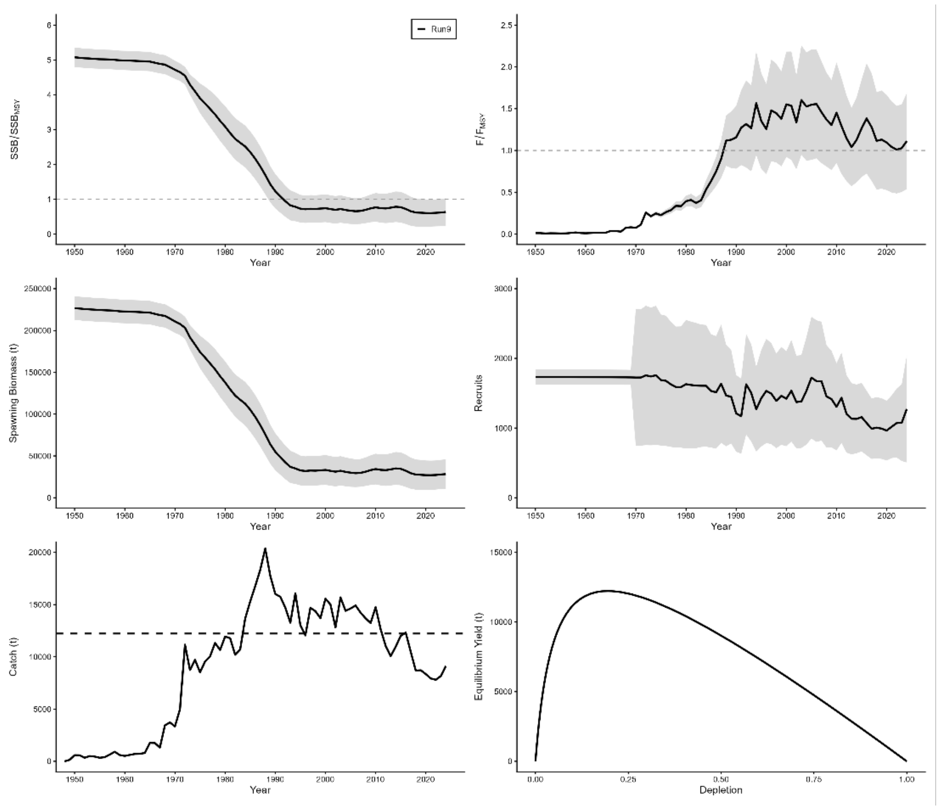


Figure 21. Stock Synthesis (SS3) outputs for Mediterranean swordfish from SS3 run 9. Panels show the trajectories of relative spawning biomass (SSB/SSB_{MSY}), relative fishing mortality (F/F_{MSY}), spawning biomass, recruitment, total catch, and equilibrium yield curves. Shaded areas represent 95% credibility intervals derived from the standard deviations estimated in SS3.

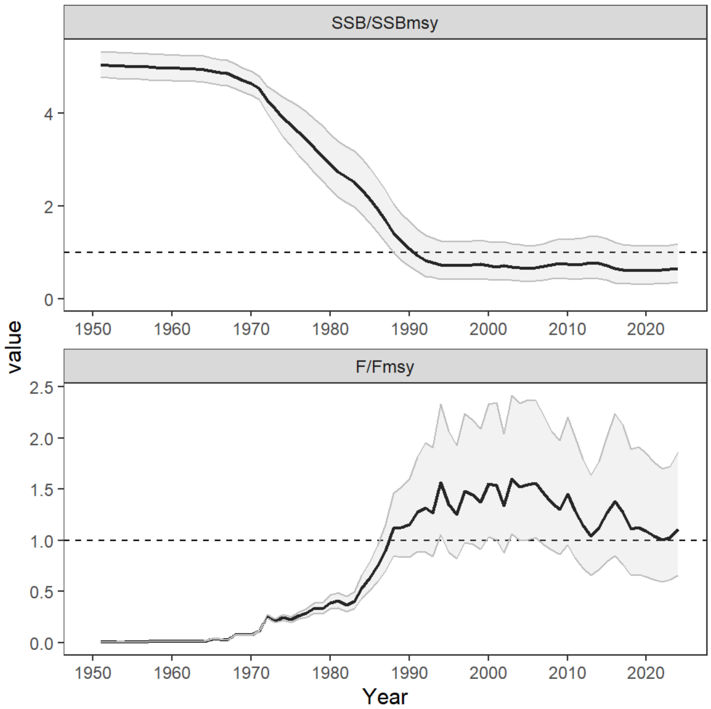


Figure 22. Estimated trajectories of relative spawning biomass (SSB/SSB_{MSY}; upper panel) and relative fishing mortality (F/F_{MSY}; lower panel) from the final Stock Synthesis scenario (run 9), built with 10,000 iterations based on the Monte-Carlo multivariate lognormal (MVLN) approach for the Mediterranean swordfish. Trajectories were produced with SSB at the end of each year. The shaded area represents a 95% confidence interval, and the horizontal dashed lines indicate the management reference points (SSB/SSB_{MSY} = 1 and F/F_{MSY} = 1).

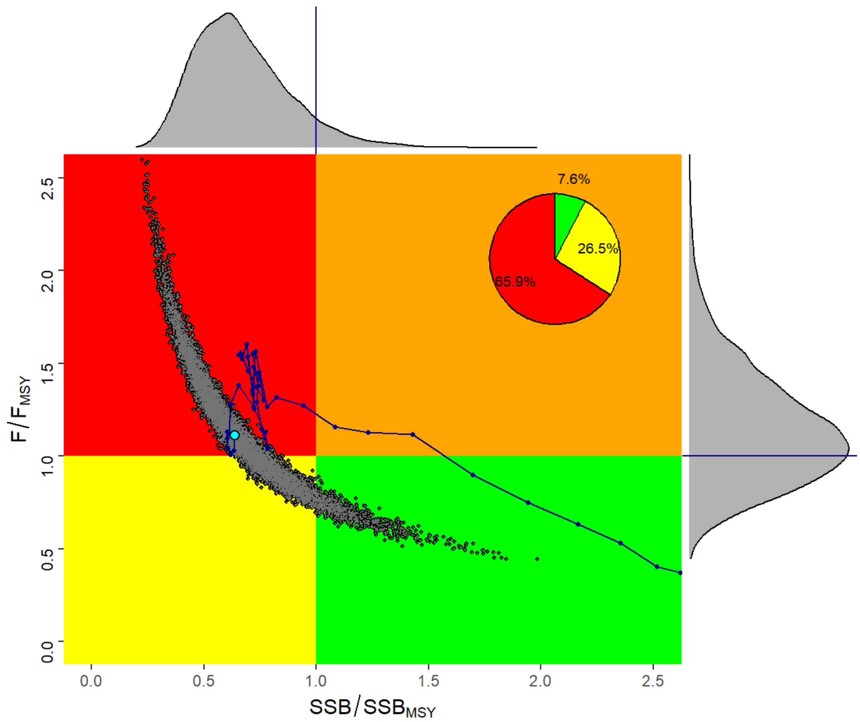


Figure 23. Kobe phase plot from the final Stock Synthesis scenario (run 9) obtained with 10,000 MVLN iterations for the Mediterranean swordfish. Solid blue dots and line indicate the stock status trajectory, with the light green dot indicating the terminal year (2024), grey dots are the interactions for the terminal year with the marginal distributions plotted in the lateral axis. Trajectory (starting in 1982 in the figure) and Kobe plot were produced with SSB at the end of each year.

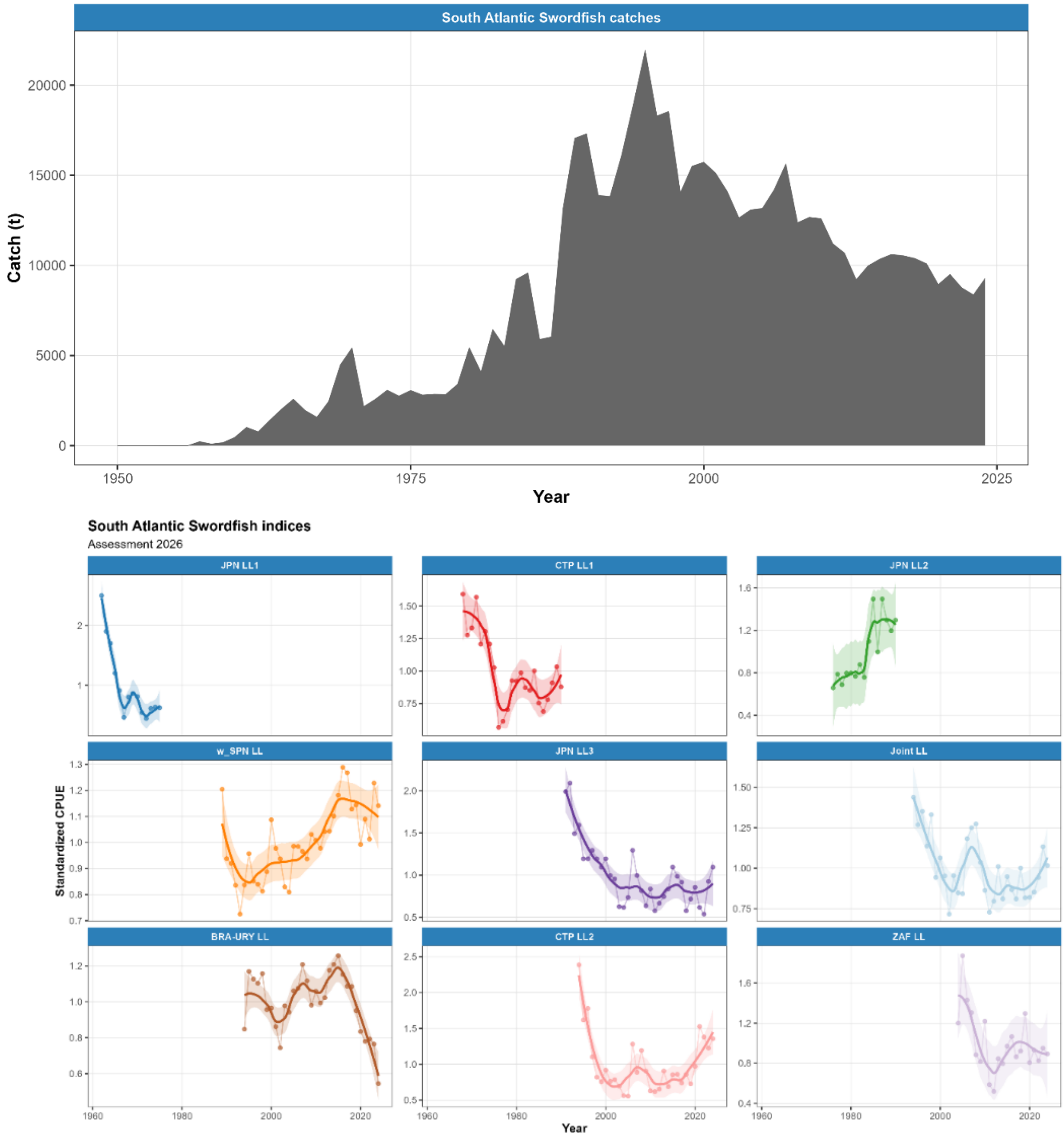


Figure 24. Catch and CPUE data used in the 2026 South Atlantic swordfish assessment. The upper panel shows annual catches (1950–2024), while the remaining panels present the standardized CPUE indices considered in the analyses. Points represent annual observations, solid lines show smoothed trends, and shaded areas indicate approximately 95% credibility intervals. The Joint_CPUE and All_CPUEs configurations were constructed from alternative subsets of these indices.

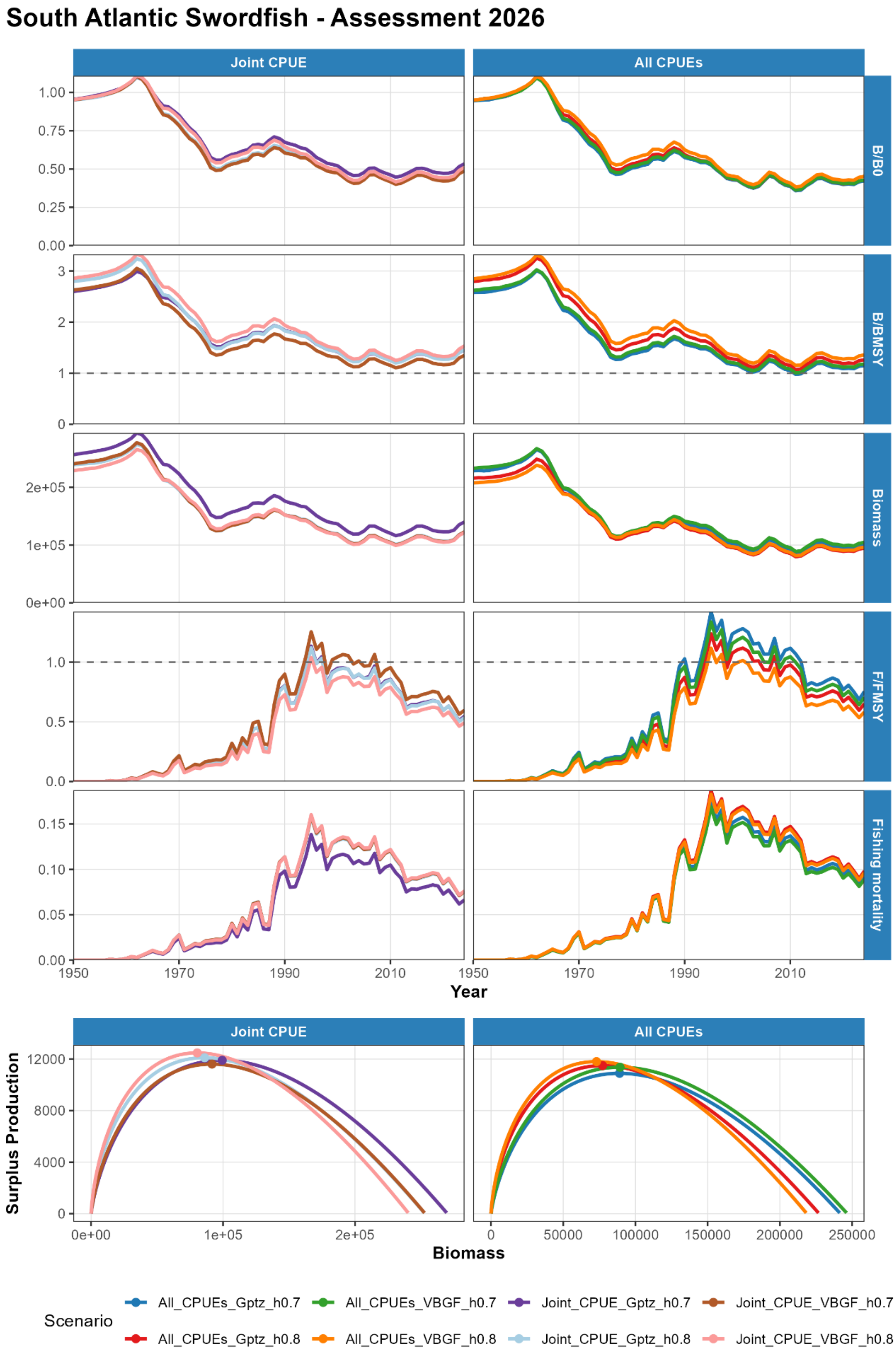


Figure 25. Historical trajectories of stock biomass, stock status, fishing mortality, and surplus production estimated under alternative biological prior scenarios for the "Joint_CPUE" and "All_CPUEs" configurations. Panels show trajectories of B/B_0, B/B_{MSY}, biomass, F/F_{MSY}, and fishing mortality through time. Dashed horizontal lines indicate B_{MSY} and F_{MSY} reference levels. The lower panels show surplus-production curves and associated estimates of B_{MSY}. Results were broadly consistent among biological scenarios and abundance-index configurations, indicating limited sensitivity of stock-status estimates to alternative biological assumptions.

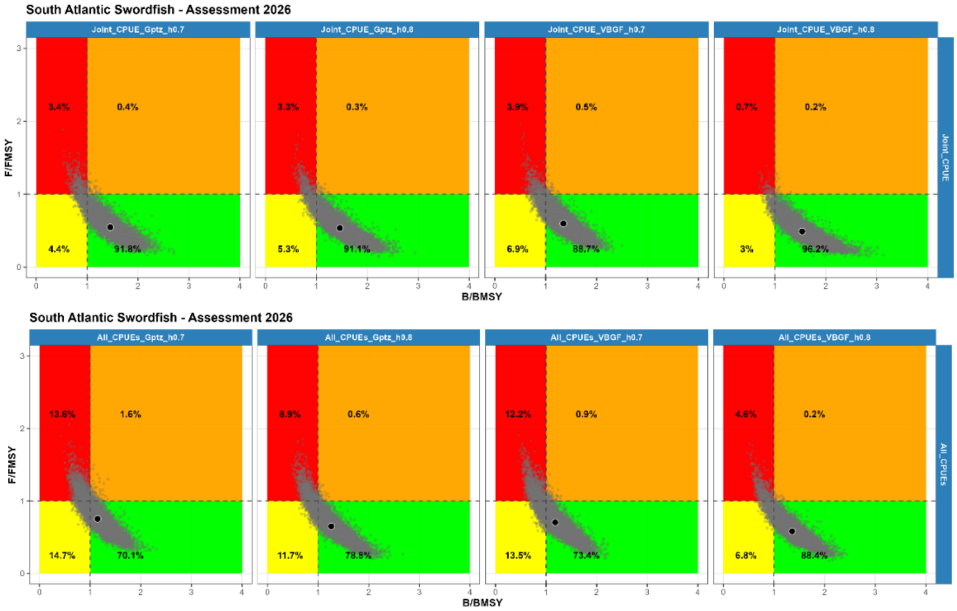


Figure 26. Kobe phase plots showing the joint posterior distributions of stock status (B/B_{MSY} and F/F_{MSY}) estimated by JABBA for South Atlantic swordfish under eight alternative model configurations. The upper row corresponds to the Joint_CPUE scenarios, whereas the lower row shows the All_CPUEs scenarios. Columns represent the four biological prior combinations derived from the Age Structured Estimation Model (ASEM): Gompertz (h = 0.7), Gompertz (h = 0.8), VBGF (h = 0.7), and VBGF (h = 0.8). Grey points represent posterior MCMC samples, the white point indicates the posterior median estimate, and percentages indicate the posterior probability associated with each Kobe quadrant.

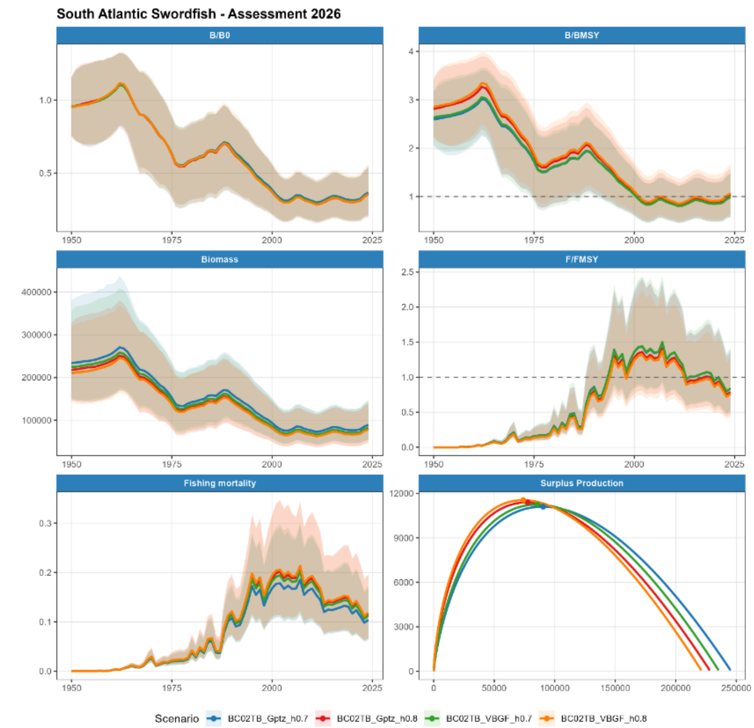


Figure 27. Historical trajectories of stock biomass, stock status, fishing mortality, and surplus production estimated for the four BC02-TB scenarios, in which the Spanish longline (w_SPN LL) abundance index was split into two time blocks (1989–1999 and 2000–2024). Panels show trajectories of B/B_0, B/B_{MSY}, biomass, F/F_{MSY}, and fishing mortality through time. Dashed horizontal lines indicate the B_{MSY} and F_{MSY} reference levels. The lower-right panel shows the surplus-production curves and corresponding estimates of B_{MSY}. Stock trajectories were highly consistent among the alternative biological prior scenarios, indicating that the incorporation of the time-block structure had a greater influence on stock status than the alternative growth and steepness assumptions.

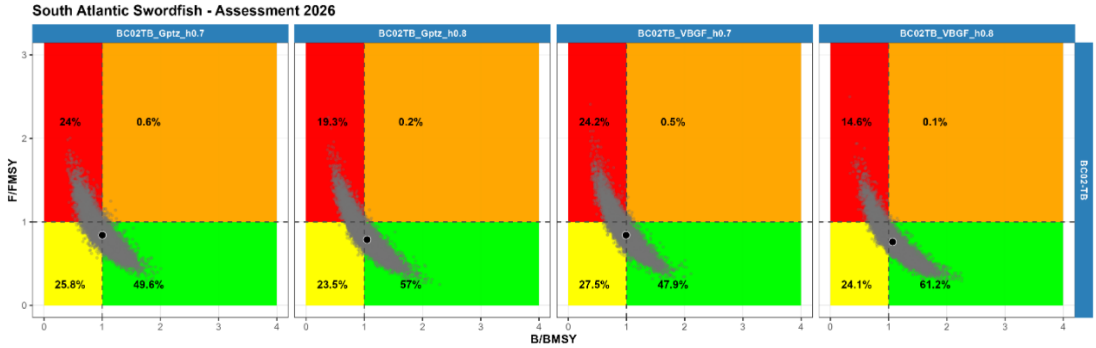


Figure 28. Kobe phase plots showing the joint posterior distributions of stock status (B/B$_{MSY}$ and F/F$_{MSY}$) estimated by JABBA for South Atlantic swordfish under the four BC02-TB scenarios, in which the w_SPN LL abundance index was split into two time blocks (1989–1999 and 2000–2024). The panels represent the four biological prior combinations derived from the Age Structured Estimation Model (ASEM): Gompertz (*h* = 0.7), Gompertz (*h* = 0.8), VBGF (*h* = 0.7), and VBGF (*h* = 0.8). Grey points represent posterior MCMC samples, the black point indicates the posterior median estimate, and percentages indicate the posterior probability associated with each Kobe quadrant. The posterior median stock status remained within the Kobe green quadrant for all scenarios, although the inclusion of the time-block structure resulted in a lower probability of the stock occurring in the green quadrant compared with the initial model configurations.

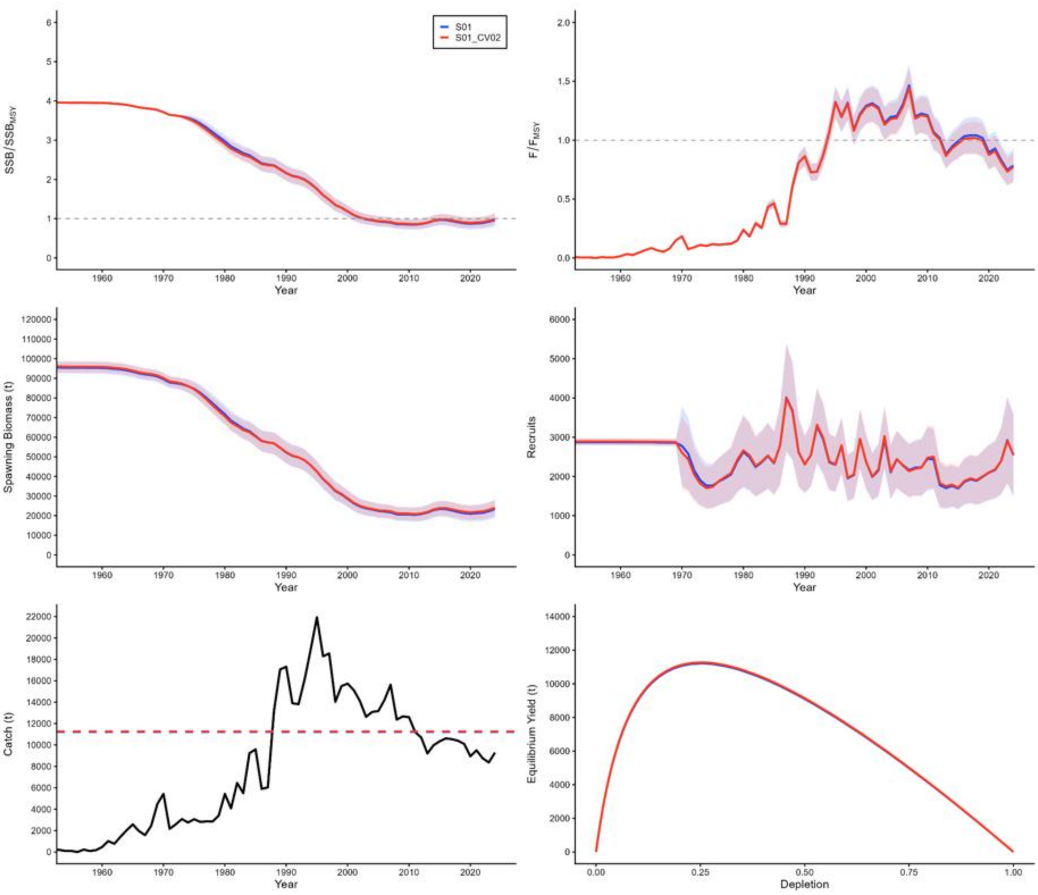


Figure 29. Comparison of Stock Synthesis (SS3) outputs for South Atlantic swordfish for the Scenario 01 (SCRS/2026/166) and the same scenario considering a CV=0.2. Panels show the trajectories of relative spawning biomass (SSB/SSB$_{MSY}$), relative fishing mortality (F/F$_{MSY}$), spawning biomass, recruitment, total catch, and equilibrium yield curves. Shaded areas represent 95% credibility intervals derived from the standard deviations estimated in the SS3. In the catch panel, the solid black line represents the historical total catch trajectory, while the coloured dashed horizontal lines indicate the estimated MSY for each model scenario.

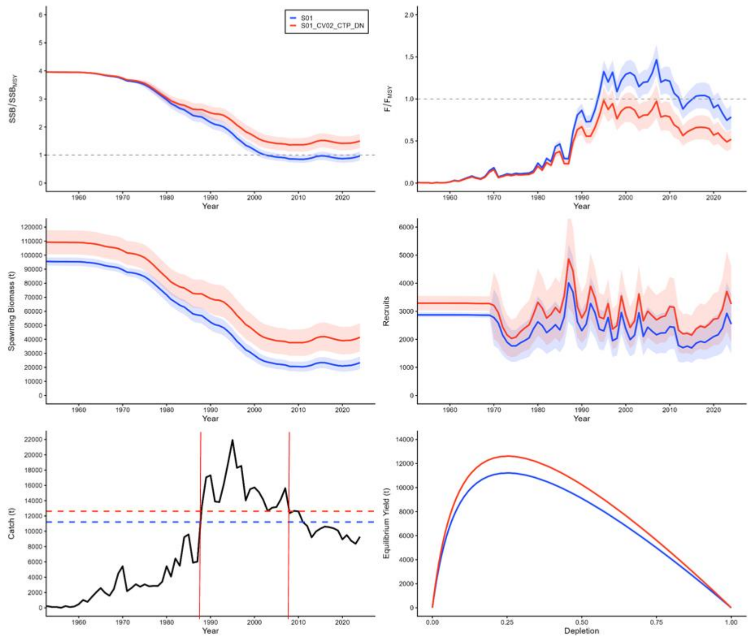


Figure 30. Comparison of Stock Synthesis (SS3) outputs for South Atlantic swordfish for the Scenario 01 (SCRS/2026/166) and the same scenario considering a DN selectivity for the end of the time series for Chinese Taipei fleet. Right panels show the trajectories of relative spawning biomass (SSB/SSB_{MSY}), relative fishing mortality (F/F_{MSY}), spawning biomass, recruitment, total catch, and equilibrium yield curves. Shaded areas represent 95% credibility intervals derived from the standard deviations estimated in the SS3. In the catch panel, the solid black line represents the historical total catch trajectory, while the coloured dashed horizontal lines indicate the estimated MSY for each model scenario. The vertical red lines in the bottom left panel represent the period in which the catches were above the estimated MSY for the scenario that considered the double-normal selectivity for the Chinese Taipei fleet.

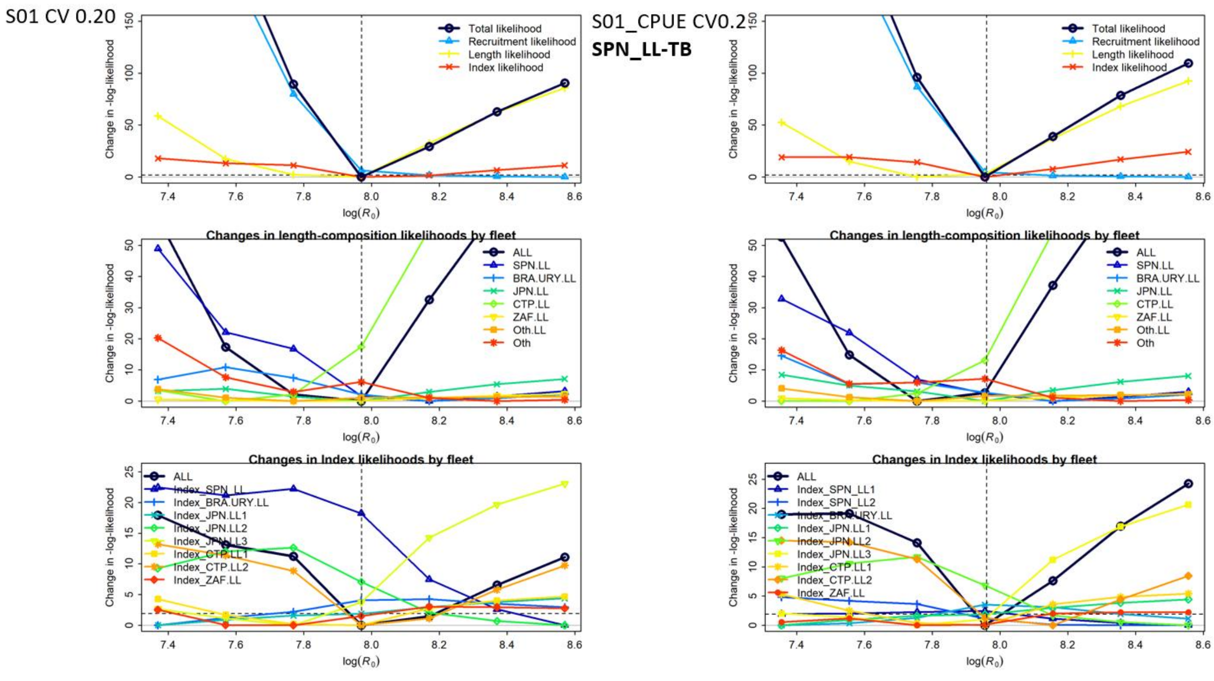


Figure 31. Likelihood profiles for log(R0) for the S01_CV0.2 (left) and S01_CPUE_CV0.2_SPN LL TB (right) scenarios. Top panels show the contributions of the total, recruitment, length composition, and abundance-index likelihoods. Middle and bottom panels show fleet-specific contributions from length-composition and abundance-index data, respectively. The vertical dashed line indicates the estimated value of log(R0).

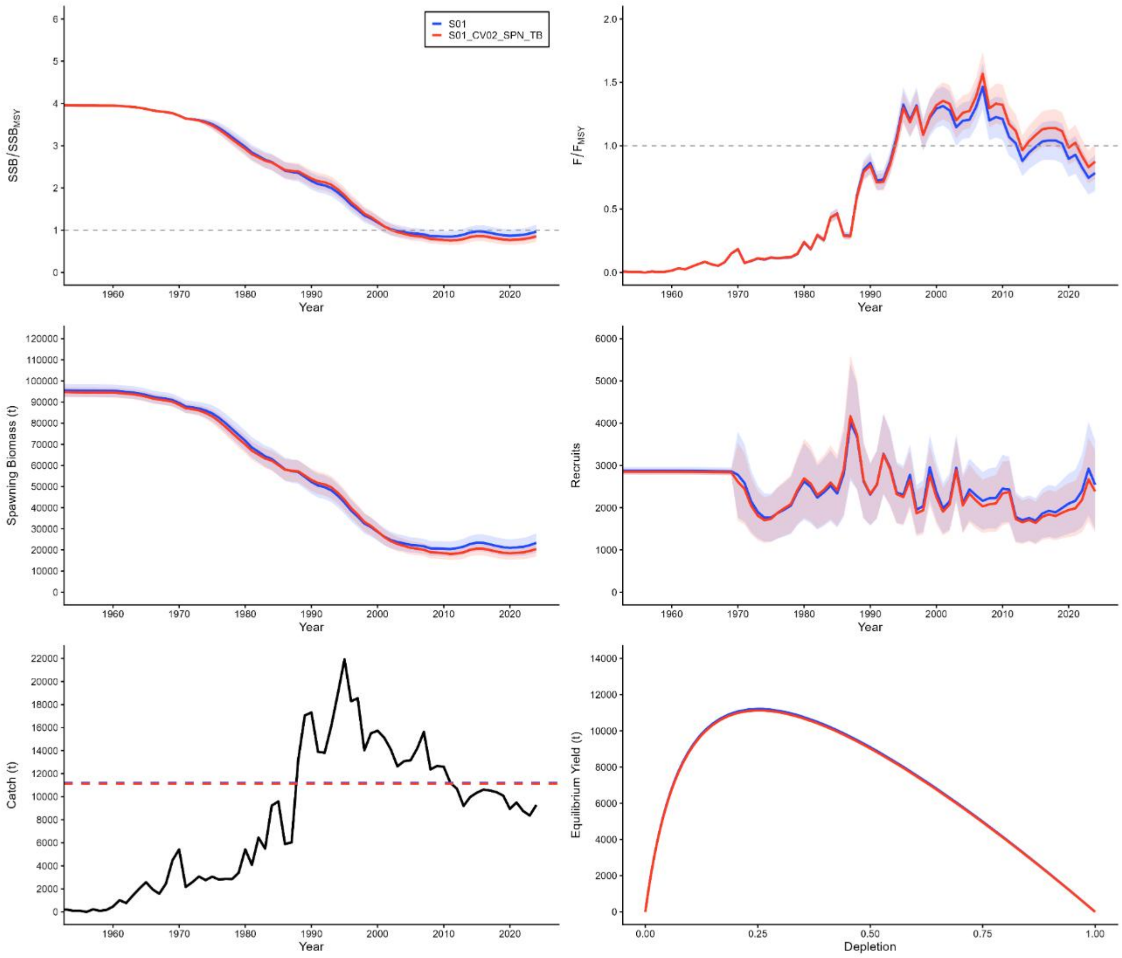


Figure 32. Comparison of Stock Synthesis (SS3) outputs for South Atlantic swordfish for the Scenario 01 (SCRS/2026/166) and the same scenario with a time block for the Spanish index. Panels show the trajectories of relative spawning biomass (SSB/SSB$_{MSY}$), relative fishing mortality (F/F$_{MSY}$), spawning biomass, recruitment, total catch, and equilibrium yield curves. Shaded areas represent 95% credibility intervals derived from the standard deviations estimated in the SS3. In the catch panel, the solid black line represents the historical total catch trajectory, while the coloured dashed horizontal lines indicate the estimated MSY for each model scenario.

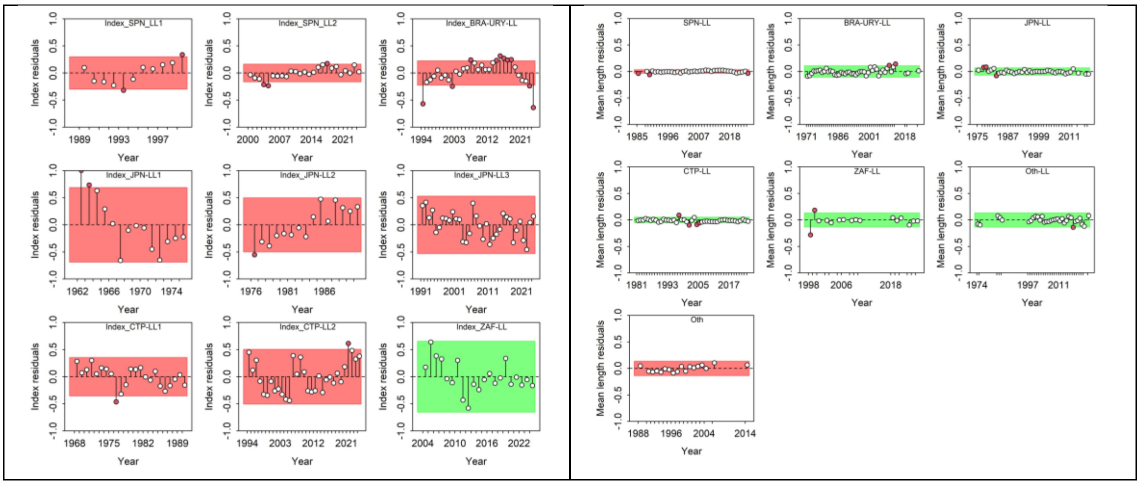


Figure 33. Index (left panel) and mean length residuals (right panel) by fleet outputs for South Atlantic swordfish for the Scenario 01 (SCRS/2026/166) model configuration with a time-block for the Spanish index. Green panels indicate runs tests consistent with random residual patterns, whereas red panels indicate significant departures from randomness.

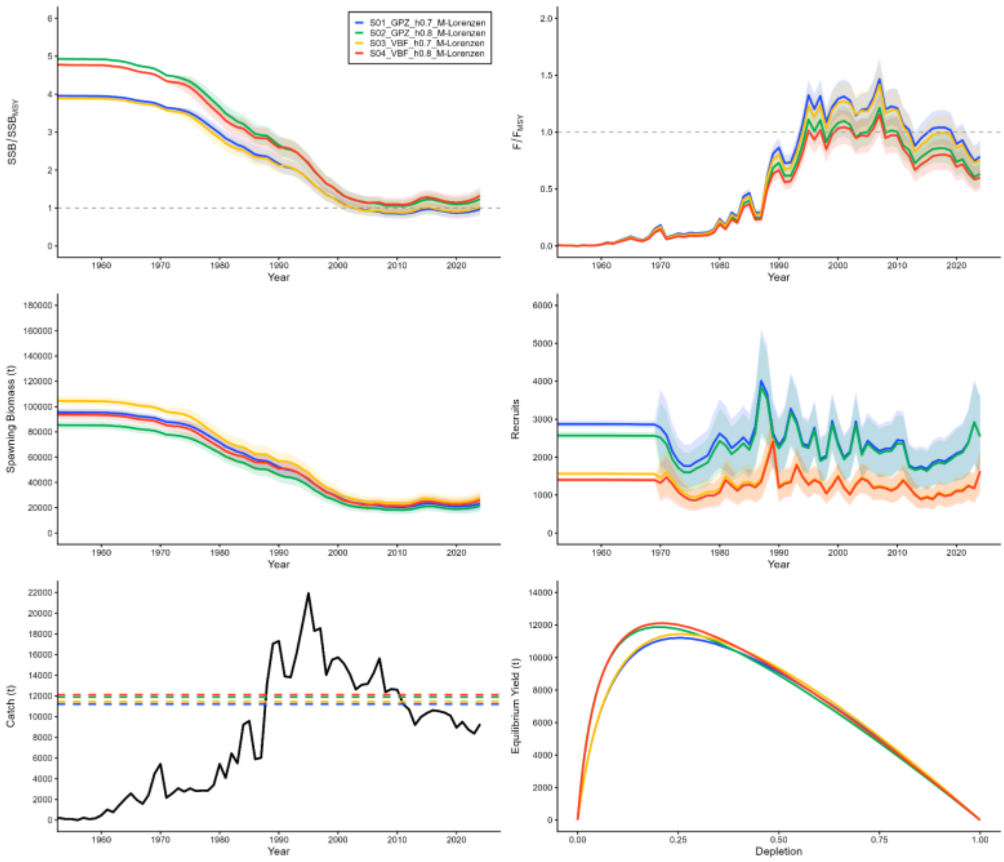


Figure 34. Comparison of Stock Synthesis (SS3) outputs for South Atlantic swordfish under alternative life-history scenarios and the Lorenzen M-at-age assumption. Panels show the trajectories of relative spawning biomass (SSB/SSB_{MSY}), relative fishing mortality (F/F_{MSY}), spawning biomass, recruitment, total catch, and equilibrium yield curves. Shaded areas represent 95% credibility intervals derived from the standard deviations estimated in SS3. In the catch panel, the solid black line represents the historical total catch trajectory, while the coloured dashed horizontal lines indicate the estimated MSY for each model scenario.

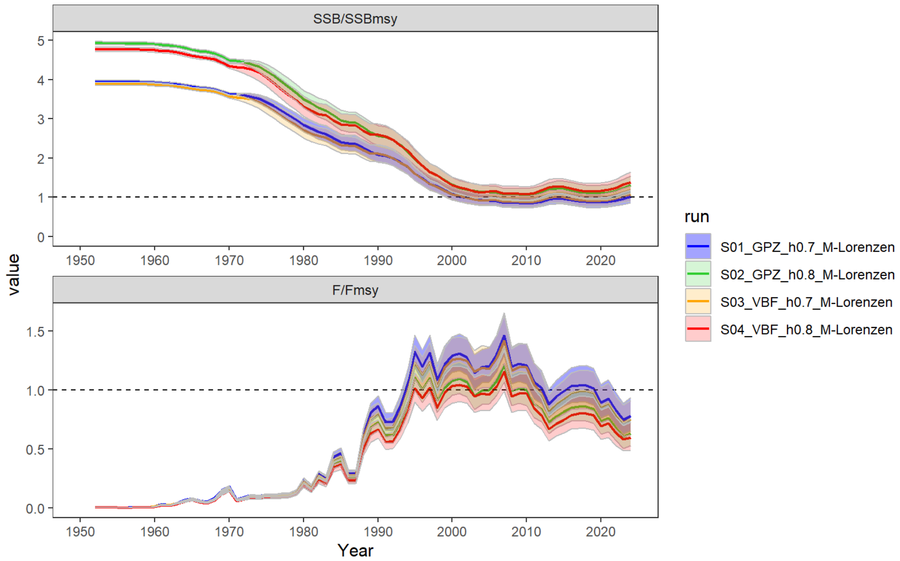


Figure 35. Comparison of SSB/SSB$_{MSY}$ and F/F$_{MSY}$ trajectories from the four Stock Synthesis scenarios outputs for South Atlantic swordfish with the 95% credibility intervals, built with 10,000 iterations based on the Monte-Carlo multivariate lognormal (MVLN) approach. Trajectories were produced with SSB at the end of each year.

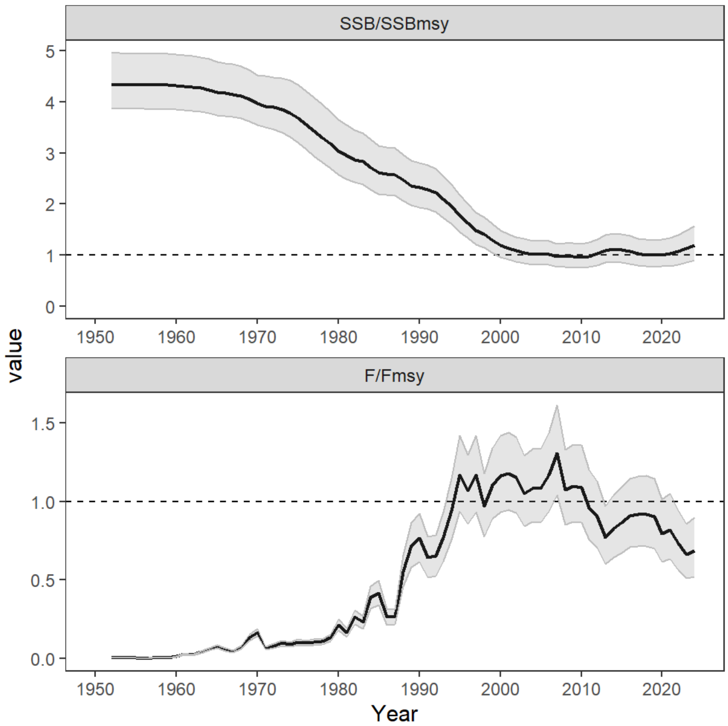


Figure 36. Estimated trajectories of relative spawning biomass (SSB/SSB$_{MSY}$; upper panel) and relative fishing mortality (F/F$_{MSY}$; lower panel) from the joint four Stock Synthesis scenarios outputs for South Atlantic swordfish, built with 10,000 iterations based on the Monte-Carlo multivariate lognormal (MVLN) approach for the South Atlantic Swordfish. Trajectories were produced with SSB at the end of each year. The shaded area represents a 95% confidence interval, and the horizontal dashed lines indicate the management reference points (SSB/SSB$_{MSY}$ = 1 and F/F$_{MSY}$ = 1).

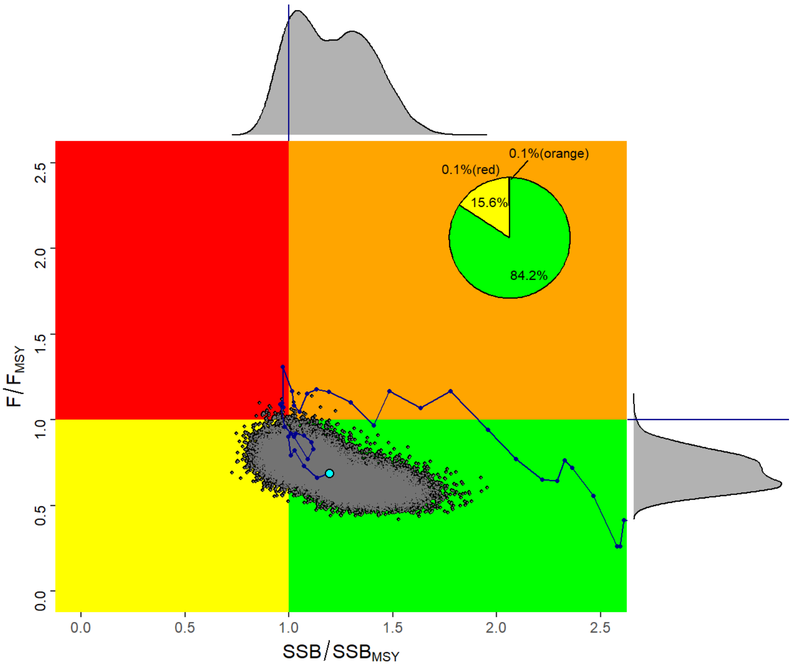


Figure 37. Kobe phase plot from the joint results from the four Stock Synthesis scenarios obtained with 4x10,000 MVLN iterations for the South Atlantic swordfish. Solid blue dots and line indicate the stock status trajectory, with the light green dot indicating the terminal year (2024), grey dots are the interactions for the terminal year with the marginal distributions plotted in the lateral axis. Trajectory (starting in 1985 in the figure) and Kobe plot were produced with SSB at the end of each year.

Figure 38. Projected SSB/SSB$_{MSY}$ trajectories across constant TAC scenarios for the joint Stock Synthesis model for the South Atlantic swordfish stock. Zero catch scenarios are shown in red, and the coloured lines show the constant catch stock projection scenarios between 6,000 t and 15,000 t for the period 2027 to 2043.

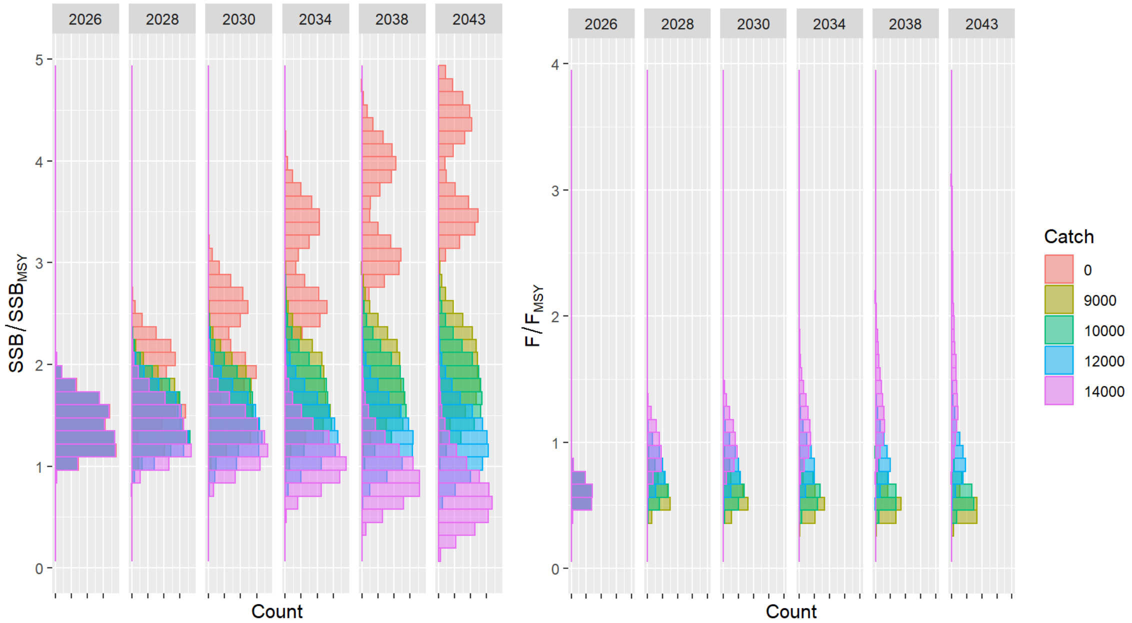


Figure 39. Histogram of SSB/SSB$_{MSY}$ and F/F$_{MSY}$ with 0 t, 9000 t, 10000 t, 12000 t, and 14000 t constant catch scenarios by year (2026, 2028, 2030, 2034, 2038, and 2043) from the combined projections for the South Atlantic swordfish stock.

Appendix 1

Agenda

1. Opening, adoption of the agenda and meeting arrangements
2. Review of updates to data inputs
3. Mediterranean assessment models
    - 3.1 JABBA
        - 3.1.1 Model settings
        - 3.1.2 Diagnostics
        - 3.1.3 Stock status results
    - 3.2 a4a
        - 3.2.1 Model settings
        - 3.2.2 Diagnostics
        - 3.2.3 Stock status results
    - 3.3 Stock Synthesis
        - 3.3.1 Model settings
        - 3.3.2 Diagnostics
        - 3.3.3 Stock status results
    - 3.4 Synthesis of Mediterranean assessment results

4. South Atlantic assessment models
    - 4.1 JABBA
        - 4.1.1 Model settings
        - 4.1.2 Diagnostics
        - 4.1.3 Stock status results
    - 4.2 Stock Synthesis
        - 4.2.1 Model settings
        - 4.2.2 Diagnostics
        - 4.2.3 Stock status results
    - 4.3 Synthesis of South Atlantic assessment results

5. Projections
    - 5.1 Mediterranean assessment
    - 5.2 South Atlantic assessment

6. North Atlantic MSE updates
7. Recommendations
8. Responses to the Commission
9. Review of the workplan
    - 9.1 Intersessional work in 2026
    - 9.2 Workplan for 2027
10. Other matters
11. Adoption of the report and closure

Appendix 2

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Appendix 3

List of papers and presentations

Document	Title	Authors
SCRS/2026/090	Estimation of undersize Mediterranean swordfish (*Xiphias gladius*) dead discards between 2019–2024 for the main longline fleets	Ortiz M., and Kimoto A.
SCRS/2026/166	Southern SWO stock assessment using Stock Synthesis	Kikuchi E., Mourato B., Sant'Ana R., Gillespie K., and Cardoso L.G.
SCRS/2026/167	Age and growth of South Atlantic and Mediterranean swordfish (*Xiphias gladius*) stocks based on spines and otoliths	Rosa D., Krusic-Golub K., Busawon D., Quelle P., Garibaldi F., Mariani A., Di Natale A., Schirripa M., Alves Bezerra N., Su N.-J., Cardoso L.G., Arocha F., Lombardo S., Campello T., Santos M.N., Travassos P., Brown C., Hanke A., Gillespie K., and Coelho R.
SCRS/2026/168	Analysis of catch-at-size data of swordfish (*Xiphias gladius*) caught by longline fisheries operating in the Ligurian Sea (Italy, Western Mediterranean), period 1990–2024	Garibaldi F.
SCRS/2026/169	Continuity model runs for the Mediterranean swordfish stock assessment using the a4a initiative	Mantopoulou-Palouka D., Tserpes G., Kimoto A., and Jardim E.
SCRS/2026/170	Assessing Mediterranean swordfish using the Assessment for All (a4a) model	Mantopoulou-Palouka D., Tserpes G., Kimoto A., and Jardim E.
SCRS/2026/171	Assessment of Mediterranean swordfish (*Xiphias gladius*) status using the Bayesian state-space surplus production model JABBA	Liniers G., Rueda L., Kimoto A., Ortiz M., Gillespie K., and Tserpes G.
SCRS/2026/172	Exploring the trade-offs between selectivity, retention, and discard mortality for north Atlantic swordfish	Hordyk A., and Gillespie K.
SCRS/2026/173	Stock assessment of south Atlantic swordfish in 2026: exploring alternative biological priors with JABBA model	Mourato B., Kikuchi E., Gillespie K., Sant'Ana R., Kimoto A., Ortiz M., and Cardoso L.G.
SCRS/2026/174	First swordfish CPUE index of Tunisian longlines	Zarrad R
SCRS/P/2026/078	Preliminary Stock Synthesis Analysis for Mediterranean swordfish	Liniers G., Rueda L., Kimoto A., Ortiz M., Gillespie K., and Tserpes G.

Appendix 4

SCRS Documents and Presentation Abstracts as provided by the authors

SCRS/2026/090 - Catches of undersize Mediterranean dead discards of swordfish were estimated using the size samples (task2sz) from the longline gear for 2019 – 2024. ICCAT minimum size landing regulations for Med swordfish were implemented in 2014 (90 cm LJFL) and updated again in 2017 (100 cm LJFL). Prior research indicated that not all fleets have reported undersized catches/discards that can account for a significant percent of the swordfish caught by the longline operations, which is currently the main fishing gear in the Mediterranean Sea. Previous estimates of discards since 2008 represent overall about 12% to 14% between 2008 and 2017, increasing to 19% in 2017/18 when the current minimum size was implemented, at present estimates of dead discards average at about 8%. At present report of dead discards remain low for major fleets in the Mediterranean Sea.

SCRS/2026/166 - Stock Synthesis (SS3) was applied to assess the South Atlantic swordfish (Xiphias gladius) stock using fishery-dependent data for the period 1950–2024. Eight scenarios were developed to evaluate uncertainty associated with alternative assumptions for growth (Gompertz and von Bertalanffy), steepness (0.7 and 0.8), and natural mortality (M), represented by a constant M assumption across all ages and an age-dependent Lorenzen formulation. All scenarios converged successfully and provided similar fits to the available abundance indices and length-composition data, with broadly comparable diagnostic performance. However, scenarios assuming the Lorenzen formulation consistently showed slightly better diagnostic performance across multiple evaluation metrics than the corresponding scenarios assuming constant M across all ages. The choice of natural mortality approach had the greatest influence on assessment outcomes, consistently affecting the scale of biomass estimates and the interpretation of stock status, while alternative steepness values also affected relative biomass and fishing mortality. In contrast, the choice of growth model had comparatively smaller effects and primarily influenced the scale of biomass estimates. Across the eight scenarios, SSB2024/SSBMSY ranged from 0.68 to 1.33 and F2024/FMSY from 0.60 to 1.08, indicating that the interpretation of current stock status remains dependent on the biological assumptions adopted and highlighting the importance of uncertainty grids that adequately represent the range of plausible hypotheses.

SCRS/2026/167 - Spine and otoliths sections collected from the North Atlantic, South Atlantic and Mediterranean stocks were analysed. Annual age estimates ranged from 0–15 years in the North Atlantic, 0–14 years in the South Atlantic and 0–7 years in the Mediterranean. Otoliths vs spines showed good agreement between structures at younger ages, although spine ages tended to underestimate otolith ages in older fish. Growth models were fit to decimal ages in the South Atlantic stock and integer ages to the Mediterranean stock. For the South stock, frequentist von Bertalanffy model provided the best fit, with sex-specific growth trajectories from otoliths and spines being similar. The otolith-based Bayesian fit was used in the stock assessment (males – L_{inf}= 207.37 cm, k= 0.28 yr-1, t0= -1.68; females - L_{inf}= 304.43cm, k= 0.12 yr-1, t0= -3.14). For the Mediterranean, no significant differences were found between sexes, therefore a combined curve was fit (L_{inf}= 204.45cm, k= 0.19 yr-1, t0= -2.45). Continued sampling of larger sizes may improve growth parameters estimation and maximum age estimates.

SCRS/2026/168 - This study presents the analysis of catch-at-size (CAS) data collected during the 1990–2024 period in the Ligurian Sea, describing long-term changes in length-frequency distributions (LFDs) associated with the evolution of fishing gears and fishing strategies. A total of 28,471 swordfish were measured (SLJFL). Comparative analyses were performed to evaluate gear selectivity and temporal trends in average size. Clear differences in selectivity were observed among métiers; mesopelagic longline (LLMESO) consistently targeted larger fish (modal size approximately 120–130 cm) than the other two longline. Despite substantial changes in fishing practices over the last 35 years, the overall size structure of swordfish catches has remained relatively stable, even if interannual variability mainly reflecting differences in recruitment, fishing season, fishing grounds, and gear use are present. The representativeness of Ligurian CAS data relative to Italian and Mediterranean ICCAT was also investigated, showing that Ligurian catches are broadly representative of the regional stock.

SCRS/2026/169 - This document updates the 2020 age-structured (a4a) assessment of the Mediterranean swordfish (*Xiphias gladius*) by incorporating catch-at-age and standardized catch-per-unit-effort (CPUE) data extended through 2024. To ensure continuity with the 2020 assessment, the updated model retained the same assumptions (constant natural mortality and a plus group at age 5) and was fitted to six standardized CPUE series within the a4a statistical catch-at-age framework. The updated assessment is compared with the 2020 evaluation, as well as with two sensitivity runs that truncate the series to the 2018 terminal year; one run uses the estimated CPUE indices from 2020, while the other uses the indices provided for the 2026 assessment. Although the estimated spawning stock biomass, recruitment, and fishing mortality trajectories of the new runs generally align with the previous assessment, notable discrepancies have emerged in the scales of fishing mortality and spawning stock biomass.

SCRS/2026/170 - Following the continuity update of the 2020 Mediterranean swordfish (*Xiphias gladius*) assessment (SCRS/2026/169), this document explores different sub model configurations in light of the new catch-at-age matrix using the a4a statistical catch-at-age framework. The exploratory runs address historical data coverage, alternative natural mortality assumptions, and time-varying selectivity. Specifically, we evaluate the impact of assuming an age-dependent Lorenzen natural mortality vector compared with constant natural mortality (M = 0.2). Additionally, a tensor-product interaction is incorporated into the fishing mortality sub model to capture dynamic changes in selectivity across age classes over time.

SCRS/2026/171 - Bayesian State-Space Surplus Production Models, implemented via the 'JABBA' R package, were applied to catch and CPUE data for Mediterranean swordfish (*Xiphias gladius*). Three different configurations were implemented: a Schaefer formulation with a pre-existing prior distribution for r, a Pella-Tomlinson formulation informed by priors derived from an Age-Structured Equilibrium Model and a modification of the latter that estimates the shape parameter. Continuity runs were evaluated in order to inspect the effect of the data update with respect to 2020 Stock Assessment. Several sensitivity runs were evaluated to all of the 'main' models in order to test the robustness of model results to alternative configurations and data assumptions.

SCRS/2026/172 - The North Atlantic swordfish fishery has had a minimum size limit since 1991, intended to protect small fish. However, discard mortality of undersized swordfish released under this regulation is estimated to exceed 80%, raising questions about its effectiveness. This paper uses an equilibrium, per-recruit simulation analysis, based on an operating model developed for the stock's management strategy evaluation, to examine trade-offs between yield and spawning biomass across a range of retention, discard mortality, and selectivity scenarios. Under current discard mortality assumptions, a full retention policy (removing the minimum size limit) is expected to produce higher yields than the current or higher minimum size limits, without a corresponding loss in reproductive potential. Only if fishing and discard mortality on small sized fish were substantially reduced would maintaining or increasing the minimum size limit outperform full retention. These results indicate that current selectivity and retention patterns permit substantial capture of immature fish, and that minimum size regulations do not prevent growth or recruitment overfishing while discard mortality remains high.

SCRS/2026/173 - The 2026 South Atlantic swordfish assessment explored the influence of alternative biological priors on stock status estimates using the Bayesian state-space surplus production model JABBA. Informative priors for the intrinsic rate of population increase (r) and BMSY/K were derived from an Age Structured Estimation Model (ASEM) under four biological scenarios combining two growth models (von Bertalanffy and Gompertz) and two steepness assumptions (h = 0.7 and 0.8). Each scenario was evaluated using both the assessment Joint_CPUE dataset and an expanded All_CPUEs configuration. Model performance was assessed through convergence diagnostics, residual analyses, posterior predictive checks, hindcast, retrospective analyses, and leave-one-index-out jackknife tests. Results were highly consistent across all scenarios, indicating limited sensitivity of stock status estimates to alternative biological assumptions and abundance-index configurations. Posterior estimates consistently indicated biomass above BMSY and fishing mortality below FMSY in the terminal year, supporting the robustness of the 2026 South Atlantic swordfish assessment.

SCRS/2026/174 - Les données de prise et d'effort de l'espadon (*Xiphias gladius*) ont été standardisées à l'aide de modèles linéaires généralisés (GLM) Les débarquements d'espadon ont été suivis à partir d'échantillons issus de la flottille de pêche côtière du port de Mahdia (centre-est de la Tunisie). Ce suivi a été réalisé au niveau de la criée du port. La période d'échantillonnage s'étend de 2018 à 2025. Le nombre d'observations s'élève à environ 387. La flottille suivie est constituée de palangriers ciblant l'espadon durant la campagne de pêche. Les résultats mettent en évidence un effet significatif du facteur « année » sur l'évolution de la CPUE des palangriers ciblant l'espadon dans la région de Mahdia (Méditerranée centrale). On observe une baisse relative de la CPUE au cours des deux dernières années (2024 et 2025). En termes de perspectives, nous envisageons d'analyser l'influence des paramètres environnementaux sur les variations de la CPUE et d'examiner les données relatives à la pêche d'espadon provenant d'autres ports du littoral tunisien.

SCRS/P/2026/078 - A preliminary Stock Synthesis analysis for Mediterranean Swordfish for the period 1950–2024 was conducted with the setting recommended at the 2026 Swordfish Data Preparatory Meeting.

Appendix 5

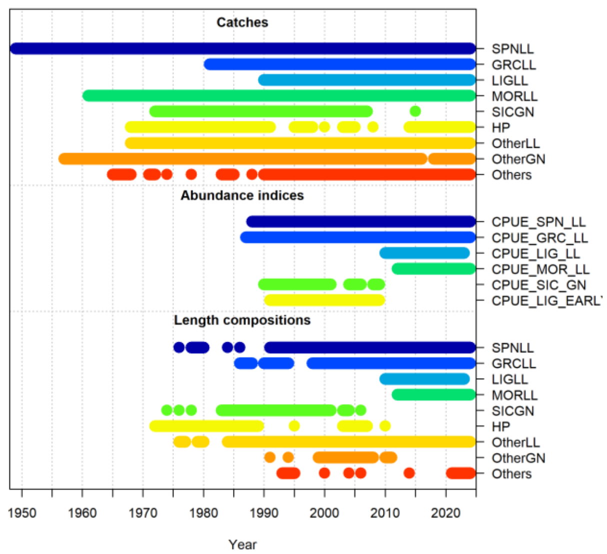
Settings Stock Synthesis assessment reference model (run 9) Mediterranean Swordfish

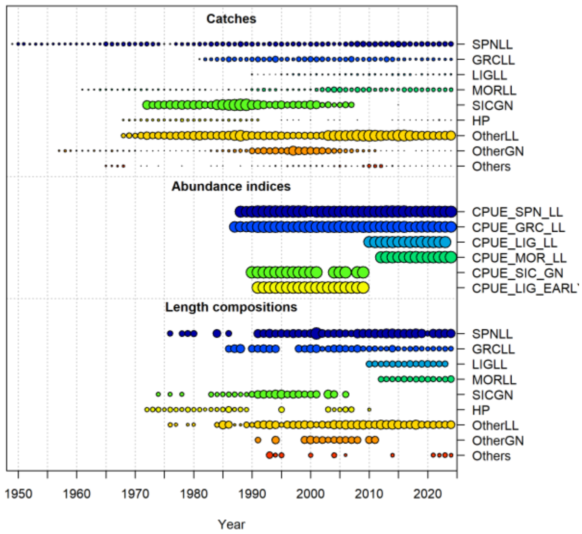
This section provides the initial settings, input summaries and assumptions used for the reference model (run 9) of the Mediterranean swordfish using the Stock Synthesis platform. Please see Section 3.3 for further details.

SS version: 3.30.24.2;_safe;_compile_date:_Mar 9 2026;
Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB_13.2

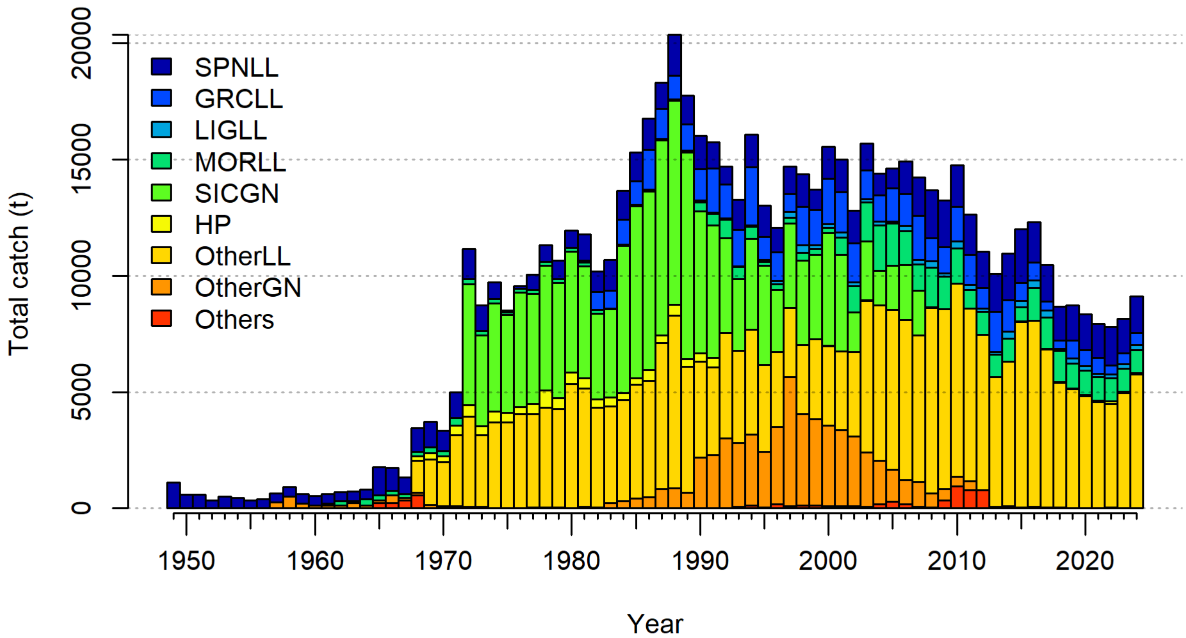
r4ss info:
Version: 1.52.1
Date: NULL
Built: R 4.5.1; ; 2026-07-14 16:18:40 UTC; windows
RemoteType: github
RemoteHost: api.github.com
RemoteRepo: r4ss
RemoteUsername: r4ss
RemoteRef: 5936a03
RemoteSha: 5936a036472c2abe9676e2c3b4f200526f693222

Starting time of model: Fri Jul 17 14:59:35 2026





Input data summary: Catch series 1950 – 2024 disaggregated into 9 Fleets, 6 indices of abundance series with 4 series (CPUE_SPN_LL, CPUE_GRC_LL, CPUE_LIG_LL, CPUE_MOR_LL) used as base case scenario, and 2 series (CPUE_SIC_GN, CPUE_LIG_EARL) used as sensitivity analyses, and associated length compositions by fleet. Left panel shows the same information but the size of the circles is scaled relative to maximum within each type, but not comparable among classes (e.g. CPUE vs catch).

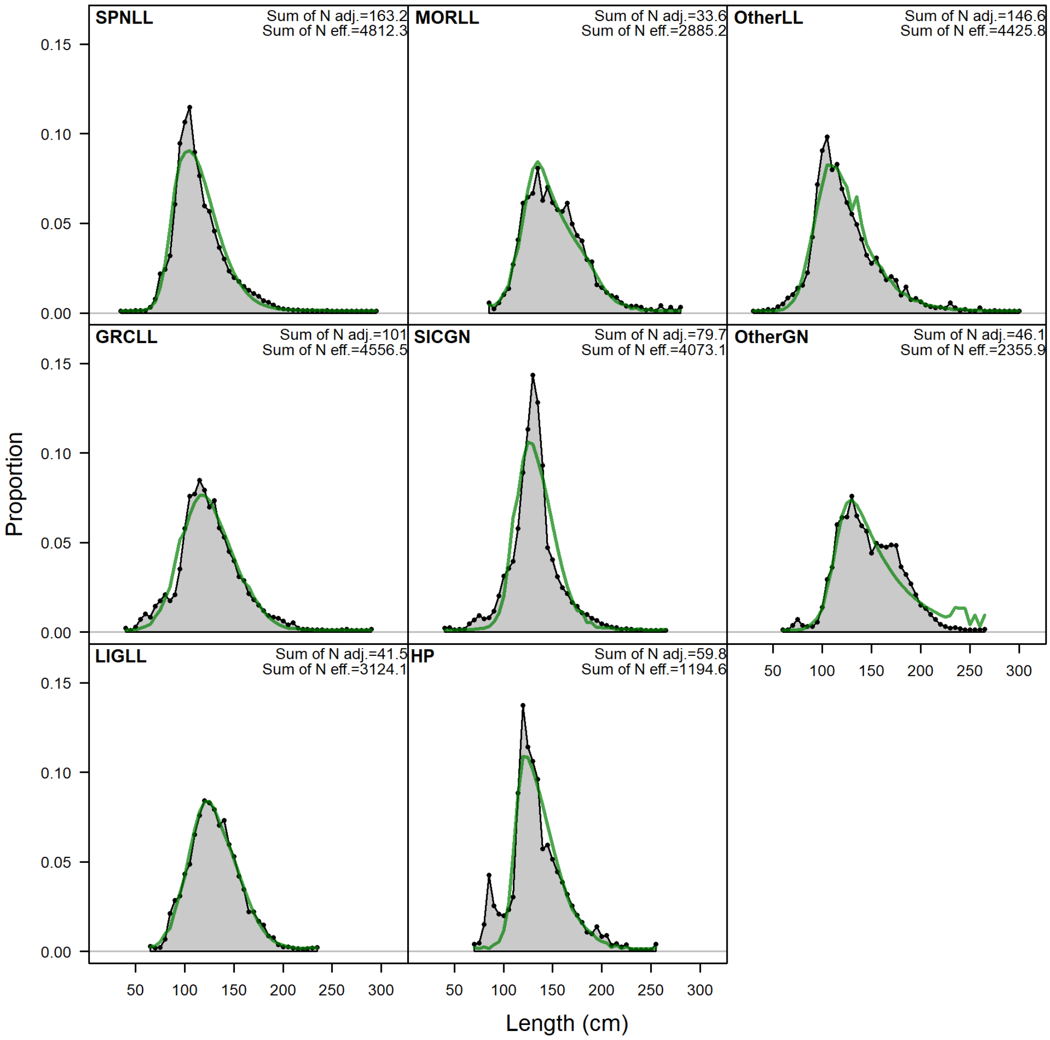


Summary of the catch by fleet/gear used in the base model 1950 – 2024, total catch included the estimated dead discards agreed by the Group during the meeting.

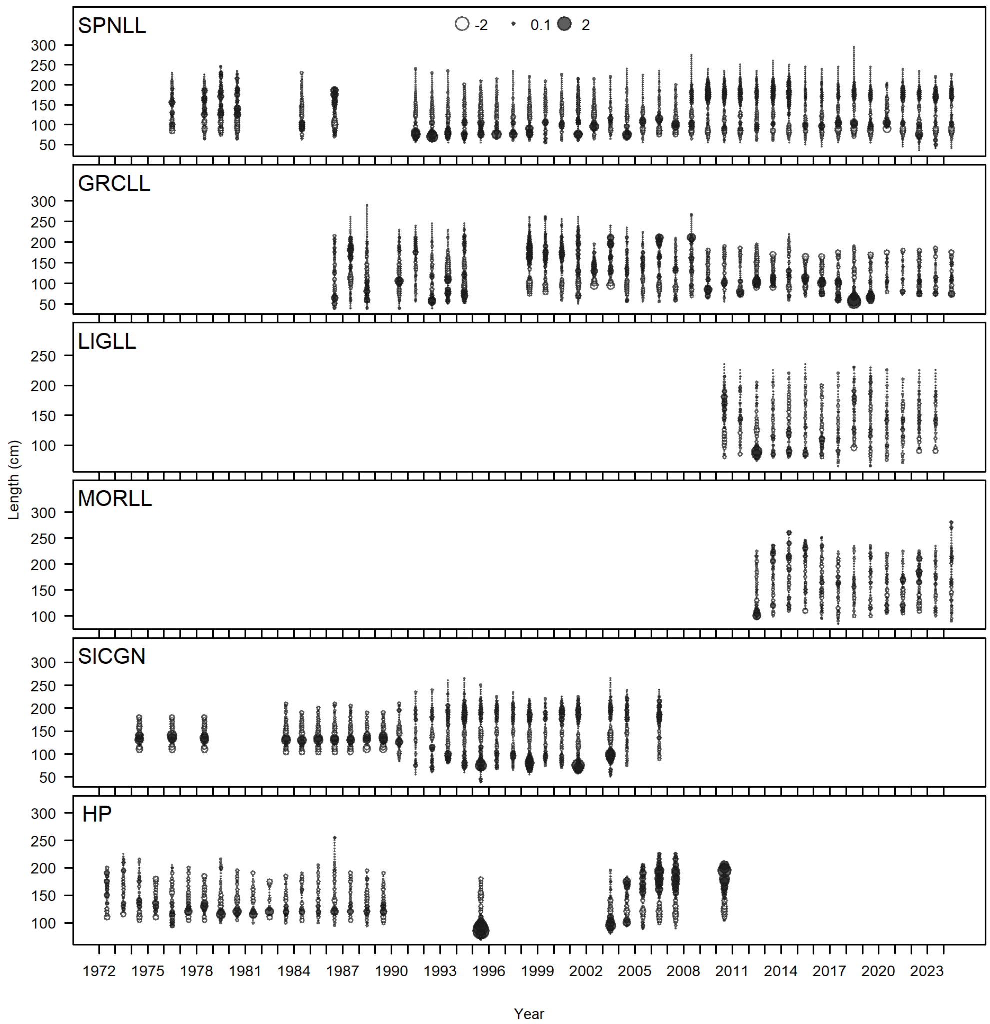
List of parameters estimated in the SS3 reference model (run 9) for the Mediterranean swordfish stock, including the final value, phase of estimation, initial values, priors, and bound check status.

Parameter	Value	Phase	Min	Max	Init	Status	Parm_StDev	Gradient	Pr_type	Prior	Pr_SD	Pr_Like	Afterbound
SR_LN(R0)	7.4578400	1	0.0001	20.0	6.9573300	OK	0.0316983	-9.22367e-05	No_prior	NA	NA	NA	OK
InitF_seas_1_flt_1SPNLL	0.0028012	1	0.0010	0.3	0.0510522	LO	0.0007733	1.88207e-07	Log_Norm_w/biasadj	-2.5000	1.00	4.1406200	OK
Size_DblN_peak_SPNLL(1)	99.9171000	2	62.5000	297.5	98.9955000	OK	5.0220500	-1.42234e-06	Sym_Beta	84.2383	0.05	0.0312294	OK
Size_DblN_top_logit_SPNLL(1)	-7.3711900	3	-10.0000	4.0	-7.3375200	OK	6.6295100	1.74211e-07	Sym_Beta	-6.0000	0.05	0.0247080	OK
Size_DblN_ascend_se_SPNLL(1)	5.9035500	3	-1.0000	9.0	5.8806500	OK	0.5349050	-7.61547e-09	Sym_Beta	4.7000	0.05	0.0078268	OK
Size_DblN_descend_se_SPNLL(1)	7.9624100	3	-1.0000	9.0	7.8508200	OK	0.3934880	-1.17881e-06	Sym_Beta	8.3000	0.05	0.0494412	OK
Size_DblN_end_logit_SPNLL(1)	-3.7738800	4	-5.0000	5.0	-3.2561600	OK	2.4846500	-1.45026e-07	Sym_Beta	-5.0000	0.05	0.0421574	OK
Size_DblN_peak_GRCLL(2)	133.0260000	2	62.5000	297.5	129.0250000	OK	11.3568000	-1.8783e-06	Sym_Beta	112.7910	0.05	0.0087070	OK
Size_DblN_top_logit_GRCLL(2)	-5.5593600	3	-10.0000	4.0	-5.8880400	OK	10.1239000	-3.58758e-08	Sym_Beta	-6.0000	0.05	0.0071734	OK
Size_DblN_ascend_se_GRCLL(2)	7.5773500	3	-1.0000	9.0	7.5101100	OK	0.5652550	4.19549e-07	Sym_Beta	4.7000	0.05	0.0358573	OK
Size_DblN_descend_se_GRCLL(2)	7.5888400	3	-1.0000	9.0	7.5916900	OK	0.7083250	-6.48428e-07	Sym_Beta	8.3000	0.05	0.0361959	OK
Size_DblN_end_logit_GRCLL(2)	-4.0528500	4	-5.0000	5.0	-4.1899400	OK	2.8593600	-7.8996e-08	Sym_Beta	-5.0000	0.05	0.0534989	OK
Size_DblN_peak_LIGLL(3)	133.4400000	2	62.5000	297.5	130.2050000	OK	19.2553000	-3.61309e-07	Sym_Beta	119.7980	0.05	0.0085403	OK
Size_DblN_top_logit_LIGLL(3)	-3.4703100	3	-10.0000	4.0	-3.6164500	OK	6.5884600	-2.55301e-08	Sym_Beta	-6.0000	0.05	0.0002248	OK
Size_DblN_ascend_se_LIGLL(3)	6.9451500	3	-1.0000	9.0	6.8666800	OK	0.9329520	1.2244e-07	Sym_Beta	4.7000	0.05	0.0213025	OK
Size_DblN_descend_se_LIGLL(3)	7.2678100	3	-1.0000	9.0	7.3025900	OK	1.5579100	-1.49372e-07	Sym_Beta	8.3000	0.05	0.0278525	OK
Size_DblN_end_logit_LIGLL(3)	-3.5963800	4	-5.0000	5.0	-3.8189300	OK	3.4699800	-1.1871e-07	Sym_Beta	-5.0000	0.05	0.0364198	OK
Size_DblN_peak_MORLL(4)	142.3730000	2	62.5000	297.5	138.9060000	OK	14.5723000	-1.42591e-06	Sym_Beta	129.4290	0.05	0.0054095	OK
Size_DblN_top_logit_MORLL(4)	-1.5901400	3	-10.0000	4.0	-1.6604000	OK	1.3076600	2.80565e-07	Sym_Beta	-6.0000	0.05	0.0020691	OK
Size_DblN_ascend_se_MORLL(4)	6.2051600	3	-1.0000	9.0	6.0696900	OK	0.9796600	2.91031e-07	Sym_Beta	4.7000	0.05	0.0108127	OK
Size_DblN_descend_se_MORLL(4)	7.0486000	3	-1.0000	9.0	7.1307000	OK	2.0988400	5.98894e-08	Sym_Beta	8.3000	0.05	0.0232384	OK
Size_DblN_end_logit_MORLL(4)	-3.2952100	4	-5.0000	5.0	-3.4475400	OK	4.2570900	4.54691e-08	Sym_Beta	-5.0000	0.05	0.0284843	OK
Size_DblN_peak_SICGN(5)	133.5420000	2	62.5000	297.5	132.4900000	OK	4.9537100	-2.24031e-06	Sym_Beta	127.4340	0.05	0.0084995	OK
Size_DblN_top_logit_SICGN(5)	-7.2773300	3	-10.0000	4.0	-7.3670900	OK	6.8155700	1.08051e-07	Sym_Beta	-6.0000	0.05	0.0233684	OK
Size_DblN_ascend_se_SICGN(5)	6.1526700	3	-1.0000	9.0	6.1505700	OK	0.4475610	8.17208e-07	Sym_Beta	4.7000	0.05	0.0102480	OK
Size_DblN_descend_se_SICGN(5)	6.9365600	3	-1.0000	9.0	6.8918400	OK	0.7314180	-6.19231e-07	Sym_Beta	8.3000	0.05	0.0211480	OK
Size_DblN_end_logit_SICGN(5)	-3.4847800	4	-5.0000	5.0	-3.8128500	OK	2.6742300	-7.98452e-07	Sym_Beta	-5.0000	0.05	0.0332481	OK
Size_DblN_peak_HP(6)	125.6840000	2	62.5000	297.5	124.9810000	OK	5.5291800	-1.70212e-07	Sym_Beta	121.0910	0.05	0.0120197	OK
Size_DblN_top_logit_HP(6)	-6.3119500	3	-10.0000	4.0	-6.5540600	OK	8.6673700	-3.94304e-09	Sym_Beta	-6.0000	0.05	0.0126691	OK
Size_DblN_ascend_se_HP(6)	5.2274200	3	-1.0000	9.0	5.2174300	OK	0.8378430	1.09915e-07	Sym_Beta	4.7000	0.05	0.0031056	OK
Size_DblN_descend_se_HP(6)	7.5270900	3	-1.0000	9.0	7.4472200	OK	0.4415480	2.2643e-08	Sym_Beta	8.3000	0.05	0.0344154	OK
Size_DblN_end_logit_HP(6)	-4.3412900	4	-5.0000	5.0	-4.3748500	OK	2.0760900	2.17559e-07	Sym_Beta	-5.0000	0.05	0.0700873	OK

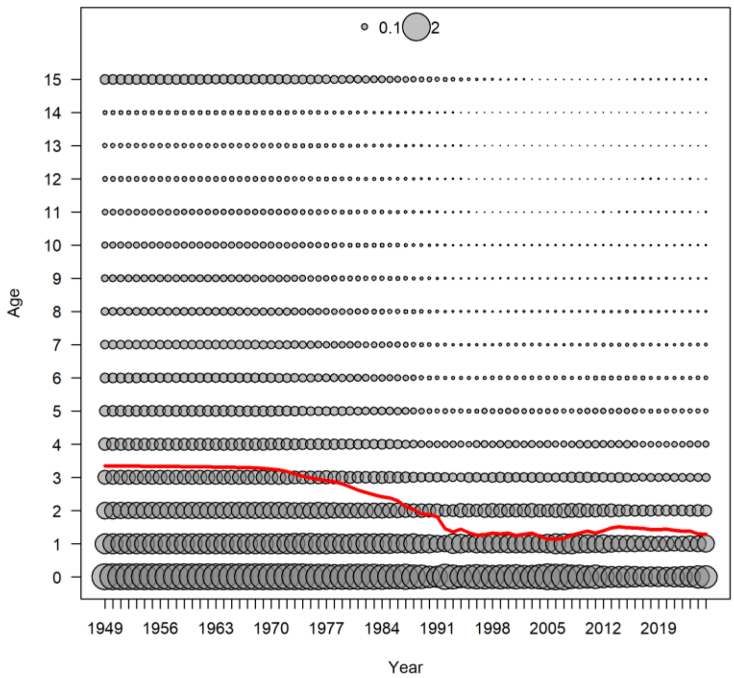
Parameter	Value	Phase	Min	Max	Init	Status	Parm_StDev	Gradient	Pr_type	Prior	Pr_SD	Pr_Like	Afterbound
Size_DblN_peak_OtherLL(7)	110.7120000	2	62.5000	297.5	108.8570000	OK	7.4138300	-3.83893e-06	Sym_Beta	92.9081	0.05	0.0213648	OK
Size_DblN_top_logit_OtherLL(7)	-5.6802300	3	-10.0000	4.0	-6.3384000	OK	9.9214200	-5.15817e-07	Sym_Beta	-6.0000	0.05	0.0079249	OK
Size_DblN_ascend_se_OtherLL(7)	6.6098200	3	-1.0000	9.0	6.5499500	OK	0.6090100	1.64277e-06	Sym_Beta	4.7000	0.05	0.0159006	OK
Size_DblN_descend_se_OtherLL(7)	8.6753700	3	-1.0000	9.0	8.4745800	OK	0.6322870	-1.22094e-06	Sym_Beta	8.3000	0.05	0.1037030	OK
Size_DblN_end_logit_OtherLL(7)	-2.6026100	4	-5.0000	5.0	-3.0190500	OK	2.6656700	-1.75215e-06	Sym_Beta	-5.0000	0.05	0.0157975	OK
Size_inflection_OtherGN(8)	118.3150000	2	50.0000	400.0	115.2640000	OK	7.4721300	-7.61419e-07	Sym_Beta	120.0000	0.05	0.0232326	OK
Size_95%width_OtherGN(8)	22.0954000	3	0.0000	200.0	19.4285000	OK	11.3183000	4.37901e-07	Sym_Beta	80.0000	0.05	0.0466859	OK
SR_LN(R0)	7.4578400	1	0.0001	20.0	6.9573300	OK	0.0316983	-9.22367e-05	No_prior	NA	NA	NA	OK
InitF_seas_1_flt_1SPNLL	0.0028012	1	0.0010	0.3	0.0510522	LO	0.0007733	1.88207e-07	Log_Norm_w/biasadj	-2.5000	1.00	4.1406200	OK
Size_DblN_peak_SPNLL(1)	99.9171000	2	62.5000	297.5	98.9955000	OK	5.0220500	-1.42234e-06	Sym_Beta	84.2383	0.05	0.0312294	OK
Size_DblN_top_logit_SPNLL(1)	-7.3711900	3	-10.0000	4.0	-7.3375200	OK	6.6295100	1.74211e-07	Sym_Beta	-6.0000	0.05	0.0247080	OK
Size_DblN_ascend_se_SPNLL(1)	5.9035500	3	-1.0000	9.0	5.8806500	OK	0.5349050	-7.61547e-09	Sym_Beta	4.7000	0.05	0.0078268	OK
Size_DblN_descend_se_SPNLL(1)	7.9624100	3	-1.0000	9.0	7.8508200	OK	0.3934880	-1.17881e-06	Sym_Beta	8.3000	0.05	0.0494412	OK
Size_DblN_end_logit_SPNLL(1)	-3.7738800	4	-5.0000	5.0	-3.2561600	OK	2.4846500	-1.45026e-07	Sym_Beta	-5.0000	0.05	0.0421574	OK
Size_DblN_peak_GRCLL(2)	133.0260000	2	62.5000	297.5	129.0250000	OK	11.3568000	-1.8783e-06	Sym_Beta	112.7910	0.05	0.0087070	OK
Size_DblN_top_logit_GRCLL(2)	-5.5593600	3	-10.0000	4.0	-5.8880400	OK	10.1239000	-3.58758e-08	Sym_Beta	-6.0000	0.05	0.0071734	OK
Size_DblN_ascend_se_GRCLL(2)	7.5773500	3	-1.0000	9.0	7.5101100	OK	0.5652550	4.19549e-07	Sym_Beta	4.7000	0.05	0.0358573	OK



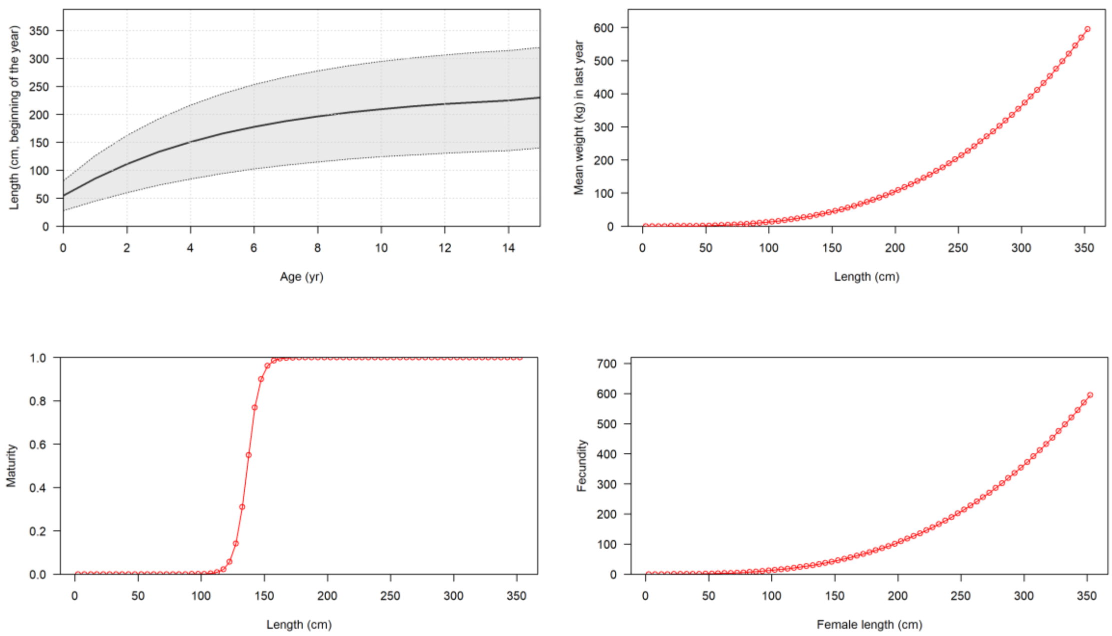
Summary of the input length composition data (shaded distribution) and the model fitted estimates (green line) aggregated across time by fleet. After review the Group recommended excluding the length composition data of the Others fleet as it represents size samples of multiple gears and fisheries with non-constant in time and coverage a relative few samples.



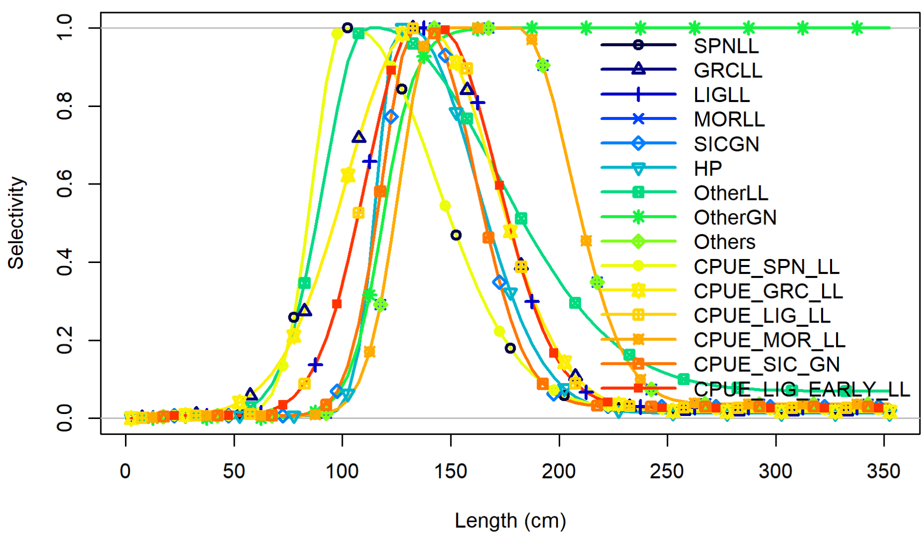
Pearson residuals of the length composition comparing across fleets and year. Closed bubbles are positive residuals (Obs > predicted).



Model estimated numbers at age by year (circles) and average mean age (red line) from the SS3 reference model (run 9) for the Mediterranean swordfish stock.



Summary of the biological input parameters for the Mediterranean swordfish SS3 reference model (run 9); von Bertalanffy growth model (Tserpes and Tsimenides, 1995) and assumed variability of size at age (95% CI) of 20% CV (top left), length-weight relationship (top-right), maturity at length (bottom left) and fecundity at length (bottom-right).



Model estimated size selectivity by fleet/gear in the SS3 reference model (run 9) for the Mediterranean swordfish stock.