Report of the Second 2026 Intersessional Meeting of the Bluefin Tuna Species Group

(hybrid, Nara, Japan, 1-4 July 2026)

The results, conclusions and recommendations contained in this report reflect only the view of the Bluefin Tuna Species Group (BFT SG). 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, meeting arrangements, and assignment of rapporteurs

The hybrid meeting was held at Nara Kasugano International Forum Iraka in Nara (Japan) from 1 to 4 July 2026. The East Atlantic Bluefin Tuna Rapporteur, Dr Tristan Rouyer (EU-France), and the West Atlantic Bluefin Tuna Rapporteur, Dr John Walter (U.S.), and meeting Chairs, opened the Second 2026 Intersessional Meeting of the Bluefin Tuna Species Group (the "Group") and welcomed participants. The Chair of the SCRS and the ICCAT Assistant Executive Secretary welcomed the participants, highlighted the importance of the subjects to be discussed and wished everyone a successful meeting.

The Chairs proceeded to review the Agenda which was adopted with some changes (**Appendix 1**). The List of participants is included in **Appendix 2**. The List of papers and presentations provided at the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents and presentations are included in **Appendix 4**. The following participants served as rapporteurs:

Sections	*Rapporteur*
Items 1, 9	A. Kimoto
Item 2	K. Gillespie
Item 3	M. Lauretta
Item 4	H. Arrizabalaga, A. Parma
Item 5	J. Walter, T. Rouyer
Item 6	F. Alemany, M. Neves dos Santos
Item 7	J. Walter, T. Rouyer
Item 8	S. Varsamos

2. Status check model diagnostics

2.1 Stock Synthesis

East Atlantic and Mediterranean

Document SCRS/2026/152 presented the updated size frequency data for the East Atlantic and Mediterranean bluefin tuna (BFT-E) Stock Synthesis (SS) models, mainly for the Mediterranean purse seine fishery in 2022-2024. Some data were added from ST-04 official new submissions and corrections of Task 2 size data and stereo video camera data (ST-06). However, among the large harvesters, there were no size data available from EU-Spain for 2022-2024, and it was not possible to extract them from ST-06 data.

The Group acknowledged the significant efforts made by the Secretariat in revising the size data for this assessment. Extensive discussions were held regarding the complications associated with this task, particularly the potential mismatches between the length measurement types recorded by stereo cameras (Straight Fork Length (SFL)) and those submitted in some of the official national reports (Curved Fork Length (CFL)). Furthermore, integrating ST-06 data from joint (mixed) fishing operations into the existing Stock Synthesis fleet structure remained a notable challenge. Given that the Stock Synthesis models in 2026 are continuity runs, further revisions to fleet structure were not considered.

The Group emphasized the need for CPCs with catch allocations to submit size frequency data through the official Task 2 Size data form (ST-04), even if the similar information has also been provided by farming CPCs via form ST-06. As there is no information from CPCs with catch allocations in ST-06 data that have been collected as caging reports according to paragraph 188 of the *Recommendation by ICCAT amending the Recommendation 22-08 establishing a multi-annual management plan for bluefin tuna in the eastern Atlantic* *and the Mediterranean* (Rec. 24-05), the Secretariat may be forced to make assumptions (i.e. assign CPCs with catch allocation from eBCD data) that introduce unintended biases. Noting that such data gaps hamper the ability of the SCRS to provide management and scientific advice, the Group stressed that strict adherence to data reporting requirements is important. The Secretariat confirmed its capacity to continue supporting any requests from the SCRS.

The Group requested clarification on a number of differences in the size composition across fleets and years. In many cases these could be explained by variation in targeting practices, gear types, or changes in management regulations.

Document SCRS/2026/163 described the Stock Synthesis 3 model runs for BFT-E developed after the First 2026 Intersessional Meeting of the Bluefin Tuna Species Group (Anon., 2026c) held in March 2026. The data used included catch (**Figure 1**), length composition, conditional age-at-length data (CAAL), and abundance indices (**Figure 2**) and main aspects of the model configuration and biological parameters were explained, paying particular attention to the data weighting approaches explored for the conditional age-at-length data. Model diagnostics were presented and a set of runs suggested as a potential basis for the SS update assessment of BFT-E.

The Group acknowledged the substantial efforts from the authors to update and improve upon the 2022 assessment model. There was extensive discussion regarding the underlying model inputs, the drivers of biomass scale, assumptions on fleet selectivity, historical recruitment dynamics, diagnostics, and alternative model runs and sensitivity runs. The Group discussed weighting of various data streams within SS, making particular note of potential conflicts between data types.

It was noted that there has been a substantial revision of the length composition dataset, as well as a substantial increase in available age-at-length data relative to the previous assessment. The Group clarified that length data were explicitly collected to reflect the size composition of total catches. However, certain data may not be fully representative of the broader fishery, which may explain the anomalous presence of very small fish in those samples. The Group recommended that length data undergo additional scrutiny in advance of future assessment exercises so that the origin of some of the anomalous data is better understood. It was noted that an advantage of using conditional age-at-length data in this model was that it allows for internal growth curve estimation while avoiding the double-counting of age and size compositions.

The Group discussed the model's sensitivity to length composition data. It was noted that because length compositions were already down-weighted across all runs using the logarithm of the number of measured fish as input sample sizes, applying further iterative Francis re-weighting could be counterproductive. It was noted that following the removal of the Francis weighting scheme, the model fit to Fleet 10 (Mediterranean purse seine in Q2) improved significantly. As changes in the data collection process which may not be possible to account in the current fleet structure may have occurred, it was suggested that the final years (2022-2024) of length composition for Fleet 11 (PS by EU-Spain and EU-France) be removed in an additional sensitivity model run, as it was potentially not fully representative of that fleet.

The Group engaged in extensive discussions regarding the core drivers of model scale. A primary technical concern was that the model's determination of scale is highly sensitive to asymptotic selectivity assumptions. It was noted that without fixing or strongly informing at least one asymptotic selectivity curve, the model struggled to resolve absolute biomass scale. In the current configurations, the historical asymptotic assumption applied to the Norwegian purse seine fleet (Fleet 7) acted as a dominant driver of overall scale, a feature that must be clearly understood when considering the overall utility of the results to provide biomass scale.

Clarification was sought regarding selectivity in the Norwegian fleet, where it was taken as asymptotic historically but shifted to a double-normal structure for later years. Maintaining an asymptotic curve until 2015 and shifting to double-normal thereafter was justified by a documented shift in operational behavior, as the Norwegian fleet caught smaller fish in the most recent period of the fishery compared to the historical one.

The Group discussed whether specific trap fisheries (specifically in the Mediterranean) that operate differently should be split into distinct fleets. However, it was noted that when data are sparse, further stratification would likely yield negligible differences in model outputs. For instance, Fleet 15 (traps from countries except EU-Spain, EU-Portugal, and Morocco) has maintained minor catches (100-400 t) since 2012 and not substantially variable length distribution; consequently, splitting this fleet was deemed a low priority.

Significant discussion centered on the estimated recruitment time series, specifically a pronounced pulse of high recruitment from 1990 to the early 2000s. Because this period serves as a critical axis of uncertainty within the Management Strategy Evaluation (MSE), verifying whether there is a biological basis for this pulse is of high importance. The Group highlighted that this period of higher recruitment estimates directly coincide with a historical period of known illegal catches. To reconcile these high catches, the model may be forced to estimate large and positive recruitment deviations. Concerns were raised that the length and age composition data from that period may lack the signal necessary to independently confirm such a large recruitment pulse but a comparison to data collected in the West Atlantic during that period could be a good initial step for detecting whether the pulse represented a true biological phenomenon. It was also suggested that there be an additional diagnostic run with recruitment deviations turned off to observe which data streams exhibit the greatest lack of fit to try and pinpoint the source of the high deviations.

There was discussion on whether the final set of model runs (**Table 1**) were meant to represent a set of "best models" or rather to represent a broad range of structural uncertainty. The author noted that these final models represent a spectrum of sensible down-weighting options for CAAL data and together, these runs form a composite "best assessment" framework. The Group noted that the outstanding challenges and uncertainty of the stock assessment model in particular in relation to the scale persist and reaffirmed that the primary objective of this exercise was a continuity "health check" - to understand stock status relative to previous advice rather than capture structural uncertainty or optimize a single model for catch advice.

The Group discussed whether additional runs and diagnostics were needed. Given that the Management Procedure (MP) relies exclusively on abundance indices to guide yield advice, the Group proposed an additional run upweighting the abundance indices to ensure the model prioritized their trends. Rather than reducing input coefficient of variation (CV) values, the Group recommended increasing the lambda values for the indices 100-fold on a single candidate model (Run 39). To prevent convergence issues caused by internal conflicts among indices, it was suggested that the analyst may need to fix the selectivity parameters. However, it was agreed that this would only be implemented if numerical instabilities arose and that the preference would be to allow the selectivities to be freely estimated. The run without fixing the selectivity parameters did not converge. The run with fixed selectivity parameters converged and provided some improvement in the fits to the indices relative to the original Run 39, although it specifically did not improve the fit to the Japanese Longline Northeastern Atlantic (JPN LL NEA2) index the improvement was, on the whole, not substantial. This run estimated a somewhat steeper increase in the spawning stock biomass (SSB) trend and lower fishing mortality (F) values over the most recent 15 years than the original Run 39.

It was noted that an additional run with an alternative steepness value could be conducted. Steepness is currently fixed in the SS runs, as past attempts to estimate it resulted in the parameter hitting the upper bound. To capture this source of uncertainty, the Group requested an alternative fixed sensitivity run at h=0.7 to match the axis of uncertainty explored within the MSE. The run with h=0.7 resulted in a larger estimate of R_0 and virgin stock biomass, but the estimated SSB and F values since the early 2000s were very close to those from the original Run 39.

Furthermore, an additional run excluding the 2022-2024 length composition data of Fleet 11 was requested. This run produced identical results (SSB, F and recruitment estimates) to the original Run 39 including these data.

Finally, it was observed that, for one of the runs considered for the assessment (Run 37), the constant added in the SS runs to each bin of the conditional age-at-length data had an impact on the estimated stock scale, so it was decided to reduce strongly the value of the added constant in that particular run. For the other runs for which this issue was examined (Runs 39, 41, 43 and 44) there seem to be no impact.

West Atlantic

Document SCRS/2026/153 presented recovered historical observations on close to 3 million BFT fish size measurements in the West Atlantic in 1936-1985. The recovered size data were added to the Stock Synthesis and MSE operating models (OMs) size input data provided in March 2026, and the authors suggested the Group use this information as a part of sensitivity runs.

The Group acknowledged the importance of this data recovery effort, adding that it fills significant historical gaps in western bluefin tuna stock (BFT-W) ICCAT Task 2 size database. While a substantial portion of these data were newly available, it was noted that certain records may duplicate existing ICCAT records. Consequently, further collaborative efforts are required to cross-reference the datasets and determine which specific sections of the ICCAT database warrant revision. Furthermore, the Group noted that the measurement units and conversion factors applied to some of the historical datasets require additional technical review. The authors and Canadian scientists agreed to collaborate on further historical data recovery initiatives for the BFT-W stock. The Secretariat reminded the Group that all official data submissions must strictly adhere to standard ICCAT protocols and be transmitted by CPCs using the mandatory statistical forms together with an SCRS document. Finally, it was clarified that for the purposes of the sensitivity run completed in Stock Synthesis for the current assessment, the newly recovered data were used exclusively to fill existing data gaps and were not used to overwrite or replace any historical records already established in the ICCAT database.

The updated preliminary BFT-W SS results incorporating the discussion held in the First 2026 Intersessional Meeting of the Bluefin Tuna Species Group (Anon., 2026c) were provided to the Group with three SCRS Documents about data (catch (**Figure 3**), length composition, conditional age-at-length data, and abundance indices (**Figure 4**) and model specifications (SCRS/2026/160), model diagnostics and results (SCRS/2026/161) and sensitivity runs (SCRS/2026/162)).

The Group acknowledged the substantial work required for updating the BFT-W SS models. The Group's discussions focused on data weighting methodologies, model stability issues, data conflicts, and recommendations on alternative diagnostic and sensitivity runs.

Clarity from the authors was requested on the choice of data weighting methods used in the base configuration, noting that the McAllister-Ianelli data weighting method may not be optimal and that alternative approaches such as square-root transformation should be considered. The author clarified that the McAllister-Ianelli method was maintained primarily to ensure model continuity with the previous assessment, while a Francis weighting scheme was explored within a supplementary sensitivity run. The Group noted that, for the purposes of this status check, analysts were requested to largely follow the structures of previous assessments, leaving limited latitude for introducing new baseline assumptions during the model updates. It was emphasized that future stock assessments could allow more flexibility to improve these status-check models.

Among the diagnostic indicators, the Group comprehensively discussed model stability, data conflicts, and the performance of jittering and jackknife exercises. Concerns were raised regarding the lack of stability and high variation observed during the jittering diagnostic. The Group noted that variations in estimated R_0 across different jitter runs may indicate that key parameters remain poorly resolved. To address these instabilities, it was suggested that the correlation patterns and parameterization of fleet selectivities be thoroughly checked. To stabilize the model before making further management inferences, there was a suggestion that normal priors on the top logit parameters of the selectivity functions be used, rather than fixing them outright. However, applying a prior for the top logit parameters did not sufficiently reduce the instability.

The Group highlighted that the model was likely challenged by conflicts in the input data, noting that the likelihood profiles for the length compositions and CAAL data displayed an opposite pattern to those observed in the BFT-E SS models. It was argued that relying strictly on statistical weighting functions to resolve these fundamental conflicts may not be the most scientifically defensible approach. It was noted that a more robust approach to data conflict resolution involves grouping data inputs that exhibit similar trends, running multiple distinct structural models, and using expert judgment to determine the most realistic scenarios. However, because this was a continuity assessment, the Group acknowledged the limits placed on making such structural changes.

When discussing the jackknife diagnostics, the Group noted that varying levels of spatial mixing among the abundance indices could introduce internal inconsistencies into the model. The magnitude of mixing differed substantially across individual indices, which could account for some of the inconsistencies in results.

The Group requested a set of alternative sensitivity runs which were completed during the meeting. Similar to the BFT-E assessment, there was a request for a run with index upweighting following the same protocol used in the BFT-E models. In addition, excluding the length data from likelihood components while fixing all selectivity parameters as well as excluding the CAAL data while fixing the growth parameters was proposed. The results indicated that excluding one data component strongly affected the biomass scale estimation. Noting an implausible spike in the estimated recruitment deviation in 1961, the Group suggested that recruitment deviation estimation could instead begin in 1965, which might stabilize the model without substantially affecting the time series or model parameters. However, the model with the alternative setting produced the similarly poor numerical stability in the jittering analysis as the original continuity model.

2.2 MultiSA model

Document SCRS/2026/165 described the development of the multi-stock model (multiSA). The data include catch, length composition, and indices of abundance used in typical stock assessments. Additional data from tags and stock of origin inform seasonal movement and the extent of stock mixing. The model also incorporated an estimate of BFT-W stock biomass derived from close-kin mark-recapture (CKMR). Evaluation of the preliminary model fits identified conflicts between the various data sources that impact the size and distribution of both stocks' biomass.

The discussion centered on spatial and temporal model dimensions, the integration of tagging and stock of origin (SOO) data, model scaling, diagnostic stability, and strategies for future model development. The Group discussed the fundamental structure of the multiSA platform, contrasting it with the existing M3 platform used to develop the MSE OMs.

The current application of the multiSA model implements a 4-area, 4-season configuration, which is a simplification of the 7-area structure found in the M3 model. It was noted that the seasonal movement matrix by area and stock was currently assumed to be time-invariant. The Group noted that electronic tags with known SOO data are sparse relative to the full tagging database, which presents challenges for informing the full set of seasonal transitions within a 4-area model for small fish. Specifically, electronic tagging data assigned to younger age-classes from the West Atlantic were missing. Consequently, estimating time-varying (by year) and age-specific movement was currently precluded by data limitations. It was clarified that even with a time-invariant movement matrix, estimated SOO fractions can still shift over time because the relative abundance of the two stocks varies dynamically. The analyst noted that changes to the spatial or seasonal resolution were possible, but would require adjustments to the data-processing inputs to match the desired dimensions, which would necessitate recalculating the movement matrix.

It was noted that the tagging data used in the multiSA model were restricted to individuals for which a known stock of origin was available (either genetics or time spent in the spawning areas). It was noted that while historical tagging records are extensive, a lack of associated genetic data limits the sample size available for movement estimation. To resolve this data gap, the Group will be continuing to work with collaborators to analyze tissue samples from tagged fish so they can be used in the model.

There was a request to expand the model structure to explicitly address bluefin tuna originating from the Slope Sea. The Group considered that it was not enough understanding about the Slope Sea component yet to be considered in the model.

It was noted that the current multiSA parameterization assumed selectivity patterns that differ slightly from those used in the BFT-E SS models. For example, in the SS the Norwegian fleet was parameterized with temporal selectivity blocks to reflect documented historical changes in operational targeting. The analyst agreed to incorporate these temporal selectivity blocks into subsequent iterations of the multiSA model.

The integration of mixing data was a central focus of discussions, particularly regarding data constraints and weighting. The SOO time series was used in the population model as an observation of stock composition in the fishery catch-at-age aggregated across all fishing fleets in time and area strata, with the likelihood calculated in logit space. The Group observed that, depending on treatment, the data could contain highly rigid probabilities (near 0 or 1) and very small standard errors (SEs). The high level of precision appears to create numerical conflict, forcing the model to heavily prioritize the SOO data. To get the models to run the analyst had to increase the SOO SEs and apply lambda down-weighting. The Group recommended that the BFT Technical Sub-group on Stock Mixing investigate methods to better characterize uncertainty within this dataset (see item 7) to prevent it from exerting an inappropriate level of influence over the total likelihood (see section 4 of this report).

The Group reviewed how absolute abundance and biomass scale were informed within the multiSA platform. The analysts noted that none of the current abundance indices inform relative abundance across multiple seasons or span across distinct areas, which represents an area for future index development to better ground the spatial model. Participants emphasized that survey and catch per unit effort (CPUE) indices are strongly influenced by environmental conditions. For example, environmental conditions may alter the detectability of schools during data collection. For example, ongoing research into environmental effects on the Gulf of Lion aerial survey has shown that accounting for these factors can fundamentally alter the index trend. The Group agreed that further research is required to ensure these environmental corrections are robust before integration.

There were a number of questions regarding how the BFT-W spawning biomass prior from the CKMR study was incorporated into the model. The analyst clarified that the model incorporates a lognormal penalty on western-origin spawning biomass in 2018 based on the estimate from the CKMR study, using an SE of 0.05. It was also clarified that the current prior should be applied to the age 8+ component of the western stock – an assumption that will be adjusted in future configurations of the model. The Group agreed that modelers should evaluate how to best incorporate CKMR data into the multiSA framework, for example, treating the estimate as an absolute index of abundance time series or fitting close-kin pairs directly in the population model with explicit mechanistic equations that predict the probability of close-kin pairs. The model is fully prepared to accept a formal time series of BFT-W spawning biomass close-kin estimates, which will be updated next year, as an index of abundance.

The BFT Technical Sub-group on Assessment Models was tasked with outlining steps to be completed for the multiSA models. The findings of this Group are outlined below:

1. For this meeting, the intended exercise with the multi-stock model was to present a new software package (multiSA) and present an initial model fit to Atlantic bluefin tuna with a similar structure to previous multi-stock models (M3). However, the exercise did not produce acceptable model fits due to numerical stability problems, likely associated with conflicting interpretations of various data.

2. A small group met to identify a path to model building. Two issues were discussed: (1) re-interpretation of stock mixing estimates and the corresponding model structure needed to accommodate alternative stock mixing data; and (2) developing simpler models that sufficiently capture important biological dynamics and achieve numerical stability. To a certain extent, the two topics are related.

3. Currently, stock mixing data are treated as an observation of the stock composition in the fishery catch by year, season, and area, and aggregated across age classes and, importantly, all fishing fleets. However, aggregation across all fishing fleets in a spatial stratum is likely not appropriate. Various fleets within a spatial stratum have differing stock composition in their catch, and this discrepancy is exacerbated if the spatial strata definitions in the model are large.

4. Accordingly, the BFT Technical Sub-group on Stock Mixing was asked to estimate proportions by fishing fleet, as this stratification more accurately reflects how the sampling is done and it would better inform how the model apportions the catches by stock of origin.

5. Currently, the multi-stock model is capable of predicting differing stock composition by fleet within a single spatial stratum. This is accomplished by estimating a separable, stock-specific selection parameter for each fleet that modifies fishing mortality, analogous to how selectivity modifies fishing mortality by age.

6. Discussions on re-interpreting stock mixing data informed strategies to simplify model complexity in other ways. The stock-specific selection parameter implicitly accounts for seasonality in stock availability. Therefore, the multi-stock model may not need seasonal time steps; an annual time step would sufficiently capture stock mixing dynamics in the catch.

7. Model building should start with very simple assumptions to achieve numerical stability and understand model behaviour, then continue with increasing complexity.

3. Status check model results

3.1 Stock Synthesis

East Atlantic and Mediterranean

i. Model fits

Ten final reference case models were selected to provide stock status determination for BFT-E, integrated into an overall distribution of status estimates. The models differed primarily in the treatment of data components, in particular, the weighting of the conditional age-at-length data. A brief description of the different data treatments in each model is listed in **Table 1**. The model diagnostics and model fits for the 10 BFT-E reference case models are available in **Appendix 5**.

ii. Stock status

The time series of estimated spawning stock biomasses across all ten models is shown in **Figure 5**, and the estimated time series of fishing mortalities is shown in **Figure 6**. Spawning stock biomass was estimated to have increased by approximately 21% (average across the 10 models) over the last four years (2021 to 2024). Concurrently, average fishing mortality (2021-2024) increased by approximately 9-10% compared to the prior four-year period (2016-2019). The estimated recruitment time series is shown in **Figure 7**. Relatively high recruitments were estimated for years 2018 and 2021. Recent average recruitment (2020 to 2023) was estimated to have declined by approximately 30% compared to the prior four-year average (2016 to 2019) (averaged across the ten reference case models).

Fishing mortality rate status was determined as exploitation rate (catch/biomass) divided by the estimated $F_{0.1}$ benchmark (**Table 2**). The status determination of BFT-E is that overfishing was not occurring in 2024 (**Table 3**). The median estimate of fishing mortality in 2024 relative to the $F_{0.1}$ benchmark was 0.73 (95% confidence interval (CI) = 0.31 to 0.98). The estimated probability of overfishing was 1.8 %. **Figure 8** plots the distribution of current F (in 2024) over $F_{0.1}$ from the integrated model results.

West Atlantic

i. Model fits

Two final reference case models (early and late maturity) were agreed for providing status determination of BFT-W. The two models differed in the parameterization of maturity-at-age, including the early (fully mature at age 5) and late maturity (fully mature at approximately age 13) assumptions. The model diagnostics and model fits for the BFT-W reference case models are available in **Appendix 6**. The estimated time series of spawning stock biomass and fishing mortality are presented in **Figures 9** and **10**, respectively. Both models showed a continuous increasing trend in spawning stock biomass for the updated model since 2021 (**Figure 9**), and relatively stable fishing mortality (measured as exploitation rate as catch/total biomass). The spawning stock biomass was estimated to have increased by approximately 3 to 10% over the period 2020 to 2024, depending on the maturity assumption. The difference in spawning stock biomass estimates between the two models was due to the defined age classes comprising the biomass summaries.

Fishing mortality estimates were nearly identical between the two models. Average recruitment for the BFT-W over the period (2020 to 2023) was approximately 45% higher than the previous four-year terminal period of the 2021 western bluefin stock assessment (2016 to 2019) (Anon., 2021).

Recruitment estimates indicated relatively strong year-classes observed in 2015, 2018 and 2021, and lower recruitment in years 2014, 2017 and 2019 (**Figure 11**). Notably, estimates from 2019 to 2023 were relatively high compared to the average of the last four decades, while the uncertainty in recruitment deviation estimates was also high. The Group noted that the decline in recruitment estimates in the early 1970s corresponded to both the reduction of purse seine fisheries in the West Atlantic (sharp decrease in the catch series), as well as the increase in fishing mortality in the Mediterranean. Furthermore, the observed increase in recruitment estimates in recent years corresponded to the reduction in juvenile fishing mortality in BFT-E. The Group hypothesized that the availability of eastern fish migrants in the West Atlantic could explain the observed patterns in recruitment, which historically have been considered changes in recruitment of the BFT-W stock.

Sensitivity analyses included integration of historical size composition information, alternative weighting of data components, and replacement of the U.S. and Canadian handline indices with spatiotemporally adjusted indices of relative abundance which explicitly modeled changes in fish density over time. For the spatio-temporal index sensitivity, covariation of catchability associated with the Atlantic Multidecadal Oscillation was not modeled in conjunction with the spatiotemporal indices. Estimates of biomass scale differed considerably across sensitivity runs; however, the status determination (not overfishing) was consistent with the base models.

ii. Stock status

Fishing mortality rate status was determined as exploitation rate (catch/biomass) divided by the estimated $F_{0.1}$ benchmark (**Table 4**). The status determination of BFT-W was that overfishing was not occurring in 2024, with the estimate of fishing mortality relative to the $F_{0.1}$ benchmark equal to 0.69 (95% CI = 0.6 to 0.79) (**Table 3**). The estimated probability of overfishing was <1%. **Figure 12** plots the distribution of F to $F_{0.1}$, integrated across both models.

3.2 MultiSA model

The Group discussed how outputs from the multiSA platform may be used given the diagnostic and convergence issues identified. There was a consensus that this multiSA model is currently not at a stage of development where it can be used to provide stock status advice in 2026. Despite these limitations, the Group emphasized that the exercise of running data through the multiSA framework remains highly valuable. Rather than evaluating individual datasets in isolation, integrating them into the model provides insights into data conflicts, identifies which data sources are most influential, and clarifies how the different inputs interact to drive parameter estimates. The Group considered that the western CKMR approach represents the most informative empirical information to inform the BFT-W stock population size. However, it noted that further work is required to standardize its integration into the multiSA framework, with a view toward anchoring future OM for the MSE. The Group noted that an additional possible objective for multiSA is to serve as a platform for operating model development for the BFT MSE.

3.3 Synthesis of status check model results

Overall neither the two BFT-W models and the set of BFT-E models achieved fully satisfactory diagnostic performance (sensitivity to data weighting and general lack of fit to some of the abundance indices) but they were still deemed useful for providing relative status advice on fishing mortality. This was due to the robustness of estimated status advice across numerous sensitivity runs. Similar to models used in previous assessments (2021 for BFT-W, and 2022 for BFT-E (Anon., 2022)) they were not determined to provide reliable biomass-based benchmarks, due to known uncertainties in the catch data used to determine scale for BFT-E (Ianelli, 2023) and as, for the BFT-W, the assessment was area based while there is well-documented influence of the eastern stock in the West Atlantic (Maunder, 2021). These complications plus long-standing data conflicts limit the inference that can be obtained from these assessments relative to biomass and maximum sustainable yield (MSY) based benchmarks. Nonetheless, from the perspective of evaluating fishing mortality status relative to the status determinations provided previously, they are useful and provide solid indications that neither stock is undergoing overfishing currently nor has overfishing been occurring since the adoption of the MP through 2024 (**Table 3**).

The Group maintains that the most effective way to address the inherent uncertainties for Atlantic bluefin tuna is to consider a model that explicitly considers stock mixing informed by the best available information based on tagging, genetics and otolith microchemistry. The Group evaluated the utility of an initial multi-stock assessment model (multiSA), document SCRS/2026/165 as a potential future stock assessment model and, as well as, to provide a possible modern update to the OMs underlying the MSE. The Group further noted that substantial data conflict issues and the inherent complexity of fitting to mixing and movement data precluded its use for status advice in 2026. The Group also outlined a series of investigations, and possibly model formulations, to improve the use of the mixing data in multiSA and to improve many aspects of model fitting, so that it can be fully considered as a replacement for the M3 OMs for the future MSE review.

Despite the challenges of modeling a complex and multi-stock fishery, the Group will also consider the trends in the indices as empirical indicators of the stock trends when it will have all indices updated through 2025, as part of the annual advice framework at the 2026 September Species Group meeting.

4. Topics related to the Management Strategy Evaluation

4.1 Discussion of data inputs and assumptions for MSE revisions

Presentation SCRS/P/2026/076 provided the summary of the discussion by the BFT Technical Sub-group on Stock Mixing that was tasked to develop a standardized approach for generating robust, statistically reliable, and biologically realistic estimates of stock-mixing proportions for Atlantic bluefin tuna, including their associated measures of uncertainty, for use in the BFT MSE.

The presentation emphasized that the first and foundational step - conditioning all subsequent results - is the individual origin assignment (probability of belonging to the western stock, *p*_west). These probabilities are derived from genetic data (86- and 96-SNP panels, the BFT array and the CKMR panel) and from otolith data (δ^{13}C and δ^{18}O values), using different methods and baselines.

Because the treatment of input data and the way individual assignments are combined strongly influence the final proportions *per stratum*, several key questions were identified: i) how to account for heterogeneity across methods; ii) how to integrate and weight assignments derived from different data types and approaches; and iii) when to retain probabilities ("soft calls") *versus* converting them into categories ("hard calls"). Addressing these questions requires understanding the nature of each data type used and making information on markers, baselines and approaches used for individual stock assignments.

After setting the context, the presentation concluded with short-term recommendations: i) accompany individual stock-identification data with minimum genetic stock-identification information; ii) understand the assumptions and potential biases of each data type and marker set (for genetic data); and iii) agree on if, when and how *p*_west should be translated into hard calls. It also proposed next steps for the Sub-group's work: 1) compile and assess all approaches used for *p*_west estimation; 2) build a joint table to identify patterns across data types and methods; and 3) from there derive a standardized procedure to integrate *p*_west values for estimating stock-mixing proportions.

The Group emphasized the need to understand differences among stock of origin assignment methods, noting that discrepancies across genetic and otolith approaches can influence mixing-proportion estimates. It is known that some methods tend to overestimate proportions. For example, the use of the 86 single nucleotide polymorphisms (SNP) panel for individual stock assignment, results in larger western proportions than when the Atlantic-Wide Research Programme for Bluefin Tuna (GBYP BFT) array is used (see Diaz-Arce *et al.*, 2025). These potential over/underestimations should be assessed for the other marker sets as it is critical to understand how certain methods might overestimate stock proportions given the implications on East/West BFT biomass estimates.

Other comments identified that the proportions for some strata were based on a few samples, and the need for considering whether the samples were representative enough in time and space to be considered as inputs was stressed. Given that the composition data needs to represent specific fleets this analysis will also need to consider whether the data are adequate for this purpose.

The Group acknowledged that this is a complex and influential issue, and that fully harmonizing methods may be a longer-term effort. Given the upcoming MSE review and the next MP cycle planned by 2028, it will be necessary that the BFT Technical Sub-group on Stock Mixing develop an agreed set of otolith and genetic stock mixing matrices or a set of plausible alternatives according to the workplan outlined in section 7 of this report. If this is not possible, the Group may need to consider alternative solutions to use the SOO data in the MSE review.

The BFT Technical Sub-group on Stock Mixing is scheduled to meet to advance the preparation of the SOO data for inclusion within multiSA. The Group discussed timelines and organizational needs for the Sub-group. Considering the next intersessional meeting will take place around April 2027; SOO would therefore need to be completed by February 2027 to leave enough time for the contractor to include them in the work. The Sub-group will meet to organize tasks, define leadership and assess resource requirements. It was agreed that the Sub-group should not be assigned more work than it can realistically accomplish. Re-evaluation of CKMR stock-identification methodology - particularly the first step involving origin assignment - was considered feasible within the Sub-group's remit, but will be more comprehensively addressed in a dedicated meeting on CKMR, noted in a recommendation by the Group outlined in section 7 of this report.

The Group also supported including a larger expertise in the Sub-group. Collaboration among statisticians, modellers, geneticists and otolith experts was considered essential to guide the Sub-group and ensure a clear understanding of the SOO dataset for correct use in subsequent modelling approaches. This will help the Sub-group to address two main tasks. First, the compilation and understanding of how *p*_west values are generated. This work is focused on genetic and should be led by colleagues with expertise in that area but also will need expertise in otolith data. Second, the post-treatment of *p*_west to obtain mixing proportions for strata and fleets depending on how the data are fitted in the estimation model. This requires solid data-treatment skills, and modellers should be involved to ensure consistency and proper representation of uncertainty depending on the strata for which mixing is inferred.

Presentation SCRS/P/2026/074 provided updated Japanese pelagic longline (JPNLL) abundance indices for the western and northeastern Atlantic. The authors reported on a strict update of the existing index series while noting that efforts were underway to develop improved indices for future assessments. The recent values depicted an increase in the West Atlantic, while they depicted a decrease in the East Atlantic.

During the discussion, several changes in the spatial and temporal distribution of the fishery, as well as shifts in the cohorts targeted over time, were noted as factors influencing abundance estimates. It was also noted that increases in quota allocations have led the fleet to extend its fishing season in order to fully utilize the available quota, which could explain the observed spatial change, to avoid the challenging meteorological conditions.

Document SCRS/2026/158 was developed to clarify the concept and implementation of MP reviews, particularly for members of Panel 2.

Participants emphasized the importance of carefully framing the document as reflecting the Group's perspective rather than a recommendation on how the Commission should conduct MP reviews. Discussion also addressed whether modifications to MP parameters (i.e. after retuning) should be referred to as a "new MP" or not, and the Group decided to avoid such terminology to avoid confusion.

The need to differentiate between routine retuning of an existing MP and broader and more comprehensive comparative evaluations of alternative MPs (as when an MP is selected for the first time) was highlighted.

While the document was considered broadly applicable across fisheries and management bodies, it was suggested that the Bluefin Tuna Species Group record its views during the current meeting and allow the SCRS to further review and endorse the framework as appropriate. It was noted that the purpose and need for the document was to clarify the BFT MSE review process. The Group agreed to work offline between this meeting and the September 2026 Bluefin Tuna Species Group to further refine the document.

4.2 Development of 'Simplified' OM structure by combining existing strata

The Group favored a simplified structure for OMs based on the multiSA model being developed, which already simplified the spatial structure used in M3, from 7 to 4 areas. Given that, in the current configuration, several strata (combinations of area, age class and quarter) do not have enough information for e-tags transitions and/or SOO composition, the Group mentioned the possibility to further simplify the models, including suggestions to move to a yearly based model, and/or a two-area model. This would also be supported by the fact that fisheries generally operate in specific areas and quarters, so a "fleets as areas" approach could be considered rather than explicitly modelling areas and quarters. This discussion was taken further by the BFT Technical Sub-group on Assessment Models.

The BFT Technical Sub-group on Assessment Models met to advise on the future development of the multiSA model. The Sub-group discussed the need to proceed in a stepwise approach, starting with developing simpler model configurations and compared several potential options on model structure and fitting. Once a stable model is available, subsequent steps can be taken to increase complexity. The Sub-group plans to meet intersessionally to discuss progress and updates prior to presenting an updated SCRS document in September 2026. The Group, as a whole, endorsed this approach.

4.3 Plan for the evaluation of exceptional circumstances in 2026

The Group did not identify any major concern based on the work conducted in this meeting, and will evaluate the exceptional circumstances, according to the standard protocols (*Recommendation by ICCAT amending the Recommendation 22-09 establishing a management procedure for Atlantic bluefin tuna to be used for both the western Atlantic and eastern Atlantic and Mediterranean management areas* (Rec. 23-07)), in September 2026.

4.4 Guidance from Panel 2

During the 2026 Intersessional Meeting of Panel 2 it was recommended that the SCRS should:

1. utilize the latest mixing and movement data to assess the distribution of BFT across the Atlantic and inform advice for sustainable yields based on the total BFT biomass availability in each management area.

2. consider the opportunity and feasibility of including genetics-based information in the BFT MSE framework and assist the Commission to better understand the key underlying concepts, their pros and cons, to inform and thereby build confidence in the inclusion of outputs from genetics-based approaches in the ICCAT scientific processes.

The Group noted that the SCRS is already using the latest mixing and movement data in their advice. For the second aspect, a recommendation is included in section 7 of this report, regarding convening meetings.

5. Draft Executive Summary sections

The Executive Summary from the *Report for biennial period, 2024-25 Part II (2025) - Vol. 2* will be modified to include the outcomes of the current meeting for the stock status and the Chairs will present their proposals to the Group at the September 2026 Bluefin Tuna Species Group meeting.

6. Update on GBYP activities

Presentation SCRS/P/2026/077 provided an update of the current status of the activities developed within GBYP Phase 15 in 2026, including some preliminary results of those already completed. A brief review of the GBYP conventional tagging was also presented, aiming to provide advice on the continuity of such a programme.

The Group acknowledged that all 2026 planned activities are now ongoing or have been already completed (i.e. aerial survey in the Balearic area and some of the e-tagging campaigns in the eastern and western Mediterranean).

Regarding the conventional tagging programme, it was suggested that the Group carefully evaluate the costs and benefits of maintaining this initiative. Participants noted that while the programme incurs substantial financial and operational costs for both the Secretariat and tagging partners - specifically concerning staff time dedicated to coordination, materials, and tag return rewards - it has yielded few scientific products or analyses over the past 15 years.

The Group recognized that due to the scarcity and lack of reliability of the information related to size at release and at recovery of conventionally tagged individuals, as well as the low percentage of recovered tags and the variability observed in these reporting rates over time, the information from the GBYP conventional tagging programme had a limited use for determining or validating parameters such as natural and fishing mortality.

The Group reviewed the current use of conventional tagging data on the ongoing modelling activities. It was clarified that the biggest benefit to the database in the recent period has been refining estimates of growth, namely L_{INF} (Ailloud *et al*., 2017). Since then, it has been noted convergence in the growth estimates for both East and West stocks from otolith aging, consistent with Ailloud's analysis integrating the conventional tagging data. Extensive simulation testing of the conventional tagging programmes in the Atlantic (Lauretta and Goethel, 2017; Sculley, 2016) has demonstrated that the data are useful for movement, but not for mortality estimation in the absence of information on fleet specific reporting rates, and to a lesser extent tag loss and handling mortality. Along those lines, the data were used to describe movement into the Mediterranean Sea (Carruthers *et al.*, 2017), but extensive electronic tagging efforts in recent years are providing much higher quality data that are used within the MSE and that are now the focus of the Group. It was noted that the current multiSA model and the M3 OMs do not use conventional tagging data. Due to the unknown reporting rates of conventional tags, the satellite tag data are preferred currently. However, it was noted that the multiSA model would benefit from as much data with known stock of origin as possible.

Due to the limited use of the conventional tagging data, it was suggested a phase-out of the conventional bluefin tuna tagging programme. However, the Group highlighted the importance of continuing the reward activities to honor tags already in the water. Furthermore, it was noted conventional tags should still be required to be deployed on fish tagged with internal archival tags to increase the reporting probability. In addition, the Group suggested that the Secretariat consider how to make better use of the remaining conventional tags and how these could be used by CPCs for other purposes.

7. Recommendations

1. The Group recommends exploring opportunities for building a common understanding of CKMR in coordination with the relevant Commission and SCRS officers:

   a) Informal webinar at technical level around February 2027 on BFT CKMR to include overview of BFT-W CKMR estimation and potential applications to MSE and management. Participants can provide questions in advance or during the meeting.

   b) High-level, plain language "Close-kin mark recapture, global perspective and potential management applications in the context of ICCAT fisheries" webinar, in 3 languages. Target audience: scientists, managers and interested stakeholders. Three webinars (French, English, Spanish in February 2027). The Chair of the SCRS consults with the Chair of Panel 2 to finalize the format.

2. Recover genetic samples from pop-up satellite archival tag (P-SAT) tagged fish and run for genetic stock ID and sex using the array. This may come with a funding request for genotyping in September 2026.

3. The Group reiterated the recommendation that utilizing Artificial Intelligence (AI) to collect measurements for 100% of the stereo-camera footage at the time of first transfer or first caging would streamline the integration of these data into the stock assessment.

4. For the purpose of the 2027 MSE review, the Group recommended:

   a) Further investigation of the different methods to determine *p*_west and SOO proportions, given their influence on the multiSA model. The BFT Technical Sub-group on Stock Mixing, including modellers, should meet to refine SOO inputs for otoliths and genetics and report on progress to the Group.

   b) That the BFT Technical Sub-group on Assessment Models continues its workplan to refine the multiSA models and report on progress to the Group.

5. Based on discussions detailed on section 6 and the shift towards e-tagging, the Group recommended a phase-out of the conventional tagging programme for BFT within GBYP. Tag rewards would continue to be honored for tags still in the water and conventional tags would still be required on fish with internal tags.

6. The Group recommended the deadline on documents and presentations submission to be enforced by the Chairs.

7. The Group recommended that national scientists continue reviewing and compiling novel historical size data for BFT-W fisheries to consider for inclusion in the ICCAT databases following the standard procedure for historical data revisions adopted by the SCRS.

8. The Group recommended all the e-tag data from the different tagging activities to be used in the MSE work to be provided to the Secretariat, and requested an inventory to identify any outstanding gap.

9. Acknowledging that important Task 2 size data (ST-04) from the Mediterranean purse seine have not been reported on time for this meeting, the Group reiterates the need for CPCs to comply with the data submission obligations adopted by the SCRS and the Commission. The Group also acknowledged that some, but not all, CPCs have submitted their size data in ST-06 forms and encouraged them to continue working with the Secretariat with the aim to ensure that these data are provided timely for the stock assessments.

10. The Group recommended to task the Secretariat to carry out a global review of the main research lines of activities developed within GBYP, including a cost analysis, inputs for the provision of advice and how the programme has contributed to improve bluefin tuna fisheries management.

Workplan for the BFT Technical Sub-group on Stock Mixing

The BFT Technical Sub-group on Stock Mixing should meet, together with modellers, to refine SOO inputs for otoliths and genetics and report on progress to the Group. The objective is to fully consider the different methods used to determine *p*_west and SOO proportions, given their influence in the 2-stock modelling, such as the following:

i. Sampling representativeness - Compile metadata for all genetic and otolith samples and consider the sample selection protocols. Determine whether the given samples are representative of the fleet catch in a given season and area.

ii. Probability-west determination - Compile information about all approaches used for *p*-west estimation (markers, baselines, assignment method). Evaluate and assess each of them as well as alternatives (aimed at reducing heterogeneity).

iii. Compile a joint mixing table - Include all *p*_west estimates available and derive patterns, focusing on comparing stock ID derived from different data types. E.g. otoliths produce intermediate probability values due to reduced discriminant power: methodological reason; focus on comparing stock ID derived from different approaches; focusing on potential effects of heterogeneity within area.

Based on the outlined work, the BFT Technical Sub-group on Stock Mixing will agree on a standardized procedure for generating robust, statistically reliable, and biologically realistic estimates of stock mixing proportions, including associated measures of uncertainty.

Key dates:

September 2026 - online coordination meeting;
September SCRS - meeting to report on progress and possibly to meet;
February 2027 - best available revised mixing datasets, based on interactions with the BFT Technical Sub-group on Assessment Models.

8. Other matters

Document SCRS/2026/164 investigated reproductive biology using standardized histological criteria from 2007-2024 across the Gulf of Mexico (GOM) and U.S. Atlantic waters. Spawning capable females were observed from March to July in all regions, with the highest activity in the GOM. No spawning capable or actively spawning ovaries were observed in females <180 cm, and ovary weight data similarly indicated minimal reproductive activity below this size, although the study identified a critical gap in fish between 145 and 180 cm. Length- and age-at 50% maturity was estimated under the functional threshold (L_{50}=155.5 cm; A_{50}=7.08 years).

The Group raised several questions, including whether this work had considered aspects such as size/season/source of sampling and mixing effects that could, separately or in combination, affect the results presented. The authors acknowledged that there were limitations in the sampling and indicated that while the maturity ogive might not be fully specified, efforts were ongoing to address missing size classes and the forthcoming genetic stock of origin information. It was also noted that in such studies it is important not only to try to ensure the presence of all size classes (in particular small fish in this case), but also the representative proportions. Furthermore, it is possible that some of the fish were of East origin and that regenerating females of less than 150 cm could spawn in the region, but it was not clear in what proportions. For fish smaller than 150 cm, minimal active spawning was observed so far. It was noted that in the GOM and North Atlantic the actively spawning females were found to be around 180 cm and above.

Noting that the samples come from rod and reel fisheries that do not target all age classes, possible ideas and support for filling the sampling gaps (in particular fish ranging from 145-205 cm) were discussed. According to the authors, a targeted scientific research programme/survey allowing collecting fisheries independent samples could assist in filling the missing information, in particular through histology readings for females between 140-180 cm and genetic assignment of samples. Some members of the Group reiterated long-standing concerns regarding the biological relevance of the significant discrepancies between the maturity ogives of the BFT-E versus the higher age at maturity axis of uncertainty for BFT-W. The Group encouraged the authors to continue this work focusing on filling in the key gaps in fish between 100-180 cm.

Presentation SCRS/P/2026/075 provided that histological analysis of 42 female bluefin tuna sampled in the Slope Sea reveals that 93% (n = 39) were mature adults, including fish as small as 120 cm SFL with advanced vitellogenic follicles. The presence of post-ovulatory follicles in 10 females (26%; 168–231 cm SFL) provides direct biological validation of active spawning in the Northwest Atlantic.

The Group was keenly interested in the new data coming from a targeted fishery-dependent cruise in the Slope Sea. Initial indications found that fish as small as 120 cm were mature and fish above 168 cm exhibited post-ovulatory follicles indicating recent spawning. Spawning in this area was further confirmed by a larval survey two weeks later that captured many thousands of larvae. Nonetheless the Group noted that while these are groundbreaking new data, the sample sizes remain low and future inferences on age at maturity of the BFT-W only stock will be aided once the stock of origin information becomes available soon.

A question was raised regarding the ability of the western CKMR programme to inform about total reproductive output and calculate spawning fractions from parent offspring pairs. The western CKMR programme leader shared information about the ongoing work and prospects in regard to this topic, noting that CKMR is, indeed, a critical tool to evaluate total reproductive output, as well as the importance of spawning in the Slope Sea and that this is one of the key reasons for targeting larval sampling in the area. While estimating total reproductive output is not the top priority of the programme, it is part of the hierarchy of planned tasks in the ongoing work. The Group noted that the new data coming from the Slope Sea are extremely important and looks forward to continued updates on ongoing research to evaluate the importance of spawning in this area.

The Group noted that uncertainty related to maturity is a long-standing issue for BFT in the stock assessments, though it is much less influential than other axes of uncertainty. The MSE framework includes a dedicated uncertainty axis related to total reproductive output at age and natural mortality, of which age at maturity plays a role. Ongoing research could reduce one of the axes of uncertainty. The Group recommends that researchers explore the opportunity of using the findings of this work to fill the fish size gaps in the study presented in document SCRS/2026/164. However, noting the methodological limitations and concerns expressed above, it was concluded that this work will need to consider the representativeness of the existing samples to reflect population-level age-at-maturity for the BFT-W stock.

SCRS/P/2026/071 introduced 3 papers together: Block *et al.* (2026), Mikles *et al.* (2026), and Aalto *et al.* (in print).

The first paper in SCRS/P/2026/071 by Block *et al.* (2026) combines and reports on three decades of Atlantic BFT electronic tag data and examines the distribution of the species fisheries impact over 70 years. The authors hypothesize that, under the historical two-stock management paradigm, escapement from the Mediterranean Sea to the lower fishing mortality of the North Atlantic has contributed to the recovery of the eastern stock, with the 45°W meridian acting as an indirect conservation measure.

The Group questioned the methodology and some assumptions. In particular, it was noted some lack of clarity on the fish assignment to stock of origin and it was confirmed that many of the fish tagged still remained unassigned, since the research programme had prioritized genome-wide studies and the establishment of reference populations by region before expanding to other relevant work.

The Group raised questions regarding the lack of younger age classes (fish smaller than 160 cm) and some areas in the study which indicated potential limitations of the results. It also noted that, while a lot of information was presented in the paper, it remained a subset of all of the available tagging data included in the GBYP database, highlighting that centralization of BFT tagging information is extremely useful for future ICCAT scientific work. The authors clarified that they are providing and will continue to provide relevant data to ICCAT, however there was generally a lag due to the time needed to extract and mine the data from the tags. They also informed about their efforts to address gaps by expanding their sampling efforts to other relevant areas, such as the eastern Mediterranean.

The Group questioned the "refuge" hypothesis proposed by the authors, particularly given years of successful management, strong recruitment in 2003 (and later), conservation efforts and as the current MP explicitly includes stock mixing and movement. The Group stressed the importance of ensuring that all relevant information from various BFT tagging studies, such as this one feed into the MSE work as needed and provides a recommendation in this regard in section 7 of this report.

The second paper in SCRS/P/2026/071 by Mikles *et al.* (2026) analyzed 82 whole-genome sequences obtained from mature BFT tracked to geographically distinct spawning grounds, as well as larvae representing the two recognized stocks. Both neutral and adaptive SNP markers reflect the same genomic population structure as the spatial movement patterns, and candidate genes with potentially adaptive roles are highlighted. The analyses show that the two populations diverged ~27,000 years ago, overlapping with the Last Glacial Maximum.

The Group acknowledged the innovative nature of this work. Subsequently, it discussed the genetic differences among BFT-E and BFT-W stocks and the specific case of the Slope Sea, in an attempt to disentangle the effects of environmental and genetic drivers of genomic differentiation in this highly migratory species in the context of rapidly changing oceanographic conditions in the Atlantic notably due to climate change.

The results from the specimens sampled in the Slope Sea triggered a robust discussion aiming at providing plausible hypotheses that could explain the presence of genetic differences despite the possibly substantial interbreeding between fish from the Mediterranean (eastern origin) and GOM (western origin), that were found to spawn during the same period in the Slope Sea. The possibility of a simultaneous presence of the Mediterranean and GOM fish in the Slope Sea without mixing is not excluded, nor the possibility that this area became a common spawning ground only very recently on genetic time scale, not allowing enough time for interbreeding effects to play in.

More and multidisciplinary work is needed to advance our understanding and that could also possibly include high throughput sequencing and genome expression. According to the authors, although 550 fish have already been genotyped, more work is needed to fully understand what makes two different populations, including reference work in all relevant regions. The recent decrease in sequencing services costs offers the opportunity to expand this work on a larger scale. The authors also highlighted the importance for ICCAT CPCs to continue supporting financially BFT research.

The third paper in SCRS/P/2026/071 by Aalto *et al.* (in print) combined electronic tagging datasets with environmental data to model distributions for Atlantic bluefin tuna, blue shark, swordfish, and blue marlin. By comparing with species-specific CPUEs reported to management, regions were identified where reported catches were low compared to predicted species density. This data science approach may be useful to management, potentially indicating regions where fleets may be under-reporting or other management assumptions may be invalid.

The Group expressed concern that it was not able to review this paper as it is preprint and was not available at the time of the meeting, nor did the Group have time to review the presentation before the meeting. The Group encouraged all authors to submit SCRS documents and presentations at least by one week prior to the start of a meeting to allow participants to analyze, provide feedback and benefit from relevant new scientific information. A specific recommendation by the Group is included in section 7 to this effect. The Group noted that this work has implications for bycatch and may be useful to present to the Subcommittee on Bycatch and Ecosystems.

A table of the number of tags available in the GBYP tagging database (**Table 5**) was presented per tagging group and stock of origin (East, West, and Unclassified). The purpose was to allow participants to identify which datasets were included, possibly which were missing, and which tags necessitated to be assigned to a stock of origin (i.e. unclassified), for instance based on genetic information.

9. Adoption of the report and closure

The report was adopted during the meeting. The Chairs thanked all the participants for their efforts and deeply thanked the Japanese delegation again for hosting the meeting. The meeting was adjourned.

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Table 1. Brief description of BFT-E Stock Synthesis model runs used to estimate stock status.

Run	Description
R35	Estimates all Richards growth model parameters except L_{inf}. It also estimates CV_{young} and CV_{old}, as well as R_0 (steepness and sigmaR were fixed). Selectivity parameters are estimated, with an assumption of asymptotic selectivity for the Norwegian purse seine fleet before 2016. Abundance indices are used with the original CVs provided by the authors. The sample sizes for the length composition data are the log of the number of measured fish. The sample sizes used for the CAAL data are the number of fish measured, without any reweighting.
R36	Like R35, also estimating the L_{inf} parameter
R37	Like R36, with the CAAL sample size entered as log(original sample size) by fleet and year, similarly to how the length composition data are used. The added constant to the CAAL age bins is substantially reduced relative to the other runs
R38	Like R36, excluding the year 2013 CAAL data of Fleet 2 (BB_BB_post2007)
R39	Like R38, applying Francis weights to the CAAL data
R40	Like R39, increasing the CVs of age reading for the youngest ages to 0.3 and transitioning to 0.1 for older ages
R41	Like R39, increasing the CVs of age reading to 0.3 for all ages
R42	Like R40, with L_{inf} fixed at 271 cm
R43	Like R40, with some minor changes to the selectivities of Fleets 6 and 14 at the smallest lengths to try and improve the fits to CAAL for the smallest lengths
R44	Like R42, with some minor changes to the selectivities of Fleets 6 and 14 at the smallest lengths to try and improve the fits to CAAL for the smallest lengths

Table 2. Annual estimates of relative fishing mortality ($F/F_{0.1}$) from the ten BFT-E Stock Synthesis models with standard deviations.

Model	R35		R36		R37		R38		R39		R40		R41		R42		R43		R44	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1950	0.332	0.020	0.312	0.019	0.261	0.014	0.297	0.017	0.282	0.015	0.272	0.015	0.178	0.012	0.281	0.014	0.272	0.015	0.280	0.014
1951	0.388	0.023	0.364	0.022	0.304	0.016	0.347	0.020	0.329	0.018	0.317	0.017	0.206	0.014	0.328	0.017	0.317	0.017	0.327	0.017
1952	0.525	0.031	0.492	0.029	0.409	0.022	0.468	0.027	0.444	0.024	0.427	0.023	0.275	0.019	0.443	0.023	0.427	0.023	0.441	0.023
1953	0.563	0.034	0.526	0.032	0.435	0.024	0.499	0.030	0.474	0.026	0.455	0.025	0.290	0.021	0.473	0.025	0.455	0.025	0.470	0.025
1954	0.571	0.035	0.531	0.033	0.438	0.024	0.503	0.030	0.478	0.027	0.458	0.026	0.288	0.021	0.477	0.026	0.458	0.026	0.474	0.026
1955	0.729	0.045	0.674	0.042	0.553	0.032	0.637	0.039	0.606	0.035	0.580	0.033	0.359	0.027	0.605	0.033	0.580	0.033	0.602	0.033
1956	0.547	0.035	0.501	0.032	0.409	0.024	0.473	0.030	0.450	0.027	0.429	0.025	0.261	0.020	0.450	0.026	0.429	0.025	0.448	0.025
1957	0.701	0.045	0.638	0.042	0.519	0.032	0.601	0.039	0.572	0.035	0.545	0.033	0.326	0.026	0.574	0.034	0.545	0.033	0.571	0.033
1958	0.714	0.048	0.643	0.044	0.522	0.033	0.605	0.040	0.576	0.036	0.547	0.035	0.321	0.027	0.580	0.035	0.547	0.035	0.576	0.035
1959	0.619	0.043	0.551	0.039	0.445	0.030	0.518	0.036	0.493	0.032	0.467	0.031	0.268	0.023	0.498	0.031	0.467	0.031	0.495	0.031
1960	0.668	0.048	0.588	0.043	0.474	0.033	0.551	0.039	0.526	0.036	0.496	0.034	0.279	0.025	0.532	0.035	0.497	0.034	0.529	0.034
1961	0.782	0.058	0.681	0.051	0.547	0.039	0.638	0.047	0.608	0.043	0.573	0.041	0.315	0.029	0.618	0.042	0.573	0.041	0.614	0.041
1962	0.899	0.069	0.772	0.060	0.616	0.046	0.722	0.056	0.688	0.051	0.646	0.048	0.346	0.034	0.701	0.049	0.647	0.048	0.697	0.049
1963	0.550	0.044	0.466	0.038	0.369	0.029	0.435	0.035	0.414	0.032	0.387	0.030	0.202	0.020	0.423	0.031	0.388	0.030	0.420	0.031
1964	0.612	0.050	0.513	0.043	0.405	0.033	0.480	0.040	0.456	0.036	0.426	0.034	0.218	0.023	0.467	0.035	0.427	0.034	0.465	0.035
1965	0.641	0.052	0.532	0.045	0.419	0.035	0.497	0.042	0.472	0.038	0.440	0.036	0.221	0.024	0.485	0.037	0.441	0.036	0.483	0.037
1966	0.597	0.049	0.490	0.042	0.384	0.032	0.458	0.039	0.435	0.036	0.404	0.034	0.199	0.022	0.448	0.035	0.404	0.034	0.445	0.035
1967	0.819	0.069	0.666	0.059	0.521	0.045	0.624	0.054	0.590	0.049	0.547	0.047	0.265	0.030	0.609	0.049	0.548	0.047	0.606	0.048
1968	0.601	0.051	0.482	0.044	0.374	0.033	0.452	0.040	0.426	0.037	0.393	0.034	0.185	0.021	0.441	0.036	0.394	0.035	0.438	0.036
1969	0.698	0.060	0.555	0.051	0.428	0.039	0.521	0.047	0.488	0.042	0.450	0.040	0.208	0.024	0.507	0.042	0.451	0.040	0.504	0.042
1970	0.527	0.046	0.415	0.038	0.318	0.029	0.390	0.036	0.364	0.032	0.335	0.030	0.151	0.018	0.378	0.032	0.335	0.030	0.376	0.032
1971	0.564	0.049	0.441	0.041	0.336	0.031	0.416	0.038	0.385	0.034	0.354	0.032	0.158	0.019	0.401	0.034	0.354	0.032	0.399	0.033
1972	0.563	0.048	0.439	0.041	0.331	0.031	0.414	0.038	0.381	0.033	0.350	0.032	0.153	0.018	0.397	0.033	0.350	0.032	0.395	0.033
1973	0.589	0.050	0.457	0.042	0.344	0.032	0.432	0.040	0.396	0.035	0.363	0.033	0.157	0.019	0.413	0.035	0.363	0.033	0.411	0.034
1974	1.048	0.087	0.813	0.074	0.610	0.057	0.771	0.071	0.704	0.061	0.645	0.058	0.276	0.033	0.736	0.061	0.644	0.058	0.732	0.060
1975	1.228	0.103	0.947	0.087	0.707	0.067	0.898	0.083	0.818	0.072	0.746	0.069	0.312	0.038	0.856	0.072	0.746	0.069	0.852	0.071
1976	1.364	0.115	1.044	0.098	0.773	0.075	0.991	0.094	0.897	0.081	0.816	0.077	0.332	0.041	0.941	0.080	0.816	0.077	0.936	0.080
1977	1.247	0.108	0.948	0.092	0.692	0.069	0.900	0.087	0.808	0.075	0.732	0.071	0.288	0.037	0.849	0.074	0.732	0.071	0.844	0.074
1978	1.038	0.089	0.790	0.077	0.574	0.058	0.751	0.074	0.672	0.062	0.607	0.060	0.234	0.030	0.706	0.062	0.607	0.060	0.702	0.062
1979	0.879	0.074	0.672	0.065	0.488	0.050	0.640	0.063	0.570	0.053	0.516	0.051	0.196	0.025	0.601	0.053	0.516	0.051	0.597	0.053
1980	1.004	0.082	0.775	0.073	0.564	0.057	0.739	0.071	0.659	0.061	0.597	0.058	0.225	0.029	0.693	0.060	0.597	0.058	0.689	0.060
1981	1.024	0.081	0.799	0.074	0.581	0.058	0.763	0.072	0.679	0.062	0.615	0.060	0.229	0.030	0.713	0.061	0.615	0.060	0.710	0.061
1982	1.656	0.127	1.304	0.119	0.947	0.094	1.247	0.117	1.109	0.100	1.004	0.097	0.372	0.049	1.162	0.098	1.003	0.097	1.155	0.098
1983	1.694	0.129	1.337	0.123	0.964	0.097	1.278	0.120	1.134	0.103	1.022	0.100	0.371	0.049	1.183	0.100	1.020	0.100	1.177	0.100
1984	2.016	0.151	1.595	0.147	1.147	0.117	1.524	0.144	1.351	0.124	1.212	0.120	0.432	0.058	1.405	0.119	1.210	0.119	1.398	0.119
1985	1.971	0.148	1.555	0.145	1.107	0.115	1.485	0.143	1.312	0.123	1.173	0.119	0.406	0.055	1.367	0.118	1.172	0.119	1.360	0.118
1986	1.797	0.131	1.425	0.132	1.016	0.106	1.361	0.130	1.205	0.112	1.074	0.109	0.367	0.051	1.249	0.107	1.072	0.108	1.244	0.107
1987	1.709	0.117	1.372	0.122	0.994	0.102	1.314	0.121	1.170	0.106	1.047	0.104	0.359	0.050	1.215	0.101	1.045	0.104	1.210	0.101
1988	2.205	0.139	1.797	0.150	1.330	0.132	1.727	0.149	1.552	0.134	1.393	0.133	0.486	0.067	1.606	0.126	1.390	0.132	1.600	0.126
1989	1.959	0.118	1.612	0.129	1.210	0.118	1.553	0.130	1.407	0.119	1.266	0.119	0.442	0.061	1.457	0.111	1.263	0.118	1.452	0.111
1990	2.052	0.112	1.724	0.126	1.324	0.120	1.668	0.127	1.536	0.120	1.381	0.121	0.502	0.069	1.572	0.110	1.377	0.120	1.567	0.110
1991	2.089	0.102	1.796	0.117	1.437	0.120	1.747	0.119	1.633	0.116	1.491	0.120	0.568	0.077	1.680	0.106	1.487	0.119	1.675	0.106
1992	2.354	0.106	2.059	0.122	1.691	0.130	2.011	0.124	1.898	0.123	1.740	0.128	0.692	0.092	1.941	0.111	1.736	0.128	1.936	0.111
1993	2.381	0.100	2.118	0.115	1.765	0.124	2.076	0.117	1.969	0.117	1.814	0.123	0.752	0.098	2.003	0.104	1.810	0.122	1.997	0.105
1994	2.989	0.118	2.704	0.134	2.307	0.147	2.661	0.137	2.529	0.137	2.365	0.146	1.029	0.131	2.579	0.123	2.359	0.145	2.572	0.124
1995	2.908	0.110	2.657	0.123	2.316	0.138	2.621	0.126	2.497	0.125	2.362	0.136	1.060	0.135	2.554	0.114	2.357	0.135	2.548	0.115
1996	3.100	0.115	2.853	0.127	2.515	0.141	2.820	0.128	2.692	0.128	2.565	0.139	1.176	0.149	2.755	0.117	2.559	0.138	2.748	0.119
1997	3.048	0.111	2.825	0.121	2.541	0.136	2.798	0.122	2.685	0.122	2.575	0.133	1.199	0.153	2.749	0.113	2.570	0.132	2.742	0.114
1998	2.944	0.105	2.745	0.112	2.494	0.126	2.722	0.113	2.620	0.113	2.521	0.122	1.197	0.154	2.673	0.105	2.514	0.121	2.666	0.106
1999	2.991	0.107	2.803	0.113	2.543	0.124	2.781	0.113	2.675	0.112	2.584	0.121	1.232	0.160	2.727	0.106	2.577	0.120	2.720	0.106
2000	3.005	0.107	2.832	0.112	2.570	0.121	2.812	0.111	2.699	0.109	2.629	0.119	1.257	0.164	2.758	0.105	2.622	0.118	2.751	0.106
2001	3.093	0.111	2.923	0.115	2.640	0.122	2.903	0.115	2.783	0.112	2.728	0.122	1.295	0.171	2.849	0.109	2.718	0.121	2.843	0.110
2002	3.196	0.117	3.019	0.120	2.713	0.125	3.000	0.119	2.886	0.116	2.818	0.125	1.334	0.179	2.937	0.112	2.806	0.124	2.932	0.113
2003	3.285	0.122	3.091	0.124	2.764	0.127	3.072	0.123	2.981	0.121	2.966	0.134	1.382	0.189	3.092	0.120	2.952	0.133	3.086	0.122
2004	3.161	0.118	2.954	0.119	2.701	0.123	2.941	0.118	2.891	0.117	2.833	0.127	1.397	0.192	2.948	0.115	2.813	0.126	2.943	0.116
2005	3.019	0.121	2.793	0.120	2.648	0.124	2.785	0.119	2.759	0.118	2.706	0.126	1.396	0.193	2.842	0.117	2.694	0.126	2.831	0.118
2006	2.924	0.135	2.681	0.130	2.601	0.132	2.679	0.129	2.660	0.126	2.592	0.132	1.377	0.192	2.749	0.126	2.590	0.132	2.730	0.126
2007	3.403	0.196	3.123	0.183	3.136	0.180	3.131	0.183	3.137	0.171	3.057	0.177	1.640	0.232	3.267	0.177	3.067	0.178	3.232	0.175
2008	1.454	0.097	1.315	0.087	1.356	0.097	1.323	0.087	1.328	0.090	1.291	0.092	0.665	0.100	1.392	0.095	1.300	0.093	1.372	0.094
2009	1.069	0.079	0.970	0.070	1.012	0.079	0.979	0.070	0.979	0.072	0.956	0.074	0.498	0.074	1.029	0.078	0.965	0.075	1.012	0.076
2010	0.546	0.044	0.498	0.038	0.521	0.043	0.505	0.039	0.506	0.040	0.497	0.041	0.260	0.038	0.533	0.044	0.502	0.041	0.523	0.042
2011	0.407	0.033	0.373	0.029	0.393	0.033	0.380	0.030	0.381	0.031	0.378	0.032	0.201	0.028	0.404	0.034	0.382	0.032	0.396	0.033
2012	0.403	0.034	0.370	0.030	0.390	0.034	0.383	0.030	0.384	0.032	0.379	0.032	0.203	0.028	0.404	0.035	0.384	0.033	0.396	0.034
2013	0.446	0.038	0.410	0.033	0.426	0.037	0.423	0.034	0.422	0.035	0.414	0.036	0.223	0.030	0.441	0.039	0.419	0.037	0.433	0.038
2014	0.416	0.037	0.383	0.032	0.392	0.035	0.396	0.033	0.390	0.033	0.382	0.034	0.204	0.027	0.406	0.037	0.386	0.034	0.399	0.035
2015	0.471	0.042	0.434	0.036	0.438	0.040	0.449	0.037	0.441	0.038	0.429	0.038	0.230	0.030	0.456	0.042	0.434	0.039	0.448	0.040
2016	0.538	0.049	0.495	0.042	0.494	0.046	0.512	0.043	0.499	0.044	0.482	0.044	0.257	0.034	0.513	0.048	0.488	0.044	0.504	0.046
2017	0.635	0.059	0.582	0.051	0.572	0.054	0.602	0.052	0.581	0.052	0.557	0.052	0.295	0.039	0.592	0.056	0.563	0.052	0.582	0.054
2018	0.723	0.069	0.661	0.059	0.640	0.062	0.682	0.061	0.653	0.060	0.622	0.059	0.327	0.043	0.661	0.064	0.629	0.060	0.651	0.062
2019	0.784	0.077	0.714	0.066	0.681	0.068	0.735	0.067	0.698	0.066	0.661	0.064	0.346	0.046	0.702	0.070	0.668	0.065	0.692	0.068
2020	0.860	0.087	0.781	0.075	0.735	0.076	0.801	0.076	0.754	0.074	0.709	0.072	0.370	0.050	0.754	0.078	0.717	0.073	0.744	0.076
2021	0.846	0.090	0.766	0.077	0.712	0.076	0.784	0.078	0.730	0.074	0.683	0.072	0.354	0.048	0.726	0.078	0.690	0.073	0.717	0.076
2022	0.823	0.091	0.745	0.078	0.682	0.076	0.759	0.079	0.700	0.075	0.652	0.071	0.337	0.047	0.693	0.078	0.660	0.072	0.685	0.076
2023	0.904	0.104	0.819	0.089	0.740	0.086	0.831	0.090	0.759	0.084	0.705	0.080	0.363	0.051	0.748	0.087	0.714	0.081	0.741	0.085
2024	0.887	0.107	0.804	0.092	0.716	0.087	0.813	0.093	0.736	0.086	0.682	0.081	0.349	0.050	0.723	0.088	0.691	0.082	0.716	0.086

Table 3. Summary of fishery status estimates for both Atlantic eastern and western bluefin tuna.

Stock	Model	$F_{2024}/F_{0.1}$	
		Mean	SD
E-BFT	R35	0.887	0.107
	R36	0.804	0.092
	R37	0.716	0.087
	R38	0.813	0.093
	R39	0.736	0.086
	R40	0.682	0.081
	R41	0.349	0.050
	R42	0.723	0.088
	R43	0.691	0.082
	R44	0.716	0.086
W-BFT	Early maturity	0.693	0.049
	Late maturity	0.692	0.048

Table 4. Annual estimates of relative fishing mortality ($F/F_{0.1}$) from the BFT-W Stock Synthesis models with standard deviations.

Model	Early Maturity		Late Maturity	
	Mean	SD	Mean	SD
1950	0.049	0.004	0.050	0.004
1951	0.054	0.004	0.055	0.004
1952	0.033	0.003	0.034	0.003
1953	0.052	0.004	0.054	0.004
1954	0.040	0.003	0.041	0.003
1955	0.026	0.002	0.027	0.002
1956	0.012	0.001	0.012	0.001
1957	0.026	0.002	0.027	0.002
1958	0.058	0.004	0.060	0.005
1959	0.079	0.006	0.082	0.006
1960	0.050	0.004	0.052	0.004
1961	0.079	0.006	0.081	0.006
1962	0.281	0.020	0.289	0.022
1963	0.686	0.049	0.705	0.052
1964	0.986	0.072	1.013	0.077
1965	0.839	0.064	0.864	0.069
1966	0.534	0.042	0.550	0.044
1967	0.427	0.033	0.440	0.035
1968	0.247	0.018	0.253	0.019
1969	0.247	0.017	0.253	0.018
1970	0.470	0.029	0.480	0.030
1971	0.609	0.035	0.620	0.036
1972	0.398	0.021	0.404	0.022
1973	0.419	0.021	0.425	0.021
1974	0.621	0.029	0.628	0.030
1975	0.640	0.029	0.646	0.029
1976	0.819	0.036	0.826	0.036
1977	1.049	0.046	1.058	0.046
1978	1.038	0.045	1.046	0.046
1979	1.285	0.057	1.294	0.057
1980	1.381	0.062	1.390	0.063
1981	1.617	0.076	1.626	0.076
1982	0.552	0.027	0.555	0.027
1983	0.895	0.042	0.899	0.042
1984	0.876	0.041	0.879	0.041
1985	1.088	0.049	1.092	0.049
1986	1.023	0.046	1.026	0.046
1987	1.155	0.050	1.157	0.050
1988	1.405	0.060	1.407	0.060
1989	1.421	0.060	1.423	0.060
1990	1.470	0.060	1.471	0.060
1991	1.598	0.065	1.599	0.065
1992	1.293	0.052	1.293	0.052
1993	1.358	0.054	1.358	0.054
1994	1.216	0.048	1.215	0.048
1995	1.371	0.053	1.370	0.052
1996	1.403	0.054	1.402	0.054
1997	1.304	0.050	1.303	0.050
1998	1.460	0.056	1.459	0.056
1999	1.528	0.059	1.527	0.059
2000	1.537	0.061	1.536	0.061
2001	1.549	0.063	1.548	0.063
2002	1.854	0.079	1.853	0.079
2003	1.343	0.061	1.342	0.061
2004	1.212	0.057	1.211	0.057
2005	0.990	0.048	0.990	0.048
2006	0.973	0.048	0.972	0.048
2007	0.843	0.042	0.843	0.042
2008	0.979	0.049	0.979	0.049
2009	0.921	0.047	0.921	0.047
2010	0.819	0.043	0.819	0.043
2011	0.834	0.044	0.835	0.044
2012	0.689	0.037	0.689	0.037
2013	0.544	0.030	0.544	0.030
2014	0.559	0.030	0.559	0.030
2015	0.592	0.032	0.592	0.032
2016	0.580	0.032	0.580	0.032
2017	0.541	0.030	0.541	0.030
2018	0.577	0.032	0.578	0.032
2019	0.622	0.035	0.622	0.035
2020	0.583	0.034	0.584	0.034
2021	0.594	0.036	0.594	0.036
2022	0.675	0.042	0.675	0.042
2023	0.629	0.041	0.629	0.041
2024	0.693	0.049	0.692	0.048

Table 5. List of electronic tags used available for the bluefin tuna MSE. Tags identified as UNCL are not possible to use given that they do not have stock of origin.

Group	stock	No. tags
AZTI	UNCL	27
DFO	GOM	8
DFO	MED	1
DFO	UNCL	92
GBYP	GOM	4
GBYP	MED	218
GBYP	UNCL	162
GBYP/ACPR	MED	7
GBYP/IEO	UNCL	2
GBYP/WWF	MED	6
IFREMER	MED	91
IFREMER	UNCL	3
LPRC	GOM	29
LPRC	MED	1
LPRC	UNCL	301
NOAA	GOM	31
STANFORD	GOM	89
STANFORD	MED	43
STANFORD	UNCL	333
UNIMAR	MED	7
WWF	MED	45

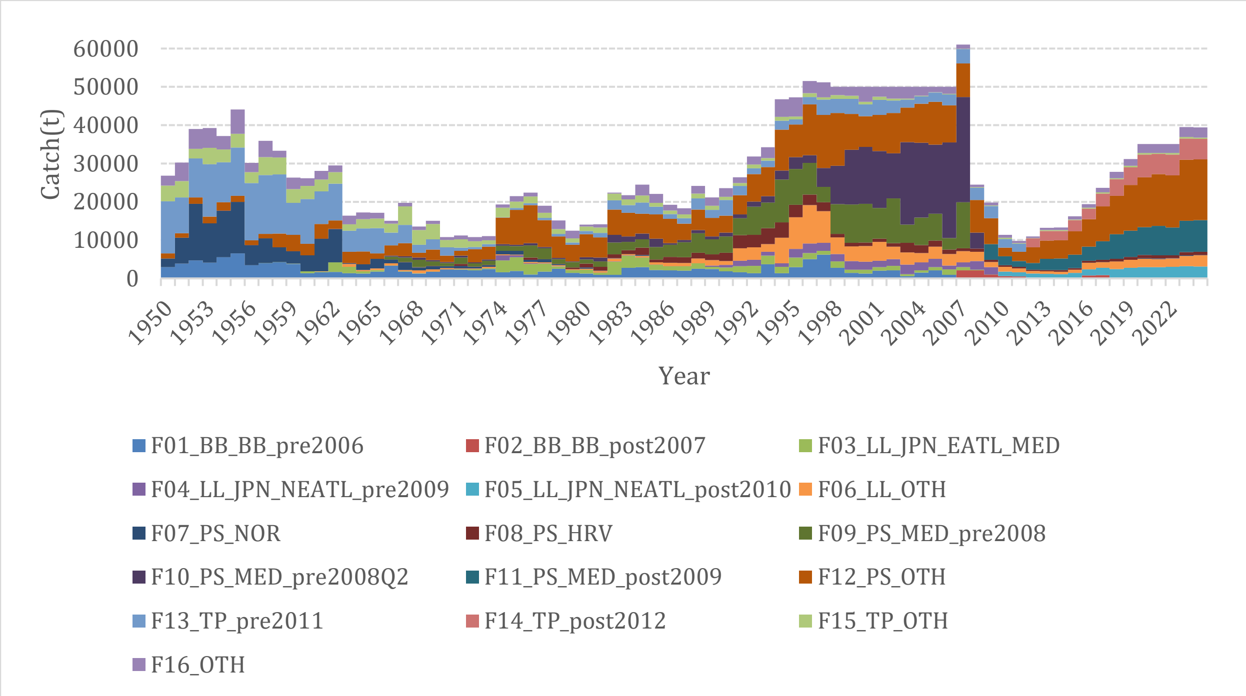


Figure 1. Annual landings (mt) for each of the fishing fleets for the East Atlantic and Mediterranean bluefin tuna stock.

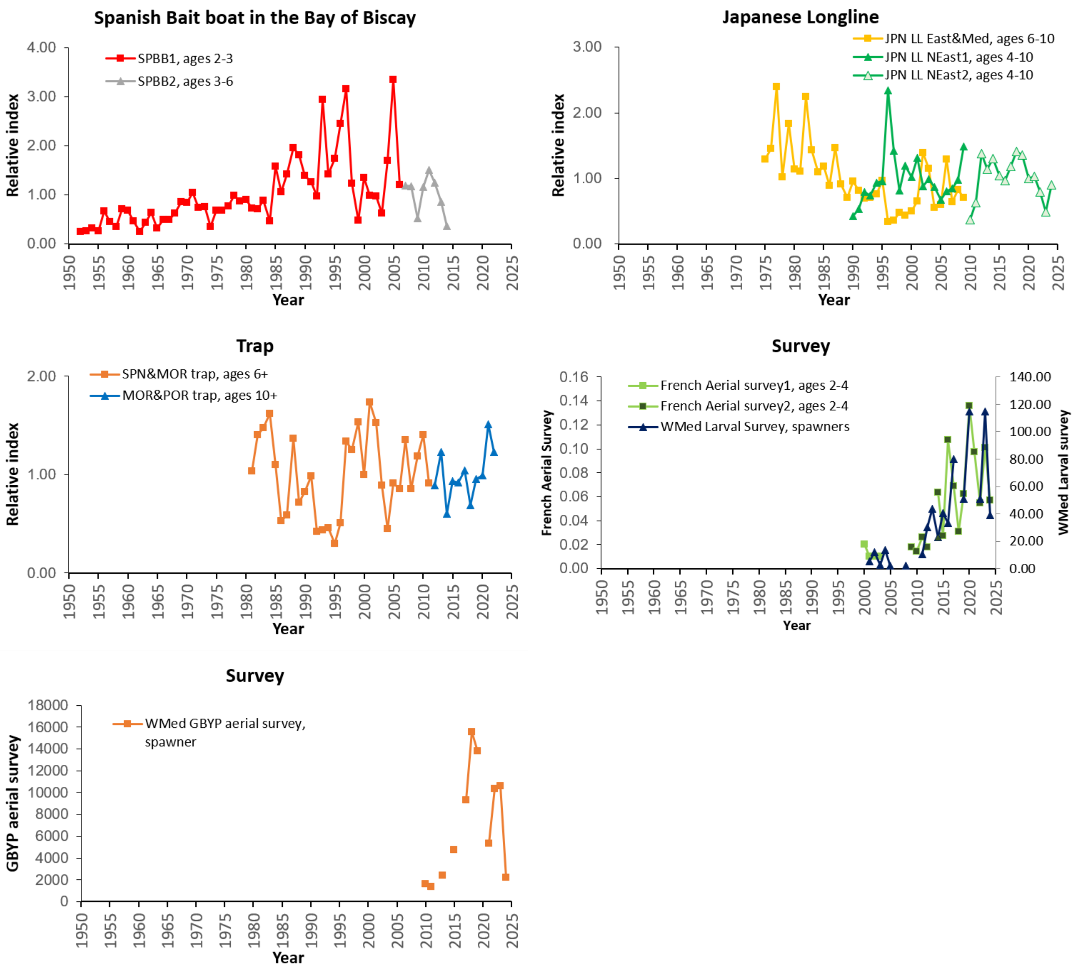


Figure 2. Indices used in the SS3 assessment for the East Atlantic and Mediterranean bluefin tuna stock.

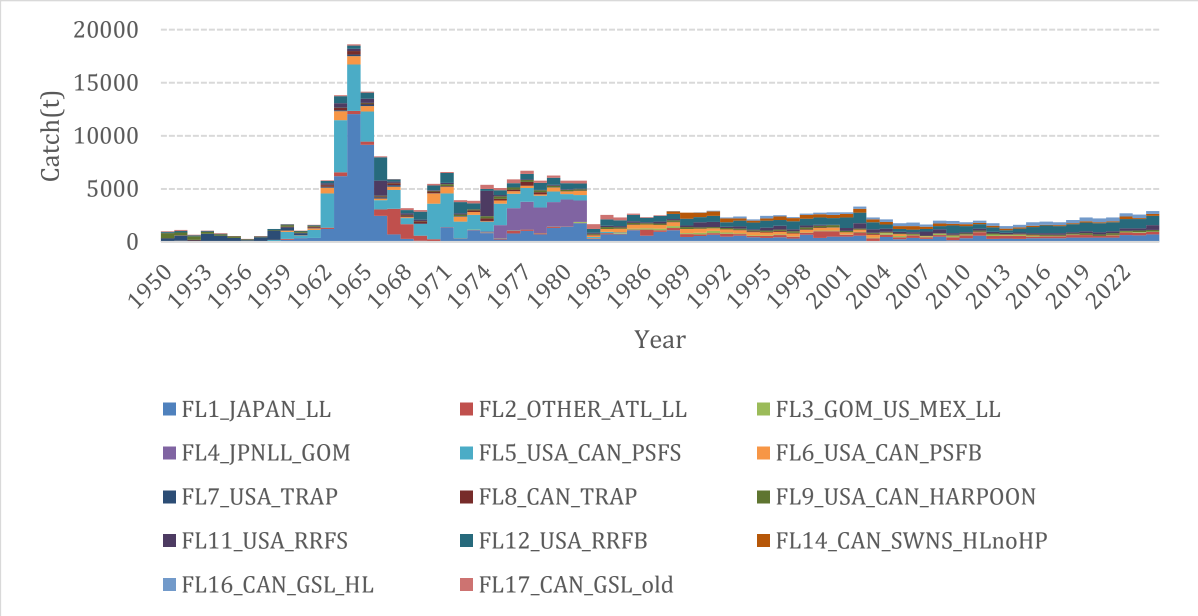


Figure 3. Annual landings (mt) for each of the fishing fleets for the West Atlantic bluefin tuna stock.

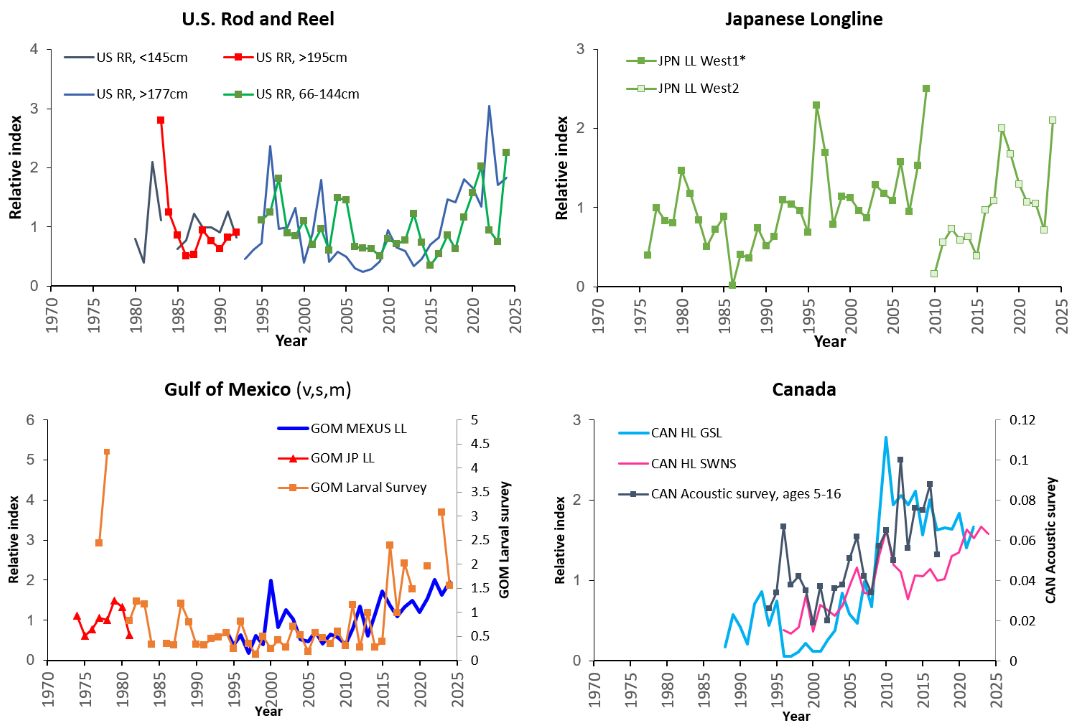


Figure 4. Indices used in the SS3 assessment for the West Atlantic bluefin tuna stock. The value for 1986 in Japanese longline index for the West period 1 (JPNLL1 West1*) was not used in Stock Synthesis model in 2026.

a) 1950-2024 **b) 2015-2024**

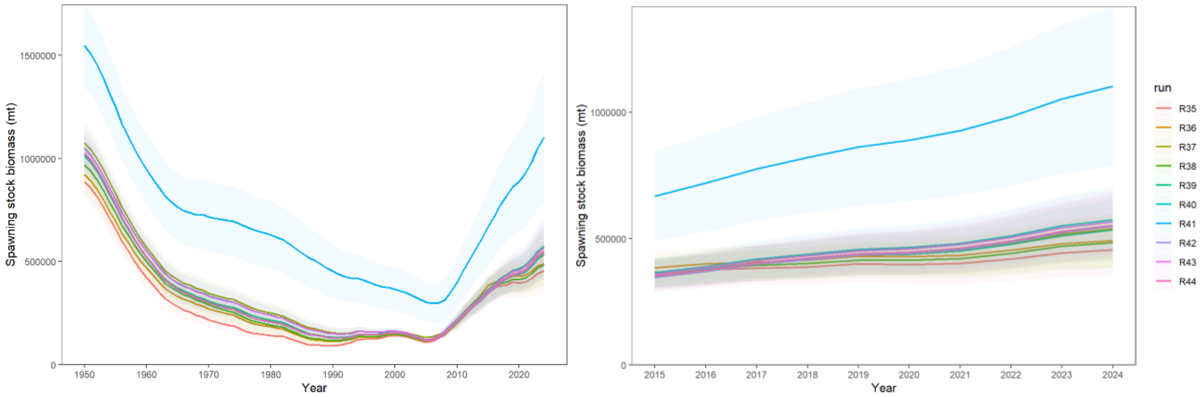
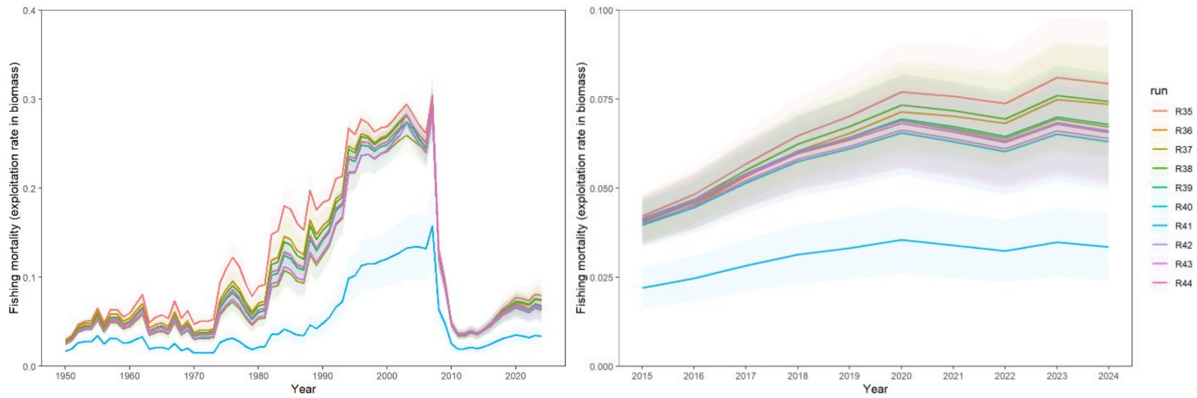


Figure 5. Spawning stock biomass estimates across the 10 BFT-E SS runs. (a) Left panel shows the entire time series; and (b) right panel shows the recent 10-year time series. Note difference in scales between the plots.

a) 1950-2024 **b) 2015-2024**

Figure 6. Time series of estimated fishing mortality (exploitation rate in biomass) across the 10 BFT-E SS runs. (a) Left panel shows the entire time series; and (b) right panel shows the recent 10-year time series.



a) 1950-2024 **b) 2015-2024**

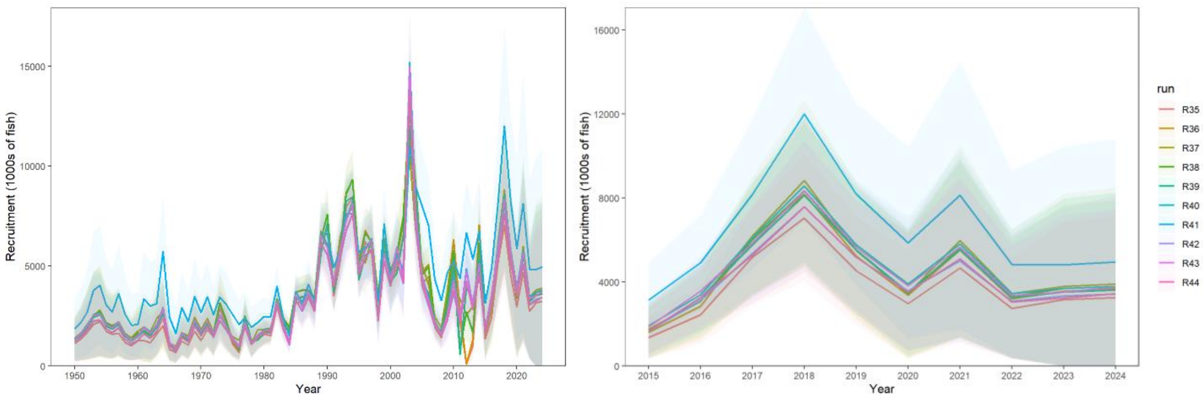


Figure 7. Estimated time series of bluefin tuna recruitment (age 0) across the 10 BFT-E SS runs. (a) Left panel shows the entire time series; and (b) right panel shows the recent 10-year time series. Note difference in scales between the plots.

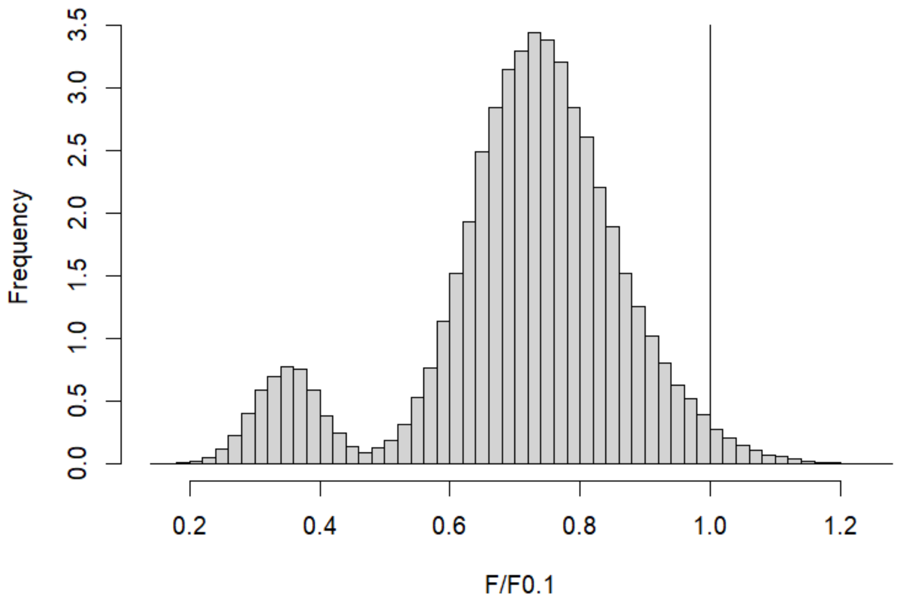
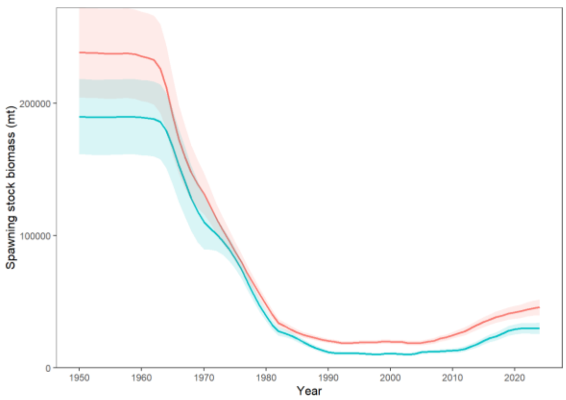


Figure 8. Histogram of $F_{2024}/F_{0.1}$ (exploitation rate measured as total catch/biomass) across the ten BFT-E SS reference case models.

a) 1950-2024 **b) 2015-2024**



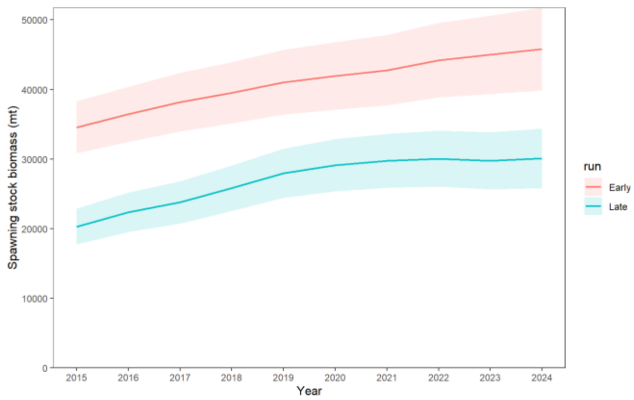


Figure 9. Spawning stock biomass estimates across the BFT-W continuity model SS runs. (a) Left panel shows the entire time series; and (b) right panel shows the recent 10-year time series. Note difference in scales between the plots.

a) 1950-2024 **b) 2015-2024**

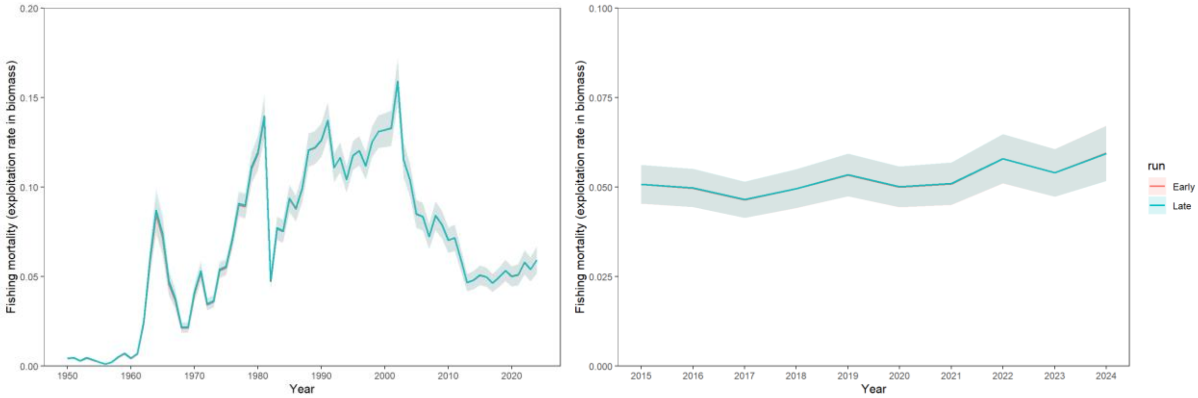


Figure 10. Time series of estimated fishing mortality (exploitation rate in biomass) across the BFT-W continuity model SS runs. (a) Left panel shows the entire time series; and (b) right panel shows the recent 10-year time series. Note difference in scales between the plots.

a) 1950-2024 **b) 2015-2024**

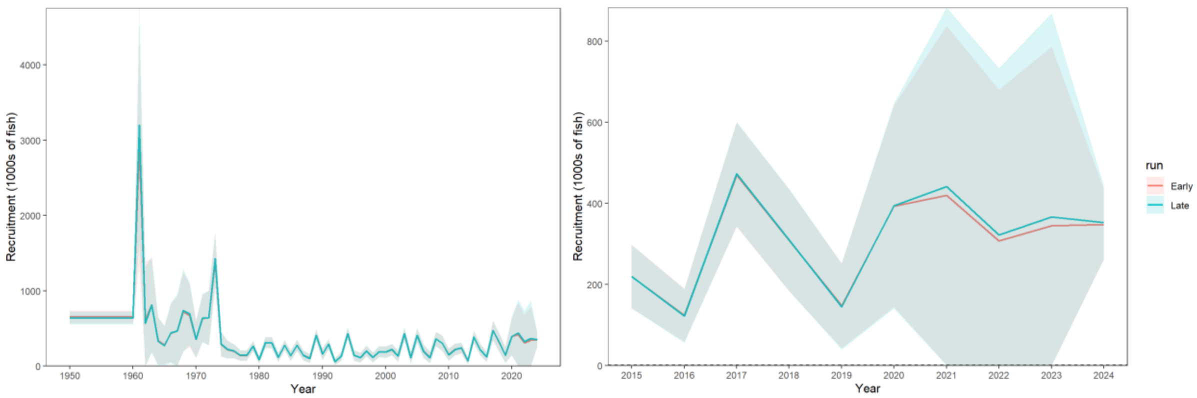


Figure 11. Estimated time series of bluefin tuna recruitment (age 0) across the BFT-W continuity model SS runs. (a) Left panel shows the entire time series, and (b) right panel shows the recent 10-year time series. Note difference in scales between the plots.

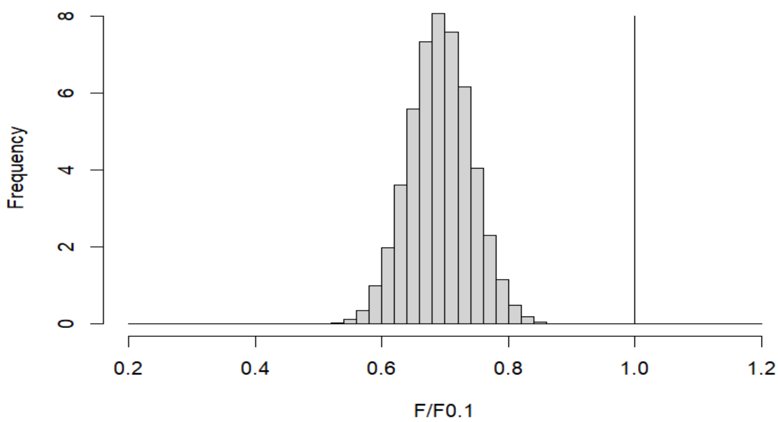


Figure 12. Histogram of $F_{2024}/F_{0.1}$ (exploitation rate measured as total catch/biomass) across the BFT-W continuity model SS runs (early and late maturity models).

Appendix 1

Agenda

1. Opening, adoption of the agenda and meeting arrangements

2. Status check model diagnostics

   2.1 Stock Synthesis (East and West)
   2.2 Multi-SA model

3. Status check model results

   3.1 Stock Synthesis (East and West)
   3.2 Multi-SA model

4. Topics related to the Management Strategy Evaluation

   4.1 Discussion of data inputs and assumptions for MSE revisions
   4.2 Development of 'Simplified' OM structure by combining existing strata
   4.3 Plan for the evaluation of exceptional circumstances in 2026
   4.4 Guidance from PA2

5. Draft Executive Summary sections

6. Update on GBYP activities

7. Recommendations

8. Other matters

9. Adoption of the report and closure

Appendix 2

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Appendix 3

List of papers and presentations

Number	Title	Authors
SCRS/2026/152	Updated size frequency data of the Atlantic bluefin tuna East Atlantic and Mediterranean stock for the 2026 status check	Kimoto A., Mayor C., Deprez B., and Ortiz M.
SCRS/2026/153	Updated size frequency data of West Atlantic bluefin tuna including reconstructed historical data	Kimoto A., Boustany A.M., McClenachan L., Van-Houtan K., Walter J., and Lauretta M.
SCRS/2026/158	Bluefin tuna management procedure reviews	Butterworth D.
SCRS/2026/160	Continuity model using Stock Synthesis 3 for a status assessment of Atlantic bluefin tuna in the West Atlantic Ocean: part 1 input data and model specification	Tsukahara Y., Gillespie K., Kimoto A., Ortiz M., Lauretta M., and Walter J.
SCRS/2026/161	Continuity model using Stock Synthesis 3 for a status assessment of Atlantic bluefin tuna in the West Atlantic Ocean: part 2 model diagnostics and results	Tsukahara Y., Gillespie K., Kimoto A., Ortiz M., Lauretta M., and Walter J.
SCRS/2026/162	Continuity model using Stock Synthesis 3 for a status assessment of Atlantic bluefin tuna in the West Atlantic Ocean: part 3 sensitivity runs	Tsukahara Y., Gillespie K., Kimoto A., Ortiz M., Lauretta M., and Walter J.
SCRS/2026/163	Stock Synthesis model runs for the 2026 stock assessment for eastern Atlantic and Mediterranean bluefin tuna	Fernández C., Carmona I., Kimoto A., Lauretta M., Ortiz M., Rouyer T., and Walter J.
SCRS/2026/164	Assessing the reproductive biology of western Atlantic bluefin tuna using histological techniques (2009-2024)	Pacicco A., Farley J.
SCRS/2026/165	Development of the multi-stock age-structured model for Atlantic bluefin tuna in 2026	Huynh Q.
SCRS/P/2026/071	Recent bluefin tuna science: genetics, tagging and fishery interactions	Block B., Aalto E., and Mikles C.
SCRS/P/2026/074	Updates of Japanese longline indices for West and Northeast Atlantic Ocean up to 2026 fishing year	Tsukahara Y., Fukuda H., and Nakatsuka S.
SCRS/P/2026/075	Cryptic no more: mature bluefin tuna spawn in the Slope Sea, Northwest Atlantic	Lutcavage M., Heinisch G., Lam C.H., Del Frassino D., Zupa R., and Corriero A.
SCRS/P/2026/076	Understanding how individual assignment estimates are produced as a prerequisite for harmonized stock proportion estimates	Rodriguez-Ezpeleta N., Kerr L., and Fraile I.
SCRS/P/2026/077	Current status of GBYP Phase 15 activities and review of GBYP Conventional Tagging Program	ICCAT Secretariat

Appendix 4

Abstracts of SCRS documents and presentations as provided by the authors

SCRS/2026/152 - The ICCAT Bluefin Species Group recommended the Secretariat further review on missing size data in 2022-2024 for the Mediterranean purse sein fishery at the Intersessional Meeting in March 2026. After the meeting, the Secretariat received ST-04 official new submissions and corrections for Task 2 size data from 3 CPCs (47002 fish size). Furthermore, size data measured by stereo video camera (ST-06) across the other ICCAT database sources was examined, and 2.7% of the total available ST-06 purse sein data in the Mediterranean (5927 fish size) were finally used for this purpose. In total, 52929 fish size measurements were further added in the size frequency data provided at the 2026 March BFT Intersessional Meeting. However, among the large harvesters, there is no size data available from EU-Spain for 2022-2024, and it was not possible to extract them from ST-06 data. Although ST-04 size data by EU-Croatia is available for 2022-2024, the size sample is less than 60 fish and the sampling coverage to their total catch is extremely small (<0.1%). Because this fleet captures smaller size fish, the authors recommend them to resubmit the ST-04 data.

SCRS/2026/153 - This document summarizes the newly reconstructed historical data for western bluefin tuna to the BFT SG. Close to 3 million BFT fish size measurements were recovered in the West Atlantic between 1936 and 1985. Generally, the recovered size data were in the range of the average size frequency in the ICCAT database, but the recovered size data frequently varied among years by some fleets. The recovered size data showed large fish over 300 cm which were rarely observed in the ICCAT database. This would be important information in the stock assessment. During the data cleaning, it was noticed that most of data contained decimals, while the number of fish was supposed to be integer. Some recovered data overlapped with the ICCAT database, and sometimes the size frequencies were similar. It is recommended to check the original data together with ICCAT Task 2 size data. The recovered size data was added to the Stock Synthesis and OMs size input data provided in March 2026. The authors suggested the BFTSG use this information as a part of sensitivity runs.

SCRS/2026/158 - This document is a draft to clarify the concept and implementation of BFT Management Procedure (MP) reviews, particularly for PA2 members.

SCRS/2026/160 - The stock assessment for Atlantic bluefin tuna in 2026 is a scheduled activity in the MSE roadmap as a "status check" to monitor if the stock status is in the state previously simulated in the MSE, and thus it is not for the calculation of TAC advice. This document presents the input data and model specifications, including biological assumptions, fleet structure, selectivity and indices settings for the West Atlantic bluefin tuna stock assessment using Stock Synthesis 3.3. Because this model was designed as "continuity model", the model specifications were materially similar to the 2021 stock assessment model for this species. This is the first of three documents for this assessment model, describing data and model specifications (part 1), mode diagnostics and results (part 2), and sensitivity runs (part 3).

SCRS/2026/161 - The stock assessment for Atlantic bluefin tuna in 2026 is a scheduled activity in the MSE roadmap as "status check" to monitor if the stock status is in the state previously simulated in the MSE, and thus it is not for the calculation of TAC advice from the assessment result. This document presents the model results and diagnostics with a "continuity model" described in Part 1. The diagnostic results indicated overall poor model performance as well as the 2021 assessment, although the models with both maturity scenario were well converged in numerical optimization. While the estimated trend in the SSB and recruitment were similar to those in the previous assessment, the biomass scale, i.e., unfished biomass level, was the highest among the assessments since 2017. The uncertainty on the biomass scale estimation still persisted based on the diagnostics and model estimation results.

SCRS/2026/162 - The stock assessment for Atlantic bluefin tuna in 2026 is a scheduled activity in the MSE roadmap as "status check" to monitor if the stock status is in the state previously simulated in the MSE, and thus it is not for the calculation of TAC advice from the assessment result. This document presents the model results with alternative and different data or model assumptions from the "continuity model" described in Part 1 document of this trilogy as sensitivity runs. There are four sensitivity runs documented here: 1) inclusion of recovered historical size composition data; 2) an alternative method for data weighting; 3) alternative abundance indices for Canadian fisheries, and; 4) alternative abundance indices for both Canadian and US fisheries. All of these sensitivity runs indicated that the current base case model is sensitive to these changes in terms of biomass scale estimation. These results would contribute to the discussion on future model development.

SCRS/2026/163 - This document presents Stock Synthesis model runs for the 2026 stock assessment of eastern Atlantic and Mediterranean population of bluefin tuna using Stock Synthesis. It develops further run R20 from SCRS/2026/023. The model covers years 1950-2024 and includes 16 fishing fleets. It fitted to 11 indices of abundance, length composition data and conditional age-at-length from several fleets. Growth is modeled by a Richards function with L_{inf} fixed at 271 cm or estimated in Stock Synthesis, depending on the model run. The Richards growth shape parameter, the length at age 1 and the K parameter were all estimated in the model runs. A Beverton-Holt stock recruitment relationship was assumed, with the steepness and sigmaR fixed at 0.9 and 0.6, respectively, and R0 freely estimated. Of the 24 runs presented in this document, it is suggested that R37, R39, R43 and R44 could be used as basis for the 2026 stock assessment with Stock Synthesis, possibly in an ensemble.

SCRS/2026/164 - The reproductive biology of western Atlantic bluefin tuna was investigated using standardized histological criteria for ovaries collected from 2007-2024 across the Gulf of America/Mexico (GOA/GOM) and the North and South U.S. Atlantic. Spawning capable females were observed from March to July in all regions, with the highest activity in the GOA/GOM. No spawning capable or actively spawning ovaries were observed in females <180 cm, and ovary weight data similarly indicated minimal reproductive activity below this size. Spawning fraction was consistently higher in the GOA/GOM than in the U.S Atlantic. Length- and age-at-50% maturity was estimated using physiological and functional maturity thresholds for all samples and for an unbiased subset excluding peak spawning months and all GOA/GOM samples. The highest estimates were obtained from the unbiased dataset under the functional threshold (L50=155.5 cm; A50=7.08 years), though limited sampling of females 145–180 cm introduces uncertainty. Whole ovary weight data suggests that true maturity may occur at larger sizes than indicated by L50. Several 'mature' females <140 cm exhibited weak indicators of prior spawning, consistent with aborted or incomplete maturation, indicating these individuals likely did not contribute to egg production and may bias maturity estimates downward if classified as mature.

SCRS/2026/165 - This paper describes the implementation of a multi-stock model as part of the status health check in 2026 for Atlantic bluefin tuna. multiSA (MSA) is an implementation of a next generation, multi-stock age-structured model coded in RTMB. MSA is intended to be a flexible and general successor for M3 and could be suitable for various purposes, i.e., MSE and stock assessment. This document presents the model structure of the status check and preliminary results to several stock of origin (SOO) time series, with and without a prior for western stock biomass derived from a 2018-2021 close kin mark-recapture study. Comparison of the four models indicate continuing data conflicts regarding the size of the western stock and uncertainty in recent trend for the Eastern stock. The first SOO set infers a relatively large western stock due to high proportions of western fish in the East Atlantic (EATL). The second SOO set infers a smaller Western stock, although various issues pertaining to numerical stability remain.

SCRS/P/2026/071 - The first paper, "Ensuring the future of Atlantic bluefin tuna [ABT]", combines and reports on three decades of ABT electronic tag data and examines the distribution of ABT fisheries impact over 70 years. The authors hypothesize that, under the historical two-stock management paradigm, escapement from the Mediterranean Sea to the lower fishing mortality of the North Atlantic has contributed to the recovery of the eastern stock, with the 45°W meridian acting as an indirect conservation measure. The second paper, "Adaptive genomic divergence parallels migratory behavior in Atlantic bluefin tuna", analyzes 82 whole-genome sequences obtained from mature ABT tracked to geographically distinct spawning grounds, as well as larvae representing the two recognized stocks. Both neutral and adaptive SNP markers reflect the same genomic population structure as the spatial movement patterns, and candidate genes with potentially adaptive roles are highlighted. The analyses show that the two populations diverged ~27,000 years ago, overlapping with the Last Glacial Maximum. The final paper, "Fish & Ships: Using overlap between Atlantic fishing fleets and highly migratory pelagic species to reveal hotspots of potential management interest", combines electronic tagging datasets with environmental data to model distributions for Atlantic bluefin tuna, blue shark, swordfish, and blue marlin. By comparing with species-specific CPUEs reported to management, regions were identified where reported catches were low compared to predicted species density. This data science approach may be useful to management, potentially indicating regions where fleets may be under-reporting or other management assumptions may be invalid.

SCRS/P/2026/074 - This presentation provided updated Japanese longline indices for the west and Northeast Atlantic Ocean through the 2026 fishing year. These indices were standardized using a GLMM, following the guidance on strict updates for exceptional circumstances evaluation and MP calculations. The index in the West Atlantic showed a relatively high trend over the past three years and had its highest value in the 2026 fishing year. In contrast, the index in the Northeast Atlantic has shown a continuous declining trend in recent years.

SCRS/P/2026/075 - Bluefin management frameworks have historically assumed that the western stock exhibits a delayed age at maturity compared to its eastern counterpart, despite striking biological similarities in their larval life history, diets, growth rates, and migratory mobility. This study provides the missing empirical evidence, presenting clear histological validation of an active western Atlantic spawning ground in the Slope Sea. Biological sampling conducted aboard a commercial longline vessel in late June 2025 secured samples from 90 adult bluefin tuna. While 100% of the examined males were mature, histological examination of 42 females revealed that 93% (39 individuals) were mature adults - including fish as small as 120 cm straight fork length (SFL). Crucially, 10 females possessed post-ovulatory follicles (POFs), providing an unambiguous marker of active spawning within 24 to 48 hours of capture across five distinct longline sets. Given these findings, the authors suggest a unified sexual maturation schedule across the Atlantic basin. Subsequent discussions welcomed the availability of new, targeted field data, pointing to the historic divergence as a possible artifact of incomplete or biased sampling.

SCRS/P/2026/076 - The Working Group on mixing proportions was established to develop and agree on a standardized approach for generating robust, statistically reliable, and biologically realistic estimates of stock mixing proportions for Atlantic bluefin tuna, including their associated measures of uncertainty, for use in management strategy evaluation (MSE). The presentation stresses that the first step, and the one conditioning all subsequent results, is the individual origin assignment (probability of belonging to the western stock, *p*_west). These probabilities are derived from genetic data (86 and 96 SNP panels, the ABFT array and the CKMR panel) and from otolith data (δ13C and δ18O values), using different methods and baselines. Because how input data is treated and how individual assignments are combined strongly affects the final proportions per stratum, several questions to address are identified, such as how to account for heterogeneity across methods, how to integrate and weight assignments derived from different data and approaches, and when to keep probabilities ("soft calls") versus categories ("hard calls"). After setting the scene, the presentation finishes with a set of short term recommendations (accompany stock identification data with the minimum genetic stock identification (GSI) information, understand the assumptions and potential biases of each data type, and agree on when and how *p*_west should be translated into hard calls) and a proposal for next steps to continue the work of the group: compile and assess all approaches used for *p*_west estimation, build a joint table to identify patterns across data types and approaches and, from there, derive the standardized procedure to obtain *p*_wests and how to use them for estimating stock mixing proportions.

SCRS/P/2026/077 - The presentation provided an update of the status of the GBYP Phase 15 activities planned for 2026. Three MoUs have been signed and another two have been already agreed aiming the deployment of 70 GBYP electronic tags (23 internal archival and 47 pop-up satellite tags) in spawning areas of the eastern and western Mediterranean and southern regions of the northeastern Atlantic, and 41 acoustic tags in the Gulf of Cadiz. Several e-tagging campaigns have been already completed (i.e. first campaign for acoustic transmitters deployment in Southern Portugal; campaigns of popup tags deployment in the Canary Islands, eastern and western Mediterranean). The aerial survey aiming for the estimation of abundance of adults (SSB) in the Balearic archipelago has been successfully completed, in which a high number of juvenile schools have been detected. A contract has been signed for the analysis of the aerial survey collected data, aiming at providing a strict update of the GBYP Balearics aerial survey SSB index and for the standardization of the whole index time series following a model-based approach that takes into account environmental variability. Another contract related to biological studies, focused on the development of epigenetic clocks for eastern BFT, and another for the genotyping of western stock individuals, have been also signed. The contract for carrying out the modelling tasks towards the MSE review and stock health check is already ongoing and the first results have been presented at the meeting. Moreover, an external expert has been hired to provide advice and support to the Secretariat, aiming at the completion of the development of the ETAGS platform. Finally, aiming receiving guidance on the GBYP conventional tagging program, a brief overview was provided, that included the initial objectives and detailed information on the number of tags delivered to and deployed by team and year, the number of tags recovered by year and the costs derived from the payment of the rewards for these recoveries. In addition, it is highlighted the direct (rewards for recoveries) and indirect (Secretariat staff working time) increasing costs of the maintenance of this research line, aiming a decision on how to proceed with this component of the tagging programme.

Appendix 5

Model diagnostics, biological parameters, model fits, and model estimates of BFT-E Stock Synthesis runs R35-R44

Table 1. Median, Minimum and Maximum estimated parameter values across the 10 E-BFT SS reference model runs. The L_{inf} parameter (L_at_Amax_Fem_GP_1) is not estimated in all of the runs.

Parameter	Median	Min	Max
L_at_Amin_Fem_GP_1	52.3379	52.1637	53.7315
L_at_Amax_Fem_GP_1	282.246	271	291.834
VonBert_K_Fem_GP_1	0.1671045	0.139772	0.185433
Richards_Fem_GP_1	0.255755	0.118019	0.430551
CV_young_Fem_GP_1	0.0805205	0.0667188	0.0978269
CV_old_Fem_GP_1	0.0571418	0.02	0.0721991
SR_LN(R0)	8.2526	8.12468	8.52575
Early_InitAge_4	-0.8237725	-0.922358	-0.762164
Early_InitAge_3	-0.846772	-0.946145	-0.738589
Early_InitAge_2	-0.8609595	-0.948584	-0.710033
Early_InitAge_1	-0.9116235	-0.972837	-0.819594
Early_RecrDev_1950	-0.96139	-0.991858	-0.897869
Early_RecrDev_1951	-0.781139	-0.816069	-0.73964
Early_RecrDev_1952	-0.536744	-0.58757	-0.498609
Early_RecrDev_1953	-0.3126515	-0.369926	-0.173439
Early_RecrDev_1954	-0.2658495	-0.314543	-0.101996
Early_RecrDev_1955	-0.495677	-0.530624	-0.378398
Early_RecrDev_1956	-0.576617	-0.62069	-0.497693
Early_RecrDev_1957	-0.4598185	-0.572362	-0.19753
Early_RecrDev_1958	-0.774355	-0.888794	-0.532147
Early_RecrDev_1959	-0.946028	-1.03178	-0.759344
Early_RecrDev_1960	-0.779152	-0.853214	-0.679233
Main_RecrDev_1961	-0.5922655	-0.792967	-0.248221
Main_RecrDev_1962	-0.726443	-0.883325	-0.35586
Main_RecrDev_1963	-0.4541845	-0.549396	-0.307591
Main_RecrDev_1964	-0.1882515	-0.298701	0.299049
Main_RecrDev_1965	-1.034315	-1.16642	-0.547147
Main_RecrDev_1966	-1.30835	-1.38626	-0.94556
Main_RecrDev_1967	-0.689733	-0.767814	-0.361744
Main_RecrDev_1968	-0.833423	-0.914501	-0.62919
Main_RecrDev_1969	-0.323367	-0.432125	-0.177445
Main_RecrDev_1970	-0.589653	-0.719837	-0.434303
Main_RecrDev_1971	-0.333252	-0.407476	-0.171567
Main_RecrDev_1972	-0.63411	-0.64655	-0.472322
Main_RecrDev_1973	-0.181218	-0.225258	0.125141
Main_RecrDev_1974	-0.3958415	-0.470418	-0.206902
Main_RecrDev_1975	-0.7703265	-0.87932	-0.467156
Main_RecrDev_1976	-1.093335	-1.3343	-0.680653
Main_RecrDev_1977	-0.306043	-0.522864	-0.113907

Table 1. (continued).

Parameter	Median	Min	Max
Main_RecrDev_1978	-0.888711	-0.98857	-0.74288
Main_RecrDev_1979	-0.6378055	-0.778858	-0.547671
Main_RecrDev_1980	-0.499359	-0.533343	-0.411049
Main_RecrDev_1981	-0.483057	-0.530361	-0.459319
Main_RecrDev_1982	0.1301355	-0.0208818	0.212654
Main_RecrDev_1983	-0.3256495	-0.490796	-0.0707022
Main_RecrDev_1984	-0.6767255	-0.986824	-0.270501
Main_RecrDev_1985	0.238535	-0.08038	0.378211
Main_RecrDev_1986	0.09298475	-0.235258	0.441309
Main_RecrDev_1987	0.301816	0.0166809	0.433263
Main_RecrDev_1988	0.1174555	-0.217435	0.352329
Main_RecrDev_1989	0.8625535	0.511637	0.973858
Main_RecrDev_1990	0.8209645	0.510165	1.15036
Main_RecrDev_1991	0.40782	0.217935	0.50311
Main_RecrDev_1992	0.777725	0.382259	0.847136
Main_RecrDev_1993	1.011225	0.658345	1.24163
Main_RecrDev_1994	1.112545	0.659204	1.27684
Main_RecrDev_1995	0.6085665	0.372326	0.695248
Main_RecrDev_1996	0.759534	0.417136	0.970637
Main_RecrDev_1997	0.825482	0.420754	0.86569
Main_RecrDev_1998	-0.09789465	-0.17639	0.222155
Main_RecrDev_1999	0.739971	0.604978	0.872946
Main_RecrDev_2000	0.4584	0.133104	0.57159
Main_RecrDev_2001	0.716332	0.361178	0.763033
Main_RecrDev_2002	0.6949155	0.237691	1.01826
Main_RecrDev_2003	1.58557	1.05424	1.71446
Main_RecrDev_2004	1.075255	0.857106	1.24548
Main_RecrDev_2005	0.5365095	0.499398	0.75156
Main_RecrDev_2006	0.367305	0.225421	0.663858
Main_RecrDev_2007	-0.203376	-0.302524	0.133262
Main_RecrDev_2008	-0.5242085	-0.620263	-0.143146
Main_RecrDev_2009	0.06586112	-0.133217	0.278742
Main_RecrDev_2010	0.41048	0.272765	0.785401
Main_RecrDev_2011	-0.179995	-1.61618	0.099839
Main_RecrDev_2012	0.3624255	-3.37366	0.50848
Main_RecrDev_2013	-0.00312425	-0.990331	0.280969
Main_RecrDev_2014	0.52182	0.476587	0.836388
Main_RecrDev_2015	-0.594301	-0.727488	-0.301367
Main_RecrDev_2016	0.01863465	-0.166322	0.117156
Main_RecrDev_2017	0.558846	0.528639	0.596489
Late_RecrDev_2018	0.8704265	0.839034	0.952136
Late_RecrDev_2019	0.453576	0.368476	0.542005
Late_RecrDev_2020	0.0129676	-0.10986	0.181524
Late_RecrDev_2021	0.421402	0.369902	0.50237

Table 1. (continued).

Parameter	Median	Min	Max
Late_RecrDev_2022	-0.108095	-0.161513	-0.0185336
Late_RecrDev_2023	-0.02595435	-0.0616057	-0.0245137
Late_RecrDev_2024	0	0	0
InitF_seas_1_flt_13F13_TP_pre2011	0.02275205	0.0170215	0.029455
InitF_seas_1_flt_15F15_TP_OTH	0.00379868	0.00369945	0.00404854
InitF_seas_1_flt_16F16_OTH	0.003272	0.00284778	0.00426004
SizeSpline_GradHi_F01_BB_BB_pre2006(1)	-0.225681	-0.238374	-0.203217
SizeSpline_Val_2_F01_BB_BB_pre2006(1)	-3.22746	-3.43191	-2.99224
SizeSpline_Val_3_F01_BB_BB_pre2006(1)	-0.606507	-0.705223	-0.505583
SizeSpline_Val_5_F01_BB_BB_pre2006(1)	-0.3016825	-0.373255	-0.259523
SizeSpline_Val_6_F01_BB_BB_pre2006(1)	-9.60722	-9.6505	-9.49038
SizeSpline_GradHi_F02_BB_BB_post2007(2)	-0.285805	-0.292891	-0.273589
SizeSpline_Val_1_F02_BB_BB_post2007(2)	-6.780855	-6.78086	-6.78084
SizeSpline_Val_2_F02_BB_BB_post2007(2)	-3.82075	-3.99773	-3.79455
SizeSpline_Val_3_F02_BB_BB_post2007(2)	-3.573555	-3.61737	-3.47122
SizeSpline_Val_4_F02_BB_BB_post2007(2)	-3.87732	-3.89539	-3.69794
SizeSpline_Val_5_F02_BB_BB_post2007(2)	-10.71455	-11.2342	-10.6476
Size_DblN_peak_F03_LL_JPN_EATL_MED(3)	240.4755	232.798	250.168
Size_DblN_top_logit_F03_LL_JPN_EATL_MED(3)	-9.10839	-9.10845	-9.10786
Size_DblN_ascend_se_F03_LL_JPN_EATL_MED(3)	7.788965	7.73678	7.88114
Size_DblN_descend_se_F03_LL_JPN_EATL_MED(3)	5.16642	1.69712	5.97523
Size_DblN_end_logit_F03_LL_JPN_EATL_MED(3)	-2.338445	-4.38351	-1.12857
Size_DblN_peak_F04_LL_JPN_NEATL_pre2009(4)	206.6105	193.881	214.506
Size_DblN_top_logit_F04_LL_JPN_NEATL_pre2009(4)	-9.21944	-9.21981	-9.21938
Size_DblN_ascend_se_F04_LL_JPN_NEATL_pre2009(4)	7.715575	7.51688	7.81425
Size_DblN_descend_se_F04_LL_JPN_NEATL_pre2009(4)	6.46803	6.04557	6.89373
Size_DblN_end_logit_F04_LL_JPN_NEATL_pre2009(4)	-2.69573	-4.24008	-2.35544
Size_DblN_peak_F05_LL_JPN_NEATL_post2010(5)	203.133	199.45	204.239
Size_DblN_top_logit_F05_LL_JPN_NEATL_post2010(5)	-8.38744	-8.38799	-8.38731
Size_DblN_ascend_se_F05_LL_JPN_NEATL_post2010(5)	6.125435	5.98442	6.16897
Size_DblN_descend_se_F05_LL_JPN_NEATL_post2010(5)	6.532635	6.36024	6.62282
Size_DblN_end_logit_F05_LL_JPN_NEATL_post2010(5)	-3.55859	-5.43286	-2.71582
SizeSpline_GradHi_F06_LL_OTH(6)	-0.116474	-0.164622	-0.0922819
SizeSpline_Val_2_F06_LL_OTH(6)	-5.298335	-5.35975	-3.63426
SizeSpline_Val_3_F06_LL_OTH(6)	-1.212185	-1.25309	-0.9857
SizeSpline_Val_5_F06_LL_OTH(6)	0.5519935	0.137573	0.644139
SizeSpline_Val_6_F06_LL_OTH(6)	-0.583352	-2.16653	-0.329851
Size_DblN_peak_F07_PS_NOR(7)	228.2965	204.173	229.779
Size_DblN_top_logit_F07_PS_NOR(7)	-1.26698	-9.31568	-0.52581
Size_DblN_ascend_se_F07_PS_NOR(7)	5.37679	0.0105356	5.45607
Size_DblN_descend_se_F07_PS_NOR(7)	-7.43E-05	-0.00052648	6.16616
Size_DblN_end_logit_F07_PS_NOR(7)	-2.5821	-4.79528	-1.86298
Size_DblN_peak_F08_PS_HRV(8)	72.7262	67.588	75.0724
Size_DblN_top_logit_F08_PS_HRV(8)	-12.10685	-12.1993	-11.8915

Table 1. (continued).

Parameter	Median	Min	Max
Size_DblN_ascend_se_F08_PS_HRV(8)	3.123695	-5.59027	3.74459
Size_DblN_descend_se_F08_PS_HRV(8)	6.745875	6.67235	7.46274
Size_DblN_end_logit_F08_PS_HRV(8)	-3.23917	-9.07868	-2.70966
SizeSpline_GradHi_F09_PS_MED_pre2008(9)	-0.0436361	-0.0458879	-0.0382605
SizeSpline_Val_2_F09_PS_MED_pre2008(9)	-3.090345	-3.18828	-2.64656
SizeSpline_Val_3_F09_PS_MED_pre2008(9)	-1.97768	-2.051	-1.9231
SizeSpline_Val_5_F09_PS_MED_pre2008(9)	-0.693092	-0.730609	-0.636086
SizeSpline_Val_6_F09_PS_MED_pre2008(9)	-11.17955	-12.7416	-9.45879
SizeSpline_GradHi_F10_PS_MED_pre2008Q2(10)	-0.1249465	-0.199849	-0.0921359
SizeSpline_Val_2_F10_PS_MED_pre2008Q2(10)	-4.788545	-5.01839	-4.48415
SizeSpline_Val_3_F10_PS_MED_pre2008Q2(10)	-3.564455	-3.82599	-3.47731
SizeSpline_Val_4_F10_PS_MED_pre2008Q2(10)	-1.348345	-1.46677	-1.23736
SizeSpline_Val_6_F10_PS_MED_pre2008Q2(10)	-1.364595	-1.41061	-1.29134
SizeSpline_Val_7_F10_PS_MED_pre2008Q2(10)	-1.631365	-1.8876	-1.27389
SizeSpline_Val_8_F10_PS_MED_pre2008Q2(10)	-0.339993	-2.64876	-0.257811
SizeSpline_GradHi_F11_PS_MED_post2009(11)	-0.1114105	-0.151302	-0.0963507
SizeSpline_Val_2_F11_PS_MED_post2009(11)	-3.793505	-3.84853	-3.71055
SizeSpline_Val_3_F11_PS_MED_post2009(11)	-0.749418	-0.770021	-0.726113
SizeSpline_Val_5_F11_PS_MED_post2009(11)	-2.0044	-2.60617	-1.7795
SizeSpline_GradHi_F12_PS_OTH(12)	-0.0831161	-0.110929	-0.0634834
SizeSpline_Val_2_F12_PS_OTH(12)	-3.556375	-3.56357	-3.554
SizeSpline_Val_3_F12_PS_OTH(12)	-0.5319905	-0.596644	-0.457726
SizeSpline_Val_4_F12_PS_OTH(12)	-1.026245	-1.15072	-0.940135
SizeSpline_Val_5_F12_PS_OTH(12)	0.164659	-0.269574	0.350186
SizeSpline_Val_6_F12_PS_OTH(12)	-0.8435025	-2.1652	-0.309285
Size_DblN_peak_F13_TP_pre2011(13)	232.224	222.635	238.508
Size_DblN_top_logit_F13_TP_pre2011(13)	-9.42582	-9.42597	-9.42571
Size_DblN_ascend_se_F13_TP_pre2011(13)	7.49924	7.45452	7.57137
Size_DblN_descend_se_F13_TP_pre2011(13)	5.54087	5.22085	6.32493
Size_DblN_end_logit_F13_TP_pre2011(13)	-3.851035	-4.59801	-3.05304
Size_DblN_peak_F14_TP_post2012(14)	229.8135	227.715	234.656
Size_DblN_top_logit_F14_TP_post2012(14)	-8.9313	-8.93184	-8.93101
Size_DblN_ascend_se_F14_TP_post2012(14)	7.413445	7.28876	7.66431
Size_DblN_descend_se_F14_TP_post2012(14)	4.73232	2.66817	5.16008
Size_DblN_end_logit_F14_TP_post2012(14)	-0.8468825	-1.78464	-0.351544
Size_DblN_peak_F15_TP_OTH(15)	137.2895	136.197	139.346
Size_DblN_top_logit_F15_TP_OTH(15)	-7.6249	-7.62574	-7.62346
Size_DblN_ascend_se_F15_TP_OTH(15)	5.902055	5.84005	6.01429
Size_DblN_descend_se_F15_TP_OTH(15)	9.940195	9.21168	10.6074
Size_DblN_end_logit_F15_TP_OTH(15)	-8.8611	-9.4902	-8.37163
Size_DblN_peak_F07_PS_NOR(7)_BLK2repl_1949	266.798	261.095	276.421
Size_DblN_ascend_se_F07_PS_NOR(7)_BLK2repl_1949	5.62568	5.26159	6.04987

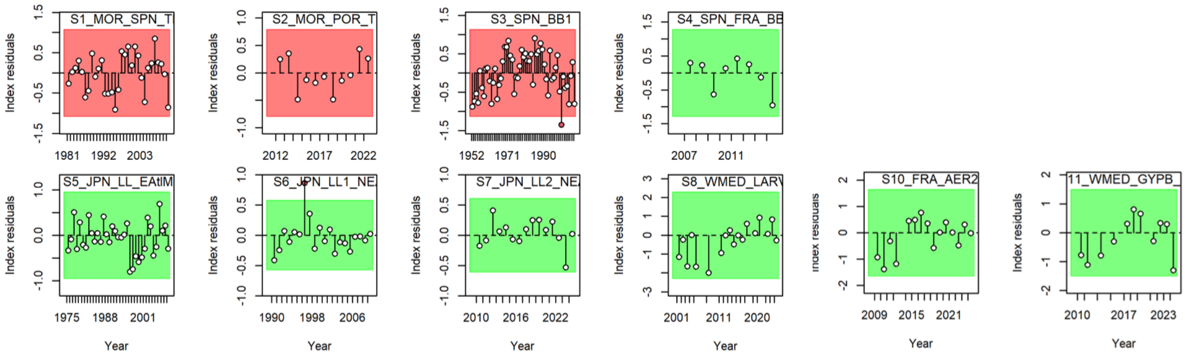


Figure 1.a R35: Residuals and runs test for log(CPUE) indices.

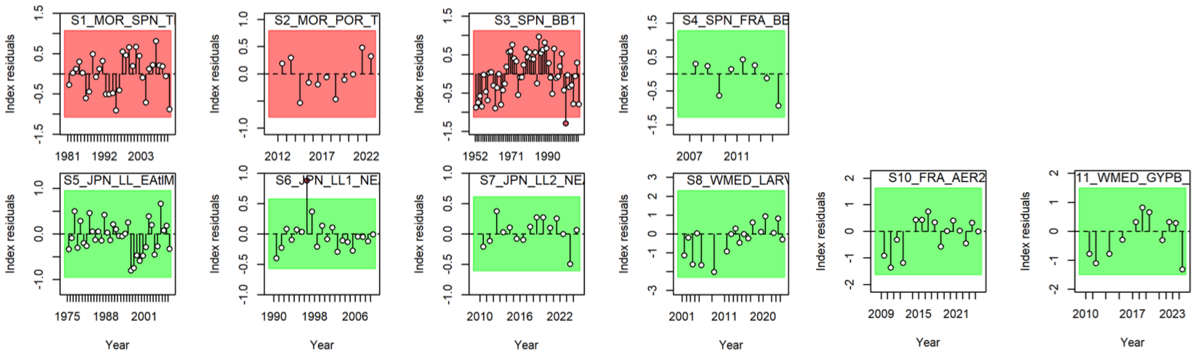


Figure 1.b R36: Residuals and runs test for log(CPUE) indices.

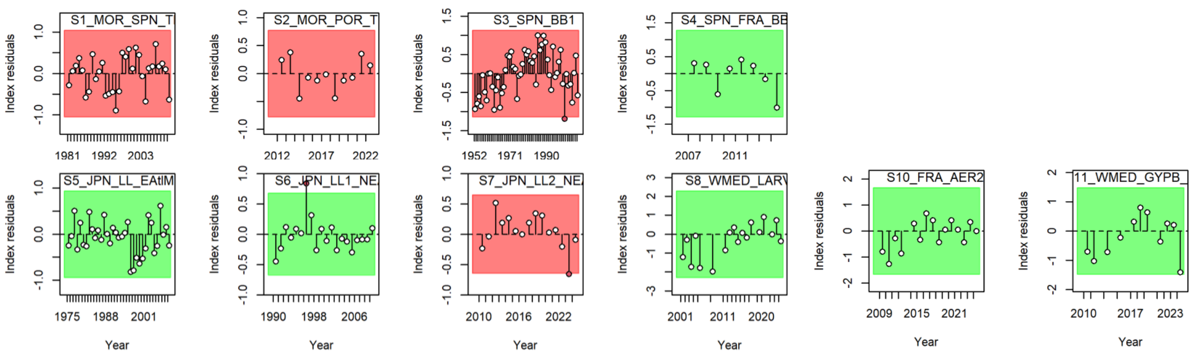


Figure 1.c R37: Residuals and runs test for log(CPUE) indices.

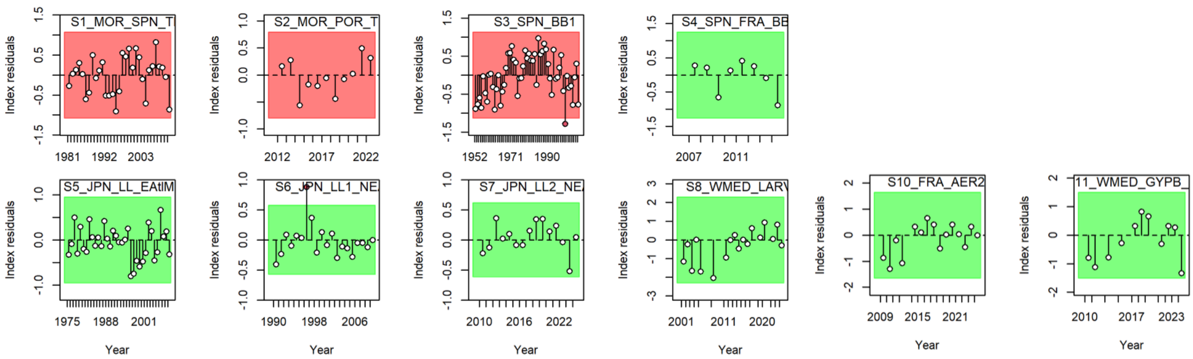


Figure 1.d R38: Residuals and runs test for log(CPUE) indices.

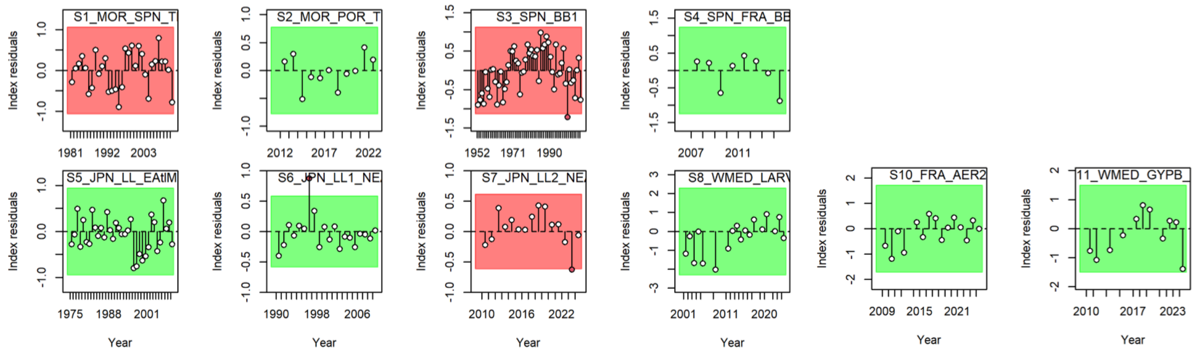


Figure 1.e R39: Residuals and runs test for log(CPUE) indices.

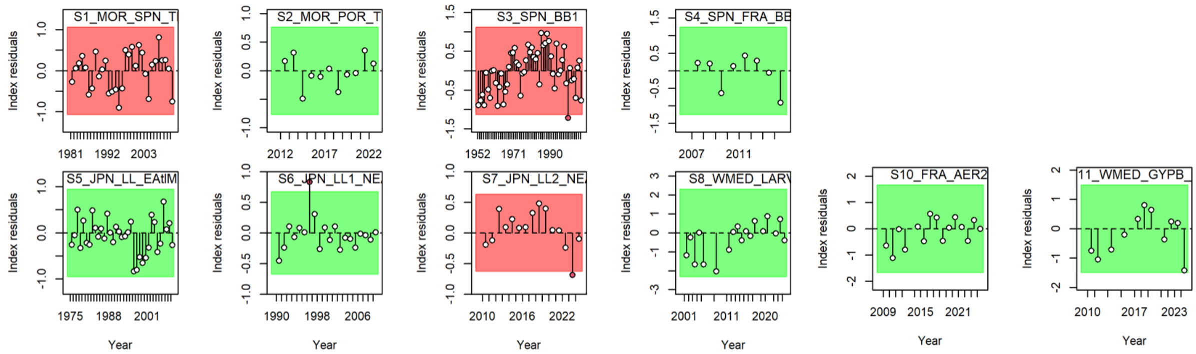


Figure 1.f R40: Residuals and runs test for log(CPUE) indices.

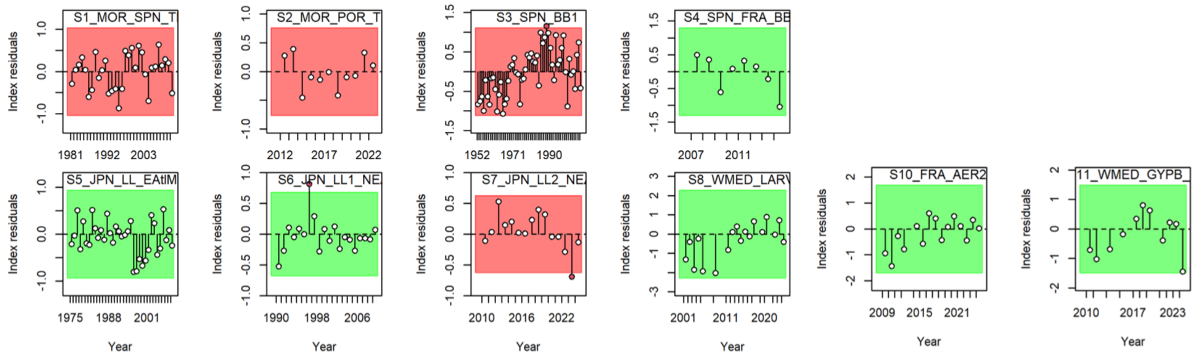


Figure 1.g R41: Residuals and runs test for log(CPUE) indices.

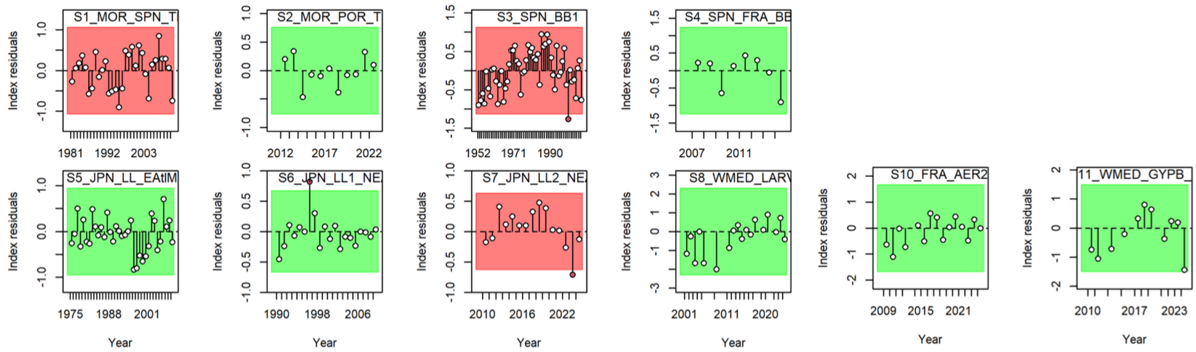


Figure 1.h R42: Residuals and runs test for log(CPUE) indices.

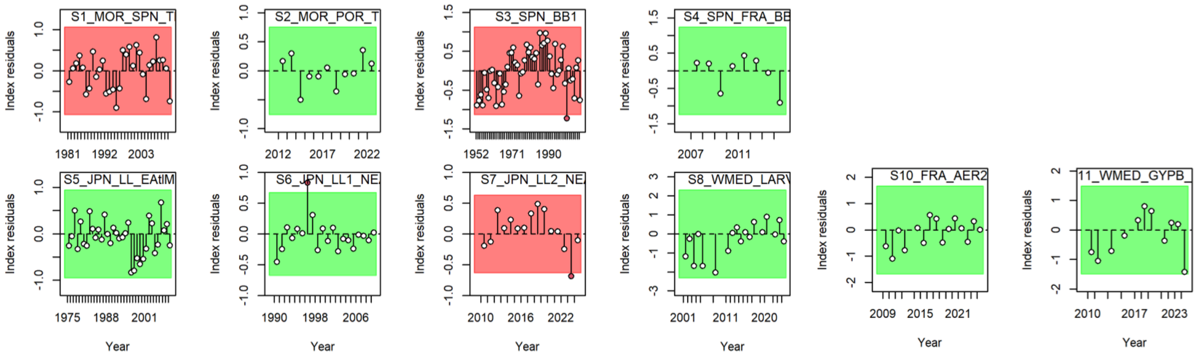


Figure 1.i R43: Residuals and runs test for log(CPUE) indices.

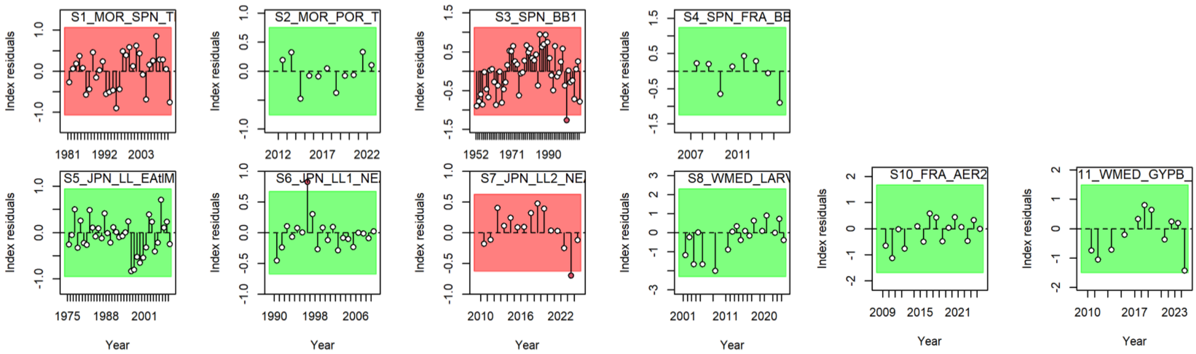


Figure 1.j R44: Residuals and runs test for log(CPUE) indices.

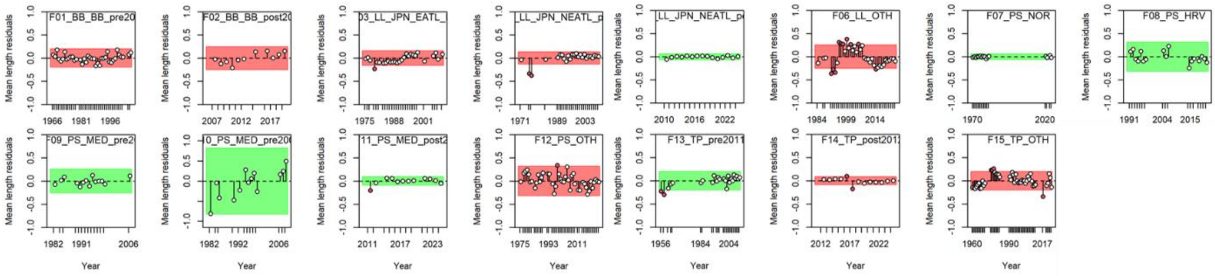


Figure 2.a R35: Residuals and runs test for the mean length of the fishing fleets.

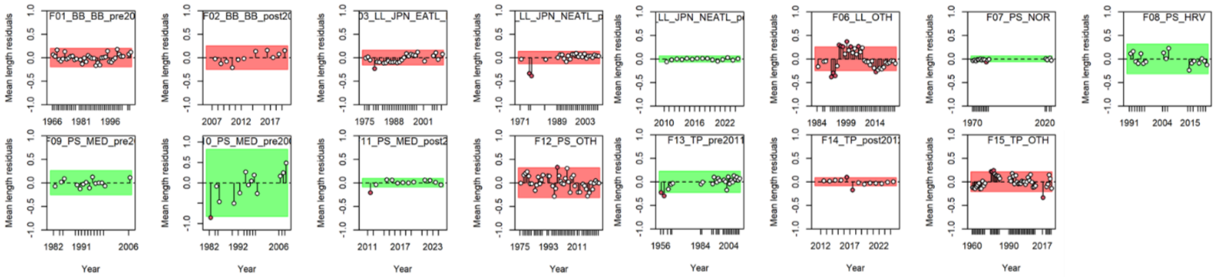


Figure 2.b R36: Residuals and runs test for the mean length of the fishing fleets.

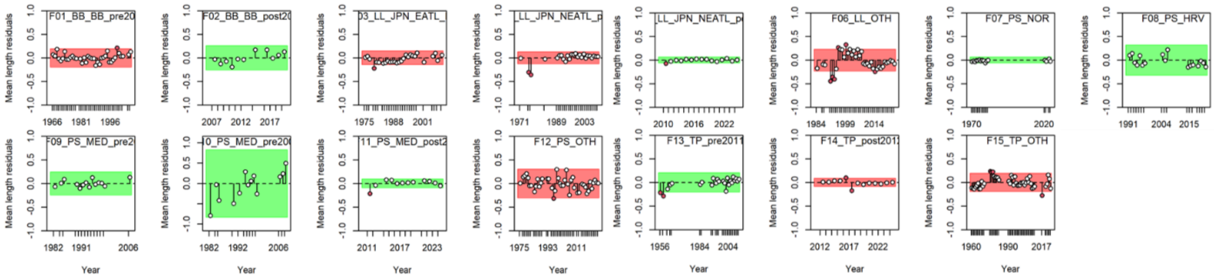


Figure 2.c R37: Residuals and runs test for the mean length of the fishing fleets.

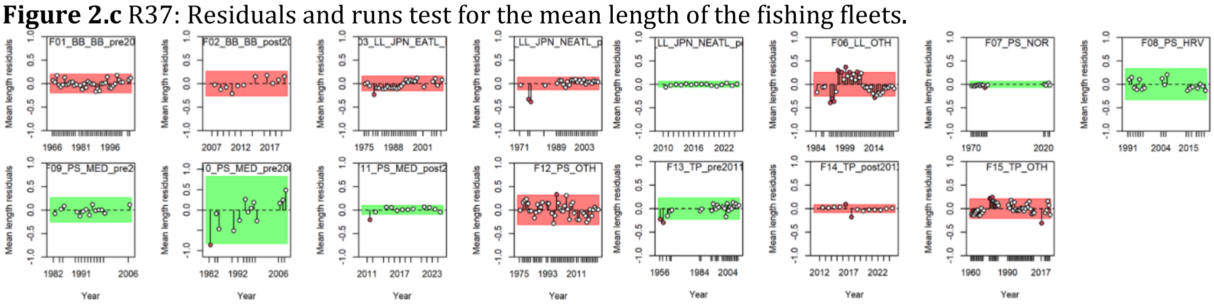


Figure 2.d R38: Residuals and runs test for the mean length of the fishing fleets.

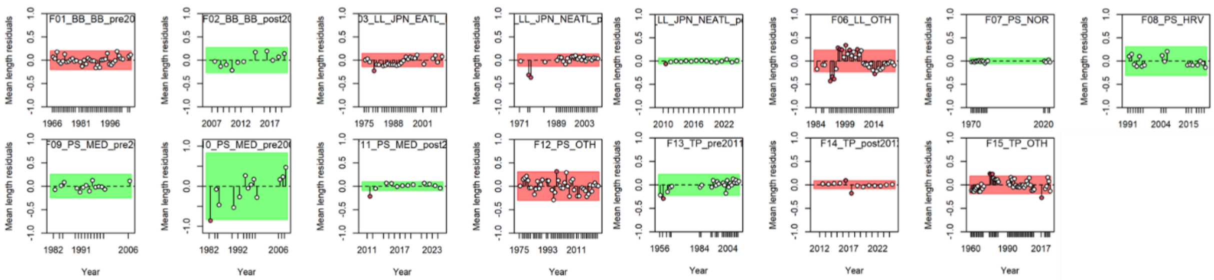


Figure 2.e R39: Residuals and runs test for the mean length of the fishing fleets.

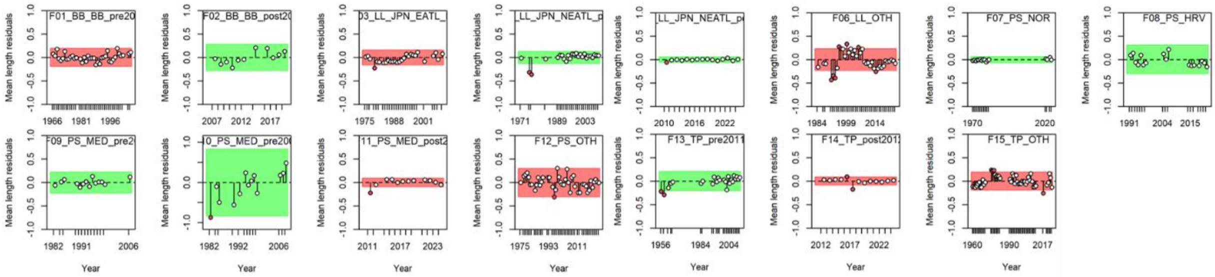


Figure 2.f R40: Residuals and runs test for the mean length of the fishing fleets.

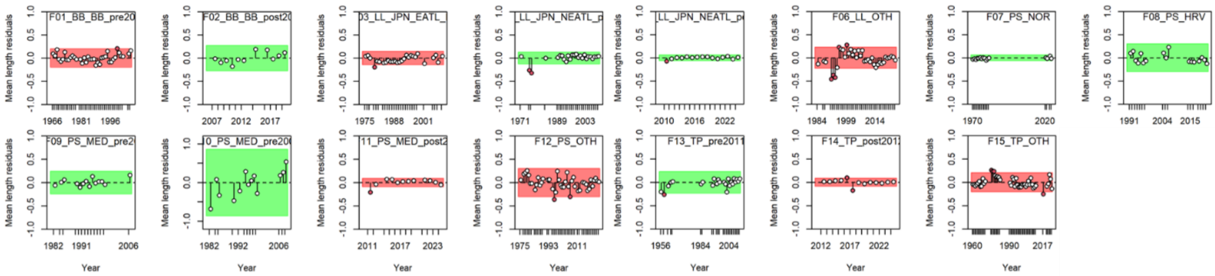


Figure 2.g R41: Residuals and runs test for the mean length of the fishing fleets.

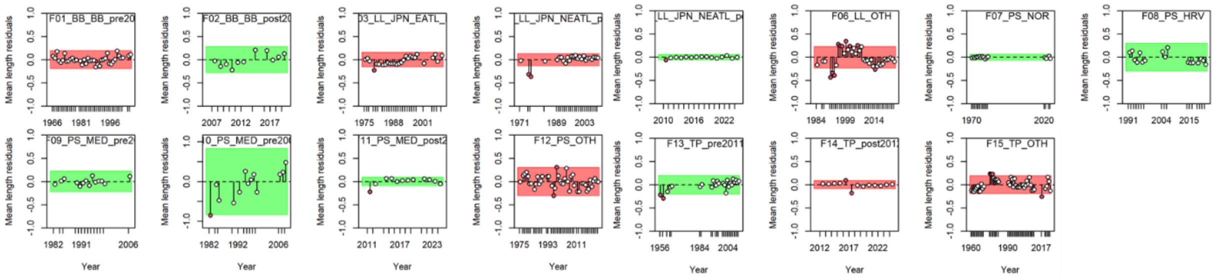


Figure 2.h R42: Residuals and runs test for the mean length of the fishing fleets.

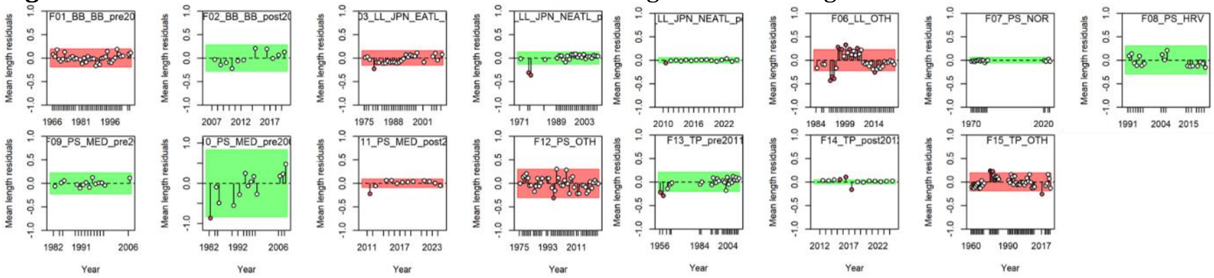


Figure 2.i R43: Residuals and runs test for the mean length of the fishing fleets.

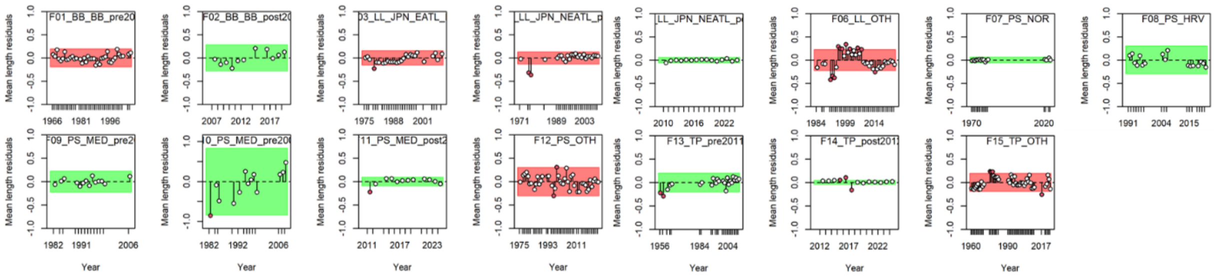
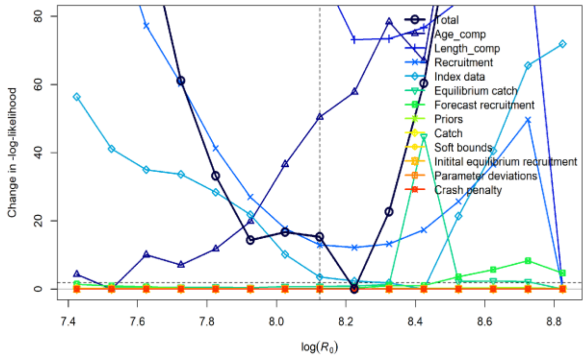
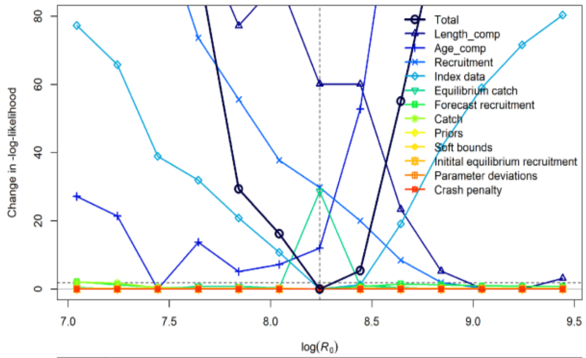
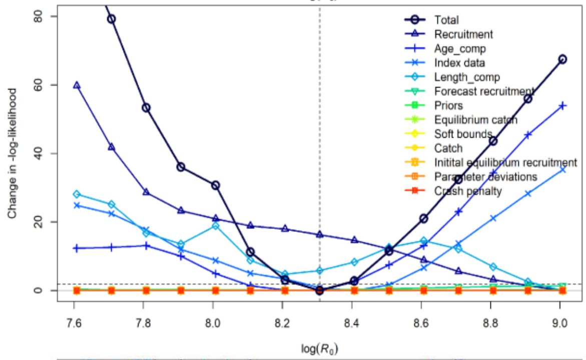
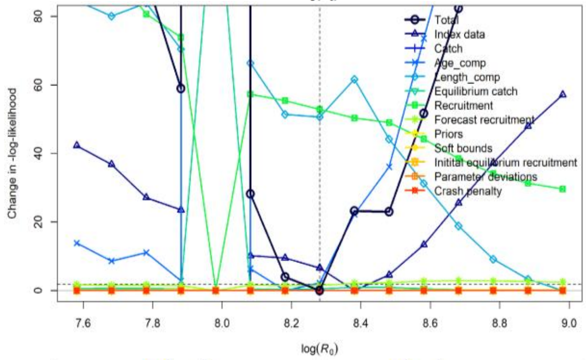


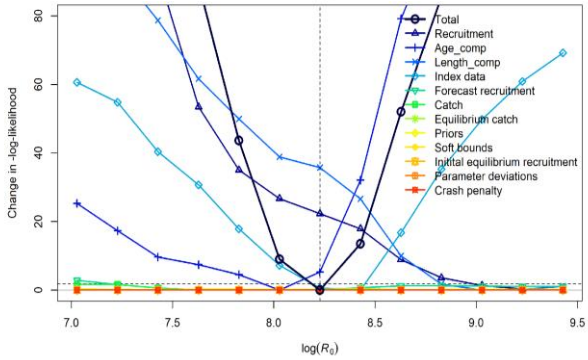
Figure 2.j R44: Residuals and runs test for the mean length of the fishing fleets.


Change in -log-likelihood
log(R_0)
Total
Age_comp
Length_comp
Recruitment
Index data
Equilibrium catch
Forecast recruitment
Priors
Catch
Soft bounds
Initital equilibrium recruitment
Parameter deviations
Crash penalty


Change in -log-likelihood
log(R_0)
Total
Length_comp
Age_comp
Recruitment
Index data
Equilibrium catch
Forecast recruitment
Catch
Priors
Soft bounds
Initital equilibrium recruitment
Parameter deviations
Crash penalty


Change in -log-likelihood
log(R_0)
Total
Recruitment
Age_comp
Index data
Length_comp
Forecast recruitment
Priors
Equilibrium catch
Soft bounds
Catch
Initital equilibrium recruitment
Parameter deviations
Crash penalty


Change in -log-likelihood
log(R_0)
Total
Index data
Catch
Age_comp
Length_comp
Equilibrium catch
Recruitment
Forecast recruitment
Priors
Soft bounds
Initital equilibrium recruitment
Parameter deviations
Crash penalty


Change in -log-likelihood
log(R_0)
Total
Recruitment
Age_comp
Length_comp
Index data
Forecast recruitment
Catch
Equilibrium catch
Priors
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Parameter deviations
Crash penalty

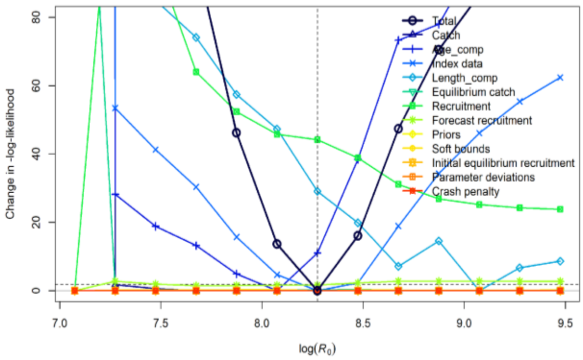


Figure 3. Likelihood profile plot for log(R0) of R35 (top left), R36 (top right), R37 (middle left), R38 (middle right), R39 (bottom left), R40 (bottom right).

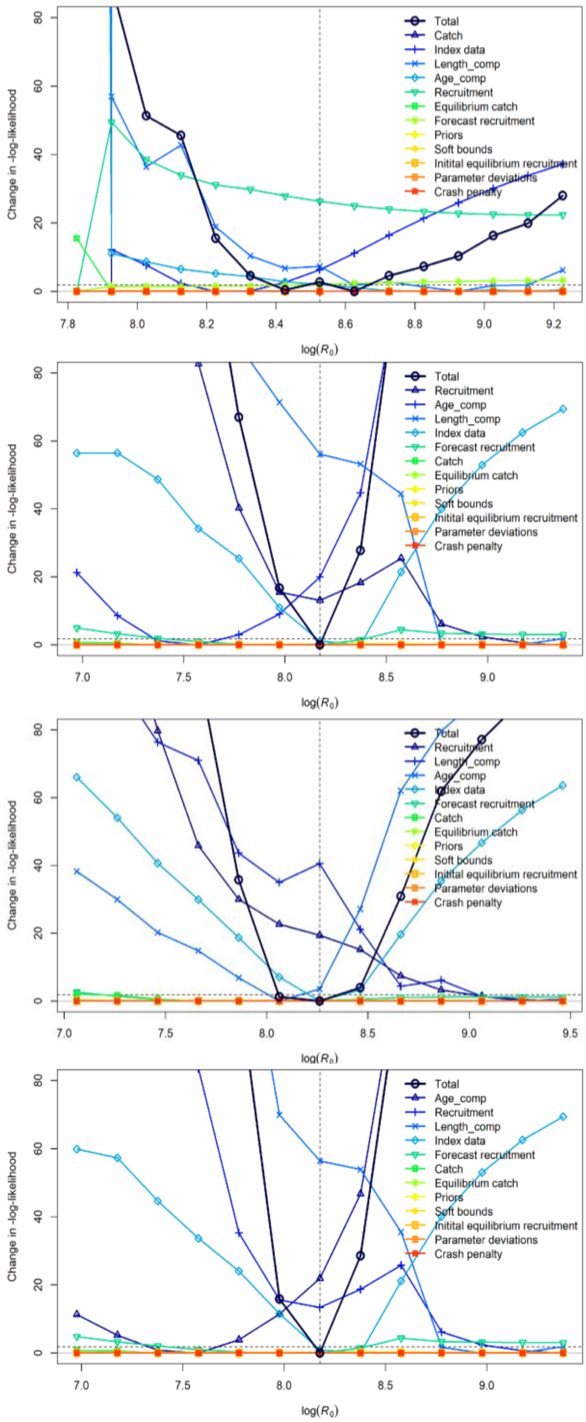


Figure 3. (continued) Likelihood profile plot for log(R0) of R41 (top left), R42 (top right), R43 (bottom left), R44 (bottom right).

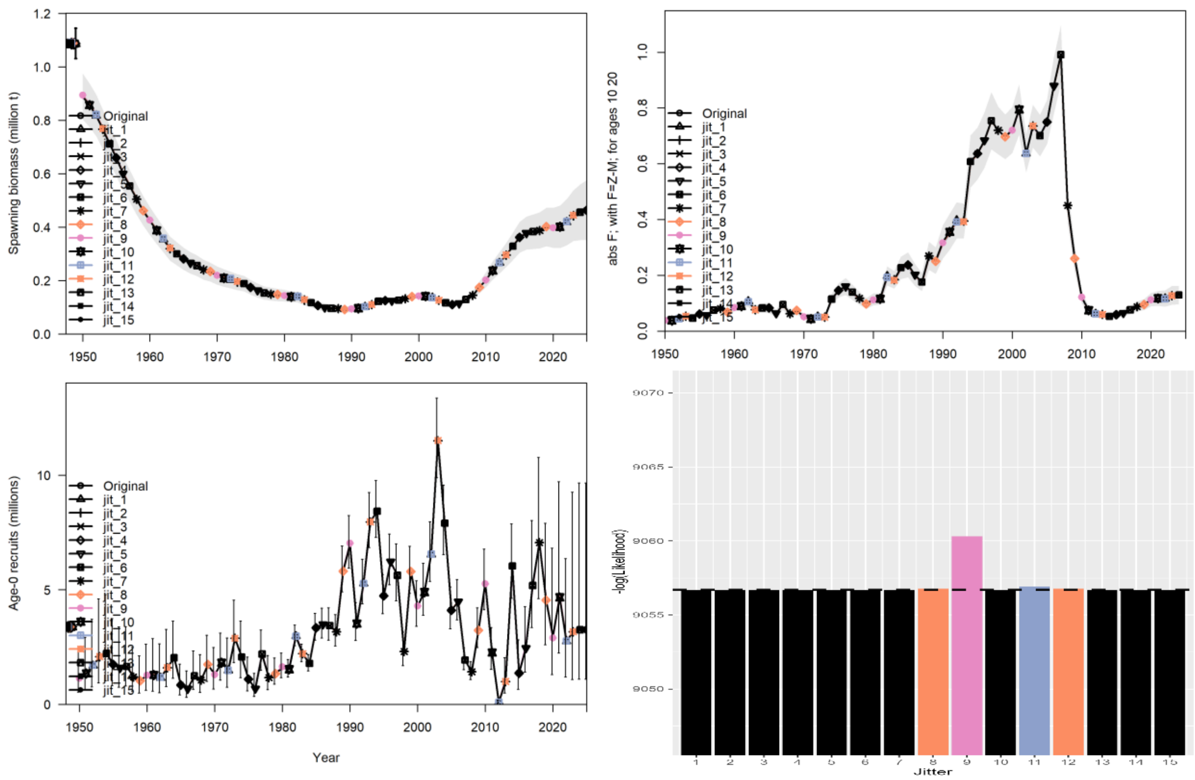


Figure 4.a R35: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

Figure 4.b R36: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

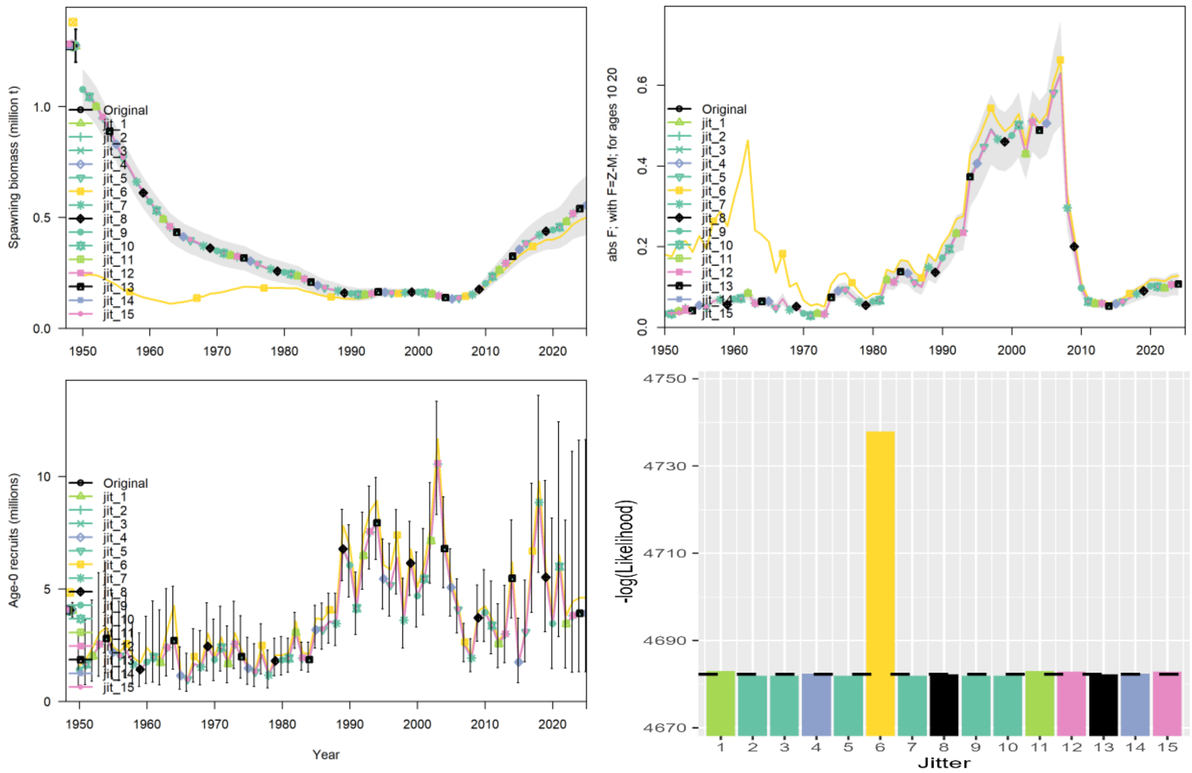


Figure 4.c R37: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

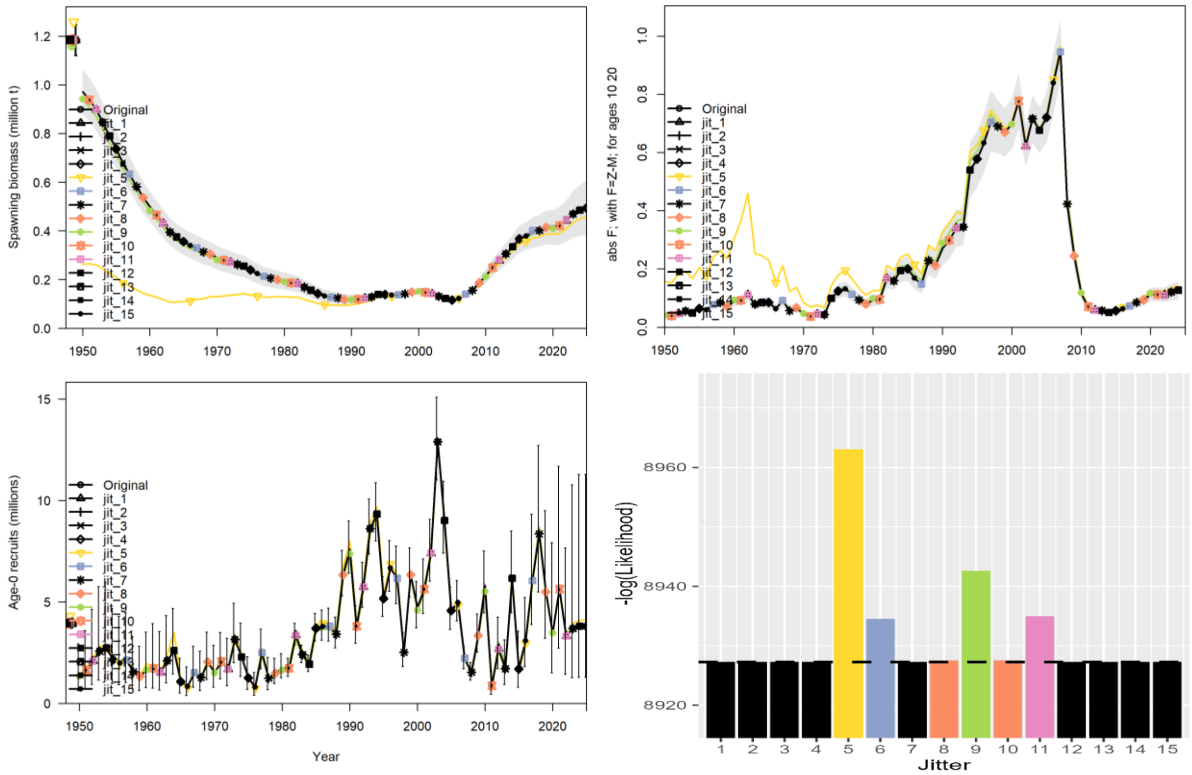


Figure 4.d R38: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

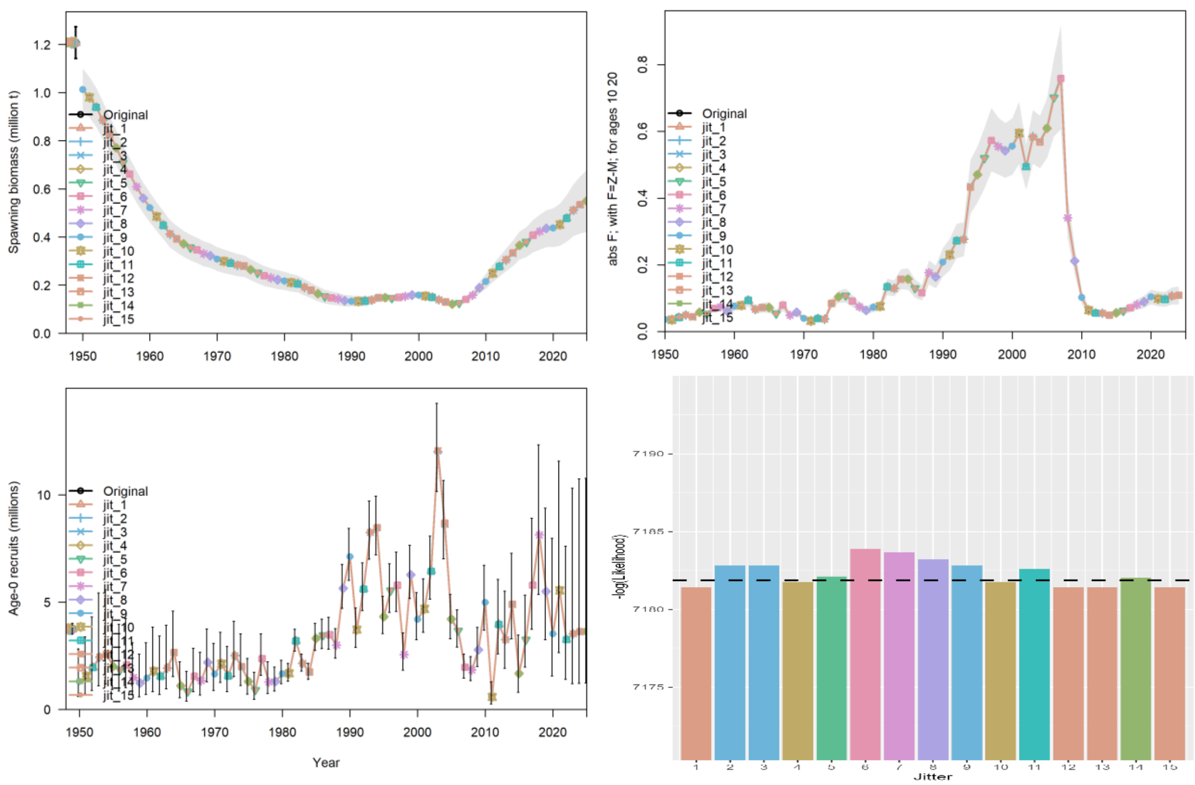


Figure 4.e R39: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

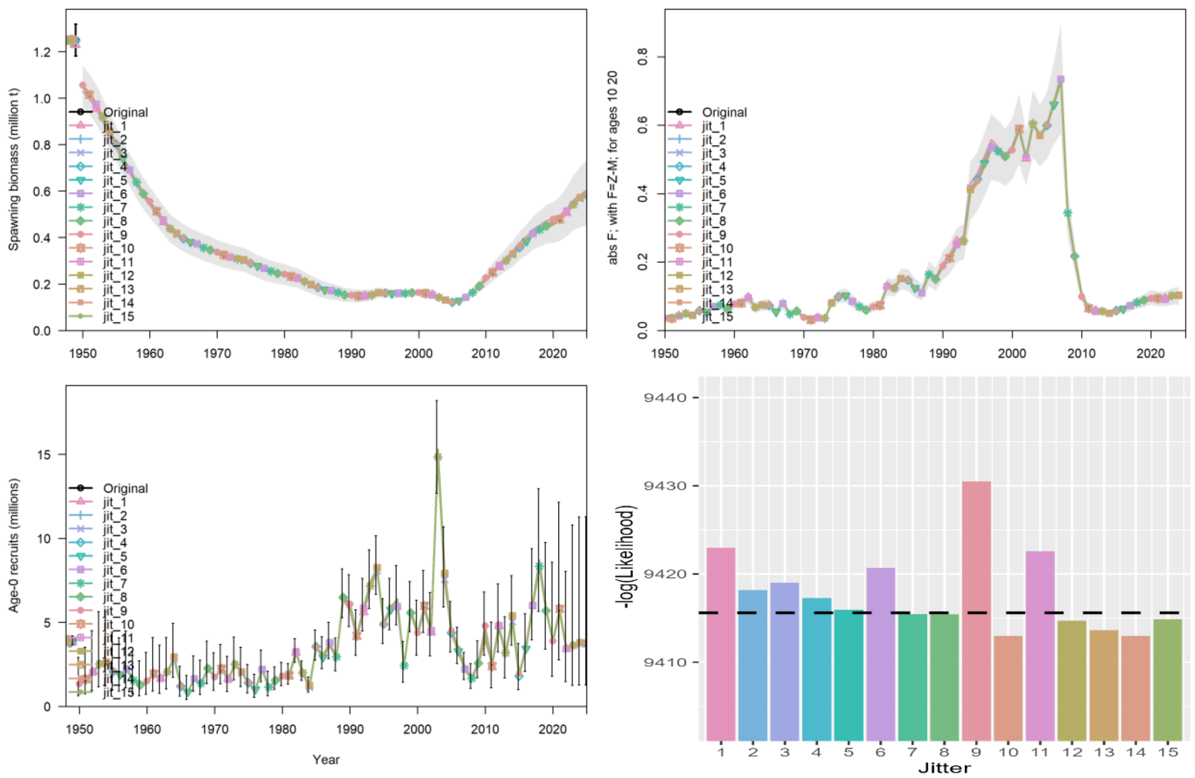


Figure 4.f R40: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

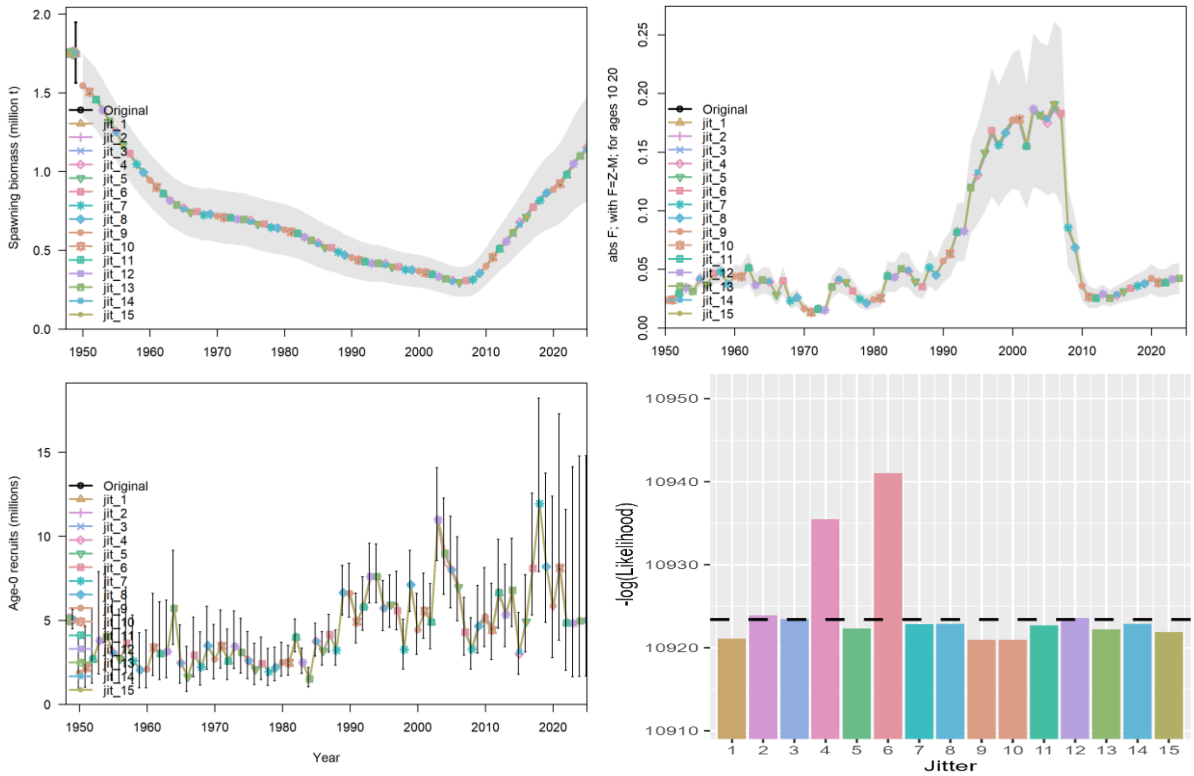


Figure 4.g R41: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

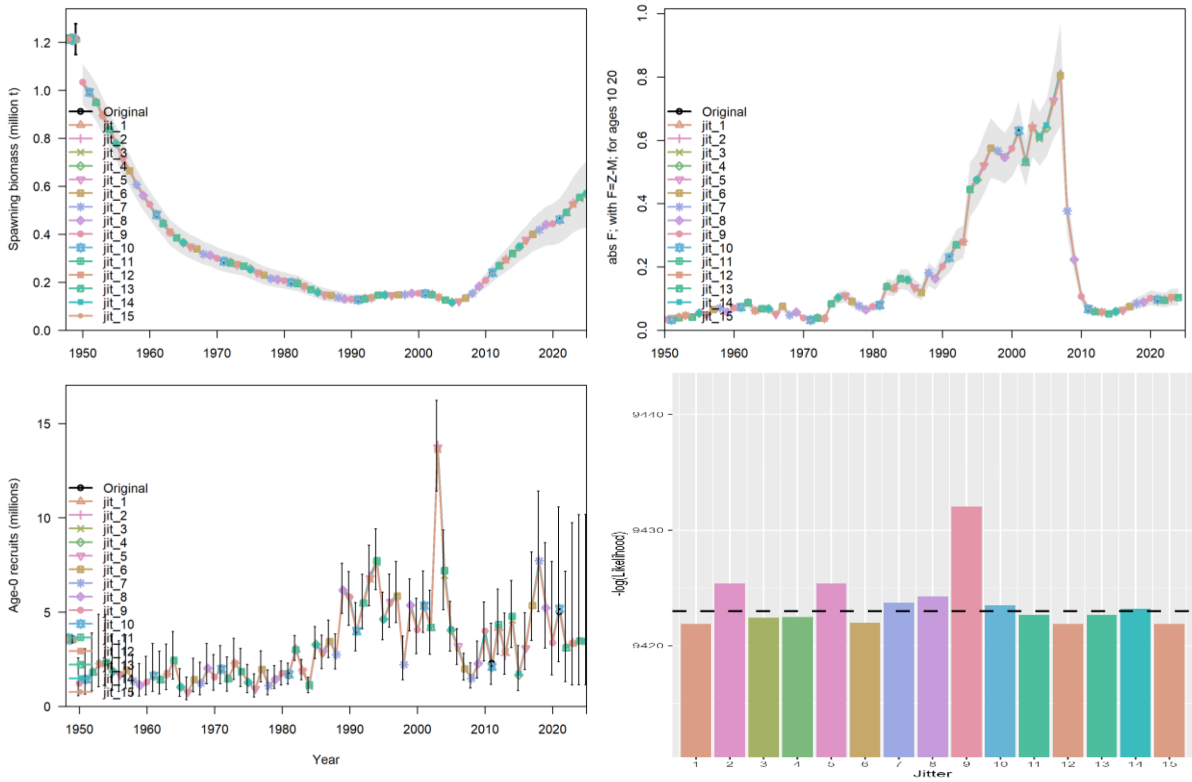


Figure 4.h R42: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

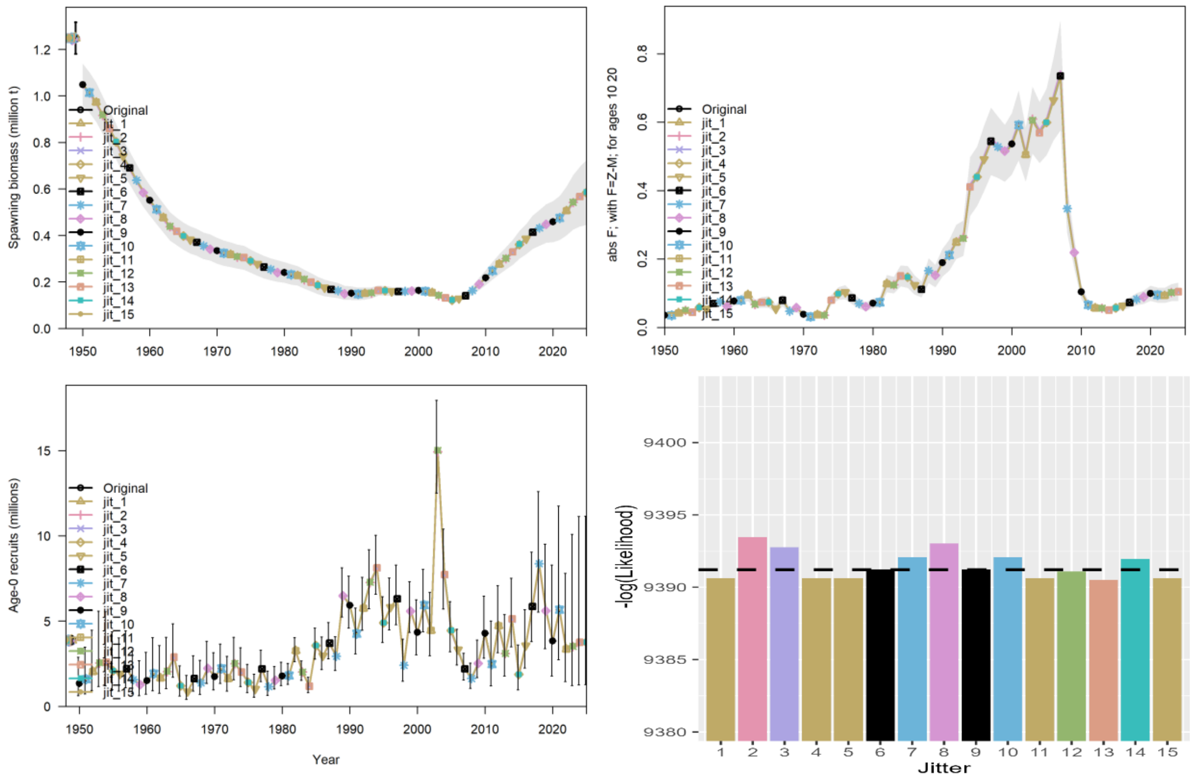


Figure 4.i R43: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

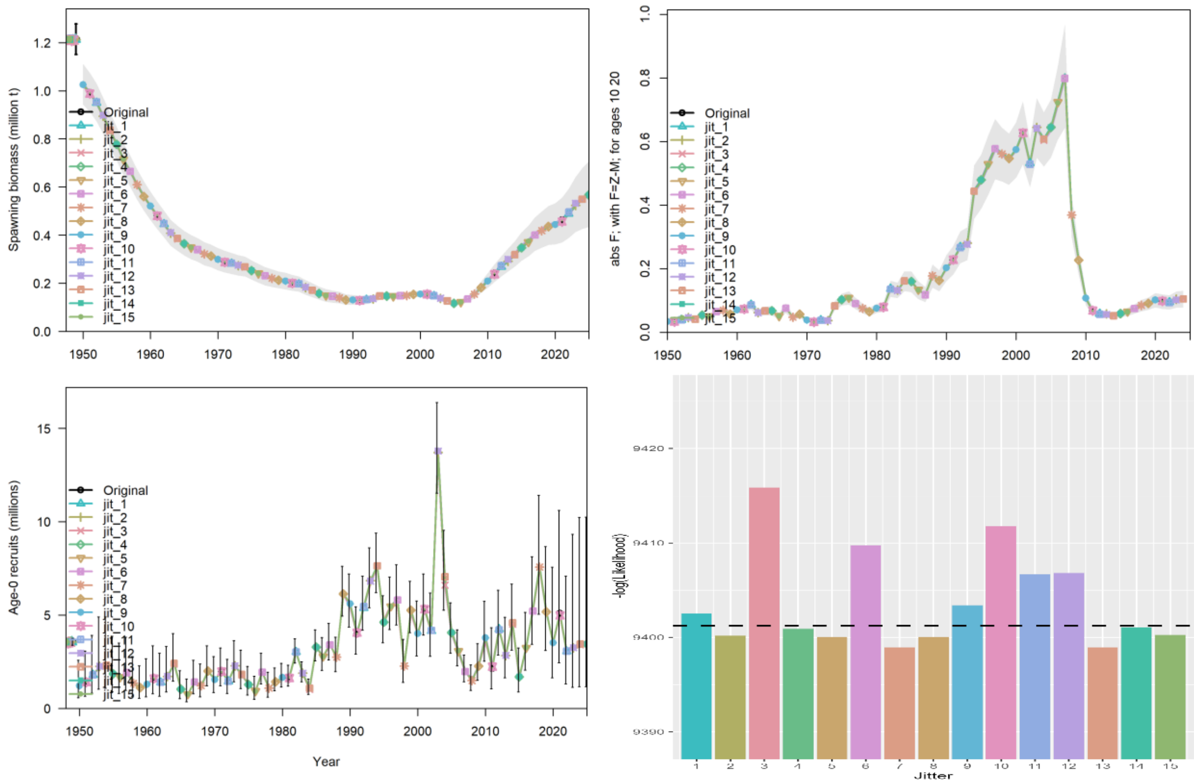


Figure 4.j R44: Jitter test for global convergence from 15 runs. Initial values were jittered by 10%. The largest gradient across the 15 runs was 0.0052. SSB (top left), F(ages 10-20) (top right), recruitment (bottom left) and total negative log-likelihood (bottom right).

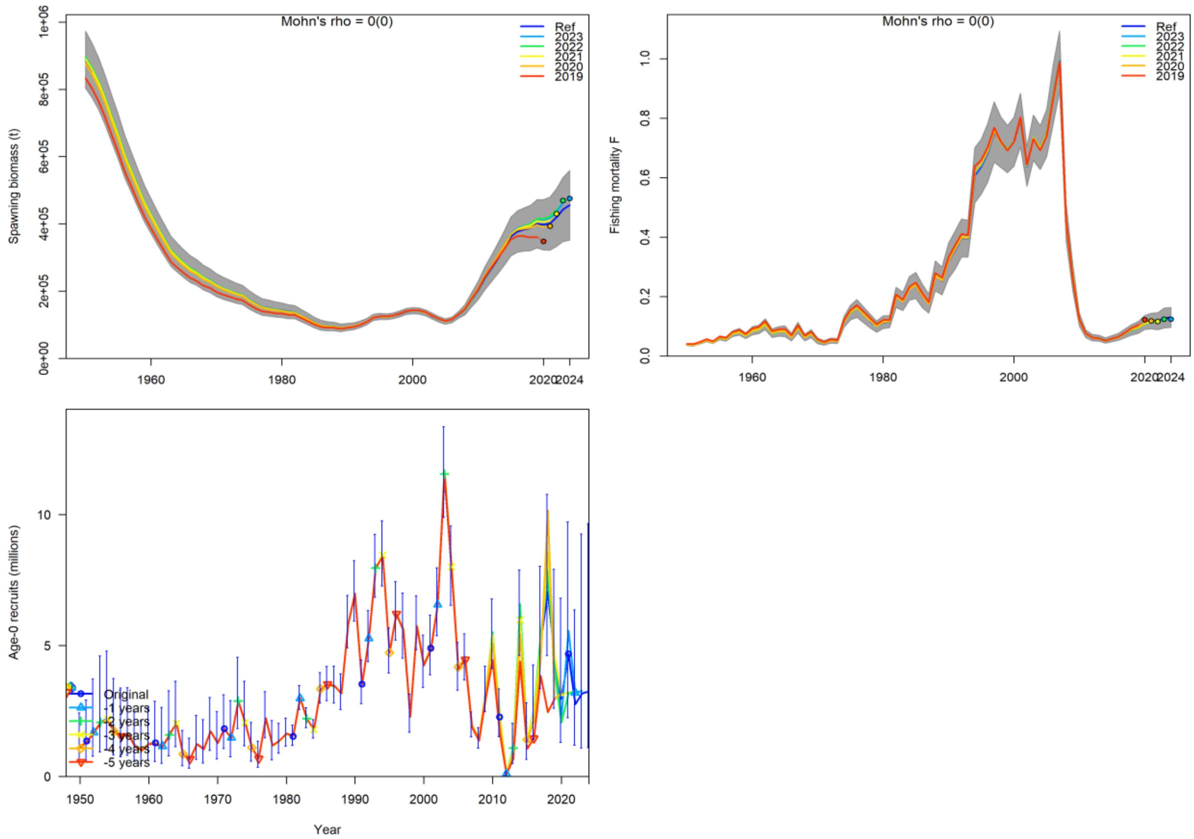


Figure 5.a R35: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

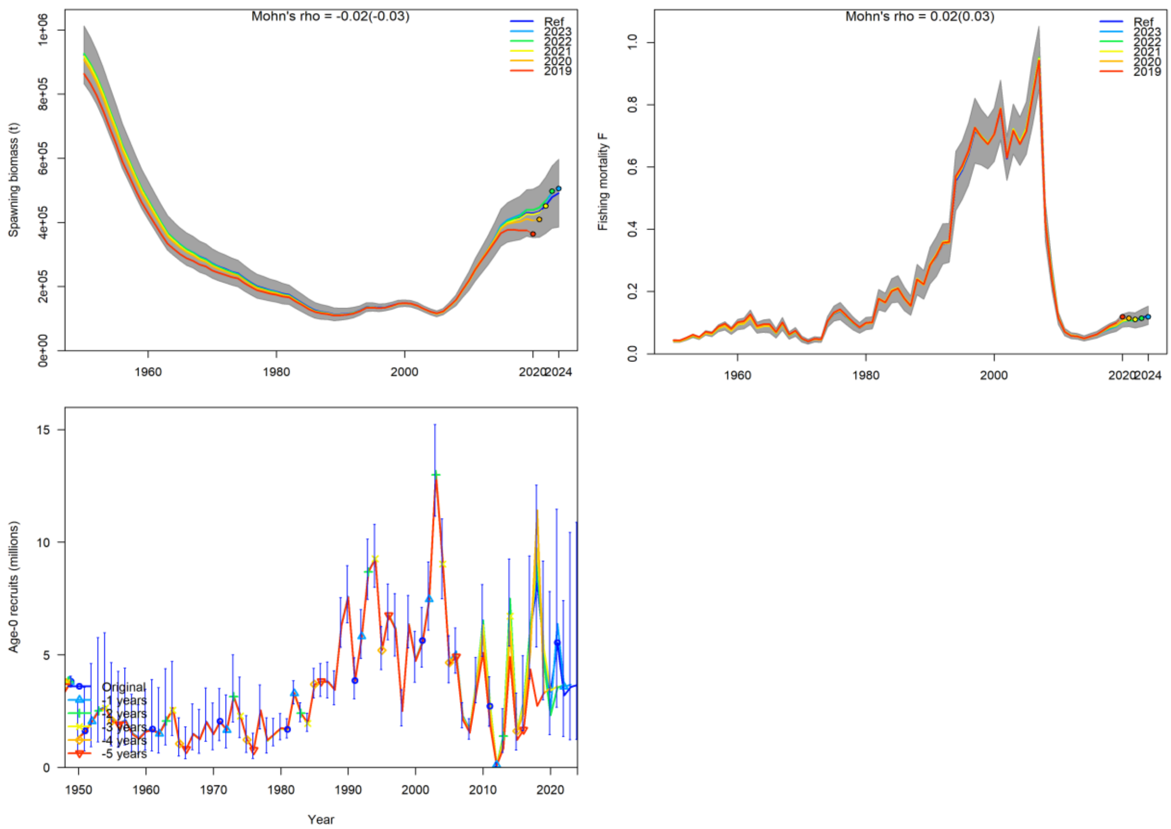


Figure 5.b R36: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

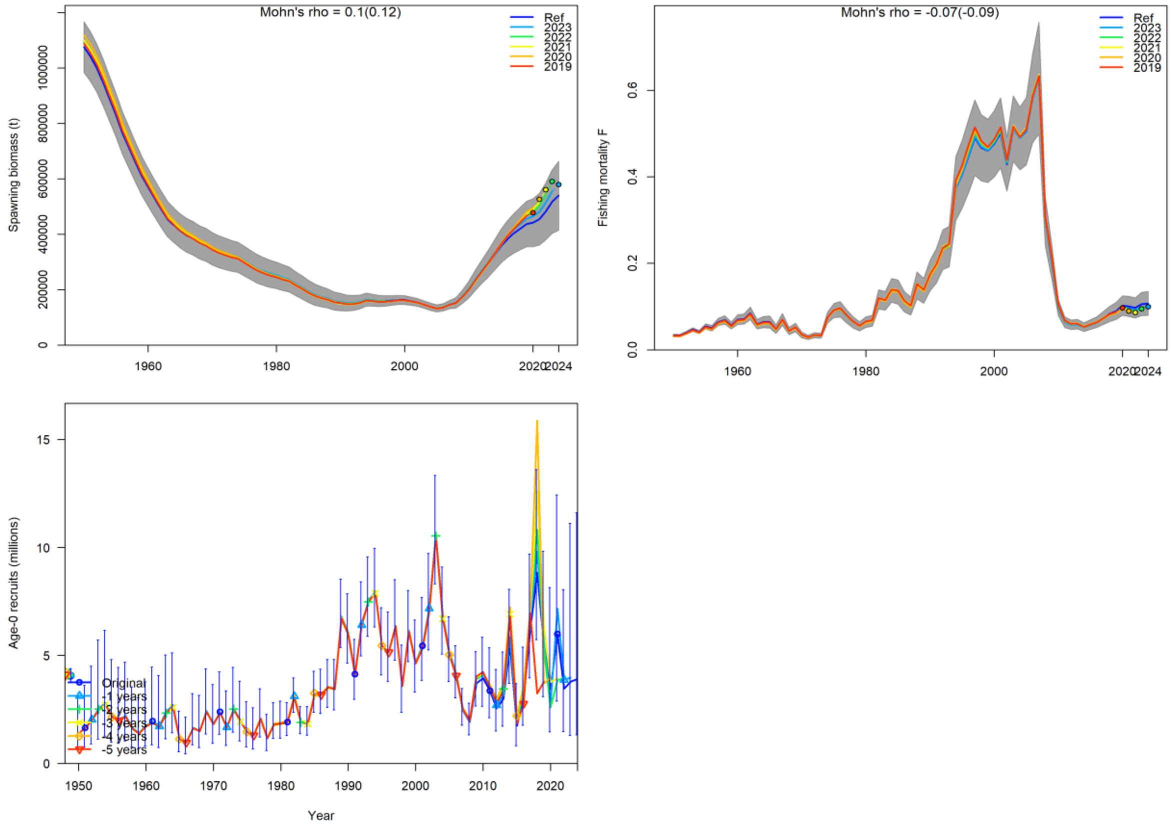


Figure 5.c R37: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

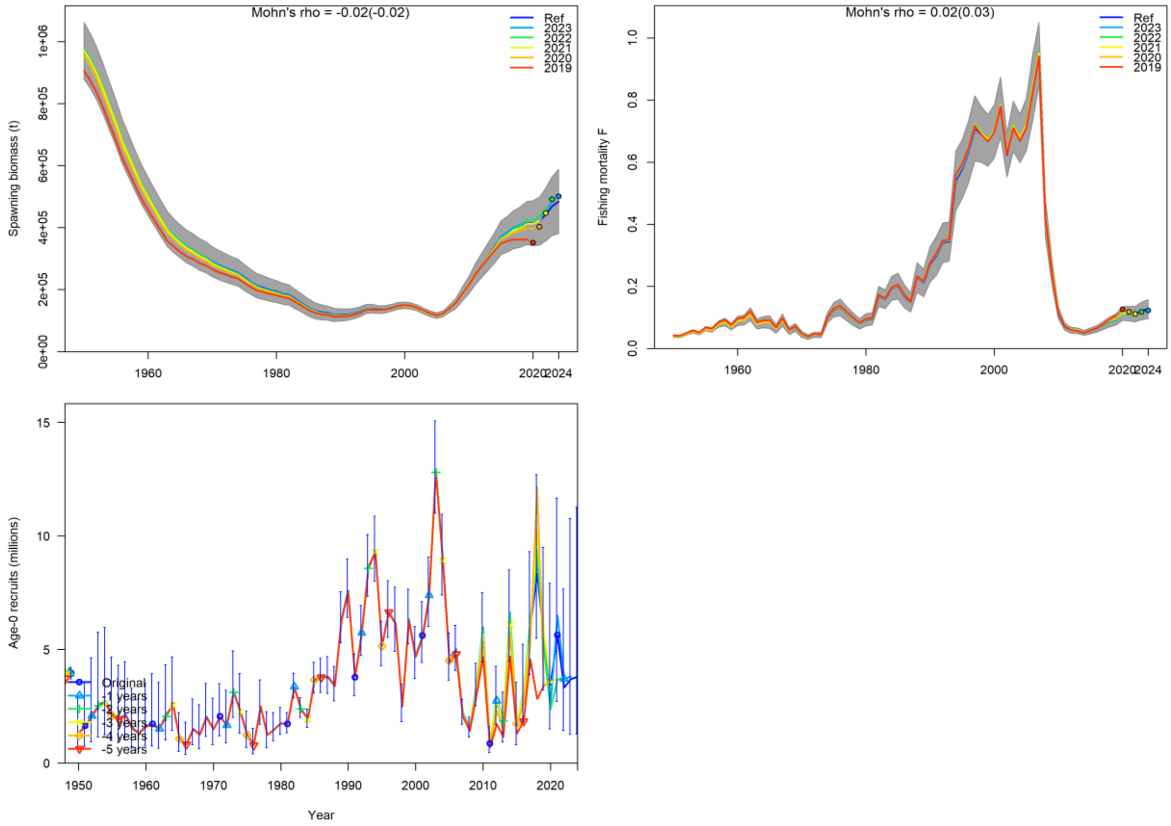


Figure 5.d R38: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

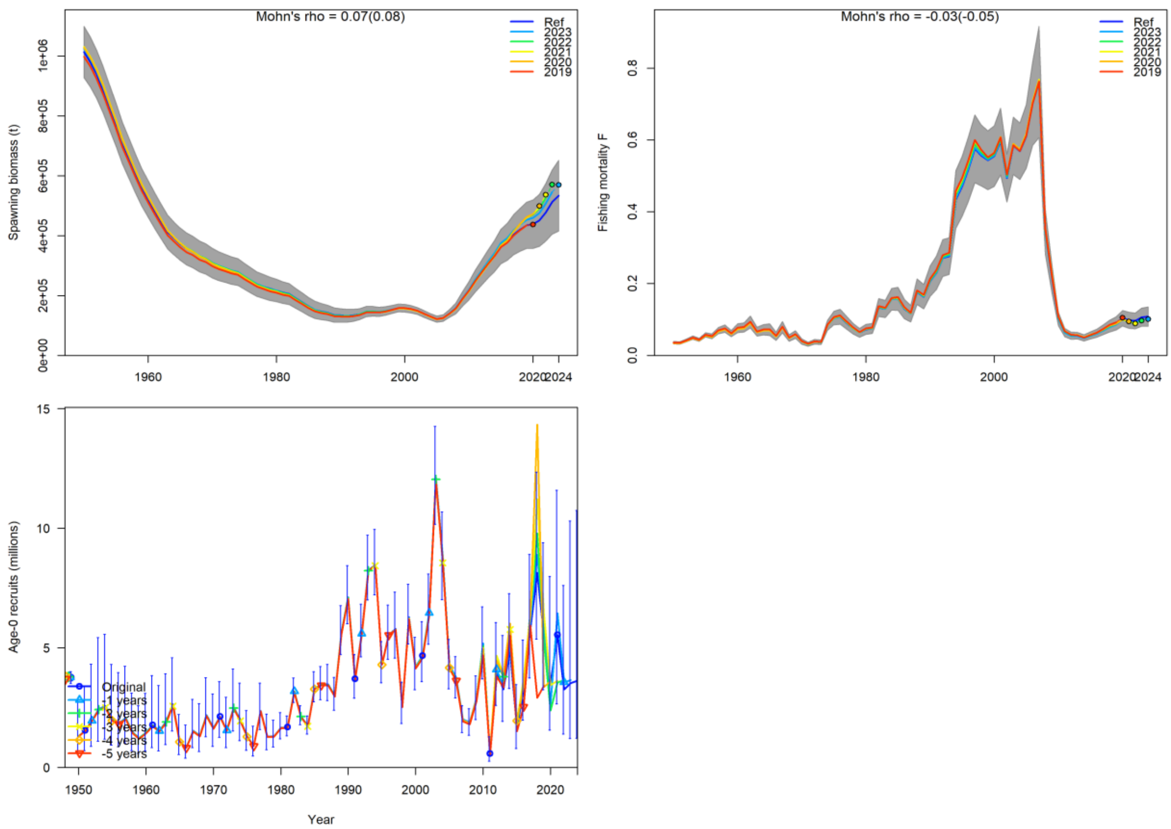


Figure 5.e R39: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

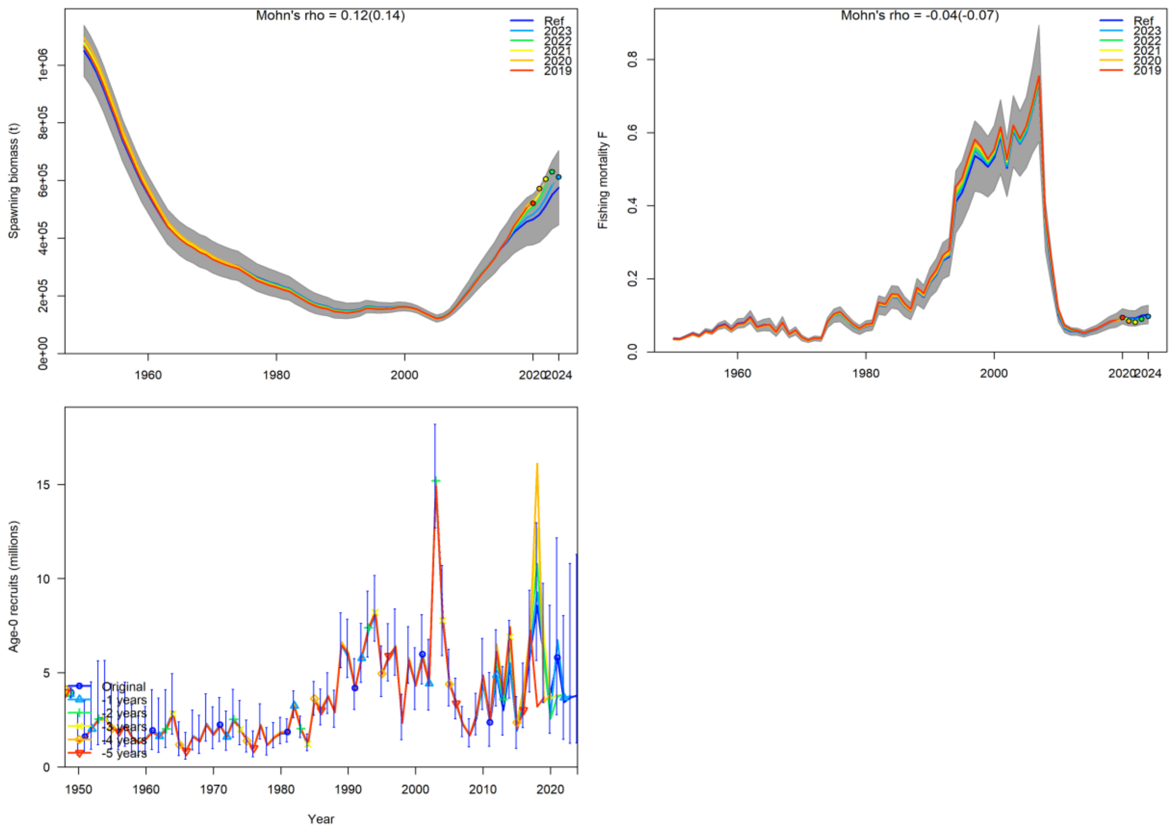


Figure 5.f R40: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

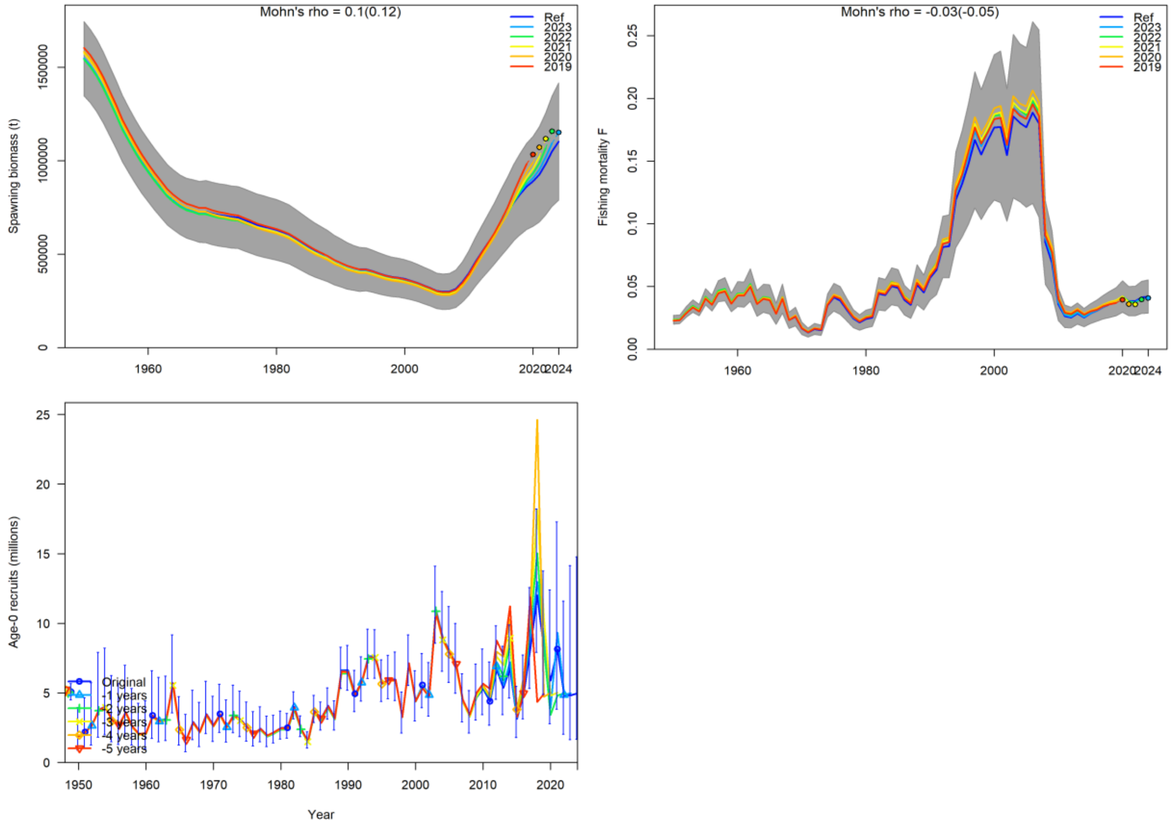


Figure 5.g R41: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

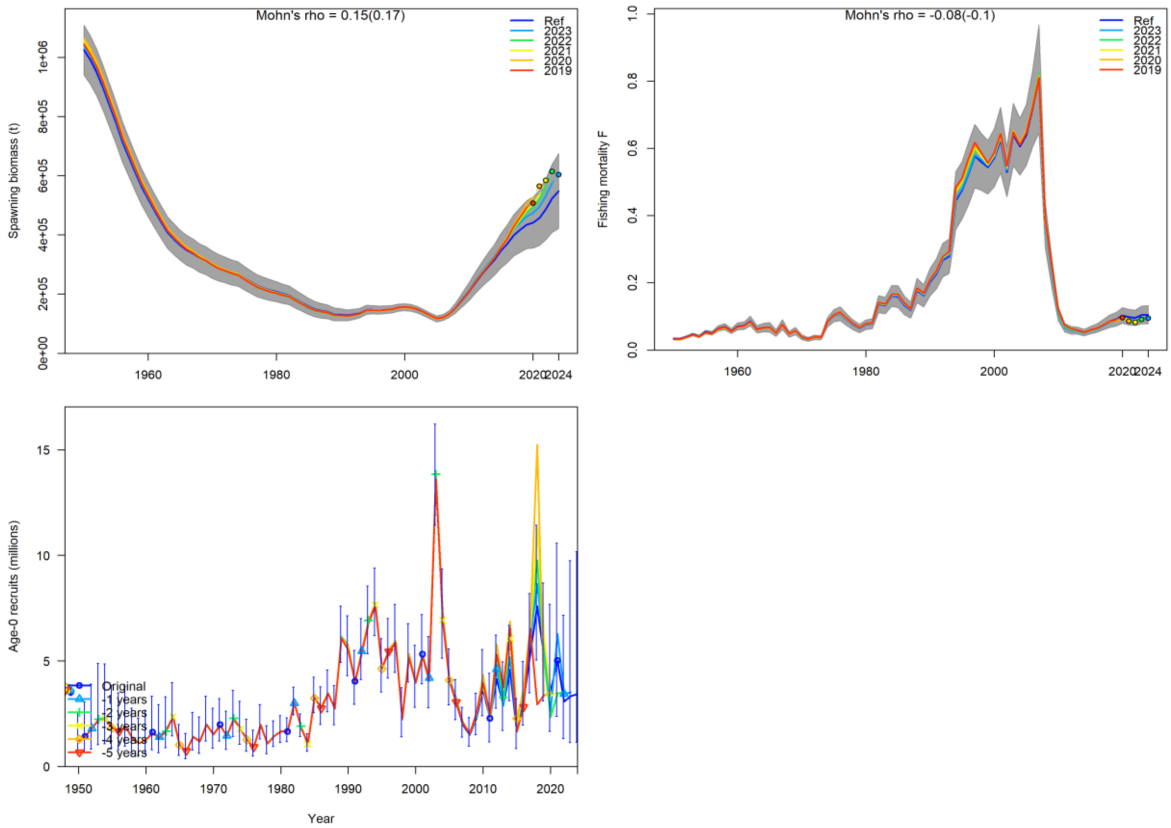


Figure 5.h R42: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

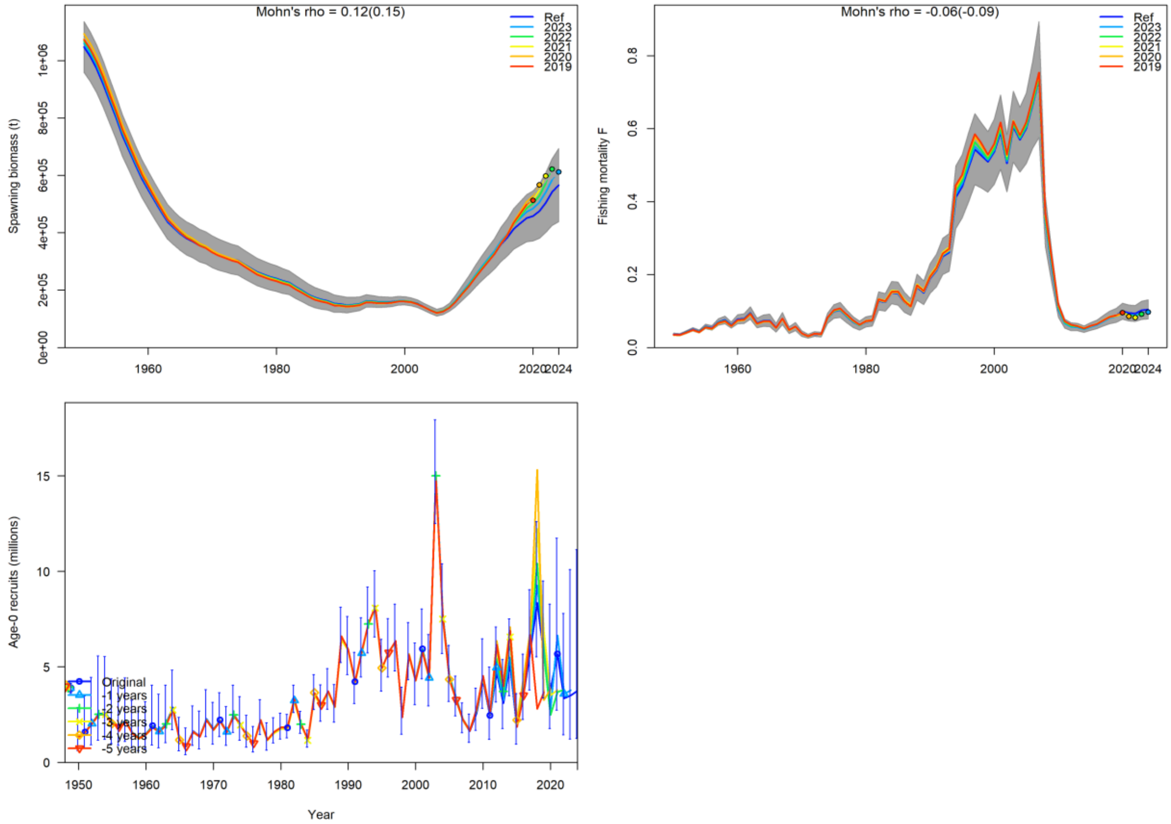


Figure 5.i R43: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

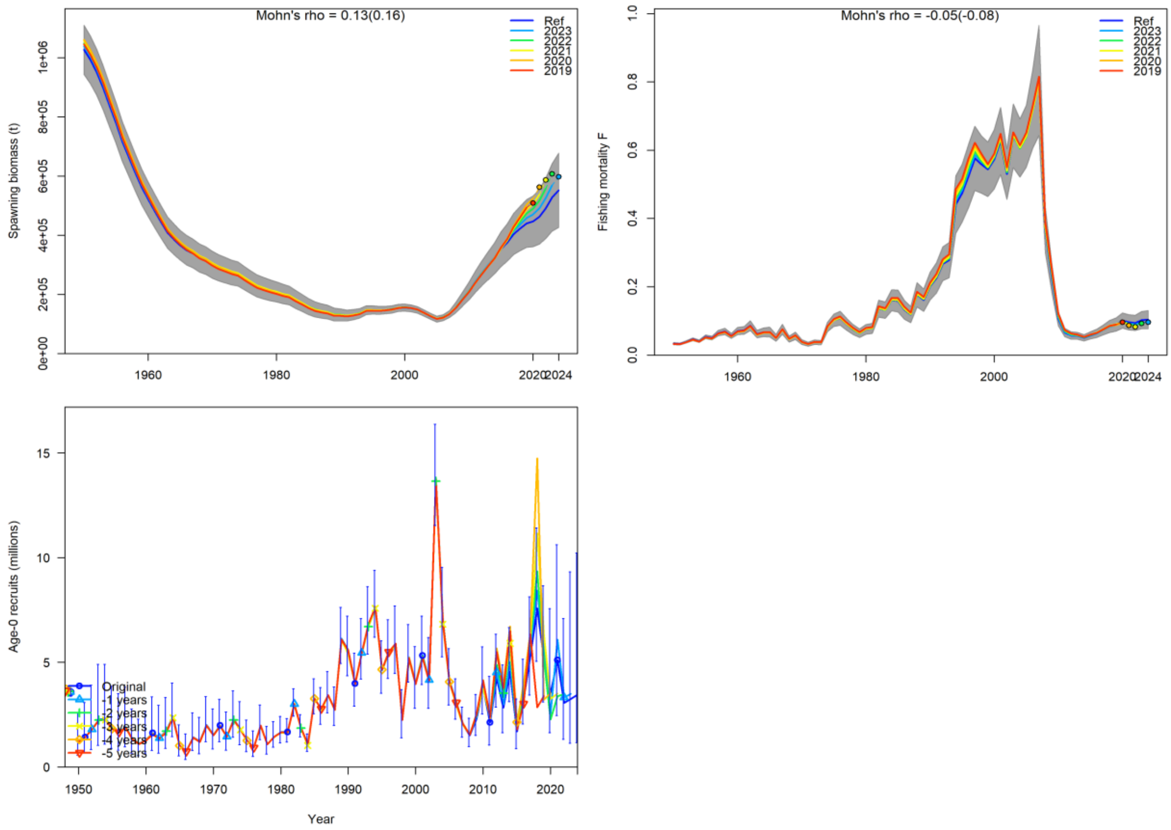


Figure 5.j R44: Retrospective analysis removing up to 5 years of data. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

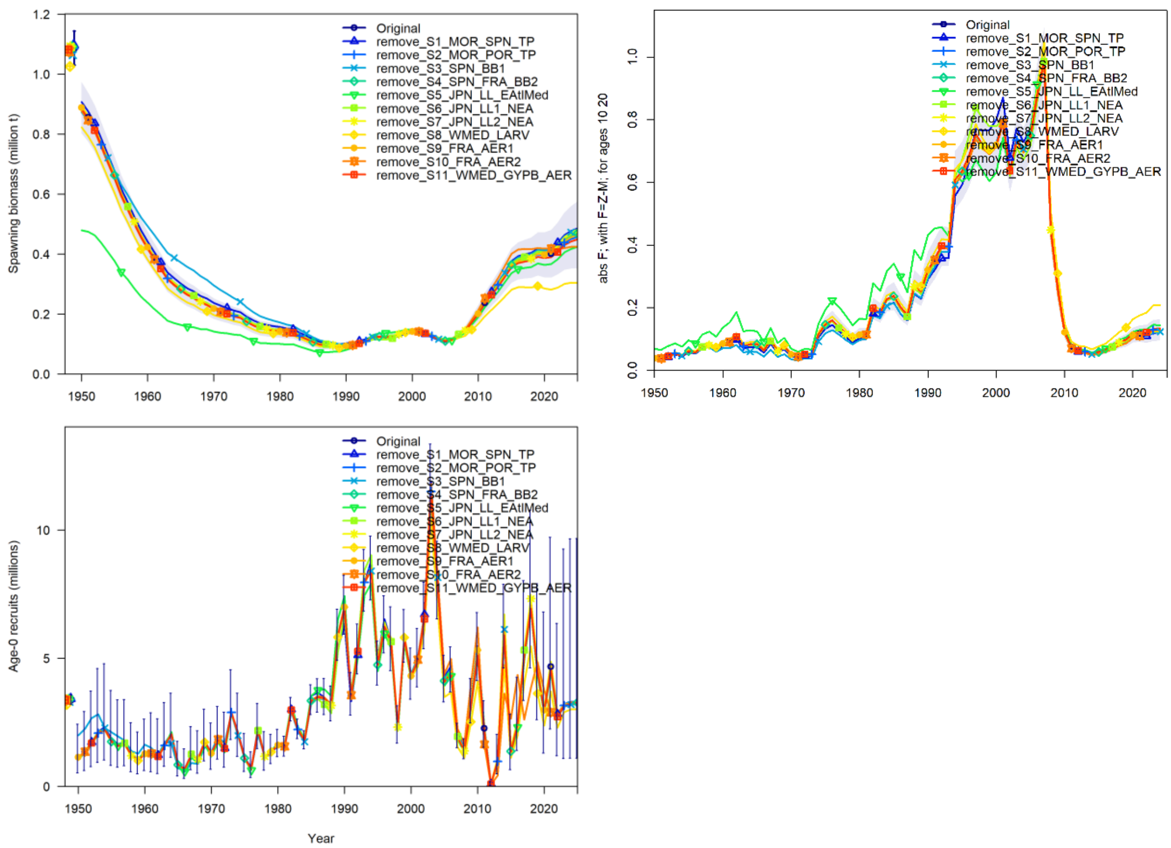


Figure 6.a R35: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

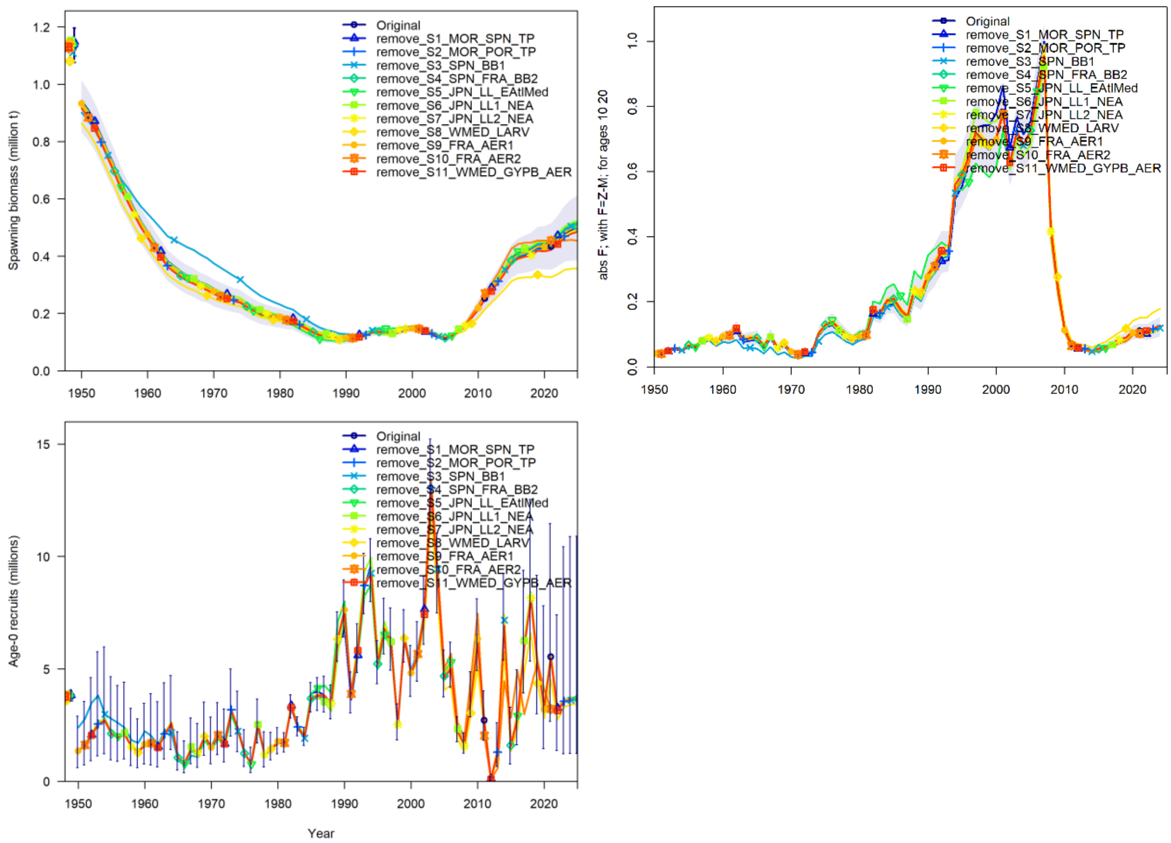


Figure 6.b R36: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

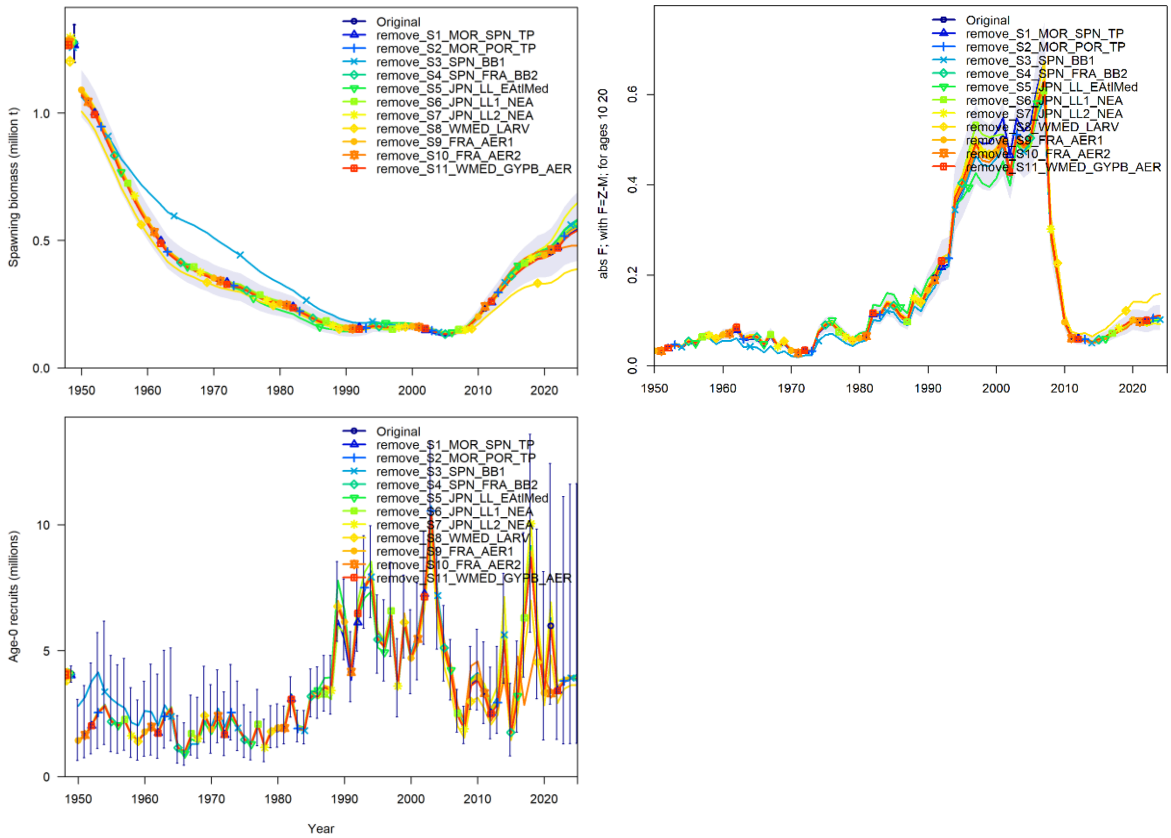


Figure 6.c R37: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

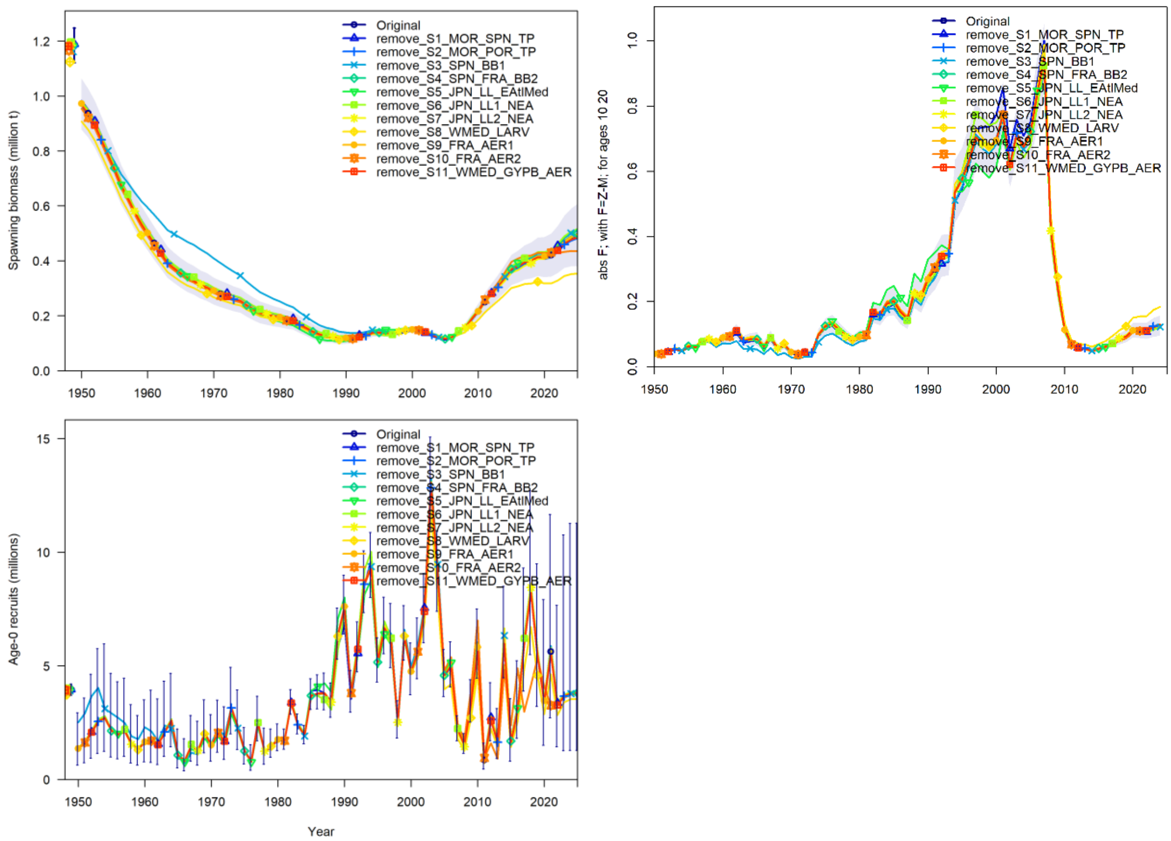


Figure 6.d R38: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

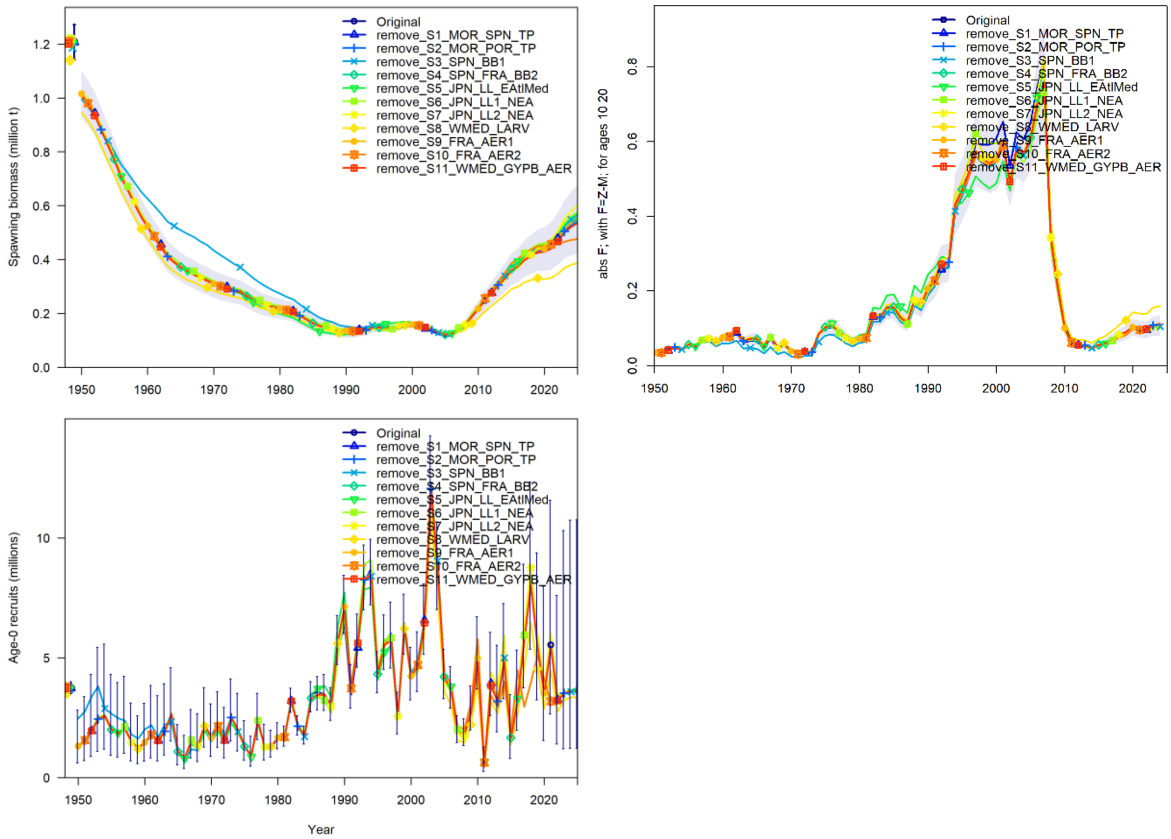


Figure 6.e R39: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

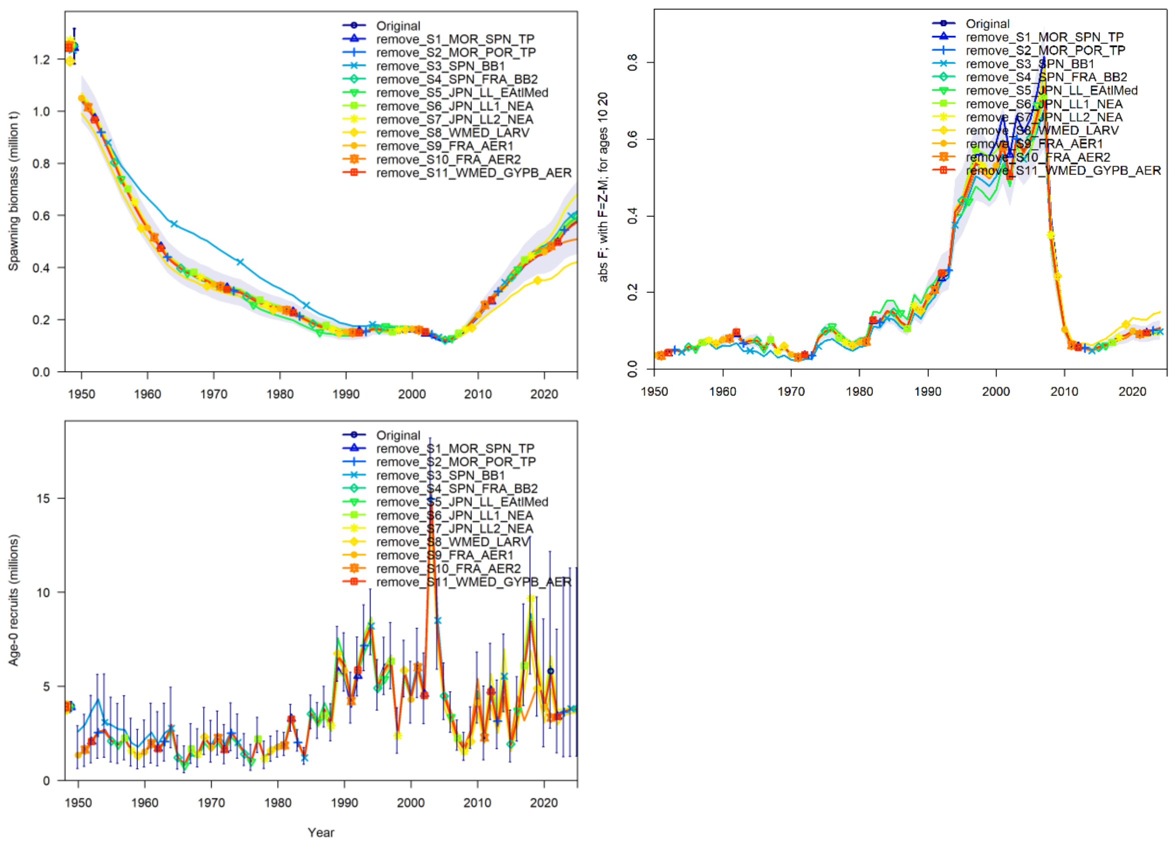


Figure 6.f R40: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

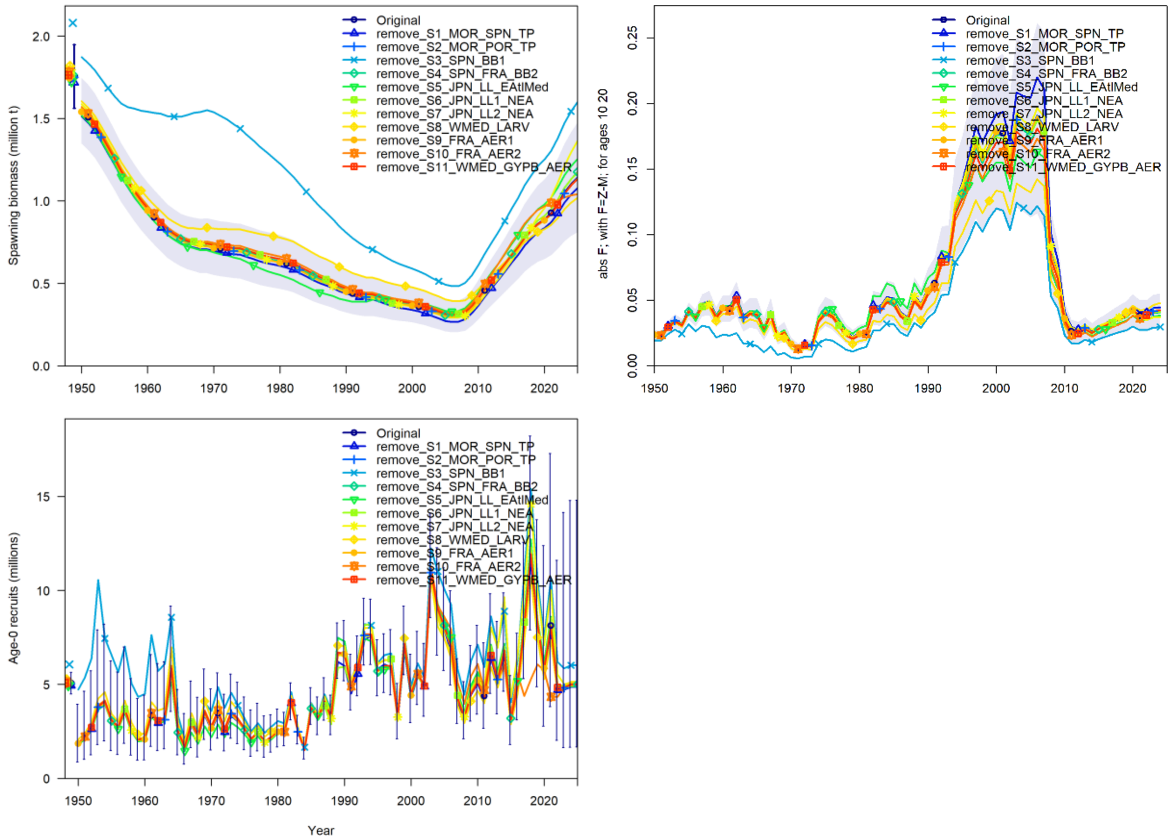


Figure 6.g R41: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

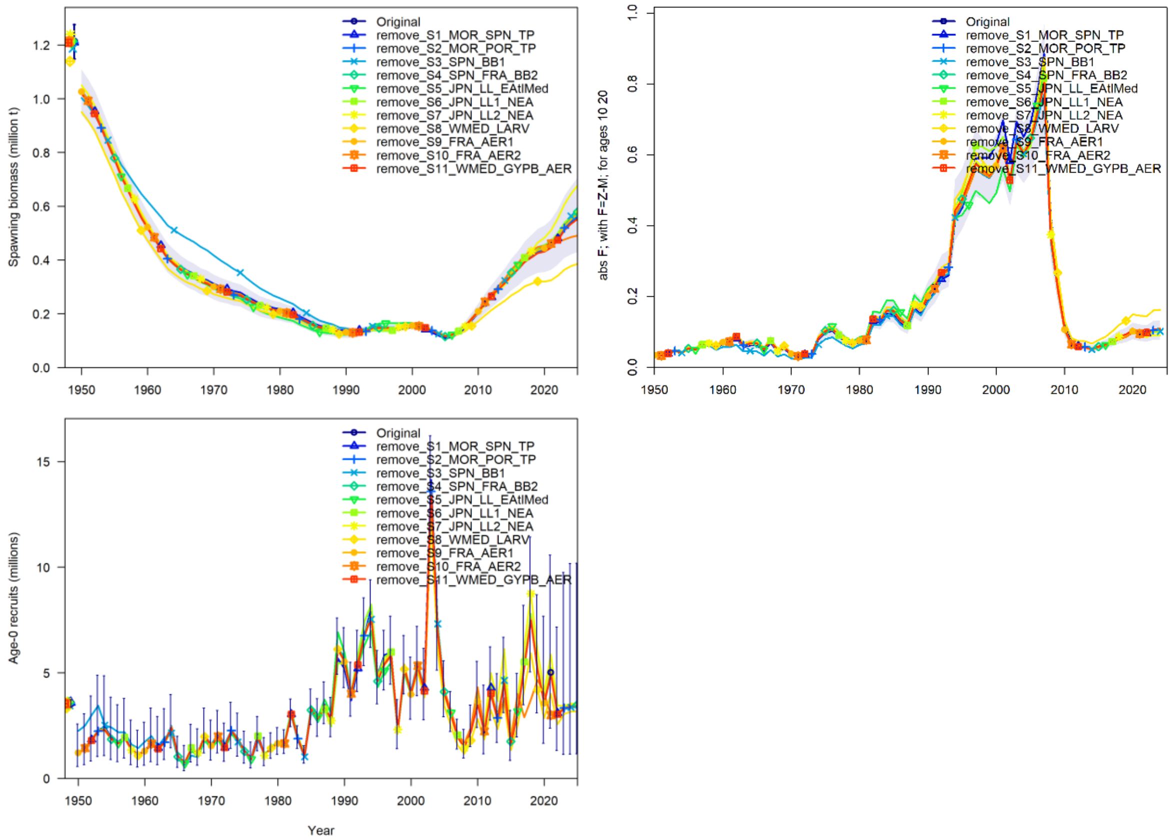


Figure 6.h R42: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

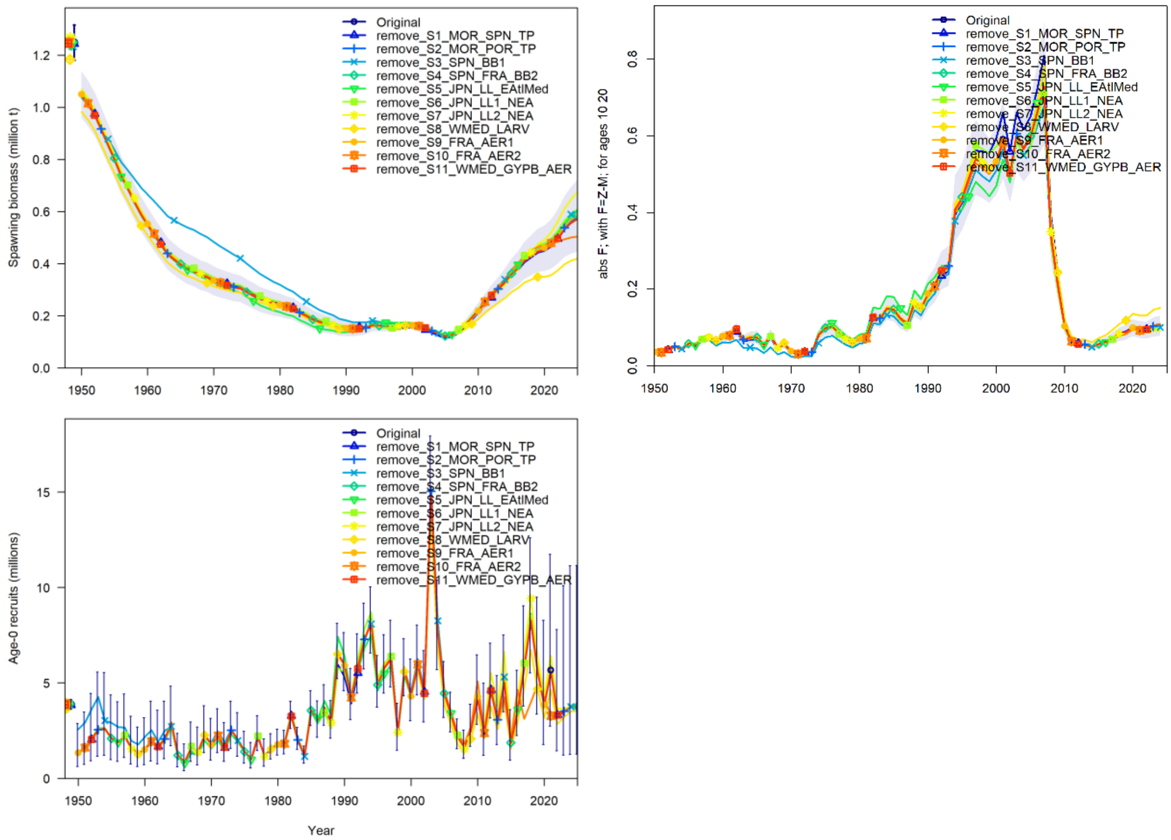


Figure 6.i R43: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

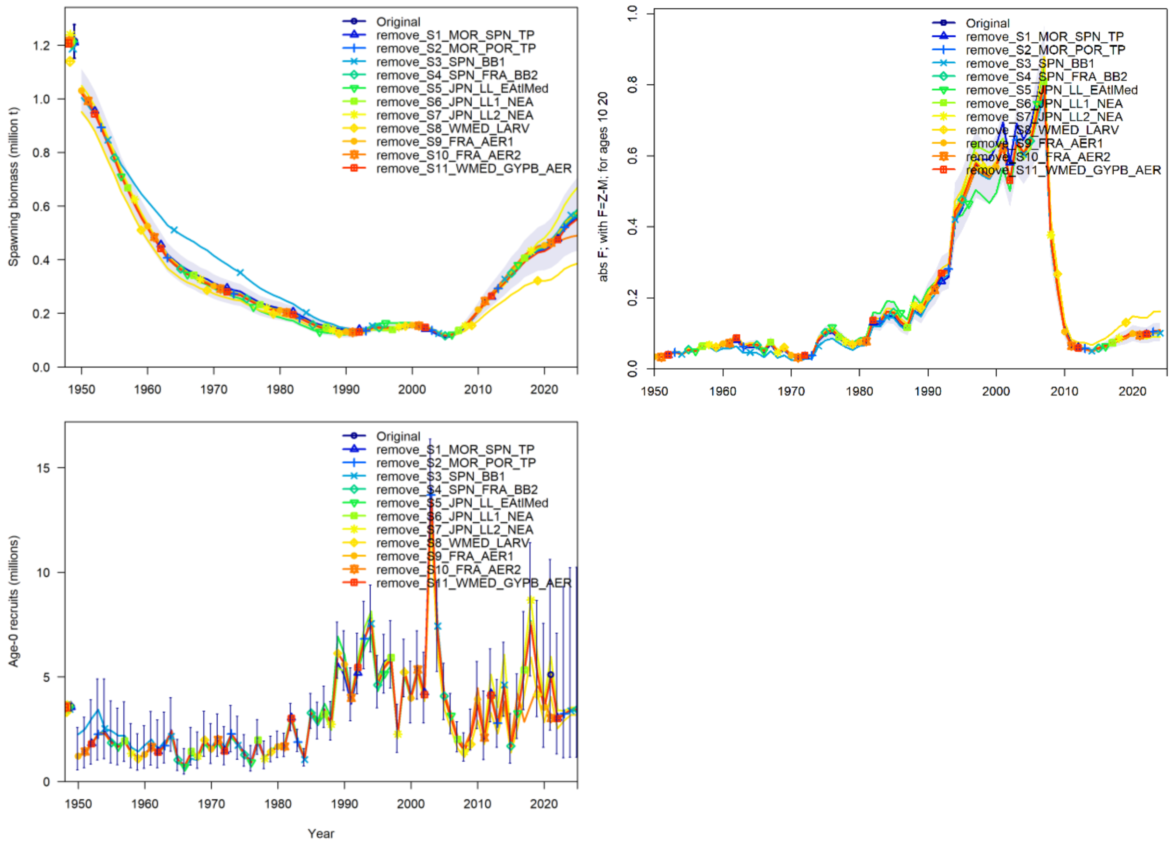


Figure 6.j R44: Sensitivity to the exclusion of 1 abundance index. SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

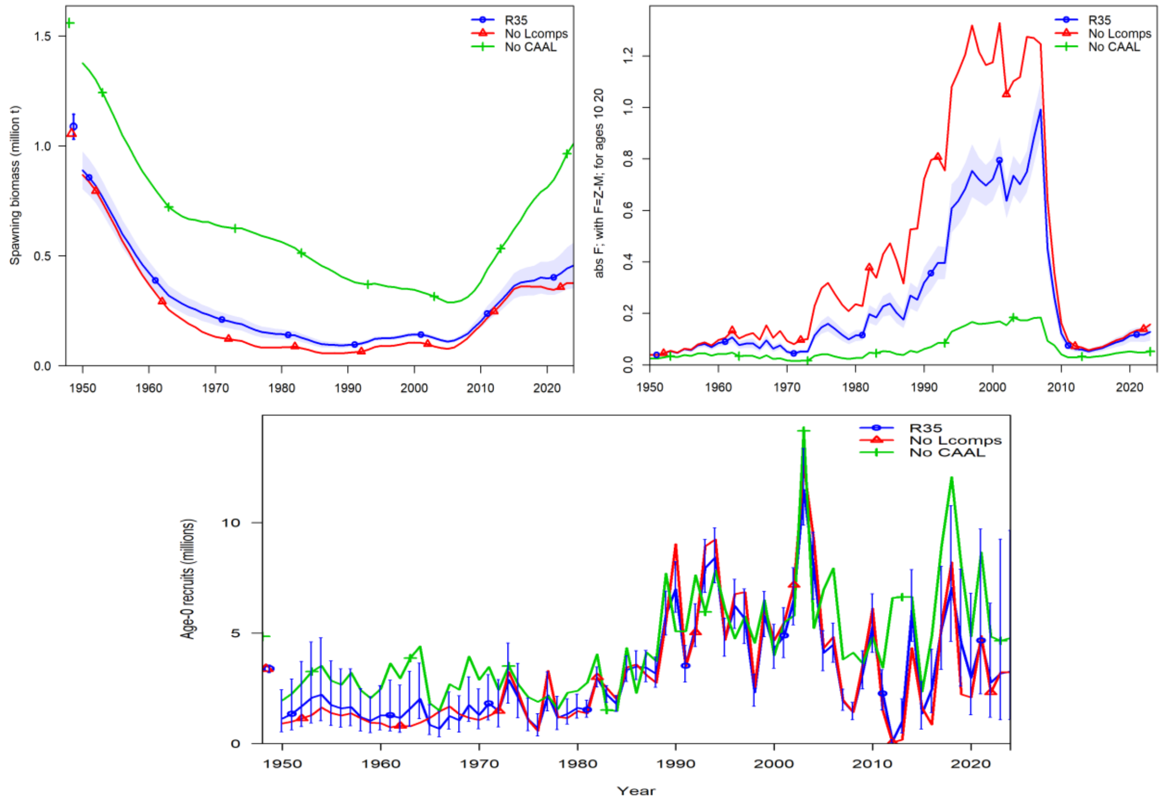


Figure 7.a R35: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

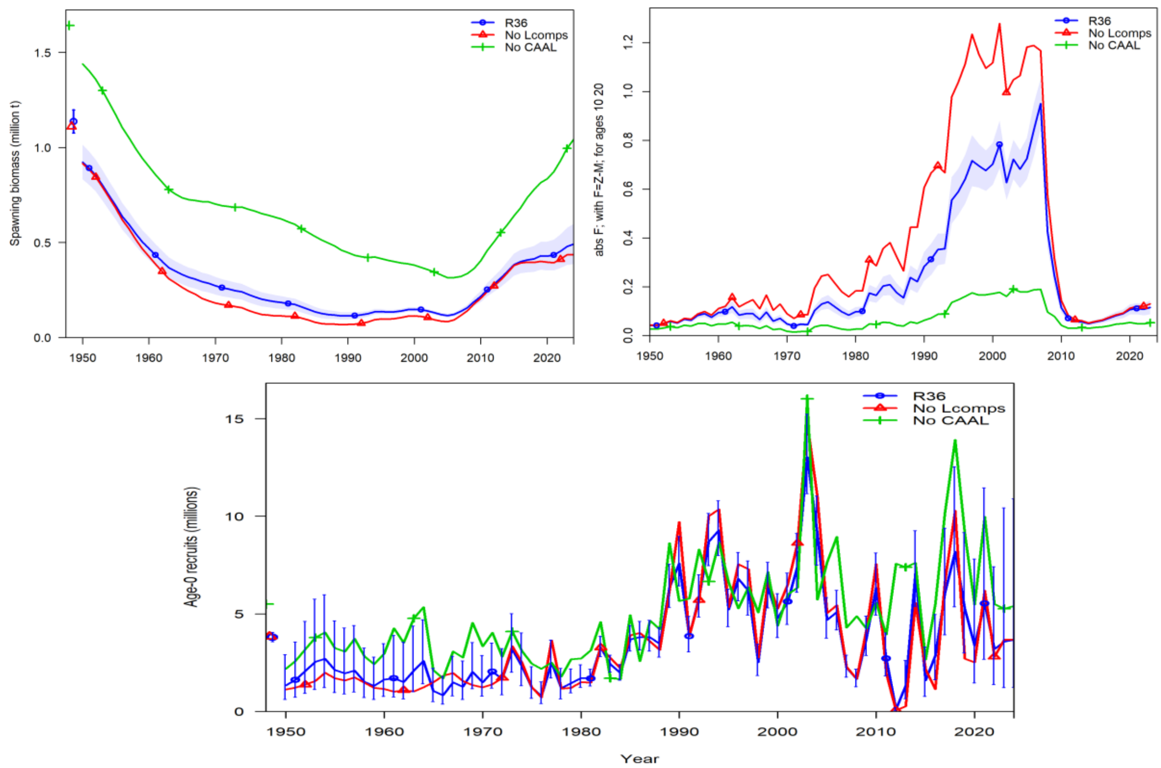


Figure 7.b R36: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

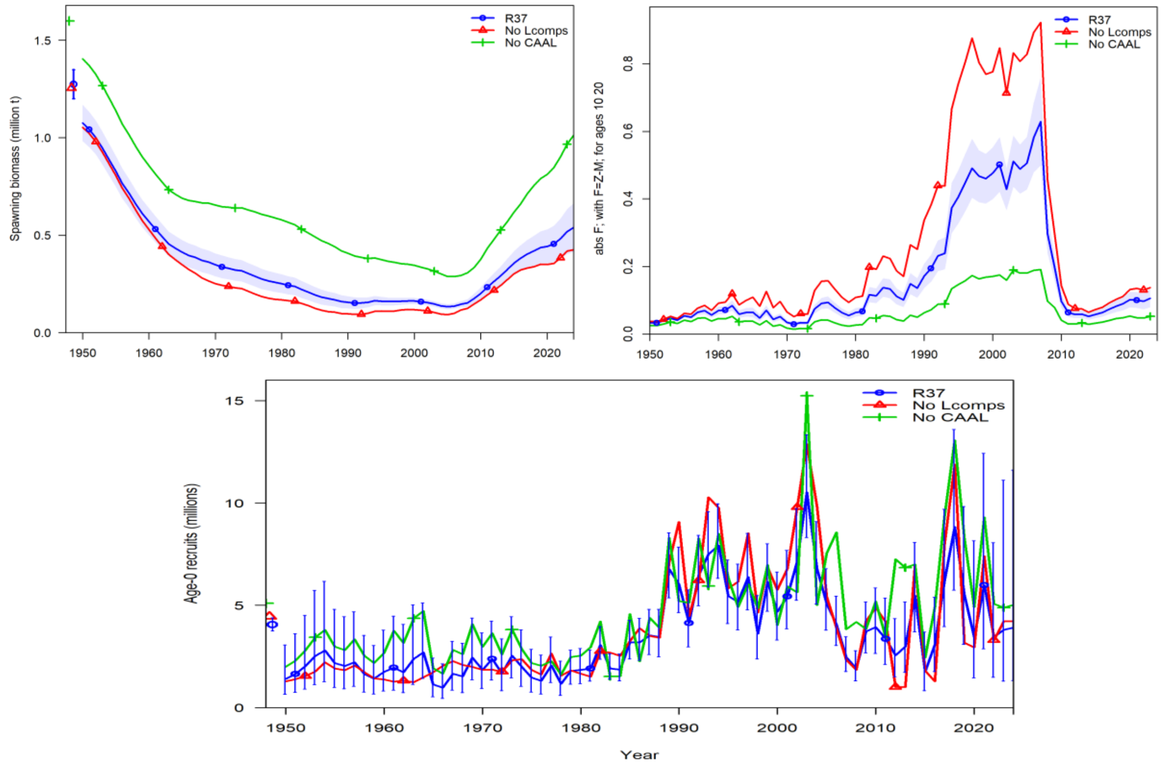


Figure 7.c R37: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

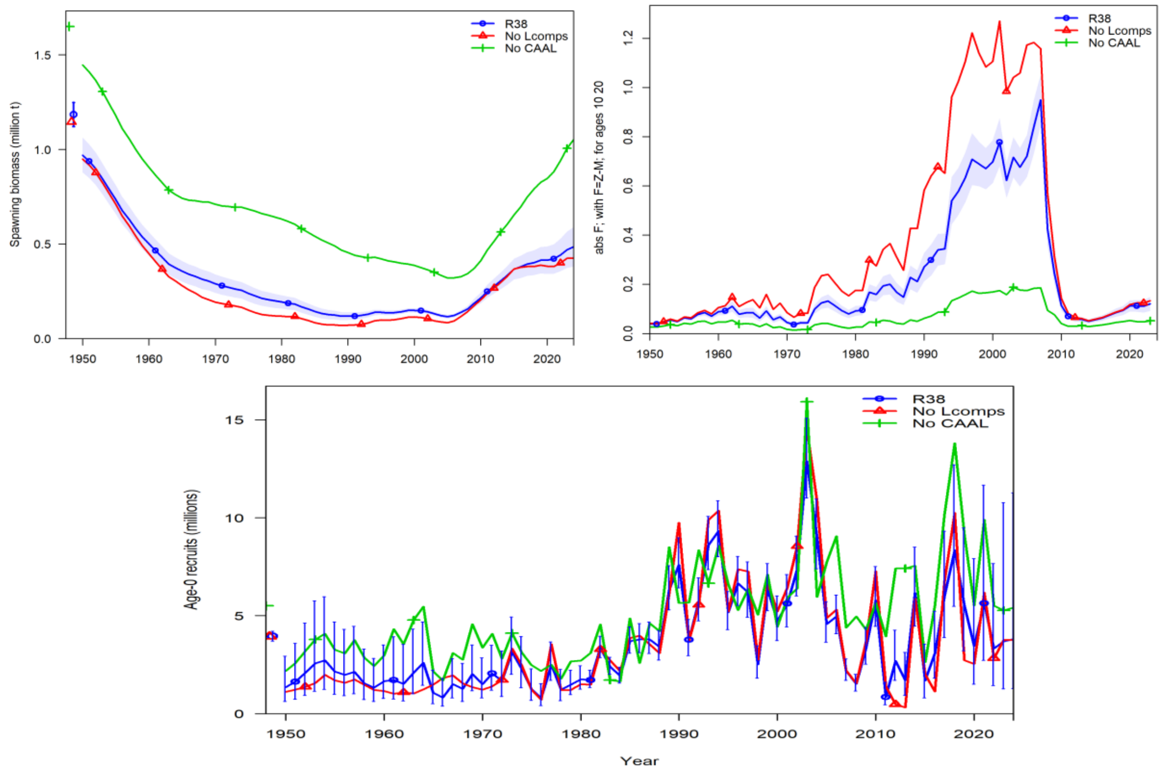


Figure 7.d R38: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

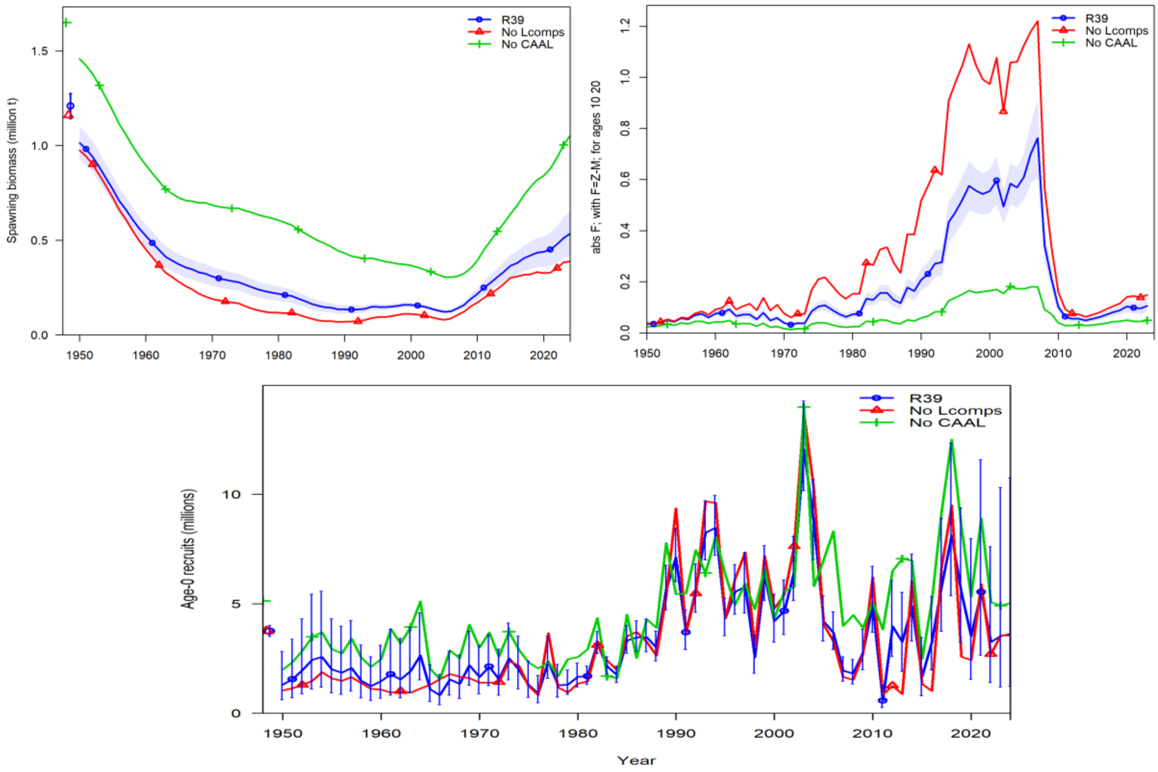


Figure 7.e R39: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

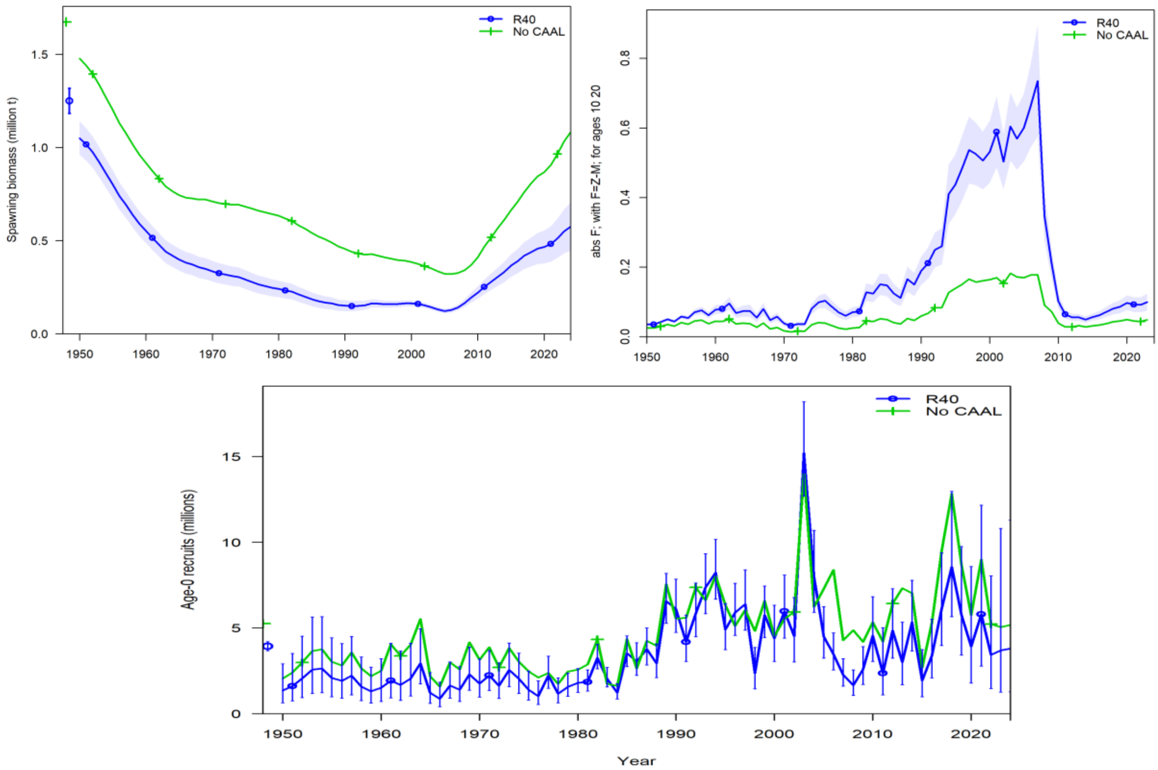


Figure 7.f R40: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

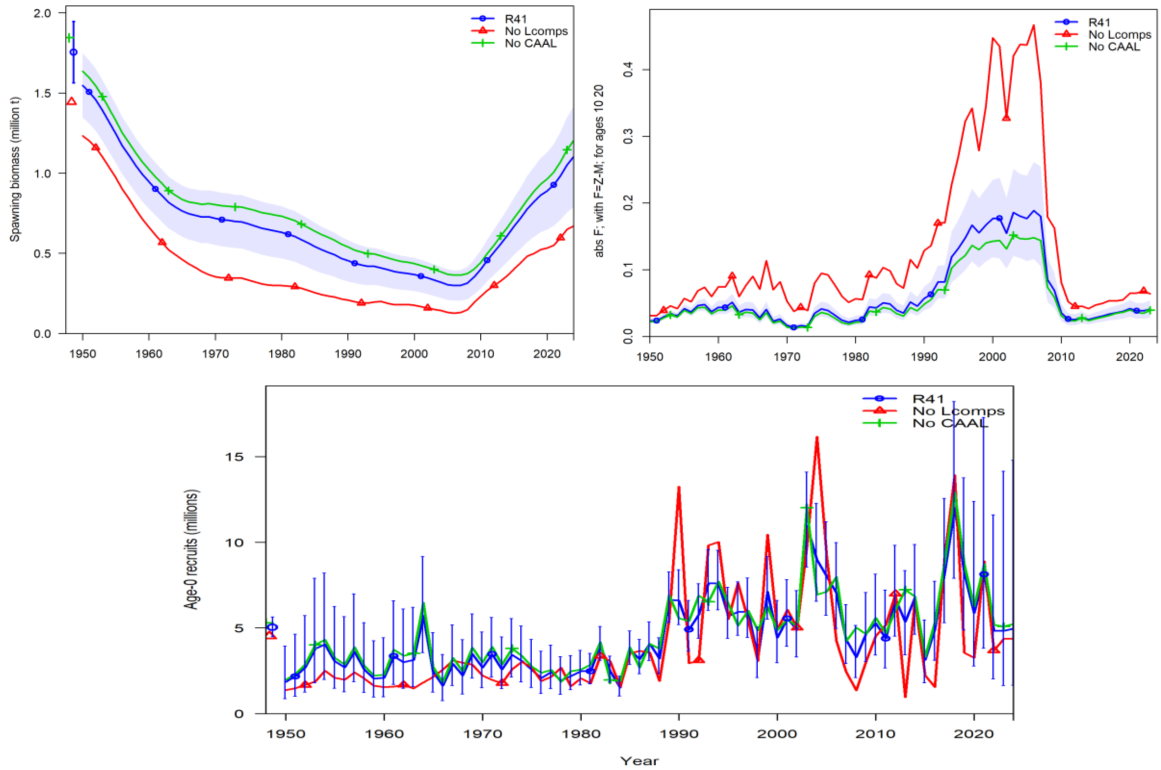


Figure 7.g R41: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

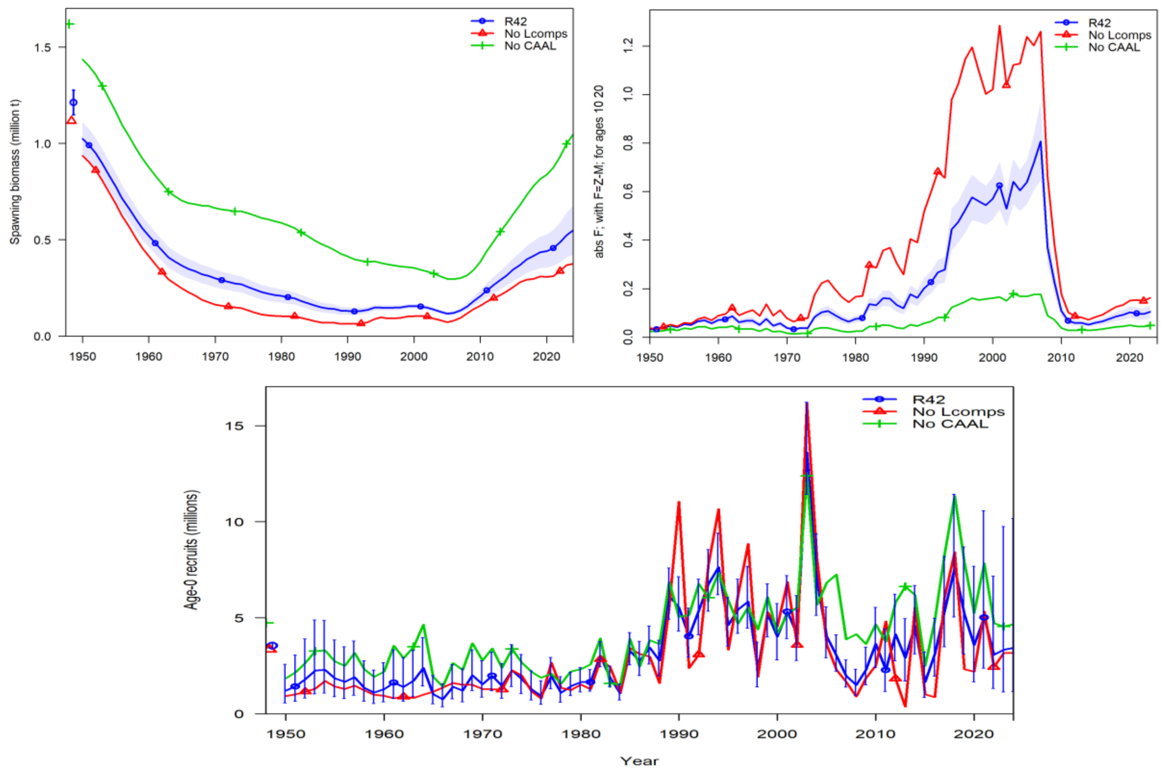


Figure 7.h R42: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

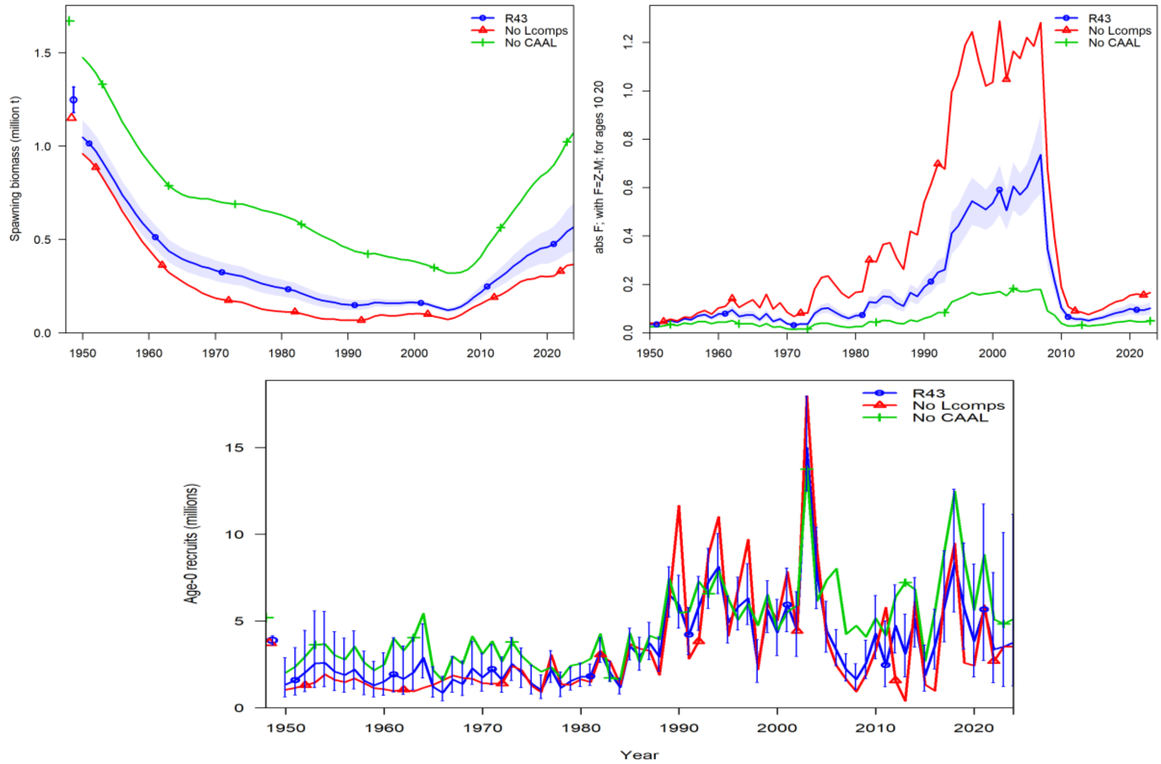


Figure 7.i R43: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

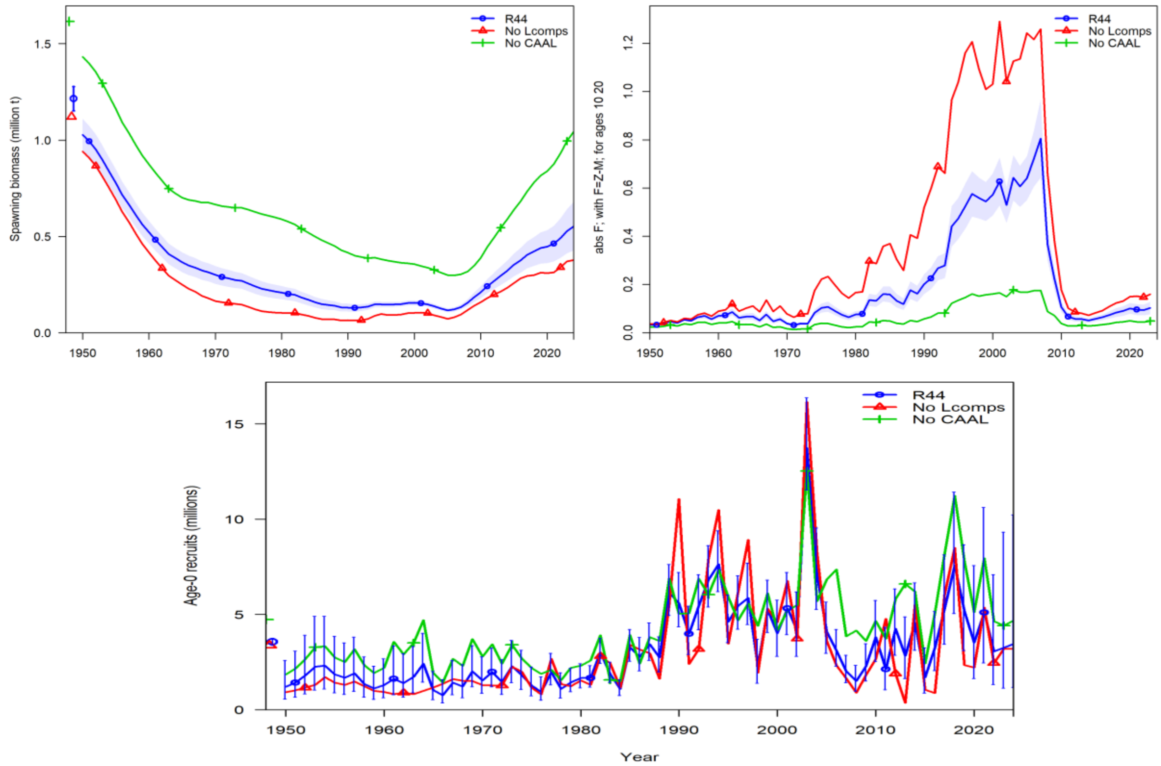


Figure 7.j R44: Sensitivity to the exclusion of the length composition data (fixing the fleets' selectivities) or the CAAL data (fixing the growth parameters). SSB (top left), F(ages 10-20) (top right) and recruitment (bottom).

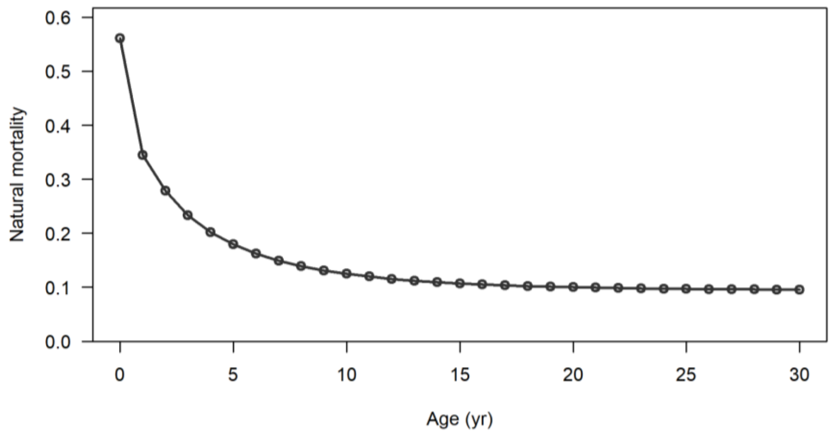


Figure 8. Natural mortality at age (Lorenzen, with M fixed at 0.1 at age 20).

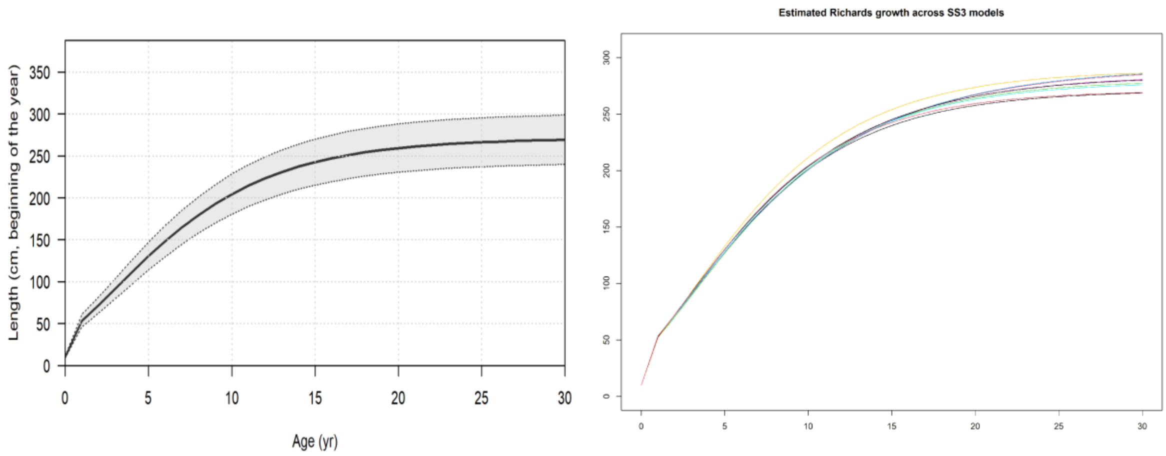


Figure 9. Growth models. Left panel: Estimated growth curve in R39, with shaded area indicating 95% distribution of length at age around estimated growth curve. Right panel: Estimated growth curves from R35-R44.

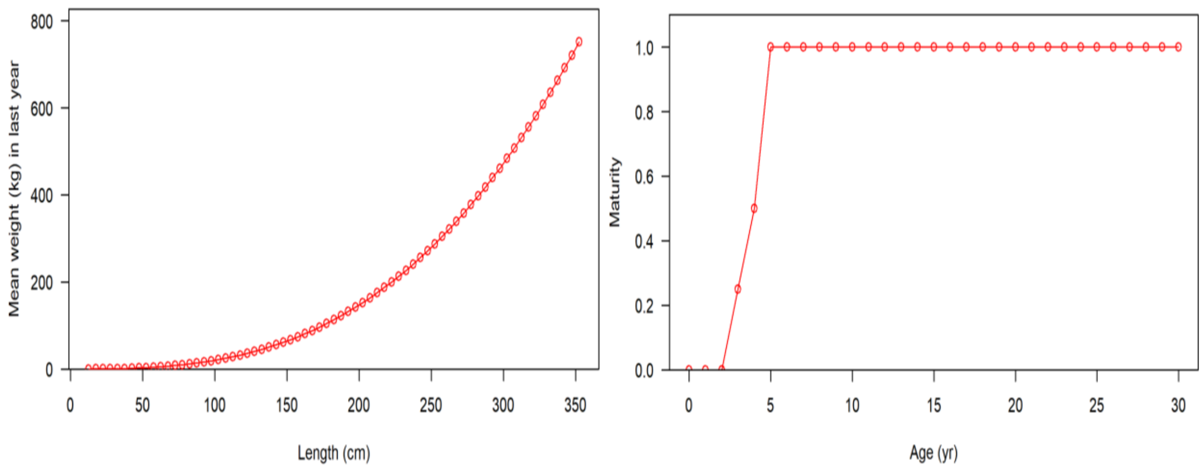


Figure 10. Left panel: Weight-at-length (assumed known). Right panel: Maturity-at-age (assumed known).

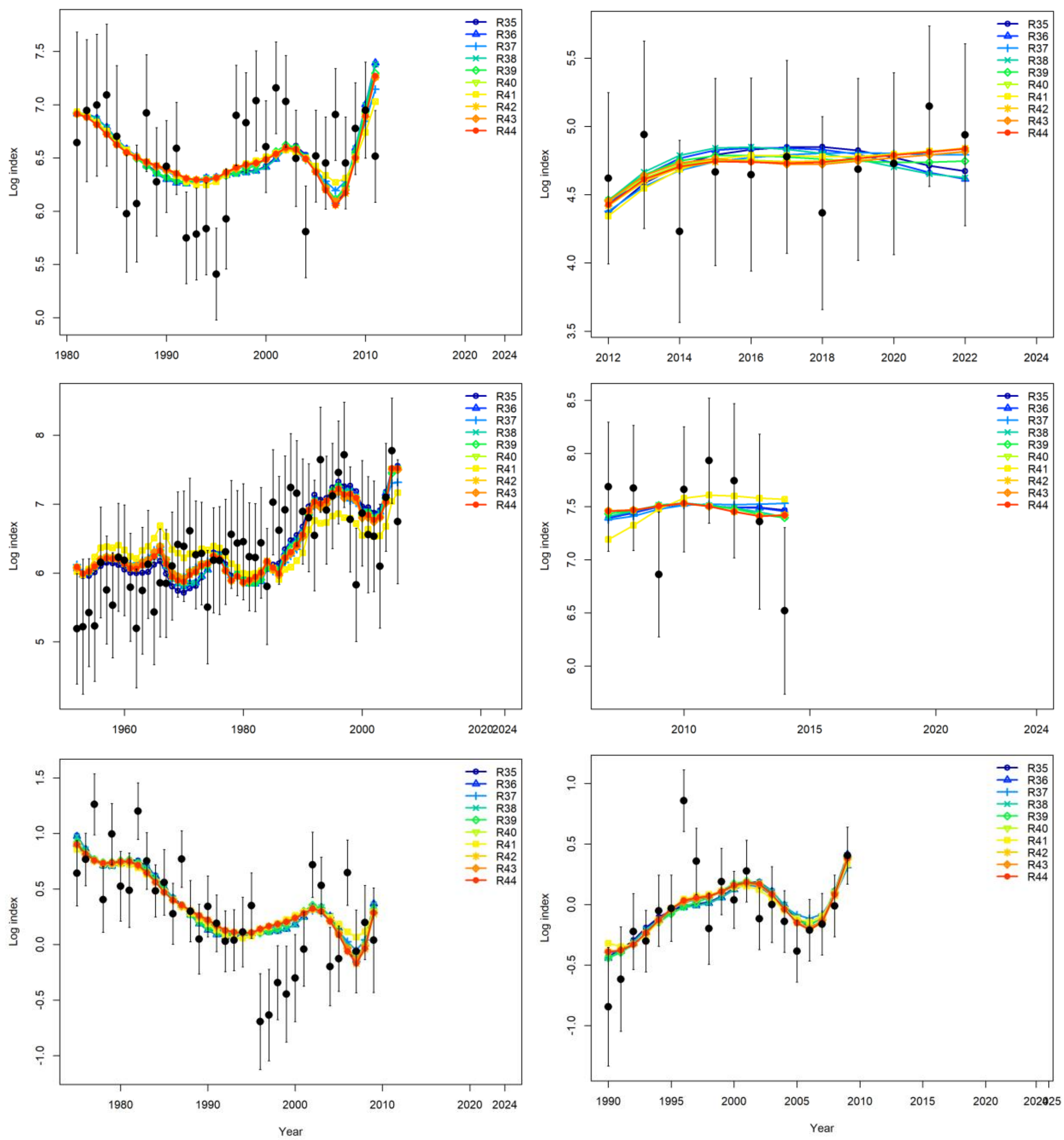


Figure 11. Fitted values to the log(CPUE) indices. The indices are S1_MOR_SPN_TP (top left), S2_MOR_POR_TP (top right), S3_SPN_BB1 (middle left), S4_SPN_FR_BB2 (middle right), S5_JPN_LL_EAtlMed (bottom left), S6_JPN_LL1_NEA (bottom right).

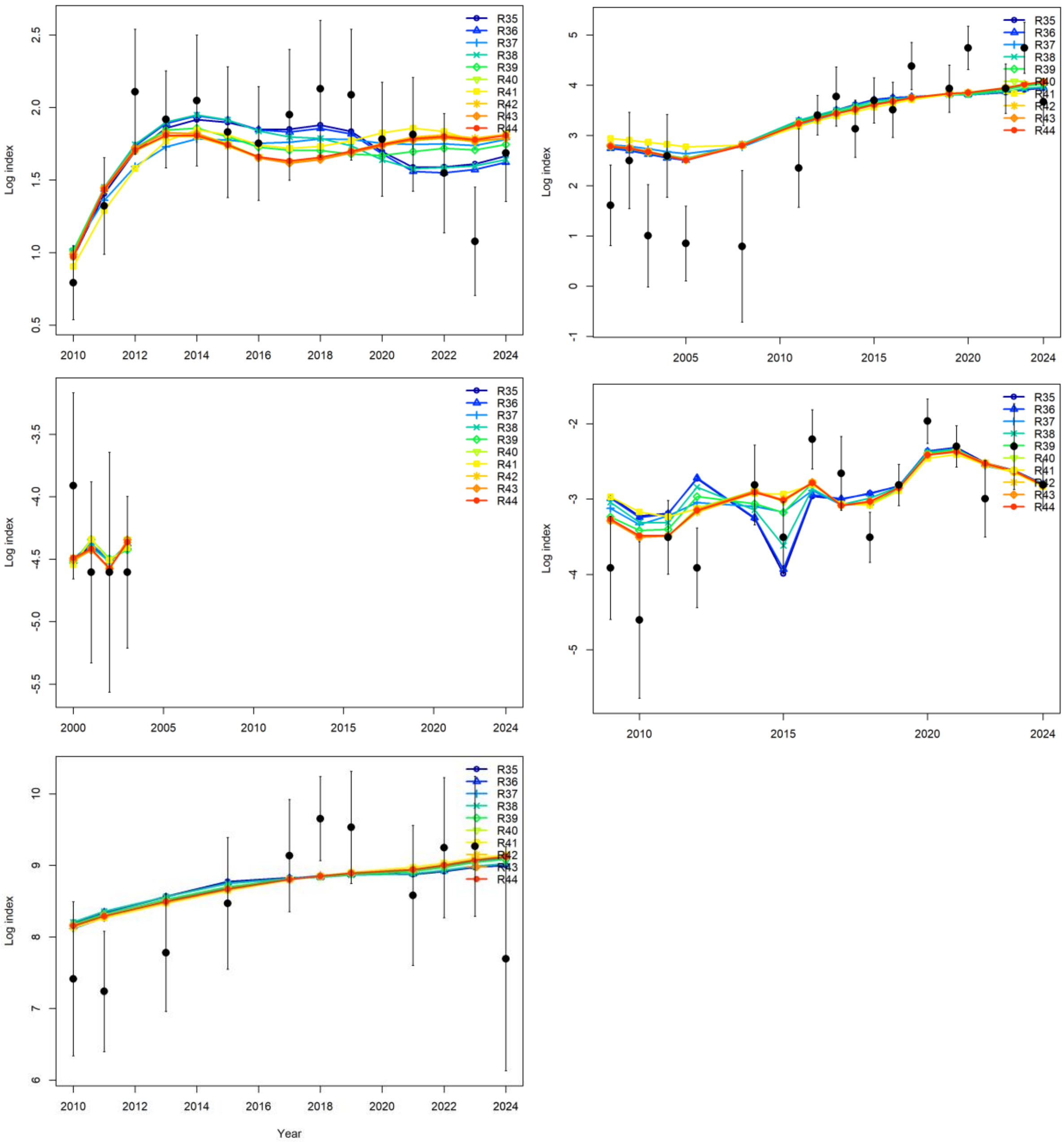


Figure 11. (continued) Fitted values to the log(CPUE) indices. The indices are S7_JPN_LL2_NEA (top left), S8_WMED_LARV (top right), S9_FRA_AER1 (middle left), S10_FRA_AER2 (middle right), S11_WMED_GBYP_AER (bottom).

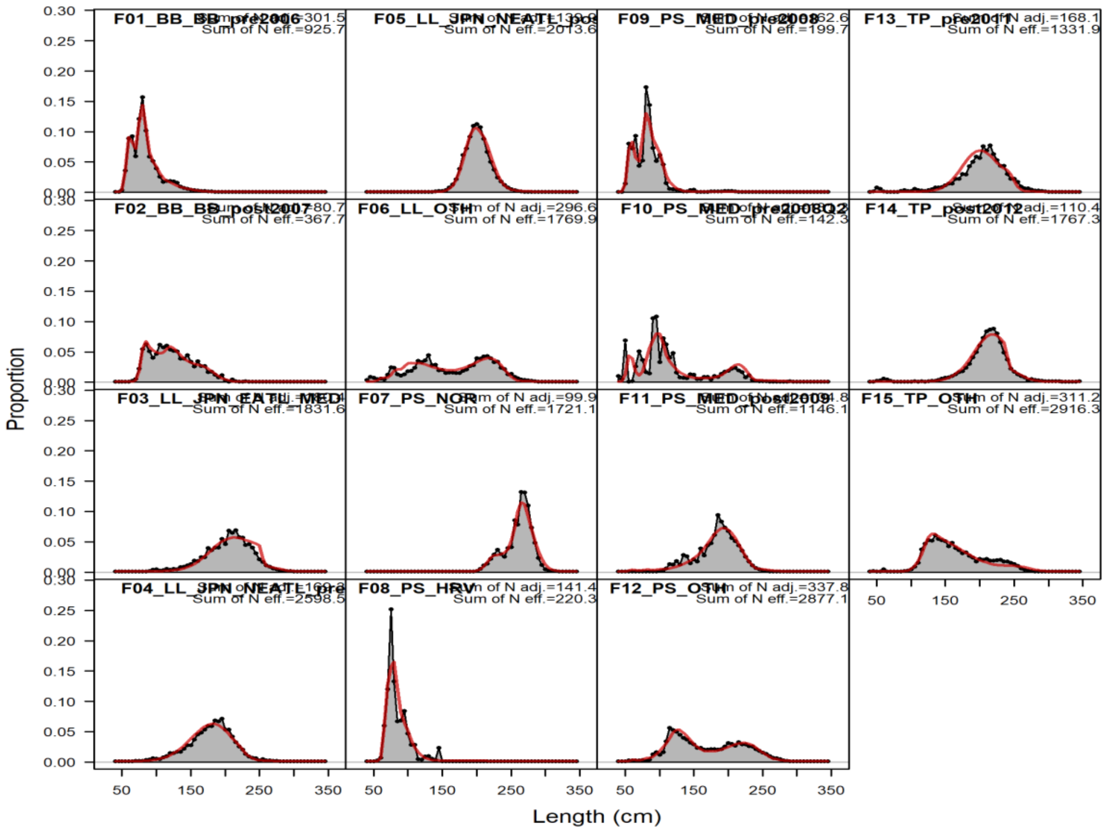


Figure 12.a R35: Aggregated length composition data (grey histograms) and the model fit (red line).

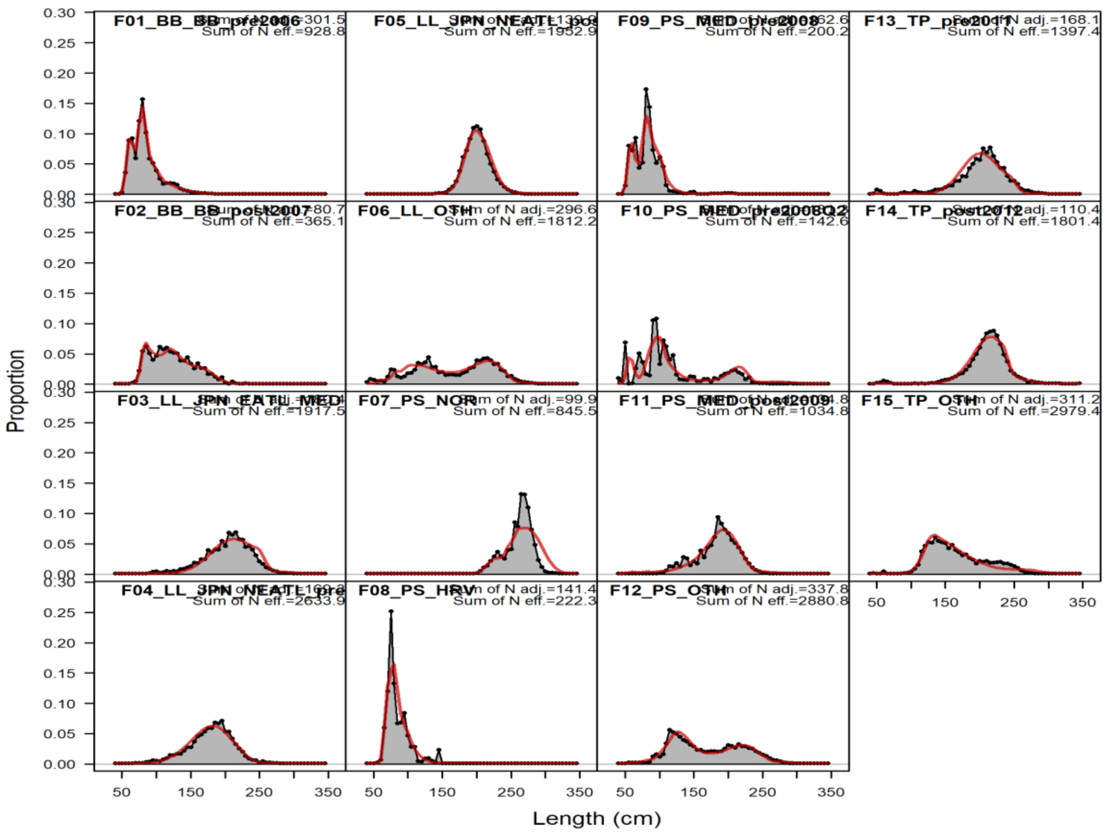


Figure 12.b R36: Aggregated length composition data (grey histograms) and the model fit (red line).

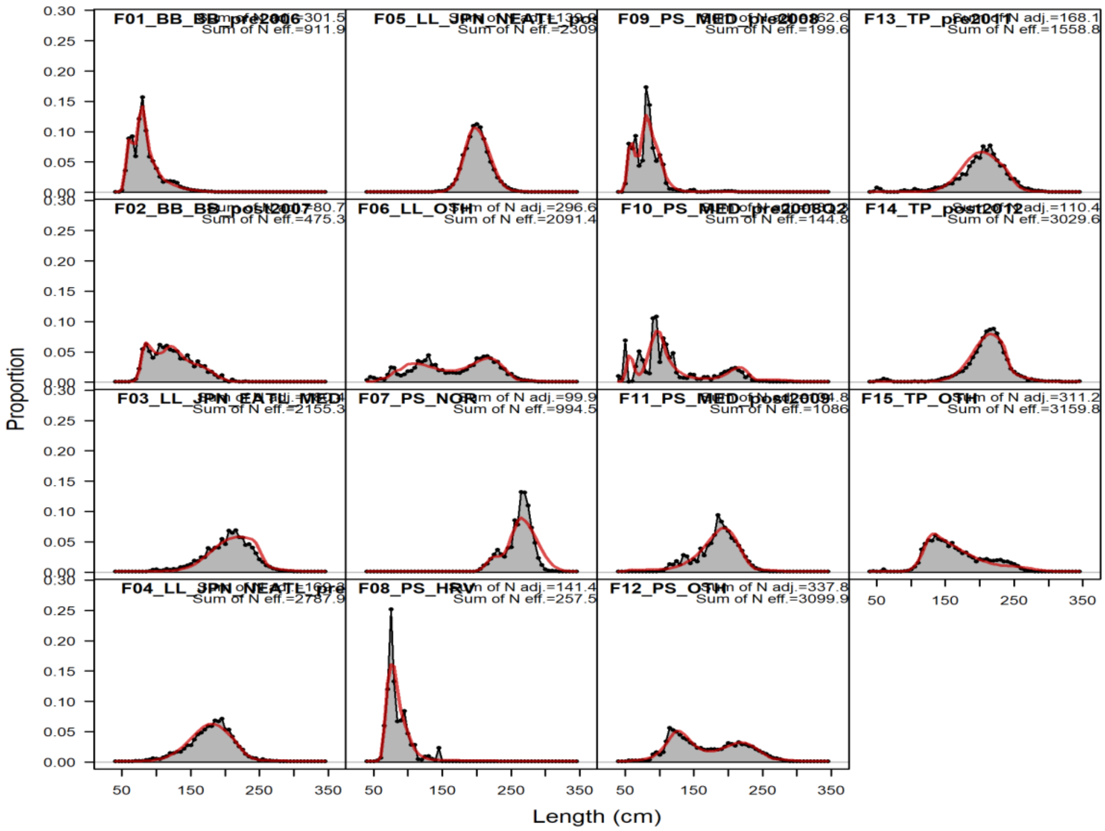


Figure 12.c R37: Aggregated length composition data (grey histograms) and the model fit (red line).

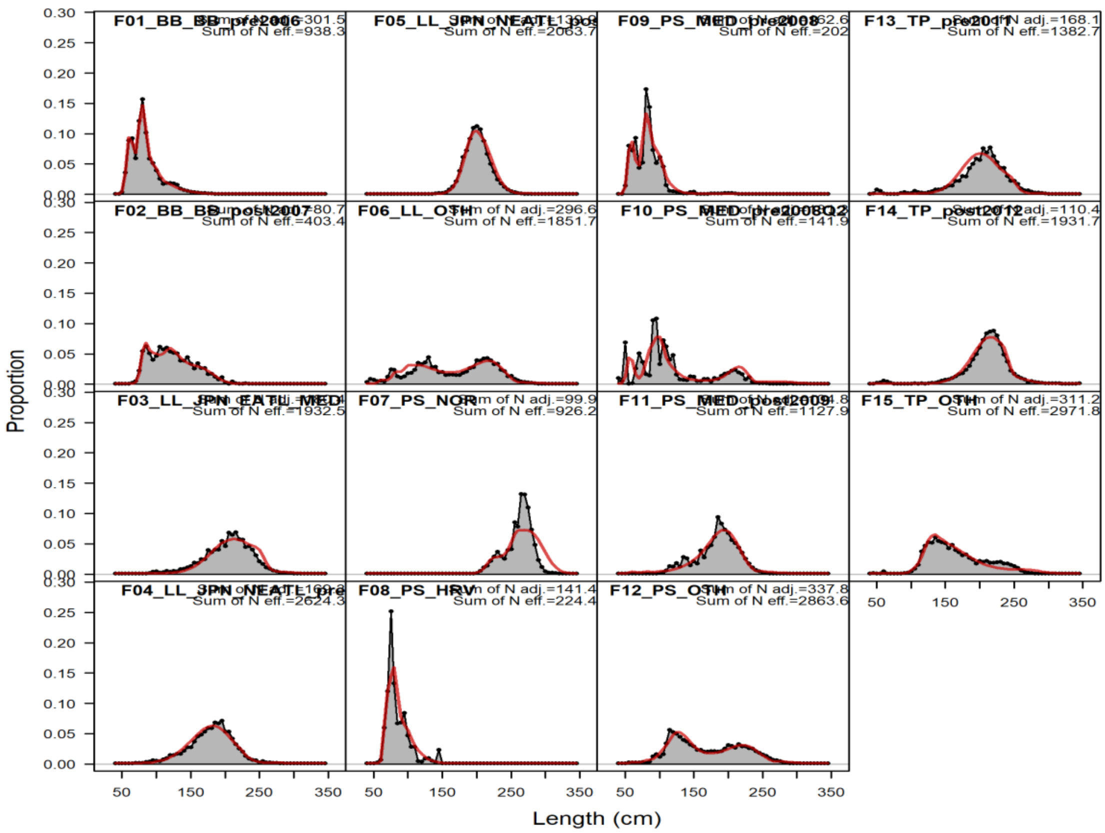


Figure 12.d R38: Aggregated length composition data (grey histograms) and the model fit (red line).

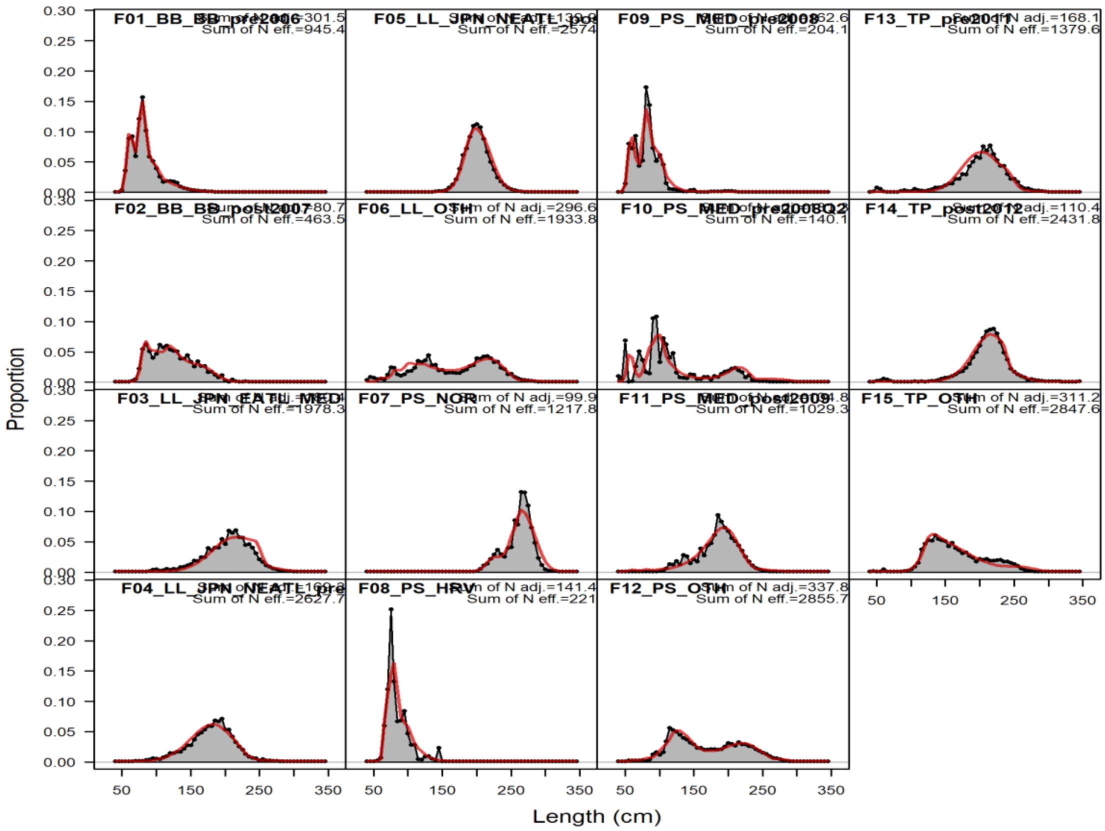


Figure 12.e R39: Aggregated length composition data (grey histograms) and the model fit (red line).

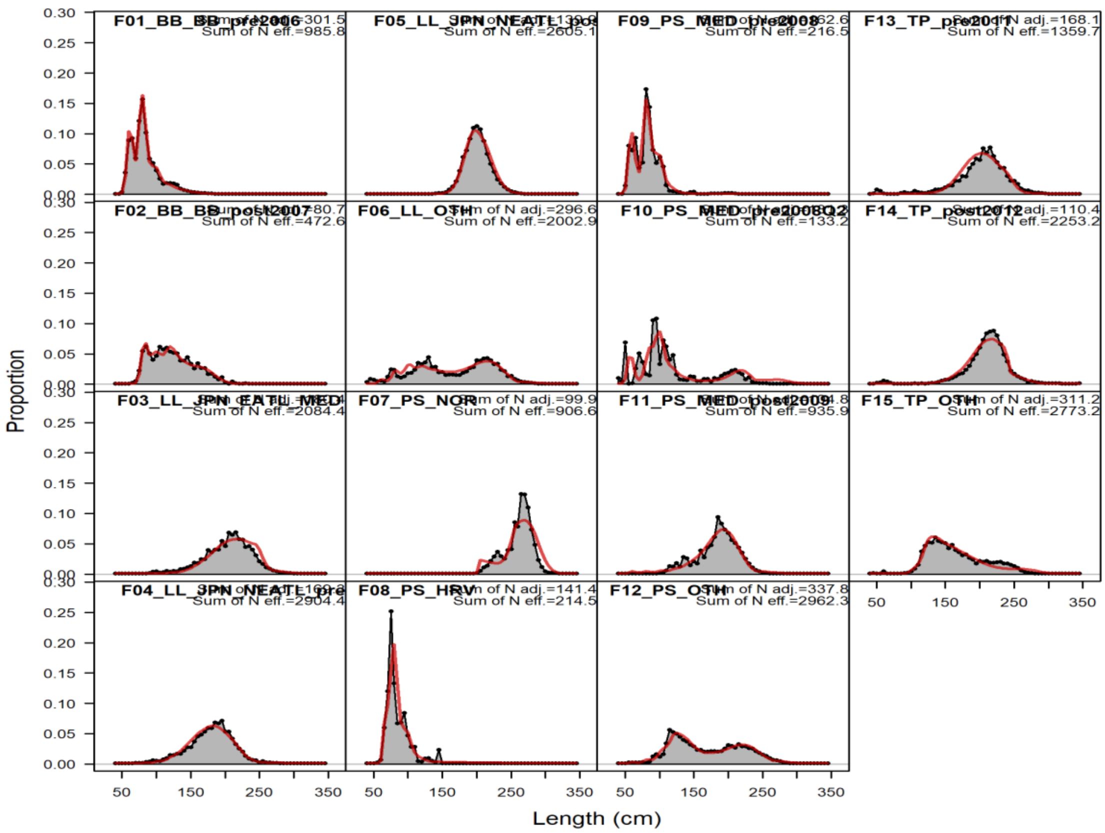


Figure 12.f R40: Aggregated length composition data (grey histograms) and the model fit (red line).

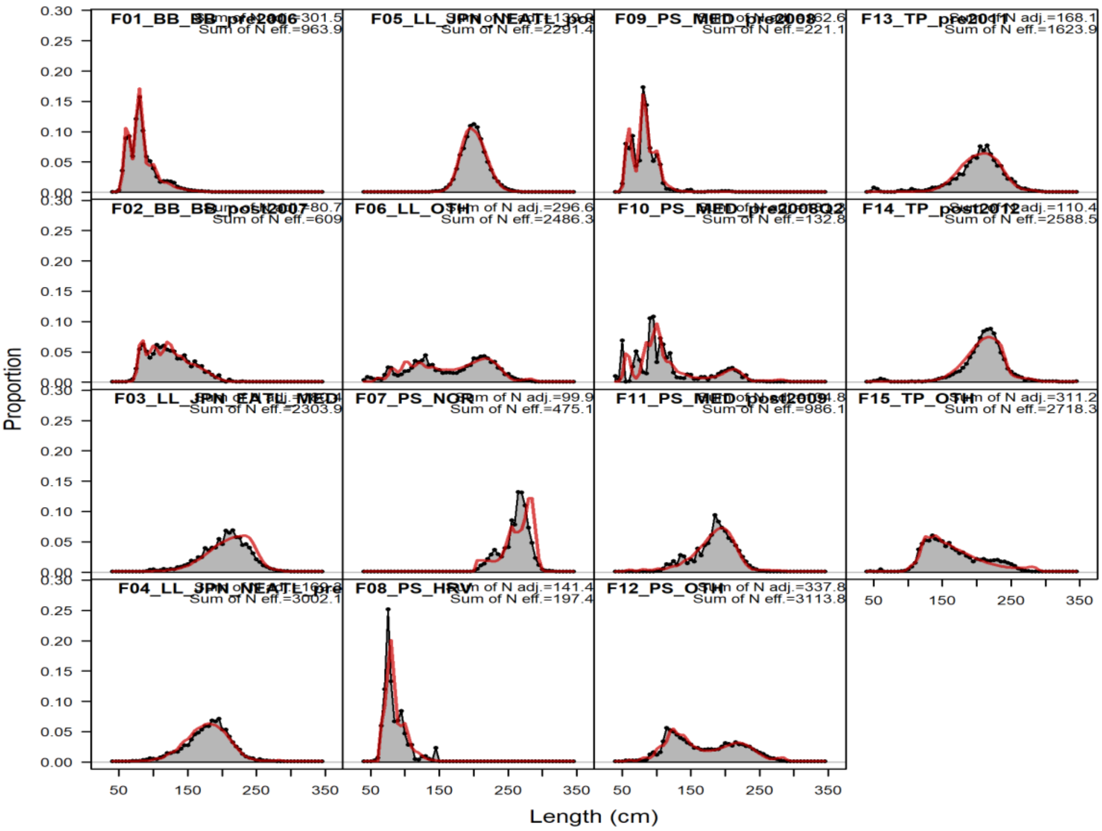


Figure 12.g R412: Aggregated length composition data (grey histograms) and the model fit (red line).

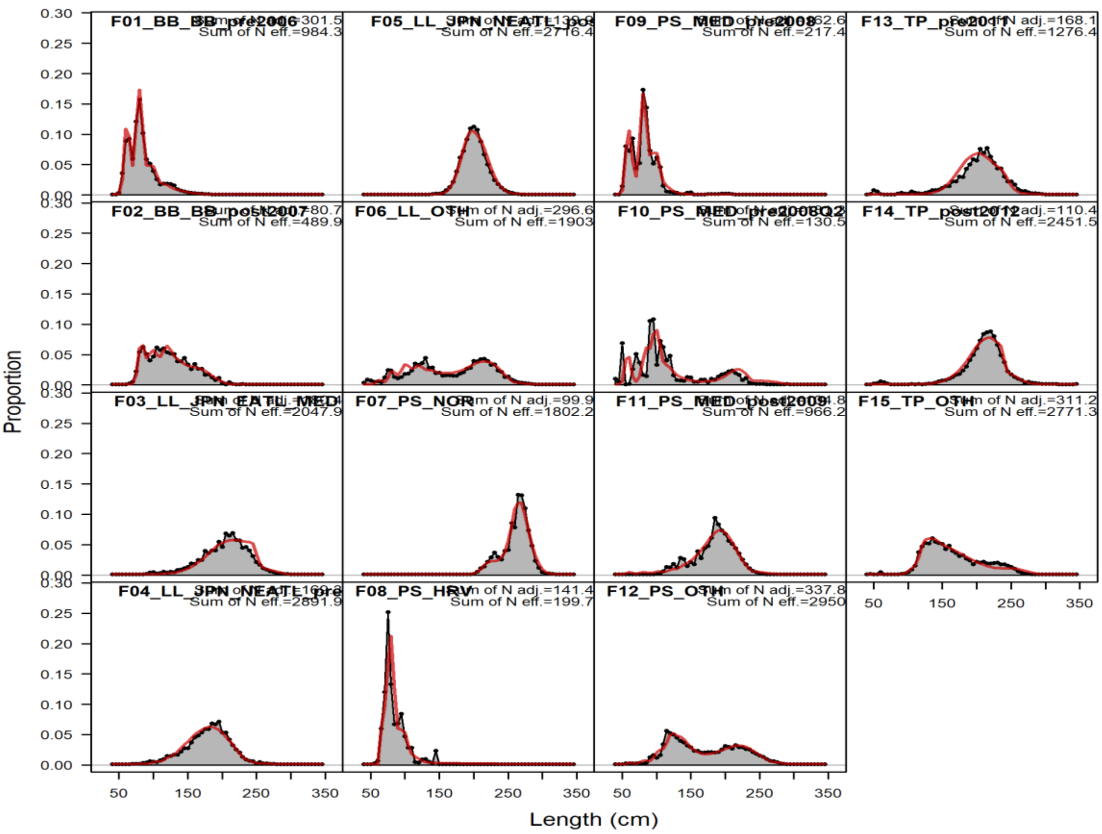


Figure 12.h R42: Aggregated length composition data (grey histograms) and the model fit (red line).

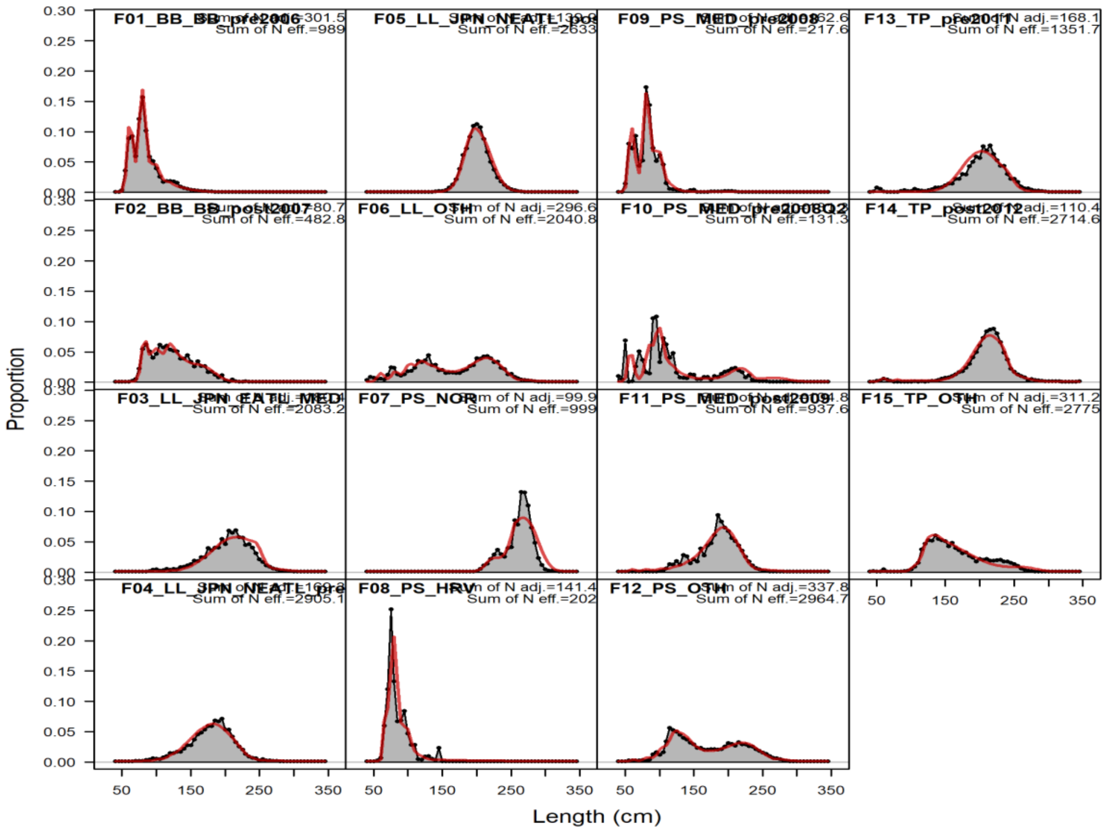
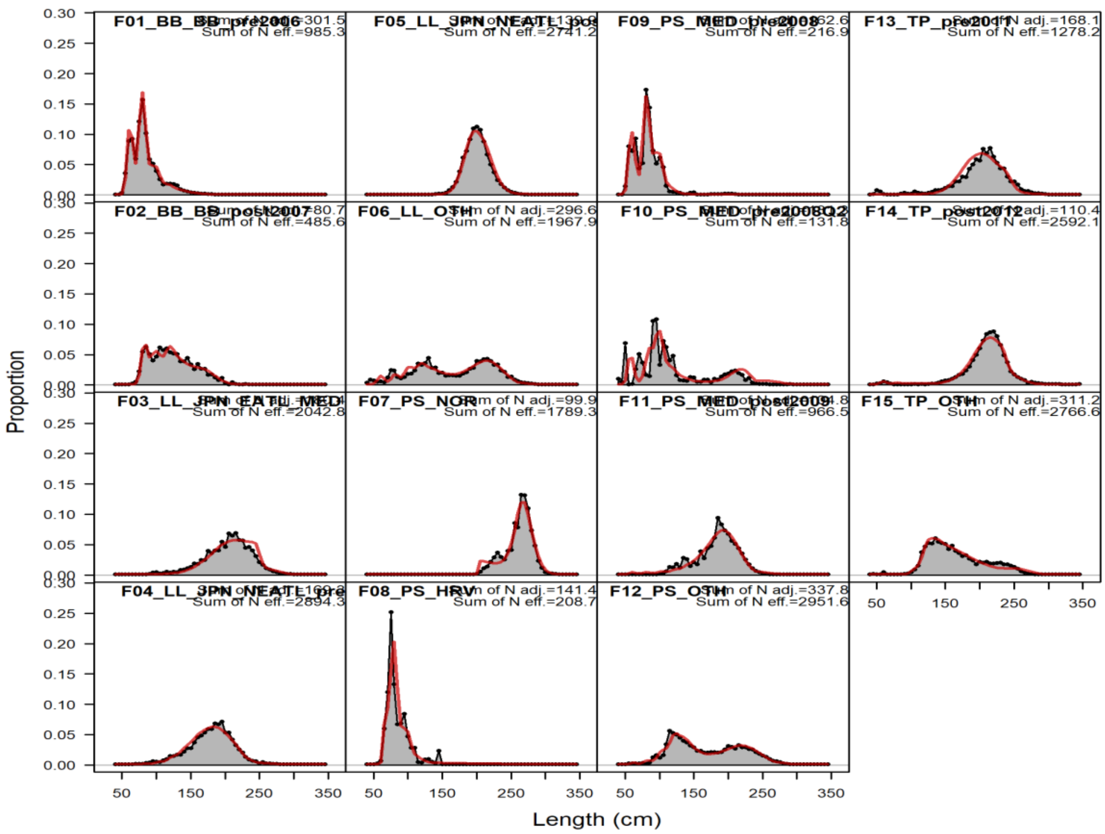


Figure 12.i R43: Aggregated length composition data (grey histograms) and the model fit (red line).



BFT-E. Figure 12.j R44: Aggregated length composition data (grey histograms) and the model fit (red line).

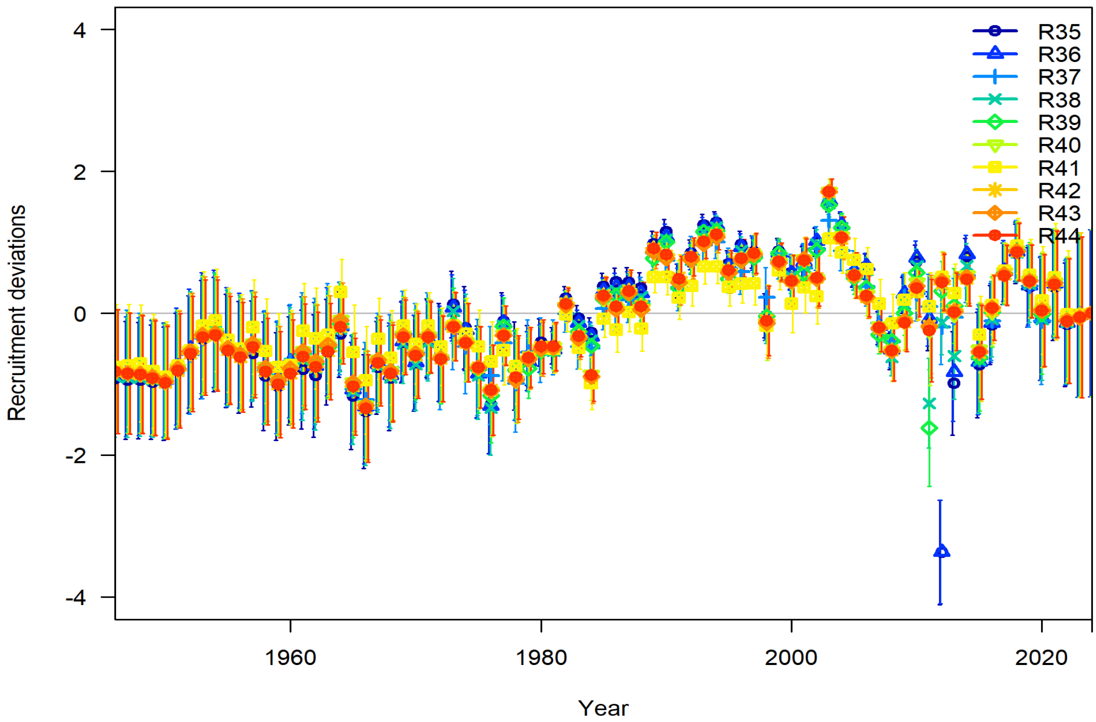


Figure 13. Estimated log(recruitment deviations), with 95% confidence intervals.

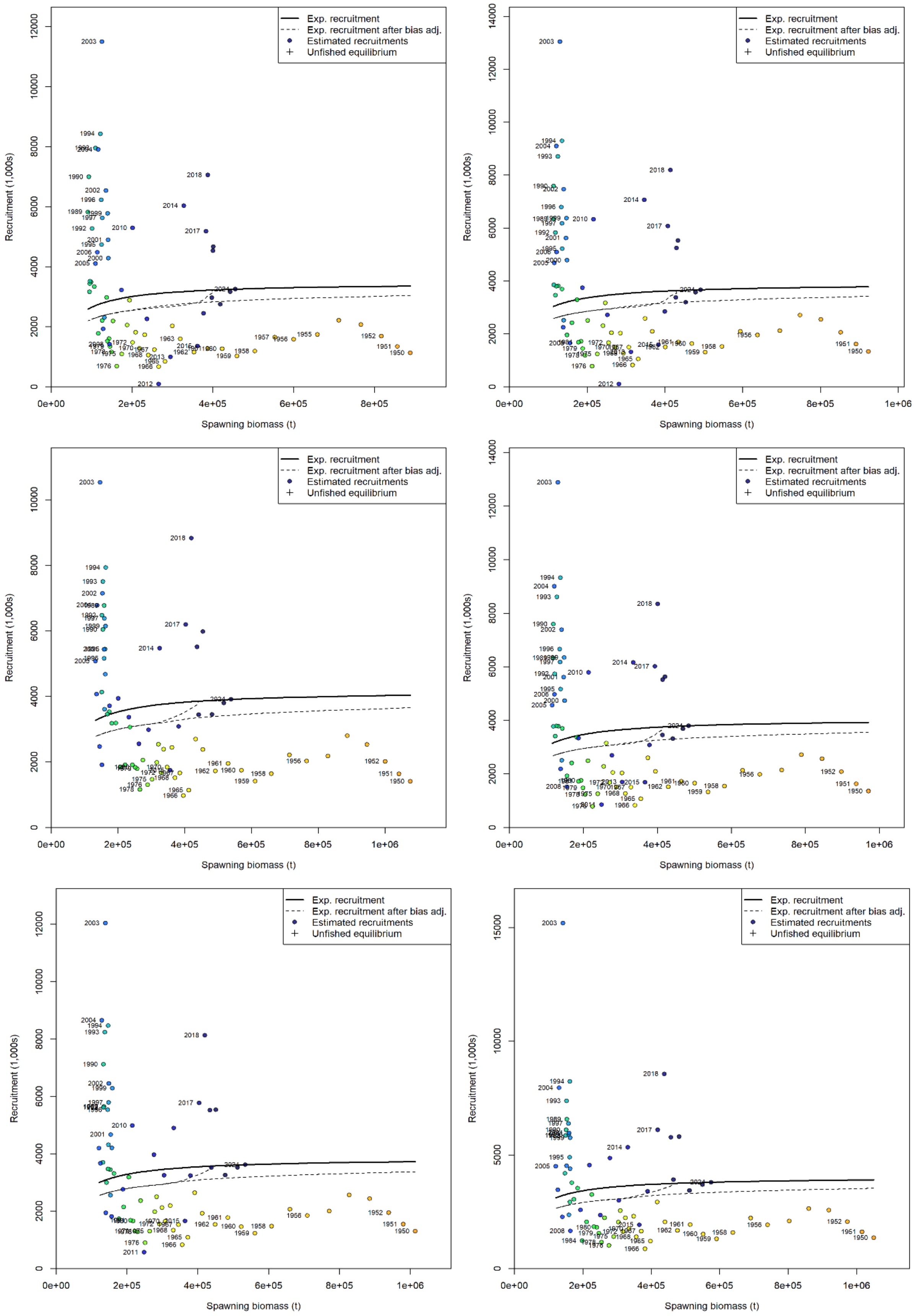


Figure 14. Estimated stock-recruitment curve (with fixed h=0.9) and annual recruitments. R35 (top left), R36 (top right), R37 (middle left), R38 (middle right), R39 (bottom left), R40 (bottom right).

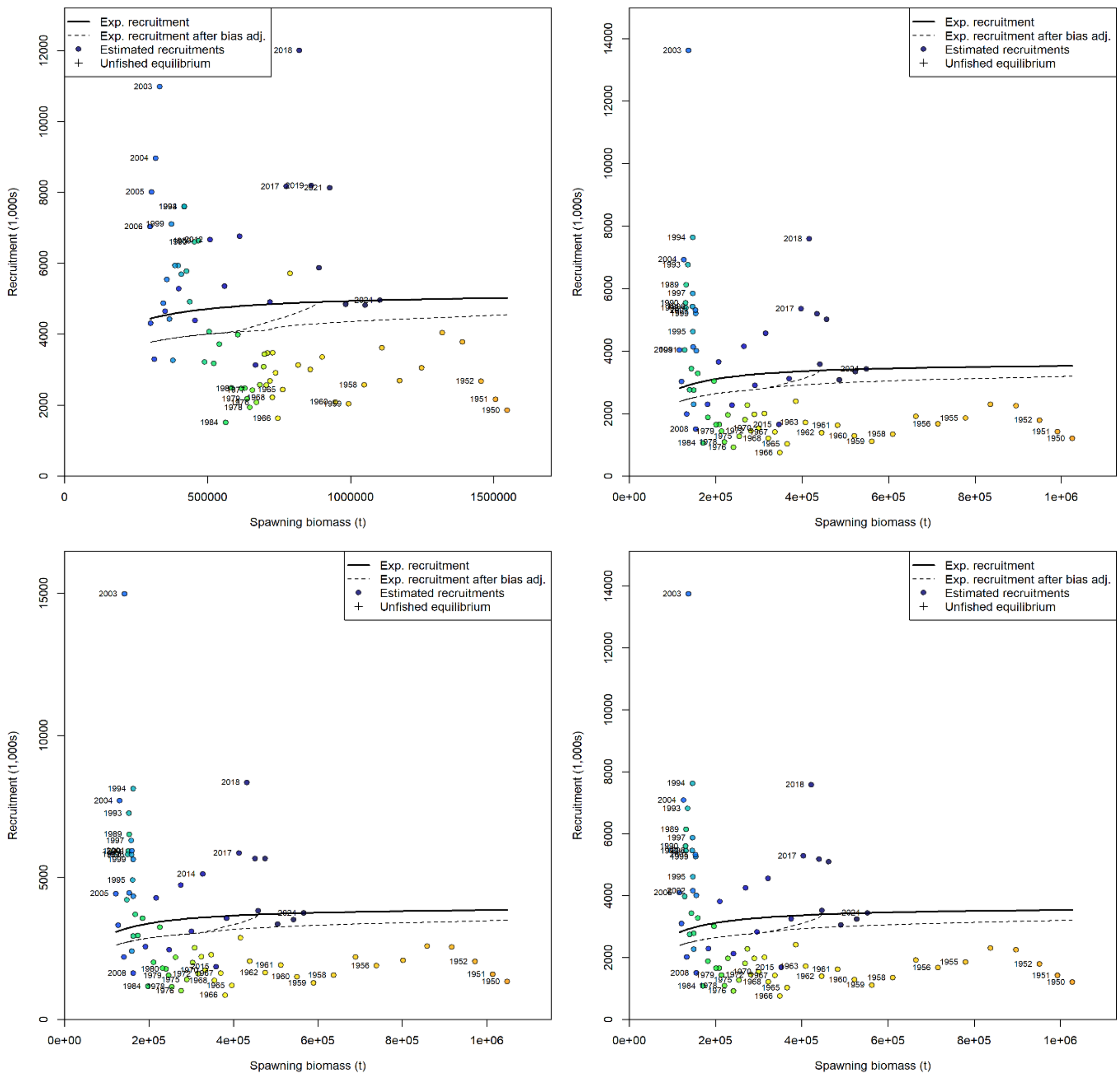


Figure 14. (continued) Estimated stock-recruitment curve (with fixed h=0.9) and annual recruitments. R41 (top left), R42 (top right), R43 (bottom left), R44 (bottom right).

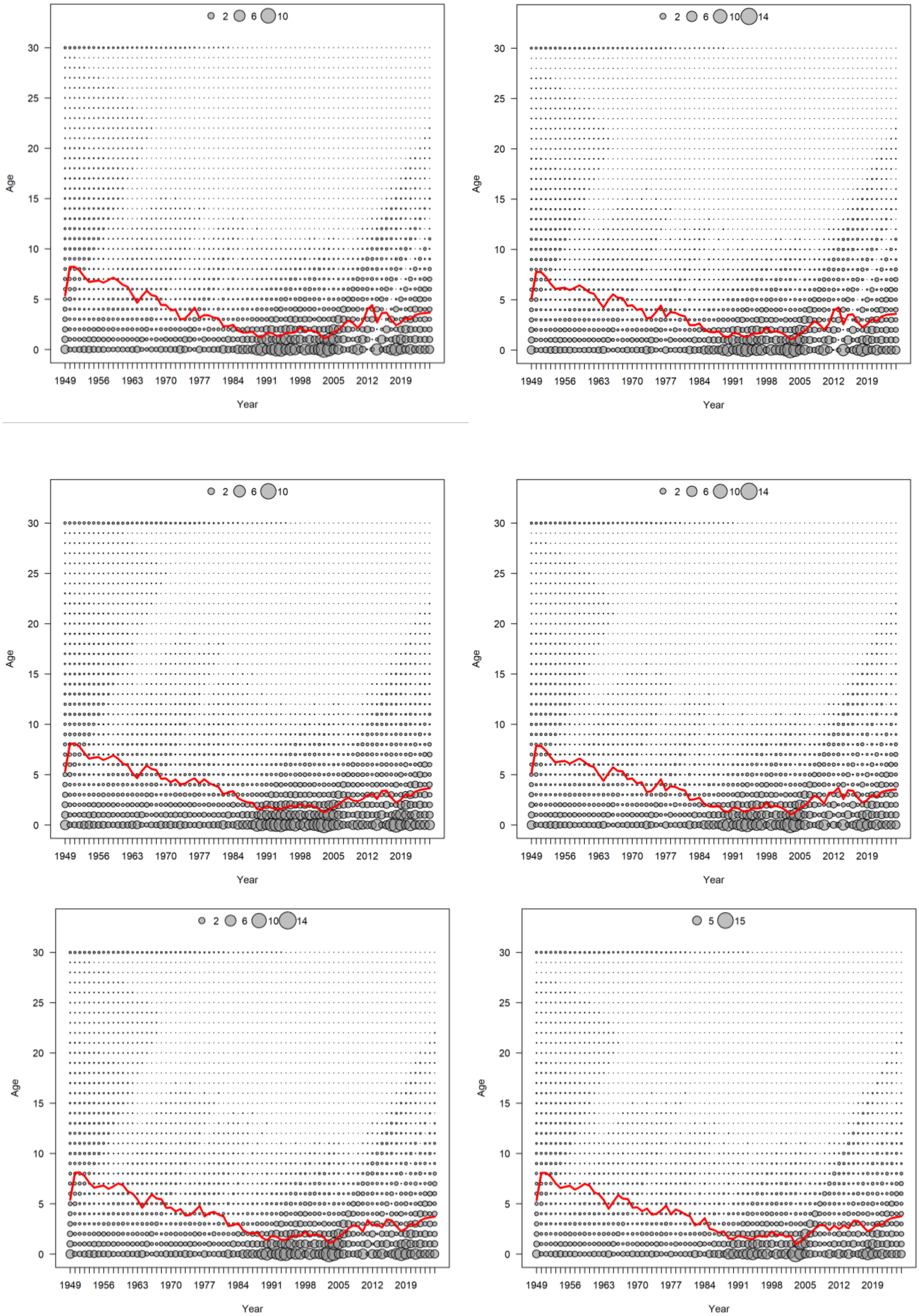


Figure 15. Estimated numbers-at-age at the start of the year. R35 (top left), R36 (top right), R37 (middle left), R38 (middle right), R39 (bottom left), R40 (bottom right).

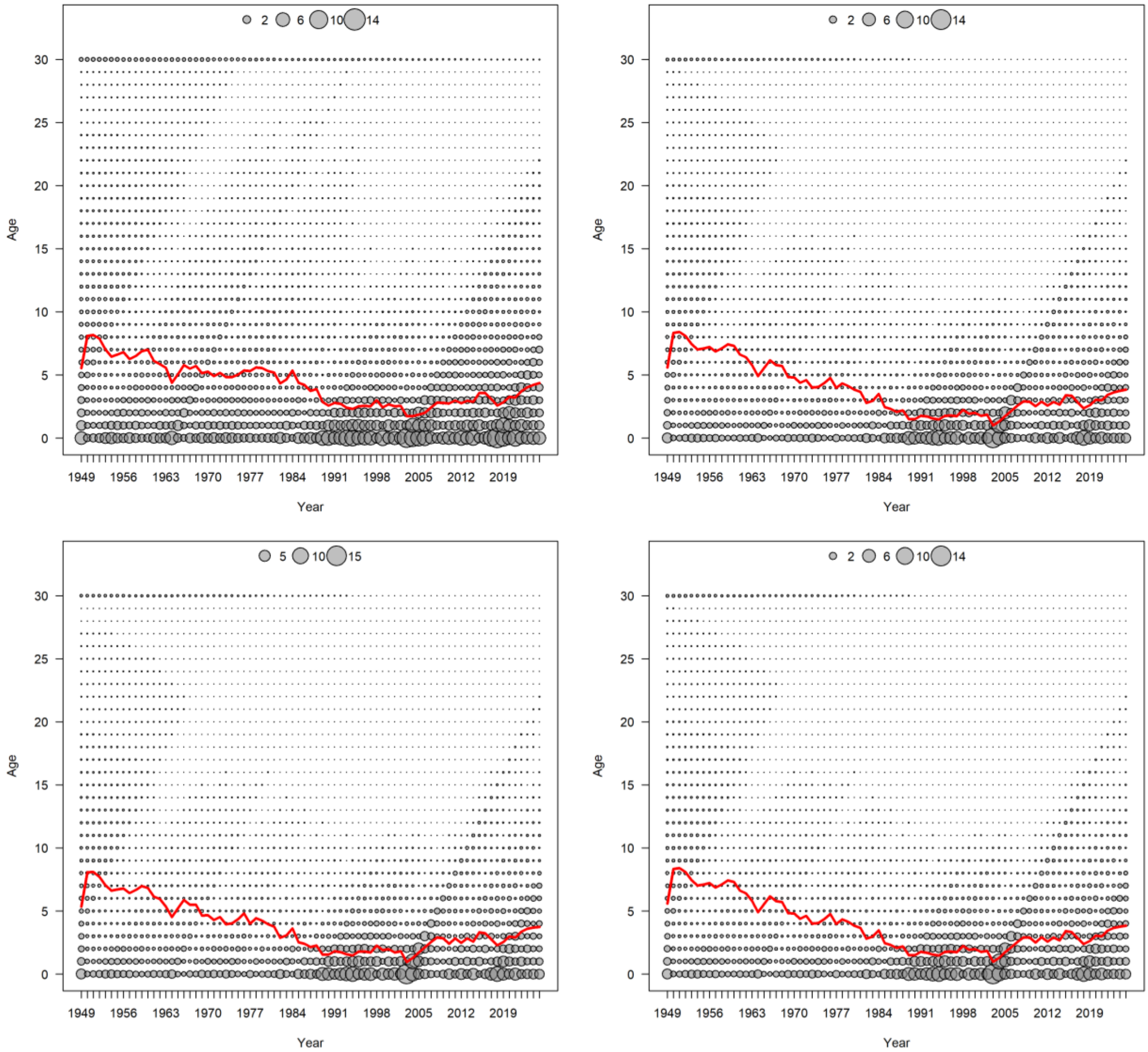


Figure 15. (continued) Estimated numbers-at-age at the start of the year. R41 (top left), R42 (top right), R43 (bottom left), R44 (bottom right).

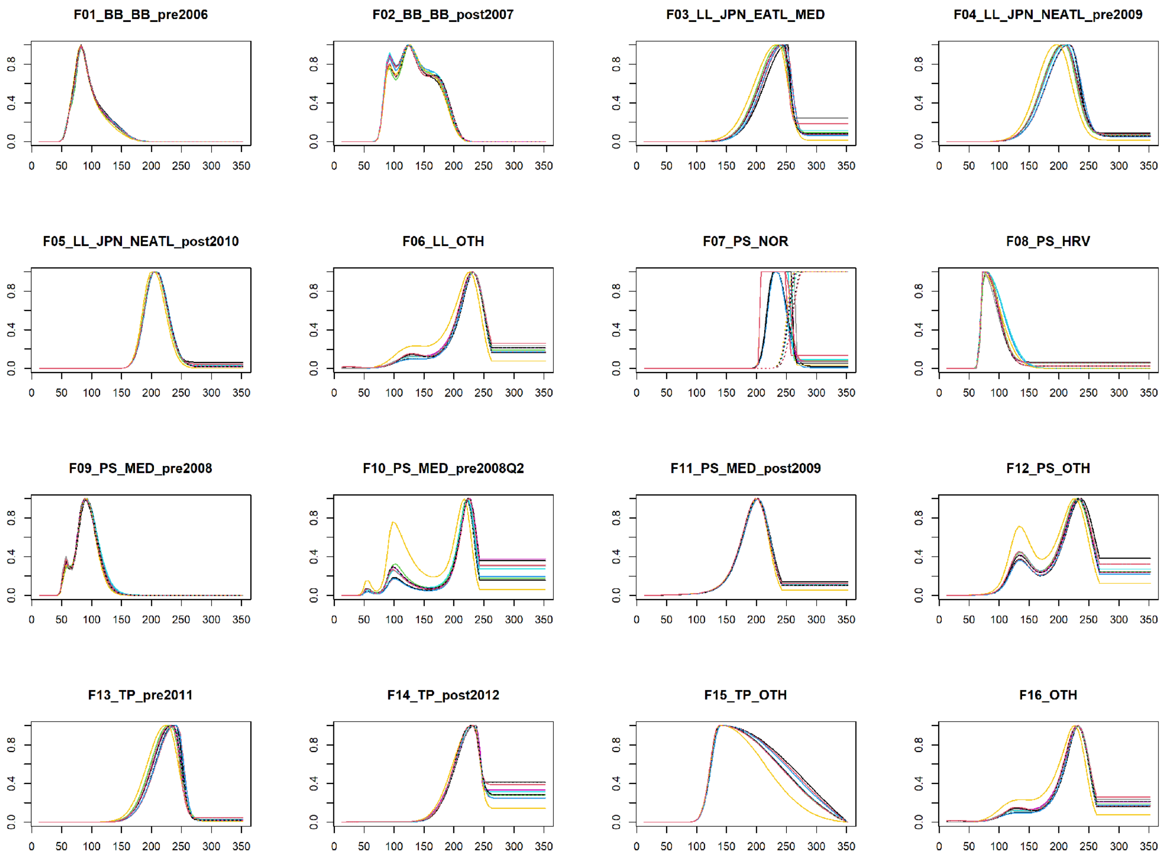


Figure 16. Estimated selectivity-at-length, by fleet, for the 10 SS3 runs overplotted. Note: the selectivity of F16 is mirrored from the selectivity of F06, and there is a time-block for the F07 selectivity, with the change occurring in 2016 and the selectivity forced to be asymptotic before 2016.

Appendix 6

Model diagnostics, biological parameters, model fits, and model estimates of W-BFT Stock Synthesis runs

The Group finally agreed with the proposed continuity base case models for W-BFT in Document SCRS/2026/161 as the final models in 2026, please see the document for further information.

BFT-W. Table 1. BFT-W Stock Synthesis parameter estimates for the early and late maturity models.

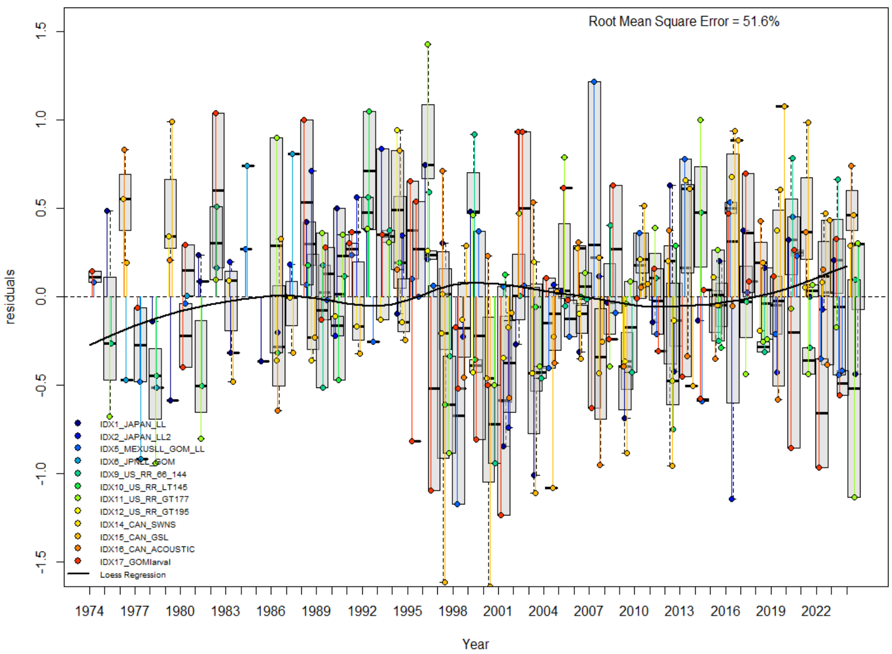
Parameter	Estimate (Early Maturity)	Estimate (Late Maturity)	Pr_type
L_at_Amax_Fem_GP_1	271.48	271.53	No_prior
VonBert_K_Fem_GP_1	0.34	0.34	No_prior
Richards_Fem_GP_1	-1.26	-1.25	No_prior
CV_young_Fem_GP_1	0.11	0.11	No_prior
CV_old_Fem_GP_1	0.07	0.07	No_prior
SR_LN(R0)	6.5	6.47	No_prior
SR_BH_steep	0.56	0.65	No_prior
SR_sigmaR	0.65	0.7	No_prior
InitF_seas_1_flt_7USA_TRAP	0.02	0.02	No_prior
InitF_seas_1_flt_9USA_CAN_HARPOON	0	0	No_prior
LnQ_base_IDX11_US_RR_GT177(28)	-4.58	-4.58	No_prior
LnQ_base_IDX14_CAN_SWNS(31)	-4.63	-4.63	No_prior
LnQ_base_IDX15_CAN_GSL(32)	-4.78	-4.77	No_prior
LnQ_base_IDX16_CAN_ACOUSTIC(33)	-5.92	-5.92	No_prior
LnQ_base_IDX11_US_RR_GT177(28)_ENV_mult	0.02	0.02	No_prior
LnQ_base_IDX14_CAN_SWNS(31)_ENV_mult	-0.07	-0.07	No_prior
LnQ_base_IDX15_CAN_GSL(32)_ENV_mult	-0.06	-0.06	No_prior
LnQ_base_IDX16_CAN_ACOUSTIC(33)_ENV_mult	0.08	0.08	No_prior
Size_DblN_peak_JAPAN_LL(1)	222.88	222.89	No_prior
Size_DblN_ascend_se_JAPAN_LL(1)	7.12	7.12	No_prior
Size_DblN_descend_se_JAPAN_LL(1)	6	6	No_prior
Size_DblN_end_logit_JAPAN_LL(1)	-3.92	-3.92	No_prior
Size_DblN_peak_OTHER_ATL_LL(2)	213.83	213.85	No_prior
Size_DblN_ascend_se_OTHER_ATL_LL(2)	7.9	7.9	No_prior
Size_DblN_descend_se_OTHER_ATL_LL(2)	7.2	7.2	No_prior
Size_DblN_end_logit_OTHER_ATL_LL(2)	-2.46	-2.46	No_prior
Size_DblN_peak_GOM_US_MEX_LL(3)	247.43	247.43	No_prior
Size_DblN_ascend_se_GOM_US_MEX_LL(3)	7.62	7.62	No_prior
Size_DblN_descend_se_GOM_US_MEX_LL(3)	-4.76	-4.76	No_prior
Size_DblN_end_logit_GOM_US_MEX_LL(3)	1.15	1.16	No_prior
Size_DblN_peak_JPNLL_GOM(4)	231.82	232.07	No_prior
Size_DblN_ascend_se_JPNLL_GOM(4)	6.74	6.75	No_prior
Size_DblN_descend_se_JPNLL_GOM(4)	6.41	6.4	No_prior
Size_DblN_end_logit_JPNLL_GOM(4)	-3.72	-3.69	No_prior
Size_DblN_peak_USA_CAN_PSFS(5)	80.97	77.4	Sym_Beta
Size_DblN_top_logit_USA_CAN_PSFS(5)	-1.64	-1.57	Sym_Beta

BFT-W. Table 1. (continued)

Parameter	Estimate (Early Maturity)	Estimate (Late Maturity)	Pr_type
Size_DblN_ascend_se_USA_CAN_PSFS(5)	5.42	5.07	Sym_Beta
Size_DblN_descend_se_USA_CAN_PSFS(5)	5.12	5.13	No_prior
Size_DblN_peak_USA_CAN_PSFB(6)	204.41	204.41	No_prior
Size_DblN_top_logit_USA_CAN_PSFB(6)	-2.86	-2.86	No_prior
Size_DblN_ascend_se_USA_CAN_PSFB(6)	5.82	5.82	Sym_Beta
Size_DblN_descend_se_USA_CAN_PSFB(6)	6.95	6.95	No_prior
Size_DblN_end_logit_USA_CAN_PSFB(6)	-8.67	-8.66	No_prior
Size_DblN_peak_USA_TRAP(7)	103.86	103.88	No_prior
Size_DblN_top_logit_USA_TRAP(7)	-1.32	-1.32	Sym_Beta
Size_DblN_ascend_se_USA_TRAP(7)	6.33	6.33	No_prior
Size_DblN_descend_se_USA_TRAP(7)	6.34	6.33	Sym_Beta
Size_DblN_peak_CAN_TRAP(8)	273.22	273.27	No_prior
Size_DblN_ascend_se_CAN_TRAP(8)	7.79	7.79	No_prior
Size_DblN_descend_se_CAN_TRAP(8)	4.34	4.33	No_prior
Size_DblN_end_logit_CAN_TRAP(8)	-2.43	-2.42	No_prior
Size_DblN_peak_USA_CAN_HARPOON(9)	194.01	194.02	No_prior
Size_DblN_top_logit_USA_CAN_HARPOON(9)	-1.02	-1.02	No_prior
Size_DblN_ascend_se_USA_CAN_HARPOON(9)	5.8	5.8	No_prior
Size_DblN_descend_se_USA_CAN_HARPOON(9)	7.23	7.23	No_prior
Size_DblN_end_logit_USA_CAN_HARPOON(9)	-3.54	-3.52	No_prior
Size_DblN_peak_USA_RRFS(11)	111.98	111.97	Normal
Size_DblN_top_logit_USA_RRFS(11)	-1.92	-1.92	Sym_Beta
Size_DblN_ascend_se_USA_RRFS(11)	6.43	6.43	No_prior
Size_DblN_descend_se_USA_RRFS(11)	-3.04	-3.04	No_prior
Size_DblN_peak_USA_RRFB(12)	202.85	202.87	Normal
Size_DblN_top_logit_USA_RRFB(12)	-1.07	-1.06	No_prior
Size_DblN_ascend_se_USA_RRFB(12)	6.92	6.92	No_prior
Size_DblN_descend_se_USA_RRFB(12)	6.56	6.55	Sym_Beta
Size_DblN_end_logit_USA_RRFB(12)	-3	-2.98	No_prior
Size_DblN_peak_CAN_SWNS_HLnoHP(14)	213.09	213.12	No_prior
Size_DblN_top_logit_CAN_SWNS_HLnoHP(14)	-1.56	-1.56	No_prior
Size_DblN_ascend_se_CAN_SWNS_HLnoHP(14)	6.73	6.73	No_prior
Size_DblN_descend_se_CAN_SWNS_HLnoHP(14)	7.04	7.03	No_prior
Size_DblN_end_logit_CAN_SWNS_HLnoHP(14)	-3.14	-3.13	No_prior
Size_DblN_peak_CAN_GSL_HL(16)	249.29	249.29	No_prior
Size_DblN_ascend_se_CAN_GSL_HL(16)	7.39	7.39	No_prior
Size_DblN_descend_se_CAN_GSL_HL(16)	6.3	6.3	No_prior
Size_DblN_end_logit_CAN_GSL_HL(16)	-3.54	-3.53	No_prior
Size_inflection_CAN_GSL_old(17)	249.54	249.66	No_prior
Size_95%width_CAN_GSL_old(17)	14.96	14.98	No_prior
Size_DblN_peak_JAPAN_LL(1)_BLK1repl_1950	152.09	152	No_prior
Size_DblN_top_logit_JAPAN_LL(1)_BLK1repl_1950	-2.43	-2.44	No_prior
Size_DblN_ascend_se_JAPAN_LL(1)_BLK1repl_1950	7.23	7.23	No_prior

BFT-W. Table 1. (continued)

Parameter	Estimate (Early Maturity)	Estimate (Late Maturity)	Pr_type
Size_DblN_descend_se_JAPAN_LL(1)_BLK1repl_1950	7.64	7.65	No_prior
Size_DblN_end_logit_JAPAN_LL(1)_BLK1repl_1950	-5.98	-5.93	No_prior
Size_DblN_peak_USA_RRFS(11)_BLK2repl_1950	90.14	90.14	Normal
Size_DblN_top_logit_USA_RRFS(11)_BLK2repl_1950	-4.77	-4.77	Sym_Beta
Size_DblN_ascend_se_USA_RRFS(11)_BLK2repl_1950	6.37	6.37	No_prior
Size_DblN_descend_se_USA_RRFS(11)_BLK2repl_1950	6.99	6.99	No_prior
Size_DblN_peak_CAN_GSL_HL(16)_BLK3repl_1950	295.22	295.25	No_prior
Size_DblN_ascend_se_CAN_GSL_HL(16)_BLK3repl_1950	7.46	7.46	No_prior
Size_DblN_descend_se_CAN_GSL_HL(16)_BLK3repl_1950	3.51	3.5	No_prior
Size_DblN_end_logit_CAN_GSL_HL(16)_BLK3repl_1950	-0.5	-0.49	No_prior



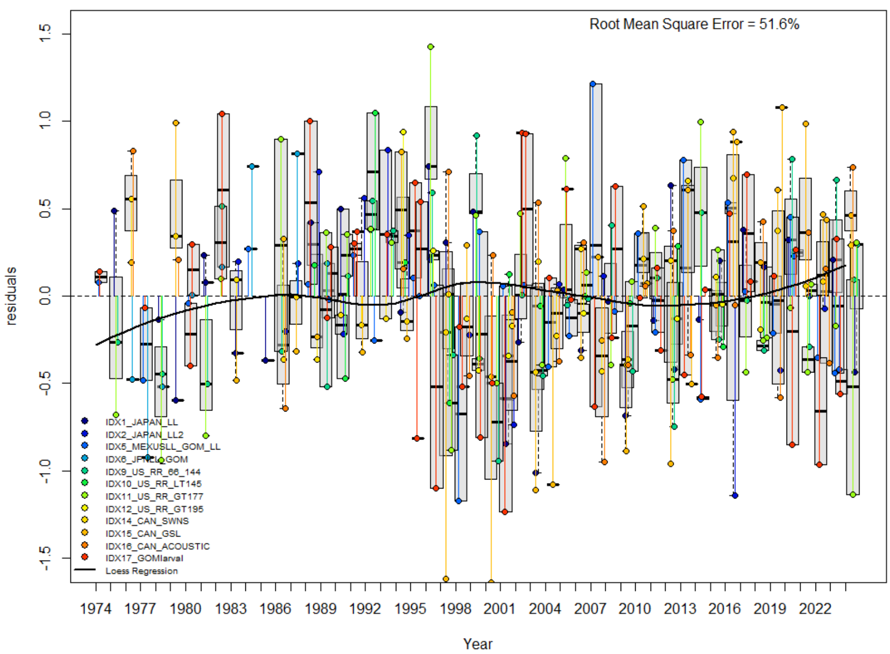


Figure 1. Annual root mean squared errors (RMSE) across abundance indices for early (top) and late (bottom) maturity scenarios.

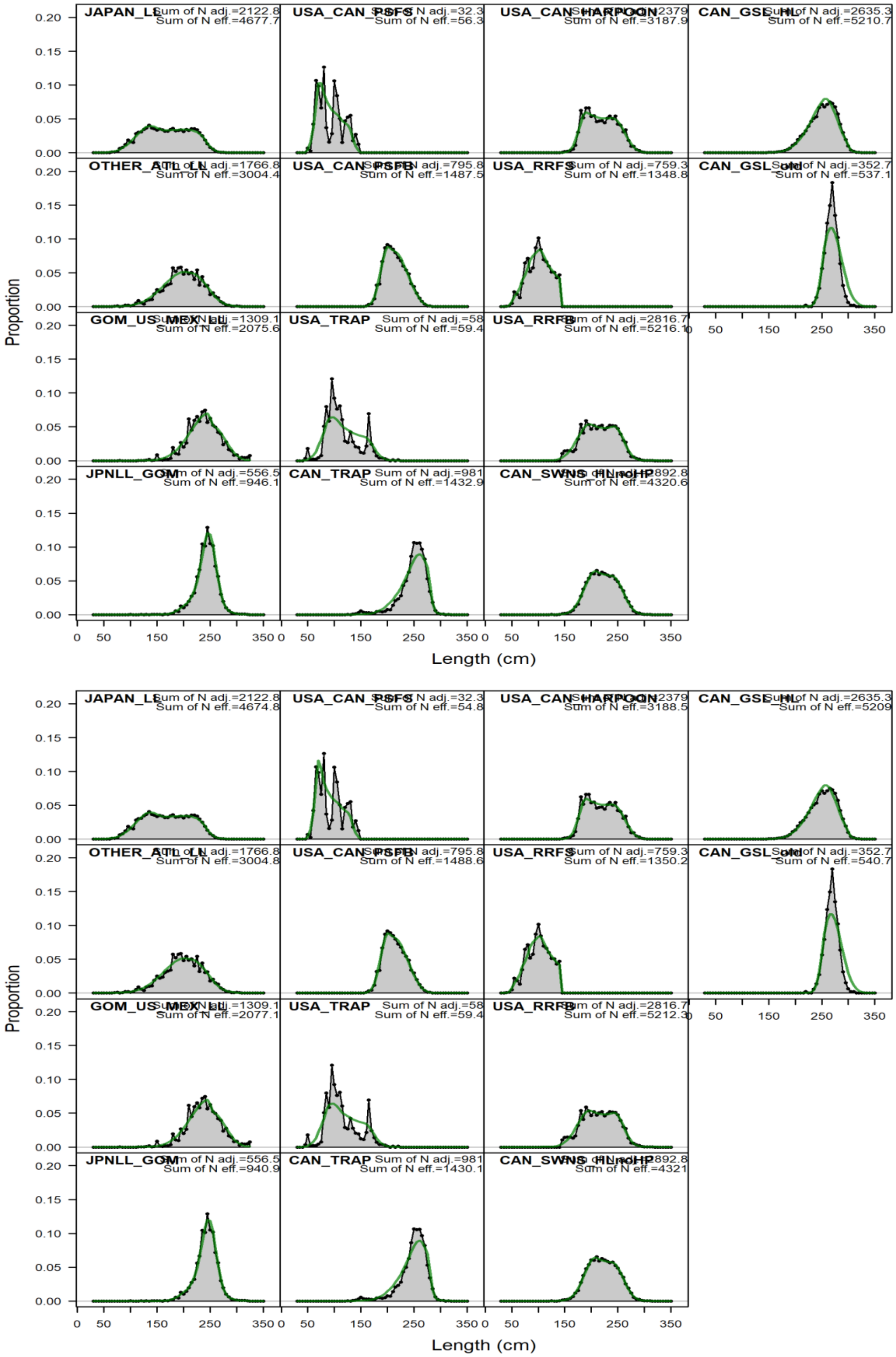


Figure 2. Aggregated length composition data (grey histograms) and the model fit (green line) for early (top) and late (bottom) maturity scenarios.

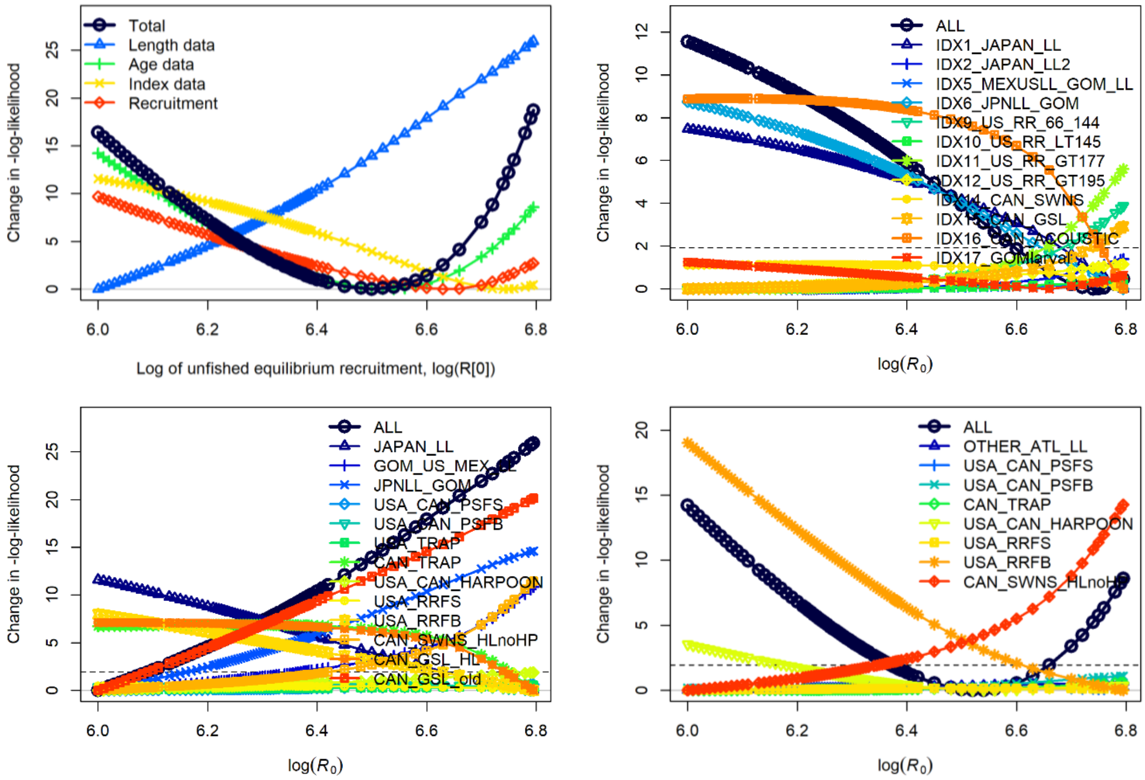


Figure 3.a R0 profiles for early maturity scenario by data component (top left), indices (top right), length composition (bottom left), and age data as conditional age at length (bottom right).

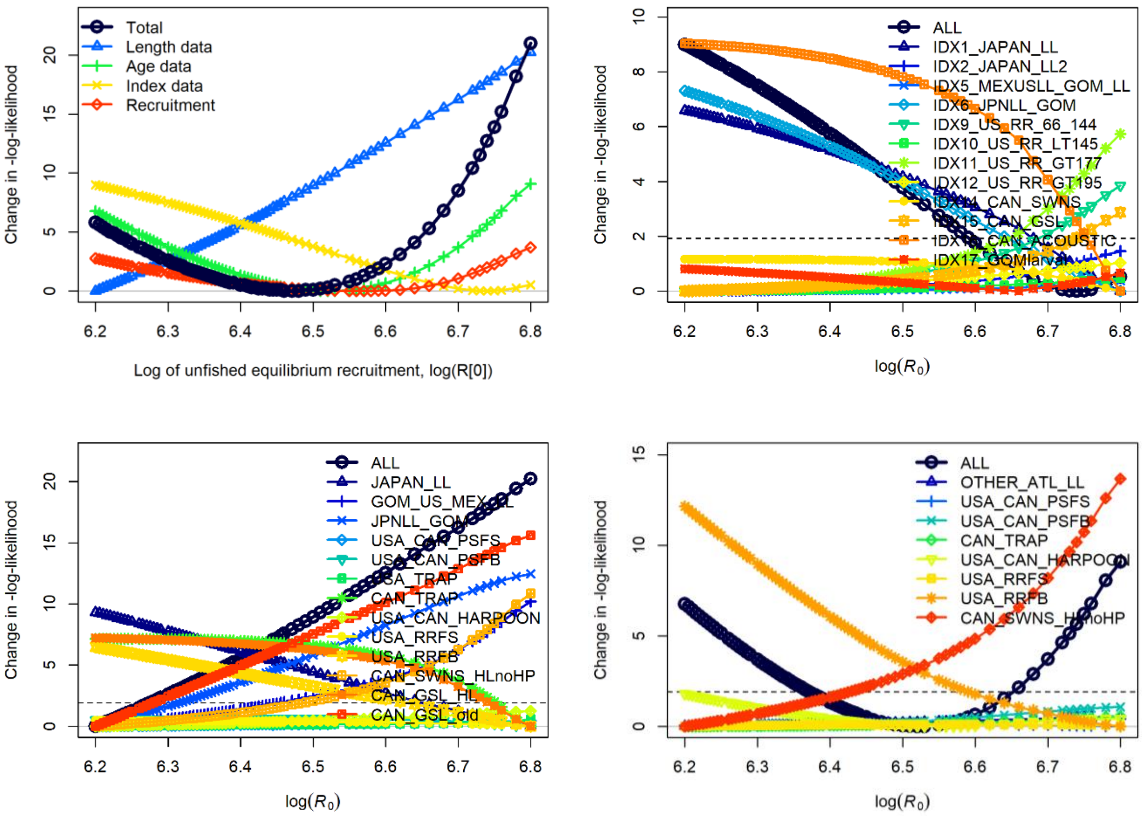


Figure 3.b R0 profiles for late maturity scenario by data component (top left), indices (top right), length composition (bottom left), and age data as conditional age at length (bottom right).

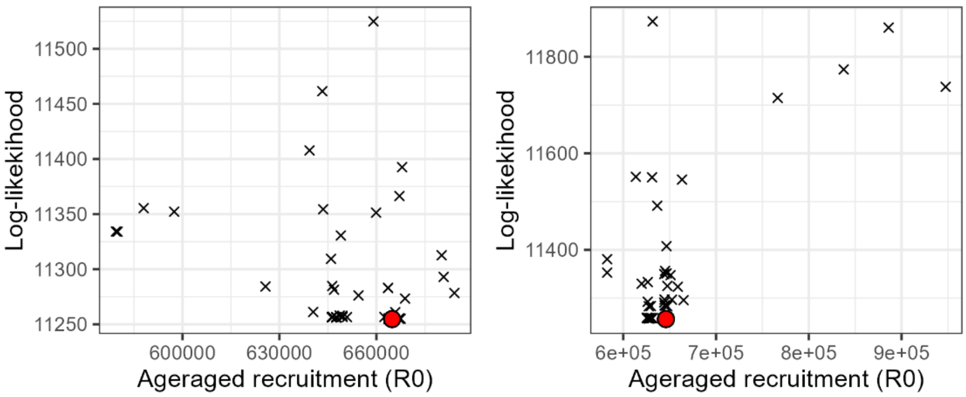


Figure 4. Scatter plots between estimated averaged recruitment across jitter runs for early (left) and late (right) maturity scenario. Cross marks indicate each jitter runs and red circle indicates base case model.

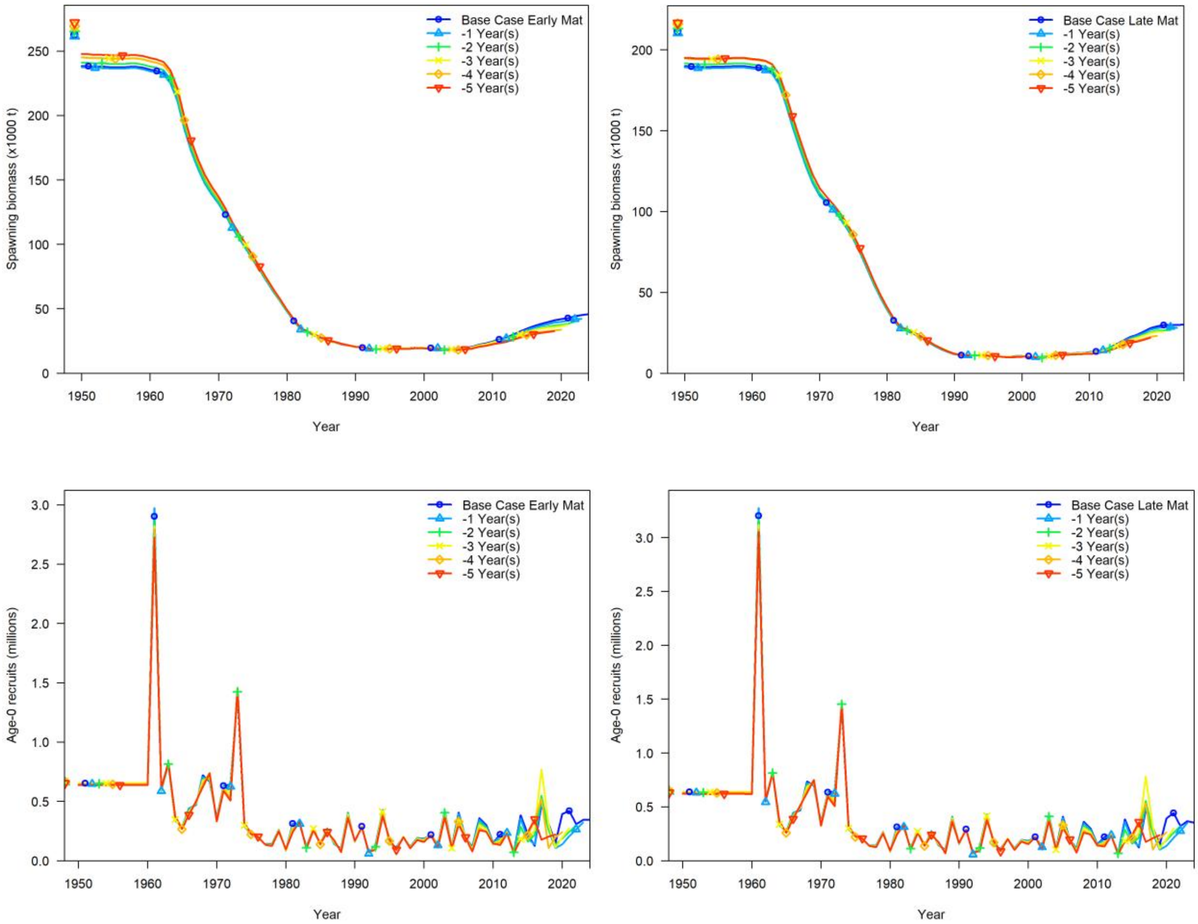


Figure 5. SSB (top) and recruitment (bottom) trajectories in the recent year by retrospective analysis for the early (left) and late (right) maturity scenario.

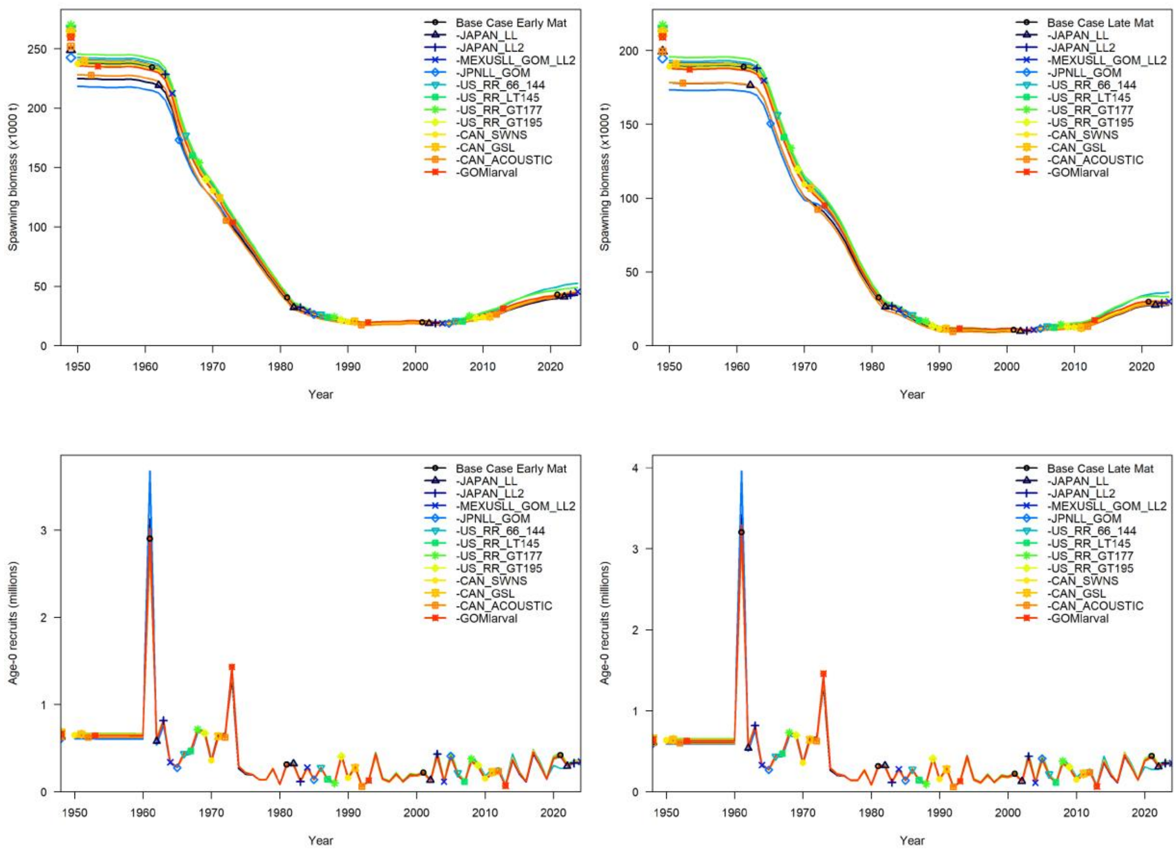


Figure 6. SSB (top) and recruitment (bottom) trajectories in the recent year by jackknife analysis for the early (left) and late (right) maturity scenario.

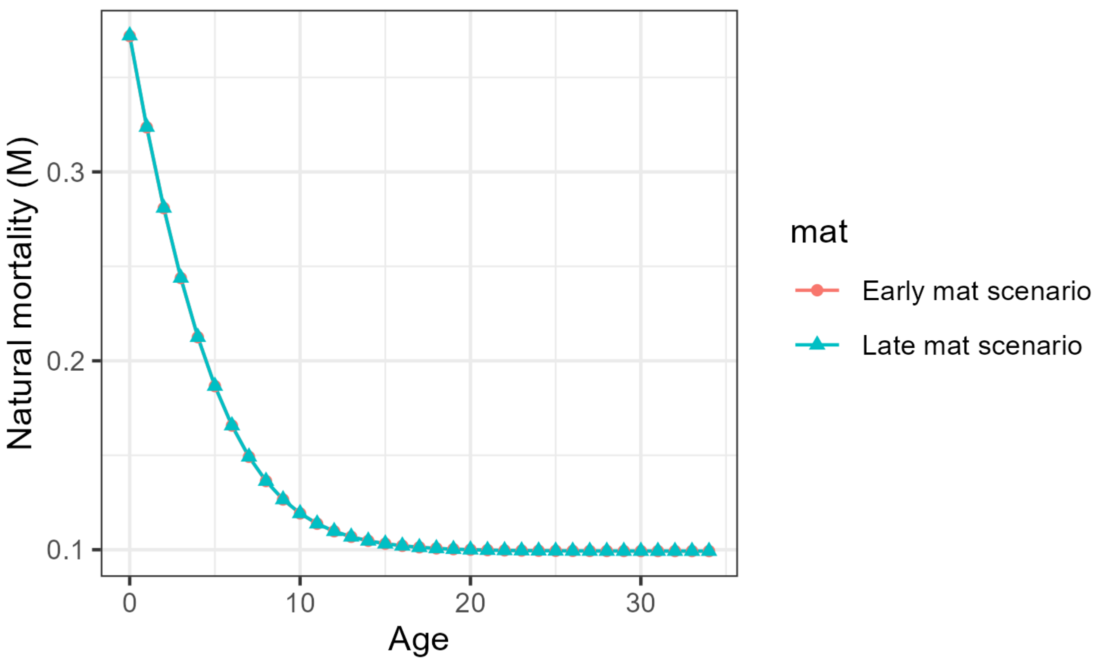


Figure 7. Estimated natural mortality at age by Lorenzen function, with M fixed at 0.1 at age 20).

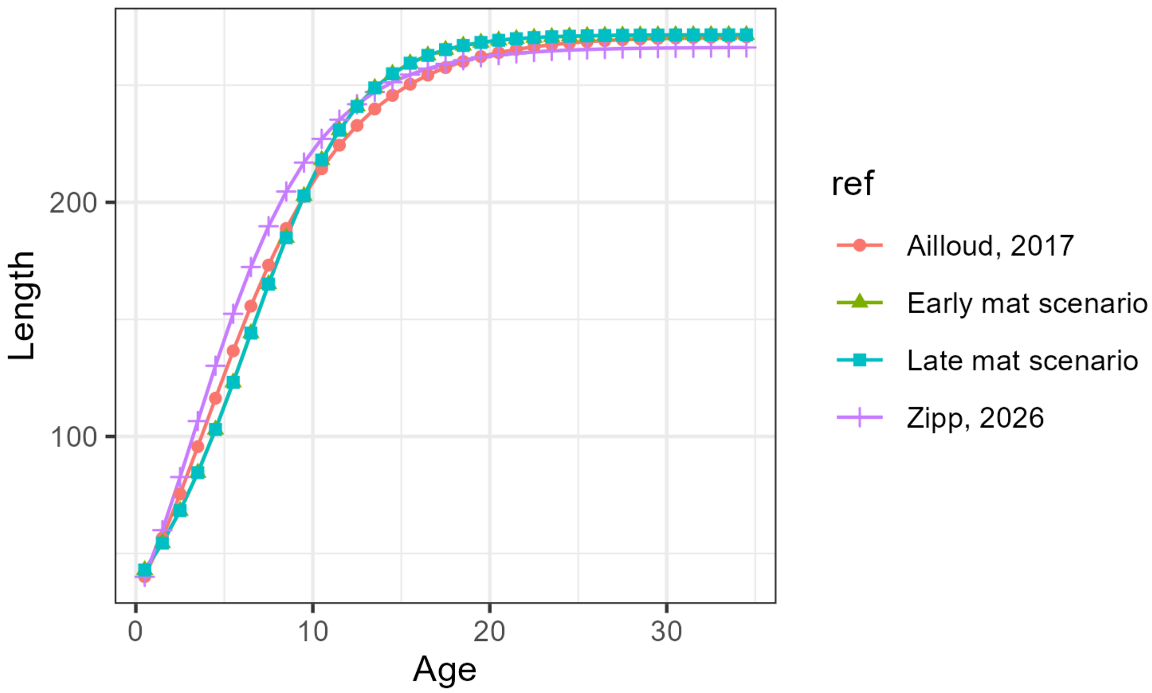


Figure 8. Estimated length at age by Richards' growth function with L1 fixed at 42.98 cm at age 0.5.

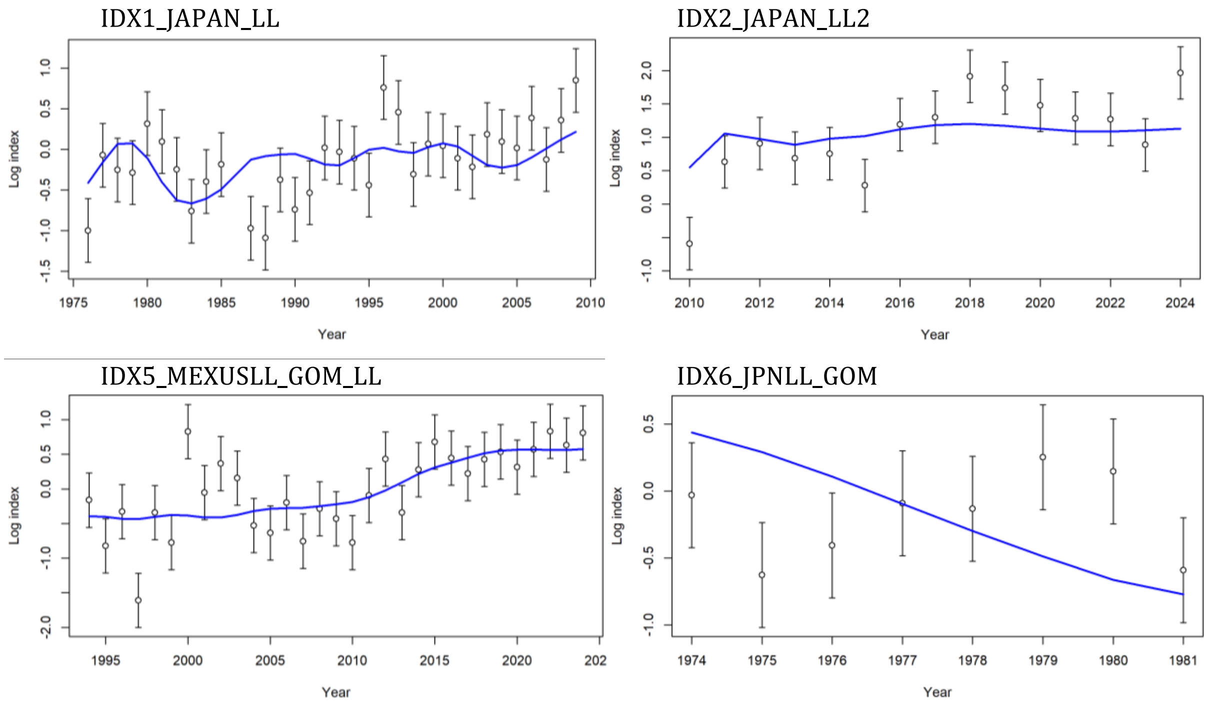


Figure 9. Fit to each abundance index in log space for early maturity scenario.

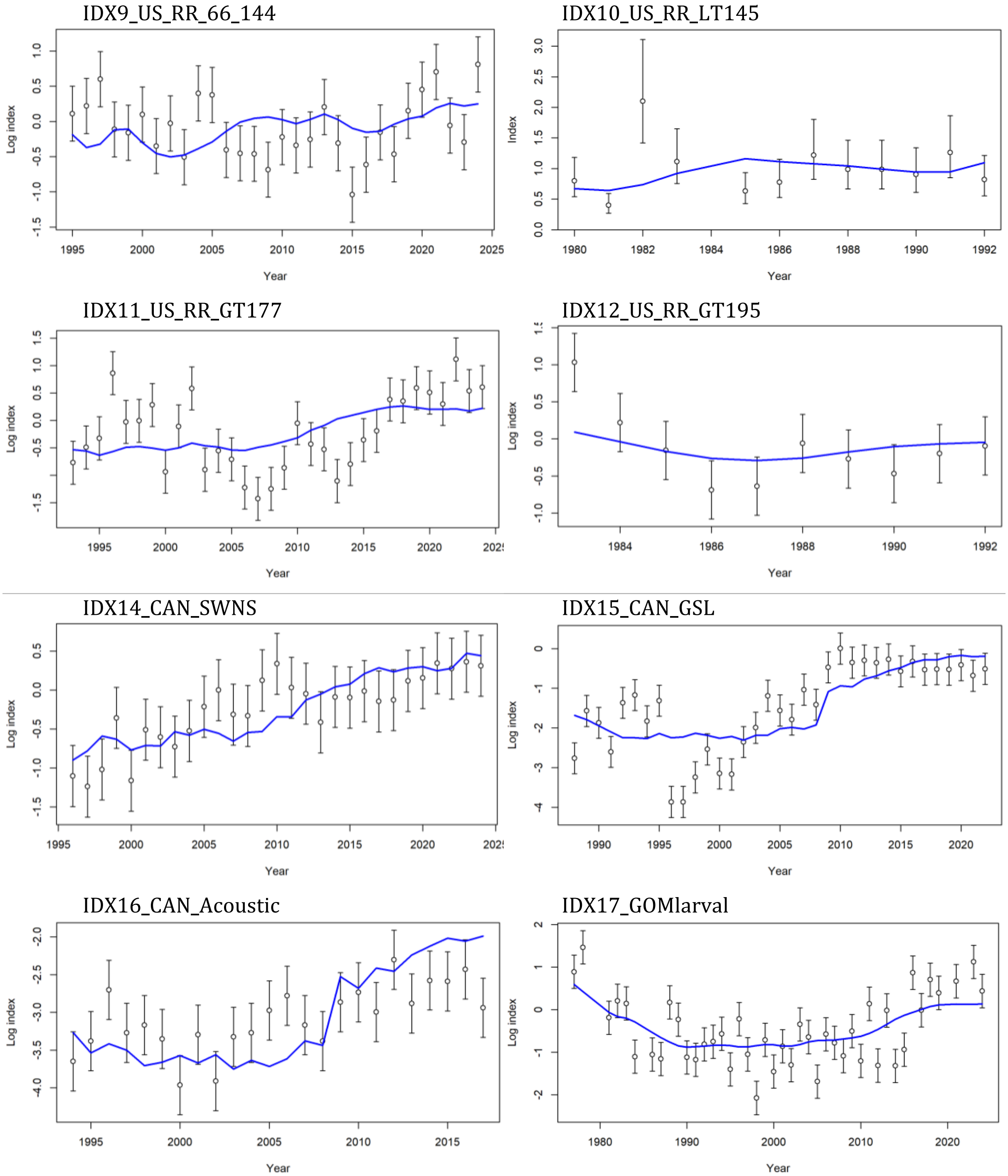


Figure 9. (continued) Fit to each abundance index in log space for early maturity scenario.

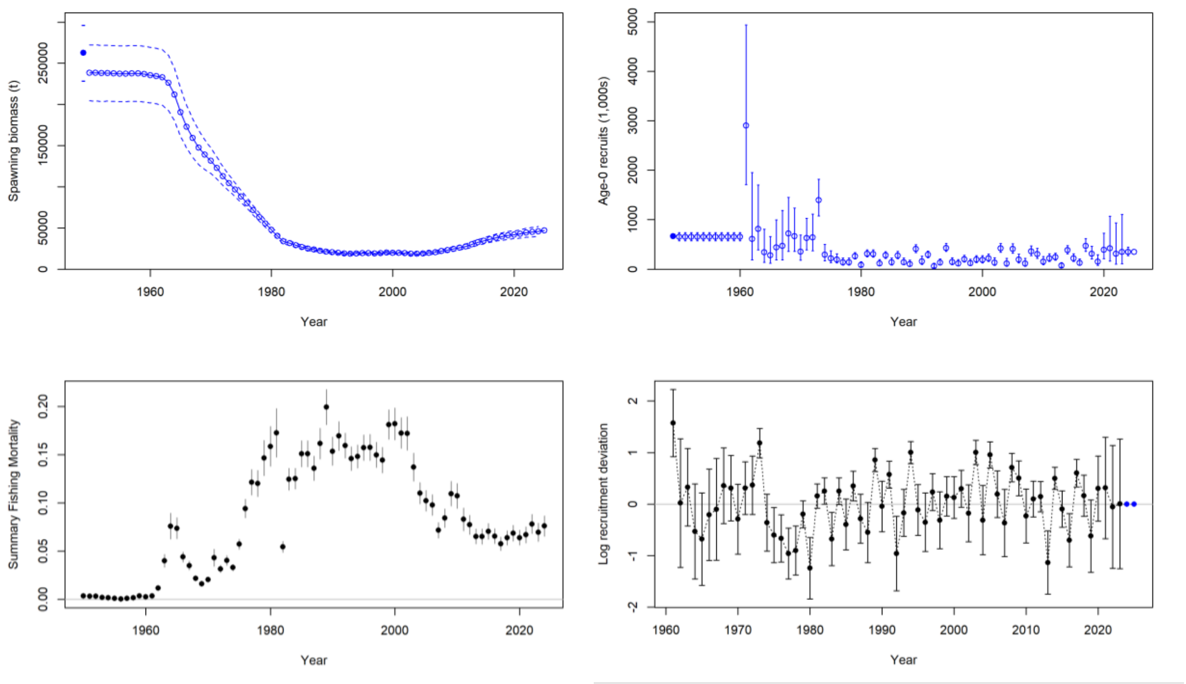


Figure 10. Estimated SSB (top left), recruitment (top right), fishing intensity (summary F for age 10-20) and recruitment deviation for early maturity scenario.

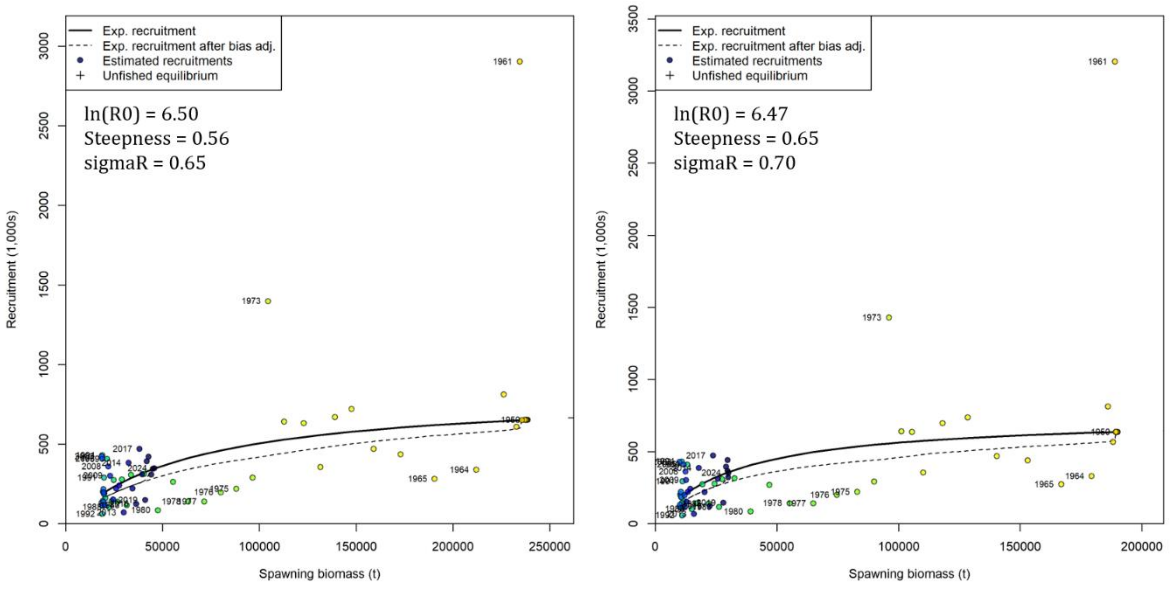


Figure 11. Estimated stock-recruitment curve (with fixed h=0.9) and actual recruitment estimates with recruitment deviation for early (left) and late (right) maturity scenarios.

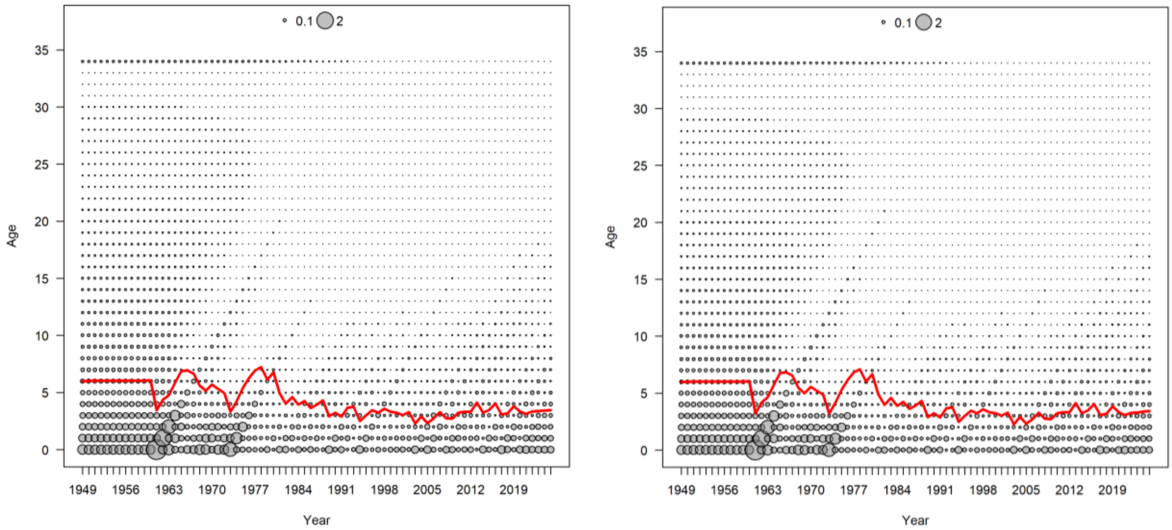


Figure 12. Estimated numbers-at-age at the start of the year for early (left) and late (right) maturity scenario.