Report of the 2024 ICCAT Meeting of the Working Group on Stock Assessment Methods
(hybrid/Madrid, Spain from 3 to 6 June 2024)

1. Opening, adoption of agenda and meeting arrangements

The hybrid meeting was held in person at the ICCAT Secretariat in Madrid (Spain), and online, from 3 to 6 June 2024. Dr Michael Schirripa (U.S.A.), the Working Group on Stock Assessment Methods (WGSAM) ("the Group") Rapporteur and meeting Chair, opened the meeting and welcomed participants. Mr Camille Manel, ICCAT Executive Secretary, welcomed the participants and wished them success in their meeting.

The Chair 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 provided at the meeting are included in **Appendix 4**. The following participants served as rapporteurs:

Sections	Rapporteur
Items 1, 7, 9	A. Kimoto
Item 2.1	C. Peterson
Item 2.2	S. Miller
Item 3	D. Die
Item 4	G. Díaz
Item 5	C. Brown, H. Arrizabalaga
Item 6	M. Schirripa
Item 8.1	D. Courtney
Item 8.2	A. Kimoto
Item 8.3	C. Brown

2. Management Strategy Evaluation (MSE)

2.1 Review the progress and direction on current MSE efforts

2.1.1 North Atlantic albacore MSE (ALB-N MSE)

SCRS/P/2024/063 presented the update of the North Atlantic albacore (ALB-N) MSE, introducing the new reference set, robustness set, and observation error model, as well as a review of climate change effects to potentially inform robustness tests. An MSE review is planned in 2026 and the MSE update and new testing are currently underway. The dynamics of the MSE, including reference Operating Model (OM) structure and data and fleet structure, have been identified.

To date, no exceptional circumstances (ECs) have been identified, and the realized biomass and fishing mortality ratios have been greater than or less than the median trajectories simulated in the MSE, respectively. The Group further discussed EC protocols (ECPs), particularly the level of discretion that the SCRS has to advise the Commission on the appropriate management response in light of the significance of the identified EC. It was noted that deviations in biomass and fishing mortality ratios that do not pose a risk to safety or status management objectives should be considered less concerning and may not require a departure from the management procedure (MP). Nevertheless, this deviation should be explored further. The ongoing MSE revision should be updated with recently observed data, which may help to explain this trend.

The Group noted that the ALB-N OMs were designed prior to heightened focus on climate considerations and future MSEs should prioritize the inclusion of climate-informed OMs. Accordingly, the Albacore Species Group (ALBSG) undertook a primary literature review (Goikoetxea *et al*., 2024) to inform of potential impacts of climate change on northern Atlantic albacore, which included expected impacts on species distributional shifts and changes in stock abundance. A lack of information about specific anticipated impacts on recruitment and productivity was noted. After reviewing these studies, the ALBSG reported a lack of information to inform climate-driven OMs within the MSE, particularly with respect to mechanistic linkages, links to recruitment or productivity, and ecosystem models of a sufficiently vast spatial scale

representative of the ALB-N ICCAT management area. The Group was reminded that an earlier study (Merino *et al*., 2019) did test the robustness of the current MP to generic hypotheses about climate change impacts similar to what is suggested in SCRS/2024/104.

The Group emphasized that the purpose of MSE is not to identify a single best prediction of climate impacts on a stock, but rather to ensure that the resulting MP is robust to the types of uncertainty that may occur. The Group encourages and recommends ICCAT Species Groups that have MSE process to readily incorporate climate uncertainty now, rather than waiting for additional data to inform a specific OM. While it was acknowledged that climate impacts are likely to lead to gradual shifts in stock parameter values and or abrupt changes to the system, the ALBSG currently lacks the requisite understanding to simulate such a mechanistic linkage. Therefore, broad consideration of potential climate impacts should be incorporated in the updated MSE, through changes to recruitment deviations, potential regime shifts, or other proxy. Communication and messaging surrounding such an MSE should be clear and purposeful; for example, instead of stating that the resulting MP is "climate-ready", state that it is robust to a reduction in productivity.

2.1.2 Atlantic bluefin tuna MSE (BFT MSE)

SCRS/P/2024/077 included a general description of ECP and the detailed EC provisions for Atlantic bluefin tuna (BFT). No ECs were identified for Atlantic bluefin tuna in 2023. The MP will be next run in 2025, which will set the total allowable catches (TACs) for the years 2026 to 2028.

The Group noted the value in plotting the density distribution of EC reference values (e.g., index values tested within the MSE). For BFT, MSE-tested index values were bimodal, reflecting the uncertain scale of the stock as tested using alternate OMs in the MSE.

The Group also discussed how ECPs were determined for BFT. It is useful to include scenarios where management fails within the MSE to fully characterize stock behavior and response to ECPs. Though mixing rate is not a key indicator for ECPs, it was explored (see the ECP application with BFT data loaded), and it is anticipated that any changes to mixing will be expressed through changes to the indices. ECPs can be revisited in the future, with increased emphasis on identifying statistical power.

The Group further discussed the SCRS responsibility to evaluate and determine the appropriate response when ECs are identified. Because every possible EC scenario cannot be run to determine plausible impacts *a priori*, SCRS reaction may optionally include re-running additional MSE robustness tests to determine appropriate action when faced with ECs. It was further noted that not all ECs should be considered problematic; for example, some indices are less influential, and missing values may not necessarily constitute a risk to stock status or safety.

The Group discussed OM weighting for BFT. OM weighting followed the Delphi approach (Anon., 2020), which is important to ensure that multiple views are represented and accordingly justified (Anon., 2021). During MSE updates, it was noted that newly collected data may eliminate potential OMs from the reference grid or suggest that individual OMs are more or less likely, which may require re-weighting of the reference OM grid.

2.1.3 North Atlantic swordfish MSE (SWO-N MSE)

SCRS/P/2024/079 provided an update on the North Atlantic swordfish (SWO-N) MSE process. The Group was presented with details on the overall SWO-N MSE process, operating model structure, candidate management procedures (CMPs), updates to the Combined Index, and a plan for engaging with Panel 4 in 2024. The author noted areas requiring feedback from the WGSAM, notably climate change robustness testing, and standardization of ICCAT MSE outputs. The SWO-N MSE team will continue to focus on MSE communication.

Climate considerations are being incorporated empirically by inducing shifts in patterns of recruitment deviations. This approach was favored considering the limited understanding of mechanistic linkages from environmental drivers, although environmental drivers are likely to affect life history parameters. However, it was noted that exploring multiple interacting or synergistic mechanistic impacts within a single MSE exercise readily becomes untenable. Species distribution shifts have been identified as an additional

potential climate impact, as exemplified through recent fleet dynamics. Though, additional consideration will be placed on this topic in the future, including the impact that nonstationarity on spatial aspects of the fisheries and or the stock could have on biological reference points.

The Group discussed the potential causes of conflicting indices for SWO-N and the validation of the new combined index. One possible explanation is that conflicting indices could be related to shifting stock boundaries and mixing behavior. Explicit consideration should be given to the treatment of management versus biological stock boundaries and how updated biological information related to mixing and stock boundaries should be considered in future revisions of the SWO-N MSE.

2.1.4 Western skipjack tuna MSE (SKJ-W MSE)

The SCRS Chair introduced western skipjack (SKJ-W) MSE based on the presentation "Western Atlantic skipjack Management Strategy Evaluation (MSE): background, overview, & next steps" provided at the Second Intersessional Meeting of Panel 1, in May 2024. SKJ-W MSE uses the openMSE platform (Hordyk *et al.*, 2021) and the most recent (2022) Stock Synthesis assessment model. Conditioned OMs ensured that the statistical properties of the indices were maintained in the MSE projection period. The presented update included a review of the OM dynamics, the reference and robustness OM grid, presentation of empirical and model-based CMPs, details of the management cycle, management objectives, and the 2024 workplan. Reduced future recruitment was identified as a robustness OM scenario as a proxy for potential negative climate impacts. It was noted that CMPs are only tuned to the reference OM, while robustness OMs are included to simulation-test the robustness of the CMP.

The presentation included a demonstration of CMP performance, with particular reference to tuning. Subsequent work will focus on CMP tuning to meet all desired management objectives. The Group discussed the importance of the tuning process, particularly when applying generic MPs (e.g., MPs built into openMSE with default parameters) to a target stock. The Group further distinguished from estimated reference points that are used in the MP and the "true" simulated reference points that are used in the performance metrics to measure MP performance.

It was raised that there is currently no TAC for SKJ-W and that an MP accordingly represents a departure from the current management approach. The acceptance and application of an MP would necessarily have to include an intrinsic agreement to manage with a TAC.

An additional document for ongoing SKJ-W MSE work by developers was provided to the Group but was not presented due to time limitations.

2.1.5 Tropical tunas multi-stock MSE for eastern skipjack, bigeye, and yellowfin

SCRS/P/2024/076 presented an update of the tropical tunas multi-stock MSE (i.e. eastern skipjack, bigeye and yellowfin). The general process for this MSE has been to: (1) identify management objectives, (2) identify uncertainties, (3) condition OMs from recent assessments, (4) develop an observation model, (5) select parameters and quantification of uncertainty, (6) identify management procedures, (7) run the simulation, and (8) summarize and report on results. Progress has been made on strategy items 1-4. Management objectives are multi-stocks to reflect fishery technical interactions between each stock. Uncertainties will include steepness, recruitment variability, natural mortality, growth, longline selectivity, maturity, and data weighting. Recent stock assessments for bigeye, yellowfin, and eastern skipjack tunas were conducted with a common fleet structure to ensure compatibility. A simulation model to conduct bio-economic evaluation of fisheries management strategies (FLBEIA) was selected as the framework for the tropical tunas multi-stock MSE. Catch per unit effort (CPUE) indices were analyzed within the observation model and used to condition the OM. In 2024, the tropical tunas multi-stock MSE will incorporate climate change scenarios, and develop and preliminarily test multi-stock CMPs.

It was noted that it is important to receive Panel 1 input on defining and prioritizing current management objectives.

2.1.6 Standardized graphics for reporting MSE results: an update to Slick

Slick is an R package and online application that has been developed as a tool for effective and interactive communication of MSE results. SCRS/P/2024/075 presented an updated version of Slick to the Group for feedback and to contribute to the discussion on the development of a standardized set of figures for communicating MSE results.

The Group reviewed Slick and agreed that the development of standardized plots would be useful for communicating MSE results to managers. Comments and feedback from the Group will be incorporated into future developments of the package.

This prompted the question of whether standardized plots for communicating MSE results should be developed for ICCAT. The Group recommended that a standard set of plots to display MSE results be identified and presented for each MSE application. The Slick App is a useful and flexible platform to use for this purpose. Slick was also used effectively during the tropical tunas multi-stock MSE ICCAT training workshops in 2023. The code is available via GitHub and developers plan to release it via CRAN to secure version control.

The Group noted that some challenges may persist in presenting MSE results (e.g., across multiple stocks/species, translating previously conducted MSE results into this App). While some MSEs may require bespoke (i.e. custom-made) presentation materials, the Slick App is a useful, open-source platform to obtain basic presentation code that can be subsequently modified. The Slick developer (Dr Hordyk) has offered to assist users in building Slick objects, and openly welcomes GitHub pull requests and co-development.

The Group recommended that current and future ICCAT MSEs utilize graphical user-friendly applications that allow to compare and use MSEs for capacity building, for example, the Slick App.

The Group discussed future support and development of the web-based App. The Slick App is currently funded by the Ocean Foundation through mid-2027 to be hosted on the Blue Matter Science server. The Group noted the importance of Slick being translated into French and Spanish, which the developer confirmed is underway. The Group recommended that the ICCAT MSEs be hosted through the ICCAT webpage, including graphical user-friendly applications (e.g. Slick). This recommendation is accompanied by associated costs and server space requirements. The App is notably open source and can be hosted anywhere, including individual users' laptops by running the code locally.

2.1.7 FLBEIA: A simulation model to conduct bio-economic evaluation of fisheries management strategies

SCRS/P/2024/074 introduced FLBEIA, an R package to conduct a bio-economic impact assessment model and to evaluate different management strategies under MSE framework. FLBEIA is being used for ALB-N and tropical tunas multi-stock MSEs. The model is flexible, can accommodate multiple stocks, multiple fleets, and métiers within the fleets, and can be seasonal. Mixed fisheries can be exploited through predetermined effort, approaches for mixed fisheries (F_{CUBE} approach, Profit maximization), or sequential fisheries (profit maximization considering seasonal behavior of the fleet). OMs can accommodate environmental, ecosystem, and socioeconomic covariates. The model is developed in a modular way to facilitate the development and use of new functions. The presentation includes links to the package source code and associated documentation).

The Group noted challenges associated with gathering data to parameterize economic submodels, especially for stocks that span over several CPCs which might each require separate economic model parameterizations. Flexibility to allow for bio-economics within this framework is a positive thing, considering that economy plays a key role in many fishery management objectives. Additional collaborations with economists may be required to take advantage of this functionality. The tropical tunas multi-stock MSE will not include an economic submodel due to limited data availability and fleet dynamics will be assumed constant into the future.

2.1.8 Observation error model for the new Management Strategy Evaluation framework for North Atlantic albacore

SCRS/P/2024/073 provided the observation error model (OEM) for the new ALB-N MSE, the conditioning of FLBEIA with the Stock Synthesis output of the basecase was shown. Details of the observation error modeling approach were presented, with an emphasis on how data would be generated in the MSE projection period to maintain autocorrelation, variance, and relationship to the vulnerable biomass or abundance depending on the CPUE. The historical CPUE time series were introduced in three different ways to evaluate what is the most appropriate way of introducing them in the MSE: observed values, simulated observed values considering uncertainty with a coefficient of variance (CV) of the CPUE, simulated observed values applying an error to the vulnerable biomass or abundance like the approach used in the projection. The ALB-N MSE was projected with recent average catches and high catches to ensure acceptable model behavior and continuity between historical and projection period dynamics.

Historical uncertainty in CPUE indices was considered following several approaches, and the question was raised to the Group about how historical uncertainty should be considered. However, there were no further discussions on this topic due to time restrictions. It was noted that uncertainty in the historical values of CPUEs has not been incorporated or considered in the observation error models of other ICCAT MSEs, where historical CPUE values are fixed.

The Group recommended that how the uncertainty of CPUEs series is being used for the OEM be further explored.

2.1.9 A preliminary roadmap for MSE development

SCRS/2024/103 presented a preliminary roadmap for general MSE framework development that organizes MSE processes into tasks and phases. The roadmap includes data guillotines and organizes participants into various groups to maximize the efficiency of the process and the value of participants' contributions. The roadmap is inclusive of MSE processes that include participants who are unfamiliar with MSE concepts.

The Group was supportive of this effort and was encouraged to review the document outside of the meeting and provide comments and recommendations to the author, who will submit an updated version to the September Species Group meetings.

2.1.10 Developing the climate test: robustness trials for "climate-ready" management procedures

SCRS/2024/104 presented a generic set of MSE climate-driven robustness tests for six ICCAT stocks that included moderate and extreme future trajectories for somatic growth, condition factor, recruitment strength, and survival. This proof-of-concept demonstration serves as a basis for the broader discussion of MSE robustness testing for informing tactical management advice given uncertain hypotheses for climate impacts.

The author argued that these types of MSE tests be used to consider hypothetical scenarios as robustness tests and emphasized that asymmetry in stationary versus nonstationary MP performance be clearly demonstrated.

The Group was supportive of this research and approach. Despite being short on time, the Group briefly discussed how this framework could be used to identify recommended sets of robustness OMs, generate a suite of generically robust and well-performing MPs, and to inform the development of ECPs. The Group further cautioned against using the broad label of "climate-ready", and instead being more specific to describe scenarios to which the MP and ECPs have been shown to be robust.

The approach proposed in SCRS/2024/104 is, in essence, the one applied by Merino *et al*. (2019) for ALB-N MSE. Based on this study, the current ALB-N MP is robust to some potential climate impacts. However, it should not be referred to as fully robust to climate change, as the hypotheses tested are not necessarily accurate or comprehensive about future climate impacts.

2.1.11 A Review of objectives, reference points, and performance indicators for Management Strategy Evaluations at tRFMOs

SCRS/2024/028 reviewed the management measures related to Management Strategy Evaluation (MSE), processes at the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Inter-American Tropical Tuna Commission (IATTC), the Indian Ocean Tuna Commission (IOTC), the Western and Central Pacific Fisheries Commission (WCPFC), and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) to document the reference points and probability limits used in these MSEs. While there were some similarities, it found no common best practices emerging from the analysis.

The Group discussed the need to clearly define how performance metrics are calculated for the purposes of comparison, including defining the years over which reference points were calculated and how probabilities are calculated (e.g., tallying the number of years that fall below B_{LIM}, whether or not a simulation falls below B_{LIM}).

The Group further raised concerns regarding the use of extreme ("tail") probabilities, noting that they are often more challenging to characterize. Probability density functions should also be explored, which may provide information on the distribution and potential multi-modality of the distributions. Additional performance metrics should continue to be considered within MSEs.

2.2 ICCAT MSE feedback

2.2.1 BFT stakeholder poll

The West Atlantic Bluefin Tuna Rapporteur presented "MSE poll regarding the MSE process" (SCRS/2024/059) provided originally at the Intersessional Meeting of Bluefin Tuna Species Group, in 2024 April (Anon., 2024d). The poll seeks to gather feedback from Panel members and the Commission on how effective the SCRS has been in presenting MSE process and information to date. The objective is to identify best practices for the dialogue among managers, scientists and stakeholders that is fundamental to MSE. The SCRS will use the input to improve the process and increase the overall degree of MSE literacy among participants.

The Group agreed that the poll holds value and discussed the intended survey group, weighing the benefits of having one response per CPC or opening it up to any past MSE meeting participants for more general feedback. The Group agreed that the poll will be most effectively requested from each CPC's Head Delegate to the Commission. The managers' view is what is most relevant for this poll. A second round of polling may be used to seek additional feedback from a broader range of participants.

The Group agreed to finalize the poll at the September SCRS meetings. The poll will be revised based on inputs received at this meeting to eliminate any bias in questions and to focus on this as a positive learning process. The updated poll will then be sent to the SCRS Species Group Rapporteurs to beta test responses. A refined, draft final poll will then be produced and presented in September as an SCRS document. It will include a description of how data will be analyzed and treated, especially with respect to data confidentiality.

The Group agreed that the SCRS Chair will ask the Commission Chair to distribute the survey to CPC Heads Delegates to the Commission. To maximize the response rate, the request will emphasize the importance of this information to improve and streamline ICCAT's MSE processes. The poll will be sent between the SCRS Plenary and Commission annual meetings when ICCAT is at the forefront of CPCs' minds.

2.2.2 Presentation and approval of MSE review questionnaire

In 2023, the Commission provided €30,000 in funding to solicit an external review of ICCAT's MSE processes. Regrettably, no bids were received in response to last year's Call for tenders, perhaps because the funding was inadequate for the amount of work required, including meeting with all of the SCRS Species Group Rapporteurs.

The Chair presented a proposal SCRS/P/2024/078, "MSE Process Scorecard for ICCAT Stocks", to attempt to streamline the review to be more commensurate with the available funding and generate interest among

potential independent expert reviewers. However, the Group feared that the truncated desktop review would be inadequate to provide the level of detail sought by this review and could inadvertently undermine the progress to date.

The Group therefore decided to reissue the 2023 Call for tenders, changing only the delivery dates as appropriate. If no bids are received, the Secretariat noted that ICCAT will soon embark on its third independent review, and given MSE spans both the SCRS and Commission functioning, the MSE process could be included in that overarching review.

3. Catch per unit effort modelling best practices

3.1 Catch per unit effort modelling for stock assessment

An overview (SCRS/P/2024/080) of good practices in CPUE standardization for stock assessment was presented by the meeting's invited External Expert speaker, Dr Simon Hoyle (Hoyle *et al*., 2024). The review focuses on issues that are most relevant to tuna RFMOs and that support the development of recommendations for CPUE analyses. Additional comments were provided on two issues of interest to the WGSAM: i) content recommendations for CPUE papers, and ii) approaches for providing CPUE for use in management procedures.

The Group enquired about the recommendation from the paper that asserts that breaking CPUE series is not a good practice. There are alternatives to not breaking the CPUE including modelling a change in catchability.

It was mentioned that using ratios of species in the catch as a proxy for targeting can lead to hyperstability. Species proportions can change through time simply due to changes in abundance so, in some cases the ratios may not reflect changes in targeting. The use of clustering is generally preferred to the use of species ratios and ideally clustering should use other attributes in the clustering process, not just exclusively species composition of the catch.

The use of joint indices as an alternative to individual indices in stock assessment was supported by the Group. The Group noted, however, that such joint indices often do not include all fleets in the fishery as some fleets are unable to share the data or the data are not available for them. The External Expert suggested that in most cases it is not practical to combine more than one fleet type in a joint index (e.g., longline and baitboat).

A critical issue related to the standardization of CPUE for bycatch is to understand whether there have been any changes in operations (e.g., changes in market demand, etc.) or in data reporting (new reporting obligations) related to bycatch.

The Group discussed the ability to estimate effort creep (i.e., increasing catchability over time) and considered the recommendation from the External Expert of assuming a minimum percentage of effort creep in stock assessments. Advances in technology tend to improve efficiency in all industries and many of such improvements are small and due to different factors. Therefore, the use of a constant annual efficiency gain is seen as a reasonable modeling practice for many industries and the authors suggest it should be the same for the fishing industry. It was proposed that average effort creep rates could be estimated globally for each type of gear and applied to stock assessments. Assuming a constant effort creep rate may be better than assuming that such a rate is zero, as is generally the case in most ICCAT stock assessments. The authors report, that vessel replacement alone can justify effort creep for the longline fleets in the order of 0.5 to 1.5% per year.
If data are available for some of the covariates that contribute to effort creep (e.g., vessel ID, use of GPS, etc.) the standardization process will be able to account for part of the effort creep. In such cases, the stock assessment team may have to decide how much of the expected effort creep has already been accounted for during standardization.

It was noted that the challenge of estimating effort creep is similar to that of estimating trends on natural mortality. Indirect methods or metadata analysis are often used to generate estimates of natural mortality for use in stock assessments. Estimating effort creep within the assessment model is as challenging as estimating natural mortality within the assessment model. It was proposed to use analogous approaches

for effort creep to those used for natural mortality, for example, to estimate priors from data obtained for similar fisheries elsewhere or from global analyses of effort creep.

It was discussed that when using CPUEs in the application of harvest control rules for MSE, it is best to refit the entire CPUE series, with the new data rather than maintain the CPUE model that was used during MSE development.

The Group also discussed the possibility of updating the CPUE chapter in the ICCAT Manual but considered postponing it to include further details on spatial explicit CPUE models like Visual, Agile, Simple Threat Modeling (VAST). It was suggested that as a minimum, guidance provided by the Group should be more easily accessible through the ICCAT webpage.

3.2 Review and potential revision of SCRS CPUE paper standards

The Group reviewed SCRS/2024/060 and SCRS/2024/061 which highlight the important aspects of the VAST model fitting process that must be considered when evaluating a spatial-temporal model. VAST models incorporate spatial and spatio-temporal correlations as Gaussian random fields, handling non-linear relationships and missing data.

The Group discussed the author's proposal on the subjective and necessary decisions one must make and convey in a VAST CPUE standardization document, and the additional proposal on the model selection and validation process with spatial-temporal model specific diagnostics (Thorson, 2019). Finally, it was demonstrated how VAST could be used to generate size or age disaggregated indices to help interpret whether the age or size composition of a combined index was changing over time.

The documents also compared the performance of alternative model setups other than VAST. Questions were asked about the imputation of location information used in the VAST analyses. It was unclear whether the comparisons of performance of VAST vs other models were performed correctly as some temporal covariates are used both in the imputation process and in the standardization model.

The Group agreed to recommend that the spatial structure used in CPUE standardization should be compatible with the fleet structure used in the stock assessment model(s).

The Group highlighted, however, that CPUE indices can be useful for purposes other than stock assessments. VAST models, for example, can provide spatially explicit estimates of abundance for the evaluation of spatial closures or other spatial management measures. It was also noted that the applications in SCRS/2024/060 and SCRS/2024/061 were conducted for a relatively small area (a few degrees of latitude and longitude) in comparison to the area of the whole stock. Ideally, spatially explicit CPUE models should represent a larger portion of the stock. Doing that may be challenging as detailed information on location is not often available for all fleets. The Group suggested that the benefit of implementing a more explicit spatial model such as VAST must always be weighted against the increase in the complexity of the modelling effort. Models such as VAST may be sometimes superior to traditional generalized linear models (GLM) and generalized linear mixed models (GLMM), but not always. The Group suggested that models like VAST can reduce biases in the estimates of variance for the index related to changes in the spatial distribution of fishing effort.

The Group reviewed the guidance table for CPUE standardization developed last year (Anon., 2023) and discussed adding new elements, largely following the recommendations provided in SCRS/P/2024/080. The resulting discussion led to the addition of a few new elements as indicated below. It was agreed that the guidance in the table applies mostly to the generalized linear model (GLM), the generalized linear mixed model (GLMM), and the generalized additive model (GAM). There is a need to expand the guidance for elements that are specifically relevant to other types of CPUE standardization, such as models that account explicitly for spatial autocorrelation (e.g., VAST) and for models that explicitly include habitat such as those that model interactions of gear and fish as a function of depth. Some specific guidance for such models can be found in Thorson (2019). These additional guidelines will be further considered at a future meeting of WGSAM.

Guidelines for the presentation of SCRS papers on CPUE standardization

- Data descriptions & discussion
    - Major management changes, including TACs (updated table)
    - Record keeping/logbook/observer changes through time (updated table)
    - Expert or scientific quality control
    - Catch
        - Unit of catch (numbers or biomass).
        - Discard rates through time
        - Species identification issues through time
    - Effort (e.g., set, trip, etc.).
    - Available covariates
    - Other noteworthy data quality issues through time
    - Stage I data grooming
        - Data filters, proportions remaining at each stage
        - Core vessel selection process
    - Imputation of covariates
    - Representativeness (% coverage) of fleet & stock/region through time
        - Percent positive observations (i.e., sets, trips, etc.)
- Characterization (plot everything)
    - Map the temporal distribution of sample/fishing effort
    - Temporal/spatial distribution of size frequency, maturity, sex ratio, and species composition (as applicable)
    - Fleet characteristics (e.g., capacity, turnover, and equipment changes)
    - Set characteristics (e.g., set times, hooks per basket, gear material, hook types, and the number of hooks)
    - Stage II quality control of the final data set
- Targeting
    - Discussion on the definition of targeting
    - Data exploration (e.g., species composition, set characteristics, nominal targets)
    - Identification of "core fleet"
    - Description of the methodology of quantifying any targeting including diagnostics
- Describe models
    - Assumptions
    - Model selection process
    - Model formula, statistical distribution assumptions
    - Description of characterization of uncertainty in the standardized model
- Diagnostics
    - Residual plots (e.g. standard, quantile, plots by covariate, DHARMa (R package, (Hartig, 2022)) simulated residual plots, and spatial resolution)
    - Coefficient plots
    - Influence plots

- Covariate influence plots
- Stepwise plots
- Residual implied coefficient plots (show the trend for each area/vessel/cluster)
- Plot standardized index vs nominal index through time, and the ratio
- Retrospective pattern analysis (similar to a stock assessment technique).

- Outputs

  - Tables of sample sizes, number of observations (records, trips, vessels), nominal and standardized CPUEs, and variance
  - Estimates of coefficients, including coefficient plots
  - Variance tables
  - The corresponding items of the Species Group CPUE Evaluation Table (Table 1 in Anon., 2017)

4. Bycatch Estimation Tool (BYET)

4.1 Contractor progress report

SCRS/024/018 presented the results of the 2023 training workshop and recommendations on improving the bycatch estimator tool (BYET).

The Group reviewed the progress made by the contractors in the development of the BYET. Based on the recommendations made during the beta-testing workshop conducted in 2023, the contractors described a series of improvements that are planned to be included in the tool. The Group inquired if any of the proposed improvements have already been incorporated in the BYET, and if that is the case if there is already a new version of the tool available. The contractor indicated that such improvements have yet to be made to the current version of the BYET. The authors of the tool will continue to develop guidelines and outputs to facilitate documenting the methodology used in bycatch estimation.

4.2 BYET training workshop in 2024 and possible workshop in 2025

The Group discussed the upcoming ICCAT Workshop on the use of the Bycatch Estimation Tool (15-17 July 2024). It was noted that the Terms of Reference (ToRs) for the workshop requires participants to provide their own data. The Group inquired if the contractors would provide any resources with regard to the needed data. It was noted that there is a plan in place to provide the participants prior to the workshop with guidelines to ensure that the data will be in the necessary format to use as input in the BYET.

The Group noted that one of the requirements for the participants of the training workshop is to have some expertise in R programming language. Recognizing that such a requirement will limit the number of scientists that can participate in future training and use the BYET, the Group inquired about the possibility of developing a web-based Shiny App as an interface to run the R code of the BYET. While the contractors indicated that developing such an App is conceptually possible, the development of the Shiny App will require additional financial resources.

The Group asked which were the criteria used to select the participants for the 2024 training workshop. It was explained that the criteria stated that the participants are the national scientists responsible for estimating bycatch, have working knowledge of the R programming language, and have access to observer and logbook data.

Besides the upcoming 2024 training workshop, the Group indicated that an additional workshop will be needed in 2025 to increase capacity building. It was noted that a similar recommendation was made by the Subcommittee on Ecosystems and Bycatch regarding further training for the BYET.

Finally, the Group discussed the need for additional funding to support the further development of the BYET, the development of the Shiny App, and additional training workshop. Given the heavy workload of the WGSAM, it was agreed the need to prioritize in the workplan the tasks of the Group and the request for

funding. Besides funding from the Commission, voluntary financial contributions from CPCs were identified as another potential source of funding.

5. Climate change

5.1 Comments on the Climate Change Proposed Plan of Action

The SCRS Chair had requested that the Climate Change Proposed Plan of Action, which will be considered during the Meeting of the Joint Experts on Climate Change on 2-3 July 2024, be placed on the WGSAM Agenda for discussion. In opening discussion on this item, the SCRS Chair explained that the Meeting of the Joint Experts on Climate Change will be a joint meeting of the SCRS and Commission, and that the SCRS should actively participate in the discussion of the proposed action plan, identifying any positive aspects or potential additions, as well as any concerns, such as feasibility, appropriateness and current lack of resources to carry out the proposed Plan.

Many of the proposed actions may involve changes in SCRS methodologies. Therefore, the SCRS Chair was seeking input from the WGSAM not only on the overall proposed plan of action but also particularly regarding implications and opportunities with respect to methods. It was noted that several relevant questions are included in the Annex of the Climate Change Proposed Plan of Action.

The Group noted that the proposed Plan of Action was very broad without many specific questions for which the SCRS could provide good and/or specific answers. Therefore, the Group provided some overall comments.

It was agreed that, until objectives are clearer or specific tasks are identified, it would be premature to evaluate the additional resources (e.g., data, personnel, infrastructure, research funding, and participation of national scientists with relevant expertise) that may be needed. With respect to the adequacy of the current SCRS structure, the Group was informed that the SCRS Workshop held on 18-20 March 2024 recommended that climate change issues initially be addressed using the current SCRS structure instead of creating new working groups.

The Group considered that it may be a good idea for the WGSAM to focus on one or two topics where there is existing expertise and experience and where progress can be made in the near term (e.g., MSE and CPUE standardization). There was an agreement that MSE was a clear avenue, where potential robustness tests could be tested to provide advice that may be somewhat robust to climate change. It is worth mentioning that the climate change impacts are not clear yet and might remain unclear in the future, thus the SCRS advice is not expected to be fully robust to the effects of climate change (i.e. climate safe), but the MSE robustness tests should aid in the selection of Management Procedures (MPs) that could be considered relatively more robust to the tested climate change effects than other candidate MPs.

The Group also noted that there are NOT yet clear definitions of terms like “climate safe, climate ready”, etc., and it should be avoided to use ambiguous terminology that is not yet clearly defined.

It was mentioned that VAST and other similar spatiotemporal models may be useful tools to evaluate the impact of climate change on CPUE standardization.

5.2 Identification of climate change questions most relevant to managing the stocks
5.3 Unification of future climate scenarios to consider

Two additional subtopics under this section i) identification of climate change questions most relevant to managing the stocks, and ii) Unification of future climate scenarios to consider, were not sufficiently discussed due to time constraints.

6. Recommendations

Recommendations with financial implications

1. The Group recommended that besides the 2024 training workshop, an additional Bycatch Estimation Tool (BYET) training workshop be organized in 2025 with the expectation that this will increase the number of CPCs that will report (dead and live discards).

2. The Group recommended implementing the recommendations from the BYET workshop in 2023 as well as the development of the Shiny App as an interface to run the R code of the BYET and to consider any further suggestions from this year upcoming 2024 workshop.

Recommendations without financial implications

1. The Group recommended that a set of standardized graphics and tables which should be included in each of ICCAT MSE products be established. These standardized graphics are intended to foster more consistent messaging between MSEs. The standard package of plots should include (e.g., boxplots of selected performance indicators with or without violin overlay, Kobe time-series plots, time series of relative biomass and fishing mortality, tradeoff plots, and a table of results, or "quilt plot"). Ideally, a standard set of performance indicators for the boxplots, tradeoff plots, and quilt plots should also be agreed, noting that different plots are better suited to display results for different types of performance indicators (e.g., boxplots and violin plots show variability across simulations, which does not work as well for performance indicators that are expressed as a probability). The Group further recommended that the standardized set of graphics be included in a graphical user-friendly App.

2. The Group recommended that a set of default climate change robustness tests related to impacts on recruitment or natural mortality parameters be included in all ICCAT MSEs. Further consideration should be placed on how those robustness OM scenarios are developed and conditioned. These robustness tests could be revised to reflect stock-specific changes as relevant information becomes available.

3. The Group recommended that the ICCAT webpage include MSE-related materials with different restriction levels of access and detailed information for the use of the SCRS and open public.

4. The ICCAT software catalogue aims to document the procedures taken to validate software that is commonly used by the various Species Groups. The Group recommended that the software used for MSEs be included on the ICCAT webpage. The Group recommended adding FLBEIA and openMSE with link to the GitHub FLBEIA repository and openMSE website, respectively, where documentation, the release versions, and the updated code are available.

5. The Group recommends that the Species Groups define during the data preparatory meeting their preferred approach for estimating the uncertainty in the stock status evaluation, either a single "best" assessment model or a grid approach with the axis of uncertainty and the levels defined for each axis.

7. Workplan for 2025

The Chair introduced a draft of a workplan for 2025 that will be finalized intersessionally and will be presented at the SCRS plenary meeting.

8. Other matters

8.1 SCRS documents

SCRS/2024/084 identified a Markov chain Monte Carlo (MCMC) workflow for obtaining uncertainty of derived and estimated parameters from Stock Synthesis with an example application from North Atlantic blue shark (a relatively data-poor stock).

The authors noted that the MCMC workflow implemented in their example application can be useful to identify and reformulate poorly estimated stock assessment parameters (primarily selectivity) and can speed up stock assessment MCMC run time. The authors recommended that if the MCMC workflow is used, then integrating the MCMC workflow into the stock assessment model development and diagnostic review could be beneficial.

The Group discussed whether it is necessary to do MCMC for an assessment to show the within-model uncertainty, and provide the Kobe phase plot and Kobe II strategy matrix (K2SM). The authors noted that the 2019 Meeting of the Working Group on Stock Assessment Methods Meeting (Anon., 2019) discussed multiple methods of calculating within and among model uncertainty to provide a Kobe phase plot and the K2SM, including a multivariate log-normal (MVLN) Monte-Carlo approach for estimating structural uncertainty about the stock status and future projections. The Group discussed that the MVLN method provides a promising solution that would allow producing the Kobe phase plot and K2SM in time for the adoption of the stock assessment report. This could also be a method to combine output from multiple modelling platforms, but care must be taken that important differences between models are adequately reported and not lost in the presentation.

The Group discussed the use of a structural uncertainty grid and appropriate methods to weight individual runs, and how the between-model uncertainty may compare to the within model uncertainty. The Group noted that this is an active area of research, and that it is related to the weighting of operational models in an MSE process. The Group discussed the situations where structural uncertainty is more influential, or larger than the within model uncertainty, and vice versa, and how to provide advice in these situations.

The Group noted that clear guidance for the assessment framework should be given in data preparatory meetings and if MCMC is to be investigated this should happen after the initial continuity runs to investigate the ability of MCMC to adequately characterize the uncertainty, and that the assessment groups indicate how uncertainty should be characterized in the assessment.

It was suggested that the Species Groups need to define during the data preparatory meeting their approach to use for estimating the uncertainty in the stock status evaluation, either a single "best" assessment model or a grid approach with the axis of uncertainty and the levels defined for each axis. For the latest option, it will also be important for the Species Groups to agree to the weighting scheme for the grid components. Then the modeler team should develop an intersessional work plan agreed by the Species Group that provides:

1. diagnostics and decisions on the single or grid approach models,
2. to evaluate if uncertainty definitions are reasonable or probable, based on the available evidence and their biological coherence, as well as
3. to identify possible combinations of parameters in the grids that are biologically unlikely.

The objective is for the Species Group to have sufficient material to complete the work and produce management advice during the assessment meeting.

The Group also recommended continuing the statistical comparison of the Multivariate Lognormal (MVLN) approach for estimating uncertainty versus the MCMC for different species and scenarios.

The Report of the Intersessional Meeting of the Subcommittee on Ecosystems and Bycatch (Anon., 2024f) described potential demographic indicators for assessing whether a population exhibits an age and size distribution that is indicative of a healthy stock that can be provided from current stock assessment results. The indicators are those considered by the International Council for the Exploration of the Sea (ICES) Workshop to compare the indicators for Common Fisheries Policy (CFP) and Marine Strategy Framework Directive (MSFD) D3 management objectives through simulations (WKSIMULD) (ICES, 2024), and the author noted that this document was discussed at the Intersessional Meeting of the Subcommittee on Ecosystems and Bycatch in May 2024 (Anon., 2024f) and the document was not presented to this Group.

The Chair noted that it would be difficult to make any recommendations on issues referenced from a document that was not presented to the Group. The Group generally agrees those indicators may be useful, but there could be several other age-based indicators and indicators need a clear link to management

advice. The Group considers that each Species Group would be a more suitable place to discuss and consider indicators in the Report of the Intersessional Meeting of the Subcommittee on Ecosystems and Bycatch (Anon., 2024f) for their assessments.

8.2 Software catalogue

During the presentation of SCRS/P/2024/074 (see section 2), it was proposed to include the FLBEIA package in the ICCAT stock assessment software catalogue. FLBEIA is a simulation toolbox implemented as an R library that facilitates the development of bio-economic impact assessments of fisheries management strategies. It is built under a management strategy evaluation framework using Fisheries Library in R (FLR) libraries. FLBEIA is a peer-reviewed software used by ICES and the North Atlantic Fisheries Organization (NAFO), and is used in ICCAT multi-stock tropical tunas MSE and North Atlantic albacore MSE processes. The Group agreed to include FLBEIA in the ICCAT web page by linking it to the FLBEIA GitHub page, with the necessary documentation (e.g., summary, reference, user manual).

The Chair reminded the Group that the stock assessment software in the catalogue needs to have, for example, documentation, version control, error checks, simulation tests, and a user manual. The Group was also reminded that the protocol for including an item in the ICCAT software catalogue was created in 2015 at the 2015 Intersessional Meeting of the Working Group on Stock Assessment Methods (WGSAM) (Anon., 2016), and it was suggested to update this procedure since the SCRS has been moving from a stock assessment paradigm to a paradigm that includes MSE.

The procedure established in 2015 requests to:

1. Contact chairs of species working groups with a summary of the old requirements and additional issues that have arisen since the establishment of the Software Catalogue, e.g. related to the Strategic Plan, Kobe advice framework, ICES Strategic Initiative for Stock Assessment Methods (SISAM) (ICES, 2012) / World Conference on Stock Assessment Methods (WCSAM) held in Boston, United States, 15-19 July 2013, recent assessment, and the use of stock assessment methods as part of a Management Procedures (MP) when conducting MSE.
2. Ask chairs to review if the old requirements are still adequate or need updating and to propose a set of revised requirements.
3. Ask chairs to use these new requirements to "certify" the new version of the Stock Production Model Incorporating Covariates (ASPIC) (as an example).
4. Canvass views of software developers since if the process becomes too burdensome then no software will be developed.
5. Canvass views of other RFMOs and bodies that use stock assessment methods.
6. Present the results of the exercise to the SCRS which would approve a new protocol.

Related to the ICCAT webpages for the software catalogue and MSE, the Group also discussed technical issues regarding the former recommendation by the Group in 2023 that the Secretariat update the MSE webpage of ICCAT's website to include capacity building materials and information pertinent to each of ICCAT's current five MSE processes, including trial specification documents, results summaries, Commission decisions and links to code and Shiny Apps. The Secretariat expressed the necessity of the SCRS guidance on sharing the MSE materials since some of them have not been publicly opened yet. The Group recommended different levels of access to detailed information for the use of the SCRS results, and creating an ad hoc sub-group including the Secretariat to discuss bringing up a proposal for the SCRS. It was suggested to review by the Ad Hoc Sub-group on MSE Communications the following overall elements:

1. MSE by species:

    a. Documentation (e.g., BFT Technical Specifications document)
    b. Code source (restrict access)
    c. App specifically designed for a given MSE process
    d. Runs evaluations

        i. Reference grid
        ii. Robust runs/climate change runs?
        iii. Updates

iv. Annual (EC) and time-scheduled MP evaluation (TACs)

e. Relevant SCRS papers
f. Relevant Commission-adopted Recommendations and Resolutions

2. MSE resources:

a. Links to MSE educational tools
b. ICCAT MSE communication resources

i. Ambassadors
ii. Presentations to COM/Panels
iii. Reports
iv. Others

8.3 Research funding

The SCRS Chair reminded the Group that all working groups and subcommittees have been requested to develop long-term (6-year) research plans, to facilitate strategic research planning, inform on the timing and likely duration of research projects and sequencing, and aid in coordinated planning across the SCRS. In addition, specific research requests including funding requirements should be provided for the initial 2 years, to coincide with the Commission's primary budgeting cycle and to be reviewed at the SCRS Plenary and included in the SCRS annual report. This recommendation is extended to the WGSAM to be developed soon following the formats and guidelines in the *Report for Biennial Period 2022-2023, Part II (2023), Vol. 2* and 2024 SCRS Workshop held on 18-20 March 2024 and to be aligned within the next SCRS Strategic Plan.

The SCRS Chair further informed the Group that, in accordance with current funding guidelines that have changed from previous years, the Science budget for 2024 must be used strictly in line with the approved budget by the Commission, which is detailed in Table 1 of Appendix 2 to ANNEX 7 to the *Report for Biennial Period 2022-2023, Part II (2023), Vol. 1*. No extensions will be permitted, but minor changes between budget line items can be considered. For example, if after receiving budget approval from the Commission the Group determines that one project requires more money than originally estimated, and that another project can be carried for less money than anticipated, it may be possible to shift funds from the overfunded project to the underfunded project. This flexibility does not, however, extend to closing out one funded budget item entirely in order to provide greater funding to another.

In order to enable the full use of provided funds within the designated calendar year, the SCRS Chair emphasized the importance of receiving all ToRs for Science funding soon after the SCRS Plenary. As such, the Secretariat would have more time to complete its administrative processes for issuing contracts. In this way, Calls for tenders or Quotation requests could be issued earlier. The SCRS Chair pointed out that these guidelines, and particularly the deadline for developing ToRs, were consistent with both the development of longer-term research plans (approximately six years), and the detailed budget requests covering the next two years. This will also facilitate the discussion of proposed science budget requests for submission to the SCRS Plenary meeting. Having all the ToRs prepared before the annual Commission meeting should help the Commission consider science funding requests, in addition to helping projects start sooner. Given the new guidelines on the use of funds, this efficiency is critical.

The optimal process for developing ToRs would be to draft ToRs to be brought to the annual meeting of the Group, having been developed in collaboration with the Group by correspondence to the extent possible. The long-term research plan can serve as guidance. This allows the Group to finalize review and adoption of the ToRs within the limited time available at the meeting. However, it is acknowledged that some new research proposals may emerge during the meeting, with no time to develop ToRs during the meeting. At the discretion of the Group, the Group can authorize the development of the ToRs after the meeting following general guidance from the Group. This work could be carried out by the WGSAM Chair and/or the SCRS Chair, or an identified sub-group. The development of ToRs in this manner is a common, established process within the SCRS.

The Group acknowledged the new guidelines and the importance of providing the ToRs in advance of the annual Commission meeting.

9. Adoption of the report and closure

The report was adopted during the meeting. The Chair of the Group thanked all the participants for their efforts. The meeting was adjourned.

References

Anonymous. 2016. Report of the 2015 Intersessional Meeting of the ICCAT Working Group on Stock Assessment Methods (WGSAM) (Miami, USA – 16 to 20 February 2015). Col. Vol. Sci. Pap. ICCAT, 72(8): 2249-2303.

Anonymous. 2017. Report of the 2017 ICCAT Working Group on Stock Assessment Methods Meeting (WGSAM) (Madrid, Spain, 8-12 May 2017). Col. Vol. Sci. Pap. ICCAT, 74(2): 331-378.

Anonymous. 2019. Report of the 2019 ICCAT Working Group on Stock Assessment Methods Meeting (WGSAM) (Madrid, Spain, 8-12 April 2019). Col. Vol. Sci. Pap. ICCAT, 76(5): 1-43.

Anonymous. 2020. Report of the 2020 Intersessional Meeting of the ICCAT Bluefin Tuna MSE Technical Group (Madrid, Spain, 24-28 February 2020). Col. Vol. Sci. Pap. ICCAT, 77(2): 1-74.

Anonymous. 2021. Report of the First 2021 Intersessional Meeting of the Bluefin Tuna Species Group (including BFT-W Data Preparatory) (Online, 5-13 April 2021). Col. Vol. Sci. Pap. ICCAT, 78(3): 1-145.

Anonymous. 2023. Report of the 2023 Meeting of the Working Group on Stock Assessment Methods (Madrid/hybrid 15-18 May 2023). Col. Vol. Sci. Pap. ICCAT, 80(6): 1-50.

Anonymous. 2024c. Report of the 2024 ICCAT Intersessional Meeting of Bluefin Tuna Species Group (hybrid/ Sliema, Malta from 15 to 18 April 2024). SCRS/2024/003 (in press).

Anonymous. 2024f. Report of the 2024 ICCAT Intersessional Meeting of Subcommittee on Ecosystems and Bycatch (hybrid/ Madrid, Spain from 27 to 31 May 2024). SCRS/2024/006 (in press).

Goikoetxea N., Arrizabalaga H., Erauskin-Extramiana M., Merino G., Andonegi E, Santiago J. 2024. Climate change effects on albacore tuna, a review. SCRS/2024/077 (in press).

Hartig F. 2022. DHARMa: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models. R package version 0.4.6, https://CRAN.R-project.org/package=DHARMa

Hordyk A., Huynh Q., Carruthers T. 2021. openMSE: Easily Install and Load the 'openMSE' Packages. R package version 1.0.0, https://CRAN.R-project.org/package=openMSE.

Hoyle S., Campbell R.A., Ducharme-Barth N.D., Grüss A., Moore B.R., Thorson J.T., Tremblay-Boyer L., Winker H., Zhou S., Maunder M.N. 2024. Catch per unit effort modelling for stock assessment: A summary of good practices. Fisheries Research 269 106860.

ICES. 2012. Report on the Classification of Stock Assessment Methods developed by SISAM. ICES Expert Group reports (until 2018). https://doi.org/10.17895/ices.pub.22725281.v1.

ICES. 2024. Workshop to compare the indicators for CFP and MSFD D3 management objectives through simulations (WKSIMULD3). ICES Scientific Reports. 6:4. 165 pp. https://doi.org/10.17895/ices.pub.25266475.

Merino, G., Arrizabalaga, H., Arregui, I., Santiago, J., Murua, H. *et al*. 2019. Adaptation of North Atlantic Albacore Fishery to Climate Change: Yet Another Potential Benefit of Harvest Control Rules. Frontiers of Marine Science. 6: 620. https://www.frontiersin.org/articles/10.3389/fmars.2019.00620/full

Thorson, J.T. 2019. Guidance for decisions using the Vector Autoregressive Spatio-Temporal (VAST) package in stock, ecosystem, habitat and climate assessments. Fish. Res. 210: 143–161. Elsevier B.V. doi:10.1016/j.fishres.2018.10.013.

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Management Strategy Evaluation

    2.1 Review the progress and direction on current MSE efforts

        2.1.1 North Atlantic albacore MSE (ALB-N MSE)
        2.1.2 Atlantic bluefin tuna MSE (BFT MSE)
        2.1.3 North Atlantic swordfish MSE (SWO-N MSE)
        2.1.4 Western skipjack tuna MSE (SKJ-W MSE)
        2.1.5 Multi-stock tropical tunas MSE for eastern skipjack, bigeye, and yellowfin
        2.1.6 Standardized graphics for reporting MSE results: an update to Slick
        2.1.7 FLBEIA: A simulation model to conduct bio-economic evaluation of fisheries management strategies
        2.1.8 Observation error model for the new Management Strategy Evaluation framework for North Atlantic albacore
        2.1.9 A preliminary roadmap for MSE development
        2.1.10 Developing the climate test: robustness trials for “climate-ready” management procedures
        2.1.11 A Review of objectives, reference points, and performance indicators for Management Strategy Evaluations at tRFMOs

    2.2 ICCAT MSE feedback

        2.2.1 BFT stakeholder poll
        2.2.2 Presentation and approval of MSE review questionnaire

3. Catch per unit effort modelling best practices

    3.1 Catch per unit effort modelling for stock assessment
    3.2 Review and potential revision of SCRS CPUE paper standards

4. Bycatch Estimation Tool (BYET)

    4.1 Contractor progress report
    4.2 BYET training workshop in 2024 and possible workshop in 2025

5. Climate change

    5.1 Comments on the Climate Change Proposed Plan of Action
    5.2 Identification of climate change questions most relevant to managing the stocks
    5.3 Unification of future climate scenarios to consider

6. Recommendations

7. Workplan for 2025

8. Other matters

    8.1 SCRS documents
    8.2 Software catalogue
    8.3 Research funding

9. Adoption of the report and closure

Appendix 2

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Appendix 3

List of papers and presentations

Doc. Ref.	*Title*	*Authors*
SCRS/2024/018	Expert-driven testing and proposed improvements to a bycatch estimator toolkit	Babcock B., Harford W.J., Adao A., Gedamke T.
SCRS/2024/028	A review of objectives, reference points, and performance indicators for management strategy evaluation at tRFMOs	Taylor N.G., Miller S., Duprey N.
SCRS/2024/060	Standardization of the fishery dependent index of abundance for Atlantic bluefin tuna in the southwestern Nova Scotia using spatio-temporal modelling based on VAST: 1996 to 2022	Akia S., Hanke A.
SCRS/2024/061	Standardization of the fishery dependent index of abundance for Atlantic bluefin tuna in the southern gulf of St Lawrence using spatio-temporal modelling based on VAST: 1988 to 2022	Akia S., Hanke A.
SCRS/2024/084	Example application of MCMC with ADNUTS for a North Atlantic blue shark Stock Synthesis model	Courtney D., Rice J.
SCRS/2024/103	A preliminary roadmap for MSE development	Carruthers T.
SCRS/2024/104	Developing the climate test: robustness trials for climate-ready management procedures	Carruthers T.
SCRS/P/2024/063	Updated summary on North Atlantic ALB MSE	Arrizabalaga H, Merino G., Urtizberea A.
SCRS/P/2024/073	Observation error model for the new Management Strategy Evaluation framework for North Atlantic albacore	Urtizberea A., Morón G., Merino G., Arrizabalaga H.
SCRS/P/2024/074	FLBEIA: Bio-Economic Impact Assessment in FLR	García D., Sanchez S., Prellezo R., Urtizberea A., Andrés M.
SCRS/P/2024/075	Towards standardized graphics for communicating MSE results: an update to Slick	Hordyk A., Miller S.
SCRS/P/2024/076	State of development of tropical tuna Management Strategy Evaluation	Merino G., Urtizberea A., Correa G., Laborda A.
SCRS/P/2024/077	ICCAT bluefin tuna Exceptional Circumstances provisions	Walter J., Rodriguez-Marin E.
SCRS/P/2024/078	MSE process scorecard for ICCAT stocks	Schirripa M.
SCRS/P/2024/079	North Atlantic swordfish MSE – update for WGSAM	Gillespie K.
SCRS/P/2024/080	Good practices in CPUE standardization for stock assessment	Hoyle S., Campbell R.A., Ducharme-Barth N.D., Grüss A., Moore B.R., Thorson J.T., Tremblay-Boyer L., Winker H., Zhou S., Maunder M.N.

Appendix 4

SCRS documents and presentations abstracts as provided by the authors

SCRS/2024/018 - Babcock (2022), R library (https://ebabcock.github.io/BycatchEstimator/), has developed a toolkit that uses model-based and design-based procedures in a semi-automated process of estimating total annual bycatch by expanding the data from an observer program to the total effort from logbooks or landings records. As part of ongoing efforts to improve the functionality and user-experience of this toolkit, an expert-driven hybrid workshop was conducted July 25th to 27th, 2023 in Miami, Florida, USA. The goal of this workshop was to allow experts familiar with bycatch data and statistical aspects of fisheries bycatch estimation to engage in 'beta-testing' of the BycatchEstimator R package. Workshop participants recommended changes to the workflow of the R package, allowing data setup, design-based estimators, and model-based estimators to be separate steps to improve user experience and to maintain scientific rigor throughout the analysis. Participants also contributed a comprehensive list of user experience and technical recommendations that will enable this toolkit to become more widely accessible to users and comprise a deeper set of statistical methods and diagnostics for bycatch estimation.

SCRS/2024/028 - We reviewed the management measures related to management strategy evaluation processes at the International Commission for the Conservation of Atlantic Tunas, the Inter-American Tropical Tuna Commission, the Indian Ocean Tuna Commission, the Western and Central Pacific Fisheries Commission, and the Commission for the Conservation of Southern Bluefin Tuna. We defined a set of data fields to create a database of Performance Indicators and associated probability requirements, as well as objectives for desired stock status, yield, and safety (as expressed by limit reference points, LRPs), and variability in yield. We show that with respect to yield and status criteria, the tRFMOs have defined relatively consistent objectives in that they are striving to maximize catches and achieve maximum sustainable yield. While LRPs were not consistently defined among tRFMOs, the establishment of probabilities in avoiding them were relatively consistent. Finally, the criteria used to measure variability in yield and the magnitude of the variance permitted in management procedure (MP) design varied greatly across the tRFMOs.

SCRS/2024/060 - The vector autoregressive spatio-temporal approach (VAST) was used to derive relative abundance indices for the Atlantic Canadian harpoon, rod and reel and tended line bluefin tuna fishery for the period 1996-2022. This work aims to improve the Hanke's (2022) standardized CPUE series by better accounting for spatial and temporal variation and incorporating environmental factors. Spatio-temporal factors, vessel effects, Julian day, fishing effort, gear, fleets and sea surface temperature were the main covariates considered in the models. The best and most significant model predicted 43% of the variance in bluefin tuna catch, with spatio-temporal factors, vessel effects, fleet, Julian day, and sea surface temperature explaining the majority of this variation, respectively. The best model was used to estimate relative abundance indices by size class.

SCRS/2024/061 - The vector autoregressive spatio-temporal approach (VAST) was used to derive relative abundance indices for the southern Gulf of St Lawrence Atlantic bluefin from the 1988-2022 Canadian rod and reel and tended line fisheries data. This work aims to improve the Hanke (2022) standardized CPUE series by better accounting for spatial and temporal variation and incorporating environmental factors. Spatio-temporal factors, vessel effects, Julian day, fishing effort, gear, fleets, sea surface temperature, and herring spawning stock biomass were the main covariates considered in the models. The best and most significant model predicted 44% of the variance in bluefin tuna catch, with spatio-temporal factors, vessel effects, fishing effort, herring biomass, and sea surface temperature explaining the majority of this variation, respectively. The best model was used to estimate relative abundance indices by size class.

SCRS/2024/084 - This paper provides an example application of Markov Chain Monte Carlo (MCMC) to assess the uncertainty in the 2023 North Atlantic blue shark (*Prionace glauca*) stock assessment implemented in Stock Synthesis. This study follows a previously published approach for regularizing poorly informed parameters, implementation of parallel computing and the use of the Automatic Differentiation No U-Turn Sampler (ADNUTS) algorithm. By using sequential shorter chains and iterative model regularization, prior to a multiple longer MCMC chains this approach has the potential to reduce what can be prohibitively long MCMC run times for integrated assessment models and provide insights into the robustness of estimated and derived parameters. However, it can be difficult to reformulate previously completed stock assessment models to achieve MCMC convergence diagnostic criteria without conducting an in depth review of each model reformulation. Consequently, we recommend integrating MCMC regularization into the stock assessment model development process, rather than after the stock assessment has been completed.

SCRS/2024/103 - A tentative roadmap for the development of management strategy evaluation frameworks is presented. The aim of the roadmap is to provide the participants of an MSE with a concise path to the adoption of an MP in which processes, products, and roles are clearly defined. The roadmap is intended to be comprehensive and aimed at new MSE processes where for example, managers are not yet familiar with MSE terminology, concepts and procedures and may not yet have explicit performance objectives.

SCRS/2024/104 - The research on climate change impacts on pelagic fish species was reviewed and organized into the theoretical linkages between climatological processes, oceanographic properties affecting habitat, mechanisms of impact and relevant operating model dynamics. The most cited impacts on species biology, ecology and behaviour related to spatial distribution, larval survival, range contraction, adult survival and condition factor. Since few quantitative predictions of climate impacts have been made with regard to these aspects, expert judgement was used to specify proof-of-concept climate tests that included moderate and extreme cases of declining somatic growth, condition factor, adult survival and mean recruitment strength. A range of management procedure (MP) archetypes were tested for their robustness to the climate scenarios including empirical index-target and index-ratio MPs, and model-based stock assessment MPs with and without harvest control rules. MPs that specified effort controls or size limits provided more robust conservation performance for climate tests than their equivalents providing catch advice. Stock assessment model MPs providing catch advice were substantially more robust to declining survival and recruitment when also incorporating a harvest control rule. In general, the most challenging climate tests involved declining survival and recruitment with these leading to larger impacts on yield outcomes than biomass outcomes.

SCRS/P/2024/063 - Presentation provided an update of the ALB MSE process that led to the adoption of the first "full" management procedure (MP) for northern albacore (Rec. 21-04), including a harvest control rule, the way to determine stock status and a protocol for exceptional circumstances. The MSE process lasted more than 10 years, since the Commission requested the SCRS to develop a limit reference point for this stock (Rec. 11-04). The presentation showed a summarized chronology of key actions by Panel 2 (e.g. definition of management objectives in 2015, the adoption of performance statistics in 2016), the interactions between scientists and managers (e.g. communication of results about MP performance and advice to develop the exceptional circumstances protocol), and some technical characteristics of the MSE framework. In the period 2023-2026 a second round MSE is being conducted based on the 2023 Stock Synthesis reference case. The Reference Set of OMs, robustness tests and observation error model are described, as well as a review on climate change effects to potentially inform robustness tests.

SCRS/P/2024/073 - This presentation provided the observation error model for the new northern albacore (ALB-N) MSE, which included a presentation of the Stock Synthesis-conditioned base case model and the axes of uncertainty that will be built into the reference and robustness OM grids. Details of the observation modeling approach were presented, with an emphasis on how data would be generated in the MSE projection period to maintain autocorrelation, variance, and relationship to the vulnerable biomass or abundance depending on the CPUE. Statistical properties (autocorrelation, lag, and significance, along with index standard deviation) of residuals and estimated catchability for each fitted index for ALB-N were presented. The historical time series of the CPUE were introduced in three different ways to evaluate what is the most appropriate way of introducing them in the MSE: observed values, simulated observed values considering uncertainty with a CV of the CPUE, simulated observed values applying an error to the vulnerable biomass or abundance like the approach used in the projection. The ALB-N MSE was projected with recent average catches and high catches to ensure acceptable model behavior and continuity between historical and projection period dynamics

SCRS/P/2024/074 - This presentation introduced FLBEIA, an R package to conduct bioeconomic impact assessment model and evaluate different management strategy under MSE framework. FLBEIA is being used for northern albacore and mixed fisheries tropical tunas MSE. The model is flexible and can accommodate multiple stocks, multiple fleets, métiers within the fleets and it can be seasonal. OM can accommodate environmental, ecosystem, and socioeconomic covariates. The model is developed in a modular way to facilitate the development and use of new functions. The presentation includes links to the documentation and package source code (https://github.com/flr/FLBEIA) and associated documentation (https://flr-project.org/ , https://github.com/flr/FLBEIA/blob/master/vignettes/FLBEIA_manual.pdf).

SCRS/P/2024/075 - Management strategy evaluation produces a large amount of results. Summarizing those results in a concise and informative way so that they are useful for decision makers is a persistent challenge. A further challenge for decision makers is that the results from different MSE processes are often presented in different ways, requiring a considerable effort for decision makers to familiarize themselves with the format of the figures and tables each time they are presented with new results. This presentation proposes the development of a standardized set of figures and tables for summarizing MSE results. It introduces Slick, an R package and online application that has been developed as a tool for effective and interactive communication of MSE results. An overview of the main features of Slick is provided, and discussion points are raised to further the conversation focused on developing a standardized process for communicating results in ICCAT MSE processes

SCRS/P/2024/076 - The North Atlantic swordfish MSE process is scheduled to conclude development of major items in 2024: revisions to the combined index, refinement of CMPs, and calculation of final performance metric values. Technical development of the MSE began in 2018 and after a series of revisions to the operating model grid, two primary axes were identified: steepness and natural mortality. A variety of candidate management procedures were developed and scored against performance metrics identified by Panel 4. Recent updates to the combined index of abundance required that final CMP results be re-calculated. These results will be presented to Panel 4 and stakeholders in June and October 2024. The technical team continues its development of climate change and minimum size limit robustness tests.

SCRS/P/2024/077 - The bluefin tuna chairs presented progress on the BFT MSE which primarily consists of the adoption of exceptional circumstances provisions and annual determination of whether exceptional circumstances exist.

SCRS/P/2024/078 - *Summary not provided by the author*.

SCRS/P/2024/079 - The North Atlantic swordfish MSE process is scheduled to conclude development of major items in 2024: revisions to the combined index, refinement of CMPs, and calculation of final performance metric values. Technical development of the MSE began in 2018 and after a series of revisions to the operating model grid, two primary axes were identified: steepness and natural mortality. A variety of candidate management procedures were developed and scored against performance metrics identified by Panel 4. Recent updates to the combined index of abundance required that final CMP results be re-calculated. These results will be presented to Panel 4 and stakeholders in June and October 2024. The technical team continues its development of climate change and minimum size limit robustness tests.

SCRS/P/2024/080 - Indices of abundance based on fishery catch-per-unit-effort (CPUE) are critically important components of tuna RFMO stock assessments, since fishery-independent surveys are unavailable. Standardizing CPUE to develop indices that better reflect the relative abundance requires the analyst to make numerous decisions, which are influenced by factors that include the biology of the study species, the structure of the fishery of interest, the nature of the available data, and objectives of the analysis such as how the index will be used in a subsequent assessment model. Alternative choices can substantially change the index, and hence stock assessment outcomes and management decisions. To guide decisions, advice on good practices is provided in 16 areas, focusing on decision points: fishery definitions, exploring and preparing data, misreporting, data aggregation, density and catchability covariates, environmental variables, combining CPUE and survey data, analysis tools, spatial considerations, setting up and predicting from the model, uncertainty estimation, error distributions, model diagnostics, model selection, multispecies targeting, and using CPUE in stock assessments. Often the most influential outcome of exploring and analysing catch and effort data is that analysts better understand the population and the fishery, thereby improving the stock assessment process.