



**SCIENTIFIC COMMITTEE  
EIGHTEENTH REGULAR SESSION**

Online meeting  
10-18 August 2022

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**DRAFT**  
**Terms of reference for an independent peer review of uncertainty characterisation  
including ensemble model approaches in WCPFC stock assessments**

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**WCPFC-SC18-2022/ SA-IP-09**

**21 July 2022**

SPC-OFP

## Background

Characterisation of uncertainty in stock assessment outputs has become a prominent discussion topic at Scientific Committee (SC) meetings, given the different approaches used across the assessments of tuna, billfish and sharks that are reported to the WCPFC. More recently, there has been a focus on the issue of model selection and or weighting in structural uncertainty grids. This led to requests by the SC for the Scientific Services Provider to explore objective weighting procedures for structural uncertainty grid model outputs. Furthermore, the recent assessment of southwest Pacific Ocean swordfish ([Ducharme-Barth et al. 2021](#)) presented a more comprehensive characterisation of uncertainty. This assessment attempted a more objective approach to weighting and selecting models for inclusion in an ensemble model grid, and also incorporated the estimation uncertainty associated with individual models. While the approaches applied in the swordfish assessment were well received by the SC, that analytical approach may not be feasible for all assessments. There is therefore not a one-size-fits-all approach when it comes to characterising stock assessment uncertainty, and this can present some confusion for managers when they use the uncertainty associated with a stock assessment output as their basis for risk assessment.

Recognising the importance of stock assessment uncertainty as the basis for assessing management risk, and the ongoing research in this area, a review of the approaches used to characterise uncertainty in WCPFC tuna, billfish and shark stock assessments is recommended. This was noted at SC17 with support to develop an SC project Terms of Reference (TOR) for *Further development of ensemble model approaches for presenting SA uncertainty* (P17X4; Table WP-02, [SC17 Outcomes Document](#)). This paper provides the basis for such a TOR to be presented to WCPFC19 for funding should it be supported by SC18. That work will also be informed by the outputs of SC project 107b refining scientific advice for Southwest Pacific blue shark assessment (see SC18-SA-WP-03).

The initial approach is to define a TOR consistent with the indicative project budget of USD 20,000 for 2023 (Annex 1, [WCPFC18 Summary Report](#)). This is described in ‘TOR1’ below. Given the amount of work involved in the review it is expected that a paid consultancy will be required rather than a voluntary review panel more typical of independent stock assessment reviews. The WCPFC Secretariat will need to consider the process for selection of reviewer(s).

Additionally, for SC consideration we separately suggest an expansion of the TOR (‘TOR2’) to provide a broader review of uncertainty characterisation within WCPO stock assessments, which would:

- Consider the differences among, and benefits and drawbacks of, the approaches currently employed for various WCPFC assessments, in the context of the management systems and how the assessment outcomes are used to inform management and risk.
- Identify and recommend approaches from the international literature and consider the applicability of selected approaches for evaluating both the ‘estimation’ and ‘structural’ uncertainty across a subset of WCPFC assessments (including case studies of tuna, billfish and shark).

SC18 would need to define the stock assessments to be reviewed under this extended TOR to cover a range of approaches while ensuring a tractable undertaking. Synthesis of the outcomes of this wider review by SC would provide a guide to managers on the implications of alternative approaches to characterising uncertainty and management risk. Noting that while it is not expected that managers should be making recommendations on how uncertainty is characterised, they should be able to consider the implications of alternative approaches when risk is considered.

# TOR1

## Objectives

1. Review the ensemble approach to model uncertainty taken within the 2021 southwest Pacific Ocean swordfish assessment ([Ducharme-Barth et al. 2021](#)) to capture both ‘structural’ and ‘estimation’ uncertainty, and provide advice on the utility of the approach for other WCPFC stock assessments.
2. Evaluate the approaches used within that assessment to select models to include in structural uncertainty grids, cognisant of the initial ensemble grid and findings of SC18 in relation to SC18-SA-WP-03, and review the implications for advice. If possible, within the funding constraints conduct a similar review of project 107b - refining scientific advice for Southwest Pacific blue shark assessment (see SC18-SA-WP-03).
3. Provide recommendations for model ensemble construction, model retention, and weighting of models included in ensembles in the context of the tuna, billfish and shark assessments reviewed by WCPFC SC.
4. Recommend approaches for characterising both ‘estimation’ and ‘structural’ uncertainty in stock assessment outputs and how the uncertainty characterisation should be used in provision of scientific advice, with a focus on the context of the management systems and decision-making processes used by the WCPFC.

## Scope and Outcomes

The scope of this review is the 2021 southwest Pacific Ocean swordfish assessment (and if possible project 107b - refining scientific advice for Southwest Pacific blue shark assessment (see SC18-SA-WP-03), specifically the approach taken to characterise estimation and structural model uncertainty within that assessment and to provide management advice.

The outcomes of this review work are expected to:

1. Provide a basis for stock assessment teams to better consider the approaches to model selection and weighting when characterising stock assessment uncertainty across the WCPFC tuna, billfish and shark assessments; and
2. Ultimately provide managers and stakeholders with a better understanding of the implications of alternative approaches to characterising uncertainty for their perceptions of risk.

## Key activities and outputs from the peer review

Activity	Output	Timeframe
1. Consultant to conduct initial planning meeting with SPC and other key scientists that have been involved in ensemble model developments for the WCPFC assessments.	Meeting conducted	1 month
2. Review the ensemble approach to model uncertainty taken within the 2021 southwest Pacific Ocean swordfish assessment (Ducharme-Barth et al. 2021) (and project 107b - refining scientific advice for Southwest Pacific blue shark assessment (see SC18-SA-WP-03) if possible).	Report chapter,	2 months
3. Evaluate the approaches used within the 2021 southwest Pacific Ocean swordfish assessment to filter models within the grid and implications for advice. (and project 107b - refining scientific advice for Southwest Pacific blue shark assessment (see SC18-SA-WP-03) if possible).		
4. Provide recommendations for model ensemble construction, model retention, and weighting of models included in	Report chapter	1 month

ensembles.		
5. Recommend approaches for characterising estimation and structural uncertainty in scientific advice in the context of the management systems and decision-making processes used by the WCPFC.		
6. Final report compiled and submitted to SC19, plenary presentation to SC19.	Final report	1 month
Total project duration is expected to be 5-6 months, cost approx. 20,000 USD		

## TOR2

TOR2 represents additional activities to those under TOR1. TOR2 activities would be included within the overall final project TOR, dependent upon SC18 decisions and available funding.

## Objectives

1. Review and describe the approaches for characterising uncertainty in SC18-selected WCPFC integrated stock assessments for tuna, billfish and sharks over the last 5 years and consider how uncertainty and risk was communicated in the context of the management systems and decision-making processes used by the WCPFC.
2. Assess the suitability of approaches for characterising uncertainty in the context of SC's provision of advice, and the management systems and decision-making processes used by the WCPFC.
3. Provide recommendations on the wider approaches for characterising uncertainty within WCPFC assessments within the report developed under TOR1.

## Scope and Outcomes

The scope of this review is specific SC18-selected tuna, billfish and shark assessments that have been reported to the WCPFC Scientific Committee over the last 5 years.

The outcomes of this review work are expected to:

1. Provide a basis for stock assessment teams to better consider and apply alternative approaches for characterising stock assessment uncertainty across the WCPFC tuna, billfish and shark assessments,
2. Provide guidance to SC on the utilisation of outputs in the provision of advice; and
3. Ultimately provide managers and stakeholders with a better understanding of the implications of approaches to characterising uncertainty for their perceptions of risk.

## Key activities and outputs from the peer review

Activity	Output	Timeframe
1. Dependent upon the assessments selected by SC18, conduct initial planning meetings with the relevant service providers of stock assessments to the WCPFC.	Meetings conducted	1 month
2. Review the approaches for characterising uncertainty in WCPFC integrated stock assessments for tuna, billfish and sharks over the last 5 years.	Report chapter	1 month
3. Assess the suitability of approaches for characterising uncertainty in the context of the management systems and decision-making processes used by the WCPFC.		
4. Provide recommendations on the wider approaches for characterising uncertainty within WCPFC assessments within the report developed under TOR1.	Report chapter	1 month
Total project duration is expected to be consistent with that of TOR1, cost approx. additional 10,000 USD		

**We invite SC18 to:**

- Note the applicability of this review to WCPFC assessments and management advice more broadly, and for the development of operating models for MSE work.
- Decided whether to include project 107b - Refining scientific advice for Southwest Pacific blue shark assessment as part of TOR1.
- Confirm that this project continues to be a priority for inclusion in the 2023 budget and that a full TOR and associated budget be provided based on TOR1 or TOR1 plus TOR2.