



**SCIENTIFIC COMMITTEE  
TWENTIETH REGULAR SESSION**

Manila, Philippines  
14-21 August 2024

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**Re-evaluation of the Skipjack Management Procedure Estimation Method - Planned Approach**

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**WCPFC-SC20-2024/MI-WP-01  
4<sup>th</sup> August 2024**

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## Executive Summary

The estimation method (EM) is an important component of the management procedure (MP). Its role is to provide a reliable estimate of stock status that can be used by the harvest control rule (HCR) to determine future fishing opportunities. For WCPO skipjack, given the stock biology and reliance on tagging information, the EM adopted in CMM 2022-01 was comparable, but not identical to, the diagnostic case model of the 2019 stock assessment.

Following the first implementation of the adopted interim skipjack MP, the monitoring strategy highlighted that while sufficient data were available to run the MP, the continued decline of pole and line fishing effort in the tropical regions presents a potential problem for the future running of the MP. This was reflected in the WCPFC20 Summary Report (paragraph 302). A re-evaluation of the estimation method was recommended prior to the next implementation of the MP (in 2026) as a high priority.

This paper summarises potential options for changing the existing estimation method within the WCPO skipjack management procedure to address the issues raised by the monitoring strategy. It provides SC20 with a timeline to consider for the next 2 years prior to the running of the skipjack MP in 2026. A technical workshop, organised by SPC, to gain external expert input into the EM re-evaluation issues is recommended. Potential approaches to modify the estimation method of the WCPO skipjack interim MP include:

1. Modification of tropical CPUE abundance indices in the existing estimation method along the lines of the approach taken using purse seine CPUE data by the 2022 stock assessment.
2. Development of a catch conditioned model, as was conducted in the 2022 assessment.
3. Further investigation of alternative stock assessment platforms and modelling approaches.

It is proposed that a re-evaluation of the revised approach will be presented to SC21 with agreement of the updated MP at WCPFC22, prior to the next running of the skipjack MP in 2026.

### **SC20 is invited to:**

- Consider and provide advice on the options provided for re-evaluating the WCPO skipjack interim MP estimation method; and
- Consider the proposed timeline for the re-evaluation process.

## Introduction

The estimation method (EM) is an important component of the management procedure (MP). Its role is to provide a reliable estimate of stock status that can be used by the harvest control rule (HCR) to determine future fishing opportunities. The MP can be classed as either empirical, employing an EM based on direct observation data of fishery status (i.e., CPUE indices of abundance), or model based where, for example, the EM is based on a stock assessment model to derive estimates of stock status.

SC16-MI-IP-09 describes the testing of the estimation method ultimately adopted within the WCPO skipjack management procedure. Given the biology of skipjack, the ability to estimate stock status is reliant on the ongoing tagging programme within the WCPO. Following testing of alternative estimation methods, the adopted EM was comparable, but not identical, to the diagnostic case model within the 2019 stock assessment. The settings of this fixed implementation of MULTIFAN-CL are described within Annex 2 of CMM 2022-01.

Following the first implementation of the adopted interim skipjack MP as required by CMM 2022-01, the monitoring strategy (SC19-MI-WP-02 and WCPFC20-2023-14\_Rev1) highlighted that while sufficient data were available to run the MP, pole and line fishing effort in tropical regions continues to decline and presents a potential problem for the future running of the MP. A re-evaluation of the estimation method was recommended prior to the next implementation of the MP (in 2026) as a high priority. This was reflected in the WCPFC20 Summary Report (paragraph 302).

This paper summarises potential options for changing the existing estimation method within the WCPO skipjack management procedure to address the observations of the monitoring strategy. It provides the SC20 with a timeline to consider for the next 2 years prior to the next running of the skipjack MP.

## Potential approaches for updating the estimation method

Options for addressing the potential future challenges arising from the decline in the tropical pole and line fishery for the estimation method are described below.

### Test the approach applied in the 2022 WCPO skipjack stock assessment

In the 2022 stock assessment (Castillo-Jordan et al., 2022), noting the challenges with reduced pole and line CPUE data within the tropical region, survey fisheries were created from purse seine fisheries within regions 5, 6, 7 and 8 of the assessment model. In Region 5 a standardised CPUE index was used based on data from the Philippines domestic purse seine fishery, primarily fishing on anchored FADs in the high seas pocket 1 (HSP-1) (Bigelow et al. 2019). For the remainder of the tropical region, CPUE series were developed using free school purse seine sets and VMS data on distance between sets as the effort metric. Associated (drift FAD) sets were considered more prone to hyperstability effects, and the influence of highly targeted fishing supported by information from acoustic satellite buoys (Tears et al., 2022). Distance between sets was considered a better effort metric than set or day as it would be more influenced by the abundance and distribution of unassociated skipjack schools, which is expected to better reflect changes in stock size. Purse seine VMS data are only available from 2010 so these indices are currently not available prior to that year. There may be potential to explore logbook information for proxies of travel distance that may facilitate extending the free school CPUE abundance indices prior to 2010.

A comparable approach utilising free school purse seine indices of abundance within the existing estimation method could be explored as a potential solution to the problem of declining pole and line

effort in the equatorial region. The use of a purse seine index to inform the EM appears appropriate, and perhaps is the only tangible option for a CPUE index into the future. However, as noted within the 2022 assessment care is needed to ensure that the index is not influenced by hyperstability and effectively tracks the underlying population abundance.

### **Examine catch-conditioned EMs**

The full MULTIFAN-CL catch-errors stock assessment for skipjack has a long run-time, taking around 10 hours to reach model convergence, which makes it impractical when simulation testing performance as part of a management procedure. To overcome the issue of lengthy run-times, the skipjack EM (as defined in CMM 2022-01) was developed as a more constrained variant of the full assessment, with initial parameters based on the 2019 skipjack assessment.

Recent assessments using MULTIFAN-CL, including the 2022 skipjack assessment, have moved from a catch-errors to a catch-conditioned approach, to reduce complexity and parameterisation. In combination with trials of the use of free school purse seine data as a tropical index of abundance, utilising the catch-conditioned approach may improve general EM performance and provide a viable longer-term option.

### **Examine alternative assessment platforms**

The current assessment of WCPO skipjack tuna utilises the MULTIFAN-CL stock assessment software that has been developed specifically to address the challenges of assessing tuna stocks in the WCPO, and notably the need to incorporate spatial structure and tagging data. Alternative assessment platforms such as SS3 and CASAL could be examined as the basis for an alternative EM, although we note that a challenge for alternative platforms is the importance of the tagging data for WCPO skipjack stock estimation. Previous attempts to use SS3 as the basis for an assessment for skipjack highlighted the difficulty this platform had in dealing with the significant levels of tagging data available, and in particular, the requirement to input tagged fish with ages rather than lengths (Takeuchi and Langley, 2016). However, recent developments in these software platforms warrants further evaluation. There are various other stock assessment platform that are being reviewed as part of WCPFC Project 123 that could also be considered in the context of their suitability as EM models.

### **Evaluate tag-based models**

Given the importance of tagging data for the skipjack assessment and the quantity of data available, the potential to examine an EM based primarily on tagging data might be considered. Initial analyses in this respect investigated the development of a tag-based tuning index that could be used within the a4a stock assessment package (Scott, et al. 2017; Jardim, et al. 2015). The relative simplicity of such an approach is appealing, however, recent experience in the development of EMs for other tuna stocks in the WCPO (see for example Scott, et al., 2024) indicate that best results are obtained when information from several types of data are combined, rather than using only a single source of information. Further work is however recommended to explore the use of tag-recapture data in external analysis to provide stock status indicators. Recent work for skipjack in the IATTC suggests some promise in this area.

### **General observations**

Within the harvest strategy approach, the operating models and estimation method should not be too similar. Where there is insufficient separation between the design, structure and model assumptions of the operating models and the EMs, important sources of uncertainty may not be adequately represented. This can lead to 'overly positive' performance when testing candidate MPs. While the

situation for skipjack is somewhat constrained given the importance of tagging information in model estimates of stock status, taking advantage of the opportunity to examine alternative EMs that are less similar to the operating models should be considered. In this regard we recommend that SPC runs a dedicated technical workshop with invited external ‘experts’ to discuss the challenges and potential options for alternative approaches to the estimation method within the skipjack MP.

CCMs noted that the implementation of the skipjack MP, at WCPFC20, had incorporated revisions to the historical data, whereas no such revision to historical data had been considered when developing and testing the MP. In some cases these data revisions were the result of inevitable changes when CPUE and tag recapture time series are updated. In other instances the revisions were due to updated catch and effort records for some fisheries. The extent to which historical data may change due, for example, to the routine updating of time series, should be more clearly detailed when running the MP and the impacts of revisions to catch and effort be investigated to provide clearer advice on the possibility of exceptional circumstances occurring.

## Indicative timeline for WCPO skipjack EM re-evaluation

An indicative timeline for the re-evaluation of the WCPO skipjack EM is provided in Table 1.

Table 1. Timeline of activities and decision points

Year	Meeting	Proposed input	Notes
2024	SMD2	Discussion of relevant SC20 outcomes	
2025	Technical Workshop	SPC technical workshop of estimation models, with focus on the skipjack EM	Invited experts, organised and run by SPC
	SC21	Performance of alternative EMs presented to SC and advice provided	New SKJ assessment is scheduled for this meeting
	WCPFC22	Commission agreement of updated MP and update of CMM 2022-01 Annex 2.	
2026	SC22	Implementation of 2 <sup>nd</sup> running of the MP and provision of advice.	
	WCPFC23	Actions as per para 8 of CMM 2022-01	

## Summary

Potential approaches to modify the estimation method of the WCPO skipjack MP are outlined as:

- Modification of tropical CPUE abundance indices in the existing estimation method along the lines of the approach taken using purse seine CPUE data by the 2022 stock assessment.
- Development of a catch conditioned model, as was conducted in the 2022 assessment.
- Further investigation of alternative stock assessment platforms and modelling approaches.

Information on the revised approach will be presented to SC21 with agreement of the updated MP at WCPFC22, prior to the next running of the skipjack MP in 2026.

## Recommendations

### SC20 is invited to:

- Consider and provide advice on the options provided for re-evaluating the WCPO skipjack interim MP estimation method; and
- Consider the proposed timeline for the re-evaluation process.

## References

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