



COMMISSION
SIXTEENTH REGULAR SESSION
Port Moresby, Papua New Guinea
5 – 11 December 2019

AN OVERVIEW OF PROGRESS IN DEVELOPING WCPFC HARVEST STRATEGIES

WCPFC16-2019-09
19 November 2019

SPC-OFP

Pacific Community (SPC), Noumea, New Caledonia

Executive Summary

WCPFC11 adopted CMM 2014-06 to develop and implement a harvest strategy approach for the management of key fisheries and stocks in the WCPO. Subsequently, WCPFC12 adopted a work plan and indicative timeframes for the development and adoption of harvest strategies, as required by CMM 2014-06. The work plan outlines, in broad terms, the necessary Commission level decisions for the implementation of Harvest Strategies for key WCPO tuna stocks and fisheries. Whilst a substantial amount of work has been completed and significant progress has been made, it is necessary to revise and update some elements of the work plan. This document outlines the elements of a harvest strategy and details the progress that has been made to date in developing these elements for each of the four tuna stocks as well as the outstanding issues that still need to be addressed in order to meet the objectives of CMM 2014-06.

Progress towards developing and implementing the respective elements of a harvest strategy for each of the four tuna stocks and their associated fisheries is summarised in the table below.

	SKJ	SP-ALB	BET	YFT
	Tropical Purse Seine	Southern Long Line	Tropical Long Line	
Management Objectives	Noted	Noted	Noted	
Performance Indicators	Identified	Identified	Identified	
Reference Points	LRP Interim TRP	LRP Interim TRP	LRP	LRP
Harvest Control Rules	Candidate HCRs tested	Example HCRs		
Management Strategy Evaluation	Developed	Developing		
Monitoring Strategy	Developing			

Table. Summary of progress towards implementing the harvest strategy elements for key WCPFC stocks and fisheries. Dark green shading indicates elements for which substantial progress has been made, light green shading indicates elements for which work is currently underway and orange shading indicates elements for which work has not yet begun.

Current progress has focussed on developing single stock evaluation frameworks for skipjack and South Pacific albacore. However, the development of frameworks for bigeye and yellowfin will require further consideration of mixed fisheries interactions. SC15 considered potential approaches for modelling mixed fisheries in the WCPO harvest strategy evaluations and endorsed the initial use of a hierarchical approach based on a collection of single species models. This allows the development of harvest strategies for skipjack and south Pacific albacore tuna to proceed initially on a single species basis and be subsequently incorporated into a mixed fishery, multi-species framework that includes bigeye and yellowfin tuna as well as other relevant stocks and fisheries.

Although the deadlines are ambitious and there is still some work to be completed and decisions to be taken, WCPFC remains on course for the implementation of single species harvest strategies for skipjack tuna in 2020 and South Pacific albacore tuna in 2021. The development of the mixed fishery hierarchical approach, however, is likely to require more work and the implementation of harvest strategies for bigeye and yellowfin tuna may require more time than currently scheduled within the work plan.

Introduction

WCPFC11 (2014) adopted CMM 2014-06 to develop and implement a harvest strategy approach for the management of key fisheries and stocks in the WCPO. WCPFC12 (2015) adopted a work plan and indicative timeframes for the development and adoption of harvest strategies, as required by CMM 2014-06. The work plan has been routinely considered and, where necessary, updated at subsequent Commission meetings.

The work plan outlines, in broad terms, the necessary Commission level decisions for the implementation of harvest strategies for skipjack tuna by 2020, for South Pacific albacore tuna by 2021 and for bigeye and yellowfin tuna by 2022. These goals were considered to be ambitious. Although a substantial amount of work has been completed and significant progress has been made towards achieving them, for some elements it is necessary to update and revise the work plan.

This document outlines the elements of a harvest strategy. It details the progress that has been made to date in developing these elements for each of the four tuna stocks and the outstanding issues that still need to be addressed in order to meet the objectives of CMM 2014-06.

Elements of a Harvest Strategy

Some harvest strategy elements have been addressed at the fishery level whilst others have, so far, been addressed only at a single species level. To the extent possible, it is intended that WCPFC harvest strategies be developed at the fishery level to appropriately account for mixed fishery and multi-species issues. However, due to the complexity of developing a multi-species modelling framework, work has initially focussed on a single species approach for skipjack and South Pacific albacore. Options for including mixed-fishery interactions in the modelling framework are currently under consideration (see WCPFC-SC15-MI-WP06).

CMM 2014-06 specifies that wherever possible, and where appropriate, each harvest strategy shall contain the following six key elements: Management objectives; performance indicators; management reference points; harvest control rules that have been tested by management strategy evaluation and a monitoring strategy.

Management Objectives

Management objectives underpin the harvest strategy approach and many of the other harvest strategy elements relate directly to them. Whilst it is expected that, once identified, management objectives will not change dramatically, they can, as for all other elements of a harvest strategy, be revised and amended periodically as and when the need arises.

Based on discussions at several working groups, most notably MOW1 from which the strawman proposal (WCPFC10-2013-15b) was developed, defined operational objectives have been recorded for the tropical purse-seine fishery, the tropical longline fishery and the southern longline fishery. These high level objectives identify the long-term management goals for the economic and social outcomes from the fishery, and biological sustainability of the stock.

Performance Indicators

Performance indicators translate the high level, and often qualitative, management objectives into quantitative metrics that measure the performance of a harvest strategy in terms of achieving those

management objectives. Performance indicators are used both for the development and testing of candidate harvest control rules (HCRs¹) and for the monitoring of an HCR once it has been adopted (see monitoring strategy).

When developing and testing candidate HCRs, performance indicators are calculated from the results of simulations to compare and contrast the expected performance of each candidate HCR relative to the others. When monitoring the performance of an adopted HCR, performance indicators are calculated from real-world observations to determine if the HCR is performing as expected. To the extent possible, these two sets of performance indicators should be the same. However, the monitoring strategy may contain additional PIs that cannot be adequately modelled in the simulation framework (e.g. PI 5).

For the purpose of developing and testing candidate HCRs, candidate performance indicators corresponding to management objectives have been proposed for skipjack tuna in relation to management objectives for the tropical purse-seine fishery (WCPFC13, Attachment M); for bigeye and yellowfin tuna in relation to management objectives for the tropical long-line fishery (WCPFC14, Attachment K) and for South Pacific albacore tuna in relation to management objectives for the southern long-line fishery (WCPFC14, Attachment K).

Reference Points

Reference points are benchmarks that allow managers to compare the current status of a stock, or performance of a fishery, to desirable, or undesirable, levels. Often they are defined in terms of stock biomass or some level of biomass depletion. Limit reference points (LRPs) identify conditions, such as very low stock biomass levels at which recruitment can become impaired, that should be avoided with high probability. Target reference points (TRPs) identify stock levels corresponding to desirable conditions in, for example, catches, revenue, or catch rates, and if achieved, result in a low probability of breaching the LRP.

In addition to agreeing LRPs managers should also decide on the acceptable level of risk of breaching the LRP. The acceptable level of risk may depend on the consequences of falling below the LRP (e.g. the risk of stock collapse, or on the severity of the measures necessary to rebuild the stock back to more sustainable levels) as well as the consequences for catches of other species that may be impacted in a multi-species, mixed fishery scenario. Consequently, the acceptable level of risk of breaching the LRP may vary between different stocks.

WCPFC has agreed an LRP of 20% of unfished biomass ($SB_{F=0}$) for all four tuna stocks based on the guidelines outlined in Preece et al (2011). In addition, interim TRPs have been agreed for skipjack tuna (50% $SB_{F=0}$, CMM 2015-06) and for South Pacific albacore tuna (56% $SB_{F=0}$, WCPFC15, paragraph 207). TRPs have not yet been agreed for bigeye or yellowfin tuna (WCPFC16-2019-15).

Acceptable levels of risk of breaching the LRP have not been agreed. However, WCPFC13 agreed that risk levels greater than 20% should be considered inconsistent with the LRP related principle in UNFSA and that, for the purpose of harvest strategy analyses, a range between 0% and 20% should be considered when determining the acceptability of potential HCRs (WCPFC13, paragraph 296). Ultimately, the choice of an acceptable level of risk may need to be informed by the associated trade-offs in other performance indicators from the results of MSE analyses (see below).

¹ Note that a Management Procedure (MP) comprises the data collection process, the estimation model and the HCR. When testing candidate HCRs we must consider the MP as a whole.

Harvest Control Rules

Harvest Control Rules (HCRs) are pre-agreed rules that determine how much fishing can take place given the status of the stock. The design and complexity of an HCR can vary greatly but at its most basic level it should maintain the stock around the TRP and it should reduce the level of fishing as the stock approaches the LRP.

Typically, information on the status of the stock is input to an HCR and information on the amount of allowable fishing is output from it. The inputs can be in the form of estimates of stock biomass or depletion as determined from a stock assessment model (model based HCR) or in the form of observed levels of e.g. CPUE (empirical HCR). The output from an HCR can be in the form of specific levels of allowable catch or effort, or as a scalar that applies to base levels of both catch and effort, depending on how the fishery is to be managed.

A range of model based HCRs have been investigated for skipjack tuna and have been tested using MSE to determine their likely performance in achieving management objectives (WCPFC16-2019-16). This work is ongoing. The results of these preliminary analyses can be visually inspected using the PIMPLE software package (WCPFC16-2019-11).

A small selection of exploratory, empirical HCRs have been developed for South Pacific albacore tuna that use CPUE as an index of stock status. Additional work will be required to further develop the range of candidate HCRs for albacore. No HCRs have yet been developed for bigeye or yellowfin tuna.

Harvest Control Rules and Management Procedures

The HCR cannot be considered in isolation. The performance of an HCR will depend on the quality and accuracy of the information input to it. A model based HCR, for example, that takes estimates of biomass depletion as input, may perform differently depending on the model used to determine those estimates of depletion. Similarly, the performance of an empirical HCR, that takes CPUE as an input, may vary depending on the method used to calculate the CPUE index.

A Management Procedure (MP) is the combination of data collection, estimation model and HCR. When testing HCRs we must assume a given data collection program and estimation model. As such, what we are really evaluating is the MP as a whole.

Management Strategy Evaluation

Ideally a MP should be tested prior to implementation to ensure that it is likely to achieve management objectives. The established method for testing candidate MPs uses a simulation modelling framework within a process termed Management Strategy Evaluation (MSE), which seeks to take account of all major sources of uncertainty in the biology of the stock (e.g. uncertainty in growth or recruitment) and the dynamics of the fishery (e.g. effort creep) to identify the MP that performs best and is robust to that uncertainty.

The design, development and parameterisation of the MSE simulation framework is a highly technical process that requires input from both scientists and stakeholders to ensure that the dynamics of the fishery and all major sources of uncertainty are adequately accounted for. These discussions are largely conducted through the Scientific Committee and supported by additional consultation at, for example, the pre-assessment workshop held at SPC.

The development of the MSE framework for WCPO skipjack (Scott, et al. 2019) has been based on the 2016 stock assessment (McKechnie, et al. 2016). Further work will be necessary to update the framework to the most recent 2019 stock assessment (Vincent, et al. 2019). This work is planned for SC16. However, it is not expected that the modelling framework will need to be updated with each new stock assessment. Once the framework has become established it should require only very occasional revision in the event of, for example, major changes in the perception of the state of the stock or significant changes in data availability.

Development of the MSE framework for South Pacific albacore (Scott, et al. 2019) is in its initial stages and is currently based on the most recent, 2018, stock assessment. Development of the MSE framework for bigeye and yellowfin tuna has not yet begun.

Mixed Fishery and Multi-species Approaches

SC15 considered two potential approaches for modelling mixed fisheries in the WCPO harvest strategy evaluations (Scott, et al. 2019d). Noting the challenges in developing a complex multi-species modelling framework, SC15 endorsed the initial use of a hierarchical approach based on a collection of single species models. This approach allows the development of harvest strategies for skipjack and South Pacific albacore tuna to proceed initially as single species approaches that can subsequently be incorporated into a mixed fishery and multi-species framework that includes bigeye and yellowfin tuna as well as other relevant stocks and fisheries.

Although generally supportive of the approach, SC15 noted a number of potential challenges including: the possible requirement for the inclusion of performance indicators from interacting stocks/fisheries when developing MPs for any single species; the possible need to prioritise the management of particular stocks or fisheries to avoid stock collapse; and the potential for target switching and resource substitution if one or more stocks are left unregulated.

The details and practical implementation of the hierarchical approach have yet to be fully developed, and hence further time will be needed for this element of the work plan.

Monitoring Strategy

Once an MP has been selected and implemented it should be monitored to check that it is performing as expected. The Monitoring Strategy specifies the data to be collected and the performance indicators that will be used to determine if outcomes are within the range predicted by the evaluations. To the extent possible, the performance indicators used to monitor the performance of the chosen MP should be the same as the performance indicators used to compare and select the MP from the MSE simulations.

The monitoring strategy should specify the data to be collected and the calculation of the performance indicators. Periodic full stock assessments, reviewed and agreed by SC, will also be required as part of the Monitoring Strategy to calculate performance indicators that are based on estimates of biomass or biomass depletion.

A second component of the Monitoring Strategy is a periodic review of the MSE simulation framework. This is necessary to ensure that the data and assumptions (e.g. the distribution of fishing) that were used to test and select the MP remain appropriate. As new data become available or as the dynamics of the fishery change over time it may be necessary to revise the design and assumptions of the modelling framework and the sources of uncertainty that need to be accounted for.

In the event that the MP deviates significantly from expected performance it may be necessary to re-evaluate the management procedure or, in severe cases where there is considered to be a risk to the stock, take remedial action. Such events are termed Exceptional Circumstances. The monitoring strategy should outline, in broad terms, the process for determining whether exceptional circumstances exist and the necessary action that should be taken in the event that they do exist.

The monitoring strategy for WCPO skipjack is currently under development and it is intended that a proposed outline of its structure and content will be presented to SC16. Development of monitoring strategies for South Pacific albacore, bigeye and yellowfin tunas has not yet begun.

Summary of Progress

Progress towards developing and implementing the respective elements of a harvest strategy for each of the four tuna stocks and their associated fisheries is summarised below (Table 1).

For skipjack tuna we consider the short-term priority areas for future work are to update the simulation framework with the latest stock assessment results; the continued testing of alternative HCRs; the development of the monitoring strategy and the refinement of visualisation tools for comparing and selecting HCRs.

For South Pacific albacore tuna, short-term priority work areas include the further development of the MSE simulation framework including appropriate methods for modelling CPUE, and the design of HCRs that use CPUE as an index of stock biomass.

For bigeye and yellowfin tunas, short-term priority work should focus on mixed fishery and multi-species approaches (described above) as well as development of the MSE simulation framework for which the upcoming assessments for these stocks, scheduled for 2020, will be informative.

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Harvest Strategy Engagement

The development of harvest strategies is a stakeholder driven, consultative process that relies heavily on an effective process for dialogue. Consultation with and between members takes place through a number of fora including the formal bodies of the Commission (Scientific Committee; annual Commission meeting) as well as the annual pre-assessment workshops conducted by SPC. This engagement is supported through a process of dedicated in-country workshops that primarily provide capacity building in harvest strategy related areas.

Effective dialogue between managers and scientists (WCPFC16-2019-12) is important to ensure that the objectives and considerations of managers are adequately represented in the simulation framework and that the outputs of the MSE analyses are fully understood and interpreted correctly by managers. This will become increasingly important as the Commission embarks on the process of identifying and selecting the best performing management procedure. With a decision regarding skipjack due in December 2020 at WCPFC17, there will be a strong need for focused stakeholder engagement across the WCPFC membership during the year. SPC will plan to utilise all available opportunities, as well as national or sub-regional workshops, to consult with CCMs to support their decision-making at WCPFC17. SPC staff are available during WCPFC16 to discuss scheduling such events during 2020.

Harvest Strategy Work Plan

The harvest strategy work plan (WCPFC15, Attachment I) is routinely updated to track progress in the development of harvest strategies under CMM 2014-06. The work plan outlines, in broad terms, the Commission level decisions for the implementation of harvest strategies. This will be discussed further under WCPFC16 Agenda Item 6.7.

As noted above, the potential approach to capturing multispecies issues under the harvest strategy process has proved the most consequential issue impacting the work plan and the assumed deadlines for implementing harvest strategies, in particular for the tropical long line fishery/bigeye and yellowfin.

Although the deadlines within the work plan remain ambitious and there is still some work to be completed, WCPFC remains on course for the implementation of single species harvest strategies for skipjack tuna in 2020 and south Pacific albacore tuna in 2021. The development of the mixed fishery hierarchical approach, however, is likely to require more work and the implementation of harvest strategies for bigeye and yellowfin tuna may require more time.

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