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**PERFORMANCE INDICATORS AND MONITORING STRATEGIES FOR SKIPJACK AND SOUTH PACIFIC  
ALBACORE COMMENSURATE WITH:  
CANDIDATE MANAGEMENT OBJECTIVES FOR THE TROPICAL PURSE SEINE AND SOUTHERN  
LONGLINE FISHERIES**

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## Abstract

The report of the second WCPFC Management Objectives Workshop (WCPFC10-2013-15b MOW 'strawperson') provides a candidate list of management objectives for WCPO fisheries, including those for the tropical purse seine and southern longline fisheries. WCPFC-SC12 was requested to develop advice on a monitoring strategy to assess performance against reference points and management objectives and a range of performance indicators to evaluate the performance of candidate harvest control rules, for WCPO skipjack and South Pacific Albacore. Following discussion of paper MI-WP-04, SC12 recommended a revised version of that paper be forwarded to WCPFC13.

The management objectives identified in the MOW 'strawperson' document (WCPFC10-2013-15b) are framed at the fishery level, however, in some cases the performance indicators and monitoring strategies considered here have been translated to the stock level (i.e. WCPO skipjack and South Pacific albacore).

We use specific definitions for *performance indicators*, which are used to evaluate how well a candidate management procedure is expected to perform and which enable the selection of a preferred option from a range of candidate procedures; and a *monitoring strategy* which tracks the actual performance of the selected management procedure, once it has been implemented, to see if it is performing as expected.

The performance measures and monitoring strategies identified in this document are based on the information presented in the MOW 'strawperson' document but additionally take account of recent experience of analyses to evaluate candidate harvest control rules for skipjack (SC12-MI-WP-06), discussions on an MSE framework for WCPFC (SC12-MI-WP-05) and discussions on an earlier version of this paper at SC12. We note that the ultimate choice of performance indicators and monitoring strategies will depend on the decisions of managers on their objectives for the fishery and that recording of those objectives is scheduled for WCPFC13. Therefore, the performance indicators and monitoring strategies presented in this document are provided as potential examples, should not be seen as definitive, and may be further developed as the MSE work progresses and as WCPFC continues to refine its fishery management objectives.

## Introduction

The 'strawperson' report of the second WCPFC Management Objectives Workshop (WCPFC10-2013-15b) provides a candidate list of management objectives, performance indicators and target reference points for each of the five major fisheries (tropical longline, purse seine, southern longline, Pacific bluefin tuna and North Pacific albacore). WCPFC-SC12 was requested to develop advice on a monitoring strategy to assess performance against reference points and management objectives; and a range of performance indicators to evaluate the performance of candidate harvest control rules for WCPO skipjack and South Pacific Albacore. Following discussion of paper MI-WP-04, SC12 recommended a revised version of that paper be forwarded to WCPFC13 for information.

The management objectives identified in the MOW 'strawperson' document are framed at the fishery level, however, in many cases the performance indicators and monitoring strategies considered here have been translated to the stock level (i.e. WCPO skipjack and South Pacific albacore).

## Performance Indicators and Monitoring Strategies: Definitions

A consistent terminology for the various components of the harvest strategy approach is needed. Throughout this paper we use the following definitions for performance indicators and the monitoring strategy:

**Performance indicators** are used to measure how well a specific harvest strategy achieves some or all of the general objectives for management. They are interpreted in relation to defined limit or target reference points, or to management objectives. Reference points may not be available for all management objectives since often you want to maximise something relative to some other objective (e.g. maximise profit while ensuring a low risk of stock collapse) rather than achieve a specific value.

The **monitoring strategy** tracks the actual performance of the selected management procedure, once it has been implemented, to see if it is performing as expected and that the actual outcomes are within the range of values predicted by the MSE. For example, in the case of a management strategy that was designed to maintain catch rates at a specific level it would be necessary to monitor that, once implemented, actual catch rates are indeed maintained close to or at the desired level.

We therefore make an important distinction between performance indicators, which are used to evaluate how well a candidate management procedure is expected to perform and which enable the selection of a preferred option from a range of candidate procedures; and a monitoring strategy which tracks the actual performance of the selected management procedure, once it has been implemented, to see if it is performing as expected.

## Performance Indicators and Monitoring Strategies: Limitations

We have used the candidate management objectives for purse seine and southern longline fisheries provided in the MOW 'strawperson' report (WCPFC10-2013-15b) as well as recent experience developing candidate harvest control rules for the skipjack fishery. With respect to the performance indicators, it may not be possible to generate informative indicators for all objectives, particularly for those social and ecosystem aspects that will be technically difficult to represent in the MSE framework (operating model) and which may depend on policy decisions made outside the control

of the management procedure. For example, it will be extremely difficult to calculate performance indicators for local market prices, average national per-capita fish consumption or employment in catching and processing sectors, which in the real world depend not only on fishery performance, but government decisions and global market conditions. However, it should be relatively easy to monitor them provided that the necessary data are collected, from the actual fishery, at the appropriate scale and frequency.

To the extent possible, the metrics used to calculate the performance indicators should be the same as those used for the monitoring strategy. However, the source of the data used to calculate the metrics may be different. We use as an example a biological management objective to maintain adult biomass at or above a given level. For this objective, the performance indicator will be based on predictions of future biomass derived from the MSE simulations, whilst the monitoring strategy may be based on estimates of current biomass derived from WCPO stock assessments.

We note that the ultimate choice of performance indicators and monitoring strategies will be dependent on manager's decisions on fishery objectives. The examples of corresponding performance indicators and monitoring strategies presented here should not be seen as definitive.

### **Management objectives, performance indicators and monitoring strategies**

We present here some potential performance indicators and monitoring strategies for each of the candidate management objectives identified in the MOW 'strawperson' report (WCPFC10-2013-15b) for the tropical purse seine fishery (Table 1) and the southern longline fishery (Table 2). Subsequently, we provide some further notes on these.

Table 1. Candidate management objectives for the tropical purse seine fishery and proposed performance indicators and monitoring strategies.

Objective Type	Objective Description	Performance Indicator	Monitoring Strategy
Biological	Maintain SKJ (and YFT & BET) biomass at or above levels that provide fishery sustainability throughout their range.	Probability of $SB/SB_{F=0} > 0.5$ (SKJ) in the short- medium-long-term as determined from MSE (may also be calculated at the assessment region level).  Probability of $SB/SB_{F=0} > 0.2$ in as determined from MSE.	Current median adult biomass, as determined from the reference set of Operating Models.  Probability of $SB/SB_{F=0} > 0.2$ in the long-term as determined from the reference set of operating models
Economic	Maximise economic yield from the fishery	Predicted effort relative to $E_{MEY}$ (to take account of multi-species considerations, SKJ, BET and YFT; may be calculated at the individual fishery level). $B_{MEY}$ and $F_{MEY}$ may also be considered at a single species level.	Observed rent from the fishery relative to MEY.  Observed effort in the fishery relative to $E_{MEY}$ .
	Increase fisheries-based development within developing states (SIDS) economies, especially on-shore processing capacity.	As a proxy: Average proportion of SIDS-catch to total catch for fisheries operating in specific regions.	Percentage contribution of fisheries to GDP.  Proportion of total catch processed by SIDS  Value of product exported from SIDS.
	Maintain acceptable CPUE.	Average deviation of predicted SKJ CPUE from 2012 levels.	Observed CPUE maintained at or greater than specified levels.
	Optimise fishing effort	$E_{MEY}$ (as for Maximise economic yield ).  Effort consistent with specified level	Annual monitoring through logbook/VMS
	Maximise SIDS revenues from resource rents	Proxy: Average proportion of SIDS-effort or catch to total effort or catch for fisheries operating in specific regions	Observed proportion of SIDS-effort/catch to total effort/catch from SIDS waters from logsheet or VMS data
	Catch stability	Average annual variation in catch in the short-, medium- and long- term (may also be calculated at the assessment region level).	Observed variation in catch from logsheet data
	Stability and continuity of market supply	Average annual variation in catch in the short-, medium- and long- term (may also be calculated at the assessment region level).	Observed variation in catch From logsheet data Observed variation in market prices

			Market throughput of tuna products
Social	Affordable protein for coastal communities	As a proxy: Average proportion of CCMs-catch to total catch for fisheries operating in specific regions.	Average fish consumption per year per person relative to some target.
	Food security in developing states (import replacement)	As a proxy: Average proportion of CCMs-catch to total catch for fisheries operating in specific regions.	Ratio of locally marketed fish to imported fish products.
	Avoid adverse impacts on small scale fishers		Monitoring of fisheries in CCMs
	Employment opportunities	As a proxy: Average proportion of CCMs-catch to total catch for fisheries operating in specific regions as determined from stochastic projections.	Monitoring of fishing and processing sector in CCMs
Ecosystem	Minimise bycatch		Ratio of target species catch to catch of non-target species from observer program
	Minimise ecosystem impact	Size or age structure of population	From observer based size sampling and stock assessment outputs

Table 2. Candidate management objectives for the southern longline fishery and proposed performance indicators and monitoring strategies.

Objective Type	Objective Description	Performance Indicators	Monitoring Strategy
Biological	Maintain albacore (and SWO, YFT & BET) biomass at or above levels that provide stock sustainability throughout their range.	Probability of $SB/SB_{F=0} > ??$ in the short- medium- long-term as determined from MSE (may also be calculated at the assessment region level).  Probability of $SB/SB_{F=0} > 0.2$ in as determined from MSE.	Current median adult biomass, as determined from the reference set of Operating Models.  Probability of $SB/SB_{F=0} > 0.2$ in the long-term as determined from the reference set of operating models
Economic	Maximise economic yield from the fishery.	Predicted effort relative to $E_{MEY}$ (to take account of multi-species considerations, BET and other spp; may be calculated at the individual fishery level). $B_{MEY}$ and $F_{MEY}$ may also be considered at a single species level.	Observed rent from the fishery relative to $MEY$ .  Observed effort in the fishery relative to $E_{MEY}$ .

	Increase fisheries based development within SIDS.	As a proxy: Average proportion of SIDS-catch to total catch for fisheries operating in specific regions.	Percentage contribution of fisheries to GDP. Proportion of total catch processed by SIDS Value of product exported from SIDS.
	Maintain acceptable CPUE.	Average variation of predicted biomass and effort levels from 2012 levels.	Observed biomass and effort levels have been maintained at or greater than defined levels.
	Optimize capacity.		Vessel numbers targeting SPA
	Catch stability.	Average annual variation in catch in the short-, medium- and long- term (may also be calculated at the assessment region level).	Observed variation in catch from logsheet data
	Maximise SIDS revenues from resource rents.	Average proportion of SIDS-catch to total catch for fisheries operating in specific regions	Observed proportion of SIDS-catch to total catch in SIDS waters from logsheet data.
	Stability and continuity of market supply.	Average annual variation in catch in the short-, medium- and long- term (may also be calculated at the assessment region level).	Observed variation in catch from logsheet data Observed variation in market prices
Social	Affordable protein for coastal communities.	As a proxy: Average proportion of CCMs-catch to total catch for fisheries operating in specific regions.	Average fish consumption per year per person relative to some target.
	Employment opportunities	As a proxy: Average proportion of CCMs-catch to total catch for fisheries operating in specific regions.	Numbers employed in fishing and processing sector relative to some target or relative to previous years
	Maintain/develop domestic fishery.	Ratio of domestic catch to total catch	Monitoring of fisheries in CCMs
	Human resource development.	As a proxy: Ratio of domestic catch to total catch	Monitoring of fisheries in CCMs
	Avoid adverse impacts on subsistence and small scale fishers.		Monitoring of fisheries in CCMs
Ecosystem	Minimise fishery impact on the ecosystem		Ratio of target species catch to catch of non-target species
	Minimise catch of non-target species.	Size or age structure of population	From observer-based size sampling and stock assessment outputs

## Notes

### Performance Indicators

Although the biological management objectives are typically species specific, many of the economic and social objectives are expressed at the fishery level and, in some cases, encompass a range of target and non-target species. The calculation of informative performance indicators for these fishery level objectives will depend on the extent to which multi-species MSE operating models can be developed and on the availability of data for both target and non-target species. Similarly, the calculation of economic performance indicators for particular components of the fishery (e.g. specific CCM fleets) will depend on the fishery groupings used in the MSE operating model (see SC12-MI-WP-06).

With reference to the development of performance indicators for ecosystem objectives, we note the considerable complexity involved in developing ecosystem models and the recommendation of the MSE expert consultation workshop (SC12-MI-WP-05) that ecosystem components of an MSE framework are something to consider much later in the development process.

We note that effort creep within WCPO fisheries is an important consideration. There are no management objectives specified for effort creep and therefore no requirement for performance indicators. However, appropriate scenarios should be included in the evaluations to test the robustness of candidate HCRs to effort creep. The influence of effort creep may be monitored through stock-based biological reference points (e.g. ability of a harvest control rule to maintain the stock around the target reference point), as well as fishing mortality-based indicators.

We also note that since the strawperson document was developed (in 2013) the dialogue on economic objectives from fisheries has moved away from 'MEY' to more sophisticated considerations of profit levels. While we retain the objectives specified within the strawperson document, these may not reflect the latest thinking.

### Monitoring Strategy

It is recommended that monitoring be conducted on a frequent basis. However, monitoring of a management procedure will require different types of data to monitor the different objectives and these data are likely to be available at different time scales. For example, information on fish prices or the number of vessels operating in the fishery may be available in real time, whereas information on stock status will require some form of stock assessment to be conducted. This currently operates on an approximate 3 year schedule and even then is likely to provide estimates of stock status only up to the year prior to the year in which the assessment is performed, at best.

An important consideration when determining the frequency of monitoring of a particular objective will be the expected variability of the metric over time and the extent of auto-correlation. Short term measurement of highly variable or auto-correlated metrics can be misleading and should be treated with caution. On the other hand, long-term monitoring is also potentially difficult because a single management procedure may not be in place for a long period of time. Although the management procedure may be evaluated over a 30 year time frame it may only be applied for a relatively short period (5 years for example) in the "real world" before being replaced with a new and improved version.



The monitoring strategy tracks the performance of the management procedure and checks that observed values are within the range of values predicted by the MSE. In the event that outcomes are not consistent with expected performance and future observations fall outside of the range predicted by the MSE it may be necessary to invoke rules for exceptional circumstances. We note that such rules (or meta-rules) will require clearly defined bounds for the extent of acceptable future variation in key variables as well as an agreed procedure to follow in order to determine alternative management action. We consider that meta-rules are an important topic for discussion to be held later in the MSE process and have not considered them in detail here.

A further consideration in the selection of performance indicators and corresponding monitoring strategy is the cost of collecting the necessary data to calculate them. The selection of performance indicators that have corresponding monitoring strategy metrics that are prohibitively expensive to calculate should be avoided. For example, such costs might be associated with the frequency of obtaining estimates of stock biomass (i.e. stock assessment frequency), or from increases in observer coverage to collect additional data.