

MANAGEMENT OBJECTIVES AND PERFORMANCE INDICATORS FOR PROGRESS ON THE EVALUATION OF MANAGEMENT PROCEDURES THROUGH MSE FOR IOTC STOCKS

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PURPOSE

To inform the Commission of the progress so far regarding the Management Strategy Evaluation (MSE) work being carried out to address the requests in Resolution 12/01 and 13/10. In addition to evaluate progress on the topic, the Commission needs to start discussions towards an agreement on explicit management objectives, performance measures, and acceptable risk thresholds to achieving or reaching both target and limit reference points. The basis for these objectives, performance measures and risk thresholds are highlighted here, as discussed and agreed by the Scientific Committee, and should form the basis for the discussion at the Commission plenary.

Progress to date on MSE: The need for clearer management objectives and performance statistics to evaluate across Management Procedures

To progress along the lines of Resolutions 12/01 and 13/10, the Working Party on Methods (WPM) was tasked with evaluating these interim target and limit reference points. However, reference points cannot be evaluated in isolation without a set of management objectives, the corresponding performance measures and the procedures to achieve those objectives in a given timeframe. The WPM thus discussed and proposed an initial list of management objectives and associated performance measures that would help illuminate the discussion around the evaluation of management procedures. This list was further discussed and finally endorsed by the SC in 2014.

The WPM provided their perspective on the range of management objectives and performance statistics that SC and COM could consider as starting points in the dialogue process:

Management Objectives: The WPM **NOTED** the potential management objectives developed for skipjack and the associated performance statistics, some of which are stock specific whereas other are more generic. Table 1 lists five broad management objectives that are commonly used in fisheries management. Each is described as seeking to maximize some aspect of the fishery but often there are trade-offs amongst these objectives and it is not possible to maximize all simultaneously.

Performance Statistic: The WPM **NOTED** that a *performance statistic* is a quantitative expression of a management objective. It translates a management objective into an indicator that can be quantified within the simulation model of the fishery. For each management objective, Table 1 suggests a suite of performance statistics that could be used to assess the performance of a MP. This is not intended to be an exhaustive list and additional performance statistics (e.g. proportional increase in spawner biomass over next 10 years) may be appropriate for particular cases (e.g. for stocks in need of rebuilding).

A summary table ([Table 1](#)), as endorsed by the SC at the recommendation of WPM, contains a wide range of management objectives, grouped under five categories: fishery and stock status, safety, yield, abundance and stability. The list includes the “default” objectives inherent in the current interim reference points and associated resolutions, such as the ratio of biomass to biomass at MSY, but also others that introduce the concerns and aspirations of different stakeholders, such as stability in catch and probability of fishery closure.

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Table 1. Performance statistics suggested for the evaluation of management procedures.

Management objective and associated performance statistics	Performance measure/s	Summary statistic
<i>Status : maximize probability of maintaining stock in the Kobe green zone</i>		
Mean spawner biomass relative to unfished	B/B_0	Geometric mean over years
Minimum spawner biomass relative to unfished	B/B_0	Minimum over years
Mean spawner biomass relative to B_{msy}	B/B_{msy}	Geometric mean over years
Mean fishing mortality relative to target	F/F_{tar}	Geometric mean over years
Mean fishing mortality relative to F_{msy}	F/F_{msy}	Geometric mean over years
Probability of being in Kobe green quadrant	B, F	Proportion of years that $B \geq B_{tar} \& F \leq F_{tar}$
Probability of being in Kobe red quadrant	B, F	Proportion of years that $B < B_{tar} \& F > F_{tar}$
<i>Safety : maximize the probability of the stock remaining above the biomass limit</i>		
Probability that spawner biomass is above 20% of B_0	B	Proportion of years that $B > 0.2B_0$
<i>Yield : maximize catches across regions and gears</i>		
Mean catch	C	Mean over years
Mean catch by region and/or gear	C	Mean over years
<i>Abundance: maximize catch rates to enhance fishery profitability</i>		
Mean catch rates by region and gear	A	Geometric mean over years
<i>Stability: maximize stability in catches to reduce commercial uncertainty</i>		
Mean absolute proportional change (MAPC) in catch	C	Mean over years of $\text{abs}(C_t/C_{t-1}-1)$
Variance in catch	C	Variance over years
Probability of shutdown	C	Proportion of years that $C=0$

Evaluation of interim and target reference points and recommendations

With respect to resolution 13/10, “*These interim target and limit reference points shall be assessed and further reviewed by the IOTC Scientific Committee and the results shall be presented to the Commission for adoption of species-specific reference points*”, the WPM methods made the following recommendations:

- The WPM **AGREED** that reference points are markers against which management procedures are evaluated, and around which they may be designed rather than something to be evaluated themselves. The WPM **NOTED** that the MSE process by itself will not result in new recommendations for limit reference points and, in the case of target reference points more *specific guidance on tolerable risks will be required (Table 2)*. The WPM **RECOMMENDED** that the SC elicit discussion and subsequent guidance from the Commission.

To provide some context to a discussion on risk tolerance, the following table is presented ([Table 2](#)) showing the definition of some of the risks (probabilities of achieving these targets) implicitly contained in Resolution 13/10, and values for these currently used in various fora.

Table 2. Probability of achieving target reference points and probability of not exceeding limits based on other sources (as well as time to achieve the targets).

Probability of achieving Performance Metrics with respect to target and limit reference points as tabled in Resolution 13/10	Probability
P ($B > B_{TARGET}$)	IPCC: 80% Canada: 75% MSC: 70%-80%
P ($B > B_{LIMIT}$)	95% (ESA, USA)
P ($F < F_{TARGET}$)	IPCC: 80% Canada: 75% MSC: 70%-80%
P ($F < F_{LIMIT}$)	95% (ESA, USA)
As short a time period as possible to be in the green zone (Kobe plot) from other quadrants	USA: 10 years or 1.5 generations Australia: 10 years + 1 generation MSC: 2 generations

The trade-offs and possible contradictions among objectives should also be noted and discussed. For example, WPM analyzed the possible conflict between the requirement of Resolution 13/10 to maintain certain biomass levels, with high probability, while fishing mortality at peak (MY) levels:

- ***The WPM NOTED the inherent risks in a system***, and that if fishing at optimal (high) fishing mortality levels, the chances that a stock would drop below a limit a high percentage of the time was inherently high. **NOTING** this feature of the system the WPM **AGREED** that contradictory ***objectives asked by the Commission in Resolution 13/10 (section 4a “maintaining the stocks in a high probability within this [green] quadrant” and SSB at MSY as target) would be hard to achieve unless the target reference points with respect to fishing mortality were reduced and that F_{MSY} were used as a limit rather than a target.*** The WPM **NOTED** the inherent risks associated with using F_{MSY} as a target rather than a limit reference point and the inconsistencies with the majority of other tuna RFMOs which treat it as a limit.
- Finally with regard to reference points, The WPM **AGREED** that in cases where MSY reference points are difficult to estimate, alternative reference point based on depletion ratios are preferable. Thus the WPM **NOTED** that an alternative would be to use reference points with respect to B_0 (i.e. targets that could be $0.4B_0$ or higher, and F would be the estimated F corresponding to the biomass target, if a precautionary buffer against reaching a biomass limit is desirable). The WPM **NOTED** that this is similar to what is currently taking place in other RFMOs such as WCPFC and **RECOMMENDED** that the use of this type of reference point is considered by the SC.
- Most of these statements were endorsed by the SC, as noted below:
 - ***Limit reference points***
 - SC17.27 (para. 103) The SC **RECOMMENDED** the Commission consider an alternative approach to identify biomass limit reference points, such as those based on biomass depletion levels, when the MSY-based reference points are difficult to estimate. In cases where MSY-based reference points can be robustly estimated, limit reference points may be based around MSY.
 - SC17.28 (para. 104) The SC **RECOMMENDED** that in cases where MSY-based reference points cannot be robustly estimated, biomass limit reference points be set at 20% of unfished levels ($B_{LIM} = 0.2B_0$).

- **Target reference points**
 - SC17.29 (para. 105) **NOTING** that the interim target reference points contained in Resolution 13/10 are also MSY-based and subject to the same difficulties with robust estimation, the SC **RECOMMENDED** that the Commission consider that stock biomass depletion levels equivalent to B_{MSY} are expected to lie in the range of 30% to 40% of unfished levels ($0.3B_0$ to $0.4B_0$), when MSY-based levels cannot be accurately estimated. The Commission may wish to consider a value of $0.4B_0$ or higher, if a precautionary buffer against reaching a biomass limit is desirable.
 - SC17.30 (para. 106) **NOTING** that the approach described in para. 105 is similar to what is currently taking place in other RFMOs such as WCPFC, the SC **RECOMMENDED** that the use of this type of reference point is adopted by the Commission. In considering target reference points, guidance will be required from the Commission on tolerable risks of exceeding limit reference points.
- **Fishing Mortality Equivalents**
 - SC17.31 (para. 107) The SC **RECOMMENDED** that with respect to fishing mortality (F) reference points, for consistency between the definitions of overfished and overfishing, the Commission should consider using those F values that correspond to the biomass reference points. For example, given a biomass limit of $0.2B_0$, a consistent F limit reference point would be $F_{B20\%}$, the fishing mortality rate that reduces the biomass to 20% of unfished levels.