WCPFC
HARVEST STRATEGY WORKSHOP

Stones Hotel
Kuta, Bali
30 November – 1 December 2015

Acceptable levels for the risk of breaching limit reference points for key tuna species in the WCPO—Background and information

HSW-WP/02 Rev 1
1 December 2015

AUSTRALIA

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Australia

Abstract

This paper provides background and a summary of information to assist WCPFC in adopting acceptable levels of risk for breaching limit reference points for the key tuna species in the WCPO. The findings presented here have previously been presented at the Scientific Committee or by the science services provider to MOW or the Commission. The need to identify such risk levels is contained within CMM 2014-06 which establishes a harvest strategy approach for key tuna species to the WCPFC.

The target reference points under consideration (in the range of 40% to 60% spawning biomass depletion) appear to be compatible with the adopted limit reference point because there is a reasonable buffer between the target reference point and the limit reference point under all of the potential acceptable risk levels evaluated. The current biomass estimates for south Pacific albacore, skipjack tuna and yellowfin tuna (from the most recent assessments) are above the "minimum" target reference point levels for all levels of acceptable risk. However, bigeye tuna is currently below the limit reference point.

There are a range of biological, economic and social consequences of breaching the limit reference point that will influence the level of risk that is acceptable to managers.

A clear and consistent scientific process is required to characterise and calculate the risk.

Need

WCPFC is adopting a harvest strategy approach for the management of key tuna species (CMM 2014-06). In addition to the key elements of target and limit reference points and harvest control rules, it is also necessary to agree acceptable levels of risk for breaching limit reference points (LRPs) when designing a harvest strategy.

CMM 2014-06 (Annex 1) contains the following additional information on acceptable levels of risk:

> *"The Commission shall define acceptable levels of risk associated with breaching limit reference points, and if appropriate, with deviating from target reference points, taking into account advice from the Scientific Committee and , where appropriate, other subsidiary bodies. In accordance with Article 6(1)(a) of the Convention, the Commission shall ensure that the risk of exceeding limit reference points is very low.*

Unless the Commission decides otherwise, target reference points shall be conservative and separated from limit reference points with an appropriate buffer, with a view to ensuring that the target reference points are not so close to the limit reference points that the chance that the limits are exceeded is greater than the agreed level of risk."

CMM 2014-06

This is consistent with Annex II of the UN Fish Stocks Agreement which states that "*Fishery management strategies shall ensure that the risk of exceeding limit reference points is very low*".

Scientific advice

The Scientific Committee (SC) has provided advice to help the Commission define the acceptable levels of risk for the key tuna stocks. The role taken by the SC (and the science services provider) has been to provide answers to technical questions, but the SC has not made a recommendation on a particular risk level because this is regarded as a management decision to be taken by the Commission.

Separation of limits from potential targets

The paper MOW3 WP-02 (2014) examined the consequences of different acceptable levels of risk for selecting target reference points (TRPs) and harvest control rules in the four main tuna stocks. Table 1 from this paper shows the median spawning biomass depletion ($SB/SB_{F=0}$) for each species associated with each of four levels of risk of exceeding the LRP (note that the estimates for south Pacific albacore have been updated following the 2015 stock assessment of that species). For example, if WCPFC were to adopt an acceptable risk of 5%, given the level of uncertainty included within the analysis, the spawning biomass would at a minimum need to be maintained above 37% for south Pacific albacore, above 28% for bigeye tuna, above 29% for skipjack tuna and 31% for yellowfin tuna[1].

Table 1. Median levels of spawning biomass depletion ($SB/SB_{F=0}$) associated with a given risk of exceeding the limit reference point of $0.2SB_{F=0}$ for the four main tuna stocks. (Source: MOW3 WP-02, except for south Pacific albacore which were derived from HSW-WP-05)

Acceptable risk	SP albacore	Bigeye tuna	Skipjack tuna	Yellowfin tuna
5%	0.37	0.28	0.29	0.31
10%	0.34	0.26	0.27	0.28
15%	0.33	0.25	0.26	0.27
20%	0.32	0.24	0.25	0.25

Three key conclusions were made from this work:

- With respect to alternative levels of acceptable risk, the lower the acceptable risk, the higher and further away from the LRP you need to keep the stock.
- With respect to levels of uncertainty, for a given level of risk, the greater the uncertainty accounted for, the higher and further away from the LRP you need to keep the stock.

[1] Note that this represents the minimum level of a TRP based only on management objectives relating to the risk of falling below the LRP. TRPs may be set at higher biomass levels to achieve other objectives such as relative stability in catches, economic objectives, food security, etc.

- With respect to the adoption of TRPs, there is the potential for TRPs and LRPs to be incompatible, i.e. too close together. Thus, the expected average biomass levels here give some indication of the minimum value of a TRP that could be compatible with the LRP and a given risk level.

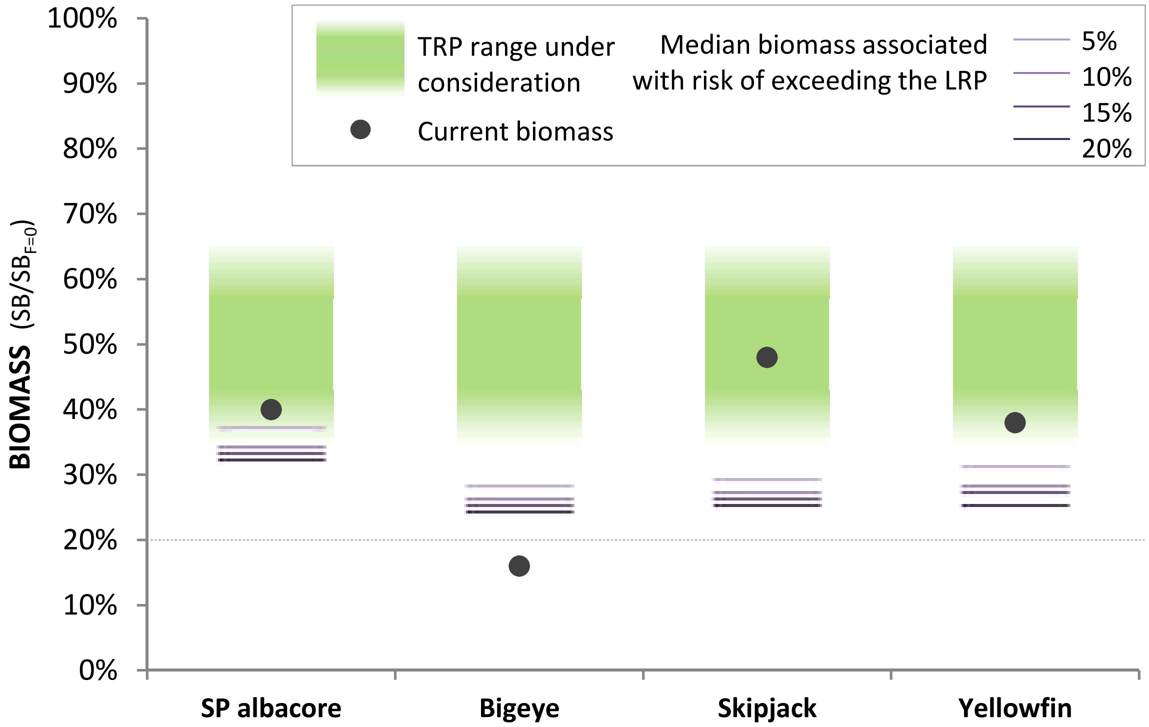

Figure 1. Relationship between the limit reference point (grey dashed line), median levels of spawning biomass depletion at different risks of exceeding the limit reference point (purple lines, as per Table 1), the current biomass (black dot) and the target reference point range under consideration (green band) (Sources: MOW3 WP-02, except for south Pacific albacore which were derived from HSW-WP-05; most recent stock assessments as at August 2015)

These estimates are a reasonable basis for determining whether there is a sufficient buffer between the agreed LRPs and the potential TRPs. Target reference points under consideration have generally been in the range of 40% to 60% spawning biomass depletion (0.4 to 0.6 SB/SB$_{F=0}$) and these are above the "minimum" spawning biomass associated with all acceptable risk levels for all species (Figure 1). Target reference points under consideration appear to be compatible with the adopted limit reference points in the sense that there is a reasonable buffer under all of the potential acceptable risk levels evaluated (Figure 1).

MOW3 WP-02 also highlighted the issue of uncertainty and how risks are calculated (this is discussed further in a section below). There is also a need to test these risks using more sophisticated harvest control rules (rather than applying a fixed level of catch/effort) as they are developed. However, well designed harvest control rules that respond to changes in stock status through time would not be expected to increase the spawning biomass depletion associated with a given risk.

Risks of breaching limit at current stock status

The current level of spawning biomass depletion ($SB_{current}/SB_{F=0}$) from the most recent stock assessment is given in Table 2. The current level of spawning biomass is above the "minimum" TRP levels for all levels of acceptable risk in the case of south Pacific albacore, skipjack and yellowfin tuna (Figure 1). However, the current estimate of spawning biomass depletion for bigeye tuna is below the LRP and also below the four levels of acceptable risk.

Table 2. Current levels of spawning biomass depletion ($SB/SB_{F=0}$) for the four main tuna stocks (reference case models of most recent assessments). (Source: Source: MOW3 WP-02, except for south Pacific albacore which has been updated from the 2015 assessment).

Indicator	SP albacore	Bigeye tuna	Skipjack tuna	Yellowfin tuna
$SB/SB_{F=0}$	0.40	0.16	0.48	0.38

Consequences of breaching limits

Deciding on the acceptable level of risk is a management decision and will be influenced by the severity of the biological, ecological, economic or social consequences of exceeding the LRP (MOW3 WP-02).

A spawning biomass depletion below 20% (the adopted LRP) has been considered a threshold for recruitment overfishing for productive stocks (Myers 1994) and recruitment declines might be expected to be observable below this level (Beddington and Cooke 1983). Other potential biological consequences for a stock that is below the LRP may include higher variability in productivity, genetic modifications, reduced age structure with consequences to the quality of spawning and changes to the ecological role of the species in the food web (Sainsbury 2008).

From an economic and social perspective, low biomass can result in reduced total yields and also lower catch rates with reduced or no economic returns (as has been demonstrated for south Pacific albacore, WCPFC-SC11-2015/ MI-WP-04). Low stock sizes would also have economic and food security consequences, particularly for nations or communities with a substantial reliance on that stock.

What is "very low"

Values such as 5% or 10% have commonly been used in simulation studies of LRPs, but otherwise there is little guidance on the definition of "very low" from a scientific perspective (SC8-MI-WP-01).

Uncertainty and calculating risk

Calculating the risk of breaching the LRPs is strongly dependant on the degree of uncertainty included within analyses. It is important that there is a scientific process to consistently characterise uncertainty in the stock assessments and for the purpose of evaluating risks. For the purpose of evaluating risks of exceeding LRPs for bigeye tuna, yellowfin tuna, skipjack tuna and south Pacific albacore, the Scientific Committee (SC10 and SC11) has characterized uncertainty in current stock status by selecting and weighting a feasible number of stock assessment runs that best capture the key uncertainties present within each stock assessment, and has included uncertainty in future recruitment levels.

It is also important to define how risk is calculated in the simulation framework. In the case of the recent work for WCPFC (such as reported in MOW3 WP-02), risk is calculated as the percentage of all the simulation runs that had a terminal (final year) biomass that was below the agreed LRP.

Sources

HSW-WP-05 “Potential target reference points for south pacific albacore fisheries”

SC7-MI-WP-03 “Identification of candidate limit reference points for the key target species in the WCPFC”

SC7-MI-WP-04 “Evaluation of stock status of bigeye, skipjack, and yellowfin tunas against potential limit reference points”

SC8-MI-WP-01-LRP-Rev-1 “Evaluation of stock status of south Pacific albacore, bigeye, skipjack, and yellowfin tunas and southwest Pacific striped marlin against potential limit reference points”

SC9-MI-IP-01 “Report of the 2013 ISSF Stock Assessment Workshop: Harvest Control Rules and Reference Points for Tuna RFMOs”

SC10-MI-WP-01 “Evaluation of risks of exceeding limit reference points for south Pacific albacore, bigeye, yellowfin and skipjack tunas with implications for target reference points: a case study using south Pacific albacore”

SC11-MI-WP-04 “Compatibility and consequences of alternative potential Target Reference Points for thesouth Pacific Albacore stock”

SC11-MI-WP-10 “Estimating potential tropical purse seine fleet sizes given existing effort limits and candidate target stock levels”

MOW3 WP-02 “Consideration of acceptable levels of risk of exceeding Limit Reference Points for the fourmain tuna stocks: uncertainty and implications for Target Reference Points and Harvest Control Rules”

Beddington J.R. and J.R. Cooke (1983). The potential yield of fish stocks. FAO Fish. Tech paper 242:47p.

Sainsbury, K.J. (2008) Best Practice Reference Points for Australian Fisheries. Australian Fisheries Management Authority, Canberra, Australia, 156 pp