

INTER-AMERICAN TROPICAL TUNA COMMISSION

**AD HOC WORKING GROUP TO STRENGTHEN THE DIALOGUE
AMONG SCIENTISTS, MANAGERS AND OTHER STAKEHOLDERS
ON MANAGEMENT STRATEGY EVALUATION (MSE DIALOGUE
WORKING GROUP, MSEDWG)**

4TH MEETING

MSEWG-04 INF-B

COMPANION GUIDE TO THE OPO BIGEYE TUNA MSE

This document was requested at the MSEDWG-03 in April 2026 and is meant to supplement Document SAC-17-05 by further describing key concepts and elements of the EPO Bigeye Tuna MSE.

Why an MSE for EPO Bigeye Tuna?

- To respond to concerns that the stock assessment was insufficient as the sole basis for management advice.
- To better account for uncertainties in data, biological processes, and fishery dynamics
- To greater consider mid- to long-term performance of the decision-making framework
- To conduct a thorough evaluation of performance trade-offs (e.g., between exploitation levels and biological risk)
- To incorporate feedback between management actions and system dynamics to provide a more accurate projection of performance
- To engage stakeholders in a more substantive and meaningful way

Key terms:

- Harvest control rule (HCR): A pre-agreed rule that sets fishing opportunities (catch limit, effort limit, seasonal closure, etc.) based on the selected indicator(s) of stock status.
- Limit reference point (LRP): A benchmark that defines an undesirable biological stock status (B_{LIM}) or fishing level (F_{LIM}) that should be avoided. To keep the stock safe, the probability of violating an LRP should be very low. However, if an LRP is violated, immediate action —such as a reduction in fishing to the F_{MIN} level—should be taken to return the stock or fishery to the target level.
 - Soft LRP: A low biomass level to be avoided (e.g., <20% probability of breaching).
 - Hard LRP: A lower biomass level to be strongly avoided (e.g., <1% probability of breaching).
- Management objectives: Formally adopted, measurable goals for a stock and fishery, such as maintaining an abundant population or supporting high catch. Operational objectives are specific and measurable, with associated timelines and minimum required likelihood that they

can be achieved. The management objectives for the EPO bigeye tuna MSE have not yet been agreed, but typical objective categories include:

- Safety: To minimize the probability that the stock will fall below the biomass limit reference point.
 - Status: To maximize the probability of maintaining the stock in the green zone of a fishery's Kobe plot (i.e., not overfished, no overfishing).
 - Stability: To maximize stability in catches and fishing effort to reduce commercial uncertainty by minimizing variability in catch and effort from year to year.
 - Yield: To maximize catch across regions and/or fishing gears.
 - Effort: To maximize fishing effort across regions and/or fishing gears.
 - Abundance: To maximize catch rates to enhance fishery profitability.
- Management procedure (MP)/harvest strategy (HS): A pre-agreed framework for making fisheries management decisions, such as setting catch limits or seasonal closures, that has been simulation-tested using management strategy evaluation (MSE) and designed to achieve specific management objectives. An MP typically includes a data collection program, stock status estimation method, and harvest control rule (HCR).
 - Management strategy evaluation (MSE): A computer simulation-based analytical framework used to evaluate the performance of alternative candidate MPs relative to the pre-specified management objectives. Also, the process of developing MPs.
 - Operating model (OM): The building blocks of MSEs. They represent the multiple plausible hypotheses for the fishery system's state of nature, including stock biology and fishery behavior. Multiple OMs based on varying assumptions are often used within a single MSE process to test the expected performance of alternative candidate management procedures. The "reference" OMs are the most likely scenarios, whereas the "robustness" OMs are more extreme but still plausible scenarios.
 - Performance indicator: A quantitative expression of a management objective used to evaluate how well the objectives are being achieved by determining the proximity of the current value of an indicator to the objective, often a reference point. For example, where high catch is an objective, a performance indicator might be the average catch level over a 10-year period. Also known as performance statistics or performance metrics.
 - Reference points: Benchmarks used to compare the current status of a fishery management system with a desirable (target reference point) or undesirable (limit reference point) state. Often defined in management objectives. Reference points may or may not be used as control parameters in HCRs.

EPO Bigeye Tuna MSE at a glance

- 22 fishery fleets: 14 longline, 5 floating object, 1 floating object discard, 2 non-associated
- Operating models are derived from the 2024 bigeye risk analysis and benchmark assessment, updated in 2025 with data through 2024. There are 36 reference OMs reflecting uncertainties in a) longline selectivity, b) longline catchability, and c) the relationship between the number of

adults and the young they produce (i.e., the stock-recruitment relationship). There is also 1 robustness test that features a sustained 25% drop in recruitment.

- The MSE uses data back to 1979 and projects forward to 2046.
- The stock status estimation method is the same for each of the eight candidate MPs – a simplified assessment model called an age-structured production model.
- Management output: Purse seine fishery closure days, assuming a linear relationship between fishing mortality and the number of days the fishery is open.
 - All eight candidate HCRs use a 3-year management cycle (so, there are 7 management cycles in the MSE’s 21-year projection period).
 - All eight candidate HCRs constrain the changes in purse seine closure days to ± 10 days if the stock is at or above dSBR or $+20/-10$ days if the stock is below dSBR.
- The eight candidate HCRs are named according to the format “ $F_{\text{target}}-S_{\text{control}}$ ”. For example, the IATTC Staff HCR is called “HCR F30-S20” because it uses $F_{30\%}$ as F_{target} and $20\%SB_0$ as S_{control} .
- Relationship to longline fishery: The MSE assumes that any HCR-based changes to the purse seine closure days will alter the longline fishing mortality at the same rate. This is untrue under the current quota-based management approach for the longline fishery. However, it is not expected to be a risk because the MSE is likely to overestimate the impact on stock size of the longline fishery, especially considering the individual vessel threshold (IVT) program and recent underharvests by the longline fleets.

Reference Points: The EPO Bigeye tuna MSE uses reference points to define the HCRs.

- dSBR (dynamic spawning biomass ratio): Ratio of the current spawning biomass to unfished spawning biomass. Sometimes referred to as $\%SB_0$. It is a “dynamic” reference point since it reflects potential changes in recruitment (therefore, for example, $20\%SB_0$ is not always the same tonnage).
- F_{target} : The target fishing mortality rate set by the HCR if the stock’s dSBR is at or above S_{control} . For example, $F_{30\%}$ means that the stock will be fished at a rate that will eventually reach 30% of unfished spawning biomass ($30\%SB_0$) at equilibrium. This inverse relationship means that $F_{40\%}$ is a lower fishery intensity than $F_{30\%}$.

For EPO bigeye tuna:

- HCRs 3, 7 and 8 use $F_{40\%}$ (lowest fishing intensity).
- HCRs 2, 5 and 6 use $F_{35\%}$ (mid fishing intensity).
- HCRs 1 and 4 use $F_{30\%}$ (highest fishing intensity).
- S_{control} : The threshold for dSBR below which fishing mortality decreases in response to stock depletion. The control parameter, or flex point, in the hockey-stick HCR. Sometimes referred to as a threshold reference point. For EPO bigeye tuna:
 - HCR 8 uses $40\%SB_0$ (most conservative control point).
 - HCRs 2, 4 and 7 use $30\%SB_0$ (lower control point).
 - HCR 6 uses $25\%SB_0$ (even lower control point).
 - HCRs 1, 3 and 5 use $20\%SB_0$ (least conservative control point).

Table 1. The eight candidate harvest control rules compared in this management strategy evaluation.

Component	Staff	WG1	WG2	WG3	WG4	WG5	WG6	WG7
HCR number	1	2	3	4	5	6	7	8
F_{target}	$F_{30\%}$	$F_{35\%}$	$F_{40\%}$	$F_{30\%}$	$F_{35\%}$	$F_{35\%}$	$F_{40\%}$	$F_{40\%}$
$S_{control}$	20%	30%	20%	30%	20%	25%	30%	40%
Range for closure change (day): $S > S_{control}$	-10 to 10	-10 to 10	-10 to 10	-10 to 10	-10 to 10	-10 to 10	-10 to 10	-10 to 10
Range for closure change (day): $S < S_{control}$	-10 to 20	-10 to 20	-10 to 20	-10 to 20	-10 to 20	-10 to 20	-10 to 20	-10 to 20
HCR Name	F30-S20	F35-S30	F40-S20	F30-S30	F35-S20	F35-S25	F40-S30	F40-S40

Performance indicators: The EPO Bigeye tuna MSE uses performance indicators to evaluate the candidate HCR's ability to achieve the various candidate management objectives.

Table 2. The management objectives and the associated performance indicators included in this MSE for evaluating the performance of candidate harvest control rules.

Management objective	Performance indicator	Unit	Description	Note	Better values
Safety – avoid the limit reference point	$p(dSBR < 0.2)$	%	The probability that dynamic spawning biomass ratio falls below $20\%SB_0$	A dynamic spawning biomass ratio of $20\%B_0$ is the limit reference point for bigeye in the WCPO. Discussed as soft limit (<20% chance of breaching).	Lower
	$p(SBR < 0.077)$	%	The probability that equilibrium spawning biomass ratio falls below $7.7\%SB_0$	An equilibrium spawning biomass ratio of $7.7\%SB_0$ is the interim limit reference point for tropical tunas in the EPO. Discussed as hard limit (<1% chance of breaching).	Lower
	$p(S/S_{MSY} < 0.5)$	%	The probability that spawning biomass falls below 50% of the spawning biomass at the maximum sustainable yield	Discussed as hard limit (<1% chance of breaching).	Lower
Status	$p(Kobe \text{ in green})$	%	The probability that the stock is in the green quadrant of the Kobe plot	The definition of the green quadrant of the Kobe plot is that $SB > SB_{MSY}$ and $F < F_{MSY}$	Higher
Stability	$AAV(catch)$	%	Average annual variability in annual bigeye catch		Lower

	<i>p(closure+20)</i>	%	The probability that the closure increases by 20 days	20 days is upper bound for the increase in fishery closure per management cycle	Lower
Yield	<i>PS catch</i>	ton	Average annual purse-seine bigeye catch		Higher
	<i>LL catch</i>	ton	Average annual longline bigeye catch		Higher
Effort	<i>closure</i>	day	Average fishery closure		Lower
Abundance	<i>CPUE</i>	%	The ratio of average longline CPUE to the average level for 2017-2019	Longline CPUE reflects the abundance of adult bigeye. The 2017-19 period is the “status quo period” when bigeye was evaluated to be in a healthy condition.	Higher

Resources:

[IATTC Ad Hoc Working Group to Strengthen the Dialogue on MSE \(MSEDWG\) \(2025-present\)](#)

[IATTC workshops on Management Strategy Evaluation for Tropical Tunas \(2019-2025\)](#)

www.HarvestStrategies.org: Factsheets, animations, and other educational materials (available in EN, ES, and 11 other languages)