INTER-AMERICAN TROPICAL TUNA COMMISSION

5TH WORKSHOP ON MANAGEMENT STRATEGY EVALUATION (MSE) FOR TROPICAL TUNAS

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OVERVIEW OF THE MANAGENEMENT STRATEGY EVALUATION (MSE) PROCESS FOR TROPICAL TUNAS AT IATTC

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1. INTRODUCTION

Management strategies (often referred as harvest strategies or management procedures) are completely specified integrated combinations of agreed upon data inputs, analyses applied to that data and the harvest control rule used to determine specific management actions (e.g., catch quotas, length of fishing seasons) to achieve management objectives. Harvest strategies can be evaluated using a process called Management Strategy Evaluation (MSE), involving a dialogue component between scientists, managers and other stakeholders, to specify the components, along with computer simulation of candidate strategies. Harvest strategies have been increasingly and widely used both nationally and internationally, including by all five regional fisheries management organizations for tuna (t-RFMOs: IATTC, IOTC, WCPFC, ICCAT, CCSBT) which are in different stages of development and implementation, CCSBT the furthest along with a successful MSE development, other RFMOs with evaluated management procedures for tropical tunas (e.g. bigeye tuna in IOTC, skipjack tuna in WCPFC) and IATTC at the earliest stage in the process with an ongoing bigeye tuna MSE.

This document summarizes the MSE process for tropical tunas at IATTC, along with harvest strategy elements already adopted or in development at the IATTC. It also outlines elements in need of refinement or in need of adoption and a set of proposed working tables to help structure the discussions during the

5th IATTC workshop on MSE for tropical tunas on May 30th, 2025, and the 1st Ad Hoc Working Group on MSE on May 31, 2025.

2. WORKPLAN

2.1. Scope

The current work plan has combined the technical development of MSE for tropical tunas and a series of workshops for training and enhancing dialogue and communication among all interested parties regarding the MSE process. Tropical tuna fisheries in the EPO are multispecies (BET, YFT and SKJ), however management has been based on the species needing the strictest management based on results of single species stock assessments for each stock. Historically, the estimated status of BET has determined management for tropical tunas and was therefore selected as the initial focus of MSE work. Although the ultimate goal is to evaluate harvest strategies in a multispecies context, experience from RFMOs and other organizations show that MSE processes are multi-year undertakings, even for single species. Given the limited and time-constrained funds available for MSE of EPO tropical tunas at the time, it was decided to start with BET on the technical work, adding the other species as their current assessment models were improved (YFT) or implemented (SKJ). The stakeholder engagement has focused on dialogue on the three species, and the technical work conducted for BET will streamline the MSE work on YFT and SKJ as their modelling improves. Therefore, ongoing MSE work will conclude the work on bigeye tuna, moving to the other tropical tuna species towards the end of the timeframe (Table 2).

2.2. OBJECTIVES

The general objective is to develop, evaluate and implement sustainable management strategies for tropical tunas in the EPO (SAC-15-08), continuing the ongoing MSE process at IATTC. Specific objectives are to develop technical tools to conduct the MSE and to improve stakeholders understanding and communication of the MSE process, elicit objectives, performance metrics, alternative control rules, and specification of risk. The development of MSE workshop materials and online resources, along with conducting of workshops with managers, industry and other stakeholders allows communication of MSE results and feedback.

2.3. IMPLEMENTATION

The work has consisted of two components that evolved in synergy 1) technical development and execution of MSE simulation framework to evaluate alternative harvest strategies, 2) enhance stakeholder dialogue, and two-way communication of required inputs for the MSE and via development of online resources and workshops (see timeline of implementation in Table 2). Both components are described below:

2.3.1. TECHNICAL COMPONENT

The technical work of MSE involves writing, testing, and implementing computer code and models of tropical tunas (continuing ongoing work with BET) under exploitation following simulated alternative harvest strategies, summarizing results, and communicating them effectively. MSE is being structured as a modular system consisting of three major components (Conditioning, Projection and Evaluation) around several model types including operating models (OM), sampling models, estimation models (EM), management models and summary models (see SAC-15-07 and Section 3 below for more details). Both the OM and EM are implemented in the integrated stock assessment platform *Stock Synthesis*, using custom code similar in structure and functionality to that used for the recent North Pacific Albacore tuna MSE and the ongoing Pacific Bluefin tuna MSE.

2.3.1. STAKEHOLDER DIALOGUE COMPONENT

Strategies are based on choosing tactics (temporal or spatial closures, catch or effort limits) to achieve management objectives. If management objectives are not explicit and clear, alternative strategies cannot be realistically evaluated. Because the elements, concepts and approaches involved in MSE are mostly new for managers and other stakeholders, a series of workshops was planned to introduce them to harvest strategies and MSE. With financial support from the FAO-GEF Common Oceans project, introductory workshops on harvest strategies for tropical tunas in the eastern Pacific Ocean (EPO) were held in Panama (2015) and the United States (2018), aimed at managers, and a further five, aimed at the tuna industry, took place during 2019 in Colombia, Ecuador, Mexico, Panama, and the United States. The IATTC MSE work plan included a series of workshops with the support from the European Commission, the first held at the end of 2019, a second one in May 2021, a third one in December 2022 whose terms of reference were established in Resolution C-19-07. The workshop goals were to explain and clarify the MSE process, enhance communication and foster mutual understanding among fisheries scientists, managers, and other stakeholders on matters related to harvest strategies and MSE, and further discuss potential management goals, performance metrics, alternative reference points and harvest control rules with managers and other stakeholders. A fourth workshop was held on March 20-21, 2025 (workshop report), reviewing the development of harvest strategies across tuna RFMOs, recapping previous workshops on MSE for tropical tunas, highlighting elements in need of refinement for the development of alternative candidate harvest strategies for the ongoing bigeye tuna MSE and providing a first draft of a candidate harvest strategy for bigeye tuna, describing elements already adopted, in need of adoption or in development at IATTC. A summarized table (Table 1) of Management Objectives, Performance Indicators and other elements discussed during previous IATTC MSE workshops was presented and discussed during the 4th IATTC MSE workshop, along with a set of candidate HCRs (Figure 1) which provide the basis for the next steps of the technical work. Training, communication materials and online interactive tools in English and Spanish continues to be developed to enhance understanding of the MSE process and results. See, for example, the online MSE demonstration tool used in recent workshops:

https://valeromaspez.shinyapps.io/TunaMSE_EPO_ENG/

https://valeromaspez.shinyapps.io/TunaMSE_OPO_SPN/

Prior to 2025, there were no dedicated communication channels on harvest strategies and MSE within the IATTC, SAC meetings (when time allowed) and workshops have provided opportunity for dialogue, communication, and training on MSE, along with initial discussions on potential candidate management objectives, HCRs and other harvest strategy components. Following requests by stakeholders for the establishment of a dedicated dialogue Working Group (WG), to enhance or replace the MSE workshops and recommendations from SAC-14 and from staff in SAC-15 for the Commission consider a Science-Management Dialogue (SMDWG) or informal workshops approach to continue the MSE process, Resolution C-24-08 outlined the creation of an ad hoc Working Group to strengthen the dialogue among scientists, managers and other stakeholders on MSE, with its first meeting set for May 31, 2025.

3. DEVELOPMENT OF BIGEYE TUNA HARVEST STRATEGIES

Management Objectives:

General objectives are defined in IATTC's Antigua Convention's Article IV (c) stating *"to ensure the long-term conservation and sustainable use of the fish and to maintain or restore the populations of harvested species at levels of abundance which can produce the maximum sustainable yield"*.

Additional proposed objectives resulting from stakeholder input and IATTC MSE workshops are listed in Table 1. Some of the objectives need further specification, such as desired probabilities around limit and target reference points.

Type of strategy: Model-based (based on an age structured production model with recruitment deviates, or alternatives, see below). Alternative strategies were discussed during workshops, such as empirical strategies, which could be applicable depending on the types of objectives (such as Stability, Yield/Abundance relative to historical periods or Status Quo, See Table 1) but not directly to others that depend on model-based quantities relative to reference points.

Management cycle: 1 or 3 years

In recent history, management cycles at IATTC have varied in their lengths in years. A three-year cycle is expected to provide stability to the fishery over shorter cycles, it has been used previously by the IATTC and is also employed by other t-RFMOs.

Strategy inputs: total catch, Japanese longline index of relative abundance (CPUE), length compositions for the index of abundance and the longline fishery.

Limit Reference points:

Adopted interim as defined in Resolution C-16-02 and its amendment C-23-06. 7.7% equilibrium virgin spawning biomass under a conservative steepness of h: 0.75, fishing mortality associated with that level of B_0. Alternatives proposed during IATTC MSE workshops included using F_{MSY} and either S_{MSY} or $0.5S_{MSY}$ as limit reference points.

Target Reference points:

Target reference points (TRP) were adopted at the IATTC in 2014 on an interim basis both in terms of the fishing mortality (F_{MSY}) and spawning biomass (S_{MSY}) corresponding to the maximum sustainable yield (MSY). Unlike the equilibrium LRP, TRP are dynamic, that is its calculation considers changes over time in recruitment. Proxy target reference points were adopted in 2023 (Resolution C-23-06) for cases where MSY-based TRP cannot be reliably estimated, or otherwise specified, from parameters estimated within the assessment model. Proxy reference points corresponding to $0.3S_0$ were used for skipjack tuna for the first time in the 2022 stock assessment. Staff revisited TRP for tropical tunas in 2024 (SAC-15-05) following concerns about the definition of the target reference point and estimated highly depleted stock levels at MSY ($S_{MSY}/S_0 = 0.17$) for some scenarios of the 2024 bigeye tuna assessment given recent changes in the assumptions about age-specific natural mortality. A more global approach to defining MSY, which is designed to support a range of proportioning of catch among the fleets, supports a less depleted biomass ($S_{MSY}/S_0 = 0.3$). The staff has proposed to consider $S_{MSY}/S_0 = 0.3$ as interim target reference point until discussions under a comprehensive Management Strategy Evaluation framework process determine target reference points based on a variety of objectives (SAC-15-05, SAC 15-07). Other alternative target reference points proposed during the IATTC MSE workshops included $S_{40\%}$, $F_{40\%}$ and $F_{45\%}$.

Operating models:

Based on the model grid from the 2024 bigeye tuna stock assessment (SAC-15-02, SAC-15-07). Main structural uncertainties of the 2024 bigeye tuna model ensemble that will be carried into the MSE as alternative states of nature for the reference set includes 36 model configurations with different assumptions on individual growth, selectivity for fisheries (asymptotic or all dome), steepness of the Beverton-Holt stock recruitment relationship (h values: 1.0, 0.9, 0.8), natural mortality (Natural mortality M values for adult male 0.1, 0.12, 0.125, 0.13) and three rates of annual increase in longline catchability

(0%, 1%, 2%). A robustness set with natural mortality, growth and selectivity assumptions from the previous (SAC-11) benchmark stock assessment has been considered.

Estimating models:

The current MSE framework includes an age-structured production model with estimated recruitment deviates (ASPM-Rdev) based on the base case model of the 2024 bigeye benchmark stock assessment SAC-15-02. Alternatives to consider include an ASPM-Rdev with length composition data (SAC-16-06) for the longline abundance index (which assumes dome-shape selectivity) and for the longline fishery (which assumes asymptotic selectivity), and a gear-aggregated simplified stock assessment model.

Performance Indicators: Not defined yet, alternatives discussed during recent IATTC MSE workshops are listed in Table 1.

Harvest control rules:

Alternative HCRs were discussed during the 4th IATTC Workshop on tropical tuna MSE as candidates for evaluation during the bigeye tuna MSE (Figure 1). In addition to the current HCR which is defined by a abrupt change at the interim limit reference point of $S_{7.7\%}$, alternative HCRs being considered include a declining/ramping up from the origin to a threshold reference point that acts as an HCR control point either at $S_{20\%}$ or $S_{30\%}$ where fishing mortality is set at $F_{20\%}$, $F_{30\%}$ or $F_{40\%}$ (Figure 1). The specific quantities used in the Figure 1 HCRs are illustrative only at this stage but are based on what are considered reasonable and consistent with previous decisions or discussions during previous workshops. In general, it is desirable that management action should be taken before a limit reference point is exceeded to avoid the abrupt introduction of restrictive management measures and therefore the fishing mortality should be reduced before the limit is reached. Fishing at levels corresponding to the target biomass level even when the biomass is below the target biomass level will, on average, drive the biomass towards the target. The biomass will fluctuate around the target due to a variety of factors.

Management actions:

A review of alternative management actions and analyses carried out over the past several years by the IATTC staff with respect to the purse seine fishery for tropical tuna in the EPO was conducted by Maunder et al (2021). Tropical tunas in the EPO are currently managed using temporal closures for purse seine vessels, catch limits for longline vessels, and BET Individual Vessel Thresholds (IVT) for some fleet components. Other measures such as capacity limits, full retention, active FAD limits, and spatial closures are also in place. The longline fishery is managed using annual catch quotas for bigeye tuna divided among the major longline fishing nations. Although Resolution C-16-02 and its amendment C-23-06 state that management measures shall be as consistent as possible with those adopted for the purse-seine fishery, there is no clear mechanism for the potential adjustment of the longline quotas. Presently, only fishing mortality strategies can be tested in the current MSE framework and the relationship between the actual management action(s) and fishing mortality needs to be estimated or assumed.

Monitoring Strategy:

The monitoring strategy routinely evaluates the performance of the adopted harvest strategy to check that it is working as expected. The monitoring strategy considers all aspects of the harvest strategy in place including procedures for its evaluation and testing; the identification of any scenarios that should be added to the operating model grid; the preparation and application of the estimation model and the performance of the harvest strategy as a whole. In addition, it may identify changes in the dynamics of the fishery resulting from environmental, economic or social factors that may require a reconsideration for the management objectives and the testing of alternative harvest strategies. Elements of the monitoring strategy many include:

- Conducting a full benchmark stock assessment every 3 years, occurring in the year after the setting of a new 3-year management cycle following the adopted harvest strategy
- Yearly monitoring of the number of OBJ sets
- Monitoring of the species-specific total catches of tropical tunas
- Monitoring implementation of the EMP required for continuation of the BET IVT program
- Monitoring the Stock Status Indicators (e.g. SAC-16-02)
- Identify any other data (e.g. additional abundance indices, tagging data, genetic information), as available, that might not be included in the MSE framework

Exceptional circumstances:

Although exceptional circumstances have not been defined yet, some candidates are outlined below.

- When there is evidence that the stock is in a state not previously considered to be plausible in the context of the management strategy evaluation (MSE);
- When there is new evidence about the biology of the stock that will likely impact the MSE results or fleet structure/or fishing operations have changed substantially;
- When one or a combination of stock status indicators exceed their historical ranges;
- When the number of OBJ sets exceeds the historical status quo level (2017-2019) (Other years);
- When there is evidence that the data (e.g. longline CPUE index of abundance, sampling/monitoring for the BET IVT program) required to apply the harvest strategy are not available or are no longer reliable or appropriate; and/or,
- When there is evidence that implementation of the HCR (i.e. converting the specified *F* into actual management action e.g. effort or catch limits) is different than intended or evaluated.
- When a stock assessment indicates that the previous MSE is no longer applicable
- When a stock assessment for the other tropical tuna stocks indicates that another stock requires stricter management measures.
- When the stock assessment indicates a limit reference point has been exceeded by 10%

If exceptional circumstances are triggered, the pre-existing management measures shall remain in place until new management measures are implemented, or other action is agreed by the Commission. Alternative actions after the triggering of exceptional circumstances include conducting a full benchmark stock assessment, reevaluation of components of the harvest strategy (data collection, data analysis, available management actions, etc.) and reevaluation of the harvest strategy via MSE.

4. HARVEST STRATEGIES FOR THE TROPICAL TUNA

Tropical tuna fisheries in the EPO are mixed fisheries (BET, YFT and SKJ), with management based on the species needing the strictest management as determined by single species stock assessments. Historically, the estimated status of BET has determined management for tropical tunas (although yellowfin tuna in some years) and was therefore selected as the initial focus of MSE work (SAC-15-08). Although the ultimate goal is to evaluate harvest strategies in a multispecies context, experience from RFMOs and other organizations show that MSE processes are multi-year undertakings, even for single species. Given the limited and time-constrained funds available for MSE of EPO tropical tunas to date, it was decided to start with BET on the technical work, adding the other species (tentatively YFT first and then SKJ) as their

current assessment models were improved and operating models covering the main hypotheses about stock and fishery dynamics can be implemented. The stakeholder engagement has focused on dialogue on the three species, and the technical work conducted for BET is expected to streamline the MSE work on YFT and SKJ. Tropical tuna fisheries in the EPO, in addition to being multispecies fisheries, they are also multi-gear (purse-seine, longline) and multiple fishing modes (FAD, Dolphin, NOA) and thus present several challenges: 1) they are more difficult to simulate and evaluate, 2) different objectives may exist for different fisheries, 3) and whether management should be based on the species needing the strictest management, the 3 species individually, or a group of species is still not clear. Although there are some multi stock MSEs in development, including multi-stock tropical tunas in ICCAT (expected for 2026 or later) and a yellowfin-bigeye MSE in development at WCPFC, there are very few truly multispecies MSEs in the world, oftentimes focusing mainly on gear interactions (Punt et al., 2016), which will probably be the approach taken by staff. What should be the next priority species to continue MSE work for tropical tunas still needs to be decided, as both skipjack (SAC-16-04) and yellowfin tuna (SAC-16-03) modeling in the EPO have seen significant advances in recent years, the staff at the moment considers likely to develop the yellowfin tuna MSE following the bigeye tuna MSE. Components of the harvest strategies for tropical tunas in the EPO, and their evaluation, will continue to be discussed, refined and planned as part of the next 5-year scientific strategic plan.

5. SUMMARY AND NEXT STEPS

Conducting MSE and implementing the resulting harvest strategies requires the specification and testing of several components (objectives, performance measures, operating models, estimation models, harvest control rules, etc.). The IATTC has adopted elements of a harvest strategy for tropical tunas such as interim HCR and reference points, amended recently to include proxy reference points. However, some elements still need to be further refined (e.g. specificity of management objectives, probability of being above target reference points) and other elements added (monitoring strategy, exceptional circumstances) or revised as needed (e.g. type, duration and derivation of implementable management actions, target and limit reference points, list of alternative HCRs) to constitute a complete strategy and help in its evaluation via MSE. In order to help structure the discussions on harvest strategy elements in need of refinement during the 5th IATTC workshop on MSE for tropical tunas on May 30th, 2025, and the 1st Ad Hoc Working, a set of working tables is provided. Table 3 summarizes alternative management objectives, Limit (LRP) and Target Reference Points (TRP) along with probability levels and timelines, either as interpreted by the staff from IATTC documents or as proposed or discussed by IATTC MSE workshop participants. Table 4 lists alternative individual harvest strategy elements for the ongoing BET MSE, related to specification of harvest control rules (HCR), either as proposed by IATTC staff (SAC-16-06) or proposed/discussed during previous IATTC MSE Workshops. Table 5 lists candidate harvest strategies for the ongoing BET MSE, related to specific combinations of HCR elements, estimation model (EM) and data inputs including the specifications for the harvest strategy proposed by the IATTC staff (SAC-16-06) as an illustration to help elicit a list of Candidate Harvest Strategies to evaluate. Expected next steps and potential chronogram of harvest strategy implementation for tropical tunas is outlined in Table 2.

6. REFERENCES

Maunder, M. N, Lennert-Cody, C. E., Deriso, R. B., Aires-da-Silva, A. M, Lopez, J. 2021. Review of alternative conservation measures for the purse seine fishery for tropical tunas in the EPO. Inter-Amer. Trop. Tuna Comm., 12th Scient. Adv. Com. Meeting: SAC-12 INF-B

Punt, A. E., Butterworth, D. S., de Moor, C. L., De Oliveira, J. A. A., Haddon, M. 2016. Management strategy evaluation: Best practices. Fish and Fisheries, 17, 303–334.

TABLE 1. Objectives, quantities and performance indicators summarized during the 4th IATTC MSE workshop (from WSMSE-04-RPT).

OBJECTIVE	Quantity	Performance Indicators
Safety *Maintain stock above limit reference points*	*Equilibrium virgin spawning biomass* S_0 • *< 10% probability SB below 7.7% of* S_0 • *< 5% probability SB below 7.7% of* S_0 < 10% P SB < Smsy Flim (< 5% *P* F > Fmsy)	Ratio of S_{yr} over S_0 Probability calculated over projected 30 years (All years, any year by replicates)
Status Maintain stock in green quadrant of Kobe plot	SB≧ dynamic SB_{MSY} and $F<F_{MSY}$ • *60% probability* • *75% probability*	% of simulated runs falling in Kobe's green quadrant Probability calculated over projected 30 years
Stability Maintain low variability of catch and effort limits, gradual changes in management measures. Caps at 10% (effort), 15% (catch)	Standard deviation of annual catch, effort Average interannual proportional change (catch, effort)	% change in catch and/or effort between years Calculated over projected 3, 15 and 30 years
Yield/Abundance Maintain catches/effort/CPUE above historical ranges	Average catch/effort/CPUE by fishery (PS and LL) • *1994-2019 (since FAD expansion)* • *2017-2019 (latest status quo)*	Ratio of projected 3, 15 and 30-year average catch/effort/CPUE by fishery over historical period
Status quo Maintain the stock at levels near the (2017-2019) status quo	Spawning biomass, Index (LL CPUE)	Ratio of projected 3, 15 and 30-year average SB, Index (LL CPUE) over status quo period (2017-2019)

TABLE 2. Potential chromogram of harvest strategy implementation for EPO tropical tunas.

	2025	2026	2027	2028	2029	2030	2031	2032
Management Measures	In place, Res. C-24-01		Set in 2026			Set in 2029		
SAC		BET MSE results BET update assessment	BET benchmark assessment YFT update assessment	YFT MSE results SKJ exploratory assessment	YFT benchmark assessment SKJ benchmark assessment	BET benchmark assessment SKJ MSE results		
IATTC	Select/Adopt BET MP	Select/Adopt BET MP Set Measures (2027-2029)			Set Measures (2030-2032)			Set Measures (2033-2035)
Harvest Strategy staff work	BET MSE YFT MSE plan	Collate data for BET MP Run BET MP Check Excep. Circumst. YFT MSE	Check Excep. Circumst. YFT MSE	Check Excep. Circumst. YFT MSE	Collate data for BET MP Run BET MP Check Excep. Circumst. SKJ MSE	Check Excep. Circumst. SKJ MSE	Check Excep. Circumst.	Collate data for BET MP Run BET MP Check Excep. Circumst.

TABLE 3. Working table on Objectives, Limit (LRP) and Target Reference Points (TRP), probability levels and timelines.

Objective from WS	**Conditions**	**Interpreted from IATTC instruments**	**Workshop discussions**
Safety Maintain above LRP	Define LRP(s) Define probability Define timeline Reduce *F* before LRP	*Resolution C-23-06* P(S< $S_{7.7\%}$) <= 10% P(F> $F_{7.7\%}$) <= 10%	P(S< $S_{7.7\%}$) <= 10% or 5% P(S<S_{MSY}) <= 10% or 5% P(F>F_{MSY}) <= 5% Timeline: Over 20 or 30 years
Status Maintain stock in green quadrant of Kobe plot	Define TRP(s) Define probability F_{max} <= F_{target}	*Antigua Convention* S >= S_{MSY} F <= F_{MSY} (implied) *Resolution C-23-06* F_{MSY} Skipjack $F_{30\%}$	P(S>dS_{MSY}) >= 50%, 60%, 70%, 75% or 80% P(F<F_{MSY}) >= 50%, 60%, 70%, 75% or 80% $F_{40\%}$, $F_{45\%}$ d$S_{40\%}$
Stability Low variability in catch and effort Gradual changes in management measures	$S_{control}$ << S_{target} Limits on management changes		Effort 10% change cap Catch 15% or 20% change cap
Yield Maintain catches above historical ranges		*Resolution C-21-04 (IVT)* Decrease for BET in PS	Average *1994-2019 (since FAD expansion)* *2017-2019 (latest status quo)* *Relative to other historical levels (maximize yield)*
Effort Maintain effort above historical ranges		*Resolution C-24-01* Increase PS OBJ (for other species) Eliminate Corralito	Average *1994-2019 (since FAD expansion)* *2017-2019 (latest status quo)*
Abundance/CPUE Maintain above historical ranges			Average *1994-2019 (since FAD expansion)* *2017-2019 (latest status quo)* *Relative to other historical levels (maximize yield)*

TABLE 4. Working table on individual harvest strategy elements for the ongoing BET MSE, related to specification of harvest control rules (HCR), either as proposed by IATTC staff (SAC-16-06) or proposed/discussed during previous IATTC MSE Workshops.

Component of HCR	Staff	Workshops	Options
F_{max}	$F_{30\%}$	$F_{20\%}$, $F_{30\%}$, $F_{40\%}$, $F_{45\%}$, F_{MSY}	
$S_{Control}$	$S_{20\%}$	$S_{7.7\%}$, $S_{20\%}$, $S_{30\%}$, $S_{40\%}$, S_{MSY}	
$S_{F=0}$	0		
S_{Fmin}	NA		
F_{min}	NA		
EM	ASPM-Rdev+ Base reference 2024 / Gear-aggregated SAM		

TABLE 5. Working table on candidate harvest strategies for the ongoing BET MSE, related to combinations of harvest control rules (HCR) elements, specification of the estimation model (EM) and data inputs. Specifications for the harvest strategy proposed by the IATTC staff (SAC-16-06) is included.

Component of HCR	**Staff**	**Candidate 1**	**Candidate 2**	**Candidate 3**	**Candidate 4**	**Candidate 5**	**Candidate...**
F_{max}	$F_{30\%}$						
$S_{Control}$	$S_{20\%}$						
$S_{F=0}$	0						
S_{Fmin}	NA						
F_{min}	NA						
EM							
Model type	ASPM-Rdev+						
Model	Base reference 2024						
Data	Catch, CPUE, LF index + LL						

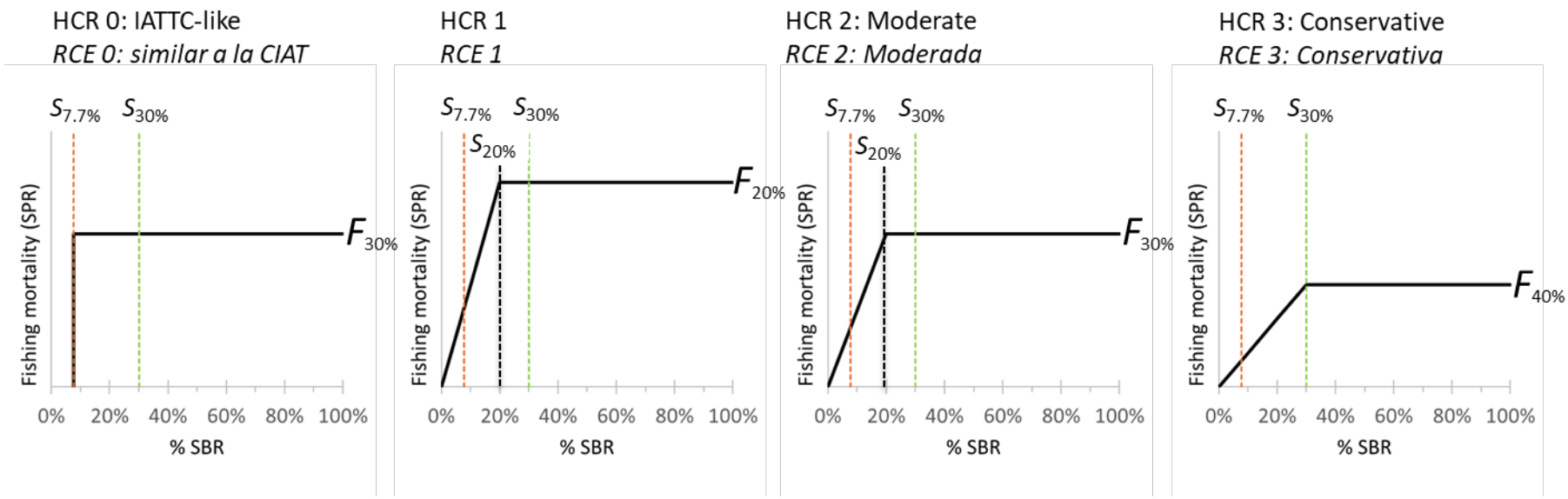

FIGURE 1. Alternative Harvest Control Rules (HCR) discussed during the 4th IATTC MSE workshop as potential candidates for evaluation during the bigeye tuna MSE (from WSMSE-04-RPT).