Estrategias de ordenación para atunes tropicales en el OPO SAC-15-08

Tropical tuna harvest strategies in the EPO SAC-15-08

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Harvest strategies

Harvest strategies (management strategies, management procedures) are 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) designed to achieve **management objectives**.

Management objectives

- General objectives are defined in IATTC's **Antigua Convention**'s Article VII (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"

- From Article II:

*"(…) ensure the long-term **conservation** and **sustainable use** of the fish (...)"*

- From Article IV Apply the **Precautionary Approach**:

"(...) be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."

Management objectives

- General objectives need to be converted into operational objectives, in terms of the values of performance statistics.
- Operational objectives include performance metrics, probabilities and timeframes that allow to evaluate how alternative harvest strategies perform using MSE
- Progress have been made IATTC MSE Workshops into developing more specific objectives
- The staff recommended additional workshops in 2024 and 2025 to further refine objectives and other harvest strategy elements, along with their evaluation for BET.

Objetivos, cantidades, indicadores de desempeño
Objectives, quantities, performance indicators

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)

IATTC Target and Limit Reference Points

- IATTC adopted interim limit and target reference points in 2014.
- Limit (LRP):
  - *B* and *F* associated with a 50% reduction in unfished equilibrium recruitment (50%R_0) using a conservative stock-recruitment relationship (steepness, or h = 0.75).
- Target (TRP):
  - Biomass (*B*) and Fishing mortality rate (*F*) corresponding to maximum sustainable yield (B_{MSY} and F_{MSY})
  - Move from equilibrium to dynamic targets in 2020
  - Adoption of proxy targets in 2023
  - Revisited by staff in 2024 (SAC-15-05)

Reference Points: Limit Reference Points

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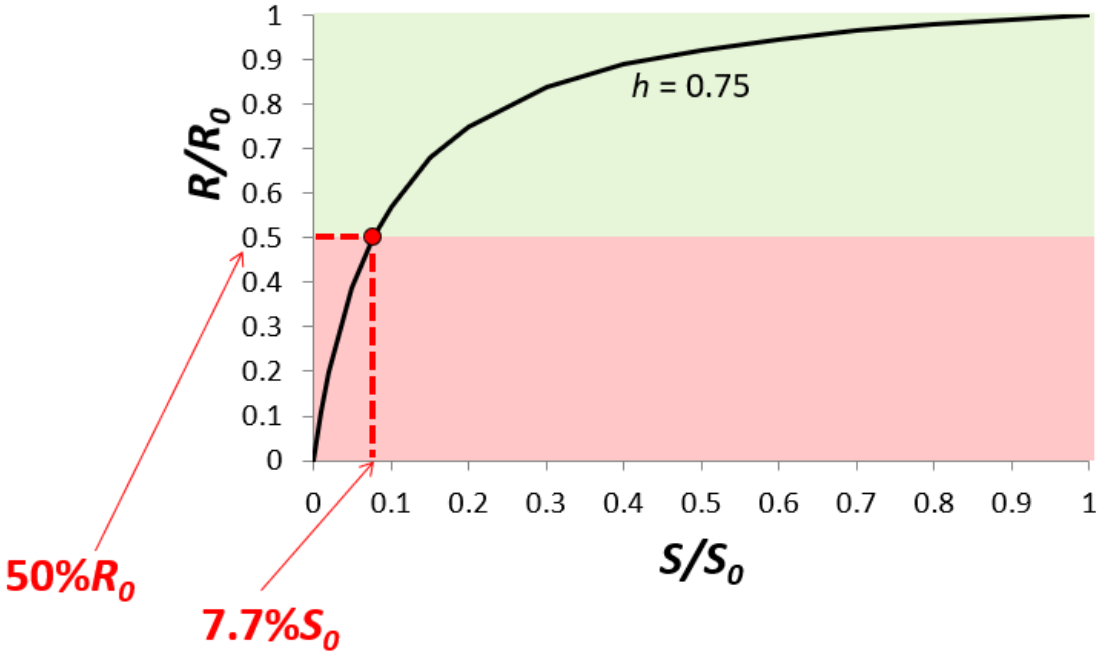
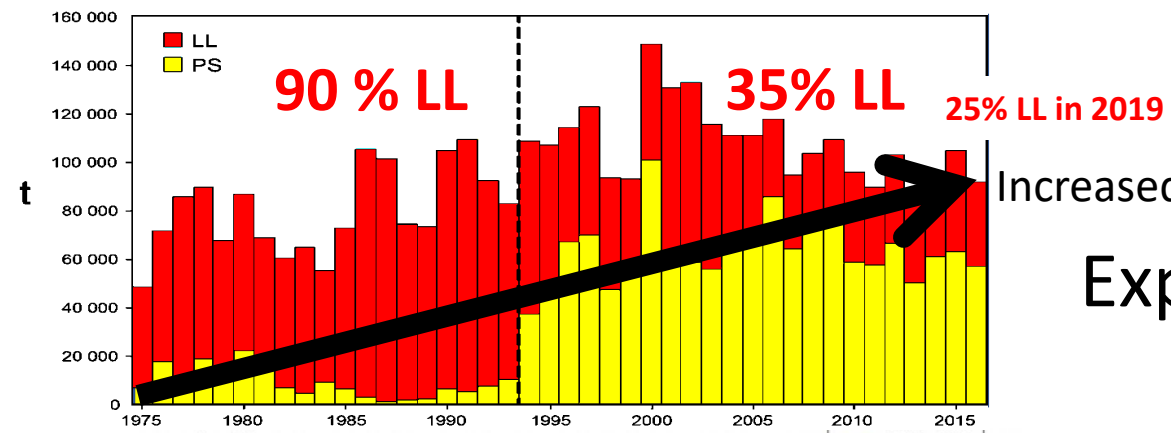


Reference Points: Target Reference Points

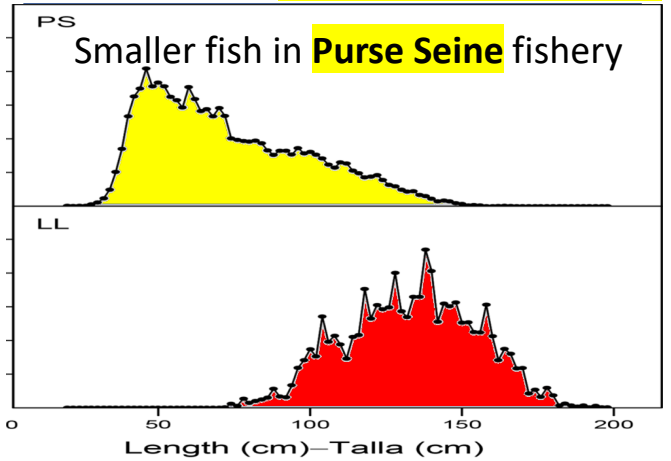
- Target (TRP):
  - Biomass (*B*) and Fishing mortality rate (*F*) corresponding to maximum sustainable yield (MSY): (B_{MSY} and F_{MSY})
  - Moved from equilibrium to dynamic targets in 2020
  - Adoption of proxy targets in 2023
  - Revisited by staff in 2024 (SAC-15-05): staff proposed $S_{MSY}/S_0 = 0.3$

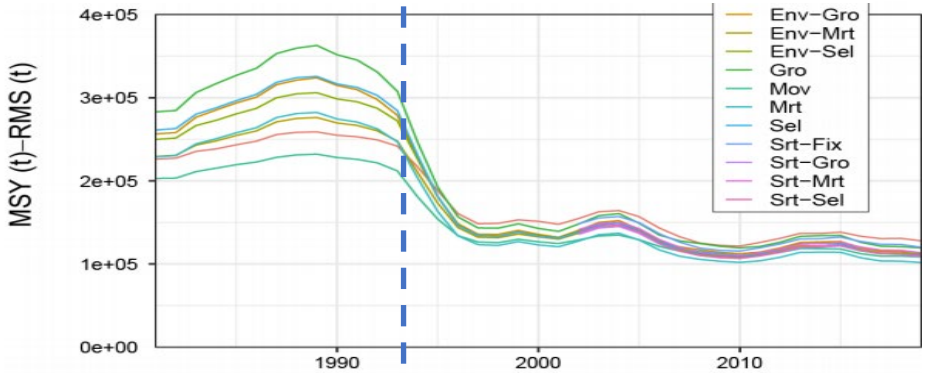
Historical changes (Bigeye tuna)

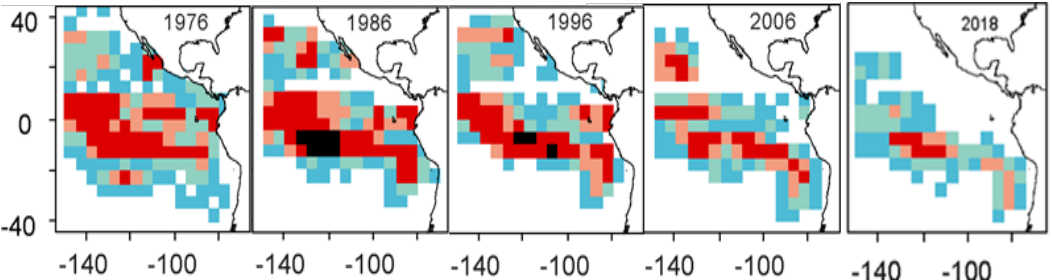


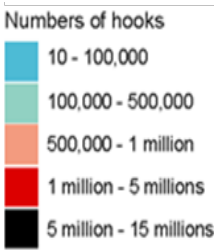
Increased **TOTAL** catch

Expansion of **Purse Seine**









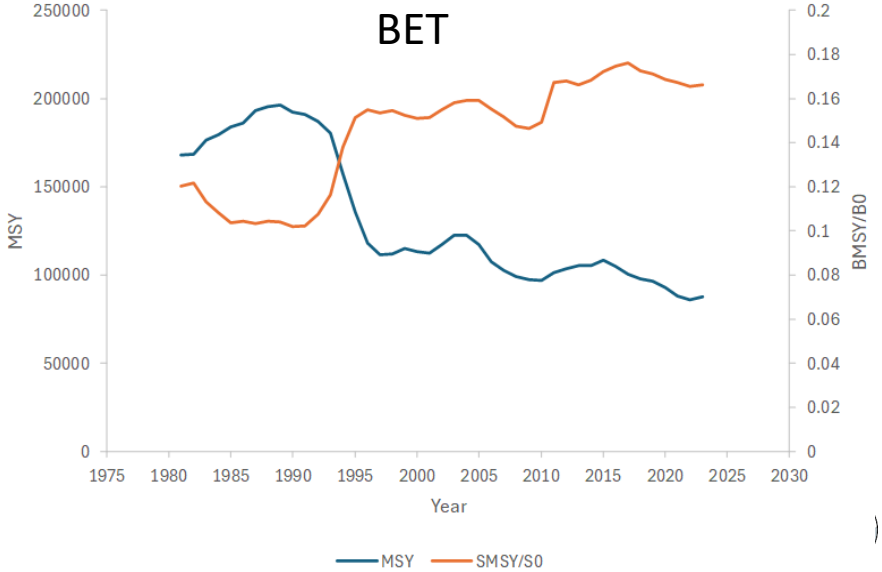
Influence of age on MSY

SAC-15-05

- MSY is conditional on the age specific fishing mortality
- Impacted by allocation of effort among fisheries
- Recent age-specific fishing mortality for calculating MSY (recent 3 years EPO tropical tunas)
- Generally, catching larger fish produces higher MSY at a higher BMSY/B0

Table 1 Estimates of MSY and associated quantities for yellowfin tuna in the EPO using different fishing methods.

Fishing method	MSY	S/S_0	Effort multiplier
Current mixture	248	0.23	1.19
Longline	425	0.26	66.47
Dolphin associated	337	0.26	3.06
Free-swimming schools	199	0.14	4.72
Floating objects	144	0.13	7.60



Influence of age on MSY

SAC-15-05

Calculate the maximum BET MSY that can be obtained using knife-edged selectivity

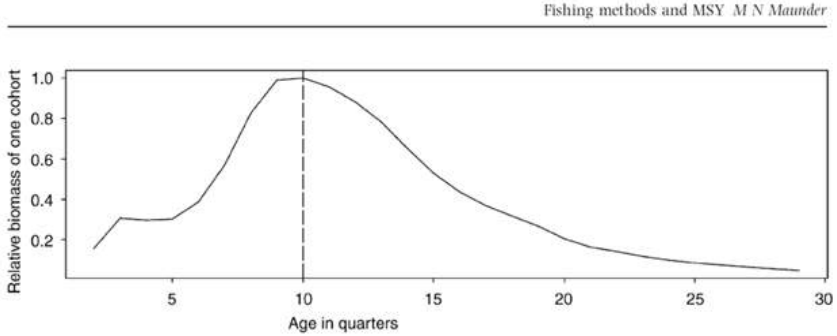


Figure 1 The relative biomass of a cohort of yellowfin tuna in the EPO as it ages. The vertical line represents the age at which the biomass of the cohort is maximized (a_{crit}).

Scenario		Age	MSY	BMSY/B0
h = 1.0	Current		87779	0.17
	OBJ		64898	0.09
	Longline		198733	0.11
	Knife edge selectivity	15	224090	0.25
h = 0.9	Current		84598	0.23
	OBJ		55407	0.19
	Longline		170769	0.20
	Knife edge selectivity	17	208332	0.31
h = 0.8	Current		82775	0.27
	OBJ		54235	0.24
	Longline		150445	0.25
	Knife edge selectivity	19	195303	0.39
h = 0.75	Current		110516	0.28
	OBJ		53901	0.26
	Longline		140976	0.27
	Knife edge selectivity	20	187512	0.44

Risk analysis weighted average $B_{MSY}/B_0 = 0.3$

Staff's revisited target reference points for tropical tunas

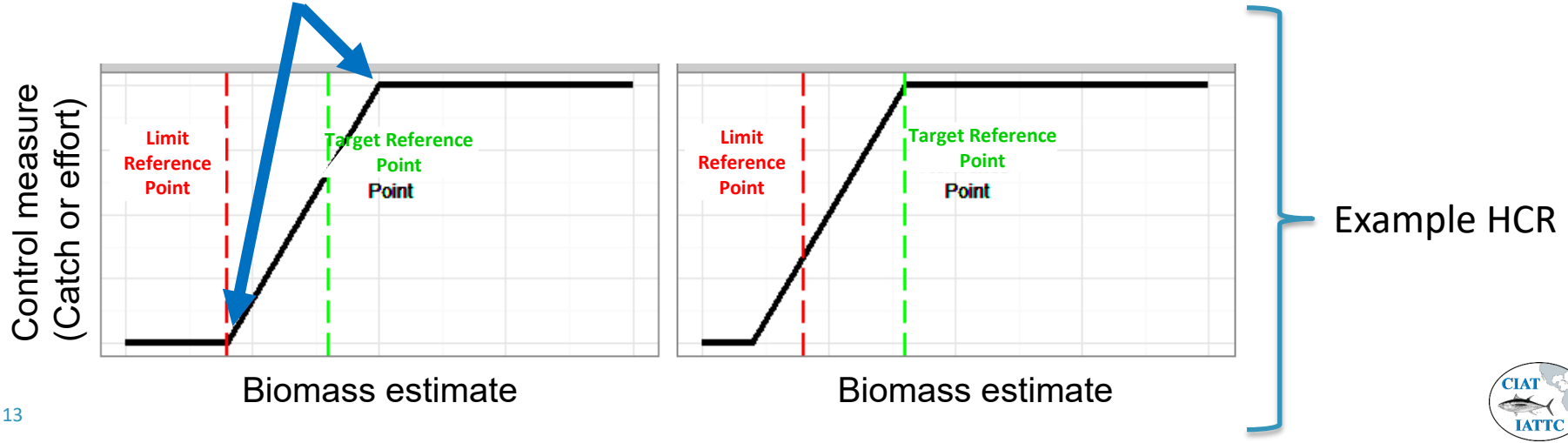
SAC-15-05

- Antigua Convention provides little guidance on reference points
- MSY based reference points are conditional on the size of the fish caught, historical changes
- B_{MSY} corresponds to 17% of the unfished level (B_0) in some BET stock assessment scenarios
- Target Reference Point = $0.3B_0$ could be an interim target reference point accommodating variation of catch among fishing methods
- Permanent target reference points need to consider diverse objectives in an MSE context

Reference Points and HCR Control Points

- Current HCR uses Reference Points
- Harvest Control Rules (HCR) can have **arbitrary control parameters**
- **Formal Reference Points** (**limit**, **target**) can be used to evaluate the performance of the HCR (but they do not need to be part of the HCR)

Control parameters (trigger reference points)



Harvest Control Rule (HCR)

C-16-02, C-23-06 have a HCR with target, limit reference points. **But:**

- HCR has not been fully evaluated using simulation
- No alternative HCR which could be better (e.g., more robust to uncertainty) has been adopted yet
- HCR does not specify what management actions are to be implemented
- HCR does not have a mechanism calculating magnitude of management actions
- Probabilities around targets are not specified

C-16-02 has elements of a management strategy, but it is not fully specified

Data collected

- No data inputs agreed to use in management setting for tropical tunas in the EPO
- Similar data collected by the IATTC for decades and used in the stock assessments (catch, length compositions by fleet, and indices or relative abundance based on fishery CPUE)
- Other data recently available (e.g. sonar buoy Indices)
- Other data collected only occasionally so far (e.g. tagging data, biometric data)

- Often difficult to specify all data to implement a strategy, however risks if not doing so
  - e.g. recent inclusion of the IVT, paired to the enhanced monitoring program (EMP). If continuation of EMP is uncertain, needed to support the IVT, unclear how to maintain strategy

Assessment or Data analyses

- The assessment method and data analyses to be used for tropical tunas are not fully specified, changes over time based on considerations of “best available science” at the time.
  - e.g. changes from ASCALA to Stock Synthesis
  - e.g. changes from GLM to spatio-temporal analyses of CPUE and length compositions

- Difficult to specify and agree all specifications of stock assessments and data analyses on a harvest strategy approach, unless the assessment is relatively simple

Role of full stock assessment model in Management Strategy

- As only Estimation Model of Management Strategy
  - Often logistically and computationally impractical

- Decoupled from Management Strategy and HCR implementation or MP
  - Stock status determination relative to reference points
  - Operating model development and modeling research
  - Typically, assessment year different from MP management action year
  - Check exceptional circumstances and meta rules

Management Strategy Evaluation

- Ongoing MSE for bigeye Tuna (see C-15-07)
- Recent large changes in the modeling of BET in the EPO
  - -2020 benchmark BET assessment issues (bimodal results, recruitment shift)
  - -Review of data and modelling for tropical tuna assessments (Oct-Nov 2023)
  - -Substantial changes and improvements on modelling for BET assessment (2024)
- Revisiting Tropical Tuna reference points (SAC-15-05)
- Finalize BET MSE and plan to present results and adoption of strategy during 2025 / 2026

Beyond bigeye tuna MSE

- EPO tropical tuna fisheries have multispecies (BET, YFT, SKJ), multi-gear (PS, LL) and fishing modes (FAD, Dolphin, NOA) present several challenges:
  - More difficult to simulate and evaluate
  - Different objectives for different fisheries?
  - Weak-stock management? Or 3 species individually? or two species?
- Very few truly multispecies MSEs in the world, focus on gear interactions
- Need to discuss / plan as part of the next 5-year IATTC Scientific Strategic plan

Current approach: some uncertainties

- The recent risk analysis approach incorporates a range of stock assessment uncertainties into tropical tuna assessments.
- Risk assessments cannot always be completed given assessments may still be under development (SKJ) or undergoing major structural changes (YFT)
- Negotiations about management decisions creates management uncertainty. If objectives are not clear and the type of management measures are not stable over time, the decisions are not part of a proper, complete strategy.
- The need to decide by consensus* can create political/industrial uncertainty. No guarantee appropriate management will continue once a Resolution expires.

** Article IX of Antigua requires consensus. Just 1 of the 21 members that is not in agreement is enough to halt a decision.*

Relationship with Management Strategies

Harvest strategies are the 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) designed to achieve **management objectives**.

- In the IATTC context, data and analyses change as new research is conducted
- Management measures (e.g. closures) and other recommended management actions can change in their adoption (or not) or their implementation over time.
- Relationship between some measures (e.g. BET IVT) and *F* is unknown.
- Therefore, although there are elements of a Management Strategy in the IATTC, those elements could be defined and improved towards a more defined strategy, along with alternatives.

Current approach: Summary

Things that could be improved:

- Perception of stock can change rapidly: changes in methodology and data.
- Management inconsistencies could occur if objectives/data/rules/actions are not fully specified.
- Difficult to evaluate long term consequences of alternative decisions.
- Need to consider additional uncertainties, in addition to assessment uncertainty.
- Difficult to evaluate how alternative strategies achieve management objectives.
- By default, there is a tendency to a system of minimal management changes.
- The process can be contentious at times.
- Costly in the long-term: many assessments and many meetings.

Management Strategies

Current IATTC approach

- Current IATTC tropical tuna management advice depends on stock assessments
- Stock assessment can have problems:
  - Bigeye (2018) and yellowfin tunas (2019, 2024)
- The process is contentious and costly in the long-term: many assessments and many meetings.

Management Strategies

- IATTC adopted elements of a management strategy for tropical tunas
- Only general objectives adopted
- Complex management: several measures in addition to closures, not clear how to include this measures and alternatives in an MSE

Questions? / ¿Preguntas?

Coming back at 1:55 PM PDT