REVISITING TARGET REFERENCE POINTS FOR TROPICAL TUNAS IN THE EPO

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Outline

- Background
- How target reference points are defined in the IATTC convention
- How target reference points are used by the IATTC
- How the sizes/ages of fish caught influence the target reference points
- Target reference points for bigeye tuna in the EPO
- Summary

Background

- Antigua Convention provides little guidance on reference points
- Commits the IATTC to applying the precautionary approach, which offers some guidance
- IATTC Resolution C-16-02 formalized a harvest control rule with interim target and limit reference points
- Target reference points corresponding to Maximum Sustainable Yield (MSY)
- MSY based reference points are conditional on the size of the fish caught
- Particular concern for bigeye tuna in which small fish are caught in the floating-object purse-seine fishery and large fish are caught in the longline fishery
- B_{MSY} corresponds to 17% of the unfished level in some BET stock assessment scenarios

How target reference points are defined

- Capable of producing B_{MSY}
  - "[The Commission shall perform the following functions…] to maintain or restore the populations of harvested species at levels of abundance which can produce the maximum sustainable yield".
- Resolution C-16-02 interpreted this to mean that the target reference points are those corresponding to MSY.
- Applying the precautionary approach, in accordance with the United Nations Fish Stocks Agreement (UNFSA):
  - "The members of the Commission, directly and through the Commission, shall apply the precautionary approach, as described in the relevant provisions of the Code of Conduct and/or the 1995 UN Fish Stocks Agreement, for the conservation, management and sustainable use of fish stocks covered by this Convention." (Article IV of the Antigua Convention).

Precautionary approach

- The risk of exceeding limit reference points is very low :
  - “Fishery management strategies shall ensure that the risk of exceeding limit reference points is very low. If a stock falls below a limit reference point or is at risk of falling below such a reference point, conservation and management action should be initiated to facilitate stock recovery. Fishery management strategies shall ensure that target reference points are not exceeded on average.” (Annex II UNFSA 1995)
- F_{MSY} is a limit reference point:
  - “The fishing mortality rate which generates maximum sustainable yield should be regarded as a minimum standard for limit reference points.” (Annex II UNFSA 1995)
- Uncertainty should be taken into consideration:
  - “In particular, the members of the Commission shall 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.” (Article IV of the Antigua Convention)

How target reference points are used

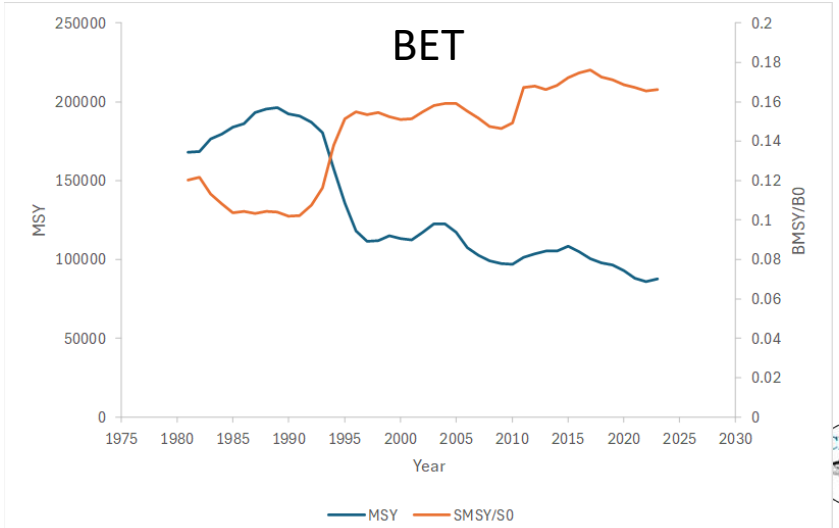
Use	Component	Source
Stock status	F_{target}	87th meeting of the IATTC
	F_{limit}	87th meeting of the IATTC; Maunder and Deriso (2014)
	B_{target}	87th meeting of the IATTC
	B_{limit}	87th meeting of the IATTC; Maunder and Deriso (2014)
	F and B proxies	Resolution C-23-06; Maunder (2024); Maunder et al. (2024)
HCR	F	e.g. Resolution C-10-01; Resolution C-16-02
HCR trigger point	F	Resolution C-16-02
	B	Resolution C-16-02
Rebuilding target	F	Resolution C-16-02
	B	Resolution C-16-02
Performance metric		Discussed

Influence of age on MSY

- MSY is conditional on the age specific fishing mortality
- Impacted by allocation of effort among fisheries
- Recent age-specific fishing mortality is used in calculating MSY (e.g. recent three years for tropical tunas in the EPO).
- Generally, catching larger fish produces higher MSY at a higher B_{MSY}/B_0

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

- Global MSY generally occurs by fishing all the fish at one age
- Not practical
- Calculate the maximum MSY that can be obtained using knife-edged selectivity

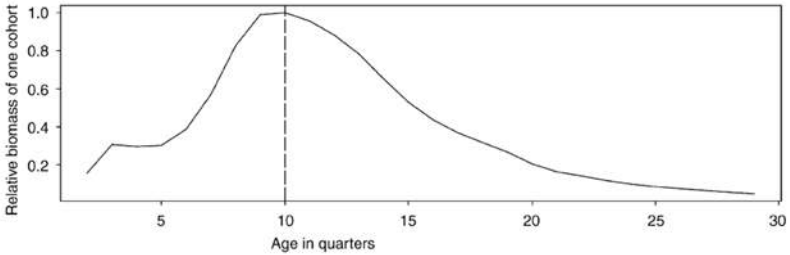
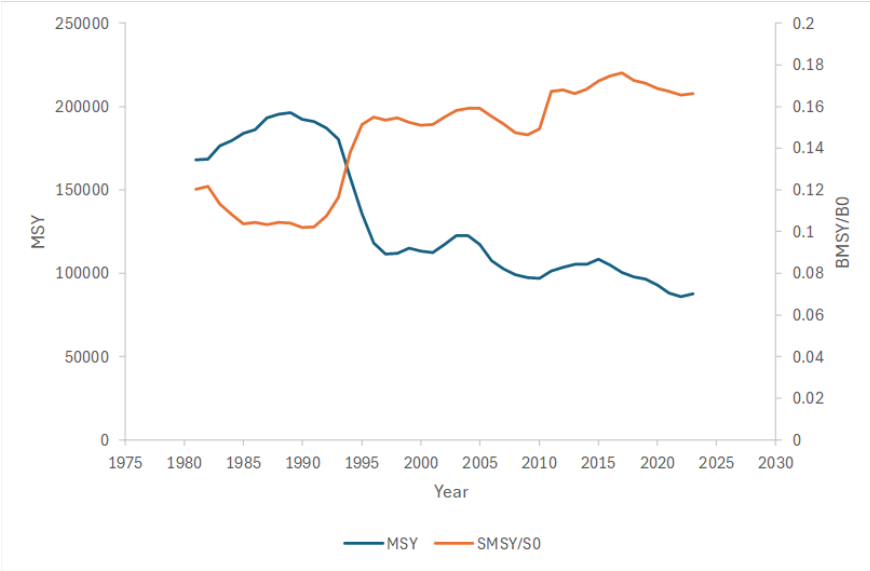


Figure 1 The relative biomass of a cohort of yellowfin tuna in the EPO as it ages. The vertical line represents the age at which the biomass of the cohort is maximized (a_{crit}).

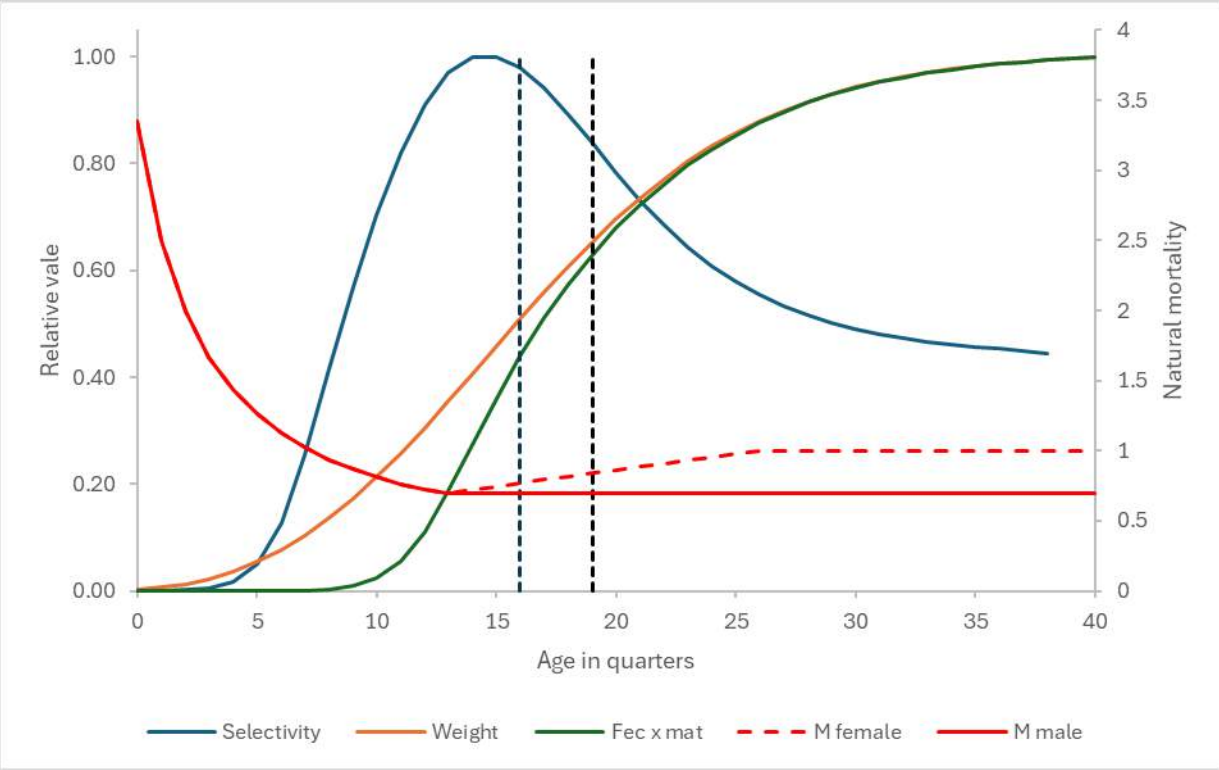
Bigeye tuna

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 $B_{MSY}/B_0 = 0.3$

Summary

- Antigua Convention provides little guidance on reference points
- Precautionary approach is conflicted
- Resolution C-16-02 formalized interim MSY target reference points
- MSY based reference points are conditional on the size of the fish caught
- B_{MSY} corresponds to 17% of the unfished level in some BET stock assessment scenarios
- B_{MSY} = 0.3 could be an interim target reference point that accommodates variation of catch among fishing methods
- Permanent target reference points need to consider diverse objectives in an MSE context

Influence of age on MSY