

IATTC-SAC15 Agenda 7b

## Updates from ISC PBFWG: MSE and Harvest Strategies

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ISC Pacific Bluefin tuna Working Group



# Acknowledgements

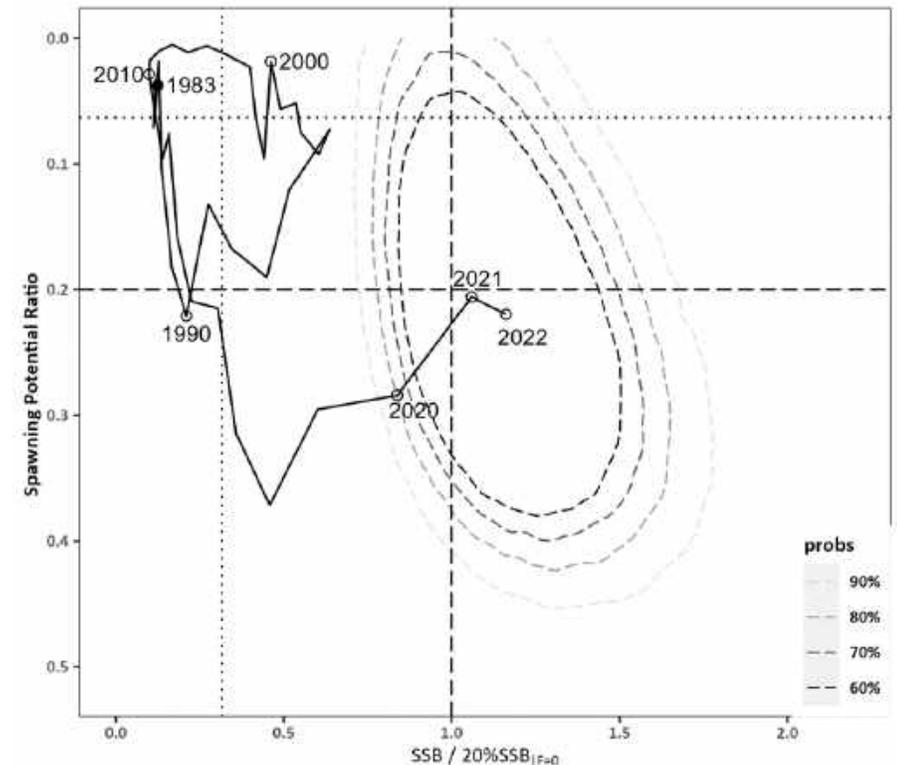
- ❖ All works to develop and improve the PBF MSE were done by the following members of the ISC PBFWG as a team effort;
  - M. Maunder, J. Valero (MSE Analyst) (IATTC)
  - S.K. Chang (Chinese Taipei and WG vice chair)
  - M. Dreyfus-Leon, M. Betancourt (Mexico)
  - J. Lee, Y. Kwon (Korea)
  - H.H. Lee, D. Tommasi (MSE analyst), S. Teo (U.S.A.)
  - H. Fukuda, N. Takahashi (MSE analyst), Y. Tsukahara, K. Nishikawa (Japan)
  - S. Nakatsuka (WG chair)



# Why do a Management Strategy Evaluation for PBF?



- Currently, the PBF stock is subject to a recovery plan. This includes implementation of strict catch limits for PBF fisheries by the IATTC and WCPFC, with some revisions in accordance with the stock assessment results.
- The need for a long-term management measure for the fishery after achieving the second rebuilding target has been discussed at the JWG of the WCPFC NC and the IATTC.
- The JWG agreed to work on an MSE **to evaluate the expected performance of alternative long-term management strategies for PBF fisheries** once the 2<sup>nd</sup> PBF rebuilding target is reached.
- The JWG requested to the ISC to complete the technical analyses for the MSE in 2025.
- According to the latest ISC stock assessment, the 2<sup>nd</sup> PBF rebuilding target was reached in 2021.



# What is Management Strategy Evaluation?

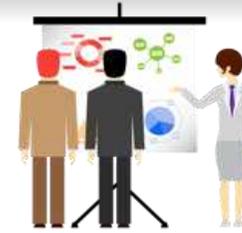


- MSE is a process to evaluate the **trade offs** and **performance** of **candidate management strategies** under a range of **scenarios** and **uncertainties** using computer simulations
- Flight simulator for fisheries management but with a lot more uncertainty
- If a management strategy does not perform adequately in a computer simulation, we should not expect it to work in the real world
- Difference between forward projections and MSE is that MSE uses a feedback loop

# Brief History of PBF MSE Process

**1<sup>st</sup> ISC PBF MSE Workshop (May 2018)**  
**Yokohama, JAPAN**

- ✓ ~70 participants
- ✓ **Purpose:** review the requirements to implement an MSE, define stakeholder roles, review recent progress made by tuna RFMOs towards implementing the MSE process



**2<sup>nd</sup> ISC PBF MSE Workshop (May 2019)**  
**San Diego, USA**

- ✓ ~70 participants
- ✓ **Purpose:** promote understanding of MSE among stakeholders and continue discussion on required elements for PBF MSE

**7<sup>th</sup> Meeting of the IATTC\_WCPFC NC JWG on PBF (July 2022)**  
**Virtual**

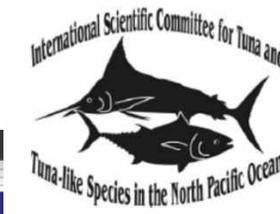
- ✓ Workplan for development of long-term harvest strategy (including MSE) adopted
- ✓ Candidate **operational management objectives** and **harvest control rules (HCRs) for MSE** discussed
- ✓ To be revisited at JWG08 meeting

**8<sup>th</sup> Meeting of the IATTC\_WCPFC NC JWG on PBF (July 2023)**  
**Fukuoka, JAPAN**

- ✓ Candidate **operational management objectives** and **harvest control rules for MSE** finalized
- ✓ Reviewed and adopted by WCPFC NC at NC19

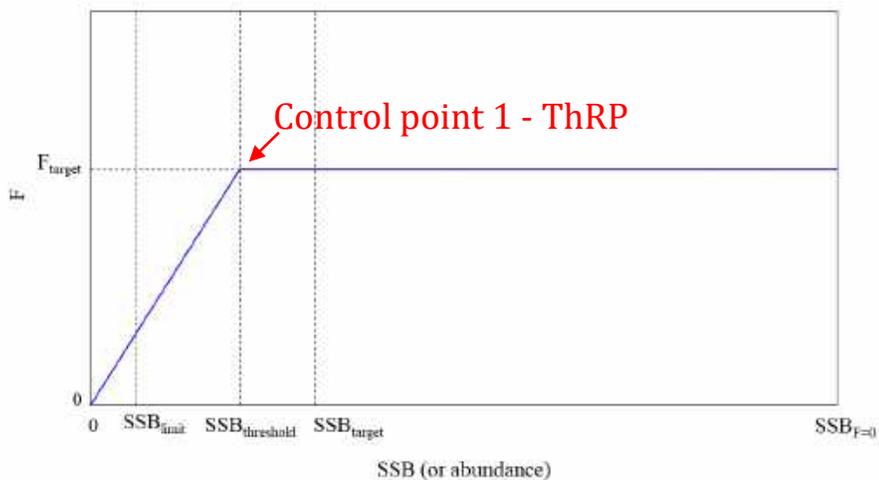
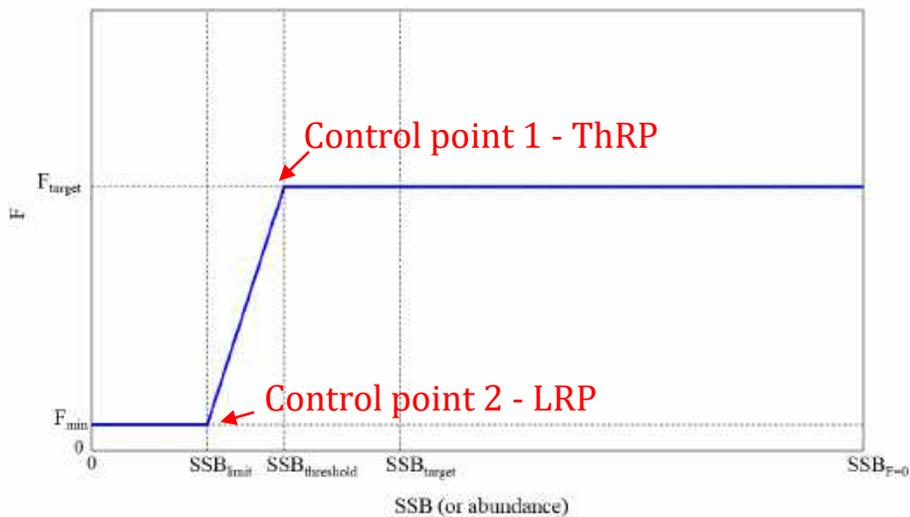
**2025** - ISC presents **final results** from the **MSE** to JWG10  
JWG recommends a final HS to WCPFC and IATTC for adoption

# Candidate Operational Management Objectives for PBF



Category	Operational Management Objective	Performance Indicator
<b>Safety</b>	There should be a less than 20% probability of the stock falling below the limit reference point (LRP)	<ul style="list-style-type: none"> <li>Probability that <math>SSB &lt; LRP</math> in any given year of the evaluation period</li> </ul>
<b>Status</b>	To maintain fishing mortality at or below $F_{target}$ with at least 50% probability	<ul style="list-style-type: none"> <li>Probability that <math>F \leq F_{target}</math> in any given year of the evaluation period</li> <li>Probability that <math>SSB</math> is below the equivalent biomass depletion levels associated with the candidate for <math>F_{target}</math></li> </ul>
<b>Stability</b>	To limit changes in overall catch limits between management periods to no more than 25% unless the ISC has assessed the stock is below the LRP	<ul style="list-style-type: none"> <li>Percent change upwards in catches between management periods excluding periods when <math>SSB &lt; LRP</math></li> <li>Percent change downwards in catches between management periods excluding periods when <math>SSB &lt; LRP</math></li> </ul>
<b>Yield</b>	Maintain an equitable balance in proportional fishery impact between the WCPO and EPO	<ul style="list-style-type: none"> <li>Median fishery impact (in %) on <math>SSB</math> in the terminal year of the evaluation period by fishery and by WCPO fisheries and EPO fisheries</li> </ul>
	To maximize yield over medium (5-10 years) and long (10-30 years) terms, as well as average annual yield from the fishery	<ul style="list-style-type: none"> <li>Expected annual yield over years 5-10 of the evaluation period, by fishery</li> <li>Expected annual yield over years 10-30 of the evaluation period, by fishery</li> <li>Expected annual yield in any given year of the evaluation period, by fishery</li> </ul>
	To increase average annual catch in all fisheries across WCPO and EPO	

# Candidate HCRs and Reference Points for PBF MSE



HCR Number	$F_{target}$	SSB Control Point 1 (ThRP)	SSB Control Point 2 (LRP)	Number of SSB control points	$F_{min}$
1	FSPR30%	20%SSB <sub>F=0</sub>	15%SSB <sub>F=0</sub>	2	10%F <sub>target</sub>
2	FSPR30%	25%SSB <sub>F=0</sub>	15%SSB <sub>F=0</sub>	2	10%F <sub>target</sub>
3	FSPR40%	20%SSB <sub>F=0</sub>	15%SSB <sub>F=0</sub>	2	10%F <sub>target</sub>
4	FSPR40%	25%SSB <sub>F=0</sub>	15%SSB <sub>F=0</sub>	2	10%F <sub>target</sub>
5	FSPR40%	25%SSB <sub>F=0</sub>	20%SSB <sub>F=0</sub>	2	10%F <sub>target</sub>
6	FSPR30%	20%SSB <sub>F=0</sub>	10%SSB <sub>F=0</sub>	2	FSPR70%
7	FSPR25%	20%SSB <sub>F=0</sub>	10%SSB <sub>F=0</sub>	2	FSPR50%
8	FSPR30%	20%SSB <sub>F=0</sub>	Median SSB 1952-2014	2	CMM limits
9	FSPR20%	20%SSB <sub>F=0</sub>	NA	1	NA
10	FSPR25%	15%SSB <sub>F=0</sub>	NA	1	NA
11	FSPR30%	15%SSB <sub>F=0</sub>	7.7%SSB <sub>F=0</sub>	2	5%F <sub>target</sub>
12	FSPR30%	20%SSB <sub>F=0</sub>	7.7%SSB <sub>F=0</sub>	2	5%F <sub>target</sub>

Changes in TAC between consecutive management periods constrained to be no more than 25%

Tuned to reach WCPO:EPO impact ratio of 70:30 and 80:20

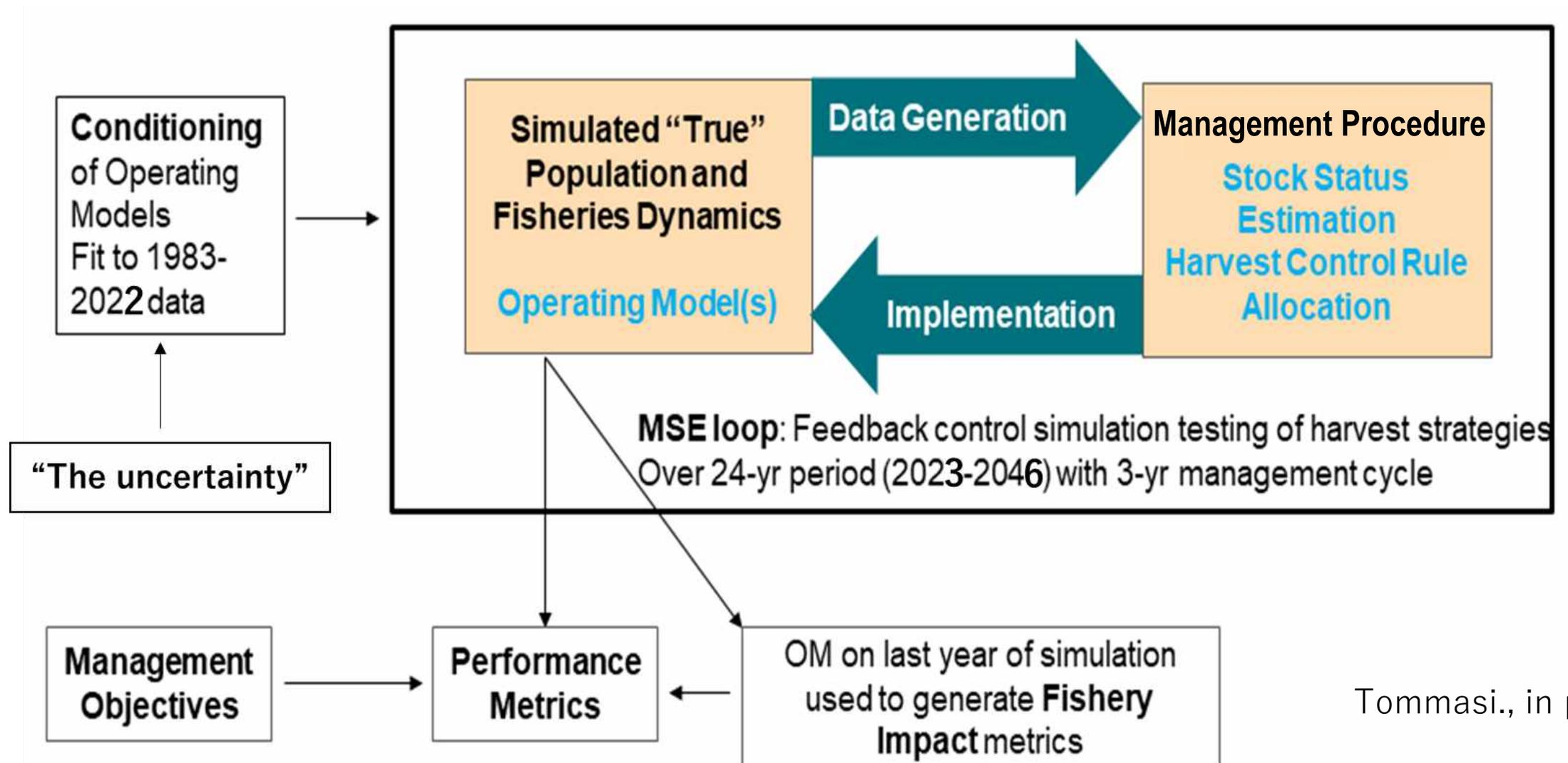
# Plan for the stock assessment and MSE/MP TAC update

- ❖ The ISC is requested to provide the results from PBF MSE in 2025.
  - The PBFWG plans to finalize the MSE package in 2024 and evaluate MPs in early 2025.
    - ✓ There is some available time to have a science-management dialogue in Jan.-Feb. 2025.
  - The results from the MSE will be provided to the IATTC-WCPFC JWG in 2025 (June-Sept.?).
  - 3-year management cycle is currently considered.
    - ✓ SA (2024) -> 1<sup>st</sup> MSE with multiple MPs (2025) -> Research (2026) -> SA (2027) -> MP TAC update
    - ✓ The MP selected in 2025 will be updated every 3 years to calculate the TAC for the next 3 years.
    - ✓ SA focused on detailing what is going on the stock, and whether anything unexpected happens.

	2024	2025	2026	2027	2028	2029
Stock assessment	○			○		
CMM@ interim HCR						
MSE/MP		1 <sup>st</sup> formal MSE			MP TAC update	
CMM@ MSE			 			

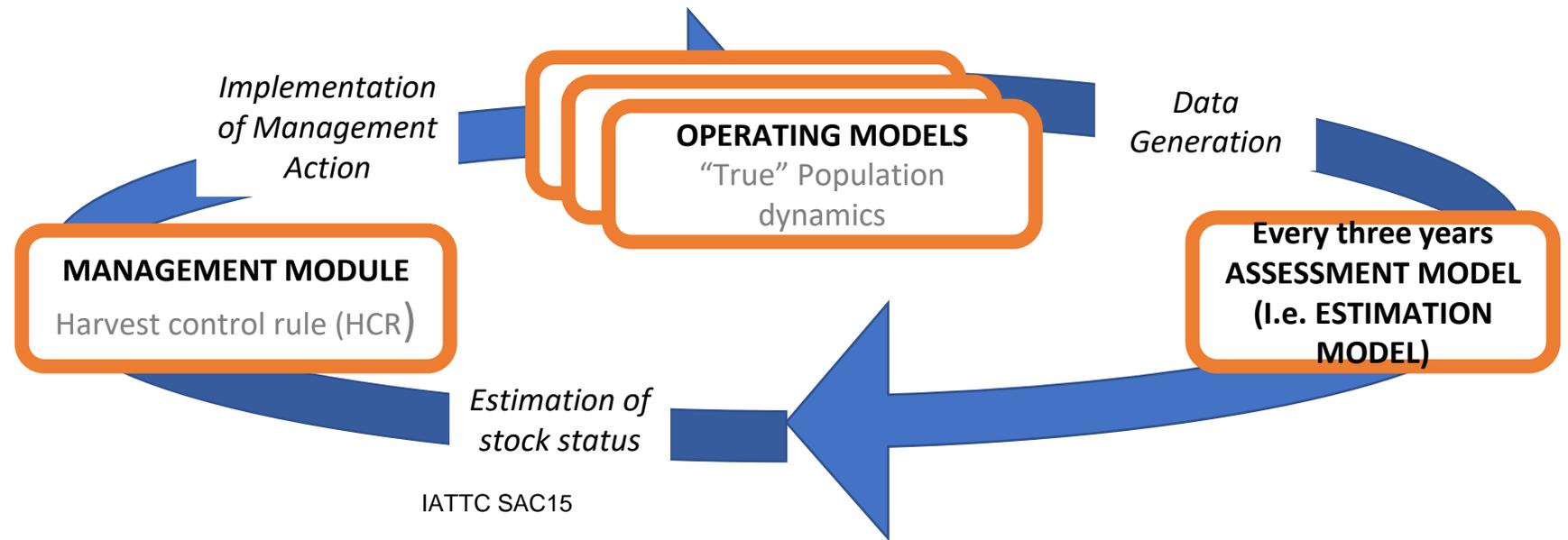
# Work Progress on MSE development

# Framework of the PBF MSE



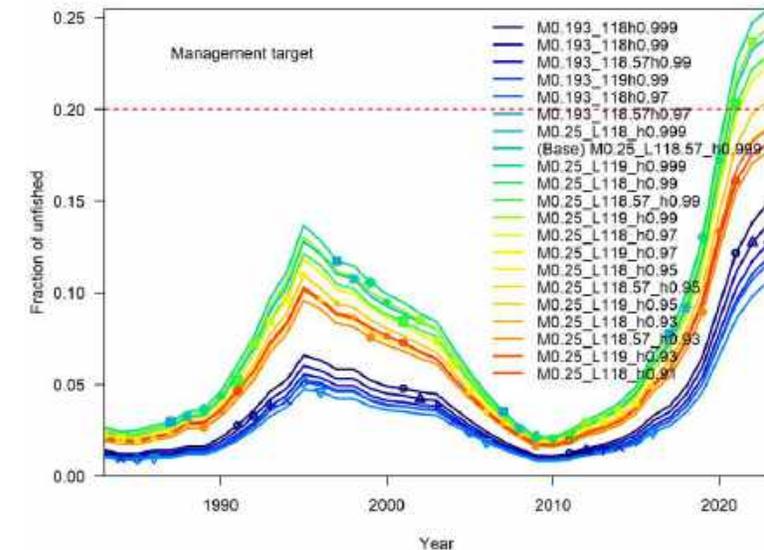
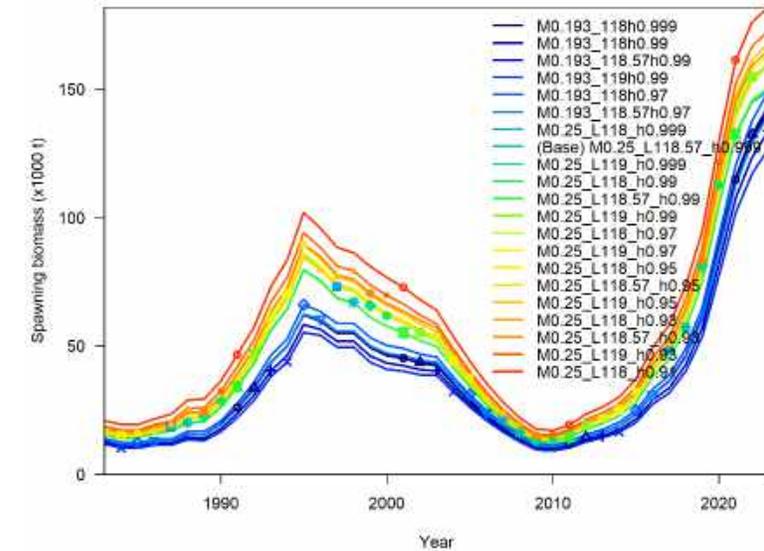
# Framework of the PBF MSE

- The ISC PBFWG decided to apply the MSE framework developed for the NP ALB stock for PBF MSE.
- This allows for simulation testing of the performance of a management procedure (MP, including a HCR) in a feedback manner with the operating model developed for PBF.
- Framework is coded in R, with Operating Models (OMs) and Estimation Models (EMs) developed in Stock Synthesis 3.3.



# Operating Model(s) – Reference set

- ❖ The OM reference set captures the most likely plausible range of stock and fishery dynamics
- ❖ Base case OM is ISC PBF 2024 assessment
- ❖ ISC PBFWG developed methodology to select final reference OM set based on model diagnostics (Lee and Tommasi 2024)
- ❖ Use of reference set allows for consideration of *parameter uncertainty* in PBF steepness, natural mortality, and growth
- ❖ PBF MSE framework also considers
  - ❖ *Process uncertainty* in recruitment by using multiple iterations with different random recruitment deviations
  - ❖ *Observation uncertainty* by generating data with error to be input into the EM
  - ❖ *Estimation uncertainty* by simulating an assessment model (EM)
  - ❖ *Implementation uncertainty* due to discards



# Operating Model(s) – Robustness Set

- ❖ Robustness OMs are still plausible but unlikely
- ❖ The robustness set allows for a check that the management procedure still behave as intended even in an unlikely, but still plausible, scenario
- ❖ ISC PBFWG considers the following scenarios as high priority for inclusion in the robustness set:
  - ❖ No adult longline index
  - ❖ Catchability change in the Taiwanese longline index
  - ❖ Recruitment drop (10-yr long drop as in the 1980's)
  - ❖ Implementation error reflecting higher discards than the currently considered 5% (WPO catch) and 6% (EPO release)

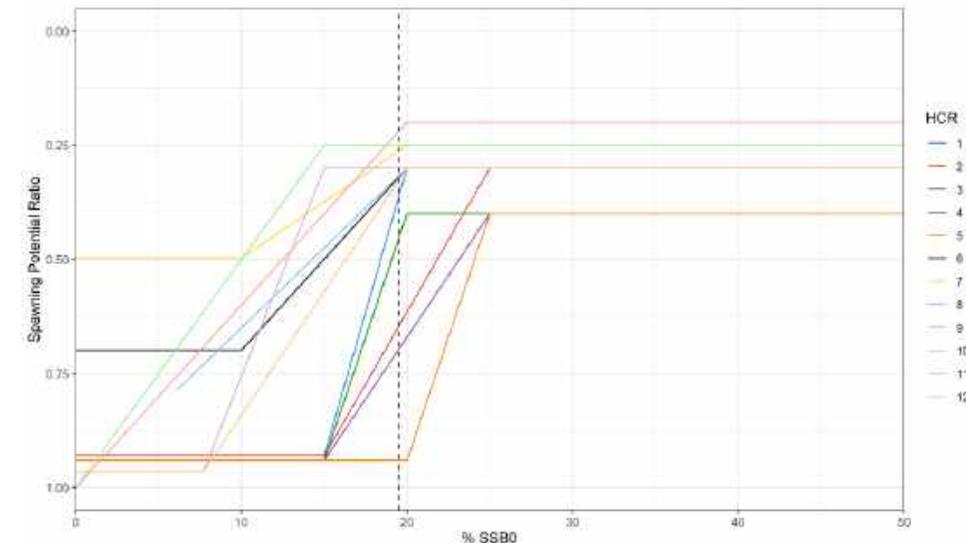
Tommasi and Lee 2024, ISC PBF WG meeting report, spring 2024

# Estimation model (EM) in MP

- ❖ EM is a module to estimate the stock status for the harvest control rule.
  - For the last decade (in the real world), the management measure has been decided based on the stock assessment using the fully integrated model (SS3 model).
  - The base-case SS3 model of the 2024 assessment could be used as the default EM in the MSE.
  - Due to the high computational burden to run the full SS3 model in each MP, simpler assessment models (e.g. ASPM-R) are currently under consideration to optimize the tradeoff between calculation time and actualism.
  - Preliminary evaluation showed that use of ASPM-R reduced computation time to  $\frac{1}{4}$  and produced future TAC and SSB trajectories similar to those of a full SS3 EM (Takahashi et al. 2024).

# Management Module

- ❖ All the candidate harvest control rules proposed by the JWG08 have been implemented in the MSE (Tommasi et al. 2023), with the 25% limit on TAC changes between management periods (Tommasi and Lee 2024a).
- ❖ Work is underway to apply the method to tune the impact ratio (Tommasi and Lee 2024b) to obtain the requested EPO:WCPO impact ratios of 70:30 or 80:20 (Tommasi and Lee 2024) using the new OM based on the 2024 assessment. Note this is dependent on the assumed selectivity.



# Summary for the PBF MSE

- ❖ The ISC PBFWG has been developing the PBF MSE package, with final report and results to be available in 2025 (JWG 10).
  - The ISC PBFWG obtained all required inputs from the IATTC-WCPFC JWG;
  - The technical work is proceeding according to the timeline
    - ✓ General PBF MSE simulation framework developed and candidate harvest control rules implemented
    - ✓ OM based on 2024 stock assessment developed and reference and robustness sets identified
    - ✓ Preliminary comparison of alternative EM formats carried out
    - ✓ Fishery Impact performance metric implemented
    - ✓ Method to tune relative F to obtain desired impact developed, needs to be tested with updated OM
  - The JWG could consider holding an intersessional meeting in early 2025 to review progress of MSE and preliminary results
- ❖ This information will be presented at JWG 9 in July 2024.

Questions?

