IATTC-SAC14 Agenda 6f-i

Updates from ISC PBFWG

ISC Pacific Bluefin tuna Working Group

International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean

Acknowledgements

❖ All works to develop and improve the PBF assessment and MSE were done by a following member of the ISC PBFWG as a team effort;

- M. Maunder, (IATTC)
- S.K. Chang (Taiwan and WG vice chair)
- M. Dreyfus-Leon (Mexico)
- H.W. Park, H.W. Lee, S.I. Lee (Korea)
- H.H. Lee, D. Tommasi (U.S.A.)
- H. Fukuda, N. Takahashi, K, Fujioka, Y. Tsukahara, K. Nishikawa, S. Asai (Japan)
- S. Nakatsuka (WG chair)

Management and Stock Assessment of Pacific Bluefin tuna

❖ Management

- PBF is a single Pacific-wide stock managed by both the IATTC and the WCPFC.
  - ✓ The Conservation and Management Measures (CMM) of PBF have been discussed and crafted in the IATTC-WCPFC NC joint WG (JWG) and adopted by each Commission since 2018.
  - ✓ The CMMs involving a catch upper limit were firstly introduced in 2011 (WCPFC) and 2012 (IATTC), and those were strengthened in 2014 and 2015-2021 with the explicit rebuilding targets in both areas.
    - $SSB_{Med\ 1952-2014}$ ($6.3\%SSB_0$) as the initial rebuilding target; $20\%SSB_0$ as the second rebuilding target.

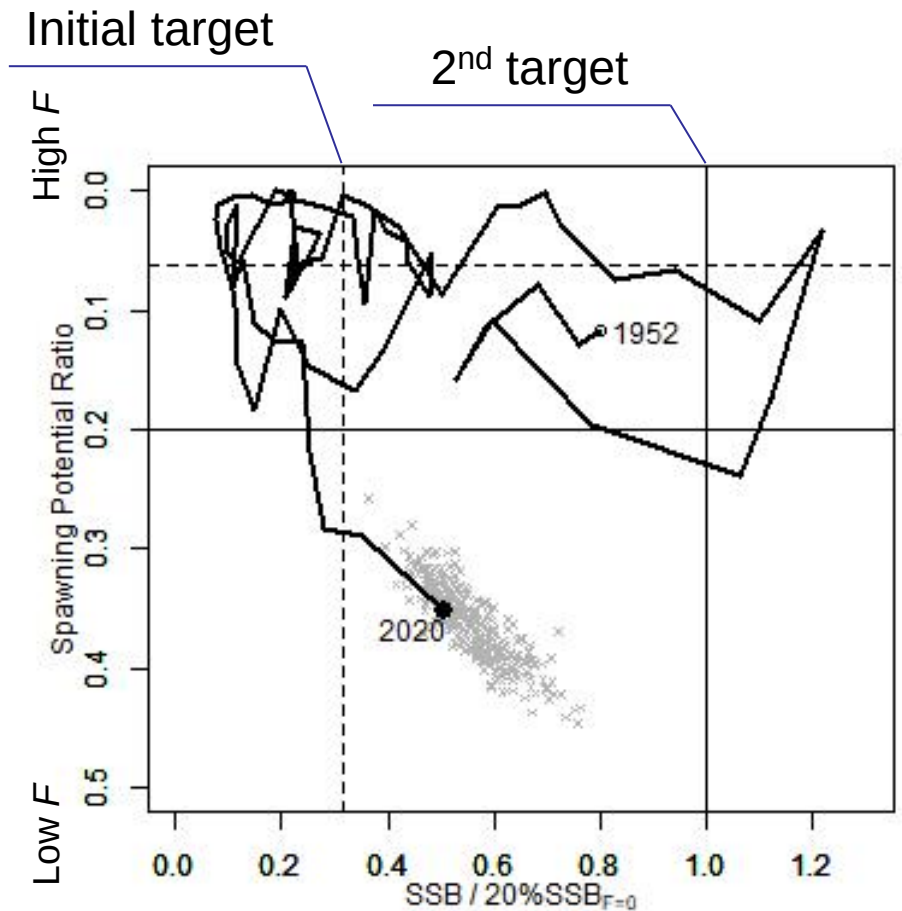
❖ Stock Assessment

- ISC PBFWG conducts a regular stock assessment of PBF every two years.
- 2022 assessment was the latest assessment.
  - ✓ The assessment result was reported to the IATTC SAC13, and the current recommendations by the Staff and SAC were based on this assessment.
  - ✓ No assessment in 2023.
- The next assessment is scheduled in 2024.
  - ✓ 2023 is a research year to improve the assessment model and to develop the PBF MSE.

Stock Status

PBF SSB has gradually increased in the last 10 years, and the rate of increase is accelerating. These biomass increases coincide with a decline in fishing mortality, particularly for fish aged 0 to 3, over the last decade. The latest (2020) SSB is estimated to be 10.2% of SSB_0. Based on these findings, the following information on the status of the PBF stock is provided:

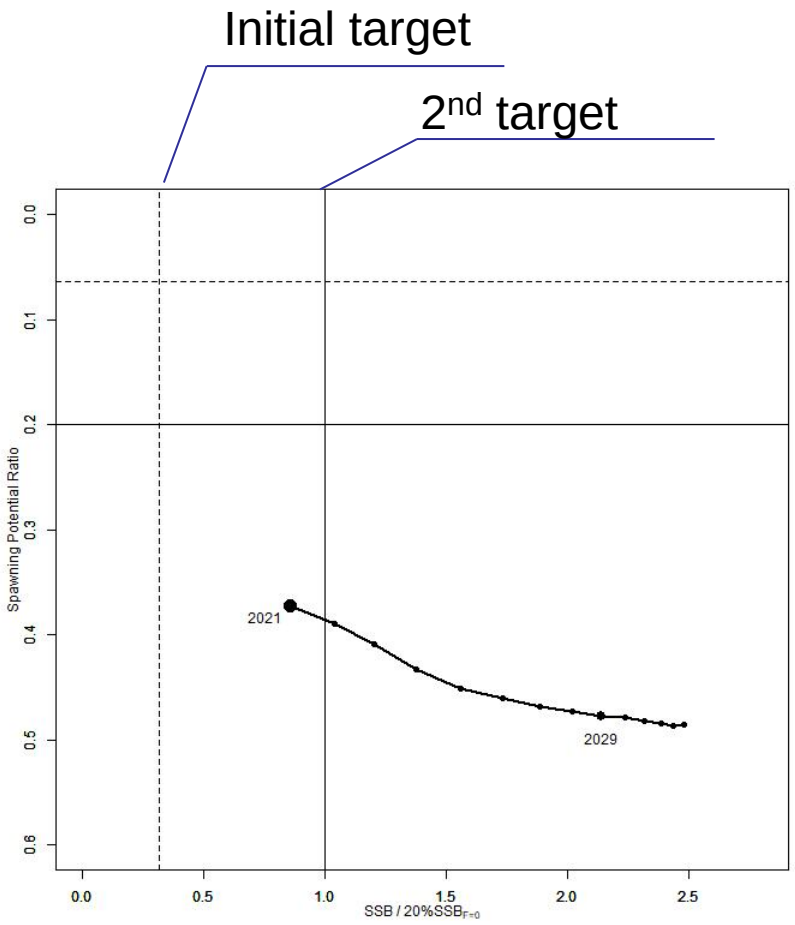
1. No biomass-based limit or target reference points have been adopted for PBF, but the PBF stock is overfished relative to the potential biomass-based reference points (20%SSB0) adopted for other tuna species by the IATTC and WCPFC. On the other hand, SSB reached its initial rebuilding target (SSB_{MED} = 6.3%SSB_0) in 2019, 5 years earlier than originally anticipated by the RFMOs.
2. No fishing mortality-based reference points have been adopted for PBF by the IATTC and WCPFC. The recent (2018-2020) $F_{\%SPR}$ is estimated to produce a fishing intensity of 30.7%SPR and is below the level corresponding to overfishing for many F-based reference points proposed for tuna species, including $SPR_{20\%}$.



Conservation information (summary)

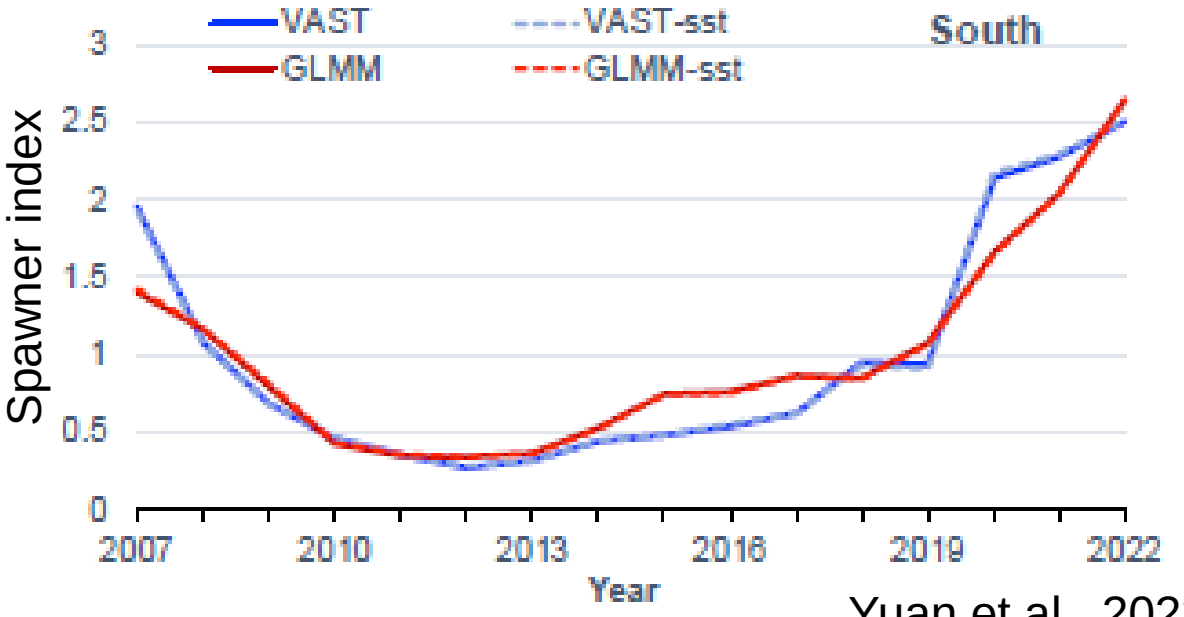
1. The PBF stock is recovering from the historically low biomass in 2010 and has exceeded the initial rebuilding target ($SSB_{MED1952-2014}$) five years earlier than expected. The rate of recovery is increasing and under all projection scenarios evaluated, it is very likely the second rebuilding target ($20\%SSB_0$ with 60% probability) will be achieved (probabilities > 90%) by 2029. The risk of SSB falling below the historical lowest observed SSB at least once in 10 years is negligible.

2. The projection results show that increases in catches are possible without affecting the attainment of the second rebuilding objective. Increases in catch should consider both the rebuilding rate and the distribution of catch between small and large fish.

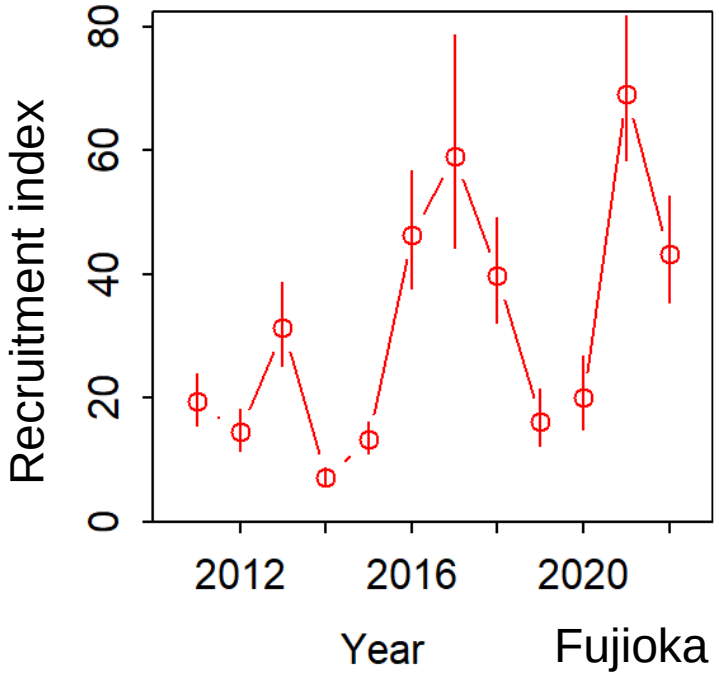


Most recent updates

- To confirm if there is any unexpected behavior in the stock, the ISC PBFWG held in March 2023 checked the most recent catch as well as the abundance indices of spawner and recruitment..
  - The retained catch in 2022 by the ISC member countries were within the catch assumed in the future projection of the latest stock assessment.
  - The spawner index showed continuous increasing trend and the recruitment index showed its high variability from low to high.



Yuan et al., 2023

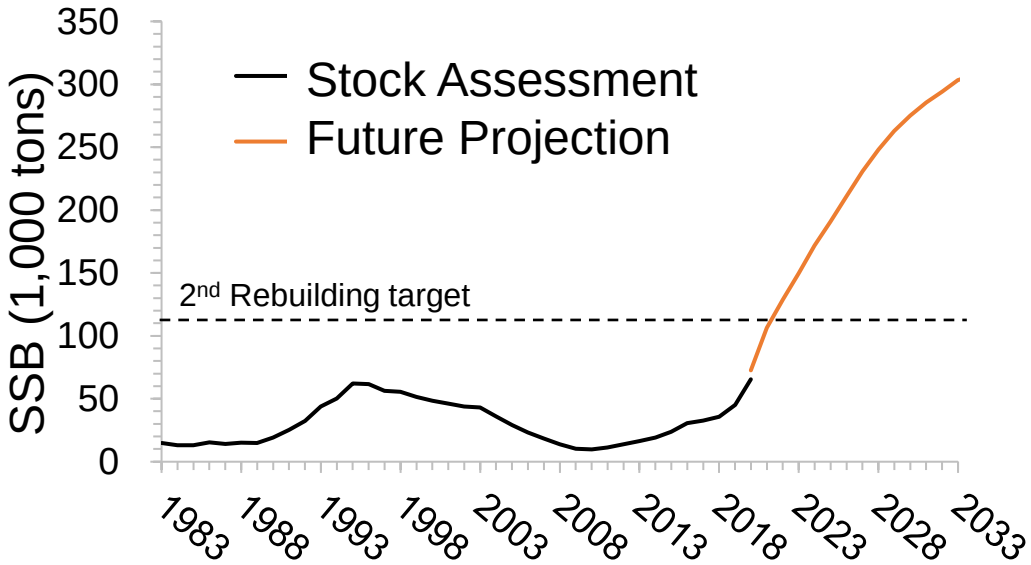


Fujioka et al., 2023

Work Progress on MSE development

Background and Objective of PBF MSE

- PBF stock is subject to a recovery plan, and the IATTC and WCPFC implemented the Management measures including a strict catch limit for PBF fisheries with some revisions in accordance with the stock assessment results.
- A management measure for the fishery after achieving the rebuilding target has been discussed at the JWG of the WCPFC NC and the IATTC.
- **To evaluate the expected performance of alternative long-term management strategies for PBF fisheries** once the 2nd rebuilding target is reached, the JWG agreed to work on the MSE for this species.
- Then, the JWG requested to the ISC for the technical works to complete the MSE in 2025.



Timeline of the PBF MSE development

Work by the ISC

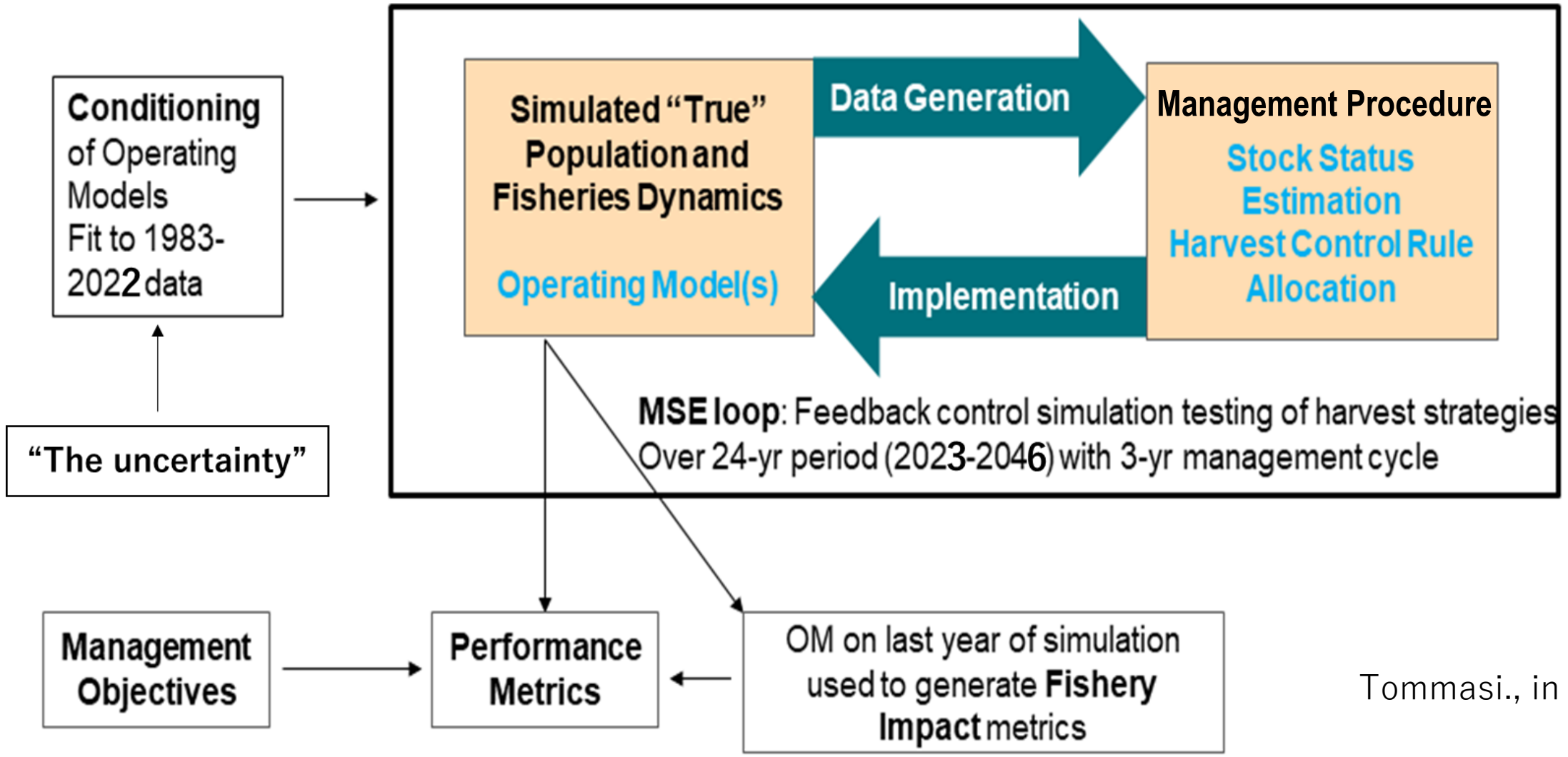
2023 Mar. - Nov.	Nov. – 2024 Mar.	2024 Mar. – Nov.	Nov. - 2025 Mar.	2025 Mar. –
✓ Data prep. ✓ Develop OM & its Grid, general framework of MP.	✓ Stock Assess. ✓ Refine MP and Performance metrics.	✓ Finalize OMs, cMPs, Metrics ✓ Exceptional circumstance (EC)	✓ Evaluate cMPs ✓ Documentation of the results	✓ Present all results to the JWG

JWG08 · JWG09 · JWG10

Subject to decide by the JWG

Management Objective	• The ISC will translate to the performance metrics to evaluate the achievement of those objectives.
Management Procedure	• Realistic number (<10) of candidate MPs is Aspired. • Management cycle (Interval of TAC change). • Select a MP for the long-term management at the JWG 10.
Specific Request	• Ex; Empirical approach, Fishery impact ratio for EPO/WPO, Catch allocation for large/small fish, etc.

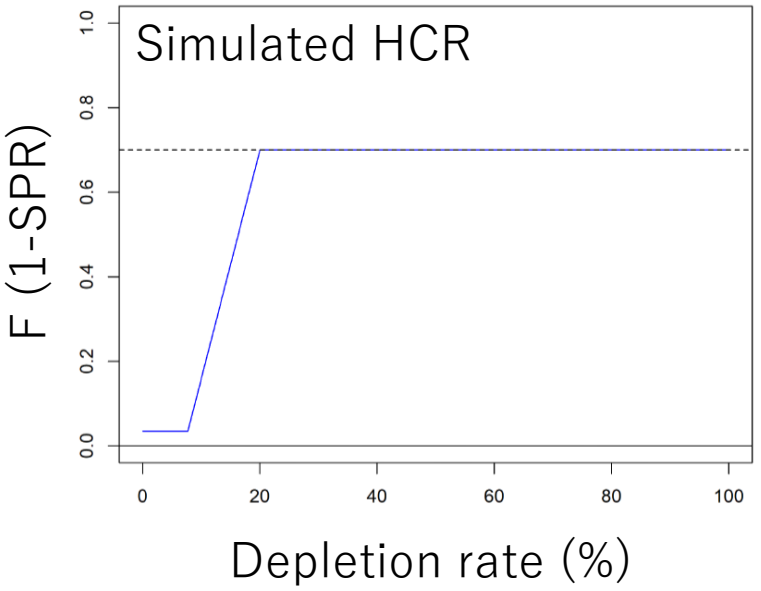
Framework of the PBF MSE

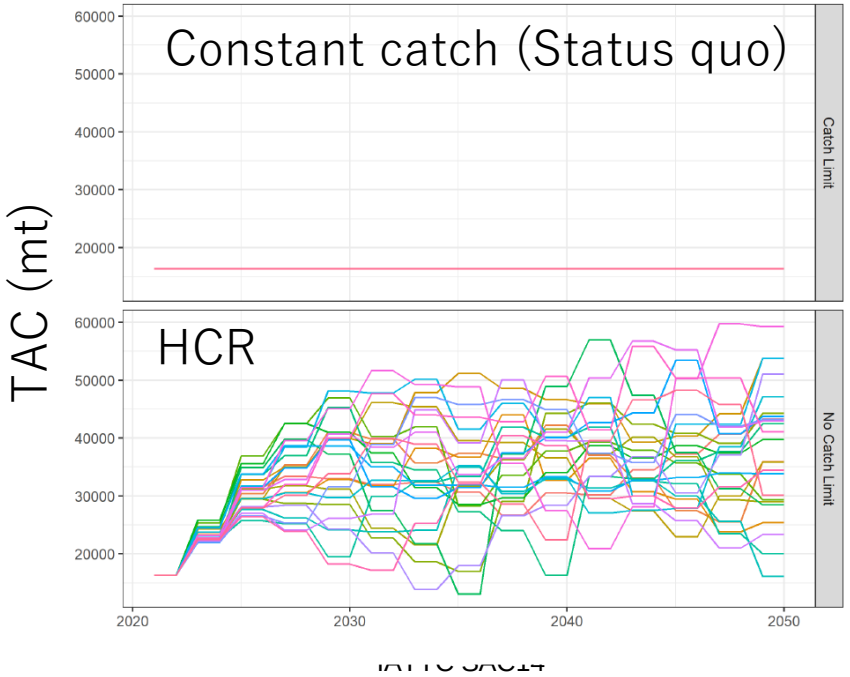


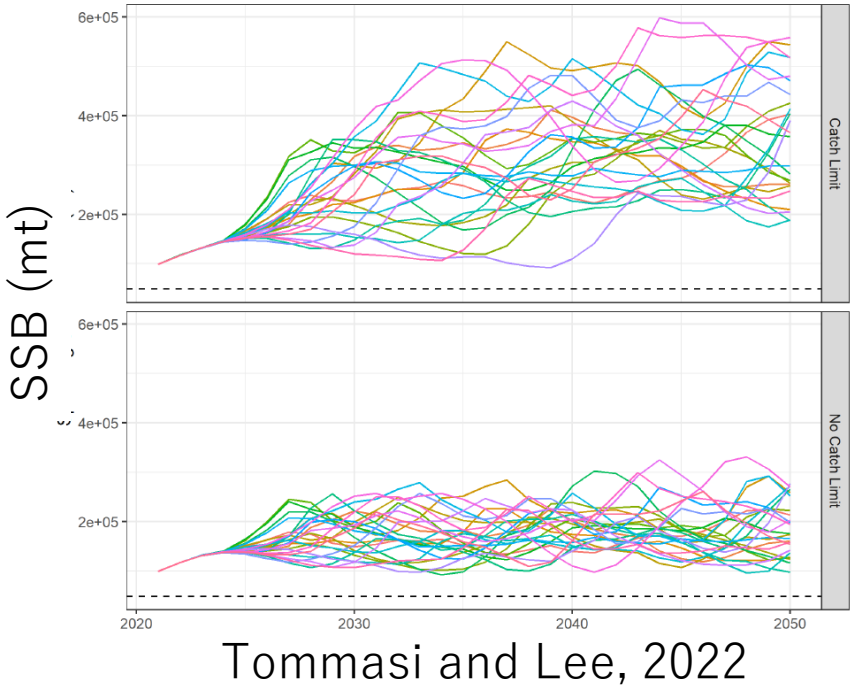
Tommasi., in prep.

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 to simulate the performance of a MP (HCR) in feedback manner within the operating model developed for the PBF.







Tommasi and Lee, 2022

Operating Model

- Platform of OM: Stock synthesis 3.3.
  - The short-term model will be conditioned by the observed data from 1983 to 2022 FY.
  - This will be a compatible data-set with the ISC PBF assessment scheduled in 2024.
- Uncertainty Grid
  - System dynamics model:
    1. Steepness of the SRR (tentative; 0.85-1)
    2. Natural Mortality for age 2+ (tentative; 0.2-0.25/y)
    3. ~~(Growth)~~ <- removed from GRID tentatively
  - Observation Model
    1. Unseen mortality- Implementation error
    2. (Additional error to the recruitment index)
  - Process Uncertainty
    1. Future Recruitment

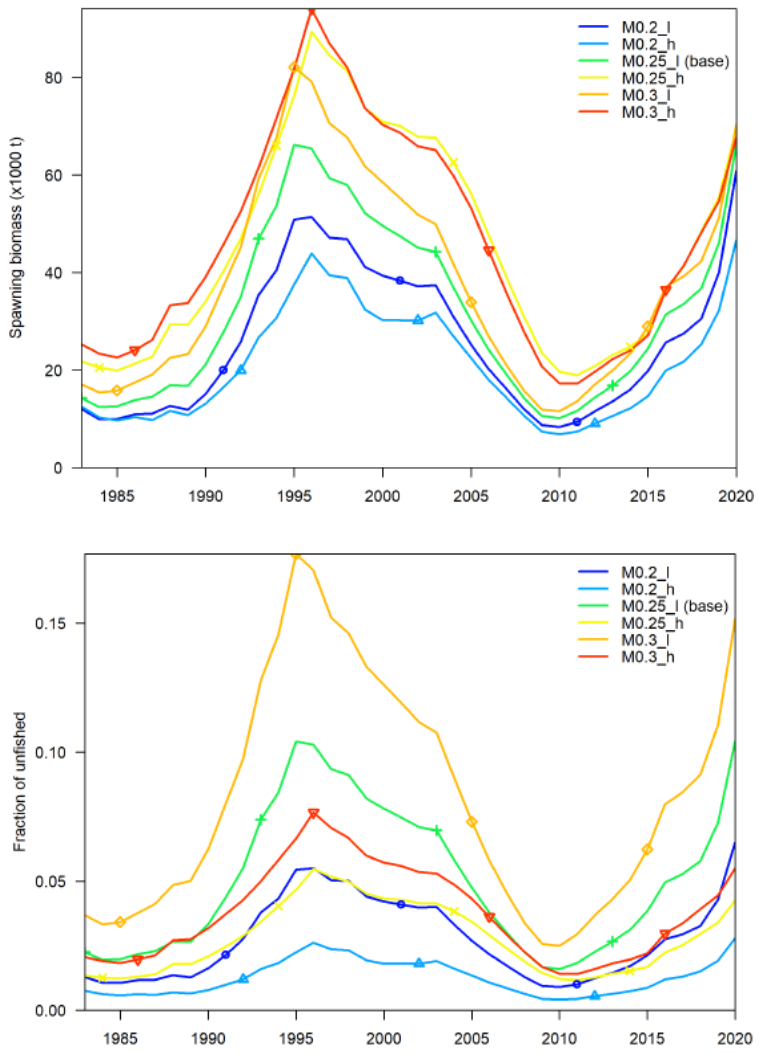
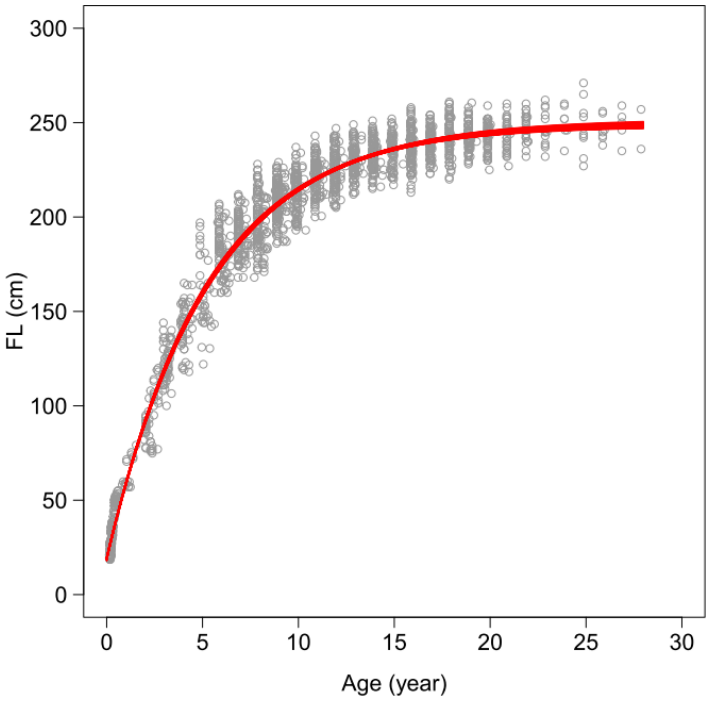


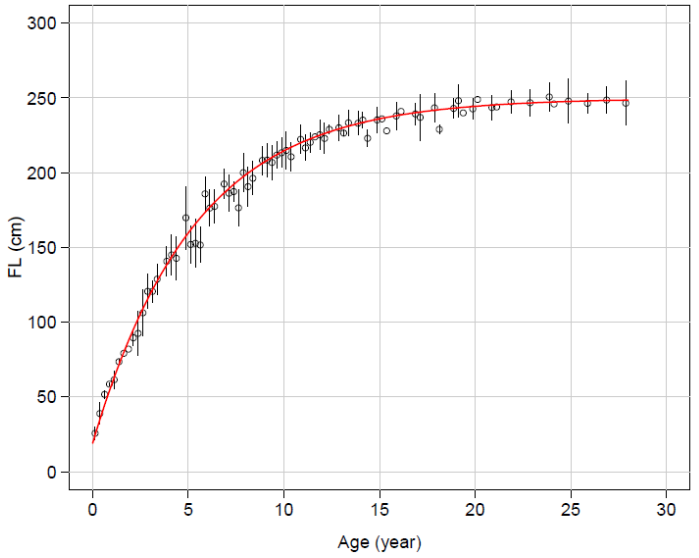
Figure 3. The trajectory of the spawning biomass (upper panel) and spawning stock biomass ratio (lower panel) estimated from the full models with largest and smallest model scales for each M_{2+} (referred to Table 3).

Lee et al., 2023

Growth uncertainty

- PBFWG critically reviewed growth assumption of PBF.
  - More than 2,000 otolith were sampled at Japan and Chinese Taipei for which covered entire life stage of PBF from more than 25 cohorts.
  - The age determination manual was published through the ISC age determination workshop.
  - All samples were analyzed by multiple biologists in accordance with the manual.
  - The age determination result was validated by the Radiocarbon dating method (Ishihara et al., 2017).
  - Bootstrap analysis and mean-length-at-age suggested the current growth function is reasonably representative of the otolith samples.
- <u>The PBFWG concluded that there is no strong rationale to account Growth uncertainty in the PBF MSE.</u>



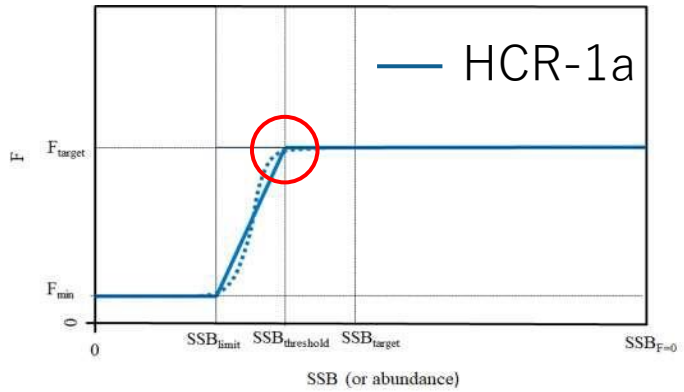


Ishihara et al., 2023

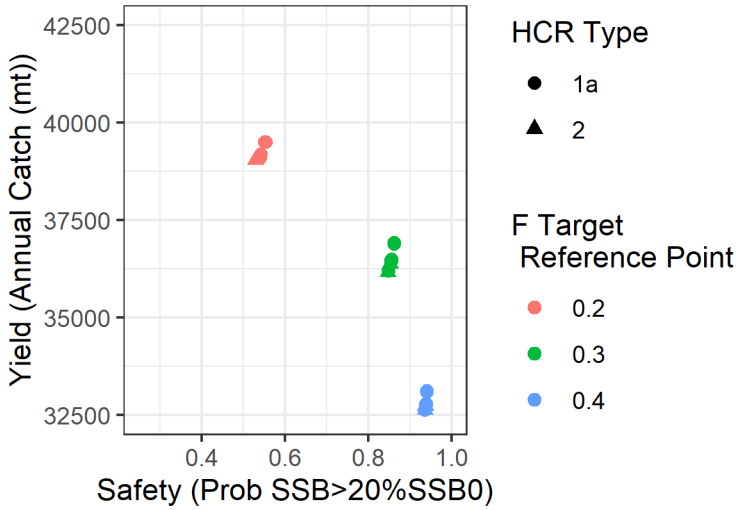
Estimation model (EM) in MP

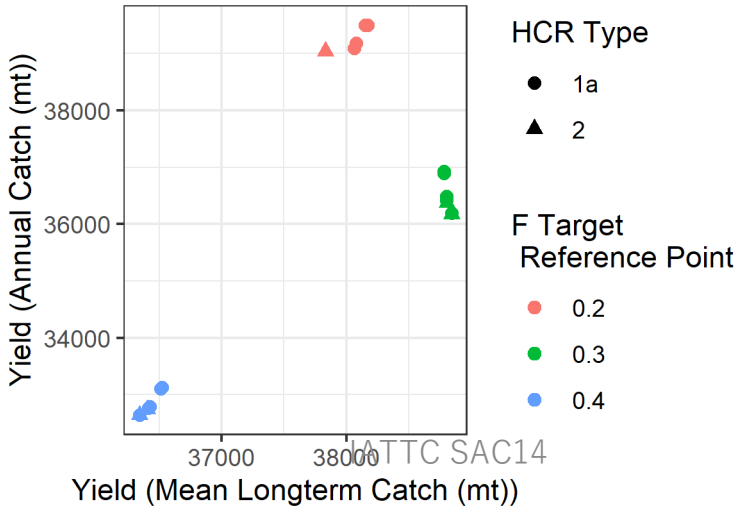
- EM is a module to estimate the stock status for the harvest control rule.
  - For the last decade (in the real world), the management measure has been decided based on the stock assessment using the fully integrated model (SS3 model).
  - Using the base-case SS3 model of 2024 assessment could be a default.
  - However, due to the high computational burden to built-in 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.
  - Currently active indices (Taiwan LL index (and Japan recruit index)) could be used.
- An empirical approach to consider the recruitment strength for the TAC of small fish (candidate HCR-3) is not implemented in the current PBF MSE framework at this time.
  - To incorporate this HCR, the ISC needs additional efforts for coding, validation of the recruitment monitoring index, consideration of the relationship between the recruitment index and TAC for the small and large PBF.

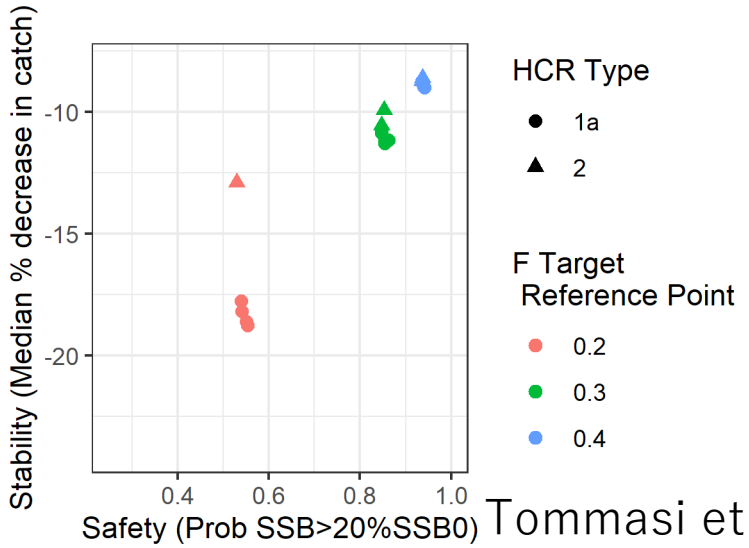
Management Procedure



- The JWG-04 (2019) adopted a F-based HCR as a candidate.
  - The combination of the candidate Reference points for the F-based HCR is more than 100.
  - Some HCRs would not perform differently.
    - Example; HCR1-a and HCR2 Rules with the same first control point.
    - Same performance for FSPR30% and FSPR40%, but a bit lower long-term catch for HCR2 and lower stability for HCR1a for FSPR20% .



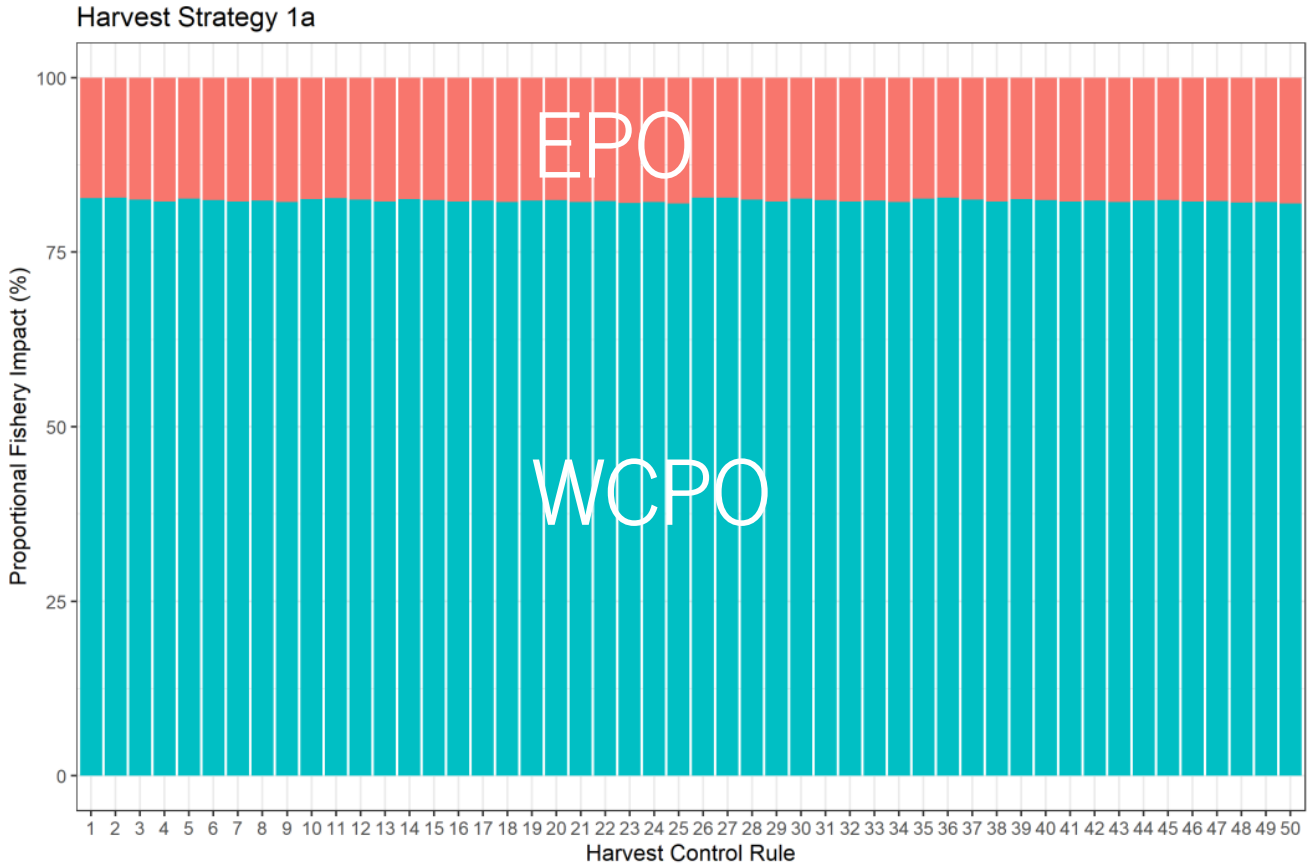




Tommasi et al., 2023

Future impact

- The ISC PBFWG prepared a performance metric related to the Proportional fishery impact.
  - This could be calculated as a post-hoc of MP implementation (the last year of simulation),.
  - Feedback control to change the TAC to tune the impact ratio at given value was not implemented.



Tommasi et al., 2023

Allocation

- The JWG-07 (2022) discussed a management objective about fishery impact ratio between EPO and WCPO, but could not reach consensus.
  - This request implies that the JWG wants to see the results of the MPs which have different allocations among fleets.
  - There are potential trade-offs in the fishery between EPO and WCPO, as well as small PBF fishery and large PBF fishery.
  - JWG needs to provide clear guidance how to change the allocation among them.
  - Note that no MSE in the other tuna RFMO change the allocation of fishery.

Period of MSE and management cycle

❖Recommendation from the ISC PBFWG.

- The PBFWG needs to conduct regular stock assessments to check the trajectory of stock and fishery in the meantime of the MP updates.
- In the case of two-years management cycle, the year of assessment and MP update will alternate each other.
- 3-years management cycle, such as a cycle of the MSE year (2025; MP update), the Research year (2026), and the Assessment year (2027), gives PBFWG to focus on the research about the stock and model, which enables to maintain the quality of science. This cycle is consistent with the SBT MSE by CCSBT.
- 24 years of projection period (2~3 generation time for PBF).

Summary for the PBF MSE

- The ISC PBFWG has been developing the PBF MSE package to be available in 2025 (JWG 10).
  - The technical work was going well so far.
  - The ISC PBFWG still required several important inputs from the IATTC-WCPFC JWG;
    - ✓Operational Management Objectives;
    - ✓Realistic number of candidate MPs to be tested;
    - ✓3-year management cycle was recommended from the WG.
- Those information will be presented at the JWG 8 in July 2023.

Question?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