

IATTC SAC 13 Agenda 6. e.i (Document SAC-13 INF-R)

ISC report on 2022 stock assessment of Pacific Bluefin tuna



ISC Pacific Bluefin tuna Working Group



Management and Stock Assessment of Pacific Bluefin tuna

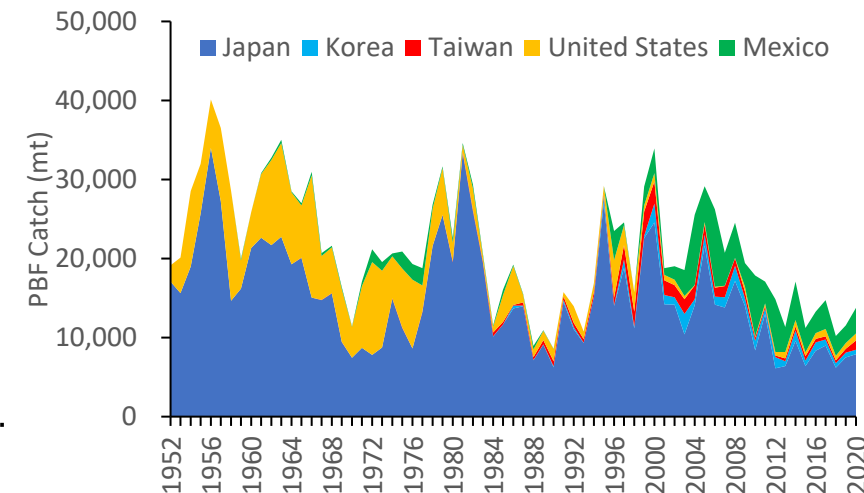


❖ Management

- PBF is a single Pacific-wide stock managed by both the IATTC and the WCPFC.
 - The conservation and management measures (CMMs) 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 the catch upper limits 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; 20% SSB_0 as the second rebuilding target.
 - In 2022, new CMMs, which relaxed those catch upper limits slightly, were introduced in both areas.

❖ Stock Assessment

- ISC PBFWG conducts a stock assessment of PBF every two years.
 - WG Members were consisted of the scientists from Chinese Taipei, Japan, Korea, Mexico, U.S.A., SPC, and IATTC.
- 2022 assessment was conducted on 8–18 March, online.
 - A data update assessment.
 - The latest benchmark assessment was conducted in 2020.
 - The assessment report will be reviewed and adopted by the ISC 22 in July.



Overview of the 2022 assessment model



- ❖ A fully integrated model (Stock Synthesis–Version 3.30)
 - Length-based, age-structured (0–20+) model
 - From 1952 to 2020 fishing year (July 1952 to June 2021)
- ❖ Pan-Pacific Assessment
 - No-spatially defined model (Area as Fleet approach) with consideration of the migration of fish through the age-based time-varying availability (and/or length-based gear selectivity) for each fleet based on the simulation study.
- ❖ Input Data
 - Quarterly catch time series from 25 fisheries (fleets)
 - Quarterly size composition data from 19 fisheries
 - 3 annual CPUEs (Twn & Jpn Longlines, Jpn Troll)
- ❖ Given biological traits (Growth, Maturity, Reproduction, M)
- ❖ Estimate initial conditions, population scale, catchability of the index, recruitments, and fishery selectivity

Major modifications in Data and Modeling



❖ Data

- from July 1952 to June 2021 (Add 2 years of data)
- A minor change in the standardization model of the Jpn LL CPUE index.
- A minor change in the JLL fleet to maintain consistency with the CPUE standardization model.
- The CPUE indices were not available in 2020 (Jpn LL) and 2017–2020 (Jpn troll).

❖ Modeling

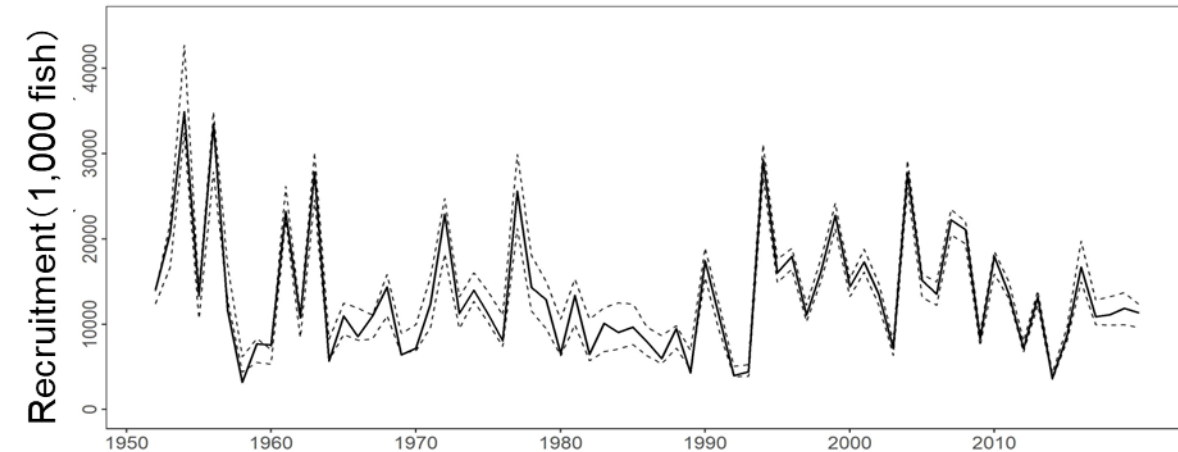
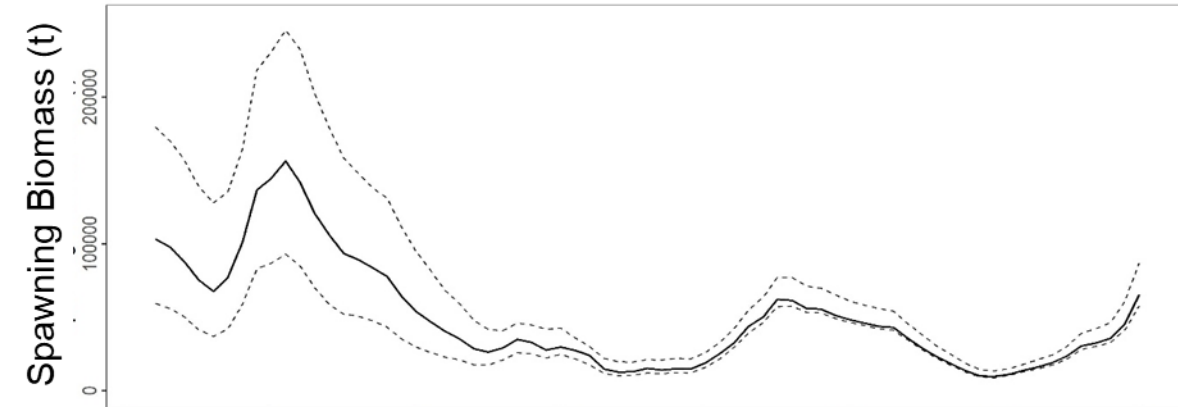
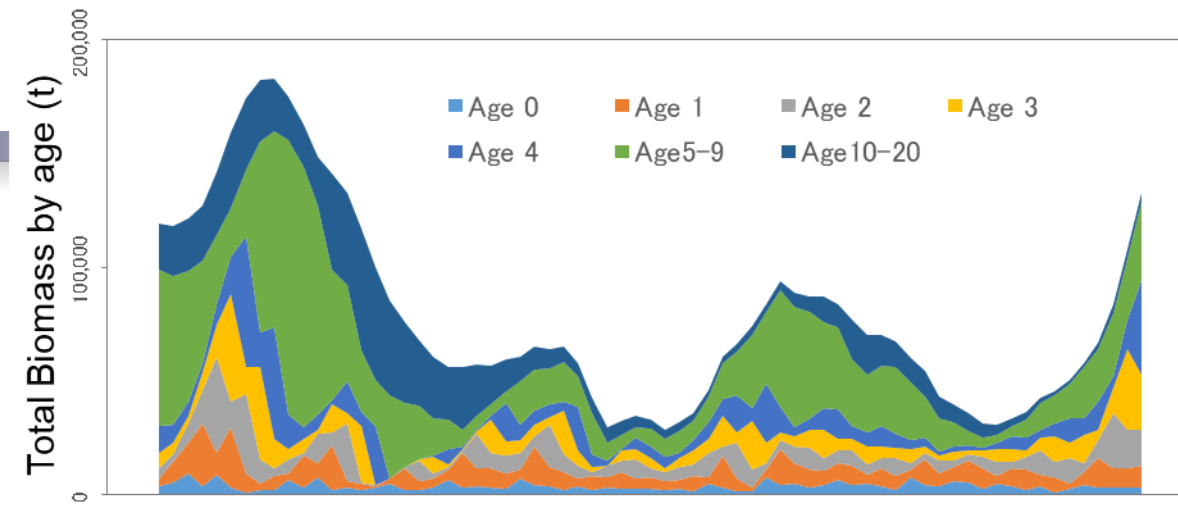
- Basically, no change in the assessment base-case model.
- Performed two sets of sensitivity analyses to address observation model (base-case) and system dynamics model (short time-series model).

❖ Projection

- Applied a new procedure for the bootstrapping replicate runs to correct the bias between the base case point estimates and the median estimates of the bootstrapping replicates.
- Performed status quo projections based on the base-case model and some sensitivity models to test the robustness of the management advice to the different assumptions of the system dynamics model and observation model.

Results: Biomass time series

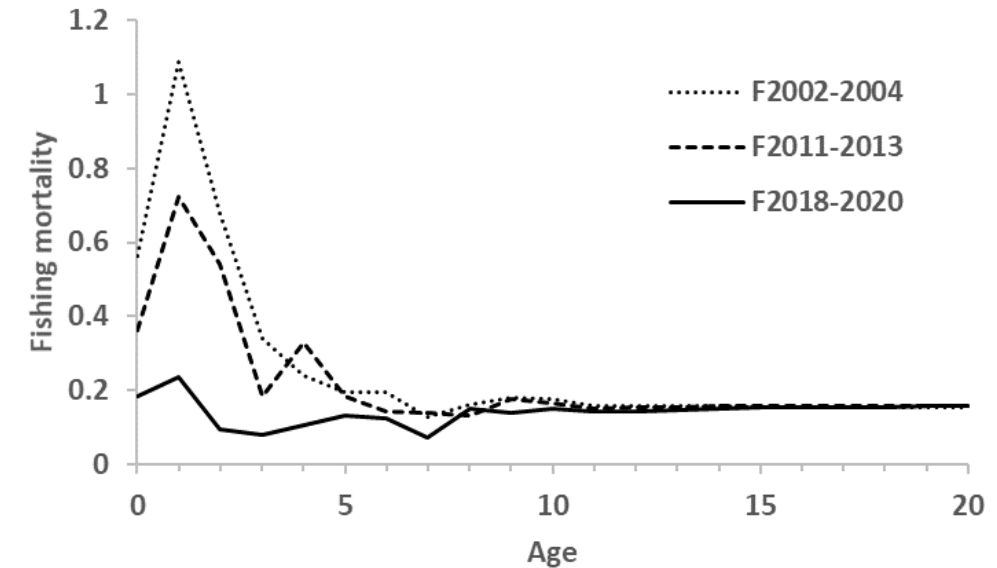
- ❖ Total biomass in the terminal year (2020) is the 2nd highest peak in the assessment history.
- ❖ SSB declined from 1996 to 2010 and has increased since 2011.
 - Achieving the initial target ($SSB_{med1952-2014}$) in 2019.
 - SSB at 2020 was 65,000 t (10.2% SSB_0).
- ❖ Recruitments have fluctuated since 1952.
 - 2016 year-class was estimated to be high.
 - 2017–2020 recruits were uncertain.
 - Lack of reliable recruitment index in the base case model.



Results: Fishing mortality at Age and Candidate Reference Points



- ❖ A substantial decrease in estimated F-at-Age is observed in young (< age 3) fish compared to the reference year in the WCPFC (2002–2004) or when the catch upper-limit first introduced (2011–2013).
- ❖ Terminal F ($F_{2018-2020}$) has declined lower than most of the reference points commonly used.

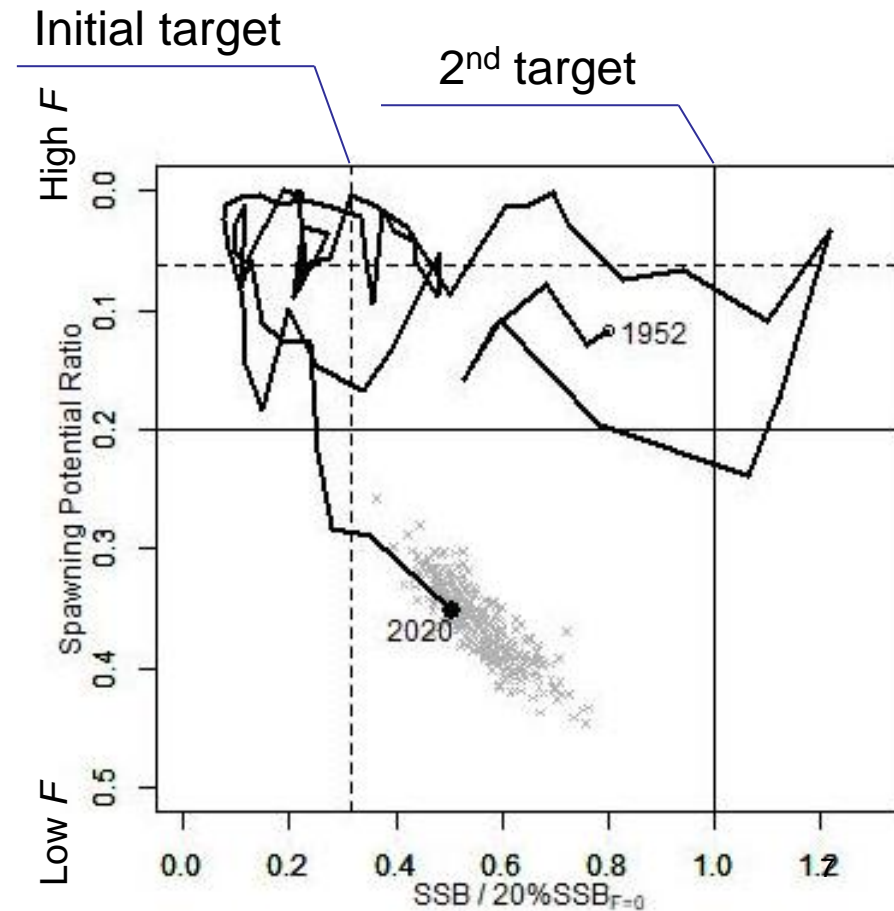


Reference Period	Fmax	F0.1	Fmed	(1-SPR)/(1/SPR _{xx%})				Estimated SSB for terminal year of each period (ton)	Depletion rate for terminal year of each period (%)
				SPR _{10%}	SPR _{20%}	SPR _{30%}	SPR _{40%}		
2002-2004	1.96	2.89	1.16	1.08	1.21	1.38	1.61	35,881	5.6%
2011-2013	1.54	2.27	0.87	1.04	1.17	1.34	1.56	16,313	2.5%
2018-2020	0.75	1.14	0.33	0.77	0.87	0.99	1.15	65,464	10.2%

Stock Status

The PBF SSB has gradually increased in the last 10 years, and its pace of increase is accelerating. These changes in biomass coincide with a decline in fishing mortality over the last decade. Based on these findings, the following information on the status of the PBF stock is provided:

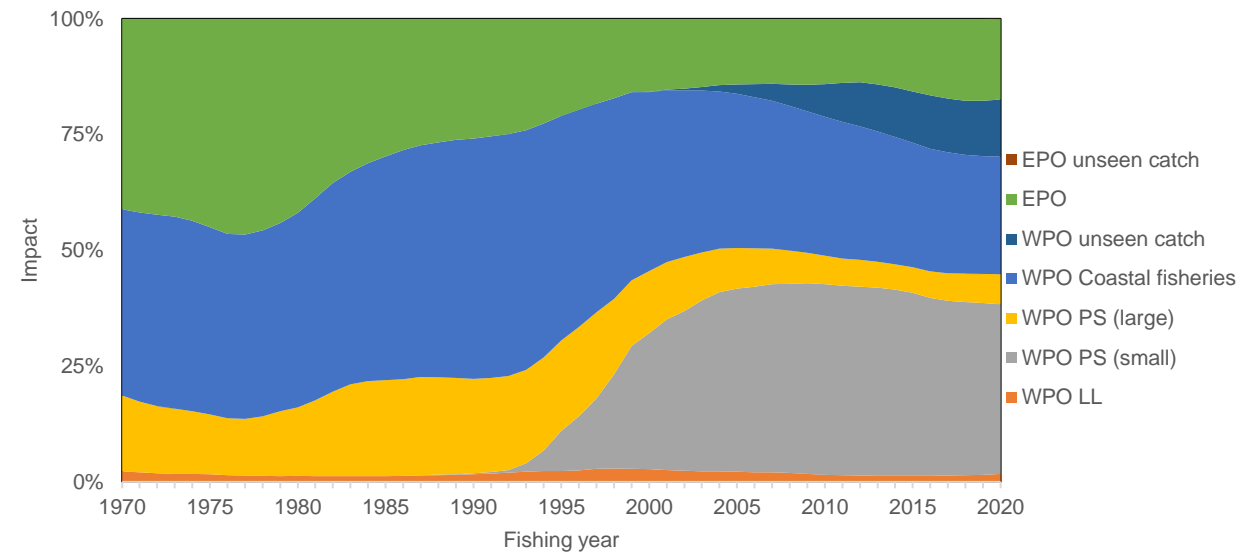
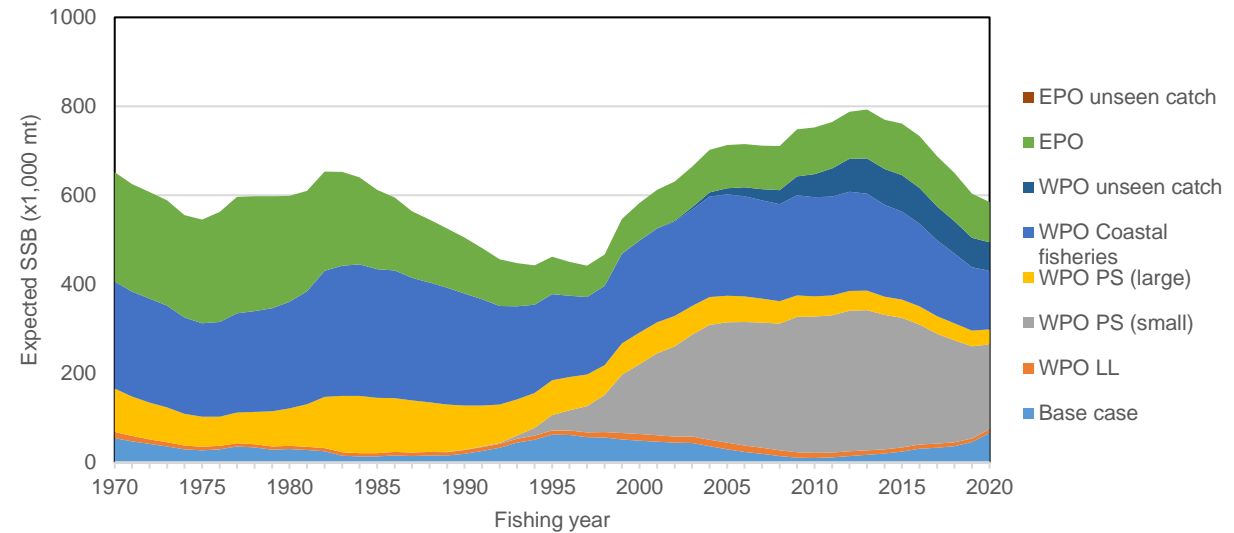
1. No biomass-based limit or target reference points have been adopted for PBF, but the PBF stock is overfished relative to the potential biomass-based reference points ($20\%SSB_{F=0}$) adopted for other tuna species by the IATTC and WCPFC. On the other hand, SSB reached its initial rebuilding target ($SSB_{MED} = 6.3\%SSB_{F=0}$) in 2019, 5 years earlier than originally planned by RFMOs.
2. Although 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 have reduced to a level to produce $30.7\%SPR$, which is below the level producing $20\%SPR$.



Results: Fishery Impact plot



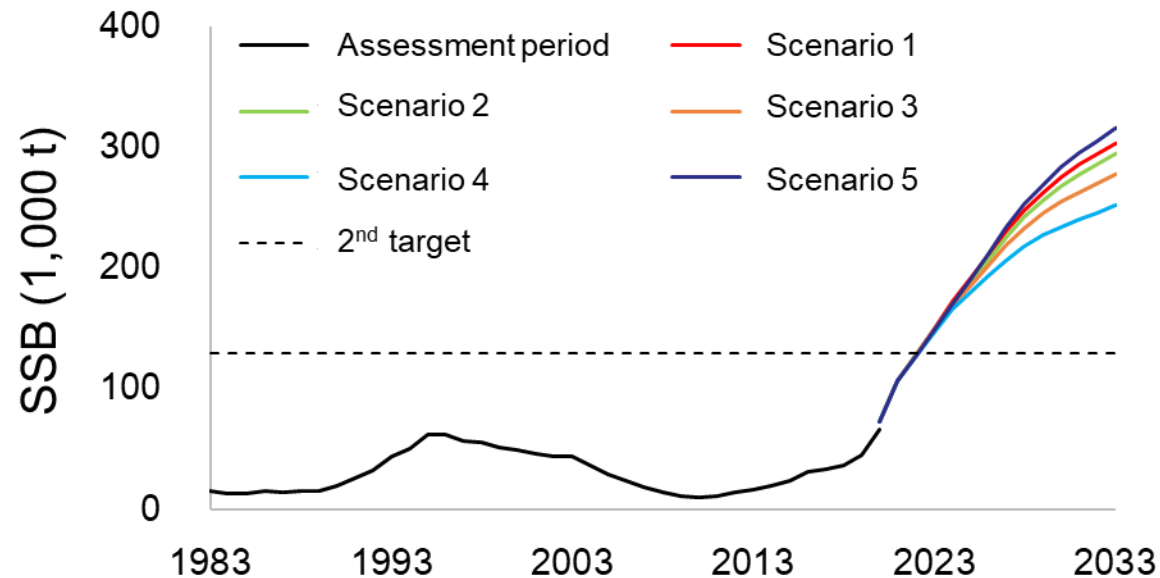
- The impact of the EPO fisheries group was large before the mid-1980s, decreasing significantly thereafter.
- From the mid-1980s to the late 1990s, the WPO coastal fisheries group has had the greatest impact on the PBF stock.
- Since the introduction of the WPO purse seine fishery group targeting small fish (ages 0–1), the impact of this group has rapidly increased, and the impact in 2020 was greater than any of the other fishery groups.
- The WPO longline fisheries group has had a limited effect on the stock throughout the analysis period.
- In 2020, the estimated cumulative impact proportion between WPO and EPO fisheries is about 83% and 17%, respectively.



Conservation info: Future projections



- ❖ Under all examined scenarios, the second rebuilding target of WCPFC and IATTC, rebuilding to 20%SSB_{F=0} by 2029 FY (10 years after reaching the initial rebuilding target) with at least 60% probability, is reached, and the risk of SSB falling below the historical lowest SSB at least once in 10 years is negligible.
- ❖ Also, amongst the projection scenarios assessed, Scenario 5 (the conversion of small fish quota to large fish quota at the current conversion factor of 1.47) achieved the second highest SSB when the second rebuilding target was met and in 2034 relative to the old CMM, Scenario 10.

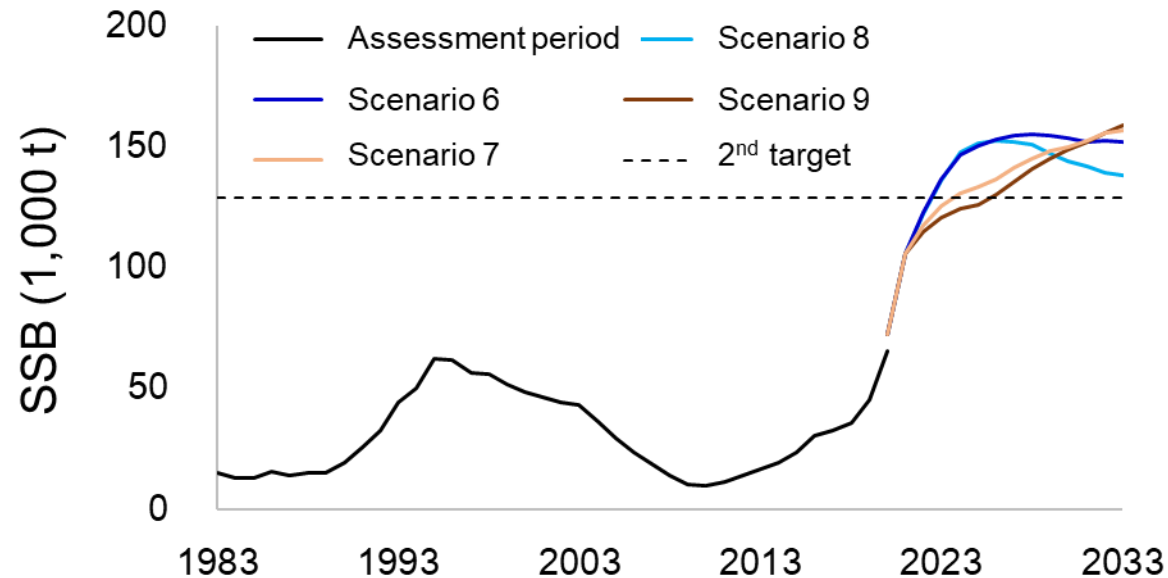


#	WCPO		EPO		Year expected to achieve 2 nd target w/ 60% probability	Probability of achieving 2 nd target at 2029	Fishery impact ratio of WPO in 2029	Fishery impact ratio of EPO in 2029
	Small	Large	Small	Large				
1	Status quo				2023	98.8%	81.1%	18.9%
2	-	+500 tons	+500 tons		2023	98.2%	80.3%	19.7%
3	10% increase on the New CMM				2023	96.9%	82.3%	17.7%
4	20% increase on the New CMM				2023	94.0%	83.4%	16.6%
5	-580 tons	+853 tons	-		2023	99.3%	80.2%	19.8%

Conservation info: Future projections (Tuning scenarios)



- ❖ In scenarios 6–9 where future fishery impact ratios between WPO and EPO are specified by the RFMOs (ca 80:20 or 75:25 for WPO:EPO), the recovery probability or impact ratio was approximated during the search for the appropriate increase levels.
- ❖ More specifically, those scenarios were tuned to achieve the 2nd rebuilding target in 10 years after achieving the initial rebuilding target with 60% probability, and as a result, the catch increases are much more aggressive than other scenarios.

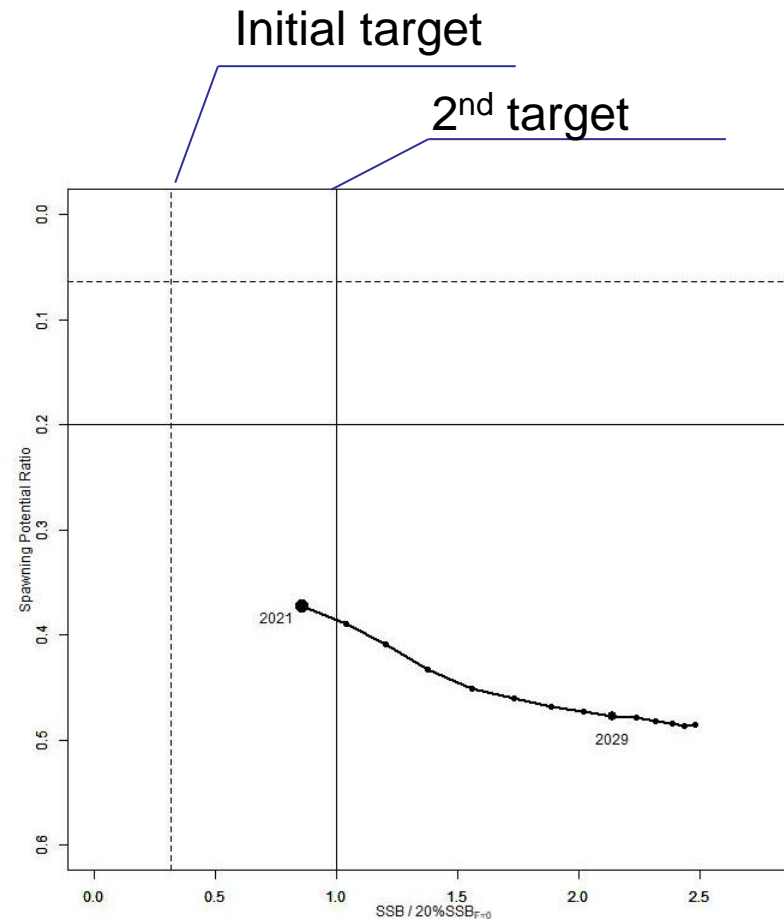


#	WCPO		EPO		Year expected to achieve 2 nd target w/ 60% probability	Probability of achieving 2 nd target at 2029	Fishery impact ratio of WPO in 2029	Fishery impact ratio of EPO in 2029
	Small	Large	Small	Large				
1	Status quo				2023	98.8%	81.1%	18.9%
6	+30%	+30%	+190%		2023	64.1%	75.5%	24.5%
7	-	+130%	+190%		2029	60.0%	75.2%	24.8%
8	+60%	+60%	+90%		2023	61.3%	80.6%	19.4%
9	-	+230%	+90%		2030	58.6%	78.3%	21.7%

Conservation information: Kobe plot for projection



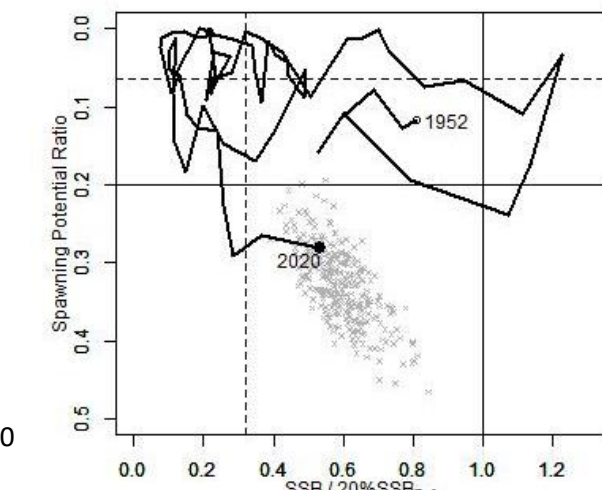
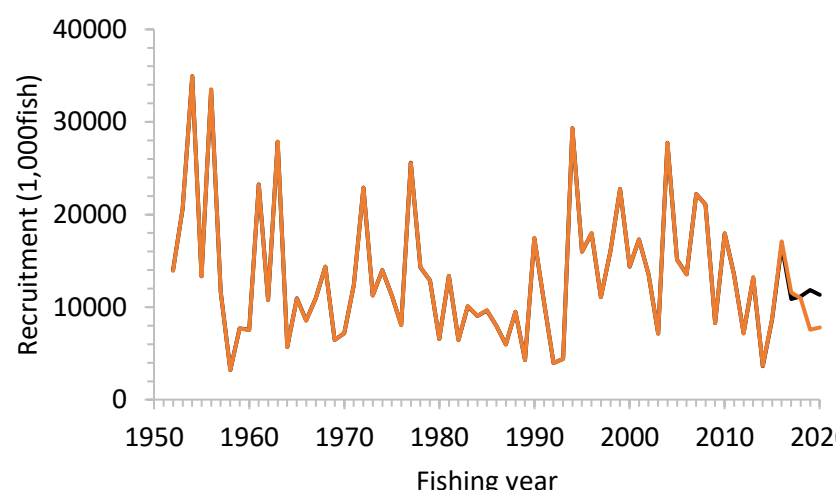
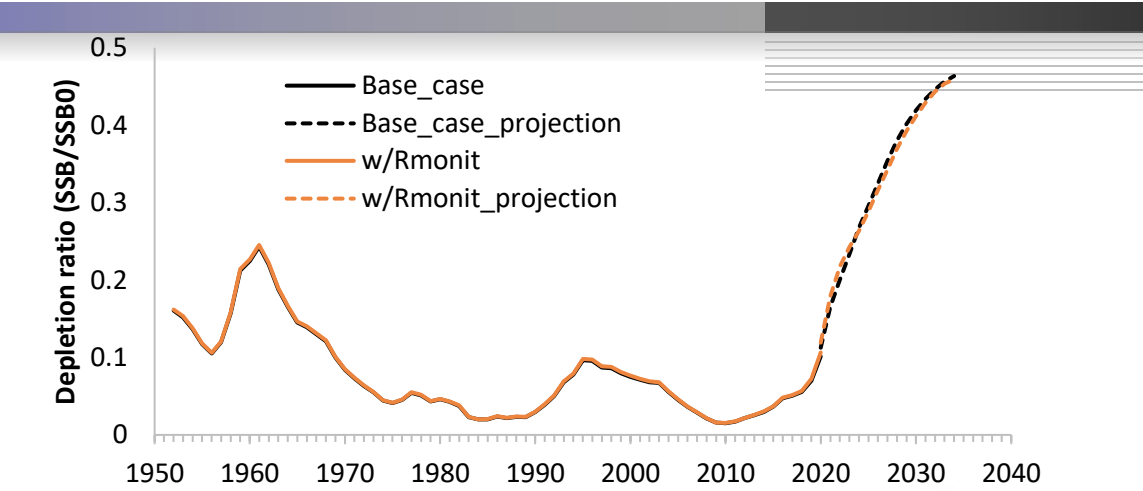
The Kobe chart of the projection results shows that PBF SSB will recover to the 2nd rebuilding target due to reduced fishing mortality.



Sensitivity runs and Robustness test: observation model



- ❖ The recruitment monitoring survey has been conducted by Japan FRI since 2011.
- ❖ Index from this survey for the period when the troll index was not available (2017–2020) was submitted to the WG.
- ❖ The WG used this index as one of the sensitivity runs of the assessment.
- ❖ Also, the WG conducted a projection based on this sensitivity run to see the robustness of the management quantities.

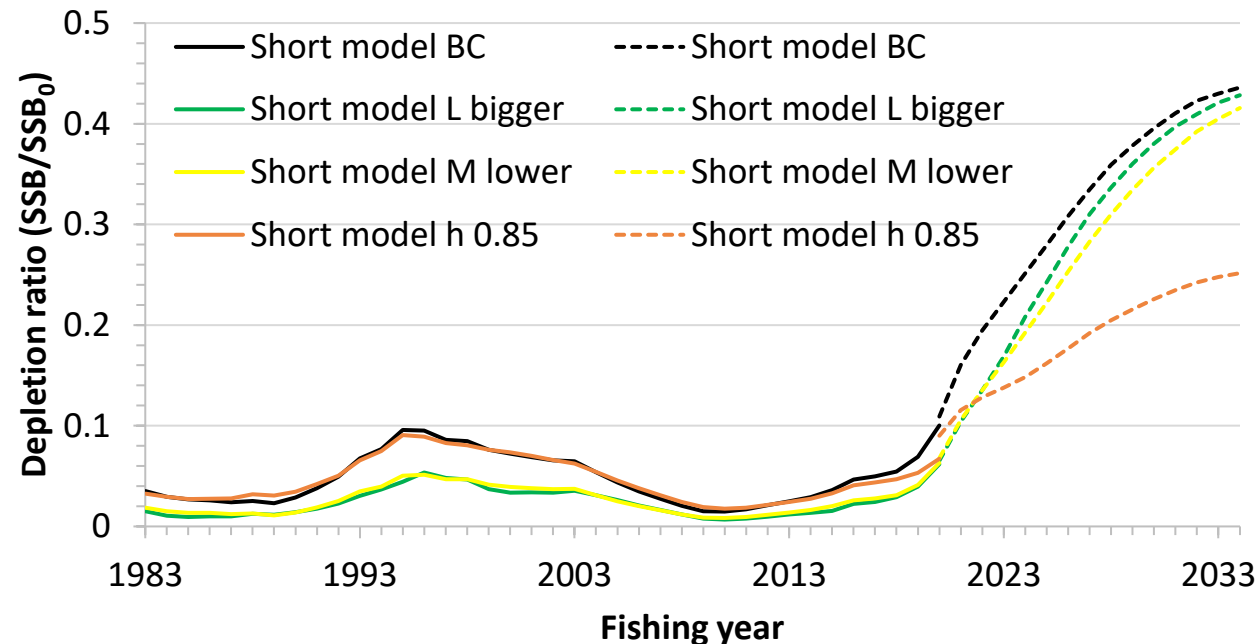


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				SPR _{10%}	SPR _{20%}	SPR _{30%}	SPR _{40%}		
2002-2004	1.95	2.88	1.18	1.08	1.21	1.38	1.61	36,108	5.7%
2011-2013	1.53	2.26	0.89	1.04	1.17	1.34	1.56	16,421	2.6%
2018-2020	0.81	1.23	0.37	0.80	0.90	1.03	1.20	67,929	10.7%

Sensitivity runs and Robustness test: dynamics model



- ❖ The projections based on sensitivity runs for different (pessimistic side only) assumptions for the productivity of the stock were conducted to examine the effect of those alternative assumptions on the management advice based on the 2022 stock assessment base case as robustness tests.
- ❖ Lower steepness (0.85), Larger L infinity (5%), Lower M at age2+ (20%) were tested.
- ❖ All sensitivity models showed a recent recovery of the stock and projected to achieve the second rebuilding target within the specified period (10 years after achieving the initial target).



Summary of the 2022 ISC PBF assessment



- ❖ A data update assessment was conducted with 2 additional years of data (1952–2020 FY).
 - The model showed positive diagnostic results (ASPM, R0 profile, retrospective runs, hind-casting, goodness of fit).
 - The PBF Stock showed recovery of SSB continues since 2011.
 - ✓ SSB met its initial rebuilding target in 2019.
 - ✓ Fishing mortality in 2020 was lower than that corresponding to the 2nd rebuilding target ($F_{20\%SPR}$).
- ❖ Projections were conducted for the new CMM (as status quo) and other requested scenarios by JWG.
 - Under all examined scenarios, the 2nd rebuilding target is reached.
 - The conversion of small fish quota to large fish quota at the current conversion factor of (1.47) does not affect negatively to the stock recovery.
 - The future catch is expected to be much larger if the projection scenarios were tuned to achieve the 2nd target 10 years after achieving the initial target with a 60% probability.
 - The proportion of catch between small and large bluefin affects the expected future catch if the projection is tuned to achieve the 2nd target in 10 years after achieving the initial target with a 60% probability.
- ❖ Robustness of the management quantities (e.g. probability of achieving rebuilding target) was examined for the alternative assumptions for the observation model and population dynamics model (productivity).
 - The management information based on the 2022 base case model was robust to those alternative assumptions.¹⁴



Thank you for your attention.

Questions?