ISC 2nd Pacific bluefin tuna MSE work shop

Day 1;

Latest information about Pacific Bluefin tuna

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Today's topic

-Latest information about Pacific Bluefin tuna-

1. Review of the stock assessment & Projection
   - New projections based on the requests from the joint tRFMOs working group
2. New information on the PBF stock
   - Updates of the Abundance indices
3. New information on the PBF fishery
4. Candidate Biological Reference points for PBF

ISC PBFWG

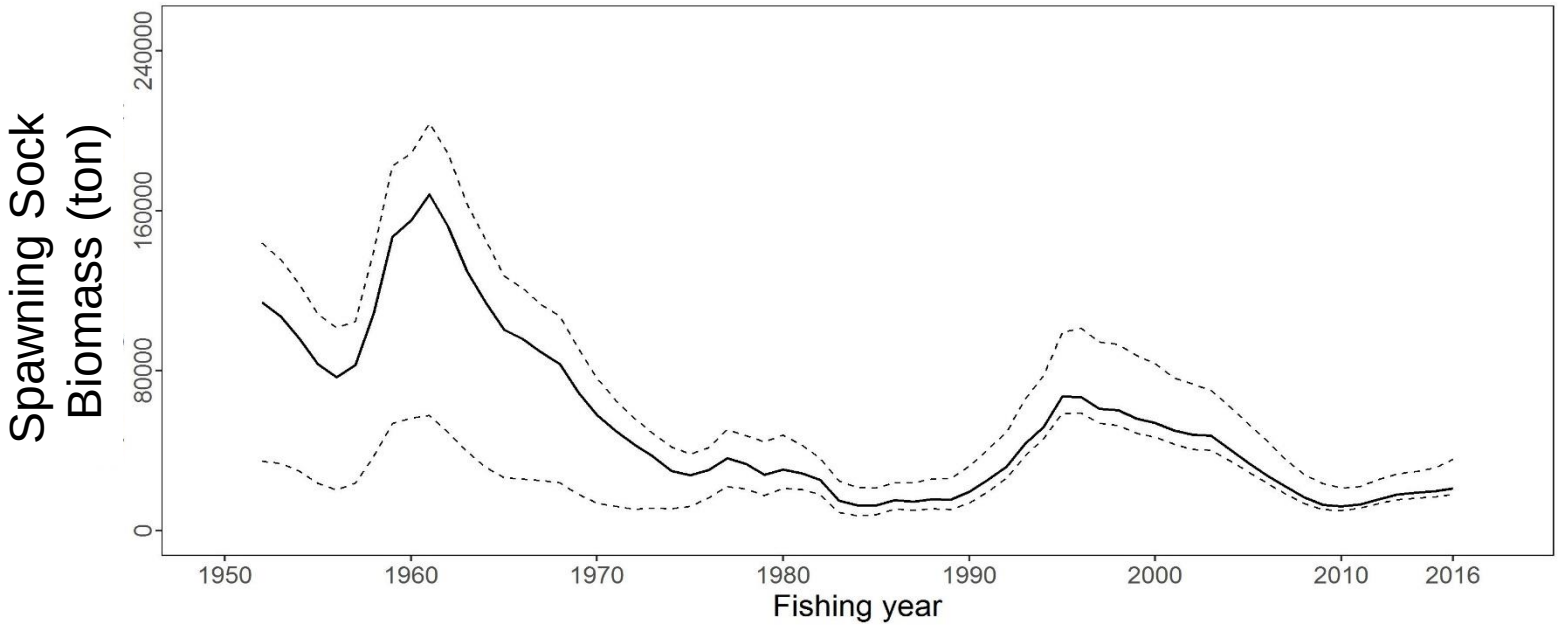
- Consisted by the scientists from U.S.A., Mexico, Korea, Taiwan, Japan, SPC, and IATTC.
- Stock assessment
  - WG has conducted regular stock assessment for every two years.
  - The latest assessment was completed in March 2018@La Jolla, CA, including a series of projections according to the request from the WCPFC NC & IATTC Joint WG.
  - Next Assessment is scheduled in March 2020@Japan.
- Management Strategy Evaluation
  - The ISC is requested to start the work to develop a MSE for PBF fisheries in 2019 and have a goal of completing it by 2024.

Overview of the 2018 assessment model

- A fully integrated model (Stock Synthesis-Version 3)
  - Length-based, age-structured (0-20+) model
  - From 1952 to 2016 (Fishing year)
- Pan-Pacific Assessment
  - No-spatially defined model (Area as Fleet approach)
- Fishery definitions
  - 19 Fisheries (Catch & Size comp (if available))
  - 3 CPUEs (Twn & Jpn Longlines, Jpn Troll)
- Given biological traits (Growth, Maturity, Natural mortality)
- Input data; Catch, CPUE based abundance index, Size comp.
- Estimate initial conditions, population scale, recruitments, and fishery selectivity

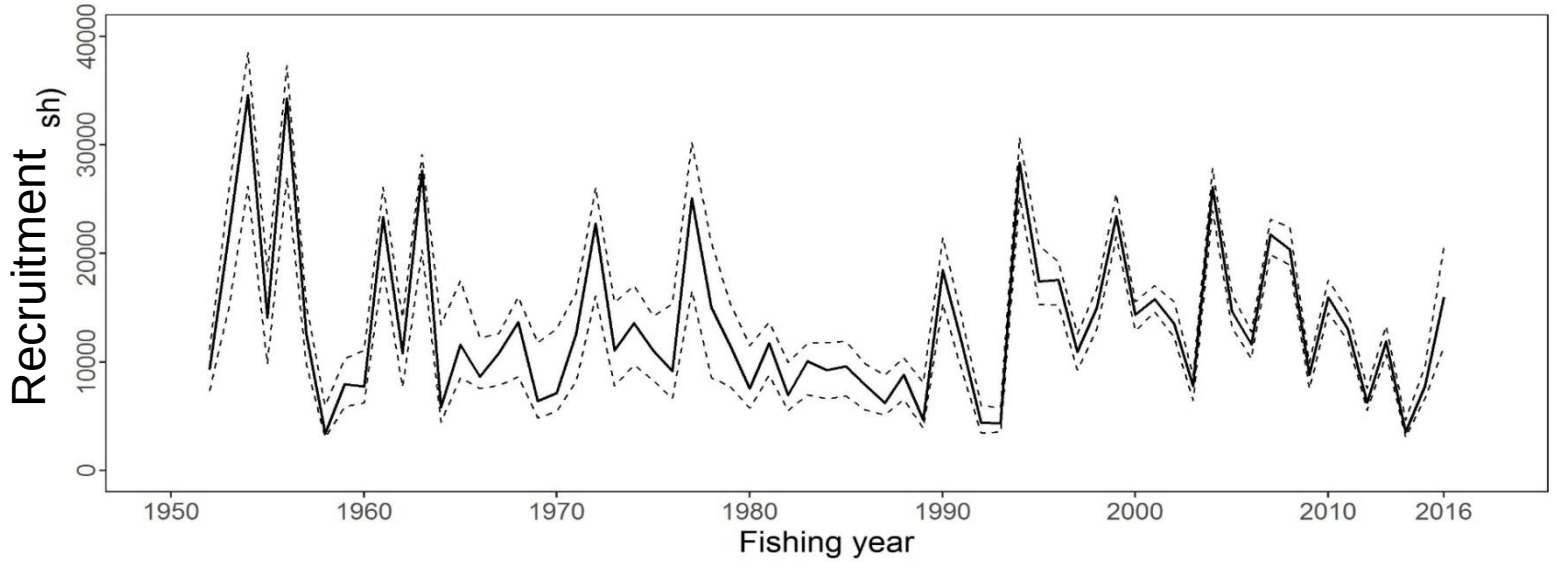
Assessment result; Spawning Stock Biomass

- Spawning Stock Biomass (SSB) fluctuated throughout the assessment period.
- The SSB steadily declined from 1996 to 2010.
- The slow increase of the stock continues since 2011.
- The stock size is lower than the rebuilding targets at 2016.



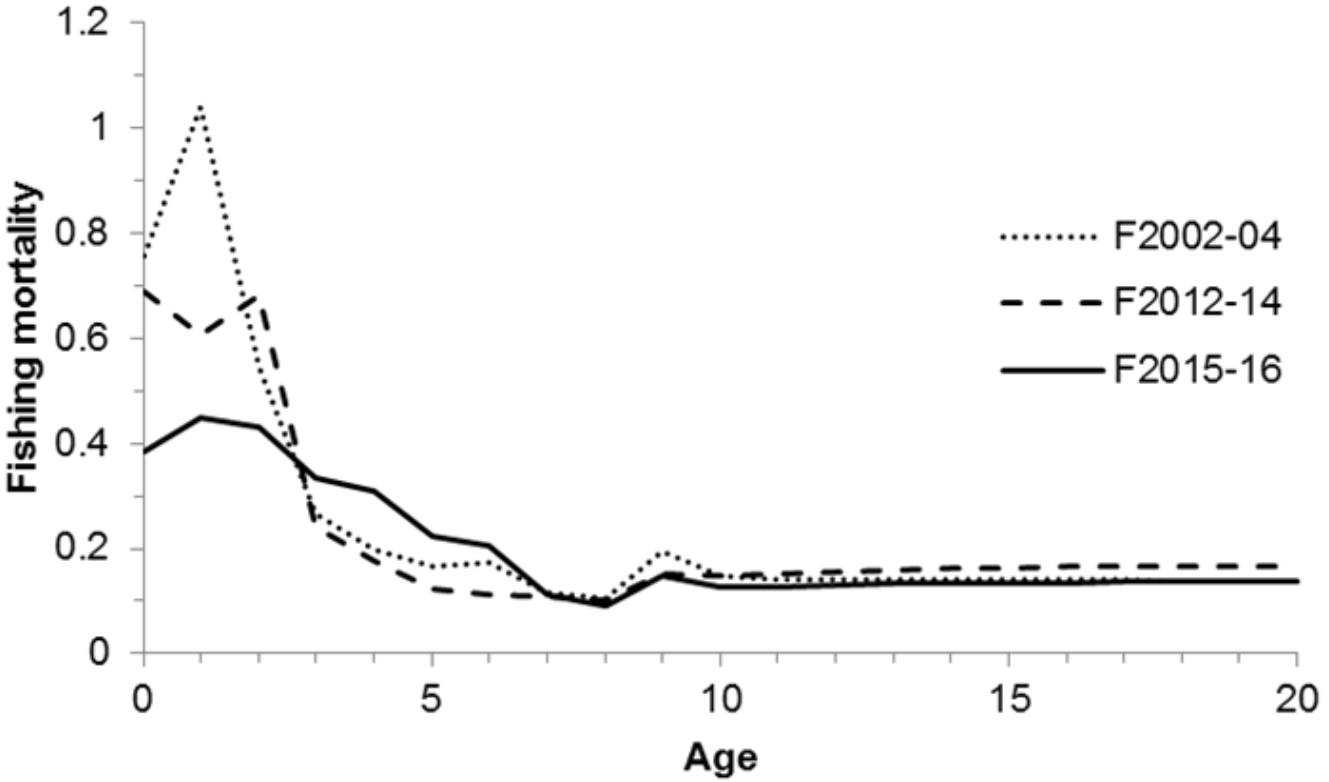
Assessment result; Recruitment

- Historical recruitment have fluctuated without an apparent trend.
- The low recruitment estimated in 2010–2014 have been a concern.
- The 2015 recruitment are low and similar to estimates from previous years.
- The 2016 recruitment is higher than the historical average.



Assessment result; Age specific fishing mortality

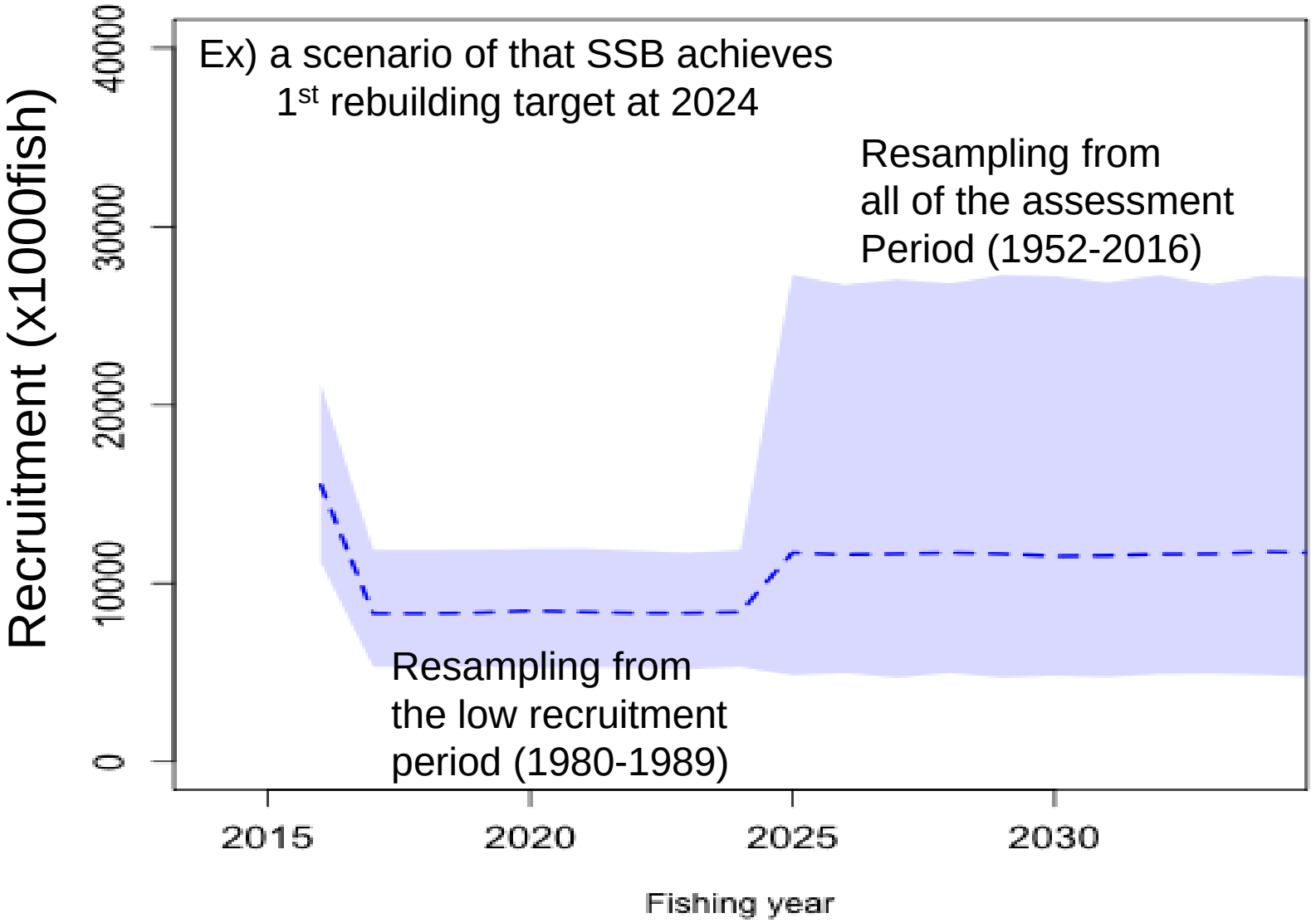
- Substantial decrease of F is observed in ages 0–2 in 2015–2016.
- Note that stricter management measures in IATTC and WCPFC have been in place since 2015.



Projection model overview

- Age-structured forward projection model (*ssfuturePBF*)
  - Identical model structure with the stock assessment of PBF
  - Given growth, maturity and Natural mortality which are identical with those used in the stock assessment
  - Initial condition (2016) was based on the stock assessment result.
- Uncertainty
  - 300 bootstrap replicates followed by 20 recruitments resampling.
- Recruitment
  - Low recruitments were assumed until the stock meets the initial rebuilding target (SSB of the historical (1952-2014) median).
  - Then after that, historical average recruitments were assumed.
  - These assumptions were based on the WCPFC HS 2017-02.

Assumption for Future recruitment



Basic Harvesting scenario (Based on CMMs)

Area	Fishery	Target	Catch limit for fish less than 30kg (t/yr)	Catch limit for fish more than 30kg (t/yr)
WPO	Jpn longline	Adult	0	1,317
	Japanese Purse seine	Juvenile	2,000	3,098
		Adult		
		Both		
	Japanese Coastal fisheries	Juvenile	2,007	467
		Juvenile		
		Both		
		Both		
		Juvenile		
	Kor Purse seine	Juvenile	718	
	Twn longline	Adult	0	1,700
EPO	EPO Commercial	Both	3,300	
	EPO Recreational	Both	-	-

Fishing mortality and Catch controls in projection

When the stock remains at low, Catch does not meet its upper limit even fishery operates at given Fishing mortality (F).

Once the stock gets recovery, fishery could get better yield with same given F. In the projection, when the catch approaches to its limit, F is adjusted or to be 0 (ban) to maintain catch limit.

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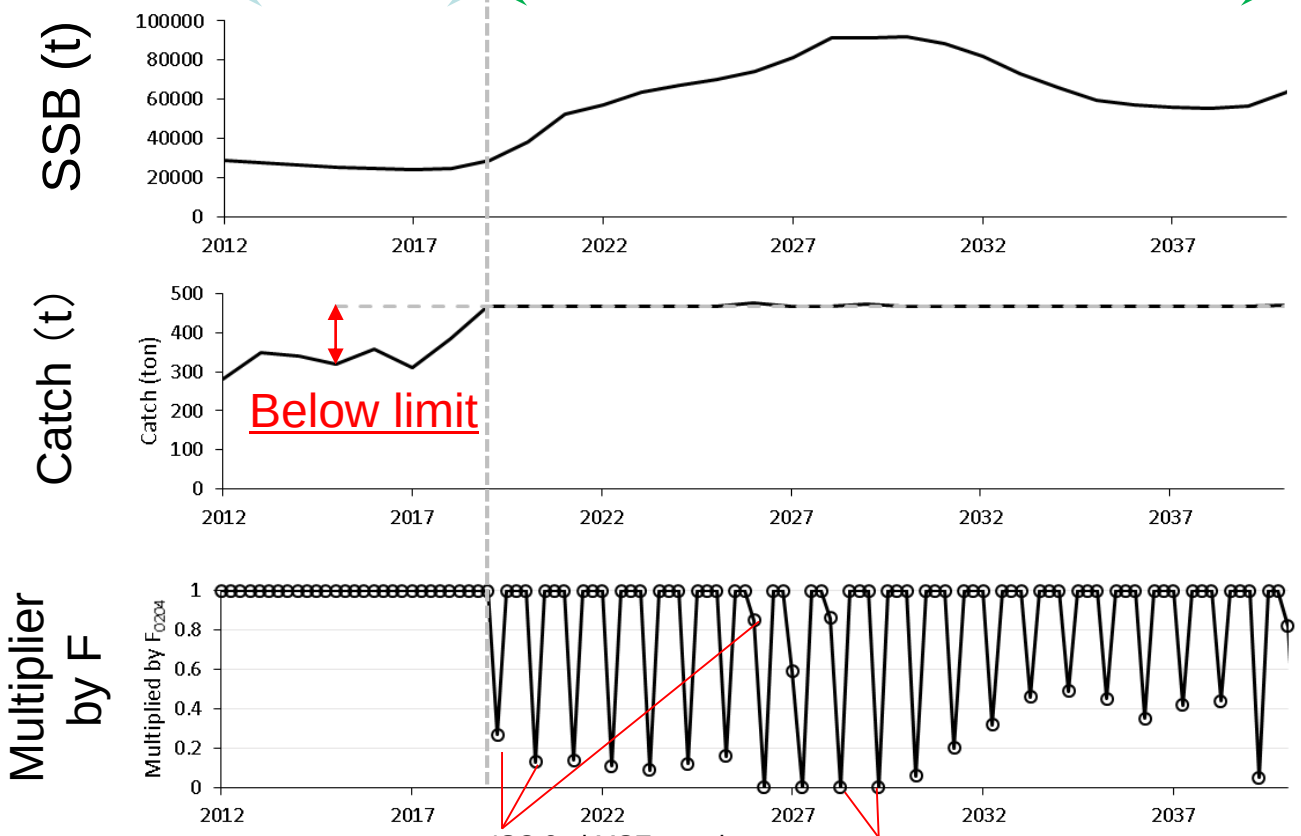
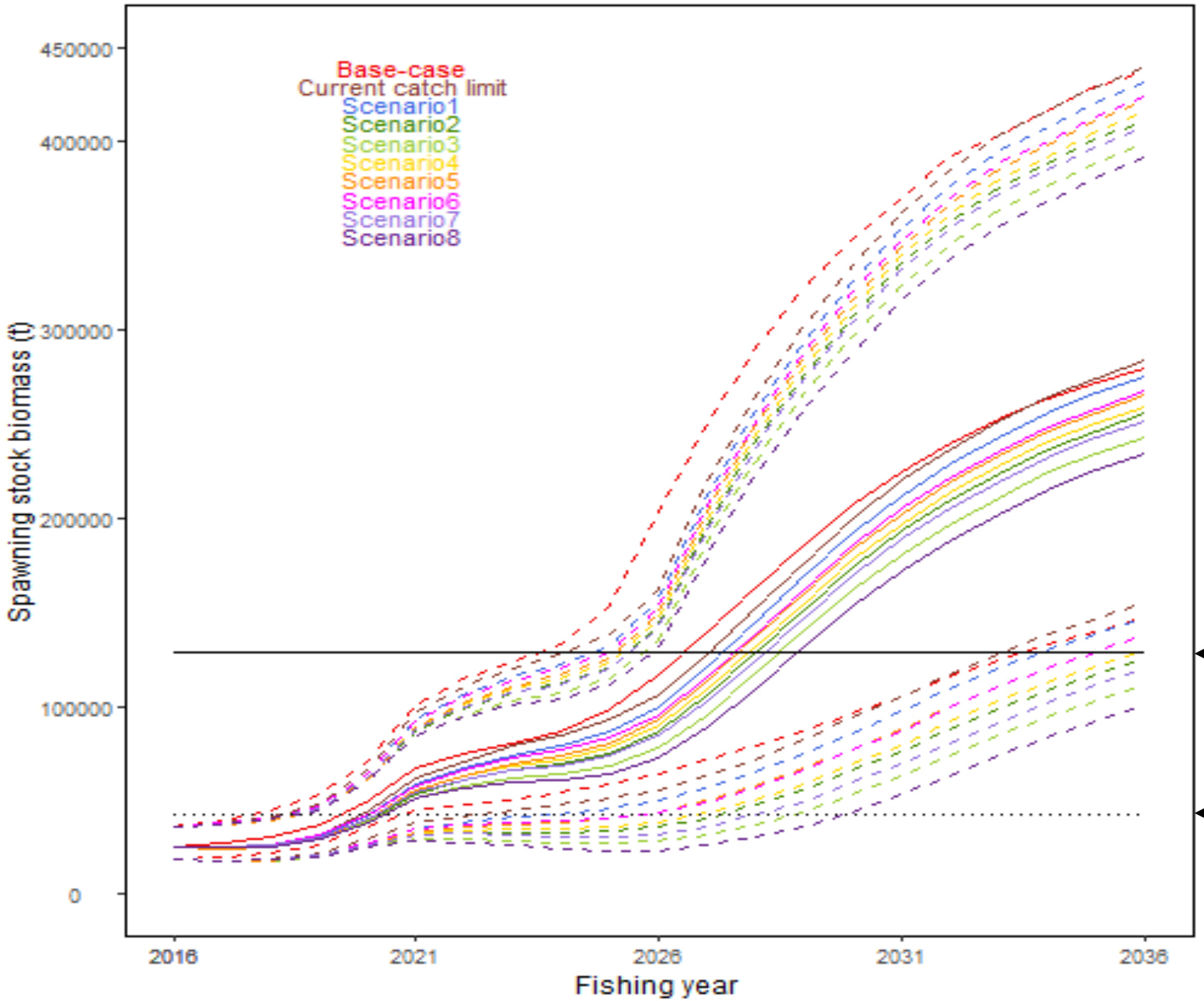


Projection Scenarios: Requests from RFMOs

❖ "Conduct projections of harvest scenarios shown below based on 2018 assessment and provide probability of achieving initial and 2nd rebuilding targets in accordance with paragraph 2.1 of HS2017-02"

West Pacific		East Pacific
Small fish	Large fish	
0	600t	400t
5%	1300t	700t
10%	1300t	700t
5%	1000t	500t
0	1650t	660t
5%		5%
10%		10%
15%		15%

Projection Results (figure)



2nd Rebuilding target

Initial Rebuilding target

Projection Results (table)

- A projection mimicking the current CMMs (Base case) showed a high probability of achieving the initial rebuilding target even under the low recruitments.
- All of the scenarios tested achieved both of the rebuilding targets in higher probability than those prescribed in the WCPFC HS2017-02.
- Increasing the catch limit of small PBF (<30 kg) has the large impact on the probability of achieving the rebuilding targets.

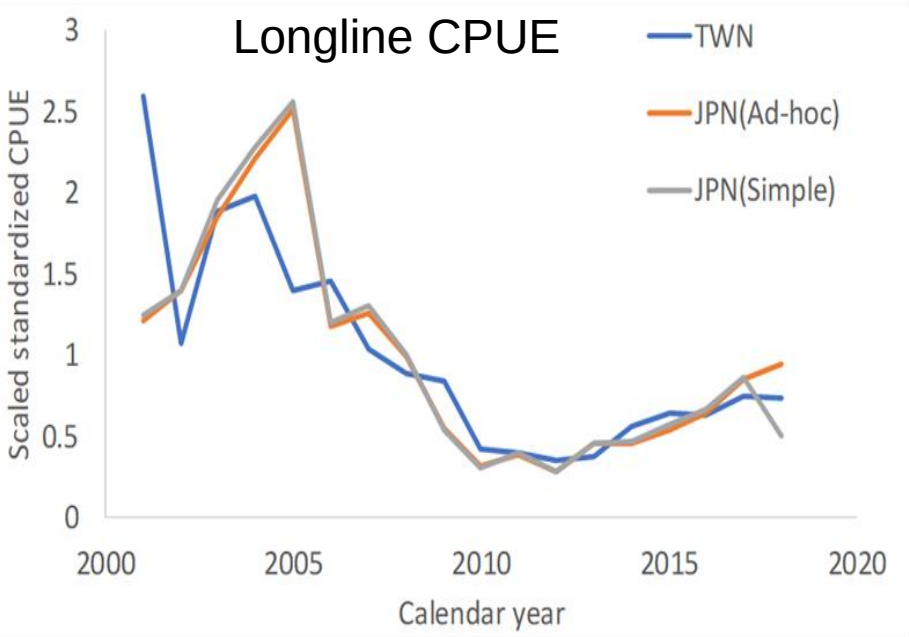
Scenario #	Catch limit Increase				Initial rebuilding target			Second rebuilding target		Median SSB (mt) at 2034
	WPO		EPO		The year expected to achieve the target with >60% probability	Probability of achiving the target at 2024	Probability of SSB is below the target at 2024 under the low recruitment	The year expected to achieve the target with >60% probability	Probability of achiving the target at 2034	
	Small	Large	Small	Large						
Base case	0%				2020	99%	0%	2028	96%	262,952
Current catch limit	0%				2021	97%	0%	2028	96%	264,748
1	0%	600	400		2021	95%	0%	2028	95%	256,252
2	5%	1300	700		2021	88%	0%	2029	91%	236,691
3	10%	1300	700		2021	81%	1%	2030	88%	224,144
4	5%	1000	500		2021	89%	0%	2029	92%	240,739
5	0%	1650	660		2021	92%	0%	2029	94%	246,593
6	5%				2021	93%	0%	2029	94%	248,757
7	10%				2021	86%	1%	2029	90%	232,426
8	15%				2021	76%	2%	2030	85%	215,385

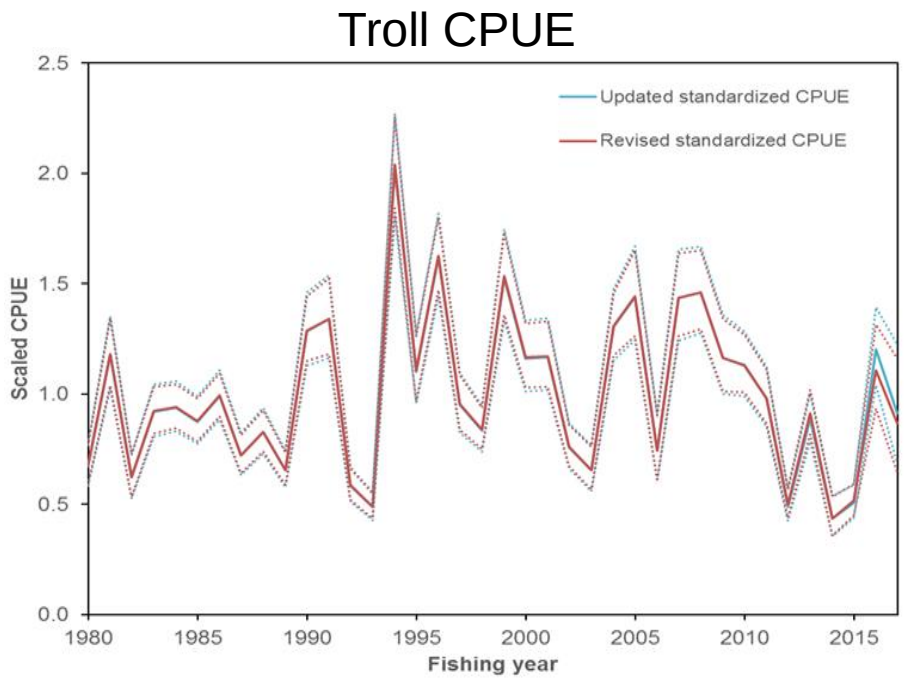
Latest information on the PBF stock

Review of the updated abundance indices

❖ Requests from the RFMOs joint WG.

"Review the updated abundance indices, including recruitment index, up to 2017 to evaluate the need to change its scientific advice in 2018."





❖ **PBFWG reviewed standardized CPUEs for adult as well as recruitment abundance.**

Review of the updated abundance indices

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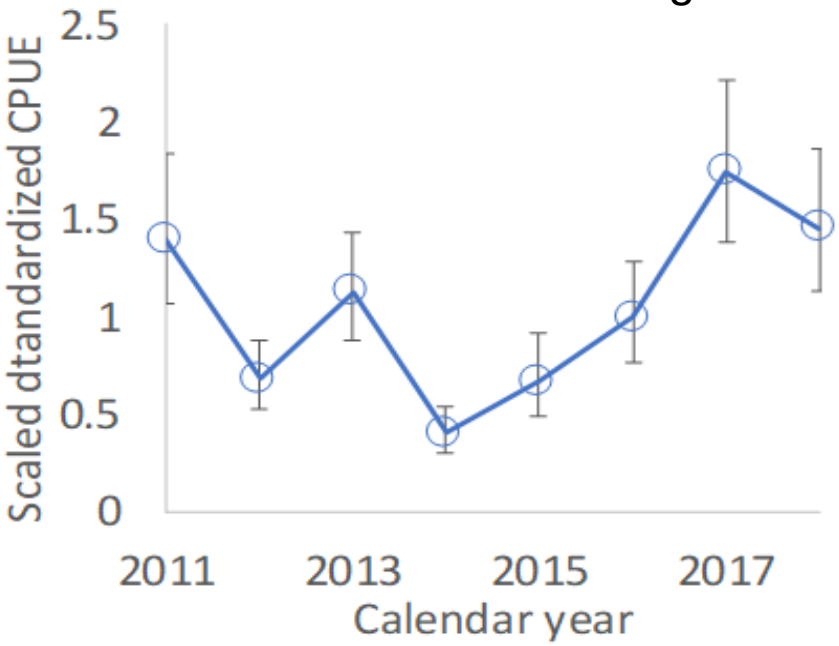
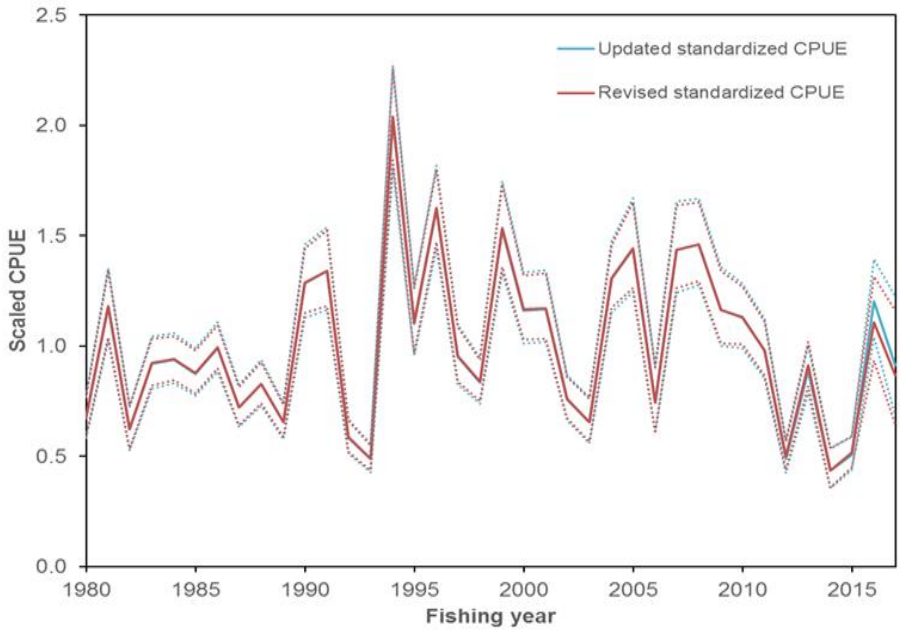
Recruitment monitoring index



Troll CPUE



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ISC Meeting in March: Requests from RFMOs

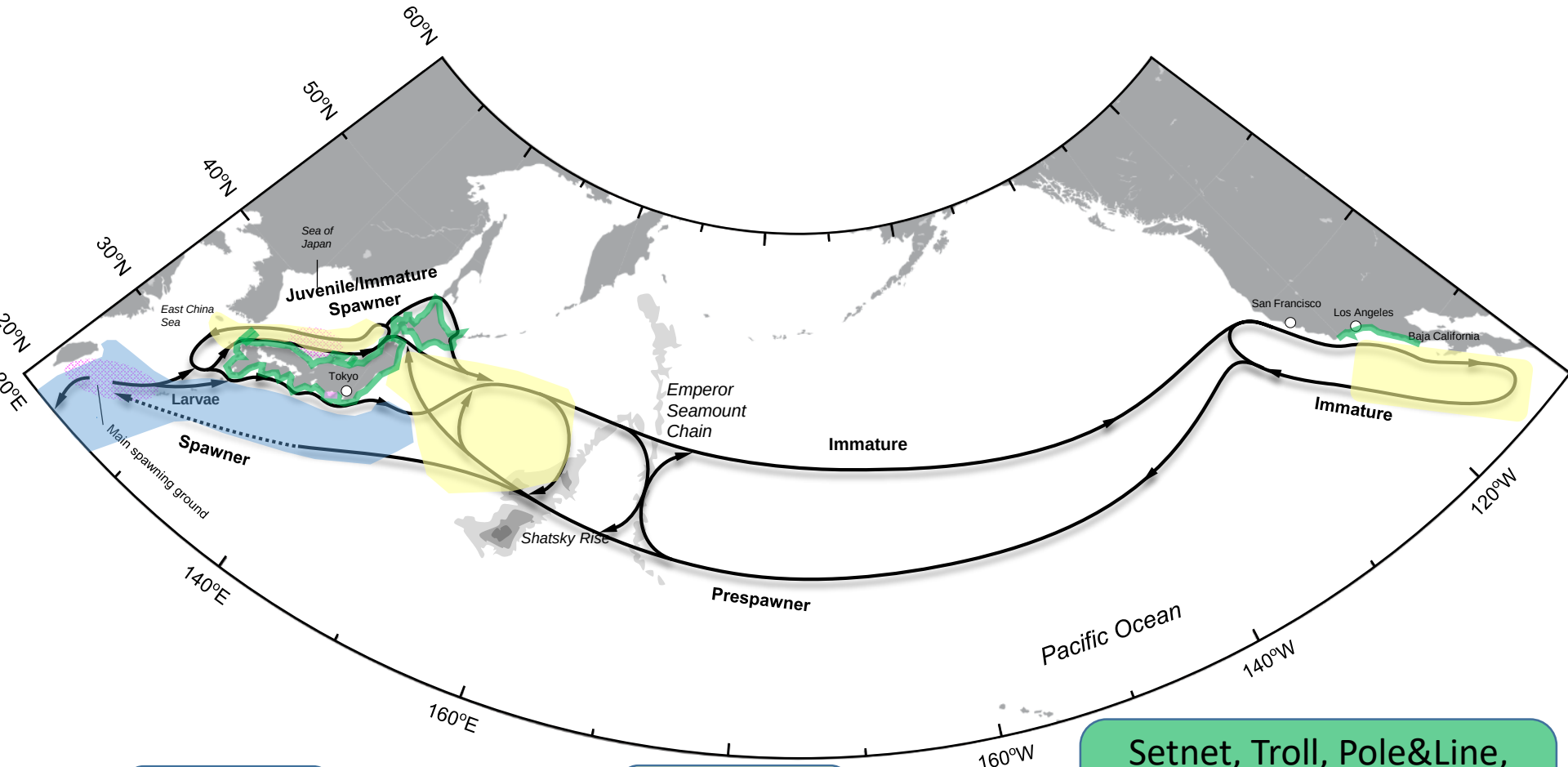
- "Review the updated abundance indices, including recruitment index, up to 2017 to evaluate the need to change its scientific advice in 2018."
- **Response from ISC PBFWG**
  - **After reviewing updated CPUE indices as well as Japanese recruitment monitoring, the WG recommends to maintain the conservation advice from ISC18 (in 2018).**
  - **In addition, the WG noted that some positive signs of PBF stock were observed after the last assessment. New positive information this year includes that the troll CPUE recruitment index in 2017 is similar to its historical average, that Japanese recruitment monitoring indices in 2017 and 2018 are higher than 2016 and that larger fish are apparently becoming more abundant in EPO, although this information needs to be confirmed through stock assessment in the future.**

IATTC Staff Recommendation at SAC10

1. The current resolution (C-16-08) is adequate and, for this reason, no additional recommendations are made.
2. Increased catches based on the scenarios analyzed are possible under the harvest strategy prepared by the joint tRFMO working group. The choice of catch scenario should take into account the desired rebuilding rate and the distribution of catch between small and large bluefin.

Latest information on the PBF Fishery

Schema of PBF and its Fishery distribution

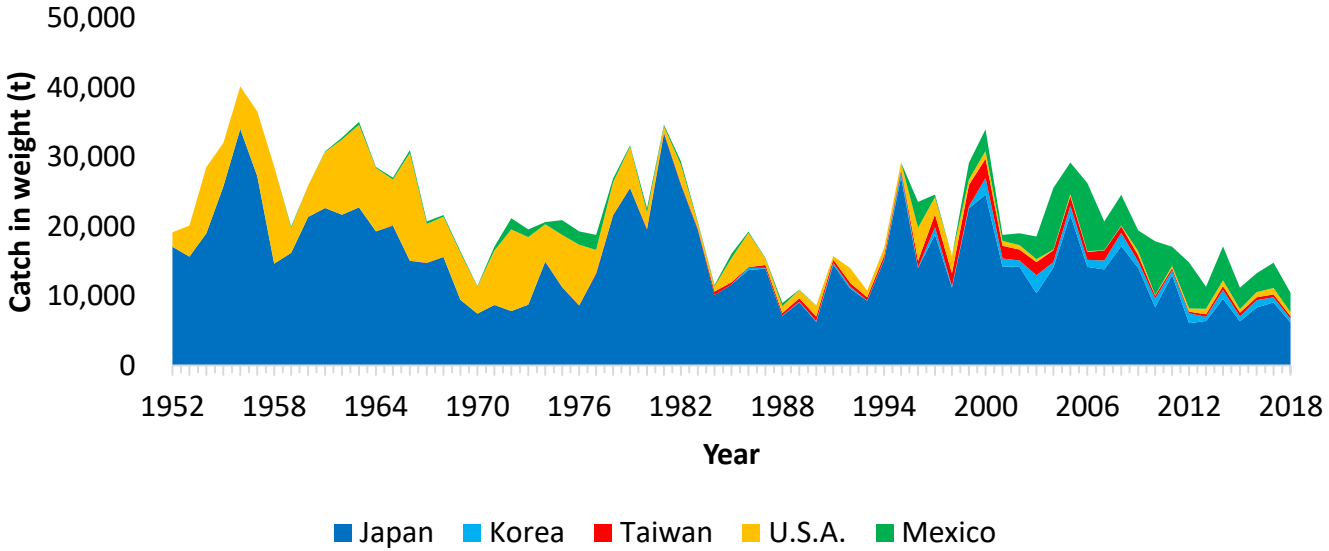


Longline	Purse seine	Setnet, Troll, Pole&Line, Sports fishery and other coastal fisheries
Japan, Taiwan	Japan, Mexico, Korea, U.S.A.	Japan, U.S.A.

Total catch by country (mt):

Year	Japan	Korea	Taiwan	USA	Mexico	ISC PBFWG catch
2011	12,994	684	316	343	2,732	17,069
2012	6,093	1,423	214	442	6,669	14,841
2013	6,411	605	334	820	3,154	11,324
2014	9,573	1,311	525	844	4,862	17,115
2015	6,357	677	578	**497**	3,082	**11,191**
2016	8,341	1,030	454	**723**	2,709	**13,257**
2017	**9,055**	743	**416**	**936**	3,643	**14,793**
2018	**6,174**	**528**	**380**	**547**	**2,840**	**10,496**

* Catch in the latest year are provisional.



Total catch by gear (mt):

Year	PS	LL	Troll	PL	Setnet	Others	ISC PBFWG catch
2011	11,740	1,129	1,820	63	1,667	649	17,069
2012	10,550	883	570	113	1,934	790	14,841
2013	6,529	1,116	904	8	1,418	1,349	11,324
2014	12,024	1,166	1,023	5	1,951	946	17,115
2015	7,470	1,170	413	8	1,268	**862**	**11,191**
2016	9,144	1,142	778	44	1,230	**918**	**13,257**
2017	9,383	**1,324**	603	86	2,258	**1,140**	**14,793**
2018	**7,425**	**1,058**	**368**	**8**	**643**	**967**	**10,496**

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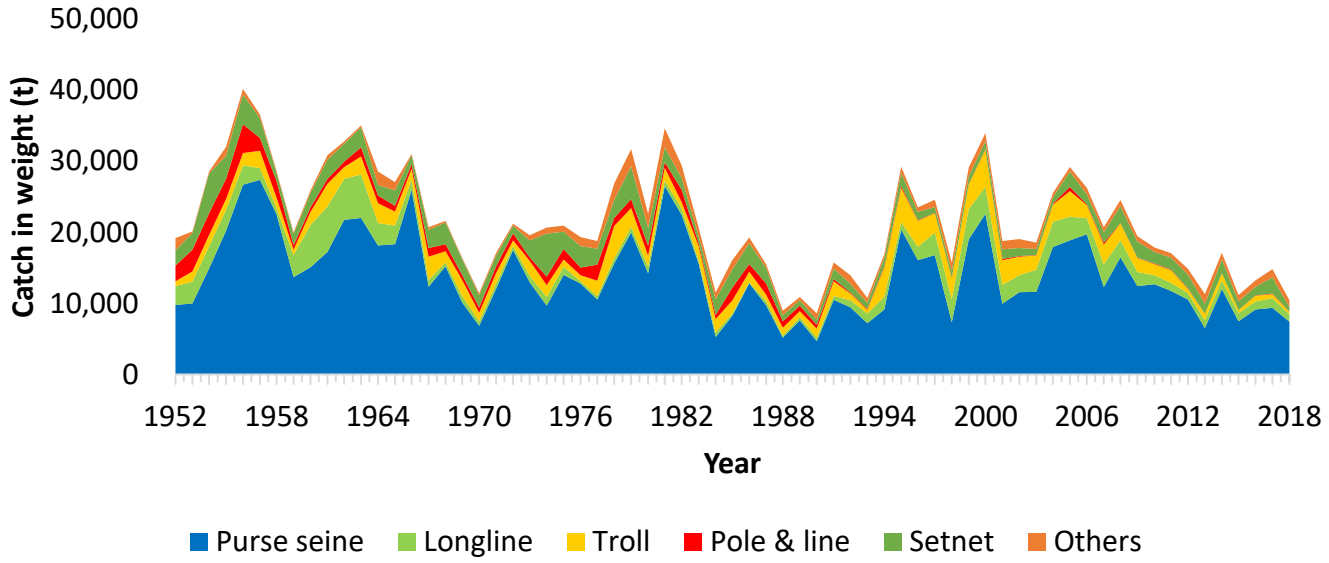


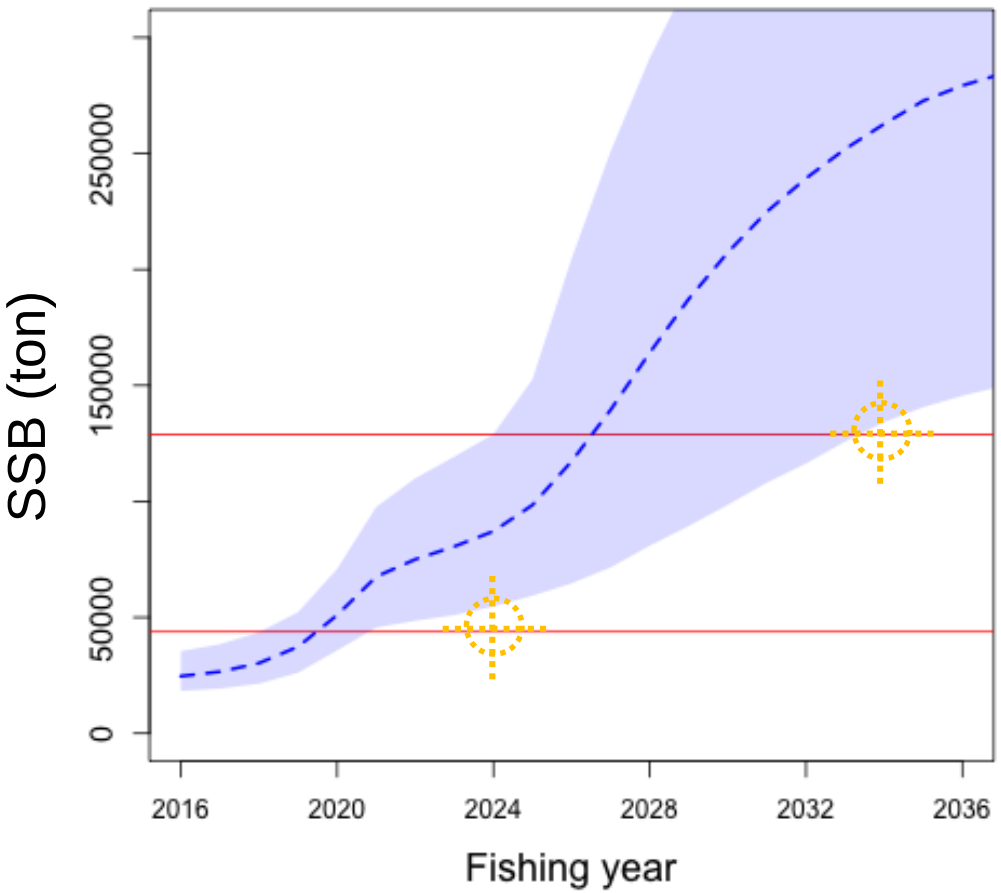
Biological Reference Point

-Metrics to assess if the stock is in a desirable state or undesirable state.

Current status of BRP for PBF

- No limit or target reference points are adopted in the WCPFC and IATTC for PBF.
- Two rebuilding targets and a HCR have been introduced for the PBS stock recovery.
  - Initial rebuilding target; Median SSB during 1952-2014
  - 2^{nd} rebuilding target; 20% SSB_0
  - Probability of achieving those targets at given year; keep higher than 60%

Schema of the HCR (WCPFC HS 2017-02)



2nd rebuilding target (20%SSB0)
keep 60% if consider catch increase

Initial rebuilding target
($SSB_{med1952-2014}$)

WCPFC HS 2017-02
If ($prob_{init\ reb2024}$<60%) reduce F
If ($prob_{init\ reb2024}$>75%) increase C

Biological reference point

F-based RPs

- F_{msy}
- F_{max}
- $F_{0.1}$
- $F_{\%SPR}$ series (10-40%)
- F_{med}

B-based RPs

- SSB_{msy}
- SSB_{max}
- $SSB_{0.1}$
- Depletion rate (10-40% of SSB_0)
- SSB_{med}
- $SSB_{50\%R0}$

Growth overfishing RP; If fishery exceed it, you'll lose some yield.
Recruitment overfishing RP; If the stock exceed it, you'll lose some recruitment.

Biological reference point

❖ Limit Reference Point

- Purpose: to maintain the stock sustainability by avoiding a risk of impaired recruitment due to unsustainable exploitation and other environment.
- Comparing to the TRP, a priority to develop the LRP should be higher.
- LRP needs to be developed with the associated management action(s).

❖ Target Reference Point

- Purpose: to reflect the management objectives which include socio-economic and/or political aspects.
- Setting TRP is more complicated since the multiple management objectives can not evaluate by a simple performance index.

Thank you