

MSE Applications – West Pacific

**Management Strategy for Pacific Bluefin
Tuna**

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ISC MSE WORKSHOP

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This Presentation is about;

2

- ▶ **This presentation is intended to spur a discussion about the management of Pacific Bluefin Tuna (PBF).**
- ▶ **In this presentation, various information surrounding PBF is considered with a view to conduct MSE for the species in the future.**
- ▶ **Then possible management frameworks are presented for further consideration.**

Flow of the Presentation

- ▶ **What is PBF?**
 - ▶ **Biology of PBF**
 - ▶ **Stock Status of PBF**
 - ▶ **Fisheries Targeting PBF**
 - ▶ **Management of PBF**
- ▶ **How should PBF be managed?**
 - ▶ **Consideration for Possible Reference Points**
 - ▶ **Possible Harvest Control Rules**

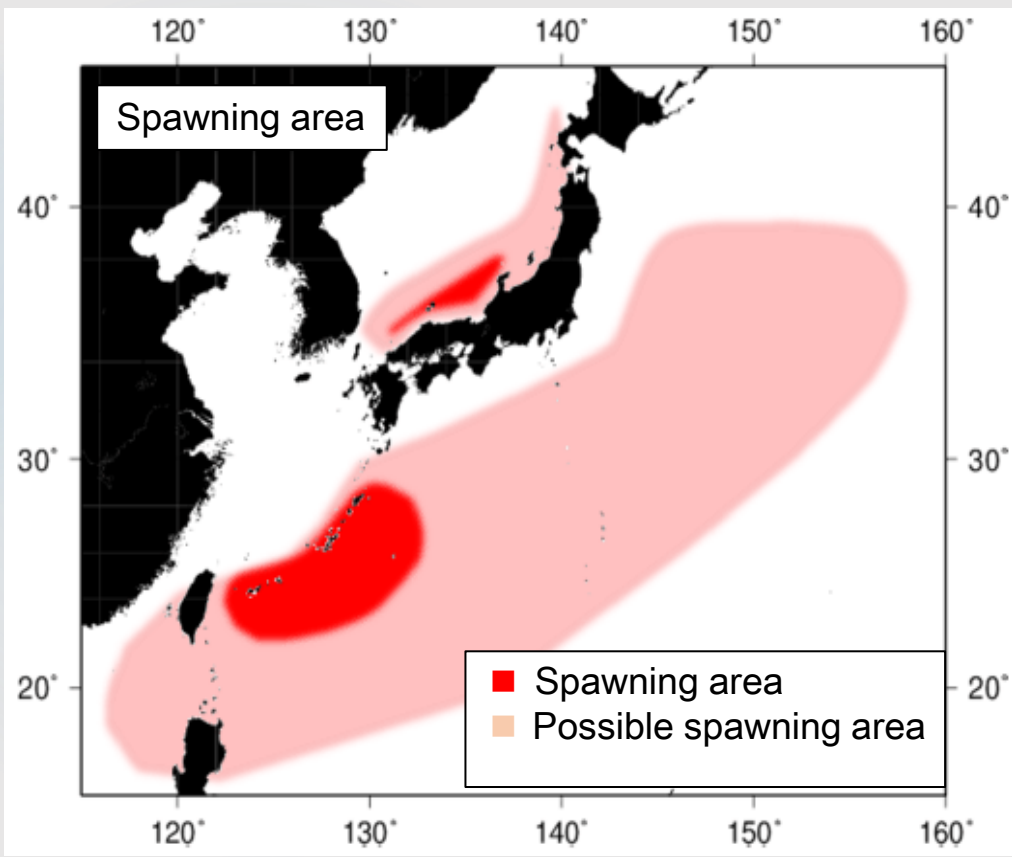
What is PBF?

Biology of PBF

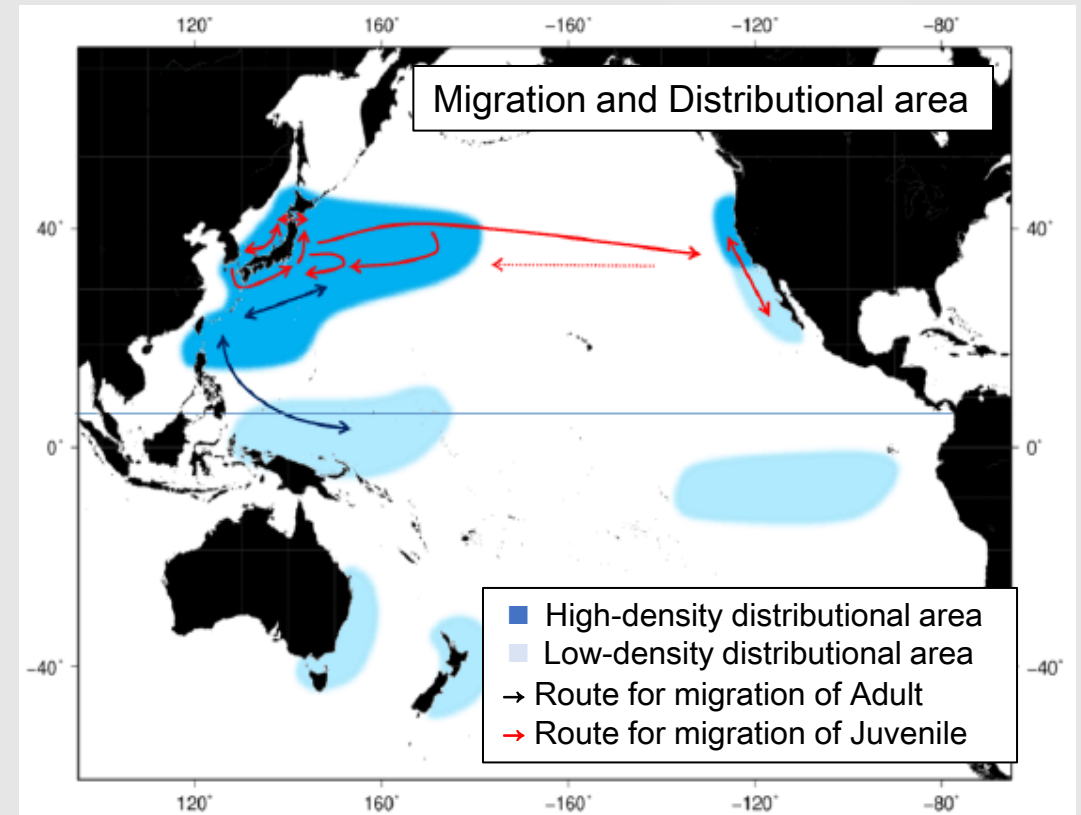
(1) Distribution

5

- Most of spawning area of PBF is located in EEZ surrounding Japan.
- Some of one year old juvenile fish migrate to eastern Pacific.



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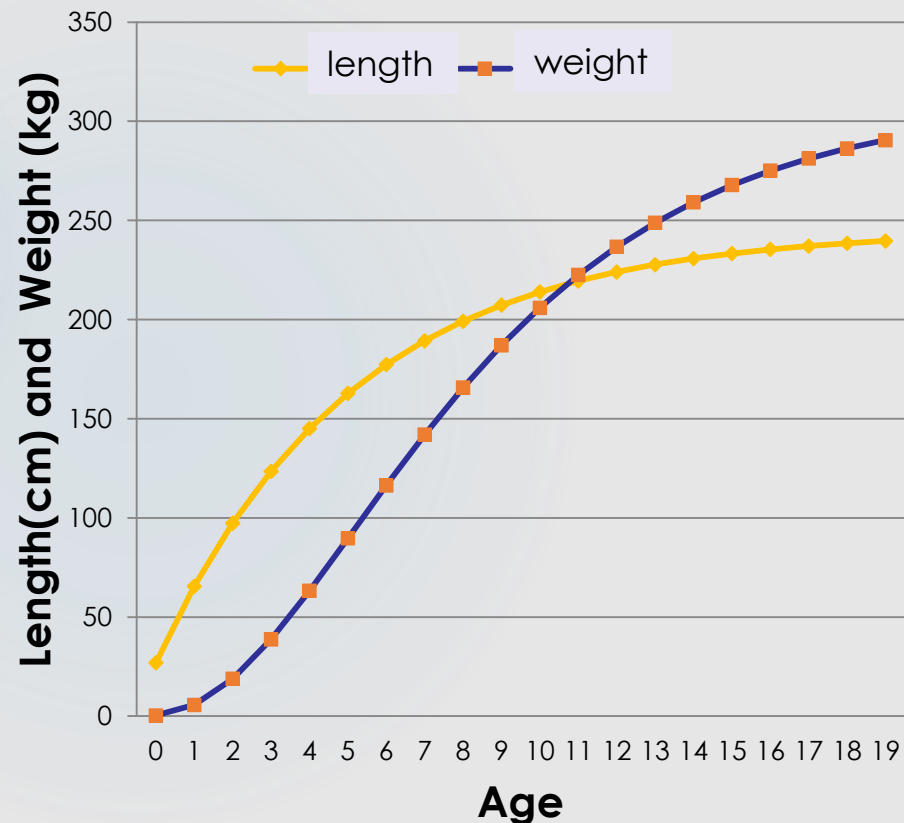
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Biology of PBF

(2) Growth

6

- Some of age 3 fish start to spawn and all of age 5 fish are mature.
- Fish below approximately 100cm in length are immature.



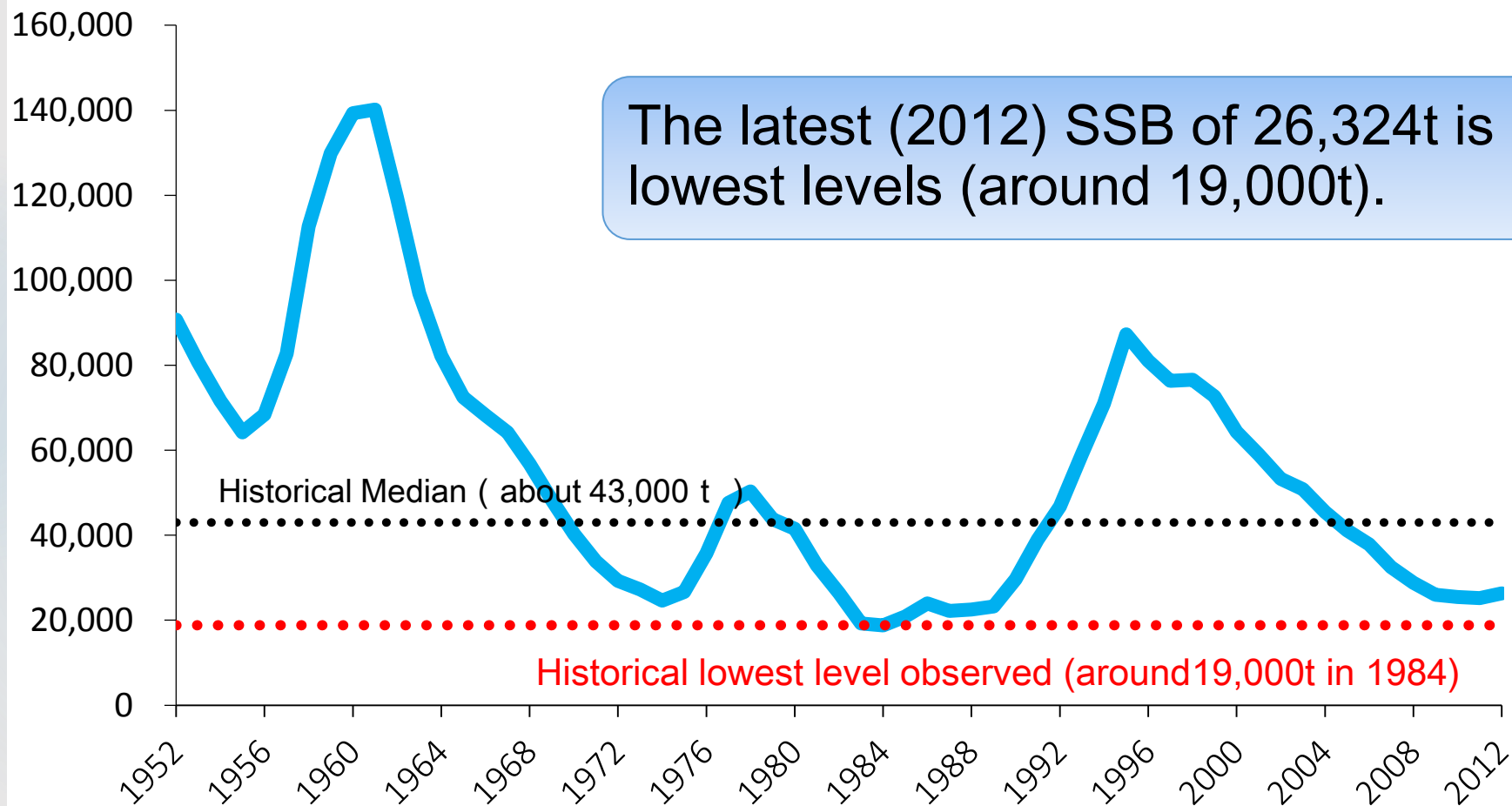
Age 0 : 30cm 0.4kg
Age 1 : 66cm 5.7kg
Age 2 : 97cm 19kg
Age 3 : 124cm 39kg
(20% of fish are mature.)
Age 4 : 145cm 63kg
(Half of fish are mature.)
Age 5 : 163cm 90kg
(All fish are mature.)

*Measured in October

Stock Status of PBF

7

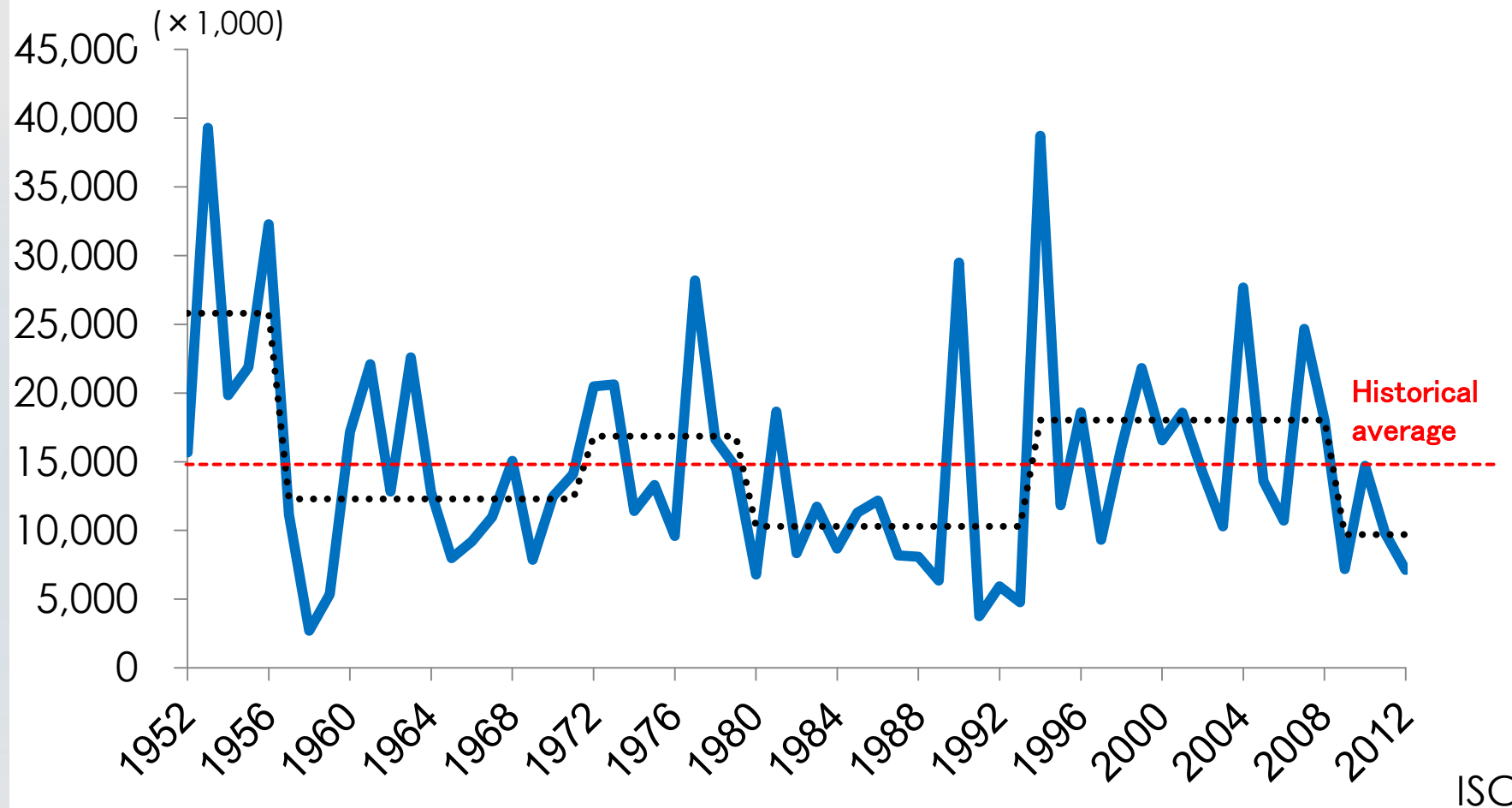
Spawning Stock Biomass of PBF



Recruitment of PBF

8

Recruitment of PBF fluctuates relatively independent with the level of SSB. However, the recruitment level for the last 5 years may have been below the historical average level.



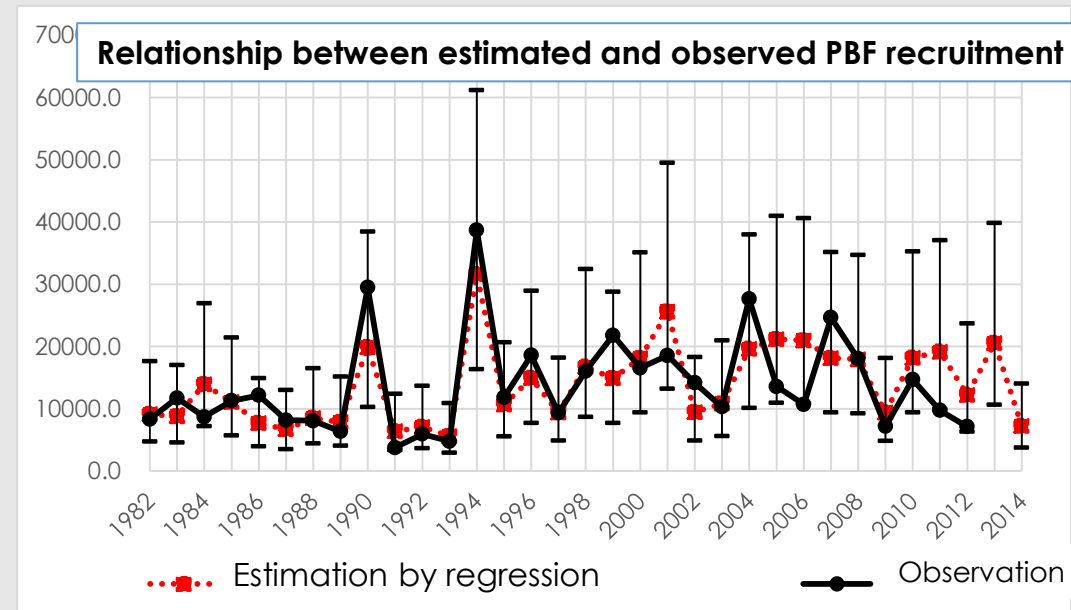
Relationship between Recruitment and Environmental Factors

9

- From the analysis of 9,555 combinations of biological as well as environmental factors, it was found that the following equation resulted in the highest co-relation ($r=0.84$).

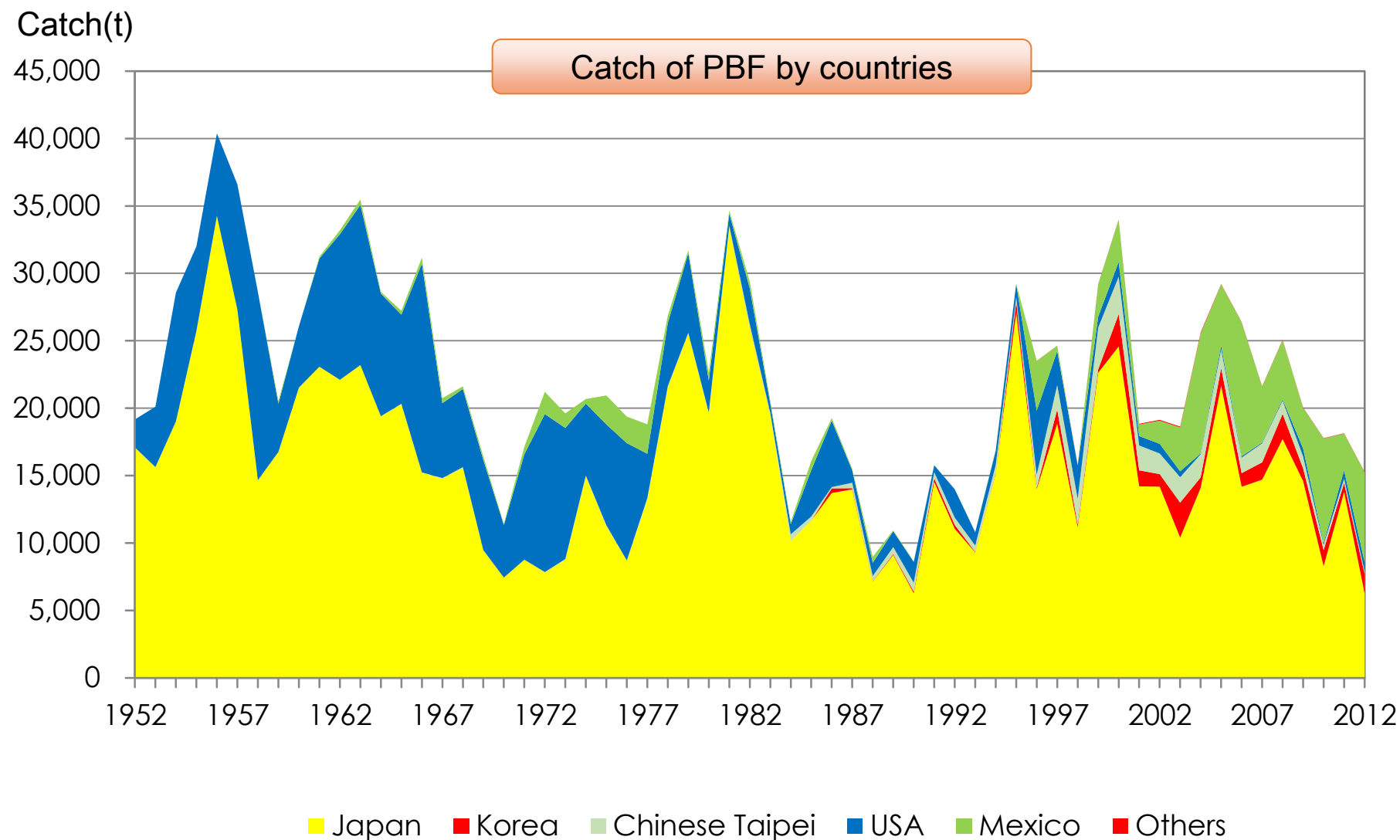
$$\begin{aligned} \text{Recruitment} = & 0.14 \times (\text{temp. deviation of northern East China Sea in summer}) \\ & + 6.54 \times (\text{ratio of the area with temp. in the } 26^{\circ}\text{Cs in the Sea of Japan in summer}) \\ & + 0.32 \times (\text{temp. deviation of northern East China Sea in autumn}) \\ & - 0.09 \times (\text{Pacific Decadal Oscillation Index in autumn}) \\ & + 9.1 \end{aligned}$$

- Environmental factors had stronger co-relationship with recruitment than SSB.
- Further work is necessary to understand the mechanism of the impact of environmental factors on PBF recruitment



Fisheries Targeting PBF (1)

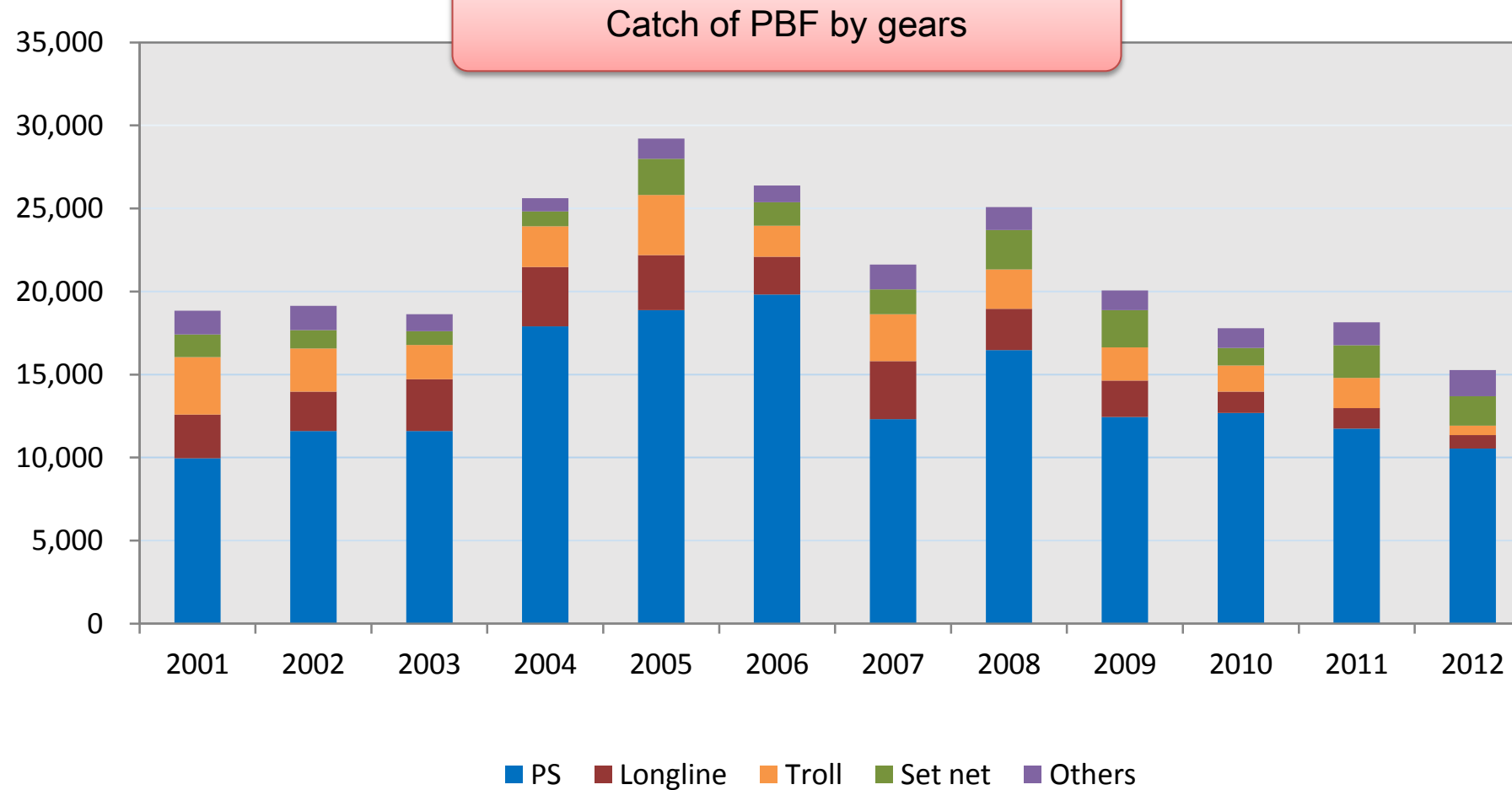
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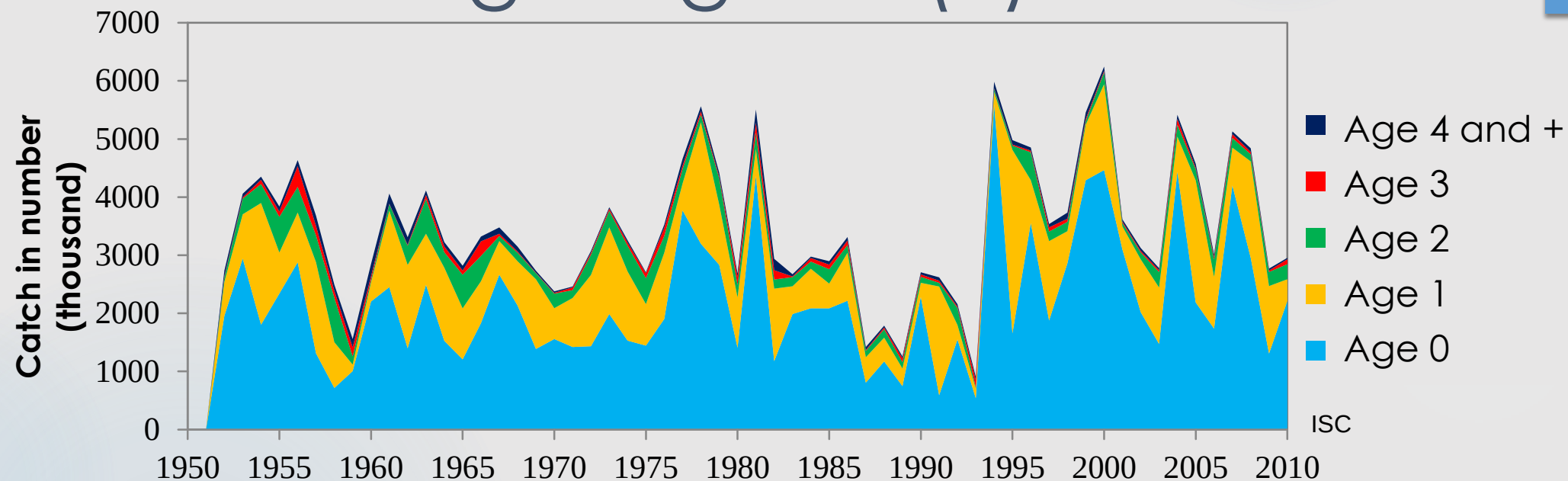
Fisheries Targeting PBF (2)

11

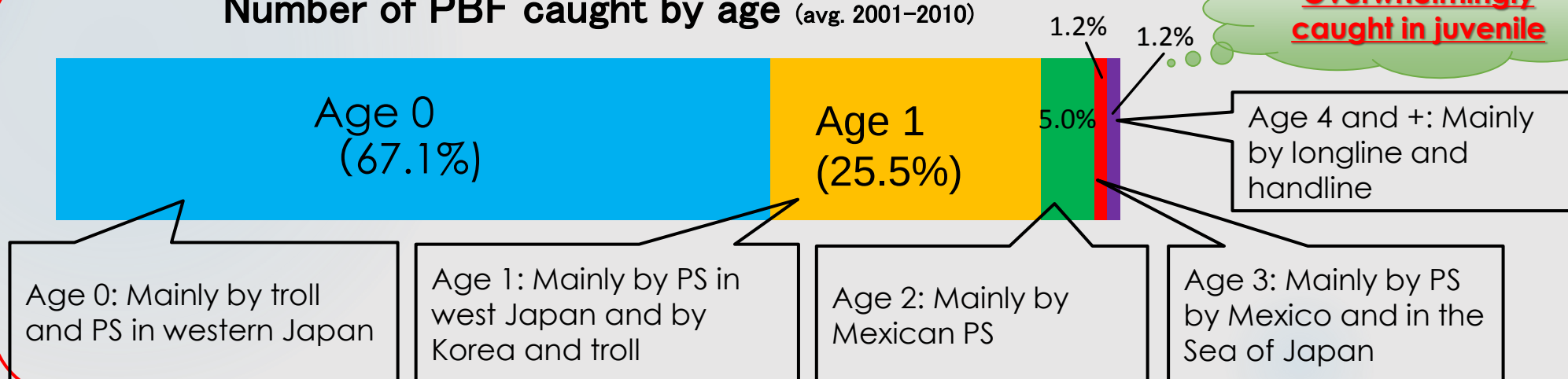


Fisheries Targeting PBF (3)

12



Number of PBF caught by age (avg. 2001–2010)

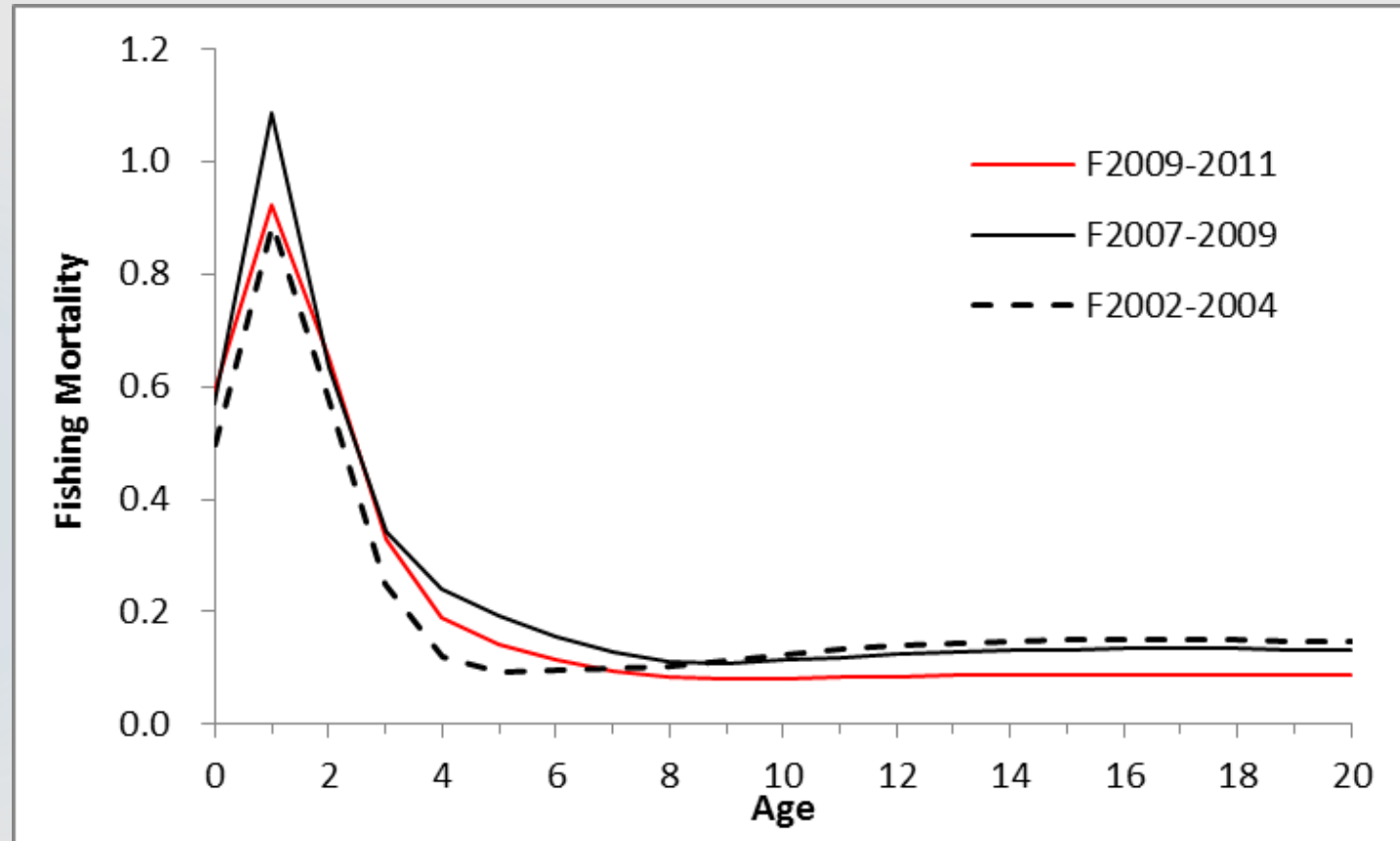


Overwhelmingly caught in juvenile

Fisheries Targeting PBF (4)

13

- ▶ Fishing mortality of juvenile is very high.



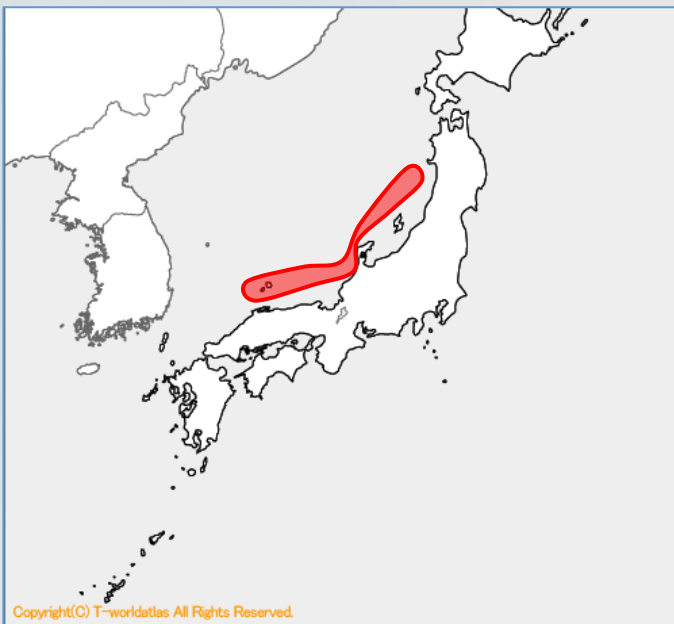
PBF Fisheries in Japan

Purse Seine

14

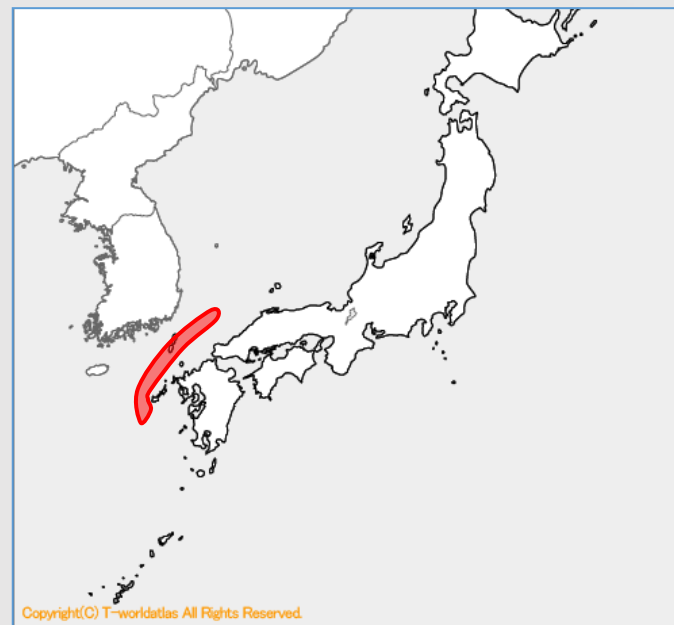
PS targeting Adult

- In the Sea of Japan
- Average annual catch 2,431t ('05-09)
- 18 vessels



PS targeting Juvenile

- Western Japan
- Average annual catch 6,207t ('05-09)
- 22 vessels



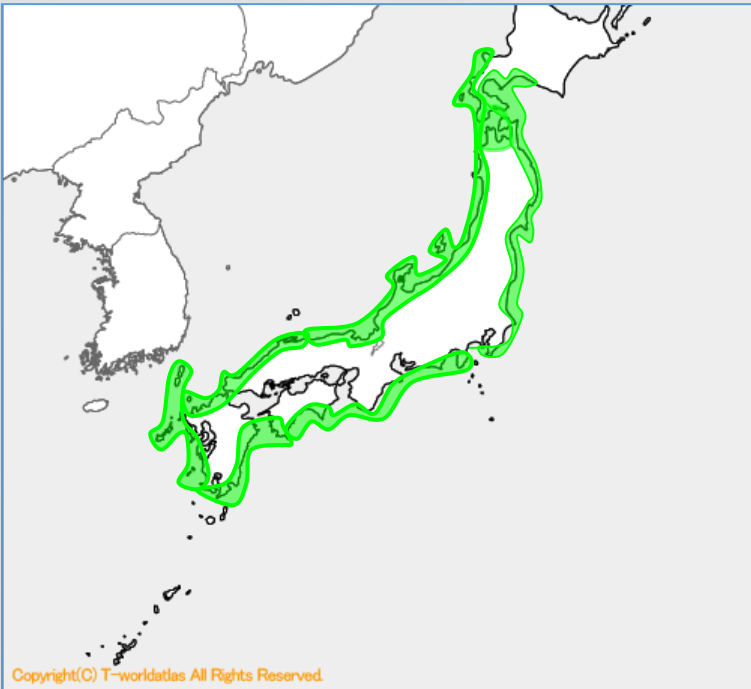
PBF Fisheries in Japan

Artisanal Fisheries and Set net

15

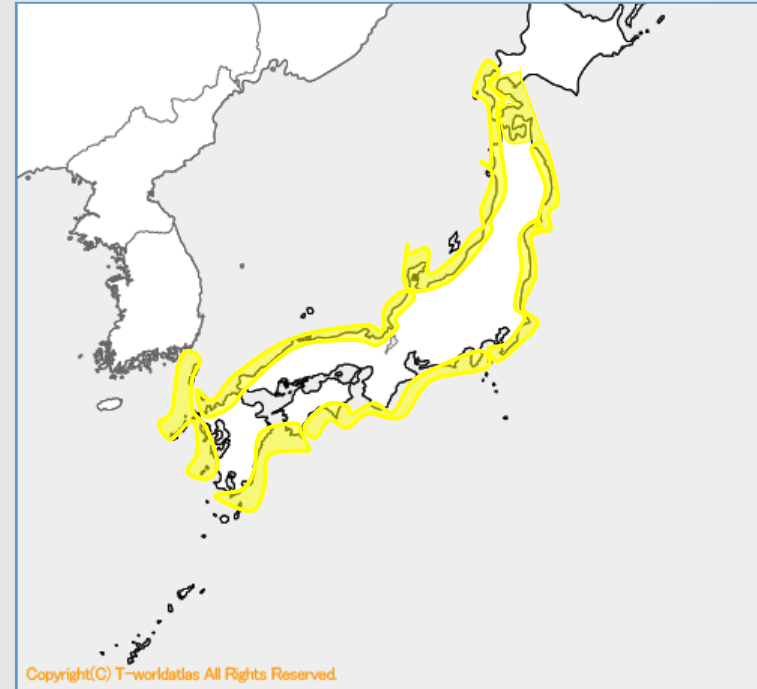
Artisanal Fisheries

- Throughout the coast of Japan
- Targeting juvenile (0-1 y-old)
- Average annual catch 2,539t ('05-09)
- 24,086 vessels licensed



Set net

- Throughout the coast of Japan
- PBF not main target but catch all ages
- Average annual catch 1,940t ('05-09)
- 1,800 licenses issued



Management of PBF Fisheries (1)

16

Development of Management Measures

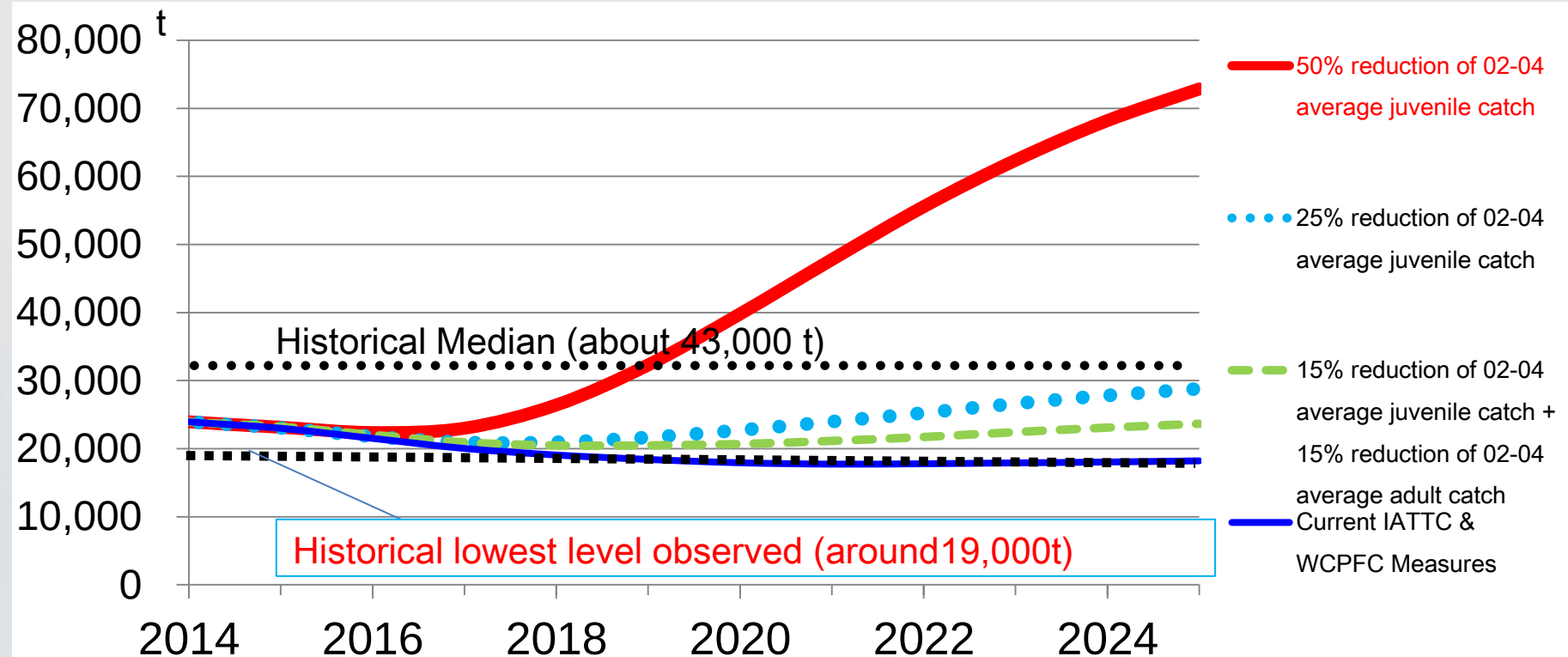
	WCPFC	IATTC
2010	• Effort limit to 2002-04 level, <u>except for artisanal fisheries</u>	
2011-2013	• Effort limit to 2002-04 level, <u>except for artisanal fisheries</u> • Catch reduction of juvenile below 2002-04 level, <u>except for Korea</u>	• Total catch limit of 10,000t for 2012 and 2013 with annual limit of 5,600t • Additional 500t for countries with catch history
2014	• Effort limit to 2002-04 level • <u>15%</u> Catch reduction of juvenile below 2002-04 level	• Catch limit of 5,000t • Additional 500t for countries with catch history

Management of PBF (2)

17

Stock projections by ISC in 2014 (low R scenario)

No scenario except for 50% reduction of juvenile catch demonstrates recovery to the historical median within 10 years.



“further substantial reductions in fishing mortality and juvenile catch over the whole range of juvenile ages should be considered to reduce the risk of SSB falling below its historically lowest level.”

Management of PBF Fisheries (4)

18

Current Management Measures

	WCPFC	IATTC
2010	Effort limit to 2002-04 level, <u>except for artisanal fisheries</u>	
2011-2013	- Effort limit to 2002-04 level, <u>except for artisanal fisheries</u> - Catch reduction of juvenile below 2002-04 level, <u>except for Korea</u>	- Total catch limit of 10,000t for 2012 and 2013 with annual limit of 5,600t - Additional 500t for countries with catch history
2014	- Effort limit to 2002-04 level <u>15%</u> Catch reduction of juvenile below 2002-04 level	- Catch limit of 5,000t - Additional 500t for countries with catch history
2015	- Effort limit to 2002-04 level 15% 50% Catch reduction of juvenile below 2002-04 level <u>Catch limit of adult fish at 2002-04 level</u>	- Catch limit of 5,000t <u>6,600t for 2 yrs</u> Additional 500t for countries with catch history <u>Endeavor to reduce juvenile catch by 50%</u>

Management of PBF Fisheries (5)

Implementation in Japan

19

- In accordance with WCPFC CMM, Japan is committed to **urgent resource recovery by 50% juvenile catch reduction commencing from 2015.**
- This requires **reducing juvenile catch from 8,015t (2002-04 average) to 4,007t.**
- Among 4,007t, **2,000t is allocated to purse seine and remaining 2,007t is to other fisheries including artisanal ones.**

Management of PBF Fisheries (5)

Implementation in Japan

20

	No. of Vessel	Catch (05-09)	Main target (age)	Management Scheme in 2014			After 2015 Management Scheme
Purse Seine (Western Japan)	22	6,207 t	0-1	Licensing (Limited entry)	Catch limit for juvenile (4,250 t) — 30% (since 2014)	Effort Limit + Catch Limit	Current Effort Limit + <i>Juvenile catch limit</i> 2,000t + Current Catch limit for adult (Sea of Japan)
Purse Seine (Pacific side)	26	729 t	2,3~	Licensing (Limited entry)	Catch limit for juvenile (500t) — 46% (since Apr. 2012)		
Purse Seine (Sea of Japan)	18	2,431 t	3~	Licensing (Limited entry)	Catch limit for adult (2,000 t) — 13 % (since Apr. 2011)		

Management of PBF Fisheries (5)

Implementation in Japan

21

	No. of Vessel	Catch (05-09)	Main target (age)	Management Scheme in 2014			After 2015 Management Scheme
Artisanal Fishery	24,086	-	0-1	Licensing	Licensing system and mandatory reporting (since April 2014)	Effort Limit	Current Effort Limit + <i>Juvenile catch limit 2,007t</i>
Set Net	1,800 (No. of license)	1,940 t	All	Licensing by prefectural government (Limited entry)	Administrative instruction by Minister not to increase the number of licenses (since Jan. 2010)	Effort Limit	
Longline	688 (No. license)	1,597 t (EEZ)	4~	Licensing (Limited entry)	-	Effort Limit	
Aquaculture	147 (No. of sites)	-		Licensing by prefectural government	Registration and mandatory reporting (since Jan. 2011) Ministerial order to prohibit increase of farming cages (since October 2012)		

Summary of “What is PBF?”

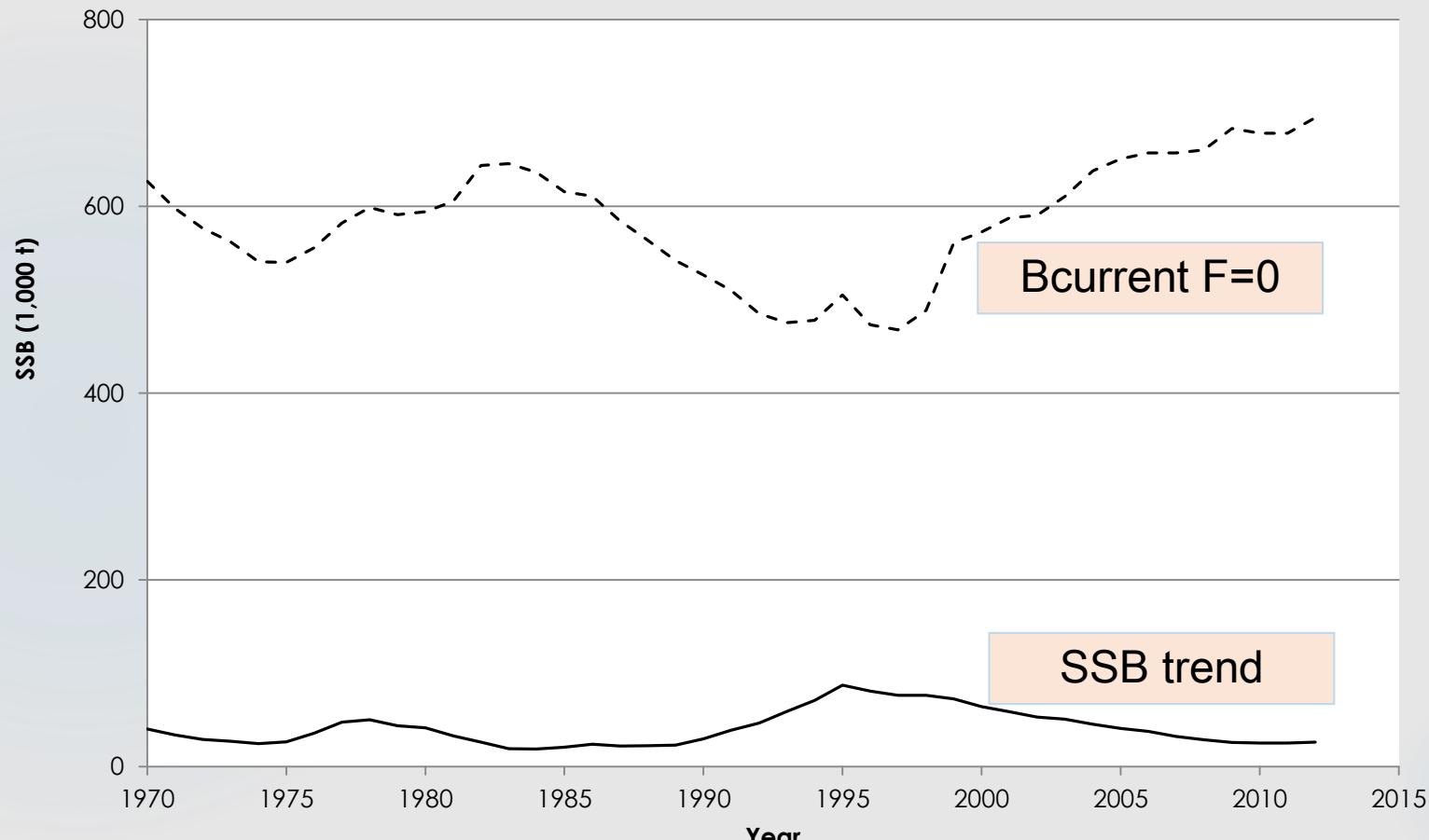
22

- ▶ Long history of harvest. Large catch in juvenile throughout observed history.
- ▶ Stock fluctuated substantially (20 – 100 thousand tonnes) at low level (approximately 3 – 20% of theoretical B_0).
- ▶ Weak spawner - recruitment relationship. Relatively robust recruitment with low SSB.
- ▶ Complex fisheries, particularly in Japan. Stricter measures to commence in 2015.

How should PBF be managed?

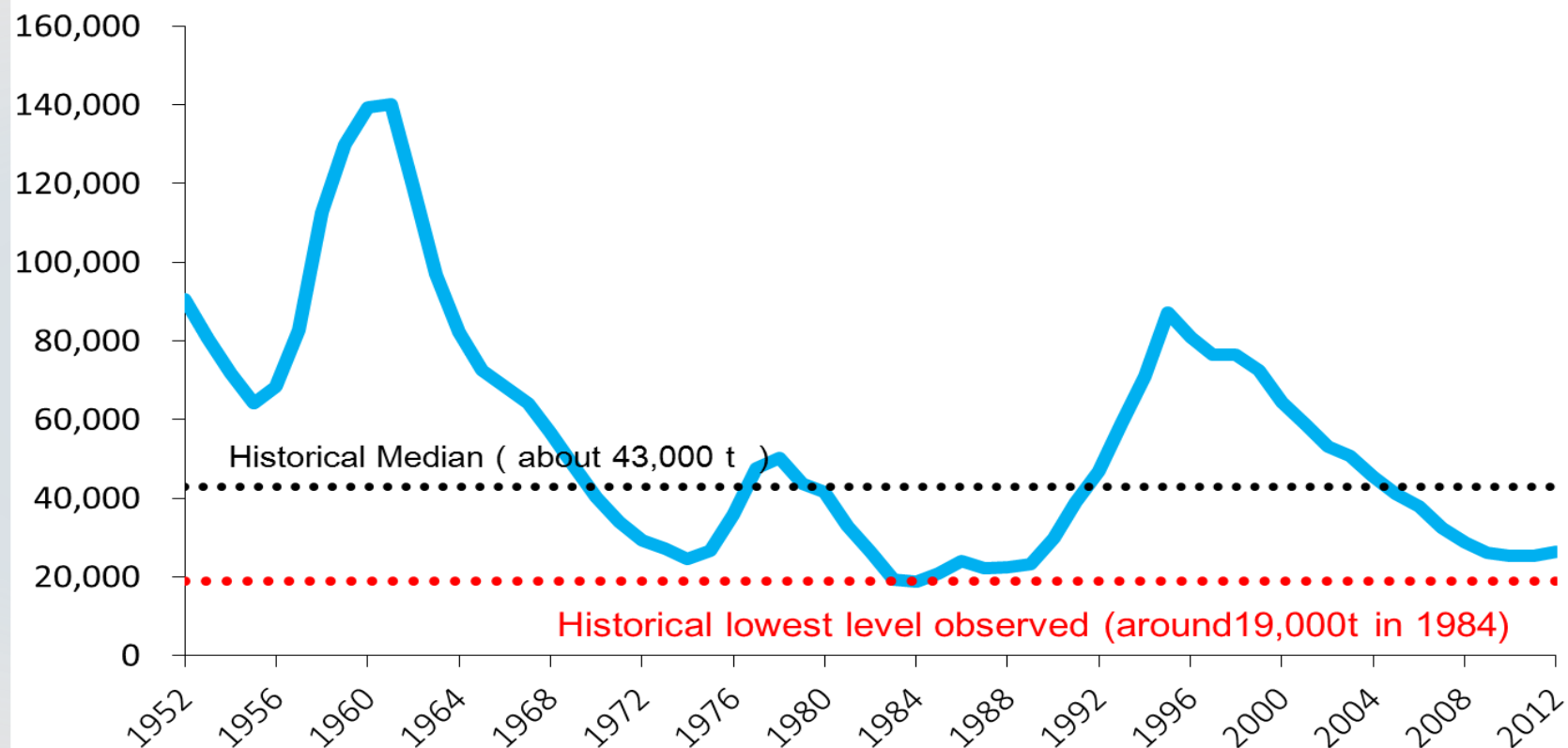
Can PBF be managed using standard reference points?

- ▶ 20% of $B_{\text{current}} F=0$ would have fluctuated from 100 – 140 thousand ton. It is based on the past recruitment, which can vary substantially in the future.



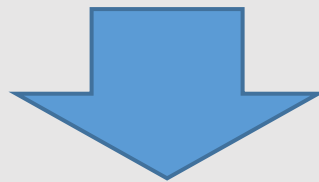
Can PBF be managed using standard reference points? (2)

- ▶ **Stock size (in median) had almost never experienced 20% (about 120,000t) of B_{current} F=0 level.**



Can PBF be managed using standard reference points? (3)

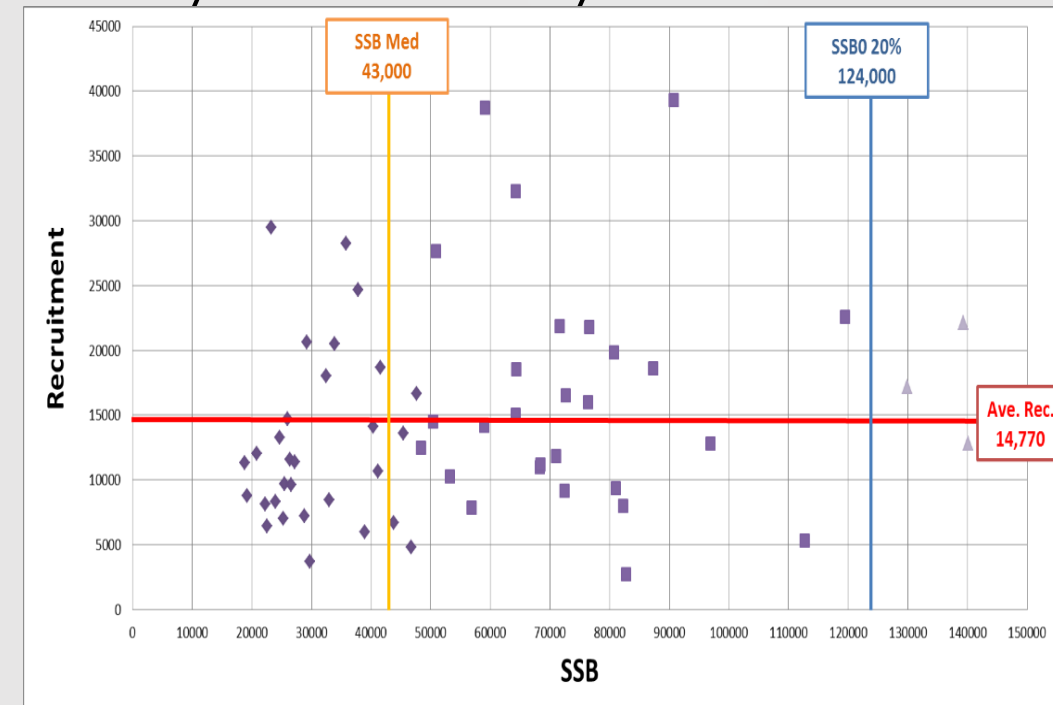
- ▶ The PBF stock have fluctuated at low level for a long period.
- ▶ Almost never experienced 20% $B_{\text{current}} F=0$ level.
 - ▶ $\Rightarrow$ Do we need “Maximum” Sustainable Yield as Limit (= Minimum) Reference Point?
- ▶ Are $B_{\text{msy}}/20\% B_{\text{current}} F=0$ for real? $\Rightarrow$ With fluctuating recruitment, “current” $B_{F=0}$ cannot predict future.



More realistic framework for PBF may be needed

What is realistic management framework, then?

- ▶ Concept of LRP is a threshold where you don't want to be (to avoid recruitment collapse).
- ▶ However, recruitment will not collapse suddenly below Bmsy.
- ▶ Hillborn (2010) reported that “Pretty Good Yield” (within 80% of Optimum Yield) can occur from 5 to 40% of unfished biomass for species with high productivity.
- ▶ In case of PBF, recruitment is considered to be robust even substantially below the estimated Bmsy



What is realistic management framework, then? (2)

- ▶ From the experience, it is possible to say that PBF has maintained “pretty good” reproduction potential, if not full, within the range of the past fluctuation (SSB at 20 – 100 thousand ton).
- ▶ Of course, this does not guarantee the future; the chance for the stock to go below historical lowest level must be minimized.
- ▶ Preliminary results of the research conducted by FRA indicate that PBF recruitment has a stronger correlation with environmental factors than SSB.

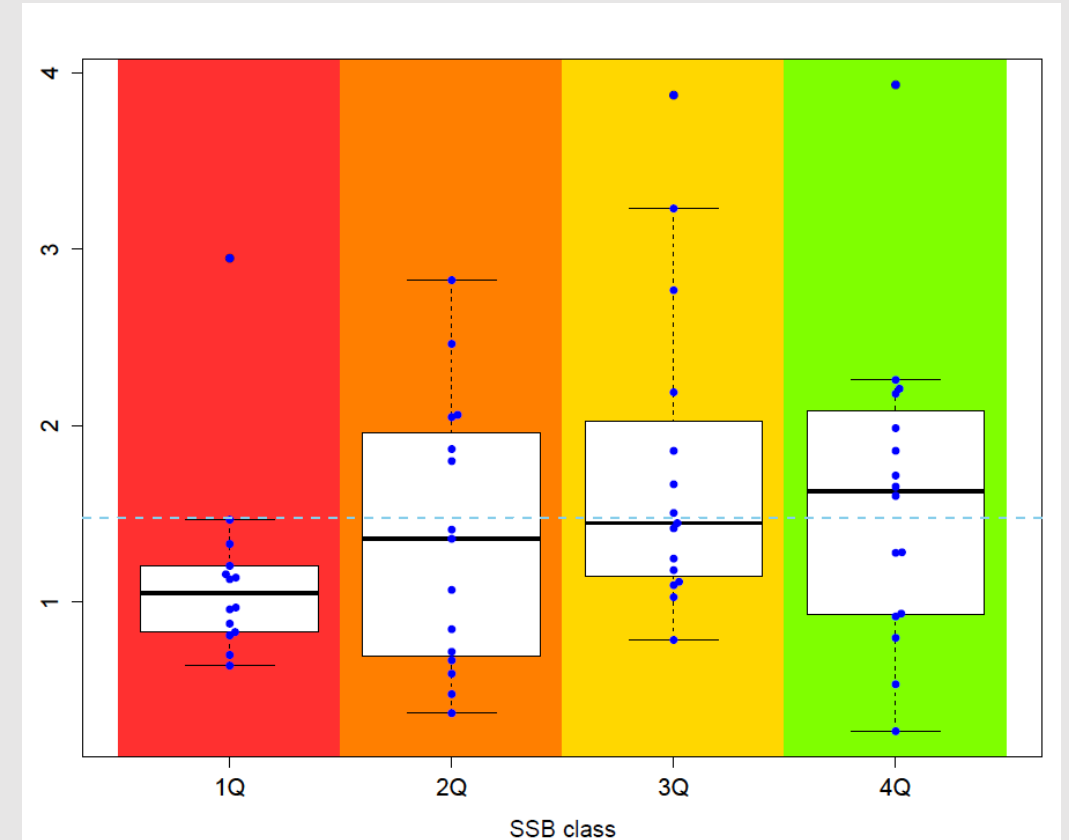
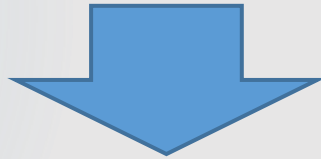


A management framework that ensure appropriate level of juvenile to mature to sustain the stock level could be an option.

More specifically?

(1) a standard approach

- ▶ Experience shows that as far as the stock is at a level which can produce average recruitment, the PBF stock can recover.
⇒ Manage stock so as not to go below a level where recruitment decrease.
- ▶ Analysis shows that recruitment decreases when the stock is at lower 25 percentile.



One obvious approach is to maintain the stock level where average recruitment is expected.

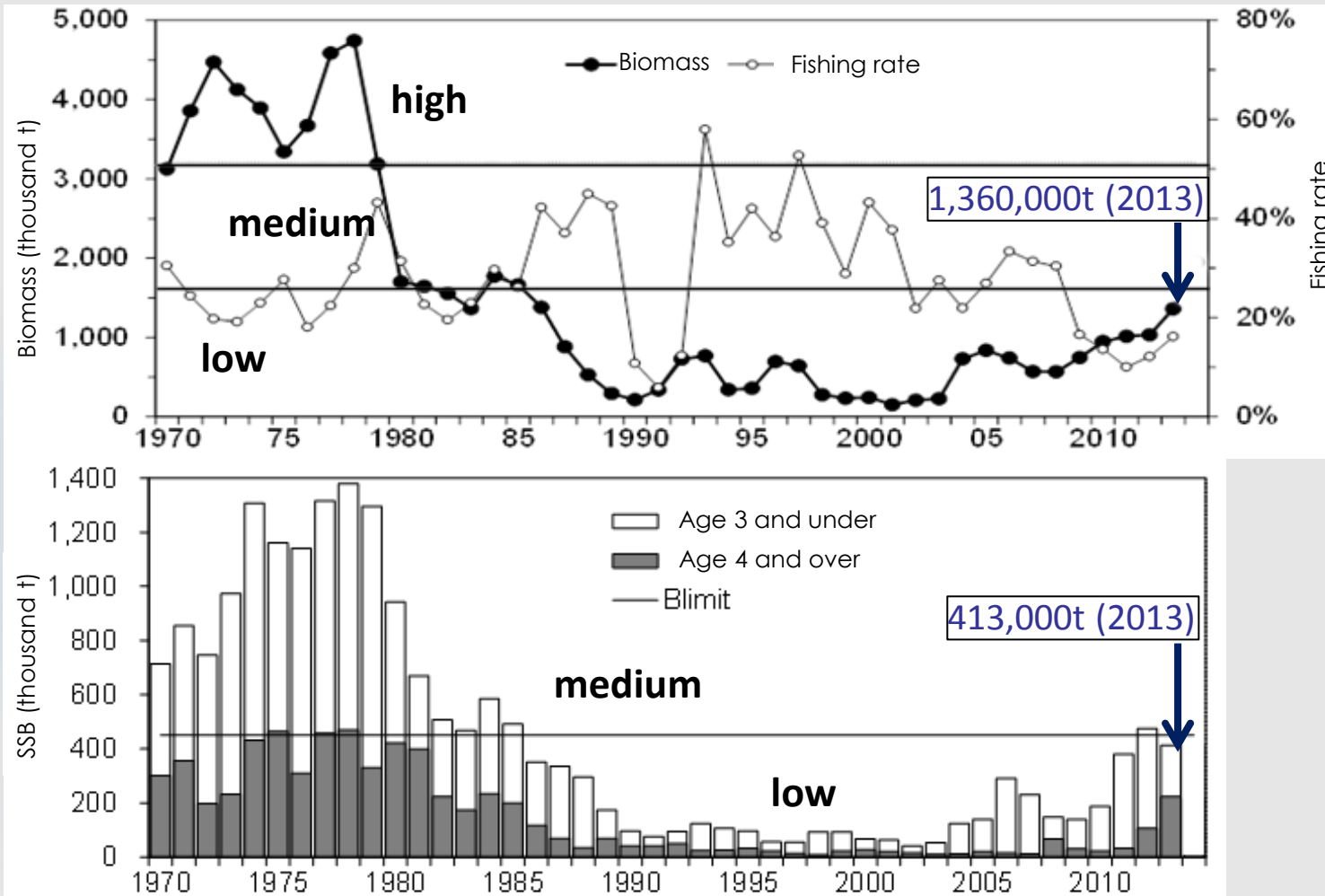
More specifically?

(2) an approach focusing on recruitment

- ▶ Another possible management approach is to control fisheries targeting juvenile so as to allow a certain level of age 5 fish is left to be able to reproduce, in order maintain the SSB at a sufficient level to sustain the stock.
- ▶ Current WCPFC CMM2014-04 (F control + 50% reduction of juvenile catch) could be considered one example of this approach and the ISC simulation shows the effectiveness of such an approach.

Recovery of western Pacific Mackerel

31



- ▶ Blimit is set as a biomass above which stable recruitment is expected.
- ▶ ABC is set based on fishing mortality at which stock recovery to Blimit is expected.
- ▶ TAC is allocated to respective fishery and could be further distributed to season or fleets. Due to the reduced fishing mortality, the stock is on recovery trend in recent years.

Recovery of Atlantic Bluefin Tuna

32

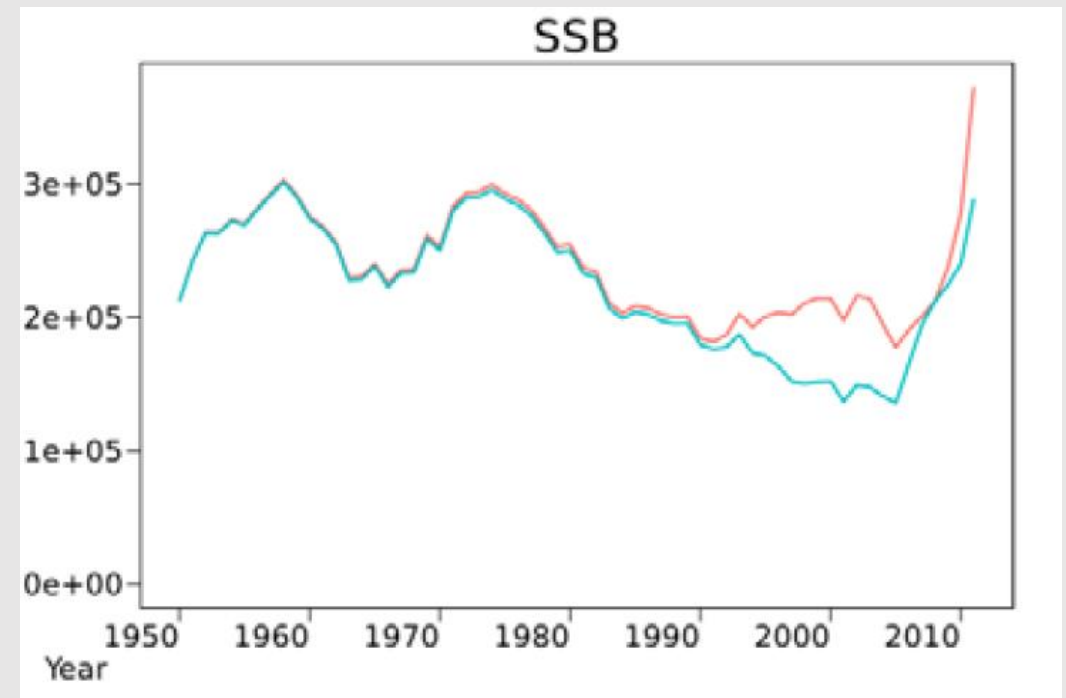
► Recovery Target:

- East Atlantic: Recovery to Bmsy level by 2022 with 60%+ probability
- West Atlantic: Recovery to Bmsy level by 2018 with 50%+ probability

► TAC:

- As a very strong cohort in year 2003 was effectively protected by strict management measures introduced timely (reduced TAC and prohibition of catch of juvenile ($<30\text{kg}$)), the stock is considered to be recovering rapidly.
- TAC was agreed to be increased in the Commission meeting in 2014.

Stock Trajectory of east Atlantic Bluefin



Towards MSE of PBF

33

- ▶ The following aspects should be paid particular attention when considering MSE for PBF;
 - ▶ **How to develop a feasible management framework suitable for PBF, taking into account its characteristics and covering wide variety of fisheries targeting it**
 - ▶ **How to achieve consensus among diverse and numerous stakeholders**
 - ▶ **How to incorporate uncertainty related to the stock fluctuation caused by environmental changes**
 - ▶ **MSE could be used in the development of HCR for PBF.**

Thank you.