ISC Pacific Bluefin Tuna Stock Assessment 2016

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Presentation Topics

- Assessment Model – structural overview
  - 2014 vs 2016
- Data and Assumptions
- Results
  - Fits to the data
  - Biomass, Fishing mortality, Fishery impact
- Future Projections

Assessment Model - Structure

- A fully integrated model (Stock Synthesis-Version 3)
  - Length-based, age-structured (0-20+) model
- Fishery data (From 1952 to 2014)
- Fishery definitions: 19 fisheries (Fleets)
- Single stock - no spatial structure
- Given growth, maturity, natural mortality, stock-recruitment relationship

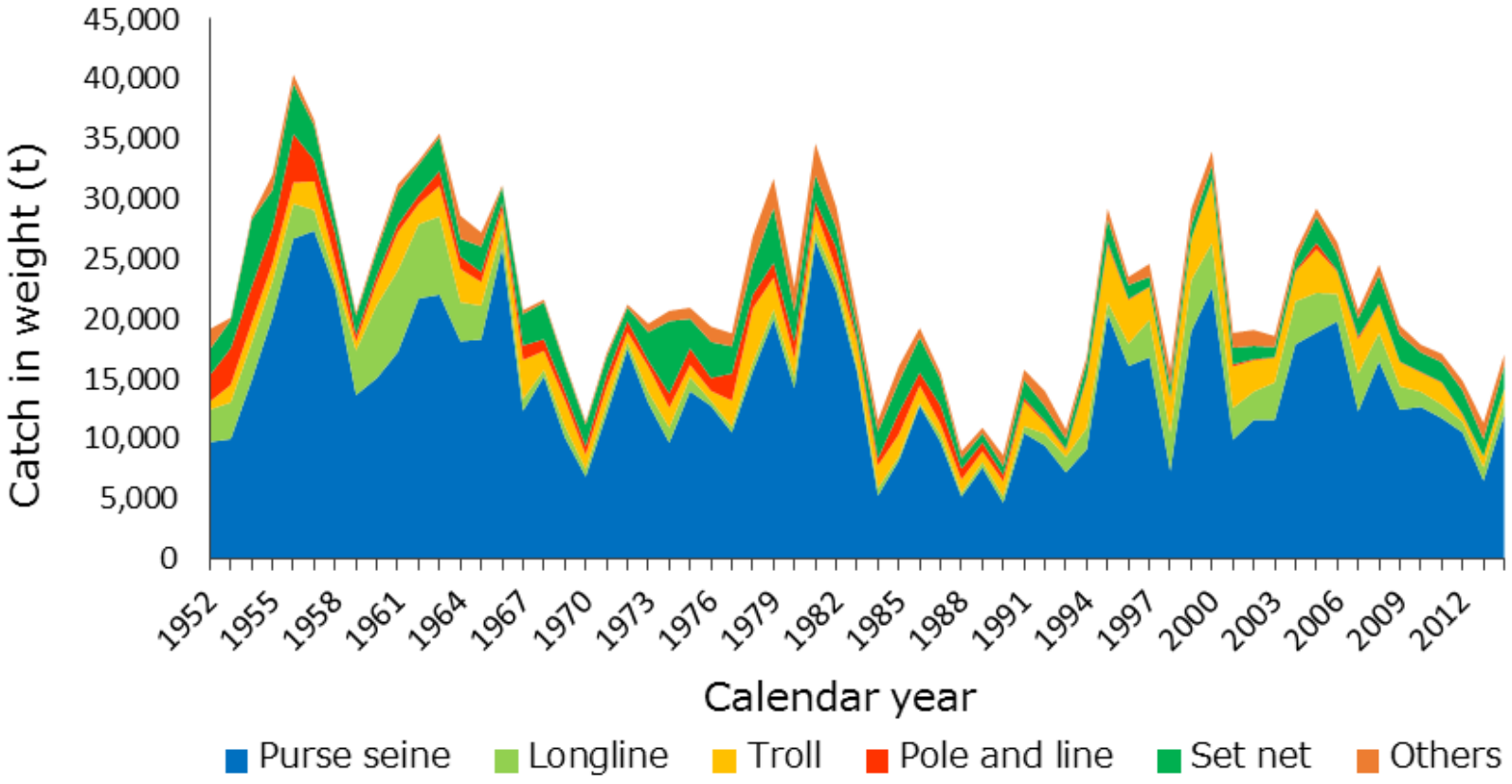
Difference Between 2014 and 2016 Assessments

- Fishery definition: from 14 fleets to 19 fleets
- CPUE standardization methods
  - Jpn LL (targeting effect) and Twn LL (area effect)
- Size comp. data
- Method to raise the catch to number at size
- Growth curve
- Methods to estimate the selectivity of fishery
  - Implement more time variant processes.

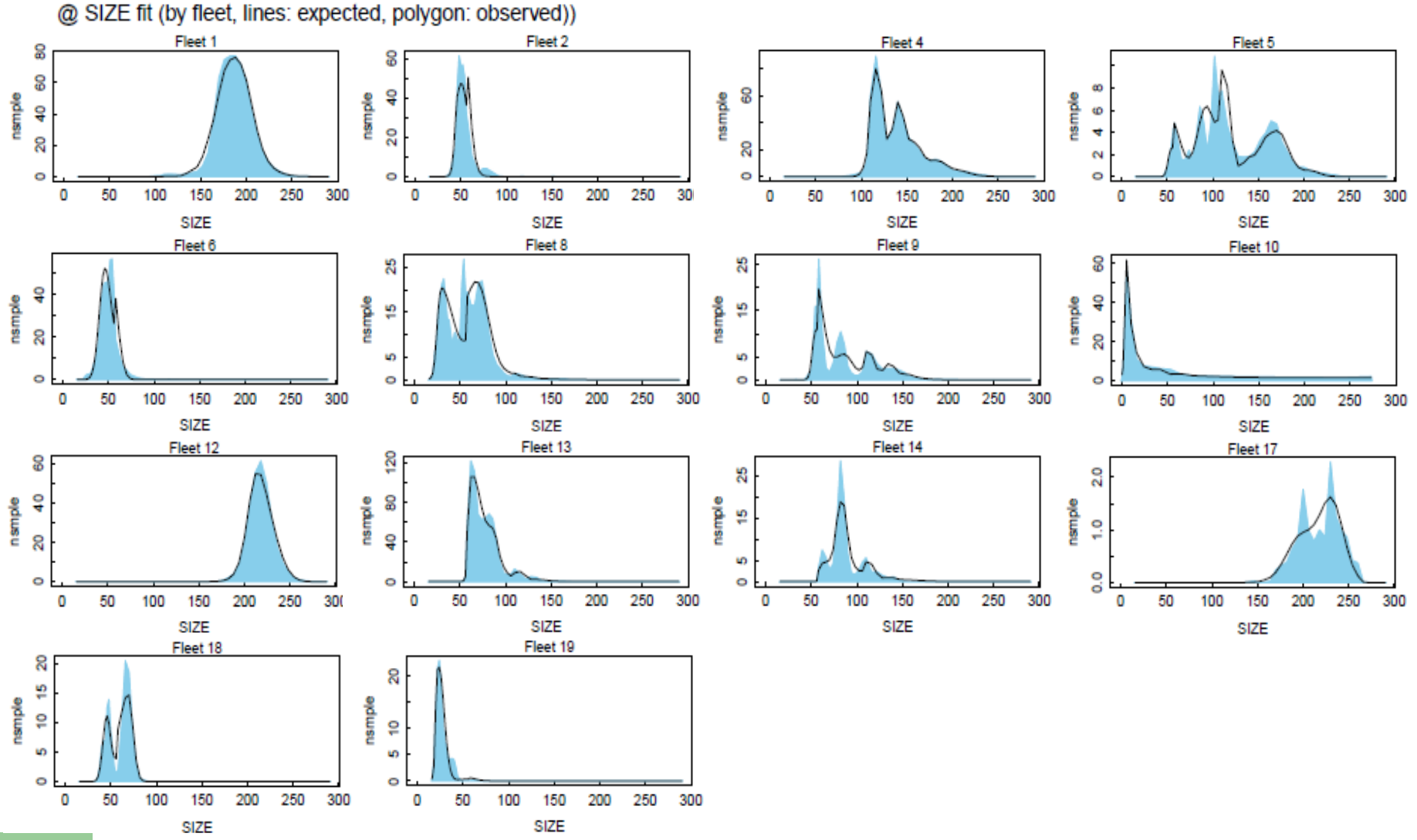
Data and Assumptions

- **Catch**
  - **19 Fleets (1952-2014)**
- **Size composition**
  - **Raised to the total number of fish caught by size**
  - **6 purse seines, 3 longlines, 3 set-nets, 2 trolls.**
- **CPUE abundance indices**
  - **2 Fleets for large adult (Jpn and Twn longlines)**
  - **1 Fleet for age-0 fish (Jpn troll)**

Catch By Fisheries

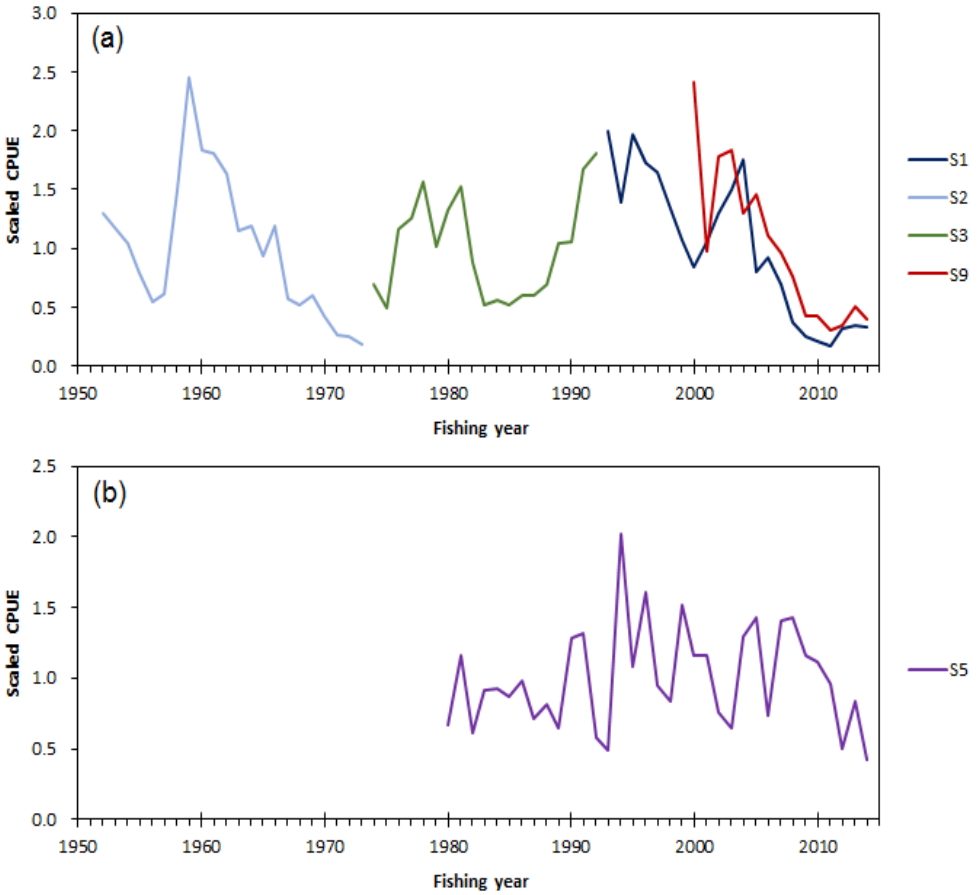


Size Compositions



CPUEs

Survey#	Fisheries	Duration	Standardization
S1	Japanese Longline	1993-2014	ZINB
S2		1952-1973	GLM(LN)
S3		1974-1992	GLM(LN)
S5	Troll	1980-2014	GLM(LN)
S9	Taiwanese Longline (S)	2000-2014	GLMM



a. Longline CPUEs

- Large adult (age 7+)

b. Troll CPUE

- Mainly age-0 fish

Population Dynamics Assumptions

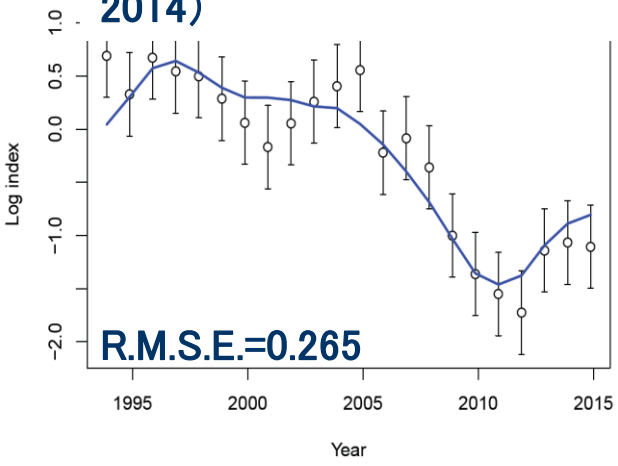
- Natural mortality (declining with age)
  - Age 0: 1.6; Age 1: 0.386; Age 2+: 0.25
- Maturity
  - Age 3: 20%; Age 4: 50%; Age 5+: 100%
- Growth, Length-Weight relationship
  - Von Bertalanffy growth function estimated externally
- Stock-Recruitment (S-R) Relationship
  - Beverton-Holt Relationship（h=0.999）
- Selectivity of Fisheries
  - Constant throughout the assessment period
  - Time varying selectivity

Results

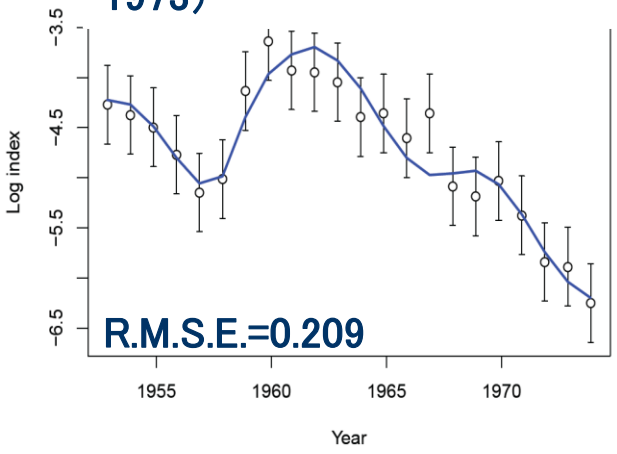
- Goodness of fit to:
  - CPUE based abundance indices
  - Size composition
- Biomass trend
- Recruitment trend
- Age-specific fishing mortality

Goodness of fit to CPUEs

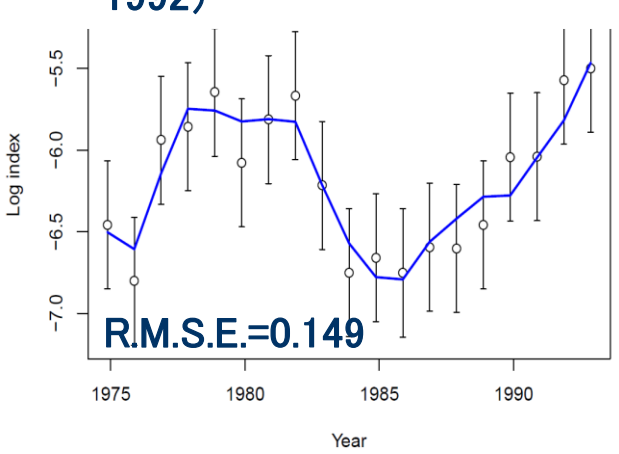
S1: Jpn Longline (1993-2014)



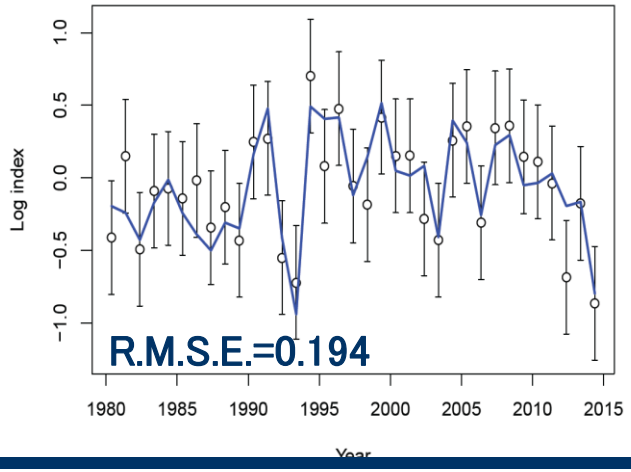
S2: Jpn Longline (1952-1973)



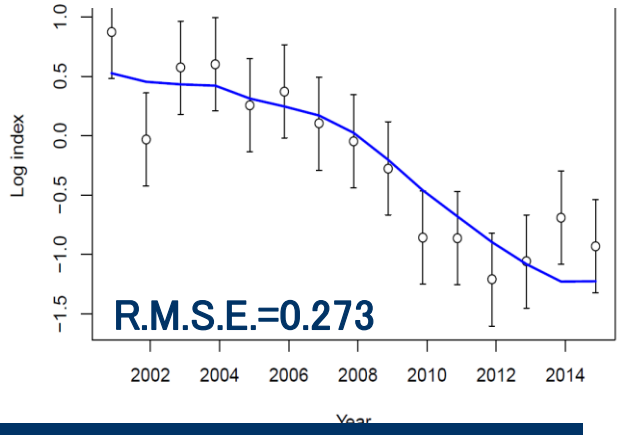
S3: Jpn Longline (1974-1992)



S5: Jpn Troll (1980-2014)



S9: Twn Longline (2000-2014)

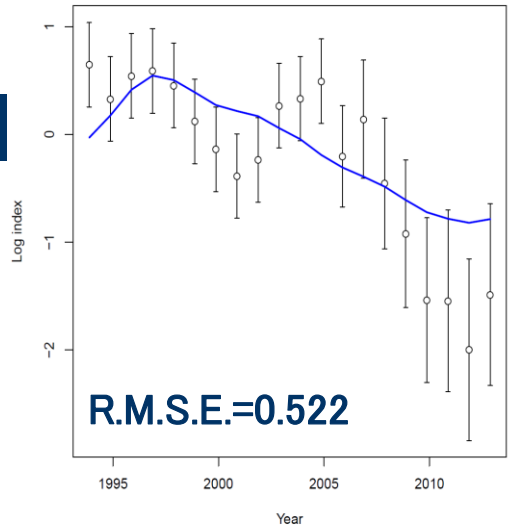


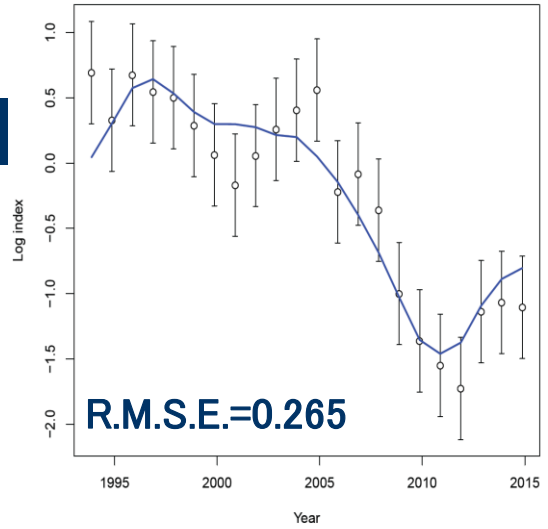
Comparison of Model Fits

2014 Stock Assessment

2016 Stock Assessment

S1: Jpn Longline (1993–2014)





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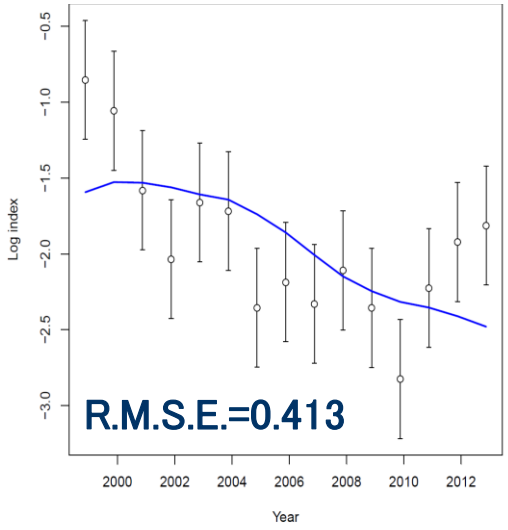
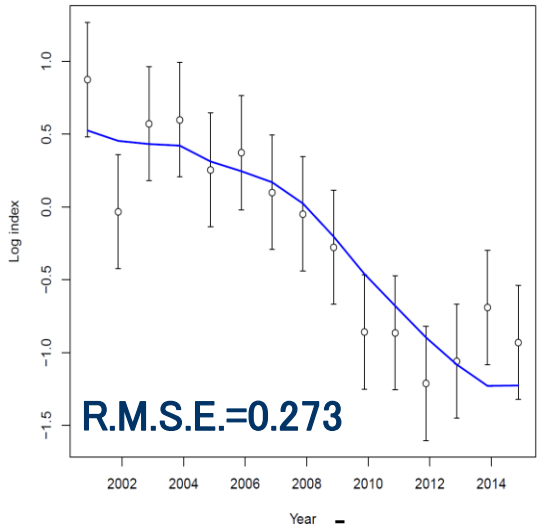
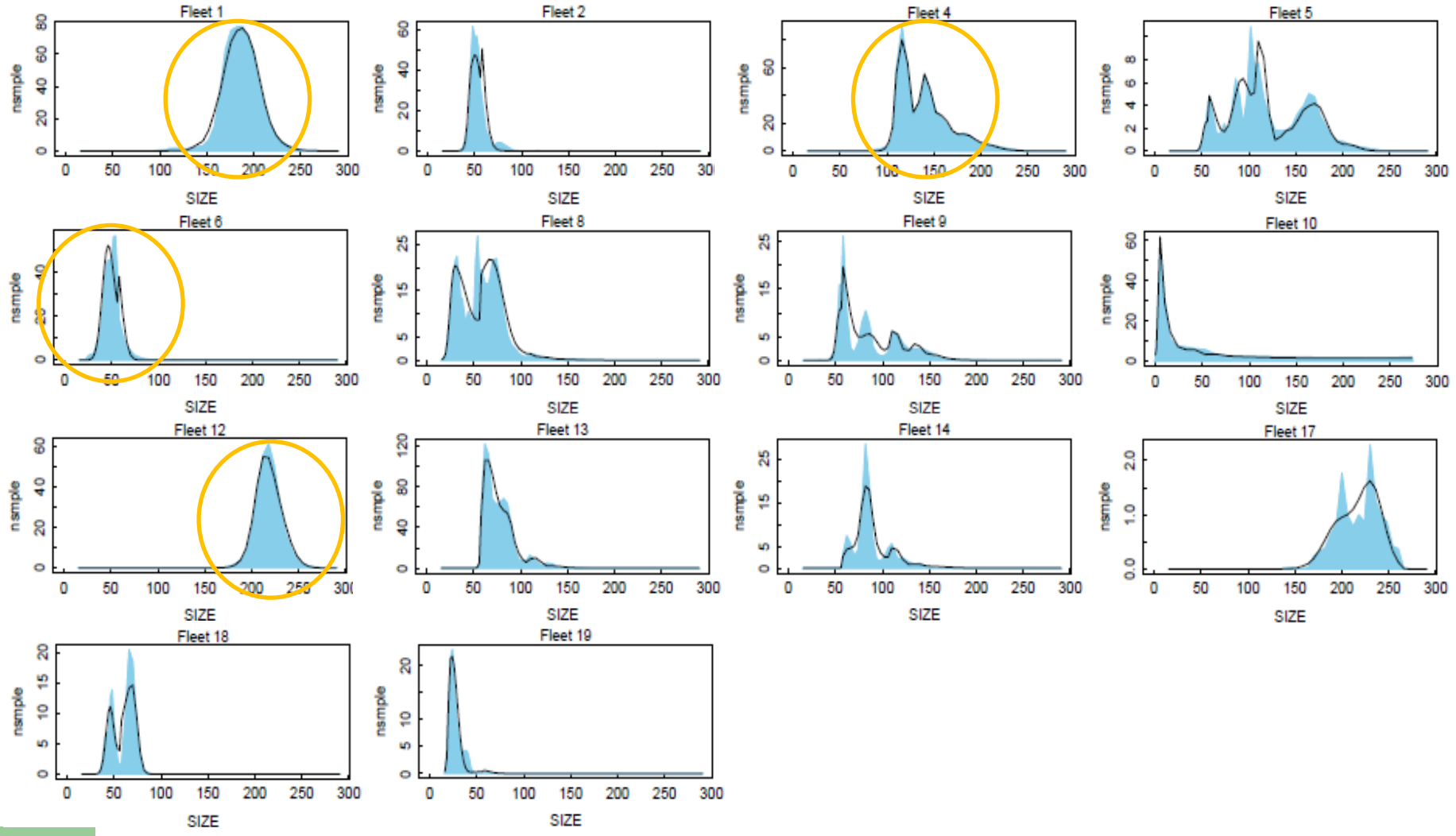


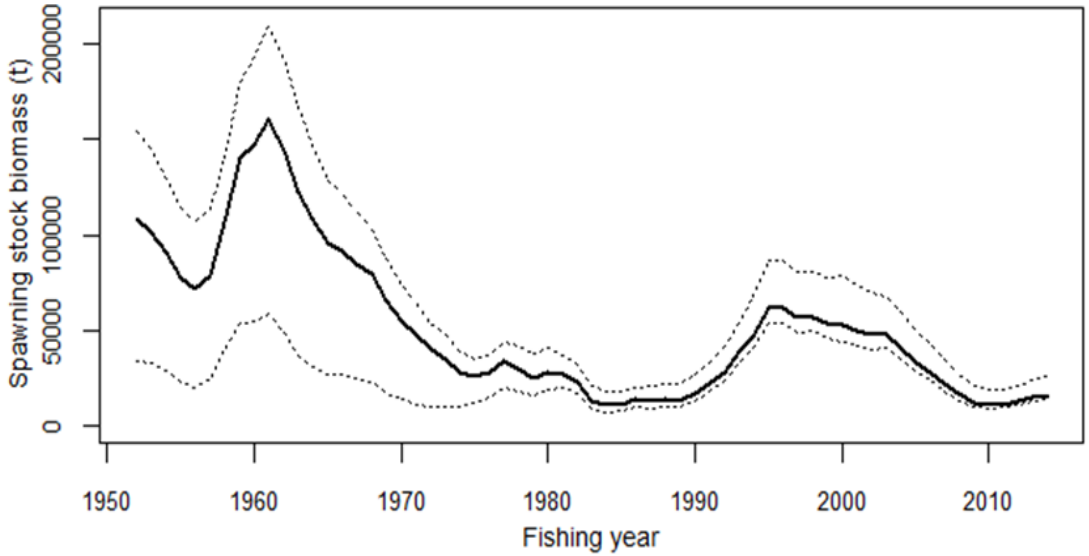


Average fits to size composition data



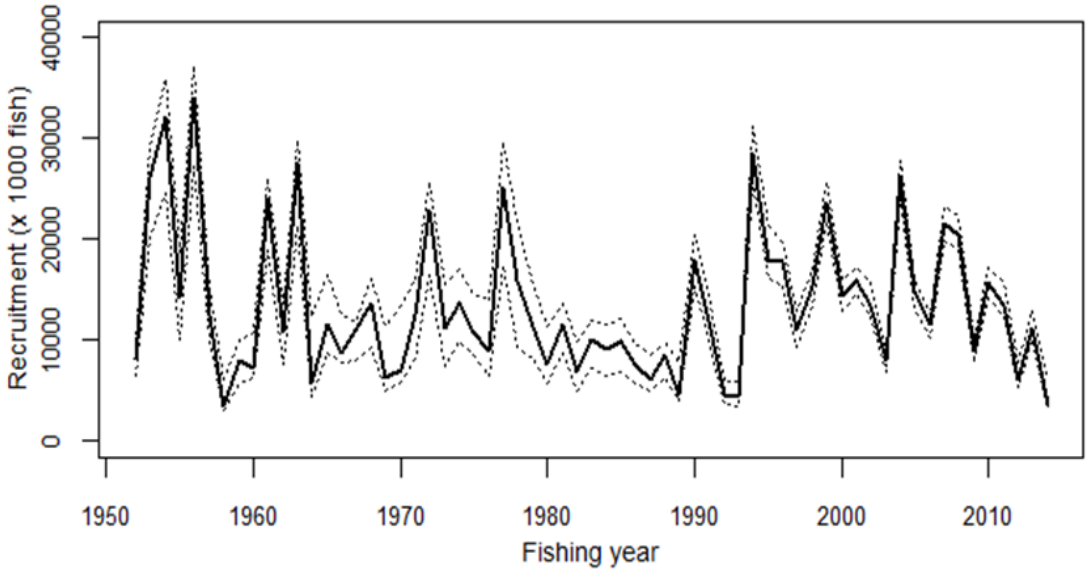
Spawning stock biomass

- Fluctuated ranging from 160,000 tons (1961) to 11,000 tons (1984).
- Declined from the second highest level of about 62,000 tons at 1996 to 12,000 tons at 2010.
- The decline appears to have ceased since 2010, and showed a tendency of slight increase.
- Terminal (2014) SSB was estimated to be 17,000 tons (2.6% SSB_0).



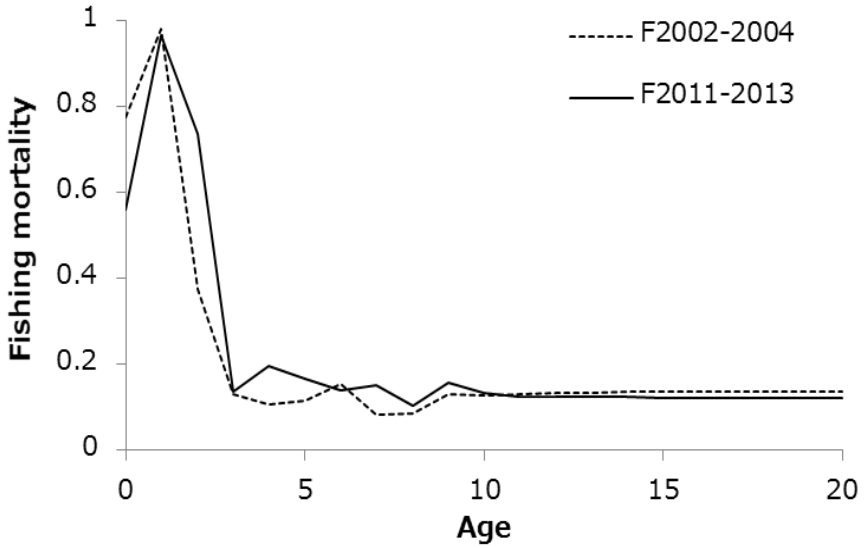
Recruitment

- Highly fluctuated with an average of 13.4 million fish.
- Recent strong cohorts occurred in 1994, 1999, 2004, and 2007.
- A low recruitment was estimated in the terminal year.
- The last 5 year's average might be below the historical average.



Fishing Mortality (F)

- Throughout the stock assessment period, average fishing mortality for age 0-2 juveniles was higher than that for age 3+ .
- Most age-specific F for intermediate ages (2-10 years) in recent years (2011-2013) are above the 2002-2004 F while those for age 0 as well as ages 11 and above are lower.



Reference Points

- No limit/target reference points have been established for the PBF stock under the auspices of the WCPFC and IATTC
- 2011-2013 F exceeds the all calculated biological reference points except for F_{MED} and F_{loss}
- Fishing mortality has decreased slightly in recent years

Year	F_{max}	$F_{0.1}$	F_{med}	F_{loss}	$F_{10\%}$	$F_{20\%}$	Estiamted SSB for terminal year of each reference period	Depletion ratio for terminal year of each reference period
2002-2004	1.86	2.59	1.09	0.80	1.31	1.89	41,069	0.064
2009-2011	1.99	2.78	1.17	0.85	1.41	2.03	11,860	0.018
2011-2013	1.63	2.28	0.96	0.70	1.15	1.66	15,703	0.024

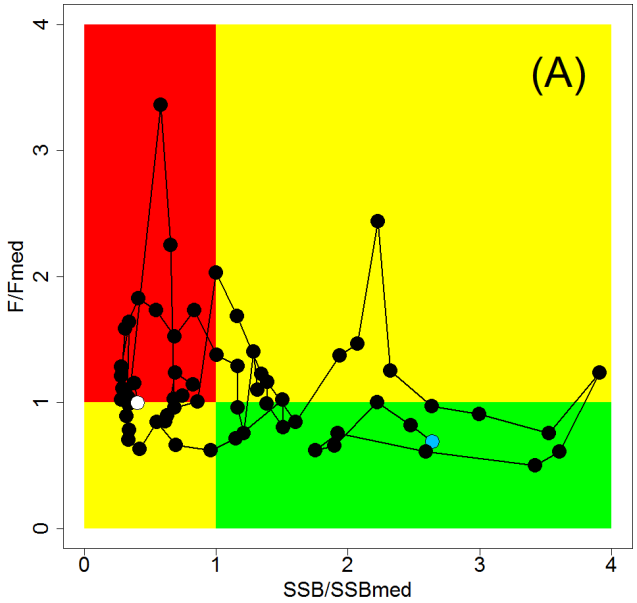
Stock Status and Conservation Advice

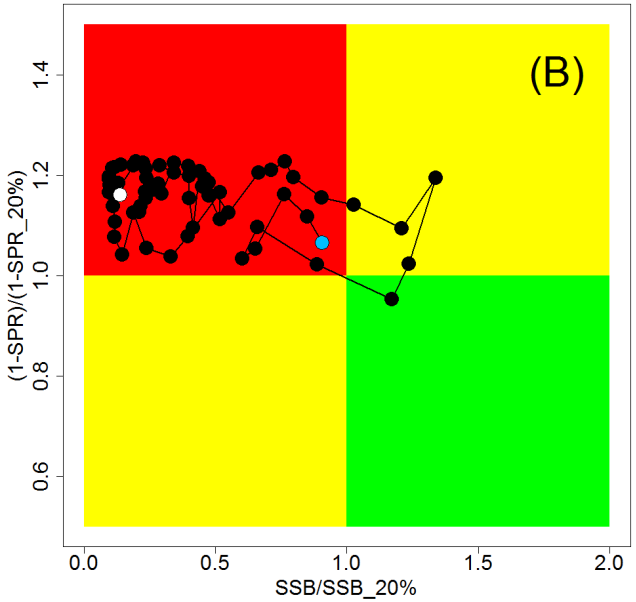
Pacific Bluefin Tuna - Stock Status

- Although no limit reference points have been established for the PBF stock under the auspices of the WCPFC and IATTC, the $F_{2011\text{-}2013}$ exceeds all calculated biological reference points except for F_{MED} and F_{LOSS} despite slight reductions to F in recent years
- The ratio of SSB in 2014 relative to the theoretical unfished SSB ($SSB^{2014}/SSB_{F=0}$, the depletion ratio) is 2.6% and $SSB_{2012}/SSB_{F=0}$ is 2.1% indicating a slight increase from 2012 to 2014

Stock Status and Conservation Advice

Pacific Bluefin Tuna - Stock Status

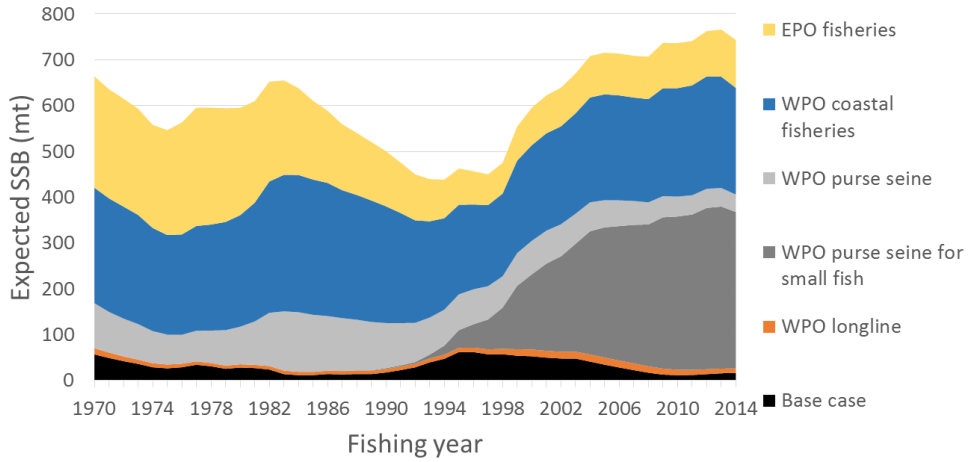




Stock Status and Conservation Advice

Fishery Impact

- Historically, the WPO coastal fisheries group has had the greatest impact on the PBF stock.
- Since about the early 1990s the WPO purse seine fleets, in particular those targeting small fish, has increased its impact.
- The impact of the EPO fishery was large before the mid-1980s, thereafter decreasing significantly.



Stock Status and Conservation Advice

Pacific Bluefin Tuna - Conservation Advice: Projection Scenarios (11 scenarios)

- Same with the last assessment (Scenario 1)
- Approximation of the 'WCPFC CMM 2015-04' and 'IATTC Resolution C-14-06' (Scenario 2)
- Stricter Catch limit (Scenario 5-10)
  - 10/20 % reduction of catch limit for small fish/large fish/all sized fish.
- Different definition of the threshold of the small and large fish.
  - 50 kg/80kg (Scenario 3-4)
- Status Quo (Scenario 11)
  - Recent Fishing mortality (F2011-2013) and Current catch limit.

Stock Status and Conservation Advice

Pacific Bluefin Tuna - Conservation Advice

- Projection using the base-case model under several harvest, recruitment and time schedules were conducted. Under all examined scenarios the initial goal of WCPFC, rebuilding to SSB_{MED} by 2024 with at least 60% probability, is reached.
- Given the low SSB, the uncertainty in future recruitment, and the influence of recruitment has on stock biomass, monitoring recruitment and SSB should be strengthened so that the recruitment trends can be understood in a timely manner.

Stock Status and Conservation Advice

Pacific Bluefin Tuna - Conservation Advice

- The current calculation of SSB_{MED} in the projection incorporates the most recent estimates of SSB and unless a fixed period of years is specified to calculate SSB_{MED}, its calculation could be influenced by future trends in spawning biomass. The ISC recommends defining SSB_{MED} as the median point estimate for a fixed period of time, either, 1952-2012 or 1952-2014.
- Absolute values should not be used for the initial rebuilding target, as the calculated values of reference points would change from assessment to assessment.

Stock Status and Conservation Advice

Pacific Bluefin Tuna - Conservation Advice

- **The probability of achieving the WCPFC's initial target (SSB_{MED} by 2024) would increase if more conservative management measures were implemented.**
- **WCPFC CMM 2015-04 specifies that catches of fish smaller than 30kg should be reduced. The weight threshold needs to be increased to 85kg (weight of age 5) if the intent is to reduce catches on all juveniles according to the maturity ogive in the assessment.**

THANKS!