Stock Assessment of Pacific bluefin tuna

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

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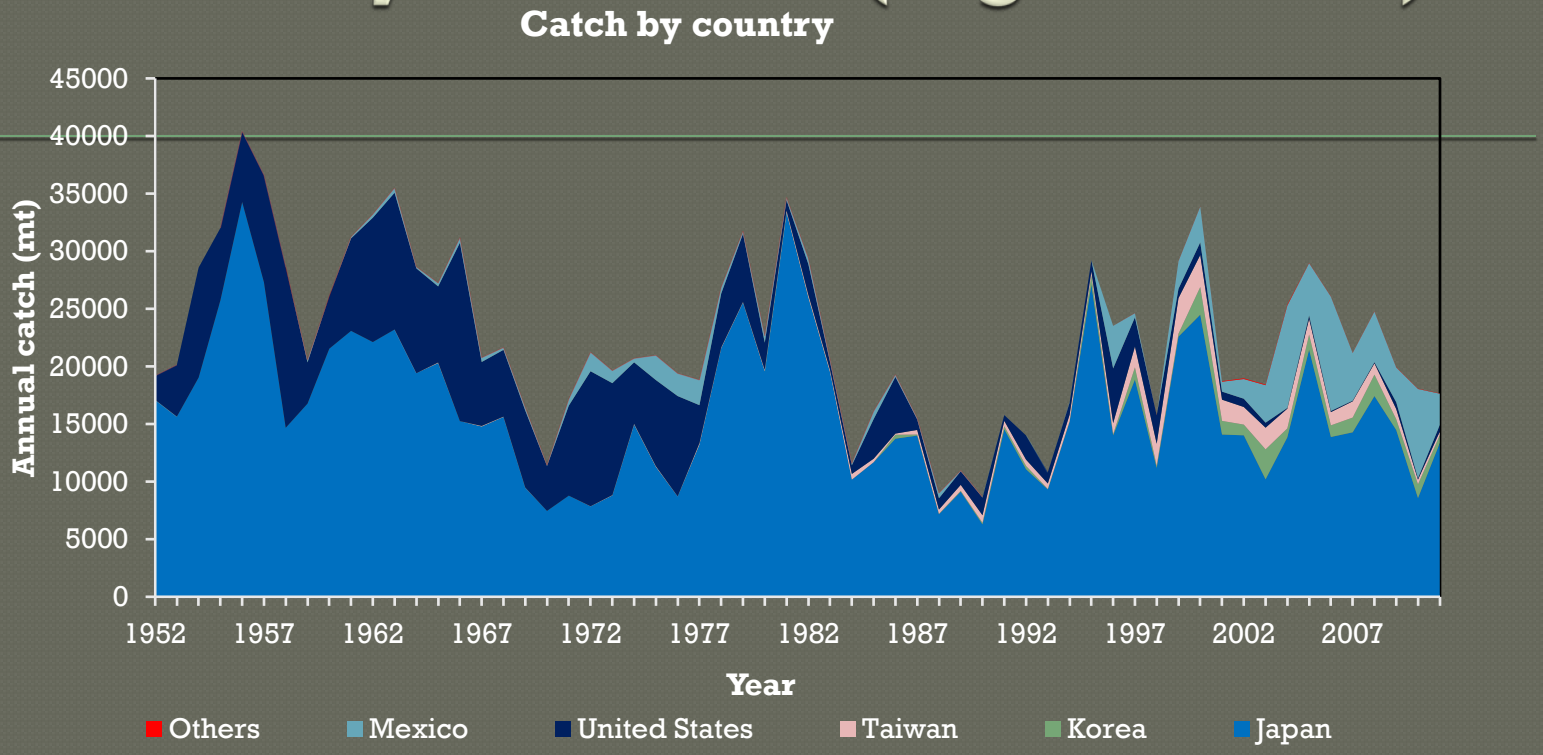
Back ground

- Full new stock assessment since 2010
- Based on discussions at May-June ISC PBF stock assessment workshop
- Concluded in Nov. 2011 ISC PBF WS
- Used data from 1952 to 2010 (in fishing year starting from July 1st)

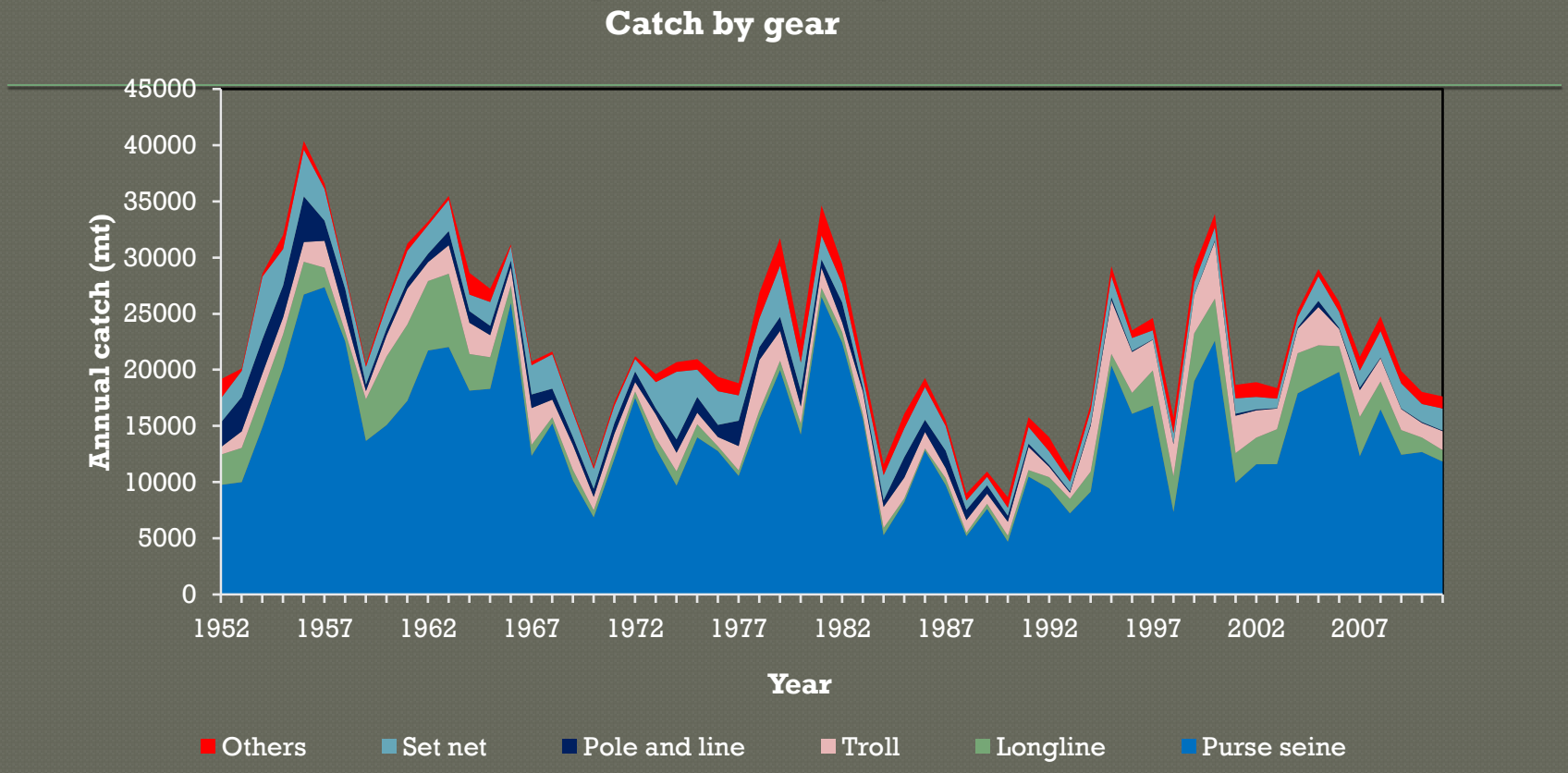
Catch

PBF catch by countries(Figure Ex-1)



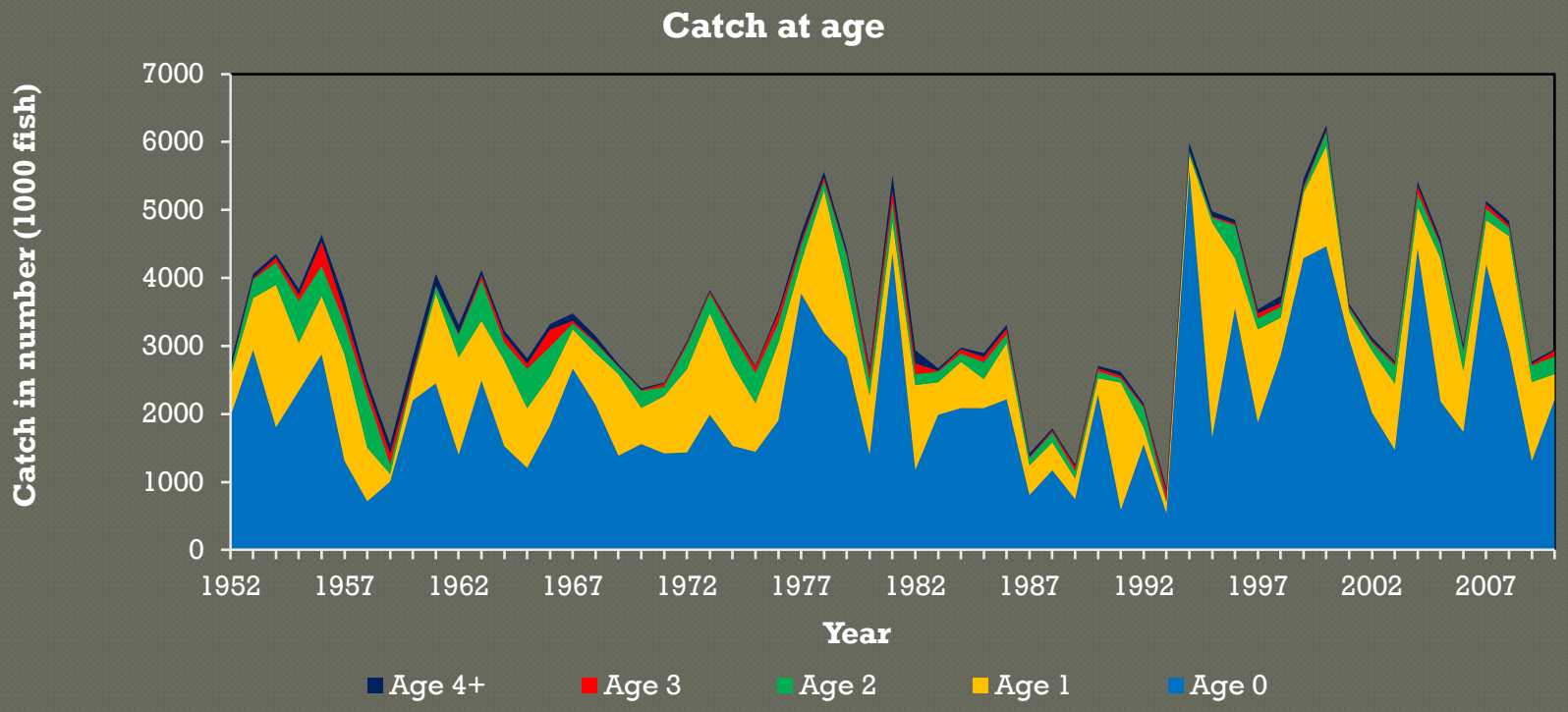
- Historical catches have fluctuated widely during the assessment period 1952-2011 (Figure Ex-1)
- Catch in 2011 was 17,651 ton (18,057 ton in 2010,20346 ton in 07-11)
- Japan : 13,324 ton (8,524 ton in 2010,13,607 ton in 07-11)
- Mexico: 2,730 ton (7,745 ton in 2010,4,410 ton in 07-11)

PBF catch by gear (Figure Ex-1 cont'd)



- Purse Seine:1,1830 ton in 2011 (12,863 ton in 2010)
- Longline : 1,005 ton in 2011 (1,287 ton in 2010)

Catch at age



- Since 1952, the majority of catch has been of juveniles with the catch of age-0 fish increasing in the 1990's

Data and model for stock assessment

- Quarterly catch
- Quarterly size composition, if available
- 1952-2010
- 14 fleets
- standardized CPUEs
  - Japanese LL (Adults)
  - Taiwanese LL (Adults)
  - Japanese troll (age 0)

- Stock Synthesis v3.23b
  - fit to the input data in a likelihood-based statistical framework.
  - MLEs of model parameters, derived outputs, and their variances were used to characterize stock status and to develop stock projections.

More on model setting

- Single spatial area including WCPO and EPO
- Maximum age =20
- Steepness=0.999
  - Smaller h is difficult to be explained by data
  - Monte Carlo simulation from life history parameter (Mangel' method , Iwata 2012) supported

Biological parameters for stock assessment

GROWTH CURVE

- Externally input VBGF determined from otolith with adjustment of observed length at age 0 from length comps
- L1=21.5cm at age=0
- L2=109.194 at age=3
- And k=0.157
- (Linf=254.4)
- CV_young : estimated
- CV_old=0.05:fixed

NATURAL MORTALITY

- Age specific
- Age-0 M=1.6
  - Determined from tag recapture data
- Age-1 M=0.38 mimics SBT's M (determined from tagging) of same size
- Age-2 and older M =0.25 from life history consideration

Uncertainties recognized by the WG

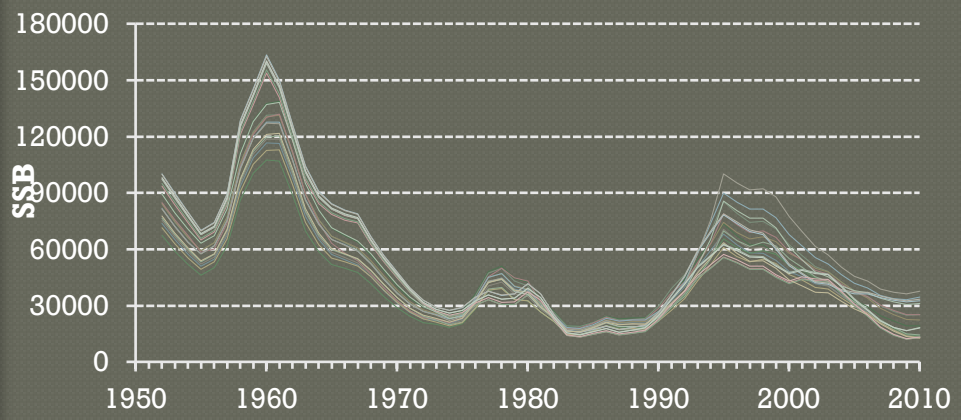
- Standardized CPUE series
- Weighting of data
- Methods used to estimate selectivity patterns.

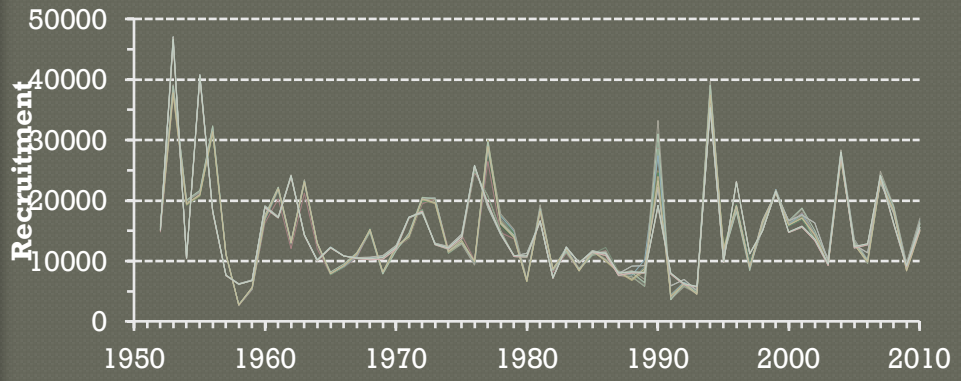
- The influences on stock dynamics were considered using
  - alternative models
  - characterized by 20 trial runs.
  - The trial runs are further discussed under the "Status of Stock" and listed in Table Ex-1.

Status of Stock

- Extensive model runs were conducted using alternative data weightings and structural assumptions.
- No single model provided a good fit to all sources of data which were considered reliable,

Status of stock; A general agreement among models

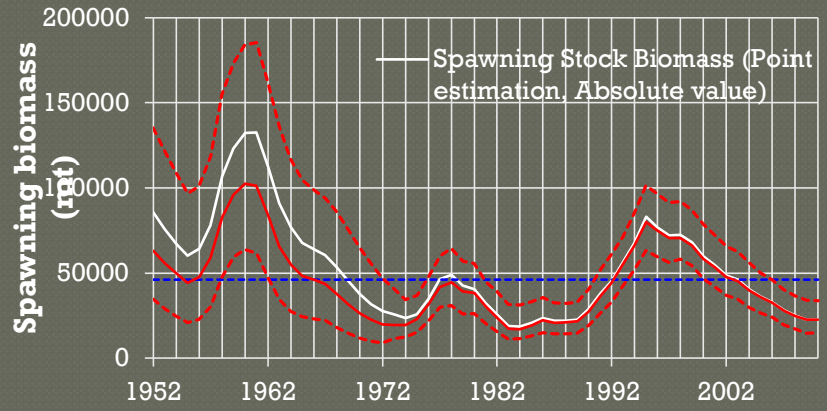


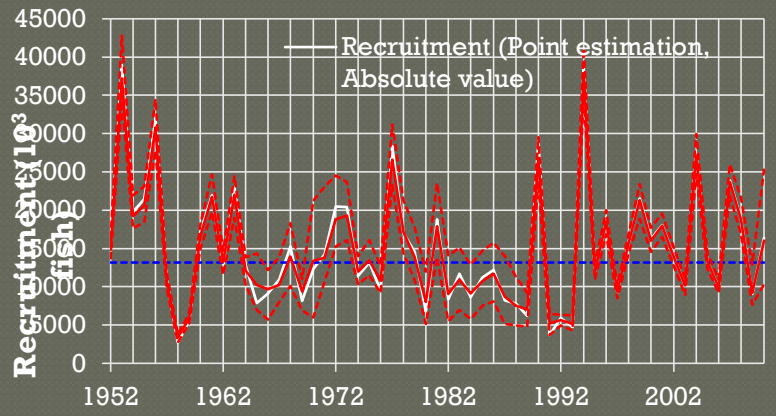


- large long-term fluctuations in SSB
- A highly depleted stock that has been declining for over a decade.
- Current biomass are at or near the lowest level
- however there is no evidence of reduced recruitment (Figure Ex-3).

The Base case Run

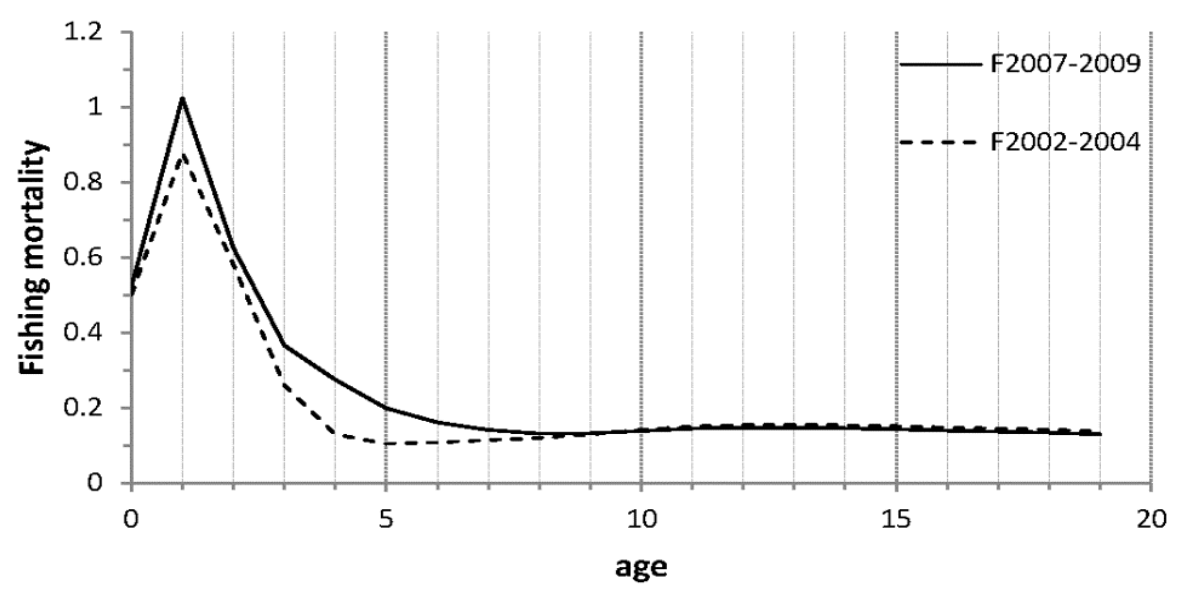
- The WG agreed to use a Representative Run to determine stock status and provide management advice





- the current(2010) stock biomass (age 0+) as well as SSB
  - 53,216 mt and 22,606 mt
- The recent 5-year average level of recruitment (2006-2010)
  - 15.6 million fish.

Fishing mortalities



- F in 2007-2009 relative to 2002-2004 (the base period for the current WCPFC CMM 2010-04) show 4,17, 8, 41 and 10% increases for ages 0,1,2,3 and 4+

Biological Reference Points

- No target or limit reference points have been established for the Pacific bluefin tuna stock under the auspices of the WCPFC and IATTC
- the current F (average 2007-2009) is above all reasonable target and limit BRPs

	F_{MAX}	$F_{0.1}$	F_{MED}	F_{loss}	$F_{10\%}$	$F_{20\%}$	$F_{30\%}$	$F_{40\%}$
F_{0204}	0.57	0.40	0.91	1.19	0.85	0.58	0.43	0.33
F_{0709}	0.48	0.34	0.73	0.95	0.68	0.47	0.35	0.26

Future projection scenarios

- 6000 stochastic simulations by 2030 with four harvesting scenarios
- Each simulation starts from 2010
- F at age and N at age in 2010 is taken from 300 parametric bootstrap SS runs
- For each bootstrap replicate, 20 simulations conducted with resampled recruitment in 1952-2009

Harvesting scenarios

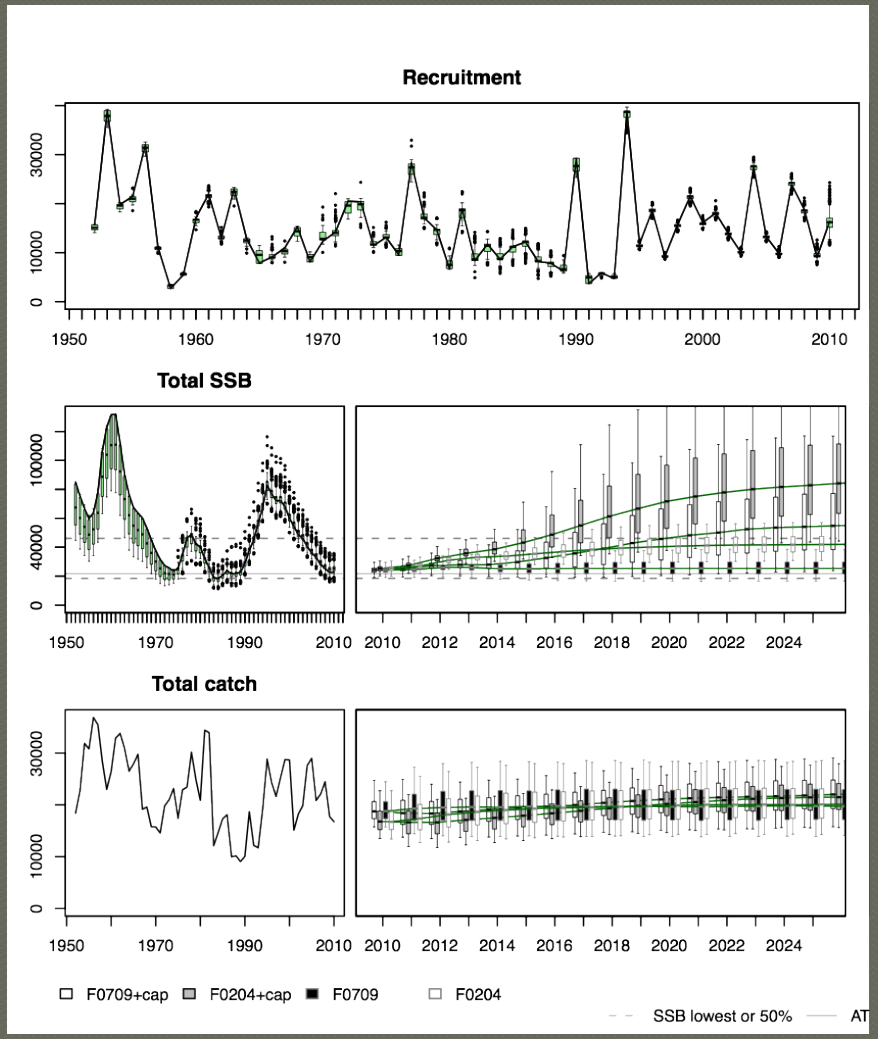
1. Constant F at current F ($F_{2007\text{-}2009}$);
2. Constant F at $F_{2002\text{-}2004}$;
3. Constant F at $F_{2007\text{-}2009}$ and setting catch limitations on purse seine fleets in the EPO and WPO
4. Constant F at F2002-2004 and setting catch limitations on purse seine fleets in the EPO and WPO.

Remarks on harvesting scenarios

- Current F at $F_{2007\text{-}2009}$ corresponds to the fishing before management of PBF started in EPO(2012-) and WCPO (2011-)
- Constant F at $F_{2002\text{-}2004}$ corresponds to ISC's conservation advise
- Constant F at $F_{2002\text{-}2004}$ + catch limitations of purse seine in EPO and WPO approximately corresponds to the management in EPO and WPO

Projections results

1. Fishing before the start of management is not expected to increase SSB
2. $F_{2002\text{-}2004}$ +PS catch limits may increase SSB about 4 times with large variations
3. Future yield will have large fluctuations



Summary from projections

1) The median SSB is not expected to recover substantially in $F_{2007\text{-}2009}$
2) The median SSB is expected to recover to approximately 41,000 mt by 2030 in $F_{2002\text{-}2004}$
3) The median SSB is expected to recover to approximately 50,000 mt by 2030 in $F_{2007\text{-}2009}$ with catch limits
4) The median SSB is expected to recover to approximately 83,000 mt by 2030 in $F_{2002\text{-}2004}$ with catch limits

Findings from projections

- Implementation of catch limits is particularly effective in increasing future SSB when strong recruitment occurs.
- If recruitment is less favorable, a reduction of F is more effective than catch limits to reduce the risk of the stock declining (see table Ex-3).

ISC's Conservation Advise (1)

- The current (2010) PBF biomass level is near historically low biomass levels and experiencing high exploitation levels above all potential biological reference points (BRPs). Extending the status quo (2007-2009) fishing levels is unlikely to improve the stock condition.

ISC's Conservation Advise (2)

- Recently implemented WCPFC (entered into force in 2011) and IATTC (entered into force in 2012) conservation and management measures combined with additional Japanese voluntary domestic regulations aimed at reducing mortality, if properly implemented and enforced, are expected to contribute to the recovery of the stock.

ISC's Conservation Advise (3)

- Based on those findings, it should be noted that implementation of catch limits is particularly effective in increasing future SSB when strong recruitment occurs.
- It is also important to note that if recruitment is less favorable, a reduction of F could be more effective than catch limits to reduce the risk of the stock declining.

Works to be done

- Additional future projection runs with low future recruitment regime
- More harvesting scenarios