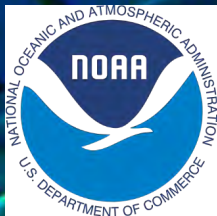


A management strategy evaluation framework to assess robustness of harvest guidelines for North Pacific albacore tuna to variable productivity and distribution

October 30, 2018 – PICES Annual Meeting, Yokohama, Japan

Desiree Tommasi, Barbara Muhling, Steven Teo, Gerard DiNardo

With thanks to the ISC ALBWG, Juan Valero, Huihua Lee, and all the stakeholders that participated in the NPALB MSE workshops



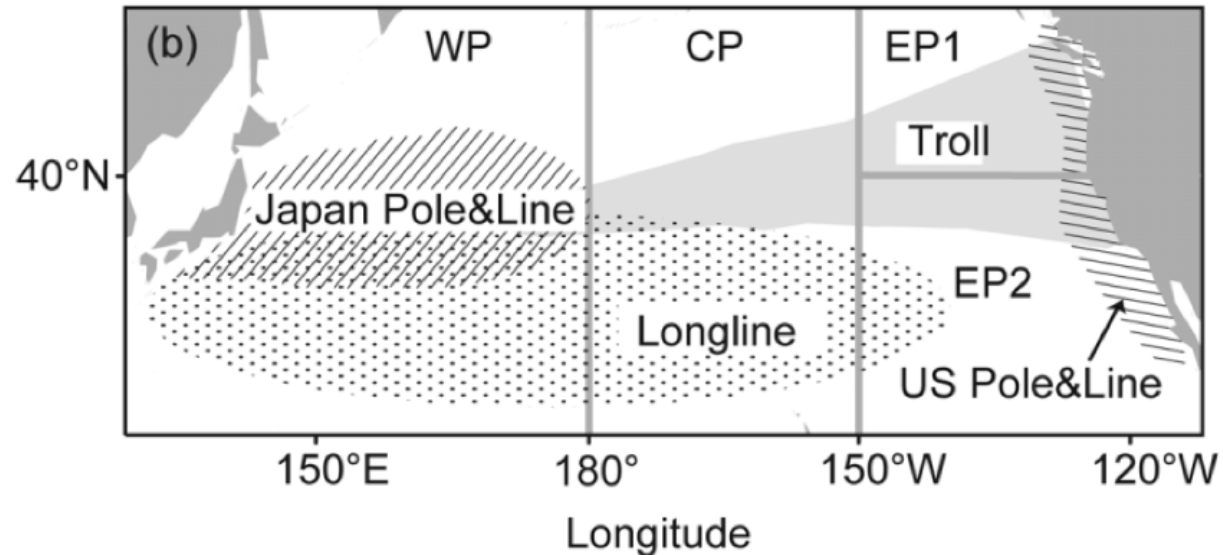
North Pacific Albacore Ecology

Highly migratory species whose habitat spans the entire North Pacific Ocean



North Pacific Albacore Fisheries

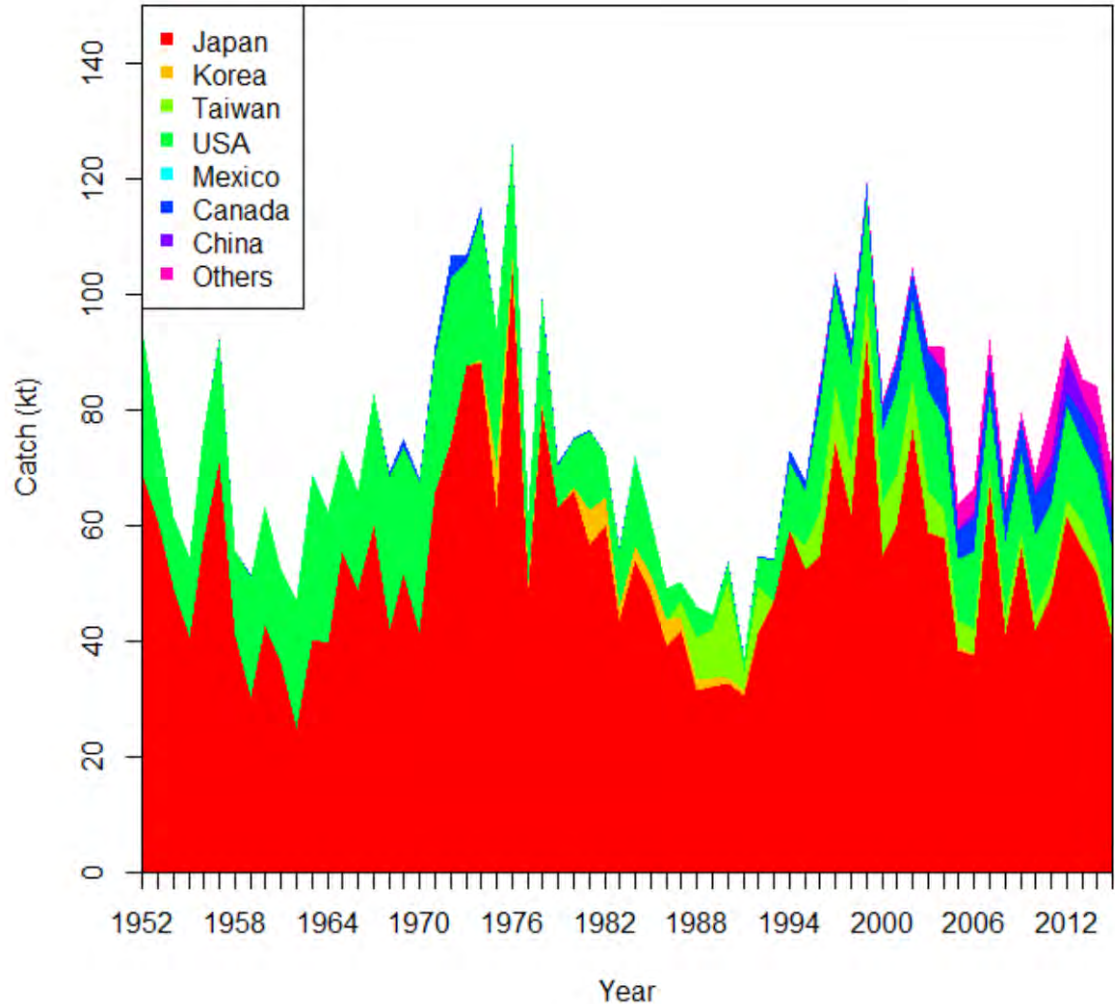
Fisheries include longline largely targeting adults and surface gears targeting juveniles



Ichinokawa et al. 2008, Canadian Journal of Fisheries and Aquatic Sciences

North Pacific Albacore Fisheries

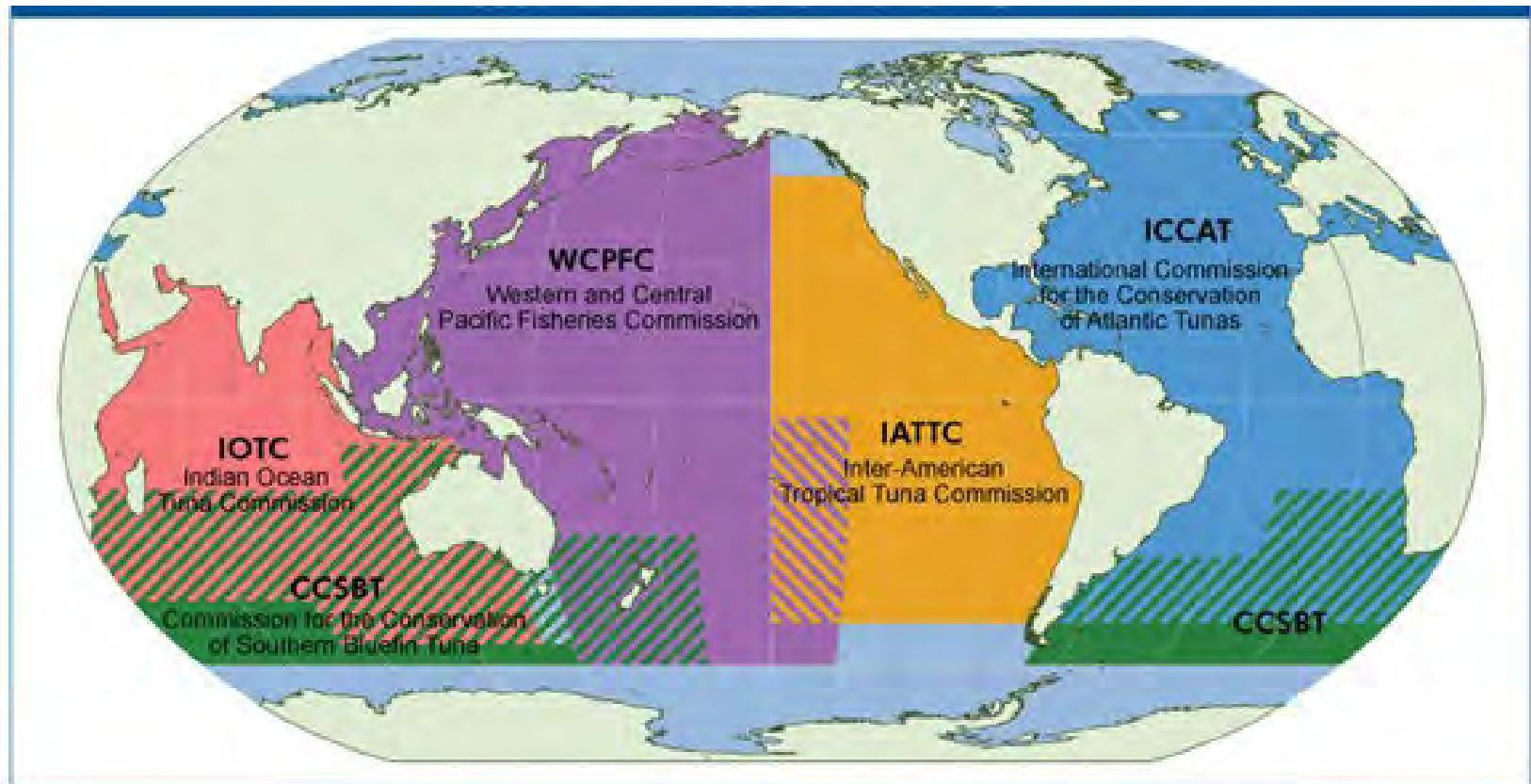
Majority of the catch occurs in the Western Pacific



*ISC 2017 NPALB
Stock Assessment*

North Pacific Albacore Management

Managed by two Regional Fisheries Management Organizations, WCPFC and IATTC



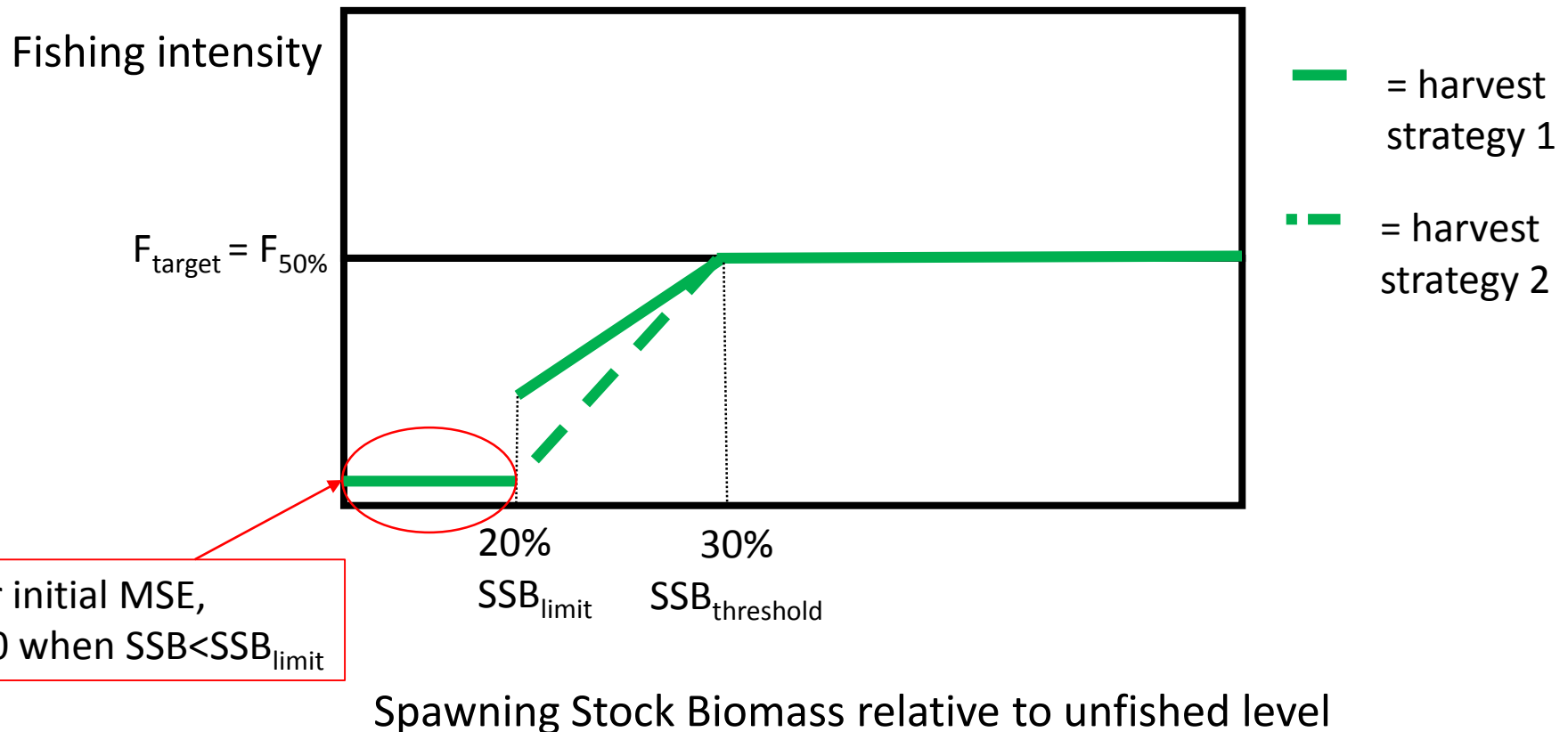
Management Strategy Evaluation (MSE)

“Use of simulation to evaluate the trade-offs achieved by alternative management strategies and to assess the consequences of uncertainty in achieving management goals”

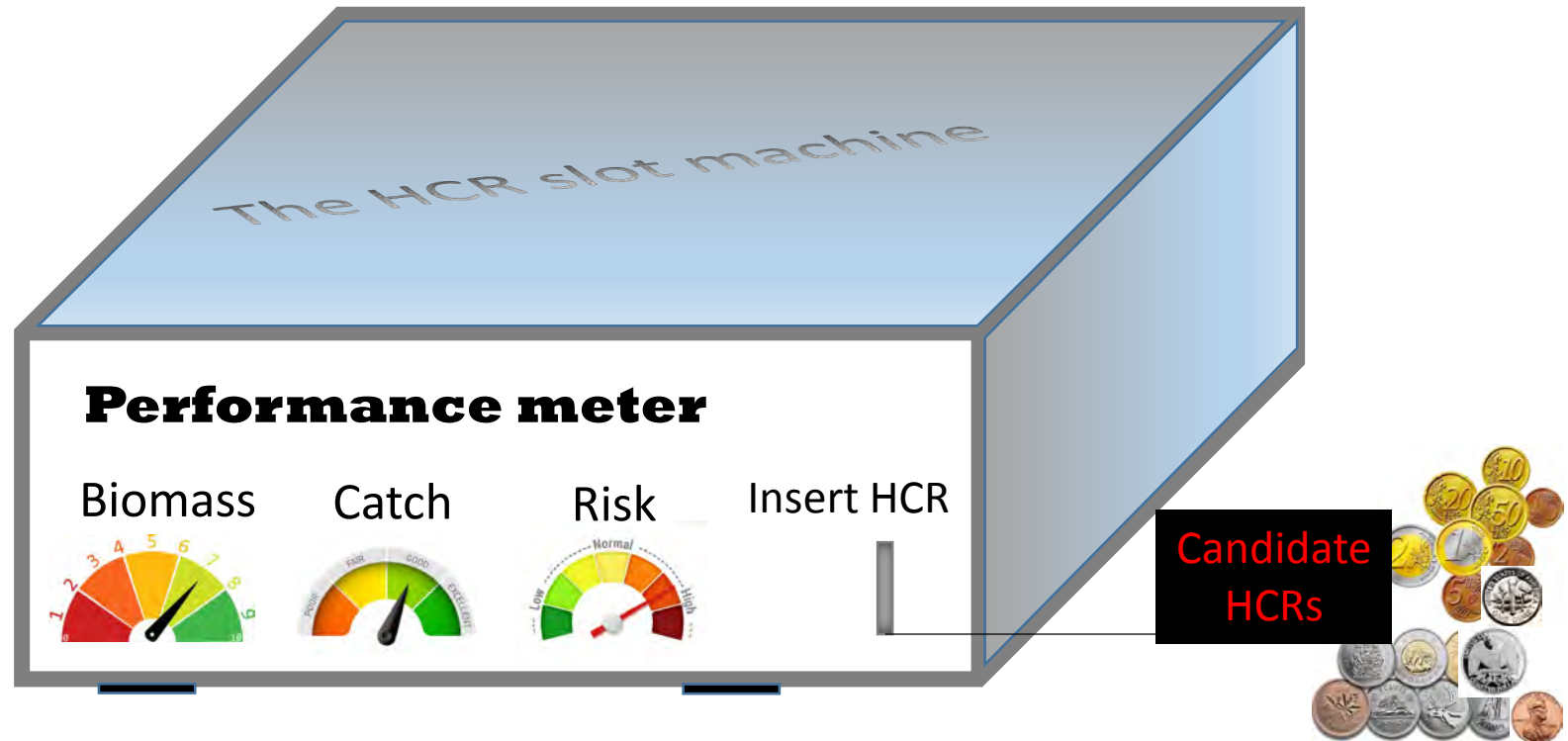
Punt et al. 2016, Fish and Fisheries

Example Harvest Strategies

Target, Limit, and Threshold Reference Points define the harvest control rule within each harvest strategy (i.e. shape)



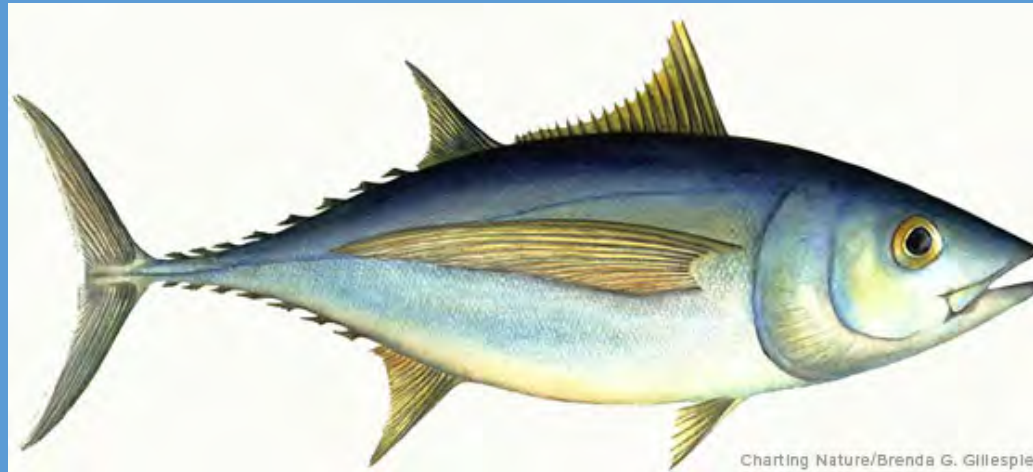
MSE = a harvest control rule (HCR) slot machine



Slide courtesy of Carsten Hvingel and Jacqueline Perry, Greenland Halibut MSE, NAFO RBMS Working Group

Goal of North Pacific Albacore MSE

Examine performance of **alternative management strategies** and **reference points** for North Pacific albacore given uncertainty



Management strategies to be tested developed together with stakeholders

1st ISC MSE WS (16-17 April 2015 at Yokohama, JAPAN)

- **71 participants:** fishery managers, stakeholders, NGOs, and scientists
- **Purpose:** to learn about and understand the MSE process; review the objectives, benefits, and requirements to implement an MSE; as well as recent progress made by tuna RFMOs towards adopting and implementing the MSE process

2nd ISC MSE WS (24-25 May 2016 at Yokohama, JAPAN)

- **24 participants:** fishery managers, stakeholders, NGOs, and scientists
- **Purpose:** to develop management objectives and performance indicators, based on input from managers, stakeholders and scientists

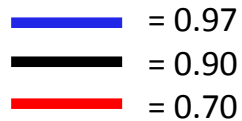
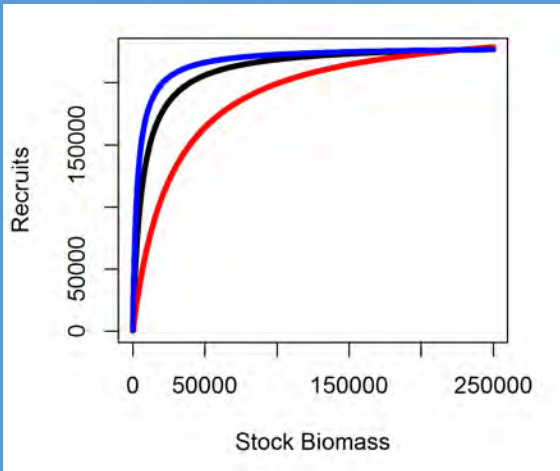
3rd ISC MSE WS (17-19 October 2017 at Vancouver, CANADA)

- **23 participants:** fishery managers, stakeholders, NGOs, and scientists
- **Purpose:** to identify acceptable level of risk for each management objective; and develop candidate reference points and harvest control rules for testing

Parameter Uncertainty – use an ensemble of operating models

Recruitment

Test a range of steepness values



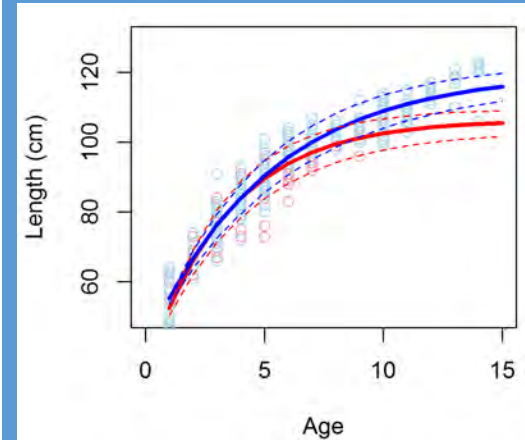
Natural Mortality

- Age and sex specific
- Test a range of values

| | Option 1 | | Option 2 | | Option 3 | |
|-----|----------|--------|----------|--------|----------|--------|
| Age | Male | Female | Male | Female | Male | Female |
| 0 | 1.01 | 1.01 | 1.84 | 1.84 | 1.36 | 1.36 |
| 1 | 0.42 | 0.42 | 0.76 | 0.76 | 0.56 | 0.56 |
| 2 | 0.33 | 0.33 | 0.61 | 0.61 | 0.45 | 0.45 |
| 3+ | 0.29 | 0.36 | 0.53 | 0.66 | 0.39 | 0.48 |

Growth

- Sex specific
- Test a range of values



Albacore MSE Framework

Catch is allocated to different fisheries using 1999-2015 catch ratios

Autocorrelated recruitment
Time-varying age selectivity
Different growth, mortality, steepness

Catch with implementation error

OPERATING MODELS

"True" Population dynamics

Data Generation

MANAGEMENT MODEL

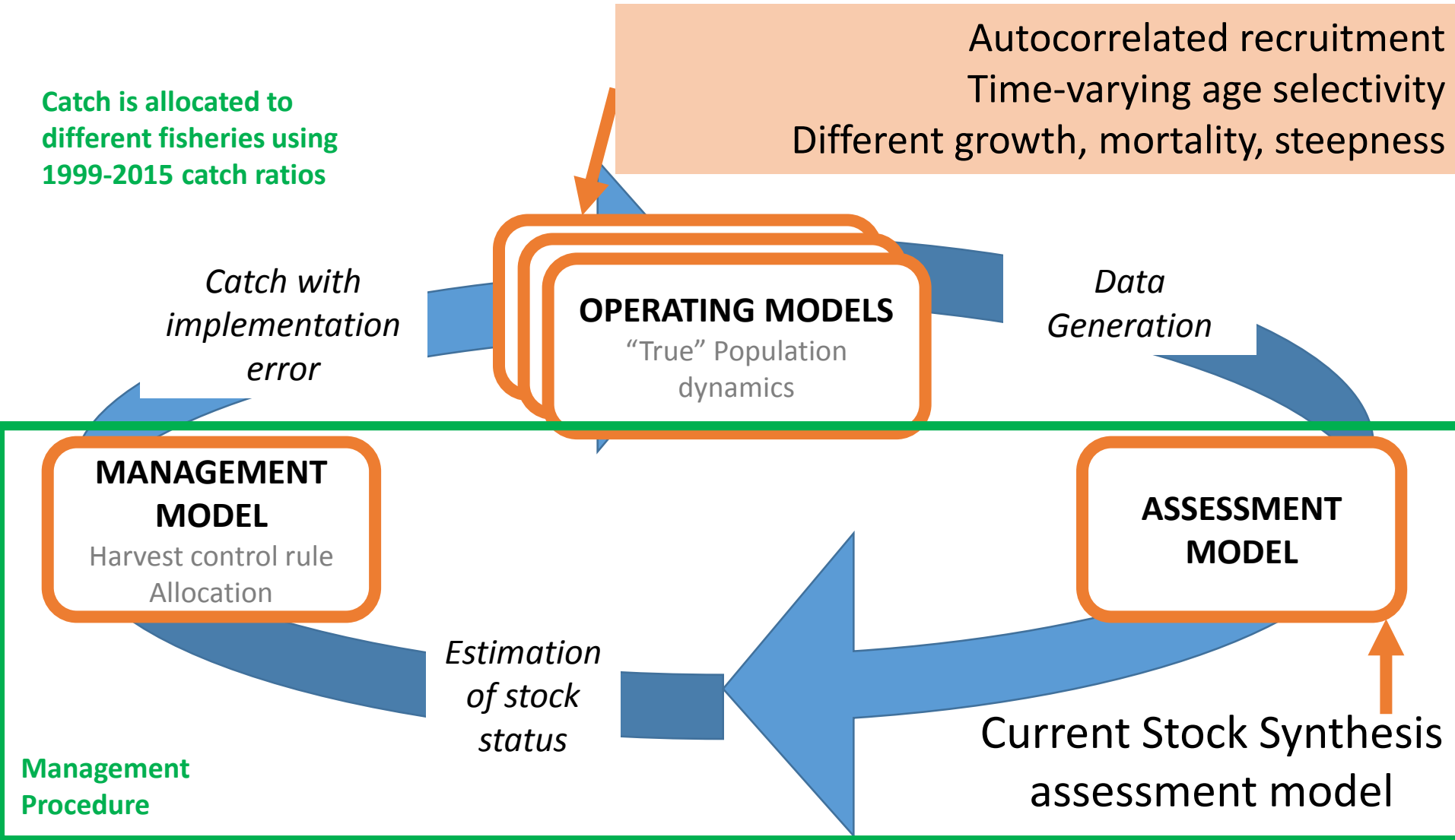
Harvest control rule
Allocation

ASSESSMENT MODEL

Estimation of stock status

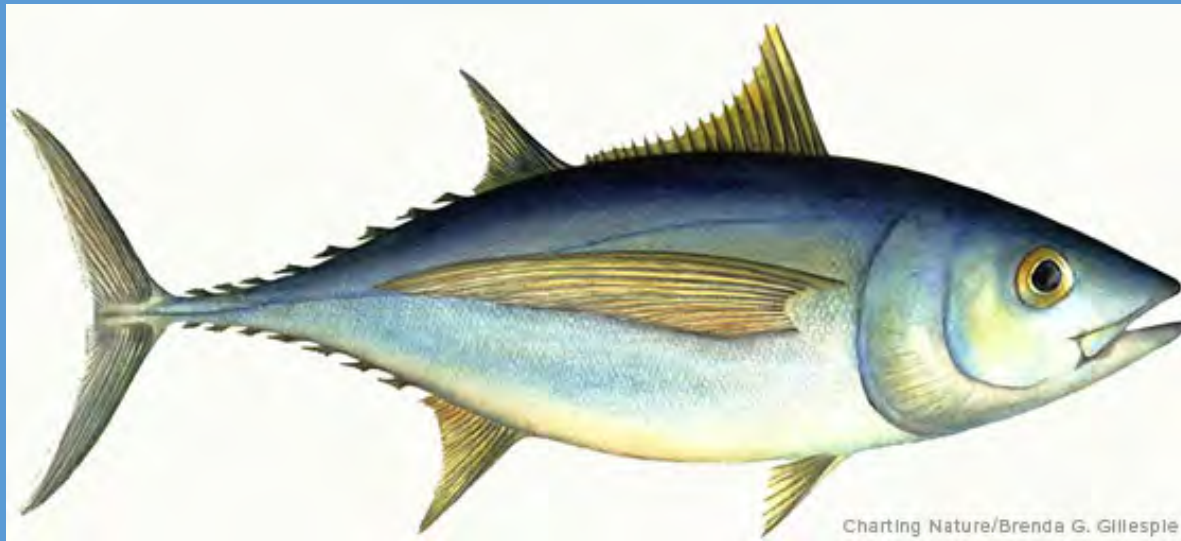
Current Stock Synthesis assessment model

Management Procedure

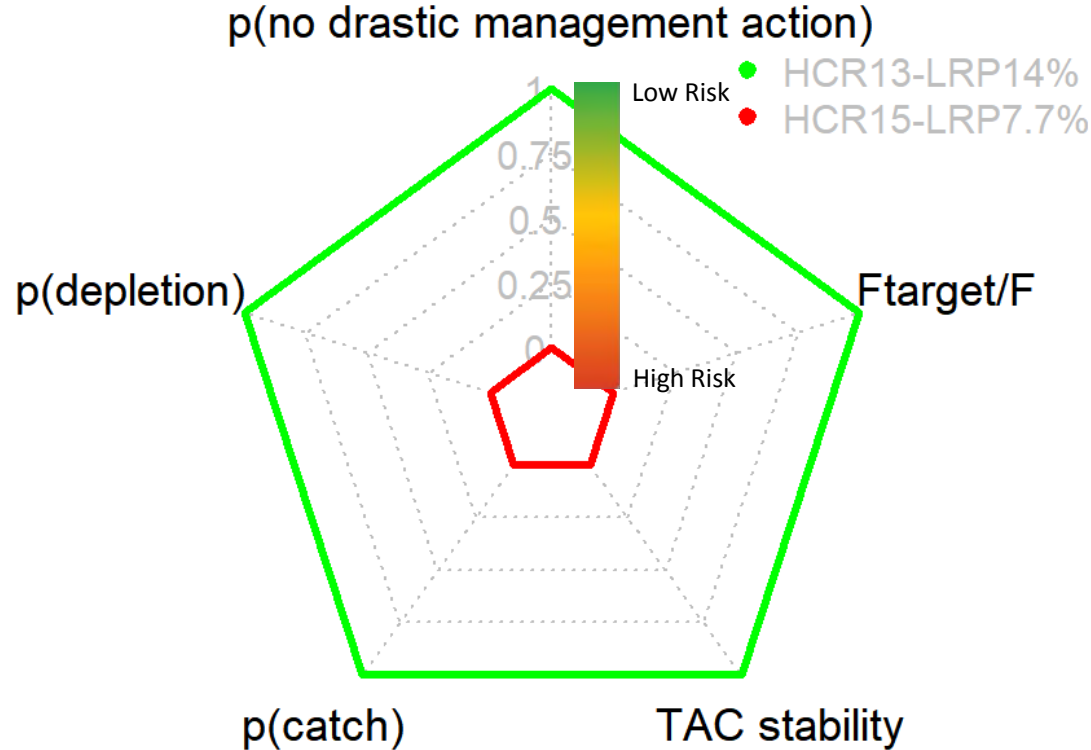


Goal of North Pacific Albacore MSE

Examine **performance** of alternative management strategies and target reference points for North Pacific albacore given uncertainty



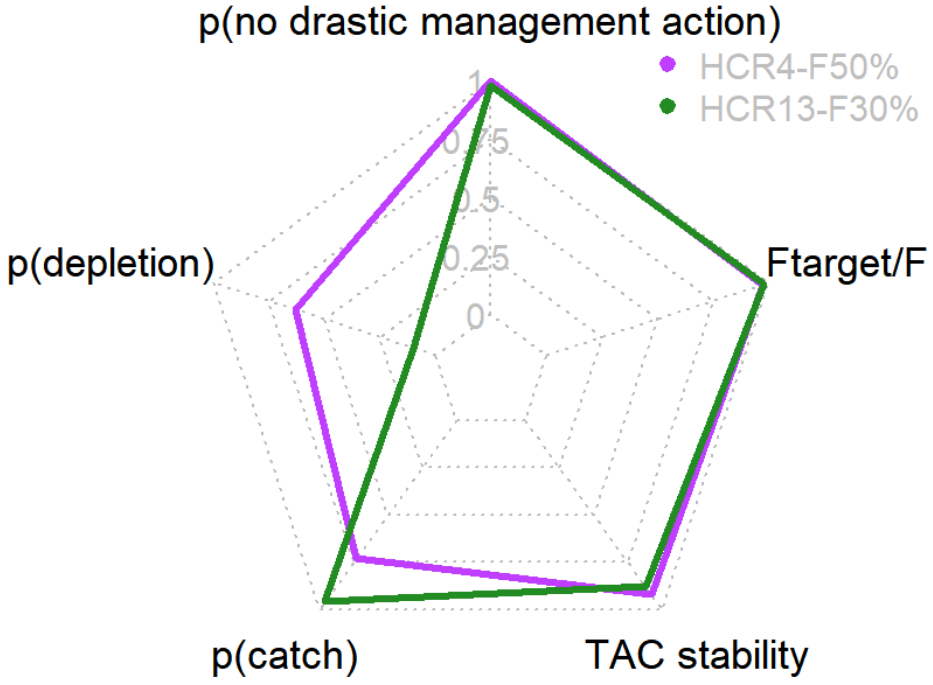
Performance Metrics



- $p(\text{no drastic mgmt action}) = \text{Probability of SSB being } > \text{LRP}$
- $p(\text{depletion}) = \text{Probability of depletion being } > \text{minimum historical depletion}$
- $\text{TAC stability} = 1 - \% \text{ absolute difference in TAC between years}$
- $p(\text{catch}) = \text{Probability of catch being } > \text{average historical catch}$

Impact of F_{target} on performance metrics

Base Case



• Trade-off between depletion and catch

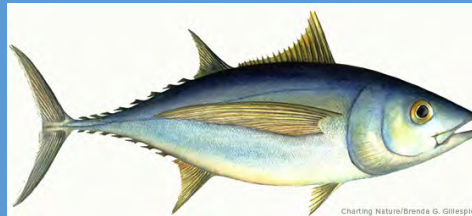
- $p(\text{no drastic management action})$ = Probability of SSB being $>$ LRP
- $p(\text{depletion})$ = Probability of depletion being $>$ minimum historical depletion
- $\text{TAC stability} = 1 - \% \text{ absolute difference in TAC between years}$
- $p(\text{catch})$ = Probability of catch being $>$ average historical catch

- Preliminary results presented at 2018 IATTC SAC in La Jolla, at the 2018 ISC Science Meeting in Yeosu, Korea, and WCPRFC NC 2018 Meeting in Fukuoka Japan
- MSE Report available at <https://www.wcpfc.int/meetings/14th-regular-session-northern-committee>



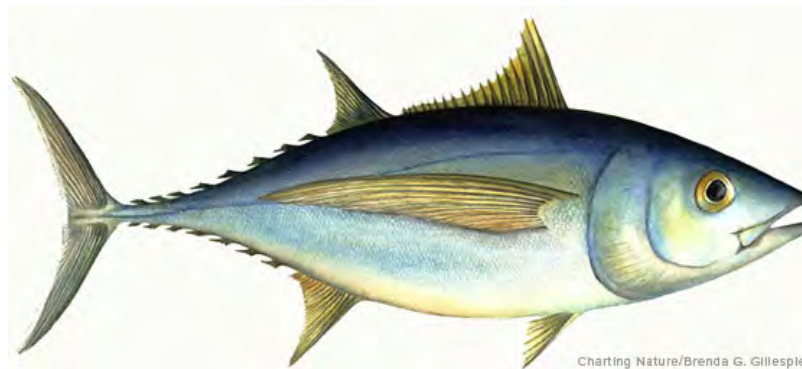
Preliminary Conclusions

- Proposed HCRs generally robust to past range of variability in productivity and distribution
- Important to assess robustness to parameter uncertainty
- Climate responsive rather than climate informed HCRs
- More work required to better understand drivers of North Pacific albacore productivity and movement



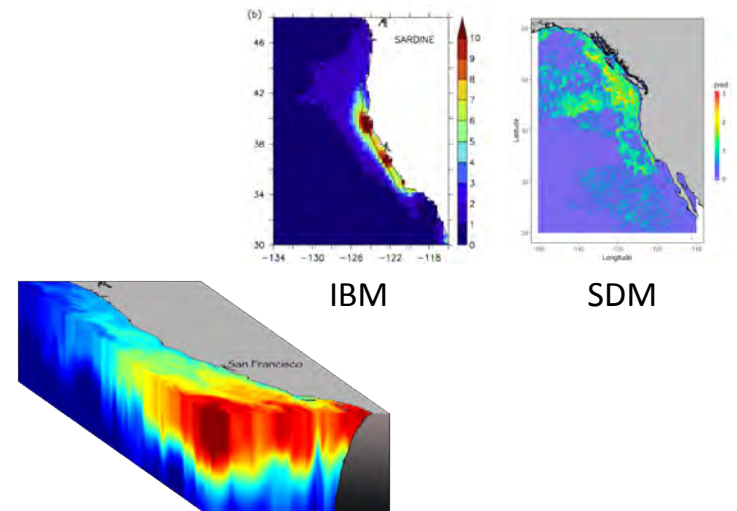
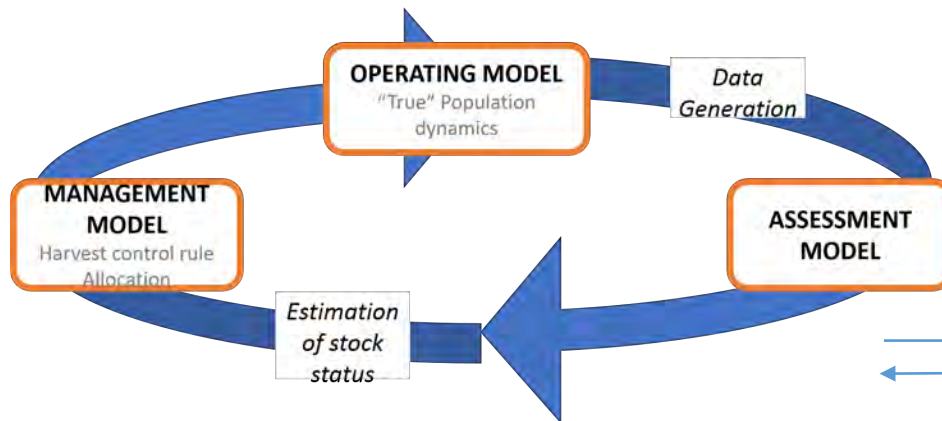
Future Work

- Finish first round of results by stakeholders meeting in early spring 2019
- Develop economics informed performance metrics
- Refine recruitment and movement analysis



Future work

- Assess climate change impacts on albacore distribution within California Current /US fishing communities as part of Future Seas Project



Large Scale Dynamics

California Current Distribution

Thank you!



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