IPHC Secretariat MSE Program of Work (2023) and an update on progress

Agenda Item 4.1.2

IPHC-2023-SRB022-07

Outline

- Additional simulations since SRB021
- Low/High PDO simulations
- Objectives and performance metrics
- Updating the OM
- Exceptional Circumstances

Additional Simulations

- Increased number of replicates for a small set of MPs from 500 presented at MSAB018 to 1,100 for AM099
- Reminders
  - Integrated over five (5) distribution procedures
  - Three options for non-assessment years
    a) The same TCEY from the previous year for each IPHC Regulatory Area
    b) Updating the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE and updating the distribution of the TCEY using FISS results and the applied distribution procedure
    c) Maintaining the same coastwide TCEY as the previous year but updating the distribution of the TCEY using FISS results and the applied distribution procedure

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Additional simulations

MP name	MP-A0	MP-A26	MP-A32	MP-Bb32	MP-Tb32
Assessment Frequency	Annual	Annual	Annual	Biennial	Triennial
Size Limit	0	26	32	32	32
Empirical Rule	–	–	–	b	b
500 replicates					
P(RSB<20%)	PASS	PASS	PASS	PASS	PASS
P(RSB<36%)	0.143	0.143	0.148	0.156	0.225
Median TCEY	60.1	59.8	58.2	58.5	58.4
Median AAV TCEY	18.0%	18.2%	18.5%	19.0%	14.2%
1100 replicates					
P(RSB<20%)	PASS	PASS	PASS	PASS	PASS
P(RSB<36%)	0.174	0.174	0.180	0.164	0.197
Median TCEY	60.5	59.9	58.3	58.5	58.3
Median AAV TCEY	17.2%	17.5%	17.8%	17.0%	14.1%

Pacific Decadal Oscillation

- Linked to the PDO Regimes
  - Average Recruitment
  - Distribution of recruits
  - Movement 4→3 & 3 →2
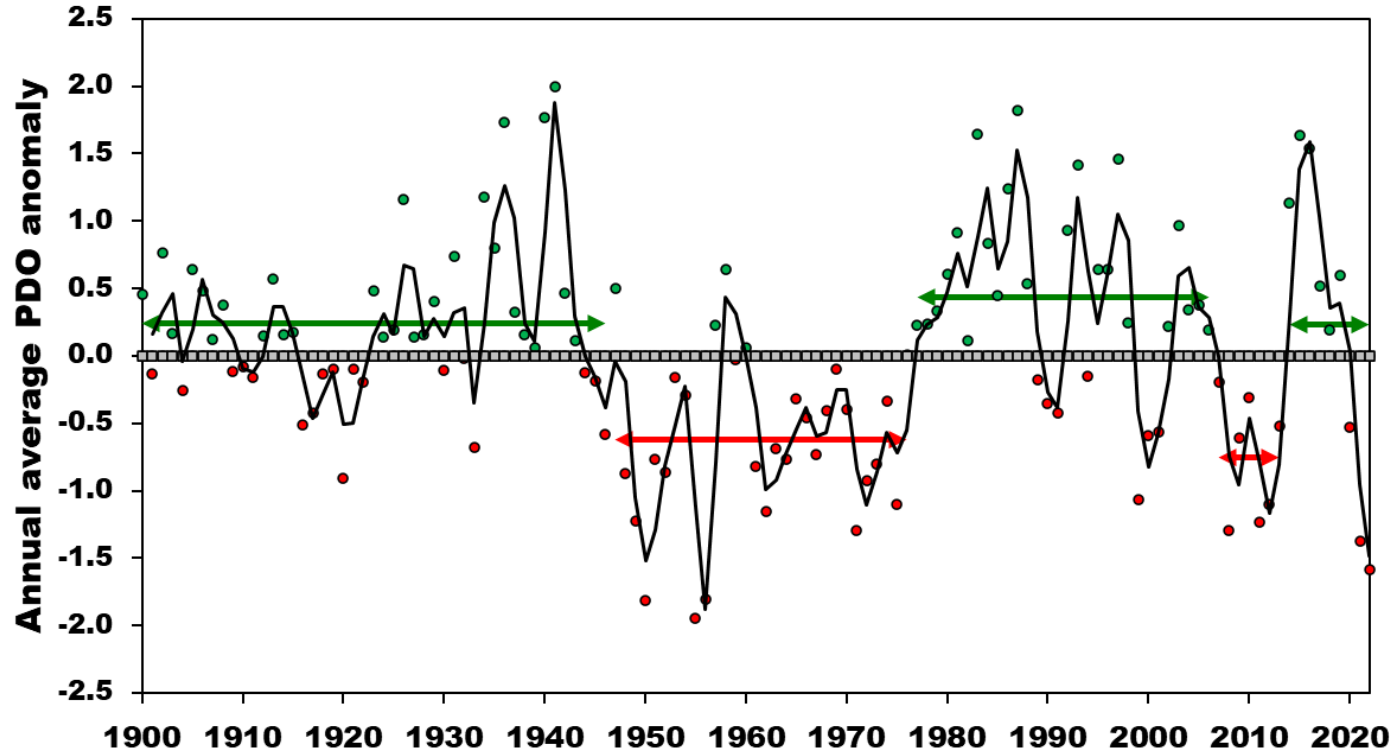
# Effects of the PDO on MSE outcomes

- PDO is simulated as switching between high & low
- Conducted simulations with persistent high OR low PDO

Two questions

1. Is the IPHC interim harvest strategy robust to environmental regimes?
   - We investigated this at SRB015 (IPHC-2019-SRB015-11) and these results agree
2. How do fishing and the environment affect the distribution of Pacific halibut spawning biomass?

International Pacific Halibut Commission

Harvest Strategy: Status and yield

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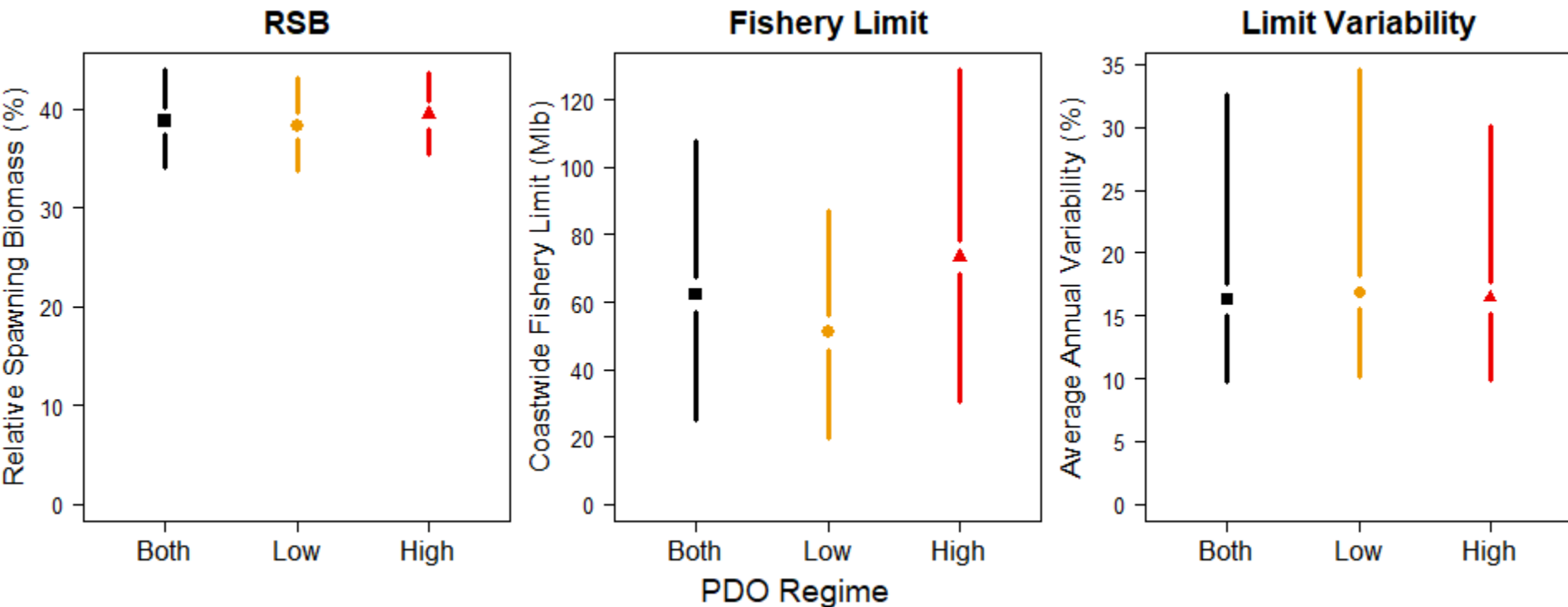
Spawning Biomass Distribution
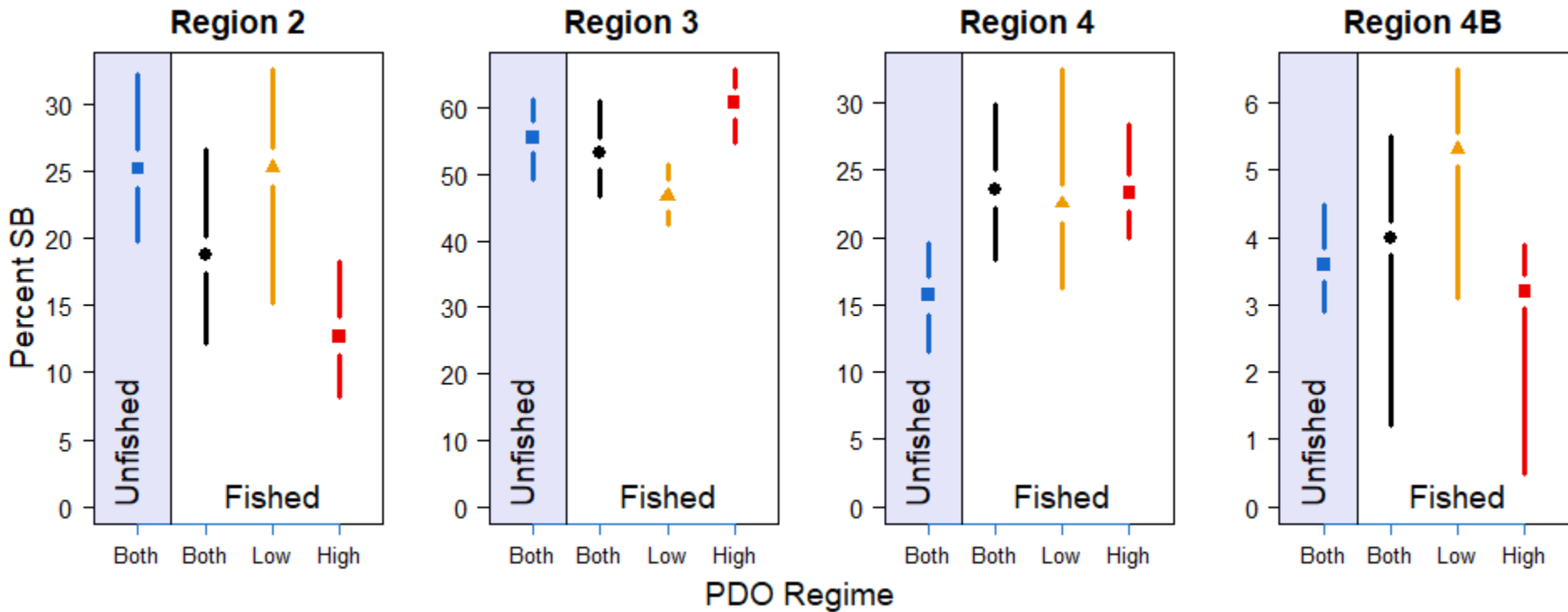
Summary of examining PDO effects

- Even though we cannot "manage" the PDO regime, it is useful to investigate the effects of the PDO regime, allowing for an understanding of the effects of fishing and the effects of the environment
  - the environment sometimes may have a larger effect on the distribution of spawning biomass than fishing does (at an SPR of 43% integrating over five distribution procedures)

Priority Coastwide Objectives (order of importance)

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
1.1. Keep female spawning biomass above a limit to avoid critical stock sizes and conserve spatial population structure	Maintain a female spawning stock biomass above a biomass limit reference point at least 95% of the time	SB < Spawning Biomass Limit (SB_{Lim}) SB_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(SB < SB_{Lim})$ Fail if greater than 0.05
2.1 Maintain spawning biomass at or above a level that optimizes fishing activities	Maintain the coastwide female spawning biomass at or above a biomass reference point at least 50% of the time	SB<Spawning Biomass Threshold (SB_{Thresh}) SB_{Thresh}=36% unfished spawning biomass	Long-term	0.50	$P(SB < SB_{36\%})$ Fail if greater than 0.50
2.2. Provide Directed Fishing Yield	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		Median $\overline{TCEY}$
2.3. Limit Variability in Mortality Limits	Limit annual changes in the coastwide TCEY	Median coastwide Average Annual Variability (AAV)	Short-term		Median AAV

Primary Objectives (Biomass)

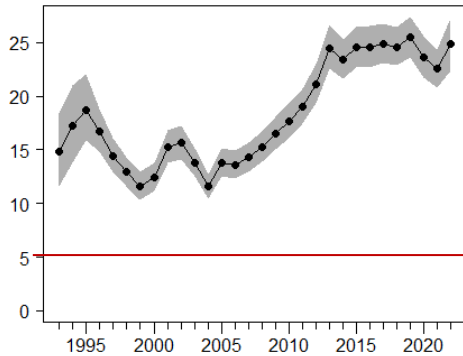| GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point at least 95% of the time	B < Spawning Biomass Limit (B_{Lim}) B_{Lim}=20% unfished spawning biomass
	Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the long-term coastwide female spawning stock biomass at or above a biomass reference point ($B_{36\%}$) 50% or more of the time	B<Spawning Biomass Threshold (B_{Thresh}) B_{Thresh}=$B_{36\%}$ unfished spawning biomass

Historical stock distribution (observed)

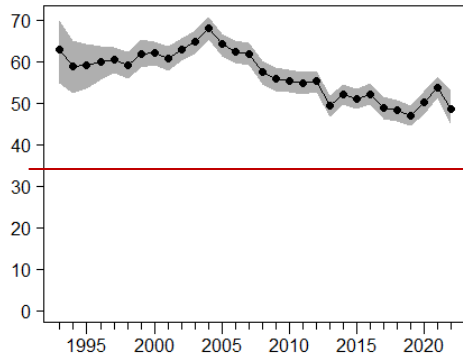| MEASURABLE OBJECTIVE	MEASURABLE OUTCOME
Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$
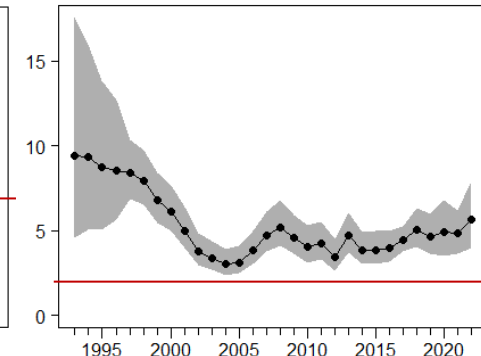
Projected stock distribution (simulated)

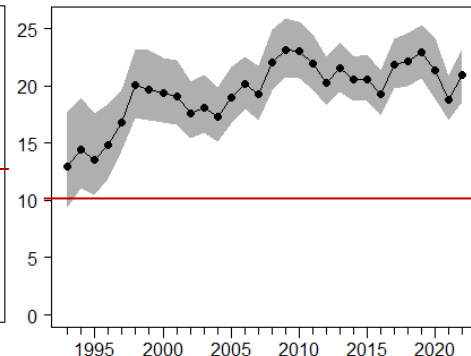| MEASURABLE OBJECTIVE	MEASURABLE OUTCOME
Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$

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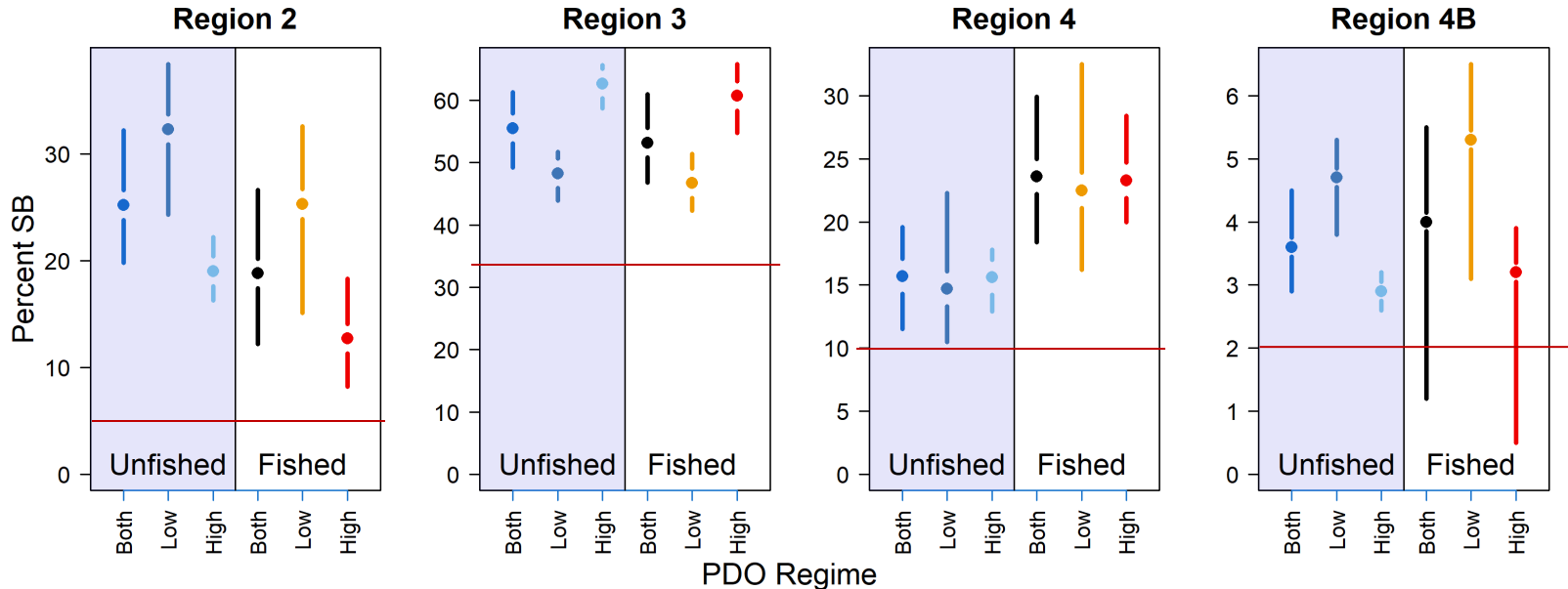
Stock distribution objective

- Determine a new value for the minimum percentage in Biological Region 4B (currently 2%).

- Adjust the tolerance to a value great than 5%.

- Find a management procedure that will meet the current objective.

  - This may be achieved by lowering the relative harvest rate in IPHC Regulatory Area 4B. For example, a yield-per-recruit analysis suggested a relative harvest rate of 0.5 for Biological Region 4B

- Redefine an objective to conserve spatial population structure

Primary Objectives (Yield)

General Objective	Measurable Objective	Measurable Outcome
2.2. Provide Directed Fishing Yield	Optimize average coastwide TCEY	Median coastwide TCEY
	Optimize TCEY among Regulatory Areas	Median $TCEY_A$
	Optimize the percentage of the coastwide TCEY among Regulatory Areas	Median $\%TCEY_A$
	Maintain a minimum TCEY for each Regulatory Area	Minimum $TCEY_A$
	Maintain a percentage of the coastwide TCEY for each Regulatory Area	Minimum $\%TCEY_A$
2.3. Limit Variability in Mortality Limits	Limit annual changes in the coastwide TCEY	Annual Change (AC) > 15% in any 3 years
		Median coastwide Average Annual Variability (AAV)
	Limit annual changes in the Regulatory Area TCEY	Annual Change (AC) > 15% in any 3 years
		Average AAV by Regulatory Area (AAV_A)

Conditioning the OM (concepts)

- **Previous** OM composed of 2 models with high M and two models with low M (female M =0.15)
- New full assessment estimates M in three of the 4 models at values greater than 0.15
- **Currently** conditioning four models
    1. Based on long AAF assessment model
    2. Based on short AAF assessment model
    3. Based on long coastwide assessment model
    4. Based on short coastwide assessment model
- Goals
    - four models covering a range of SB greater than assessment
   - Incorporate structural uncertainty to explain observations

Conditioning the OM (details)

- Parameters taken from associated assessment model
  - Regional parameters taken from long AAF
- Models begin in 1958
- Conditioning parameters
  - R_0
  - Initial fishing mortality
  - Proportion of recruits to each region
  - Movement from 4→3 and 3 →2
- Conditioning observations
  - Stock distribution by Biological Region
  - Spawning biomass from assessment
  - FISS index and age-compositions
- Uncertainty
  - Sample parameters from covariance matrix determined using Hessians from conditioning and assessment

OM1_longAAF
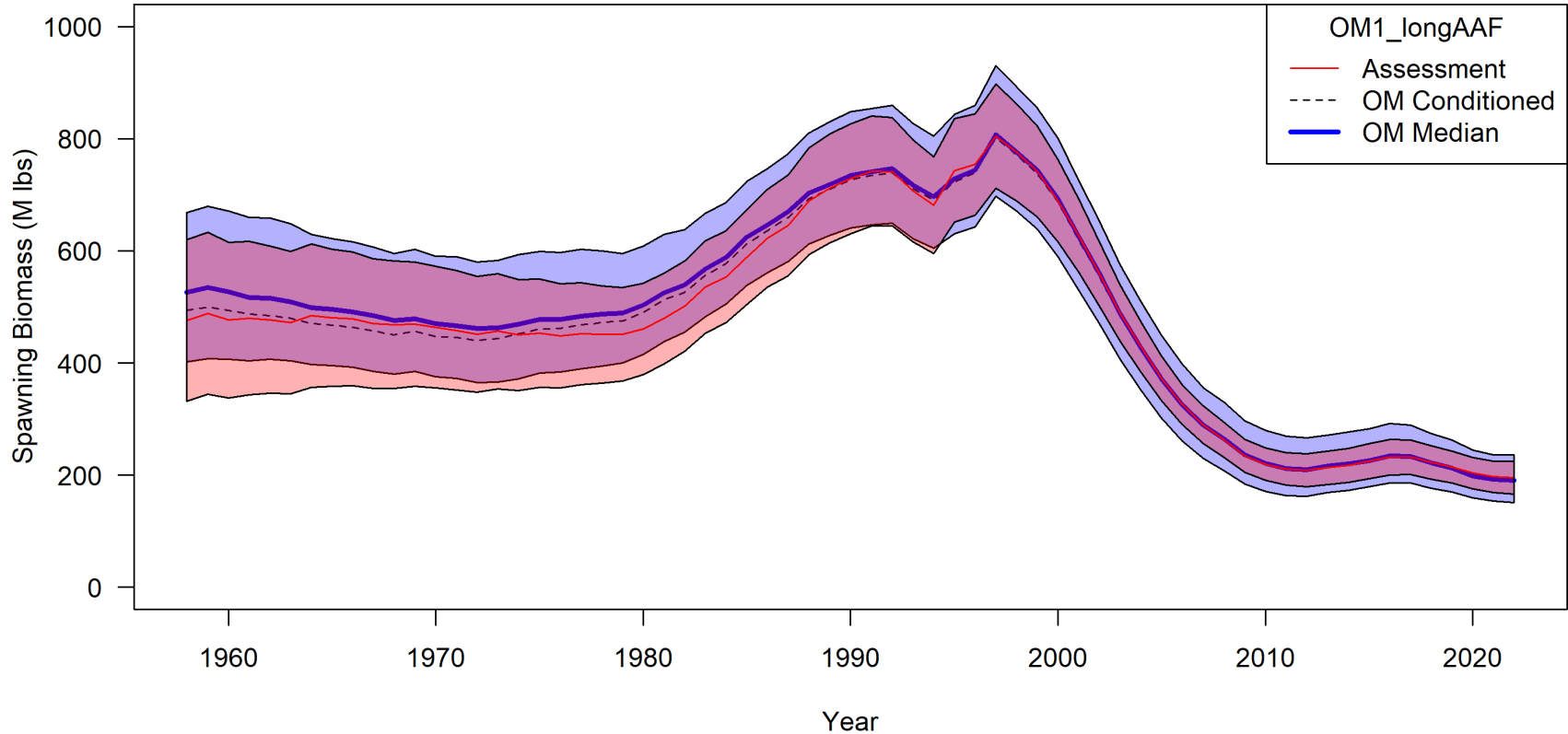
OM3_longCW
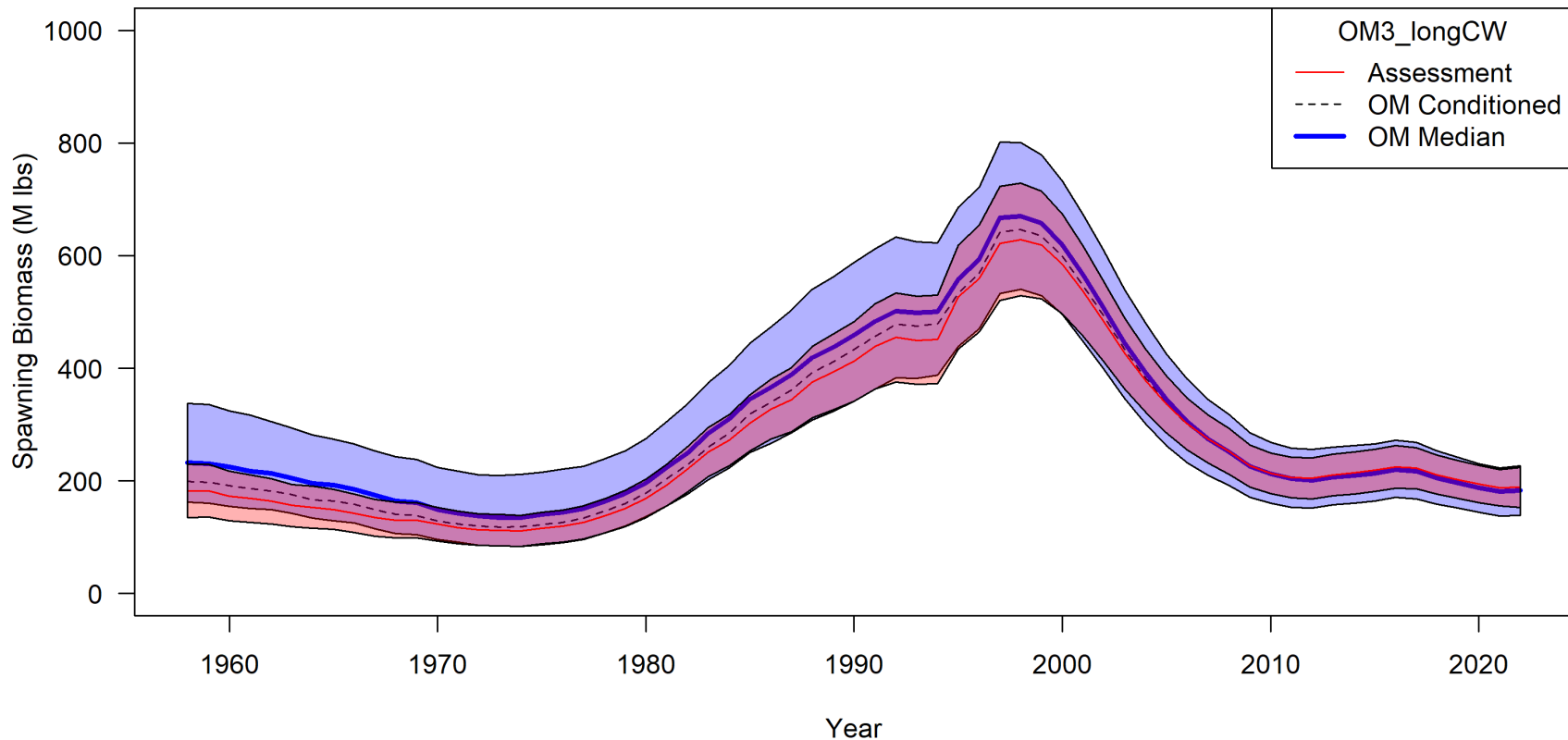
Short models

- Difficulty fitting short time-series starting in 1992
- Moving to setups similar to long models
  - Some parameters from short models
  - Fit to short assessment spawning biomass

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Exceptional circumstances

- Exceptional circumstances
  - AM099–R (para. 88): **NOTING** paragraph 60 from the 21st Session of the SRB (SRB021), the Commission **REQUESTED** the Secretariat develop a description of options to responding to exceptional circumstances that would trigger a stock assessment in nonassessment years and additional MSE analyses
  - SRB021-R (para 60): The SRB **RECOMMENDED** that Exceptional Circumstances be defined to determine whether monitoring information has potentially departed from their expected distributions generated by the MSE. Declaration of Exceptional Circumstances may warrant re-opening and revising the operating models and testing procedures used to justify a particular management procedure

Exceptional Circumstances

- A process for deviating from an adopted MP (de Moor et al 2022)
- Monitoring information has potentially departed from their expected distributions generated by the MSE (SRB021)
  - Declaration of Exceptional Circumstances may warrant re-opening and revising the operating models and testing procedures used to justify a particular management procedure
- Should be defined using observations rather than model outputs and should be compared to the distribution generated by the MSE simulations
- Important to have clear definitions for when the agreed upon MP should be re-evaluated
- An undesirable situation (e.g. low catch-rates) could trigger a stock assessment in non-assessment years, but would not necessarily be an exceptional circumstance
  - Can be defined as an element of a MP

de Moor CL, Butterworth DS, Johnston S. 2022. Learning from three decades of Management Strategy Evaluation in South Africa. ICES Journal of Marine Science. 79. 1843-1852

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Potential exceptional circumstances

a) The coastwide all-sizes FISS WPUE or NPUE falls above the 97.5^{th} percentile or below the 2.5^{th} percentile of the MSE simulated FISS index.

b) The observed percentage of FISS all-sizes WPUE is above the 97.5^{th} percentile or below the 2.5^{th} percentile of the MSE simulated FISS index for each Biological Region. These data were used to condition the OM, so may be a reasonable choice.

c) The proportions-at-age in the coastwide or region-specific FISS observations are above the 97.5^{th} percentile or below the 2.5^{th} percentile of the simulated FISS proportions-at-age. Exactly how to make this comparison over all ages would have to be determined.

All-sizes index would be a better option because to calculate O32,
the OM needs to make an assumption how to split the observations into U32 and O32

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Response to an exceptional circumstance

- Specify a MSE program of work
  - Review and possibly create new OM
  - Examine objectives
  - Identify MPs to evaluate in addition to current
  - Evaluate MPs with updated OM

- If a non-assessment year, conduct a stock assessment as well, if possible
  - Timing may be an issue

Recommendations

1. The SRB **NOTE** paper IPHC-2023-SRB022-07 presenting simulations performed since MSAB017, outcomes of AM099, and potential MSE-related tasks for 2023–2025.

2. The SRB **NOTE** that additional simulations beyond those presented at MSAB017 resulted in more precise values of the performance metrics, but the relative comparisons between management procedures remained the same.

3. The SRB **NOTE** that different PDO regimes (i.e. always high or always low)
   a) had little effect on the priority conservation objective, but low PDO resulted in low TCEYs and high PDO resulted in high TCEYs;
   b) affected the long-term distribution of spawning biomass differently in each Biological Region and;
   c) may have as much or a larger effect on the long-term distribution of spawning biomass in each Biological Region than fishing with the current interim harvest strategy policy does.
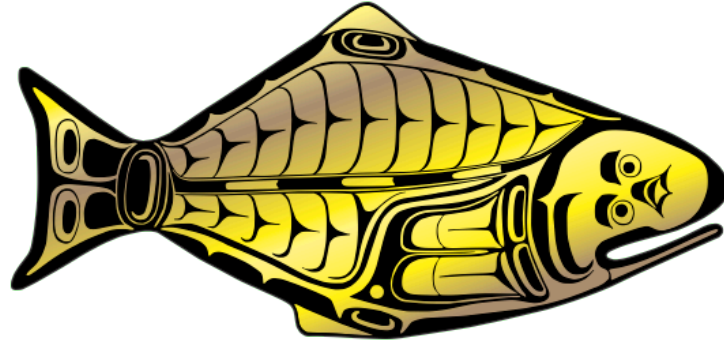
Recommendations

4. The SRB **ENDORSE** the process for developing and conditioning the 2023 OM, and that conditioning should occur following each full stock assessment.

5. The SRB **REQUEST** management procedures to develop and simulate using the MSE framework.

6. The SRB **REQUEST** that exceptional circumstances be based on comparing the MSE simulations to the uncertainty of modelled FISS estimates (e.g. a 95% credible interval) and if an exceptional circumstance occurred the MSE framework would be reviewed by the SRB, re-developed where necessary, and MPs would be re-evaluated as appropriate.

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