

INTERNATIONAL PACIFIC



HALIBUT COMMISSION
Celebrating 100 Years
1924-2024

IPHC MSE updates

Agenda item: 4.1.2
IPHC-2023-SRB023-07
(A. Hicks, I. Stewart)



MSE Topics for SRB023

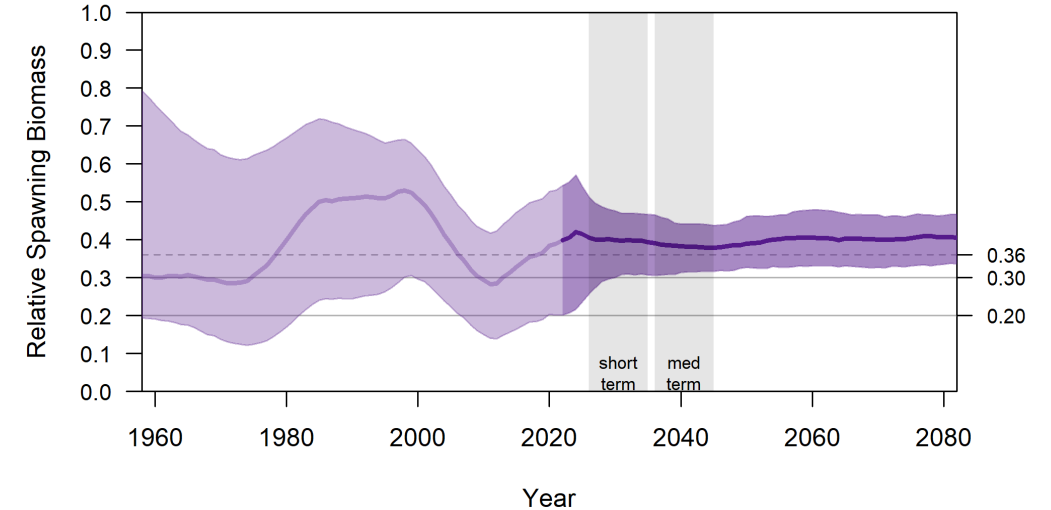
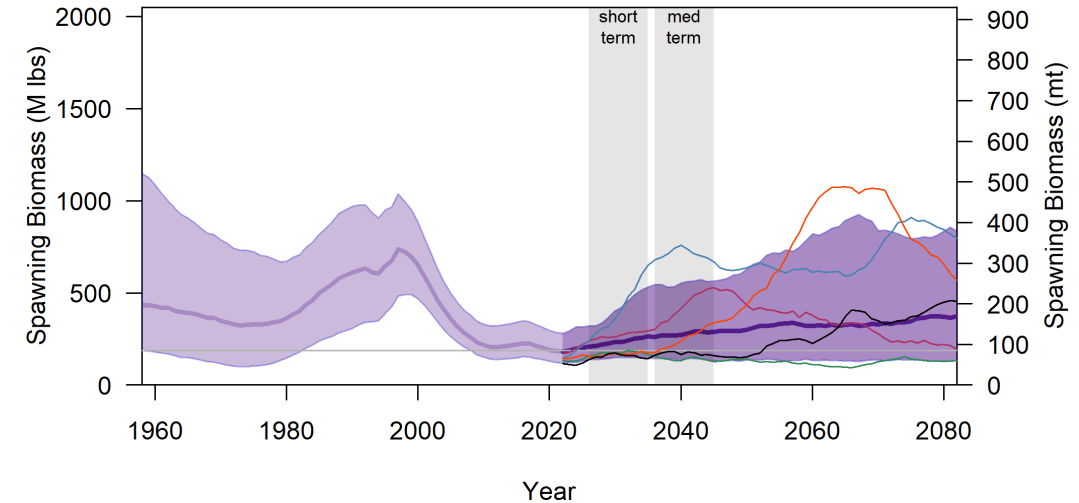
- Update the Operating Model (OM)
- Examine the objectives and performance metrics
- Equalize MP Performance on an Objective
- Examining FISS data scenarios
- Define Exceptional Circumstances
- Management Procedures (MPs) to evaluate

2023 Operating Model (OM)

- OM updated following the 2022 full stock assessment
- Four models each with four Biological Regions and multiple fisheries
- SRB recommendation
 - *The SRB RECOMMENDED that the Secretariat consider using explicit informative priors for conditioning the operating model to make fitting constraints more explicit*
- Detailed in 2023 Technical Document

SPR = 43%

OM 5th & 95th

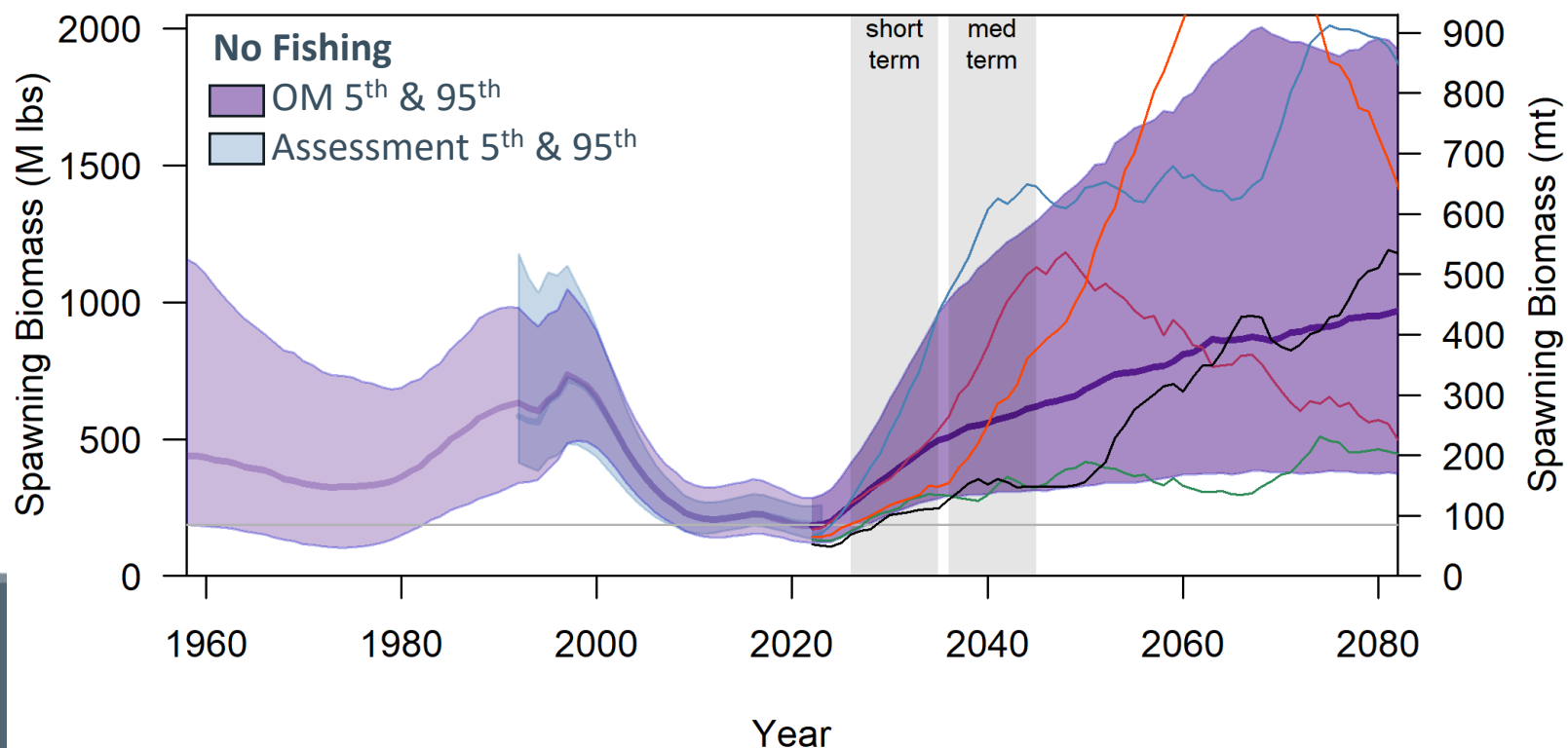


Four individual models

- Parameterized from 2022 stock assessment models
- Movement (age-specific) between adjacent regions
- Estimated parameters
 - R_0
 - Proportion of age-0 recruits in each Region (low/high PDO)
 - Movement: 4→3 and 3→2 (low/high PDO)
- Conditioned to
 - Estimated spawning biomass from stock assessment
 - All-sizes regional stock distribution from FISS
 - Region FISS indices
 - Region FISS proportions-at-age

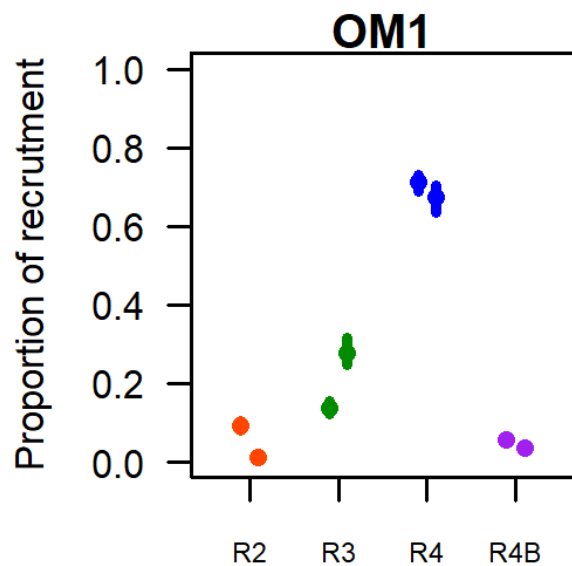
Four individual models: Comparison

	OM1	OM2	OM3	OM4
Female M	0.183	0.213	0.215	0.15
Male M	0.164	0.178	0.203	0.147
SigmaR	0.50	0.50	0.54	0.54
Conditioning SB	Long AAF	Short AAF	Long CW	Short CW

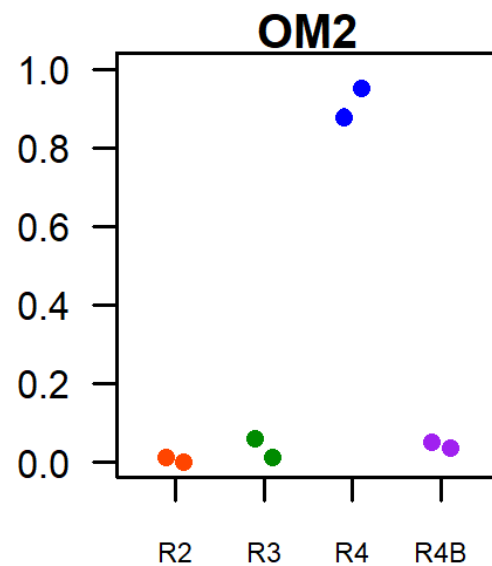


Distribution of age-0 recruits

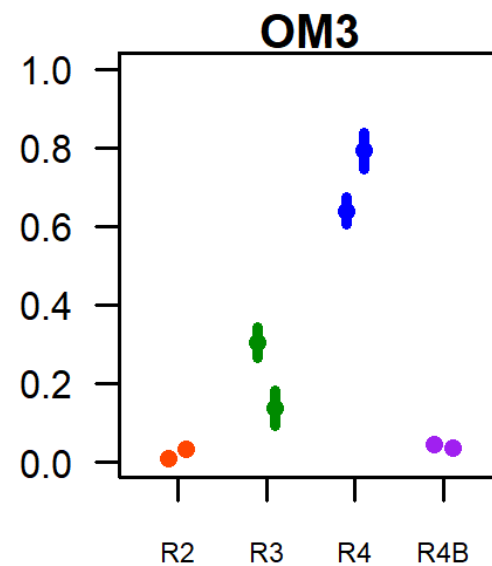
- Sadorus et al. (2020): recruits more likely to end up in Bering Sea in “warm years”



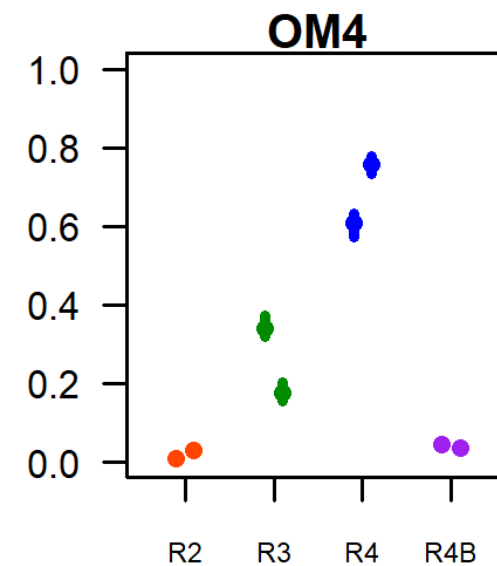
Biological Region



Biological Region



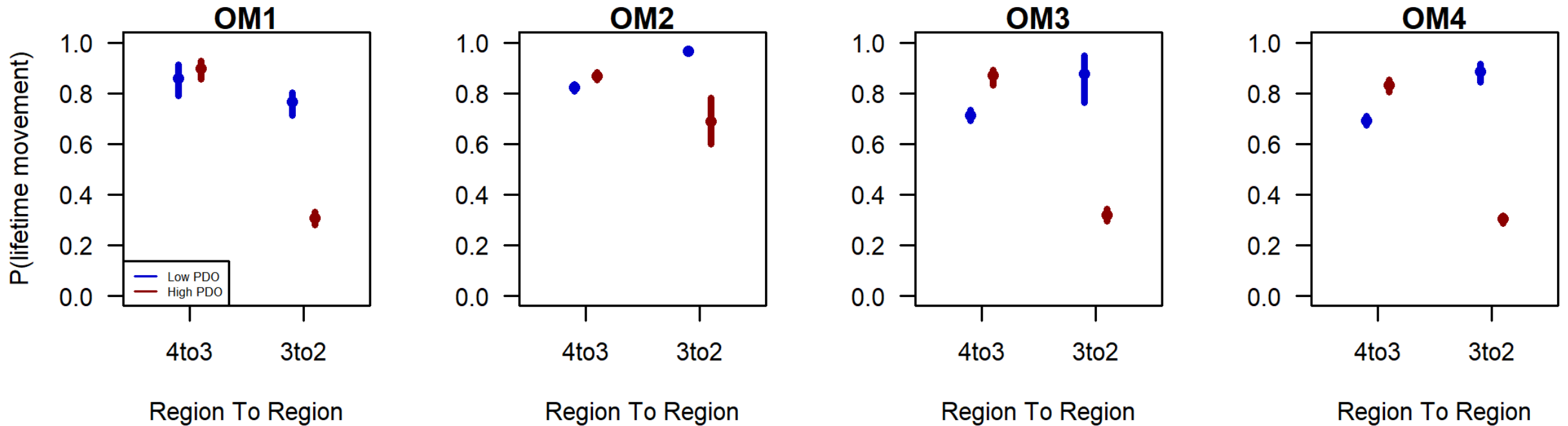
Biological Region



Biological Region

Lifetime Movement

- One minus the product of age-specific probability of not moving to the other area



Future Operating Models

- *The SRB RECOMMENDED that reconditioning the operating model should be limited to situations where the stock assessment has changed significantly. This likely means a three-year schedule for reconditioning the operating model in the year following each full stock assessment*
- Next OM likely in 2026

Objectives and Performance Metrics

- Four priority coastwide objectives are currently endorsed for the MSE.
 - Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point (B20%) at least 95% of the time.
 - Maintain the long-term coastwide female spawning stock biomass above a biomass reference point (B36%) at least 50% of the time.
 - Optimise average coastwide TCEY.
 - Limit annual changes in the coastwide TCEY.
- Current work on other (primary) objectives
 - Is there an additional coastwide objective to consider?
 - Develop a region-specific objective to conserve spatial structure that is informative of the changes in biomass within a Biological Region

Additional Objective?

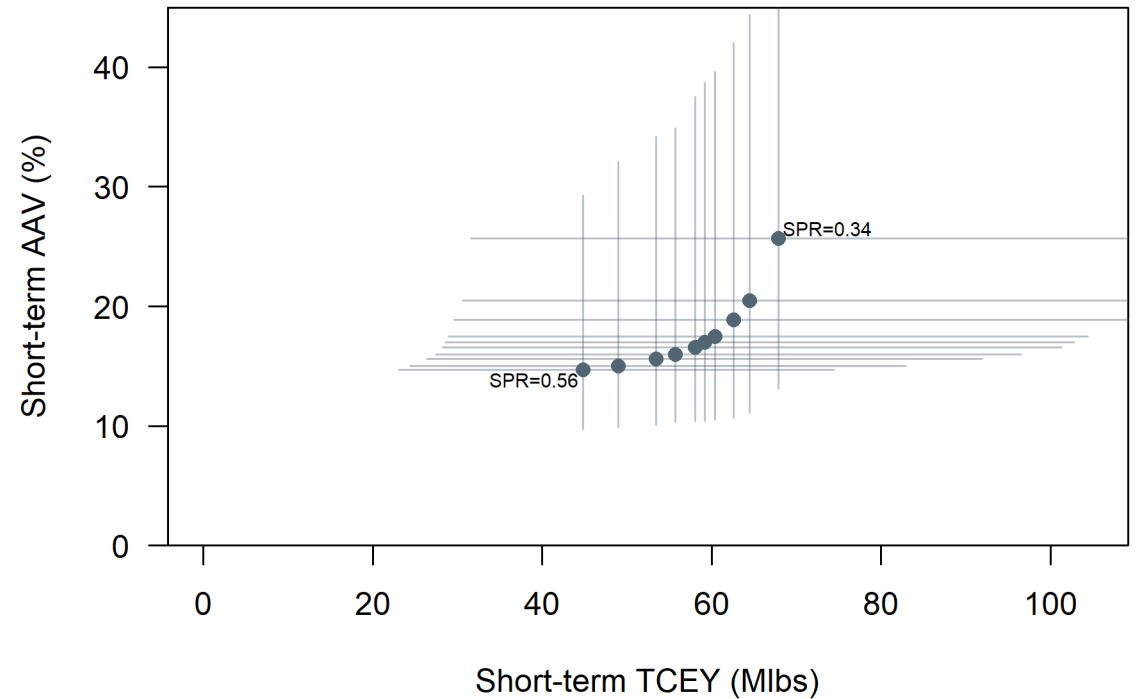
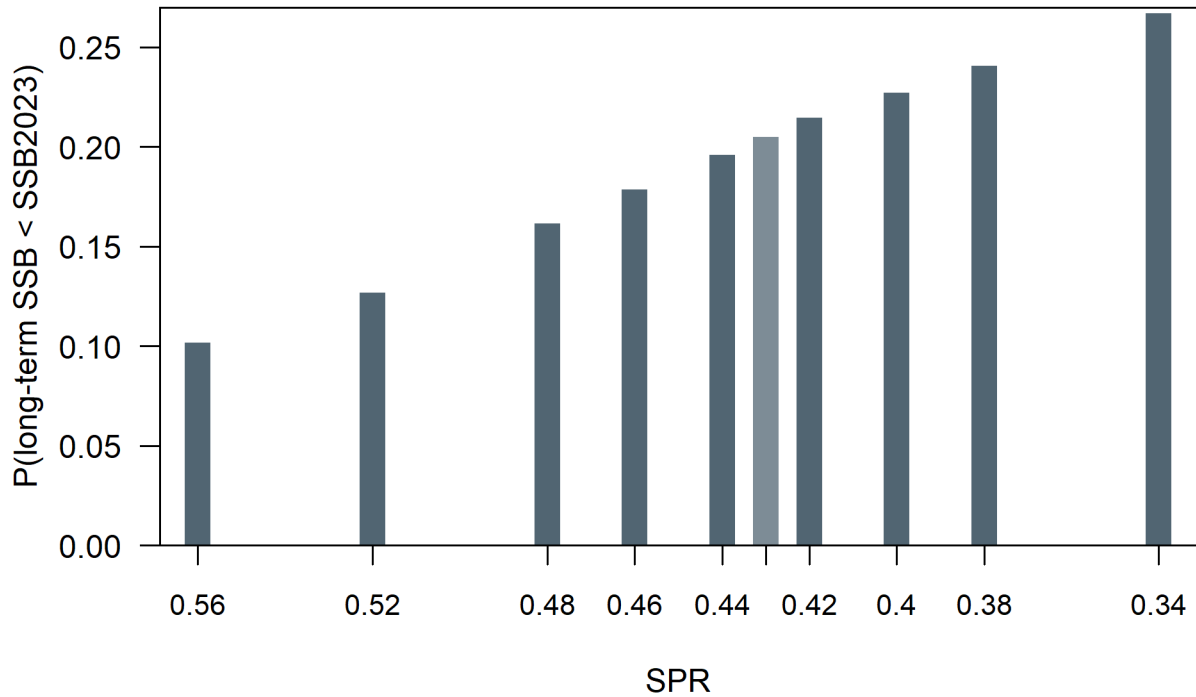
- At AM099
 - Coastwide 2022 FISS index of O32 WPUE was at its lowest value observed in the time-series
 - Results from the 2022 full stock assessment using an SPR of 43% was a 2023 TCEY of 52.0 Mlbs, and would have resulted in a 75% chance of a lower spawning biomass in 2024
 - The Commission departed from the current interim management procedure at AM099 and chose a TCEY of 36.97 Mlbs for 2023
 - [IPHC-2023-AM099-R](#), para. 94. *The Commission **NOTED** that the adopted mortality limits for 2023 correspond to a 38% probability of stock decline through 2024, and a 36% probability of stock decline through 2026.*
- Is there a desire to maintain the long-term coastwide spawning biomass above the estimated 2023 spawning biomass?

Objective related to 2023 spawning biomass

- Maintain the long-term coastwide female spawning stock biomass above the estimated 2023 female spawning biomass at least XX% of the time
- Benefits
 - Useful contrast to dynamic reference points
 - An observed reference that has concrete meaning to stakeholders
 - Indicator of efficiency and opportunity

SPR	38%	40%	42%	43%	44%	46%	48%	52%	56%
Long-Term Metrics									
Median RSB	34.4%	35.6%	37.0%	37.8%	38.7%	40.4%	42.2%	46.2%	50.2%
P(RSB _y <20%)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P(RSB<36%)	0.659	0.541	0.418	0.353	0.294	0.189	0.111	0.027	0.003
P(SB<SB ₂₀₂₃)	0.234	0.221	0.208	0.199	0.190	0.172	0.155	0.120	0.095
Short-term Metrics (4-13 yrs)									
Median TCEY	64.5	62.6	60.4	59.2	58.0	55.7	53.4	49.0	44.8
Median AAV TCEY	20.5%	18.9%	17.5%	17.0%	16.6%	16.0%	15.6%	15.0%	14.7%

Fishing intensity (SPR)

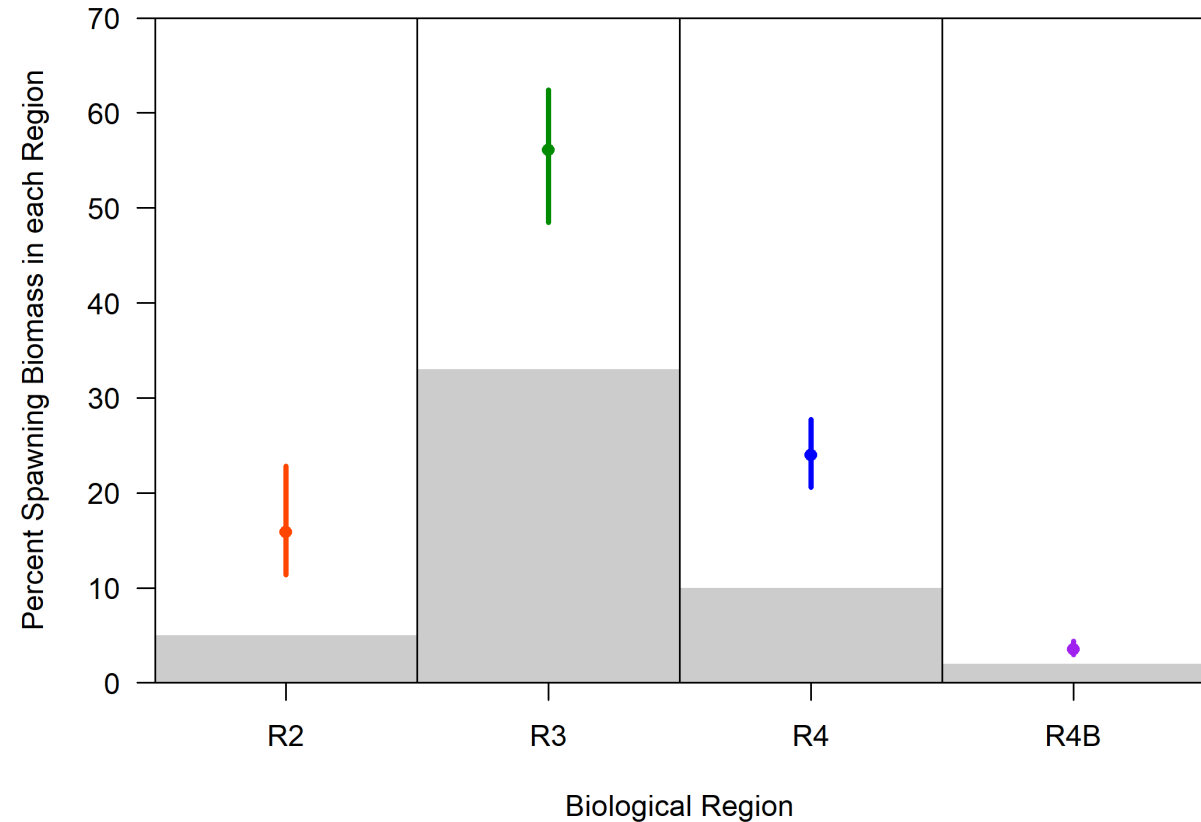


- There are many ways to create an MP to meet an objective to maintain SB above SB2023
 - Lower fishing intensity (increase SPR)
 - Create a control rule that is related to SB relative to 2023
 - Create a control rule that is related to FISS WPUE

Conserve spatial population structure

The SRB **NOTED** that the spatial structure objective could be better addressed through a criterion that compares biomass in each region to unfished biomass in the same region rather than using proportions of the total stock-wide biomass.

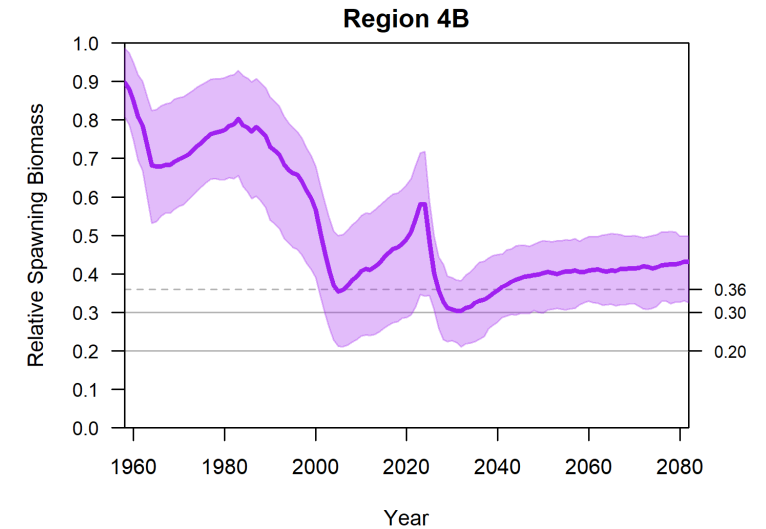
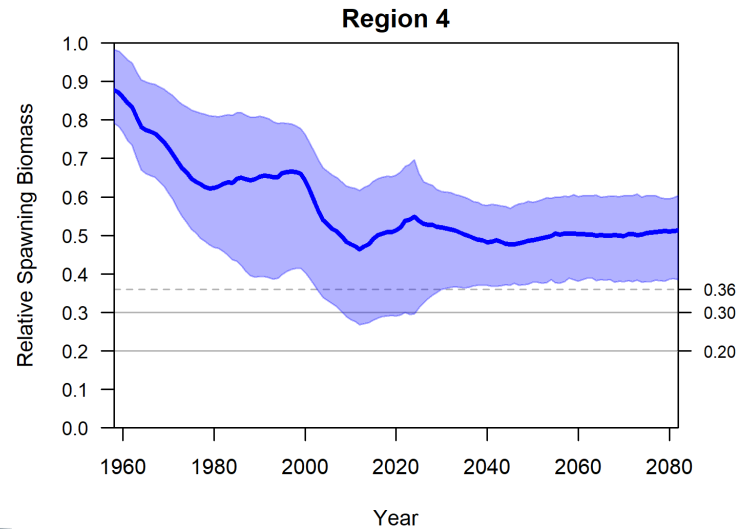
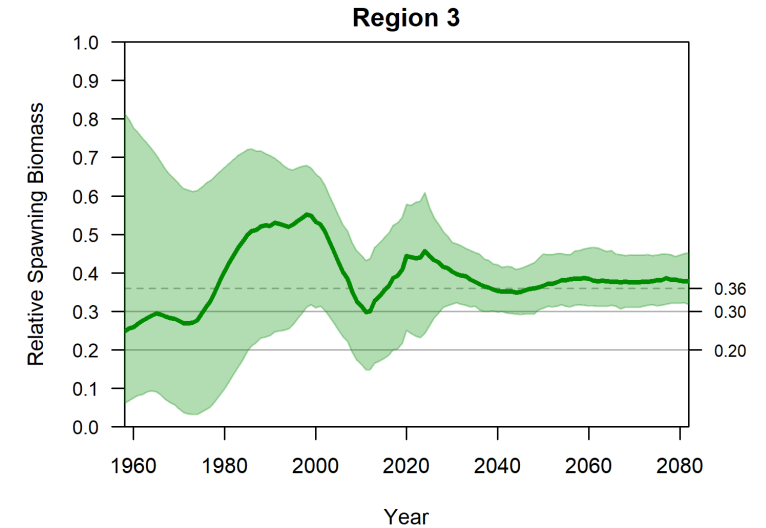
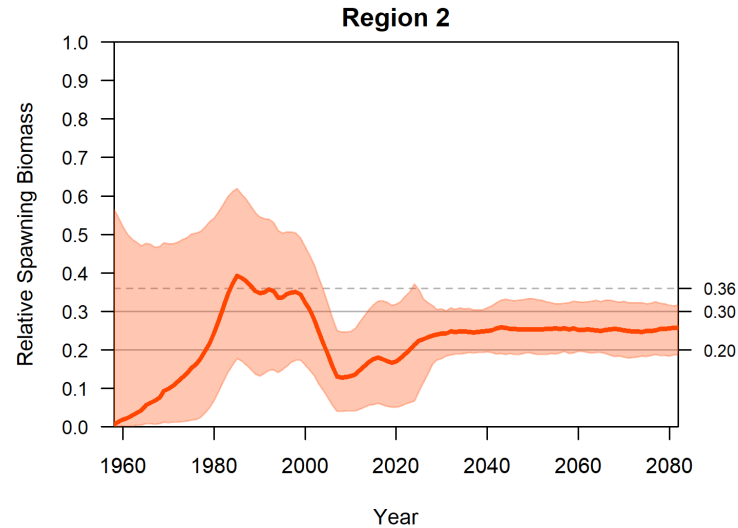
- Current objective is
 - Maintain a defined minimum proportion of female spawning biomass in each Biological Region
 - Is subject to biomass within a region and the biomass in other regions
 - The new OM now meets objective for 4B



Regional relative spawning biomass

- Relative to SB within each Biological Region
 - Important to be dynamic
 - Movement depends on environment and age
 - Recruits depend on environment
- Need to define thresholds

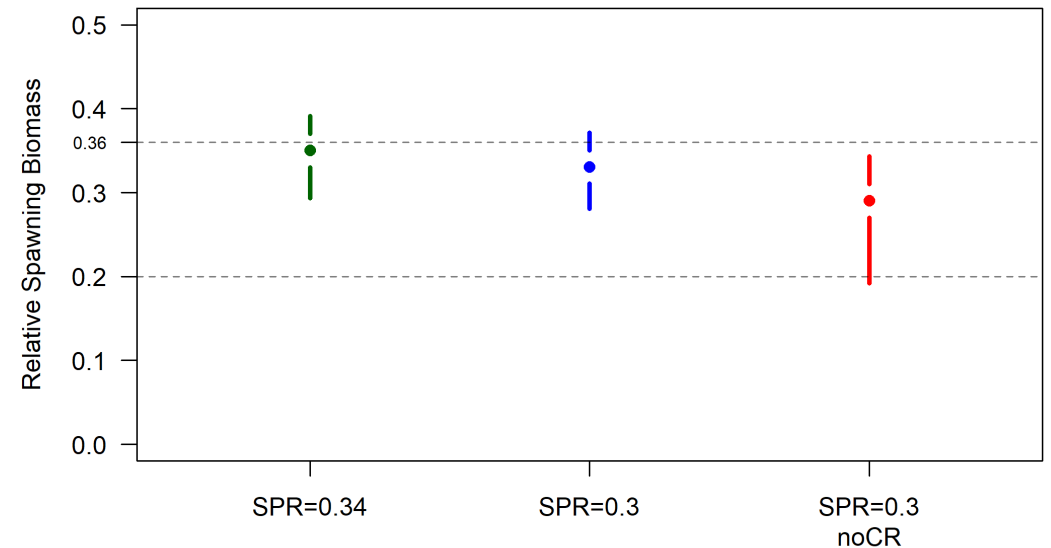
SPR=43%



Equalizing MP performance on an objective

[IPHC-2023-SRB022-R](#) (para. 25). *To improve comparability of MPs in performance achieving TCEY objectives, the SRB **RECOMMENDED** equalizing MP performance on one of the conservation objectives.*

- With the 30:20 control rule, the 20% objective could not be achieved exactly
- The 36% objective could be met with an SPR near 41%
- A new objective related to SB2023 may be a possibility for equalizing MPs



Note: These are preliminary results with fewer replicates and based on earlier code, but are consistent. They may differ from final results.

FISS design scenarios

*The SRB **NOTED** that situations in which critical data streams (e.g. FISS index or age data) are unavailable for one or more years does not constitute an "exceptional circumstance" and **REQUESTED** that the MSE include evaluation of such missing FISS data scenarios for the SRB023.*

*The SRB **NOTED** the presentation demonstrating how secondary FISS objectives influence choices for future FISS designs that may have already been endorsed by the SRB based only on primary objectives. The SRB **RECOMMENDED** that the MSE include some scenarios in which the FISS is skipped (as also requested above in para. 30) because of occasional (or persistent) economic constraints on executing full FISS designs. Such simulation scenarios would provide some indication of the potential scale of impacts on MP performance of maintaining long-term revenue neutrality of the FISS.*

- Use MSE to investigate effects of reduced FISS effort
- Define how reduced FISS effort affects data and assessment variability
- Pilot study

FISS Design Types

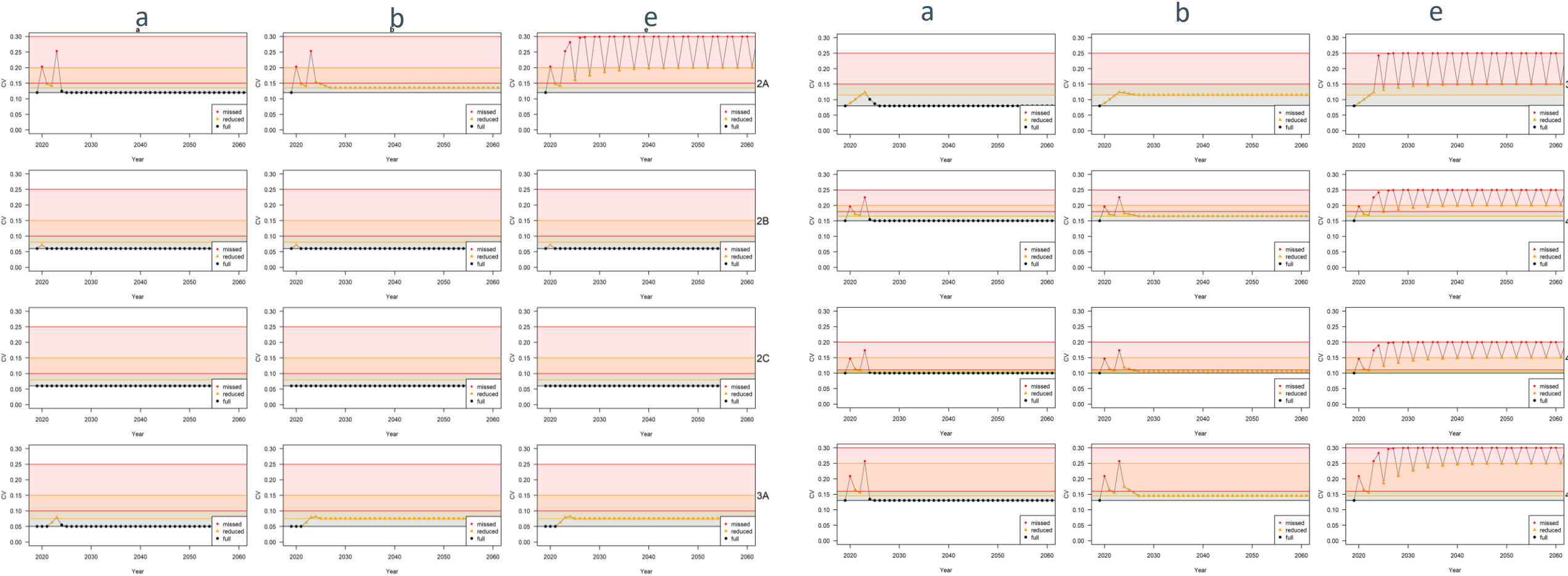
- Types of design in an IPHC Regulatory Area
 - **Full:** sufficient stations surveyed, CV near target
 - **Reduced:** some stations surveyed, but CV above target
 - **Missed:** no stations surveyed, and CV can go to highest possible

Design	CV	2A	2B	2C	3A	3B	4A	4CDE	4B
Full	Min	12.0%	6.0%	6.0%	5.0%	8.0%	15.0%	10.0%	13.0%
	Max	15.0%	10.0%	10.0%	10.0%	15.0%	18.0%	11.0%	16.0%
Reduced	Min	13.5%	7.0%	7.0%	7.5%	11.0%	16.5%	10.5%	14.5%
	Slope	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Max	20.0%	15.0%	15.0%	15.0%	15.0%	20.0%	15.0%	25.0%
Missed	Min	15.0%	8.0%	8.0%	10.0%	14.0%	18.0%	11.0%	16.0%
	Slope	1	1	1	1	1	1	1	1
	Max	30.0%	25.0%	25.0%	25.0%	25.0%	25.0%	20.0%	30.0%

FISS Design Scenarios

- a. A Full design in every IPHC Regulatory Area and every year.
 - This is the best-case scenario and is not cost-optimised. It is hypothetical and unlikely, but useful for comparison.
- b. Reduced design for IPHC Regulatory Areas other than 2B and 2C. 2B and 2C are always a Full design.
 - This is based on recent patterns of nearly Full designs in 2B and 2C when other IPHC Regulatory Areas are reduced. However, as stock distribution changes, other areas may be preferable for a Full design (which is not captured here).
- e. Miss every other year for IPHC Regulatory Areas 2A, 3B, 4A, 4CDE, and 4B. Reduced otherwise. 2B and 2C always Full and 3A always Reduced.
 - In other words, every other year is only a full survey of 2B and 2C and reduced for 3A.

FISS Design Scenarios: CVs

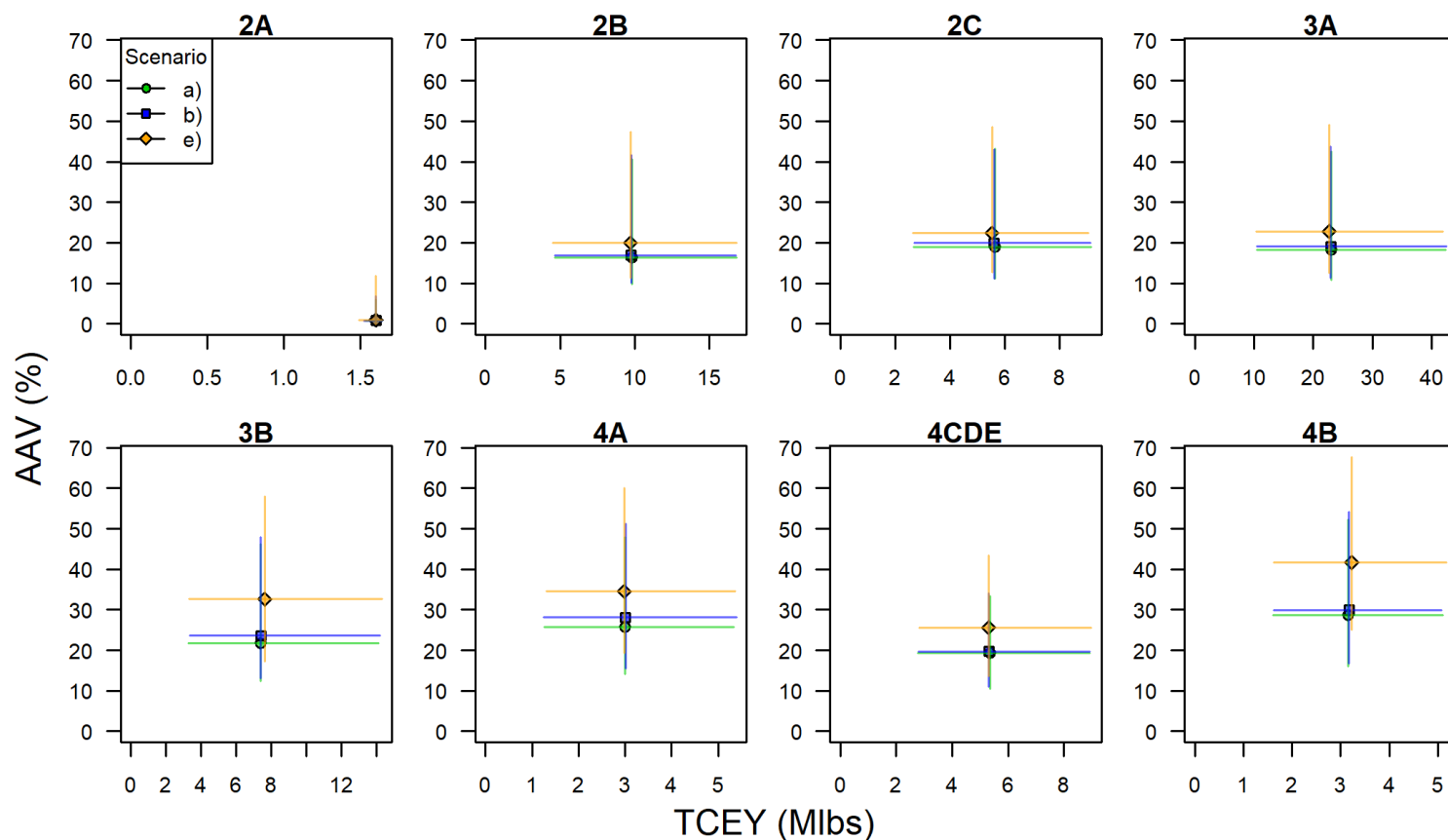


FISS Design Scenarios: Estimation Error

- MSE simply simulates error in TM and RSB
 - Bivariate lognormal with CV of 15% for both and correlation of 0.5
 - Autocorrelation = 0.4
- Estimation error CV is a linear function of sum of FISS CVs
 - Ad hoc minimum CV of 15% and maximum of 21.5%
- Do not currently have an estimation model to mimic the ensemble assessment with simulated data inputs

FISS design scenarios

- Increase in TCEY variability
- Upcoming designs likely to show higher CV than this pilot study
- Can be improved based on recent decisions and analyses



Exceptional Circumstances

IPHC-2023-SRB022-R (para. 28 and 29)

- Evaluate annually by comparing simulated MSE values to realized FISS estimates
- Clearly distinguish an exceptional Circumstance from unusual conditions
- Persistence necessary for an exceptional circumstance
- SRB reviews evidence of an Exceptional Circumstance and assists with response

Defining Exceptional Circumstances (possibilities)

- The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls outside a defined distribution of the simulated FISS index for two or more consecutive years
- The observed FISS all-sizes stock distribution for any Biological Region is outside of a defined distribution of the simulated FISS index over a period of two or more years
- Some biological observations or new research indicate parameters that are outside a reasonable range used or calculated in the MSE simulations

Potential action if exceptional circumstance is declared

- If an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.
- Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM. Present these recommendations to the Commission.
- Further consult with the SRB and MSAB after simulations are complete to identify if a new MP is appropriate. Present these recommendations to the Commission.

Management Procedures (MPs) to evaluate

PRIORITY

- Annual and Multi-year stock assessment MPs
- Fishing intensity (SPR values)
- FISS design scenarios

SECONDARY

- Constraints on the TCEY
- Stock distribution smoothing

ADDITIONAL

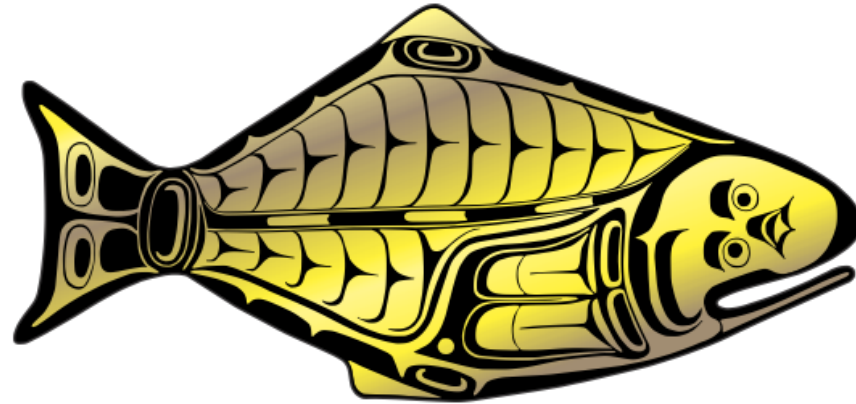
- Elements related to maintaining SB above an absolute threshold
- TCEY distribution procedures

Recommendations

That the SRB:

- **NOTE** paper IPHC-2023-SRB023-07
- **ENDORSE** the 2023 operating model
- **RECOMMEND** that an objective to maintain spatial population structure be added or redefined
- **RECOMMEND** that an objective to maintain the long-term coastwide female spawning stock biomass above an absolute reference be added
- **RECOMMEND** continued examination of FISS scenarios that are representative of future FISS designs
- **RECOMMEND** specific quantifiable events to declare an exceptional circumstance
- **RECOMMEND** that if an exceptional circumstance occurred specific actions would take place
- **RECOMMEND** MPs to evaluate as part of this program of work

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