

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

MSE updates

Agenda item: 4
IPHC-2024-MSAB019-06
(A. Hicks & I. Stewart)



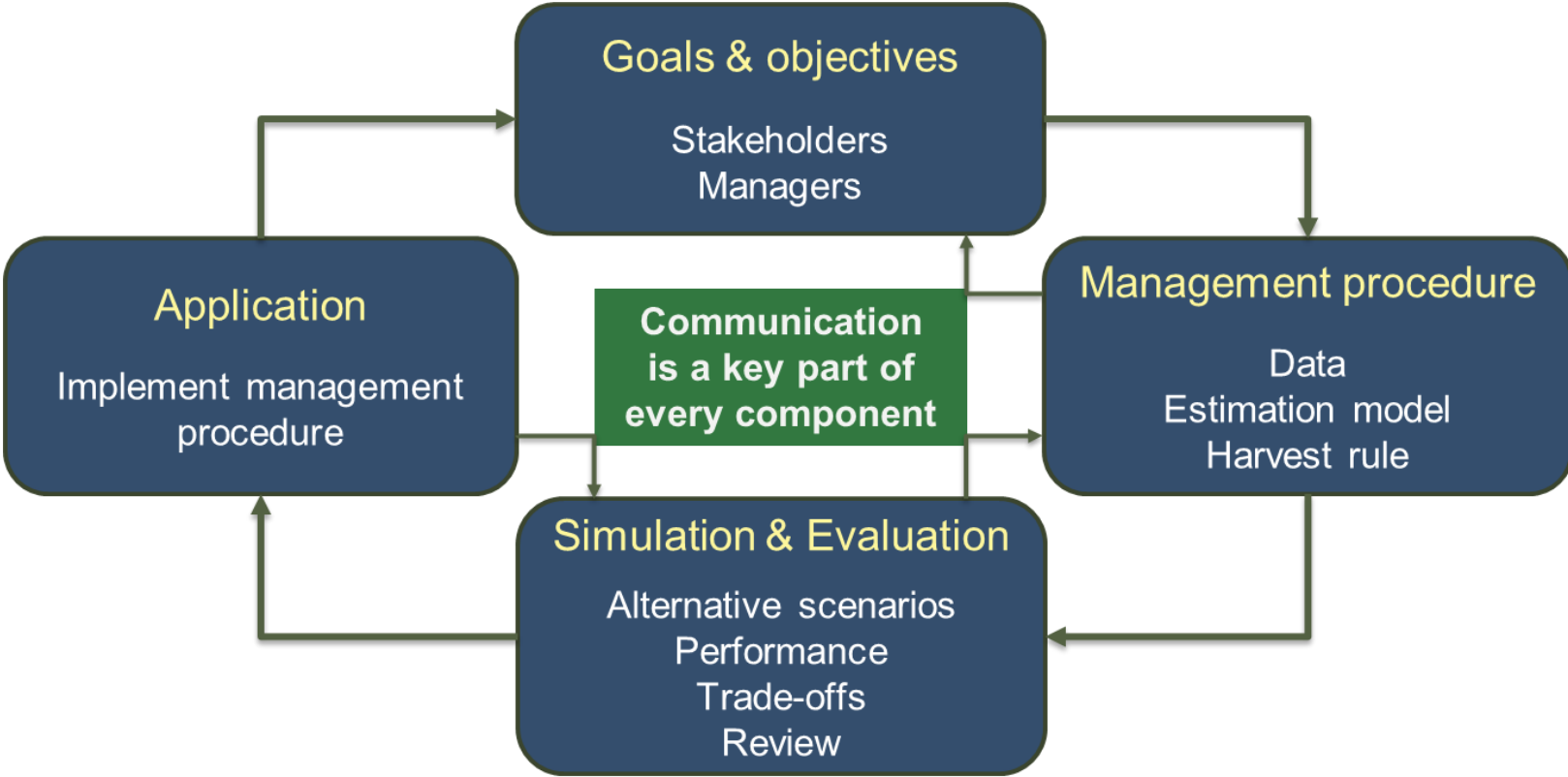
MSAB018 (2023)

- May 2018
- Nine (9) requests
 - Membership (1)
 - Evaluations (1)
 - MPs (2)
 - Objectives (3)
 - Meetings (2)

See [IPHC-2024-MSAB019-04](#)

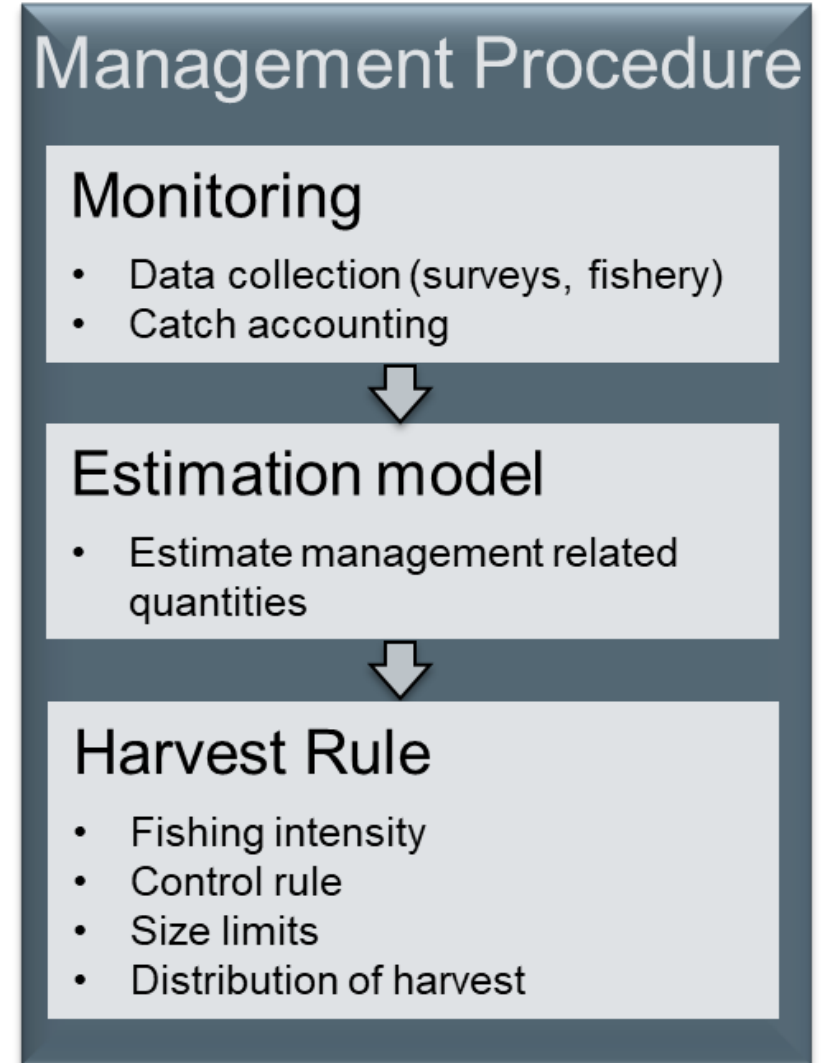
Management Strategy Evaluation (MSE)

a process to **evaluate** harvest strategies and develop a **management procedure** that is **robust** to **uncertainty** and **meets defined objectives**



Uses of MSE

- Evaluate many different elements of MPs
 - Size limits
 - Fishing intensity (i.e. SPR)
 - Assessment frequency
- Assist in the development a Harvest Strategy Policy
- Meet requirements of certification agencies
 - Marine Stewardship Council
- Design monitoring strategies
 - FISS designs
- Examine scenarios
 - Environmental effects



Harvest Strategy Policy

A framework for applying a consistent and transparent science-based approach to setting mortality limits while ensuring sustainability

- Policy and process for setting mortality limits
- Objectives and standards for management of the fishery
- Reference points
- Balancing risk, cost, and catch
- Rebuilding strategies
- Validation of the harvest strategy
- Joint management with other agencies

Harvest Strategy Policy Framework

IPHC-2023-SRB023-R, para. 30: *The SRB **RECOMMENDED** that the Commission consider revising the harvest policy to*

(i) determine coastwide TCEY via a formal management procedure and

(ii) negotiate distribution independently (e.g. during annual meetings).

Such separated processes are used in other jurisdictions (e.g. most tuna RFMOs, Mid Atlantic Fishery Management Council, AK Sablefish, etc.).

Harvest Strategy Policy Framework

- Management Procedure

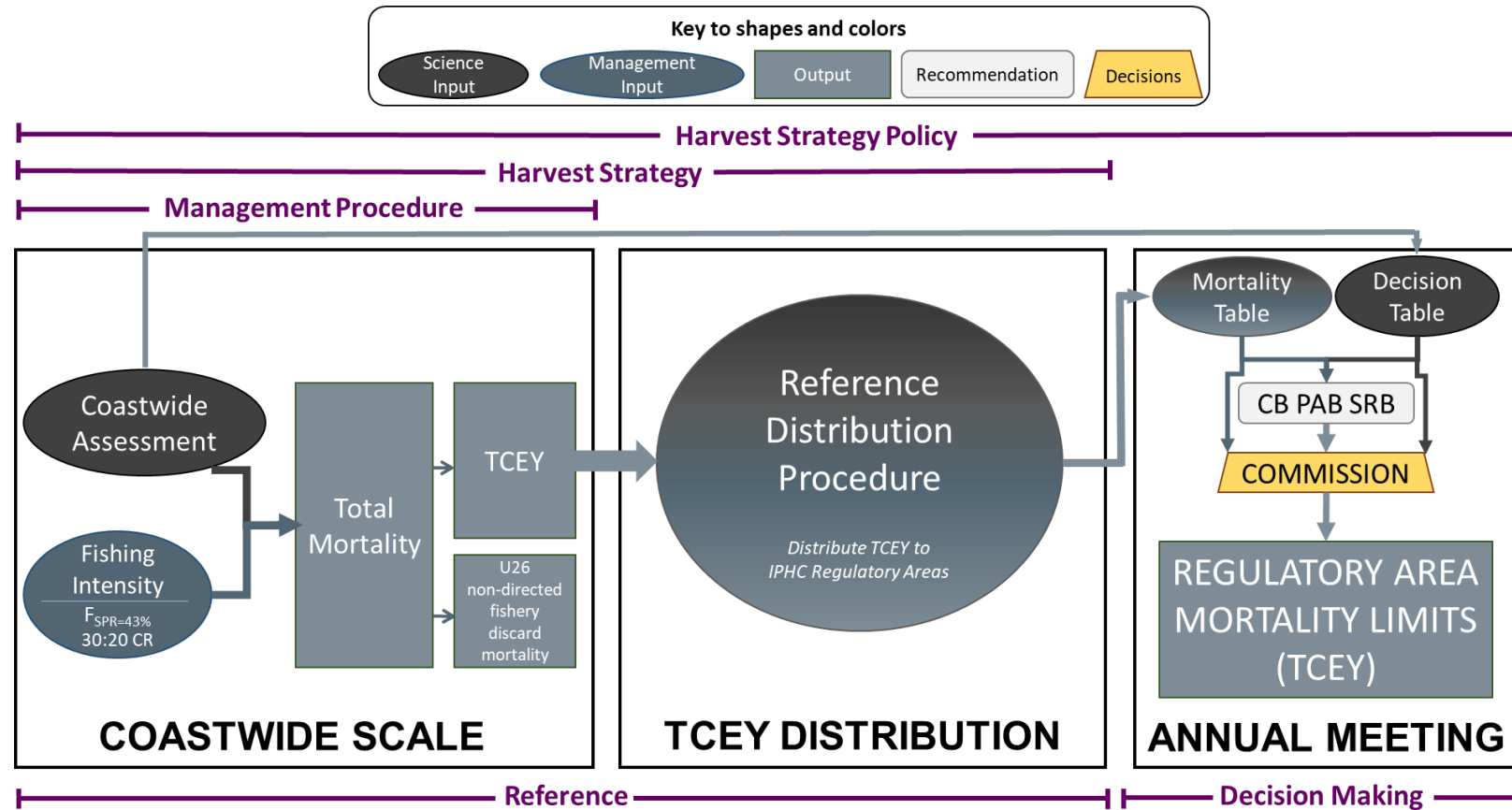
- A procedure that is formally specified and simulation tested
- Coastwide TCEY

- Harvest Strategy

- Process of determining endpoint management outcomes
- May not entirely be a specific procedure
- Reference mortality limits (TCEY) for each IPHC Regulatory Area

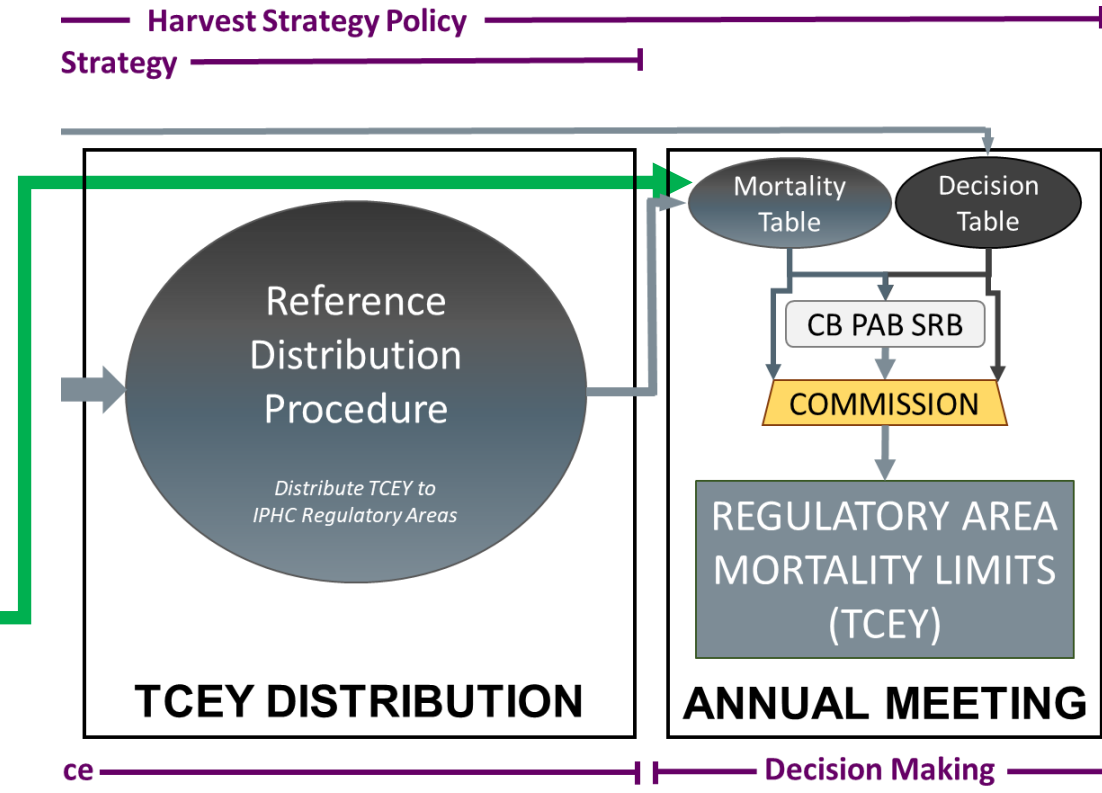
- Harvest Strategy Policy

- Decision-making and potential departure from reference



TCEY Distribution Procedure

- Separating TCEY distribution can be part of the harvest strategy and decision-making
- MSE simulations represent this entire HSP framework
 - Simulation test the MP with other uncertainties
 - Integrate over distribution and decision-making uncertainty
- A defined reference distribution procedure may be useful to inform the decision-making process



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Objectives and Performance Metrics

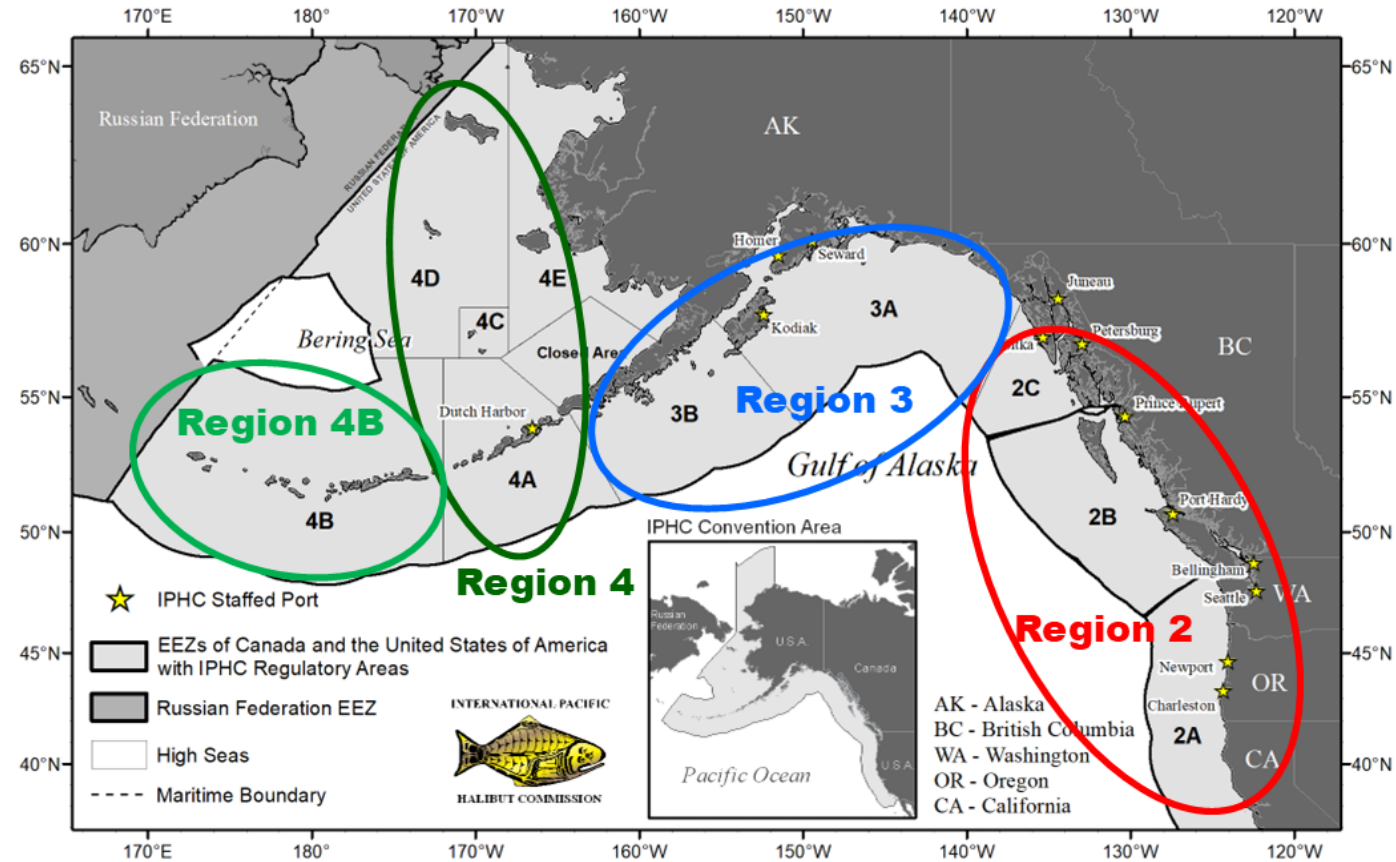
- Four priority coastwide objectives are currently endorsed for the MSE.
 - a) Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point (B20%) at least 95% of the time.
 - b) Maintain the long-term coastwide female spawning stock biomass above a biomass reference point (B36%) at least 50% of the time.
 - c) Optimise average coastwide TCEY.
 - d) Limit annual changes in the coastwide TCEY.

IPHC-2023-SRB023-R, para. 25. *The SRB **RECOMMENDED** that the Commission re-evaluate the target objective for long-term coastwide female spawning stock biomass given that estimated 2023 female spawning biomass (and associated WPUE), which was well-above the current target B36%, in part triggered harvest rate reductions from the interim harvest policy. Such ad-hoc adjustments limited the value of projections and performance measures from MSE.*

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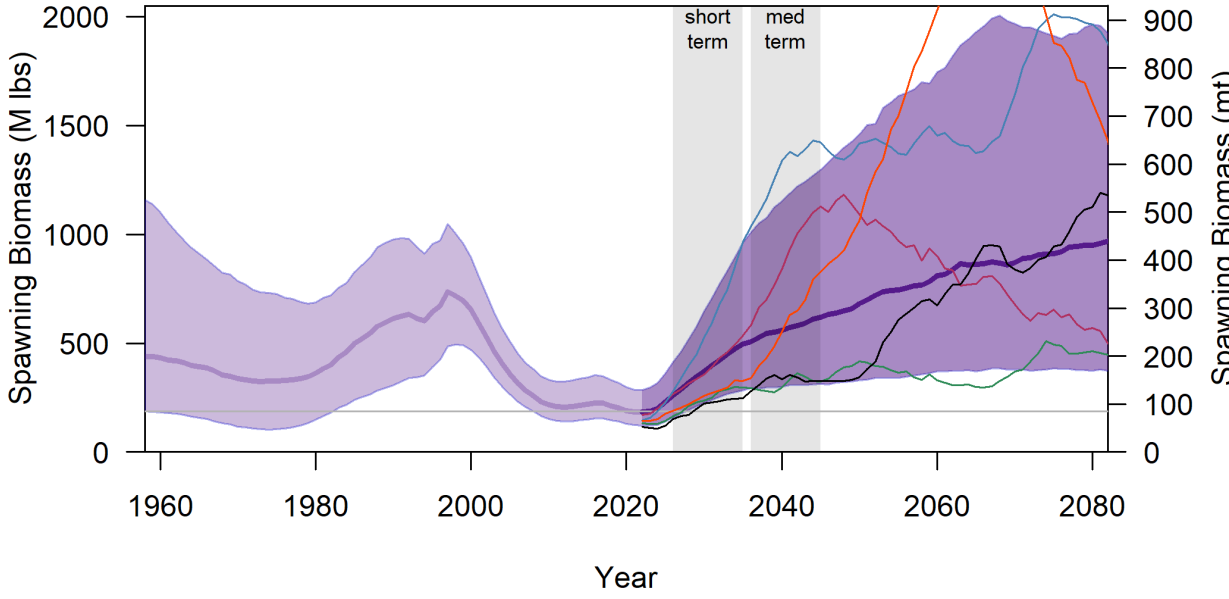
MSE Operating Model (OM)

- Spatially structured (Regions)
- Multiple fisheries (Reg Areas)
- Updated in 2023
 - 2022 stock assessment
 - FISS observations through 2022
- Next update expected in 2026

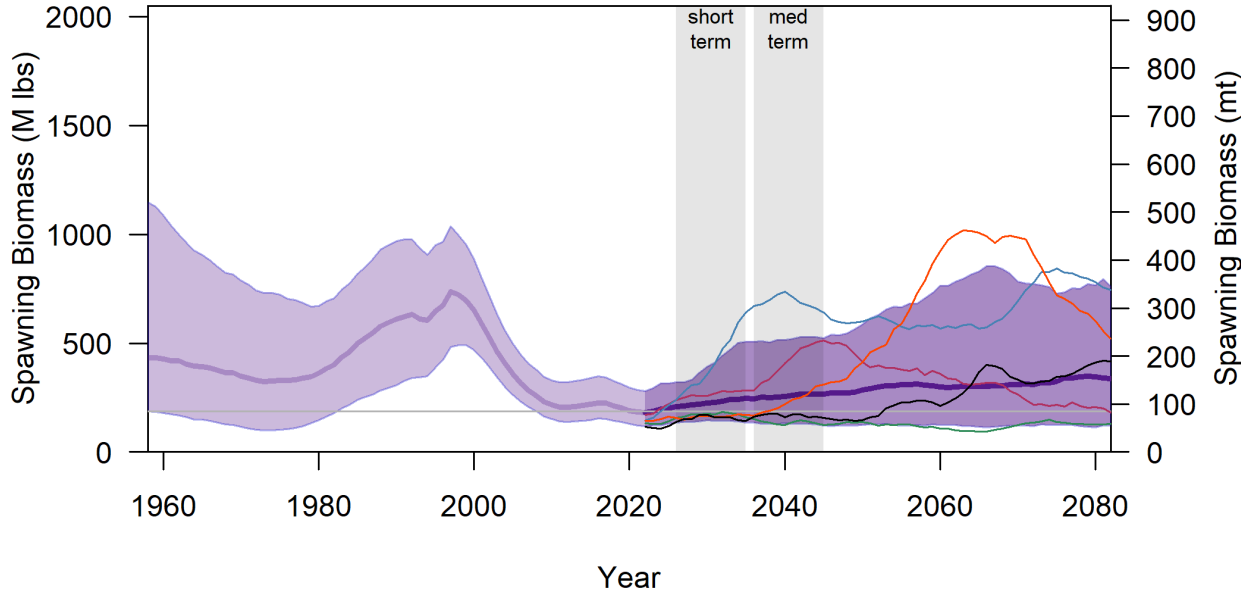


Updated OM (Spawning Biomass)

No Fishing

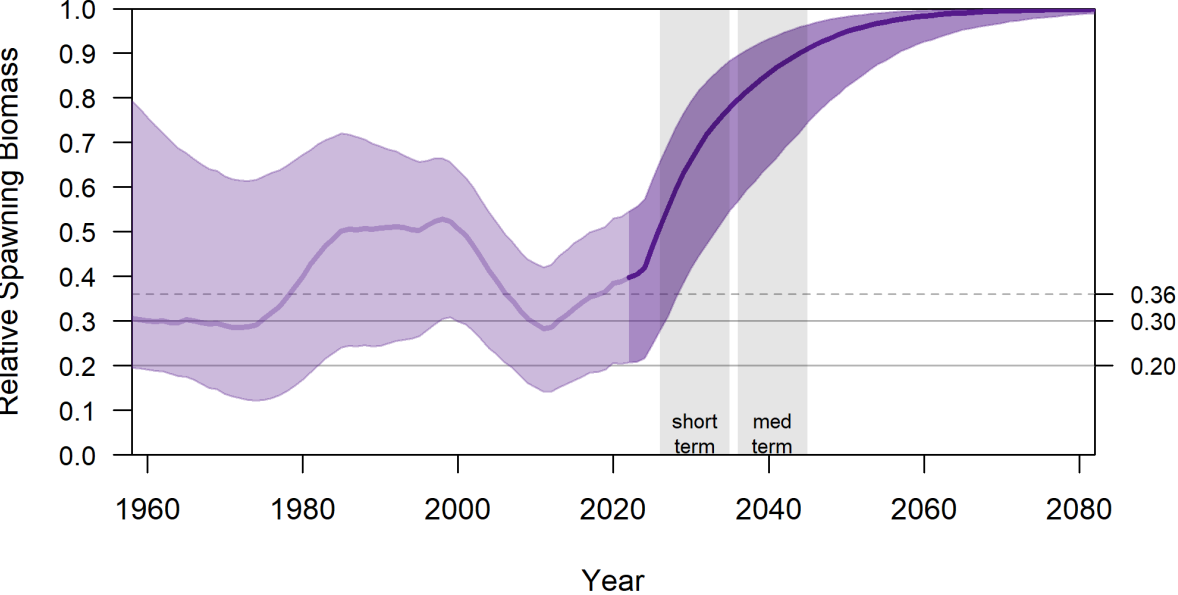


With Fishing (SPR=43%)

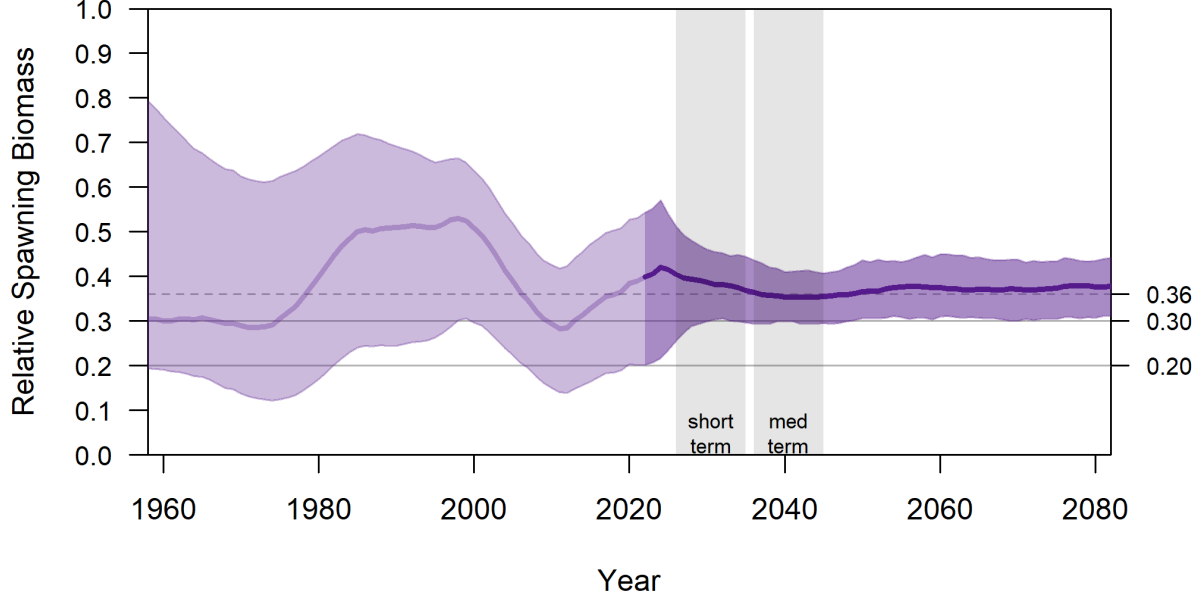


Updated OM (Relative Spawning Biomass)

No Fishing



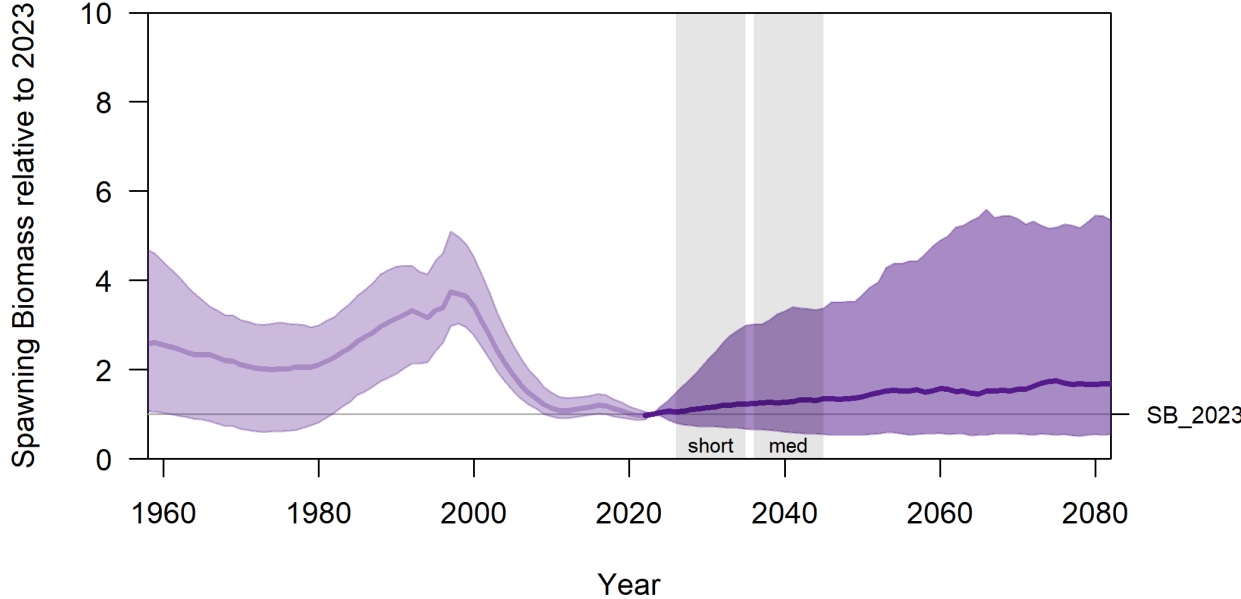
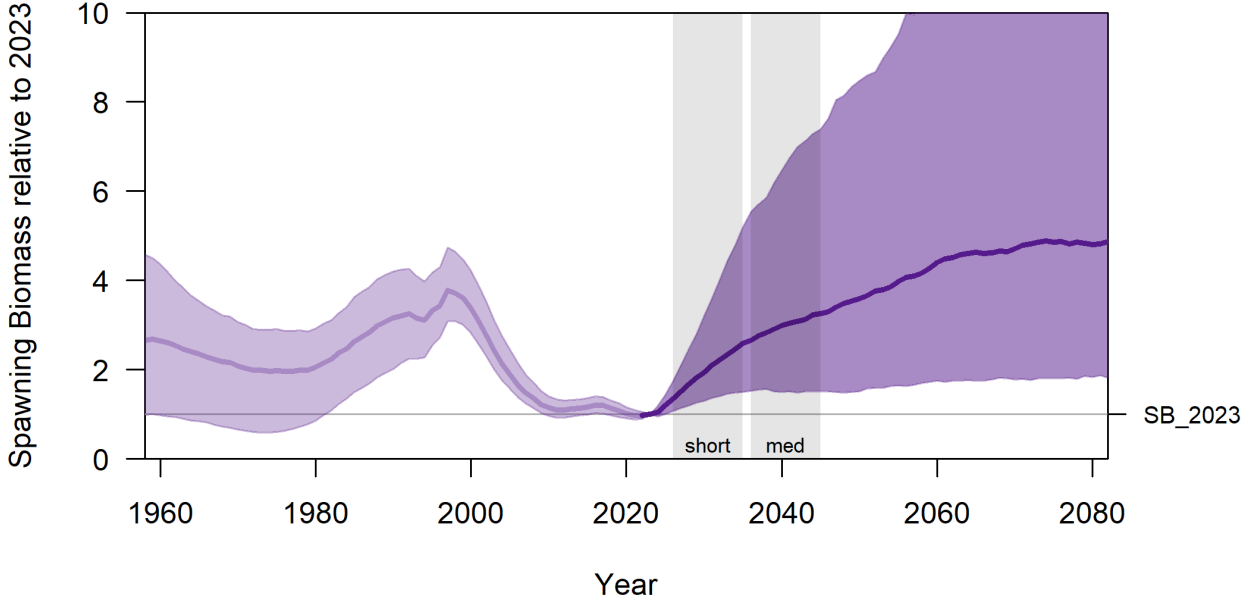
With Fishing (SPR=43%)



Updated OM (Relative to 2023 Spawning Biomass)

No Fishing

With Fishing (SPR=43%)



Comparison with previous OM

- Similar long-term results
- Short-term results differ due to additional data informing recent spawning biomass trajectory

Past results are still relevant

Period	Performance Metric	2022 OM	2023 OM
Long-term	P(RSB<20%)	PASS	PASS
	P(RSB<36%)	0.31	0.35
Short-term	Median average TCEY	59.0	59.2
	Median AAV TCEY	18.1%	17.0%
	$P(SB_{2027-2036} < SB_{2023})$	0.17	0.29

Management Procedures (MPs)

[IPHC-2023-MSAB018-R](#), para. 29. *The MSAB REQUESTED that subsequent to an agreement on a distribution procedure by the Commission, the evaluation of annual and multi-year assessments include, but not limited to, the following concepts.*

- a) *Annual changes in the TCEY driven by FISS observations in non-assessment years of a multi-year MP;*
- b) *A constraint on the coastwide TCEY to reduce inter-annual variability and the potential for large changes in assessment years of a multi-year. This may be a 10% or 15% constraint, a slow-up fast-down approach, or similar approach;*
- c) *A smoothing element in the distribution procedure to account for uncertainty in the estimates of stock distribution and reduce the variability in area-specific TCEYs. For example, this may include a 3-year rolling average of stock distribution estimates;*
- d) *SPR values ranging from 30% to 56% and alternate trigger reference points in the harvest control rule.*

MPs: assessment frequency

- Conducting assessments
 - annually (every year),
 - biennially (every 2nd year), or
 - triennially (every third year)
- Years with no assessment
 - A simpler empirical approach
 - The same coastwide TCEY from the previous year until an assessment is done
 - Update the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE
- Use a simple approach every year and conduct an assessment as needed to verify management and determine stock status

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MPs: assessment frequency costs/benefits

Costs		Benefits
Detailed management information not available every year		Reduced interannual variability in the TCEY
TCEY in non-assessment year may not follow stock trends (especially with constant TCEY)		Multi-year stability and short-term predictability of the TCEY
Previous simulations showed a potential small loss in yield when using a constant TCEY across non-assessment years		Use of the annual FISS index in a transparent process to determine TCEY
Previous simulations showed a higher chance of smaller stock size		More focused assessment research
		Potential for additional time to collaborate on research supporting the stock assessment within Secretariat
		Triennial assessment frequency consistent with current full assessment cycle
		Empirical rule has precedent at other fisheries commissions

MPs: retrospective analysis of empirical rule

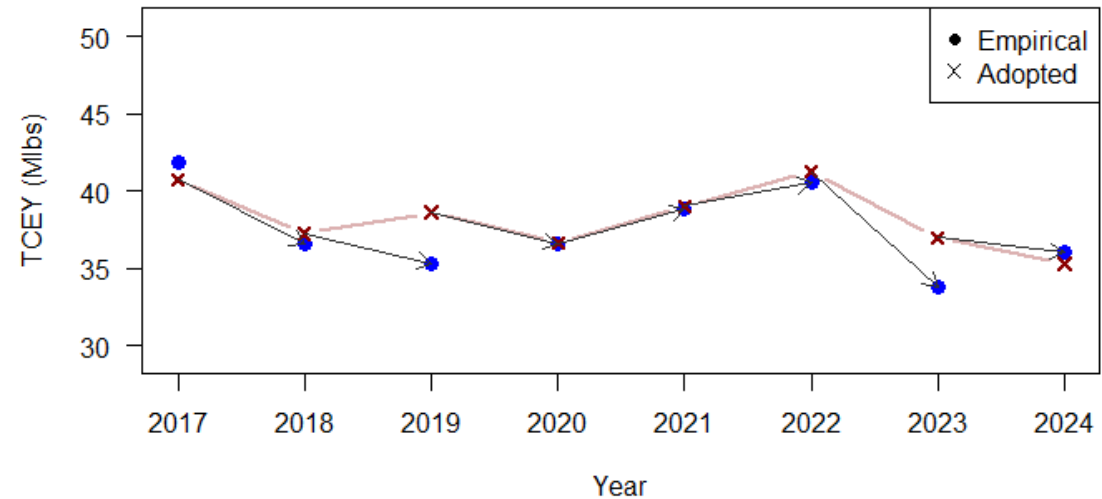
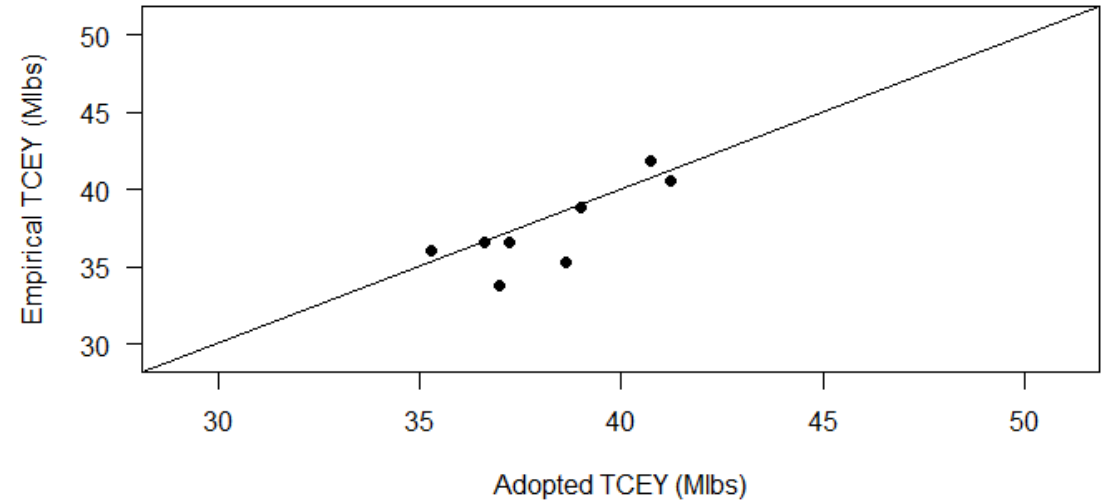
IPHC-2023-MSAB018-R, para. 33: *The MSAB REQUESTED a retrospective analysis of an empirical rule that adjusts the coastwide TCEY proportionally to the change in the coastwide FISS 032 WPUE to compare the coastwide TCEY determined from the assessment to the TCEY determined empirically.*

- Individual years since 2017
 - Different FISS analysis before 2017
- Difficult to compare to assessment because assessment has been updated, used different reference SPRs, and empirical based on adopted

$$TCEY_{y+1} = TCEY_y \times \frac{WPUE_{032,y}}{WPUE_{032,y-1}}$$

MPs: retrospective analysis of empirical rule

- Empirical rule was similar, but sometimes quite a bit less than adopted
- In 2017 and 2024 empirical was greater than adopted



MPs: assessment frequency performance metrics

[IPHC-2023-MSAB019-R](#), para. 38. *The MSAB REQUESTED new performance metrics representing the change in the TCEY in non-assessment years and the change in TCEY in assessment years be developed for the evaluation of multi-year assessment MPs.*

- Current performance metrics are averaged over a 10-year period
- What is the objective?
 - Smaller, on average, changes in TCEY for any year **OR**
 - A stable 1- or 2-year period with a larger biennial or triennial change

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MPs: fishing intensity (SPR)

[IPHC-2023-MSAB018-R](#), para. 29. *The MSAB REQUESTED that subsequent to an agreement on a distribution procedure by the Commission, the evaluation of annual and multi-year assessments include, but not limited to, the following concepts.*

- d) *SPR values ranging from 30% to 56% and alternate trigger reference points in the harvest control rule.*
- Fishing intensity is determined by finding the fishing rate (F) that would result in a defined spawning potential ratio (F_{SPR})
 - SPR is a better indicator of fishing intensity than F because F depends on current conditions and demographics
 - $F_{SPR=35\%}$ is the MSY proxy
 - $F_{SPR=40\%}$ is the MEY proxy

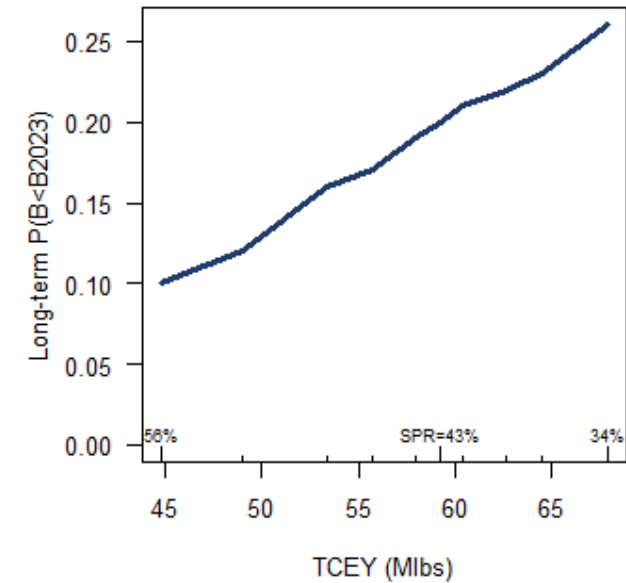
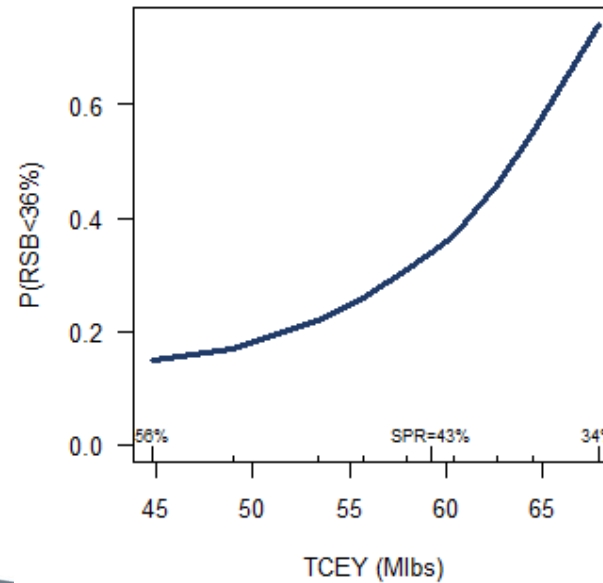
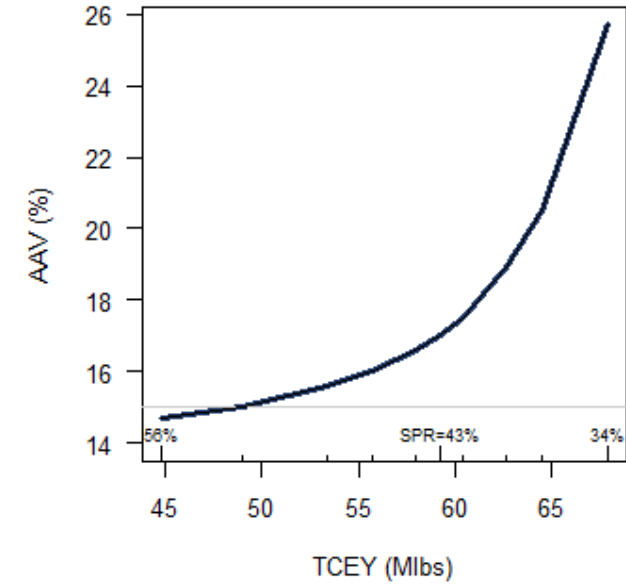
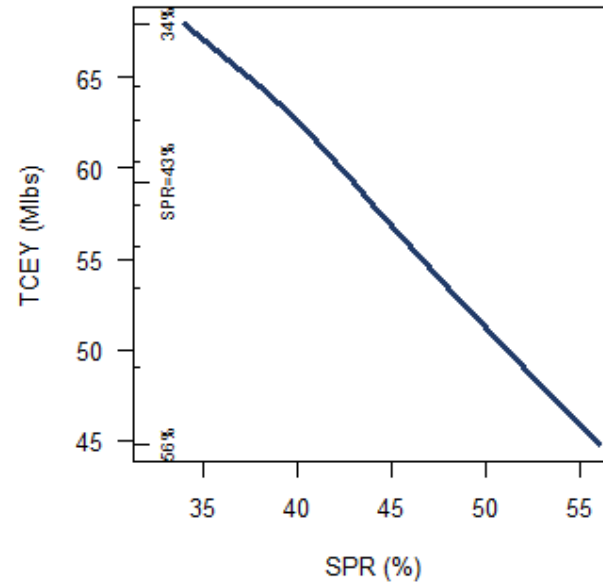
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MPs: Fishing Intensity (performance metrics)

		High Fishing intensity				SPR			Low Fishing intensity		
Term	Performance Metric	34	38	40	42	43	44	46	48	52	56
Long	P(RSB<20%)	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
	P(RSB<36%)	0.74	0.55	0.46	0.37	0.35	0.31	0.26	0.22	0.17	0.15
Short	Median TCEY	67.9	64.5	62.6	60.4	59.2	58.0	55.7	53.4	49.0	44.8
	Median AAV TCEY	25.7%	20.5%	18.9%	17.5%	17.0%	16.6%	16.0%	15.6%	15.0%	14.7%

MPs: Fishing Intensity

- Yield has decreasing slope at higher fishing intensity
 - 30:20 control-rule
 - Also increases variability in TCEY
- Probability long-term SB is less than 2023 SB is nearly linear
- As yield decreases, stock size is larger and variability in yield is smaller



MPs: constraints

- MSAB has identified two methods to reduce inter-annual variability
 - Reduce fishing intensity
 - Add a constraint to the change in the TCEY
- Recent decisions have reduced annual variability, similar to a constraint

Percent Change in TCEY from previous year

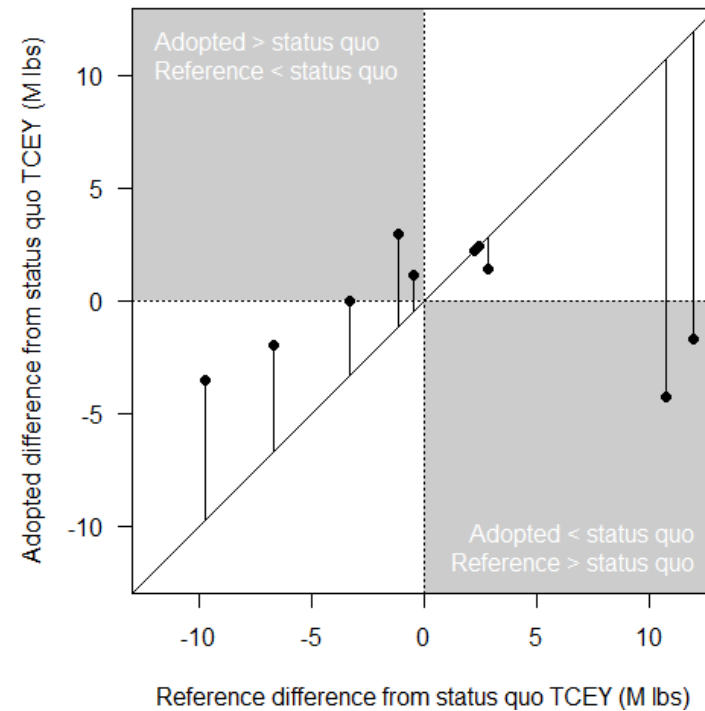
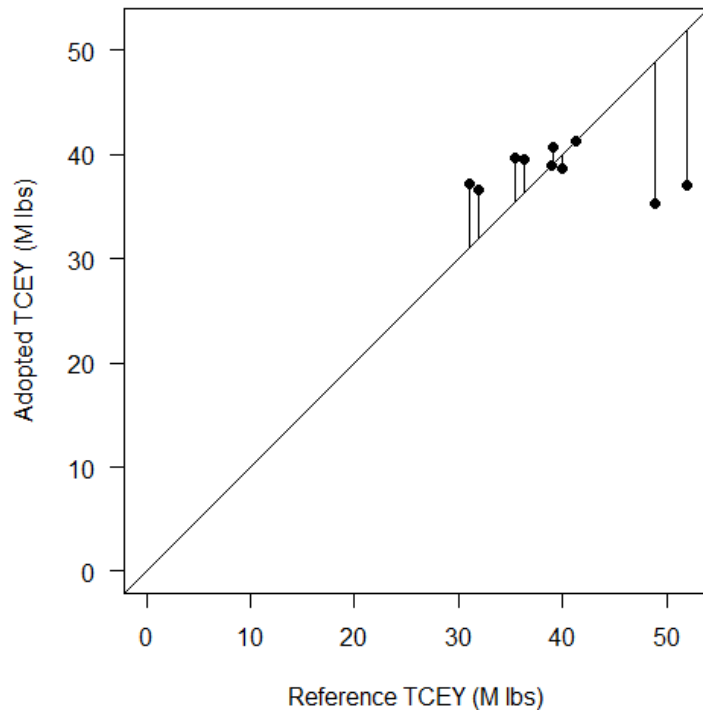
	Coastwide Adopted	Coastwide Reference
2015	8.1%	6.0%
2016	-0.1%	2.3%
2017	2.9%	7.7%
2018	-8.7%	-20.7%
2019	3.8%	29.0%
2020	-5.2%	-20.3%
2021	6.6%	22.3%
2022	5.7%	5.7%
2023	-10.3%	26.0%
2024	-4.6%	-5.9%

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MPs: constraints (recent decisions)

- Decisions tended to remain between 30 and 40 Mlbs
- When reference was near status quo, decision remained near status quo



Exceptional Circumstances

- Events beyond the expected range of the MSE evaluation
- Trigger specific actions that should be taken to re-examine the harvest strategy
- Defines a process for deviating from the harvest strategy
 - Decision-making variability is included in the MSE simulations
- 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 a process for Exceptional Circumstances

Events

- Coastwide all-sizes FISS observations are beyond simulated FISS index
- Regional FISS all-sizes distribution is beyond simulated FISS distribution
- Persistent for two or more consecutive years
- A new understanding or perception of the stock

Actions

- Identify why it occurred
- Decide what can be done to resolve it
- Conduct MSE simulations
- Consult with SRB and MSAB

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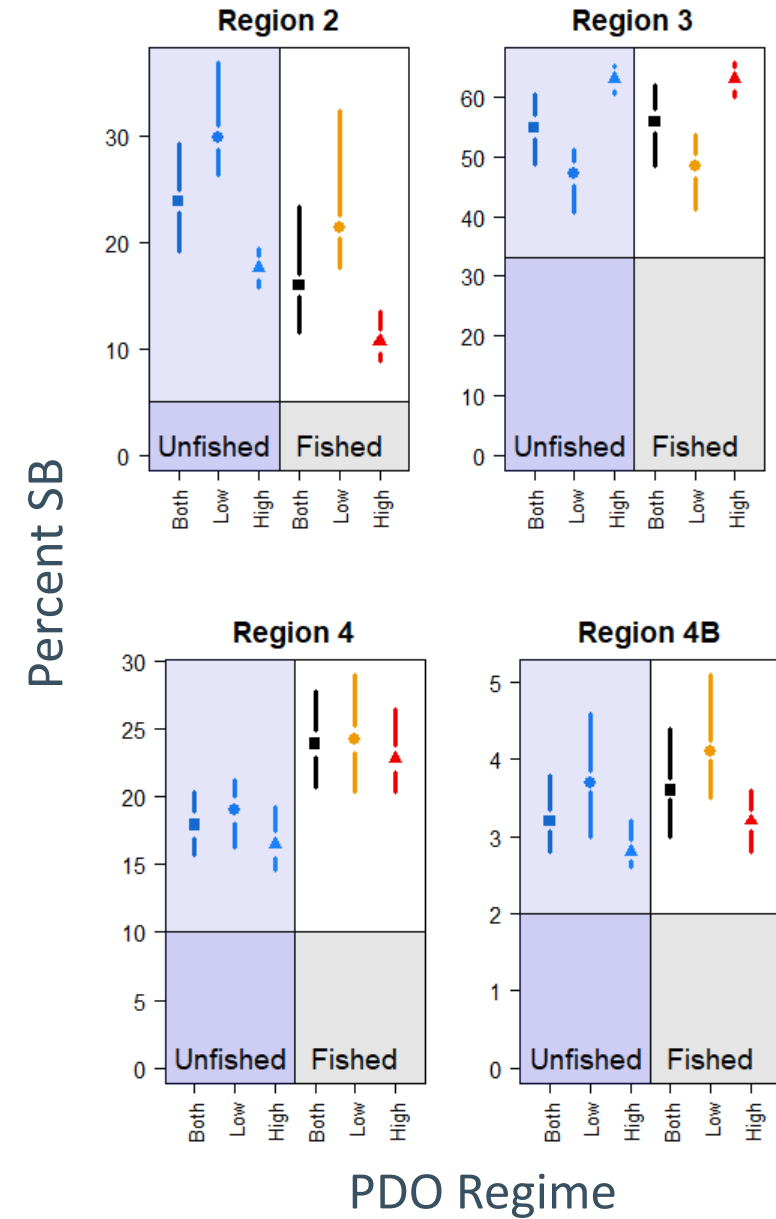
Environment vs fishing

[IPHC-2023-MSAB018-R](#), para. 21. *The MSAB REQUESTED that outreach materials be developed that synthesize the effect of the PDO (e.g. via recruitment) on the coastwide and regional stock dynamics and the relative effect of fishing. This may be a pamphlet or poster to be reviewed at a future MSAB meeting.*

- Update of results that were presented at MSAB018
- Poster at AM100 ([IPHC-2024-MSAB019-INF01](#))
- Distribution of SB affected by fishing and environment (PDO)
 - Effects specific to each Biological Region

Environment vs Fishing results

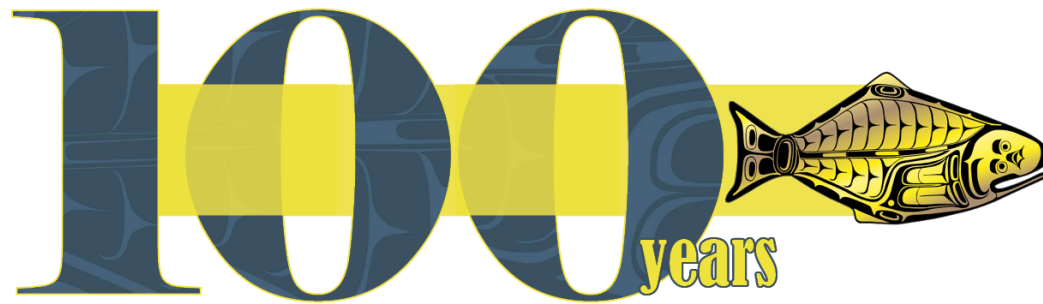
	PDO	Both	Low	High
Long-term metrics	Median RSB	38.8%	37.6%	39.2%
	P(RSB<20%)	<0.001	<0.001	<0.001
	P(RSB<36%)	0.238	0.329	0.157
	Median TCEY (Mlbs)	65.6	51.4	83.0
	Median AAV TCEY	5.2%	4.5%	4.5%
	Median TCEY Region 2 (Mlbs)	20.5	19.1	21.2
	Median TCEY Region 3 (Mlbs)	33.7	23.0	48.7
	Median TCEY Region 4 (Mlbs)	8.1	6.6	9.4
	Median TCEY Region 4B (Mlbs)	2.4	2.2	2.6



Recommendations

- The MSAB **NOTE** paper IPHC-2024-MSAB019-06 presenting recent MSE work including the 2023 operating model, exceptional circumstances, simulations exploring the effects of fishing and the environment, and an evaluation of various levels of fishing intensity.

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