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MSE Program of Work

Agenda item: 5

IPHC-2024-MSAB019-07

(A. Hicks & I. Stewart)

MSE Program of Work

In support of adopting a Harvest Strategy Policy

- Management Procedures to investigate and adopt
- Clear goals and objectives
- Exceptional Circumstances and actions to take
- Additional considerations

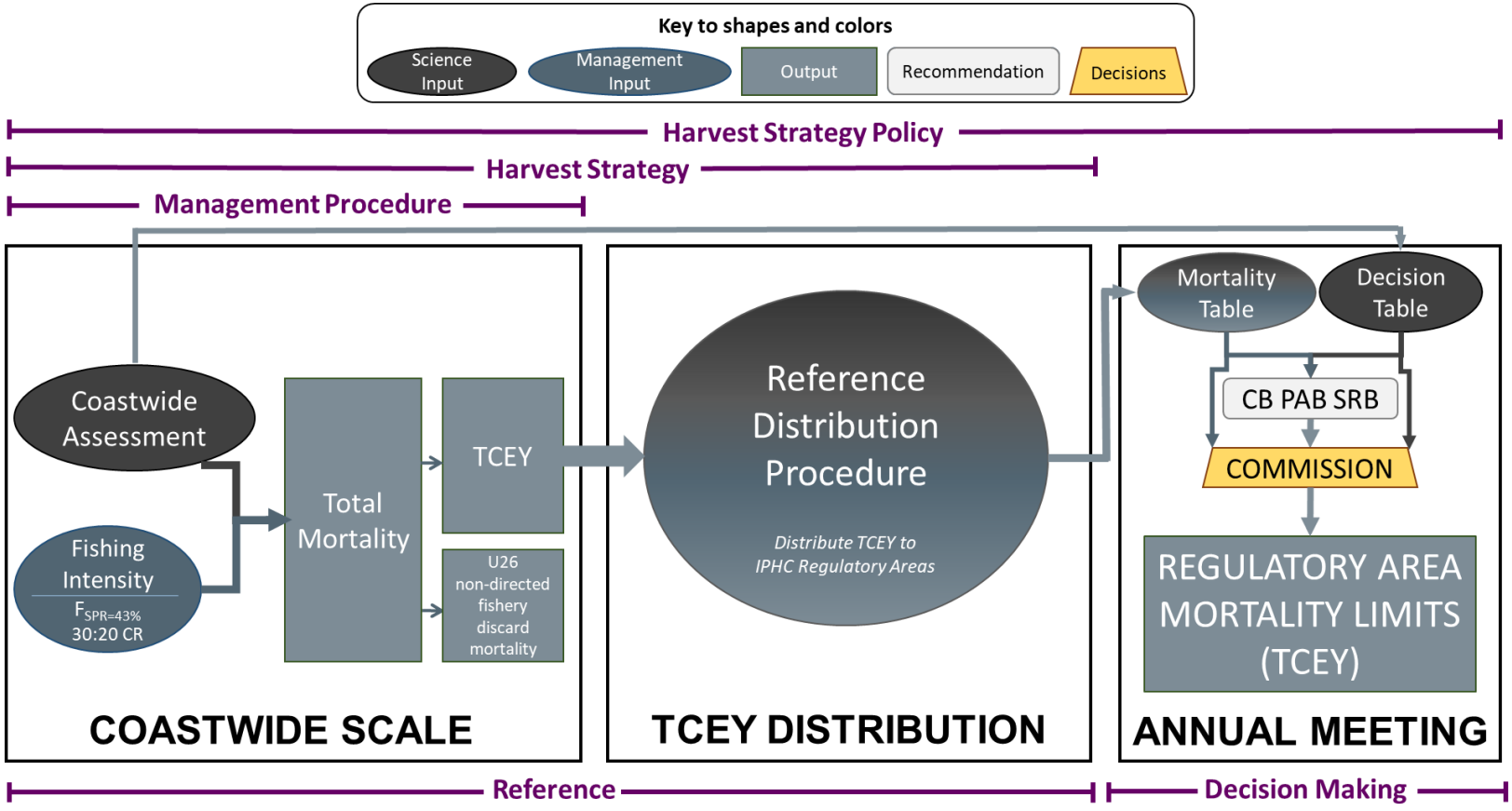
Harvest Strategy Policy

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

- 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



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
    1. The same coastwide TCEY from the previous year until an assessment is done
    2. Update the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE
    3. Update the coastwide TCEY proportionally to the change in the coastwide FISS all-sizes WPUE
    4. Use projected TCEY's from the stock assessment with the reference SPR and control rule
    5. Incorporate commercial fishery catch-rates into the empirical rule
- Only simpler model used to set coastwide TCEY

MPs: constraints

- Limit annual changes
- Potential methods
  - No constraint (lower fishing intensity)
  - A maximum 15% change in the coastwide TCEY in either direction from one year to the next.
  - A slow-up/fast-down approach where the TCEY increases by one-third of the increase suggested by the unconstrained MP or decreases by one-half of the decrease suggested by the unconstrained MP.
  - A multi-year TCEY set constant for a specified number of years.
  - An additional component specifying to not exceed a maximum fishing intensity consistent with an SPR of 35%

MPs: fishing intensity (SPR)

- Fishing intensity is determined by finding the fishing rate (F) that would result in a defined spawning potential ratio (F_{SPR})
- F_{SPR}=35% is the MSY proxy
- F_{SPR}=40% is the MEY proxy
- Recent TCEYs associated with an SPR above 50%

Distribution of the TCEY

- NOT part of the MP (but important to the simulations)
- Simulate uncertainty in the distribution
  1. Use multiple distribution procedures
  2. Use a single distribution procedure and add uncertainty
  3. Use recent years to define percentage of TCEY in each IPHC Regulatory Area and add uncertainty

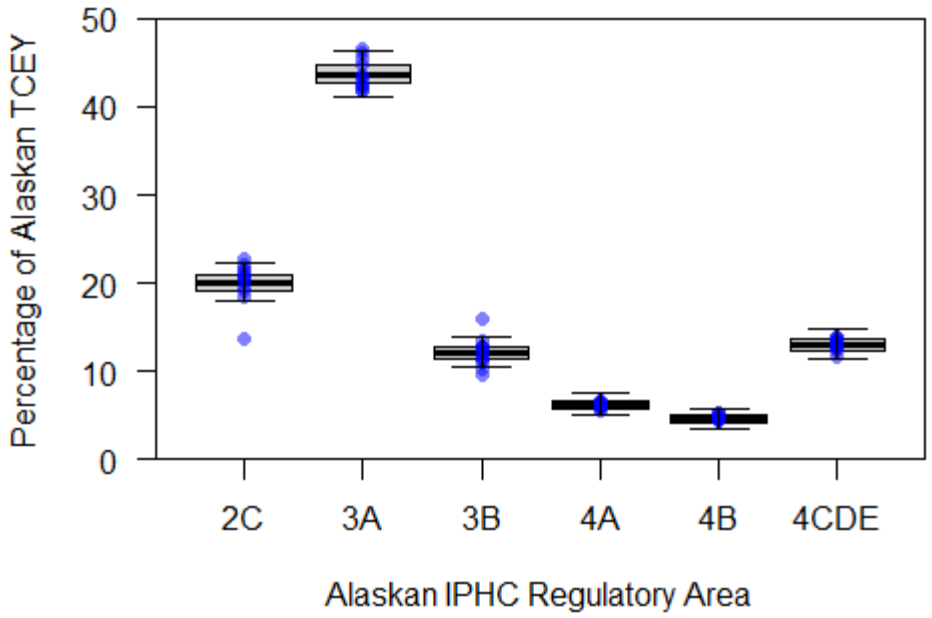
Method to distribute TCEY

- 2A = 1.65 Mlbs
- 17% < 2B < 21%
- AK areas could be distributed using percentages or with a procedure

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2013	2.4%	17.1%	11.0%	37.5%	12.9%	5.3%	4.2%	9.4%
2014	3.0%	20.8%	14.9%	32.9%	10.2%	4.3%	4.1%	9.8%
2015	2.7%	20.0%	15.6%	32.8%	9.4%	4.9%	3.9%	10.8%
2016	3.2%	20.8%	16.5%	32.2%	8.6%	4.9%	3.5%	10.3%
2017	3.6%	20.4%	17.3%	31.8%	9.8%	4.4%	3.3%	9.4%
2018	3.5%	19.1%	17.0%	33.7%	8.8%	4.7%	3.4%	9.7%
2019	4.3%	17.7%	16.4%	35.0%	7.5%	5.0%	3.8%	10.4%
2020	4.5%	18.7%	16.0%	33.3%	8.5%	4.8%	3.6%	10.7%
2021	4.2%	17.9%	14.9%	35.9%	8.0%	5.3%	3.6%	10.2%
2022	4.0%	18.3%	14.3%	35.3%	9.5%	5.1%	3.5%	9.9%
2023	4.5%	18.3%	15.8%	32.7%	9.9%	4.7%	3.7%	10.4%
2024	4.7%	18.3%	16.4%	32.2%	9.8%	4.6%	3.5%	10.5%

AK only percentage of TCEY

Year	2C	3A	3B	4A	4B	4CDE
2013	13.7%	46.6%	16.0%	6.6%	5.3%	11.7%
2014	19.6%	43.2%	13.4%	5.6%	5.3%	12.8%
2015	20.2%	42.4%	12.1%	6.4%	5.0%	13.9%
2016	21.7%	42.4%	11.3%	6.5%	4.6%	13.5%
2017	22.7%	41.9%	12.9%	5.8%	4.3%	12.4%
2018	22.0%	43.6%	11.4%	6.0%	4.4%	12.6%
2019	21.0%	44.8%	9.6%	6.4%	4.8%	13.3%
2020	20.8%	43.4%	11.1%	6.2%	4.7%	13.9%
2021	19.1%	46.1%	10.3%	6.8%	4.6%	13.1%
2022	18.5%	45.5%	12.2%	6.6%	4.5%	12.8%
2023	20.5%	42.3%	12.9%	6.1%	4.8%	13.5%
2024	21.3%	41.8%	12.7%	5.9%	4.6%	13.6%



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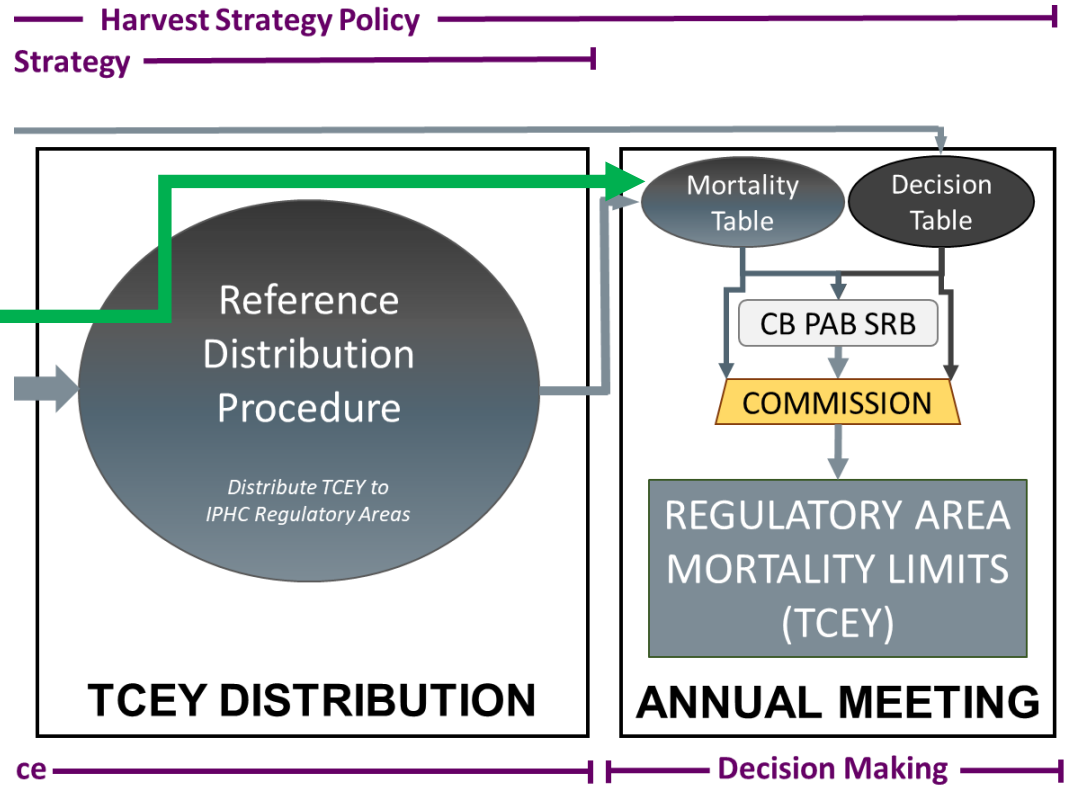
Reference TCEY Distribution

- A defined reference distribution procedure may be useful to inform the decision-making process
  - Starting point for decision-making
  - Able to present mortality tables before AM
  - Used in MSE simulations (with uncertainty)



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.

Measurable Objectives

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 the long-term coastwide female spawning stock biomass above a biomass limit reference point ($B_{20\%}$) at least 95% of the time	B < Spawning Biomass Limit (B_{Lim}) B_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(B < B_{Lim})$ PASS/FAIL Fail if greater than 0.05
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 Reference (B_{Thresh}) B_{Thresh}=$B_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(B < B_{Thresh})$ Fail if greater than 0.5
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

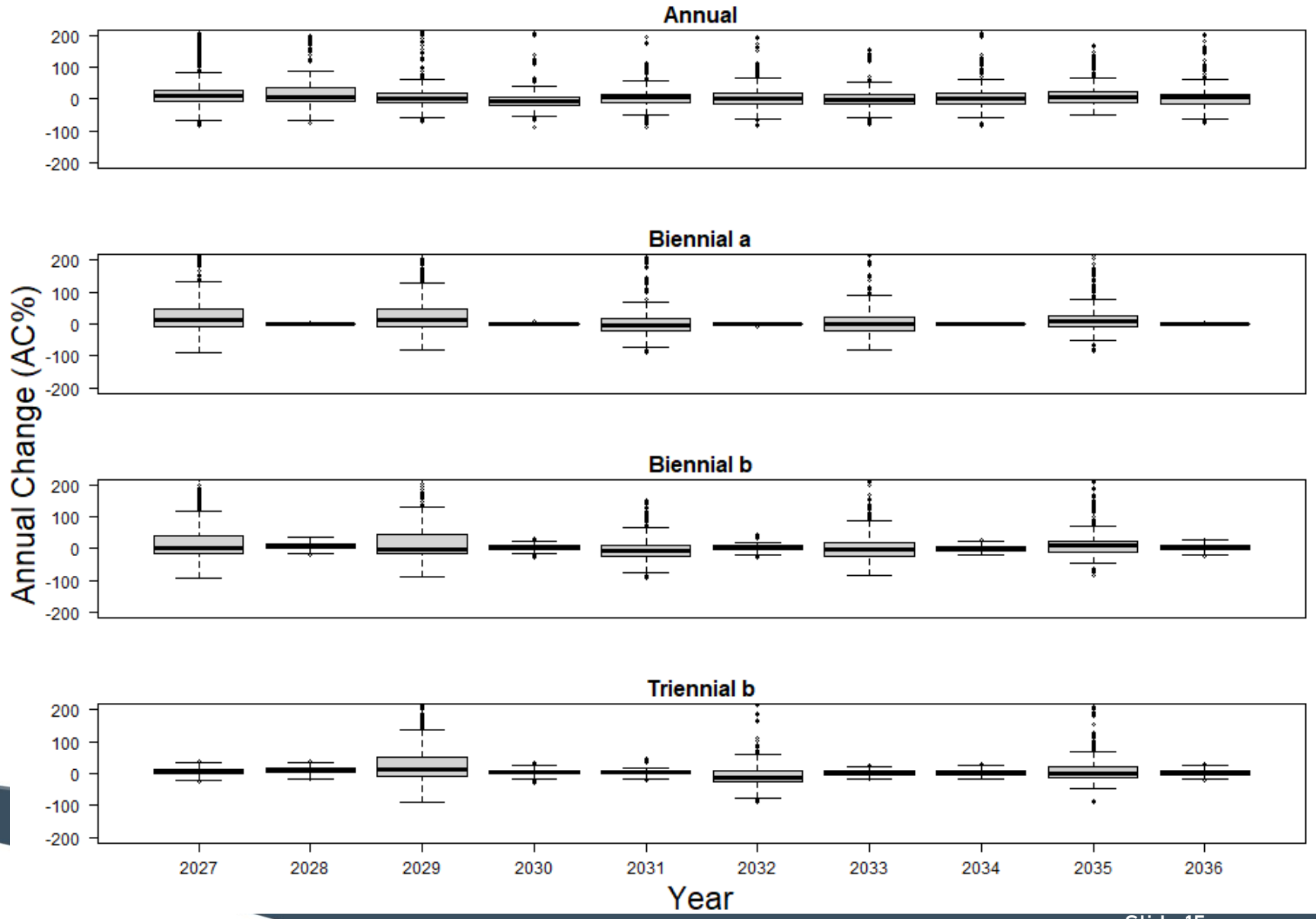
Performance metric for multi-year assessments

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 average over a 10-year period
- We can look at Annual Change (AC) for individual years
  - Relative percent change in TCEY from previous year

Annual Change (AC)

- Need Performance Metrics that are consistent across all MPs to allow each to be evaluated against each other



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Potential assessment frequency performance metrics

- Reporting the average annual variability (AAV) calculated separately for only the years with an assessment and only the years without an assessment.
  - This can be challenging because the same years need to be compared otherwise the performance metric is confounded with change in the population.
- The percent change in the TCEY from the previous year calculated separately for assessment years and non-assessment years summarized over a 10-year period and all simulations.
  - As with the AAV, this can be challenging to make sure that the same years are included in the calculation to avoid confounding from other factors.
- The maximum annual change observed in a ten-year period.
  - This would be consistent
  - As with other metrics, assuring that the same years are compared is essential, if separating by assessment and non-assessment years.

Consider the objectives

Smaller, on average, changes in TCEY for any year

- Add a constraint to the MP
- Measure with AAV and AC over a ten-year period

A stable 1- or 2-year period with a larger biennial or triennial change

- Less frequent assessments with lower variability in TCEY for non-assessment years
- Measure with chance that any annual change exceeds threshold
  - P(AC > 15% in any three years)

Considering the variability objective

- If current measurable outcomes DO NOT encompass the objectives
  - What concepts are missing?
  - Is a period of stability desired? How stable? How long?
  - Is a more predictable and transparent rule to determine the coastwide TCEY desired?
  - What is the maximum allowable change in any year? How many years can exceed that?
  - Is a 10-year period appropriate to measure stability?
  - Is stability prioritized below, the same, or above the yield objective?
  - Is a maximum percentage desired or a maximum absolute change?

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
2.3. Limit Variability in Mortality Limits	Limit annual changes in the coastwide TCEY	Annual Change (AC) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Median coastwide Average Annual Variability (AAV)	Short-term		Median AAV

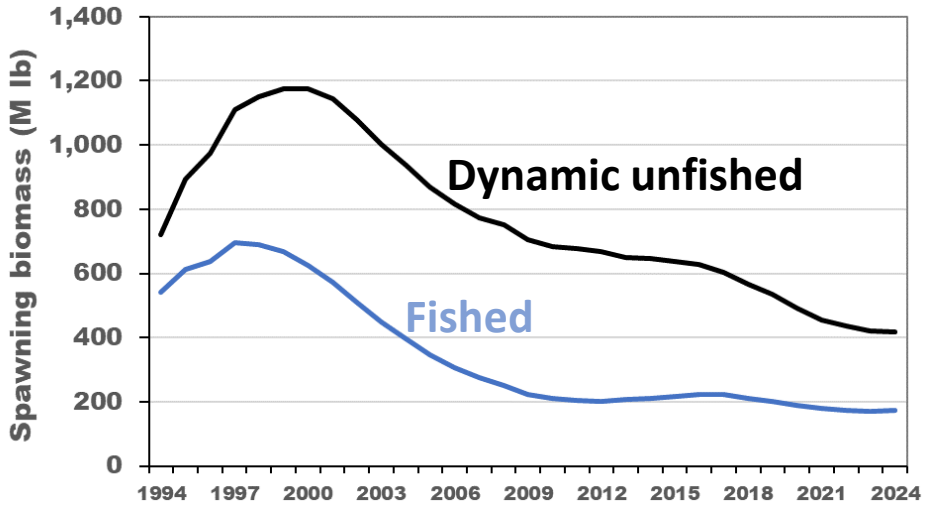
Different performance metrics

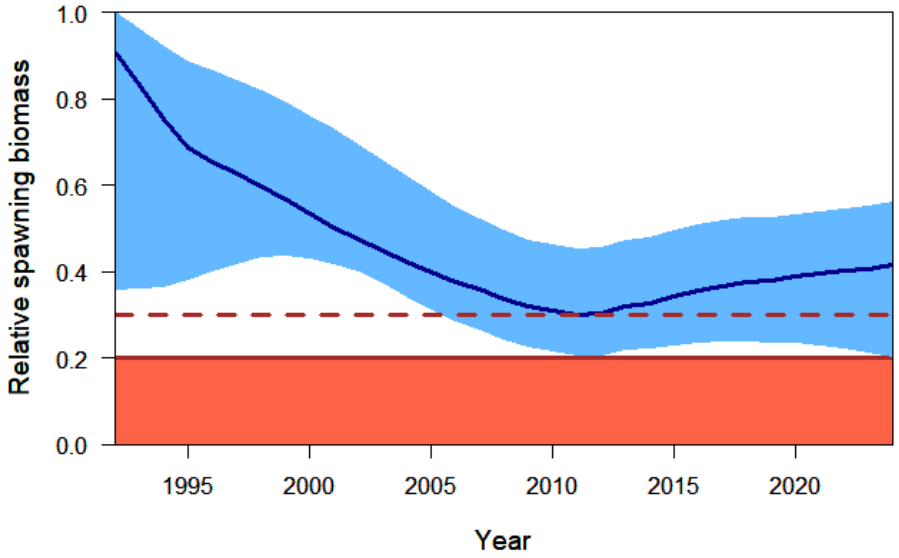
Period	Performance Metric	Annual	Biennial Static	Biennial WPUE	Triennial WPUE
Short-term	Median average TCEY	58.33	57.76	58.46	58.32
	P(any1 change TCEY > 15%)	1.0000	0.9955	0.9918	0.9600
	P(any2 change TCEY > 15%)	0.9955	0.9418	0.9655	0.8700
	P(any3 change TCEY > 15%)	0.9055	0.6818	0.8091	0.6282
	P(any4 change TCEY > 15%)	0.7064	0.3864	0.5436	0.3145
	P(any5 change TCEY > 15%)	0.5045	0.1109	0.2818	0.0773
	P(any decrease TCEY > 15%)	0.9182	0.8236	0.9464	0.8200
	P(any increase TCEY > 15%)	0.9636	0.9682	0.9709	0.9164
	Median AAV TCEY	17.8%	13.2%	17.0%	14.1%

Maximum change in a 10-year period?

An objective related to absolute spawning biomass

- Conservation objective “maintain long-term spawning biomass above a biomass limit reference point”
  - The spawning biomass is relative dynamic spawning biomass
    - Dynamic spawning biomass changes through time with changes in the population
    - Measures the effect of fishing instead of the effects of fishing and the environment

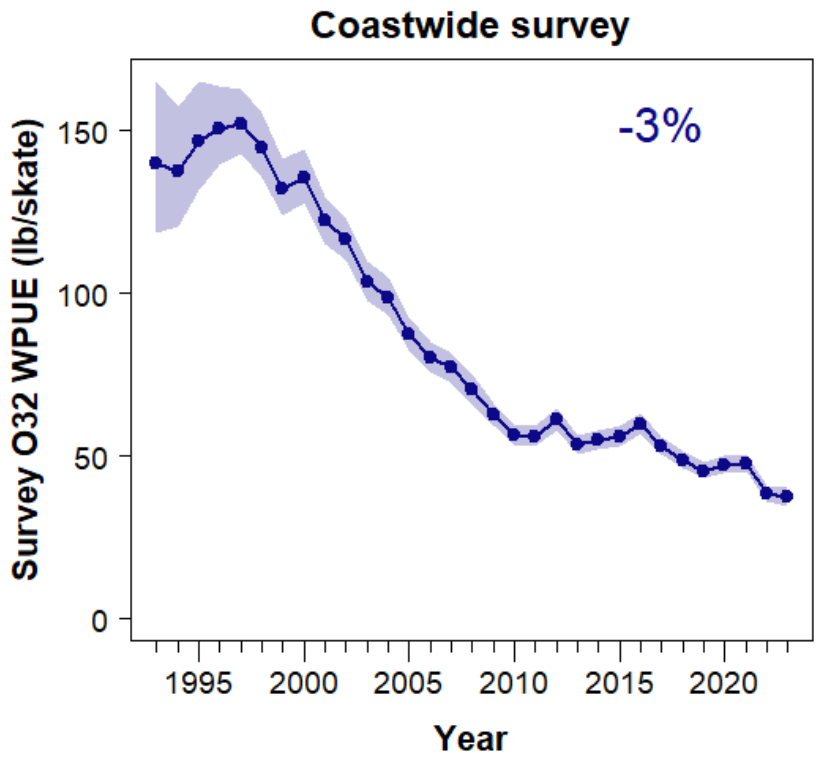


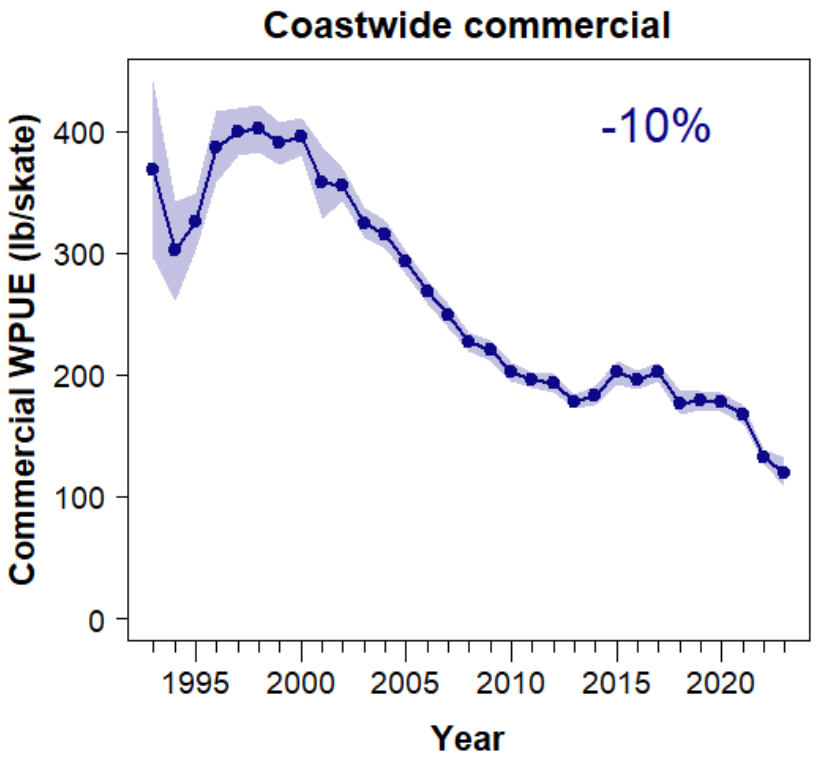


Observations

- Coastwide FISS WPUE and Commercial WPUE have declined in recent years

Absolute spawning biomass is the actual spawning biomass





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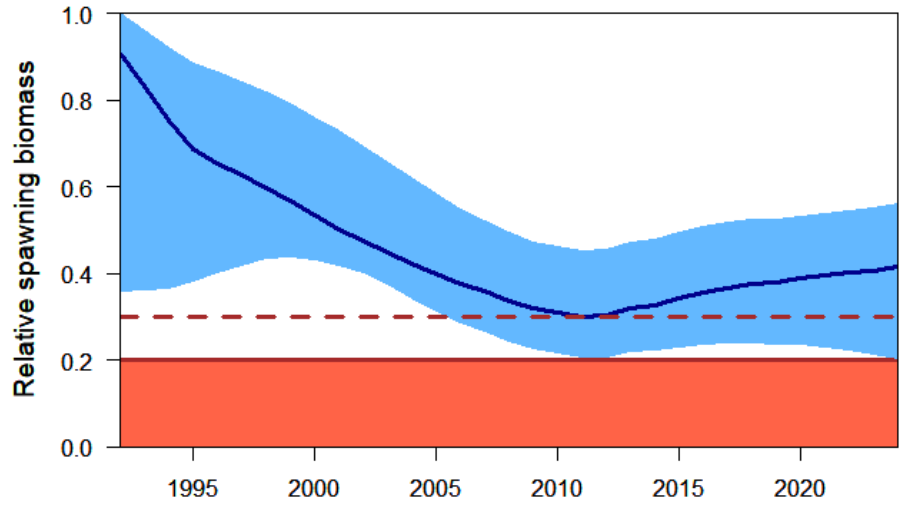
Different perceptions

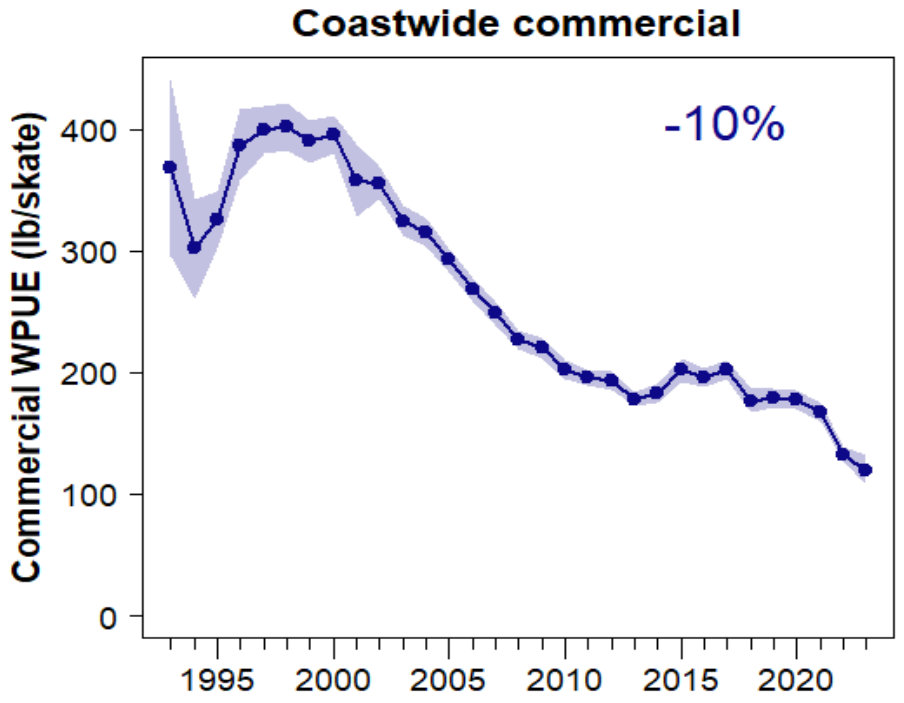
- Stock status (effect of fishing) is 42% and above proxy threshold $B_{36\%}$
- Long-term average stock status when fishing consistently at SPR=43% would be near 38%

Stock Status



- Catch-rates are at lowest level since early 1990's
- Commission decisions (2023 and 2024) set coastwide TCEYs less than the reference TCEY suggested by the stock assessment and SPR=43%

Catch Rate



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Commission Notes

IPHC-2024-AM100-R

- Estimated spawning biomass at a 35-year low and likely to remain low
- Fishing at SPR=43% would have a high likelihood of stock decline
- Wide uncertainty in estimated spawning biomass and actual fishing intensity
- Adopted mortality limits for 2024 correspond to a 41% chance of stock decline
- Adopted mortality limits for 2024 correspond to a fishing intensity SPR=52%

Last two years: adopted TCEY is lower than reference TCEY

Are we missing an objective?

- Catch-rates and absolute biomass seem to be important
  - Especially when they are low
- Threshold objective ($B_{36\%}$) does not seem to be important
  - See **IPHC-2023-SRB023-R, para. 25**
- Thompson (1937)
  - "… obtaining a catch from a larger accumulated stock … less effort, but also less time at sea"
- Clark & Hare (2006)
  - Commission's objective is to maintain a healthy level of spawning biomass

- Perhaps an objective is to maintain catch-rates or absolute biomass above the level seen in 2023 (or some other reference)

Objective related to absolute biomass or catch-rate

- Spawning biomass likely correlates with catch-rates
- Current conservation objectives use dynamic RSB which may result in a low spawning biomass but a satisfactory stock status
- A minimum absolute coastwide spawning biomass may be necessary to ensure successful reproduction (not currently known)
- An observed absolute spawning biomass or catch-rate reference may have concrete meaning to stakeholders

- Possibly replace $B_{36\%}$ with an absolute reference point for which dropping below would result in serious hardships to the fishery

A new objective

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
2.1 Maintain spawning biomass at or above a level that optimizes fishing activities	Maintain the long-term coastwide female spawning stock biomass (or FISS WPUE or fishery catch-rate) at or above a reference point (YY) XX% or more of the time	Reference (YY_{Thresh}) YY_{Thresh}=YY	???	XX	

Details of a new objective

- What to maintain
  - Coastwide absolute biomass (spawning, O26, O32)
  - FISS WPUE (all-sizes, O32)
  - Commercial fishery WPUE
- Reference level (YY_{thresh})
  - An actual value
  - Relative to a specific year
- Time-frame
  - Long-term has a general meaning and is applicable when starting from any year
  - Short-term is specific to start year and may be moot if starting at a high biomass
    - But may want to rebuild to from now
- Tolerance
  - Chance of being below the reference level

Ways to meet a new objective

- Re-evaluate fishing intensity
  - Reduced TCEYs with lower variability result in higher biomass (catch-rates) on average
- Change the 30:20 control rule
- Add a second control rule based on the new metric

		High Fishing intensity			SPR					Low Fishing intensity
Term	Performance Metric	34	38	40	42	43	44	46	48	52	56
Long	$P(B<B_{2023})$	0.26	0.23	0.22	0.21	0.20	0.19	0.17	0.16	0.12	0.10
Short	$P(B<B_{2023})$	0.45	0.38	0.34	0.31	0.29	0.28	0.24	0.20	0.15	0.12

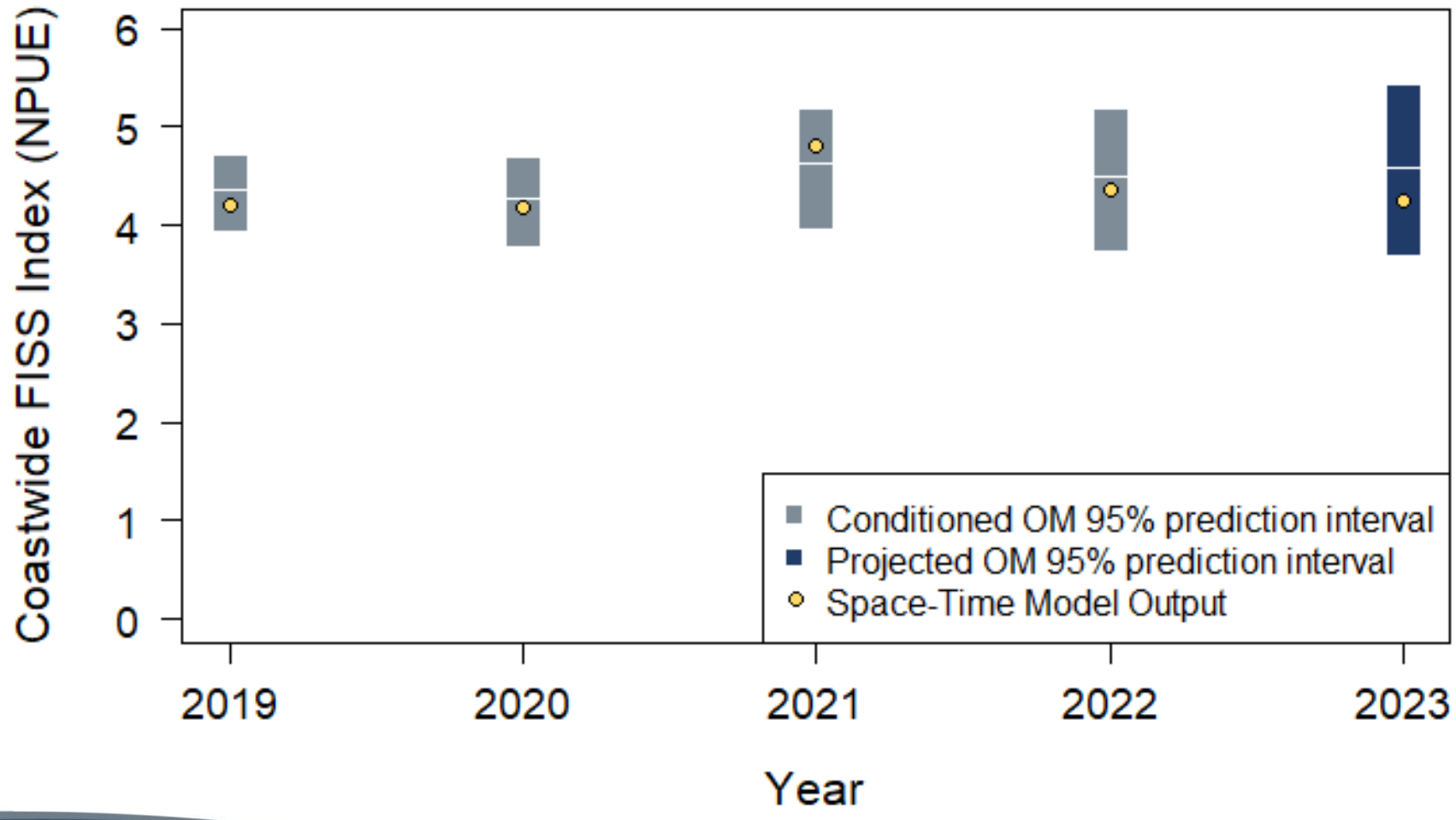
Exceptional Circumstances

a) The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.

b) The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.

c) Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations

Coastwide FISS Index



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Actions if exceptional circumstance

a) A review of the MSE simulations to determine if the OM can be improved and MPs should be reevaluated.

b) If a multi-year MP was implemented and 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.

c) 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.

d) Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.

Additional MPs to evaluate

- Trigger in the control rule (currently 30%)
  - May increase variability and spawning biomass
- Element related to maintain the absolute spawning biomass above a threshold
  - Reduce fishing intensity when absolute SB or WPUE is low
- Elements related to distribution of the TCEY (for a reference distribution)
  - Running average of stock distribution estimates
- Changes to survey design
  - Robustness analysis of different uncertainty in FISS data
  - Developing scenarios with SRB input

Additional Considerations

Recommendations

1) The MSAB **NOTE** paper IPHC-2024-MSAB019-07 describing a harvest strategy policy, presenting potential elements of management procedures to evaluate, objectives to consider, and additional considerations for the MSE workplan in 2023–2025.
2) The MSAB **REQUEST** the following elements of MPs to investigate:
    a. Annual, biennial, and triennial assessment frequency with a fixed TCEY or an empirical rule based on O32 FISS WPUE in non-assessment years.
    b. Constraints of a maximum annual change of the TCEY equal to 15% or 20%, or a slow-up/fast-down rule where the TCEY increases by 1/3rd or decreases by 1/2 of the change to the reference TCEY.
    c. A range of fishing intensities from SPR=36% to SPR=56%.
    d. Options for control rules that reduce the fishing intensity when biomass is low.

Recommendations

3) The MSAB **REQUEST** adding the following measurable objective related to variability in TCEY:
   a. The median average of the maximum change in the TCEY for 1, 2, and/or 3 years of a ten-year period.

4) The MSAB **RECOMMEND** equal prioritization for the fishery objectives optimise average coastwide TCEY and limit annual changes in the coastwide TCEY to allow for a more transparent evaluation of trade-offs between the two objectives.

5) The MSAB **RECOMMEND** adding a measurable objective related to absolute spawning biomass under the general objective 2.1 “maintain spawning biomass at or above a level that optimizes fishing activities” to be included in the priority Commission objectives after the current biomass threshold objective:
   a. Maintain the absolute spawning biomass above the estimated 2023 absolute spawning biomass, noting that the threshold, term, and tolerance are yet to be defined.

Recommendations

6) The MSAB **RECOMMEND** adopting the following exceptional circumstances:

   a. The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.

   b. The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.

   c. Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.

Recommendations

1) The MSAB **RECOMMEND** adopting the follow actions if an exceptional circumstance occurs:
    a. A review of the MSE simulations to determine if the OM can be improved and MPs should be reevaluated.
    b. If a multi-year MP was implemented and 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.
    c. 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.
    d. Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.


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