



IPHC Management Strategy Evaluation and Harvest Strategy Policy Updates

PREPARED BY: IPHC SECRETARIAT (A. HICKS, I. STEWART & D. WILSON; 30 OCTOBER 2023)

PURPOSE

To provide the Commission with an update of the Management Strategy Evaluation (MSE) process and the Harvest Strategy Policy, and to seek guidance on the MSE Program of Work.

INTRODUCTION

The Management Strategy Evaluation (MSE) Program of Work for 2021–2023 ([IPHC-2021-MSE-02](#)) was completed in early 2023 and presented at the [99th Session of the IPHC Annual Meeting](#) (AM099).

MSE is used to evaluate management procedures with the ultimate goal of determining a harvest strategy that is robust to uncertainty and variability. The IPHC currently has an [interim management procedure](#), which is a major part of a harvest strategy, but to formally define an IPHC harvest strategy, a few tasks remain. This includes evaluating multi-year MPs and determining if the current reference fishing intensity (SPR=43%) still meets IPHC objectives. Additions and edits to the current [harvest strategy policy document](#) are also necessary for the adoption of a formal harvest strategy policy.

This summary document describes various tasks related to ongoing MSE work that would assist in adopting a harvest strategy policy. These tasks include:

- 1) outcomes of the [18th Session of the IPHC Management Strategy Advisory Board](#) (MSAB018);
- 2) updates to the operating model (OM);
- 3) considering new objectives and performance metrics;
- 4) evaluating various elements of management procedures (MPs);
- 5) defining exceptional circumstances; and
- 6) updating the Harvest Strategy Policy document.

Potential decision points are listed at the end of each section and summarized in the final Recommendation/s section.

OUTCOMES OF THE 18TH SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD

The MSAB018 occurred in May 2023 and members discussed membership, past evaluations, and a Program of Work.

The MSAB discussed MSAB member succession planning and the potential for the designation of alternate members. Some members expressed interest in having alternates available in case the member is unable to attend a meeting or ends their term. The MSAB requested that domestic agency staff consider providing text to update the IPHC Rules of Procedure.

IPHC-2023-MSAB018-R, para. 10: *NOTING the extensive discussion surrounding MSAB member succession planning and how the appointment of alternates may be useful, the MSAB **REQUESTED** that domestic agency staff from the Contracting Parties consider drafting text to amend the IPHC Rules of Procedure to allow alternates to be designated for MSAB members, for Commission consideration in the future.*

Results of MSE simulations assuming a persistent low or high Pacific Decadal Oscillation (PDO) were presented at MSAB018. Even though we cannot “manage” the PDO regime, it is useful to understand the effects of the PDO regime on the results, allowing for the separation of the effects of fishing from the effects of the environment. For Pacific halibut, the environment sometimes may have a larger effect on the distribution of spawning biomass than fishing does (at an SPR of 43%). These results are dependent upon the harvest strategy, and different fishing intensities or distribution procedures may produce different outcomes.

MSAB members were very interested in these results and requested that outreach materials be developed explaining the effects of the environment (i.e. PDO) on coastwide and regional stock dynamics and the relative effect of fishing. This may be done as a poster for future IPHC meetings that could potentially be turned into a pamphlet.

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.*

A major outcome of MSAB018 was the request that the evaluation of annual and multi-year assessments be done subsequent to an agreement on a distribution procedure and include elements such as multi-year management procedures, constraints on the coastwide TCEY, smoothing elements on the calculation of stock distribution, and various SPR values.

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.

This is congruent with an agreement by the Commission at AM099.

IPHC-2023-AM099-R, para. 87: The Commission **AGREED** that following agreement about a distribution procedure, the IPHC Secretariat and MSAB should reassess multi-year stock assessment management procedures, as well as coastwide elements of a management procedure such as the SPR value.

The MSAB also discussed exceptional circumstances and gained a better understanding of what an exceptional circumstance is and what details need to be defined.

IPHC-2023-MSAB018-R, para. 42: *The MSAB **AGREED** that FISS observations (coastwide or by area/region) are useful to define the limits defining an exceptional circumstance and that individual years may be used as well as observed trends over time.*

IPHC-2023-MSAB018-R, para. 43: *The MSAB **NOTED** that the defined responses to an exceptional circumstance may include: a) reviewing the MSE framework including the operating model; IPHC-2023-MSAB018-R Page 12 of 19 b) examining objectives; c) evaluating additional MPs; d) completing a stock assessment at the next appropriate time.*

IPHC-2023-MSAB018-R, para. 44: *The MSAB **AGREED** that there are other circumstances within the acceptable range simulated by the MSE when one may deviate from an adopted MP because of an unexpected event. For example, a high probability of predicted declines in the spawning biomass under the interim management procedure may have been contributing factors in the decision to depart from the interim management procedure in 2023, even though these declines were within the simulated range of MSE results.*

Finally, the MSAB requested that MSAB019 be held in the Spring of 2024.

IPHC-2023-MSAB018-R, para. 47: *The MSAB **REQUESTED** that MSAB019 be held in May 2024, rather than October 2024, as previously noted by the Commission, and that future MSAB meetings occur prior to the June SRB meeting in that same year.*

Decision/Action

None

UPDATED 2023 OPERATING MODEL

The Scientific Review Board (SRB) has reviewed the IPHC's MSE Operating Model (OM) for 2023 at the [22nd Session of the SRB](#) (SRB022) and the [23rd Session of the SRB](#) (SRB023). The IPHC's MSE Operating Model for 2023 has been updated to reflect the 2022 stock assessment ensemble and is performing well for evaluating management procedures, noting that further adjustments may be made, at the request of the Commission. The SRB endorsed the 2023 OM.

Specific details of the OM are presented in the document Technical Details of the IPHC MSE Framework ([IPHC-2023-MSE-02](#)). Overall, the 2023 OM is ready to be used to investigate elements of MPs that will lead to the adoption of a harvest strategy. This may include, for example, multi-year assessments and fishing intensity. Additionally, the 2023 OM may be used to inform decisions regarding monitoring of the Pacific halibut stock, such as investigating the effects of FISS designs on management outcomes.

Decision/Action

1. **Note** that the SRB endorsed the 2023 OM for use in MSE evaluations of MPs that would lead to the adoption of a harvest strategy, including assessment frequency, fishing intensity, and data monitoring.

OBJECTIVES

Four priority coastwide objectives are currently endorsed by the Commission for use in the IPHC's MSE process.

- a. Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point ($B_{20\%}$) at least 95% of the time.
- b. Maintain the long-term coastwide female spawning stock biomass above a biomass target reference point ($B_{36\%}$) at least 50% of the time.
- c. Optimise average coastwide TCEY.
- d. Limit annual changes in the coastwide TCEY.

The SRB made a recommendation to re-evaluate what they called the [biomass] target objective. This is objective (b): to maintain the spawning biomass above $B_{36\%}$.

[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 $B_{36\%}$, 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.*

However, instead of updating the $B_{36\%}$ objective, it may be prudent to consider an absolute spawning biomass, or catch-rate, threshold in a new objective to meet some concerns

expressed at the [99th Session of the IPHC Annual Meeting](#) (AM099). This may be a possible topic for the MSAB in 2024.

Additional area-specific objectives are listed in [Appendix A](#). The IPHC Secretariat is working with the SRB to develop a region-specific objective to conserve spatial structure that is informative of the changes in biomass within a region. This would be a secondary objective to consider after meeting all priority objectives.

[IPHC-2023-SRB023-R](#), para 24. *The SRB **RECOMMENDED** that an objective to maintain spatial population structure be added or redefined to maintain the spawning biomass in a Biological Region above a defined threshold relative to the dynamic unfished equilibrium spawning biomass in that Biological Region with a pre-defined tolerance. The percentage and tolerance may be defined based on historical patterns and appropriate risk levels recognizing the limited fishery control of biomass distribution.*

Decision/Action

Consider whether the Commission should

2. **Recommend** that the Secretariat, working with the MSAB and SRB, develop a new coastwide objective related to absolute spawning biomass or catch-rates, to either replace the current B_{36%} objective or be added as a fifth priority objective. The Secretariat supports developing a new objective for the Commission to decide if it is a useful objective to assist in determining an MP that optimizes yield.

PERFORMANCE METRICS

The IPHC Secretariat is using performance metrics developed for the four (4) priority objectives listed above. These are a subset of the various metrics presented in [Appendix A](#). Other performance metrics are useful to gain additional insight into management procedures, and is often used by the MSAB in identifying trade-offs between MPs.

The MSAB also requested that a new performance metric be developed to assist with evaluating multi-year MPs.

[IPHC-2023-MSAB018-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.*

The Secretariat will continue to work with the MSAB on how to calculate these new performance metrics, and then report them in the [MSE Explorer](#).

Decision/Action

None

MANAGEMENT PROCEDURES (MPs)

The MSAB and the SRB have provided requests to investigate various MP elements.

[IPHC-2023-SRB023-R](#), para. 29: *The SRB **RECOMMENDED** evaluating fishing intensity and frequency of the stock assessment elements of management procedures and FISS uncertainty scenarios using the MSE framework. MP elements related to constraints on the interannual change in the TCEY and calculation of stock distribution may be evaluated for a subset of the priority management procedures as time allows.*

The following describes these elements of MPs that could be evaluated as part of the future MSE Program of Work.

Annual and multi-year stock assessment MPs: These are management procedures that conduct a stock assessment annually or every 2nd or 3rd year and use an empirical MP based on the FISS survey trends to determine the TCEY in non-assessment years.

Fishing intensity: A range of SPR values (i.e. fishing intensity, currently 43%) and alternative trigger reference points (currently 30%) in the harvest control rule.

FISS reductions: Investigate scenarios where the FISS effort is reduced or occasionally eliminated in various IPHC Regulatory Areas.

Constraints: A constraint on the coastwide TCEY to reduce inter-annual variability. Past examples include a 15% constraint and a slow-up/fast-down approach.

Stock distribution: A method to reduce the inter-annual variability in the estimates of stock distribution for use in the MP. This may include using the average of the stock distribution estimates over the past 3 years, for example.

TCEY distribution: Procedures to distribute the TCEY to IPHC Regulatory Areas.

Decision/Action

Consider if the Commission should:

3. **Recommend** the evaluation of multi-year management procedures along with fishing intensity, which may be done subsequent to an agreement on distribution of the TCEY, or could incorporate uncertainty in how the TCEY is distributed. These are two MP elements that are necessary to evaluate for the adoption of a coastwide MP in the harvest strategy policy.
4. **Recommend** the evaluation of FISS design scenarios using the MSE framework, as recommended by the SRB. This will provide an understanding of how reductions in the FISS design may affect management outcomes.
5. **Recommend** any additional management procedures to evaluate including constraints on the coastwide TCEY, methods to smooth estimation of stock distribution, and procedures to distribute the TCEY to IPHC Regulatory Areas. These are additional MP elements that may be beneficial to the harvest strategy policy.

EXCEPTIONAL CIRCUMSTANCES

Exceptional circumstances are used as part of a process that identifies specific actions for deviating from an adopted harvest strategy. An exceptional circumstance is an event that is beyond the expectations of the MSE evaluation and is used to determine if specific actions should be taken to re-examine the harvest strategy. This is useful to ensure that the adopted harvest strategy is retained unless it is absolutely necessary to deviate from the adopted process. The [IPHC interim harvest strategy policy](#) has a decision-making step after the MP, thus the Commission may deviate from an adopted MP as part of the harvest strategy. This decision-making variability is included in the MSE simulations. However, defining exceptional circumstances would involve defining events that result in re-examination of the MSE process to determine if an update to the framework and evaluation of management procedures is necessary. Potential exceptional circumstances (i.e. events) and the actions following the declaration of an exceptional circumstance are given below.

An exceptional circumstance, in an MSE context, does not usually trigger an action within the management procedure. Instead, a trigger can be defined as part of a management procedure such that a management action takes place. An example is the 30:20 control rule which defines a reduction in the fishing intensity when stock status is less than 30%. A similar trigger could be defined that indicates an assessment should be done in a year when one was normally not scheduled (if time allows). On the other hand, an exceptional circumstance is declared if it is persistent and beyond the simulated variability of the MSE.

The Secretariat, with the assistance of the SRB and MSAB, is defining exceptional circumstances and prescribing the response that would be initiated, as well as identifying potential triggers in a management procedure that would result in a stock assessment being done (if time allows) in a year that would normally not have one scheduled (e.g. in multi-year MPs). Working with the SRB, the following potential exceptional circumstances have been described:

- 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.

Furthermore, if an exceptional circumstance is declared, the SRB and MSAB have prescribed that the following actions may take place.

- 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.

Decision/Action

Consider if the Commission should:

6. **Recommend** that the Secretariat continue to work with the SRB and MSAB to define exceptional circumstances (events) using FISS observations, biological observations, and new research. These should be defined as part of the adopted harvest strategy.
7. **Recommend** that the Secretariat continue to work with the SRB and MSAB to prescribe the actions to take when an exceptional circumstance is triggered.. These should be defined as part of the adopted harvest strategy.

RESULTS

MSE simulations are currently being conducted, with a priority on multi-year assessments and SRB-requested FISS scenarios. Results will be added to the [MSE Explorer website](#) as they become available.

Results of MSE simulations assuming a persistent low or high PDO were presented at MSAB018. These results were not available at AM099 and were also presented at the fifth conference for Effects of Climate Change on the Worlds Oceans ([ECCWO5](#)) and the PICES 2023 Annual Meeting ([PICES-2023](#)). Since then, similar MSE simulations were performed using the updated operating model (OM) for 2023, without decision-making variability, estimation error, or observation error. Variable weight-at-age and recruitment were used. These updated results, presented here, are very similar to the previous analysis presented at MSAB018.

Updated results, using the 2023 Operating Model (OM) show similar results to what was presented to MSAB members at MSAB018. The median relative spawning biomass (RSB) when fishing at an SPR equal to 43% was similar for the high and low PDO scenarios ([Table 1](#)). However, even though the median was near 38%, there was a higher probability that the RSB was less than 36% for the low PDO scenario. The long-term median TCEY was 22% less for the low PDO scenario and 26% more for the high PDO scenario when compared to the median TCEY for the base simulations that modelled PDO regime shifts. The TCEY for a persistent high PDO was 1.6 times greater than the TCEY for a persistent low PDO. Inter-annual variability in the TCEY was the same for the persistent low and high PDO scenarios, but less than the AAV when PDO regime shifts were modelled. Without decision-making variability, estimation error,

and observation error, the AAVs are less than when these additional sources of variation are included, as expected.

Table 1. Performance metrics related to primary objectives for scenarios with modeled cycles of PDO (both), always low PDO (Low), and always high PDO (High) with an annual assessment, 32-inch size-limit, no decision-making variability, no estimation error, and no observation error. Long-term results are only shown for all performance metrics.

MP name	MP-A32	MP-A32	MP-A32
PDO	Both	Low	High
SPR	0.43	0.43	0.43
Long-Term Metrics			
Median RSB	38.8%	37.6%	39.2%
P(RSB _y <20%)	<0.001	<0.001	<0.001
P(RSB<36%)	0.238	0.329	0.157
Median TCEY (Mlbs)	65.64	51.42	82.95
Median AAV TCEY	5.2%	4.5%	4.5%
Median TCEY Region 2 (Mlbs)	20.49	19.07	21.20
Median TCEY Region 3 (Mlbs)	33.67	22.98	48.74
Median TCEY Region 4 (Mlbs)	8.13	6.55	9.35
Median TCEY Region 4B (Mlbs)	2.40	2.24	2.63

The percentage of spawning biomass in each Biological Region is affected by fishing under an SPR-based management procedure ([Figure 1](#)). The distribution of spawning biomass across the Biological Regions is also affected by the PDO regime because movement, recruitment distribution, and average recruitment are dependent on the PDO regime. Region 2 shows a reduction in the percentage of spawning biomass with fishing, and the low PDO scenario results in a higher percentage than the persistent high PDO scenario. Region 3 shows a similar percentage of spawning biomass with fishing and a higher percentage of spawning biomass with a high PDO. Region 4 shows a higher percentage of spawning biomass with fishing and is largely unaffected by the PDO regime. Region 4B has a higher percentage of spawning biomass with fishing and a higher spawning biomass for the low PDO scenario.

Decision/Action

None

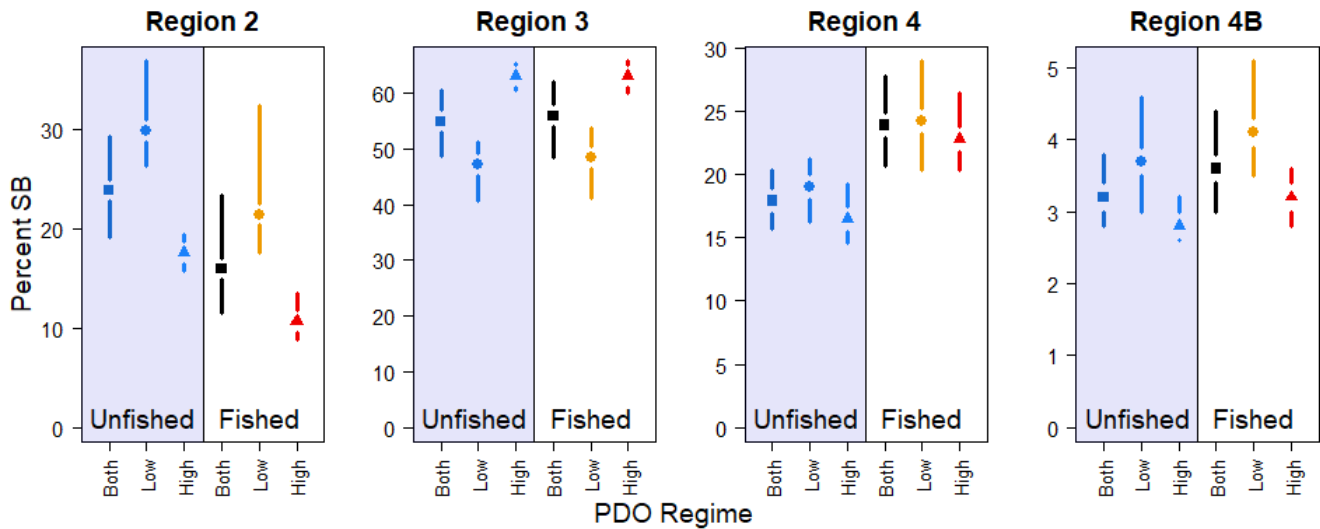


Figure 1. Percentage of spawning biomass in each Biological Region when fished with an SPR of 43% (no estimation error, no observation error, and no implementation error) and when not fished. The PDO is modelled with cyclical low and high periods in “Both”, is persistently low in “Low”, and is persistently high in “High”.

IPHC HARVEST STRATEGY POLICY

The IPHC Secretariat is currently in the process of updating the existing [IPHC harvest strategy policy](#) document, which was last edited in 2019. The new document will update text and add sections to reflect decisions of the Commission since the 95th Annual Meeting of the IPHC (AM095). [Appendix B](#) presents the current harvest strategy policy text with comments and potential edits.

Some topics that could be added to the Harvest Strategy Policy document include the following:

- More details on the IPHC Harvest Strategy Policy framework, such as described in the Interim IPHC Harvest Strategy and Policy ([IPHC-2020-IntHSP](#)). This includes the management procedure, tactical decision-making as part of the Commission process, and strategic development of the management procedure.
- An explanation how MSE is used to inform/develop the harvest strategy, and how risk is incorporated.
- A description of the priority objectives.
- A description of each element of a management procedure including monitoring, assessment, and determination of coastwide and area-specific mortality limits.
 - Monitoring and data collection goals and requirements.
 - Stock assessment schedule and necessary outputs.
 - Technical details of how the coastwide TCEY is determined.

- Pertinent details on how the TCEY may be distributed to IPHC Regulatory Areas, and any other technical details that affect the final determination of mortality limits for sectors that may not be specifically under IPHC jurisdiction. This may or not be a part of a tested management procedure but a decision-making process that occurs after the coastwide TCEY is determined, this is part of the policy but not necessarily the harvest strategy.
- The annual meeting schedule and involvement of IPHC subsidiary bodies.

To move towards formally adopting a harvest strategy policy at AM101, with potentially an interim harvest strategy policy at AM100, the SRB recommended separating the coastwide TCEY management procedure from the distribution procedure.

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.).*

The coastwide TCEY determined from the MP in the harvest strategy would be an input into the allocation decision-making process. This process would be described in the harvest strategy policy document, including the distribution procedure used as a starting point of the decision-making process.

Decision/Action

8. **Recommend** that the Secretariat continue developing an updated Harvest Strategy Policy document, noting that decisions regarding the assessment frequency and potentially a change to the reference fishing intensity need to be made. An interim harvest strategy policy may be adopted at AM100 given the current interim management procedure (i.e. annual assessment and a reference SPR=43%).

RECOMMENDATION/S

That the Commission

- 1) **NOTE** paper IPHC-2023-IM099-11 presenting outcomes of MSAB018 and SRB023, potential additions to the MSE Program of Work for 2023–2025, and potential edits to the Harvest Strategy Policy document.
- 2) **NOTE** that the SRB endorsed the 2023 operating model for use in MSE evaluations of MPs that would lead to the adoption of a harvest strategy, including assessment frequency, fishing intensity, and data monitoring.
- 3) **NOTE** the current priority objectives and **RECOMMEND** that the Secretariat, working with the MSAB and SRB, develop a new coastwide objective related to absolute spawning biomass or catch-rates, to either replace the current $B_{36\%}$ objective or be added as a fifth priority objective. The Secretariat supports developing a new objective for the Commission to decide if it is a useful objective to assist in determining an MP that optimizes yield via optimal catch-rates or opportunity.
- 4) **NOTE** that the following decisions are necessary for the adoption of a Harvest Strategy Policy at the 101st Annual Meeting of the IPHC (AM101), or sooner:
 - a) that the harvest strategy is related to a management procedure to determine the coastwide TCEY, and that the TCEY distribution is an independent negotiation that is part of the policy;
 - b) the evaluation of multi-year management procedures along with fishing intensity incorporating uncertainty in how the TCEY is distributed;
 - c) additional management procedure elements to evaluate including constraints on the coastwide TCEY, methods to smooth estimation of stock distribution, and, if desired, procedures to distribute the TCEY to IPHC Regulatory Areas;
 - d) the Secretariat to continue to work with the SRB and MSAB to define specific exceptional circumstances using FISS observations, biological observations, and new research;
 - e) the Secretariat to continue to work with the SRB and MSAB to prescribe the actions to take when an exceptional circumstance occurs;
 - f) edits and additions to the current harvest strategy policy document.
- 5) **NOTE** that to understand how reductions in the FISS design may affect management outcomes, the evaluation of FISS design scenarios using the MSE framework was recommended by the SRB at SRB023.
- 6) **NOTE** that an interim Harvest Strategy Policy document may be adopted at the 100th Annual Meeting of the IPHC (AM100) using the current interim management procedure for a coastwide TCEY along with edits and additions to the current harvest strategy policy document.

APPENDICES

[Appendix A](#): Objectives used by the Commission for the MSE

[Appendix B](#): The draft IPHC harvest strategy policy

[Appendix C](#): Supplementary material

APPENDIX A

OBJECTIVES USED BY THE COMMISSION FOR THE MSE

Table A1. Primary objectives, evaluated over a simulated ten-year period, accepted by the Commission at the 7th Special Session of the Commission (SS07). Objective 1.1 is a biological sustainability (conservation) objective and objectives 2.1, 2.2, and 2.3 are fishery objectives. Priority objectives are shown in green text.

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	$B < \text{Spawning Biomass Limit } (B_{Lim})$ $B_{Lim}=20\%$ unfished spawning biomass	Long-term	0.05	$P(SB < SB_{Lim})$ Fail if greater than 0.05
	Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,A} > 10\%$ $p_{SB,AB} > 2\%$	Long-term	0.05	$P(p_{SB,R} < p_{SB,R,min})$
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	$B < \text{Spawning Biomass Reference } (B_{Thresh})$ $B_{Thresh}=B_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(SB < SB_{Thresh})$ Fail if greater than 0.5
2.2. PROVIDE DIRECTED FISHING YIELD	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		$Median \overline{TCEY}$
	Optimize TCEY among Regulatory Areas	Median $TCEY_A$	Short-term		$Median \overline{TCEY_A}$
	Optimize the percentage of the coastwide TCEY among Regulatory Areas	Median $\%TCEY_A$	Short-term		$Median \left(\frac{\overline{TCEY_A}}{\overline{TCEY}} \right)$
	Maintain a minimum TCEY for each Regulatory Area	Minimum $TCEY_A$	Short-term		$Median \text{Min}(TCEY)$
	Maintain a percentage of the coastwide TCEY for each Regulatory Area	Minimum $\%TCEY_A$	Short-term		$Median \text{Min}(\%TCEY)$
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		$Median \text{AAV}$
	Limit annual changes in the Regulatory Area TCEY	Annual Change (AC) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Average AAV by Regulatory Area (AAV_A)	Short-term		$Median \text{AAV}_A$

APPENDIX B

THE DRAFT IPHC HARVEST STRATEGY POLICY

The following is a Draft document based on an amalgamation of current IPHC practices and best practices in harvest strategy policy. It is not intended to be a definitive policy, noting that the IPHC is yet to adopt a formal harvest strategy for Pacific halibut. It is expected that over the coming years, the IPHC will develop and implement a harvest strategy, and that this policy document will then be updated accordingly.

The text below is from the draft harvest strategy policy currently available on the IPHC website (<https://www.iphc.int/the-commission/harvest-strategy-policy>) with potential edits **highlighted in red** and comments *highlighted in orange italics*.

1 Introduction

The *IPHC Harvest Strategy Policy* provides a framework for applying a science-based approach to setting harvest levels for Pacific halibut (*Hippoglossus stenolepis*) throughout the Convention Area.

It defines biological and economic objectives that apply to the development of a harvest strategy for Pacific halibut. It also identifies reference points for use in the harvest strategy to achieve the Commission's stated objectives. This policy, together with the *Protocol amending the Convention between Canada and the United States of America for the preservation of the [Pacific] halibut fishery of the northern Pacific Ocean and Bering Sea (1979)*, provides the basis to manage the risk to Pacific halibut fisheries and the Pacific halibut population.

A harvest strategy developed under this policy will take available information about the Pacific halibut resource and apply a science-based approach to setting catch levels. A harvest strategy consistent with this policy will provide all interested sectors with confidence that Pacific halibut is being managed for long-term ecological sustainability and economic viability. The implementation of a clearly specified harvest strategy will also provide the fishing industry with a more certain operating environment.

Harvest strategy defined: A harvest strategy sets out a decision framework necessary to achieve defined biological and economic objectives for Pacific halibut. A harvest strategy will outline:

- Objectives and key principles for the sustainable and profitable use of Pacific halibut.
- Reference points and other quantities used when applying the harvest strategy.
- Processes for monitoring and assessing the biological and economic conditions of Pacific halibut in relation to fishery and biological reference levels (a reference point or points).
- Pre-determined rules that control fishing activity according to the biological and economic conditions of the fishery (as defined by monitoring and/or assessment). These rules are referred to as **harvest** control rules or decision rules.

1.1 Scope

The IPHC Harvest Strategy Policy applies to the Pacific halibut population managed by the IPHC, and where overlap with domestic jurisdictional management exists (e.g. managed jointly by the IPHC and Contracting Party domestic agencies) the IPHC will seek to apply and encourage the adoption of this policy in negotiating and implementing joint or cooperative management arrangements.

2 Objectives and Key Principles

The objective of the IPHC Harvest Strategy Policy is the sustainable and profitable use (optimum yield) of Pacific halibut through the implementation of a harvest strategy that maintains the stock at sustainable levels while maximising economic returns (*simply maximising economic returns is unlikely to meet a future distribution agreement. I think it would be useful to move the paragraph after the bullets to here because it explains this.*) Maximising the net economic return from the fishery may not always equate with maximising the profitability of the fishery. Net economic return (NER) may consider inter-annual stability to maintain markets, and economic activity may also arise from recreational and Indigenous fishing, and the need to share the resources appropriately will be considered where necessary.

To achieve this objective the IPHC will implement a harvest strategy that pursues **optimal yield** and seeks to: *I reordered these so they are in the priority order endorsed by the Commission, although I do not mention priority as that is more of a MSE concept.*

- maintain Pacific halibut above a **dynamic** female spawning biomass limit where the risk to the stock is regarded as unacceptable (SB_{LIM}), at least **95%** of the time;
- maintain Pacific halibut, **at least 50% of the time**, at **or above** a target (~~fixed or~~ dynamic female spawning biomass equal to the stock size required to produce maximum **coastwide** net economic returns **accounting for** a spatial and temporal scale relevant to the fishery;
- **maintain Pacific halibut above the estimated biomass in 2023 (an observed low abundance that is preferred to be avoided)** at least **XX%** of the time. *Note that this is a potential objective that is not currently endorsed by the Commission.*
- **pursue** maximum **coastwide** economic yield (MEY) for the directed Pacific halibut fishery given agreed upon distribution of mortality limits among IPHC Regulatory Areas (IPHC) and fishery sectors (domestic).
- **Limit annual changes in mortality limits.**

Maximising the net economic return from the fishery may not always equate with maximising the profitability of the fishery. Net economic return may consider inter-annual stability to maintain markets, and economic activity may also arise from recreational and Indigenous fishing, and the need to share the resources appropriately will be considered where necessary. *This paragraph moved above.*

The harvest strategy will ensure fishing is conducted in a manner that does not lead to *overfishing*. *Overfishing* is defined as where the stock is subject to a level of fishing that would move it to an overfished state, or prevent it from rebuilding to a '*not overfished*' state, within a specific time-frame and probability. Where it is identified that *overfishing* of the stock is occurring, action will be taken immediately to cease that *overfishing* and action taken to recover the overfished stock to levels that will ensure long-term sustainability and productivity to maximise NER.

The harvest strategy will also ensure that if the stock is overfished, the fishery must be managed such that, with regard to fishing impacts, there is a high degree of probability the stock will recover. If the stock is assessed to be below the female spawning biomass limit reference point (i.e. *overfished*), a stock rebuilding strategy will be developed to rebuild the stock to the limit female spawning biomass level, whereby the harvest control rules would then take effect to build the stock further to target female spawning biomass levels.

Overfished: when the estimated probability that female spawning stock biomass is below the limit reference point (SB_{LIM}) is greater than 50%.

Overfishing: where the stock is subject to a level of fishing that would move it to an overfished state, or prevent it from rebuilding to a '*not overfished*' state, within a specific time-frame and probability, to be determined.

3 Applying the Harvest Strategy Policy

The following requirements provide the basis for a transparent and systematic approach for developing the harvest strategy to assist in meeting the objectives of the Harvest Strategy Policy.

3.1 Accounting for all sources of fishing mortality

The harvest strategy will account for all known sources of fishing mortality on the stock, including recreational and Indigenous fishing; and fishing under the management of another jurisdiction, such as non-directed (incidental) fishing mortality.

3.2 Establishing and applying decision rules

The harvest strategy developed under this policy will specify any required management actions or considerations for Pacific halibut, at the stock or management unit level, necessary to achieve the ecological and economic management objectives for the fishery.

3.3 Balancing risk, cost, and catch

This policy establishes a risk-based management approach, which provides for an increased level of caution when establishing control rules in association with increasing levels of uncertainty about stock status. *Currently, control rules do not change with increased uncertainty, but structural and observation uncertainty are accounted for and risk neutral (median) quantities are used in the control rules. Also note that overfished is defined above with a 50% probability.*

In the context of this policy, the risk, cost, and catch trade-off, refers to a trade-off between the amount of resources invested in data collection, analysis and management of Pacific halibut, and the level of catch (or fishing mortality) applied. Fishing mortality should always be

constrained to levels at which scientific assessment indicates Pacific halibut is not exposed to an 'unacceptable ecological risk' (that is the risk that stocks will fall below the limit reference point).

The management decision to be taken in this context is whether investment of more resources in data collection and analyses and/or additional management will increase the understanding of the risk to a species or stock from fishing and provide confidence in the sustainability of a higher level of fishing pressure or catch. In the absence of this additional information—and associated improved understanding of a stock—it may be necessary to reduce the fishing effort in order to manage the risk. Decisions about investment in managing risk versus the economic return of the catch taken will be transparently made, clearly documented and publicly available.

I wonder if this section could use some work to separate the concepts used for tactical decision-making and the concepts evaluated with the MSE simulations. In other words, how was risk evaluated when the HSP was developed (and evaluated further such as the effect of additional info), and how is risk used in the application for annual decision-making.

APPENDIX C

SUPPLEMENTARY MATERIAL

The IPHC MSE Research website contains additional documents with more detailed information.

<https://www.iphc.int/management/science-and-research/management-strategy-evaluation>

This includes a technical description in document IPHC-2023-MSE-02.

The MSE Explorer will be updated as additional results are produced. Links to the current MSE Explorer as well as archived results are available at

<http://iphcapps.westus2.cloudapp.azure.com/>