INTERNATIONAL PACIFIC
HALIBUT COMMISSION

IPHC–2025–MSAB021–00
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21st Session of the IPHC Management Strategy Advisory Board (MSAB021) – *Compendium of meeting documents*

13-15 May 2025, Juneau, AK, USA

Commissioners

Canada	United States of America
Paul Ryall	Jon Kurland
Neil Davis	Robert Alverson
Peter DeGreef	Richard Yamada

Executive Director

David T. Wilson, Ph.D.

DISTRIBUTION: IPHC WEBSITE
LAST UPDATE: 6 May 2025

BIBLIOGRAPHIC ENTRY
IPHC 2025. 21st Session of the IPHC Management Strategy Advisory Board (MSAB021) - Compendium of meeting documents. Int. Pac. Halibut Comm.

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2025-MSAB021-01

Last updated: 6 May 2025

DRAFT: AGENDA AND SCHEDULE FOR THE 21st SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB021)

Date: 13-15 May 2025
Location: Juneau, AK
Location: NOAA office, Balsiger Rm
Link: https://iphc.adobeconnect.com/msab021/
Time (AKDT): 09:00-17:00 (daily)
Co-Chairpersons: Ms Gwyn Mason (Canada); Dr Pete Hulson (USA)

Notes:

- ***Document deadline****: 13 April 2025 (30 days prior to the opening of the Session)*
- *All sessions are open to observers and the general public via online access only due to space limitations.*

1. OPENING OF THE SESSION

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

- *IPHC-2025-MSAB021-01: Agenda & Schedule for the 21st Session of the IPHC Management Strategy Advisory Board (MSAB021)*
- *IPHC-2025-MSAB021-02: List of Documents for the 21st Session of the IPHC Management Strategy Advisory Board (MSAB021)*

3. IPHC PROCESS

3.1. MSAB Membership (D. Wilson)
- *IPHC-2025-MSAB021-03: MSAB Membership (D. Wilson)*

3.2. Update on the actions arising from the 20th Session of the MSAB (MSAB020) (A. Hicks)
- *IPHC-2025-MSAB021-04: Update on the actions arising from the 20th Session of the MSAB (MSAB020) (A. Hicks)*

3.3. Outcomes of the 101st Session of the IPHC Annual Meeting (AM101) (A. Hicks)
- *IPHC-2025-MSAB021-05: Outcomes of the 101st Session of the IPHC Annual Meeting (AM101) (A. Hicks)*

4. MANAGEMENT STRATEGY EVALUATION

4.1. Understanding MSE and how it is used for Pacific halibut management
- *IPHC-2025-MSAB021-06: Understanding MSE and its role in the management of Pacific halibut (A. Hicks)*

4.2. Update on the IPHC MSE process
- *IPHC-2025-MSAB021-07: Updates to the IPHC MSE and a review of coastwide management procedures (A. Hicks & I. Stewart)*

5. MANAGEMENT STRATEGY EVALUATION PROGRAM OF WORK (2025-2026)

5.1. Development of a Program of Work for 2025

- *IPHC-2025-MSAB021-08: Considerations for the Management Strategy Evaluation Program of Work for 2025-2026 (A. Hicks & I. Stewart)*

6. UPDATE: HARVEST STRATEGY POLICY

6.1. Update: Harvest Strategy Policy (A. Hicks)

- *IPHC-2025-MSAB021-09: Interim IPHC Harvest Strategy Policy (IPHC Secretariat)*

7. OTHER BUSINESS

8. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 21ST SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB021)

Tuesday 13 May 2025		
Time (AKDT)	**Agenda item**	**Lead (support)**
08:45-09:00	Connect electronically and troubleshoot connections for those not in-person	IPHC Secretariat
09:00-09:10	**1. Opening of the Session**	Co-Chairperson & Secretariat
09:10-09:30	**2. Adoption of the agenda and arrangements for the Session**	Co-Chairpersons
09:30-10:00	**3. IPHC Process** 3.1. MSAB Membership 3.2. Update on the actions arising from the 20th Session of the MSAB (MSAB020) 3.3. Outcomes of the 101st Session of the IPHC Annual Meeting (AM101)	 D. Wilson A. Hicks A. Hicks
10:00-10:45	**4. Management Strategy Evaluation** 4.1. Understanding MSE and how it is used for Pacific halibut management	A. Hicks
10:45-11:15	Break	
11:15-12:00	**4. Management Strategy Evaluation (continued)** 4.1. Understanding MSE and how it is used for Pacific halibut management (discussion)	A. Hicks
12:00-13:30	Lunch	
13:30-14:45	**4. Management Strategy Evaluation (continued)** 4.2. Update on the IPHC MSE process	A. Hicks
14:45-15:15	Break	
15:15-15:45	**4. Management Strategy Evaluation (continued)** 4.2. Update on the IPHC MSE process (discussion)	A. Hicks
15:45-16:00	Review of Day 1	Co-chairpersons
16:00-17:00	MSAB Drafting Session	MSAB
18:00-21:00	MSAB Dinner (details announced at meeting)	IPHC Secretariat

Wednesday 14 May 2025		
Time (AKDT)	**Agenda item**	**Lead (support)**
08:45-09:00	Connect electronically and troubleshoot connections for those not in-person	IPHC Secretariat
09:00-09:30	Review of Day 1 and discussion of draft report	Co-Chairpersons
09:30-10:30	**5. Management Strategy Evaluation Program of Work (2025-2026)** 4.2. Development of a Program of Work for 2025	
10:30-11:00	Break	
11:00-12:00	**5. Management Strategy Evaluation Program of Work (2025-2026) (continued)** 5.1. Development of a Program of Work for 2025	A. Hicks
12:00-13:30	Lunch	
13:30-14:45	**5. Management Strategy Evaluation Program of Work (2025-2026) (continued)** 5.1. Development of a Program of Work for 2025	A. Hicks
14:45-15:15	Break	
15:15-15:30	Review of Day 2	Co-chairpersons
15:30-17:00	MSAB Drafting Session	MSAB

Thursday 15 May 2024		
Time (AKDT)	**Agenda item**	**Lead (support)**
08:30-09:00	Connect electronically and troubleshoot connections	IPHC Secretariat
09:00-10:00	Review of Day 2 and discussion of draft report	Co-Chairpersons
10:00-10:45	**6. Update: Harvest Strategy Policy** 6.1. Update: Harvest Strategy Policy	A. Hicks
10:45-11:15	Break	
11:15-11:30	**7. Other Business**	A. Hicks
11:30-12:30	MSAB Drafting Session	MSAB
12:30-14:00	Lunch	
14:00-16:00	**8. Review of the Draft and Adoption of the Report of the 21st Session of the IPHC Management Strategy Advisory Board (MSAB021)**	Co-Chairpersons

LIST OF DOCUMENTS FOR THE 21st SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB021)

Meeting documents	Title	Availability
IPHC-2025-MSAB021-01	Agenda & Schedule for the 21st Session of the IPHC Management Strategy Advisory Board (MSAB021)	✓ 11 Feb 2025 ✓ 28 Mar 2025
IPHC-2025-MSAB021-02	List of Documents for the 21st Session of the IPHC Management Strategy Advisory Board (MSAB021)	✓ 11 Feb 2025 ✓ 10 Apr 2025 ✓ 06 May 2025
IPHC-2025-MSAB021-03	MSAB membership (D. Wilson)	✓ 7 Apr 2025
IPHC-2025-MSAB021-04	Update on actions arising from the 20th Session of the MSAB (MSAB020) (A. Hicks)	✓ 7 Apr 2025
IPHC-2025-MSAB021-05	Outcomes of the 101st Session of the IPHC Annual Meeting (AM101) (A. Hicks)	✓ 7 Apr 2025
IPHC-2025-MSAB021-06	Understanding MSE and its role in the management of Pacific halibut (A. Hicks)	✓ 7 Apr 2025
IPHC-2025-MSAB021-07	Updates to the IPHC MSE and a review of coastwide management procedures (A. Hicks & I. Stewart)	✓ 7 Apr 2025
IPHC-2025-MSAB021-08	Considerations for the Management Strategy Evaluation Program of Work for 2025-2026 (A. Hicks & I. Stewart)	✓ 10 Apr 2025
IPHC-2025-MSAB021-09	Interim: IPHC Harvest Strategy Policy (IPHC Secretariat)	✓ 7 Apr 2025

MSAB Membership 2025

PREPARED BY: IPHC SECRETARIAT (7 APRIL 2025)

PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with an updated membership list as of 03 April 2025.

BACKGROUND

Rule II of Appendix V [Management Strategy Advisory Board (MSAB) – Terms of Reference and Rules of Procedure] of the IPHC Rules of Procedure (2024), states:

> *3. The MSAB will include the following interests (in alphabetical order): harvesters (commercial, sport, and subsistence), fisheries managers, processors, science advisors and other experts as required may be represented, and be facilitated by the IPHC Secretariat. Upon request, the IPHC shall cover the travel costs, in accordance with IPHC travel policies, for non-State and non-Federal board members, to attend one (1) MSAB session each year.*
>
> *4. The term of MSAB members will be four years, and members may serve additional terms at the discretion of the IPHC.*

DISCUSSION

At the 99th Session of the IPHC Annual Meeting (AM099), the Commission made the following agreements related to MSAB membership.

> **IPHC-2023-AM099-R, para. 69**. *The Commission **AGREED** that the Management Strategy Evaluation process and the Management Strategy Advisory Board continue to support the Commission's management of the stock and fishery by providing the means to define fishery objectives and evaluate the performance of management measures against these objectives. The two Contracting Parties have reviewed MSAB membership with the intention of ensuring that the MSAB represents the diversity of interests and remains at a manageable size.*
>
> **IPHC-2023-AM099-R, para. 70**. *The Commission **AGREED** that term appointments can continue to be renewed without limit at the discretion of the Commissioners.*
>
> **IPHC-2023-AM099-R, para. 71**. *The Commission **AGREED** that current MSAB membership terms which expired on 31 December 2022 should be renewed for up to four (4) years to facilitate staggered term expiry among members.*

No recommendations were made at the 100th Annual Meeting of the IPHC (AM100) pertaining to MSAB meetings or membership. The following recommendation was made at the 101st Annual Meeting of the IPHC (AM101).

> **IPHC-2025-AM101-R, para. 119.** *The Commission **AGREED** to make an exception to Rule II, para. 3.c of the IPHC Rules of Procedure (2024) (shown below) that limits Contracting Party representation to four (4) government agency personnel from each Contracting Party. The exception allows domestic agencies to nominate additional representatives to the MSAB, noting that costs for participation are to be borne by the domestic agency, and not the IPHC.*
>
> *II.3.c: "Government agencies (incl. domestic management representatives and science advisors to each Contracting Party) (4-8; max of 4 from each Contracting Party)"*

Provided at Appendix A are the current MSAB membership and term expirations, taking into account the AM101 agreement detailed above, updated expirations based on indications to serve another term, and changes in membership since MSAB020.

RECOMMENDATION/S

That the MSAB **NOTE** paper IPHC-2025-MSAB021-03 which details the MSAB membership and term expirations, as of 03 April 2025.

APPENDICES

Appendix A: MSAB Membership as of 03 April 2025.

APPENDIX A
MANAGEMENT STRATEGY ADVISORY BOARD (MSAB) MEMBERSHIP

(*AS OF 3 APRIL 2025 ; REFLECTING IPHC-2025-CR-009*)

Membership category	Member	Canada	U.S.A.	Current Term commencement	Current Term expiration
Commercial harvesters (6-8)					
1	Sporer, Chris	CDN Commercial		10-April-23	31-Dec-26
2	Hauknes, Robert	CDN Commercial		03-Apr-25	02-Apr-29
3	Grout, Angus	CDN Commercial		10-April-23	31-Dec-26
4	Vacant	CDN Commercial			Vacant
5	Behnken, Linda		USA Commercial	01-May-24	30-April-28
6	Elwood, Garrett		USA Commercial	03-Apr-25	02-Apr-29
7	Conrad, Michele		USA Commercial	01-May-24	30-Apr-28
8	Johnson, James		USA Commercial	03-Apr-25	02-Apr-29
First Nations/ Tribal fisheries (2-4)					
1	Lane, Jim	CDN First Nations		10-April-23	31-Dec-26
2	Vacant	CDN First Nations			Vacant
3	Mazzone, Scott		USA Treaty Tribes	03-Apr-25	02-Apr-29
4	Fitting, Emily		USA Treaty Tribes	25-Sept-24	24-Sept-28

Membership category	Member	Canada	U.S.A.	Current Term commencement	Current Term expiration
Government Agencies (4-8)					
1	Mason, Gwyn	DFO		16-April-24	15-April-28
2	Huang, Ann-Marie	CDN Science Advisor		1-Jan-25	31-Dec-28
3	Vacant	DFO			Vacant
4	Iverson, Kurt		NOAA-Fisheries	17-Oct-22	16-Oct-26
5	Hulson, Pete		USA Science Advisor	1-Jan-25	31-Dec-28
6	Mattes, Lynn		PFMC	25-Jun-24	31-Dec-26
7	Bush, Karla		NPFMC	10-Jan-25	9-Jan-29
8	Joy, Philip		ADFG	1-Jan-25	31-Dec-28
Processors (2-4)					
1	Vacant	CDN Processing			Vacant
2	Vacant	CDN Processing			Vacant
3	Parker, Peggy		USA Processing	03-Apr-25	02-Apr-29
4	Drobnica, Angel		USA Processing	17-Apr-23	31-Dec-26
Recreational/ Sport fisheries (2-4)					
1	Fowler, Michael	CDN Sportfishing		01-May-24	30-April-28
2	Vacant	CDN Sportfishing			Vacant
3	Marking, Tom		USA Sportfishing (CA)	9-May-23	31-Dec-26
4	Braden, Forrest		USA sportfishing (AK)	03-Apr-25	02-Apr-29

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2025-MSAB021-04

Update on the Actions Arising from the 20th Session of the IPHC Management Strategy Advisory Board (MSAB020)

PREPARED BY: IPHC SECRETARIAT (7 APRIL 2025)

PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with an opportunity to consider the progress made during the intersessional period, on the recommendations/requests arising from the MSAB020.

BACKGROUND

At the MSAB020, the members recommended/requested a series of actions to be taken by the IPHC Secretariat, as detailed in the MSAB020 meeting report (IPHC-2024-MSAB020-R) available from the IPHC website, and as provided in Appendix A.

DISCUSSION

During the 21st Session of the MSAB (MSAB021), efforts will be made to ensure that any recommendations/requests for action are carefully constructed so that each contains the following elements:

1) a specific action to be undertaken (deliverable);
2) clear responsibility for the action to be undertaken (such as the IPHC Staff or MSAB officers);
3) a desired time frame for delivery of the action (such as by the next session of the MSAB or by some other specified date).

RECOMMENDATION/S

That the MSAB:

1) **NOTE** paper IPHC-2025-MSAB021-04, which provided the MSAB with an opportunity to consider the progress made during the inter-sessional period in relation to the consolidated list of recommendations/requests arising from the previous MSAB meeting (MSAB020).
2) **AGREE** to consider and revise the actions as necessary and to combine them with any new actions arising from MSAB021.

APPENDICES

Appendix A: Update on actions arising from the 20th Session of the IPHC Management Strategy Advisory Board (MSAB020)

APPENDIX A
Update on actions arising from the 20th Session of the IPHC Management Strategy Advisory Board (MSAB020)

RECOMMENDATIONS

Action No.	Description	Update
MSAB020–Rec.1 (para 14)	The MSAB **RECOMMENDED** that the Commission priority objective "optimise average coastwide TCEY" (c in paragraph 12) be changed to "maximise average coastwide TCEY" and that this objective along with the variability in yield objective (d in paragraph 12) be given equal consideration to allow for the evaluation of trade-offs between these two objectives	**Status: In progress** Will be considered by the Commission at future meetings of the Commission.
MSAB020–Rec.2 (para 41)	The MSAB **RECOMMENDED** updating the reference MP for one three-year cycle on a trial basis using a triennial stock assessment frequency (synchronised with the full stock assessment scheduled in 2025 to inform 2026 mortality limits). The coastwide TCEY would be based on SPR=46% in assessment years and based on the proportional change in the FISS O32 WPUE index in non-assessment years. The triennial stock assessment frequency may increase the median coastwide TCEY and reduce the interannual variability in the coastwide TCEY. A lower fishing intensity would also reduce the probability that the spawning biomass is less than the 2023 spawning biomass in the short- and long-term, and result in lower interannual variability as noted in paragraph 26.	**Status: In progress** Will be considered by the Commission in the future.
MSAB020–Rec.3 (para 42)	The MSAB **RECOMMENDED** further evaluations of the following MP elements: d) A triennial assessment frequency with each of the three FISS designs; e) Various empirical rules to determine the reference coastwide TCEY in non-assessment years; f) Constraints on the interannual change in the reference coastwide TCEY, such as a maximum change in the coastwide TCEY of 15%, a slow-up fast down approach, or a fixed TCEY in non-assessment year	**Status: In progress** These tasks will be considered at MSAB021 for inclusion in the MSE Program of Work.
MSAB020–Rec.4 (para 47)	The MSAB **RECOMMENDED** that the Commission consider endorsing the draft HSP **NOTING** that changes may be made to the HSP in the future as more research and MSE evaluations are completed.	**Status: Completed** The Commission has scheduled a workshop in April 2025 to discuss the HSP and will consider it for adoption in 2025.

Action No.	Description	Update
MSAB020-Rec.5 (para 49)	The MSAB **RECOMMENDED** that the 21st Session of the MSAB (MSAB021) be held in the first half of May 2025, occur over 2-3 days, and be in-person, if possible	**Status: Completed** MSAB021 is scheduled to take place in Juneau, AK from 13-15 of May and also available electronically.

REQUESTS

Action No.	Description	Update
MSAB020–Req.1 (para 28)	The MSAB **REQUESTED** more exploration into understanding the patterns presented in paragraph 27. para 27. "*The MSAB NOTED that lower fishing intensities (i.e. higher SPR values) resulted in higher absolute spawning biomass but reduced the median coastwide TCEY. There is a greater than 1-in-3 chance that the short-term absolute spawning biomass will be less than the 2023 spawning biomass when fishing at a reference SPR=43%. The chance was approximately 1-in-4 for long-term spawning biomass. Fishing at an SPR=52% reduced these chances to approximately 1-in-4 and 1-in-6 for the short- and long-terms, respectively. However, lower fishing intensities did not realize high TCEYs seen at higher fishing intensities, and did result in lower TCEYs more often than seen at higher fishing intensities, over the short-term.*"	**Status: Completed** These investigations are presented in IPHC-2025-MSAB021-07.
MSAB020–Req.2 (para 39)	The MSAB **REQUESTED** more research into performance metrics that may be informative of changes in the TCEY for non-assessment years and changes in the TCEY for assessment years when using a triennial assessment frequency	**Status: Completed** This research is presented in IPHC-2025-MSAB021-07.
MSAB020–Req.3 (para 37)	**NOTING** that increased uncertainty due to reductions in the FISS design resulted in only declines in the median coastwide TCEY, the MSAB **REQUESTED** further exploration into the causes of this, especially since there is a monetary value being attributed to the FISS design	**Status: Completed** These explorations are presented in IPHC-2025-MSAB021-07.
MSAB020–Req.4 (para 45)	The MSAB **REQUESTED** the following edits to the draft HSP: a) Improvements to the Harvest Strategy Policy figure including specifying that the adopted coastwide TCEY is an outcome along with the Regulatory Area Mortality Limits.	**Status: Completed** The draft HSP contains this change (IPHC-2025-AM101-17).

Outcomes of the 101st Session Of The IPHC Annual Meeting (AM101)

PREPARED BY: IPHC SECRETARIAT (A. HICKS, 7 APRIL 2025)

PURPOSE

To provide the MSAB with the outcomes of the 101st Session of the IPHC Annual Meeting (AM101) relevant to the mandate of the MSAB.

BACKGROUND

The agenda of the 101st Session of the IPHC Annual Meeting (AM101) included items relevant to the MSAB.

DISCUSSION

During the course of the 101st Session of the IPHC Annual Meeting (AM101) the Commission made one request regarding the Management Strategy Evaluation (MSE) and Harvest Strategy Policy (HSP) processes. Relevant sections from the report of AM101 (IPHC-2025-AM101-R) are provided in Appendix A for the MSAB's consideration.

RECOMMENDATION

That the MSAB:

1) **NOTE** paper IPHC-2025-MSAB021-05, which details the outcomes of the 101st Session of the IPHC Annual Meeting (AM101).

APPENDICES

Appendix A: Excerpts from the 101st Session of the IPHC Annual Meeting (AM101) Report (IPHC-2025-AM101-R).

APPENDIX A
Excerpt from the 101st Session of the IPHC Annual Meeting (AM101) Report (IPHC-2025-AM101-R)

RECOMMENDATIONS

Nil

REQUESTS

IPHC-2025-AM101-R, para 53. *The Commission* ***REQUESTED*** *that the Secretariat facilitate informal intersessional workshops, consisting of Commissioners and key advisors, to review and consider the draft Harvest Strategy Policy, for adoption in mid-to-late 2025.*

Understanding MSE and its role in the management of Pacific halibut

PREPARED BY: IPHC SECRETARIAT (A. HICKS; 7 APRIL 2025)

PURPOSE

To provide the MSAB with an overview of the IPHC Management Strategy Evaluation (MSE) and how it has supported the development of the draft IPHC Harvest Strategy Policy (HSP).

1 INTRODUCTION

MSE has been used by the Commission since 1968 (Southward 1968) to inform the Commission on best performing management strategies for the Pacific halibut fishery. In 2013, the Commission hosted the first meeting of the Management Strategy Advisory Board (MSAB), which has met at least once a year since then to advise the Commission on the MSE process. The Scientific Review Board (SRB), holding it's first meeting in 2013 as well, reviews the MSE work. The MSE process, input from the MSAB, and review by the SRB have been instrumental in the development of a HSP for the management of Pacific halibut. This document describes the history of that development and the influence of MSE on the current draft HSP.

2 MANAGEMENT STRATEGY EVALUATION

Management Strategy Evaluation is a process to identify management procedures that meet defined objectives and are robust to uncertainty. There are four basic components to MSE: objectives, management procedures (MPs), simulation/evaluation, and application. Objectives are defined with the assistance of resource users, stakeholders, and managers. Candidate MPs to evaluate are identified, based on those objectives and with input from users, stakeholders, and managers. Simulation of the fish stock and fisheries is done for each candidate MP and performance metrics associated with the objectives are reported to aid in the evaluation. Finally, the best performing MP is determined and applied in the HSP. Punt et al. (2016) provides an overview of best practices for MSE.

2.1 Objectives

The Commission has previously defined four priority coastwide objectives and associated performance metrics for evaluating MSE simulations.

> **IPHC-2023-AM099-R, para. 76.** *The Commission **RECOMMENDED** that for the purpose of a comprehensive and intelligible Harvest Strategy Policy (HSP), four coastwide objectives should be documented within the HSP, in priority order:*

a) Maintain the long-term coastwide female spawning stock biomass above a [relative spawning][1] *biomass limit reference point (B20%) at least 95% of the time.*

b) Maintain the long-term coastwide female spawning stock biomass at or above a [relative spawning][1] *biomass reference point (B36%) 50% or more of the time.*

c) Optimise average coastwide TCEY.

d) Limit annual changes in the coastwide TCEY.

IPHC-2023-AM099-R, para. 77. *The Commission **AGREED** that the performance metrics associated with the objectives in Paragraph 76 are:*

a) P(RSB): Probability that the long-term Relative Spawning Biomass (RSB) is less than the Relative Spawning Biomass Limit, failing if the value is greater than 0.05.

b) P(RSB<36%): Probability that the long-term RSB is less than the Relative Spawning Biomass Reference Point, failing if the value is greater than 0.50.

c) Median TCEY: the median of the short-term average TCEY over a ten-year period, where the short-term is 4-14 years in the future.

d) Median AAV TCEY: the average annual variability of the short-term TCEY determined as the average difference in the TCEY over a ten-year period.

There are many more potential objectives and performance metrics, which may include area- and fleet-specific concepts.

2.1.1 Biomass objective

Research in 2019 (IPHC-2019-SRB015-11 Rev_1) suggested that reducing the stock to a relative spawning biomass (RSB) of 30% would be a reasonable proxy for Maximum Sustainable Yield (MSY) and an RSB of 36% would represent a proxy for Maximum Economic Yield (MEY). Therefore, the 36% threshold for RSB was chosen for objective b), which is not a target because other objectives may result in a desire to maintain the RSB above MEY. This objective is to ensure that when consistently using an MP the biomass is above B_{MEY} more often than it is below B_{MEY}, which may occur because of natural fluctuations.

The Commission has been discussing the utility of objective b) in light of recent results indicating a current stock status above 36% (due to low recent fishing intensities) but a low level of absolute spawning biomass corresponding to low fishery and fishery-independent setline survey (FISS) catch-rates. This combination of relative spawning biomass above the 36% threshold and low absolute spawning biomass reflects recent low weight-at-age and recruitment. Some of those discussions have focused on considering a new objective related to an absolute level of spawning biomass in addition to the relative spawning biomass used to determine stock status.

[1] Bracketed text added for clarity, identifying that relative spawning biomass is used as the reference point for these objectives.

An objective to maintain the absolute spawning biomass (or FISS WPUE as a data-based proxy) above a threshold may be a useful objective for several reasons. First, the level of spawning biomass likely correlates with catch-rates in the commercial fishery, and a higher spawning biomass would likely result in a more efficient and economically viable commercial fishery as well as greater opportunity for recreational and subsistence fisheries. Second, current priority conservation objectives use dynamic relative spawning biomass which may result in a low absolute spawning biomass with a satisfactory stock status. Third, a minimum absolute coastwide spawning biomass may be necessary to ensure successful reproduction (such a level is currently unknown for Pacific halibut). Lastly, an observed reference stock level in absolute biomass may have concrete meaning to stakeholders as it can be related to direct recent fishing experience. For example, the recent estimated spawning biomass may be near or below the lowest spawning biomass estimated since the mid-1970's and observed fishery catch rates were historically low in 2022 and 2023. A list of pros and cons of an absolute spawning biomass objective are provided in Table 1.

Table 1. Some pros and cons of using an absolute biomass threshold as a fishery objective to optimise fishing activities and opportunities.

Pros	Cons
Higher spawning biomass likely correlates with a more efficient fishery (e.g. catch-rates).	Defining an appropriate threshold can be challenging.
Measures the actual amount of biomass rather than the biomass relative to an unfished level.	The threshold is dependent on external factors that may not be influenced by management decisions.
Maintaining a level of absolute biomass may ensure that successful reproduction can occur.	Area-specific absolute biomass may be more important than a coastwide absolute biomass.
Absolute biomass can represent a direct reference level that is meaningful to stakeholders.	Interpretation of an appropriate absolute biomass differs among stakeholders

Further discussion is summarized in IPHC-2025-AM101-12 and suggests an additional objective, such as "maintain the coastwide female spawning biomass (or FISS WPUE) above a threshold." Further evaluation of this type of objective could be part of the MSE Program of Work for 2025.

2.1.2 Yield objective

The current objective "optimise coastwide average yield" was implemented to provide flexibility when evaluating management procedures. However, following discussions with the SRB, the flexibility is not conducive to determining a single best performing management procedure because what optimise means is not well defined. Taking a broad view, to optimise yield is a general objective that encompasses multiple more specific objectives such as achieving high yields, minimising the interannual change in yield, and maintaining high catch-rates, all of which are important to the Commission. For example, optimising yield involves balancing the trade-offs between maximising short- or long-term yield and minimising the annual change in yield.

The MSAB recommended that 'optimise' be changed to 'maximise' and this objective be given equal consideration along with minimising interannual variability in yield.

> **IPHC-2024-MSAB020-R, para 14**. *The MSAB **RECOMMENDED** that the Commission priority objective "optimise average coastwide TCEY" (c in paragraph 12) be changed to "maximise average coastwide TCEY" and that this objective along with the variability in yield objective (d in paragraph 12) be given equal consideration to allow for the evaluation of trade-offs between these two objectives.*

Changing this objective from 'optimise' to 'maximise' would not change the overall goal of the Commission to optimise yield. In fact, the two objectives "maximise yield" and "minimise interannual variability in yield" are both a part of optimising yield. Giving equal consideration to both objectives would better meet the general goal of the Commission to optimise yield.

2.1.3 Hierarchical grouping of Commission objectives

An important part of the four priority objectives of the Commission is that they are hierarchical. The objectives can be categorized into two groups (Table 2). The first group contains long-term objectives a) and b), in priority order, which define the overarching objectives of the Commission (ensuring sustainability of the stock and optimising fishing activities and opportunities) and unambiguously identifies MPs that do not support long-term objectives of the Commission. All MPs that do not meet these two objectives would not be considered as a potential reference MP. Furthermore, the sustainability objective (a) may be used to define an 'overfished' status, and the fishing opportunity objective (b) may be associated with an 'overfishing' status. The first group also clearly defines the boundaries of the management space over which Commission decision-making can apply.

The second group contains short-term objectives c) and d) which define the management objectives of the Commission related to optimal yield. A reference MP will represent a trade-off between the amount of yield and the interannual variability in that yield. The optimal trade-off may be considered differently by different users and stakeholders and may change over time, thus there is no inherent priority between these two objectives when selecting a reference MP. Justification of a reference MP is therefore provided after evaluation of this trade-off. This trade-off may also be considered during the annual decision-making process while also incorporating many other objectives.

Table 2. Commission priority objectives for the long-term sustainable management of Pacific halibut that supports optimal fishing opportunities. Light grey text shows potential additions/changes that are not in the current Commission objectives.

PURPOSE	TYPE	GOAL	GENERAL OBJECTIVE	MEASURABLE OBJECTIVE
LONG-TERM OVERARCHING OBJECTIVES DEFINING MPS TO AVOID	CONSERVATION	SUSTAINABILITY	**1.** KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES	**a)** Maintain the long-term coastwide female relative spawning biomass above a biomass limit reference point ($RSB_{20\%}$) at least 95% of the time
	FISHERY	OPTIMISE FISHING ACTIVITIES AND OPPORTUNITIES	**2.** MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT SUPPORTS OPTIMAL FISHING ACTIVITIES AND OPPORTUNITIES	**b)** Maintain the long-term coastwide female relative spawning biomass at or above a biomass threshold reference point ($RSB_{36\%}$) 50% or more of the time.
				) Maintain the long-term coastwide female absolute spawning biomass at or above a biomass threshold reference point (XX) YY% or more of the time.
SHORT-TERM MANAGEMENT OBJECTIVES DEFINING A REFERENCE MP	FISHERY	OPTIMISE YIELD	**3.** PROVIDE DIRECTED FISHING YIELD WHILE LIMITING VARIABILITY IN MORTALITY LIMITS	**c)** Maximise average coastwide TCEY
				d) Limit annual changes in the coastwide TCEY

2.2 Management Procedures

An MP is a defined process to determine a mortality limit. This process is composed of multiple elements, is repeatable, and can be coded in a computer simulation to evaluate its performance. MPs are not subject to variability from the decision-making process.

Many elements of MPs for Pacific halibut mortality limits have been investigated and some of those elements are discussed below. Elements may include the fishing intensity, the frequency of stock assessments and the use of empirical rules in years without a stock assessment, size limits, constraints on the interannual change in the TCEY, and distribution of the TCEY to IPHC Regulatory Areas. Recently, the IPHC has been focusing on fishing intensity, frequency of the stock assessment, and empirical rules to determine the TCEY in years when a stock assessment would not be done.

2.3 Simulation and evaluation

The IPHC Secretariat has developed an MSE framework to rapidly investigate MPs. This framework includes conditioned operating models (OMs) representing uncertainty and variability in both the stock and fishery dynamics. The OMs are used to simulate the stock and fisheries in a closed-loop feedback system where a management procedure provides a mortality limit on an annual basis that is used by the OM to further simulate the dynamics of the population. Closed-loop feedback is essential to the MSE process. Simulations project many years into the future to represent equilibrium outcomes that are independent of the starting conditions and integrate over the entire range of uncertainty. Quantities are extracted from the simulations to calculate performance metrics used in the evaluation process.

An example of MSE simulations is shown in Figure 1. The conditioned model (the lighter early region) starts each projection from different starting points representing historical uncertainty. Individual trajectories projecting forward make up the variability that the performance metrics summarize. Capturing a wide range of uncertainties is an important aspect of MSE.

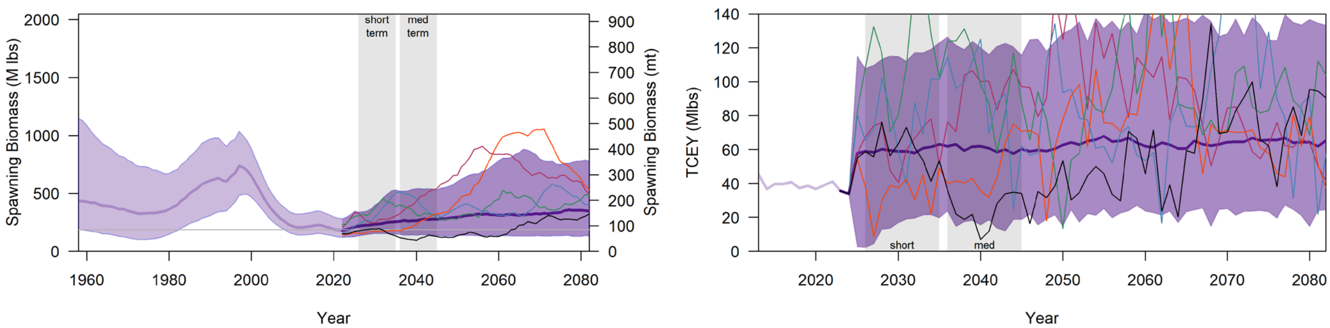

Figure 1. MSE simulations of spawning biomass (left) and TCEY (right) with a fishing intensity equal to $F_{SPR=43\%}$. The dark line is the median, the shaded area the 5th and 95th percentiles, and the individual lines example single trajectories. The short-term and medium-term periods are shown in grey. The long-term period is the last 10 years of the projection. The lighter region at the start of the simulation is the conditioned historical period.

Theoretically, evaluation should be as simple as identifying the MP that best meets the objectives. In practice, however, that can be challenging because there are trade-offs between objectives, as presented above. Discussing these trade-offs with users, stakeholders, and managers is useful to identify an MP that may be a compromise between objectives. The MSAB, SRB, and Commission meetings provide opportunities for those discussions.

3 HISTORICAL HARVEST POLICIES

The long history of the IPHC has seen numerous harvest policies to manage the Pacific halibut fisheries. During the early history of the Commission, the policy was to increase catch-rates by reducing total fishing mortality through reductions in effort and landings and shortening the fishing season (Clark 2003; Clark and Hare 2006; Southward 1968; Thompson 1937; Thompson and Bell 1934). The latter part of the 20th century and early 21st century used constant exploitation rates to determine mortality limits, with reductions in the exploitation level informed by research and simulations similar to MSE. Throughout the 20th century the focus was on area management assuming that each area was an independent management unit. Tagging studies in the early 2000's indicated that the IPHC Regulatory Areas were not independent stocks and a coastwide approach should be used to avoid biased stock size estimates and ensure sustainability of the entire Pacific halibut stock. This has been further supported by recent genetics work on stock structure. A constraint on the annual change in the mortality limit was implemented in 2001, called "slow up fast down", and was later changed to "slow up full down". A description of the harvest policy in the early 2000's is given in Hare and Clark (2008) and Hare (2011). A description of historical harvest policies for Pacific halibut is given in Valero (2012).

4 DEVELOPMENT OF THE CURRENT DRAFT HARVEST STRATEGY POLICY

4.1 Coastwide SPR

After the change to coastwide management in 2006 (Clark and Hare 2006; Clark and Hare 2007a, 2007b), a constant exploitation rate was retained to determine the coastwide mortality limit. However, this was challenging because total fishing mortality came from a mixture of various gears from different areas intercepting age classes in different proportions. Exploitable biomass was therefore an abstract concept without direct application to the coastwide determination of total mortality.

An alternative approach is to adjust the fishing intensity such that the spawning potential of the coastwide stock given this fishing intensity is a pre-defined percentage of the spawning potential with any fishing. In other words, apply a fishing intensity such that in the long-term the spawning potential ratio (SPR) of fished to unfished would be a defined percentage. This is called an SPR-based approach (Goodyear 1993; Mace et al. 1996) and represents the standard management approach across most fisheries in the NE Pacific. The benefit of this approach is that it does not rely on an exploitation rate or exploitable biomass, it accounts for mortality of all sizes and from all sources, accounts for current conditions of the stock, and is widely accepted and implemented in fisheries management. SPR is different than relative spawning biomass (RSB) because SPR is calculated using spawning biomass per recruit, thus measures the spawning potential of an individual fish (i.e. how much will fishing mortality reduce its spawning potential) rather than the reduction in spawning biomass which includes reductions to recruitment due to reduced spawning biomass (i.e. the stock-recruit relationship). SPR has the benefit of managing on a per-recruit basis rather than attempting to incorporate the highly uncertain stock-recruit relationship.

Hicks and Stewart (2017) noted the problems of using exploitable biomass in the IPHC harvest policy and provided support for an SPR-based approach. The IPHC adopted an SPR-based approach in 2017 to be first used when determining total coastwide mortality limits in 2018.

> **IPHC-2017-AM093-R, para 29**. ***NOTING*** *that the IPHC Secretariat and the IPHC Scientific Review Board (SRB) have demonstrated that Ebio is outdated and inconsistent with current assessment results, and that numerous elements of the current harvest policy are reliant on Ebio, and that the Commission has agreed that the current harvest policy is considered to be outdated (IPHC–2016–IM092–R, items 21, 22), the Commission* ***RECOMMENDED*** *that reference to all elements of the current harvest policy reliant on Ebio, as well as the use of the Blue line, be eliminated subsequent to the close of the 93rd Session of the Commission. The "status quo SPR" (F46%) may serve as an interim "hand rail" that allows all participants to gauge this and future years' catch limit discussions in comparison to previous years.*

The adopted 46% for SPR was determined from the average SPR from recent management decisions at that time, and was considered as a “hand rail” meaning that Commission decisions may depart from that fishing intensity as part of the decision making process.

The MSE process subsequently evaluated various SPR levels showing that an SPR value greater than 40% would meet fishery and conservation objectives. The Commission subsequently recommended an interim harvest policy with an SPR of 43% in 2020.

> **IPHC-2020-SS06-R, para 3**. *The Commission **NOTED** that given the results from the coastwide MSE, the following elements from the scale (coastwide) component of the management procedure meet the coastwide objectives:*
>
> *a) SPR values greater than 40%;*
>
> *b) A control rule of 30:20;*
>
> *c) Constraints on the annual change in the TCEY that either limit the annual change to 15%, use a slow-up, fast-down approach, or fix the mortality limits for three-year periods, recognizing that additional types of constraints may also meet the objectives.*
>
> **IPHC-2020-SS06-R, para 4**. *The Commission **RECOMMENDED** a reference SPR fishing intensity of 43% with a 30:20 control rule be used as an updated interim harvest policy consistent with MSE results pending delivery of the final MSE results at AM097, noting the additional components intended to apply for a period of 2020 to 2022 as defined in IPHC-2020-AM096-R paragraphs 97 b, c, d, and e. Specifically, these additional components are allocations to 2A and 2B, accounting for some impacts of U26 non-directed discard mortality, and the use of a rolling three-year average for projecting non-directed fishery discard mortality*

Given that RSBs of 30% and 36% represent reasonable proxies for MSY and MEY (IPHC-2019-SRB015-11 Rev_1), SPR values near 35% and 40% would result in RSB_{MSY} and RSB_{MEY}, respectively. A higher value of SPR (lower fishing intensity and thus RSB being greater than RSB_{MEY} more often) was justified to meet the fishery objective of minimising interannual variability in yield. Research is currently underway to determine if the MSY and MEY proxies remain consistent given recent improvements in the understanding of the biology and productivity of Pacific halibut.

The most recent MSE results show that an SPR of 43% still meets conservation and fishery objectives, but an SPR of 46% (lower fishing intensity) may minimize the interannual variability in the TCEY across SPR values (IPHC-2025-AM101-12). However, the optimal SPR is dependent on other factors in the management procedure (e.g. control rule), the allocation among areas and fisheries, and conditions of the stock (e.g. size-at-age and recruitment regime).

4.2 Harvest Control Rule

The fishing intensity is determined from a harvest control rule where the reference fishing intensity (e.g. SPR=43%) is the default at high RSB, declines between a trigger RSB and limit RSB, and is effectively zero at low RSB (Figure 2). A similar control rule with a trigger at 30% and a limit at 20% has been used since the early 2000’s, although referencing a static absolute spawning biomass rather than a dynamic RSB accounting for changes in stock conditions (Clark and Hare 2006). Different values for the trigger and limit (using RSB), as well as no control rule, were evaluated in 2020 using the current MSE framework. Although differences were found with different control rules, the 30:20 trigger and limit have been retained because it appeared to balance risk to the stock and interannual variability in the TCEY.

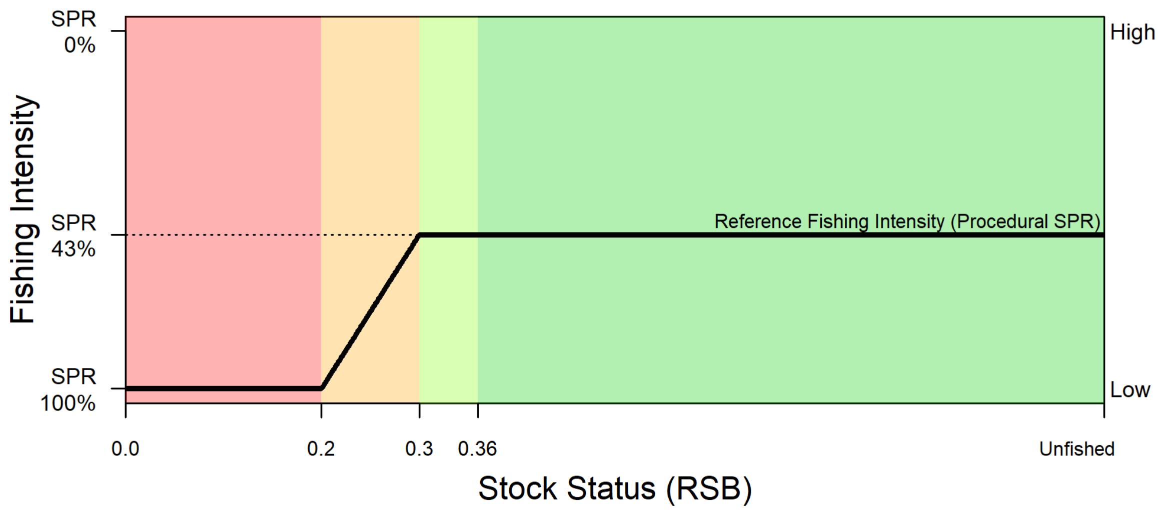

Figure 2. Harvest control rule showing the change in fishing intensity dependent on stock status defined as relative spawning biomass (RSB).

4.3 Distribution

The paradigm adopted along with a coastwide SPR was to determine the coastwide TCEY and then distribute that among IPHC Regulatory Areas. Domestic management would then allocate the TCEY to individual sectors within each IPHC Regulatory Area. The distribution of the TCEY was evaluated using the MSE and many different distribution procedures were found to meet the coastwide conservation and fishery objectives. The Commission has not adopted a specific distribution procedure but has decided to focus the MSE efforts on determining an optimal coastwide procedure and maintain distribution of the TCEY as a decision of the Commission.

> **IPHC-2024-ID006**. *The Commission **RECOMMENDED** that the Secretariat draft a revised harvest strategy policy document that will be reviewed at the IPHC Work Meeting in September 2024 (WM2024):*
>
> *a) incorporating the outcomes of ID003, ID004 and ID005 for Commission review;*
>
> *b) clearly identifying the distribution of the TCEY as a component of the decision-making process and not an output of the management procedure.*

4.4 Size limit

A size limit for landed Pacific halibut from the directed commercial fishery has been in place since 1940, beginning with a 5 pound (2.27 kg) limit (Myhre 1974). This subsequently changed to a 26 inch limit which was in place until 1973, when it changed to the current limit of 32 inches. Many analyses of the size limit have been completed (see IPHC-2021-AM097-09 for a brief review), but most recently, the MSE framework was used to investigate a 32-inch size limit, a 26-inch size limit, and no size limit (IPHC-2023-AM099-13). Results showed that reducing the size limit would result in an increase in yield, on average. However, the increased yield would be composed of Pacific halibut under 32 inches (U32) and the landings of Pacific halibut over 32 inches (O32) would decrease. There was concern that the price of U32 Pacific halibut would be less than O32 Pacific halibut, and that targeting of small Pacific halibut may occur, resulting in a reduced economic value of the fishery. Therefore, the 32-inch size limit has been maintained.

4.5 Current interim harvest strategy policy

These components combined with the decision-making process make up the current interim harvest strategy policy (Figure 3). The SPR-based MP uses a fishing intensity defined by a reference SPR of 43% which is linearly reduced when the stock is estimated below $RSB_{30\%}$ and directed fishing is halted when the stock is estimated at or below $RSB_{20\%}$. Fishery-dependent and fishery-independent data are used in the annual coastwide stock assessment to estimate the stock status and total mortality limits associated with the SPR-based fishing intensity. The MP defines a reference coastwide TCEY which is presented in a decision table along with other TCEYs representing alternative fishing intensities to assist with decision-making. Other sources of management supporting information and advice from subsidiary bodies of the IPHC assist the Commission with the decision-making process. The Commission decides on the annual coastwide TCEY (which may depart from the reference coastwide TCEY) and then decides on the distribution of the TCEY among IPHC Regulatory Areas.

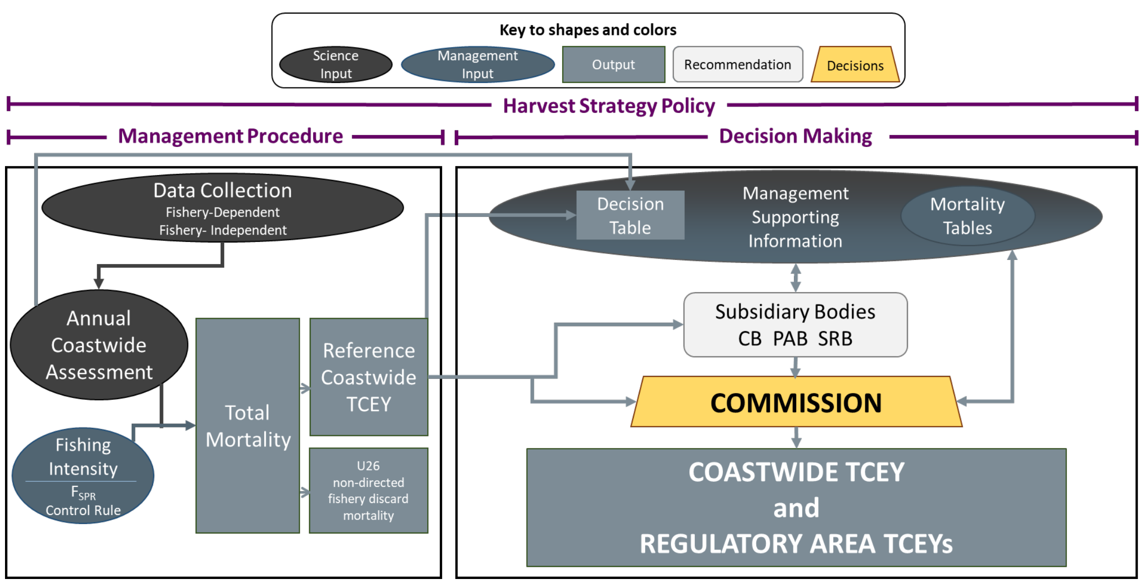

Figure 3. Illustration of the interim harvest strategy policy for the IPHC showing the determination of the coastwide TCEY (the management procedure at the coastwide scale) and the decision-making component that mainly occurs at the Annual Meeting.

A draft of the current IPHC HSP was presented at the 101st Annual Meeting of the IPHC (AM101). This draft (IPHC-2025-AM101-17) describes what an HSP is, defines objectives and key principles of the Commission, describes the development of the HSP, and presents the general elements that make up the HSP. The Commission is currently considering the draft HSP for potential adoption in 2025.

5 SUMMARY

The IPHC has used many different harvest strategies to manage Pacific halibut in the past but has not adopted a formal harvest strategy policy that defines a framework for applying a consistent and transparent approach to setting mortality limits. MSE is a common tool used to evaluate MPs for inclusion in an HSP and has been used in the last two decades to evaluate many MP elements. Recently, an MSE framework has been developed to evaluate the fishing intensity, assessment frequency, and size limits for an SPR-based management procedure. These results, presented in recent Annual Meeting documents, have influenced the development of a draft HSP (IPHC-2025-AM101-17) to be considered for adoption by the Commission in 2025.

RECOMMENDATION/S

That the MSAB **NOTE** paper IPHC-2025-MSAB021-06 providing a description the MSE process, a history of harvest policies at IPHC, and how the current MSE process has influenced the development of the draft Harvest Strategy Policy.

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Updates to the IPHC MSE and a review of coastwide management procedures

PREPARED BY: IPHC SECRETARIAT (A. HICKS & I. STEWART; 7 APRIL 2025)

PURPOSE

To provide the MSAB with an overview work done since the 20th meeting of the Management Strategy Advisory Board (MSAB020) using the IPHC Management Strategy Evaluation (MSE) framework.

1 INTRODUCTION

Rapid investigation of different questions is possible with the fully developed MSE framework. The operating models (OMs) in this framework were conditioned using the 2022 stock assessment and will be reconditioned after the 2025 full stock assessment to reflect new understanding of the Pacific halibut population and fishery dynamics. The MSAB made three requests for further investigation, which are reported here. Additionally, an investigation into the effects of weight-at-age and recruitment regimes is provided.

2 MSAB020 REQUESTS

The 20th meeting of the Management Strategy Advisory Board (MSAB020) took place the 29th and 30th of October 2024. Three requests were made at this meeting for additional investigation. Outcomes of these additional investigations are shown below.

2.1 Additional understanding of patterns

The MSE results presented at MSAB020 showed many interesting outcomes, but some of the complex outcomes were not fully understood. The MSAB was interested in how different fishing intensities affected the range of TCEYs and made this request.

> **IPHC-2024-MSAB020-R, para 27**. *The MSAB **NOTED** that lower fishing intensities (i.e. higher SPR values) resulted in higher absolute spawning biomass but reduced the median coastwide TCEY. There is a greater than 1-in-3 chance that the short-term absolute spawning biomass will be less than the 2023 spawning biomass when fishing at a reference SPR=43%. The chance was approximately 1-in-4 for long-term spawning biomass. Fishing at an SPR=52% reduced these chances to approximately 1-in-4 and 1-in-6 for the short- and long-terms, respectively. However, lower fishing intensities did not realize high TCEYs seen at higher fishing intensities, and did result in lower TCEYs more often than seen at higher fishing intensities, over the short-term.*

> **IPHC-2024-MSAB020-R, para 28**. *The MSAB **REQUESTED** more exploration into understanding the patterns presented in paragraph 27.*

Figure 1 shows the spawning biomass increasing with lower fishing intensity and Figure 2 shows the TCEY declining with lower fishing intensity. The long-term showed higher spawning biomass and higher TCEYs at a specific fishing intensity. The change in the TCEY relative to the change in spawning biomass at different SPR values was different for the short- and long-term (Figure 3). The TCEY showed larger changes across fishing intensities than the spawning biomass in the short-term. The protracted and lower range of spawning biomass in the short-term resulted in the control rule reducing the realized SPR more often (Figure 4). Smaller spawning biomass and the control rule reducing the realized fishing intensity results in only a slight reduction in the TCEY at high fishing intensities or low SPR (Figure 2). Increasing fishing intensity resulted in higher probabilities that the spawning biomass was below the spawning biomass in 2023 for both the short- and long-term (Figure 5). These probabilities were lower in the long-term due the spawning biomass being typically larger, as noted at MSAB020.

The range of TCEYs was large for all SPR values simulated, but was reduced at lower fishing intensity (Figure 2). The high range declined faster than the lower range. A useful metric is the probability that the TCEY is less than a specific amount, with a desire to minimise the chance of being below any amount. As shown in Figure 6, the chance that the TCEY is less than a specific amount is minimised at higher fishing intensities (lower SPR), except for low thresholds like 20 Mlb and 30 Mlb where the chance of being less than these values is minimised near SPR values of 45%. Narrowing this down to two performance metrics, the chance that the TCEY is less than 20 Mlbs and the chance that the TCEY is less than 80 Mlbs, the trade-offs between avoiding very low TCEYs and achieving very high TCEYs become clear (Figure 7).

Jointly minimising the chance that the TCEY is less than 20 Mlb and the chance that the TCEY is less than 80 Mlb is possible for low fishing intensities, but at SPR values near 45% and lower, these two performance metrics cannot be minimised at the same time. Increasing fishing intensity beyond SPR=45% results in a higher chance of realizing TCEYs greater than 80 Mlb, but a higher chance of realizing TCEYs less than 20 Mlb. The higher fishing intensities take advantage of high biomass with high TCEYs but at a higher risk of realizing lower TCEYs in poor conditions. There is not a single optimal solution for these two performance metrics and the trade-offs are important to consider when making a decision.

The minimum TCEY across simulations in each IPHC Regulatory Area shows a similar pattern where the minimum is highest at intermediate values of SPR (Figure 8). This pattern is consistent across all IPHC Regulatory Areas.

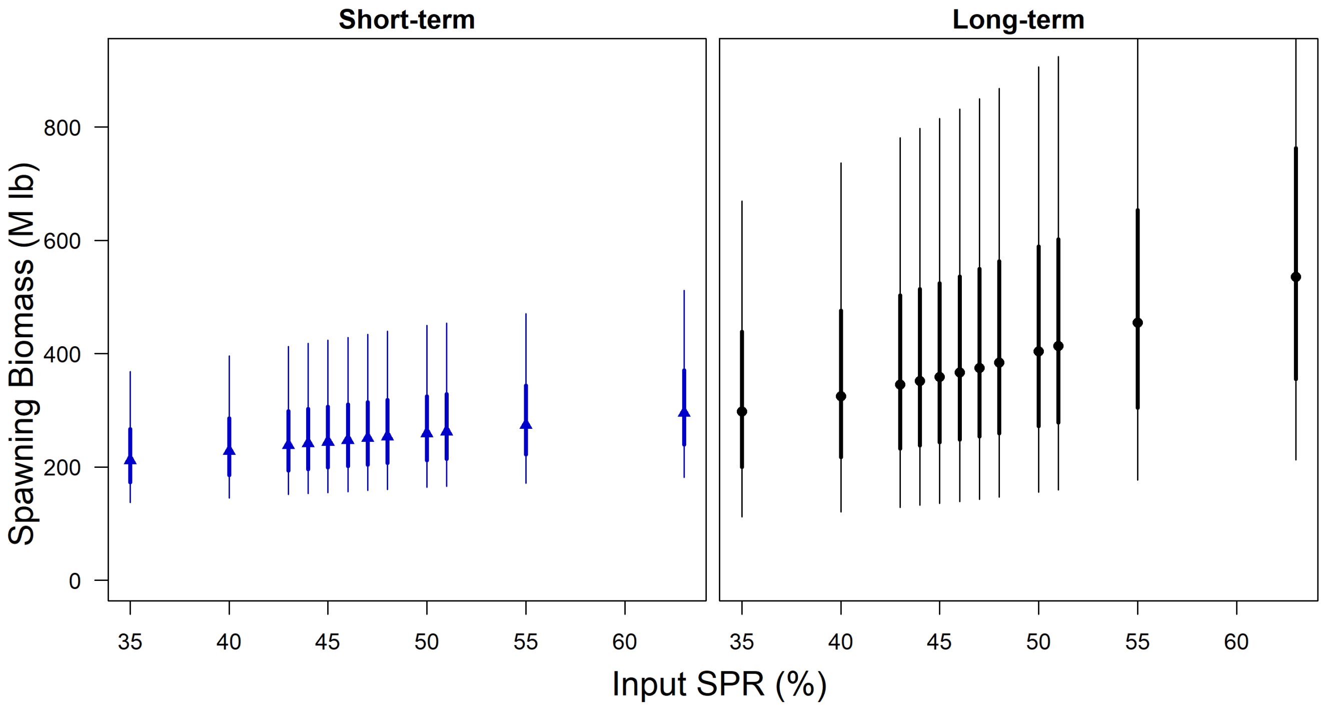

Figure 1. Spawning biomass at different SPR values over the short- and long-term. The thick lines show the 25th and 75th percentiles. The thin lines show the 5th and 95th percentiles.

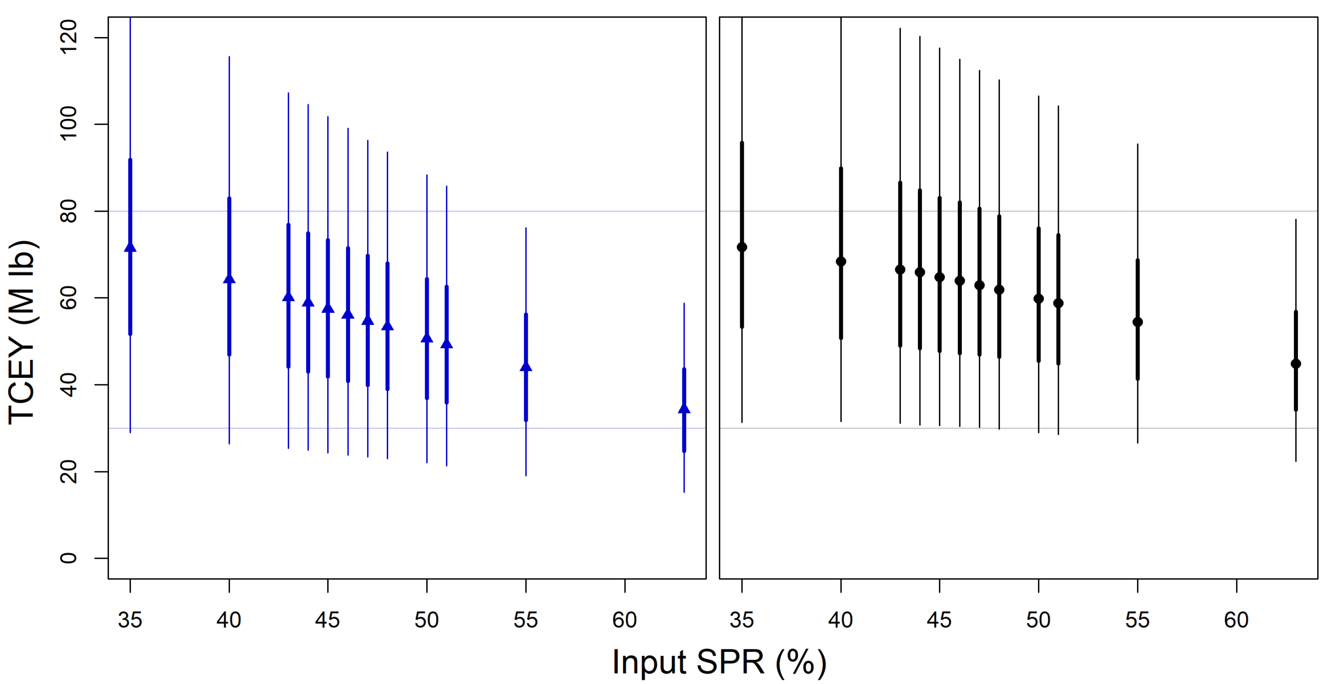

Figure 2. TCEY at different SPR values over the short- and long-term. The thick lines show the 25th and 75th percentiles. The thin lines show the 5th and 95th percentiles.

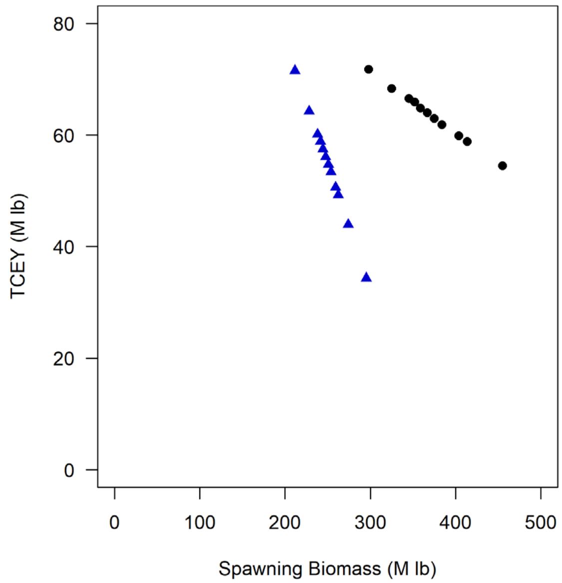

Figure 3. TCEY vs spawning biomass for short- (blue triangles) and long-term (black circles) results.

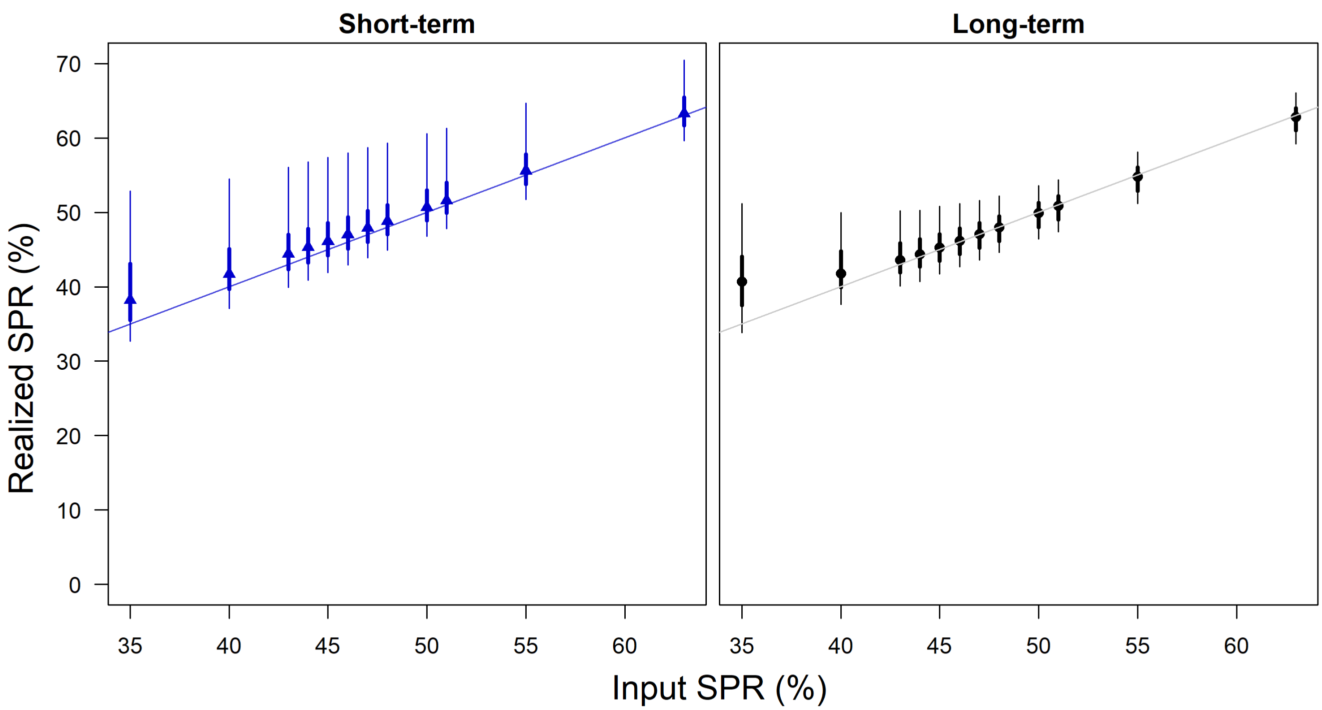

Figure 4. The realized SPR in the short- and long-term for different input fishing intensities. The thick lines show the 25th and 75th percentiles. The thin lines show the 5th and 95th percentiles.

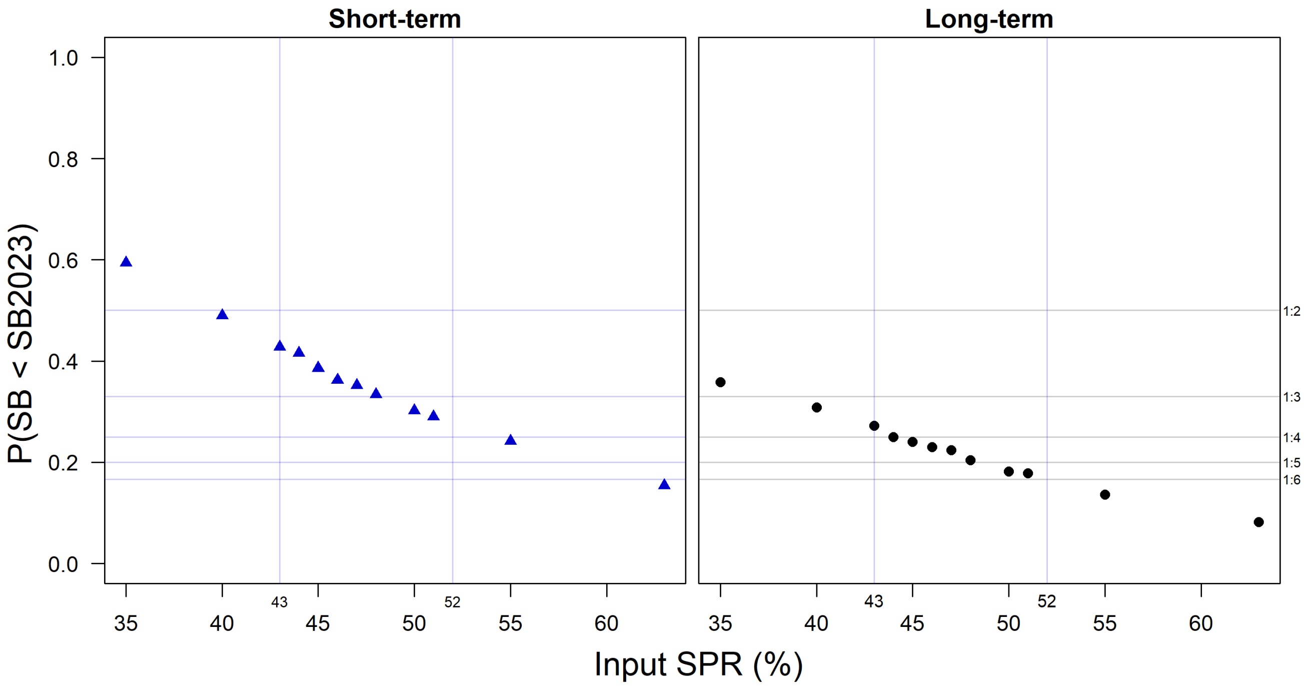

Figure 5. The probability that the short-term and long-term spawning biomass is less than the spawning biomass in 2023. Horizontal lines show the 1 in 2, 1 in 3, up to a 1 in 6 chance. The vertical lines show 43% and 52% SPR values.

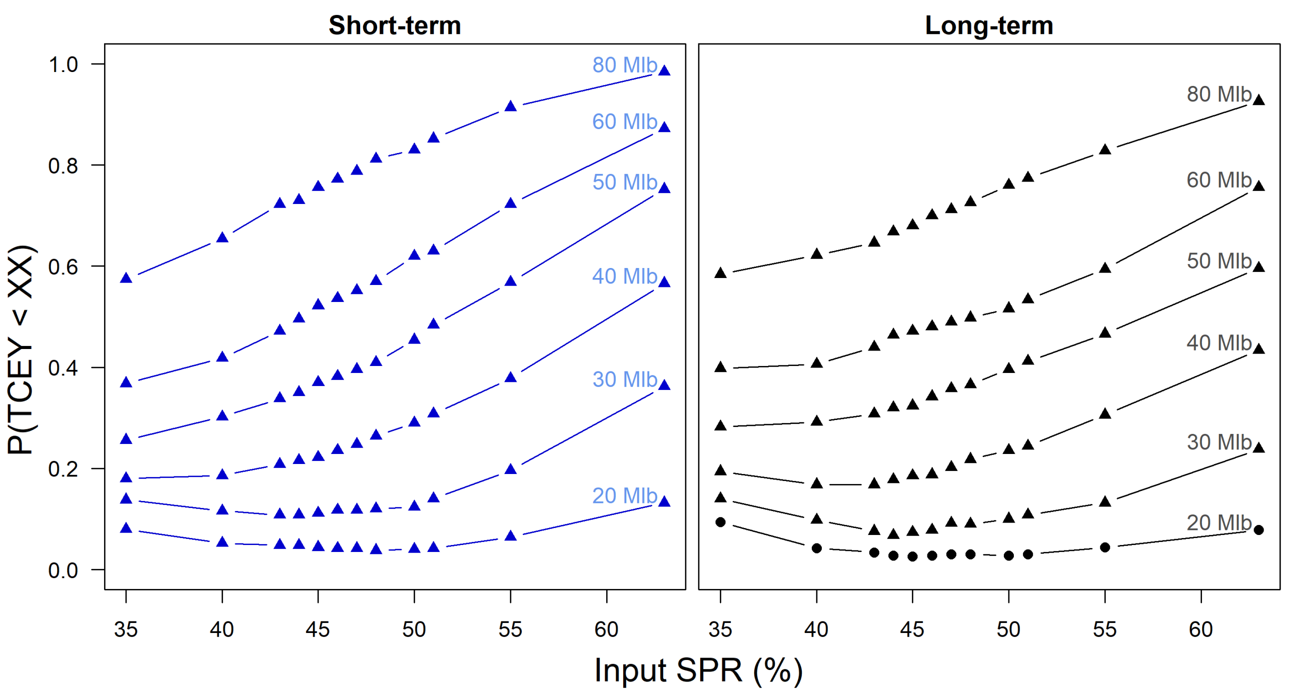

Figure 6. The probability that the TCEY is less than a specific amount (shown at the right of each curve) for various SPR values.

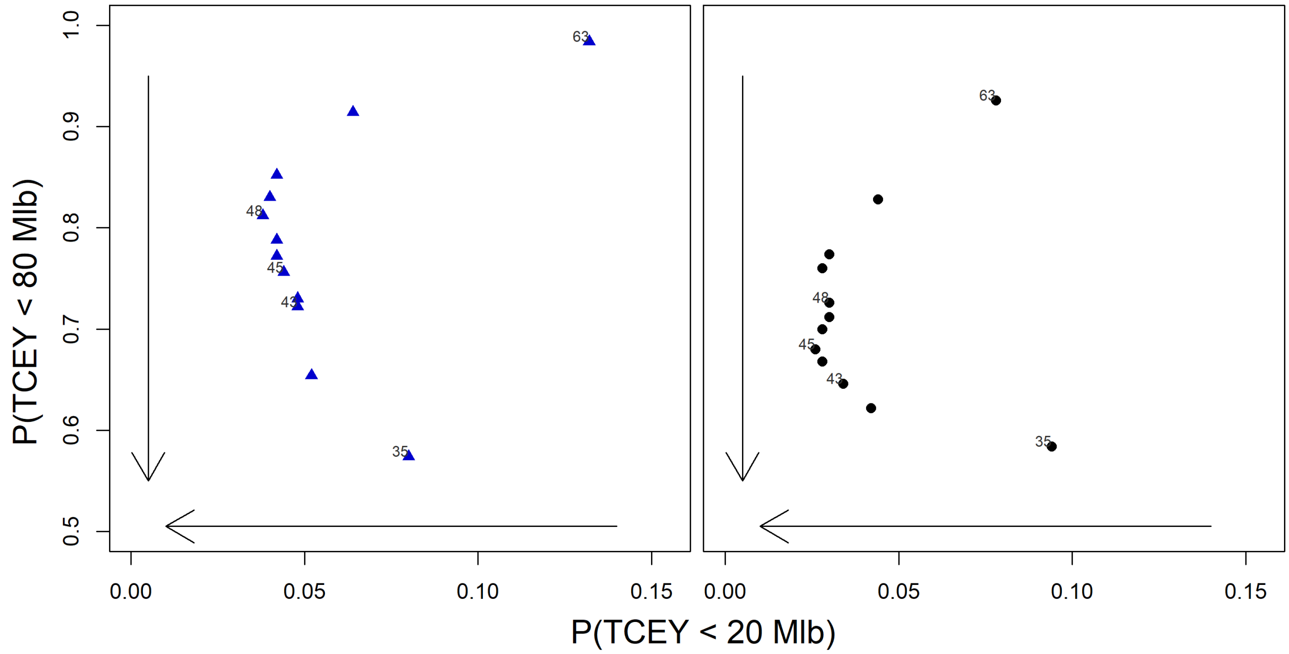

Figure 7. The probability that the TCEY is less than 80 Mlb plotted against the probability that the TCEY is less than 20 Mlb for various SPR values. The arrows indicate the desired direction (to minimise the chance) for each metric.

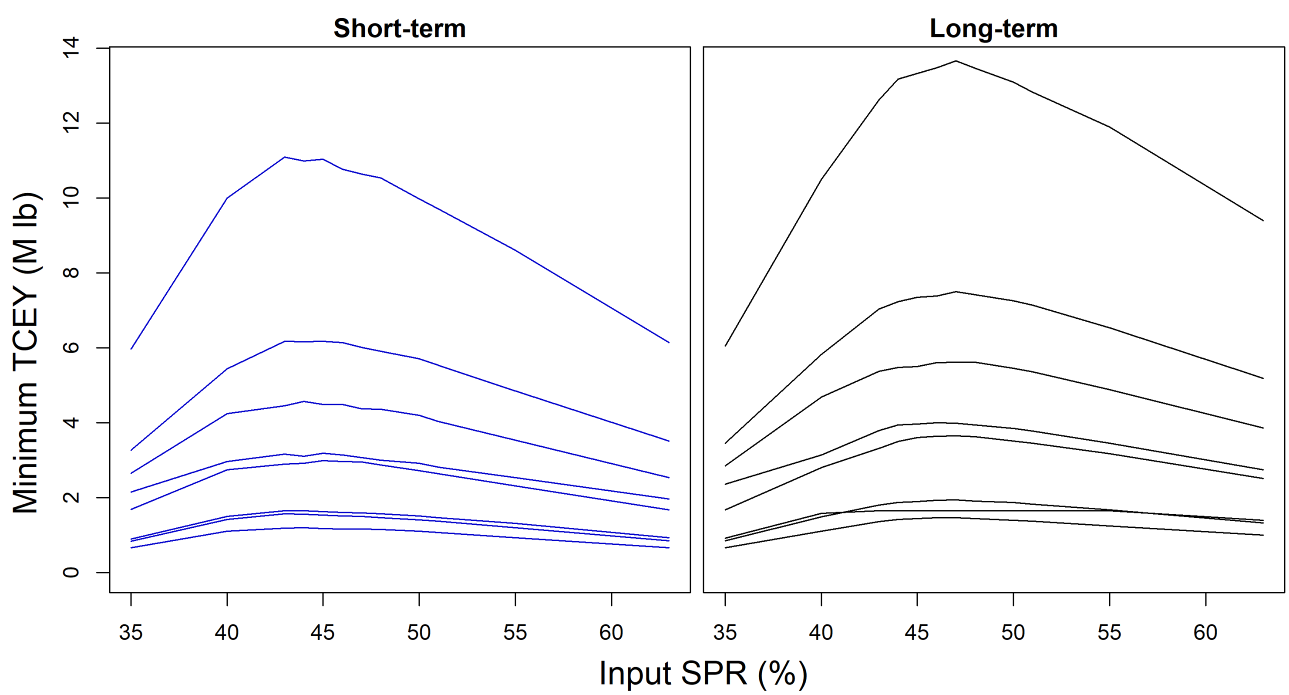

Figure 8. Minimum TCEY by IPHC Regulatory Area across fishing intensity. The individual IPHC Regulatory Areas are not labeled because the general shape of the curves is of interest.

2.2 Triennial assessment frequency performance metrics

The stock assessment undergoes a full examination every third year and is subject to smaller changes in the intervening years. This has sparked interest in examining a triennial assessment frequency using the MSE framework where the two years between full assessments do not use an assessment to determine stock status, risks (e.g. decision table), and a reference coastwide TCEY, but instead use FISS observations to determine only the reference coastwide TCEY. The current priority objectives were used to evaluate this triennial assessment frequency with an empirical harvest rule (IPHC-2025-AM101-12), but it was difficult to fully compare the interannual variability in the TCEY because it was not known what the change in the assessment year was. This was challenging when comparing a biennial assessment frequency with a triennial assessment frequency because there are fewer assessments in a ten-year period to compare with these two periods, and other factors, such as changes in the population, are confounding without consistent years with an assessment for comparison.

Document IPHC-2024-MSAB020-06 presented additional performance metrics to compare annual, biennial, and triennial assessment frequencies (partially reproduced in Table 1), but none were adopted for evaluation. The performance metrics for maximum change and maximum duration less than a 15% change from year to year were of interest and showed a longer period with a change in the TCEY less than 15% but larger maximum changes within a 10-year period. The MSAB, therefore, requested to continuing research into useful performance metrics to compare MPs with different assessment frequencies.

> **IPHC-2025-MSAB020-R, para 31.** The MSAB **REQUESTED** more research into performance metrics that may be informative of changes in the TCEY for non-assessment years and changes in the TCEY for assessment years when using a triennial assessment frequency.

If the Commission preferred to focus on only annual and triennial assessment frequencies, it would be possible to compare the years with an assessment to the years without an assessment. Choosing a ten-year period that begins with an assessment would result in four years with an assessment occurring triennially and six years without an assessment. The annual change (AC) could be calculated for the assessment and non-assessment set of years corresponding to the triennial assessment frequency (compared to the previous year). The probability that the AC exceeds a threshold could also be calculated for the assessment and non-assessment years. A similar approach could be taken with a biennial assessment, but the comparisons would only be meaningful when comparing the same assessment years. Figure 9 shows the percent AC over all 10-years of the short and long-term. The triennial assessment frequency has a lower percent AC on average, but there are high values at lower fishing intensities that are similar to the annual assessment frequency. Figure 10 shows the percent AC for only the years with an assessment in the triennial assessment frequency. The assessment years have a higher percent AC in the triennial assessment frequency compared to the annual assessment frequency. Figure 11 shows the percent AC for the years without an assessment in the triennial assessment frequency. The percent AC is lower for the triennial assessment frequency.

Table 1. Additional performance metrics for various fishing intensities (SPR) and an annual, biennial, or triennial assessment with an empirical rule proportional to FISS O32 WPUE used to determine the TCEY in non-assessment years. All simulations assumed the Base Block FISS design, estimation error, and decision-making variability. No constraints are applied to the interannual change in the TCEY. All performance metrics are short-term with 10-year being 4-13 years and 15-years being 4-18 years into the projection period. Partially reproduced from IPHC-2024-MSAB020-06.

Assessment Frequency	**Annual**				
SPR	**40**	**43**	**46**	**49**	**52**
AAV 10-year	25.3%	24.2%	23.5%	23.5%	23.7%
AAV 15-year	26.4%	24.5%	23.9%	24.0%	24.6%
P(AC3>15%) 10-year	0.992	0.988	0.986	0.988	0.986
P(AC3>15%) 15-year	1.000	1.000	1.000	1.000	1.000
Max Change (10-yr, absolute Mlbs)	47.7	40.3	36.1	32.7	30.2
Mean Max Duration < 15% AC (10-yr)	2.53	2.55	2.52	2.48	2.45
Assessment Frequency	**Biennial**				
SPR	**40**	**43**	**46**	**49**	**52**
AAV 10-year	23.3%	22.6%	22.5%	22.8%	23.5%
AAV 15-year	23.0%	22.9%	22.4%	22.6%	22.7%
P(AC3>15%) 10-year	0.972	0.980	0.978	0.974	0.976
P(AC3>15%) 15-year	0.998	1.000	1.000	0.996	0.996
Max Change (10-yr, absolute Mlbs)	48.2	42.6	38.5	34.9	32.5
Mean Max Duration < 15% AC (10-yr)	3.00	3.02	2.95	2.84	2.79
Assessment Frequency	**Triennial**				
SPR	**40**	**43**	**46**	**49**	**52**
AAV 10-year	20.7%	20.2%	20.0%	20.5%	21.0%
AAV 15-year	23.0%	21.6%	21.6%	21.7%	22.0%
P(AC3>15%) 10-year	0.914	0.906	0.926	0.932	0.940
P(AC3>15%) 15-year	0.988	0.986	0.986	0.992	0.992
Max Change (10-yr, absolute Mlbs)	49.5	43.8	40.4	37.8	34.6
Mean Max Duration < 15% AC (10-yr)	3.26	3.29	3.31	3.22	3.12

Assessment years in the triennial assessment tend to have a higher percent change in the TCEY when compared to the annual assessment, but the non-assessment years have a lower percent change. Table 2 shows the probability that the percent AC is greater than 15%. The annual assessment frequency is the same for years with and without a triennial assessment because an assessment is done every year. This probability is higher in triennial assessment years and lower in triennial non-assessment years. With more non-assessment years in the triennial assessment frequency, the overall percent AC over the entire 10-year period is lower for the triennial assessment frequency. The effect of this difference depends on the assumed estimation error (accuracy of the stock assessment) and the error in the FISS because the non-assessment years use the trend in the FISS WPUE. These simulations used a single assumption based on a retrospective analysis of stock assessment results and a single assumption of the FISS error (although the FISS design analysis used different assumptions). Furthermore, the usefulness of these performance metrics depends on the objectives related to variability in the TCEY. If the objective is to reduce the variability in any year, then looking at the assessment and non-assessment years is important. However, if the objective is to reduce the variability in yield over time, then the performance metric over the entire 10-year period would be more appropriate.

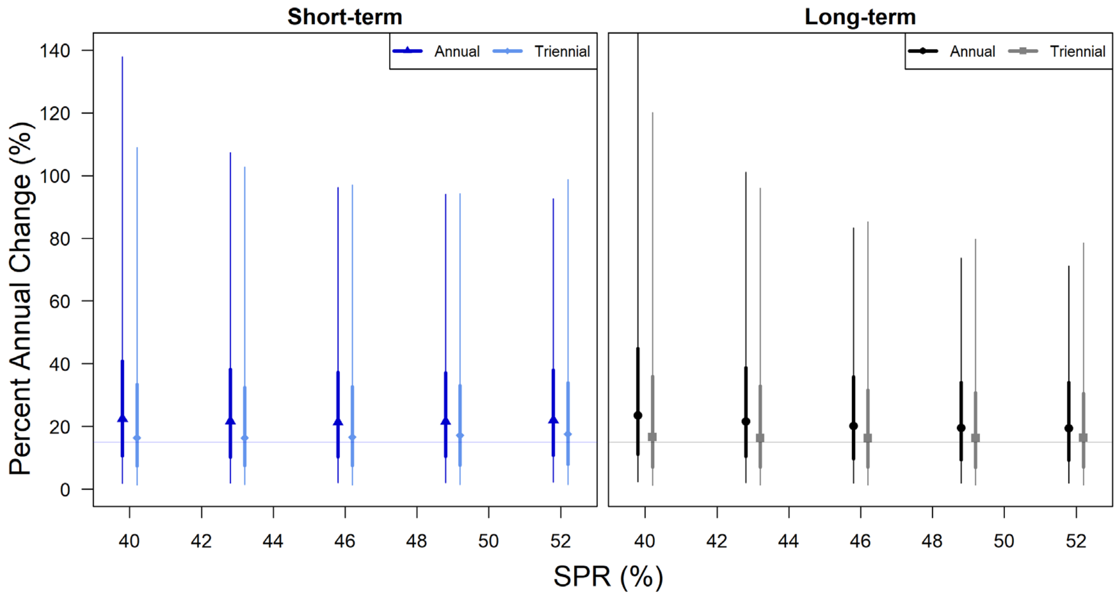

Figure 9. The percent annual change calculated over an entire 10-year period in the short- and long-term for different fishing intensities. The annual assessment frequency is shown by the darker lines. A horizontal line is shown at 15%.

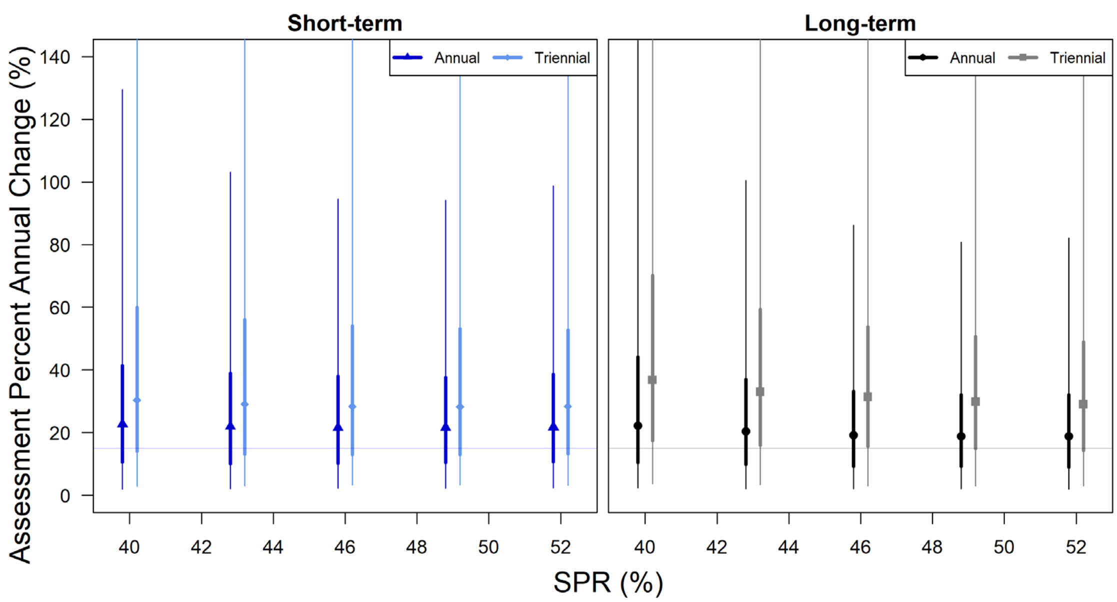

Figure 10. The percent annual change calculated over triennial assessment years only within an entire 10-year period in the short- and long-term for different fishing intensities. The annual assessment frequency is shown by the darker lines. A horizontal line is shown at 15%.

Table 2. Additional performance metrics highlighting the differences between changes in the TCEY in assessment years and non-assessment years. The percent Annual Change (AC) is calculated as the percentage change in the TCEY from the previous year.

Assessment Frequency	**Annual**				
SPR	**40**	**43**	**46**	**49**	**52**
P(AC>15%) assessment years (triennial)	0.649	0.636	0.634	0.640	0.644
P(AC>15%) non-assessment years (triennial)	0.653	0.648	0.640	0.645	0.648
Assessment Frequency	**Triennial**				
SPR	**40**	**43**	**46**	**49**	**52**
P(AC>15%) assessment years	0.728	0.713	0.703	0.710	0.715
P(AC>15%) non-assessment years	0.402	0.410	0.418	0.428	0.448

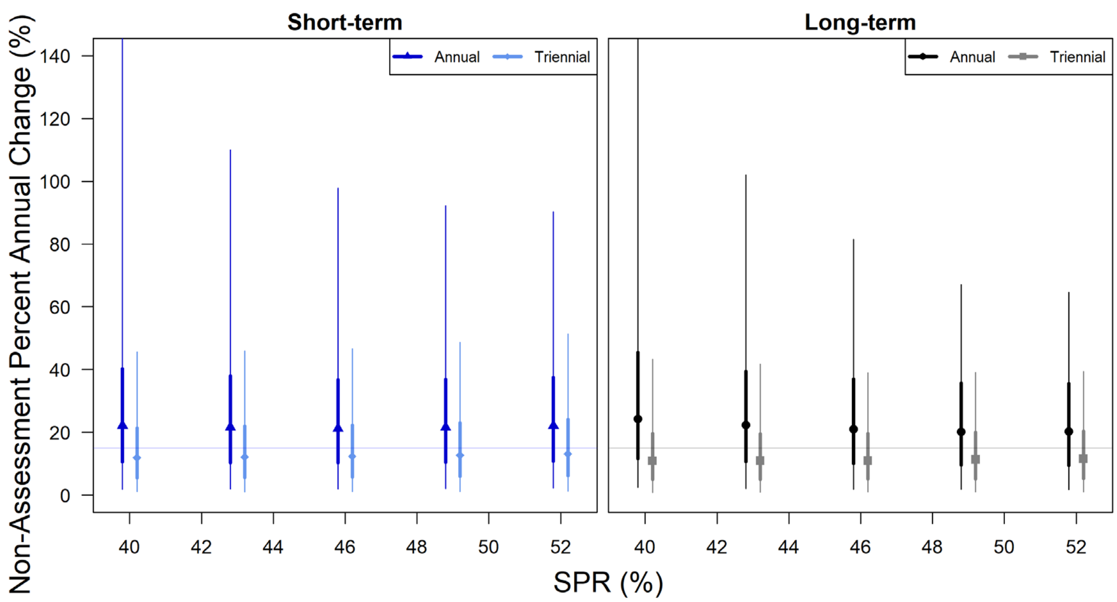

Figure 11. The percent annual change calculated over triennial non-assessment years only within an entire 10-year period in the short- and long-term for different fishing intensities. The annual assessment frequency is shown by the darker lines. A horizontal line is shown at 15%.

2.3 Additional FISS design investigations

Three FISS designs were investigated at MSAB020, and reductions in the amount of area surveyed showed a reduction in the short-term TCEY, on average (Figure 12). The MSAB made the following request to further investigate these trends.

> **IPHC-2025-MSAB020-R, para 37.** ***NOTING*** *that increased uncertainty due to reductions in the FISS design resulted in only declines in the median coastwide TCEY, the MSAB* ***REQUESTED*** *further exploration into the causes of this, especially since there is a monetary value being attributed to the FISS design.*

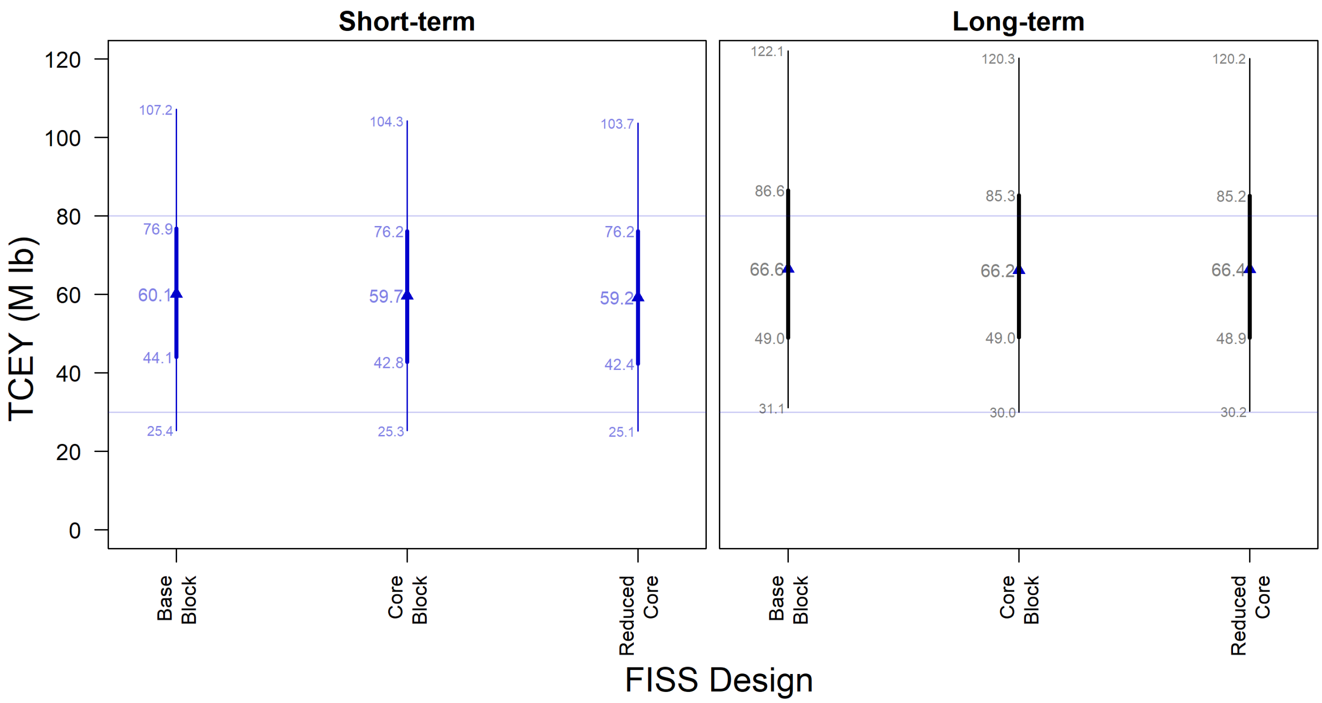

Figure 12. The distribution of simulated short- and long-term TCEY (M lb) for each FISS design. The points are the medians, the thick lines show the 25th and 75th percentiles, and the thin lines show the 5th and 95th percentiles. Actual values are shown for convenience.

There are three sources of variability and uncertainty in the simulations, all of which may be affected by the FISS design.

- **FISS uncertainty** affects the estimates of FISS WPUE and NPUE directly. This is used in the empirical rule and affects the stock assessment estimates. It may have some feedback into decision-making variability.
- **Estimation error** is from the stock assessment and is influenced by FISS uncertainty. Estimation error is also influenced by the variability in the population and fishery-dependent data.
- **Decision-making variability** is the variability resulting from decisions made by the Commission to depart from the MP. This could be affected by bias in the FISS and assessment estimates because the Commission may respond similarly based on the trends they perceive (e.g. autocorrelation in the deviations from the MP). It is possible to correlate decision-making with the FISS estimate, but this may mimic a control rule (i.e. element of the MP) and would conflate the estimation error with the decision-making variability, possibly making performance metrics, such as the probability that the spawning biomass is less than the 2023 spawning biomass, less meaningful. FISS uncertainty is not currently modelled with an effect on decision-making variability.

The MSE framework is capable of examining FISS designs, given the necessary inputs. Projections of estimated uncertainty of FISS O32 WPUE (see document IPHC-2024-SRB024-06) and simulations investigating the outcomes of the stock assessment given different FISS design assumptions (see IPHC-2024-SRB025-06) informed the inputs to the MSE simulations.

Unlike the stock assessment simulations, where specific trends in the population are investigated, the MSE simulations have emergent trends influencing uncertainty and bias.

Three FISS designs were simulated, representing increasing observation and assessment error (Table 3). The Base Block FISS design includes sampling in all Biological Regions and IPHC Regulatory Areas each year and is considered the status quo, although it has not been fully realized since 2019. It relies on a rotating selection of entire charter regions where individual charter regions are sampled every 1-5 years. The Core FISS design samples charter regions in IPHC Regulatory Areas 2B, 2C, 3A, and 3B every year and other areas are not surveyed. The Reduced Core FISS design samples a subset of higher catch-rate charter regions in areas 2B, 2C, 3A, and 3B. Bias is expected in the Core and Reduced Core FISS designs because some areas are not surveyed. It would not be expected that either of these core designs would be implemented in perpetuity without occasionally surveying other areas.

Table 3. Assumptions of observation and estimation error for four FISS designs.

FISS Design	Frequency	Coastwide WPUE CV	Coastwide WPUE Bias	Assessment Uncertainty	Assessment Bias
Base Block	Every year	4%	None	18%	None
Core	2-4 years	6%	Increases annually up to 3%	19%	Increases annually up to 2%
Reduced Core	2-4 years	8%	Increases annually up to 4%	20%	Increases annually up to 2.5%

The Core FISS and Reduced Core FISS designs have additional details in how bias is modelled. Bias is additive depending on the trend in spawning biomass, and is halved when a base block design surveys non-core areas. When the spawning biomass is large, the survey is more likely to be revenue neutral increasing the ability to survey non-core areas.

Core FISS design

- Frequency
  - When the spawning biomass is less than the spawning biomass in 2020 other areas are surveyed every 5th year and bias is reduced by one-half.
  - When the spawning biomass is greater than the spawning biomass in 2020 other areas are surveyed every 3rd year and bias is reduced by one-half.

- FISS bias
  - Bias depends on the recent 3-year coastwide trend and the number of years without a block design surveying non-core areas
    - 0-5%: ±0.5% bias added to current bias. Sign chosen randomly.
    - 5-15%: annual increase of 1% bias opposite direction of trend

        - 15-30%: annual increase of 2% bias opposite direction of trend
        - >30%: annual increase of 3% bias opposite direction of trend

- Assessment bias
    - Bias depends on the recent 3-year coastwide trend and the number of years without a block design surveying non-core areas
        - 0-5%: ±0.25% bias added to current bias. Sign chosen randomly.
        - 5-15%: annual increase of 0.5% bias opposite direction of trend
        - 15-30%: annual increase of 1% bias opposite direction of trend
        - >30%: annual increase of 2% bias opposite direction of trend

Reduced Core FISS design

- Frequency
    - When the spawning biomass is less than the spawning biomass in 2020 other areas are surveyed every 5th year and bias is reduced by one-half.
    - When the spawning biomass is greater than the spawning biomass in 2020 other areas are surveyed every 3rd year and bias is reduced by one-half.
- FISS bias
    - Bias depends on the recent 3-year coastwide trend and the number of years without a block design surveying non-core areas
        - 0-5%: ±0.5% bias added to current bias. Sign chosen randomly.
        - 5-15%: annual increase of 2% bias opposite direction of trend
        - 15-30%: annual increase of 3% bias opposite direction of trend
        - >30%: annual increase of 4% bias opposite direction of trend

- Assessment bias
    - Bias depends on the recent 3-year coastwide trend and the number of years without a block design surveying non-core areas
        - 0-5%: ±0.25% bias added to current bias. Sign chosen randomly.
        - 5-15%: annual increase of 0.75% bias opposite direction of trend
        - 15-30%: annual increase of 1.5% bias opposite direction of trend
        - >30%: annual increase of 2.5% bias opposite direction of trend

These assumptions determine the overall bias in the short- and long-term. There was no FISS bias in the Base Block design, and the FISS bias was more often negative than positive in the short-term for the Core Block and Reduced Core designs (Figure 13). The FISS bias for the long-term was on average near zero, but showed a wider range. This difference between short- and long-term occurred because the trend was more often increasing in the short-term when starting from the current low spawning biomass. The long-term TCEY was slightly reduced with the Core Block and Reduced Core designs, but less than the short-term TCEY (Figure 12). Occasional TCEYs larger than the true TCEY for a given fishing intensity have longer term effects than TCEYs smaller than the true TCEY.

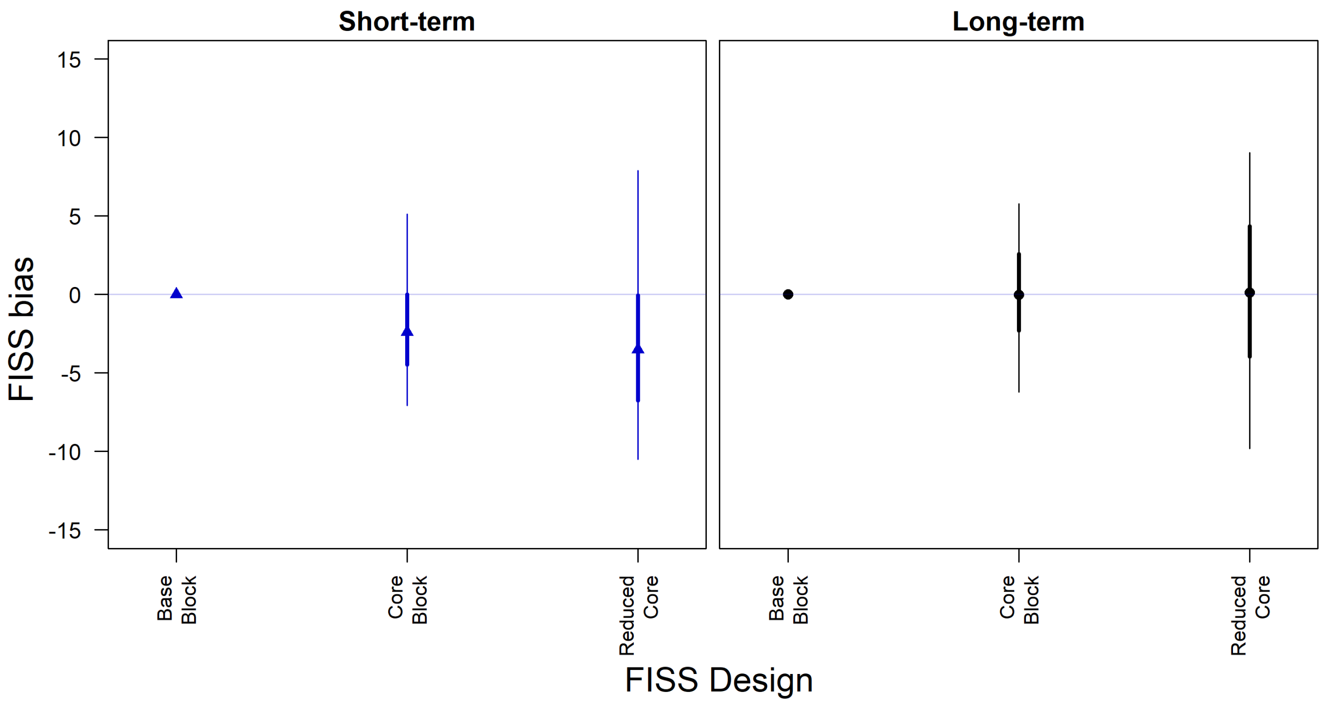

Figure 13. Simulated short- and long-term bias for the Core Block and Reduced Core designs.

3 Effects of weight-at-age and recruitment regimes

Pacific halibut exhibit high variability in weight-at-age and recruitment. Over the past 100 years, the average weight of an age 12 Pacific halibut has ranged from below 20 pounds in recent years to near 40 pounds in the mid-1970's (Figure 14). In the last ten years, the weight of the oldest fish has been declining or stable, but the weight of younger fish has been increasing. Recruitment is variable as well, and 1987 was one of the largest recruitments on record, as estimated in both 'long' assessment models (Figure 15). The two "long time-series" models in the IPHC stock assessment (IPHC-2025-SA-01) estimated a link between the Pacific Decadal Oscillation (PDO, Mantua et al. (1997)) and average unfished equilibrium recruitment (R_0), with an estimated average recruitment more than 50% greater during a positive PDO . Previous analyses (Clark and Hare 2002; Stewart and Martell 2016) have also shown that a positive PDO phase is correlated with enhanced productivity, while productivity decreases in negative PDO phases. Although the PDO is strongly correlated with historical recruitments, it is unclear whether the effects of climate change and other recent anomalous conditions in both the Bering Sea and Gulf of Alaska are comparable to those observed in previous decades (Litzow et al. 2020).

To investigate the effects of these low and high weight-at-age and recruitment regimes, different scenarios were defined from past observations and the population was projected 70 years with an SPR of 43%, assuming constant weight-at-age and average recruitment defined by the scenario. Three levels were developed for weight-at-age: low weight-at-age was defined from a five-year period in the 2010s, high weight-at-age was defined from a five-year period in the 1970s, and current weight-at-age was defined as the most recent five-years (Figure 14). These three weight-at-age levels show different patterns and although the low weight-at-age and current weight-at-age scenarios were both low in general, they differed between the weight of young fish and older fish. The current weight-at-age scenario had larger young fish but smaller older fish. High and low recruitment regimes were defined based on the stock assessment estimates of average recruitment in positive and negative PDO regimes. That resulted in six scenarios.

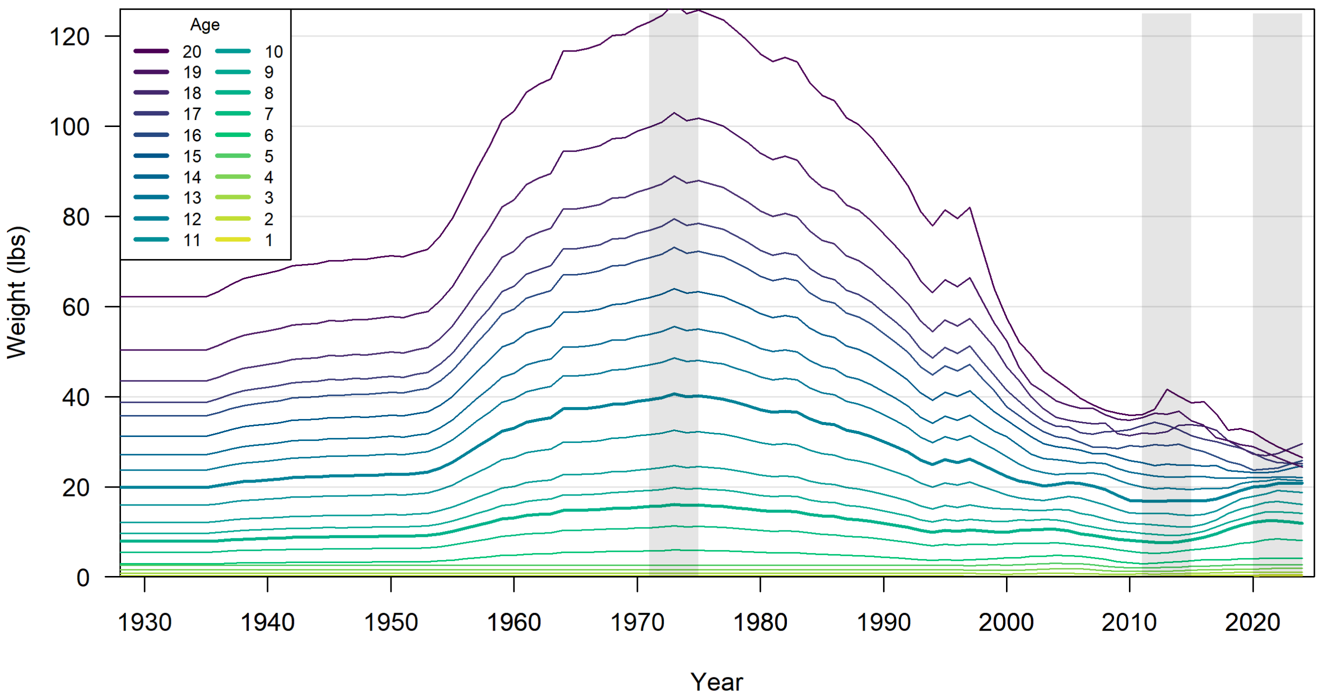

Figure 14. Average historical weight of Pacific halibut for ages one to twenty. Gray bands show three blocks of five years classified as high (1970s), low (2010s) and current (recent).

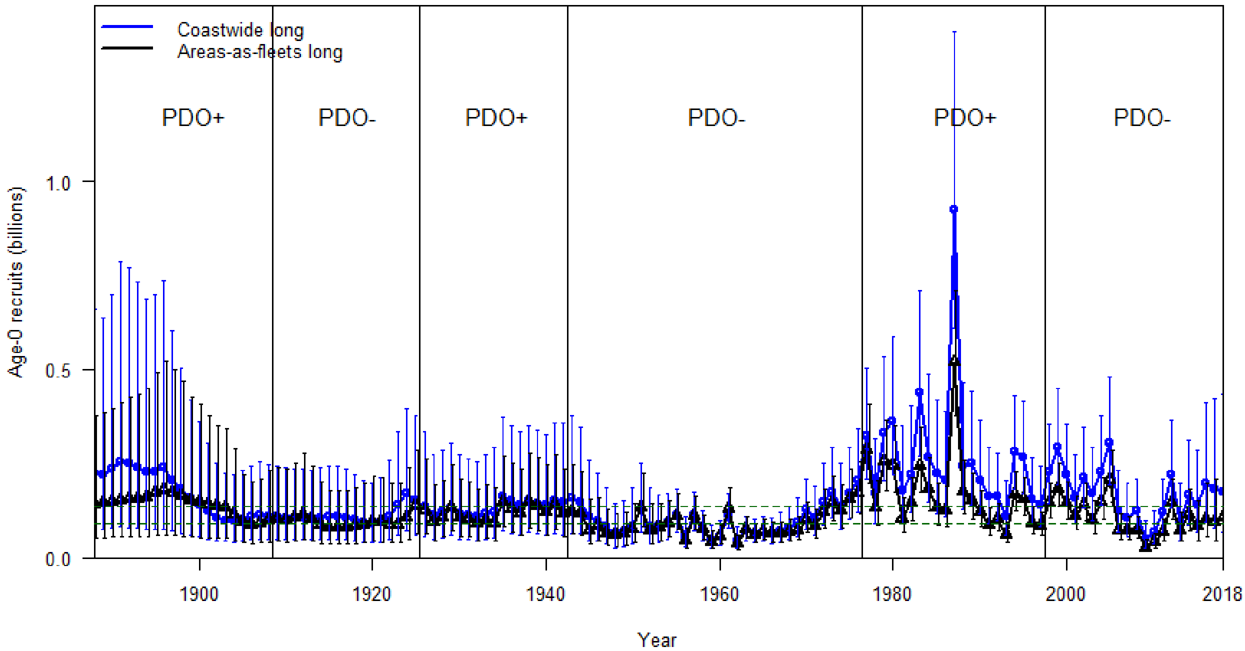

Figure 15. Trend in historical recruitment strengths (by birth year) estimated by the two long time-series stock assessment models, including the effects of the Pacific Decadal Oscillation (PDO) regimes. Figure reproduced from IPHC-2025-SA-01.

The spawning biomass differed substantially across different scenarios, but the high weight-at-age scenarios showed a considerable higher spawning biomass than the others (Figure 16). The sudden increase in the spawning biomass when the projections began indicates that weight-at-age is an important driver to the spawning biomass in the current year and future years. Average recruitment had a significant effect as well, but affected the spawning biomass in the longer term since the fish must age into the spawning biomass and was more prevalent with higher weight-at-age. For a given recruitment regime, the current weight-at-age scenario resulted in a smaller spawning biomass than the low weight-at-age scenario. This indicates the importance of the older fish in the spawning biomass.

Simulated TCEYs showed the same pattern for high weight-at-age, but different patterns for low and current weight-at-age scenarios. Weight-at-age and recruitment both had a profound effect on the TCEY with the high weight-at-age and high recruitment scenario supporting TCEYs near 120 Mlb and the high weight-at-age and low recruitment scenario supporting TCEYs near 75 Mlb. The low and current weight-at-age scenarios resulted in TCEYs in the range of 30 to 60 Mlb, on average. The TCEY showed a different pattern in the low and current weight-at-age scenarios when compared to the spawning biomass. The TCEY was higher for the current weight-at-age scenario while the spawning biomass was higher for the low weight-at-age scenario. Young Pacific halibut are more influential to the TCEY than to the spawning biomass because some are selected by the fishery before they become mature.

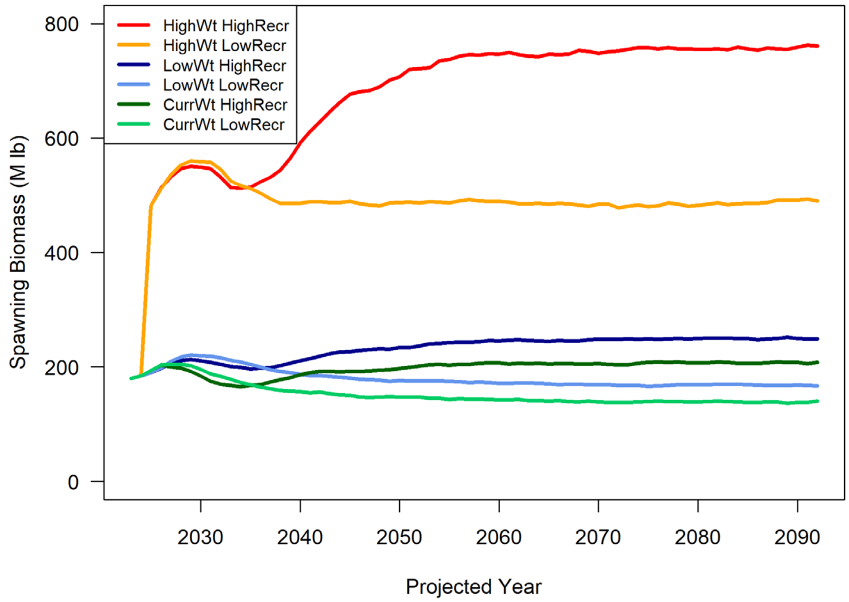

Figure 16. Simulated projections of spawning biomass assuming six different regimes for combinations of weight-at-age and recruitment and an SPR of 43%. Each projection held the weight-at-age and average recruitment at the defined level for all projected years.

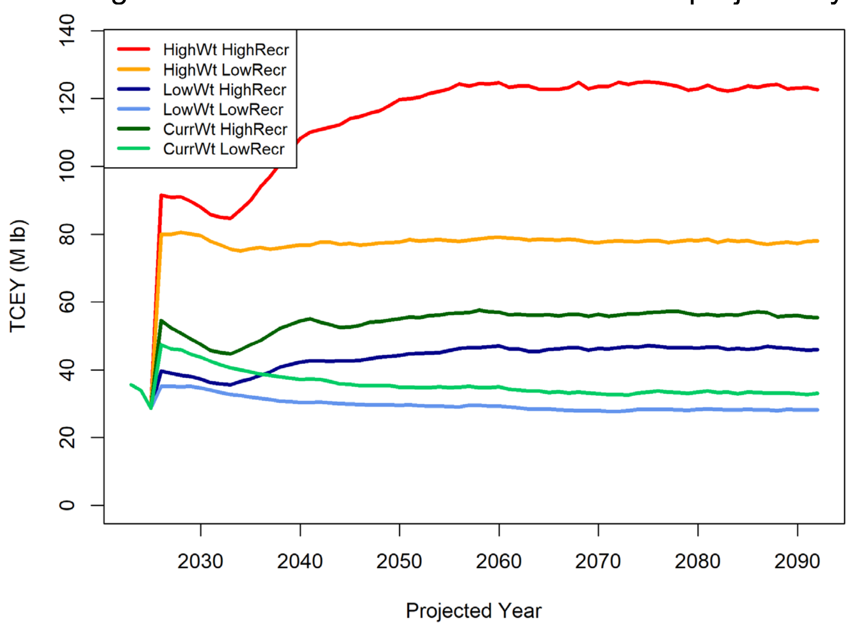

Figure 17. Simulated projections of the TCEY assuming six different regimes for combinations of weight-at-age and recruitment and an SPR of 43%. Each projection held the weight-at-age and average recruitment at the defined level for all projected years.

RECOMMENDATION/S

That the MSAB:

1) **NOTE** paper IPHC-2025-MSAB021-07 which details responses to requests of the MSAB and other work done using the management strategy evaluation framework.

REFERENCES

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Considerations for the Management Strategy Evaluation Program of Work for 2025-2026

PREPARED BY: IPHC SECRETARIAT (A. HICKS & I. STEWART; 10 APRIL 2025)

PURPOSE

To provide the MSAB with an overview of potential work topics for the IPHC MSE in 2025-2026.

1 INTRODUCTION

Work from the Management Strategy Evaluation (MSE) Program of Work for 2023–2025 that has been completed is reported in documents IPHC-2024-MSAB020-06 and IPHC-2025-AM101-12. This includes defining exceptional circumstances and actions to take when an exceptional circumstance occurs, evaluating a wide range of fishing intensities along with annual, biennial, and triennial assessment frequencies, and considering constraints on the annual change in the TCEY.

The potential topics for the MSE Program of Work presented in this paper support the continued understanding of managing Pacific halibut fisheries.

2 PROGRAM OF WORK TOPICS

2.1 Objectives

The Commission defined a small set of priority coastwide objectives and associated performance metrics for current evaluations.

> **IPHC-2023-AM099-R, para. 76.** *The Commission RECOMMENDED that for the purpose of a comprehensive and intelligible Harvest Strategy Policy (HSP), four coastwide objectives should be documented within the HSP, in priority order:*
>
> *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 at or above a biomass reference point (B36%) 50% or more of the time.*
>
> *c) Optimise average coastwide TCEY.*
>
> *d) Limit annual changes in the coastwide TCEY.*

IPHC-2023-AM099-R, para. 77. *The Commission AGREED that the performance metrics associated with the objectives in Paragraph 76 are:*

a) P(RSB): Probability that the long-term Relative Spawning Biomass (RSB) is less than the Relative Spawning Biomass Limit, failing if the value is greater than 0.05.

b) P(RSB<36%): Probability that the long-term RSB is less than the Relative Spawning Biomass Reference Point, failing if the value is greater than 0.50.

c) Median TCEY: the median of the short-term average TCEY over a ten-year period, where the short-term is 4-14 years in the future.

d) Median AAV TCEY: the average annual variability of the short-term TCEY determined as the average difference in the TCEY over a ten-year period.

These priority objectives and performance metrics come from a larger list of objectives which includes objectives specific to Biological Regions and IPHC Regulatory Areas (Appendix A).

2.2 An objective related to absolute spawning biomass

The spawning biomass reference points in the conservation objective to "maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point..." and in the objective to "maintain the long-term coastwide female spawning stock biomass at or above a biomass reference point…" use relative spawning biomass, which is the estimated female spawning biomass divided by the estimated unfished female spawning biomass (dynamic relative spawning biomass, RSB). Furthermore, unfished female spawning biomass is estimated as the unfished spawning biomass that would have occurred if there was no fishing up to the year of interest. This metric, dynamic unfished spawning biomass (or dynamic B_0) reflects the changes in the population due to natural variability in the population, and RSB measures only the effects of fishing. RSB is useful for managing a fish species because it is consistent with other reference points (e.g. SPR), accounts for changes in biology, incorporates variation in recruitment, and allows for a clear determination of "overfished" without confounding stock changes with natural variability.

Pacific halibut have seen large changes in average weight-at-age and high variability in recruitment, which has changed the stock dynamics considerably. Figure 1 shows the dynamic unfished spawning biomass, the current spawning biomass, and the RSB since 1993. Dynamic unfished spawning biomass is lower than the late 1990's because weight-at-age has decreased considerably and dynamic unfished spawning biomass has decreased in recent years because of a recent period of low recruitment. The current spawning biomass trajectory (with fishing) has been stable in recent years, resulting in an increasing RSB. Therefore, the Pacific halibut stock is likely to be above the B_{lim} (20%), B_{trigger} (30%), and B_{thresh} (36%) reference points.

However, the coastwide FISS O32 WPUE and coastwide commercial WPUE has been declining in recent years (Figure 2), causing concern about the absolute stock size and fishery catch-rates. The coastwide FISS index of O32 WPUE was at its lowest value observed in the time-series, declining by 3% from the previous year and coastwide commercial WPUE is also at its lowest value in the recent time-series, declining by 10% from the previous year (and likely more as additional logbook information is obtained). In contrast, the stock assessment for 2023 estimates current stock status (42%, Figure 1) above reference levels and a high probability of further decline in spawning biomass at the reference fishing intensity (SPR=43%). The reference coastwide TCEY of 48.9 Mlbs predicts a greater than 70% chance that the spawning biomass in any of the next three years will be less than the spawning biomass in 2023. The long-term average RSB when fishing consistently at an SPR of 43% would be near 38%.

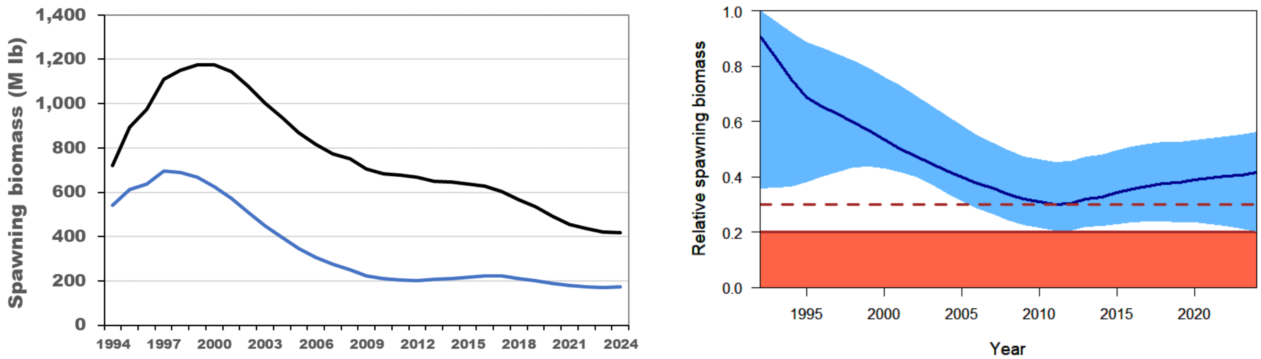

Figure 1. Dynamic unfished spawning biomass (black line) and current spawning biomass (blue line) from the 2023 stock assessment (left) and dynamic relative spawning biomass (right) with an approximate 95% credible interval in light blue and the control rule limit and trigger in red. Figures from IPHC-2024-SA-01.

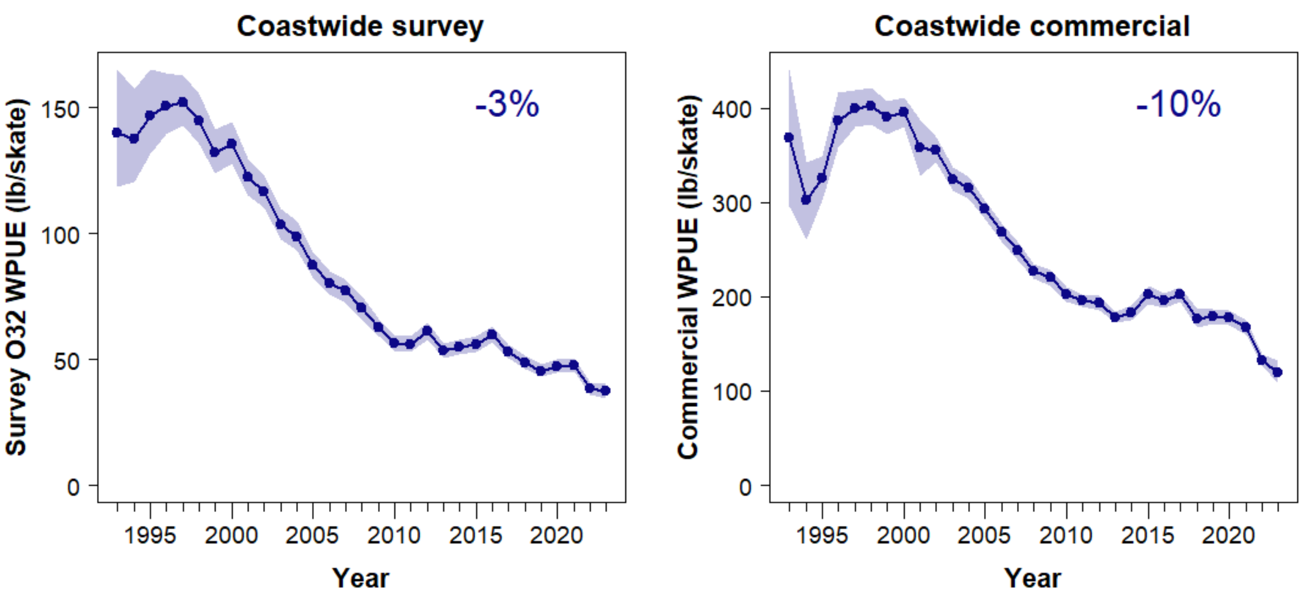

Figure 2. The coastwide FISS O32 WPUE index (left) and coastwide commercial WPUE (right) showing the percent change in the last year (from IPHC-2024-SA-02). Based on past calculations, additional logbooks collected in 2024 will likely further reduce the decline in commercial WPUE to -12%.

Recent Commission decisions (2023 and 2024) have set coastwide TCEYs less than the reference TCEY suggested by the stock assessment and current interim management strategy, noting the following.

> **IPHC-2024-AM100-R, para 38**. *The Commission NOTED that the estimated absolute spawning biomass is at a 35-year low and likely to remain low for several more years given recruitments currently in the water.*
>
> **IPHC-2024-AM100-R, para 56**. *The Commission NOTED that:*
>
> *a) the status quo coastwide TCEY of 36.97 million pounds corresponds to a 45/100 chance of stock decline over the next 1-3 years;*
>
> *b) coastwide TCEYs at or above 39.1 million pounds would have a greater than a 50% chance of stock decline over the next three years;*
>
> *c) fishing at the reference level (F43%) would equate to a coastwide TCEY of 48.9 million pounds in 2024 and have a high likelihood of stock decline over one-year (74/100) and three-years (72%).*
>
> **IPHC-2024-AM100-R, para 57**. *The Commission NOTED several additional risks not included in the harvest decision table:*
>
> *a) the estimated absolute spawning biomass is at a 30+-year low and likely to remain low for several more years given recruitments currently in the water;*
>
> *b) low 2023 catch-rates in the FISS and directed commercial fisheries compared to those observed over the last 30 years;*
>
> *c) Biological Region 3 is currently at the lowest observed proportion of the coastwide biomass since 1993 (the full historical range is unknown), and uncertainty associated with changes to the ecosystem and climate remains high.*
>
> **IPHC-2024-AM100-R, para 59**. *The Commission NOTED the wide uncertainty intervals around the estimated spawning biomass and that once a mortality limit is selected there is a correspondingly large amount of uncertainty in the actual fishing intensity.*
>
> **IPHC-2024-AM100-R, para 88**. *The Commission NOTED that the adopted mortality limits for 2024 correspond to a 41% probability of stock decline through 2025, and a 41% probability of stock decline through 2027.*
>
> **IPHC-2024-AM100-R, para 89**. *The Commission NOTED that the adopted mortality limits for 2024 correspond to a fishing intensity of F52%, equal to the estimate for 2023.*
>
> **IPHC-2025-AM101-R, para 77.** *The Commission NOTED that the adopted mortality limits for 2025 correspond to a 25% probability of stock decline through 2026, and a 29% probability of stock decline through 2028.*
>
> **IPHC-2025-AM101-R, para 78.** *The Commission NOTED that the adopted mortality limits for 2025 correspond to a fishing intensity of F51%, lower than the fishing intensity estimate for 2024.*

Main concerns noted by the Commission include 1) low absolute spawning biomass, 2) low catch-rates in the commercial fishery, 3) high probability of decline in absolute spawning biomass at the reference fishing mortality, and 4) a large amount of uncertainty in the projections.

The continued departure from the current interim MP and reduction in coastwide TCEY suggests that there may be an additional objective. Related to these concerns, the SRB made a recommendation to re-evaluate what they called the target objective. This is objective (b): to maintain the relative 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 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.*

The MSAB made a similar recommendation at MSAB019 to discuss a new objective, which was also discussed at the 20th Session of the MSAB (MSAB020).

> **IPHC-2024-MSAB019-R, para 51.** *NOTING paragraph 48, the MSAB RECOMMENDED developing an objective and identifying a management procedure that addresses the current circumstances and differences in perception of the stock status.*

> **IPHC-2024-MSAB020-R, para 15.** *The MSAB NOTED that a new objective may be defined using absolute biomass, commercial catchrates, or coastwide TCEY. However, commercial catch-rates may not be the best option because they are dependent on other factors. The coastwide TCEY and/or a reference absolute spawning biomass IPHC-2024-MSAB020-R Page 9 of 19 based on what has been observed may be more meaningful, but all have downsides in being a holistic metric.*

> **IPHC-2024-MSAB020-R, para 16.** *The MSAB NOTED that a new objective to maintain the coastwide TCEY above a threshold may be useful because it is meaningful to stakeholders, may define a minimum coastwide TCEY necessary for economic viability, and may be a proxy for maintaining catch-rates and absolute spawning biomass above a threshold which may be important to stakeholders.*

> **IPHC-2024-MSAB020-R, para 17.** *The MSAB NOTED that the RSB36% objective (b in paragraph 12) is a useful objective because it separates fishing effects from environmental effects on the stock, scales with changes in productivity, defines a desired relative spawning biomass to be at or above, is based on a proxy for RSBMEY, and is an objective that is often important to fishery certification agencies.*

A higher $B_{36\%}$ reference point could be achieved with a lower reference fishing intensity or an alternative control rule, such as 40:20. However, instead of updating the $B_{36\%}$ relative spawning biomass objective, it may be prudent to consider an absolute spawning biomass, or catch-rate, threshold in a new objective.

Clark & Hare (2006) noted that "[t]he Commission's paramount management objective is to maintain a healthy level of spawning biomass, meaning a level above the historical minimum that last occurred in the mid-1970s." Thompson (1937) stated the following.

> *In actual practice, capital is accumulated in order that interest may be secured from it, and an accumulated stock of fish may also be profitable.*
>
> *The most obvious gain is the greater economy of effort in obtaining a catch from a larger accumulated stock. It not only means less effort, but also less time at sea before the catch is landed. (William F. Thompson, International Fisheries Commission, 1937)*

The Commission currently has conservation objectives to maintain the spawning biomass above certain thresholds, measured as relative spawning biomass, but these reference points are relative to dynamic unfished spawning biomass, thus may not indicate when spawning biomass is at a low absolute level resulting from non-fishing effects (e.g. weight-at-age and recruitment). An absolute biomass threshold would ensure that the biomass of fish available is above a desired level.

Most fisheries management authorities use an absolute spawning biomass threshold because they do not consider dynamic unfished spawning biomass (dynamic B_0). Instead, reference points are defined as a percentage of a static B_0 that is calculated using a pre-defined productivity regime. This, however, conflates environmental effects with fishing effects. A compromise is to determine status of the stock using a dynamic approach to account for only fishing effects, and to also define an absolute spawning biomass limit to avoid low stock levels (even if not caused by fishing) below a value that may result in unacceptably low catch-rates and/or the potential for reduced reproduction (Bessell-Browne et al. 2024).

An objective to maintain the absolute spawning biomass above a threshold may be a useful objective for several reasons. First, the level of spawning biomass likely correlates with catch-rates in the fishery, and a higher spawning biomass would likely result in a more efficient and economically viable fishery. Second, current priority conservation objectives use dynamic relative spawning biomass which may result in a low absolute spawning biomass with a satisfactory stock status. Third, a minimum absolute coastwide spawning biomass may be necessary to ensure successful reproduction (such a level is currently unknown for Pacific halibut). Lastly, an observed reference stock level may have concrete meaning to stakeholders. For example, the recent estimated spawning biomass may be near or below the lowest spawning biomass estimated since the mid-1970’s and the Commission noted historically low observed fishery catch rates in 2022 and 2023.

> **IPHC-2023-AM099-R, para 56.** *The Commission NOTED that there are additional risks associated with the stock condition and mortality limit considerations for 2023 that are not quantitatively captured in the decision table, these include:*
>
> > *a) Historically low observed fishery catch rates corresponding to reduced efficiency/performance in 2022;*

The threshold and the tolerance for being below that threshold are not obvious choices. Clark and Hare (2006) used the estimated spawning biomass in 1974, which subsequently produced recruitment resulting in an increase in the stock biomass. However, there is a high uncertainty in the estimates of historical absolute spawning biomass before the 1990’s. Recent estimates of spawning biomass may be reasonable as they are relevant to concerns of low catch-rates, but it is unknown how and if the stock will quickly recover from this current state. Setting an absolute spawning biomass to avoid low catch-rates may also *de facto* protect the stock from serious harm (i.e. avoid dropping below the current relative spawning biomass limit of 20%).

A second approach is to define an objective based on catch-rates in the fishery. If an efficient fishery is the objective, then catch-rates may be a reasonable choice for the same reasons listed above for an absolute level of spawning biomass. A subtle difference between catch-rates and spawning biomass are that catch-rates may increase or decrease due to many factors (e.g. improvements in technology, avoidance of non-target species) without a change in spawning biomass.

An alternative way to think about this is to define a population biomass limit reference point for relative spawning biomass as a threshold for which dropping below would cause serious harm to the stock (the Commission has already adopted $SB_{20\%}$), and a second fishery biomass limit reference point for which dropping below would result in serious hardships to the fishery. The fishery biomass limit reference point could be defined using an absolute metric that could be in units of spawning biomass, fishery CPUE, FISS WPUE, or some other estimable quantity. Note that a fishery limit reference point is a different objective than a fishing intensity limit, where the former is a threshold used to maintain catch-rates and the latter is a threshold used to indicate the potential for overfishing. As mentioned above, a fishery absolute spawning biomass limit may add extra protection for the stock by further reducing the probability of breaching existing limit and threshold reference points. A new objective related to fishery performance may be phrased as

> Maintain the coastwide female spawning stock biomass (or FISS WPUE or fishery catch-rates) above a threshold.

The threshold may be an absolute value of spawning biomass or a defined static biomass reference point such as the spawning biomass in 2023. It is important to first decide if this is a useful general objective. If it is, then specifying a measurable objective would require defining the threshold, the term, and a tolerance. From that, a performance metric would be developed.

2.3 Optimise yield

The SRB made a recommendation to quantify the objective to "optimise yield" so that it is meaningful and can have a performance metric that identifies the best performing MP.

> **IPHC-2024-SRB024-R, para 22**. *The SRB RECOMMENDED that the Commission develop a more specific and quantifiable catch objective to replace Objective c) (from AM099–Rec.02) "Optimize average coastwide TCEY".*

Optimising yield may include multiple objectives, such as maximising yield and minimising variability in yield, and evaluation may include examining trade-offs between multiple objectives.

The MSAB recommended that 'optimise' be changed to 'maximise' and this objective be given equal consideration along with minimising interannual variability in yield

> **IPHC-2024-MSAB020-R, para 14**. *The MSAB RECOMMENDED that the Commission priority objective "optimise average coastwide TCEY" (c in paragraph 12)*

be changed to "maximise average coastwide TCEY" and that this objective along with the variability in yield objective (d in paragraph 12) be given equal consideration to allow for the evaluation of trade-offs between these two objectives.

Changing this objective from 'optimise' to 'maximise' would not change the overall goal of the Commission to optimise yield. In fact, the two objectives "maximise yield" and "minimizer interannual variability in yield" are both a part of optimising yield. Giving equal consideration to both objectives would better meet the general goal of the Commission to optimise yield.

2.4 Hierarchical grouping of Commission objectives

An important part of the four priority objectives of the Commission is that they are hierarchical. The objectives can be categorized into two groups (Table 1). The first group contains long-term objectives a) and b), in priority order, which define the overarching objectives of the Commission (ensuring sustainability of the stock and optimising fishing activities and opportunities) and unambiguously identifies MPs that do not support long-term objectives of the Commission. All MPs that do not meet these two objectives would not be considered as a potential reference MP. Furthermore, the sustainability objective (a) may be used to define an 'overfished' status, and the fishing opportunity objective (b) may be associated with an 'overfishing' status. The first group also clearly defines the boundaries of the management space over which Commission decision-making can apply.

The second group contains short-term objectives c) and d) which define the management objectives of the Commission related to optimal yield. A reference MP will represent a trade-off between the amount of yield and the interannual variability in that yield. The optimal trade-off may be considered differently by different users and stakeholders and may change over time, thus there is no inherent priority between these two objectives when selecting a reference MP. Justification of a reference MP is therefore provided after evaluation of this trade-off. This trade-off may also be considered during the annual decision-making process while also incorporating many other objectives.

Table 1. Commission priority objectives for the long-term sustainable management of Pacific halibut that supports optimal fishing opportunities. Light grey text shows potential additions/changes that are not in the current Commission objectives.

PURPOSE	TYPE	GOAL	GENERAL OBJECTIVE	MEASURABLE OBJECTIVE
LONG-TERM OVERARCHING OBJECTIVES DEFINING MPS TO AVOID	CONSERVATION	SUSTAINABILITY	**1.** KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES	**a)** Maintain the long-term coastwide female relative spawning biomass above a biomass limit reference point ($RSB_{20\%}$) at least 95% of the time
	FISHERY	OPTIMISE FISHING ACTIVITIES AND OPPORTUNITIES	**2.** MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT SUPPORTS OPTIMAL FISHING ACTIVITIES AND OPPORTUNITIES	**b)** Maintain the long-term coastwide female relative spawning biomass at or above a biomass threshold reference point ($RSB_{36\%}$) 50% or more of the time.
				) Maintain the long-term coastwide female absolute spawning biomass at or above a biomass threshold reference point (XX) YY% or more of the time.
SHORT-TERM MANAGEMENT OBJECTIVES DEFINING A REFERENCE MP	FISHERY	OPTIMISE YIELD	**3.** PROVIDE DIRECTED FISHING YIELD WHILE LIMITING VARIABILITY IN MORTALITY LIMITS	**c)** Maximise average coastwide TCEY
				d) Limit annual changes in the coastwide TCEY

2.5 Management Procedures

Various levels of fishing intensity, assessment frequencies, and some constraints were evaluated in 2024. Based on these results, the MSAB made a recommendation to modify the current interim management procedure.

> **IPHC-2024-MSAB020-R, para 41**. *The MSAB RECOMMENDED updating the reference MP for one three-year cycle on a trial basis using a triennial stock assessment frequency (synchronised with the full stock assessment scheduled in 2025 to inform 2026 mortality limits). The coastwide TCEY would be based on SPR=46% in assessment years and based on the proportional change in the FISS O32 WPUE index in non-assessment years. The triennial stock assessment frequency may increase the median coastwide TCEY and reduce the interannual variability in the coastwide TCEY. A lower fishing intensity would also reduce the probability that the spawning biomass is less than the 2023 spawning biomass in the short- and longterm, and result in lower interannual variability as noted in paragraph 26.*

The Commission has not updated the reference MP at this time, but is considering the draft Harvest Strategy Policy. Additional analysis were also recommended by the MSAB at MSAB020.

IPHC-2025-MSAB020-R, para 42: *The MSAB RECOMMENDED further evaluations of the following MP elements: d) A triennial assessment frequency with each of the three FISS designs; e) Various empirical rules to determine the reference coastwide TCEY in nonassessment years; f) Constraints on the interannual change in the reference coastwide TCEY, such as a maximum change in the coastwide TCEY of 15%, a slow-up fast down approach, or a fixed TCEY in non-assessment years.*

Adding some elements to the already evaluated MPs would be useful, as would be further understanding the trade-offs between the elements already evaluated. Some of this is presented in IPHC-2025-MSAB021-07. However, given that a full assessment is scheduled for 2025, the MSE OM is likely to be updated in early 2026, and a full evaluation of MPs would be warranted then to reflect any new understanding of the Pacific halibut population and fisheries.

2.6 References points and understanding variability

Past analyses (IPHC-2019-SRB015-11) showed that, for Pacific halibut, biomass-based reference points, such as MSY and B_0, are affected by a change in environmental regime, but relative reference points, such as relative spawning biomass (RSB) and SPR_{MSY}, are similar across regimes. This indicates that a consistent SPR-based management regime is likely robust across different environmental regimes. Analyses investigating persistent high and low PDO regimes show similar results, and also provide performance metrics specific to the IPHC MSE.

Results of MSE simulations assuming a persistent low or high PDO were initially presented at the 18th Session of the MSAB (MSAB018), the fifth conference for Effects of Climate Change on the Worlds Oceans (ECCWO5), and the PICES 2023 Annual Meeting (PICES-2023). Results were recently updated and showed that fishing and the environment affect the proportion of spawning biomass in each Biological Region in different ways. This analysis was performed with two levels on average recruitment, and integrated over variability in weight-at-age. A recent analysis showed highly variable outcomes with low or high average recruitment crossed with low or high weight-at-age (IPHC-2025-MSAB021-07).

These analyses were done with OMs conditioned to assessment results before the most recent stock assessment. Some assumptions have recently changed, especially regarding the productivity of Pacific halibut. It may be worthwhile to repeat these analyses after the 2025 full stock assessment with a newly conditioned operating model to reflect the most recent understanding of the Pacific halibut stock as fisheries.

RECOMMENDATION/S

That the MSAB:

1) **NOTE** paper IPHC-2025-MSAB021-08, which details potential topics for an MSE Program of Work in 2025-2026, including topics related to objectives, management procedures, and further understanding variability.
2) **REQUEST** adding or updating an objective related to optimising fishing activities and opportunities to the priority objectives of the IPHC.
3) **REQUEST** further evaluations of the following MP elements: a) A triennial assessment frequency with each of the three FISS designs; b) Various empirical rules to determine the reference coastwide TCEY in non-assessment years; c) Constraints on the interannual change in the reference coastwide TCEY, such as a maximum change in the coastwide TCEY of 15%, a slow-up fast down approach, or a fixed TCEY in non-assessment years.
4) **REQUEST** conducting further analyses of reference points and the effects of recruitment regimes and variable weight-at-age after conditioning the OM following the full 2025 stock assessment.

REFERENCES

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APPENDIX A
PRIMARY OBJECTIVES USED BY THE COMMISSION FOR THE MSE EVALUATIONS

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 relative spawning biomass above a biomass limit reference point ($RSB_{20\%}$) at least 95% of the time	*RSB* < Spawning Biomass Limit (RSB_{Lim}) RSB_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(RSB < RSB_{Lim})$ Fail if greater than 0.05
	Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$	Long-term	0.05	$P\left(p_{SB,R} < p_{SB,R,min}\right)$
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the long-term coastwide female relative spawning biomass at or above a biomass reference point ($RSB_{36\%}$) 50% or more of the time	*RSB*<Spawning Biomass Reference (RSB_{Thresh}) RSB_{Thresh}=$RSB_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(RSB < RSB_{Thresh})$ 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* $\overline{\left(\frac{TCEY_A}{TCEY}\right)}$
	Maintain a minimum TCEY for each Regulatory Area	Minimum $TCEY_A$	Short-term		*Median Min(TCEY)*
	Maintain a percentage of the coastwide TCEY for each Regulatory Area	Minimum $\%TCEY_A$	Short-term		*Median 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 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* AAV_A

$$AAV_t = \frac{\sum_{t+1}^{t+9}\left|TCEY_t - TCEY_{t-1}\right|}{\sum_{t}^{t+9} TCEY_t}$$

$$AC_t = \frac{\left|TCEY_t - TCEY_{t-1}\right|}{TCEY_{t-1}}$$

Interim: IPHC Harvest Strategy Policy

PREPARED BY: IPHC SECRETARIAT (A. HICKS, I. STEWART, & D. WILSON; 04 DECEMBER 2025)

PURPOSE

To provide the MSAB with a draft of the interim Harvest Strategy Policy (HSP) to be considered by the Commission in 2025.

INTRODUCTION

A draft Harvest Strategy Policy (HSP) has been developed for consideration by the Commission. The HSP provides a framework for applying a consistent and transparent science-based approach to setting mortality limits for Pacific halibut (*Hippoglossus stenolepis*) fisheries throughout the Convention Area while ensuring sustainability of the Pacific halibut population. This draft contains principles developed during the Management Strategy Evaluation (MSE) process at IPHC. This document may be updated based on decisions in 2025.

POTENTIAL UPDATES TO THE DRAFT INTERIM HSP

In its current state, the HSP is a complete document describing the management framework for Pacific halibut. However, ongoing discussions with the Scientific Review Board (SRB) and the Management Strategy Advisory Board (MSAB), and recent MSE work, may provide useful information for updating the HSP in 2025. The following areas may be updated given work completed in 2024 (see IPHC-2025-AM101-12), should the Commission direct the Secretariat to do so:

- Update the Commission's priority objectives based on recommendations of the SRB and MSAB (see IPHC-2025-AM101-12).
- Update the following elements of the coastwide management procedure based on recent MSE work: reference SPR, assessment frequency, and a constraint on the interannual change in the TCEY (see IPHC-2025-AM101-12).
- A more complete definition of overfishing.
- Any edits to the HSP.

The HSP may also be updated in the future, with the Commission's endorsement, when research or recommendations from subsidiary bodies suggest that improvements are warranted.

RECOMMENDATION/S

That the MSAB:

1) **NOTE** paper IPHC-2025-MSAB021-09 that provides a draft interim Harvest Strategy Policy.

APPENDICES

Appendix A: International Pacific Halibut Commission Interim: Harvest Strategy Policy (2024)

APPENDIX A

INTERNATIONAL PACIFIC HALIBUT COMMISSION

INTERIM: HARVEST STRATEGY POLICY

(2024)

INTERNATIONAL PACIFIC

HALIBUT COMMISSION

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IPHC 2024. Interim: IPHC Harvest Strategy Policy
IPHC–2024–HSP, 19 pp.

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NOTE: The following is an interim document based on an amalgamation of current IPHC practices and best practices in harvest strategy policy. Current research is ongoing and it is expected that this policy document will then be updated accordingly.

ACRONYMS

CB	Conference Board
HCR	Harvest Control Rule
HSP	Harvest Strategy Policy
IPHC	International Pacific Halibut Commission
LIM	Limit
MEY	Maximum Economic Yield
MP	Management Procedure
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
NER	Net Economic Returns
OM	Operating Model
PAB	Processor Advisory Board
RAB	Research Advisory Board
RSB	Relative Spawning Biomass
SB	Spawning Biomass (female)
SPR	Spawning Potential Ratio
SRB	Scientific Review Board
TCEY	Total Constant Exploitable Yield
THRESH	Threshold
U.S.A.	United States of America

DEFINITIONS

A set of working definitions are provided in the IPHC Glossary of Terms and abbreviations: https://www.iphc.int/the-commission/glossary-of-terms-and-abbreviations

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EXECUTIVE SUMMARY

The *IPHC Harvest Strategy Policy* (HSP) provides a framework for applying a consistent and transparent science-based approach to setting mortality limits for Pacific halibut (*Hippoglossus stenolepis*) fisheries throughout the Convention Area while ensuring sustainability of the Pacific halibut population. It defines biological and economic objectives that apply to the development of a harvest strategy for Pacific halibut. It also identifies a management procedure and 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)*[1], provides the basis to manage the risk to Pacific halibut fisheries and the Pacific halibut population.

The IPHC is responsible for determining the coastwide mortality limit and the allocation of this limit among eight (8) IPHC Regulatory Areas. The mortality limit in each IPHC Regulatory Area consists of all fishing mortality of all sizes and from all sources, except for discard mortality of under 26-inch (U26) Pacific halibut from non-directed commercial (e.g. trawl) fisheries, which is accounted for at the coastwide level. The distribution of the mortality limit to each sector within an IPHC Regulatory Area is determined by Contracting Party domestic agencies. Therefore, this Harvest Strategy Policy is specific to the mortality limit in each IPHC Regulatory Area, across all sectors (i.e. TCEY).

Being a framework, the harvest strategy policy encompasses the entire process of the management procedure and decision-making process to determine mortality limits as well as other important considerations such as objectives, key principles, and responses to specific events. A harvest strategy, which may also be referred to as a management strategy, is the decision framework necessary to achieve defined biological and economic objectives for Pacific halibut.

Management Procedure (MP): A formulaic procedure to determine a management outcome (e.g. mortality limit) that has been simulation tested and produces a repeatable outcome.

Harvest Strategy: The framework for managing a fish stock, including the MP and objectives.

Harvest Strategy Policy (HSP): The harvest strategy and decision-making process that results in endpoint management outcomes.

A goal of the IPHC Harvest Strategy Policy is the long-term 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. The Commission's current priority objectives to achieve this goal, which may be updated, are to:

- maintain Pacific halibut female spawning biomass, above a 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 female spawning biomass, at least 50% of the time, at or above a threshold reference (fixed or dynamic) female spawning biomass that optimises fishing activities on a spatial and temporal scale relevant to the fishery;

[1] https://www.iphc.int/uploads/pdf/basic-texts/iphc-1979-pacific-halibut-convention.pdf

- optimise average coastwide yield given the constraints above;
- limit annual changes in the coastwide mortality limit (TCEY) given the constraints 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.

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.

A transparent and systematic approach to meet the objectives of the Harvest Strategy Policy is supported by a number of requirements. These include accounting for all mortality of all sizes and from all sources; accounting for multiple sources of uncertainty including environmental and biological; balancing risk, cost, and catch; developing threshold and limit reference points as indicators for managing Pacific halibut; robust simulation testing of management procedures; and identifying circumstances when the harvest strategy may be reconsidered and possibly updated. One threshold reference point and one biological limit reference point are currently defined.

Reference point	Definition	Proxy
Threshold reference point SB_{THRESH}	The female dynamic spawning biomass level at maximum economic yield (SB_{MEY}).	36% of the unfished spawning biomass ($SB_{36\%}$).
Biological limit reference point SB_{LIM}	The female dynamic spawning biomass level where the ecological risk to the population is regarded as unacceptable.	20% of the unfished female spawning biomass ($SB_{20\%}$).

The coastwide reference mortality limit from the management procedure is currently determined using the stock assessment and a fishing intensity ($F_{SPR=43\%}$). The reference SPR is linearly reduced when the stock status is estimated below 30% and is set to 100% (no fishing for directed fisheries) when the stock status is estimated at or below 20% (SB_{LIM}). A rebuilding strategy must be developed if the stock is estimated to be below SB_{LIM}.

The management of Pacific halibut is an annual process with a coastwide mortality limit and allocation to each IPHC Regulatory Area decided upon by the Commission at each Session of the IPHC Annual Meeting with the input of management supporting information including mortality tables, the harvest decision table, stakeholder input, and any other requests by the Commission. A mortality table shows the resulting allocation of mortality limits to each sector within each IPHC Regulatory Area. The harvest decision table is a stock assessment output that provides an estimate of risk relative to stock trend, stock status, fishery trends, and fishery status for a range of short-term (3-year) coastwide mortality levels including the coastwide reference fishing mortality.

Chapter 1 INTRODUCTION

The *IPHC Harvest Strategy Policy* (HSP) provides a framework for applying a consistent and transparent science-based approach to setting mortality limits for Pacific halibut (*Hippoglossus stenolepis*) fisheries throughout the Convention Area while ensuring sustainability of the Pacific halibut population.

It defines biological and economic objectives that apply to the development of a harvest strategy for Pacific halibut. It also identifies a management procedure and 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)*[2], 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 consistent and transparent science-based approach to setting mortality limits. A harvest strategy consistent with this policy will provide all interested sectors with confidence that the Pacific halibut fisheries are being managed for long-term economic viability while ensuring long-term ecological sustainability of the Pacific halibut population. The implementation of a clearly specified harvest strategy will also provide the fishing industry with a more certain operating environment.

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. coordinated management between the IPHC and Contracting Party domestic agencies) the IPHC will seek to apply and encourage the adoption of this policy in negotiating and implementing cooperative management arrangements.

The IPHC is responsible for determining the coastwide mortality limit and the allocation of this limit among eight (8) IPHC Regulatory Areas (Figure 1). The mortality limit in each IPHC Regulatory Area consists of all fishing mortality of all sizes and from all sources, except for discard mortality of under 26-inch (U26) Pacific halibut from non-directed commercial (e.g. trawl) fisheries, which is accounted for at the coastwide level. This mortality limit without U26 non-directed commercial discard mortality has been termed the Total Constant Exploitation Yield, or the TCEY, but mortality limit is used here.

The distribution of the mortality limit to each sector within an IPHC Regulatory Area is determined by Contracting Party domestic agencies. Therefore, this Harvest Strategy Policy is specific to the mortality limit in each IPHC Regulatory Area, across all sectors (i.e. TCEY).

[2] https://www.iphc.int/uploads/pdf/basic-texts/iphc-1979-pacific-halibut-convention.pdf

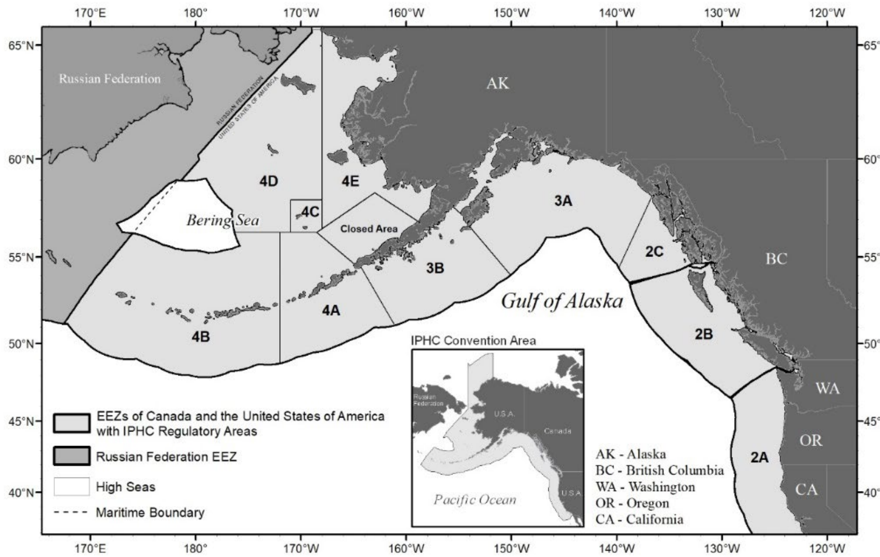

Figure 1. IPHC Regulatory Areas, where 4C, 4D, 4E, and the closed area are considered one IPHC Regulatory Area (4CDE). The IPHC Convention Area is shown in the inset.

1.2 WHAT IS A HARVEST STRATEGY POLICY (HSP)?

Being a framework, the harvest strategy policy encompasses the entire process of the management procedure and decision-making process to determine mortality limits (Figure 2) as well as other important considerations such as objectives, key principles, and responses to specific events. To determine mortality limits, the process begins with determining the coastwide scale of fishing mortality (the Management Procedure or MP). The decision-making process then occurs at the Annual Meeting of the IPHC where various forms of supporting information are used by subsidiary bodies to provide a recommendation to the Commission of the coastwide mortality limit and allocation to each IPHC Regulatory Area. The Commission uses all this information to arrive at a final decision defining mortality limits for that year. Due to many considerations in this decision-making process, the final coastwide mortality limit may deviate from the coastwide reference mortality limit determined from the management procedure.

1.3 WHAT IS A HARVEST STRATEGY?

A harvest strategy, which may also be referred to as a management strategy, is the 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 conditions of the Pacific halibut population and economic conditions of Pacific halibut fisheries in relation to biological and fishery reference levels (reference points).
- Pre-determined rules that adjust fishing mortality according to the biological status of the Pacific halibut stock and economic conditions of the Pacific halibut fishery (as defined by monitoring and/or assessment). These rules are referred to as harvest control rules or decision rules.

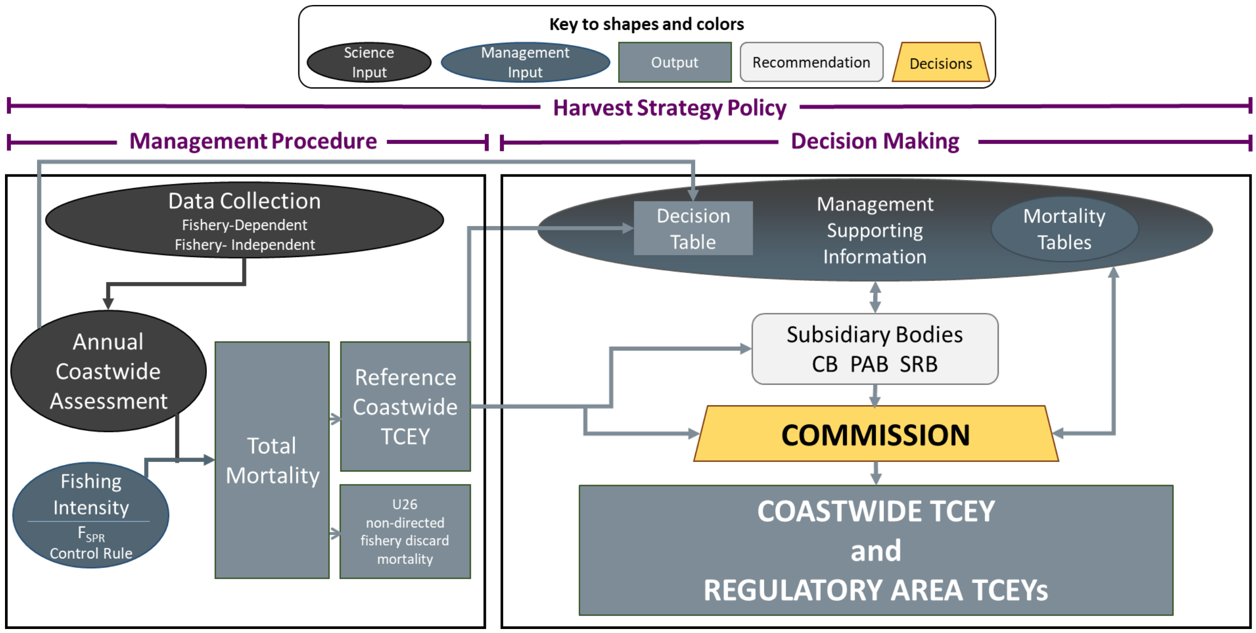

Figure 2. Illustration of the interim IPHC harvest strategy policy process to determine mortality limits showing the management procedure affecting the coastwide scale and the decision-making component, that considers inputs from many sources to distribute the coastwide TCEY to IPHC Regulatory Areas and may result in the coastwide TCEY deviating from the reference coastwide scale management procedure.

A management procedure (MP) contains many of the components of a harvest strategy and is sometimes synonymous with harvest strategy. Here, we define an MP as the formulaic procedure that defines data collection, assessment, and harvest rules to determine the coastwide reference mortality limit. The MP has been shown to meet the objectives through simulation testing while also being robust to uncertainty and variability. Harvest strategy is a more general concept containing the MP as well as objectives. Simulation testing of MPs is done using Management Strategy Evaluation (MSE) models with decision-making variability to ensure that a harvest strategy policy is robust to this uncertainty as well as other sources of uncertainty.

Management Procedure (MP): A formulaic procedure to determine a management outcome (e.g. mortality limit) that has been simulation tested and produces a repeatable outcome.

Harvest Strategy: The framework for managing a fish stock, including the MP and objectives.

Harvest Strategy Policy (HSP): The harvest strategy and decision-making process that results in endpoint management outcomes.

Chapter 2 OBJECTIVES AND KEY PRINCIPLES

A goal of the IPHC Harvest Strategy Policy is the long-term 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.

To achieve this goal the IPHC will implement a harvest strategy that minimises risk to the stock and pursues maximum economic yield (MEY) for the directed Pacific halibut fisheries. Maximising the net economic returns (NER) from the fishery may not always equate with maximising the profitability of the fishery. Net economic returns may consider inter-annual stability to maintain markets, and economic activity may also arise from recreational and Indigenous fishing. The need to share the resources appropriately will also be considered where necessary. The Commission's current priority objectives to achieve this goal, which may be updated, are:

- maintain Pacific halibut female spawning biomass, above a 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 female spawning biomass, at least 50% of the time, at or above a threshold reference (fixed or dynamic) female spawning biomass that optimises fishing activities on a spatial and temporal scale relevant to the fishery;
- optimise average coastwide yield given the constraints above;
- limit annual changes in the coastwide mortality limit (TCEY) given the constraints 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 to 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. In this case, a stock rebuilding strategy will be developed to rebuild the stock, with high certainty, to the limit female spawning biomass level, whereby the harvest control rules would then take effect to build the stock further to the threshold reference female spawning biomass level.

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.

Chapter 3 DEVELOPMENT OF THE HARVEST STRATEGY

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

3.1 ACCOUNTING FOR FISHING MORTALITY ON ALL SIZES AND FROM ALL SOURCES

The harvest strategy accounts for all known sources of fishing mortality on the stock and all sizes of Pacific halibut mortality, including directed commercial, recreational, subsistence, and fishing mortality from fisheries targeting species other than Pacific halibut and may be under the management of another jurisdiction, such as non-directed fishing mortality. Discard mortality of released fish is accounted for using best available knowledge.

3.2 VARIABILITY IN THE ENVIRONMENT AND BIOLOGICAL CHARACTERISTICS

The productivity of Pacific halibut is affected by variability in the environment and by changes in biological characteristics. The environment fluctuates naturally and is altered due to climate change and other factors, which may affect biological characteristics such as size-at-age and recruitment of age-0 fish. The following types of variability were considered when developing the harvest strategy for Pacific halibut:

- Variability in recruitment of age-0 Pacific halibut due to unknown causes
- Variability in average recruitment of age-0 Pacific halibut due to the environment (e.g. indexed by the Pacific Decadal Oscillation, PDO).
- Variability in the geographical distribution of age-0 recruits linked to the PDO.
- Changes in weight-at-age due to unknown causes
- Variability in movement throughout the Convention Area due to the environment (e.g. linked to the PDO).

Some potential impacts of climate change were taken into account when developing the harvest strategy policy and future research on additional effects of climate change on Pacific halibut fisheries and stocks will be incorporated as knowledge improves.

3.3 MONITORING

The harvest strategy includes best practices for monitoring the stock and fisheries and the collection of fishery-dependent and fishery-independent data on the distribution, abundance, and demographics of Pacific halibut, as well as other key biological data. These observations are used in the stock assessment and inform other management supporting information. Fisheries-dependent data include observations from the fisheries and should be collected across the entire geographical range and across all sectors, including landed catch and discards. Fishery-independent data include observations collected from scientifically designed surveys providing standardised biological and ecological data that are independent of the fishing fleet.

3.4 ESTABLISHING AND APPLYING DECISION RULES

The harvest strategy developed under this policy specifies all required management actions or considerations for Pacific halibut, at the stock or IPHC Regulatory Area level, necessary to achieve the ecological and economic management objectives for the fishery. Specifics are provided in Chapter 4.

3.5 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.

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 the 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 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.

3.6 REFERENCE POINTS AND PROXIES

A reference point is a specified level of an indicator used as a basis for managing Pacific halibut. A reference point will often be based on indicators of the female spawning stock size (relative or absolute spawning biomass), the amount of harvest (fishing mortality), or on other factors such as economic return from the fishery.

A harvest strategy for Pacific halibut shall be based on 'threshold' reference points and 'limit' reference points. A threshold reference point is a level that achieves the policy objectives (e.g. acceptable levels of biological impact on the stock and desired economic outcomes from the fishery) if the indicator is at or above that level. When the stock is at or above a threshold reference point, optimal yield is possible. A limit reference point indicates a point beyond which the long-term biological health of the stock or the performance of the commercial fishery is considered unacceptable and should be avoided. Fishing when the Pacific halibut population is below the biological limit reference point places the Pacific halibut stock at a range of biological risks, including an unacceptable risk to recruitment and productivity, and an increased risk that the stock will fail to maintain its ecological function, although risk of extinction is not a major concern. A fishery limit reference point indicates a stock level below which the fishery is unlikely to remain profitable. Proxy reference points are described in Table 1.

Spawning biomass reference points may be dynamic or absolute calculations. A dynamic calculation pertains to relative spawning biomass (RSB) being the estimated value relative to the estimated spawning biomass that would have occurred without any fishing given natural variability (e.g. recruitment deviations, changes in size-at-age, etc). This measures the effect of only fishing, rather than the effect of fishing and the environment. Absolute spawning biomass is not relative to another value and is typically presented as a number or a value estimated in a particular year. Absolute spawning biomass may be useful as a threshold reference point where being below would result in low catch rates and possibly other concerns. Currently there are no absolute spawning biomass reference points, but they may be a useful addition to dynamic reference points.

Table 1. Proxy reference points

Reference point	Definition	Proxy
Threshold reference point SB_{THRESH}	The female dynamic spawning biomass level at maximum economic yield (SB_{MEY}).	36% of the unfished spawning biomass ($RSB_{36\%}$).
Biological limit reference point SB_{LIM}	The female dynamic spawning biomass level where the ecological risk to the population is regarded as unacceptable.	20% of the unfished female spawning biomass ($RSB_{20\%}$).

3.7 TECHNICAL EVALUATION OF THE HARVEST STRATEGY

A harvest strategy should be formally tested to demonstrate that it is highly likely to meet the objectives and key principles of this policy, and outcomes of that testing should be made publicly available. Management strategy evaluation (MSE), a procedure where alternative management strategies are tested and compared using simulations of stock and fishery dynamics, is one of the best options to test harvest strategies. MSE involves determining objectives, identifying MPs to evaluate, simulating those MPs with a closed-loop simulation framework, evaluating the MPs to determine which one best meets the objectives (Chapter 2) , and finally adopting that MP as part of the harvest strategy. This process receives input from stakeholders through meetings of the Management Strategy Advisory Board (MSAB) and is reviewed by the IPHC Scientific Review Board (SRB).

The MSE supporting this HSP incorporates variability and uncertainty, such as described in Section 3.2, structural uncertainty in an operating model (OM), and implementation variability from decision-making and realized fishing mortality. The MSE also represents all fishing sectors as necessary to appropriately remove different cohorts from the population and to determine if objectives are met for each sector. An important component to this HSP is the decision-making component (Figure 2) where the Commission considers management inputs and additional relevant factors when deciding on the coastwide TCEY and distribution of the TCEY to IPHC Regulatory Areas to balance risk, cost, and catch (Section 3.5). The MSE uses historical decisions to determine how to simulate decision-making variability, ensuring that an MP is robust to that variability as well as other sources of uncertainty.

3.8 RE-EVALUATING THE HARVEST STRATEGY AND MANAGEMENT PROCEDURE

A harvest strategy is a transparent and science-based approach to determining mortality limits and is meant to remain in place for many years. Frequent modifications or departures from the harvest strategy reduce the transparency and science-based approach. Therefore, it is important to specify, as part of the harvest strategy, time periods for re-evaluation of management procedures and to identify exceptional circumstances that would trigger a re-evaluation before that time period.

The IPHC currently operates of a schedule of three-years for full stock assessments, with update stock assessments in the intervening two years, and the MSE OM is updated following each full stock assessment to maintain consistent approaches and paradigms. Therefore, MPs are re-evaluated at a minimum of three years after implementation. An exceptional circumstance may trigger a re-evaluation before then and are defined as follows.

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

Exceptional circumstances would be reviewed by the SRB to determine if one should be declared.

In the event that an exceptional circumstance is declared, the following actions are to be completed.

- Review the MSE simulations to determine if the OM can be improved and MPs should be re-evaluated.
- 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.
- Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.

MSE work is currently ongoing to supplement this interim harvest strategy policy. Current elements of MPs being investigated include conducting a stock assessment every second or third year and using an empirical rule based on the FISS WPUE in years without a stock assessment to determine the coastwide TCEY. With the harvest strategy currently being evaluated, updates to this interim harvest strategy policy may occur before three years.

Chapter 4 APPLYING THE HARVEST STRATEGY

4.1 COORDINATED MANAGEMENT OF DOMESTIC STOCKS

Consistent 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), the IPHC will pursue the sustainable use of Pacific halibut within fisheries managed by other jurisdictions.

4.2 COORDINATED MANAGEMENT OF INTERNATIONAL STOCKS

The IPHC Harvest Strategy Policy does not prescribe management arrangements in the case of fisheries that are managed by a Party external to the IPHC Convention. This includes management arrangements for commercial and traditional fishing in the US Treaty Tribes and Canadian First Nations, that are governed by provisions within relevant Treaties. However, it does articulate the IPHC preferred approach.

4.3 STOCK ASSESSMENT

A full stock assessment occurs triennially and incorporates all available data through the current year, investigates all data and modelling aspects, and potentially makes changes to any of these components as needed. In the intervening years, an update stock assessment is completed to include all available data through the most current year. The stock assessment includes a summary of the data available for analysis, estimates of current stock size, recent trends of stock size relative to reference points, and uncertainty in the estimates of stock size.

The stock assessment also produces a harvest decision table containing short-term projections of various risk metrics under different levels of future harvest (input as a specific amount of fishing mortality, e.g. TCEY). Risk metrics include the probability of a decline in spawning biomass for the next 1 to 3 years, the probability of a decline in spawning biomass that is greater than 5% for the next 1 to 3 years, the probability that the spawning biomass is less than 20% or 30% of unfished spawning biomass in the next 1 to 3 years, the probability that the TCEY is less than the selected TCEY in the next 1 to 3 years, the probability that the TCEY is at least 10% less than the selected TCEY in the next 1 to 3 years, and the probability that the fishing intensity in the upcoming year is greater than the reference fishing intensity as specified in the MP (currently $F_{SPR=43\%}$). The harvest levels including the reference fishing mortality (i.e. TCEY determined from the MP), a range less than and greater than the reference fishing mortality , no fishing mortality (to assess short-term maximum biological productivity), various levels based on status quo (the previous year's coastwide mortality), a 3-year surplus that would maintain the spawning biomass at the same level in three years with a 50% probability, fishing mortality based on the SPR proxy for MEY, and the fishing mortality based on the SPR proxy for MSY.

4.4 COASTWIDE REFERENCE MORTALITY LIMIT

The coastwide reference mortality limit is determined using the stock assessment and a fishing intensity (i.e. F_{SPR}) defined by a harvest control rule (Figure 3). The stock assessment estimates the stock status (dynamic RSB) which is used in the harvest control rule to determine if fishing intensity should be reduced from the reference SPR (currently 43%). The reference SPR is linearly reduced when the stock status is estimated below 30% and is set to 100% (no fishing for directed fisheries) when the stock status is estimated at or below 20% (SB_{LIM}).

This management procedure determining the coastwide reference mortality limit (TCEY) is brought into the decision-making step as a reference value from which the Commission uses additional management supporting information to account for other relevant factors during the annual decision-making process on the coastwide TCEY and the distribution of the coastwide TCEY to IPHC Regulatory Areas. The MP provides a reference value in the decision table (see Section 4.3). The MSE simulations account for this decision-making variability (see Section 3.7).

The decision table represents short-term projections that are useful for tactical decision-making and are an important item in the management supporting information. Longer-term strategic implications of the choices in the decision table could be determined from the MSE simulations. If available, performance metrics associated with the four priority objectives (Chapter 2) determined from the most recent MSE simulations should be presented for, at a minimum, some F_{SPR} values associated with the fishing mortality options presented in the decision table.

4.5 REBUILDING IF THE STOCK BECOMES OVERFISHED

If Pacific halibut is determined to be overfished (when the probability that female spawning stock biomass is below the limit reference point (SB_{LIM}) is greater than 50%), immediate action is required to constrain directed fishing and rebuild the stock to levels that will ensure long-term sustainability and productivity, i.e. at or above SB_{LIM}. A rebuilding strategy must be developed to rebuild the stock to above its limit reference point, for agreement by the Commission. A rebuilding strategy will be required until the stock is above the limit reference point with a reasonable level of certainty (at least a 70% probability that the stock has rebuilt to or above the limit reference point). It must ensure adequate monitoring and data collection is in place to assess the status of the stock and rebuilding progress.

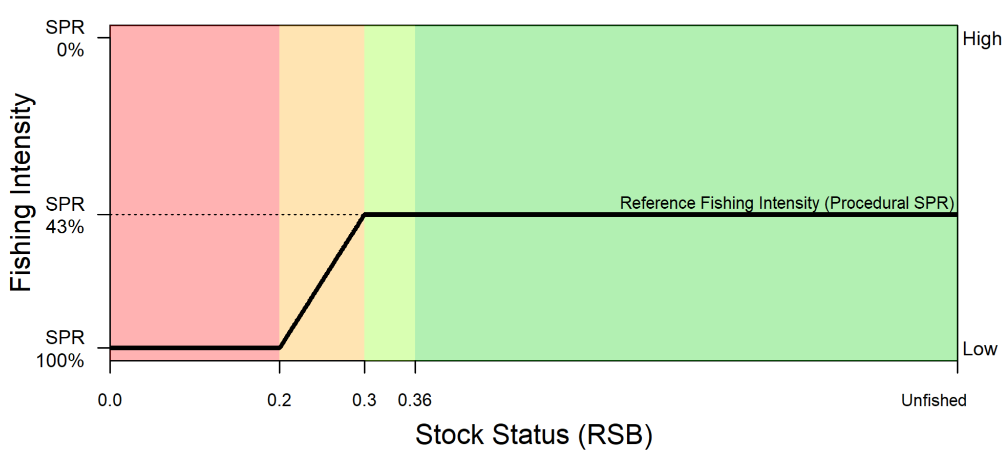

Figure 3. Harvest control rule for the fishing intensity (i.e. F_{SPR}) to determine the coastwide total mortality limit. The stock status is the dynamic relative spawning biomass (RSB) determined from the stock assessment. The reference fishing intensity is $F_{SPR=43\%}$, and is applied when stock status is above the trigger of 30%. SPR is linearly reduced between a stock status of 30% and 20%, and set to 100% when at or below

20% (no directed fishing). A stock status of 20% is also the reference point SB_{LIM}. The threshold RSB, 36%, is related to an objective to maintain the relative spawning biomass at or above $SB_{36\%}$ at least 50 percent of the time. Colours show the area below B_{LIM}, the area 'on the ramp', the area above the trigger and below SB_{THRESH}, and the area above SB_{THRESH}.

Directed fishing and incidental mortality of Pacific halibut, if determined to be overfished, should be constrained as much as possible to levels that allow rebuilding to the limit reference point (SB_{LIM}) within the specified timeframe. Once a stock has been rebuilt to above the limit reference point with a reasonable level of certainty, it may be appropriate to increase directed fishing, and increase incidental mortality in line with the harvest strategy, noting that the usual harvest strategy requirements regarding the application of the harvest control rule and risk of breaching the limit reference point will apply.

The rebuilding strategy should note where sources of mortality exist that cannot be constrained by the IPHC, and must take this mortality into account. Where practical and appropriate, the IPHC will coordinate with other jurisdictions to ensure other sources of mortality from fishing are reasonably constrained consistent with any catch sharing arrangement.

When a rebuilding strategy is being developed, it must include performance measures and details on how and when these measures will be reported. Where there is no evidence that a stock is rebuilding, or is going to rebuild in the required timeframe and probability, the IPHC will review the rebuilding strategy and make the result of the review public. If changes to the rebuilding strategy are considered necessary, such changes should be made in a timely manner.

Rebuilding timeframes

Rebuilding timeframes are explicitly related to the minimum timeframe for rebuilding in the absence of fishing. Rebuilding timeframes should take into account Pacific halibut productivity and recruitment; the relationship between spawning biomass and recruitment; and the stock's current level of depletion.

4.6 MORTALITY LIMITS FOR EACH IPHC REGULATORY AREA

The final outputs of the harvest strategy policy before domestic management is applied are mortality limits for each IPHC Regulatory Area. These are decided upon by the Commission at the Annual Meeting with the input of management supporting information (Figure 2) requested by the Commission including mortality tables and the harvest decision table (see Section 4.3).

Mortality table: A mortality table shows the resulting allocation of mortality limits to each sector within each IPHC Regulatory Area. Domestic catch-sharing plans and Commission agreements on projecting non-directed discard mortality are used to fill out the details. This table can be produced for any projected year but is commonly presented for only the first projected year. Mortality limits for each IPHC Regulatory Area are defined by the Commission as part of the decision-making process.

4.7 STAKEHOLDER AND SCIENTIFIC INPUT

Stakeholder and scientific input into the application of the harvest strategy is an important process to support the sustainable and profitable management of the Pacific halibut fishery. Input from both sources occurs at meetings throughout the year.

Stakeholder input

Stakeholder input can occur via public testimony at any public IPHC meeting or at meetings of various IPHC subsidiary bodies. In particular, the MSAB, Research Advisory Board (RAB), Conference Board (CB), and Processor Advisory Board (PAB) are populated by individuals representing various interests related to Pacific halibut. Terms of reference and rules of procedure are provided for each subsidiary body.

MSAB: The Management Strategy Advisory Board suggests topics to be considered in the MSE process, provide the IPHC Secretariat with direct input and advice on current and planned MSE activities, and represent constituent views in the MSE process. The MSAB meets at least once per year and makes recommendations to the Commission regarding the MSE analyses.

CB: The Conference Board consists of individuals representing Pacific halibut harvesters, organisations, and associations. The CB provides a forum for the discussion of management and policy matters relevant to Pacific halibut and provides advice to the Commission on these matters. This subsidiary body also reviews regulatory proposals received by the Commission and IPHC Secretariat reports and recommendations, and provides its advice concerning these items to the Commission at its Annual Meeting, or on other occasions as requested. The CB meets during the week of the Annual Meeting.

PAB: The Processor Advisory Board represents the commercial Pacific halibut processing industry from Canada and the United States of America and advises the Commission on issues related to the management of the Pacific halibut resource in the Convention Area. The PAB meets during the week of the Annual Meeting.

RAB: The Research Advisory Board, composed of members of the Pacific halibut community, provides the IPHC Secretariat staff with direct input and advice from industry on current and planned research activities contemplated for inclusion in the IPHC 5-year program of integrated research and monitoring. This subsidiary body suggests research topics to be considered and comments upon operational and implementation considerations of those research and monitoring activities. The RAB meets once per year, typically before the Interim Meeting.

Scientific input

Scientific input occurs through independent, external reviews, including, but not limited to, semi-annual meetings of the SRB. The SRB reviews science/research proposals, programs, products, strategy, progress, and overall performance, as well as the recommendations arising from the MSAB and RAB.

4.8 ANNUAL PROCESS

A series of meetings occurs throughout the year, leading up the Annual Meeting in January when mortality limit decisions are made. The MSAB meets at least once a year in spring to provide guidance on the MSE and may also meet in autumn if necessary. The SRB meets in June and September to peer review IPHC science products, including the stock assessment and MSE. The CB and the PAB meet during the week of the Annual Meeting to advise the Commission on issues related to the management of the Pacific halibut resource in the Convention Area.

An Interim Meeting, typically late November, precedes the Annual Meeting and is when the stock assessment, stock projections, and harvest decision table are first publicly presented. The final stock assessment, stock projections, and harvest decision table are presented at the Annual Meeting, typically in late January, to support mortality limit decisions.