INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC–2023–MSAB019–00
Last Update: 30 April 2024

19th Session of the IPHC Management Strategy Advisory Board (MSAB019) – *Compendium of meeting documents*

1-3 May 2024 Seattle, WA, USA

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BIBLIOGRAPHIC ENTRY
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DRAFT: AGENDA & SCHEDULE FOR THE 19th SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB019)

Date: 1-3 May 2024
Location: Electronic
Link: Please Register here
Time (PDT): 13:00-17:00 (1st), 09:00-17:00 (2nd), 09:00-15:00 (3rd)
Co-Chairpersons: Vacant (Canada); Dr Pete Hulson (USA)

Notes:
- ***Document deadline**: 1 April 2024 (30 days prior to the opening of the Session)*
- *All sessions are open to observers and the general public, unless the Commission specifically decides otherwise.*

1. OPENING OF THE SESSION
- Election of Canadian Co-Chairpeson

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION
- *IPHC-2024-MSAB019-01: Agenda & Schedule for the 19th Session of the IPHC Management Strategy Advisory Board (MSAB019)*
- *IPHC-2024-MSAB019-02: List of Documents for the 19th Session of the IPHC Management Strategy Advisory Board (MSAB019)*

3. IPHC PROCESS
3.1. MSAB Membership (D. Wilson)
- *IPHC-2024-MSAB019-03: MSAB Membership (D. Wilson)*

3.2. Update on the actions arising from the 18th Session of the MSAB (MSAB018) (A. Hicks)
- *IPHC-2024-MSAB019-04: Update on the actions arising from the 18th Session of the MSAB (MSAB018) (A. Hicks)*

3.3. Outcomes of the 100th Session of the IPHC Annual Meeting (AM100) (A. Hicks)
- *IPHC-2024-MSAB019-05: Outcomes of the 100th Session of the IPHC Annual Meeting (AM100) (A. Hicks)*

4. MANAGEMENT STRATEGY EVALUATION UPDATES
4.1. Updates to the MSE framework to investigate management procedures for Pacific halibut fisheries (A. Hicks)

4.2. Updates to evaluations of the current interim harvest policy (A. Hicks)
- *IPHC-2024-MSAB019-06: Updates to the Management Strategy Evaluation framework and a review of coastwide management procedures (A. Hicks & I. Stewart)*

5. MANAGEMENT STRATEGY EVALUATION PROGRAM OF WORK (2024-2025)

5.1. Potential management procedures to simulate and evaluate (A. Hicks)
5.2. Primary MSE objectives and associated performance metrics (A. Hicks)
5.3. Additional considerations for the MSE process and harvest strategy policy (A. Hicks)

- *IPHC-2024-MSAB019-07: Considerations for the Management Strategy Evaluation Program of Work for 2023-2025 (A. Hicks & I. Stewart)*

6. OTHER BUSINESS

7. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 19TH SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB019)

Wednesday 1 May 2024		
Time	**Agenda item**	**Lead (support)**
12:30-13:00	Connect electronically and troubleshoot connections	IPHC Secretariat
13:00-13:15	**1. Opening of the Session** 1.1. Election of Canadian co-chair	Co-Chairperson & Secretariat
13:15-13:30	**2. Adoption of the agenda and arrangements for the Session**	Co-Chairpersons
13:30-14:15	**3. IPHC Process** 3.1. MSAB Membership 3.2. Update on the actions arising from the 18th Session of the MSAB (MSAB018) 3.3. Outcomes of the 100th Session of the IPHC Annual Meeting (AM100)	D. Wilson A. Hicks A. Hicks
14:15-15:00	**4. Management Strategy Evaluation Updates** 4.1. Updates to the MSE framework to investigate management procedures for Pacific halibut fisheries	A. Hicks
15:00-15:15	Break	
15:15-15:45	**4. Management Strategy Evaluation Updates (cont.)** 4.1. Updates to evaluations of the current interim harvest policy	A. Hicks
15:45-16:00	Review of Day 1	Co-chairpersons
16:00-17:00	MSAB Drafting Session	MSAB drafting group

Thursday 2 May 2024		
Time	**Agenda item**	**Lead (support)**
08:30-09:00	Connect electronically and troubleshoot connections	IPHC Secretariat
09:00-09:30	Discussion of draft report from Day 1	Co-Chairpersons
09:30-10:00	**4. Management Strategy Evaluation Updates (cont.)** **4.1.** Updates to evaluations of the current interim harvest policy	A. Hicks
10:00-10:30	**5. Management Strategy Evaluation Program of Work (2024-2025)** 5.1. Potential management procedures to simulate and evaluate	A. Hicks
10:30-11:00	Break	
11:00-12:00	**5. Management Strategy Evaluation Program of Work (2024-2025) (cont.)** 5.1. Potential management procedures to simulate and evaluate 5.2. Primary MSE objectives and associated performance metrics	A. Hicks
12:00-13:00	Lunch	
13:00-15:00	**5. Management Strategy Evaluation Program of Work (2023-2025) (cont.)** **5.2.** Primary MSE objectives and associated performance metrics **5.3.** Additional considerations for the MSE process and harvest strategy policy	A. Hicks
15:00-15:30	Break	
15:30-15:45	Review of Day 2	Co-Chairpersons
15:45-17:00	MSAB Drafting Session	MSAB drafting group

Friday 3 May 2024		
Time	**Agenda item**	**Lead (support)**
08:30-09:00	Connect electronically and troubleshoot connections	IPHC Secretariat
09:00-10:00	Discussion of draft report from Day 2	Co-Chairpersons
10:00-10:30	**6. Other Business**	Co-chairpersons
10:30-11:00	Break	
11:00-12:00	MSAB Drafting Session	A. Hicks
12:00-13:00	Lunch	
13:00-15:00	**7. Review of the Draft and Adoption of the Report of the 18th Session of the IPHC Management Strategy Advisory Board (MSAB018**	Co-Chairpersons & A. Hicks

DRAFT: LIST OF DOCUMENTS FOR THE 19th SESSION OF THE IPHC MANAGEMENT STRATEGY ADVISORY BOARD (MSAB019)

Meeting documents	Title	Availability
IPHC-2024-MSAB019-01	Agenda & Schedule for the 19th Session of the IPHC Management Strategy Advisory Board (MSAB019)	✓ 29 Jan 2024 ✓ 28 Mar 2024
IPHC-2024-MSAB019-02	List of Documents for the 19th Session of the IPHC Management Strategy Advisory Board (MSAB019)	✓ 31 Jan 2024 ✓ 28 Mar 2024 ✓ 30 Apr 2024
IPHC-2024-MSAB019-03	MSAB membership 2024 (D. Wilson)	✓ 28 Mar 2024
IPHC-2024-MSAB019-04	Update on actions arising from the 18th Session of the MSAB (MSAB018) (IPHC Secretariat)	✓ 13 Mar 2024
IPHC-2024-MSAB019-05	Outcomes of the 100th Session of the IPHC Annual Meeting (AM100) (A. Hicks)	✓ 20 Mar 2024
IPHC-2024-MSAB019-06	Updates to the Management Strategy Evaluation framework and a review of coastwide management procedures (A. Hicks & I. Stewart)	✓ 28 Mar 2024
IPHC-2024-MSAB019-07	Considerations for the Management Strategy Evaluation Program of Work for 2023-2025 (A. Hicks & I. Stewart)	✓ 28 Mar 2024
Information Papers		
IPHC-2024-MSAB019-INF01	Management Strategy Evaluation – Environment vs fishing (A. Hicks)	✓ 20 Mar 2024
IPHC-2024-MSAB019-INF02	Interim: IPHC Harvest Strategy Policy (IPHC Secretariat)	✓ 30 Apr 2024

MSAB Membership 2024

PREPARED BY: IPHC SECRETARIAT (28 MARCH 2024)

PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with an updated membership list as of 28 March 2024.

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.*

> **IPHC-2023-AM099-R, para. 72**. *The Commission **NOTED** that there are vacancies within the current membership, and **AGREED** that there will not be active solicitations to fill these vacancies. The MSAB process remains open to observers, including to people who may be interested in applying for an appointment to the MSAB at a later date.*

No recommendations were made at the 100th Annual Meeting of the IPHC (AM100) pertaining to MSAB meetings or membership.

Provided at Appendix A are the current MSAB membership and term expirations, taking into account the AM099 decisions detailed above and any changes in membership since MSAB018.

RECOMMENDATION/S

That the MSAB **NOTE** paper IPHC-2024-MSAB019-03 which details the MSAB membership and term expirations as of 28 March 2024.

APPENDICES

Appendix A: MSAB Membership as of 28 March 2024

APPENDIX A
MANAGEMENT STRATEGY ADVISORY BOARD (MSAB) MEMBERSHIP

(*AS OF 28 MARCH 2024*)

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		10-April-23	31-Dec-24
3	Grout, Angus	CDN Commercial		10-April-23	31-Dec-26
4	Vacant	CDN Commercial			Vacant
5	Vacant		USA Commercial		Vacant
6	Odegaard, Per		USA Commercial	10-April-23	31-Dec-24
7	Vacant		USA Commercial		Vacant
8	Johnson, James		USA Commercial	17-Apr-23	31-Dec-24
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	9-May-23	31-Dec-24
4	Vacant		USA Treaty Tribes		Vacant

Membership category	Member	Canada	U.S.A.	Current Term commencement	Current Term expiration
Government Agencies (4-8)					
1	Vacant	DFO			Vacant
2	Huang, Ann-Marie	CDN Science Advisor		10-April-23	31-Dec-24
3	Vacant	DFO			Vacant
4	Iverson, Kurt		NOAA-Fisheries		31-Dec-26
5	Hulson, Pete		USA Science Advisor	13-Jul-22	31-Dec-24
6	Hall, Heather		PFMC	17-May-22	31-Dec-26
7	Bush, Karla		NPFMC	25-Oct-21	31-Dec-24
8	Vacant		ADFG		Vacant
Processors (2-4)					
1	Vacant	CDN Processing			Vacant
2	Vacant	CDN Processing			Vacant
3	Parker, Peggy		USA Processing	9-May-23	31-Dec-24
4	Drobnica, Angel		USA Processing	17-Apr-23	31-Dec-26
Recreational/ Sport fisheries (2-4)					
1	Ashcroft, Chuck	CDN Sportfishing		17-Apr-23	31-Dec-24
2	Vacant	CDN Sportfishing			Vacant
3	Marking, Tom		USA Sportfishing (CA)	9-May-23	31-Dec-26
4	Braden, Forrest		USA sportfishing (AK)	17-Apr-23	31-Dec-24

Update on the Actions Arising from the 18th Session of the IPHC Management Strategy Advisory Board (MSAB018)

PREPARED BY: IPHC SECRETARIAT (13 MARCH 2024)

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 MSAB018.

BACKGROUND

At the MSAB018, the members recommended/requested a series of actions to be taken by the IPHC Secretariat, as detailed in the MSAB018 meeting report (IPHC-2023-MSAB018-R) available from the IPHC website, and as provided in Appendix A.

DISCUSSION

During the 19th Session of the MSAB (MSAB019), 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-2024-MSAB019-04, 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 (MSAB018).
2) **AGREE** to consider and revise the actions as necessary, and to combine them with any new actions arising from MSAB019.

APPENDICES

Appendix A: Update on actions arising from the 18th Session of the IPHC Management Strategy Advisory Board (MSAB018)

APPENDIX A
Update on actions arising from the 18th Session of the IPHC Management Strategy Advisory Board (MSAB018)

RECOMMENDATIONS

Nil

REQUESTS

Action No.	Description	Update
MSAB018–Req.1 (para 10)	**NOTING** the extensive discussion surrounding MSAB member succession planning and how the appointment of alternates may be useful, the MSAB **REQUESTED** that domestic agency staff from the Contracting Parties consider drafting text to amend the IPHC Rules of Procedure to allow alternates to be designated for MSAB members, for Commission consideration in the future.	**Pending** The Commission and domestic agency staff decided to take no action on this request. Unless the MSAB wishes for this to be pursued further, it will be dropped from tasking.
MSAB018–Req.2 (para 21)	The MSAB **REQUESTED** that outreach materials be developed that synthesize the effect of the PDO (e.g. via recruitment) on the coastwide and regional stock dynamics and the relative effect of fishing. This may be a pamphlet or poster to be reviewed at a future MSAB meeting	**Completed** A poster was presented at AM100 and is available as an information document at MSAB019.
MSAB018–Req.3 (para 29)	The MSAB **REQUESTED** that subsequent to an agreement on a distribution procedure by the Commission, the evaluation of annual and multi-year assessments include, but not limited to, the following concepts. a) Annual changes in the TCEY driven by FISS observations in non-assessment years of a multi-year MP; b) A constraint on the coastwide TCEY to reduce inter-annual variability and the potential for large changes in assessment years of a multi-year. This may be a 10% or 15% constraint, a slow-up fast-down approach, or similar approach; c) A smoothing element in the distribution procedure to account for uncertainty in the estimates of stock distribution and reduce the variability in area-specific TCEYs. For example, this may include a 3-year rolling average of stock distribution estimates; d) SPR values ranging from 30% to 56% and alternate trigger reference points in the harvest control rule.	**In progress** The Commission has focused management procedures on the coastwide scale and consider distribution as part of the policy and decision-making process. Options a) and d) will be evaluated in 2024, option b) will be discussed at MSAB019, and option c) may be considered in the future to define a reference distribution.

Action No.	Description	Update
MSAB018–Req.4 (para 33)	The MSAB **REQUESTED** a retrospective analysis of an empirical rule that adjusts the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE to compare the coastwide TCEY determined from the assessment to the TCEY determined empirically.	**Completed** Results for this analysis are presented in document **IPHC-2024-MSAB019-06**.
MSAB018–Req.5 (para 35)	**NOTING** that objective a) from paragraph 34 above is a risk metric that must be met, the MSAB **REQUESTED** that the performance metric for this objective be reported as a pass or fail.	**Completed** The probability that the coastwide relative spawning biomass is less than 20% is reported as pass/fail.
MSAB018–Req.6 (para 37)	**NOTING** that objective b) from paragraph 34 above is a priority objective that must be met in a single direction (e.g. may be higher than B36%), and the performance metric is a measure of the range and variability in the relative spawning biomass, the MSAB **REQUESTED** that the performance metric for this objective be reported as a pass or fail, along with the actual numerical value.	**Completed** The probability that the coastwide relative spawning biomass is less than 36% is reported as pass/fail and an actual numerical value.
MSAB018–Req.7 (para 38)	The MSAB **REQUESTED** new performance metrics representing the change in the TCEY in non-assessment years and the change in TCEY in assessment years be developed for the evaluation of multi-year assessment MPs.	**In progress** Potential performance metrics will be presented at MSAB019.
MSAB018–Req.8 (para 46)	**NOTING** that some participants thought that a November MSAB informational session (ref. IPHC Rules of Procedure (2023), Rule 6, para. 15) may be useful if the Secretariat thought that there were important updates that the MSAB may need to be updated upon prior to the IPHC Interim Meeting, the MSAB **REQUESTED** that such a meeting be scheduled in November 2023	**Completed** An MSAB meeting in the fall of 2023 was not necessary.
MSAB018–Req.9 (para 47)	The MSAB **REQUESTED** that MSAB019 be held in May 2024, rather than October 2024, as previously noted by the Commission, and that future MSAB meetings occur prior to the June SRB meeting in that same year	**Completed** MSAB019 will be held 1-3 May 2024.

Outcomes of the 100th Session Of The IPHC Annual Meeting (AM100)

PREPARED BY: IPHC SECRETARIAT (A. HICKS, 20 MARCH 2024)

PURPOSE

To provide the MSAB with the outcomes of the 100th Session of the IPHC Annual Meeting (AM100) relevant to the mandate of the MSAB.

BACKGROUND

The agenda of the 100th Session of the IPHC Annual Meeting (AM100) included items relevant to the MSAB.

DISCUSSION

During the course of the 100th Session of the IPHC Annual Meeting (AM100) the Commission made one agreement regarding the MSE process. Relevant sections from the report of the meeting are provided in Appendix A for the MSAB's consideration.

RECOMMENDATION

That the MSAB:

1) **NOTE** paper IPHC-2024-MSAB0019-05 which details the outcomes of the 100th Session of the IPHC Annual Meeting (AM100) relevant to the mandate of the MSAB.

APPENDICES

Appendix A: Excerpts from the 100th Session of the IPHC Annual Meeting (AM100) Report (IPHC-2024-AM100-R).

APPENDIX A
Excerpt from the 100th Session of the IPHC Annual Meeting (AM100) Report (IPHC-2024-AM100-R)

RECOMMENDATIONS

Nil

REQUESTS

Nil

AGREEMENTS

IPHC Management Strategy Evaluation: update

AM100 (para. 53) The Commission **AGREED** to undertake intersessional discussions on the recommendations contained within paper IPHC-2024-AM100-11, and provide further direction to the IPHC Secretariat.

Updates to the Management Strategy Evaluation framework and a review of coastwide management procedures

PREPARED BY: IPHC SECRETARIAT (A. HICKS, I. STEWART; 28 MARCH 2024)

PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with an update of changes to the Management Strategy Evaluation (MSE) framework and additional evaluations performed since the 18th Session of the IPHC Management Strategy Advisory Board (MSAB018).

1 BACKGROUND

MSAB018 took place in May 2018 and made a number of requests outlined in IPHC-2023-MSAB018-R. The 22nd and 23rd sessions of the Scientific Review Board (SRB022 and SRB023) and the 99th Session of the IPHC Interim Meeting (IM099) made additional requests for the MSE and harvest strategy work. This document describes work using the MSE framework that has been completed related to some of those requests. The full actions arising from all MSE related requests are available in documents IPHC-2024-MSAB019-04 and IPHC-2024-MSAB019-05.

The IPHC interim harvest strategy policy consists of three components: coastwide scale (the management procedure, MP, determining the coastwide TCEY), TCEY distribution (part of the harvest strategy that distributes the TCEY among IPHC Regulatory Areas), and decision-making (which occurs at the Annual Meeting). An illustration of the harvest strategy policy is shown in Figure 1. Currently, there is no defined distribution procedure and the TCEY distribution is negotiated at the Annual Meeting. Distribution procedures are not currently being evaluated and the MSE process is focused on management procedures related to the coastwide scale. Therefore, distribution procedures are simulated with variability in the MSE simulations to represent this uncertainty in decision-making.

The Commission has endorsed four priority coastwide objectives with associated performance metrics and has recognized other objectives for the evaluation of MPs (Appendix A). These four objectives are listed below in priority order, meaning that if one is not met, subsequent ones need not be considered and the MP is not considered as an option.

a. Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point ($B_{20\%}$) at least 95% of the time.

b. Maintain the long-term coastwide female spawning stock biomass at or above a biomass threshold reference point ($B_{36\%}$) at least 50% of the time.

c. Optimise average coastwide TCEY.

d. Limit annual changes in the coastwide TCEY.

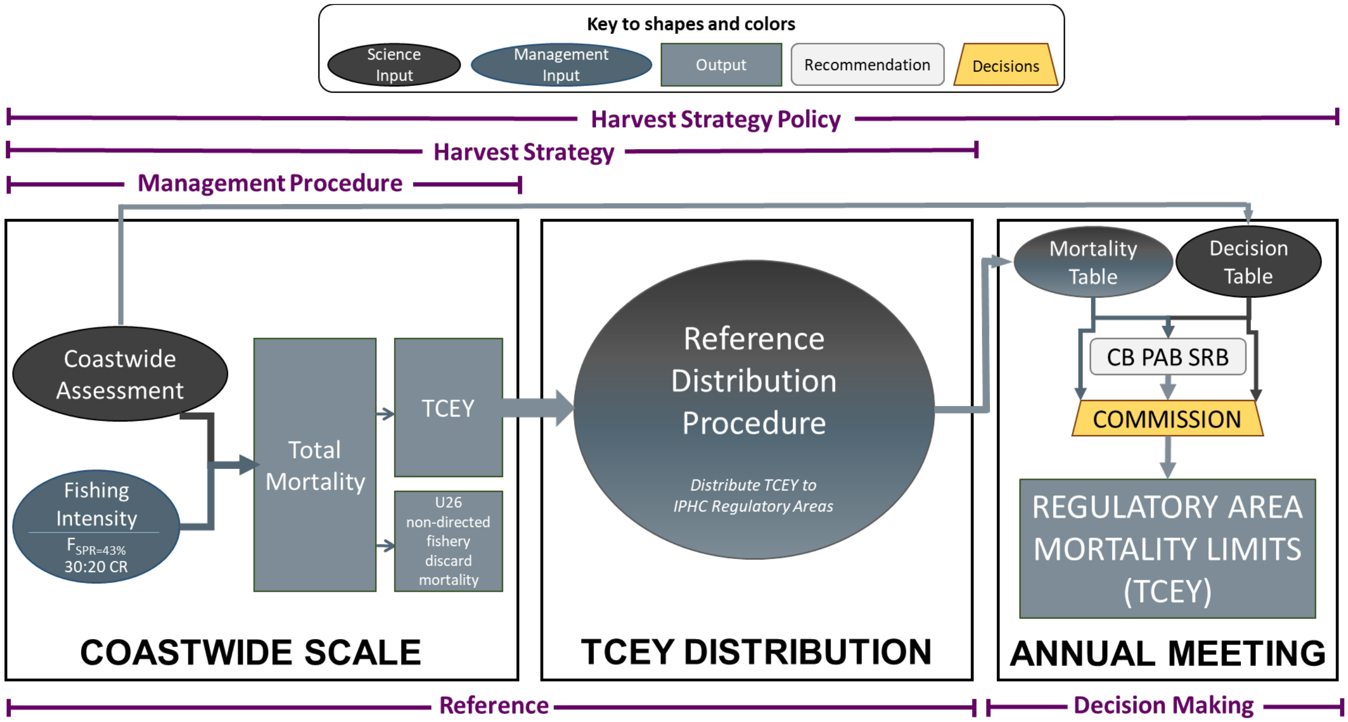

Figure 1. Illustration of the interim harvest strategy policy for the IPHC showing the coastwide scale (management procedure), the TCEY distribution (part of the harvest strategy), and the policy component that mainly occurs at the Annual Meeting.

2 UPDATED MSE OPERATING MODEL

The MSE operating model (OM) is spatially structured with movement of Pacific halibut occurring between Biological Regions (Figure 2). Multiple fishing sectors are modelled within IPHC Regulatory Areas including both landings and discard mortality. Fisheries are specified by IPHC Regulatory Area because many of the Commission objectives used to evaluate management procedures (MPs) are specific to Biological Regions and IPHC Regulatory Areas. Therefore, the simulated TCEY determined from a coastwide MP is distributed among IPHC Regulatory Areas and then sectors within IPHC Regulatory Areas. The OM incorporates four individual models and integrates them into an ensemble to account for structural uncertainty and differing hypotheses about recruitment and distribution.

The IPHC's MSE Operating Model was updated in 2023 to reflect the 2022 stock assessment ensemble and is performing well for evaluating management procedures. The Scientific Review Board (SRB) reviewed the IPHC's MSE Operating Model (OM) for 2023 at the 22nd Session of the SRB (SRB022) and the 23rd Session of the SRB (SRB023) and endorsed the 2023 OM. The SRB recommended updating the operating model following full stock assessments.

> **IPHC-2023-SRB022-R, para. 26:** *The SRB RECOMMENDED that reconditioning the operating model should be limited to situations where the stock assessment has changed significantly. This likely means a three-year schedule for reconditioning the operating model in the year following each full stock assessment.*

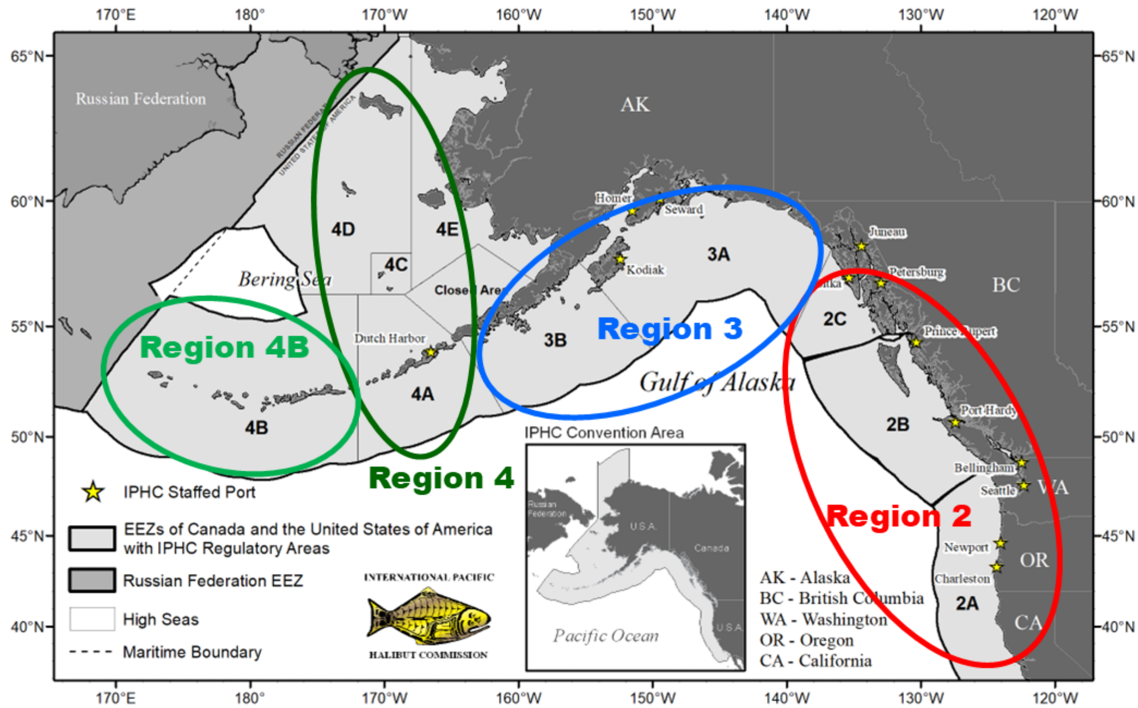

Figure 2. The IPHC convention area with Biological Regions and IPHC Regulatory Areas.

It is expected that this OM will be used until after the next full assessment is completed, but further improvements may be made, as needed or at the request of the Commission.

The estimated historical spawning biomass and projected spawning biomass with no fishing mortality and with fishing intensity equal to a spawning potential ratio (SPR) of 43% from the updated OM are shown in Figure 3. Individual trajectories of spawning biomass are also shown in Figure 3, which show similar increases and decreases with and without fishing. This is because weight-at-age and recruitment are large drivers of spawning biomass while fishing at a constant SPR has a large effect on the overall scale of spawning biomass.

The 2023 OM is consistent with the assumptions used in the 2022 assessment (i.e. three of the four models in the stock assessment ensemble estimated female natural mortality at values greater than 0.18), but includes a wider range of variability in key parameters than the tactical stock assessment. Long-term performance metrics related to spawning biomass and short-term performance metrics for the TCEY from simulations using the 2022 OM and the 2023 OM with the same specifications of an MP (SPR=43%) were similar (Table 1). The short-term median average TCEY was approximately 59 million pounds and the median average annual variability (AAV) for the TCEY changed from 18% to 17%. The probability of the long-term spawning biomass being less than 36% of unfished spawning biomass changed from 0.31 to 0.35. Even though the 2022 stock assessment showed a large increase in the TCEY based on SPR=43% when compared to 2021 stock assessment outputs, the MSE outputs are very similar due to the inclusion of additional uncertainty on natural mortality in both the 2022 and 2023 OMs. Therefore, the relative ranking of management procedures and other MSE results from the 2022 OM remain relevant.

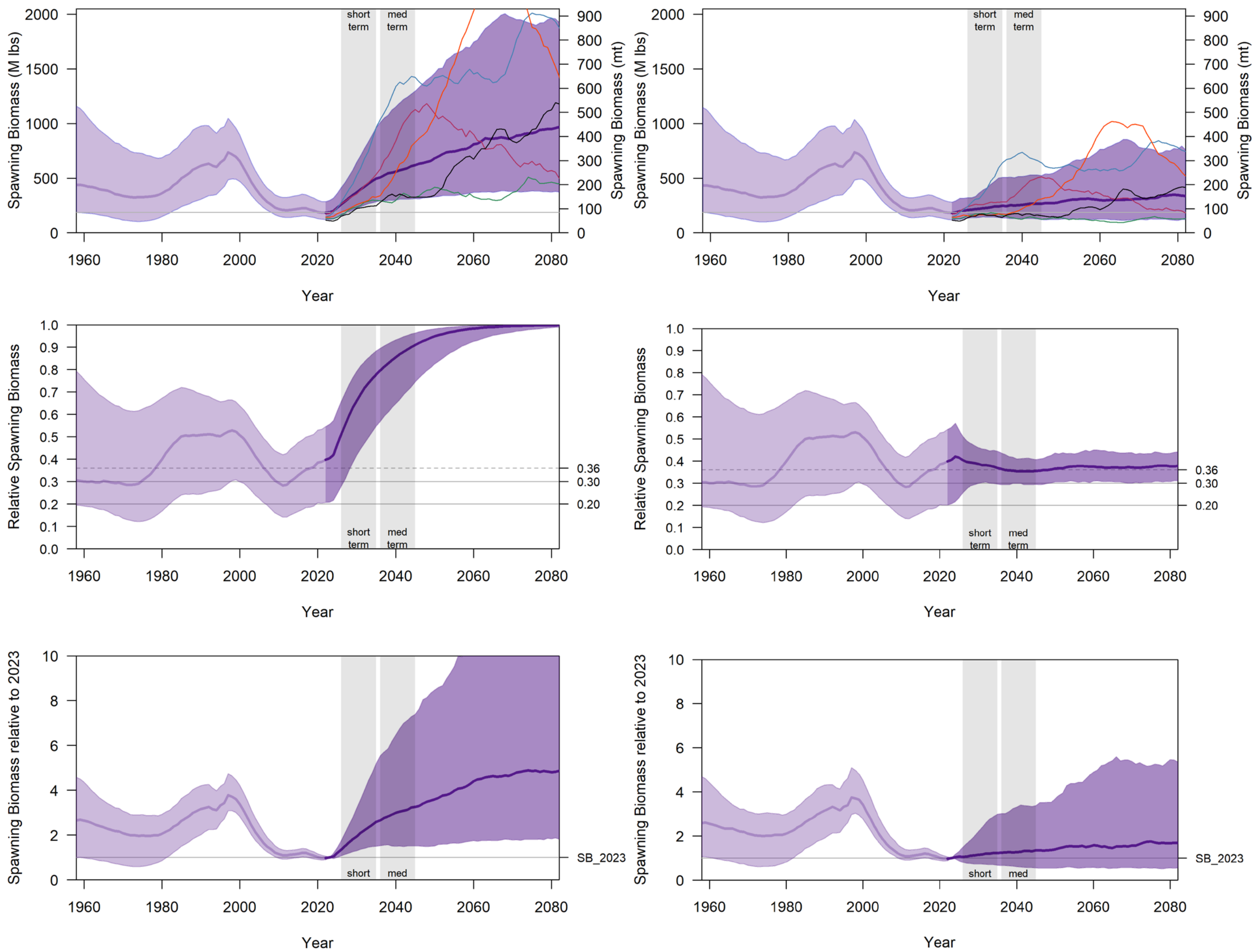

Figure 3. Simulated spawning biomass (top row), relative spawning biomass (middle row), and spawning biomass relative to the spawning biomass in 2023 (bottom row) assuming no fishing mortality (left column) and a fishing intensity equal to an SPR of 43% (right column). The median is shown by the thick dark line and the 5th and 95th percentiles are shown as the shaded polygon (the darker polygon indicates the projected time-period). Individual trajectories of spawning biomass are shown as small lines of different colors. Grey vertical panels indicate the short and medium time-periods used for calculating performance metrics.

Table 1. Performance metrics for the same management procedure simulated with similar assumptions using the 2022 OM and the 2023 OM. The MP uses an SPR=43%, a 30:20 control rule, and an annual assessment.

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

One difference between the two OMs is a performance metric related to the 2023 estimate of spawning biomass. In the 2023 OM there is a higher chance that the spawning biomass in 4 to 13 years (short-term) will be less than the 2023 spawning biomass. This is due to the additional data informing the spawning biomass trajectory in recent years.

Specific details of the 2023 OM are available on the IPHC MSE Research Website in the document "Technical Details of the IPHC MSE Framework" (IPHC-2023-MSE-02).

3 MANAGEMENT PROCEDURES (MPS)

The MSAB018 made a request to investigate various elements of management procedures related to coastwide scale and distribution of the TCEY.

> **IPHC-2023-MSAB018-R, para. 29**. *The MSAB REQUESTED that subsequent to an agreement on a distribution procedure by the Commission, the evaluation of annual and multi-year assessments include, but not limited to, the following concepts.*
>
> a) *Annual changes in the TCEY driven by FISS observations in non-assessment years of a multi-year MP;*
> b) *A constraint on the coastwide TCEY to reduce inter-annual variability and the potential for large changes in assessment years of a multi-year. This may be a 10% or 15% constraint, a slow-up fast-down approach, or similar approach;*
> c) *A smoothing element in the distribution procedure to account for uncertainty in the estimates of stock distribution and reduce the variability in area-specific TCEYs. For example, this may include a 3-year rolling average of stock distribution estimates;*
> d) *SPR values ranging from 30% to 56% and alternate trigger reference points in the harvest control rule.*

3.1 Assessment frequency and an empirical management procedure

The frequency of conducting the stock assessment is a priority element of the MP to be investigated (see IPHC-2023-MSAB018-R, para. 29 above). This includes conducting assessments annually (every year), biennially (every 2nd year), or triennially (every third year) to determine the status of the Pacific halibut stock and the coastwide TCEY for that year. In years with no assessment, the coastwide TCEY would be determined using a simpler approach and the estimated status of the stock would not be available. Costs and benefits of a reduced assessment frequency were considered at AM099 in document IPHC-2023-AM099-13 and those pertinent to the coastwide TCEY are repeated here.

Costs include the following.

a) Detailed management information is not available every year (e.g. stock status).
b) The TCEY in non-assessment years may not follow stock trends (without an empirical rule on coastwide TCEY).
c) Previous simulations showed a potential small loss in yield when using a constant coastwide TCEY across non-assessment years.

d) Previous simulations showed a higher chance of a smaller stock size.

Benefits include the following.

e) Reduced interannual variability of the coastwide TCEY.

f) Multi-year stability and short-term predictability of the TCEY.

g) Use of the annual FISS index in a transparent process to determine the TCEY in non-assessment years.

h) More focused assessment research.

i) Potential for additional time to collaborate on research supporting the stock assessment within the Secretariat.

j) A triennial assessment frequency would be consistent with the current assessment cycle of update and full assessments.

k) The reduced assessment frequency and use of empirical data approach has precedent at other fisheries commissions.

The mortality limits in a year with a stock assessment can be determined as specified by previous defined MPs (i.e. SPR-based approach). In years without a stock assessment, the mortality limits would need an alternative approach. This may be as simple as setting a constant multi-year TCEY until the next assessment was completed or using empirical observations (e.g. FISS modelled output) to adjust the coastwide TCEY in non-assessment years. There are many different empirical rules that could be applied to determine the coastwide TCEY in non-assessment years and two have been identified for evaluation.

a. The same coastwide TCEY from the previous year until a stock assessment is available.

b. Update the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE.

Alternative approaches could be based entirely on the MSE; these would not require the current stock assessment for setting mortality limits in any year, and would use a simpler estimation model that is tuned to achieve the performance desired (i.e. meet primary objectives) or an empirical-based MP as the method for setting annual mortality limits in every year. The stock assessment would be used at a defined interval to verify that management is effective, determine status of the stock, and to potentially tune the MSE OM and existing MP (Cox and Kronlund 2008). This concept was a request of the SRB in 2022:

> **IPHC-2022-SRB020-R, para 20** *The SRB REQUESTED that the MSE not attempt to implement a Stock Synthesis estimation procedure as part of the management procedure and, instead, to integrate a simpler assessment modelling approach into the management procedure via tuning.*

This method is used in other fisheries with well-developed MSE analyses and has the benefit of being relatively simple and not requiring an extensive limit-setting process: the annual MP results from the MSE are applied each year and the process is periodically reviewed. This approach has not yet been evaluated for Pacific halibut and regular occurring stock assessments are assumed to continue in the near future for setting the coastwide TCEY.

3.1.1 Retrospective analysis of an empirical rule

The MSAB018 requested a retrospective analysis of an empirical rule to examine the coastwide TCEYs that would have resulted in the past.

> **IPHC-2023-MSAB018-R, para. 33**: *The MSAB REQUESTED a retrospective analysis of an empirical rule that adjusts the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE to compare the coastwide TCEY determined from the assessment to the TCEY determined empirically*.

This retrospective analysis can only be interpreted for each specific year alone because the FISS O32 WPUE would have been different if a different fishing mortality occurred. Therefore, this analysis looks at the empirical coastwide TCEY given what actually occurred in the previous years. The results are on a year-to-year basis and do not represent a forward simulation from a past year.

The coastwide TCEY for year (*y*+1) was determined using the proportional change in the FISS O32 WPUE from year (*y*-1) to year (*y*). In other words, the coastwide TCEY for next year is determined using the recent year coastwide TCEY multiplied by the proportional change in the FISS O32 WPUE from last year to this year. This offset of years occurs because next year's FISS results are available after the fishery occurs.

$$TCEY_{y+1} = TCEY_y \times \frac{WPUE_{O32,y}}{WPUE_{O32,y-1}}$$

A space-time model has been used to estimate the FISS O32 WPUE since 2016. Therefore, the empirical coastwide TCEY can only be determined for 2017 onwards. Estimates of the O32 WPUE are available for years prior to 2016 from the 2016 space-time model, but those estimates are inconsistent with the estimates that would have been available in those prior years without using observations beyond that year in the space-time model. Further, the historical expansion of the FISS design continued through 2019; during this period the understanding of the full stock distribution and abundance in historically unsampled areas was rapidly evolving.

Figure 4 shows the actual adopted TCEYs since 2017 compared to the theoretical empirical TCEY for those same years. The empirical TCEY was similar to the adopted TCEY, but more often slightly below than the adopted TCEY. Because this is not a replay of the time-series with the empirical TCEYs, two or more years of empirical TCEYs cannot be compared. For example, the 2024 empirical TCEY is greater than the 2023 empirical TCEY even though the FISS O32 WPUE decreased slightly. This is because the 2024 empirical TCEY is based on the 2023 adopted TCEY since the population dynamics (and FISS observations) are dependent on the actual fishery removals.

The MSAB018 also requested that new performance metrics be developed for evaluating assessment frequency.

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

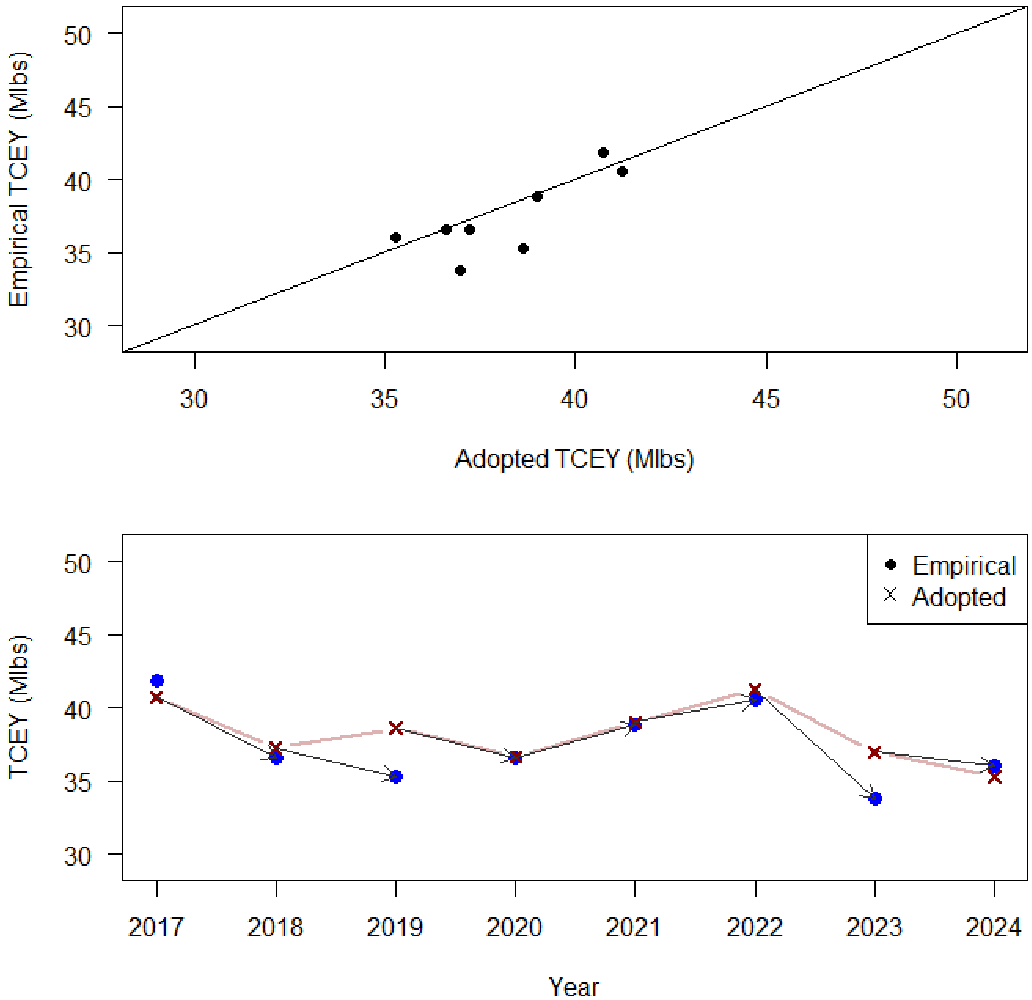

Figure 4. Two comparisons of adopted TCEYs and empirically determined TCEYs for each specific year. The top plot compares the empirical TCEY directly to the actual adopted TCEY. The bottom plot shows the time-series of the adopted and empirical TCEYs, noting that the empirical TCEYs are not a replay from 2017, but are a comparison to the adopted TCEY for each individual year. Arrows shows that the empirical TCEY is based on the previous year's adopted TCEY.

Current performance metrics for the interannual variability in the TCEY include the average annual variation (AAV) and the probability that 3 or more years of a 10-year period have a change in the TCEY greater than 15% from one year to the next. Neither of these metrics measure the potential change every second or third year when using biennial or triennial assessments. This is especially important if the TCEY is held constant during non-assessment years. The current performance metrics, averaged over a 10-year period, regardless of the assessment frequency, are still useful and simply represent the variability over that 10-year period, but an indication of the change in the TCEY when an assessment occurs and when using an empirical rule may be useful when evaluating management procedures.

It is important to consider the objective when developing performance metrics, and sometimes multiple performance metrics may be useful to the evaluation. One consideration here is whether a stable 2-year period with a larger biennial or triennial change is preferable to possibly smaller annual changes in the TCEY. Additional separate metrics are useful to indicate the changes in assessment years and non-assessment years, but if they are not pertinent to the objectives, they can become confusing and superfluous.

3.2 Fishing intensity

The fishing intensity is determined by finding the fishing rate (*F*) that would result in a defined spawning potential ratio (F_{SPR}). Because the fishing rate changes depending on the stock demographics and the distribution of catch across fishery sectors, SPR is a better indicator of fishing intensity and its effect on the stock than *F*. A range of SPR values (interim reference SPR is currently 43%) and possibly alternative trigger reference points (currently 30%) in the harvest control rule may be investigated. This was also recommended by the MSAB (see IPHC-2023-MSAB018-R, para. 29 above). Evaluation of a range of fishing intensities is a high priority and some results are shown in Section 5.2.

3.3 Constraints on the coastwide TCEY

One of the priority objectives (Appendix A) is to limit annual changes in the coastwide TCEY. Due to variability in many different processes (e.g. population, estimation, and decision making) the interannual variability of the TCEY from MSE simulations is typically higher than 15%. Over the past ten years (2015–2024), the interannual variability (average annual variability or AAV) in the adopted coastwide TCEY was 5.4% and the AAV of the reference coastwide TCEY was 14.5%. The percent change in the adopted coastwide TCEY ranged from -10% to 8% across years, and ranged from -21% to 29% for the coastwide reference TCEY across years (Table 2).

Decision-making since 2015 has reduced the interannual variability in the coastwide TCEY, compared to the reference, over the last ten years. The adopted TCEYs have a smaller range than the reference TCEYs and tend to cluster around 39 million pounds (Figure 5). The adopted TCEYs also tend to be closer to the status quo (i.e. the TCEY from the previous year) than the reference TCEYs when the reference TCEY difference from status quo was not near zero (Table 2 & Figure 5). This is akin to saying the change from one year to the next is less for the adopted TCEYs than the reference TCEYs. The spawning biomass has been relatively stable during the last ten years, and it is not known how the recent decision-making process would react to a rapidly increasing or decreasing spawning biomass.

This interannual variability in the coastwide reference TCEY can be reduced by adding a constraint in the MP, mimicking the recent decision-making process. The MSAB has suggested many different constraints including a 15% constraint on the change in the coastwide TCEY from one year to the next, and a slow-up/fast-down approach. The MSAB has requested further investigating constraints on the coastwide TCEY (see IPHC-2023-MSAB018-R, para. 29 above). Evaluating constraints on the coastwide TCEY is a secondary priority.

Table 2. Percent change in the adopted TCEY from the previous year (2015–2024) for each IPHC Regulatory Area and coastwide, and for the coastwide reference TCEY determined from the interim management procedure in place for that year.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Coastwide Adopted	Coastwide Reference
2015	-4.5%	3.5%	13.3%	7.9%	-0.3%	25.6%	2.7%	19.3%	8.1%	6.0%
2016	18.9%	4.2%	5.5%	-1.9%	-8.3%	-0.5%	-10.5%	-4.7%	-0.1%	2.3%
2017	16.7%	1.0%	7.6%	1.6%	16.7%	-7.7%	-2.2%	-5.7%	2.9%	7.7%
2018	-10.2%	-14.7%	-9.9%	-3.2%	-17.8%	-3.3%	-4.5%	-5.7%	-8.7%	-20.7%
2019	25.0%	-3.8%	0.0%	7.7%	-11.3%	11.5%	13.3%	10.5%	3.8%	29.0%
2020	0.0%	0.0%	-7.7%	-9.6%	7.6%	-9.8%	-9.7%	-2.5%	-5.2%	-20.3%
2021	0.0%	2.5%	-0.9%	14.8%	0.0%	17.1%	6.9%	2.1%	6.6%	22.3%
2022	0.0%	8.0%	1.9%	3.9%	25.0%	2.4%	3.6%	3.0%	5.7%	5.7%
2023	0.0%	-10.3%	-1.0%	-17.0%	-5.9%	-17.6%	-6.2%	-6.1%	-10.3%	26.0%
2024	0.0%	-4.6%	-1.0%	-6.0%	-6.0%	-6.9%	-8.1%	-3.9%	-4.6%	-5.9%

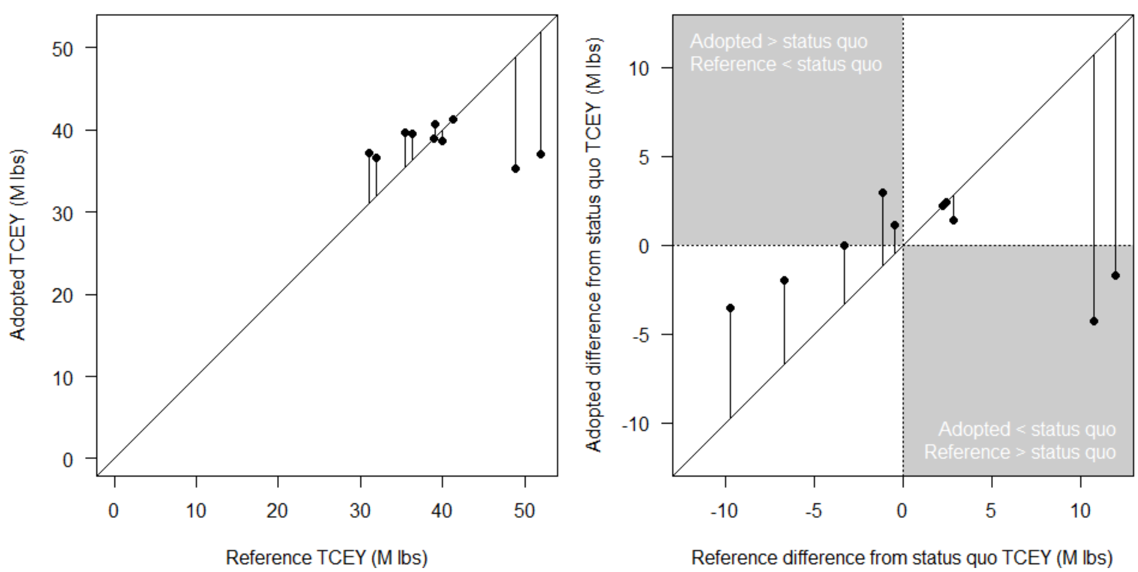

Figure 5. The adopted TCEY vs the reference TCEY (left) and the adopted difference from the status quo TCEY vs the reference difference from the status quo TCEY (right) for the last ten years (2015–2024). The 1:1 line shows when the two are equal. The grey quadrants in the right plot show when the adopted and reference TCEY differences from the status quo are opposite.

4 Exceptional Circumstances

An exceptional circumstance is an event that is beyond the expected range of the MSE evaluation and triggers specific actions that should be taken to re-examine the harvest strategy. Exceptional circumstances, and actions taken if one or more is met, define a process for deviating from an adopted harvest strategy (de Moor et al. 2022). It is important to ensure that the adopted harvest strategy is retained unless there are clear indications that the MSE may not be accurate. The IPHC interim harvest strategy policy (Figure 1) has a decision-making step after the MP, thus the Commission may deviate from an adopted MP as part of the harvest strategy policy. This decision-making variability is included in the MSE simulations.

Defining exceptional circumstances involves defining events that would lead to re-examination of the MSE process to determine if an update to the framework and evaluation of management procedures is necessary. The SRB provided clarity at SRB021 of what an exceptional circumstance is relative to the IPHC process.

> **IPHC-2022-SRB021-R, para 60:** *The SRB **RECOMMENDED** that Exceptional Circumstances be defined to determine whether monitoring information has potentially departed from their expected distributions generated by the MSE. Declaration of Exceptional Circumstances may warrant re-opening and revising the operating models and testing procedures used to justify a particular management procedure.*

This statement indicates that exceptional circumstances should be defined using observations rather than model outputs and should be compared to the distribution generated by the MSE simulations. If the observation(s) are outside of that range, revising the MSE framework and conducting additional simulations should be considered. It is important to have clear definitions for when the agreed upon MP should be re-evaluated.

An exceptional circumstance, in an MSE context, is not usually defined to trigger an action within the management procedure. An example of a trigger within the MP is the 30:20 control rule which defines a reduction in the fishing intensity when stock status is less than 30%.

> **IPHC-2023-AM099-R, para. 88:** ***NOTING*** *paragraph 60 from the 21st Session of the SRB (SRB021), the Commission **REQUESTED** the Secretariat develop a description of options to responding to exceptional circumstances that would trigger a stock assessment in nonassessment years and additional MSE analyses.*

The Secretariat, with the assistance of the SRB and MSAB, is defining exceptional circumstances and the response that would be initiated, as well as potential triggers in a management procedure that would result in a stock assessment being done (if time allows) in a year that would normally not have one scheduled (e.g. in multi-year MPs). For example, an exceptional circumstance would trigger a review of the MSE simulations to determine if the OM can be improved and MPs should be re-evaluated. If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE. Additionally, the SRB recommended to define a threshold for persistent deviation such that an exceptional circumstance is really an exception rather than a one-year outlier.

> **IPHC-2023-SRB022-R, para 28:** *The SRB **RECOMMENDED** that exceptional circumstance (i) be evaluated annually based on comparisons between the simulation distribution (e.g. a 95% interval) of FISS values from MSE simulations to the realized FISS estimates; and (ii) be clearly distinguished from "unusual conditions". For example, exceptional circumstances should have a high threshold for persistent (i.e. more than a single year) deviation from MSE simulations.*

> **IPHC-2023-SRB022-R (para. 29).** *The SRB **RECOMMENDED** that an initial response to a suspected "exceptional circumstance" should include presentation at the next SRB meeting to establish whether the situation meets the definition of an "exceptional circumstance" and to formulate a response.*

Working with the SRB, the following potential triggers for an exceptional circumstance have been defined.

> **IPHC-2023-SRB023-R, para. 27:** ***RECOGNIZING*** *the spatial variability of environmental factors that influence population dynamics, the SRB **RECOMMENDED** that an exceptional circumstance be defined based on regional as well as stockwide deviations from expectations. For example, an exceptional circumstance could be declared if any of the following are met:*
>
> *a) The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.*
>
> *b) The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.*
>
> *c) Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations*.

Furthermore, the following actions may take place if an exceptional circumstance is declared.

> **IPHC-2023-SRB023-R, para. 28:** *The SRB **RECOMMENDED** that if an exceptional circumstance occurred the following actions would take place:*
>
> *a) A review of the MSE simulations to determine if the OM can be improved and MPs should be reevaluated.*
>
> *b) If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.*
>
> *c) Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM.*
>
> *d) Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.*

If there are other concerns that are not exceptional, i.e. an unexpected event, a stock assessment could be initiated without declaring an exceptional circumstance. However, the time available to prepare, conduct, and review a stock assessment must be taken into account.

> **IPHC-2023-MSAB018-R, para. 32:** *The MSAB NOTED that there are logistical considerations (e.g. data availability, time to fit models) when an assessment is desired in a non-assessment year, especially if a request for an assessment is made between the time the FISS results are available and the Annual Meeting*

The FISS coastwide modelled NPUE was compared to projections from the 2023 OM to determine if an exceptional circumstance has occurred (Figure 6). The current interim reference fishing intensity associated with an SPR of 43% was used because that is the current interim MP and includes decision-making variability to account for departing from that fishing intensity. The 2023 observation from the FISS space-time model is within the 95% prediction interval from the OM, thus an exceptional circumstance has not occurred.

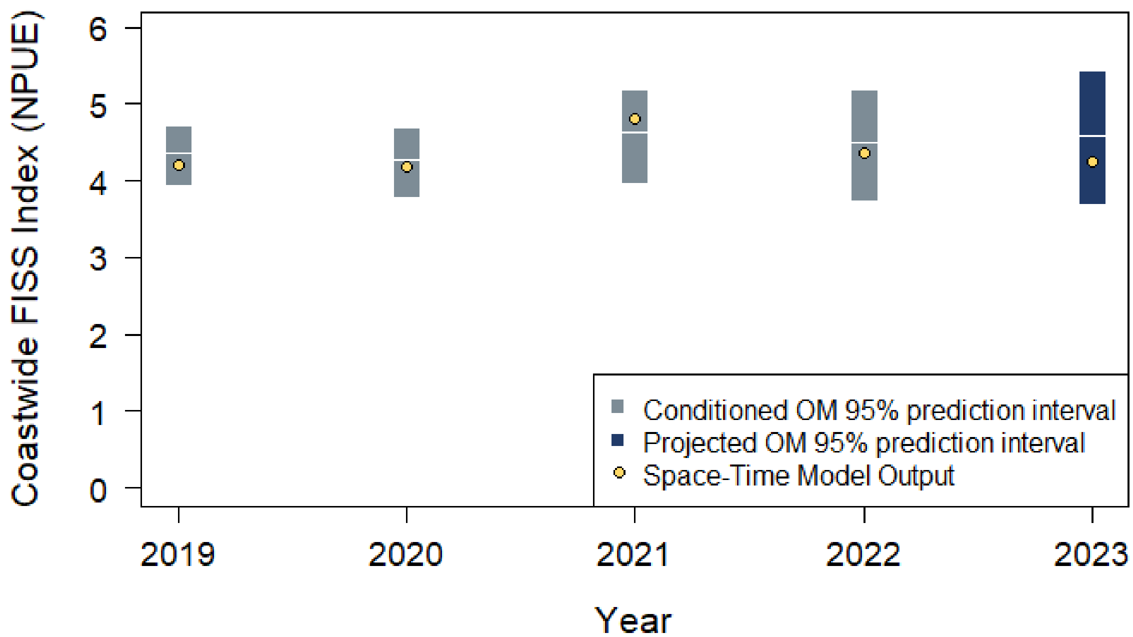

Figure 6. Prediction interval from the 2023 OM projected to 2023 using an SPR of 43, decision-making variability, estimation error, and observation error plotted along with the FISS all-sizes NPUE index from the space-time model (yellow dot). The dark blue box is the 95% prediction interval for all-sizes NPUE from the projected 2023 OM.

5 ADDITIONAL SIMULATIONS SINCE MSAB018

Additional MSE simulations have been conducted since MSAB018 investigating the effects of the environment. Preliminary results for the MP elements described above have been added to the MSE Explorer website and additional results will be added as they become available. Past MSE Explorer websites are available at http://iphcapps.westus2.cloudapp.azure.com/.

5.1 Examining the effect of the environment

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.

The median relative spawning biomass (RSB) when fishing at an SPR equal to 43% was similar for the high and low PDO scenarios (Table 3). However, even though the median was near 38%, there was a higher probability that the RSB was less than 36% for the low PDO scenario. The long-term median TCEY was 22% less for the low PDO scenario and 26% more for the high PDO scenario when compared to the median TCEY for the base simulations that modelled cyclical PDO regime shifts. The median average TCEY for a persistent high PDO was 1.6 times greater than the TCEY for a persistent low PDO. Inter-annual variability in the TCEY was the same for the persistent low and high PDO scenarios, but less than the AAV when PDO regime shifts were modelled because the changing PDO adds additional variability. There were important differences in the variability of the TCEY in each region. Specifically, the TCEY more than doubled (212%) in Biological Region 3 from the low PDO to high PDO, but differences were much smaller in other regions (111% in Biological Region 2, 142% in Biological Region 4 and 118% in Biological Region 4B).

Table 3. Performance metrics related to primary objectives for scenarios with modeled cycles of PDO (both), always low PDO (Low), and always high PDO (High) with an annual assessment, 32-inch size-limit, no decision-making variability, no estimation error, no observation error, and an SPR of 43%. Long-term results are only shown for all performance metrics.

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

The percentage of spawning biomass in each Biological Region is affected by fishing under an SPR-based management procedure (Figure 7). The distribution of spawning biomass across the Biological Regions is also affected by the PDO regime because movement, recruitment distribution, and average recruitment are dependent on the PDO regime. Region 2 shows a reduction in the percentage of spawning biomass with fishing, and the low PDO scenario results in a higher percentage than the persistent high PDO scenario. Region 3 shows a similar percentage of spawning biomass with fishing and a higher percentage of spawning biomass with a high PDO. Region 4 shows a higher percentage of spawning biomass with fishing and is largely unaffected by the PDO regime. Region 4B has a higher percentage of spawning biomass with fishing and a higher spawning biomass for the low PDO scenario.

A range of fishing intensities from SPR=40% to SPR=46% were simulated to determine the response to low or high fishing intensities (Table 4 and Figure 8). The range of fishing intensity had a much smaller effect that the PDO. The percentage of spawning biomass in Biological Region 3 was mostly unresponsive to fishing intensity and the TCEY change was of a similar magnitude to SPR=43%..

Even though we cannot "manage" the PDO regime, it is useful to understand the effects of the PDO regime on the results, allowing for the separation of the effects of fishing from the effects of the environment. For Pacific halibut, the environment sometimes may have a larger effect on the distribution of spawning biomass than fishing does (at a range SPR values from 40% to 46%). These results are dependent upon the full harvest strategy, and different distribution procedures would likely produce different outcomes.

The MSAB018 requested the development of outreach materials related to the results investigating environmental influences and effects of fishing on management outcomes.

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

A poster was presented at AM100 and is available as document IPHC-2024-MSAB019-INF01.

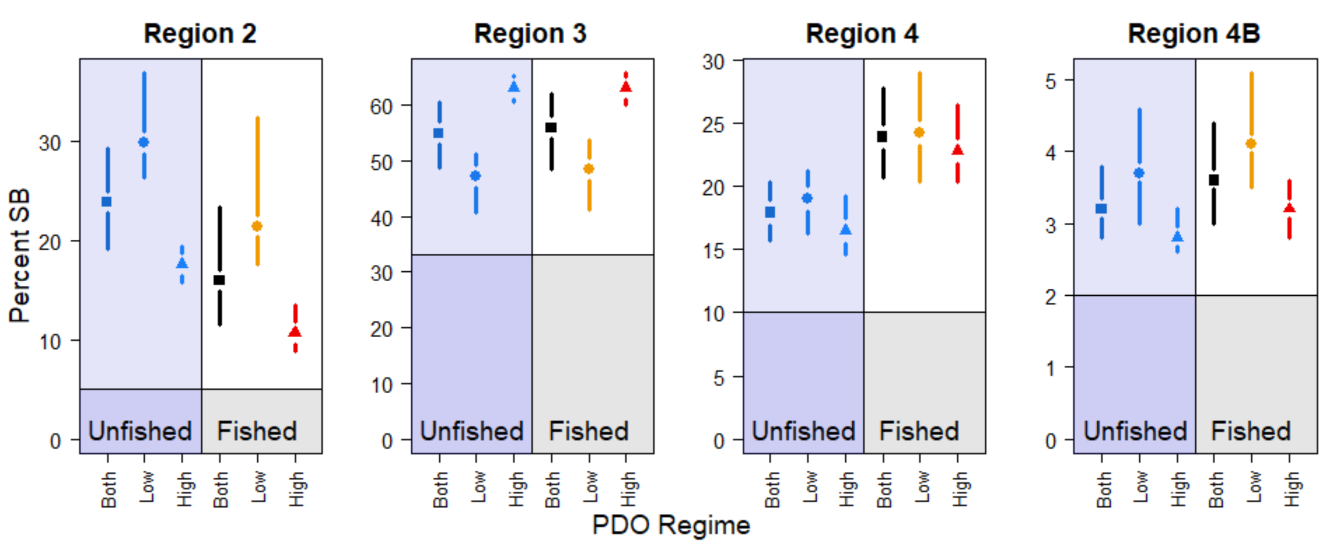

Figure 7. Percentage of spawning biomass in each Biological Region when fished with an SPR of 43% (no estimation error, no observation error, and no implementation error) and when not fished. The PDO is modelled with cyclical low and high periods in "Both", is persistently low in "Low", and is persistently high in "High". The darker shaded area indicates the area below the threshold in the spatial conservation objective (Appendix A).

Table 4. Performance metrics related to primary objectives for scenarios with modeled cycles of PDO (both), always low PDO (Low), and always high PDO (High) with an annual assessment, 32-inch size-limit, no decision-making variability, no estimation error, and no observation error, and SPR values equal to 40% and 46%. Long-term results only are shown for all performance metrics.

	PDO **SPR**	**Both** **0.40**	**Low** **0.40**	**High** **0.40**	**Both** **0.46**	**Low** **0.46**	**High** **0.46**
Long-term metrics	Median RSB	35.7%	34.5%	36.0%	42.0%	40.9%	42.4%
	P(RSB<20%)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	P(RSB<36%)	0.569	0.676	0.501	0.053	0.102	0.024
	Median TCEY (Mlbs)	68.3	53.7	86.8	62.7	49.0	79.0
	Median AAV TCEY	5.3%	4.9%	4.7%	5.1%	4.4%	4.4%
	Median TCEY Region 2 (Mlbs)	21.1	19.6	22.0	19.7	18.4	20.4
	Median TCEY Region 3 (Mlbs)	35.3	24.1	51.0	32.0	22.0	46.5
	Median TCEY Region 4 (Mlbs)	8.6	6.9	9.9	7.7	6.2	8.8
	Median TCEY Region 4B (Mlbs)	2.5	2.3	2.8	2.3	2.1	2.5

5.2 Investigating fishing intensity

Using the 2023 OM, fishing intensity was evaluated using SPR values from 34% to 56% assuming an annual assessment and decision making variability, along with estimation error and observation error that would likely result from rationalized FISS surveys. Performance metrics associated with primary objectives and a performance metric for the probability that the biomass in that time-period will be less than the 2023 spawning biomass are shown in Table 5. Stock assessment frequencies other than annual were not simulated.

All fishing intensities pass the conservation objective to maintain the relative spawning biomass (RSB) above 20% with a probability greater than 95%, which occurs because the 30:20 control rule reduces fishing intensity at RSB less than 30%. As expected, with increasing fishing intensity (decreasing SPR) the long-term RSB has a higher probability of being less than 36% and would be above and below 36% an equal amount of time near an SPR value of 39%. The median short-term TCEY ranged from 44.8 Mlbs to 67.9 Mlbs and the median AAV ranged from 14.7% to 25.7%. An SPR of 52% resulted in a median AAV equal to 15%.

It is often useful to consider performance metrics not associated with the priority objectives. One metric reported in Table 5 is the probability that the biomass in the future (long-term and short-term presented) is less than the spawning biomass in 2023. In the long-term, there is a 1 in 10 chance that the spawning biomass is less than that in 2023 when fishing at a low fishing intensity of SPR=56%. At an SPR of 43% (the current interim reference fishing intensity) the chance is 1 in 5, in the long-term. The short-term shows slightly higher chances because recent recruitment has been low, which will continue to influence the stock size as these low recruitments move through the population age structure.

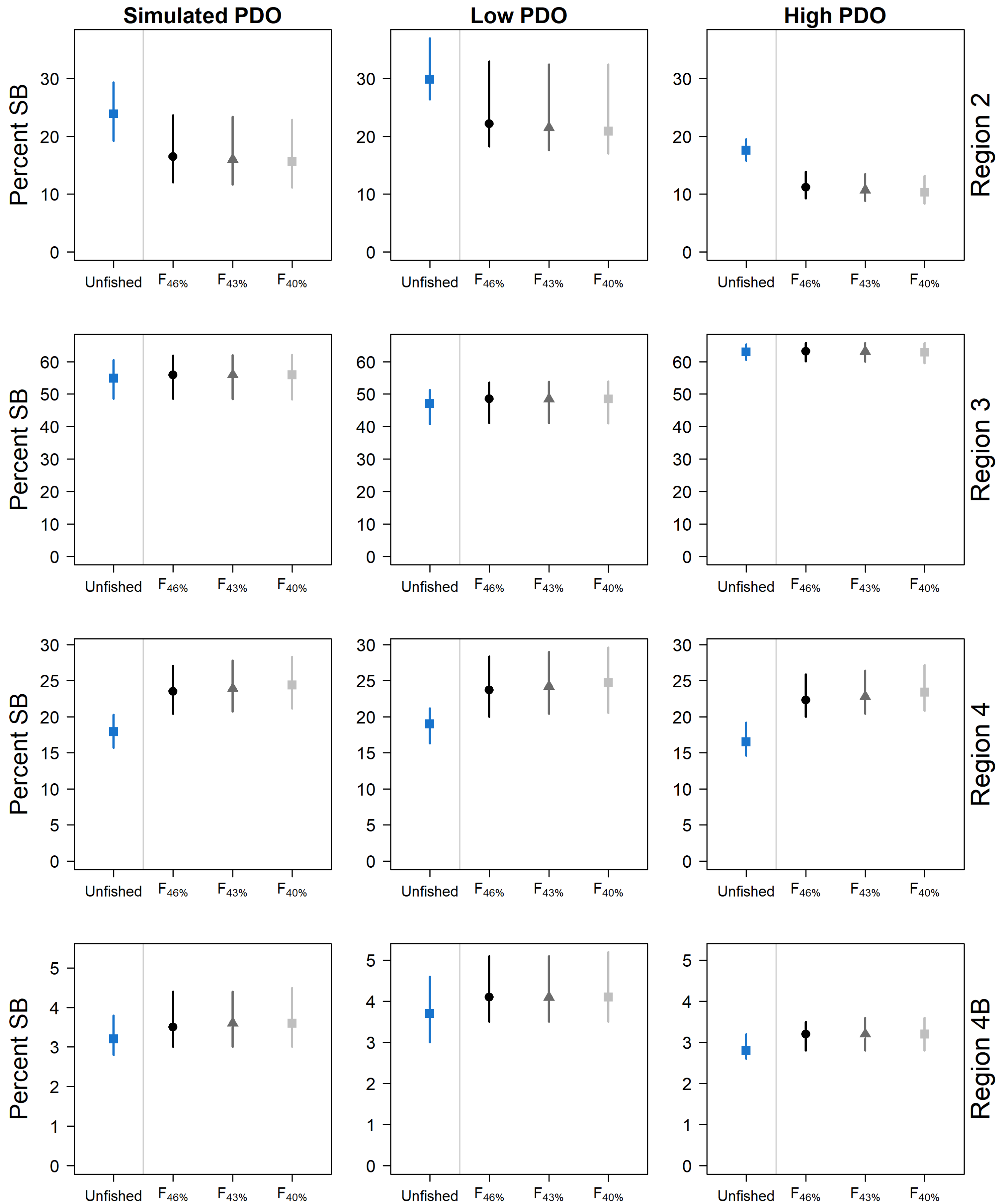

Figure 8. Percent biomass in each Region (rows) for simulated PDO (both low and high regimes), low PDO, and high PDO (columns) at different levels of fishing intensity.

Table 5. Performance metrics related to primary objectives for MSE simulations using different SPR values (i.e. fishing intensity, FI) assuming an annual assessment and decision making variability, along with estimation error and observation error that would likely result from rationalized FISS surveys.

		High Fishing intensity				**SPR**					Low Fishing intensity
Term	**Performance Metric**	**34**	**38**	**40**	**42**	**43**	**44**	**46**	**48**	**52**	**56**
Long	P(RSB<20%)	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
	P(RSB<36%)	0.74	0.55	0.46	0.37	0.35	0.31	0.26	0.22	0.17	0.15
Short	Median TCEY	67.9	64.5	62.6	60.4	59.2	58.0	55.7	53.4	49.0	44.8
	Median AAV TCEY	25.7%	20.5%	18.9%	17.5%	17.0%	16.6%	16.0%	15.6%	15.0%	14.7%
Long	P(B<B_{2023})	0.26	0.23	0.22	0.21	0.20	0.19	0.17	0.16	0.12	0.10
Short	P(B<B_{2023})	0.45	0.38	0.34	0.31	0.29	0.28	0.24	0.20	0.15	0.12

Overall, there are trade-offs between amount of yield, variability in yield, and stock size (Figure 9). Yield increases with increasing fishing intensity (lower SPR), but at higher fishing intensities (SPR values less than approximately 40%) the yield relationship begins to show a decreasing slope because the 30:20 control rule is effectively reducing fishing intensity. The control rule decreases the effective fishing intensity and increases the variability in yield. This increase in the interannual variability of yield can be seen with the curvature in the AAV vs yield curve, and the AAV is greater than 19% at SPR values less than 40%. The probability that the RSB is less than 36% increases in a similar non-linear manner as the variability relationship with yield, with a rapid increase in the probability of lower stock size at higher fishing intensity. Interestingly, over the range of fishing intensities examined, the probability that the long-term spawning biomass would be less than the 2023 spawning biomass increases linearly with increasing fishing intensity or yield. In summary, as yield decreases the stock size is larger and variability in yield is smaller, but there are non-linear trends that are important to understand.

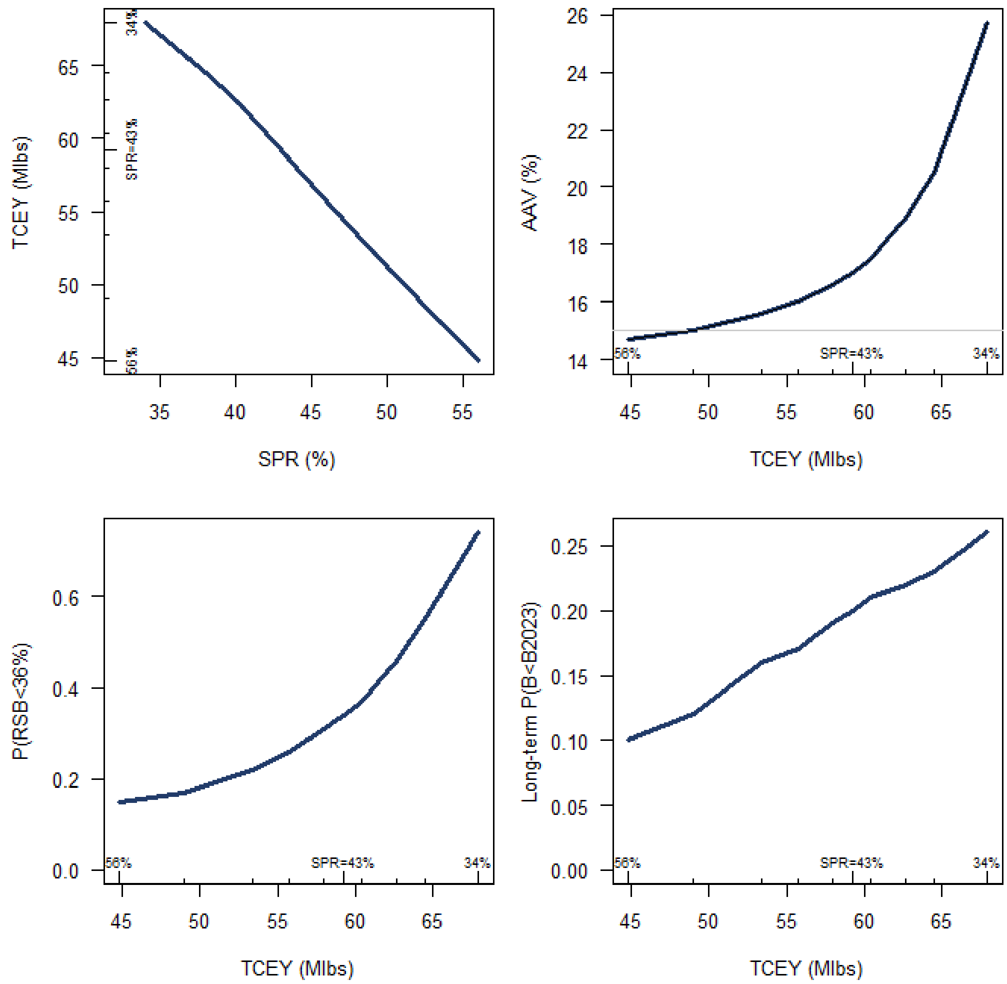

Figure 9. Relationships between TCEY, AAV, and stock size using various performance metrics. Corresponding SPR values are shown along the same axis that the TCEY is plotted.

RECOMMENDATION/S

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

REFERENCES

Cox, S. P. and Kronlund, A. R. 2008. Practical stakeholder-driven harvest policies for groundfish fisheries in British Columbia, Canada. Fisheries Research 94(3): 224-237.

de Moor, C.L., Butterworth, D., and Johnston, S. 2022. Learning from three decades of Management Strategy Evaluation in South Africa. ICES Journal of Marine Science 79: 1843-1852.

APPENDICES

Appendix A: Primary objectives used by the Commission for the MSE

Appendix A
Primary objectives used by the Commission for the MSE

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

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
1.1. Keep female spawning biomass above a limit to avoid critical stock sizes and conserve spatial population structure	Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point ($B_{20\%}$) at least 95% of the time	*B* < Spawning Biomass Limit (B_{Lim}) B_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(B < B_{Lim})$ PASS/FAIL Fail if greater than 0.05
	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 spawning stock biomass at or above a biomass reference point ($B_{36\%}$) 50% or more of the time	*B*<Spawning Biomass Reference (B_{Thresh}) B_{Thresh}=$B_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(B < B_{Thresh})$ Fail if greater than 0.5
2.2. Provide Directed Fishing Yield	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		*Median* $\overline{TCEY}$
	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

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

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

Considerations for the Management Strategy Evaluation Program of Work for 2023–2025

PREPARED BY: IPHC SECRETARIAT (A. HICKS, I. STEWART; 28 MARCH 2024)

PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with potential topics to consider adding to an MSE program of work in 2024.

1 BACKGROUND

Work from the Management Strategy Evaluation (MSE) Program of Work for 2023–2025 that has been completed is reported in documents IPHC-2024-MSAB019-06 and IPHC-2024-MSE-01. This includes updating the operating model (OM), defining exceptional circumstances and actions to take when an exceptional circumstance occurs, investigating the environmental and fishing effects on the abundance and distribution of Pacific halibut, and evaluating a wide range of fishing intensities (SPR=34% to SPR=56%). Updates to the MSE Program of Work for 2023–2025 are being considered by the Commission.

> **IPHC-2024-AM100-R, para 53**. *The Commission AGREED to undertake intersessional discussions on the recommendations contained within paper IPHC-2024-AM100-11, and provide further direction to the IPHC Secretariat*.

The potential additions to the MSE Program of Work discussed in this paper support the development of a harvest strategy policy document.

2 IPHC HARVEST STRATEGY POLICY

A Harvest Strategy Policy (HSP) provides a framework for applying a science-based approach to setting harvest levels. At IPHC, this would be specific to the TCEY for each IPHC Regulatory Area throughout the Convention Area. Currently, the IPHC has not formally adopted a harvest strategy policy, but has set harvest levels under an SPR-based framework with elements adopted at multiple Annual Meetings of the IPHC since 2017.

Adopting an HSP is important for any fisheries management authority because it outlines the long-term vision for management and specifies the framework for a consistent and transparent science-based approach to setting mortality limits. An HSP:

- identifies an appropriate method to manage natural variability and scientific uncertainty,
- accounts for risk and balances trade-offs,
- reduces the time needed to make management decisions,
- ensures long-term sustainability and profitability,
- increases market stability due to a more predictable management process,

- adheres to the best practices of modern fisheries management that is consistent with other fisheries management authorities and certification agencies, and
- allows for the implementation of the precautionary approach.

Overall, an HSP spells out the management process, which benefits the fish, the stakeholders, and other interested parties.

The MSE work and guidance from the MSAB and SRB have been a very important part of developing the HSP. To move towards formally adopting a HSP at the IPHC in the near term, the SRB recommended separating the coastwide TCEY management procedure (MP) from the distribution procedure.

> **IPHC-2023-SRB023-R, para. 30:** *The SRB **RECOMMENDED** that the Commission consider revising the harvest policy to (i) determine coastwide TCEY via a formal management procedure and (ii) negotiate distribution independently (e.g. during annual meetings). Such separated processes are used in other jurisdictions (e.g. most tuna RFMOs, Mid Atlantic Fishery Management Council, AK Sablefish, etc.).*

The coastwide TCEY determined from the MP in the harvest strategy would be an input into the allocation decision-making process.

An HSP can be divided into three components: management procedure, harvest strategy, and policy (Figure 1). A management procedure is an agreed upon procedure that determines an output that meets the objectives defined for management. The MP is reproducible and codified such that it can be consistently calculated. The harvest strategy component contains the MP but is broader and encompasses the objectives as well as additional procedures that produce the final necessary outputs, but may not be procedural and pre-defined. For example, at the IPHC the harvest strategy consists of the procedure to determine the coastwide TCEY as well as the concept of distributing the TCEY to each IPHC Regulatory Area. Currently, the determination of the coastwide TCEY is defined using a harvest control rule and reference fishing intensity, but there is not an agreed upon procedure to distribute the TCEY. However, a reference TCEY distribution, calculated using a defined procedure, may be useful to inform the decision-making process. The policy component is the aspect of decision-making where management may deviate from the outputs of the harvest strategy to account for other objectives not considered in the harvest strategy. This may be to modify the coastwide TCEY and/or the distribution of the TCEY to account for economic factors, for example. At IPHC, the policy component occurs at the Annual Meeting of the IPHC where stakeholder input is considered along with scientific information to determine the mortality limits for each IPHC Regulatory Area.

Some additional MSE work would be useful for drafting an HSP document for adoption, noting that the HSP may be updated at any time following additional MSE-related work. The MSE tasks to complete are outlined in this document along with other tasks that may be useful for Commission decisions.

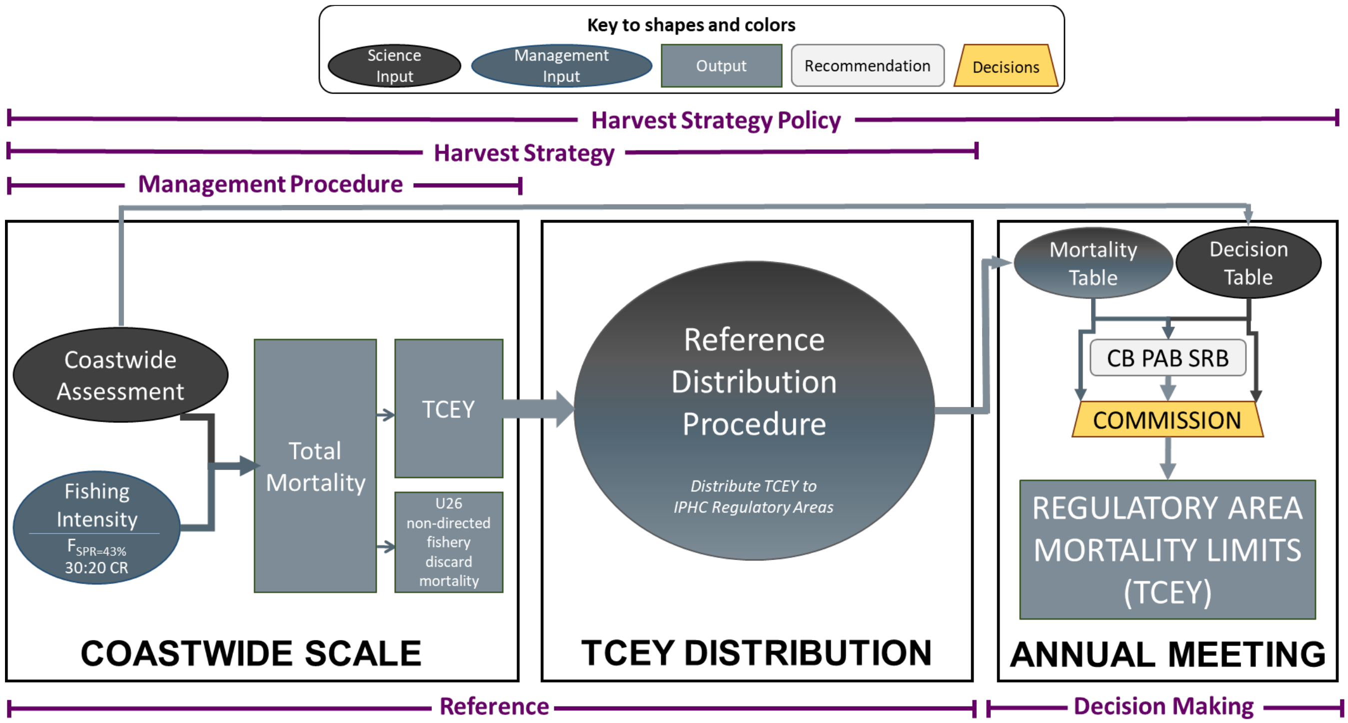

Figure 1. Illustration of the interim harvest strategy policy for the IPHC showing the coastwide scale (management procedure), the TCEY distribution (part of the harvest strategy), and the policy component that mainly occurs at the Annual Meeting.

3 MANAGEMENT PROCEDURES

The MSAB018 made a request to investigate various elements of management procedures related to coastwide scale and distribution of the TCEY.

> **IPHC-2023-MSAB018-R, para. 29**. *The MSAB REQUESTED that subsequent to an agreement on a distribution procedure by the Commission, the evaluation of annual and multi-year assessments include, but not limited to, the following concepts.*
>
> a) *Annual changes in the TCEY driven by FISS observations in non-assessment years of a multi-year MP;*
> b) *A constraint on the coastwide TCEY to reduce inter-annual variability and the potential for large changes in assessment years of a multi-year. This may be a 10% or 15% constraint, a slow-up fast-down approach, or similar approach;*
> c) *A smoothing element in the distribution procedure to account for uncertainty in the estimates of stock distribution and reduce the variability in area-specific TCEYs. For example, this may include a 3-year rolling average of stock distribution estimates;*
> d) *SPR values ranging from 30% to 56% and alternate trigger reference points in the harvest control rule.*

An evaluation of SPR values (i.e. fishing intensity) was presented in IPHC-2024-MSAB019-06, but further evaluation of fishing intensities would be useful when evaluating other elements of the MP.

3.1 Assessment frequency and an empirical management procedure

The frequency of conducting the stock assessment is a priority element of the MP to be investigated (see IPHC-2023-MSAB018-R, para. 29 above). This includes conducting assessments annually (every year), biennially (every second year), or triennially (every third year) to determine the status of the Pacific halibut stock and the coastwide TCEY for that year. In years with no assessment, the coastwide TCEY would be determined using a simpler approach and the estimated status of the stock would not be available.

The mortality limits in a year with a stock assessment can be determined as specified by previous defined MPs (i.e. SPR-based approach), and in years without a stock assessment, the mortality limits would need an alternative approach. This may be as simple as setting a constant multi-year TCEY until the next assessment was completed or using empirical observations (e.g. Fishery-Independent Setline Survey (FISS) modelled output) to adjust the coastwide TCEY in non-assessment years. There are many different empirical rules that could be applied to determine the coastwide TCEY in non-assessment years and two have been previously identified for evaluation.

a. A multi-year TCEY set constant until a stock assessment is available.
b. Update the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE.

Other potential methods to set the TCEY in years without an assessment include, but are not limited to, the following.

c. Update the coastwide TCEY proportionally to the change in the coastwide FISS all-sizes WPUE.
d. Use projected TCEY's from the stock assessment with the reference SPR and control rule. This method is common among other fisheries management organizations.
e. Incorporate commercial fishery catch-rates into the empirical rule.

3.2 Constraints

One of the priority objectives (Appendix A) is to limit annual changes in the coastwide TCEY, and adding a constraint on the change in the TCEY from year to year is a way to ensure that the annual changes in the TCEY are limited. However, this often results in a trade-off with yield (i.e. a lower TCEY on average). Document IPHC-2024-MSAB019-06 presents an analysis of the variability in past TCEYs and the reduction in interannual variability as a result of the decisions of the Commission. MSE simulations can be used to examine the short- and long-term outcomes of applying a consistent constraint in the interannual change in the TCEY.

Past considerations of constraints included the following:

- A maximum 15% change in the coastwide TCEY in either direction from one year to the next.

- A slow-up/fast-down approach where the TCEY increases by one-third of the increase suggested by the unconstrained MP or decreases by one-half of the decrease suggested by the unconstrained MP.
- A multi-year TCEY set constant for a specified number of years.
- An additional component specifying to not exceed a maximum fishing intensity consistent with an SPR of 36%.

The specifications of these constraints can easily be adjusted and tested. The maximum $F_{SPR=36\%}$ could be an added component of a constraint to ensure that the fishing intensity does not exceed the fishing intensity consistent with maximum sustainable yield (see IPHC-2019-SRB015-11 Rev_1).

3.3 Fishing intensity

The fishing intensity is determined by finding the fishing rate (*F*) that would result in a defined spawning potential ratio (F_{SPR}). Because the fishing rate changes depending on the stock demographics and distribution of yield across fisheries, SPR is a better indicator of fishing intensity and its effect on the stock than a single *F*. A range of SPR values (interim reference SPR is currently 43%) and possibly alternative trigger reference points (currently 30%) in the harvest control rule may be investigated. This was also recommended by the MSAB (see IPHC-2023-MSAB018-R, para. 29 above).

Some results of the evaluation of SPR values were presented in IPHC-2024-MSAB019-06. However, it should be standard to test a range of SPR values when modifying other elements of the MP. For example, a constraint may have significant effects on the performance metrics, which may be mitigated with different SPR values, if desired. The results in IPHC-2024-MSAB019-06 may provide a guide for the range of SPR values to include in future evaluations.

3.4 Distribution of the TCEY

The distribution of the TCEY to IPHC Regulatory Areas is a necessary part of the harvest strategy, but is not a part of the management procedure currently being evaluated. Therefore, distribution of the TCEY is a source of uncertainty. There are many options to include distribution of the TCEY in the MSE simulations. In the past, five reasonable distribution procedures spanning the potential range were integrated into the simulations.

An alternative approach is to use the observed distribution of the TCEY in recent years to define distributions of the potential TCEY or percentage of TCEY in each IPHC Regulatory Area. This approach allows progress to be made in evaluating other components of the harvest strategy pending a formal agreement on a distribution procedure, but does not constrain the uncertainty during testing. Different methods may be applicable for different IPHC Regulatory Areas based on the recent history of management decisions.

For the last six years, the TCEY in IPHC Regulatory Area 2A has been 1.65 M lbs (Table 1). Over the last twelve years, the adopted TCEY in IPHC Regulatory Area 2B has ranged from 17.1% to 20.8% of the coastwide TCEY with the three most recent years equal to 18.3% and no relationship with the coastwide TCEY (Table 2 and Figure 2). A reasonable process to represent distribution of the TCEY to IPHC Regulatory Areas 2A and 2B would be assume 1.65 Mlbs for

2A and randomly draw a percentage from a distribution of percentages ranging from 17% to 21% for 2B with the mode of the distribution at 18.3% (Figure 3).

The TCEY in IPHC Regulatory Areas in Alaska could be distributed after the TCEY has been distributed to IPHC Regulatory Areas 2A and 2B. Observed percentages using only Alaskan areas are shown in Table 3. Using the average of these recent observations, a multinomial distribution could be used to randomly draw percentages for each Alaskan IPHC Regulatory Area, as shown in Figure 4.

Table 1. Adopted TCEYs (millions of pounds) for each IPHC Regulatory Area from 2013 to 2024.

Year	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
2013	1.11	7.78	5.02	17.07	5.87	2.43	1.93	4.28	45.48
2014	1.11	7.64	5.47	12.05	3.73	1.56	1.49	3.58	36.65
2015	1.06	7.91	6.2	13.00	3.72	1.96	1.53	4.27	39.63
2016	1.26	8.24	6.54	12.75	3.41	1.95	1.37	4.07	39.59
2017	1.47	8.32	7.04	12.96	3.98	1.80	1.34	3.84	40.74
2018	1.32	7.10	6.34	12.54	3.27	1.74	1.28	3.62	37.21
2019	1.65	6.83	6.34	13.5	2.90	1.94	1.45	4.00	38.61
2020	1.65	6.83	5.85	12.2	3.12	1.75	1.31	3.9	36.60
2021	1.65	7.00	5.80	14.00	3.12	2.05	1.40	3.98	39.00
2022	1.65	7.56	5.91	14.55	3.90	2.10	1.45	4.10	41.22
2023	1.65	6.78	5.85	12.08	3.67	1.73	1.36	3.85	36.97
2024	1.65	6.47	5.79	11.36	3.45	1.61	1.25	3.7	35.28

Table 2. Adopted percentage of the coastwide TCEY (millions of pounds) for each IPHC Regulatory Area from 2013 to 2024.

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

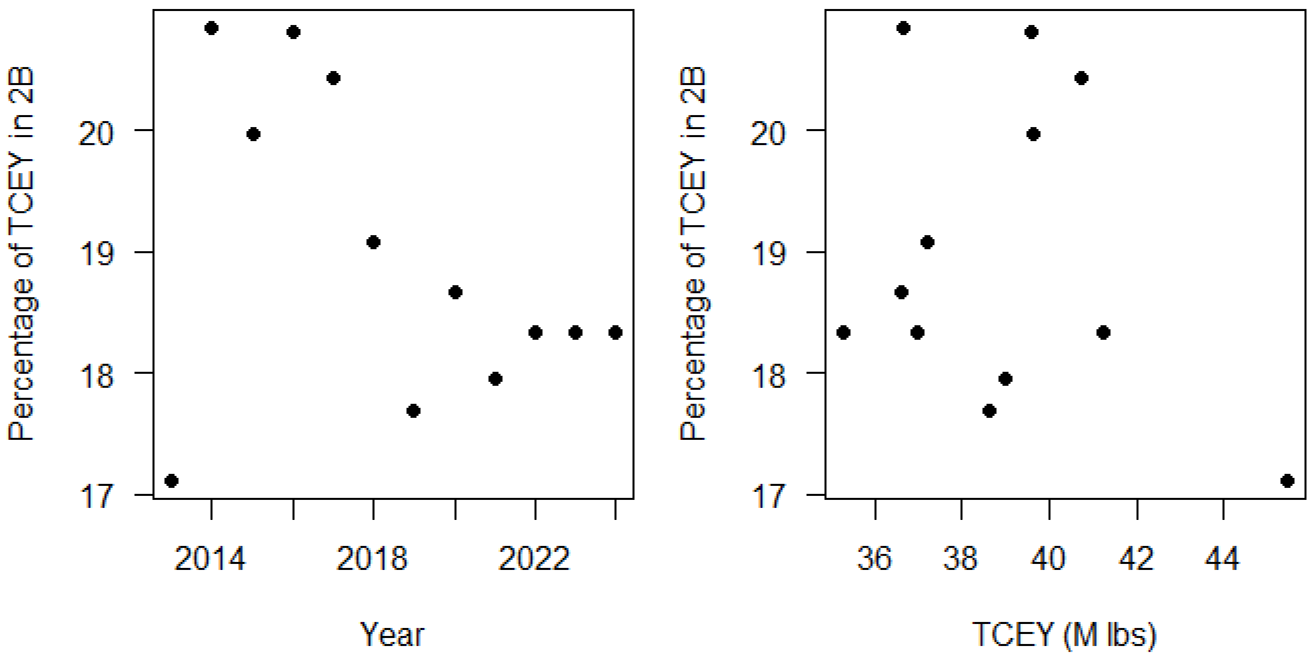

Figure 2. The percentage of the coastwide TCEY in IPHC Regulatory Area 2B plotted against year (left) and the coastwide TCEY (right).

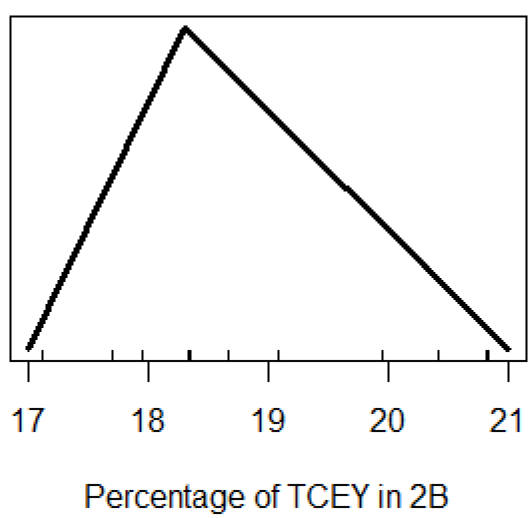

Figure 3. A triangle distribution ranging from 17% to 21% potentially to be used to randomly draw the percentage of the coastwide TCEY in 2B in MSE simulations. The ticks above the axis on the bottom show observed percentages from the past twelve years.

Table 3. Percentage of the adopted TCEY for Alaskan IPHC Regulatory Areas only in each Alaskan IPHC Regulatory Area. IPHC Regulatory Areas 2A and 2B are omitted.

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

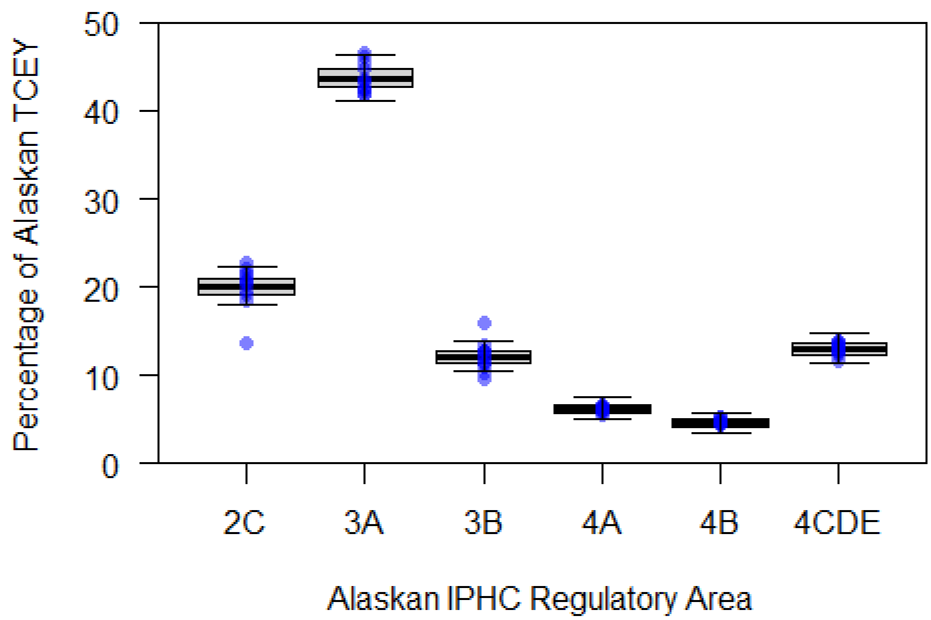

Figure 4. Observed percentage of the TCEY in Alaskan IPHC Regulatory Areas from 2013–2024 (blue points) and simulated percentage of the TCEY in Alaskan IPHC Regulatory Areas showing the median (thick black horizontal line), the central 50% (black box), and the 5th and 95th percentiles of the simulated distribution (black lines).

3.5 Additional MPs to evaluate

There are an endless number of MPs that could be evaluated with the MSE framework. Some potential MPs of interest include evaluating different triggers in the control rule (currently 30%) resulting in reductions in fishing intensity, an element related to maintaining the absolute spawning biomass above a threshold, and specific procedures for distribution of the TCEY to IPHC Regulatory Areas.

An MP to maintain the absolute spawning biomass above a threshold could be similar to the control rule currently used for stock status. A ramp could reduce the fishing intensity when the absolute spawning biomass (or catch-rates) fall below a specified threshold. Alternatively, a reduced reference fishing intensity could be used to avoid low stock sizes and be tuned to meet current Commission objectives. However, a specific objective to avoid low absolute spawning biomass or catch-rates would need to be added (see Section 4.2 below).

The MSAB suggested investigating methods to reduce the interannual variability in the estimates of stock distribution at MSAB018 (see IPHC-2023-MSAB018-R, para. 29 above). This may include using the average of the stock distribution estimates over the past 3 years, for example. This approach would recognize that there is a lag between the most recent estimate and the next year's fishery, such that there may be actual changes in the distribution, and also that there is observation variability in the estimates themselves, particularly given recent reductions in the FISS design.

The distribution of the TCEY to IPHC Regulatory Areas is not a part of the MP in the harvest strategy, but it is a required output of the harvest strategy. Investigating methods to produce a reference TCEY distribution to inform the decision-making process may be useful to assist the Commission. This could be one part of the products presented at the Annual Meeting.

4 Goals and 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).

4.1 Performance metric for multi-year assessments

The MSAB018 also requested that new performance metrics be developed for evaluating assessment frequency.

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

Current performance metrics describing the interannual variability in the TCEY include the average annual variation (AAV) and the probability that 3 or more years of a 10-year period have a change in the TCEY greater than 15% from one year to the next (Appendix A). Additional metrics may be useful in understanding the performance of an MP using biennial or triennial assessments, especially if the TCEY is held constant during non-assessment years. The current performance metrics, averaged over a 10-year period, regardless of the assessment frequency, are still useful and simply represent the variability over that 10-year period.

MSE simulations were performed in 2022 for annual, biennial, and triennial assessments with two empirical rules used to determine the coastwide TCEY in non-assessment years (see IPHC-2023-MSE-01).

a. The same coastwide TCEY from the previous year until a stock assessment is available.
b. Update the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE.

Simulations for the triennial assessment frequency used only option (b). These simulations for biennial and triennial assessment frequencies assumed a full FISS design, thus high precision, and the results are available in the MSE Explorer for AM099.

Annual Change (AC) is one performance metric that shows interannual variability in the TCEY and measures the relative percent change in the TCEY from the previous year (see Appendix A for a mathematical description). Figure 2 shows the AC for annual, biennial, and triennial assessment frequencies. The years with an assessment show a wider range of annual change in the TCEY because estimation error from the assessment is greater than fixing the TCEY or changing the TCEY in proportion to the change in the O32 FISS WPUE (noting that a less precise FISS WPUE index would result in more variability in non-assessment years).

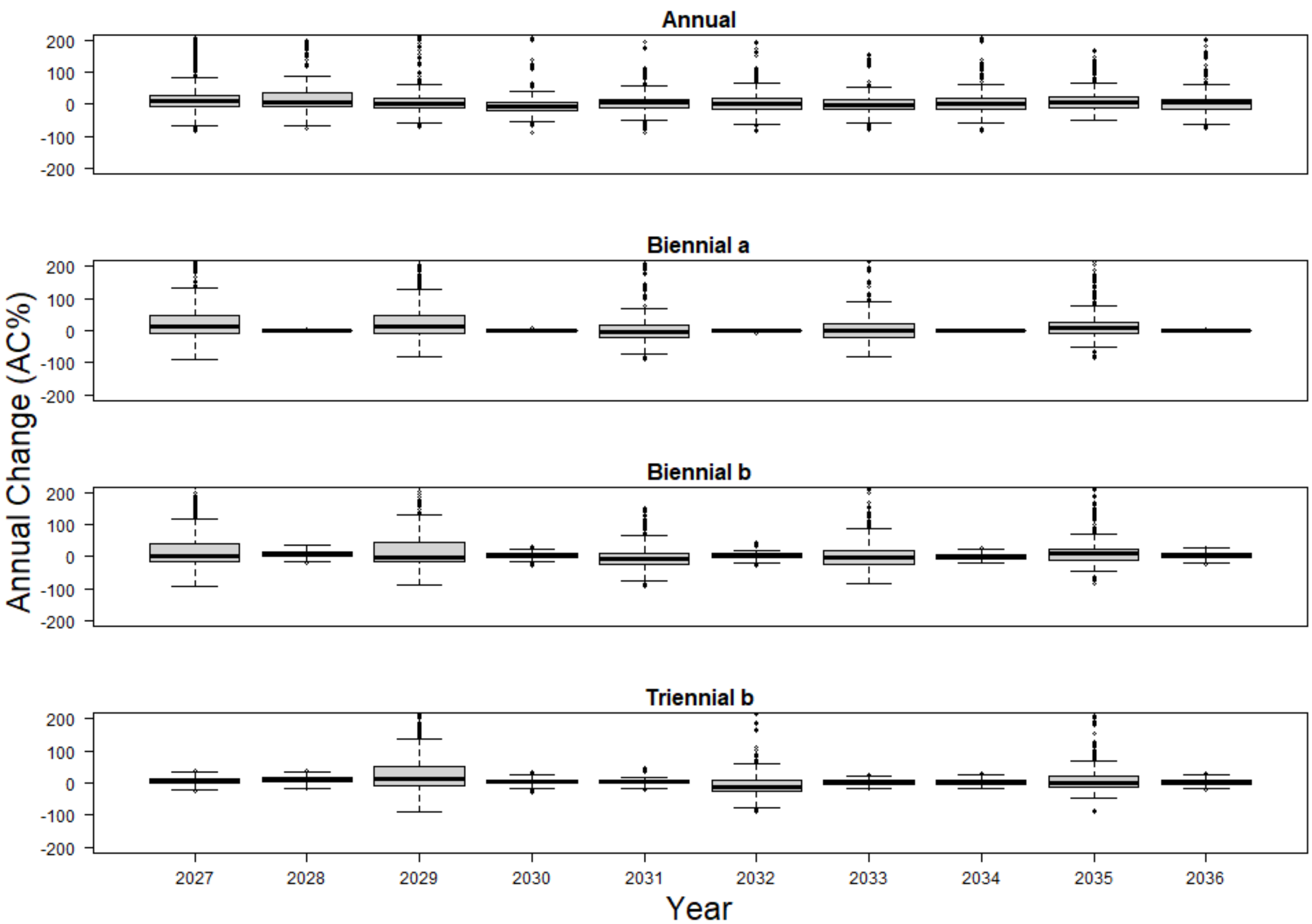

Figure 5. Boxplots of the annual change (AC) in percentage for annual, biennial, and triennial assessment frequencies. The biennial assessment frequency used a static TCEY in non-assessment years (a) and the biennial and triennial assessment frequencies use a proportional change determined from the O32 FISS WPUE (b).

Potential performance metrics to report when evaluating assessment frequency are:

- Reporting the average annual variability (AAV) calculated separately for only the years with an assessment and only the years without an assessment. This can be challenging because the same years need to be compared otherwise the performance metric is confounded with change in the population. This reduces the number of comparable years in a ten-year period, reducing the usefulness of an average.

- The percent change in the TCEY from the previous year calculated separately for assessment years and non-assessment years summarized over a 10-year period and all simulations. As with the AAV, this can be challenging to make sure that the same years are included in the calculation to avoid confounding from other factors.
- The maximum annual change observed in a ten-year period. As with other metrics, assuring that the same years are compared is essential, if separating by assessment and non-assessment years.

The biggest challenge with developing a performance metric to measure changes in assessment years is defining a statistic that is consistent across all MPs and can be summarized in a way that allows for the MPs to be evaluated against each other. With annual, biennial, and triennial MPs, the statistic is reduced to only two comparable years in a ten-year period. Comparing consistent assessment years across MPs would be much more challenging.

It is important to consider the objective when developing performance metrics, and sometimes multiple performance metrics may be useful to the evaluation. With a well-defined measurable objective, a performance metric is easily defined. Regarding assessment frequency, one consideration is whether a stable period with an occasional larger biennial or triennial change is preferable to an annual assessment and potentially smaller changes in the TCEY. If multi-year stability is an important objective, that can be developed into the MP (such as less frequent assessments), then the current performance metrics (AAV and AC) for a ten-year period will measure the overall interannual variability in the TCEY. If maintaining the change in all years to be less than a specific amount is the objective, this can be designed into the MP or measured with a performance metric determining the chance that any annual change in the TCEY for a ten-year period exceeds some threshold. For example, a currently reported performance metric is the probability that the annual change is greater than 15% in any three years of a ten-year period. However, this could also be affected by how many assessment years occur in the time-period. A metric that may not as affected by the number of assessments in a time-period is the maximum change in the TCEY in any one year.

Therefore, before additional performance metrics to evaluate MPs with different assessment frequencies can be developed, it will be useful to revisit the objectives related to interannual variability in the TCEY. One question to ask is whether the measurable outcomes in Appendix A encompass the objectives related to interannual variability in the TCEY. If not, then the following questions may be helpful to define additional objectives.

- What concepts are missing from the measurable outcomes in Appendix A?
- Is a period of stability followed by a year adjusting the TCEY, possibly with a higher percent change than without a period of stability, acceptable?
  - How stable is the period of stability (e.g. fixed TCEY or adjusted using empirical data)?
  - How many years of stability are desired?
- Is a more predictable and transparent empirical rule desired to determine the coastwide TCEY?

- What is the maximum allowable change in any year, and is it acceptable if one, two, or more years exceeds that maximum on a rare occasion?
- Is a ten-year period appropriate to measure stability?
- Is stability prioritized below, the same, or above the yield objective?

If performance metrics are not pertinent to the objectives, they can become confusing and superfluous.

4.2 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 3 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 4), 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 3) 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%.

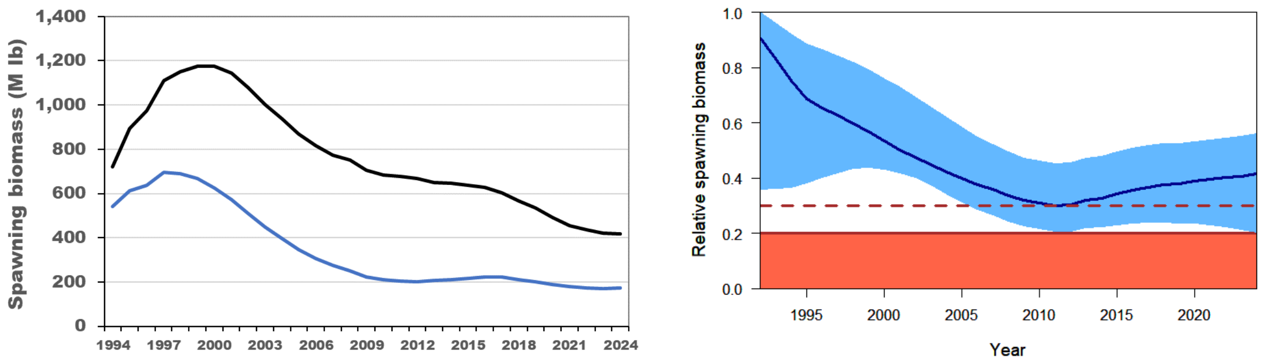

Figure 6. Dynamic unfished spawning biomass (black line) and current spawning biomass (blue line) from the 2023 stock assessment (left) and dynamic relative spawning biomass (right) with an approximate 95% credible interval in light blue and the control rule limit and trigger in red. Figures from IPHC-2024-SA-01.

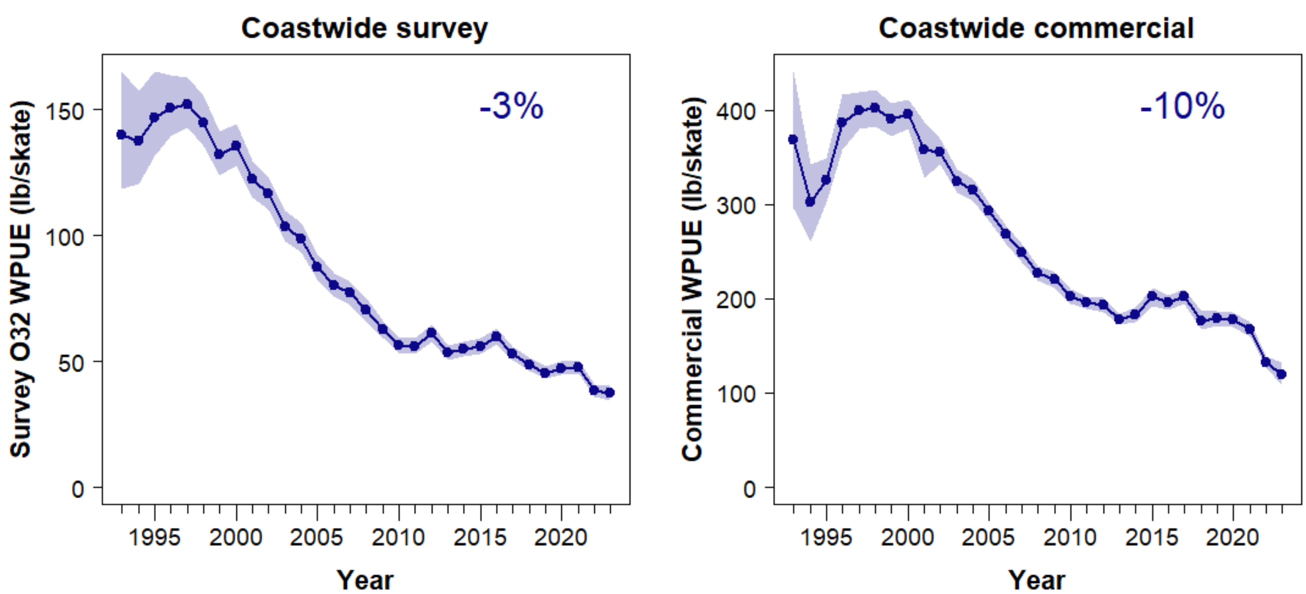

Figure 7. The coastwide FISS O32 WPUE index (left) and coastwide commercial WPUE (right) showing the percent change in the last year (from IPHC-2024-SA-02). Based on past calculations, additional logbooks collected in 2024 will likely further reduce the decline in commercial WPUE to -12%.

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.*

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 fishing mortality above 39 Mlbs, 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.*

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 and 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.

5 EXCEPTIONAL CIRCUMSTANCES

An exceptional circumstance is an event that is beyond the expected range of the MSE evaluation and triggers specific actions that should be taken to re-examine the harvest strategy. Exceptional circumstances, and actions taken if one or more is met, define a process for deviating from an adopted harvest strategy (de Moor et al. 2022) and is useful to ensure that the adopted harvest strategy is retained unless there are indications that the MSE may not be accurate. The IPHC interim harvest strategy policy (Figure 1) has a decision-making step after the MP, thus the Commission may deviate from an adopted MP as part of the harvest strategy policy. This decision-making variability is included in the MSE simulations.

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

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

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

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

Furthermore, the following actions may take place if an exceptional circumstance is declared.

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

b) If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.

c) Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM.

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

6 ADDITIONAL CONSIDERATIONS

The MSE framework is a generalized framework that can be used to evaluate any part of the harvest strategy. A management procedure consists of the elements in fisheries management that can (or are chosen to) be controlled. This includes how data are collected and analysed, how those data are synthesized in an estimation model (e.g. stock assessment), and the rules that determine how the TCEY is calculated. Many of these elements can be evaluated using the MSE framework.

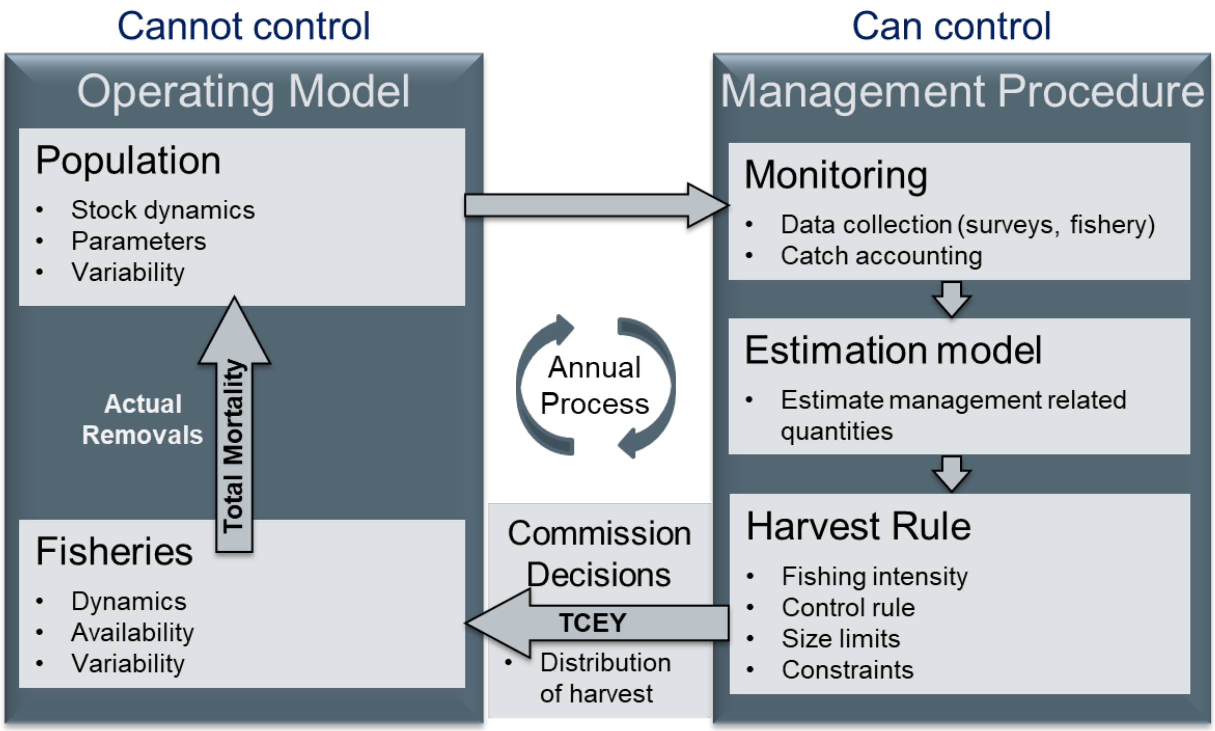

Figure 8. An illustration of the closed-loop feedback between the operating model and the management procedure.

6.1 FISS reductions

The FISS design was reduced in 2022, 2023, and 2024 to maintain revenue neutrality and future reductions may be necessary. The Commission is interested in understanding how FISS designs may affect management outcomes, as noted in the report from the 99th Interim Meeting (IM099).

> **IPHC-2023-IM099-R, para. 38:** *The Commission NOTED that:*
>
> a) *to understand how reductions in the FISS design may affect management outcomes, the evaluation of FISS design scenarios using the MSE framework was recommended by the SRB at SRB023;* [see IPHC-2023-SRB023-R paragraphs 29 and 64].

The Secretariat will investigate scenarios where the FISS effort is reduced or occasionally eliminated in various IPHC Regulatory Areas. Work is currently being done to determine how FISS design changes affect the inputs into the MSE. Different scenarios will be investigated, ranging from full FISS designs with high precision to reduced FISS designs and missed years showing low precision. Evaluation of FISS scenarios is a high priority for the Commission.

RECOMMENDATION/S

1) The MSAB **NOTE** paper IPHC-2024-MSAB019-07 describing a harvest strategy policy, presenting potential elements of management procedures to evaluate, objectives to consider, and additional considerations for the MSE workplan in 2023–2025.
2) The MSAB **REQUEST** the following elements of MPs to investigate:
   a. Annual, biennial, and triennial assessment frequency with a fixed TCEY or an empirical rule based on O32 FISS WPUE in non-assessment years.
   b. Constraints of a maximum annual change of the TCEY equal to 15% or 20%, or a slow-up/fast-down rule where the TCEY increases by 1/3rd or decreases by 1/2 of the change to the reference TCEY.
   c. A range of fishing intensities from SPR=36% to SPR=56%.
   d. Options for control rules that reduce the fishing intensity when biomass is low.
3) The MSAB **REQUEST** adding the following measurable objective related to variability in TCEY:
   a. The median average of the maximum change in the TCEY for 1, 2, and/or 3 years of a ten-year period.
4) The MSAB **RECOMMEND** equal prioritization for the fishery objectives optimise average coastwide TCEY and limit annual changes in the coastwide TCEY to allow for a more transparent evaluation of trade-offs between the two objectives.
5) The MSAB **RECOMMEND** adding a measurable objective related to absolute spawning biomass under the general objective 2.1 “maintain spawning biomass at or above a level that optimizes fishing activities” to be included in the priority Commission objectives after the current biomass threshold objective:
   a. Maintain the absolute spawning biomass above the estimated 2023 absolute spawning biomass, noting that the threshold, term, and tolerance are yet to be defined.
6) The MSAB **RECOMMEND** adopting the following exceptional circumstances:
   a. The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.
   b. The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.
   c. Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.

7) The MSAB **RECOMMEND** adopting the follow actions if an exceptional circumstance occurs:
    a. A review of the MSE simulations to determine if the OM can be improved and MPs should be reevaluated.
    b. If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.
    c. Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM.
    d. Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.

REFERENCES

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APPENDICES

Appendix A: Primary objectives used by the Commission for the MSE

APPENDIX A
PRIMARY OBJECTIVES USED BY THE COMMISSION FOR THE MSE

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

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain the long-term coastwide female spawning stock biomass above a biomass limit reference point ($B_{20\%}$) at least 95% of the time	*B* < Spawning Biomass Limit (B_{Lim}) B_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(B < B_{Lim})$ PASS/FAIL Fail if greater than 0.05
	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 spawning stock biomass at or above a biomass reference point ($B_{36\%}$) 50% or more of the time	*B*<Spawning Biomass Reference (B_{Thresh}) B_{Thresh}=$B_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(B < B_{Thresh})$ Fail if greater than 0.5
2.2. PROVIDE DIRECTED FISHING YIELD	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		*Median* $\overline{TCEY}$
	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

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

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

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MANAGEMENT STRATEGY EVALUATION
Environment vs fishing

MSE is a process to evaluate harvest strategies and develop a management procedure that is robust to uncertainty and meets defined objectives. It can also be used to examine the effects of scenarios on the stock and fishery yield.

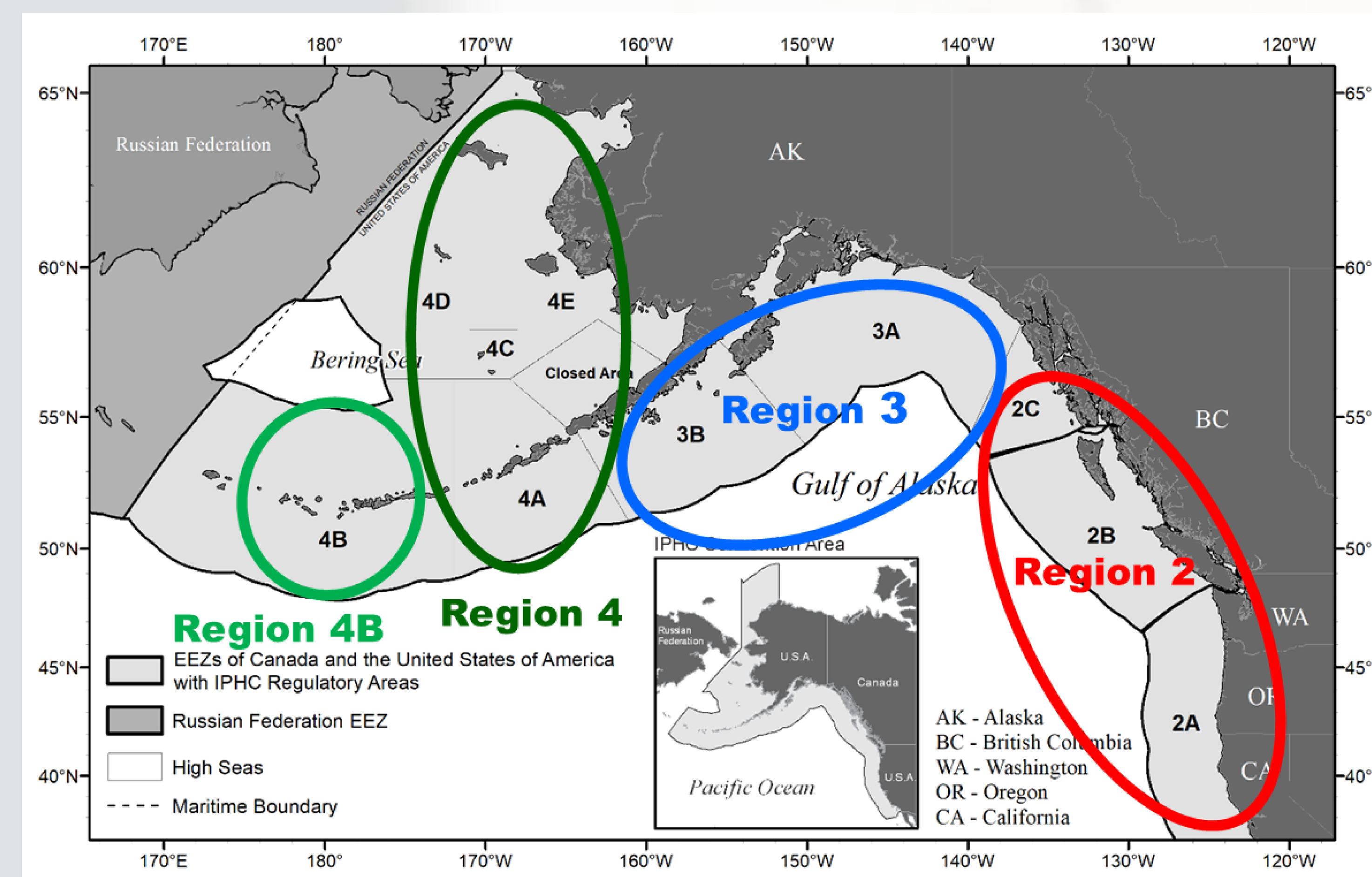
MSE simulations were performed linking recruitment & movement to environmental conditions.

- PDO: has 10- to 20-year cycles of low and high.
- Scenarios: a persistent low PDO and a persistent high PDO.

Fishing Intensity: SPR=43%

No observation error, No estimation error, No decision-making variability

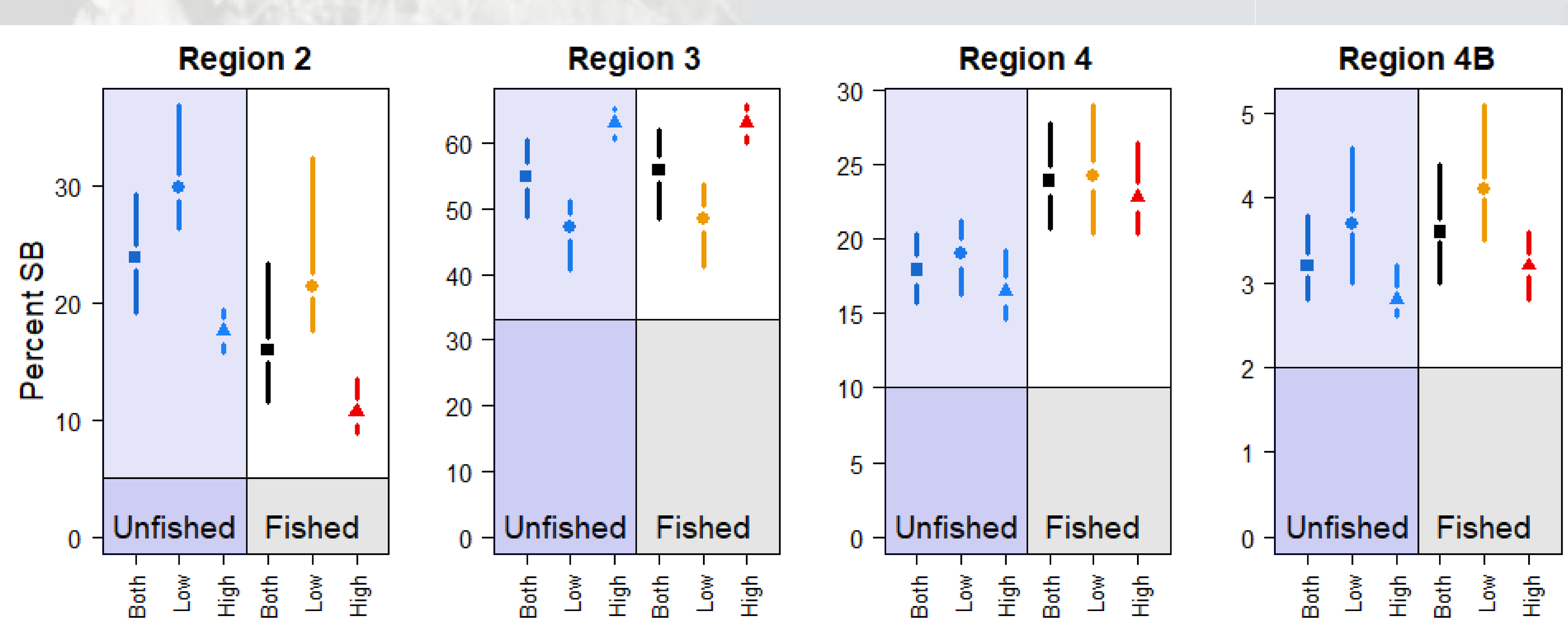
Low PDO	High PDO
Low average recruitment	High average recruitment
Typically, less recruitment in Region 4	Typically, more recruitment in Region 4
Less movement from Region 4 to 3	More movement from Region 4 to 3
More movement from Region 3 to 2	Less movement from Region 3 to 2



- The median relative coastwide spawning biomass (RSB) was similar for high and low PDO scenarios.
- There was a higher probability that the RSB was less than 36% for the low PDO scenario.
- The long-term median TCEY was 22% less for the low PDO scenario and 26% more for the high PDO scenario when compared to a cyclical PDO.
- The median average TCEY for a high PDO was 1.6 times greater than the TCEY for the low PDO.

Long-Term Performance Metrics

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



Percentage of spawning biomass in each Biological Region when not fished and when fished. The PDO is modelled with cyclical low and high periods in "Both". Darker shaded area shows below the threshold for the spatial conservation objective.

MSE simulations assuming a persistent low or high PDO show that fishing and the environment affect the percentage of spawning biomass in each Biological Region in different ways.

- Region 2: affected by PDO and fishing
- Region 3: affected by PDO.
- Region 4: affected by fishing.
- Region 4B: affected by PDO and fishing

- Even though we cannot "manage" the PDO regime, it is useful to understand the effects of the PDO on the spawning biomass and TCEYs, separating the effects of fishing from the effects of the environment.
- The environment may have a larger effect on the distribution of spawning biomass than fishing does.
- Different distribution procedures would likely produce different outcomes of percent spawning biomass in each area

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

INTERIM: HARVEST STRATEGY POLICY

(2024)

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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. It is not intended to be a definitive policy, noting that the IPHC is yet to adopt a formal harvest strategy for Pacific halibut. It is expected that over the coming year, the IPHC will develop and implement a harvest strategy, and that this policy document will then be updated accordingly.

ACRONYMS

HCR	Harvest Control Rule
HSP	Harvest Strategy Policy
IPHC	International Pacific Halibut Commission
LIM	Limit
MP	Management Procedure
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
NER	Net economic returns
OM	Operating Model
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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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 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.

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. managed jointly by the IPHC and Contracting Party domestic agencies) the IPHC will seek to apply and encourage the adoption of this policy in negotiating and implementing joint or cooperative management arrangements.

The IPHC is responsible for determining the mortality limit in each of 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 fisheries. 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.

Mortality limits for each sector within an IPHC Regulatory Area, and all sizes of non-directed commercial discard mortality, are determined by Contracting Party domestic agencies. Therefore, this Harvest Strategy Policy is specific to the mortality limit in each IPHC Regulatory Area.

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

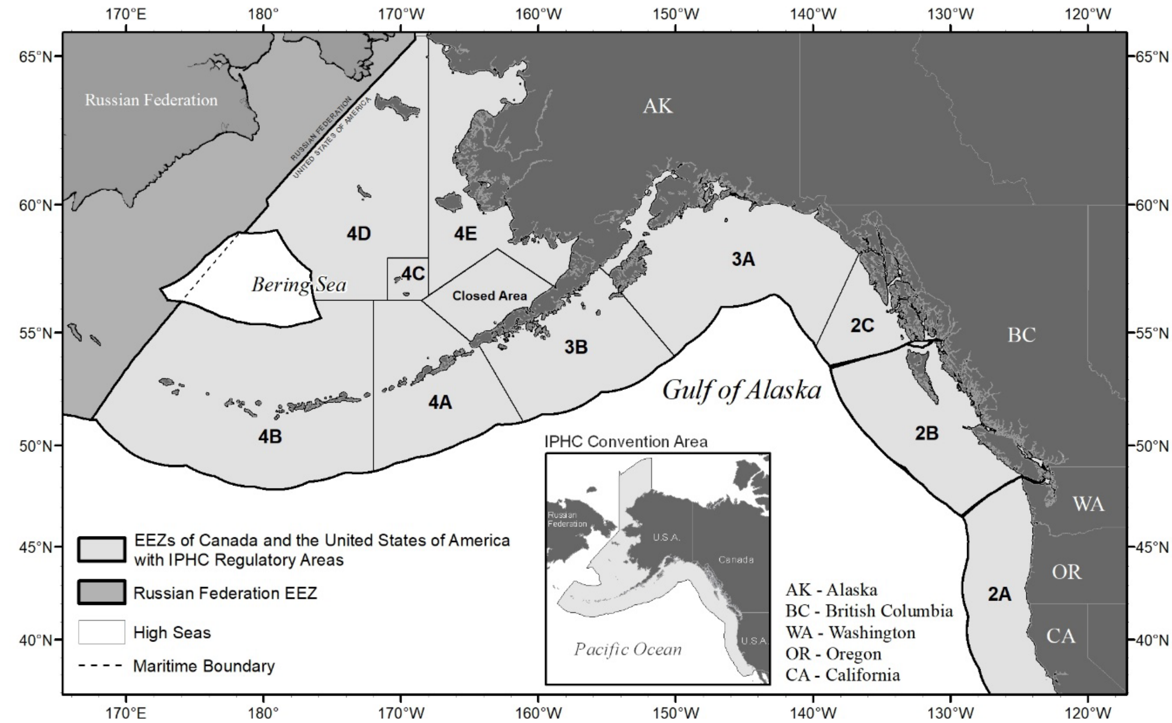

Figure 1. IPHC Regulatory Areas where 4C, 4D, 4E, and the closed area are considered one IPHC Regulatory Area (4CDE). The IPHC Convention Area is shown in the inset.

1.2 WHAT IS A HARVEST STRATEGY POLICY (HSP)?

Being a framework, the harvest strategy policy encompasses the entire process of the harvest strategy 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 MP) followed by the process for distributing the TCEY among IPHC Regulatory Areas (part of the harvest strategy). The final step of the HSP, which is not part of the MP, is the decision-making process that occurs at the Annual Meeting of the IPHC. The final mortality limits may deviate from those determined from the management procedure, resulting in less transparency in the process.

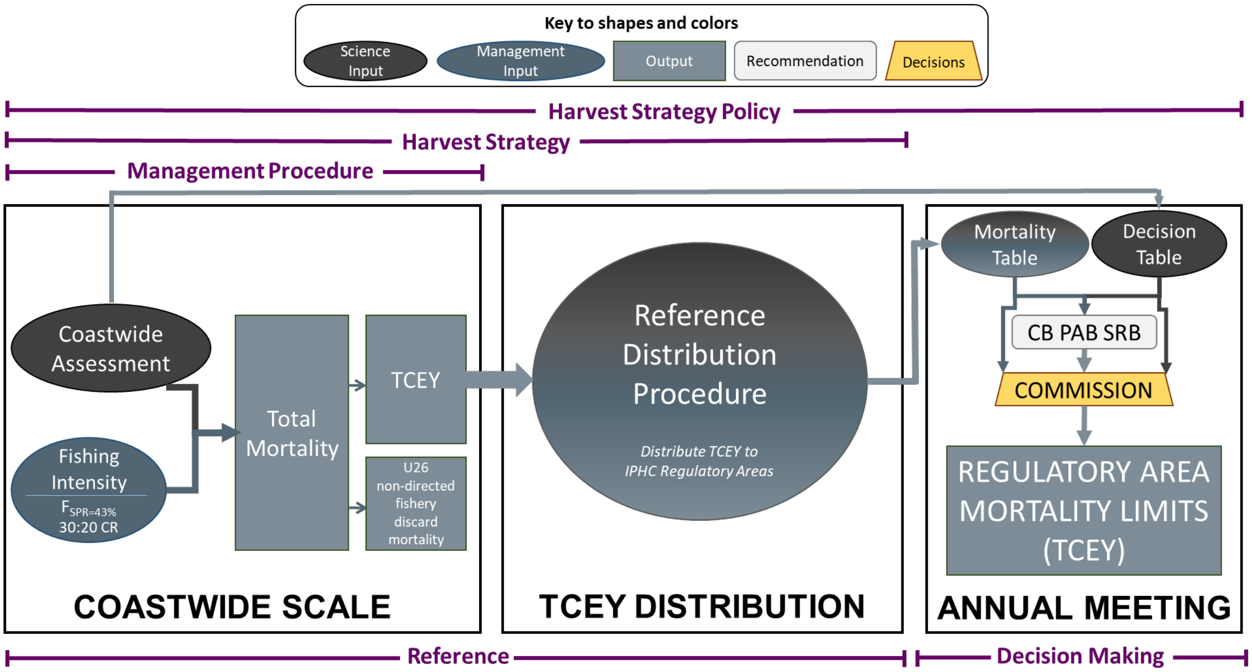

Figure 2. Illustration of the interim IPHC harvest strategy policy process to determine mortality limits showing the coastwide scale component as the management procedure along with the TCEY distribution component that comprise the harvest strategy. The TCEY distribution and Annual Meeting components make up the Commission decision-making process, which considers inputs from many sources and may deviate 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 (a reference point or points).
- Pre-determined rules that determine 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.

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 different from a harvest strategy in that each component of an MP is more formally specified and 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 and refers to the entire process needed for determining reference mortality limits (i.e. the TCEY for each IPHC Regulatory Area) that are then subject to the decision-making step. Some steps, such as the distribution of the TCEY, may not have been simulation tested and are subject to negotiation and decision-making. Simulation testing MPs using MSE models with decision-making variability ensure that a harvest strategy policy is robust to this 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 entire process to produce endpoint reference management outcomes (e.g. TCEYs for each IPHC Regulatory Area) which may have some components that are not simulation tested and subject to uncertainty. This outcome informs the decision-making process.

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 return from the fishery may not always equate with maximising the profitability of the fishery. Net economic return may consider inter-annual stability to maintain markets, and economic activity may also arise from recreational and Indigenous fishing, and the need to share the resources appropriately will be considered where necessary. Priority objectives to achieve this goal include:

- 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 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).

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

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

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

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

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 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 natural 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. Additional environmental linkages to the ecology and biology of Pacific halibut should be considered as knowledge improves.

- 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. Pacific Decadal Oscillation, PDO).
- Variability in the 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).

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

3.3 MONITORING STANDARDS

[To be completed] This section describes standards for monitoring. For example, FISS, port sampling, catch monitoring, etc.

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 a species or stock from fishing and provide confidence in the sustainability of a higher level of fishing pressure or catch. In the absence of this additional information–and associated improved understanding of a stock, it may be necessary to reduce the fishing effort in order to manage the risk. Decisions about investment in managing risk versus the economic return of the catch taken will be transparently made, clearly documented and publicly available.

3.6 REFERENCE POINTS AND PROXIES

A reference point is a specified level of an indicator used as a basis for managing Pacific halibut. The reference point should reflect acceptable levels of biological impact on the stock and the desired economic outcomes from the fishery. A reference point will often be based on indicators of either the total or 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 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 biological limit reference point indicates a point beyond which the long-term health of the stock or 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 relative to the spawning biomass that would have occurred if fishing had not occurred, but other variability had occurred (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. An absolute spawning biomass is typically a specified spawning biomass level and may be presented as a number or a value estimated in a particular year. An 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 contrast 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 ($SB_{36\%}$).
Biological limit reference point SB_{LIM}	The female dynamic spawning biomass level where the ecological risk to the population is regarded as unacceptable (i.e. at least 95 percent of the time)	20%of the unfished female spawning biomass ($SB_{20\%}$).

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 objective 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. An MSE should incorporate variability and uncertainty, such as described in Section 3.2, structural uncertainty in operating models (OMs), and represent spatial fishing sectors appropriately. An accepted harvest strategy should, at a minimum, be evaluated using MSE and meet the priority objectives outlined in Chapter 2.

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, and finally adopting that MP as part of the harvest strategy. This process takes input from stakeholders through meetings of the Management Strategy Advisory Board (MSAB) and is reviewed by the IPHC Scientific Review Board (SRB).

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, if needed. 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 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.
- The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of two or more years.
- Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.

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.

- A review of 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 not conducting a stock assessment every 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 JOINTLY-MANAGED 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 JOINTLY-MANAGED 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

[To be completed] The stock assessment occurs annually, although a full stock assessment, investigating all aspects and potentially making major changes, occurs triennially. The stock assessment will include a summary of the data available for analysis, estimates of current stock size and trend relative to reference points, and short-term projections of various risk metrics (probability of stock decrease, probability of exceeding fishing intensity reference points, etc.) under different levels of future harvest.

4.4 COASTWIDE MORTALITY LIMIT

The coastwide 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 which is used in the harvest control rule to determine if fishing intensity should be reduced from a reference SPR of 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%.

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 cease 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.

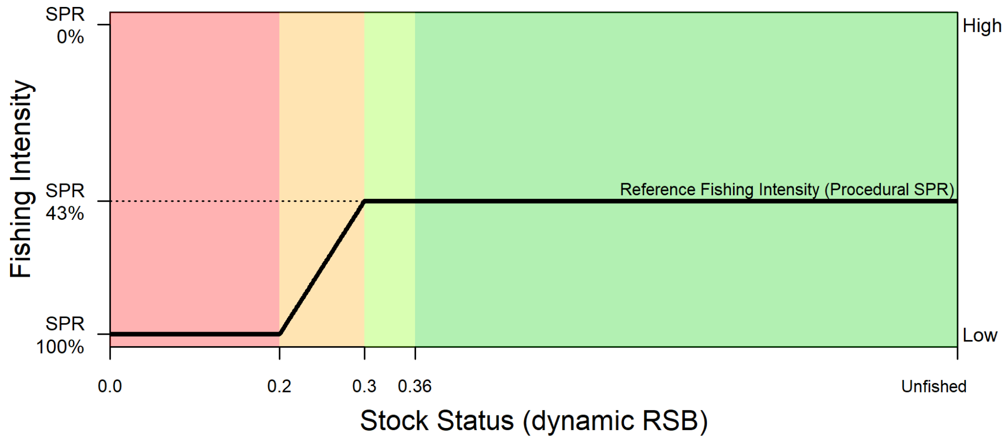

Figure 3. Harvest control rule for the fishing intensity (i.e. F_{SPR}) to determine the coastwide total mortality limit. The stock status is the dynamic relative spawning biomass (RSB) determined from the stock assessment. The reference fishing intensity is $F_{SPR=43\%}$, and is applied when stock 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 recommence 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 managed or constrained by the IPHC, and must take this mortality into account. Where practical and appropriate, the IPHC will work 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 detail on how and when these measures will be reported on. 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.

4.5.1 Rebuilding timeframes

Rebuilding timeframes are explicitly related to the minimum timeframe for rebuilding in the absence of commercial 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. This component (Figure 2) is part of the harvest strategy but is not part of the management procedure because it is subject to negotiation and decision-making. During this process, the coastwide mortality limit may change as well, which has been accounted for in the MSE by incorporating decision-making variability.

Reference mortality limits for each IPHC Regulatory Area are useful for the decision-making process. These are determined using the coastwide TCEY, stock distribution estimated from the FISS observations, and defined relative harvest rates for each IPHC Regulatory Area (1.0 for IPHC Regulatory Areas 2A, 2B, 3C, and 3A, and 0.75 for IPHC Regulatory Areas3B, 3A, 4CDE, and 4B). Using stock distribution provides insight into where biomass is distributed, and lower relative harvest rates in western areas protects biomass that may still move to eastern areas and may have lower sustainable harvest rates.

4.7 Common outputs used for decision-making

Two outputs are produced as part of the harvest strategy policy to assist the decision-making process at the Annual Meeting (Figure 2): a *mortality table* and a *decision table*.

Mortality table: The mortality table uses the output of the harvest strategy, mortality limits for each IPHC Regulatory Area, and defines the mortality limits for 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.

Decision table: The decision table is a stock assessment output that provides risk relative to stock trend, stock status, fishery trends, and fishery status for a range of coastwide mortality levels. The decision table is not dependent on the harvest strategy, although the reference F_{SPR} is a provided as a central point of the range and allocation of mortality among IPHC Regulatory Areas and sectors may have a small influence. Alternative coastwide mortality limits are presented on either side of the reference mortality limit. The decision table presents probabilities for different metrics over a three-year projection period.

4.8 Stakeholder and scientific input

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

4.8.1 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 before the Annual Meeting.

CB: The Conference Board consists of individuals representing Pacific halibut harvesters, organisations, and associations, and provides a forum for the discussion of management and policy matters relevant to Pacific halibut and provides advice to the Commission on these matters. The CB also reviews IPHC Secretariat reports and recommendations, regulatory proposals received by the Commission, and provide 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, suggests research topics to be considered for incorporation in the IPHC integrated research and monitoring activities and comments upon operational and implementation considerations of those research and monitoring activities. The RAB also 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. The RAB meets once per year, typically before the Interim Meeting.

4.8.2 Scientific input

Scientific input occurs through independent, external reviews, including, but not limited to, semi-annual meetings of the Scientific Review Board (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.

4.9 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 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.