INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC–2025–RAB026–00

Last Update: 20 October 2025

26th Session of the IPHC Research Advisory Board (RAB026) – *Compendium of meeting documents*

18-19 November 2025, Seattle, WA, USA

Commissioners

Canada	United States of America
Mark Waddell	Jon Kurland
Neil Davis	Robert Alverson
Peter DeGreef	Richard Yamada

Executive Director

David T. Wilson, Ph.D.

DISTRIBUTION: IPHC WEBSITE
LAST UPDATE: 20 October 2025

BIBLIOGRAPHIC ENTRY
IPHC 2025. 26th Session of the IPHC Research Advisory Board (RAB026) - Compendium of meeting documents. Int. Pac. Halibut Comm.

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IPHC-2025-RAB026-01

Last updated: 14 October 2025

DRAFT: AGENDA FOR THE 26th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB026)

Date: 18-19 November 2025
Location: Seattle, Washington, USA
Venue: IPHC HQ office
Time: 18th: 09:00-16:00; 19th: 09:00-12:00
Chairperson: Dr David T. Wilson (Executive Director)
Vice-Chairperson: Dr Josep V. Planas (Biological & Ecosystem Sciences Branch Manager)

1. **OPENING OF THE SESSION** (Chairperson)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chairperson)
3. **IPHC PROCESS** (Chairperson)
   - 3.1 Update on the actions arising from the 25th Session of the RAB (RAB025)
   - 3.2 Outcomes of the 101st Session of the IPHC Annual Meeting (AM101)
4. **SEASON OVERVIEW – 2025: RAB MEMBERS**
5. **INTERNATIONAL PACIFIC HALIBUT COMMISSION INTEGRATED RESEARCH AND MONITORING PLAN**

   5.1 RESEARCH

   5.1.1 Biology and ecology
   - Description of IPHC Biological and Ecosystem Sciences Research (Core research streams)

   5.2 MONITORING

   5.2.1 Fishery-dependent data

   5.2.2 Fishery-independent data
   - 2025 FISS season: Design and implementation (K. Ualesi)
   - IPHC Fishery-Independent Setline Survey (FISS)
     - 2026-28 FISS design evaluation (R. Webster)
6. **GUIDANCE ON, AND DISCUSSION OF, OTHER POTENTIAL APPLIED RESEARCH PROJECTS** (Chairperson & Vice-Chairperson)
7. **OTHER BUSINESS**
8. **REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 26th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB026)** (Chairperson)

SCHEDULE FOR THE 26th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB026)

Tuesday, 18 November 2025		
Time	**Agenda item**	**Lead**
09:00-09:05	1. Opening of the Session	D. Wilson
09:05-09:15	2. Adoption of the agenda and arrangements for the Session	D. Wilson
09:15-09:30	3. IPHC Process	D. Wilson
09:30-10:30	4. Season overview: RAB members	RAB Members
10:30-10:45	Break	
10:45-10:55	5. International Pacific Halibut Commission Integrated Research and Monitoring Plan	D. Wilson
10:55-11:40	5.1 Research: Biology and Ecology - Description of IPHC Biological and Ecosystem Sciences Research (Core research streams)	J. Planas & Project leaders
11:40-12:30	5.2 Monitoring: 5.2.1 Fishery-dependent data 5.2.2 Fishery-independent data • 2025 FISS season: Design and implementation • IPHC Fishery-Independent Setline Survey (FISS) – 2026-28 FISS design evaluation	B. Hutniczak K. Ualesi R. Webster
12:30-13:30	Lunch	
13:30-16:00	6. Guidance on, and discussion of, other potential applied research projects	RAB Members
16:30-21:00	RAB Function/dinner	All
Wednesday, 19 November 2025		
Time	**Agenda item**	**Lead**
09:00-10:15	Guidance on, and discussion of, other potential applied research projects (cont.)	RAB Members
10:15-10:30	7. Other business	D. Wilson
10:30-10:45	Break	
10:45-12:00	8. Review of the draft and adoption of the report of the 26th Session of the IPHC Research Advisory Board (RAB026)	D. Wilson
12:00-13:00	Lunch and Depart for Fish Expo	

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2025-RAB026-02

LIST OF DOCUMENTS FOR THE 26th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB026)

LAST UPDATED: 20 OCOTBER 2025

Document	Title	Availability
IPHC-2025-RAB026-01	Agenda & Schedule for the 26th Session of the IPHC Research Advisory Board (RAB026)	✓ 20 Aug 2025 ✓ 14 Oct 2025
IPHC-2025-RAB026-02	List of Documents for the 26th Session of the IPHC Research Advisory Board (RAB026)	✓ 20 Aug 2025 ✓ 20 Oct 2025
IPHC-2025-RAB026-03	Update on the actions arising from the 25th Session of the RAB (RAB025) (D. Wilson & J. Planas)	✓ 09 Oct 2025
IPHC-2025-RAB026-04	Outcomes of the 101st Session of the IPHC Annual Meeting (AM101) (D. Wilson)	✓ 08 Oct 2025
IPHC-2025-RAB026-05	International Pacific Halibut Commission Integrated Research and Monitoring Plan (D. Wilson, J. Planas, I. Stewart, A. Hicks, B. Hutniczak, & R. Webster)	✓ 08 Oct 2025
IPHC-2025-RAB026-06	Report on current and future biological and ecosystem science research activities (J. Planas, C. Dykstra, A. Jasonowicz, C. Jones)	✓ 14 Oct 2025
IPHC-2025-RAB026-07	IPHC Fishery-independent setline survey (FISS) design and implementation in 2025 (K. Ualesi, R. Rillera, T. Jack, & K. Coll)	✓ 16 Oct 2025
IPHC-2025-RAB026-08	2026-28 FISS designs (R. Webster, I. Stewart, K. Ualesi, T. Jack, & D. Wilson)	✓ 19 Oct 2025

Update on actions arising from the 25th Session of the IPHC Research Advisory Board (RAB025)

PREPARED BY: IPHC SECRETARIAT (D. WILSON & J. PLANAS; 9 OCTOBER 2025)

PURPOSE

To provide the RAB with an opportunity to consider the progress made during the inter-sessional period, in relation to the recommendations and requests of the 25th Session of the IPHC Research Advisory Board (RAB025).

BACKGROUND

At the previous RAB meeting, a series of actions were agreed upon for implementation by the IPHC Secretariat. These action items and progress made on their implementation are detailed in Appendix A.

DISCUSSION

Noting that best practice governance requires the prompt delivery of core tasks assigned by the Commission, at each subsequent session of the Commission and its subsidiary bodies, attempts will be made to ensure that any recommendations and 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 (i.e. a specific Contracting Party, the IPHC Secretariat, a subsidiary body of the Commission or the Commission itself);
3) a desired time frame for delivery of the action (i.e. by the next session of an subsidiary body, or other date).

This involves numbering and tracking all action items (see Appendix A) from the RAB, as well as including clear progress updates and document reference numbers.

RECOMMENDATIONS

That the RAB:

1) **NOTE** paper IPHC-2025-RAB026-03, that provided the RAB with an opportunity to consider the progress made during the inter-sessional period, in relation to the recommendations and requests of the 25th Session of the IPHC Research Advisory Board (RAB025).
2) **AGREE** to consider and revise as necessary the actions, and for these to be combined with any new actions arising from RAB026.

APPENDICES

Appendix A: Update on actions arising from the 25th IPHC Research Advisory Board (RAB025)

APPENDIX A

Update on actions arising from the 25th Session of the Research Advisory Board (RAB025)

Action No.	Description	Update
	RECOMMENDATIONS	
RAB025-Rec.01 (para. 17)	***Reproductive assessment of the female Pacific halibut population*** The RAB **RECOMMENDED** adding maturity data from maturity samples collected in 2024 to establish a revised maturity schedule covering three consecutive years of data and determine its effects in stock assessment.	Completed: Update: Maturity data from 2022-2024 has been analyzed and will be presented at the RAB026 meeting.
RAB025-Rec.02 (para. 21)	***Whale depredation mitigation strategies involving longline catch protection devices*** The RAB **NOTED** paper IPHC-2024-RAB025-06, that provided a description of an ongoing study designed to identify and test new tools to minimize marine mammal depredation of hook-captured Pacific halibut and **RECOMMENDED** that the IPHC continue efforts towards this goal.	In Progress: Update: Results from the continuation of this work during 2025 will be presented at the RAB026 meeting.
RAB025-Rec.03 (para. 35)	***IPHC Meeting Calendar (2025)*** The RAB **AGREED** that the placement of the RAB meeting in November, before the Pacific Marine Expo and prior to the Interim Meeting, over 1.5 days is optimal and **RECOMMENDED** to continue this meeting format moving forward.	Completed & Ongoing Update: The IPHC meeting calendar has been approved by the Commission to include 1.5 days for each RAB meeting.
	REQUESTS	
RAB025-Req.01 (para. 10)	***IPHC 5-year program of Integrated Research and Monitoring (2022-26)*** **NOTING** the substantial potential of incorporating AI techniques to supplement the IPHC Secretariat's current aging protocol informing on the population age structure and serving as input to the Pacific halibut stock assessment, the RAB **REQUESTED** ongoing updates on the project as part of the IPHC 5-year Program of Integrated Research and Monitoring (2022-26).	Completed & Ongoing: Update: See paper **IPHC-2025-RAB026-05**.
RAB025-Req.02 (para. 27)	***2025 FISS design evaluation*** The RAB **SUPPORTED** an annual FISS design with sufficient coverage across all Biological Regions and **REQUESTED** that the IPHC	Completed & Ongoing: Update: See paper **IPHC-2025-RAB026-08**.

Action No.	Description	Update
	Secretariat continue its efforts to obtain supplementary funding for FISS activities that would support this goal, including through direct increases in Contracting Party contribution.	
RAB025-Req.03 (para. 29)	The RAB **REQUESTED** that the IPHC Secretariat produce maps showing how long it has been since each FISS station was last sampled, and for these to be made available at RAB026, or earlier.	Completed Update: Map was created following RAB025 and has been presented at subsequent IPHC meetings.
RAB025-Req.04 (para. 30)	The RAB **REQUESTED** that the IPHC Secretariat work with relevant Contracting Party agencies to determine the feasibility of combining FISS charters alongside a vessel's commercial quota.	Completed Update: This idea was evaluated for Commissioners in 2023 and was not pursued further due to operational and legal risks to the IPHC.
RAB025-Req.05 (para. 32)	***Guidance on, and Discussion of, other Potential Applied Research Projects*** The RAB **REQUESTED** that the IPHC Secretariat collect information on possible conditions that could lead to the observed increased prevalence of sand fleas affecting longline catches.	In Progress: Update: Information on sand flea affecting host species, including Pacific halibut, is being collected both from the published literature and from individual accounts.
RAB025-Req.06 (para. 33)	The RAB **REQUESTED** that the IPHC Secretariat continue investigations on Pacific halibut juvenile stages, including the mapping of juvenile habitat throughout IPHC Convention Waters.	In Progress: Update: Data on juvenile habitat for Pacific halibut in Alaskan waters are being analysed.
RAB025-Req.07 (para. 34)	The RAB **REQUESTED** that the IPHC Secretariat set up efforts to secure vessels to conduct field studies in 2025 to test catch protection devices in areas with known whale depredation.	Completed: Update: A vessel was secured and the field studies were successfully completed in May 2025. The preliminary results will be presented at the RAB026 meeting.

OUTCOMES OF THE 101ST SESSION OF THE IPHC ANNUAL MEETING (AM101)

PREPARED BY: IPHC SECRETARIAT (D. WILSON, 8 OCTOBER 2025)

PURPOSE

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

BACKGROUND

The agenda of the Commission's Annual Meeting (AM101) included several agenda items relevant to the RAB:

3. IPHC PROCESS

3.1 Update on actions arising from the 100th Session of the IPHC Annual Meeting (AM100), 2024 Special Sessions, intersessional decisions, and the 100th Session of the IPHC Interim Meeting (IM100) (D. Wilson)
- ***IPHC-2025-AM101-03*** *Update on actions arising from the 100th Session of the IPHC Annual Meeting (AM100), 2024 Special Sessions, intersessional decisions, and the 100th Session of the IPHC Interim Meeting (IM100) (D. Wilson)*

3.2 Report of the IPHC Secretariat (2024) (D. Wilson & B. Hutniczak)
- ***IPHC-2025-AM101-04*** *Report of the IPHC Secretariat (2024) (D. Wilson & B. Hutniczak)*

3.3 2nd IPHC Performance Review (PRIPHC02): Implementation of recommendations (D. Wilson)
- ***IPHC-2025-AM101-05*** *Implementation of the Recommendations from the 2nd IPHC Performance Review (PRIPHC02) (D. Wilson)*

3.4 Reports of the IPHC Management Strategy Advisory Board (MSAB Co-Chairpersons)
- ***IPHC-2024-MSAB019-R*** *Report of the 19th Session of the IPHC Management Strategy Advisory Board (MSAB019)*
- ***IPHC-2024-MSAB020-R*** *Report of the 20th Session of the IPHC Management Strategy Advisory Board (MSAB020)*

3.5 Reports of the IPHC Scientific Review Board (SRB Chairperson)
- ***IPHC-2024-SRB022-R*** *Report of the 24th Session of the IPHC Scientific Review Board (SRB024)*
- ***IPHC-2024-SRB023-R*** *Report of the 25th Session of the IPHC Scientific Review Board (SRB025)*

3.6 Report of the 25th Session of the IPHC Research Advisory Board (RAB025) (RAB Chairperson)
- ***IPHC-2024-RAB025-R*** *Report of the 25th Session of the IPHC Research Advisory Board (RAB025)*

3.7 International Pacific Halibut Commission 5-year program of Integrated Research and Monitoring (2022-26) (D. Wilson, J. Planas, I. Stewart, A. Hicks, B. Hutniczak, & R. Webster)

- ***IPHC-2025-AM101-06*** *International Pacific Halibut Commission 5-Year program of integrated research and monitoring (2022-26): Updates (D. Wilson, J. Planas, I. Stewart, A. Hicks, B. Hutniczak, & R. Webster)*

4. FISHERY MONITORING

4.1 Fishery-dependent data overview (2024)

4.1.1 Port operations

- ***IPHC-2025-AM101-07 Rev_1*** *Fisheries data collection design and implementation in 2024 - Port Operations (M. Thom, I. Stewart, R. Webster)*

4.1.2 Fisheries data

- ***IPHC-2025-AM101-08 Rev_1*** *Fisheries data overview (2024) (B. Hutniczak, H. Tran, T. Kong, K. Sawyer van Vleck. & K. Magrane)*

4.2 Fishery-independent data overview (2024)

4.2.1I PHC Fishery-Independent Setline Survey (FISS) design and implementation in 2024 (T. Jack)

- ***IPHC-2025-AM101-09*** *IPHC Fishery-independent setline survey (FISS) design and implementation in 2024 (K. Ualesi, T. Jack, R. Rillera & K. Coll)*

5. STOCK STATUS OF PACIFIC HALIBUT (2024)

5.1 Space-time modelling of survey data (R. Webster)

- ***IPHC-2025-AM101-10*** *Space-time modelling of survey data (R. Webster)*

5.2 Stock Assessment: Data overview and stock assessment (2024)

- ***IPHC-2025-AM101-11*** *Data overview and stock assessment for Pacific halibut (Hippoglossus stenolepis) at the end of 2024 (I. Stewart, A. Hicks, R. Webster, D. Wilson)*

6. MANAGEMENT STRATEGY EVALUATION

6.1 IPHC Management Strategy Evaluation: update (A. Hicks)

- ***IPHC-2025-AM101-12*** *IPHC Management Strategy Evaluation and Harvest Strategy Policy (A. Hicks, I. Stewart, & D. Wilson)*
- ***IPHC-2025-AM101-17*** *IPHC Interim Harvest Strategy Policy (A. Hicks, I. Stewart, & D. Wilson)*

7. HARVEST DECISION TABLE 2025

7.1 Stock projections and harvest decision table 2025-2027 (I. Stewart & A. Hicks)

- ***IPHC-2025-AM101-13*** *Stock projections and harvest decision table for 2025-2027 (I. Stewart & A. Hicks)*

8. FISS DESIGN EVALUATIONS 2025-2029

8.1 2025-29 FISS design evaluation (R. Webster)

- ***IPHC-2025-AM101-14*** *2025 and 2026-29 FISS designs (R. Webster, I. Stewart, K. Ualesi, T. Jack, & D. Wilson)*

9. BIOLOGICAL AND ECOSYSTEM SCIENCES – PROJECT UPDATES

9.1 Report on Current and Future Biological and Ecosystem Science Research Activities (J. Planas)

- ***IPHC-2025-AM101-15*** *Report on Current and Future Biological and Ecosystem Science Research Activities (J. Planas)*

10. IPHC FISHERY REGULATIONS: PROPOSALS FOR THE 2024-25 PROCESS

- ***IPHC-2025-AM101-16 Rev_1*** *IPHC Fishery Regulations: Proposals for the 2024-25 process (B. Hutniczak)*

10.1 IPHC Secretariat fishery regulation proposals (B. Hutniczak)

- ***IPHC-2025-AM101-PropA1*** *IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5)*
- ***IPHC-2025-AM101-PropA2*** *IPHC Fishery Regulations: Commercial Fishing Periods (Sect. 9)*
- ***IPHC-2025-AM101-PropA3*** *IPHC Fishery Regulations: Minor amendments*

10.2 Contracting Party fishery regulation proposals (Contracting Parties)

- ***IPHC-2025-AM101-PropB1*** *IPHC Fishery Regulations: Recreational (Sport) Fishing for Pacific Halibut – IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E (Sect. 29) (Charter Management Measures in IPHC Regulatory Areas 2C and 3A (USA))*

10.3 Stakeholder fishery regulation proposals (Stakeholders)

- ***IPHC-2025-AM101-PropC1*** IPHC Fishery Regulations: Commercial Fishing Periods (Sect. 9) – year-round commercial Pacific halibut fishery in IPHC Regulatory Area 2B (R. Hauknes)
- ***IPHC-2025-AM101-PropC2*** IPHC Fishery Regulations: Application of Commercial Fishery Limits (Sect. 12) – addressing concerns regarding localized depletion around St. Matthew Island (S. McManus)
- ***IPHC-2025-AM101-PropC3*** IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5) - TCEY in Regulatory Area 2A (T. Greene)
- ***IPHC-2025-AM101-PropC4*** Other proposal (Non-IPHC Fishery Regulations): Rebuilding Plan for Pacific halibut (M. Laukitis)
- ***IPHC-2025-AM101-PropC5*** IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5) – definition of reaction to overfishing (M. Milne)

10.4 Stakeholder statements (B. Hutniczak)

- ***IPHC-2025-AM101-INF01 Rev_1*** *Stakeholder Statements on IPHC Fishery Regulations or published regulatory proposals (B. Hutniczak)*

DISCUSSION

During the course of the 101st Session of the IPHC Annual Meeting (AM101) the Commission made a number of specific recommendations and requests for action regarding the stock assessment, MSE process, and 5-year research program. Relevant sections from the report of the meeting are provided in Appendix A for the RAB's consideration.

RECOMMENDATION

That the RAB:

1) **NOTE** paper IPHC-2025-RAB026-04 which details the outcomes of the 101st Session of the IPHC Annual Meeting (AM101), relevant to the mandate of the RAB.

APPENDICES

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

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

RECOMMENDATIONS

Nil

REQUESTS

Report of the 25th Session of the IPHC Research Advisory Board (RAB025)

AM101–Req.01 (para. 21) The Commission **REQUESTED** that additional Canadian membership beyond the two (2) current RAB members would be desirable and encouraged the Canadian delegation to explore recruiting new members from Canada.

Port Operations

AM101–Req.02 (para. 30) The Commission **REQUESTED** an annual compilation of reports of comments received by the IPHC's Fisheries Data Specialists (Field) on current harvesting conditions.

Fisheries Data

AM101–Req.03 (para. 32) The Commission **REQUESTED** that the description of data on non-directed discard mortality for IPHC Regulatory Areas 3A and 3B be updated to align with the information provided in IPHC-2025-AM101-NR02 Rev_1. (Note: A Rev_2 of this paper was published on 30 January 2025 to accommodate this request in-session: IPHC-2025-AM101-08 Rev_2).

IPHC Fishery Regulations: Commercial Fishing Periods (Sect. 9) (Regulatory Area 2B)

AM101–Req.05 (para. 88) The Commission **REQUESTED** that the IPHC Secretariat prepare an analysis detailing the biological, logistical and socioeconomic effects of year-round fishing in Canada, including challenges related to data compilation and marketing implications, for presentation at AM102.

OTHER

Port Operations

Para. 29. ***NOTING*** *that the stock assessment is currently relying heavily on fishery dependent data in light of the limited footprint of the FISS in recent years, the Commission* ***AGREED*** *with the Secretariat's recommendation not to further reduce sampling in the ports selected for sampling or the periods sampled in each port at this time.*

2025-29 FISS design evaluation

Para. 61. *The Commission* ***AGREED*** *to updated priorities for the FISS as outlined in Table 4.*

Table 4. *Prioritization of FISS objectives and corresponding design layers.*

Priority	***Objective***	***Design Layer***
Primary	*Sample Pacific halibut for stock assessment and*	*Minimum sampling requirements in terms of:* • *Station distribution;*

	stock distribution estimation.	• *Station count;* • *Skates per station.*
Secondary	*Cost effectiveness without compromising the scientific integrity of the FISS design.*	*Logistics, cost, scientific integrity: operational feasibility and cost/revenue, and scientific needs. With an aspirational target reserve of US$2,000,000*
Tertiary	*Minimize removals, and assist others where feasible on a cost-recovery basis.*	*Removals: minimize impact on the stock while meeting primary priority; Assist: assist others to collect data on a cost-recovery basis; IPHC policies: ad-hoc decisions of the Commission regarding the FISS design.*

IPHC-2025-RAB026-05

INTERNATIONAL PACIFIC HALIBUT COMMISSION INTEGRATED RESEARCH AND MONITORING PLAN: DRAFT

PREPARED BY: IPHC SECRETARIAT (D. WILSON, J. PLANAS, I. STEWART, A. HICKS, B. HUTNICZAK, AND R. WEBSTER; 8 OCTOBER 2025)

PURPOSE

To provide the RAB with an update on the development of the next Integrated Research and Monitoring Plan.

BACKGROUND

Recalling that:

a) the IPHC Secretariat conducts activities to address key issues identified by the Commission, its subsidiary bodies, the broader stakeholder community, and the IPHC Secretariat;

b) the process of identifying, developing, and implementing the IPHC's science-based activities involves several steps that are circular and iterative in nature, but result in clear project activities and associated deliverables;

c) the process includes developing and proposing projects based on direct input from the Commission, the experience of the IPHC Secretariat given its broad understanding of the resource and its associated fisheries, and concurrent consideration by relevant IPHC subsidiary bodies, and where deemed necessary, including by the Commission, additional external peer review;

Also recalling that an overarching goal of the IPHC's Integrated Research and Monitoring Plans are to promote integration and synergies among the various research and monitoring activities of the IPHC Secretariat in order to improve knowledge of key inputs into the Pacific halibut stock assessment, and Management Strategy Evaluation (MSE) processes, thereby providing the best possible advice for management decision making processes.

The 1st iteration of the Plan was formally presented to the Commission at IM097 in November 2021 (IPHC-2021-IM097-12) for general awareness of the documents ongoing development. At the 98th Session of the IPHC Annual Meeting (AM098) in January 2022, the Commission requested a number of amendments which were subsequently incorporated.

In 2023 and 2024, the plan went through two cycles of review and improvement with the SRB, with amendments being suggested and incorporated accordingly. The current plan is provided at **Appendix A** for reference.

Noting that the current 5YPIRM is due to end in 2026, the Secretariat, in collaboration with the SRB, is in the process of updating the Plan to reflect changing priorities in light of major progress on research area, as well as ongoing monitoring and funding challenges.

DISCUSSION

The RAB should note that:

a) the intention is to ensure that the next plan is kept as a '*living plan*', and is reviewed and updated annually based on the resources available to undertake the work of the Commission (e.g. internal and external fiscal resources, collaborations, internal expertise);

b) the plan focuses on core responsibilities of the Commission; and any redirection provided by the Commission;

c) each year the SRB may choose to recommend modifications to the current Plan, and that any modifications subsequently made would be documented both in the Plan itself, and through reporting back to the SRB and then the Commission.

Next steps:

The SRB considered the draft of the Integrated Research and Monitoring Plan at its September meeting (SRB027: 16-18 September 2025) and provided the following suggestions for future refinement:

REQUESTS

International Pacific Halibut Commission Integrated Research and Monitoring Plan

SRB027–Req.01 (para. 12) The SRB **REQUESTED** that, in a future iteration of the Plan, the following elements be considered:

a) **Tactical workplan**: Develop a 3-5 year tactical workplan with defined milestones.

b) **Prioritizing research**: according to needs for stock assessment, MSE, and other potential applications. This may require a new process for determining priority such as sensitivity analyses on the stock assessment or MSE.

c) **Rang-wide research**: including collaboration with western Pacific Ocean countries fishing for Pacific halibut (Ref. PRIPHC02-Rec.03).

d) **Cost-benefit analysis**: innovation and emerging scientific methods could use a procedure for determining the cost-benefit of proposed or ongoing projects. For example, AI-assisted ageing and epigenetic ageing presumably have different operational costs as supplemental ageing methods (although non-lethal epigenetic ageing has other potential applications)

e) **Addition of decision-points**: to determine whether internally funded projects continue or stop. Many of the items in the IRMP are potentially open-ended but should not be continued indefinitely if the question is answered sufficiently to remove it from the high priority list. For example, questions about stock structure could certainly be continued, but they have been sufficiently addressed that the possibility of stock structure is no longer a high priority risk

f) **Observer coverage**: Evaluation of observer coverage and/or other methods of catch and discard reporting across the entire fishery (Ref. PRIPHC02-Rec.09)

g) **Dashboards**: The IRMP emphasizes outreach via websites, meetings, publications, and plain language summaries. Outputs could be made more actionable for decision-makers and other stakeholders through graphical dashboard summaries of key stock and harvest indicators, perhaps by IPHC Regulatory Area.

h) **Communication**: supplemental documentation is needed of completed projects, progress against independent review recommendations, etc., and how these may or may not affect organization and prioritization of ongoing projects. For example, the IRMP Supplement could include a brief summary of the stock structure conclusions and what that means for ongoing stock structure related projects.

i) **Measures of Success**: although the plan lists broad performance categories, there is a need for project-level indicators. Some performance measures, such as relevance and impact, may require surveys of science information users to elicit performance data.

j) **Capacity building**: Is there a formal capacity building plan to ensure the long-term viability of the IRMP?

The Secretariat is in the process of considering and incorporating the suggestions into a revised draft.

Recommendation

That the RAB:

1) **NOTE** paper IPHC-2025-RAB026-05 that provides an update on the development of the next Integrated Research and Monitoring Plan.

Appendices

Appendix A: IPHC Integrated Research and Monitoring Plan: Draft

APPENDIX A

INTERNATIONAL PACIFIC HALIBUT COMMISSION INTEGRATED RESEARCH AND MONITORING PLAN (IRMP)

Commissioners

Canada	United States of America
Mark Waddell	Jon Kurland
Neil Davis	Robert Alverson
Peter DeGreef	Richard Yamada

Executive Director

David T. Wilson, Ph.D.

BIBLIOGRAPHIC ENTRY

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ACRONYMS

AI	Artificial Intelligence
AM	Annual Meeting
CB	Conference Board
DMR	Discard Mortality Rate
FAC	Finance and Administration Committee
FISS	Fishery-Independent Setline Survey
FSC	First Nations Food, Social, and Ceremonial [fishery]
IM	Interim Meeting
IPHC	International Pacific Halibut Commission
IRMP	Integrated Research and Monitoring Plan
MP	Management Procedure
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
OM	Operating Model
PAB	Processor Advisory Board
PDO	Pacific Decadal Oscillation
QAQC	Quality assurance/quality control
RAB	Research Advisory Board
SHARC	Subsistence Halibut Registration Certificates
SRB	Scientific Review Board
TCEY	Total Constant Exploitation Yield
U.S.A.	United States of America
WM	Work Meeting

DEFINITIONS

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

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EXECUTIVE SUMMARY

To be developed once the IRMP is developed in full

1. Introduction

The International Pacific Halibut Commission (IPHC) is a public international organisation so designated via Presidential Executive Order 11059 and established by a Convention between Canada and the United States of America. The IPHC Convention was signed on 2 March 1923, ratified on 21 July 1924, and came into effect on 21 October 1924 upon exchange. The Convention has been revised several times since, to extend the Commission's authority and meet new conditions in the fishery. The most recent change occurred in 1979 and involved an amendment to the 1953 Halibut Convention. The 1979 amendment, termed a "protocol", was precipitated in 1976 by Canada and the United States of America extending their jurisdiction over fisheries resources to 200 miles. The 1979 Protocol, along with the U.S. legislation that gave effect to the Protocol (Northern Pacific Halibut Act of 1982), has affected the way the fisheries are conducted and redefined the role of IPHC in the management of the fishery. Canada does not require specific enabling legislation to implement the protocol.

The basic texts of the Commission are available on the IPHC website: https://www.iphc.int/the-commission, and prescribe the mission of the organisation as:

*"..... **to develop the stocks of [Pacific] halibut in the Convention waters to those levels which will permit the optimum yield from the fishery and to maintain the stocks at those levels**. ....." IPHC Convention*, Article I, sub-article I, para. 2). The IPHC Convention Area is detailed in Fig. 1.

The IPHC Secretariat, formed in support of the Commission's activities, is based in Seattle, WA, U.S.A. As its shared vision, ***the IPHC Secretariat aims to deliver positive economic, environmental, and social outcomes for the Pacific halibut resource for Canada and the U.S.A. through the application of rigorous science, innovation, and the implementation of international best practice.***

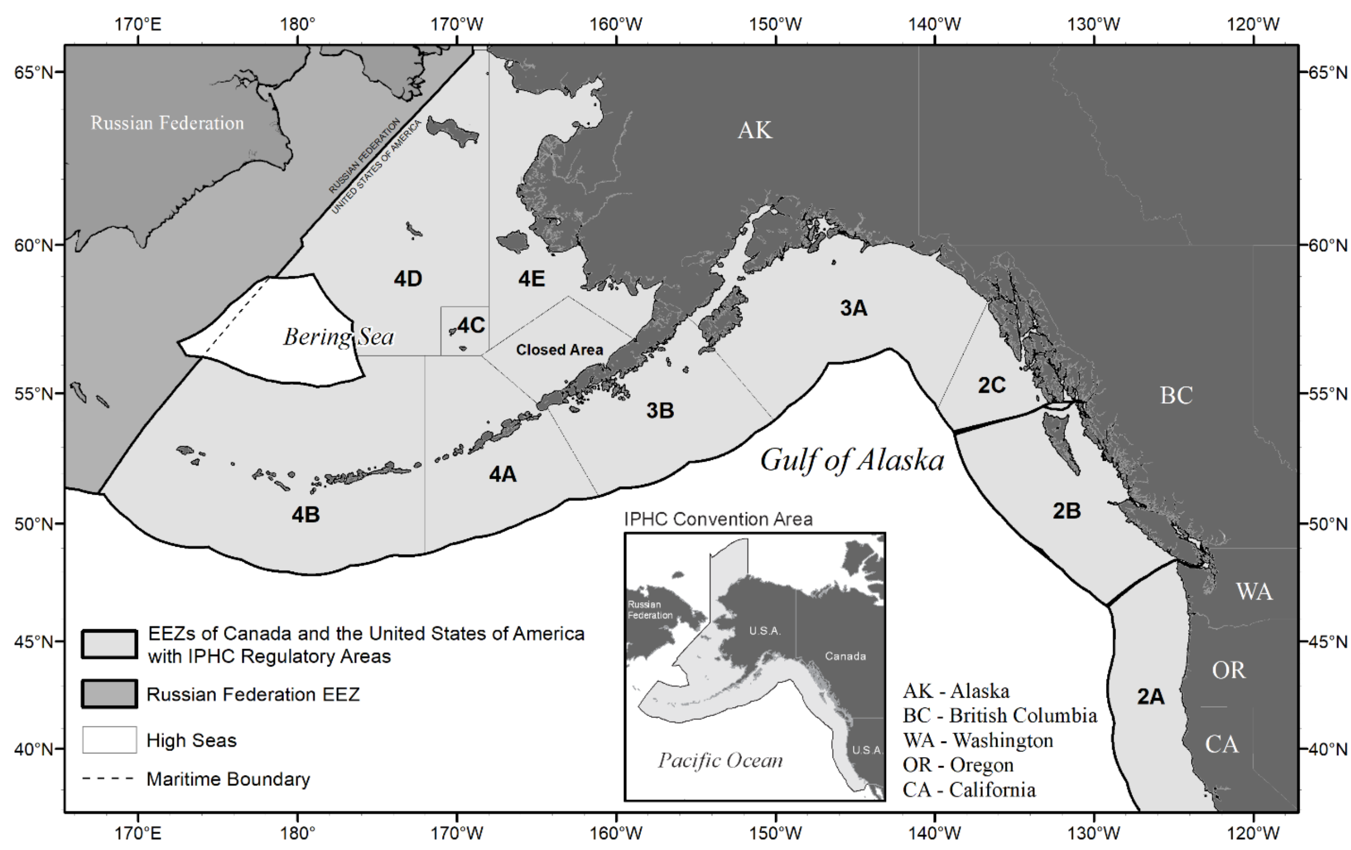

Figure 1. Map of the IPHC Convention Area (map insert) and IPHC Regulatory Areas.

2. Objectives

The IPHC has a long-standing history (since 1923) of collecting data, undertaking research, and stock assessment, devoted to describing and understanding the Pacific halibut (*Hippoglossus stenolepis*) stock and the fisheries that interact with it. Research at IPHC can be classified as "use-inspired basic research" (Stokes 1997) which combines knowledge building with the application of existing and emerging knowledge to provide for the management of Pacific halibut. The stock assessment, management strategy evaluation, management supporting information, and biology & ecology, all interact with each other as well as with fisheries monitoring activities in the IPHC program of integrated research and monitoring. Progress and knowledge building in one focal area influences and informs application in other core focal areas, also providing insight into future research priorities. The circular feedback loop is similar to the scientific method of observing a problem, creating a hypothesis, testing that hypothesis through research and analysis, drawing conclusions, and refining the hypothesis.

The IPHC Secretariat conducts activities to address key issues identified by the Commission, its subsidiary bodies, the broader stakeholder community, and of course, the IPHC Secretariat itself. The process of identifying, developing, and implementing our science-based activities involves several steps that are circular in nature, but result in clear research activities and associated deliverables. The process includes developing and proposing projects based on direct input from the Commission, the experience of the IPHC Secretariat given our broad understanding of the resource and its associated fisheries, and concurrent consideration by relevant IPHC subsidiary bodies, and where deemed necessary, additional external peer review.

Over the last ten (10) years, the research conducted by the IPHC Secretariat has been guided by two sequential detailed plans.

- 2017-2021: 5-Year Biological and Ecosystem Science Research Plan (IPHC–2019–BESRP-5YP).
- 2022-2026: 5-Year Program of Integrated Research and Monitoring (2022-2026) (IPHC-2022-5YPIRM)

The aim of the first plan (2017-2021) was to increase our knowledge on the biology of Pacific halibut in order to improve the accuracy of the stock assessment and in the management strategy evaluation (MSE) process. The IPHC-2019-BESRP-5YP contemplated research activities in five focal areas, namely Migration and Distribution, Reproduction, Growth and Physiological Condition, Discard Mortality Rates and Survival, and Genetics and Genomics. Research activities were highly integrated with the needs of stock assessment and MSE by their careful alignment with biological uncertainties and parameters, and the resulting prioritisation (IPHC–2019–BESRP-5YP). The outcomes of the IPHC-2019-BESRP-5YP (summarised in Appendix I of IPHC-2023-5YPIRM) provided key inputs into stock assessment and the MSE process and, importantly, provided foundational information for subsequent plans. The first plan (2017-2021) developed into a second broader and more inclusive plan that encompassed all research and monitoring activities planned and conducted by the IPHC Secretariat as described in the 5-Year Program of Integrated Research and Monitoring (2022-2026) (IPHC-2023-5YPIRM).

The 2nd Performance Review of the IPHC (IPHC-2019-PRIPHC02-R), carried out over the course of 2019, also provided a range of recommendations to the Commission on ways in which it could continue to improve on the quality of scientific advice being provided to the Commission. There were nine (9) specific recommendations relevant to the research and monitoring, as provided below. Of these, only recommendations 3 and 9 remain to be fully implemented and have been incorporated into this current IRMP:

Science: Status of living marine resources

*PRIPHC02–Rec.03 (para. 44) The PRIPHC02 **RECOMMENDED** that opportunities to engage with western Pacific halibut science and management agencies be sought, to strengthen science links and data exchange. Specifically, consider options to investigate pan-Pacific stock structure and migration of Pacific halibut.*

*PRIPHC02–Rec.04 (para. 45) The PRIPHC02 **RECOMMENDED** that:*

a) further efforts be made to lead and collaborate on research to assess the ecosystem impacts of Pacific halibut fisheries on incidentally caught species (retained and/or discarded);

b) where feasible, this research be incorporated within the IPHC's 5-Year Research Plan (https://www.iphc.int/uploads/pdf/besrp/2019/iphc-2019-besrp-5yp.pdf);

c) findings from the IPHC Secretariat research and that of the Contracting Parties be readily accessible via the IPHC website.

Science: Quality and provision of scientific advice

*PRIPHC02–Rec.05 (para. 63) The PRIPHC02 **RECOMMENDED** that simplified materials be developed for RAB and especially MSAB use, including training/induction materials.*

*PRIPHC02–Rec.06 (para. 64) The PRIPHC02 **RECOMMENDED** that consideration be given to amending the Rules of Procedure to include appropriate fixed terms of service to ensure SRB peer review remains independent and fresh; a fixed term of three years seems appropriate, with no more than one renewal.*

*PRIPHC02–Rec.07 (para. 65) The PRIPHC02 **RECOMMENDED** that the peer review process be strengthened through expanded subject specific independent reviews including data quality and standards, the FISS, MSE, and biological/ecological research; as well as conversion of "grey literature" to primary literature publications. The latter considered important to ongoing information outreach efforts given the cutting-edge nature of the Commission's scientific work.*

*PRIPHC02–Rec.08 (para. 66) The PRIPHC02 **RECOMMENDED** that the IPHC Secretariat develop options for simple graphical summaries (i.e. phase plot equivalents) of fishing intensity and spawning stock biomass for provision to the Commission.*

Conservation and Management: Data collection and sharing

*PRIPHC02–Rec.09 (para. 73) The PRIPHC02 **RECOMMENDED** that observer coverage be adjusted to be commensurate with the level of fishing intensity in each IPHC Regulatory Area.*

Conservation and Management: Consistency between scientific advice and fishery Regulations adopted

*PRIPHC02–Rec.10 (para. 82) The PRIPHC02 **RECOMMENDED** that the development of MSE to underpin multi-year (strategic) decision-making be continued, and as multi-year decision making is implemented, current Secretariat capacity usage for annual stock assessments should be refocused on research to investigate MSE operating model development (including consideration of biological and fishery uncertainties) for future MSE iterations and regularized multi-year stock assessments.*

*PRIPHC02–Rec.11 (para. 83) The PRIPHC02 **RECOMMENDED** that ongoing work on the MSE process be prioritised to ensure there is a management framework/procedure with minimal room for ambiguous interpretation, and robust pre-agreed mortality limit setting frameworks.*

The work outlined in this document builds on the previous Research and Monitoring Plans (IPHC–2019–BESRP-5YP; and IPHC-2023-5YPIRM), closing completed projects, extending efforts where needed, and adding new avenues in response to new information. Appendix I provides a detailed summary of the outcomes of the previous IPHC-2023-5YPIRM plan and the status of the work specifically undertaken. Key highlights relevant to the stock assessment and MSE include:

- Investigations on population genomics, including the delineation of a genetic baseline and genomic analyses of population structure.
- Population-level sampling and analysis of maturity and fecundity leading to incorporation of an updated maturity ogive in the 2025 stock assessment and ongoing progress toward an updated fecundity relationship.
- Investigations on methods for reducing whale depredation in the Pacific halibut commercial longline fishery.

All previously described research areas continue to represent critical sources of information for the stock assessment and MSE and thus are closely linked to management performance. The previous 5-year plans were successful in either providing direct new information to the stock assessment or building the foundation for the collection/analysis of such information in this updated plan. As noted below, some new priorities have emerged, and others have evolved based on the work completed to date. The incorporation of research objectives in the current IRMP that address climate change as a factor influencing Pacific halibut biology and ecology as well as fishery performance and dynamics constitutes a timely and relevant contribution towards advancing IPHC-led research to the forefront of fisheries science.

An **overarching goal** of this current *IPHC Integrated Research and Monitoring Plan* (IRMP) is to continue to promote integration and synergies among the various research and support activities of the IPHC Secretariat in order to improve the Pacific halibut stock assessment and MSE process and our knowledge of key inputs into the Pacific halibut stock assessment and MSE processes, in order to provide the best possible advice for management decision-making processes. In doing so, the Plan also responds to emerging challenges and opportunities, particularly those presented by advances in artificial intelligence (AI), to enhance analytical capacity, improve efficiency, and support innovation across scientific and operational domains. The intention is no longer to designate the Plan for a defined period, but rather, to annually review and update the Plan as needed, based on resources available to the IPHC, as well as new Commission directives.

Along with the implementation of the short- and medium-term activities contemplated in this IRMP and in pursuit of the overarching goal, the IPHC Secretariat will also aim to:

1) undertake cutting-edge research programs in fisheries research in support of fisheries management of Pacific halibut.
2) undertake groundbreaking methodological research.
3) undertake applied research.
4) establish new collaborative agreements and interactions with research agencies and academic institutions.
5) promote the international involvement of the IPHC by continued and new participation in international scientific organisations and by leading international science and research collaborations.
6) effectively communicate IPHC research outcomes
7) incorporate talented students and early researchers in research activities.

The research and monitoring activities conducted by the IPHC Secretariat are organized into the following five

(5) areas: stock assessment, MSE, biology and ecology, monitoring, and additional management support. The overall aim is to provide integrated research and monitoring where each area informs and benefits from the others (Fig. 2):

Research

1) **Stock assessment**: to improve the accuracy and reliability of the current stock assessment and the characterisation of uncertainty in the resultant stock management advice provided to the Commission;
2) **Management Strategy Evaluation (MSE)**: to develop an accurate, reliable, and informative MSE process to appropriately characterize uncertainty and provide for the robust evaluation of the consequences of alternative management options, known as harvest strategies, using defined conservation and fishery objectives;
3) **Biology and Ecology**: identify and assess critical knowledge gaps in the biology and ecology of Pacific halibut within its known range, including the influence of environmental conditions on population and fishery dynamics;

Monitoring

4) **Monitoring**: collect representative fishery dependent and fishery-independent data on the distribution, abundance, biology, and demographics of Pacific halibut through ongoing monitoring activities;

Integrated management support

5) **Additional management-supporting inputs**: respond to Commission requests for additional information supporting management and policy development.

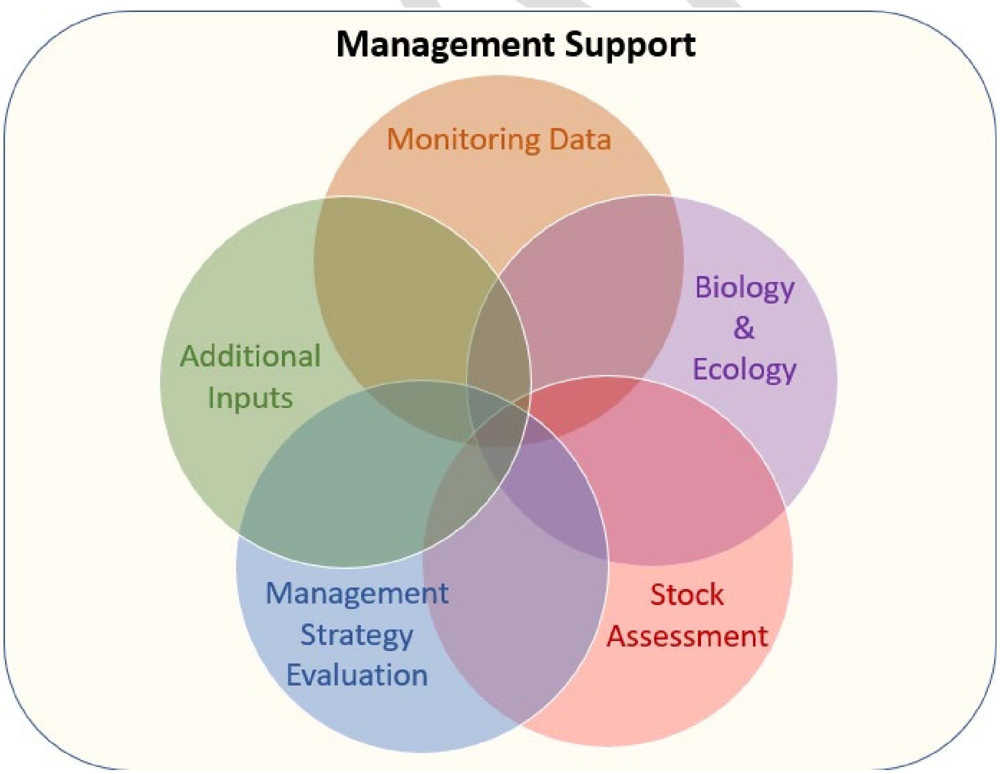

Figure 2. Core areas of the IPHC's Integrated Research and Monitoring Plan (IRMP) provide management support.

3. *Strategy*

The IPHC Secretariat has five (5) enduring strategic goals in executing our mission, including our overarching goal and associated science and research objectives, as articulated in our Strategic Plan (IPHC Strategic Plan (2023-27)): 1) To operate in accordance with international best practice; 2) Be a world leader in scientific excellence and science-based decision making; 3) To foster collaboration (within Contracting Parties and internationally) to enhance our science, monitoring, and management advice; 4) Create a vibrant IPHC culture; and 5) Set the standard for fisheries commissions globally.

Although priorities and tasking will change over time in response to events and developments, the Strategic Plan provides a framework to standardise our approach when revising or setting new priorities and tasking. The Strategic goals as they apply to the science and research activities of the IPHC Secretariat, are operationalised through a multi-year tactical activity matrix at the organisational and management unit (Branch) level (Fig. 3). The tactical activity matrix is described in the sections below and has been developed based on the core needs of the Commission, in developing and implementing robust, scientifically-based management decisions on an annual, and multi-year level. Relevant IPHC subsidiary bodies will be involved in project development and ongoing review.

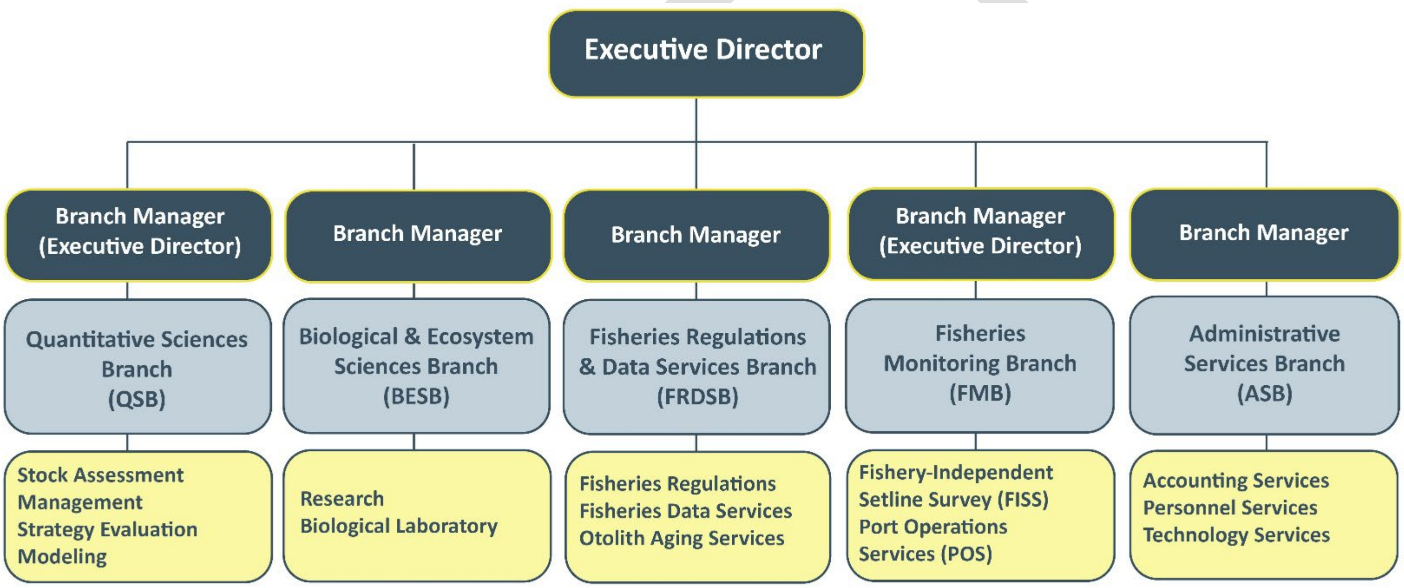

Figure 3. IPHC Secretariat organisation chart (2025).

4. *Measures of Success*

The Secretariat's success in implementing the IRMP will be measured according to the following criteria relevant to the stock assessment, the MSE, and for all inputs to IPHC management:

1) Timeliness – was the research conducted, analysed, published, and provided to the Commission at the appropriate points to be included in annual management decisions?
2) Accessibility – was the research published and presented in such a way that it was available to other scientists, stakeholders, and decision-makers?
3) Relevance - was the information used to inform decisions made by the Commission?
4) Impact – did the research improve the perceived accuracy of or provide a better estimate of the uncertainty associated with information for use in management?

5) Reliability - has research resulted in more consistent information provided to the Commission for decision-making.

4.1 Delivery of specified products

Each project line item will contain specific deliverables that constitute useful inputs into the understanding of the Pacific halibut stock and fisheries, the stock assessment, and the management strategy evaluation process, as well as support their implementation in the decision-making process at the level of the Commission.

4.2 Communication

The IPHC Secretariat will disseminate information about the activities contemplated in the IRMP and the resulting products to Contracting Parties, stakeholders, the scientific community, and the general public through a variety of channels:

1) IPHC website (www.iphc.int);
2) Formal documentation provided for IPHC meetings (Interim and Annual Meetings, Subsidiary Body meetings, etc.);
3) Presentations at national and international scientific conferences;
4) Published reports and peer-reviewed publications (section 4.4);
5) Outreach events;
6) Posts on social media platforms;
7) Informal presentations and interactions with partners, stakeholders, and decision-makers at varied times and venues when needed;
8) Accessible and plain-language summaries of key findings, where appropriate, to facilitate broader stakeholder engagement and understanding.

4.3 External research funding

The Secretariat has set a funding goal of at least 20% of the funds for our research and monitoring activities, to be sourced from external funding bodies on an annual basis. Continuing the successful funding-recruitment strategy adopted during the previous plans (Appendix II), the Secretariat will target available external funding opportunities that are timely and that aim at addressing key research objectives that have important implications for stock assessment and the MSE process. The IPHC Secretariat has the necessary expertise to propose novel and important research questions to funding agencies and to recruit external collaborators from research agencies and universities as deemed necessary. The IPHC Secretariat will continue to capitalise on the strong analytical contributions of quantitative scientists to the development of biological research questions within the framework of research projects funded by external as well as internal funding sources. While the external funding environment has changed substantially in recent years, we will continue with this goal and adapt accordingly.

4.4 Peer-reviewed journal publication

Publication of research outcomes in peer-reviewed journals will be clearly documented and monitored as a primary measure of success. This may include single publications at the completion of a particular project, or a series of publications throughout the project, as well as at its completion. Each sub-project shall be published in a timely manner and shall be submitted no later than 12 months after the end of the research. In the sections that follow, the expected publications from each research stream and cross-stream are defined.

5. Core focal areas – Background

The main activities of the IRMP involve 1) monitoring (fisheries-dependent and –independent data collection), 2) research (biological, ecological), and 3) modelling (FISS, stock assessment, and MSE), as outlined in the following sub-sections. These components are closely linked to one another, have goals that are integrated across the organisation, and all feed into management decision-making (Fig. 4). Additionally, management-supporting information constitutes a range of additional decision-making inputs within and beyond IPHC's current research and monitoring programs. The current program builds on the outcomes and experiences of the Commission arising from the implementation of the previous two (2) plans, and which are summarised in IPHC-2023-5YPIRM and Appendix I, respectively.

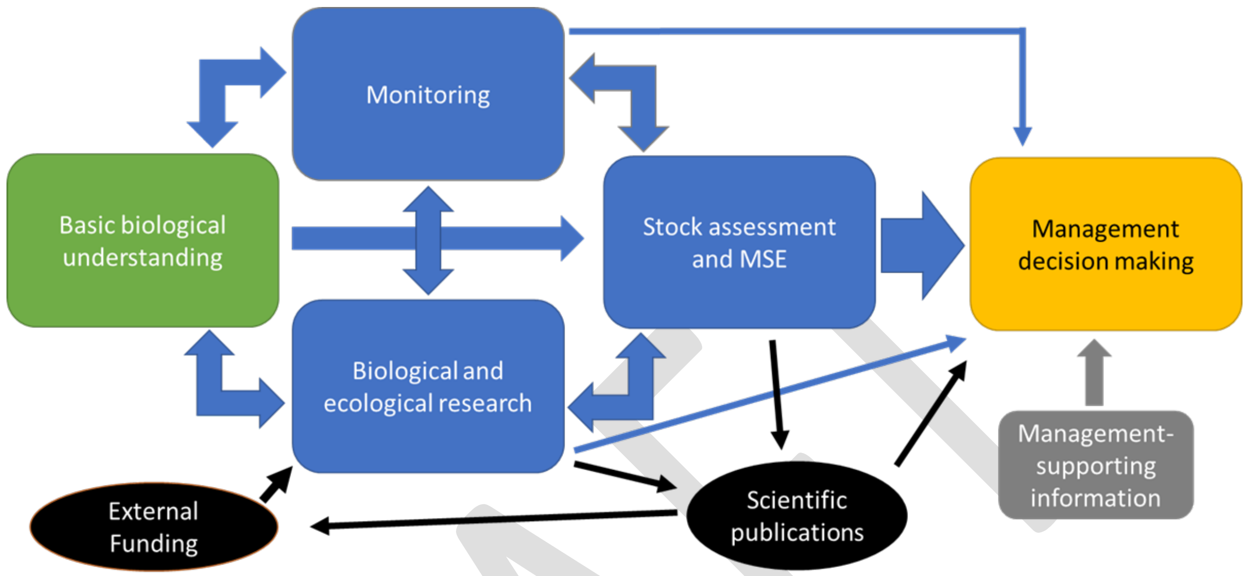

Figure 4. Flow of information from basic biological understanding of the Pacific halibut resource, through IPHC research components (monitoring, biological and ecological research, stock assessment, and MSE) to management decision-making. Management-supporting information (grey) constitutes a range of additional decision-making drivers within and beyond IPHC's current research and monitoring programs. Arrows indicate the strength (size of the arrow) and direction of information exchange. Also identified (in black) are the external links from funding and scientific publications, which supplement the IPHC's internal process.

5.1 Research

5.1.1 Stock Assessment

Focal Area Objective	To improve the accuracy and reliability of the current stock assessment and the characterisation of uncertainty in the resultant stock management advice provided to the Commission.
IPHC Website portal	https://www.iphc.int/management/science-and-research/stock-assessment

The IPHC conducts an annual stock assessment, using data from the fishery-independent setline survey (FISS), the commercial Pacific halibut and other directed and non-directed fisheries, as well as biological information from its research program and programs from other fisheries agencies. The assessment includes the Pacific halibut resource in the IPHC Convention Area, covering the Exclusive Economic Zones of Canada and the United States of America. Data sources are updated each year to reflect the most recent scientific information available for use in management decision-making.

All recent stock assessments have relied on an ensemble of four population dynamics models to estimate the probability distributions describing the current stock size, trend, and demographics. The ensemble is designed to capture both uncertainty related to the data and stock dynamics (due to estimation) as well as uncertainty related to our understanding of the way in which the Pacific halibut stock functions and is best approximated by a statistical model (structural uncertainty).

Stock assessment results are used as inputs for harvest strategy calculations, including mortality projection tables for the upcoming year that reflect the IPHC's harvest strategy policy and other considerations, as well as the harvest decision table. The harvest decision table uses the probability distributions from short-term (three-year) assessment projections to evaluate the trade-offs between alternative levels of potential yield (catch) and the associated risks to the stock and fishery.

The stock assessment research priorities have been subdivided into three categories:

1) Assessment data collection and processing;
2) technical development;
3) biological understanding and fishery yield

It is important to note that ongoing monitoring, including the annual FISS and directed commercial landings sampling activities, is not considered research and is therefore not included in this research priority list despite the critical importance of these collections. These are described in the sections below.

5.1.2 Management Strategy Evaluation (MSE)

Focal Area Objective	To develop an accurate, reliable, and informative MSE process to appropriately characterise uncertainty and provide for the robust evaluation of the consequences of alternative management options, known as harvest strategies, using defined conservation and fishery objectives.
IPHC Website portal	https://www.iphc.int/management/science-and-research/management-strategy-evaluation

Management Strategy Evaluation (MSE) is a process to evaluate alternative management options, known as harvest strategies. MSE uses a simulation tool to determine how alternative harvest strategies perform given a set of pre-defined fishery and conservation objectives, taking into account the uncertainties in the system and how likely candidate harvest strategies are to achieve the chosen management objectives.

The MSE uses an operating model that includes each part of the management cycle: the population and all fisheries, management decisions, the monitoring program, the estimation model, and potential ecosystem effects using a closed-loop simulation.

MSE is a simulation technique based on modelling the population and fisheries with closed-loop feedback from each part of the management cycle. An operating model (OM) represents aspects that are not controlled by management, such as fishery behavior, recruitment into the population, natural sources of mortality, and potential environmental and ecosystem effects. The management procedure (MP) represents the elements of the decision-making process, including data collection, estimation models (e.g. stock assessment), and harvest rules such as fishing intensity. The MP also characterizes uncertainty in the decision-making process through sampling error, estimation error, and decision-making variability.

MSE reveals the trade-offs among a range of possible management decisions, given alternative harvest strategies, preferences, and attitudes to risk. The MSE is an essential part of the process of developing, evaluating, and adopting a harvest strategy, and is used to develop and maintain a Harvest Strategy Policy.

The MSE process involves:

- Defining fishery and conservation objectives with the involvement of stakeholders and managers;
- Identifying harvest strategies (a.k.a. management procedures) to evaluate;
- Simulating a Pacific halibut population using those harvest strategies;
- Evaluating and presenting the results in a way that examines trade-offs between objectives;
- Applying a chosen harvest strategy for the management of Pacific halibut;
- Repeating this process in the future in case of changes in objectives, assumptions, or expectations.

There are many research priorities that would continue to improve the MSE framework and the presentation of future results to the Commission; they can be divided into five general categories:

1. **Objectives**: The goals and objectives that are used in the evaluation.
2. **Management Procedures (MPs)**: Specific, well-defined management procedures that can be coded in the MSE framework to produce simulated Total Constant Exploitation Yields (TCEY) for each IPHC Regulatory Area.
3. **Framework**: The specifications and computer code for the closed-loop simulations, including the operating model and how it interacts with the MP.
4. **Evaluation**: The performance metrics and presentation of results. This includes how the performance metrics are evaluated (e.g. tables, figures, and rankings), presented to the Commission and its subsidiary bodies, and disseminated for outreach.
5. **Application**: Specifications of how an MP may be applied in practice and re-evaluated in the future, including responses to exceptional circumstances.

All these categories provide inputs and outputs of the MSE process, but the Framework category benefits most from the integration of biological and ecosystem research because the operating model, the simulation of the monitoring program, the estimation model, and potential ecosystem effects are determined from this knowledge. Outcomes of the MSE process inform the Commission on updates to the Harvest Strategy Policy.

5.1.3 Biology and Ecology

Focal Area Objective	To identify and assess critical knowledge gaps in the biology and ecology of Pacific halibut within its known range, including the influence of environmental conditions on population and fishery dynamics.
IPHC Website portal	https://www.iphc.int/research/biological-and-ecosystem-science-research/

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of and fisheries for the Pacific halibut. At present, the main objectives of the Biological and Ecosystem Science Research activities at the IPHC are to: 1) identify and assess critical knowledge gaps in the biology of the Pacific halibut; 2) understand the influence of environmental conditions in the biology of the Pacific halibut and its fisheries; and 3) apply the resulting knowledge to reduce uncertainty in the stock assessment and MSE.

The primary biological research activities at the IPHC follow Commission objectives, are selected for their important management implications, and are identified and described in this current IRMP. An overarching goal of the IRMP is to promote integration and synergies among the various research activities led by the IPHC to improve our knowledge of key biological inputs that feed into the stock assessment and MSE process. The goals of the main research activities of the IRMP are therefore aligned and integrated with the IPHC stock assessment and MSE processes.

The biological research activities contemplated in the IRMP and their specific aims are detailed in Section 6. Overall, the biological research activities at the IPHC aim to provide information on 1) factors that influence the biomass of the Pacific halibut population (e.g. distribution and movement of fish among IPHC Regulatory Areas, growth patterns and environmental influences on growth in larval, juvenile and adult fish, drivers of changes in size-at-age); 2) the spawning (female) population (e.g. reproductive maturity and fecundity, skipped spawning, reproductive migrations); and 3) resulting changes in population structure and dynamics. Furthermore, the research activities of IPHC also aim to develop and evaluate methods for estimating and reducing incidental mortality of Pacific halibut, to investigate modifications of fishing gear and/or methods to reduce whale depredation and bycatch of non-targeted species, and to investigate changes in the directed Pacific halibut fishery in response to environmental, biological, and technological drivers.

5.2 Monitoring

Focal Area Objective	To collect fishery-dependent and fishery-independent data on the distribution, abundance, and demographics of Pacific halibut, as well as other key biological data, through ongoing monitoring activities.
IPHC Website portal	***Fishery-dependent data:*** • https://www.iphc.int/fisheries/commercial-fisheries/ • https://www.iphc.int/fisheries/recreational-fisheries/ • https://www.iphc.int/fisheries/subsistence-fisheries/ • https://www.iphc.int/data/time-series-datasets/ ***Fishery-independent data:*** • https://www.iphc.int/data/fishery-independent-setline-survey-fiss/ • https://www.iphc.int/data/water-column-profiler-data/

5.2.1 Fishery-dependent data

The IPHC estimates the magnitude and demographics of all Pacific halibut removals within the IPHC Convention Area and uses this information in its annual stock assessment and other analyses. These data are collected and compiled by the IPHC Secretariat and include information provided by Federal and State agencies of each Contracting Party. Specific activities in this area are described below.

5.2.1.1 Directed commercial fisheries data

The IPHC Secretariat collects logbooks, otoliths, tissue samples, and associated sex-length-weight data from directed commercial landings coastwide (Fig. 5). For each IPHC Regulatory Area, a sampling rate is determined by port and calculated annually based on the current year's mortality limits and the estimated proportion of Pacific halibut weight landed and sampled in each port. This ensures that an adequate number of biological samples is collected by IPHC Regulatory Area. Details on the data collected and sampling methods are provided in the annually updated *IPHC Directed Commercial Landings Sampling Manual* (e.g. for 2025: IPHC-2025-PSM01). Complementary to these efforts, the IPHC provides training to Tribal commercial fishery stakeholders in IPHC Regulatory Area 2A that supply additional data. In addition, the IPHC Secretariat summarises annually directed commercial fishery landings recorded by Federal and State agencies of each Contracting Party. Discard mortality for the directed commercial fishery is currently estimated using a combination of logbook, research survey, and observer data.

5.2.1.2 Recreational fisheries data

Recreational removals of Pacific halibut, including estimated recreational discard mortality, are provided by Federal and State agencies of each Contracting Party. These data are compiled annually for use in the stock assessment and other analysis.

5.2.1.3 Subsistence fisheries data

Subsistence fisheries refer to non-commercial, customary, and traditional use of Pacific halibut for direct personal, family, or community consumption, sharing as food, or customary trade. The primary subsistence fisheries include:

- the Treaty Indian Ceremonial and Subsistence fishery in IPHC Regulatory Area 2A off northwest Washington State (USA),
- the First Nations Food, Social, and Ceremonial (FSC) fishery in British Columbia (Canada), and
- the subsistence fishery in Alaska (USA), carried out by rural residents and federally recognised Native Tribes under the Subsistence Halibut Registration Certificate (SHARC) program.

Subsistence fishery removals of Pacific halibut, including estimated subsistence discard mortality, are provided by State and Federal agencies of each Contracting Party. These data are compiled annually for use in the stock assessment and other analyses.

5.2.1.4 Non-directed commercial discard mortality data

Non-directed commercial discard mortality estimates by IPHC Regulatory Area and sector are provided by State and Federal agencies of each Contracting Party and compiled annually for use in the stock assessment and other analyses.

Non-directed commercial discard mortality of Pacific halibut is estimated because not all fisheries are allowed to retain Pacific halibut, and not all discarded Pacific halibut are assumed to die. In most fisheries, non-directed commercial discard mortality is estimated directly using data from observer programs operated by Contracting Party agencies. In cases where observer data are unavailable, estimates are based on non-IPHC research surveys or other sources.

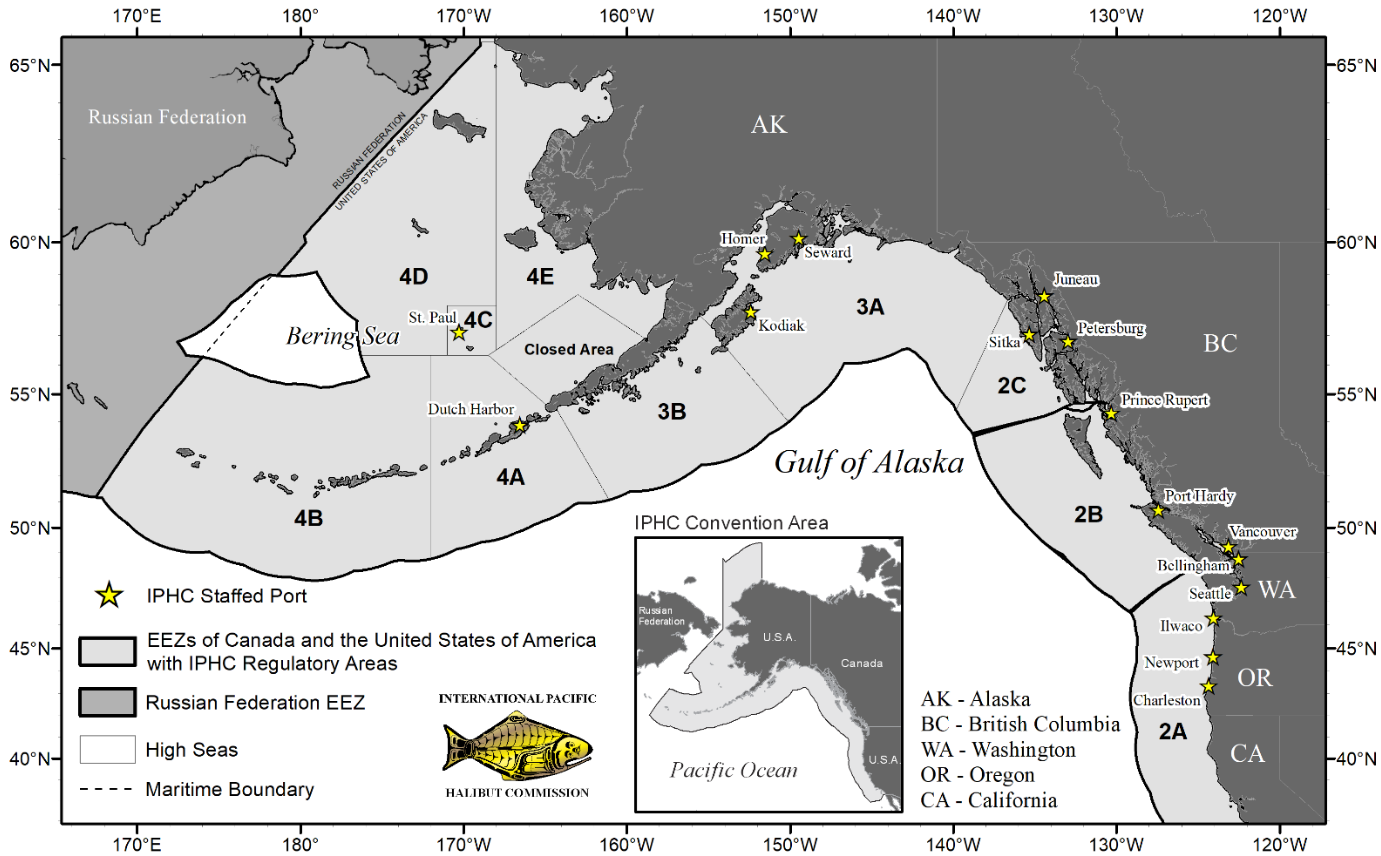

Figure 5. Ports where the IPHC has sampled directed commercial landings throughout the fishing period in recent years (note: ports sampled may change from year to year for operational reasons).

5.2.2 Fishery-independent data

Data collection and monitoring activities aimed at providing a standardised time-series of biological and ecological data that is independent of the fishing fleet.

5.2.2.1 Fishery-independent setline survey (FISS)

The IPHC Fishery-Independent Setline Survey (FISS) provides catch-rate information and biological data on Pacific halibut that are independent of the fisheries. These data, collected using standardised methods, bait, and gear, are used to estimate the primary index of population abundance used in the stock assessment. The FISS is restricted to the summer months but encompasses almost all known Pacific halibut habitat in Convention waters outside the Bering Sea, including the commercial fishing grounds in the Pacific halibut fishery. The standard FISS grid totals 1,890 stations from which a subset is sampled each year (Fig. 6). Biological data collected on the FISS (e.g. the length, weight, age, and sex of Pacific halibut) are used to monitor changes in year-class strength, biomass, growth, and mortality. In addition, records of non-target species caught during FISS operations provide the basis for estimating bait competition and are used to index species abundance over time, making them valuable to the potential management and avoidance of non-target species. Environmental data are also collected, including water column temperature, salinity, dissolved oxygen, pH, and chlorophyll concentration, to help identify the conditions in which the fish were caught, and these data can serve as covariates in space-time modeling used in the stock assessment. An example of the data collected and the methods used is provided in the annually updated FISS sampling manual (e.g. IPHC FISS Sampling Manual 2025: IPHC-2025-VSM01).

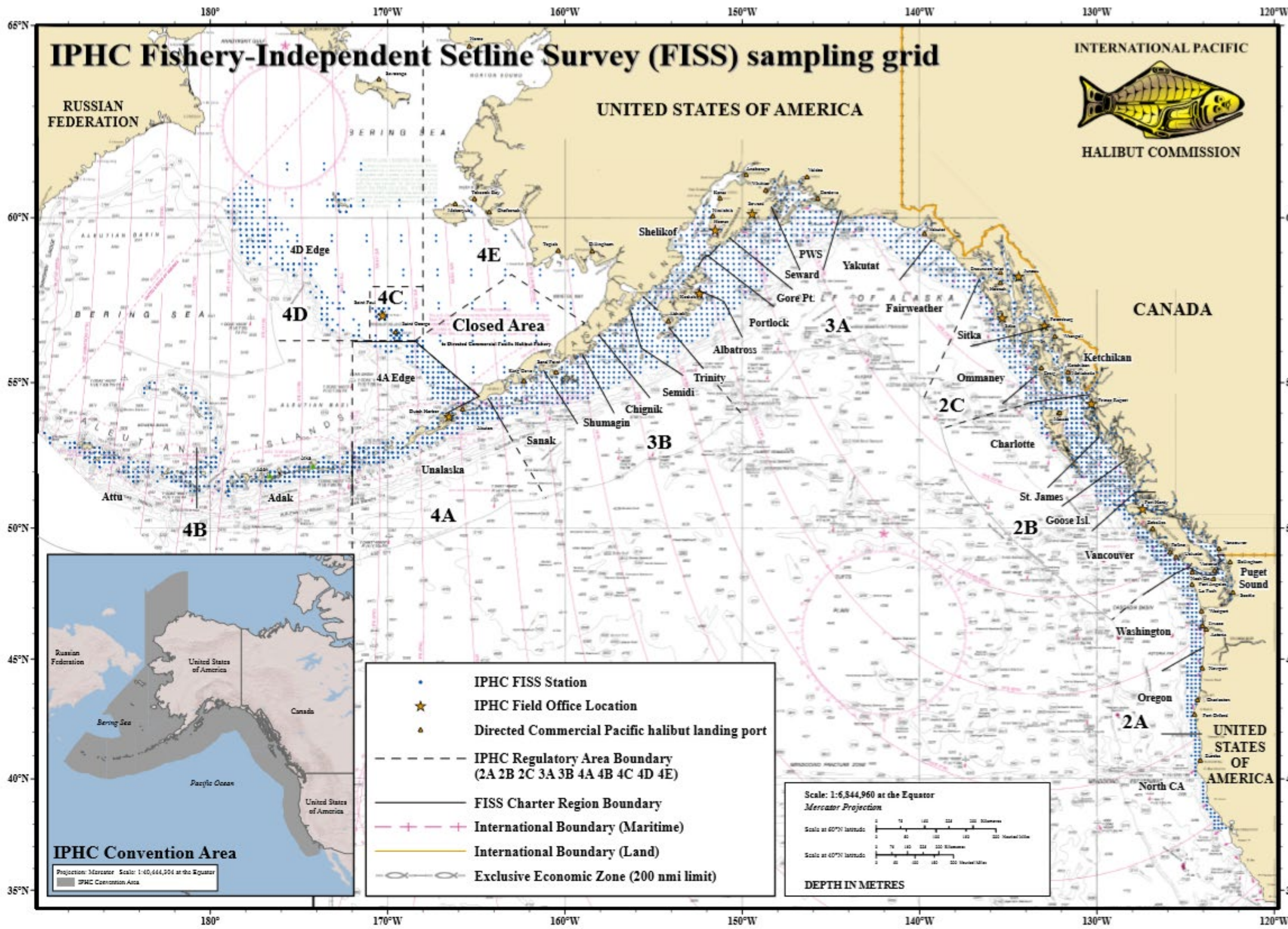

Figure 6. IPHC Fishery-Independent Setline Survey (FISS) with full sampling grid and charter regions.

Following a program of planned FISS expansions from 2014-19, a process of rationialisation of the annual FISS designs was undertaken. Currently, sampled stations are prioritised each year so that density indices will be estimated with high precision and low potential for bias. Based on funding and previous FISS results, potential FISS designs for the subsequent three years are evaluated. The resulting proposed designs and their evaluation are presented for review at the June Scientific Review Board (SRB) meetings and modified following SRB input and in-year FISS sampling results before presentation to the Commissioners at the Work Meeting and Interim Meeting. Annual biological sampling rates for each IPHC Regulatory Area are calculated based on the previous year's catch rates and an annual target of 2000 sampled fish (with 100 additional archive samples).

5.2.2.2 Fishery-independent Trawl Survey (FITS)

The IPHC relies on the NOAA Fisheries trawl surveys operating in the Bering Sea (Fig. 7), Aleutian Islands and Gulf of Alaska. The information collected from Pacific halibut caught on these surveys, together with data from the IPHC Fishery-Independent Setline Survey (FISS) is used in estimating indices of abundance and to monitor population demographics.

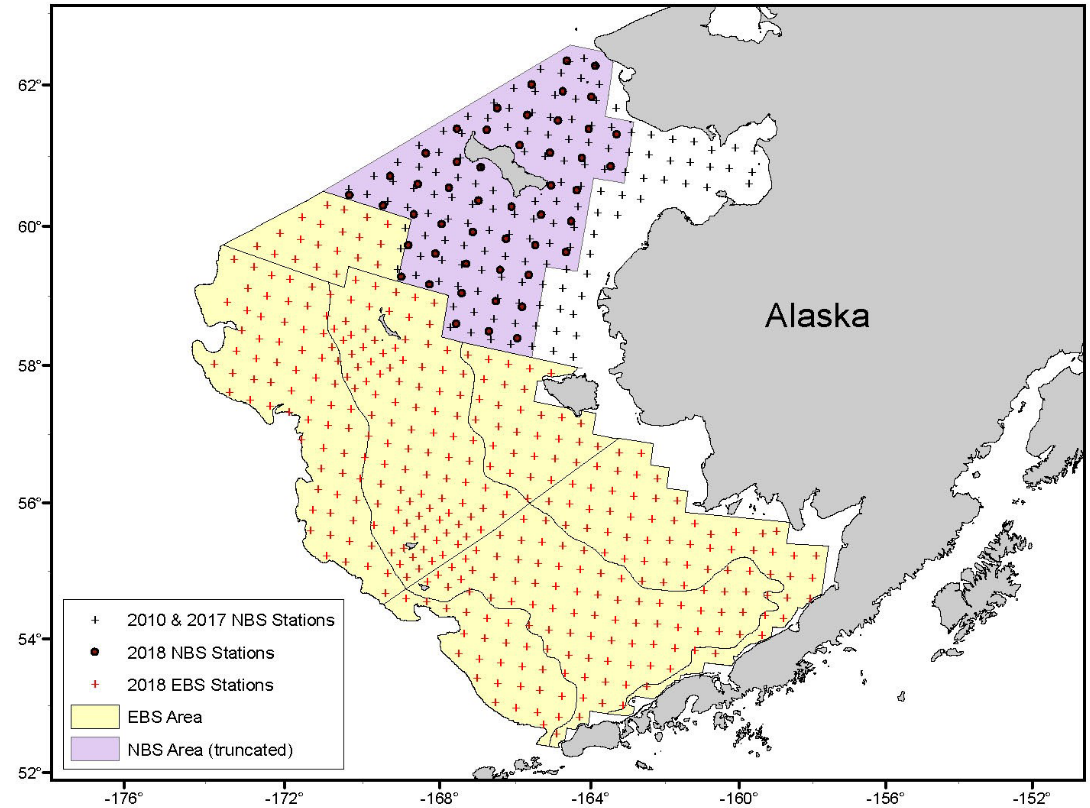

Figure 7. Representative sampling design for the NOAA Bering Sea bottom trawl survey. Black dots are stations sampled in the 2018 and black plus signs are stations sampled in subsequent Northern Bering Sea trawl surveys.

5.2.2.3 Norton Sound trawl survey

The Alaska Department of Fish and Game's annual Norton Sound trawl survey data contribute to the estimation of Pacific halibut indices of abundance in IPHC Regulatory Area 4CDE.

5.2.3 Age composition data (both fishery-dependent and fishery-independent)

Biological samples collected annually from commercial fisheries and FISS include otoliths, crystalline calcium carbonate structures found in the inner ear of fish whose growth patterns can be analysed to estimate the age of fish. Fish age is a key input to stock assessment models that inform management decisions related to fish exploitation and harvest strategies. Since its inception, the IPHC has aged over 1.5 million otoliths by trained readers under the stereoscopic microscope.

The IPHC Secretariat continues to age otoliths manually to provide the high-quality age estimates for the stock assessment. However, substantial progress has now been made toward an AI-assisted workflow. A deep-ensemble convolutional neural network (CNN) model has been developed and trained on otolith images. Adopting fine-tuning procedure, the model outputs results with progressively improving predictive accuracy. The deep ensemble approach also provides uncertainty estimates, allowing low-confidence cases to be flagged for expert review. This facilitates a mixed-method protocol where portion of high-confidence estimates is fast-tracked while manual verification is retained for the remainder.

In addition to AI-based methods, the IPHC is exploring epigenetic ageing that may offer comparable precision to traditional human-read methods, potentially expanding the toolkit for robust and scalable age estimation in the future.

5.3 Management-supporting information

To support science-based decision-making and advance the Commission's objective of developing Pacific halibut stock to the level that permits the optimum yield from the fishery over time, the IPHC Secretariat undertakes a range of supplementary analyses that provide direct input into management procedures and policy evaluations. These efforts complement the stock assessment and biological data streams by addressing specific questions raised by the Commission, domestic agencies, and other stakeholders.

In recent years, the IPHC Secretariat has undertaken a project evaluating Pacific halibut multiregional economic impact, illustrating economic interdependencies between sectors and regions to bring a better understanding of the role and importance of the Pacific halibut resource to regional economies of Canada and the United States of America. Other work has focused on regulatory questions, such as evaluating size limits and associated tradeoffs between yield optimisation, reducing discards, and economic outcomes, as well as assessing the socioeconomic and logistical challenges of implementing year-round fishing.

The IPHC Secretariat remains well-positioned to respond to requests from the Commission or Contracting Parties for technical support on a broad range of management-relevant topics. These may include, among others, socioeconomic considerations, community development, political constraints, or logistical feasibility analyses to inform emerging policy needs. Such analyses are developed collaboratively, leverage a range of available data sources and partners, and can be tailored to specific regulatory or planning contexts.

6. Core focal areas – Planned and opportunistic activities (2027-31)

The IPHC Secretariat works with IPHC advisory bodies and the Commission to identify research priorities and refine hypotheses. This process occurs via an annual schedule of meetings, as shown in Fig. 8. In May, an MSE informational session may be held to prepare stakeholders for the Management Strategy Advisory Board (MSAB) meeting in October. Recommendations related to the MSE and development of a harvest strategy are then directed to the Commission. The SRB holds two meetings each year: one in June, where requests are typically directed to IPHC Secretariat, and one in September, where recommendations are made to the Commission. The June SRB meeting has a focus on research; the September meeting represents a final check of science products to be presented to the Commission for use in management. The Research Advisory Board (RAB) meets in November to discuss ongoing research, provide guidance, and recommend new research projects. The Work Meeting (WM) is held in September to allow the IPHC Secretariat and the Commission to prepare for the Interim Meeting (IM) held in November and the Annual Meeting (AM) held in January. Outcomes from the AM include mortality limits (coastwide and by IPHC Regulatory Area), directed fishery commercial fishing period dates, domestic regulations, and requests and recommendations for the IPHC Secretariat. In conjunction with the AM are meetings of the Finance and Administration Committee (FAC), the Conference Board (CB), and the Processor Advisory Board (PAB). The Commission may also hold Special Sessions (SS) throughout the year to take up and make decisions on specific topics.

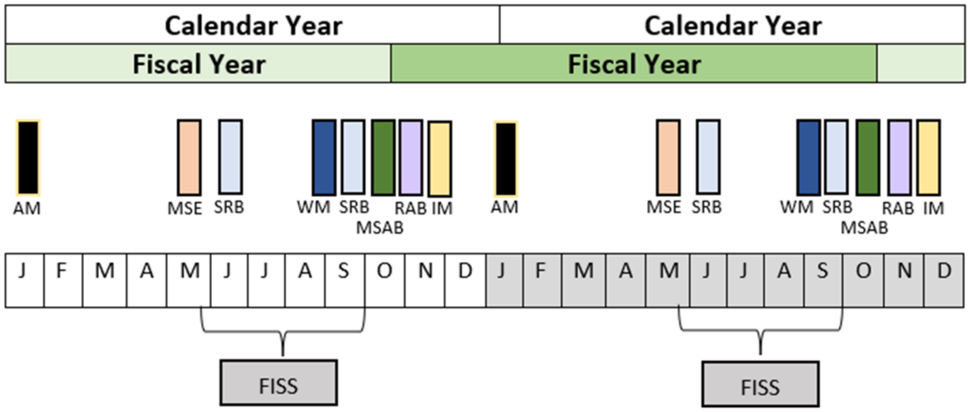

Figure 8. The typical IPHC annual meeting schedule with the calendar year and fiscal year shown. The meetings, shown in the middle row are: Annual Meeting where the Commission makes many final decisions for that year (AM), an MSE informational session (MSE), Scientific Review Board meetings (SRB), the Commission Work Meeting (WM), the Management Strategy Advisory Board meeting (MSAB), the Research Advisory Board Meeting (RAB), and the Interim Meeting (IM). The annual FISS schedule is also shown.

In addition to the annual meeting process at IPHC, individual core focal areas of research may identify and prioritise research for other core focal areas. For example, stock assessment research often identifies gaps in the knowledge of Pacific halibut biology and ecology, which then identifies priority research for the Biology and Ecology core area. Vice versa, basic biological and ecological research can identify concepts that could be better understood and result in improved implementation in any of the core areas. Furthermore, Management Strategy Evaluation can often be used to identify priority research topics for any core areas by simulation testing to identify research that may have the largest benefit to improving the management of Pacific halibut.

The top priorities of research for various categories in each of the core focal areas are provided below. The top priorities are a subset of the potential research topics in each core focal area. More exhaustive and up-to-date lists of research topics, that may extend beyond a five-year timeframe, can be found in recent meeting documents related to each core focal area.

6.1 Research

6.1.1 Stock Assessment

Within the three assessment research categories, the following topics have been identified as top priorities in order to focus attention on their importance for the stock assessment and management of Pacific halibut. A brief narrative is provided here to highlight the specific use of products from these studies in the stock assessment. More extensive lists of research topics are produced every three years as part of each full stock assessment analysis.

6.1.1.1 Stock Assessment data collection and processing

6.1.1.1.1 Commercial fishery sex-ratio-at-age via genetics

Commercial fishery sex-ratio information has been found to be closely correlated with the absolute scale of the population estimates in the stock assessment and has been identified as the greatest source of uncertainty since 2013. With only a short time-series (2017-24) of commercial sex-ratio-at-age information available for the 2025 stock assessment, the annual genetic assay of fin clips sampled from the landings remains critically important. When the time series grows longer, it may be advantageous to determine the ideal frequency at which these assays need to be conducted. This assessment priority directly informs *6.1.3.2 Reproduction* as described below.

6.1.1.1.2 Whale depredation accounting and tools for avoidance

Whale depredation represents a source of unobserved and unaccounted-for mortality in the assessment and management of Pacific halibut. Reduction of depredation mortality through improved fishery avoidance and/or catch protection would be a preferable extension and/or solution to methods for estimation. As such, research to provide the fishery with tools to reduce depredation is considered a high priority. This assessment priority directly informs *6.1.3.4.2 Fishing Innovations* as described below.

6.1.1.2 Stock Assessment technical development

6.1.1.2.1 Maintaining coordination with the MSE

The stock assessment and MSE operating models have been developed in close coordination in order to identify plausible hypotheses regarding the processes governing Pacific halibut population dynamics. Important aspects of Pacific halibut dynamics include recruitment (possibly related to extrinsic environmental factors in addition to spawning biomass), size-at-age, movement/migration, and spatial patterns in fishery catchability and selectivity. Many approaches developed as part of the tactical stock assessment have been explored in the MSE operating model, and conversely, the MSE operating model has highlighted areas of data uncertainty or alternative hypotheses for exploration in the assessment (e.g. movement rates). Although these two modelling efforts target differing objectives (tactical vs. strategic), continued coordination is essential to ensure that the stock assessment and the MSE represent the Pacific halibut similarly and provide consistent and useful advice for tactical and strategic decision-making.

6.1.1.2.2 Estimation of natural mortality

The stock assessment has been shown to be extremely sensitive to the value of natural mortality. The current approach uses four separate models to estimate management quantities, with three of these models estimating natural mortality directly from the data and one using a fixed historical assumption. Further work to determine the conditions under which natural mortality is estimable in the fourth model and plausible ranges of values for this parameter could reduce perceived and actual uncertainty in the stock assessment and the management information arising from it. As time-series of critically informative data sources like the FISS and the sex-ratio of the commercial landings grow longer, it may be possible to better integrate this source of uncertainty into the stock assessment ensemble.

6.1.1.2.3 Development of state-space models

The IPHC has relied on statistical catch-at-age models for most of its stock assessment history (Stewart and Martell 2014). New programming environments (e.g., TMB; Kristensen et al. 2016) have led to an increased use of state-space models for stock assessment (e.g. SAM, WHAM; Nielsen and Berg 2014; Nielsen et al. 2021; Stock and Miller 2021). These models provide extremely efficient capabilities for modelling random effects and sparse matrices. As the Pacific halibut stock assessment models include time-varying processes (i.e. recruitment, selectivity, and catchability), it would be ideal to treat them as random effects, rather than using the penalised likelihood approach currently employed. Although few such applications include sex-specific dynamics that can accommodate the necessary dimorphic growth capability to be applicable to Pacific halibut, development of a state-space model for Pacific halibut is prioritised in this research plan.

6.1.1.3 Stock Assessment biological inputs

6.1.1.3.1 Maturity, skip-spawning, and fecundity

Management of Pacific halibut is currently based on reference points that rely on relative female spawning biomass. Therefore, any changes to the understanding of reproductive output – either across age/size (maturity), over time (skip spawning), or as a function of body mass (fecundity) are crucially important. Each of these components directly affects the annual reproductive output estimated in the assessment. Ideally, the IPHC would have a program in place to monitor each of these three reproductive processes over time and use that information in the estimation of the stock-recruitment relationship and the annual reproductive output relative to reference points. This would reduce the potential for biased time-series estimates created by non-stationarity in these traits (illustrated via sensitivity analyses in several of the recent assessments). Building on the success of the previous research plan, we now have an updated maturity relationship included in the 2025 stock assessment. Moving forward, we will extend that research to include an updated fecundity relationship and an investigation of the potential for skip-spawning. After updated stock-wide estimates have been achieved, a program for extending this information to a time-series via transition from research to monitoring can be developed. This assessment priority directly informs *6.1.3.2 Reproduction* as described below.

6.1.1.3.2 Factors affecting size-at-age

Changes in size-at-age, along with recruitment, have been the largest contributors to the historical trends in biomass and fishery yield from the Pacific halibut stock. The relative role of potential factors underlying changes in size-at-age is not currently understood. Delineating between competition, density dependence, environmental effects, size-selective fishing, and other factors could allow improved prediction of size-at-age under future conditions and a better understanding of how management can adapt to changing trends.

6.1.2 Management Strategy Evaluation

MSE priorities have been subdivided into three categories: 1) biological parameterisation, 2) fishery parameterisation, and 3) technical development. Research provides specifications for the MSE simulations, such as inputs to the Operating Model (OM), but another important outcome of the research is to define the range of plausibility to include in the MSE simulations as a measure of uncertainty. The following topics have been identified as top priorities.

6.1.2.1 MSE Biological and population parameterisation

6.1.2.1.1 Distribution of life stages

Research topics in this category will mainly inform parameterisation of movement in the OM but will also provide further understanding of Pacific halibut movement, connectivity, and temporal variability. This knowledge may also be used to refine specific MSE objectives. Larval and juvenile distribution is a main source of uncertainty in the OM and continued research in this area will improve the OM and provide justification for parameterising temporal variability. Outcomes may also provide information on recruitment strength and the relationship with environmental factors. For example, recent work by Sadorus et al (2021) used biophysical and spatio-temporal models to examine connectivity across the Bering Sea and Gulf of Alaska. Furthermore, improved understanding of the distribution of adults resulting from ontogenetic movement will assist with conditioning the OM, verify patterns simulated from the OM, and provide information to develop reasonable sensitivity scenarios to test the robustness of MPs. Research under Section 6.1.3.1 will inform this MSE priority.

Finally, genomic analysis of population size (close-kin mark-recapture, *6.1.3.1*) is also included in this ranked category. Close-kin mark-recapture (CKMR) may provide insights into spatial relationships between juveniles and adults as well as abundance in specific regions. It would help inform the development of the OM as well as the biological sustainability objective related to maintaining a minimum spawning biomass in each IPHC Regulatory Area. An understanding of the spatial distribution of population size will help to inform this objective as well as the OM conditioning process.

6.1.2.1.2 Understanding growth variation

Changes in the average weight-at-age of Pacific halibut is one of the major drivers of changes in biomass over time. The OM currently simulates temporal changes in weight-at-age via a random autocorrelated process which is unrelated to population size or environmental factors. Ongoing research in drivers related to growth in Pacific halibut will help to improve the simulation of weight-at-age. Research under Section 6.1.3.3 will inform this MSE priority.

6.1.2.1.3 Spatial spawning patterns and connectivity between spawning populations

Further research into sub-population structure and connections between those sub-populations would provide an understanding of the importance of spatial heterogeneity in the Pacific halibut population. This may be incorporated directly into the OM, and/or into an objective to maintain spatial heterogeneity. This includes the identification of important spawning locations, temporal variability in spawning and recruitment, and the importance of spawning locations to a sustainable population and efficient fisheries across the IPHC convention area. This research is described in Section 6.1.3.1 below.

6.1.2.1.4 MSE fishery parameterisation

The definition of fisheries and their parameterisations in the MSE operating model involved consultation with Pacific halibut stakeholders, but some aspects of those parameterisations would benefit from targeted research. One specific example is knowledge of discarding and discard mortality rates in directed and non-directed fisheries. Discard mortality can be a significant source of fishing mortality in some IPHC Regulatory Areas, and appropriately modelling that mortality will provide a more robust evaluation of MPs. Research under Sections 6.1.3.4 will inform this MSE priority.

6.1.2.2 MSE technical development

Technical improvements to the MSE framework will allow for rapid development of alternative operating models and efficient simulation of management strategies for future evaluation and support of the Harvest Strategy Policy. Coordination with the technical development of the stock assessment (Section 6.1.1.2.1) is necessary to ensure consistent assumptions and hypotheses for tactical (i.e. stock assessment) and strategic (i.e. MSE) models. Investigations done in the stock assessment will inform the MSE operating model, which will then inform management and stock assessment development through investigations using the closed-loop simulation framework. Conducting assessments at intervals longer than annually may allow for additional opportunity to coordinate between stock assessment and MSE.

6.1.2.2.1 Alternative migration scenarios

Including alternative migration hypotheses in the MSE simulations will assist in identifying management procedures that are robust to this uncertainty. This exploration will draw on general research on the movement and migration of Pacific halibut, observations from FISS and fisheries data, and outcomes of the stock assessment. Identification of reasonable hypotheses for the movement of Pacific halibut is essential to the robust investigation of management procedures. Research under Section 6.1.3.1 will inform this MSE priority.

6.1.2.2.2 Realistic simulations of estimation error

Closed loop simulation uses feedback from the management procedure to update the population in the projections. The management procedure consists of data collection, an estimation model, and harvest rules; currently IPHC uses a stock assessment as the estimation model. Future development of an efficient simulation process to mimic the stock assessment will more realistically represent the current management process. This involves using multiple estimation models to represent the ensemble and appropriately adding data and updating those models in the simulated projections. Improvements to the current MSE framework include adding additional estimation models to better represent the ensemble stock assessment, ensuring that the simulated estimation accurately represent the stock assessment now and, in the future, and speeding up the simulation process.

6.1.2.2.3 Incorporate additional sources of implementation uncertainty

Implementation uncertainty consists of three subcategories: 1) decision-making uncertainty, 2) realised uncertainty, and 3) perceived uncertainty. Decision-making uncertainty is the difference between mortality limits determined from the management procedure and those adopted by the Commission. This uncertainty is currently implemented in the MSE framework but improvements could be made. Realised uncertainty is the difference between the mortality limit set by the Commission and the actual mortality realised by the various fisheries. This type of uncertainty is currently partially implemented in the MSE framework. Finally, perceived uncertainty is the difference between the realised mortality and the estimated mortality limits from the various fisheries, which would be used in the estimation model. This third type of implementation uncertainty has not been implemented in the MSE framework. Improving the implementation of decision-making uncertainty is a priority for the MSE and will assist in understanding the performance of management procedures given the flexibility desired by the Commission.

6.1.2.3 Potential Future MSE projects

Management Strategy Evaluation is an iterative process where new management procedures may be evaluated, current management procedures may be re-evaluated under different assumptions, and the understanding of the population, environment, and fisheries may be updated with new information stemming from the stock assessment and biological/ecological research. The current research priorities focus on technical development, but various elements of Management Procedures will likely be of interest once technical improvements are made. The research being done now will inform the development of the MSE in the future to ensure a robust evaluation of any management procedure.

6.1.3 Biology and Ecology

Capitalising on the outcomes of the first 5-year plan (IPHC–2019–BESRP-5YP), the second 5-year plan (IPHC-2022-5YPIRM) developed five research areas to provide key inputs for stock assessment and the MSE process. In addition to linking genetics and genomics with migration and distribution studies in the area of Migration and Population Dynamics, a novel research area on Fishing Technology was incorporated in the IPHC-2023-5YPIRM. The outcomes of IPHC-2023-5YPIRM are provided in Appendix I, and the resulting peer-reviewed publications are provided in Appendix III. The present plan (IPHC-2026-5YPIRM) describes the continuation of these five research areas into the next phase of management-serving research goals, with Fishing Technology being incorporated into a new research area that includes Mortality Estimations and Fishery Practices and Behavior. A series of key objectives for each of the five research areas has been identified that integrate with specific needs for stock assessment and MSE processes and that are ranked according to their relevance (Appendix IV and Appendix V, respectively). To further describe the IPHC Secretariat's rationale for establishing research priorities, a ranked list of biological uncertainties and parameters for stock assessment and the MSE process, and their links to research activities and outcomes derived from the IRMP is also provided.

6.1.3.1 Migration and Population Dynamics

Studies aimed at improving current knowledge of Pacific halibut distribution and population dynamics throughout all life stages in order to achieve a complete understanding of stock structure and distribution across the entire range of Pacific halibut in the North Pacific Ocean and the biotic and abiotic factors that influence it through multiple approaches. Specific objectives in this area include:

- Integrate analyses of Pacific halibut population dynamics, connectivity, and distribution changes by incorporating genomic approaches.
- Improve our understanding of the influences of oceanographic and environmental variation on connectivity, population structure, and adaptation at a genomic level using seascape genomics approaches.
- Improve our understanding of population structure.
- Improve our understanding of the contribution of known and putative (e.g. Washington coast) spawning areas to nursery/settlement areas in relation to year-class, recruit survival and strength, juvenile genetic diversity, and environmental conditions in the North Pacific Ocean.
- Improve our understanding of the relationship between the presence of juveniles in mapped nursery/settlement areas and adult distribution and abundance over temporal and spatial scales.
- Build upon the current conceptual model of Pacific halibut movement through a synthetic analysis of existing tagging data.
- Apply methods for individual identification based on computer-assisted tail image matching systems as an alternative for traditional mark and recapture tagging.

Horizon scan:

- Evaluate the potential use of environmental DNA (eDNA) for improving current understanding of Pacific halibut distribution and assist with mapping of juvenile habitat.
- Examine the feasibility of close-kin mark-recapture-based approaches to improve estimates of population size, migration rates among geographical regions, and demographic parameters (e.g. fecundity-at-age, natural mortality).

6.1.3.2 Reproduction

Studies aimed primarily at addressing several critical issues for stock assessment analysis based on estimates of female spawning biomass: 1) the sex ratio of the commercial catch; 2) revised maturity estimates, and 3) fecundity estimates. Specific objectives in this area include:

- Continued temporal and spatial analysis of female histology-based maturity-at-age estimates: identification of potential drivers (e.g. environmental, etc.) of temporal and spatial changes in maturity schedules.
- Develop and validate methods for fecundity estimations based on the auto-diametric method applied to other species.
- Provide estimates of fecundity-at-age and fecundity-at-size.
- Investigate the possible presence of skip spawning in Pacific halibut females.
- Improve accuracy in the current staging criteria of maturity status used in the field.
- Investigate possible environmental effects on the ontogenetic establishment of the phenotypic sex and their influence on sex ratios in the adult Pacific halibut population.
- Improve our understanding of the genetic basis of variation in age and/or size-at-maturity, fecundity, and spawning timing, by conducting genome-wide association studies.
- Characterise the temporal progression of reproductive development and gamete production throughout an entire annual reproductive cycle in male Pacific halibut.

6.1.3.3 Growth and size-at-age

Studies aimed at describing the role of factors responsible for the observed changes in size-at-age and at evaluating growth and physiological condition in Pacific halibut. Specific objectives in this area include:

- Investigate the effects of environmental and ecological conditions driving size-at-age and somatic growth in Pacific halibut.
- Investigate the influence of early growth (e.g. juveniles) in determining growth patterns during adulthood. Analysis of NMFS trawl data and investigation of potential early life regulatory mechanisms (e.g. epigenetic, etc.) that direct adult growth patterns.
- Investigate variation in somatic growth patterns in Pacific halibut as informed by physiological growth markers, physiological condition, energy content, and dietary influences.
- Evaluate the relationship between somatic growth, temperature, and trophic histories in Pacific halibut through the integrated use of physiological growth markers (e.g. gene expression, stable isotope profiles).
- Develop a non-invasive alternative method for aging Pacific halibut based on genetic analyses of DNA methylation patterns in tissues (fin clips). Development of an epigenetic clock and possible insights into the aging process/senescence in Pacific halibut.
- Improve our understanding of the genetic basis of variation in somatic growth and size-at-age by conducting genome-wide association studies.
- Explore emerging technological advances in genome sequencing that produce genomic and epigenetic data (e.g. PacBio, Oxford Nanopore) to assist in understanding the genetic and epigenetic basis of growth.
- Investigate the feasibility of otolith (or eye lens lamina) growth increment analyses for reconstructing individual growth histories in Pacific halibut.

Horizon scan:

- Investigate dietary composition in stomachs through metabarcoding (i.e. molecular identification of prey items in stomach contents).
- Investigate liver parasite loading and its effect on physiological conditions in Pacific halibut

6.1.3.4 Fishery dynamics and fishing technology

6.1.3.4.1. Mortality estimations. Studies aimed at developing and evaluating methods for estimating and reducing incidental mortality of Pacific halibut. Specific objectives in this area include:

- Incorporate experimentally-derived discard mortality rate data in the recreational fishery (based on research conducted under IPHC-2023-5YPIRM) into management.
- Review status of discard mortality rate (DMR) research conducted by the IPHC: synthesis paper of experimentally-derived DMR for Pacific halibut in different fisheries, with future research avenues and management recommendations.
- Investigate the application of electronic monitoring and AI-based analyses of discards for mortality estimations.
- Investigate new methods (e.g. AI-based) for improved estimation of depredation mortality from marine mammals.
- Support and collaborate in efforts to reduce Pacific halibut bycatch in other fisheries

- Investigate potential biological and ecological causes of mortality in Pacific halibut.

6.1.3.4.2. Fishing innovations. Studies investigating modifications of fishing gear/methods with the purpose of reducing depredation of Pacific halibut by toothed whales and reducing bycatch of non-targeted species. Specific objectives in this area include:

- Prepare a review paper summarising past and present directed (fixed) gear-related research by the IPHC.
- Investigate methods for whale avoidance and/or deterrence for the reduction of Pacific halibut depredation by whales (e.g. catch protection methods, pots).
- Investigate physiological and behavioral responses of Pacific halibut to fishing gear in order to increase the catch and reduce bycatch of non-targeted species: influence of lights on fishing gear, hook size, design or modification, pots, etc.

6.1.3.4.3. Fishery practices and behavior. Studies aimed at investigating changes in the directed Pacific halibut fishery in response to environmental, biological, and technological drivers. Specific objectives in this area include:

- Investigations into the interaction between climate change and fishing patterns
- Evaluations of the effects of sand fleas- and dogfish-prevalent areas on longline fisheries
- Tradeoffs of snap, fixed, and Autoline gear use on fishery efficiency.

6.2 Monitoring

The Commission's monitoring programs include both direct data collection by the IPHC Secretariat and coordination with domestic agencies to generate comprehensive fishery-dependent and fishery-independent information on Pacific halibut stock and fishery trends. These critical sources include estimates of fishing mortality across all fisheries encountering Pacific halibut, biological sampling from these fisheries, as well as catch rates and biological sampling from longline and trawl surveys. Monitoring data will continue to underpin the stock assessment and MSE process, support numerous biological research studies, and inform the decision-making process (Fig. 4).

6.2.1 Fishery-dependent data

The IPHC Secretariat will continue collecting fishery-dependent data from the directed commercial fishery, with a focus on maintaining adequate spatial and temporal coverage of catch, effort, and biological data. Coordination with Tribal, State and Federal agencies will continue to support the standardisation of data collection protocols, increase data collection capacity, improve reporting consistency, and help identify and fill data gaps that may impact stock assessment and management.

Collaborative work with commercial stakeholders will also continue to further the use of electronic logbooks which began in 2023, to enhance the accuracy and efficiency of data submission. The ongoing development of digital QA/QC systems will strengthen data integrity, ease operational demands, and increase the capacity of IPHC Secretariat for other advancements.

Efforts will include annual reviews of sampling distribution across ports, data collection methods, sampling rates, and QA/QC procedures, with in-season assessments of port sampling completely yearly. These initiatives aim to ensure that data collection continues to support stock assessment, MSE, and management needs, while integrating relevant research findings into long-term monitoring strategies.

6.2.2 Fishery-independent setline survey (FISS)

An annual review process for the FISS station design has been developed (Fig. 9) and is expected to continue in the coming years. This process involves scientific review of proposed FISS designs by the Scientific Review Board and includes input from stakeholders prior to review and approval of designs by the Commissioners.

Sample rates for genetic monitoring will need to be determined for future sampling. Sampling rates of otoliths for aging, archive otoliths, and tagged fish will continue to be reviewed annually to ensure the data needs of the IPHC stock assessment and research program are met. Annual FISS sampler training and data QAQC (including at the point of data collection and during post-sampling review) will ensure high-quality data from the FISS program.

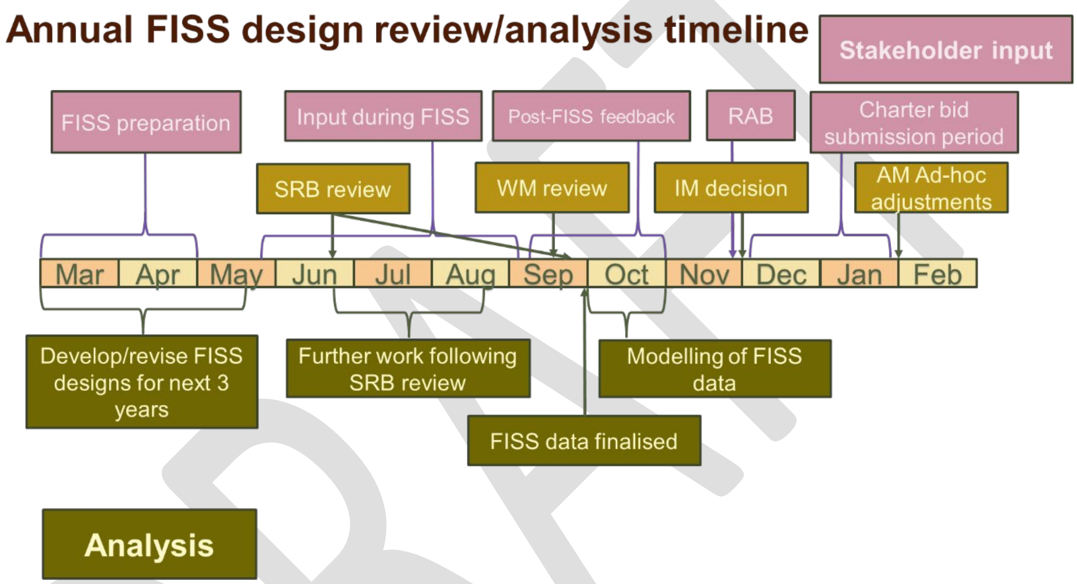

Figure 9. Timeline of annual FISS design review process.

6.2.2.1 Fishery-independent Trawl Survey (FITS)

The IPHC will continue to collaborate with NMFS on sampling procedures for Pacific halibut and on the placement of an IPHC sampler onboard a survey vessel for the collection of biological data.

6.2.3 Ageing methods (both fishery-dependent and fishery-independent)

6.2.3.1. Application of artificial intelligence (AI) for determining the age of fish from images of collected otoliths.

Progress in applying AI for determining the age of Pacific halibut from images of collected otoliths presents both opportunities and challenges, particularly in balancing gains in efficiency with the need to maintain data integrity and spatiotemporal consistency.

Integration and testing in the assessment: AI-generated ages will be introduced as an auxiliary input in a split-sample experiment. One assessment run will use the current manual series, while a parallel run will blend AI-derived ages ranked by confidence estimates (based on standard deviation scores), selecting increasing proportions (e.g., 25%, 50%, and 75%) of AI-derived ages, with manual ages used elsewhere. Additional assessment runs may explore prediction performance across regions and years that are not represented or are underrepresented in the training data, in order to understand the potential for bias when applying AI out-of-sample. Further development of accuracy and imprecision matrices will support comparisons between manual ages and different blends of AI-derived ages, based on ranked confidence thresholds. Uncertainty in management quantities and year-class strengths will be used to evaluate the robustness of incorporating AI-derived ages into the stock assessment model.

Cost-benefit analysis: The comparative scenarios will include the current manual-only protocol and hybrid protocols that apply AI-derived ages to high-confidence images. Evaluation metrics will include labor costs, turnaround time, variance in cohort-specific age compositions, and implications for stock assessment performance, particularly with respect to stability and reliability in informing mortality limit decisions.

Spatial-coverage considerations: As currently observed, AI accuracy declines when applied to otolith images from regions or years not represented in the training data. If future reductions in spatial coverage of the FISS occur, the risk of regional data imbalances in the training set may increase, potentially affecting AI reliability. However, this limitation may be mitigated over time as the training database expands to include a broader diversity of samples, potentially improving the model's generalisation across space and time. To ensure robustness in the interim, the continued inclusion of a subset of manually aged otoliths remains important. Additionally, the AI model can be fine-tuned using targeted market samples to reinforce spatial coverage and improve training representativeness when needed.

6.2.3.2. Application of an epigenetic clock for aging Pacific halibut using fin clips.

Epigenetic aging is a genetic method for aging that is based on the fact that methylation patterns on genomic DNA change predictably with age. Therefore, age-associated DNA methylation patterns can be modelled to generate molecular (i.e., epigenetic) age predictors capable of estimating chronological age with high accuracy. These are referred to as "epigenetic clocks" and can be developed from DNA isolated from any tissue, including non-lethal biological samples, such as a fin clip.

The objective of this project is to develop an epigenetic clock for Pacific halibut using fin clips from Pacific halibut of known ages. The specific objectives are (1) to identify DNA methylation signals in Pacific halibut fin tissue, (2) to develop an age prediction model based on age-associated DNA methylation patterns, and (3) to develop a targeted assay with selected age-associated epigenetic markers for cost-effective, high-throughput age estimations in Pacific halibut.

6.3 Management-supporting information

6.3.1 Potential of integrating human dynamics into management decision-making

Effective Pacific halibut management requires understanding not only biological stock dynamics, but also the human dimensions that shape fishery outcomes (Lane and Stephenson 1995). As new technologies such as AI, digital logbooks, and real-time monitoring evolve, so too does the potential to integrate human behavior, economic dependencies, and community-level impacts into the management framework.

Recent socioeconomic analyses conducted by the IPHC highlight disparities in how different regions and user groups benefit from Pacific halibut fisheries, and how external forces such as shifting markets and climate change can amplify these differences (Cheung and Frölicher 2020). Recognising these factors can improve both the fairness and resilience of fishery policies.

Looking ahead, the IPHC Secretariat aims to be prepared to integrate human dynamics, such as fleet behavior, market access, or social vulnerability, into stock assessment and MSE, where such complementary analyses may add value to the decision-making process (Lynch et al. 2018). This may include linking fishery performance metrics to socioeconomic indicators or exploring how alternative management scenarios affect community and fisher behavior. These efforts will ensure that science-based advice not only supports biological sustainability but is also responsive to the evolving realities of people and communities who depend on the resource.

7. Amendment

As with the previous two (2) plans, the IPHC Secretariat intends to maintain this IRMP document as a '*living plan'*, subject to annual reviews and updates as necessary. Revisions will reflect evolving priorities, resources available to undertake the work (e.g. internal and external fiscal resources, collaborations, internal expertise), and emerging opportunities. The IPHC Secretariat remains committed to transparency and to upholding the principles of open science in the development and implementation of this plan.

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Sadorus, Lauri L., Esther D. Goldstein, Raymond A. Webster, William T. Stockhausen, Josep V. Planas, and Janet T. Duffy-Anderson. 2020. "Multiple life-stage connectivity of Pacific halibut (*Hippoglossus stenolepis*) across the Bering Sea and Gulf of Alaska." Fisheries Oceanography 30 (2): 174-193.

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ACKNOWLEDGEMENTS

To be populated

APPENDICES

Appendix I: Outcomes of IPHC-2023-5YPIRM

Appendix II: External funding received by the IPHC

Appendix III: Publications arising

Appendix IV: List of ranked research priorities for stock assessment

Appendix V: List of ranked research priorities for management strategy evaluation

APPENDIX I
OUTCOMES OF THE IPHC-2023-5YPIRM

1. Biology and Ecology

A. Outcomes by Research Area:

1. Migration and Population Dynamics

1.1. Development and application of genomic approaches. Planned research outcomes: generation of genomic resources for Pacific halibut that will support genomic research.

Main results:

- Sequencing of the Pacific halibut genome.
- Generation of a high-quality chromosome-level genome assembly for Pacific halibut and full characterisation of the genome
- Complete sequencing and annotation of the Pacific halibut genome into a publicly available online resource
- Identification of the sex determining region of the Pacific halibut genome in Chromosome 9.
- Successful mapping of single nucleotide polymorphisms used for genetic sexing into the sex determining region of the Pacific halibut genome.
- Generation of tissue-specific transcriptomes and combined transcriptome for Pacific halibut. Identification of tissue-specific transcriptomic characteristics.

1.2. Population genomic studies. Planned research outcomes: delineation of population structure within Convention Waters.

Main results:

- Application of low-coverage whole-genome resequencing to screen genomic variation at very high resolution.
- Development of a bioinformatic platform to process and analyse high-throughput whole genome sequencing data.
- Establishment of a baseline of genetic diversity by whole genome resequencing of genetic samples from spawning individuals collected from the main five spawning areas within Convention Waters.
- Lack of evidence for population structure, as evidenced by the inability of high-resolution genomics techniques to identify discrete genetic groups.
- Low ability to assign individuals back to the location in which they were sampled.
- Lack of population structure supports the modeling of the Pacific halibut stock as a single coastwide stock

1.3. Environmental influences on Pacific halibut distribution. Planned research outcomes: relationship between Pacific halibut distribution and environmental variables.

Main results:

- Establishment of baseline environmental data for Pacific halibut habitat for older juvenile and adult individuals in different Biological Regions.
- Application of environmental profiler data in spatio-temporal modeling.
- Identification of changes in Pacific halibut density and distribution of Pacific halibut in Biological Region 2 associated with low near-bottom dissolved oxygen levels. These hypoxic events are the result of seasonal upwelling.

Publications:

Jasonowicz, A.J., Simeon, A., Zahm, M., Cabau, C., Klopp, C., Roques, C., Iampietro, C., Lluch, J., Donnadieu, C., Parrinello, H., Drinan, D. P., Hauser, L., Guiguen, Y., Planas, J.V. Generation of a chromosome-level genome assembly for Pacific halibut (*Hippoglossus stenolepis*) and characterization of its sex-determining genomic region. *Molecular Ecology Resources*. 2022. 22: 2685–2700. https://doi.org/10.1111/1755-0998.13641.

Jasonowicz, A.J., Simchick, C., Planas, J. V. Tissue-specific and reference transcriptomes for Pacific halibut (*Hippoglossus stenolepis*). 2025. In Preparation.

Jasonowicz, A.J., Simchick, C., Dawson, L., Spies, I., Larson, W., Planas, J.V. Genomic support for a single stock of Pacific halibut (*Hippoglossus stenolepis*) in the Northeastern Pacific Ocean. 2025. In Preparation.

Planas, J.V., Rooper, C.N., Kruse, G.H. Integrating biological research, fisheries science and management of Pacific halibut (Hippoglossus stenolepis) across the North Pacific Ocean. *Fisheries Research*. 2023. 259: 106559. https://doi.org/10.1016/j.fishres.2022.106559.

Sadorus, L.L., Webster, R.A. and Sullivan, M.E. Environmental conditions on the Pacific halibut (Hippoglossus stenolepis) fishing grounds obtained from a decade of coastwide oceanographic monitoring, and the potential application of these data in stock analyses. *Marine and Freshwater Research*. 2024. 75: MF23175. https://doi.org/10.1071/MF23175.

Integration with Stock Assessment and MSE: The relevance of research outcomes from activities in this research area for stock assessment is in evaluating the biological support for modeling the Pacific halibut stock as a coastwide stock and in the improvement of estimates of productivity. Research outcomes will be used to generate potential recruitment covariates and to inform minimum spawning biomass targets by Biological Region and represent one of the top three biological inputs into stock assessment. Additionally, current assumptions of stock structure used in the current stock assessment will be tested by these research activities. The relevance of these research outcomes for MSE is in the improvement of the parametrisation of the Operating Model and represent the top ranked biological input into the MSE.

2. Reproduction

2.1 Sex ratio of commercial landings. Planned monitoring outcomes: sex ratio information.

Main results:

- Sex ratio information for the 2017-2024 commercial landings.

2.2 Histological maturity assessment. Planned research outcomes: updated maturity schedule.

Main results:

- Application of histological ovarian development classification criteria to revise female maturity and establishment of criteria to identify immature versus mature females.
- Successful staging of ovarian samples collected in the FISS from 2022 to 2024.
- Testing of various types of models (i.e. generalised linear models (GLMs) and generalised additive models (GAMs)) to fit maturity data.
- Application of best-fit GAM models to estimate maturity ogives by Biological Region and year.
- Generation of a coastwide maturity ogive using weighed Biological Region ogives for the period 2022-2024.
- Development of a calibration factor between histology- and field (visual)-based maturity estimates.
- Integrate the calibration factor to revise FISS historical maturity data with which to investigate decadal changes in female maturity.
- Description of endocrine parameters that are associated with female developmental stages and identification of potential physiological markers for maturity.
- Collection of samples in the summers of 2023-2025 and fall of 2024 for the development of the fecundity estimation method and for generating the first estimates of fecundity.

Publications:

Fish, T., Wolf, N., Harris, B.P., Planas, J.V. A comprehensive description of oocyte developmental stages in Pacific halibut, *Hippoglossus stenolepis*. *Journal of Fish Biology*. 2020. 97: 1880-1885. doi: 10.1111/jfb.14551.

Fish, T., Wolf, N., Smeltz, T. S., Harris, B. P., and Planas, J. V. Reproductive Biology of Female Pacific Halibut (*Hippoglossus stenolepis*) in the Gulf of Alaska. *Frontiers in Marine Science.* 2022. 9:801759. doi: 10.3389/fmars.2022.801759.

Simchick, C., Simeon, A., Bolstad, K., Planas, J.V. Endocrine patterns associated with ovarian development in female Pacific halibut (*Hippoglossus stenolepis*). *General and Comparative Endocrinology*. 2024. 347: 114425. https://doi.org/10.1016/j.ygcen.2023.114425

Integration with Stock Assessment and MSE: Research activities in this Research Area aim at providing information on key biological processes related to reproduction in Pacific halibut (maturity and fecundity) and to provide sex ratio information of Pacific halibut commercial landings. The relevance of research outcomes from these activities for stock assessment is in the scaling of Pacific halibut biomass and in the estimation of reference points and fishing intensity. These research outputs will result in a revision of current maturity schedules and will be included as inputs into the stock assessment and represent the most important biological inputs for stock assessment. The relevance of these research outcomes for MSE is in the improvement of the simulation of spawning biomass in the Operating Model.

3. Growth

3.1 Identification of physiological growth markers and their application for growth pattern evaluation. Planned research outcomes: informative physiological growth markers to monitor somatic growth variation in Pacific halibut.

Main results:

- Transcriptomic profiling by RNA sequencing of white skeletal muscle from juvenile Pacific halibut subjected to temperature-induced growth manipulations.
- Identification of a set of genes that change their expression levels in response to growth suppression and to growth stimulation: growth marker identification.
- Proteomic profiling by LC-MS/MS of white skeletal muscle from juvenile Pacific halibut subjected to temperature-induced growth manipulations.
- Identification of a set of proteins that change their abundance in response to growth suppression and to growth stimulation: growth marker identification.
- Application of putative growth marker genes in the characterisation of somatic growth variation in Pacific halibut juveniles collected in the Eastern Bering Sea by the NMFS Trawl Survey.
- Transcriptomic profiling by RNA sequencing of white skeletal muscle from juvenile Pacific halibut subjected to density- and stress-induced growth manipulations under experimental conditions.

Publications:

Planas, J.V., Jasonowicz, A.J., Simeon, A., Simchick, C., Timmins-Schiffman, E., Nunn, B.L., Kroska, A.C., Wolf, N., and Hurst, T.P. Molecular mechanisms underlying thermally induced growth plasticity in juvenile Pacific halibut. *Journal of Experimental Biology*. 2025. In Review.

Integration with Stock Assessment and MSE: Research activities conducted in this Research Area aim at providing information on somatic growth processes driving size-at-age in Pacific halibut. The relevance of research outcomes from these activities for stock assessment resides, first, in their ability to inform yield-per-recruit and other spatial evaluations for productivity that support mortality limit-setting, and second, in that they may provide covariates for projecting short-term size-at-age and may help delineate between fishery and environmental effects, thereby informing appropriate management responses. The relevance of these research outcomes for MSE is in the improvement of the simulation of variability and to allow for scenarios investigating climate change.

4. Mortality and Survival Assessment

4.1 Discard mortality rate estimation in the longline Pacific halibut fishery. Planned research outcomes: full characterisation of discarded Pacific halibut in the longline fishery.

Main results:

- Hook release methods strongly influence the viability category assigned to discarded Pacific halibut in the longline fishery, with careful shaking and gangion cutting resulting in >75% of fish being assigned to the excellent viability category.
- The use of the hook stripper results in >85% of the fish being classified in the moderate and poor viability categories, and sustained injuries of medium and high severity particularly among

smaller fish. These results support minimising the use of hook strippers in non-directed fisheries to optimise survival of discarded Pacific halibut.

- High lactate plasma levels and low hematocrit were characteristic of fish assigned to the dead viability category, and were attributed to sand flee intrusion.
- Reducing the use of hook strippers and limiting soak times in areas of known sand flea activity are likely to improve viability outcomes of Pacific halibut released from commercial longline gear.

Publications:

Dykstra, C., Wolf, N., Harris, B.P., Stewart, I.J., Hicks, A., Restrepo. F., Planas, J.V. Relating capture and physiological conditions to viability and survival of Pacific halibut discarded from commercial longline gear. *Ocean & Coastal Management*. 2024. 249: 107018. https://doi.org/10.1016/j.ocecoaman.2024.107018.

4.2 Discard mortality rate estimation in the guided recreational Pacific halibut fishery. Planned research outcomes: experimentally-derived discard mortality rate, full characterisation of discarded Pacific halibut and assessment of best handling practices.

Main results:

- The mortality rate estimated from Pacific halibut captured and released in excellent viability category is 1.35%.
- The size of circle hooks (12/0 and 16/0) does not affect the size of the catch nor the types of injuries incurred by captured fish, with torn cheek being the predominant injury for both hook sizes.
- The levels of stress indicators in the blood (glucose and lactated, and cortisol to a lesser extent) increase with fight time.
- Our results on the low level of mortality associated with the release of Pacific halibut in excellent viability category is consistent with current discard mortality estimates.

Integration with Stock Assessment and MSE: The relevance of research outcomes from these activities for stock assessment resides in their ability to accurately capture trends in unobserved mortality in order to improve estimates of stock productivity and represent the most important inputs in fishery yield for stock assessment. The relevance of these research outcomes for MSE is in fishery parametrisation

5. Fishing Technology

5.1 Investigations on new methods for whale avoidance and/or deterrence for the reduction of Pacific halibut depredation by whales (e.g. catch protection methods). Planned research outcomes: information on feasibility, and performance of catch protection devices.

Main results:

- A virtual International Workshop (link) was organised in 2022 on protecting fishery catches from whale depredation with industry (affected fishers, gear manufacturers), gear researchers and scientists to identify methods to protect fishery catches from depredation.
- Development of two catch protection designs stemming from the outcomes of the International Workshop into functional prototypes.

- Successful initial testing of two selected catch protection devices (underwater shuttle and branch gear with sliding shroud system) in the field.
- As a catch protection device, the shuttle is a safe and effective gear type that entrained comparable quantities, sizes and types of fish as control (i.e. longline) gear.
- Additional testing in the presence of whales was conducted in May of 2025.

5.2 Investigate physiological and behavioral responses of Pacific halibut to fishing gear in order to reduce bycatch. Planned research outcomes: effective ways to reduce Pacific halibut bycatch and bycatch of non-targeted species.

Main results:

- Hook size did not significantly affect the catch efficiency of Pacific halibut or yelloweye rockfish.
- Circle hooks with a 45° appendage angle caught fewer yelloweye rockfish than hooks without an appendage, irrespective of hook size, and did not affect the catch efficiency of Pacific halibut.
- Hook appendages could have potential use in reducing catch rates on yelloweye rockfish in Pacific halibut longline fisheries.

Publications:

Lomeli, M.J.M., Wakefield, W.W., Abele, M., Dykstra, C.L., Herrmann, B., Stewart, I.J., and G.C. Christie. 2023. Testing of hook sizes and appendages to reduce yelloweye rockfish bycatch in a Pacific halibut longline fishery. Ocean & Coastal Management 241: 106664. https://doi:10.1016/j.ocecoaman.2023.106664.

Integration with Stock Assessment and MSE: The relevance of research outcomes from these activities for stock assessment resides in the improvement of mortality accounting through a reduction of depredation mortality, thereby increasing the available yield for directed fisheries. Depredation mortality can also be included as another explicit source of mortality in the stock assessment and mortality limit setting process depending on the estimated magnitude.

APPENDIX II
EXTERNAL FUNDING RECEIVED BY THE IPHC

Project #	Grant agency	Project name	PI	Partners	IPHC Budget ($US)	Management implications	Grant period
1	**Saltonstall-Kennedy NOAA**	Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post-release survival (NOAA Award No. NA17NMF4270240)	IPHC	Alaska Pacific University	$286,121	Bycatch estimates	September 2017 – August 2020
2	**North Pacific Research Board**	Somatic growth processes in the Pacific halibut (*Hippoglossus stenolepis*) and their response to temperature, density and stress manipulation effects (NPRB Award No. 1704)	IPHC	AFSC-NOAA-Newport, OR	$131,891	Changes in biomass/size-at-age	September 2017 – February 2020
3	**Bycatch Reduction Engineering Program - NOAA**	Adapting Towed Array Hydrophones to Support Information Sharing Networks to Reduce Interactions Between Sperm Whales and Longline Gear in Alaska	Alaska Longline Fishing Association	IPHC, University of Alaska Southeast, AFSC-NOAA	-	Whale Depredation	September 2018 – August 2019
4	**Bycatch Reduction Engineering Program - NOAA**	Use of LEDs to reduce Pacific halibut catches before trawl entrainment	Pacific States Marine Fisheries Commission	IPHC, NMFS	-	Bycatch reduction	September 2018 – August 2019
5	**National Fish & Wildlife Foundation**	Improving the characterisation of discard mortality of Pacific halibut in the recreational fisheries (NFWF Award No. 61484)	IPHC	Alaska Pacific University, U of A Fairbanks, charter industry	$98,902	Bycatch estimates	April 2019 – November 2021
6	**North Pacific Research Board**	Pacific halibut discard mortality rates (NPRB Award No. 2009)	IPHC	Alaska Pacific University,	$210,502	Bycatch estimates	January 2021 –March 2022
7	**Bycatch Reduction Engineering Program - NOAA**	Gear-based approaches to catch protection as a means for minimising whale depredation in longline fisheries (NA21NMF4720534)	IPHC	Deep Sea Fishermen's Union, Alaska Fisheries Science Center-NOAA, industry representatives	$99,700	Mortality estimations due to whale depredation	November 2021 – October 2022
8	**North Pacific Research Board**	Pacific halibut population genomics (NPRB Award No. 2110)	IPHC	Alaska Fisheries Science Center-NOAA	$193,685	Stock structure	December 2021- January 2024

9	**Bycatch Reduction Engineering Program - NOAA**	Full scale testing of devices to minimize whale depredation in longline fisheries (NA23NMF4720414)	IPHC	NOAA Fisheries -Alaska Fisheries Science Center (Seattle)	$199,870	Mortality estimations due to whale depredation	November 2023 – April 2026
10	**Alaska Sea Grant**	Development of a non-lethal genetic-based method for aging Pacific halibut (R/2024-05)	IPHC, Alaska Pacific Univ. (APU)	Alaska Fisheries Science Center-NOAA (Juneau)	$60,374	Stock structure	January 2025-December 2026
				Total awarded ($)	**$1,281,045**		

APPENDIX III
PUBLICATIONS ARISING

2020:

Fish, T., Wolf, N., Harris, B.P., Planas, J.V. A comprehensive description of oocyte developmental stages in Pacific halibut, *Hippoglossus stenolepis*. *Journal of Fish Biology*. 2020. 97: 1880-1885. https://doi: 10.1111/jfb.14551.

Stewart, I.J., Hicks, A.C., and Carpi, P. 2021. Fully subscribed: Evaluating yield trade-offs among fishery sectors utilizing the Pacific halibut resource. Fisheries Research **234**. doi:10.1016/j.fishres.2020.105800.

Webster, R.A., Soderlund, E., Dykstra, C.L., and Stewart, I.J. 2020. Monitoring change in a dynamic environment: spatio-temporal modelling of calibrated data from different types of fisheries surveys of Pacific halibut. Canadian Journal of Fisheries and Aquatic Sciences **77**: 1421–1432.

Forrest, R.E., Stewart, I.J., Monnahan, C.C., Bannar-Martin, K.H., and Lacko, L.C. 2020. Evidence for rapid avoidance of rockfish habitat under reduced quota and comprehensive at-sea monitoring in the British Columbia Pacific halibut fishery. Canadian Journal of Fisheries and Aquatic Sciences **77**: 1409–1420.

2021:

Carpi, P., Loher, T., Sadorus, L., Forsberg, J., Webster, R., Planas, J.V., Jasonowicz, A., Stewart, I. J., Hicks, A. C. Ontogenetic and spawning migration of Pacific halibut: a review. *Rev Fish Biol Fisheries*. 2021. https://doi.org/10.1007/s11160-021-09672-w.

Kroska, A.C., Wolf, N., Planas, J.V., Baker, M.R., Smeltz, T.S., Harris, B.P. Controlled experiments to explore the use of a multi-tissue approach to characterizing stress in wild-caught Pacific halibut (*Hippoglossus stenolepis*). *Conservation Physiology* 2021. 9(1):coab001. https://doi:10.1093/conphys/coab001.

Loher, T., Bath, G. E., Wischniowsky, S. The potential utility of otolith microchemistry as an indicator of nursery origins in Pacific halibut (*Hippoglossus stenolepis*) in the eastern Pacific: the importance of scale and geographic trending. *Fisheries Research*. 2021. 243: 106072. https://doi.org/10.1016/j.fishres.2021.106072.

Lomeli, M.J.M., Wakefield, W.W., Herrmann, B., Dykstra, C.L., Simeon, A., Rudy, D.M., Planas, J.V. Use of Artificial Illumination to Reduce Pacific Halibut Bycatch in a U.S. West Coast Groundfish Bottom Trawl. *Fisheries Research*. 2021. 233: 105737. doi: 10.1016/j.fishres.2020.105737.

Sadorus, L., Goldstein, E., Webster, R., Stockhausen, W., Planas, J.V., Duffy-Anderson, J. Multiple life-stage connectivity of Pacific halibut (*Hippoglossus stenolepis*) across the Bering Sea and Gulf of Alaska. *Fisheries Oceanography*. 2021. 30:174-193. doi: https://doi.org/10.1111/fog.12512.

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APPENDIX IV
LIST OF RANKED RESEARCH PRIORITIES FOR STOCK ASSESSMENT

Research priorities for the Pacific halibut stock assessment are delineated into three broad categories: improvements in basic biological understanding (including fishery dynamics), investigation of existing data series and collection of new information, and technical development of models and modelling approaches. The highest priority items in each of these categories are highlighted in the 5YPIRM and are expected to be the primary focus of ongoing efforts. However, it is helpful to maintain a longer list of items to inform future prioritization, to create a record of data and research needs, and to foster opportunistic and/or collaborative work on these topics when possible.

Biological understanding and fishery yield:

- *Highest priority*: Updating the fecundity-weight relationship and the presence and/or rate of skip spawning.
- *Highest priority*: The relative role of potential factors underlying changes in size-at-age is not currently understood. Delineating between competition, density dependence, environmental effects, size-selective fishing and other factors could allow improved prediction of size-at-age under future conditions.
- Movement rates among Biological Regions at the adult, juvenile and larval stages remain uncertain and likely variable over time. Long-term research to inform these rates could lead to a spatially explicit stock assessment model for future inclusion into the ensemble.
- Improved understanding of recruitment processes and larval dynamics could lead to covariates explaining more or the residual variability about the stock-recruit relationship than is currently accounted for via the binary indicator used for the Pacific Decadal Oscillation.

Potential projects relating to existing and new data sources that could benefit the Pacific halibut stock assessment:

- *Highest priority*: Continued collection of sex-ratio from the commercial landings will provide valuable information for determining relative selectivity of males and females, and therefore the scale of the estimated spawning biomass, and the level of fishing intensity as measured by SPR.
- *Highest priority*: Evaluation of the magnitude of marine mammal depredation and tools to reduce it.
- A space-time model could be used to calculate weighted FISS and/or commercial fishery age-composition data. This might alleviate some of the lack of fit to existing data sets that is occurring not because of model misspecification but because of incomplete spatial coverage in the annual FISS sampling which is accounted for in the generation of the index, but not in the standardization of the composition information.
- The work of Monnahan and Stewart (2015) modelling commercial fishery catch rates could be used to provide a standardized fishery index for the recent time-series that would be analogous to the space-time model used for the FISS.
- There is a vast quantity of archived historical data that is currently inaccessible until organized, electronically entered, and formatted into the IPHC's database with appropriate meta-data. Information

on historical fishery landings, effort, and age samples would provide a much clearer (and more reproducible) perception of the historical period.

- Additional efforts could be made to reconstruct estimates of subsistence harvest prior to 1991.
- Discard mortality estimates for the IPHC Regulatory Area 2B recreational fishery are currently unavailable, but there is an estimation system in place. Further work to develop these estimates would be preferable to the use of proxy rates from IPHC Regulatory Area 2C.
- NMFS observer data from the directed Pacific halibut fleet in Alaska could be evaluated for use in updating discard mortality rates and the age-distributions for discard mortality. This may be more feasible if observer coverage is increased and if smaller vessels (< 40 feet LOA, 12.2 m) are observed in the future. Post-stratification and investigation of observed vs. unobserved fishing behavior may be required.
- Historical bycatch length frequencies and mortality estimates should be reanalyzed accounting for sampling rates in target fisheries and evaluating data quality over the historical period.
- There are currently no comprehensive variance estimates for the sources of mortality used in the assessment models. In some cases, variance due to sampling and perhaps even non-sampling sources could be quantified and used as inputs to the models via scaling parameters or even alternative models in the ensemble.

Technical explorations and improvements that could benefit the stock assessment models and ensemble framework:

- *Highest priority*: Maintaining consistency and coordination between MSE, and stock assessment data, modelling and methodology.
- *Highest priority*: Exploration of state-space models for Pacific halibut allowing for direct estimation of the variance in time-varying processes.
- *Highest priority*: Continued exploration into the estimation of *M* in the short coastwide model.
- Continued refinement of the ensemble of models used in the stock assessment. This may include investigation of alternative approaches to modelling selectivity that would reduce relative down-weighting of certain data sources (see section above), evaluation of additional axis of uncertainty (e.g., steepness, as explored above), or others.
- Exploration of methods for better including uncertainty in directed and non-directed discard mortalities in the assessment (now evaluated only via alternative mortality projection tables or model sensitivity tests) in order to better include these sources uncertainty in the decision table. These could include explicit discard/retention relationships, including uncertainty in discard mortality rates, and allow for some uncertainty directly in the magnitude of mortality for these sources.
- Bayesian methods for fully integrating parameter uncertainty may provide improved uncertainty estimates within the models contributing to the assessment, and a more natural approach for combining the individual models in the ensemble (see section above).

- Alternative model structures, including a growth-explicit statistical catch-at-age approach and a spatially explicit approach may provide avenues for future exploration. Efforts to develop these approaches thus far have been challenging due to the technical complexity and data requirements of both. Previous reviews have indicated that such efforts may be more tractable in the context of operating models for the MSE, where conditioning to historical data may be much more easily achieved than fully fitting an assessment model to all data sources for use in tactical management decision making.

APPENDIX V
LIST OF RANKED RESEARCH PRIORITIES FOR MANAGEMENT STRATEGY EVALUATION

To be populated after HSPWS02 – 6 August 2025

Report on Current and Future Biological and Ecosystem Science Research Activities

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, C. DYKSTRA, A. JASONOWICZ, C. JONES, 14 OCTOBER 2025)

PURPOSE

To provide the RAB with a description of the biological and ecosystem science research projects conducted and planned by the IPHC Secretariat and contemplated within the Five-year Program of Integrated Research and Monitoring (2022-2026).

BACKGROUND

The main objectives of the Biological and Ecosystem Science Research at the IPHC are to:

1) identify and assess critical knowledge gaps in the biology of the Pacific halibut (*Hippoglossus stenolepis*);
2) understand the influence of environmental conditions; and
3) apply the resulting knowledge to reduce uncertainty in current stock assessment models.

The primary biological research activities at IPHC that follow Commission objectives are identified and described in the IPHC Five-Year Program of Integrated Research and Monitoring (2022-2026). These activities are summarized in five broad research areas designed to provide inputs into stock assessment and the management strategy evaluation processes (Appendix I), as follows:

1) Migration and Population Dynamics. Studies are aimed at improving current knowledge of Pacific halibut migration and population dynamics throughout all life stages in order to achieve a complete understanding of stock structure and distribution across the entire distribution range of Pacific halibut in the North Pacific Ocean and the biotic and abiotic factors that influence it.
2) Reproduction. Studies are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity.
3) Growth. Studies are aimed at describing the role of factors responsible for the observed changes in size-at-age and at evaluating growth and physiological condition in Pacific halibut.
4) Mortality and Survival Assessment. Studies are aimed at providing updated estimates of discard mortality rates in the guided recreational fisheries and at evaluating methods for reducing mortality of Pacific halibut.
5) Fishing Technology. Studies are aimed at developing methods that involve modifications of fishing gear with the purpose of reducing Pacific halibut mortality due to depredation and bycatch.

Discussion on Current Research Activities

1. Migration and Population Dynamics.

   The IPHC Secretariat is currently conducting studies on Pacific halibut juvenile habitat and movement through conventional wire tagging, as well as studies that incorporate genomics approaches to produce useful information on population structure and distribution and connectivity of Pacific halibut. The relevance of research outcomes from these activities for stock assessment (SA) resides (1) in the introduction of possible changes in the structure of future stock assessments, as separate assessments may be constructed if functionally isolated components of the population are found (e.g. IPHC Regulatory Area 4B), and (2) in the improvement of productivity estimates, as this information may be used to define management targets for minimum spawning biomass by Biological Region. These research outcomes provide the second and third top ranked biological inputs into SA (Appendix II). Furthermore, the relevance of these research outcomes for the management and strategy evaluation process is in biological parametization and validation of movement estimates, on one hand, and of recruitment distribution, on the other hand (Appendix III).

   1.1. Population genomics. conservation of natural resources. Pacific halibut in US and Canadian waters are managed as a single, coastwide stock on the basis of tagging studies and historical (pre-2010) analyses of genetic population structure that failed to demonstrate significant differentiation in the eastern Pacific Ocean. While genetic techniques previously employed in fisheries management have generally used a small number of markers (i.e. microsatellites, ~10-100), advances in genomic technology now enable whole-genome scale approaches to be conducted with lower cost and provide orders of magnitude more data (millions of markers). Using low-coverage whole genome resequencing the IPHC Secretariat has the capability to examine genetic structure of Pacific halibut in IPHC Convention Waters with unprecedented resolution. By studying the genomic structure of spawning populations, genetic signatures of geographic origin can be established and, consequently, could be used to identify the geographic origin of individual Pacific halibut and, therefore, inform on the movement and distribution of Pacific halibut.

   The main purpose of the present study is to resolve the genetic structure of Pacific halibut population structure in IPHC Convention waters using state-of-the-art low-coverage whole genome resequencing methods. For this purpose, genetic samples from male and female adult Pacific halibut collected during the spawning (winter) season in five known spawning grounds have been used: Western and Central Aleutian Islands, Bering Sea, Central Gulf of Alaska and British Columbia (**Figure 1**). As a requisite for the low-coverage whole genome resequencing approach used, the IPHC Secretariat first produced a high-quality reference genome (Jasonowicz et al., 2022) that has been used to generate genomic sequences from 731 individual Pacific halibut collected from the five above-mentioned geographic areas (**Figure 1**) using low-coverage whole-genome resequencing (lcWGR).

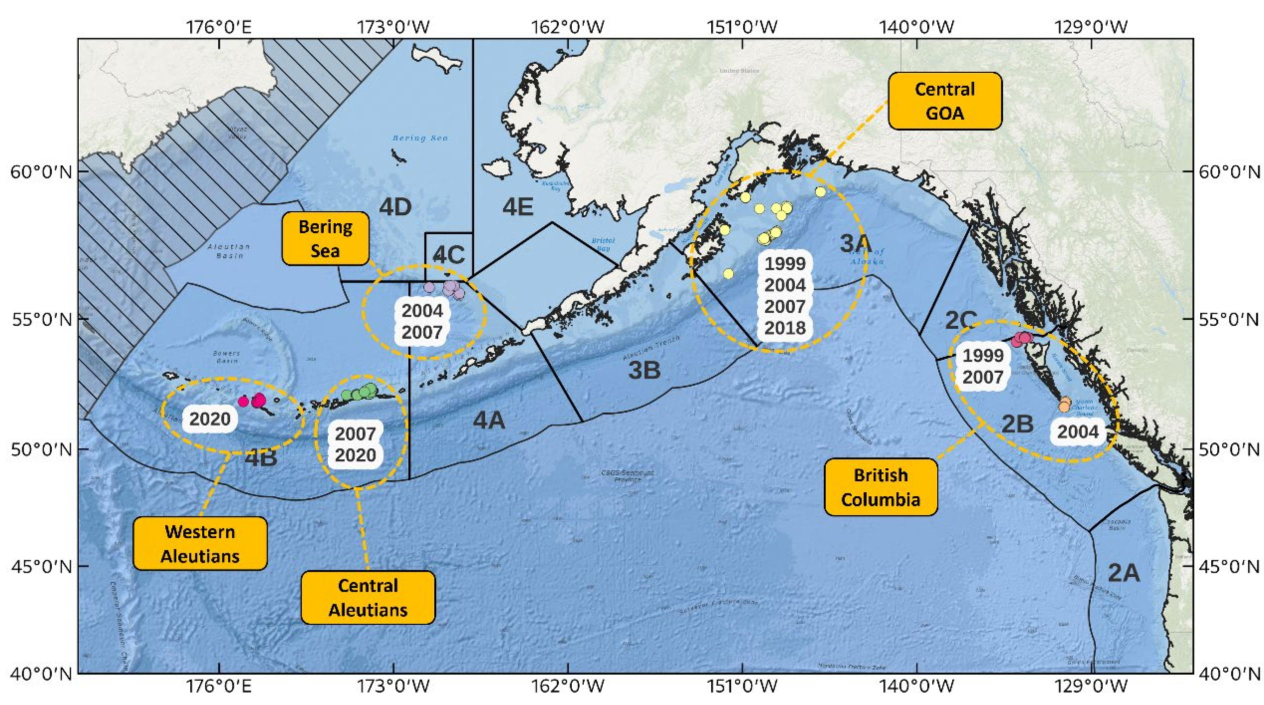


Figure 1. Map of sample collections made during the spawning season used for genomic analysis of population structure in Pacific halibut in the northeast Pacific Ocean.

Using the lcWGR approach, have identified millions of single nucleotide polymorphisms (SNPs) that have been used to evaluate population structure at the highest resolution possible. Despite the use of a very high-resolution genomic approach, our analyses of population structure using a genome-wide subset of 3.7 million SNPs, indicated that no distinct genetic groups were apparent in the dataset. Multiple methods were used to characterize population structure: principal component analysis revealed a considerable degree of genetic similarity between samples collected in different geographic areas (**Figure 2**), and unsupervised clustering methods (K-means clustering and the estimation of admixture proportions) also failed to detect discrete genetic groups (data not shown). These results suggest that there is very little spatial structure among the five spawning groups sampled in different geographic areas within IPHC Convention Waters. Furthermore, assignment testing was carried out to assess our ability to accurately assign samples back to their location in which they were collected. Assignment accuracy was estimated using cross-validation techniques and indicated a limited ability to accurately assign (~35% assignment accuracy) samples back to the geographic location in which they were collected from (data not shown), despite using a subset of 5,000 SNPs showing the highest levels of differentiation among the geographic areas sampled. We hypothesize that the absence of distinct genetic groups among our sample collections is due to a considerable degree of geneflow among the geographic areas sampled in this study and, consequently, to the genetically panmictic nature of the Pacific halibut population sampled for this study.

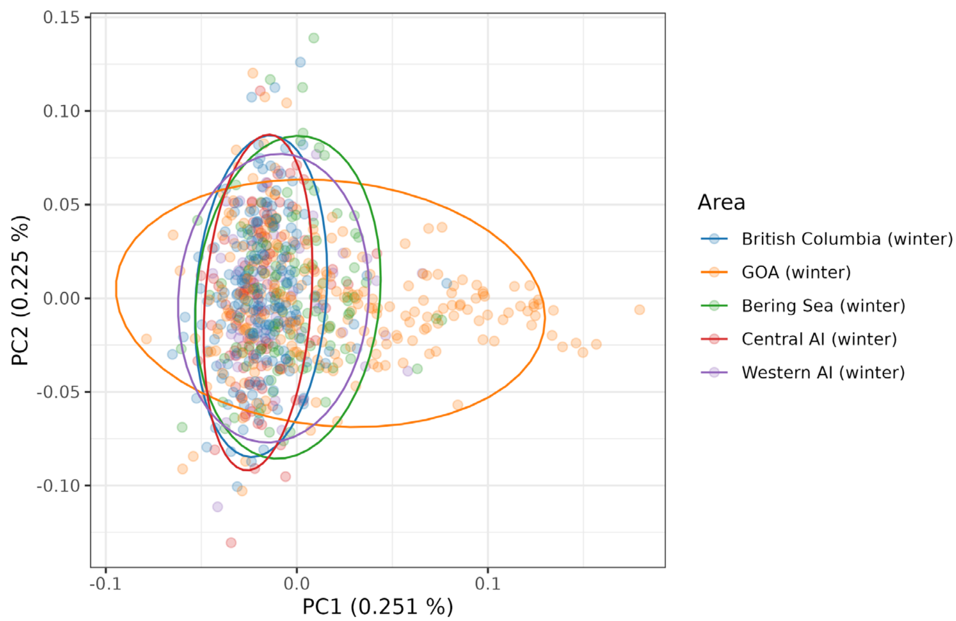


Figure 2. Genetic relationships among individual samples visualized using principal component analysis. Each point represents an individual fish and each fish is colored by the geographic area in which they were sampled. Note the lack of distinct clusters and overlap among areas. Circles represent 95% confidence ellipses.

The lack of structure observed here is not surprising given our current knowledge and understanding of Pacific halibut biology. Annual migration rates estimated from tag recovery data suggest that there is ample opportunity for individuals to move among IPHC Regulatory Areas throughout their lives (Webster et al. 2013). Analysis of tag recovery data has shown that approximately 11% of Pacific halibut tags are recovered in a different IPHC Regulatory Area than they are released (Carpi et al. 2021). This varies by Regulatory Area but for most IPHC Regulatory Areas, the percentage of migrants observed exceeds 10% (Carpi et al. 2021). Additionally, strong oceanographic connectivity between the Bering Sea and Gulf of Alaska has been linked to a considerable degree of larval exchange between these areas. It has been estimated that 47%-58% of larvae originating from spawning grounds in the Western Gulf of Alaska are transported to the Bering Sea (Sadorus et al. 2021). These rates can still be as high as 4.5%-8.6% for larvae originating from spawning grounds in the Eastern Gulf of Alaska (Sadorus et al. 2021).

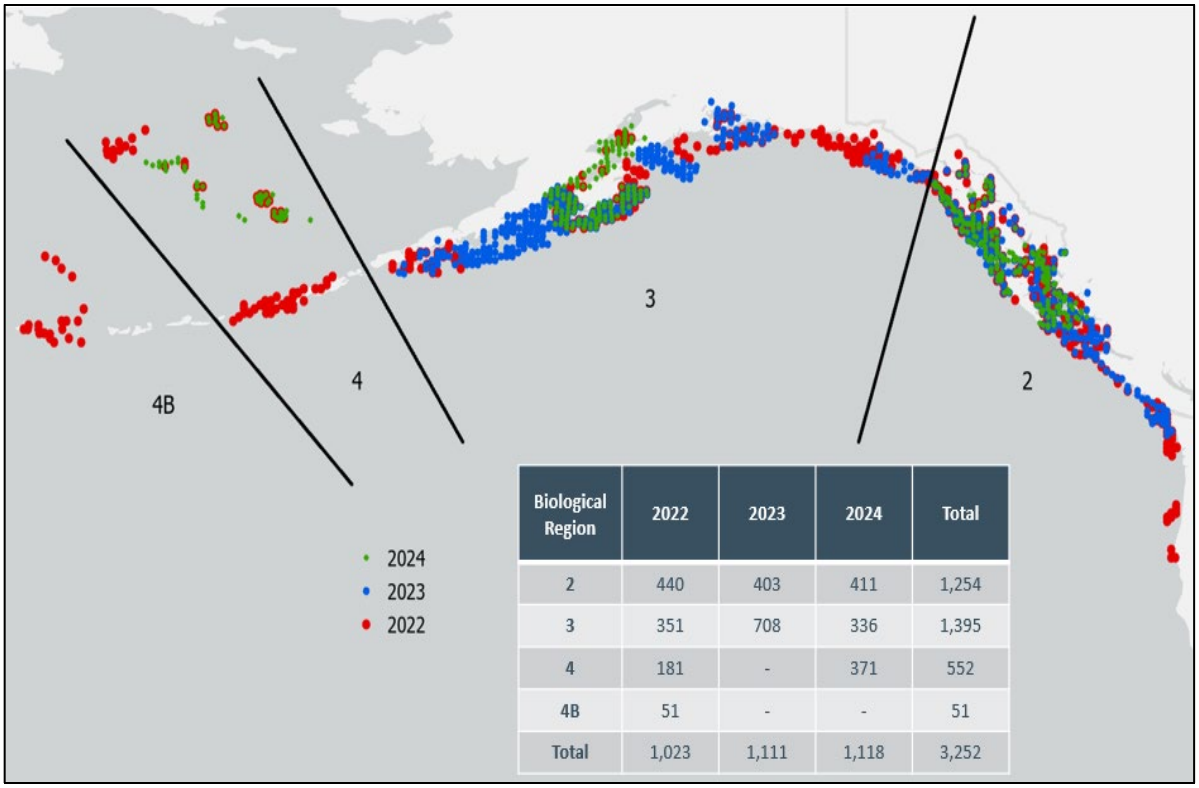
The concept of stock and the ability to define management units is central to sound management of marine fishes (Begg et al. 1999; Cadrin 2020). Advances in genomic technology have led to the development of useful and powerful tools that can aid in the delineation of management units (Bernatchez et al. 2017). Despite using very high-resolution genomic methods to characterize genomic variation in spawning groups of Pacific halibut collected over large spatial and temporal scales, the results presented here are consistent with genetic panmixia. From a management perspective, these results support IPHC's current stock assessment practices that model the Pacific halibut stock as a single coastwide unit (Stewart and Hicks 2024).

2. Reproduction.

Research activities in this Research Area aim at providing information on key biological processes related to reproduction in Pacific halibut (maturity and fecundity) and to provide sex ratio information of Pacific halibut commercial landings. The relevance of research outcomes from these activities for stock assessment (SA) is in the scaling of Pacific halibut biomass and in the estimation of reference points and fishing intensity. These research outputs will result in a revision of current maturity schedules and will be included as inputs into the SA (Appendix II) as they represent the most important biological inputs for SA. The relevance of these research outcomes for the management and strategy evaluation process is in the improvement of the simulation of spawning biomass in the Operating Model (Appendix III).

Recent sensitivity analyses have shown the importance of changes in spawning output due to changes in maturity schedules and/or skip spawning and fecundity for SA (Stewart and Hicks, 2018). Information on these key reproductive parameters provides direct input to SA. For example, information on fecundity-at-age and -size could be used to replace spawning biomass with egg output as the metric of reproductive capability in the SA and management reference points. This information highlights the need for a better understanding of factors influencing reproductive biology and success of Pacific halibut. To fill existing knowledge gaps related to the reproductive biology of female Pacific halibut, research efforts are devoted to characterizing female reproduction in this species. Specific objectives of current studies include: 1) updating maturity schedules based on histological-based data; and 2) calibration of historical visual maturity schedules using histological-based data.

2.1. Update of maturity schedules based on histological-based data. The IPHC Secretariat is undertaking studies to revise maturity schedules in all four IPHC Biological Regions through histological (i.e. microscopic) characterization of maturity, as reported previously. The coastwide maturity schedule (i.e. the proportion of mature females by age) that is currently used in SA was based on visual (i.e. macroscopic) maturity classification in the field (Fishery-independent Setline Survey (FISS)). To revise currently used maturity schedules, the IPHC Secretariat has collected ovarian samples for histology during the 2022, 2023 and 2024 FISS. The 2022 FISS sampling resulted in a total of 1,023 ovarian samples collected. Due to a reduced FISS design in 2023, sampling only occurred in Biological Regions 2 and 3 and resulted in a total of 1,111 ovarian samples collected. In 2024, 411, 336 and 371 ovarian samples were collected in Biological Regions 2, 3 and 4, respectively. In total, 3,252 ovarian samples have been collected for histology between 2022 and 2024 (**Figure 3**).



Biological Region	2022	2023	2024	Total
2	440	403	411	1,254
3	351	708	336	1,395
4	181	-	371	552
4B	51	-	-	51
Total	1,023	1,111	1,118	3,252

Figure 3. Map of 2022, 2023 and 2024 maturity samples for histology collected on FISS. Red dots (2022), blue dots (2023) and green dots (2024) indicate a distinct FISS station in which a sample was collected.

The IPHC Secretariat continued to collect ovarian samples in the 2025 FISS. Targets for 2025 were to collect 400 samples in Biological Regions 2 and 3, 188 in Biological Region 4, and 414 in Biological Region 4B. These samples will allow us to further investigate both spatial and temporal differences in histological-based female Pacific halibut maturity.

Ovarian samples from 2022 to 2024 were processed for histology and we finalized scoring samples for maturity using histological maturity classifications, as previously described in Fish et al. (2020, 2022). Following this maturity classification criteria, all sampled Pacific halibut females were assigned to either the mature or immature categories. Mature female Pacific halibut are deemed to have at least reached the early vitellogenesis (Vtg1) stage of oocyte development.

Maturity ogives (i.e., the relationships between the probability of maturity determined by histological assessments and variables including IPHC Biological Region, age, and year) were estimated by fitting generalized additive models (GAM) with logit link (i.e., logistic regression). We first ran again the best-fit logistic GAM models using log(Age), Biological Region, and year for the 2022-2024 samples. By examining the 2024 output for the logistic GAM (**Figure 4**), Biological Region 2 once again shows older maturity-at-age (indicated by the dashed lines for A50 and A95) and lower maturity-at-age from ages 10-20 than Biological Region 3. Biological Region 3 once again in 2024 shows a steep increase in maturity-at-age when compared to all other Biological Regions, with over 80% of mature females by age 9. Biological Region 4 shows a delayed start to maturation with only 5% of mature females at age 9 but maturation rapidly increases to ~90% mature females at age 15.

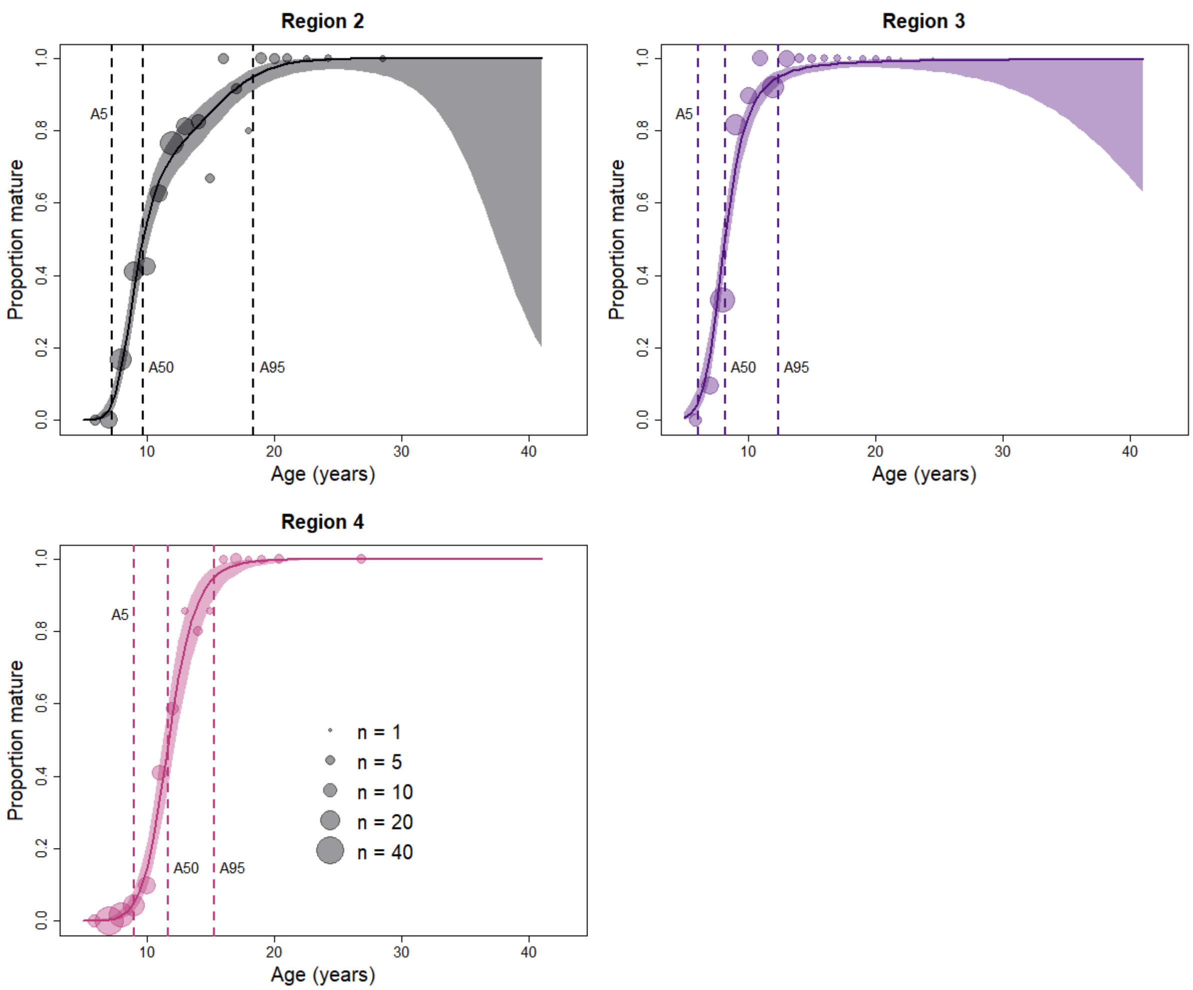


Figure 4. Female Pacific halibut age at maturity by IPHC Biological Region in 2024 using best-fit logistic GAM, with color shading indicating 95% CI for each IPHC Biological Region. Vertical dashed lines indicate proportion mature at 5% (A5), 50% (A50), and 95% (A95).

To examine temporal changes across all Biological Regions, we overlayed all three years of histological data by region (**Figure 5**). Overall, there is an observed shift to the left in maturity ogives from 2022 to 2024 in the three Biological Regions (2, 3, and 4) that have multiple years of data, indicating younger maturing females in 2024 than in 2022 and 2023. This could be indicative of a particular year class maturing through the population; however, this is difficult to discern with only three years of data. Biological Region 2 had a significant change from 2022 to 2023. With more individuals classified as mature between the ages of 8-20 in 2023 than in 2022, the rate of maturation in Biological Region 2 increased at younger ages causing the steepness of the curve to rapidly increase. There did not appear to be a difference between 2023 and 2024 for Biological Region 2. For Biological Region 3, there is a similar trend in that the maturity ogive has progressively shifted slightly to the left from 2022 to 2024. This indicates that a higher proportion of females at any given age are mature in 2024 compared to the previous two years. Biological Region 4 also showed a shift to the left from 2022 to 2024 (no data in 2023). It will be important to continue to monitor temporal trends in histological-based maturity ogives to determine if the observed shifts in maturity ogives continue.

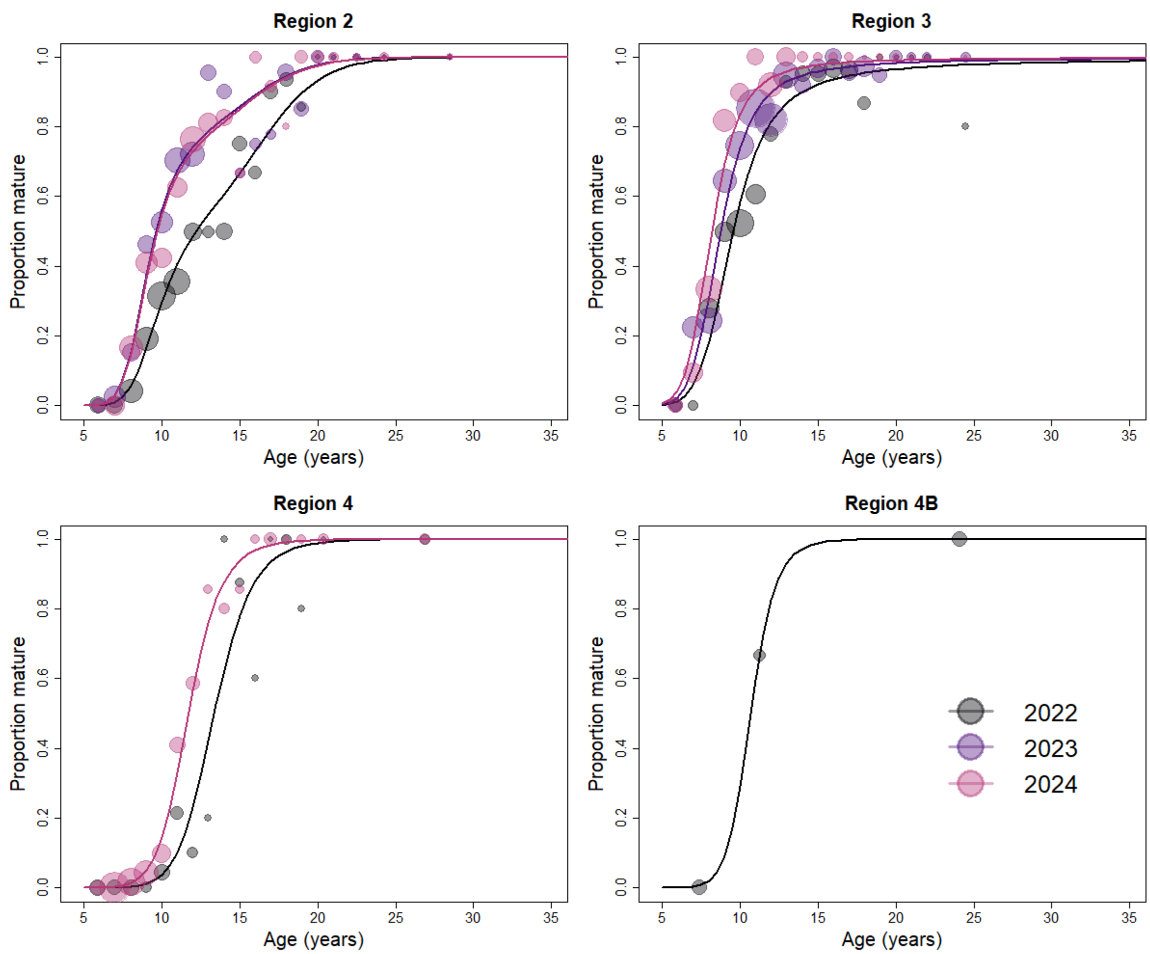


Figure 5. Female Pacific halibut age at maturity by IPHC Biological Region and year using best-fit logistic GAM.

To estimate a coastwide ogive with the 2022-2024 histology-based maturity data, we removed the year effect from the logistic GAM model and pooled all years by Biological

Region. The logistic GAM estimated maturity curves for each IPHC Biological Region. Noting that sample size was not proportional to population size for each region, we used the average estimated regional abundance proportions from 2022-2024 from IPHC's space-time modeling of FISS numbers per unit effort (NPUE) data as weights in estimating a coastwide maturity ogive (**Figure 6**). The modeled coastwide ogive for maturity-at-age falls between the maturity ogives for Biological Regions 2 and 3 (**Figure 6**). This outcome was expected as these two Biological Regions currently have the highest estimated abundance. Age at 50% maturity (A50) was estimated to be 9.8 years, an almost two-year shift to younger maturing females when compared to our current maturity estimates from visual (field) data of 11.6 years.

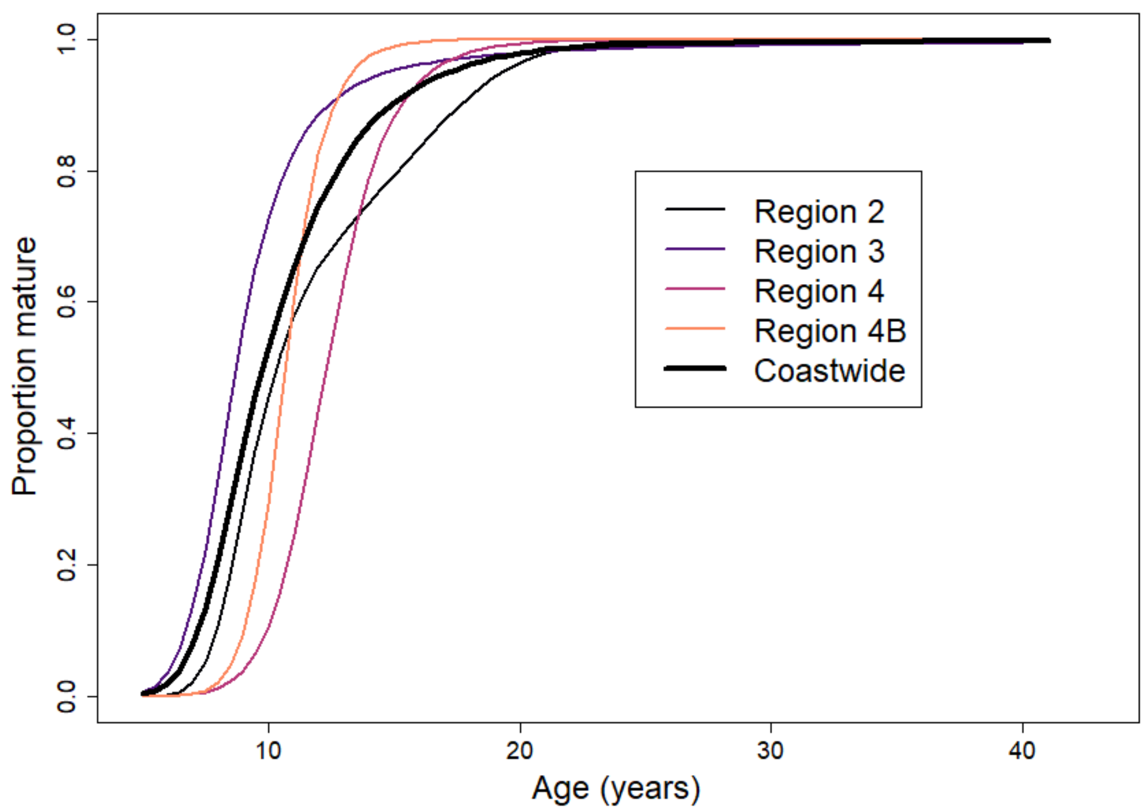


Figure 6. Coastwide maturity ogive generated from 2022-2024 average estimated regional abundance proportions (thick black line) and individual Biological Region ogives. Ogives shown without CI to better visualize differences between the coastwide and Biological Region ogives.

2.2. Calibration of historical visual maturity schedules using histology-based data. After creating a new coastwide maturity ogive using histology-based maturity estimates from 2022 to 2024, we investigated how visual maturity estimates have changed over the same timeframe. All females that we obtained a histology sample from also received a visual maturity estimate in the field. Using the same logistical GAM and methods used to create a coastwide ogive from the histology-based maturity data, we created a new coastwide visual maturity ogive (**Figure 7**, blue line).

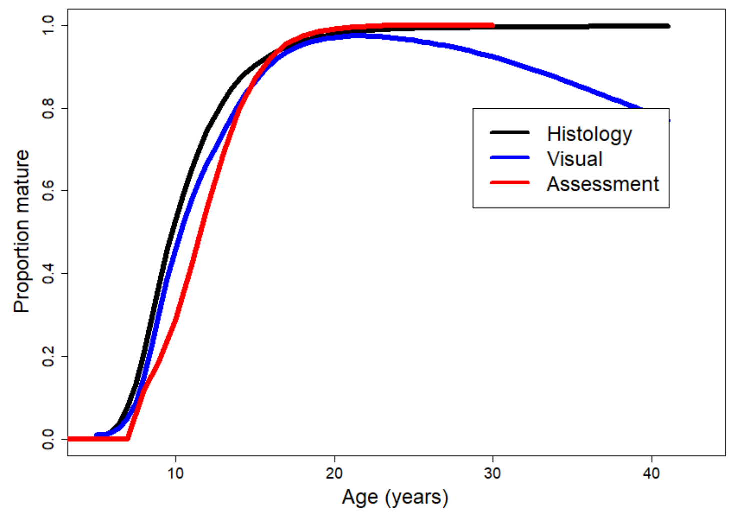


Figure 7. Coastwide maturity ogive generated from 2022-2024 average estimated regional abundance proportions using histological (black) and visual (blue) maturity estimation methods. The current coastwide ogive (red) used in stock assessment is shown for reference.

The A50 value of the 2022-2024 coastwide visual maturity ogive was calculated to be 10.3 years. When comparing the new coastwide visual ogive to the current SA ogive (**Figure 7**, red line), a shift to the left is observed, with a higher proportion of mature females observed between the ages of 8 to 13 years. The drop in the proportion of mature females for older individuals in the new visual maturity ogive was caused by two older females (25-30 years old) that were visually classified as immature in the field.

The IPHC Secretariat has visual maturity assessment data from the FISS going back to 2002 with ages determined using the current break-and-burn ageing method. To create a time series consistent with the more accurate histological assessments, we first developed a calibration between histological and visual maturity curves from the 2022-2024 data. Just as maturity curves are estimated for each Biological Region, we estimated separate calibration factors for each region. It is possible that differences between visual and histological assessments vary with time, due to observer differences and to other factors. This is something we can examine as we collect histological data over a greater number of years, although our ability to account for such factors when calibrating historical curves could be limited.

Coastwide maturity curves by year estimated from visual maturity assessment data are shown in **Figure 8**. Each curve was estimated using three-year rolling data windows, e.g., the 2003 curve is estimated from 2002-2004 data. Three years is the minimum timeframe that ensures that there are data in all Biological Regions within each rolling window. For the ends of the visual assessment time series, i.e. 2002 and 2024, where the three-year data window includes years with no observations (2001 or 2025), we expanded the window to ensure that three years of data were included in the analysis. This indicates that the logistic GAM models for 2002 and 2003 use the same data (from 2002-2004), as is the case for 2023 and 2024 (data from 2022-2024). Corresponding calibrated curves are shown in **Figure 9**. To obtain a final coastwide calibrated visual maturity ogive for the 2002-2024 time series, we averaged across all three-year rolling data windows (i.e. 2002-2004, 2003-2005, 2004-2006, etc.). This is depicted with the mean calibrated visual ogive shown in **Figure 10** (black line).

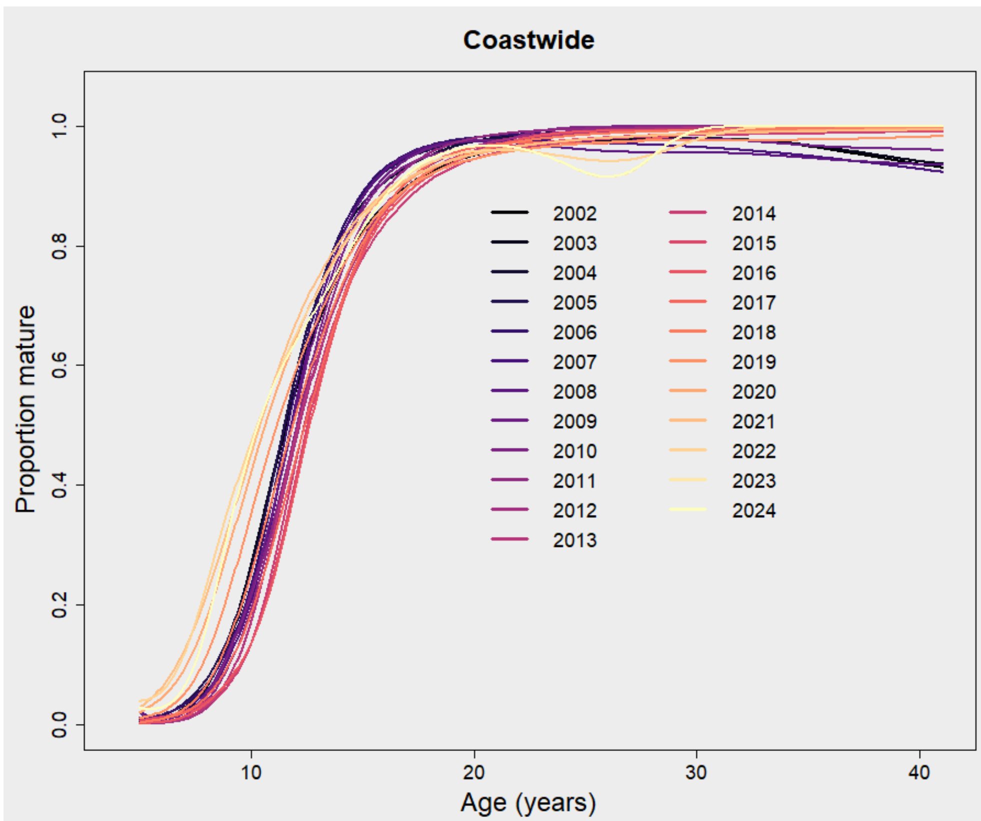


Figure 8. Estimated maturity ogives as a function of age based on visual maturity assessment data from rolling three-year data windows from 2002-2024.

When comparing the new coastwide calibrated visual maturity ogive to the current ogive used in the SA, the curve shifted slightly to the left from ages 8-15 (**Figure 10**, overlapping black and green lines). The calibrated visual ogive has a calculated A50 of 11.0 years, lower than the A50 value of 11.6 from the current SA ogive (red line) and indicates a slight decrease in the proportion of mature females from ages 15-20 years. These shifts in the maturity curves are to be expected as the histology-based data provide a better indicator of younger maturing females, but also older immature females. It is important to note that these maturity ogives do not offer a direct comparison, given that the current SA ogive is based on visual estimates exclusively from IPHC Regulatory Areas 2B and 3A, whereas the new calibrated ogive incorporates data from all four Biological Regions. For input into the SA, we truncated the new calibrated ogive at age 7 years (**Figure 10**, green line) as histology-based maturity estimations did not find females < 7 years old that were mature. Previous maturity ogives using visual estimates truncated the curve at age 8 years.

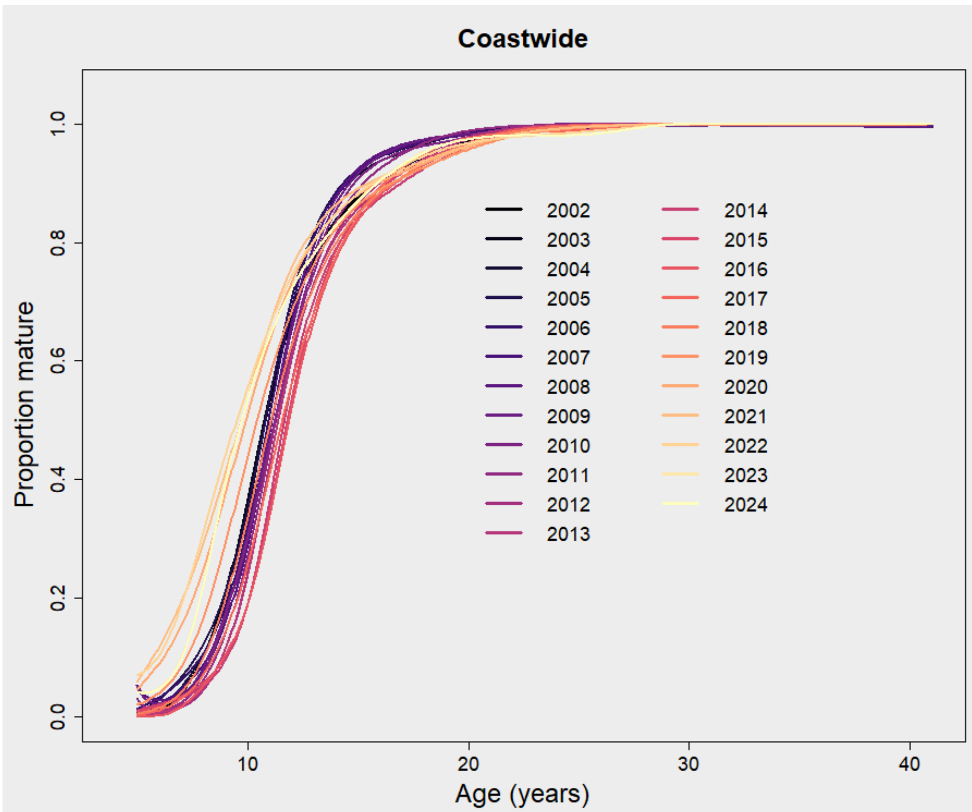


Figure 9. Estimated maturity ogives as a function of age calculated by applying the estimated calibration factors to the curves estimated from visual maturity assessment data from Figure 8.

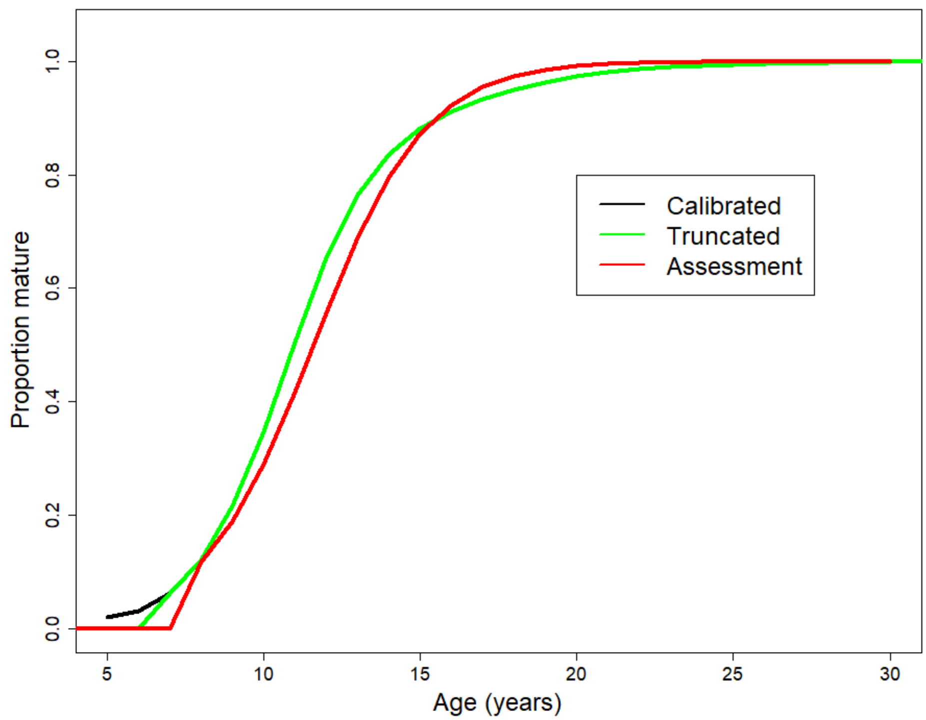


Figure 10. Estimated mean calibrated visual maturity ogive (black) with same ogive overlayed but truncated to zero at age 7 (green). Current coastwide ogive (red) used in stock assessment shown for reference.

2.3. Fecundity estimations. The IPHC Secretariat has initiated studies that are aimed at improving our understanding of Pacific halibut fecundity. This will allow us to estimate fecundity-at-size and -age and could be used to replace spawning biomass with egg output as the metric for reproductive capability in stock assessment and management reference points. Fecundity determinations will be conducted using the auto-diametric method (Thorsen and Kjesbu 2001; Witthames et al., 2009). IPHC Secretariat staff received training on this method by experts in the field (NOAA Fisheries, Northeast Fisheries Science Center, Wood Hole, MA) in May 2023. Ovarian samples for the development and application of the auto-diametric method to estimate fecundity in female Pacific halibut were collected during the IPHC's FISS in 2023, 2024 and 2025. In 2023, sampling was conducted only in Biological Region 3, with a total of 456 fecundity samples collected. In 2024, sampling was conducted in Biological Regions 2 and 4, with 149 and 359 fecundity samples collected, respectively. In the Fall of 2024, 273 additional fecundity samples targeting large females (85-200+ cm in fork length) were collected in Biological Region 2. In 2025, in addition to samples collected in the FISS, fecundity samples were again collected in Biological Region 2 in a special project targeting large females. This comprehensive collection of ovarian samples will be used initially for the development of the auto-diametric method, followed by actual fecundity estimations by age and by size (length and weight).

3. Fishing Technology.

The IPHC Secretariat has determined that research to provide the Pacific halibut fishery with tools to reduce whale depredation is considered a high priority. This research is now contemplated as one of the research areas of high priority within the 5-year Program of Integrated Research and Monitoring (2022-2026).

Removal of captured fish from fishing gear (known as depredation) is a growing problem among many hook-and-line fisheries worldwide. In the north Pacific Ocean, both Killer (*Orcinus orca*) and Sperm (*Physeter macrocephalus*) whales are involved in depredation behavior in Pacific halibut, sablefish (*Anoplopoma fimbria*), and Greenland turbot (*Reinhardtius hippoglossoides*) longline fisheries. In 2011 and 2012, fisheries observers estimated that 21.4% of sablefish sets, 9.9% of Greenland turbot sets, and 6.9% of Pacific halibut sets were affected by whale depredation in the Bering Sea (Peterson et al. 2014). Reductions in catch per unit effort (CPUE) when whales were present ranged across geographic regions from 55%-69% for sablefish, 54%-67% for Greenland turbot, and 15-57% for Pacific halibut (Peterson et al. 2014). These impacts also incur significant time, fuel, and personnel costs to fishing operations. From a fisheries management perspective, depredation creates an additional and highly uncertain source of mortality, loss of data (e.g. compromised survey activity), and reduces fishery efficiency. Stock assessments of both Pacific halibut and sablefish have adjusted their analysis of fishery-independent data to account for the effects of whale depredation on catch rates. In the sablefish assessment, fishery limits are also adjusted downward to reflect expected depredation during the commercial fishery. In recent years, whale depredation has been limiting fishers' ability to harvest their Greenland turbot allocations, and they have been well below (35-78% in the last 5 years) the total allowable catch for that fishery. Meanwhile, potential risks to the whales include physical injury due to being near vessels and gear, disruption of social structure and developing an artificial reliance on food items that can be affected by fishery dynamics.

Many efforts have been made over the years to mitigate this problem, with fishers generally limited to simple methods that can be constructed, deployed, or enacted without significantly disrupting normal fishing operations, or without violating gear regulations. Existing approaches include catch protection, physical and auditory deterrents, and spatial or temporal avoidance. These approaches have had variable degrees of success and ease of adoption, but none have solved the problem. Terminal gear modification and catch protection have been identified as an avenue with the highest likelihood of 'breaking the reward cycle' in depredation behaviors. Particularly for Pacific halibut and Greenland turbot, two species whose catches are prohibited and closely regulated, respectively, in trawl fisheries and that are difficult to capture efficiently in pots, novel approaches to protection of longline catch are necessary.

This project focuses on investigating strategies aimed at protecting longline-caught fish, through low cost, easy to adopt gear modifications that securely retain catch, while breaking the 'reward cycle' in depredation. This project, that received funding from the Bycatch Reduction Engineering Program (BREP)-NOAA, was structured in two parts. First, in early 2022 we conducted a virtual International Workshop (link) on protecting fishery catches from whale depredation with industry (affected fishers, gear manufacturers), gear researchers and scientists to identify methods to protect fishery catches from depredation.

The second part of the project involved developing the top catch protection design outcomes of the Workshop into functional prototypes and conducting field testing in longline sea trials. The two selected catch protection devices were: 1) an underwater shuttle (**Figure 11A**) and 2) a branch gear with a sliding shroud system.

Results from field testing conducted in May 2023 indicated that the shuttle was a safe and effective gear type which entrained comparable quantities, sizes, and types of fish as the control gear, whereas the sliding shroud and branch gear had substantial logistical issues that would need to be addressed before scaling up to a fishery level.

Based on the success of the first two components of this work, the IPHC secured additional funding from BREP-NOAA to expand testing of the shuttle concept in the presence of depredating Orcas in Alaskan waters (Appendix IV). This work focused on further refinement and performance characterization of the shuttle device in the presence of toothed whales in IPHC Regulatory Area 4A. Field operations occurred from 21-28 May 2025 aboard the F/V Oracle (**Figure 11**). Eighteen sets were successfully completed, generating 15 sets of shuttle and control catch comparison data along with close to 80 hours of underwater footage combined (control, shuttle exterior, shuttle interior). Depredating orcas were present at 6 of the paired sets.

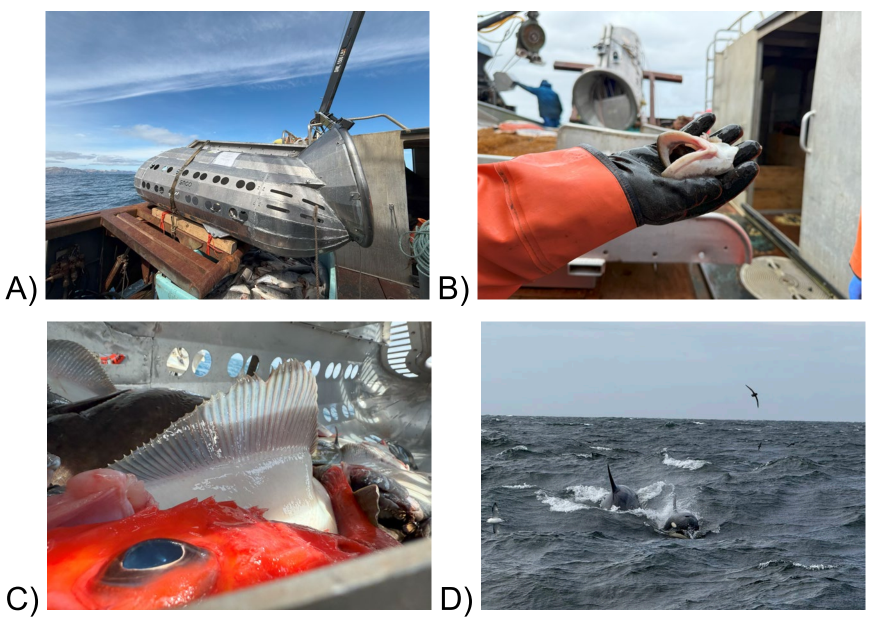


Figure 11. A) Shuttle device in transport. B) Typical evidence (lips only) of depredation. C) Catch entrained within the shuttle. D). Killer whales rapidly approaching the hauling site.

Preliminary comparisons of data from 10 sets with completed video review show good entrainment for Pacific halibut, but high escapement for sablefish (**Table 1**). Species morphology is the predominant reason for this and simple modifications to the entry tines and to the snugness of stopper fit should easily achieve much higher retention rates.

Common Name	Encountered	Excluded	Entered	Escaped	Passed Through	Entrained
Pacific halibut	89	1 (1.1%)	88	0	8 (9.1%)	80 (90.9%)
Sablefish	160	2 (1.3%)	158	45 (28.5%)	30 (19.0%)	83 (52.5%)
Pacific cod	124	3 (2.4%)	121	13 (10.7%)	6 (5.0%)	102 (84.3%)
Rockfish	16	7 (43.8%)	9	2 (22.2%)	1 (11.1%)	6 (66.7%)
Skate	18	3 (16.7%)	15	0	2 (13.3%)	13 (86.7%)

Table 1. Numbers of fish encountered by the shuttle device that are either excluded, entered, escaped, passed through still on the hook, and/or finally entrained on 10 of 15 sets with video footage analyzed to date.

The shuttle was deployed across two skates of gear (200 hooks). Catch rate (numbers of fish) comparisons (**Figure 12**) between the control gear and the shuttle demonstrated capacity for good entrainment by the shuttle, but with variable rates overall between sets.

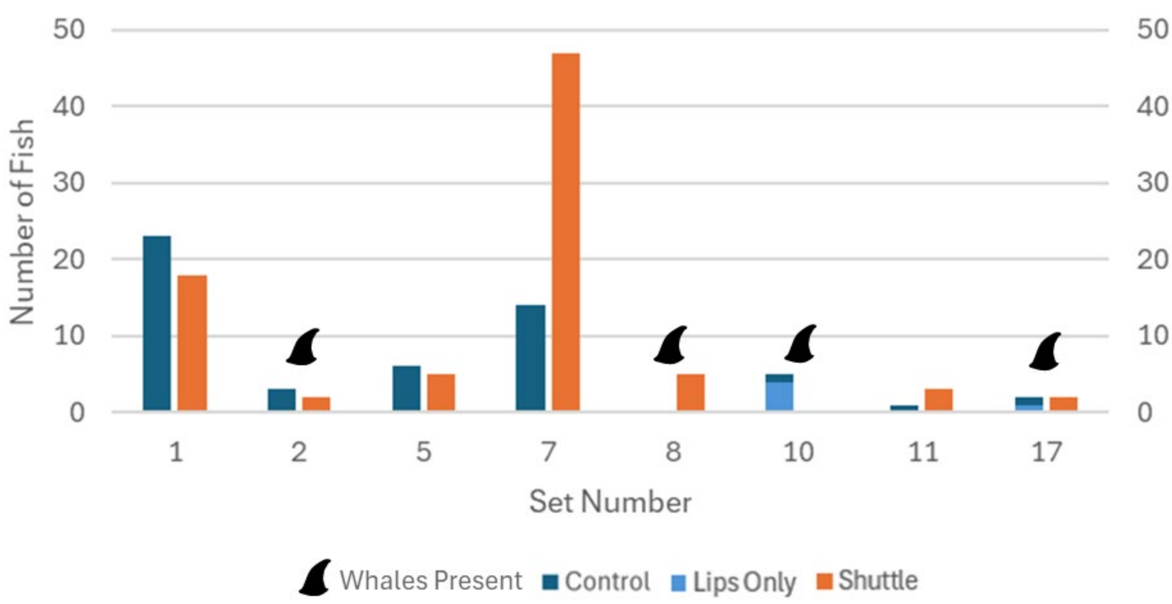


Figure 12. Preliminary catch rates for sets with paired shuttle and control gear where Pacific halibut were captured.

Video review and data analysis are ongoing. Field trials during a quota fishing trip are currently underway in the Bering Sea to provide additional metrics of the device under typical commercial fishing conditions.

RECOMMENDATION/S

1) That the RAB **NOTE** IPHC-2025-RAB026-06, that provides a report on current and planned biological and ecosystem science and research activities contemplated in the IPHC's Five-Year Program of Integrated Research and Monitoring (2022-2026).

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APPENDICES

Appendix I: Biological research areas in the 5-Year Program of Integrated Research and Monitoring (2022-2026) and ranked relevance for stock assessment and management strategy evaluation (MSE)

Appendix II: List of ranked research priorities for stock assessment

Appendix III: List of ranked research priorities for management strategy evaluation (MSE)

Appendix IV: Summary of current competitive research grants awarded to IPHC

APPENDIX I

Biological research areas in the 5-Year Program of Integrated Research and Monitoring (2022-2026) and ranked relevance for stock assessment and management strategy evaluation (MSE)

Research areas	Research activities	Research outcomes	Relevance for stock assessment	Relevance for MSE	Specific analysis input	SA Rank	MSE Rank	Research priorization
Migration and population dynamics	Population structure	Population structure in the Convention Area	Altered structure of future stock assessments	Improve parametization of the Operating Model	If 4B is found to be functionally isolated, a separate assessment may be constructed for that IPHC Regulatory Area	2. Biological input	1. Biological parameterization and validation of movement estimates and recruitment distribution	2
	Distribution	Assignment of individuals to source populations and assessment of distribution changes	Improve estimates of productivity		Will be used to define management targets for minimum spawning biomass by Biological Region	3. Biological input		2
	Larval and juvenile connectivity studies	Improved understanding of larval and juvenile distribution	Improve estimates of productivity		Will be used to generate potential recruitment covariates and to inform minimum spawning biomass targets by Biological Region	3. Biological input	1. Biological parameterization and validation of movement estimates	2
Reproduction	Histological maturity assessment	Updated maturity schedule	Scale biomass and reference point estimates	Improve simulation of spawning biomass in the Operating Model	Will be included in the stock assessment, replacing the current schedule last updated in 2006	1. Biological input		1
	Examination of potential skip spawning	Incidence of skip spawning			Will be used to adjust the asymptote of the maturity schedule, if/when a time-series is available this will be used as a direct input to the stock assessment			1
	Fecundity assessment	Fecundity-at-age and -size information			Will be used to move from spawning biomass to egg-output as the metric of reproductive capability in the stock assessment and management reference points			1
	Examination of accuracy of current field macroscopic maturity classification	Revised field maturity classification			Revised time-series of historical (and future) maturity for input to the stock assessment			1
Growth	Evaluation of somatic growth variation as a driver for changes in size-at-age	Identification and application of markers for growth pattern evaluation	Scale stock productivity and reference point estimates	Improve simulation of variability and allow for scenarios investigating climate change	May inform yield-per-recruit and other spatial evaluations of productivity that support mortality limit-setting		3. Biological parameterization and validation for growth projections	5
		Environmental influences on growth patterns			May provide covariates for projecting short-term size-at-age. May help to delineate between effects due to fishing and those due to environment, thereby informing appropriate management response			5
		Dietary influences on growth patterns and physiological condition			May provide covariates for projecting short-term size-at-age. May help to deleineate between effects due to fishing and those due to environment, thereby informing appropriate management response			5
Mortality and survival assessment	Discard mortality rate estimate: longline fishery	Experimentally-derived DMR	Improve trends in unobserved mortality	Improve estimates of stock productivity	Will improve estimates of discard mortality, reducing potential bias in stock assessment results and management of mortality limits	1. Fishery yield	1. Fishery parameterization	4
	Discard mortality rate estimate: recreational fishery				Will improve estimates of discard mortality, reducing potential bias in stock assessment results and management of mortality limits			4
	Best handling and release practices	Guidelines for reducing discard mortality			May reduce discard mortality, thereby increasing available yield for directed fisheries	2. Fishery yield		4
Fishing technology	Whale depredation accounting and tools for avoidance	New tools for fishery avoidance/deterence; improved estimation of depredation mortality	Improve mortality accounting	Improve estimates of stock productivity	May reduce depredation mortality, thereby increasing available yield for directed fisheries. May also be included as another explicit source of mortality in the stock assessment and mortality limit setting process depending on the estimated magnitude	1. Assessment data collection and processing		3

APPENDIX II

List of ranked research priorities for stock assessment

SA Rank	Research outcomes	Relevance for stock assessment	Specific analysis input	Research Area	Research activities
1. Biological input	Updated maturity schedule	Scale biomass and reference point estimates	Will be included in the stock assessment, replacing the current schedule last updated in 2006	Reproduction	Histological maturity assessment
	Incidence of skip spawning		Will be used to adjust the asymptote of the maturity schedule, if/when a time-series is available this will be used as a direct input to the stock assessment		Examination of potential skip spawning
	Fecundity-at-age and -size information		Will be used to move from spawning biomass to egg-output as the metric of reproductive capability in the stock assessment and management reference points		Fecundity assessment
	Revised field maturity classification		Revised time-series of historical (and future) maturity for input to the stock assessment		Examination of accuracy of current field macroscopic maturity classification
2. Biological input	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area	Altered structure of future stock assessments	If 4B is found to be functionally isolated, a separate assessment may be constructed for that IPHC Regulatory Area	Migration and population dynamics	Population structure
3. Biological input	Assignment of individuals to source populations and assessment of distribution changes	Improve estimates of productivity	Will be used to define management targets for minimum spawning biomass by Biological Region		Distribution
	Improved understanding of larval and juvenile distribution		Will be used to generate potential recruitment covariates and to inform minimum spawning biomass targets by Biological Region		Larval and juvenile connectivity studies
1. Assessment data collection and processing	Sex ratio-at-age	Scale biomass and fishing intensity	Annual sex-ratio at age for the commercial fishery fit by the stock assessment	Reproduction	Sex ratio of current commercial landings
	Historical sex ratio-at-age		Annual sex-ratio at age for the commercial fishery fit by the stock assessment		Historical sex ratios based on archived otolith DNA analyses
2. Assessment data collection and processing	New tools for fishery avoidance/deterence; improved estimation of depredation mortality	Improve mortality accounting	May reduce depredation mortality, thereby increasing available yield for directed fisheries. May also be included as another explicit source of mortality in the stock assessment and mortality limit setting process depending on the estimated magnitude	Fishing technology	Whale depredation accounting and tools for avoidance
1. Fishery yield	Physiological and behavioral responses to fishing gear	Reduce incidental mortality	May increase yield available to directed fisheries	Fishing technology	Biological interactions with fishing gear
2. Fishery yield	Guidelines for reducing discard mortality	Improve estimates of unobserved mortality	May reduce discard mortality, thereby increasing available yield for directed fisheries	Mortality and survival assessment	Best handling practices: recreational fishery

APPENDIX III

List of ranked research priorities for management strategy evaluation (MSE)

<table>
<tr><th>MSE Rank</th><th>Research outcomes</th><th>Relevance for MSE</th><th>Research Area</th><th>Research activities</th></tr>
<tr><td rowspan="2">1. Biological parameterization and validation of movement estimates</td><td>Improved understanding of larval and juvenile distribution</td><td rowspan="2">Improve parametization of the Operating Model</td><td rowspan="3">Migration and population dynamics</td><td>Larval and juvenile connectivity studies</td></tr>
<tr><td>Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area</td><td>Population structure</td></tr>
<tr><td rowspan="2">2. Biological parameterization and validation of recruitment variability and distribution</td><td>Assignment of individuals to source populations and assessment of distribution changes</td><td>Improve simulation of recruitment variability and parametization of recruitment distribution in the Operating Model</td><td>Distribution</td></tr>
<tr><td>Establishment of temporal and spatial maturity and spawning patterns</td><td>Improve simulation of recruitment variability and parametization of recruitment distribution in the Operating Model</td><td>Reproduction</td><td>Recruitment strength and variability</td></tr>
<tr><td rowspan="3">3. Biological parameterization and validation for growth projections</td><td>Identification and application of markers for growth pattern evaluation</td><td rowspan="3">Improve simulation of variability and allow for scenarios investigating climate change</td><td rowspan="3">Growth</td><td rowspan="3">Evaluation of somatic growth variation as a driver for changes in size-at-age</td></tr>
<tr><td>Environmental influences on growth patterns</td></tr>
<tr><td>Dietary influences on growth patterns and physiological condition</td></tr>
<tr><td>1. Fishery parameterization</td><td>Experimentally-derived DMRs</td><td>Improve estimates of stock productivity</td><td>Mortality and survival assessment</td><td>Discard mortality rate estimate: recreational fishery</td></tr>
</table>

APPENDIX IV

Summary of current competitive research grants awarded to IPHC

Project #	Grant agency	Project name	PI	Partners	IPHC Budget ($US)	Grant period	Research area	Management implications	Research prioritization
1	**Bycatch Reduction Engineering Program-NOAA**	Full scale testing of devices to minimize whale depredation in longline fisheries (NOAA Award Number NA23NMF4720414)	IPHC	Alaska Fisheries Science Center-NOAA	$199,870	November 2023 – April 2026	Fishing technology	Mortality estimations due to whale depredation	3
2	**Alaska Sea Grant (pending award)**	Development of a non-lethal genetic-based method for aging Pacific halibut (R/2024-05)	IPHC APU	Alaska Fisheries Science Center-NOAA (Juneau)	$60,374	January 2025-December 2026	Population dynamics	Stock structure	2
Total awarded ($)					**$260,244**				

IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2025

PREPARED BY: IPHC SECRETARIAT (K. UALESI , T. JACK, R. RILLERA, K. COLL; 16 OCTOBER 2025)

PURPOSE

To provide a summary of the IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2025.

BACKGROUND

The annual IPHC Fishery-Independent Setline Survey (FISS) of the Pacific halibut stock was augmented from 2014-2019 with expansion stations that filled in gaps in coverage in the annual FISS. Prior to 2020, the standard grid of stations comprised 1,200 stations. Following the completion in 2019, expansion stations were added to the standard grid in all IPHC Regulatory Areas, now totaling 1,890 stations for the full FISS design (Figure 1), within the prescribed depth range of 18 to 732 metres (10 to 400 fathoms).

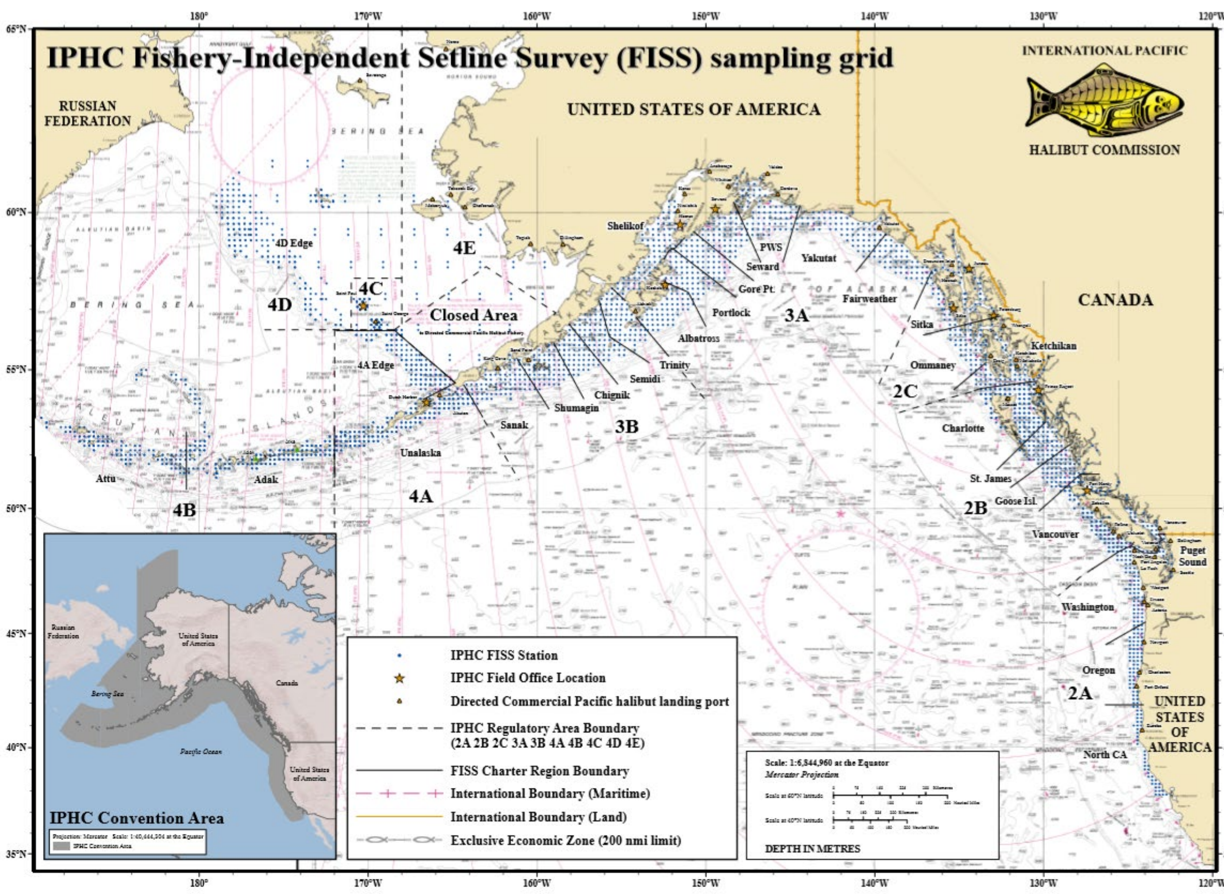

Figure 1. IPHC Fishery-Independent Setline Survey (FISS) with full sampling grid shown.

Prior to 2019, only fixed gear was used to fish FISS sets. With increasing use of snap gear in the commercial fishery, this restriction has limited the number of vessels available for the FISS. Further, any differences between snap and fixed gears (including catch rate differences and differences in fishing locations) may affect our understanding of trends in commercial fishery indices. This has motivated the need for a study comparing the two gear types with this work being done in 2019, 2020, and again in 2021. While no study was completed in 2022, we recognized the increased use of snap gear and integrated snap gear into the FISS tender specifications for 2023 and 2024 and 2025.

Beginning in 2019, individual weight data were collected coastwide from Pacific halibut caught on the FISS to eliminate questions that have arisen regarding the accuracy of estimates that depend on these weights, including weight per unit effort (WPUE) indices of density. Data from IPHC collections from commercial landings and other sources had provided evidence that the current standard length-net weight curve used for estimating Pacific halibut weights on the FISS may have been over-estimating weights on average in most IPHC Regulatory Areas, and that the relationship between weight and length may vary spatially.

2025 FISS design

On 13 December 2024, the 2025 FISS Tender Specifications were published to the IPHC website with a deadline of 3 February 2025 for tenders.

Following SS014, the final 2025 FISS design was approved via inter-sessional agreement (IPHC-2024-CR-030, IPHC-2024-CR-031).

The design (Figure 2) comprised sampling of subareas within IPHC Regulatory Areas 2A, 2B, 2C, 3A, 3B, 4A and 4B intended to balance the Commissions primary and secondary objectives for the FISS.

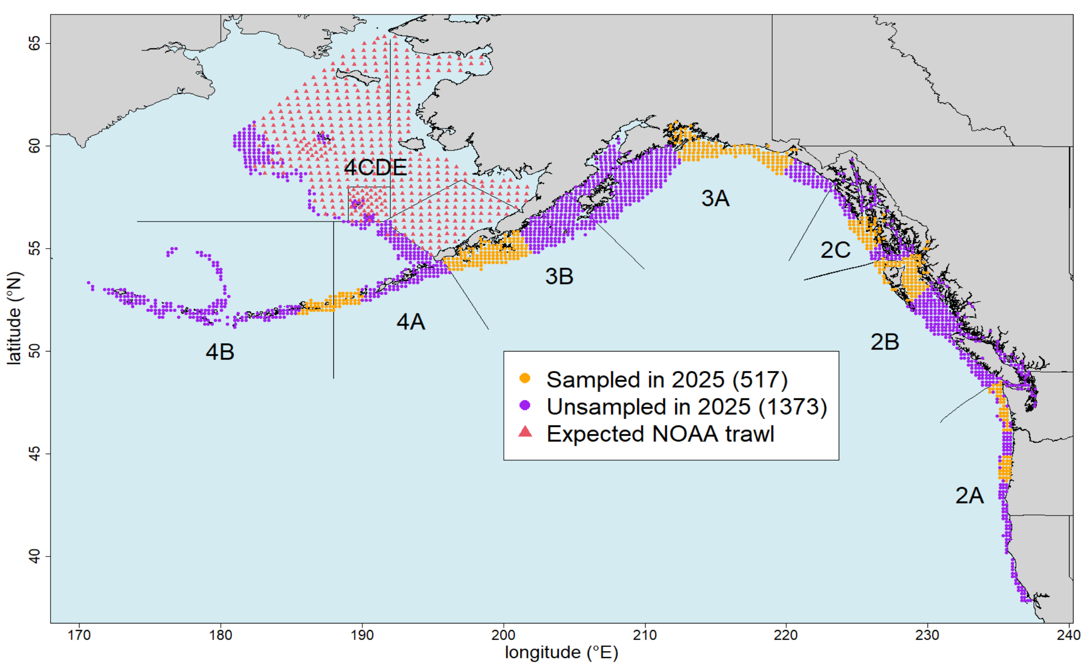

Figure 2. Map of the 2025 FISS design approved by the Commission on 8 November 2024. Purple circles were not sampled in 2025.

MATERIALS AND METHODS

The IPHC's FISS design encompasses nearshore and offshore waters of the IPHC Convention Area (Fig. 1). The IPHC Regulatory Areas are divided into 29 charter regions, each requiring between 10 and 46 charter days to complete. FISS stations are located at the intersections of a 10 nmi by 10 nmi square grid within the depth range occupied by Pacific halibut during summer months (18 – 732 m [10 – 400 fm]). Figure 2 depicts the 2025 FISS station positions, and IPHC Regulatory Areas.

Fishing vessels are chosen through a competitive bid process where up to four (4) charter regions per vessel may be awarded and typically 8-15 vessels are chosen. In 2025, the process was clearly documented on the IPHC website for accountability and transparency purposes: Vessel Recruiting - IPHC.

In 2025, six (6) vessels were chartered to complete the FISS, as detailed in IPHC-2025-MR-007 Notification of IPHC Fishery-Independent Setline Survey (FISS) 2025 Contract Awards - IPHC. There was an additional vessel chartered to complete the 2025 Catch Protection Study in 4A Edge that provided FISS data as well.

Sampling protocols

IPHC Setline Survey Specialists (Field) collected data according to protocols established in the 2025 FISS Sampling Manual (IPHC-2025-VSM01).

Sampling challenges - 2025

There were six (6) stations completed during the 2025 Catch Protection Study in 4A Edge that met FISS tender specifications and were added to the total 2025 FISS, making a total of 523 FISS stations planned for the 2025 FISS season. Of the 523 FISS stations planned for the 2025 FISS season, 497 (95%) were effectively sampled.

Not sampled: A total of four (4) stations initially planned for sampling in 2025 were not completed. One station in the Yakutat charter region was not sampled due to the presence of ice. In the Charlotte charter region, one station was excluded because it was located within the Hecate Marine Protected Area. Additionally, two stations in the Unalaska charter region were originally scheduled for sampling but were ultimately removed during the planning phase, following negotiations with the vessel operator.

Ineffective stations: Coastwide, twenty-two (22) stations were deemed ineffective due to orca depredation (n=6), sperm whale depredation (n=10), pinniped depredation (n=1), unknown depredation (n=2), sand fleas (n=1), soak time (n=1), and setting and gear issues (n=1).

Bait (Chum salmon)

The minimum quality requirement for FISS bait is No. 2 semi-bright (Alaska Seafood Marketing Institute grades A through E), headed and gutted, and individually quick-frozen chum salmon. Bait usage is based on 0.17 kilograms (0.37 pounds) per hook resulting in approximately 136 kilograms (300 pounds) per eight skate station. Bait quality was monitored and documented throughout the season and found to meet the standard as described above.

Pre-season: In September 2024 (IPHC Media Release 2024-MR015), the Secretariat made pre-season bait purchases of approximately 72.6 tonnes (145,200 lbs) of chum salmon to ensure a smooth start to the 2025 FISS.

RESULTS

Interactive views of the FISS results are provided via the IPHC website here:

https://www.iphc.int/data/setline-survey-catch-per-unit-effort

As in previous years, legal-sized (O32) Pacific halibut caught on the FISS were sacrificed in order to obtain biological data and were retained for sale. In addition, beginning in 2020, sub-legal (U32) Pacific halibut randomly selected for otolith sampling were also retained and sold. This helped to offset costs of the FISS. FISS vessels also retained for sale incidentally captured rockfish (*Sebastes spp*.) and Pacific cod (*Gadus macrocephalus*) as these species rarely survive the barotrauma resulting from capture. Most vessel contracts provided the vessel a lump sum payment, along with a 10% share of the Pacific halibut proceeds and a 50% share of the incidental catch proceeds.

The 2025 FISS chartered seven (7) commercial longline vessels (three Canadian and four USA), during a combined 33 trips and 271 charter days (Tables 1). Otoliths were removed from 5,670 fish coastwide. Approximately 119 tonnes (261,912 pounds) of Pacific halibut, 28 tonnes (60,662 pounds) of Pacific cod, and 24 tonnes (52,669 pounds) of rockfish were landed from the FISS stations.

Table 1a. Effort and landing summary by FISS charter region and vessel for all 2025 stations and all Pacific halibut (sampled U32 and all O32).

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number1	Charter Days2	Planned Stations	Effective Stations[3]	Pacific halibut Sold (t)[4]	Pacific halibut Sold (lb)[4]	Average Price USD/kg[5]	Average Price USD/lb[5]
2A	Oregon	*Pacific Surveyor*	947061	14	26	26	1	3,276	$16.05	$7.28
2A	Washington	*Pacific Surveyor*	947061	26	42	42	4	7,746	$16.20	$7.35
2B	Charlotte	*Vanisle*	21912	49	89	86	20	44,460	$21.29	$9.66
2C	Ommaney	*Pender Isle*	27282	27	52	49	31	68,407	$22.03	$9.99
3A	Prince William Sound	*Kema Sue*	41033	30	67	66	13	29,128	$17.27	$7.83
3A	Yakutat	*Kema Sue*	41033	31	64	57	17	37,431	$16.47	$7.47
3B	Sanak	*Star Wars II*	99997	35	71	68	13	28,262	$14.45	$6.56
3B	Shumagin	*Star Wars II*	99997	28	54	53	9	20,898	$12.71	$5.77
4A	Unalaska	*Kema Sue*	41033	16	30	26	6	13,265	$13.95	$6.33
4A	4A Edge	*Oracle*	77897	4	6	4	1	1,398	$11.36	$5.15
4B	Adak	*Polaris*	19266	15	30	28	4	9,040	$13.67	$6.20
Total		**7 Vessels**		**271**	**531**	**505**	**119**	**263,310**	**$18.04**	**$8.18**

[1] Canada: Vessel Registration Number and USA: ADF&G vessel number.

[2] Days are estimated - some vessels fished two charter regions in one day.

[3] Stations that did not meet setting parameters or deemed ineffective are excluded.

[4] Net weight (head-off, dressed, washed). May not sum to correct total due to rounding.

[5] Ex-vessel price.

Table 1b. Effort and landing summary by FISS charter region and vessel for all 2025 stations and O32 Pacific halibut.

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number1	Charter Days2	Planned Stations	Effective Stations[3]	Pacific halibut Sold (t)[4]	Pacific halibut Sold (lb)[4]	Average Price USD/kg[5]	Average Price USD/lb[5]
2A	Oregon	*Pacific Surveyor*	947061	14	26	26	1	2,687	$17.64	$8.00
2A	Washington	*Pacific Surveyor*	947061	26	42	42	4	4,823	$18.38	$8.34
2B	Charlotte	*Vanisle*	21912	49	89	86	20	42,155	$21.50	$9.75
2C	Ommaney	*Pender Isle*	27282	27	52	49	31	66,787	$22.16	$10.05
3A	Prince William Sound	*Kema Sue*	41033	30	67	66	13	28,099	$17.30	$7.84
3A	Yakutat	*Kema Sue*	41033	31	64	57	17	36,796	$16.48	$7.48
3B	Sanak	*Star Wars II*	99997	35	71	68	13	26,258	$14.63	$6.64

3B	Shumagin	*Star Wars II*	99997	28	54	53	9	19,423	$12.75	$5.78
4A	Unalaska	*Kema Sue*	41033	16	30	26	6	8,043	$14.58	$6.61
4A	4A Edge	*Oracle*	77897	4	6	4	1	777	$11.83	$5.36
4B	Adak	*Polaris*	19266	15	30	28	4	6,111	$14.01	$6.36
Total		**7 Vessels**		**271**	**531**	**505**	**110**	**241,959**	**$18.43**	**$8.36**

[1] Canada: Vessel Registration Number and USA: ADF&G vessel number.

[2] Days are estimated - some vessels fished two charter regions in one day.

[3] Stations that did not meet setting parameters or deemed ineffective are excluded.

[4] Net weight (head-off, dressed, washed). May not sum to correct total due to rounding.

[5] Ex-vessel price.

Table 1c. Effort and landing summary by FISS charter region and vessel for all 2025 stations and sampled U32 Pacific halibut.

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number1	Charter Days2	Planned Stations	Effective Stations[3]	Pacific halibut Sold (t)[4]	Pacific halibut Sold (lb)[4]	Average Price USD/kg[5]	Average Price USD/lb[5]
2A	Oregon	*Pacific Surveyor*	947061	14	26	26	1	589	$8.82	$4.00
2A	Washington	*Pacific Surveyor*	947061	26	42	42	4	2,923	$12.60	$5.71
2B	Charlotte	*Vanisle*	21912	49	89	86	20	2,305	$17.36	$7.87
2C	Ommaney	*Pender Isle*	27282	27	52	49	31	1,620	$16.86	$7.65
3A	Prince William Sound	*Kema Sue*	41033	30	64	63	13	1,029	$17.27	$7.83
3A	Yakutat	*Kema Sue*	41033	31	67	60	17	634	$15.47	$7.02
3B	Sanak	*Star Wars II*	99997	35	71	68	13	2,004	$12.16	$5.52
3B	Shumagin	*Star Wars II*	99997	28	54	53	9	1,475	$12.26	$5.56
4A	Unalaska	*Kema Sue*	41033	16	30	26	6	5,222	$12.96	$5.88
4A	4A Edge	*Oracle*	77897	4	6	4	1	621	$10.77	$4.89
4B	Adak	*Polaris*	19266	15	30	28	4	2,929	$12.96	$5.88
Total		**7 Vessels**		**271**	**531**	**505**	**10**	**21,351**	**$13.63**	**$6.18**

[1] Canada: Vessel Registration Number and USA: ADF&G vessel number.

[2] Days are estimated - some vessels fished two charter regions in one day.

[3] Stations that did not meet setting parameters or deemed ineffective are excluded.

[4] Net weight (head-off, dressed, washed). May not sum to correct total due to rounding.
[5] Ex-vessel price.

Vessels chartered by the IPHC delivered fish to eleven (11) different ports (Tables 2). Fish sales were awarded based on obtaining a fair market price. When awarding sales, the Commission considered the price offered, the number of years that a buyer had been buying and marketing Pacific halibut, how fish were graded at the dock (including the determination of No. 2 and chalky Pacific halibut), and the promptness of settlements following deliveries. In the case of multi-port bidding, vessel transit logistics and operational requirements were also considered. Individual sales were evaluated after each event to ensure that the buyer was meeting IPHC standards. Average prices increased from $13.71/kg in 2024 to $18.04/kg in 2025 (Tables 3). This represents a 24% increase in price.

Table 2a. FISS Pacific halibut landings by port for all Pacific halibut (sampled U32 and all O32), 2025[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Cordova	1	5	10,052	$64,554.11	$14.16	$6.42
Dutch Harbor	3	11	23,703	$147,175.43	$13.69	$6.21
False Pass	1	5	9,981	$61,444.80	$13.57	$6.16
Kodiak	1	4	8,718	$68,278.37	$17.27	$7.83
Newport	3	2	3,919	$28,248.00	$15.89	$7.21
Port Angeles	1	1	2,462	$11,633.72	$10.42	$4.73
Prince Rupert	9	51	112,867	$1,113,004.49	$21.74	$9.86
Sand Point	5	14	17,164	$141,691.20	$18.20	$8.26
Seward	2	8	6,888	$56,598.90	$18.12	$8.22
Westport	2	2	4,641	$40,881.64	$19.42	$8.81
Whittier	1	3	6,224	$49,792.00	$17.64	$8.00
Yakutat	4	15	33,118	$251,698.35	$16.76	$7.60
Grand Total	**33**	**119**	**263,310**	**$2,154,484.59**	**$18.04**	**$8.18**

[1] Net weight (head-off, dressed, washed).
[2] Prices based on net weight.

Table 2b. FISS Pacific halibut landings by port for O32 Pacific halibut, 2025[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Cordova	1	4	9,729	$62,545.45	$14.17	$6.43
Dutch Harbor	3	7	14,931	$96,212.77	$14.21	$6.44
False Pass	1	4	9,331	$57,700.80	$13.63	$6.18
Kodiak	1	4	8,029	$63,317.57	$17.39	$7.89
Newport	3	1	3,143	$25,144.00	$17.64	$8.00
Port Angeles	1	1	1,355	$7,305.35	$11.89	$5.39
Prince Rupert	9	49	108,942	$1,082,471.27	$21.91	$9.94
Sand Point	5	13	28,321	$165,526.56	$12.89	$5.84
Seward	2	8	16,717	$138,294.00	$18.24	$8.27
Westport	2	1	3,012	$29,256.61	$21.41	$9.71
Whittier	1	3	5,828	$46,624.00	$17.64	$8.00
Yakutat	4	15	32,621	$248,101.35	$16.77	$7.61
Grand Total	**33**	**110**	**241,959**	**$2,022,499.73**	**$18.43**	**$8.36**

[1] Net weight (head-off, dressed, washed).
[2] Prices based on net weight.

Table 2c. FISS Pacific halibut landings by port for sampled U32 Pacific halibut, 2025[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Cordova	1	4	8,772	$50,962.66	$12.81	$5.81
Dutch Harbor	3	0	323	$2,008.66	$13.71	$6.22
False Pass	1	0	650	$3,744.00	$12.70	$5.76
Kodiak	1	0	689	$4,960.80	$15.87	$7.20
Newport	3	0	776	$3,104.00	$8.82	$4.00
Port Angeles	1	1	1,107	$4,328.37	$8.62	$3.91
Prince Rupert	9	2	3,925	$30,533.22	$17.15	$7.78
Sand Point	5	1	2,140	$10,555.92	$10.87	$4.93
Seward	2	0	447	$3,397.20	$16.76	$7.60
Westport	2	1	1,629	$11,625.03	$15.73	$7.14
Whittier	1	0	396	$3,168.00	$17.64	$8.00
Yakutat	4	0	497	$3,597.00	$15.96	$7.24
Grand Total	**33**	**10**	**21,351**	**$131,984.86**	**$13.63**	**$6.18**

[1] Net weight (head-off, dressed, washed).
[2] Prices based on net weight.

Table 3a. FISS landings (total pounds and price) of all Pacific halibut (sampled U32 and all O32) by IPHC Regulatory Area in 2025[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	Total Weight and Average Price
Tonnes	5	20	31	30	22	7	4	119
Pounds	11,022	44,460	68,407	66,558	49,160	14,663	9,040	263,310
Price USD/kg	$16.15	$21.29	$22.03	$16.82	$13.71	$13.70	$13.67	$18.04
Price USD/lb	$7.33	$9.66	$9.99	$7.63	$6.22	$6.21	$6.20	$8.18

[1] Net weight (head-off, dressed, washed)

Table 3b. FISS landings (total pounds and price) of O32 Pacific halibut by IPHC Regulatory Area in 2025[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	Total Weight and Average Price
Tonnes	3	19	30	29	21	4	3	110
Pounds	7510	42,155	66,787	64,895	45,681	8,820	6,111	241,959
Price USD/kg	$18.04	$21.50	$22.16	$16.84	$13.79	$14.34	$13.89	$18.43
Price USD/lb	$8.18	$9.75	$10.05	$7.64	$6.26	$6.50	$6.30	$8.36

[1] Net weight (head-off, dressed, washed)

Table 3c. FISS landings (total pounds and price) of sampled U32 Pacific halibut by IPHC Regulatory Area in 2025[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	Total Weight and Average Price
Tonnes	2	1	1	1	2	3	1	10
Pounds	3512	2,305	1,620	1,663	3,479	5,543	2,929	21,351
Price USD/kg	$12.12	$17.36	$16.86	$16.15	$12.71	$12.73	$13.23	$13.63
Price USD/lb	$5.50	$7.87	$7.65	$7.32	$5.77	$5.77	$6.00	$6.18

[1] Net weight (head-off, dressed, washed)

FISS timing

The months of June, July, and August are targeted for FISS fishing every year. In 2025, this activity took place from 24 May through 5 September. On a coastwide basis, FISS vessel activity was highest in intensity at the beginning of the FISS season and declined in early August as most boats finished their charter regions (Figure 3). All FISS activity was completed by early September.

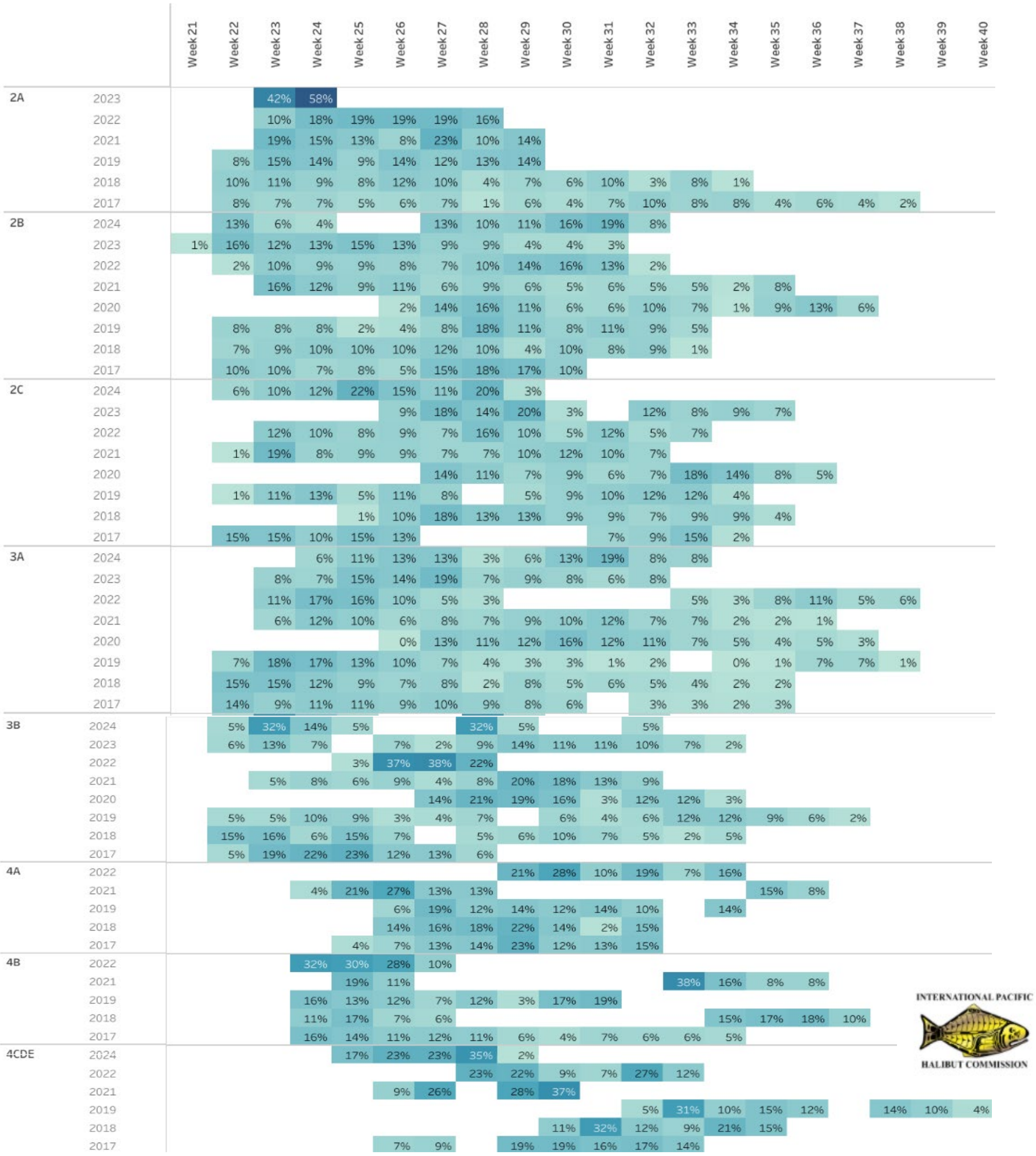

Figure 3. Percent of the total FISS stations completed by IPHC Regulatory Area during each week of the year (2017-2024). Week 21 begins in late May or early June, depending on the year. **NOTE**: This figure will be updated prior to the meeting.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2025-RAB026-07 that provides a summary of the IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2025.

APPENDICES

Nil.

2026-28 FISS designs

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER, I. STEWART, K. UALESI, T. JACK, D. WILSON; 19 OCTOBER 2025)

PURPOSE

To provide the Research Advisory Board with design options under consideration by the Commission for the 2026 Fishery-Independent Setline Survey (FISS) together with potential designs for 2027-28.

BACKGROUND

The IPHC's Fishery-Independent Setline Survey (FISS) provides data used to compute indices of Pacific halibut density for use in monitoring stock trends, estimating stock distribution, and as an important input in the stock assessment. Stock distribution estimates are based on the annual mean weight per unit effort (WPUE) for each IPHC Regulatory Area, computed as the average of WPUE of all Pacific halibut and for O32 (greater than or equal to 32" or 81.3cm in length) Pacific halibut estimated at each station in an area. Mean numbers per unit effort (NPUE) is used to index the trend in Pacific halibut density for use in the stock assessment models. Annual FISS designs are developed by selecting a subset of stations for sampling from the full 1890-station FISS footprint (Figure 1).

In recent years, the FISS has been implemented using reduced designs due to increasing costs and reduced catches of Pacific halibut, resulting in some stations, particularly in western areas, not having been sampled for five or more years (Figure 2). Such sampling gaps result in reduced precision and increased potential for bias in estimates of density indices and stock distribution.

At the Commission Work Meeting (September 2025), Commissioners were presented with:

- The Base Block design for 2026-28, a design based on rotating blocks of stations that provides full coverage of core IPHC Regulatory Areas (2B, 2C, 3A and 3B) over a two to three-year period, and prioritizes sampling elsewhere based on maintaining precise estimates with low bias
- A Reduced Loss design for 2026, which samples FISS charter regions that together maintain a projected financial loss of close to US$0.5 million
- A series of 2026 designs intermediate to the Base Block and Reduced Loss design, giving Commissioners the ability to assess the costs and benefits of modular changes to either design

Prior to the 2025 Work Meeting, it was confirmed that The Commission has secured a voluntary contribution of US$513,000 from the United States government to subsidize the FISS:

- $265,000 to fund the IPHC Regulatory Area 4B survey
- $163,000 to fund one charter region in IPHC Regulatory Area 3B
- $85,000 to partially fund the survey in IPHC Regulatory Area 4A

This contribution, together with revised cost projections for 2026, allowed Secretariate staff to expand the Reduced Loss design to create the Supplemented Reduced Loss design. This design will be presented to the Commission for review at the upcoming Interim Meeting (IM101, December 2 2025).

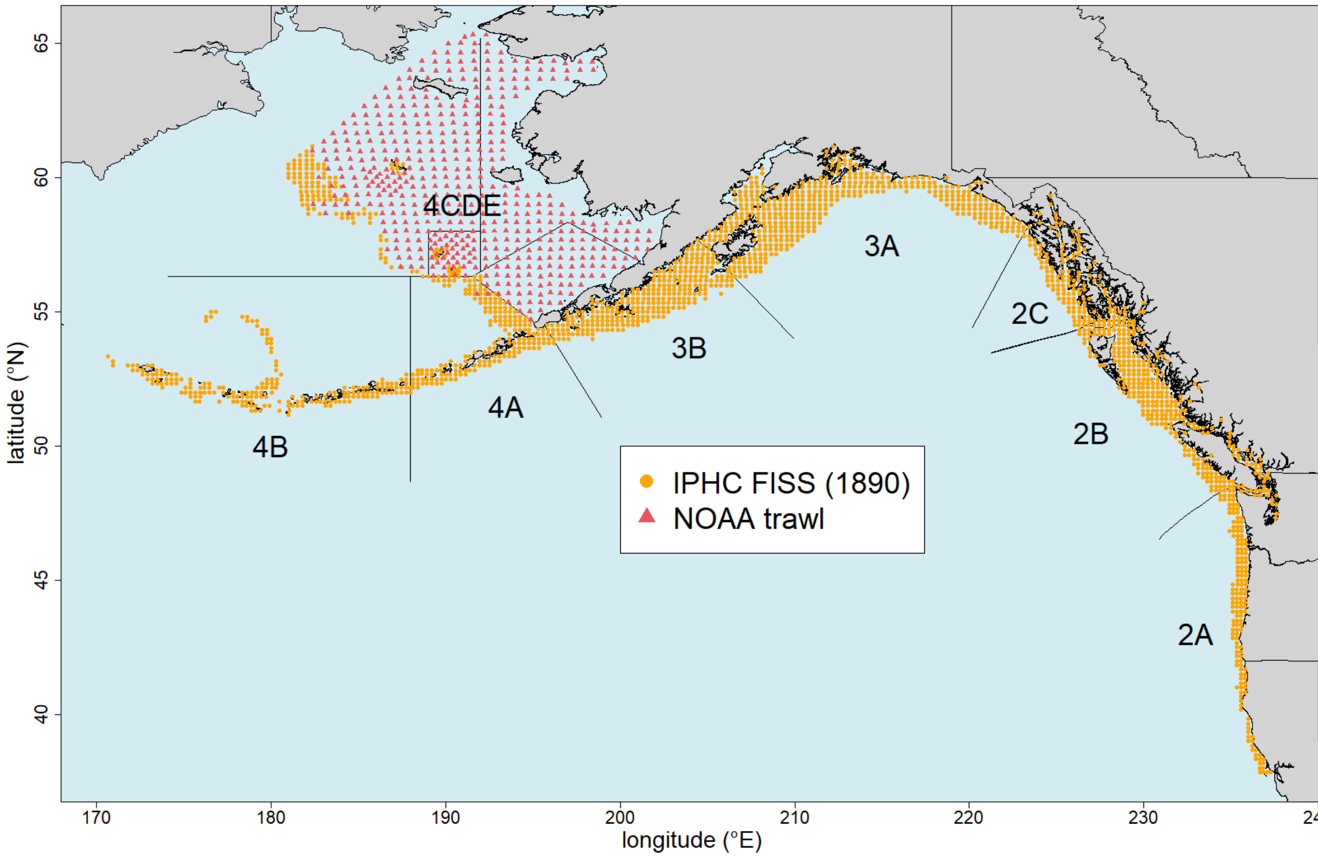

Figure 1. Map of the full 1890 station FISS design, with orange circles representing stations available for inclusion in annual sampling designs. Red triangles represent the locations NOAA trawl stations used to provide complementary data for Bering Sea modelling (not all are sampled each year).

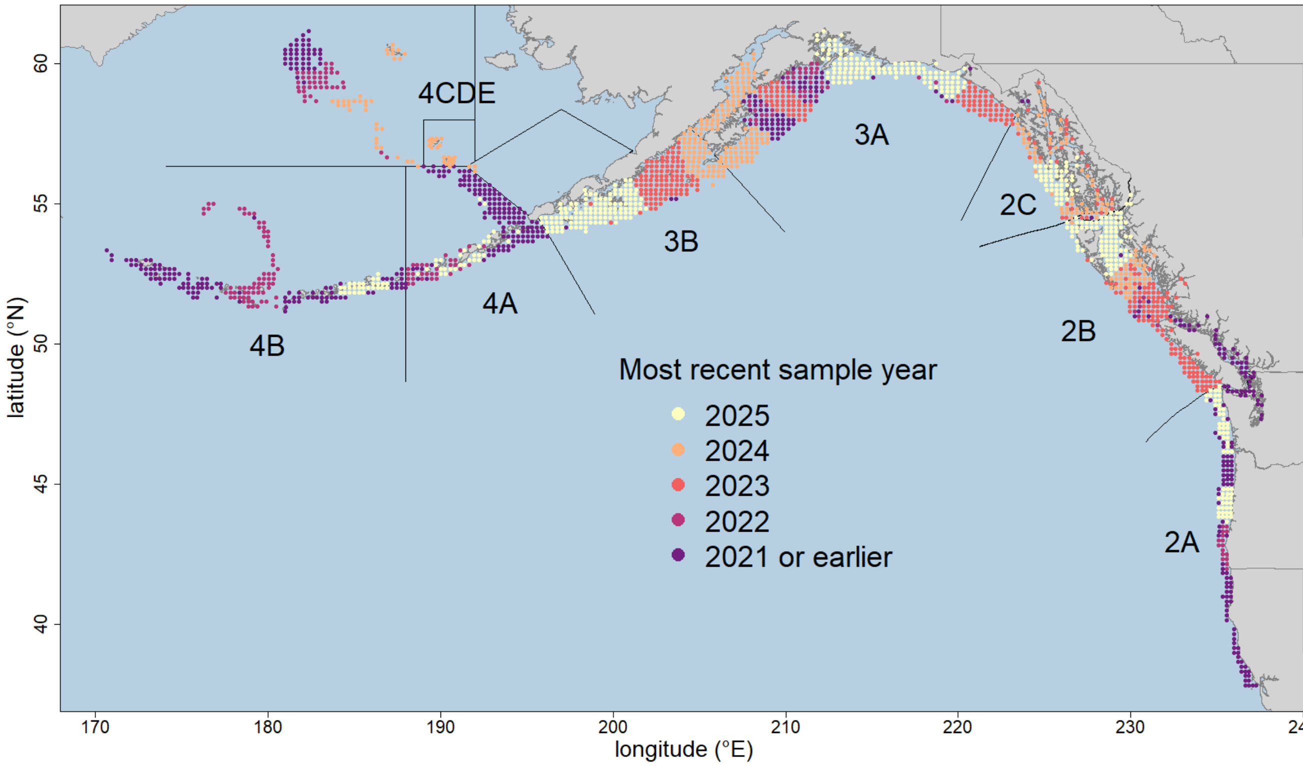

Figure 2. Map showing the most recent sample year of each station on the FISS grid.

FISS DESIGN OBJECTIVES (TABLE 1)

Primary objective: *To sample Pacific halibut for stock assessment and stock distribution estimation.*

The primary purpose of the annual FISS is to sample Pacific halibut to provide data for the stock assessment (abundance indices, biological data) and estimates of stock distribution for use in management. The priority of the current rationalized FISS is therefore to maintain or enhance data quality (precision and bias) by establishing baseline sampling requirements in terms of station count, station distribution and skates per station.

Secondary objective: *Cost effectiveness.*

The FISS is intended to be cost-effective without compromising the scientific integrity of the design. Any implemented design must consider logistics and cost together with scientific integrity.

Tertiary objective: *Minimize removals and assist others where feasible on a cost-recovery basis.*

Consideration is also given to the total expected FISS removals (impact on the stock), data collection assistance for other agencies, and emerging IPHC informational needs.

Table 1 Prioritized FISS objectives and corresponding design layers.

Priority	Objective	Design Layer
Primary	Sample Pacific halibut for stock assessment and stock distribution estimation	Minimum sampling requirements in terms of: • Station distribution • Station count • Skates per station
Secondary	Cost effectiveness without compromising the scientific integrity of the FISS design.	Balance operational feasibility/logistics, cost/revenue, and scientific needs. Includes an aspirational target reserve of US$2,000,000
Tertiary	Minimize removals, assist others where feasible on a cost-recovery basis, address specific Commission informational needs.	Removals: minimize impact on the stock while meeting primary priority Assist: assist others to collect data on a cost-recovery basis IPHC policies: ad-hoc decisions of the Commission regarding the FISS design

POTENTIAL DESIGNS FOR 2026-28

BASE BLOCK DESIGN

At AM101, Secretariat staff presented the Base Block design for 2025 and subsequent years based a rotational block design (IPHC-2025-AM101-14). This design implements sampling of complete FISS charter regions (subsets of stations generally sampled by a single vessel via multiple trips) in each area rather than randomly selected stations as was previously done in the core of the stock. Sampled charter regions are rotated over two or three years depending on area. Block designs are potentially more efficient from an operational perspective than a randomized design, as they involve less running time between stations, possibly leading to cost reductions on a per station basis.

The Base Block designs shown in Figures 3 to 5 for 2026-28 were revised from the designs presented to Commissioners at AM101 to account for the Commission-approved 2025 design. In particular, charter regions not selected in IPHC Regulatory Areas 3A and 3B in 2025 were prioritized for sampling in 2026.

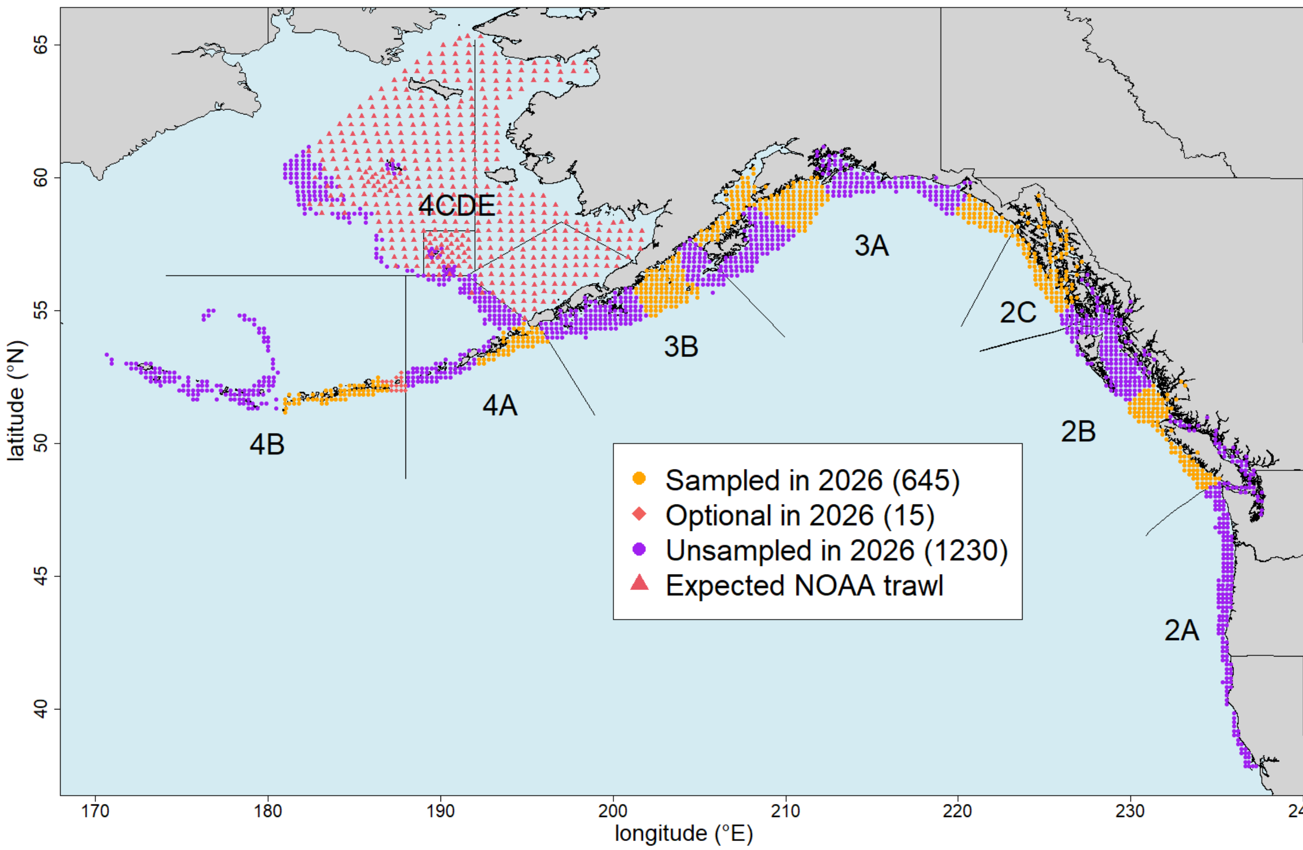

Figure 3. Base Block design for 2026 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere. Fifteen stations in IPHC Area 4B have proved challenging to fish successfully in recent years and are considered optional for 2026 to help attract charter bids.

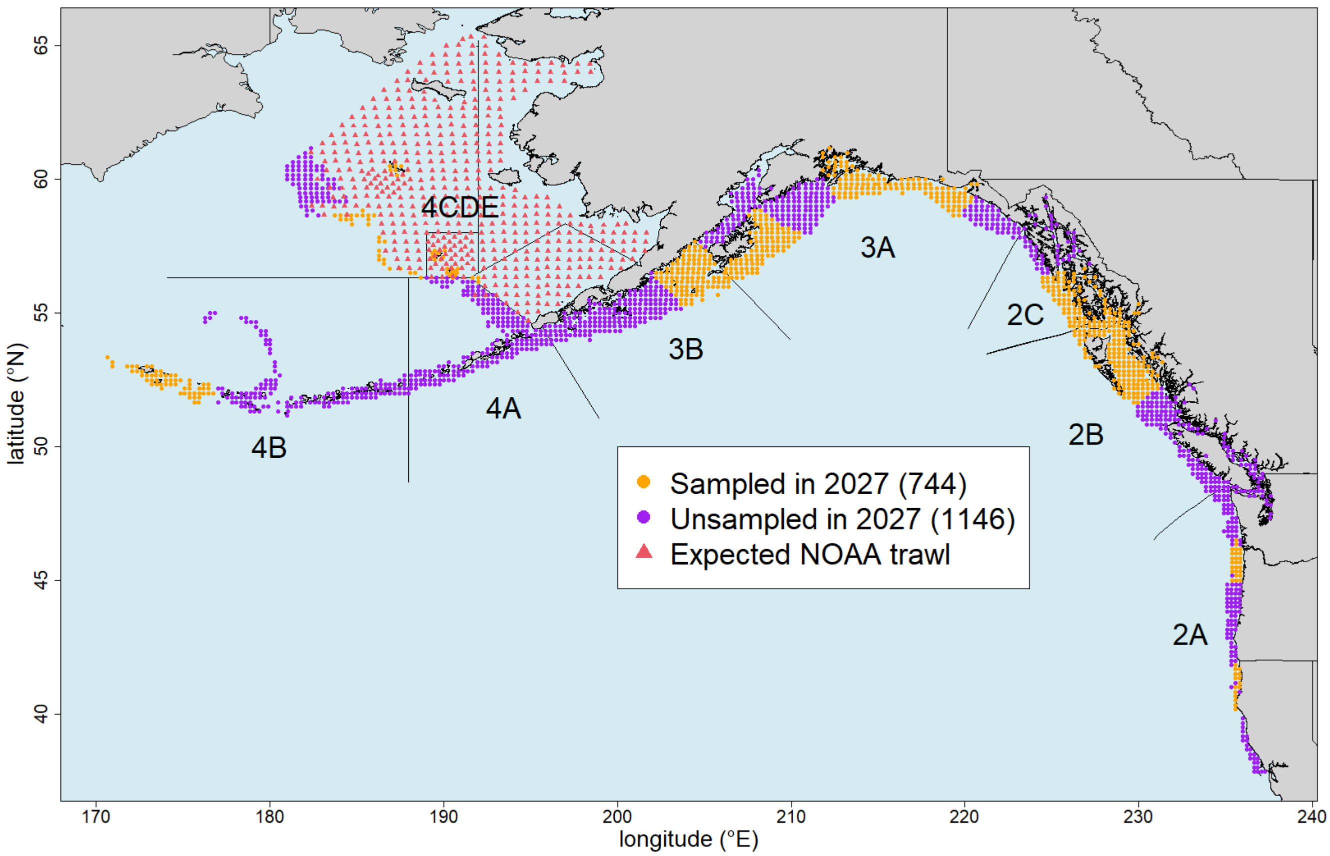

Figure 4. Base Block design for 2027 (orange circles) – indicative only. Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

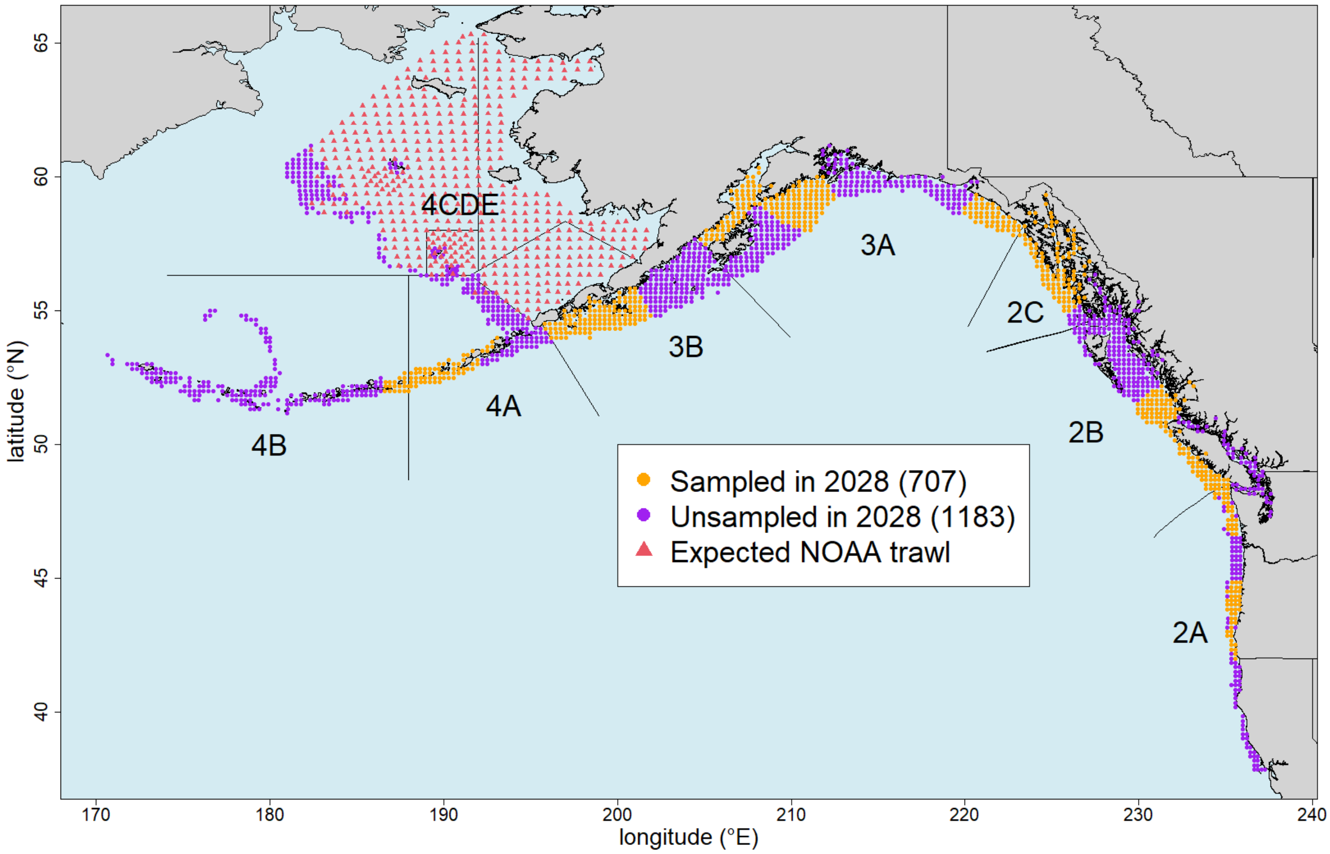

Figure 5. Base Block design for 2028 (orange circles) – indicative only. Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

Supplemented Reduced Loss Design

The Base Block design is projected to result in a substantial operating loss (see below) and would require supplementary funding to be viable. As an alternative, the Secretariat staff developed a preliminary design that would result in a net operating loss of approximately $500,000 (IPHC-2025-SRB027-09). The voluntary contribution of US$513,000 from the United States, together with a revision of cost projections, allowed this design to be expanded to include additional charter regions in IPHC Regulatory Areas 2B, 2C, 3A and 3B, resulting in the Supplemented Reduced Loss design (SRL, Figure 6).

Cost Projections

Projected costs of the 2026 Base Block and SRL designs were based on the following:

- Designs are optimized for numbers of skates, with 4, 6 or 8 skate-sets used, depending on projected catch rates and bait costs.
- Pacific halibut price will decline by 10% from 2025 values
- Pacific halibut landings will decline by 5% from 2025 values

- The price of chum salmon bait increases to US$2.50 per pound from $1.65 per pound in 2025.

Given these values, it is projected that implementation of the **Base Block design** will result in a net operating loss of **US$1.155 million**, while the **Supplemented Reduced Loss design** will lose **US$502,000**.

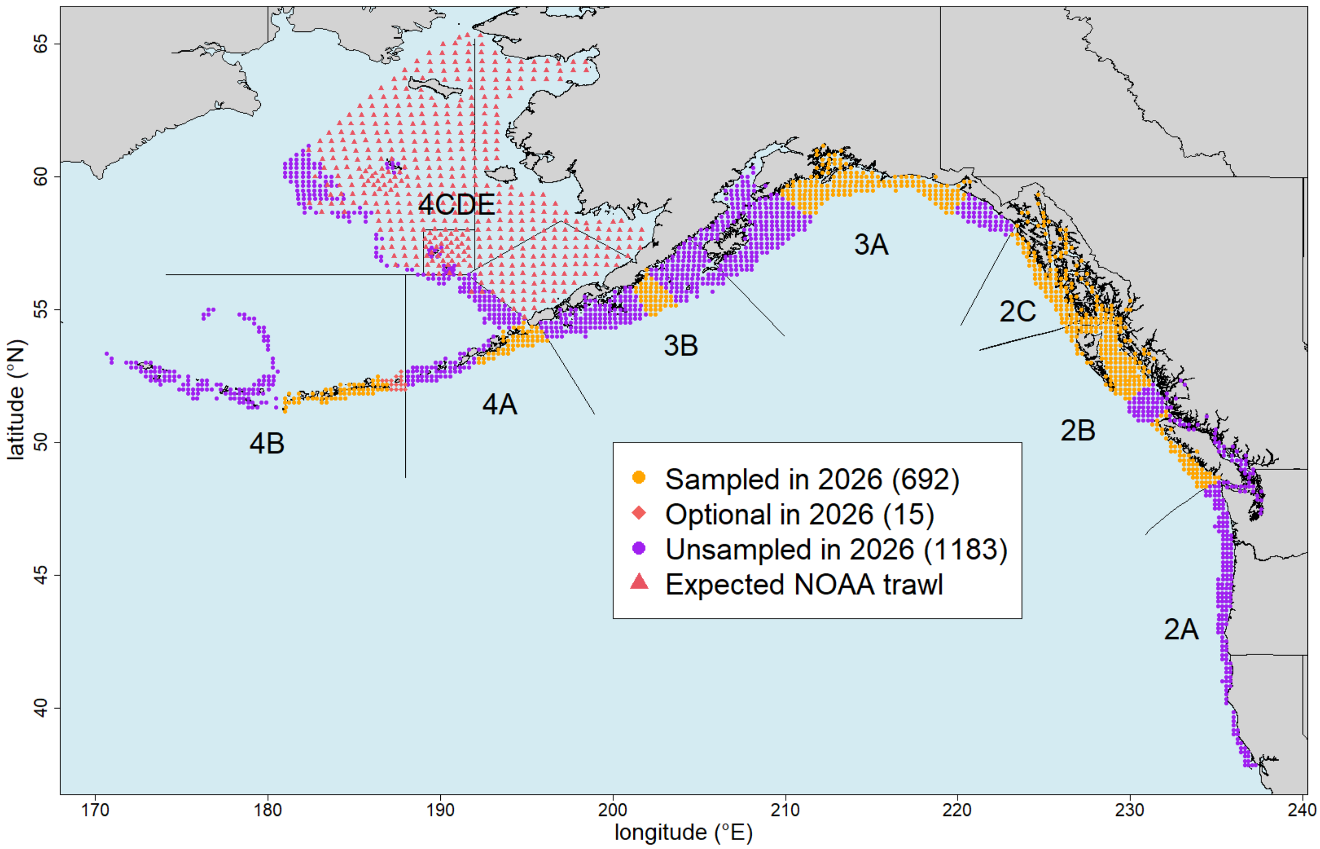

Figure 6. Supplemented Reduced Loss design for 2026 that includes the most cost-effective charter regions in Biological Region 3, projected revenue-positive charter regions in Biological Region 2, and stations in IPHC Regulatory Areas 2A, 4A and 4B covered by supplementary funding. Fifteen stations in IPHC Area 4B have proved challenging to fish successfully in recent years and are considered optional for 2026 to help attract charter bids.

DISCUSSION

If adopted, the SRL design would include FISS sampling in all IPHC Biological Regions, and some sampling in all IPHC Regulatory Areas except 4CDE (expected to be sampled by NOAA trawl) and 2A. The SRL design differs from the Base Block design as follows:

- Replaces one revenue-negative charter region in IPHC Regulatory Area 2B with two regions projected to be revenue-positive
- Adds one revenue-positive region to IPHC Regulatory Area 2C
- Replaces three high-cost regions in IPHC Regulatory Area 3A with two regions that ensure projected overall losses are maintained close to US$0.5 million
- Has one fewer charter region in IPHC Regulatory Area 3B

While the reduced spatial coverage in IPHC Biological Region 3 relative to the Base Block design increases the chance of bias in estimates for that region, the SRL represents a substantial improvement in coverage over the implemented 2025 design. The overall design includes a similar number of stations to the Base Block design and complements the 2025 design by including seven charter regions not fished this year (two each in 2B and 2C, one each in 3A and 3B, and one in 4A). Compared with 2024 and 2025, this will result in more representative biological data, more precise indices of abundance and stock distribution, and an assessment model that is less reliant on commercial data.

We note that water column profiler information from the FISS in IPHC Regulatory Area 2A shows evidence for hypoxia in some parts of that area. However, initial analysis shows dissolved oxygen levels in most of the sampled habitat to be high enough to support Pacific halibut.

RECOMMENDATION

That the Research Advisory Board **NOTE** paper IPHC-2025-RAB026-08, that provides potential FISS designs for 2026-2028.

REFERENCES

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