INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC–2022–AM098–00
Last Update: 18 February 2022

98th Session of the IPHC Annual Meeting (AM098) – *Compendium of meeting documents*

24 January - 28 January 2022, Bellevue, WA, USA

Commissioners

Canada	United States of America
Paul Ryall	Glenn Merrill
Neil Davis	Robert Alverson
Peter DeGreef	Richard Yamada

Executive Director

David T. Wilson, Ph.D.

DISTRIBUTION: IPHC WEBSITE
LAST UPDATE: 18 FEBRUARY 2022

BIBLIOGRAPHIC ENTRY
IPHC 2022. 98th Session of the IPHC Annual Meeting (AM098) - Compendium of meeting documents. Int. Pac. Halibut Comm.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Contact details:

International Pacific Halibut Commission
2320 W. Commodore Way, Suite 300
Seattle, WA, 98199-1287, U.S.A.
Phone: +1 206 634 1838
Fax: +1 206 632 2983
Email: secretariat@iphc.int
Website: http://iphc.int/

DRAFT: AGENDA & SCHEDULE FOR THE 98th SESSION OF THE IPHC ANNUAL MEETING (AM098)

Date: 24-28 January 2022
Location: Electronic
Venue: Adobe Connect
Time: 24 Jan: 12:30-17:30;
25-28 Jan: 09:00-17:00 daily
Chairperson: Mr Glenn Merrill (USA)
Vice-Chairperson: Mr Paul Ryall (Canada)

Notes:
- ***Document deadline**: 25 December 2021 (30 days prior to the opening of the Session)*
- *All sessions are open to observers and the general public, unless the Commission specifically decides otherwise.*
- *All open sessions will be webcast. Webcast sessions will also take audience comments and questions as directed by the Chairperson of the Commission.*

AGENDA FOR THE 98th SESSION OF THE IPHC ANNUAL MEETING (AM098)

1. **OPENING OF THE SESSION** (Chairperson)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chairperson & Executive Director)

3. **IPHC PROCESS**
   - 3.1 Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097), 97th Session of the IPHC Interim Meeting (IM097), and 2021 Special Sessions (D. Wilson)
   - 3.2 Report of the IPHC Secretariat (2021) (D. Wilson)
   - 3.3 2nd IPHC Performance Review (PRIPHC02): Implementation of recommendations (D. Wilson)
   - 3.4 Report of the 22nd Session of the IPHC Research Advisory Board (RAB022) (D. Wilson)
   - 3.5 Reports of the IPHC Scientific Review Board (SRB Chairperson)

4. **FISHERY DATA OVERVIEW (2021)** (T. Kong, H. Tran & C. Prem)

5. **STOCK STATUS OF PACIFIC HALIBUT (2021) & HARVEST DECISION TABLE (2022)**
   - 5.1 IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021 (K. Ualesi, D. Wilson, C. Jones & R. Rillera)
   - 5.2 Space-time modelling of survey data (R. Webster)
   - 5.3 2022-24 FISS designs (R. Webster)

5.4 Stock Assessment: Data overview and stock assessment (2021), and harvest decision table (2022) (I. Stewart, A. Hicks, R. Webster, D. Wilson, & B. Hutniczak)
5.5 Pacific halibut mortality projections using the IPHC mortality projection tool (2022) (I. Stewart)

6. IPHC SCIENCE AND RESEARCH
6.1 IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): update (J. Planas)

7. MANAGEMENT STRATEGY EVALUATION
7.1 IPHC Management Strategy Evaluation: update (A. Hicks)

8. PACIFIC HALIBUT FISHERY ECONOMICS – PROJECT REPORT
8.1 Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA) (B. Hutniczak)

9. IPHC FISHERY REGULATIONS: PROPOSALS FOR THE 2020-21 PROCESS
9.1 IPHC Secretariat fishery regulation proposals (B. Hutniczak)
9.2 Contracting Party fishery regulation proposals (Contracting Parties)
9.3 Stakeholder fishery regulation proposals (Stakeholders)
9.4 Stakeholder statements (B. Hutniczak)

10. CONTRACTING PARTY NATIONAL REPORTS
10.1 Canada (TBA)
10.2 United States of America (TBA)

11. REPORT OF THE 98th SESSION OF THE IPHC FINANCE AND ADMINISTRATION COMMITTEE (FAC098) (D. Wilson)

12. REPORT OF THE 92nd SESSION OF THE IPHC CONFERENCE BOARD (CB092) (CB Co-Chairpersons)

13. REPORT OF THE 27th SESSION OF THE IPHC PROCESSOR ADVISORY BOARD (PAB027) (PAB Chairperson)

14. OTHER BUSINESS
14.1 IPHC meetings calendar (2022-24) (D. Wilson)
14.2 Election of Chairperson and Vice-Chairperson for the next year (D. Wilson)

15. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 98th SESSION OF THE IPHC ANNUAL MEETING (AM098) (Chairperson)

SCHEDULE FOR THE 98th SESSION OF THE IPHC ANNUAL MEETING (AM098)

Monday, 24 January 2022		
Time	**Agenda item**	**Lead (support)**
	98th Session of the IPHC Annual Meeting (AM098): *Virtual Room link*	
Time	**Agenda item**	**Lead (support)**
12:30-12:40	1. Opening of the Session	Chairperson and Vice-Chairperson
12:40-12:50	2. Adoption of the agenda and arrangements for the Session ➢ ***IPHC-2022-AM098-01****: Agenda & Schedule for the 98th Session of the IPHC Annual Meeting (AM098)* ➢ ***IPHC-2022-AM098-02****: List of Documents for the 98th Session of the IPHC Annual Meeting (AM098)*	G. Merrill (D. Wilson)
12:50-13:30	3. IPHC Process 3.1 Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097), 97th Session of the IPHC Interim Meeting (IM097), and 2021 Special Sessions ➢ ***IPHC-2022-AM098-03:*** *Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097), 97th Session of the IPHC Interim Meeting (IM097) and 2021 Special Sessions (D. Wilson)* ➢ ***IPHC-2021-IM097-R****: Report of the 97th Session of the IPHC Interim Meeting (IM097)* 3.2 Report of the IPHC Secretariat (2021) ➢ ***IPHC-2022-AM098-04:*** *Report of the IPHC Secretariat (2021) (D. Wilson)* 3.3 2nd IPHC Performance Review (PRIPHC02): Implementation of recommendations ➢ ***IPHC-2022-AM098-05:*** *Implementation of the Recommendations from the 2nd IPHC Performance Review (PRIPHC02) (D. Wilson)*	D. Wilson

	3.4 Report of the 22nd Session of the IPHC Research Advisory Board (RAB022) ➢ ***IPHC-2021-RAB022-R:*** *Report of the 22nd Session of the IPHC Research Advisory Board (RAB022)* 3.5 Reports of the IPHC Scientific Review Board ➢ ***IPHC-2021-SRB018-R:*** *Report of the 18th Session of the IPHC Scientific Review Board (SRB018)* ➢ ***IPHC-2021-SRB019-R:*** *Report of the 19th Session of the IPHC Scientific Review Board (SRB019)*	SRB Chairperson
13:30-13:45	4. Fishery data overview (2021) ➢ ***IPHC-2022-AM098-06****: Fishery data overview (2021) (T. Kong, H. Tran & C. Prem)*	T. Kong
13:45-14:10	5. Stock status of Pacific halibut (2021) & harvest decision table (2022) 5.1 IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021 ➢ ***IPHC-2022-AM098-07:*** *IPHC Fishery-independent setline survey (FISS) design and implementation in 2021 (K. Ualesi, D. Wilson, C.Jones & R. Rillera)*	K. Ualesi
14:10-15:00	5.2 Space-time modelling of survey data ➢ ***IPHC-2022-AM098-08:*** *Space-time modelling of survey data (R. Webster)* 5.3 2022-24 FISS designs ➢ ***IPHC-2022-AM098-09****: 2022-24 FISS Designs (R. Webster)*	R. Webster
15:00-16:00	5.4 Stock *Assessment: Data overview and stock assessment (2021), and harvest* decision *table (2022)* ➢ ***IPHC-2022-AM098-10****: Summary of the data, stock assessment, and harvest decision table for Pacific halibut (Hippoglossus stenolepis) at the end of 2021 (I. Stewart, A. Hicks, R. Webster, D. Wilson, & B. Hutniczak)*	I. Stewart
16:00-16:15	Break	
16:15-17:00	5.5 Pacific halibut mortality projections using the IPHC mortality projection tool (2022) ➢ ***IPHC-2022-AM098-INF02***: The IPHC mortality projection tool for 2022 mortality limits	I. Stewart
17:00-17:30	*Public comment and questions* ***(Agenda items 4-5)***	Chairperson

Tuesday, 25 January 2022		
Time	**Agenda item**	**Lead (support)**
	98th Session of the IPHC Annual Meeting (AM098): *Virtual Room link*	
09:00-10:00	6. IPHC Science and Research 6.1 IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): update (J. Planas) ➢ ***IPHC-2022-AM098-11:*** *IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): Update (J. Planas)*	J. Planas
10:00-10:40	7. Management strategy evaluation 7.1 IPHC Management Strategy Evaluation: update ➢ ***IPHC-2022-AM098-12****: Update on the IPHC Secretariat MSE Program of Work (2021-23) (A. Hicks & I. Stewart)*	A. Hicks
10:40-10:50	Break	
10:50-11:30	8. Pacific halibut fishery economics – Project Report 8.1 Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA) ➢ ***IPHC-2022-AM098-13****: Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): Progress report (B. Hutniczak)*	B. Hutniczak
11:30-12:15	9. IPHC Fishery Regulations: Proposals for the 2021-22 process ➢ ***IPHC-2022-AM098-14:*** IPHC Fishery Regulations: Proposals for the 2021-22 process (B. Hutniczak & D. Wilson) 9.1 IPHC Secretariat fishery regulation proposals ➢ ***IPHC-2022-AM098-PropA1****: Mortality and Fishery Limits (Sect. 5) (IPHC Secretariat)* ➢ ***IPHC-2022-AM098-PropA2****: Commercial Fishing Periods (Sect. 9) (IPHC Secretariat)* ➢ ***IPHC-2022-AM098-PropA3****: IPHC Fishery Regulations: minor amendments (IPHC Secretariat)* 9.2 Contracting Party fishery regulation proposals ➢ ***IPHC-2022-AM098-PropB1 Rev_1:*** *Recreational (sport) fishing for Pacific halibut—IPHC Regulatory Areas 2c, 3a, 3b, 4a, 4b, 4c, 4d, 4e (Sect. 29) - Recordkeeping for charter Pacific halibut annual limits (USA: NOAA-Fisheries)* ➢ ***IPHC-2022-AM098-PropB2:*** *Recreational (sport) fishing for Pacific halibut—IPHC Regulatory Areas 2c, 3a, 3b, 4a, 4b, 4c, 4d, 4e (Sect.*	B. Hutniczak *USA: NOAA-Fisheries* *USA: NOAA-Fisheries*

	29) - Charter Management Measures in IPHC Regulatory Areas 2C and 3A (USA: NOAA-Fisheries) ➢ ***IPHC-2022-AM098-PropB3:*** *Fishing gear (Sect. 18) - Trap gear use in IPHC Regulatory Area 2B (Canada: Fisheries and Oceans Canada)* ➢ ***IPHC-2022-AM098-PropB4:*** Recreational (Sport) Fishing for Pacific Halibut—IPHC Regulatory Area 2B (*Sect. 28) - Daily bag limit in IPHC Regulatory Area 2B (Canada: Fisheries and Oceans Canada)* 9.3 Other Stakeholder fishery regulation proposals ➢ ***IPHC-2022-AM098-PropC1****: Processing Pacific halibut for eating and/or preservation (Sect. 29; John Fields)* 9.4 Stakeholder statements ➢ ***IPHC-2022-AM098-INF01:*** *Stakeholder statements on IPHC Fishery Regulation proposals for 2022*	 *Canada: DFO* *Canada: DFO* Stakeholders B. Hutniczak
12:15-12:30	*Public comment and questions* ***(Agenda Items 6-9)***	Chairperson
12:30-13:30	Lunch	
13:30-14:00	10. Contracting Party: National Reports 10.1 Canada ➢ ***IPHC-2022-AM098-NR01:*** *Canada*	Canada
14:00-14:30	10.2 United States of America ➢ ***IPHC-2022-AM098-NR02:*** *USA*	USA
14:30-15:30	11. Report of the 98th Session of the IPHC Finance and Administration Committee (FAC098) ➢ ***IPHC-2022-FAC098-R:*** *Report of the 98h Session of the IPHC Finance and Administration Committee (FAC098)*	D. Wilson
15:30-17:00	No AM098 Session: Commissioner opportunity to caucus and/or listen to CB/PAB proceedings	-
Wednesday, 26 January 2022		
Time	**Agenda item**	**Lead (support)**
09:00-17:00	No AM098 Session: Commissioner opportunity to caucus and/or listen to CB/PAB proceedings	-
Thursday, 27 January 2022		
98th Session of the IPHC Annual Meeting (AM098): ***Virtual Room link***		

09:00-12:30	No AM098 Session: Commissioner opportunity to caucus and/or listen to CB/PAB proceedings	-
12:30-13:30	Lunch	
13:30-14:15	12. Report of the 92nd Session of the IPHC Conference Board (CB092) ➢ ***IPHC-2022-CB092-R***: *Report of the 92nd Session of the IPHC Conference Board (CB092)*	CB Co-Chairpersons
14:15-15:30	13. Report of the 27th Session of the IPHC Processor Advisory Board (PAB027) ➢ ***IPHC-2022-PAB027-R***: *Report of the 27th Session of the IPHC Processor Advisory Board (PAB027)*	PAB Chairperson
15:30-15:45	Break	
15:45-17:00	Revisit Regulatory proposals for 2022: for decision (Agenda item 10)	B. Hutniczak
Friday, 28 January 2022		
98th Session of the IPHC Annual Meeting (AM098): *Virtual Room link*		
09:00-10:00	Decision summary from AM098 – Final actions	D. Wilson
10:00-10:30	Mortality limits for 2022: For decision/announcement (Agenda Item 9)	Chairperson
10:30-10:45	Break	
10:45-11:30	Revisit final mortality projections based on adopted mortality limits for 2022	I. Stewart
11:30-12:30	14. Other business 14.1 IPHC meetings calendar (2022-24) ➢ ***IPHC-2022-AM098-15:*** *IPHC 3-year meetings calendar (2022-24)* 14.2 Election of a Chairperson and Vice-Chairperson for the next year	D. Wilson D. Wilson
12:30-13:30	Lunch	
13:30-17:00	15. Review of the draft and adoption of the Report of the 98th Session of the IPHC Annual Meeting (AM098)	Chairperson (D. Wilson)

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2022-AM098-02

Last updated: 13 January 2022

DRAFT: LIST OF DOCUMENTS FOR THE 98th SESSION OF THE IPHC ANNUAL MEETING (AM098)

Meeting documents	Title	Availability
IPHC-2022-AM098-01	Agenda & Schedule for the 98th Session of the IPHC Annual Meeting (AM098)	✓ 16 Nov 2021 ✓ 23 Dec 2021 ✓ 13 Jan 2022
IPHC-2022-AM098-02	List of Documents for the 98th Session of the IPHC Annual Meeting (AM098)	✓ 16 Nov 2021 ✓ 24 Dec 2021 ✓ 13 Jan 2022
IPHC-2022-AM098-03	Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097), 2021 Special Sessions and the 97th Session of the IPHC Interim Meeting (IM097) (D. Wilson)	✓ 10 Dec 2021
IPHC-2022-AM098-04	Report of the IPHC Secretariat (2021) (D. Wilson)	✓ 13 Dec 2021
IPHC-2022-AM098-05	Implementation of the Recommendations from the 2nd IPHC Performance Review (PRIPHC02) (D. Wilson)	✓ 10 Dec 2021
IPHC-2022-AM098-06 Rev_1	Fishery data overview (2021) (T. Kong, H. Tran, & C. Prem)	✓ 17 Dec 2021 ✓ 13 Jan 2022
IPHC-2022-AM098-07	IPHC Fishery-independent setline survey (FISS) design and implementation in 2021 (K. Ualesi, D. Wilson, C. Jones, R. Rillera, & T. Jack)	✓ 10 Dec 2021
IPHC-2022-AM098-08	Space-time modelling of survey data (R. Webster)	✓ 10 Dec 2021
IPHC-2022-AM098-09	2022-24 FISS Designs (R. Webster)	✓ 10 Dec 2021
IPHC-2022-AM098-10	Summary of the data, stock assessment, and harvest decision table for Pacific halibut (*Hippoglossus stenolepis*) at the end of 2021 (I. Stewart, A. Hicks, R. Webster, D. Wilson, & B. Hutniczak)	✓ 20 Dec 2021
IPHC-2022-AM098-11	IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): Update (J. Planas)	✓ 10 Dec 2021
IPHC-2022-AM098-12	Update on the IPHC Secretariat MSE Program of Work (2021-23) (A. Hicks & I. Stewart)	✓ 10 Dec 2021
IPHC-2022-AM098-13	PHMEIA Update (Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): summary of progress) (B. Hutniczak)	✓ 23 Dec 2021
IPHC-2022-AM098-14	IPHC Fishery Regulations: Proposals for the 2021-22 process (B. Hutniczak & D. Wilson)	✓ 24 Dec 2021

IPHC-2022-AM098-15	IPHC 3-year meetings calendar (2022-24) (IPHC Secretariat)	✓ 13 Dec 2021
Contracting Party National Reports		
IPHC-2022-AM098-NR01	**Canada**: Fisheries and Oceans Canada (DFO)	✓ 24 Dec 2021
IPHC-2022-AM098-NR02	**United States of America**: NOAA – National Marine Fisheries Service (NMFS); North Pacific Fishery Management Council (NPFMC); Pacific Fishery Management Council (PFMC)	✓ 23 Dec 2021
IPHC Fishery Regulation proposals for 2022		
IPHC Secretariat Fishery Regulation proposals for 2022		
IPHC-2022-AM098-PropA1	Mortality and Fishery Limits (Sect. 5) (IPHC Secretariat)	✓ 8 Dec 2021
IPHC-2022-AM098-PropA2	Commercial Fishing Periods (Sect. 9) (IPHC Secretariat)	✓ 8 Dec 2021
IPHC-2022-AM098-PropA3	IPHC Fishery Regulations: minor amendments (IPHC Secretariat)	✓ 8 Dec 2021
Contracting Party Fishery Regulation proposals for 2022		
IPHC-2022-AM098-PropB1 Rev_1	Recreational (sport) fishing for Pacific halibut—IPHC Regulatory Areas 2c, 3a, 3b, 4a, 4b, 4c, 4d, 4e (Sect. 29) - *Recordkeeping for charter Pacific halibut annual limits* (USA: NOAA-Fisheries)	✓ 21 Oct 2021 ✓ 22 Dec 2021
IPHC-2022-AM098-PropB2	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: NOAA-Fisheries)	✓ 21 Dec 2021
IPHC-2022-AM098-PropB3	Fishing gear (Sect. 18) – *Trap gear use in IPHC Regulatory Area 2B* (Canada: DFO)	✓ 24 Dec 2021
IPHC-2022-AM098-PropB4	Recreational (sport) fishing for Pacific halibut—IPHC Regulatory Area 2B (Sect. 28) – *Daily bag limit* (Canada: DFO)	✓ 24 Dec 2021
Other Stakeholder Fishery Regulation proposals for 2022		
IPHC-2022-AM098-PropC1	Recreational (Sport) Fishing for Pacific Halibut—IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E (Sect. 29) - Processing Pacific halibut for eating and/or preservation (J. Fields)	✓ 20 Dec 2021
Information papers		
IPHC-2022-AM098-INF01	Stakeholder Statements on IPHC Fishery Regulation proposals (B. Hutniczak)	✓ 10 Dec 2021
IPHC-2022-AM098-INF02	The IPHC mortality projection tool for 2022 mortality limits (I. Stewart)	✓ 8 Dec 2021

IPHC-2022-AM098-INF03	Pacific Fishery Management Council correspondence regarding recommendations for 2022 Pacific halibut regulations applicable to the IPHC Regulatory Area 2A (IPHC Secretariat, (PFMC)	✓ 9 Dec 2021
IPHC-2022-AM098-INF04	Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): Final Report (B. Hutniczak)	✓ 23 Dec 2021
IPHC-2022-AM098-INF05 Rev_1	Pacific halibut market profile (B. Hutniczak)	✓ 24 Dec 2021 ✓ 13 Jan 2022
IPHC-2022-AM098-INF06	The IPHC Space-Time Explorer tool (R.A. Webster)	✓ 17 Dec 2021
Reports from IPHC subsidiary bodies (2021-22)		
IPHC-2021-SRB018-R	Report of the 18th Session of the IPHC Scientific Review Board (SRB018)	✓ 17 Jun 2021
IPHC-2021-SRB019-R	Report of the 19th Session of the IPHC Scientific Review Board (SRB019)	✓ 23 Sept 2021
IPHC-2021-RAB022-R	Report of the 22nd Session of the IPHC Research Advisory Board (RAB022)	✓ 29 Nov 2021
IPHC-2021-IM097-R	Report of the 97th Session of the IPHC Interim Meeting (IM097)	✓ 8 Dec 2021
IPHC-2022-FAC098-R	Report of the 98th Session of the IPHC Finance and Administration Committee (FAC098)	Expected: 25 Jan 2022
IPHC-2022-PAB027-R	Report of the 27th Session of the IPHC Processor Advisory Board (PAB027)	Expected: 27 Jan 2022
IPHC-2022-CB092-R	Report of the 92nd Session of the IPHC Conference Board (CB092)	Expected: 27 Jan 2022

Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097), 2021 Special Sessions, and the 97th Session of the Interim Meeting (IM097)

PREPARED BY: IPHC SECRETARIAT (D. WILSON; 10 DECEMBER 2021)

PURPOSE

To provide the Commission with an opportunity to consider the progress made during the inter-sessional period in relation to the direct requests for action by the Commission during the 97th Session of the IPHC Annual Meeting (AM097), 2021 Special Sessions, and the 97th Session of the IPHC Interim Meeting (IM097).

BACKGROUND

At the 97th Session of the IPHC Annual Meeting (AM097), Contracting Parties agreed on a series of actions to be taken by Commissioners, subsidiary bodies, and the IPHC Secretariat on a range of issues as detailed in Appendix A.

In addition, the Commission made a number of decisions during Specials Sessions in 2021, as detailed in Appendix B, and the 97th Session of the IPHC Interim Meeting (IM097), as detailed in Appendix C.

DISCUSSION

Noting that best practice governance requires the prompt delivery of core tasks assigned to the IPHC Secretariat by the Commission, at each session of the Commission and its subsidiary bodies, any recommendations 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 staff, 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 a subsidiary body, or other date).

This involves numbering and tracking all action items from the Commission, as well as including clear progress updates and document reference numbers.

RECOMMENDATION/S

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-03, which provided the Commission with an opportunity to consider the progress made during the inter-sessional period, in relation to the direct requests for action by the Commission during the 97th Session of the IPHC Annual Meeting (AM097), 2021 Special Sessions, and the 97th Session of the IPHC Interim Meeting (IM097).

APPENDICES

Appendix A: Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097: January 2021)

Appendix B: 2021 Special Session decisions

Appendix C: Update on action arising from the 97th Session of the IPHC Interim Meeting (IM097)

APPENDIX A

Update on actions arising from the 97th Session of the IPHC Annual Meeting (AM097: January 2021)

97th Session of the IPHC Annual Meeting (AM097)		
Action No.	**Description**	**Update**
	RECOMMENDATIONS	
AM097–Rec.01 (para. 87)	***Commercial Fishing Period*** The Commission **RECOMMENDED** that further consultations between Contracting Parties and fishery stakeholders on the administrative and policy implications of a year round fishery would support the decision process for the 98th Session of the IPHC Annual Meeting (AM098; January 2022) on potential further extensions of the direct commercial fishing period.	**Lead**: Contracting Party Heads of Delegation **Status/Plan**: Pending At the IM097, CPs indicated that no available process was ready to report. This item may be discussed at AM098
	REQUESTS	
AM097–Req.01 (para. 27)	***IPHC Fishery-Independent Setline Survey (FISS)*** The Commission **REQUESTED** that the IPHC Secretariat coordinate with Contracting Parties to develop a Memorandum of Understanding (MOU) to promote data sharing among the IPHC Secretariat and Contracting Parties at no additional cost to the Contracting Parties.	**Lead**: IPHC Secretariat **Status/Plan**: In progress Current and Expired Memoranda of Understanding and Agreements are being reviewed. See paper **IPHC-2022-AM098-04** All are available on the IPHC website: https://www.iphc.int/the-commission/cooperation-with-other-organisations The Secretariat also makes ALL data collected on the FISS available via the IPHC website. An example are the rockfish and other species data collected at a fine scale in Reg. Area 2B, which are now accessed directly by DFO, thus ensuring no additional costs to either Party.
AM097–Req.02 (para. 70)	***Management Strategy Evaluation*** The Commission **REQUESTED** that the IPHC Secretariat consider and develop a draft MSE Program of Work for review by the Commission. The MSE Program of Work should describe technical versus policy-oriented issues, linkages between/among specific work products, and sequencing considerations between/among items. The MSE Program of Work should describe the resources required to complete items.	**Lead**: IPHC Secretariat (A. Hicks) **Status/Plan**: Completed See paper **IPHC-2022-AM097-12** Further refinements were made and presented to the Commission at the 11th Special Session (SS011). See Special Session in Appendix B below.

97th Session of the IPHC Annual Meeting (AM097)		
Action No.	**Description**	**Update**
AM097–Req.03 (para. 75)	***IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5)*** The Commission **REQUESTED** additional information on the management and data collection procedures used in the unguided recreational fishery in IPHC Regulatory Areas 2C and 3A, and for these to be presented to the Commission no later than the next Interim Meeting of the Commission.	**Lead**: USA **Status/Plan**: Pending update from USA
AM097–Req.04 (para. 94)	***Pacific halibut fishery economics update*** The Commission **REQUESTED** that the IPHC Secretariat develop and distribute a Media Release on the Fishery economic project and the associated economic survey for industry to complete.	**Lead**: IPHC Secretariat **Status/Plan**: Completed Media release published 16 Feb 2021. See IPHC Media Release 2021-008
AM097–Req.05 (para. 104)	***IPHC Financial Regulations (2021)*** The Commission **ENDORSED** and **ADOPTED** the IPHC Financial Regulations (2021) as provided in paper IPHC-2021-AM097-INF04 Rev_3 by consensus, and **REQUESTED** that the IPHC Secretariat finalise and publish them accordingly.	**Lead**: IPHC Secretariat (D. Wilson) **Status/Plan**: Completed Published 29 February 2021 IPHC-2021-FR21
AM097–Req.06 (para. 105)	The Commission **REQUESTED** that the IPHC Secretariat will undertake an inter-sessional review and recommend further improvements to the Financial Regulations of the Commission, including the basis of accounting to better align with GAAP standards while maintaining regulatory compliance.	**Lead**: IPHC Secretariat (with Sommerville and Associates LLC) **Status/Plan**: In progress See paper **IPHC-2022-FAC098-08**
AM097–Req.07 (para. 106)	***IPHC Rules of Procedure (2021)*** The Commission **ADOPTED** the IPHC Rules of Procedure (2021), as provided in IPHC-2021-FAC097-09 by consensus, and **REQUESTED** that the IPHC Secretariat finalise and publish them accordingly.	**Lead**: D. Wilson **Status/Plan**: Completed Published 29 February 2021 IPHC-2021-ROP21
AM097–Req.08 (para. 107)	The Commission **REQUESTED** that the IPHC Secretariat undertake an inter-sessional review and recommend further improvements to the IPHC Rules of Procedure to the Commission, noting the CB's recommendation (to change when Chairs are elected in their rule), PAB noting the conflicting text in the Rules, and roles of the Commissions Secretariat.	**Lead**: D. Wilson **Status/Plan**: In progress See paper **IPHC-2022-FAC098-09** Includes amendments to the CB and PAB terms of reference.
AM097–Req.09 (para. 122)	***Review of the draft and adoption of the report of the 97th Session of the IPHC Annual Meeting (AM097)*** The Commission **REQUESTED** that the IPHC Secretariat finalise and publish the IPHC *Pacific Halibut Fishery Regulations (2021)* as soon as possible, **NOTING** that only minor editorial and formatting changes are permitted beyond the decisions made by the Commission at the AM097.	**Lead**: D. Wilson **Status/Plan**: Completed Published on 3 February 2021 (note SS009 additional amendment below)

APPENDIX B

2021 Special Sessions of the Commission

Action No.	Description	Update
10th Special Session of the IPHC (SS010) (8 January 2021)		
SS010–Req.01 (para. 8)	The Commission **REQUESTED** that the IPHC Secretariat make the adopted amendments to Section 28, paragraph (c) of the IPHC Fishery Regulations (2021), and for these to be submitted to the Contracting Parties after the current amendments (from AM097) are confirmed by both Parties. The expectation is that the amendments to Section 28, paragraph (c) would be in place prior to 1 April 2021.	**Lead**: D. Wilson **Status/Plan**: Completed The IPHC Fishery Regulations (2021) were circulated, approved, and then published on 22 February 2021.
11th Special Session of the IPHC (SS011) (22 June 2021)		
SS011-Rec.01 (para. 7)	The Commission **RECOMMENDED** that the IPHC Secretariat: a) prioritize tasks F1, F.2, F.3 and F.5 to support the development of a robust framework, and E.3 to work with stakeholders and the Commission to improve the methods of presenting MSE results. b) continue to work on task M.3 to understand the trade-offs with multi-year stock assessments. c) continue investigation of size limits (M.1) to understand the long-term effects of a change in the size limit, including under different realizations of population dynamics such as size-at-age.	**Lead**: A. Hicks **Status/Plan**: In progress See paper **IPHC-2022-AM098-12** The recommended Program of Work for the IPHC Secretariat (2021-23) is available on the IPHC website and will be implemented accordingly. https://www.iphc.int/uploads/pdf/msab/tech/iphc-2021-mse-02.pdf
SS011-(Para.11)	The Commission **ADOPTED** the FY2022 budget (1 October 2021 to 30 September 2022), as detailed in Appendix IV, including the Contracting Party contributions to the General Fund as follows: • Canada: Contribution to the General Fund: US\$900,407 • U.S.A.: Contribution to the General Fund: US\$4,157,760	**Lead**: D. Wilson **Status/Plan**: Completed Both Contracting Parties were invoiced for FY2022 contributions on 21 September 2021. Contributions fell due on 1 October 2021. The contributions to the General Fund were received from both CPs on 10 November 2021.

APPENDIX C

97th Session of the IPHC Interim Meeting (IM097)

Action No.	Description	Update
	RECOMMENDATIONS	
IM097-Rec.01 (para. 67)	***IPHC Fishery regulations: Proposals for the 2021-22 process*** The Commission **RECOMMENDED** that interested stakeholders note the deadline for submission of IPHC Fishery Regulation proposals, for consideration at the 98th Session of the Annual Meeting (AM098), of **25 December 2021**. Late proposals will not be considered at AM098, but stakeholders may also submit statements up until the day before the AM098. More information is available via the IPHC website: https://iphc.int/the-commission/fishery-regulations/	**Lead**: Nil **Status/Plan**: Completed Deadline published on the IPHC Website and communicated.
	REQUESTS	
IM097-Req.01 (para. 24)	***IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021*** The Commission **REQUESTED** that the IPHC Secretariat develop and provide a time series representation of depredation, in particular whale depredation, and other reasons for ineffective sets, at future Interim and Annual meetings.	**Lead**: K. Ualesi **Status/Plan**: In progress An initial attempt to meet this request will be provided at AM008, during the presentation of paper **IPHC-2022-AM098-07**
IM097-Req.02 (para. 33)	***2022-24 FISS design evaluation*** The Commission **REQUESTED** further information be provided intersessionally, on how secondary and tertiary FISS objectives are incorporated into the final FISS design (using the optimized FISS 2022 option 1 design as a working example).	**Lead**: R. Webster **Status/Plan**: Completed If design 1 is implemented, the following additional stations will be added in other areas: **Canada**: 2B = 5 **USA**: 65 2C=7 3A=58 These are the specific stations shown on the maps in the IM097 report. See the presentation for paper **IPHC-2022-AM098-09**

Report of the IPHC Secretariat (2021)

PREPARED BY: IPHC SECRETARIAT (D. WILSON, 13 DECEMBER 2021)

Contents

PURPOSE

To provide the Commission with a draft update on the activities of the IPHC Secretariat in 2021, not already contained within other papers before the Commission.

1. STAFFING CHANGES

FT Arrivals	Type	Hire Date	Status	Branch and Position Title
Rachel **Rillera**	Regular full-time	1 June 2021	Active	FSSB: Setline Survey Specialist
Ola **Wietecha**	Regular full-time	26 Jul 2021	Active	FPSB: Administrative Specialist
Tina **Wisnowski**	Regular full-time	2 Aug 2021	Active	FPSB: Staff Accountant
Crystal **Simchick**	Temporary full-time	23 Aug 2021	Active	BESB: Biological Science Laboratory Technician
Tyler Jack-**McCollough**	Regular full-time	16 Sept 2021	Active	FSSB: Setline Survey Specialist (HQ)

We bid farewell to Nick Wilson (Staff Accountant), Keith Jernigan (Assistant Director), Monica Mocaer (Setline Survey Specialist), Dana Rudy (Otolith technician), Anna Simeon (Laboratory Technician), and Lara Erikson (Manager).

2. IPHC INTERNSHIP PROGRAM: 2021

The IPHC funds full-time internships each summer. In 2021 the IPHC hosted two undergraduate interns, Ms Maya **Stock** from Oregon State University (Corvallis, OR), and Ms Eva **Sukphon-Devita** from Western Washington University (Bellingham, WA).

Maya and Eva have participated in two activities of the Biological and Ecosystem Sciences Branch. Firstly, Maya and Eva have contributed to the generation of sex ratio information from the 2020 commercial samples by participating in all components of this important monitoring effort: from DNA extraction from fin clips to conducting the genotyping assays. Secondly, Maya and Eva have participated in the processing of blood samples and in the determination of stress indicators from Pacific halibut captured and released in the recently conducted DMR Recreational Study. The internship period runs from 21 June through 10 September 2021.

3. IPHC MERIT SCHOLARSHIP FOR 2020-23

The IPHC funds several Merit Scholarships to support university, technical college, and other post-secondary education for students from Canada and the United States of America who are connected to the Pacific halibut fishery. Generally, a single new scholarship valued at US$4,000 per year is awarded every two years. The scholarships are renewable annually for the normal four-year period of undergraduate education, subject to maintenance of satisfactory academic performance.

A four (4) person IPHC Merit Scholarship Panel reviews applications and determines recipients based on academic qualifications, career goals, and relationship to the Pacific halibut industry.

In 2020, the IPHC Merit Scholarship was awarded to Mr Hahlen **Behnken-Barkhau** (Whitman College).

The list of current recipients and their expected years of receipt are provided below. Note that in 2016, the IPHC Merit Scholarship shifted from an award of US$2,000 per year for four years, with a new recipient selected each year, to an award of US$4,000 per year for four years, with a new recipient selected every other year.

Name	2018	2019	2020	2021	2022	2023
Kaia Dahl (Petersburg, AK, USA)	$4,000	$4,000	$4,000	$4,000	-	-
Hahlen Behnken-Barkhau (Sitka, AK, USA)	-	-	$4,000	$4,000	$4,000	$4,000

4. MEETINGS OF THE COMMISSION AND SUBSIDIARY BODIES DURING 2021

Meeting	No.	Date	Location
Finance and Administration Committee (FAC)	97th	25 Jan	Electronic
Annual Meeting (AM)	**97th**	**25-29 Jan**	Electronic
Conference Board (CB)	91st	26-27 Jan	Electronic
Processor Advisory Board (PAB)	26th	26-27 Jan	Electronic
Scientific Review Board (SRB)	18th	15-17 June	Electronic
	19th	21-23 Sept	Electronic
Work Meeting (WM)	2021	15-16 Sept	Electronic
Research Advisory Board (RAB)	22nd	29 Nov	Electronic
Interim Meeting (IM)	**97th**	**30 Nov – 1 Dec**	Electronic

5. IPHC PACIFIC HALIBUT FISHERY REGULATIONS (2021)

5.1. IPHC FISHERY REGULATIONS ADOPTED IN 2021

In 2021, the Commission adopted **six (6)** fishery regulations/amendments in accordance with Article III of the Convention, as follows:

IPHC Fishery Regulations: Morality and Fishery Limits (Sect. 5)

(para. 72) The Commission **NOTED** and **ADOPTED** fishery regulation proposal IPHC-2021-AM097-PropA1, which provides the mortality and fishery limits framework for population at AM097 (Appendix IV).

(para. 73) The Commission **ADOPTED** the distributed mortality limits for each Contracting Party, by IPHC Regulatory Area, (Table 6) and sector, as provided in Appendix IV. [**Canada**: In favour=3, Against=0][**USA**: In favour=3, Against=0]

Table 6. Adopted TCEY mortality limits for 2021

Contracting Party IPHC Regulatory Area	Mortality limit (TCEY) (metric tonnes)	Mortality limit (TCEY) (mlbs)
Canada Total: 2B	**3,175**	**7.00**
USA: 2A	748	1.65
USA: 2C	2,631	5.80
USA: 3A	6,350	14.00
USA: 3B	1,415	3.12
USA: 4A	930	2.05
USA: 4B	635	1.40
USA: 4CDE	1,805	3.98
United States of America Total	**14,515**	**32.00**
Total (IPHC Convention Area)	**17,690**	**39.00**

IPHC Fishery Regulations: Commercial fishing periods (Sect. 9)

(para. 77) The Commission **ADOPTED** fishing periods for 2021 as provided below, thereby superseding the relevant portions of Section 9 of the IPHC Pacific halibut fishery regulations (Appendix V) by specifying that commercial fishing for Pacific halibut in all IPHC Regulatory Areas may begin no earlier than 6 March and must cease on 7 December.

IPHC Fishery Regulations: minor amendments

(para. 78) The Commission **NOTED** and **ADOPTED** fishery regulation proposal IPHC-2021-AM097-PropA3, which proposed amendments to ensure IPHC Secretariat were formally regulated to allow them to sample Pacific halibut at the point of landing, with minor modification as identified during AM097 (Appendix VI).

Contracting Party fishery regulation proposals

IPHC Fishery Regulations: Charter management measures in IPHC Regulatory Areas 2C and 3A (Sect. 29)

(para. 79) The Commission **NOTED** and **ADOPTED** fishery regulation proposal IPHC-2021-AM097-PropB1, which proposed IPHC Regulation changes for charter recreational Pacific halibut fisheries in IPHC Regulatory Areas 2C and 3A (Appendix VII), in order to achieve the charter Pacific halibut allocation under the North Pacific Fisheries Management Council's (NPFMC) Pacific halibut Catch Sharing Plan:

a) IPHC Regulatory Area 2C – one-fish bag limit with size limit of less than or equal to 50 inches or greater than or equal to 72 inches;

b) IPHC Regulatory Area 3A – two-fish bag limit with one fish of any size and a second fish less than or equal to 32 inches, Wednesdays closed to retention of Pacific halibut, one trip per vessel and one trip per permit per day (no annual limit). See IPHC-2021-AM097-PropB1 for additional detail.

IPHC Fishery Regulations: Commercial fishing periods (Sect. 9)

(para. 83) The Commission **ADOPTED** fishery regulation changes contained within IPHC-2021-AM097-INF05, which revises the derby season structure from openings Monday through Wednesday, to openings Tuesday through Thursday (Appendix VIII).

6. INTERACTIONS WITH CONTRACTING PARTIES

6.1. *CONTRACTING PARTY REPORTS*

In 2021, the IPHC Secretariat has engaged agency representatives from both Contracting Parties regarding more comprehensive and timely reporting of all forms of Pacific halibut removals and directed commercial fishery revenue data. The IPHC Secretariat is working to identify and address data gaps in reporting.

In addition, the IPHC Secretariat continues to actively collaborate with domestic agencies from both Contracting Parties through existing and new Collective Agreements, and MoUs. These are detailed in the section below.

6.2. *CANADA*

6.2.1. *Fisheries and Oceans Canada (DFO)*

Memorandum of Understanding/Collective Agreement – Rockfish

The objective of the Memorandum of Understanding (MOU) / Collective Agreement with DFO and the PHMA is to 1) collect and utilize catch and biological sample data from species caught during the IPHC's annual fishery-independent setline survey (FISS); 2) lay forth the financial obligations associated with (1) hook by hook species identification data on the total catch and (2) biological data on rockfish species caught during FISS operations, as requested by DFO to survey rockfish populations off the British Columbia coastline. The activities covered under the MoU/CA are 100% cost recovered from the PHMA.

In early 2021, PHMA indicated to DFO and the IPHC that is had insufficient funds to provide for this sampling during the 2021 FISS.

Discussions are ongoing in developing an MoU for 2022.

Areas of conservation concern

The IPHC Secretariat continues to work with Fisheries and Oceans representatives to address gaps in coverage for the IPHC Fishery-Independent Setline Survey (FISS) in the IPHC Convention Area. An application was submitted again in 2021 to fish the FISS stations within the Marine Protected Areas in Canadian waters, which was denied.

Halibut Advisory Board (HAB)

The Executive Director participates as a HAB member, with Dr Basia Hutniczak as the IPHC alternate. This relationship is expected to continue into the future given the HAB's contributions to the Canadian decision-making process.

6.3. *UNITED STATES OF AMERICA*

6.3.1. *NOAA Alaska Port Sampling Grant:*

Incremental cost to the International Pacific Halibut Commission sampling program due to IFQ/CDQ programs (2019-2023)

The IPHC Port Sampling Program runs annually in Alaskan ports. The USA, via NOAA provide funds directly to the IPHC to pay for some of our Port Sampling costs (this is in addition to the annual USA Contributions to the IPHC General Budget). For background understanding, the IPHC is one of those who receive funds each year to cover off on partial costs for our Pacific halibut Fisheries Data program which had to be expanded in 1995 when the US implemented the IFQ program in Alaska. This change extended the length of the commercial season in Southeast Alaska (IPHC Regulatory Area 2C) and the Gulf of Alaska (IPHC Regulatory Areas 3A, 3B, 4A) from two days to 260 days. In the Bering Sea and Aleutian Islands, the season length went from 1-22 days to 260 days (season length varied by IPHC Regulatory Area). Prior to the implementation of the IFQ program in Alaska, the Commission's catch effort data collection was accomplished through the use of one or multiple personnel stationed temporarily in Pacific halibut landing ports for up to a week following the directed commercial fishing period, to collect the necessary data throughout the intensive landing period that existed with the 'Derby'-style pre-IFQ fishery. With the implementation of the IFQ program and the associated longer fishing season, it became necessary to alter the catch effort personnel deployment patterns to accomplish similar scientific protocols for representative sampling of the fishery landings. These sampling protocols require both biological and logbook targets specific to each IPHC Regulatory Area with both spatial and temporal requirements.

To meet these targets, it was necessary to station personnel in major ports for the extended, nine-month fishery season with employees on call to collect the necessary data (12 hours a day and six days a week). It also provides some funds that are meant to cover the costs of the sablefish data collection and reporting program as a service for NOAA.

The current Grant agreement was set up for 5 years and will end at the close of the 2023 fishing period, and is budgeted to cover 81% of our expenses for the Port Program. The IPHC is currently in discussions with NOAA personnel to update, improve, and extend the current arrangement past 2023. We expect to bring the new agreement to the Commission for consideration in the first half of 2022.

6.3.2. *NOAA Pacific cod and Pacific spiny dogfish sampling agreement*

NOAA-Fisheries, through the Alaska Fisheries Science Center (AFSC) requested sex and length data from Pacific spiny dogfish and length data from Pacific cod from all surveyed stations in 2021. The IPHC has been collecting this requested data from a subsample of Pacific spiny dogfish since 2011, and for Pacific cod in the Bering Sea since 2007 and in the Gulf of Alaska (GOA) since 2017. This remains a valuable collaboration and one which the IPHC will continue.

In 2021, the IPHC FISS team collected lengths of Pacific Cod and Pacific spiny dogfish at the request of NOAA-Fisheries.

IPHC Regulatory Area	Pacific spiny dogfish lengths/sex
2A	143
2B	516
2C	332
3A	807
3B	227
4A	3
4B	1
TOTAL	**2,029**
IPHC Regulatory Area	**Pacific cod lengths**
2B	500
2C	1380
3A	944
3B	497
4A	317
4B	217
4C	99
4D	160
IPHC Closed Area	15
TOTAL	**4,129**

6.3.3. *Memorandum of Understanding – Rockfish – Washington Department of Fish and Wildlife*

The objective of the Memorandum of Understanding (MoU) with WDFW is to 1) collect and utilize catch and biological sample data from species caught during the IPHC's annual fishery-independent setline survey (FISS); 2) agree on how proceeds from the sale of Pacific halibut (*Hippoglossus stenolepis*), rockfish (*Sebastes* spp.) and Pacific cod (*Gadus microcephalus*) will be disbursed; and 3) lay forth the financial obligations associated with undertaking additional FISS stations, as requested by the WDFW to survey rockfish populations off the Washington coastline.

In 2021, the IPHC sampled the eight (8) additional stations at the request of the WDFW. The IPHC tagged 187 rockfish at sea, which were then sampled by WDFW staff during the offloads in Westport, WA. The costs incurred by these activities are 100% cost-recovered from the WDFW.

6.3.4. *NORTH Pacific Fishery Management Council (NPFMC)*

Abundance-Based Management of Pacific halibut bycatch (ABM)

The NPFMC's Abundance-Based Management Working Group (ABMWG) continued its work, with participation of the IPHC Secretariat. The Commission has supported the development of ABM due to its potential effect on the directed Pacific halibut fisheries.

At its January/February 2020 meeting, the NPFMC revised the ABM motion (Council D4 Motion AM80) to focus solely on the Amendment 80 sector for the forthcoming Pacific halibut ABM PSC limit analysis and added a second motion (Council D4 Motion PSC Limits) containing additional options to consider in a discussion paper.

ABM was a priority agenda at the NPFMC October 2020 meeting. The Scientific and Statistical Committee (SSC) discussed the operating model and results from the simulation analysis. However, a misspecification in the simulation model left little time to review the updated results before the end of the SSC meeting, and the SSC unanimously decided to not review the results at that time. The Council discussed the outcomes extensively and moved to a new approach in Council C6 Motion as well as updating the purpose and need. The motion specifies four alternatives for analysis with one being status quo and the other three variations of a lookup table incorporating the two indices calculated from the FISS data and the EBS trawl survey data. Four options were specified that would reduce variability in the annual PSC limits and introduce performance standards that may increase or decrease the PSC limit depending on percent usage of the limit.

Following an initial review of a preliminary draft environmental impact statement (DEIS) in April 2020, the NPFMC modified the specified options, removed the option annual roll-overs, and requested the draft DEIS be revised in response to SSC requests before publishing it for a public comment period (Council C2 Motion ABM). The National Marine Fisheries Service (NMFS) will provide an analysis of comments at the November 2021 NPFMC meeting followed in December 2021 with the NPFMC taking final action to recommend a preferred alternative. Given this timeline, implementation could occur in January 2023.

6.3.5. *PACIFIC FISHERY Management Council (PFMC)*

IPHC Regulatory Area 2A Catch Sharing Plans and in-season management

The IPHC Secretariat collaborated with NOAA Fisheries and State agencies to conduct in-season management of the various fisheries identified in the IPHC Regulatory Area 2A Catch Sharing Plan. Date and possession restrictions were adjusted in season among the various fisheries to meet identified fishery needs while attaining and remaining within the applicable catch limits. Estimates of removals for 2021 will be presented during Agenda Item 5.

IPHC Regulatory Area 2A fishery management handover to the USA

The Council took final action in November 2020, and adopted the following:

- The Council will consider the directed fishery framework during the Catch Sharing Plan process in September and November; include any guidance for vessel limits and in-season changes for NMFS implementation.
- NMFS will issue permits for all Area 2A halibut fisheries: commercial-directed, incidental salmon troll, incidental sablefish, and recreational charter halibut fisheries.
- NMFS will determine the appropriate application deadlines for all commercial halibut applications, set to accommodate Council meetings and NMFS processing time.
- Proof of permit will be required to be onboard the fishing vessel and made readily available upon request, regardless of the type of permit (e.g., paper or electronic). NMFS will provide access to permits in a printable format or send paper copies directly to the participant.

As for the status of implementation, NMFS is anticipating the following schedule:

- A proposed rule will be published this fall with the expectation that the rule will be finalized by June/July 2022
- Collect information necessary to issue permits in June/July 2022

- Consider management alternatives through the Council process in September and November 2023
- Issue Permits by early 2023
- NMFS will manage the non-Indian directed commercial fishery beginning in 2023

7. IPHC COMMUNICATIONS AND OUTREACH

7.1. *IPHC Website*

The IPHC Secretariat continues to develop new ways to display data and statistics for our stakeholders and other interested parties, focusing particularly on the addition of timely and useful visual displays such as interactive maps for the IPHC Fishery-Independent Setline Survey (FISS) data, and commercial fishery data pages and catch tables. https://www.iphc.int/www.iphc.int/data

7.2. *Annual Report*

The 2020 Annual Report (1 January to 31 December 2020) was published on 2 April 2021 and is available for download from the IPHC website at the following link: https://www.iphc.int/uploads/pdf/ar/iphc-2021-ar2020-r.pdf

We continue to implement an accelerated production timeline for the IPHC Annual Report, thereby ensuring users of the report receive the summary information as close to the relevant year as possible. Continued feedback on the content, format and presentation of the Annual Report is welcome.

7.3. *IPHC Circulars and Media Releases*

IPHC Circulars continue to serve as the formal inter-sessional communication mechanism for the Commission. Circulars are used to announce meetings of the Commission and its subsidiary bodies, as well as inter-sessional decisions made by the Commission.

https://www.iphc.int/library/documents/category/circulars

IPHC Media Releases are the primary informal communication with all stakeholders. In some cases, these will duplicate the formal communications provided in IPHC Circulars.

https://www.iphc.int/library/documents/category/media-releases

Stakeholders are encouraged to request that their email addresses be added to IPHC distribution lists at the following link: https://www.iphc.int/form/media-and-news

7.4. *IPHC External engagement*

There is a considerable amount of effort put into public outreach, attending conferences and meetings that enhance knowledge, contributing expertise to the broader scientific community through participation on boards and committees, and seeking further education and training. In 2021, much of this engagement took place electronically due to the COVID-19 pandemic.

Committees and external organisation appointments

North America:

1) *Technical Subcommittee (TSC) of the Canada-United States Groundfish Committee* - Dr. Josep Planas & Ms. Lara Erikson

Canada:

1) *Halibut Advisory Board* (Canada) - Dr. David Wilson (Dr. Basia Hutniczak – Alternate)

United States of America:

1) *Bering Sea/Aleutian Islands Plan Team* - Dr. Allan Hicks
2) *Bering Sea Fishery Ecosystem Plan Team* - Dr. Ian Stewart
3) *North Pacific Fishery Management Council (NPFMC) Abundance-based Management Working Group* – Dr. Allan Hicks
4) *NPFMC Scientific and Statistical Committee* - Dr. Ian Stewart
5) *NPFMC Trawl Electronic Monitoring Committee* – Ms. Huyen Tran
6) *North Pacific Research Board Science Panel* - Dr. Josep Planas
7) *Fisheries Monitoring Science Committee (NOAA-Alaska)* – Dr. Ray Webster
8) *Interagency electronic reporting system for commercial fishery landings in Alaska (eLandings) Steering Committee – Ms. Kamala Carroll and Ms. Huyen Tran*
9) *Interagency electronic reporting system for commercial fishery landings in Alaska (eLandings) IT Steering Committee – Ms. Huyen Tran and Mr. Afshin Taheri*
10) *Interagency electronic reporting system for commercial fishery landings in Alaska (eLandings) Interagency Coordination Committee (ICC) – Ms. Huyen Tran*
11) *Stock Assessment Review (STAR) of Vermilion and Sunset Rockfishes (PFMC) – Dr. Allan Hicks*

Conferences and symposia (chronological order)

1) Participation (remote) in the North American Association of Fisheries Economists biannual meeting - Dr. Basia Hutniczak
2) World Fisheries Congress, Adelaide, SA, Australia – remote participation – Dr David T. Wilson, Dr Josep Planas, Mr Andy Jasonowicz, Mr Colin Jones.

Academic affiliations 2021

Affiliate Faculty:

1) Dr. Allan Hicks - University of Washington School of Aquatic and Fishery Sciences, Seattle, WA, USA
2) Dr. Ian Stewart - University of Washington School of Aquatic and Fishery Sciences, Seattle, WA, USA
3) Dr. Josep Planas - Alaska Pacific University, Anchorage, AK, USA

Graduate student committee member:

1) Dr. Allan Hicks - University of Massachusetts School for Marine Science & Technology, Dartmouth, MA, USA
2) Dr. Allan Hicks - University of Washington School of Aquatic & Fishery Sciences, Seattle, WA, USA
3) Dr. Ian Stewart - Alaska Pacific University, Anchorage, AK, USA
4) Dr. Ian Stewart - University of Washington School of Aquatic & Fishery Sciences, Seattle, WA, USA
5) Dr. Josep Planas - Alaska Pacific University, Anchorage, AK, USA

8. IPHC PUBLICATIONS IN 2021

***Published* peer-reviewed journal papers**

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

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

Loher, T., Bath, G.E., and Wischniowski, S. (2021). The potential utility of otolith microchemistry as an indicator of nursery origins in Pacific halibut (*Hippoglossus stenolepis*). Fisheries Research 243: 106072. 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.,** and **Planas, J.V.** (2021) Use of Artificial Illumination to Reduce Pacific Halibut Bycatch in a U.S. West Coast Groundfish Bottom Trawl. Fisheries Research. 233:105737. doi.org/10.1016/j.fishres.2020.105737

Sadorus, L.L., Goldstein, E.D., **Webster, R.A.,** Stockhausen, W.T., **Planas, J.V.,** and Duffy-Anderson, J.T. (2021) Multiple life-stage connectivity of Pacific halibut (*Hippoglossus stenolepis*) across the Bering Sea and Gulf of Alaska. Fisheries Oceanography. Vol. 30(2):174-193. doi.org/10.1111/fog.12512

Stewart, I.J., Hicks, A.C., and **P. Carpi** (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

Stewart, I.J., Scordino, J. J., Petersen, J.R., Wise, A.W., Svec, C.I., Buttram, R.H., Monette, J.L., Gonzales, M.R., Svec, R., Scordino, J. Butterfield, K., Parker, W., and Buzzell, L.A. (2021) Out with the new and in with the old: Reviving a traditional Makah halibut hook for modern fisheries management challenges. Fisheries Magazine: American Fisheries Society (early view). doi.org/10.1002/fsh.10603

Taylor, I.G., Doering, K.L., Johnson, K.F., Wetzel, C.R., and **Stewart, I.J.** (2021). Beyond visualizing catch-at-age models: Lessons learned from the r4ss package about software to support stock assessments. Fisheries Research. Vol. 439:105924. doi.org/10.1016/j.fishres.2021.105924

***In press* peer-reviewed journal papers**

Loher, T., Dykstra, C.L., Hicks, A., Stewart, I.J., Wolf, N., Harris, B.P., **Planas, J.V.** Estimation of post-release longline mortality in Pacific halibut (*Hippoglossus stenolepis*) using acceleration-logging tags. North American Journal of Fisheries Management (In Press).

***Submitted* peer-review journal papers – In review**

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 (In Review).

Hutniczak, B. Method for Efficient Updating of Regional Supply and Use Tables, Journal of Economic Structures (In Review).

Jasonowicz AJ, Simeon A, Zahm M, Cabau C, Klopp C, Roques C, Iampietro C, Lluch J, Donnadieu C, Parrinello H, Drinan DP, Hauser L, Guiguen Y, and **Planas JV**. Generation of a chromosome-level genome assembly for Pacific halibut (*Hippoglossus stenolepis*) and characterization of its sex-determining genomic region. Molecular Ecology Resources (In Review)

Loher, T., McCarthy, O., **Sadorus, L.L., Erikson, L.M., Simeon, A.,** Drinan, D.P., Hauser, L., **Planas, J.V.**, and **Stewart, I.J**. A test of deriving sex-composition data for the North American Pacific halibut (*Hippoglossus stenolepis*) directed commercial fishery via an at-sea marking program. Fisheries Research (In Review).

9. RECOMMENDATION

That the Commission **NOTE** paper IPHC-2022-AM098-04 which provides the Commission with an update on activities of the IPHC Secretariat in 2021 not detailed in other papers before the Commission.

APPENDICES

Nil.

Implementation of the Recommendations from the 2nd IPHC Performance Review (PRIPHC02)

PREPARED BY: IPHC SECRETARIAT (D. WILSON; 10 DECEMBER 2021)

To provide the Commission with an update on the implementation of the recommendations arising from the 2nd Performance Review of the IPHC (PRIPHC02).

BACKGROUND

The Report of the 2nd Performance Review of the IPHC (PRIPHC02), IPHC-2019-PRIPHC02-R (adopted on 11 October 2019) is available for download from the IPHC website: https://www.iphc.int/library/documents/post/iphc-2019-priphc02-r-report-of-the-2nd-performance-review-of-the-international-pacific-halibut-commission-priphc02

At the 96th Session of the IPHC Annual Meeting (AM096), the Commission:

> *(para. 137) "The Commission **NOTED** that the PRIPHC02 was carried out over the course of 2019 via three face-to-face meetings: one in Seattle, USA (4-6 June 2019), one in New York City, USA (25 August 2019) and one in Ottawa, Canada (7-11 October 2019). The Panel held several additional tele-conferences, both among themselves, and with stakeholders. The meeting was also supported by Independent Legal and Science Experts who each dedicated additional working days to providing technical reviews and reports on specific components of the review criteria relevant to their areas of expertise."*
>
> *(para 138) "The Commission **NOTED** para. 22 of the report which stated:*
>
>> *(para. 22) "The PRIPHC02 **CONGRATULATED** the Commission and Secretariat for the positive strides in response to the first performance review. Through the course of the consultations, document review and interviews, the panel saw consistent and significant improvements in transparency, availability and modernisation of documentation and background information, and heard resounding praise for this increased transparency and the movement away from previously "closed-door" and perceived "secretive" processes and decision-making."*
>
> *(para. 139) "The Commission **REQUESTED** that paper IPHC-2020-AM096-14 be reviewed intersessionally by each Contracting Party, with the intention of providing edits/additions, for endorsement. The IPHC Secretariat will facilitate this request by proposing intersessional meeting dates."*

During the 6th Special Session of the IPHC (SS06) held on 3 March 2020, the Commission:

> (para. 6) "*The Commission **ENDORSED** the recommendations, priorities, responsibilities, timelines and updates provided at Appendix B, and **AGREED** that these would be reported on at each IPHC meeting.*" (IPHC-2020-SS06-R)

Recommendation

That the Commission **NOTE** paper IPHC-2022-AM098-05 that provides the Commission with an update on the implementation of the recommendations arising from the 2nd Performance Review of the IPHC (PRIPHC02).

Appendices

Appendix A: Table of recommendations arising from the PRIPHC02, including 1) responsibilities, 2) timeline, 3) priorities; and 4) any initial comments of relevance.

Appendix A
RECOMMENDATIONS OF THE 2ND PERFORMANCE REVIEW OF THE INTERNATIONAL PACIFIC HALIBUT COMMISSION (PRIPHC02)

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
PRIPHC02 –Rec.01 (para. 32)	***Legal analysis of the IPHC Convention*** The PRIPHC02 **RECOMMENDED** that consideration be given to updating the Convention at the next opportunity, to become consistent with newer international legal instruments, and specifically consider including the following elements: a) – z)	N/A	N/A	N/A	**N/A:** At this time, the Contracting Parties do not wish to commence the process of updating the IPHC Convention.
PRIPHC02 –Rec.02 (para. 33)	The PRIPHC02 **RECOMMENDED** to update the Convention, while in the interim period seek alternate mechanisms to implement international best practices and* legal principles.	N/A	N/A	N/A	**N/A**
	Commission directive: The Commission **RECOMMENDED** the exploration and implementation of alternate mechanisms to implement international best practices, such as revisions to the IPHC Rules of Procedure, IPHC Financial Regulations and IPHC Fishery Regulations.	High	Commission	2020-24	**Complete** (2020, 2021) and **In progress (**2022): The IPHC Rules of Procedure (ROP) and the IPHC Financial Regulations (FR) will be periodically updated (at least once every 2 years) and where possible, should accommodate applicable improvements as recommended in the legal review of the IPHC Convention. Revised ROPs and FRs will be submitted to the annual **Finance and Administration Committee (FAC)** for consideration and potential recommendation to the Commission, each year, as necessary. See papers: **IPHC-2022-FAC098-08** **IPHC-2022-FAC098-09**

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
PRIPHC02 –Rec.03 (para. 44)	***Science: Status of living marine resources*** 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.	High	IPHC Secretariat	2020-24	**In progress**: There are three non-Contracting Parties who exploit Pacific halibut: Russia, Rep. of Korea and Japan. Most recently we have engaged Russian scientists working on Pacific halibut through PICES (https://meetings.pices.int/). We will continue to explore this avenue via PICES, noting that COVID-19 has hindered/delayed interactions to a certain degree.
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.	Medium	IPHC Secretariat	2020-24	**In progress**: The IPHC's work in this area has been limited to date. However, some efforts to incorporate ecosystem considerations into the MSE work has commenced.
PRIPHC02 –Rec.05 (para. 63)	***Science: Quality and provision of scientific advice*** The PRIPHC02 **RECOMMENDED** that simplified materials be developed for RAB and especially MSAB use, including training/induction materials.	High	IPHC Secretariat	2020-24	**In progress**: The IPHC Secretariat continues to seek ways to ensure broad stakeholder understanding of our work. For the MSAB and associated MSE work, an interactive web-based tool has been developed to provide a user friendly means to explore and understand the utility of MSE and the simulation results arising. See paper **IPHC-2022-AM098-12** for the latest iteration. Additionally, an information paper describing how to use the IPHC MSE Explorer tool (IPHC-2021-AM097-inf03) was provided at the 97th Annual Meeting. MSE Explorer. https://www.iphc.int/management/science-

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
					and-research/management-strategy-evaluation
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.	Medium	Commission; IPHC Secretariat	2020	**Completed**: The IPHC Secretariat provided the Commission with revised Rules of Procedure for consideration at AM096, which included a two-term limit. This was adopted by the Commission and is now in force. See **IPHC Rules of Procedure (2020)**
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.	High	Commission; IPHC Secretariat	2020-24	**Completed**:The Commission approved peer review of the IPHC stock assessment which was **concluded** in 2019, the IPHC MSE which was concluded on 25 September 2020. See **IPHC-2020-CR-022**. The Commission has indicated its strong support topic based peer review moving forward.
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.	High	IPHC Secretariat	2020	**Completed**: The IPHC Secretariat now includes both time-series' and phase plots of management-related quantities See paper **IPHC-2021-AM097-08**.
PRIPHC02 –Rec.09 (para. 73)	***Conservation and Management: Data collection and sharing*** The PRIPHC02 **RECOMMENDED** that observer coverage be adjusted to be commensurate with the level of fishing intensity in each IPHC Regulatory Area. Commission directive: The Commission **RECOMMENDED** that the IPHC Secretariat, in consultation with the Commission, develop minimum data collection standards for Pacific halibut by scientific observer programs. The intention would be for the Commission to review and approve the minimum standards, and recommend them for implementation by domestic agencies.	N/A High	N/A Contracting Parties	N/A 2020-24	**N/A** **Pending**

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
PRIPHC02 –Rec.10 (para. 82)	***Conservation and Management: Consistency between scientific advice and fishery Regulations adopted*** 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 regularised multi-year stock assessments.	High	IPHC Secretariat	2021-24	**In progress**: To be considered once update MSE products, including multi-year management procedures, are delivered at AM098 in January 2022, and updated complete results are presented at AM099 in January 2023. Evaluating multi-year stock assessments is a priority task in the MSE program of work for 2021-2023.
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.	High	IPHC Secretariat	2020-21	**In progress**: See paper **IPHC-2022-AM098-12** for the latest iteration and https://www.iphc.int/uploads/pdf/msab/tech/iphc-2021-mse-02.pdf for the most recent MSE program of work.
PRIPHC02 –Rec.12 (para. 88)	***Fishing allocations and opportunities*** The PRIPHC02 **STRONGLY URGED** the Commission to conclude its MSE process and **RECOMMENDED** it meet its 2021 deadline to adopt a harvest strategy.	High	IPHC Secretariat	2020-21	**In progress**: See paper **IPHC-2022-AM098-12** for the latest iteration.
PRIPHC02 –Rec.13 (para. 96)	***Compliance and enforcement: Port State measures*** The PRIPHC02 **RECOMMENDED** that Contracting Party enforcement agencies adopt common standards for assessment of implementation of the principles of port State measures.	Medium	Contracting Parties	2020-24	**Pending**: Potentially to be incorporated into the Contracting Party National Reports at each Annual Meeting. The Secretariat will work with each Contracting Party.
PRIPHC02 –Rec.14 (para. 105)	***Compliance and enforcement: Monitoring, control and surveillance (MCS)*** The PRIPHC02 **RECOMMENDED** enhancement of coordination of MCS activities to result in a common, integrated enforcement report for each Contracting Party to facilitate assessment of compliance efforts, trends and input into management decisions.	Medium	Contracting Parties	2021-24	**Pending**: Potentially to be incorporated into the Contracting Party National Reports at each Annual Meeting.

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
PRIPHC02 –Rec.15 (para. 106)	The PRIPHC02 **RECOMMENDED** that the Commission re-assess the 'derby-style' fisheries management concept in operation in IPHC Regulatory Area 2A in terms of available resources, impact on validity of monitoring results, and safety of fishers, and amend the management processes, if and as necessary.	High	IPHC Secretariat; Commission	2020	**In progress**: The IPHC Secretariat is coordinating with relevant Contracting Party domestic agencies regarding shifting management of all Pacific halibut fisheries in IPHC Regulatory Area 2A from the IPHC to the relevant domestic agencies. At IM095, the Commission requested: IM095 (para. 89) *The Commission **WELCOMED** the PFMC's commitment to transition management of Pacific halibut fisheries in IPHC Regulatory Area 2A from the IPHC to domestic agencies and **REQUESTED** that the IPHC Secretariat continue to support this process in the short-term, with the aim of transitioning management of the fishery to the domestic agencies at the earliest opportunity.* See paper **IPHC-2022-AM098-14** for the latest iteration. Handover is expected in early 2023.
PRIPHC02 –Rec.16 (para. 108)	***Compliance and enforcement: Follow-up on infringements*** The PRIPHC02 **RECOMMENDED** that the IPHC request information regarding Contracting Party follow-up of infringements, to assist in determining the overall efficacy of MCS and enforcement activities. This would support best practices with respect to transparency.	High	IPHC Secretariat; Commission	2020	**In progress**: The IPHC Secretariat has requested this information be provided by domestic agencies via the Contracting Party National Reports to the Commission.
PRIPHC02 –Rec.17 (para. 109)	The PRIPHC02 **RECOMMENDED** that the Commission improve the process of Contracting Party reporting to the Commission by aggregating individual agency reports into a consolidated, standardised, Contracting Party report to the Commission.	Medium	IPHC Secretariat; Contracting Parties	2020	**In progress**: The IPHC Secretariat has requested this information be provided by domestic agencies via a consolidated Contracting Party National Report to the Commission. This will likely take several years to become an efficient process of reporting.
PRIPHC02 –Rec.18 (para. 124)	***Governance: Decision-making*** The PRIPHC02 **RECOMMENDED** that the IPHC Rules of Procedure be modified to include a clear category and recognition for observer organisations, which would be in addition to the general public.	Low	IPHC Secretariat	2020-21	**Completed**: IPHC Rules of Procedure (2020) published on 7 February 2020.

REF#	RECOMMENDATION	PRIORITY	RESPONSIBILITY	TIMELINE	UPDATE/STATUS
PRIPHC02 –Rec.19 (para. 128)	***Governance: Dispute settlement*** The PRIPHC02 **RECOMMENDED** updating the rules of procedure to reflect intersessional decision making approaches.	Medium	IPHC Secretariat	2020-21	**Completed**: IPHC Rules of Procedure (2020) published on 7 February 2020. Further amendments will be presented at FAC097 for recommendation to the Commission. **97th Session of the IPHC Finance and Administration Committee (FAC097)**
PRIPHC02 –Rec.20 (para. 137)	***Governance: Transparency*** The PRIPHC02 **RECOMMENDED** that the significant level of transparency achieved across Commission business continue to be improved.	High	Commission; IPHC Secretariat;	2020-24	**In progress**: Monitor progress through the IPHC meeting cycle.
PRIPHC02 –Rec.21 (para. 146)	***International cooperation: Relationship to non-Contracting Parties*** The PRIPHC02 **RECOMMENDED** that the Commission prioritise scientific work to confirm the full range of the Pacific halibut stock.	High	IPHC Secretariat;	2020-24	**In progress**: There are three non-Contracting Parties who exploit Pacific halibut: Russia, Rep. of Korea and Japan. Most recently we have engaged Russian scientists working on Pacific halibut through PICES (https://meetings.pices.int/).
PRIPHC02 –Rec.22 (para. 147)	The PRIPHC02 **RECOMMENDED** that if the full range of the Pacific halibut stock extends outside the Convention Area, the Contracting Parties invite collaboration with all parties involved in the harvest of this stock, to ensure science and management includes accurate data regarding all removals from the stock.	Low/ Medium	IPHC Secretariat	2020-24	**In progress**: The IPHC Secretariat is engaging with other countries harvesting Pacific halibut via PICES as a first step.
PRIPHC02 –Rec.23 (para. 156)	***Efficiency and transparency of financial and administrative management: Availability of resources for IPHC activities*** The PRIPHC02 **RECOMMENDED** the continued establishment of a Business Continuity Plan (BCP), which will serve to strengthen the long-term viability of IPHC Secretariat functioning and accountability, in line with best practices of an organisation of its size and breadth. Prioritising a financial and administrative BCP, with the ultimate goal of establishing a comprehensive BCP for the IPHC Secretariat as a whole.	High	IPHC Secretariat; FAC	2020	**In progress**: The IPHC Secretariat has developed a BCP for the Finance and Administrative Services Branch (financial and administrative BCP) over the past months, and will move to consolidate with other Branches of the organization throughout 2020.

Ref#	Recommendation	Priority	Responsibility	Timeline	Update/Status
PRIPHC02 –Rec.24 (para. 162)	***Efficiency and transparency of financial and administrative management: Efficiency and cost-effectiveness*** The PRIPHC02 **RECOMMENDED** the FAC produce a report detailing the actual FAC meeting and that the presentation of the report be incorporated into the Annual Meeting agenda and report, along with the final decisions of the Commission.	High	FAC; IPHC Secretariat	2020-24	**Completed**: The first report of the IPHC Finance and Administration Committee (FAC) was adopted on 4 February 2020, and presented to the Commission at its 96th Session for consideration.
PRIPHC02 –Rec.25 (para. 165)	***Efficiency and transparency of financial and administrative management: Advisory structure*** The PRIPHC02 **RECOMMENDED** that when revisiting PRIPHC01 Recommendation 3.1 on unifying subsidiary bodies, treat the CB and PAB as non-science process and maintain separated RAB and MSAB at least until the 2021 adoption and implementation of a new management strategy.	N/A	Commission	N/A	**Completed**: The Commission agreed to keep the two subsidiary bodies separate moving forward.
PRIPHC02 –Rec.26 (para. 166)	The PRIPHC02 **RECOMMENDED** that continued support for high quality stakeholder engagement through the science-focused subsidiary bodies (RAB and MSAB) or any future subsidiary bodies be maintained.	High	Commission; IPHC Secretariat	2020-24	**Completed**: The Commission agreed to keep the two subsidiary bodies separate moving forward, and for them to be enhanced wherever feasible.

Fisheries Data Overview (2021)

PREPARED BY: IPHC SECRETARIAT (T. KONG, H. TRAN & C. PREM; 17 DECEMBER 2021 & 13 JANUARY 2022)

PURPOSE

To provide an overview of the key fisheries data regarding Pacific halibut removals from fisheries catching Pacific halibut during 2021, including the status of landings compared to fishery limits implemented by the Contracting Parties to the Commission.

BACKGROUND

The International Pacific Halibut Commission (IPHC) estimates all Pacific halibut (*Hippoglossus stenolepis*) removals taken in the IPHC Convention Area and uses this information in its yearly stock assessment (see IPHC-2021-AM098-10) and other analyses. The data are compiled by the IPHC Secretariat and include data from Federal and State agencies of each Contracting Party. All 2021 data are in net weight (head-off, dressed, ice and slime deducted) and are considered preliminary at this time.

This paper includes Pacific halibut removals for:

- Directed commercial fisheries, including landings and discard mortality
- Recreational fisheries, including landings and discard mortality
- Subsistence fisheries
- Non-directed commercial discard mortality (e.g. trawl, pot, longline)
- IPHC Fishery-Independent Setline Survey (FISS) and other research

Figure 1 shows the distribution of Pacific halibut removals (mortality) by these fishery sources in 2021. Table 1 and Table 2 provide estimates of total removals by IPHC Regulatory Area (Figure 2).

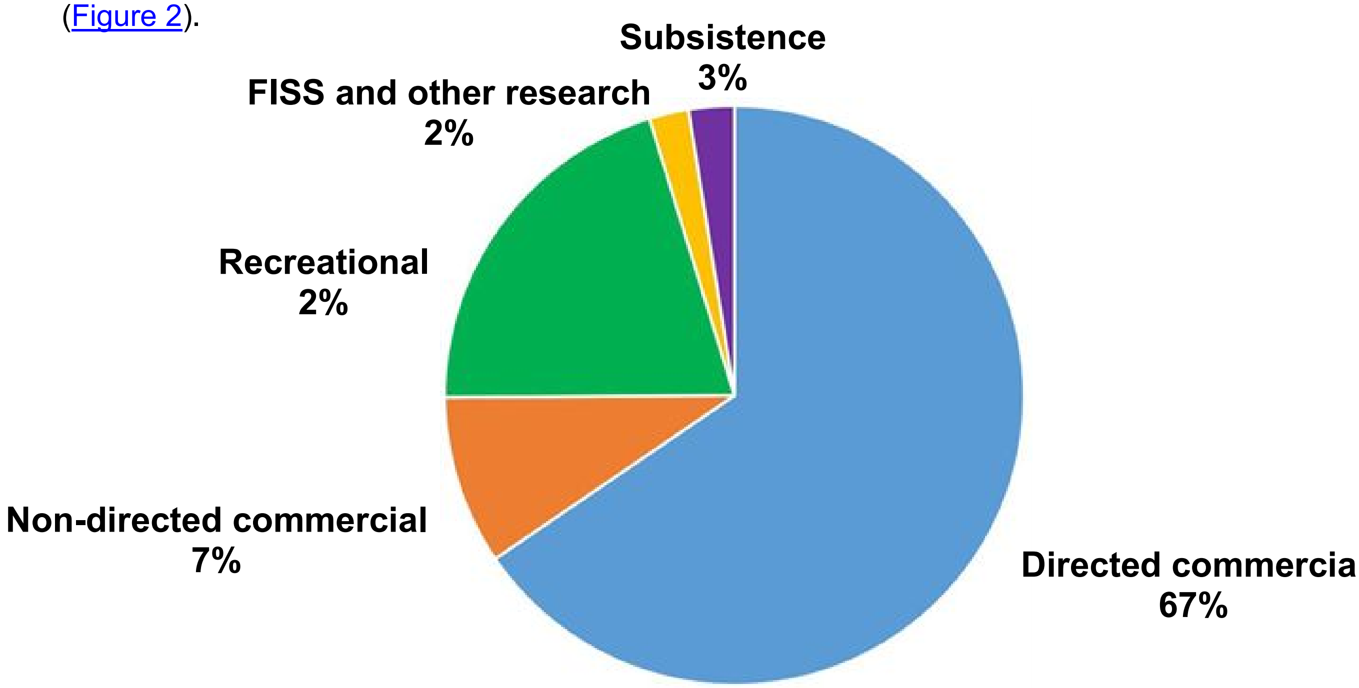


Figure 1. Distribution of Pacific halibut mortality by source in 2021.

Table 1. 2021 Mortality limits (TCEYs) and estimates (TCEYs and U26) by Contracting Party.

Contracting Party	Mortality limits (net weight)		Mortality (net weight)		Percent
	Tonnes (t)	Pounds (lb)	Tonnes (t)	Pounds (lb)	%
Canada	**3,175**	**7,000,000**	**3,134**	**6,909,511**	**99**
United States of America	**14,515**	**32,000,000**	**13,396**	**30,225,682**	**92**
IPHC Regulatory Area 2A	748	1,650,000	655	1,445,042	88
IPHC Regulatory Area 2C	2,631	5,800,000	2,841	6,264,364	108
IPHC Regulatory Area 3A	6,350	14,000,000	6,313	13,917,384	99
IPHC Regulatory Area 3B	1,415	3,120,000	1,328	2,928,737	94
IPHC Regulatory Area 4A	930	2,050,000	804	1,771,799	86
IPHC Regulatory Area 4B	635	1,400,000	370	815,294	58
IPHC Regulatory Area 4CDE and Closed Area	1,805	3,980,000	1,084	2,390,810	60
IPHC Regulatory Area 4BCDE[1]	(467)	(1,030,400)	314	692,252	67
Subtotal (TCEY)	**17,690**	**39,000,000**	**16,844**	**37,134,193**	**95**
Non-directed commercial discard mortality (U26)	567	1,250,000	462	1,019,000	82
Total	**18,257**	**40,250,000**	**17,306**	**38,153,193**	**95**

[1] Area 4BCDE mortality limits included separately in Areas 4B and 4CDE limits

Table 2. 2021 estimates of total removals (net weight), including fishery limits and mortality projections of Pacific halibut by IPHC Regulatory Area.

IPHC Regulatory Area	Fishery limit or Mortality projection		Mortality (net weight)		Percent
	Tonnes (t)	Pounds (lb)	Tonnes (t)	Pounds (lb)	%
Canada – Area 2B (British Columbia)	3,175	7,000,000	3,134	6,909,511	99
Directed commercial fishery landings	2,372	5,230,000	2,321	5,118,017	98
Directed commercial discard mortality	77	170,000	82	181,000	106
Recreational fishery	417	920,000	366	806,000	88
Recreational discard mortality[1]	18	40,000	11	25,024	63
Recreational - XRQ	n/a	n/a	7	15,000	n/a
Subsistence[1]	186	410,000	184	405,000	99
Non-directed commercial discard mortality (O26)[1]	104	230,000	98	216,000	94
IPHC fishery-independent setline survey and research[2]	n/a	n/a	65	143,470	n/a
Non-directed commercial discard mortality (U26)	14	30,000	14	31,000	103
USA – 2A (California, Oregon, and Washington)	748	1,650,000	655	1,445,042	88
Non-treaty directed commercial	116	256,122	110	242,997	95
Non-treaty incidental to salmon troll fishery	21	45,198	8	18,562	41
Non-treaty incidental to sablefish fishery	32	70,000	31	69,081	99
Treaty Indian directed commercial	225	496,300	224	494,139	100
Directed commercial discard mortality	14	30,000	32	71,000	237
Recreational – Washington	127	279,414	114	250,286	90
Recreational – Oregon	132	291,506	59	129,805	45
Recreational – California	18	39,260	12	25,778	66
Recreational discard mortality	n/a	n/a	3	5,891	n/a
Subsistence[1]	15	32,200	15	32,200	100
Non-directed commercial discard mortality (O26)[1]	45	100,000	42	93,000	93
IPHC fishery-independent setline survey and research[2]	n/a	n/a	6	12,303	n/a
Non-directed commercial discard mortality (U26)	0	0	2	4,000	n/a

continued….

Table 2 continued. 2021 estimates of total removals (net weight), including fishery limits and mortality projections of Pacific halibut by IPHC Regulatory Area.

IPHC Regulatory Area	Fishery limit or Mortality projection		Mortality (net weight)		Percent
	Tonnes (t)	Pounds (lb)	Tonnes (t)	Pounds (lb)	%
USA – Area 2C (southeastern Alaska)	2,631	5,800,000	2,841	6,264,364	108
Directed commercial fishery landings	1,601	3,530,000	1,492	3,290,345	93
Directed commercial discard mortality	32	70,000	61	135,000	193
Metlakatla (Annette Island Reserve)	n/a	n/a	12	27,391	n/a
Guided recreational fishery	367	810,000	508	1,119,116	142
Guided recreational discard mortality[3]	n/a	n/a	16	34,746	n/a
Guided recreational fishery (GAF) [1]	n/a	n/a	35	76,529	n/a
Unguided recreational fishery[1]	426	940,000	486	1,071,000	116
Unguided recreational discard mortality[3]	n/a	n/a	8	17,653	n/a
Subsistence[1]	168	370,000	132	290,137	78
Non-directed commercial discard mortality (O26)[1]	41	90,000	28	61,000	68
IPHC fishery-independent setline survey and research[2]	n/a	n/a	64	141,447	n/a
Non-directed commercial discard mortality (U26)	0	0	0	0	n/a
USA – Area 3A (central Gulf of Alaska)	6,350	14,000,000	6,313	13,917,384	99
Directed commercial fishery landings	4,060	8,950,000	3,936	8,677,885	97
Directed commercial discard mortality	109	240,000	176	387,000	161
Guided recreational fishery	885	1,950,000	1,105	2,436,437	126
Guided recreational discard mortality[3]	n/a	n/a	8	17,608	n/a
Guided recreational fishery (GAF)	n/a	n/a	2	3,377	n/a
Unguided recreational fishery[1]	694	1,530,000	704	1,552,032	103
Unguided recreational discard mortality[3]	n/a	n/a	11	25,061	n/a
Subsistence[1]	86	190,000	80	176,993	93
Non-directed commercial discard mortality (O26)[1]	517	1,140,000	122	270,000	24
IPHC fishery-independent setline survey and research[2]	n/a	n/a	168	370,991	n/a
Non-directed commercial discard mortality (U26)	132	290,000	70	154,000	53
USA – Area 3B (western Gulf of Alaska)	1,415	3,120,000	1,328	2,928,737	94
Directed commercial fishery landings	1,161	2,560,000	1,093	2,410,299	94
Directed commercial discard mortality[1]	50	110,000	63	139,000	126
Recreational fishery[1]	5	10,000	3	6,432	64
Recreational discard mortality	n/a	n/a	0	0	n/a
Subsistence[1]	9	20,000	6	13,861	69
Non-directed commercial discard mortality (O26)[1]	191	420,000	121	266,000	63
IPHC fishery-independent setline survey and research[2]	n/a	n/a	42	93,145	n/a
Non-directed commercial discard mortality (U26)	27	60,000	32	70,000	117
USA – Area 4A (eastern Aleutians)	930	2,050,000	804	1,771,799	86
Directed commercial fishery landings	753	1,660,000	649	1,430,595	86
Directed commercial discard mortality[1]	54	120,000	24	53,000	44
Recreational fishery[1]	9	20,000	5	10,829	54
Recreational discard mortality	n/a	n/a	0	0	n/a
Subsistence[1]	5	10,000	5	12,118	121
Non-directed commercial discard mortality (O26)[1]	109	240,000	107	235,000	98
IPHC fishery-independent setline survey and research[2]	n/a	n/a	14	30,257	n/a
Non-directed commercial discard mortality (U26)	36	80,000	44	97,000	121

continued….

Table 2 continued. 2021 estimates of total removals (net weight), including fishery limits and mortality projections of Pacific halibut by IPHC Regulatory Area.

IPHC Regulatory Area	Fishery limit or Mortality projection		Mortality (net weight)		Percent
	Tonnes (t)	Pounds (lb)	Tonnes (t)	Pounds (lb)	%
USA – Area 4B (central/western Aleutians)[4]	635	1,400,000	370	815,294	58
Directed commercial fishery landings (IFQ)	446	984,000	283	624,186	63
Directed commercial fishery landings (CDQ)	112	246,000	n/a	n/a	n/a
Directed commercial discard mortality[1]	23	50,000	15	32,000	64
Recreational fishery[1]	0	0	0	0	n/a
Recreational discard mortality	0	0	0	0	n/a
Subsistence[1]	0	0	<1	987	n/a
Non-directed commercial discard mortality (O26)[1]	54	120,000	61	134,000	112
IPHC fishery-independent setline survey and research[2]	n/a	n/a	11	24,121	n/a
Non-directed commercial discard mortality (U26)	5	10,000	6	14,000	140
USA – Area 4CDE and Closed (Bering Sea)[4]	1,805	3,980,000	1,084	2,390,810	60
Directed commercial fishery landings (IFQ)	402	885,600	372	819,798	93
Directed commercial fishery landings (CDQ)	356	784,400	n/a	n/a	n/a
Directed commercial discard mortality[1]	36	80,000	11	25,000	31
Recreational fishery[1]	0	0	0	0	n/a
Recreational discard mortality	0	0	0	0	n/a
Subsistence[1]	14	30,000	18	38,830	129
Non-directed commercial discard mortality (O26)[1]	998	2,200,000	680	1,500,000	68
IPHC fishery-independent setline survey and research[2]	n/a	n/a	3	7,182	n/a
Non-directed commercial discard mortality (U26)	354	780,000	294	648,000	83
USA – Area 4BCDE Directed commercial (CDQ)[4]	(467)	(1,030,400)	314	692,252	67
Totals (TCEY)	17,690	39,000,000	16,844	37,134,193	95
Directed commercial fishery landings	12,052	26,570,000	11,312	24,938,547	94
Recreational fishery	3,098	6,830,000	3,460	7,628,604	112
Subsistence[1]	476	1,050,000	440	970,126	92
Non-directed commercial discard mortality (O26)[1]	2,059	4,540,000	1,259	2,774,000	61
IPHC fishery-independent setline survey and research[2]	n/a	n/a	373	822,916	n/a
Non-directed commercial discard mortality (U26)	567	1,250,000	462	1,019,000	82

[1] 'Fishery projection' is value from 2020 estimates which were used in setting the TCEY for each IPHC Regulatory Area.

[2] Includes U32 Pacific halibut landed during FISS.

[3] Limit included in limit listed above.

[4] Areas 4B and 4CDE totals include CDQ fishery limits, but do not include CDQ mortality, for confidentiality reasons. CDQ mortality is listed on a separate Area 4BCDE line.

n/a = not available

XRQ = Experimental Quota leased from commercial quota.

GAF = Guided Angler Fish leased from commercial quota.

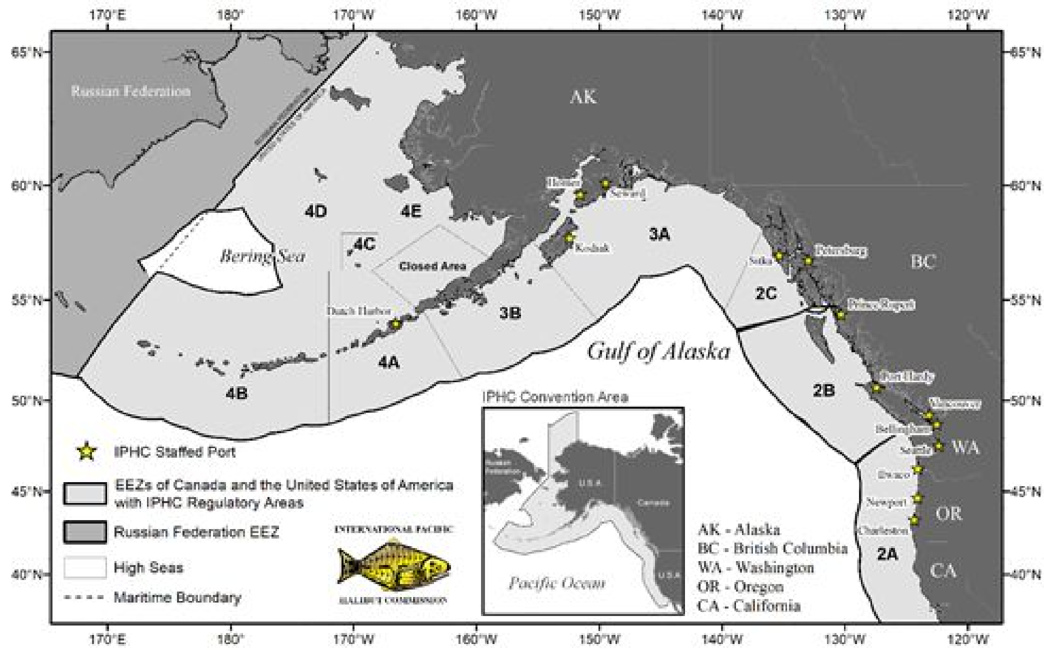


Figure 2. Map of the IPHC Convention Area (insert) and IPHC Regulatory Areas.

DEFINITIONS

Directed commercial fisheries: include commercial landings and discard mortality. Directed commercial discard mortality continues to include estimates of sub-legal Pacific halibut (under 81.3 cm (32 inches), also called U32), fish that die on lost or abandoned fishing gear, and fish discarded for regulatory compliance reasons.

Recreational fisheries: include recreational landings (including landings from commercial leasing) and discard mortality.

Subsistence fisheries: (formerly called personal use/subsistence) are non-commercial, customary, and traditional use of Pacific halibut for direct personal, family, or community consumption or sharing as food, or customary trade. Subsistence fisheries include:

i) ceremonial and subsistence (C&S) removals in the IPHC Regulatory Area 2A treaty Indian fishery,
ii) the sanctioned First Nations Food, Social, and Ceremonial (FSC) fishery conducted in British Columbia,
iii) federal subsistence fishery in Alaska, USA that uses Alaska Subsistence Halibut Registration Certificate (SHARC), and
iv) U32 Pacific halibut retained in IPHC Regulatory Areas 4D and 4E by the CDQ fishery for personal use.

Non-directed commercial discard mortality: incidentally caught Pacific halibut by fisheries targeting other species and that cannot legally be retained, e.g. by the trawl fleet. Refers only to those Pacific halibut that subsequently die due to capture.

IPHC FISS and Research: includes Pacific halibut landings and removals as a result of the IPHC Fishery-Independent Setline Survey (FISS) and other research.

DIRECTED COMMERCIAL FISHERIES

The IPHC's directed commercial fisheries span from northern California through to northern and western Alaska in USA and Canadian waters of the northeastern Pacific Ocean. The IPHC sets annual limits for the retention of Pacific halibut in each IPHC Regulatory Area. Participants in these commercial fisheries use longline and pot gear to catch Pacific halibut for sale. The directed commercial Pacific halibut fisheries in IPHC Regulatory Area 2A consisted of the directed commercial fishery with fishing period limits, the incidental Pacific halibut catch during the salmon troll and limited-entry sablefish (*Anoplopoma fimbria*) fisheries, and the treaty Indian fisheries. Farther north, the directed commercial fisheries consisted of the Individual Vessel Quota (IVQ) fishery in IPHC Regulatory Area 2B in British Columbia, Canada; the Individual Fishing Quota (IFQ) system in Alaska, USA; the Community Development Quota (CDQ) fisheries in IPHC Regulatory Areas 4B and 4CDE; and the Metlakatla fishery in IPHC Regulatory Area 2C. All 2021 landing and discard mortality data presented in this document are preliminary.

Directed Commercial Fishing Periods

The Canadian IVQ fishery in IPHC Regulatory Area 2B and the USA IFQ and CDQ fisheries in IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E commenced at 12 noon local time on 6 March and closed at 12 noon local time on 7 December (Table 3). The IPHC Regulatory Area 2A directed commercial fisheries, including the treaty Indian commercial fisheries, occurred during the same calendar period (6 March to 7 December 2021). For IPHC Regulatory Area 2A, the potential of 58-hour fishing periods every two weeks beginning on the fourth Tuesday in June for the non-treaty directed commercial fishery were adopted. Fishing periods began on the Tuesday at 0800 and ended on the Thursday at 1800 local time (58-hours), were further restricted by fishing period limits, and closed for the remainder of the year after the third opening on 22 July, when the IPHC Regulatory Area 2A directed commercial non-treaty fishery allocation was estimated to have been reached.

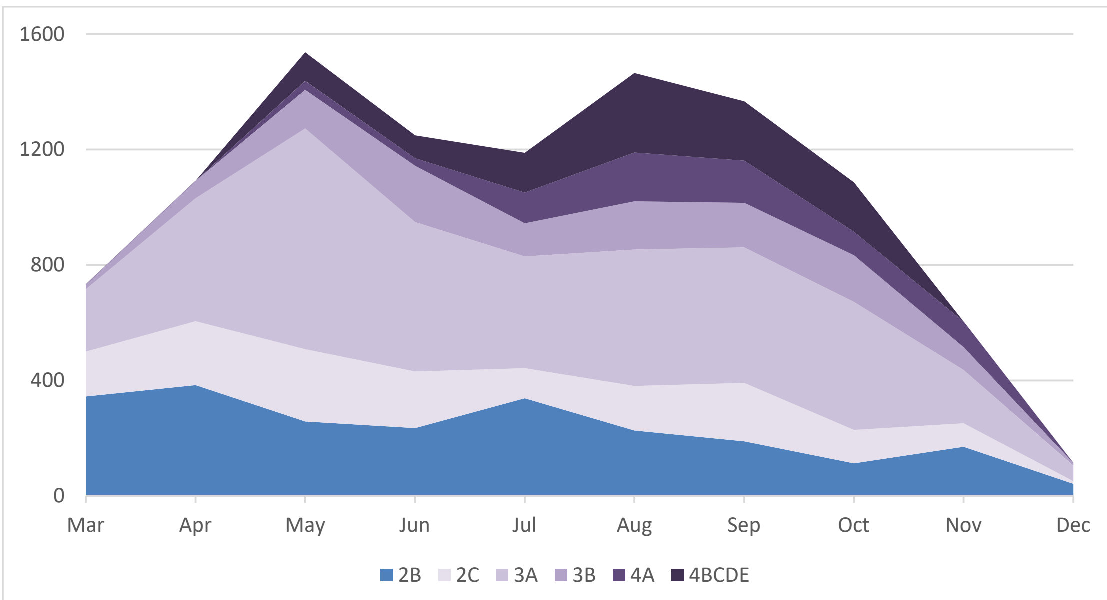
Table 3. Fishing periods for directed commercial Pacific halibut fisheries by IPHC Regulatory Area, 2012-21.

IPHC Regulatory Area	Year									
	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Canada: 2B	6 Mar– 7 Dec (276)	14 Mar- 7 Dec (268)	15 Mar- 14 Nov (244)	24 Mar– 7 Nov (228)	11 Mar– 7 Nov (241)	19 Mar– 7 Nov (233)	14 Mar–7 Nov (238)	8 Mar–7 Nov (244)	23 Mar–7 Nov (230)	17 Mar–7 Nov (236)
USA: 2A Treaty Indian	6 Mar-16 May (55 h) (Unrestricted) 6 Mar-16 May (102 h) (Restricted) 16 May-20 Jun (24 h)	14 Mar-30 Sept (55 h) (Unrestricted) 14 Mar-30 Sep (222 h) (Restricted) 5 Oct -18 Oct (800 lb per calendar day per vessel)	15 Mar-15 May (55 h) (Unrestricted) 15 Mar-15 May (84 h) 20 May-15 Jun (72 h) (Restricted) 11 Jun-24 Jul (~327 lb per tribe)	24 Mar – 28 Apr (36 h) 24 Mar – 28 Apr (37 h) 4 May – 23 May (30 h)	20 Mar, 15-16 Apr 1-2 May 19-20 May, 22-23 May 18-19 Jun 21-22 Jul	19-21 Mar, 20-21 Mar, 21- 23 Mar 1-2 Apr 1-2,11-12 May, 18 May-15 Aug, 25 Jul-2 Aug, 12 Sep-7 Nov	16-18 Mar (48 h) 1-2 Apr	11-13 Mar (48 h) 20-21Mar, 8May 8 May	23-25 Mar (48 h) 2-4 Apr, 15-16 Apr, 8 May, 6 Jun, 13 Jul, 20 Jul, 3 Aug	24-26 Mar (2) 1 May (13 h) 17-19 Mar (55 h)
USA: 2A Commercial Directed	22-24 Jun 6-8 Jul 20-22 Jul (58 h each)	22-24 Jun 6-8 Jul 20-22 Jul 3-5 Aug 17-19 Aug (58 h each)	26 Jun 10 Jul 24 Jul (10 h each)	27 Jun 11 Jul 25 Jul (10 h each)	28 Jun 12 Jul 26 Jul (10 h each)	22 Jun 6 Jul 20 Jul (10 h each)	24 Jun 8 Jul (10 h each)	25 Jun 9 Jul (10 h each)	26 Jun 10 Jul (10 h each)	27 Jun 11 Jul (10 h each)
USA: 2A Commercial Incidental	Salmon 1 Apr – 7 Dec (250) Sablefish 1 Apr – 7 Dec (250)	Salmon 15 Apr–30 Sep (WA – 168) 15 Apr–31 Oct (OR - 199) 1 Aug–30 Sep (CA - 60) Sablefish 1 Apr – 15 Nov (228)	Salmon 20 Apr - 30 Sep (WA, CA - 163) 20 Apr - 31 Oct (OR - 194) Sablefish 1 Apr- 31 Oct (213)	Salmon 24 Mar - 8 Aug (137) Sablefish 24 Mar – 7 Nov (228)	Salmon 1 Apr–3 Aug (124) Sablefish 1 Apr– 31 Oct (213)	Salmon 1 Apr – 31 Oct (213) Sablefish 1 Apr – 31 Oct (213)	Salmon 1 Apr–21 Aug (142) Sablefish 1 Apr– 31 Aug (152)	Salmon 1 Apr–11 Sep (163) Sablefish 1 Apr– 31 Oct (213)	Salmon 1 May–10 Aug (101) Sablefish 1 May– 31 Oct (184)	Salmon 1 May – 3 Jul (64) Sablefish 1 May– 31 Oct (184)
USA: Alaska (2C, 3A, 3B, 4A, 4B, 4CDE)	6 Mar– 7 Dec (276)	14 Mar- 15 Nov (246)	15 Mar- 14 Nov (244)	24 Mar– 7 Nov (228)	11 Mar– 7 Nov (241)	19 Mar–7 Nov (233)	14 Mar–7 Nov (238)	8 Mar–7 Nov (244)	23 Mar–7 Nov (230)	17 Mar–7 Nov (236)

Directed Commercial Landings

Directed commercial landings and fishery limits by IPHC Regulatory Area for the 2021 fishing season are shown in Table 2. Directed commercial fishery limit, as referred to here, is the IPHC commercial fishery limit set by the Contracting Parties following the IPHC Annual Meeting. The fishery limits with adjustments from the underage and overage programs from the previous year's quota share programs and, in IPHC Regulatory Area 2B, the Use of Fish allocation are not presented. Historical landings and fishery limits are available on the IPHC website (https://www.iphc.int/data).

The 2021 directed commercial fishery landings were spread over ten months of the year in Canada and the USA (Figure 3). On a month-to-month comparison, April took the lead as the busiest month for total poundage (17%) landed from IPHC Regulatory Area 2B. On a month-to-month comparison, May was the busiest month for total poundage (16%) from Alaska, USA. A year-to-date visualization is also available on the IPHC website: https://www.iphc.int/data/year-to-date-directed-commercial-landing-patterns-ak-and-bc



Regulatory Area 2B landings from DFO Fishery Operations System (FOS).
Regulatory Areas 2C, 3, and 4 landings from NOAA Fisheries Restricted Access Management (RAM) Program.
Regulatory Area 4A Mar-May and Nov-Dec combined for confidentiality reasons.
Regulatory Area 4BCDE Apr-May and Oct-Nov combined for confidentiality reasons.

Figure 3. 2021 directed commercial landings (tonnes, net weight, preliminary) of Pacific halibut for Alaska, USA and British Columbia, Canada by IQ fisheries,IPHC Regulatory Area and month.

Canada – IPHC Regulatory Area 2B (British Columbia)

Under the IVQ fishery in British Columbia, Canada, the number of active Pacific halibut licences (L licences), and First Nations communal commercial licences (FL licences) was 150 in 2021. In addition, Pacific halibut can be landed as incidental catch in other licensed groundfish fisheries. Therefore, Pacific halibut was landed from a total of 221 active licences in 2021, with 71 of these licences from other fisheries. The 2021 directed commercial landings represented 2,321 tonnes (5,118,017 pounds) of Pacific halibut (Table 2).

Directed commercial trips from IPHC Regulatory Area 2B were delivered into 11 different ports in 2021. The ports of Port Hardy (including Coal Harbour and Port McNeill) and Prince Rupert/Port Edward were the major landing locations, receiving 95% of the commercial landings. Port Hardy received 48% while Prince Rupert received 46% of the directed commercial landings. All of the IVQ landings were landed in IPHC Regulatory Area 2B. Only Canadian vessels landed frozen, head-off Pacific halibut in 2021: 47 landings (27 tonnes; 61,365 net lb) reported frozen-at-sea head-off product from 20 vessels.

According to logbook data, less than 0.03% by weight of Pacific halibut were caught with pot gear and landed within the directed commercial fishery in IPHC Regulatory Area 2B.

USA – IPHC Regulatory Area 2A (Washington, Oregon, California)

The 2021 IPHC Regulatory Area 2A fisheries and respective fishery limits are listed in Table 2. The total IPHC Regulatory Area 2A directed commercial landings of 374 tonnes (825,000 pounds) are 5% below the fishery limit. The total non-treaty directed commercial landings of 110 tonnes (242,997 pounds) were 5% under the fishery limit of 116 tonnes (256,122 pounds) after three 58-hour openers. The fishing period limits by vessel size class for each opening in 2021 are listed in Table 5.

The salmon troll fishery season began on 1 April with an allowable incidental landing ratio of one Pacific halibut per two Chinook (*Oncorhynchus tshawytscha*), plus an "extra" Pacific halibut per landing, and a vessel trip limit of 35 fish. On 1 July, the fishery was extended at the same ratio and landing limit. Total landings of 8 tonnes (18,562 pounds) were 59% under the fishery limit (21 tonnes (45,198 pounds)).

Incidental Pacific halibut retention during the limited-entry sablefish (*Anoplopoma fimbria*) fishery was open from 1 April to 7 December. Beginning 1 April, the allowable landing ratio was 0.11 tonnes (250 pounds) (net weight) of Pacific halibut to 0.45 tonnes (1,000 pounds) (net weight) of sablefish, and up to two additional Pacific halibut in excess of the ratio limit. Beginning 1 June, the allowable landing ratio was 0.10 tonnes (225 pounds) (net weight) of Pacific halibut to 0.45 tonnes (1,000 pounds) (net weight) of sablefish, and up to two additional Pacific halibut in excess of the ratio limit. The total landings of 31 tonnes (69,081 pounds) were 1% under the fishery limit (32 tonnes (70,000 pounds)).

In IPHC Regulatory Area 2A, north of Point Chehalis (46°53.30´ N. latitude), the treaty Indian tribes manage the directed commercial landings for three fisheries under a Memorandum of Understanding among the 13 tribes. These consist of an unrestricted fishery, a restricted fishery with trip limits, and a late season fishery. These fisheries are subject to in-season management. There was one unrestricted, open access fishery, not to exceed 55 hours from 6 March to 16 May and one restricted fishery not to exceed 102 hours and 5 total calendar days of fishing, including a vessel per day limit of 0.23 tonnes (500 pounds) from 6 March to 16 May. A final fishery not to exceed 24 hours was open from 19 May to 20 June. Estimated total landings of 224 tonnes (494,139 pounds) were at the fishery limit (225 tonnes (496,300 pounds)).

Table 5. The fishing periods and limits (tonnes, dressed, head-on with ice/slime) by vessel class used in the 2021 directed commercial fishery in IPHC Regulatory Area 2A.

Vessel Class		Fishing Period (dates) & Limits (t)		
Letter	**Feet**	**22-24 June**	**6-8 July**	**20-22 July**
A, B and C	1-35	1.03	1.03	1.03
D and E	36-45	1.55	1.55	1.55
F and G	46-55	2.06	2.06	2.06
H	56+	2.32	2.32	2.32

USA – IPHC Regulatory Areas 2C, 3, and 4 (Alaska)

In Alaska, USA, the National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) Restricted Access Management (RAM) Program allocated Pacific halibut quota share (QS) to recipients by IPHC Regulatory Area. Quota share transfers were permitted with restrictions on the amount of QS a person could hold and the amount that could be fished per vessel. In 2021, RAM reported that 2,279 persons/entities held QS.

The total 2021 landings from the IFQ/CDQ Pacific halibut fishery for the waters off Alaska, USA were 8,140 tonnes (17,945,000 pounds), 8% under the fishery limit (Table 2). By IPHC Regulatory Area, the landings were under the fishery limit by 7% for Area 2C, 3% for Area 3A, 6% for Area 3B, 14% for Area 4A, 36% for Area 4B (IFQ), 7% for 4CDE/Closed (IFQ), and 33% for Areas 4B and 4CDE CDQ combined. (Table 2).

Homer received approximately 17% (1,478 tonnes (3,258,000 pounds)) of the directed commercial landings of Alaskan catch making it the port that received the greatest number of pounds in 2021. Seward received the second and Kodiak the third largest landing volume at 10% (912 tonnes (2,008,000 pounds)) and 10% (852 tonnes (1,879,000 pounds)) of the Alaskan commercial landings, respectively. In Southeast Alaska, the two largest landing volumes were received in Juneau (619 tonnes (1,364,000 pounds)) and Sitka (577 tonnes (1,273,000 pounds)), and their combined landings represented 13% of the directed commercial Alaskan landings. The Alaskan QS catch that was landed outside of Alaska, USA was 2%.

In Alaska, 41 tonnes (90,000 pounds) of Pacific halibut were caught with pot gear and landed within the directed commercial fishery representing 0.5% of the total Alaska landings.

The Metlakatla Indian Community (within IPHC Regulatory Area 2C) was authorized by the United States government to conduct a commercial Pacific halibut fishery within the Annette Islands Reserve. There were 14 two-day openings between 12 March and 26 September for total landings of 12 tonnes (27,391 pounds). The fishery closed on 30 September.

Directed Commercial Discard Mortality

Incidental mortality of Pacific halibut in the directed commercial Pacific halibut fishery is the mortality of all Pacific halibut that do not become part of the landed catch. The three main sources of discard mortality estimate include: 1) fish that are captured and discarded because they are below the legal-size limit of 81.3 cm (32 inches), 2) fish that are estimated to die on lost or abandoned fishing gear, and 3) fish that are discarded for regulatory reasons (e.g. the vessels trip limit has been exceeded). The methods that are applied to produce each of these estimates differ due to the amount and quality of information available. Information on lost gear and regulatory discards is collected through logbook interviews and fishing logs received by mail. The ratio of U32 to O32 Pacific halibut (>81.3 cm or 32 inches in length) is determined from the IPHC Fishery-Independent Setline Survey in most areas and by direct observation in the IPHC Regulatory Area 2B fishery. Different mortality rates are applied to each category: released Pacific halibut have a 16% mortality rate and Pacific halibut mortality from lost gear is 100%.

Pacific halibut discard mortality estimates from the commercial Pacific halibut fishery are summarized by IPHC Regulatory Area in Table 2.

Recreational Fisheries

The 2021 recreational removals of Pacific halibut, including discard mortality, was estimated at 3,460 tonnes (7,628,604 pounds). Changes in harvests varied across areas; in some cases, in response to changes in size restrictions. Recreational fishery limits and landings are detailed by IPHC Regulatory Area in Table 2. Historical recreational removals are also available at the IPHC website: https://www.iphc.int/data/datatest/pacific-halibut-recreational-fisheries-data

Recreational Landings

Canada – IPHC Regulatory Area 2B (British Columbia)

IPHC Regulatory Area 2B operated under a 126 cm (49.6 inch) maximum size limit and one Pacific halibut had to be between 90 – 126 cm (35.4 - 49.6 inches) or both under 90 cm (35.4 inch) when attaining the two fish possession limit, with an annual limit of six per licence holder. On 1 April, the maximum size limit was increased to 133 cm (53.4 inch) and one Pacific halibut to be between 90 – 133 cm (35.4 – 53.4 inches) or both under 90 cm (35.4 inch) when attaining the two fish possession limit, with an annual limit of ten per licence holder. The IPHC Regulatory Area 2B recreational harvest was 12% under the recreational fishery limit at 366 tonnes (806,000 pounds).

USA – IPHC Regulatory Area 2A (Washington, Oregon, California)

The 2021 IPHC Regulatory Area 2A recreational allocation was 277 tonnes (610,180 pounds) net weight and based on the Pacific Fishery Management Council's Catch Sharing Plan formula, which divides the overall fishery limit among all sectors. The recreational allocation was further subdivided to seven subareas, after 32 tonnes (70,000 pounds) were allocated to the incidental Pacific halibut catch in the commercial sablefish fishery in Washington. This subdivision resulted in 127 tonnes (279,414 pounds) being allocated to Washington subareas and 132 tonnes (291,506 pounds) to Oregon subareas. In addition, California received an allocation of 18 tonnes (39,260 pounds). The IPHC Regulatory Area 2A recreational harvest totaled 184 tonnes (405,869 pounds), 33% under the recreational fishery limit. Recreational fishery harvest seasons by subareas varied and were managed in season with fisheries opening on 1 May.

IPHC Regulatory Areas 2C, 3, and 4 (USA: Alaska)

A reverse slot limit allowing for the retention of Pacific halibut, if ≤ 127.0 cm (50 inches) or ≥ 182.9 cm (72 inches) in total length, was in place for the charter fishery in IPHC Regulatory Area 2C. In IPHC Regulatory Area 3A, charter anglers were allowed to retain two fish per day, but only one could exceed 81.3 cm (32 inches) in length, with a recording requirement. A possession limit equaled to 2 daily bag limits with no annual limit. One trip per calendar day per charter permit was allowed, with no charter retention of Pacific halibut on Wednesdays.

The Contracting Party agencies in Alaska (USA) have a program that allow recreational harvesters to land fish that is leased from commercial fishery quota shareholders for the current season.

Recreational Discard Mortality

Pacific halibut discarded for any reason suffer some degree of discard mortality, and impacts more of the stock with the increasing use of size restrictions, such as reverse slot limits. Current year estimates from Contracting Parties' agencies of recreational discard mortality have been received from both Contracting Parties and are provided in Table 2.

SUBSISTENCE FISHERIES

Pacific halibut is taken throughout its range as subsistence harvest by several fisheries. Subsistence fisheries are non-commercial, customary, and traditional use of Pacific halibut for direct personal, family, or community consumption or sharing as food, or customary trade. The primary subsistence fisheries are 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 by rural residents and federally recognized native tribes in Alaska (USA) documented via Subsistence Halibut Registration Certificates (SHARC).

The coastwide subsistence estimate for 2021 was 440 tonnes (970,126 pounds) (Table 2). Historical subsistence removals are also available at the IPHC website: https://www.iphc.int/datatest/subsistence-fisheries

Estimated subsistence harvests by area

In the commercial Pacific halibut fisheries coastwide, the state and federal regulations require that take-home Pacific halibut caught during commercial fishing be recorded as part of the commercial fishery on the landing records (i.e., State fish tickets or Canadian validation records). This is consistent across areas, including the quota share fisheries in Canada and USA, and as part of fishing period limits and Pacific halibut ratios in the incidental fisheries in IPHC Regulatory Area 2A. Therefore, personal use fish or take-home fish within the commercial fisheries are accounted for as commercial catch and are not included here.

IPHC Regulatory Area 2A (USA: Washington, Oregon, California)

The Pacific Fishery Management Council's Catch Sharing Plan allocates the Pacific halibut fishery limit to commercial, recreational, and treaty Indian users in IPHC Regulatory Area 2A. The treaty tribal fishery limit is further sub-divided into commercial and ceremonial and subsistence (C&S) fisheries. It is estimated that 15 tonnes (32,200 pounds) were retained as C&S. A revised estimate of the 2021 removals will be provided at the end of the year and may be higher than previous years due to an increased usage for food security as a result of the COVID-19 pandemic.

IPHC Regulatory Area 2B (Canada: British Columbia)

The source of Pacific halibut subsistence harvest in British Columbia is the First Nations FSC fishery. The IPHC receives some logbook and landing data for this harvest from the DFO, but those data have not been adequate for the IPHC to make an independent estimate of the FSC fishery harvest. DFO estimated the First Nations FSC harvest to be 136 tonnes (300,000 pounds) annually until 2006, and since 2007, the yearly estimate has been provided as 184 tonnes (405,000 pounds).

IPHC Regulatory Areas 2C, 3, and 4 (USA: Alaska)

In 2003, the subsistence Pacific halibut fishery off Alaska was formally recognized by the North Pacific Fishery Management Council and implemented by IPHC and NOAA Fisheries regulations. The fishery allows the customary and traditional use of Pacific halibut by rural residents and members of federally recognized Alaska, USA native tribes who can retain Pacific halibut for non-commercial use, food, or customary trade. The NOAA Fisheries regulations define legal gear, number of hooks, and daily bag limits, and IPHC regulations set the fishing season. Prior to subsistence fishing, eligible persons registered with NOAA Fisheries Restricted Access Management to obtain a SHARC. The Division of Subsistence at ADF&G was contracted by NOAA Fisheries to estimate the subsistence harvest in Alaska, USA through a data collection program. A voluntary survey of fishers is conducted by mail or phone, with some onsite visits. Beginning in 2018, this survey is conducted on a biannual schedule, rather than annually. The 2020 estimate has been carried forward for 2021.

In addition to the SHARC harvest, IPHC regulations allow Pacific halibut less than 81.3 cm or 32 inches in fork length (also called U32) to be retained in the IPHC Regulatory Area 4D and 4E commercial Pacific halibut CDQ fishery, under an exemption requested by the North Pacific Fishery Management Council, as long as the fish are not sold or bartered. The exemption originally applied only to CDQ fisheries in IPHC Regulatory Area 4E in 1998, but was expanded in 2002 to also include IPHC Regulatory Area 4D. The CDQ organizations are required to report to the IPHC the amounts retained during their commercial fishing operations. This harvest is not included in the SHARC program estimate and is reported separately.

Reports for 2021 removals were received from three CDQ management organizations: Bristol Bay Economic Development Corporation (BBEDC), Norton Sound Economic Development Corporation (NSEDC), and Coastal Villages Regional Fund (CVRF), with CVRF reporting no removals.

CDQ - Bristol Bay Economic Development Corporation (BBEDC)

BBEDC requires their fishers to record the lengths of retained U32 Pacific halibut in a separate log, which are then tabulated by BBEDC at the conclusion of the season. The lengths were converted to weights using the IPHC length/weight relationship and summed to estimate the total retained U32 weight. Pacific halibut were landed by BBEDC vessels primarily in Togiak and Dillingham in a lesser amount. A small amount was landed equally in Naknek and King Salmon. BBEDC reported 13 harvesters landed 158 U32 Pacific halibut (<1 tonne; 1,641 pounds).

CDQ - Coastal Villages Regional Fund (CVRF)

CVRF reported that no Pacific halibut were landed by their fishers or received by their facilities.

CDQ - Norton Sound Economic Development Corporation (NSEDC)

NSEDC required their fishers to offload the U32 Pacific halibut for weighing. The fish were not washed nor were the heads removed. The U32 Pacific halibut were then returned to the harvester. NSEDC reported 54 U32 Pacific halibut weighing <1 tonne (466 pounds) were caught in the local CDQ fishery and landed at the Nome plant.

NON-DIRECTED COMMERCIAL DISCARD MORTALITY

The IPHC accounts for non-directed commercial discard mortality by IPHC Regulatory Area and sector. All removals for 2021 are available in Table 2. Historical data are also available on the IPHC website: https://www.iphc.int/data/datatest/non-directed-commercial-discard-mortality-fisheries

Estimating Non-Directed Commercial Discard Mortality

Non-directed commercial discard mortality of Pacific halibut is estimated because not all fisheries have 100% monitoring and not all Pacific halibut that are discarded are assumed to die. Agencies estimate the amount of non-directed commercial discard that will not survive, called non-directed commercial discard mortality.

The IPHC relies upon information supplied by observer programs run by Contracting Party agencies for non-directed commercial discard mortality estimates in most fisheries. Non-IPHC research survey information is used to generate estimates of non-directed commercial discard mortality in the few cases where fishery observations are unavailable. Trawl fisheries off British Columbia, Canada are monitored and non-directed commercial discard mortality information is provided to IPHC by DFO. NOAA Fisheries operates observer programs off the USA West Coast and Alaska, which monitor the major groundfish fisheries. Data collected by those programs are used to estimate non-directed commercial discard mortality. A breakout of these removals by IPHC Regulatory Area and year is available on the IPHC website: https://www.iphc.int/data/datatest/non-directed-commercial-discard-mortality-fisheries.

Non-directed Commercial Discard Mortality by Area

Canada – IPHC Regulatory Area 2B (British Columbia)

In Canada, Pacific halibut non-directed commercial discard mortality in trawl fisheries are capped at 454 tonnes round weight by DFO. Non-trawl non-directed commercial discard mortality is handled under an IFQ system within the directed Pacific halibut fishery cap.

USA – IPHC Regulatory Area 2A (Washington, Oregon, California)

Groundfish fisheries off Washington, Oregon, and California are managed by NOAA Fisheries, following advice and recommendations developed by the Pacific Fishery Management Council.

USA – IPHC Regulatory Areas 2C, 3, and 4 (Alaska)

Groundfish fisheries in Alaska are managed by NOAA Fisheries, following advice and recommendations developed by the North Pacific Fishery Management Council. Non-directed commercial discard mortality projected estimates for Alaskan areas are provided by NOAA Fisheries.

IPHC Regulatory Area 2C (Southeast Alaska)

For the federal waters of IPHC Regulatory Area 2C, only non-directed commercial discard mortality by hook-and-line vessels fishing in the outside waters were reported by NOAA Fisheries. These vessels are primarily targeting Pacific cod and rockfish (*Sebastes* spp.) in open access fisheries, and sablefish in the IFQ fishery.

Fisheries occurring within state waters and resulting in Pacific halibut non-directed commercial discard mortality include pot fisheries for red and golden king crab, and tanner crab. Information is provided periodically by ADF&G, and the estimate was again rolled forward.

IPHC Regulatory Area 3 (Eastern, Central and Western Gulf of Alaska)

IPHC Regulatory Area 3 is comprised of Areas 3A and 3B. IPHC tracks non-directed commercial discard mortality for each IPHC Regulatory Area due to assessment and stock management needs, while groundfish fisheries operate throughout both areas. Trawl fisheries are responsible for the majority of the non-directed commercial discard mortality in these IPHC Regulatory Areas, with hook-and-line fisheries a distant second. State-managed crab and scallop fisheries are also known to take Pacific halibut as non-directed commercial discard mortality, but at low levels.

IPHC Regulatory Area 3 remains the area where non-directed commercial discard mortality is estimated most poorly. Observer coverage for most fisheries is relatively low. Tendering, loopholes in trip cancelling, and safety considerations likely result in observed trips not being representative of all trips (observed and unobserved) in many regards (e.g., duration, species composition, etc.). This, plus low coverage, lead to increased uncertainty in these non-directed commercial discard mortality estimates and to potential for bias.

IPHC Regulatory Area 4 (Bering Sea and Aleutian Islands)

The Pacific cod fishery, which is conducted in the late winter/early spring and late summer, is the major contributor to Pacific halibut non-directed commercial discard mortality in IPHC Regulatory Area 4. Almost all of the vessels are required to have 100% observer coverage because of the vessel's size and requirements of their fishery cooperative; very few small vessels fish Pacific cod in this IPHC Regulatory Area. Because of this high level of observer coverage, non-directed commercial discard mortality estimates for this and other IPHC Regulatory Area 4 fisheries are considered reliable.

Pots are used to fish for Pacific cod and sablefish and are very selective. Non-directed commercial discard mortality rates are quite low, and survival is relatively high. Annual non-directed commercial discard mortality estimates are typically low, usually less than 7 tonnes.

Within the Bering Sea, non-directed commercial discard mortality estimates have typically been the highest in IPHC Regulatory Area 4CDE (Table 2) due to the groundfish fisheries which operate in the area, i.e., those for flatfish.

IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS) AND OTHER RESEARCH

Approximately 373 tonnes (822,916 pounds) of Pacific halibut were landed from the FISS and other research in 2021 with the amount landed from each IPHC Regulatory Area documented in Table 2.

RECOMMENDATION

That the Commission **NOTE** paper IPHC-2022-AM098-06 Rev_1 which provides an overview of the key fisheries data regarding Pacific halibut removals from fisheries catching Pacific halibut during 2021, including the status of landings compared to fishery limits implemented by the Contracting Parties of the Commission.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021

PREPARED BY: IPHC SECRETARIAT (K. UALESI , D. WILSON, C. JONES, R. RILLERA & T. JACK; 10 DECEMBER 2021)

PURPOSE

To provide Commissioners with a summary of the IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021.

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 (Fig. 1), within the prescribed depth range of 18 to 732 metres (10 to 400 fathoms).

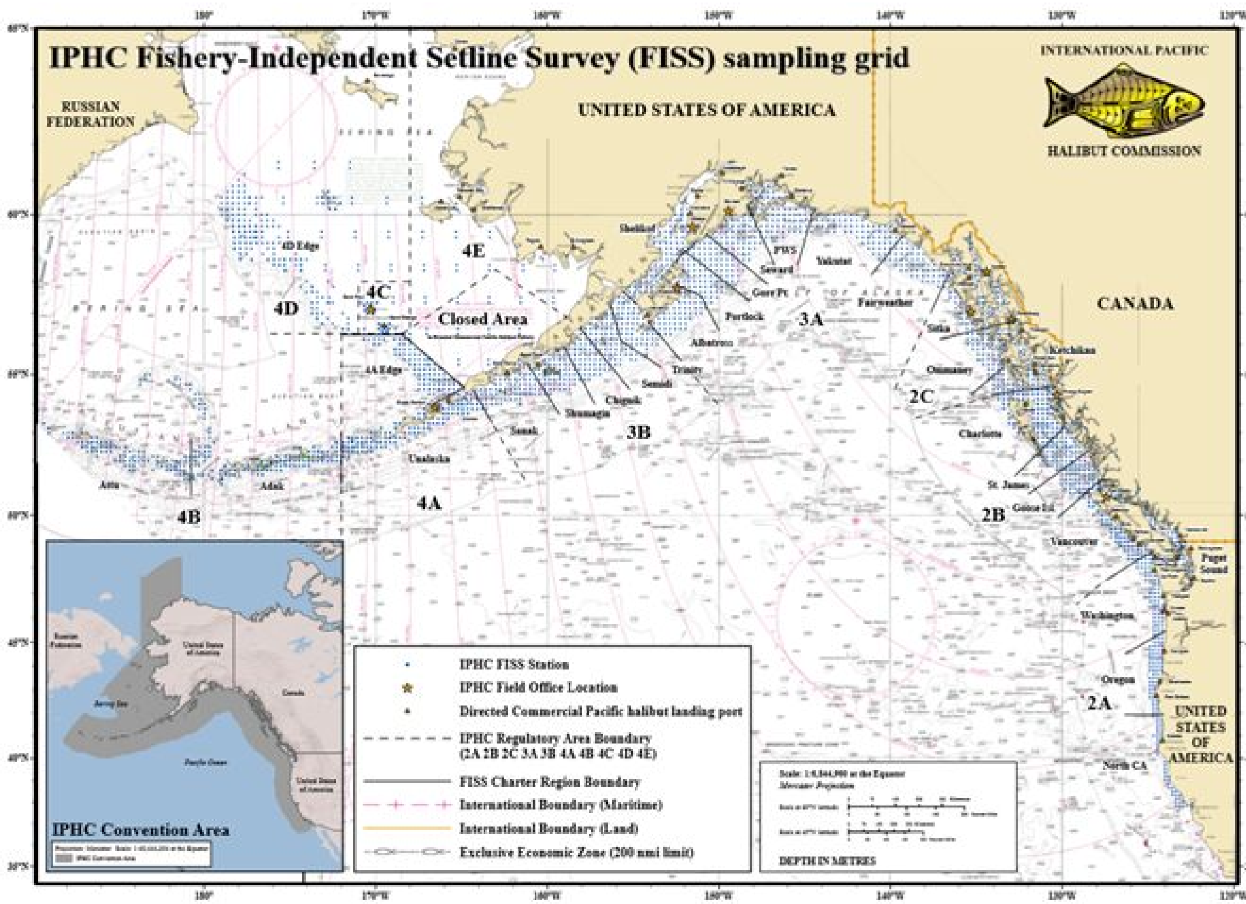


Figure 1. IPHC Fishery-Independent Setline Survey (FISS) with full sampling grid shown.

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.

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.

2021 FISS design

At the 9th Special Session of the Commission (SS09), the Commission recommended a FISS design for 2021 that included 1,346 stations coastwide (Fig. 2). The design comprised sampling of subareas within IPHC Regulatory Areas 2A, 4A, and 4B intended to reduce potential bias (relative to historical observed changes year-to-year) and to achieve a level of precision comparable to or better than recent setline surveys. 2021 sampling in IPHC Regulatory Areas 2B (except inside waters), and 3B included random subsampling from the full design to provide for unbiased estimates, while increasing precision relative to recent setline surveys. Sampling in IPHC Regulatory Area 4CDE included 100% of the full FISS design.

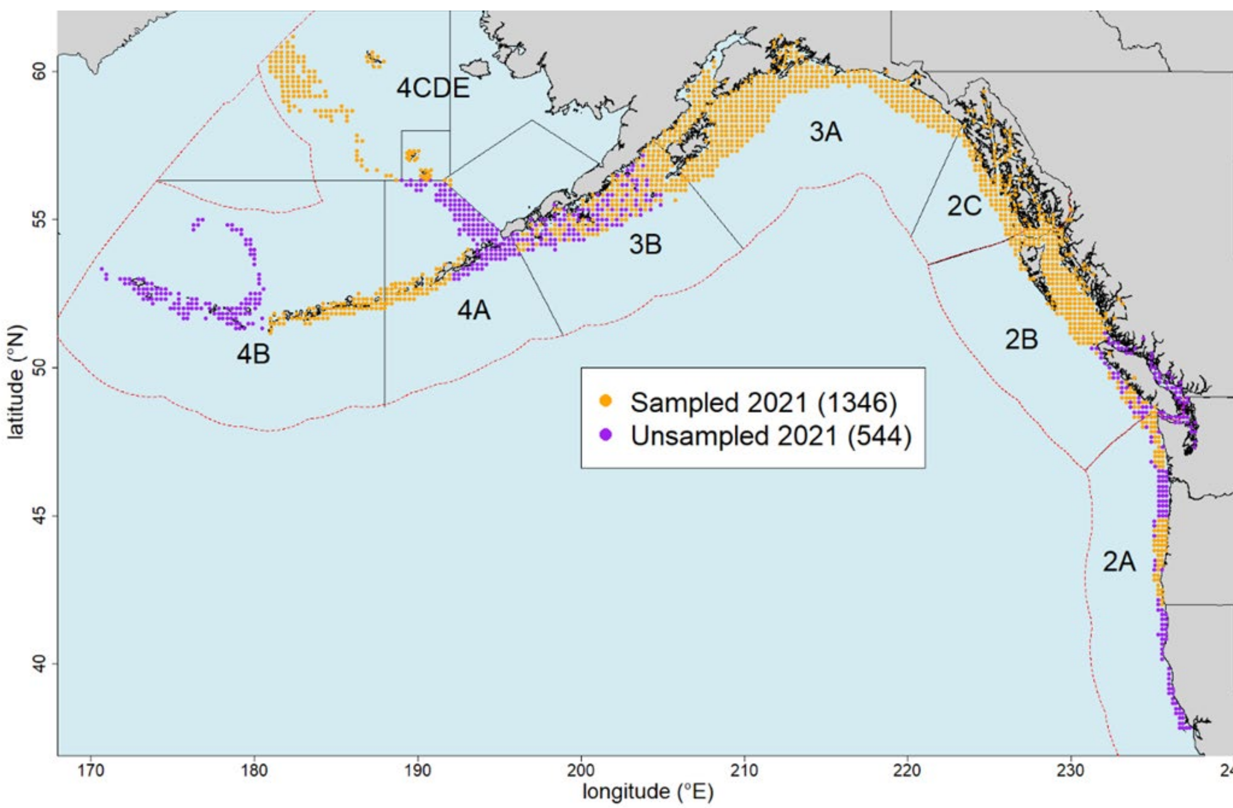


Figure 2. Map of the 2021 FISS design endorsed by the Commission on 8 December 2020 (IPHC-2020-SS09-R). Purple circles were not sampled in 2021.

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 2021 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 10-15 vessels are chosen. In 2021, the process has been clearly documented on the IPHC website for accountability and transparency purposes: https://www.iphc.int/management/science-and-research/fishery-independent-setline-survey-fiss/62-fiss-vessel-recruiting.

In 2021, 13 vessels were chartered to complete the FISS, as detailed in Media Release 2021-019: Notification of IPHC Fishery-Independent Setline Survey (FISS) 2021 Contract Awards.

Sampling protocols - 2021

IPHC Setline Survey Specialists (Field) collected data according to protocols established in the 2021 FISS Sampling Manual (IPHC-2021-VSM01).

Sampling challenges - 2021

Of the 1,346 FISS stations planned for the 2021 FISS season, 1,167 (87%) were effectively sampled.

Not sampled: A total of 128 planned stations were not sampled in 2021. 75 of the 140 stations planned for Area 4CDE were not completed in 2021 due to mechanical issues and crew challenges aboard the vessel completing this area. In Adak, 36 of the 73 planned stations were not completed due to significant technological issues aboard the vessel. In Unalaska, the vessel faced several instances of lost gear and other logistical challenges at the end of the season, leaving 11 stations not sampled. In Yakutat, the presence of sea ice restricted the vessel's access and resulted in three (3) stations not being sampled and stations located in the Marine Protected Areas of IPHC charter regions St James and Charlotte prevented three (3) stations from being sampled.

Ineffective stations: Coastwide, fifty-nine (59) stations were deemed ineffective due to whale depredation (n=43), pinniped predation (n=1), gear soak time (n=3), shark predation (n=3), sand flea activity (n=2), station moved > 3nmi (n=1), and setting and gear issues (n=6).

Fixed versus Snap Gear comparison

A third comparison of the use of snap gear to the use of fixed gear on the FISS was conducted in IPHC Regulatory Area 3A (Seward charter region) in 2021 (Fig. 3). The design again featured each station being fished twice, once with fixed gear and once with snap gear. The comparison will provide data on any differences between catch (e.g. Pacific halibut catch rates, age and size distribution, bycatch species) on the two gears, and move the FISS closer to accommodating both data sources into its annual design in the near future.

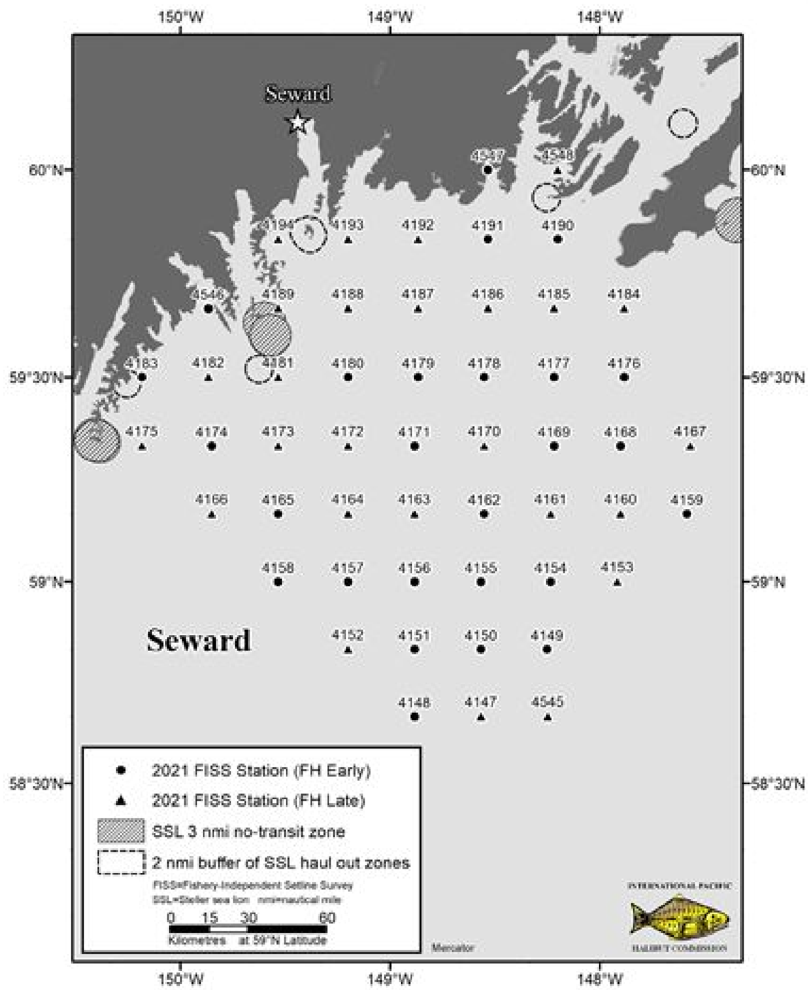


Figure 3. IPHC Fishery-Independent Setline Survey fixed-hook/snap gear comparison stations in the Seward region of IPHC Regulatory Area 3A. Early Fixed Hook stations equate to late Snap Gear stations and late Fixed Hook stations to early Snap Gear stations.

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 October 2020 (IPHC Media Release 2020-031), the Secretariat made pre-season bait purchases of approximately 90 tonnes (200,000 lbs) to ensure a smooth start to the 2021 FISS, and to take advantage of advance purchase prices.

In-season: In March 2021 the Secretariat made an in-season bait RFT (IPHC Media Release 2021-013) for approximately 77 tonnes (170,000 lbs) of bait, to supplement pre-season purchases and complete the 2021 FISS successfully.

Results

Interactive views of the FISS results are provided via the IPHC website and can be found here:

https://www.iphc.int/data/setline-survey-catch-per-unit-effort
(published 29 October 2021)

As in previous years, legal-sized (O32) Pacific halibut that were caught on FISS stations and sacrificed in order to obtain biological data were retained and sold. In addition, beginning in 2020, sub-legal (U32) Pacific halibut that were caught and randomly selected for otolith sampling were also retained and sold. This helps to offset costs of the FISS. FISS vessels also retained for sale incidentally captured rockfish (*Sebastes spp.*) and Pacific cod (*Gadus macrocephalus*). These species were retained because they 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 2021 FISS chartered 13 commercial longline vessels (four Canadian and nine USA) during a combined 82 trips and 801 charter days (Tables 1). Otoliths were removed from 13,258 fish coastwide. Approximately 373 tonnes (823,000 pounds) of Pacific halibut, 33 tonnes (73,600 pounds) of Pacific cod, and 40 tonnes (87,250 pounds) of rockfish were landed from the FISS stations.

Table 1a. Effort and landing summary by FISS charter region and vessel for all 2021 stations and all Pacific halibut (sampled U32 and all O32).

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number[1]	Charter Days[2]	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	25	43	42	2	5,161	$11.94	$5.41
2A	Washington	*Pacific Surveyor*	947061	20	37	34	3	7,142	$11.06	$5.02
2B	Charlotte	*Vanisle*	21912	51	89	86	30	65,460	$18.01	$8.17
2B	Goose Island	*Vanisle*	21912	42	57	56	17	36,725	$17.87	$8.11
2B	St. James	*Pender Isle*	27282	34	60	59	17	37,493	$17.68	$8.02
2B	Vancouver	*Pender isle*	27282	14	29	29	2	3,792	$16.45	$7.46
2C	Ketchikan	*Bold Pursuit*	99997	26	43	43	16	34,885	$15.35	$6.96
2C	Ommaney	*Star Wars II*	99997	31	52	49	24	52,600	$14.41	$6.54
2C	Sitka	*Bold Pursuit*	27282	31	52	49	24	53,962	$14.66	$6.65
3A	Albatross	*Predator*	33133	26	49	46	22	47,980	$13.54	$6.14
3A	Fairweather	*Bold Pursuit*	99997	24	51	40	12	26,632	$14.35	$6.51
3A	Gore Point	*Kema Sue*	41033	26	48	47	13	28,642	$15.04	$6.82
3A	Portlock	*Kema Sue*	41033	33	51	49	19	42,168	$15.72	$7.13
3A	PWS	*Star Wars II*	99997	44	67	65	22	47,709	$16.09	$7.39
3A	Seward	*Kema Sue*	41033	27	52	52	17	38,398	$16.30	$7.39
3A	Seward (Snap)	*Star Wars II*	99997	37	52	49	15	33,907	$16.15	$7.32
3A	Shelikof	*Devotion*	42892	38	64	62	25	54,414	$15.00	$6.80
3A	Yakutat	*Seymour*	17530	35	64	57	23	51,141	$15.85	$7.19
3B	Chignik	*Polaris*	19266	18	31	30	7	16,250	$13.79	$6.25

3B	Sanak	*Allstar*	55922	14	25	24	4	8,052	$11.46	$5.20
3B	Semidi	*Polaris*	19266	18	32	31	5	10,522	$13.84	$6.28
3B	Shumagin	*Allstar*	55922	23	30	30	7	14,502	$12.30	$5.58
3B	Trinity	*Allstar*	55922	32	56	52	20	43,819	$13.63	$6.18
4A	Unalaska	*Devotion*	42892	31	59	33	14	30,257	$11.73	$5.32
4B	Adak	*Norcoaster*	38137	53	73	37	11	24,121	$12.14	$5.51
4C	4CDE	*Grant*	19262	12	57	20	2	5,487	$11.84	$5.37
4D	4CDE	*Norcoaster*	38137	30	80	42	1	1,583	$11.60	$5.26
Closed Area	4CDE	*Grant*	19262	6	3	3	0	112	$11.84	$5.37
Total		**13 Vessels**		**801**	**1,406**	**1,216**	**373**	**822,916**	**$15.13**	**$6.86**

[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 2021 stations and O32 Pacific halibut.

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number [1]	Charter Days[2]	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	25	43	42	2	4,131	$12.57	$5.70
2A	Washington	*Pacific Surveyor*	947061	20	37	34	2	5,272	$12.64	$5.73
2B	Charlotte	*Vanisle*	21912	51	89	86	29	63,954	$18.06	$8.19
2B	Goose Island	*Vanisle*	21912	42	57	56	16	35,251	$17.97	$8.15
2B	St. James	*Pender Isle*	27282	34	60	59	17	36,970	$17.72	$8.04
2B	Vancouver	*Pender isle*	27282	14	29	29	2	3,615	$16.51	$7.49
2C	Ketchikan	*Bold Pursuit*	99997	26	43	43	16	34,268	$15.36	$6.97
2C	Ommaney	*Star Wars II*	99997	31	52	49	23	51,170	$14.43	$6.55
2C	Sitka	*Bold Pursuit*	27282	31	52	49	24	52,334	$14.70	$6.67
3A	Albatross	*Predator*	33133	26	49	46	21	46,454	$13.55	$6.15
3A	Fairweather	*Bold Pursuit*	99997	24	51	40	12	26,228	$14.37	$6.52
3A	Gore Point	*Kema Sue*	41033	26	48	47	13	28,067	$15.05	$6.83
3A	Portlock	*Kema Sue*	41033	33	51	49	19	41,840	$15.74	$7.14
3A	PWS	*Star Wars II*	99997	44	67	65	21	47,373	$16.11	$7.31
3A	Seward	*Kema Sue*	41033	27	52	52	17	38,039	$16.30	$7.39
3A	Seward (Snap)	*Star Wars II*	99997	37	52	49	15	33,727	$16.15	$7.33
3A	Shelikof	*Devotion*	42892	38	64	62	24	53,331	$15.02	$6.81
3A	Yakutat	*Seymour*	17530	35	64	57	23	50,314	$15.87	$7.20
3B	Chignik	*Polaris*	19266	18	31	30	7	14,365	$13.81	$6.27
3B	Sanak	*Allstar*	55922	14	25	24	3	7,109	$11.54	$5.23
3B	Semidi	*Polaris*	19266	18	32	31	4	9,355	$13.88	$6.29
3B	Shumagin	*Allstar*	55922	23	30	30	6	12,910	$12.37	$5.61
3B	Trinity	*Allstar*	55922	32	56	52	19	42,028	$13.63	$6.18
4A	Unalaska	*Devotion*	42892	31	59	33	12	25,446	$11.94	$5.42

4B	Adak	*Norcoaster*	38137	53	73	37	10	22,177	$12.15	$5.51
4C	4CDE	*Grant*	19262	12	57	20	2	4,966	$12.05	$5.46
4D	4CDE	*Norcoaster*	38137	30	80	42	1	1,362	$12.05	$5.46
Closed Area	4CDE	*Grant*	19262	6	3	3	0	101	$12.05	$5.46
Total		**13 Vessels**		**801**	**1,406**	**1,216**	**359**	**792,157**	**$10.51**	**$6.91**

[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 2021 stations and sampled U32 Pacific halibut.

IPHC Regulatory Area	Charter Region	Vessel	Vessel Number[1]	Charter Days[2]	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	25	43	42	0	1,030	$9.41	$4.27
2A	Washington	*Pacific Surveyor*	947061	20	37	34	1	1,870	$6.61	$3.00
2B	Charlotte	*Vanisle*	21912	51	89	86	1	1,506	$15.72	$7.13
2B	Goose Island	*Vanisle*	21912	42	57	56	1	1,474	$15.45	$7.01
2B	St. James	*Pender Isle*	27282	34	60	59	0	523	$14.62	$6.63
2B	Vancouver	*Pender isle*	27282	14	29	29	0	177	$15.13	$6.86
2C	Ketchikan	*Bold Pursuit*	99997	26	43	43	0	617	$14.47	$6.56
2C	Ommaney	*Star Wars II*	99997	31	52	49	1	1,430	$13.78	$6.25
2C	Sitka	*Bold Pursuit*	27282	31	52	49	1	1,628	$13.42	$6.09
3A	Albatross	*Predator*	33133	26	49	46	1	1,526	$13.23	$6.00
3A	Fairweather	*Bold Pursuit*	99997	24	51	40	0	404	$12.94	$5.87
3A	Gore Point	*Kema Sue*	41033	26	48	47	0	575	$14.12	$6.40
3A	Portlock	*Kema Sue*	41033	33	51	49	0	328	$12.27	$5.56
3A	PWS	*Star Wars II*	99997	44	67	65	0	336	$16.09	$7.30
3A	Seward	*Kema Sue*	41033	27	52	52	0	359	$16.20	$7.35
3A	Seward (Snap)	*Star Wars II*	99997	37	52	49	0	180	$15.86	$7.20
3A	Shelikof	*Devotion*	42892	38	64	62	0	1,083	$14.05	$6.37
3A	Yakutat	*Seymour*	17530	35	64	57	0	827	$14.37	$6.52
3B	Chignik	*Polaris*	19266	18	31	30	1	1,885	$13.57	$6.16
3B	Sanak	*Allstar*	55922	14	25	24	0	944	$10.86	$4.92
3B	Semidi	*Polaris*	19266	18	32	31	1	1,167	$13.58	$6.16
3B	Shumagin	*Allstar*	55922	23	30	30	1	1,591	$11.76	$5.34
3B	Trinity	*Allstar*	55922	32	56	52	1	1,791	$13.73	$6.23
4A	Unalaska	*Devotion*	42892	31	59	33	2	4,811	$10.58	$4.80
4B	Adak	*Norcoaster*	38137	53	73	37	1	1,944	$11.97	$5.43
4C	4CDE	*Grant*	19262	12	57	20	0	521	$9.92	$4.50
4D	4CDE	*Norcoaster*	38137	30	80	42	0	221	$8.82	$4.00
Closed Area	4CDE	*Grant*	19262	6	3	3	0	11	$9.92	$4.50

Total	**13 Vessels**	**801**	**1406**	**1216**	**14**	**30,759**	**$9.16**	**$5.66**

[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 19 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. Individual sales were evaluated after each event to ensure that the buyer was meeting IPHC standards. Average prices increased from $10.49/kg in 2020 to $15.13/kg in 2021 (Tables 3). This represents a 44.2% increase in price.

Table 2a. FISS Pacific halibut landings by port for all Pacific halibut (sampled U32 and all O32), 2021[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Akutan	7	21	47,284	$258,146.09	$12.04	$5.46
Alitak	1	5	10,086	$52,382.27	$11.45	$5.19
Coos Bay	1	0	636	$3,808.75	$13.20	$5.99
Cordova	2	9	20,852	$150,976.65	$15.96	$7.24
Dutch Harbor	2	6	14,276	$73,972.26	$11.42	$5.18
Homer	4	22	49,592	$359,935.42	$16.00	$7.26
Juneau	3	17	37,244	$245,130.63	$14.51	$6.58
Ketchikan	4	19	42,205	$288,623.96	$15.08	$6.84
King Cove	2	4	8,965	$46,511.29	$11.44	$5.19
Kodiak	12	65	142,288	$895,636.20	$13.88	$6.29
Newport	2	2	4,525	$24,135.50	$11.76	$5.33
Petersburg	3	21	45,280	$298,141.46	$14.52	$6.58
Port Hardy	8	31	67,980	$539,792.38	$17.51	$7.94
Prince Rupert	7	34	75,490	$621,518.45	$18.15	$8.23
Sand Point	1	5	10,692	$57,773.76	$11.91	$5.40
Seward	16	76	167,098	$1,213,823.80	$16.01	$7.26
Sitka	2	16	34,732	$233,800.83	$14.84	$6.73
Westport	2	3	7,142	$35,830.80	$11.06	$5.02
Yakutat	3	17	36,549	$246,807.35	$14.89	$6.75
Grand Total	**82**	**373**	**822,916**	**$5,646,747.85**	**$15.13**	**$6.86**

[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, 2021[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Akutan	7	19	42,016	$232,426.29	$12.20	$5.53
Alitak	1	5	10,086	$52,382.27	$11.45	$5.19
Coos Bay	1	0	503	$3,143.75	$13.78	$6.25
Cordova	2	9	20,694	$150,151.65	$16.00	$7.26
Dutch Harbor	2	5	12,036	$62,772.26	$11.50	$5.22
Homer	4	22	49,063	$356,464.67	$16.02	$7.27
Juneau	3	16	36,080	$238,042.48	$14.55	$6.60
Ketchikan	4	19	40,904	$280,300.34	$15.11	$6.85
King Cove	2	4	7,889	$41,269.29	$11.53	$5.23
Kodiak	12	61	134,830	$849,719.36	$13.89	$6.30
Newport	2	2	3,628	$20,402.50	$12.40	$5.62
Petersburg	3	20	44,534	$293,478.96	$14.53	$6.59
Port Hardy	8	30	65,500	$522,701.69	$17.59	$7.98
Prince Rupert	7	34	74,290	$612,859.97	$18.19	$8.25
Sand Point	1	4	9,693	$52,778.76	$12.00	$5.45
Seward	16	75	165,430	$1,202,817.01	$16.03	$7.27
Sitka	2	15	34,013	$229,371.28	$14.87	$6.74
Westport	2	2	5,272	$30,220.80	$12.64	$5.73
Yakutat	3	16	35,696	$241,435.95	$14.91	$6.76
Grand Total	**82**	**359**	**792,157**	**$5,472,739.28**	**$15.23**	**$6.91**

[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, 2021[1,2].

Offload Port	Trips	Tonnes	Pounds	Total USD	Average Price (USD/kg)	Average Price (USD/lb)
Akutan	7	2	5,268	$25,719.80	$10.76	$4.88
Alitak	1	0	0	$0.00	$0.00	$0.00
Coos Bay	1	0	133	$665.00	$11.02	$5.00
Cordova	2	0	158	$825.00	$11.51	$5.22
Dutch Harbor	2	1	2,240	$11,200.00	$11.02	$5.00
Homer	4	0	529	$3,470.75	$14.46	$6.56
Juneau	3	1	1,164	$7,088.15	$13.43	$6.09
Ketchikan	4	1	1,301	$8,323.62	$14.10	$6.40
King Cove	2	0	1,076	$5,242.00	$10.74	$4.87
Kodiak	12	3	7,458	$45,916.84	$13.57	$6.16
Newport	2	0	897	$3,733.00	$9.17	$4.16
Petersburg	3	0	746	$4,662.50	$13.78	$6.25
Port Hardy	8	1	2,480	$17,090.69	$15.19	$6.89
Prince Rupert	7	1	1,200	$8,658.48	$15.91	$7.22
Sand Point	1	0	999	$4,995.00	$11.02	$5.00
Seward	16	1	1,668	$11,006.79	$14.55	$6.60
Sitka	2	0	719	$4,429.55	$13.58	$6.16
Westport	2	1	1,870	$5,610.00	$6.61	$3.00
Yakutat	3	0	853	$5,371.40	$13.88	$6.30
Grand Total	**82**	**14**	**30,759**	**$174,008.57**	**$12.47**	**$5.66**

[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 2021[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	4C	4D	Closed Area	Combined
Tonnes	6	65	64	168	42	14	11	2	1	0	373
Pounds	12,303	143,470	141,447	370,991	93,145	30,257	24,121	5,487	1,583	112	822,916
Price USD/kg	$11.43	$17.85	$14.74	$15.35	$13.29	$11.73	$12.14	$11.84	$11.60	$11.84	$15.13
Price USD/lb	$5.18	$8.09	$6.69	$6.96	$6.03	$5.32	$5.51	$5.37	$5.26	$5.37	$6.86

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

Table 3b. FISS landings (total pounds and price) of O32 Pacific halibut by IPHC Regulatory Area in 2021[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	4C	4D	Closed Area	Combined
Tonnes	4	63	62	166	39	12	10	2	1	0	359
Pounds	9403	139,790	137,772	365,373	85,767	25,446	22,177	4,966	1,362	101	792,157
Price USD/kg	$12.61	$17.91	$14.77	$15.37	$13.32	$11.94	$12.15	$12.05	$12.05	$12.05	$15.23
Price USD/lb	$5.72	$8.12	$6.70	$6.97	$6.04	$5.42	$5.51	$5.46	$5.46	$5.46	$6.91

[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 2021[1].

IPHC Regulatory Area	2A	2B	2C	3A	3B	4A	4B	4C	4D	Closed Area	Combined
Tonnes	1	2	2	3	3	2	1	0	0	0	14
Pounds	2900	3,680	3,675	5,618	7,378	4,811	1,944	521	221	11	30,759
Price USD/kg	$7.61	$15.43	$13.73	$13.87	$12.87	$10.58	$11.97	$9.92	$8.82	$9.92	$12.47
Price USD/lb	$3.45	$7.00	$6.23	$6.29	$5.84	$4.80	$5.43	$4.50	$4.00	$4.50	$5.66

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

FISS timing

Each year, the months of June, July, and August are targeted for FISS fishing. In 2021, this activity took place from 29 May through 14 September. On a coastwide basis, FISS vessel activity was highest in intensity at the beginning of the FISS season and declined early in August as boats finished their charter regions (Figure 8). All FISS activity was completed by mid-September.

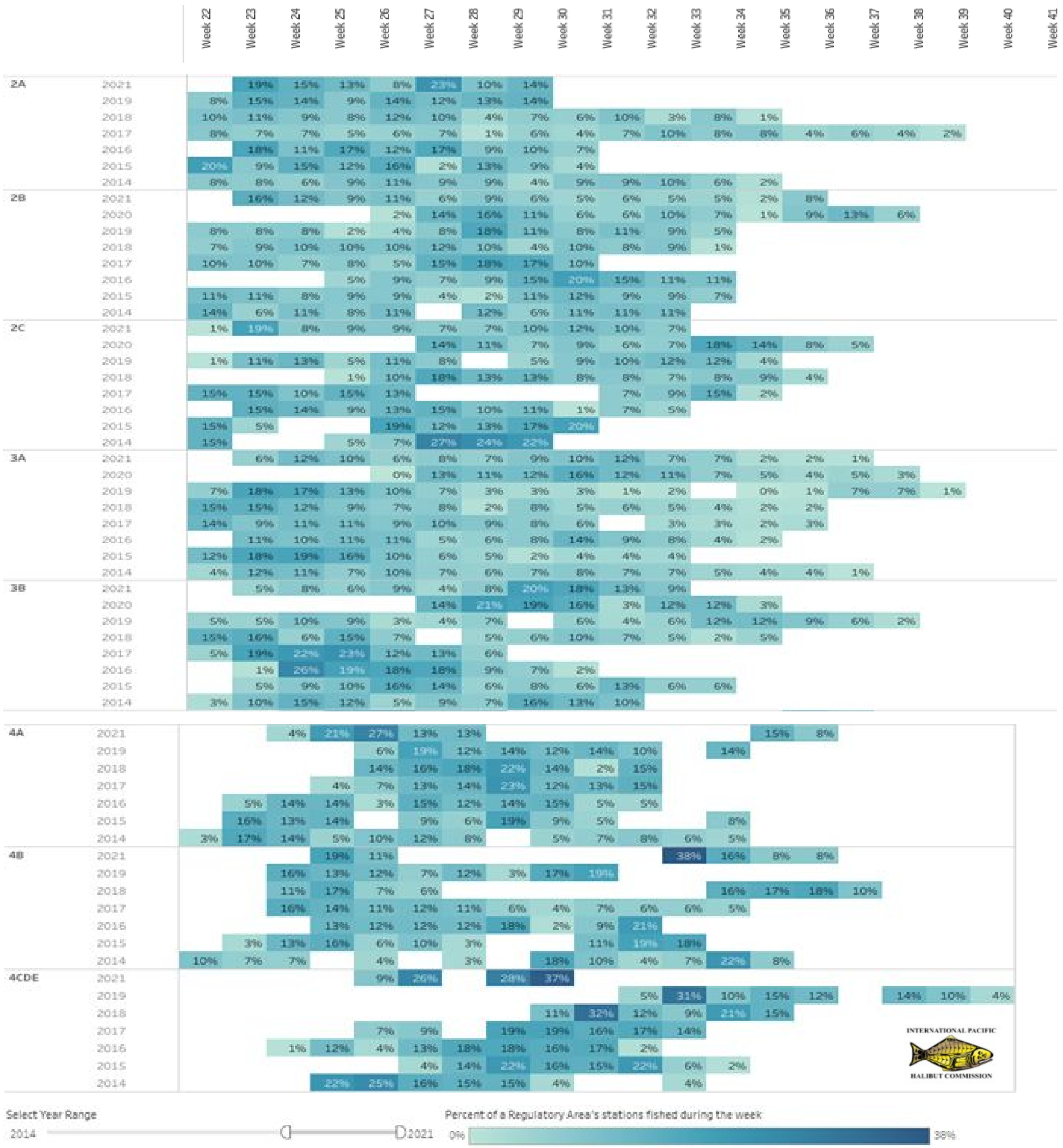


Figure 8. Percent of the total FISS stations completed by IPHC Regulatory Area during each week of the year (2014-2021). Week 22 begins in late May or early June depending on the year.

Recommendation/s

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-07 which provides the Commission a summary of the IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2021.

Appendices

Nil.

Space-time modelling of survey data

PREPARED BY: IPHC SECRETARIAT (R. A. WEBSTER; 10 DECEMBER 2021)

PURPOSE

To provide results of the space time modelling of Pacific halibut survey data for the period 1993-2021.

INTRODUCTION

As described in Webster (2021a), since 2016 space-time modelling has been used by the IPHC to produce estimates of mean O32 WPUE (weight per unit effort), all sizes WPUE and all sizes NPUE (numbers per unit effort) indices of Pacific halibut density and abundance. The modelling depends primarily on data from the IPHC's fishery-independent setline survey (FISS, Ualesi et al, 2021), but in the Bering Sea also integrates data from the National Marine Fisheries Service annual trawl survey and the Alaska Department of Fish and Game's annual Norton Sound trawl survey. Both surveys are fishery-independent data sources.

Since 2019, weighing of Pacific halibut onboard FISS charter vessels has meant that the vast majority of the weight data used to compute WPUE has come from observed weights of fish rather than estimates from a length-net weight relationship. For fish without directly measured weights, weights are predicted from a year- and IPHC Regulatory Area-specific length-net weight relationship estimated from the FISS length and weight data. For U32 fish with round weight recorded, net weights are estimated from a round-net weight relationship estimated from coastwide sample data from the 2019 FISS (Webster 2021b).

In 2021, a comparison of snap gear to fixed gear on the FISS was conducted in the Seward charter region (IPHC Regulatory Area 3A) to expand on data collected in 2019 and 2020 in IPHC Regulatory Areas 2B and 2C. The design featured each station being fished twice, once with fixed gear and once with snap gear, with randomisation of the order of the two gear types for each station. It was hoped that results of this comparison would contribute to our overall understanding of gear differences and whether such differences were consistent across geographic regions or not.

Results of space-time modelling in 2021

Figures 1 and 2 show time series estimates of O32 WPUE (most comparable to fishery catch-rates) and all sizes NPUE over the 1993-2021 period included in the 2021 space-time modelling. Overall, there was an estimated increase of 4% in the coastwide O32 WPUE index from 2020, due largely to a 11% increase in Region 3 (Figure 1). The estimated increase in coastwide all sizes NPUE was greater, with a 17% estimated increase (Figure 2), driven by increases in both Regions 2 and 3. Estimated 1993-21 time series by IPHC Regulatory Area are in Appendix A.

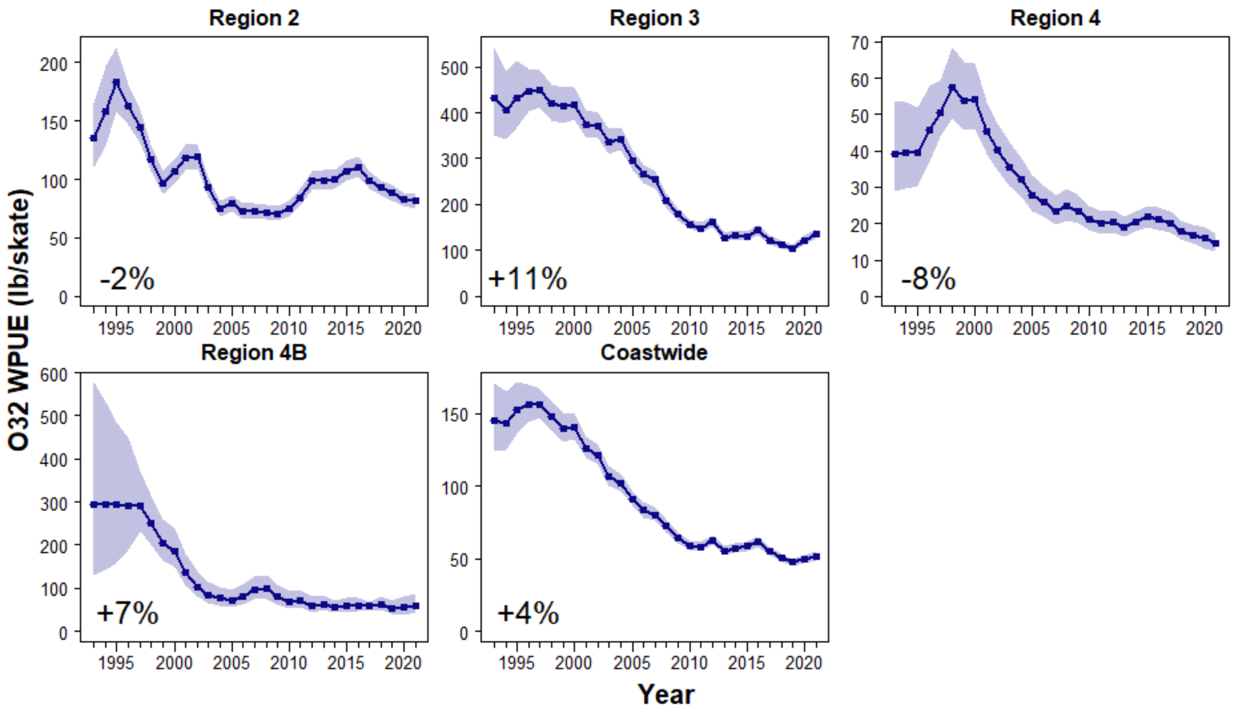


Figure 1. Space-time model output for O32 WPUE for 1993-2021 for Biological Regions. Filled circles denote the posterior means of O32 WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean O32 WPUE from 2020 to 2021.

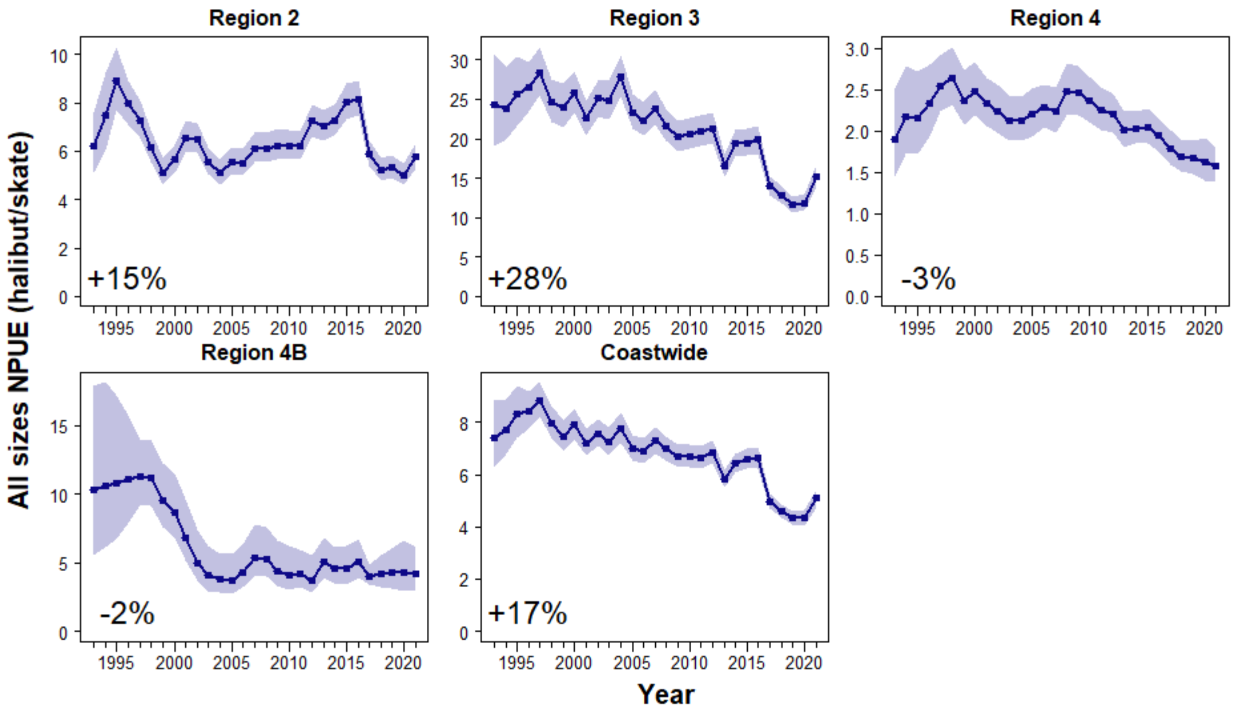


Figure 2. Space-time model output for all sizes NPUE for 1993-2021 for Biological Regions. Filled circles denote the posterior means of all sizes NPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean all sizes NPUE from 2020 to 2021.

In Regulatory Area 3A, data from both fixed and snap gears were used in the modelling. Parameters allowing for different catch rates of the two gears were included in the models, and estimates of WPUE and NPUE series were based on model predictions assuming fixed gear to ensure consistency with other Regulatory Areas. The design and analysis is consistent with the treatment of the data from both gears fished in IPHC Regulatory Areas 2C and 2B in 2019 and 2020 respectively. Parameter estimates of gear type differences all implied that snap gear catch rates were greater on average (Table 1), with estimated catch rate ratios of 1.18 to 1.43 for the three indices modelled in 2021 (i.e., we estimate snap gear had 125% to 143% of the catch rates of fixed gear, depending on the index). These results are at odds with those of the much larger gear comparison study in all of IPHC Regulatory Area 2C, which estimated a ratio of 0.86 for all three indices, and from the IPHC Regulatory Area 2B study in the St James charter region, which estimated ratios of 0.72-0.83. The 2021 study had two design limitations that make it impossible to draw conclusions regarding the cause of the differences: two vessels were used, each fishing a different gear; and there was almost no overlap in the time periods over which each gear was fished. In other words, gear differences were confounded with vessel effects and possible changes in underlying Pacific halibut density during the study period. These ambiguous and inconsistent results imply the need for a larger and more carefully designed comparison in this geographic region, one that controls as much as possible for factors such as vessel and temporal effects on catch rates of Pacific halibut, as was the case in the 2019 gear comparison study.

Table 1. Posterior estimates of the ratio of snap to fixed gear catch rates for O32 and all sizes WPUE, and all sizes NPUE, from space-time modelling of data from the Seward charter region in Regulatory Area 3A in 2021.

Variable	**Ratio of snap to fixed catch rate**	
	Posterior mean	**95% credible interval**
O32 WPUE	1.28	0.96 – 1.72
All sizes WPUE	1.18	0.89 – 1.56
All sizes NPUE	1.43	1.08 – 1.89

RECOMMENDATION

That the Commission **NOTE** paper IPHC-2022-AM098-08 which provides results of the space-time modelling of Pacific halibut survey data for 1993-2021.

REFERENCES

Ualesi, K., Wilson, D., Jones, C. & Rillera, R. IPHC Fishery-independent setline survey (FISS) design and implementation in 2021. IPHC-2021-IM097-07.

Webster R. 2021a. 2022-24 FISS design evaluation. IPHC-2021-IM097-09.

Webster R. 2021b. IPHC Fishery-Independent Setline Survey (FISS) and commercial data modelling. IPHC-2021-SRB019-05.

APPENDIX A

Space-time modelling results by IPHC Regulatory Area

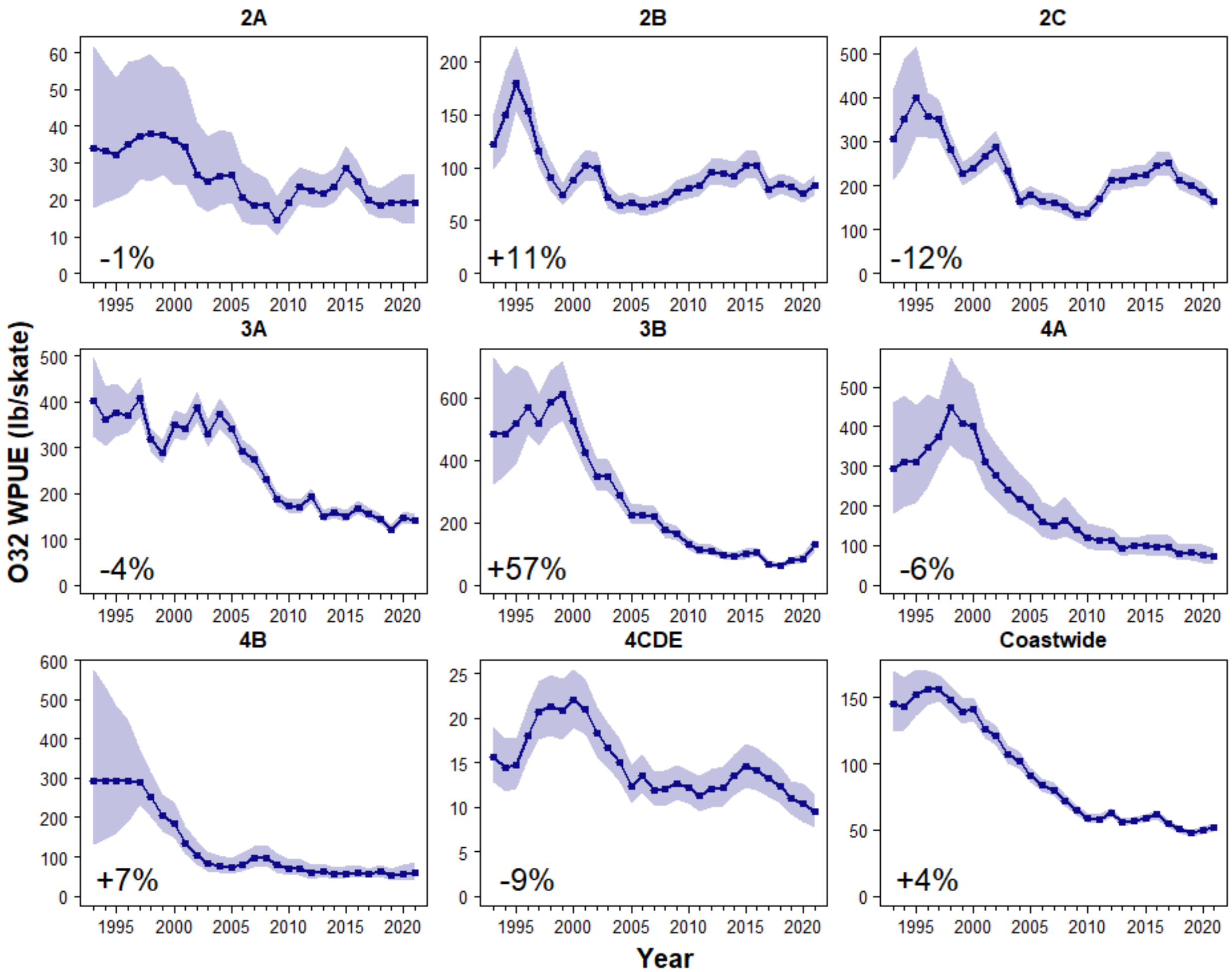


Figure A.1. Space-time model output for O32 WPUE for 1993-2021. Filled circles denote the posterior means of O32 WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean O32 WPUE from 2019 to 2021.

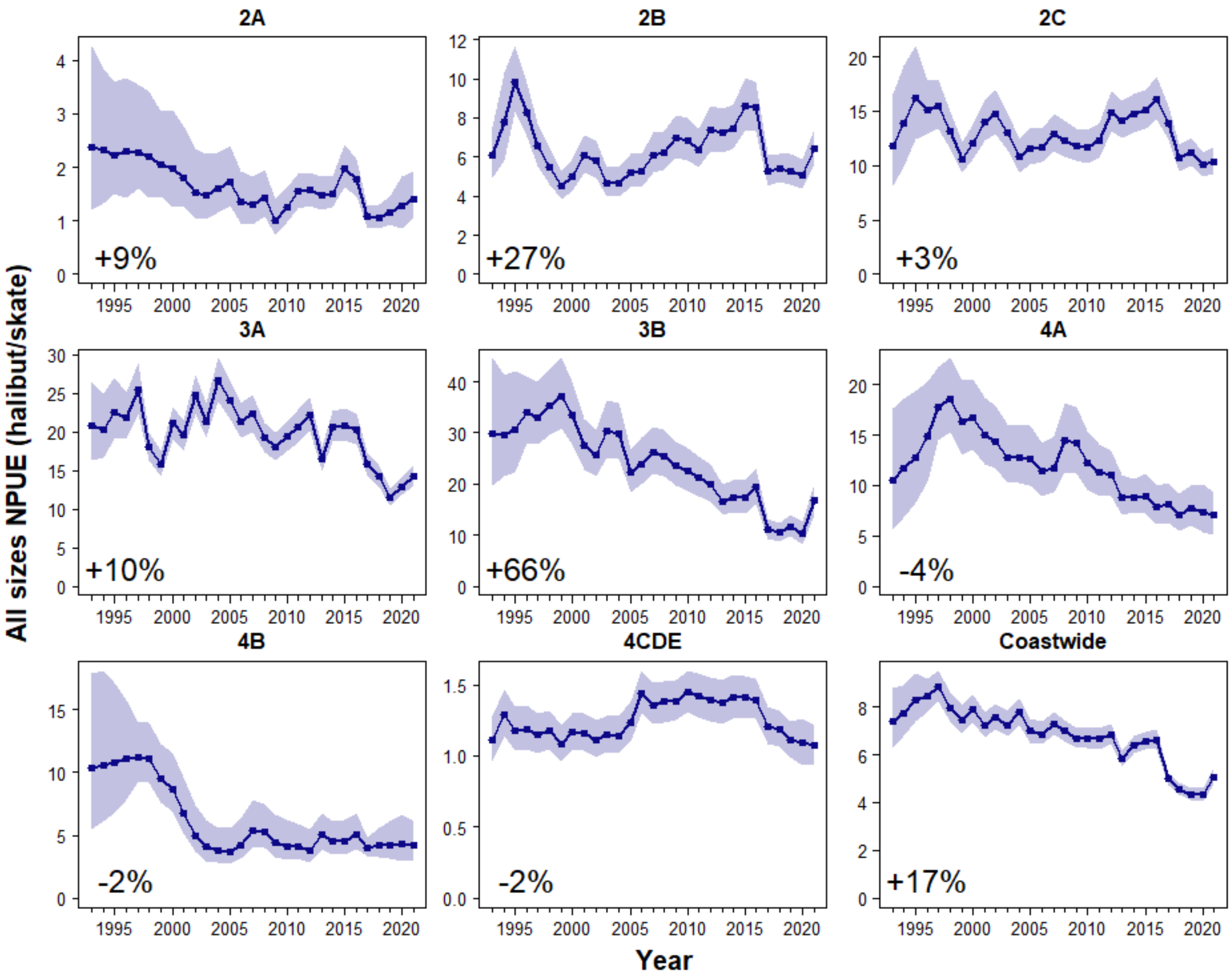


Figure A.2. Space-time model output for all sizes NPUE for 1993-2021. Filled circles denote the posterior means of all sizes NPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean total NPUE from 2019 to 2021.

2022-24 FISS designs

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER; 10 DECEMBER 2021)

PURPOSE

To present proposed designs for the IPHC's Fishery-Independent Setline Survey (FISS) for the 2022-24 period.

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.

FISS history 1993-2019

The IPHC has undertaken FISS activity since the 1960s. However, methods were not standardized to a degree (e.g., the bait and gear used) that allows for simple combined analyses until 1993. From 1993 to 1997, the annual design was a modification of a design developed and implemented in the 1960s, and involved fishing triangular clusters of stations, with clusters located on a grid (IPHC 2012). Coverage was limited in most years, and was generally restricted to IPHC Regulatory Areas 2B through 3B. The modern FISS design, based on a grid with 10 nmi (18.5 km) spacing, was introduced in 1998, and over the subsequent two years was expanded to include annual coverage in parts of all IPHC Regulatory Areas within the depth ranges of 20-275 fathoms (37-503 m) in the Gulf of Alaska and Aleutian Islands, and 75-275 fathoms (137-503 m) in the Bering Sea (IPHC 2012). Annually-fished stations were added around islands in the Bering Sea in 2006, and in the same year, a less dense grid of paired stations was fished in shallower waters of the southeastern Bering Sea, providing data for a calibration with data from the annual National Marine Fishery Service (NMFS) trawl survey (Webster et al. 2020).

Based on examination of commercial logbook data and information from other sources, it became clear by 2010 that the historical FISS design had gaps in coverage of Pacific halibut habitat that had the potential to lead to bias in estimates derived from its data. These gaps included deep and shallow waters outside the FISS depth range (0-20 fathoms and 275-400 fathoms), and unsurveyed stations on the 10 nmi grid within the 20-275 fathom depth range within each IPHC Regulatory Area. This led the IPHC Secretariat to propose expanding the FISS to provide coverage within the unsurveyed habitat with United States and Canadian waters. In 2011 a pilot expansion was undertaken in IPHC Regulatory Area 2A, with stations on the 10 nmi grid added to deep (275-400 fathoms) and shallow (10-20 fathoms) waters, the Salish Sea, and other, smaller gaps in coverage. The 10 fathom limit was due to logistical difficulties in fishing longline gear in shallower waters. A second expansion in IPHC Regulatory Area 2A was completed in 2013, including waters off California between latitudes of 40-42°N.

The full expansion program began in 2014 and continued through 2019, resulting in the sampling of the entire FISS design of 1890 stations in the shortest time logistically possible. The FISS expansion program allowed us to build the first complete picture of Pacific halibut density throughout its range in Convention waters. The expansion stations in 2015 also provided a second calibration with trawl data in IPHC Regulatory Area 4CDE. Sampling the full FISS design has reduced bias as noted above, and, in conjunction with space-time modelling of survey data (see below), has improved precision and fully quantified the uncertainty associated with estimates based on partial annual sampling of the species range. It has also provided a complete set of observations over the full FISS design (Figure 1) from which an optimal subset of stations can be selected when devising annual FISS designs. This station selection process began in 2019 for the 2020 FISS and continues with the current review of design proposals for 2022-24. Note that in the Bering Sea, the full FISS design does not provide complete spatial coverage, and FISS data are augmented with calibrated data from National Marine Fisheries Service (NMFS) and Alaska Department of Fish and Game (ADFG) trawl surveys (stations can vary by year – 2019 designs are shown in Figure 1). Both supplementary surveys are conducted approximately annually.

Space-time modelling

In 2016, a space-time modelling approach was introduced to estimate time series of weight and numbers-per-unit-effort (WPUE and NPUE), and to estimate the stock distribution of Pacific halibut among IPHC Regulatory Areas. This represented an improvement over the largely empirical approach used previously, as it made use of additional information within the survey data regarding the degree of spatial and temporal of Pacific halibut density, along with information from covariates such as depth (Webster et al. 2020). It also allowed a more complete accounting of uncertainty: for example, prior to the use of space-time modelling, uncertainty due to unsurveyed regions in each year was ignored in the estimation - these unsampled regions were either filled in using independently estimated scalar calibrations (if fished at least once), or catch-rates at unsampled stations were assumed to be equal to the mean for the entire Regulatory Area. The IPHC's Scientific Review Board (SRB) has provided supportive reviews of the space-time modelling approach (e.g., IPHC-2018-SRB013-R), and the methods have been published in a peer-review journal (Webster et al. 2020). Similar geostatistical models are now routinely used to standardise fishery-independent trawl surveys for groundfish on the West Coast of the U.S. and in Alaskan waters (e.g., Thorson et al. 2015 and Thorson 2019).

FISS design objectives

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 the IPHC's management procedure. The priority of a rationalised 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. Potential considerations that could add to or modify the design are logistics and cost (secondary design layer), and FISS removals (impact on the stock), data collection assistance for other agencies, and IPHC policies (tertiary design layer). These priorities are outlined in Table 1.

Table 1. Prioritization of 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	Long term revenue neutrality	Logistics and cost: operational feasibility and cost/revenue neutrality
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

Design review and finalisation process

Since completion of the FISS expansions, a review process has been developed for annual FISS designs created according to the above objectives:

- The Secretariat presents design proposals based only on primary objectives (Table 1) to the SRB for three subsequent years at the June meeting (recognizing that data from the current summer FISS will not be available for analysis prior to the September SRB meeting);
- These design proposals, revised (if necessary) based on June SRB input, are then reviewed by Commissioners at the September work meeting;
- At their September meeting, the SRB reviews revisions to the design proposals made to account for secondary and tertiary objectives

Following the review process, designs may be further modified to account for any updates to secondary and tertiary objectives before being finalised during the Interim and Annual meetings and the period prior to implementation:

- Presentation of FISS designs for 'endorsement' by the Commission occurs at the November Interim Meeting;
- Ad hoc modifications to the design for the current year (due to unforeseen issues arising) are possible at the Annual Meeting;
- The endorsed design for current year is then modified (if necessary) to account for any additional tertiary objectives prior to summer implementation (February-April).

Consultation with industry and stakeholders occurs throughout the FISS planning process, at the Research Advisory Board meeting (29 November in 2021) and particularly in finalizing design details as part of the FISS charter bid process, when stations can be added and other adjustments made to provide for improved logistical efficiency. We also note the opportunities for stakeholder input during public meetings (Interim and Annual Meetings).

Note that while the review process examines designs for the next three years, revisions to designs for the second and third years are expected during subsequent review periods as additional data are collected. Having design proposals available for three years instead of the next year only assists the IPHC with medium-term planning of the FISS, and allows reviewers (SRB, IPHC Commissioners) and stakeholders to see more clearly the planning process for sampling the entire FISS footprint over multiple years. Extending the proposed designs beyond three years was not considered worthwhile, as we expect further evaluation undertaken following collection of data during the one to three-year time period to influence design choices for subsequent years.

PROPOSED DESIGNS FOR 2022-24

The designs proposed for 2022-24 (Figures 2 to 4) use efficient subarea sampling in IPHC Regulatory Areas 2A, 4A and 4B, and incorporate a randomized subsampling of FISS stations in IPHC Regulatory Areas 2B, 2C, 3A and 3B (except for the near-zero catch rate inside waters around Vancouver Island), with a sampling rate chosen to keep the sample size close to 1000 stations in an average year. This was also used to generate the designs originally proposed for 2020 (but modified as a result of the impact of COVID19 and cost considerations), and for those proposed and approved for 2021. In 2020, designs for 2022-23 were also approved subject to revision. We are proposing one change from that 2022 design, bringing forward by one year (from 2023 to 2022) the sampling of the central and western subareas of IPHC Regulatory Area 4B to reduce the risk of bias in estimates from that area. Thus, we proposed that:

- In 2022 the lower-density western and central subareas of IPHC Regulatory Area 4B are sampled, followed by the higher-density eastern subarea in 2023-24
- The higher-density western subarea of IPHC Regulatory Area 4A be sampled in all three years, with the medium-density northern shelf edge subarea added in 2023 only
- The highest-density waters of IPHC Regulatory 2A in northern Washington and central/southern Oregon are proposed for sampling in each year of the 2022-24 period
- The low-density waters of the Salish Sea in IPHC Regulatory Areas 2A and 2B are not proposed for sampling in 2022-24

Following this three-year period, it is expected that all subareas not recently sampled will be included during the subsequent 3-5 years. These include the southeastern subarea of IPHC Regulatory 4A, and lower-density waters of IPHC Regulatory 2A (see below).

The design proposals again include full sampling of the standard FISS grid in IPHC Regulatory Area 4CDE. The Pacific halibut distribution in this area continues to be of particular interest, with an apparently northward-shifting distribution of Pacific halibut, and increasing uncertainty regarding connectivity with populations adjacent to and within Russian waters. Distribution and density shifts of other demersal species and crab stocks, as well as sustained environmental change, continue to indicate the need for increased monitoring in this IPHC Regulatory Area. Further, the truncated survey design in 2020 and loss of many stations in 2021 due to logistical issues have reduced recent data below what was expected in both years.

We note that at SRB018, the SRB endorsed the final 2022 FISS design as presented in Figure 2, and provisionally endorsed the 2023-24 designs (Figs. 3 and 4) (IPHC-2021-SRB018-R).

SCIENTIFIC EVALUATION OF FISS DESIGNS

Proposed designs undergo a statistical evaluation to ensure they meet precision targets and that the potential for bias is minimised. The results of this evaluation were presented to the SRB at its June meeting (IPHC-2021-SRB018-R), and showed that through 2024, precision targets are expected to be achieved while the potential bias due to incomplete coverage in IPHC Regulatory Areas 2A, 4A and 4B is maintained at low levels. The 2021 evaluation was based on the assumption that all stations in the 2021 FISS design would be sampled. Due to logistical issues, this was not the case in IPHC Regulatory Areas 4A, 4B and 4CDE. Particularly for the former two areas, the reduced sampling in 2021 will affect our ability to meet precision and bias targets going forward and may lead to revisions to the 2023-24 designs during the 2023 evaluation period prior to SRB020.

CONSIDERATION OF COST

Ideally, the FISS design would be based only on scientific needs. However, some IPHC Regulatory Areas are consistently more expensive to sample than others, so for these the efficient subarea designs were developed. The purpose of factoring in cost was to provide a statistically efficient and logistically feasible design for consideration by the Commission. After initial scientific designs, focused solely on primary objectives have been established, secondary and tertiary considerations (Table 1) are factored in to produce the final design for implementation in the current year. It is anticipated that under most circumstances, cost considerations can be addressed by adding stations to the minimum design proposed in this report (2020 was an exceptional case). In particular, the FISS is funded by sales of captured fish and is intended to have long-term revenue neutrality, meaning that any design must also be evaluated in terms of the following factors:

- Expected catch of Pacific halibut
- Expected Pacific halibut sale price
- Charter vessel costs, including relative costs per skate and per station
- Bait costs
- IPHC Secretariat administrative costs

Balancing these factors has generally resulted in modifications to the designs such as increasing sampling effort in high-density regions and decreasing effort in low density regions.

OPTIMISED DESIGNS FOR 2022

IPHC Secretariat proposed two potential modifications of the proposed scientific minimum design (Figure 2) for 2022 that optimise the design to help achieve the secondary objective of long-term revenue neutrality. Optimised Design 1 (Figure 5) adds stations to the core IPHC Regulatory Areas (2B, 2C, 3A and 3B) to meet the secondary objective. Optimised Design 2 (Figure 6) adds fewer stations than those added in Optimised Design 1 and removes the northern stations from IPHC Regulatory Area 4CDE to meet the secondary objective. Both optimised designs meet the precision and bias criteria of the evaluation conducted above, as reducing the northern Bering Sea design for a single year is not expected to have a meaningful impact on either precision or bias in that area. Both designs benefit from a modest rollover from the revenue generated during the 2021 survey ($200k), which was higher than projected due primarily to increased price.

At SRB019, the optimised designs were noted by the SRB (IPHC-2021-SRB019-R), which also drew attention to the potential importance of increased sampling in the Bering Sea.

SRB019–Rec.02 (para. 14):

NOTING the presentation of three alternative 2022 sampling designs (Figs. 1, 2, and 3) that optimize the SRB018-endorsed proposed 2022 design for cost, thereby meeting the goals of long-term revenue neutrality (Secondary Objective), without compromising the scientific goals of the FISS (Primary Objective), the SRB RECOMMENDED that the Secretariat prioritize 2022 sampling designs that include IPHC Regulatory Area 4CDE despite the relatively low contribution of this area to overall biomass and variance. This region is an important area to monitor for future range shifts and biological samples collected here are likely to be important for understanding the biology of Pacific halibut at their leading range edge.

Based on the SRB's comments and the factors suggesting elevated priority for 4CDE identified by the Secretariat above, Optimised Design 1 (all stations in IPHC Regulatory Area 4CDE) was recommended by the Secretariat at IM097, with Optimised Design 2 reserved as an alternative if bid availability and or other logistical challenges arise.

At IM097 (IPHC-2021-IM097-R), the Commission endorsed Optimised Design 1 for 2022 (Figure 5), and Optimised Design 2 (Figure 6) as an alternative.

IM097 para. 31:

*The Commission **ENDORSED** optimized design 1 for the 2022 FISS, with full sampling in IPHC Regulatory Area 4CDE (Appendix IV), and optimized design 2, reduced sampling in IPHC Regulatory Area 4CDE (Appendix V), as an alternative if necessary. As with all years, the Commission will have an additional opportunity to modify the 2022 FISS design at AM098.*

The Commission also provisionally endorsed the proposed designs for 2023-24 (Figures 3-4).

IM097 para 32:

*The Commission provisionally **ENDORSED** the proposed designs for 2023-24, as provisionally endorsed by the Scientific Review Board at SRB018, recognizing that the 2023-24 designs are expected to be modified in subsequent years.*

RECOMMENDATIONS

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-09 that presents the scientific FISS design proposals for 2022-24 together with 2022 designs optimised for the secondary objective of long-term revenue neutrality;
2) **RECOMMEND** ad hoc modifications to the design for 2022 if necessary.

REFERENCES

IPHC 2012. IPHC setline charters 1963 through 2003 IPHC-2012-TR058. 264p.

IPHC 2018. Report of the 13th Session of the IPHC Scientific Review Board (SRB) IPHC-2018-SRB013-R. 17 p.

IPHC 2021. Report of the 18th Session of the IPHC Scientific Review Board (SRB) IPHC-2021-SRB018-R. 21 p.

IPHC 2021. Report of the 19th Session of the IPHC Scientific Review Board (SRB) IPHC-2021-SRB019-R. 25 p.

IPHC 2021. Report of the 97th Session of the IPHC Interim Meeting (IM097) IPHC-2021-IM097-R. 28 p.

Thorson, J. T., Shelton, A. O., Ward, E. J., and Skaug, H. J. 2015. Geostatistical delta-generalized linear mixed models improve precision for estimated abundance indices for West Coast groundfishes. ICES Journal of Marine Science 72(5): 1297-1310. doi:10.1093/icesjms/fsu243.

Thorson, J. T. 2019. Guidance for decisions using the Vector Autoregressive Spatio-Temporal (VAST) package in stock, ecosystem, habitat and climate assessments. Fisheries Research 210: 143-161. doi:10.1016/j.fishres.2018.10.013.

Webster R. 2019. Space-time modelling of IPHC Fishery-Independent Setline Survey (FISS) data. IPHC-2020-AM096-07. 32 p.

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. Can. J. Fish. Aquat. Sci. 77(8): 1421-1432.

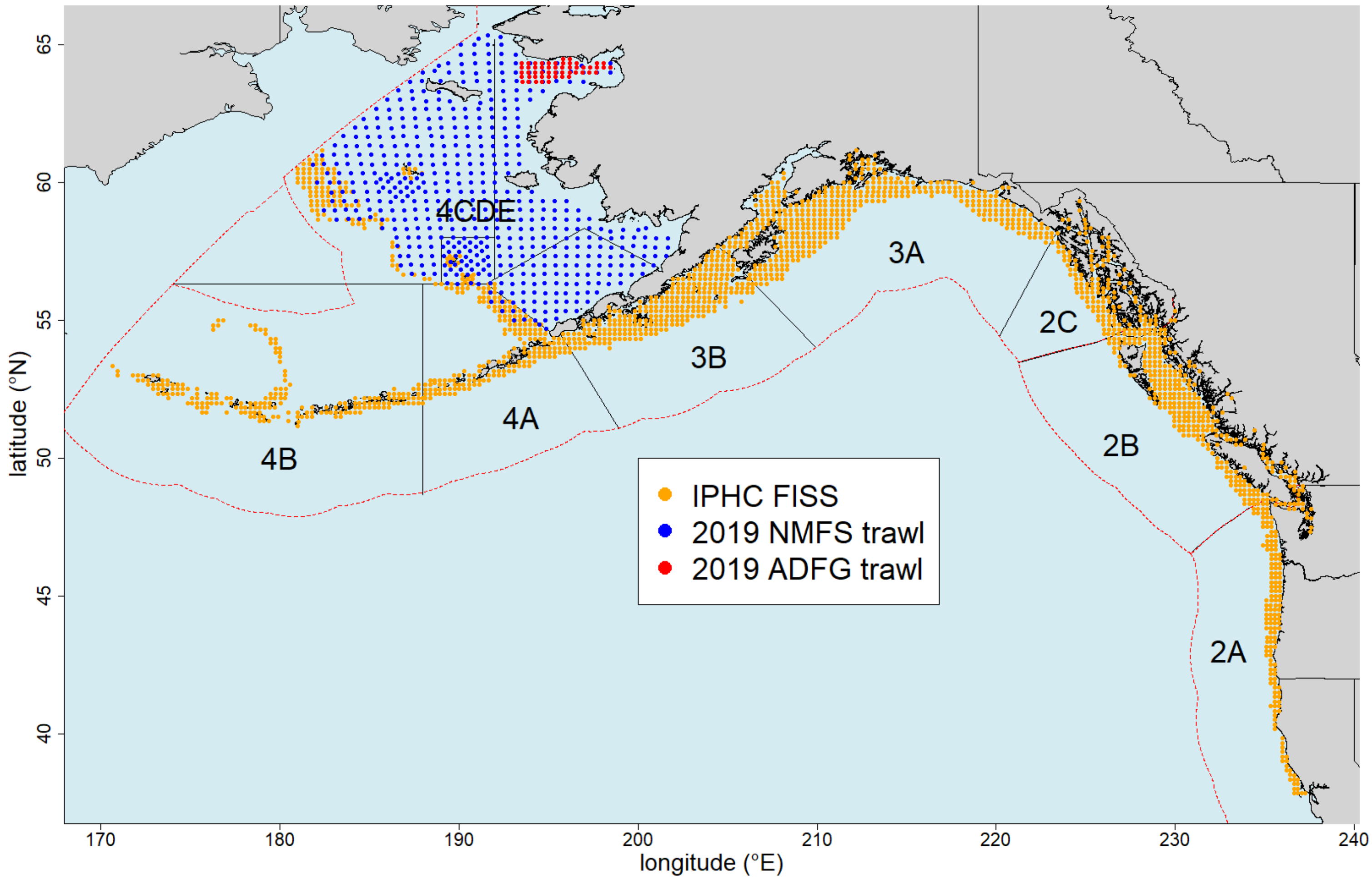
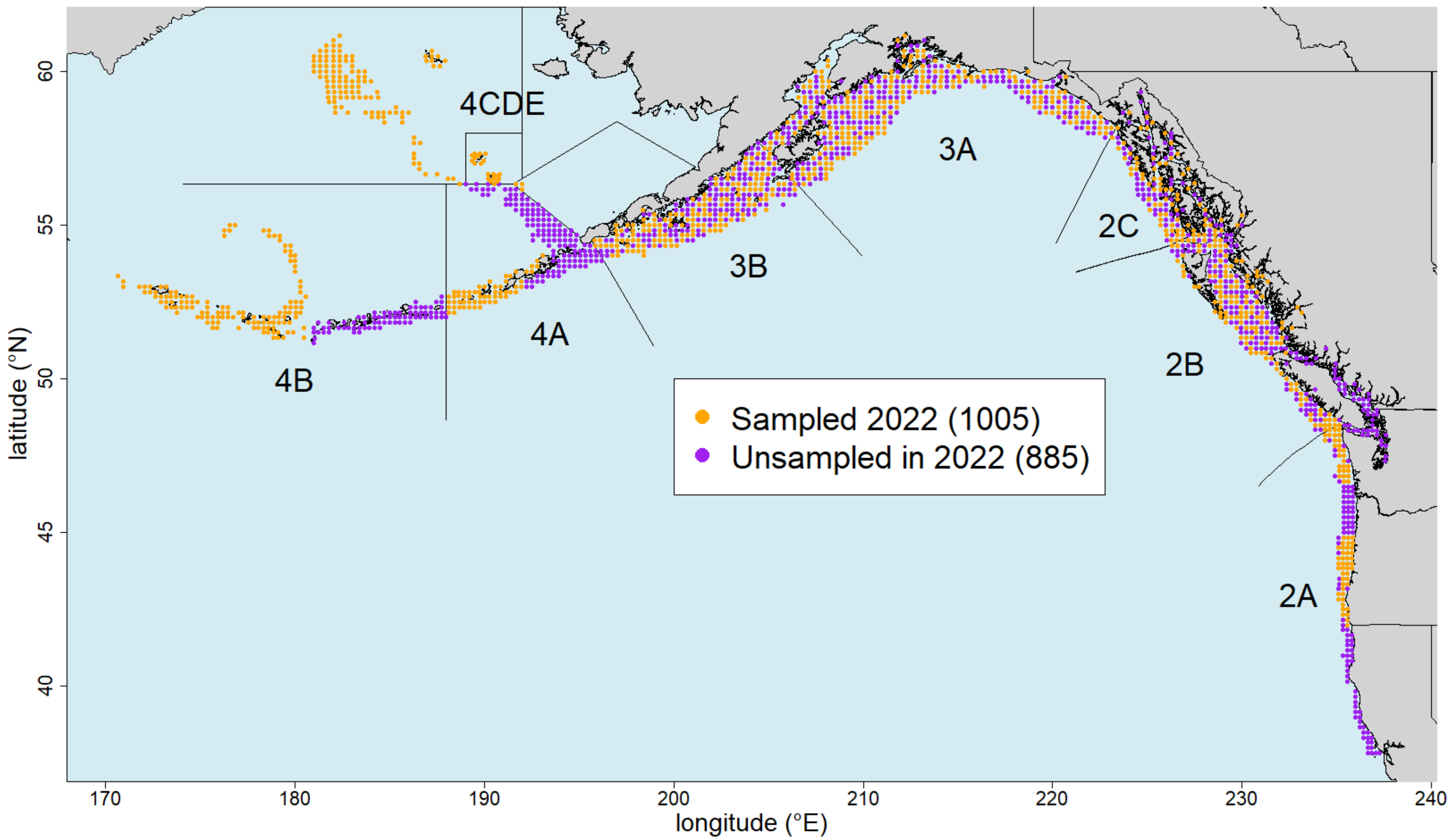
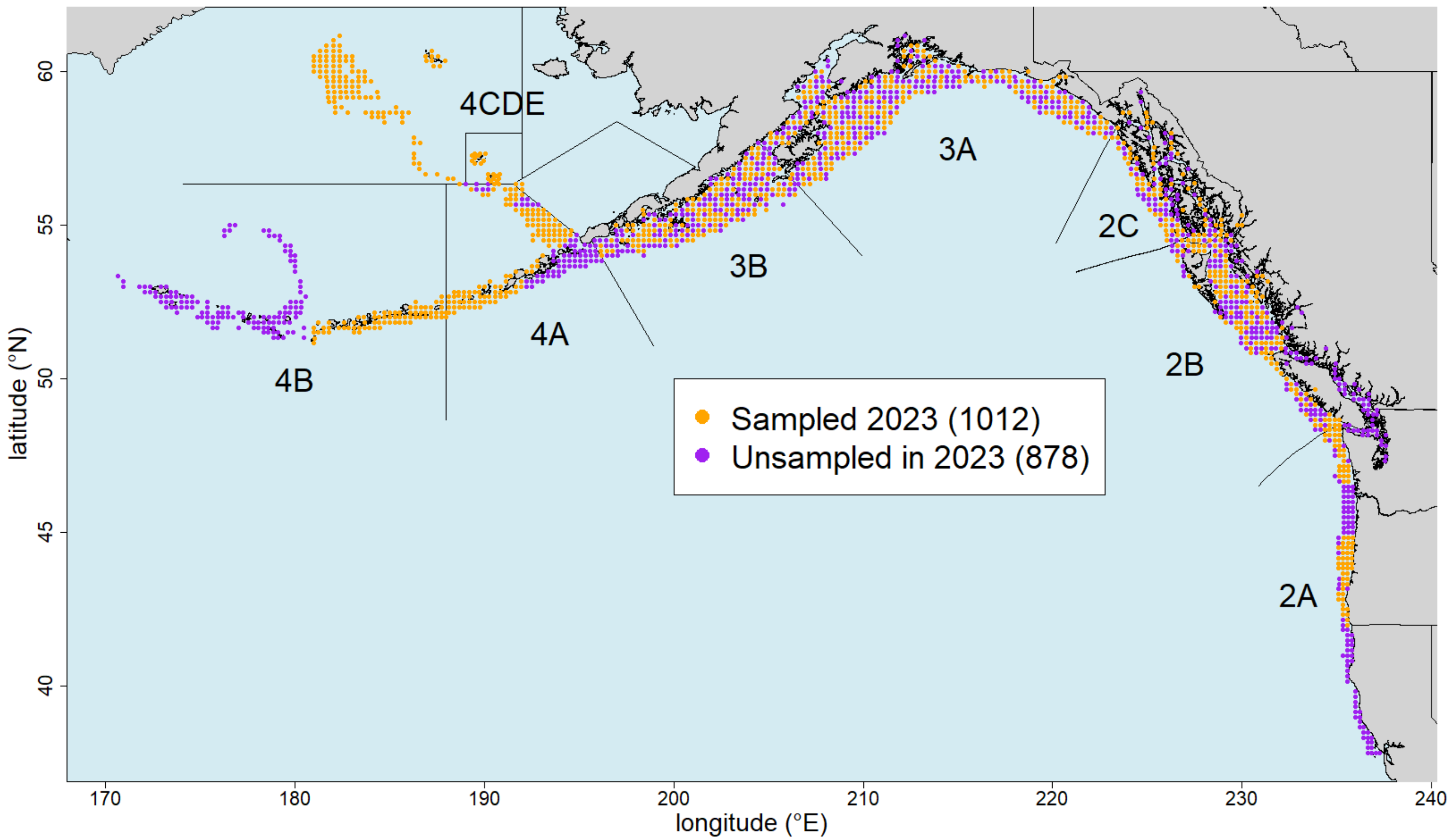
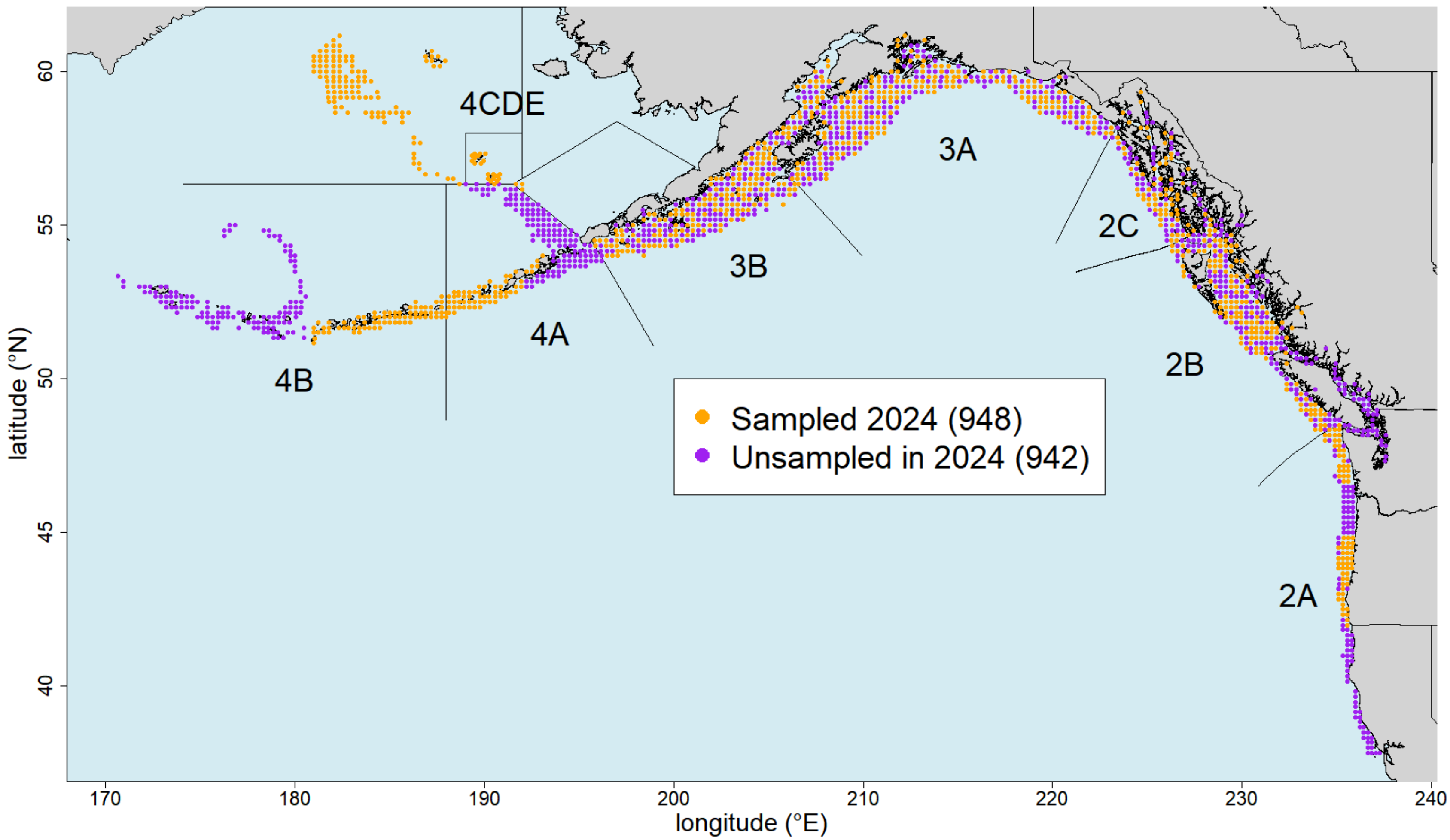


Figure 1. Map of the full 1890 station FISS design, with orange circles representing stations available for inclusion in annual sampling designs, and other colours representing trawl stations from 2019 NMFS and ADFG surveys used to provide complementary data for Bering Sea modelling.


4CDE
3A
2C
3B
4A
2B
4B
2A
Sampled 2022 (1005)
Unsampled in 2022 (885)
latitude (°N)
longitude (°E)
60
55
50
45
40
170
180
190
200
210
220
230
240



4CDE
3A
2C
3B
4A
2B
4B
2A
Sampled 2023 (1012)
Unsampled in 2023 (878)
latitude (°N)
longitude (°E)
60
55
50
45
40
170
180
190
200
210
220
230
240



4CDE
3A
3B
4A
4B
2C
2B
2A
Sampled 2024 (948)
Unsampled in 2024 (942)
latitude (°N)
longitude (°E)
60
55
50
45
40
170
180
190
200
210
220
230
240

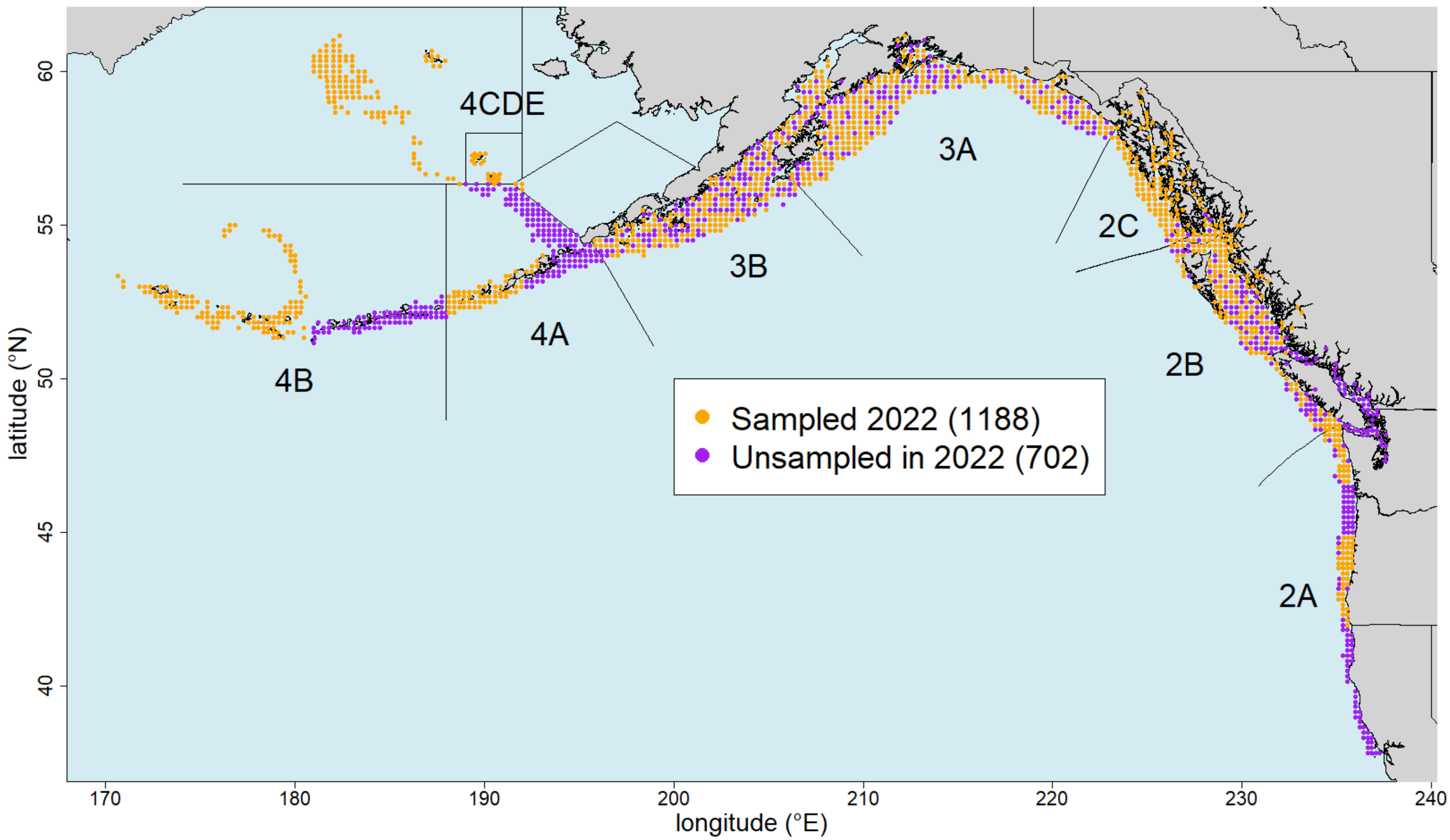


Figure 5. Optimized FISS design 1 (endorsed) for 2022, with original design endorsed at SRB018 augmented with additional stations in IPHC Regulatory Areas 2B, 2C, 3A, and 3B in order to help achieve the secondary objective of long-term revenue neutrality.

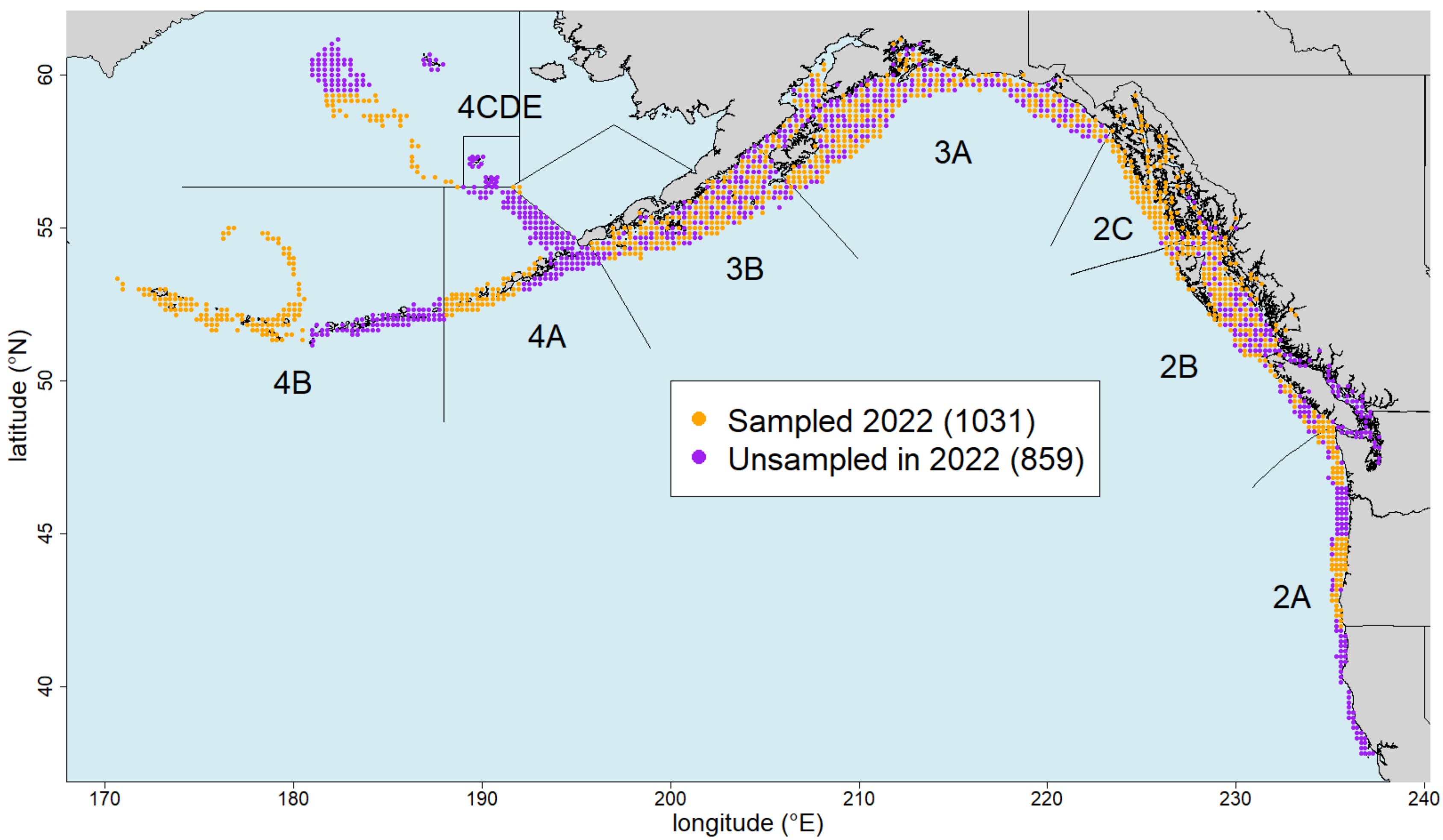


Figure 6. Optimized FISS design 2 (alternative) for 2022, with original design endorsed at SRB018 modified to remove northern Bering Sea shelf edge stations fished in 2021 augmented with additional stations in IPHC Regulatory Areas 2B, 2C, 3A, and 3B in order to help achieve the secondary objective of long-term revenue neutrality.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Summary of the data, stock assessment, and harvest decision table for Pacific halibut (*Hippoglossus stenolepis*) at the end of 2021

PREPARED BY: IPHC SECRETARIAT (I. STEWART, A. HICKS, R. WEBSTER, D. WILSON, AND B. HUTNICZAK; 20 DECEMBER 2021)

PURPOSE

To provide the Commission with a summary of the data, stock assessment, and harvest decision table at the end of 2021.

INTRODUCTION

In 2021 the International Pacific Halibut Commission (IPHC) undertook its annual coastwide stock assessment of Pacific halibut (*Hippoglossus stenolepis*). This assessment represents an update to the 2020 stock assessment (IPHC-2021-SA01), with incremental changes documented through a two-part review by the IPHC's Scientific Review Board (SRB; IPHC-2021-SRB018-R, IPHC-2021-SRB019-R). Changes and new data for 2021 include:

1. Update the version of the stock synthesis software (Methot and Wetzel 2013) used for the analysis (3.30.17).
2. New modelled trend information from the 2021 IPHC's FISS (fishery-independent setline survey), including estimates covering the entire 1890 station design and all IPHC Regulatory Areas.
3. Age, length, individual weight, and average weight-at-age estimates from the 2021 FISS for all IPHC Regulatory Areas.
4. 2021 (and a small amount of 2020) Commercial fishery logbook trend information from all IPHC Regulatory Areas.
5. 2021 Commercial fishery biological sampling (age, length, individual weight, and average weight-at-age) from all IPHC Regulatory Areas. Sex-ratios-at-age for the 2020 commercial fishery (building on the 2017-2019 sex-ratios used in the 2020 stock assessment).
6. Biological information (lengths and/or ages) from non-directed discards (IPHC Regulatory Areas where available) and the recreational fishery (IPHC Regulatory Area 3A only) from 2020.
7. Updated mortality estimates for 2020 (where preliminary values were used) and estimates for all sources in 2021.

This document provides an overview of the final data sources available for the 2021 Pacific halibut stock assessment including the population trends and distribution among IPHC Regulatory Areas based on the modelled IPHC fishery-independent setline survey (FISS), directed commercial fishery data, and results of the stock assessment.

Overall, model results remain highly consistent with those of recent stock assessments. Spawning biomass trends continue slightly downward, although the 2021 assessment reports less decline than projected, partly due to estimated mortality below that associated with limits set for 2021. The 2012 year-class, estimated to be stronger than any since 2005, is critically important to short-term projections of stock and fishery dynamics.

STOCK AND MANAGEMENT

The stock assessment reports the status of the Pacific halibut (*Hippoglossus stenolepis*) resource in the IPHC Convention Area. As in recent stock assessments, the resource is modelled as a single stock extending from northern California to the Aleutian Islands and Bering Sea, including all inside waters of the Strait of Georgia and the Salish Sea, but excludes known extremities in the western Bering Sea within the Russian Exclusive Economic Zone (Figure 1).

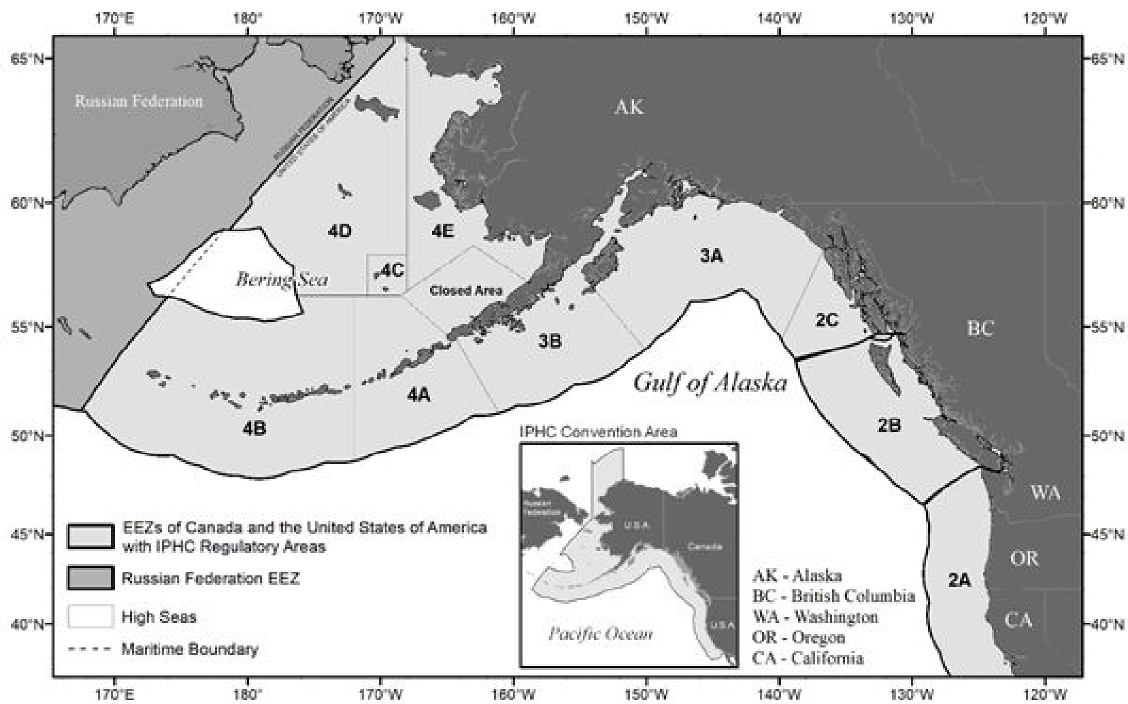


FIGURE 1. IPHC Convention Area (insert) and IPHC Regulatory Areas.

The Pacific halibut fishery has been managed by the IPHC since 1923. Mortality limits for each of eight IPHC Regulatory Areas[1] are set each year by the Commission. The stock assessment provides a summary of recently collected data, and model estimates of stock size and trend. Specific management information is summarized via a decision table reporting the estimated short-term risks associated with alternative management actions. Mortality tables projecting detailed summaries for fisheries in each IPHC Regulatory Area (and reference levels indicated by the IPHC's interim management procedure) will be provided in early January 2022 for exploration via the IPHC's mortality projection tool (IPHC-2022-AM098-INF02).

DATA

Historical mortality

Known Pacific halibut mortality consists of target commercial fishery landings and discard mortality (including research), recreational fisheries, subsistence, and discard mortality in fisheries targeting other species ('non-directed' fisheries where Pacific halibut retention is prohibited). Over the period 1888-2021 mortality has totaled 7.3 billion pounds (~3.3 million metric tons, t). Since 1922, the fishery has ranged annually from 34 to 100 million pounds

[1] The IPHC recognizes sub-Areas 4C, 4D, 4E and the Closed Area for use in domestic catch agreements but manages the combined Area 4CDE.

(15,000-45,000 t) with an annual average of 63 million pounds (~29,000 t; Figure 2). Annual mortality was above this 100-year average from 1985 through 2010 and has averaged 38.5 million pounds (~17,500 t) from 2017-21.

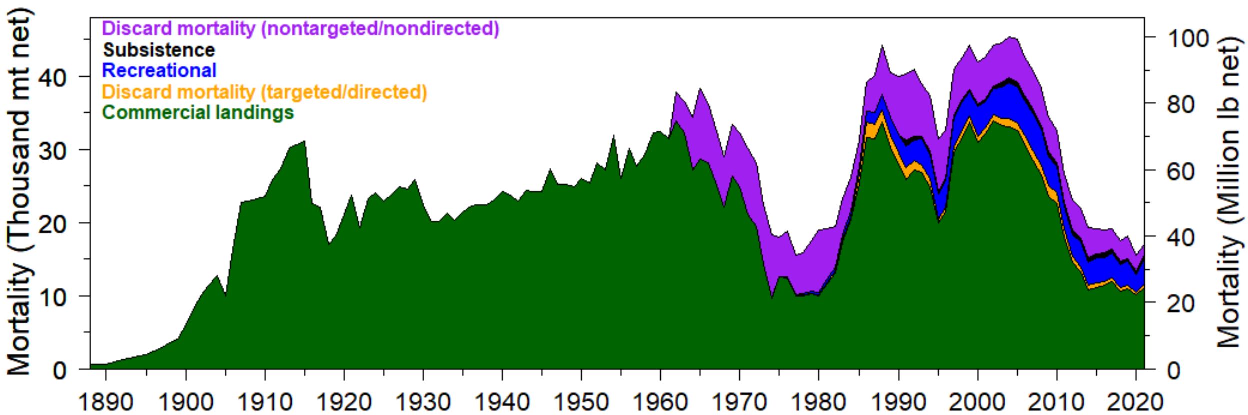


FIGURE 2. Summary of estimated historical mortality by source (colors), 1888-2021.

2021 Fishery and IPHC FISS statistics

Data for stock assessment use are compiled by IPHC Regulatory Area, and then aggregated to four Biological Regions: Region 2 (Areas 2A, 2B, and 2C), Region 3 (Areas 3A, 3B), Region 4 (4A, 4CDE) and Region 4B and then coastwide (Figure 1). The assessment data from both fishery dependent and fishery independent sources, as well as auxiliary biological information, are most spatially complete since the late-1990s. Primary sources of information for this assessment include mortality estimates from all sources (IPHC-2022-AM098-06), modelled indices of abundance (IPHC-2022-AM098-08) based on the IPHC's FISS (in numbers and weight) and other surveys, commercial Catch-Per-Unit-Effort (in weight), and biological summaries from both sources (length-, weight-, and age-composition data).

All data sources are reprocessed each year to include new information from the terminal year, as well as any additional information for or changes made to the entire time-series. For 2021, the most important information came from the modelled index of abundance reflecting the extensive 2021 FISS and associated biological sampling. Routine updates of logbook records from the 2021 (and earlier) directed commercial fishery, as well as age-frequency observations and individual weights from the commercial fishery were also included. Directed commercial fishery sex-ratios at age were available for 2020 (building on the genetic data for 2017-2019 previously available). Beginning in 2019, individual weights have been collected during FISS operations such that WPUE (weight per unit effort) and stock distribution estimates are calculated directly, without the use of the historical weight-length relationship. All mortality estimates (including changes to the existing time-series where new estimates have become available) were extended to include 2021. All available information was finalized on 1 November 2021 in order to provide adequate time for analysis and modeling. As has been the case in all years, some data are incomplete (i.e., commercial fishery logbook and age information), or include projections for the remainder of the year (i.e., mortality estimates for ongoing fisheries or for fisheries where final estimation is still pending).

Coastwide commercial Pacific halibut fishery landings (including research landings) in 2021 were approximately 24.5 million pounds (~11,100 t), up 9% from 2020[2]. Discard mortality in non-directed fisheries was estimated to be 3.5 million pounds in 2021 (~1,600 t)[3], down 23% from 2020 and representing the smallest estimate in the time-series. The total recreational mortality (including estimates of discard mortality) was estimated to be 7.6 million pounds (~3,470 t) up 43% from reduced fisheries that occurred in 2020. Mortality from all sources increased by 10% to an estimated 37.7 million pounds (~17,100 t) in 2021 based on preliminary information available through 1 November 2021.

The 2021 modelled FISS results detailed a coastwide aggregate NPUE (numbers per unit effort) which increased by 17% from 2020 to 2021, reversing the declines observed over the last four years (Figure 3). Biological Region 3 increased by 28%, while Biological Region 2 increased by 15%. Biological Regions 4, and 4B (sampled as planned in 2021 after the curtailed survey in 2021) both showed small declines (3 and 2%) and are at or near the lowest values in the estimated time-series. The 2021 modelled coastwide WPUE of legal (O32) Pacific halibut, the most comparable metric to observed commercial fishery catch rates, increased by 4% from 2020 to 2021. This reduced trend relative to that for NPUE indicates that recruitment of younger fish is contributing more to current stock productivity than somatic growth of fish already over the legal minimum size limit. Individual IPHC Regulatory Areas varied from a 57% increase (Regulatory Area 3B) to a 9% decrease (Regulatory Area 4CDE; Figure 4) in O32 WPUE. Due to the extensive survey conducted in 2021, uncertainty was near or below historical levels for most IPHC Regulatory Areas in 2021.

[2] The mortality estimates reported in this document are those available on 1 November 2021 and used in the assessment analysis; they include projections through the end of the fishing season.

[3] The IPHC receives preliminary estimates of the current year's non-directed commercial discard mortality in from the NOAA-Fisheries National Marine Fisheries Service Alaska Regional Office, Northwest Fisheries Science Center, and Fisheries and Oceans Canada in late October. Where necessary, projections are added to approximate the total mortality through the end of the calendar year. Further updates are anticipated in January 2022 and will be incorporated into final projections for 2022.

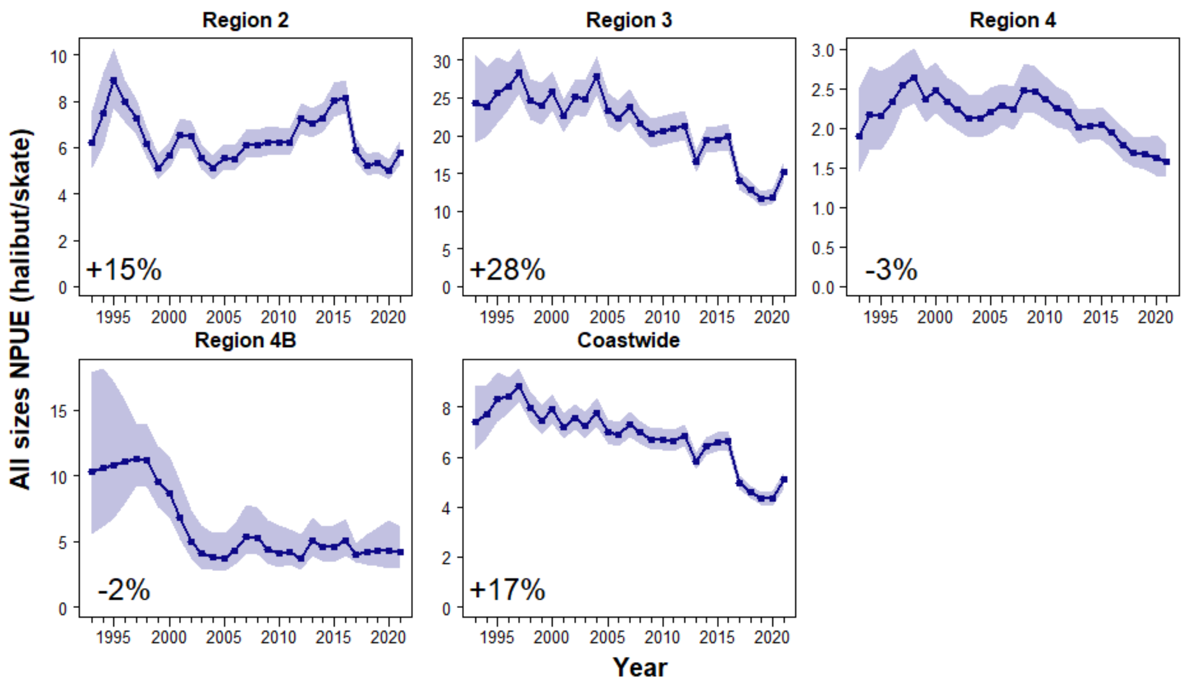


FIGURE 3. Trends in modelled FISS NPUE by Biological Region, 1993-2021. Percentages indicate the change from 2020 to 2021. Shaded zones indicate 95% credible intervals.

Preliminary commercial fishery WPUE estimates from 2021 logbooks increased by 2% at the coastwide level (Figure 5). The bias correction to account for additional logbooks compiled after the fishing season resulted in an estimate of no change (+/- 0%) coastwide. Trends varied among IPHC Regulatory Areas and gears; however, Area-specific trends were mixed, and generally similar to those from the FISS, with the exception of IPHC Regulatory Area 4A which showed a sharp increase in the commercial data.

Biological information (ages and lengths) from the commercial fishery landings continue to show the 2005 year-class as the largest coastwide contributor (in number) to the fish encountered, with the 2012 year-class nearly as abundant. The FISS observed the 2012 cohort (9 years old) at the largest proportion in the total catch of any age class for the first time. Observation of these fish both above and below the commercial fishery minimum size limit indicates their increasing importance to the stock and to future fisheries. Individual size-at-age appears to be increasing for younger ages (<14) in most IPHC Regulatory Areas and coastwide. Although size-at-age changes slowly, if the current pattern persists into older ages, it could have large implications for overall yield.

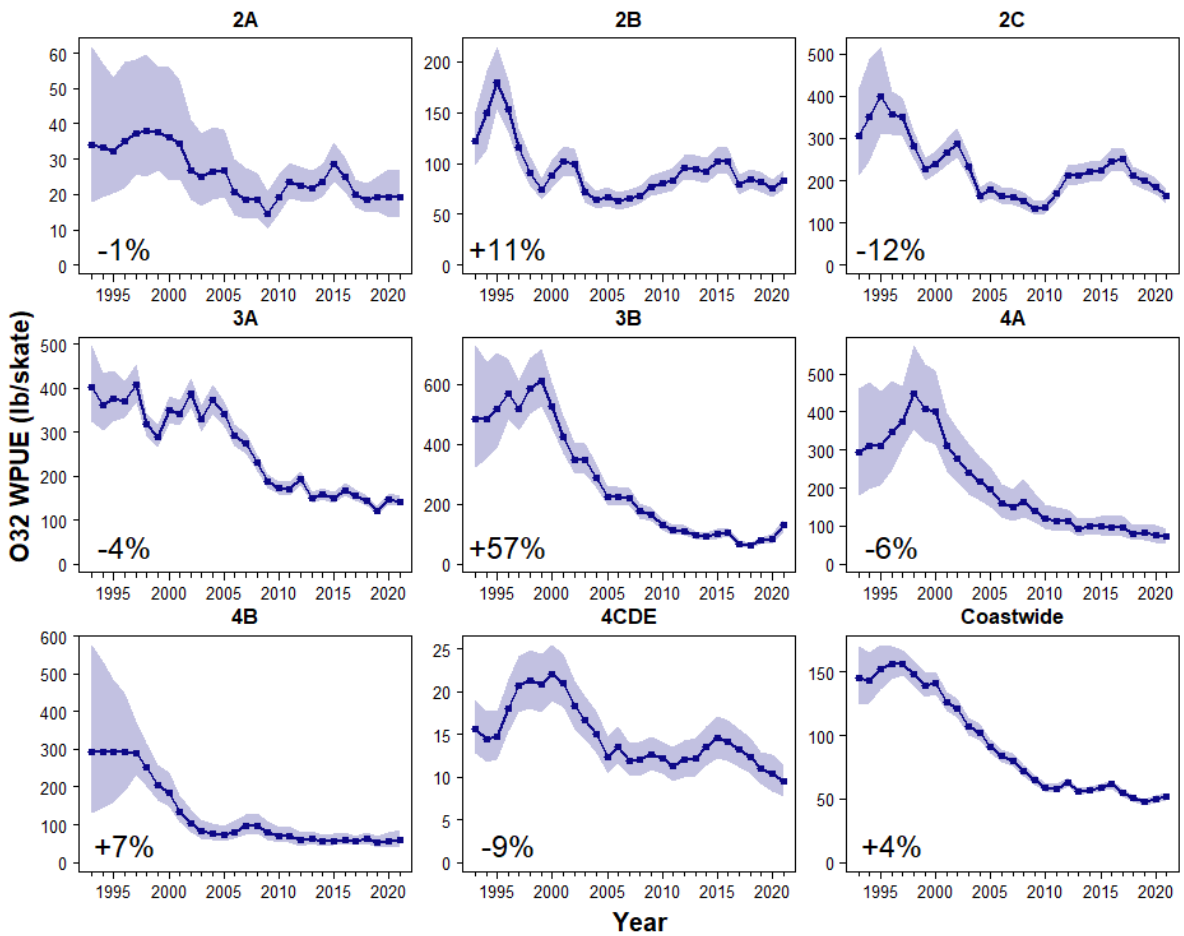


FIGURE 4. Trends in modelled FISS legal (O32) WPUE by IPHC Regulatory Area, 1993-2021. Percentages indicate the change from 2020 to 2021. Shaded zones indicate 95% credible intervals.

Biological stock distribution

The current trend in population distribution (measured via the modelled FISS catch in weight of all Pacific halibut) appears to be shifting back toward Biological Region 3 after more than a decade of decline. In both 2020 and 2021, Biological Regions 2 and 4 have decreased, while Region 4B has stayed relatively constant (Figure 6; recent years in Table 1). Survey data are insufficient to estimate stock distribution prior to 1993. It is therefore unknown how historical distributions or the average distribution in the absence of fishing mortality may compare with recent observations.

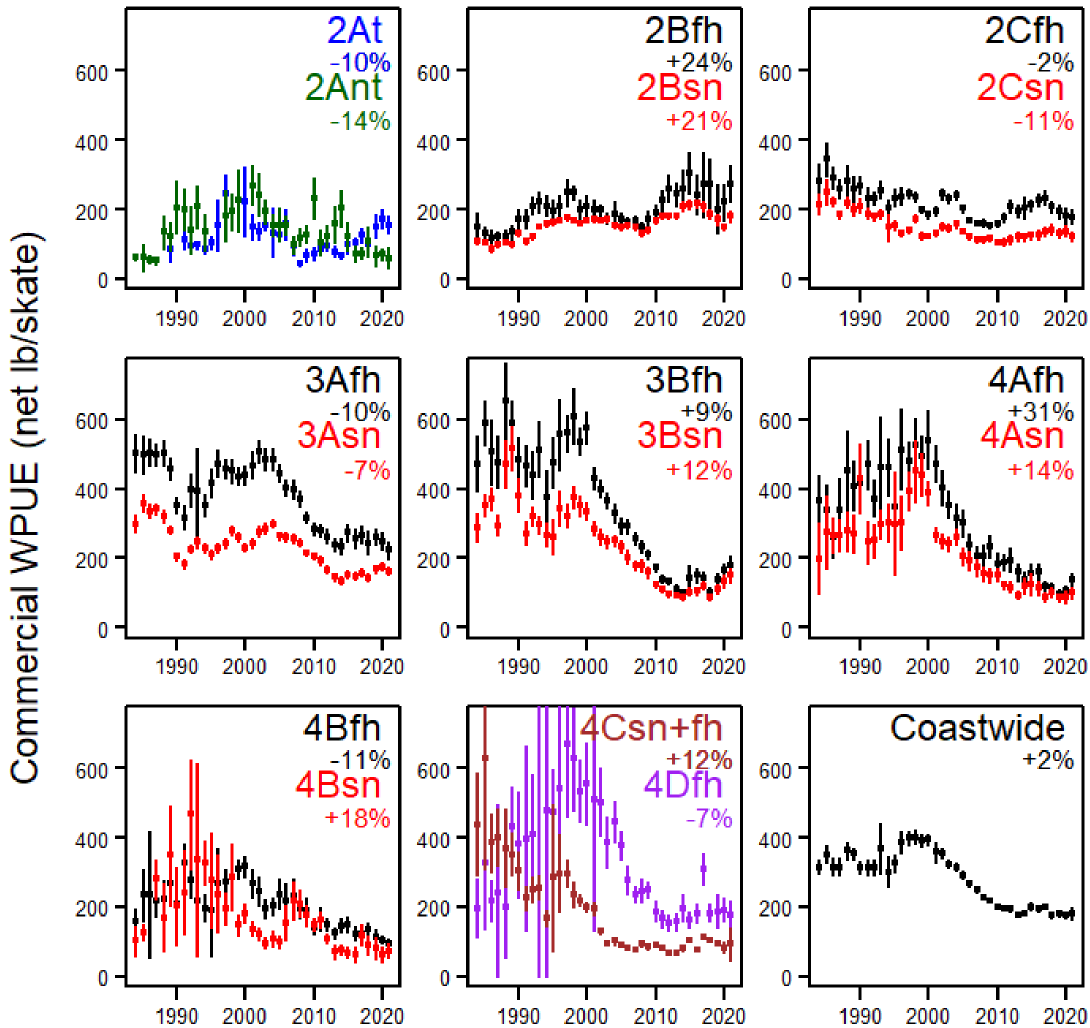


FIGURE 5. Trends in commercial fishery WPUE by IPHC Regulatory Area and fishery or gear, 1984-2021. The tribal fishery in 2A is denoted by "2At", non-tribal by "2Ant", fixed hook catch rates by "fh" and snap gear catch rates by "sn" for IPHC Regulatory Areas 2B-4D. Percentages indicate the change from 2020 to 2021 uncorrected for bias due to incomplete logbooks (see text above). Vertical lines indicate approximate 95% confidence intervals.

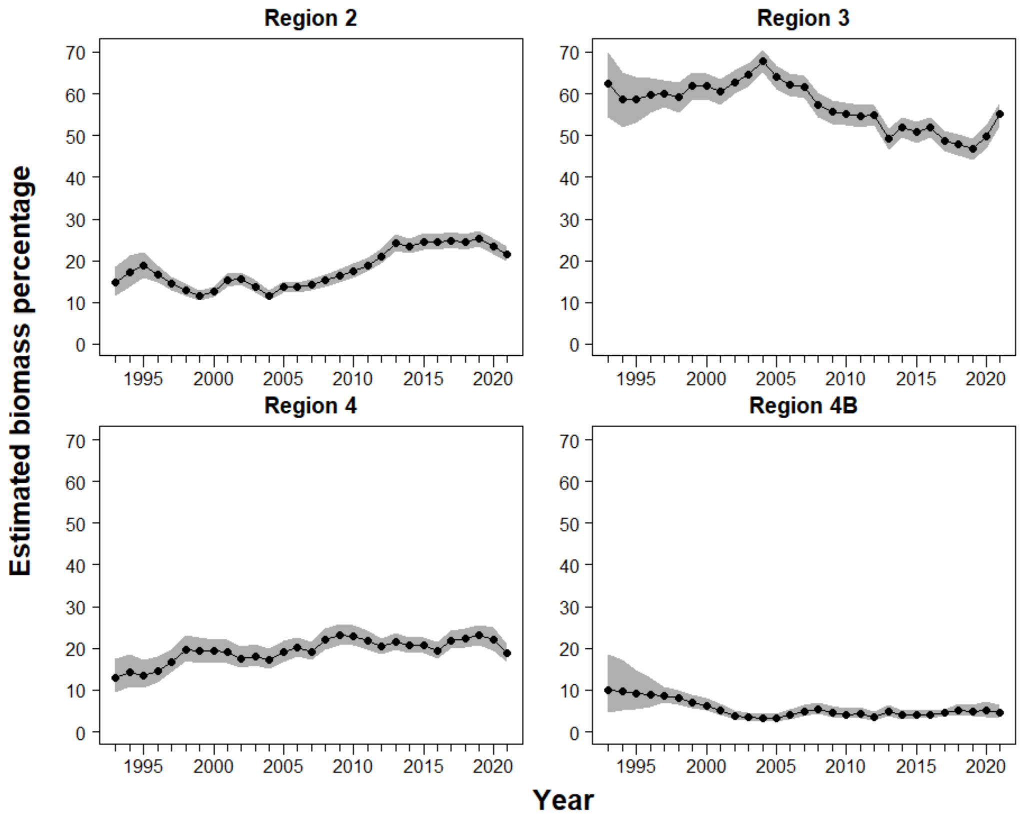


FIGURE 6. Estimated stock distribution (1993-2021) based on modelled survey catch weight of all sizes of Pacific halibut. Shaded zones indicate 95% credible intervals.

TABLE 1. Recent stock distribution estimates by Biological Region based on modelling of all Pacific halibut captured by the FISS.

Year	Region 2 (2A, 2B, 2C)	Region 3 (3A, 3B)	Region 4 (4A, 4CDE)	Region 4B
2017	24.5%	48.3%	22.6%	4.6%
2018	24.1%	47.6%	22.9%	5.4%
2019	24.9%	46.3%	23.8%	5.0%
2020	23.0%	49.4%	22.6%	5.1%
2021	21.3%	54.8%	19.2%	4.7%

STOCK ASSESSMENT

This stock assessment continues to be implemented using the generalized software stock synthesis (Methot and Wetzel 2013). The analysis consists of an ensemble of four equally weighted models: two long time-series models, reconstructing historical dynamics back to the beginning of the modern fishery, and two short time-series models incorporating data only from 1992 to the present, a time-period for which estimates of all sources of mortality and survey indices for all regions are available. For each time-series length, there are two models: one fitting to coastwide aggregate data, and one fitting to data disaggregated into the four Biological Regions. This combination of models includes uncertainty in the form of alternative hypotheses about several important axes of uncertainty, including: natural mortality rates (estimated in the long time-series models, fixed in the short time-series models), environmental effects on recruitment (estimated in the long time-series models), and other model parameters.

The 2019 stock assessment was a full analysis, including a complete re-evaluation of all data sources and modelling choices, particularly those needed to accommodate the newly available sex-ratio at age data from the commercial fishery. The 2020 stock assessment represented an update to the 2019 analysis, adding data sources where available, but retaining the same basic model structure for each of the four component models. The 2021 assessment again updates the same model structure with new data; incremental changes were again documented through a two-part review by the IPHC's scientific review process (IPHC-2021-SRB018-R, IPHC-2021-SRB019-R).

The results of this stock assessment are based on the approximate probability distributions derived from the ensemble of models, thereby incorporating the uncertainty within each model (parameter or estimation uncertainty) as well as the uncertainty among models (structural uncertainty). This uncertainty provides a basis for risk assessment and reduces the potential for abrupt changes in management quantities as improvements and additional data are added to individual models. The four models continue to be equally weighted. Within-model uncertainty was propagated through to the ensemble results via the maximum likelihood estimates and an asymptotic approximation to individual model variance estimates. Point estimates in this stock assessment correspond to median values from the ensemble with the simple probabilistic interpretation that there is an equal probability above or below the reported value.

BIOMASS AND RECRUITMENT TRENDS

The results of the 2021 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2012 (Figure 7). That trend is estimated to have been largely a result of decreasing size-at-age, as well as somewhat weaker recruitment strengths than those observed during the 1980s. The spawning biomass (SB) is estimated to have increased gradually to 2016, and then decreased to an estimated 191 million pounds (~86,600 t) at the beginning of 2022, with an approximate 95% credible interval ranging from 129 to 277 million pounds (~58,700-125,400 t; Figure 8). The recent spawning biomass estimates from the 2021 stock assessment are very consistent with previous analyses, back to 2012 (Figure 9). Prior to that period, the current assessment indicates a high probability of larger biomass than estimated prior to the 2019 stock assessment; this is largely the result of the addition of sex-ratio information for the directed commercial landings. All assessments since 2015 have indicated a decreasing spawning biomass in the terminal year.

Average Pacific halibut recruitment is estimated to be higher (71 and 72% for the coastwide and AAF models respectively) during favorable Pacific Decadal Oscillation (PDO) regimes, a widely recognized indicator of ecosystem productivity in the north Pacific (primarily the Gulf of Alaska). Historically, these regimes included positive conditions prior to 1947, poor conditions from 1947-77, positive conditions from 1978-2006, and poor conditions from 2007-13. Annual averages from 2014 through 2019 were positive, with 2020 and 2021 (through September) showing negative average conditions. Although strongly correlated with historical recruitments, it is unclear whether recent conditions are comparable to those observed in previous decades.

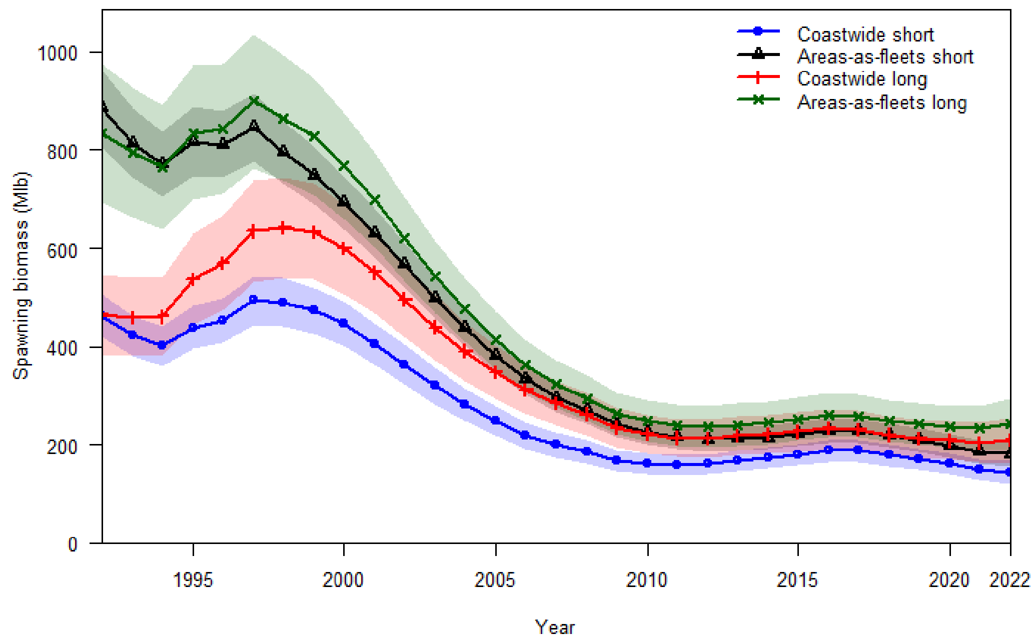


FIGURE 7. Estimated spawning biomass trends (1992-2022) based on the four individual models included in the 2021 stock assessment ensemble. Series indicate the maximum likelihood estimates; shaded intervals indicate approximate 95% credible intervals.

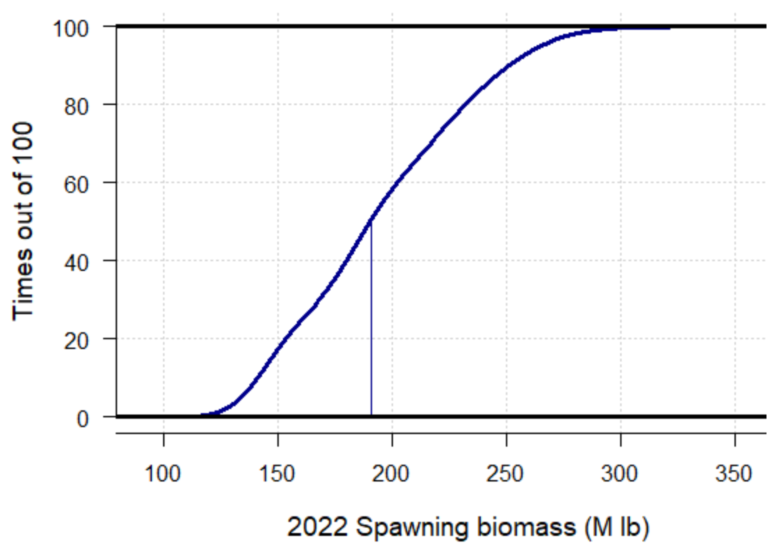


FIGURE 8. Cumulative distribution of the estimated spawning biomass at the beginning of 2022. Curve represents the estimated probability that the biomass is less than or equal to the value on the x-axis; vertical line represents the median (191 million pounds, ~86,600 t).

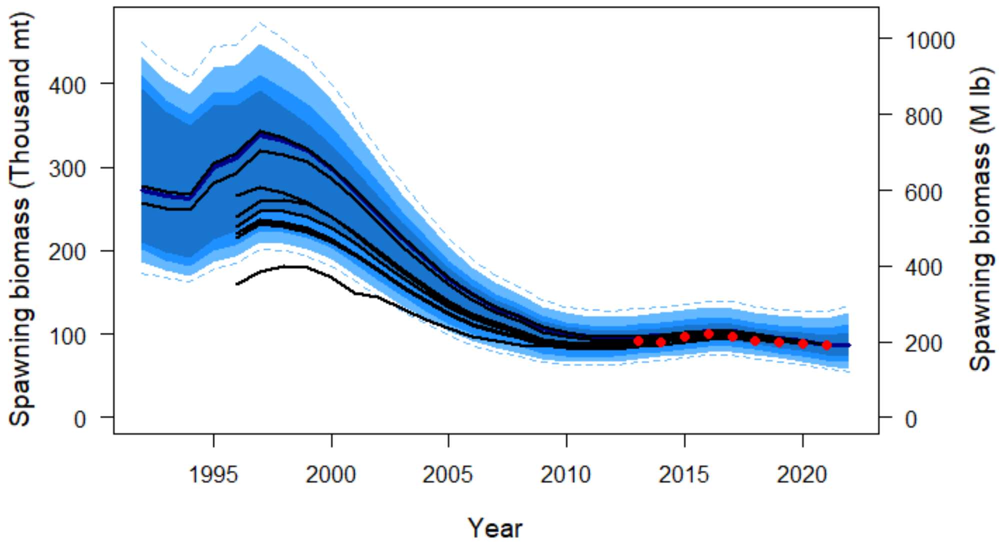


FIGURE 9. Retrospective comparison among recent IPHC stock assessments. Black lines indicate estimates of spawning biomass from assessments conducted in 2012-2020 with the terminal estimate shown as a red point. The shaded distribution denotes the 2021 ensemble: the dark blue line indicates the median (or "50:50 line") with an equal probability of the estimate falling above or below that level; and colored bands moving away from the median indicate the intervals containing 50/100, 75/100, and 95/100 estimates; dashed lines indicating the 99/100 interval.

Pacific halibut recruitment estimates show the recent large cohorts in 1999 and 2005 (Figure 10). Cohorts from 2006 through 2011 are estimated to be much smaller than those from 1999-2005, which has resulted in a decline in both the stock and fishery yield as these low recruitments have moved into the spawning biomass. Based on age data through 2021, individual models in this assessment produced estimates of the 2012 year-classes that are comparable to the magnitude of the 2005 year-class. The 2012 year-class is estimated to be 19% mature in 2021, and the maturation of this cohort has a strong effect on the short-term projections.

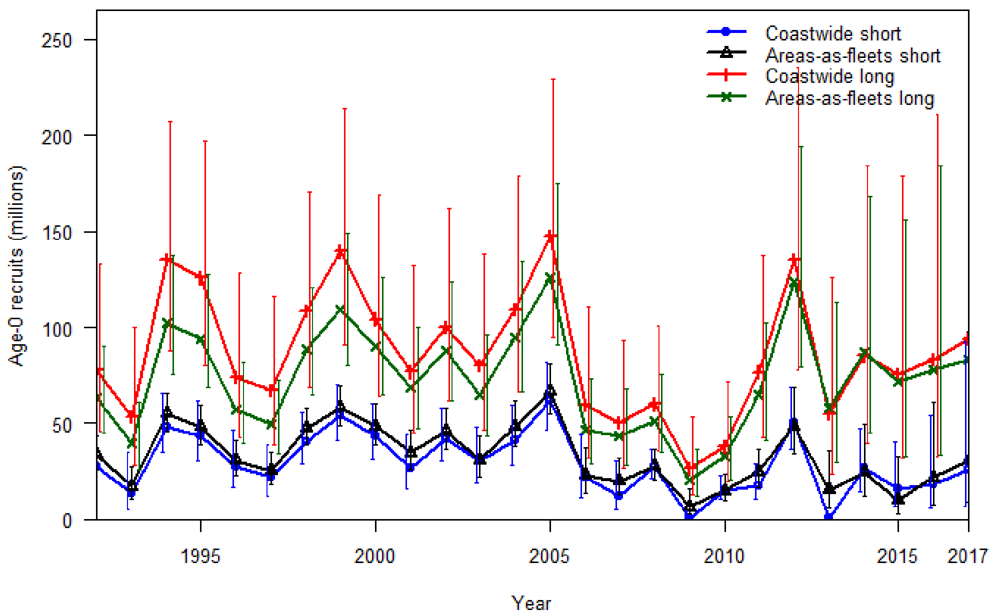


FIGURE 10. Estimated age-0 recruitment trends (1992-2017) based on the four individual models included in the 2021 stock assessment ensemble. Series indicate the maximum likelihood estimates; vertical lines indicate approximate 95% credible intervals.

The IPHC's interim management procedure uses a relative spawning biomass of 30% as a trigger, below which the reference fishing intensity is reduced. At a spawning biomass limit of 20%, directed fishing is halted due to the critically low biomass condition. This calculation is based on recent biological conditions: current weight-at-age and estimated recruitments still influencing the stock. Thus, the 'dynamic' calculation measures only the effect of fishing on the spawning biomass. The relative spawning biomass in 2022 was estimated to be 33% (credible interval: 22-54%) equal to the estimate from 2020, and greater than the values estimated for the previous decade. The probability that the stock is below the $SB_{30\%}$ level is estimated to be 45% at the beginning of 2022, with less than a 1% chance that the stock is below $SB_{20\%}$. The two long time-series models (coastwide and areas-as-fleets) show different results when comparing the current stock size to that estimated at the historical low in the 1970s. The AAF model estimates that recent stock sizes are well below those levels (57%), and the coastwide model above (225%). The relative differences among models reflect both the uncertainty in historical dynamics as well as the importance of spatial patterns in the data and population processes, for which all of the models represent only simple approximations.

The IPHC's interim management procedure specifies a reference level of fishing intensity of a Spawning Potential Ratio (SPR) corresponding to an $F_{43\%}$; this equates to the level of fishing that would reduce the lifetime spawning output per recruit to 43% of the unfished level given current biology, fishery characteristics and demographics. The 2021 fishing intensity is estimated to correspond to $F_{46\%}$ (credible interval: 35-63%; Table 2). Both 2020 and 2021 are estimated to be less than values estimated for the last 20+ years. This drop in fishing intensity corresponds both to reduced mortality limits (2020) and actual mortality below the limits (2020 and 2021). Comparing the relative spawning biomass and fishing intensity over the recent historical period shows that the relative spawning biomass decreased as fishing intensity increased through 2010, then increased as the fishing intensity decreased through 2016, and has been relatively stable since then (Figure 11).

TABLE 2. Status summary of the Pacific halibut stock and fishery in the IPHC Convention Area at beginning of 2022.

Indicators	Values	Trends	Status
BIOLOGICAL			
SPR_{2021}: P(SPR<43%): P(SPR<limit):	46% (35-63%)[2] 47% LIMIT NOT SPECIFIED	FISHING INTENSITY INCREASED FROM 2020 TO 2021	**FISHING INTENSITY BELOW REFERENCE LEVEL[3]**
SB_{2022} (MLBS): SB_{2022}/SB_0: $P(SB_{2022}<SB_{30})$: $P(SB_{2022}<SB_{20})$:	191 (129–277) MLBS 33% (22-54%) 45% <1%	SB DECREASED 17% FROM 2016 TO 2022	**NOT OVERFISHED[4]**
Biological stock distribution:	SEE TABLES AND FIGURES	REGION 3 INCREASING	**WITHIN HISTORICAL RANGES**
FISHERY CONTEXT			
Total mortality 2021: Percent retained 2021: Average mortality 2017–21:	37.66 MLBS, 17,084 T[1] 88% 38.48 MLBS, 17,456 T	MORTALITY INCREASED FROM 2020 TO 2021	**2021 MORTALITY NEAR 100-YEAR LOW**

[1] Weights in this document are reported as 'net' weights, head and guts removed; this is approximately 75% of the round (wet) weight.
[2] Ranges denote approximate 95% credible intervals from the stock assessment ensemble.
[3] Status determined relative to the IPHC's interim reference Spawning Potential Ratio level of 43%.
[4] Status determined relative to the IPHC's interim management procedure biomass limit of $SB_{20\%}$.

MAJOR SOURCES OF UNCERTAINTY

This stock assessment includes uncertainty associated with estimation of model parameters, treatment of the data sources (e.g., short and long time-series), natural mortality (fixed vs. estimated), approach to spatial structure in the data, and other differences among the models included in the ensemble. Although this is an improvement over the use of a single assessment model, there are important sources of uncertainty that are not included.

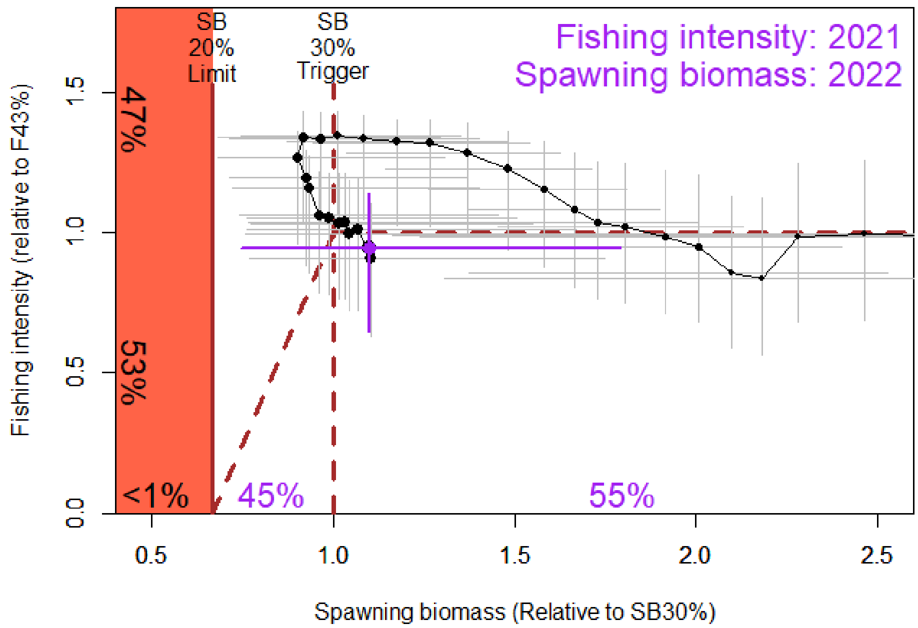


FIGURE 11. Phase plot showing the time-series (1992-2022) of estimated spawning biomass and fishing intensity relative to the reference points specified in the IPHC's interim management procedure. Dashed lines indicate the current $F_{43\%}$ (horizontal) reference fishing intensity, with linear reduction below the $SB_{30\%}$ (vertical) trigger, the red area indicates relative spawning biomass levels below the $SB_{20\%}$ limit. Each year of the time series is denoted by a solid point (credible intervals by horizontal and vertical whiskers), with the relative fishing intensity in 2021 and spawning biomass at the beginning of 2022 shown as the largest point (purple). Percentages along the y-axis indicate the probability of being above and below $F_{43\%}$ in 2021; percentages on the x-axis the probabilities of being below $SB_{20\%}$, between $SB_{20\%}$ and $SB_{30\%}$ and above $SB_{30\%}$ at the beginning of 2022.

The assessment utilized four years (2017-20) of sex-ratio information from the directed commercial fishery landings. However, uncertainty in historical ratios and future fisheries remains unknown. Additional years of data are likely to further inform selectivity parameters and cumulatively reduce uncertainty in stock size in the future. The treatment of spatial dynamics and movement rates among Biological Regions, which are represented via the coastwide and AAF approaches, has large implications for the current stock trend, as evidenced by the different results among the four models comprising the stock assessment ensemble. This assessment also does not include mortality, trends, or explicit demographic linkages in Russian waters, although such linkages may be increasingly important as warming waters in the Bering Sea allow for potentially important exchange across the international border.

Additional important contributors to assessment uncertainty (and potential bias) include the lag in estimation of incoming recruitment between birth year and direct observation in the fishery and survey data (6-10 years). Like most stock assessments, there is no direct information on natural mortality, and increased uncertainty for some estimated components of the fishery mortality. Fishery mortality estimates are assumed to be accurate; therefore, uncertainty due to discard mortality estimation (observer sampling and representativeness), discard mortality rates, and any other documented mortality in either directed or non-directed fisheries (e.g., whale depredation) could create bias in this assessment. Maturation schedules and fecundity are currently under renewed investigation by the IPHC. Currently used historical values are based on visual field assessments, and the simple assumption that fecundity is proportional to spawning biomass and that Pacific halibut do not experience appreciable skip-spawning (physiologically mature fish which do not actually spawn due to environmental or other conditions). To the degree that maturity, fecundity or skip spawning may be temporally variable, the current approach could result in bias in the stock assessment trends and reference points. New information will be incorporated as it becomes available; however, it may take years to better understand trends in these biological processes at the scale of the entire population. Projections beyond three years are avoided due to the lack of mechanistic understanding of the factors influencing size-at-age and relative recruitment strength, the two most important factors in historical population trends.

Due to the many remaining uncertainties in Pacific halibut biology and population dynamics, a high degree of uncertainty in both stock scale and trend will continue to be an integral part of an annual management process. Results of the IPHC's ongoing Management Strategy Evaluation (MSE) process can inform the development management procedures that are robust to estimation uncertainty via the stock assessment, and to a wide range of hypotheses describing population dynamics.

OUTLOOK

Stock projections were conducted using the integrated results from the stock assessment ensemble in tandem with summaries of the 2021 directed and non-directed fisheries. The harvest decision table (Table 3) provides a comparison of the relative risk (in times out of 100), using stock and fishery metrics (rows), against a range of alternative harvest levels for 2022 (columns). The block of rows entitled "Stock Trend" provides for evaluation of the risks to short-term trend in spawning biomass, independent of all harvest policy calculations. The remaining rows portray risks relative to the spawning biomass reference points ("Stock Status") and fishery performance relative to the approach identified in the interim management procedure. The alternatives (columns) include several levels of mortality intended for evaluation of stock and management procedure dynamics including:

- No fishing mortality (useful to evaluate the stock trend due solely to population processes)
- A 30 million pound (~13,600 t) 2022 TCEY
- The mortality at which there is a 50% chance that the spawning biomass will be smaller in three years than in 2022 ("*3-year surplus*")
- The mortality consistent with repeating the TCEY set for 2021 (39.0 million pounds, 17,690 t; *"status quo"*).
- The mortality consistent with the current "Reference" SPR ($F_{43\%}$) level.
- A 60 million pound (~27,200 t) 2022 TCEY

A grid of alternative TCEY values corresponding to SPR values from 40% to 46% is also provided to allow for finer detail across the range of estimated SPR values identified by the MSE process as performing well with regard to stock and fishery objectives. For each column of the decision table, the total fishing mortality (including all sizes and sources), the coastwide TCEY and the associated level of fishing intensity projected for 2022 (median value with the 95% credible interval below) are reported.

The projections for this assessment are more optimistic than those from the 2019 and 2020 assessments due to the increasing projected maturity of the 2012 year-class. This translates to a lower probability of stock decline for 2022 than in recent assessments as well as a decrease in this probability through 2023-24. There is greater than a 50% probability of stock decline in 2023 (55-64/100) for the entire range of SPR values from 40-46%, which include the *status quo* TCEY and the $F_{43\%}$ reference level. The 2022 "3-year surplus" alternative, corresponds to a TCEY of 38.0 million pounds (~17,240 t), and a projected SPR of 48% (credible interval 32-63%; Table 3, Figure 12). At the reference level (a projected SPR of 43%), the probability of spawning biomass decline from 2022 to 2023 is 59%, decreasing to 55% in three years, as the 2012 cohort matures. The one-year risk of the stock dropping below $SB_{30\%}$ ranges from 43% at the $F_{46\%}$ level to 45% at the at the $F_{40\%}$ level of fishing intensity.

TABLE 3. Harvest decision table for 2022 mortality limits. Columns correspond to yield alternatives and rows to risk metrics. Values in the table represent the probability, in "times out of 100" (or percent chance) of a particular risk.

2022 Alternative						3-Year Surplus		*Status quo*		*Reference* $F_{43\%}$					
		Total mortality (M lb)	0.0	31.2	38.7	39.2	39.9	40.2	41.1	42.4	43.8	45.2	46.6	61.2	
		TCEY (M lb)	0.0	30.0	37.5	38.0	38.7	39.0	39.9	41.2	42.6	44.0	45.4	60.0	
		2022 fishing intensity	$F_{100\%}$	$F_{53\%}$	$F_{46\%}$	$F_{46\%}$	$F_{45\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{32\%}$	
		Fishing intensity interval	--	38-69%	32-64%	32-63%	32-63%	31-63%	31-62%	30-61%	29-60%	28-59%	28-59%	21-51%	
Stock Trend (spawning biomass)	in 2023	is less than 2022	<1	39	55	55	56	57	58	59	61	63	64	84	a
		is 5% less than 2022	<1	3	14	16	18	19	21	25	30	34	37	58	b
	in 2024	is less than 2022	<1	39	53	54	55	55	56	58	59	61	62	80	c
		is 5% less than 2022	<1	16	37	39	40	41	43	46	48	50	52	66	d
	in 2025	is less than 2022	<1	33	49	50	51	52	53	55	56	58	60	77	e
		is 5% less than 2022	<1	18	38	39	41	42	43	46	48	50	52	67	f
Stock Status (Spawning biomass)	in 2023	is less than 30%	31	40	43	43	43	43	44	44	44	45	45	48	g
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	h
	in 2024	is less than 30%	16	34	39	39	40	40	41	41	42	43	44	49	i
		is less than 20%	<1	<1	<1	<1	<1	1	1	1	1	1	1	6	j
	in 2025	is less than 30%	4	29	36	37	37	37	38	40	41	42	43	49	k
		is less than 20%	<1	<1	1	1	1	1	1	1	2	2	3	12	l
Fishery Trend (TCEY)	in 2023	is less than 2022	0	21	48	49	49	49	50	50	50	50	51	70	m
		is 10% less than 2022	0	7	41	42	44	45	47	48	49	50	50	58	n
	in 2024	is less than 2022	0	22	48	48	49	49	50	50	50	50	50	69	o
		is 10% less than 2022	0	9	41	42	44	45	46	48	49	50	50	58	p
	in 2025	is less than 2022	0	22	47	48	48	49	49	50	50	50	50	68	q
		is 10% less than 2022	0	10	40	42	43	44	46	48	49	49	50	58	r
Fishery Status (Fishing intensity)	in 2022	is above $F_{43\%}$	0	20	48	49	49	50	50	50	50	50	51	70	s

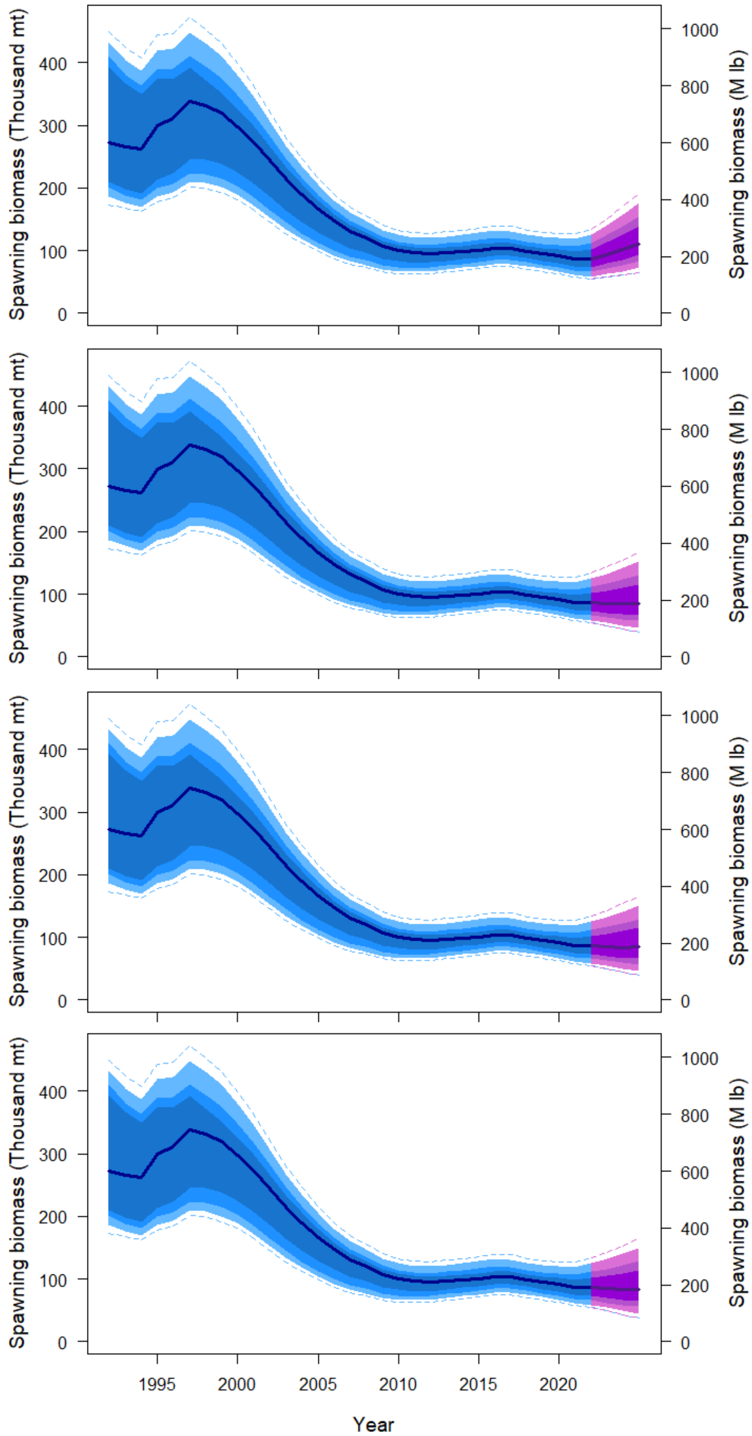


FIGURE 12. Three-year projections of stock trend under alternative levels of mortality: no fishing mortality (upper panel), the 3-year surplus (a TCEY of 38.0 million pounds, ~17,240 t; second panel), the *status quo* TCEY set in 2021 of 39.0 million pounds, 17,690 t; third panel), and the TCEY projected for the IPHC's interim management procedure (41.2 million pounds, 18,690 t; lower panel).

SCIENTIFIC ADVICE

Sources of mortality: In 2021, total Pacific mortality due to fishing increased to 37.66 million pounds (17,084 t) but remained below the 5-year average of 38.48 million pounds (17,456 t). Of that total, 88% comprised the retained catch (Table 2), up from 84% in 2020.

Fishing intensity: The 2021 fishing mortality corresponded to a point estimate of SPR = 46%; there is a 47% chance that fishing intensity exceeded the IPHC's current reference level of $F_{43\%}$ (Table 2). The Commission does not currently have a coastwide fishing intensity limit reference point.

Stock status (spawning biomass): Current (beginning of 2022) female spawning biomass is estimated to be 191 million pounds (86,600 t), which corresponds to an 45% chance of being below the IPHC trigger reference point of $SB_{30\%}$, and less than a 1% chance of being below the IPHC limit reference point of $SB_{20\%}$. The stock is estimated to have declined by 17% since 2016 but is currently at 33% of the unfished state. Therefore, the stock is considered to be '**not overfished**'. Projections indicate that mortality consistent with the interim management procedure reference fishing intensity ($F_{43\%}$) is likely to result in further declining biomass levels in the near future.

Stock distribution: The proportion of the coastwide stock represented by Biological Region 3 has increased sharply over 2020-21, reversing over a decade of steady decline (Figure 6,Table 1). This trend occurs in tandem with declines in Biological Regions 2 and 4; however, all regions remain within the historical range observed from 1993-2021. These estimates have been updated and strongly informed by the comprehensive FISS design implemented in 2021 (IPHC-2022-AM098-07).

RESEARCH PRIORITIES

Research priorities for the stock assessment and related analyses have been consolidated with those for the IPHC's MSE and the Biological Research program and are included in the IPHC's 5-year research plan (IPHC-2022-AM098-11).

DETAILED MANAGEMENT INFORMATION

The IPHC's interim management procedure, in place for 2021-22, includes setting a coastwide TCEY, and also a method for distributing that TCEY among IPHC Regulatory Areas. The distribution method uses the current estimate of stock distribution, relative harvest rates by IPHC Regulatory Area, specific adjustments to the TCEY in IPHC Regulatory Areas 2A and 2B, as well as an increase in the TCEY in IPHC Regulatory Area 2B accounting for the U26 non-directed discard mortality in Alaska. Details of the calculation framework are provided in IPHC-2022-AM098-INF02. The 2022 mortality projection tool will be produced in early January 2022, and will include any end-of-year revisions to mortality estimates from 2021 that are used as a basis for projections.

ADDITIONAL INFORMATION

A more detailed description of the stock assessment (IPHC-2022-SA-01) and the data sources (IPHC-2022-SA-02), will be published directly to the stock assessment page on the IPHC's website. That page also includes recent peer review documents and previous stock assessment documents. Further, the IPHC's website contains many interactive tools for both FISS and commercial fishery information, as well as historical data series that replace appendices and tables from previous year's documents.

RECOMMENDATION/S

That the Commission:

a) **NOTE** paper IPHC-2022-AM098-10 which provides a summary of data, the 2021 stock assessment and the harvest decision table for 2022.

REFERENCES

Kong, T., Tran, H., and Prem, C. 2021. State of the fishery (2021): preliminary statistics. IPHC-2022-IM098-06. 15 p.

IPHC. 2021a. Report of the 19th Session of the IPHC Scientific Review Board (SRB019). Meeting held electronically, 21-23 September 2021. IPHC-2021-SRB019-R. 25 p.

IPHC. 2021b. Report of the 18th session of the IPHC Scientific Review Board (SRB018). IPHC-2021-SRB018-R. 21 p.

Methot, R.D., and Wetzel, C.R. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research **142**(0): 86-99. doi:http://dx.doi.org/10.1016/j.fishres.2012.10.012.

Planas, J. 2022. IPHC 5-year biological and ecosystem science research plan: update. IPHC-2022-AM098-11. 13 p.

Stewart, I. 2022. The IPHC mortality projection tool for 2022 mortality limits. IPHC-2022-AM098-INF02. 5 p.

Stewart, I., and Hicks, A. 2021. Assessment of the Pacific halibut (*Hippoglossus stenolepis*) stock at the end of 2020. IPHC-2021-SA-01. 33 p.

Stewart, I., and Hicks, A. 2022. Assessment of the Pacific halibut (*Hippoglossus stenolepis*) stock at the end of 2021. IPHC-2022-SA-01. 36 p.

Stewart, I., and Webster, R. 2022. Overview of data sources for the Pacific halibut stock assessment, harvest policy, and related analyses. IPHC-2022-SA-02. 56 p.

Ualesi, K., Wilson, D., Jones, C., Rillera, R., and Jack, T. 2022. IPHC Fishery Independent Setline Survey (FISS) design and implementation in 2021. IPHC-2022-AM098-07. 13 p.

Webster, R. 2022. Space-time modelling of survey data. IPHC-2022-AM098-08. 6 p.

IPHC 5-year Biological and Ecosystem Science Research Plan: Update

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, 10 DECEMBER 2021)

PURPOSE

To provide the Commission with a description of progress on the IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21).

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;
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 Biological and Ecosystem Science Research Plan (2017-21). 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 Distribution. Studies are aimed at further understanding reproductive migration and identification of spawning times and locations as well as larval and juvenile dispersal.
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 and Physiological Condition. Studies are aimed at describing the role of some of the factors responsible for the observed changes in size-at-age and to provide tools for measuring growth and physiological condition in Pacific halibut.
4) Discard Mortality Rates (DMRs) and Survival. Studies are aimed at providing updated estimates of DMRs in both the longline and the trawl fisheries.
5) Genetics and Genomics. Studies are aimed at describing the genetic structure of the Pacific halibut population and at providing the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences.

UPDATE ON PROGRESS ON THE MAIN RESEARCH ACTIVITIES

1. Migration and Distribution.

   Research activities in this Research Area aim at improving existing knowledge on Pacific halibut larval and juvenile distribution. The relevance of research outcomes from these activities for stock assessment (SA) is in the improvement of estimates of productivity. These 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 SA (Appendix II). The relevance of these research outcomes for the management and strategy evaluation (MSE) process is in the improvement of the parametrization of the Operating Model and represent the top ranked biological input into the MSE (Appendix III).

1.1. Larval distribution and connectivity between the Gulf of Alaska and Bering Sea.
Principal Investigator: Lauri Sadorus (M.Sc.)
Objective: To investigate larval and juvenile connectivity of Pacific halibut within and between the Gulf of Alaska and the Bering Sea.

Knowledge of the dispersal of Pacific halibut larvae and subsequent migration of young juveniles has remained elusive because traditional tagging methods are not effective on these life stages due to the small size of the animals. This larval connectivity project, in cooperation with NOAA EcoFOCI, used two recently developed modeling approaches to estimate dispersal and migration pathways of larval and young juvenile Pacific halibut in order to better understand the connectivity of populations between the Gulf of Alaska and Bering Sea and within each of these two ocean basins. The results of this initial study have been published in the journal *Fisheries Oceanography* (Sadorus et al., 2021). Additional studies are currently planned to investigate the potential of Pacific halibut larvae to be successfully delivered from offshore spawning sites to potential inshore settlement habitats identified by the IPHC Secretariat, under different climatic regimes.

1.2. Wire tagging of U32 Pacific halibut.
Principal Investigator: Joan Forsberg (B.Sc.; Fisheries Statistics & Services Branch)
Objective: To investigate the migratory patterns of young Pacific halibut.

The patterns of movement of Pacific halibut among IPHC Regulatory Areas have important implications for management of the Pacific halibut fishery. The IPHC Secretariat has undertaken a long-term study of the migratory behavior of Pacific halibut through the use of externally visible tags (wire tags) on captured and released fish that must be retrieved and returned by workers in the fishing industry. In 2015, with the goal of gaining additional insight into movement and growth of young Pacific halibut (less than 32 inches [82 cm]; U32), the IPHC began wire-tagging small Pacific halibut encountered on the National Marine Fisheries Service (NMFS) groundfish trawl survey and, beginning in 2016, on the IPHC fishery-independent setline survey (FISS). In 2021, 2,534 Pacific halibut were tagged and released on the IPHC FISS but no tagging was conducted in the NMFS groundfish trawl surveys. Therefore, a total of 6,111 U32 Pacific halibut have been wire tagged and released on the IPHC FISS and 126 of those have been recovered to date. In the NMFS groundfish trawl surveys through 2019, a total of 6,536 tags have been released and, to date, 76 tags have been recovered.

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), and represent the most important biological inputs for stock assessment. 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).

2.1. Sex ratio of the commercial landings.
Principal Investigators: Crystal Simchick (B.Sc.)
Objective: To provide information on the sex ratio of the commercial landings.

The IPHC Secretariat has completed the processing of genetic samples from the 2020 aged commercial landings. The IPHC Secretariat has now produced four consecutive years of commercial catch sex-ratio information (2017-2020) that will inform selectivity parameters and cumulatively reduce uncertainty in future estimates of stock size.

2.2. Maturity assessment.
Principal Investigator: Josep Planas (Ph.D.)
Objective: To characterize maturity and fecundity in female Pacific halibut.

Recent sensitivity analyses have shown the importance of changes in spawning output due to skip spawning and/or changes in maturity schedules for stock assessment (Stewart and Hicks, 2018). Information of these key reproductive parameters provides direct input to stock assessment. For example, information on fecundity-at-age and –at-size could be used to replace spawning biomass with egg output as the metric of reproductive capability in the stock assessment and management reference points. This information highlights the need for a better understanding of factors influencing reproductive biology and reproductive success of Pacific halibut. In order to fill existing knowledge gaps related to the reproductive biology of female Pacific halibut, research efforts are devoted to characterize female maturity in this species. Specific objectives of current studies include: 1) histological assessment of the temporal progression of female developmental stages and reproductive phases throughout an entire reproductive cycle; 2) investigation of skip-spawning in females; and 3) fecundity estimations.

The IPHC Secretariat has described for the first time the different oocyte stages that are present in the ovary of female Pacific halibut and how these are used to classify females histologically to specific maturity stages. This information is contained in a manuscript that was published in the *Journal of Fish Biology* (Fish et al., 2020). In brief, 8 different oocyte developmental stages have been described, from early primary growth oocytes until preovulatory oocytes, and their size and morphological characteristics established. Maturity classification was determined by assigning maturity status to the most advanced oocyte developmental stage present in ovarian tissue sections and 7 different microscopic maturity stages were established. Analysis of oocyte size frequency distribution among the seven different maturity stages provided the first direct evidence for the group-synchronous pattern of oocyte development and for determinate fecundity as the reproductive strategy in female Pacific halibut. The results of this study will be instrumental to establish a comparison of the microscopic/histological and macroscopic/field classification criteria that are currently used to assign the maturity status of females that is used in stock assessment. This first study set the stage for a subsequent in-depth study that investigate the temporal changes in reproductive development, as assessed by microscopic observations of ovarian samples collected throughout an entire annual reproductive cycle and that is now completed (Fish et al. in review). The results obtained confirm that the peak period of spawning for Pacific halibut in the central Gulf of Alaska takes place in January and February and that Pacific halibut females spawn following an annual reproductive cycle. Analysis of the temporal changes in female reproductive phase shows that spawning capable females are detected as early as August, therefore marking the beginning of the spawning capable reproductive phase. For stock assessment purposes, the spawning capable reproductive phase comprises females that are considered mature. Importantly, the detection of spawning capable females in July-August is conducive to conducting routine histological assessments of female maturity during the IPHC's FISS sample collection period (i.e. June to late August). As a result of this information, the IPHC Secretariat will collect ovarian samples in each of the four Biological Regions in order to conduct histology-based maturity curves to revise the current maturity schedule and to investigate potential spatial differences in maturity schedules.

Furthermore, the IPHC Secretariat is also establishing a comparison of the microscopic (e.g. histological) and macroscopic (e.g. visual) maturity classification criteria to determine whether field classification criteria that are currently used to assign the maturity status of females that is used in stock assessment needs to be revised in light of the improved knowledge on ovarian development.

3. Growth.
Principal Investigator: Josep Planas (Ph.D.)
Objective: To investigate somatic growth variation as a driver for changes in size-at-age.

Research activities conducted in the Research Area on Growth 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 (Appendix II). The relevance of these research outcomes for the management and strategy evaluation process is in the improvement of the simulation of variability and to allow for scenarios investigating climate change (Appendix III).

The IPHC Secretariat has conducted studies aimed at elucidating the drivers of somatic growth leading to the decline in size-at-age by investigating the physiological mechanisms that contribute to growth changes in the Pacific halibut. The two main objectives of these studies have been: 1) the identification and validation of physiological markers for somatic growth; and 2) the application of molecular growth markers for evaluating growth patterns in the Pacific halibut population.

The IPHC Secretariat has completed a study funded by the North Pacific Research Board (NPRB Project No. 1704; 2017-2020) to identify relevant physiological markers for somatic growth. This study resulted in the identification of 23 markers in skeletal muscle that were indicative of temperature-induced growth suppression and 10 markers in skeletal muscle that were indicative of temperature-induced growth stimulation. These markers represented genes and proteins that changed both their mRNA expression levels and abundance levels in skeletal muscle, respectively, in parallel with changes in the growth rate of Pacific halibut. A manuscript describing the results of this study is currently in preparation (Planas et al., In Preparation).

In addition to temperature-induced growth manipulations, the IPHC Secretariat has conducted similar studies as part of NPRB Project No. 1704 to identify physiological growth markers that respond to density- and stress-induced growth manipulations. The respective justifications for these studies are that (1) population dynamics of the Pacific halibut stock could be affected by fish density, and (2) stress responses associated with capture and release of discarded Pacific halibut may affect subsequent feeding behavior and growth. Investigations related to the effects of density and stress exposure are still underway.

4. Discard Mortality Rates (DMRs) and Survival Assessment.
Information on all Pacific halibut removals is integrated by the IPHC Secretariat, providing annual estimates of total mortality from all sources for its stock assessment (SA). Bycatch and wastage of Pacific halibut, as defined by the incidental catch of fish in non-target fisheries and by the mortality that occurs in the directed fishery (i.e. fish discarded for sublegal size or for regulatory reasons), respectively, represent important sources of mortality that can result in significant reductions in exploitable yield in the directed fishery. Given that the incidental mortality from the commercial Pacific halibut fisheries and bycatch fisheries is included as part of the total removals that are accounted for in the SA, changes in the estimates of incidental mortality will influence the output of the SA and, consequently, the catch levels of the directed fishery. Research activities conducted in this Research Area aim at providing information on discard mortality rates and producing guidelines for reducing discard mortality in Pacific halibut in the longline and recreational fisheries. The relevance of research outcomes from these activities for SA resides in their ability to improve trends in unobserved mortality in order to improve estimates of stock productivity and represent the most important inputs in fishery yield for SA (Appendix II). The relevance of these research outcomes for the management and strategy evaluation process is in fishery parametization (Appendix III).

For this reason, the IPHC Secretariat is conducting two research projects to investigate the effects of capture and release on survival and to improve estimates of DMRs in the directed longline and guided recreational Pacific halibut fisheries:

4.1. Evaluation of the effects of hook release techniques on injury levels and association with the physiological condition of captured Pacific halibut and estimation of discard mortality using remote-sensing techniques in the directed longline fishery.

Principal Investigator: Claude Dykstra (B.Sc.)
Objective: To provide estimates of discard mortality and best-handling practices in the Pacific halibut directed fishery.

The IPHC Secretariat, with funding by a grant from the Saltonstall-Kennedy Grant Program NOAA (NA17NMF4270240; 2017-2020), has conducted studies to evaluate the effects of hook release techniques on injury levels, their association with the physiological condition of captured Pacific halibut and, importantly, has generated experimentally-derived estimates of discard mortality rate (DMR) in the directed longline fishery. The initial results on individual survival outcomes for Pacific halibut released in excellent condition as the viability category assigned to the fish following capture indicate a range of DMRs between 4.2% (minimum) and 8.4% (maximum), that is consistent with the currently-applied DMR value of 3.5%. A manuscript describing these results has been accepted for publication in the *Journal of North American Fishery Management* (Loher et al., In Press).

The IPHC Secretariat is currently conducting modeling analyses of potential relationships between individual physiological characteristics of discarded Pacific halibut, environmental conditions and handling practices, as well as on the ability of electronic monitoring systems to capture release methods and individual lengths of captured fish.

4.2. Discard mortality rates of Pacific halibut in the charter recreational fishery.
Principal Investigator: Claude Dykstra (B.Sc.)
Objective: To provide estimates of discard mortality and best-handling practices in the Pacific halibut guided recreational fishery.

The IPHC Secretariat is conducting a research project to better characterize the nature of charter recreational fisheries with the ultimate goal of better understanding discard practices relative to that which is employed in the directed longline fishery. This project has received funding from the National Fish and Wildlife Foundation (NFWF Project No. 61484) and the North Pacific Research Board (NPRB Project No. 2009) (Appendix IV). The experimental field components of this research project took place in Sitka, Alaska (IPHC Regulatory Area 2C) from 21-27 May 2021, and in Seward, Alaska (IPHC Regulatory Area 3A) from 11-16 June 2021. In brief, Pacific halibut were captured with the use of 12/0 and 16/0 circle hooks that best reflect the gear currently used and fish sizes were targeted to cover the Pacific halibut size distribution recorded by ADFG on an annual basis. All injuries were documented, along with length, weight, somatic fat measurements (using the Distell Fatmeter), and a blood sample (for measuring the levels of physiological stress indicators in plasma) was collected for each fish, before they were tagged and released. Environmental information on temperature (bottom/surface) and time (fight time, time on deck) was also tracked. Eighty (80) Pacific halibut of Excellent release viability were fitted with satellite pop-up archival tags (sPAT) for near term survival estimation in IPHC Regulatory Area 3A. Analyses of survival data and levels of blood stress indicators are currently underway.

5. Genetics and genomics.
   Principal Investigator: Andy Jasonowicz (M.Sc.)
   Objective: To investigate the genetic structure of the Pacific halibut population and to conduct genetic analyses to inform on Pacific halibut movement and distribution in the Convention Waters.

   The IPHC Secretariat is conducting studies that incorporate genomics approaches in order 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).

   Understanding population structure is imperative for sound management and conservation of natural resources (Hauser, 2008). Pacific halibut in Canadian and USA waters are managed by the International Pacific Halibut Commission (IPHC) as a single coastwide unit stock since 2006. The rationale behind this management approach is based on our current knowledge of the highly migratory nature of Pacific halibut as assessed by tagging studies (Webster et al., 2013) and of past analyses of genetic population structure that failed to demonstrate significant differentiation in the North-eastern Pacific Ocean population of Pacific halibut by allozyme (Grant, 1984) and small-scale microsatellite analyses (Bentzen, 1998; Nielsen *et al.*, 2010). However, more recent studies have reported slight genetic population structure on the basis of genetic analysis conducted with larger sets of microsatellites suggesting that Pacific halibut captured in the Aleutian Islands may be genetically distinct from other areas (Drinan et al., 2016). These findings of subtle genetic structure in the Aleutian Island chain area are attributed to limited movement of adults and exchange of larvae between this area and the rest of the stock due to the presence of oceanographic barriers to larval and adult dispersal (i.e. Amchitka Pass) that could represent barriers to gene flow. Unfortunately, genetic studies suggesting subtle genetic structure (Drinan et al., 2016) were conducted based on a relatively limited set of microsatellite markers and, importantly, using genetic samples collected in the summer (i.e. non-spawning season) that may not be representative of the local spawning population. With the collection of winter (i.e. spawning season) genetic samples in the Aleutian Islands by the IPHC in early 2020, a collection of winter samples from 5 different geographic areas across the North-eastern Pacific Ocean (i.e. British Columbia, Central Gulf of Alaska, Bering Sea, Central and Western Aleutian Islands) is now available to re-examine the genetic structure of the Pacific halibut population. Importantly, novel, high-throughput and high-resolution genomics approaches are now available for use, such as low-coverage whole genome resequencing, in order to describe with unprecedented detail the genetic structure of the Pacific halibut population. The recently sequenced Pacific halibut genome, described in a manuscript currently in review in a peer-reviewed journal (Jasonowicz et al., 2021) constitutes an essential resource for the success of the whole genome resequencing approach. The results from the proposed genomic studies will provide important information on spawning structure and, consequently, on the genetic baselines of source populations. Importantly, the results from these studies will provide management advice regarding the relative justifiability for considering the western Aleutians as a genetically-distinct substock. This work has recently received funding from the North Pacific Research Board (NPRB Project No. 2110) (Appendix IV).

6. Other research.

The IPHC Secretariat (PI's: Mr. Claude Dykstra and Dr. Ian Stewart) has been successful in securing funding from NOAA's 2021 Bycatch Reduction Engineering Program (BREP) to conduct a project entitled "Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries" (Appendix IV). This project aims to identify potential methods for protecting hook captured fish from whale depredation and to develop and field-test several simple low-cost catch-protection designs that can be deployed effectively using current longline fishing techniques. The proposed work entails conducting a workshop with industry (affected fishers, gear researchers, scientists) in February 2022 to identify methods to protect fishery catches from depredation. The top two or three catch protection design outcomes from the workshop will be incorporated into functional prototypes and field tested later in 2022 on longline sea trials targeting flatfish.

RECOMMENDATION/S

That the Commission **NOTE** paper IPHC-2022-AM098-11 which outlines progress on the IPHC 5-year Biological and Ecosystem Science Research Plan.

References

Bentzen, P., Britt, J., and Kwon, J., 1998. Genetic variation in Pacific halibut (*Hippoglossus stenolepis*) detected with novel microsatellite markers. Report of Assessment and Research Activities. International Pacific Halibut Commission, Seattle, WA, pp. 229–241.

Drinan, D.P., Galindo, H.M., Loher, T., and Hauser, L., 2016. Subtle genetic population structure in Pacific halibut *Hippoglossus stenolepis*. Journal of Fish Biology 89, 2571-2594.

Drinan, D.P., Loher, T., and Hauser, L., 2018. Identification of Genomic Regions Associated With Sex in Pacific Halibut. Journal of Heredity 109, 326-332.

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

Fish, T., Wolf, N., Smeltz, T. S., Harris, B. P., Planas, J. V. 2021. Reproductive biology of female Pacific halibut (*Hippoglossus stenolepis*) in the Gulf of Alaska. Frontiers in Marine Science. (In Review).

Grant, W.S., Teel, D. J., and Kobayashi, T., 1984. Biochemical Population Genetics of Pacific Halibut (*Hippoglossus stenolepis*) and Comparison with Atlantic Halibut (*Hippoglossus hippoglossus*). Canadian Journal of Fisheries and Aquatic Sciences 41, 1083-1088.

Hauser, L., and Carvalho, G. R., 2008. Paradigm shifts in marine fisheries genetics: ugly hypotheses slain by beautiful facts. Fish and Fisheries 9, 333-362.

Jasonowicz, A.C., 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. 2021. Generation of a chromosome-level genome assembly for Pacific halibut (*Hippoglossus stenolepis*) and characterization of its sex-determining genomic region. Molecular Ecology Resources (In Review).

Loher, T., Dykstra, C.L., Hicks, A., Stewart, I.J., Wolf, N., Harris, B.P., Planas, J.V. 2021. Estimation of post-release longline mortality in Pacific halibut (*Hippoglossus stenolepis*) using acceleration-logging tags. North American Journal of Fisheries Management (In Press).

Nielsen, J.L., Graziano, S.L., Seitz, A.C., 2010. Fine-scale population genetic structure in Alaskan Pacific halibut (*Hippoglossus stenolepis*). Conservation Genetics 11, 999-1012.

Planas, J.V., Jasonowicz, A., Simeon, A., Rudy, D., Timmins-Schiffman, E., Nunn, B.L., Kroska, A., Wolf, N., and Hurst, T.P. Physiological signatures of temperature-induced growth manipulations in white skeletal muscle of juvenile Pacific halibut (*Hippoglossus stenolepis*). (In Preparation).

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

Stewart, I.J., and Hicks, A. 2020. Assessment of the Pacific halibut (*Hippoglossus stenolepis*) stock at the end of 2019. Int. Pac. Halibut Comm. Annual Meeting Report: IPHC-2020-SA-01.

Webster, R.A., Clark, W.G., Leaman, B.M., Forsberg, J.E., Hilborn, R., 2013. Pacific halibut on the move: a renewed understanding of adult migration from a coastwide tagging study. Canadian Journal of Fisheries and Aquatic Sciences 70, 642-653.

APPENDICES

Appendix I: Integration of ongoing biological research activities, stock assessment and management strategy evaluation.

Appendix II: List of ranked biological uncertainties and parameters for stock assessment and their links to potential research areas and research activities (2017-21)

Appendix III: List of ranked biological uncertainties and parameters for management strategy evaluation and their potential links to research areas and research activities (2017-21)

Appendix IV: Summary of awarded collaborative research grants current in 2021

APPENDIX I

Integration of ongoing biological research activities, stock assessment and management strategy evaluation

Research areas	Research activities	Research outcomes	Relevance for stock assessment	Relevance for MSE	Specific analysis input	SA Rank (Top 3)	MSE Rank (Top 3)
Migration	Larval and juvenile connectivity and early life history studies	Improved understanding of larval and juvenile distribution	Improve estimates of productivity	Improve parametrization of the Operating Model	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
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	
	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		
	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		
	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		
	Sex ratio of current commercial landings	Sex ratio-at-age	Scale biomass and fishing intensity		Annual sex-ratio at age for the commercial fishery fit by the stock assessment	1. Assessment data collection and processing	
	Historical sex ratios based on archived otolith DNA analyses	Historical sex ratio-at-age			Annual sex-ratio at age for the commercial fishery fit by the stock assessment		
	Recruitment strength and variability	Establishment of temporal and spatial maturity and spawning patterns	Improve stock-recruitment curve for more precise assessment	Improve simulation of recruitment variability and parametization of recruitment distribution in the Operating Model	May be used to provide a weighted spawning biomass calculation and or inform targets for minimum spawning biomass by Biological Region		2. Biological parameterization and validation of recruitment variability and distribution
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
		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		
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 parameterization
	Discard mortality rate estimate: recreational fishery				Will improve estimates of discard mortality, reducing potential bias in stock assessment results and management of mortality limits		2. Fishery parameterization
	Best handling practices: longline fishery	Guidelines for reducing discard mortality			May reduce discard mortality, thereby increasing available yield for directed fisheries		
	Best handling practices: recreational fishery	Guidelines for reducing discard mortality			May reduce discard mortality, thereby increasing available yield for directed fisheries		
Genetics and genomics	Population structure	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area	Altered structure of future stock assessments	Improve parametrization 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.
	Distribution	Assignment of individuals to source populations and assessment of distribution changes			Will be used to define management targets for minimum spawning biomass by Biological Region	3. Biological input	2. Biological parameterization and validation of recruitment distribution

APPENDIX II

List of ranked biological uncertainties and parameters for stock assessment and their links to potential research areas and research activities (2017-21)

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	Genetics and Genomics	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	Migration	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	Mortality and survival assessment	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	Mortality and survival assessment	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 biological uncertainties and parameters for management strategy evaluation (MSE) and their potential links to research areas and research activities (2017-21)

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

APPENDIX IV

Summary of awarded collaborative research grants current in 2021

Project #	Grant agency	Project name	PI	Partners	IPHC Budget ($US)	Management implications	Grant period
1	**National Fish & Wildlife Foundation**	Improving the characterization of discard mortality of Pacific halibut in the recreational fisheries (NFWF Award No. 61484)	IPHC Dr J. Planas and Mr Claude Dykstra	Alaska Pacific University, U of A Fairbanks, charter industry	$98,902	Bycatch estimates	1 April 2019 – 1 November 2021
2	**North Pacific Research Board**	Pacific halibut discard mortality rates (NPRB Award No. 2009)	IPHC Dr. J. Planas	Alaska Pacific University	$210,502	Bycatch estimates	1 January 2021 – 31 March 2022
3	**Bycatch Reduction Engineering Program-NOAA**	Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries (NOAA Award Number NA21NMF4720534)	IPHC Mr. Claude Dykstra and Dr. I. Stewart	Deep Sea Fishermen's Union, Alaska Fisheries Science Center-NOAA, industry representatives	$99,700	Whale depredation	1 November 2021 – 30 April 2022
4	**North Pacific Research Board**	Pacific halibut population genomics (NPRB Award No. 2110)	IPHC Dr. J. Planas	Alaska Fisheries Science Center-NOAA	$193,685	Stock structure	1 December 2021 – 31 January 2024
		Total awarded ($)			**$602,789**		

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Update on the IPHC Secretariat MSE Program of Work (2021–2023)

PREPARED BY: IPHC SECRETARIAT (A. HICKS & I. STEWART; 10 DECEMBER 2021)

PURPOSE

To provide the Commission with an update of progress on the Management Strategy Evaluation (MSE) program of work for 2021–2023.

1 INTRODUCTION

The current interim management procedure (MP) at the International Pacific Halibut Commission (IPHC) is shown in Figure 1.

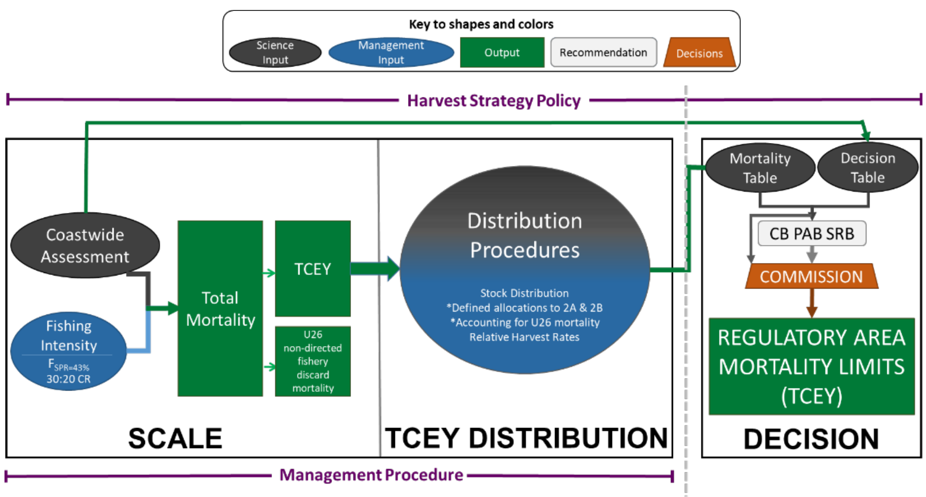


Figure 1. Illustration of the Commission interim IPHC harvest strategy policy (reflecting paragraph ID002 in IPHC-2020-CR-007) showing the coastwide scale and TCEY distribution components that comprise the management procedure. Items with an asterisk are interim agreements in place through 2022. The decision component is the Commission decision-making procedure, which considers inputs from many sources.

The Management Strategy Evaluation (MSE) at the IPHC completed an evaluation in 2021 of management procedures (MPs) relative to the coastwide scale and distribution of the Total Constant Exploitation Yield (TCEY) to IPHC Regulatory Areas for the Pacific halibut fishery using a recently developed framework. The development of this MSE framework supports the evaluation of the trade-offs between fisheries management scenarios. The MSE framework with a multi-area operating model (OM) and three options for examining estimation error is described in Hicks et al. (2020) with technical details available in IPHC-2021-MSE-01. Descriptions of the MPs evaluated and simulation results are presented in Hicks et al. (2021). Additional tasks were identified at the 11th Special Session of the IPHC (IPHC-2021-SS011-R) to supplement and extend this analysis for future evaluation (Table 1). Document IPHC-2021-MSE-02 contains details of the current MSE Program of Work.

Table 1. Tasks recommended by the Commission at SS011 (IPHC-2021-SS011-R para 7) for inclusion in the IPHC Secretariat MSE Program of Work for 2021–2023.

ID	Category	Task	Deliverable
F.1	Framework	Develop migration scenarios	Develop OMs with alternative migration scenarios
F.2	Framework	Implementation variability	Incorporate additional sources of implementation variability in the framework
F.3	Framework	Develop more realistic simulations of estimation error	Improve the estimation model to more adequately mimic the ensemble stock assessment
F.5	Framework	Develop alternative OMs	Code alternative OMs in addition to the one already under evaluation.
M.1	MPs	Size limits	Identification, evaluation of size limits
M.3	MPs	Multi-year assessments	Evaluation of multi-year assessments
E.3	Evaluation	Presentation of results	Develop methods and outputs that are useful for presenting outcomes to stakeholders and Commissioners

This document provides updates on the progress for the framework related tasks and the MP related tasks. Potential improvements to the evaluation and presentation of results are provided in this document and work will continue in 2022 with input from the MSAB.

2 FRAMEWORK

The framework category consists of three tasks (F.1, F.2, and F.3) that will improve the OM and lead to the completion of the fourth task (F.5) to develop alternative operating models. Current progress on these tasks are reported here.

2.1 Task F.1: Develop migration scenarios

Conditioned movement rates at age in the current OM differed from historically estimated rates for some Regions. This may be due to a number of reasons, two of which are described below.

First, the estimated movement rates from past data may have been reflective of smaller spatial and temporal scales than the entire IPHC Convention Area covered in the OM. The OM was not conditioned to the same observations that the data-determined movement rates were estimated from. Instead, the OM was attempting to describe broad scale historical population trends over the last 100+ years.

Second, the distribution of age-0 recruits (called recruitment distribution) was fixed at the same proportions for each Biological Region over all years in the OM, but it is likely that these proportions vary across years. Time-varying recruitment distribution has an effect on estimated movement because it places age-0 recruits in specific regions and movement rates must 'move' the fish to the places they are expected to be based on data that are representative of older fish. If the distribution of recruits is not correct, movement rates will be estimated differently in the OM than from direct observations of adult movement.

Sadorus et al. (2020) found that recruits were more likely to end up the Bering Sea in "warm years" for most spawning areas in the Gulf of Alaska. Furthermore, "cold years" were likely to have less dispersal to the west in the Bering Sea and "warm years" were more likely to have more dispersal to the northwest from spawning in the Western Gulf of Alaska. Therefore, in the OM with four Biological Regions this may be modelled by allowing the recruitment distribution to change with the phase of the Pacific Decadal Oscillation (PDO; Mantua et al. 1997), thus higher proportions of recruits would go to Regions 4 and 4B in years of a positive PDO.

The OM code was updated in 2021 to allow for time-varying recruitment distribution that is tied to the low and high phases of the PDO, as defined in the stock assessment. Initial investigations conditioning the OM with time-varying recruitment distribution showed the expected pattern of the proportion recruited to western regions (Figure 2), improved expectations of movement rates (relative to historical estimates), and produced similar fits to the spawning biomass trajectory (estimated from the stock assessment ensemble) and distribution of O32 Pacific halibut (estimated from FISS data).

This improvement in the modelling of recruitment was necessary before beginning the identification of movement scenarios.

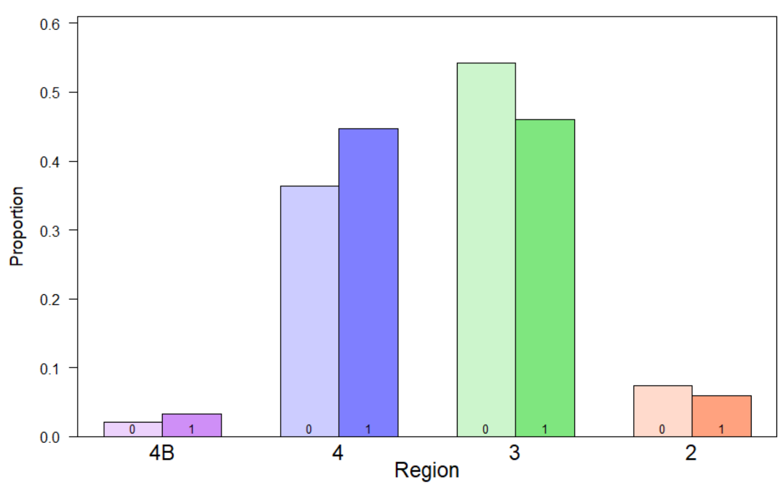


Figure 2. Proportion of coastwide recruitment assigned to each Biological Region in the OM in low PDO years (left bars shown with a 0) and high PDO years (right bars shown with a 1).

2.2 Task F.2: Implementation variability and uncertainty

Implementation variability is defined as the deviation of the fishing mortality from the mortality limit determined from an MP. It can be thought of as what is believed to have happened compared to the limits that were set. It is useful to define four different fishing mortalities that are subject to different types of implementation variability.

- **MP mortality limit**: This is the mortality limit determined from the management procedure which is calculated from a defined method without ambiguity and is repeatable.
- **Adopted mortality limit**: This is the mortality limit set by the Commission after reviewing all inputs from the stock assessment, subsidiary bodies, and public. It is determined in the "decision" step of Figure 1.
- **Estimated fishing mortality**: This is the perceived mortality after fishing occurs that is determined from landings, at-sea samples, discard mortality rates, and any other observations used in catch accounting. It may also be determined from methods or assumptions that do not used direct observations of catches or landings (e.g. effort). These estimates have sampling uncertainty and are used in estimation models, such as the stock assessment.
- **Actual fishing mortality**: This is the mortality that actually occurred from fishing activities. It is unknown in reality but is used in the OM which simulates the Pacific halibut population. Estimated fishing mortality may affect actual fishing mortality in cases where in-season management uses estimates of fishing mortality to determine if fisheries should be closed or opened.

These four types of mortality are hierarchically related to each other as shown in Figure 3. There are multiple pathways for modelling estimated and actual fishing mortalities. For example, estimated fishing mortality may be a function of the adopted mortality limit or a function of the actual fishing mortality. Actual fishing mortality may be a function of the adopted mortality limit or a function of the estimated fishing mortality. These pathways may differ for different sectors.

We have identified three types of implementation variability that define these relationships. If there is no implementation variability, then all four types of fishing mortality are equal to each other.

1. **Decision-making** variability is the difference between the MP mortality limits and the adopted mortality limits set by the Commission.
2. **Realized** variability is the difference between the adopted mortality limits set by the Commission and the actual mortality resulting from fishing.
3. **Perceived** variability is the variation that determines the estimated fishing mortality, which can differ importantly from actual mortality.

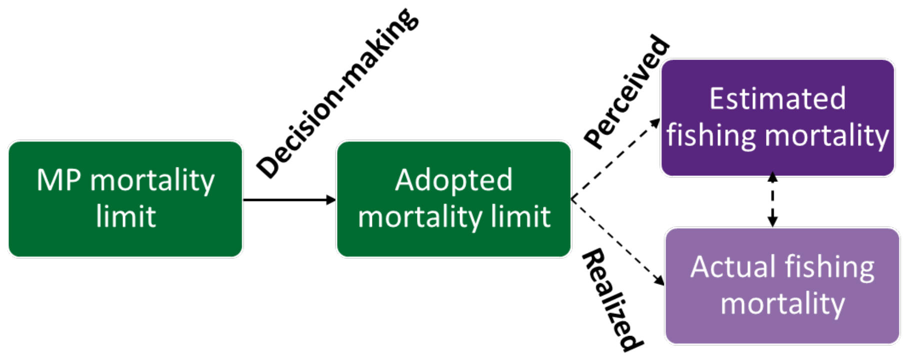


Figure 3. The hierarchy between four fishing mortality types (green and purple boxes) and where implementation variability occurs (black text). Dashed lines indicate that the estimated and actual fishing mortalities could be modelled from different pathways (e.g., estimated fishing mortality is a function of the adopted mortality limit or a function of the actual fishing mortality). Actual fishing mortality is not known in reality but is used in the OM, thus is shown in a lighter color.

Variability is defined as the inherent heterogeneity in the data or population, which cannot be reduced. On the other hand, uncertainty is defined as the incomplete understanding of the data, estimate, or process. Uncertainty can be reduced to zero with increased sampling. With these definitions, we refer to historical variations in implementation of mortality limits as implementation variability, and the future simulation of potential variations in the implementation of mortality limits as implementation uncertainty. Variability has already happened in the past and can be determined and not changed, whereas future simulations are uncertain about the variations, thus simulate a range of possible deviations.

To identify reasonable methods to simulate implementation uncertainty in the MSE, we considered some possible hypotheses and looked at historical implementation variability. First, decision-making uncertainty can be applied to the MP mortality limit ($TCEY_t$) as a multiplier.

$$\widetilde{TCEY}_t = TCEY_t \varepsilon_I$$

where $\widetilde{TCEY}_t$ is the adopted mortality and ε_I is the multiplier. Using observations from 2014 to 2021 of the MP mortality limit determined from the interim management procedure and the adopted mortality limits set by the Commission for that year and IPHC Regulatory Area, the multipliers are shown in Figure 4. These years were chosen because they used a relatively consistent management procedure, although as noted in the following paragraphs from Annual Meeting reports, explicit use of SPR was added in 2017, additional agreements were added in 2019 and 2020, and the reference SPR changed from 46% to 43% in 2021.

> ***IPHC-2017-AM093–R*** ***(para. 29) NOTING*** *that the IPHC Secretariat and the IPHC Scientific Review Board (SRB) have demonstrated that Ebio is outdated and inconsistent with current assessment results, and that numerous elements of the current harvest policy are reliant on Ebio, and that the Commission has agreed that the current harvest policy is considered to be outdated (IPHC–2016–IM092–R, items 21, 22), the Commission*

***RECOMMENDED** IPHC–2017–AM093–R Page 8 of 61 that reference to all elements of the current harvest policy reliant on Ebio, as well as the use of the Blue line, be eliminated subsequent to the close of the 93rd Session of the Commission. The "status quo SPR" (F46%) may serve as an interim "hand rail" that allows all participants to gauge this and future years' catch limit discussions in comparison to previous years.*

***IPHC-2020-AM096-R** **(para. 97)** The Commission **ADOPTED**: a)[…]; and b) a fixed TCEY for IPHC Regulatory Area 2A of 1.65 million pounds is intended to apply for a period from 2019-2022, subject to any substantive conservation concerns; and c) a share-based allocation for IPHC Regulatory Area 2B. The share will be defined based on a weighted average that assigns 30% weight to the current interim management procedure's target TCEY distribution and 70% on 2B's recent historical average share of 20%. This formula for defining IPHC Regulatory Areas 2B's annual allocation is intended to apply for a period of 2019 to 2022. For 2020, this equates to a share of 18.2% before accounting for U26; and […]*

***IPHC-2020-CR-007** **(ID002).** The Commission **RECOMMENDED** a reference SPR fishing intensity of 43% with a 30:20 control rule be used as an updated interim harvest policy consistent with MSE results pending delivery of the final MSE results at AM097 […]*

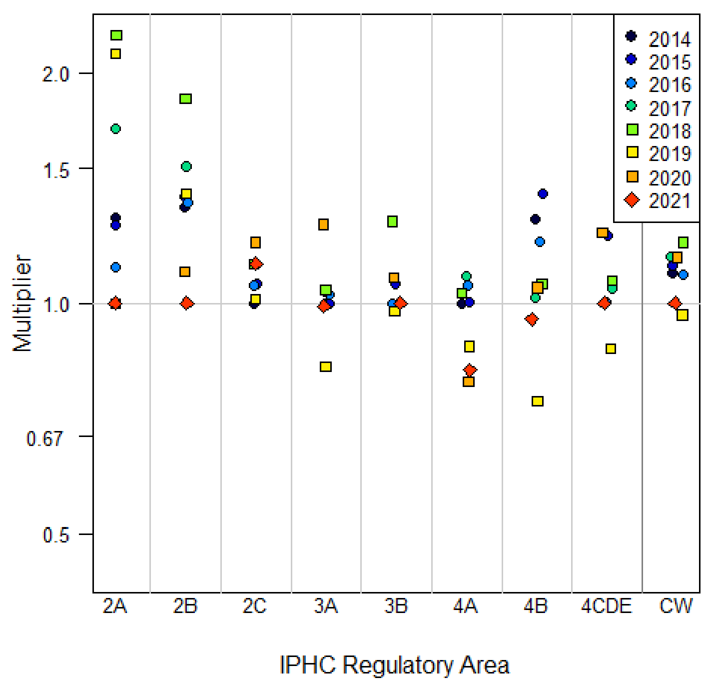


Figure 4. Multipliers for the difference between MP mortality limits and adopted mortality limits from 2014 to 2021. "CW" refers to coastwide.

This investigation of past decisions can inform the development of methods to simulate decision-making uncertainty. To further aid in the development, six potential decision-making response hypotheses were identified from discussions with the SRB and Management Strategy Advisory Board (MSAB), as well as from past observations.

1) When the TCEY is high the Commission may be less inclined to increase the coastwide TCEY above the MP TCEY (the multipliers become closer to 1).
2) When the TCEY is decreasing from the previous year, the multiplier is typically above 1, whereas when the TCEY is increasing, it is typically around 1. The SRB made a recommendation related to this scenario.

   SRB019–Rec.06 (para. 35) ***NOTING*** *the inclusion of uncertainty stemming from implementation* ***uncertainty****, the SRB* ***RECOMMENDED*** *that the IPHC Secretariat develop, for presentation at SRB020, alternative scenarios that represent implementation* ***bias****, i.e. the potential for quota reductions called for by the management procedure to be less likely implemented than quota increases.*

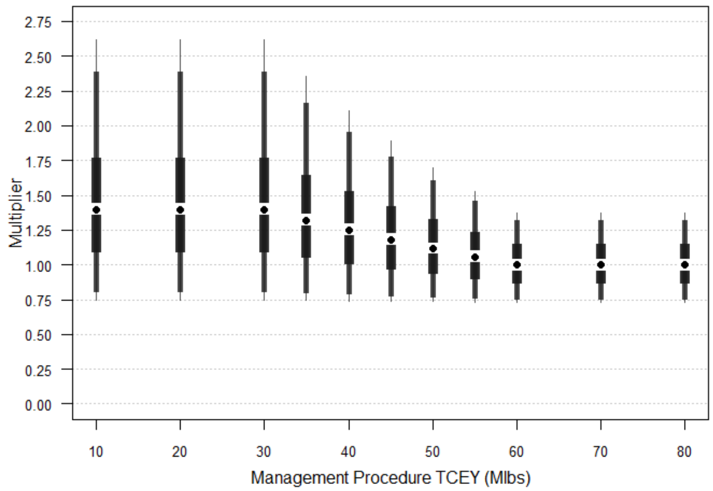
3) When the stock status is less than 30%, the Commission may deviate (increased fishing intensity/higher TCEY) from the MP. An extreme example is that they may decide to not set the TCEY to zero when the relative spawning biomass is less than 20%, as defined by the interim control rule.
4) When coastwide stock status is above 30% (trigger point of CR) the multiplier may be increasingly greater than one as the TCEY becomes lower or is below some threshold.
5) When the decision table from the assessment indicates a lower risk of stock decline or falling below 30% RSB, the multiplier may become increasingly greater than 1.
6) When there is an agreement for an IPHC Regulatory Area, the implementation variability is much less, or near 1.0 for these areas.

2.2.1 Method to simulate decision-making uncertainty

The multiplier to simulate decision-making uncertainty is drawn from a lognormal distribution with correlation between multipliers for each IPHC Regulatory Area. The mean ($\boldsymbol{\mu_\varepsilon}$) and standard deviation ($\boldsymbol{\sigma_\varepsilon}$) of that distribution are modified as follows depending on the TCEY from the MP.

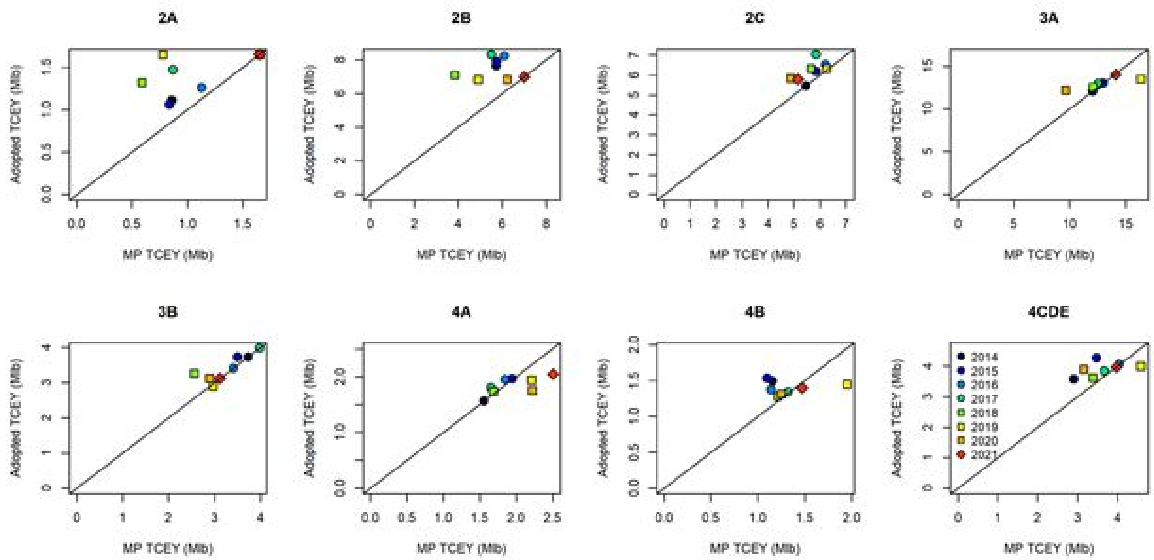
$$\boldsymbol{\mu_\varepsilon}\ or\ \boldsymbol{\sigma_\varepsilon} = \begin{cases} \boldsymbol{\bar{x}}\ or\ \boldsymbol{s} & TCEY < TCEY_{low} \\ \boldsymbol{a} + \boldsymbol{b} * TCEY & TCEY_{low} \le TCEY \le TCEY_{high} \\ \mathbf{1.0}\ or\ \boldsymbol{s}/\mathbf{2} & TCEY > TCEY_{high} \end{cases}$$

Using IPHC Regulatory Area 2A as an example (without a TCEY agreement in place), with a coastwide $TCEY_{low}$ of 30 Mlbs and a coastwide $TCEY_{high}$ equal to 60 Mlbs, the distribution of simulated multipliers gets closer to 1 as the TCEY increases (Figure 5).



This method relates to each management response hypothesis as follows:

1) This is an attempt to directly account for hypothesis 1.
2) This does not take into account decreases or increases. For example, in 2013, the Commission specifically chose to not take the entire decrease. However, it partially addresses hypothesis 2 because as the TCEY increases the multiplier becomes closer to 1, and vice versa.
3) Hypothesis 3 is indirectly addressed because when the stock status is low, the multiplier is more likely to be above 1 because the TCEY will likely be low as well. However, a multiplier on a very low number is still a low number, therefore a minimum on the adopted TCEY may be a scenario to explore.
4) This is an attempt to directly account for hypothesis 4, which is a special case of hypothesis 1.
5) This does not account for the decision table, but if there is a high risk of falling below 30%, the TCEY is likely to be low. Hypothesis 5 suggests the opposite (that the Commissioners will act in a cautionary manner to avoid falling below 30%) of the method proposed above. Therefore, this method does not address hypothesis 5 but could be investigated separately.
6) This method does not address hypothesis 6, but a simple modification when an agreement is in place could be easily implemented for these special case MPs.



Actual decision-making variability is likely more complex than this simple method. In fact, some IPHC Regulatory Areas show a consistent adopted TCEY over a range of MP TCEYs (e.g., 4B in Figure 6). However, the goal of including decision-making uncertainty in the MSE simulations isn't to exactly simulate what the pattern is, but to identify the effect of decision-making uncertainty and identify MPs that are robust to a plausible amount of uncertainty. Therefore, simulations will be done with and without decision-making uncertainty to identify MPs that are robust to this uncertainty.

2.2.2 Methods to simulate realized and perceived implementation uncertainty

Realized uncertainty is currently implemented in the OM by simulating a range of actual non-directed discard mortality, recreational mortality, and subsistence mortality. These are likely the largest sources of realized variability in the Pacific halibut fisheries.

Perceived uncertainty is currently not simulated in the OM but will be considered as work progresses.

2.3 Task F.3: Develop more realistic simulations of estimation error

Past simulations used a simple process to simulate estimation error. This did not specifically include a simulated stock assessment, but instead assumed unbiased, correlated variability around the TCEY and stock status. Work has been ongoing to simulate the stock assessment and current progress is reported in the MSE Technical document (IPHC-2021-MSE-01). Additional work will bring in additional estimation models to simulate the stock assessment ensemble.

2.4 Task F.5: Develop alternative OMs

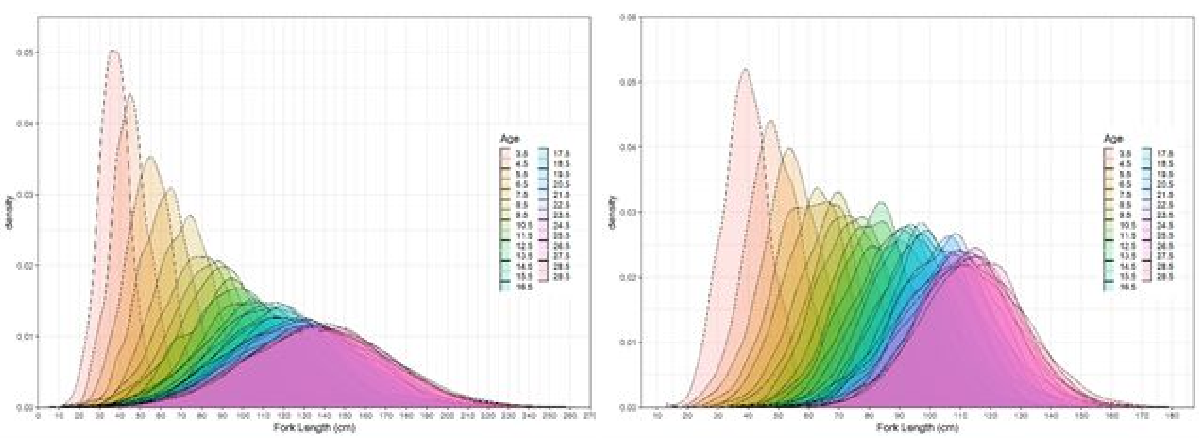
The progress on tasks F.1 and F.2 necessitates the development of operating models. Past simulations used a single OM with a considerable amount of variability, but did not use multiple OMs to represent multiple hypotheses about the population dynamics. Alternative OMs are currently being conditioned that have different hypotheses related to historical dynamics and movement.

3 Management Procedures

Two categories of MPs were prioritised in the MSE Program of Work for 2021–2023. One was the investigation of size limits (M.1) and the other was to investigate multi-year stock assessments (i.e. not conducting the stock assessment annually; M.3). The investigation of SPR-based MPs, as was done for 2021 will also continue as needed to evaluate the performance of a range of MPs.

3.1 Task M.1: Size limits

Pacific halibut have shown highly variable size- and weight-at-age over time. Studies on growth and analysis of length data continue, but recent population modelling of Pacific halibut has converted numbers-at-age to biomass using weight-at-age relationships directly, instead of using intermediate length-at-age calculations. The OM follows the direct weight-at-age method to avoid modelling the complexities of changing length-at-age relationships over time. However, this means that defining size-based quantities, such as needed for size limits or U26/O32 metrics, for example, must be approximated. The OM currently uses static distributions of length-at-ages (Figure 7) determined from pooled coastwide data to determine quantities such as O32 WPUE from the Fishery-Independent Setline Survey (FISS).



3.1.1 Modelling time-varying length in the OM

There are two paths for incorporating time-varying length-based processes in the OM. One is to model it independently, not linked to population processes, and use it to calculate size-based quantities only when necessary. The second is to model length-at-age and weight-at-length explicitly such that weight-at-age is determined from these two growth functions.

Modelling length through length-at-age distributions to determine the probability that a specific age fish is above a defined size is the quickest solution as this is partially implemented in the current OM. These length-at-age distributions, however, are currently static across years in the OM, but could be updated on an annual basis in the projections to simulate time-varying changes in length-at-age. The most simple and quickest method would be to determine a mean length from the simulated mean weight-at-age using an assumed weight-length relationship. This may not, however, capture some population effects of a size limit and completely account for changes in selectivity with changes in a size limit. This method has been chosen so that some investigation of size limits can be completed for the 99th Annual Meeting in 2023 along with other tasks in the MSE program of work. Work continues to determine appropriate simulation methods and update the OM code..

The second method, directly modelling length-at-age and weight-at-length to determine weight-at-age allow for length-based processes such as selectivity and movement. However, it would take a considerable amount of time to determine the appropriate methods and to code the operating model. Therefore, this method is not being considered at this time.

Given a method, the specifics size limits to evaluate need to be determined. Past analyses have investigated no size limit, minimum size limits up to 32 inches, and a maximum size limit of 60 inches (see IPHC-2021-AM097-09 for a history of analyses).

3.2 Task M.3: Multi-year stock assessments

Management procedures with multi-year assessments incorporate a process where the stock assessment occurs at intervals longer than annually. The mortality limits in a year with the stock assessment can be determined as in previously defined MPs, but in years without a stock assessment, the mortality limits would need an alternative approach. This may be as simple as maintaining the same mortality limits for each IPHC Regulatory Area in years with no stock assessment, or as complicated as invoking an alternative MP that does not require a stock assessment (such as an empirical-based MP relying only on data/observations).

Simulations using an MP where the stock assessment occurs biennially and the mortality limits remain unchanged from the previous year were performed using the 2020 MSE framework. The specifications of the simulation model are the same as reported in Hicks et al. (2020), Hicks et al. (2021), and IPHC-2021-MSE-01. The MP specified as A was used with the addition of a biennially assessment (Table 2). Coastwide performance metrics for MP-A with and without the biennial mortality limit specification are shown in Table 3 along with MP-D and MP-J which were the best performing MPs from the previous MSE simulations.

The biennial mortality limit specification improved the coastwide performance metrics related to variability in the TCEY compared to MP-A with an annual mortality limit specification. The median average TCEY was less than MP-A and MP-D, but slightly higher than MP-J. The median relative spawning biomass was above the 36% target, but slightly closer than MP-A.

Table 2. Specifications of MPs with an annual stock assessment and management advice (MP-A, MP-D, and MP-J), and with a biennial stock assessment and mortality limit specification (MP-A2).

Element	MP-A	MP-A2	MP-D	MP-J
Maximum coastwide TCEY change of 15%				
Maximum Fishing Intensity buffer (SPR=36%)				
O32 stock distribution				
O32 stock distribution (5-year moving average)				
All sizes stock distribution				
Fixed shares updated in 5th year from O32 stock distribution				
Relative harvest rates of 1.0 for 2-3A, and 0.75 for 3B-4				
Relative harvest rates of 1.0 for 2-3, 4A, 4CDE, and 0.75 for 4B				
Relative harvest rates by Region: 1.0 for R2-R3, 0.75 for R4-R4B				
1.65 Mlbs fixed TCEY in 2A				
Formula percentage for 2B				
National Shares (2B=20%)				
Frequency of stock assessment & mortality limits				

Table 3. Coastwide long-term performance metrics for the biological sustainability objective and P(all RSB<36%) and short-term performance metrics for the remaining fishery sustainability objectives for MPs A, D, and J with an annual mortality limit setting process, and MP-A with a biennial mortality limit setting process (A2). All results use an SPR value of 43% with simulated estimation error.

Input SPR/TM	**43**	**43**	**43**	**43**
Management Procedure	**A**	**A2**	**D**	**J**
Biological Sustainability				
P(any RSB_y<20%)	<0.01	<0.01	0.01	<0.01
Fishery Sustainability				
P(all RSB<36%)	0.25	0.28	0.44	0.28
Median average TCEY (Mlbs)	39.92	38.31	40.22	37.90
P(any3 change TCEY > 15%)	0.44	0.36	0.10	0.00
Median AAV TCEY	12.1%	9.0%	5.9%	9.5%

MP-A2 shows a different pattern of variability that is not completely captured with the performance metrics presented in Table 3. The variability performance metrics with the biennial mortality limit specification show improvements because half of the years in a ten-year period have no change in the TCEY compared to an MP with an annual mortality limit specification while the other half may show a slightly larger change. Trajectories of the projected TCEY for a 60-year period show the biennial specification process in MP-A2 (Figure 8). Comparing the trajectories for MP-A and MP-A2 shows that the biennial process generally follows the annual process but with steps. However, there are cases where the biennial process takes longer to catch up (e.g. the start of the trajectory) and where the biennial process does not unnecessarily change the TCEY (e.g. near the year 2065 for some simulations).

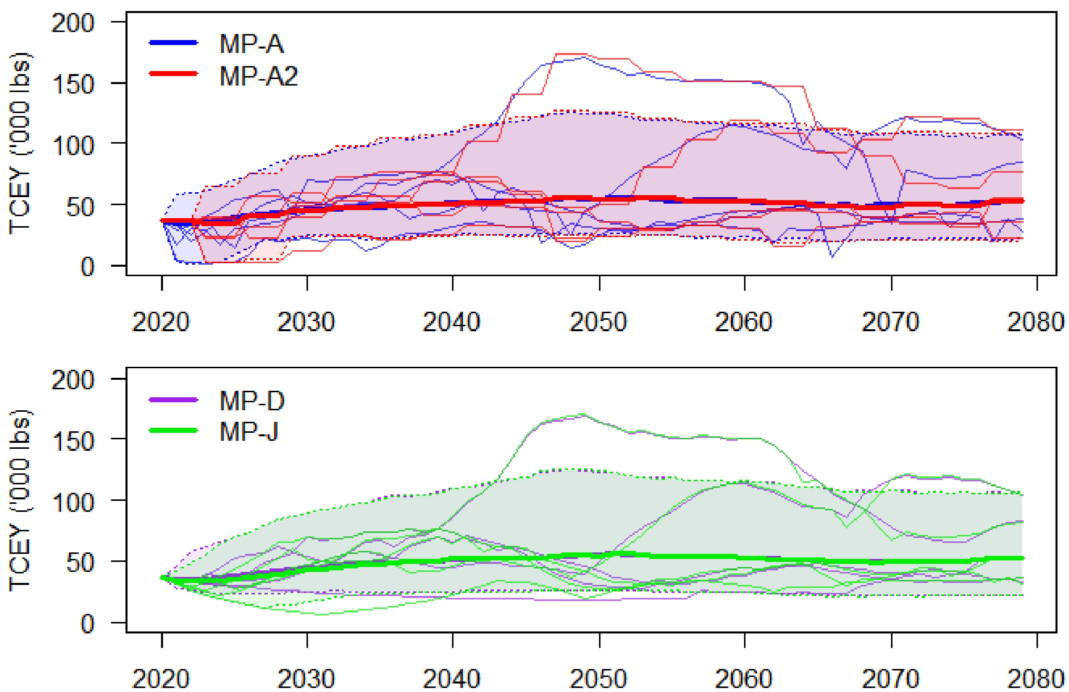


Figure 8. Trajectories of TCEY for MPs A, D, and J with an annual mortality limit setting process, and MP-A with a biennial mortality limit specification process (A2). All results use an SPR value of 43% with simulated estimation error. The 5th and 95th quantiles are shown as a shaded polygon. Five individual trajectories are shown as thin lines and the median of all simulations is shown as a thick line.

Different performance metrics may help to understand the differences between annual stock assessment MPs and multi-year assessment MPs. Three new performance metrics are reported in Table 4 to provide a better indication of how the TCEY may change in a given year. Over a ten-year period these are, the probability that the TCEY exceeds a change greater than 15% in any one year [P(any1 change TCEY > 15%)], the probability that the TCEY exceeds a change greater than 15% in any two years [P(any2 change TCEY > 15%)], and the median maximum absolute percentage change (up or down) in the TCEY over a 10-year period (Median max abs % change TCEY). Table 4 shows that all of these performance metrics are highest for MP-A2, indicating that the change in the TCEY is typically higher in years when it changes compared to an annual mortality limit specification process. Additional performance could be developed, such as a metric for cumulative change over a number of years to bring the measure of variability on the same temporal scale.

Table 4. Additional coastwide short-term and long-term performance metrics for the fishery sustainability objectives related to TCEY variability for MPs A, D, and J with an annual mortality limit setting process, and MP-A with a biennial mortality limit specification process (A2). All results use an SPR value of 43% with simulated estimation error.

	Short-term				Long-term			
Input SPR/TM	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**
Management Procedure	**A**	**A2**	**D**	**J**	**A**	**A2**	**D**	**J**
Fishery Sustainability								
P(any1 change TCEY > 15%)	0.75	0.93	0.56	0.00	0.46	0.67	0.17	0.00
P(any2 change TCEY > 15%)	0.63	0.74	0.26	0.00	0.31	0.32	0.02	0.00
Median max absolute % change TCEY	18%	23%	11%	15%	13%	21%	9%	14%

Overall, there is a clear trade-off between slightly higher biennial change and consistency within each two-year period. The benefits to a biennial mortality limit specification include stability for a two-year period and resources needed for conducting a stock assessment can be directed towards other research such as improving the stock assessment or MSE. However, it is likely that the change in the mortality limit every other year may be larger than that for an annual process. These trade-offs must be considered when analysing an MP with a static biennial mortality limit specification.

The mortality limit does not need to be held constant in years when there is no stock assessment, but may instead use other methods to determine a mortality limit. The projection from the stock assessment may be used, or an empirical, data-driven approach can inform changes to the mortality limit. This may reduce the potential for large changes when implementing biennial stock assessments, would make immediate use of FISS results in intervening years, and could be extended to periods of longer than two years between stock assessments.

An alternative approach that would not require a stock assessment for setting mortality limits in any year would be to adopt an empirical-based MP as the method for setting annual mortality limits. The stock assessment would be used at a defined interval to verify that management is effective and to potentially tune the MSE OM and existing MP (Cox and Kronlund 2008). Any of the MPs mentioned in this section, empirical- or model-based or a hybrid of the two, can be evaluated using the current MSE framework.

In summary, some elements related to multi-year assessments that may be evaluated include the following, which may include appropriate combinations.

a. Biennial, triennial, quadrennial, quinquennial assessments
b. Constant TCEY by IPHC Regulatory Areas in non-assessment years
c. Setting multi-year TCEY using projections from the stock assessment
d. Updating distribution of the TCEY in non-assessment years using FISS results and/or other data sources
e. Updating the coastwide TCEY in non-assessment years using FISS results and/or other data sources

4 EVALUATION

4.1 Task E.3: Presentation of results

The methods to evaluate simulation results and present those for decision-making are always being improved. Current tasks specifically include updates to the MSE Explorer tool, improving the ranking procedure to identify best performing management procedures, determining new methods to identify best performing management procedures, and providing new types of plots and tables that effectively communicate the results. This task will benefit from interactions with stakeholders and management agencies, which may include MSAB meetings.

RECOMMENDATION/S

That the Commission

a) **NOTE** paper IPHC-2022-AM098-12 describing progress on the MSE Program or Work for 2021–2023, including progress on modelling the distribution of recruitment and its effects on estimated movement, simulating implementation uncertainty, methods to investigate size limits, and multi-year assessments.
b) **NOTE** that implementation uncertainty will be incorporated to evaluate the robustness of MPs to plausible departures from the MP determined TCEY.
c) **RECOMMEND** elements of size limit management procedures for evaluation, which may include no size limits, minimum size limits, and maximum size limits.
d) **RECOMMEND** elements of management procedures related to multi-year assessments, including holding the TCEY constant, incorporating empirical approaches in non-assessment years, and the number of years between stock assessments.
e) **ADOPT** a 2022 schedule for the MSAB possibly consisting of a meeting in May and a meeting in October 2022.

References

Cox, Sean P., and Allen Robert Kronlund. 2008. "Practical stakeholder-driven harvest policies for groundfish fisheries in British Columbia, Canada." *Fisheries Research* 94 (3): 224-237. https://doi.org/10.1016/j.fishres.2008.05.006.

Hicks, A, P Carpi, S Berukoff, and I Stewart. 2020. *An update of the IPHC Management Strategy Evaluation process for SRB017.* https://iphc.int/uploads/pdf/srb/srb017/iphc-2020-srb017-09.pdf.

Hicks, A, P Carpi, I Stewart, and S Berukoff. 2021. *IPHC Management Strategy Evaluation for Pacific halibut (Hippoglossus stenolepis).* https://iphc.int/uploads/pdf/am/am097/iphc-2021-am097-11.pdf.

Mantua, N.J., S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997. "A Pacific interdecadal climate oscillation with impacts on salmon production." *Bulletin of the American Meteorological Society* 78 (6): 1069-1079.

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. https://doi.org/10.1111/fog.12512.

Appendices

Nil

Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): summary of progress

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK; 23 DECEMBER 2021 & 20 JANUARY 2022)

PURPOSE

The purpose of this document is to provide the Commission with an update on the development of the Pacific halibut multiregional economic impact assessment (PHMEIA) model. PHMEIA is a core product of the IPHC socioeconomic study that directly responds to the Commission's "desire for more comprehensive economic information to support the overall management of the Pacific halibut resource in fulfillment of its mandate" (economic study terms of reference adopted at FAC095 (IPHC-2019-FAC095) and endorsed at AM095 in 2019). The update complements full project report available to the Commission as information paper IPHC-2022-AM098-INF04.

BACKGROUND

The goal of the IPHC socioeconomic study is to provide stakeholders with an accurate and all-sectors-encompassing assessment of the socioeconomic impact of the Pacific halibut resource that includes the full scope of Pacific halibut's contribution to regional economies of Canada and the United States of America. To that end, the Secretariat developed the Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA) model that informs stakeholders on the importance of the Pacific halibut resource and fisheries to their respective communities, but also broader regions and nations, and contributes to a wholesome approach to Pacific halibut management that is optimal from both biological and socioeconomic perspective, as mandated by the Convention.

The PHMEIA is a multiregional social accounting matrix (SAM)-based model describing economic interdependencies between sectors and regions developed to assess three **economic impact (EI)** components pertaining to Pacific halibut. The **direct EIs** reflect the changes realized by the direct Pacific halibut resource stock users (fishers, charter business owners), as well as the forward-linked Pacific halibut processing sector (i.e., EI related to downstream economic activities). The **indirect EIs** are the result of business-to-business transactions indirectly caused by the direct EIs. The indirect EIs provide an estimate of the changes related to expenditures on goods and services used in the production process of the directly impacted industries. In the context of the PHMEIA, this includes an impact on upstream economic activities associated with supplying intermediate inputs to the direct users of the Pacific halibut resource stock, for example, impact on the vessel repair and maintenance sector or gear suppliers. Finally, the **induced EIs** result from increased personal income caused by the direct and indirect effects. In the context of the PHMEIA, this includes economic activity generated by households spending earnings that rely on the Pacific halibut resource, both directly and indirectly.

The economic impact is most commonly expressed in terms of output, that is the total production linked (also indirectly) to the evaluated sector. PHMEIA also provides estimates using several other metrics, including compensation of employees, contribution to the gross domestic product (GDP), employment opportunities, and households' prosperity (income by place of residence).

To accommodate an increasing economic interdependence of regions and nations, the model also accounts for interregional spillovers. These represent economic stimulus in regions other than the one in which the exogenous change is considered. Economic benefits from the primary area of the resource extraction are leaked when inputs are imported, when wages earned by nonresidents are spent outside the place of employment, or when earnings from quota holdings flow to nonresident beneficial owners. At the same time, there is an inflow of economic benefits to the local economies from when products are exported, or services are offered to non-residents.

MODEL SETUP

The model reflects the interdependencies between eleven major sectors and two Pacific halibut-specific sectors. These include the Pacific halibut fishing sector, as well as the forward-linked Pacific halibut processing sector. While the complete path of landed fish includes, besides harvesters and processors, also seafood wholesalers and retailers, and services when it is served in restaurants, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts beyond wholesale in PHMEIA, as opposed to assessing the snapshot contribution to the GDP along its entire value chain, would be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail or services level gross revenues (Steinback and Thunberg, 2006). Snapshot assessment of Pacific halibut contribution to the GDP along the entire value chain, **from the *hook-to-plate***, is available in IPHC-2021-ECON-06.

The extended model (referred here as PHMEIA-r) introduces to the SAM also the saltwater charter sector that is disaggregated from the services-providing industry. The estimates assume that the economic impact of Pacific halibut charter fishing is equivalent to estimating the total economic loss resulting from the saltwater charter sector in each region shrinking by share of Pacific halibut effort in total effort. The results for the charter sector, however, should be interpreted cautiously because of the uncertainty on how much of the saltwater angling effort directly depends on Pacific halibut.[1]

The list of industries considered in the PHMEIA and PHMEIA-r models, as well as the primary commodities they produce, is available in **Table 1**. Production by these industries is allocated between three primary Pacific halibut producing regions, as well as residual regions to account for cross-boundary effects of fishing in the Pacific Northwest:

- Alaska (AK)
- US West Coast (WOC – including WA, OR, and CA)
- British Columbia (BC)
- Rest of the United States (US-r)
- Rest of Canada (CA-r)

[1] Additional analysis of the demand for Pacific halibut recreational trips is proposed in the *IPHC 5-year program of integrated research and monitoring* (2022-26) (IPHC-2021-IM097-12). Current results rely on the available statistics that do not necessarily reflect the willingness to substitute the target species. See details in IPHC-2021-ECON-02.

- Rest of the world (ROW)[2]

The adopted methodology is an extension from the multiregional SAM model for Southwest Alaska developed by Seung, Waters, and Taylor (2019) (see IPHC-2021-ECON-03 for details on adopted methodology) and draws on a few decades' worth of experience in developing IO models with applications to fisheries (see IPHC-2021-ECON-01). Model description can be also found in the economic study section of the IPHC website. The complete model documentation (project report) is available as an information paper for the AM098 (IPHC-2022-AM098-INF04).

Table 1: Industries and commodities considered in the PHMEIA and PHMEIA-r models.

	Industry	Primary commodity produced
1	Pacific halibut fishing	Pacific halibut
2	Other fish and shellfish fishing	Other fish and shellfish[(1)]
3	Agriculture and natural resources (ANR)	Agriculture and natural resources
4	Construction	Construction
5	Utilities	Utilities
6	Pacific halibut processing	Seafood
7	Other fish and shellfish processing	Seafood
8	Food manufacturing (excluding seafood manufacturing)	Food (excluding seafood) [(2)]
9	Manufacturing (excluding food manufacturing)	Manufactured goods (excluding food)
10	Transport	Transport
11	Wholesale	Wholesale
12	Retail	Retail
13	Services (including public administration)	Services (including public administration)
14	Saltwater charter sector[(3)]	Saltwater fishing trips

Notes: [(1)]In the case of Canada, other fish and shellfish commodity includes, besides wild capture production, also aquaculture output produced by the aquaculture industry that is a part of the ANR industry. Other fish and shellfish processing industry in the USA component, on the other hand, draws more on the ANR commodity that includes aquaculture output. However, this misalignment between model components is not concerning as linking these is based on the trade of aggregated seafood commodity. [(2)]There is a slight misalignment between model components related to the allocation of beverage and tobacco manufacturing products that, in some cases, are considered non-durable goods and lumped with the food commodity. In the case of the USA component, this misalignment is corrected with the use of additional data available from the Annual Survey of Manufactures (ASM) (US Census, 2021). [(3)]Saltwater charter sector extension included in PHMEIA-r model. Model results rely on the estimated share of the sector output that directly depends on Pacific halibut.

Demand for goods and services related to anglers' fishing trips, both guided and unguided, also contributes to the economy. In addition to economic impact related to Pacific halibut sectors, PHMEIA-derived multipliers are used to estimate economic impact related to marine angler expenditures on fishing trips (travel, lodging, other trip-related expenses) and durable goods (rods, tackle, boat purchase, other fishing equipment and accessories, second home, or additional vehicle purchase).

[2] The ROW region in the model is considered exogenous. This implies that the trade relations with the ROW are unaffected by the changes to the Pacific halibut sectors considered in this project. While the full inclusion of the ROW component allows for assessment of impact outside Canada and the United States if trade with ROW was to be considered responsive to changes in Pacific halibut sector activity, this is not typically seen in the literature.

UPDATE ON THE MODEL DEVELOPMENT

The current PHMEIA incorporates a series of improvements to the economic impact assessment[3] model presented to the Commission at the AM097. These are as follows:

(1) The model uses an updated set of data, and estimates are now available for 2020. At the AM097, the estimates were available up to 2018, and at the IM097, up to 2019. Note that using the updated set of data implies re-estimation of the model for the entire analyzed period (2014-2020) using revised 2014-2019 data. Thus, final estimates for earlier years may have changed. However, no substantial adjustments have been recorded. Extending the model to 2020 illustrates the Covid-19 impact on the Pacific halibut fisheries.

(2) The estimates incorporate flows of earnings related to all Pacific halibut sectors in the model. See IPHC-2021-ECON-02 for the compilation of data on the flows of benefits in the Pacific halibut sectors. These are particularly pronounced in Alaska where substantial flows are identified from harvest location to buyer's headquarters, from the landing area to vessel owner residence and quota holder residence, and from sport fishing location to Charter Halibut Permit owner residence.

(3) The latest update of the PHMEIA provides preliminary estimates of community effects. The model informs on the county-level economic impacts in Alaska and highlights areas particularly dependent on Pacific halibut fishing-related economic activities. The current model update also makes use of regional COAR (COAR, 2021) data to refine the spatial distribution of the processing sector contribution to the economy of each Alaskan county (an improvement from results presented in IPHC-2021-SRB019-09).

(4) The extended model (labeled PHMEIA-r) provides preliminary estimates for the saltwater charter sector that is disaggregated from the services-providing industry.

(5) The model incorporates estimates of angler expenditures on fishing trips and durable goods. These are used in conjunction with an estimate of the share of marine angler effort that relies directly on the Pacific halibut stock.

(6) The model adopts an improved production structure for commercial fishing in British Columbia making use of data on quota lease price (Castlemain, 2019).

(7) This update on the PHMEIA development is supplemented by an analysis of the formation of the price paid for Pacific halibut products by final consumers (end-users) that is intended to provide a better picture of Pacific halibut contribution to the GDP along the entire value chain, ***from the hook-to-plate*** (IPHC-2021-ECON-06).[4]

It is important to note that the model continues to rely heavily on secondary data sources,[5] and as such, the results are conditional on the adopted assumptions for the components for which up-to-date data are not available (details on data inputs are available in IPHC-2021-ECON-02). That said, the

[3] While this type of assessment is typically termed "economic impact assessment," calculated alongside the impact in terms of output also the impact on employment and wages, and households' prosperity, introduce a broader socioeconomic context.

[4] This analysis will be further refined as a part of collaboration with NOAA Alaska Fisheries Science Center on market profiles for Alaska Groundfish.

[5] That is data collected by other parties, not the IPHC.

Secretariat made the best use of data collection programs of national and regional agencies, academic publications on the topic, and grey literature reporting on fisheries in Canada and the United States. The model also uses a set of non-fisheries data inputs described in IPHC-2021-ECON-07.

Looking forward, the Secretariat also identified a number of tasks that will enhance the study's ability to support the management of the Pacific halibut resource in fulfillment of the Commission's mandate. These are incorporated into the *IPHC's 5-year program of integrated research and monitoring (2022-26)* (IPHC-2021-IM097-12).

PRIMARY DATA COLLECTION

More accurate results can be achieved by incorporating into the model primary economic data collected directly from members of Pacific halibut-dependent sectors. An essential input to the SAM model is data on production structure (i.e., data on the distribution of revenue between profit and expenditure items). The IPHC is collecting these data directly from stakeholders since the AM096 through the web-based survey available:

- Here, for Pacific halibut commercial harvesters;
- Here, for Pacific halibut processors; and
- Here, for Pacific halibut charter business owners.

It should be recognized that the project was challenged by the Covid-19 pandemic that impacted particularly the components directly dependent on the inputs from stakeholders. Should the Commission wish to continue improving the PHMEIA, the Secretariat will introduce an improved strategy for primary data collection following the 2021 fishing season, including further simplification of the surveys. The Secretariat is also cautiously optimistic regarding engagement with stakeholders on socioeconomic data collection in post-covid times aimed at **better characterization of the Pacific halibut sectors' economic impact**.

STUDY OBJECTIVES

Appendix A summarizes the progress to date against the IPHC economic study objectives, as first defined in IPHC-2020-IM096-14.

UPDATE ON PHMEIA MODEL RESULTS

The model results suggest that Pacific halibut commercial fishing's total estimated impact in 2019 amounts to USD 196 mil. (CAD 260 mil.) in households' earnings,[6] including an estimated USD 52.5 mil (CAD 69.7 mil) in direct earnings in the Pacific halibut fishing sectors and USD 12.2 mil.

[6] Earnings include both employee compensation and proprietors' income.

(CAD 16.1 mil.) in the processing sector, and USD 179 mil (CAD 238 mil.) in household income (**Table 2**).[7]

Detailed results are provided for 2019 as this represents a more typical year for the economy. The estimates for 2020 suggest that Pacific halibut commercial sectors' contribution to households decreased by 25%, and output related to Pacific halibut commercial fishing decreased by 27%. **Figure 1** depicts EI estimates for Pacific halibut commercial fishing for 2014-2020 in comparison with landed value. To make the values comparable over time, the estimates are adjusted for inflation.[8]

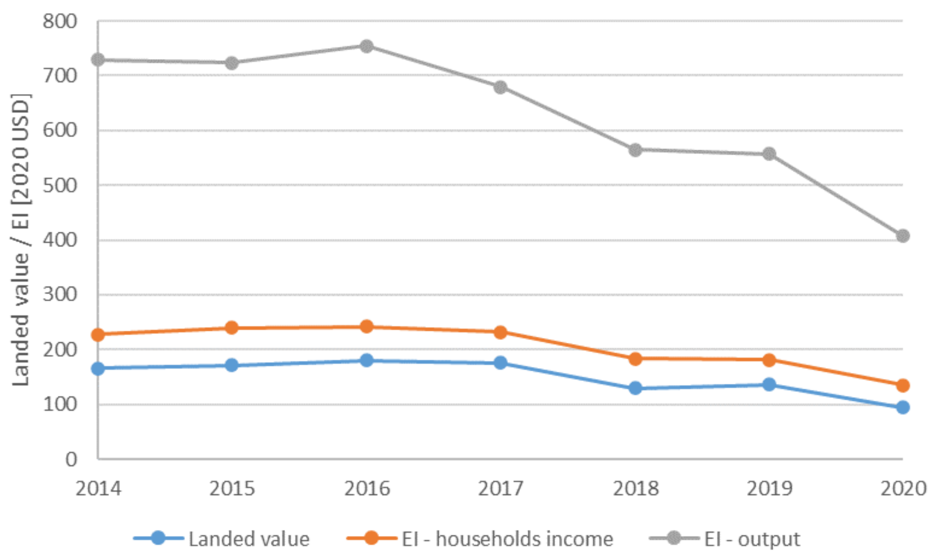


Figure 1: Pacific halibut commercial fishing EI estimates for 2014-2020 in comparison with landed value in mil 2020 USD.

PHMEIA model also informs on the economic impact by county (limited to Alaska), highlighting regions where communities may be particularly vulnerable to changes in the access to the Pacific halibut resource. In 2019, from USD 23.7 mil. (CAD 31.4 mil.) of direct earnings from Pacific halibut commercial sectors in Alaska, 70% was retained in Alaska.[9] These earnings were unevenly distributed between Alaskan counties (**Figure 2**). The most direct earnings per dollar landed are estimated for Ketchikan Gateway, Petersburg and Sitka countries, while the least for Aleutians East, Yakutat and Aleutians West counties. Low earnings per 1 USD of Pacific halibut landed in the county are a result of

[7] Income reflects earnings adjusted for any transfers, including interregional spillovers, i.e., income is related to the place of residence, not the place of work.
[8] Using the GDP deflator data published by the Organisation for Economic Co-operation and Development (OECD, 2021). The estimates are expressed in 2020 USD.
[9] Community effects assessment is currently limited to Alaska. The feasibility of a similar assessment for other regions is under investigation. For example, Canadian quotas (L fishery), which are vessel-based, can be allocated based on vessel owner's residency, searchable in the Canadian Register of Vessels available through Transport Canada's Vessel Registration Query System.

the outflow of earnings related to vessels' home base, vessels' ownership and quota ownership, processing locations, and processing companies' ownership.

The total contribution of the Pacific halibut charter sector to household income is assessed at USD 42 mil. (CAD 56 mil.) for 2019. Accounting for angler expenditures adds another USD 108 mil. (CAD 143 mil.) to the economic impact of the recreational sector. This translates into 19% less for the charter sector and 45% less for the recreational sector overall in comparison with the commercial sector when looking at impact per USD of landed value (for the commercial sector) and USD spent (for the recreational sector, including trip costs and expenditures on durable goods). This is not surprising since the commercial sector's production supports not only suppliers to the harvesting sector, but also the forward-linked processing sector (thus, also households employed by these sectors). Recreational sector results, on the other hand, to a large degree are driven by expenditures on goods that are often imported, consequently supporting households elsewhere.

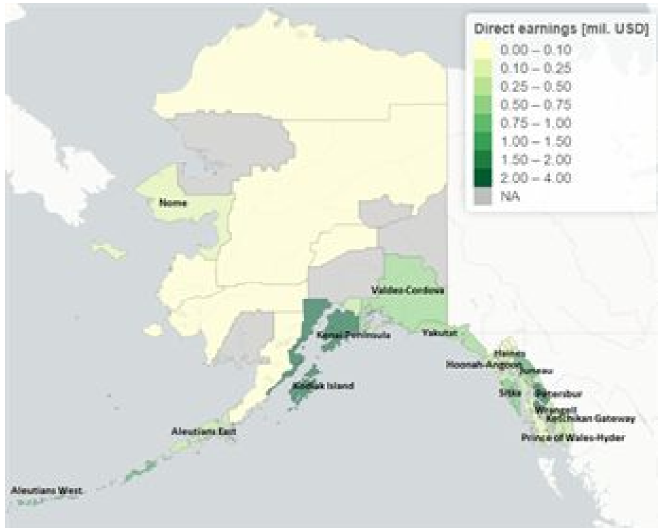
A somewhat different picture emerges when comparing EI per pound of Pacific halibut removal counted against allowed catch by area in the stock assessment. This measure is 63% higher for the charter sector, and more than double for the recreational sector overall when compared with the commercial sector. These differences, however, are less pronounced when focusing only on the EI retained within the harvest region (56% and 139%, respectively).

It should also be noted, however, that this analysis should not be used as an argument in sectoral allocations discussions because, as a snapshot analysis, it does not reflect the implications of shifting supply-demand balance. Participation in sport fishing do not typically scale in a linear fashion with changes to harvest limits.

Table 2: Economic impact on households

Economic impact	Unit	Commercial	Charter(1)	Recreational
EI on households	Total in mil. USD/CAD	179.1/237.6	42.2/55.9	146.9/194.9
EI locally (excludes spillovers)	Total in mil. USD/CAD	114.1/151.4	27.6/36.6	79.0/104.9
EI on households	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	1.34	1.08	0.74(2)
EI locally (excludes spillovers)	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	0.85	0.71	0.40(2)
EI on households	USD/CAD per 1 lb of removals	7.4/9/8	12.0/15.9(3)	20.9/27.7
EI locally (excludes spillovers)	USD/CAD per 1 lb of removals	4.7/6.2	7.3/9.7(3)	11.2/14.9

Notes: (1) This includes only the economic impact generated through businesses offering charter trips, i.e., it excludes the impact of angler expenditures other than charter fees. (2)In A considerable share of angler expenditures originates from import, which drives the estimate down. (3)Charter sector impact per 1 lb of removals was based on EI on households for Alaska where removals estimates are clearly divided between guided and unguided sectors.

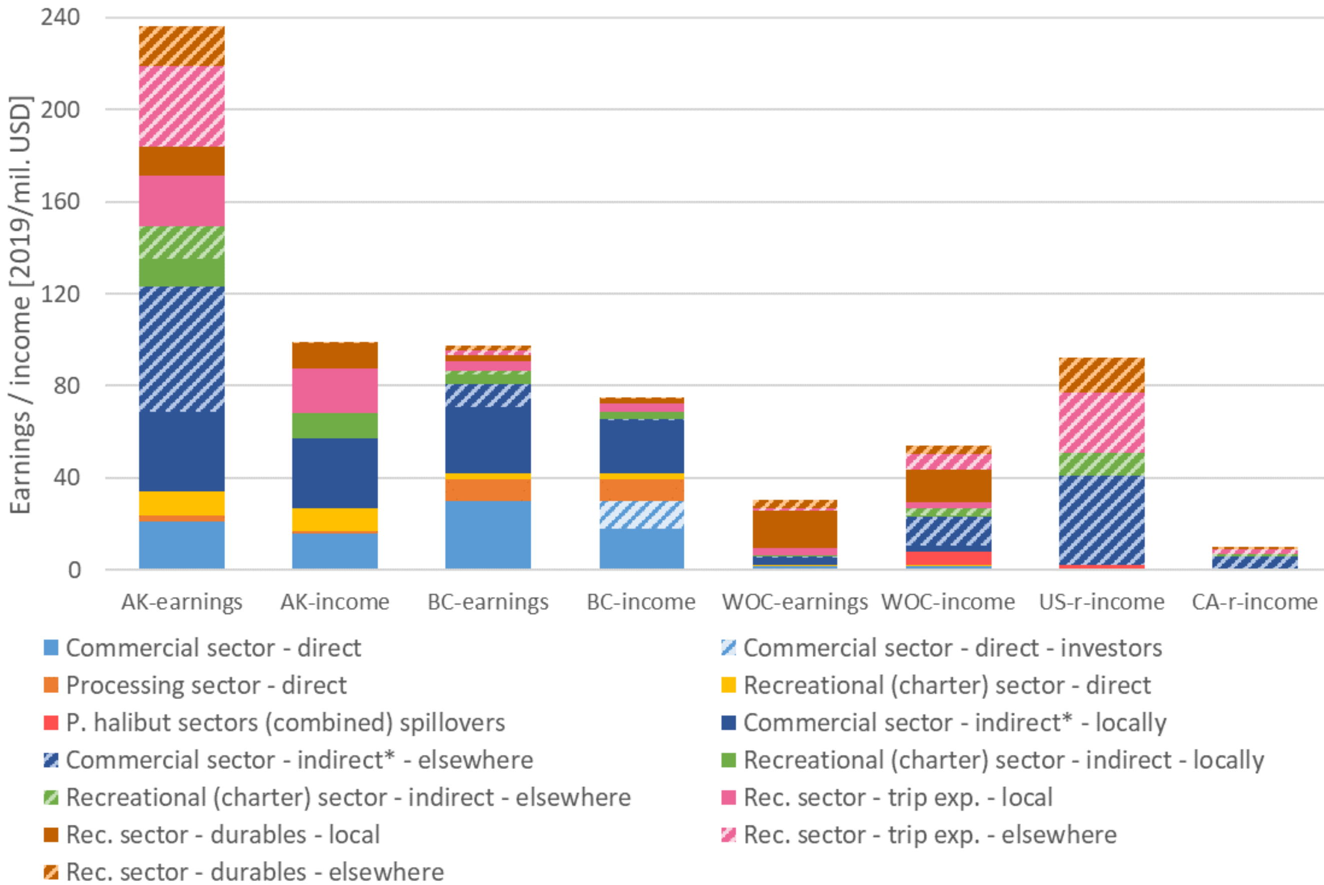


Notes: Alaska retains 70% of direct earnings within the state.

Figure 2: County-level estimates of direct earnings in the Pacific halibut commercial sectors in Alaska in 2019.

Figure 3 depicts the impact of Pacific halibut commercial and recreational fishing on household earnings and income, highlighting the importance of considering cross-regional effects. Earnings estimates (bars with '-earnings' suffix) summarize economic impact by place of work (i.e., where the fishing activity occurs). Income estimates (bars with '-income' suffix) reflect earnings after adjustments for cross-regional flows, i.e., provide estimates by the place of residence of workers, business owners, or owners of production factors (i.e., quota or permit owners).

Results in terms of output, depicted in a similar fashion, are available in **Appendix B**.



Notes: Legend description available in Box 1. Figure omits the impact on ROW (marginal).*Commercial indirect effects include processing.

Figure 3: Pacific halibut impact on household earnings and income (2019).

Box 1: Figure 3 legend description

a) **Commercial sector – direct**: includes earnings and income directly attributable to the Pacific halibut commercial fishing sector within the indicated region.
b) **Commercial sector - direct – investors**: indicates the share of the income described in **Commercial sector – direct** that is retained in the region, but flows from the fishing sector to investors. This component captures the value of the leased quota paid to non-fishing stakeholders.
c) **Processing sector – direct**: includes earnings and income directly attributable to the Pacific halibut processing sector within the indicated region.
d) **Recreational (charter) sector – direct**: includes earnings and income directly attributable to businesses offering Pacific halibut sport fishing within the indicated region.
e) **P. halibut sectors (combined) spillovers**: include income attributable to Pacific halibut sectors (commercial fishing, processing, sport fishing) that leaks from the region where the activity occurs as a result of cross-regional flows.
f) **Commercial sector - indirect** - locally**: includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
g) **Commercial sector - indirect** - elsewhere**: as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings' bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-income' bars).
h) **Recreational (charter) sector - indirect – locally**: includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
i) **Recreational (charter) sector - indirect – elsewhere**: as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-region' bars).
j) **Rec. sector - trip exp. – local**: includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
k) **Rec. sector - trip exp. – elsewhere**: includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).
l) **Rec. sector - durables – local**: includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
m) **Rec. sector - durables – elsewhere**: includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).

ECONOMIC IMPACT VISUALIZATION TOOL

The section on PHMEIA and PHMEIA-r results focuses on the economic impact on households as the most meaningful metric to the general population. However, as noted in the introduction, the EI can be expressed with various other metrics, and derived for just a subset of sectors. Regulators and stakeholders may be also interested in assessing various combinations of regional allocations of mortality limits. Thus, PHMEIA and PHMEIA-r are accompanied by the economic impact visualization tool[10] which disseminates the full set of model results. The use of this interactive web-based application can be guided by the PHMEIA app manual (IPHC-2021-ECON-04).

The app update aligning it with the series of latest model improvements is anticipated ahead of the AM098.

ECONOMIC IMPACT OF SUBSISTENCE FISHING

Previous research suggested that noncommercial or nonmarket-oriented fisheries' contribution to national GDP is often grossly underestimated, particularly in developing countries (e.g., Zeller, Booth, and Pauly 2006). Subsistence fishing is also important in traditional economies, often built around indigenous communities. Wolfe and Walker (1987) found that there is a significant relationship between the percentage of the native population in the community and reliance on wildlife as a food source in Alaska. However, no comprehensive assessment of the economic contribution of the subsistence fisheries to the Pacific northwest is available. The only identified study, published in 2000 by Wolfe (2000), suggests that the replacement value of the wild food harvests in rural Alaska may be between 131.1 and 218.6 million dollars, but it does not distinguish between different resources and assumes equal replacement expense per lb. Aslaksen et al. (2008) proposed an updated estimate for 2008 based on the same volume, noting that transportation and food prices have risen significantly between 2000 and 2008, and USD 7 a pound is a more realistic replacement value. This gives the total value of USD 306 million, but the approach relies upon the existence of a like-for-like replacement food (in terms of taste and nutritional value), which is arguably difficult to accept in many cases (Haener *et al.*, 2001) and ignores the deep cultural and traditional context of the Pacific halibut in particular (Wolfe, 2002). A more recent study by Krieg, Holen, and Koster (2009) suggests that some communities may be particularly dependent on wildlife, consuming annually up to 899 lbs per person, but no monetary estimates are derived. Moreover, although previous research points to the presence of sharing and bartering behavior that occurs in many communities (Wolfe, 2002; Szymkowiak and Kasperski, 2020), the economic and cultural values of these networks have yet to be thoroughly explored.

The subsistence component of the study is a subject of a collaborative project with NOAA Alaska Fisheries Science Center: Fish, Food, and Fun - Exploring the Nexus of Subsistence, Personal Use, and Recreational Fisheries in Alaska (SPURF project).

FINAL REMARKS

The PHMEIA model fosters stakeholders' better understanding of a broad scope of regional impacts of the Pacific halibut resource. Leveraging multiple sources of socioeconomic data, it provides essential input for designing policies with desired effects depending on regulators' priorities. By tracing the socioeconomic impacts cross-regionally, the model accommodates the transboundary nature of the Pacific halibut and supports joint management of a shared resource, such as the case of collective management by the IPHC. Moreover, the study informs on the vulnerability of communities to changes in the state of the Pacific halibut stock throughout its range, highlighting regions particularly dependent

[10] The tool is available at: http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/ (full link for printed version).

on economic activities that rely on Pacific halibut. A good understanding of the localized effects is pivotal to policymakers who are often concerned about community impacts, particularly in terms of impact on employment opportunities and households' welfare. Fisheries policies have a long history of disproportionally hurting smaller communities, often because potential adverse effects were not sufficiently assessed (Carothers, Lew, and Sepez 2010; Szymkowiak, Kasperski, and Lew 2019).

The results suggest that the revenue generated by Pacific halibut at the harvest stage accounts for only a fraction of economic activity that would be forgone if the resource was not available to fishers in the Pacific Northwest. On average, in 2019, one USD/CAD of Pacific halibut commercial landings was linked to over four USD/CAD-worth economic activity in Canada and the United States and contributed USD/CAD 1.3 to households. In the recreational sector, one USD/CAD spent by recreational anglers was linked to USD/CAD 2.3 circulating in the economy and USD/CAD 0.7 impact on households. The total economic activity linked to Pacific halibut sectors is estimated at USD 1,014 mil. (CAD 1,346 mil), and contribution to households at USD 326 mil. (CAD 432 mil.), highlighting how important Pacific halibut is to regional economies. The estimates of county-level earnings in Alaska were unevenly distributed, but most importantly to resource managers and policymakers, the model suggests that the local earnings were often not aligned with how much was landed within the county.

Understanding the complex interactions within the fisheries sectors is now more important than ever considering how globalized it is becoming. Local products compete on the market with a large variety of imported seafood. High exposure to international markets makes seafood accessibility fragile to perturbations, as shown by the covid-19 outbreak (OECD, 2020). Pacific halibut contribution to households' income dropped by a quarter throughout the pandemic. While signs of strong recovery were present in 2021 (Fry, 2021), the study calls attention to Pacific halibut sectors' exposure to external factors beyond stock condition. Fisheries are also at the forefront of exposure to the accelerating impacts of climate change. A rapid increase in water temperature of the coast of Alaska, termed *the blob*, is affecting fisheries (Cheung and Frölicher, 2020) and may have a profound impact on Pacific halibut distribution.

Integrating economic approaches with stock assessment and management strategy evaluation (MSE) can assist fisheries in bridging the gap between the current and the optimal economic performance without compromising the stock biological sustainability. Economic performance metrics presented alongside already developed biological/ecological performance metrics bring the human dimension to the IPHC products, adding to the IPHC's portfolio of tools for assessing policy-oriented issues (as requested by the Commission, IPHC-2021-AM097-R, AM097-Req.02). Moreover, the study can also inform on socioeconomic drivers (human behavior, human organization) that affect the dynamics of fisheries, and thus contribute to improved accuracy of the stock assessment and the MSE (Lynch, Methot and Link, 2018). As such, it can contribute to research integration at the IPHC (as presented in IPHC-2021-IM097-12) and provide a complementary resource for the development of harvest control rules, thus directly contributing to Pacific halibut management.

Lastly, while the quantitative analysis is conducted with respect to components that involve monetary transactions, Pacific halibut's value is also in its contribution to the diet through subsistence fisheries and importance to the traditional users of the resource. To native people, traditional fisheries constitute a vital aspect of local identity and a major factor in cohesion. One can also consider the Pacific halibut's existence value as an iconic fish of the Pacific Northwest. While these elements are not quantified at this time, recognizing such an all-encompassing definition of the Pacific halibut resource contribution, the project echoes a broader call to include the human dimension into the research on the impact of management decisions, as well as changes in environmental or stock conditions.

RECOMMENDATION/S

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-13 Rev_1 which provides an update on the development of the Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA).

LITERATURE

Aslaksen, I. *et al.* (2008) 'Interdependency of subsistence and market economies in the Arctic', in *The Economy of the North*. Statistics Norway. Available at: http://www.ssb.no/english/subjects/00/00/30/sa84_en/kap5.pdf.

Carothers, C., Lew, D. K. and Sepez, J. (2010) 'Fishing rights and small communities: Alaska halibut IFQ transfer patterns', *Ocean and Coastal Management*, 53(9), pp. 518–523. doi: 10.1016/j.ocecoaman.2010.04.014.

Castlemain (2019) *Analysis of commercial fishing licence, quota, and vessel values: Prepared for Fisheries and Oceans Canada, Pacific region*.

Cheung, W. W. L. and Frölicher, T. L. (2020) 'Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific', *Scientific Reports*, 10(1), pp. 1–10. doi: 10.1038/s41598-020-63650-z.

COAR (2021) *Commercial Fishing Reporting*, *Commercial Operator's Annual Reports*. Available at: https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar.

Fry, C. (2021) 'Seawatch : Halibut prices soaring', *Homer News*. Available at: https://www.homernews.com/business/seawatch-halibut-prices-soaring/.

Haener, M. K. *et al.* (2001) 'Can Stated Preference Methods be used to Value Attributes of Subsistence Hunting by Aboriginal Peoples? A Case Study in Northern Saskatchewan', *American Journal of Agricultural Economics*, 83(5), pp. 1334–1340. doi: https://doi.org/10.1111/0002-9092.00287.

Krieg, T. M., Holen, D. L. and Koster, D. (2009) *Subsistence harvests and uses of wild resources in Igiugig, Kokhanok, Koliganek, Levelock, and New Stuyahok, Alaska, 2005*.

Lynch, P. D., Methot, R. D. and Link, J. S. (2018) 'Implementing a Next Generation Stock Assessment Enterprise: Policymakkers' Summary', *NOAA Technical Memorandum NMFS-F/SPO-183*.

OECD (2020) 'Fisheries, aquaculture and COVID-19: Issues and Policy Responses', *Tackling Coronavirus (Covid-19)*.

OECD (2021) *Main Economic Indicators - complete database*, *Main Economic Indicators (database)*.

Available at: https://doi.org/10.1787/data-00052-en.

Seung, C. K., Waters, E. and Taylor, M. L. (2019) 'Developing a Multi-Regional Social Accounting Matrix (MRSAM) for Southwest Alaska Fisheries', *NOAA Technical Memorandum NMFS-AFSC*, 399.

Steinback, S. R. and Thunberg, E. M. (2006) 'Northeast Region Commercial Fishing Input-Output Model', *NOAA Technical Memorandum NMFS-NE*, 188.

Szymkowiak, M. and Kasperski, S. (2020) 'Sustaining an Alaska Coastal Community: Integrating Place Based Well-Being Indicators and Fisheries Participation', *Coastal Management*, pp. 1–25. doi: 10.1080/08920753.2021.1846165.

Szymkowiak, M., Kasperski, S. and Lew, D. K. (2019) 'Identifying community risk factors for quota share loss', *Ocean and Coastal Management*, 178, p. 104851. doi: 10.1016/j.ocecoaman.2019.104851.

US Census (2021) *Annual Survey of Manufactures*, *United States Census Bureau*. Available at: https://www.census.gov/programs-surveys/asm.html.

Wolfe, R. J. (2000) *Subsistence in Alaska : A Year 2000 Update*.

Wolfe, R. J. (2002) *Subsistence halibut harvest assessment methodologies. Report prepared for the National Marine Fisheries Service, Sustainable Fisheries Division*. San Marcos, CA.

Wolfe, R. J. and Walker, R. J. (1987) 'Subsistence Economies in Alaska: Productivity, Geography and Development Impacts', *Arctic Anthropology*, 24(2), pp. 56–81.

Zeller, D., Booth, S. and Pauly, D. (2006) 'Fisheries Contributions to the Gross Domestic Product: Underestimating Small-scale Fisheries in the Pacific', *Marine Resource Economics*, 21(4).

Appendix A
The study objectives – summary of progress and notes on outputs

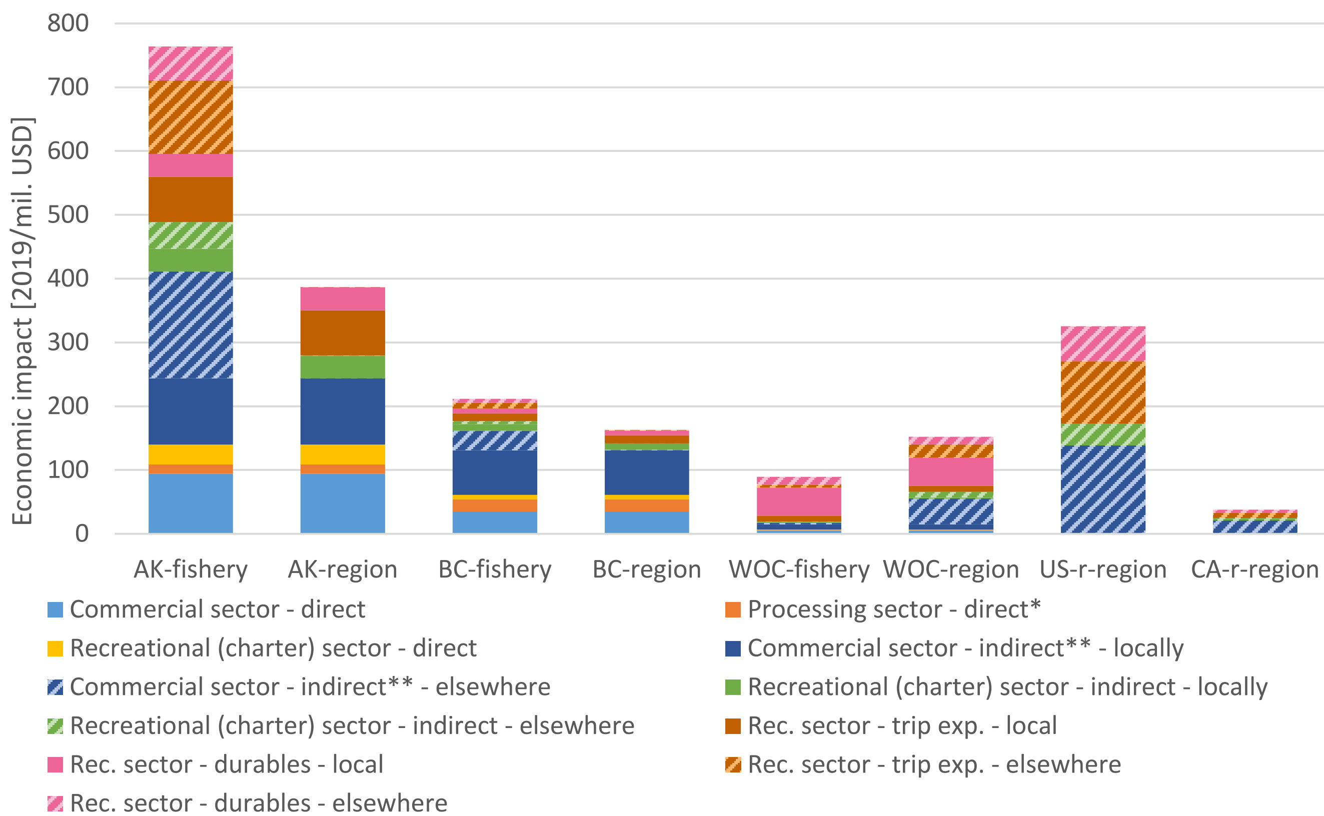
Objective	Status*	Output
Item 1: Survey of previous studies and existing information	---	---
Item 1.a: Literature review	**COMPLETED**	See IPHC-2021-ECON-01 (last revised on 2/9/2021) and project report (IIPHC-2022-AM098-INF04)
Item 1.b: Description of ongoing regular data collection programs	**COMPLETED**	See IPHC-2021-ECON-02-R03 (last revised on 12/31/2021) and project report (IPHC-2022-AM098-INF04)
Item 1.c: Collection of primary data – commercial sector survey	**IN PROGRESS**	Developed in response to the identified data gaps: Commercial Vessel Expenditures Survey Processor Expenditures Survey Preliminary results available via IPHC economic survey results app
Item 1.d: Collection of primary data – charter sector survey	**IN PROGRESS**	Developed in response to the identified data gaps: Charter Sector Expenditures Survey Preliminary results available via IPHC economic survey results app
Item 2: Comprehensive qualitative structural description of the current economics of the Pacific halibut resource	---	---
Item 2.a: Description of the economics of the Pacific halibut commercial sector	**COMPLETED**	See Economic Research section of the IPHC website and project report (IPHC-2022-AM098-INF04)
Item 2.b: Description of the economics of the Pacific halibut recreational sector	**COMPLETED**	See Economic Research section of the IPHC website and project report (IPHC-2022-AM098-INF04)
Item 2.c: Description of the economics of other Pacific halibut sectors (bycatch, subsistence, ceremonial, research, non-directed)	**IN PROGRESS**	See section on subsistence and ceremonial fishing in IPHC-2022-AM098-INF04 The economic impact of bycatch (U32) was considered in the size limits paper (IPHC-2021-AM097-09) Note also additional work proposed in the *IPHC's 5-year program of integrated research and monitoring (2022-26)* (IPHC-2021-IM097-12)

Item 3: Quantitative analysis of the economic impact of the directed Pacific halibut fishery	**---**	**---**
Item 3.a: Methodology – a model of the economy	**COMPLETED**	See details in project report (IPHC-2022-AM098-INF04)
Item 3.b: Methodology – inclusion of the commercial sector in the SAM	**COMPLETED(1)**	See project report (IPHC-2022-AM098-INF04) and Economic Research section of the IPHC website
Item 3.c: Methodology – inclusion of the recreational sector in the SAM	**COMPLETED(1)**	See project report (IPHC-2022-AM098-INF04) and Economic Research section of the IPHC website
Item 3.d: Methodology – economic value of the subsistence use	**IN PROGRESS**	Subject of collaboration with NOAA Alaska Fisheries Science Center (Fish, Food, and Fun: Exploring the Nexus of Subsistence, Personal Use, and Recreational Fisheries (SPURFs) in Alaska)
Item 4: Account of the geography of the economic impact of the Pacific halibut sectors	**---**	**---**
Item 4.a: Visualization of region-specific economic impacts	**COMPLETED(1)**	See online economic impact visualization tool
Item 5: Analysis of the community impacts of the Pacific halibut fishery throughout its range, including all user groups	**---**	**---**
Item 5.a: Community impacts assessment of the Pacific halibut fishery	**COMPLETED(1)**	See project report (IPHC-2022-AM098-INF04) See economic impact visualization tool (*Community impacts in AK* tab) Further improvement of spatial granularity of the estimates is proposed in the *IPHC's 5-year program of integrated research and monitoring (2022-26)*
Item 6: Summary of the methodology and results of the IPHC study in comparison to other economic data and reports for the Pacific halibut resource, other regional fisheries, and comparable seafood industry sectors	**---**	**---**
Item 6.a: Putting results into perspective	**COMPLETED(1)**	See project report (IPHC-2022-AM098-INF04)

* All items marked as COMPLETED are subject to updates based on the direction of the project and the evolution of the situation in the Pacific halibut fisheries. (1)Subject to changes based on the data collected through the IPHC economic survey and publication or revision of relevant secondary data.

Appendix B
Pacific halibut economic impact in terms of output

Figure 4 depicts the economic impact of Pacific halibut commercial and recreational fishing in terms of output. The figure distinguishes between the impact by fishery (i.e., by region where the fishing activity occurs, bars with '-fishery' suffix) and impact by region (i.e., by region where the impact is realized; bars with '-region' suffix).



Notes: The figure omits the impact on the ROW (marginal). *Adjusted to the wholesale mark-up and does not include fish buying cost; **Commercial indirect impact includes processing.

Figure 4: Pacific halibut economic impact in terms of output (2019).

The figure specifies the following components:

a. **Commercial sector – direct**: includes direct output of the Pacific halibut commercial fishing sector, which is equivalent to the landing value or value of sales by Pacific halibut directed commercial fisheries. This component is equal in the 'by fishery' and 'by region' EI estimate.
b. **Processing sector – direct**: includes direct output of the Pacific halibut processing sector (wholesale value) adjusted to include only the wholesale mark-up. This means that the estimate does not include the fish buying cost, avoiding this way double counting the landing value of the Pacific halibut commercial sector in the EI estimate. This component is equal in the 'by fishery' and 'by region' EI estimate.

c. **Recreational (charter) sector – direct**: includes value of direct sales by businesses offering services in the form of guided Pacific halibut recreational (sport) fishing (charter boats, fly-in loges, package deals, etc.). The estimate intends to capture the share of output by the sport fishing sector that depends on the Pacific halibut resource availability, i.e., it is adjusted for mixed target species offers. This component is equal in the 'by fishery' and 'by region' EI estimate.
d. **Commercial sector - indirect** - locally**: includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.
e. **Commercial sector - indirect** - elsewhere**: as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).
f. **Recreational (charter) sector - indirect – locally**: includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.
g. **Recreational (charter) sector - indirect – elsewhere**: as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).
h. **Rec. sector - trip exp. – local**: includes an estimate of the economic contribution of marine angler trip expenditures (travel, lodging, other trip-related expenses) that is realized locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.
i. **Rec. sector - trip exp. – elsewhere**: includes an estimate of the economic impact of marine angler trip expenditures (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).
j. **Rec. sector - durables – local**: includes an estimate of the economic contribution of marine angler expenditures on durable goods (rods, tackle, bout purchase, other fishing equipment and accessories, second home, or additional vehicle purchase) that is occurring locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.
k. **Rec. sector - durables – elsewhere**: includes an estimate of the economic impact of marine angler expenditures on durable goods (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).

IPHC Fishery Regulations: Proposals for the 2021-22 process

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK & D. WILSON; 24 DECEMBER 2021)

PURPOSE

To provide the Commission with the IPHC Fishery Regulation proposals that the IPHC Secretariat, Contracting Parties, and other stakeholders submitted for consideration by the Commission at the 98th Session of the IPHC Annual Meeting (AM098), and associated implementation notes.

BACKGROUND

Recalling the IPHC fishery regulation proposal submission and review process instituted in 2017, this paper is intended to provide details on the fishery regulation proposals being submitted to the Commission in the 2021-22 process.

DISCUSSION

A list of the titles, subjects, and sponsors for IPHC Fishery Regulation proposals submitted for consideration by the Commission at the 98th Session of the IPHC Annual Meeting (AM098) is provided at Appendix I, with links to subsequent implementation notes developed by the IPHC Secretariat.

RECOMMENDATION

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-14, which provides the Commission with the IPHC Fishery Regulation proposals that the IPHC Secretariat, Contracting Parties, and other stakeholders submitted for consideration by the Commission at the 98th Session of the IPHC Annual Meeting (AM098), and associated implementation notes.

APPENDICES

Appendix I: Titles, subjects, and sponsors for IPHC Fishery Regulation proposals (2021-22) process.

APPENDIX I
Titles, subjects, and sponsors for IPHC Fishery Regulation proposals (2021-22 process)

Ref. No.	Title	Brief description if provided (Sector/Area)
IPHC Secretariat		
IPHC-2022-AM098-PropA1	Mortality and Fishery Limits (Sect. 5)	To improve clarity and transparency of fishery limits within the IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5).
IPHC-2022-AM098-PropA2	Commercial Fishing Periods (Sect. 9)	To specify fishing periods for the directed commercial Pacific halibut fisheries within the IPHC Fishery Regulations: Commercial Fishing Periods (Sect. 9).
IPHC-2022-AM098-PropA3	Minor amendments	To improve clarity and consistency in the IPHC Fishery Regulations.
Contracting Parties		
IPHC-2022-AM098-PropB1 Rev_1	Recordkeeping for charter Pacific halibut annual limits (Sect. 29)	**Proponent**: USA (NOAA-Fisheries) The National Marine Fisheries Service (NMFS) proposes a change to Section 29 of the IPHC Fisheries Regulations related to recordkeeping for charter Pacific halibut annual limits.
IPHC-2022-AM098-PropB2	Charter Management Measures in IPHC Regulatory Areas 2C and 3A (Sect. 29)	**Proponent**: USA (NOAA-Fisheries) To provide charter management measures reflective of fishery limits for the recreational fisheries in IPHC Regulatory Areas 2C and 3A.
IPHC-2022-AM098-PropB3	Trap gear use in IPHC Regulatory Area 2B (Sect. 18)	**Proponent**: Canada (Fisheries and Oceans Canada) Canada is proposing changes to Section 18 of the IPHC Fisheries Regulations (Fishing Gear) to allow trap gear use on directed commercial trips in IPHC Regulatory Area 2B.
IPHC-2022-AM098-PropB4	Daily bag limit in IPHC Regulatory Area 2B (Sect. 28)	**Proponent**: Canada (Fisheries and Oceans Canada) Canada is proposing changes to Section 28 of the IPHC Fisheries Regulations (Recreational (Sport) Fishing for Pacific Halibut – IPHC Regulatory Area 2B) to allow daily bag limit of three fish per person.
Stakeholders		
IPHC-2022-AM098-PropC1	Processing Pacific halibut for eating and/or preservation (Sect. 29)	**Proponent**: John Fields, recreational fisherman To propose an exception that allows recreational fishermen on pleasure craft in Alaska Regulatory Area to process Pacific halibut for eating and/or preservation, subject to measures to facilitate enforcement of the applicable daily bag limits.

IPHC 3-year meetings calendar (2022-24)

PREPARED BY: IPHC SECRETARIAT (13 DECEMBER 2021)

PURPOSE

To provide the Commission with an opportunity to consider the tentative IPHC 3-year meetings calendar (2022-24) (Appendix I).

BACKGROUND

Commission: The Commission's annual cycle of meetings is built around the management needs of the Pacific halibut fishery. The IPHC Interim Meeting (IM) follows the completion of the commercial fishing period, and is timed to allow the IPHC Secretariat to incorporate data from that fishing period into the stock assessment and harvest decision support for the coming season. The IPHC Annual Meeting (AM) is scheduled to allow harvest and regulation decisions to be made by the Commission and implemented by the Contracting Parties in time for the opening of the next commercial fishing period.

Subsidiary bodies: The Finance and Administration Committee (FAC), Conference Board (CB) and Processor Advisory Board (PAB) meet adjacent to or during the course of the Annual Meeting. The Scientific Review Board (SRB) and Management Strategy Advisory Board (MSAB) have historically each met twice during the course of the year, in a sequence that supports both their mutual collaboration and the timing of their advice for the Commission. The Research Advisory Board (RAB) meets in November, immediately prior to the Interim Meeting (IM), when its members are best able to convene and consider the IPHC's research activities.

DISCUSSION

Meetings of the Commission and its subsidiary bodies are of interest to the Pacific halibut stakeholder community and the general public, and the publication of their schedule as far in advance as possible enhances meeting preparation and collaboration among stakeholders and Contracting Party agencies.

At this time, due to the ongoing COVID-19 pandemic, all dates and venues for IPHC meetings are tentative. The 98th Session of the IPHC Annual Meeting (AM098) in 2022 has been slated for Bellevue, WA, USA.

The 99th Session of the IPHC Annual Meeting (AM099) has been booked for Victoria, Canada, due to the original contract for 2021 having been deferred due to COVID-19.

RECOMMENDATIONS

That the Commission:

1) **NOTE** paper IPHC-2022-AM098-15, which provides the Commission with an opportunity to consider the IPHC 3-year meetings calendar (2022-24).
2) **APPROVE** the IPHC 3-year meetings calendar (2022-24), while also noting the uncertain operating environment may result in date and venue changes.

APPENDICES

Appendix I: IPHC 3-year meetings calendar (2022-24)

APPENDIX I

IPHC 3-year meetings calendar (2022-24)

	2022			2023			2024		
Meeting	**No.**	**Dates**	**Location**	**No.**	**Dates**	**Location**	**No.**	**Proposed Dates**	**Location**
Annual Meeting (AM)	**98th**	**24-28 Jan**	**Bellevue, WA, USA / Electronic**	**99th**	**23-27 Jan**	**Victoria, Canada**	**100th**	**22-26 Jan**	TBD, **USA**
Finance and Administration Committee (FAC)	98th	24 Jan	Bellevue, WA, USA / Electronic	99th	23 Jan	Victoria, Canada	**100th**	22 Jan	TBD, USA
Conference Board (CB)	92nd	25-26 Jan	Bellevue, WA, USA / Electronic	93rd	24-25 Jan	Victoria, Canada	94th	23-24 Jan	TBD, USA
Processor Advisory Board (PAB)	27th	25-26 Jan	Bellevue, WA, USA / Electronic	28th	24-25 Jan	Victoria, Canada	29th	23-24 Jan	TBD, USA
Scientific Review Board (SRB)	20th	21-23 June	Seattle, USA	22nd	TBD June	Seattle, USA	24th	TBD June	Seattle, USA
	21st	20-22 Sept	Seattle, USA	23rd	TBD Sept	Seattle, USA	25th	TBD Sept	Seattle, USA
Management Strategy Advisory Board (MSAB)	17th	TBD Oct	TBD, WA, USA	18th	TBD Oct	TBD, WA, USA	19th	TBD Oct	TBD, WA, USA
Work Meeting (WM)	--	14-15 Sept	Bellingham, USA	--	13-14 Sept	Bellingham, USA	--	11-12 Sept	Bellingham, USA
Research Advisory Board (RAB)	23rd	29 Nov	Seattle, USA	24th	28 Nov	Seattle, USA	25th	26 Nov	Seattle, USA
Interim Meeting (IM)	**98th**	**30 Nov – 1 Dec**	**Seattle, USA**	**99th**	**29-30 Nov**	**Seattle, USA**	**100th**	**27-28 Nov**	**Seattle, USA**

IPHC Contracting Party Report: Canada

DATE: 22/DEC/2021

CONTRACTING PARTY: CANADA

AGENCY:

Fisheries and Oceans Canada

Maureen Finn, Halibut Coordinator, Maureen.Finn@dfo-mpo.gc.ca

FISHERY SECTOR/S

All

IPHC REGULATORY AREA/S

IPHC Regulatory Area 2B (Canada: British Columbia)

DISCUSSION

Each year Fisheries and Oceans Canada provides harvest opportunities to First Nations for food, social and ceremonial (FSC) purposes (or domestic purposes for First Nations with modern treaties), and the commercial and recreational fisheries. First Nations, recreational, and commercial fisheries on the Pacific coast of Canada have long harvested groundfish. Groundfish serve as a source of food, they provide jobs, income, and enjoyment for individuals, businesses, and coastal communities and they play key roles in natural ecosystems.

The B.C. Ministry of Agriculture is responsible for collection and reporting of data and statistics for the agri-food sector. An important part of that mandate is to analyze the impact of various sectors, including fisheries and seafood to the broader provincial economy. B.C. commercially harvests and reports on over 25 wild fisheries including Pacific halibut which is within B.C.'s top most valuable wild fishery commodities.

Indigenous fisheries

In the 1990 Sparrow decision, the Supreme Court of Canada found that where an Indigenous group has an Indigenous right to fish for food, social, and ceremonial (FSC) purposes, it takes priority, after conservation, over other uses of the resource. Fisheries are authorized via a Communal Licence issued by the Department under the Aboriginal Communal Fishing Licences Regulations.

Commercial fisheries

There are seven distinct commercial groundfish sectors: Groundfish trawl, Halibut, Sablefish, Inside Rockfish, Outside Rockfish, Lingcod, and Dogfish fisheries that are managed according to the measures set out in the Integrated Fisheries Management Plan (IFMP). The management of these sector groups is integrated, with all groups subject to 100% at-sea monitoring and 100% dockside monitoring, individual vessel accountability for all catch (both retained and released), individual transferable quotas (ITQ), and reallocation of these quotas between vessels and fisheries to cover catch of non-directed species. There are approximately 308 active commercial groundfish vessels. Information on licensed vessels is available online at the DFO website: http://www.pac.dfo-mpo.gc.ca/fm-gp/licence-permis/index-eng.htm.

The 2021 commercial fishery is described in appendix 1 of this report, "Fisheries and Oceans Canada 2021 IPHC Annual Report," and appendix 3 of this report, "Halibut Compliance and Enforcement."

Recreational fisheries

A recreational fishery may occur where authorized by a valid Tidal Waters Sport Fishing licence, which is required for the recreational harvest of all species of fish. Approximately 300,000 Tidal Waters Sport Fishing licences are sold each year. Tidal Waters Sport Fishing Licences can be purchased online by using the DFO website:
http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/licence-permis/application-eng.html

The 2021 recreational fishery is described in appendix 2 of this report, "2021 Canadian Recreational Fishery Halibut Catch Report," and appendix 3 of this report, "Halibut Compliance and Enforcement."

RECOMMENDATIONS

That the Commission:

1) **NOTE** paper IPHC-2021-AM098-NR01 which provides the Commission with a summary from Fisheries and Oceans Canada of halibut fisheries in IPHC Regulatory Area 2B.

REFERENCES

Integrated Fisheries Management Plan for Groundfish, effective February 21, 2021. https://waves-vagues.dfo-mpo.gc.ca/Library/4093732x.pdf

APPENDICES

Appendix 1: Fisheries and Oceans Canada 2021 Fishery Overview Report
Appendix 2: Fisheries and Oceans Canada 2021 Recreational Fishery Report
Appendix 3: Fisheries and Oceans Canada 2021 Enforcement Report
Appendix 4: Province of British Columbia 2021 Annual Report

APPENDIX 1

Fisheries and Oceans Canada 2021 Fishery Overview Report

PREPARED BY: Fisheries and Oceans Canada (22Dec2021)

DATE: 22/DEC/2021

CONTRACTING PARTY: CANADA

AGENCY:

Fisheries and Oceans Canada

CONTACT:

Maureen Finn, Halibut Coordinator, Maureen.Finn@dfo-mpo.gc.ca

FISHERY SECTOR/S:

All

IPHC REGULATORY AREA:

IPHC Regulatory Area 2B (Canada: British Columbia)

Discussion

Catch Limits

Fisheries and Oceans Canada follows an allocation policy that defines access to the Pacific Halibut Canadian Total Allowable Catch (CTAC) for Canadian commercial, recreational, and food, social, and ceremonial (FSC) fisheries. For 2021, the CTAC was 6,560,000 net pounds (fresh, head-off, dressed weight). The CTAC is composed of the catch limit for regulatory area 2B and an allocation for FSC. In addition to the CTAC, a carryover of quota from previous seasons is allocated to some licences.

Priority access is provided to the CTAC for FSC purposes, while commercial and recreational access is divided between the sectors 85% / 15% respectively. The 2021 Commercial and Recreational catch limit for allocation purposes was 6,365,000 net pounds. After accounting for O26 wastage, domestic research, commercial carryover from 2020 to 2021 and net reallocations into and out of the 2021 fishery, the resulting TAC for commercial and recreational harvest in 2021 was 6,245,860 net pounds.

Commercial and Recreational Fishery Summaries

For allocation purposes, the commercial / recreational total allowable catch (TAC) is equal to the Canadian catch limit, plus "O26" wastage mortality. The TAC is then allocated between the commercial and recreational sectors, and the respective "O26" wastage mortality is removed from the commercial and recreational TACs (Table 1). The domestic research allocation (use of fish) is also removed from the commercial sector's allocation prior to establishing the 2021 commercial TAC. The combined commercial and recreational TAC, including carryover adjustments, for 2021 was 6,245,860 net pounds. As of December 22, 2021, the combined commercial and recreational halibut catch (including XRQ landed catch, commercial landed catch and mortality associated with all released fish in the commercial groundfish fisheries) was 5,846,029 net pounds.

Commercial Fishery Summary

The 2021 Canadian commercial Halibut TAC, including the catch limit allocation and carryover, was 5,310,299 net pounds. Halibut may be caught and retained by all commercial hook and line, and trap groundfish fisheries in Canada. This includes category L, K, ZN, and Schedule II licences.

In 2021, the Canadian commercial Halibut catch totalled 5,034,506 net pounds (Table 2). This catch, reported by all hook and line/trap groundfish fisheries in area 2B, includes both landed and released at-sea mortality. Given that non-halibut groundfish fisheries continue throughout the Halibut winter closure, additional released at-sea mortality will continue to be attributed to the 2021 Halibut catch until February 20, 2022, after which released at-sea mortality will be attributed to the 2022 TAC. As such the 2021 commercial catch is current as of December 22, 2021.

Commercial Integrated Management Plan

First introduced as a pilot program in 2006, the Commercial Groundfish Integration Program (CGIP) was made permanent in January 2010 to manage groundfish fisheries, including Pacific Halibut, in British Columbia. The objectives of the CGIP are to improve and maintain groundfish harvest sustainability and management through improved catch monitoring and catch accountability. The CGIP implemented individual vessel accountability for all catch, both retained and released, via individual transferable quotas which may be reallocated between licences and fisheries to cover non-directed catch. In addition these management tools are supported by 100% at-sea monitoring and 100% dockside monitoring for all groundfish vessels.

Notable management changes for the 2021 season include:

- The ongoing rebuilding measures for Yelloweye Rockfish and Bocaccio Rockfish in all commercial groundfish fisheries.
- A new Halibut Advisory Board (HAB) was elected and appointed in 2021. Commercial Halibut licence holders elected new commercial HAB representatives for the proceeding four (4) year term (2021-2024). Fisheries and Oceans Canada subsequently made appointments to additional seats to ensure HAB has broad representative fishery interests that are consistent

with the HAB Terms of Reference. HAB membership information will be available in the 2022/23 Groundfish Integrated Fisheries Management Plan when publically released in February of 2022.

- Unlike in 2020, the 2021 Experimental Recreational Halibut fishery (XRQ) was open. Any 2019 licence holders who were subsequently licensed to participate in the 2021 fishery were able to carry forward their allowable 2019 uncaught quota in the 2021 fishery.

.

- A rollover of the seasonal expansion (Nov 1st, 2021 – April 30th, 2022) to the existing 800-line pilot bottom trawl closure was first implemented in 2020. The existing and expanded seasonal closures are at a fishing location in the Queen Charlotte Sound known as the Circle Tow by the groundfish trawl fleet and the 800-line by the Halibut fleet. This expanded seasonal closure is an interim management measure that is intended to limit harvest of spawning aggregations of Arrowtooth Flounder and Halibut. The year-round pilot bottom trawl closure that was implemented in March 2019 continues to be in effect. This expanded seasonal closure is intended for the short term and will be re-evaluated during the 2022/2023 fishing season. More information can be found at: https://notices.dfo-mpo.gc.ca/fns-sap/index-eng.cfm?pg=view_notice&DOC_ID=251970&ID=all

The 2022/2023 commercial groundfish fishing season will commence February 21, 2022, at which time the renewed Groundfish Integrated Fisheries Management Plan (IFMP) will be available. All commercial groundfish management measures are detailed in the IFMP, which can be requested once available at: http://www.pac.dfo-mpo.gc.ca/fm-gp/ifmp-eng.html#Groundfish

Recreational Fishery Summary

There are two opportunities for recreational halibut fishing in area 2B, the recreational fishery, and the Experimental Recreational Halibut fishery pilot program (XRQ fishery). The 2021 recreational Halibut TAC was 914,750 net pounds. The 2021 XRQ fishery was open and acquired 20,811 lbs of quota from the commercial fishery, with 11,962 lbs of catch (as of Dec 22, 2021). The estimated 2021 Canadian recreational Halibut catch totalled 799,561 net pounds. The estimation methods of the recreational catch are outlined in *2021 Canadian Recreational Fishery Halibut Catch Report*. Management measures for the 2021 recreational fishery are summarised in the Area 2B Recreational Fishery Halibut Catch Report.

Halibut Experimental Recreational Fishery Program

The Experimental Recreational Halibut fishery pilot program allows individual anglers as well as guides, charters, lodges, marinas and other fishing experience providers to lease Halibut quota from the commercial fishery and subsequently retain Halibut that is in excess of the regular recreational fisheries daily and possession limits, and maximum size limits. An XRQ licence holder is permitted to fish for and retain Halibut from April 1 – December 31, even if the traditional recreational fishery is closed prior to December 31. Participants in the XRQ fishery must complete logbooks and submit them electronically within seven days of retaining a Halibut.

The XRQ fishery has operated as a pilot program since 2011. A regulatory process is underway to create a category of annual sport fishing licence in s.17 of the *British Columbia Sport Fishing Regulations, 1996*. Public consultations about the regulatory changed were held throughout 2012/2013, and a Regulatory Impact Assessment Statement that summarizes feedback from the public meetings on the experimental licence and regulatory change has been presented to the Minister. A regulatory intent document will be presented for additional public comment prior to the proposed regulatory changes being posted in Canada Gazette 1.

Due to the COVID-related closure of the 2020 XRQ fishery, 2019 Licence holders were allowed to carry forward uncaught quota from the 2019 fishery into 2021 and 7,428 lbs of uncaught quota was carried forward. For the 2021 season, 13,383 lbs of quota has been reallocated from commercial groundfish fisheries, resulting in a total available quota of 20,811 lbs and a total YTD catch of 11,962 lbs (as of Dec 22, 2021).

Additional details about the XRQ program are available online: http://www.pac.dfo-mpo.gc.ca/fm-gp/commercial/ground-fond/index-eng.html

Canadian Aquaculture Research

There were no halibut aquaculture research or production activities in area 2B for 2021.

Food, Social and Ceremonial and Treaty Fishery

The estimated Food, Social, and Ceremonial (FSC) halibut catch in area 2B is 405,000 pounds. Since 2009, new conditions have been applied to commercial Halibut licences and many communal halibut permits, to improve catch reporting of FSC caught fish on commercial trips. Of the total FSC halibut caught in 2021, approximately 45,278 net pounds were caught in conjunction with commercial fishing trips and were subject to all commercial monitoring requirements, including 100% at-sea and 100% dockside monitoring. In addition, First Nations engaging in fishing only for FSC used tools such as catch calendars, some dockside monitoring and phone surveys to estimate their catch. Fisheries and Oceans Canada continues to work with First Nations to improve catch reporting within the FSC fisheries.

In April 2011 the Maa-nulth Final Agreement came into effect. The agreement allocates 26,000 pounds of FSC Halibut (part of the 405,000 pounds described above) plus 0.39% of the total CTAC to the Maa-nulth First Nations for FSC purposes (equivalent to 51,584 pounds in 2021). In 2011 DFO mitigated for the additional treaty allocation through acquisition of 0.47% of the commercial TAC which is set aside for the Maa-nulth First Nation on an annual basis (identified as part of the "net reallocations into/out of the commercial fishery" in Table 1).

RECOMMENDATIONS: NA

REFERENCES: See hyperlinks above

Appendices

Tables

Table 1. Halibut allocations in 2B as of December 22, 2021. All values in net pounds.

Commercial / recreational TAC for allocation		6,365,000
Commercial allocation	x 85%	
O26 wastage	- 170,000	
Research (use of fish)	- 60,000	
Commercial TAC for allocation purposes		5,180,250
Net carryover and net reallocations into/out of the commercial fishery [C]	+ 130,049	
Commercial TAC (Total Available Quota)		5,310,299

Recreational allocation	x 15 %	
O26 wastage	- 40,000	
Recreational TAC	914,750	
XRQ allocation	X 0%	
XRQ acquired quota	+13,383	
Net carryover	+7,428	
XRQ TAC [D]	20,811	
Recreational and XRQ TAC [D]		935,561

2B commercial and recreational TAC	6,245,860
2B commercial and recreational catch [D]	5,846,029

A Underage. Unfished quota equaling 10% or less of a commercial licence's individual transferable quota is carried over into the following year.

B Overage. All catch that exceeds the available quota on an individual commercial licence at the end of a given fishing season is deducted from the individual commercial licence the following season.

C Net reallocations include quota reallocated from the commercial halibut sector to Maa-nulth First Nations Treaty, the Pacific Integrated Commercial Fisheries Initiative (PICFI), and Allocation Transfer Program (ATP), as well as the Halibut Experimental Recreational Fishery (XRQ) pilot program.

D There is no initial allocation provided to XRQ fishery, though quota may be transferred into the XRQ fishery from commercial Halibut fisheries. As a result the XRQ TAC changes proportionately with the commercial TAC as quota is transferred between fisheries.

E Catch includes all landed fish, as well as the mortality associated with legal-sized released fish in the commercial fishery

Table 2. Halibut for 2B commercial groundfish fisheries as of December 22, 2021. All values in net pounds.

Commercial TAC	5,310,299
Total Commercial Catch	5,034,506

Table 3. Halibut for 2B recreational and the Halibut Experimental Recreational pilot program (XRQ) fisheries as of as of December 22, 2021. All values in net pounds.

Recreational TAC	914,750
Recreational catch [E]	799,561
XRQ TAC	20,811
XRQ catch	11,962 [F]
Recreational and XRQ TAC [D]	935,561
Recreational and XRQ catch [E]	811,523

D There is no initial allocation provided to XRQ fishery, though quota may be transferred into the XRQ fishery from commercial Halibut fisheries. As a result the XRQ TAC changes proportionately with the commercial TAC as quota is transferred between fisheries.

E Catch includes all landed fish.

F Effective December 22, 2021.

APPENDIX 2

Fisheries and Oceans Canada 2021 Recreational Fishery Report

PREPARED BY: Fisheries and Oceans Canada (22December2021)

DATE: 22/DEC/2021

CONTRACTING PARTY: CANADA

AGENCY: Fisheries and Oceans Canada

CONTACT:

Maureen Finn, Halibut - Hook & Line Coordinator, Maureen.Finn@dfo-mpo.gc.ca

Greg Hornby, A/Regional Recreational Manager, Greg.Hornby@dfo-mpo.gc.ca

FISHERY SECTOR/S: Recreational

IPHC REGULATORY AREA: IPHC Regulatory Area 2B (Canada: British Columbia)

DISCUSSION

Table of Contents

1. Overview

This report summarizes the 2021 harvest and biological data from the Canadian recreational Halibut fishery in the tidal waters of British Columbia (BC). The recreational total allowable catch for 2021 was 914,750 pounds[1], with an estimated harvest of 799,561[2] pounds (115,289 pound underage). The estimated harvest by pieces is 60,123 pieces.

The 2021 season opened on February 15 and closed on December 31. Traditional monitoring and reporting programs, such as logbooks, lodge manifests and recreational creel surveys, collected catch, effort and biological data during peak months and areas of the fishery. Estimates of catch in months and areas not monitored by traditional programs were generated from data collected during DFO's internet-based recreational survey (iREC). Initiated in 2012, the iREC survey collects catch and effort information from recreational licence holders on a monthly basis throughout the recreational fishing year[3].

Final estimates are anticipated to be available by the spring of 2022. Estimated harvest in pieces and net weight by regional areas are noted below.

1.1. Harvest

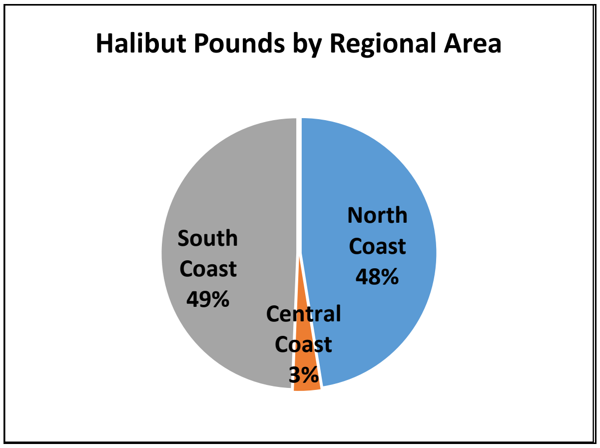
Table 1. Estimated Harvest in Pieces and Pounds by Regional Area

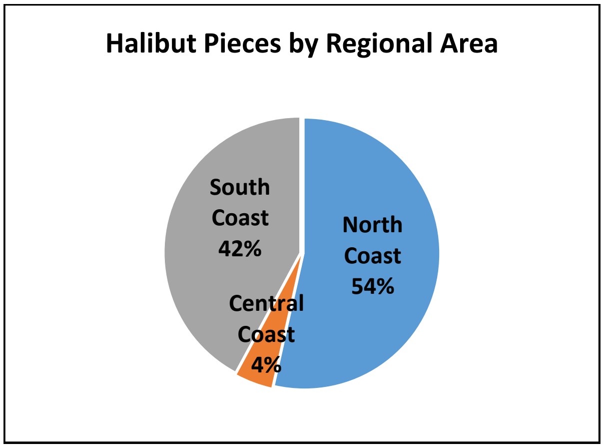
Area	Pieces	Pounds
North Coast	32,183	379,462
Central Coast	2,629	25,386
South Coast	25,311	394,713
Totals	**60,123**	**799,561**

[1] Pounds in this document refer to net weight (head off, dressed) pounds. See Biological Sampling section for the equations used to convert round weight (head on, undressed) and fork length to net weight.
[2] Landed catch up to 31 October, 2021

[3] For more information on the Internet Recreational Effort and Catch (iREC) Survey please visit the following internet site; http://www.dfo-mpo.gc.ca/csas-sccs/publications/sar-as/2015/2015_059-eng.html.

Figure 1. Percentage of Halibut harvested by piece and weight by Regional Area





1.2. Biological Samples

A coast wide total of 13,759 halibut were biologically sampled for either length or weight in 2021, representing 23% of the estimated harvest. The number of biological samples collected by regional areas is noted below. Samples were collected from lodges, guides and independent anglers interviewed at access points and converted to net weight, head off and dressed, using the following formulas developed by the IPHC:

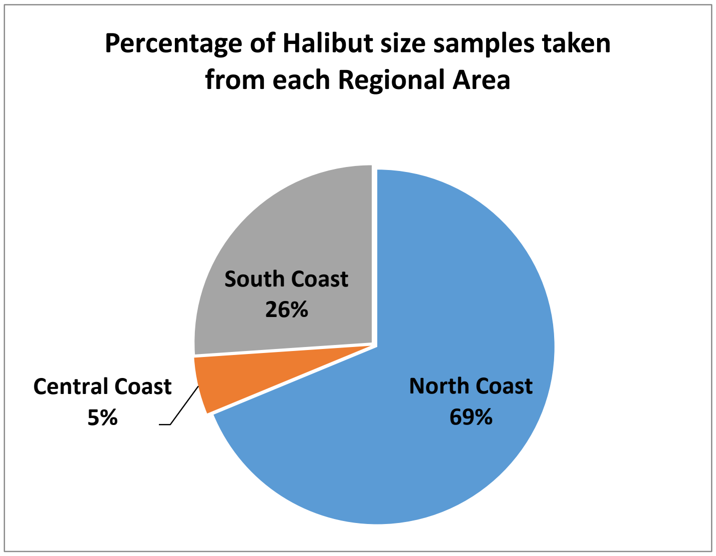
Round Weight = Fork Length (cm)$^{3.24}$ X (6.921 X 10^{-6})
Net Weight = Round Weight X 0.75

Average net weights were calculated for each Area on a monthly basis to generate estimates of total net weight by month and area caught in the fishery.

Table 2. Number of Halibut Biologically Sampled by Regional Area

Area	Samples
North Coast	9,461
Central Coast	711
South Coast	3,587
Totals	**13,759**

Figure 2. Percentage of Halibut size samples taken from each regional area.



1.3. Fishery Logistics

Catch monitoring of the recreational fishery in BC is extremely challenging given the large geographic area (numerous remote areas), the diversity of fishing opportunities and the diversity of participants.

Starting in 2015, Tidal Waters Sport Fishing Licences (TWSFL) included Conditions of Licence that make catch reporting mandatory. Specifically, the conditions state that "*The licence holder shall provide accurate information regarding their catch and fishing activities upon request of a Creel Surveyor or an on-line surveyor, authorities designated under s.61(5) of the Fisheries Act".* Conditions of Licence also included regulations related to possession limits, size limits and an annual limit.

In response to the IPHC's 2012 request for data collection programs on recreational discards, Fisheries and Oceans Canada reviewed its existing recreational halibut catch and release information and examined options for the estimation of release mortalities. DFO obtains information from anglers on the number of halibut releases through creel surveys, logbooks and internet surveys. In BC, anglers are not required to keep any records of released Halibut. Fishers are not required to record sizes of released Halibut in part because such a practice may increase release mortality and present challenges in terms of angler safety, and provide data of variable quality.. Size limits and angler preference are some reasons why released halibut may be a different average size compared to the average size of retained fish. Given these various limitations of the information available, DFO does not currently use recreational release data for the purposes of recreational halibut management or allocation decisions.

In 2020, DFO began using IPHC's estimate of Area 2B recreational release mortality. This resulted in a 2021 estimate of 40,000 lbs of release mortality. This discard mortality is accounted for before the 2B recreational catch limit is established and thus is not included in the calculation of catch relative to the recreational catch limit described elsewhere in this report.

DFO continues to work with the recreational fishery sector in BC to improve recreational fishery monitoring and catch reporting. While the focus remains on strengthening data collection and monitoring for retained catch in recreational fisheries, new reporting tools such as the iREC survey of recreational harvesters include questions about anglers' releases. As the survey continues to be refined and improved, DFO will be exploring how the data gathered on releases may be used to inform management.

2. MANAGEMENT, MONITORING and POLICY DEVELOPMENT

2.1. 2021 Recreational Fishery Management Plan

The current domestic sharing arrangement between commercial and recreational fisheries is 85% of the resource allocated to the commercial sector and 15% to the recreational sector, after accounting for First Nations' Food, Social, and Ceremonial requirements. The 15% recreational share in 2021 equates to a total allowable catch of 914,750 pounds.

The recreational halibut fishery opened on February 15, 2021, with a daily limit of 2 fish per day. The fishery operated under the 2020 recreational licence until March 31. On April 1, the 2021 licence and management measures entered into effect. Current regulations – including daily catch and possession limits, open and closed areas, size limits and gear restrictions – are available online in the BC Sport Fishing Guide: http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/index-eng.html. The 2021 measures included:

- A maximum length of 133cm head-on length
- A daily limit that is set in regulation, is defined in the conditions of licence and can be varied in-season as required. The possession limit is contingent on the daily limit as defined by the *BC Sports Fishing Regulations*, up to maximum of three per day:
    - If the Daily Limit is one (1) or two (2):
        - the Possession Limit is EITHER of: one (1) halibut measuring from 90 cm to 133 cm head-on length - OR - two (2) halibut measuring under 90 cm head-on length.
    - If the Daily Limit is three (3):
        - the Possession Limit is EITHER of: one (1) halibut measuring from 90 cm to 133 cm head-on length – OR - three (3) halibut measuring under 90 cm head-on length.
    - NOTE: If in possession of one (1) Halibut 90cm head-on length or longer, you shall not possess any other Halibut
- An annual limit of ten (10) in aggregate, from April 1, 2021 to March 31, 2022
- All halibut retained must be recorded on the Tidal Waters Licence plus the date and area from which each halibut is caught and its length
- A mandatory Condition of Licence to report catch when surveyed.

The opening was for all Pacific Fishery Management Areas (PFMAs) with the exception of portions of Area 121. Anglers were not permitted to fish for nor retain halibut in Area 121 outside the twelve nautical mile limit and in the waters of Swiftsure Bank.

The DFO and Sport Fishing Advisory Board (SFAB) Halibut Committee meets monthly throughout the fishing season to review estimated catches. Due to the continued impacts of COVID-19 on recreational lodge sector effort, by mid-summer of 2021, it was determined that the recreational sector would be unlikely to reach their TAC under the existing management conditions. Resultantly, DFO, in consultation with SFAB, proceeded with a change to the daily limit of Halibut measuring under 90cm in length – varying the daily limit from two (2) daily to three (3) daily. By the end of October, it was determined that the estimated harvest to date plus the forecasted catch to December 31 would not exceed the 914,750 pound Total Allowable Catch. Resultantly, the fishery will remain open until December 31, 2021.

Due to the Covid-19 pandemic, the issuance of 2021/22 B.C Tidal Waters Sports Fishing Licences (TWSFL) to non-residents was not permitted until the Canada-US border partially re-opened on August 9, 2021. Until August 9, 2021, the fishery was only open to residents of Canada.

For 2022, the SFAB is considering various management options they may recommend to DFO in light of existing and/or continuing impacts from the Covid-19 pandemic. These options may include considering changes to:

- Minimum and Maximum size limits
- Individual annual limits
- Daily and total possession limits
- Season length
- Time and area closures

2.2. Halibut Experimental Recreational Fishery Program

In 2011, the Department piloted an experimental fishery program where interested recreational stakeholders, such as individual recreational harvesters, lodges, charters, guides or marinas, could request an experimental licence that would allow them to lease quota from commercial harvesters through a market based transfer mechanism. The experimental licence permits licence holders to fish halibut beyond the limits and times of the regular recreational licence.

In 2012, the Minister of Fisheries and Oceans Canada confirmed that the experimental licence would continue to be available and announced the Department was moving forward with a regulatory proposal to continue the experimental fishery for the long term.

3. RECREATIONAL CATCH MONITORING and REPORTING PROGRAMS

3.1. Background

Marine creel surveys in BC began in 1980. Originally developed to estimate the catch of Chinook and Coho salmon in the Strait of Georgia, the geographical scope expanded to include Barkley Sound and Alberni Inlet in 1984, the entire West Coast of Vancouver Island (WCVI) in 1991, Haida Gwaii and the rest of the North Coast in 1995, and most recently Johnstone Strait in 1998. The objectives of the creel survey have been expanded to include estimates for most recreationally caught finfish, including halibut. Lodges operating along the coast provide census data to the Department through the logbook program, manifest data or the electronic log (elog) pilot program. The Department also receives data from some independent guides and avid anglers via logbook programs. These data are combined with the creel survey data to produce estimates of catch for each PFMA by month where traditional monitoring and reporting programs exist.

To address monitoring gaps in the recreational fishery the Department has been using and enhancing an online survey since 2012. The Internet Recreational Effort and Catch (iREC) survey was peer reviewed by the Canadian Scientific Advisory Secretariat (CSAS) in 2015. The iREC survey was developed to provide catch and effort estimates for all areas, months, fishing methods, and species harvested by the recreational sector. To minimize the effect of potential biases in iREC survey estimates, a calibration procedure was developed to relate iREC survey estimates and creel survey estimates in areas and times not covered by a creel survey.

3.2. 2021 Recreational Fishery Catch Monitoring

DFO has been working with the Sport Fishing Advisory Board on an implementation plan to strengthen recreational fishery monitoring and catch reporting in the Pacific Region. For the 2021 recreational halibut fishery, DFO used estimates from three sources; the iREC survey, logbook and lodge manifest program, and creel surveys.

DFO uses data from traditional catch monitoring (eg. creel, lodge logbooks and manifests) where available, in priority of iRec survey data. As in previous years, traditional monitoring and catch reporting programs such as logbook, lodge manifest and the creel survey were used during peak months and areas of the recreational fishery. In areas and months where traditional programs were not implemented in 2021, DFO used in-season iREC survey catch estimates. In 2021, approximately 86% of the catch estimate was derived from traditional catch monitoring sources, and 14% from iRec survey estimates.

In 2021, ongoing COVID-related restrictions on travel and the issuance of resident-only TWSFLs until mid-August led to many lodges and guided fishing businesses operating at limited capacity throughout the fishing season. This led to unanticipated early to mid-season reductions in effort and catch from this component of the sector, particularly from the Haida Gwaii region. It is likely that this witnessed reduction in anticipated lodge and guided catch is one of the main contributing factors to the 2021 recreational sector not catching their allocated TAC.

3.3. Haida Gwaii

Haida Gwaii recreational monitoring and reporting programs include a lodge logbook program and a creel survey. Lodge logbook data accounts for approximately 85% of the estimated halibut catch in Areas 1 and 2. Due to ongoing COVID pandemic impacts, many of the lodges in Haida Gwaii did not operate at full capacity in 2021. Effort in this area was significantly reduced this year leading to lower halibut catches than anticipated pre-season.

The Haida Gwaii Creel Survey (HGCS) typically estimates recreational catch from Areas 1 and 2 surrounding Haida Gwaii. Since 1995, the program has conducted creel surveys to estimate catch from recreational anglers in Masset Inlet, Naden Harbour, Langara Island, Skidegate Channel, Cartwright Sound and Rennell Sound. Fish caught in Haida Gwaii by recreational harvesters are also subject to random audits by the Haida Watchmen (Guardians) through the HGCS, which operates in the main fishing months in Area 1 and parts of Area 2.

Information collected from the creel survey is combined with data submitted through the lodge logbook program to generate total catch estimates for Areas 1 and 2. In 2021, 8,579 halibut were sampled for either length or weight.

3.4. North Coast Creel Survey

The North Coast Creel Survey program collects catch information from the recreational fishery surrounding Prince Rupert and Port Edward on the North Coast of B.C. It is focused in Areas 3 and 4, comprising the waters of Chatham Sound between the mouths of the Nass and Skeena Rivers. Chatham Sound is bordered by the Alaska/BC border to the north, Dundas and Stephens Island groups to the west and Porcher Island to the south, covering an area of approximately 4,200 km^2. This area has many lodges and guided fishing operations that were directly impacted by the Covid-19 pandemic with many lodges operating at limited capacity for the season.

The North Coast Creel Survey program has a hybrid design with four components: an access point angler interview survey, an aerial effort count survey, a trailer census and a fishing lodge logbook program. The study design is similar to the one used in the South Coast Creel Survey.

Access point angler interview surveys collect catch information, angling activity times and biological samples of selected species from anglers at the completion of the fishing trip. The data is used to calculate species specific Catch per Unit Effort (CPUE) values and create angler activity profiles. Aerial surveys are conducted to capture the 'instantaneous' counts of the number of boats fishing at the time of the flight and are expanded using the angler effort profiles generated from the ground surveys to produce an estimate of total daily effort. Lodges in the area submit logbooks to DFO post-season. Lodge data is treated as a complete census of catch, is summed and added to the creel estimates to get an estimate of total catch. To prevent bias in the effort estimates from lodge boats counted during the aerial surveys, a temporal-spatial analysis is conducted of lodge logbook data for days when the overflight occurs and any boats that were fishing in the survey area during the time of the flight are removed from the final count of boats fishing in the area.

In 2021, 882 halibut were sampled for either length or weight.

3.5. Central Coast

Catch information in Areas 7, 8 and 9 on the Central Coast is primarily collected from lodges and some charter operators operating in these areas, primarily through the logbook program. As with most areas of the coast, the Central Coast was also significantly impacted by the ongoing Covid-19 pandemic with many lodges and guided fishing operations closed or operating at limited capacity. Most lodges that were still in operation participated in the logbook program and collected catch, effort and biological data that were submitted to the Department on a monthly basis. There is no creel program to estimate the number of halibut caught by independent anglers or guides in these areas due to challenges with implementing a survey in this remote and geographically dispersed fishery.

In 2021, 711 biological samples were reported.

3.6. South Coast Creel Survey

Creel surveys continue to be the main tool to estimate catch of halibut in this area. Surveys are conducted in select fishery strata based on: the highest catch of halibut and chinook, the highest effort, in-season management requirements, and potential impact on stocks of concern. Creel surveys consist of effort surveys and estimation of catch per boat trip based on fishery observers at selected ramps and marinas.

Data collected during angler interviews are recorded in the South Coast Marine Creel Survey form and provide average catch per unit effort by species and fishing times, while aerial counts from chartered aircraft capture 'instantaneous' counts of the number of recreational boats fishing on randomly selected dates. Fishing times obtained from angler interviews are used to generate daily fishing activity profiles which are used to expand the 'instantaneous' aerial counts to estimate the number of boats fishing each day. The estimate of boats fishing is multiplied by the average catch to estimate the total number of halibut caught each day. Estimates are generated monthly, or occasionally for two week periods where samples rates are high. The estimates are stratified by weekend and holidays vs. weekday dates. In addition, logbook catch data submitted by remote fishing lodges, independent guides and expert anglers are incorporated into creel estimates post season. The survey in Kyuquot Sound (PFMA's 26, 126) is entirely logbook-based, as fishing from lodges represents essentially all recreational effort in this remote area; in 2018 estimates were improved through use of iREC survey information on the proportion of guided to unguided trips.

Catch and effort is estimated by creel sub-area and rolled up to DFO PFMAs by month. South Coast waters include PFMAs 11 through 29. The Port Hardy survey also collects information from recreational fishing trips in Area 10. Creel surveys are active during the peak season of recreational angling and vary in duration depending on location. The spatial and temporal coverage of the survey program can vary year to year in response to budget and fishery priorities.

For further details on the methodology and results of the South Coast Creel survey, including catch and effort estimates with level of uncertainty, please visit:
http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/salmon/sc%20stad/bulletins.htm

In 2021, 3,587 halibut were sampled for length or weights during the South Coast Creel survey interviews.

4. APPENDICES

The following tables provide detailed catch and biological information collected during the 2021 recreational halibut fishery in BC. Note: these figures are preliminary and subject to change.

Table 5. Summary of the 2021 Recreational Halibut Catch by Pacific Fishery Management Area (PFMA)

Regional Area	PFMA	Piece Count	Total Net Wt. (net lbs)
North Coast	1	10,410	109,305
	2	1,672	23,331
	3	7,303	87,159
	4	10,549	130,089
	5/6	2,249	29,577
Central Coast	7/8/9	2,629	25,386
South Coast	10/11/111	1,419	28,330
	12	1,305	17,758
	13/14	127	1,912
	15-18/28/29	781	10,435
	19	2,094	33,443
	20	778	12,397
	21/121	4,450	63,515
	23/123	5,802	79,889
	24/124	2,588	49,639
	25/125	1,206	19,503
	26/126	2,731	48,456
	27/127	2,031	29,435
Total Landed in Canada		60,123	799,561
		Recreational TAC	914,850
Estimated Balance - END OF OCTOBER -			115,289
			12.60%

Table 6. Recreational Halibut Monthly Catch Estimates (net wt. lbs) for 2019, 2020 and 2021

	Net Weight (net lbs)			Cumulative Net Weight (net lbs)		
	2019	**2020**	**2021**	**2019**	**2020**	**2021**
Feb	0	0	954	0	0	954
March	8,172	3,814	8,778	8,172	3,814	9,732
April	10,259	7,111	12,017	18,432	10,926	21,749
May	40,988	26,356	56,766	59,420	37,282	78,515
June	152,282	74,348	158,750	211,702	111,630	237,265
July	336,520	182,655	287,218	548,221	294,284	524,483
Aug	207,866	148,422	224,392	756,088	442,707	748,875
Sept	53,956	69,419	49,370	810,044	512,125	798,246
Oct	834	4,236	1,315	810,878	516,361	799,561
Nov	0	398		810,878	516,758	
Dec	5,761	2,216		816,639	518,974	
Total	816,639	518,974	799,561	816,639	518,974	799,561

Recreational TAC	914,850
Estimated Total Catch	799,561
Estimated Balance - END OF OCTOBER -	115,289
	12.60%

Table 7. Estimated 2021 Halibut Catch in Pieces, by Area and Month

PFMA		Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Estimated Total Weight by PFMA	% of Total Weight by PFMA
1		-	-	68	6	528	4,195	4,259	1,354	-			10,410	17.3%
2		-	-	33	28	282	667	603	57	2			1,672	2.8%
3		-	56	22	309	1,625	3,103	2,104	84	-			7,303	12.1%
4		-	58	92	1,192	2,277	3,592	2,841	433	64			10,549	17.5%
5/6		-	12	14	187	455	883	582	104	12			2,249	3.7%
7		-	-	-	20	49	21	296	14	-			400	0.7%
8		-	34	11	52	66	178	354	140	-			835	1.4%
9		-	-	-	-	138	656	441	160	-			1,395	2.3%
10/11		-	-	11	80	573	406	329	20	-			1,419	2.4%
12		-	-	70	42	149	584	256	203	-			1,305	2.2%
13/14		3	3	3	5	12	59	43	-	-			127	0.2%
15-18/28/29		-	-	-	143	107	285	161	85	-			781	1.3%
19		3	193	229	882	359	349	8	61	10			2,094	3.5%
20		59	131	155	201	77	36	74	41	4			778	1.3%
21/121		-	3	22	198	1,789	1,905	479	50	4			4,450	7.4%
23/123		-	8	40	138	605	2,237	2,298	476	-			5,802	9.6%
24/124		-	13	14	36	1,006	773	557	187	2			2,588	4.3%
25/125		-	5	33	204	279	266	254	165	-			1,206	2.0%
26/126		-	-	-	34	688	649	1,230	130	-			2,731	4.5%
27/127		-	-	31	102	171	785	701	241	-			2,031	3.4%
2021 Totals	**Monthly**	64	516	845	3,858	11,234	21,629	17,870	4,007	99	0	0	60,123	
	Cum.	64	580	1,426	5,284	16,518	38,147	56,018	60,025	60,123	60,123	688		

Table 8: Average 2021 Net Weight Estimates of Retained Halibut by Area and Month

PFMA	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1	11.3	11.3	11.3	11.3	11.8	10.8	9.9	11.2	10.5	10.5	10.5
2	13.8	13.8	13.8	13.9	13.7	14.1	13.9	13.9	13.9	13.9	13.9
3	13.2	13.2	13.2	14.8	11.5	13.1	10.1	11.6	11.6	11.6	11.6
4	13.2	13.2	13.2	14.8	11.5	13.1	11.0	12.1	12.1	12.1	12.1
5/6	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
7	10.0	10.0	10.0	8.3	11.7	9.9	8.2	8.9	8.5	8.5	8.5
8	7.4	7.4	7.4	7.4	7.9	7.0	7.9	7.9	7.9	7.9	7.9
9	10.7	10.7	9.1	10.7	8.4	13.0	10.0	9.9	9.9	9.9	9.9
10/11/111	20.0	20.0	20.0	20.0	19.4	20.6	20.1	20.4	20.4	20.4	20.4
12	15.6	15.6	15.6	16.2	15.0	13.3	13.0	13.1	13.1	13.1	13.1
13/14	18.3	18.3	14.7	18.5	10.9	16.4	13.6	15.0	15.0	15.0	15.0
15-18/28/29	13.0	13.0	13.0	13.0	13.0	14.8	11.9	12.2	12.2	12.2	12.2
19	18.6	21.2	16.1	15.2	14.6	16.1	15.3	17.1	16.6	16.6	16.6
20	14.5	17.0	12.1	13.1	25.3	19.2	16.8	21.0	21.0	21.0	21.0
21/121	14.3	14.3	14.3	14.3	15.5	13.1	14.3	14.3	14.3	14.3	14.3
23/123	15.4	15.4	15.4	15.4	18.1	12.6	14.5	9.6	12.0	12.0	12.0
24/124	19.8	19.8	19.8	19.8	18.2	18.8	20.7	20.8	20.8	20.8	20.8
25/125	14.0	14.0	14.0	14.0	13.7	14.2	21.9	18.0	18.0	18.0	18.0
26/126	19.1	19.1	19.1	19.1	14.3	19.6	18.5	19.1	19.1	19.1	19.1
27/127	16.0	16.0	16.0	16.0	17.3	14.7	14.7	10.1	12.4	12.4	12.4

Table 9. Estimated 2021 Halibut Catch in Net Weight (lbs) by Area and Month

PFMA		Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Estimated Total Weight by PFMA	% of Total Weight by PFMA
1		-	-	769	68	6,225	45,096	42,036	15,111	-	0	0	109,305	13.7%
2		-	-	452	387	3,868	9,408	8,388	793	34	0	0	23,331	2.9%
3		-	734	287	4,573	18,688	40,649	21,250	978	-	0	0	87,159	10.9%
4		-	768	1,207	17,642	26,186	47,055	31,251	5,215	766	0	0	130,089	16.3%
5/6		-	154	181	2,456	5,979	11,613	7,660	1,372	163	0	0	29,577	3.7%
7		-	-	-	167	573	205	2,418	125	-	0	0	3,488	0.4%
8		-	252	81	386	389	1,248	2,779	1,105	-	0	0	6,239	0.8%
9		-	-	-	-	1,155	8,528	4,397	1,579	-	0	0	15,659	2.0%
10/11		-	-	218	1,593	11,116	8,368	6,619	416	-	0	0	28,330	3.5%
12		-	-	1,089	687	2,229	7,761	3,320	2,670	-	0	0	17,758	2.2%
13/14		47	48	42	93	131	966	586	-	-	0	0	1,912	0.2%
15-18/28/29		-	-	-	1,863	1,391	4,227	1,913	1,042	-	0	0	10,435	1.3%
19		53	4,096	3,682	13,442	5,223	5,612	123	1,046	166	0	0	33,443	4.2%
20		854	2,230	1,869	2,623	1,945	690	1,243	862	80	0	0	12,397	1.6%
21/121		-	43	312	2,834	27,730	24,975	6,852	715	55	0	0	63,515	7.9%
23/123		-	121	611	2,121	10,975	28,186	33,321	4,555	-	0	0	79,889	10.0%
24/124		-	259	271	703	18,349	14,563	11,552	3,890	51	0	0	49,639	6.2%
25/125		-	73	456	2,841	3,822	3,777	5,555	2,979	-	0	0	19,503	2.4%
26/126		-	-	-	646	9,811	12,720	22,802	2,477	-	0	0	48,456	6.1%
27/127		-	-	490	1,642	2,965	11,571	10,326	2,442	-	0	0	29,435	3.7%
2021 Totals	Monthly	954	8,778	12,017	56,766	158,750	287,218	224,392	49,370	1,315	0	0	799,561	
	Cum.	954	9,732	21,749	78,515	237,265	524,483	748,875	798,246	799,561	799,561	799,561		

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Fisheries and Oceans Canada 2021 IPHC Annual Report

PREPARED BY: Fisheries and Oceans Canada (22 December 2021)

Canadian Enforcement Report for IPHC Regulatory Area 2B (Canada: British Columbia)

CONTACT:

Ann Bussell, Groundfish Enforcement Coordinator/

Fishery Officer

Ann.Bussell@dfo-mpo.gc.ca

DISCUSSION

Compliance and Enforcement Priorities – 2021

Groundfish, including commercial Halibut, enforcement priorities for 2020 were identified in the Groundfish Integrated Fisheries Management Plan and by the Groundfish Enforcement Coordinator as follows:

- ***Closed Area fishing*** *in rockfish conservation areas, sponge reef marine protected areas, marine conservation areas and other permanent and in-season fishing closures*;
- ***Vessel masters*** *not providing all reasonable assistance to DFO designated observers*;
- ***Owner or any person in charge or in control of a fish landing station*** *not providing the DFO designated dockside observer with such assistance as is reasonably necessary to enable observer to perform their duties*;
- ***Retention of groundfish caught, retained or possessed without a licence authority***. *Priority will be placed on occurrences where retention for the purpose of sale is indicated;*
- ***False and misleading statements*** *to DFO designated observers;*
- ***Unauthorized Dual Fishing*** (FSC/Commercial fishing on same trip);
- ***Non-deployment of seabird avoidance gear***. Seabird avoidance gear is required to be deployed as per conditions of licence.
- ***Non-compliance with hail-out, hail-in, electronic monitoring*** *and other elements of the 100 percent at-sea and dockside monitoring programs.*

Links to Pacific Region Groundfish Integrated Fisheries Management Plan – 2021/2022:

Full Text: https://waves-vagues.dfo-mpo.gc.ca/Library/40990151.pdf

Occurrences

Occurrences are reported or observed incidents which are potential violations of any Act or Regulation which falls under the mandate of a Canadian Fishery Officer.

Halibut Compliance and Enforcement – Commercial Halibut Summary 2021

2021 Commercial Halibut Fishery

The 2021 commercial halibut fishery opened at 12:00 hours local time on March 6, 2021 and closed at 12:00 hours local time on December 7, 2021. A total of **155** vessels and **532** fishing trips were recorded during the 2021 commercial halibut fishing season.

Table 1. Commercial Halibut Fishing Trips – Trip Type, Number of Fishing Trips, Number of Vessels and Licence Type – March 6, 2021 to December 7, 2021 [Source: DFO Fishery Operations System (FOS)].

Fishing Trip Type	Number of Fishing Trips	Number of Licences	Licence Type
Commercial	260	92	L
Communal Commercial	141	40	FL
Combo (Halibut/Sablefish)	108	20	K/L
Combo (Halibut/Sablefish)	23	4	FK/FL & L/FK
IPHC	16	3	XL
Experimental	10	3	XL

Table 2: ***Commercial Halibut Fishery*** *Occurrences - January 1, 2021 to December 7, 2021*[1]

Occurrence Type (not all are found to be violations)	**Number of Occurrences**
Area/Time (closed area)	4
Dual Fishing Issues	121 (*not included in total*)*
Catch Related Issues	24
Gear Illegal/Used Illegally	1
Piece Count Issues	3
Hails	2
Processed Fish On Board	3
Reported Overages	1
Offload Related Issues	4
Hold Check Not Completed	19
Undersize Fish	15
Prohibited Species	3
Total	**79**

[1]Source: DFO *Departmental Violations System (DVS), National Enforcement Tracking System (NETS) and Archipelago Marine Research Ltd.(AMR) Portal for Clients*

**A Fishery Officer is working on addressing all the dual fishing occurrences, with the support of the groundfish enforcement coordinator, until March 31, 2021. Many of the occurrences require communication and the sharing of information.*

Halibut Compliance and Enforcement – Recreational Halibut Summary – 2021

2021 Recreational Halibut Fishery

The 2021 recreational halibut fishery opened coast-wide at 00:01 hours February 15, 2021 and closes at 23:59 hours December 31, 2021. Between January 1, 2021 and December 22, 2021 a total of **306,248** recreational licences were issued.

Table 3: ***Recreational Halibut Fishery*** *Occurrences - January 1, 2021 to December 7, 2021*[2]

Number of Occurrences	Action Taken	
32	Investigation Initiated	31
	No Action Warranted	1

[2]Source: DFO *Departmental Violations System (DVS) and National Enforcement Tracking System (NETS). Occurrence type unavailable.*

2021 Halibut Experimental Recreational Fishery

For halibut, in addition to the regular tidal water sport fishing licence, recreational harvesters may obtain an experimental licence, on a voluntary basis, that will allow the licence holder to lease halibut quota from the commercial sector for use in the recreational fishery. For more information: ***Pacific Region Halibut Experimental Recreational Fishery Program Details***

The halibut experimental recreational fishery (XRQ) is open from April 1, 2021 to December 31, 2021. A total of **234** XRQ Licences have been issued as of December 20, 2021

Halibut Compliance and Enforcement – Commercial, Food, Social and Ceremonial (FSC) and Treaty Fisheries - 2021

For all dual fishing (commercial and FSC) halibut trips the vessel master is responsible for following the halibut commercial and/or communal commercial conditions of licence including those specific to dual fishing. All of the fish require 100% monitoring at-sea and 100% monitoring at the dock. In 2021 **53** commercial or communal commercial halibut vessels hailed out for **153** dual fishing trips.

Currently a Fishery Officer is working on addressing the 2021 dual fishing occurrences until March 31, 2022. The officer, with support from the groundfish enforcement coordinator, will use various approaches including direct engagement with vessel masters and Indigenous organizations and enforcement action where appropriate.

FSC halibut fishing does not have the same monitoring requirements as commercial and dual halibut fishing.

Table 4: ***Aboriginal Halibut Fishery*** *Occurrences - January 1, 2021 to December 7, 2021*[3]

Number Of Occurrences	Action Taken	
7	Investigation Initiated	4
	No Action Required	1
	Unable to Respond	2

[3]Source: DFO *Departmental Violations System (DVS) and National Enforcement Tracking System (NETS) Occurrence type unavailable.*

Fishery Officer Enforcement Effort Summary

Table 5: *2019, 2020 & 2021 Conservation & Protection (C&P) Fishery Officer groundfish enforcement hours for Aboriginal, Commercial, and Recreational Halibut fisheries and Recreational hours comparing halibut to finfish and salmon in tidal waters*[4]

	2019	2019	2020	2020	2021	2021
FISHERY TYPE	**HOURS**	**% TOTAL ENF. EFFORT**	**HOURS**	**% TOTAL ENF. EFFORT**	**HOURS**	**%TOTAL ENF EFFORT**
ABORIGINAL HALIBUT	392	0.5%	176.5	0.22%	546.25	0.77%
COMMERCIAL HALIBUT	666.5	0.85%	776.25	0.97%	1079.25	1.53%
RECREATIONAL HALIBUT	693.75	0.89%	356.5	0.45%	298.5	0.42%
TOTAL	**1,752.25**	**2.24%**	**1,309.25**	**1.64%**	**1,924.00**	**2.72%**
RECREATIONAL HALIBUT	729.75	0.94%	37.25	0.047%	82	0.12%
RECREATIONAL FINFISH – TIDAL WATERS	2,502.5	3.2%	626.5	0.78%	1254.3	1.77%
RECREATIONAL SALMON – TIDAL WATERS	4667.0	6.02%	1599.75	2.0%	3298.12	4.68%
TOTAL	**7,899.25**	**10.16%**	**2,263.5**	**2.83%**	**4634.42**	**6.57%**

[4]***Note****: The recreational patrols are typically conducted on a "multi species" or "multi fishery" basis with the predominant effort in recreational tidal directed toward salmon and other finfish. Halibut checks are conducted on these patrols so they are included as part of enforcement effort directed towards recreational halibut fishing.*

Aerial Surveillance Patrol Summary

The DFO aerial surveillance program received a new plane in 2021 with enhanced technology and ability to go greater distances including outside Canada's EEZ.

Table 6: 2021, 2020, *2019, 2018*, *C&P Aerial Surveillance Patrols – number of missions, total hours spent flying, and number of halibut vessels viewed during missions*[5]

AERIAL SURVEILLANCE PROGRAM (ASP) ACTIVITY			
Air Patrols	***Missions***	***Hours***	***Total Halibut Vessels Recorded Per Year***
January 1, 2021 – November 30, 2021	N/A	N/A	Not available in time for this report (N/A)
January 1, 2020 – November 30,2020	184	1107.3	259 (245 l, 14 FL)
January 1, 2019 – November 30, 2019	185	1036.59	146 (130 L, 16 FL)
January 1, 2018 – November 30, 2018	178	1057	294 (263 L, 31 FL)

[5]Source: Provincial Aerospace Limited - Surveillance Information System (SIS)

L = commercial halibut licence FL= communal commercial halibut licence

Violation Summaries

Table 7: *2018, 2019, 2020 & 2021 Violations for Aboriginal, Commercial and Recreational Halibut – Charges Laid, Charges Pending/Under Review, and Tickets/Warnings Issue*[7]. ***Note:*** *Not all information is in yet.*

VIOLATIONS	2018	2019	2020	2021
ABORIGINAL GROUNDFISH – HALIBUT	**2**	**14**	**4**	**4**
CHARGES LAID				
CHARGES PENDING/UNDER REVIEW	1	12	2	4
TICKET ISSUED		1		
WARNING ISSUED	1		1	
DIVERTED (ALTERNATIVE MEASURES)		1	1	
COMMERCIAL GROUNDFISH - HALIBUT	**12**	**4**	**13**	**Information not available**
CHARGES LAID		2		
CHARGES PENDING/UNDER REVIEW	3	2	9	

VIOLATIONS – cont'd	2018	2019	2020	2021
TICKET ISSUED			1	
WARNING ISSUED	9		3	
RECREATIONAL GROUNDFISH - HALIBUT	**64**	**85**	**55**	**52**
CHARGES LAID	1	6		
CHARGES PENDING/UNDER REVIEW	6	38	8	8
TICKET ISSUED	21 (1 XRQ)	25	22	21
WARNING ISSUED	36 (2 XRQ)	16	25	23
TOTAL FOR ALL HALIBUT FISHERIES	**78**	**103**	**72**	**56**

[7]Source: DFO Departmental Violations System (DVS) and National Enforcement Tracking System (NETS).

***Links of interest*:**

DFO Conviction Tables**: https://www.dfo-mpo.gc.ca/media/charges-inculpations/pac-eng.htm**

Transnational crime: **https://www.interpol.int/News-and-Events/News/2021/Depleting-fish-stocks-fueling-transnational-crime**

Canadian commercial fisher receives significant conviction/sentence: **https://www.cbc.ca/news/canada/british-columbia/nanaimo-crab-poacher-lifetime-ban-1.6292864**

Motto, vision, and mission statement

Through consultation and engagement with Conservation and Protection staff across the Pacific Region, we have developed a motto, vision and mission statement that showcases the pride we take in our collected work and reflects our Regional values.

- **Motto:** "Serving Canada, Protecting our Resources."
- **Vision:** "To be a world leader in law enforcement and natural resource protection by adapting to change and striving for excellence to conserve and protect Canada's waters, aquatic species and habitat for the benefit of future generations.
- "**Mission:** "Protecting our resources and ensuring sustainable fisheries through our dedication to law enforcement, conservation, reconciliation, and public outreach as a team of professional, knowledgeable, and passionate individuals.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Province of British Columbia 2021 Annual Report

PREPARED BY: British Columbia Ministry of Agriculture, Food and Fisheries

DATE: 22/DEC/2021

CONTRACTING PARTY: CANADA

AGENCY:

The Province of British Columbia represented by the Ministry of Agriculture, Food, and Fisheries.

CONTACT:

Mike Turner, Director. Policy; Fisheries, Aquaculture and Wild Salmon Branch Michael.R.Turner@gov.bc.ca

Kevin Romanin, Senior Seafood Analyst, Kevin.Romanin@gov.bc.ca

FISHERY SECTORS:

All sectors within British Columbia.

IPHC REGULATORY AREA

IPHC Regulatory Area 2B (Canada: British Columbia)

DISCUSSION

The Province of British Columbia (B.C.) has a long history of involvement with the Pacific halibut fishery and the International Pacific Halibut Commission (IPHC). B.C recognizes the importance of Canada working bilaterally with the United States through the Pacific Halibut Treaty as well as the work done by the IPHC to develop and conserve Pacific halibut stocks. The significant history of this Treaty, as one of the first Canadian international agreements and the near century of mutual benefit to both countries, serves as a tremendous example in global fisheries management. B.C. commends the efforts made by the Commission to reach agreement again during the 97th session of the IPHC Annual Meetings in 2021. Thousands of jobs rely on this continued cooperation and it is critical that this history of collaboration continues.

The B.C. Ministry of Agriculture, Food and Fisheries is responsible for collection and reporting of data and statistics for the agri-food sector. An important part of that mandate is to analyze the impact of various sectors, including fisheries and seafood, to the broader provincial economy. B.C. commercially harvests and reports on over 25 wild fisheries including Pacific halibut which is among B.C.'s most valuable wild fishery commodities[1]. The Pacific halibut fishery supports significant commercial harvests in Canada's waters while providing many fishing and processing jobs and is significantly important to small coastal communities and First Nations across Canada's west coast. The Province licences seafood processors and annually collects data on the volumes and values of the various seafood products. In 2020, the survey showed the processing of 3,120 tonnes (6.88M lbs) of Pacific halibut, which includes some imported halibut processed in B.C. The survey also showed landed and wholesale values of $33.26M and $64.63M respectively. In 2019 Pacific halibut accounted for 8.5% of the wholesale value of all B.C.'s wild fisheries including all groundfish, salmon, and shellfish. In 2020, B.C. exported 1.5M kilograms (3.4M lbs) of halibut products worth $30M. The Province historically conducts a seafood sector employment survey every three years which provides data on jobs, wages, and seafood processing activities, however, impacts of the COVID19 global pandemic have delayed this process and we expect to have employment data from 2019 and 2020 available for distribution in spring of 2022. The last published data from 2016 shows 85 processing facilities that reported processing halibut and generated 319 jobs with an estimated $14M paid in wages[2].

In addition, the recreational halibut fishery supports the hundreds of fishing lodges, charter companies, and individuals that contribute tremendously to the economies of coastal communities. Beginning in 2019 and through 2021, there were severe restrictions on salmon fishing in B.C. which will continue in future years. This amplifies the importance of the recreational halibut fishery to the recreational sector which contributed to an over $1.1B (2016) annual impact on the B.C. Gross Domestic Product[3]. B.C. will continue to provide available data to the IPHC from provincially licensed seafood processors to advance the IPHC economic report which will help highlight the benefits that Pacific halibut provide. As B.C.'s agency responsible for fisheries and seafood economic data, the Ministry of Agriculture, Food and Fisheries recognizes the importance of understanding the broader socioeconomic impacts and downstream effects of the Pacific halibut fishery and looks forward to continuing to work together.

First Nations are entitled to a Food, Social and Ceremonial (FSC) allocation of the total allowable catch (TAC), and many jobs within the halibut fishery and halibut processing facilities are held by members of First Nations across British Columbia. In the commercial halibut fishery, approximately 23% of licenses are held by B.C. First Nations. In 2019, B.C. became the first province in Canada to introduce legislation aimed at adopting the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which mandates that government bring its laws and policies into harmony with the aims of the declaration. The B.C. government has set Indigenous reconciliation as a top priority and is actively working to ensure that First Nations are meaningfully included in management of all B.C. fisheries.

B.C. has an integrated groundfish fishery with 100 percent monitoring and 100 percent bycatch accountability. This well-developed program, which includes at-sea observers and electronic monitoring solutions, is regarded as one of the most well-monitored fisheries in the world and has adapted quickly in response to obstacles encountered by the COVID-19 global pandemic to maintain data integrity. The B.C. Pacific halibut fishery has held Marine Stewardship Council certification since 2009 for being a sustainable, well-managed fishery.

The extensive fisheries monitoring programs come at a direct cost to fishermen and license holders as they are entirely funded by industry. West coast Canadian fishers respect that monitoring programs level the playing field by keeping all fishery participants compliant with the rules which help to ensure sustainable stocks and the future of their industry. In 2020, with the interruption of groundfish observer programs due to the COVID19 pandemic, fisheries were able to implement an Emergency Electronic Monitoring (EEM) program in place of at-sea observers and begin working on alternate methods of estimating halibut bycatch mortality like area-based halibut mortality estimations. Efforts on the EEM program continued through 2021 for improved data accuracy. The long running electronic monitoring programs in B.C. and the data sets available from these robust programs provided the ability to adapt quickly to the unprecedented changes brought on by the pandemic.

The decisions made annually by the IPHC greatly impact the livelihood of many coastal B.C. residents and local economies. With the extensive and costly efforts of accounting for all halibut bycatch in place, B.C. expects that all fishers who share access to the Pacific halibut stocks should be held to similar standards of catch accounting. B.C. fishers need to be assured that the decisions made by the IPHC are based on the best data and science possible by ensuring that all contributing data sources are as thorough and reliable as what they contribute.

The large trawl fisheries in Alaska have high volumes of bycatch that impact many species that move between Canadian and US waters. This includes over 571,000 salmon caught as bycatch in Alaskan fleets in 2020, of which 32,600 were vulnerable chinook salmon[4]. Incomplete monitoring and Alaskan bycatch of halibut in trawl fisheries impact recruitment of juvenile halibut to the fishery as many halibut caught in industrial trawl nets do not survive release. This results in significant mortality in juvenile halibut that might otherwise grow and become available to the fishery.

Uncertainty regarding post-release mortality rates and its implication for total removals adds to these concerns. The annual IPHC Fishery Statistics reports continue to confirm year after year that Regulatory Area 3 remains the area where non-directed commercial discard mortality is estimated most poorly[5]. The 2021 preliminary fishery statistics report again outlines issues in area 3 with low observer coverage and observed trips not being representative of all trips in multiple ways, leading to high uncertainty and potential for bias in the provided discard mortality estimates. This section of the IPHC data overview report has remained constant despite that as part of the interim agreement, the Commission agreed to continue the development of a workplan to 1) explore methods for improvement of monitoring requirements in directed and non-directed fisheries, and 2) examine options in each IPHC Regulatory Area for mitigating the impact of bycatch in one IPHC Regulatory Area on available harvest in other IPHC Regulatory Areas.

The Province of B.C. supports more robust monitoring programs and increased measures to more accurately estimate bycatch and ensure that fisheries are held accountable for their catch and bycatch. The lack of confidence in the total number of halibut removals in some regulatory areas continues to create issues in the management of this shared resource. British Columbia regulatory area 2B maintains an excellent understanding of total halibut removals across its integrated commercial fishery structure through robust monitoring programs that come at a direct cost to fishers.

The Province of B.C. commends the commission for reaching agreement during the 2021 IPHC annual meetings, and for recalling three paragraphs from the previous annual meeting report which intend to address the issues of bycatch accountability and better monitoring[6]. B.C. would like to see continued work on the advancement of initiatives supporting these previous agreements which include:

a) to continue the development of a workplan to explore methods for improvement of monitoring requirements in directed and non-directed fisheries;

b) to continue work on evaluating and redefining TCEY to include the U26 component of discard mortalities, including non-directed commercial fisheries, as steps towards more comprehensive and responsible management of the resource, in coordination with the IPHC Secretariat and Contracting Parties. The intent is that each Contracting Party to the Treaty would be responsible for counting its U26 mortalities against its collective TCEY; and,

c) to account for some of the impact of U26 non-directed discard mortality from US IPHC Regulatory Areas on available harvest in IPHC Regulatory Area 2B.

RECOMMENDATION

The Government of British Columbia's position is that the IPHC must exercise its authority to regulate the incidental catch of Pacific Halibut in all regulatory areas by:

1. **recommitting to the development of a workplan for addressing the needed improvements of monitoring requirements; and**
2. **establishing a robust method of accountability for all halibut mortality within each regulatory area including non-directed commercial discard mortality.**

References

1. *The B.C. Seafood Industry Year in Review (2021). British Columbia Ministry of Agriculture, Food and Fisheries.* https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/statistics/agriculture-and-seafood-statistics-publications
2. *British Columbia Fish Processing Employment 2016 (2018). British Columbia Ministry of Agriculture.* https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/statistics/industry-and-sector-profiles/employment/2016_british_columbia_seafood_processing_employment.pdf
3. *British Columbia's Fisheries and Aquaculture Sector, 2016 Edition (2018). Prepared for BC Ministry of Agriculture by BC Stats.*
4. *NOAA Fisheries Catch and Landings Reports in Alaska (2020). https://www.fisheries.noaa.gov/alaska/commercial-fishing/fisheries-catch-and-landings-reports-alaska*
5. *Fisheries data overview (2021): Preliminary (L. Erikson, H. Tran, T. Kong & C. Prem); IPHC-2021-IM097-06 Rev_1*
6. *Report of the 97th Session of the IPHC Interim Meeting (IM097); IPHC-2021-IM097-R*

National Report:

United States of America

PREPARED BY: NOAA FISHERIES (23 DECEMBER 2021)

PURPOSE

To provide an overview of the fisheries and removals of Pacific halibut during 2021 from the IPHC Convention waters and the national waters of the United States of America.

West Coast of the United States of America – IPHC Regulatory Area 2A

The 2021 Area 2A Pacific halibut (halibut) catch limit of 1,510,000 pounds was allocated according to the 2021 Catch Sharing Plan (CSP) for Area 2A as follows:

Treaty Tribes	528,500 (35%)
Non-Tribal Total	981,500 (65%)
Non-Tribal Commercial	301,321
Washington Recreational	349,414
Oregon Recreational	291,506
California Recreational	39,260

All weights in this report are net weight (gutted, head-off, and without ice and slime), unless otherwise noted. The structure of each fishery and the resulting harvests are described below.

TOTAL TRIBAL AND NON-TRIBAL FISHERIES

Best estimates of halibut catch for Area 2A indicate harvest of 735,531 pounds of the non-tribal total quota and 494,139 pounds of the tribal quota, with a total harvest estimate of 1,229,670 pounds, or 81 percent of the 1,510,000 pound catch limit. A summary of all Area 2A quotas and preliminary harvest estimates for 2021 is attached in Table 2 of this document.

TRIBAL FISHERIES

528,500 pounds (35% of the Area 2A catch limit) was allocated to tribal fisheries. The tribes estimated that 41,478 pounds would be used for ceremonial and subsistence (C&S) fisheries and the remaining 487,022 pounds were allocated to the commercial fishery.

- The unrestricted fishery was open 55 hours for each tribe between March 6 and May 16. The unrestricted fishery landed 246,180 pounds.
- The restricted fishery was open between March 6 and May 16. The restricted fishery landed 67,127 pounds.
- The late fishery was open May 19-June 20 and landed 180,832 pounds.
- The total landings for all tribal fisheries is 494,139 pounds, which is 7,117 pounds over the tribal commercial allocation. The C&S fishery will continue through December 31 and catch estimates will be reported by the tribes in January 2022.

NON-TRIBAL COMMERCIAL FISHERIES

A quota of 301,321 pounds (30.7% of the non-tribal share) was allocated to two fishery components:

1) a directed longline fishery targeting halibut south of Point Chehalis, WA; and

2) an incidental catch fishery during the salmon troll fisheries off Washington, Oregon, and California.

An additional 70,000 pounds were allocated to an incidental catch fishery in the sablefish primary fishery for vessels using longline gear north of Point Chehalis, WA. This allowance for the sablefish primary fishery is taken from the portion of the Washington recreational allocation that is above 214,110 pounds, as long as the amount is at least 10,000 pounds.

Incidental halibut catch in the salmon troll fishery

A quota of 45,198 pounds of Pacific halibut (15% of the non-tribal commercial fishery allocation) was allocated to the non-tribal commercial salmon troll fishery in Area 2A as incidental catch during salmon troll fisheries.

- Halibut retention was permitted in the salmon troll fisheries beginning April 1, with the following ratio: one halibut (minimum 32 inches) per two Chinook salmon landed by a salmon troller, except that one halibut could be landed without meeting the ratio requirement, and no more than 35 halibut could be landed per trip.
- On July 1, the fishery was extended at the same ratio and landing limit.
- The fishery is estimated to have taken 18,562 pounds. This fishery closed October 31.

Fishing with salmon troll gear is prohibited within the Salmon Troll Yelloweye Rockfish Conservation Area (YRCA) off the northern Washington coast. Additionally, the "C-shaped" North Coast Recreational YRCA off Washington is designated as an area to be avoided (a voluntary closure) by salmon trollers.

Directed fishery targeting halibut

A quota of 256,122 pounds (85% of the non-tribal commercial fishery allocation) was allocated to the directed longline fishery targeting halibut in southern Washington, Oregon, and California. The fishery was confined to the area south of Point Chehalis, WA (46°53.30' N. lat.).

Fishing periods were 58 hours in duration every other week, starting Tuesday, June 22. In 2021, the fishery was open for three fishing periods: June 22-24, July 6-8, and July 20-22. Vessels choosing to operate in this fishery could not land halibut as incidental catch in the salmon troll fishery, nor operate in the recreational fishery.

Table 1 2021 fishing period limits (dressed weight, head-on with ice and slime, in pounds per vessel) by vessel size.

Vessel Class/Size (ft)		Jun 22-24	Jul 6-8	Jul 20-22
0-25	A	2,263	2,263	2,263
26-30	B	2,263	2,263	2,263
31-35	C	2,263	2,263	2,263
36-40	D	3,410	3,410	3,410
41-45	E	3,410	3,410	3,410
46-50	F	4,545	4,545	4,545
51-55	G	4,545	4,545	4,545
56+	H	5,113	5,113	5,113

- The three directed commercial open periods resulted in a catch of approximately 242,997 pounds.

Incidental halibut catch in the sablefish primary longline fishery north of Point Chehalis, WA

A quota of 70,000 pounds was allocated to the primary sablefish fishery in Area 2A as incidental catch north of Point Chehalis, WA. This incidental fishery is only available to vessels with a groundfish limited entry permit endorsed for longline gear with a sablefish tier limit and with an IPHC license.

The fishery is confined to an area seaward of a boundary line approximating the 100-fm depth contour. Fishing is also prohibited in the North Coast Commercial YRCA, an area off the northern Washington coast. In addition, the "C-shaped" North Coast Recreational YRCA off Washington is designated as an area to be avoided (a voluntary closure) by commercial longline sablefish fishermen.

- Starting April 1, the incidental landing limit was 250 pounds (dressed weight) of halibut per 1,000 pounds (dressed weight) of sablefish and up to 2 additional halibut in excess of the landing limit ratio.
- Effective June 1, the incidental landing limit was revised to 225 pounds (dressed weight) of halibut per 1,000 pounds (dressed weight) of sablefish and up to 2 additional halibut in excess of the landing limit ratio.
- Effective October 29, the sablefish primary fishery season was extended from October 31 to December 31, and as part of the emergency action, NMFS included an extension of incidental halibut retention to December 7.
- This fishery is projected to have landed 69,081 pounds, which is 919 pounds under the quota.

RECREATIONAL FISHERIES (NON-TRIBAL)

610,180 pounds were allocated between recreational fisheries in Washington (35.6% of non-tribal share, minus 70,000 pounds allocated to the incidental catch in the sablefish primary fishery), Oregon (29.7% of the non-tribal share), and California (4.0% of the non-tribal share). The allocations were further subdivided as quotas among six geographic subareas as described below. Unless otherwise noted, the daily bag limit in all subareas was one halibut of any size, per person, per day.

Washington Inside Waters Subarea (Puget Sound and Strait of Juan de Fuca)

This area was allocated 78,291 pounds (23.5% of the first 130,845 pounds allocated to the Washington recreational fishery, and 32% of the Washington recreational allocation between 130,845 and 224,110 pounds). The fishery in Puget Sound was open April 22-24, April 29-May 1; May 6-8, 13-15, 20-22, 28-30; June 3-5, 10-12, 17-19, 24-26; August 19-21, 26-28; September 2-4, 9-11, 16-18, and 23-24.

- The estimated total catch in this area is 54,955 pounds, which is 23,336 pounds under the quota.

Northern Washington Coastal Waters Subarea (landings in Neah Bay and La Push)

The coastal area off Cape Flattery to Queets River was allocated 128,928 pounds (62.2% of the first 130,845 pounds allocated to the Washington recreational fishery, and 32% of the Washington recreational allocation between 130,945 and 224,110 pounds). The fishery was open May 6, 8, 13, 15, 20, 22, 28, 30; June 3, 5, 10, 12, 17, 19, 24, 26; August 19-21, 26-28; September 2-4, 9-11, 16-18, and 23-24. The "C-shaped" North Coast Recreational YRCA, southwest of Cape Flattery, was closed to recreational halibut fishing.

- The estimated total catch for this area is 84,759 pounds, which is 44,169 pounds under the quota.

Washington South Coast Subarea (landings in Westport)

The area from the Queets River to Leadbetter Point was allocated 63,636 pounds (12.3% of the first 130,845 pounds allocated to the Washington recreational fishery and 32% of the Washington recreational allocation between 130,845 and 224,110 pounds). The all-depth fishery was open May 6, 9, 13, 16, 20, 23, 27; June 17, 20, 24; August 27 and September 24.

- The all-depth fishery estimated catch is 90,626 pounds, which is 26,990 pounds over the quota.

Columbia River Subarea (Leadbetter Point to Cape Falcon)

This recreational fishery subarea was allocated 18,662 pounds, consisting of 2.0% of the first 130,845 pounds allocated to the Washington recreational fishery, and 4.0% of the Washington recreational allocation between 130,845 and 224,110 pounds, 2.3% of the Oregon recreational allocation, and any quota over 8,000 pounds in the Southern Oregon subarea. The fishery operates with an all-depth and nearshore fishery. The nearshore fishery is allocated 500 pounds to accommodate incidental halibut retention during groundfish fishing when the all depth halibut fishery in this area is closed.

- The all-depth fishery was open May 6, 9, 13, 16, 20, 23, 27; June 3, 6, 10, 13, 17, 20, 24; August 27 and September 24. The nearshore fishery was open May 10, Monday – Wednesday each week until June 24.
- The all-depth fishery estimated catch is 21,477 pounds which is 2,815 pounds over the combined subarea quota.

Oregon Central Coast Subarea (Cape Falcon to Humbug Mountain)

This recreational fishery subarea was allocated 273,403 pounds (93.79% of the Oregon recreational allocation).

Three seasons occurred in this subarea, and harvest in these areas is summarized below.

- A restricted depth nearshore (inside 40-fathom) fishery, opened May 1, seven days a week, until September 13, when the all-depth fishery opened 7 days per week.
    - The inside 40-fathom fishery has an estimated catch of 10,982 pounds, which is 21,826 pounds under the allocation.
- a Spring season in all depths that was open on May 13-15, 20-22; June 3-5, 10-12, 17-19; and July 1-3, 15-17 and 29-31;
    - The Spring all-depth fishery resulted in an estimated catch of 69,795 pounds, which is 102,449 pounds under the spring allocation. The remaining quota would shift to other fisheries as needed.
- a Summer season in all depths that was open August 5-7, and every Thursday through Saturday through September 12. Beginning September 13, this fishery opened 7 days per week until October 31. In addition, the daily bag limit was increased from one to two fish on September 13.
    - The Summer all-depth fishery had an estimated catch of 41,799 pounds, which is 26,552 pounds under the allocation.

Southern Oregon (Humbug Mountain to the OR/CA Border)

- This recreational fishery was allocated 8,000 pounds (3.9% of the Oregon recreational fishery allocation minus the Oregon contribution to the Columbia River subarea). This area has a pre-set season of 7 days per week from May 1 to October 31. Beginning September 13, the daily bag limit was increased from one to two fish.
- This fishery has estimated catch of 5,699 pounds, which is 2,301 pounds under the quota.

California (Off the California Coast)

This recreational fishery was allocated 39,260 pounds (4.0% of the non-tribal share). The fishery was open May 1- June 30, and September 3-November 15.

- The fishery has an estimated catch of 24,800 pounds which is 14,460 pounds under the quota.
- See Appendix 1 for more details from California Department of Fish and Wildlife.

Table 2 Summary of all Area 2A quotas and preliminary 2021 harvest estimates, updated with fishery information reported to NMFS through 12/15/2021.

2021 Area 2A Catch Limit and Catch (in pounds)			2021 Quota	Catch to date	% Quota taken
Tribal			528,500		
Tribal	C&S		41,478	-	-
Tribal	Comm.		487,022	494,139	102
Non-Tribal			981,500	735,531	75
Commercial			301,321	261,559	87
Commercial	Directed		256,122	242,997	95
Commercial	Incid. Salmon Troll		45,198	18,562	41
WA Recreational			349,414	299,421	86
WA Recreational	Incid. Sablefish		70,000	69,081	99
WA Recreational	Puget Sound		78,291	54,955	70
WA Recreational	North Coast		128,928	84,759	66
WA Recreational	South Coast		63,636	90,626	142
WA/OR	Columbia River	All-Depth	18,162	21,477	118
WA/OR	Columbia River	Nearshore	500	-	0
OR Recreational			291,506	128,275	44
OR Recreational	Central OR Coast	Spring all-depth	172,244	69,795	41
OR Recreational	Central OR Coast	Summer all-depth	68,351	41,799	61
OR Recreational	Central OR Coast	Nearshore	32,808	10,982	34
OR Recreational	Southern OR		8,000	5,699	71
CA Recreational			39,260	24,800	63
Total			1,510,000	1,229,670	81

Law Enforcement – West Coast Area 2A

Enforcement of the commercial, tribal and recreational Pacific halibut fisheries in International Pacific Halibut Commission Area 2A is an ongoing multi-agency effort performed cooperatively by NOAA Fisheries Office of Law Enforcement (OLE), West Coast Division (WCD), the U.S. Coast Guard (USCG), California Depart of Fish and Wildlife Enforcement Division (CDFW), Oregon State Patrol Fish and Wildlife Division (OSP), Washington Department of Fish and Wildlife Police (WDFW), and Tribal Enforcement. Table 3, Table 4, and Table 5 present a summary by sector of IPHC Area 2A commercial and recreational statistics for 2021, using data elements provided by OLE, USCG, CDFW, OSP, and WDFW.

Table 3 ***Area 2A Enforcement Statistics for Commercial-Directed Fishery***

2021 IPHC AREA 2A ENFORCEMENT STATISTICS						
COMMERCIAL - DIRECTED						
	USCG (D13/D11)	NOAA OLE (WCD)	WDFW	OSP - ODFW	CDFW	
EFFORT						CONSOLIDATED EFFORT
AIR PATROLS						
Number of Air Patrols	30					30
Air Patrol Hours	96					96
Air Patrol Personnel Hours	N/A	71				71
VESSEL PATROLS						
Number of Vessel Patrols	68		7	4		79
Vessel Patrol Hours	875		31	21		927
At-Sea Personnel Hours	N/A	16	76	42		134
Number of Boardings/Contacts	34	3	19	10		66
SHORESIDE PATROLS						
Number of Shoreside Patrols			2	17	42	61
Shoreside Personnel Hours		178	12	147	116	453
Number of Boardings/Contacts		26	2	11	24	63
OFFICERS/AGENTS/WARDENS						
Number of Assigned Personnel	54	5	6	6	4	75
ACTIONS						CONSOLIDATED ACTIONS
Compliance Assistance		3			1	4
Written Warnings						0
Citations			3			3
Other (list below)						0
Not in Compliance			6			6
						0
						0
RESULTS						CONSOLIDATED RESULTS
Undersized Halibut						0
Over Limit						0
Prohibited Gear			4			4
Logbook/Reporting		2				2
Permit/License			1			1
Restricted/Closed Area						0
Fail to Validate Tag						0
Illegal Harvest						0
Possess Groundfish w/Halibut On Board						0
Other (list below)						0
Seabird Avoidance Gear Not Used		1				1
						0
						0

Table 4 ***Area 2A Enforcement Statistics for Commercial-Incidental Fisheries***

2021 IPHC AREA 2A ENFORCEMENT STATISTICS						
COMMERCIAL - INCIDENTAL						
	USCG (D13/D11)	NOAA OLE (WCD)	WDFW	OSP - ODFW	CDFW	
EFFORT						**CONSOLIDATED EFFORT**
AIR PATROLS						
Number of Air Patrols	222					222
Air Patrol Hours	701					701
Air Patrol Personnel Hours	N/A					0
VESSEL PATROLS						
Number of Vessel Patrols	417		1		25	443
Vessel Patrol Hours	6250		6		49	6305
At-Sea Personnel Hours	N/A		12		116	128
Number of Boardings/Contacts	156		4		9	169
SHORESIDE PATROLS						
Number of Shoreside Patrols		2				2
Shoreside Personnel Hours		16				16
Number of Boardings/Contacts		4				4
OFFICERS/AGENTS/WARDENS						
Number of Assigned Personnel	54	2	2		4	62
ACTIONS						**CONSOLIDATED ACTIONS**
Compliance Assistance		2				2
Written Warnings		1				1
Citations						0
Other (list below)						0
						0
						0
						0
RESULTS						**CONSOLIDATED RESULTS**
Undersized Halibut						0
Over Limit						0
Prohibited Gear						0
Logbook/Reporting						0
Permit/License						0
Restricted/Closed Area						0
Fail to Validate Tag						0
Illegal Harvest						0
Possess Groundfish w/Halibut On Board						0
Other (list below)						0
Retained Halibut		1				1
VMS		2				2
						0

Table 5 *Area 2A Enforcement Statistics for Recreational Fisheries*

2021 IPHC AREA 2A ENFORCEMENT STATISTICS						
RECREATIONAL						
	USCG (D13/D11)	NOAA OLE (WCD)	WDFW	OSP - ODFW	CDFW	
EFFORT						CONSOLIDATED EFFORT
AIR PATROLS						
Number of Air Patrols	222					222
Air Patrol Hours	701					701
Air Patrol Personnel Hours	N/A					0
VESSEL PATROLS						
Number of Vessel Patrols	417		29	19	25	490
Vessel Patrol Hours	6250		201	64	49	6564
At-Sea Personnel Hours	N/A		445	128	116	689
Number of Boardings/Contacts			425	263	77	765
SHORESIDE PATROLS						
Number of Shoreside Patrols		2	35	11	52	100
Shoreside Personnel Hours		18	170	50	126	364
Number of Boardings/Contacts		12	719	19	189	939
OFFICERS/AGENTS/WARDENS						
Number of Assigned Personnel	96	1	19	8	9	133
ACTIONS						CONSOLIDATED ACTIONS
Compliance Assistance						0
Written Warnings		4	130			134
Citations			105		4	109
Other (list below)						0
Vessels Not In Compliance			105			105
						0
						0
RESULTS						CONSOLIDATED RESULTS
Undersized Halibut						0
Over Limit			4			4
Prohibited Gear			80			80
Logbook/Reporting						0
Permit/License		4	52			56
Restricted/Closed Area			11			11
Fail to Validate Tag			15			15
Illegal Harvest						0
Possess Groundfish w/Halibut On Board						0
Other (list below)						0
Prohibited Species			9			9
						0
						0

Alaska – IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4CDE

Charter Halibut Fisheries

The Area 2C and 3A Halibut Catch Sharing Plan was implemented in 2014, and is used to determine the allowable charter halibut harvest in those areas. The Catch Sharing Plan also endorses a process through which the North Pacific Fishery Management Council (NPFMC) recommends annual management measures to the IPHC that are likely to limit charter harvests to their annual catch limits.

In October 2021, the Alaska Department of Fish and Game provided final estimates of the 2020 sport halibut removals and preliminary estimates of the 2021 removals for Areas 2C, 3A, 3B, and 4, including information on estimation methods (Webster, Jaenicke, et al. 2021).[1] Additional details on estimation methods are available in Webster and Buzzee (2020).[2]

2020 Final Harvest Estimates

The Area 2C charter fishery allocation for 2020 was 0.78 Mlb. Regulations included a one-fish bag limit with a reverse slot limit of less than or equal to 40 inches or greater than or equal to 80 inches through June 14, then changed June 15 by emergency action due to the COVID-19 pandemic to a one-fish bag limit with a reverse slot limit of less than or equal to 45 inches or greater than or equal to 80 inches for the remainder of the year. The Area 3A charter allocation was 1.71 Mlb. Regulations through June 14 included a two-fish bag limit with a maximum size on one of the fish of 26 inches, a limit of one trip per charter vessel per day and per CHP per day, a closure to halibut retention on Tuesdays and Wednesdays, and a 4-fish annual limit with a recording requirement. Regulations were changed by emergency action on June 15 and included a two-fish bag limit with a maximum size on one of the fish of 32 inches and limits of one trip per charter vessel per day and per CHP per day; there were no closure days or annual limits after the regulation change. Charter captains and crew were not allowed to retain halibut while guiding clients in Area 2C or Area 3A. Charter fishery regulations in the remainder of the state included a bag limit of two fish of any size. Unguided fishery regulations statewide were a bag limit of two fish of any size.

The 2020 Area 2C estimated sport harvest (excluding release mortality) was 83,471 fish, for a yield of 1.334 million pounds. Area 2C charter removals (including release mortality) were estimated to be 0.483 Mlb, approximately 38% under the allocation. Unguided removals were estimated to be 0.885 Mlb. The Area 3A estimated sport harvest was 197,355 fish, for a yield of 2.971 Mlb. Area 3A charter removals were estimated to be 1.567 Mlb, approximately 8% under the allocation. Unguided removals were estimated to be 1.437 Mlb. Areas 3B and 4 do not have separate charter allocations. The final harvest estimates for western Areas were 402 halibut in Area 3B and 549 halibut in Area 4. Applying the Kodiak unguided average weight of 18.40 lb resulted in yield estimates of 0.007 Mlb in Area 3B and 0.010 Mlb in Area 4. Additional detail on numbers of fish harvested and released, releases by size category, average weights, and

---

[1] Webster, S., M. Jaenicke, D. Tersteeg, M. Ford, and M. Schuster. 2021. Letter from ADF&G to IPHC reporting final 2020 and preliminary 2021 sport halibut harvest estimates, Oct 25, 2021. Retrieved 10 December 2021, from https://www.npfmc.org/halibut-charter-management/

[2] Webster, S. R., and B. Buzzee. 2020. Estimation and projection of statewide sport halibut harvest. Alaska Department of Fish and Game, Division of Sport Fish, Regional Operational Plan ROP.SF.4A.2020.04, Anchorage. https://www.adfg.alaska.gov/FedAidPDFs/ROP.SF.4A.2020.04.pdf

confidence intervals are included in Webster, Jaenicke, et al. (2021). Information on harvest by subarea and historical harvest can be found in North Pacific Fisheries Management Council (2021).

2021 Preliminary Harvest Estimates

The Area 2C charter fishery allocation for 2021 was 0.81 Mlb. Regulations included a one-fish bag limit with a reverse slot limit of less than or equal to 50 inches or greater than or equal to 72 inches. The Area 3A charter allocation was 1.95 Mlb. Regulations included a two-fish bag limit with a maximum size on one of the fish of 32 inches, a limit of one trip per charter vessel per day and per CHP per day, and a closure to halibut retention on Wednesdays. When management measure analyses were reviewed prior to the 2021 season, forecasts were reduced by 35% in Area 2C and by 25% in 3A to account for anticipated impacts of the COVID-19 pandemic on effort in the charter sector (COVID buffers). Charter captains and crew were not allowed to retain halibut while guiding clients in Area 2C or Area 3A. Charter fishery regulations in the remainder of the state included a bag limit of two fish of any size. Unguided fishery regulations statewide were a bag limit of two fish of any size.

One notable change to preliminary estimates in 2021 is that use of electronic logbooks (eLogbooks) became mandatory for charter operators in Southeast Alaska. As such, harvest reported through mid-October was used for the preliminary charter estimates in Area 2C, noting that in recent years there was no charter harvest reported in Area 2C after October 15th. There was no mandate to use eLogbook in most of 3A in 2021 and most operators still use paper logbooks. Preliminary logbook data were available for trips taken through August 31 in Area 3A and this was used to project harvest for the year in Area 3A. This is an improvement from past preliminary estimates that only used logbook data through July 31 in both Areas.

The preliminary reported charter harvest and estimated removal in Area 2C was 77,287 halibut and 1.154 Mlb, respectively, approximately 42% over the 2021 allocation. Unguided harvest and removal estimates in Area 2C were 61,981 fish and 1.089 Mlb. The preliminary estimates of charter harvest and removal in Area 3A were 184,160 fish and 2.454 Mlb, respectively, approximately 26% over the allocation. Unguided harvest and removal estimates in Area 3A were 109,298 fish and 1.577 Mlb. The preliminary harvest estimates for 2021 were 452 halibut in Area 3B and 761 halibut in Area 4. Applying the unguided average weight from Kodiak of 14.23 lb resulted in removal estimates of 0.006 Mlb in Area 3B and 0.011 Mlb in Area 4. Additional detail on numbers of fish harvested and released, releases by size category, average weights, and confidence intervals are included in Webster, Jaenicke, et al. (2021).

2022 Areas 2C and 3A Charter Halibut Management Measure Analyses

In addition to estimating all recreational halibut harvest in Alaska, the Alaska Department of Fish and Game is responsible for analyzing alternative management measures for the charter halibut fisheries in Areas 2C and 3A. Analyses were requested by the North Pacific Fisheries Management Council's Charter Halibut Management Committee on 26 October 2021. Results were presented at the North Pacific Fisheries Management Council meeting in December. Analyses attempted to project removals under "normal" conditions; data assumed to have been impacted because of the COVID-19 pandemic were omitted from time series forecasts, which often resulted in forecasting out three time-steps and increased uncertainty in results. No attempts were made to account for future impacts of the pandemic. Projected removals in 2021 under status quo regulations are 1.10 Mlb in Area 2C and 2.30 Mlb in Area 3A. Based on the reference allocations, charter regulations for both Areas will need to be more restrictive in 2022 than in 2021. Under the suite of management measures recommended by the NPFMC at the December

2021 meeting, removal projections range from 0.583 to 1.044 Mlb for Area 2C and from 1.795 to 2.156 for Area 3A (Webster, Jevons, & Powers 2021).[3]

NPFMC Charter Halibut Fishery actions in 2021

On December 8, 2021 the NPFMC recommended management measures for charter halibut fishing in Areas 2C and 3A for the 2022 fishing season. These recommendations are submitted as Regulatory Proposal B2 to the IPHC for consideration and adoption by the Commission at AM098 in January 2022. The measures approved by the NPFMC were developed by the Charter Halibut Management Committee based on analyses provided by ADF&G as well as the needs of the fishery.[4] These measures are expected to constrain overall charter removals to the final 2022 area allocations, as determined by the IPHC under the Catch Sharing Plan.

Guided Angler Fish Program- 2021 Summary

In 2014, NMFS implemented the guided angler fish (GAF) program to authorize limited annual transfers of commercial halibut IFQ as GAF to qualified charter halibut permit holders for harvest by charter vessel anglers in Areas 2C and 3A. The GAF program allows qualified charter halibut permit holders to offer charter vessel anglers the opportunity to retain halibut up to the limit for unguided anglers when the charter management measure in place limits charter vessel anglers to a more restrictive harvest limit.

In 2021, charter vessel anglers who used GAF in Area 2C and Area 3A could harvest up to two halibut of any size per day, and GAF were not subject to the daily closures in Area 3A. Table 6 summarizes IFQ to GAF transfers for 2017 through 2021. From the outset of the program, GAF is has been used more frequently in Area 2C than 3A. In Area 2C in 2021, 97,056 pounds of IFQ was transferred as GAF to the charter fishery; this translated into 1,312 harvestable halibut, of which 79% (1,031 fish) were actually taken. In Area 3A in 2021, 11,913 pounds IFQ was transferred as GAF, resulting in 441 harvestable fish. However, only 29% (128 fish) of the Area 3A GAF was taken.[5]

Table 6 Summary of IFQ to GAF transfers

Year	IPHC Regulatory Area	Number of GAF transferred	Number of GAF Harvested (% of amount transferred)	Actual Net Pounds of IFQ Harvested	Average Length in Inches (range)	Number of GAF Permits Issued	Number of GAF Permit Holders
2017	2C	719	576 (80%)	40,860	55 (18-79)	207	34
	3A	233	157 (67%)	6,920	48 (29-72)	22	13
	Total	952	733 (77%)	47,780		229	47

[3] Webster, S., B. Jevons, and R. Powers 2021. Analysis of management options for the Area 2C and 3A charter halibut fisheries for 2022: A report to the North Pacific Fishery Management Council, December 2021. Alaska Department of Fish and Game. Agenda item C3. Unpublished. Retrieved 10 December 2021, from https://meetings.npfmc.org/Meeting/Details/2713

[4] ADF&G Analysis is available on the December NPFMC meeting agenda under item C1 at: https://meetings.npfmc.org/Meeting/Details/2713

[5] GAF Program Annual reports are available at: https://www.fisheries.noaa.gov/resource/document/guided-angler-fish-gaf-program-annual-reports.

Year	IPHC Regulatory Area	Number of GAF transferred	Number of GAF Harvested (% of amount transferred)	Actual Net Pounds of IFQ Harvested	Average Length in Inches (range)	Number of GAF Permits Issued	Number of GAF Permit Holders
2018	2C	1,222	972 (80%)	64,365	54 (22-79)	332	46
	3A	304	215 (71%)	9,052	47 (25-89)	31	17
	Total	1,526	1,187 (78%)	73,417		363	63
2019	2C	1,601	1,237 (77%)	75,039	53 (22-83)	341	56
	3A	338	266 (79%)	10,652	46 (25-66)	29	13
	Total	1,939	1,503 (78%)	85,691		370	69
2020	2C	801	764 (95%)	55,061	56 (23-85)	235	48
	3A	92	38 (41%)	2,147	52 (34-64)	15	7
	Total	893	802 (90%)	57,208		250	55
2021	2C	1,312	1,031 (79%)	76,529	57 (29-75)	407	59
	3A	441	128 (29%)	3,446	39 (19-65)	24	8
	Total	1,753	1,159 (66%)	79,976		431	67

Commercial Groundfish Fisheries

Halibut Bycatch

This section contains preliminary information that will be updated with final 2021 data in January 2022.

Current Halibut Bycatch Amounts and Management

Halibut bycatch mortality in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) groundfish fisheries is highly regulated and closely managed by the NPFMC and NMFS through the Fishery Management Plans (FMPs) for each management area. Through regulations implementing the FMPs, NMFS manages halibut bycatch by (1) establishing annual halibut prohibited species catch (PSC) limits, (2) apportioning PSC limits to fishery categories and seasons to accommodate halibut PSC needs in specific groundfish fisheries, and (3) managing groundfish fisheries to prevent PSC from exceeding the established limits.

The FMPs specify that halibut bycatch in groundfish fisheries is managed as PSC. Catch of PSC species must be avoided while fishing for groundfish and PSC species may not be retained unless required under the FMP. Halibut PSC limits are an apportioned, non-retainable amount of halibut provided to a groundfish fishery to provide an upper limit on the bycatch of halibut in a fishery. When a halibut PSC limit is reached in an area, further fishing with specific types of gear or modes of operation is prohibited by those types of operations taking halibut PSC in that area.

Although halibut PSC is taken by vessels using all types of gear (trawl, hook-and-line, pot, and jig gear), halibut PSC primarily occurs in the trawl and hook-and-line (non-trawl) groundfish fisheries. The NPFMC and NMFS annually establish halibut PSC limits for vessels in the trawl and non-trawl groundfish fisheries in the BSAI and GOA. NMFS manages groundfish fisheries to ensure these limits are not exceeded.

The total estimated halibut PSC use for 2021 are shown in Table 7.

Table 7 Total and Projected Halibut Mortality in the GOA and BSAI (nearest metric ton) by Area and Gear (Target)

	2020 Total	2021 (1/1 to 10/19)	Projected (10/20 to 12/31)	2021 Total
Area 2C				
Hook-and-line (non-sablefish)	3	0	0	0
Hook-and-Line (sablefish)	8	12	2	14
Pot	0	1	0	1
Total	**11**	**13**	**2**	**15**
Area 3A				
Trawl	561	129	30	159
Hook-and-line (non-sablefish)	1	45	5	50
Hook-and-Line (sablefish)	8	3	1	4
Pot	0	4	0	4
Total	**570**	**181**	**36**	**217**
Area 3B				
Trawl	223	167	5	172
Hook-and-line (non-sablefish)	0	6	2	8
Hook-and-Line (sablefish)	3	4	1	5
Pot	0	4	0	4
Total	**226**	**181**	**8**	**189**
Area 4A				
Trawl	148	123	11	134
Hook-and-line (non-sablefish)	4	2	0	2
Hook-and-Line (sablefish)	0	0	0	0
Pot	2	2	0	2
Total	**154**	**127**	**11**	**138**
Area 4B				
Trawl	49	41	4	45
Hook-and-line (non-sablefish)	7	22	8	30
Hook-and-Line (sablefish)	0	0	0	0
Pot	2	1	0	1
Total	**58**	64	**12**	**76**

	2020 Total	2021 (1/1 to 10/19)	Projected (10/20 to 12/31)	2021 Total
Area 4 CDE				
Trawl	668	489	44	533
Hook-and-line (non-sablefish)	73	49	0	49
Hook-and-Line (sablefish)	0	0	0	0
Pot	0	0	0	0
Total	**741**	**538**	**44**	**582**
Area 4 Closed				
Trawl	712	568	52	620
Hook-and-line (non-sablefish)	3	8	0	8
Hook-and-Line (sablefish)	0	0	0	0
Pot	1	1	0	1
Total	**716**	**577**	**52**	**629**
TOTAL (All Areas)				
Trawl	2,361	1,517	146	1,663
Hook-and-line (non-sablefish)	91	132	15	147
Hook-and-Line (sablefish)	19	19	4	23
Pot	5	13	0	13
Total	**2,476**	**1,681**	**165**	**1,846**

Table 7 includes estimates of halibut mortality from groundfish fisheries managed by the State of Alaska, and halibut mortality from federally managed groundfish fisheries. Table 7 estimates the amount of halibut mortality by each gear type using a method of apportioning by IPHC area.

Halibut Bycatch Management Actions in Progress

This report covers actions that are under development by NMFS.

Exempted fishing permit (EFP) application

NMFS signed and issued an EFP to the Alaska Seafood Cooperative (AKSC) in April 2021. The EFP will enable a collaborative study to conduct field testing of potentially improved designs on halibut excluders in the Bering Sea flatfish trawl fishery. Additional information is available on the NMFS Alaska Region webpage under the Halibut Excluder heading at: https://www.fisheries.noaa.gov/alaska/resources-fishing/exempted-fishing-permits-alaska.

NMFS sent a letter to the IPHC in January 2021 to provide notice of this EFP application for review and determination as to whether this action requires further consultation.

BSAI Pacific Cod Trawl Catcher Vessel Cooperative Program

On October 13, 2021, the NPFMC recommended implementation of Amendment 122 to the Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI). If approved by the Secretary of Commerce and implemented by

NMFS, the Pacific cod Trawl Cooperative Program (PCTC Program) would allocate quota share (QS) to harvesters with an eligible groundfish License Limitation Program (LLP) license based on the harvest of BSAI Pacific cod during qualifying years. This Program would also allocate QS to a processors based on processing history during the qualifying years. QS allocated under this program would yield an exclusive harvest privilege to members of a PCTC Program cooperative. The NPFMC's intent in recommending Amendment 122 is to improve the prosecution of the fishery by promoting safety and stability in the harvesting and processing sectors, increasing the value of the fishery, minimizing bycatch to the extent practicable, providing for the sustained participation of fishery dependent communities, and ensuring the sustainability and viability of the Pacific cod resource in the BSAI. Under the management of the PCTC program, halibut PSC limits for the A and B season of the BSAI Pacific cod fishery would be reduced by 25 percent. The Analysis, public comments, and other documents considered by the Council in recommending Amendment 122 are available under item C4 on the October NPFMC meeting agenda at: https://meetings.npfmc.org/Meeting/Details/2352.

Halibut Abundance Based Management

The NPFMC took final action on the draft Environmental Impact Statement (DEIS) for the abundance-based management (ABM) of the Amendment 80 (A80) halibut prohibited species catch (PSC) limit. The Council has been considering this action iteratively for 6 years. The core concept of the action is linking PSC limits in the A80 commercial groundfish trawl fleet in the Bering Sea and Aleutian Islands (BSAI) to estimated halibut abundance. The current PSC limit is set as a fixed amount at 1,745 mt, which becomes an increasingly larger proportion of total halibut removals in the BSAI when halibut abundance declines. The Council and its advisory bodies, fishery stakeholders, and the public have considered several approaches for an ABM program consistent with Council fishery management objectives and the Magnuson-Stevens Act. The Council heard extensive public testimony during this and previous meetings over both the importance of providing flexibility to the A80 fleet to prosecute their quotas as well as concerns from the directed halibut users that their directed fishery catch has declined as a result of a decline in halibut abundance while fixed PSC limits have further reduced the proportion of halibut available for harvest in the directed halibut fisheries.

The preferred alternative (PA) selected determines the A80 PSC limit annually based on the most recent survey values and the associated PSC limit value from the following table:[6]

[6] The Council motion is available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=96ecabd8-0395-48e4-b04a-f91034ef1da9.pdf&fileName=C1%20Council%20Motion.pdf

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">EBS shelf trawl survey index (t)</td></tr>
<tr><td>Low
< 150,000</td><td>High
≥ 150,000</td></tr>
<tr><td rowspan="4">IPHC setline survey index in Area 4ABCDE (WPUE)</td><td>High
≥ 11,000</td><td>1,745 mt
(current limit)</td><td>1,745 mt
(current limit)</td></tr>
<tr><td>Medium
8,000 – 10,999</td><td>1,396 mt
(20% below current)</td><td>1,571 mt
(10% below current)</td></tr>
<tr><td>Low
6,000-7,999</td><td>1,309 mt
(25% below current)</td><td>1,396 mt
(20% below current)</td></tr>
<tr><td>Very Low
< 6,000</td><td>1,134 mt
(35% below current)</td><td>1,134 mt
(35% below current)</td></tr>
</table>

If approved, implementation of this action would occur in either 2023 (mid-year) or for the beginning of the 2024 fishing year.

The DEIS, other documents, and public comments considered by the Council in recommending their PA are available under item C2 on the December NPFMC meeting agenda at: https://meetings.npfmc.org/Meeting/Details/2713.

Observer and Electronic Monitoring Coverage Rates

Overall, for all federal fisheries off Alaska, 4,072 trips (44.8%) and 375 vessels (38.2%) were monitored by either an observer or electronic monitoring (EM) system in 2020.[7] A total of 373 individual observers were trained, briefed, and equipped for deployment to vessels and processing facilities operating in the BSAI and GOA groundfish and halibut fisheries.

In 2020, observers collected data on board 259 fixed gear and trawl vessels and at 11 processing facilities for a total of 40,838 observer days (39,153 full coverage days on vessels and in processing plants; and 1,685 partial coverage days on vessels and processing plants).

Starting in March, 2020, the COVID-19 pandemic created limitations on available air travel and “shelter in place” restrictions, particularly in many remote Alaskan communities. Under the emergency rule signed on March 24, 2020, NMFS temporarily waived the requirement for vessels in the partial coverage category to carry a fishery observer from March 27 through April 19, 2020. On April 18, 2020, NMFS announced a limited extension of the temporary waiver of observer requirements, which narrowed the scope and reinitiated deployment of observers on trips departing from the port of Kodiak, Alaska (the majority of GOA trawl fisheries occurred out of Kodiak during this timeframe). On June 28, 2020, NMFS expanded observer deployment in the partial coverage category to include 13 ports in addition to Kodiak, which further reduced the scope of waivers issued.

[7] The North Pacific Observer Program 2020 Annual Report is available at: https://www.fisheries.noaa.gov/resource/document/north-pacific-observer-program-2020-annual-report

The largest component of the Alaskan groundfish fisheries, vessels, and processors in the full coverage category (including catcher processors and participants in limited access privilege programs), were not issued waivers in 2020 and 2021. Additionally, requirements for deployment of EM was not waived for trawl catcher vessels fishing under the trawl EM exempted fishing permit and only a few trips were released from coverage under the fixed gear EM portion of the partial coverage category for circumstances when an EM service technician was unable to travel.

A summary of the number of vessels and trips in each stratum and realized coverage rates in 2020 were as follows:

Coverage category	Strata		Total vessels	Total trips	Sampled trips	Coverage rate
Full coverage	Full		143	2,864	2,856	99.7
	Trawl EM (BSAI)		21	494	494	100.0
Partial coverage	Hook-and-Line	Jan. 1 - Mar. 25	50	82	11	13.4
		Mar. 26 - Jun. 30*	180	547	6	
		Jul. 1 - Dec. 31	239	849	87	10.2
	Pot	Jan. 1 - Mar. 25	64	161	25	15.5
		Mar. 26 - Jun. 30*	38	152	5	
		Jul. 1 - Dec. 31	80	295	25	8.5
	Trawl	Jan. 1 - Mar. 25	45	392	88	22.4
		Mar. 26 - Jun. 30*	20	171	16	
		Jul. 1 - Dec. 31	29	347	56	16.1
	EM Hook-and-Line		126	643	193	30.0
	EM Pot		30	194	60	30.9
	Trawl EM (GOA)		31	477	153	32.1
No selection	Zero Coverage		320	1,403	0	0.0
	Zero Coverage- EM Research		2	22	0	0.0

*Partial Coverage rates were not evaluated between March 26 – June 30 due to waivers related to COVID-19 restrictions.

In December, 2020, NMFS released the final 2021 ADP with the following strata and deployment rates:[8]

- No Selection – 0%
- Trawl – 16%
- Hook-and-line – 15%
- Pot – 15%
- Fixed-Gear EM – 30%
- Trawl EM EFP–100% at-sea EM; plus: 30% shoreside monitoring in GOA or 100% shoreside monitoring in BS

In December, 2021, NMFS released the final 2022 ADP with the following strata and deployment rates:[9]

- No Selection – 0%
- Trawl vessels not participating in the EM EFP – 30%
- Hook-and-line – 19%
- Pot – 17%
- Fixed-Gear EM – 30%
- Trawl EM EFP–100% at-sea EM; plus: 30% shoreside monitoring in GOA or 100% shoreside monitoring in BS

Improvements in Discard Estimates of Halibut in the Directed Halibut Fishery

January 2013 marked the beginning of a new method of deploying at-sea observers into the Federal groundfish and Pacific halibut (Hippoglossus stenolepis) fisheries off Alaska. The new program provided for at-sea data collection on longline vessels participating in the Pacific halibut fishery. Previously, data collections on these boats was not authorized and had severely limited the NMFS's ability to estimate incidental catch and at-sea discard of halibut and groundfish species. The Pacific halibut fishery is the only federally managed groundfish fishery off Alaska with a regulatory minimum size limit and any halibut intended for commercial sale must be at least 32 inches (~81 cm) in total length.

The minimum size limit complicates estimation of halibut discard due to the limited amount of disposition-specific data collected by observers available to calculate mean weights. Observers collect fish weights that are used to estimate the mean weight per fish from the unsorted (retained and discarded) catch. They also collect counts of retained fish to estimate the percent of the catch retained. The calculation of the mean weight per fish using observer data may overestimate the mean weight of discarded fish and underestimate the weight of retained fish. While estimates of retained catch are based on landings data and thus are not biased, the haul-specific estimates of at-sea discards of halibut in the halibut fishery are biased. To correct for this bias, NMFS has developed an analytic method to mitigate the bias by adjusting the percentage of halibut retained to reflect the differences in mean weight for retained (and discarded) halibut. A NOAA Technical Memorandum describing the change is forthcoming.

[8] The 2020 Annual Deployment Plan for Observers and Electronic Monitoring in the Groundfish and Halibut Fisheries off Alaska is available at: https://www.fisheries.noaa.gov/resource/document/2020-annual-deployment-plan-observers-and-electronic-monitoring-groundfish-and

[9] The 2021 Annual Deployment Plan for Observers and Electronic Monitoring in the Groundfish and Halibut Fisheries off Alaska is available at: https://www.fisheries.noaa.gov/resource/document/2021-annual-deployment-plan-observers-and-electronic-monitoring-groundfish-and

Commercial Halibut IFQ Program

On February 10, 2021, the NPFMC recommended two emergency or expedited changes to regulations governing the Commercial Halibut IFQ Program.

Effective March 30, 2021 through September 27, 2021, IFQ Temporary Transfers were available to individuals holding B, C, or D class QS (86 FR 16542, March 30, 2021).

Effective May 26, 2021 through December 31, 2021, limits are removed on the maximum amount of halibut IFQ that may be harvested by a vessel, commonly known as vessel use caps, in IFQ regulatory areas 4A (Eastern Aleutian Islands), 4B (Central and Western Aleutian Islands), 4C (Central Bering Sea), and 4D (Eastern Bering Sea) for the 2021 IFQ fishing year (86 FR 28294, May 26, 2021).

IFQ Omnibus Analysis

The NPFMC is considering several revisions to the Halibut and Sablefish Individual Fishing Quota (IFQ) Program regulations. This action evaluates five elements relevant to pot gear used to fish IFQ, including gear specifications and configuration requirements, pot limits, and gear retrieval requirements, and one element to authorize jig gear as a legal gear type for the harvest of sablefish IFQ. The Council's motion also included an alternative to temporarily remove the Adak community quota entity (CQE) residency requirement for five years, in response to public comment.[10] The NPFMC is scheduled to review this action again at its meeting in April 2022.

Subsistence

Through a grant from the National Marine Fisheries Service (NMFS) (NA18NMF4370086), the Alaska Department of Fish and Game (ADF&G) Subsistence Section conducted a study to estimate the subsistence harvests of Pacific halibut in Alaska in 2020. The full results appear in Technical Paper No. 485, "Subsistence Harvests of Pacific Halibut in Alaska, 2020" (Sill and Koster 2022).[11]

In May 2003, the NMFS published final federal regulations for a subsistence halibut fishery in Alaska. Residents of 118 rural communities and designated rural areas, and members of 123 tribes are eligible to participate. Fishers must obtain a subsistence halibut registration certificate (SHARC) from NMFS before fishing.

To estimate the 2020 harvests, a one-page survey form was mailed to SHARC holders in early 2021. Staff also remotely administered surveys in four communities using modified methods due to the COVID-19 pandemic. After three mailings and community outreach, 5,127 of 8,135 potential subsistence halibut fishers (63%) responded. Participation in the survey was voluntary.

An estimated 3,777 individuals subsistence fished for halibut in Alaska in 2020, about 8% below the 2018 fishing year and 26% below the long-term average since 2003. The estimated subsistence harvest was 27,241 halibut or 530,757 pounds net weight. This was the lowest harvest estimate since the new regulations were adopted in 2003 and, as expressed in pounds net weight, nearly 14% below 2018 harvests and 41% below the previous 13-year average. It is important to note that the 2020 study year included the unusual circumstances of the COVID-19

[10] The initial review draft analysis and Council motion are available under item C2 on the October 2021 NPFMC meeting agenda: https://meetings.npfmc.org/Meeting/Details/2352.

[11] Sill, L. A. and D. Koster. 2021. Subsistence Harvests of Pacific Halibut in Alaska, 2020—DRAFT. Alaska *Department* of Fish and Game Division of Subsistence, Technical Paper No. 485, Anchorage. Retrieved 14 December 2021, from https://www.adfg.alaska.gov/techpap/TP485.pdf

global pandemic and it is unclear exactly how this pandemic affected subsistence harvesting activities. Of the 2020 total subsistence halibut harvest, 75% was harvested with setline (stationary) gear (longline or skate) and 25% was harvested with hand-operated gear (handline or rod and reel). This pattern was similar to other study years.

Also similar to all other years, in 2020, the largest subsistence harvests of halibut occurred in Southeast Alaska (Halibut Regulatory Area 2C), with 55% of the total, followed by Southcentral Alaska (Area 3A) at 33%, and East Bering Sea Coast (Area 4E) at 6%. Remaining areas combined accounted for about 6% of the state total.

Based on data from the International Pacific Halibut Commission and this study, the estimated halibut removal in Alaska in 2020 was 27.093 million pounds, net weight. Subsistence harvests accounted for 2% of this total.

In response to a new question first asked in 2018, 51% of survey respondents said they had met their needs for halibut in 2020, and 49% said they had not. Family or personal reasons, lack of effort, inoperative equipment, and time constraints were the most-cited reasons for not meeting needs. As noted above, the effect of the COVID-19 pandemic on subsistence harvesting activities remains unknown; however, approximately 10% of survey respondents who reported that their needs were not met indicated that the pandemic was the reason.

The 2020 data collection effort was a success, with good response rates and a reliable estimate of subsistence halibut harvests in Alaska for 2020. Outreach continues to be necessary to maximize enrollment of fishers in the SHARC program, as is additional research to understand trends in the fishery. However, section staff were limited in their outreach capacity because of limitations on travel to rural Alaska due to the pandemic. Budget constraints dictate that a survey to estimate subsistence halibut harvests in Alaska in 2021 will not take place. The report recommends that monitoring of the Alaska subsistence halibut harvest resume in the future.

NOAA Fisheries Law Enforcement - Alaska

Alaska Enforcement Division

The Alaska Enforcement Division (AKD) utilizes enforcement officers, special agents, and partnerships with the Alaska Wildlife Troopers and the U.S. Coast Guard to enforce federal fishing regulations in Alaska, covering over 1.4 million square miles of ocean, 66,000 miles of Arctic and Subarctic coastline, and 2,690 named islands. Compliance is achieved by providing outreach and education, conducting patrols, monitoring offloads, and investigating violations of civil and criminal marine resource laws, including the Northern Pacific Halibut Act.

In 2021, there were 3,375 Individual Fishing quota (IFQ) halibut permits issued in Alaska and 30 IFQ landing ports. There were 1067 charter halibut permits issued (578 for IPHC Area 2C; 488 for IPHC Area 3A), and 6,394 subsistence halibut permits.

Patrol and Boardings

In 2021, AKD personnel spent over 3,093 hours conducting patrols to deter potential violators, monitor fishing and other marine activities, detect violations, provide compliance assistance, and provide outreach and education to halibut fishery participants. OLE boarded 964 vessels with 692 of those boardings being related to halibut.

Table 8 Results of NOAA OLE AKD Vessel Boardings

	2019	2020	2021
	Vessel Boardings	Vessel Boardings	Vessel Boardings
Subsistence Halibut	14	27	14
Commercial Halibut	216	314	334
Charter Halibut	302	136	149
Sport Halibut	261	171	195
Total	**793**	**648**	**692**

Compliance Assistance

In 2021, AKD personnel spent over 1,632 hours providing outreach and education to marine resource users. Outreach efforts at a number of organized events were canceled due to COVID-19. The goal of OLE outreach efforts is to ensure the most current and accurate regulatory information is widely distributed and understood.

Incidents

In 2021, AKD opened 1,010 halibut-related incidents, including outreach, vessel boardings, dockside monitoring, and compliance assistance. Of those incidents; agents and officers identified 500 halibut-related violations, which were resolved by Compliance Assistance, Summary Settlement, or a Written Warning.

Table 9. NOAA Fisheries OLE Alaska Halibut Violations

	2019	2020	2021
Subsistence Halibut	29	14	18
Commercial Halibut	250	197	123
Charter Halibut	159	50	133
Sport Halibut	57	51	54
Commercial Groundfish involving Halibut	60	84	52
Total	**555**	**396**	**380**

***Not all violations resulted in an enforcement action. This table does not include ongoing or NOVA adjudicated cases.**

2021 Halibut-Related Violations documented by NOAA in Alaska:

18 Subsistence halibut fishing violations; most common violations included:

- Unqualified person applied for a SHARC

- Subsistence halibut with sport caught halibut.
- Improperly or unmarked subsistence halibut fishing gear
- Subsistence halibut fishing without a SHARC
- Exceeding vessel hook limit
- Fillet, mutilate, or otherwise disfigure subsistence halibut in any manner that prevents the determination of the number of fish caught, possessed, or landed
- Non-resident pulling subsistence halibut gear
- Subsistence halibut offered for sale.

123 Commercial IFQ/CDQ halibut violations; most common violations included:

- IFQ halibut overages greater than 10%
- Record keeping or reporting violations (PNOL, Landing Report, Logbook, PTR, Production Reports)
- Gear marking violations
- Failure to release undersized halibut with a minimum of injury by allowing fish to hit the crucifier, remain on deck for a prolonged period of time, and other mishandling issues (e.g. lifting fish solely by caudal peduncle).
- Retain undersized halibut, or discarding legal sized halibut
- Hired master and permit holder violations
- Vessel cap overages
- Misreporting IFQ area fished or fishing in an area with no IFQ available
- Fishing without an FFP

52 Commercial groundfish violations involving halibut; most common violations included:

- Failure to carefully release halibut or allow halibut to contact a crucifier or hook stripper
- Release halibut caught with longline gear by any method other than— positioning the gaff on the hook and twisting the hook from the halibut, straightening the hook by using the gaff to catch the bend of the hook, and bracing the gaff against the vessel or any gear attached to the vessel
- Puncture halibut with a gaff or other device
- Failure to have an IFQ hired master permit, as appropriate, in the name of the individual making the landing

54 Sport halibut violations; most common violations included:

- Sale or attempted sale of sport caught halibut
- Exceeding bag and/or possession limits

- Filleting, mutilating or skinning halibut onboard a vessel, other than 2 ventral pieces, 2 dorsal pieces, and 2 cheek pieces, with a patch of skin on each piece, naturally attached
- Fishing without a license/permit
- Using illegal gear
- Sport caught halibut onboard with commercial caught salmon

Photo: OLE checking to see if Halibut fillets were in a condition other than whole filets with skin on, in violation of IPHC Fishery Regulations §26(1)(d).

133 Charter halibut fishing violations; most common violations included:

- Logbook violations-
  - o Failure to ensure charter halibut anglers sign the logbook
  - o Failure to record CHP in the ADFG logbook/invalid CHP
  - o Report inaccurate information
- Failure to report GAF in the required time period or submitting inaccurate information
- Illegal guiding - no CHP
- Filleting, mutilating or skinning halibut onboard a vessel, other than 2 ventral pieces, 2 dorsal pieces, and 2 cheek pieces, with a patch of skin on each piece, naturally attached
- Exceeding bag limit, possession limit, size limits, or annual limits
- Charter fish without a CHP

Partnerships & Patrols Highlights

During 2021, NOAA Office of Law Enforcement (OLE), Alaska Division (AKD) conducted extensive patrols for the purposes of enforcement and education. In addition to daily dockside and vessel patrols, AKD conducted several multi-day patrols. Patrols were often coordinated with partners including U.S. Customs and Border Protection (CBP), U.S. Fish and Wildlife Service (USFWS), U.S. Coast Guard (USCG), Alaska Wildlife Troopers (AWT), and National Park Service (NPS). Partnering with multiple agencies broadens enforcement and outreach opportunities and allows for shared knowledge across agencies.

In April, a team of four Enforcement Officers along with USCG and AWT boarding officers conducted boardings and surveillance in Southcentral Alaska during the 2021 Homer King Salmon Derby. Teams conducted 66 boardings and identified 16 violations including two failure to sign logbooks, four chunked halibut, eight state violations, and two USCG safety violations.

In June, a team consisting of three Enforcement Officers and one Alaska Wildlife Trooper completed a three-day patrol from Seward to Whittier, AK on the PV Kingfisher. A USCG Boarding officer joined on day two. 20 boardings were completed and 25 violations were discovered. The violations consisted of four North Pacific Halibut Act violations, 18 State of Alaska violations, and three Coast Guard violations. Over 100 pounds of illegally processed halibut, 11 non-pelagic rockfish, and one lingcod were seized.

In June, OLE and AWT completed a patrol of Prince of Wales (POW) Island and surrounding communities onboard PV Gowtaukan. During the sea-based joint patrol, multiple strings of unmarked commercial shrimp gear were pulled, recorded, and deck loaded. Unmarked longline gear was also discovered. Officers provided outreach to the Thorne Bay Charter Association and to the community of Hollis during a town meeting. Multiple dockside boardings resulted in outreach with halibut charter operators to discuss and assist with eLogBooks.

In September, an Enforcement Officer completed a two-week patrol with AWT on the PV Enforcer in Southeast AK with a total of 92 vessels boarded and 18 state and federal citations. Four federal citations were issued, one fix-it for subsistence gear markings, and three unreported Guided Angler Fish (GAF).

Case Updates

Notice of Violation and Assessment

The NOAA Office of General Counsel, Enforcement Section (GCES) issued Notices of Violation and Assessment (NOVA) in the following civil administrative cases. A NOVA is not evidence of liability; it is only an allegation. A respondent is entitled to a fair hearing before an administrative law judge at which the government must prove liability by a preponderance of the evidence.

AK1906496; Keta Seafoods, L.L.C. and Gregory V. McMillan – Shoreside processor Keta Seafoods, LLC, and owner Gregory V. McMillan were charged jointly and severally under the Northern Pacific Halibut Act (NPHA) with failing to submit a required IFQ Registered Buyers ex-vessel Volume and Value Report. A $1,500 NOVA was issued.

AK2003816; F/V Gulf Maiden – Owner Gulf Maiden Corporation and operator Randall Shears were charged jointly and severally under the NPHA and MSA with failing to return Pacific halibut to the sea with a minimum of injury, unlawful discard of rockfish and Pacific cod, and failure to record discards. A $22,800 NOVA was issued, and the case settled for $20,250.

Cases Settled

AK1905767 and AK1905392; F/V Anita – Owner F/V Anita LLC and operator Jay Gillman were charged jointly and severally under the MSA and the NPHA with discarding IFQ sablefish and IFQ halibut, failing to report discards, and failing to register an IFQ fishing trip in the Observer Declare and Deploy System. A $78,250 NOVA was issued. The case settled for $55,270.

AK2003816; F/V Gulf Maiden – Owner Gulf Maiden Corporation and operator Randall Shears were charged jointly and severally under the NPHA and MSA with failing to return Pacific halibut to the sea with a minimum of injury, unlawful discard of rockfish and Pacific cod, and failure to record discards. A $22,800 NOVA was issued, and the case settled for $20,250.

Default

AK1906496; Keta Seafoods, L.L.C. and Gregory V. McMillan – Shoreside processor Keta Seafoods, LLC, and owner Gregory V. McMillan were charged jointly and severally under the Northern Pacific Halibut Act (NPHA) with failing to submit a required IFQ Registered Buyers ex-vessel volume and Value Report. A $1,500 NOVA was issued.

Criminal Sentencing

NOAA OLE and GCES assisted the U.S. Attorney's Office in Anchorage with the following criminal prosecution in U.S. District Court:

United States v. Stevens, No. 3:20-cr-00773-JMK-DMS (D. Alaska 2021). On August 5, 2021, James A. Stevens, vessel owner, operator, fleet manager, and IFQ permit holder was sentenced for violating the Lacey Act's felony false labeling provision. Stevens must pay a $1,000,000 fine, serve six months in federal prison, 126 days in a halfway house, and perform 80 hours of community service. During the three years that he is supervised by the United States Probation Office after he is released from prison, Stevens will be subject to VMS and EM conditions, drug testing, and other standard conditions. Stevens pled guilty to knowingly submitting false information concerning the locations and regulatory areas where 903,208 pounds of IFQ halibut and IFQ sablefish were harvested on IFQ landing reports, ADF&G fish tickets, and in his logbooks. His crime spanned four IFQ fishing seasons (i.e., 2014–2017). He is currently serving his prison sentence.

United States Coast Guard Enforcement Report – Alaska Region

I. Coast Guard Resources in Alaska

The U.S. Coast Guard (USCG) 17th District (D17) covers the U.S. waters of Alaska out to 200 nautical miles, and encompasses the IPHC Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E. Resources used for fisheries enforcement include cutters, aircraft, and boats from coastal stations.

Cutters:

- The 282-foot Medium Endurance Cutter USCGC ALEX HALEY home-ported in Kodiak regularly patrols the Bering Sea and North Pacific waters.
- 418-foot National Security Cutters (NSCs) from California and Hawaii are assigned to patrol D17 waters throughout the year.
- Four 225-foot Buoy Tenders conduct law enforcement throughout Alaska and are home-ported in Sitka, Cordova, Kodiak, and Homer.
- Two 154-foot Fast Response Cutters (FRCs) home-ported in Ketchikan conduct routine law enforcement throughout Southeast and South Central Alaska.
- Five 110-foot patrol boats conduct routine law enforcement and are home-ported in Petersburg, Juneau, Valdez, Seward, and Homer.
- Four 87-foot Coastal Patrol Boats located in Washington State home-ports make occasional patrols in Southeast Alaska.

Aircraft:

- Fixed wing and rotary wing aircraft are based out of Air Stations in Kodiak and Sitka.
    - Five C-130 fixed wing aircraft
    - Nine MH-60 rotary wing aircraft
    - Four MH-65 rotary wing aircraft

Stations:

The three coastal small boat stations operating 29-foot and 45-foot boats are located in Ketchikan, Juneau, and Valdez.

D17 routinely deploys Maritime Safety and Security Teams (MSSTs) to specific locations for safety and law enforcement during periods of high commercial, charter, and recreational fishing activity.

The primary at-sea fisheries enforcement assets are our cutters, ranging in size from the 87-foot patrol boats up to 418-foot NSCs. Patrol boats are limited in sea keeping abilities, and conduct the majority of enforcement inside of 50 nautical miles from shore. This role is fulfilled by 154-foot FRCs and 110-foot patrol boats in Alaskan waters with occasional deployments from 87-foot cutters from Washington State, which provide regular law enforcement presence in the commercial, charter, subsistence, and recreational fishing fleets. By 2024, D17 anticipates the addition of four more 154-foot FRCs and two 87-foot patrol boats permanently stationed throughout Alaska that will eventually replace the 110-foot patrol boat fleet and greatly enhance boarding capabilities both inshore and offshore.

Beyond 50 nautical miles, we rely on our larger cutters to enforce federal fisheries regulations, with USCGC ALEX HALEY and NSCs from throughout the west coast assigned to patrol Alaskan waters. Additionally, 225-foot Buoy Tenders effectively patrol both offshore and inshore waters.

Small boat stations primarily focus on recreational, subsistence, and charter halibut activity in their regions. This does not preclude them from boarding larger commercial vessels sighted in the course of their duties.

The USCG routinely conducts fisheries law enforcement flights from Air Stations in Kodiak and Sitka using a variety of fixed wing C-130 aircraft and rotary wing MH60 and MH65 helicopters.

All units involved in fisheries enforcement receive training from the Coast Guard's North Pacific Regional Fisheries Training Center in Kodiak prior to patrolling the region. NOAA's Office of Law Enforcement (OLE) agents and state fisheries enforcement officers routinely participate in the training. The success of USCG fisheries enforcement operations is enhanced by collaboration with our enforcement partners from NOAA OLE and the state of Alaska, ensuring consistent presence on the fishing grounds and at landing sites.

II. Halibut Enforcement

In Calendar Year 2021, the USCG distributed its enforcement assets throughout the IPHC Areas, with boarding numbers listed in Table 10. The USCG's enforcement focus is to protect the resource in accordance with the Fishery Management Plan, to ensure equal economic opportunity for all participants, and to ensure safety of life at sea.

Table 10 2020 & 2021 Geographic Distribution of Boardings on Vessels Targeting Halibut

IPHC Area	2020 Boardings	2021 Boardings
2C	264	200
3A	134	251
3B	0	0
4A	16	10
4B	3	2
4C	0	0
4D	1	1
4E	0	0
Total	418	464

III. Commercial Halibut Enforcement

D17 law enforcement assets routinely patrolled the fishing grounds, often conducting joint boardings in collaboration with NOAA OLE throughout the season from the Bering Sea to Southeast Alaska. These operations included at-sea boardings, aircraft patrols, and dockside inspections. Joint agency efforts are a regular and important aspect of law enforcement coordination as they enable the broadest contact rate with the fishing fleets in order to ensure compliance with federal regulations while also providing the most accurate and complete picture of fishing activity on the fishing grounds and at catch landing sites.

The lack of a universal requirement for fishing vessels targeting halibut to be equipped with VMS onboard means there is not a centralized means to assess and monitor fishing activity in Areas 2C through 4E. Time intensive patrols by surface and aviation assets are the primary means to identify where vessels are fishing for halibut. The need for patrols is amplified when market forces and/or fair weather conditions cause an increase in fishing activity.

During boardings of the commercial hook and line vessels, USCG enforcement efforts focus on (1) adherence to permit requirements for area and individual quota, (2) safe release of halibut bycatch by other commercial vessels, (3) consistent use of seabird avoidance gear, (4) indicators of high-grading catch, (5) retention of rockfish and Pacific Cod, (6) complete offload of catch, and (7) timely compliance with all recordkeeping requirements.

IV. Recreational and Charter Halibut Enforcement

Recreational activity most often occurs in Areas 2C, 3A, and 3B in the form of individual sport and charter fishing. The season lasts from 01 February to 31 December, but is most prevalent from May through September. USCG assets increase fisheries patrols during this time to focus on popular fishing grounds in Southeast Alaska, Prince William Sound, Cook Inlet, and the Gulf of Alaska. Recreational and charter vessels comprised 77% of the halibut boardings in D17.

During boardings, the USCG places emphasis on compliance with licensing and charter operation requirements, size limits, daily catch limits, trip limits, and at-sea processing of halibut.

V. Violations and Enforcement Summary

In 2021, USCG assets boarded a total of 464 vessels and detected 16 violations. The USCG documented violations and referred them to NOAA OLE or Alaska Wildlife Troopers (for violation detected on recreational vessels) for final action. Table 11 compares at-sea boardings and violations between 2020 and 2021.

Table 11 2020 & 2021 Boarding and Violation Summaries by Industry Sector

2020 Boardings/Violations		2021 Boardings/Violations	
Total At-Sea Boardings	418	Total At-Sea Boardings	464
Commercial	98	Commercial	102
Charter	73	Charter	108
Recreational/Subsistence	247	Recreational/Subsistence	254
Fisheries Violations	11	Fisheries Violations	16
Commercial	8	Commercial	14
Charter	3	Charter	0
Recreational/Subsistence	0	Recreational/Subsistence	2
Fisheries Compliance Rates	97.4%	Fisheries Compliance Rates	96.6%
Commercial	91.8%	Commercial	86.3%
Charter	95.8%	Charter	100%
Recreational/Subsistence	100%	Recreational/Subsistence	99.3%

In Area 2C:

- Two commercial vessels were cited for failing to have permits onboard.
- One subsistence vessel was cited for not having a subsistence halibut license onboard.
- One commercial vessel was cited for not having sea bird avoidance gear onboard.

In Area 3A:

- One commercial vessel was cited for mutilated rec halibut catch onboard. The catch was seized and transferred to NOAA OLE.
- Two commercial vessels were cited for logbook discrepancies.

- One commercial Pacific Cod longliner was cited for illegally retaining halibut. The catch was seized and transferred to NOAA OLE.

In Area 4A:

- One commercial vessel was cited for improper seabird avoidance gear and longline buoy markings.
- One commercial vessel was cited for not having correct permits or hired master permits onboard.
- One commercial vessel was cited for improper longline buoy markings and noted for VMS not transmitting.

In Area 4D:

- One commercial vessel was cited for not retaining bycatch and logbook errors.

The USCG transferred detected violations to NOAA OLE for disposition, and outcomes included compliance assistance, summary settlements, or catch seizures.

In addition to the IPHC violations summarized in Table 11, USCG assets documented 32 safety violations including insufficient lifesaving equipment, improper navigation equipment, and missing documentation. The USCG continues to pursue increased at-sea boarding opportunities to promote compliance with both safety and fisheries regulations in all IPHC Areas and across all fishery sectors.

VI. Enforcement Plans for 2022

The USCG will continue joint pulse operations with NOAA and state partners to focus enforcement efforts across the commercial, charter, subsistence, and sport sectors of the halibut fishery.

The commercial and recreational halibut fisheries in Alaskan waters continue to draw high national and international interest. D17 will continue to actively patrol throughout the season and emphasize joint operations with our federal and state partners, NOAA OLE, and the Alaska Wildlife Troopers.

By sustaining efforts to monitor and patrol areas where halibut fisheries occur, the USCG will strive to continually promote a level playing field for all participants and enhance safety at sea. Our goal is a consistent and targeted enforcement presence applied fairly across all commercial, charter, subsistence, and recreational fleets.

With the continued replacement of the 110-foot cutters with Fast Response Cutters, there will be higher contact rates with the fishing fleets. The longer endurance and better sea keeping abilities will allow the 154-foot FRCs to stay on scene longer and more effectively monitor the fisheries. This will increase law enforcement presence and at-sea boardings in areas with historically low enforcement.

Point of Contact:
LCDR Jedediah Raskie, USCG
+1 907-463-2223
Jedediah.A.Raskie@uscg.mil

Contacts

NOAA Fisheries Alaska Regional Office

Glenn Merrill
Assistant Regional Administrator for Sustainable Fisheries
Glenn.merrill@noaa.gov
907-586-7228

Alicia M Miller
Sustainable Fisheries Divisions
Catch Shares Branch Chief
Alicia.m.miller@noaa.gov
907-586-7228

Kurt Iverson
Sustainable Fisheries Division
Recreational Fisheries Coordinator
Kurt.iverson@noaa.gov
907-586-7210

Doug Duncan
Sustainable Fisheries Division
Fishery Management Specialist
Doug.duncan@noaa.gov
907-586-7425

Alaska Department of Fish and Game

Division of Sport Fish:
Sarah Webster
Fisheries Scientist
sarah.webster@alaska.gov
907-267-2212

Subsistence Section:
Caroline Brown
Statewide Research Director
caroline.brown@alaska.gov
907-459-7317

Lauren Sill
Subsistence Resource Specialist III
lauren.sill@alaska.gov
907-465-3617

United States Coast Guard

District 17
LCDR Jedediah Raskie, USCG
+1 907-463-2223
Jedediah.A.Raskie@uscg.mil

NOAA Office for Law Enforcement

Alaska Enforcement Division
P.O. Box 21767
Juneau, AK 99802
907-586-7225

TO REPORT VIOLATIONS:
Call 1-800-853-1964

IPHC Fishery Regulations:

Mortality and Fishery Limits (Sect. 5)

PREPARED BY: IPHC SECRETARIAT (8 DECEMBER 2021; 27 JANUARY 2022)

PURPOSE

To improve clarity and transparency of fishery limits within the IPHC Fishery Regulations: Mortality and Fishery Limits (Sect. 5).

BACKGROUND

The Commission considers new and revised IPHC Fishery Regulations, including proposed changes to mortality and fishery limits, and makes changes as deemed necessary at each Annual Meeting. In the absence of changes being deemed necessary, the existing IPHC Fishery Regulations remain in effect.

In accordance with the IPHC Convention[1], the Contracting Parties may also implement fishery regulations that are more restrictive than those adopted by the IPHC.

This proposal is to amend IPHC Fishery Regulations Section 5, '*Mortality and Fishery Limits,*' to reflect TCEY values adopted by the IPHC and the applicable fishery sector limits resulting from those TCEY values according to existing Contracting Party domestic catch sharing arrangements.

DISCUSSION

IPHC Fishery Regulations Section 5, '*Mortality and Fishery Limits,*' was adopted in 2021 in order to provide clear documentation of the limits for fishery sectors within defined Contracting Party domestic catch sharing arrangements, which are themselves tied to the mortality distribution (TCEY) decisions of the Commission. This section includes a table of the TCEY values adopted by the Commission for clarity, and to emphasize the role of the TCEY values as the basis for the subsequent setting of sector allocations through the operation of the Contracting Parties' existing catch sharing arrangements. Both the TCEY and the fishery sector allocation table will be populated as TCEY decisions are made for each IPHC Regulatory Area by the Commission during the 98th Session of the IPHC Annual Meeting (AM098) in January 2022.

Benefits/Drawbacks: The benefit is a clear identification of fishery limits resulting from Commission decisions on distributed mortality (TCEY) values for each IPHC Regulatory Area. The potential drawback is a misconception that the resulting catch sharing arrangements and associated fishery limits are within the Commission's mandate, when in fact they are the responsibility of the Contracting Parties. The intention is to reinforce that distinction by clarifying which decisions are made by the Commission.

Sectors Affected: This proposal affects all sectors of the Pacific halibut fishery.

[1] The Convention between Canada and the United States of America for the Preservation of the [Pacific] Halibut Fishery of the Northern Pacific Ocean and Bering Sea.

ADDITIONAL DOCUMENTATION / REFERENCES

None

RECOMMENDATIONS

That the Commission:

1) **NOTE** regulatory proposal IPHC-2022-AM098-PropA1, which provides the Commission with an opportunity to recall the format of the IPHC Fishery Regulations: *Mortality and Fishery Limits* (Sect. 5), which will be populated at the next Annual Meeting of the Commission.

APPENDICES

Appendix A: Suggested IPHC Fishery Regulation Language

APPENDIX A

SUGGESTED REGULATORY LANGUAGE

5. Mortality and Fishery Limits

(1) The Commission has adopted the following distributed mortality (TCEY) values:

IPHC Regulatory Area	*Distributed mortality limits (TCEY) (net weight)*	
	Tonnes (t)	**Million Pounds (Mlb)**
Area 2A (California, Oregon, and Washington)		
Area 2B (British Columbia)		
Area 2C (southeastern Alaska)		
Area 3A (central Gulf of Alaska)		
Area 3B (western Gulf of Alaska)		
Area 4A (eastern Aleutians)		
Area 4B (central/western Aleutians)		
Areas 4CDE (Bering Sea)		
Total		

(2) The fishery limits resulting from the IPHC-adopted distributed mortality (TCEY) limits and the existing Contracting Party catch sharing arrangements are as follows, recognising that each Contracting Party may implement more restrictive limits:

IPHC Regulatory Area	*Fishery limits (net weight)*	
	Tonnes (t)	**Million Pounds (Mlb)**
Area 2A (California, Oregon, and Washington)		
Non-tribal directed commercial (south of Pt. Chehalis)		
Non-tribal incidental catch in salmon troll fishery		
Non-tribal incidental catch in sablefish fishery (north of Pt. Chehalis)		
Treaty Indian commercial		
Treaty Indian ceremonial and subsistence (year-round)		
Recreational – Washington		
Recreational – Oregon		
Recreational – California		
Area 2B (British Columbia) (combined commercial/recreational)		
Commercial fishery		
Recreational fishery		

Area 2C (southeastern Alaska) (combined commercial/guided recreational)		
Commercial fishery (includes X.XX Mlb ~~catch~~ landings and ~~-~~XX Mlb ~~incidental~~ discard mortality)		
Guided recreational fishery (includes ~~catch~~ landings and ~~incidental~~ discard mortality)		
Area 3A (central Gulf of Alaska) (combined commercial/guided recreational)		
Commercial fishery (includes X.XX Mlb ~~catch~~ landings and ~~-~~XX Mlb ~~incidental~~ discard mortality)		
Guided recreational fishery (includes ~~catch~~ landings and ~~incidental~~ discard mortality)		
Area 3B (western Gulf of Alaska)		
Area 4A (eastern Aleutians)		
Area 4B (central/western Aleutians)		
Areas 4CDE (Bering Sea)		
Area 4C (Pribilof Islands)		
Area 4D (northwestern Bering Sea)		
Area 4E (Bering Sea flats)		
Total		

* Allocations resulting from the IPHC Regulatory Area 2A Catch Share Plan are listed in *pounds*.

IPHC Fishery Regulations:

Commercial Fishing Periods (Sect. 9)

PREPARED BY: IPHC SECRETARIAT (8 DECEMBER 2021)

PURPOSE

To specify fishing periods for the directed commercial Pacific halibut fisheries within the IPHC Fishery Regulations: Commercial Fishing Periods (Sect. 9).

BACKGROUND

Each year the International Pacific Halibut Commission (IPHC) selects fishing period dates for the directed commercial Pacific halibut fisheries in each of the IPHC Regulatory Areas. Historically, the first management measures implemented by the IPHC were to limit periods when fishing was allowed. Biological factors considered in the past when setting fishing period dates included migration and spawning considerations, neither of which is now used as a basis for determining fishing periods.

These dates have varied from year to year, and in recent years have allowed directed commercial fishing to begin sometime in March and end sometime in November or December for all IPHC Regulatory Areas with the exception of IPHC Regulatory Area 2A.

DISCUSSION

The IPHC Secretariat proposes that the commercial fishing periods for all IPHC Regulatory Areas be set at AM098 following stakeholder input.

No change is recommended for IPHC Regulatory Area 2A for 2022. This aligns with the Pacific Fishery Management Council Recommendations for the 2022 non-Tribal Commercial Directed Halibut Fishery in Area 2A (see details in IPHC-2022-AM098-INF03).

Expected outcomes

Should the transition of management authority of the IPHC Regulatory Area 2A non-tribal directed commercial Pacific halibut fishery from the IPHC to the Pacific Fishery Management Council (PFMC) and NOAA-Fisheries be completed, the need for setting dates for the 2A derby fishery would no longer be an IPHC consideration and the dates would be set by the Contracting Party within the overall commercial fishing period dates.

Sectors Affected: Commercial Pacific halibut fisheries in each IPHC Regulatory Area.

RECOMMENDATIONS:

That the Commission:

1) **NOTE** fishery regulation proposal IPHC-2022-AM098-PropA2, which proposed the adoption of fishing periods for the commercial Pacific halibut fisheries within the IPHC Pacific Halibut Fishery Regulations: Commercial Fishing Periods (Sect. 9).

APPENDICES

Appendix A: Suggested regulatory language

APPENDIX A
SUGGESTED REGULATORY LANGUAGE

9. Commercial Fishing Periods

(1) The fishing periods for each IPHC Regulatory Area apply where the fishery limits specified in section 5 have not been taken.

(2) Unless the Commission specifies otherwise, commercial fishing for Pacific halibut in all IPHC Regulatory Areas may begin no earlier in the year than 1200 local time on ~~6 March~~DD MMMM.

(3) All commercial fishing for Pacific halibut in all IPHC Regulatory Areas shall cease for the year at 1200 local time on ~~7 December~~DD MMMM.

(4) The first fishing period in the IPHC Regulatory Area 2A non-tribal directed commercial fishery[2] shall begin at 0800 on the fourth Tuesday in June and terminate at 1800 local time on the subsequent Thursday, unless the Commission specifies otherwise. If the Commission determines that the fishery limit specified for IPHC Regulatory Area 2A in Section 5 has not been exceeded, it may announce a second fishing period of up to three fishing days to begin on Tuesday two weeks after the first period, and, if necessary, a third fishing period of up to three fishing days to begin on Tuesday four weeks after the first period.

(5) Notwithstanding paragraph (4), and paragraph (6) of section 12, an incidental catch fishery[3] is authorized during the sablefish seasons in IPHC Regulatory Area 2A in accordance with regulations promulgated by NOAA Fisheries. This fishery will occur between the dates and times listed in paragraphs (2) and (3) of this section.

(6) Notwithstanding paragraph (4), and paragraph (6) of section 12, an incidental catch fishery is authorized during salmon troll seasons in IPHC Regulatory Area 2A in accordance with regulations promulgated by NOAA Fisheries. This fishery will occur between the dates and times listed in paragraphs (2) and (3) of this section.

[2] The non-tribal directed fishery is restricted to waters that are south of Point Chehalis, Washington, (46°53.30´ N. latitude) under regulations promulgated by NOAA Fisheries and published in the Federal Register.

[3] The incidental fishery during the directed, fixed gear sablefish season is restricted to waters that are north of Point Chehalis, Washington, (46°53.30´ N. latitude) under regulations promulgated by NOAA Fisheries at 50 CFR 300.63. Landing restrictions for Pacific halibut retention in the fixed gear sablefish fishery can be found at 50 CFR 660.231.

12. Application of Commercial Fishery Limits

(1) …

(5) If the Commission determines that the fishery limit specified for IPHC Regulatory Area 2A in section 5 would be exceeded in an additional directed commercial fishing period as specified in paragraph (4) of section 9, the fishery limit for that area shall be considered to have been taken and the directed commercial fishery closed as announced by the Commission.

IPHC Fishery Regulations: minor amendments

PREPARED BY: IPHC SECRETARIAT (8 DECEMBER 2021)

PURPOSE

To improve clarity and consistency in the IPHC Fishery Regulations.

BACKGROUND

This proposal would make minor clarifying amendments to the existing IPHC Fishery Regulations. The proposed revisions are a result of a review by the Secretariat and consultations with domestic agencies.

DISCUSSION

Periodically, the IPHC Fishery Regulations are reviewed to ensure they are clear, concise, consistent, and current. The proposed revisions, which are outlined below in detail, are a result of a holistic review performed by the Secretariat, as well as discussions with the domestic agencies. Input from Contracting Parties was sought to streamline the process of adopting the revised regulations at the 98th Session of the IPHC Annual Meeting (AM098).

Proposed amendments to the IPHC Fishery Regulations:

1. Section 3, Definitions, (1)(b) would include "*an authorized representative of the Commission*."
2. Section 3, Definitions would include the following definition of an authorized representative of the Commission: "any IPHC employee or contractor authorized to perform any task described in these Regulations."
3. Section 8, Retention of Tagged Pacific Halibut, (1)(a) and (1)(b) would include "an authorized representative of the Commission."
4. Section 11, Closed Periods, (6) and (7) would include "an authorized representative of the Commission."
5. Section 16, Vessel Clearance in IPHC Regulatory Area 4, (3)-(5) and (7)-(10) would use "*the authorized clearance personnel*."
6. Minor edits throughout for stylistic consistency among Sections.

Appendix A provides details on the suggested regulatory language.

Benefits/Drawbacks: The benefit is clearer and more consistent regulations that are easier to use. No known drawbacks.

Sectors Affected: This proposal affects all sectors of the Pacific halibut fishery.

RECOMMENDATIONS:

That the Commission:

1) **NOTE** regulatory proposal IPHC-2022-AM098-PropA3, which recommends changes to improve the clarity and transparency of the IPHC Fishery Regulations.
2) **ADOPT** the recommended changes to the IPHC Fishery Regulations as provided in Appendix A at AM098 in January 2022.

ADDITIONAL DOCUMENTATION / REFERENCES

None

APPENDICES:

APPENDIX A: Suggested regulatory language

APPENDIX A
Suggested Regulatory Language

1. Section 3, Definitions, (1)(b) would include "an authorized representative of the Commission."

3. Definitions

(1) In these Regulations, […]

(b) "authorized clearance personnel" means an authorized officer of the United States of America, an authorized representative of the Commission, or a designated fish processor;

1. Section 3, Definitions would include the following definition of an authorized representative of the Commission: "any IPHC employee or contractor authorized to perform any task described in these Regulations."

3. Definitions

(1) In these Regulations, […]

(c) "authorized representative of the Commission" means any IPHC employee or contractor authorized to perform any task described in these Regulations.

2. Section 8, Retention of Tagged Pacific Halibut, (1)(a) and (1)(b) would include "an authorized representative of the Commission."

8. Retention of Tagged Pacific Halibut

(1) Nothing contained in these Regulations prohibits any vessel at any time from retaining and landing a Pacific halibut that bears a Commission external tag at the time of capture, if the Pacific halibut with the tag still attached is reported at the time of landing and made available for examination by an authorized representative of the Commission or by an authorized officer.

(2) After examination and removal of the tag by an authorized representative of the Commission or an authorized officer, the Pacific halibut:

(a) may be retained for personal use; or

(b) may be sold only if the Pacific halibut is caught during commercial Pacific halibut fishing and complies with the other commercial fishing provisions of these Regulations.

3. Section 11, Closed Periods, (6) and (7) would include "an authorized representative of the Commission."

11. Closed Periods

(6) A vessel that has no Pacific halibut on board may retrieve any Pacific halibut fishing gear during the closed period after the operator notifies an authorized officer or an authorized representative of the Commission prior to that retrieval.

(6) A vessel that has no Pacific halibut on board may retrieve any Pacific halibut fishing gear during the closed period after the operator notifies an authorized officer or an authorized representative of the Commission prior to that retrieval.

4. Section 16, Vessel Clearance in IPHC Regulatory Area 4, (3)-(5) and (7)-(10) would use “*the authorized clearance personnel*.”

16. Vessel Clearance in IPHC Regulatory Area 4

(3) The vessel clearance required under paragraph (1) prior to fishing in IPHC Regulatory Area 4A may be obtained only at Nazan Bay on Atka Island, Dutch Harbor, or Akutan, Alaska, from the authorized clearance personnel.

(4) The vessel clearance required under paragraph (1) prior to fishing in IPHC Regulatory Area 4B may only be obtained at Nazan Bay on Atka Island or Adak, Alaska, from the authorized clearance personnel.

(5) The vessel clearance required under paragraph (1) prior to fishing in IPHC Regulatory Area 4C or 4D may be obtained only at St. Paul or St. George, Alaska, from the authorized clearance personnel by VHF radio and allowing the person contacted to confirm visually the identity of the vessel.

[…]

(7) Before unloading any Pacific halibut caught in IPHC Regulatory Area 4A, a vessel operator may obtain the clearance required under paragraph (1) only in Dutch Harbor or Akutan, Alaska, by contacting the authorized clearance personnel.

(8) Before unloading any Pacific halibut caught in IPHC Regulatory Area 4B, a vessel operator may obtain the clearance required under paragraph (1) only in Nazan Bay on Atka Island or Adak, by contacting the authorized clearance personnel by VHF radio or in person.

(9) Before unloading any Pacific halibut caught in IPHC Regulatory Areas 4C and 4D, a vessel operator may obtain the clearance required under paragraph (1) only in St. Paul, St. George, Dutch Harbor, or Akutan, Alaska, either in person or by contacting the authorized clearance personnel. The clearances obtained in St. Paul or St. George, Alaska, can be obtained by VHF radio and allowing the person contacted to confirm visually the identity of the vessel.

(10) Any vessel operator who complies with the requirements in Section 17 for possessing Pacific halibut on board a vessel that was caught in more than one regulatory area in IPHC Regulatory Area 4 is exempt from the clearance requirements of paragraph (1) of this Section, provided that:

(a) the operator of the vessel obtains a vessel clearance prior to fishing in IPHC Regulatory Area 4 in either Dutch Harbor, Akutan, St. Paul, St. George, Adak, or Nazan Bay on Atka Island by contacting the authorized clearance personnel. The clearance obtained in St. Paul, St. George, Adak, or Nazan Bay on Atka Island can be obtained by VHF radio and allowing the person contacted to confirm visually the identity of the vessel. This clearance will list the areas in which the vessel will fish; and

(b) before unloading any Pacific halibut from IPHC Regulatory Area 4, the vessel operator obtains a vessel clearance from Dutch Harbor, Akutan, St. Paul, St. George, Adak, or Nazan Bay on Atka Island by contacting the authorized clearance personnel. The clearance obtained in St. Paul or St. George can be obtained by VHF radio and allowing the person contacted to confirm visually the identity of the vessel. The clearance obtained in Adak or Nazan Bay on Atka Island can be obtained by VHF radio.

5. Minor edits throughout for stylistic consistency among Sections.

IPHC-2021-AM098-PropB1 Rev_1

Received: 22 December 2021

FISHERY REGULATORY PROPOSAL 2022

TITLE: RECREATIONAL (SPORT) FISHING FOR PACIFIC HALIBUT—IPHC REGULATORY AREAS 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E (SECT. 29) - RECORDKEEPING FOR CHARTER PACIFIC HALIBUT ANNUAL LIMITS

SUBMITTED BY:
UNITED STATES OF AMERICA
NOAA-FISHERIES
AFFILIATION: NMFS, ALASKA REGION
USA

All Regulatory Areas ☐ All Alaska Regulatory Areas ☐ All U.S. Regulatory Areas ☐

2A ☐ 2B ☐ 2C ☒ 3A ☒ 3B ☐ 4A ☐ 4B ☐ 4C ☐ 4D ☐ 4E ☐

Fishery Sectors

Directed Commercial ☐ Recreational ☒ Subsistence ☐ Non-directed Commercial ☐ All ☐

The National Marine Fisheries Service (NMFS) proposes a change to Section 29 of the IPHC Fisheries Regulations related to recordkeeping for charter halibut annual limits.

Justification provided:

This proposal establishes recordkeeping requirements needed to enforce Pacific halibut annual limits for recreational (sport) fishing for halibut in Convention waters in and off Alaska. Two primary elements are included.

1. It consolidates the recordkeeping requirements needed to enforce annual limits (when implemented) for recreational halibut fishing into the general provisions of Section 29. This eliminates the requirement to annually add or remove these regulatory provisions for each area. Under this proposal, in a year when halibut annual limits are implemented, these regulations would be in effect without requiring additional modifications to IPHC regulations.
2. It authorizes the use of ADF&G approved electronic harvest records to satisfy this harvest record requirement. Currently, ADF&G authorizes the use of electronic harvest records in State managed recreational fisheries. This proposal would allow anglers to use ADF&G approved electronic harvest records to legibly record recreational halibut catch off Alaska to satisfy the annual limit record keeping requirement when in place. Existing approved physical harvest records would also continue to be accepted. This creates regulatory consistency for anglers that may concurrently retain halibut as well as State managed species for which there is an annual limit.

The suggested modifications to the IPHC Fishery Regulations are provided in red text, at Appendix I.

APPENDIX I

Suggested Regulatory Language

29. Sport Fishing for Pacific Halibut—IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E

(1) In Convention waters in and off Alaska: [8, 9]

(a) The recreational (sport) fishing season is from 1 February to 31 December.

(b) The daily bag limit is two Pacific halibut of any size per day per person unless a more restrictive bag limit applies in Commission regulations or Federal regulations at 50 CFR 300.65.

(c) No person may possess more than two daily bag limits.

(d) No person shall possess on board a vessel, including charter vessels and pleasure craft used for fishing, Pacific halibut that have been filleted, mutilated, or otherwise disfigured in any manner, except that each Pacific halibut may be cut into no more than 2 ventral pieces, 2 dorsal pieces, and 2 cheek pieces, with a patch of skin on each piece, naturally attached;

(e) Pacific halibut in excess of the possession limit in paragraph (1)(c) of this section may be possessed on a vessel that does not contain recreational (sport) fishing gear, fishing rods, hand lines, or gaffs.

(f) Pacific halibut harvested on a charter vessel fishing trip in IPHC Regulatory Areas 2C or 3A must be retained on board the charter vessel on which the Pacific halibut was caught until the end of the charter vessel fishing trip as defined at 50 CFR 300.61.

(g) Guided angler fish (GAF), as described at 50 CFR 300.65, may be used to allow a charter vessel angler to harvest additional Pacific halibut up to the limits in place for unguided anglers, and are exempt from the requirements in paragraphs (2) and (3) of this section; and

(h) if there is an annual limit on the number of Pacific halibut that may be retained by a charter vessel angler as defined at 50 CFR 300.61, for purposes of enforcing the annual limit, each charter vessel angler must:

(1) maintain a nontransferable harvest record in the angler's possession if retaining a Pacific halibut for which an annual limit has been established. Such harvest record must be maintained either on the angler's State of Alaska recreational (sport) fishing license, an ADF&G approved electronic harvest record, or on a Sport Fishing Harvest Record Card obtained, without charge, from ADF&G offices, the ADF&G website, or fishing license vendors;

(2) immediately upon retaining a Pacific halibut for which an annual limit has been established, permanently and legibly record the date, location (IPHC Regulatory Area), and species of the catch (Pacific halibut) on the harvest record;

(3) record the information required by paragraph 1(h)(2) on any duplicate or additional recreational (sport) fishing license issued to the angler, duplicate electronic harvest record, or any duplicate or additional Sport Fishing Harvest Record Card obtained by the angler for all Pacific halibut previously retained during that year that were subject to the harvest record reporting requirements of this section.

[8] NOAA Fisheries could implement more restrictive regulations for the recreational (sport) fishery or components of it, therefore, anglers are advised to check the current Federal or State regulations prior to fishing.

[9] Charter vessels are prohibited from harvesting Pacific halibut in IPHC Regulatory Areas 2C and 3A during one charter vessel fishing trip under regulations promulgated by NOAA Fisheries at 50 CFR 300.66.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2022-AM098-PropB2

Received: 22 December 2021

FISHERY REGULATION PROPOSAL 2022
TITLE: CHARTER MANAGEMENT MEASURES IN IPHC REGULATORY AREAS 2C AND 3A (SECT. 29)

SUBMITTED BY:
UNITED STATES OF AMERICA
NOAA-FISHERIES
AFFILIATION: NMFS, ALASKA REGION
USA

All Regulatory Areas ☐ All Alaska Regulatory Areas ☐ All U.S. Regulatory Areas ☐

2A ☐ 2B ☐ 2C ☒ 3A ☒ 3B ☐ 4A ☐ 4B ☐ 4C ☐ 4D ☐ 4E ☐

The North Pacific Fishery Management Council (NPFMC) recommended the following management measures for charter Pacific halibut fisheries in IPHC Regulatory Areas 2C and 3A for application in 2022, in order to achieve the charter Pacific halibut allocation under the NPFMC Halibut Catch Sharing Plan.

Area 2C recommendations:
Management measures for all allocations shown below include a daily bag limit of one Pacific halibut, combined with a progression of size limits, closed days, and annual limits in the following order:

1. A reverse slot with an upper limit fixed at O80, and a lower limit decreased until the allocation is reached, but no lower than U40, determined from the following table:

Minimum Charter Allocation (Mlb)	Reverse Slot Limit
0.814	U40 to O80
0.840	U41 to O80
0.856	U42 to O80
0.875	U43 to O80
0.901	U44 to O80
0.930	U45 to O80
0.949	U46 to O80
0.975	U47 to O80
0.992	U48 to O80
1.023	U49 to O80
1.044	U50 to O80

2. If the allocation is insufficient to maintain at least a U40 on the lower limit, add Monday closures starting September 19th and work consecutively toward the beginning of the season until a lower limit of U40 is reached determined from the following table:

Minimum Charter Allocation (Mlb)	Monday closures & U40 to O80 rev. slot limit
0.689	All year
0.689	Starting May 16
0.689	Starting May 23
0.691	Starting May 30
0.694	Starting June 06
0.698	Starting June 13
0.702	Starting June 20
0.709	Starting June 27
0.718	Starting July 04
0.725	Starting July 11
0.735	Starting July 18
0.747	Starting July 25
0.758	Starting Aug 01
0.769	Starting Aug 08
0.780	Starting Aug 15
0.791	Starting Aug 22
0.801	Starting Aug 29
0.807	Starting Sept 05
0.811	Starting Sept 12
0.813	Starting Sept 19

3. If a lower limit of U40 can't be reached after closing all Mondays, add an annual limit of 4-fish (Yield 0.679 Mlb), progressing to an annual limit of 3-fish, as necessary to meet the allocation (Yield 0.648 Mlb); if possible, use any unused allocation to increase the lower limit above U40 until the allocation is reached.

4. If the allocation is not reached by closing all Mondays and a 3-fish annual limit, allow the lower limit to drop until the allocation is reached.

If an annual limit is adopted in Area 2C, implement a requirement for charter anglers to record, immediately upon retaining a halibut, the date, location (IPHC area), and species (halibut) on their harvest record, consistent with the past reporting requirement in Area 3A.

Area 3A recommendations:
Management measures for all allocations shown below include a daily bag limit of two Pacific halibut with one halibut of any size and a maximum size for the second halibut of 28 inches; no annual limit on the number of retained Pacific halibut for charter anglers; Wednesdays closed to Pacific halibut retention all year; one trip per Pacific halibut charter vessel per day; and one trip per charter Pacific halibut permit (CHP) per day.

1. Adjust Tuesday closures to bring the projected harvest within the Area 3A allocation determined from to the following table:

Minimum Charter Allocation (Mlb)	Tuesday Closures
1.795	February 01 - December 31
1.836	June 07 - August 30 (13)
1.851	June 07 - August 23 (12)
1.866	June 14 - August 23 (11)
1.884	June 14 - August 16 (10)
1.904	June 21 - August 16 (9)
1.928	June 28 - August 16 (8)
1.953	June 28 - August 09 (7)
1.979	July 05 - August 09 (6)
2.006	July 12 - August 09 (5)
2.034	July 12 - August 02 (4)
2.068	July 19 - August 02 (3)
2.096	July 26 - August 02 (2)
2.125	July 26 (1)
2.156	0

Justification provided:

The NPFMC selected these management measures at its December 2021 meeting, following review of the Alaska Department of Fish and Game (ADFG) analysis of proposed management measures for 2022, and after receiving input from the Charter Halibut Management Committee, which includes stakeholder representatives from both IPHC Regulatory Areas 2C and 3A.

The 2C committee members selected the following harvest measures and their order of application to keep the Area 2C guided recreational fishery within their allocation. As harvest measures impact different business operations differently, the order of harvest measures reflects the committee's best attempt to spread the impacts equitably among the many areas and business models in Area 2C.

Area 2C Charter Halibut Management Committee members highlighted that this is likely to be a particularly challenging year for their 2C operations, especially if the IPHC adopts the Area 2C charter allocation resulting from the interim management procedure's reference TCEY (0.60 Mlb). One member noted that without any adjustments the IPHC International agreement to assign a fixed allocation percentage in Area 2B could potentially impact the 2C reverse slot limit by 3 critical inches.

For Area 3A, Committee members acknowledged management measures would need to be similar to those implemented in pre-pandemic conditions, as the overages in 2021 demonstrated a rebound in angler effort. Measures were chosen to maintain consistency with previous regulations adopted. One member suggested that 28 inches would be the smallest acceptable size for the second fish and that while day-of-the-week closures limited halibut opportunities for operations, this negative impact was relatively equitable across operations in Area 3A. Thus, the Committee recommended adjusting the number of Tuesday closures as needed to fit the projected yield under the adopted catch limits. If the resulting allocation is outside of the range listed, Committee members confirmed they recommend managers use Table 16 and Table 17 to continue to adjust the number of Tuesdays accordingly.

The December ADFG analysis is available on the NPFMC website.

The report from the December Charter Halibut Management Committee meeting is provided in Appendix I for reference. NPFMC motion on Charter Halibut Management Measures is provided in Appendix II.

The suggested modification to the IPHC Fishery Regulations are provided in red in Appendix III.

APPENDIX I

Charter Halibut Management Committee Report from December 6, 2021

North Pacific Fishery Management Council

Simon Kinneen, Chair | David Witherell, Executive Director
1007 W. 3rd Avenue, Suite 400, Anchorage, AK 99501
Phone 907-271-2809 | www.npfmc.org

Charter Halibut Management Committee

REPORT

Dec 6, 2021, virtual Zoom meeting

The North Pacific Fishery Management Council's Charter Halibut Management Committee held an online public meeting December 6, 2021 to review the analysis of potential Area 2C and 3A charter halibut management measures for 2022 and provide recommendations to the Council. All meeting materials are posted to the eAgenda.

Committee Members in Attendance:

Andy Mezirow (Area 3A), *Chair*	Mike Flores (Area 3A)	Steve Zernia (Area 3A)
Seth Bone (Area 2C)	Kent Huff (Area 2C)	
Forrest Braden (Area 2C)	Matt Kopec (Area 3A)	
Daniel Donich (Area 3A)	Richard Yamada (Area 2C)	Sarah Marrinan, *Coordinator*

Members Absent: Stan Malcolm (Area 2C)

Others in Attendance

Sarah Webster	Doug Duncan	Mason Smith	Bob Powers
Kurt Iverson	Kristen Labrecque	Leslie Pemberton	Alicia Miller
James Hasbrouck	Karla Bush	Mel Erickson	Leslie Pemberton
Tom Gemmell	Jim Martin	Martin Schuster	

ADF&G Analysis of Management Measure Scenarios for 2022

The Committee receive a presentation of the ADF&G analysis of management options for the Area 2C and 3A charter halibut fisheries for 2022 from Sarah Webster (ADF&G). This report and the corresponding presentation are linked in the eAgenda.

The analysis used the charter allocation that would result from the IPHC's reference Total Constant Exploitation Yield (TCEY) as produced by the interim management procedure and the 2021 charter allocation. For Area 2C the charter allocation under the reference TCEY was **0.60 Mlb** and the 2021 allocation was **0.81 Mlb**. For Area 3A the charter allocation under the reference TCEY was **2.05 Mlb** and the 2021 allocation was **1.95 Mlb**. The report included the analysis requested by the Charter Halibut Management Committee from the Oct 2021 meeting.

Public Testimony

Public testimony was received from Mel Erikson.

Recommended Management Measures for 2022

For Area 2C, the Charter Halibut Management Committee recommends a progression of management measures in the following order as needed:

1) A reverse slot with an upper limit fixed at O80, and a lower limit decreased until the allocation is reached, but no lower than U40; Yield of 0.814 Mlb (rounds to status quo 0.81) (**Table 6, page 26 in ADF&G analysis of proposed harvest regulations for 2022**)

2) If the allocation is insufficient to maintain at least a U40 on the lower limit, add Monday closures starting September 19th and work consecutively toward the beginning of the season until a lower limit of U40 is reached; Yield of 0.689 Mlb (**Table 9, page 31**)

3) If a lower limit of U40 can't be reached after closing all Mondays, add an annual limit of 4-fish (Yield of 0.679 Mlb; **Table 12, page 40**), progressing to an annual limit of 3-fish, as necessary to meet the allocation (Yield of 0.648 Mlb; **Table 13, page 44**); if possible, use any unused allocation to increase the lower limit above U40 until the allocation is reached

4) If the allocation is not reached by closing all Mondays and a 3-fish annual limit, allow the lower limit to drop until the allocation is reached; Yield of 0.583 Mlb at U37O80 (**Table 13, page 44**)

If an annual limit is adopted in Area 2C, implement a requirement for charter anglers to record, immediately upon retaining a halibut, the date, location (IPHC area), and species (halibut) on their harvest record, consistent with the past reporting requirement in Area 3A.

Rationale and discussion:

The 2C committee members selected the following harvest measures and their order of application to keep the Area 2C guided recreational fishery within their allocation. As harvest measures impact different business operations differently, the order of harvest measures reflects the committee's best attempt to spread the impacts equitably among the many areas and business models in Area 2C.

Area 2C Charter Halibut Management Committee members highlighted that this is likely to be a particularly challenging year for their 2C operations, especially if the IPHC adopts the Area 2C charter allocation resulting from the interim management procedure's reference TCEY (0.60 Mlb). One member noted that without any adjustments the IPHC International agreement to assign a fixed allocation percentage in Area 2B could potentially impact the 2C reverse slot limit by 3 critical inches.

For Area 3A, the Charter Halibut Management Committee recommends:

- A two-fish daily bag limit
- One halibut of any size and a maximum size for one of the two fish is 28 inches
- One trip per CHP per day
- One trip on which halibut is harvested per vessel per day
- Prohibition on halibut charter fishing on Wednesdays, all year
- Adjust Tuesday closures according to **Table 16 and Table 17 on page 52 and 53** in ADF&G analysis of proposed harvest regulations for 2022 to bring the projected harvest within the Area 3A allocation.
    - For example, in combination with the other proposed measures:
        - 4 Tuesdays closed would result in a yield of 2.034 Mlb (**see Table 17, page 52**)
        - 8 Tuesdays closed would result in a yield of 1.928 Mlb (**see Table 17, page 52**)

For Area 3A, it is unnecessary to include a requirement to record retained halibut on the back of the license or harvest record card as an enforcement mechanism because an annual limit is not recommended for 2022.

Rationale and discussion:

For Area 3A, Committee members acknowledged management measures would need to be similar to those implemented in pre-pandemic conditions, as the overages in 2021 demonstrated a rebound in angler effort. Measures were chosen to maintain consistency with previous regulations adopted. One member suggested that 28 inches would be the smallest acceptable size for the second fish and that while day-of-the-week closures limited halibut opportunities for operations, this negative impact was relatively equitable across operations in Area 3A. Thus, the Committee recommended adjusting the number of Tuesday closures as needed to fit the projected yield under the adopted catch limits. If the resulting allocation is outside of the range listed, Committee members confirmed they recommend managers use **Table 16 and Table 17** to continue to adjust the number of Tuesdays accordingly.

Future Meetings and Other Business

There are two items tentatively scheduled for the February Council meeting that members may wish to discuss (Area 2C and 3A Catch Sharing Plan Allocation Review and the Recreational Quota Entity funding mechanism). The Committee chair will work with staff to identify if there is time for an additional Committee meeting before the February Council meeting and inform Committee members.

The Council has put out a request for another Area 3A representative on the Charter Halibut Management Committee. Appointments will be made during Staff Tasking of the upcoming December Council meeting.

Finally, the Charter Halibut Management Committee thanked two instrumental ADF&G staff members who are moving on. Sarah Webster has been promoted to Fisheries Scientist I at ADF&G and Bob Powers is retiring in March 2022 after ~15 years with ADF&G Sport Fish Division. The Committee thanks these two for their integral role with the Committee and wishes them well on their next endeavors.

Appendix II

Council Motion C1 Charter Halibut Management Measures motion from December 6, 2021

Council Motion
C1 Charter Halibut Management Measures motion
December 8, 2021

The Council recommends the following management measures for the 2022 charter halibut fishery in Area 2C and Area 3A, based on initial IPHC reference level allocations, resulting from the 2021 IPHC interim meeting.

Area 3A recommendations:

- Two-fish daily bag limit.
- One halibut of any size and a maximum size for one of the two fish is 28 inches.
- One charter vessel fishing trip per CHP per day (use of each charter halibut permit is limited to one charter halibut fishing trip per boat in one calendar day).
- Prohibition on halibut charter fishing on Wednesdays, all year.
- Adjust Tuesday closures according to Table 17 on page 53 in ADF&G analysis of proposed harvest regulations for 2022 to bring the projected harvest within the Area 3A allocation.
  - For example, in combination with the other proposed measures:
    - 4 closed Tuesdays closed would result in a harvest of 2.034 Mlb
    - 8 Tuesdays closed would result in a harvest of 1.928 Mlb

In 2022, it is unnecessary to include a requirement to record retained halibut on the back of the license or harvest record card as an enforcement mechanism for the annual limit for 2022.

Area 2C recommendations:
A progression of management measures in the following order as needed:

1. A reverse slot with an upper limit fixed at O80, and a lower limit decreased until the allocation is reached, but no lower than U40; Harvest of 0.814 Mlb (rounds to status quo 0.81 Mlb (Table 6, Page 26)
2. If the allocation is insufficient to maintain at least a U40 on the lower limit, add Monday closures starting September 19th and work consecutively toward the beginning of the season until a lower limit of U40 is reached; Yield 0.689 Mlb. (table 9 Page 31)
3. If a lower limit of U40 can't be reached after closing all Mondays, add an annual limit of 4-fish (Yield 0.679 Mlb), progressing to an annual limit of 3-fish, as necessary to meet the allocation (Yield 0.648 Mlb); if possible, use any unused allocation to increase the lower limit above U40 until the allocation is reached (Table 13, Page 44) .
4. If the allocation is not reached by closing all Mondays and a 3-fish annual limit, allow the lower limit to drop until the allocation is reached; Yield 0.583 Mlb at U37/O80.(table 13, Page 44)

If an annual limit is adopted in Area 2C, implement a requirement for charter anglers to record, immediately upon retaining a halibut, the date, location (IPHC area), and species (halibut) on their harvest record, consistent with the past reporting requirement in Area 3A.

Appendix III

Suggested Regulatory Language

29. Sport Fishing for Pacific Halibut—IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E

(1) …

(2) For guided recreational (sport) fishing (as referred to in 50 CFR 300.65) in IPHC Regulatory Area 2C:

(a) ~~No~~no person on board a charter vessel (as referred to in 50 CFR 300.65) shall catch and retain more than one Pacific halibut per calendar day~~.~~;

(b) ~~No~~no person on board a charter vessel (as referred to in 50 CFR 300.65) shall catch and retain any Pacific halibut that with head on is greater than ~~50 inches (127.0)~~ 40 inches (101.6 cm) [to be adjusted according to Table 6 in the ADF&G analysis of proposed harvest regulations for 2022 to bring the projected harvest within the Area 2C allocation] and less than ~~72 inches (182.9)~~ 80 inches (203.2 cm) [to be adjusted according to Table 6 in the ADF&G analysis of proposed harvest regulations for 2022 to bring the projected harvest within the Area 2C allocation] as measured in a straight line, passing over the pectoral fin from the tip of the lower jaw with mouth closed, to the extreme end of the middle of the tail~~.~~;

(c) no person on board a charter vessel may catch and retain Pacific halibut on the following Mondays: [to be implemented and adjusted according to Table 9 in the ADF&G analysis of proposed harvest regulations for 2022 if required to bring the projected harvest within the Area 2C allocation]; and

(d) charter vessel anglers may catch and retain no more than four (4) [to be implemented and adjusted according to Table 13 in the ADF&G analysis of proposed harvest regulations for 2022 if required to bring the projected harvest within the Area 2C allocation] Pacific halibut per calendar year on board charter vessels in IPHC Regulatory Area 2C. Pacific halibut that are retained as GAF while on a charter vessel fishing trip in other Commission regulatory areas, or retained while fishing without the services of a guide do not accrue toward the 4-fish annual limit.[1]

(3) For guided recreational (sport) fishing (as referred to in 50 CFR 300.65) in IPHC Regulatory Area 3A:

(a) ~~No~~no person on board a charter vessel (as referred to in 50 CFR 300.65) shall catch and retain more than two Pacific halibut per calendar day~~.~~;

(b) ~~At~~at least one of the retained Pacific halibut must have a head-on length of no more than ~~32 inches (81.3 cm)~~ 28 inches (71.1 cm) as measured in a straight line, passing over the pectoral fin from the tip of the lower jaw with mouth closed, to the extreme end of the middle of the tail. If a person recreational (sport) fishing on a charter vessel in IPHC Regulatory Area 3A retains only one Pacific halibut in a calendar day, that Pacific halibut may be of any length~~.~~;

(c) ~~A~~a "charter halibut permit" (as referred to in 50 CFR 300.67) may only be used for one charter vessel fishing trip in which Pacific halibut are caught and retained per calendar day. A charter vessel fishing trip is defined at 50 CFR 300.61 as the time period between the first deployment of fishing gear into the water by a charter vessel angler (as defined at 50 CFR 300.61) and the offloading of one or more charter vessel anglers or any Pacific halibut from that vessel. For purposes of this trip limit, a charter vessel fishing trip ends at 2359 (Alaska local time) on the same calendar day that the fishing trip began, or when any anglers or Pacific halibut are offloaded, whichever comes first~~.~~;

(d) ~~A~~a charter vessel on which one or more anglers catch and retain Pacific halibut may only make one charter vessel fishing trip per calendar day. A charter vessel fishing trip is defined at 50 CFR 300.61 as the time period between the first deployment of fishing gear into the water by a charter vessel angler (as defined at 50 CFR 300.61) and the offloading of one or more charter vessel anglers or any Pacific halibut from that vessel. For purposes of this trip limit, a charter vessel fishing trip ends at 2359 (Alaska local time) on the same calendar day that the fishing trip began, or when any anglers or Pacific halibut are offloaded, whichever comes first~~.~~; and

(e) ~~No~~no person on board a charter vessel may catch and retain Pacific halibut on any Wednesday, or on the following Tuesdays: [to be adjusted according to Table 17 in the ADF&G analysis of proposed harvest regulations for 2022 to bring the projected harvest within the Area 3A allocation].

[1] Required recordkeeping provisions are addressed in IPHC-2022-AM098-PropB1 Rev_1. If adopted, 29(2)(d) will not be needed.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2022-AM098-PropB3

Received: 24 December 2021

FISHERY REGULATORY PROPOSAL 2022

TITLE: FISHING GEAR (SECT. 18) – TRAP GEAR USE IN IPHC REGULATORY AREA 2B

SUBMITTED BY:
CANADA
FISHERIES AND OCEANS CANADA

All Regulatory Areas ☐ All Alaska Regulatory Areas ☐ All U.S. Regulatory Areas ☐

2A ☐ 2B ☒ 2C ☐ 3A ☐ 3B ☐ 4A ☐ 4B ☐ 4C ☐ 4D ☐ 4E ☐

Fishery Sectors

Directed Commercial ☒ Recreational ☐ Subsistence ☐ Non-directed Commercial ☐ All ☐

Canada is proposing changes to Section 18 of the IPHC Fisheries Regulations (Fishing Gear) to allow trap gear use on directed commercial trips in IPHC Regulatory Area 2B.

Justification provided:

Canada is proposing changes to Section 18 (Fishing Gear) of the IPHC Fishery Regulations. The purpose of the proposed change is for consistency and parity between the two contracting parties with respect to the retention of Pacific halibut caught using pot/trap gear. While referring to the same gear type, "pot" is the term used in the United States and "trap" is the term used in Canada.

Section 18 of the IPHC Regulations state Pacific halibut taken with longline or single pot gear may be retained if authorized by NOAA regulations. This IPHC Regulatory Proposal proposes similar wording be adopted for Canada, specifically that Pacific halibut taken with longline or single trap gear may be retained if authorized by Fisheries and Oceans Canada (DFO) regulations and conditions of licence.

Ensuring parity between Canada and the United States with respect to fishing gear is important as IPHC will be bringing researchers, fishers, fishery managers and academics together in February 2022 to discuss novel approaches to protecting fish caught on commercial fishing gear from marine mammal depredation (1st International Workshop on Protecting Fishery Catches from Whale Depredation). The stated goal of this workshop being to collectively share information on tools and approaches and to brainstorm new or modified ideas and concepts for field testing.

The suggested modifications to the IPHC Fishery Regulations are provided in red text, at Appendix I.

APPENDIX I

Suggested Regulatory Language

18. Fishing Gear

(1) No person shall fish for Pacific halibut using any gear other than hook and line gear,

~~(a) except that vessels licensed to catch sablefish in IPHC Regulatory Area 2B using sablefish trap gear as defined in the Condition of Licence can retain Pacific halibut caught as bycatch under regulations promulgated by DFO; or~~

(a) except that a person may retain Pacific halibut taken with longline or single trap gear if such retention is authorized by DFO as defined by Pacific Fishery Regulations and Conditions of Licence.

(b) except that a person may retain Pacific halibut taken with longline or single pot gear if such retention is authorized by NOAA Fisheries regulations published at 50 CFR Part 679.

(2) No person shall possess Pacific halibut taken with any gear other than hook and line gear,

~~(a) except that vessels licensed to catch sablefish in IPHC Regulatory Area 2B using sablefish trap gear as defined by the Condition of Licence can retain Pacific halibut caught as bycatch under regulations promulgated by DFO; or~~

(a) except that a person may possess Pacific halibut taken with longline or single trap gear if such retention is authorized by DFO as defined by Pacific Fishery Regulations and Conditions of Licence.

(b) except that a person may possess Pacific halibut taken with longline or single pot gear if such possession is authorized by NOAA Fisheries regulations published at 50 CFR Part 679.

[…]

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2022-AM098-PropB4

Received: 24 December 2021

FISHERY REGULATORY PROPOSAL 2022
TITLE: RECREATIONAL (SPORT) FISHING FOR PACIFIC HALIBUT—IPHC REGULATORY AREA 2B (SECT. 28) – DAILY BAG LIMIT

SUBMITTED BY:
CANADA
FISHERIES AND OCEANS CANADA

All Regulatory Areas ☐ All Alaska Regulatory Areas ☐ All U.S. Regulatory Areas ☐

2A ☐ 2B ☒ 2C ☐ 3A ☐ 3B ☐ 4A ☐ 4B ☐ 4C ☐ 4D ☐ 4E ☐

Fishery Sectors

Directed Commercial ☐ Recreational ☒ Subsistence ☐ Non-directed Commercial ☐ All ☐

Canada is proposing changes to Section 28 of the IPHC Fisheries Regulations (Recreational (Sport) Fishing for Pacific Halibut – IPHC Regulatory Area 2B) to allow daily bag limit of three fish per person.

Justification provided:

Canada is proposing changes to section 28 (Recreational (Sport) Fishing for Pacific Halibut – IPHC Regulatory Area 2B) of the IPHC Fishery Regulations to allow a maximum daily bag limit of three (3) fish per day, per person. The purpose of the proposed change is to align IPHC fishery regulations with Canada's domestic sportfishing regulations, to simplify unnecessary regulatory complexity, and to retain Canada's ability and autonomy to manage its domestic fishery.

The Commission previously supported and approved an increase in the Canadian daily bag limit from two (2) per day, to three (3) per day, on a one-year basis from 1 April 2021 and 31 March 2022 only. When mid-season catch monitoring showed that the recreational sector was unlikely to reach its allocated TAC, Canada used this conditional flexibility and implemented an increase to the daily bag limit from two (2) fish per day to three (3) fish day in August of 2021. This flexibility increased Canadian domestic benefits, whilst ensuring that the recreational sector fished well within its Total Allowable Catch (TAC).

The default IPHC daily bag limit of two (2) fish per day constrains Canada's flexibility to make critical in-season changes to the fishing plan to support meeting TAC goals and Canadian domestic fishery objectives.

Canadian Sport Fishing Advisory Board (SFAB) has a long history of collaborating with Fisheries and Oceans Canada (DFO) in Canada's endeavors to achieve IPHC objectives, while maximizing Canadian domestic objectives. DFO and SFAB meet monthly in-season to review timely and robust recreational catch estimates to consider and evaluate appropriate fishery management measures. Increased regulatory flexibility would augment the existing successful management tool kit to achieve improved fishery performance.

The suggested modifications to the IPHC Fishery Regulations are provided in red text, at Appendix I.

APPENDIX I

Suggested Regulatory Language

28. Recreational (Sport) Fishing for Pacific Halibut—IPHC Regulatory Area 2B

(1) In all waters off British Columbia: [6, 7]

(a) the recreational (sport) fishing season will open on 1 February unless more restrictive regulations are in place;

(b) the recreational (sport) fishing season will close when the recreational (sport) fishery limit allocated by DFO is taken, or 31 December, whichever is earlier; and

~~(c) the daily bag limit is two (2) Pacific halibut of any size per day, per person, except that between 1 April 2021 and 31 March 2022 only, DFO may implement a daily bag limit of three (3) Pacific halibut per day, per person.~~

(c) the daily bag limit is three (3) Pacific Halibut of any size per day, per person [6,7].

(2) In British Columbia, no person shall fillet, mutilate, or otherwise disfigure a Pacific halibut in any manner that prevents the determination of minimum size or the number of fish caught, possessed, or landed.

(3) The possession limit for Pacific halibut in the waters off the coast of British Columbia is three Pacific halibut [6, 7].

[6] DFO could implement more restrictive regulations for the recreational (sport) fishery, therefore anglers are advised to check the current Federal or Provincial regulations prior to fishing.

[7] For regulations on the experimental recreational fishery implemented by DFO check the current Federal or Provincial regulations.

IPHC Fishery Regulation Proposal:

Recreational (Sport) Fishing for Pacific Halibut—IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E (Sect. 29) - Processing Pacific halibut for eating and/or preservation

SUBMITTED BY: JOHN FIELDS, RECREATIONAL FISHERMAN (20 DECEMBER 2021)

Directed Commercial ☐ Recreational ☒ Subsistence ☐ Non-directed commercial ☐ All ☐

All Regulatory Areas ☐ All Alaska Regulatory Areas ☒ All U.S. Regulatory Areas ☐

2A ☐ 2B ☐ 2C ☐ 3A ☐ 3B ☐ 4A ☐ 4B ☐ 4C ☐ 4D ☐ 4E ☐

PURPOSE

To propose an exception that allows recreational fishermen on pleasure craft in Alaska Regulatory Area to process Pacific halibut for eating and/or preservation, subject to measures to facilitate enforcement of the applicable daily bag limits.

EXPLANATORY MEMORANDUM

This proposal is submitted on behalf of John Fields by his counsel, Matthew Krueger of Foley & Lardner LLP.

1. <u>Background</u>

Mr. Fields is a life-long recreational angler who has been taking several trips per year to Southeast Alaska with his family and friends for the last 30 years. Mr. Fields maintains and keeps his own boat in Sitka, Alaska. During the trips, which typically last about five to six days, Mr. Fields and his guests anchor out on his boat and generally return to port just once, if at all, during the trip to refuel. In all of these trips—well over 50 in total—Mr. Fields and his guests have always complied with the daily bag limits.

On these trips, Mr. Fields and his guests want to catch and eat or freeze meal-sized portions of Pacific halibut that they catch within the daily bag limit. But the International Pacific Halibut Commission's ("IPHC") current regulations effectively prohibit recreational anglers who, like Mr. Fields, do not return to port each day from doing so. Specifically, § 29(1)(d) of the 2021 Fishery Regulations promulgated by the IPHC provides:

> *In Convention waters in and off Alaska … [n]o person shall possess on board a vessel, including charter vessels and pleasure craft used for fishing, Pacific halibut that have been filleted, mutilated, or otherwise disfigured in any manner, except that each Pacific halibut may be cut into no more than 2 ventral pieces, 2 dorsal pieces, and 2 cheek pieces, with a patch of skin on each piece, naturally attached.*

Section 29(1)(d) thus effectively prohibits anglers from cutting up halibut and removing its skin to be consumed while on aboard the vessel. Further, the current IPHC regulations effectively prohibit recreational anglers like Mr. Fields who do not return to port each day from being able to process and preserve halibut in reasonable, meal-sized portions. The regulations therefore impose an unreasonable hardship on all recreational anglers who, like Mr. Fields, do not return to port each day.

The hardship is not theoretical: Mr. Fields received a Written Warning from a NOAA enforcement officer who boarded his boat on September 1, 2021 and determined that Pacific halibut had been processed in a way that did not comply with 50 C.F.R. § 300.66(m) and § 29(1)(d) of the Fishery Regulations. Mr. Fields and his six guests were each licensed anglers. In total, they had only approximately eight small halibut—an amount that was well within the daily bag limit. Nonetheless, the official issued the Warning on the ground that the halibut were filleted into more than two ventral pieces and two dorsal pieces, with no skin remaining. The enforcement officer issued the Warning even though she had no trouble determining that Mr. Fields and his guests had complied with the applicable daily bag limit.

Nor is the hardship limited to Mr. Fields: The 2018 IPHC Annual Meeting received five proposals to allow recreational anglers who do not return to port each day to catch and consume or process halibut. *See* IPHC-2018-AM094-R. Following are excerpts from the proposals, which underscore the unfair burden imposed by the current regulations:

- The regulations "do not allow for proper processing and preservation of the catch" for recreational anglers who do not "return to day for processing their catch. … The result … is that any surplus fish caught and not immediately consumed must be wasted and not kept on board to satisfy the regulations." A. Cooper Proposal, IPHC-2018-AM094-PropC2.
- "While [the regulations] may make sense for the day fisherman who brings their catch back to port for processing and storage at their home ashore, it is impractical for the long term or full time cruiser. To minimize waste the current regulation below should be revised to permit processing and storage aboard the vessel in usable portion sizes with the skin removed." W. Cornell Proposal, IPHC-2018-AM094-PropC12.
- "The result of these [regulations] is that any surplus fish caught and not immediately consumed must be wasted and not kept on board" vessels that do not return to port each day "to satisfy the regulations." M. Cowart Proposal, IPHC-2018-AM094-PropC9.
- "The current IPHC regulation prevents personal use of Halibut on the boat" where the angler does not return to port each day "and prevents the proper preservation of the catch for future use." D. Robertson Proposal, IPHC-2018-AM094-PropC6.
- "The current halibut regulations do not allow for long term preservation and storage of halibut for personal use aboard pleasure vessels. The inability to package and preserve fish in serving size portions will result in waste and therefore increase the number of halibut required to supplement a family's diet." L. Thompson Proposal, IPHC-2018-AM094-PropC7.

The IPHC convened a Working Group to address this issue but took no action, despite the clear and unreasonable burden the regulation places on recreational anglers like Mr. Fields. *See* IPHC-2018-AM094-R.

Mr. Fields has filed an appeal with NOAA, asking that the Written Warning be vacated. In that appeal, Mr. Fields demonstrated that § 29(1)(d) of the Fishery Regulations is arbitrary and capricious, and contrary to law. If the IPHC does not modify the Fishery Regulations for 2022, Mr. Fields may be forced to discontinue taking recreational fishing trips that are so meaningful to his family and beneficial to the Alaska economy.

2. <u>The Current Regulation is Arbitrary and Capricious, and Contrary to Law</u>

Section 29(1)(d) of the 2021 Fishery Regulations promulgated by the IPHC prohibits recreational anglers from cutting up Pacific halibut on board their vessels in portions that can be consumed or frozen in reasonable, meal-sized portions. In so doing, § 29(1)(d) imposes restrictions on processing Pacific halibut caught in certain areas beyond the restrictions imposed by § 300.66(m) and far beyond the purpose of the underlying Convention and Northern Pacific Halibut Act. The heightened restrictions are arbitrary and capricious, and contrary to law, both on their face and as applied to someone like Mr. Fields. This is so for several reasons.

First, on their face, the heightened restrictions effectively prohibit a whole category of recreational fishing—*i.e.*, recreational fishing by anglers who do not return to port each day—in a manner that is contrary to the express provisions of the governing Convention. The Convention makes clear in Article I, § 5 that its primary purpose is to regulate "commercial halibut fishing," while allowing "sport fishing for halibut." To be sure, § 5 provides that "sport fishing for halibut" is subject to IPHC "regulations and permit and licensing requirements, including the payment of fees." But § 5 then emphasizes that besides those basic requirements, "sport fishing for halibut and other species by nationals and vessels of each Party may be conducted in Convention waters." Section 5 reiterates: "All provisions of this Convention except this paragraph, refer to commercial halibut fishing."

Read in context, the Convention's main purpose is to regulate commercial fishing, not recreational anglers like Mr. Fields. The Convention contemplates that any regulations created for sport fishing would facilitate responsible sport fishing, not prohibit it. Yet, § 29(1)(d) effectively prohibits fishing by a whole category of recreational anglers—those who like Mr. Fields do not return to port each day, or who do not have access to facilities where they can process and store the fish that they catch when they do return to port. Prohibiting halibut fishing by recreational anglers who do not return to port each day is a plain violation of the Convention. Nor does it provide a "fair and equitable distribution of access privileges in the fishery." *Cf.* 16 U.S.C. § 1853(b)(6) (setting forth the factors to be considered for creating a fishery management plan under U.S. law).

Second, on their face, the heightened restrictions draw an arbitrary distinction between Pacific halibut caught "[i]n Convention waters in and off Alaska," and Pacific halibut caught in other areas, including California, Oregon, Washington, and British Columbia. Only the former are subject to heightened restrictions on processing. *See* 2021 Fishery Regulations, §§ 27(3) & 28(2). That is, for regulatory areas that include California, Oregon, Washington, and British Columbia, the Fishery Regulations simply provide that "no person shall fillet, mutilate, or otherwise disfigure a Pacific halibut in any manner that prevents the determination of minimum size or the number of fish caught, possessed, or landed." *See* §§ 27(3) & 28(2). Although Mr. Fields had processed the fish in more than six pieces and removed the skin, the NOAA officer was still able to determine that the size and daily bag limits were not exceeded. Thus, the exact same conduct that led to Mr. Fields receiving the Warning would have been perfectly permissible if Mr. Fields had been fishing in waters off of California, for instance, rather than waters off of Alaska.

Third, the heightened restrictions are also arbitrary and capricious, and contrary to law, as applied to a person in Mr. Fields' particular circumstances. The restrictions' obvious purpose is to facilitate enforcement of the daily bag limits for Pacific halibut. But when applied to a recreational angler who has only a small number of Pacific halibut on board his boat at any given time, the restrictions serve no purpose other than effectively to prohibit the recreational angler from either eating or freezing the fish that he has caught without first returning to port. The result is that recreational fishermen who take multi-day trips without returning to port, or who do not have access to facilities for processing and storing fish other than on their vessels, face an unfair choice: They must either forgo fishing for Pacific halibut altogether or know that any halibut that they catch will necessarily go to waste. *See* 2018 Regulatory Proposals cited above.

By adopting the accompanying proposal, IPHC can remove the heightened restrictions that apply only to recreational fishermen in Convention waters in and off Alaska, and give these recreational anglers who do not return to port each day the same ability that anglers who do return to port have to process and keep halibut they catch. To the extent that enforcement officials require additional means of enforcing daily bag limits, this proposal also suggests alternative, less restrictive measures than the complete prohibition effected by the current rules.

3. Proposal and Improvements It Offers

We offer here a proposal to amend § 29(1)(d) in ways that would satisfy IPHC's need to allow officials to verify the size and daily bag limits while removing the unlawful prohibition on the ability of recreational anglers who do not return to port each day to consume and preserve halibut. The proposal has two features: (A) making the restrictions on processing fish in Alaska consistent with the processing restrictions in other IPHC regulatory areas, and (B) providing a new exception for recreational fishers to further process fish if they comply with logging requirements.

A. Harmonize Alaska's Restrictions with Other Regions' Restrictions

The first feature would eliminate the heightened restrictions that apply only to recreational anglers in Convention waters in and off Alaska by amending § 29(1)(d) so it is consistent with the restrictions that apply to recreational anglers in regulatory areas 2A (California, Oregon, and Washington) and 2B (British Columbia). As noted, the provisions that govern regulatory areas 2A and 2B neither specifically limit the number of pieces into which a Pacific halibut may be cut nor require that a patch of skin remains naturally attached to each piece. Instead, the restrictions governing regulatory areas 2A and 2B simply provide that "no person shall fillet, mutilate, or otherwise disfigure a Pacific halibut in any manner that prevents the determination of minimum size or the number of fish caught, possessed, or landed." 2021 Fishery Regulations, §§ 27(3) & 28(2). The proposal would make the same restrictions that apply in areas 2A and 2B also apply in Alaska.

This feature brings appropriate consistency to the IPHC regulations and removes an unreasonable distinction between the enforcement regime in Alaska versus other regions. This feature would also give recreational anglers in Alaska some additional flexibility in how they process Pacific halibut for eating or preserving on board their vessels. At the same time, the proposal would maintain the same safeguards that the IPHC has deemed sufficient to allow effective enforcement of bag and possession limits in other regulatory areas.

Standing alone, however, the proposed restriction still could be read to prohibit recreational anglers like Mr. Fields from cutting halibut into small pieces for eating and meal-sized processing, to the extent doing so prevents authorized officers from determining the number and size of fish caught. Further, standing alone, the proposed restriction does not give clear instructions to recreational anglers like Mr. Fields regarding exactly how much they can process Pacific halibut. We therefore also propose adding the second feature, a limited exception for recreational anglers.

B. Add a New Exception for Recreational Fishers Who Log Catches

The second feature would add an exception for recreational fishers who are on board a pleasure craft used for fishing that would permit them to cut Pacific halibut into smaller pieces and remove the skin for consumption or preservation, provided they comply with specific procedures. Those procedures would require the angler to take a photograph of the halibut alongside a measuring device so the authorized officer could determine the size of the halibut. The angler would also be required to label any packages with the halibut according to the date, the sequence of the fish caught (*e.g.*, 1 of 2 of the daily bag limit), and with a sequence letter to reflect the portion of the fish in the package (*e.g.*, A, B, C, D, etc.). For example, if an angler processed the first halibut he caught that day into 9 pieces, each package would be labeled with the date, the number "1," and a letter going from A to I. Finally, the angler would be required to keep a log that recorded that same information.

This proposal would allow an authorized officer easily to compare the required photograph showing the size of the fish to the log and to each portion of packaged fish on board the vessel, quickly determining if the packages correspond to what the log and photograph represent. If the vessel had more fish than what was represented, the authorized officer could determine that the size or daily limits were violated. Critically, this proposal still leaves in place a prohibition on processing fish in ways that prevent the determination of the minimum size or number of fish caught so that if an angler did not comply with each requirement of the exception, the angler could still be held accountable for violating daily bag and size limits. This proposal is also limited in scope, applying only to pleasure craft and not applying to charter vessels.

We considered including with this proposal a reporting requirement for an angler who intends to use the exception. Specifically, the angler could be required to notify an authorized officer before embarking on a trip of the angler's intended length of trip, areas of travel, and names of licensed anglers. Upon finishing the trip, the angler could be required to submit a copy of the photographs and log to the authorized officer. This reporting requirement would allow the IPHC to track how many recreational anglers are making use of the new exception so that the IPHC could evaluate its impact and make modifications in future years. In addition, the requirement could enhance awareness and increase compliance among anglers who would otherwise face enforcement if they did not report their activities.

We opted not to include the above-described reporting requirement, however, for two reasons. First, we are mindful that implementing such a requirement would impose additional record-keeping burdens on authorized officers. Second, we believe that a reporting requirement is likely unnecessary, given the lack of evidence that recreational anglers who do not return to port each day are responsible for any significant number of violations. Nonetheless, we stand ready to amend our proposal to include a reporting requirement if doing so would give the IPHC additional comfort in adopting a new exception.

By adopting this proposal, the IPHC would be removing an unreasonable hardship that has led to recurring complaints by recreational anglers like Mr. Fields—a hardship that the IPHC recognized in 2018 by forming a working group. The proposal would give recreational anglers in Alaska who do not return to port each day the ability to enjoy the halibut they catch for consumption and for processing in meal-sized portions. The proposal offered here would also remedy the unlawfully arbitrary and capricious nature of the current regulations.

4. Potential Negative Impacts.

The proposal would not create any negative impacts. In explaining its unwillingness to recommend changes, the 2018 IPHC Working Group stated that § 29(1)(d) is "necessary for the enforcement of the bag and possession limits among sport fishermen," and that it had not received "a consistent, easily verifiable option that would … still allow effective enforcement of the bag and possession limits." IPHC-2018-IM094-INFO2, Appendix I, at p. 3.

This proposal would offer a consistent, easily verifiable method for authorized officers to enforce the size and daily bag limits for recreational anglers who do not return to port each day. Moreover, we are not aware of, and the 2018 IPHC Working Group did not cite, any data indicating that fishing by recreational anglers who do not return to port each day contributed to a significant amount of halibut catches or violations of the size or daily bag limits. Indeed, that is highly unlikely to be the case because there are relatively few recreational anglers who do not return to port each day. The current regulations—and the 2018 IPHC Working Committee's position—apply a blunt, broad tool to what is, at most, a miniscule issue. We offer here a scalpel to address the issue properly, without harming all of the recreational anglers who do not return to port each day and fish responsibly.

RECOMMENDATIONS

That the Commission:

1) **NOTE** fishery regulation proposal IPHC-2022-AM098-PropC, which adds an exception that allows recreational fishermen on pleasure craft in Alaska Regulatory Area to process Pacific halibut for eating and/or preservation, subject to measures to facilitate enforcement of the applicable daily bag limits, submitted for consideration at AM098.

APPENDICES

Appendix A: Suggested Regulatory Language.

APPENDIX A

SUGGESTED REGULATORY LANGUAGE

Proposal: Amend § 29(1) (governing IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E) to be consistent with § 27(3) (governing IPHC Regulatory Area 2A) and § 28(2) (governing IPHC Regulatory Area 2B), and add an exception that allows recreational fishermen on pleasure craft to process Pacific halibut for eating and/or preservation, subject to measures to facilitate enforcement of the applicable daily bag limits, as follows:

29. Recreational (Sport) Fishing for Pacific Halibut—IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, 4E

(1) In Convention waters in and off Alaska:

…

(d) No person shall possess on board a vessel, including charter vessels and pleasure craft used for fishing, Pacific halibut that have been filleted, mutilated, or otherwise disfigured in any manner~~, except that each Pacific halibut may be cut into no more than 2 ventral pieces, 2 dorsal pieces, and 2 cheek pieces, with a patch of skin on each piece, naturally attached.~~ that prevents the determination of minimum size or the number of fish caught, possessed, or landed; except that any person who, while on board a pleasure craft used for fishing, may further fillet or otherwise process Pacific halibut for immediate consumption or preservation for later consumption if the person does all of the following:

(a) Maintain on board the pleasure craft and available for inspection by an authorized officer a photograph of each Pacific halibut caught. The Pacific halibut must be photographed alongside a measuring device that allows an authorized officer who inspects the photograph to determine the length of the Pacific halibut. Each photograph must be accompanied with information indicating the date and approximate time at which the Pacific halibut in the photograph was caught.

(b) For each Pacific halibut processed for later consumption, store the Pacific halibut in a package or packages labeled with (A) the date and approximate time at which the Pacific halibut was caught, (B) the length of the Pacific halibut, (C) a sequence number corresponding to the daily bag limit (i.e. 1 of 2), and (D) a sequence letter corresponding to a portion of the Pacific halibut in the package (i.e., A, B, C, etc.).

(c) Maintain on board the pleasure craft and available for inspection by an authorized officer a log of each Pacific halibut caught. The log must specify (A) the date and approximate time at which each Pacific halibut was caught, (B) the length of each Pacific halibut, (C) the sequence number corresponding to the daily bag limit (i.e., 1 of 2), and (D) an indication of the portions of the Pacific halibut packaged for later consumption (i.e., A, B, C, etc.).

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Stakeholder statements on IPHC Fishery Regulation proposals

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK; 10 DECEMBER 2021)

PURPOSE

To provide the Commission with a consolidated document containing 'Statements' from stakeholders submitted to the Commission for its consideration at the 98th Session of the IPHC Annual Meeting (AM098).

BACKGROUND

The IPHC Secretariat has continued to make improvements to the Fishery Regulations portal on the IPHC website, which includes instructions for stakeholders to submit statements to the Commission for its consideration. Specifically:

> "Informal Statements by stakeholders should be submitted as an email to the following address, *secretariat@iphc.int*, which will then be provided to the Commissioners as Stakeholder Statements at each Session.

DISCUSSION

Table 1 provides a list of the Stakeholder Statements which are provided in full in the Appendices. The IPHC Secretariat does not provide commentary on the Statements, but simply collates them in this document for the Commission's consideration. Not all relate to current proposals before the Commission.

Table 1. Statements from stakeholders received by 1200 on 10 December 2021.

Appendix No.	Title and author	Date received
Appendix I	Statement by Andrew Smyth	29 September 2021
Appendix II	Statement by Steve Ramp	14 October 2021
Appendix III	Statement by Sean Daly	22 October 2021

APPENDICES

As listed in Table 1.

APPENDIX I

Statement by Andrew Smyth

IPHC Regulatory Areas that may be affected	All
Fishery Sectors	• Directed Commercial
Explanatory Memorandum	To address commercial bottom trawl Regs.
Suggested Regulatory Language	Propose to limit commercial bottom trawls only to areas deeper than 400 ft. This would leave the areas used by recreational and charter fishing companies better stocks and encourage economic benefit to a broader segment of the people living in our coastal communities.

APPENDIX II

Statement by Steve Ramp

IPHC Regulatory Areas that may be affected	2C
Fishery Sectors	• Recreational
Explanatory Memorandum	In recent years, there has been large growth of businesses in Southeast Alaska that rent sportfishing vessels to non-residents, who utilize this arrangement to qualify for more liberal "Non-Guided" bag limits for Halibut. Most of these vessels are smaller than the average charter vessel and, as a result, I believe these anglers focus their halibut harvests in areas close to the communities of Southeast AK. The Sitka Fish and Game Advisory Committee (in which I currently hold the Resident Sport Fishing seat) believes this activity reduces the opportunity for resident anglers to harvest halibut close to our homes and has submitted a State of Alaska Board of Fisheries proposal similar to this one.
Suggested Regulatory Language	Enact a new regulation that would require any Non-Resident Unguided Angler fishing from a rented vessel in the waters of Halibut Management Area 2C abide by the NOAA halibut bag limits then in effect for Guided Anglers.

APPENDIX III

Statement by Sean Daly

IPHC Regulatory Areas that may be affected	All
Fishery Sectors	• Non-directed Commercial (bycatch)
Explanatory Memorandum	To Whom it May Concern: My name is Sean Daly, I am a United States citizen and a resident of Alaska. I am a father of two boys who one day will be old enough to fish in Alaskan waters. I ask that the commission advocate for expansion of the halibut stock assessment analysis focused on halibut sex ratios to include those of the halibut caught by the A80 fleet, and establish enforcement of quotas for the A80 fleet so that the fishery is immediately closed when the quotas are met or exceeded. I also ask that the council consider revising the bycatch limits to a lower number given declining stocks for numerous saltwater species commonly caught by the A80 fleet as bycatch, and the destructive practice of bottom trawling to ocean habitat on the sea floor including sponges, coral, etc. To date there has been no evidence of any ocean bottom recovery in or near Alaskan waters in the North Pacific after being trawled by bottom trawling vessels, even after decades of research. In my comment, I've included some data on wasted Halibut bycatch from the A80 fleet in Alaska that could have made it to Alaskan residents' freezers, on consumer's tables, or left in the wild to maintain overall fishing stocks and ocean habitat. Statewide Halibut: 3,022,537 lbs. Grand total of above categories is over 24 million pounds of waste. Note that the above categories are just the "Hot Topic" bycatch categories. If you go through and tally total bycatch for ALL species, it comes out to close to 100 million pounds per year. Approximately 10% of total halibut and salmon bycatch is kept and donated each year. Historically, approximately 70% of that donated halibut and salmon goes out-of-state. Thank you for your time!
Suggested Regulatory Language	N/A

The IPHC mortality projection tool for 2022 mortality limits

PREPARED BY: IPHC SECRETARIAT (I. STEWART; 8 DECEMBER 2021)

PURPOSE

This document provides a description of the IPHC's web-based mortality projection tool (https://www.iphc.int/data/projection-tool) for setting mortality limits in 2022.

BACKGROUND

To support the IPHC's process for setting the 2019 mortality limits, IPHC Secretariat staff developed an interactive tool for the evaluation of alternative Pacific halibut mortality levels based on the coastwide TCEY and the distribution of that mortality among IPHC Regulatory Areas. The tool was updated for use in developing mortality limits for 2020; however, agreements made during AM095 and IM095 led to additional complexity that rendered simple use of the tool challenging.

For the evaluation of 2021 mortality limits, the existing web-based tool was updated to again provide all participants in the process the ability to create alternative projection tables as is necessary for decision making, without having to rely directly on the IPHC Secretariat. Specifically, agreements in place for 2021-022 were included by default in the automatic calculations. No additional changes were made for 2022, beyond updating the data sources and assessment results underlying the tool.

THE MORTALITY PROJECTION TOOL

The tool relies on previously calculated stock assessment outputs representing a broad range of total mortality. These include projections of spawning stock size and fishing intensity, such that alternative harvest levels can be evaluated in the context of the harvest decision table as well as relative trends. The tool is divided into five components:

1) Inputs
2) Summary results
3) Biological distribution
4) Detailed sector mortality information
5) Graphics

A brief description of each of these is provided below.

Inputs

The first section of the tool provides the user with inputs primary information (Figure 1):

1) The total distributed mortality limit (TCEY) in millions of net[1] pounds.
2) The percent of the distributed mortality limit (TCEY) assigned to each IPHC Regulatory Area.

[1] Net pounds refer to the weight with the head and entrails removed; this is approximately 75% of the round (wet) weight.

The default values loaded into the tool reflect the IPHC's interim management procedure, adjusted for current agreements for 2022 mortality limits and TCEY distribution, as well as an intersessional decision during 2020. The total TCEY is based on the value that produces a projected level of fishing intensity equal to $F_{43\%}$, or the fishing intensity that reduces the spawning output of the stock per recruit to 43% of its unfished level (SPR=43%) given recent recruitment, and current biology (weight at age, maturity, fecundity), allocation among fisheries and selectivity within fisheries. This level of fishing intensity reflects an adjustment made intersessionally (after AM096; IPHC 2020a) to the previous $F_{46\%}$ handrail adopted in 2016, in response to the results from the IPHC's ongoing Management Strategy Evaluation (MSE) process. The MSE results, presented at AM096 (IPHC-2020-AM096-12), found that a management procedure utilizing an $F_{43\%}$ target level of fishing intensity, and a control rule reducing that level of fishing intensity linearly if the relative spawning biomass drops below 30%, to a target value of $F_{100\%}$ (no fishing) if the spawning biomass reaches 20% successfully met the coastwide conservation and fishery objectives.

Inputs

Enter 2022 coastwide mortality limit (TCEY) **39.00**

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Enter 2022 distributed mortality limit %	4.2%	17.9%	14.9%	35.9%	8.0%	5.3%	3.6%	10.2%	100.0%

Select non-directed discard option: **Three-year average discards**
Select weight units: **Millions of net pounds**

Figure 1: Example of the "Inputs" section of the mortality projection tool. Cells in yellow are intended to be modified by the user. Note that specific values are for illustration only and do **NOT** correspond to default values for 2022.

The IPHC's interim management procedure also includes a method for distributing the coastwide TCEY among IPHC Regulatory Areas. The distribution method consists of the following steps:

1) Determine the current stock distribution of Pacific halibut greater than 32-inches (82.5 cm, O32) from the modeled survey WPUE and geographic extent of each IPHC Regulatory Area.
2) Assign relative harvest rates of 1.0 to IPHC Regulatory Areas 2A-3A and 0.75 to IPHC Regulatory Areas 3B-4CDE.
3) Generate a target TCEY distribution, as the normalized product (sums to 100%) of steps 1 and 2.

During AM095 (para. 69) two additional steps were adopted by the Commission, to apply to mortality limits for 2019-2022:

4) Set the IPHC Regulatory Area 2A TCEY to a value of 1.65.
5) Set the IPHC Regulatory Area 2B target TCEY percentage to a weighted average of 20% (weight = 0.7) and the result of step 3 (weight = 0.3).

6) In order to satisfy the coastwide TCEY as well as steps 4-5, reduce the target TCEY percentages for IPHC Regulatory Areas 2C-4CDE in proportion to the result of step 3.

At IM095 (Req.03, para. 49) an additional adjustment was added:

7) Remove all non-directed commercial discard ('bycatch') mortality of Pacific halibut less than 26 inches in length (66 cm; U26) occurring in Alaska from the projections.
8) Recalculate the TCEY (using the stock assessment ensemble) that corresponds to the reference fishing intensity (coastwide) and the distribution percentages from step 6.
9) Compare the recalculated TCEYs to those from step 6 to determine the 'yield gained' in IPHC Regulatory Area 2B.

This adjustment was further modified during AM096 (para. 97):

10) Add 50% the yield gained for IPHC Regulatory Area 2B (step 9) to that from step 6.
11) In order to satisfy the coastwide TCEY as well as steps 6 and 10, reduce the target TCEY percentages for IPHC Regulatory Areas 2C-4CDE in proportion to the result of step 6 (also equivalent to step 3).

The mortality projection tool satisfies these constraints by using the input coastwide TCEY to determine the distributed components. This relies on the inputs described above, as well as a range of pre-calculated yield gained values for 2B due to accounting for U26 non-directed discard mortality (the yield gained depends on the overall level of fishing intensity). Therefore, the distribution percentages for 2A and 2B are shaded grey[2] in the mortality projection tool, and will update to the appropriate percentages if the coastwide TCEY is adjusted. The distribution percentages for IPHC Regulatory Areas 2C-4CDE can be adjusted manually. Although the percentages describing the distribution of the mortality limit are intended to sum to 100%, if they do not the total will be highlighted in red, and 2C-4CDE are automatically rescaled so that the sum of the distributed mortality limits across all IPHC Regulatory Area will exactly match the coastwide total input.

There are two optional inputs, with drop-down menus, specifying:

1) The basis for projecting non-directed discard mortality. The default projection, consistent with the IPHC's Interim Management Procedure (specified during AM096 para. 97), is to use the three-year average non-directed discard mortality from the most recent year. Alternatives include the previous year's estimates and the values consistent with full regulatory attainment of domestic non-directed discard mortality limits.
2) The units of mortality measurement. This can either be millions of net pounds (default) or net metric pounds.

Summary results

The second section of the tool provides the projected coastwide SPR for comparison with the harvest decision table. In addition, this section reports the distributed mortality limit (TCEY) for each IPHC Regulatory Area; the total can be compared to the total input above to verify that

[2] Note that the percentages for 2A and 2B can be adjusted manually for comparison of alternative distribution procedures, but the tool must be refreshed to return to automatic calculations that satisfy the Interim Management Procedure.

the calculations are working properly. The total mortality limit (all sizes and sources of mortality, including U26 non-directed discard mortality of Pacific halibut) is also summarized by IPHC Regulatory Area.

Biological and fishery distribution

The third section of the mortality projection tool provides the most current modelled estimates of stock distribution by Biological Region, compared to the distributed mortality limits (TCEY). These two values are then used to project a harvest rate by Region, standardized such that Region 3 (IPHC Regulatory Areas 3A and 3B) is always equal to a value of 1.0 and the other Regions (2, 4 and 4B) are relative to that value.

Detailed sector mortality information

This section provides a full distribution of mortality among IPHC Regulatory Areas and fishery sectors. Calculations are based on catch sharing agreements used by the domestic agencies for IPHC Regulatory Areas 2A, 2B, 2C, 3A, and 4CDE (4CDE allocating among sub-Areas). Static projections are used for non-directed discard mortality (see above), and subsistence mortality (based on the most recent estimates available). Discard mortality in directed fisheries scales with the landings based on the most recently observed rates for each fishery. The total of this section (matching the total in the summary results) provides the best projection of all sizes and sources of Pacific halibut mortality based on the specified mortality limits.

Graphics

The last section of the projection tool provides a series of five graphical results updated to reflect the inputs made by the user. These graphics are similar to those provided in the annual stock assessment and/or presentation material.

The first figure uses previously calculated three-year projections for a range of coastwide TCEY (and corresponding SPR) values to illustrate the coastwide spawning biomass trend associated with the specified inputs to the tool. Uncertainty is shown as a shaded region, with the projected period highlighted by the brighter color relative to the darker estimated time-series. Importantly, not all possible SPR values are available, so the closest value available is reported. The projected SPR is reported above the figure, and a warning will be returned if the user has specified a coastwide TCEY outside of the range of values available, or if the value lies between the pre-calculated grid.

The second figure provides a bar chart of the time-series of estimated relative fishing intensity with 95% confidence intervals. The inputs to the projection tool provide the basis for the projected fishing intensity, shown as the hatched bar at the end of the series. Values are relative to the IPHC's Interim Management procedure, currently based on an SPR of 43% (see description above), such that values above the target ('handrail' from 2016-2020) represent higher fishing intensity.

The third figure provides a graphical display of the relative harvest rates by Biological Region as reported in the ***Biological and fishery distribution*** section.

The fourth and fifth figures provided the detailed sector mortality information (allocations) in both absolute values (millions of net pounds) and relative values (percent of the projected mortality) by IPHC Regulatory Area.

DISCUSSION

There may be some alternatives (e.g., evaluations of alternative relative harvest rates by IPHC Regulatory Area) that will not be possible using this tool. Such alternatives will continue to be produced by the Secretariat staff as needed to support all meetings and decision-making.

UPDATE SCHEDULE

The existing mortality projection tool will be updated in early January 2022, in order to include the final end-of-year 2021 mortality estimates from various fisheries, for use during the 2022 Annual Meeting (AM098).

REFERENCES

Hicks, A., Carpi, P., Berukoff, S., and Stewart, I. 2020. IPHC Management Strategy Evaluation (MSE): update.

IPHC. 2019a. Report of the 95th Session of the IPHC Annual Meeting (AM095). Victoria, Canada, 28 January to 1 February 2019.

IPHC. 2019b. Report of the 95th Session of the IPHC Interim Meeting (IM095).

IPHC. 2020a. IPHC Circular 2020-007: Intersessional Decisions (1 January - 17 March 2020).

IPHC. 2020b. Report of the 96th Session of the IPHC Annual Meeting (AM096).

Pacific Fishery Management Council correspondence regarding recommendations for 2022 Pacific halibut regulations applicable to the IPHC Regulatory Area 2A

PREPARED BY: IPHC SECRETARIAT (9 DECEMBER 2021)

PURPOSE

To provide additional details on the Pacific Fishery Management Council recommendation for the 2022 non-tribal commercial directed Pacific halibut fishery, the 2022 Pacific Halibut Catch Sharing Plan for Area 2A, and Annual Fishery Regulations.

BACKGROUND

At their November 2021 meeting, the Pacific Fishery Management Council adopted a recommendation for the 2022 season structure of the non-tribal commercial directed Pacific halibut fishery. The letter transmitting the Council's recommendation for IPHC consideration at the annual IPHC meeting in January 2022 was sent to the Secretariat on 1 December 2021 (Appendix A).

The Secretariat reviewed the letter and concluded that the transmitted recommendation implies no change to IPHC Fishery Regulations (Sect. 9, pt. 4) from the previous year and thus no additional action is required.

In a separate letter dated December 1, 2021, the Pacific Fishery Management Council also informed the IPHC about the recommendations for the 2022 Pacific Halibut Catch Sharing Plan for Area 2A and Annual Fishery Regulations (Appendix B). The request for adoption of regulations consistent with these recommendations will be transmitted to National Marine Fisheries Service (NMFS).

APPENDICES

Appendix A: Letter from the Pacific Fishery Management Council dated December 1, 2021, regarding Council Recommendations for the 2022 non-Tribal Commercial Directed Halibut Fishery in Area 2A

Appendix B: Letter from the Pacific Fishery Management Council dated December 1, 2021, regarding Pacific Council Recommendations for the 2022 Pacific Halibut Catch Sharing Plan for Area 2A and Annual Fishery Regulations

APPENDIX A

LETTER FROM THE PACIFIC FISHERY MANAGEMENT COUNCIL DATED DECEMBER 1, 2021, REGARDING COUNCIL RECOMMENDATIONS FOR THE 2022 NON-TRIBAL COMMERCIAL DIRECTED HALIBUT FISHERY IN AREA 2A

Pacific Fishery Management Council

7700 NE Ambassador Place, Suite 101 Portland, OR 97220-1384
Phone 503-820-2280 | Toll free 866-806-7204 | Fax 503-820-2299 | www.pcouncil.org
Marc Gorelnik, Chair | Charles A. Tracy, Executive Director

December 1, 2021

Dr. David Wilson, Executive Director
International Pacific Halibut Commission
2320 West Commodore Way, Suite 300
Seattle, WA 98199-1278

Re: Council Recommendations for the 2022 non-Tribal Commercial Directed Halibut Fishery in Area 2A

Dear Dr. Wilson:

The Pacific Fishery Management Council (Council) adopted recommended changes for the 2022 Area 2A Pacific Halibut Catch Sharing Plan (CSP) and related annual fishery regulations at their November 2021 meeting, held via webinar. The Council's recommendations will be transmitted to the National Marine Fisheries Service (NMFS) requesting adoption of regulations consistent with the Council's recommendation. These recommendations were also provided to the International Pacific Halibut Commission (IPHC) in a separate letter.

At their November 2021 meeting, the Council also adopted a recommendation for the 2022 season structure of the non-tribal commercial directed halibut fishery. This letter transmits the Council's recommendation for IPHC consideration at the annual IPHC meeting in January 2022.

Area 2A non-tribal commercial directed halibut fishery 2022 season structure:

- A series of three-day openings, beginning at 8 a.m. on the fourth Tuesday in June and ending at 6 p.m. on the Thursday of that week. Additional three-day openings would occur every other week, Tuesday through Thursday, until the directed fishery allocation is obtained.

- Inseason management, and vessel trip limits necessary to ensure that the quota is not exceeded will be determined by the IPHC and implemented in IPHC 2022 regulations.

The season recommended for 2022 by the Council is identical in nature to the season adopted by IPHC in 2021. It is the Council's understanding that no additional action or information need be submitted by the Council, as the regulations will not change from the previous year.

Page 2

Please have your staff call upon Ms. Robin Ehlke of the Council staff if you need any further clarification or assistance in implementing the Council's proposed revisions.

Sincerely,

Marc Gorelnik
Chairman

RDE:rdd

Cc: Mr. Marc Gorelnik
Mr. Chuck Tracy
Mr. Merrick Burden
Mr. Barry Thom
Mr. Ryan Wulff
Mr. Frank Lockhart
Mr. Josh Lindsay
Ms. Kathryn Blair
Mr. Phil Anderson
Ms. Maggie Sommer
Ms. Robin Ehlke

APPENDIX B

LETTER FROM THE PACIFIC FISHERY MANAGEMENT COUNCIL DATED DECEMBER 1, 2021, REGARDING PACIFIC COUNCIL RECOMMENDATIONS FOR THE 2022 PACIFIC HALIBUT CATCH SHARING PLAN FOR AREA 2A AND ANNUAL FISHERY REGULATIONS

Pacific Fishery Management Council

7700 NE Ambassador Place, Suite 101 Portland, OR 97220-1384
Phone 503-820-2280 | Toll free 866-806-7204 | Fax 503-820-2299 | www.pcouncil.org
Marc Gorelnik, Chair | Charles A. Tracy, Executive Director

December 1, 2021

Dr. David Wilson, Executive Director
International Pacific Halibut Commission
2320 West Commodore Way, Suite 300
Seattle, WA 98199-1278

Re: Pacific Council Recommendations for the 2022 Pacific Halibut Catch Sharing Plan for Area 2A and Annual Fishery Regulations

Dear Dr. Wilson:

The Pacific Fishery Management Council (Council or Pacific Council) adopted recommended changes to the Area 2A Pacific Halibut Catch Sharing Plan (CSP) and annual fishery regulations for 2022 at their November 2021 meeting. The Council's recommendations will be transmitted to National Marine Fisheries Service (NMFS) requesting adoption of regulations consistent with the Council's recommendation.

The Council recommendations for the 2022 CSP and associated regulations are described below. These recommendations are consistent with recommendations provided to the Council by the Washington Department of Fish and Wildlife (WDFW) and the Oregon Department of Fish and Wildlife (ODFW). California Department of Fish and Wildlife (CDFW) did not provide any recommendations for Council consideration.

- WDFW: Revise the CSP language to 1) describe the management objectives for the Washington sport fishery and the need for flexible inseason management to maximize fishing opportunity and achieve the Washington sport allocation; 2) allow opening the Puget Sound subarea (Marine Areas 5 – 10) up to five days per week during August and September, and 3) allow opening the Coastal subareas (Marine Areas 1 – 4) up to five days per week during August and September. The WDFW report to the Council described justification for the recommended changes and included a series of proposed dates for the 2022 season.

- ODFW: Revise the CSP language to state that 1) if the Central Oregon Coast Subarea Spring All-Depth allocation is greater than 100,000 pounds, the season may open up to seven days per week starting the second Thursday in May through June 30; then open every Thursday through Saturday, except weeks can be skipped to avoid adverse tides. 2.) if after the first summer all-depth opening (first Thurs-Sat in August), it is estimated that there will be 60,000 pounds or more remaining on the Central Oregon Coast combined nearshore and all-depth quotas remaining, the all-depth fishery may open up to seven days per week beginning September 1, and 3) at the conclusion of the spring all-depth season, the International Pacific Halibut Commission (IPHC), NMFS, Council, and ODFW will consult to determine whether increasing the bag limit to two fish is warranted with the intent of taking the subarea quota by September 30. Additionally, if Central Oregon Coast Subarea bag limit is increased to two halibut, then the Southern Oregon subarea will increase to two halibut at the same time. The ODFW report to the Council described justification for the recommended changes for the 2022 season.

The Council provided their recommendation regarding the 2022 season structure for the Area 2A non-Indian commercial directed halibut fishery in a separate letter. Please consider the recommendation at your annual meeting in 2022 when you determine the season structure and vessel trip limits necessary to ensure that the quota is not exceeded.

Thank you for continuing to assist the Council and NMFS in managing the Area 2A fisheries and implementing IPHC regulations for 2022. Please have your staff call upon Ms. Robin Ehlke of the Council staff if you need any further clarification or assistance in implementing the Council's proposed revisions.

Sincerely,

Mr. Marc Gorelnik
Council Chairman

RDE:rdd

Cc: Mr. Phil Anderson
Ms. Kathryn Blair
Mr. Merrick Burden
Ms. Robin Ehlke
Ms. Heather Hall
Mr. Marc Gorelnik
Mr. Josh Lindsey
Mr. Frank Lockhart
Mr. Brad Pettinger
Ms. Maggie Sommer
Mr. Barry Thom
Mr. Chuck Tracy
Mr. Brett Wiedoff
Mr. Ryan Wulff
Ms. Marci Yaremko

INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2022-AM098-INF04 Rev_1

PACIFIC HALIBUT MULTIREGIONAL ECONOMIC IMPACT ASSESSMENT (PHMEIA) – PROJECT REPORT

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK; 23 DECEMBER 2021 & 20 JANUARY 2022)

PURPOSE

Under the Convention, the IPHC's mandate is *optimum* management of the Pacific halibut resource, which necessarily includes an economic dimension. Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA) is a core product of the IPHC socioeconomic study that directly responds to the Commission's "desire for more comprehensive economic information to support the overall management of the Pacific halibut resource in fulfilment of its mandate" (economic study terms of reference adopted at FAC095 (IPHC-2019-FAC095) and endorsed at AM095 in 2019).

ABSTRACT

The economic effects of changes to harvest levels can be far-reaching. Fisheries management policies that alter catch limits have a direct impact on commercial harvesters, but at the same time, there is a ripple effect through the economy. Fisheries operations create demand for inputs from other sectors, while at the same time support industries further along the value chain that rely on the supply of fish, such as seafood processors. Recreational fishing is key to a broad set of local businesses' prosperity and creates employment opportunities supporting local households. Policies or any other exogenous changes may also have an economic impact not only on the region where they are observed but also on the regions with strong economic ties with the region subjected to the change.

Pacific halibut multiregional economic impact assessment (PHMEIA) model is a multiregional social accounting matrix-based model describing economic interdependencies between sectors and regions developed to bring a better understanding of the role and importance of Pacific halibut resource in a regions' economies. The model describes the within-region production structure of the Pacific halibut sectors (fishing, processing, charter) and accounts for economic activity generated through sectors that supply fishing vessels, processing plants, and charter businesses with inputs to production, by embedding Pacific halibut sectors into the model of the entire economy of Canada and the United States. In addition, the PHMEIA model traces the flow of earnings from the harvest stage to the beneficial owners of the resource, accounting for cross-regional income spillovers, which represent economic stimulus in the regions other than the one in which the harvest occurs.

The results suggest that the revenue generated by Pacific halibut at the harvest stage accounts for only a fraction of economic activity that would be forgone if the resource was not available to fishers in the Pacific Northwest. On average, in 2019, one USD/CAD of Pacific halibut commercial landings was linked to over four USD/CAD-worth economic activity in Canada and the United States and contributed USD/CAD 1.3 to households. This adds up to USD 551 mil. (CAD 731 mil) of economic impact in terms of output and USD 179 mil (CAD 238 mil) impact on households. The charter sector contribution to economic activity is estimated at USD/CAD 3.4 per one USD/CAD spent on party/charter fishing services, adding up to USD 133 mil (CAD 177 mil) economic impact in terms of output. However, when the economic impact of marine angler expenditures on fishing trips and durable goods is added, the Pacific halibut recreational fishing total contribution stands at USD 463 mil. (CAD 615 mil.)

and contribution to households at USD 147 mil. (CAD 195 mil.). The total economic activity linked to Pacific halibut sectors in 2019 is estimated at USD 1,014 mil. (CAD 1,346 mil), and contribution to households at USD 326 mil. (CAD 432 mil.). These estimates represent what is considered a more typical year in the economy. Pacific halibut commercial sector contribution to households' income in 2020 dropped by a quarter, highlighting the devastating impact of the covid-19 pandemic.

INTRODUCTION

While previous studies examined aspects of socioeconomic impacts of the Pacific halibut fisheries and there is a regular reporting of fisheries-related economic data by agencies of both Canada and the United States of America, the total picture of the economic impact of the Pacific halibut fisheries is incomplete. Pacific halibut-dependent sectors have not been examined in a comprehensive way and most of the economic data is limited to ex-vessel or wholesale value. In addition, the value of the community, social, and cultural impacts of the fishery have generally not been assessed. As a result, the resource managers and policy makers are unable to meaningfully compare the economic and social impact of the different sectors of the Pacific halibut fishery to each other, to other fisheries, to other communities, or to other industries. Additionally, achievement of optimum yield (understood as yield balancing biological and socioeconomic objectives) has not been quantified or assessed.

The goal of the IPHC socioeconomic study is to provide stakeholders with an accurate and all-sectors-encompassing assessment of the socioeconomic impact of the Pacific halibut resource that includes the full scope of Pacific halibut's contribution to regional economies of Canada and the United States of America. To that end, the IPHC developed the Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA)[1] model that informs stakeholders on the importance of the Pacific halibut resource and fisheries to their respective communities, but also broader regions and nations, and contributes to a wholesome approach to Pacific halibut management that is optimal from both biological and socioeconomic perspective, as mandated by the Convention.

The economic effects of changes to harvest levels can be far-reaching. Fisheries management policies that alter catch limits have a direct impact on commercial harvesters, but at the same time, there is a ripple effect through the economy. Industries that supply commercial fishing vessels with inputs, generally referred to as *backward-linked* sectors, rely on this demand when making decisions related to their production levels and expenditure patterns. For example, vessels making more fishing trips purchase more fuel and leave more money in a local grocery store that supplies crew members' provisions. More vessel activity means more business to vessel repair and maintenance sector or gear suppliers. An increase in landings also brings more employment opportunities, and, as a result, more income from wages is in circulation. When spending their incomes, local households support local economic activity that is indispensable to coastal communities' prosperity.

[1] While this type of assessment is typically termed "economic impact assessment," calculated alongside the impact in terms of output also the impact on employment and wages, and households' prosperity, introduce a broader socioeconomic context.

Changes in the domestic fisheries output, unless fully substituted by imports, are also associated with production adjustments by industries relying on the supply of fish, such as seafood processors. These changes also affect suppliers to the *forward-linked sectors*, creating an additional ripple effect.

Economic impacts are also attributed to recreational fishing activities. By running their businesses, charter operators create demand for fuel, bait fish, boat equipment, and fishing trip provisions. They also create employment opportunities and generate incomes that, when spent locally, support various local businesses. Pacific halibut supports various angling-dependent services, for example, hospitality services in the case of fly-in lodges that specialize in serving customers interested in Pacific halibut fishing.

What is more, anglers themselves contribute to the economy by creating demand for goods and services related to their fishing trips. This includes expenses related to the travel that would otherwise not be incurred (e.g., auto rental, fuel cost, lodging, food, site access fees), as well as money spent on durable goods that are associated with recreational fishing activity, e.g., rods, tackle, outdoor gear, boat purchase, and applies to both guided and unguided recreational fishing.

These types of economic impacts are typically estimated with the use of an input-output (IO) model. The traditional IO model is used to investigate how changes in final demand affect economic variables such as output, income and employment or contribution to the region's gross domestic product (GDP). This is known as impact analysis. With an adjustment for the shock type, the model can also demonstrate the magnitude of changes in supply-constrained industries such as total allowable catch (TAC) constrained fisheries. Adopting a multiregional approach, the model accommodates the cross-regional trade. The IO model can also be extended to the so-called social accounting matrix (SAM). Adopting SAM, the calculated effects account for labor commuting patterns and residency of beneficial owners of production factors, and as a result, the flow of earnings between regions.

The PHMEIA is a multiregional SAM-based model describing economic interdependencies between sectors and regions developed to assess three **economic impact (EI)** components pertaining to Pacific halibut. The **direct EIs** reflect the changes realized by the direct Pacific halibut resource stock users (fishers, charter business owners), as well as the forward-linked Pacific halibut processing sector (i.e., EI related to downstream economic activities). The **indirect EIs** are the result of business-to-business transactions indirectly caused by the direct EIs. The indirect EIs provide an estimate of the changes related to expenditures on goods and services used in the production process of the directly impacted industries. In the context of the PHMEIA, this includes an impact on upstream economic activities associated with supplying intermediate inputs to the direct users of the Pacific halibut resource stock, for example, impact on the vessel repair and maintenance sector or gear suppliers. Finally, the **induced EIs** result from increased personal income caused by the direct and indirect effects. In the context of the PHMEIA, this includes economic activity generated by households spending earnings that rely on the Pacific halibut resource, both directly and indirectly.

To accommodate an increasing economic interdependence of regions and nations, the model accounts for cross-regional spillovers. These represent economic stimulus in regions other than the one in which the exogenous change, for example, management intervention, is considered. Economic benefits from the primary area of the resource extraction are leaked when inputs are imported, when wages earned by nonresidents are spent outside the place of employment, or when earnings from quota holdings flow to nonresident beneficial owners. At the same time, there is an inflow of economic benefits to the local economies from when products are exported, or services are offered to non-residents. PHMEIA offers the first consistent estimation of both backward-linked (related to inputs) and forward-linked (input-dependent) effects of changes to the fisheries sectors in a multiregional setup tracing the transmission of economic impacts internationally. By linking multiple spatial components, the model offers a better understanding of the impacts of shared stock supply changes (see **Figure 1** for the map of the IPHC Convention area).

Besides providing economic impact estimates for broadly-defined regions,[2] the PHMEIA model details the geography of impacts in Alaska and highlights areas particularly dependent on Pacific halibut fishing-related economic activities, addressing the Commission's interest in community impacts. A good understanding of localized effects is pivotal to policymakers who are often concerned about community impacts, particularly in terms of impact on employment opportunities and households' welfare. Fisheries policies have a long history of disproportionally hurting smaller coastal communities, often because potential adverse effects were not sufficiently assessed.

What is more, the economic impact assessment is supplemented by an analysis of the formation of the price paid for Pacific halibut products by final consumers (end-users) that is intended to provide a better picture of Pacific halibut contribution to the GDP along the entire value chain, ***from the hook-to-plate***. This supplemental material is available in IPHC-2021-ECON06. Moreover, the IPHC is working with the National Oceanic and Atmospheric Administration (NOAA) Alaska Fisheries Science Center on the Pacific halibut portion of the update of the report *Wholesale Market Profiles for Alaska Groundfish and Crab Fisheries* (AFSC, 2019).

[2] Full economic impact assessment based on the SAM methodology is conducted for six regions: (1) Alaska, (2) British Columbia, (3) the US West Coast (CA, OR, WA), (4) the rest of the USA, (5) the rest of Canada, and (6) the rest of the world. The results, however, treat transactions with the rest of the world as exogenous.

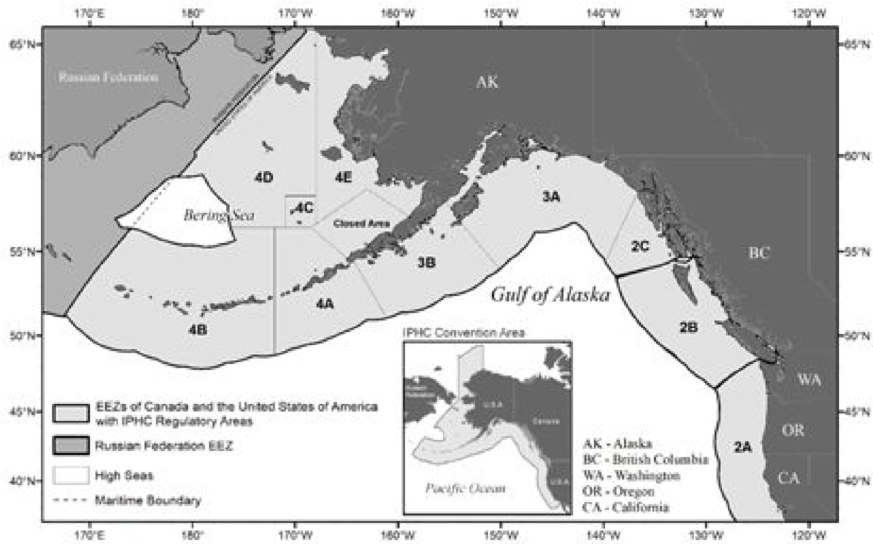


Figure 1: Map of the IPHC Convention area.

MOTIVATION

Under the Convention, the IPHC's mandate is optimum management of the Pacific halibut resource, which necessarily includes a socioeconomic dimension. The study brings the human dimension to the IPHC's research framework and portfolio of tools for assessing policy-oriented issues, providing for an essential input to optimum management of Pacific halibut that is aligned with socioeconomic objectives prevalent in the legislation of Canada and the USA.

Federal laws governing US marine fisheries require assessing any proposed fishery management action in terms of its regional or community economic impacts. These laws include, among others, the Magnuson-Stevens Fishery Conservation and Management Act (MSA, amended on January 12, 2007), National Environmental Policy Act (NEPA), and Executive Order 12866. For example, the National Standard 8, one of the principles mandated by the MSA, requires that while the conservation and management measures must be consistent with the conservation requirements, they must also account for "*the importance of fishery resources to fishing communities*" and "*to the extent practicable, minimize adverse economic impacts on such communities*" (Section 301[a]8). It implies that fishery managers, when considering any action, must take into account the economic impact on various stakeholder groups, including fishers, but also processors and fishing-dependent communities. The MSA also establishes Regional Fishery Management Councils, which role is to develop fisheries management plans that "*take into account the social and economic needs of the States*" while working on the stewardship of fishery resources. Lately, NOAA recommended routine consideration of socioeconomic drivers in the fisheries stock assessment process (Next Generation Stock Assessment framework, NOAA 2018).

The document establishing national fisheries policy in Canada for the modern era is the 1976 Policy for Canada's Commercial Fisheries. It states that "*the guiding principle in fishery management no longer would be maximization of the crop sustainable over time but the best use of society's resources.*" The "*best use"* is defined as "*the sum of net social benefits (personal income, occupational opportunity, consumer satisfaction and so on) derived from the fisheries and the industries linked to them*" (Fisheries Act, R.S.C. 1985, c. F-14). These objectives have been affirmed in legislation (Oceans Act, S.C. 1996, c.31), according to which fisheries are expected to be managed to meet a full spectrum of social and economic objectives. More recently, the commitment to the sustainability of fisheries – "*as a vital part of our* [Canada's] *food supply, as well as an important source of jobs and economic activity for coastal communities*" – has been reaffirmed in the Government Response to the report *West Coast Fisheries: Sharing Risks and Benefits* by the Standing Committee on Fisheries and Oceans (House of Commons Canada, 2019).

LITERATURE

There is a few decades' worth of experience in developing economic impact assessment models with applications to fisheries. Seung and Waters (2006) provide an excellent overview of IO studies available up to 2006, starting with papers published as early as 1967 (Rorholm *et al.*, 1967). The majority of these studies consider a single region with one exception. Butcher et al. (1981) offer an early example of multiregional analysis applied to the Alaska shellfish fishery. An early example of a supply-driven model for fisheries is available in Leung and Pooley (2002), who use the IO modeling technique to assess the impact of the reduction in fishing areas adopted in order to protect certain turtle populations. The majority of earlier models are using the demand-driven approach.

More recent models offer ever more complex mathematical depictions of the economy comprised of hundreds of interlinked sectors that are built with the purpose of assessing the economic effects of fishery management policies that alter seafood sectors. The majority of these models, developed for various regions of the United States, rely on adaptations to the widely distributed commercial regional input-output modeling system known as IMPLAN (IMPLAN Group LLC. IMPLAN 2020. Huntersville, NC. IMPLAN.com.). Currently, IMPLAN data contains 546 sectors representing all private industries in the United States classified based on the U.S. Census Bureau's North American Industry Classification System (NAICS). It includes three sectors that are directly related to the seafood supply chain: commercial fishing (sector 17), seafood product preparation and packaging (sector 92), and wholesale - grocery and related product wholesalers (sector 398). IMPLAN is a widely-used tool for academic and professional economists for the estimation of economic impact in a variety of sectors.

One of the earlier examples of IMPLAN adaptations to fisheries is the Northeast Region Commercial Fishing Input-Output Model (Steinback and Thunberg, 2006). The model covers 24 regions in the Northeast and focuses on refining fishing-related sectors by disaggregating them into more detailed subsectors. The modifications include splitting the commercial fishing sector based on gear type and vessel size class, detaching seafood wholesalers from a more general wholesale category, and adding seafood dealer sectors for each coastal region. Given the high spatial granularity, the model makes a number of simplifying assumptions on the industries' structure. Harvesters are assumed to sell all of their output to wholesale dealers via direct sales or through fish exchanges/auctions. Wholesale dealers are assumed to sell their output to final consumers, intermediate demand industries (including seafood processors), and businesses located outside of the Northeast region (export). Seafood dealer sectors and fish exchanges/auctions are treated as margin sectors. This means the value of their sales excludes the cost of the sold goods, i.e., the sales include only the value added to the sold product, and impacts that may accrue beyond the processor level are not incorporated. The model is only partially multiregional as it accounts for the interconnections only between the fishing-related businesses (commercial harvesters, wholesale seafood dealers, bait suppliers, and seafood processors). The non-fishing effects are estimated jointly and appropriated to regions according to their relative importance to the total Northeast economy. Due to its extensive data requirements, this model was difficult to keep up-to-date and is not maintained anymore (Steinback, personal communication).

The US-wide application of the IO modeling technique to commercial fishing and seafood industry is a model developed for the National Marine Fisheries Service (NMFS) by Kirkley (2009). Economic impacts are expressed in terms of employment (full-time and part-time jobs), personal income, and output (sales by US businesses), separately for 18 categories of species of fish defined by the model, as well as for seafood processors, wholesalers/distributors, grocers, and restaurants. Geographically, the model estimates impacts for the US as a whole and for 23 coastal states. At the state level, estimates for each sector are based on fishery products harvested in that state or imported to that state from a foreign source. The model serves as a base for producing annual fisheries impacts estimates for the Fisheries Economics in the United States report, published since 2006 and available here. The latest report is available for 2018 (NOAA, 2021b).

IMPLAN customization for the US Pacific Coast has been developed by Leonard and Watson (2011), largely following the approach by Steinback and Thunberg (2006). The model distinguishes 19 vessel categories that produce 32 unique species and gear commodity outputs. These include three groundfish sectors (large groundfish trawlers, small groundfish trawlers, other groundfish fixed gear) that harvest Pacific halibut. Data used to build the custom fishing sectors were obtained from Pacific Fisheries Information Network (PacFIN) fish ticket data maintained by the Pacific States Marine Fisheries Commission (PSMFC), the Northwest Fisheries Science Center's (NWFSC) cost earnings surveys, moorage rates from ports along the West Coast, and collection statistics for the Washington Enhanced Food Fish Tax used to estimate the flow of fish landings to wholesalers. Default IMPLAN 2006 data were used for the regional non-fishing economy, as well as the various institutions in the region such as households and the government.

Periodically, NOAA also provides an assessment of the economic contribution of marine angler expenditures in the United States (Steinback and Gentner, 2008; Lovell, Steinback and Hilger, 2013; Lovell *et al.*, 2016). The latest estimates (based on data from 2014), limited to the contribution of expenditures on durable goods (excluding trip cost, covered in the report from 2013), suggest that at the national level, marine anglers spent USD 28 billion on fishing equipment and durable goods (e.g., fishing rods, tackle, boats). These expenditures are assessed to generate an estimated USD 49.6 billion in total output, added USD 29 billion in contribution to GDP, contributed USD 18 billion to personal income, and supported more than 358,000 jobs across the United States. No estimates specific to subsectors defined based on target species are available.

BC Stats (Sun and Hallin, 2018) provide estimates of direct, indirect, and induced effects arising from the economic activities of industries within the fisheries sector in British Columbia, including capture fisheries, seafood processing, and sport fishing. The assessment is based on the British Columbia input-output model built using information from the 2014 IO tables for the province available from Statistics Canada (Statistics Canada, 2019). The results suggest that for every dollar of output in capture fishery, aquaculture, and fish and seafood processing combined, an additional CAD 0.386 is generated in the province by industries supplying goods and services used by commercial fishing, aquaculture, fish processing, and sport fishing industries. This model, however, does not provide Pacific-halibut specific estimates and analyses economic impact only within the region of the resource extraction, omitting impacts outside British Columbia.

The fisheries sector is often fixed on the supply side as fisheries policies usually target output by setting TAC limits. Supply-driven approach applications have been applied in a variety of settings, for example, to study backward and forward linkage effects of Alaska fisheries (Seung and Waters, 2009) or to assess the economic impacts of restricting catch of Pacific cod and Atka mackerel in the Aleutian Islands in order to protect Steller sea lions (Seung and Waters, 2013), Chinook salmon fishery failures (Seung, 2017) and catch limits on Alaska pollock fishery (Seung, 2014).

The most advanced multiregional economic analysis focused on fisheries, applied at borough level to the seafood industry in Alaska, is a social accounting matrix developed at the NOAA Alaska Fisheries Science Center (AFSC) by Seung, Waters, and Taylor (2019). The model allows for analysis of the impacts on individual fishing-dependent communities (at the borough level) rather than broad administrative areas (e.g., the entire state), serving as a useful tool to fishery managers interested in more localized impacts of exogenous shocks, either natural or policy-induced. The model uses the results of a detailed survey of fish harvesting vessel owners and interviews with key seafood business stakeholders from six boroughs and census areas in the Southwest Alaska region. The survey, designed specifically to account for cross-regional effects, collected information on the geographic distribution of expenditures. A detailed survey description is available in Waters, Baker, and Taylor (2016). An earlier, three-region version of this model (Alaska, West Coast, and rest of USA) has been used for several economic impact assessments in the pacific northwest, including Alaska head and gut (H&G) fishing fleet (Waters *et al.*, 2014). The full description of this model, accompanied by a manual to a web-based application for custom estimates, is available in Seung and Miller (2018).

No models focused on fisheries connecting the economies of the United States and Canada were identified. Although (Gislason *et al.*, 2017) analyze the impact of Pacific Salmon fisheries on the economy of both countries using the IO approach, their models are disconnected and do not offer the consistency of an integrated multiregional model.

The IO approach can also be used to assess the impact of the reduced number of recreational fishing trips. A multiregional computable general equilibrium (CGE) model developed by Seung and Lew (2017) assesses the economic impact of restrictions imposed on saltwater sport fishing in Alaska, considering a variety of limit changes to Pacific halibut, chinook salmon, and coho salmon. The findings suggest that although adverse economic impacts of reduced bag limits on Alaska can be to some degree compensated for by increases in economic activities in the other regions or other sectors, the cost of one fewer Pacific halibut allowance can still decrease the economic activity in Alaska by USD 4.7-9.0 mil. The model uses fishing participation changes arising due to changes in the limits predicted from a stated-preference model.

METHODS

Input-output framework

Traditional Leontief (Leontief, 1966) single-region IO model, a Nobel prize (1973) worth advance in understanding economic impact in a system consisting of multiple interlinked industries, can be described by:

$$\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}, \qquad [\ 1\ ]$$

where $\mathbf{X}$ is the total industry output (production) vector, $\mathbf{A}$ is the matrix of technical coefficients, and $\mathbf{f}$ is the vector of total industry final demands. $(\mathbf{I} - \mathbf{A})^{-1}$ is collectively known as Leontief inverse or total requirements matrix. This model requires data input in the form of $n \times n$ transaction matrix $\mathbf{Z} = |z_{ij}|$, as $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-1}$. Here, z_{ij} represent sector j's demand for input from sector i. For each industry, the sum of its intermediate inputs ($\mathbf{Z}$ column) and value added components should equal the sum of intermediate outputs ($\mathbf{Z}$ row) and final demand components. The value added components typically include labor income (employee compensation, including salaries and wages, and social contributions) and proprietors' income (income from self-employment), taxes and subsidies on production and imports, and other property income (return on capital). Taxes and subsidies on products are not considered value added components. Final demand categories typically include final consumption by households and government, and net export.

The IO models are used to investigate how changes in final demand affect economic variables such as output, income[3] and employment or value added that provides an assessment of the sector's contribution to the GDP in a region (Lovell *et al.*, 2016). This is known as impact analysis.

In order to account for the fact that industry may produce more than one commodity (i.e., secondary products), economic impact assessment models typically adopt a commodity-by-industry approach. In this case, $\mathbf{Z}$ is replaced by *Use matrix*, $\mathbf{U} = |u_{ij}|$, where u_{ij} is the value of the purchase of commodity i by industry j, that is presented in conjunction with the transpose of supply matrix, *Make matrix*, $\mathbf{V} = |v_{ij}|$, where v_{ij} is the value of the output of commodity j that is produced by industry j. These two matrices allow to build an analogous industry-based technology single region IO model:

$$\mathbf{q} = (\mathbf{I} - \mathbf{BD})^{-1}\mathbf{e}. \qquad [\ 2\ ]$$

Here, $\mathbf{q}$ is the vector of total commodity output, $\mathbf{e}$ is the vector of total commodity demand, and $\mathbf{BD}$ is equivalent to $\mathbf{A}$ in the original Leontief model, with $\mathbf{B}$ defined as $\mathbf{B} = \mathbf{U}\hat{\mathbf{x}}^{-1}$, where column j represents the value of inputs of each commodity per dollar's worth of industry j's output, and $\mathbf{D}$ defined as $\mathbf{D} = \mathbf{V}\hat{\mathbf{q}}^{-1}$, where each element d_{ij} in $\mathbf{D}$ denote the fraction of total commodity j output produced by industry i. Derived from *Make* and *Use matrices* $(\mathbf{I} - \mathbf{BD})^{-1}$ is the commodity-by-commodity total requirements matrix. The total requirement matrix can be used to assess the effects of exogenous changes on the final demand for each commodity specified by the model.

[3] This can include both personal income (wages and salaries) and proprietors' income (income from self-employment).

Alternatively, one may want to build a commodity-based single-region IO model (Miller and Blair, 2009). Research on which method is more economically-sound remains ongoing. Choosing the industry-based model is dictated by proven consistency with Leontief demand-driven model (De Mesnard, 2004; Jackson and Schwarm, 2007).

Linking multiple regions

Policies or any other exogenous changes may have an economic impact not only on the region where they are observed but also on the regions with strong economic ties with the region subjected to the change. A multiregional IO model accounts for that.

Linking multiple spatial components is done by the mean of trade coefficients matrix $\mathbf{C}$. In the multiregional version of the model, the vector of gross outputs by sector and region is given by:

$$\mathbf{q} = (\mathbf{I} - \mathbf{CBD})^{-\mathbf{1}}\mathbf{Ce}. \qquad [\ 3\ ]$$

Here, the matrix of technical coefficients ($\mathbf{BD}$) is combining technical coefficients for each region considered in the model. In a two-region (r, s) example, this matrix takes the form:

$$\mathbf{BD} = \begin{bmatrix} \mathbf{BD}^r & 0 \\ 0 & \mathbf{BD}^s \end{bmatrix}, \qquad [\ 4\ ]$$

where $\mathbf{BD}^r$ is the matrix of technical coefficients for region r and $\mathbf{BD}^s$ is the matrix of technical coefficients for region s. The two-region $\mathbf{C}$ matrix takes then the form:

$$\mathbf{C} = \begin{bmatrix} \hat{\mathbf{c}}^{rr} & \hat{\mathbf{c}}^{rs} \\ \hat{\mathbf{c}}^{sr} & \hat{\mathbf{c}}^{ss} \end{bmatrix}, \qquad [\ 5\ ]$$

where $\hat{\mathbf{c}}^{rr}$ and $\hat{\mathbf{c}}^{ss}$ are intraregional trade coefficients matrices of region r and s, and $\hat{\mathbf{c}}^{rs}$ and $\hat{\mathbf{c}}^{sr}$ are interregional trade coefficients matrices derived from transaction matrices. $\hat{\mathbf{c}}^{rs}$ ($\hat{\mathbf{c}}^{rs}$) describe the flow of commodities from region r (s) to region s (r), or how much of good or services used in s (r) comes from region r (s). The trade coefficients indicate the shares of domestic vs. imported input to the domestic production process. This widely used specification (e.g., Bachmann, Roorda, and Kennedy 2015) implies the same pattern of inputs use between domestically produced and imported commodities. This simplification implies that the possibility of different use patterns for domestic vs. imported commodities is not considered.

Economic impact multipliers

Output multiplier for sector j is defined as the total value of production in all sectors of the economy necessary to satisfy a dollar's worth of final demand for sector j's output (Miller and Blair 2009, pp. 245). Simple multipliers are obtained by summing the columns of the $(\mathbf{I} - \mathbf{CBD})^{-1}$ matrix. Formally, defining elements of this matrix as l_{ij}, the output multiplier is given by:

$$m(o)_j = \sum_{i=1}^{n} l_{ij}. \qquad [\ 6\ ]$$

This sum reflects direct and indirect effects. Direct effects for sector j are captured by l_{jj}.[4]

The same matrices can be used to explore the impact of changes in final demand on jobs created or wages earned. Labor input coefficients (γ_i) - either monetary, in the form of wages per unit of output or physical, in the form of, for example, number of jobs per unit of output - are multiplied by l_{ij} coefficients that relate final demand in sector j to output in sector i:

$$m(l)_j = \sum_{i=1}^{n} \gamma_i l_{ij}. \quad [\,7\,]$$

Employment can be specified on the basis of full-time and part-time jobs, or full-time equivalents. There is significant part-time and seasonal employment in commercial and recreational fishing and many other industries. Employment is an important metric when considering community impacts. The impact on value added that reflects changes in sectors' contribution to the GDP is calculated the same way. The same approach can also be applied to various other variables, for example, CO_2 emissions.

It is also worth noting that multipliers based on single-region models may overstate the effects when the industry is operating at or near its capacity, and some of the additional inputs may need to be imported or shifted from exports. This, however, is addressed by using multiregional analysis, where such effects are accounted for (Miller and Blair 2009, pp. 246).

Worth noting is also that standard economic multipliers do not capture intangible benefits of the fish as a resource, for example, ecosystem services or cultural value. However, the non-market values can be consistently incorporated into the IO model (Carbone and Smith, 2013). Such an avenue can be explored, but it is not considered at this stage.

Supply-driven approach

The standard input-output approach uses output multipliers to describe the economy-wide backward linked output effects associated with exogenously specified changes in final demand for commodities ($\mathbf{e}$). Demand-side shocks include changes in consumer demand, investment patterns, exports, government spending, or exogenous changes to taxes that affect demand. However, in the case of fisheries that are rather fixed on the supply side as it is the output that is usually targeted by fisheries policies, a supply-driven approach is more appropriate for assessing the economic impact (Leung and Pooley 2002; Steinback and Thunberg 2006; Seung and Miller 2018).

The modified IO approach based on the method developed by Tanjuakio, Hastings, and Tytus (1996) is used to demonstrate the magnitude of changes in supply-constrained industries. Accordingly, the impact assessment is conducted using a modified total requirements matrix. The process of "*extracting*" the sector is done by setting regional purchase coefficients (elements of $\mathbf{CBD}$, denoted here by α_{ij}) for exogenized sectors to zero, which implies the elimination of these sectors as suppliers of inter-industrial inputs. Then, the changes in output are modeled as if they originated from the final demand.

[4] Calculation of induced effects requires adopting a matrix that is closed with respect to households or a fully articulated SAM matrix. See Social accounting matrix subsection below for details on the calculation of induced effects using PHMEIA.

Forward linkages

In the input-output framework, changes to the production by a particular sector have two kinds of effects on other industries. Backward linkages refer to the changes to the goods and services that serve as inputs to the affected sector, defining relations with so-called *upstream* sectors. For the fisheries sector, these include, for example, impacts on the vessel building sector or supply stores equipping vessels for their fishing trips. These effects are captured by the equation [3].

Changes in the domestic fisheries output, unless fully substituted by imports, are also associated with production adjustments by industries relying on the supply of fish, such as seafood processors. Forward linkages describe the effects on the industries for which the affected sector is a supplier, defining its relations with the *downstream* industries. While these forward linkages are not typically included in the calculation of economic impacts, mainly because early attempts (e.g., Cai et al. 2005) using Ghosh approach have been criticized for the lack of economic foundation (Oosterhaven, 1988, 1989), application of the method described in Seung (2014, 2017) allows for such extension. The proposed method implies exogenous specification of changes in the forward linked industries (here, seafood processors) and setting regional purchase coefficients associated with these industries to zero, the same way as done for the directly impacted industry (as described in section Supply-driven approach). This way, the model does not calculate the effects on downstream industries endogenously because fish processing industries are restricted in terms of the amount of raw fish input. The advantage of this method is that the calculated effects are additive so that the total effects can be consistently derived as a sum of backward and forward linkages. However, to avoid double-counting the value of landings, the direct economic impact of the processing sector is adjusted for just wholesale margins. This means the value of sales by processors excludes the cost of raw fish input, i.e., the sales include only the value added to the sold products.

While the complete path of commercially landed fish includes, besides harvesters and processors, also seafood wholesalers and retailers, and services when it is served in restaurants, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts beyond wholesale in PHMEIA, as opposed to assessing the snapshot contribution to the GDP along its entire value chain, would be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail or services level gross revenues (Steinback and Thunberg, 2006). Supplementary snapshot assessment of Pacific halibut contribution to the GDP along the entire value chain, **from the *hook-to-plate***, accounting for the trade balance, is available in IPHC-2021-ECON-06.

Social accounting matrix

The standard IO model depends on the existence of exogenous sectors that are disconnected from the technologically interrelated productive structure and generate final demands for outputs. This includes purchases by households, sales to the government, gross private domestic investment, or export. The input-output framework provides also little insight into the demographics of the workforce that builds the market for supply and demand of labor. All this can be accommodated in the SAM-based model. PHMEIA considers households as an endogenous sector that earns income in return for their labor inputs to production processes and spends that income in a structured fashion (Picek and Schröder, 2018) and accounts for commuting patterns where the labor's place of employment and place of residence differ. It is of particular importance when focusing on industries that employ a considerable share of non-residents for temporary assignments that imply a negative net flow of income to the region and, consequently, impacts on households are not necessarily equal to impacts on earnings in the region. The SAM approach is also used to trace the flow of profits related to non-resident investment in production factors. This accommodates the returns to quotas and permits that should be allocated according to the residency of their beneficial owners rather than their users.

The SAM-based model with endogenous households also allows for a detailed accounting of household income by place of residence, including earnings from other sources (e.g., government transfers, dividends, interest, and rent), outflows to the government (e.g., personal income taxes), and households net savings by region.

The SAM model can be expressed as follows:

$$\mathbf{x}^{\mathrm{SAM}} = (\mathbf{I} - \mathbf{S})^{-1}\mathbf{f}^{\mathrm{SAM}}, \qquad [\,8\,]$$

where $\mathbf{x}^{\mathbf{SAM}}$ is a total production vector, $\mathbf{f}^{\mathbf{SAM}}$ is a vector of SAM exogenous accounts, $\mathbf{S}$ is a matrix of direct SAM coefficients ($\mathbf{S} = (\mathbf{SAM})\widehat{\mathbf{x}^{\mathrm{SAM}}}^{-1}$) and $(\mathbf{I} - \mathbf{S})^{-1}$ is SAM total requirements matrix. SAM total requirements matrix can be used to derive multipliers used in calculation of economic impact metrics.

The PHMEIA model components largely align with these considered in Seung (2014). The SAM-derived total requirement matrix captures induced effects that account for commuting patterns and the flow of investment earnings. The general structure of the adopted SAM matrix is available in Appendix A. The SAM framework also allows for endogenizing additional sectors, for example, government expenditures or savings and investment. This extension of the modeling framework is not considered at this stage.[5]

Adapting SAM to project needs

SAM matrix is typically built from supply and use tables (SUTs). SUTs lay out a detailed picture of the entire economy, providing an overview of the production process and use of commodities, and typically produced by the governmental agencies at the national level to derive components related to the calculation of the GDP.

The national SUTs, however, do not capture the heterogeneity of regions within a single country. This deficiency is problematic as the differences between regions and subnational interdependencies can be substantial. It follows from industries' diversification in terms of the production structure that may be related to the location, availability of resources, or ability to attract talent. A policy that is targeting a specific sector when the reliance on that sector varies between regions will produce unevenly distributed economic effects.

While regional SUTs are informative to policymakers who may be interested in the localized effects of their decisions, these are rarely available. Detailed regional tables are often a product of a specific project with a limited sectoral focus, available for a narrow time frame, and rarely set for routine updating. This is because such products are data-intensive, requiring information on the whole range of industries that comprise the region's economy. Compiling data from all sectors and ensuring its consistency across takes resources and time. Values are not always available; often, this is because there is a mismatch in the categorization of commodities or

[5] Impact on taxes can be still calculated through the use of multipliers described in subsection Economic impact multipliers. These estimates, however, will not include the feedback to the economy related to households and government spending the tax-generated revenue.

industries, and numbers are available only for an aggregate. As a result, timely policy advice based on regional SUTs is rare. Instead, inputs to policy-making decisions tend to be based on tables updated with limited data using a hybrid approach in which superior information (e.g., focused survey, expert opinion) is incorporated into otherwise mechanically updated tables.

The MR-GRAS technique described in Temursho et al. (2020) offers the most advanced approach to updating a partitioned matrix that needs to conform to new row sums, column sums, and, additionally, non-overlapping aggregation constraints.[6] While using row and column constraints is at the core of more traditional updating methods (e.g., RAS method, Lahr and de Mesnard 2004), adding aggregation constraints provides an opportunity to maximize the utilization of available data by making use of the national-level statistics. As a result, the MR-GRA technique can make the multiregional model consistent with aggregated national data[7] and include up-to-date estimates from a limited number of sectors derived from, for example, a focused survey or statistics published by a governmental agency responsible for a specific sector.

PHMEIA adopts a modified MR-GRAS technique that, in addition, imposes the identity of GDP by income and GDP by expenditure at the regional level in the output matrix. As a result, the updated matrix efficiently accommodates regional data on GDP components that are often produced by statistical agencies even when there is no attempt to derive the full set of regional SUTs. For more details on the updating approach, please refer to the article *Method for efficient updating of regional supply and use tables*.

The modified MR-GRAS technique applied in PHMEIA also allows the derivation of balanced tables that disaggregate Pacific halibut sectors from more broadly defined sectors using external information (e.g., landings value, see Data inputs section for details). Although these external data may be fragmentary, research finds that disaggregation of data going into economic impact assessment, even if based on a few real data points, is superior to using aggregates in determining SAM multipliers (Su *et al.*, 2010; Lenzen, 2011; Temursho, Oosterhaven and Cardenete, 2020). Severe aggregation bias occurs, especially if sectors within an aggregate are heterogeneous with regards to their economic and environmental characteristics (Lenzen, 2011).

PACIFIC HALIBUT CASE STUDY

The IPHC is an international organization established by a Convention between Canada and the United States of America that entered into force in 1923. The objective of the Commission is 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. The responsibilities of the Commission include: (1) establish open or closed seasons for Pacific halibut fisheries, (2) limit the size of the fish and the quantity of the catch to be taken from

[6] The MR-GRAS approach is based on tri-proportional scaling. The algorithm is set to minimize the weighted logarithm of the relative distance between the entries of the new and the old SUTs, subject to row, column and aggregation constraints. To find the solution that accounts for negative entries, the original matrix serving as an initial input to the scaling procedure is decomposed to a matrix containing positive elements and a matrix containing the negative entries' absolute values. What follows is the adjustment procedure consisting of a sequence of computations deriving adjustment multipliers that is set to stop when the multipliers converge to a solution conforming to a preset sufficiently low tolerance level. The last iteration multipliers are used to derive the output SUTs.

[7] For example, data from the National Economic Accounts (NEA). NEA data provide a comprehensive view of national production, consumption, investment, exports and imports, and income and saving. These statistics are best known by summary measures such GDP, corporate profits, personal income and spending, and personal saving.

each area within any season during which fishing is allowed; (3) during both open and closed seasons, permit, limit, regulate or prohibit the incidental catch of Pacific halibut that may be taken, retained, possessed, or landed from each area or portion of an area, by vessels fishing for other species of fish; (4) fix the size and character of Pacific halibut fishing appliances to be used in any area; (5) make such regulations for the licensing of vessels and for the collection of statistics on the catch of Pacific halibut as it shall find necessary to determine the condition and trend of the Pacific halibut fishery and to carry out the other provisions of this Convention; and (6) close to all taking of Pacific halibut any area or portion of an area that the Commission finds to be populated by small, immature Pacific halibut and designates as nursery grounds.

Detailed information about regulations for each IPHC-managed area are available in the IPHC annual publication International *Pacific Halibut Fishery Regulations* running since 1932.

Regulatory environment - Alaska

The Alaska Pacific halibut longline fishery (together with the sablefish longline fishery) is managed by the North Pacific Fisheries Management Council (NPFMC). The fishery is under the individual fishing quota (IFQ) program since 1995. The quota originally assigned to each person was proportional to their historical halibut landings, by regulatory area, during the qualifying period, and are represented as quota shares (QS). QSs were assigned to one of four vessel categories: A - freezer vessels of any length; B - catcher vessels greater than 60ft; C - catcher vessels less than or equal to 60ft for sablefish, or between 35-60ft for halibut; D - catcher vessels less than or equal to 35ft for halibut. Restrictions on transfer, together with use and ownership caps, are designed to maintain the fleet's owner/operator characteristics and prevent consolidation of QSs in the hands of a few participants. The fleet is also subject to a limited fishing season, historically running from March to November, but recently spanning to December.

The IFQ program in Alaska also gives provisions for halibut and sablefish community development quotas (CDQs). These were created to provide western Alaska communities an opportunity to participate in the Bering Sea and the Aleutian Islands fisheries that had been effectively closed to them because of the high capital investment needed to enter the fishery (NPFMC, 2020). Eligible communities can also form nonprofit entities called Community Quota Entities (CQEs) that are authorized to purchase commercial halibut and sablefish QSs and lease them to their residents.

Controls on the charter sector were established in 1975 (two-fish bag limit with no size limit) and remained unchanged for over 30 years, until 2007 in Southeast Alaska and 2014 in Southcentral Alaska (Chan, Beaudreau and Loring, 2018). However, the concerns regarding the sector's growth led to the implementation of the Charter Halibut Limited Access Program (CHLAP) in 2011. Additional measures in the form of trip limits and temporary closures came along the Pacific halibut Catch Sharing Plan (CSP) that was introduced with an intention to stabilize the allocation of Pacific halibut between the commercial and charter sectors. The CSP also authorizes limited annual leases of commercial IFQ for use in the charter fishery as guided angler fish (GAF). This gives anglers an opportunity to retain more or larger halibut than they might have otherwise been entitled to. Under CHLAP, communities[8] may also apply for a Community Charter Halibut Permit (CCHP). Unguided sport fishing

[8] Eligible communities must form a CQE.

for Pacific halibut in Alaska is subject to less restrictive rules than the charter sector. Currently, the daily bag limit is two fish of any size per day per person.

Pacific halibut is an important subsistence fishery in Alaska, where fish are caught for direct personal or family consumption as food or customary trade. Since 2003, fishers participating in the federal subsistence halibut sector must qualify as a recognized rural resident or tribal member to register for a Subsistence Halibut Registration Certification (SHARC) through NOAA (50 CFR 300).

Substantial Pacific halibut volume is also taken as bycatch, particularly in the groundfish fishery, mostly taken by trawlers. These catches used to be subject to fixed allocation, unchanging despite fluctuating regional allocations set based on the stock's condition. On 13 December 2021, the NPFMC's action tied Pacific halibut bycatch limits for the Amendment 80 fleet (groundfish trawlers) to Pacific halibut abundance (Pacific halibut abundance-based management, NPFMC motion C2 Halibut ABM from 13 December 2021). This recommendation is yet to be adopted by the NMFS.

Regulatory environment - British Columbia

In British Columbia, individual vessel quotas (IVQs) were implemented in the halibut "L" licensed fishery in 1991. This stabilized the season and allowed for increased fresh fish sales, better product quality, and a wider choice of processing options for fishers, including the option to directly market the catches to wholesalers, retailers, institutional purchasers, and restaurants (Squires, Kirkley and Tisdell, 1995; Homans and Wilen, 1997; Hackett *et al.*, 2005). Since the introduction of IVQs, gradually more flexibility was introduced to the scheme. Limited temporary transferability was introduced in 1993 and full temporary and permanent transferability in 1999. Currently, the transferability between "L" license holders is only restricted by the minimum and maximum holdings on the license and the minimum unit of transfer – 1 lb. There is evidence of increasing control over Pacific halibut fisheries by processors, who doubled their ownership of quota between 1996 and 2016 (Edwards and Pinkerton, 2019).

Apart from "L" license fishery, in the effort to repatriate fishing opportunities to Indigenous people, an indigenous communal "FL" license was introduced in the 1990s. In 2018, combined holdings of "FL" designation accounted for about 16% of the Pacific halibut allocation to British Columbia (IPHC area 2B). Much of the increase can be attributed to the government buyback of "L" licenses and transferring them to "FL" designation occurring since 1997. First Nations members in British Columbia also have access to a separate Pacific halibut fishery for food, social, and ceremonial purposes.

Up to 2003, the Canadian sport anglers were restricted only by bag and possession limits. Since 2004, a fixed share of the Canadian portion of Pacific halibut TAC is allocated to recreational fishing. Season length adjustments, reduced bag and possession limits, and area closures are used to maintain the sport catch within its allocation. Since 2019, Fisheries and Oceans Canada (DFO) is also testing a program that provides recreational harvesters an opportunity to retain halibut in excess of the size and daily possession limits under the Tidal Waters Sport Fishing License by leasing quota from a commercial sector. The Experimental Recreational Halibut Program (XRQ), however, has been put on hold in 2020 due to the covid-19 outbreak. The program resumed in 2021.

Regulatory environment – US West Coast

The overall limit for area 2A is set by the IPHC and distributed between user groups according to the Catch Sharing Plan (NOAA, 2020) set by Pacific Fishery Management Council (PFMC). This plan allocates 35% of the area 2A TAC to US treaty Indian tribes in the state of Washington in subarea 2A-1, and 65% to non-Indian fisheries in Area 2A.

Pacific halibut directed commercial fishery on the US West Coast remains the last non-tribal derby fishery for halibut. It operates based on 10-hour openings with catch restrictions based on vessel size and a requirement to obtain a license from the IPHC. In 1995, an option to opt for the incidental catch fishery during the salmon troll fishery was introduced, and in 2001, the retention of incidentally-caught halibut during the longline sablefish fishery north of Point Chehalis, Washington.

Since 1995, non-treaty fishers had to also choose between participating in commercial and charter fishery. The charter fishery in IPHC Regulatory Area requires a license from the IPHC and is managed by bag and possession limits. In-season adjustments to opening dates keep the west coast recreational fishery at or near its overall catch limit.

The Council has recently taken steps to transition routine management of the non-Indian commercial directed Pacific halibut fishery from IPHC to the Council and NMFS (PFMC, 2020).

In Washington state, thirteen tribes exercise treaty rights to obtain an allocation of the total Pacific halibut from the Indian treaty pool. The CSP gives provisions for a tribal commercial fishery and a ceremonial and subsistence fishery. Halibut taken for ceremonial and subsistence purposes may not be offered for sale or sold.

Fluctuations in abundance and fisheries output

The Pacific halibut Fishery Constant Exploitation Yield (FCEY), as adopted by the Commission at the time for each year, declined substantially, from a peak of over 76 mil. net lbs in 2004 to volumes fluctuating between 27 and 30 mil. net lbs since 2014 (**Figure 2**). The majority of the Pacific halibut stock biomass, and therefore the fishery yield, is located in the Gulf of Alaska, primarily in the IPHC regulatory area 3A. FCEY captures opportunities available to the stock users (i.e., fishers).

Currently, the Pacific halibut stock is estimated to be fully exploited, with recent levels of fishing intensity at or slightly below target, due to challenging recent fishery conditions. The stock is estimated to have been declining since 2016 and is currently at 33% of the unfished state. The spawning biomass is projected to continue to decrease slightly over the next three years. This relatively flat trajectory, following a period of low recruitment years from 2006-2011, is based on a 2012 cohort strongly represented in the 2021 FISS and fishery observations. As this cohort matures over the next 7 years it is expected to largely stabilize the stock and fishery near current levels. Size-at-age remains low relative to fluctuations observed over the last 100 years, resulting in reduced yield (on the order of 50%) for the same number of fish harvested in previous decades; however, younger Pacific halibut (< age-12) have shown some increase in size-at-age over the last 5 years. The distribution of the stock, and therefore available yield, is measured each year via the Fishery-Independent Setline Survey (IPHC, 2021), varies each year, with trends in the last 2 years increasing in the central portion of the stock (Biological Region 3, IPHC Regulatory Areas 3A-3B) and decreasing in Biological Regions 2 and 4 (IPHC Regulatory Areas 2A-2C, 4A, 4CDE).

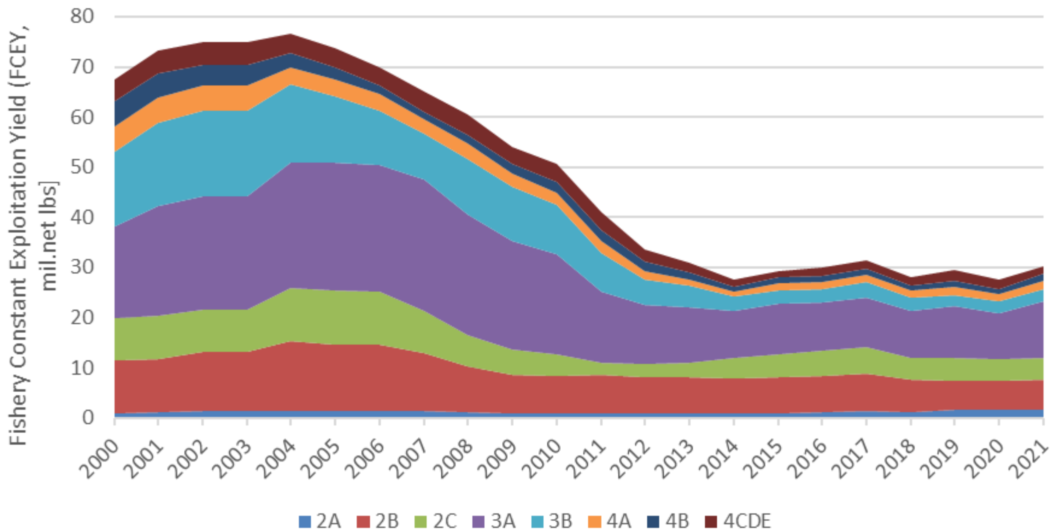


Figure 2: Pacific halibut Fishery Constant Exploitation Yield (FCEY, millions of net pounds) for each IPHC Regulatory Area (200-2021, table IPHC-2020-TSD-013), as adopted by the Commission at the time for that year. 2018 IPHC Regulatory area limits 'suggested' by the Commission and subsequently adopted by the contracting parties.

Size limits and U32 fish

Pacific halibut commercial fishery is subject to 32-inch minimum size limit (IPHC Fishery Regulations, section 19). However, since 2020 the IPHC sells Pacific halibut less than 32-inch (U32) that has been caught as a part of the FISS design. These fish, although limited in number, provide the first direct information on the price for U32 Pacific halibut for comparison with the price of fish larger than 32 inch (O32), as well as the critical price ratios found in the IPHC's analysis of size limits (**Table 1**, IPHC-2020-IM096-09).[9]

Table 1: Pacific halibut U32 vs. U32 price ratio (2020-2021).

	2020			2021		
	p U32	p O32	price ratio	p U32	p O32	price ratio
Coastwide	$4.16	$4.77	87%	$5.66	$6.91	82%
2A	*NA*	*NA*	*NA*	$3.45	$5.72	60%
2B	$5.70	$5.91	96%	$7.00	$8.12	86%
2C	$4.16	$4.57	91%	$6.23	$6.70	93%
3A	$3.72	$4.39	85%	$6.29	$6.97	90%
3B	$3.82	$4.43	86%	$5.84	$6.04	97%
4A-E	*NA*	*NA*	*NA*	$4.92	$5.46	90%

Notes: *NA* indicates that the survey design did not cover the specified IPHC Regulatory Area.

[9] The 2020 analysis found that if the relative price for U32 Pacific halibut is at least 63% of the price of current catch of O32 fish, then the fishery as a whole is projected to achieve equal or increased value if the minimum size limit was removed.

MODEL SETUP

The PHMEIA model is a multiregional SAM-based model developed with the specific purpose of assessing the economic contribution of Pacific halibut resource to the economy of the United States and Canada. The model reflects the interdependencies between eleven major sectors and two Pacific halibut-specific sectors.[10] The extended model (referred here as PHMEIA-r) introduces to the SAM also the saltwater charter sector that is disaggregated from the services-providing industry. The PHMEIA-r estimates assume that the economic impact of Pacific halibut charter fishing is equivalent to estimating the total economic loss resulting from the saltwater charter sector in each region shrinking by share of Pacific halibut effort in total effort. The results for the charter sector, however, should be interpreted cautiously because of the uncertainty on how much of the saltwater angling effort directly depends on Pacific halibut.[11]

The list of industries considered in the PHMEIA and PHMEIA-r models, as well as the primary commodities they produce, is available in **Table 2**. Production by these industries is allocated between three primary Pacific halibut producing regions, as well as residual regions to account for cross-boundary effects of fishing in the Pacific Northwest:

- Alaska (AK),
- US West Coast (WOC – including WA, OR, and CA),
- British Columbia (BC),
- rest of the United States (US-r),
- rest of Canada (CA-r), and
- rest of the world (ROW).

The ROW region in the model is considered exogenous. This implies that the trade relations with the ROW are unaffected by the changes to the Pacific halibut sectors considered in this project. While the full inclusion of the ROW component[12] would allow for assessment of impact outside Canada and the United States if trade with ROW was to be considered responsive to changes in Pacific halibut sector activity, this is not typically seen in the literature.

[10] Derived use of commodities by Pacific halibut sectors is appended to SUTs and subtracted from production by general fishing and processing industries.
[11] Additional analysis of the demand for Pacific halibut recreational trips is proposed in the *IPHC 5-year program of integrated research and monitoring* (2022-26) (IPHC-2021-IM097-12). Current results rely on the available statistics that do not necessarily reflect the willingness to substitute the target species. Estimates of the charter sector dependence on Pacific halibut can be also improved through participation of charter business owners in the IPHC economic survey. See Discussion and conclusions for details.
[12] ROW component could be constructed using, for example, World Input-Output Tables (WIOT, Timmer *et al.*, 2015).

Table 2: Industries and commodities considered in the PHMEIA and PHMEIA-r models.

	Industry	Primary commodity produced
1	Pacific halibut fishing	Pacific halibut
2	Other fish and shellfish fishing	Other fish and shellfish[(1)]
3	Agriculture and natural resources (ANR)	Agriculture and natural resources
4	Construction	Construction
5	Utilities	Utilities
6	Pacific halibut processing	Seafood
7	Other fish and shellfish processing	Seafood
8	Food manufacturing (excluding seafood manufacturing)	Food (excluding seafood)[(2)]
9	Manufacturing (excluding food manufacturing)	Manufactured goods (excluding food)
10	Transport	Transport
11	Wholesale	Wholesale
12	Retail	Retail
13	Services (including public administration)	Services (including public administration)
14	Saltwater charter sector[(3)]	Saltwater fishing trips

Notes: [(1)]In the case of Canada, other fish and shellfish commodity includes, besides wild capture production, also aquaculture output produced by the aquaculture industry that is a part of the ANR industry. Other fish and shellfish processing industry in the USA component, on the other hand, draws more on the ANR commodity that includes aquaculture output. While this misalignment between model components is not concerning as linking these is based on trade of aggregated seafood commodity, the SUTs are adjusted so that the Canadian and US model components are better aligned. [(2)]There is a slight misalignment between model components related to the allocation of beverage and tobacco manufacturing products that, in some cases, are considered non-durable goods and lumped with the food commodity. In the case of the USA component, this misalignment is corrected with the use of additional data available from the Annual Survey of Manufactures (ASM) (US Census, 2021a). [(3)]Saltwater charter sector extension included in PHMEIA-r model. Model results rely on the estimated share of the sector output that directly depends on Pacific halibut.

In this model, all wild capture production, including all Pacific halibut harvest, is assumed to be supplying the seafood processing industry (Pacific halibut commodity supplying Pacific halibut processing industry). This implies a broader scope of the processing sector that also includes entities responsible for product preparation and packaging. Under this assumption, Pacific halibut and other harvested species are sold to other industries or final users only as a seafood commodity[13] as opposed to a fish commodity. Leonard and Watson (2011) note that about 30% of fish harvested in the US West Coast flow directly to the seafood wholesale sector, but no data to make such a distinction are available to the Secretariat, and simplifying assumptions are made. At this stage, the model also omits the economic benefit of Pacific halibut not sold but retained by commercial fishers for personal consumption.

The model adopts exogenous changes to Pacific halibut processing based on constant margins for calculation of effects related to forward-link industries. This means the model assumes a proportional change between the Pacific halibut processing sector and the Pacific halibut fishing sector in each region. The model omits Pacific halibut impacts beyond the processing sector for reasons explained in subsection Forward linkages.

The model components are derived for the period 2014-2020, adopting the MR-GRAS technique (method details in section Adapting SAM to project needs). Extending the model to 2020 illustrates the Covid-19 impact on the Pacific halibut fisheries. The PHMEIA-r extension is available up to 2019 due to data availability lag. All values

[13] This is the reason why both industry 6 and 7 are assigned seafood as a primary commodity produced. This also implies a different total number of industries (13) and commodities (12) considered in the model.

are in producer prices, in current US dollars (Canadian dollars).[14] The additional details on each model component are available in the following two subsections: Base model for the United States and Base model for Canada. The subsection Linking model components explains how the model components are assembled into an integrated multiregional SAM model. The following subsections in the Data inputs section explain how Pacific halibut sectors are incorporated into the SAM matrix.

In addition to economic impact related to Pacific halibut sectors, PHMEIA-derived multipliers are used to estimate economic impact related to marine angler expenditures on fishing trips (travel, lodging, other trip-related expenses) and durable goods (rods, tackle, boat purchase, other fishing equipment and accessories, second home, or additional vehicle purchase).

DATA INPUTS

Base model for the United States

The matrix depiction of the economy of the United States is based on data published by the US Bureau of Economic Analysis (BEA, 2021a) supplemented with BEA Regional Data resources (BEA, 2021c), data from United States Census Bureau's Annual Survey of Manufactures (ASM; US Census, 2021) and Quarterly Census of Employment and Wages conducted by the US Bureau of Labour Statistics (QCEW; BLS, 2021).

The national SUTs from BEA's Input-Output Accounts Data (last updated in November 2021, include revised 2016-2019 data and the first release of 2020 data) are disaggregated into regional tables (AK, WOC, and US-r) using the method described in Adapting SAM to project needs and data from the species-based SAM developed by Seung, Waters, and Taylor (2019). The regional SAM used for updating, calibrated for 2014, is a partitioned matrix that consists of make, use, value added, and final demand tables for multiple Southwest Alaska regions, rest of Alaska, Alaska's at-sea operations, US West Coast, rest of the US, and data on exogenous accounts (capital account, government account and rest of the world account describing US imports and exports). For the purpose of PHMEIA, all Alaska regions, all fishing industries but the Pacific halibut fishing industry, all processing industries but the Pacific halibut processing industry, and all marine species besides Pacific halibut are aggregated. Aggregation of marine species implies two fisheries-sourced commodities – Pacific halibut and other fish and shellfish. Although the original regional model is calibrated for 2014, using the same set of data for updating the tables also for this year ensures model consistency over the years.

The ASM data, which includes statistics by state on employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, value of shipments and value added for manufacturing industries provides additional detail for disaggregation of the seafood processing sector from the food manufacturing sector included in the SUTs. The QCEW data supplements employment statistics published by the BEA (SAEMP25N: Total Full-Time and Part-Time Employment by NAICS Industry).

BEA regional data are also used to build into the model the household accounts. The model utilizes data on personal consumption expenditures (table SAPCE1), value added and income (SAGDP2N: GDP by state; SAGDP4N: Compensation of Employees, SAINC5N Personal Income by Major Component and Earnings by

[14] Following BEA's definition, current-dollar estimates are valued in the prices of the period when the transactions occurred - that is, at "market value." Also referred to as "nominal estimates" or as "current-price estimates."

NAICS Industry;[15] SAGDP3N: Taxes on production and imports less subsidies; SAGDP7N: Gross operating surplus[16]), and supplementary data on personal income taxes (table SAINC50), disposable income (SAINC30: Economic Profile) and gross flow of earnings (table SAINC91). The earnings outflows are split between destination regions using the average state-to-state flow reported by the Internal Revenue Service (IRS, 2020), and allocated between destination regions using BEA data on International Transactions (BEA, 2021b). Details on household accounts[17] by region are available in **Table 3** for 2019. Data for the remaining years in the model can be supplied upon request.

Table 3: Household accounts – USA 2019 [USD].

	AK	WOC	US-r	Source/table
[1] Employee compensation	29,108	2,069,338	9,361,006	SAGDP4N/SUTs
[2] Social contributions	3,224	248,685	1,202,296	SAINC5N/SAINC6N
[3] Net earnings from labor ([1] – [2])	25,8964	1,820,652	8,158,710	-
[4] Proprietors' income	3,164	295,311	1,302,138	SAINC5N
[5] Adjustment for residence	-197	-2,576	6,326	SAINC91
[6] Net earnings by place of residence ([3]+[4]+[5])	28,831	2,113,388	9,467,174	-
[7] Net property income[(1)]	8,498	645,265	2,999,795	SAINC5N
[8] Government transfers	7,965	486,609	2,644,479	SAINC5N
[9] Personal income ([6]+[7]+[8])	45,294	3,245,262	15,111,449	-
[10] Personal income taxes	3,394	451,234	1,751,589	SAINC50
[11] Disposable income ([9]-[10])	41,900	2,794,028	13,359,860	- (SAINC30)
[12] Households' expenditure	37,780	2,465,313	11,925,580	SAPCE1
[13] Household net savings ([11]-[12])	4120	328,715	1,434,280	-

[(1)]Includes dividends, interest, and rent.

Base model for Canada

The structure of the Canadian economy is based on data published by Statistics Canada (Statistics Canada, 2021b). Canada is one of the few countries that produce annual SUTs at the national and sub-national (by province) levels. Provincial SUTs are identical in structure to the national tables with one exception - the provincial tables include estimates of interprovincial trade. Consequently, the import column in the supply table and the export column in the final uses table are split into two columns each, to show international imports/exports and interprovincial imports/exports. To be compatible with the SUTs for the United States, Canadian tables are adjusted to producer prices[18] and converted to USD using exchange rates published by the Organisation for Economic Co-operation and Development (OECD, 2020a). Moreover, the tables are adjusted so that commodity MPG114000 (*Fish, crustaceans, shellfish and other fishery products*) is split between wild

[15] Note that earnings minus compensation of employees equals proprietors' income.

[16] Note that values in the SAGDP7N table need to be adjusted for proprietors' income derived from tables SAGDP4N and SAINC5N.

[17] Household accounts presents data on disposable income, spending, savings, debt and financial assets of households.

[18] Canadian SUTs are given in basic prices with trade and transportation margins allocated to relevant trade and transportation industries. *Use table: Taxes on products* is used to adjust the use tables to producer prices. To derive tables in producer prices, *Use table: Taxes on products* is used to adjust value for taxes on products, while subsidies on products are allocated proportionally to use.

capture fishery products and aquaculture products, with aquaculture products reallocated as an output of the ANR industry.

The most recent release of the SUTs by Statistics Canada includes tables up to 2018 (updated in September 2021). While there is no need to apply MR-GRAS technique to disaggregate Canadian SUTs into regions[19] as these are available by province, this technique is used to update the 2018 tables with a limited set of statistics that comprise these tables that are available for 2019 and 2020 from other Statistics Canada resources:

- Table 36-10-0402-01: *Gross domestic product (GDP) at basic prices, by industry, provinces and territories* (Statistics Canada, 2021j)
- Table 36-10-0221-01: *Gross domestic product, income-based, provincial and territorial, annual* (includes data on employee compensation, employer social contributions, and net mixed income) (Statistics Canada, 2021h)
- Table 16-10-0048-01: *Manufacturing sales by industry and province, monthly* (Statistics Canada, 2021e)
- Table 16-10-0117-01: *Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS)* (Statistics Canada, 2021f)
- Table 12-10-0098-01: *Trade in goods by exporter characteristics, by industry of establishment* (Statistics Canada, 2021c)
- Table 25-10-0021-01: *Electric power, electric utilities and industry, annual supply and disposition* (Statistics Canada, 2021g)
- Table 14-10-0023-01: *Labour force characteristics by industry, annual* (Statistics Canada, 2021d)

Additionally, to fully account for the effects of personal income generated by industries and the feedback it provides to the economy, the household accounts were constructed using:

- Table 36-10-0432-01: *Detailed household final consumption expenditure - sales taxes and expenditure excluding sales taxes, provincial and territorial, annual* (reports on the flow of earnings) (Statistics Canada, 2021k)
- Table 36-10-0450-01: *Revenue, expenditure and budgetary balance - General governments, provincial and territorial economic accounts* (includes data on income taxes and government transfers to households) (Statistics Canada, 2021l)
- Table 36-10-0224-01 *Household sector, current accounts, provincial and territorial, annual* (includes data on net property income and other transfers related to households) (Statistics Canada, 2021i)

Details on Canadian household accounts by region are available in **Table 4** for 2019. Data for the remaining years in the model can be supplied upon request.

[19] As done for the SUTs representing the economy of the United States.

Table 4: Household accounts - Canada 2019 [USD].

	BC	CA-r	Source/table
[1] Employee compensation	114,990	769,984	36-10-0221-01
[2] Social contributions	14,463	105,690	36-10-0221-01
[3] Net income from labor ([1] – [2])	100,527	664,294	- (36-10-0221-01)
[4] Net mixed income	32,998	123,989	36-10-0221-01
[5] Adjustment for residence	2,513	-7,987	36-10-0432-01
[6] Net earnings by place of residence ([3]+[4]+[5])	136,037	780,296	-
[7] Net property income(1)	13,433	99,072	36-10-0224-01
[8] Government transfers	21,553	153,328	36-10-0450-01
[9] Personal income ([6]+[7]+[8])	174,336	1,029,972	-
[10] Personal income taxes	27,403	183,212	36-10-0450-01
[11] Disposable income ([9]-[10])	147,336	846,759	-
[12] Households' expenditure	146,318	833,144	36-10-0432-01(2)
[13] Household net savings ([11]-[12])	1,017	13,615	-

(1)Includes net property income and net of other transfers to and from households (e.g. related to non-profit institutions serving households and corporations). (2)Values reported here are adjusted for taxes on products calculated with MR-GRAS.

Linking model components

The two separate model components[20] that describe the economies of Canada and the United States are linked using the method suggested by Bachmann, Roorda, and Kennedy (2015) (details in section *Linking multiple regions*). Accordingly, international linkages are established through trade matrices. These, in turn, are constructed based on available trade statistics (Statistics Canada, 2021a; US Census, 2021b) and data on international transactions (BEA, 2021b; Statistics Canada, 2021g). For industries with no regional trade statistics available (some services), a split between destination regions is done based on regional GDP estimates. Interstate (for the USA) and interprovincial (for Canada) trade matrices are estimated as parts of each model component.

SAM matrix is used to calculate induced SAM-type effects, i.e., induced effects that take into account the flow of earnings between regions. Details on flows related to earnings from Pacific halibut sectors are provided in the following sections.

Pacific halibut commercial sectors

An essential input to the PHMEIA model is data on production structure (i.e., data on the distribution of revenue between profit and expenditure items) of investigated sectors. In the fisheries sector, the gross revenue (**Figure 3**) is the landed value of the catch, which in the case of the Pacific halibut fleet will include Pacific halibut catch and non-directed catch of other species (e.g., sablefish, lingcod, rockfish). The gross revenue must cover the cost of leasing the quota (when allowed, i.e., for Pacific halibut, this applies to British Columbia), operational

[20] Each model component comes in the form of a collection of matrices. This includes make matrix, use matrix, final demand matrix, and value added matrix for each region, as well as interstate (for the USA) and interprovincial (for Canada) transaction matrices that connect regions within each component.

costs, annual fixed costs, labour costs (crew share and captain share), and EBITDA (earnings before interest, taxes, depreciation, and amortization – long-run costs plus net profit[21]).

The model also incorporates the production structure for the Pacific halibut processing sector. The processing sector is supplied directly by Pacific halibut wild capture production and included in the model to account for the forward linkages in the estimated economic impact (details in section Forward linkages).

<table>
<tr><td rowspan="17">Gross revenue</td><td></td><td colspan="2">Lease fees</td><td rowspan="12">Short-run costs</td></tr>
<tr><td rowspan="16">After-lease revenue</td><td rowspan="5">Operational costs</td><td>License fees</td></tr>
<tr><td>Fuel</td></tr>
<tr><td>Bait & ice</td></tr>
<tr><td>Gear</td></tr>
<tr><td>Monitoring</td></tr>
<tr><td rowspan="4">Fixed costs</td><td>Insurance</td></tr>
<tr><td>Moorage</td></tr>
<tr><td>Maintenance</td></tr>
<tr><td>Other</td></tr>
<tr><td rowspan="2">Labor costs</td><td>Crew share</td></tr>
<tr><td>Captain share</td></tr>
<tr><td rowspan="5">EBITDA</td><td>Amortization</td><td rowspan="4">Long-run costs</td></tr>
<tr><td>Depreciation</td></tr>
<tr><td>Taxes</td></tr>
<tr><td>Interest</td></tr>
<tr><td>Net profit</td><td></td></tr>
</table>

Figure 3: Fishing sector cost and earnings categories. Adapted from Edwards (2019).

The US component of the model uses as a base for Pacific halibut fishing and processing in Alaska the data from the species-based SAM developed by Seung, Waters, and Taylor (2019) updated using annual estimates of landing value and wholesale value. Alaska's landings data are collected from mandatory trip tickets by the Alaska Department of Fish and Game (ADFG), then consolidated and disseminated (as aggregates) by the Alaska Fisheries Information Network (AKFIN, 2021). Commercial Operator's Annual Report (COAR, 2021) reports on the by species statewide raw input purchase cost and wholesale value of the processed seafood. COAR data on Pacific halibut are also available by COAR Areas (ADFG, personal communication), supplementing the county-level analysis for Alaska.

Pacific halibut-specific production structure for the WOC region is adapted from estimates for the West Coast provided directly by the authors of the NOAA input-output model for the Pacific Coast fisheries (Leonard and Watson 2011; Pacific halibut estimates not published). Then, the fisheries portion of the WOC component of the model is updated using data on Pacific halibut fishing in Washington, Oregon, and California (reported collectively as WOC) collected by the Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), and California Department of Fish and Wildlife (CDFW), respectively. Each of these state agencies requires submitting fish tickets reporting on Pacific halibut sales. These data are processed and disseminated by the PacFIN (PacFIN, 2021). No data on the wholesale value of Pacific halibut are routinely

[21] The SAM matrix incorporates net profit as proprietors' income. Proprietors' income is the excess of revenue over explicit production cost of owner-operated businesses.

collected for the US West Coast. The model uses the latest (2017) NOAA estimates on species-specific processor markups suggesting that for every dollar spent on Pacific halibut, the processors deliver USD 1.15 worth of product.

British Columbia's Pacific halibut commercial fishing production structure is based on average operational and fixed cost available in the literature (Edwards and Pinkerton, 2020) adjusted for quota leasing estimated from values published in Castlemain (2019). The production structure is used in the model in conjunction with annual estimates of landing value. Data on British Columbia's commercial fisheries landed volume and value are published in the *British Columbia Seafood Year In Review* (BCSYIR) by Canada's Ministry of Agriculture (AgriService BC, 2020) and are based on data received from fish slips collected by the DFO.

As no secondary data are available on British Columbia's Pacific halibut processing production structure, the allocation of expenditures for this sector follows general production structure in the *Seafood product preparation and packaging* sector adjusted for wages reported for Pacific halibut processing in BC (AgriService BC, 2018). The year-to-year changes in the scale of Pacific halibut processing operations are assessed based on the wholesale value for halibut published in the BCSYIR. These estimates, in turn, are based on the provincial Annual Fish Production Schedule (AFPS) survey which is sent to all British Columbia processers, receivers (buyers), and custom clients (all seafood sellers). Worth noting is that while the wholesale of Pacific halibut increased from 2018 to 2019, the *Seafood product preparation and packaging* sector in British Columbia is shrinking, noting a 21% drop in contribution to GDP over the same period, as reported by Statistics Canada (Statistics Canada, 2021j).

Data on commercial landing value (available for all regions for 1951-2020, **Figure 4**) suggest a considerable increase in Pacific halibut output driven by Alaska fisheries since the 1980s. However, revenue has been decreasing throughout the last decade. The statistics for recent years (years included in the model) are available in **Table 5**.

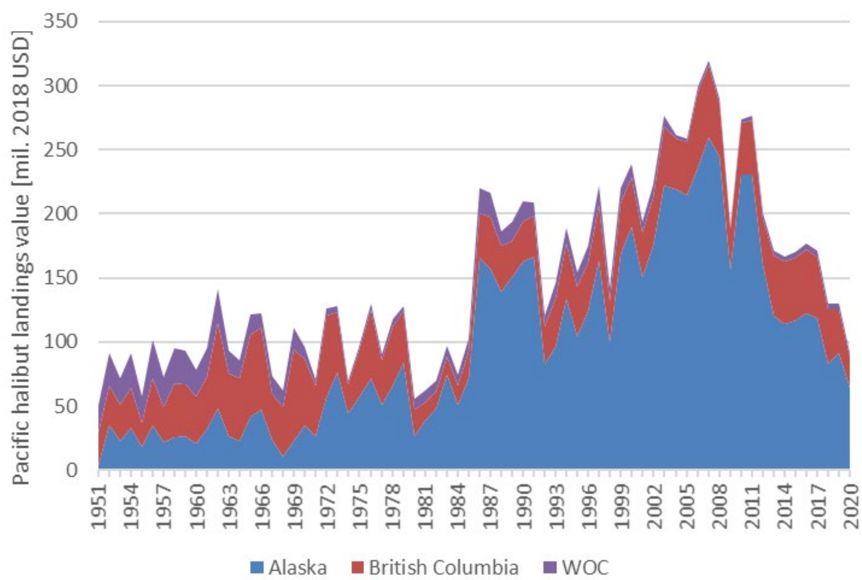


Figure 4: Pacific halibut landings value (1951-2020) in 2018 USD.

Table 5: Summary of available data on Pacific halibut landings and wholesale value.

Region	2014	2015	2016	2017	2018	2019	2020	Unit	Source
Pacific halibut commercial landings value									
AK	105.3	112.0	118.9	117.1	88.0	94.1	66.6	mil. USD	AKFIN
BC	46.9	53.8	58.3	58.9	44.1	46.4	33.3	mil. CAD	Province of BC
WOC	3.7	3.9	4.6	4.6	4.2	5.0	3.3	mil. USD	PacFIN
Pacific halibut wholesale value									
AK	109.9	133.8	138.9	136.6	110.5	108.6	78.3	mil. USD	COAR
BC	106.9	98.5	94.9	70.4	65.9	75.1	64.6	mil. CAD	AgriService BC
WOC	1.17(1)	1.12(1)	NA	1.15(1)	NA	NA	NA		NOAA

Notes: NA indicates that the value is not available. All monetary values in current USD/CAD, as reported in the cited source. (1)No wholesale value data available. Instead, the table reports on markup values for Pacific halibut.

To report on the direct economic impact in terms of the number of jobs, the model also utilizes the available employment estimates. Data on employment in major fisheries in Alaska, including Pacific halibut fisheries, is compiled on a monthly basis by the Alaska Department of Labor and Workforce Development (AK DLWD, 2021). Share of nonresident wages in fisheries is reported annually in the report *Nonresidents Working in Alaska* (Kreiger and Whitney, 2021). Statistics Canada (2021d) reports annually on employment in *Fish, hunting and trapping* sector, but no estimates specific to the Pacific halibut fishery are available. No specific estimates on jobs in Pacific halibut fishing are available for the US West Coast states, and these are derived as a share of the total employment in fishing reported in *Fisheries Economics of the United States* (NOAA, 2021a).

In terms of employment in processing, AK DLWD reports on the number of resident and non-resident workers in the Alaska seafood industry, as well as the associated wages (AK DLWD, 2021). Estimates of employment in seafood processing in the lower 48 are available from the *Quarterly Census of Employment and Wages* (BLS, 2021). Pacific halibut supported share of processing employment is derived based on the portion of the wholesale value associated with Pacific halibut products. Detailed data on employment and wages in British Columbia seafood processing are available via AgriService BC series of publications *British Columbia Fish Processing Employment* (AgriService BC, 2018). The statistics are reported by species, with estimates based on the additional information each company provides on the species groups that are processed in the facility and the estimated percent of jobs attributed to each group. The latest report from 2018 includes data up to 2016.

Cross-regional flows of earnings

The model specifies the flow of earnings related to Pacific halibut sectors. If the vessel or quota share is owned by a nonresident, the returns to that property or holding leak away from the area of resource extraction towards the owner's place of residence. The outflow of earnings also occurs when wages are paid to nonresidents. Pacific halibut-specific earnings flows are accommodated in the SAM model through transaction matrices (i.e., Te21 or Te12 in Appendix A). Flows specific to Pacific halibut are depicted in Appendix B.

In 2020, about 37% of Alaska quota share units were reported as owned by residents of other states, mainly Washington, about 23%, but this includes also landlocked states. Moreover, about 16% of vessels fishing halibut (under IFQ or CDQ license) were registered as owned by a resident of a state other than Alaska. Most of Alaska's harvest is landed in state (97% in 2019 and 2020), although some is delivered to ports in Washington or Oregon. Detailed statistics on the structure of beneficial ownership of Pacific halibut fishing in Alaska have been compiled using eLandings data and information available CFEC Public Search Application (CFEC, 2021b, 2021a), and are available in **Table 6**. Landing values from fish tickets matched with permit owner and vessel owner information were also used to derive flows related to profits in the PHMEIA SAM matrix. When the residence of the permit owner and vessel owner differs, the model applies a fifty-fifty split.

In case of Canada, the cross-provincial transfer of benefits related to harvest profit is less pronounced. While the distribution issue is present, it is more of a question whether the quota owner is an active participant or investor (Edwards and Pinkerton, 2019). Most of the non-participants live in British Columbia, although many in the lower mainland, far from fishing grounds (UBC, personal communication). According to DFO's Fishing License Statistics, no vessel holding a Pacific halibut quota is registered as foreign, but it is important to note that there is no rule against it (House of Commons Canada, 2019).

The majority of the commercial licenses in the WOC region are held by residents of Washington, Oregon, and California (99%), implying that the vast majority of profits are retained within the region.

Table 6: Beneficial ownership of AK Pacific halibut fishery in 2020.

Vessel owner's state of residence	Permit (quota) owner's state of residence	Landed value [mil. USD]	Unique vessels	Unique permits	Revenue share	Landed in AK
AK	AK	40.7	572	903	67.7%	100%
AK	WOC	2.9	36	40	4.8%	98.5%
AK	US-r	1.3	21	21	2.2%	100%
WOC	AK	1.2	14	19	2.0%	100%
WOC	WOC	11.3	68	90	18.8%	87.3%
WOC	US-r	1.7	7	8	2.8%	94.6%
US-r	AK	0.2	4	6	0.4%	100%
US-r	WOC	*	*	*	*	*
US-r	US-r	0.6	10	11	1.0%	100%

Note: Compiled using eLandings data on the value of landings and information from the CFEC Public Search Application. Includes only landings under IFQ and CDQ management program. *Indicates values removed to preserve confidentiality (less than three vessels or permits).

The flow of earnings is also associated with labor compensation. When wages are paid to non-residents, the majority of that money will flow to the place of their primary residence. While no statistics on the composition of employment in the Pacific halibut fisheries sector are available for the regions considered in the model, some notable general statistics are worth mentioning. According to the AK DLWD, nonresidents made up 20.8% of Alaska's workforce in 2019 and earned 15.3% of wages (Kreiger and Whitney, 2021). This share is considerably higher, reaching 61.2%, for the fishing sector. However, the preliminary results from the IPHC economic survey focused on the Pacific halibut fleet suggest more local employment in this part of the fishing sector. Consequently, PHMEIA assumes the following composition of the labor force (in terms of wages) in the Pacific halibut fishing sector: 78% Alaska residents, 20% residents of the US West Coast and 2% residents of other US states. Due to the currently low sample size, the adopted estimates on the cross-state flow of wages in the Pacific halibut fishing sector are subject to change. Kreiger and Whitney (2021) also report that nonresidents made up 68.3% of the 2019 workforce in the *Seafood processing* sector. The model adopts the same share to Pacific halibut processing, assuming there is no significant difference in the operations of processing plants depending on the species. The nonresident origin is assumed to follow the general trends reported by the Internal Revenue Service (IRS, 2020).

No equivalent estimates were identified for British Columbia or the US West Coast. The model applies no earnings flows related to the residency of employees in these two regions.

Cross-county flows in Alaska

According to 2020 data from eLandings combined with information on vessels and permits available via CFEC (details in **Table 7**), the county of landing matched the county of vessel owner residence for about 48.5% worth of Alaskan harvest. When it comes to the residence of the permit owner, it matched the county of landing for 46.1% harvest value. Vessel homeport matched about 50.0% worth of landings. The direction of the flow of benefits from the landing area to vessel owner residence, quota holder residence, and vessel homeport location is depicted in **Figure 5**. Here, the inner circle represents the county where the fish was landed, and the outer circle represents the county where (1) the vessel owner resides, (2) where the quota owner resides, and (3) the vessel homeport is located. The width of the ring section represents the estimated value of landings.

Table 7: Cross-regional and cross-county flow of benefits related to the residence of the vessel owner, the permit owner, and vessel homeport. Based on 2020 data.

	Landing value	Value by the residence of the vessel owner	Change vs. landing value	Value by the residence of the quota holder	Change vs. landing value	Value by vessel homeport location(1)	Change vs. landing value
Aleutians East	5.69	0.62	-89.2%	0.67	-88.3%	1.23	-78.4%
Aleutians West	7.04	1.44	-79.6%	1.81	-74.3%	4.52	-35.9%
Anchorage	0	0.77	+	1.42	+	0.37	+
Bristol Bay	*	0	NA	0	NA	0	NA
Dillingham	0.05	0.06	25.7%	0.06	25.7%	0.06	25.7%
Fairbanks North Star	0	*	+	*	+	0	+
Haines	*	1.02	NA	0.72	NA	0.38	NA
Hoonah-Angoon	1.64	0.76	-53.7%	0.65	-60.6%	0.97	-40.9%
Juneau	5.81	2.96	-49.1%	2.87	-50.5%	6.04	4.0%
Kenai Peninsula	16.81	12.50	-25.6%	10.44	-37.9%	11.69	-30.5%
Ketchikan Gateway	0.82	0.81	-0.9%	0.89	9.3%	1.05	27.8%
Kodiak Island	6.29	6.97	10.7%	5.74	-8.8%	8.30	31.9%
Lake and Peninsula	0	*	+	*	+	*	+
Matanuska-Susitna	0	2.01	+	1.30	+	*	+
Nome	0.57	0.57	0.0%	0.57	0.0%	0.49	-13.8%
Petersburg	3.79	6.32	66.6%	6.58	73.5%	7.15	88.5%
Prince of Wales-Hyder	0.51	0.52	1.9%	0.55	7.8%	0.61	18.4%
Sitka	1.07	1.92	79.1%	1.79	67.7%	2.04	91.2%
Southeast Fairbanks	0	1.14	+	1.04	+	*	+
Skagway	*	0	NA	*	NA	0	NA
Valdez-Cordova	3.53	1.26	-64.2%	1.95	-44.9%	1.78	-49.6%
Wrangell	1.16	1.25	7.7%	1.15	-1.1%	1.10	-5.3%
Yakutat	3.68	1.95	-47.0%	1.83	-50.1%	1.61	-56.3%
WOC	1.57	14.22	803.4%	14.33	810.7%	10.34	556.7%
US-r	0	0.96	+	3.60	+	0	+

Notes: * indicates confidential values, representing less than three vessels; + represents a positive flow when the landing base was zero. (1)Vessel homeport was not identified for about USD 228,600 worth of landings.

(1) Landing area vs. vessel owner residence (2) Landing area vs. permit owner residence (3) Landing area vs. vessel homeport location

Figure 5: Direction of the flow of benefits from the landing area to (1) vessel owner residence, (2) quota holder residence, and (3) vessel homeport location. Plots use 2020 data.

The majority of the Pacific halibut buyers (according to the 2020 data) were located in Alaska (97.8% in terms of value); 2.2% worth of harvest went to out-of-state buyers and could not be traced further. Within Alaska, 99.7% of buyers were shorebased processors. Processing typically occurs in the buyer's location. Only about 10.9% of the harvest in terms of landing value went through custom processing, of which 23.9% was in a place different to the location of the buyer, typically right where it was landed (100%). The remaining harvest (i.e., not going through custom processing) matched the landing county for about 91.4% of landings in terms of value, with the remainder going through buying stations located at the landing location.

Following the flow of revenues further, about 58.9% worth of harvest purchased by shorebased processors was purchased by shorebased processors that listed as a point of contact a county other than the location of the processing facility. What is more, 96.3% of the above value can be traced to processors with a point of contact on the US West Coast. Note that the share here was calculated based on the original landing value and does not account for variation in wholesale value dependent on the type of produced outputs.

Figure 6 depicts the flow of revenue from the harvest location to the processor point of contact. Here, nods represent spatial aggregations:

- blue – harvest by IPHC Regulatory Areas;
- red – county of the landing site;
- yellow – if ordered, county of the custom processing;
- green – county of the reported buyer (location of the buying station not included in the figure);
- purple – location of the Fisheries Business License holder (based on the contact address).

Ribbons represent flows in terms of the estimated value of landings (in mil. USD; not adjusted for value added through processing):

- blue ribbons represent the flows from harvest grounds to landing sites in Alaska;
- grey ribbons represent the flows between nodes that are located in the same Alaskan county;
- orange ribbons represent the flows between nodes that are located in different counties;
- red ribbons represent the flows out of Alaska.

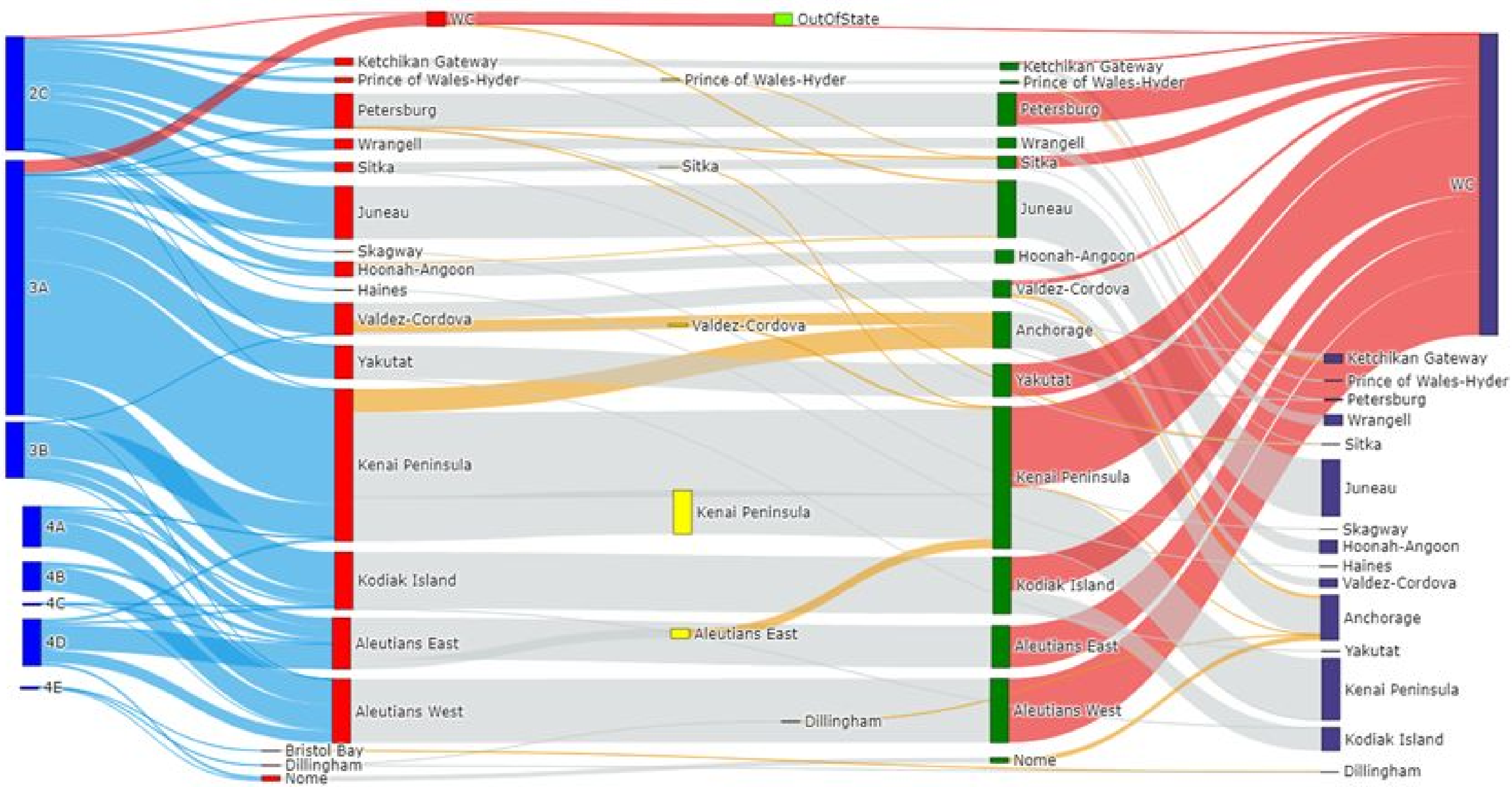


Figure 6: Flow of Pacific halibut harvest from harvest location to buyer's headquarters. Plot uses 2020 data.

Pacific halibut recreational fishing

PHMEIA-r expands the PHMEIA model and incorporates into the SAM matrix production structure for saltwater charter fishing. Using the estimated share of charter fishing effort directly dependent on Pacific halibut, the extended PHMEIA-r provides estimates of the economic impact of the Pacific halibut charter sector.

Production structure for the charter sector in Alaska is adopted from Seung and Lew (2017) and updated using results of the latest cost, earnings, and employment in the Alaska saltwater sport fishing sector survey (Lew and Lee, 2019). Alaska charter owners are regularly surveyed on their costs and earnings (Alaska Saltwater Sport Fishing Charter Business Cost and Earnings Survey). The survey was previously administered in 2012, 2013, 2014, and 2016 to collect data on the 2011-2013 and 2015 seasons. The latest survey, administered in 2018, describes the 2017 fishing season. The earnings are then allocated between regions according to the ownership structure of Alaskan Charter Halibut Permits (CHPs) derived in terms of the number of endorsed anglers. The adopted in the model flow of earnings for the charter sector is depicted in **Figure 7**. No statistics on labor composition in the charter sector were identified.

The annual variation in sport fishing participation is derived from the Alaska Sport Fishing Survey that the Sport Fish Division of the ADFG conducts annually to estimate sport fishing total harvest, total catch and participation in the number of anglers, the number of days fished, and the number of trips by type (bottomfish, salmon, mix).[22] Pacific halibut share is estimated as a share of bottomfish trips in total saltwater angler trips. This excludes mixed trips as it is assumed that these would still take place even if Pacific halibut was excluded from the choice set. Share of resident charterer angler-days is based on Marine Recreational Information Program (MRIP) query results (NOAA, 2021c). Non-residents anglers are then distributed between regions outside Alaska based on the report by Southwick Associates (2014).

[22] Estimated number of trips by type is available for 2010-2014 in Powers and Sigurdsson (2016). The more recent estimates were provided to the IPHC directly by the ADFG. General recreational effort statistics are available through the ADFG website (ADFG, 2021).

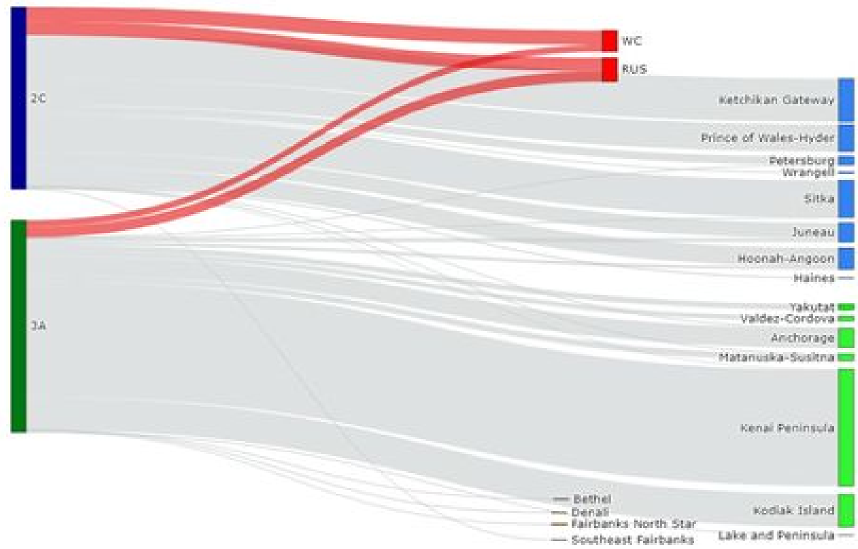


Figure 7: Ownership structure in Alaska charter sector. Plot uses 2020 data.

On the US West Coast, marine recreational fishing is monitored by the Pacific Coast Recreational Fisheries Information Network (RecFIN, 2021). RecFIN surveys include the Ocean Sampling Program and Puget Sound Sampling Program, administered in Washington, the Ocean Recreational Boat Survey and Shore and Estuary Boat Survey, administered in Oregon, and the California Recreational Fishing Surveys. Participation in the recreational fishery is reported in terms of the number of angler trips and the number of boat trips per region, mode, and trip type. Trip type is defined in terms of target species.

For the charter sector in the WOC region production structure, the PHMEIA-r model utilizes data from the NOAA input-output model for the Pacific Coast fisheries (Leonard and Watson, 2011) for distribution of revenue estimates updated using trends reported by RecFIN. WOC revenue for the guided sector is assessed based on the values reported in the report *The Economic Contribution of Marine Angler Expenditures in the United States* (Lovell, Steinback and Hilger, 2013), using the charter fees and crew tips expenditure categories.

Pacific halibut share is derived based on the share of angler-trips designated as halibut trips by RecFIN (in 2019, 0.9% for charter sector, 1.8% for the recreational sector overall). The Pacific halibut earnings are assumed to be mostly retained within the WOC region as 99% of 2A Pacific halibut sport licenses are held by residents of Washington, Oregon, and California. The out-of-state participation rate is derived from the MRIP query.

Catch and effort data for recreational fishing in British Columbia is collected using the Internet Recreational Effort and Catch (iREC) reporting program. The program collects information every month from randomly selected participants on fishing activity including kept and released catch of over 80 species of finfish and shellfish, as well as effort information by date, area, and fishing method. Canadian catch and effort data is also collected via logbooks, lodge manifests, and recreational creel surveys.

Effort estimates for British Columbia are used to approximate annual changes in revenue reported for 2015 in DFO's nation-wide *Survey of Recreational Fishing in Canada* (DFO, 2019). Revenue for the guided sector is assessed based on the results for the anglers' expenditures on the package deals and fishing services. The distribution of BC revenue between expenditure items follows estimates for the WOC region. Recreational sector dependence on Pacific halibut was estimated using BC annual recreational limit and general estimates for the IPHC Regulatory Area 2A.

Demand for goods and services related to anglers' fishing trips, both guided and unguided, also contributes to the economy. In addition to economic impact related to Pacific halibut sectors, PHMEIA-derived multipliers are used to estimate economic impact related to marine angler expenditures on fishing trips (travel, lodging, other trip-related expenses) and durable goods (rods, tackle, boat purchase, other fishing equipment and accessories, second home, or additional vehicle purchase).

Periodically, all anglers in the United States are surveyed about their annual expenditures on saltwater recreational fishing. The latest survey covering both trip-based expenditures (e.g., ice, bait, and fuel) and cost of fishing equipment and other durable goods (e.g., fishing rods, fishing tackle, and boats) was conducted in 2011 (Lovell, Steinback and Hilger, 2013). A reduced scope survey, inquiring only about expenditures on durable goods, was conducted last in 2014 (Lovell *et al.*, 2016).[23]

BC Stats reports on key indicators for sport fishing, including GDP, revenue, employment, and wages associated with sport fishing activities in *British Columbia's Fisheries and Aquaculture Sector* report, but the latest data are available for 2016 (Sun and Hallin, 2018). The revenues therein are based on the *Survey of Recreational Fishing in Canada* conducted in 2015 (DFO, 2019). The survey targets all individuals identified in the provincial and territorial recreational fishing license databases and inquiries about direct expenditures associated with their fishing trips.

Table 8 summarizes available recreational fishing statistics, including data on participation, revenue, and expenditures in all Pacific halibut producing regions.

[23] Expenditures on durable goods accounted for 33% and 66% of the total expenditures in 2011 in Alaska and WOC, respectively.

Table 8: Recreational fishing statistics – available data on participation, revenue and expenditures.

Region	2014	2015	2016	2017	2018	2019	2020	Unit	Source
Effort – saltwater recreational fishing									
AK	876.5	890.1	782.4	811.9	773.7	829.7	565.6	1000 angler-trips	(NOAA, 2021c)
BC	NA	2,014.3	*NA*	*NA*	*NA*	*NA*	*NA*	1000 angler-days	(DFO, 2019)
WOC[1]	2,844.8	2,939.3	2,664.3	2,733.0	1,796.8	1,832.6	1,389.8	1000 angler-trips	(RecFIN, 2021)
Effort - saltwater party/charter/guided fishing									
AK	248.9	253.8	255.1	260.3	262.4	262.6	*NA*	1000 angler-days	ADFG
BC	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-	-
WOC[1]	653.2	713.1	657.0	667.2	654.4	670.8	452.1	1000 angler-trips	(RecFIN, 2021)
Participation in Pacific halibut recreational fishing									
AK-guided[2]	199.4	199.4	205.0	205.7	210.5	210.3	191.6[3]	1000 angler-days	(Webster and Powers, 2020)
AK-unguided	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-	-
BC	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-	-
WOC-charter[4]	5.4	5.8	5.7	6.9	5.6	5.9	4.57	1000 angler-trips	(RecFIN, 2021)
WOC-private[4]	18.9	20.7	26.2	28.2	27.3	26.2	23.55	1000 angler-trips	(RecFIN, 2021)
Business revenue from saltwater recreational fishing									
AK	*NA*	116.1[5]	*NA*	111.5[5]	*NA*	*NA*	*NA*	mil. USD	(Lew and Lee, 2018, 2019)
BC	598.2	626.9[6]	655.7	*NA*	*NA*	*NA*	*NA*	mil. CAD	(Sun and Hallin, 2018; DFO, 2019)
WOC[7]	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-	-
Expenditures on saltwater recreational fishing									
AK	115[8]	122.4[5]	*NA*	89.2[5]	*NA*	*NA*	*NA*	mil. USD	(Lovell *et al.*, 2016; Lew and Lee, 2018, 2019)
BC	*NA*	578.1	*NA*	*NA*	*NA*	*NA*	*NA*	mil. CAD	(DFO, 2019)
WOC	2219[8]	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	mil. USD	(Lovell *et al.*, 2016)

Notes: *NA* indicates that the value is not available. All monetary values in current USD/CAD, as reported in the cited source. [1]Includes estuary fishing. [2]Effort here is defined as angler-days with recorded bottomfish hours or harvest of at least one halibut. However, because mix trips are commonplace in Alaska, the PHMEIA-r model adopts the share of reported bottomfish trips (excluding mix trips) vs. all saltwater trips, to calculate the share of Pacific halibut dependent effort. [3]Forecast. [4]In general this could include California halibut (species not specified), although no halibut trips are reported for California. [5]Includes only the charter sector. [6]Revenue for the guided sector in the PHMEIA-r model is assessed based on the results of DFO's Survey of Recreational Fishing in Canada, and follows from the estimates on the anglers' expenditures on the Package Deals and Fishing Services. [7]Revenue for the guided sector in the PHMEIA-r model is assessed based on the values reported in the report *The Economic Contribution of Marine Angler Expenditures in the United States* (Lovell, Steinback and Hilger, 2013), using the following expenditure categories: charter fees and crew tips. [8]Includes only expenditures on durable goods. These accounted for 33% in Alaska and 66% in WOC of the total expenditures in 2011 (Lovell, Steinback and Hilger, 2013).

MODEL RESULTS

The PHMEIA model results suggest that Pacific halibut commercial fishing's total estimated impact in 2019 amounts to USD 195.9 mil. (CAD 259.9 mil.) in earnings,[24] including an estimated USD 52.5 mil (CAD 69.7 mil) in direct earnings in the Pacific halibut commercial fishing sector and USD 12.2 mil. (CAD 16.1 mil.) in the processing sector, and USD 179.1 mil (CAD 237.6 mil.) in household income.[25] The results also suggest that Pacific halibut commercial fishing contributed USD 279.7 mil. (CAD 371.1 mil.) to the GDP of Canada and the United States, created over 5,000 jobs and is linked to over USD 550 mil. (CAD 730 mil) of output of Canadian and American economy (**Table 9**). This is about 4.1 times the fishery output value of USD 134.1 mil. (CAD 177.9 mil.) recorded for 2019.

Table 9: Economic impact of Pacific halibut commercial fishing (2019).

	Value in mil. USD*	Value in mil. CAD	Value (in mil. USD/CAD) per 1 mil. USD/CAD of output
Value of landings	134.1	177.9	-
Economic impact - output**	550.9	731.0	4.1
Economic impact – contribution to the GDP	279.7	371.1	2.1
Economic impact – earnings	195.9	259.9	1.5
Economic impact – wages	145.2	192.6	1.1
Economic impact - employment	5058		37.7/28.4
Household income	179.1	237.6	1.3

*With exception of employment, which is reported in number of jobs.**Adjusted for processing value added only; does not include the fish buying cost.

Detailed results are provided for 2019 as this represents a more typical year for the economy. The estimates for 2020 suggest that Pacific halibut commercial sectors' contribution to households decreased by 25%, and output related to Pacific halibut commercial fishing decreased by 27%. **Figure 8** depicts EI estimates for Pacific halibut commercial fishing for 2014-2020 in comparison with landed value. To make the values comparable over time, the estimates are adjusted for inflation and expressed in 2020 USD.[26] The figure also reports on Pacific halibut contribution to personal income in Alaska as a share of total income. This has been decreasing from ca. 0.5% in 2014-2017 to 0.3% in 2020.

[24] Earnings include both employee compensation and proprietors' income.

[25] Income reflects earnings adjusted for any transfers, including interregional spillovers, i.e., income is related to the place of residence, not the place of work.

[26] The adjusted estimates use the GDP deflator based on data published by the Organisation for Economic Co-operation and Development (OECD, 2021).

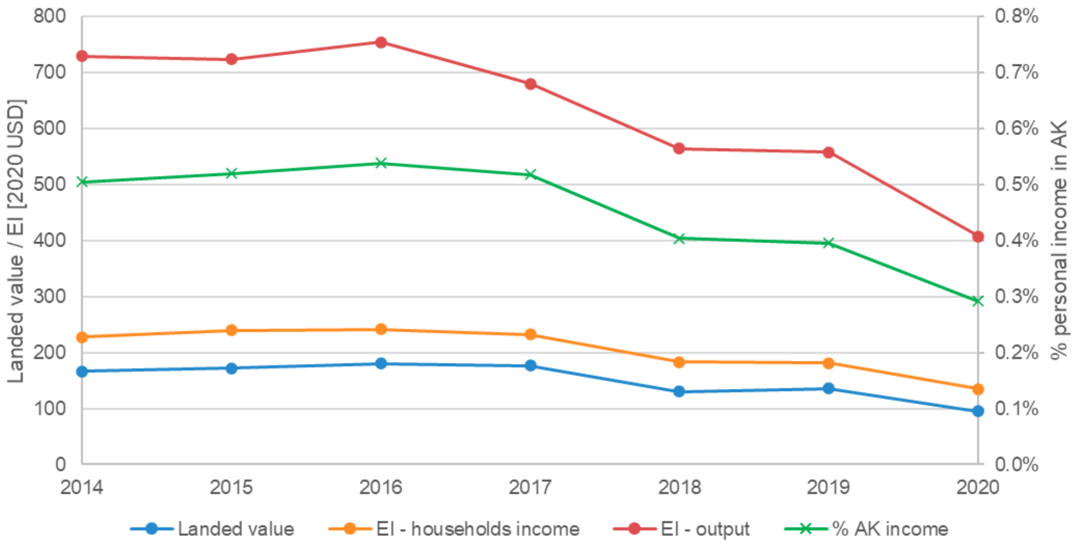


Figure 8: Pacific halibut commercial fishing EI estimates for 2014-2020 in comparison with landed value in mil 2020 USD, and Pacific halibut contribution to personal income in Alaska as a share of total income (secondary axis).

The charter sector contribution to economic activity is estimated at USD/CAD 3.4 per one USD/CAD spent on party/charter fishing services, adding to USD 132.6 mil (CAD 176.0 mil) economic impact in terms of output. The total contribution of the Pacific halibut charter sector to household income is assessed at USD 42.2 mil. (CAD 55.9 mil.) for 2019 (**Table 10**, including a comparison with the commercial sector). Accounting for angler expenditures on fishing trips and durable goods adds another USD 104.7 mil. (CAD 139.0 mil.) to the impact of recreational fishing on households' welfare. This translates into 19% less per 1 USD/CAD of output for the charter sector and 45% less for the recreational sector overall in comparison with the commercial sector when looking at impact per USD/CAD of landed value (for the commercial sector) and USD/CAD spent (for the recreational sector, including trip costs and expenditures on durable goods). This is not surprising since the commercial sector's production supports not only suppliers to the harvesting sector, but also the forward-linked processing sector (thus, also households employed by these sectors). Recreational sector results, on the other hand, to a large degree are driven by expenditures on goods that are often imported, consequently supporting households elsewhere.

A somewhat different picture emerges when comparing EI per pound of Pacific halibut removal counted against allowed catch by area in the stock assessment. This measure is 63% higher for the charter sector, and more than double for the recreational sector overall when compared with the commercial sector. These differences, however, are less pronounced when focusing only on the EI retained within the harvest region (56% and 139%, respectively).

The Pacific halibut recreational fishing total contribution to economic activity stands at USD 463.4 mil. (614.8 mil). Adding the commercial sector, the total economic activity linked to the Pacific halibut sectors is estimated at USD 1,014 mil. (CAD 1,346 mil), and contribution to households at USD 326 mil. (CAD 432 mil.). See Appendix C for the full set of results.

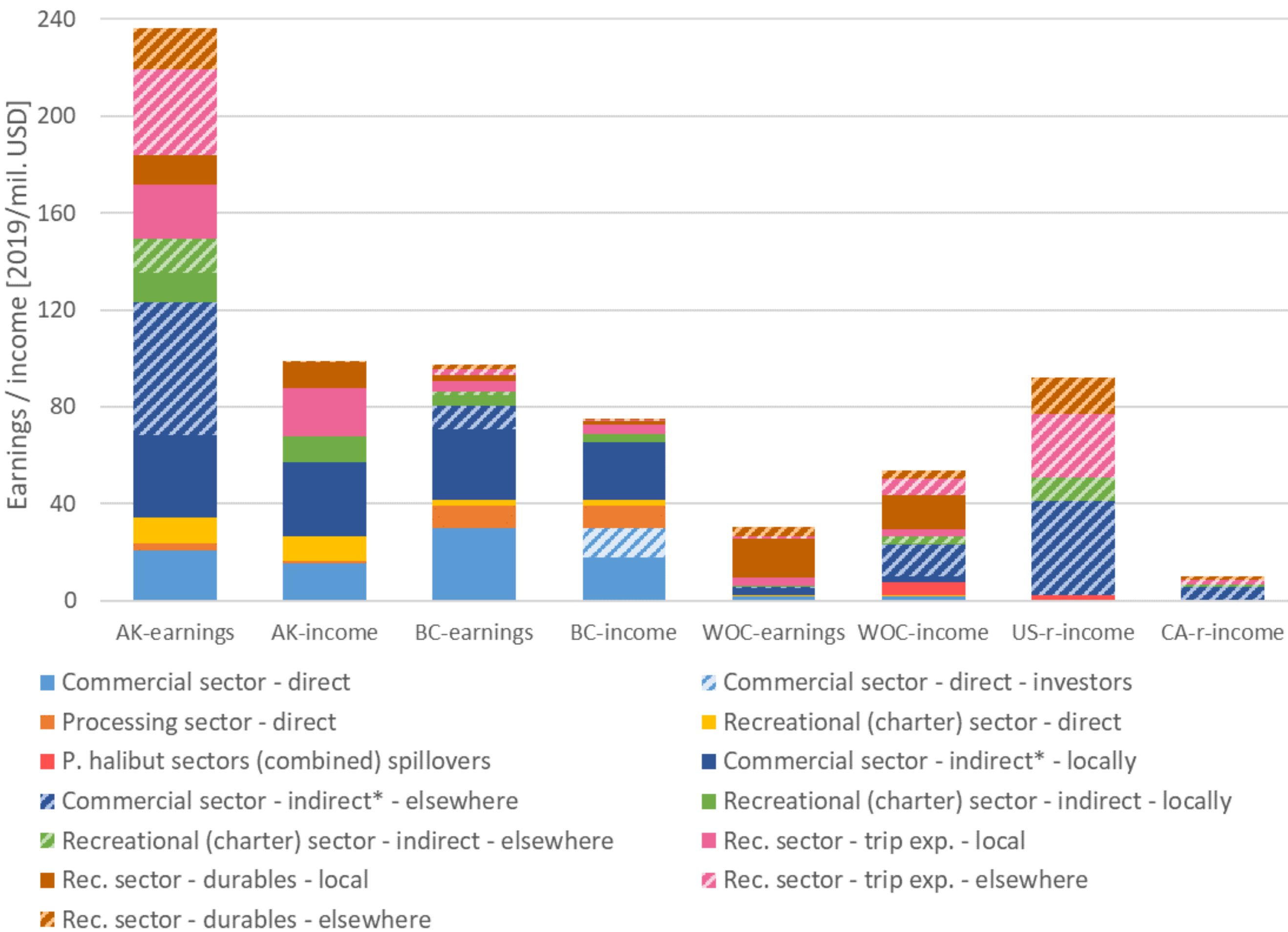
It should also be noted, however, that this analysis should not be used as an argument in sectoral allocations discussions because, as a snapshot analysis, it does not reflect the implications of shifting supply-demand balance. Participation in sport fishing does not typically scale in a linear fashion with changes to harvest limits.

Table 10: Economic impact on households.

Economic impact	Unit	Commercial	Charter[(1)]	Recreational
EI on households	Total in mil. USD/CAD	179.1/237.6	42.2/55.9	146.9/194.9
EI locally (excludes spillovers)	Total in mil. USD/CAD	114.1/151.4	27.6/36.6	79.0/104.9
EI on households	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	1.34	1.08	0.74[(2)]
EI locally (excludes spillovers)	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	0.85	0.71	0.40[(2)]
EI on households	USD/CAD per 1 lb of removals	7.4/9.8	12.0/15.9[(3)]	20.9/27.7
EI locally (excludes spillovers)	USD/CAD per 1 lb of removals	4.7/6.2	7.3/9.7[(3)]	11.2/14.9

Notes: [(1)] This includes only the economic impact generated through businesses offering charter trips, i.e., it excludes the impact of angler expenditures other than charter fees. [(2)]In A considerable share of angler expenditures originates from import, which drives the estimate down. [(3)]Charter sector impact per 1 lb of removals was based on EI on households for Alaska where removals estimates are clearly divided between guided and unguided sectors.

Figure 9 depicts elements of the impact of Pacific halibut commercial and recreational fishing on household earnings and income, highlighting the importance of considering cross-regional flows related to Pacific halibut. Earnings estimates (bars with '-earnings' suffix) summarize economic impact by place of work (i.e., where the fishing activity occurs), while income estimates (bars with '-income' suffix) reflect earnings after adjustments for cross-regional flows, i.e., provide estimates by the place of residence of workers, business owners, or owners of production factors (i.e., quota or permit owners). These results can be compared with EI expressed in terms of output, that is the total production linked (also indirectly) to the Pacific halibut sectors (**Figure 10**). The figure distinguishes between the impact by fishery (i.e., by region where the fishing activity occurs, bars with '-fishery' suffix) and impact by region (i.e., by region where the impact is realized; bars with '-region' suffix).

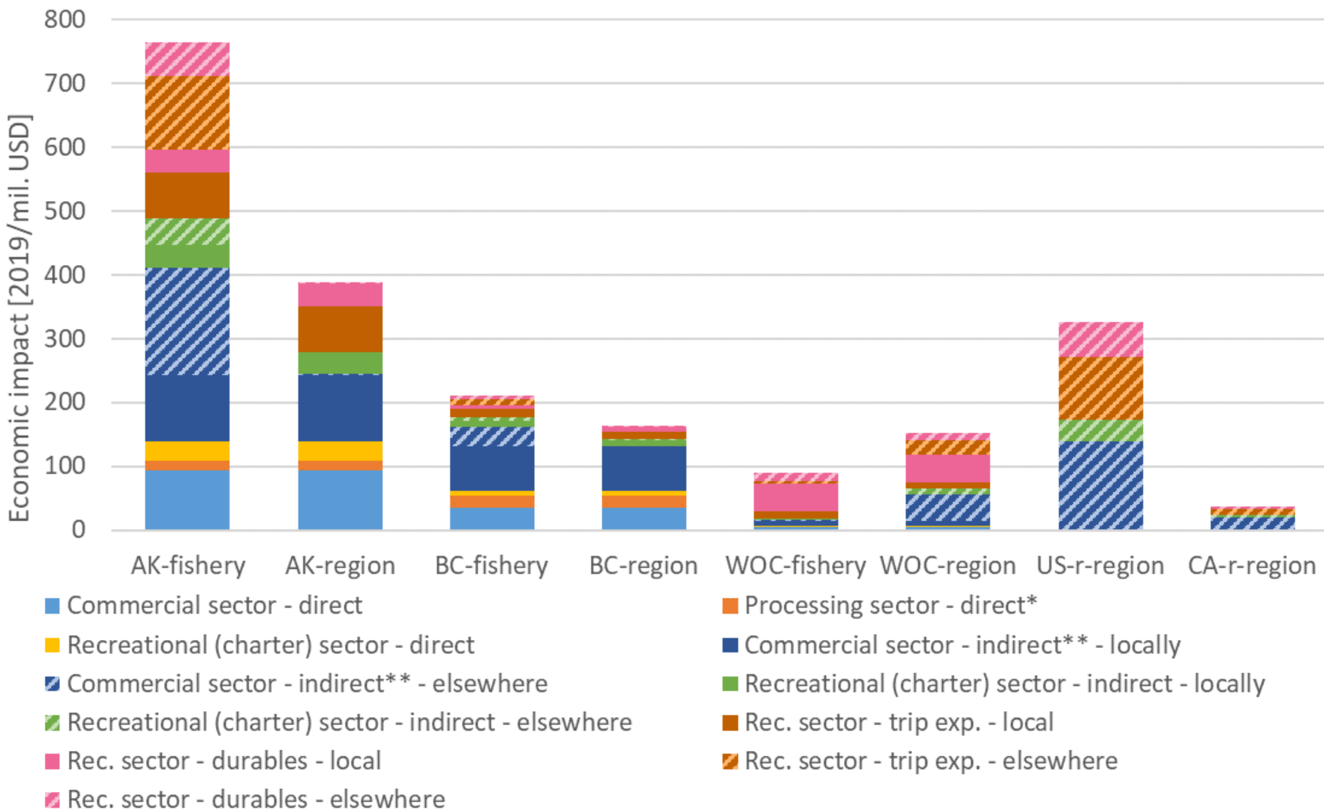


Notes: Legend description available in Box 1. Figure omits the impact on ROW (marginal).*Commercial indirect impact includes processing.

Figure 9: Pacific halibut impact on household earnings and income (2019).

Box 1: Figure 9 legend description

a) **Commercial sector – direct**: includes earnings and income directly attributable to the Pacific halibut commercial fishing sector within the indicated region.
b) **Commercial sector - direct – investors**: indicates the share of the income described in **Commercial sector – direct** that is retained in the region, but flows from the fishing sector to investors. This component captures the value of the leased quota paid to non-fishing stakeholders.
c) **Processing sector – direct**: includes earnings and income directly attributable to the Pacific halibut processing sector within the indicated region.
d) **Recreational (charter) sector – direct**: includes earnings and income directly attributable to businesses offering Pacific halibut sport fishing within the indicated region.
e) **P. halibut sectors (combined) spillovers**: include income attributable to Pacific halibut sectors (commercial fishing, processing, sport fishing) that leaks from the region where the activity occurs as a result of cross-regional flows.
f) **Commercial sector - indirect* - locally**: includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
g) **Commercial sector - indirect* - elsewhere**: as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings' bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-income' bars).
h) **Recreational (charter) sector - indirect – locally**: includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
i) **Recreational (charter) sector - indirect – elsewhere**: as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-region' bars).
j) **Rec. sector - trip exp. – local**: includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
k) **Rec. sector - trip exp. – elsewhere**: includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).
l) **Rec. sector - durables – local**: includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
m) **Rec. sector - durables – elsewhere**: includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).



Notes: Legend description available in Box 2. The figure omits the impact on the ROW (marginal). *Adjusted to the wholesale mark-up and does not include fish buying cost; **Commercial indirect impact includes processing.

Figure 10: Pacific halibut economic impact in terms of output (2019).

Box 2: Figure 10 legend description

a) **Commercial sector – direct**: includes direct output of the Pacific halibut commercial fishing sector, which is equivalent to the landing value or value of sales by Pacific halibut directed commercial fisheries. This component is equal in the 'by fishery' and 'by region' EI estimate.

b) **Processing sector – direct***: includes direct output of the Pacific halibut processing sector (wholesale value) adjusted to include only the wholesale mark-up. This means that the estimate does not include the fish buying cost, avoiding this way double counting the landing value of the Pacific halibut commercial sector in the EI estimate. This component is equal in the 'by fishery' and 'by region' EI estimate.

c) **Recreational (charter) sector – direct**: includes value of direct sales by businesses offering services in the form of guided Pacific halibut recreational (sport) fishing (charter boats, fly-in loges, package deals, etc.). The estimate intends to capture the share of output by the sport fishing sector that depends on the Pacific halibut resource availability, i.e., it is adjusted for mixed target species offers. This component is equal in the 'by fishery' and 'by region' EI estimate.

d) **Commercial sector - indirect** - locally**: includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.

e) **Commercial sector - indirect** - elsewhere**: as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).

f) **Recreational (charter) sector - indirect – locally**: includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.

g) **Recreational (charter) sector - indirect – elsewhere**: as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).

h) **Rec. sector - trip exp. – local**: includes an estimate of the economic contribution of marine angler trip expenditures (travel, lodging, other trip-related expenses) that is realized locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.

i) **Rec. sector - trip exp. – elsewhere**: includes an estimate of the economic impact of marine angler trip expenditures (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).

j) **Rec. sector - durables – local**: includes an estimate of the economic contribution of marine angler expenditures on durable goods (rods, tackle, bout purchase, other fishing equipment and accessories, second home, or additional vehicle purchase) that is occurring locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.

k) **Rec. sector - durables – elsewhere**: includes an estimate of the economic impact of marine angler expenditures on durable goods (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).

PHMEIA model also informs on the economic impact by county (limited to Alaska), highlighting regions where communities may be particularly vulnerable to changes in the access to the Pacific halibut resource. In 2019, from USD 23.7 mil. (CAD 31.4 mil.) of direct earnings from Pacific halibut commercial sectors in Alaska, 70% was retained in Alaska.[27] These earnings were unevenly distributed between Alaskan counties, as shown in the map below (**Figure 11**, see also **Table 11**). The most direct earnings per dollar landed are estimated for Ketchikan Gateway, Petersburg, and Sitka countries, while the least for Aleutians East, Yakutat, and Aleutians West counties. Low earnings per 1 USD of Pacific halibut landed in the county are a result of the outflow of earnings related to vessels' home base, vessels' ownership, and quota ownership, processing locations, and processing companies' ownership.

Notes: According to the PHMEIA estimates, Alaska retained 70% of direct earnings within the state.

Figure 11: County-level estimates of direct earnings in the Pacific halibut commercial sectors in Alaska in 2019.

[27] Community effects assessment is currently limited to Alaska. The feasibility of a similar assessment for other regions is under investigation. For example, Canadian quotas (L fishery), which are vessel-based, can be allocated based on vessel owner's residency, searchable in the Canadian Register of Vessels available through Transport Canada's Vessel Registration Query System.

Table 11: County-level estimates of direct earnings in the Pacific halibut commercial sectors in Alaska in 2019.

County	Estimated earnings from Pacific halibut commercial sectors (fishing and processing)	Earning per 1 USD of Pacific halibut landed in the county	Change in % value of landings vs. % estimated earnings
Aleutians East	0.28	**0.057**	-
Aleutians West	1.27	**0.114**	-
Anchorage	0.41	NA	+
Bristol Bay	c	NA	+
Dillingham	c	c	c
Fairbanks North Star	c	NA	+
Haines	0.15	NA	+
Hoonah-Angoon	0.34	0.173	-
Juneau	1.46	0.210	+
Kenai Peninsula	**3.93**	0.151	-
Ketchikan Gateway	0.32	**0.412**	+
Kodiak Island	**2.71**	0.311	+
Lake and Peninsula	c	NA	c
Matanuska-Susitna	c	NA	+
Nome	0.18	0.238	+
Petersburg	**2.38**	**0.371**	+
Prince of Wales-Hyder	0.19	0.309	+
Sitka	0.89	**0.358**	+
Skagway	c	NA	+
Southeast Fairbanks	c	NA	+
Valdez-Cordova	0.68	0.147	-
Wrangell	0.45	0.183	-
Yakutat	0.55	**0.097**	-

Notes: Counties with no Pacific halibut landings or earnings from Pacific halibut sectors omitted. Full economic impact omitted, pending research on cross-county commodity flows in Alaska. c – masked to preserve confidentiality; NA – not applicable (no landings reported for the given county).

ECONOMIC IMPACT VISUALIZATION TOOL

The Model results section focuses mainly on the economic impact on households' prosperity (income by place of residence) as the most meaningful metric to the general population. The economic impact is also often expressed in terms of output, that is the total production linked (also indirectly) to the evaluated sector. However, the economic impact can be expressed with various other metrics, including compensation of employees, contribution to the GDP, and employment opportunities, and derived for just a subset of sectors. Regulators and stakeholders may also be interested in assessing various combinations of regional allocations of mortality limits. Thus, the PHMEIA and PHMEIA-r are accompanied by the economic impact visualization tool[28] designed to display the full set of model results. The use of this application can be guided by the PHMEIA app manual (IPHC-2021-ECON-04).

[28] The tool is available at: http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/ (full link for printed version).

The latest release of the app (January 11, 2022) also translates harvest allocations by IPHC Regulatory Area to county-level estimates of direct earnings using data described in subsection Cross-county flows in Alaska. While the community impact assessment is currently limited to Alaska, the feasibility of improving the model resolution for other regions is considered in the *IPHC's 5-year program of integrated research and monitoring (2022-26)* (IPHC-2021-IM097-12).

ECONOMIC IMPACT OF SUBSISTENCE FISHING

Previous research suggested that noncommercial or nonmarket-oriented fisheries' contribution to national GDP is often grossly underestimated, particularly in developing countries (e.g., Zeller, Booth, and Pauly 2006). Subsistence fishing is also important in traditional economies, often built around indigenous communities. Wolfe and Walker (1987) found that there is a significant relationship between the percentage of the native population in the community and reliance on wildlife as a food source in Alaska. However, no comprehensive assessment of the economic contribution of the subsistence fisheries to the Pacific northwest is available. The only identified study, published in 2000 by Wolfe (2000), suggests that the replacement value of the wild food harvests in rural Alaska may be between USD 131.1 and 218.6 million, but it does not distinguish between different resources and assumes equal replacement expense per pound. Aslaksen et al. (2008) proposed an updated estimate for 2008 based on the same volume, noting that transportation and food prices have risen significantly between 2000 and 2008, and USD 7 a pound is a more realistic replacement value. This gives the total value of USD 306 million, but the approach relies upon the existence of a like-for-like replacement food (in terms of taste and nutritional value), which is arguably difficult to accept in many cases (Haener *et al.*, 2001) and ignores the deep cultural and traditional context of the Pacific halibut in particular (Wolfe, 2002). A more recent study by Krieg, Holen, and Koster (2009) suggests that some communities may be particularly dependent on wildlife, consuming annually up to 899 lbs per person, but no monetary estimates are derived. Moreover, although previous research points to the presence of sharing and bartering behavior that occurs in many communities (Wolfe, 2002; Szymkowiak and Kasperski, 2020), the economic and cultural values of these networks have yet to be thoroughly explored.

All-sectors-encompassing quantitative assessment of the economic impact of the Pacific halibut resource necessitates the development of a methodological approach for the remaining sources of Pacific halibut mortality, including subsistence fishing. Methods adopted for the commercial and charter sector are not adequate for this portion of the harvest. As a part of the socioeconomic study, the IPHC established a collaboration with the Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G), and will be participating in the following project: Fish, Food, and Fun: Exploring the Nexus of Subsistence, Personal Use, and Recreational Fisheries in Alaska (SPURF project). The SPURF project aims to understand the intersection of Alaska subsistence, personal use, and marine recreational fisheries in fulfilling household food needs and contribute to an improved understanding of the economic and social values of non-commercial Alaska fisheries. The project commenced in Fall 2021.

DISCUSSION AND CONCLUSIONS

The PHMEIA model fosters stakeholders' better understanding of a broad scope of regional impacts of the Pacific halibut resource. Leveraging multiple sources of socioeconomic data, it provides helpful insights for designing policies with desired effects depending on regulators' priorities. By tracing the socioeconomic impacts cross-regionally, the model accommodates the transboundary nature of the Pacific halibut and supports joint management of a shared resource, such as the case of collective management by the IPHC. Moreover, the study informs on the vulnerability of communities to changes in the state of the Pacific halibut stock throughout its range, highlighting regions particularly dependent on economic activities that rely on Pacific halibut. A good understanding of the localized effects is pivotal to policymakers who are often concerned about community impacts, particularly in terms of impact on employment opportunities and households' welfare. Fisheries policies have a long history of disproportionally hurting smaller communities, often because potential adverse effects were not sufficiently assessed (Carothers, Lew, and Sepez 2010; Szymkowiak, Kasperski, and Lew 2019).

The results suggest that the revenue generated by Pacific halibut at the harvest stage accounts for only a fraction of economic activity that would be forgone if the resource was not available to fishers in the Pacific Northwest. On average, in 2019, one USD/CAD of Pacific halibut commercial landings was linked to over four USD/CAD-worth economic activity in Canada and the United States and contributed USD/CAD 1.3 to households. In the recreational sector, one USD/CAD spent by recreational anglers was linked to USD/CAD 2.3 circulating in the economy and USD/CAD 0.7 impact on households. The total economic activity linked to Pacific halibut sectors is estimated at USD 1,014 mil. (CAD 1,346 mil), and contribution to households at USD 326 mil. (CAD 432 mil.), highlighting how important Pacific halibut is to regional economies. The estimates of county-level earnings in Alaska were unevenly distributed, but most importantly to resource managers and policymakers, the model suggests that the local earnings were often not aligned with how much was landed within the county.

Understanding the complex interactions within the fisheries sectors is now more important than ever considering how globalized it is becoming. Local products compete on the market with a large variety of imported seafood. High exposure to international markets makes seafood accessibility fragile to perturbations, as shown by the covid-19 outbreak (OECD, 2020b). Pacific halibut contribution to households' income dropped by a quarter throughout the pandemic. While signs of strong recovery were present in 2021 (Fry, 2021), the study calls attention to Pacific halibut sectors' exposure to external factors beyond stock condition. Fisheries are also at the forefront of exposure to the accelerating impacts of climate change. For example, a rapid increase in water temperature off the coast of Alaska in the mid-2010s, termed *the blob*, is affecting fisheries (Cheung and Frölicher, 2020) and may have a profound impact on Pacific halibut distribution.

Integrating economic approaches with stock assessment and management strategy evaluation (MSE) can assist fisheries in bridging the gap between the current and the optimal economic performance without compromising the stock biological sustainability. Economic performance metrics presented alongside already developed biological/ecological performance metrics bring the human dimension to the IPHC scientific products, adding to the IPHC's portfolio of tools for assessing policy-oriented issues. Moreover, the study can also inform on socioeconomic drivers (human behavior, human organization) that affect the dynamics of fisheries, and thus contribute to improved accuracy of the stock assessment and the MSE (Lynch, Methot and Link, 2018). As such, it can contribute to research integration at the IPHC (as presented in the *IPHC's 5-year program of integrated research and monitoring 2022-26,* IPHC-

2021-IM097-12) and provide a complementary resource for the development of harvest control rules, thus directly contributing to Pacific halibut management.

It is important to note, however, that the model continues to rely heavily on secondary data sources[29] such as NOAA or DFO surveys that did not necessarily target specifically Pacific halibut users or were not collected annually. As such, the model results are conditional on the adopted assumptions for the components for which data inputs were imputed or derived from broader scope surveys (as described in section Data inputs). While the Secretariat made the best use of data collection programs of national and regional agencies, academic publications on the topic, and grey literature reporting on fisheries in Canada and the United States, more accurate results can be achieved by incorporating into the model primary economic data collected directly from members of Pacific halibut-dependent sectors. The IPHC has been collecting economic data directly from stakeholders since 2020 through a web-based survey. More details on the survey can be found on the IPHC website. However, it should be recognized that the project was challenged by the COVID-19 pandemic that impacted particularly the components directly dependent on the inputs from stakeholders. Should the Commission wish to continue improving the PHMEIA, the Secretariat will introduce a modified strategy for primary data collection following the 2021 fishing season, including further simplification of the surveys. The Secretariat is also cautiously optimistic regarding engagement with stakeholders on socioeconomic data collection in post-covid times aimed at better characterization of the Pacific halibut sectors' economic impact.

Lastly, while the quantitative analysis is conducted with respect to components that involve monetary transactions, Pacific halibut's value is also in its contribution to the diet through subsistence fisheries and importance to the traditional users of the resource. To native people, traditional fisheries constitute a vital aspect of local identity and a major factor in cohesion. One can also consider the Pacific halibut's existence value as an iconic fish of the Northeast Pacific. While these elements are not quantified at this time, recognizing such an all-encompassing definition of the Pacific halibut resource contribution, the IPHC echoes a broader call to include the human dimension into the research on the impact of management decisions, as well as changes in environmental or stock conditions. The Secretariat is also anticipating being able to provide additional details on the economics of subsistence fishing as a part of reporting on the SPURF project (as described in section Economic impact of subsistence fishing).

FURTHER WORK

Looking forward, the Secretariat identified several tasks that would enhance the PHMEIA's ability to support the management of the Pacific halibut resource in fulfillment of the Commission's mandate. These are incorporated into the *IPHC's 5-year program of integrated research and monitoring (2022-26)* (IPHC-2021-IM097-12).

Expanding the static SAM model to a computable general equilibrium model

Relaxing the assumption of fixed technical coefficients by specifying these coefficients econometrically as a function of relative prices of inputs is one of the most compelling extensions to the static SAM-based model. Such models, generally referred to as computable general equilibrium (CGE) models, require

[29] That is data collected by other parties, not the IPHC.

research to develop credible functional relationships between prices and consumption that would guide economic agents' behavior in the model. The CGE approach is a preferred way forward when expanding the model usability and applying it in conjunction with the Pacific halibut management strategy evaluation. In addition, the dynamic model is well suited to analyze the impact of a broad suite of policies or external factors (e.g., climate change) affecting the stock over time.

Improving the spatial granularity of the SAM model

Extending the community analysis beyond a simplified approach relying on the calculated multiplier effects and local exposure to the region's Pacific halibut economic impact to a full community level (or any other spatial scale) SAM-based model requires identifying the economic relationships between different sectors or industries (including both seafood and non-seafood industries) within each broader-defined region, this including deriving estimates on intra-regional trade in commodities and flow of earnings. This extension of the current model has a great potential for more accurate estimates of the community effects. Detailing the geography of impacts of the Pacific halibut fisheries, paying particular attention to quantifying leakage of economic benefits from communities strongly dependent on fisheries, will provide a coherent picture of the exposure of fisheries-dependent households by location to changes in resource availability.

Study of recreational demand

It is important to note that while it is reasonable to assume that changes in harvest limits have a relatively proportional impact on production by commercial fishers (unless these are dramatic and imply fleet restructure or a significant shift in prices), the effects on the recreational sector are not so straightforward. A separate study estimating changes in saltwater recreational fishing participation as a response to the changing recreational harvest limits applicable to Pacific halibut is necessary to assess policy impacts in the recreational sector rather than provide a snapshot of economic impact. Such studies typically require surveying recreational fishers, but adoption of alternative approaches can be also assessed.

Study of demand for Pacific halibut products

Catches can be converted to revenues, but one has to determine what price to multiply harvests by. Since price fluctuates with harvest levels, pragmatic assessment of harvest limits changes needs to be supplemented with a model of demand for Pacific halibut. The demand-adjusted prices provide more economics-sound projections of gross revenues in the sector. The demand model (e.g., Synthetic Inverse Demand System) can also be used to estimate final consumer benefits from changing Pacific halibut harvests and prices (i.e., consumer surplus).

Analysis of Pacific halibut value chain

In 2021, fresh Alaskan Pacific halibut fillets routinely sold for USD 24-28 a pound, and often more, downtown Seattle (e.g., USD 38 at Pike Place Market). Pacific halibut dishes at the restaurants typically sell for USD 37-43 for a dish including a 6oz fish portion. The complete path of landed fish, from the hook to the plate, includes, besides harvesters, processors, and wholesalers, also retailers, and services. Pacific halibut is primarily sold to upscale retail outlets and white-tablecloth restaurants, resulting in a high price markup in the supply chain.

Understanding the formation of the price paid by final consumers (end-users) is an important step in assessing the contribution of Pacific halibut to the GDP along the entire value chain. However, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts (as defined in the Introduction section) beyond processors and wholesalers could be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail or services level gross revenues (Steinback and Thunberg, 2006). Moreover, isolating data on Pacific halibut wholesale, retail and services[30] is challenging given the limited availability of relevant statistics.

While economic impact multipliers (type of analysis requested in the economic study terms of reference) do not typically account for the sectors beyond processing because of the availability of substitutes, the suitability of alternative approaches can be considered. At the same time, the EI estimates herein are supplemented by analysis focused on the formation of mark-ups for Pacific halibut products (see Pacific halibut market profile in IPHC-2021-ECON-06).

Uncertainty in the PHMEIA model

The PHMEIA model results focus on the magnitude of the Pacific halibut contribution to the economy and its spatial distribution. To increase confidence in the PHMEIA results, the model needs to consider sources of input variations and the cumulative effect of interactions among them. The natural next step is to conduct sensitivity analysis to account for the uncertainties in the system. The current framework would benefit from proposing methods for calculating the range (confidence intervals) of impacts from input variations within a PHMEIA framework, explicitly accounting for multiple sources of input variations.

ACKNOWLEDGEMENTS

The report was written by Barbara Hutniczak with helpful comments from colleagues at the IPHC.

The author would like to acknowledge inputs from multiple agencies of Contracting Parties: NOAA (Chang Seung, Dan Lew, Jerry Leonard), ADFG (Sarah Webster, James Hasbrouck, Bill Romberg), DFO (Maureen Finn), and B.C. Ministry of Agriculture (Kevin Romanin, James Dalby, Katie Fraser, Fatemeh Mokhtarzadeh).

The author would also like to thank Forrest Braden (SEAGO), Brian Richie (Alaska Charter Association), Owen Bird (Fishing Institute of BC), Martin Paish and Chuck Ashcroft (Sport Fishing Advisory Board) for participation in discussions on the charter survey, and all IPHC economic survey participants who contributed to date to the assessment of the importance of the Pacific halibut resource to the economy of Canada and the United States of America.

[30] Note, this this refers to production structure, not mark-up within sector. Production structure here refers to the distribution of revenue between profit, labor compensation, business tax liabilities, and expenditure items.

LITERATURE

ADFG (2021) *Alaska Sport Fishing Survey database*, *Alaska Department of Fish and Game, Division of Sport Fish*. Available at: http://www.adfg.alaska.gov/sf/sportfishingsurvey.

AFSC (2019) *Wholesale Market Profiles for Alaska Groundfish and Crab Fisheries*, *Alaska Fisheries Science Center*. Available at: http://www.mcdowellgroup.net/wp-content/uploads/2020/09/wholesale-market-profiles-for-alaska-groundfish-and-crab-fisheries-noaa.pdf.

AgriService BC (2018) *British Columbia Fish Processing Employment 2016*.

AgriService BC (2020) *British Columbia Seafood Industry, Year in Review 2018*.

AK DLWD (2021) *Statewide Data: Fishing and Seafood Industry Data*, *Department of Labor and Workforce Development*. Available at: https://live.laborstats.alaska.gov/seafood/seafoodstatewide.cfm.

AKFIN (2021) *Alaska Fisheries Information Network (AKFIN) APEX reporting system*, *Alaska Fisheries Information Network*. Available at: https://reports.psmfc.org/akfin.

Aslaksen, I. *et al.* (2008) 'Interdependency of subsistence and market economies in the Arctic', in *The Economy of the North*. Statistics Norway. Available at: http://www.ssb.no/english/subjects/00/00/30/sa84_en/kap5.pdf.

Bachmann, C., Roorda, M. J. and Kennedy, C. (2015) 'Developing a multi-scale multi-region input-output model', *Economic Systems Research*, 27(2), pp. 172–193.

BEA (2021a) *Input-Output Accounts Data*, *Bureau of Economic Analysis*. Available at: https://www.bea.gov/industry/input-output-accounts-data.

BEA (2021b) *International Transactions, International Services, and International Investment Position Tables*. Available at: https://apps.bea.gov/iTable/iTable.cfm?reqid=62.

BEA (2021c) *Regional Economic Accounts: GDP and Personal Income*, *Bureau of Economic Analysis*.

BLS (2021) *Quarterly Census of Employment and Wages*, *US Bureau of Labor Statistics*.

Butcher, W. *et al.* (1981) 'Economic impacts of the Alaska shellfish fishery: an input-output analysis', *NOAA Technical Memorandum NMFS F/NWC*, 9.

Cai, J. *et al.* (2005) 'Economic linkage impacts of Hawaii's longline fishing regulations', *Fisheries Research*, 74, pp. 232–242. doi: 10.1016/j.fishres.2005.02.006.

Carbone, J. C. and Smith, V. K. (2013) 'Valuing nature in a general equilibrium', *Journal of Environmental Economics and Management*, 66(1), pp. 72–89. doi: https://doi.org/10.1016/j.jeem.2012.12.007.

Carothers, C., Lew, D. K. and Sepez, J. (2010) 'Fishing rights and small communities: Alaska halibut IFQ transfer patterns', *Ocean and Coastal Management*, 53(9), pp. 518–523. doi: 10.1016/j.ocecoaman.2010.04.014.

Castlemain (2019) *Analysis of commercial fishing licence, quota, and vessel values: Prepared for Fisheries and Oceans Canada, Pacific region*.

CFEC (2021a) *CFEC Public Search Application - Permits*. Available at: https://www.cfec.state.ak.us/plook/#permits.

CFEC (2021b) *CFEC Public Search Application - Vessels*. Available at: https://www.cfec.state.ak.us/plook/#vessels.

Chan, M. N., Beaudreau, A. H. and Loring, P. A. (2018) 'Evaluating the recreational fishery management toolbox: Charter captains' perceptions of harvest controls, limited access, and quota leasing in the guided halibut fishing sector in Alaska', *Marine Policy*, 91(February), pp. 129–135. doi: 10.1016/j.marpol.2018.02.013.

Cheung, W. W. L. and Frölicher, T. L. (2020) 'Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific', *Scientific Reports*, 10(1), pp. 1–10. doi: 10.1038/s41598-020-63650-z.

COAR (2021) *Commercial Fishing Reporting*, *Commercial Operator's Annual Reports*. Available at: https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar.

DFO (2019) *Survey of Recreational Fishing in Canada, 2015*.

Edwards, D. N. (2019) *Addressing questions on the social and economic outcomes of an individual transferable quota fishery*.

Edwards, D. N. and Pinkerton, E. (2019) 'Rise of the investor class in the British Columbia Pacific halibut fishery', *Marine Policy*, 109. doi: 10.1016/j.marpol.2019.103676.

Edwards, D. N. and Pinkerton, E. (2020) 'Priced out of ownership: Quota leasing impacts on the financial performance of owner-operators', *Marine Policy*, 111. doi: 10.1016/j.marpol.2019.103718.

Fry, C. (2021) 'Seawatch : Halibut prices soaring', *Homer News*. Available at: https://www.homernews.com/business/seawatch-halibut-prices-soaring/.

Gislason, G. *et al.* (2017) *Economic Impacts of Pacific Salmon Fisheries*.

Hackett, S. C. *et al.* (2005) 'Derby Fisheries, Individual Quotas, and Transition in the Fish Processing Industry', *Marine Resource Economics*, 20(1), pp. 47–60. Available at: http://search.proquest.com/docview/56421572?accountid=13042%5Cnhttp://oxfordsfx.hosted.exlibrisgroup.com/oxford?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ:econlitshell&atitle=Derby+Fisheries,+Individual+Quotas,+.

Haener, M. K. *et al.* (2001) 'Can Stated Preference Methods be used to Value Attributes of Subsistence Hunting by Aboriginal Peoples? A Case Study in Northern Saskatchewan', *American Journal of Agricultural Economics*, 83(5), pp. 1334–1340. doi: https://doi.org/10.1111/0002-9092.00287.

Homans, F. R. and Wilen, J. E. (1997) 'A model of regulated open access resource use', *Journal of Environmental Economics and Management*, 32, pp. 1–21. doi: 10.1006/jeem.1996.0947.

House of Commons Canada (2019) *West Coast Fisheries: Sharing Risks and Benefits*. Available at: https://www.ourcommons.ca/DocumentViewer/en/43-1/FOPO/report-1/.

IPHC (2021) *The Fishery-Independent Setline Survey (FISS)*, *International Pacific Halibut Commission*. Available at: https://www.iphc.int/management/science-and-research/fishery-independent-setline-survey-fiss.

IRS (2020) *SOI Tax Stats - Migration Data*, *Internal Revenue Service*. Available at: https://www.irs.gov/statistics/soi-tax-stats-migration-data.

Jackson, R. W. and Schwarm, W. R. (2007) 'Issues in the implementation of interregional commodity by industry input-output models', *Regional Research Institute Publications and Working Papers*, 72.

Kirkley, J. E. (2009) *The NMFS Commercial Fishing & Seafood Industry Input/Output Model (CFSI I/O Model)*.

Kreiger, R. and Whitney, S. (2021) *Nonresidents Working in Alaska 2019*, *Alaska Department of Labor and Workforce Development*.

Krieg, T. M., Holen, D. L. and Koster, D. (2009) *Subsistence harvests and uses of wild resources in Igiugig, Kokhanok, Koliganek, Levelock, and New Stuyahok, Alaska, 2005*.

Lahr, M. and de Mesnard, L. (2004) 'Biproportional Techniques in Input-Output Analysis: Table Updating and Structural Analysis', *Economic Systems Research*, 16(2), pp. 115–134. doi: 10.1080/0953531042000219259.

Lenzen, M. (2011) 'Aggregation versus disaggregation in input-output analysis of the environment', *Economic Systems Research*, 23(1), pp. 73–89. doi: 10.1080/09535314.2010.548793.

Leonard, J. and Watson, P. (2011) 'Description of the Input-Output model for Pacific Coast fisheries', *NOAA Technical Memorandum NMFS-NWFSC*, 111(April).

Leontief, W. (1966) *Input-output economics*. New York: Oxford University Press.

Leung, P. and Pooley, S. (2002) 'Regional economic impacts of reductions in fisheries production: A supply-driven approach', *Marine Resource Economics*, 16(4), pp. 251–262. doi: 10.1086/mre.16.4.42629336.

Lew, D. K. and Lee, J. (2018) 'Costs, Earnings, and Employment in the Alaska Saltwater Sport Fishing Charter Sector, 2015', *NOAA Technical Memorandum NMFS-AFSC*, 383. doi: 10.7289/V5KP803N.

Lew, D. K. and Lee, J. (2019) 'Costs, Earnings, and Employment in the Alaska Saltwater Sport Fishing Charter Sector, 2017', *NOAA Technical Memorandum NMFS-AFSC*, 398. Available at: https://repository.library.noaa.gov/view/noaa/22556.

Lovell, S. J. *et al.* (2016) 'The Economic Contribution of Marine Angler Expenditures on Durable Goods in the United States, 2014', *NOAA Technical Memorandum NMFS-F/SPO*, 165. Available at: http://spo.nmfs.noaa.gov/tm/ or http://www.st.nmfs.noaa.gov/economics/index.

Lovell, S. J., Steinback, S. and Hilger, J. (2013) 'The Economic Contribution of Marine Angler Expenditures in the United States, 2011', *NOAA Technical Memorandum NMFS-F/SPO*, 134. Available at: http://spo.nwr.noaa.gov/pp2.pdf.

Lynch, P. D., Methot, R. D. and Link, J. S. (2018) 'Implementing a Next Generation Stock Assessment Enterprise: Policymakkers' Summary', *NOAA Technical Memorandum NMFS-F/SPO-183*.

De Mesnard, L. (2004) 'Understanding the Shortcomings of Commodity-based Technology in Input–Output Models: an Economic-Circuit Approach', *Journal of Regional Science*, 44(1), pp. 125–141. doi: 10.1111/j.1085-9489.2004.00330.x.

Miller, R. E. and Blair, P. D. (2009) *Input-Output Analysis: Foundations and Extensions*. Cambridge: Cambridge University Press. doi: DOI: 10.1017/CBO9780511626982.

NOAA (2018) *Implementing a Next Generation Stock Assessment Enterprise: An Update to the NOAA Fisheries Stock Assessment Improvement Plan*, *NOAA Technical Memorandum NMFS-F/SPO*. Edited by P. D. Lynch, R. D. Methot, and J. S. Link.

NOAA (2020) *2020 Pacific Halibut Catch Sharing Plan*. Available at: https://www.fisheries.noaa.gov/action/2020-pacific-halibut-catch-sharing-plan.

NOAA (2021a) 'Fisheries Economics of the United States 2017', *NOAA Technical Memorandum NMFS-F/SPO-219*.

NOAA (2021b) 'Fisheries Economics of the United States 2018', *NOAA Technical Memorandum NMFS-F/SPO-225*.

NOAA (2021c) *Marine Recreational Information Program Query Results*. Available at:

https://www.fisheries.noaa.gov/data-tools/recreational-fisheries-statistics-queries.

NPFMC (2020) *Community Development Quota Program*, *North Pacific Fishery Management Council*. Available at: https://www.npfmc.org/community-development-program/.

OECD (2020a) *Exchange rates*. Available at: https://data.oecd.org/conversion/exchange-rates.htm.

OECD (2020b) 'Fisheries, aquaculture and COVID-19: Issues and Policy Responses', *Tackling Coronavirus (Covid-19)*.

OECD (2021) *Main Economic Indicators - complete database*, *Main Economic Indicators (database)*. Available at: https://doi.org/10.1787/data-00052-en.

Oosterhaven, J. (1988) 'On the plausibility of the supply-driven input–output model', *Journal of Regional Science*, 28(2), pp. 203–217. doi: 10.1111/j.1467-9787.1988.tb01208.x.

Oosterhaven, J. (1989) 'The supply-driven input–output model: a new interpretation but still implausible', *Journal of Regional Science*, 29(3), pp. 459–465. doi: 10.1111/j.1467-9787.1989.tb01391.x.

PacFIN (2021) *Pacific Fisheries Information Network (PacFIN) APEX reporting system*, *Pacific Fisheries Information Network*. Available at: https://reports.psmfc.org/pacfin.

PFMC (2020) *Pacific halibut*, *Pacific Fishery Management Council*. Available at: https://www.pcouncil.org/managed_fishery/pacific-halibut/.

Picek, O. and Schröder, E. (2018) 'Spillover effects of Germany's final demand on Southern Europe', *World Economy*, 41(8), pp. 2216–2242. doi: 10.1111/twec.12635.

Powers, B. and Sigurdsson, D. (2016) *Participation, Effort , and Harvest in the Sport Fish Business/Guide Licensing and Logbook Programs, 2014*.

RecFIN (2021) *Pacific Recreational Fisheries Information Network (RecFIN) APEX reporting system*, *Recreational Fisheries Information Network*. Available at: https://reports.psmfc.org/recfin/f?p=601.

Rorholm, N. *et al.* (1967) 'Economic Impact of Marine-oriented Activities: A Study of the Southern New England Marine Region', *Agricultural Experiment Station Bulletin*, 396. Available at: https://books.google.com/books?id=4aUpAQAAMAAJ.

Seung, C. K. (2014) 'Estimating effects of exogenous output changes: an application of multi-regional social accounting matrix (MRSAM) method to natural resource management', *Regional Science Policy & Practice*, 6(2), pp. 177–193. doi: 10.1111/rsp3.12037.

Seung, C. K. (2017) 'A Multi-regional Economic Impact Analysis of Alaska Salmon Fishery Failures', *Ecological Economics*, 138, pp. 22–30. doi: 10.1016/j.ecolecon.2017.03.020.

Seung, C. K. and Lew, D. K. (2017) 'A multiregional approach for estimating the economic impact of harvest restrictions on saltwater sportfishing', *North American Journal of Fisheries Management*, 37(5), pp. 1112–1129. doi: 10.1080/02755947.2017.1345808.

Seung, C. K. and Miller, S. (2018) 'Regional Economic Analysis for North Pacific Fisheries', *NOAA Technical Memorandum NMFS-AFSC*, 380.

Seung, C. K. and Waters, E. C. (2006) 'A review of regional economic models for fisheries management in the U.S.', *Marine Resource Economics*, 21(1), pp. 101–124. doi: 10.1086/mre.21.1.42629497.

Seung, C. K. and Waters, E. C. (2009) 'Measuring the economic linkage of Alaska fisheries: A supply-driven social accounting matrix (SDSAM) approach', *Fisheries Research*, 97(1), pp. 17–23. doi: https://doi.org/10.1016/j.fishres.2008.12.013.

Seung, C. K. and Waters, E. C. (2013) 'Calculating impacts of exogenous output changes: application of a social accounting matrix (SAM) model to Alaska fisheries', *The Annals of Regional Science*, 51(2), pp. 553–573. doi: 10.1007/s00168-012-0546-9.

Seung, C. K., Waters, E. and Taylor, M. L. (2019) 'Developing a Multi-Regional Social Accounting Matrix (MRSAM) for Southwest Alaska Fisheries', *NOAA Technical Memorandum NMFS-AFSC*, 399.

Southwick Associates (2014) *Alaska's Nonresident Anglers, 2009-2013*.

Squires, D., Kirkley, J. and Tisdell, C. A. (1995) 'Individual transferable quotas as a fisheries management tool', *Reviews in Fisheries Science*, 3(2), pp. 141–169. doi: 10.1080/10641269509388570.

Statistics Canada (2019) *Provincial Symmetric Input-Output Tables*. Available at: https://www150.statcan.gc.ca/n1/en/catalogue/15-211-X.

Statistics Canada (2021a) *Canadian International Merchandise Trade Database*. Available at: https://www5.statcan.gc.ca/cimt-cicm/home-accueil?lang=eng.

Statistics Canada (2021b) *Supply and Use Tables*. Available at: https://www150.statcan.gc.ca/n1/en/catalogue/15-602-X.

Statistics Canada (2021c) *Table 12-10-0098-01: Trade in goods by exporter characteristics, by industry of establishment*. Available at: https://doi.org/10.25318/1210009801-eng.

Statistics Canada (2021d) *Table 14-10-0023-01: Labour force characteristics by industry, annual*. Available at: https://doi.org/10.25318/1410002301-eng.

Statistics Canada (2021e) *Table 16-10-0048-01: Manufacturing sales by industry and province, monthly*. Available at: https://doi.org/10.25318/1610004801-eng.

Statistics Canada (2021f) *Table 16-10-0117-01: Principal statistics for manufacturing industries, by North American Industry Classification System (NAICS)*. Available at: https://doi.org/10.25318/1610011701-eng.

Statistics Canada (2021g) *Table 25-10-0021-01: Electric power, electric utilities and industry, annual supply and disposition*. Available at: https://doi.org/10.25318/2510002101-eng.

Statistics Canada (2021h) *Table 36-10-0221-01: Gross domestic product, income-based, provincial and territorial, annual*. Available at: https://doi.org/10.25318/3610022101-eng.

Statistics Canada (2021i) *Table 36-10-0224-01: Household sector, current accounts, provincial and territorial, annual*. Available at: https://doi.org/10.25318/3610022401-eng.

Statistics Canada (2021j) *Table 36-10-0402-01: Gross domestic product (GDP) at basic prices, by industry, provinces and territories*. Available at: https://doi.org/10.25318/3610040201-eng.

Statistics Canada (2021k) *Table 36-10-0432-01: Detailed household final consumption expenditure - sales taxes and expenditure excluding sales taxes, provincial and territorial, annual*. Available at: https://doi.org/10.25318/3610043201-eng.

Statistics Canada (2021l) *Table 36-10-0450-01: Revenue, expenditure and budgetary balance - General governments, provincial and territorial economic accounts*. Available at: https://doi.org/10.25318/3610045001-eng.

Steinback, S. and Gentner, B. (2008) 'The Economic Contribution of Marine Angler Expenditures in the United States, 2006', *NOAA Technical Memorandum NMFS-F/SPO*, 94. Available at: http://unicat.bangor.ac.uk:4550/resserv?genre=report&issn=&title=Economic+Contribution+of+Marine+Angler+Expenditures+in+the+United+States%252C+2006+%2528Revised+December+2008%2529&vo

lume=&issue=&date=2008-01-01&atitle=&spage=321&aulast=Gentner&sid=ProQ:Aq.

Steinback, S. R. and Thunberg, E. M. (2006) 'Northeast Region Commercial Fishing Input-Output Model', *NOAA Technical Memorandum NMFS-NE*, 188.

Su, B. *et al.* (2010) 'Input–output analysis of CO2 emissions embodied in trade: The effects of sector aggregation', *Energy Economics*, 32(1), pp. 166–175. doi: https://doi.org/10.1016/j.eneco.2009.07.010.

Sun, D. and Hallin, L. (2018) *British Columbia's Fisheries and Aquaculture Sector, 2016 Edition*. Available at: http://www.gov.bc.ca/com/copy/req.

Szymkowiak, M. and Kasperski, S. (2020) 'Sustaining an Alaska Coastal Community: Integrating Place Based Well-Being Indicators and Fisheries Participation', *Coastal Management*, pp. 1–25. doi: 10.1080/08920753.2021.1846165.

Szymkowiak, M., Kasperski, S. and Lew, D. K. (2019) 'Identifying community risk factors for quota share loss', *Ocean and Coastal Management*, 178, p. 104851. doi: 10.1016/j.ocecoaman.2019.104851.

Tanjuakio, R. V, Hastings, S. E. and Tytus, P. J. (1996) 'The Economic Contribution of Agriculture in Delaware', *Agricultural and Resource Economics Review*, 25(1), pp. 46–53. doi: 10.1017/s106828050000006x.

Temursho, U., Oosterhaven, J. and Cardenete, M. A. (2020) 'A multiregional generalized RAS updating technique', *Spatial Economic Analysis*, 2.

Timmer, M. P. *et al.* (2015) 'An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production', *Review of International Economics*, 23, pp. 575–605. Available at: http://www.wiod.org/database/wiots16.

US Census (2021a) *Annual Survey of Manufactures*, *United States Census Bureau*. Available at: https://www.census.gov/programs-surveys/asm.html.

US Census (2021b) *USA Trade® Online*. Available at: https://usatrade.census.gov/.

Waters, E. C. *et al.* (2014) 'Measuring the multiregional economic contribution of an Alaska fishing fleet with linkages to international markets', *Marine Policy*, 50, pp. 238–248. doi: https://doi.org/10.1016/j.marpol.2014.07.003.

Waters, E. C., Baker, J. R. and Taylor, M. L. (2016) *Collecting Borough and Census Area-Level Data for Regional Economic Modeling of Southwest Alaska Commercial Fisheries*.

Webster, S. and Powers, R. (2020) *Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2021: A Report to the North Pacific Fishery Management Council*.

Wolfe, R. J. (2000) *Subsistence in Alaska : A Year 2000 Update*.

Wolfe, R. J. (2002) *Subsistence halibut harvest assessment methodologies. Report prepared for the National Marine Fisheries Service, Sustainable Fisheries Division*. San Marcos, CA.

Wolfe, R. J. and Walker, R. J. (1987) 'Subsistence Economies in Alaska: Productivity, Geography and Development Impacts', *Arctic Anthropology*, 24(2), pp. 56–81.

Zeller, D., Booth, S. and Pauly, D. (2006) 'Fisheries Contributions to the Gross Domestic Product: Underestimating Small-scale Fisheries in the Pacific', *Marine Resource Economics*, 21(4).

APPENDIX A

		Region 1 (R1)						Region 2 (R2)						Exogenous accounts
		Industries	Commodities	LAB	PROP	Earnings	Households (HH)	Industries	Commodities	LAB	PROP	Earnings	Households	
Region 1 (R1)	Industries		V1											
	Com.	U1					Households' expenditure (R1)		T12					Government's expenditure Investment
	LAB	Employee compensation (R1) – LAB1												
	PROP	Proprietors' income (R1) – PROP1												
	Earn.			Net income from LAB1	Net income from PROP1							Inflow of earnings from region 1 to region 2 (Te12)		
	HH					Net earnings by place of residence (R1)								Government transfers Net property income
Region 2 (R2)	Industries								V2					
	Com.		Trade matrix – import by R1 from R2 (T21)					U2					Households' expenditure (R1	Government's expenditure Investment
	PROP							LAB2						
	PROP							GOS2						
	Earn.					Leakage/outflow of earnings from region 1 to region 2 (Te21)				Net income from LAB2	Net income from GOS2			
	HH											Net earnings by place of residence (R2)		Government transfers Net property income
Exogenous accounts		Taxes on production and imports GOS* (R1)		Social contributions (R1)			Personal income taxes Households' net savings (R1)	Taxes on production and imports GOS* (R2)		Social contributions (R2)			Personal income taxes Households' net savings (R2)	

Notes: GOS* represents gross operating surplus minus proprietors' income, i.e., consumption of fixed capital (CFC), corporate profits, and business current transfer payments (net).

APPENDIX B

		Region 1 (R1)									
		Industries	Commodities	LAB^{Ph} (Pacific halibut sectors)	PROP^{Ph} (Pacific halibut sectors)	LAB (other sectors)	PROP (other sectors)	Earnings from LAB^{Ph}	Earnings from PROP^{Ph}	Earnings from other sectors	Households
Region 1 (R1)	Industries		V1								
	Commo-dities	U1									Households' expenditure (R1)
	LAB^{Ph} (Pacific halibu	Employee compensation in Pacific halibut sectors (R1) – LAB^{Ph}1									
	PROP^{Ph} (Pacific	Proprietors income in Pacific halibut sectors (R1) – PROP^{Ph}1									
	LAB (other sectors)	Employee compensation in other sectors (R1) – LAB1									
	PROP (other sectors)	Proprietors income in other sectors (R1) - PROP1									
	Earnings from LAB^{Ph}			Net income from LAB^{Ph}1							
	Earnings from PROP^{Ph}				Net income from PROP^{Ph}1						
	Earnings from other sectors					Net income from LAB1	Net income from PROP1				
	House-holds							Net earnings from LAB^{Ph}1 by place of residence (R1)	Net earnings from PROP^{Ph}1 by place of residence (R1)	Other net earnings by place of residence (R1)	
Region 2 (R2)	(includes only outflows)							↓ Leakage related to out-of-state employment	↓ Leakage related to out-of-state quota or permit ownership and processing plant ownership	↓ Leakage of other earnings from region 1 to region 2	

APPENDIX C

Economic impact (EI) [2019]	Commercial sector			Charter sector			Recreational sector			Sum	
	In mil. USD(1)	In mil. CAD	R(2)	In mil. USD(1)	In mil. CAD	R(2)	In mil. USD(1)	In mil. CAD	R(2)	In mil. USD(1)	In mil. CAD
Value of landings/amount spent	134.1	177.9	-	38.9	51.6	-	198.3	263.1	-	-	-
EI - output(3)	550.9	731.0	4.1	132.6	176.0	3.4	463.4	614.8	2.3	1014	1346
EI - contribution to the GDP	279.7	371.1	2.1	66.5	88.2	1.7	266.2	353.2	1.3	546	724.3
EI – earnings	195.9	259.9	1.5	46.0	61.1	1.2	164.3	218.1	0.8	360	477.9
EI – wages	145.2	192.6	1.1	34.5	45.8	0.9	105.4	139.8	0.5	251	332.4
EI - employment	5058	-	38 (28)	2207	-	57 (43)	3948	-	20 (15)	9006	-
Household income	179.1	237.6	1.3	42.2	55.9	1.1	146.9	194.9	0.7	326	432

(1)With exception of employment, which is reported in number of jobs. (2)R – indicates value in USD (CAD) per 1 USD (CAD) of landed value (for the commercial sector) or USD (CAD) spent (for the charter and recreational sector; recreational sector includes trip costs and expenditures on durable goods). (3)For the commercial sector, adjusted for processing value added only; does not include the fish buying cost.

PACIFIC HALIBUT MARKET PROFILE

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK; 4 & 13 JANUARY 2022)

PURPOSE

The purpose of this document is to provide stakeholders with general information about the Pacific halibut markets and the formation of the price paid for Pacific halibut products by final consumers (end-users). The content of this analysis serves as a base for understanding Pacific halibut's contribution to the Gross Domestic Product (GDP) along the entire value chain, ***from the hook-to-plate***.

INTRODUCTION

Canada and the United States of America account for the majority (70-80% over the 2014-2019 period, **Table 1**) of Pacific halibut global output, as reported by the Food and Agriculture Organization of the United Nations (FAO, 2021b). The aquaculture output of Pacific halibut is currently marginal (not specified by the FAO (2021a)), but on the rise (Welch, 2020a). In Canada's and the United States' Pacific Northwest (including Alaska), Pacific halibut accounts for about 5% of fish production (harvest) value, while in terms of volume, less than 0.5% (based on 2019 data, AKFIN, 2021; DFO, 2021; PacFIN, 2021). This showcases its high unit value (typically over USD 5/lb, see also **Figure 1**) in comparison with other fisheries in the Pacific Northwest region.

Pacific halibut is a premium product known for its mild taste and flaky texture, suitable for a variety of dishes and flavor combinations. It is commonly grilled, fried, baked, sautéed, and poached. As it has relatively few bones, it makes for a popular food fish. It is primarily sold to upscale retail outlets and white-tablecloth restaurants, resulting in high price markups in the supply chain. Amidst the pandemic, Pacific halibut products also noted an increase in online sales, following the general trend for more seafood products consumption at home (Wells, 2020), but since then the restaurant industry started showing a strong recovery (Kelso, 2021).

Pacific halibut is typically consumed as fillets, but it is also sold as fletches,[1] steaks, collars, or cheeks. Cheeks are considered a high-valued delicacy. Fresh products are available during the Pacific halibut commercial fishing season, starting typically sometime in March and ending in November or December.[2] Frozen products can be found year-

[1] Fletch is a skinless fillet cut for large flatfish, such as Pacific halibut. The fletch is then further divided into boneless portions.

[2] Until 2019, the fishing season end date was set for November. In 2020, an extended commercial fishing season in Canada was agreed upon because of unusual circumstances (Covid-19 pandemic), and the extension allowed fishing

round. Excess fish parts are ground and discharged as waste or turned into fish meal (AFSC, 2019).

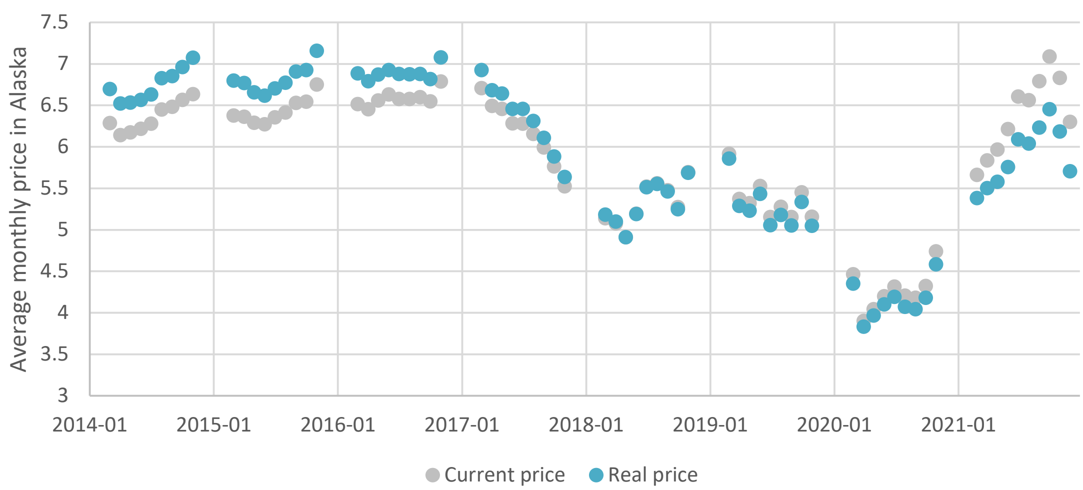
The majority of Pacific halibut on the North American market is produced from fish landed in Alaska or British Columbia, and processed in Canada or the United States, but wholesalers carry also Pacific halibut products originating from Russian waters processed in China. These are typically offered in the form of fletches (Tradex, 2021c).

The main substitute product is Atlantic halibut, but weak substitutes include Pacific cod and other whitefish (AFSC, 2019).

Table 1: *Global Pacific halibut production (t, round weight, 2014-2020).*

	2014	2015	2016	2017	2018	2019	2020[1]
Canada	3,619	3,710	3,747	3,812	3,330	3,163	2,959
USA	10,479	11,008	11,286	11,895	9,877	11,203	10,106
Russia	4,754	4,220	4,346	3,895	5,932	4,172	NA
% IPHC	74.8%	77.7%	77.6%	80.1%	69.0%	77.5%	NA

[1] Based on IPHC data. Note that the FAO data in principle should include harvest volume for all commercial, industrial, recreational, and subsistence purposes, and aquaculture. However, the FAO values for Canada and USA align with commercial landings reported by DFO (2021) and NOAA (2021a).



Notes: Based on eLandings data (ADFG, 2021). Converted from nominal to real prices using Consumer Price Index (CPI, BLS 2021), with baseline in January 2019.

Figure 1: *Average monthly Pacific halibut ex-vessel price in Alaska.*

in the IPHC Regulatory Area 2B up to December 7 (regulatory update from 17 September 2020). Current (2021) regulations provide for the fishing season lasting until December 7 in all IPHC Regulatory Areas (latest update from 22 February 2021).

PROCESSING AND PRIMARY WHOLESALE

The total value of Pacific halibut products processed by Alaska and British Columbia (i.e., wholesale value)[3] in 2019 was about USD 165.3 mil., of which Alaska accounted for 66%.[4] The covid-19 pandemic had a considerable impact on the 2020 output of the processing sector in Alaska. The state noted a 28% year-on-year drop in wholesale value, from USD 108.6 mil. in 2019 to USD 78.3 mil in 2020. However, the 2021 season was marked by a prompt recovery, with wholesale prices continuing an upward trend throughout the year (Tradex, 2021a). British Columbia noted a less pronounced Pacific halibut wholesale value drop between 2019 and 2020, about 10%, from USD 53.8 mil. to USD 48.2 mil. Early indicators for 2021 based on monthly data on sales by the *Seafood product preparation and packaging* sector in British Columbia (Statistics Canada, 2021b; data available for July-October) suggest a recovery in earlier months (year-on-year increase in July and August, data for January-June suppressed to meet the confidentiality requirements) but overall further decrease in sales by 11%.

The main Pacific halibut product of both Alaska and British Columbia is headed and gutted (H&G) fish. It accounted for 65% of 2019 Alaska production. Fresh products dominate British Columbia's production, while Alaska delivers a mix of fresh and frozen products (fresh products typically account for 50-60% of output value). **Figure 2** and **Figure 3** show year-to-year changes in Pacific halibut processing output by type of product (fresh, frozen, other, for Alaska only), and wholesale value in comparison with landings value (values in 2020 USD).

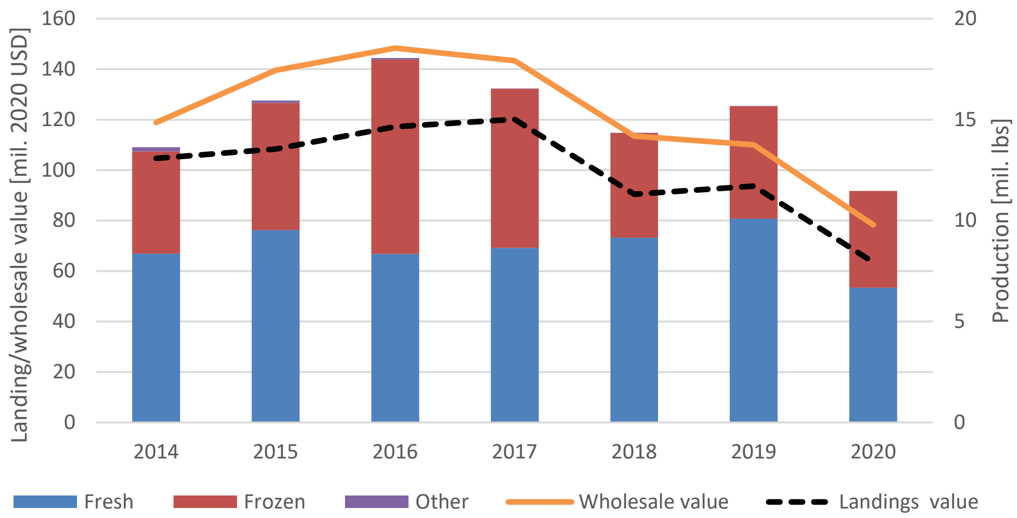
H&G fish are typically available as individually quick frozen (IQF) product, most commonly 60-80lb in size.[5] H&G fish marketed in North America are typically produced by national processors from Alaska and British Columbia's harvest. The second most popular product at the wholesale level is Pacific halibut IQF fletches (typically 1-3lb in size). The origin of

[3] This excludes commercial production in Washington, Oregon, and California (collectively, WOC). See details on gaps in economic statistics for the Pacific halibut processing sector described in IPHC-2021-ECON-02. The estimated output of the US West Coast is USD 5.0 mil. The estimate is based on the Pacific halibut multiregional economic impact assessment (PHMEIA) model (see details in IPHC-2022-AM098-INF04).

[4] The sum is based on values reported by the Alaska Department of Fish and Game (COAR, 2021) and the Province of BC (as reported to the IPHC, see IPHC-2021-AM097-NR01 or IPHC-2022-AM098-NR01) In the case of British Columbia, the wholesale value may include the value of imported seafood. This is not the case for Alaska, particularly not for the last number of years. As noted by the ADFG, there may be a handful of records pertaining to such scenario, but these are not recent (Sabrina Larsen, ADFG, personal communication). The Secretariat also discussed with the Province of BC the possibility of splitting locally sourced production and processing of imports, but no estimates related to product origin are currently available.

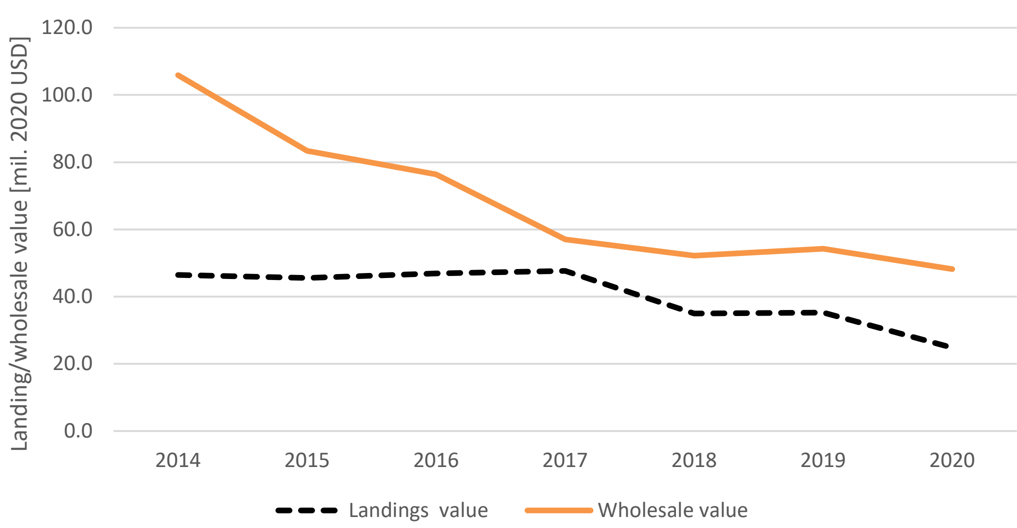
[5] Wholesale market analysis beyond statistics published by national agencies is based on the historical prices for offers made via Tradex Live (Tradex, 2021c). Tradex Foods is sourcing, processing, distributing and marketing frozen seafood supplying over 40 mil. lbs per year to food service, supermarkets, and retailers worldwide. Tredex is based in Canada and has offices in Victoria and Vancouver. The sample size for Pacific halibut products for 2018 was 153, for 2019 72, for 2020 34, and for 2021, to date, 13. Pacific halibut products are typically offered as Free on Board (FOB) Seattle, FOB Vancouver, or FOB Bellingham. FOB refers to a trade agreement in which the seller is responsible for clearing goods for export, delivering them to the vessel, and loading them for transport at the named port of departure.

the fletches, unlike the H&G fish, varies. What is available on the market is typically a mix of USA-produced fish originating from Alaskan waters and China-produced fish (typically 20-30% of offers on fletches, besides for 2020), much of which is produced from fish harvested in Russian waters. Harvest from Russia is typically about 10-35% cheaper (**Table 2**).



Based on data submitted through Commercial Operator's Annual Report (COAR, 2021).

Figure 2: *Pacific halibut production – Alaska (2014-2020).*



Based on data provided by the Province of BC (Ministry of Agriculture). Output by type of product not available.

Figure 3: *Pacific halibut production - British Columbia (2014-2020).*

Table 2: *Pacific halibut prices on the wholesale market – comparison between Alaskan and Russian harvest* (Tradex, 2021b).

	Fishing Area	2020	2019
Pacific halibut fletches, USA production, 1-3lb, 3-5lb	Alaska	USD 10.25-12.75/lb	USD 13.25-14.50/lb
Pacific halibut fletches, China production, 1-3lb, 3-5lb	Russia	USD 9.25-10.75/lb	USD 8.50-10.50/lb
Pacific halibut H&G, USA production, 10-20lb, 20-40lb	Alaska	USD 6.35-6.65/lb	USD 6.50-7.90/lb
Pacific halibut H&G, Russia production, 10-20lb, 20-40lb	Russia	USD 5.80/lb	USD 5.80/lb

RETAIL MARKET AND SERVICES

On the retail market, Pacific halibut is most commonly sold in the form of fillets (portions, 4-8oz each), but one can also find Pacific halibut steaks and halibut cheeks. Some retailers (e.g., Pike Place Fish Market in Seattle) also sell fish whole. In 2021, fresh Alaskan Pacific halibut fillets routinely sold for USD 24-28 a pound (Welch, 2021), and often more, downtown Seattle (e.g., USD 38 at Pike Place Market). Online, Pacific halibut fillets retailed in late 2021 at about USD 35-48 per pound for fillet portions and USD 35-36 per pound for steaks. Cheeks were available at USD 34-47 per pound.[6] Online, the shoppers can also choose between Pacific halibut and Atlantic halibut. Atlantic halibut typically retails at slightly lower prices. One online retailer also carried aquaculture-produced halibut from Norway at USD 30 per pound.[7]

Pacific halibut dishes at the restaurants in metropolitan areas typically sell for USD 37-43 for a dish including a 6oz fish portion.[8] This translates to about USD 100-115 per pound.

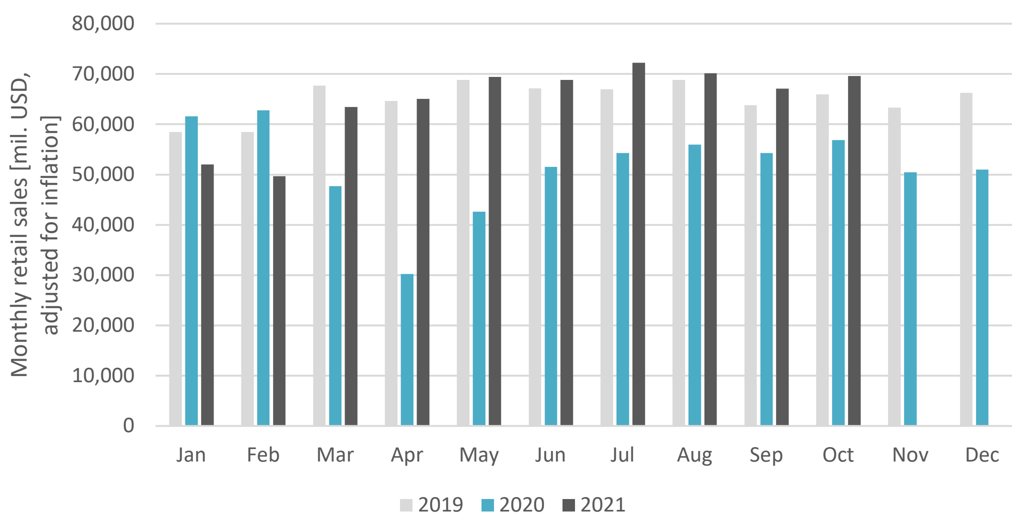
Pacific halibut retail market and COVID-19

Widespread closure of restaurants (**Figure 4**),[9] the Pacific halibut's biggest customers, diminished the demand for fish, particularly high-quality fresh fish that fetch higher prices. Lower prices, down in 2020 by up to 30% in comparison with the previous year (Stremple, 2020), also seen in data from fish tickets from the eLandings reporting system, ADFG,

[6] The analysis is based on the database created specifically to analyze retail prices of Pacific halibut. The database currently includes 21 retailers carrying Pacific halibut. It covers all places mentioned in the USA today as the best places to order seafood online (Birdsall, 2020), as well as major retailers that advertise Pacific halibut as a product available on Instacart (i.e., prices could be verified via www.instacart.com). The database includes only products that are specifically advertised as Pacific halibut, i.e., excludes products when halibut species was not specified. The database also records the fishing area.
[7] Norway is increasing aquaculture production of Atlantic halibut for export, including production of sashimi-grade halibut (Wright, 2018).
[8] Based on prices in 26 seafood restaurants in major metropolitan areas in Alaska, Washington, and Oregon (Anchorage, Seattle, Bellingham, Portland) that publish menus online (dinner offerings).
[9] Equivalent data for Canada is published by Statistics Canada annually and is currently available up to 2019 (Table 11-10-0125-01, Statistics Canada 2021). Thus, at this time, similar effects cannot be confirmed for Canada.

2021), caused a slow first half of the 2020 season (Ess 2020, IPHC, 2021). However, amidst the pandemic, Pacific halibut products also noted an increase in online sales, following the general trend for more seafood products consumption at home (Wells, 2020). At the beginning of the lockdown in spring 2020, halibut was the top 5th surging cooking recipe searched online in the Seattle-Tacoma metro area (Varriano, 2020). By spring 2021, the restaurant industry started showing a strong recovery (Kelso, 2021), pushing up the prices of Pacific halibut.

Less harvest activity in 2020 had repercussions in the economy beyond the harvest sector as it also affected harvest sector suppliers and downstream industries that rely on its output. Outbreaks of covid-19 in fish processing plants (Estus, 2020; Krakow, 2020) affected economic activity generated regionally by this directly related to the Pacific halibut supply sector. Moreover, seafood processors incurred additional costs related to protective gear, testing, and quarantine accommodations (Ross, 2020; Sapin & Fiorillo, 2020; Welch, 2020b), and these costs were passed on to consumers.



Converted from nominal to real values using Consumer Price Index (CPI, BLS 2021), with baseline in January 2020.

Figure 4: *Monthly Retail Trade and Food Services - Food Services and Drinking Places: U.S. Total* (US Census, 2021).

Certification of Pacific halibut products

Pacific halibut longline fishery in the Bering Sea off Alaska, and the Pacific waters off British Columbia and Washington state are certified by the Marine Stewardship Council (MSC). Sustainable production certification, such as the one offered by the MSC, typically adds about 15%, and up to 30% depending on fishery, premium to the product price (Asche & Bronnmann, 2017; Blomquist et al., 2019; Roheim et al., 2011; Vitale et al., 2020).

The USA MSC catch certification requires product landing at a processor listed on the certificate.[10] The BC catch is certified via the Pacific Halibut Management Association of BC (PHMA). Access to the certificate for Canada Pacific halibut is limited to approved fish buyers in good standing with PHMA.[11]

Pacific halibut Alaska catch is also certified through the Responsible Fisheries Management (RFM) certification program, which is aligned with the FAO Code of Conduct for Responsible Fisheries. RFM certificate also covers Pacific halibut delivered by Southeast Alaska salmon trollers.

Western Bering Sea Pacific halibut longline fishery in Russian territorial waters operated by Longline Fishery Association (57 vessels in total) is also certified by the MSC (MSC-F-31439). This fishery is primarily processing fish on board and landing in the ports of Vladivostok or Petropavlovsk-Kamchatskyis.

Traceability

The ability to fully trace a product from the point of sale back to its point of origin, assuring fish is sustainably and legally caught, is increasingly important to customers, although it is mostly adopted in the relation to products that may be illegally sourced (e.g., use of blockchain for strengthening tuna traceability to combat illegal fishing, Visser & Hanich, 2018).

All Pacific halibut in Canada, including Canadian-caught Pacific halibut landed in the United States, are tagged by an observer and certified by Fisheries and Oceans Canada at the point of initial offloading. Each tag has a unique serial number that can be used to trace the fish back to its point of landing.

No widely-practiced traceability initiatives were identified for the USA-caught Pacific halibut. However, some online retailers offer products linked to specific harvesters in Alaska.[12]

SEAFOOD TRADE

Understanding the Pacific halibut trade balance is vital to assessing the total supply of Pacific halibut products available on the market. Export of the raw products eliminates it from the country's value chain, preventing additional value added contribution. Imports

[10] There are 35 companies approved to participate in the use of MSC Certification for Alaska and Washington state Pacific halibut (MSC-F-31514)
[11] Currently, there are 13 authorized fish buyers named in the Certificate (MSC-F-30019).
[12] For example, Crowd Cow advertises Pacific halibut from a specific fisher in the Prince William Sound. See details at https://www.crowdcow.com/products/wild-alaskan-halibut.

compete with other domestically-produced seafood, but can create additional economic impact when there are associated markups.

NOAA database (NOAA, 2021b) provides no evidence for the export of fresh Pacific halibut, although some must be included in the generic category HS[13] 0302290100: *Flatfish NSPF fresh*. There is a modest import by Canada[14] of fresh halibut (HS 0302210090: *Halibut NES fresh/chilled*) from Alaska (USD 11.9 mil. in 2019, USD 9.5 mil. in 2020), and Washington and Oregon (USD 7.3 mil. in 2019, USD 3.7 mil. in 2020), presumably dominated by Pacific halibut. Frozen Pacific halibut exports from the United States are lumped with Atlantic halibut (HS 303310015: *Flatfish halibut Atlantic, Pacific frozen)*. Within this category, exports from Alaska and WOC were USD 4.6 mil. in 2019 and USD 4.1 mil. in 2020. Comparing this with Canadian statistics suggests that the majority of frozen Pacific halibut is sent to the Canadian market (USD 4.3 mil. in 2019 and USD 4.0 mil. in 2020, HS 0303310020: *Halibut, Pacific, frozen*). Overall, this suggests that the majority of the US-caught Pacific halibut is contributing to the US economy throughout its value chain. Exports of processed Pacific halibut products (e.g., fillets) are difficult to trace because they are generally merged with other halibut species and could include imported products.

Imports of fresh Pacific halibut, primarily coming from Canada (USD 29.5 mil. with 89% from Canada in 2019; USD 23.1 mil. with 89% from Canada in 2020), adds to the US domestic supply. There is, however, strong evidence that the domestic Pacific halibut is facing increasing pressure from imports. While the imports of fresh products (HS 302210020: *Flatfish Halibut Pacific Fresh*) increased between 2018 and 2019 only modestly (6%), import of frozen Pacific halibut (HS 0303310020: *Flatfish Halibut Pacific Frozen*) increased by 165%. The majority of the increase is attributed to imports from Russia. Although the import of frozen Pacific halibut is still modest (USD 7.5 mil. in 2019), and decreased in 2020 (to USD 5.9 mil.), there are growing concerns regarding the Alaskan Pacific halibut sector's vitality given the competition flooding the market with cheaper products (Welch, 2020a).

Fresh Pacific halibut accounts for about 5% of fresh fish exports from British Columbia, amounting to USD 26.1 mil. in 2019 (USD 20.8 mil. in 2020). Canadian statistics on exports of frozen Pacific halibut (HS 03033120: *Pacific halibut, frozen*) end in 2016, but replacing it generic frozen halibut category (HS 03033100: *Halibut frozen*) suggest that British Columbia exported in 2019 also up to USD 0.6 mil. worth of frozen Pacific halibut products. This export category noted also an increase in 2020 to USD 1.4 mil. There are no fresh Pacific halibut-specific import statistics for Canada. Fresh Pacific halibut is lumped in HS 0302210090: *Halibut NES fresh/chilled*, but data on import from Alaska and

[13] The Harmonized System (HS) is a standardized numerical method of classifying traded products.
[14] Trade statistics provided directly by the Agriservice BC (Province of British Columbia), personal communication.

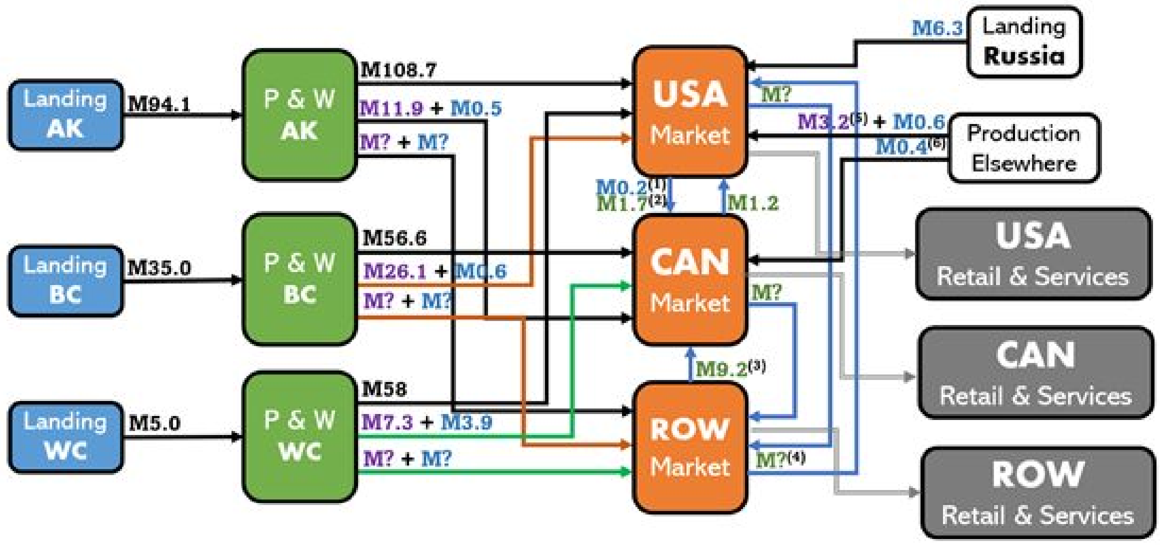
WOC suggest import by British Columbia of USD 6.1 mil. in 2019 and USD 4.1 mil. in 2020, and by Canada as a whole of USD 19.2 mil. in 2019 and USD 13.2 mil. in 2020. Imports of frozen Pacific halibut fillets (HS 0304830020: *Fillets, of Pacific halibut, frozen*) by Canada amounted to USD 11.0 mil. in 2019, of which USD 9.0 mil. (81%) was from China, and USD 7.4 mil. in 2020, of which USD 6.0 mil. (82%) from China.

FINAL REMARKS

Figure 5 summarizes market flows for Pacific halibut, from the landing area to retail and services, accounting for trade balance in fresh, frozen, and processed products, when these could be attributed to Pacific halibut specifically.[15] Overall, it is estimated that the total value added activity related to Pacific halibut products added up to USD 230 mil. in the United States and USD 140 mil. in Canada. The total consumer expenditures on Pacific halibut products in the United States are assessed at USD 460 mil, and in Canada at USD 232 mil. **Table 3** in **Appendix I** summarizes calculations of the value added, margins, and consumer expenditures for commercial Pacific halibut fishery products in Canada and the United States in 2019.

Understanding the formation of the price paid by final consumers (end-users) is an important step in assessing the contribution of Pacific halibut to the GDP along the entire value chain. However, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts beyond processors and wholesalers in the economic impact assessment (i.e., PHMEIA model, see details in IPHC-2022-AM098-INF04), as opposed to assessing the snapshot contribution to the GDP along its entire value chain, would be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail or services level gross revenues (Steinback & Thunberg, 2006).

[15] As noted in section Seafood trade, processed Pacific halibut products (e.g., fillets) are often difficult to trace because they are generally merged with other halibut species and could include imported products.



Notes: All values associated with arrows are based on 2019 data, all in millions USD. P&W stands for processing and wholesale. This includes seafood products preparation and packaging., i.e., the output can be fresh fish. ROW stands for the rest of the world, i.e., all countries besides Canada and the United States. Values in black indicate domestic production. Values in color inform on trade: purple – fresh fish, blue – frozen fish, and green – processed products (here: fillets). (1) Imports of frozen products from states other than AK, WA, OR, or CA. (2) See footnote 18. (3) Of which USD 9.0 mil. coming from China. (4) Excludes processed products because it is reported without the distinction between halibut species. However, fletches produced from Russian harvest processed in China are available on the market (Tradex, 2021c). (5) USD 2.5 mil. reported as imported from Mexico. (6) Of which USD 0.3 mil. coming from South Korea.

Figure 5: *Market flows for Pacific halibut.*

REFERENCES

ADFG. (2021). *Commercial Fishing Reporting: eLandings*. http://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.elandings

AFSC. (2019). Wholesale Market Profiles for Alaska Groundfish and Crab Fisheries. In *Alaska Fisheries Science Center*. http://www.mcdowellgroup.net/wp-content/uploads/2020/09/wholesale-market-profiles-for-alaska-groundfish-and-crab-fisheries-noaa.pdf

AKFIN. (2021). *Alaska Fisheries Information Network (AKFIN) APEX reporting system*. Alaska Fisheries Information Network. https://reports.psmfc.org/akfin

Asche, F., & Bronnmann, J. (2017). Price premiums for ecolabelled seafood: MSC certification in Germany. *Australian Journal of Agricultural and Resource Economics*, *61*(4), 576–589. https://doi.org/10.1111/1467-8489.12217

Birdsall, L. (2020). The 10 best places to order seafood online. *USA Today*. https://www.usatoday.com/story/tech/reviewedcom/2020/08/11/10-best-places-order-seafood-online/3348908001/

Blomquist, J., Bartolino, V., & Waldo, S. (2019). Price premiums for eco-labelled seafood: effects of the MSC certification suspension in the Baltic Sea cod fishery. *European Review of Agricultural Economics*, *47*(1), 50–70. https://doi.org/10.1093/erae/jby047

BLS. (2021). *CPI for All Urban Consumers (CPI-U)*. US Bureau of Labor Statistics. https://data.bls.gov/cgi-bin/surveymost

COAR. (2021). *Commercial Fishing Reporting*. Commercial Operator's Annual Reports. https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar

DFO. (2021). *Seafisheries Landings*. Fisheries and Oceans Canada. https://www.dfo-mpo.gc.ca/stats/commercial/sea-maritimes-eng.htm

Ess, C. (2020). Restaurant closings, depressed Japan market push halibut, blackcod prices down. *National Fisherman*. https://www.nationalfisherman.com/alaska/restaurant-closings-depressed-japan-market-push-halibut-blackcod-prices-down

Estus, J. (2020). COVID spikes at Alaska fish processing plants raise alarm. *Indian Country Today*. https://indiancountrytoday.com/news/covid-spikes-at-alaska-fish-processing-plants-raise-alarm

FAO. (2021a). *Global Aquaculture Production*. Food and Agriculture Organization. http://www.fao.org/fishery/statistics/global-aquaculture-production/query/en

FAO. (2021b). *Global Capture Production*. Food and Agriculture Organization. https://www.fao.org/fishery/statistics/global-capture-production/en

IPHC. (2021). *Percentage of Directed Commercial Pacific halibut fishery limit landed by week of year*. https://www.iphc.int/data/year-to-date-directed-commercial-landing-patterns-ak-and-bc

Kelso, A. (2021). Restaurant Industry Showing Strong Recovery , But Sales Remain Down By $ 110 Billion From Pre-Pandemic Projections. *Forbes*. Restaurant Industry Showing Strong Recovery , But Sales Remain Down By $ 110 Billion From Pre-Pandemic Projection

Krakow, M. (2020). 56 workers at Anchorage seafood plant test positive for COVID-19. *Anchorage Daily News*. https://www.adn.com/alaska-news/anchorage/2020/07/24/56-workers-at-anchorage-seafood-processing-plant-test-positive-for-covid-19/

NMFS. (2018). *Fisheries of the United States 2017*. https://www.fisheries.noaa.gov/national/fisheries-united-states-2017

NOAA. (2021a). *Annual commercial landing statistics*. https://foss.nmfs.noaa.gov/apexfoss/f?p=215

NOAA. (2021b). *Foreign Trade*. NOAA Fisheries. https://www.st.nmfs.noaa.gov/apex/f?p=213:3

PacFIN. (2021). *Pacific Fisheries Information Network (PacFIN) APEX reporting system*.

Pacific Fisheries Information Network. https://reports.psmfc.org/pacfin

Roheim, C. A., Asche, F., & Santos, J. I. (2011). The Elusive Price Premium for Ecolabelled Products: Evidence from Seafood in the UK Market. *Journal of Agricultural Economics*, *62*(3), 655–668. https://doi.org/https://doi.org/10.1111/j.1477-9552.2011.00299.x

Ross, I. (2020). *For Alaska's seafood processors, the COVID-19 pandemic has cost tens of millions of dollars*. KDLG. https://www.kdlg.org/post/alaskas-seafood-processors-covid-19-pandemic-has-cost-tens-millions-dollars

Sapin, R., & Fiorillo, J. (2020). Seafood processors pay a steep price to keep workers safe from coronavirus. *IntraFish*. https://www.intrafish.com/processing/seafood-processors-pay-a-steep-price-to-keep-workers-safe-from-coronavirus/2-1-852502

Statistics Canada. (2021a). *Table 11-10-0125-01 Detailed food spending, Canada, regions and provinces*. https://doi.org/10.25318/1110012501-eng

Statistics Canada. (2021b). *Table 16-10-0048-01 Manufacturing sales by industry and province, monthly*. https://doi.org/10.25318/1610004801-eng

Steinback, S. R., & Thunberg, E. M. (2006). Northeast Region Commercial Fishing Input-Output Model. *NOAA Technical Memorandum NMFS-NE*, *188*.

Stremple, C. (2020). Local fish put Haines residents to work despite COVID-19 economic slump. *KHNS*. https://khns.org/local-fish-put-haines-residents-to-work-despite-covid-19-economic-slump

Tradex. (2021a). *Halibut Inventories Fall Short Despite Strong Market*. 3-Minute Market Insight. http://www.tradexfoods.com/3mmi/2021/09-13-halibut-inventories-fall-short-despite-strong-market

Tradex. (2021b). *Pacific Halibut Update: 2021 Fishery Limit, a 2020 Season through a Pandemic, Stabilized Pricing and Increased Demand*.

Tradex. (2021c). *Tradex Live: Historical prices*. http://live.tradexfoods.com/historical-prices.php

US Census. (2021). *Monthly Retail Trade and Food Services*. https://www.census.gov/econ/currentdata/

Varriano, J. (2020). Everyone's been cooking like crazy during the coronavirus stay-home order. Here's what Seattle's been making. *The Seattle Times*. https://www.seattletimes.com/life/food-drink/everyones-been-cooking-like-crazy-during-the-coronavirus-stay-home-order-heres-what-seattles-been-making/

Visser, C., & Hanich, Q. A. (2018). How blockchain is strengthening tuna traceability to combat illegal fishing. *The Conversation*, 1–4. https://theconversation.com/how-blockchain-is-strengthening-tuna-traceability-to-combat-illegal-fishing-89965

Vitale, S., Biondo, F., Giosuè, C., Bono, G., Okpala, C. O. R., Piazza, I., Sprovieri, M., & Pipitone, V. (2020). Consumers' perception and willingness to pay for eco-labeled seafood in Italian hypermarkets. *Sustainability*, *12*, 1–13. https://doi.org/10.3390/su12041434

Welch, L. (2020a). Alaska Halibut Gets Battered by Foreign Import. *Fish Factor*. https://www.adn.com/business-economy/2020/05/12/alaska-halibut-gets-battered-by-foreign-imports-including-a-new-russian-fishery/

Welch, L. (2020b). Alaska Seafood Processors Get Clobbered by COVID Costs. *Alaska Fish Radio*. https://www.seafoodnews.com/Story/1179409/Alaska-Seafood-Processors-Get-Clobbered-by-COVID-Costs

Welch, L. (2021). Halibut prices to AK fishermen remain high along with customer demand. *Alaska Fish Radio*. http://www.alaskafishradio.com/halibut-prices-to-ak-fishermen-remain-high-along-with-customer-demand/

Wells, P. (2020). A Quarantine Silver Lining for Seafood. *The New York Times*. https://www.nytimes.com/2020/05/05/dining/seafood-fish-coronavirus.html

Wright, J. (2018). Norway showcases halibut farm as sustainability star. *Responsible Seafood Advocate*. https://www.globalseafood.org/advocate/norway-showcases-halibut-farm-as-sustainability-star/

Appendix I

***Table 3**: Summary of 2019 value added, margins, and consumer expenditures for commercial Pacific halibut fishery products in Canada and the United States.*

Sector or type of activity	Purchase of fishery inputs	Mark-up of fishery inputs	Total mark-up within sector	Value added as a percent of total mark-up	Value added within sector	Value of sales by sector	Value added contribution	Exported fishery products[16]	Source
	[mil. USD]	Percentage of fishery inputs	[mil. USD]	Percentage	[mil. USD]	[mil. USD]	Percentage of GDP contribution	[mil. USD]	
USA									
Domestic harvest									
AK	-	100%	94.1	27.9%	26.3	94.1	11.4%	-	AKFIN (2021)
WA, OR, CA (WOC)	-	100%	5.0	40.4%	2.0	5.0	0.9%	-	PacFIN (2021)
Processing/wholesale									
AK	92.5	17.5%	16.2	17.4%	2.8	108.7	1.2%	-	COAR (2021)
WA, OR, CA (WOC)	5.0	14.8%	0.7	37.1%	0.3	5.8	0.1%	-	Markup based on communication with NOAA (Jerry Leonard, NOAA NWFSC)
Rest of the USA	~0	n.a.	n.a.	n.a.	~0	~0	~0%	-	No indication of processing outside AK/WOC
Imports, fresh	29.5	-	-	-	-	29.45	-	-	NOAA (2021b)[17]
Exports, fresh	-	-	-	-	-	-	-	19.2	AgriService BC[18]
Import, frozen	7.5					7.45			NOAA (2021b)[19]
Export, frozen	-	-	-	-	-	-	-	4.3	AgriService BC [20]

[16] This could also include harvest landed in foreign ports, but this does not apply to Pacific halibut.
[17] Includes HS 0302210020: *Flatfish halibut Pacific fresh*. Canada accounts for the majority (89% in 2019) of this import.
[18] Pacific halibut may be included in NOAA's database (NOAA, 2021b) under HS 0302290100: *Flatfish NSPF fresh*. Canadian statistics specify the import of fresh halibut (HS 0302210090: *Halibut NES fresh/chilled)* from Alaska, Washington, and Oregon. Here, we assume that fresh halibut from these regions is most likely Pacific halibut.
[19] Includes HS 0303310020: *Flatfish halibut Pacific frozen*. The majority of this production (84% in 2019) is coming from Russia but minor import is also recorded from China and South Korea. Canada accounts for a small portion (3% in 2019) of this import.
[20] NOAA's database (NOAA, 2021b) lumps exports of frozen Pacific halibut with frozen Atlantic halibut (HS 0303310015: *Flatfish halibut Atlantic Pacific frozen*). As the majority of this category is reported as destined for Canada, we use here HS 0303310020: *Halibut Pacific frozen* imports to Canada from Alaska, Washington, Oregon, and California.

Imports, processed	1.2	-	-	-	-	1.2	-	-	NOAA (2021b)[21]
Exports, processed	-	-	-	-	-	-	-	2.1	NOAA (2021b)[22]
Secondary processing	127.0	63%	80.0	28%	22.4	207.0	9.8%		FUS[23]
Retail									
Food service	124.2	182%	226.0	70%	158.2	350.19	68.9%	-	FUS
Stores	82.8	33%	27.3	64%	17.5	110.11	7.6%	-	FUS
TOTAL VALUE ADDED ACTIVITY					229.5		100%		
CONSUMER EXPENDITURES						460.3			
Canada									
Domestic harvest									
BC	-	100%	35.0 [CAD 46.4]	88.9	31.1	35.0 [CAD 46.4]	22.2%	-	Direct report to the IPHC (IPHC-2021-AM097-NR01)
Processing / wholesale									
BC	35.0 [CAD 46.4]	61.7%	21.6	42.4%	9.1	56.6 [CAD 75.1]	6.5%	-	Direct report to the IPHC (IPHC-2021-AM097-NR01)
Rest of Canada	~0	n.a.	n.a.	n.a.	~0	~0	~0%	-	No indication of processing outside BC
Imports, fresh	19.2	-	-	-	-	19.2	-	-	AgriService BC[24]
Exports, fresh	-	-	-	-	-	-	-	26.1	AgriService BC [25]
Import, frozen	5.0	-	-	-	-	5.0	-		AgriService BC[26]
Export, frozen	-	-	-	-	-	-	-	0.6	NOAA (2021b)[27]

[21] This includes HS 0304835025: *Flatfish Halibut NSPF fillet frozen* imported from Canada to Alaska and WOC only. This is most likely an underestimate, because the Pacific halibut is also produced by Russia. The number may be also confounded by imports of Atlantic halibut from Canada, but imports to the West Coast are assumed to be dominated by Pacific halibut.

[22] This includes HS 0304835005: *Flatfish halibut NSPF fillet frozen*, only export from Alaska and Washington (97.8% for this product export). This would be an underestimate in the case of secondary processing elsewhere in the United States.

[23] Calculated based on the average mark-up of fishery inputs and value added as a percent of total mark-up reported by NMFS (2018), Fisheries in the United States (FUS) report.

[24] Canadian trade statistics only record imports for generic fresh halibut products (HS 0302210090: *Halibut NES fresh/chilled*). Here, we report only import from Alaska, Washington and Oregon, assuming this reflects import of Pacific halibut as opposed to Atlantic halibut. However, import from the rest of the world is expected to play an increasing role in the coming years, and alternative sources for understanding Canada's Pacific halibut imports should be reviewed.

[25] Here, HS 03022120: *Halibut Pacific fresh/chilled* was used. US market is nearly the only export destination recorded for this product (99.994% in 2019).

[26] This includes HS 0303310020: *Halibut Pacific frozen*. Alaska, Washington and Oregon account for the majority (86.3% in 2019) of frozen import.

[27] Includes US imports of HS 0303310020: *Flatfish halibut Pacific frozen*. More generic category in the Canadian database (HS 03033100: *Halibut frozen*) reports nearly the same value and indicates that nearly all of this product (96.8% in terms of value in 2019) goes to the United States.

Imports, processed	11.0	-	-	-	-	11.0	-	-	AgriService BC [28]
Exports, processed	-	-	-	-	-	-	-	1.2	NOAA (2021b)[29]
Secondary processing	63.9	63%	40.3	28%	11.3	104.2	8.1%		FUS
Retail									
Food service	62.5	182%	113.8	70%	79.7	176.3	56.9%	-	FUS
Stores	41.7	33%	13.8	64%	8.8	55.4	6.3%	-	FUS
TOTAL VALUE ADDED ACTIVITY					140.0		100%		
CONSUMER EXPENDITURES						231.8			

Note: The table reports the contribution of commercial marine fishing to the national economy as measured by margin, value added, and sales. These measures are consistent with the Bureau of the Census definitions. n.a. – not applicable. Values in blue are from the Pacific halibut multiregional economic impact assessment (PHMEIA) model (see details in IPHC-2022-AM098-INF04). Values in grey are trade values that are derived based on the noted assumptions and may be underestimates/overestimates. All reported trade may be underestimated if Pacific halibut or some of its products are included in more generic product categories. Values in orange are calculated based on the average mark-up of fishery inputs and value added as a percent of total mark-up reported by NMFS (2018), in the Fisheries in the United States (FUS) report. These are likely underestimates for Pacific halibut, which is typically sold as a high-end product. FUS assumes reports about fifty-fifty split for edible products between food services and stores. For Pacific halibut, we assume a slightly higher share of restaurant sales (60%). The results herein are part of a continuing analysis and subject to change.

[28] Includes HS 0304830020: *Fillets of Pacific halibut*.
[29] Includes HS 0304835025: *Flatfish halibut NSFP Fillet frozen*, limited to imports by WOC from Canada. This is likely an underestimate, because it would not include any exports to other countries.

The IPHC Space-Time Explorer tool

PREPARED BY: IPHC SECRETARIAT (R. A. WEBSTER; 17 DECEMBER 2021)

PURPOSE

This document provides a description of the IPHC's web-based Space-time Explorer tool for calculating space-time model estimates of survey weight and numbers per unit effort (WPUE and NPUE) for any region of Pacific halibut habitat within Convention waters, and for visualising the model-estimated spatial distribution of Pacific halibut density.

INTRODUCTION

Since 2016, space-time modelling has been used by the IPHC to produce estimates of mean O32 WPUE (weight per unit effort), all sizes WPUE and all sizes NPUE (numbers per unit effort) indices of Pacific halibut density and abundance (Webster et al. 2020, Webster 2021 Appendix B). The modelling depends primarily on data from the IPHC's fishery-independent setline survey (FISS, Ualesi et al, 2021), but in the Bering Sea also integrates data from the National Marine Fisheries Service annual trawl survey (through a calibration calculated from years the surveys overlapped, Webster et al. 2020) and the Alaska Department of Fish and Game's annual Norton Sound trawl survey. Both surveys are fishery-independent data sources.

Each year, the IPHC publishes "official" output from the space-time modelling in the form of estimates of WPUE and NPUE time series by IPHC Regulatory Area and Biological Region, and for the coastwide stock in Convention waters (https://www.iphc.int/data/time-series-datasets). The IPHC has also fielded ad hoc requests for estimates calculated at a sub-IPHC Regulatory Area level, and Secretariat staff has met these requests as needed.

The purpose of the IPHC Space-time Explorer tool is to make the model output more readily available to the public. This tool allows users to produce estimates of WPUE and NPUE tailored to their needs or interests, and to visualize the changing distribution of Pacific halibut since 1993 (the start of the modern FISS, and the first year of input data in the space-time model).

THE SPACE-TIME EXPLORER TOOL

Introduction and Guide tabs

Clicking on the IPHC website link to the tool will begin the loading process. Note that it can take a minute or two for the tool (**add hyperlink here**) to appear due to the large datasets being loaded, during which time it may appear as if nothing is happening. Once loaded, the tool will open with an Introduction tab selected (Figure 1). A guide to the interactive pages of the tool is selected using the second tab (Guide), which will produce a drop-down menu with a tab of information for each of the tool's interactive components (Figure 2).

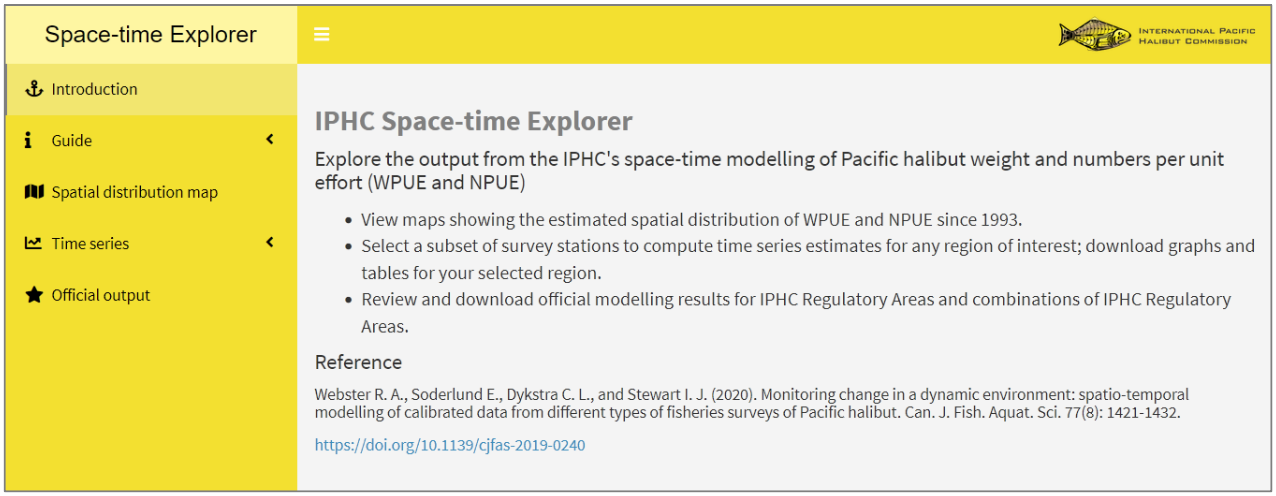


Figure 1. The IPHC Space-time Explorer tool showing the Introduction tab that appears when the tool is opened.

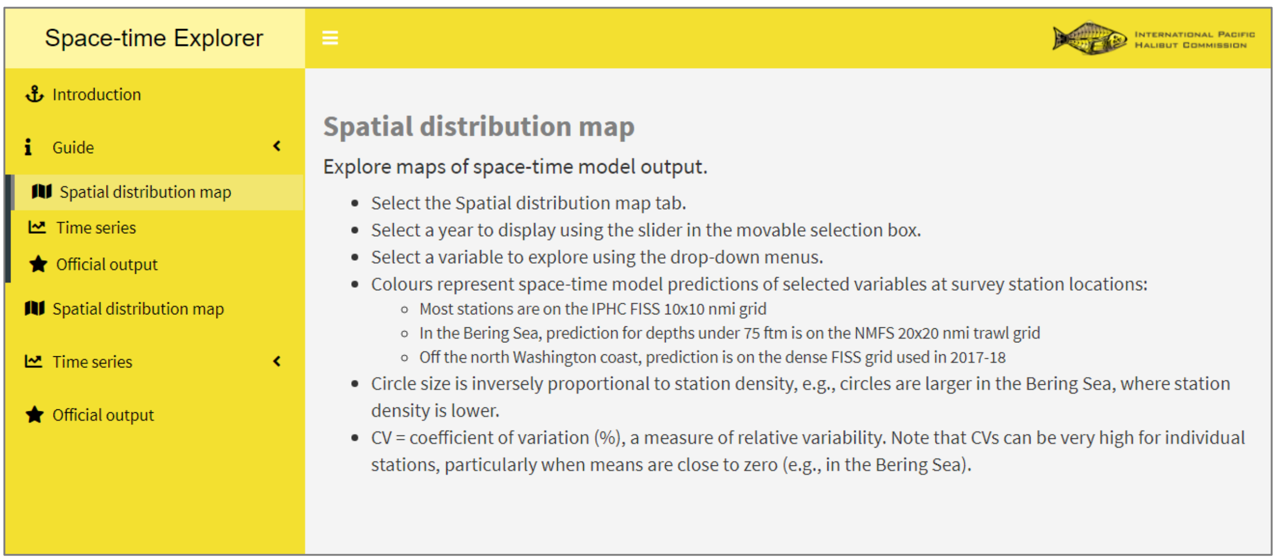


Figure 2. The Space-Time Explorer tool showing the items in the Guide drop-down menu with the Spatial distribution map tab selected.

Spatial distribution map

Selecting the Spatial distribution map tab (Figure 3) displays a map of survey stations represented by circles with colours representing values of WPUE or NPUE (legend at upper right). The user can zoom using the + or – buttons at upper left or the user's mouse wheel. The mouse can also be used to drag the map. The transparent dialog box is also draggable, allowing the user to move it away from an area of interest.

Year slider: The year for display is selected using the slider. Placing the curser on the slider circle allows the user to move between years using the keyboard arrow keys (although sometimes it shifts by two years instead of one).

Variable selection: A drop-down menu gives a choice of density index to display (O32 WPUE, all sizes WPUE and all sizes NPUE)

Mean or CV selection: A second drop-down list allows the user to display either the station means or CVs (coefficient of variation, the ratio of the mean to standard deviation as a %). Note that the legend colour scale for means is not linear: a square root transformation was applied to the station means to make it easier to see changes in regions of low density.

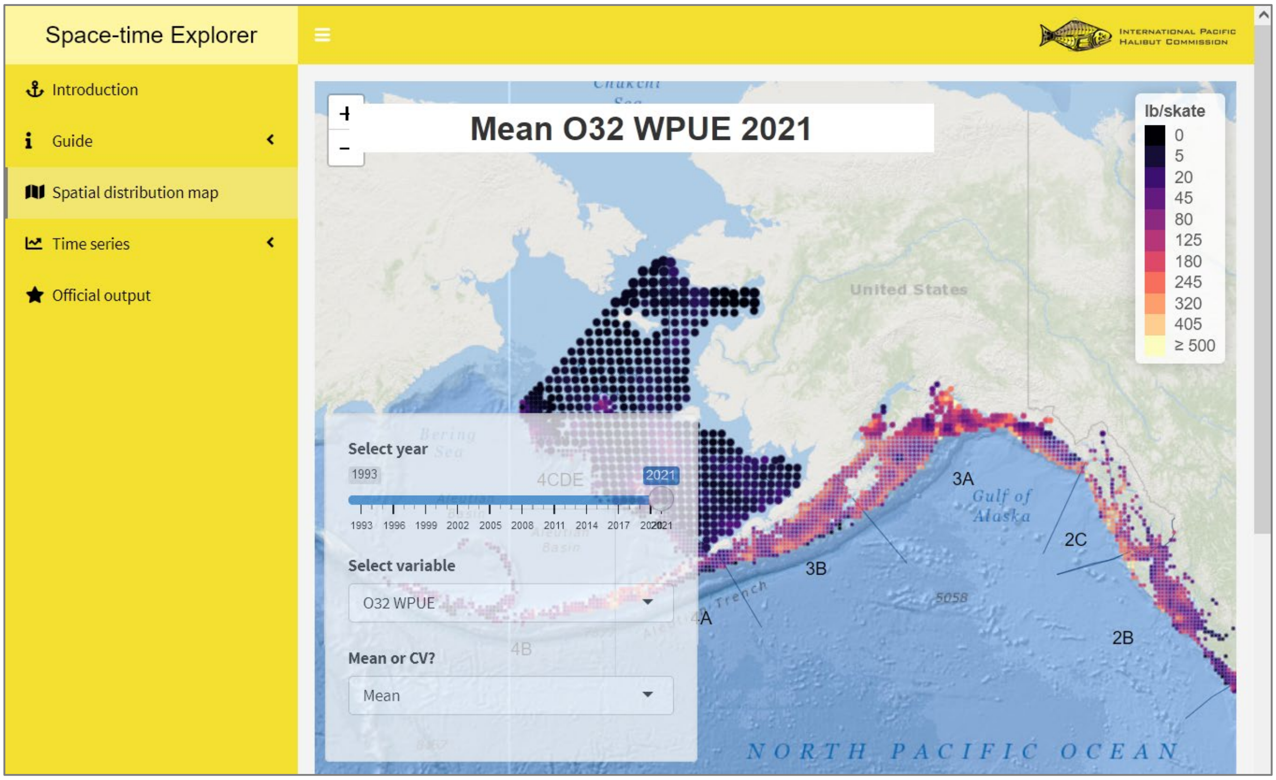


Figure 3. The Spatial distribution map tab of the Space-Time Explorer tool, showing mean O32 WPUE for 2021.

Time series

Selecting the Time series tab at left drops down a menu of two items. The Station selection tab is for the user to select which regions (groups of stations) they want to produce time series output for. Selected stations are shown with orange circles, while purple is for stations outside the selection. The resulting output is shown by selecting the Time series output tab. See the example in Figures 4 and 5.

Station selection

Polygon tools: Found at upper left, these are used to select a region, with each subsequent selection added to previous selections. Clicking the trash can icon and selecting "Clear all" removes all selected polygons.

Check boxes: Entire IPHC Regulatory Areas can be selected or added to polygon selections using the check boxes. To select an entire Biological Region, select all IPHC Regulatory Areas listed within that region.

Depth range slider: This slider allows the user to produce output for a narrower depth range than the full 0-400 fathom (0-732 m) depth range used on the FISS. It will only subset stations for selected IPHC Regulatory Areas – all stations within polygon selections will still be included, regardless of depth. If the user desires to create a polygon that only includes a specific depth range, this can be done as follows:

- First ensure any polygons are cleared and all IPHC Regulatory Areas are unchecked
- Select the IPHC Regulatory Area(s) containing user's the region of interest
- Use the depth slider to choose a depth range - only stations within those depths will display in orange
- Carefully draw polygon(s) around stations within the region of interest, only including orange stations (zoom in for more precise polygon selection). See Figure 6 for an example.
- Unselect the IPHC Regulatory Area(s), which will leave just the stations within the polygon(s) as selected (orange)

Year range slider: The year range slider is used to select part of the time series for output, for example if the user is only interested in estimates from the most recent years.

Variable selection: Choose from O32 WPUE, all sizes WPUE, or all sizes NPUE.

Time series output

The output resulting from the selections made in the Station selection tab is shown in the Time series output tab. Depending on the number of stations selected, it may take several seconds of processing time before the output appears. Processing progress is tracked by the bar at lower right of the screen.

Time series plot: The plot shows the estimated mean of WPUE or NPUE over the selected stations for each year as a solid circle, with lines connecting the circles to help make the trend easier to see. Variability ("uncertainty") in the estimates is shown with shaded regions representing 95% posterior credible intervals: there is a 95% chance the true mean for a year is within the shaded region, and thus wider shaded regions represent more variability/greater uncertainty/less precision.

Time series table: The data in the plot are also presented in tabular form, along with the CV (%) and the number of stations included in the selection (n). The latter is not the same as the number of stations fished each year – it simply represents the size of the selection and makes no adjustment for different station densities in the Bering Sea and northern IPHC Regulatory Area 2A. The columns p2.5 and p97.5 give the upper and lower limits of the 95% intervals, i.e., the limits of the shaded regions in the plot.

Both the plot and the table may be downloaded as png and csv files respectively. Users can create their own plots using the data in the downloaded table files. For example, the user may wish to compare time series for multiple selections in a single figure, something the Space-time Explorer Tool does not do at present.

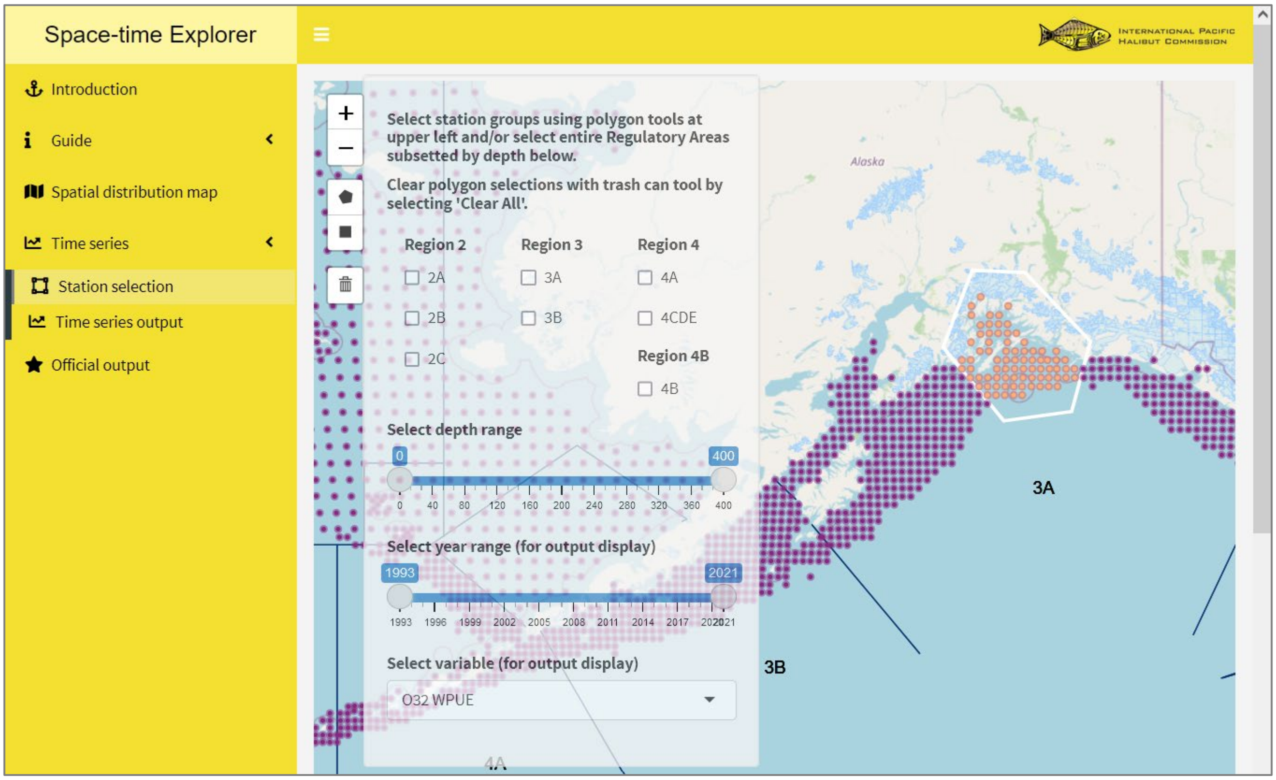


Figure 4. The Station selection page from the Time series drop-down tab, showing the stations around Prince William Sound selected using the polygon selection tool at upper left.

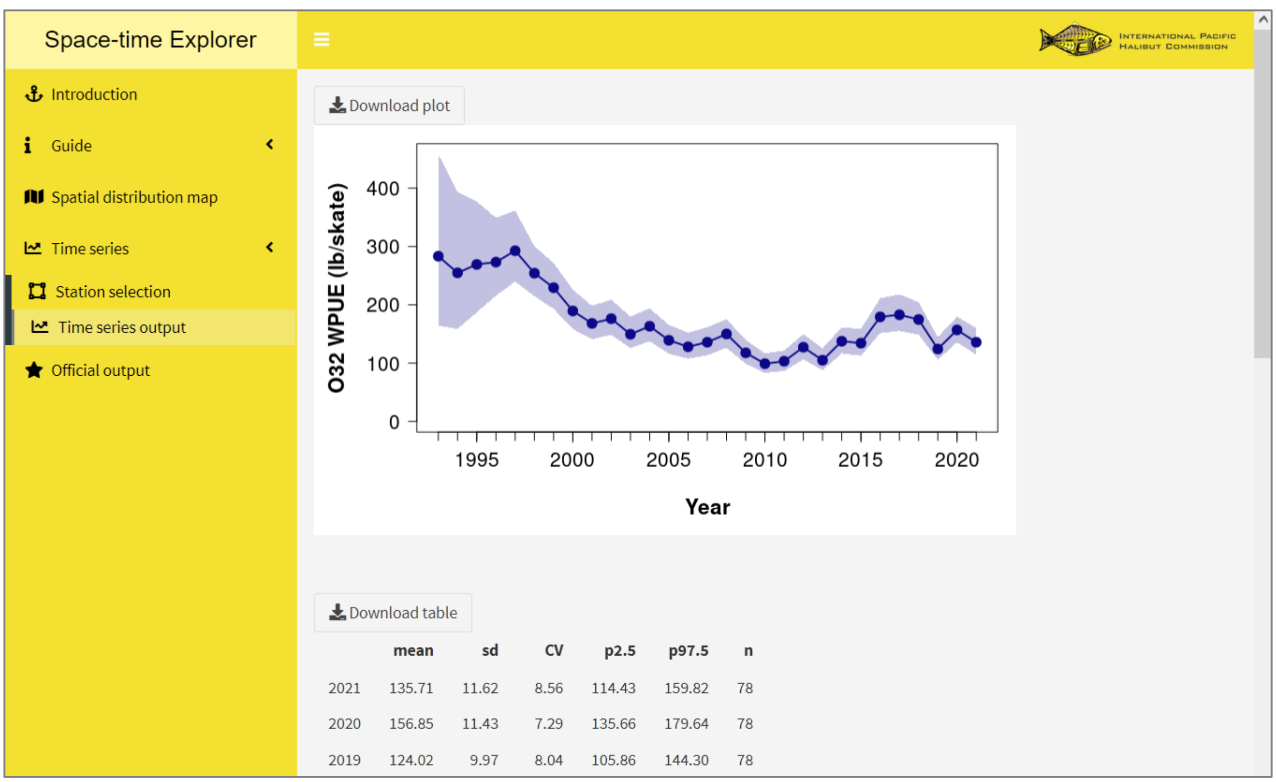


Figure 5. The Time series output page of the Time series drop-down tab, showing the output for the stations selected in Figure 4.

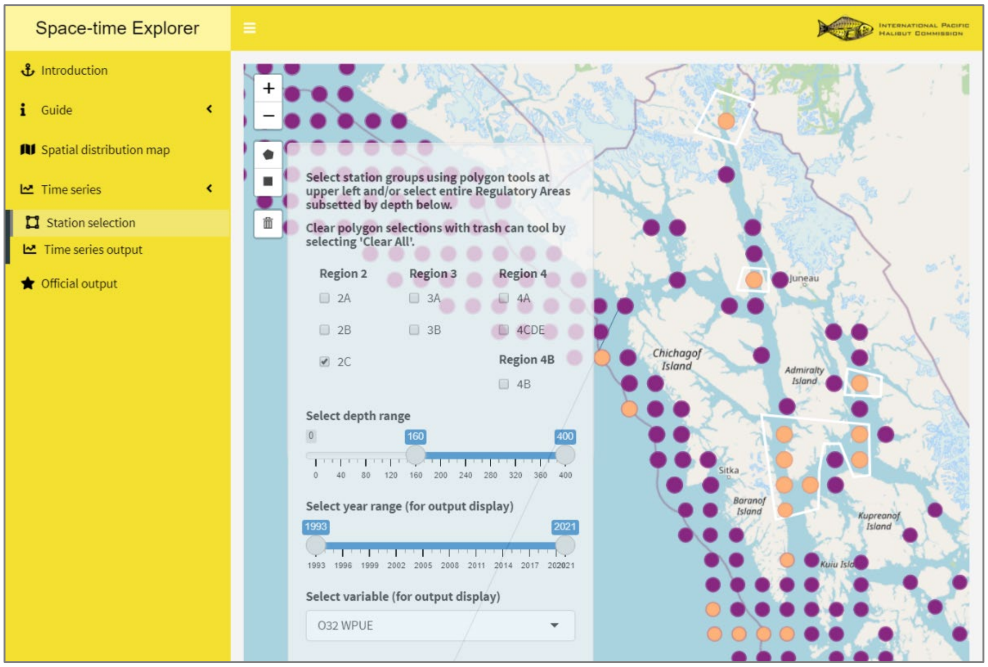


Figure 6. Example of a polygon selection for a limited depth range. Here the user in interested in trends in deeper inside waters (≥160 fathoms, as selected by slider) in northern IPHC Regulatory Area 2C. The final step would be to uncheck the 2C check box, leaving only the stations within the polygons selected.

Official output

The Time series tab output for combined IPHC Regulatory Areas (e.g., grouping areas into Biological Regions) can differ slightly from the output published annually by the IPHC in documents and presentations – see the Guide tabs for details. For this reason, a tab with published IPHC space-time model output for IPHC Regulatory Areas (Official output) is included with the Space-time Explorer tool. As with the Time Series tab, IPHC Regulatory Areas can be combined (e.g., into Biological Regions) by checking the boxes for multiple areas (Figure 7).

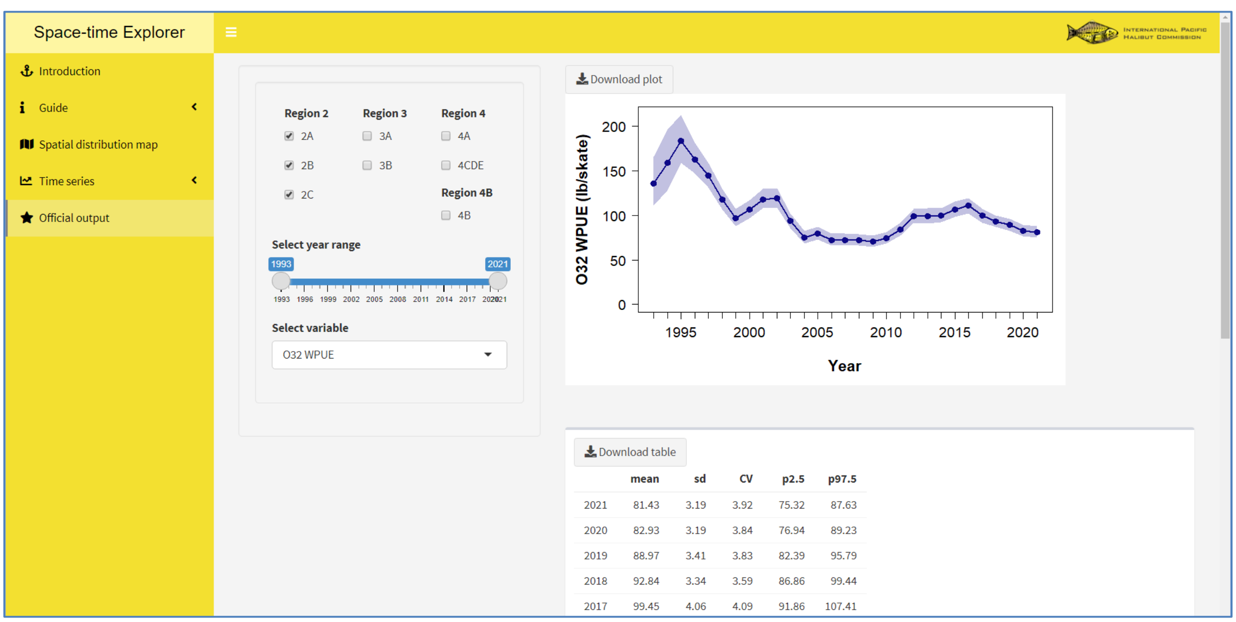


Figure 7. The Official output tab from the Space-time Explorer tool, showing results for O32 WPUE in Biological Region 2 created by selecting the check boxes for IPHC Regulatory Areas 2A, 2B and 2C.

UPDATE SCHEDULE

The modelling required to produce the input data for the Space-Time Explorer tool is typically completed by mid-November each year. We expect the tool to be updated annually with the most recent year's data by early December. Improvements and fixes to the tool may occur throughout the year.

REFERENCES

Ualesi, K., Wilson, D., Jones, C. Rillera, R. and Jack, T. IPHC Fishery-independent setline survey (FISS) design and implementation in 2021. IPHC-2022-AM098-07.

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. doi.org:10.1139/cjfas-2019-0240

Webster, R. A. 2021. 2022-24 FISS design evaluation. IPHC-2021-SRB018-05 Rev_1.

Revision of the IPHC length-weight relationship

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER AND I. STEWART; 23 JANUARY 2022)

PURPOSE

To present updated length-weight relationships for Pacific halibut by IPHC Regulatory Area with the goal of improving the accuracy of estimates of catch weight from all sources.

BACKGROUND

To monitor the Pacific halibut fisheries and model the population dynamics, the IPHC must be able to accurately and precisely estimate the fishing mortality in terms of the weight of fish removed. For many fisheries, fish can be easily weighed prior to any dressing (e.g., removal of the entrails, gills) taking place. However, for Pacific halibut dressing often occurs at sea. Further, due to their large size, it is frequently easier to measure the length of Pacific halibut than the weight. For these reasons, prediction of weight from measured length and various conversions among weights collected at different times relative to capture (at sea or 'fresh', vs. at the time of landing, which can be up to several days later) and for fish in different states (e.g., round, head-on but entrails removed) have been historically used to determine fishing mortality. As the directed commercial Pacific halibut fishery relied solely on sampling at the time of landing and sale for many decades, the standard weight measurement used for all analyses has been net weight, or the weight of a fresh fish with head and entrails removed. Historically, the accuracy of net weights relied on consistency in how the heads were cut, but since 2017 the definition of net weight represents an arbitrary choice of 0.75 × round weight as IPHC Regulations require weights to be collected prior to removal of the heads (IPHC 2017, para. 48).

Historical length-weight curve

The IPHC's standard length to net weight relationship was used in all Commission work to convert length to net weight of halibut until 2015, when individual weights were added to standard sampling of commercial landings. More recently, the IPHC's Fishery Independent Setline Survey (FISS) began collecting individual weights in 2017 and made such collections comprehensive in 2019. The relationship continues to be used in estimation of catch weight from recreational, non-directed discard mortality (bycatch) and subsistence components of the fishery, and is also used in some agency survey estimation.

The parameters of this historical relationship were estimated in 1926 based on a sample of 454 Pacific halibut collected off Masset in IPHC Regulatory Area 2B. Using 1989 data, Clark (1992) re-estimated the relationship's parameters and found good agreement with the earlier curve, and therefore the IPHC relationship was not revised at the time. While it was recognized that such a calculated relationship will not be consistently accurate when computing total or mean weights from small numbers of Pacific halibut, it was assumed that predictions should be accurate when data come from larger samples of fish (Clark 1992). However, when Courcelles (2012) estimated the relationship from data collected in 2011, she found significant differences between her estimated curve and that derived from the 1989 data, while noting that inference was limited to a relatively small part of Area 3A and to the time of the FISS. Reports from staff working on the FISS, along with other anecdotal reports, suggested that the historical length-net weight relationship has been overestimating the weight of Pacific halibut on average in recent years.

Adjustments and conversion factors

Various adjustment and conversion factors have been used to account for Pacific halibut measured at different stages of processing following capture (Table 1), in order to convert measured weights of one type into the desired weight measure. The conversion multipliers in Table 1 are for converting measured to net weight, but other conversions can be calculated from these if required. Net weight remains the standard measure for the accounting of mortality of Pacific halibut, however, since 2017 it is no longer a legal weight for catch reporting due to the high variability of head cuts - all landed catch must be weighed head-on, and converted to net weight using a multiplier from Table 1.

Table 1. Definitions of types of weight measures used by the IPHC and multipliers used to convert to net weight.

Weight	Definition	Multiplier to convert to net weight	Notes on multipliers
Round ("fresh")	Head-on, not gutted, no ice and slime[1], no shrinkage[2]	0.75	
Gross (vessel weight)	Head-on, gutted, with ice and slime, no shrinkage	0.8624	Assumes 10% head weight and 2% shrinkage, or 12% head, each with 2% ice and slime
Dressed (vessel weight)	Head-on, gutted, no ice and slime, no shrinkage	0.88	Assumes 10% head weight and 2% shrinkage, or 12% head only
Gross (dock weight)	Head-on, gutted, with ice and slime	0.882 or 0.88	Assumes 10% head weight and 2% ice and slime; deductions either additive (10+2=12% in 2A and 2B) or multiplicative (1-0.9*0.98=0.118 or 11.8% in Alaska)
Dressed (dock weight)	Head-on, gutted, no ice and slime (washed)	0.9	Assumes 10% head weight
Net	Head-off, gutted, no ice and slime (washed)	1	

[1]Ice and slime become attached to the outside of the fish while stored on ice. The 'poke ice', commonly inserted into the body cavity is not included in this conversion as it should always be removed prior to weighing.

[2]Shrinkage is defined as the loss of weight after the fish has died and while it is stored on ice.

The historical relationship between fork length and net weight includes adjustments for the weight of the head, and of ice and slime: gross landed weight (gutted, with head, ice and slime) was assumed to include a proportion of 12% head weight and 2% ice and slime, which combine to give a multiplier of 0.8624 to convert gross to net weight. Clark (1992) noted that subsequent studies showed the head weighed less than 12% of gross weight, but that the adjustment factor worked well anyway, possibly because of additional shrinkage of fish after being weighed at sea (as they were in the 1926 study in which the relationship was estimated). In practice, combined multipliers of 0.88 in IPHC Regulatory Areas 2A and 2B, and 0.882 in Alaska, were applied to commercial landings to convert from gross to net weight. These both include the 2% deduction for ice and slime assumed in the IPHC length-net weight relationship and use 10% as the proportion for the head. This head deduction has been required as part of IPHC regulations since 2008 (Leaman and Gilroy 2008, Gilroy et al. 2008). The way the two deductions are combined differs among areas. In IPHC Regulatory Areas 2A and 2B, these deductions are added (10+2=12%), while in Alaska, the corresponding multipliers (1 minus the deduction) are multiplied, leading to a multiplier of 0.882, or a deduction of 11.8%.

There is a lack of data to support many of the conversions in Table 1, including conversions from round weight to dressed weight, and the assumed 2% deduction for ice and slime. Regarding shrinkage, a subsample of 550 Pacific halibut from FISS sampling was weighed both on the vessels and later at the dock during the 2016 and 2017 FISS seasons. At-sea weights were recorded as round weights, while dockside weights were of head-on and washed fish (i.e., dockside dressed, Table 1). To estimate shrinkage, round weights must first be converted into at-sea dressed weights, requiring multiplication of round weights by 0.85 (0.75/0.88 from Table 1). Given the assumed 0.85 multiplier, the average % shrinkage across all 550 fish with both weights is 1.9% (SE=0.2%) and is therefore consistent with a shrinkage multiplier of 2% as assumed in Table 1.

Webster (2021) estimated a relationship between round and dressed weight for U32 Pacific halibut (those under 32” or 81.3 cm) from fished weighed twice onboard FISS vessels in 2019. There are currently no contemporary FISS data for estimating such a relationship for larger Pacific halibut.

Revising the length-net weight relationship

The current commercial sampling program and the FISS weight sampling provide us with two independent data sources to use in estimating contemporary length-net weight relationships. While the FISS data are typically collected in a spatially comprehensive manner within each IPHC Regulatory Area, they are temporally restricted to the May-September summer period. Conversely, commercial samples are collected throughout the fishing season, but may be more geographically limited due to the concentration of fishing effort in the most productive habitat.

As proposed at SRB019 (Webster 2021), our approach is to combine data from the commercial sampling with that from the FISS sampling in order to estimate length-net weight relationships that are as broadly applicable as possible. Data from the most recent three years (2019-21) were used in the modelling. Webster (2021) fitted models to commercial and FISS data by area and year, showing general temporal consistency in the estimated length-net weight relationships, but variability among relationships across IPHC Regulatory Areas. We have therefore estimated a revised relationship for each IPHC Regulatory Area using the combined data from 2019-21.

For estimating the relationship between fork length and net weight, only dressed, head-on fish (with the same standard head and ice and slime deductions assumed in the historical IPHC relationship, 10% and 2% respectively) were used due to the high spatial variability in the proportion of the weight removed when cutting heads (see Webster 2021). A 2% shrinkage deduction was also applied to fish weighed onboard.

Parameters were estimated by fitting linear models (on the log scale) using least squares. Let *L* be the fork length of a halibut in centimetres, and *W* be its net weight in kilograms. The historical IPHC length-net weight relationship is

$$W = 3.139 \times 10^{-6} L^{3.24} \tag{1}$$

For weights in pounds, the first parameter is 6.921×10^{-6}. More generally, the relationship between length and weight is assumed to have the following form

$$W = \alpha L^{\beta}$$

With *N* halibut in our sample, each is indexed by *i*, *i* = 1, …, *N*, we fit linear models on the log scale of the form

$$\log(W_i) = \log(\alpha) + \beta \log(L_i) + \varepsilon_i \tag{2}$$

where $\varepsilon_i \sim N(0, \sigma^2)$.

For both FISS and commercial data, several extreme outliers remained in the data even after careful review. To avoid these extreme observations (assumed to be errors in data collection or entry) influencing the estimated relationships, observations with measured weight more than twice or less than half the value predicted by the historical length-weight curve were excluded from the statistical analyses. These represented less than 0.05% of all observations.

Sample sizes often differed greatly between commercial and FISS data sources (Appendix A). This was due to the former having a fixed target of 1500 randomly sampled Pacific halibut per area, while the goal was to obtain a dressed weight for every fish of legal commercial size (O32, or over 32" or 81.3 cm in length) and a subsample of U32 fish (2019 only) on the FISS. To avoid one data source (commercial or FISS) dominating the estimation, we fitted a model that allowed parameters to vary with source, and then averaged the estimates across the two sources for each IPHC Regulatory Area.

Results

The parameter estimates for each IPHC Regulatory Area are given in Table 2, for both net and round weight (using the conversion in Table 1) in kg and lb.

Table 2. Parameter estimates for length-net weight and length-round weight by IPHC Regulatory Area, in kg and lb.

Reg. Area	Parameter estimates: net weight			Parameter estimates: round weight		
	α (kg)	α (lb)	β	α (kg)	α (lb)	β
2A	2.438×10^{-6}	5.375×10^{-6}	3.29	3.251×10^{-6}	7.167×10^{-6}	3.29
2B	3.189×10^{-6}	7.031×10^{-6}	3.23	4.252×10^{-6}	9.375×10^{-6}	3.23
2C	3.719×10^{-6}	8.198×10^{-6}	3.20	4.958×10^{-6}	1.093×10^{-5}	3.20
3A	4.821×10^{-6}	1.063×10^{-5}	3.13	6.428×10^{-6}	1.417×10^{-5}	3.13
3B	2.662×10^{-6}	5.869×10^{-6}	3.27	3.549×10^{-6}	7.825×10^{-6}	3.27
4A	4.762×10^{-6}	1.050×10^{-5}	3.14	6.350×10^{-6}	1.400×10^{-5}	3.14
4B	4.260×10^{-6}	9.391×10^{-6}	3.16	5.680×10^{-6}	1.252×10^{-5}	3.16
4CDE	4.443×10^{-6}	7.796×10^{-6}	3.16	5.925×10^{-6}	1.306×10^{-5}	3.16

Figures 1 to 8 compare the revised length-net weight relationships with the historical relationships by IPHC Regulatory Area. The left panels present the two relationships, while the right panels show the ratio of predicted weights from the revised relationship to those predicted by the historical relationship. With only a couple of exceptions, predicted net weights from revised relationships are consistently lower than historical predictions. For six out of eight IPHC Regulatory Areas, the relative difference between the two curves increases with increasing fork length (Figures 2 to 4 and 6 to 8). The magnitude of the relative difference between the two curves varies by area, with greatest differences for IPHC Regulatory Areas 3A and 4B (Figures 4 and 7) and least for IPHC Regulatory Areas 2B and 3B (Figures 2 and 5).

Tables of net weight for a wide range of Pacific halibut lengths are provided in Appendices B (metric units) and C (Imperial units).

Discussion

The revised length-weight relationships support the observations in the field that Pacific halibut have become lighter than predicted by the historical relationship in recent years. The degree of bias in the historical relationship's predictions of weight depends on fish length and IPHC Regulatory Area, but we expect that the revised relationships will provide improved estimates of Pacific halibut weights across the range of the stock. As new data become available each year, we will evaluate the need to update the length-weight relationships, and further revise as necessary to ensure any ongoing changes are accounted for.

There remain two components to the estimation of weight from length that are not directly estimable from recent FISS and commercial sample data: the conversion from round to dressed (dockside) weight, and the adjustment factors for ice and slime (conversion from unwashed to wash). The latter will be essential for reconciling the currently differing treatments of head weight, ice and slime and shrinkage in Alaska vs BC and the US West Coast. We have previously recommended (Webster 2021) that future FISS sampling include a random sample of O32 fish weighed twice, before and after dressing, and that greater effort should be made to weigh some sampled fish twice dockside, before and after washing.

References

Clark, W. G. 1992. Validation of the IPHC length-weight relationship for halibut. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1991: 113–116.

Courcelles, D. 2012. Re-evaluation of the length-weight relationship of Pacific halibut (Hippoglossus stenolepis). Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2011: 459-470.

Gilroy, H. L., Hutton, L. M. and MacTavish, K. A. 2009. 2008 commercial fishery and regulation changes. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2008: 37-48.

IPHC 2017. Report of the 93rd Session of the IPHC Annual Meeting (AM093) IPHC-2017-AM093-R.

Leaman, B. M. and Gilroy, H. L. 2008. IPHC staff regulatory proposals: 2008. Int. Pac. Halibut Comm. Annual Meeting Handout: 105-110.

Webster, R. A. and Erikson, L. M. 2017. Analysis of length-weight data from commercial sampling in 2016. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016: 101-109.

Webster, R. A. 2021. IPHC Fishery-Independent Setline Survey (FISS) and commercial data modelling. IPHC-2021-SRB019-05.

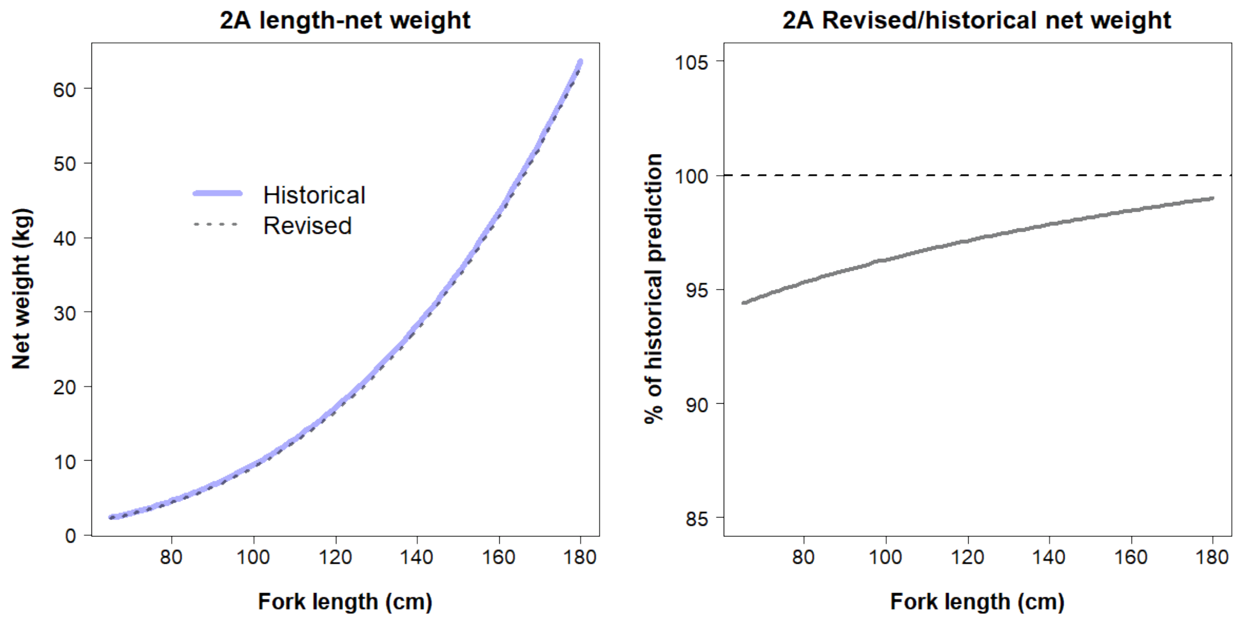


Figure 1. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 2A (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

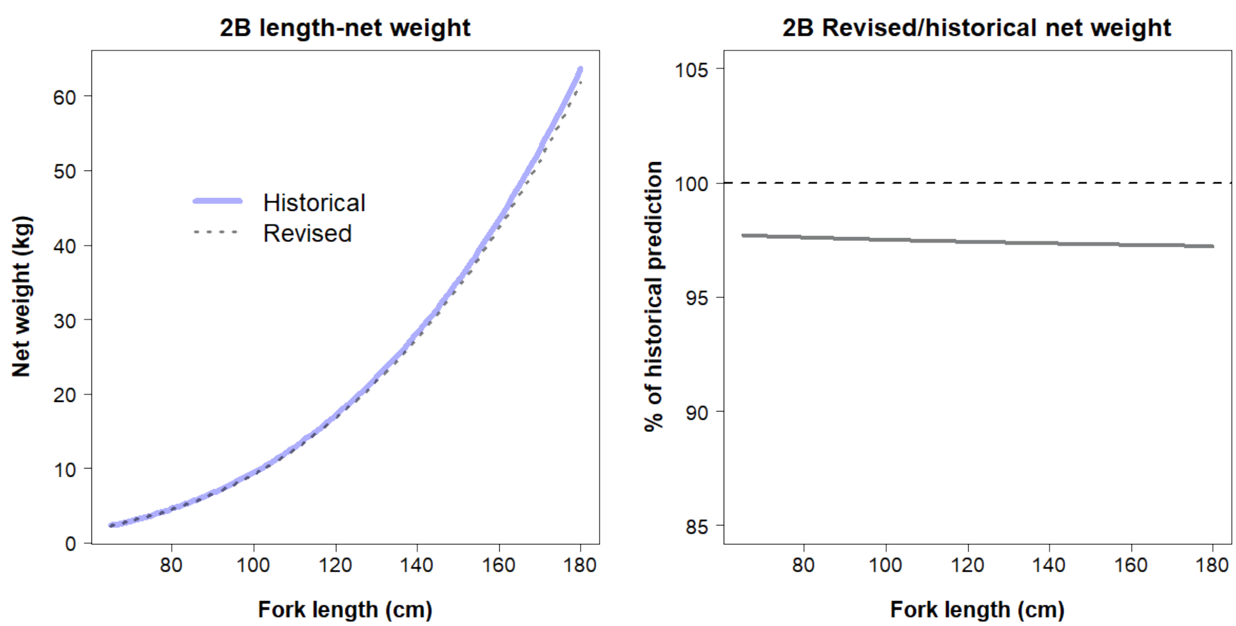


Figure 2. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 2B (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

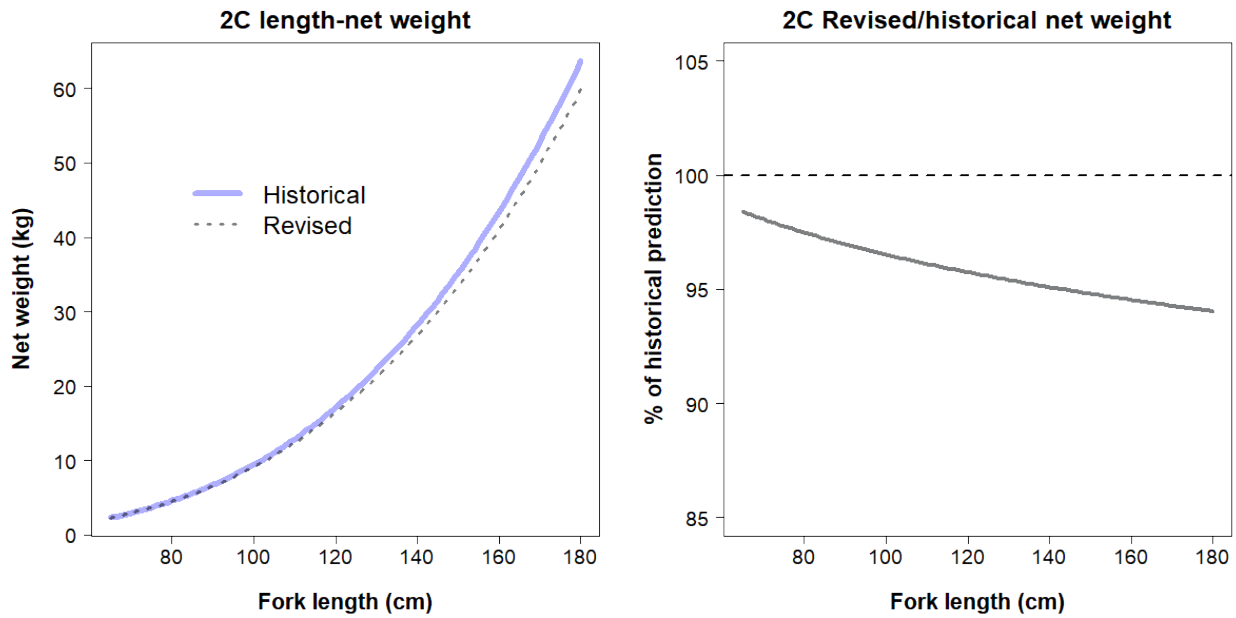


Figure 3. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 2C (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

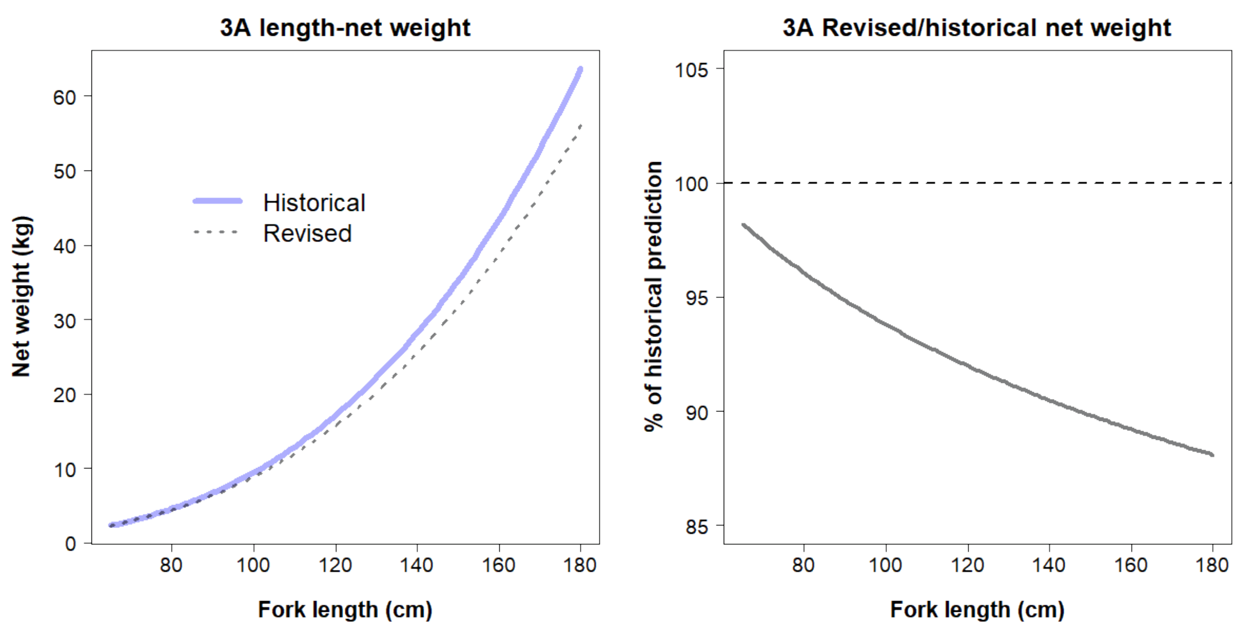


Figure 4. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 3A(left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

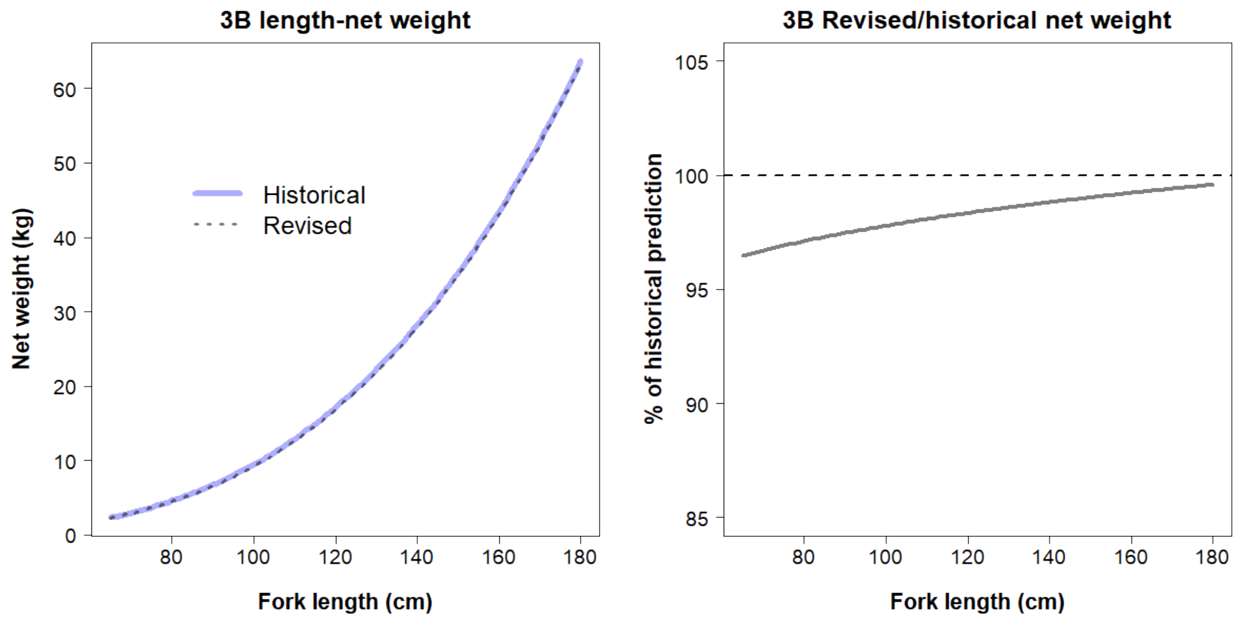


Figure 5. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 3B (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

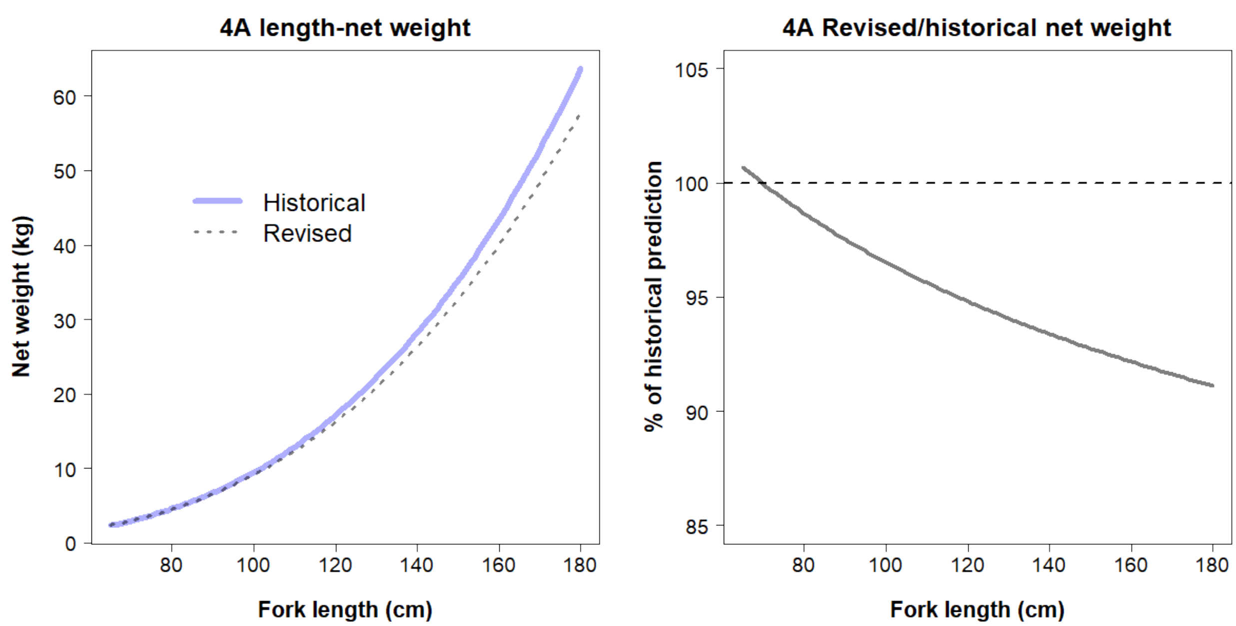


Figure 6. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 4A (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

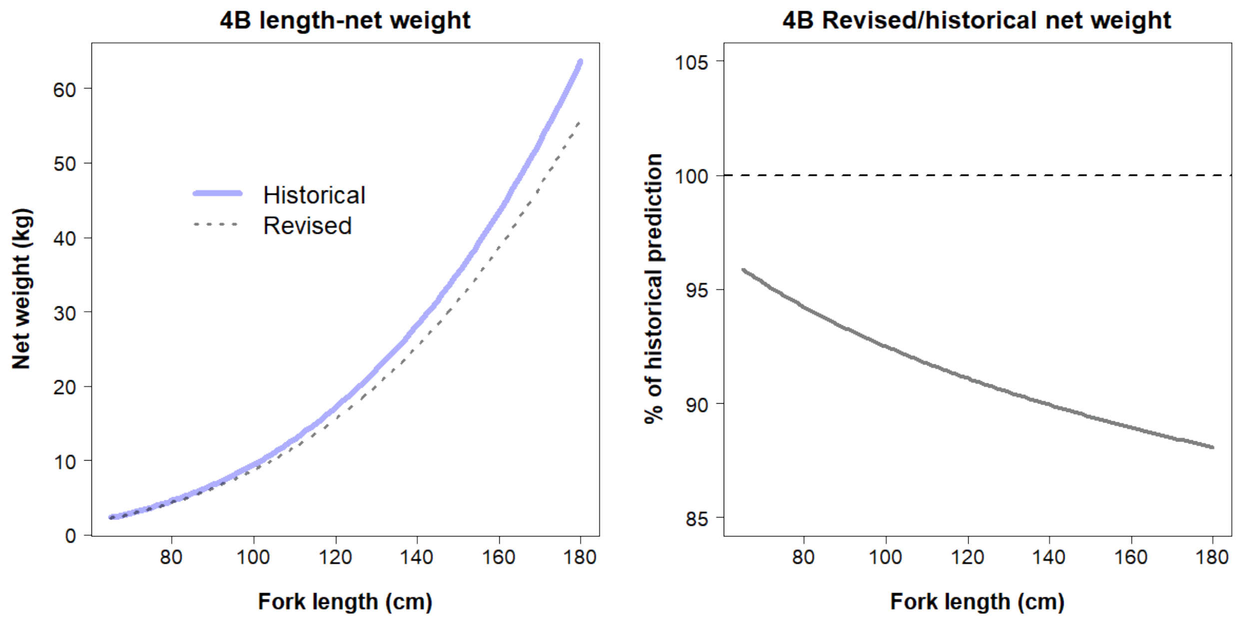


Figure 7. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 4B (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

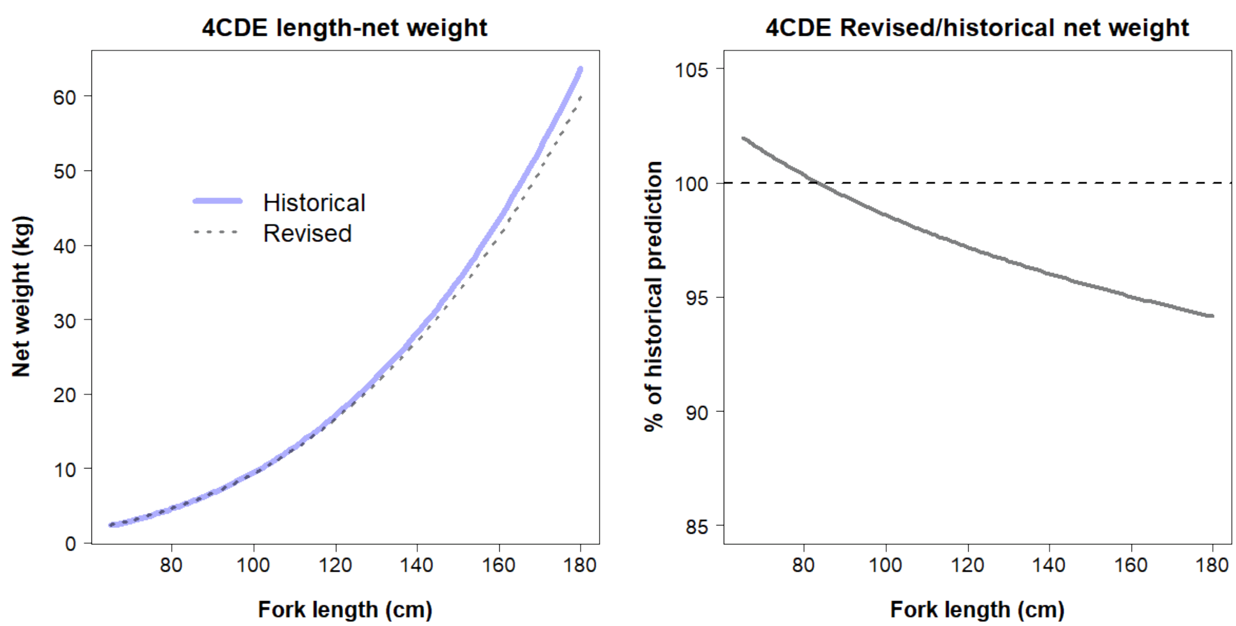


Figure 8. Length-net weight relationship estimated from 2019-21 commercial and FISS sampling data (dashed line) compared with the historical length-net weight relationship (solid blue line) for IPHC Regulatory Area 4CDE (left panel). The right panel shows the ratio of the predicted weights from the revised and historical relationships: values less than the dashed line at 100% mean the revised relationship predicts lighter Pacific halibut than the historical relationship.

Appendix A: Sample sizes of weighed Pacific halibut from commercial and FISS sampling.

Table A.1 Sample sizes of weighed commercial Pacific halibut by year and IPHC Regulatory Area.

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2015	32	801	1431	1538	1133	798	192	147
2016	303	1943	1673	1470	1492	1574	1466	1270
2017	1118	1376	1367	1453	1381	997	1816	1632
2018	2253	1421	1612	1676	808	925	1307	1494
2019	1731	1076	1573	1751	1751	1322	968	960
2020	1318	1694	1717	1608	1606	937	1264	905
2021	2803	1869	1481	1358	1027	1118	1207	162

Table A.2 Sample sizes of weighed FISS Pacific halibut by year and IPHC Regulatory Area.

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2019	786	3889	10898	15460	4530	3758	495	1545
2020	0	8101	6392	24813	2642	0	0	0
2021	785	6335	6200	20634	5862	2167	1579	329

Appendix B: Pacific halibut length-net weight tables (metric units)

Table B1. Length-net weight table for IPHC Regulatory Area 2A (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.0	111	12.9	151	35.4	191	76.6
72	3.1	112	13.3	152	36.2	192	77.9
73	3.2	113	13.6	153	36.9	193	79.3
74	3.4	114	14	154	37.7	194	80.6
75	3.5	115	14.5	155	38.6	195	82.0
76	3.7	116	14.9	156	39.4	196	83.4
77	3.9	117	15.3	157	40.2	197	84.8
78	4.0	118	15.7	158	41.1	198	86.2
79	4.2	119	16.2	159	41.9	199	87.7
80	4.4	120	16.6	160	42.8	200	89.1
81	4.6	121	17.1	161	43.7	201	90.6
82	4.8	122	17.6	162	44.6	202	92.1
83	4.9	123	18.0	163	45.5	203	93.6
84	5.1	124	18.5	164	46.4	204	95.1
85	5.4	125	19.0	165	47.4	205	96.6
86	5.6	126	19.5	166	48.3	206	98.2
87	5.8	127	20.0	167	49.3	207	99.8
88	6.0	128	20.6	168	50.2	208	101.4
89	6.2	129	21.1	169	51.2	209	103.0
90	6.5	130	21.6	170	52.2	210	104.6
91	6.7	131	22.2	171	53.2	211	106.3
92	6.9	132	22.7	172	54.3	212	107.9
93	7.2	133	23.3	173	55.3	213	109.6
94	7.5	134	23.9	174	56.4	214	111.3
95	7.7	135	24.5	175	57.5	215	113.0
96	8.0	136	25.1	176	58.5	216	114.8
97	8.3	137	25.7	177	59.6	217	116.5
98	8.5	138	26.3	178	60.8	218	118.3
99	8.8	139	27.0	179	61.9	219	120.1
100	9.1	140	27.6	180	63.0	220	121.9
101	9.4	141	28.2	181	64.2	221	123.7
102	9.7	142	28.9	182	65.4	222	125.6
103	10.1	143	29.6	183	66.5	223	127.4
104	10.4	144	30.3	184	67.7	224	129.3
105	10.7	145	31.0	185	69.0	225	131.2
106	11.1	146	31.7	186	70.2	226	133.2
107	11.4	147	32.4	187	71.4	227	135.1
108	11.8	148	33.1	188	72.7	228	137.1
109	12.1	149	33.9	189	74.0	229	139.1
110	12.5	150	34.6	190	75.3	230	141.1

Table B2. Length-net weight table for IPHC Regulatory Area 2B (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.1	111	13.0	151	35.0	191	74.8
72	3.2	112	13.3	152	35.8	192	76.1
73	3.3	113	13.7	153	36.5	193	77.4
74	3.5	114	14.1	154	37.3	194	78.7
75	3.7	115	14.5	155	38.1	195	80.0
76	3.8	116	14.9	156	38.9	196	81.4
77	4.0	117	15.4	157	39.7	197	82.7
78	4.1	118	15.8	158	40.5	198	84.1
79	4.3	119	16.2	159	41.4	199	85.4
80	4.5	120	16.7	160	42.2	200	86.8
81	4.7	121	17.1	161	43.1	201	88.3
82	4.9	122	17.6	162	44.0	202	89.7
83	5.1	123	18.1	163	44.8	203	91.1
84	5.3	124	18.5	164	45.7	204	92.6
85	5.5	125	19.0	165	46.6	205	94.1
86	5.7	126	19.5	166	47.6	206	95.5
87	5.9	127	20.0	167	48.5	207	97.1
88	6.1	128	20.5	168	49.4	208	98.6
89	6.3	129	21.1	169	50.4	209	100.1
90	6.6	130	21.6	170	51.4	210	101.7
91	6.8	131	22.1	171	52.3	211	103.2
92	7.1	132	22.7	172	53.3	212	104.8
93	7.3	133	23.2	173	54.4	213	106.4
94	7.6	134	23.8	174	55.4	214	108.1
95	7.8	135	24.4	175	56.4	215	109.7
96	8.1	136	25.0	176	57.5	216	111.4
97	8.4	137	25.6	177	58.5	217	113.0
98	8.7	138	26.2	178	59.6	218	114.7
99	9.0	139	26.8	179	60.7	219	116.4
100	9.2	140	27.4	180	61.8	220	118.2
101	9.6	141	28.1	181	62.9	221	119.9
102	9.9	142	28.7	182	64.0	222	121.7
103	10.2	143	29.4	183	65.2	223	123.4
104	10.5	144	30.0	184	66.3	224	125.2
105	10.8	145	30.7	185	67.5	225	127.1
106	11.2	146	31.4	186	68.7	226	128.9
107	11.5	147	32.1	187	69.9	227	130.7
108	11.9	148	32.8	188	71.1	228	132.6
109	12.2	149	33.5	189	72.3	229	134.5
110	12.6	150	34.3	190	73.6	230	136.4

Table B3. Length-net weight table for IPHC Regulatory Area 2C (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.1	111	12.8	151	34.2	191	72.4
72	3.2	112	13.1	152	34.9	192	73.6
73	3.3	113	13.5	153	35.6	193	74.8
74	3.5	114	13.9	154	36.4	194	76.1
75	3.6	115	14.3	155	37.1	195	77.3
76	3.8	116	14.7	156	37.9	196	78.6
77	4.0	117	15.1	157	38.7	197	79.9
78	4.1	118	15.5	158	39.5	198	81.2
79	4.3	119	16.0	159	40.3	199	82.5
80	4.5	120	16.4	160	41.1	200	83.8
81	4.7	121	16.8	161	41.9	201	85.2
82	4.9	122	17.3	162	42.8	202	86.5
83	5.0	123	17.7	163	43.6	203	87.9
84	5.2	124	18.2	164	44.5	204	89.3
85	5.4	125	18.7	165	45.3	205	90.7
86	5.7	126	19.2	166	46.2	206	92.1
87	5.9	127	19.6	167	47.1	207	93.6
88	6.1	128	20.1	168	48.0	208	95.0
89	6.3	129	20.6	169	48.9	209	96.5
90	6.5	130	21.2	170	49.9	210	98.0
91	6.8	131	21.7	171	50.8	211	99.5
92	7.0	132	22.2	172	51.8	212	101.0
93	7.3	133	22.8	173	52.7	213	102.5
94	7.5	134	23.3	174	53.7	214	104.1
95	7.8	135	23.9	175	54.7	215	105.6
96	8.0	136	24.4	176	55.7	216	107.2
97	8.3	137	25.0	177	56.7	217	108.8
98	8.6	138	25.6	178	57.8	218	110.4
99	8.9	139	26.2	179	58.8	219	112.0
100	9.2	140	26.8	180	59.9	220	113.7
101	9.4	141	27.4	181	60.9	221	115.3
102	9.7	142	28.1	182	62.0	222	117.0
103	10.1	143	28.7	183	63.1	223	118.7
104	10.4	144	29.3	184	64.2	224	120.4
105	10.7	145	30.0	185	65.3	225	122.1
106	11.0	146	30.7	186	66.5	226	123.9
107	11.4	147	31.3	187	67.6	227	125.6
108	11.7	148	32.0	188	68.8	228	127.4
109	12.1	149	32.7	189	70.0	229	129.2
110	12.4	150	33.4	190	71.2	230	131.0

Table B4. Length-net weight table for IPHC Regulatory Area 3A (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.0	111	12.3	151	32.3	191	67.5
72	3.2	112	12.7	152	33.0	192	68.6
73	3.3	113	13.0	153	33.7	193	69.8
74	3.5	114	13.4	154	34.4	194	70.9
75	3.6	115	13.8	155	35.1	195	72.1
76	3.8	116	14.2	156	35.8	196	73.2
77	3.9	117	14.5	157	36.5	197	74.4
78	4.1	118	14.9	158	37.3	198	75.6
79	4.2	119	15.3	159	38.0	199	76.8
80	4.4	120	15.7	160	38.8	200	78.0
81	4.6	121	16.2	161	39.5	201	79.2
82	4.8	122	16.6	162	40.3	202	80.5
83	5.0	123	17.0	163	41.1	203	81.7
84	5.2	124	17.4	164	41.9	204	83.0
85	5.3	125	17.9	165	42.7	205	84.3
86	5.5	126	18.3	166	43.5	206	85.6
87	5.7	127	18.8	167	44.3	207	86.9
88	6.0	128	19.3	168	45.2	208	88.2
89	6.2	129	19.7	169	46.0	209	89.5
90	6.4	130	20.2	170	46.9	210	90.9
91	6.6	131	20.7	171	47.8	211	92.3
92	6.8	132	21.2	172	48.6	212	93.6
93	7.1	133	21.7	173	49.5	213	95.0
94	7.3	134	22.2	174	50.4	214	96.4
95	7.6	135	22.8	175	51.3	215	97.8
96	7.8	136	23.3	176	52.3	216	99.3
97	8.1	137	23.8	177	53.2	217	100.7
98	8.3	138	24.4	178	54.2	218	102.2
99	8.6	139	25.0	179	55.1	219	103.7
100	8.9	140	25.5	180	56.1	220	105.2
101	9.2	141	26.1	181	57.1	221	106.7
102	9.5	142	26.7	182	58.1	222	108.2
103	9.8	143	27.3	183	59.1	223	109.7
104	10.1	144	27.9	184	60.1	224	111.3
105	10.4	145	28.5	185	61.1	225	112.8
106	10.7	146	29.1	186	62.1	226	114.4
107	11.0	147	29.7	187	63.2	227	116.0
108	11.3	148	30.4	188	64.3	228	117.6
109	11.6	149	31.0	189	65.3	229	119.2
110	12.0	150	31.7	190	66.4	230	120.9

Table B5. Length-net weight table for IPHC Regulatory Area 3B (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.0	111	13.0	151	35.7	191	77.0
72	3.2	112	13.4	152	36.5	192	78.3
73	3.3	113	13.8	153	37.3	193	79.6
74	3.5	114	14.2	154	38.1	194	81.0
75	3.6	115	14.6	155	38.9	195	82.4
76	3.8	116	15.1	156	39.7	196	83.8
77	3.9	117	15.5	157	40.5	197	85.2
78	4.1	118	15.9	158	41.4	198	86.6
79	4.3	119	16.4	159	42.3	199	88.0
80	4.5	120	16.8	160	43.1	200	89.5
81	4.7	121	17.3	161	44.0	201	91.0
82	4.8	122	17.8	162	44.9	202	92.5
83	5.0	123	18.2	163	45.8	203	94.0
84	5.2	124	18.7	164	46.8	204	95.5
85	5.4	125	19.2	165	47.7	205	97.0
86	5.7	126	19.7	166	48.7	206	98.6
87	5.9	127	20.3	167	49.6	207	100.2
88	6.1	128	20.8	168	50.6	208	101.7
89	6.3	129	21.3	169	51.6	209	103.4
90	6.6	130	21.9	170	52.6	210	105.0
91	6.8	131	22.4	171	53.6	211	106.6
92	7.1	132	23.0	172	54.6	212	108.3
93	7.3	133	23.6	173	55.7	213	110.0
94	7.6	134	24.1	174	56.7	214	111.7
95	7.8	135	24.7	175	57.8	215	113.4
96	8.1	136	25.3	176	58.9	216	115.1
97	8.4	137	26.0	177	60.0	217	116.9
98	8.7	138	26.6	178	61.1	218	118.6
99	9.0	139	27.2	179	62.3	219	120.4
100	9.3	140	27.9	180	63.4	220	122.2
101	9.6	141	28.5	181	64.6	221	124.1
102	9.9	142	29.2	182	65.7	222	125.9
103	10.2	143	29.9	183	66.9	223	127.8
104	10.5	144	30.6	184	68.1	224	129.7
105	10.9	145	31.3	185	69.3	225	131.6
106	11.2	146	32.0	186	70.6	226	133.5
107	11.6	147	32.7	187	71.8	227	135.4
108	11.9	148	33.4	188	73.1	228	137.4
109	12.3	149	34.2	189	74.4	229	139.4
110	12.7	150	34.9	190	75.7	230	141.4

Table B6. Length-net weight table for IPHC Regulatory Area 4A (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.1	111	12.7	151	33.4	191	69.9
72	3.3	112	13.1	152	34.1	192	71.0
73	3.4	113	13.4	153	34.8	193	72.2
74	3.6	114	13.8	154	35.5	194	73.4
75	3.7	115	14.2	155	36.3	195	74.6
76	3.9	116	14.6	156	37.0	196	75.8
77	4.0	117	15.0	157	37.8	197	77.0
78	4.2	118	15.4	158	38.5	198	78.3
79	4.4	119	15.8	159	39.3	199	79.5
80	4.5	120	16.2	160	40.1	200	80.8
81	4.7	121	16.7	161	40.9	201	82.0
82	4.9	122	17.1	162	41.7	202	83.3
83	5.1	123	17.5	163	42.5	203	84.6
84	5.3	124	18.0	164	43.3	204	86.0
85	5.5	125	18.4	165	44.1	205	87.3
86	5.7	126	18.9	166	45.0	206	88.6
87	5.9	127	19.4	167	45.8	207	90.0
88	6.1	128	19.9	168	46.7	208	91.4
89	6.3	129	20.4	169	47.6	209	92.7
90	6.6	130	20.9	170	48.5	210	94.1
91	6.8	131	21.4	171	49.4	211	95.6
92	7.0	132	21.9	172	50.3	212	97.0
93	7.3	133	22.4	173	51.2	213	98.4
94	7.5	134	23.0	174	52.1	214	99.9
95	7.8	135	23.5	175	53.1	215	101.4
96	8.0	136	24.0	176	54.1	216	102.9
97	8.3	137	24.6	177	55.0	217	104.4
98	8.6	138	25.2	178	56.0	218	105.9
99	8.9	139	25.8	179	57.0	219	107.4
100	9.2	140	26.3	180	58.0	220	109.0
101	9.4	141	26.9	181	59.0	221	110.5
102	9.7	142	27.5	182	60.1	222	112.1
103	10.0	143	28.2	183	61.1	223	113.7
104	10.4	144	28.8	184	62.2	224	115.3
105	10.7	145	29.4	185	63.2	225	116.9
106	11.0	146	30.0	186	64.3	226	118.6
107	11.3	147	30.7	187	65.4	227	120.2
108	11.7	148	31.4	188	66.5	228	121.9
109	12.0	149	32.0	189	67.6	229	123.6
110	12.3	150	32.7	190	68.7	230	125.3

Table B7. Length-net weight table for IPHC Regulatory Area 4B (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.0	111	12.2	151	32.2	191	67.6
72	3.1	112	12.5	152	32.9	192	68.7
73	3.2	113	12.9	153	33.6	193	69.9
74	3.4	114	13.3	154	34.3	194	71.0
75	3.5	115	13.6	155	35.0	195	72.2
76	3.7	116	14.0	156	35.7	196	73.4
77	3.8	117	14.4	157	36.4	197	74.6
78	4.0	118	14.8	158	37.2	198	75.8
79	4.2	119	15.2	159	37.9	199	77.0
80	4.3	120	15.6	160	38.7	200	78.2
81	4.5	121	16.0	161	39.4	201	79.4
82	4.7	122	16.4	162	40.2	202	80.7
83	4.9	123	16.9	163	41.0	203	82.0
84	5.1	124	17.3	164	41.8	204	83.2
85	5.2	125	17.7	165	42.6	205	84.5
86	5.4	126	18.2	166	43.4	206	85.9
87	5.6	127	18.6	167	44.3	207	87.2
88	5.9	128	19.1	168	45.1	208	88.5
89	6.1	129	19.6	169	46.0	209	89.9
90	6.3	130	20.1	170	46.8	210	91.2
91	6.5	131	20.6	171	47.7	211	92.6
92	6.7	132	21.1	172	48.6	212	94.0
93	7.0	133	21.6	173	49.5	213	95.4
94	7.2	134	22.1	174	50.4	214	96.8
95	7.5	135	22.6	175	51.3	215	98.3
96	7.7	136	23.1	176	52.2	216	99.7
97	8.0	137	23.7	177	53.2	217	101.2
98	8.2	138	24.2	178	54.1	218	102.7
99	8.5	139	24.8	179	55.1	219	104.1
100	8.8	140	25.4	180	56.1	220	105.7
101	9.0	141	25.9	181	57.1	221	107.2
102	9.3	142	26.5	182	58.1	222	108.7
103	9.6	143	27.1	183	59.1	223	110.3
104	9.9	144	27.7	184	60.1	224	111.8
105	10.2	145	28.3	185	61.1	225	113.4
106	10.5	146	29.0	186	62.2	226	115.0
107	10.9	147	29.6	187	63.3	227	116.6
108	11.2	148	30.2	188	64.3	228	118.3
109	11.5	149	30.9	189	65.4	229	119.9
110	11.8	150	31.5	190	66.5	230	121.6

Table B8. Length-net weight table for IPHC Regulatory Area 4CDE (metric, 71-230 cm).

Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
71	3.2	111	13.0	151	34.4	191	72.3
72	3.3	112	13.4	152	35.1	192	73.5
73	3.5	113	13.8	153	35.9	193	74.7
74	3.6	114	14.1	154	36.6	194	76.0
75	3.8	115	14.5	155	37.4	195	77.2
76	3.9	116	14.9	156	38.1	196	78.5
77	4.1	117	15.4	157	38.9	197	79.7
78	4.3	118	15.8	158	39.7	198	81.0
79	4.4	119	16.2	159	40.5	199	82.3
80	4.6	120	16.6	160	41.3	200	83.6
81	4.8	121	17.1	161	42.1	201	85.0
82	5.0	122	17.5	162	43.0	202	86.3
83	5.2	123	18.0	163	43.8	203	87.7
84	5.4	124	18.5	164	44.7	204	89.0
85	5.6	125	18.9	165	45.5	205	90.4
86	5.8	126	19.4	166	46.4	206	91.8
87	6.0	127	19.9	167	47.3	207	93.2
88	6.2	128	20.4	168	48.2	208	94.7
89	6.5	129	20.9	169	49.1	209	96.1
90	6.7	130	21.4	170	50.0	210	97.6
91	6.9	131	21.9	171	51.0	211	99.1
92	7.2	132	22.5	172	51.9	212	100.5
93	7.4	133	23.0	173	52.9	213	102.1
94	7.7	134	23.6	174	53.8	214	103.6
95	7.9	135	24.1	175	54.8	215	105.1
96	8.2	136	24.7	176	55.8	216	106.7
97	8.5	137	25.3	177	56.8	217	108.2
98	8.8	138	25.9	178	57.9	218	109.8
99	9.1	139	26.5	179	58.9	219	111.4
100	9.3	140	27.1	180	59.9	220	113.0
101	9.6	141	27.7	181	61.0	221	114.7
102	10.0	142	28.3	182	62.1	222	116.3
103	10.3	143	29.0	183	63.2	223	118.0
104	10.6	144	29.6	184	64.3	224	119.7
105	10.9	145	30.3	185	65.4	225	121.4
106	11.2	146	30.9	186	66.5	226	123.1
107	11.6	147	31.6	187	67.6	227	124.8
108	11.9	148	32.3	188	68.8	228	126.6
109	12.3	149	33.0	189	69.9	229	128.3
110	12.6	150	33.7	190	71.1	230	130.1

Appendix C: Pacific halibut length-net weight tables (Imperial units)

Table C1. Length-net weight table for IPHC Regulatory Area 2A (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.2	40.0	21.2	57.5	69.9	75.0	167.4
23.0	3.4	40.5	22.1	58.0	71.9	75.5	171.1
23.5	3.7	41.0	23.0	58.5	74.0	76.0	174.9
24.0	4.0	41.5	23.9	59.0	76.1	76.5	178.7
24.5	4.2	42.0	24.9	59.5	78.2	77.0	182.5
25.0	4.5	42.5	25.9	60.0	80.4	77.5	186.5
25.5	4.8	43.0	26.9	60.5	82.6	78.0	190.4
26.0	5.1	43.5	27.9	61.0	84.9	78.5	194.5
26.5	5.5	44.0	29.0	61.5	87.2	79.0	198.6
27.0	5.8	44.5	30.1	62.0	89.6	79.5	202.7
27.5	6.2	45.0	31.2	62.5	91.9	80.0	207.0
28.0	6.6	45.5	32.4	63.0	94.4	80.5	211.3
28.5	7.0	46.0	33.6	63.5	96.9	81.0	215.6
29.0	7.4	46.5	34.8	64.0	99.4	81.5	220.0
29.5	7.8	47.0	36.0	64.5	102.0	82.0	224.5
30.0	8.2	47.5	37.3	65.0	104.6	82.5	229.0
30.5	8.7	48.0	38.6	65.5	107.3	83.0	233.6
31.0	9.2	48.5	40.0	66.0	110.0	83.5	238.2
31.5	9.7	49.0	41.3	66.5	112.7	84.0	243.0
32.0	10.2	49.5	42.7	67.0	115.6	84.5	247.8
32.5	10.7	50.0	44.2	67.5	118.4	85.0	252.6
33.0	11.3	50.5	45.6	68.0	121.3	85.5	257.5
33.5	11.8	51.0	47.1	68.5	124.3	86.0	262.5
34.0	12.4	51.5	48.7	69.0	127.3	86.5	267.6
34.5	13.0	52.0	50.2	69.5	130.3	87.0	272.7
35.0	13.7	52.5	51.8	70.0	133.4	87.5	277.9
35.5	14.3	53.0	53.5	70.5	136.6	88.0	283.1
36.0	15.0	53.5	55.2	71.0	139.8	88.5	288.4
36.5	15.7	54.0	56.9	71.5	143.1	89.0	293.8
37.0	16.4	54.5	58.6	72.0	146.4	89.5	299.3
37.5	17.2	55.0	60.4	72.5	149.8	90.0	304.8
38.0	17.9	55.5	62.2	73.0	153.2	90.5	310.4
38.5	18.7	56.0	64.1	73.5	156.7	91.0	316.1
39.0	19.5	56.5	66.0	74.0	160.2	91.5	321.8
39.5	20.3	57.0	67.9	74.5	163.8	92.0	327.6

Table C2. Length-net weight table for IPHC Regulatory Area 2B (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.3	40.0	21.5	57.5	69.3	75.0	163.6
23.0	3.6	40.5	22.3	58.0	71.3	75.5	167.1
23.5	3.8	41.0	23.2	58.5	73.3	76.0	170.8
24.0	4.1	41.5	24.2	59.0	75.3	76.5	174.4
24.5	4.4	42.0	25.1	59.5	77.4	77.0	178.1
25.0	4.7	42.5	26.1	60.0	79.6	77.5	181.9
25.5	5.0	43.0	27.1	60.5	81.7	78.0	185.7
26.0	5.3	43.5	28.1	61.0	83.9	78.5	189.6
26.5	5.7	44.0	29.2	61.5	86.2	79.0	193.5
27.0	6.0	44.5	30.3	62.0	88.4	79.5	197.5
27.5	6.4	45.0	31.4	62.5	90.8	80.0	201.5
28.0	6.8	45.5	32.5	63.0	93.1	80.5	205.6
28.5	7.2	46.0	33.7	63.5	95.5	81.0	209.8
29.0	7.6	46.5	34.9	64.0	98.0	81.5	214.0
29.5	8.0	47.0	36.1	64.5	100.5	82.0	218.3
30.0	8.5	47.5	37.4	65.0	103.0	82.5	222.6
30.5	8.9	48.0	38.7	65.5	105.6	83.0	227.0
31.0	9.4	48.5	40.0	66.0	108.2	83.5	231.4
31.5	9.9	49.0	41.3	66.5	110.9	84.0	235.9
32.0	10.4	49.5	42.7	67.0	113.6	84.5	240.5
32.5	11.0	50.0	44.1	67.5	116.4	85.0	245.1
33.0	11.5	50.5	45.6	68.0	119.2	85.5	249.8
33.5	12.1	51.0	47.1	68.5	122.1	86.0	254.6
34.0	12.7	51.5	48.6	69.0	125.0	86.5	259.4
34.5	13.3	52.0	50.1	69.5	127.9	87.0	264.3
35.0	13.9	52.5	51.7	70.0	130.9	87.5	269.2
35.5	14.6	53.0	53.3	70.5	134.0	88.0	274.2
36.0	15.3	53.5	54.9	71.0	137.0	88.5	279.3
36.5	16.0	54.0	56.6	71.5	140.2	89.0	284.4
37.0	16.7	54.5	58.3	72.0	143.4	89.5	289.6
37.5	17.4	55.0	60.1	72.5	146.6	90.0	294.9
38.0	18.2	55.5	61.8	73.0	149.9	90.5	300.2
38.5	19.0	56.0	63.7	73.5	153.3	91.0	305.6
39.0	19.8	56.5	65.5	74.0	156.7	91.5	311.0
39.5	20.6	57.0	67.4	74.5	160.1	92.0	316.6

Table C3. Length-net weight table for IPHC Regulatory Area 2C (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.4	40.0	21.2	57.5	67.7	75.0	158.2
23.0	3.6	40.5	22.1	58.0	69.6	75.5	161.6
23.5	3.9	41.0	23.0	58.5	71.5	76.0	165.0
24.0	4.1	41.5	23.9	59.0	73.5	76.5	168.5
24.5	4.4	42.0	24.8	59.5	75.5	77.0	172.1
25.0	4.7	42.5	25.8	60.0	77.5	77.5	175.7
25.5	5.0	43.0	26.7	60.5	79.6	78.0	179.3
26.0	5.4	43.5	27.7	61.0	81.7	78.5	183.0
26.5	5.7	44.0	28.8	61.5	83.9	79.0	186.8
27.0	6.0	44.5	29.8	62.0	86.1	79.5	190.6
27.5	6.4	45.0	30.9	62.5	88.3	80.0	194.4
28.0	6.8	45.5	32.0	63.0	90.6	80.5	198.3
28.5	7.2	46.0	33.2	63.5	92.9	81.0	202.3
29.0	7.6	46.5	34.3	64.0	95.3	81.5	206.3
29.5	8.0	47.0	35.5	64.5	97.7	82.0	210.4
30.0	8.5	47.5	36.8	65.0	100.1	82.5	214.5
30.5	8.9	48.0	38.0	65.5	102.6	83.0	218.7
31.0	9.4	48.5	39.3	66.0	105.1	83.5	222.9
31.5	9.9	49.0	40.6	66.5	107.7	84.0	227.2
32.0	10.4	49.5	41.9	67.0	110.3	84.5	231.6
32.5	10.9	50.0	43.3	67.5	113.0	85.0	236.0
33.0	11.5	50.5	44.7	68.0	115.7	85.5	240.5
33.5	12.0	51.0	46.1	68.5	118.4	86.0	245.0
34.0	12.6	51.5	47.6	69.0	121.2	86.5	249.6
34.5	13.2	52.0	49.1	69.5	124.0	87.0	254.2
35.0	13.9	52.5	50.6	70.0	126.9	87.5	258.9
35.5	14.5	53.0	52.2	70.5	129.8	88.0	263.7
36.0	15.2	53.5	53.8	71.0	132.8	88.5	268.5
36.5	15.8	54.0	55.4	71.5	135.8	89.0	273.4
37.0	16.5	54.5	57.0	72.0	138.9	89.5	278.3
37.5	17.3	55.0	58.7	72.5	142.0	90.0	283.3
38.0	18.0	55.5	60.4	73.0	145.1	90.5	288.4
38.5	18.8	56.0	62.2	73.5	148.3	91.0	293.5
39.0	19.6	56.5	64.0	74.0	151.6	91.5	298.7
39.5	20.4	57.0	65.8	74.5	154.9	92.0	303.9

Table C4. Length-net weight table for IPHC Regulatory Area 3A (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.4	40.0	20.6	57.5	64.2	75.0	147.7
23.0	3.6	40.5	21.4	58.0	66.0	75.5	150.8
23.5	3.9	41.0	22.3	58.5	67.8	76.0	153.9
24.0	4.2	41.5	23.1	59.0	69.6	76.5	157.1
24.5	4.4	42.0	24.0	59.5	71.5	77.0	160.4
25.0	4.7	42.5	24.9	60.0	73.4	77.5	163.6
25.5	5.0	43.0	25.8	60.5	75.3	78.0	167.0
26.0	5.3	43.5	26.8	61.0	77.3	78.5	170.3
26.5	5.7	44.0	27.8	61.5	79.3	79.0	173.8
27.0	6.0	44.5	28.8	62.0	81.3	79.5	177.2
27.5	6.4	45.0	29.8	62.5	83.4	80.0	180.8
28.0	6.7	45.5	30.9	63.0	85.5	80.5	184.3
28.5	7.1	46.0	31.9	63.5	87.7	81.0	187.9
29.0	7.5	46.5	33.0	64.0	89.8	81.5	191.6
29.5	7.9	47.0	34.2	64.5	92.1	82.0	195.3
30.0	8.4	47.5	35.3	65.0	94.3	82.5	199.0
30.5	8.8	48.0	36.5	65.5	96.6	83.0	202.9
31.0	9.3	48.5	37.7	66.0	98.9	83.5	206.7
31.5	9.7	49.0	38.9	66.5	101.3	84.0	210.6
32.0	10.2	49.5	40.2	67.0	103.7	84.5	214.6
32.5	10.8	50.0	41.5	67.5	106.2	85.0	218.6
33.0	11.3	50.5	42.8	68.0	108.6	85.5	222.6
33.5	11.8	51.0	44.1	68.5	111.2	86.0	226.7
34.0	12.4	51.5	45.5	69.0	113.7	86.5	230.9
34.5	13.0	52.0	46.9	69.5	116.3	87.0	235.1
35.0	13.6	52.5	48.3	70.0	119.0	87.5	239.3
35.5	14.2	53.0	49.8	70.5	121.6	88.0	243.7
36.0	14.8	53.5	51.2	71.0	124.4	88.5	248.0
36.5	15.5	54.0	52.8	71.5	127.1	89.0	252.4
37.0	16.1	54.5	54.3	72.0	129.9	89.5	256.9
37.5	16.8	55.0	55.9	72.5	132.8	90.0	261.4
38.0	17.5	55.5	57.5	73.0	135.7	90.5	266.0
38.5	18.3	56.0	59.1	73.5	138.6	91.0	270.6
39.0	19.0	56.5	60.8	74.0	141.6	91.5	275.3
39.5	19.8	57.0	62.5	74.5	144.6	92.0	280.1

Table C5. Length-net weight table for IPHC Regulatory Area 3B (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.3	40.0	21.5	57.5	70.6	75.0	168.3
23.0	3.5	40.5	22.4	58.0	72.6	75.5	172.0
23.5	3.8	41.0	23.3	58.5	74.7	76.0	175.7
24.0	4.0	41.5	24.3	59.0	76.8	76.5	179.5
24.5	4.3	42.0	25.3	59.5	78.9	77.0	183.4
25.0	4.6	42.5	26.3	60.0	81.1	77.5	187.3
25.5	4.9	43.0	27.3	60.5	83.3	78.0	191.3
26.0	5.3	43.5	28.3	61.0	85.6	78.5	195.3
26.5	5.6	44.0	29.4	61.5	87.9	79.0	199.4
27.0	6.0	44.5	30.5	62.0	90.3	79.5	203.6
27.5	6.3	45.0	31.6	62.5	92.7	80.0	207.8
28.0	6.7	45.5	32.8	63.0	95.1	80.5	212.1
28.5	7.1	46.0	34.0	63.5	97.6	81.0	216.4
29.0	7.5	46.5	35.2	64.0	100.2	81.5	220.8
29.5	8.0	47.0	36.5	64.5	102.7	82.0	225.3
30.0	8.4	47.5	37.8	65.0	105.4	82.5	229.8
30.5	8.9	48.0	39.1	65.5	108.0	83.0	234.4
31.0	9.4	48.5	40.4	66.0	110.8	83.5	239.1
31.5	9.9	49.0	41.8	66.5	113.5	84.0	243.8
32.0	10.4	49.5	43.2	67.0	116.3	84.5	248.5
32.5	10.9	50.0	44.7	67.5	119.2	85.0	253.4
33.0	11.5	50.5	46.1	68.0	122.1	85.5	258.3
33.5	12.1	51.0	47.7	68.5	125.1	86.0	263.3
34.0	12.7	51.5	49.2	69.0	128.1	86.5	268.3
34.5	13.3	52.0	50.8	69.5	131.2	87.0	273.4
35.0	13.9	52.5	52.4	70.0	134.3	87.5	278.6
35.5	14.6	53.0	54.0	70.5	137.4	88.0	283.8
36.0	15.3	53.5	55.7	71.0	140.6	88.5	289.1
36.5	16.0	54.0	57.5	71.5	143.9	89.0	294.5
37.0	16.7	54.5	59.2	72.0	147.2	89.5	300.0
37.5	17.4	55.0	61.0	72.5	150.6	90.0	305.5
38.0	18.2	55.5	62.8	73.0	154.0	90.5	311.1
38.5	19.0	56.0	64.7	73.5	157.5	91.0	316.7
39.0	19.8	56.5	66.6	74.0	161.0	91.5	322.5
39.5	20.7	57.0	68.6	74.5	164.6	92.0	328.3

Table C6. Length-net weight table for IPHC Regulatory Area 4A (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.5	40.0	21.2	57.5	66.3	75.0	152.8
23.0	3.7	40.5	22.0	58.0	68.1	75.5	156.0
23.5	4.0	41.0	22.9	58.5	70.0	76.0	159.3
24.0	4.3	41.5	23.8	59.0	71.9	76.5	162.6
24.5	4.5	42.0	24.7	59.5	73.8	77.0	166.0
25.0	4.8	42.5	25.7	60.0	75.8	77.5	169.4
25.5	5.2	43.0	26.6	60.5	77.8	78.0	172.9
26.0	5.5	43.5	27.6	61.0	79.8	78.5	176.4
26.5	5.8	44.0	28.6	61.5	81.9	79.0	179.9
27.0	6.2	44.5	29.6	62.0	84.0	79.5	183.5
27.5	6.5	45.0	30.7	62.5	86.2	80.0	187.2
28.0	6.9	45.5	31.8	63.0	88.4	80.5	190.9
28.5	7.3	46.0	32.9	63.5	90.6	81.0	194.6
29.0	7.7	46.5	34.0	64.0	92.8	81.5	198.4
29.5	8.1	47.0	35.2	64.5	95.1	82.0	202.3
30.0	8.6	47.5	36.4	65.0	97.5	82.5	206.2
30.5	9.0	48.0	37.6	65.5	99.9	83.0	210.1
31.0	9.5	48.5	38.8	66.0	102.3	83.5	214.1
31.5	10.0	49.0	40.1	66.5	104.7	84.0	218.2
32.0	10.5	49.5	41.4	67.0	107.2	84.5	222.3
32.5	11.0	50.0	42.7	67.5	109.8	85.0	226.4
33.0	11.6	50.5	44.1	68.0	112.3	85.5	230.7
33.5	12.1	51.0	45.5	68.5	114.9	86.0	234.9
34.0	12.7	51.5	46.9	69.0	117.6	86.5	239.2
34.5	13.3	52.0	48.4	69.5	120.3	87.0	243.6
35.0	13.9	52.5	49.8	70.0	123.0	87.5	248.0
35.5	14.6	53.0	51.3	70.5	125.8	88.0	252.5
36.0	15.2	53.5	52.9	71.0	128.6	88.5	257.0
36.5	15.9	54.0	54.4	71.5	131.5	89.0	261.6
37.0	16.6	54.5	56.0	72.0	134.4	89.5	266.3
37.5	17.3	55.0	57.7	72.5	137.4	90.0	271.0
38.0	18.0	55.5	59.3	73.0	140.4	90.5	275.7
38.5	18.8	56.0	61.0	73.5	143.4	91.0	280.6
39.0	19.6	56.5	62.8	74.0	146.5	91.5	285.4
39.5	20.4	57.0	64.5	74.5	149.6	92.0	290.4

Table C7. Length-net weight table for IPHC Regulatory Area 4B (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.3	40.0	20.3	57.5	63.9	75.0	147.9
23.0	3.5	40.5	21.1	58.0	65.7	75.5	151.0
23.5	3.8	41.0	22.0	58.5	67.5	76.0	154.2
24.0	4.1	41.5	22.8	59.0	69.3	76.5	157.4
24.5	4.3	42.0	23.7	59.5	71.2	77.0	160.7
25.0	4.6	42.5	24.6	60.0	73.1	77.5	164.0
25.5	4.9	43.0	25.5	60.5	75.0	78.0	167.3
26.0	5.2	43.5	26.5	61.0	77.0	78.5	170.8
26.5	5.5	44.0	27.5	61.5	79.0	79.0	174.2
27.0	5.9	44.5	28.5	62.0	81.1	79.5	177.7
27.5	6.2	45.0	29.5	62.5	83.2	80.0	181.3
28.0	6.6	45.5	30.5	63.0	85.3	80.5	184.9
28.5	7.0	46.0	31.6	63.5	87.4	81.0	188.5
29.0	7.4	46.5	32.7	64.0	89.6	81.5	192.2
29.5	7.8	47.0	33.8	64.5	91.8	82.0	196.0
30.0	8.2	47.5	35.0	65.0	94.1	82.5	199.8
30.5	8.6	48.0	36.1	65.5	96.4	83.0	203.6
31.0	9.1	48.5	37.3	66.0	98.8	83.5	207.5
31.5	9.6	49.0	38.6	66.5	101.1	84.0	211.4
32.0	10.0	49.5	39.8	67.0	103.6	84.5	215.4
32.5	10.6	50.0	41.1	67.5	106.0	85.0	219.5
33.0	11.1	50.5	42.4	68.0	108.5	85.5	223.6
33.5	11.6	51.0	43.8	68.5	111.1	86.0	227.8
34.0	12.2	51.5	45.1	69.0	113.6	86.5	232.0
34.5	12.7	52.0	46.5	69.5	116.3	87.0	236.2
35.0	13.3	52.5	48.0	70.0	118.9	87.5	240.5
35.5	13.9	53.0	49.4	70.5	121.6	88.0	244.9
36.0	14.6	53.5	50.9	71.0	124.4	88.5	249.3
36.5	15.2	54.0	52.4	71.5	127.2	89.0	253.8
37.0	15.9	54.5	54.0	72.0	130.0	89.5	258.3
37.5	16.6	55.0	55.5	72.5	132.8	90.0	262.9
38.0	17.3	55.5	57.2	73.0	135.8	90.5	267.5
38.5	18.0	56.0	58.8	73.5	138.7	91.0	272.2
39.0	18.8	56.5	60.5	74.0	141.7	91.5	277.0
39.5	19.5	57.0	62.2	74.5	144.8	92.0	281.8

Table C8. Length-net weight table for IPHC Regulatory Area 4CDE (Imperial, 22.5-92 inches).

Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)	Length (in)	Weight (lb)
22.5	3.5	40.0	21.7	57.5	68.2	75.0	158.1
23.0	3.8	40.5	22.5	58.0	70.1	75.5	161.4
23.5	4.0	41.0	23.4	58.5	72.1	76.0	164.8
24.0	4.3	41.5	24.3	59.0	74.0	76.5	168.3
24.5	4.6	42.0	25.3	59.5	76.0	77.0	171.8
25.0	4.9	42.5	26.2	60.0	78.1	77.5	175.3
25.5	5.2	43.0	27.2	60.5	80.1	78.0	179.0
26.0	5.6	43.5	28.2	61.0	82.3	78.5	182.6
26.5	5.9	44.0	29.3	61.5	84.4	79.0	186.3
27.0	6.3	44.5	30.4	62.0	86.6	79.5	190.1
27.5	6.6	45.0	31.4	62.5	88.8	80.0	193.9
28.0	7.0	45.5	32.6	63.0	91.1	80.5	197.7
28.5	7.4	46.0	33.7	63.5	93.4	81.0	201.6
29.0	7.8	46.5	34.9	64.0	95.7	81.5	205.6
29.5	8.3	47.0	36.1	64.5	98.1	82.0	209.6
30.0	8.7	47.5	37.3	65.0	100.6	82.5	213.7
30.5	9.2	48.0	38.6	65.5	103.0	83.0	217.8
31.0	9.7	48.5	39.8	66.0	105.5	83.5	222.0
31.5	10.2	49.0	41.2	66.5	108.1	84.0	226.2
32.0	10.7	49.5	42.5	67.0	110.7	84.5	230.5
32.5	11.2	50.0	43.9	67.5	113.3	85.0	234.8
33.0	11.8	50.5	45.3	68.0	116.0	85.5	239.2
33.5	12.4	51.0	46.7	68.5	118.7	86.0	243.7
34.0	13.0	51.5	48.2	69.0	121.5	86.5	248.2
34.5	13.6	52.0	49.7	69.5	124.3	87.0	252.7
35.0	14.2	52.5	51.2	70.0	127.1	87.5	257.4
35.5	14.9	53.0	52.7	70.5	130.0	88.0	262.0
36.0	15.5	53.5	54.3	71.0	132.9	88.5	266.8
36.5	16.2	54.0	56.0	71.5	135.9	89.0	271.6
37.0	16.9	54.5	57.6	72.0	138.9	89.5	276.4
37.5	17.7	55.0	59.3	72.5	142.0	90.0	281.3
38.0	18.4	55.5	61.0	73.0	145.1	90.5	286.3
38.5	19.2	56.0	62.8	73.5	148.3	91.0	291.3
39.0	20.0	56.5	64.6	74.0	151.5	91.5	296.4
39.5	20.8	57.0	66.4	74.5	154.8	92.0	301.6