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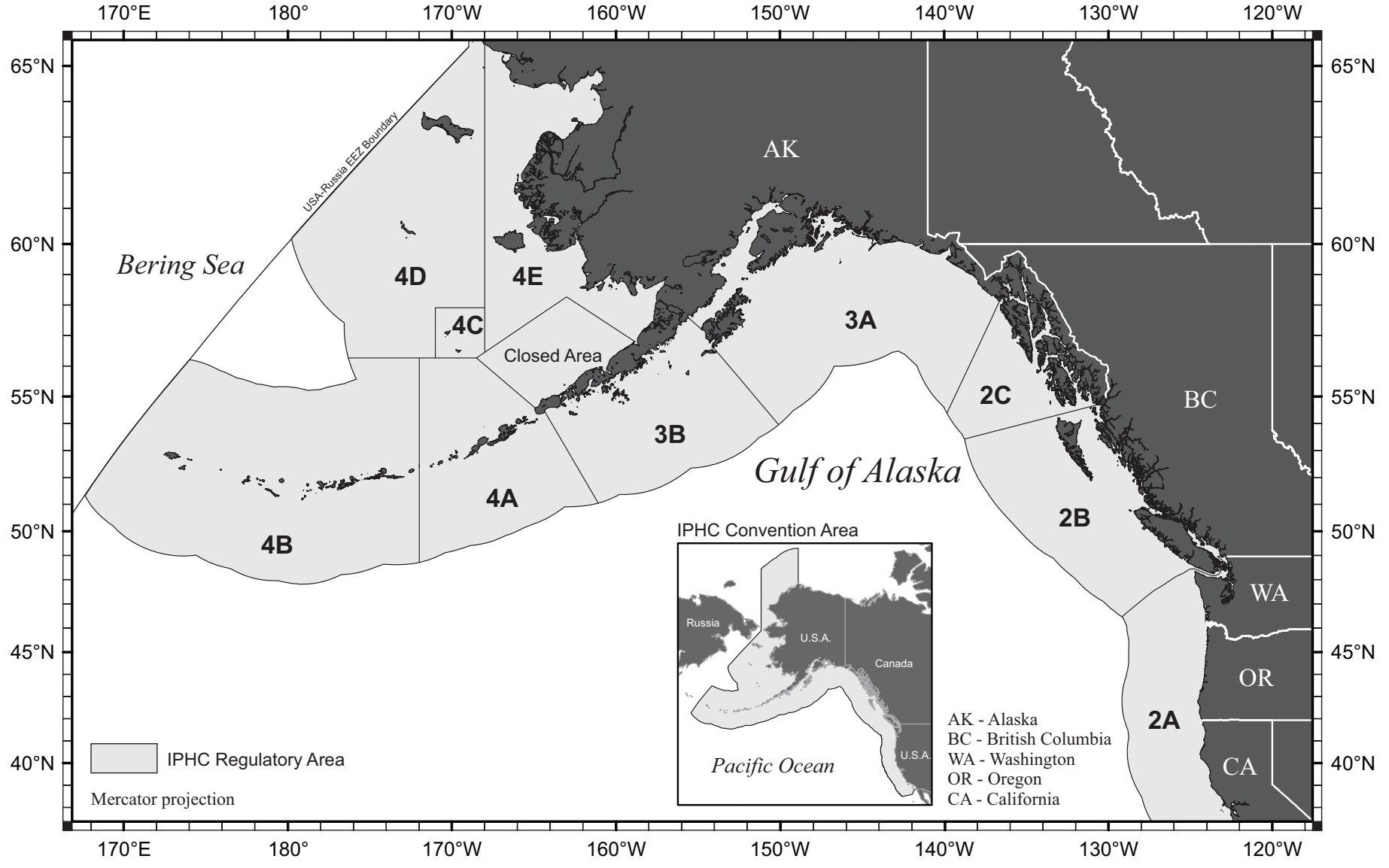
INTERNATIONAL PACIFIC

HALIBUT COMMISSION

Annual Report

2017



IPHC Regulatory Areas for 2017

ISSN: 0074-7238

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report
2017

Established by a Convention between
Canada and the United States of America

This report produced by IPHC Secretariat
and Katherine Gustafson
2018

International Pacific Halibut Commission
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Co-producer

Katherine Gustafson is a freelance writer and editor who resides in the Pacific northwest. She has worked extensively with environmental nonprofits, including Conservation International, World Wildlife Fund, and Oceana. Her first book, Change Comes to Dinner, about positive change in the U.S. food industry, was published in 2012. This is Katherine's third year as co-producer of this report.

Preface

The International Pacific Halibut Commission (IPHC) was established in 1923 by a Convention between Canada and the United States of America for the preservation of the Pacific halibut (Hippoglossus stenolepis) fishery of the north Pacific Ocean and the Bering Sea. The Convention was the first international agreement providing for the joint management of a marine resource. The Commission's authority was expanded by several subsequent conventions, the most recent being signed in 1953 and amended by the Protocol of 1979.

Three (3) IPHC Commissioners are appointed by the Governor General of Canada and three (3) by the President of the United States of America. The Commissioners appoint the Executive Director, who supervises the scientific, technical, field, and administrative staff. The scientific staff collects and analyzes the statistical and biological data needed to manage the Pacific halibut stock within Convention waters. The IPHC headquarters and laboratory are located in Seattle, Washington, U.S.A.

The Commission meets annually to review all regulatory proposals, including those made by the IPHC Secretariat, Contracting Parties, and by industry. The measures adopted by the Commission are recommended to the two governments for approval and implementation. Upon approval the regulations are published in the U.S. Federal Register and the Canada Gazette and are enforced by the appropriate agencies of both governments.

The IPHC publishes three serial publications: Annual Reports (U.S. ISSN 0074-7238), Scientific Reports—formerly known as Reports— (U.S. ISSN 0074-7246) and Technical Reports (U.S. ISSN 0579-3920). Until 1969, only the Report series was published; the numbers of that series have been continued with the Scientific Reports.

How to interpret this report

Data in this report have been updated using all information received by IPHC through 31 December 2017 and reported at the 94th Annual Meeting in 2018. Some data may have been subsequently updated and readers are encouraged to access the IPHC website: https://iphc.int/. Unless otherwise indicated, all weights in this report are dressed weight (eviscerated, head-off). Round (live) weight may be calculated by dividing the dressed weight by 0.75.

On the Cover

The photo featured on the cover of this report shows Jason Roberts of the *F/V Pender Isle* pulling a Pacific halibut aboard during the IPHC fishery-independent setline survey. The photographer is Kaitlin Johnson, a sea sampler who has worked for the IPHC since 2012.

Acronyms used in this report

ADEC - Alaska Department of Environmental Conservation
ADF&G - Alaska Department of Fish and Game
BBEDC - Bristol Bay Economic Development Corporation
BSAI - Bering Sea and Aleutian Islands
CDFW - California Department of Fish and Wildlife
CDQ - Community Development Quota
CGOARP - Central Gulf of Alaska Rockfish Program
COAC - Clean Otolith Archive Collection
C&S - Ceremonial and Subsistence
CSP - Catch Sharing Plan
CVRF - Coastal Villages Regional Fund
DFO - Fisheries and Oceans Canada
DMR - Discard Mortality Rate
DO - Dissolved Oxygen
EBS - Eastern Bering Sea
EC - Electronic Monitoring
FISS - Fishery-independent setline survey
GAF - Guided Angler Fish
HCR - Harvest Control Rule
HARM - Halibut Angler Release Mortality
IFMP - Integrated Fisheries Management Plan
IFQ - United States Individual Fishing Quota
IPHC - International Pacific Halibut Commission
IQ - Individual Quota
IVQ - Canadian Individual Vessel Quota
MP - Management Procedure
MPR - Mortality Per Recruit
MSAB - Management Strategy Advisory Board
MSE - Management Strategy Evaluation
NMFS - National Marine Fisheries Service
NOAA - National Oceanic and Atmospheric Administration
NPFMC - North Pacific Fishery Management Council
NPUE - Numbers-Per-Unit-Effort
NSEDC - Norton Sound Economic Development Corporation
ODFW - Oregon Department of Fish and Wildlife
PAT - Pop-up Archival Transmitting
PDO - Pacific Decadal Oscillation
PFMC - Pacific Fishery Management Council
PHI - Prior Hook Injury
PSC - Prohibited Species Catch
PSMFC - Pacific States Marine Fisheries Commission
QS - Quota Share
RDE - Remote Data Entry
RI - Rockfish Index
RSL - Reverse Slot Limit
SRB - Scientific Review Board
SPR - Spawning Potential Ratio
WDFW - Washington Department of Fish and Wildlife
WPUE - Weight-Per-Unit-Effort
XRQ - Experimental Recreational Halibut

Executive Director's message

In 2017, I was fortunate enough to undertake port visits to Port Hardy, Seward, Homer, and Sitka, where a number of you were gracious enough to take the time to impart your ideas, thoughts and updates on the fishery. These port visits are a unique and invaluable opportunity for me to engage with stakeholders away from the office and the formal IPHC meeting cycle.

Throughout the course of 2017, we have made tremendous progress in enhancing the IPHC's scientific processes and the communication of scientific advice emanating from our core functions. This has occurred in tandem with an evaluation of the supporting governance procedures of the organization, including how stakeholder inputs are incorporated into the decision-making framework to ensure that all points of view are being adequately considered in a transparent manner. The aim of improved communication, inclusiveness, and transparency, was partially delivered upon in 2017 via the redesign, population, and publication of the IPHC's new website (https://iphc.int/). The IPHC Secretariat will continue to expand upon the utility of the website, including the development of different ways to publish data and statistics for our stakeholders to access, over the coming year.

From a fishery perspective, we start the year with the Commission adopting an informal 'fish-down' strategy of the Pacific halibut resource, due largely to our stock assessment that estimated female spawning biomass at the beginning of 2017 to be 41% (27–59%) of the equilibrium unfished level (SB_0). The estimated level of biomass was consistent with the recent slow increase in the primary stock abundance indices, the IPHC fishery-independent setline survey weight-per-unit-effort (WPUE) indices and directed longline fishery WPUE. Such a level of biomass is widely considered to be a reasonable target level for sustaining optimal harvest rates of groundfish species, though species biology and ecology play a large role in determining species specific levels. The subsequent stock assessment completed at the close of the 2017 fishing and setline survey seasons, confirmed predictions that the level of harvest adopted by the Commission for 2017 would result

Dr. Wilson presents a bonus award to IPHC sea sampler Chris Clarke during a port visit to Homer, Alaska. Photo by Lara Erikson.

in a slight decrease of female spawning biomass, estimated to be 40% (26-60%) of the equilibrium unfished level (SB_0) at the end of 2017.

Of concern however, is that Pacific halibut recruitment estimates show that the largest recent cohorts of young fish occurred from 1999-2005 and are rapidly decreasing in importance to the fishery. Cohorts from 2006 through 2013 are estimated to be substantially smaller in volume, which suggests that there is a high probability of continued decline in both the stock size and fishery yield as these cohorts move through the fishery, irrespective of fishing pressure.

Rest assured, the staff and I will continue to develop and communicate the best possible scientific advice, to ensure that the Commission is equipped with the information it needs to make informed, timely, and scientifically-based management decisions. The overall aim of course, being to take a precautionary based approach to fishery management, thereby ensuring a sustainable resource and its associated fishery.

I truly look forward to engaging with all of you over the coming year, either through the Commission's subsidiary bodies, or in person at our landing ports and communities that so heavily rely on Pacific halibut as a source of income, food, and cultural identity.

David T. Wilson, Ph.D.
Executive Director

Activities of the Commission

The IPHC meets several times a year, in both formal and informal capacities, to consider matters relevant to the Pacific halibut stock, the fisheries, and governance.

Annual Meeting 2017

The IPHC held its 93rd Annual Meeting in Victoria, B.C., Canada, from 23-27 January 2017. The Commission is composed of six members (Commissioners) and for 2017, Mr. Paul Ryall of Canada presided as Chairperson and Dr. James Balsiger of the United States of America presided as Vice-Chairperson. The Commission heard reports from the IPHC Secretariat about the health of the Pacific halibut population, reviewed finance and administration, discussed bycatch issues and minimum size limits, considered the suggestions of its subsidiary bodies, and solicited public comments before passing regulations and setting catch limits for 2017.

The Commission adopted a total overall catch limit of 31.4 million pounds (just under 14,243 t) for the 2017 fishery.

Catch limits and dates for 2017

The IPHC adopted catch limits for each IPHC Regulatory Area. The Commission recommended to the governments of Canada and the United States of America that the total catch limit for 2017 should be 31,400,000 pounds, net weight (14,242.80 metric tons, t), a 5.05 percent increase from the 2016 catch limit of 29,890,000 pounds (13,557.88 t). Note that for Area 2B, the number

Chairperson Mr. Paul Ryall and Vice-chairperson Dr. James Balsiger, discuss issues facing the Pacific halibut fishery at the 93rd Annual Meeting. Photo by Tracee Geernaert.

shown is allocated between commercial and sport fisheries. The limit was divided among Regulatory Areas as follows:

Area 2A - California, Oregon, and Washington: 1,330,000 pounds (603.28 t)
Area 2B - British Columbia, including sport catch allocation: 7,450,000 pounds (3,379.26 t)
Area 2C - Southeastern Alaska, combined commercial/guided sport: 5,250,000 pounds (2,381.36 t)
Area 3A - Central Gulf of Alaska, combined commercial/guided sport: 10,000,000 pounds (4,535.92 t)
Area 3B - Western Gulf of Alaska: 3,140,000 pounds (1,424.28 t)
Area 4A - Eastern Aleutians: 1,390,000 pounds (630.49 t)
Area 4B - Central/western Aleutians: 1,140,000 pounds (517.10 t)
Area 4CDE – Bering Sea: 1,700,000 pounds (771.10 t)
Area 4C - Pribilof Islands: 752,000 pounds (341.10 t)
Area 4D - Northwestern Bering Sea: 752,000 pounds (341.10 t)
Area 4E - Bering Sea flats: 196,000 pounds (88.90 t)

The Commission approved the application of domestic government catch share and allocation plans in Regulatory Areas 2A, 2B, 2C, 3A, and 4CDE.

The Commission approves catch limits by IPHC Regulatory Area, except in Regulatory Area 4CDE where the Commission adopts a single overall catch limit. Catch sharing plans developed and implemented by the domestic governments allocate the catch further in some areas, which the Commission applies.

The Commission applied the North Pacific Fishery Management Council's (NPFMC's) catch sharing plan for Regulatory Area 4CDE to divide the catch among those three Regulatory Areas, and the Pacific Fishery Management Council's (PFMC's) catch sharing plan that allocates the Regulatory Area 2A catch among the treaty and non-treaty commercial fisheries, the recreational fisheries, and the treaty ceremonial and subsistence fishery.

In Regulatory Area 2B, Fisheries and Oceans Canada's (DFO) allocation plan for First Nation, sport, and commercial fisheries was also approved. The Commission noted the NPFMC catch sharing plan, which allocates the catch for Areas 2C and 3A between commercial and charter sport sectors, including specific charter recreational sector management measures (noted below). More in-depth information on all of these subjects can be found in the applicable sections of this report.

The 2017 fishing period (season) for all Alaska and British Columbia quota-share commercial fisheries was designated to open on 11 March and to close 7 November. Both treaty and non-treaty commercial fishing in Washington, Oregon, California, and the Annette Islands Reserve in Alaska utilize shorter open periods that take place within the period designated for the quota-share fisheries.

Other decisions made at the meeting

The Commission made a range of other decisions at the 2017 Annual Meeting:

- Approval of a range of regulatory changes, including charter recreational sector management measures for IPHC Regulatory Areas 2C and 3A; a head-on Pacific halibut landing requirement; harmonization of IPHC and NOAA-Fisheries regulations regarding fishing in multiple regulatory areas; and directing the use of the eLog electronic logging system in British Columbia.

- Removal of the outdated "blue line" reference in the harvest decision table of the current IPHC harvest policy. The Commission will use the "status quo SPR" (F46%) fishing intensity as the reference line for this and future years' catch limit discussions, and will use its Management Strategy Evaluation (MSE) process to evaluate harvest policy options.
- Approval of further expansions to the annual fishery-independent setline survey, specifically in IPHC Regulatory Areas 2A and 4B during 2017. The purpose of the expansion series is to provide more accurate and precise estimates among Regulatory Areas and to encompass all depths over which the stock is distributed.

The U.S.A. and Canadian governments in total provided contributions of approximately $5.7 million USD to fund the IPHC in 2017.

Interim Meeting

The 93rd Session of the IPHC Interim Meeting, held 28-29 November 2017 in Seattle, WA, U.S.A., was an occasion to prepare for the 94th Session of the IPHC Annual Meeting scheduled for January 2018. The Commissioners and the public were able to hear IPHC Secretariat staff presentations and discuss a variety of topics, including a review of the 2017 fisheries and preliminary stock assessment results, and the 2018 harvest decision table. There was also discussion about the reduction in bycatch, changes in the spatial distribution of the stock, proposed sport regulation changes, a proposal for Pacific halibut retention in pot fisheries, budgeting and staffing issues, and various regulatory proposals.

Mr. Jonathan Pollard, NOAA General Counsel and long-time U.S.A. advisor, retired, making 2017 his final year working with the Commission. Photo by Tracee Geerneart.

Other topics covered included the progress of the Management Strategy Advisory Board, the Scientific Review Board report, and a summary of bycatch-related meetings with the NPFMC and National Marine Fisheries Service.

IPHC Finances

The IPHC is funded jointly by the governments of Canada and the U.S.A. For fiscal year 2017, the U.S.A. appropriated $4.16 million USD to the IPHC, which included funding designated for pension deficits and the IPHC headquarter leases. Canada provided $878,720 USD and additional payments of $95,508 USD and $563,476 USD to cover pension deficits.

IPHC Regulatory Areas for 2017

On its formation in 1923, IPHC established four regulatory areas, covering California northward through the Bering Sea. They have changed in their numbering and their geographic boundaries over the years, but the current boundary lines have remained the same since 1990. Convention waters extend further north than the designated regulatory areas, but to date, no Pacific halibut have been found north of the Bering Strait so this area is currently unassigned. For an illustration of the boundaries, refer to the map on the inside front cover of this report.

Area 2A—waters off the coasts of California, Oregon, and Washington.
Area 2B—waters off the coast of British Columbia.
Area 2C—waters off the coast of Southeast Alaska, south and east of Cape Spencer.
Area 3A—Central Gulf of Alaska. Waters off South Central Alaska, between Cape Spencer and the southernmost tip of Kodiak Island (Cape Trinity).
Area 3B—Western Gulf of Alaska. Waters south of the Alaska Peninsula, from west of Cape Trinity (Kodiak Island) to a line extending southeast from Cape Lutke (Unimak Island).
Area 4A—Waters surrounding the Eastern Aleutian Islands. The specific boundaries are "all waters in the Gulf of Alaska west of Area 3B and in the Bering Sea west of the Closed Area (defined below) that are east of 172°00'00" W. longitude and south of 56°20'00" N. latitude."
Area 4B—Waters surrounding the Western Aleutian Islands. This includes "all waters in the Bering Sea and Gulf of Alaska west of Area 4A and south of 56°20'00" N. latitude."
Area 4C—A 'square' of water surrounding the Pribilof Islands in the Bering Sea. It is measured as "all waters in the Bering Sea north of Area 4A and north of the Closed Area defined in section 10 which are east of 171°00'00" W. longitude, south of 58°00'00" N. latitude, and west of 168°00'00" W. longitude."
Area 4D—Northwestern Bering Sea, including "all waters in the Bering Sea north of Areas 4A and 4B [56°20'00" N. latitude], north and west of Area 4C, and west of 168°00'00" W. longitude."
Area 4E—Northeastern Bering Sea, including "all waters in the Bering Sea north and east of the Closed Area, east of 168°00'00" W. longitude, and south of 65°34'00" N. latitude."
Closed Area—This trapezoid-shaped body of water in Bristol Bay is closed to commercial halibut fishing. This relatively shallow body of water serves as a nursery for juvenile Pacific halibut. The area is more precisely described as "all waters in the Bering Sea north of 55°00'00" N. latitude in Isanotski Strait that are enclosed by a line from Cape Sarichef Light (54°36'00" N. latitude, 164°55'42" W. longitude) to a point at 56°20'00" N. latitude, 168°30'00" W. longitude; thence to a point at 58°21'25" N. latitude, 163°00'00" W. longitude; thence to Strogonof Point (56°53'18" N. latitude, 158°50'37" W. longitude); and then along the northern coasts of the Alaska Peninsula and Unimak Island to the point of origin at Cape Sarichef Light. Furthermore, all waters in Isanotski Strait between 55°00'00" N. latitude and 54°49'00" N. latitude."

The current IPHC Regulatory Area boundary lines have remained unchanged since 1990.

COMMERCIAL FISHERY

Pacific halibut landings were up 4.5 percent in 2017 compared with 2016.

The commercial Pacific halibut landings in 2017, along with the Pacific halibut landed on the IPHC fishery-independent setline survey (FISS), totaled 26,156,000 pounds (11,864 metric tons (t)) (Tables 1 and 2), up 4.5 percent from 2016. All values in this section are provided as net weight unless otherwise noted. Net-weight is defined as the weight of Pacific halibut without gills, entrails, head, ice, and slime. Keep in mind that this chapter reflects data received for 2017 as of 9 Nov 2017, except for the otolith data which is as of 13 Feb 2018. For updates on landings data, please refer to the IPHC website at: http://iphc.int .

Table 1. Pacific halibut commercial and research landings (net weight) by IPHC Regulatory Area for 2017 (preliminary, as of 9 Nov 2017). Note that the catch limits in many of the areas are further subdivided and those details are included in the sections to follow.

Regulatory Area	Catch Limit	Commercial Landings	Research Landings	Total Landings	
				pounds	tons
2A	771,300	737,000	16,000	753,000	342
2B	6,272,000	6,193,000	65,000	6,258,000	2,838
2C	4,212,000	4,108,000	124,000	4,232,000	1,920
3A	7,739,000	7,587,000	198,000	7,785,000	3,531
3B	3,140,000	3,022,000	72,000	3,094,000	1,403
4A	1,390,000	1,270,000	28,000	1,298,000	589
4B	1,140,000	1,048,000	44,000	1,092,000	495
4C	752,000	1,620,000	9,000	1,644,000	746
4D	752,000		15,000		
4E	196,000				
Total	**26,364,300**	**25,585,000**	**571,000**	**26,156,000**	**11,864**

Table 2. Commercial, incidental, and treaty Indian Pacific halibut landings (net weight) in Area 2A (preliminary, as of 9 Nov 2017).

Regulatory Area 2A	Catch Limit	Commercial Landings	Research Landings	Total Landings	
				pounds	tons
Treaty Indian	435,900	432,500		432,500	196
Incidental in Salmon Fishery	39,800	38,600		38,600	18
Incidental in Sablefish Fishery	70,000	35,900		35,900	16
Directed	225,600	230,000		230,000	104
2A Total	**771,300**	**737,000**	**16,000**	**753,000**	**342**

Licensing and landings

Licensing

Licensing regulations for IPHC Regulatory Area 2A non-treaty fisheries were unchanged in 2017. All vessels had to procure an IPHC license, harvesters were required to select one type of license, and there was a deadline for the submission of commercial fisheries license applications.

In IPHC Regulatory Area 2B, the number of active Pacific halibut licenses (L licenses), and First Nations communal commercial licenses (FL licenses) was 160 in 2017. In addition, Pacific halibut can be landed as incidental catch in other licensed groundfish fisheries. Therefore, Pacific halibut was landed from a total of 231 active licenses in 2017, with 71 of these licenses from other fisheries.

Landings

When Pacific halibut are delivered to a port for processing, they are considered to be "landed" for tracking purposes. The following sections review commercial landings, seasons, and trends for each area, with data from the IPHC, National Marine Fisheries Service (NMFS), Fisheries and Oceans Canada (DFO), Metlakatla Indian Community, Washington treaty Indian tribal fisheries management departments (including the Northwest Indian Fisheries Commission, Makah, Lummi, Jamestown S'Klallam, Swinomish, Port Gamble S'Klallam, Quileute, and Quinault Indian tribes), and state agencies including Alaska Department of Fish and Game, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, and California Department of Fish and Wildlife.

In Area 2A, non-treaty fishers were required to choose one fishery and obtain an IPHC license.

IPHC Secretariat staff members Jamie Goen, Dave Jackson, and Lara Erikson (left to right) sample a Pacific halibut offload in Kodiak, AK. Photo by Jamie Goen.

IPHC Regulatory Area 2A (California, Oregon, and Washington; U.S.A.)

The total IPHC Regulatory Area 2A catch (not including IPHC research) was within one percent of the catch limit. The total directed commercial landings were two percent over the catch limit of 225,591 pounds (102 t) after three 10-hour fishing periods.

As in 2016, at the start of the season on 1 April, the allowable incidental catch ratio of Pacific halibut during the salmon troll fishery was one Pacific halibut per three Chinook salmon (*Oncorhyhus tshawytscha*), plus an "extra" Pacific halibut per landing, and a vessel trip limit of 20 fish. On 1 May, the landing restrictions were changed to one Pacific halibut per each two Chinook salmon, plus an "extra" Pacific halibut per landing, and a vessel trip limit of 35 fish. On 1 July, the landing restrictions changed again, this time to one Pacific halibut per four Chinook salmon, plus an "extra" Pacific halibut per landing, and a vessel trip limit of 10 fish.

At the start of the season on 1 April, the allowable incidental catch ratio of Pacific halibut during the sablefish fishery was 110 pounds (0.05 t; net weight) dressed weight of Pacific halibut for every 1,000 pounds dressed weight of sablefish landed and up to two additional Pacific halibut in excess of that ratio. On 11 May 2017, the ratio was increased to 140 pounds (0.06 t; net weight) of Pacific halibut to 1,000 pounds (0.45 t; net weight) of sablefish, and up to two additional Pacific halibut in excess of the ratio.

In IPHC Regulatory Area 2A, north of Point Chehalis, the treaty Indian tribes manage the commercial landings by allocating 75 percent to an open access fishery and 25 percent to a restricted fishery with daily and vessel limits. The restricted fishery had a vessel per day limit of 500 pounds (0.23 t). The 2017 tribal commercial season closed with total landings coming in one percent under the catch limit of 435,900 pounds (198 t).

IPHC Regulatory Area 2B (British Columbia; Canada)

Top landing ports in Area 2B were Port Hardy and Prince Rupert/Port Edward, together receiving 92 percent of the commercial landings in the area.

During the 2017 season, the commercial catch for Individual Vessel Quota (IVQ) fisheries of British Columbia was one percent under the catch limit of 6,272,000 pounds (2,845 t).

Commercial trips from IPHC Regulatory Area 2B were delivered into 16 different ports in 2017. The ports of Port Hardy (including Coal Harbour and Port McNeill) and Prince Rupert/Port Edward were the major landing locations, receiving 92 percent of the commercial landings. Port Hardy received 38 percent while Prince Rupert received 54 percent (2,359,000 and 3,343,000 pounds (1,070 and 1,516 t), respectively) of the commercial landings. All of the IVQ landings were landed in IPHC Regulatory Area 2B. The 2017 landings of live Pacific halibut from IPHC Regulatory Area 2B resulted in a total landed weight of 202 pounds. Only Canadian vessels landed frozen, head-off Pacific halibut in 2017, and only in Canadian ports: 56 landings (70,272 pounds; ~31.9 t) reported frozen-at-sea head-off product from 28 vessels.

IPHC Regulatory Areas 2C, 3, and 4 (Alaska; U.S.A.)

In 2017, the total landings by the Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) Pacific halibut fisheries in the waters off Alaska was less than three percent under the catch limit. The total commercial Quota Share (QS) landings was two percent below the catch limit in IPHC Regulatory Areas 3A and 2C, four percent for Area 3B, nine percent for Area 4A,

Port samplers and associated Secretariat staff during training at IPHC headquarters in Seattle, WA. Photo by Tom Kong.

and eight percent for Area 4B. The total combined IPHC Regulatory Area 4CDE commercial landings were five percent under the combined Area 4CDE catch limit (1,700,000 pounds [771 t]). The North Pacific Fishery Management Council's Catch Sharing Plan allowed IPHC Regulatory Area 4D CDQ to be harvested in IPHC Regulatory Areas 4D or 4E and Area 4C IFQ and CDQ to be fished in Areas 4C or 4D.

IPHC Regulatory Area 2C includes the Annette Islands Reserve (just south of the city of Ketchikan), where the Metlakatla Indian Community has been authorized by the U.S. Bureau of Indian Affairs to conduct a commercial Pacific halibut fishery. In 2017, there were 13 two-day fishing periods between 14 April and 8 October, resulting in a total catch of 64,363 pounds (29 t). This was lower than the 2016 catch, but within the historical catch range that has varied over time from a low of 12,000 pounds (5 t) in 1998 to a high of 126,000 pounds (57 t) in 1996.

Alaska landings accounted for 73% of the coastwide commercial and research landings with Kodiak as the top Alaskan landing port.

Landing patterns

The landed catch in Alaska, weighing in at 19,145,000 pounds (8,684 t), accounted for the majority of the total commercial (including research) landings (73%). IPHC Regulatory Area 3A again had the highest catch limit and landed catch level in 2017. As in 2016, Kodiak received the largest portion of the Alaskan commercial catch, with 3,258,000 pounds (919 t; 18%). Seward received the second and Homer the third largest landing volumes at 12 percent (2,096,000 pounds, 951 t) and 11 percent (2,027,000 pounds, 919 t) of the Alaskan commercial landings, respectively. In Southeast Alaska (Regulatory Area 2C), Petersburg, Sitka, and Juneau, in that order, received the three largest commercial landed weights.

In IPHC Regulatory Area 2B, two ports among the 16 on the British Columbia coast received 92 percent of the area's landed catch: Port Hardy and Prince Rupert/Port Edward. Port Hardy received 38 percent of the area's commercial landed catch (2,359,000; 1,070 t), and Prince Rupert received 54 percent (3,343,000 pounds; 1,516 t).

IPHC port samplers occupy ports coastwide to obtain information and samples that are representative of the Pacific halibut landed population.

IPHC Secretariat staff member Aregash Tesfatsion climbs a ladder back to the dock after collecting logbook information from the *F/V Tyee*. Photo by Ed Henry.

Sampling commercial landings

Sampling commercial landings is a key component to collecting data on Pacific halibut for the stock assessment. Port samplers collect otoliths—also called *ear bones* or *ear stones* that, when read under a microscope, give the animal's age in years—plus sex-marking information (when available), tissue samples, associated fork lengths and fish weights, as well as logbook information, final landing weights, and any IPHC tags caught during fishing. Lengths and weights of sampled Pacific halibut allow the IPHC to calculate length-weight ratios by area and, in combination with age data, size-at-age information. Mean weights are combined with final landing weights to estimate catch in numbers. Logbook information provides weight-per-unit effort data, fishing location for the landed weight, and data for research projects. Tags can provide information on migration, growth, exploitation rates, and natural and discard mortality.

Sampling protocols are designed to ensure that the sampled Pacific halibut are representative of the population of landed Pacific halibut; sampling times and places, and percentage of fish sampled are based on landing patterns and are reviewed annually. The protocols can vary slightly from port to port to achieve the appropriate sampling representation.

Considering that vessels travel to multiple regulatory areas and are not limited in where they may land their catch, IPHC samplers were stationed in Pacific halibut ports coastwide. In IPHC Regulatory Area 2A, IPHC port samplers were present in Newport and Charleston, Oregon and in Bellingham and Ilwaco, Washington. In addition, samples were taken in several treaty Indian ports in Washington by port samplers from the treaty Indian fishery management offices. For the second year, samples from the directed commercial fishery off northern California were collected in Eureka, California by California Department of Fish and Wildlife samplers. In Canada, IPHC port samplers staffed Port Hardy, Prince Rupert, and Vancouver. In Alaska, the ports of Dutch Harbor, Kodiak, Homer, Seward, Juneau, Sitka, Petersburg, and St. Paul were staffed.

Otoliths

Port samplers aimed to collect 11,500 total Pacific halibut otoliths in 2017, with the target for each of IPHC Regulatory Areas 2B through 4B and Area 4CD (combined) set at 1,500 (±500). The target for IPHC Regulatory Area 2A was set at 1,000; subdivided into a target of 650 for Regulatory Area 2A-1 treaty Indian fisheries and 350 for Regulatory Area 2A directed commercial fishery. Samplers collected 11,339 otoliths by sampling from 34 percent of the landed catch in the 705 landings sampled.

Samplers also collected specimens for the Clean Otolith Archive Collection (COAC), which comprises structures gathered from all IPHC otolith collection programs and other research opportunities; these otoliths are not used for age determination, but are cleaned, dried, and stored whole in climate-controlled conditions for future analysis. The COAC is primarily supplied via the IPHC fishery-independent setline survey; however, in IPHC Regulatory Areas 2A and 4CD the otolith sampling rate for the 2017 setline survey was 100 percent. For this reason, COAC samples were collected from commercial landings from these two IPHC Regulatory Areas. The annual COAC target is 100 otoliths from IPHC Regulatory Areas 2A and 4CD; this target was attained or exceeded in IPHC Regulatory Areas 2A and 4CD.

Logbooks

Alongside otolith samples, IPHC port samplers collected logbook information from harvesters. In total, 3,587 logs were collected in 2017. A total of 3,175 (89 percent by count) were collected from U.S. landings and 412 (11 percent by count) were collected from Canadian landings.

IPHC port samplers collected 14 tags in 2017 representing fish tagged and released during four seperate projects.

Recovered tags

In 2017, samplers collected 14 tags from tagged Pacific halibut, five of which originated from the 2017 setline U32 wire tagging project; three were recovered in Prince Rupert, and one each in Bellingham and Port Hardy. Two tagged Pacific halibut from the 2015 NMFS trawl survey wire tagging pilot were recovered: one in Petersburg and one in Kodiak. Six tagged fish from the 2013 dummy archival study were recovered in Seward (four fish) and Kodiak (two fish). Lastly, one Pacific halibut from the 2010 Aleutian wire tagging study was recovered in Kodiak. Tag data collected dockside included fork lengths, otoliths, and capture location of the recovered tagged fish.

Electronic data collection

IPHC is digitizing data collection to eliminate or reduce the need for post-collection data entry and increase the efficiency of data editing. In 2017, each IPHC port sampler in Alaska and Bellingham, Washington, used an electronic tablet to input data from paper logbooks into a remote data entry application. Samplers were tasked with entering data from as many of the logs they collected as priorities and time allowed during the course of their regular port sampling duties. Modifications and enhancements to the application continue.

In British Columbia, samplers were provided with a field version of the log entry program used by the IPHC's data transcription Secretariat staff in Seattle. The samplers were tasked with entering as many Canadian paper logs as time permitted, though priority was given to other tasks such as biological sampling.

In addition, samplers were supplied with Bluetooth-enabled tablets for collection of electronic logs from vessels using Archipelago Marine Research's FLOAT Fishing Log Application for Android.

Length-weight

Pacific halibut average forklength for all areas combined increased by 0.5 cm in 2017.

In 2017, IPHC port samplers weighed Pacific halibut in all staffed ports as part of standard random sampling procedures. This was an expansion of the 2016 coverage of the weighing procedure coastwide, to include Newport and all tribal samplers in IPHC Regulatory Area 2A. These data can be used to estimate the relationship between fork length and net weight, including the estimation of adjustments necessary to convert head-on weight to net weight and adjust for the presence of ice and slime (unwashed weight versus washed weight). Length-weight ratios vary by region and seasonally, so the collections allow the IPHC Secretariat to review the patterns and degree of variability among IPHC Regulatory Areas or seasons.

Age distribution of commercial fishery

In 2017, the age distribution of Pacific halibut sampled from commercial landings is based on 10,820 otoliths aged. Of the 11,345 otoliths collected, ages could not be determined for 525 of them because they were crystallized, right-sided, or badly broken. The 12-year-olds from the 2005 year class were the most abundant (2,121 fish, or 20% of the total). The next most abundant year classes for all Regulatory Areas combined were 2004 and 2006, accounting for 16 and 12 percent of the sampled catch, respectively.

Average fork length of sampled Pacific halibut increased in IPHC Regulatory Areas 2B, 2C, 3A, 4B, 4C, and 4D in 2017, but decreased in all other areas. Average fork length for all areas combined increased by 0.5 cm in 2017. The average age from all areas combined in 2017 (13.2 years) was slightly higher than it was in 2016. The youngest and oldest Pacific halibut in the 2017 commercial samples were determined to be five and 40 years old, respectively.

Voluntary at-sea sex marking

Uncertainty regarding the sex ratio of commercial Pacific halibut landings represents one of the largest sensitivities within the current Pacific halibut stock assessment, in particular generating considerable variability around estimates of total female spawning biomass. A decades-long trend in which the average size of Pacific halibut landed in the commercial longline fishery declined (falling from 40 to 20 pounds [9-18 kg] between the mid-1970s and 2010) has caused concern regarding sex-specific mortality within the commercial fishery. Female Pacific halibut grow faster than males and are therefore viable targets for the fishery at a younger age. The behavior and seasonal characteristics of Pacific halibut also likely cause fishers to effectively target one sex over the other, resulting in the potential for large amounts of catch to come from times and places in which the population's underlying sex ratio is highly skewed.

The sex ratio of the commercial landings cannot be determined using direct observations because commercially harvested Pacific halibut are dressed

This fish was marked at sea with two cuts to the dorsal fin to indicate it was female. IPHC photo archive.

(eviscerated) at sea. To allow assessment, IPHC formally launched its five-year at-sea sex marking and validation program in 2014. Voluntary at-sea marking by the commercial fleet was initiated within IPHC Regulatory Area 2B in 2016. Tissue samples were collected at offload for genetic validation. The program is designed to culminate in the incorporation of sex-mark data collection into routine port sampling for commercial size and age data beginning during the 2019 commercial Pacific halibut fishing season.

The 2017 fishing season saw the scaling up of this activity to include all IPHC Regulatory Areas. Tissue samples collected during the 2017 season have been archived but validation of individual sexes and sex ratios within the samples has not yet been conducted. Genetic sex of the sampled individuals will be determined in 2018. Following those assays, the sex-mark data will be compared to the validation results to determine the accuracy associated with the at-sea marking program to date, and make a determination regarding the degree to which the program as conceived will satisfy assessment needs, or will require modifications. At-sea marking will not occur during the 2018 fishing season; instead the program will be refined for 2019 as informed by the aforementioned analyses.

At-sea sex marking, in collaboration with the commercial fishing fleet, commenced in 2016 and continued in 2017.

Recreational fishery

The 2017 catch of about 8.1 million pounds (3,670 t) was above the 2016 catch but below the historic average.

The 2017 recreational harvest of Pacific halibut, including discard mortality, was estimated at about 8.1 million pounds (3,670 t) by the IPHC, using information provided by State and Federal agencies from each of the Contracting Parties. The 2017 take was above that of 2016 but remained below the historic levels seen in 2004-08 (when harvest averaged 10.7 million pounds; 4,853 t). The regulations governing recreational fishing of Pacific halibut were specifically geared to each Regulatory Area. Table 3 provides a brief summary of overall catch and more detailed tables providing a summary of seasons and catch can be found on the IPHC website: https://iphc.int.

Table 3. Summary of 2017 recreational Pacific halibut allocations and catch by IPHC Regulatory Area.

Area	Allocation		Catch		% of allocation
	Pounds	Metric tons	Pounds	Metric tons	
2A[1]	529,098	240	514,781	234	97%
2B[1]	1,118,000	507	1,137,867	516	102%
2C (charter)[2]	915,000	415	922,000	418	101%
3A (charter)[2]	1,890,000	857	2,101,000	953	111%
3B	no limit		-[3]		-
4	no limit		-[3]		-

[1] The associated discard mortality for IPHC Regulatory Area 2A is 3,686 pounds (1.7 t) and for Area 2B is 51,604 pounds (23.4 t).

[2] There is no allocation limit for the non-charter recreational fishery in these Regulatory Areas.

[3] Not yet reported as of the writing of this report.

IPHC Regulatory Area 2A (California, Oregon, and Washington; U.S.A.)

The 2017 IPHC Regulatory Area 2A recreational allocation was 599,099 pounds (271.7 t) net weight and based on the Pacific Fishery Management Council's Catch Sharing Plan formula, which divides the overall fishery catch limit among all sectors.

IPHC biologist Ed Henry tries his hand at hook and line. Photo by Claude Dykstra.

The recreational allocation was further subdivided to seven subareas, after 70,000 pounds (31.8 t) was allocated to the incidental Pacific halibut catch in the commercial sablefish fishery in Washington. This subdivision resulted in 230,868 pounds (104.7 t) being allocated to Washington subareas, 250,851 pounds (113.8 t) to Oregon subareas, and 12,799 pounds (5.8 t) shared between Washington and Oregon in the Columbia River region. In addition, California received an allocation of 34,580 pounds (15.7 t). The IPHC Regulatory Area 2A recreational harvest totaled 514,781 pounds (233.5 t), 3% under the recreational allocation. Recreational fishery harvest seasons by subareas varied and were managed in season, with fisheries opening on 1 May.

IPHC Regulatory Area 2B (British Columbia; Canada)

IPHC Regulatory Area 2B operated under a 133 cm (52.4 inch) maximum size limit, and one Pacific halibut had to be less than 83 cm (32.7 inch) when attaining the two-fish possession limit, with an annual limit of six per license holder. The IPHC Regulatory Area 2B fishery closed on 6 September because the allocation of 1,118,000 pounds (507 t) was estimated to have been attained. Recreational fishing continued to be allowed after this closure in IPHC Regulatory Area 2B for any fish that was leased from commercial fishery quota shares for that area. Canada and Alaska both have programs that allow recreational harvesters to land fish that is leased from commercial fishery quota shareholders for the current season. In Canada, 6,000 pounds (2.7 t) were leased from the commercial quota fishery and landed as recreational harvest.

The recreational fisheries in Areas 2B-3A are managed largely using size limits as well as bag and possession limits.

IPHC Regulatory Areas 2C, 3A, 3B, and 4 (Alaska; U.S.A.)

The Area 2C charter fishery continued to be managed using a reverse slot limit, allowing for the retention of one Pacific halibut that was ≤ 44 inches (112 cm) or ≥ 80 inches (203 cm) in total length (compared to ≤ 43 inches [109 cm] and ≥ 80 inches [203 cm] in 2016). In IPHC Regulatory Area 3A, charter anglers were allowed to retain two fish, but only one could exceed 28 inches (71 cm) in length. In addition, there was a four-fish annual limit with a recording requirement, one trip per calendar day per charter permit, and no charter retention of Pacific halibut on Wednesdays throughout the season and on certain Tuesdays (18 July, 25 July, and 1 August). In IPHC Regulatory Area 2C, the charter allocation in 2017 was 915,000 pounds (415 t), with an estimated total for retained charter Pacific halibut plus discard mortality at 922,000 pounds (418 t) or one percent over allocation. In IPHC Regulatory Area 3A, the charter allocation was 1,890,000 pounds (857 t), with an estimated total for retained charter Pacific halibut plus discard mortality at 2,101,000 pounds (953 t) or 11 percent over allocation.

Similar to Canada, Alaska has programs that allow recreational harvesters to land fish that is leased from commercial fishery quota shareholders for the current season. In IPHC Regulatory Areas 2C and 3A, 41,000 pounds (18.6 t) and 7,000 pounds (3.2 t), respectively, were leased from the commercial quota fisheries in those areas and landed as recreational harvest.

Discard mortality of Pacific halibut in the directed longline fishery

In the commercial Pacific halibut fishery, some Pacific halibut are captured every year that are not kept and, therefore, do not become part of the landed catch. Not all Pacific halibut caught and released at sea survive. Discarded Pacific halibut are subject to release mortality, which form the part of removals known as discard mortality.

Estimates of discard mortality in 2017 amounted to 988,000 pounds (448 t; net weight) (Table 4), which is a decrease of about 16 percent from the estimated discard mortality in 2016. Data in this chapter are as of 9 Nov 2017. There are three main sources of discard mortality accounted for by IPHC: (1) fish caught and never retrieved on lost or abandoned fishing gear; the discard of fish that measure below the legal size limit of 32 inches (U32; 81.3 cm) and subsequently die; and (3) the discard of legal-sized Pacific halibut (O32; ≥32 inches or 81.3 cm) for regulatory reasons, such as a vessel reaching its trip or catch limit.

Discard mortality in the directed longline fishery was estimated to be about 16% lower in 2017 compared to 2016.

Table 4. Commercial discard mortality of Pacific halibut (net weight) by IPHC Regulatory Area, 2017.

IPHC Regulatory Area	Discard Mortality	
	Pounds	Metric tons
2A	19,000	9
2B	175,000	79
2C[1]	87,000	39
3A	347,000	157
3B	234,000	106
4A	67,000	30
4B	31,000	14
4CDE	28,000	13
Total	988,000	448

[1]In Area 2C, includes the Metlakatla fishery.

Discard mortality from lost or abandoned gear

In the 1980s and early 1990s in Alaska and British Columbia, 'derby' fisheries with short fishing periods led to fishers competing to catch as many Pacific halibut as quickly as possible. This resulted in a considerable quantity of lost fishing gear, which continued to catch fish. Estimates of the amount of missing gear were extrapolated to total catch values using available logbook catch and effort statistics.

The rate of O32 wastage from gear loss is calculated by first figuring out the ratio of effective skates lost to effective skates hauled aboard the vessels for trips for which there was a log, then multiplying that number by the total landed catch. "Effective skates" refers to those that include all requisite data (such as skate

length, hook spacing, and number of hooks per skate), and for which the gear type met the standardization criteria. The ratio includes both snap gear and fixed-hook gear in all areas. U32 discard mortality from lost gear was calculated in a similar manner incorporating the U32:O32 ratio calculations for discarded U32 Pacific halibut as described below.

Discard mortality from discarded U32 Pacific halibut

The weight of discarded U32 Pacific halibut must be measured indirectly where direct observation and electronic monitoring are not available. Of all the areas, the British Columbia fishery (IPHC Regulatory Area 2B) offers the most accurate accounting due to direct observation. Fishers there self-report their discards and are monitored by video on their vessels. In all other IPHC Regulatory Areas, considering that the IPHC fishery-independent setline survey (FISS or setline survey) uses similar fishing gear, the setline survey data have been used as a proxy for the expected encounter rates by area and year. Results are filtered to use setline survey stations with a higher catch rate (by weight) of O32 Pacific halibut, similar to those observed in the commercial fishery. A universal mortality rate of 16 percent has been applied to all Pacific halibut discards from the individual quota fisheries (Canada and Alaska). For derby fisheries in previous years in British Columbia and Alaska, and for the IPHC Regulatory Area 2A directed fishery, a mortality rate of 25 percent is applied. Accordingly, the amount of discarded U32 Pacific halibut in a commercial fishery is estimated by multiplying the ratio of U32 to O32 Pacific halibut by the landed commercial catch and then by the mortality rate for that fishery.

Discard mortality for regulatory reasons

In IPHC Regulatory Area 2A, the commercial fishery is still managed by derby fishing periods in which the quantity of fish that can be caught by each vessel is limited by a fishing period limit and size of vessel. This results in catches that may exceed the vessel or trip limits, so that "excess" O32 Pacific halibut are discarded. Some skippers logged the amount of discards, which were then compared to the landed catch of Pacific halibut for those trips to arrive at a ratio of landed Pacific halibut to O32 discarded Pacific halibut. This ratio was then applied to all landed catch reported on fish tickets to determine the discard of O32 Pacific halibut for all landings to which the mortality rate of 25 percent was applied. U32 Pacific halibut were accounted for in a similar manner incorporating the U32:O32 ratio calculations for discarded Pacific halibut. The amount of Pacific halibut retained by the IPHC Regulatory Area 2A salmon and sablefish fisheries was not included in these numbers, however, as they were accounted for under bycatch mortality estimates. Finally, quota share fisheries in British Columbia and Alaska were not included in these numbers. These fishers typically discard small amounts of fish (if any) on the last fishing trip of the season.

Discard mortality of O32 Pacific halibut is calculated for the derby fishery that takes place off the U.S. West Coast (Area 2A).

SUBSISTENCE HARVEST

Just under 1.167 million pounds (529 t) of Pacific halibut was caught as subsistence fish in 2017.

Pacific halibut that are caught by those that have traditionally relied on this fish as a critical food source or for customary purposes are classified as "subsistence" (formerly "personal use"), as opposed to recreational or commercial catch. Subsistence harvest is barred from resale, so by nature does not make up a part of the commercial catch. The IPHC defines subsistence harvest further as Pacific halibut taken in: 1) the federal subsistence fishery in Alaska; 2) the sanctioned First Nations Food, Social, and Ceremonial (FSC) fishery in British Columbia; 3) treaty Indian Ceremonial and Subsistence (C&S) fisheries in Washington state; and 4) U32 Pacific halibut (those under the legal size limit of 32 inches or 81.3 cm) retained by commercial fishers in IPHC Regulatory Areas 4D and 4E under IPHC regulations. In the latter case, IPHC permits U32 Pacific halibut to be retained because of its history of customary use in the area and because the remote location makes it unlikely that these fish will end up being commercially traded. State and federal regulations require that 'take-home' Pacific halibut caught during commercial fishing be recorded as part of the commercial catch on the landing records, so those fish caught within the commercial fisheries and not sold are accounted for as commercial catch and are not included in the estimates here. Table 5 provides a summary of catch followed by more detail for each area.

Table 5. Subsistence Pacific halibut fisheries removals (net weight) by IPHC Regulatory Area, 2017.

IPHC Regulatory Area	Subsistence Removals	
	Pounds	Metric tons
2A	27,000	12
2B	405,000	184
2C	436,500	198
3A	222,500	101
3B	14,200	6
4A	8,100	4
4B	300	0
4C	4,300	2
4D	0	0
4E	41,400	19
4D/4E[1] (CDQ U32)	7,400	3
Total	1,166,700	529

[1] 2016 Alaska estimates were carried over for the 2017 catch estimate, with the exception of IPHC Regulatory Area 4D/4E subsistence harvest in the CDQ fishery, which were updated.

A calm afternoon in Sitka, AK. IPHC photo archive.

Estimated harvests by area

Regulatory Area 2A (California, Oregon, and Washington; U.S.A.)

The subsistence allocation in IPHC Regulatory Area 2A consists of the C&S fishery that the Treaty tribes have subdivided from their catch limit. The 2017 final estimate of C&S was 27,000 pounds (12 t).

Regulatory Area 2B (British Columbia; Canada)

The FSC fishery constituted British Columbia's subsistence harvest. Fisheries and Oceans Canada (DFO) estimates 405,000 pounds (184 t) were harvested in the FSC fishery. DFO has estimated the same level of harvest for this fishery since 2007.

DFO estimates that the level of harvest in the First Nations Food, Social, and Ceremonial fishery has remained steady since 2007 at 405,000 pounds (184 t).

Regulatory Areas 2C, 3, and 4 (Alaska; U.S.A.)

After the Alaska subsistence program began in 2003, the coastwide subsistence catch declined until 2013, after which it rose until 2016. The 2017 estimate of 1,166,700 pounds (529 t) is down slightly from the 2016 estimate of 1,204,800 pounds (547 t). The Alaska estimates for the subsistence Pacific halibut harvest typically lag by a year, so the 2017 estimates are not yet complete.

The 2017 subsistence estimate for Alaska, carried over from the 2016 harvest. Regulations on the subsistence fishery in Alaska set by the National Marine Fisheries Service include a registration program, and specifications on the type of gear, including the number of hooks and daily bag limits. The IPHC sets the fishing season.

According to Alaska Department of Fish and Game's voluntary annual survey, with a new estimate for 2016 and 2017, IPHC Regulatory Area 2C pulled in the most Pacific halibut as subsistence, followed by IPHC Regulatory Area 3A. The remaining IPHC Regulatory Areas accounted for a small fraction of these two.

Retention of U32 Pacific halibut in the CDQ fishery

The IPHC allows commercial Pacific halibut vessels fishing for certain Community Development Quota (CDQ) organizations in IPHC Regulatory Areas 4D and 4E (Bering Sea) to retain U32 (fork length < 32 inches or 81.3 cm) Pacific halibut under an exemption requested by the North Pacific Fishery Management Council. The CDQ harvest supplements the Alaskan personal use catch. In 2017, retention of U32 Pacific halibut in the CDQ fishery increased from the 5,457 pounds (2.5 t) of Pacific halibut retained in 2016. Changes in harvest each year tend to reflect the amount of effort by local fishing fleets and the availability of fish in their nearshore fisheries.

Bristol Bay Economic Development Corporation

The Bristol Bay Economic Development Corporation (BBEDC), the southernmost of the three CDQ organizations, comprises 17 member villages on the shores of Bristol Bay, AK: Port Heiden, Ugashik, Pilot Point, Aleknagik, Egegik, King Salmon, South Naknek, Naknek, Levelock, Ekwok, Portage Creek, Ekuk, Clark's Point, Dillingham, Manokotak, Twin Hills, and Togiak. The BBEDC aims to use sustainable fish harvesting to improve community life and livelihoods in its member communities. The BBEDC reported that in 2017, twenty-two harvesters brought in a catch of 513 U32 Pacific halibut, weighing 5,261 pounds (2 t), a 52 percent increase from 2016. As in 2016, vessels out of Togiak landed the majority of Pacific halibut, followed by those at Dillingham.

U32 Pacific halibut retained in the CDQ exemption program amounted to just under 7400 pounds (3 t) in 2017.

Coastal Villages Regional Fund

The Coastal Villages Regional Fund (CVRF) lies between the Norton Sound Economic Development Corporation (NSEDC) to the north, and the BBEDC to the south. It comprises 20 remote coastal villages: Platinum, Goodnews Bay, Quinhagak, Eek, Napaskiak, Oscarville, Napakiak, Tuntutuliak, Kongiganak, Kwigillingok, Kipnuk, Chefornak, Nightmute, Toksook Bay, Mekoryuk, Tununak, Newtok, Chevak, Hooper Bay, and Scammon Bay. In 2017, for the fourth year in a row, CVRF reported that their fishers landed zero Pacific halibut and no fish were received by their facilities in Chefornak, Hooper Bay, Kipnuk, Mekoryuk, Toksook Bay, and Tununak.

Norton Sound Economic Development Corporation

The NSEDC is the northernmost of the three organizations, centered on Nome, AK. The NSEDC's purpose is to provide fishing opportunities for its 15 member communities, which are primarily on the coast of the Seward Peninsula, bounded by Kotzebue Sound on the north and Norton Sound on the south: Saint Michael, Stebbins, Unalakleet, Shaktoolik, Koyuk, Elim, Golovin, White Mountain, Nome, Teller, Brevig Mission, Wales, and the island communities of Little Diomede, Gambell, and Savoonga. In 2017, the area's only plant at Nome, received 247 U32 Pacific halibut, weighing 2,119 pounds (1 t), a decrease of 6.6 percent from 2016.

Bycatch mortality of Pacific halibut in other fisheries

Bycatch of Pacific halibut in this section consists of fish caught incidentally by fisheries targeting other species and that cannot legally be retained. Bycatch mortality, or bycatch removals, refers only to those fish that subsequently die due to capture. This section summarizes the estimated bycatch mortality across fisheries where Pacific halibut are incidentally caught and discarded within the IPHC Convention Area.

There has been a declining trend in bycatch mortality over the last few decades, with 2017 representing the lowest level in 25 years. In 2017, there were an estimated 6,051,000 pounds (2,744.7 t) of Pacific halibut bycatch mortality, representing a 14 percent decrease from the 7,036,000 pounds (3,191.4 t) recorded in 2016. Estimates for 2017 are preliminary and subject to change as new information becomes available. Current values are available on the IPHC website: https://iphc.int.

The lowest level of bycatch mortality seen in 25 years occurred in 2017 at 6.051 million pounds (2.745 t).

Sources of bycatch information

The IPHC relies on observer and electronic monitoring programs run by government agencies from Canada and the U.S.A. for bycatch information. The National Marine Fisheries Service (NMFS) monitors trawl fisheries off the coast of Alaska (Regulatory Areas 2C-4) and the U.S. west coast (Area 2A), while Fisheries and Oceans Canada (DFO) monitors fisheries off British Columbia (Area 2B).

Off the U.S. west coast, there is 100 percent fishery monitoring for the trawl groundfish fishery. There are varying levels of monitoring on U.S. non-trawl fleets.

Sorting the results of a haul made during the NMFS trawl survey. Incidental catch of Pacific halibut can occur with any gear including trawl, pot, as well as hook and line. Photo by Christina Conrath.

In British Columbia, there is 100 percent fishery monitoring for the groundfish trawl and hook-and-line fisheries. There are varying levels of monitoring for non-groundfish fleets in British Columbia. Several fishery programs in Alaska have a mandatory 100 percent monitoring requirement, including the Central Gulf of Alaska (GOA) Rockfish Program, the Bering Sea/Aleutian Islands (BSAI) Community Development Quota (CDQ) fisheries, the American Fisheries Act pollock cooperatives, and the BSAI Amendment 80 fishery cooperatives. In Alaska, an annual deployment plan (ADP) provides the scientific guidelines that determine how vessels not involved in these full coverage programs are chosen for monitoring, including vessels in the directed Pacific halibut Individual Fishing Quota (IFQ) fishery.

Discard mortality rates

The percentage of Pacific halibut that die as a result of being caught (called discard mortality rate or DMR) varies by both fishery and area. If observers are present, DMRs are calculated by judging the likelihood of survival for the Pacific halibut they see, using pre-set criteria. For fisheries without observers, assumed DMRs are used, which are based on similar fisheries in other areas where data are available.

One hundred percent monitoring is required in the groundfish trawl and hook-and-line fisheries in British Columbia as well as a variety of fisheries operating in the Gulf of Alaska and Bering Sea.

Bycatch mortality by IPHC Regulatory Area

This section describes the estimated bycatch mortality from each IPHC Regulatory Area (Table 6).

Table 6. Bycatch mortality estimates of Pacific halibut (net weight) by year, IPHC Regulatory Area, and fishery, for 2017. Estimates are preliminary.[1]

Regulatory Area and Gear Type	Bycatch	
2A	Pounds	Metric tons
Groundfish Trawl	--	--
IFQ Bottom Trawl	71,000	32.4
Other Groundfish Trawl	2,000	0.9
Groundfish Pot	0	0.0
Hook & Line	38,000	17.2
Shrimp Trawl	0	0.0
Total	**111,000**	50.5
2B		
Groundfish Bottom Trawl	251,000	114.0
Total	**251,000**	114.0
2C		
Crab Pot	1,000	0.2
Groundfish Trawl	0	0.0
Hook & Line (non-IFQ) 7	5,000	2.3
Hook & Line (IFQ)	13,000	6.0
Chatham Str. Sablefish	n/a	n/a
Clarence Str. Sablefish	n/a	n/a
Total	**19,000**	8.5

3A		
Scallop Dredge	24,000	10.9
Groundfish Trawl	1,230,000	558.0
Hook & Line (non-IFQ)	127,000	57.8
Hook & Line (IFQ)	35,000	15.8
Groundfish Pot	10,000	4.5
Pr Wm Sd Sablefish n/a	n/a	n/a
Total	**1,426,000**	646.9
3B		
Crab Pot	0	0.0
Scallop Dredge	0	0.0
Groundfish Trawl	767,000	348.0
Hook & Line (non-IFQ)	93,000	42.0
Hook & Line (IFQ)	17,000	7.5
Groundfish Pot	13,000	6.0
Total	**890,000**	403.5
4A		
Crab Pot	0	0.0
Scallop Dredge	0	0.0
Groundfish Trawl	304,000	138.0
Hook & Line (non-IFQ)	89,000	40.5
Hook & Line (IFQ)	2,000	0.8
Groundfish Pot	5,000	2.3
Total	**400,000**	181.5
4B		
Crab Pot	0	0.0
Groundfish Trawl	193,000	87.8
Hook & Line (non-IFQ)	13,000	6.0
Hook & Line (IFQ)	0	0.0
Groundfish Pot	0	0.0
Total	**207,000**	93.8
4CDE+CA		
Crab Pot	37,000	16.8
Scallop Dredge	0	0.0
Groundfish Trawl	2,441,000	1,107.0
Hook & Line (non-IFQ)	268,000	121.5
Hook & Line (IFQ)	0	0.0
Groundfish Pot	2,000	0.8
Total	**2,747,000**	1246.0
4 Subtotal		
Crab Pot	0	0.0
Scallop Dredge	37,000	16.8
Groundfish Trawl	2,938,000	1,332.8
Hook & Line (non-IFQ)	370,000	168.0
Hook & Line (IFQ)	2,000	0.8
Groundfish Pot	7,000	3.0
Total	**3,354,000**	1,521.3
GRAND TOTAL	6,051,000	2,744.7

[1] Note that some totals may not sum precisely due to rounding.

Preliminary estimates in Area 3 show a 13 percent decline in bycatch mortality in 2017 compared to 2016.

IPHC Regulatory Area 2A (California, Oregon, and Washington; U.S.A.)

As in prior years, the bottom trawl fishery and hook-and-line fishery for sablefish were responsible for the bulk of the bycatch mortality in IPHC Regulatory Area 2A. Groundfish fisheries in Area 2A are managed by NMFS, following advice and recommendations developed by the Pacific Fishery Management Council (PFMC). Pacific halibut bycatch in the trawl IFQ fishery (also called trawl catch shares) in this area is capped at 100,000 pounds of O32 (> 32 inches fork length; 81.3 cm) Pacific halibut.

IPHC Regulatory Area 2B (British Columbia; Canada)

DFO staff at the Pacific Biological Station estimated bycatch mortality for the bottom trawl fishery in IPHC Regulatory Area 2B to be down 2.7 percent from 2016. In Canada, Pacific halibut bycatch in trawl fisheries is capped at 750,000 pounds net weight (453.6 t round weight) by DFO. Non-trawl bycatch is handled under the IFQ system within the directed Pacific halibut fishery cap. The reported bycatch mortality data were complete through September. Projections for the full calendar year 2017 were made by extrapolating to the full 12 months.

IPHC Regulatory Area 2C (Southeast Alaska; U.S.A.)

NMFS reported bycatch by hook-and-line vessels fishing in the outside (federal) waters of IPHC Regulatory Area 2C in 2017. The vessels in this area were mostly targeting Pacific cod and rockfish in open access fisheries, and sablefish in the IFQ fishery. In state waters, fisheries that take bycatch include pot fisheries for red and golden king crab, and tanner crab. Information is provided periodically by ADFG, and the estimate was again rolled forward for 2017.

IPHC Regulatory Area 3 (Eastern, Central, and Western Gulf of Alaska; U.S.A.)

Trawl fisheries are responsible for the largest proportion of bycatch compared to hook-and-line and pot fisheries.

A preliminary estimate of Pacific halibut bycatch mortality for IPHC Regulatory Area 3 in 2017 amounts to a 13 percent decrease from 2016. Bycatch mortality decreased by 20 percent in IPHC Regulatory Area 3A and increased by two percent in Area 3B from 2016.

Trawl fisheries are responsible for the majority of the bycatch 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 bycatch, but at low levels. IPHC Regulatory Area 3 remains the area where bycatch mortality is estimated most poorly. Observer coverage for most fisheries is relatively low. This low coverage, along with tendering, loopholes in trip scheduling, and safety considerations, likely results in observed trips not being representative of all trips.

IPHC Regulatory Area 4 (Bering Sea/Aleutian Islands; U.S.A.)

Pacific halibut bycatch mortality for IPHC Regulatory Area 4 in 2017 saw a 16 percent decrease from 2016, with the groundfish trawl fishery being responsible for most of the decrease. Hook-and-line bycatch mortality in 2017 was estimated at an 11 percent decrease from the 2016 estimates. Bycatch rates for pot fisheries are relatively low, resulting in an estimated 7,000 pounds (3.0 t) for 2017.

Crab pots stacked up and ready to go in the western Gulf of Alaska. Photo by Paul Logan.

In this IPHC Regulatory Area, almost all of the vessels are required to have 100 percent observer coverage because of vessel size and the requirements of their fishery cooperative; very few small vessels fish Pacific cod or other flatfish in this IPHC Regulatory Area. Because of this high level of observer coverage, bycatch estimates for this and other IPHC Regulatory Area 4 fisheries are considered more reliable. Within the Bering Sea, bycatch has typically been the highest in IPHC Regulatory Area 4CDE due to the flatfish groundfish fishery in the area. In 2017, bycatch in Area 4CDE accounted for 82 percent of the total Bering Sea bycatch.

Observer coverage in Area 4 tends to be fairly high, resulting in more reliable bycatch estimates compared to lower coverage areas.

Survey activities

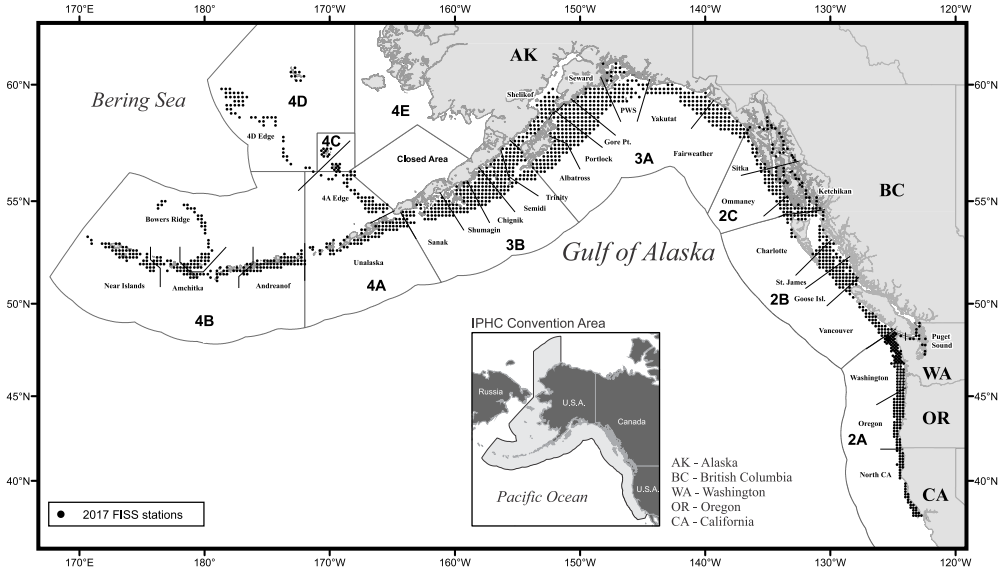
Every year the International Pacific Halibut Commission (IPHC) conducts a fishery-independent setline survey (FISS or setline survey) and participates in National Marine Fisheries Service (NMFS) trawl surveys. Activities during these cruises include collection of biological and oceanographic data, tagging and release of fish, and other projects. Core survey activities are summarized here and other projects are described in more detail in the Biological Research section of this report.

IPHC fishery-independent setline survey

A special thank you to the 12 fishing vessels contracted for the 2017 setline survey: Allstar, Bold Pursuit, Clyde, Free to Wander, Kema Sue, Norcoaster, Pacific Surveyor, Pender Isle, Predator, St. Nicholas, Star Wars II, Vanisle.

The IPHC fishery-independent setline survey gathers catch rate information and biological data such as the size, age, and sex composition of Pacific halibut, and is used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the Pacific halibut population. The setline survey uses standardized methods, bait, and gear during summer months to gain a balanced picture that can be compared over a large area and from year to year. When other species are caught in these setline surveys, their presence provides data about bait competition and the rate of bait attacks. Other species data can also provide an indication of abundance over time, making them valuable to the assessment, management, and avoidance of bycatch species. The setline survey data are standardized (including fishing locations), which means they are independent of the common changes in gear, bait, and set location seen in the commercial fisheries. The two data sets together, from the setline survey and the commercial fishery, provide a complete picture of the Pacific halibut population in convention waters.

Pulling a Pacific halibut over the roller. Photo by Daniella Griffay.



Stations fished during the 2017 fishery-independent setline survey.

Design and procedures

The 2017 setline survey covered both nearshore and offshore waters of northern California, Oregon, and Washington, U.S.A., British Columbia, Canada, and Alaska, U.S.A., including southeast Alaska, the central and western Gulf of Alaska, Aleutian Islands, and the Bering Sea continental shelf. The IPHC chartered 12 commercial longline vessels for setline survey operations. During a combined 74 trips and 780 charter days, these vessels fished 32 charter regions. Each region required between 10 and 46 days to complete.

The setline survey expansion in 2017 included additional stations in Area 2A and Area 4B.

The setline survey was conducted via stations arranged in a grid reflecting the depth range occupied by Pacific halibut during summer months (20-275 fathoms or 37-503 m in most areas). In 2017, an additional 145 stations were added to Regulatory Area 4B as a continuation of the multi-year coastwide effort to expand the setline survey depth profile and update calibration with other surveys, These included stations as shallow as 50 fathoms (91 m) and as deep as 400 fathoms (732 m). Regulatory Area 2A was fished with the same expansion as in 2014, including an additional 17 stations in the Northern California charter region, an additional densified grid of 26 stations in the Washington charter region, and repeating the 14 stations in Puget Sound. All 1,499 setline survey stations planned for the 2017 setline survey season were either scouted or completed. Of these stations, 1,493 (99.6%) were considered successful for stock assessment analysis.

Six skates were set at each station in Regulatory Area 2A and seven skates in Regulatory Area 4CDE. Regulatory Areas 2B, 2C, 3A, 3B, 4A, and 4B had five skates of baited gear set at each setline survey station in all charter regions. Setline survey sampling work involved each vessel setting from one to four stations every day, with boats setting gear as early as 0500 hrs and allowing it to soak for at least five hours (but not overnight, if possible) before hauling. Data from gear soaked longer than 24 hours were discarded from the setline survey, as were sets for which predetermined limits for lost gear, snarls, predation, or displacement were exceeded. Setline survey gear consisted of fixed-hook, 1,800-

In 2017, an additional grid of stations was fished in Areas 4B and 2A as part of a multi-year expansion.

foot (549 m) skates with 100 circle hooks of size 16/0 spaced 18 feet (5.5 m) apart. The length of the gangions ranged from 24 to 48 inches (61 to 122 cm). Each hook was baited with 1/4 to 1/3 pounds (0.11 to 0.15 kg) of chum salmon.

Sampling protocols

Following protocols set out in the 2017 Fishery-Independent Setline Survey Manual, shipboard sea samplers assessed the functionality of bird avoidance devices during setting of the gear, and also recorded the number of hooks set and baits lost per skate. During gear retrieval, the sea samplers recorded hook status (whether hooks were pulled up empty or what species were captured) for the first 20 consecutive hooks of each skate. In northern stations of Regulatory Area 2A, and all of Area 2B, samplers recorded the status of all hooks in the order in which they were hauled, in lieu of 20-hook subsample counts.

Sea samplers recorded lengths of all Pacific halibut caught along with the corresponding skate numbers, and assessed the sex and maturity, prior hooking injury (PHI) incidence and severity, and evidence of depredation for each fish captured. They also collected otoliths from a randomized subsample of Pacific halibut for later age determination.

The male fish were assessed as either mature or immature, and the females were categorized as immature, ripening, spawning, or spent/resting. The sex and maturity level of U32 (fork length < 32 inches or 81.3 cm) Pacific halibut was recorded only if that fish was randomly selected for otolith removal or was already dead upon hauling. All U32 Pacific halibut not selected for otolith collection were measured and released alive.

Bait purchases

To ensure consistency from year to year, the bait used for the setline survey is always No. 2 semi-bright (Alaska Seafood Marketing Institute grades A through E), headed and gutted, and individually quick-frozen chum salmon. In August 2016, the IPHC Secretariat began arranging bait purchases for the 2017 setline survey. Approximately 247,000 pounds (~112 t) of chum salmon were utilized from three suppliers. The amount of bait used varied by vessel and charter region. Bait quality was monitored and documented throughout the season and found to meet the standard as described above.

Fish sales

O32 (fork length ≥ 32 inches or 81.3 cm) Pacific halibut caught during setline survey work are generally kept and sold as a way to offset the cost of the setline survey. Most vessel contracts contain a lump sum payment along with a 10 percent share of the Pacific halibut proceeds. Rockfish and Pacific cod landed incidentally during the setline survey are also kept, because they rarely survive the trauma of capture and release. Proceeds from retained bycatch captured in U.S.A. waters are divided equally between the vessel (for handling expenses) and the appropriate state management agency. For boats in Canadian waters, Fisheries and Oceans Canada (DFO) kept all the bycatch proceeds, but paid a bycatch processing fee to those boats. The IPHC does not keep any proceeds from the sale of bycatch species.

During the 2017 setline survey, IPHC's chartered vessels delivered a total of 569,576 pounds (~258 t) of Pacific halibut to 22 different ports. The coastwide average price per pound was $6.53 USD, amounting to a sales totaling $3.7 million USD.

Crewmen Al Mack and Shane Strand from the *F/V Bold Pursuit* retrieve the gear at a setline survey station. Photo by Jason Taylor.

Field personnel

The 2017 setline survey vessels were staffed by 26 seasonal sea samplers, who worked a total of 1,716 person-days, including travel days, sea days, and debriefing days. Two samplers are typically aboard each setline survey vessel. At a given time, one sea sampler handles fish, collects data, and samples on deck, while the other sea sampler, in a portable shelter, records data and observations and stores samples collected by the deck sea sampler. Low catch rates in Regulatory Area 2A required only one sampler for all but the first trip in the northern portion of the Washington charter region. Three sea samplers were deployed on some vessels in some areas to support additional data collection or special research projects. The IPHC also deployed five sea samplers on the NOAA-AFSC trawl survey—three on the *F/V Ocean Explorer* during the Gulf of Alaska groundfish trawl survey and two on the F/*V Vesteraalen* during the Bering Sea groundfish trawl survey.

Bait used during the setline survey is No. 2 semi-bright chum salmon. In 2017, about 247 thousand pounds (112 t) of bait were used during the survey.

Additional research projects

In addition to core operations, the setline survey is a platform for a number of IPHC research projects as well as external special projects and data collections. Details of those projects are contained in the Biological Research section of this report.

IPHC fishery-independent setline survey results

As always, the IPHC targeted the summer months—May, June, July, and August—for setline survey work, and the vast majority (about 98%) of all stations were surveyed in those months. The early part of the setline survey season saw the greatest activity; coastwide activity declined early in August and was fully completed by mid-September.

Weight and number per unit effort (WPUE)

As a result of including both commercial and non-commercial fishing grounds, the setline survey results have an average weight per unit effort (WPUE) for all IPHC Regulatory Areas below that of the directed longline fleet (Table 7).

Table 7. The average total raw WPUE figures for the Regulatory Areas (not including expansion stations in the eastern Bering Sea.

Regulatory Area	lbs/skate	kg/skate
2A	14	6
2B	80	36
2C	218	99
3A	117	53
3B	66	30
4A	52	24
4B	52	24
4C	76	34
4D	37	17

Compared to 2016 results, setline survey WPUE increased in Regulatory Areas 2C (+23%), 4A (+2%), 4C (+28%), and 4D (+95%). WPUE decreased in Regulatory Areas 2A (-53%), 2B (-10%), 3A (-10%), 3B (-20%) and 4B (-7%). Since 2011, Area 2C's WPUE has exceeded Area 3A's, and has been the highest WPUE of all the regions. Although weight is the primary unit of measure when studying population and removals, the number of Pacific halibut is also a critical

Twenty-six seasonal vessel staff were hired in 2017 to collect samples on board both the setline and trawl surveys.

Setline survey 2017 field personnel and associated Secretariat staff. Photo by Tom Kong.

measure. There was a 31 percent decrease in the relative numbers of U32 Pacific halibut caught and a six percent decrease in catch rates of O32 Pacific halibut when compared to 2016. In 2017, there were 16 percent more U32 Pacific halibut captured than O32 Pacific halibut, which is a nine percent decrease in difference from 2016.

Otolith collection

Collection of Pacific halibut otoliths for aging is a major activity of the setline survey. In 2017, the otolith collection goal was 2,000 per Regulatory Area (with a minimum target of 1,500 per area). Samplers removed a total of 12,922 otoliths from 55,146 Pacific halibut, a 23.4 percent sampling rate. Due to low catch rates and few survey stations, the minimum 1,500 otolith goal was not reached in five Regulatory Areas. Additional otoliths were collected in most Regulatory Areas for the clean otolith archive collection.

Bycatch

Around 112 species of fish and invertebrates were captured as bycatch by the IPHC setline survey. The predominant incidental catches in Regulatory Areas 2A, 2B, 2C, and 3A were sharks. The most frequent incidental catch in Areas 3B, 4A, and 4D was Pacific cod. In Areas 4B and 4C, the "other species" category was most common and was comprised of yellow Irish lord sculpins (*Hemilepidotus jordani*), unidentified starfish, grenadiers (*Macrouridae*), and arrowtooth flounder (*Atheresthes stomias*).

Numbers of U32 Pacific halibut decreased by 31 percent in 2017 and O32 fish by six percent compared to 2016.

Trends in seabird counts from the setline surveys (2002-17)

Counts of live seabirds, taken immediately following gear retrieval, have been conducted during setline surveys since 2002. A total of 20,921 seabird counts have been conducted over the last 16 years, with 1,368 occurring in 2017. More than 916,000 observations of seabirds have been recorded since 2002. Northern fulmars (*Fulmarus glacialis*), glaucous-winged gulls (*Larus glaucescens*), blackfooted albatross (*Phoebastria nigripes*), and fork-tailed storm petrels (*Oceanodroma furcata*) represent the most commonly observed species. The observed number of unidentified gulls has decreased, inversely correlated with an increased number of observations of glaucous-winged gulls and herring gulls (*L. argentatus*). This shift was likely the result of increased emphasis on gull identification during annual IPHC field biologist training. A total of 389 endangered short-tailed albatross (*P. albatrus*) sightings have been recorded overall, with an average of 24 observed annually since 2002.

Pacific halibut distribution

Just upwards of 47 percent of Pacific halibut caught during the setline survey were smaller than the current commercial legal size limit (U32) with a median fork length of 79 cm (31 inches). In 2017, median length increased in all Regulatory Areas except 4A. Regulatory Areas 3A, 3B, and 4A had median lengths below the legal-size limit. The largest median length was in Area 2A (97 cm or 38 inches).

The sex composition of setline survey-caught O32 Pacific halibut varied widely among areas, ranging from 41 percent to 87 percent female. As in the

This blackfooted albatross was spotted alongside the *F/V Kema Sue* during the fishery-independent setline survey. Photo by Orion McCarthy.

Median length of Pacific halibut caught during the setline survey increased in all areas except Area 4A compared to 2016.

prior year, Area 4B had the lowest percentage of females in the catch—not surprising considering this area has had less than 50 percent females consistently since 1998. Also, as in previous years, Area 4C showed the highest concentration of females. Most female Pacific halibut caught during the setline survey period (i.e., summer months) were in the ripening stage and expected to spawn in the upcoming season.

Age distribution

The otoliths collected on the setline survey give us an age distribution of Pacific halibut coastwide. Of the otoliths collected during the setline survey 12,565 were successfully aged. The most commonly occurring year class for both males and females was 2005 (12-year-olds), with 2,268 caught. Next most common were the year classes 2004 (13-year-olds), with 1,877 caught, and 2006 (11-year-olds), with 1,455 caught.

In 2017, the youngest and oldest Pacific halibut caught in the setline survey samples were four and 46 years old, respectively. There were four fish determined to be four years old: a female from Regulatory Area 3A measuring 53 cm fork length (21 inches); two females from Regulatory Area 3B measuring 53 [21 inches] and 55 cm [22 inches] fork length); and one male from Regulatory Area 3B measuring 71 cm (28 inches) fork length. The 46-year-old was a male captured in Regulatory Area 4B with a fork length of 119 cm (47 inches). The maximum fork length recorded for setline survey-caught Pacific halibut in 2017 was 190 cm (75 inches): a female from Regulatory Area 3A aged at 22 years. The smallest Pacific halibut sampled in the 2017 setline survey measured 33 cm (13 inches) fork length: a male from Regulatory Area 4A aged at five years.

Setline survey expansions in 2018

The IPHC is in the middle of a six-year fishery-independent setline survey expansion with the primary purpose of reducing the potential for bias in the indices of Pacific halibut density and abundance. The expansion, begun in 2014 in Regulatory Areas 2A and 4A, and set to complete in 2019, moves the setline

survey into deep (275-400 fathoms; 503-731 m) and shallow (10-20 fathoms; 18-37 m) waters, and into gaps in the 20-275 fathom (37-503 m) waters not covered by the standard 10-nautical-mile station grid. Observations have shown there to be significant commercial harvest in deep waters, particularly in Regulatory Area 4A, and in shallow waters in some areas. It is apparent that the current setline survey range does not cover the entirety of Pacific halibut habitat. Other gaps within the 20-275 fathom (37-503 m) range are at times substantial, particularly in Areas 2B and 4.

In 2018, it is anticipated that the setline survey will be conducted in all 27 traditional regions and the IPHC will be continuing with the setline survey expansion into Regulatory Areas 2B and 2C, as approved by the Commission in 2014. There are 142 expansion stations planned in 2018 in Regulatory Area 2B and 48 in Area 2C.

NMFS groundfish trawl surveys

Annual Bering Sea shelf survey

The IPHC has been part of the National Oceanic and Atmospheric Administration (NOAA)/NMFS groundfish trawl survey on the eastern Bering Sea shelf annually since 1998. The 2017 trawl survey took place aboard two vessels, and the IPHC biologist was aboard the *F/V Vesteraalen* for the duration of the survey which lasted from 31 May to 7 August, plus an additional trip to sample the northern Bering Sea, which extended the survey to 31 August. A total of 591 Pacific halibut otoliths were collected along with sex, maturity, and prior hooking injury information at the standard stations and an additional 28 were sampled in the northern extension. This year, Pacific halibut were tagged and released from both vessels, resulting in 756 releases. The swept-area abundance estimate for 2017 was 53 million fish, which reflects a continued decline seen over the past several years. Note that trawl surveys capture Pacific halibut as small as about 20 cm (8 inches) fork length and can miss fish that are greater than about 100 cm (39 inches) fork length.

The northern extension, which includes Norton Sound, was last surveyed in 2010 and relative results were similar to those in 2017. Although densities tended to be lower, both the median size and average age were higher in the northern extension than in the standard survey. In the north, the median size was 61 cm (24 inches) compared to 51 cm (20 inches) in the south, and average age was 6.4 years in the north compared to 5.7 years in the south.

The area north of the standard trawl survey grid in the Bering Sea was surveyed in 2017, which was last sampled in 2010. Pacific halibut there tended to be slighter larger and older on average than fish sampled from the standard grid.

Biennial Gulf of Alaska survey

In 2017, the IPHC participated in the NOAA/NMFS Gulf of Alaska Biennial Bottom Trawl Survey. Two survey vessels sampled the area from Island of Four Mountains to Dixon Entrance, AK. An IPHC biologist was deployed on the *F/V Ocean Explorer* for the duration of the survey. A total of 4,645 Pacific halibut were captured by both vessels combined. A total of 818 were sampled for length, otoliths, sex, maturity, and prior hooking injuries on the *Ocean Explorer*. Another 776 were measured and, if in suitable condition and < 82 cm (32 inches) fork length, were tagged and released, resulting in 713 total tag releases. Swept-area abundance and biomass were estimated at 114 million fish and 658 million pounds, respectively, which reflected a slight decline relative to the last survey in 2015.

Population assessment

Since 1923, one of the IPHC's primary tasks has been to assess the population (or stock) of Pacific halibut, a complex undertaking that requires some explanation. In 2017, the IPHC undertook its annual coastwide stock assessment of Pacific halibut using a range of updated data sources. This section covers three main topics that have bearing on the population assessment process: (1) the data sources available for the Pacific halibut stock assessment and related analyses, (2) the results of the stock assessment, and (3) the outlook for the stock, scientific advice, and future research directions.

Data sources

Data for the stock assessment come from both fishery-dependent (e.g. commercial fisheries) and fishery-independent (e.g. the IPHC setline survey) sources.

The data for the stock assessment is based on fishery and fishery-independent data, as well as auxiliary data. The data sources also include historical information going back to the late 1800s, which allows scientists to better identify cyclical trends over time that may be of import to the current population. While data collection has continuously improved and is now the best it has ever been, the historical data are incomplete and/or imperfect, limiting the conclusions that can be drawn.

Pacific halibut fishing aboard the *F/V Bold Pursuit*. Photo by Jason Taylor.

Historical Data

Known Pacific halibut removals (mortality) consist of target fishery landings and discard mortality (including research), recreational fisheries, subsistence, and bycatch mortality in fisheries targeting other species (where Pacific halibut retention is prohibited). Over the period 1918-2017 removals have totaled 7.2 billion pounds (~3.2 million metric tons, t), ranging annually from 34 to 100 million pounds (16,000-45,000 t) with an annual

average of 63 million pounds (~29,000 t). Annual removals were above this long-term average from 1985 through 2010 and have been relatively stable near 42 million pounds (~19,000 t) since 2014.

2017 fishery and fishery-independent setline survey data

Fishery-dependent data includes information from commercial, recreational, personal use, and non-Pacific halibut target fisheries. Pacific halibut landings data from the commercial fishery since 1981 have been reported to IPHC by way of commercial fish tickets. Since 1991, Fisheries and Oceans Canada (DFO) and National Marine Fisheries Service (NMFS) have provided estimates of subsistence (or personal use) harvests. These estimates are not made every year in all cases, so in some instances they must be interpolated for intervening years.

NMFS and DFO estimate bycatch of Pacific halibut from non-Pacific halibut fisheries and report it annually to the IPHC, though this estimation varies widely in quality depending upon the year, fishery, type of estimation method, and many other factors. The peak level of bycatch occurred in 1992, with over 20 million pounds (~9,070 t) caught, and has mostly declined since then, with an estimated 6 million pounds (~2,720 t) caught in 2017 (a decrease from the 7 million pounds [3,175 t] caught in 2016).

Both fishery and fishery-independent data are used to assess: 1) weight-per-unit-effort (WPUE), numbers-per-unit-effort (NPUE), 2) age distributions, and 3) weight-at-age. The primary source of trend information is the IPHC fishery-independent setline survey (FISS); however, IPHC considers the commercial fishery WPUE to be another indicator for the stock, and so its estimates are also treated as a proxy for density, while accounting for possible changes in fishery practices and locations from year-to-year.

Coastwide commercial Pacific halibut fishery landings in 2017 were approximately 26.2 million pounds (~11,900 t), up from a low of 23.7 million pounds (~10,700 t) in 2014. Bycatch mortality was estimated to be 6.0 million pounds in 2017 (~2,720 t), the lowest level in the estimated time series, beginning with the arrival of foreign fishing fleets in 1962, and just over one million pounds (~450 t) less than estimated for 2016. The total recreational removals were estimated to be 8.1 million pounds (~3,675 t), up 10 percent from 2016. Removals from all sources in 2017 were estimated to be 42.4 million pounds (~19,200 t), up slightly from 41.8 million pounds in 2015 (~18,960 t).

The 2017 FISS WPUE for Pacific halibut ≥ 82 cm fork length was 10% lower than in 2016.

The 2017 FISS detailed a coastwide aggregate legal (O32, ≥ 81.3 cm or 32 inches) WPUE which was 10 percent lower than the value observed in 2016, with individual IPHC Regulatory Areas varying from a one percent increase (Area 2C) to a 32 percent decrease (Area 3B). Setline survey NPUE showed a more pronounced decrease from 2016 to 2017 (24 percent coastwide), with individual Regulatory Areas ranging from a one percent increase (Area 4A) to a 44 percent decrease (Area 2A).

Commercial fishery WPUE (based on extensive, but still incomplete logbook records available for this assessment) was slightly increased (five percent) at the coastwide level with mixed trends among Regulatory Areas. Based on review by the IPHC's Scientific Review Board (SRB), a bias correction specific to each Regulatory Area was developed using the last five years of post-assessment updates resulting from additional logbooks available after the assessment deadline in early November. Applying these corrections reduced the increase in coastwide commercial fishery WPUE to only three percent and

Baited up and ready to go on the IPHC fishery-independent setline survey. Photo by Jason Taylor.

negative trends were predicted for all Areas except Area 4D (+71 percent), Area 4C (+20 percent) and Area 3A (+6 percent). Tribal and non-tribal commercial fishery trends in Area 2A are reported separately this year in response to important differences in the timing and spatial extent of the two components. Tribal fishery WPUE has been increasing since 2014 in that Area, and non-tribal WPUE has been declining over the same period, although a small increase (five percent) from 2016 to 2017 was observed. The very large increase in WPUE observed in Area 4D appears to be a function of much higher catch-rates around St. Matthew Island (also observed in the setline survey) and a shift of 25 percent of the catch previously occurring along the shelf-edge to the waters around that island in 2017.

Efforts to improve the data sources included in the assessment have been ongoing since 2013, with a complete reprocessing of all inputs completed for 2015. Further improvements in 2016 included the transition to model-based setline survey indices. For 2017, additional data was included in the form of age data from setline survey expansions and additional stations sampled historically, individual Pacific halibut weights collected during port sampling of commercial fishery landings as well as an extended time-series (1993-2017) from the setline survey modelling, making use of six additional years of data (1993-1997 and 2017). As is standard practice, all mortality estimates and existing time-series were updated for 2016 and extended to include 2017 observations.

Auxiliary inputs to the assessment are information products that are treated like data, but are actually products of analyses themselves.

Auxiliary inputs

The population assessment includes a number of additional information sources that are treated as data, even though they represent the products of

analyses themselves. These are: 1) the weight-length relationship, 2) the maturity schedule, 3) estimates of ageing bias and imprecision, and 4) the regimes of the Pacific Decadal Oscillation (PDO). Details of these data sources are as follows.

1. The headed and gutted weight (net pounds) of a Pacific halibut can be estimated via a simple equation of weight-length relationship that uses fork length as its variable. As length increases, weight corresponds at a rate slightly greater than cubic increase.

2. Female Pacific halibut are estimated to become sexually mature on a set schedule that has been estimated to be stable through several historical investigations. Across all Regulatory Areas, half of all female Pacific halibut become sexually mature by 11.6 years, and nearly all fish are mature by age 17.

3. Age estimates are based on the counting of rings on an otolith, a method that is by nature subject to bias and imprecision, however slight. That being said, it is relatively easy to estimate the age of Pacific halibut (compared to other groundfish), and analysis shows that the current aging method—referred to as "break-and-bake"—is remarkably precise.

4. The PDO is a pattern of Pacific climate variability that changes about every 30 years. Research has shown that during the 20th century these environmental conditions have been correlated with the recruitment of Pacific halibut. In "positive" phases of the PDO (through 1947, and 1977-2006), the stock saw an increase in younger fish. The PDO's longest "negative" phase since the late 1970s occurred from 2006 through 2013. Highly positive values were observed over 2014-17; however, it is unclear if this represents a change of phase or a different set of environmental conditions altogether.

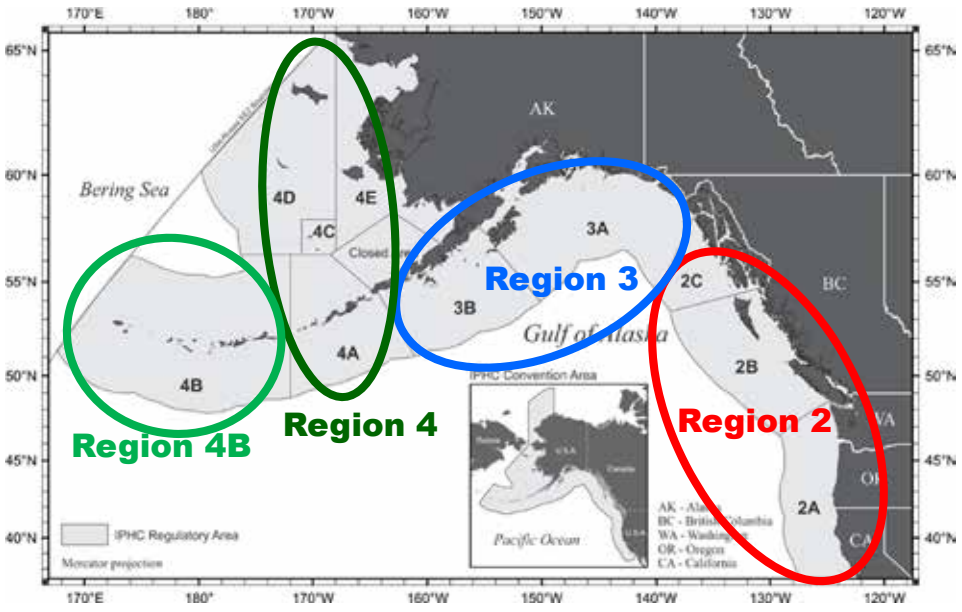
Stock distribution estimates are currently achieved using the IPHC fishery-indpendent setline survey.

Stock distribution estimation

This is achieved using the FISS mean O32 WPUE index of Pacific halibut density, weighted by bottom area. To account for factors that are known to affect setline survey catch rates, two adjustments to the WPUE are made for survey timing relative to the harvest and hook competition. The measure of "hook competition" accounts for competition from all species including other Pacific halibut. Adjusting for the presence of such competition reduces bias in the observed WPUE index of density into setline survey results. As with the timing adjustment, adjustments for competition are also applied at the station level.

Stock distribution

Stock distribution estimates in 2017 indicate that our understanding of the distribution of the stock has changed somewhat from last year, indicating a larger proportion of the coastwide stock in Regulatory Areas 2C, 3A, 4A, 4B, and 4CDE in 2017 and a smaller proportion in 2A, 2B, and 3B. During 2017, there was extensive consideration by the IPHC Secretariat of what constitutes a biologically-based stock distribution estimate. Although IPHC Regulatory Areas have been used for distributional summary historically, there is no biological



IPHC Regulatory Areas can be divided into four biological regions that are more meaningful for population studies.

Over a decadal time period, there has been an increasing proportion of the coastwide stock occurring in Region 2.

basis for that level of resolution. Instead, population-level information suggests that broader regions (with the exception of Area 4B) are more biologically meaningful.

Trends over the last five years in these biological regions indicate that population distribution, measured either via the O32 component of the setline survey catch or all sizes has been relatively stable. However, over a decadal time-period, there has been an increasing proportion of the coastwide stock occurring in Region 2 and a decreasing proportion occurring in Region 3. It is unknown to what degree either of these periods corresponds to historical distributions from the mid-1900s or to the average distribution likely to occur in the absence of fishing mortality.

For the 2017 setline survey, the stock distribution for Pacific halibut was estimated as shown in Table 8.

Table 8. Recent regional stock distribution estimates based on modelling of the fishery-independent setline survey data.

Region	All sizes stock distribution	O32 stock distribution
Region 2 (2A, 2B, 2C)	25.9%	29.7%
Region 3 (3A, 3B)	50.7%	45.6%
Region 4 (4A, 4CDE)	19.2%	20.0%
Region 4B	4.2%	4.8%

Population assessment at the end of 2017

Stock assessment

The methods for undertaking the population assessment for Pacific halibut have been improved many times over the last 30 years due to a continual effort to improve model assumptions and analytical approaches. For the last five years, a method called the "ensemble approach" has been used as a way to make the process both stronger and more flexible to future model changes. Originating from the field of weather and hurricane forecasting, it recognized that there is no "perfect" assessment model, and that robust risk assessment can only be achieved with the inclusion of multiple models in the estimation of management quantities (and the uncertainty about these quantities).

This basic assessment approach used in 2017 remains unchanged and continues to make use of the extensive historical time series of data, as well as integrating both structural and estimation uncertainty via an ensemble of individual models. For 2017, the four models were equally weighted, as work-to-date on retrospective and predictive performance continues to suggest that each can be considered approximately equally plausible. Within-model uncertainty from each model was propagated through to the ensemble results. The risk analysis and decision table include the full range of uncertainty from all the models in the assessment. Therefore, key quantities such as reference points and stock size are reported as distributions, such that the entire plausible range can be evaluated. Point estimates reported in this stock assessment correspond to median values from the ensemble, and can therefore be described probabilistically.

***F/V Northern Prince* in Kodiak, AK. Photo by Jamie Goen.**

For 2017, an ensemble of four models that were equally weighted were used to describe the assessment.

Spawning Biomass and recruitment trends

The results of the 2017 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010. 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. Since the estimated female spawning biomass (SB) stabilized near 200 million pounds (~90,100 t) in 2010, the stock is estimated to have increased gradually to 2017. The SB at the beginning of 2018 is estimated to be 202 million pounds (~91,600 t), with an approximate 95 percent confidence interval ranging from 148 to 256 million pounds (~67,100-116,100 t). Comparison with previous stock assessments indicates that the 2017 results are very consistent (although slightly lower) with estimates from 2012 through 2016, all of which lie inside the 50 percent interval. The 2017 SB estimate from the 2017 stock assessment is only two percent below the estimate from the 2016 stock assessment.

Based on the two long time-series models, average Pacific halibut recruitment is estimated to be higher (41 and 76 percent for the coastwide and AAF models, respectively) during favorable PDO regimes, a widely used indicator of productivity in the north Pacific. 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 October 2017 have been positive; however, many other environmental indicators, current and temperature patterns have been anomalous relative to historical periods. Further, observed declines in Pacific cod in the Gulf of Alaska, seabird mortality events and other conditions suggest that historical patterns of productivity related to the PDO may not be relevant to the most recent few years. Pacific halibut recruitment estimates show the largest recent cohorts in 1999 and 2005. Cohorts from 2006 through 2013 are estimated to be smaller than those from 1999-2005. This indicates a high probability of decline in both the stock and fishery yield as recent recruitments become increasingly important to the age range over which much of the harvest and spawning takes place.

At the end of 2017, it was estimated that the stock biomass was at 40% of unfished levels.

Reference points

A comparison of the median 2018 ensemble SB to reference levels specified by the interim management procedure suggests that the stock is currently at 40 percent (approximate 95 percent credible range = 26-60 percent) of specified unfished levels (relative to the SB specified by the current management procedure). The probability that the stock is below the SB30 percent level is estimated to be six percent, with less than a one percent chance that the stock is below SB20 percent. Consistent with the interim management procedure (while improvements are ongoing), estimates of spawning biomass are compared to equilibrium values representing poor recruitment regimes and relatively large size-at-age. Alternative reference points include the spawning biomass estimated to have occurred at the lowest point in the historical time-series (1977-78), as well as the spawning biomass that would be estimated to occur at present (given recent recruitment and biology) in the absence of fishing. The two long time-series models provide a comparison with SB levels estimated to have occurred during the historically low stock sizes of the 1970s: the AAF model suggests that recent stock sizes are at 96 percent of those levels, and the coastwide model at 215 percent. The estimates of current spawning biomass relative to the dynamic reference point (the current stock size predicted to have occurred if no fishing had taken place) range from 26-43 percent among the four stock assessment models, with an average value of 33 percent. Relatively large differences among the four 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

Sources of uncertainty

The Pacific halibut population assessment, like any statistical model, includes a substantial level of uncertainty due to estimations, data treatment, natural mortality, and other structural differences among the models. The way in which differences among Regulatory Areas are treated in the assessment model and the spatial processes in the underlying stock are important sources of uncertainty, particularly with regard to the distribution of recruitment, and the fishes' movement rates among Areas as they grow. With SRB approval, the staff is working to develop additional alternative models that take into account the way Pacific halibut migrate among the grounds and the factors influencing this movement for future stock assessments, as well as refinement of available models.

IPHC Secretariat staff member Afshin Taheri samples a commercial landing in Illwaco, WA. Photo by Tom Kong.

The IPHC staff is currently working on alternative stock assessment models that take into account the way Pacific halibut migrate among areas and the factors that influence this movement.

Two primary uncertainties continue to hinder our current understanding of the Pacific halibut resource: 1) the sex-ratio of the commercial catch (not sampled due to the dressing of fish at sea), which in tandem with assumptions regarding natural mortality, determine the productivity of the stock, and 2) the treatment of spatial dynamics and movement rates among Areas, which have very strong implications for the current stock trend.

Other important contributors to assessment uncertainty and potential bias include recruitment, size-at-age, and fishery removals. The link between Pacific halibut recruitment strengths and environmental conditions remains poorly understood, and there is no guarantee that observed correlations continue in the future. Therefore, recruitment variability remains a substantial source of uncertainty in current stock estimates due to the lag between birth year and direct observation in the fishery and survey data (6-10 years). Reduced size-at-age relative to levels observed in the 1970s is the most important driver of recent stock trends, but its cause also remains unknown. The historical record suggests

that size-at-age changes relatively slowly; therefore, although projection of future values is highly uncertain, near-term values are unlikely to be substantially different than those currently observed.

A wide range of sensitivity analyses were conducted during the development of the 2015 stock assessment. These efforts form the primary basis for the identification of important sources of uncertainty outlined above. The most important contributors to estimates of both population trend and scale included: the sex-ratio of the commercial catch, the treatment of historical selectivity in the long time-series models, and natural mortality. Several sensitivity analyses were revisited this year in order to update and illustrate their importance, particularly with regard to the IPHC's research program.

Current sensitivity analyses illustrate the importance of ongoing research into factors influencing reproductive biology and success for Pacific halibut.

The first sensitivity conducted for this assessment was an investigation into the potential effects of a downward trend in spawning output for the Pacific halibut stock. This could be caused by a change in the underlying fecundity or maturity schedules, or by a trend in the rate of skip-spawning (where a reproductively mature fish does not actually spawn in a particular year). To implement this sensitivity, a reduction in spawning output was added to the assessment beginning in 2002 and ending with 10 percent less spawning output in 2017 (a 15-year trend). When compared with the short coastwide model included in the ensemble, the change in maturity results in a nearly proportional decrease in the estimate of spawning biomass over the same period, leading to a bias in recent trend and scale of the current stock. This result illustrates the importance of ongoing research into factors influencing reproductive biology and success for Pacific halibut. Currently, the survey is assumed to be a reasonable proxy for relative fishery selectivity of the oldest male and female Pacific halibut. The second sensitivity examined the effect of higher or lower relative fishery selectivity of males (using the coastwide short model); effectively testing the sensitivity to the assumption of sex-ratio of the commercial catch. A decrease in relative selectivity for males was found to result in larger absolute levels of spawning biomass, but little effect on trend, given a constant

Crewman Al Newton dresses a Pacific halibut during the fishery-independent setline survey. Photo by Kaitlin Johnson.

assumption over time. An increase in the relative selectivity of males did not produce greatly differing results for this model. It is likely that trends in sex-ratio could result in a bias to the estimated stock trends if it were unaccounted for. This sensitivity illustrates the importance of ongoing efforts to directly measure the sex-ratio of the commercial catch through marking at sea and genetic validation. The third sensitivity added for this assessment explored the effect of additional unobserved mortality on the halibut stock. The sensitivity included two tests: 1) a 20 percent increase in mortality over the whole time-series, and 2) a trend of increasing mortality to 20 percent over the most recent 15 years. Unobserved mortality increases the estimate of stock size, and the trend causes a very small bias at the terminal end of the series, but mainly results in a small bias as well. Both of these results are relevant to both the stock assessment and harvest policy development, if unobserved mortality were occurring.

Each of the models contributing to this assessment underwent a retrospective analysis, with neither coastwide model revealing any strong pattern in the most recent years. All models' estimates for the most recent three years of the retrospective analysis were within the currently estimated confidence intervals.

Outlook

Stock projections were conducted using the integrated results from the stock assessment ensemble, summaries of the 2017 fishery, and other sources of mortality, as well as the results of stock distribution calculations and the target harvest rates. The projections required estimating stock distribution; applying area-specific harvest rates to estimate yield and removals, and calculating the total mortality and projecting the stock trends both one and three years into the future. This is explained further in the following sections.

The harvest decision table contains a range of harvest levels and an estimate of risk to the stock for each level.

Projections indicate gradual stock decrease between 2018 and 2020, with the risk of stock decline growing rapidly for TCEYs above 31 million pounds (~14,060 t) and becoming more pronounced by 2020.

The decision table includes a range of harvest levels and risk assessments, including the *status-quo* Spawning Potential Ratio (SPR). The *status quo* SPR (31 million pounds, ~14,060 t, total removals) corresponds to a 78/100 (78 percent) chance of stock decline in 2019 and a 46 percent chance of at least a five percent decline through 2021. There is a relatively small chance (<21/100; 21 percent) that the stock will decline below the threshold reference point in projections for all the levels of Total Constant Exploitation Yield (TCEY) up to 40 million pounds (~18,100 t) evaluated over three years; for TCEYs exceeding that level, the probability begins to increase rapidly.

Scientific advice

Sources of mortality

In 2017, total removals were below the 100-year average, and have been stable near 42 million pounds (19,050 t) from 2014-17. In 2017, eighty-three percent of the total removals from the stock were retained compared to 80 percent in 2016.

		2018 Alternative	No removals							*Reference: SPR=46%*							
		Total removals (M lb)	0.0	11.8	21.8	28.8	29.8	30.8	31.8	32.8	33.8	34.8	35.8	37.3	41.8	51.8	61.9	
		TCEY (M lb)	0.0	10.0	20.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.5	40.0	50.0	60.0	
		Fishing intensity	$F_{100\%}$	$F_{73\%}$	$F_{58\%}$	$F_{50\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{39\%}$	$F_{32\%}$	$F_{27\%}$	
		Fishing intensity interval	--	61-84%	45-73%	37-67%	36-66%	36-65%	35-65%	34-64%	33-63%	32-63%	32-62%	31-61%	28-58%	23-53%	19-48%	
Stock Trend (spawning biomass)	in 2019	is less than 2018	1	3	24	59	64	69	74	78	81	85	87	91	98	>99	>99	a
		is 5% less than 2018	<1	<1	<1	2	2	3	4	5	7	9	11	14	29	69	96	b
	in 2020	is less than 2018	<1	1	14	46	52	57	62	67	71	76	80	85	95	>99	>99	c
		is 5% less than 2018	<1	<1	1	9	11	14	18	21	25	29	34	41	61	94	>99	d
	in 2021	is less than 2018	<1	2	23	59	63	68	72	76	79	83	86	90	97	>99	>99	e
		is 5% less than 2018	<1	<1	5	27	32	36	41	46	50	55	59	66	83	99	>99	f
Stock Status (Spawning biomass)	in 2019	is less than 30%	3	4	5	6	6	7	7	7	7	7	7	8	9	11	15	g
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	h
	in 2020	is less than 30%	2	2	4	6	6	6	7	7	8	8	9	9	12	21	32	i
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	j
	in 2021	is less than 30%	1	1	4	7	8	8	9	10	11	12	13	15	21	37	54	k
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	2	7	l
Fishery Trend (TCEY)	in 2019	is less than 2018	<1	<1	7	33	38	43	49	55	60	64	68	71	78	89	97	m
		is 10% less than 2018	<1	<1	3	23	26	30	34	38	43	48	53	59	72	82	92	n
	in 2020	is less than 2018	<1	<1	10	38	43	49	54	59	63	67	70	73	79	91	98	o
		is 10% less than 2018	<1	<1	6	27	31	36	40	45	50	54	59	64	74	84	95	p
	in 2021	is less than 2018	<1	<1	14	44	50	55	59	63	67	69	72	74	81	93	>99	q
		is 10% less than 2018	<1	<1	9	34	38	43	48	52	56	60	63	67	75	86	99	r
Fishery Status (Fishing intensity)	in 2018	is above $F_{46\%}$	0	<1	4	29	33	38	43	50	54	60	64	69	77	87	95	s

Harvest decision table produced at the end of 2017.

Fishing intensity

The 2017 mortality from all sources corresponds to a point estimate of SPR= 40 percent (there is a 75 percent chance that fishing intensity exceeded the IPHC's reference level of 46 percent). In order to reach the interim reference level, catch limits would need to be reduced for 2018. The Commission does not currently have a coastwide limit fishing intensity reference point.

Stock status (spawning biomass)

Current female spawning biomass is estimated to be just above 200 million pounds (90,700 t), which corresponds to only a six percent chance of being below the IPHC threshold (trigger) reference point of SB30 percent, and less than a one percent chance of being below the IPHC limit reference point of SB20 percent. Therefore, no adjustment to the target fishing intensity is required, and the stock is not considered to be 'overfished'. Projections indicate that the target fishing intensity is likely to result in similar, but declining biomass levels in the near future.

A plant worker guides a brailer full of Pacific halibut during an offload in Kodiak, AK. Photo by Jamie Goen.

Stock distribution

Regional stock distribution has been stable within estimated credibility intervals over the last five years. Region 2 currently represents a greater proportion, and Region 3 a lesser proportion of the coastwide stock than observed in previous decades.

Regional stock distribution has been stable over the past five years, although from a historical perspective, Region 2 currently represents a greater proportion of the coastwide biomass and Region 3 a lesser proportion.

Future research in support of the stock assessment

The IPHC's stock assessment, Management Strategy Evaluation (MSE), and harvest strategy policy methods is ongoing, and responds to new developments in the data or analyses necessary each year. New approaches are tested, reported to the IPHC's SRB (generally in June), refined (and reviewed again in October, as needed), and ultimately incorporated in the development of the best scientific information available for the annual management process. Current technical research priorities include:

The Secretariat will continue to evaluate and refine the stock assessment process with the goal of maintaining consistency and coordination between MSE, stock sssessment data, modelling, and methodology.

1. Maintaining consistency and coordination between MSE, and stock assessment data, modelling, and methodology.

2. Continued refinement of the ensemble of models used in the stock assessment.

3. Continued development of weighting approaches for models included in the ensemble, potentially including fit to the survey index of abundance, retrospective, and predictive performance.

4. Exploration of methods for better including uncertainty in discard mortality and bycatch estimates in the assessment (now evaluated only via alternative catch tables or model sensitivity tests) in order to better include these sources uncertainty in the decision table.

5. Bayesian methods for fully integrating parameter uncertainty may provide improved uncertainty estimates within the models contributing to the assessment, and a more natural approach for combining the individual models in the ensemble.

Harvest strategy policy

Harvest strategy policy has a long history at the IPHC and many analyses and simulation studies have informed the development of past policies. The IPHC harvest strategy policy is the procedure that uses scientific and management procedures to determine the coastwide Total Constant Exploitation Yield (TCEY) across all Areas, as well as the TCEY and Fishery Constant Exploitation Yield (FCEY) for each Area.

At the 2017 Annual Meeting the Commission agreed to modify the policy by separating the scale (coastwide fishing intensity) and the distribution of fishing mortality. The first step in the modified sequence would be to set the coastwide fishing intensity (scale) on the coastwide stock by defining an acceptable level of fishing mortality based on Spawning Potential Ratio (SPR). Once the scale is determined, the coastwide TCEY can be determined and split into a TCEY for each Area. This second step is the distribution of catch. This separation of scale and distribution accounts for all mortality from all sources, and allows Commissioners to separate the decision of coastwide fishing intensity from distributing the TCEY.

At the 2017 Annual Meeting, the Commission agreed to separate the scale of fishing and the distribution of fishing mortality in the decision making process.

The interim harvest strategy policy (also referred to as the SPR-based harvest strategy) centers around a fishing mortality rate that corresponds to a SPR of 46 percent (a 54 percent reduction in the spawning potential). The SPR can be thought of as the percentage of spawning potential for a fish over its lifetime given a constant level of fishing. For example, a fish may have many chances to spawn without fishing, but that potential will be reduced with fishing. The interim SPR of 46 percent was based on status quo over the years 2014-2016, and is also called the reference SPR.

Management Strategy Evaluation

Management Strategy Evaluation (MSE) is a formal process in which to evaluate the performance of alternative management procedures for the Pacific halibut fishery against defined goals and objectives. Incorporating uncertainty about stock parameters and dynamics into the MSE can identify management procedures that are robust to those uncertainties. At the IPHC, the MSE process has been interactive, with a Management Strategy Advisory Board (MSAB) made up of stakeholders and managers involved in the resource, guiding the process. The MSAB will provide recommendations that are evaluated against objectives defined by all of the parties involved, and these recommendations are considered by Commissioners when developing a new harvest strategy policy.

MSAB work in the coming year will involve evaluating various fishing intensities.

Management Strategy Advisory Board (MSAB)

The MSAB met twice in 2017, and developed a five-year work plan, along with terms of reference and an outreach plan to better focus the group and communicate progress to stakeholders. The central role of the MSAB is to define fishery objectives, develop candidate management procedures, develop performance metrics, and measure the performance of various management strategies against the defined objectives.

The MSAB made progress on the investigation of the current harvest strategy policy, an examination of the realized decisions made over the last three years, and development of a revised harvest strategy policy to account for mortality of all sizes and from all sources (described above as an Spawning Potential Ratio SPR-based harvest policy). Work in 2018 will involve evaluating various fishing intensities to determine one that best meets the objectives defined by the MSAB.

Management Strategy Advisory Board meetings are held twice yearly at IPHC headquarters in Seattle, WA, U.S.A. Photo by Tom Kong.

RESEARCH

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of the Pacific halibut (*Hippoglossus stenolepis*). The main objectives of the Biological and Ecosystem Science Five-Year Research Plan at 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.

Traditionally, the IPHC Secretariat propose new projects annually that are designed to address key biological issues as well as the continuation of certain projects initiated in previous years. Proposals are based on staff input as well as input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC such as the Scientific Review Board (SRB) and the Research Advisory Board (RAB). Proposed research projects are presented to the Commissioners for feedback and subsequent approval. Importantly, biological research activities at IPHC are guided by a Five-Year Research Plan that is put forward by the Branch Head identifying key research areas that follow Commission objectives (Table 9).

Research at the IPHC is guided by a 5-year research plan that identifies key research areas that follow Commission objectives.

Table 9. A summary of the key research areas as described in the Five-Year Research Plan for the period 2017-21.

Key research areas	Description
Reproduction	Provide information on the sex ratio of the commercial catch and improve current estimates of maturity
Growth and Physiological Condition	Describe the role of some of the factors responsible for the observed changes in size-at-age over the past several decades and provide tools for measuring growth and physiological condition in Pacific halibut.
Discard Mortality and Survival	Provide updated estimates of discard mortality rates (DMRs) in both the longline and the trawl fisheries
Distribution and Migration	Advance further understanding of reproductive migration and identification of spawning times and locations as well as larval and juvenile dispersal.
Genetics and Genomics	Describe the genetic structure of the Pacific halibut population and provide the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences.

Research projects on these five main research areas are selected for their important management implications. In addition to these five research areas, IPHC is conducting environmental monitoring for oceanographic physical parameters and for contaminant and parasite presence in Pacific halibut. Data collection programs that are conducted by the IPHC from the fishery-independent setline survey and commercial fishery landings, are described earlier in this report.

Reproduction

Efforts at IPHC are currently underway to address two critical issues in stock assessment based on estimates of female spawning biomass: the sex ratio of the commercial catch and maturity estimations.

Sex ratio of the commercial catch

In the commercial fishery, Pacific halibut are eviscerated at sea and male and female fish cannot be distinguished at the processing plants in the ports, where biological data are collected by IPHC samplers. Therefore, the sex ratio of the commercial catch has not been determined to date, but having this information would be greatly beneficial to the stock assessment.

In 2017, almost 600 samples from 50 sex marked trips were collected.

In order to obtain accurate sex information, IPHC worked with commercial fishers to establish protocols for sex marking fish at sea on commercial vessels and also worked to genetically determine the sex by developing molecular assays using fin clip samples from offloaded fish. If protocols for sex marking at sea proved to be successful, genetic sex assays could then be used as a validation tool to determine the sex-marking accuracy.

In 2016, a developed sex-marking protocol, involving identifying females by cuts in the dorsal fin and males by a cut in the operculum, was implemented in a voluntary fashion in British Columbia. A total of 10 commercial vessels

IPHC sea sampler Kaitlin Johnson processes a Pacific halibut caught aboard the *F/V Pender Isle* during the IPHC fishery-independent setline survey. Photo by Jamie Goen.

The *F/V Kema Sue* ready to conduct IPHC research studies. Photo by Orion McCarthy.

participated in the study by sex marking a total of 325 Pacific halibut that were sampled for fin clips at the ports by IPHC port samplers. In parallel, work in collaboration with geneticists at the University of Washington resulted in the identification of three genetic markers that were associated with sex. Molecular assays were developed for two of the three markers and it was determined that each of the two had an accuracy of at least 97.5 percent when using samples originating from fish whose sex was identified. The two molecular assays were applied to the 325 fish that were marked at sea in 2016. By comparing the sex-related marking and genetic sex identification for each of these fish, it was determined that the accuracy of sex marking at sea in the 2016 project component was 79 percent.

In 2017, the sex marking project involved requesting voluntary participation coastwide from the commercial fleet. To date, approximately 47 vessels from the Alaskan fleet have participated in the project and the number of participating vessels from British Columbia is still undetermined. In total, approximately 591 samples from 50 marked trips have been collected coastwide.

Reproductive assessment of female and male Pacific halibut

Each year, the fishery-independent setline survey collects biological data on the maturity of female Pacific halibut that are used in the stock assessment. In particular, a female maturity schedule based on characteristics that can be identified through direct examination is used to estimate spawning stock biomass. Currently used estimates of maturity-at-age indicate that the age at which 50 percent of female Pacific halibut are sexually mature is 11.6 years on average. However, the current method using macroscopic visual criteria of the ovaries collected in the field to estimate maturity, results in a level of uncertainty. Furthermore, estimates of maturity-at-age have not been revised in recent years and may be outdated. For this reason, current research efforts are devoted to understanding reproductive development and maturity in female Pacific halibut.

A recently completed project provided a first description of the changes that take place in the ovary during reproductive development leading to spawning in Pacific halibut by comparing oocyte (egg) stages and characteristics between fish caught during the non-spawning season (summer) and the spawning season (winter) in three different known spawning areas including eastern Bering Sea, central Gulf of Alaska, and southern Gulf of Alaska.

The current macroscopic examination of gonads used on the FISS has a certain level of uncertainty associated with it. A project started in 2017 will validate those assessments.

In order to further characterize the gonadal maturation schedule, the IPHC is undertaking a full characterization of the annual reproductive cycle in female and male Pacific halibut. At monthly intervals, 30 each of female and male Pacific halibut are being captured from the Portlock region in the central Gulf of Alaska and a variety of samples are collected for physiological analyses of reproductive parameters. The results of this study will substantially improve the accuracy of current maturity staging techniques, in addition to updating current estimates of maturity-at-age. Overall, the current effort to engage in a comprehensive reproductive monitoring of the adult Pacific halibut population will result in improved estimates of the actual spawning biomass.

Growth and physiological condition

Part of IPHC research is aimed at developing tools for measuring growth and physiological condition in Pacific halibut.

Current studies in this research area are aimed at understanding the possible role of body growth variation in the observed changes in size-at-age (SAA), and at developing tools for measuring growth and physiological condition in Pacific halibut. In view of our limited knowledge on the underlying physiological basis of body growth and, importantly, on the possible contribution of growth alterations in driving changes in SAA, the IPHC is conducting studies to develop and apply tools to evaluate age-specific growth patterns and their response to environmental influences in Pacific halibut over space and time. The specific objectives of these studies are to investigate the effects of temperature, population density, social structure, and stress on biochemical and molecular indicators of body growth. In addition to significantly improving our understanding of the physiological mechanisms regulating growth, this study will identify molecular and biochemical growth signatures that could be used to monitor growth patterns in the Pacific halibut population.

Discard mortality and survival

Discard mortality rates in the directed longline fleet

In 2017, the IPHC conducted a field experiment investigating the relationship between Pacific halibut release practices, physiological condition, injury levels, and post-release survival in an effort to improve discard mortality rate estimates in the directed Pacific halibut longline fishery. Longline gear was deployed southeast of Chignik, AK, to collect Pacific halibut smaller than 84 cm (33 in), subject them to different hook-release techniques, measure physiological conditions, and tag a subsample of them to determine factors that affect discard mortality. Physiological parameters that will be measured from determinations and samples collected from these fish will include information on condition status at capture (condition index, lipid levels) and post-handling stress levels (blood stress hormones, metabolites, and ions). Electronic monitoring (EM) equipment was also deployed during the project to collect data on the accuracy of its ability to be used to identify release methods. Over two trips and 38 sets, 79 Pacific halibut were fitted with accelerometer pop-up archival transmitting (PAT) tags to assess near-term (96 days) survival, and 1,048 fish were wire tagged to investigate longer-term survival. Vitality (injury and condition) profiles by hook-release method will be developed as a proxy for discard mortality rates on EM trips.

Distribution and migration

Wire tagging to study migration of young Pacific halibut

In 2015, the IPHC began a long-term effort to wire-tag young Pacific halibut with the goal of providing data on juvenile Pacific halibut movement and growth. Migration information on adult Pacific halibut has been well documented in recent tagging studies, but less is known about juvenile Pacific halibut movement. This tagging effort began with a pilot study on the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) groundfish trawl surveys in 2015. Tagging has continued on the NOAA/NMFS trawl surveys and was expanded to the IPHC fishery-independent setline survey in 2016.

Pacific halibut are wire tagged on both the FISS and the NMFS trawl survey to better understand juvenile migration.

In 2017, a total of 3,396 small Pacific halibut (< 82 cm fork length or "U32") were tagged and released. Of this total, 1,927 U32 Pacific halibut were tagged during the IPHC setline survey and 1,469 U32 Pacific halibut were tagged and released during the NOAA/NMFS trawl survey. Tissue samples (fin clips) for genetic analyses were also collected from tagged fish.

This fish is wire tagged and ready to be released. Photo by Paul Logan.

Deployment and reporting of pop-up archival transmitting tags to study seasonal and interannual dispersal of Pacific halibut on Bowers Ridge (Area 4B)

The IPHC has conducted a series of PAT tag studies in the Bering Sea and Aleutian Islands (BSAI) region in order to identify winter spawning locations,

In 2017, a total of 22 Pacific halibut were tagged with PAT tags on Bowers Ridge in Area 4B.

determine the timing of seasonal movements, and investigate mixing within the BSAI and between the Bering Sea and Gulf of Alaska. However, neither PAT nor passive integrated transponder tagging has been conducted on Bowers Ridge (Area 4B) because this region has not been previously surveyed by the IPHC.

In 2017, IPHC took advantage of the setline survey expansion in order to generate data for this unstudied region that will complement prior work. From 5-10 July 2017, twenty-two Pacific halibut ranging from 115-170 cm (45-67 inches) fork length (FL) were tagged with Wildlife Computers miniPAT pop-up archival transmitting tags. Sixteen tags were programmed to detach from their host fish to report their location and download environmental data to passing Argos (Advanced research and global observation system) satellites during the 2017-18 spawning season, on 15 January 2018; six tags were programmed to detach and report after 365 days at liberty, in July of 2018. In addition to determining the length of the tagged Pacific halibut, blood samples were obtained for future analysis of plasma hormone levels that might be predictive of individual migratory behavior, and ultrasound was employed to determine sex and the likelihood that tagged females (13 fish) were mature.

Evaluating Pacific halibut larval connectivity between the Gulf of Alaska and Bering Sea

While a larval Pacific halibut can somewhat control its position vertically in the water column within a few weeks after hatch, horizontal distribution of larvae is largely determined by the currents that are accessed as well as the strength and direction of those currents. Tagging studies show that there is connectivity of demersal-stage Pacific halibut between the Gulf of Alaska (GOA) and Bering Sea by way of actively migrating fish through Aleutian Island passes. While currents could feasibly carry larvae through any of the Aleutian Island passes, this study focuses on inter-basin connectivity via Unimak Pass, which is the main connection between the GOA and the Bering Sea continental shelves.

The IPHC, in collaboration with NOAA/Eco-FOCI is currently working to achieve a number of objectives related to Pacific halibut early life history. These include: 1) update and redefine the understanding of larval distribution in the GOA and Bering Sea, 2) investigate the likelihood and magnitude of larval connectivity between the GOA and the Bering Sea, 3) identify possible environmental factors that influence larval year class strength, organism size, degree of connectivity between basins, and recruitment to demersal stages, and 4) define parameters for the oceanographic transport modeling phase of the project.

Genetics and genomics

Sequencing of the Pacific halibut genome

One of the most important biological resources for a fish species with high socio-economic importance and a fascinating life history such as the Pacific halibut is the sequenced genome. Through the genome comes an understanding of the genetic basis of biological processes such as growth or reproduction as well as the genetic and evolutionary changes in Pacific halibut that occur in response to environmental and fisheries-related influences. The IPHC has begun to generate a first draft of the genome of the Pacific halibut.

Environmental monitoring

Oceanographic monitoring

This year was the ninth consecutive year of the IPHC coastwide oceanographic data collection program whereby water column profiles are attempted at each fishery-independent setline survey station. Oceanographic data are collected using water column profilers manufactured by Seabird Scientific that collect pressure (depth), conductivity (salinity), temperature, dissolved oxygen, pH, and fluorescence (chlorophyll concentration) throughout the water column. The survey area extends from southern Oregon in the U.S.A. to British

IPHC sea samplers Nathan Willse and Peter Jankiewicz with an oceanographic profiler. Photo credit: Peter Jankiewicz.

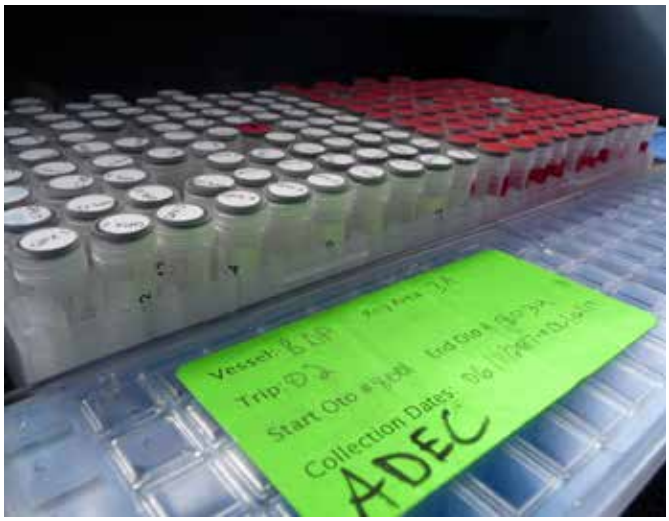
The coastwide profiler program to collect environmental data completed its ninth consecutive year in 2017.

Columbia, Canada, and into the Gulf of Alaska, Bering Sea, and Aleutian Islands. Oceanographic data were successfully collected by 12 vessels with a total of 1,281 stations out of a possible 1,420 completed successfully in 2017. The coldest near-bottom water (-0.82° C) was detected around St. Matthew Island in the Bering Sea. The warmest near-bottom water (13.85° C) was found at a shallow station off of southern Oregon. For the first time in several years, profiler data indicated a severe hypoxic zone off of the Washington coast with near-bottom dissolved oxygen levels measured as low as 0.069 ml/L.

Contaminant and parasite monitoring of Pacific halibut

The IPHC has been working cooperatively with the Alaska Department of Environmental Conservation (ADEC) to investigate the presence of heavy metals (arsenic, selenium, lead, cadmium, nickel, mercury, and chromium) and persistent organic pollutants (POPs) in Pacific halibut caught in Alaskan waters

The IPHC works with ADEC to monitor environmental contaminants in Pacific halibut.



The IPHC works cooperatively with ADEC to collect tissue saples during the IPHC fishery-independ3nt setline survey. Photo by Jason Taylor.

since 2002. In 2017, eighty-five samples from a variety of sizes were collected in the Bowers Ridge/Amchitka setline survey region (20 P, 20 S, 20 M, 5 XL), 60 samples were collected in the Gore Pt. charter region (15 P, 19 S, 20 M, 6 L), and 83 samples were collected in the Unalaska charter region (20 P, 20 S, 20 M, 20 L, 3 XL). Samples will be tested for a broad suite of environmental contaminants, including organochlorine pesticides, dioxins, furans, polybrominated diphenyl ethers, polychlorinated biphenyl congeners, methyl mercury, and heavy metals. Additional small muscle and liver tissue samples were collected to be examined for genetic expression of genes that are responsive to contaminant load. Continued collaborative work with ADEC is anticipated.

In 2017, the IPHC continued investigating *Ichthyophonus* incidence in Pacific halibut. *Ichthyophonus* is a protozoan parasite from the class Mesomycetozoea, a highly diverse group of organisms with characteristics of both animals and fungi, which has been identified in many marine fish. The project resampled the three geographically distinct areas (Oregon, Prince William Sound, and 4D Edge (Bering Sea) setline survey charter regions) that have been sampled since 2011, to investigate temporal stability of *Ichthyophonus* prevalence. Prevalence in these samples was similar to previous years with Prince William Sound being much higher than the other areas. Genetic and histology results for these samples are still pending.

LOOKING FORWARD

This section summarizes the main decisions made at the 94th Session of the IPHC Annual Meeting, held in January 2018 , and are based on data collected and analyses done in 2017. For a full accounting of documents provided to the Commission during the meeting, and the complete report of the meeting, visit the IPHC webpage: https://www.iphc.int/venues/details/94th-session-of-the-iphc-annual-meeting-am094.

Catch limits

Due to the lack of agreement on catch limits for 2018, the Commission agreed that the status quo catch limits set for the 2017 fishing periods will apply for 2018, until such a time as the Contracting Parties apply more restrictive measures as permitted in the IPHC Convention. In accordance with the IPHC Convention, the two Contracting Parties may implement more restrictive limits in their areas, and at the time of publication of this report, both governments were pursuing reduced catch limits within their domestic fishery management processes.

At the time of publication of this report, both the Canadian and U.S.A. domestic governments were pursuing reduced catch limits within their jurisdictions for the 2018 fishery.

Catch sharing plans

IPHC Regulatory Area 2A

The Pacific Fishery Management Council's (PFMC) Catch Sharing Plan (CSP) for Regulatory Area 2A, which allocates catch among various fishery sectors, was noted by the Commission.

IPHC Regulatory Area 2B

Fisheries and Oceans Canada (DFO) will allocate the Regulatory Area 2B catch limit between commercial and sport fisheries.

IPHC Regulatory Areas 2C and 3A

The North Pacific Fishery Management Council's (NPFMC) CSP for Regulatory Areas 2C and 3A was noted by the Commission. This CSP sets the allocation between the commercial and charter sport sectors and allows for the specification of charter management measures in those two Regulatory Areas.

IPHC Regulatory Area 4CDE

The IPHC sets a combined catch limit for Regulatory Area 4CDE. The individual catch limits for Areas 4C, 4D, and 4E reflect the 4CDE CSP adopted by the NPFMC and noted by the Commission. The CSP also allows Area 4D Community Development Quota (CDQ) harvest to be taken in Area 4E, and Area 4C Individual Fishing Quota (IFQ) and CDQ to be fished in Areas 4D and 4C.

Fishing periods (season dates)

The Commission approved a fishing period of 24 March to 7 November 2018, for the Canada and United States of America quota fisheries. The fishing period will commence at noon local time on 24 March and terminate at noon local time on 7 November 2018 for the following fisheries and areas: the Canadian Individual Vessel Quota (IVQ) fishery in Regulatory Area 2B, and the United States IFQ and CDQ fisheries in Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E. All Regulatory Area 2A commercial fishing, including the treaty Indian commercial fishery, will take place between 24 March and 7 November 2018.

In Regulatory Area 2A, seven 10-hour fishing periods for the non-treaty directed commercial fishery south of Point Chehalis, Washington, were recommended: 27 June, 11 July, 25 July, 8 August, 22 August, 5 September, and 19 September 2018. All fishing periods will begin at 08:00 hrs and end at 18:00 hrs local time, and will be further restricted by fishing period limits announced at a later date.

The fishing season for IQ fisheries in both Canada and the U.S.A. is set to commence on 24 March 2017.

Regulatory Area 2A fishing dates for incidental commercial Pacific halibut fisheries concurrent with the limited-entry sablefish fishery north of Point Chehalis and the salmon troll fishing seasons will be established under U.S. domestic regulations by the National Marine Fisheries Service (NMFS). The remainder of the Regulatory Area 2A CSP, including sport fishing seasons and depth restrictions, will be determined under regulations promulgated by NMFS.

Regulatory changes

In addition to the adoption of several wording changes to clarify existing regulations, the Commission adopted a measure that allows the use of leased IFQ by CDQ organizations in IPHC Regulatory Areas 4B, 4C, 4D, and 4E.

Other actions

The Commission recommended that the draft goals, objectives, and performance metrics of the Harvest Strategy Policy and procedure be used for ongoing evaluation in the Management Strategy Evaluation (MSE) process. The objectives should be evaluated in a hierarchical manner, with conservation as the first priority. In addition, the Commission recommended that the IPHC Secretariat consider the fishery-independent setline survey weight-per-unit-effort grid across the fishery as well as other biological factors (e.g. habitat configuration, size distribution in the region, etc.) and provide alternatives to the current management areas (e.g. biological regions), and that the Management Strategy Advisory Board (MSAB) consider additional ways to incorporate biological information into Total Constant Exploitation Yield (TCEY) distribution procedures. Long- and mid-term performance metrics for conservation objectives should be considered in the MSE process for conservation objectives, and short-term metrics should be included for fishery-related objectives in the MSE process, via the MSAB.

In addition, the Commission requested that the proposed TCEY distribution methodology of the Harvest Strategy Policy reflect an understanding of both stock distribution and fishery management distribution procedures.

Expanded fishery-independent setline survey (FISS)

The Commission approved the next in a series of expansions to its annual fishery-independent setline survey. The purpose of the expansion series is to provide more accurate and precise estimates among Regulatory Areas and to encompass all depths over which the stock is distributed. In 2018, the Commission's setline survey in Regulatory Areas 2A, 2B, and 2C will be expanded.

Upcoming meetings

The Commission's 2018 Interim Meeting will be held 27-28 November 2018, in Seattle, WA, U.S.A. The 95th Session of the IPHC Annual Meeting (AM095) will take place 28 January - 1 February 2019 in Victoria, B.C., Canada. The 96th Annual Meeting (AM096) is tentatively planned for 27-31 January 2020 in Sitka, AK, U.S.A.

The 2019 Annual Meeting is scheduled to take place in Victoria, B.C., Canada.

Commission officers

Canadian Commissioner Mr. Paul Ryall was elected Chairperson for the 2018 Annual Meeting. Commissioner Dr. James Balsiger of the United States of America was elected Vice-Chairperson for 2018. The other Canadian Commissioners are Mr. Jake Vanderheide, and Mr. Ted Assu. The other U.S.A. Commissioners are Mr. Robert Alverson and Ms. Linda Behnken.

Secretariat staff update

The research and programs highlighted in this report account for the majority of IPHC Secretariat staff time. However, there is also 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 committees outside of the IPHC, and seeking further education and training. This section highlights some of those activities.

Committees and organization appointments

- NPFMC Bering Sea Fishery Ecosystem Plan Team - Ian Stewart
- 19th Western Groundfish Conference Organizing Committee - Claude Dykstra, Ed Henry
- NPFMC abundance based management working group - Allan Hicks
- 10th International Flatfish Symposium steering committee - Tim Loher
- NPFMC Scientific and Statistical Committee - Ian Stewart
- External reviewer for IATTC North Pacific albacore stock assessment - Allan Hicks
- NPFMC BSAI groundfish plan team - Allan Hicks
- Editorial activities as Board Member of the following peer-reviewed journals: PLoS One, Scientific Reports, Frontiers in Physiology-Aquatic Physiology, Fishes, Reproductive Biology, and Endocrinology - Josep Planas

IPHC Secretariat staff at the Interbay office facility in Seattle, WA, U.S.A. Staff are listed here along with their associated branch: Back row (from left): Tim Loher (BES), Jay Walker (ITDS), Kelly Chapman (AD), Aaron Ranta (ITDS), Josep Planas (BES), Lauri Sadorus (BES), Jamie Goen (FSS), Raymond Webster (QS), Joan Forsberg (BES), Lara Erikson (FSS). Second row (from left): Jason Taylor (FSS), Afshin Taheri (ITDS), Collin Winkowski (FSS), Eric Soderlund (FSS), Chris Johnston (BES), Claude Dykstra (BES), Ian Stewart (QS), Ed Henry (FSS), Allan Hicks (QS), Michael Larsen (AD), Steven Keith (Assistant Director), Keith Jernigan (ITDS). Front row (from left): Tamara Briggie (AD), Dana Rudy (BES), David Wilson (Executive Director), Huyen Tran (FSS), Aregash Tesfatsion (FSS), Thomas Kong (FSS), Tracee Geernaert (FSS), Robert Tobin (BES). Branch key: AD = Administrative Services, BES = Biological and Ecosystem Sciences, FSS = Fisheries Statistics and Services, ITDS = Information Technology and Database Services, QS = Quantitative Sciences.

Conferences, meetings, and workshops

- Committee of Age Reading Experts workshop, Seattle, WA - Joan Forsberg, Chris Johnston, Dana Rudy, Robert Tobin
- American Fisheries Society meeting, Tampa, FL - Allan Hicks
- 10th International Flatfish Symposium, St. Malo, France - Lauri Sadorus, Josep Planas, Tim Loher
- Wakefield Fisheries Symposium, Anchorage, AK - Ray Webster, Josep Planas

Outreach and education

- Booth at Pacific Marine Expo, Seattle, WA - Chris Johnston, Steve Keith, Eric Soderlund, Joan Forsberg, Kelly McElligot, Dana Rudy, Claude Dykstra, David Wilson
- Booth at Fishermen's Fall Festival, Seattle, WA - Dana Rudy, Lara Erikson, Tracee Geernaert, Steve Keith, Jamie Goen, Kelly McElligot
- Booth at Pacific Northwest Sportsmen's Show, Portland, OR - Claude Dykstra, Ian Stewart, David Wilson, Steve Keith
- BC Boat and Sportsmen's Show, Abbotsford, BC - Tracee Geerneart, Dana Rudy, Claude Dykstra
- Invited plenary speaker, American Fisheries Society chapter meeting, Fairbanks, AK - Ian Stewart
- UW guest speaker on U.S. Policy, Seattle, WA - Jamie Goen
- Invited presenter at Pacific Biological Station/DFO, Nanaimo, BC - Josep Planas
- Affiliate faculty, University of Washington, Seatte, WA - Ian Stewart
- Affiliate faculty, Alaska Pacific University, Anchorage, AK - Josep Planas
- Part-time statistics lecturer, University of Washington, Seattle, WA - Ray Webster
- Graduate jury member, University of Porto CIIMAR, Portugal - Tim Loher
- Graduate student committee member, University of Washington School of Aquatic and Fishery Sciences, Seattle, WA - Ian Stewart
- Graduate student committee member, University of Alaska College of Fisheries and Ocean Sciences, Anchorage, AK - Tim Loher
- Acoustic tagging consultant for MyTag Project, FCT-Portugal - Tim Loher
- STEM ambassador for Edmonds School District, Edmonds, WA - Lauri Sadorus

Thank You

The Commissioners and Secretariat wish to thank all of the agencies, industry, and individuals who helped us in our scientific investigations this year. A special thank you goes to the following:

- Personnel in the many processing plants who assist the IPHC port sampling and survey programs by storing and staging equipment and supplies.
- The Bering Sea and Gulf of Alaska NOAA/NMFS/RACE division groups for saving us a spot on their groundfish surveys and for tagging Pacific halibut for us on the Bering Sea survey vessel not staffed by an IPHC sampler.
- The NOAA National Marine Mammal Laboratory and the Central Bering Sea Fishermen's Association for providing us space at their St. Paul residences when our field biologists are in town.
- Jamestown S'Klallam, Lummi, Makah, Port Gamble S'Klallam, Quinault, Quileute, and Swinomish biologists for port sampling Area 2A tribal commercial fisheries.
- CDQ managers for providing the total number and weight of undersized halibut taken and retained by authorized persons and the methodology used to collect these data.
- The NMFS Observer Program for deploying observers on the Area 2A directed commercial fishery, and for collecting, documenting, and forwarding tags recovered during observer deployments on commercial vessels.
- The staffs of the PFMC and NPFMC for their ongoing coordination with IPHC.
- Fisheries and Oceans Canada staff for their ongoing coordination, in particular with electronic logbooks and with survey operations given protected habitats and species.
- State and federal agency staffs, as well as government contractors for their assistance in the provision of data for recreational and subsistence fisheries, commercial fisheries, as well as the provision of halibut bycatch estimates, and for their assistance in conducting the fishery-independent setline survey.
- The skippers and crews of vessels who voluntarily conducted at-sea sex marking in support of the IPHC's research to better understand the sex ratio of the commercial catch.
- The skippers, crews, and plant personnel, as well as those individuals from outside agencies, whose dedicated contributions and efforts make the IPHC operations a success.

PUBLICATIONS

The IPHC publishes three serial publications - Annual reports, Scientific reports, and Technical Reports - and also prepares and distributes regulation pamphlets and information bulletins. Articles and reports produced during 2017 by the Commission and Secretariat staff are shown below and a list of all Commission publications is shown on the following pages. All reports published by IPHC are available through the online documents library at https://iphc.int/library/documents.

2017 research publications

International Pacific Halibut Commission. 2017. Annual Report 2016. 84 p.

Drinan, D. P., Loher, T., and Hauser, L. 2017. Identification of genomic regions associated with sex in Pacific halibut. Journal of Heredity (online). doi: 10.1093/jhered/esx102

Fisher, J. A. D., Robert, D., Le Bris, A., and Loher, T. 2017. Pop-up satellite archival tag (PSAT) temporal data resolution affects interpretations of spawning behavior and vertical habitat use. Animal Biotelemetry 5:27. doi: 10.1186/s40317-017-0137-8

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Murphy, H. M., Fisher, J. A. D., Le Bris, A., Desgagnés, M., Castonguay, M., Loher, T., and Robert, D. 2017. Pop-up satellite tags provide the first characterizations of depth distributions, temperature associations, and seasonal migrations of Atlantic halibut in the Gulf of St. Lawrence. Marine and Coastal Fisheries 9(1):341-346. doi: 10.1080/19425120.2017.1327905

Seitz, A. C., Loher, T., Farrugia, T. J., Norcross, B. L., and Nielsen, J. L. 2017. Basin-scale reproductive segregation of Pacific halibut (Hippoglossus stenolepis). Fisheries Management and Ecology 24:339-346. doi: 10.1111/fme.12233

Stewart, I. J. and Monnahan, C. C. 2017. Implications of process error in selectivity for approaches to weighting compositional data in fisheries stock assessments. Fisheries Research. 192:126-134.

IPHC Publications 1930-2017

Reports

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2. Life history of the Pacific halibut. Marking experiments. William F. Thompson and William C. Herrington. 137 p. (1930).
3. Determination of the chlorinity of ocean waters. Thomas G. Thompson and Richard Van Cleve. 14 p. (1930).
4. Hydrographic sections and calculated currents in the Gulf of Alaska, 1927 and 1928. George F. McEwen, Thomas G. Thompson, and Richard Van Cleve. 36 p. (1930).
5. History of the Pacific halibut fishery. William F. Thompson and Norman L. Freeman. 61 p. (1930).
6. Biological statistics of the Pacific halibut fishery. Changes in the yield of a standardized unit of gear. William F. Thompson, Harry A. Dunlop, and F. Heward Bell. 108 p. (1930). [Out of print]
7. Investigations of the International Fisheries Commission to December 1930, and their bearing on the regulation of the Pacific halibut fishery. John Pease Babcock, William A. Found, Miller Freeman, and Henry O'Malley. 29 p. (1930). [Out of print]
8. Biological statistics of the Pacific halibut fishery, Effects of changes in intensity upon total yield and yield per unit of gear. William F. Thompson and F. Heward Bell. 49 p. (1934). [Out of print]
9. Life history of the Pacific halibut - Distribution and early life history. William F. Thompson and Richard Van Cleve. 184 p. (1936). [Out of print]
10. Hydrographic sections and calculated currents in the Gulf of Alaska. 1929. Thomas G. Thompson, George F. McEwen, and Richard Van Cleve. 32 p. (1936).
11. Variations in the meristic characters of flounder from the northeastern Pacific. Lawrence D. Townsend. 24 p. (1936).
12. Theory of the effect of fishing on the stock of halibut. William F. Thompson. 22 p. (1937).
13. Regulation and investigation of the Pacific halibut fishery in 1947 (Annual Report). IFC. 30 p. (1948).
14. Regulation and investigation of the Pacific halibut fishery in 1948 (Annual Report). IFC. 30 p. (1949).
15. Regulation and investigation of the Pacific halibut fishery in 1949 (Annual Report). IFC. 24 p. (1951).
16. Regulation and investigation of the Pacific halibut fishery in 1950 (Annual Report). IFC. 16 p. (1951).
17. Pacific Coast halibut landings 1888 to 1950 and catch according to areas of origin. F. Heward Bell, Henry A. Dunlop, and Norman L. Freeman. 47 p. (1952).
18. Regulation and investigation of the Pacific halibut fishery in 1951 (Annual Report). Edward W. Allen, George R. Clark, Milton C. James, and George W. Nickerson. 29 p. (1952).
19. The production of halibut eggs on the Cape St. James spawning bank off the coast of British Columbia 1935-1946. Richard Van Cleve and Allyn H. Seymour. 44 p. (1953).
20. Regulation and investigation of the Pacific halibut fishery in 1952 (Annual Report). Edward W. Allen, George R. Clark, Milton C. James, George W. Nickerson, and Seton H. Thompson. 29 p. (1953).
21. Regulation and investigation of the Pacific halibut fishery in 1953 (Annual report). IPHC. 22 p. (1954).
22. Regulation and investigation of the Pacific halibut fishery in 1954 (Annual Report). IPHC. 32 p. (1955).
23. The incidental capture of halibut by various types of fishing gear. F. Heward Bell. 48 p. (1955).
24. Regulation and investigation of the Pacific halibut fishery in 1955 (Annual Report). IPHC 15 p. (1956).

25. Regulation and investigation of the Pacific halibut fishery in 1956 (Annual Report). IPHC. 27 p. (1957).
26. Regulation and investigation of the Pacific halibut fishery in 1957 (Annual report). IPHC. 16 p. (1958).
27. Regulation and investigation of the Pacific halibut fishery in 1958 (Annual Report). IPHC. 21 p. (1959).
28. Utilization of Pacific halibut stocks: Yield per recruitment. IPHC Staff. 52 p. (1960).
29. Regulation and investigation of the Pacific halibut fishery in 1959 (Annual Report). IPHC. 17 p. (1960).
30. Regulation and investigation of the Pacific halibut fishery in 1960 (Annual Report). IPHC. 24 p. (1961).
31. Utilization of Pacific halibut stocks: Estimation of maximum sustainable yield, 1960. Douglas G. Chapman, Richard J. Myhre, and G. Morris Soutward, 35 p. (1962).
32. Regulation and investigation of the Pacific halibut fishery in 1961 (Annual Report). IPHC. 23 p. (1962).
33. Regulation and investigation of the Pacific halibut fishery in 1962 (Annual Report). IPHC. 27 p. (1963).
34. Regulation and investigation of the Pacific halibut fishery in 1963 (Annual Report). IPHC. 24 p. (1964).
35. Investigation, utilization and regulation of the halibut in southeastern Bering Sea. Henry A. Dunlop, F. Heward Bell, Richard J. Myhre, William H. Hardman, and G. Morris Soutward. 72 p. (1964).
36. Catch records of a trawl survey conducted by the International Pacific Halibut Commission between Unimak Pass and Cape Spencer, Alaska from May 1961 to April 1963. IPHC. 524 p. (1964).
37. Sampling the commercial catch and use of calculated lengths in stock composition studies of Pacific halibut. William H. Hardman and G. Morris Southward, 32 p. (1965).
38. Regulation and investigation of the Pacific halibut fishery in 1964 (Annual Report). IPHC 18 p. (1965).
39. Utilization of Pacific halibut stocks: Study of Bertalanffy's growth equation. G. Morris Southward and Douglas G. Chapman. 33 p. (1965).
40. Regulation and investigation of the Pacific halibut fishery in 1965 (Annual Report). IPHC. 23 p. (1966).
41. Loss of tags from Pacific halibut as determined by double-tag experiments. Richard J. Myhre. 31 p. (1966).
42. Mortality estimates from tagging experiments on Pacific halibut. Richard J. Myhre. 43 p. (1967).
43. Growth of Pacific halibut. G. Morris Southward. 40 p. (1967).
44. Regulation and investigation of the Pacific halibut fishery in 1966 (Annual Report). IPHC 24 p. (1967).
45. The halibut fishery, Shumagin Islands westward not including Bering Sea. F. Heward Bell. 34 p. (1967).
46. Regulation and investigation of the Pacific halibut fishery in 1967 (Annual Report). IPHC. 23 p. (1968).
47. A simulation of management strategies in the Pacific halibut fishery. G. Morris Southward. 70 p. (1968).
48. The halibut fishery south of Willapa Bay, Washington. F. Heward Bell and E.A. Best. 36 p. (1968).
49. Regulation and investigation of the Pacific halibut fishery in 1968 (Annual report). IPHC. 19 p. (1969).
50. Agreements, conventions and treaties between Canada and the United States of America with respect to the Pacific halibut fishery. F. Heward Bell. 102 p. (1969). [Out of print]
51. Gear selection and Pacific halibut. Richard J. Myhre. 35 p. (1969).
52. Viability of tagged Pacific halibut. Gordon J. Peltonen. 25 p. (1969).

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53. Effects of domestic trawling on the halibut stocks of British Columbia. Stephen H. Hoag. 18 p. (1971).
54. A reassessment of effort in the halibut fishery. Bernard E. Skud. 11 p. (1972).
55. Minimum size and optimum age of entry for Pacific halibut. Richard J. Myhre. 15 p. (1974).
56. Revised estimates of halibut abundance and the Thompson-Burkenroad debate. Bernard Einar Skud. 36 p. (1975).
57. Survival of halibut released after capture by trawls. Stephen H. Hoag. 18 p. (1975).
58. Sampling of landings of halibut for age composition. G. Morris Southward. 31 p. (1976).
59. Jurisdictional and administrative limitations affecting management of the halibut fishery. Bernard Einar Skud. 24 p. (1976).
60. The incidental catch of halibut by foreign trawlers. Stephen H. Hoag and Robert R. French. 24 p. (1976).
61. The effect of trawling on the setline fishery for halibut. Stephen H. Hoag. 20 p. (1976).
62. Distribution and abundance of juvenile halibut in the southeastern Bering Sea. E.A. Best. 23 p. (1977).
63. Drift, migration, and intermingling of Pacific halibut stocks. Bernard Einar Skud. 42 p. (1977).

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Children's book

Pacific Halibut Flat or Fiction? Lauri Sadorus and Birgit Soderlund (*illustrator*). 24 p. (2005). This is a full-color, non-fiction children's book. Hardcopies are available free of charge in limited quantities upon request and a downloadable pdf is available on the IPHC website (https://iphc.int/the-commission/outreach-and-education).

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These reports provide summaries of Commission and Secretariat staff research and activities as well as the state of the fishery, and have been produced annually since 1969. Reports are available on the IPHC website. Limited quantities of the most current reports in hard copy may be available upon request.

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