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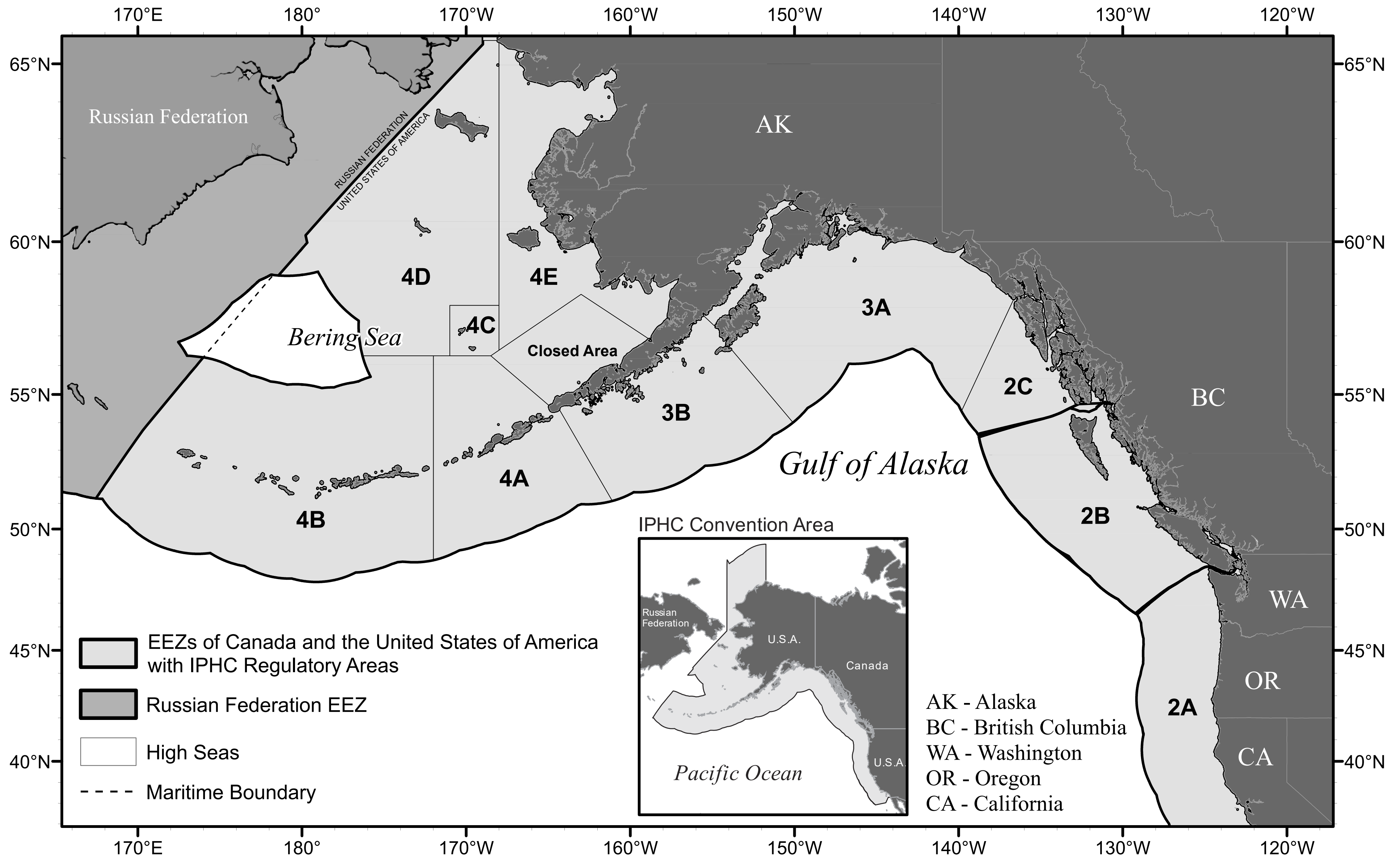
INTERNATIONAL PACIFIC HALIBUT COMMISSION

ANNUAL REPORT 2020



IPHC Regulatory Areas

ISSN: 0074-7238

INTERNATIONAL PACIFIC HALIBUT COMMISSION

ANNUAL REPORT
2020

INTERNATIONAL PACIFIC

HALIBUT COMMISSION

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Bibliography entry

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Preface

The International Pacific Halibut Commission (IPHC) was established in 1923 by a Convention between Canada and the United States of America. 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.

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

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 personnel at the Secretariat. The scientific Secretariat collects and analyzes the statistical and biological data needed to inform the management of the Pacific halibut stock within Convention waters. The IPHC Secretariat headquarters is 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 stakeholders. The measures adopted by the Commission are recommended to the two governments for approval and implementation. Upon approval the regulations are published in the Canada Gazette and U.S. Federal Register and are enforced by the appropriate agencies of both governments.

Our shared vision is to deliver positive economic, environmental, and social outcomes for the Pacific halibut resource for Canada and the U.S.A. through the application of rigorous science, innovation, and the implementation of international best practice.

Data in this report have been updated using all information received by the IPHC through 31 December 2020 and reported at the 97th Session of the IPHC Annual Meeting in 2021. Some data may have been subsequently updated and readers are encouraged to access the IPHC website for the latest information: https://www.iphc.int/. Unless otherwise indicated, all weights in this report are net weight (eviscerated, head-off, no ice and slime). Round (whole) weight may be calculated by dividing the net weight by 0.75.

On the Cover

The photograph on the cover of this report features Fisheries Data Specialist Kimberly Sawyer Van Vleck sampling a commercial offload from the *F/V Polaris*. The picture was taken in Bellingham, WA, U.S.A. in September 2020 by Fisheries Statistics and Services Branch Manager Lara Erikson.

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

To say that 2020 was a unique and challenging year for the Commission, would be a huge understatement, though I feel we faired the storm that was 2020 better than most. Our thoughts remain with those who were less fortunate than ourselves.

Throughout 2020, the IPHC Secretariat has continued to make progress in enhancing our scientific processes and the communication of scientific advice emanating from our core functions as a Secretariat serving the Commission. This has continued to occur in tandem with an evaluation of the supporting governance procedures of the organisation, 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.

Despite the difficulties and constraints of operating within a pandemic, we successfully completed our 2020 Fishery-Independent Setline Survey (FISS). We estimated that approximately 70% of the standing stock biomass of Pacific halibut in the Convention Area was sampled, which placed the 2020 FISS on a similar level or higher than many previous years. Over the core of the stock distribution, sampling in 2020 produced the most data-rich setline-survey in the IPHC's history. Despite planned gaps in coverage at the northern and southern ends of the distribution, the 2020 FISS produced a precise and reliable index of the Pacific halibut stock, providing the primary source of biomass trend information for the 2020 stock assessment and the basis for the 2021 management decision making processes. The intention is to sample the areas not sampled in 2020, over the coming years to maintain precision.

Executive Director Dr. David Wilson and Fisheries Data Specialist Binget Nilsson on the docks in Seward, AK, U.S.A. during a non-pandemic year. Photo by Lara Erikson.

We are thankful that all of the IPHC Setline Survey Specialists (field) returned home, having undergone quarantine, with no health concerns or COVID-19 interactions among staff or crew. This was largely due to the rigorous COVID-19 mitigation procedures put in place prior to the season and active compliance throughout the year. Similarly, we are very appreciative of our Fisheries Data Specialists (field) operating in ports coast-wide, who were equally operating under trying conditions, and succeeded.

From a fishery perspective, the 2021 TCEY (39.0 million pounds; 17,690 t) represented a modest increase over that set for 2020 (36.6 million pounds; 16,602 t). This increase represents a slight increase in the scale of the biomass estimated in the 2020 stock assessment, as well as an increase in the reference level of fishing intensity to $F_{43\%}$ (the level of fishing that is estimated to reduce the lifetime reproductive potential per fish to 43% of that in the absence of fishing mortality) from the previous reference level of $F_{46\%}$. This change to the reference level was extensively reviewed through the Management Strategy Evaluation process and found to best meet Commission objectives for avoiding biomass levels associated with conservation concern while still optimizing fishery yield and minimising fishery variability. Primary stock abundance indices continue to show little change at the coastwide level: the FISS numbers-per-unit-effort were down 2% from 2019, weight-per-unit-effort (WPUE) was up 2%, and the directed longline fishery WPUE was unchanged from 2019.

However, the 2020 stock assessment (consistent with all recent assessments) estimated that the spawning biomass has been declining slowly since 2016, and that this decline will continue with a very high probability (65%) at current fishing mortality levels. This projected decrease is primarily due to low recruitments from 2006-10, and the Commission has opted to continue fishing the stock at the reference level as these year-classes grow toward maturity. Recent year classes in 2011-12, estimated to be the largest since 2005 are not expected to mature until 2022-24 and surplus production in 2021-23 was estimated to be only 24.4 million pounds; 11,068 t). This means that for all TCEYs greater than the surplus production we should expect that female spawning biomass will decrease with a high probability in the coming years.

We started the year with the female spawning biomass estimated to be at 34% (24-51%) of the level expected in the absence of fishing, and at the beginning of 2021 this estimate was 33% (22–52%). Such a level of relative biomass is widely considered to be close to 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. For Pacific halibut, simulations have indicated that $SB_{30\%}$ is a reasonable proxy for SB_{MSY} (the spawning biomass that produces the maximum fishery yield), and $SB_{36\%}$ is likely near SB_{MEY} (the biomass that produces the maximum economic yield).

Rest assured, the IPHC Secretariat 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 fisheries.

I look forward to engaging with all of you over the coming year, either through the Commission's subsidiary bodies, or in person (once the pandemic has eased sufficiently) 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 Commission is composed of six members (Commissioners), and meets several times a year, in both formal and informal capacities, to consider matters relevant to the Pacific halibut stock, the fisheries, and governance. All meeting documents, presentations, and reports are posted on the IPHC website (https://www.iphc.int).

96th Session of the IPHC Annual Meeting (AM096; 2020)

The IPHC recommended a mortality limit for 2020 of 16,601 t (36.60 Mlbs).

The 96th Session of the IPHC Annual Meeting (AM096) was held in Anchorage, AK, U.S.A., from 3 to 7 February 2020. For AM096, Mr. Chris Oliver of the United States of America presided as Chairperson and Mr. Paul Ryall of Canada presided as Vice-Chairperson. The Commission heard reports from the IPHC Secretariat about the status of the Pacific halibut (*Hippoglossus stenolepis)* population, reviewed finance and administration, discussed stakeholder concerns, considered the suggestions of its subsidiary bodies, and solicited public comment before adopting fishery regulations and making other decisions.

Mortality and fishery limits, and fishing periods for 2020

The Commission recommended to the governments of Canada and the United States of America a total mortality limit for 2020 of 16,601 tonnes (36.60 million pounds) net weight[1], and adopted the mortality limits for each IPHC Regulatory Area as described in Table 1.

[1] Note that all weight values in this section are expressed in terms of net weight, meaning the weight of Pacific halibut that is without gills and entrails, head-off, washed, and without ice and slime.

Commissioners hear presentations by the Secretariat at the 2020 Annual Meeting in Anchorage, AK, U.S.A.. Photo by Ed Henry.

Table 1. Adopted mortality limits (net weight) from AM096.

IPHC Regulatory Area	Mortality limit (TCEY) (tonnes)	Mortality limit (TCEY) (Mlbs)
2A	748	1.65
2B	3,098	6.83
2C	2,654	5.85
3A	5,534	12.20
3B	1,415	3.12
4A	794	1.75
4B	594	1.31
4CDE	1,769	3.90
Total (IPHC Convention Area)	**16,601**	**36.60**

The area and sector mortality and fishery limits resulting from the IPHC-adopted total mortality limits and the application of the existing Contracting Party catch sharing arrangements were as described in Table 2.

The total fishery limit (FCEY) for 2020 was set at 12,465 tonnes (27.48 million pounds), a 6.6 percent decrease from the fishery limits of 13,349 tonnes (29.43 million pounds) implemented by the Commission in 2019.

The Commission adopted fishing periods for 2020 as follows:

- All commercial fishing for Pacific halibut in all IPHC Regulatory Areas could begin no earlier than 14 March and must cease on 15 November, with the exception of IPHC Regulatory Area 2B which must cease on 7 December.
- For the IPHC Regulatory Area 2A non-tribal directed commercial fishery, three-day (58-hour) fishing periods could take place beginning on 22 June, 6 July, 20 July, 3 August, 17 August, 31 August, and 14 September, with additional openings and fishing period limits (vessel quota) to be determined and communicated by the IPHC Secretariat.

The adopted fishing periods for the IQ fisheries were 14 March to 15 November for U.S.A. waters and 14 March to 7 December for Canadian waters.

Other decisions made at the meeting

The Commission made a range of other decisions at the 96th Session of the IPHC Annual Meeting (AM096), including recommendations concerning the following:

- The IPHC's ongoing Management Strategy Evaluation (MSE);
- The process of transferring management of fisheries in IPHC Regulatory Area 2A from the IPHC (an international fisheries management body) to the relevant Contracting Party agencies.

Table 2. 2020 Mortality and Fishery limits and application of the existing Contracting Party catch sharing arrangements.

IPHC Regulatory Area	**Fishery limits (net weight)**	
	Tonnes (t)	**Million Pounds (Mlb)**
Area 2A (California, Oregon, and Washington)	**680**	**1.50**
Non-treaty directed commercial (south of Pt. Chehalis)	115	254,426*
Non-treaty incidental catch in salmon troll fishery	20	44,899*
Non-treaty incidental catch in sablefish fishery (north of Pt. Chehalis)	32	70,000*
Treaty Indian commercial	224	492,800*
Treaty Indian ceremonial and subsistence (year-round)	15	32,200*
Recreational – Washington	126	277,100*
Recreational – Oregon	131	289,575*
Recreational – California	18	39,000*
Area 2B (British Columbia) (includes recreational catch allocation)	**2,722**	**6.00**
Commercial fishery	2,322	5.12
Recreational fishery	399	0.88
Area 2C (southeastern Alaska) (combined commercial/guided recreational)	**1,932**	**4.26**
Commercial fishery (3.41 Mlb retained catch and 0.07 Mlb discard mortality)	1,579	3.48
Guided recreational fishery (includes retained catch and discard mortality)	354	0.78
Area 3A (central Gulf of Alaska) (combined commercial/guided recreational)	**4,110**	**9.06**
Commercial fishery (7.05 Mlb retained catch and 0.29 Mlb discard mortality)	3,329	7.34
Guided recreational fishery (includes retained catch and discard mortality)	776	1.71
Area 3B (western Gulf of Alaska)	**1,093**	**2.41**
Area 4A (eastern Aleutians)	**640**	**1.41**
Area 4B (central/western Aleutians)	**499**	**1.10**
Areas 4CDE	**785**	**1.73**
Area 4C (Pribilof Islands)	347	0.766
Area 4D (northwestern Bering Sea)	347	0.766
Area 4E (Bering Sea flats)	90	0.198
Total	**12,645**	**27.48**

* Allocations resulting from the IPHC Regulatory Area 2A catch sharing arrangement are listed in pounds.

96th Session of the IPHC Interim Meeting (IM096; 2020)

The 96th Session of the IPHC Interim Meeting, held 18-19 November 2020 via electronic means, was an occasion to prepare for the 97th Session of the IPHC Annual Meeting (AM097) scheduled for 25-29 January 2021. For IM096, Mr. Paul Ryall of Canada presided as Chairperson and Mr. Chris Oliver of the United States of America presided as Vice-Chairperson. The Commissioners and the public were able to hear IPHC Secretariat presentations and discuss a variety of topics, including a review of the 2020 fisheries statistics and preliminary stock assessment results, and the preliminary 2021 harvest decision table.

The 96th Session of the IPHC Interim Meeting (IM096) was held electronically, and included the usual meeting components including Secretariat presentations, Commissioner discussion, and stakeholder input.

IPHC Meetings during the pandemic required electronic formats and additional work space to accommodate social distancing. Photo by Lara Erikson.

Pacific halibut commercial fishery

Pacific halibut commercial landings totaled 9.822 t (21,652,933 pounds) in 2020.

Commercial fishing is the activity of catching fish for commercial profit. The commercial Pacific halibut landings in 2020 totaled 9,822 tonnes or 21,652,933 pounds (Table 3). 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 as of 1 February 2021. For updates on landings data, please refer to the IPHC website at: https://www.iphc.int .

Licensing and landings

Licensing

Licensing regulations for IPHC Regulatory Area 2A non-tribal fisheries were unchanged in 2020. 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.

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, Fisheries and Oceans Canada (DFO), NOAA Fisheries, Metlakatla Indian Community, Washington 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

Fisheries Data Specialist Kamala Carroll collects Pacific halibut biological data during a vessel offload in Bellingham, WA, U.S.A.. Photo by Caroline Prem.

of Fish and Game, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, and California Department of Fish and Wildlife.

Landing patterns

In Canada (IPHC Regulatory Area 2B), two out of the 16 ports receiving commercial deliveries in 2020, received 93 percent of the landed catch: Port Hardy and Prince Rupert/Port Edward. Port Hardy (including Coal Harbour and Port McNeill) received 52 percent of the commercial landed catch (1,154 tonnes; 2,545,000 pounds), and Prince Rupert received 40 percent (897 tonnes; 1,978,000 pounds).

In the U.S.A. (Alaska), the landed catch was 7,229 tonnes (15,937,000 pounds). IPHC Regulatory Area 3A again had the highest fishery limit and landed catch. Homer received the largest portion of the Alaskan commercial catch, with 1,282 tonnes (2,826,000 pounds; 18%). Dutch Harbor received the second and Kodiak the third largest landing volumes at 12 percent (867 tonnes; 1,912,000 pounds) and 11 percent (804 tonnes; 1,773,000 pounds) of the Alaskan commercial landings, respectively. In Southeast Alaska (IPHC Regulatory Area 2C), Sitka and Juneau received the most in landed weight, together totaling 15% of total commercial Alaskan landings (Table 3).

In Canada, 93% of the catch was landed at two fishing ports, Port Hardy, and Prince Rupert/Port Edward.

Table 3. 2020 Pacific halibut landings (net weight) by IPHC Regulatory Area (as of 1 February 2021).

IPHC Regulatory Area	Fishery limits (net weight)		Landings (net weight)		Per-cent
	tonnes	pounds	tonnes	pounds	(%)
Area 2A (California, Oregon, Washington)	**391**	**862,125**	**374**	**823,932**	**96**
Non-treaty directed commercial	115	254,426	110	242,647	95
Non-treaty incidental to salmon troll fishery	20	44,899	13	29,012	65
Non-treaty incidental to sablefish fishery	32	70,000	29	63,358	91
Treaty Indian directed commercial	224	492,800	222	488,915	99
Area 2B (British Columbia)	**2,322**	**5,120,000**	**2,219**	**4,891,833**	**96**
Area 2C (southeastern Alaska)[1]	**1,547**	**3,410,000**	**1,463**	**3,224,846**	**95**
Area 3A (central Gulf of Alaska)	**3,198**	**7,050,000**	**3,093**	**6,818,145**	**97**
Area 3B (western Gulf of Alaska)	**1,093**	**2,410,000**	**1,019**	**2,246,209**	**93**
Area 4A (eastern Aleutian Is.)	**640**	**1,410,000**	**520**	**1,146,995**	**81**
Area 4B (central/western Aleutian Is.)	**499**	**1,100,000**	**406**	**894,971**	**81**
Areas 4CDE and Closed	**785**	**1,730,000**	**728**	**1,606,002**	**93**
Total	**10,474**	**23,092,125**	**9,822**	**21,652,933**	**94**

[1]Includes Metlakatla landings.

Sampling of commercial landings

Sampling commercial landings is a key component to collecting data on Pacific halibut for the annual IPHC stock assessment. IPHC Secretariat collects otoliths (*ear bones*) that, when read under a microscope, give the animal's age in years; tissue samples for analysis and sex determination; 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 seasonal length-weight ratios by area and, in combination with age data, size-at-age information. Fin tissue samples are analyzed to provide the sex of individual fish and, in turn, estimate the sex composition of the commercial landings. Mean weights are combined with final landing weights to estimate landed 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 protocols are designed to ensure that the sampled Pacific halibut are representative of the population of landed Pacific halibut; sampling days 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 IPHC Regulatory Areas and are not limited in where they may land their catch, IPHC Secretariat was stationed in ports coastwide. In Canada, IPHC Secretariat was in Port Hardy and Prince Rupert. In the U.S.A., in IPHC Regulatory Area 2A, IPHC Secretariat was present in Newport and Charleston, Oregon and in Ilwaco and Bellingham, Washington. In addition, samples were taken in several ports in Washington by staff from the treaty Indian fishery management offices. Samples from the directed commercial fishery off northern California were collected in Eureka, California by California Department of Fish and Wildlife staff. In Alaska, IPHC Secretariat was in the ports of Dutch Harbor, Kodiak, Homer, Seward, Juneau, Sitka, and Petersburg.

Otoliths

The IPHC Secretariat aimed to collect 11,500 total Pacific halibut otoliths in 2020, with the target for each of IPHC Regulatory Areas 2B through 4B and Area 4CD (combined) set at 1,500. The target for IPHC Regulatory Area 2A was set at 1,000; subdivided into a target of 650 for the treaty Indian fisheries and 350 for the IPHC Regulatory Area 2A non-tribal directed commercial fisheries. All collections resulted in 10,997 otoliths by sampling from 34 percent of the landed catch in 641 samples.

IPHC Secretariat 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. COAC samples are collected from the fishery-independent setline survey (FISS) unless the sampling rate for the age determination collection is 100%. For this reason, COAC samples were collected from commercial landings from IPHC Regulatory Areas 4B and 4CD in 2020. The annual COAC target is 100 otoliths from each IPHC Regulatory Area; this target was not attained in IPHC Regulatory Area 4B (91%) or IPHC Regulatory Area 4CD (0%) due to COVID-19 changes in landing patterns.

The processing plant crew sorts the offload as Fisheries Data Specialist Kimberly Sawyer Van Vleck samples the catch. Photo by Caroline Prem.

Logbooks

Alongside otolith samples, IPHC Secretariat collected logbook information from harvesters. In total, 2,521 logs were collected in 2020 (as of 31 December 2020). A total of 428 (16 percent by count) were collected from Canadian landings, and 2,251 (84 percent by count) were collected from U.S.A. landings.

In 2020, the IPHC Secretariat collected 10,997 otoliths, 2,521 logs, and 39 tags from commercial landings.

Recovered tags

In 2020, IPHC Secretariat collected 39 tags of several types from tagged Pacific halibut. A total of 35 of these recoveries were from U32 wire tagging releases conducted between 2015 and 2020 and which included subsets from discard mortality and tail pattern recognition studies. Tag data collected dockside included fork lengths, weight(s), otoliths, fin clips, and capture location of the recovered tagged fish.

Electronic data collection

IPHC has digitized data collection to eliminate or reduce the need for post-collection data entry and increase the efficiency of data editing. IPHC Secretariat in Alaska used an electronic tablet to input data from paper logbooks into a remote data entry application. The Secretariat was tasked with entering data from as many of the logs collected as priorities and time allowed during the course of regular port duties. Modifications and enhancements to the application continue.

In British Columbia, Canada, the IPHC Secretariat was provided with a field version of the log entry program used by the IPHC's Secretariat at the Headquarters' office. The Secretariat in the field was tasked with entering as many Canadian logs as time permitted, though priority was given to other tasks such as biological sampling. In addition, the IPHC Secretariat was supplied with Bluetooth-enabled tablets for collection of electronic logs from vessels using Archipelago Marine Research's FLOAT - Fishing Log On A Tablet.

Recreational fishery

The 2020 recreational harvest of Pacific halibut, including discard mortality, was estimated at approximately 2,722 tonnes (6,000,327 pounds) by the IPHC, using information provided by state and federal agencies from each of the Contracting Parties. The regulations governing recreational fishing of Pacific halibut were specifically geared to each IPHC Regulatory Area. Table 4 provides a brief summary of overall removals and more detailed tables providing a summary of seasons and retained catch can be found on the IPHC website: https://www.iphc.int.

A total of 2.722 t (6,000,327 pounds) of Pacific halibut were harvested by the recreational sector in 2020. This includes both the catch and amount estimated to have died when discarded.

Table 4. Summary of 2020 recreational Pacific halibut allocations and landed catch by IPHC Regulatory Area.

	Allocation		Retained catch		Percent of
Area	tonnes	pounds	tonnes	pounds	allocation
2A	275	605,675	185	408,538	67
2B	399	880,000	235	518,639	59
2C (charter)[1]	354	780,000	216	477,041	61
3A (charter)[1]	776	1,710,000	718	1,582,333	93

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

Recreational fishing on a flat-calm day. Photo by Ed Henry.

IPHC Regulatory Area 2B – British Columbia (CANADA)

IPHC Regulatory Area 2B operated under a 126 cm (49.6 inch) maximum size limit and one Pacific halibut had to be between 90 – 126 cm (35.4 - 49.6 inches) or both under 90 cm (35.4 inch) when attaining the two fish possession limit with an annual limit of six per licence holder. On 14 August the daily limit was matched to the possession limit.

British Columbia, Canada and Alaska, U.S.A. both have programs that allow recreational harvesters to land fish that is leased from directed commercial fishery quota share holders for the current season. In Canada, this program was not opened in 2020 in response to the COVID-19 pandemic.

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

IPHC Regulatory Area 2A's recreational allocation was based on the Pacific Fishery Management Council's Catch Sharing Plan formula, which divides the overall fishery limit among all sectors. The recreational allocation was further subdivided to seven subareas, after 32 tonnes or 70,000 pounds were allocated to the incidental Pacific halibut catch in the commercial sablefish fishery in Washington. This subdivision resulted in 126 tonnes or 277,100 pounds being allocated to Washington subareas and 131 tonnes or 289,575 pounds to Oregon subareas. In addition, California received an allocation of 18 tonnes or 39,000 pounds. Recreational fishery harvest seasons by subareas varied and were managed in-season in coordination with the Contracting Party agencies, with fisheries opening on 1 May. The IPHC Regulatory Area 2A recreational harvest totaled 185 tonnes (408,538 pounds), 33% under the recreational allocation (Table 4).

British Columbia and Alaska have programs where Pacific halibut can be leased from the commercial sector and landed by the recreational sector. This program was not implemented in 2020 in IPHC Regulatory Area 2B because of COVID-19 concerns.

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

The IPHC Regulatory Area 2C charter fishery continued to be managed using a reverse slot limit, allowing for the retention of one Pacific halibut that was ≤ 114 cm or 45 inches or ≥ 203 cm or 80 inches in total length. During the 7th Special Session of the IPHC (SS07) on 20 May, the reverse slot limit was changed to allow retention of one Pacific halibut that was ≤ 102 cm (40 inches) or ≥ 203 cm (80 inches) in total length. In IPHC Regulatory Area 3A, charter anglers were allowed to retain two fish, but only one could exceed 66 cm (26 inches) in length, a four fish annual limit with a recording requirement, one trip per calendar day per charter permit, with no charter retention of Pacific halibut on Tuesdays or Wednesdays. During the 7th Special Session of the IPHC (SS07) on 20 May, the maximum length of the second fish was changed to 81 cm (32 inches) and all day closures were removed as well as the annual limit.

Similar to British Columbia (Canada), Alaska (U.S.A.) has a program that allows recreational harvesters to land fish that is leased from commercial fishery quota shareholders for the current season. In IPHC Regulatory Areas 2C and 3A, a total of 25 tonnes (55,061 pounds) and 1 tonne (2,147 pounds), respectively, were leased from the directed commercial quota fisheries and landed as recreational harvest.

Discard mortality of Pacific halibut in the directed fishery

Discard mortality from the directed commercial fishery can be from fish caught on lost or abandoned gear and never retrieved, the percentage of fish under the legal size limit that are estimated to die from their capture and release, and regulatory compliance.

In the directed 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 or in this case, directed commercial discard mortality.

Estimates of directed commercial discard mortality in 2020 amounted to 337 tonnes (743,000 pounds; net weight) (Table 5). Data in this chapter are as of 1 February 2021. There are three main sources of directed commercial discard mortality accounted for by IPHC: (1) fish caught and never retrieved on lost or abandoned fishing gear; (2) 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 compliance reasons, such as a vessel reaching its trip, catch or quota share limit.

Table 5. Directed commercial discard mortality of Pacific halibut (net weight) by IPHC Regulatory Area, 2020.

IPHC Regulatory Area	Discard Mortality	
	tonnes	pounds
2A	15	33,000
2B	75	165,000
2C[1]	29	63,000
3A	85	188,000
3B	44	96,000
4A	38	83,000
4B	16	36,000
4CDE	36	79,000
Total*	337	743,000

[1]Includes the Metlakatla fishery.

Directed commercial 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 advent of quota-share fishery management in these areas has greatly reduced the mortality from lost or abandoned gear.

The rate of O32 Pacific halibut discard mortality 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 IPHC Convention waters. U32 Pacific halibut 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.

Setline Survey Specialist Jonathan Turnea aboard the *F/V Star Wars II* displays a U32 Pacific halibut. Photo by Sean Burns.

Directed commercial discard mortality from discarded U32 Pacific halibut

Weights are estimated from various means. In IPHC Regulatory Area 2B, direct observations of length are used and in other IPHC Regulatory Areas, FISS data are used as a proxy.

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

Directed commercial discard mortality for regulatory compliance reasons

In IPHC Regulatory Area 2A, derby-style fishing with fishing period limits can result in overages and subsequent discards. The IPHC uses the catch rate of the retained catch to estimate these discards.

In IPHC Regulatory Area 2A, the directed commercial fishery is still managed by 'derby' fishing periods in which the quantity of fish that may be caught by each vessel is limited by a fishing period limit and the size of vessel. This may result in catches that exceed the vessel or trip limits, so that "excess" O32 Pacific halibut are discarded. Some vessel captains 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 amount of discarded 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 directed commercial fisheries was not included in these calculations, however, as these removals were accounted for under non-directed commercial discard mortality estimates. In the quota share fisheries in British Columbia and Alaska a mortality rate of 16 percent was applied to these discards to account for these removals.

Subsistence harvest

Pacific halibut that are caught by those who have traditionally relied on this fish as a critical food source or for customary purposes are classified as "subsistence," as opposed to recreational or commercial removals. Subsistence harvest is barred from resale, so by nature does not make up a part of the commercial landings. The IPHC defines subsistence harvest further as Pacific halibut taken in: 1) the sanctioned First Nations Food, Social, and Ceremonial (FSC) fishery in British Columbia, Canada; 2) the federal subsistence fishery in Alaska, U.S.A.; 3) tribal Indian Ceremonial and Subsistence (C&S) fisheries in Washington State, U.S.A.; 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 (U.S.A.) under IPHC Fishery Regulations (2020). 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 landings and are not included in the estimates here. Table 6 provides a summary of subsistence removals followed by more detail for by IPHC Regulatory Area.

Subsistence is a category of removals reserved for customary and traditional uses and is barred from resale.

Table 6. Subsistence Pacific halibut fishery removals (net weight) by IPHC Regulatory Area, 2020.

IPHC Regulatory Area	Subsistence Removals	
	tonnes	pounds
2A	19	41,478
2B	184	405,000
2C	166	366,214
3A	85	187,698
3B	8	16,644
4A	6	13,237
4B	<1	1,684
4CDE/Closed[1]	15	33,247
Total	**483**	**1,065,202**

[1] 2018 Alaska estimates were carried over for the 2020 estimates, with the exception of IPHC Regulatory Area 4D/4E subsistence harvest in the CDQ fishery, which were updated.

Estimated harvests by IPHC Regulatory Area

Canada (IPHC Regulatory Area 2B; British Columbia)

The FSC fishery constituted British Columbia's subsistence harvest. Fisheries and Oceans Canada (DFO) has estimated the same level of harvest for this fishery since 2007.

Pacific halibut ready to be weighed. Photo by Caroline Prem.

Regulations used to manage the fishery in Alaska include a registration program, gear specifications, and bag limits.

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

The subsistence allocation in IPHC Regulatory Area 2A consists of the C&S fishery that the tribes have subdivided from their directed commercial fishery limit.

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

After the Alaska subsistence program began in 2003, the Alaska subsistence catch declined until 2013, after which it rose until 2015. A new 2018 estimate was used for 2018 and 2019. The Alaska estimates for the subsistence Pacific halibut harvest typically lag by a year, so the 2020 estimates are not yet complete.

Regulations on the subsistence fishery in Alaska set by NOAA Fisheries 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 dates.

According to Alaska Department of Fish and Game's voluntary annual survey, 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 the total.

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 2020, retention of U32 Pacific halibut in the CDQ fishery was 1.3 tonnes or 2,935 pounds, a decrease from the 3.2 tonnes of Pacific halibut retained in 2019. 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 2020, thirteen harvesters brought in a catch of 91 U32 Pacific halibut, weighing 0.5 tonnes or 995 pounds. Pacific halibut were landed by BBEDC vessels equally at Togiak and Naknek, with a small amount landed in Dillingham and King Salmon.

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 2020, for the seventh year in a row, CVRF reported that their fishers landed zero Pacific halibut and no fish were received by their facilities.

Three CDQ organizations in Areas 4D and 4E are authorized by the IPHC to retain U32 Pacific halibut during commercial fishing.

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 2020, the area's only plant at Nome, received 196 U32 Pacific halibut, weighing 1.0 tonnes or 2,199 pounds.

DISCARD MORTALITY OF PACIFIC HALIBUT IN NON-DIRECTED COMMERCIAL FISHERIES

In 2020, an estimated 2.12 t (4,674,000 pounds) of non-directed discard mortality was recorded.

Discard mortality of Pacific halibut in this section consists of fish caught incidentally by commercial fisheries targeting other species (a.k.a. bycatch) and that cannot legally be retained. Discard mortality in non-directed commercial fisheries refers only to those fish that subsequently die due to capture. This section summarizes the estimated discard mortality in non-directed commercial fisheries across fisheries where Pacific halibut are incidentally caught, discarded and subsequently die, within the IPHC Convention Area.

In 2020, there was an estimated 2,120 tonnes or 4,674,000 pounds of Pacific halibut non-directed commercial fisheries discard mortality, representing a 29 percent decrease from the 2,977 tonnes or 6,564,000 pounds recorded in 2019. Estimates for 2020 are preliminary and subject to change as new information becomes available. Current values are available on the IPHC website: https://www.iphc.int

Sources of information for discard mortality in non-directed fisheries

The IPHC relies on observer and electronic monitoring programs run by government agencies from Canada and the U.S.A. for discard mortality in non-directed commercial fisheries estimates and information. In Canada, Fisheries and Oceans Canada (DFO) monitors fisheries off British Columbia (IPHC Regulatory Area 2B) where there is '100 percent' fishery monitoring for the groundfish trawl and hook-and-line fisheries. There are varying levels of monitoring for

Bringing the codend aboard a trawl vessel (Photo taken during the NOAA groundfish trawl survey). Photo by Ben Burnett.

non-groundfish fleets in British Columbia. The COVID-19 pandemic affected the implementation of fishery monitoring in 2020.

In the U.S.A., the NOAA Fisheries monitors trawl fisheries off the coast of Alaska (IPHC Regulatory Areas 2C-4) and the west coast (IPHC Regulatory Area 2A). Off the west coast of the U.S.A., there is '100 percent' fishery monitoring for the commercial trawl groundfish fishery. There are varying levels of monitoring on non-trawl vessels and fisheries. 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 commercial Pacific halibut fishery. The COVID-19 pandemic affected implementation of the fishery monitoring and its level of coverage.

Discard mortality rates

There are varying levels of direct incidental catch monitoring depending on the regulatory area and fishery.

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.

Discard mortality in non-directed commercial fisheries by IPHC Regulatory Area

This section describes the estimated non-directed commercial fisheries discard mortality from each IPHC Regulatory Area (Table 7).

Table 7. Non-directed commercial fisheries discard mortality estimates of Pacific halibut (net weight) by year, IPHC Regulatory Area, and fishery, for 2020.[1]

IPHC Regulatory Area and Gear Type	Non-directed commercial fisheries discard mortality	
2A	tonnes	Pounds (in thousands)
Trawl (Groundfish)	6	13
Trawl (IFQ Bottom)	20	45
Trawl (Other Groundfish)	0	0
Pot (Groundfish)	<1	1
Hook & Line	22	49
Trawl (Shrimp)	0	0
Total	49	108
2B		
Trawl (Groundfish Bottom)	104	230
Total	104	230

2C		
Pot (Shellfish)	0	0
Trawl (Groundfish)	0	0
Hook & Line (non-IFQ)	2	5
Hook & Line (IFQ)	25	55
Hook & Line (State Water)	15	33
Total	42	93
3A		
Dredge (Scallop & Sea Cucumber)	11	24
Trawl (Groundfish)	421	928
Hook & Line (non-IFQ)	1	2
Hook & Line (IFQ)	6	13
Pot (Groundfish)	0	0
Hook & Line (State Water)	5	11
Total	444	978
3B		
Pot (Shellfish)	23	50
Dredge (Scallop & Sea Cucumber)	6	14
Trawl (Groundfish)	167	369
Hook & Line (State Water)	n/a	n/a
Hook & Line (non-IFQ)	0	0
Hook & Line (IFQ)	2	5
Pot (Groundfish)	<1	2
Total	200	440
4A		
Pot (Shellfish)	12	26
Dredge (Scallop & Sea Cucumber)	0	0
Trawl (Groundfish)	111	245
Hook & Line (State Water)	n/a	n/a
Hook & Line (non-IFQ)	3	7
Hook & Line (IFQ)	0	0
Pot (Groundfish)	1	3
Total	127	281
4B		
Pot (Shellfish)	<1	2
Trawl (Groundfish)	37	81
Hook & Line (State Water)	n/a	n/a
Hook & Line (non-IFQ)	5	12
Hook & Line (IFQ)	0	0
Pot (Groundfish)	1	3
Total	44	98
4CDE/Closed		
Pot (Shellfish)	17	37
Dredge (Scallop & Sea Cucumber)	0	0
Trawl (Groundfish)	1,035	2,282
Hook & Line (State Water)	n/a	n/a
Hook & Line (non-IFQ)	57	126
Hook & Line (IFQ)	0	0
Pot (Groundfish)	<1	2
Total	1,110	2,447
GRAND TOTAL	2,120	4,674

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

Pacific halibut caught alongside other species during the NOAA groundfish trawl survey. Photo by Brian Knoth.

Trawl fishery incidental mortality caps for Pacific halibut is a management tool used in multiple areas.

Canada (IPHC Regulatory Area 2B; British Columbia)

In Canada, Pacific halibut non-directed commercial discard mortality in trawl fisheries is capped at 454 tonnes round weight or 750,000 pounds net weight by DFO. Non-directed commercial discard mortality in non-trawl groundfish fisheries is largely handled under the quota system within the directed Pacific halibut fishery limit for.

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

As in prior years, the bottom trawl fishery and hook-and-line fishery for sablefish were responsible for the bulk of the non-directed commercial discard mortality in IPHC Regulatory Area 2A. Groundfish fisheries in IPHC Regulatory Area 2A are managed by NOAA Fisheries, following advice and recommendations developed by the Pacific Fishery Management Council (PFMC). Pacific halibut non-directed commercial discard mortality in the trawl IFQ fishery (also called trawl catch shares) in this area is capped at 45 tonnes or 100,000 pounds of O32 (> 32 inches fork length; 81.3 cm) Pacific halibut.

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

NOAA Fisheries reported non-directed commercial discard mortality by hook-and-line vessels fishing in the outside (federal) waters of IPHC Regulatory Area 2C. 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 contribute to the amount of non-directed commercial discard mortality 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 2020.

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

Trawl fisheries are responsible for the majority of the non-directed commercial discard mortality in these IPHC Regulatory Areas, with hook-and-line fisheries a distant second. State-managed crab and scallop fisheries are also known to take Pacific halibut as non-directed commercial discard mortality, but at low levels. IPHC Regulatory Area 3 remains the area where non-directed commercial discard mortality is estimated most poorly. Observer coverage for some fisheries is relatively limited. Limited observer coverage, along with tendering, loopholes in trip scheduling, and safety considerations, likely result in observed trips not being representative of all trips.

U.S.A. (IPHC Regulatory Areas 4A, 4B, 4CDE; Bering Sea/Aleutian Islands)

Regulatory Areas 3A and 3B remain the areas where non-directed commercial discard mortality is estimated most poorly.

The Pacific cod fishery is conducted in the late winter/early spring and late summer, and is the major fishery in this IPHC Regulatory Area contributing to the amount of Pacific halibut non-directed commercial discard mortality. 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 level of observer coverage, non-directed commercial discard mortality estimates for IPHC Regulatory Area 4 fisheries are considered reliable. Pots are used to fish for Pacific cod and sablefish and fish very selectively. Non-directed commercial discard mortality rates are quite low and survival is relatively high. Within the Bering Sea, the non-directed commercial discard mortality has typically been the highest in IPHC Regulatory Area 4CDE due to the groundfish fishery within that area.

Fishery-independent survey activities

Every year the International Pacific Halibut Commission (IPHC) conducts a Fishery-Independent Setline Survey (FISS), participates in NOAA Fisheries (National Oceanic and Atmospheric Administration Fisheries) trawl surveys, and receives survey data from other organisations. Activities during these surveys include collection of biological and oceanographic data, tagging and release of fish, and other projects. NOAA surveys were not conducted in 2020 due to the COVID-19 pandemic.

The 2020 FISS design included a subset of 1,232 fishing stations compared to the full FISS design of 1,890 stations.

IPHC Fishery-Independent Setline Survey (FISS)

The IPHC Fishery-Independent Setline Survey (FISS) gathers catch rate information to monitor changes in biomass in the Pacific halibut population. The FISS uses standardised methods, including bait, gear, fishing locations, and time of year, to gain a balanced picture that can be compared over a large area and from year to year.

When other species are caught on the FISS, their presence provides data about bait competition, commonly known as ‘hook competition’. Other species catch data also provide an indication of their abundance over time, making them valuable for population assessments, management, and potential avoidance strategies.

Setline Survey Specialist Blanka Lederer collects maturity information from a Pacific halibut captured during the IPHC FISS on the *F/V Devotion*. Photo by Kevin Coll.

> *The IPHC chartered 11 commercial longline fishing vessels for the FISS work including a gear comparison study in 2020. Thank you to F/Vs:*
> *Allstar*
> *Bold Pursuit*
> *Devotion*
> *Hanna-Lio*
> *Kema Sue*
> *Pender Isle*
> *Saint Nicholas*
> *Polaris*
> *Star Wars II*
> *Seymour*
> *Vanisle*

Design and procedures

The 2020 IPHC Fishery-Independent Setline Survey (FISS) covered both nearshore and offshore waters of British Columbia, Canada, and Alaska, U.S.A., including southeast Alaska, the central and western Gulf of Alaska (Figure 1). The IPHC chartered 11 commercial longline vessels for FISS operations. During a combined 62 trips and 558 charter days, these vessels fished 17 charter regions. Each region required between 19 and 51 days to complete.

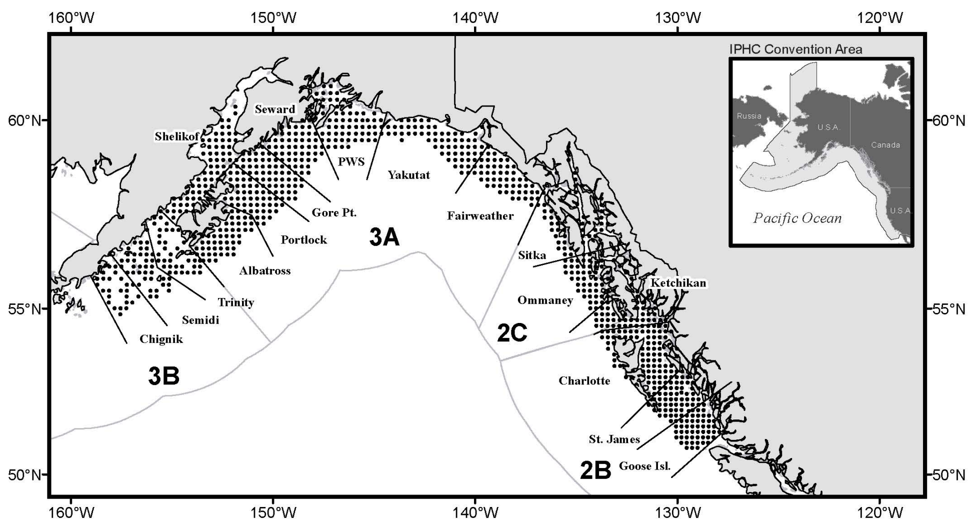


Figure 1. Stations fished during the 2020 IPHC Fishery-independendent setline survey.

The FISS was conducted via stations arranged in a grid of 10x10 nautical miles with a depth range of 18 to 732 metres (10 to 400 fathoms)The 2020 FISS design was a selection of stations from the full FISS design of 1,890 stations. The 2020 FISS was to comprise a random subsample of 1,232 stations following decisions made at the 96th Session of the IPHC Annual Meeting (AM096). However, due to the impact of COVID-19, a reduced FISS was implemented totaling 898 stations with stations in IPHC Regulatory Areas 2B, 2C, 3A and 3B. Each FISS station in the St. James charter region in IPHC Regulatory Area 2B was fished twice for a gear-comparison study (once with fixed gear and once with snap gear in random order). Of the 898 FISS stations planned for 2020, a total of 872 (97%) were surveyed and incorporated into the stock assessment analysis. Four standard skates of gear were set at each station in IPHC Regulatory Area 3B and eight standard skates in IPHC Regulatory Areas 2B, 2C, and 3A. Each vessel conducting FISS work set 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 results, as were sets for which predetermined limits for lost gear, snarls, depredation, or displacement were exceeded. Other than the vessels using snap gear for the gear comparison work, FISS gear consisted of fixed-hook, 549 metre (1,800-foot) skates with 100 circle hooks of size 16/0 spaced 5.5 metres (18 feet) apart. The length of the gangions ranged from 61 to 122 centimetres (24 to 48 inches). Each hook was baited with 0.11 to 0.15 kilograms (1/4 to 1/3 pounds) of chum salmon.

Sampling protocols

Following protocols set out in the 2020 Fishery-Independent Setline Survey Manual, shipboard Setline Survey Specialists 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 Setline Survey Specialists recorded hook status (hook occupancy data to species or whether the hook was pulled up empty) for the first 20 consecutive hooks of each skate.

Setline Survey Specialists recorded lengths and weights 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 or from every captured 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 < 81.3 cm or 32 inches) 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 FISS has always been No. 2 semi-bright (Alaska Seafood Marketing Institute grades A through E), headed and gutted, and individually quick-frozen chum salmon. In August 2019, the IPHC Secretariat began arranging bait purchases for the 2020 FISS. Approximately 114 tonnes (250,000 pounds) of chum salmon were utilized from three suppliers. Bait usage was based on 0.17 kilograms (0.37 pounds) per hook, resulting in approximately 117 kilograms (259 pounds) per seven-skate station. Bait quality was monitored and documented throughout the season and found to have met the standard as described above.

Fish sales

O32 (fork length ≥ 81.3 cm or 32 inches) Pacific halibut caught during the FISS have historically been kept and sold as a way to offset the cost of the work. In 2020, U32 (fork length ≤ 81.3 cm or 32 inches) Pacific halibut that were randomly selected for sampling were also kept and sold. All vessel contracts contained a lump sum payment along with a 10 percent share of the O32 Pacific halibut proceeds.

During the 2020 FISS, IPHC's chartered vessels delivered a total of 402 tonnes (887,000 pounds) of Pacific halibut to 13 different ports. The coastwide average price per kilogram was $10.49 USD or $4.76 USD per pound, amounting to sales totaling $4,217,777 USD.

A portion of the Pacific halibut caught during the FISS are retained and sold to help offset the cost of the FISS. In 2020, a total of 402 t (887,000 pounds) of Pacific halibut were landed.

Field personnel

The 2020 FISS vessels were staffed by 19 Setline Survey Specialists, who worked a total of 1,158 person-days, including travel days, sea days, and debriefing days. Two setline survey specialists were aboard each FISS vessel. At a given time, one specialist handled fish, collected data, and sampled on deck, while the other setline survey specialist, in a portable shelter, recorded data and

Setline survey specialist Jonathan Turnea showcases some of the gear used by IPHC samplers during the FISS. Photo by Sean Burns.

observations and stored samples collected by the specialist on deck. The IPHC did not deploy specialists on the NOAA Fisheries (AFSC) trawl survey in 2020 due to the survey being cancelled as a result of the COVID-19 pandemic.

Oceanographic monitoring

This was the twelfth consecutive year of the IPHC oceanographic data collection program whereby water column profiles were collected during the FISS. Oceanographic data were collected using instruments manufactured by Seabird Scientific that collected pressure (depth), conductivity (salinity), temperature, dissolved oxygen, pH, and fluorescence (chlorophyll *a* concentration) throughout the water column. Routinely, profiles are attempted at each FISS station, but because of unforeseen delays in instrument readiness due to the coronavirus, this year the profilers were deployed at a subset of FISS stations resulting in a total of 311 successful casts spanning IPHC Regulatory Areas 2B, 2C, and 3A.

Additional research projects

In addition to core operations, the FISS provides 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 and Ecosystem Science section of this report.

In addition to core FISS operations, a number of IPHC research projects were also conducted during the FISS. Details of these projects can be found in the Research section of this report.

IPHC Fishery-Independent Setline Survey (FISS) results

As is typical, the IPHC targeted the summer months—May, June, July, and August—for FISS work. In 2020, due to COVID-19 impacts, the FISS began in June instead of May, and the vast majority (about 94%) of all stations were surveyed in July and August. The early part of the FISS season saw the greatest activity; coastwide activity declined early in August and was fully completed by early-September.

Weight and number per unit effort (WPUE)

As a result of including both commercial and non-commercial fishing grounds, the FISS results show an average weight per unit effort (WPUE) for all IPHC Regulatory Areas below that of the directed commercial Pacific halibut fleet (Table 8).

Table 8. The average total raw WPUE for each of the IPHC Regulatory Areas during the FISS 2020.

Regulatory Area	kg/skate	lb/skate	Station Count
2B	50	109	198
2C	80	175	145
3A	81	177	431
3B	52	114	99

Typically the FISS encounters around 115 different species of fish and invertebrates.

Non-Pacific halibut catch

Around 115 species of fish and invertebrates are captured each year as bycatch by the IPHC FISS (https://www.iphc.int/data/fiss-bycatch). The predominant incidental catches in IPHC Regulatory Areas 2A, 2B, 2C, and 3A are sharks, primarily spiny dogfish (*Squalus suckleyi*). The most frequent incidental catch in IPHC Regulatory Areas 3B, 4A, and 4CDE/Closed are Pacific cod (*Gadus microcephalus*). In IPHC Regulatory Areas 4B and 4C, the “other species” category is most common and is comprised of yellow Irish lord sculpins (*Hemilepidotus jordani*), unidentified starfish, grenadiers (*Macrouridae*), and arrowtooth flounder (*Atheresthes stomias*).

Size and age observations

Just upwards of 36 percent of Pacific halibut caught during the IPHC FISS were smaller than the current commercial legal size limit (U32) with a median fork length of 74 cm (29 inches). In 2020, median length increased in all IPHC Regulatory Areas fished (2B, 2C, 3A and 3B). No IPHC Regulatory Area saw a decrease in median length. IPHC Regulatory Area 3B had a median length below the legal-size limit. The largest median length was in IPHC Regulatory Area 2C (92 cm or 36.2 in).

The sex composition of FISS-caught O32 Pacific halibut varied widely among IPHC Regulatory Areas, ranging from 53 percent (3B) to 79 percent (2C) female. As in previous years, IPHC Regulatory Area 2C showed the highest concentration of females. Most female Pacific halibut caught during the setline survey period (i.e. summer months) were in the mature stage and expected to spawn in the upcoming season.

Population assessment

Since 1923, one of the IPHC's primary tasks has been to assess the population (or stock) of Pacific halibut. In 2020, the IPHC conducted its annual coastwide stock assessment of Pacific halibut using updated data sources and new information from the 2020 fishing period. 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.

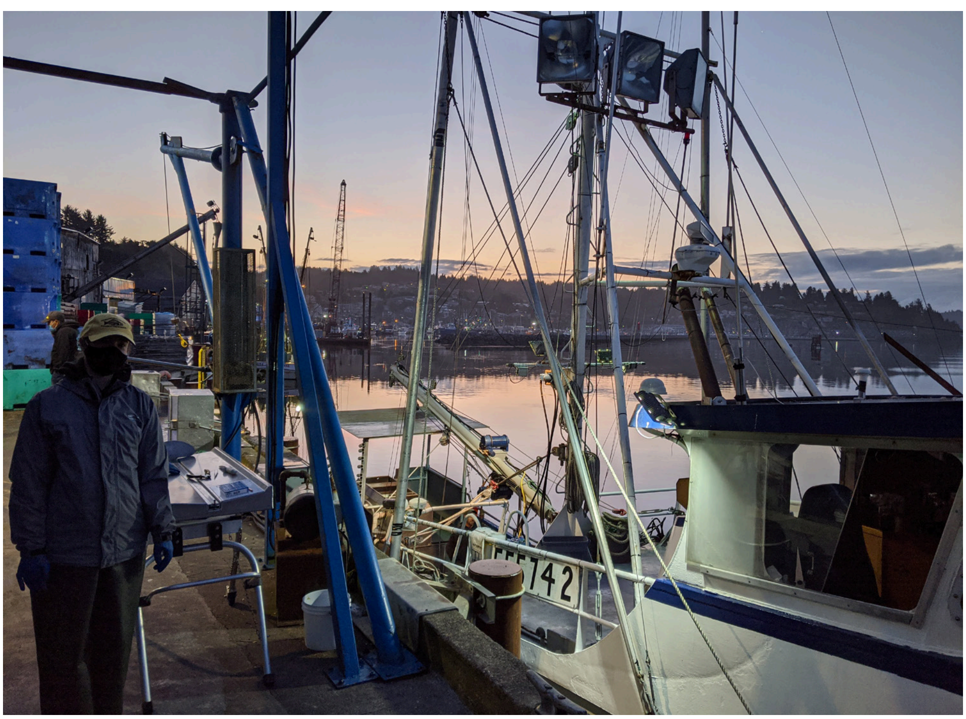
Data sources used in the Pacific halibut assessment are a combination of historical and current.

Data sources

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

Historical data

Known Pacific halibut mortality consists of target/directed commercial fishery landings and discard mortality (including research), recreational fisheries, subsistence, and non-targeted/directed discard mortality ('bycatch') in fisheries



Fisheries Data Specialist Kimberly Sawyer Van Vleck ready to begin the day in Newport, OR, U.S.A. during an IPHC Regulatory Area 2A fishing period. Photo by Caoline Prem.

targeting other species where Pacific halibut retention is prohibited. Over the period 1921-2020 mortality has totaled 7.3 billion pounds (~3.3 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 mortality was above this long-term average from 1985 through 2010, and have averaged 40 million pounds (~18,000 t) from 2016-20.

2020 fishery-dependent and fishery-independent survey data

Fishery-dependent data includes information from directed commercial, recreational, subsistence, and non-directed commercial fisheries. Pacific halibut landings data from the commercial fishery since 1981 have been reported to IPHC by way of commercial fish tickets. Annual recreational mortality estimates are provided to the IPHC by state agencies (U.S.A. waters) and DFO. Since 1991, Fisheries and Oceans Canada (DFO) and NOAA Fisheries have provided estimates of subsistence (or personal use) harvests; these estimates are not made every year in all cases, so in some instances they are simply repeated from previous years when no new data are available.

Fishery-dependent and fishery-independent data include: 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 an index of abundance, while accounting for possible changes in fishery practices and locations from year to year.

While the coastwide aggregate NPUE decreased slightly, the WPUE increased, indicating that somatic growth is contributing more to current stock productivity than incoming recruitment.

The 2019 modelled FISS results detailed a coastwide aggregate NPUE which decreased by 1% from 2019 to 2020, the fourth consecutive year of a declining trend. The modelled coastwide WPUE of legal (O32) Pacific halibut, the most comparable metric to observed commercial fishery catch rates, increased by 6% from 2019 to 2020. This positive trend relative to that for NPUE indicates that somatic growth, primarily of O32 Pacific halibut is contributing more to current stock productivity than incoming recruitment. Individual IPHC Regulatory Areas varied from a 24% increase (Regulatory Area 3A) to a 10% decrease (Regulatory Area 2B; Figure 4) in O32 WPUE. Uncertainty was greater in IPHC Regulatory Areas that were not directly sampled in 2020 (2A, 4A, 4B, and 4CDE), but still comparable with the recent time-series due to the spatial and temporal correlations in the data that are captured in the space-time modelling.

Preliminary commercial fishery WPUE estimates from 2020 logbooks increased by 2% at the coastwide level. The bias correction to account for additional logbooks compiled after the fishing season resulted in an estimate of no change coastwide. Trends varied among IPHC Regulatory Areas and gears, with generally positive trends observed in IPHC Regulatory Areas 2A, 2C, 3B, 4C and 4D. The largest decreases were observed in IPHC Regulatory Areas 2B and 4B, and these are likely to be even larger when 2020 logbook records are complete.

All information used in the 2020 stock assessment was finalized on 31 October 2020 in order to provide adequate time for analysis and modeling. As has been the case in all years, some data are incomplete, or include projections for the remainder of the year. These include commercial fishery WPUE, commercial fishery age composition data, and 2020 mortality estimates for all fisheries still operating. All preliminary data series in this analysis will be fully updated as part of the 2021 stock assessment.

Setline Survey Specialist Jonathan Turnea samples a Pacific halibut on the *F/V Star Wars II* during the IPHC FISS. Photo by Sean Burns.

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.

Auxiliary inputs to the stock assessment include additional information that are products of analyses themselves.

1. The headed and gutted weight (net pounds) of a Pacific halibut has historically been estimated via a simple equation of weight based on fork length. As length increases, weight corresponds at a rate slightly greater than cubic increase. Due to the direct sampling of individual Pacific halibut weights in the port sampling program (beginning in 2015) and the FISS (beginning in 2019), the weight-length relationship is used only for other sources and is currently under review.

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 10-30 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 (before 1947, and 1977-2006), the stock saw a higher average recruitment of younger fish. The PDO’s longest “negative” phase since the late 1970s occurred from 2006 through 2013. Positive values were observed over 2014-19; however, it is unclear if this represents a change of phase or a different set of environmental conditions altogether.

Stock distribution estimation

This is achieved using the modelled FISS WPUE index of Pacific halibut density, weighted by the geographical extent of each IPHC Regulatory Area. To account for factors that are known to affect FISS catch rates, two adjustments to the raw WPUE prior to modelling are made for FISS 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, and are applied at the station level.

Stock distribution estimation uses FISS catch information along with adjustments for FISS timing and hook competition.

Stock distribution

Modelled survey WPUE (a proxy for density of all sizes of Pacific halibut captured by the FISS), and the geographical extent of Pacific halibut habitat, are used to produce the best available estimates of the stock distribution by Biological Region (Figure 2). Trends since 2004 indicate that population distribution has been decreasing in Biological Region 3, and increasing in Biological Regions 2 and 4. However, in 2020 there was a notable increase in Biological Region 3 and a decrease in Biological Region 2. Biological Region 4 remained near the historical high, with the caveat that the 2020 value represents a space-time model prediction in the absence of direct sampling (Table 9). It is unknown to what degree current stock distribution corresponds to historical distributions from the mid-1900s or to the average distribution likely to occur in the absence of fishing mortality, as modelled survey estimates are only available beginning in 1993.

Table 9. Recent stock distribution estimates by Biological Region based on modelling of all sizes of Pacific halibut captured by the FISS.

Year	Region 2 (2A, 2B, 2C)	Region 3 (3A, 3B)	Region 4 (4A, 4CDE)	Region 4B
2016	24.4%	51.9%	19.6%	4.1%
2017	24.7%	48.6%	22.3%	4.5%
2018	24.2%	47.9%	22.8%	5.2%
2019	25.0%	46.4%	23.9%	4.7%
2020	23.1%	48.5%	23.6%	4.7%

Population assessment at the end of 2020

Stock assessment

The ensemble stock assessment approach allows for an analysis of the uncertainty surrounding the estimates.

The methods for undertaking the population assessment for Pacific halibut have been improved many times over the last 30 years with the development of better model assumptions and analytical approaches. For the last eight 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 recognizes that there is no "perfect" assessment model, and risk assessment based on multiple models provides a basis for the estimation of management quantities (and the uncertainty about these quantities).

The 2020 stock assessment represents an update to the 2019 analysis, adding data sources where available, but retaining the same basic model structure for each of the four component models. Incremental changes made during 2020 were documented through a two-part review by the IPHC's scientific review process. The 2020 assessment 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 four equally weighted individual models. Within-model uncertainty from each model was propagated through to the risk analysis and decision table. 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.

Spawning biomass and recruitment trends

The results of the 2020 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2012. That trend is estimated to have been largely a result of decreasing size-at-age, as well as somewhat weaker recruitment strengths than those observed during the 1980s. The spawning biomass (SB) is estimated to have increased gradually to 2016, and then decreased to an estimated 192 million pounds (~87,050 t) at the beginning of 2021, with an approximate 95% credible interval ranging from 125 to 292 million pounds (~56,800-132,600 t; Figure 2). The recent spawning biomass estimates from the 2020 stock assessment are very consistent with previous analyses, back to 2012. All assessments since 2015 have indicated a decreasing spawning biomass in the terminal year.

Average Pacific halibut recruitment is estimated to be higher (70 and 75% for the coastwide and AAF models respectively) during favorable PDO regimes. Pacific halibut recruitment estimates show the large cohorts in 1999 and 2005. Cohorts from 2006 through 2010 are estimated to be much smaller than those from 1999-2005, which results in a high probability of near-term decline in both the stock and fishery yield as these low recruitments become increasingly important to the age range over which much of the harvest and spawning takes place. Based on age data through 2020, individual models in this assessment produced estimates of the 2011 and 2012 year-classes that ranged extensively: from below to above the magnitude of the 2005 year-class. Even with a third year of observation from the FISS, and now a year from the commercial fishery, these two important year-classes remain uncertain. Some of this uncertainty is due to

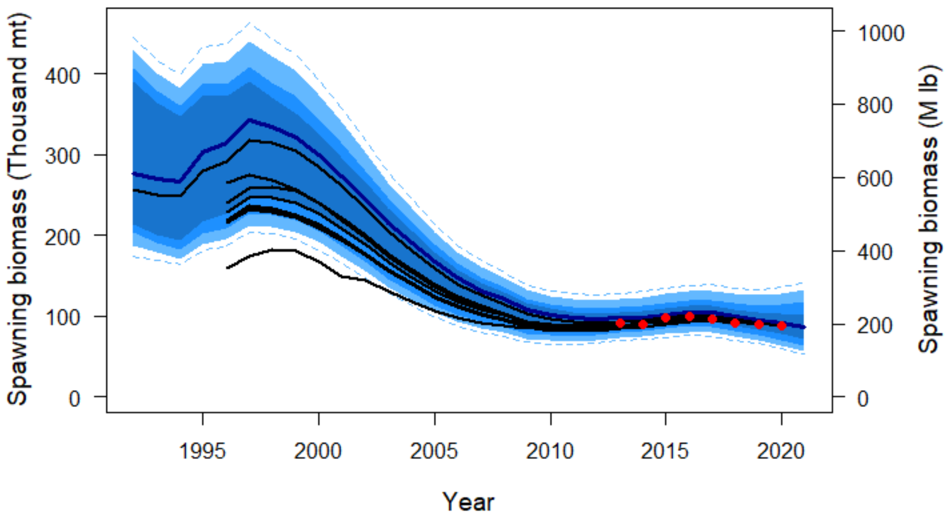


Figure 2. Retrospective comparison among recent IPHC stock assessments. Black lines indicate estimates of spawning biomass estimated by assessments conducted from 2012-2019 with the terminal estimate shown as a point, the shaded distribution denotes the 2020 ensemble: the dark blue line indicates the median (or "50:50 line") with an equal probability of the estimate falling above or below that level; colored bands moving away from the median indicate the intervals containing 50/100, 75/100, and 95/100 estimates; dashed lines indicate the 99/100 interval.

the relatively flat trends observed which do not clearly identify these cohorts as being above average, despite the strong representation in the age structure of the samples. The projected spawning biomass over the next 3 years includes the effects of these year classes maturing at ages 8-12.

The relative spawning biomass in 2021 was estimated to be 33% (credible interval: 22-52%) down slightly from 34% in 2020, but greater than the values estimated for the previous decade.

Reference points

The IPHC's interim management procedure uses a relative spawning biomass of 30% as a trigger, below which the target fishing intensity is reduced. At a spawning biomass limit of 20%, directed fishing is halted due to the critically low biomass condition. Beginning with the 2019 stock assessment, this calculation has been based on recent biological conditions rather than a long-term static average. By using current weight-at-age and estimated recruitments influencing the current stock only, the 'dynamic' calculation measures the effect of fishing on the spawning biomass. The relative spawning biomass in 2021 was estimated to be 33% (credible interval: 22-52%) down slightly from 34% in 2020, but greater than the values estimated for the previous decade. The probability that the stock is below the $SB_{30\%}$ level is estimated to be 41% at the beginning of 2021, with less than a 1% chance that the stock is below $SB_{20\%}$. The IPHC's current interim management procedure specifies a target level of fishing intensity of a Spawning Potential Ratio (SPR) corresponding to an $F_{43\%}$; this equates to the level of fishing that would reduce the lifetime spawning output per recruit to 43% of the unfished level given current biology, fishery characteristics and demographics. Based on the 2020 assessment, the 2020 fishing intensity is estimated to correspond to an $F_{48\%}$ (credible interval: 34-65%), less than values estimated over the previous decade. This drop in fishing intensity corresponds to the reduction in mortality limits adopted for 2020 and the actual mortality of several sectors totaling less than predicted.

Sources of uncertainty

Sources of uncertainty are considered where possible, but there are important sources that are not included. For example, the historical sex ratio information and degree of variability remains unknown.

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

Offloading Pacific halibut at Bellingham Cold Storage in Bellingham, WA, U.S.A.. Photo by Caroline Prem.

The assessment utilized three years (2017-19) of sex-ratio information from the directed commercial fishery landings. However, uncertainty in historical ratios, and the degree of variability likely present in those and future fisheries remains unknown. Additional years of data are likely to further inform selectivity parameters and cumulatively reduce uncertainty in stock size in the future; efforts to better understand historical sex-ratios are underway. The treatment of spatial dynamics and movement rates among Biological Regions, which are represented via the coastwide and AAF approaches, has large implications for the current stock trend, as evidenced by the different results among the four models comprising the stock assessment ensemble. This assessment also does not include mortality, trends or explicit demographic linkages with Russian waters, although such linkages may be increasingly important as warming waters in the Bering Sea allow for potentially important exchange across the international border.

Fisheries Data Specialist Kamala Carroll sampling a Pacific halibut dockside. Photo by Caroline Prem.

Additional important contributors to assessment uncertainty (and potential bias) include factors influencing recruitment, size-at-age, and some estimated components of the fishery removals. The link between Pacific halibut recruitment strengths and environmental conditions remains poorly understood, and although correlation with the Pacific Decadal Oscillation is currently useful, it may not remain so in the future. Therefore, recruitment variability remains a substantial source of uncertainty in current stock estimates due to the lack of mechanistic understanding and 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 have been a critically important driver of stock trends, but its cause also remains unknown. Like most stock assessments, mortality estimates are assumed to be accurate. Therefore, uncertainty due to discard mortality estimation (observer sampling and representativeness), discard mortality rates, and any other unreported sources of removals in either directed or non-directed fisheries (e.g. whale depredation) could create bias in this assessment.

Maturation schedules are currently under renewed investigation by the IPHC. Currently used historical values are based on visual field assessments, and the simple assumption that fecundity is proportional to spawning biomass and that Pacific halibut do not experience appreciable skip-spawning (physiologically mature fish which do not actually spawn due to environmental or other conditions). To the degree that maturity, fecundity or skip spawning may be temporally variable, the current approach could result in bias in the stock assessment trends and reference points. New information will be incorporated as it becomes available; however, it may take years to better understand these biological processes at the scale of the entire population.

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

Due to the many remaining uncertainties in Pacific halibut biology and population dynamics, a high degree of uncertainty in both stock scale and trend will continue to be an integral part of an annual decision making process.

Outlook

Stock projections were conducted using the integrated results from the stock assessment ensemble in tandem with summaries of the 2020 directed and non-directed fisheries. The harvest decision table (Table 10) provides a comparison of the relative risk (in times out of 100), using stock and fishery metrics (rows), against a range of alternative harvest levels for 2021 (columns). A grid of alternative TCEY values corresponding to SPR values from 40% to 46% is also provided to allow for finer detail across the range of estimated SPR values identified by the MSE process as performing well with regard to stock and fishery objectives. For each row of the decision table, the mortality (including all sizes and sources), the coastwide TCEY and the associated level of fishing intensity projected for 2021 (median value with the 95% credible interval below) are reported.

The projections for this assessment are slightly more optimistic than in the 2019 assessment; however, a high probability of stock decline (approximately 2/3) is estimated for the entire range of SPR values from 40-46%. The stock is projected to decrease with at least a 51% chance over the period from 2021-23 for all TCEYs greater than the "3-year surplus" of 24.4 million pounds (~11,068 t), corresponding to a projected SPR of 58% (credible interval 39-76%). At the *status quo* TCEY (36.6 million lb, (~16,600 t), the probability of spawning biomass declines is 62 and 61% for one and three years respectively. At the reference level (a projected SPR of 43%) the probability of spawning biomass decline to 2022 is 65%, decreasing to 63% in three years, as the 2011 and 2012 cohorts mature. The one-year risk of the stock dropping below $SB_{30\%}$ ranges from 35% (at the 3-year surplus level) to 41% at the reference TCEY. Over three years these probabilities range from 29% to 44% depending on the level of mortality.

Scientific advice

Sources of mortality

In 2020, total Pacific mortality due to fishing was down to 35.50 million pounds (16,103 t) from 39.87 million pounds (18,086 t) in 2019 (updated for this assessment). Of that total, 84% comprised the retained catch, up from 81% in 2019.

In 2020, total Pacific halibut mortality was 89% of that estimated in 2019.

Stock status (spawning biomass)

Current (beginning of 2021) female spawning biomass is estimated to be 192 million pounds (87,050 t), which corresponds to an 41% chance of being below the IPHC trigger reference point of $SB_{30\%}$, and less than a 1% chance of being below the IPHC limit reference point of $SB_{20\%}$. The stock is estimated to have declined by 17% since 2016 but is currently at 33% of the unfished state (Figure 3). Therefore, the stock is considered to be '**not overfished**'. Projections indicate that mortality consistent with the interim management procedure reference fishing intensity ($F_{43\%}$) is likely to result in further declining biomass levels in the near future.

Fishing intensity

The 2020 mortality corresponded to a point estimate of SPR = 48%; there is a 38% chance that fishing intensity exceeded the IPHC's current reference level of 43% (Figure 3). The Commission does not currently have a coastwide fishing intensity limit reference point. However, given that the stock is above the spawning biomass limit reference point, the stock is by default classified as '**not subject to overfishing**'.

Table 10. Harvest decision table for the 2021 mortality limits. Columns correspond to yield alternatives and rows to risk metrics. Values in the table represent the probablity, in "times out of 100" (or percent chance) of a particular risk.

		2021 Alternative		3-Year Surplus		Status quo		Reference $F_{43\%}$					
		Total mortality (M lb)	0.0	25.7	36.8	37.9	39.1	40.3	41.5	42.9	44.1	61.3	
		TCEY (M lb)	0.0	24.4	35.5	36.6	37.8	39.0	40.3	41.6	42.8	60.0	
		2021 fishing intensity	$F_{100\%}$	$F_{58\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{30\%}$	
		Fishing intensity interval	--	39-76%	29-65%	29-64%	28-63%	27-62%	26-61%	26-60%	25-59%	18-49%	
Stock Trend (spawning biomass)	in 2022	is less than 2021	<1	42	61	62	64	65	66	67	69	82	a
		is 5% less than 2021	<1	7	32	34	36	39	41	44	46	66	b
	in 2023	is less than 2021	<1	51	62	63	64	65	66	67	69	81	c
		is 5% less than 2021	<1	32	53	54	55	56	57	59	59	74	d
	in 2024	is less than 2021	<1	50	60	61	62	63	64	66	67	80	e
		is 5% less than 2021	<1	40	55	56	57	57	58	59	60	74	f
Stock Status (Spawning biomass)	in 2022	is less than 30%	29	35	39	40	40	41	41	42	42	47	g
		is less than 20%	<1	<1	<1	<1	1	1	1	1	1	4	h
	in 2023	is less than 30%	23	32	39	40	40	41	42	43	43	49	i
		is less than 20%	<1	<1	2	2	3	3	4	5	5	19	j
	in 2024	is less than 30%	12	29	38	39	40	41	42	43	44	50	k
		is less than 20%	<1	<1	4	5	6	8	9	10	12	25	l
Fishery Trend (TCEY)	in 2022	is less than 2021	0	17	48	49	50	50	50	51	51	77	m
		is 10% less than 2021	0	6	41	44	46	48	49	50	50	63	n
	in 2023	is less than 2021	0	21	49	50	50	50	50	51	51	75	o
		is 10% less than 2021	0	11	45	47	48	49	50	50	50	64	p
	in 2024	is less than 2021	0	23	49	50	50	50	50	51	51	74	q
		is 10% less than 2021	0	13	47	48	49	49	50	50	50	64	r
Fishery Status (Fishing intensity)	in 2021	is above $F_{43\%}$	0	15	48	49	50	50	50	51	51	78	s

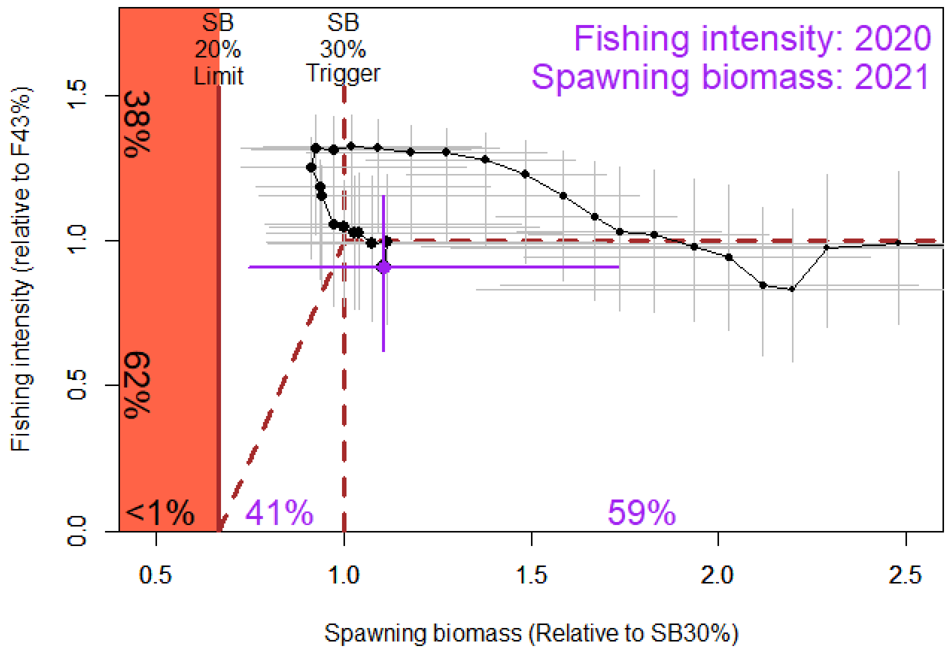


Figure 3. Phase plot showing the time-series (1992-2021) of estimated spawning biomass and fishing intensity relative to the reference points specified in the IPHC's interim management procedure. Dashed lines indicate the current $F_{43\%}$ (horizontal) reference fishing intensity, with linear reduction below the $SB_{30\%}$ (vertical) trigger, the red area indicates relative spawning biomass levels below the $SB_{20\%}$ limit. Each year of the time series is denoted by a solid point (credible intervals by horizontal and vertical whiskers), with the relative fishing intensity in 2020 and spawning biomass at the beginning of 2021 shown as the largest point (purple). Percentages along the y-axis indicate the probability of being above and below $F_{43\%}$ in 2020; percentages on the x-axis the the probabilities of being below $SB_{20\%}$, between $SB_{20\%}$ and $SB_{30\%}$ and above $SB_{30\%}$ at the beginning of 2021.

Biological Region 4 (made up of IPHC Regulatory Areas 4A, 4C, 4D, 4E) is near the historical high estimated for 2019, and has shown an increasing trend since the early 1990s.

Stock distribution

The proportion of the coastwide stock represented by Biological Region 3 has been largely decreasing since 2004, and increasing in Biological Regions 2 and 4. However, there was an increase in Biological Region 3 in 2020 and a decrease in Biological Region 2. Biological Region 4 is near the historical high estimated for 2019, and has shown an increasing trend since the early 1990s.

Future research in support of the stock assessment

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

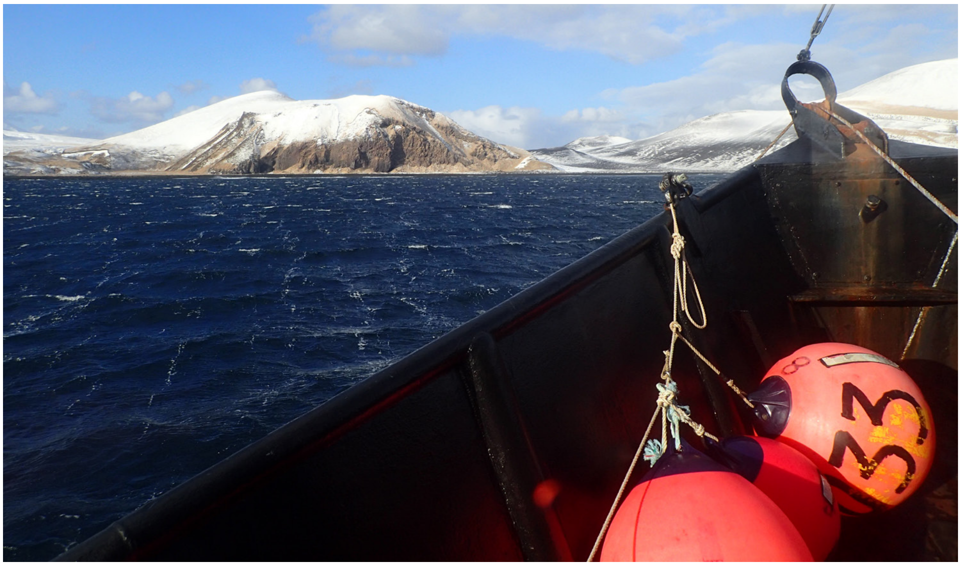
Harvest strategy policy

Harvest strategy policy has a long history at the IPHC and many analyses and simulation studies have informed the development of past policies, and resultant harvest strategies. The IPHC Harvest Strategy Policy provides a framework for applying a science-based approach to setting harvest levels for Pacific halibut throughout the IPHC Convention Area. The policy uses a management procedure that incorporates science and policy to determine the coastwide Total Constant Exploitation Yield (TCEY) and then distribute it across all IPHC Regulatory Areas.

In 2017 the Commission agreed to modify the policy by separating the scale (coastwide fishing intensity) and the distribution of fishing mortality. In 2018, the Management Strategy Evaluation (MSE) process provided recommendations on the scale portion of the policy. The first step in the modified harvest strategy policy would be to determine the TCEY from the coastwide fishing intensity (scale) on the coastwide stock based on Spawning Potential Ratio (SPR). Once the coastwide TCEY is determined it is split into a TCEY for each IPHC Regulatory Area. 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.

The interim harvest strategy currently centers around a fishing mortality rate that corresponds to a SPR of 43 percent.

The interim harvest strategy (also referred to as the SPR-based harvest strategy) currently centers around a fishing mortality rate that corresponds to a SPR of 43 percent (a 57 percent reduction in the spawning potential). This interim SPR was based on the range of values identified through the MSE process, considering the trade-off between yield and variability in the stock and fishery dynamics while ensuring that conservation objectives are met. 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.



A view from the bow of the *F/V Kema Sue* near the Aleutian Islands, AK, U.S.A.. Photo by Anna Simeon.

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. The MSAB will provide suggestions that are evaluated against objectives defined by all of the parties involved.

At the IPHC, the MSE process has been interactive and includes a board made up of stakeholders and managers involved in the resource.

The MSE analysis was completed in 2020 with an evaluation and comparison of many candidate management procedures to be presented to the Commission for potential adoption and implementation in 2021. These management procedures were made up of many different elements to determine the coastwide TCEY and distribute it to IPHC Regulatory Areas. Conservation and fishery objectives were used for the evaluations and trade-offs between those objectives were considered. It was found that SPR values in the range of 40% to 46% met the currently defined objectives and averaging recent estimates of the stock distribution improved stability of the TCEY for IPHC Regulatory Areas. Potentially increasing the fishing intensity to accommodate some IPHC Regulatory Areas may also meet short-term objectives but could perform worse in the long-term. The various elements investigated could be combined to create new management procedures and subsequently evaluated to determine if the new combination would show improved outcomes.

Management Strategy Advisory Board (MSAB)

The central role of the Management Strategy Advisory Board (MSAB) is to provide advice to the Commission on options for fishery objectives, performance metrics, candidate management procedures, and to measure the performance of various management strategies against the defined objectives. After three meetings in 2020, the MSAB discussed objectives, defined the management procedures to simulate, provided insight to the evaluations, and examined trade-offs between the management procedures. Five management procedures were identified by the MSAB that would meet the Commission objectives.

Research

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology and ecology of the Pacific halibut. The main objectives of the IPHC's 5-year Biological and Ecosystem Sciences 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.

The IPHC has a 5-year research plan that organizes objectives and resources for biological and ecological research.

The IPHC Secretariat develops new projects that are designed to address key biological and ecological topics as well as the continuation of certain projects initiated in previous years. Projects are based on 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). Importantly, biological and ecological research activities at IPHC are guided by a 5-year plan that identifies key research areas that follow Commission objectives (Table 11).

The IPHC conducts data collection activities from fishery-independent and fishery-dependent sources such as the IPHC fishery-independent setline survey and commercial fishery landings, respectively, which are described in other chapters of this report.

F/V Kema Sue docking in the Aleutian Islands, AK, U.S.A. during a winter research charter to collect Pacific halibut reproductive samples. Photo by Anna Simeon.

Table 11. A summary of the key research areas as described in the Five-Year Research Plan for the period 2017-21.

Key research areas	Description
Migration and Distribution	Improve our knowledge of Pacific halibut migration throughout all life stages in order to achieve a complete understanding of stock distribution and the factors that influence it
Reproduction	Provide information on the sex ratio of the commercial landings 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 directed longline, recreational and trawl fisheries
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

Projects are based on input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC.

Migration and distribution

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) Fisheries groundfish trawl surveys in 2015. Tagging has continued on the trawl surveys and was expanded to the IPHC fishery-independent setline survey (FISS) in 2016.

In 2020, no tagging of small Pacific halibut (< 82 cm fork length or "U32") took place on the NOAA-Fisheries groundfish trawl survey due its cancellation as a result of COVID-19. On the IPHC FISS, a total of 3,980 U32 Pacific halibut have been wire tagged are released and 74 of those have been recovered to date. In 2020, 868 U32 fish were wire-tagged and released: 321 fish in Regulatory Area 2B and 547 fish in Regulatory Area 3A. Tissue samples (fin clips) for genetic analyses were also collected from tagged fish (Table 12).

Table 12. Recoveries of tagged Pacific halibut from U32 wire tagging conducted between 2015 and 2020 by release and recovery Regulatory Area.

Releases		Recovery Regulatory Area										
Reg Area	**Total releases**	**2A**	**2B**	**2C**	**3A**	**3B**	**4A**	**4B**	**4D**	**4E**	**CLS**	**Total**
2A	**34**	1	3									**4**
2B	**956**	1	32									**33**
2C	**747**		9	23	1							**33**
3A	**2,570**				36	1						**37**
3B	**2,291**		1		4	27	1			1	1	**35**
4A	**1,095**			1	2		7	1		1		**12**
4B	**369**							6				**6**
4C	**244**			1			1					**2**
4D	**469**		1				1		3	1		**6**
4E	**1,420**								1	2	3	**6**
CLS	**544**				2	1	1			1		**5**
Total	**10,739**	**2**	**46**	**25**	**45**	**29**	**11**	**7**	**4**	**6**	**4**	**179**

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

Modelling of larval connectivity found that up to 50-60% of simulated larvae from the western GOA arrive in the BS through Aleutian Island passes with progressively fewer larvae arriving proportional to distance from spawning grounds further east.

Knowledge of the dispersal of Pacific halibut larvae and subsequent migration of young juveniles has remained elusive because traditional tagging methods are not effective on these life stages due to the small size of the fish. This larval connectivity project, in cooperation with NOAA EcoFOCI, used two recently developed modeling approaches to estimate dispersal and migration pathways in order to better understand the connectivity of populations both within and between the Gulf of Alaska (GOA) and Bering Sea (BS) (Sadorus et al. 2021[1]). In brief, to improve current understanding of larval dispersal pathways and migrations of young fish within and between GOA and BS, investigations were conducted to (1) examine pelagic larval dispersal and connectivity between the two basins using an individual-based biophysical model (IBM), and (2) track movement of fish up to age-6 years using annual age-based distributions and a spatio-temporal modeling approach. IBM results indicate that the Aleutian Islands constrain connectivity between GOA and BS, but that large island passes serve as pathways between these ecosystems. The degree of connectivity between GOA and BS is influenced by spawning location such that up to 50-60% of simulated larvae from the westernmost GOA spawning location arrive in the BS with progressively fewer larvae arriving proportional to distance from spawning grounds further east. There is also a large degree of connectivity between eastern and western GOA and between eastern and western BS. Spatial modeling of 2-6 year old fish shows ontogenetic migration from the inshore settlement areas of eastern BS towards Unimak Pass and GOA by age 4. The pattern of larval dispersal from GOA to BS, and subsequent post-settlement migrations back from BS toward GOA, provides evidence of circular, multiple life-stage, connectivity between these ecosystems, regardless of temperature stanza or year

[1] Sadorus LL, Goldstein ED, Webster RA, Stockhausen WT, Planas JV, Duffy-Anderson JT (2021) Multiple life-stage connectivity of Pacific halibut (Hippoglossus stenolepis) across the Bering Sea and Gulf of Alaska. *Fish. Oceanogr.* 30(2):174-193.

class strength. The results of these studies will improve estimates of productivity by contributing to the generation of potential recruitment covariates and by informing minimum spawning biomass targets by Biological Region. In addition, these results will assist in the biological parameterization and validation of movement estimates in the MSE Operating Model.

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 landings

The IPHC has generated sex information of the entire set of aged commercial fishery samples collected in 2017 and in 2018 (>10,000 fin clips per year) using genetic techniques.

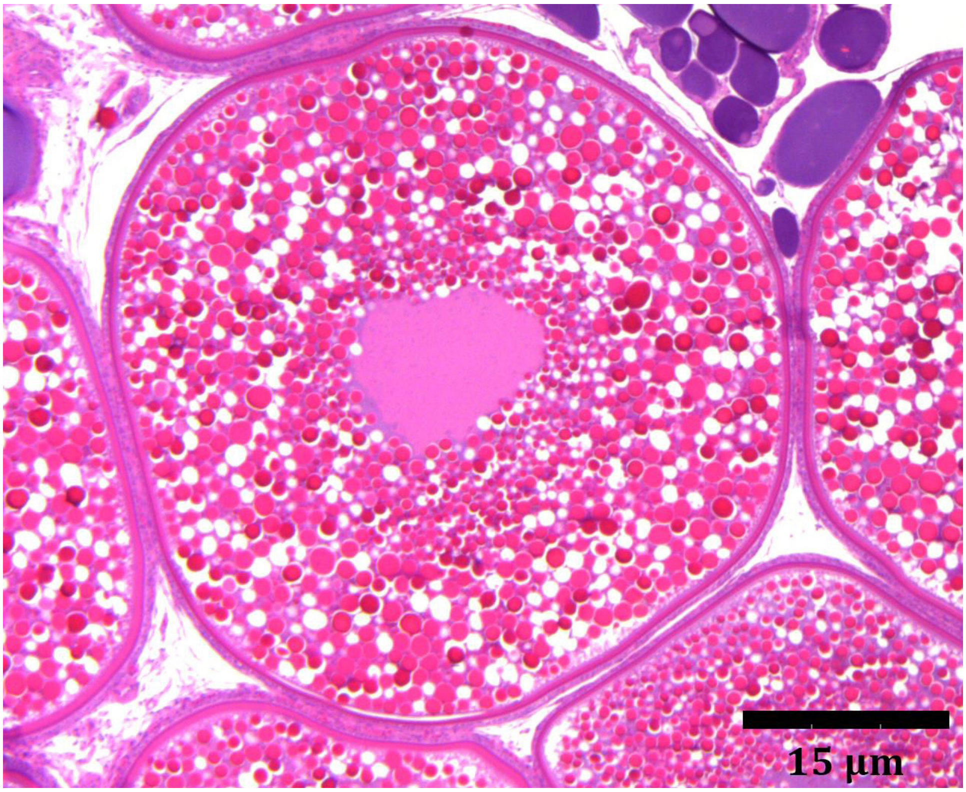
Throughout the fishery's history, the sex ratio of commercially-caught Pacific halibut has remained unknown as landed individuals are eviscerated at sea and otherwise sexually indistinguishable. Historically, the sex ratio from the IPHC's fishery independent setline survey (FISS) has been the only direct source of sex-ratio information, but differences in size between individuals landed commercially and on the FISS suggested a greater proportion of females in the fishery.

The IPHC has generated sex information of the entire set of aged commercial fishery samples collected in 2017 and in 2018 (>10,000 fin clips per year) using genetic techniques based on the identification of sex-specific single nucleotide polymorphisms (SNPs) (Drinan et al., 2018[2]) using TaqMan qPCR assays conducted at the IPHC's Biological Laboratory. Therefore, for the first time, direct estimates of the sex-ratio at age for the directed commercial fishery have been available for stock assessment. Genetic analyses of commercial samples from 2017 showed that the proportion of females coastwide was high (82%), ranging from 65% to 92% depending on the biological region. Data from the 2018 commercial samples showed almost identical patterns, with females comprising 80% of the coastwide commercial landings (by number). Given that the sex-ratio data constitutes one of the two most important contributors to estimates of both population trend and scale, the inclusion of this information in the 2019 stock assessment resulted in higher spawning biomass. The IPHC Secretariat has recently completed the processing of genetic samples from the 2019 commercial landings and the results indicate that the percentage of females coastwide in the commercial catch is 78%, showing a continuous decline since 2017. Additional years of sex-ratio information of the commercial catch are likely to further inform selectivity parameters and cumulatively reduce uncertainty in future estimates of stock size, in addition to improving simulation of spawning biomass in the MSE Operating Model.

Reproductive assessment of female and male Pacific halibut

Each year, the IPHC 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

[2] Drinan DP, Loher T, and Hauser L (2018) Identification of Genomic Regions Associated With Sex in Pacific Halibut. *J Hered* 109: 326-332.



Histological image of Pacific halibut ovarian follicles. Photo by Teresa Fish.

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 may introduce an unknown 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 describing reproductive development and maturity in female Pacific halibut.

Seven different microscopic ovarian maturity stages have been established.

The IPHC Secretariat has described for the first time the different oocyte stages that are present in the ovary of female Pacific halibut and how these are used to classify females histologically to specific maturity stages (Fish et al.[3]). In brief, 8 different oocyte developmental stages have been described, from early primary growth oocytes until preovulatory oocytes, and their size and morphological characteristics established. Maturity classification was determined by assigning maturity status to the most advanced oocyte developmental stage present in ovarian tissue sections and 7 different microscopic maturity stages were established. Analysis of oocyte size frequency distribution among the seven different maturity stages provided evidence for the group-synchronous pattern of oocyte development and for the determinate fecundity reproductive strategy in female Pacific halibut. The results of this study will allow us to establish a comparison of the microscopic/histological and macroscopic/field classification

[3] Fish T, Wolf N, Harris BP, Planas JV (2020) A comprehensive description of oocyte developmental stages in Pacific halibut, Hippoglossus stenolepis. *J Fish Biol.* 97: 1880–1885.

criteria that are currently used to assign the maturity status of females that is used in stock assessment. The results of this study set the stage for and in-depth study on temporal changes in maturity, as assessed by microscopic observations of ovarian samples collected throughout an entire annual reproductive cycle, that is currently underway. Furthermore, the IPHC Secretariat is also establishing a comparison of the microscopic (e.g. histological) and macroscopic (e.g. visual) maturity classification criteria to determine whether field classification criteria that are currently used to assign the maturity status of females that is used in stock assessment needs to be revised in light of the improved knowledge on ovarian development.

Growth and physiological condition

The IPHC is conducting studies to try and understand the underlying reasons for changes in growth.

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 aims at identifying key molecular and biochemical growth signatures that could be used to monitor growth patterns in the Pacific halibut population. At the present time, transcriptomic and proteomic analyses of skeletal muscle from fish subjected to different temperature-induced growth manipulations have resulted in the identification of a number of genes and proteins that could represent potential growth markers for Pacific halibut.

In summary, temperature acclimation laboratory studies were conducted at the Hatfield Marine Science Center in Newport, OR in collaboration with scientists from the Alaska Fisheries Science Center under the framework of a research grant funded by the North Pacific Research Board to the IPHC (NPRB 1704; 2017-2020). These studies resulted in the successful manipulation of growth patterns: 1) growth suppression by acclimation to low water temperature and 2) growth stimulation by temperature-induced growth compensation in juvenile Pacific halibut. White skeletal muscle samples from the control and treatment groups resulting from the two types of growth manipulations were collected and processed for transcriptomic (i. e. RNAseq) and proteomic analyses. Temperature induced growth suppression resulted in a significantly decrease in the mRNA expression levels of 676 annotated genes and in a significantly decrease in the abundance of 150 annotated proteins. In contrast, temperature-induced growth stimulation resulted in a significant increase in the mRNA expression levels of 202 annotated genes and a significant increase in the abundance of 149 annotated proteins. Based on the transcriptomic results, a set of potential growth marker genes has been selected for validation by qPCR as well as a set of potential housekeeping genes for normalization of expression levels. The identified growth marker genes will be tested using muscle samples from wild-caught Pacific halibut in order to validate the use of these markers to monitor growth patterns in the wild.

Other studies that the Secretariat is conducting with regards to the study of factors that may result in growth alterations involve investigating the effects of density and handling stress on somatic growth. In particular, additional laboratory experiments were conducted in which juvenile Pacific halibut were held in groups of 8 fish per tank (with 4 replicate tanks), 4 fish per tank (with 4 replicate tanks) and also individually (with 10 replicate tanks) under restricted feeding (at 50% of maximal feeding rate) for a period of 6 weeks. White skeletal muscle samples and liver samples were collected from fish at different densities and differential gene expression by conducted by RNAseq analyses. Our studies evaluating the effects of handling stress on somatic growth involved air exposure of juvenile Pacific halibut and white muscle samples from fish exposed or not to air were collected for analysis of growth marker gene expression. These studies will allow (1) the identification of genes whose expression is indicative of growth changes and (2) the identification of common or unique responses to the different growth manipulations (i.e. temperature- versus density- or stress-induced).

F/V Kema Sue and *F/V Advancer* docked in Adak, AK, U.S.A.. Photo by Anna Simeon.

Discard mortality and survival

Information on all Pacific halibut removals is integrated by the IPHC Secretariat, providing annual estimates of total mortality from all sources for its stock assessment. Discarding of Pacific halibut via the incidental catch of fish in non-target fisheries and the mortality that occurs in the directed fishery (i.e. fish discarded for sublegal size or for regulatory reasons), respectively, represent important sources of mortality that can result in significant reductions in exploitable yield in the directed fishery. Given that the incidental mortality from the commercial Pacific halibut fisheries and bycatch fisheries is included as part of the total removals that are accounted for in stock assessment, changes in the estimates of incidental mortality will influence the output of the stock assessment and, consequently, the catch levels of the directed fishery. For this reason, the IPHC Secretariat is conducting investigations on the effects of capture and release on survival and on providing experimentally-derived estimates of DMRs in the directed longline and guided recreational Pacific halibut fisheries that will improve trends in unobserved mortality in stock assessment and that will be important for fishery parameterisation.

The IPHC Secretariat is conducting investigations on the effects of capture and release on survival and on providing experimentally-derived estimates of DMRs in the directed longline and guided recreational Pacific halibut fisheries.

Discard mortality rates in the directed Pacific halibut fishery

In order to better estimate post-release survival of Pacific halibut caught incidentally in the directed longline fishery, the IPHC Secretariat is conducting investigations to understand the relationship between fish handling practices and fish physical and physiological condition and survival post-capture as assessed by tagging. We initially evaluated the effects of different release techniques (i.e. careful shake, gangion cutting) on injury levels and the results indicate that a majority (more than 70%) of Pacific halibut released by careful shake and by gangion cutting are classified in the excellent injury category. In contrast, Pacific halibut that encounter the hook stripper are primarily classified in the medium and poor injury categories. In addition, the physiological condition of Pacific halibut subjected to the different hook release techniques is currently being assessed by relating the injury category assigned to each fish with the condition factor, fat levels and levels of stress indicators in the blood (e.g. glucose, lactate and cortisol).

Discard mortality rates of Pacific halibut in the recreational fishery

The IPHC initiated a research project in 2019 aimed at experimentally deriving discard mortality rates from the charter recreational fishery for the first time. As an initial step in this project, information from the charter fleet on types of gear and fish handling practices was collected through stakeholder meetings and on dock interviews with charter captains and operators. Results show that the guided recreational fleet predominantly uses circle hooks (75-100%), followed by jigs. Predominant hook release methods included reversing the hook (54%), or twisting the hook out with a gaff (40%), and the fish were generally handled by supporting both the head and tail (65%), while other common techniques included handling by the operculum (10%) or by the tail alone (10%). These results will inform the design of the experimental test fishing that will take place in Spring/Summer of 2021 and in which injury levels, fish condition and stress parameters will be evaluated to identify best practices intended to minimize discard mortality in this fishery and to provide direct estimates of discard survival.

Genetics and genomics

Genetic studies at the IPHC are focused on the investigation of population structure and genetic diversity.

Novel technical advances in genetic analyses of wild fish populations through the application of whole genome sequencing allow for an unprecedented level of resolution of genetic diversity. The IPHC Secretariat is currently conducting genomic analyses of population structure and genetic diversity of Pacific halibut with the use of whole genome resequencing technologies that are now possible with the completed draft sequence of the Pacific halibut genome.

Genomic analyses of stock structure and genetic diversity

Understanding population structure is imperative for sound management and conservation of natural resources (Hauser, 2008[4]). Pacific halibut in Canadian and U.S.A. waters are managed by the International Pacific Halibut Commission (IPHC) as a single coastwide unit stock since 2006. The rationale

[4] Hauser L, and Carvalho GR (2008). Paradigm shifts in marine fisheries genetics: ugly hypotheses slain by beautiful facts. Fish and Fisheries 9, 333-362.

Biological and Ecosystem Sciences Branch Manager, Dr. Josep Planas, presents the IPHC 5-year research plan at the 2020 Annual Meeting (AM096).

behind this management approach is based on our current knowledge of the highly migratory nature of Pacific halibut as assessed by tagging studies (Webster et al., 2013[5]) and of past analyses of genetic population structure that failed to demonstrate significant differentiation in the North-eastern Pacific Ocean population of Pacific halibut by allozyme (Grant, 1984[6]) and small-scale microsatellite analyses (Bentzen, 1998[7]; Nielsen et al., 2010[8]). However, more recent studies have reported slight genetic population structure on the basis of genetic analysis conducted with larger sets of microsatellites suggesting that Pacific halibut captured in the Aleutian Islands may be genetically distinct from other areas (Drinan et al., 2016[9]). These findings of subtle genetic structure in the Aleutian Island chain area are attributed to limited movement of adults and exchange of larvae between this area and the rest of the stock due to the presence of oceanographic barriers to larval and adult dispersal (i.e. Amchitka Pass) that could represent barriers to gene flow. Unfortunately, genetic studies suggesting subtle genetic structure (Drinan et al., 2016[8]) were conducted based on a relatively limited set of microsatellite markers and, importantly, using genetic samples collected in the summer (i.e. non-spawning season) that may not be representative of the local spawning population. With the collection of winter (i.e. spawning season) genetic samples in the Aleutian Islands by the IPHC in early 2020, a collection of winter samples from 5 different geographic areas across the North-eastern Pacific Ocean (i.e. British Columbia, Central Gulf of Alaska, Bering Sea, Central and Western Aleutian Islands) is now available to re-examine the genetic structure of the Pacific halibut population. Importantly, novel, high-throughput and high-resolution genomics approaches are now available for use, such as low-coverage whole genome resequencing, in

A second genetic objective is to evaluate the genetic diversity among juvenile Pacific halibut in a given ocean basin.

[5] Webster RA, Clark WG, Leaman BM, and Forsberg JE (2013) Pacific halibut on the move: a renewed understanding of adult migration from a coastwide tagging study. *Can. J. Fish. Aquat. Sci.*, 70:642-653.
[6] Grant WS, Teel DJ, and Kobayashi T (1984) Biochemical Population Genetics of Pacific Halibut (Hippoglossus stenolepis) and Comparison with Atlantic Halibut (Hippoglossus hippoglossus). *Can. J. Fish. Aquat. Sci.*41, 1083-1088.
[7] Bentzen P, Britt J, and Kwon J (1998) Genetic variation in Pacific halibut (Hippoglossus stenolepis) detected with novel microsatellite markers. Report of Assessment and Research Activities.1998.
[8] Nielsen JL, Graziano SL, Seitz AC (2010) Fine-scale population genetic structure in Alaskan Pacific halibut (Hippoglossus stenolepis). *Conservation Genetics* 11: 999-1012.
[9] Drinan DP, Galindo HM, Loher T, and Hauser L (2016) Subtle genetic population structure in Pacific halibut Hippoglossus stenolepis. *J Fish Biol* 89: 2571-2594.

The research into genetic diversity may eventually provide the ability to assign individuals to source populations.

order to describe with unprecedented detail the genetic structure of the Pacific halibut population. The recently sequenced Pacific halibut genome represents an essential resource for the success of the whole genome resequencing approach. The results from the proposed genomic studies will provide important information on spawning structure and, consequently, on the genetic baselines of source populations. Importantly, the results from these studies will provide management advice regarding the relative justifiability for considering the western Aleutians as a genetically-distinct substock. These research outcomes will represent important avenues for improving estimates of productivity and parametrization of the MSE Operating Model.

A second genetic objective is to evaluate the genetic variability or genetic diversity among juvenile Pacific halibut in a given ocean basin in order to infer information on the potential contribution from fish spawned in different areas to that particular ocean basin. We hypothesize that genetic variability among juvenile Pacific halibut captured in one particular ocean basin (e.g. eastern Bering Sea) may be indicative of mixing of individuals originating in different spawning grounds and, therefore, of movement. By comparing the genetic variability of fish between two ocean basins (i.e. eastern Bering Sea and Gulf of Alaska) with the application of low-coverage whole genome resequencing approaches, we will be able to evaluate the extent of the potential contribution from different sources (e.g. spawning groups) in each of the ocean basins and provide indications of relative movement of fish to these two different ocean basins. The use of genetic samples from juvenile Pacific halibut collected in the National Marine Fisheries Service trawl survey in the eastern Bering Sea and in the Gulf of Alaska, aged directly by otolith reading or indirectly through a length-age key, will allow us to provide information on genetic variability among fish that are at or near their settlement or nursery grounds. These studies will provide the ability to assign individual juvenile Pacific halibut to source populations (as established by investigating population structure) and genetic information on movement and distribution of juvenile Pacific halibut.

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 Secretariat has recently completed the generation of a first draft sequence of the Pacific halibut genome, the blueprint for all the genetic characteristics of the species. Briefly, the Pacific halibut genome has a size of 586 Mb and contains 24 chromosomes- covering 98.6% of the complete assembly with a N50 scaffold length of 25 Mb at a coverage of 91x. The Pacific halibut genome sequence has been submitted to the National Center for Biological Information (NCBI) with submission number SUB7094550 and with accession number JABBIT000000000. Furthermore, the Pacific halibut genome has been annotated and is available in NCBI as NCBI *Hippoglossus stenolepis* Annotation Release 100. The generated genomic resources will greatly assist current studies on the genetic structure of the Pacific halibut population, on the application of genetic signatures for assigning individuals to spawning populations and for a thorough characterization of regions of the genome or genes responsible for important traits of the species.

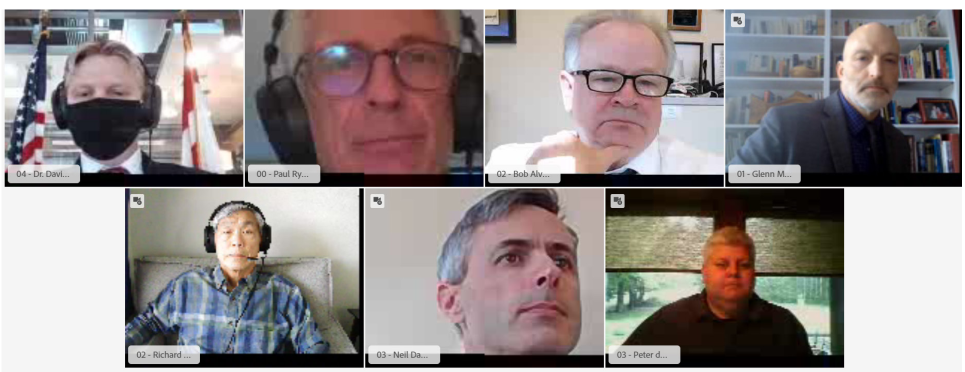
Looking forward

This section summarises the major decisions made at the 97th Session of the IPHC Annual Meeting (AM097), held 25-29 January 2021 in Seattle, WA, U.S.A. and via an electronic platform due to the COVID-19 pandemic. For a full accounting of documents and presentations provided to the Commission for the meeting, and the final report of the meeting, visit the IPHC webpage: https://www.iphc.int/venues/details/97th-session-of-the-iphc-annual-meeting-am097

Mortality limits

The 97th Session of the IPHC Annual Meeting (AM097) was held on an electronic platform due to the COVID-19 pandemic.

The Commission adopted mortality limits (described as Total Constant Exploitation Yield, TCEY limits) for 2021 as provided in Table 13. These mortality limits include a variety of estimated sources of mortality which are detailed in Table 14a and 14b.



Stakeholders were able to interact with Commissioners and the Secretariat electronically throughout AM097.

Table 13. Adopted Mortality limits (TCEY) for 2021.

Contracting IPHC Regulatory Area	Mortality limits (TCEY, net weight)		Percent
	Tonnes	Million Pounds	
Area 2B (British Columbia)	3,175	7.00	17.95
Total Canada	**3,175**	**7.00**	**17.95**
Area 2A (California, Oregon, and Washington)	748	1.65	4.23
Area 2C (southeastern Alaska)	2,631	5.80	14.87
Area 3A (central Gulf of Alaska)	6,350	14.00	35.90
Area 3B (western Gulf of Alaska)	1,415	3.12	8.00
Area 4A (eastern Aleutians)	930	2.05	5.26
Area 4B (central/western Aleutians)	635	1.40	3.59
Areas 4CDE (Bering Sea)	1,805	3.98	10.20
Total United States of America	**14,515**	**32.00**	**82.05**
Total (IPHC Convention Area)	**17,690**	**39.00**	**100**

Table 14a. Mortality table projected for the 2021 mortality limits (tonnes) by IPHC Regulatory Area.

Sector	IPHC Regulatory Area								
	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Commercial discard mortality	14	77	NA	NA	50	54	23	36	254
O26 non-directed discard mortality	45	104	41	517	191	109	54	998	2,059
Non-CSP recreational (+ discards)	NA	18	426	694	5	9	0	0	1,152
Subsistence	NA	186	168	86	9	5	0	14	463
Total non-FCEY	64	381	630	1,297	254	177	77	1,048	3,928
Commercial discard mortality	NA	NA	32	109	NA	NA	NA	NA	141
CSP recreational (+ discards)	277	417	367	885	NA	NA	NA	NA	1,946
Subsistence	14	NA	NA	NA	NA	NA	NA	NA	14
Commercial landings	395	2,372	1,601	4,060	1,161	753	558	757	11,657
Total FCEY	**685**	**2,790**	**2,000**	**5,053**	**1,161**	**753**	**558**	**757**	**13,762**
TCEY	**748**	**3,175**	**2,631**	**6,350**	**1,415**	**930**	**635**	**1,805**	**17,690**
U26 non-directed discard mortality	0	14	0	132	27	36	5	354	567
Total Mortality	**748**	**3,189**	**2,631**	**6,482**	**1,442**	**966**	**640**	**2,159**	**18,257**

Table 14b. Mortality table projected for the 2021 mortality limits (millions of net pounds) by IPHC Regulatory Area.

Sector	IPHC Regulatory Area								
	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Commercial discard mortality	0.03	0.17	NA	NA	0.11	0.12	0.05	0.08	0.56
O26 non-directed discard mortality	0.10	0.23	0.09	1.14	0.42	0.24	0.12	2.20	4.54
Non-CSP recreational (+ discards)	NA	0.04	0.94	1.53	0.01	0.02	0.00	0.00	2.54
Subsistence	NA	0.41	0.37	0.19	0.02	0.01	0.00	0.03	1.02
Total non-FCEY	0.14	0.84	1.39	2.86	0.56	0.39	0.17	2.31	8.66
Commercial discard mortality	NA	NA	0.07	0.24	NA	NA	NA	NA	0.31
CSP recreational (+ discards)	0.61	0.92	0.81	1.95	NA	NA	NA	NA	4.29
Subsistence	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Commercial landings	0.87	5.23	3.53	8.95	2.56	1.66	1.23	1.67	25.70
Total FCEY	**1.51**	**6.15**	**4.41**	**11.14**	**2.56**	**1.66**	**1.23**	**1.67**	**30.34**
TCEY	**1.65**	**7.00**	**5.80**	**14.00**	**3.12**	**2.05**	**1.40**	**3.98**	**39.00**
U26 non-directed discard mortality	0.00	0.03	0.00	0.29	0.06	0.08	0.01	0.78	1.25
Total Mortality	**1.65**	**7.03**	**5.80**	**14.29**	**3.18**	**2.13**	**1.41**	**4.76**	**40.25**

Fishing periods (season dates)

The Commission recommended a fishing period **6 March to 7 December** for all commercial Pacific halibut fisheries in Canada and the United States of America. All commercial fishing for Pacific halibut in all IPHC Regulatory Areas may begin no earlier than noon local time on 6 March and must cease by noon local time on 7 December.

Recommendations

Commercial Fishing Period – Year-round

The Commission recommended that further consultations between Contracting Parties and fishery stakeholders on the administrative and policy implications of a year round fishery would support the decision process for the 98th Session of the IPHC Annual Meeting (AM098; January 2022) on potential further extensions of the direct commercial fishing period.

IPHC Financial Regulations (2021)

The Commission:

1. endorsed and adopted the IPHC Financial Regulations (2021).
2. requested that the IPHC Secretariat will undertake an inter-sessional review and recommend further improvements to the Financial Regulations of the Commission, including the basis of accounting to better align with GAAP standards while maintaining regulatory compliance.

IPHC Rules of Procedure (2021)

The Commission:

1. adopted the IPHC Rules of Procedure (2021);
2. requested that the IPHC Secretariat undertake an inter-sessional review and recommend further improvements to the IPHC Rules of Procedure to the Commission, noting the CB's recommendation (to change when Chairs are elected in their rule), PAB noting the conflicting text in the Rules, and roles of the Commissions Secretariat.

Mr. Glenn Merrill was elected Chairperson for the 2021-22 cycle and Mr. Paul Ryall was elected Vice-Chairperson.

Upcoming IPHC meetings

Meeting	Date	Location
97th Session of the IPHC Interim Meeting (IM097)	30 November - 1 December 2021	Seattle, WA, U.S.A.
98th Session of the IPHC Annual Meeting (AM098)	24-28 January 2022	Seattle/Bellevue, WA, U.S.A.

Commission officers

The Commission elected Mr. Glenn Merrill (U.S.A.) as Chairperson of the IPHC, and Mr. Paul Ryall (Canada) as Vice-Chairperson of the IPHC.

IPHC Secretariat update

The activities highlighted in this report account for the majority of IPHC Secretariat time. However, there is also considerable effort put into public outreach, attending conferences and meetings that enhance knowledge, and contributing expertise to the broader scientific community through participation on boards and committees. Throughout 2020, the COVID-19 pandemic meant that most of the external engagement moved from in-person to electronic/virtual formats. This section highlights some of those activities.

Committees and Organization appointments

- Halibut Advisory Board – Dr. David T. Wilson
- NPFMC Bering Sea Fishery Ecosystem Plan Team - Dr. Ian Stewart
- North Pacific Research Board Science Panel - Dr. Josep Planas
- NPFMC Bering Sea/Aleutian Island Groundfish Plan Team - Dr. Allan Hicks
- NPFMC Scientific and Statistical Committee - Dr. Ian Stewart
- Interagency electronic reporting system for commercial fishery landings in Alaska (eLandings) - Huyen Tran (Steering committee)
- NPFMC Trawl Electronic Monitoring Committee - Huyen Tran

Conferences, Meetings, and Workshops (chronological order)

- Alaska Marine Science Symposium, 27-31 January, Anchorage, AK, U.S.A. – Dr. Josep Planas (presenter)
- Ocean Sciences Meeting, 16-21 February, San Diego, CA, U.S.A. - Lauri Sadorus (presenter)
- State of the Pacific Ocean (DFO), 10-11 March, Electronic - Lauri Sadorus
- 2nd AFSC Workshop on Ecosystem and Socioeconomic Profiles, 10-12 March, Seattle, WA – Dr. Ian Stewart
- Deep-Sea Coral and Sponge Alaska Initiative Workshop, 12-15 May, Electronic – Lauri Sadorus
- Working Group on Size and Species Selection Experiments (ICES-FAO), 10 December, Electronic – Claude Dykstra (observer)

Outreach

- Booth at the Pacific Northwest Sportsmen's Show, 5-9 February, Portland, OR, U.S.A. – Caroline Prem, Robert Tobin, Kimberly Sawyer Van Vleck
- Opportunities for Lifelong Education (Alaska Pacific University), 7 February, Anchorage, AK, U.S.A. – Dr. Josep Planas

Academic activities

- Alaska Pacific University affiliate faculty, Anchorage, AK, U.S.A. - Dr. Josep Planas
- University of Washington affiliate faculty, Seattle, WA, U.S.A. - Dr. Ian Stewart, Dr. Allan Hicks
- University of Washington student committee member, Seattle, WA, U.S.A. - Dr. Allan Hicks, Dr. Ian Stewart
- Alaska Pacific University student committee member, Anchorage, AK, U.S.A. - Dr. Josep Planas, Dr. Ian Stewart
- University of Massachusetts Dartmouth student committee member, Dartmouth, MA, U.S.A. - Dr. Allan Hicks

Financial performance report and statements

The IPHC is funded jointly by the governments of Canada and the United States of America (U.S.A.). For fiscal year 2020, contributions for general operating expenses were as follows:

- Canada: US$874,182;
- U.S.A.: US$4,075,094.

Additional contributions were made to the International Fisheries Commission's Pension Fund by each Party, and the U.S.A. is responsible for the IPHC Headquarters lease and maintenance.

Independent Auditor

The Commission's financial accounts for FY2020 were audited by the accounting firm of Moss Adams LLP. The auditor's opinion stated the IPHC's financial statements present fairly in all material respects. The basis of accounting is Regulatory Basis. The IPHC's Regulatory Compliance basis of accounting differs from the Generally Accepted Accounting Principles (GAAP) as follows:

1. Revenues are recorded in the fiscal year when appropriated by the governments of Canada and the United States of America and expenditures are recorded in the fiscal year in which the funds are committed by the Commission. Carryover funds and transfers between funds are recognized as income.
2. Fixed assets are charged to expenditures in the current year and are not capitalized.
3. Annual leave and severance pay are charged to expenses when paid.
4. Pension costs are charged to expense when funds necessary to fund the employer's normal pension costs are paid. Certain disclosures of pension costs required by generally accepted accounting principles are not included in the notes to the financial statements.
5. Post-retirement health care and life insurance costs are charged to expense when the related premiums are paid. Certain disclosures required by generally accepted accounting principles are not included in the notes to the financial statements.
6. Rent expense related to operating leases is expensed when paid and is not recognized on a straight-line basis over the life of the lease.

Statement of financial activities

For FY2020 (1 Oct. 2019 to 30 Sept. 2020), the IPHC total budgeted income for the General Fund was US$5,966,994 and US$262,186 from Carryover from FY2019 totaling US$6,229,180. The total expenditures were budgeted at US$7,104,094 which provided for a revenue over expenditures totaling US$(874,914).

The Supplemental Fund budget was US$4,910,707 and US$558,949 from Carryover from FY2019 totaling US$5,469,656. The total expenditures were budgeted at US$4,539,499 which provided for an excess in revenue over expenditures totaling US$930,157.

The IPHC total expenditure was US$11,044,554 against budgeted amount of US$11,643,593.

Statement of financial position

The fund balance total for the General Fund and the Supplemental Fund for FY2020 was US$1,941,489. The cash available in the Wells Fargo checking account at year end was US$2,407,747. The total equity or combined fund balance at year-end closing totaled US$1,941,434.32.

1. General Fund: US$275,872 – There was a correction for erroneous accounts payables in the amount of $356,669. This correction was incorporated into the fund balance.
2. Supplemental Fund: US$(1,665,617) – The supplemental fund balance includes designated funds totaling US$1,130,265 and undesignated funds totaling US$811, 224.

	2020		
	General Fund	Supplemental Fund	Total
Cash checking	$ 2,322,674	$ 85,073	$ 2,407,747
Investments - undesignated	-	2,838	2,838
Investments - designated	-	198,509	198,509
Accounts receivable	111,491	304,827	416,318
Deposits	12,789	-	12,789
Prepaid expenses	34,672	-	34,672
Advance (from)/to supplemental	(1,122,620)	1,122,620	-
Accounts payable	(1,083,134)	(48,250)	(1,131,384)
Fund balance	$ 275,872	$ 1,665,617	$ 1,941,489
Fund balance			
Designated	$ -	$ 1,130,265	$ 1,130,265
Undesignated	275,872	535,352	811,224
Fund balance	$ 275,872	$ 1,665,617	$ 1,941,489

MOSSADAMS

Report of Independent Auditors

To the Commissioners
International Pacific Halibut Commission

Report on the Financial Statements

We have audited the accompanying special purpose statement of revenues and expenses (compared to budget) and fund balances – regulatory basis, of the International Pacific Halibut Commission (a nonprofit organization), which comprise the statement of revenues and expenses (compared to budget) and fund balances – regulatory basis as of September 30, 2020, and the related notes to the financial statements.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with the financial reporting practices prescribed or permitted by the governments of the United States of America and Canada. Management is also responsible for the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements referred to above present fairly, in all material respects, the statement of revenues and expenses (compared to budget) and fund balances – regulatory basis of International Pacific Halibut Commission as of September 30, 2020, and for the year then ended, in accordance with the financial reporting practices prescribed or permitted by the governments of the United States of America and Canada as described in Note 1.

Other Matters

2019 Financial Statements

The financial statements as of and for the year ended September 30, 2019, were audited by other accountants, whose report thereon, dated August 6, 2020, stated that in their opinion, those financial statements present fairly, in all material respects, the statements of revenues and expenses (compared to budget) and fund balances – regulatory basis of International Pacific Halibut Commission as of and for the year then ended, in accordance with the financial reporting practices prescribed or permitted by the governments of the United States of America and Canada as described in Note 1.

Basis of Accounting

We draw attention to Note 1 of the financial statements, which describes the basis of accounting. As described in Note 1, these financial statements were prepared in conformity with the financial reporting practices prescribed or permitted by the governments of the United States of America and Canada, which is a basis of accounting other than accounting principles generally accepted in the United States of America, to meet the requirements of the governments of the United States of America and Canada. Our opinion is not modified with respect to this matter.

Restriction of Use

Our report is intended solely for the information and use of the commissioners and management of International Pacific Halibut Commission and is not intended to be and should not be used by anyone other than these specified parties.

Moss Adams LLP

Everett, Washington
December 18, 2020

Statement of financial activities

Revenues and expenses (compared to budget) for the period ending 30 September 2020.

Income	General Budget	Supplem. Fund Budget	Total Budget	General Income & Expense	Supplem. Funds Income & Expense	Total Income / Expense	Percent Of Budget	Over (Under) Budget
CONTRIBUTION FROM CANADA	$ 985,432	$ -	$ 985,432	$ 985,427	$ -	$ 985,427	100.0%	$ (5)
CONTRIBUTION FROM THE USA	4,532,000	-	4,532,000	4,532,000	-	4,532,000	100.0%	-
INTEREST	-	1,125	1,125	2,205	9,487	11,692	1039.3%	10,567
INTEREST - RESTRICTED ACCOUNTS	-	5,000	5,000	-	-	-	0.0%	(5,000)
OTHER INCOME	449,562	-	449,562	612,395	77,848	690,243	153.5%	240,681
FISH SALES REVENUE	-	4,904,582	4,904,582	49,048	4,294,566	4,343,614	88.6%	(560,968)
TOTAL INCOME	5,966,994	4,910,707	10,877,701	6,181,075	4,381,901	10,562,976	97.1%	(314,725)
CARRYOVER GENERAL	262,186	-	262,186	262,186	-	262,186	100.0%	-
CARRYOVER SUPPLEMENTAL FUNDS	-	558,949	558,949	-	181,664	181,664	32.5%	(377,285)
FUND BALANCE Prior Period Adjustment	-	-	-	356,669	-	356,669	0.0%	356,669
TRANSFER BETWEEN FUNDS	-	-	-	468,342	23,941	492,283	0.0%	492,283
TOTAL FUNDS AVAILABLE	6,229,180	5,469,656	11,698,836	7,268,272	4,587,506	11,855,778	101.3%	156,942
GENERAL EXPENSES								
SALARIES	3,727,384	451,959	4,179,343	3,604,932	727,945	4,332,877	103.7%	153,534
BENEFITS	1,559,413	14,025	1,573,438	1,456,619	175,992	1,632,611	103.8%	59,173
PAYROLL TAXES	-	-	-	-	-	-	-	-
RELOCATION EXPENSES	-	-	-	-	-	-	-	-
EMPLOYEE RELATED EXPENSES	100,580	86,644	187,224	51,411	3,317	54,728	29.2%	(132,496)
RESTRICTED ACCT: MEDICAL ANNUITANTS	-	-	-	-	-	-	0.0%	-
RESTRICTED ACCT: SCHOLARSHIP	-	-	-	-	-	-	0.0%	-
OTHER	87,225	552,202	639,427	112,675	82,056	194,731	30.5%	(444,696)
OCCUPATION INSURANCE	-	-	-	-	-	-	-	-
TOTAL GENERAL EXPENSES	5,474,602	1,104,830	6,579,432	5,225,637	989,310	6,214,947	94.5%	(364,485)
PROGRAM EXPENSES								
MEETINGS/CONFERENCES	154,500	-	154,500	177,528	-	177,528	114.9%	23,028
TRAVEL	197,200	111,920	309,120	81,405	32,933	114,338	37.0%	(194,782)
COMMUNICATIONS	22,265	82,650	104,915	16,510	1,034	17,544	16.7%	(87,371)
PRINTING & BINDING	37,000	-	37,000	31,082		31,082	84.0%	(5,918)
MAILING AND SHIPPING	-	-	-	14,875	76,372	91,247	0.0%	91,247
ADMINISTRATION	-	-	-	-	-	-	-	-
BUILDING LEASE AND MAINTENANCE	457,518	60,000	517,518	408,236	-	408,236	78.9%	(109,282)
SUPPLIES	273,487	889,505	1,162,992	64,782	572,567	637,349	54.8%	(525,643)
LEASES AND CONTRACTS	311,762	2,258,194	2,569,956	547,380	2,304,757	2,852,137	111.0%	282,181
PROFESSIONAL FEES	34,750	-	34,750	240,008	156	240,164	691.1%	205,414
TECHNOLOGY	-	-	-	137,808	-	137,808	-	137,808
CAPITAL ACQUISITIONS	141,010	32,400	173,410	47,149	75,025	122,174	70.5%	(51,236)
TOTAL PROGRAM EXPENSES	1,629,492	3,434,669	5,064,161	1,766,763	3,062,844	4,829,607	95.4%	(234,554)
TRANSFERS	-	-	-	-	-	-		
TOTAL EXPENDITURES	7,104,094	4,539,499	11,643,593	6,992,400	4,052,154	11,044,554	94.9%	(599,039)
EXCESS REVENUES OVER EXPENDITURES	$ (874,914)	$ 930,157	$ 55,243	$ 275,872	$ 535,352	$ 811,224		

Thank You

The IPHC wishes to thank all of the agencies, industry, and individuals who helped us in our investigations this year in support of the Commission's mandate. A special thank you goes to the following:

- Personnel in the many processing plants who assist the IPHC Secretariat in-port sampling and Fishery-Independent Setline Survey (FISS) by storing and staging equipment and supplies.
- IPHC Regulatory Area 2A tribal biologists and state agency staff for sampling IPHC Regulatory Area 2A tribal and non-tribal commercial fishery landings.
- CDQ managers for providing the total number and weight of undersized Pacific halibut retained by authorized persons and the methodology used to collect these data.
- The NOAA-Fisheries (NMFS) Observer Program for deploying observers on the IPHC Regulatory Area 2A directed commercial fishery, and for collecting, documenting, and forwarding tags recovered during observer deployments on commercial vessels.
- The NPFMC for their ongoing coordination with the IPHC.
- Fisheries and Oceans Canada for their ongoing coordination, in particular with electronic logbooks, Pacific halibut removal estimates and with IPHC FISS operations given protected habitats and species.
- Provincial, state and federal agency staff from both Canada and the U.S.A., as well as government contractors, for their assistance in the provision of data for the various fisheries impacting Pacific halibut mortality, landing notifications and for their assistance in conducting the IPHC FISS.
- The captains, crew, and plant personnel, as well as those individuals from outside agencies, whose dedicated contributions and efforts make the IPHC Secretariat operations a success.

2020 Publications

The IPHC publishes three serial publications - Annual reports, Scientific reports, and Technical Reports - and also prepares and distributes regulation pamphlets, information bulletins, and news releases. All items published by the IPHC can be found on the IPHC webpage (https://www.iphc.int). Articles and reports produced during 2020 and authored by the Secretariat are shown below.

IPHC (2020) International Pacific Halibut Commission 2019 Annual Report. IPHC-2020-AR2019-R. 72 p.

Fish T, Wolf N, Harris BP, Planas JV (2020) A comprehensive description of oocyte developmental stages in Pacific halibut, Hippoglossus stenolepis. Journal of Fish Biology. 97: 1880-1885. https://doi.org/10.1111/jfb.14551.

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Hutniczak B, Meere F (2020) International Co-operation as a Key Tool to Prevent IUU Fishing and Disputes over It. International Community Law Review 22:439–448. doi.org/10.1163/18719732-12341440

Lomeli MJM, Wakefield WW, Herrmann B, Dykstra CL, Simeon A, Rudy DM, Planas JV (2020) Use of Artificial Illumination to Reduce Pacific Halibut Bycatch in a U.S. West Coast Groundfish Bottom Trawl. Fisheries Research:233. doi.org/10.1016/j.fishres.2020.105737

Nielsen JK, Mueter FJ, Adkison MD, Loher T, McDermott SF, Seitz AC (2020) Potential utility of geomagnetic data for geolocation of demersal fishes in the North Pacific Ocean. Animal Biotelemetry. 8: 17. doi.org/10.1186/s40317-020-00204-0. doi.org/10.1111/faf.12425

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Commissioners

Canada

John Pease Babcock 1924-1936
William A. Found 1924-1936
George L. Alexander 1936-1937
Lewis W. Patmore.................. 1937-1943
A. J. Whitmore 1936-1948
Stewart Bates......................... 1948-1949
George W. Nickerson 1943-1953
George W. Clark 1949-1955
S. V. Ozere............................ 1955-1957
Harold S. Helland 1953-1963
Richard Nelson...................... 1953-1964
William Sprules..................... 1957-1973
Martin K. Eriksen.................. 1963-1973
Jack T. Prince......................... 1974-1976
Francis W. Millerd 1964-1977
Clifford R. Levelton 1974-1979
John A. O'Connor.................. 1978-1980
Peter C. Wallin....................... 1977-1982
Michael Hunter...................... 1979-1984
Sigurd Brynjolfson 1982-1986
Donald McLeod..................... 1981-1987
Garnet E. Jones...................... 1986-1987
Dennis N. Brock 1988-1989
Gary T. Williamson 1987-1992
Linda J. Alexander................. 1987-1992
Allan T. Sheppard.................. 1991-1995
Brian Van Dorp...................... 1993-1997
Gregg Best............................. 1995-1999
Rodney Pierce........................ 1997-1999
Kathleen Pearson................... 2000-2001
John Secord 2000-2005
Richard J. Beamish................ 1990-2005
Clifford Atleo......................... 2002-2008
Larry Johnson 2009-2011
Gary Robinson....................... 2005-2012
Laura Richards 2006-2012
Michael Pearson 2012-2014
David Boyes 2012-2016
Ted Assu 2014-2018
Jake Vanderheide................... 2017-2018
Robert Day 2018-2018
Paul Ryall 2013-
Neil Davis.............................. 2018-
Peter DeGreef........................ 2018-

United States of America

Miller Freeman...................... 1924-1932
Henry O'Malley 1924-1933
Frank T. Bell.......................... 1933-1940
Charles E. Jackson................. 1940-1946
Milton C. James..................... 1946-1952
Edward W. Allen.................... 1932-1955
J.W. Mendenhall.................... 1954-1958
Seton H. Thompson............... 1952-1959
Andrew W. Anderson 1959-1961
Mattias Madsen 1955-1964
William A. Bates 1958-1964
L. Adolph Mathisen............... 1965-1970
Harold E. Crowther 1961-1972
Haakon M. Selvar.................. 1964-1972
Neils M. Evens 1970-1982
Robert W. Schoning............... 1972-1982
William S. Gilbert 1972-1983
Gordon Jensen 1983-1983
Robert W. McVey 1983-1988
James W. Brooks 1988-1989
George A. Wade..................... 1984-1992
Richard Eliason 1984-1995
Kris Norosz............................ 1995-1997
Steven Pennoyer.................... 1989-2000
Andrew Scalzi 1998-2003
Ralph Hoard 1993-2013
Phillip Lestenkof 2003-2013
Chris Oliver 2013-2013
Donald Lane 2014-2015
Jeffrey Kauffman 2015-2016
James Balsiger....................... 2000-2018
Linda Behnken 2016-2018
Chris Oliver 2018-2020
Robert Alverson..................... 2014-
Richard Yamada..................... 2018-
Glenn Merrill......................... 2021-

Executive Directors

William F. Thompson............... 1923-1940
Henry A. Dunlop...................... 1940-1963
F. Heward Bell 1963-1970
Bernard E. Skud....................... 1970-1978
Donald A. McCaughran 1978-1998
Bruce M. Leaman..................... 1997-2016
David T. Wilson 2016-

Secretariat

Seattle Headquarters		
Name (Official)	**Branch**	**Job Title (Official)**
David T. Wilson, Ph.D.	Executive	Executive Director
Keith Jernigan, M.I.T.	Executive	Assistant Director
Barbara Hutniczak, Ph.D.	Fisheries Policy & Economics	Fisheries Economist
Kelly Chapman, B.A.	Finance and Personnel Services	Administrative Specialist
Robert Tynes	Finance and Personnel Services	Systems Administrator
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Ian Stewart, Ph.D.	Quantitative Sciences	Quantitative Scientist
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Andy Jasonowicz, M.Sc.	Biological & Ecosystem Sciences	Research Biologist
Timothy Loher, Ph.D.	Biological & Ecosystem Sciences	Research Scientist
Lauri Sadorus, M.Sc.	Biological & Ecosystem Sciences	Research Biologist
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Adam Ziegler	Biological & Ecosystem Sciences	Undergraduate Intern
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Huyen Tran	Fisheries Statistics & Services	Fisheries Data Manager
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Christopher Johnston, B.Sc.	Fisheries Statistics & Services	Otolith Technician
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Kayla Ualesi, B.Sc.	Fisheries Statistics & Services	Setline Survey Coordinator
Colin Jones, M.Sc.	Fisheries Statistics & Services	Setline Survey Specialist
Monica Thom	Fisheries Statistics & Services	Setline Survey Specialist
Jason Taylor	Fisheries Statistics & Services	Setline Survey Gear Assistant

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Michele Drummond	Juneau, AK
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Chelsea Hutton	Port Hardy, B. C.
David Jackson	Kodiak, AK
Jessica Marx	Homer, AK
Binget Nilsson	Seward, AK
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Danielle Bennett	Blanka Lederer
Sean Burns	Francis Maddox
Kevin Coll	Jessica Miller
Ian Eis	Samuel Parker
Allen (Dean) Gaidica	Noelle Rucinski
Ralph (Tyler) Jack-McCollough	Jason Taylor
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