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INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report
2014

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

This report produced by IPHC staff
and Katherine Gustafson
2015

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PREFACE

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

Three IPHC Commissioners are appointed by the Governor General of Canada and three by the President of the United States. The commissioners appoint the Director, who supervises the scientific and administrative staff. The scientific staff collects and analyzes the statistical and biological data needed to manage the halibut fishery. The IPHC headquarters and laboratory are located in Seattle, Washington.

The Commission meets annually to review all regulatory proposals, including those made by the scientific staff and industry; specifically the Conference Board and the Processor's Advisory Group. The measures recommended by the Commission are submitted to the two governments for approval. Upon approval the regulations are enforced by the appropriate agencies of both governments.

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

Unless otherwise indicated, all weights in this report are dressed weight (eviscerated, head-off). Round (live) weight may be calculated by dividing the dressed weight by 0.75.

On the Cover

The artwork on this year's cover was created by IPHC port sampler, Bryna Mills. Bryna is a biologist and artist, a graduate of Western Washington University and the University of Washington. She spends the summers and winters working in Western Alaska, and drawing in her spare time. In between seasons Bryna returns to the Seattle area, her home, and tries to catch as many Seahawks and Mariners games as possible.

Writer

Katherine Gustafson is a Seattle-based freelance writer and editor who has worked extensively with environmental nonprofits, including Conservation International, World Wildlife Fund, and Oceana. Her first book, Change Comes to Dinner, about positive change in the U.S. food industry, was published in 2012.

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INTRODUCTION

The state of the Pacific halibut stock today is receiving a lot of scrutiny. Fish numbers in some areas are at some of their lowest levels in the 90-year history of this fishery's management. However, they are not at their lowest ever and the recent trend in the stock is level. The International Pacific Halibut Commission (IPHC) applies sound science and careful, context-appropriate management to determine the appropriate yield from the stock. However, experience has shown that Mother Nature plays a big role in halibut stock levels and we need to see increases in recruitment before the stock will increase substantially. The IPHC staff is undertaking a wide range of projects that support the annual stock assessment, which will guide the establishment of harvest levels most fitting for the species and the fishery.

The IPHC is involved in a wide range of projects that guide the establishment of halibut harvest levels.

Amid the stress about population levels, there is promising news: Bycatch has declined by almost 25 percent coastwide over the course of the past decade.

Schooners tied up to the dock at Fishermen's Terminal in Seattle, WA. Photo by Steve Keith.

The IPHC knows that even such positive progress is not enough, however, and will continue to work with the North Pacific and Pacific Fishery Management Councils (NPFMC, PFMC, respectively) and Fisheries and Oceans Canada (DFO) to achieve further reduction. Also tempering this result is the inescapable fact that while bycatch has declined, so has the halibut stock, and the proportion of total removals from the stock resulting from bycatch has increased from 12% to 21% over the same period. Measures to address the problem include new domestic programs in Alaska such as a catch-sharing program, a restructured observer program, and an ongoing effort to design an electronic monitoring system for small vessels.

While the Pacific halibut population faces challenges, the IPHC and its partners have all the knowledge, technology, and determination to adequately meet them. The IPHC process represents best practices in fishery management, an example that guides similar efforts around the world. The success of the IPHC model is based largely on its process being a truly binational, intersectoral collaboration that incorporates government, industry, and the community.

Caring for this vulnerable species is a task that the IPHC undertakes to benefit everyone and the process would not be nearly so successful without the open and energetic collaboration of all the many stakeholders in the management process. The Commission looks forward to many more years of pushing the boundaries of management science and working closely with all of those in our communities to ensure successful outcomes for the resource.

Director's report

In my comments in last year's Annual Report, I noted how much and how rapidly change was coming to what we do at the Commission. That can be unsettling. After all, we need to have business plans, feed our families, work with partners, and that can be hard in the midst of changing approaches to how we analyse, understand, and manage the halibut resource. It would be easier to keep doing the same thing but there is peril in that. One of my favourite quotes on change is from the British author, C.S. Lewis and I'll paraphrase it slightly here:

> *It may be hard for an egg to turn into a bird: it would be a darn sight harder for it to learn to fly while remaining an egg. We are all like eggs. We cannot go on indefinitely being just ordinary, decent eggs. We must be hatched or go bad.*

Well, the good news is that we are reaching a more stable approach to many of our functions – but we're still hatching some eggs too!

Bruce walks the docks with Seward port sampler, Jaelee Vanidestine. Photo by Kirsten MacTavish.

In 2014, we continued to develop improved ways to understand the halibut stock and to understand how to best manage it to achieve our objectives. The first part of this is the work that our assessment staff is doing on ensemble modelling. We have expanded the approach to include using the data from broad areas as units of the assessment process. It does not try to capture the movement of halibut but it does allow accommodation for how the halibut fishery developed

over the past 90 years, especially the differing age and size compositions that the fleets encounter in different areas. We also introduced a new approach to characterize mortality on the stock, Spawning Potential Ratio (SPR), which allows us to put the mortality from all removals in the same framework. Previously, we had separated how U26 and O26 mortality was treated in our harvest policy. The SPR approach allows us to develop a more comprehensive harvest policy and we are continuing with this approach. The second part of this work is the Management Strategy Evaluation (MSE) that our staff is leading, along with participants from the Management Strategy Advisory Board (MSAB), a board comprised of industry representatives and personnel from other agencies. This process is helping us identify management objectives and the procedures to achieve them. In 2014, we spent a great deal of time building tools to help us conduct these evaluations and the MSE process is likely to be very deliberate and measured. So, we should not expect a flurry of suggested management approaches out of this group; rather it will be trying to reduce multiple options into a smaller number of candidate management procedures for broader consideration by the Commission and the industry.

We also progressed on the field front, starting a multi-year process of extending our surveys in shallow and deeper waters to accommodate where fishing occurs. In 2014, the survey extensions occurred in Area 2A (Washington to California) and Area 4A (Eastern Aleutians, southern Bering Sea). In Area 2A, we extended down to 39°N, although no halibut were encountered south of 40°N. In the Aleutians, we found good signs of fish in some of the deeper waters that the fleet has been moving into over the past half-decade. This program of survey expansion is designed to occupy these deeper and shallower stations occasionally and act to calibrate data from standard survey stations in intervening years.

A persistent issue that became more acute in 2014 is the mortality of halibut in trawl fisheries in the eastern Bering Sea. Bycatch mortality has been increasing in this area since 2011 while the halibut stock size available for commercial and subsistence harvest has been decreasing. In order to meet halibut conservation requirements, the Commission has had to decrease yields to the directed fisheries. The limits on bycatch in the area are under the purview of the North Pacific Fishery Management Council but the limits have not undergone any meaningful reduction in many years. Much of this bycatch is composed of small fish, well below recruitment age to the directed fisheries. Tagging studies have shown that these juvenile fish can migrate from the eastern Bering Sea to all areas of the coast within 3-5 years after tagging. Reductions in this bycatch mortality must occur if the viability of the halibut fisheries is to be sustained. The Commission and the Council will be meeting jointly in 2015 to tackle this problem. The solution will not be easy but the impact of migrating fish from this area on yields to halibut fisheries elsewhere on the coast places critical importance on the solution.

Bruce M. Leaman
Executive Director

Activities of the Commission

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

Annual Meeting 2014

The IPHC held its 90th Annual Meeting in Seattle, Washington, from January 13 through 17. The Commission is made up of six members and this year Dr. James Balsiger of the U.S. presided as chair of the meeting, and Mr. Michael Pearson of Canada presided as vice-chair. The Commission heard reports from IPHC staff about the health of the Pacific halibut population, considered the suggestions of stakeholder advisory groups, and solicited public comments before passing regulations and setting catch limits for 2014.

Commissioners adopted a coastwide total catch limit of 27,515,000 pounds for the 2014 fishery.

IPHC Commissioners listen to stakeholder comments during the 2014 Annual Meeting in Seattle, WA. Photo by Tracee Geernaert.

Catch limits and dates for 2014

The IPHC adopted biologically based catch limits for all individual regulatory areas (and for Area 4CDE combined). The Commission recommended to the governments of Canada and the United States that the total catch limit for 2014 should be 27,515,000 pounds, an 11.3 percent decrease from the 2013 catch limit of 31,028,000 pounds. Note that for Areas 2A-3A, the number shown includes recreational catch. The limit was divided by regulatory areas as follows:

- Area 2A 960,000 pounds
- Area 2B 6,850,000 pounds
- Area 2C 4,160,000 pounds
- Area 3A 9,430,000 pounds
- Area 3B 2,840,000 pounds

- Area 4A 850,000 pounds
- Area 4B 1,140,000 pounds
- Area 4C 596,600 pounds
- Area 4D 596,600 pounds
- Area 4E 91,800 pounds

While the Commission uses biologically-based criteria to subdivide the coastwide stock by regulatory area, the domestic governments allocate the catch further in some areas and require Commission approval to implement these allocation plans. The Commission approved the PFMC catch-sharing plan that allocates the Area 2A catch among the non-treaty directed commercial fishery, non-treaty incidental fisheries, Treaty Indian fisheries, and sport fisheries. Also approved were the DFO commercial/sport allocation plan; the NPFMC catch-sharing plan allocating the catch for Areas 2C and 3A between commercial and charter sport sectors; and the NPFMC catch-sharing plan for Areas 4CDE that allocates catch among the areas. More in-depth information on all of these subjects can be found in the following sections of this report.

The 2014 commercial season for Alaska, British Columbia, and Washington, Oregon, and California treaty fisheries was designated to open coastwide on March 8, 2014, and to close November 7, 2014. Seven 10-hour fishing periods were designated for Area 2A, non-treaty directed commercial fisheries ranging from June to September.

For Alaska, B.C., and the west coast treaty fisheries, the commercial season was set for March 8 to November 7.

Other decisions made at the meeting

Control of charter harvest in Area 2C and 3A

The Commission adopted the NPFMC charter halibut sector management measures for Areas 2C and 3A in an effort to keep the sport charter catch within its limit. The measure instituted a one-fish daily bag limit and a reverse slot size limit restriction of < 44 and > 76 inches in Area 2C; and a two-fish daily bag limit, a maximum size limit for the second fish of 29 inches, and a vessel limit of one trip per calendar day in Area 3A. Further, in both Areas 2C and 3A, if a halibut is filleted, the entire carcass, with head and tail connected as a single piece, must be retained on board the vessel until all fillets are offloaded.

Development of pending proposals

The Commission reviewed an NPFMC proposal to allow halibut retention in the Area 4A sablefish pot fishery. The Commission agreed that the proposal's intention was not to develop a new directed fishery for halibut but to utilize bycatch in a productive manner. The Commission did not approve the proposal, but asked the NPFMC to develop explicit details for consideration at a future IPHC Annual Meeting.

The Bycatch Project

The Commission agreed that two members would lead a Bycatch Project Team in the coming year. The idea was that as Commission and agency staffs develop plans surrounding halibut bycatch, IPHC staff will assist to help improve accountability and data collection results.

Interim Meeting

The IPHC's 2014 Interim Meeting on December 2nd and 3rd in Seattle, Washington, was an occasion to prepare for the 2015 Annual Meeting one month later. The Commissioners and the public were able to hear IPHC staff presentations and discussion on topics including a review of the 2014 fisheries, stock assessment, the need for standardized data, sport fishery estimates, effectiveness of setline survey data, the reasoning behind the ensemble modeling approach, and data sources for bycatch estimates.

The Interim Meeting occurs late in the year and provides a venue for Commissioners and stakeholders to understand the issues that will be decided upon at the Annual Meeting in January.

IPHC quantitative scientist Ian Stewart reviews the stock assessment at the 2014 Interim Meeting in Seattle, WA. Photo by Tracee Geernaert.

Other topics covered included the MSE framework, progress of the MSAB, the Scientific Review Board (SRB) report, managing total mortality, bycatch reduction, regulatory proposals, the proposed research plan, and budgetary and administrative issues. The meeting also included presentations about the effects of potentially decreasing the minimum commercial size limit from 32 to 30 inches, and a lengthy discussion regarding a possible survey expansion into the Bering Sea flats in 2015.

For the second year, the entire meeting (with the exception of the Finance and Administration session) was webcast to allow for broader public participation. The Commission also tested a new public format for the 2014 Interim Meeting. Previous meetings were held in the IPHC headquarters offices in Seattle and, although the meetings were webcast, the available space limited outside attendance to a small number. This year's meeting was held at the Hotel Deca in Seattle, allowing a greater number of the public to attend. The public were also asked to participate in an online survey asking for their feedback on IPHC communications, including quality and ease of access to information.

IPHC budget

The IPHC is funded jointly by the U.S. and Canadian governments. For fiscal year 2014, the U.S. appropriated $4.35 million to the IPHC which included funding earmarked for pension deficits and the IPHC headquarters lease. Canada appropriated $848,720 and provided an additional payment of $98,400 to cover pension deficits, similar to that provided in the U.S. appropriations.

IPHC REGULATORY AREAS FOR 2014

On its formation in 1923, IPHC established four regulatory areas, covering California northward through the Bering Sea. They have changed in their numbering and their geographic boundaries over the years, but the current boundary lines have remained the same since 1990. For an illustration of the boundaries, refer to the map on the inside front cover of this report.

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

The North American Pacific halibut fishery grounds are broken out into 10 regulatory areas and a closed area.

COMMERCIAL FISHERY

The Pacific halibut fishery has been built on the hard-won knowledge that local harvesters have developed over generations. These pioneers of the industry painstakingly acquired a nuanced understanding of halibut's preferred resting spots, both in sheltered local grounds and the deep-sea banks. More than a century later, the harvesters still use this knowledge to search out millions of fish every year. The commercial halibut catch in 2014 (including those that were landed from the IPHC stock assessment surveys) was 23,695,000 pounds, down 18.4 percent from the 29,043,000 pounds caught in 2013. See Appendix I for more information.

Seasons

Stakeholders requested a Saturday opening date to facilitate marketing of fresh fish.

At the 2014 Annual Meeting, the Commission received recommendations to open the fishery on a Saturday to facilitate marketing. Accordingly, the Canadian Individual Vessel Quota (IVQ) fishery in Area 2B and the United States Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) fisheries in Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E commenced at 12 noon local time on March 8 (a Saturday) and closed at 12 noon local time on November 7 (a Friday).

The Area 2A commercial fisheries, including the treaty Indian commercial fisheries, were required to also take place during the same eight-month window (March 8-November 7). The adopted 2A non-treaty directed commercial fishery dates included seven 10-hour fishing periods: June 25, July 9, July 23, August 6, August 20, September 3, and September 17, 2014. All fishing periods were to begin at 8:00 AM and end at 6:00 PM local time, were further restricted by fishing period limits, and were to remain open only until the commercial allocation was estimated to have been reached.

Port sampler Jaelee Vanidestine descends the ladder to collect logbook information from the *F/V Malia* at Resurrection Bay Seafoods in Seward, AK. Photo by Lara Erikson.

Licensing, catch limits, and landings

The 2014 coastwide commercial catch amounted to 22,927,000 pounds, 137,600 pounds shy of the 23,064,600-pound limit for the year. Catch limits are set by the Commission for all individual regulatory areas and for Areas 4CDE combined (Appendix I Tables 1-4). Catch Sharing Plans (CSPs) allocate catch limits by user groups in Areas 2A, 2B, 2C, and 3A and among areas for Area 4CDE.

F/V Deliverance **skippered by Todd Hoppe, leaving the dock after offloading the catch in Homer, AK. Photo by Lara Erikson.**

Area 2A is composed of a variety of fisheries, each with differing catch limits. There are two treaty Indian fisheries: a ceremonial and subsistence use fishery, which had a 2014 catch limit of 28,500 pounds, and a commercial fishery, with a limit of 307,500 pounds. In 2014, the three non-treaty commercial fisheries operated under limits of 168,137 pounds allocated to the directed fishery, 29,671 pounds to the incidental halibut fishery during the salmon troll season, and 14,274 pounds to the incidenta1 halibut fishery during the limited-entry sablefish fishery. The area's two sport fishery catch limits (Washington and Oregon/California) totaled 411,917. The total 2014 Area 2A catch (not including IPHC research) was 1,015,300 pounds in 2014, which was 5.8 percent above the catch limit.

In Area 2A, there are a number of different fisheries that fall under the catch limit: two treaty Indian fisheries, three non-treaty commercial fisheries, and a sport fishery.

Part of the Area 2A licensing regulations for non-treaty fisheries remained the same as in 2013: all vessels required an IPHC license, harvesters were required to choose one license type, and the commercial fisheries license applications had a deadline date. Two changes to the 2A licensing regulations were made in 2014. One change was a shift in the license application deadline date for the incidental halibut in the salmon troll and the sablefish fisheries: In 2014, it was March 15, as opposed to March 31. The second change is that a unique license was issued for each commercial fishery, where previously only one license applied to vessels that participated in both the directed commercial and the incidental halibut in the sablefish fisheries.

IPHC assigned Area 2B a combined sport and commercial catch limit of 6,850,000 pounds for 2014. DFO further restricted this limit to a ratio of 85 percent commercial to 15 percent sport—that is 5,792,500 pounds and 1,057,500 pounds, respectively. The total 2014 Area 2B combined commercial and sport catch was 6,689,000 million pounds, below the catch limit by two percent.

2014 was the first year of a catch sharing plan for Areas 2C and 3A that included both commercial and sport charter fisheries.

For the first time, the NPFMC recommended a CSP for Areas 2C and 3A that included the commercial and sport charter fisheries. Consequently, the Commission's adopted catch limits for Areas 2C (4,160,000 pounds) and 3A (9,430,000 pounds) included the commercial and charter fishery catch limit, plus discard and lost gear mortality estimates. The individual catch limits adopted for Regulatory Areas 4C (596,600 pounds), 4D (596,600 pounds), and 4E (91,800 pounds) are determined by a NPFMC CSP. The NPFMC CSP and IPHC regulations allowed Area 4D CDQ to be harvested in Areas 4D or 4E, and Area 4C IFQ and CDQ to be harvested in Areas 4C or 4D.

Landings

"Landed" Pacific halibut are those that have been delivered to a port for processing. The following sections review commercial catch, seasons, and trends for each area, which include data from the IPHC, National Marine Fisheries Service (NMFS), DFO, Metlakatla Indian Community, Washington treaty Indian tribes, Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), and California Department of Fish and Wildlife (CDFW).

Area 2A (California, Oregon, and Washington)

The Area 2A directed fishery south of Point Chehalis, Washington, operated during two 10-hour fishing periods in 2014, during which time harvesters landed 156,000 pounds of halibut, seven percent below the 168,137-pound catch limit. Each H-class vessel (56 feet or longer) was allowed to bring in 9,000 pounds on June 25 and 2,000 pounds on July 9. Smaller vessel classes were limited to less poundage according to their sizes. As stipulated in the CSP, 4,000 pounds of potential catch rolled over from the directed commercial fishery after it closed to be made available to the incidental fishery during the salmon season.

Vessel licenses for Area 2A increased in 2014 from the prior year, with IPHC issuing 724 total licenses. The directed commercial halibut fishery and the sablefish fishery accounted for 167 licenses (18 more than in 2013). In addition, 424 (91 more than in 2013) licenses went to the salmon troll fishery for retaining incidental halibut caught, and 133 licenses (six more than in 2013) went to sport charter vessels.

The incidental halibut retention during the salmon troll fishery closed on September 11 with a total catch of 34,100 pounds, which was one percent over the catch limit including the rollover (33,671 pounds). The allowable incidental catch ratio at the start of the season on April 1 was one halibut per four Chinook (*Oncorhynchus tsawytscha*), plus an "extra" halibut per landing, and a vessel trip limit of 12 fish. The landing restrictions were changed several times throughout the season with the goal of extending the fishing opportunity through the summer.

Incidental halibut retention during the limited-entry sablefish fishery resulted in a total catch of 12,100 pounds, which was 15 percent under the catch limit (14,274 pounds). Incidental halibut retention remained open from April 1 to October 31, closing in tandem with the end of the sablefish fishing season. As in 2013, the allowable landing ratio was 75 pounds (net weight) of halibut to 1,000 pounds (net weight) of sablefish, and up to two additional halibut in excess of the ratio limit.

The total treaty Indian commercial catch for Area 2A-1 was 308,400 pounds, less than one percent over the catch limit (307,500 pounds). The treaty

IPHC quantitative scientist Steve Martell and port sampler Tachi Sopow, brave the elements in Sitka, AK to sample the commercial catch. Photo by Lara Erikson.

Indian tribes allocated 75 percent of the commercial catch limit to an open-access fishery, and the remaining 25% to a restricted fishery with daily and vessel catch limits. There was one unrestricted, open-access fishery between March 11 and 13; two restricted fisheries, including vessel per-day limits of 500 pounds for a March 20-21 opening, and a 400-pound vessel and trip limit on a 10-hour May 8 opening. The 2014 tribal commercial season closed to all parties on May 9, 2014.

Area 2B (British Columbia)

During the 2014 season, the IVQ fisheries of British Columbia landed 5,776,000 pounds of halibut, less than one percent shy of the 5,792,500-pound commercial catch limit. As part of the groundfish Integrated Fisheries Management Plan (IFMP), IVQ fisheries operate under limits aimed at bolstering conservation, including increasing protection for rockfish and improving catch monitoring. These limits include quota shares on all hook-and-line groundfish fisheries, limited transferability between license holders, and 100% monitoring.

The Area 2B IVQ fishery landed a total poundage that was less than one percent shy of the commercial catch limit.

DFO allocates each halibut vessel a fixed poundage limit for the season and designates each with either an "L" or "FL" license. L commercial licenses are limited and vessel-based. FL communal licenses are reserved for First Nations. This year, 221 licensed vessels landed halibut. Of those vessels, 146 (an all-time low) had halibut licenses and 75 had licenses from other groundfish fisheries.

Alaska—Quota share fisheries

In 2014, the total catch by the IFQ/CDQ halibut fisheries in the waters off Alaska was 16,641,000 pounds, less than one percent under the catch limit. The commercial Quota Share (QS) catch in Area 3B was also less than one percent below the catch limit, while in Area 3A the catch was less than one percent over the catch limit yet under the adjusted catch limit. In Areas 4A and 4B, the catches

were three percent and four percent under the catch limits, respectively. As mentioned previously, the NPFMC CSP allowed Area 4D CDQ to be harvested in Areas 4D or 4E and Area 4C IFQ and CDQ to be fished in Areas 4C or 4D. These two regulations were the reason the catches in Areas 4D and 4E exceeded the catch limits. The total combined Area 4CDE commercial catch of 1,243,000 pounds was three percent under the combined Area 4CDE catch limit (1,285,000 pounds).

Alaska—Area 2C Metlakatla fishery

Area 2C includes the Annette Islands Reserve (just south of the city of Ketchikan), home to the Metlakatla Indian Community, which the U.S. Bureau of Indian Affairs has authorized to conduct a commercial halibut fishery within the Reserve. In 2014, there were 13 two-day openings between April 17 and October 5, resulting in a total catch of 79,709 pounds. This was 25,200 pounds higher than the 2013 catch and within the historical catch range that has varied over time from a low of 12,000 pounds in 1998 to a high of 126,000 pounds in 1996.

Homer, Kodiak, and Seward were the top landing ports in Alaska.

Landing patterns

The bulk of the total commercial catch—73 percent—was landed in Alaska. Area 3A topped all other regulatory areas in catch level in 2014, with about 44 percent of the Alaskan commercial catch landed in three ports. Homer brought in 2,762,000 pounds (17 percent), Kodiak accounted for 2,522,000 pounds (15 percent), and Seward landed 1,756,000 pounds (11 percent). For ports in Area 2C, the top-catch ports were Sitka, Petersburg, and Juneau, respectively, for 19 percent of the commercial Alaskan catch (3,211,000 pounds).

Port Hardy and Prince Rupert combined saw 89 percent of the landed commercial catch in Area 2B.

In Area 2B—among 12 ports on the British Columbia coast—89 percent of the fish came from just two of those: Port Hardy and Prince Rupert/Port Edward. The top-landing port was Prince Rupert/Port Edward, with 2,570,000 pounds (44 percent of the BC total). Port Hardy (including Coal Harbour and Port McNeill) took in 2,555,000 pounds (44 percent). Ucluelet took third place for halibut landings, as it did in 2013, and Vancouver took fourth place.

Offloading halibut from the *F/V Miss Linda* in Kodiak, AK. Photo by Lara Erikson.

The QS landings peaked in May, with 19 percent of poundage from Alaska landed in that month, as

in 2013. In British Columbia, the first part of the season was most productive—March was the busiest, accounting for 15 percent of total poundage, and 41 percent of catch was landed by the end of May. The 2014 landing of live halibut from Area 2B (allowed by the DFO since 1999 as a means to get halibut to certain markets in a fresher state) resulted in a total landed weight of 3,010 pounds; this is down 32 percent from 4,437 pounds in 2013, and is the lowest amount since retention of live halibut began. Landings of live halibut reached a high of 103,821 pounds in 1999.

Commercial catch sampling

Sampling of the commercial catch was one of the key methods the IPHC used to collect data on Pacific halibut in 2014. Samplers are tasked with collecting otoliths (earbones used for aging) and tags, and recording halibut lengths, logbook information, and final landing weights. The sampling protocols—places and dates chosen for sampling, and the percentage of fish sampled—are designed to ensure that results faithfully represent the entire catch. The protocols can vary slightly from port to port to achieve the appropriate sampling representation.

Port sampler Jessica Marx extracts an otolith from a commercially caught halibut in Homer, AK. Photo by Lara Erikson.

Port samplers collected commercial fishing information and otoliths in 14 major ports coastwide. Additionally, treaty Indian biologists in Area 2A collected samples in smaller ports.

Considering that vessels travel to multiple regulatory areas and are not limited in where they may land their catch, IPHC samplers were stationed in halibut ports coastwide. In Area 2A, IPHC samplers were present in Newport (Oregon) and Bellingham (Washington). Samples were taken in several smaller treaty Indian ports in Washington state by biologists from the treaty Indian fishery management offices. In Area 2B, IPHC samplers staffed Port Hardy, Prince Rupert, and Vancouver. In Alaska, they staffed nine ports, including Petersburg, Sitka, and Juneau in Area 2C; Seward, Homer, and Kodiak in Area 3A; Sand Point in Area 3B; Dutch Harbor in Area 4A; and St. Paul in Area 4C.

Otoliths

Samplers aimed to collect 11,500 total halibut otoliths in 2014, and they went beyond this number, collecting 12,965 by sampling 42 percent of the catch in 722 sampled landings. The target number for otoliths in Areas 2B, 2C, 3A, 3B, 4A, 4B, and the combined number for Area 4CD was 1,500 ± 500. The only area

in which collection exceeded the target number was 3A, where samplers brought in 2,165 otoliths. All other areas were within the targeted range. In British Columbia, samplers took in 1,966 otoliths. Samplers in ports receiving Alaskan catch collected 9,930 otoliths: 1,492 (Area 2C), 2,165 (Area 3A), 1,624 (Area 3B), 1,993 (Area 4A), 1,013 (Area 4B), and 1,643 (Area 4CD).

In Area 2A, samplers collected 1,069 otoliths, within the target range of 1,000 ± 500. They anticipated pulling in 650 from the treaty Indian fishery (Area 2A-1) and the remaining 350 from the directed commercial catch and the incidental retention of halibut in the sablefish fishery (Area 2A). The targets were good predictors—non-treaty fishery sampling fell just one otolith shy, with 349 collected, while treaty Indian fishery sampling produced 720 otoliths.

Samplers also collected specimens for the Clean Otolith Archive Collection (COAC), which are otoliths being collected over time, area, and fishery to be used for future, yet to be identified, research. The COAC samples are supplied primarily by the Standardized Stock Assessment (SSA) survey and trawl surveys, but where there is a danger of falling short of the target, otoliths are also collected from the commercial fisheries. A total of 100 otoliths per area were targeted for collection in three IPHC areas. Samplers collected a total of 99 COAC otoliths in Area 2A, 105 in Area 4B, and 124 in Area 4CD.

In addition to biological samples, port samplers collect logbook information from the skippers.

Logbooks

IPHC samplers also collected logbook information from harvesters in key ports, which totaled 4,790 logbooks. In total, 5,117 logs were collected in 2014. Of the latter number, 4,338 (85 percent) were collected from U.S. landings and 779 (15 percent) were collected from Canadian landings.

Petersburg port sampler Levy Boitor along with Dan and Stewart Vick from the *F/V Heather Lee*. Photo by Lara Erikson.

Tags

In 2014, samplers collected 28 halibut tags from recaptured halibut that were tagged during various research studies. Twenty-six came from a 2013 archival tag project in which halibut were either double-tagged with an internal 'dummy' archival tag and a pink wire cheek tag, or tagged with a single external dummy archival tag on the cheek. Additionally, one tag from the 2011 archival tag release was recovered in Prince Rupert, and one pop-up transmitting archival (PAT) tag was recovered from a halibut landed in Juneau. See tagging studies under the research section for more details.

Electronic data collection

Port sampling is currently done with paper and pencil, the same way it has been carried out for decades. Advances in ruggedized computing are allowing the IPHC to experiment with digitizing data collection, which has led to the goal of equipping each IPHC port sampler in Alaska and Bellingham, WA with an electronic tablet. Paper logbooks continued to be used, but the data recorded there were entered into a remote data entry (RDE) application at these ports. Research scientists will be able to receive digital data more quickly, which will allow greater precision, better verification, and more time for data analysis.

The digitization plan is proceeding apace. At the start of the 2014 season, tablets were provided to all samplers in Alaskan ports. In early September, a tablet was sent to the Bellingham, Washington port sampler. Samplers were tasked with entering data from as many logs as priorities and time allowed. Modifications and enhancements to the application are still in progress. In 2015, RDE of log data will continue to be a regular part of the port sampling program log collection protocol for Alaska and Area 2A.

The IPHC continued a project begun in 2013 whereby weight samples are taken alongside length samples.

Length-weight project

Starting in 2013, a length-weight pilot project has been used to collect data to allow for the estimation of the relationship between fork length and net weight in Pacific halibut. This included developing the appropriate formula to convert head-on weight to net weight. Length-weight ratios may vary by region and season, so the purpose of the project is to rule out systematic bias among regulatory areas or seasons.

IPHC samplers collected data on the randomly selected day each week throughout the season in all ports in which they were present. In 2014, most ports had scales, with the exception of Dutch Harbor, Sand Point, and St Paul in Alaska. Halibut were sampled at different rates, depending on length, to provide an even distribution of measurements across all possible lengths. In 2014, samplers measured and weighed 2,351 halibut, a massive increase over 2013, when a mere 831 fish were sampled. In 2014, the largest number of halibut was sampled in Area 3B (649), closely followed by Area 3A (640).

HARM project

Matching removals to available yield has led to increasingly restrictive halibut fishing regulations for charter-fishing anglers, including specific regulations for retention by size of halibut. The Halibut Angler Release Mortality

(HARM) program gives anglers access to a smartphone application that allows them to measure the fish while it is still in the water, thereby reducing handling injuries and release times. Though IPHC does not run the HARM project, IPHC port samplers from Petersburg, Juneau, Sitka, Seward, and Homer helped with the pilot phase and obtained head length and fork length data from the same fish to determine if a relationship between the two lengths exists. IPHC staff involvement ended when the 2014 commercial season closed and data collection for the project was concluded.

Age distribution of commercial fishery

Port samplers collected a total of 12,977 market sample otoliths for stock assessment in 2014, of which 12,606 were usable. Otoliths were deemed not usable for a number of reasons, including crystallization, collected from the wrong side of the body, badly broken, or accidentally separated from their sample information.

As determined by reading the otoliths at the lab in Seattle, halibut in the commercial sample ranged in age from six to 40 years old.

Juneau port sampler Michele Drummond collects an otolith from a commercially caught halibut. Photo by Lara Erikson.

In 2014's sampling of otoliths from commercially caught halibut, 12-year-olds from the 2002 class were the most abundant (2,107 fish, or 16.7 percent of the total). The most abundant grouping was 10- to 14-year-olds, which comprised 65.4 percent of the total (8,247 fish).

The age range of the halibut in the commercial samples was six to 40 years. Sampling brought in 20 six-year-old fish: 12 from Area 2B measuring between 81 and 113 cm, three from Area 3A measuring between 87 and 102 cm, two each from Areas 2C and 3B measuring between 86 and 100 cm, and one from Area 4A measuring 82 cm. The 40-year-old, with a fork length of 115 cm, was captured in Area 4B. The largest halibut in the 2014 commercial samples was a 20-year-old 218-cm fish from Area 3A. The smallest halibut in the 2014 commercial catch samples was a 10-year-old 73-cm specimen from Area 2B.

Recreational fishery

The sport harvest of Pacific halibut in 2014 was 6.9 million pounds, as estimated by the IPHC with help from state and federal agencies. The 2014 take represented a 6.4 percent decrease from 2013 and a substantial drop below the 10.7 million-pound average of 2004-2008. The regulations governing sport fishing of halibut were specifically geared to each regulatory area so as to better support the welfare of each fishery. The IPHC relied on state and federal agencies to assemble the sport estimates.

Regulations varied among areas in order to address the unique characteristics of each.

Recreational charter vessel out of Neah Bay, WA. Photo by Ed Henry.

Area 2A (California, Oregon, and Washington)

Sport harvesters in Area 2A were estimated to have landed 472,868 pounds of Pacific halibut, above the 411,917-pound allocation by 60,951 pounds (15 percent). The allocation was subdivided into seven subareas: Washington Inside Waters (57,393 pounds), Washington North Coast (108,030 pounds), Washington South Coast (42,739 pounds), Columbia River (11,895 pounds), Oregon Central Coast (181,908 pounds), Southern Oregon (3,712 pounds), and California (6,240 pounds).

In 2014, sport-fishing harvests remained, as in previous years, dependent on the availability of salmon or albacore tuna. It was noted as an especially good salmon year for recreational anglers. Each subarea was open between four and 172 days, depending on conditions. One of the subareas, Washington North Coast, was estimated to be within five percent of the allocated amount. Area 2A estimates were provided by the Departments of Fish and Wildlife of Washington, Oregon, and California.

Area 2B (British Columbia)

The 2014 sport harvest in Area 2B was estimated by the DFO to total 913,000 pounds. That is 14 percent (144,000 pounds) below the year's 1,057,000 allocation, and 11 percent (91,000 pounds) above the 2013 harvest. In February 2012 the DFO announced a catch plan allocating 85 percent of the catch limit to the commercial fishery and 15 percent to the sport fishery, a division that has been continued in 2013 and 2014.

Within the constraints of the allocation it had set, DFO implemented several restrictions in 2014 aimed at slowing the pace of the harvest and lengthening the season. A new length restriction states that the one fish allowed in the daily limit must not be larger than 133 cm in total length (increased from 126 cm in 2013). In addition, the possession limit for halibut is two, of which one must be smaller than 90 cm (increased from the 83 cm in 2013). DFO also continued an annual limit of six fish per angler and used area closures. DFO estimated its numbers from a combination of aircraft overflights, on-water vessel counts, creel sampling, and self-reporting by fishing lodges .

New in 2014 was the initiation of the GAF program which allows the transfer of quota from the commercial to the guided sport sector in Areas 2C and 3A.

Areas 2C, 3A, and 4 (Alaska)

In 2014, the guided fishery in Alaskan waters was included in a NPFMC catch sharing plan for the guided sport (charter) and commercial fisheries for Pacific halibut. This new plan, which replaced the Guideline Harvest Level (GHL) program, establishes an annual process for allocating halibut among the charter and commercial fisheries in Area 2C and Area 3A. The limits now include mortality associated with fishery discards.

A Guided Angler Fish (GAF) program was new for 2014. The GAF program enables quota transfer from the commercial to the guided sport sector under the CSP. This allowed charter vessel operators who participated the opportunity to offer their clients up to two halibut of any size per day. Charter anglers using GAF were subject to the harvest limits in place for unguided sport anglers in that area.

In Area 2C, the sport harvest was estimated to be 1.94 million pounds in 2014, a slight decrease from the 2.12 million pounds caught in 2013. Charter boats caught 825,000 pounds (42.5 percent) of the total. Private boats caught 1.11 million pounds (57.5 percent). In Area 3A, the total estimated sport catch was 3.59 million pounds, an increase of 375,000 pounds (9.5 percent) from the 3.97 million pounds caught in 2013. Charter boats caught 2.14 million pounds (59.6 percent) of the total. Private boats caught 1.45 million pounds (40.4 percent). The catch regulations in Area 3A stipulated a 29-inch maximum size limit on one fish. Charter vessels were only permitted to take one trip per day where anglers could retain halibut.

Sport fishing in Area 3B and Area 4 was far less common than in other parts of Alaska, due to the relative remoteness of the ports. For Area 3B, there was an estimated catch of 19,000 pounds, an increase of 4,000 pounds from the 15,000 pounds caught in 2013. For Area 4, the estimated catch was 23,000 pounds, an increase of 14,000 pounds from the 9,000 pounds caught in 2013. Estimates from these areas may be problematic in that the results relied on the numerical fish count from Alaska Department of Fish and Game (ADF&G)'s Statewide Harvest Survey, from which the IPHC estimates weight by applying the average weight of fish landed in Kodiak. However, the small amount of halibut caught was unlikely to skew the overall results very much.

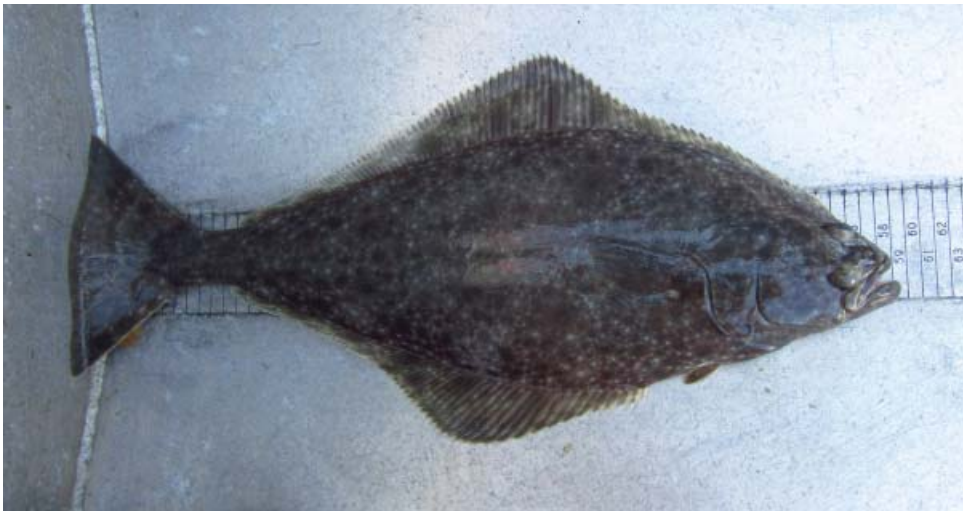
Incidental mortality of halibut in the commercial fishery (wastage)

In the commercial fishery, all halibut that do not become part of the landed catch are considered to be subject to release mortality, otherwise known as "wastage." In 2014, wastage amounted to more than a million pounds of Pacific halibut: It is estimated that 1,286,000 pounds of fish died from incidental mortality in the coastwide commercial fishery. While this is a decrease of 143,000 pounds from the prior year, it is still a large amount of fish that die most often in one of three ways. First, fish that do not measure up to the legal size limit of 32 inches (U32) are discarded after being caught and some of those die. Second, fish die when hooked on lost or abandoned fishing gear. Third, some caught fish are discarded if harvesters exceed their allowable catch, such as a vessel exceeding its trip limit or individual quota, and a portion of those released die. Each of these categories contains different mortality information and so requires different methods to account for it.

In short, wastage is the mortality of halibut that have been captured and discarded during the halibut fishery.

Wastage from discarded U32 halibut

Due to limitations on observation and electronic monitoring in commercial halibut fisheries, it is only possible to indirectly estimate the amount (weight) of U32 halibut mortality. Of all the areas, the British Columbian fishery provides the most accurate estimate because since 2006 harvesters there are required to



U32 Pacific halibut. Photo by Sam Parker.

report their U32 discards in their logbooks, which are verified for accuracy via electronic/video monitoring. The estimated weight of discards is then determined based on the observed weight of U32 halibut in the setline survey. In all other regulatory areas, numbers of discards counted in IPHC's setline survey were extrapolated to produce estimates for halibut mortality, a task accomplished by filtering results from setline survey stations to stations with a higher catch rate

(by weight) of O32 halibut, similar to those observed in the commercial fishery. Since individual quota fisheries were established (1991 in Canada and 1995 in Alaska), a universal mortality rate of 16 percent has been applied to all halibut discards. For derby fisheries in previous years in B.C. and Alaska, and for the Area 2A directed commercial fishery (and when open, the incidental halibut fishery during the sablefish season), a mortality rate of 25 percent was applied.

To estimate the pounds of U32 halibut captured in the commercial halibut fishery, the area-specific U32:O32 (≥ 32 inches) ratio was multiplied by the estimated commercial catch in each regulatory area. The resulting poundage was then multiplied by the discard mortality rate to obtain the estimated poundage of U32 halibut killed in the commercial fishery.

Wastage from lost or abandoned gear

Halibut are also killed accidentally by lost and abandoned gear. The rate of fish loss by this method was calculated by first figuring out the ratio of effective skates lost to effective skates hauled aboard each vessel, 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 included both snap gear and fixed-hook gear in all areas.

In Area 2A, because of the derby nature of the fishery, regulatory restrictions contribute to wastage.

Wastage from discard mortality for regulatory reasons

In Area 2A, where the commercial fishery is still managed by a derby system, regulatory restrictions continue to contribute to ongoing wastage. "Excess" O32 halibut are discarded when catches accidentally exceed the limit allowed per vessel, per trip. Some vessels logged the amount of discards, and that figure could be compared to a vessel's reporting on landed halibut to estimate O32 halibut discards for all landings reported on fish tickets. U32 halibut were accounted for in a similar manner. The amount of halibut retained by the Area 2A salmon and sablefish fisheries was not included in these numbers, however, as they were accounted for under bycatch mortality estimates. Finally, quota share fisheries in British Columbia and Alaska were not included in these numbers either, since these harvesters typically discard small amounts of fish (if any) on the last fishing trip of the season.

PERSONAL USE (SUBSISTENCE) HARVEST

Halibut classified as being caught for personal use are fish reeled in by those who have traditionally relied on halibut as a critical food source or for customary use. These fish are not considered to be caught for sport or--being barred from resale--commercial purposes. The IPHC defines personal harvest further as halibut taken in: 1) the federal subsistence fishery in Alaska; 2) the sanctioned First Nations Food, Social, and Ceremonial (FSC) fishery in British Columbia; 3) treaty Indian Ceremonial and Subsistence fisheries in Washington state; and 4) U32 halibut retained by commercial harvesters in Areas 4DE under IPHC regulations. In the last case, IPHC permits U32 halibut to be retained because of its history of customary use in the area and because the remote location calms any worry that these undersized halibut will enter the marketplace.

The personal use harvest in 2014 came in at just over 1.1 million pounds.

Estimated harvests by area

The 2014 subsistence catch coastwide was the lowest since 2003 (the first year of the Alaska subsistence harvest registration program). The coastwide personal use harvest came to 1,125,300 pounds in 2014, down from the 1,130,500 pounds caught in 2013, and 1,144,200 in 2012. The estimates for the subsistence halibut harvest typically lag by a year, so the 2014 estimates are not complete.

The day's catch. Photo by Lara Erkson.

Area 2A (California, Oregon, and Washington)

The personal use allocation in Area 2A consists of the ceremonial and subsistence (C&S) fishery that the Treaty tribes have subdivided from their allocated catch limit. In 2014, the allocation for that C&S fishery was 28,500 pounds, and 31,800 pounds were harvested.

Along with the allocation for the treaty Indian fisheries operating off the northwest coast of Washington state, Area 2A's catch limit incorporates both commercial fisheries (both directed and incidental) and sport fisheries. State regulations required that any halibut caught for personal use from commercial hook-and-line fisheries be counted in the commercial catch, and so were not counted again here as personal use.

Area 2B (British Columbia)

The FSC fishery constituted British Columbia's DFO-sanctioned personal use harvest. The IPHC receives logbook and halibut landing information for this harvest from DFO. The insufficient data supplied by that system led the IPHC to rely instead on DFO's estimate, which has held at 405,000 pounds since 2007. Personal use halibut within the IVQ commercial fisheries has already been counted as part of the commercial catch so was not counted again here.

Areas 2C, 3, and 4 (Alaska)

The personal use fishery in Alaska has been declining since 2004. In 2014, it was estimated at 692,500 pounds of Pacific halibut (61.3 percent of the coastwide total), a drop from 697,000 pounds (61.7 percent of the coastwide total) in 2013 and 707,200 pounds (61.8 percent of the coastwide total) in 2012. NPFMC reserves this fishery for customary use by rural residents and members of federally recognized Alaska Native tribes. NMFS regulations on the fishery include a registration program, and specifications on type of gear, number of hooks, and daily bag limits, and IPHC sets the fishing season. According to ADF&G's voluntary annual survey, Area 2C pulled in the most halibut, at 396,000 pounds (57.2 percent of the Alaskan total), followed closely by Area 3A, at 253,500 pounds (36.6 percent). The remaining regulatory areas accounted for a small fraction of these two, with Area 3B claiming 16,000 pounds (2.3 percent), while the combined Area 4 pulled in 21,000 pounds (3.0 percent). Not counted with the ADF&G survey—though still recognized as part of the coastwide total—were the 5,533 pounds of fish caught by the Alaskan CDQ fishery in Areas 4D and 4E. As in other areas, fish used for personal use and not sold during the commercial fisheries are counted within the person's quota so are not accounted for here.

The CDQ fishery in Areas 4D and 4E are authorized to keep undersized halibut for personal use. A total of 5,533 pounds was caught and kept in 2014.

Retention of U32 halibut in the CDQ fishery

In Area 4DE (Bering Sea), the IPHC allows commercial halibut vessels fishing for certain CDQ organizations to retain U32 halibut, under an exemption requested by the NPFMC. This CDQ harvest supplements the Alaskan personal use catch. In 2014, this fishery pulled in 5,533 pounds of halibut, a 45 percent decrease from the 10,033 pounds caught in 2013. Changes in harvest each year reflect the amount of effort by local fishing fleets and the availability of fish in their nearshore fisheries.

The IPHC compiled the amount of U32 halibut caught in this commercial fishery as an additional personal use removal. Although the ADF&G annual subsistence survey included all registered harvesters and households in all areas in the state, commercial harvesters in the CDQ fisheries in Areas 4D and 4E were instructed to exclude any commercially-caught (and retained) U32 halibut from

their survey responses. The amount of halibut they caught needed to be fully counted, and so were included in this section.

Bristol Bay Economic Development Corporation

The Bristol Bay Economic Development Corporation (BBEDC), the southernmost of the three CDQ organizations, reported a catch of 3,456 pounds of halibut in 2014, a one percent decrease from the 3,493 pounds processed in 2013. The average weight of the 408 U32 halibut caught was 8.5 pounds, and 96 percent of the fish measured at least 26 inches in length. The BBEDC comprises 17 member villages on the shores of Bristol Bay: Port Heiden, Ugashik, Pilot Point, Egegik, King Salmon, South Naknek, Naknek, Levelock, Ekwok, Portage Creek, Ekuk, Clark's Point, Dillingham, Aleknagik, Manokotak, Twin Hills, and Togiak. Togiak accounted for the majority of halibut landings, followed by Dillingham. The BBEDC aims to use sustainable fish harvesting to improve community life and livelihoods—this involves providing jobs, training, educational opportunities, and economic development resources to its member communities.

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. In 2014, the CVRF landed 963 pounds of Pacific halibut, an 81.7 percent decrease from 5,250 pounds in 2013. The average weight of the 112 halibut processed was 8.6 pounds. Twenty communities that comprise the CVRF are remote coastal villages bounded by Norton Sound to the north and Bristol Bay to the south: 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.

CDQ organizations provide the IPHC with detailed landing information.

Norton Sound Economic Development Corporation

The NSEDC is the northernmost of the three organizations, centered on Nome. In 2014, it processed 1,114 pounds of halibut, a 13.6 percent decrease from the 1,290 pounds processed in 2013. The average weight of the 115 U32 halibut in this catch was 9.7 pounds. The NSEDC's purpose is to provide fishing opportunities for its 15 member communities that lie 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.

INCIDENTAL MORTALITY

Incidental mortality refers to the unintentional catching of Pacific halibut by other fisheries. This accidental harvest is called "bycatch," and while regulations require these fish be returned safely to the sea, a significant number of them ultimately die, usually from injuries sustained in handling or from remaining too long out of water before being tossed back overboard. There has been a decreasing trend in bycatch levels over the last few decades, with 2013 representing a 20-year low. According to NMFS estimates, numbers have risen again slightly in 2014, with 9,315,000 pounds of Pacific halibut killed as bycatch in other fisheries, representing a five percent increase from the 8,900,000 pounds lost in 2013. While 2014's incidental mortality is less than half of the high of 20,293,000 pounds recorded in 1992, the proportion of total removals from the halibut stock that results from bycatch has been increasing as the halibut stock has decreased. Estimates for 2014 are preliminary and subject to change as new information becomes available.

The proportion of bycatch removals from the halibut stock has been increasing because the overall stock size has been decreasing.

Sources of bycatch information

The IPHC lacks the resources to monitor bycatch on its own, and so must rely on observer programs run by U.S. and Canadian government agencies. NMFS monitors trawl fisheries off the coast of Alaska and the U.S. west coast, while DFO monitors fisheries off British Columbia. Estimates of bycatch off Alaska for 2014 were based on bycatch reported by NMFS from fishing

Bycatch of halibut can occur with any gear. Pictured here is a net full of fish being hauled aboard a trawl vessel. Photo by Paul Logan.

conducted through October 25 and projected through the remainder of the year. The methods used for recovering bycatch information for British Columbia include catch sampling and 100 percent at-sea monitoring. Off the U.S. west coast, 100 percent coverage for fishery monitoring is mandatory, so all vessels must carry an observer. Estimates for various fisheries, such as shrimp trawling off the west coast and crab pots in Alaska, were provided by government agencies.

Discard mortality rates

Discard mortality rates (DMRs) are fixed ratios applied to estimates of discards that predict the number of halibut killed as bycatch in a given area, particularly where physical observation is not possible. These estimates vary by both fishery and area. Where present, observers can calculate DMRs based on the release viability of the halibut. Observers collected data on the groundfish fisheries off Alaska and on bottom trawl vessels in Areas 2A and 2B. Data to determine DMRs for other fisheries are not available, so estimates are based on fisheries with known DMRs. In Alaska, the DMRs for groundfish trawl and longline fisheries are in place for a three-year period, after which new data are used to update the assumed estimates for another three years.

An increase in fishing effort from 2013 to 2014 resulted in a slightly lower observer coverage rate.

Monitoring Alaska groundfish fisheries

This was the second year of implementation for a new method of choosing fishing vessels for monitoring incidental catch. While the previous method in place until 2012 allowed vessel operators to choose when observers accompanied the vessel, the new plan, started in 2013, puts in place a scientific selection process to assign observers and thus reduce bias. The plan does not apply to vessels in fishery programs that already implement 100 percent observer coverage, such as the Central Gulf of Alaska Rockfish Program (CGOARP), the American Fisheries Act pollock cooperative, the (Bering Sea and Aleutian Islands (BSAI) CDQ fisheries, and the BSAI Amendment 80 fishery cooperative. NMFS funds the plan largely via a 1.25 percent fee (split between the vessel and the processor) on the value of landings. For 2014, NMFS estimated a deployment rate of 13.7 percent for the trip selection vessels, and 10.2 percent for the vessel selection group. These levels of deployment are slightly lower than in 2013 (14-15 percent for trip selection, and 11 percent in vessel selection) due to an estimated increase in effort from 2013 to 2014.

Bycatch of Pacific halibut in the groundfish fisheries off Alaska is managed by the NPFMC's Prohibited Species Catch limits. The limits are subdivided by gear type, target fishery and time period. Halibut limits are set as mortality rather than total catch, and the amounts are given in both metric tons and in pounds (round weight, not net pounds). In 2014, the limits totaled 2,127 metric tons (3,520,000 pounds) in the Gulf of Alaska and 4,425 metric tons (7,300,000 pounds) in the Bering Sea. However, under Fishery Management Plan Amendment 80 for the Bering Sea trawl fishery, only 3,525 metric tons of the fishery's 3,675 metric ton limit was allocated in 2014, similar to previous years.

Bycatch mortality by regulatory area

Area 2A (California, Oregon, and Washington)

Reporting for this area lags by one year, so the numbers for 2014 are not yet available. The results from 2013 are reported here as projections for 2014. The final estimate for Area 2A bycatch in 2014 was 70,000 pounds, one of the lowest figures since 1998, when bycatch estimation started in this area. The 2014 estimation is an 81 percent decrease from 350,000 pounds of bycatch reported in 2010, the final year of the open-access fishery. The PFMC set the 2013 IQ mortality limit for halibut in the coastwide groundfish trawl fishery at 194,033 net pounds. This total constituted 177,495 net pounds reserved for trawl fisheries operating north of 40°10' N (Cape Mendocino, just south of Eureka, California) and 16,538 pounds reserved for fisheries operating south of that latitude. In the hook-and-line fishery, bycatch in 2013 came to an estimated 9,000 pounds, a substantial 50,000-pound drop from 2012. Reduced effort by harvesters accounted for part of this decrease, but an increase in the amount of halibut retained by sablefish harvesters relative to the target catch was another factor. The shrimp fishery maintains zero bycatch due to fish excluders that were implemented in 2003.

The bycatch in Area 2 is relatively low compared to other areas of the coast.

Area 2B (British Columbia)

DFO staff at the Pacific Biological Station estimated bycatch mortality in Area 2B for the 2014 bottom trawl fishery to be 240,000 pounds, relatively unchanged from the final 2013 estimate of 230,000 pounds. The groundfish trawl fishery accounted for all of it, largely during the summer months, though in 2014, bycatch during January-March reached its highest point since 2007. The January-March period typically accounts for less than 40,000 pounds of bycatch, but in 2014 that number approached 70,000 pounds.

Area 2C (Southeast Alaska)

For the federal waters of Area 2C in 2014, NMFS only reported bycatch by hook-and-line vessels fishing in the outside waters, which mostly target Pacific cod and rockfish. These fisheries are estimated to have pulled in some 12,000 pounds of bycatch in 2014. Vessels fishing in the federal sablefish IFQ fishery (which do not have halibut QS to enable bycatch retention) also account for a minor amount of bycatch.

Historically, Alaskan bycatch has been attributed to three major fisheries in Area 2C: 1) beam trawling for shrimp and flounder in inside waters; 2) hook-and-line fisheries for sablefish in Chatham Strait, Clarence Strait, and outside waters; and 3) king/tanner crab and shrimp fisheries. As there has been a lack of comprehensive observer coverage for these fisheries, for years the IPHC has been making its estimates based on research data from the early 1980s. In 2012, the IPHC changed this, beginning the process of reviewing these four fisheries and their datasets, with the eventual goal of revising the bycatch estimates. In 2014, ADF&G provided estimates for crab fisheries in southeast Alaska and shrimp fisheries in Prince William Sound. IPHC and ADF&G staff are also working together to establish up-to-date estimates for other fisheries, to be available in fall 2015. Certain information is unavailable until this revision process is finished.

Anything not targetted can be considered bycatch. This is the result of a haul made during the NMFS trawl survey. Photo by Paul Logan.

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

A preliminary estimate of bycatch mortality for Area 3 in 2014 amounts to 2,860,000 pounds, a 12 percent increase from 2013, which recorded 2,318,000 pounds of halibut bycatch (including 1,823,000 pounds from the groundfish trawl fishery). Despite the increase (which was largest in area 3B), the level of bycatch in this area is the second lowest recorded since 2005. Notably, the trawl fisheries in 3A and 3B, and the hook-and-line fishery, saw increases in bycatch. The hook-and-line fishery in 3A was the only one that decreased in 2014. It should be noted that Area 3 has the most poorly estimated bycatch estimates of all the regulatory areas, due to limited observer coverage.

Under the CGOARP established in 2012, harvesters are able to form voluntary cooperatives and take advantage of exclusive harvest privileges for certain rockfish species. Participants' catch histories inform their assigned rockfish quota shares, which are aggregated to the cooperative and fished collectively by its members. Two cooperatives have been formed—one for catcher/processors and one for catcher vessels—both of which operate under a requirement for full coverage by observers and limits to halibut bycatch mortality. These limits were a portion of the overall trawl bycatch mortality limit for the Gulf of Alaska. The total limit for halibut bycatch was set at 320,000 pounds (net weight) for all cooperative fishing in 2014, but the operational limit, when fishing must cease, was 270,000 pounds. By the end of November, 2014 only 140,000 pounds (47 percent of the 270,000 pounds bycatch allocation) had been taken, while 92 percent of the CGOARP groundfish allocation of 4,231,000 had been taken.

Area 4 (Bering Sea/Aleutian Islands)

In 2014, halibut bycatch mortality in Area 4 was estimated at 6,131,000 pounds, a 1.7 percent increase from 6,027,000 pounds in 2013. This estimate for 2014 is the third lowest since 2000, and is below the 2005-2014 mean of 6,500,000 pounds. While the trawl fishery bycatch increased by 3.3 percent, 2014

Bycatch mortality in Area 4 (6.131 million pounds) was up slightly from 2013 but was still below the 2005-2014 mean.

saw a 7.4 percent decrease in hook-and-line bycatch. Bycatch from the trawl fishery—including rock sole, yellowfin sole, Pacific cod, and pollock—accounted for 5,268,000 pounds of the total. Hook-and-line fisheries (targeting mostly Pacific cod) took an estimated 858,000 pounds of halibut. Finally, pots used to catch sablefish and Pacific cod accounted for 5,000 pounds of halibut bycatch.

Prohibited Species Donation program

The amount of halibut donated in 2013 and 2014 combined represented 294,832 meals.

The Prohibited Species Donation (PSD) program of the Alaska groundfish fishery enables some Pacific halibut caught by trawl vessels in the Bering Sea/Aleutian Islands and the Gulf of Alaska to be processed and donated to food banks throughout the United States. SeaShare, an organization based on Bainbridge Island, Washington, that has operated the program since its inception in 1998, provides annual reports to IPHC on the quantity of fish it has handled and on the amount of final processed product (steaks or headed/gutted). Since its inception, the program has handled a total of 442,837 pounds (net weight) of landed halibut bycatch. After a variety of cooperating cold-storage companies weigh, inspect, steak, and repack the fish, SeaShare sends it out to hunger relief programs. Food banks receiving this fish in 2014 were Kodiak Food Bank (Baptist Mission), Brother Francis Shelter (Kodiak), St. Herman's Seminary (Kodiak), Food Bank of Alaska (Anchorage), NANA Corp. (Kotzebue), the Qawalangin Tribe (Unalaska), Oregon Food Bank (Oregon), and San Francisco Food Bank (California).

In 2014, through the end of September, preliminary figures indicated that SeaShare collected 31,838 pounds of halibut from both Bering Sea and Gulf of Alaska ports, with 10,190 pounds (32 percent) originating in the Bering Sea, and 21,648 pounds (68 percent) coming from the Gulf of Alaska. Final numbers for 2013 showed a harvest of 49,814 pounds, with 9,684 pounds (19.4 percent) originating in the Bering Sea and 40,130 pounds (80.5 percent) coming from the Gulf of Alaska. The amount of halibut donated in 2013 and 2014 represented 294,832 meals for receiving food banks.

SURVEYS

Every year the IPHC conducts an independent standardized setline survey and participates in NMFS-run trawl surveys. Each of the surveys samples a unique component of the stock and that information is then used in the stock assessment and for forecasting purposes. A number of additional projects are also conducted from the survey platforms, all of which are summarized briefly here and some of which are expounded on further in the Research section.

IPHC setline survey

The Standardized Stock Assessment Survey (a.k.a, "setline survey" or SSA) provides catch information and biological data independent of data provided by the commercial fishery. Commercial fisheries data can provide a skewed perception of halibut populations because halibut harvesters congregate where halibut are instead of assessing their presence across a wide area. Additionally, the commercial fishery is more variable in its gear composition and distribution of fishing effort over time.

The setline survey, which collects biological data such as the size, age, and sex composition of halibut, is used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the halibut population. The survey data are collected using standardized methods, bait, and gear during summer months. In addition, the other species caught in the halibut surveys provide insights into bait competition and the rate of bait attacks, and serve as an index of abundance over time, making them valuable to the assessment, management, and avoidance of bycatch species.

The fishing vessels partipating in the IPHC setline survey in 2014 were:
Pacific Surveyor
Pender Isle
Star Wars II
Bold Pursuit
Waterfall
Clyde
VanIsle
Seymour
Free to Wander
Norcoaster
Kema Sue

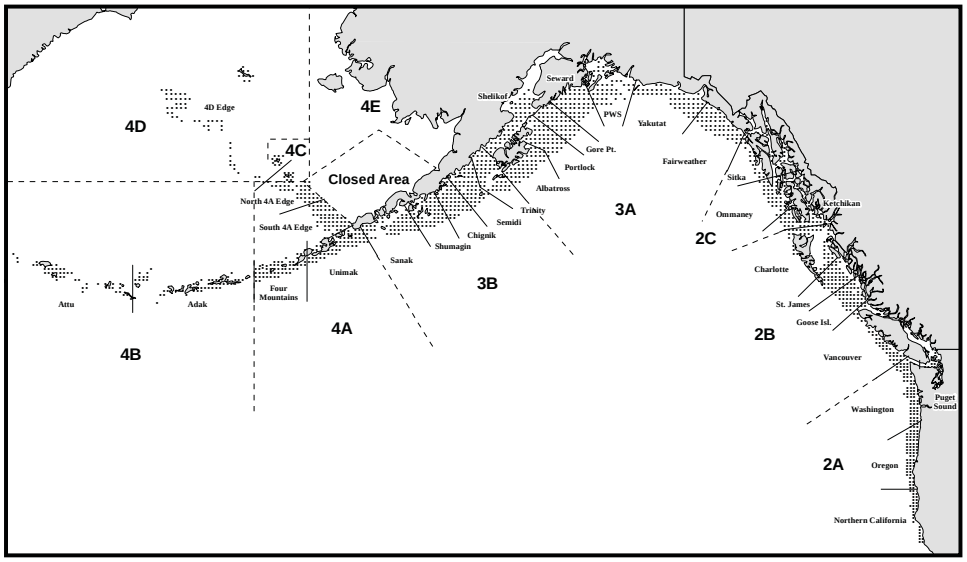
Sea samplers Hesper Kohler and Bruce Biffard aboard the *F/V Waterfall* during the 2014 setline survey. Photo by Tracee Geernaert.

Design and procedures

In 2014, the setline survey collected data covering nearshore and offshore waters coastwide from California to the Bering Sea. The IPHC chartered 11 commercial longline vessels—six Canadian and five U.S.—for survey operations. During a combined 78 trips and 747 charter days, these vessels fished 33 charter regions, covering habitat from northern California to the island of Attu in the Aleutian Islands, and north along the Bering Sea continental shelf edge. Each region required between 10 and 47 days to complete.

Eleven vessels fished 1,410 stations in 2014 from northern California to the Bering Sea and Aleutian Islands.

Survey stations were set up to create a square grid within the depth range occupied by Pacific halibut during summer months (20-275 fm in most areas). There has been a multi-year coastwide effort to expand the survey depth profile in some areas to between 10 fathoms and 400 fathoms. Specifically, in 2014 this effort added 67 stations in Area 2A and 81 stations in Area 4A, for a total of 1,410 stations fished in the 2014 survey.



2014 Setline survey stations by charter region and regulatory area. Note that each dot represents a survey fishing station.

Survey sampling work proceeded as follows: Each vessel set between one and four stations every day, starting as early as 5:00 a.m. Gear was allowed to soak for at least five hours before hauling. Data from gear soaked longer than 24 hours were discarded from the survey, as were sets for which predetermined limits for lost gear, snarls, depredation, or displacement were exceeded. The gear in question consisted of fixed-hook, 1,800-foot skates with 100 circle hooks of size 16/0 spaced 18 feet apart. The length of the gangions ranged from 24 to 48 inches. A total of seven skates were set at each station in all charter regions. Each hook was baited with 0.25 to 0.33 pounds of chum salmon.

On-board biologists recorded the fork lengths of all halibut captured to the nearest centimeter, then calculated estimated weights using a standard formula. Average weight per unit effort (WPUE), expressed as pounds per skate, was calculated by dividing the estimated catch in net pounds of O32 halibut by the number of standardized skates hauled for each station, and averaging these values for each area.

F/V Waterfall **crewman Jake Holm waves to the camera as the vessel leaves the dock. Photo by Tracee Geernaert.**

Sampling protocols

During the setting of the gear, samplers assessed the functionality of bird avoidance devices and recorded the number of hooks set and baits lost per skate. As gear was retrieved, the biologists recorded whether bait was returned on hooks, and what species were captured for the first 20 consecutive hooks of each skate. In the entire Puget Sound charter region, specific northern stations of Area 2A, and all of Area 2B, samplers recorded the status of all hooks in the order in which they were hauled, in place of 20-hook counts. Samplers also recorded the length of each halibut caught and the corresponding skate number, and, once the fish were eviscerated, collected data such as sex, maturity, severity of prior hooking injury, and evidence of depredation. Otoliths were removed from a subset of halibut; most for aging and a smaller number for the COAC.

U32 halibut were sampled for otoliths, sex, and maturity if they were randomly selected for otolith removal or were already dead on the line. Those not sampled were measured and released alive. At the end of each haul, samplers recorded the number of seabirds present within a 50-meter radius of the vessel's stern, data that would be used to judge where and when they gather in most abundance.

Special projects

The SSA survey platform provides the opportunity for the execution of experiments that may not be directly associated with the halibut stock assessment, but provide valuable information to biological studies of halibut or on other species of special interest to other agencies. In 2014, the IPHC took on a number of special projects on a variety of topics.

In addition to standard survey fishing, there were three special projects undertaken coastwide, and 11 more that took place on a smaller scale.

Seabird Occurrence

The IPHC continued its effort to collect seabird occurrence data that started in 2002. The original purpose of the project was to assemble a seabird database that could be analyzed for population purposes, and to take part in the process regulating seabird avoidance requirements for commercial fishing vessels. More information on this project can be found in the Research section of this report.

Oceanography

Seabird occurrence, environmental data, and depredation tracking were recorded on every survey vessel.

IPHC continued an ongoing project to collect environmental information on the halibut grounds. Each survey vessel was equipped with a Seabird™ water column profiler which was deployed immediately prior to hauling the gear at each station. Information collected included depth, salinity, temperature, dissolved oxygen (DO), pH, and fluorescence. More information on this project can be found in the Research section of this report.

Rockfish sampling in Regulatory Area 2A

IPHC sea samplers tagged all rockfish caught in Area 2A and recorded the station and skate of capture, which allowed for the calculation of location and depth at capture. Biologists from WDFW, ODFW, and CDFW then collected additional data, such as sex, weight, length, and maturity, as well as biological material from each fish. In 2014, state biologists sampled 419 rockfish that were captured in Area 2A.

Offloading the rockfish bycatch from the *F/V Waterfall* during the setline survey. Photo by Tracee Geernaert.

In 2014, as in 2013, eight rockfish stations were added to the standard SSA stations. At those stations, only three skates were fished in order to reduce pressure on the rockfish population. Halibut that were caught were measured and released alive, with none of the data used in the stock assessment.

Rockfish sampling in Regulatory Area 2B

As they have been doing since 2003, with the exception of 2013, IPHC samplers in Area 2B assessed all rockfish caught on the survey, collecting otoliths and recording round weight, round length, sex, and

maturity. Samplers collected biological data from 2,883 rockfish (representing 16 different species), and collected otoliths from 2,106 of those. These data and otoliths were provided to DFO.

Yelloweye rockfish enumeration in Alaska

IPHC samplers on survey vessels recorded the details of all yelloweye rockfish encountered in Area 2C and in the Fairweather charter region of Area 3A—a total of 1,495 fish. Data about these fish were sent to ADF&G for analysis.

Environmental contaminant sampling

For an ongoing study on environmental contaminants in halibut, undertaken in conjunction with the Alaska Department of Environmental Conservation, IPHC samplers collected flesh samples from Pacific halibut caught by survey vessels. Samples were collected from fish of a range of sizes. In 2014, a total of 64 samples were collected in the Fairweather survey region, 61 in the 4A Edge South region, 38 in the Puget Sound region, and 45 in the northern California region. The samples were tested for a range of environmental contaminants, including organochlorine pesticides, dioxins, furans, polybrominated diphenyl ethers, polychlorinated biphenyl congeners, methyl mercury, and heavy metals (arsenic, selenium, lead, cadmium, nickel, and chromium).

Many of the special projects are collaborations with other agencies including NMFS, ADF&G, and ADEC to name a few.

Ichthyophonus sampling

The IPHC continued its investigation of the prevalence of a microscopic protozoan parasite called *Ichthyophonus* in the Pacific halibut population. The 2014 project resampled the three geographically distinct areas that have been sampled since 2011 (Oregon, Prince William Sound, and Bering Sea charter regions) in order to investigate the prevalence of *Ichthyophonus* over time.

Spiny dogfish sampling

IPHC samplers collected data on the sex and length of 3,063 spiny dogfish as part of a study requested by NMFS Auke Bay Laboratories. The study requires data on the length and sex of the first five spiny dogfish brought aboard survey vessels in Areas 2A, 2B, 3A, and 3B; and of all spiny dogfish caught by survey vessels in Area 4A, 4B, 4C, 4D, and 4E. The results, which are compared to those from the NMFS sablefish longline surveys, shed light on species distribution and test the hypothesis that there may be two biological stocks of dogfish—one in southeast Alaska's inside waters, and one in coastal waters elsewhere. These data will be used to develop a length-based population dynamics model for the annual dogfish stock assessment.

Skate age and maturity sampling

The NMFS requested that the IPHC assist with a data-collection project to assess aspects of longnose skates and big skates in the Gulf of Alaska. In 2013, a pilot project used one vessel to collect a limited number of samples that provided data on sex and maturity. In 2014, in an expansion of the effort, six vessels collected 172 big and 265 longnose skate samples. Researchers collected data on total length, sex, maturity stage (with photos taken representing each stage), the presence of egg cases inside female skates (as well as measurements of each egg

case), and small sections of vertebral column. This information has been deemed imperative for fisheries managers to understand aspects of skate reproductive biology and development.

Coral sampling

The NMFS and the IPHC collaborated on an effort to collect data about the coral species in the Bering Sea. The eastern Bering Sea canyons have been suggested to be a unique habitat for which the NPFMC should consider conservation measures. Data on coral in the area will inform any action to preserve this unique habitat. Surveyors identified all coral brought aboard in Area 4D, as well as in the 4A Edge North and 4A Edge South charter regions. One of the survey vessels reported a total of three species, and the other vessel reported one species.

Occasionally the longline will snag coral from the seafloor. Canyon areas in the Bering Sea are of particular conservation interest and samplers there catalogued all species observed.

Pop-up Archival Transmitting (PAT) tagging

In 2014, a total of six female halibut ranging from 94-118 cm were tagged aboard the *F/V Pacific Surveyor* off the U.S. West Coast.

Six-gill shark sampling in Puget Sound

Thirty-one bluntnose sixgill sharks were opportunistically sampled in Puget Sound aboard the *F/V Pacific Surveyor* in a joint project with the Seattle Aquarium. Sex was determined externally, and up to 12 different meristic measurements were made on each shark. Genetic samples were collected from 30 of them.

Pacific cod length frequencies

The IPHC shared data on Pacific cod captured during surveys in Areas 4A and 4D with NMFS Alaska Fisheries Science Center. The data were combined with other NMFS data to assess Bering Sea and Aleutian Islands Pacific cod stocks. In 2014, samplers aboard the *F/V Kema Sue* and the *F/V Free to Wander* collected 5,422 and 621 Pacific cod lengths, respectively.

Depredation tracking

Pacific halibut hooked by commercial fishing gear are particularly vulnerable to depredation by marine mammals such as killer whales, sperm whales, seals, and sea lions. Work by IPHC samplers in 2013 established a baseline rate of gear damage against which to compare stations with suspected interference from depredating species. To gain more insight, sea samplers recorded data about any toothed whales or pinnipeds observed within 100 meters of a survey vessel. Samplers noted all damaged halibut and damaged bycatch retrieved during these encounters.

Bait purchases

The bait used for the setline survey is held to a minimum quality standard to ensure fishing success and consistency from season to season. The bait used every year is No. 2 semi-bright (Alaska Seafood Marketing Institute grades A through E), headed, gutted, and individually quick-frozen chum salmon. The 2014 survey used 340,000 pounds, with 330,000 pounds of this bait purchased ahead of time from four U.S. suppliers and an additional 10,000 pounds

purchased in-season from two Alaskan salmon processors. The bait quality was monitored throughout the season and was found to meet the IPHC's standards for the survey.

Fish sales

Fish caught during survey work—O32 Pacific halibut sampled for analysis, as well as rockfishes and Pacific cod that were landed incidentally—were retained. The halibut were kept and sold to offset the cost of the survey. Bycatch were retained because the swim bladders of rockfish and cod are typically irreversibly damaged upon landing. The IPHC does not keep any of the proceeds from selling these two species.

During the 2014 survey, IPHC's chartered vessels delivered a total of 765,419 pounds of halibut to 26 different ports. The coastwide average price per pound was $6.78, amounting to a sales total of $5.19 million. Most vessel contracts provided the vessel a lump sum payment along with a 10 percent share of the halibut proceeds and a 50 percent share of the bycatch proceeds. For boats in U.S. waters, bycatch sales were split between the survey vessel and the requisite state agency. For boats in Canadian waters, the DFO kept all the bycatch proceeds, but paid a bycatch handling fee to those boats.

Average ex-vessel price of halibut sold from the survey was $6.78 coastwide.

Field personnel

The 2014 survey vessels were crewed by a combination of seasonal hires and IPHC staff. A group of 23 seasonal hires worked a total of 1,755 person days,

Survey vessels VanIsle and Waterfall taking a break from fishing. Photo by Aaron Ranta.

including travel days, sea days, and debriefing days. One port sampler and two IPHC Seattle staff worked a total of 59 sea days. Each survey vessel typically hosts two samplers, one shipboard biologist to work on deck (handling fish and collecting data and samples), and another sampler to work in a portable shelter (recording data and storing samples). An exception to that pattern was Area 2A, where catch rates are relatively low and only one sampler was deployed for most of the survey.

Setline survey results

In 2014, the IPHC chartered 11 commercial longline vessels—six Canadian and five U.S.—to carry out survey operations. These vessels fished a combined 78 trips accounting for 747 charter days and covering 1,430 survey stations fished. Of those 1,430 stations fished, 1,417 (99.1 percent) were considered effective for stock assessment analysis.

The IPHC targeted the months of June, July, and August for survey fishing. Ninety stations (seven percent of the total stations) were fished during the last full week of May, while the remainder was fished within the target window. Coastwide survey activity was most intense at the beginning of the survey season and then declined as the end of the fishing window approached, reaching full completion by the end of August. As long as they fish all assigned stations, the boats can set their own fishing pattern without adhering to a regulated order.

Weight and number per unit effort

Considering that the SSA covered both commercial and non-commercial fishing grounds, the average WPUE for all regulatory areas fell short of that for the commercial fleet. Coastwide, the average WPUE was 72 pounds per skate, a decrease from the 87-pound average of 2013. The average WPUE figures for the regulatory areas were:

Area 2C had the highest average weight per unit effort at 185 pounds/skate.

- Area 2A (18 pounds/skate)
- Area 2B (92 pounds/skate)
- Area 2C (185 pounds/skate)
- Area 3A (115 pounds/skate)
- Area 3B (65 pounds/skate)
- Area 4A (61 pounds/skate)
- Area 4B (50 pounds/skate)
- Area 4C (44 pounds/skate)
- Area 4D (23 pounds/skate)
- Area 4E was not fished for survey purposes.

Four regulatory areas—2C, 3B, 4A, and 4C—increased in WPUE in 2014; the rest declined. Although weight is the primary unit of measure when studying population and removals, the number of halibut is also a critical measure. There was a one percent decrease in the catch rates of O32 halibut, and a 14 percent decrease in the numbers of U32 halibut caught in 2014, compared to 2013. In 2014, there were 26 percent more U32 halibut captured than O32, which is a 14 percent increase in difference from 2013. Areas 2B, 2C, 3B, and 4A all had slight increases in the rate of capture, both of large and small halibut. Area 3A showed a decrease in O32, but an increase in U32 halibut NPUE. Area 3B continues to have the largest gap between O32 and U32 halibut, with 58 percent difference between the two.

Otolith collection

One of the major activities of the SSA survey is the collection of halibut otoliths for age determination. In 2014, the otolith collection goal was 2,000 per regulatory area (with a minimum target of 1,500 per area). A total of 16,611 otoliths were removed from the 91,856 halibut caught by survey vessels coastwide, a 19 percent removal rate. Due to low catch rates and few survey

Age reader Chris Johnston examines an otolith collected during the survey. Photo by Joan Forsberg.

stations, four of the regulatory areas did not reach the minimum 1,500-otolith goal, despite 100% sampling rates: 2A (1,233), 4C (592), and 4D (839). An additional 629 otolith pairs were collected in most regulatory areas for the previously described COAC. The annual COAC sampling goal is to collect a random sample of 100 otolith pairs from each of IPHC Regulatory Areas 2A through 4B, and 100 pairs from Areas 4C and 4D combined from setline-caught halibut. These otoliths are collected from the setline survey (with help from the trawl survey), except for regulatory areas where the sampling rate is 100%. For these areas, COAC otoliths are collected from commercial deliveries.

Otoliths were collected for this year's stock assessment as well as for an otolith archive which will be used in the future for projects not yet identified.

Bycatch

The survey's activities resulted in bycatch composed of approximately 121 species of fish and invertebrates. Although precautions are taken to avoid marine mammal and bird catch, one black-footed albatross was captured in Area 3B and was provided to the Oikonos organization for genetic sampling. No marine mammals were caught on survey.

Coastwide, the most frequently caught bycatch species were sharks, followed by Pacific cod. Dogfish was the most commonly caught shark species in Areas 2A (96 percent), 2B (99 percent), 2C (94 percent), and 3A (98 percent). Sleeper sharks were the largest component of the shark species category in

Areas 3B (53 percent), 4A (57 percent), and 4D (100 percent). In 3B, 4A, and 4C, the most commonly caught bycatch species was Pacific cod. In Areas 2C, 3A, and 4B, the "other species" category was most common, usually Aleutian skates, arrowtooth flounder, big skates, longnose skates , white-blotched skates , grenadiers , and yellow Irish lord sculpins.

Halibut distribution

Slightly more than 57 percent of halibut caught on the survey were smaller than the current commercial legal size limit, with a median length of 79 cm coastwide. In 2014, the median lengths of halibut captured increased in Areas 2A, 4A, 4B, and 4C; decreased in Areas 2B, 2C, 3A, and 4D; and did not change in Area 3B. Most of the western portions of the survey (Areas 3A, 3B, 4A, 4C, and 4D) had average halibut lengths below the commercially legal size limit. The largest median length was in Area 2A (89 cm). Area 3A had the greatest proportion of U32 halibut, at 42 percent (22,296 fish). Area 3A also had the greatest proportion of O32 halibut, at 39 percent (15,327 out of a total 39,175 O32 fish).

The average median length of survey-caught halibut coastwide was 79 cm, slightly below the commercial size limit of 81.3 cm.

Sea samplers Claudia Portocarreo and Danielle Vracin soak up some sun while finishing up the paperwork. Photo by Tracee Geernaert.

The sex composition for O32 halibut from the survey catches showed considerable variation among areas, ranging from 42–85 percent females. Area 4B had the lowest percentage of females in the catch, while Area 4C had the highest. Most female halibut caught during the survey period were in the ripening stage and expected to spawn in the upcoming season.

Age distribution

Halibut age is determined by examination of the rings in otoliths. Average age was higher and average fork length was lower for males than females in all regulatory areas. Of the otoliths collected during the survey 16,193 were successfully aged. The most commonly occurring year class was 2005 (nine-year-olds), with 2,477 caught. Next most common were the years 2004 (10-year-olds) and 2003 (11-year-olds), with 2,469 (15.2 percent) and 2,469 (12.9percent) fish caught, respectively. The age distribution differed slightly for males and females. Nine-year-olds (class of 2005) were the most abundant age class for female halibut sampled from all areas combined. The second and third most abundant age classes for sampled females across all regulatory areas were 10-

and 11-year-olds, respectively. Males were most abundant among 10-year-olds (2004 year class) from all areas combined. The second and third most abundant age classes for sampled males across all regulatory areas were 11- and 12-year-olds, respectively.

In 2014, the youngest and oldest halibut caught in the setline survey samples were four and 46 years old. The four-year-old was a male from Area 2C measuring 58 cm FL. The 46-year-old was a male from Area 4B with a fork length of 130 cm. The smallest and largest halibut caught in the survey samples were 39 cm and 191 cm, respectively. The largest was a 24-year-old female from Area 2B. The smallest was an eight-year-old male from Area 3B.

The age of halibut caught on the survey ranged from four to 46 years old.

Setline survey expansion and complementary data sources

The IPHC staff has proposed a series of expansions of the annual setline survey to address gaps that currently exist in the survey's coverage. The current survey grid has 10 nmi station spacing covering depths from 20 to 275 fathoms. However, observations have shown there to be significant commercial harvest in deep waters, particularly in Area 4A, and in shallow waters in some areas. It is apparent that the current survey range does not cover the entirety of halibut habitat—to compensate, the survey began using a 0-400 fathom depth range for estimating the bottom area of each regulatory area. Other gaps within the 20-275 fathom range are at times substantial, particularly in Areas 2B and 4. To address these gaps, the IPHC has proposed a number of expansions to current and future survey efforts.

Expansion of the survey to account for regions of unsurveyed habitat may or may not result in large changes in mean WPUE, which affects apportionment. Those areas with large regions of unsurveyed habitat are Areas 2B, 4A, 4B, and Area 4D Edge. Also, a survey of the eastern Bering Sea (EBS) flats, which covers 68 percent of the total Area 4CDE bottom area, would result in a change in the Area 4CDE index and consequently this area's apportioned share of the coastwide biomass. This is of particular importance given that, in recent years, biomass has been close to the point at which, after accounting for other removals such as bycatch mortality, the commercial fishery could be closed in this area. For this reason, IPHC has prioritized improving the information available on the Bering Sea through a proposed survey of the EBS in 2015.

Survey expansions in 2014 and the use of the sablefish longline survey

The IPHC has planned a six-year setline survey expansion whose primary purpose is to reduce the potential for bias in the indices of halibut density and abundance. The expansion, begun in 2014 and set to complete in 2019, moves the survey into deep (275-400 fm) and shallow (10-20 fm) waters, and into gaps in the 20-275 fm waters covered by the standard 10 nmi station grid.

Implementation of a six year survey expansion plan began in 2014. The full plan spans all regulatory areas and is intended to fill gaps in the current design.

The expansion was carried out in Areas 2A and 4A in 2014. In Area 2A, the Salish Sea and deep and shallow expansion stations previously fished in a 2011 pilot study were repeated with the addition of deep and shallow stations in California. In addition, the survey was further expanded southward to 39° N in northern California. In Area 4A, the survey grid was expanded into deep and shallow waters, and into gaps in the standard depth range of 20-275 fathoms. One large gap was on the Area 4A Edge, where the standard survey had previously gone no shallower than 75 fathoms, which was inconsistent with the depth range

around the Aleutian Islands of 20-275 fathoms. Other significant gaps were in the west of the Aleutian Island region of Area 4A, and the region around Unimak Pass.

The NMFS sablefish survey is conducted annually in the Gulf of Alaska, and biennially alternating in the Bering Sea and around the Aleutian Islands. The sablefish survey records counts of halibut by skate on each station, but size and other biological information is not generally collected. IPHC staff has noted it has high potential for calibration with the IPHC survey to provide an index for deep waters when these are unsurveyed by the IPHC.Using the sablefish survey to index density in deep waters involved computing sablefish NPUE (i.e., numbers of halibut per 45-hook skate) indices for both deep (275-400 fm) and standard-depth (0-275 fathom) waters by averaging the NPUE across all skates in each of the depth ranges. Multiplying those numbers by the 20-275 fm setline survey index for each area resulted in a WPUE index for deep water. This was done for each year that the sablefish survey took place in an area.

NMFS Bering Sea trawl survey

This year marked the IPHC's 17th straight year of participation in the NMFS annual trawl survey on the eastern Bering Sea shelf. The trawl survey serves as an additional data source and verification tool for the IPHC halibut stock assessment, as it allows the IPHC to collect information on halibut that are not yet vulnerable to the gear used for the IPHC longline survey or commercial fishery.

The trawl survey serves as a tool to get a glimpse of young year classes of halibut that have a few years to go before recruiting to the commercial fishery.

Between June 3 and August 4, an IPHC field biologist took three trips on two different chartered vessels—*F/V Vesteraalen* and *F/V Alaska Knight,* each staffed with a scientific crew of six. The biologist collected data from all of the Pacific halibut caught during standard tows, including length, otoliths, sex, maturity, and prior hooking injuries. Additionally, 133 samples for the COAC were collected.

This annual series of crab and groundfish assessment surveys for the eastern Bering Sea provides information to the NPFMC (for understanding the distribution, abundance, and biological condition of important groundfish and crab resources); to the U.S. fishing industry (for catch-per-unit effort and size composition of commercially important groundfish species); and to stock assessment scientists (to support ongoing studies on the biology, behavior, and dynamics of key ecosystem components).

The survey consisted of 376 stations positioned on a 20x20 nautical mile (nmi) grid on the continental shelf in the eastern Bering Sea, in depths ranging from 30 to 200 meters. In 2014, a total of 176 tows were completed and 1,053 halibut were sampled. Of the total, 515 (52 percent) halibut were female and 469 (48 percent) were male. Ninety-seven percent of the female fish and 34 percent of the males were assessed to be immature.

Size and age composition

The trawl survey tends to catch halibut that are younger and smaller than those caught on the setline survey and misses the larger, older fish. It is also the only measure of abundance for much of the Bering Sea, as the IPHC does not have the financial capability to sample it in its entirety. The swept-area

abundance (numbers) estimate for the Bering Sea (for all halibut caught) in 2014 was 62.8 million halibut, which continues a downward trend in abundance since 2006, but suggests the decline may be leveling out. The estimated biomass (weight) declined in 2014 to 378 million pounds.

NMFS Aleutian Islands trawl survey

In 2014, the IPHC participated in the Aleutian Islands trawl survey operated by the NMFS for the second consecutive time in recent years. This survey has taken place every two years since 2000 and every three years prior to that, dating back to 1980. Two vessels—the *F/V Alaska Provider* and the *F/V Sea Storm*—were chartered to carry out the survey, which operated from Unimak Pass (longitude 165°W), to Stalemate Bank west of Attu Island (longitude 170°E). The IPHC biologist was aboard the *F/V Alaska Provider*. The survey was scheduled to begin June 5, but volcanic activity from Mt. Pavlof delayed departure until June 9. The first survey tow was performed on June 11 and the last tow was conducted on August 7.

Veteran sea sampler, Paul Logan, along with NOAA biologists, sample the catch aboard the *F/V Alaska Provider* during the NMFS trawl survey. Photo credit: Paul Logan.

The Aleutian trawl survey spanned the area from Unimak Pass to Stalemate Bank.

The survey is designed as a stratified random sampling scheme consisting of 420 randomly selected stations. The selected sampling sites were allocated to 45 sampling strata defined by geographical location, depth, and regulatory area, ranging from shallow, nearshore depths to approximately 500 m on the continental slope. A 15-minute tow was typically conducted at each station.

All halibut caught by both vessels were measured and all halibut caught by the *F/V Alaska Provider* were also sampled for otoliths, sex, maturity, and prior-hooking injuries. Otoliths were also collected from each halibut brought aboard. In total, the F/*V Alaska Provider* conducted 237 tows and caught 510 halibut.

Of the fish caught, 201 (39 percent) were female and 309 (61 percent) were male. The vast majority (92 percent) of the females were immature, while six percent were ripening, and two percent were spent/resting. No halibut were assessed as actively spawning. Of the males, none were assessed as immature. Thirty-three (6.5 percent) of the fish had prior-hooking injuries—24 of them minor, eight moderate, and one severe. The *F/V Alaska Provider* caught no halibut smaller than 25 cm and therefore no halibut were collected for the COAC project.

Abundance and biomass estimates

After peaking in 1997 with a biomass estimate of 146 million pounds, the Aleutian Islands halibut population index steadily declined to about 70 million pounds in 2012. In 2014, the index increased slightly to 74 million pounds, but it will take several more data points to determine if this is the beginning of a long-term increasing trend in biomass or just a result of survey variability.

Prior hook injuries

Prior hook injuries (PHIs) are the result of previous entanglements of fish with hook-and-line gear followed by their release in an injured state. The strict requirements for release techniques imposed on groundfish and halibut longline harvesters have not stanched the widespread incidence of moderate and severe PHIs. These injuries are a concern, as they are visible evidence of past rough handling, and IPHC studies show that moderate to severe injuries increase halibut mortality.

An estimated 6.1 percent of halibut examined on the setline survey had a PHI, and 4.3 percent were assessed with PHIs on the trawl survey.

All halibut captured during the 2014 IPHC SSA survey were examined for the presence of PHIs. That amounted to 91,732 halibut, a large increase from the 67,864 halibut examined during 2013. A total of 9,852 standard survey skates were examined, substantially more than the 7,608 skates examined in 2013. The addition of new stations as well as fishing seven skates instead of six at each station contributed to the increase in skates fished in 2014. Survey vessels fished a total of 1,410 survey stations in 2014 compared to the 1,276 fished in 2013.

In the 2014 survey, 5,540 halibut were found to have a prior injury. The percentage of all halibut with a prior hook injury averaged 6.1 percent coastwide (ranging from a low of 4.1 percent in Area 3A to a high of 13.3 percent in (Area 4D). This coastwide average is lower than the 7.5 percent average observed in 2013. Areas that saw increased PHIs in 2014 were 3B and 4A-Bering Sea, while the number in Areas 4A-Aleutians and 4B stayed about the same. PHI incidence decreased in all other areas, including a significant decrease in Area 4D.

The overall incidence of PHI for U32 halibut examined during the SSA survey increased significantly from that observed in 2013 (6.1 percent, up from 4.9 percent). U32 PHI incidence went down substantially in Area 2A, and increased dramatically in Areas 4A-Bering Sea and 4C. The highest occurrence of U32 PHI (11.9 percent) was observed in Area 4A-Bering Sea, up from the 8.5 percent value seen in 2013.

The samplers aboard the NMFS trawl survey in the Bering Sea and Aleutian Islands also gathered PHI data. In the Bering Sea survey, 1,053 halibut were inspected and the PHI rate was determined to be 4.3 percent, a decrease from the 5.1 percent observed in 2013. Of the 510 halibut assessed on the the Aleutian survey, 6.5% had a PHI.

It appears that this halibut suffered a hooking injury in the past that left it without an upper jaw, yet it managed to survive and bite another hook. Photo by Jack Cramer.

The high PHI rates observed in both the Bering Sea and the Aleutian Islands are most likely the result of interception of Pacific halibut by Pacific cod groundfish fisheries in those areas. The severity of the problem is probably worse than the data show, as the IPHC's PHI observations only reflect the number of injured halibut that survived the ordeal. Many halibut die from moderate to severe hooking injuries, and those that do survive often stop growing or grow slowly. The IPHC is working to analyze PHI data time series to figure out whether there are relationships (with respect to space or time) of injury rates related to fishing effort. The IPHC plans to develop models relating injury rates to commercial and sport fishing efforts.

The eventual goal with these data is to develop models that relate injury rates to commercial and sport fishing efforts.

POPULATION ASSESSMENT

Since 1923, the IPHC has been focused on assessing and managing the population (or stock) of Pacific halibut, a complex process that requires some explanation. There are three main topics to unpack, plus the details of the apportionment process, which is covered in its own chapter immediately following this one. The topics covered below are: (1) data sources and how they form the background of the assessment, (2) the assessment process and its results, and (3) the MSE concept and how it applies to the population assessment.

Three major types of data go into developing the stock assessment each year: fishery-independent data, fishery-dependent data, and auxiliary data.

Data sources

In 2013, the IPHC began including more historical data in its assessment procedure. Looking at changes in the halibut population over time allows scientists to better identify cyclical trends that affect the current population. While data collection has continuously improved and is now the best it has ever been, the historical data are incomplete and/or imperfect, limiting the conclusions that can be drawn. The IPHC currently relies on three types of data: fishery-independent data, fishery-dependent data, and auxiliary data.

Fishery-independent data

The IPHC setline survey generates the fishery-independent data, which covers the majority of Pacific halibut habitat from the northern Bering Sea and Aleutian Islands to California, at depths of 0-400 fathoms. The survey

Port sampling supervisor Lara Erikson collects biological data for the stock assessment during a visit to Homer, AK. Photo by Jessica Marx.

provides catch-rate information, as well as biological information from random sampling: sex, length, age, maturity, and presence of prior hooking injury. The stock assessment relies primarily on this information, along with that from the commercial catch. Fishery-independent data includes three measures: 1) survey weight-per-unit-effort (WPUE), 2) survey age distributions, and 3) survey weight-at-age. In 2014, there was a substantial increment to the survey data resulting in: expanded depth coverage to 10-400 fathoms in Area 2A and Area 4A, extended geographic coverage to a portion of northern California, and calibration of the survey catch rates with those observed in the NMFS sablefish longline survey in Alaska.

The first measure of fishery-independent data—the WPUE—indicates abundance and is calculated based on the catch in weight relative to the amount of gear deployed at each station. The processing of survey WPUE in the Bering Sea (Areas 4C, 4D, and 4E) is extensive—requiring several "expansions" to accurately estimate halibut density—since there are large regions that are not covered by the annual setline survey.

The IPHC setline survey is a standardized measure of halibut on the grounds and serves as the fishery-independent data source.

The second measure—survey age distributions—comes from otoliths, the sampling rates for which are adjusted annually to produce parity across regulatory areas. All otoliths collected during survey activities are read each year by IPHC age-readers. The age frequencies across areas tend not to show much deviation, but Area 2 showed a somewhat greater number of age 9-10 halibut in 2014.

The third measure—survey weight-at-age—is obtained via individual length observations on all halibut captured. These are then converted to estimated weights via the length-weight equation. Due to the random nature of age sampling for each regulatory area each year, calculations of average weight-at-age by area, sex, and year are made. Differences among the areas require appropriate weighting—using estimates generated from the survey numbers-per-unit-effort (NPUE)—to create a coastwide time-series that accurately represents the entire stock. There do not appear to be consistent or strong trends from 2010-2014 in the area-specific data.

Fishery-dependent data

Fishery-dependent data is based on halibut removals—both intentional and bycatch—from commercial, sport, and personal use fisheries. The data are comprised of several elements: catches from each source, directed fishery WPUE, fishery age distributions, and fishery weight-at-age. Fishery-dependent data is dominated by halibut landings from the commercial fishery, which since 1981 are reported to IPHC by way of commercial fish tickets. Due to different data collection methods used until 1980, landings estimates prior to 1981 are more uncertain than those after 1981. Historical landings prior to 1935 were reconstructed within current regulatory areas from summaries by historical statistical areas. The government agencies that manage the sport fisheries are responsible for reporting recreational removals to the IPHC. These include (from south to north) the CDFW, ODFW, WDFW, DFO, and ADF&G. There is an assumption that there was little sport fishing for halibut before the mid-1970s, though sport removals have grown dramatically since then, peaking in the mid-2000s with annual harvests of over 10 million pounds.

Fishery-dependent data sources are those where halibut is removed either intentionally or not and include commercial, sport, personal use, and bycatch.

Since 1991, the DFO and NMFS have provided estimates of subsistence (or personal use) harvests. These estimates are not made every year in all cases, so in some instances must be extrapolated for intervening years.

Wastage of halibut in the commercial fishery has risen and fallen, hitting a peak in the early 1980s and then undergoing another high period between 1995 and 2010. During the latter period, the size-at-age of halibut declined and fish reached the minimum size limit at older ages. Prior to 1981, wastage in Area 4 couldn't be estimated, though it is believed that little wastage actually occurred then.

NMFS and DFO report estimated bycatch of halibut from non-halibut fisheries annually to the IPHC, though this reporting varies widely in quality depending upon the year, fishery, type of estimation method, and many other factors. The peak occurred in 1992, with over 20,000,000 pounds caught, and has mostly declined since then, with an estimated 9,300,000 pounds caught in 2014 (though that is a slight increase from the 8,890,000 pounds caught in 2013).

Fishery-dependent data is processed similarly to fishery-independent data: 1) fishery WPUE, 2) fishery age distributions, and 3) fishery weight-at-age. The IPHC considers the commercial WPUE to be another "survey" of the stock, and so its estimates serve as a proxy for density. In 2013 the coastwide WPUE was 187 net pounds/skate.

Port samplers collect both lengths and otoliths, with lengths converted into individual weight estimates where needed. Ports staffed by the IPHC have samplers gather otoliths in proportion to landings in order to estimate recent fishery ages, a method that allows the direct aggregation of raw ages within each area and year. Another option is to estimate average weight within each area via the length-weight relationship. Dividing the total commercial catch for each regulatory area and year by the average fish weight gives an estimate of the number of fish captured. The age distribution obtained from this method showed a similar trend to the age distribution found in the setline survey—a plentiful 1987 class that had moved through the stock. It also revealed that halibut in the commercial landings from the 1930s to 1973 (when the current 32-inch minimum size was implemented) were predominantly between the ages of 6-14.

Another monitoring method, fishery weight-at-age, measures the average weight of halibut at a given age, allowing for the tracking of fish size over time. A picture of coastwide weight-at-age since the 1930s was constructed by considering the historical weight-at-age for each regulatory area in relation to the number of fish in the landings for that area. This method revealed increasing fish size all the way through the 1970s, followed by a decline in size that continues to the present.

Auxiliary inputs to the stock assessment model are the results of additional analyses, but are treated like data.

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

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

Crewman Conner McLellan aboard the stock assessment survey vessel *Free to Wander*, baits gear on the way to the next fishing station. Photo by Jack Cramer.

2. Halibut become sexually mature on a set schedule that has been proven stable through regular historical investigations. Across all regulatory areas, half of all female 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 halibut (compared to other groundfish), and analysis shows that the current ageing method—referred to as "break-and-bake"—is remarkably precise. Another method, called "surface aging," used prior to 2002 was not nearly as precise. A test that subjected 4,362 otoliths from the setline survey of 1998 to both aging methods showed an increasing bias for ages above 15 years. This bias is accounted for when the data are used in the stock assessment and the number of fish in the catch older than 15 years is relatively low.

Studies have shown that environmental conditions are correlated with recruitment of halibut.

4. The PDO is a pattern of Pacific climate variability that changes on average, about every 30 years. Research has shown that during the 20th Century these environmental conditions have been correlated with the recruitment of halibut to the commercial fishery. In "positive" (warm) phases of the PDO (through 1947, and 1977-2006), the commercial fishery experienced an increase in recruitment. Most recently, the PDO has been in a "negative" (cold) phase which started in 2006 and continues today. The cold phase PDO has historically been correlated with lower recruitment of halibut into the fishery.

Notable data processing changes for 2014

In 2014, there were some important changes to previously employed methods. These included the following:

- As in 2013, fishery age data are no longer disaggregated into male and female observations based on survey sex ratios, but modeled as aggregate age-frequency data for both sexes combined.
- Setline survey total NPUE is now used as an index of relative abundance, rather than only the O32 survey WPUE.
- Commercial fishery and setline survey data were summarized both at the coastwide level and also by geographic region (Area 2, Area 3, Area 4, and Area 4B) during 2014 for use in assessment modeling.
- Mortality associated with catch-and-release in the recreational fishery has been included in estimates for 2014.
- Length-frequency data collected by the North Pacific Observer Program have been updated to include the most recent complete year of sampling (2013). These data are important for use in delineating the proportion of the bycatch estimated to be above and below 26 inches for the harvest policy calculations.

Although WPUEs are substantially lower than in the 1990s, survey and fishery age distributions continue to indicate a stable stock.

Population assessment at the end of 2014

Over the last century, halibut removals from all sources have ranged annually from 34 to 100 million pounds, with an average of 64 million pounds. For 2014, total removals were well below that average, at 43 million pounds (down from 48 million pounds in 2013). Female spawning biomass is estimated to have stabilized around 200 million pounds since 2009. The median 2015 estimate of exploitable biomass is 181 million pounds. The 2014 setline survey total WPUE increased by six percent (two percent for legal-sized halibut only) relative to 2013, when it was 44 pounds coastwide. Although survey and fishery age distributions continue to indicate a relatively stable stock of halibut, WPUE is now substantially lower than it was in the late 1990s.

Assessment

The methods for undertaking the population assessment for Pacific halibut have changed many times over the last 30 years due to a continual effort to improve model assumptions and analysis approaches, and to eliminate recurring retrospective biases. Changes in 2012's methods ended the most recent retrospective bias problem, and in 2013 a method called the "ensemble approach" was introduced as a way to make the process both stronger and more flexible to future model changes. Originating from the field of weather and hurricane forecasting, it recognized that there is no "perfect" assessment model, and that healthy risk assessment can only be achieved with the inclusion of multiple models in the estimation of management quantities (and the uncertainty about these quantities).

For 2014, several alternative models were evaluated for inclusion into the stock assessment ensemble. After evaluating various options, IPHC's SRB endorsed a final ensemble that included four individual models: each of both short and long time-series models based on coastwide and Areas-As-Fleets (AAF) data structures. AAF models account for biological differences among

***F/V Free to Wander* has been a part of the survey since 2000. Photo by Jack Cramer.**

areas or sampling programs that present difficulties for coastwide summary of data sources. The particular combination of models chosen accounts for various sources of uncertainty, including natural mortality rates, environmental effects on recruitment, and fishery and survey selectivity. Understanding and assessing the stock is very difficult without accounting for such sources of uncertainty. The long time-series models are mixed with the short time-series models to combine the benefits of historical perspective with the decreased complexity of simpler approaches. Together, these models provide for a robust risk analysis that can accommodate changes or additions.

The ensemble approach allows for different models to be added or refined as more information is collected.

The ensemble approach allows for continual and transparent improvement, as additional models and refinements can be incorporated as they become available. In 2014, as in 2013, each of the models in the ensemble was given equal weight, and their integration smoothed out differences in uncertainty. In future years, this weighting may be refined based on various factors, and spatially explicit models may be incorporated into the ensemble to enhance understanding and analytical insight.

The risk analysis and decision table include the full probability distribution from the assessment. Therefore, key quantities such as reference points and stock size are reported as cumulative distributions, such that the entire plausible range can be evaluated. Where necessary, point estimates reported in this assessment correspond to median values from the ensemble.

Biomass, recruitment, and reference point results

The 2014 assessment results pointed to the gradual decline of the Pacific halibut stock that has been occurring since 2000. Recruitment trends have decreased during much of the last decade, as has size-at-age. The two long time-series models estimated that stock is currently either 35 or 37 percent of the equilibrium unfished stock size, and that current spawning biomass is at 133 or 211 percent of the minimum values estimated for the 1970s. The discrepancies are likely due to the separation of signals from each region, and the allowance for different properties in each region's fishery and survey. The long time-series models also showed that halibut recruitment was highest during periods of positive PDO conditions, and that the highest level of recruitment observed historically occurred from 1977 to 2006, which led to much larger stock sizes and therefore greater fishery yields during those years.

Current stocks are estimated to be 42 percent of what they would be in the absence of fishing, with a 10 percent chance that the stock is below the 30 percent harvest threshold. Estimated harvest intensity for 2014 generally corresponds with target rates for many similar stocks.

Major sources of uncertainty

The spatial processes in the underlying stock dynamics are a significant source of uncertainty.

The halibut population assessment includes a significant level of uncertainty due to estimations, data treatment, structure of selectivity, natural mortality, and other differences among the models. The spatial structure of the assessment model and the spatial processes in the underlying stock were important sources of uncertainty, particularly in regards to the distribution of recruitment and the fishes' movement rates among regulatory areas as they grow. With SRB input, the staff is working to develop additional alternative models using explicit spatial structure for future stock assessments, as well as refinement of existing models.

In 2014, staff began testing methods for direct marking of fish at sea to reduce the uncertainty of the sex ratio of the commercial catch. This testing will continue in 2015. Since fish are dressed at sea prior to IPHC sampling at ports, there is a lack of direct information available on sex ratio, which requires the assessment to rely on observations from the setline survey to inform the relative selectivity for male and female halibut in the commercial fishery catch. All the models are sensitive to this assumption, particularly the coastwide models.

Recruitment variability remains a significant source of uncertainty in current stock estimates, and natural mortality has been an important source of uncertainty in the assessment since 2012. In the latter case, there is discrepancy between the AAF model and the coastwide model, suggesting an avenue for future investigation. Other sources of potential uncertainty are bycatch estimation, discard mortality rates, and other unreported sources of removals in either directed or non-directed fisheries, which might create significant bias in this assessment.

Sensitivity analyses conducted in 2013 using the coastwide long time-series model are applicable to 2014 results. The sex ratio of the commercial catch remains the most influential source of uncertainty, followed by uncertainty surrounding types of halibut removals via bycatch, sport discards, and commercial wastage. The results of sensitivity analysis on removals indicated, as expected, that significantly heightened or reduced bycatch levels did not make a large difference in stock trends, but that a greater number of removals was indicative of a larger stock.

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

Forecasts and the decision table

Stock projections were created from three sources: 1) all four models of the ensemble assessment, 2) summaries of the 2014 estimated removals, and 3) the results of apportionment calculations and harvest policy application. The projections required apportioning the coastwide estimate of exploitable biomass according to the survey catch rates in each regulatory area; applying area-specific

harvest rates to estimate yield and removals, and calculating the total mortality and projecting the stock trends both one and three years into the future.

Projections indicate that the stock should increase gradually between 2016 and 2018 for any amount of removals up to 20 million pounds. The projections level out at the level of removals around 40 million pounds, after which the risk of stock declines beings to increase relatively rapidly. The Blue Line is set at 38.7 million pounds of total removals and corresponds to a 19/100 chance of stock decline in 2016 and a 23/100 chance in 2018, a conclusion slightly more optimistic than recent assessment results have been.

The decision table allows Commissioners to see the risks and rewards of various harvest limits before making the final decision. Pictured here is the table without specific metrics.

Future research

Future areas of study will include exploring the factors contributing to recruitment strength, sex ratio of the commercial catch, and model refinement, to name a few.

The data and model exploration done during 2014, combined with recommendations from the SRB, will direct future research to the following areas:

1. Continued expansion of the ensemble of models used in the stock assessment
2. Development of the technical specifications for evaluation and diagnosis of each individual model
3. Continued development of methods for sampling the sex-ratio of the commercial catch
4. Further investigation of the factors contributing to recruitment strength, recruitment distribution, and the information available from trawl surveys, particularly in the Bering Sea.
5. Exploration of methods for including uncertainty in wastage and bycatch estimates
6. Exploration of Bayesian methods for fully integrating parameter uncertainty into the models
7. Integration of the assessment analyses with ongoing development of the harvest policy and MSE process.

AREA APPORTIONMENT

Since the adoption of a coastwide stock assessment in 2007 the IPHC has required a method to divide or apportion estimated coastwide biomass into regulatory areas for management. This is done using the setline survey mean WPUE index of halibut density, weighted by bottom area and adjusted to account for catchability differences among areas. In 2013, the SRB reviewed the two adjustments to the raw WPUE index to account for factors that are known to affect survey catch rates of halibut. The adjustments are intended to better account for (1) survey timing and (2) hook competition among regulatory areas in these two factors.

Survey timing and hook competition are adjusted for in the WPUE index before apportionment.

Survey timing standardization

Survey results are affected by the timing of the setline survey—specifically, WPUE will be lower on average in areas where removals are concentrated early in the season, as opposed to in areas where for more activity occurs later in the fishing season. There is a particular concern in Area 2A, where at least 80 percent of the catch tends to have already been landed before the setline survey's mean date. To account for this, the IPHC staff standardizes the WPUE of a regulatory area to its expected value if 50 percent of all O32 removals have been taken before the mean date of the setline survey in that area. All data inputs for calculating the timing standardization have been updated in 2014.

Hook competition

Hook competition measures the pressure of non-halibut species that are competing against halibut for baited hooks. Adjusting for this type of competition avoids incorporating differences in abundance of non-halibut species among

Currently, apportionment is achieved using results from the setline survey. The *F/V Kema Sue* pictured here, has participated in the survey for many seasons. Photo by Crystal Pedersen.

regulatory areas and resulting bias in the observed WPUE index of density into survey results. This factor of the survey is measured using the fraction of baitfish not taken by halibut or other species from the survey gear within each regulatory area. If fewer baited hooks than average are retrieved among the survey gear in a given area, that area's WPUE index is adjusted upwards to account for higher competition for baits. Conversely, if more baits than average are returned then the WPUE index is adjusted downwards to signify lower competition.

Three-year weighting

To improve precision of the WPUE estimates without introducing significant bias from including past observations, the survey smooths the WPUE for apportionment using a 75:20:5 reverse-weighted average of the current and previous two years' adjusted WPUE values for each area. This weighting was intended to improve precision of the WPUE estimates by using only fractions of past observations to limit bias.

Precision of the WPUE estimates is improved by using the current year's WPUE along with the previous two years.

Apportionment results

For the 2014 fishery, the Pacific halibut stock was apportioned as follows: Area 2A (2.1%), Area 2B (15.5%), Area 2C (14.3%), Area 3A (33%), Area 3B (13.6%), Area 4A (6.5%), Area 4B (4.3%), and Area 4CDE (10.8%). Due to rounding, the above percentages fell just short of 100 percent. The current O32 halibut biomass is estimated to be roughly divided into thirds: one-third in Area 2 (2A, 2B, and 2C), one-third in Area 3A, and one-third in Areas 3B-4CDE. This distribution represents a large shift towards Area 2 from Areas 3B-4CDE in the last 15 years; in year 2000, about two-thirds of the stock was in Areas 3B-4CDE, and only 12.4 percent was in Area 2. In fact, the largest change has been in the amount of stock estimated to be in Area 2 over the last five years. Regarding the effects of the two standardizations, these changes have notably adjusted the index upwards in Area 2A, and downwards in Area 4B.

Management Strategy Evaluation

The Management Strategy Evaluation process is concerned with modeling and testing fisheries policy to ensure that the decisions being made about harvest levels are likely to achieve the goals and objectives of the fishery. Simulation trials are used to evaluate possible outcomes for different configurations of two types of variables: those that can be managed directly (such as size limits or annual catch), and those that cannot be managed directly (migration, recruitment, or natural mortality). The former can be simulated via management procedures, while the latter can be simulated through alternative scenarios.

The MSE approach involves laying out a set of management objectives and a related set of performance measures; considering a set of management procedures or alternative harvest policies; and using an operating model to simulate alternative population scenarios. The management objectives consist of three criteria: a stated variable (such as catch), a duration in which to achieve the objective, and a probability for how important the objective is (compared to other objectives). The performance measures must relate to the management objectives and be quantifiable within the operating model.

The MSE process is a way of testing harvest and policy scenarios on the modelled stock to see the impact of those decisions before applying them to the actual fishery.

Objectives

The MSAB—created at the 2013 annual meeting—held its first two meetings in 2014: an initial meeting on May 5-6 to update the Board on progress and then a major annual MSE meeting for October 20-21. The objectives of the May meeting were to receive feedback on objectives based on use of

Quantitative scientist Steve Martell enjoys some field work in Juneau, AK. Steve spearheads the MSE process at the IPHC. Photo by Lara Erikson.

the simulation tool and dialogue with other stakeholders; modify candidate procedures based on that feedback; report on progress in development of a coastwide operating model for halibut; and demonstrate the integrated coastwide modeling framework. The meeting also served to outline expectations for October meeting.

The objectives for the October 2014 MSAB meeting were to update on the status of the MSE objectives and the current status of the coast-wide operating model, define a new tool for exploring alternative policy options, compare notes with the Pacific hake MSE process, set research priorities, and develop procedures for reporting to the Commission.

The MSAB brings together scientists, harvesters, processors, and other stakeholders.

Recent developments

Creating the IPHC MSE Tool

The MSAB has developed the IPHC MSE Tool, nicknamed "Shiny" for its URL https://iphc.shinyapps.io/MSAB/. It is a web-based application that uses an equilibrium model to better understand the relationship and tradeoffs among policy variables (such as fishing mortality, size limits, and discard mortality rates) and response variables (such as yield, discards, and wastage in the directed fishery) by reviewing simulation results from the Operating Model.

The tool can handle relatively simple scenarios—requiring particular input values to be held constant—making it well suited to rapid response but not to more complex analysis. A model that could account for the required complexity would be able to account for processes (such as recruitment variation) or procedures (such as harvest control rules that are functions of stock status) that vary over time. The Shiny tool will be used to initially vet potential management procedures and that can then be more deeply tested using a dynamic operating model.

Assessing reduction in minimum size limit

MSAB members expressed interest in investigating the potential impact on overall total mortality of reducing the minimum size limit in the Gulf of Alaska. Size-at-age in the Gulf of Alaska is low relative to the past several decades, so decreasing the minimum size limit in the directed commercial fishery would likely result in an overall reduction in the wastage mortality, assuming no change in fisheries selectivity or catch limits.

The equilibrium model helped the MSAB explore how changing the minimum size limit in the directed fishery would affect long-term estimates of yield, spawning biomass, recruitment, and a number of other outputs of interest, over a range of fishing mortality rates. The result of the analysis was that reducing the minimum legal size limit from 32 inches to 30 inches results in a small increase in total mortality due to the increase in Fishery Constant Exploitation Yield (FCEY) associated with reductions in fisheries wastage. Assuming a landed price of $2.50 per pound for halibut in the 5-10 pound size category, and $5.00 per pound for all other size categories, the expected landed value would increase by $1.16 million at a 30-inch minimum size limit.

Certain assumptions must be made to assess the effects of lowered size limits using the equilibrium model. With these assumptions in place, it seems that reducing the minimum size limit would likely result in reduced total mortality in the halibut fisheries. This conclusion is critically dependent on how harvesters

will or will not change their fishing activities when faced with harvesting smaller fish. However, the trade-off is an increased risk of growth overfishing and recruitment overfishing when harvesting smaller sizes, which would indicate a lower harvest mortality rate. Understanding the effect of such a policy change would require observations of fishing practices at sea, in order to understand how the fishery selectivity may change.

A final decision on whether to enact this policy change cannot be made without testing the change in a detailed operating model. The development of such a model is underway at the IPHC. The less comprehensive equilibrium model should not be used to predict how the current stock status will respond in the short term to changes in harvest policy.

An analysis undertaken this year was to look at the effect on the fishery, markets, and stock if the minimum commercial size limit was decreased from 32 inches to 30 inches.

BIOLOGICAL RESEARCH

Biological research projects are used to supplement the knowledge base about Pacific halibut drawn from the halibut stock assessment. Unlike the standardized population assessment, research projects are more flexible—they may change each year and can respond to the shifting priorities of scientists and policymakers. In 2014, these projects included an ongoing oceanographic monitoring effort, estimating hooking success for large halibut, re-aging of IPHC archived otoliths, a study of juvenile halibut distribution and abundance, and tagging studies.

Oceanographic monitoring on the setline survey

A coastwide profiler project designed to collect oceanographic data on the halibut grounds went into its sixth consecutive year in 2014. The project aims to better understand the factors behind the fluctuations in distribution, growth, and recruitment of fish populations, especially those relating to climatic and oceanic conditions. Oceanic conditions directly affecting fish include variations in water temperature, salinity, and dissolved oxygen (among other environmental factors).

2014 was the sixth consecutive year of coastwide environmental data collection.

The IPHC used Seabird™ water column profilers at stations ranging from southern Oregon northward to the Aleutian Islands and into the Bering Sea. All survey stations are located on the continental shelf and are arranged on an equidistant 10-nmi grid. This area of investigation has gained momentum in recent years as scientists and stakeholders try to understand the direct and indirect effects of environment on fisheries. In 2014, the IPHC chartered 11 vessels, each outfitted with a Seacat19*plus* V2 profiling unit, a laptop computer, and accessory gear. Out of a possible 1,394 stations with assigned depths ≤ 500 m coastwide, 1,236 useable casts of environmental data were collected, resulting in an 89% success rate.

Sea sampler Bonnie Gauthier and crewmen on the *F/V Seymour* prepare to launch the profiler. Photo by Zach Kelleher.

Deployment of the profiler happens in the

same way at each survey station, just prior to each haul back of fishing gear. The profiler takes a "snapshot" of that specific column of seawater, measuring depth, temperature, salinity, DO, pH, and chlorophyll *a* concentration. Once the anchor hits bottom, the profiler is immediately hauled back aboard, cleaned and prepped for the next station. Approximately once a day, the data are uploaded onto an onboard computer and sent back to the Seattle office either remotely or through data storage cards. Each year's data are vetted first by IPHC researchers, then by oceanographers at NOAA and posted for public use:
http://www.ecofoci.noaa.gov/projects/IPHC/efoci_IPHCData.shtml.

Results

For the first time since collecting coastwide environmental data, the IPHC instruments did not detect hypoxia in the bottom waters off the west coast of Oregon and Washington. There were some hypoxic waters detected in the western Aleutians, which is not unusual especially at deeper stations, but there were no other areas of note coastwide. The highest chlorophyll concentration was found in the Aleutian Islands and the U.S. west coast with less intense blooms elsewhere.

From the first six years of this project, general environmental differences among the major areas of the coast can be identified. Relative to the other sampled areas, near-bottom conditions along the U.S. west coast and B.C. are characterized by low DO, low pH (more acidic water), warmer temperatures, and moderate amounts of primary production. Gulf shelf waters differ between east and west, with the western Gulf, especially around Kodiak Island and Cook Inlet, tending towards warmer temperatures, higher DO, and less acidic water than the eastern and central Gulf. The Bering Sea and Aleutian Islands are characterized by cooler temperatures, higher DO except at very deep stations, moderate primary production, and a variety of pH conditions.

Estimating hooking success for large halibut

Though the goal of observing 50 large halibut fell short, smaller halibut attacked the hooks frequently and the technique for estimating hooking parameters was ultimately validated.

A study of halibut hook attacks on a single baited hook off Afognak Island near Alaska's Kodiak Island aimed to create a hooking success point estimate for larger halibut. The team used a GoPro™ camera to observe the attacks, with a goal of observing 50 halibut of more than 40 pounds. The observers fell short of that goal—they did not see enough large halibut attack to generate this estimate. But smaller halibut did attack frequently enough to confirm earlier estimates of hooking success for halibut 60 to 100 cm fork length. The study ultimately validated the technique for estimating hooking parameters.

The study team deployed their gear 59 times from the deck of the *F/V Venturess*, with time-on-bottom durations ranging from 9 to 147 minutes. These deployments totaled 61 hours and 31 minutes, all of which was viewed in real time and recorded for future analysis. The gear was deployed in depths ranging from 20 to 65 fathoms. The team observed 152 hook attacks by halibut, 64 resulting in captures, for an overall hooking success rate of 42 percent. Length of halibut captured ranged from 66 to 138 cm, while length of halibut not captured ranged from 58 to 114 cm. The team observed hook attacks by eleven halibut 110 cm or longer in length. Ten of these eleven attacks resulted in hooked fish.

Quantitative scientist Ian Stewart examines data collected during the hooking success project aboard the *F/V Venturess*. Photo by Steve Kaimmer.

Re-aging of IPHC archived otoliths

Since 1925, the IPHC has collected otoliths from more than 1.6 million halibut, which have been aged and archived. Considering that age-determination techniques have changed over time, a project is currently underway to re-age samples that were previously aged using now-outdated techniques. The surface-aging technique was used exclusively prior to 1992, when the break-and-burn or break-and-bake method was added as a supplemental technique for otoliths that met certain criteria such a high surface age or a difficult pattern. By 2002, it was determined that break-and-bake provided more accurate ages than surface-reading, so from then on the break-and-bake method was used exclusively to age all otoliths collected from setline surveys and the commercial catch.

The re-aging study revealed that there were very few fish older than 15 years in the historical sample.

In 2014, subsets of otoliths from each decade from the 1920s to the 1980s were re-aged by both the surface and break-and-bake techniques, and the new data were compared to the original surface ages. The goal was to provide information on the bias and imprecision of historical surface ages relative to age data from the 1990s onward. Additionally, otoliths collected in 1992 and 1993 that were to be used in another project were re-aged by break-and-bake, and a systematic subsample of otoliths from the 1998 survey, re-aged in 2013, were also included in this analysis.

The re-aging study revealed that historical samples contain very few fish aged older than 15 years—data that was consistent when aging was done by either method. Based on simultaneous estimation of bias and imprecision for up to four unique ages per otolith, the properties of historical surface ageing methods were found to be very similar to current methods, becoming increasingly

biased and imprecise beyond 15 years of age. We also found that the bias was less than previously estimated because the prior estimation examined only 'difficult' otoliths while the current examination looked at all otoliths.

Juvenile halibut distribution and abundance

An analysis of what is currently known about juvenile halibut distribution and abundance in the Gulf of Alaska (GOA) and Bering Sea reveals that varying food supply, favorable or unfavorable environmental conditions, predation, and disease may all contribute to aspects of a juvenile halibut's chance to move, survive, and thrive. Preliminarily, temperatures and other oceanic conditions appear to have a large impact on the size of each year class of halibut.

Young halibut appear to begin leaving the nursery grounds by about age 2, and by age 6 are dispersed throughout the halibut range.

Juvenile Pacific halibut are highly migratory, first dependent on oceanic currents as larvae to carry them to pelagic food sources and then to suitable nursery habitat, and second as relatively small, but fully-formed fish that counter-migrate against the currents to disperse coastwide. While young halibut continue to be detected on or near nursery grounds for several years after settlement, e.g., Bristol Bay and the western Gulf of Alaska, a portion begin to disperse north, east, and west at ages as young as two years old. By six years old, halibut are dispersed widely throughout their range.

During their younger years, juvenile halibut are subject to a variety of conditions that can lead to variable survival rates. A principal component analysis showed that while there was ample variability, larger year classes tended to correspond to years of warmer water temperatures and calmer oceanic conditions, and smaller year classes corresponded to years with colder temperatures and stormier weather. It is clear that there are other factors involved, but environment does play a crucial role.

Seabird occurrence

Since 2002, the IPHC has collected seabird occurrence data during its stock assessment survey. Initially a collaborative project between the IPHC, the ADF&G, and the NMFS, the purpose of the project was to assemble a seabird database that could be analyzed for population purposes, and to take part in the process regulating seabird avoidance requirements for commercial fishing vessels. These organizations and commercial fisheries are concerned with tracking seabirds because fisheries can be shut down if the mortality of endangered seabirds (such as the short-tailed albatross) becomes too high. Although the collaboration ended in 2004, the IPHC made tracking bird encounters a permanent part of its survey program.

Over the last 13 years, the IPHC has conducted a total of 16,444 seabird observations of seabirds, resulting in the recording of a total of 738,000 birds (composed of 36 unique species). Northern fulmar (*Fulmarus glacialis*), glaucous-winged gulls (*Larus glaucescens*), black- footed albatross (*Phoebastria nigripes*), and fork-tailed storm petrels (*Oceanodroma furcata*) represent the most commonly reported species. The observed number of unidentified gulls has continually decreased, inversely correlated with an increased number of observations of glaucous-winged gulls and herring gulls (*L. argentatus*). This shift was likely the result of increased focus on gull identification during

Crested auklet. Photo by Levy Boitor.

annual IPHC sampler training. A total of 262 endangered short-tailed albatross (*Phoebastria albatrus)* sightings were recorded overall.

In 2014, a total of 1,314 observations took place, higher than the average of 1,245 observations. During these counts, survey teams counted a total of 44,964 seabirds (composed of 21 unique species). At 27,305 sightings (72 percent of total), the northern fulmar was the most commonly observed bird. In second place, 8,034 glaucous-winged gulls were observed, followed by 5,604 black-footed albatross. The endangered short-tailed albatross—which is more commonly a Western Pacific bird—was counted 20 times in 2014.

A potential good sign in the results is the increase in sightings of black-footed albatross, Laysan albatross, and fork-tailed storm petrels)—their populations may be strengthening. A concerning finding is the decrease in number of northern fulmars by nearly 14,000 birds since 2012. However, such short-term changes in observed abundance might not necessarily reflect changes in population abundance, but could instead reflect long-term spatio-temporal shifts in distribution.

Tagging studies

Since 1925, more than 50,000 tagged halibut have been recovered from various scientific studies.

Since 1925, the IPHC has tagged and released more than 450,000 halibut, from which more than 50,000 tags have been recovered. The purpose of tagging studies is to investigate patterns of migration, utilization, age, growth, and mortality. The tags have taken different forms over the years, due both to experimental requirements and to technological advancement.

Tag releases in 2014

The IPHC conducted one tagging experiment in 2014 in which 12 halibut were tagged and released with PAT tags in Area 2A.

Tag recoveries

In 2014, a total of 34 halibut from various IPHC tagging experiments were reported, as well as 12 tags from sport tagging programs. These included two tags from fish were recovered in 2013 and reported to IPHC in 2014.

Wire tags

In 2010, the IPHC tagged 773 halibut with plastic-coated wire tags and released them in the Aleutian Islands to define active spawning periods and to examine migration. In 2014, three of these tags were recovered—two from fish captured in 2014 and one from a fish captured in 2013.

Archival & dummy archival tags

In 2014, one tag from the 2011 geomagnetic-sensing archival release in Area 2C was recovered from a fish that had one tag type attached externally to the dorsal musculature and the other type implanted internally within the coelomic cavity. Tags from 30 fish from the 2013 dummy archival tag experiment in Regulatory Area 3A were returned in 2014 (29 recovered in 2014, one recovered in 2013). Twenty-four of these fish had been tagged with both a dummy archival dart tag and a plastic-coated wire cheek tag, and six had been tagged with only an external dummy archival tag attached to the operculum.

This halibut has been tagged with a wire tag through the operculum and an archival tag through the dorsal. Photo by Aaron Ranta.

The IPHC supplies tags to several sport-based fishing derbies that take place in Alaska.

Sport tags

Every year, the IPHC supplies tags to the Homer Jackpot Halibut Derby and the Seward Halibut Tournament. Additionally, for the second year, it also supplied tags to the Coffman Cove Derby of Coffman Cove, Alaska. The Homer Derby released 115 tags in 2014, eight of which were recovered. Additionally, three tags from previous Homer derbies were recovered in 2014—two from 2011 and one from 2013. All were recovered by sport harvesters during the derby. The

Seward Tournament—now in its third year—released 15 tags in 2014, one of which was recovered during the derby. Finally, the Coffman Cove Derby released five tags in 2014, and there have been no recoveries from either year's releases to date.

Other recoveries

One halibut bearing a PAT tag was processed by the IPHC port sampler in Juneau. The PAT tag was not part of an IPHC release. It was from a 2013 experiment conducted in Glacier Bay by researchers at the University of Alaska Fairbanks Juneau. In addition, one "rogue" tag was recovered from a commercially-caught halibut landed in Port Hardy: over the last 15 or so years there have been instances of unauthorized tagging and releasing of halibut in areas of Alaska and northern Washington.

Captive holding to develop long-term archival tagging protocols

In 2002, the IPHC began an electronic archival tagging program in order to investigate seasonal movements of halibut. In 2006, the IPHC began investigating the use of fishery-recaptured archival tags in order to study multi-year behavior of individual halibut and behavior of fish that have been considered too small to carry pop-up archival transmitting tags.

Captive holding was used from the beginning as a means of developing surgical techniques for internal tag implantation. In 2009, another holding experiment began, to investigate external tag-mounting protocols and compare them to internal tag implantation results. A total of 30 halibut held at the Oregon Coast Aquarium in Newport, Oregon, were affixed with inactive "dummy" archival tags. The tagging occurred using a range of experimental treatments, including:

Captive holding has been used to develop the best techniques for attaching archival tags to their halibut host.

- through-body dorsal attachment;
- opercular attachment initially oriented either perpendicularly or parallel to the main axis of the fish;
- external and intramuscular dart-and-tether configurations; and
- a treatment of intracoelomic implantation that will allow external tagging results to be directly compared to the effectiveness of surgical methods.

In 2014, the fish tagged in these various ways were monitored for mortality and morbidity, and the results carefully noted. The holding period terminated in mid-December of 2014.

Since the captive holding study began, nine fish have died. Causes included: suture failure after implantation, ovarian infections, general poor health, and unknown causes.

Persistent sores and irritation were observed in four treatments. Tag shedding was observed in three treatments, and one treatment was abandoned part way through due to extrusion of the tags. In some cases, the darts remained while the tag had been extruded and was on the outside of the fish. Up to now, no behavioral differences have been noted between the various tagging groups, though it will be analyzed statistically at the end of the experiment. No single method has yet been identified as the best future option.

Trawl tag releases of small halibut in the Bering Sea

Re-examination of historical tagging data for small halibut shows that halibut can migrate considerable distances at relatively small sizes.

The IPHC has undertaken a re-examination of historical tagging data from small (fork length less than 65 cm) halibut released into the Bering Sea. IPHC databases hold records of 21,637 small halibut that were tagged and released in the Bering Sea. Of these, 557 have at least the year of recovery recorded, and 529 have either a recovery position or recovery statistical area recorded, allowing the assessment of movement patterns of recovered halibut.

The tagged fish were released during various research studies of <65 cm halibut. From 1963 until 1986, the IPHC maintained a tagging program on trawl surveys—the Trawl Recruitment Series (TRS) release program—to study the migration and recruitment of small fish. The program undertook extensive tagging of halibut in the Bering Sea measuring <65 cm (designated "juvenile" at the time). The peak years of the program were 1970 and 1971 (with more than 2,000 tags placed each year), 1981 (3,128 tags), and 1985 (4,320 tags). Other research studies have occasioned smaller releases of small tagged fish in the Bering Sea since 1930. The early studies have incomplete or missing records, and only data from recovered tagged fish have been entered into the database. Notably, no recoveries of releases <65 cm are recorded from the 1947-1959 releases.

The data re-examination reveals that halibut can migrate into the Aleutian Islands, the Gulf of Alaska, as well as to Canada and the U.S. west coast over the course of several years following release. However, it is impossible to make reliable, unbiased estimations of migration rates from the Bering Sea based on the historical data available. There are various problems: low recovery rates from the most representative releases, unrepresentative results among releases with higher recovery rates, and the lack of consistent simultaneous tagging programs in the Gulf of Alaska.

A conclusion from the tagging studies was to not rely on fishery-independent recoveries of tagged fish. Fisheries cannot be an unbiased means of recovery, considering the low selectivity to longline gear until years after release and uncertain reporting of recovered fish. This is why the Commission conducted its own scanning of commercially landed fish during the passive integrated transponder (PIT) tagging program (2003-2009). At present, it is unclear whether the newest generation of pop-up tags would be appropriate for use on any but the largest of the fish under 65 cm in length. The best course of action, therefore, would be to first conduct holding experiments aimed at establishing lower size thresholds for the use of these tags. No such work has been conducted to-date. Lower-size-threshold tags would allow the estimation of migration rates out of the Bering Sea without the need for simultaneous releases in the Gulf of Alaska, as would be required with conventional tags.

Deployment and reporting of PAT tags

Do the halibut residing in the southern Salish Sea represent a distinct stock component from those found elsewhere in IPHC Regulatory Area 2A? It is a question met by much conjecture but little empirical data. The data one would need to answer this question properly includes the potential for the Salish Sea system to contain active and isolated spawning group(s), to retain viable larvae

throughout their developmental period, to support nursery habitats, or to derive either recruitment totally from local source(s).

During the summer and fall of 2014, IPHC began an effort to begin filling some of the substantial gaps in understanding of local population function by deploying fishery-independent pop-up archival transmitting tags at four locations in the U.S. waters (Area 2A) of the southern Salish Sea. The Mk10 PAT tags used contain sensors for light, depth (pressure), and temperature, as well as programming circuitry and a satellite transmitter.

These tags were programmed to release from their host fish either during the mid-January spawning season (8 tags) or in late spring of 2015 (4 tags). This timing was set to allow researchers to assess whether Salish Sea halibut remain in the system to spawn, and whether those that leave the system in winter usually return the following summer. Data from the tags included temperature and depth data, depth-temperature profiles, and light-based geoposition estimates.

Tag deployments were divided into four general locations: 1) southern Strait of Georgia; 2) Boundary Pass; 3) eastern Strait of Juan de Fuca, and 4) south-central Strait of Juan de Fuca. The number of fish tagged at each location ranged from 1 to 5. Tagged fish ranged in fork length from 94-131 cm. All tagged fish were females, as determined via veterinary ultrasound. One of the tags, programmed to report in January, released prematurely, on October 7, and commenced broadcast from within San Juan Channel, in the heart of the San Juan Islands group.

Hosting the International Flatfish Symposium

On November 9-14, IPHC along with NOAA's Alaska Fishery Science Center hosted the 9th International Flatfish Symposium (IFS), held in Cle-Elum, WA. The symposium attracted almost 100 participants from 19 different countries. Presentations were given on a wide range of topics including trophic interactions and community structure, pelagic interactions, stock assessment, fishery management, physiology, development, climate, and education. In addition to facilitating the meeting, a number of IPHC staff presented oral and poster presentations on subjects such as stock assessment, oceanographic data collection, early life history, parasites, feeding, and spawning behavior. This symposium is traditionally held every three years and the next installment is expected to take place in St. Malo, France.

IPHC biologist Claude Dykstra presents information on parasites found in halibut. Photo by Lara Erikson.

IPHC co-sponsored the IFS conference in Cle-Elum, WA where scientists from 19 different countries gathered and shared their research.

STAFF HAPPENINGS

The research and programs highlighted in this report account for the majority of IPHC staffers' time. However, there is also a considerable amount of effort put into public outreach, attending conferences that enhance knowledge, participating on committees outside of the IPHC, and seeking further education and training. This section highlights some of those activities.

Seattle staff pose for the camera at the Interbay office facility near Fishermen's Terminal. Staff are listed here along with the year they started work for the IPHC. Back row (from left): Jim Traub (2012), Tim Loher (2001), Tamara Briggie (2011), Dana Rudy (2013), Lara Erikson (2001), Kirsten MacTavish (2006), Ray Webster (2006), Chris Johnston (2013). Middle row (from left): Joan Forsberg (1986), Eric Soderlund (2003), Steve Kaimmer (1985), Afshin Taheri (1992), Claude Dykstra (2001), Bruce Leaman (1997), Aaron Ranta (1991), Steve Keith (2011), Mike Larsen (1989). Front row (from left): Ed Henry (2012), Stephanie Hart (2014), Lauri Sadorus (1990), Tracee Geernaert (1986), Heather Gilroy (1983), Tom Kong (1988), Jay Walker (2006), Ian Stewart (2012), Robert Tobin (2001). Not pictured: Melissa Knapp (2001),Steve Martell (2012), Sierra Summers (2013), Aregash Tesfatsion (1999), Huyen Tran (2002), Gregg Williams (1978).

Committees and organization appointments

- 9th International Flatfish Symposium local organizing committee - Tim Loher (co-chair), Lauri Sadorus, Lara Erikson, Tracee Geernaert, Tamara Briggie
- 18th Western Groundfish Conference organizing committee - Claude Dykstra, Kirsten MacTavish
- NPFMC Gulf of Alaska Plan Team - Ian Stewart
- NPFMC Scientific and Statistical Committee - Steve Martell
- IPHC liaison to the NPFMC and PFMC - Heather Gilroy, Gregg Williams
- Exxon Valdez Oil Spill Scientific and Technical Committee - Steve Martell
- Review panel, Pacific Island Fisheries Science Center stock assessment - Steve Martell
- Review panel, NMFS NW Fisheries Science Center stock assessment - Ian Stewart
- NMFS Observer Science Committee - Ray Webster
- NPFMC Crab Plan Team - Steve Martell
- Treasurer and board member, AD Model Builder (ADMB) Foundation - Steve Martell
- Technical Subcommittee of the Canada US Groundfish Committee, Seattle, WA - Claude Dykstra, Kirsten MacTavish

Conferences, meetings, and workshops

- 9th International Flatfish Symposium, Cle Elum, WA - Tim Loher, Tracee Geernaert, Lauri Sadorus, Lara Erikson, Tamara Briggie, Claude Dykstra, Ian Stewart, Bruce Leaman
- 18th Western Groundfish Conference, Victoria, B.C. - Joan Forsberg, Tracee Geernaert, Ian Stewart, Robert Tobin, Claude Dykstra, Kirsten MacTavish
- ICES Ecological Basis of Risk Analysis for Marine Ecosystems, Porvoo, Finland - Ian Stewart
- International Biometric Conference, Florence, Italy - Ray Webster
- CIE review for data poor stock assessments, Honolulu, HI - Steve Martell
- National Scientific and Statistical Committee meeting, Honolulu, HI - Steve Martell
- 2014 National Forum on Contaminants in Fish, Alexandria, VA - Claude Dykstra
- Alaska Marine Science Symposium, Anchorage, AK - Steve Martell
- International Fisheries Commission Pension Society, Ottawa, Ontario. - Bruce Leaman, Michael Larsen
- AD Model Builder training workshop, Honolulu, HI - Steve Martell
- American Fisheries Society Annual Meeting, Quebec City, Quebec - Steve Kaimmer
- American Fisheries Society chapter meeting, Vancouver, WA - Ed Henry, Steve Keith
- Bevan Symposium on the Reauthorization of the Magnuson-Stevens Act, Seattle, WA - Steve Keith, Lauri Sadorus
- 6th International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Science, Tampa, FL - Tom Kong
- 54th Meeting of the Estuarine and Coastal Sciences Assn. Sesimbra, Portugal - Tim Loher
- NPFMC meetings, multiple locations throughout the year - Steve Martell
- MARVLS Maturity Assessment, Reproductive Variability, and Life Strategies workshop, Seattle, WA - Kirsten MacTavish
- Albacore working group meeting, La Jolla, CA - Ian Stewart
- Lowell Wakefield Symposium, Anchorage, AK - Steve Martell
- Gulf of St. Lawrence Atlantic halibut tagging planning workshop, Montreal, Quebec - Ray Webster
- ISSF International Sustainable Seafood, MSE workshop, Monterey Bay, CA - Steve Martell

Awards, training, and certifications

- Supervisory development courses - Lara Erikson
- NPFVOA cold water survival training - all sea samplers and a number of Seattle Staff

Outreach and education

- Booth at Pacific Marine Expo ('Fish Expo') in Seattle, WA - Lara Erikson, Chris Johnston, Steve Keith, Dana Rudy, Jim Traub, Claude Dykstra
- Booth at Pacific Northwest Sportsmen's Show in Portland, OR - Ian Stewart, Dana Rudy, Robert Tobin
- Invited speaker, UW School of Aquatic and Fisheries Science, Seattle, WA - Tim Loher
- Invited speaker, Fisheries and Marine Institute of Memorial University of Newfoundland fall seminar series, St. John's, Newfoundland - Tim Loher
- Graduate student advisor, University of British Columbia, Vancouver, B.C. - Steve Martell
- Graduate student committee member, University of Washington, Seattle, WA - Ian Stewart
- Graduate student committee member, University of Alaska Fairbanks, Fairbanks, AK - Tim Loher, Steve Martell
- Expanding Your Horizons science workshops, Bellevue and Edmonds, WA - Lauri Sadorus
- Guest scientist at elementary schools in the greater Puget Sound area - Lara Erikson, Lauri Sadorus, Claude Dykstra
- Discover Science weekend at the Seattle Aquarium, Seattle, WA - Dana Rudy, Ed Henry

APPENDICES

The tables in Appendix I provide catch information for the 2014 fisheries. The areas specified are the IPHC Regulatory Areas, depicted in the figure located on the inside front cover of this report. Appendix II reports on the most current sport fishing statistics.

All of the weights used are dressed (eviscerated), head off. Round weight can be calculated by dividing the dressed weight by a factor of 0.75.

Appendix I.

Table 1. The 2014 estimates of total removals (thousands of pounds, net weight) and 2014 catch limits and catch of Pacific halibut by regulatory area.

Table 2. The Area 2A 2014 catch limits allocated by the Pacific Fishery Management Council Catch Sharing Plan and catch estimates (net weight).

Table 3. The 2014 Area 2B catch limits as allocated by the Canadian Department of Fisheries and Oceans and estimated catches (thousands of pounds, net weight).

Table 4. Areas 2C and 3A catch limits, including incidental mortality, as allocated by the North Pacific Fishery Management Council Catch Sharing Plan and estimated landings, incidental mortality, and total pounds (thousand, net weight).

Table 5. The total catch (thousands of pounds, net weight) of Pacific halibut from the 2014 commercial fishery, including IPHC research catch, by regulatory area and month.

Table 6. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2014 commercial fishery for Area 2A (excluding treaty Indian commercial), Area 2B, Alaska, and the Alaskan regulatory areas. All Areas, with the exception of Area 2A, include IPHC research catch.

Table 7. Commercial fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by regulatory area for the 2014 Pacific halibut commercial fishery.

Table 8. Commercial halibut catch (thousands of pounds, net weight) in 2014 by statistical area and regulatory area.

Table 9. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality; and IPHC research catch for 2014.

Table 10. The fishing period limit (pounds, net weight) by vessel class used in the 2014 directed commercial fishery in Area 2A.

Table 11. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2014.

Appendix II.

Appendix I.

Table 1. The 2014 estimates of total removals (thousands of pounds, net weight) and 2014 catch limits and catch of Pacific halibut by regulatory area.

Area	2A	2B	2C	3A	3B	4	Total
Commercial Landings	510	5,776	3,275	7,383	2,816	3,167	22,927
Commercial Mortality	21	242	120	439	326	138	1,286
Sport Landings[1]	473	913	1,940	3,591	19	23	6,959
Sport Mortality	13	34	72	83	0	1	203
Bycatch Mortality:	94	244	16	1,610	1,247	6,131	9,342
Personal Use[2]	32	405	396	254	16	27[3]	1,130
IPHC Research	21	106	147	278	100	116	768
Total Removals	1,061	7,720	5,966	13,638	4,524	9,603	42,512
2014 Catch Limits[4]	960[5]	6,850[6]	4,160[7]	9,430[7]	2,840	3,275	27,515
2014 Catch	1,015[5]	6,689[6]	4,258[7]	9,976[7]	2,816	3,167	27,818

[1] Sport landing estimates for Alaska are preliminary.
[2] Includes 2012 Alaskan subsistence harvest estimates. Updated numbers for 2013 and 2014 were not available at time of printing.
[3] Includes 5,533 pounds of sublegal halibut retained in the 2014 Area 4DE Community Development Quota.
[4] Does not include poundage from the underage/overage programs in Area 2B or Alaska.
[5] Includes commercial, sport, and treaty subsistence catch.
[6] Includes commercial and sport catch.
[7] Includes commercial and sport guided fishery catch and incidental wastage for both fisheries.

Appendix I.

Table 2. The Area 2A 2014 catch limits allocated by the Pacific Fishery Management Council Catch Sharing Plan and catch estimates (net weight).

Area	Catch Limit	Catch
Non-treaty directed commercial	168,137	156, 000
Non-treaty incidental commercial with salmon troll fishery	29,671[1]	34,100
Non-treaty incidental commercial with sablefish fishery	14,274	12,100
Treaty Indian commercial	307,500	308,400
Treaty Indian ceremonial and subsistence	28,500	31,800
Sport fisheries	411,917	472,900
Total allocation and catch	960,000	1,015,300
IPHC research catch		20,600
Total	960,000	1,035,900

[1] Does not include 4,000 pound roll-over from the directed commercial fishery after it closed, as allowed in the catch sharing plan.

Table 3. The 2014 Area 2B catch limits as allocated by the Canadian Department of Fisheries and Oceans and estimated catches (thousands of pounds, net weight).

Fishery	Allocation	Catch
Commercial fishery	5,793	5,776
Sport fishery[1]	1,057	913
Total allocation and catch	6,850	6,689
IPHC research catch		106
Total	6,850[2]	6,795

[1] An experimental permit program allowed sport operators to lease quota from commercial operators. A total of 5,724 pounds were leased from commercial quota holders in 2014 with a carryover of 3,289 pounds from 2013.

[2] The total allocation does not include adjustments totaling -121,100 pounds made to the commercial fishery catch limit which included carryover from the previous year's underage/overage plan, quota held by DFO for First Nations through relinquishment processes, and the Use of Fish allocation.

Appendix I.

Table 4. Areas 2C and 3A catch limits, including incidental mortality, as allocated by the North Pacific Fishery Management Council Catch Sharing Plan and estimated landings, incidental mortality, and total pounds (thousand, net weight).

Area 2C	**Allocation[1]**	**Catch + incidental mortality: total**
Commercial fishery	3,399	3,275 + 110 = 3,385
Guided sport fishery	761	825 + 48 = 873
Total allocation and catch	4,160[2]	4,258
IPHC research		147
Total		**4,405**
Area 3A	**Allocation[1]**	**Catch**
Commercial fishery	7,648	7,383 + 410 = 7,793
Guided sport fishery	1,782	2,139 + 44 = 2,183
Total allocation and catch	9,430[2]	9,976
IPHC research		278
Total		**10,254**

[1] The combined total includes estimated mortality from regulatory discards of sublegal halibut and lost gear in the commercial fishery, plus discard mortality in the guided sport fishery, as mandated in the U.S. catch sharing plan.
[2] This does not include adjustments, made to the commercial fishery catch limit as a result of the carryover from the previous year's underage/overage plan or the guided angler fishing program allowing sport quided operators to lease quota from commercial operators.

Appendix I.

Table 5. The total catch (thousands of pounds, net weight) of Pacific halibut from the 2014 commercial fishery, including IPHC research catch, by regulatory area and month.

	March	April	May	June	July	August	September	October	November	Grand Total
2A	286	3	49	135	44	11	3		-	531
2B	865	798	721	592	773	726	509	735	163	5,882
2C	537	667	553	411	274	364	376	223	17	3,422
3A	757	1,359	1,728	809	521	1,110	880	449	48	7,661
3B	50	206	433	440	399	686	395	242	65	2,916
4A	-	-	151	197	107	258	131	58	4	906
4B			163	211	292	237	151	49	16	1,119
4C	-	-	-	20	284	65	28	-	-	397
4D	-	-	203	190	59	127	130		-	709
4E	-	-	4	26	75	40	7		-	152
Alaska Total	1,344	2,232	3,235	2,304	2,011	2,887	2,098	1,021	150	17,282
Grand Total	2,495	3,033	4,005	3,031	2,828	3,624	2,610	1,756	313	23,695

For confidentiality:
Area 2A catch in October was combined with September.
Area 4B catch in March and April were combined with May.
Area 4D catch in October was combined with September.
Area 4E catch in October was combined with September.

Appendix I.

Table 6. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2014 commercial fishery for Area 2A (excluding treaty Indian commercial), Area 2B, Alaska, and the Alaskan regulatory areas. All Areas, with the exception of Area 2A, include IPHC research catch.

Overall Vessel Length	Area 2B		Alaska	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	14	404	55	264
0 to 25 ft.[1]			109	256
26 to 30 ft.[1]			93	423
31 to 35 ft.[1]	16	174	166	1,963
36 to 40 ft.	29	711	109	735
41 to 45 ft.	31	800	113	1,351
46 to 50 ft.	27	1,074	112	1,822
51 to 55 ft.	25	1,236	64	1,429
56 + ft.	25	1,483	211	9,039
Total	167	5,882	1,032	17,282

Overall Vessel Length	Area 2C		Area 3A	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	42	92	8	59
0 to 25 ft.	56	84	18	52
26 to 30 ft.	33	120	19	57
31 to 35 ft.	73	460	74	911
36 to 40 ft.	65	292	42	336
41 to 45 ft.	59	347	58	767
46 to 50 ft.	65	510	54	674
51 to 55 ft.	45	546	35	541
56 + ft.	86	971	166	4,264
Total	524	3,422	474	7,661

Overall Vessel Length	Area 3B		Area 4	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	7	64	3	49
0 to 25 ft.[2]			33	120
26 to 30 ft.[2]	3	4	41	242
31 to 35 ft.	29	238	24	354
36 to 40 ft.	10	65	4	42
41 to 45 ft.	26	199	3	38
46 to 50 ft.	30	267	8	371
51 to 55 ft.	10	116	4	226
56 + ft.	106	1,963	46	1,841
Total	221	2,916	166	3,283

For confidentiality reasons:

[1] Vessels 0 to 30 ft. in Area 2B were combined with 31 to 35 ft. vessels.

[2] Vessels 0 to 25 ft in Area 3B were combined with 26 to 30 ft. vessels.

Table 6. continued

Overall Vessel Length	Area 2A Directed Commercial No. of Vessels	Area 2A Directed Commercial Catch (000's lbs.)
Unk. Length	0	0.0
0 to 25 ft.	0	0.0
26 to 30 ft.[1]		
31 to 35 ft.[1]	5	1.5
36 to 40 ft.	10	15.7
41 to 45 ft.	7	14.2
46 to 50 ft.	22	48.5
51 to 55 ft.	6	10.9
56 + ft.	10	64.6
Total	60	155.4

Overall Vessel Length	Area 2A Incidental Commercial (Salmon) No. of Vessels	Area 2A Incidental Commercial (Salmon) Catch (000's lbs.)	Area 2A Incidental Commercial (Sablefish) No. of Vessels	Area 2A Incidental Commercial (Sablefish) Catch (000's lbs.)
Unk. Length[2]	0	0.0		
0 to 25 ft.	11	2.1	0	0.0
26 to 30 ft.	10	2.4	0	0.0
31 to 35 ft.	25	3.7	0	0.0
36 to 40 ft.[2]	42	5.5		
41 to 45 ft.[2]	41	8.4	4	3.3
46 to 50 ft.[3]	32	8.2		
51 to 55 ft.[3]	14	2.7	3	3.3
56 + ft.	5	1.0	6	5.4
Total	180	34.0	13	12.0

For confidentiality reasons:

[1] Vessels 26 to 30 ft. in the Area 2A Directed Commercial fishery were combined with 31 to 35 ft. vessels.

[2] Vessels of unknown length or between 36 and 45 ft. in the Area 2A Incidental Commercial (Sablefish) fishery were combined with 41 to 45 ft. vessels.

[3] Vessels 46 to 50 ft. in the Area 2A Incidental Commercial (Sablefish) fishery were combined with 51 to 55 ft. vessels.

Appendix I.

Table 7. Commercial fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by regulatory area for the 2014 Pacific halibut commercial fishery.

Area 2A	Fishing Period	Catch Limit	Length of Opening	Commercial Catch	Research Catch	Total Catch
Treaty Indian	Unrestricted:					
	3/11–13		48 hours	228		228
	Restricted:					
	3/20-21		30 hours	58		58
	Late Season:					
	5/8		10 hours	22		22
Total		307.5				308
Incidental in Salmon Fishery	4/1 – 9/11	29.7[1]	164 days	34		34
Incidental in Sablefish Fishery	4/1 – 10/31	14.3	214 days	12		12
Directed[2]	6/25		10-hours	124		
	7/9		10-hours	32		
Directed Total		168.1		156		156
2A Total		519.6		510	21	531

Area	Fishing Period	Catch Limit	Adjusted Catch Limit[3]	Commercial Catch	Research Catch	Total Catch[4]
2B	3/8 – 11/7	5,793	5,776	5,776[4]	106	5,882
2C	3/8 – 11/7	3,319	3,368	3,275[5]	147	3,422
3A	3/8 – 11/7	7,318	7,526	7,383	278	7,661
3B	3/8 – 11/7	2,840	2,937	2,816	100	2,916
4A	3/8 – 11/7	850	885	833	73	906
4B	3/8 – 11/7	1,140	1,195	1,091	28	1,119
4C	3/8 – 11/7	596.6	619	391	6	397
4D	3/8 – 11/7	596.6	611	700[6,7]	9	709
4E	3/8 – 11/7	91.8	92	152[7]	0	152
Alaska Total		16,752.0	17,233	16,641	641	17,282
Grand Total		23,064.6	23,529[8]	22,927	768	23,695

[1] Does not include 4,000 pound roll-over from the directed commercial fishery.

[2] Fishing period limits by vessel class.

[3] Includes adjustments from the underage/overage programs, and in 2B, quota held by DFO for First Nations through relinquishment processes, and the Use of Fish allocation.

[4] Includes the pounds that were landed by Native communal commercial licenses (FL licenses).

[5] Includes the pounds taken in the Metlakatla fishery within the Annette Island Reserve.

[6] Area 4C IFQ and CDQ could be fished in Area 4D by NMFS and IPHC regulations.

[7] Area 4D CDQ could be fished in Area 4E by NMFS and IPHC regulations.

[8] Includes Area 2A catch limit.

Appendix I.

Table 8. Commercial halibut catch (thousands of pounds, net weight) in 2014 by statistical area and regulatory area.

Stat Area	Catch			Reg. Area	Catch for Reg Area
	Commercial	Research	Total		
006/009	1	4	5	2A	531
010	38	6	44		
020	102	2	104		
030	3	1	4		
040	38	2	40		
050	328	6	334		
060/061	115	5	120	2B	5,882
070	97	5	102		
080	99	2	101		
081	5	0	5		
090	137	4	141		
91	278	7	285		
92	36	0	36		
100	699	1	700		
102	761	28	789		
103	57	0	57		
110	72	1	73		
112	844	23	867		
114	102	0	102		
120	37	0	37		
121	97	8	105		
122	25	0	25		
130	430	9	439		
131	764	3	767		
132	430	5	435		
133	191	4	195		
134	39	0	39		
135	461	1	462		
140	33	14	47	2C	3,422
141	18	12	30		
142	63	13	76		
143	125	5	130		
144	18	1	19		
150	128	27	155		
151	178	11	189		
152	290	5	295		
153	83	5	88		
160	494	17	511		
161	134	4	138		
162	598	9	607		
163	61	2	63		
170	177	6	183		
171	120	3	123		
173	47	3	50		
174	43	0	43		
181	297	8	305		
182	220	1	221		
183	38	1	39		
184	110	0	110		

Appendix I.

Table 8. continued.

185	642	16	658		
190	345	20	365		
200	695	21	716		
210	430	14	444		
220	577	13	590		
230	145	14	159		
232	68	4	72		
240	685	19	704	3A	7,661
242	142	10	152		
250	1,308	26	1,334		
260	786	41	827		
261	277	8	285		
270	606	26	632		
271	112	9	121		
280	533	29	562		
281	32	8	40		
290	1,376	24	1,400		
300	421	24	445		
310	273	17	290	3B	2,916
320	296	13	309		
330	241	15	256		
340	209	7	216		
350	76	6	82		
360	121	2	123		
370	35	1	36		
380	53	5	58		
390/395	3	13	16		
400	117	1	118		
410	41	3	44		
420	54	2	56	4	3,283
430	79	3	82		
440	72	2	74		
450	0	1	1		
460-480	6	2	8		
490	90	2	92		
500	0	1	1		
Bering Sea	2,420	72	2,492		
Grand Total	**22,927**	**768**	**23,695**		

Appendix I.

Table 9. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality; and IPHC research catch for 2014.

IPHCGroup	Canada	United States	IPHC Research	Grand Total
CA & OR	-	141	14	155
Seattle/Bellingham	-	585	7	592
WA	-	274	-	274
Vancouver	217	-	-	217
Port Hardy	2,555	-	26	2,581
Southern BC	269	-	6	275
Prince Rupert & Port Ed.	2,570	-	118	2,688
Northern BC	165	-	-	165
Ketchikan, Craig, Metlakatla	-	264	18	282
Petersburg, Kake	-	1,173	28	1,201
Juneau	-	857	33	890
Sitka, Hoonah, Excursion, Pelican	-	1,421	42	1,463
Southeast AK	-	639	25	664
Cordova	-	423	30	453
Seward	-	1,756	41	1,797
Homer	-	2,762	20	2,782
Kenai	-	26	-	26
Kodiak	-	2,522	117	2,639
Central AK	-	1,581	133	1,714
Dutch Harbor, Akutan, Atka	-	1,947	72	2,019
Bering Sea	-	780	38	818
Grand Total	5,776	17,151	768	23,695

Appendix I.

Table 10. The fishing period limit (pounds, net weight) by vessel class used in the 2014 directed commercial fishery in Area 2A.

Vessel Class		Fishing Period & Limits	
Letter	**Feet**	**June 25**	**July 9**
A	0-25	755	200
B	26-30	945	210
C	31-35	1,510	335
D	36-40	4,165	925
E	42-45	4,480	995
F	46-50	5,365	1,190
G	51-55	5,985	1,330
H	56+	9,000	2,000

Table 11. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2014.

Fishing Period Dates	Number of Vessels	Catch (Pounds)
April 17 – 19	7	2,871
May 2 – 4	16	6,031
May 16 – 18	14	6,416
May 30 – June 1	14	6,006
June 13 – 15	12	6,200
June 27 – 29	14	10,894
July 11 – 13	13	10,623
July 25 – 27	9	5,928
August 8 – 10	10	7,059
August 22 – 24	15	9,971
September 5 – 7	14	6,290
September 17 – 19	5	955
October 3 – 5	2	465
13 Fishing Periods		79,709

Appendix II.

Table 1. Harvest of halibut by sport fishers (millions of pounds, net weight) by IPHC regulatory area, 2001-2014.

Year	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	Total
2001	0.446	1.015	1.923	4.675	0.016	0.029	8.104
2002	0.399	1.260	2.090	4.202	0.013	0.048	8.012
2003	0.404	1.218	2.258	5.427	0.009	0.031	9.347
2004	0.487	1.613	2.937	5.606	0.007	0.053	10.703
2005	0.484	1.841	2.798	5.672	0.014	0.050	10.859
2006	0.516	1.752	2.526	5.337	0.014	0.046	10.191
2007	0.504	1.556	3.049	6.283	0.025	0.044	11.461
2008	0.487	1.536	3.264	5.320	0.026	0.040	10.673
2009	0.487	1.098	2.382	4.758	0.030	0.024	8.779
2010	0.392	1.156	1.971	4.285	0.024	0.016	7.844
2011	0.399	1.224	1.029	4.408	0.014	0.017	7.091
2012	0.455	1.156	1.583	3.626	0.022	0.028	6.870
2013	0.502	0.822	2.123	3.966	0.015	0.009	7.437
2014[1]	0.473	0.913	1.940	3.591	0.019	0.023	6.959
2013-2014 change							
Pounds	-0.100	+0.091	-0.183	-0.375	+0.004	+0.0.14	-0.581
Percent	-19.9%	+11.1%	-8.6%	-9.5%	+26.7%	+155.6%	-7.48%

[1] Alaska sport catch estimates are preliminary.

Appendix II.

Table 2. Summary of the 2014 Pacific halibut sport fishery seasons. No size limits were in effect unless otherwise noted.

Regulatory Area & Region	Fishing Dates	Fishing Days per week	No. of Fishing Days	Daily Bag Limit
Area 2A - Washington, Oregon & California				
WA Inside Waters				
East of Low Point	May 9-10	2 (Fri-Sat)	2	1
	May 17	1 (Sat)	1	1
	May 22-25	4 (Thu-Sun)	4	1
	May 29-31	3 (Thu-Sat)	3	1
	Jun 7	1 (Sat)	1	1
Low Point to Sekiu River	May 22-25	4 (Thu-Sun)	4	1
	May 29-31	3 (Thu-Sat)	3	1
	Jun 7	1 (Sat)	1	1
WA North Coast (Sekiu Rvr to Queets Rvr)				
	May 15, 17	2 (Thu, Sat)	2	1
	May 22, 24	2 (Thu, Sat)	2	1
WA South Coast (Queets Rvr to Leadbetter Pt.)				
All depths	May 4-20	2 (Sun, Tue)	5	1
Northern nearshore	May 4-21	7 (Sun-Sat)	18	1
Columbia River (Leadbetter Pt. to Cape Falcon)				
	May 1-Aug 3	4 (Thu-Sun)	56	1
	Aug 7-Sep 28	4 (Thu-Sun)	32	1
Nearshore	May 5-Sep 28	3 (Mon-Wed)	66	1
OR Central Coast (Cape Falcon - Humbug Mtn.)				
All depths	May 8-Jun 21	3 (Thu-Sat)[1]	12	1
	Aug 1-2, 15-16	2 (Fri-Sat)	4	1
Less than 40 fathoms	Jul 1-Oct 12	7 (Sun-Sat)[2]	104	1
Southern OR	May 1-Oct 12	7 (Sun-Sat)	172	1
CA	May 1-Oct 31[2]	7 (Sun-Sat)	151	1
Area 2B - British Columbia	Apr 1-Dec 31	7 (Sun-Sat)	292	1-2[3]
Area 2C - Alaska				
Guided anglers	Feb 1-Dec 31	7 (Sun-Sat)	334	1[4]
Unguided anglers	Feb 1-Dec 31	7 (Sun-Sat)	334	2
Area 3A – Alaska				
Guided anglers	Feb 1-Dec 31	7 (Sun-Sat)	334	2[5]
Unguided anglers	Feb 1-Dec 31	7 (Sun-Sat)	334	2
Areas 3B and 4 – Alaska	Feb 1-Dec 31	7 (Sun-Sat)	334	2

[1] Fishing was prohibited during May 15-17, 29-31, and Jun 12-14.

[2] Fishing was prohibited during August.

[3] During Feb 1-Mar 31, the daily bag limit was one fish with a maximum length of 126 cm. The possession limit was two fish, but only one could be greater than 83 cm. From Apr 1-Aug 30, the daily bag limit was one fish with a maximum length of 133 cm and a possession limit of two fish, but only one fish could be greater than 90 cm. From Sep 1-Dec 31, the daily bag limit was raised to two, only one of which could be greater than 90 cm. An annual limit of six fish was also in effect. Fishing was prohibited during the month of August.

[4] A reverse slot limit defining retained halibut as ≤45 inches or ≥76 inches in total length was in effect.

[5] Charter anglers were only allowed to retain two fish per day but only one fish could be greater than 29 inches.

Appendix II.

Table 3. 2014 Area 2A sport harvest allocations and harvest estimates (pounds, net weight) by subarea.

Area	Allocation	Harvest Estimate	Pct Taken	Pounds Over/(Under)
WA Inside Waters	57,393	99,942[1]	174.1%	42,549
WA North Coast	108,030	112,002	103.7%	3,972
WA South Coast	42,739	45,903	107.4%	3,164
WA/OR Columbia River	11,895	9,239	77.7%	(2,656)
OR Central Coast	181,908	168,448	92.6%	(13,460)
Southern Oregon	3,712	6,108	164.5%	2,396
CA	6,240	31,226	500.4%	24,986
Total	**411,917**	**472,868**	**114.8%**	**60,951**

[1] Preliminary.

Table 4. Estimated harvest by the private (unguided) and charter (guided) sport halibut fishery in millions of pounds (net weight) in Areas 2C and 3A, 2001–2014. Also shown is the GHL applicable to the guided fishery.

	Area 2C				Area 3A			
Year	Private	Charter	Total	GHL	Private	Charter	Total	GHL
2001	0.721	1.202	1.923	-	1.543	3.132	4.675	-
2002	0.814	1.275	2.089	-	1.478	2.724	4.202	-
2003	0.846	1.412	2.258	1.432	2.046	3.382	5.428	3.650
2004	1.187	1.750	2.937	1.432	1.937	3.668	5.605	3.650
2005	0.845	1.952	2.797	1.432	1.984	3.689	5.673	3.650
2006	0.723	1.804	2.527	1.432	1.674	3.664	5.338	3.650
2007	1.131	1.918	3.049	1.432	2.281	4.002	6.283	3.650
2008	1.265	1.999	3.264	0.931	1.942	3.378	5.320	3.650
2009	1.133	1.249	2.382	0.788	2.023	2.734	4.757	3.650
2010	0.885	1.086	1.971	0.788	1.587	2.698	4.285	3.650
2011	0.685	0.344	1.029	0.788	1.615	2.793	4.408	3.650
2012	0.977	0.605	1.582	0.931	1.341	2.284	3.625	3.103
2013	0.904	0.723	1.627	0.788	1.444	2.271	3.715	2.734
	Private	Charter	Total	Quota	Private	Charter	Total	Quota
2014[1]	1.114	0.825	1.939	0.761[2]	1.452	2.139	3.591	1.782[2]

[1] Preliminary.

[2] In 2014, the guideline harvest levels (GHL) for Areas 2C and 3A were replaced by sector quotas for the guided sport harvests.

PUBLICATIONS

The IPHC publishes three serial publications - Annual reports, Scientific reports, and Technical Reports - and also prepares and distributes regulation pamphlets and information bulletins. Articles and reports produced during 2014 by the Commission and Staff are shown below and a list of all Commission publications is shown on the following pages. All reports published by IPHC are available through the online library at www.iphc.int/library.html.

2014 research publications

International Pacific Halibut Commission (IPHC). 2014. Annual Report 2013.

IPHC. 2014. The Pacific Halibut: Biology, Fishery, and Management. Int. Pac. Halibut Comm. Tech. Rep. 59.

Martell, S. J. D., and Stewart, I. J. 2014. Towards defining good practices for modeling time-varying selectivity. Fish. Res. 158: 84-95.

Sadorus, L. L., Mantua, N. J., Essington, T., Hickey, B., and Hare, S. 2014. Distribution patterns of Pacific halibut (Hippoglossus stenolepis) in relation to environmetal variables along the continental shelf waters of the US West Coast and sountern British Columbia. Fish. Oceangr. 23(3): 225-241.

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Children's book

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

Annual Reports

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

Information bulletins and news releases

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