ISSN: 0074-7238

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report
2011

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

This report produced by IPHC staff
and Eric Chastain
2012

International Pacific Halibut Commission
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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.

Writer

Eric Chastain is a Seattle-based writer who has written articles for Edible Seattle, Food Product Design and other food magazines. Prior to this, he worked both in advertising and for Starbucks Coffee. He dreams of one day catching his very own O32 halibut.

On the Cover

Mark Witteveen moved to Alaska at a very young age and grew up commercial salmon fishing, set netting and seining for salmon, and longlining for halibut in Kodiak. After receiving his Bachelor and Master of Fisheries degrees at the University of Washington, Mark has worked as a management and research biologist for the Alaska Department of Fish and Game.

Mark has spent his entire life working with fish and wildlife in Alaska and has developed a deep respect for the animals and landscapes that make Alaska special. Working in remote Alaska also creates a need for ingenuity and resourcefulness. These facets to his life have directed an artistic passion into metal sculpture.

His sculptures are created from steel, aluminum, copper, brass, and stainless steel sheetmetal and are formed with a variety of unique tools to bring three dimensional, lifelike shape to sheet metal. The metal is buffed, heated, and patinaed to bring a variety of colors and depth to each piece. For more information, please visit the artist's website: www.metallicmarineart.com .

Cover photo taken by Carol Scott Photography.

Table of Contents

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

• The Bering Sea and Gulf NMFS/RACE division groups for saving us a spot on their surveys.
• Scott Meyer at ADF&G for sharing his expertise regarding sport fish.
• Jacob Gregg and Paul Hershberger of the USGS in Marrowstone with our pilot *Ichthyophonus* incidence work.
• USCG District 13 (Brian Corrigan and staff) and NMFS Office of Protected Resources (Dan Tonnes and staff) for their assistance with the development and execution of the expanded survey work in Puget Sound and Area 2A.
• Julie Nielsen (U of A PhD candidate) for her assistance on survey in addition to her duties deploying geomagnetic tags.
• The many processing plants who assist the IPHC port sampling and survey programs by storing and staging equipment and supplies.
• Makah, Quinault, Lummi, and Jamestown biologists for port sampling Area 2A tribal commercial fisheries.
• The owners and captains of the vessels who agreed to host IPHC staff during IQ fishing for the purpose of conducting at-sea commercial sampling.
• Lando Echeverio and Jorg Schmeisser for providing consulting regarding mooring assemblies and agreeing to deploy geomagnetic-sensing instruments.

INTRODUCTION

If tuna have been called chicken of the sea, then Pacific halibut would have to be turkeys of the sea. Both bird and fish are oversized and ungainly in appearance, with names that are used in the service of comedy. That perceived goofiness has allowed the shy halibut to land parts in silly television skits, funny songs, and quips in literature. Other fish have made the big time. A marlin was the star of Ernest Hemingway's *The Old Man and the Sea*. Rainbow trout were featured throughout Norman Maclean's *A River Runs Through It*. Even the lowly sardine, near the bottom of everyone's food chain, was immortalized by John Steinbeck in *Cannery Row*. Sadly, serious literature has ignored the worthy halibut.

Sea sampler, Sam Parker, posing with a big halibut during the IPHC setline survey. Photo credit: Sam Parker.

For now the Pacific halibut will have to be satisfied with its place in scientific tomes and cookbooks, and with its part in a well-managed fishery. The International Pacific Halibut Commission's (IPHC or Commission) continuing mission is to serve the halibut—not the one brought to your table accompanied by fried potatoes and a bottle of malt vinegar, but the entire halibut population lurking quietly in the depths of the eastern Pacific continental shelf.

The original word for halibut in Danish was helle-flynder, which means "holy flounder." This was probably due to it being eaten on holy days and not from any innate godlike qualities possessed by the Atlantic halibut.

"You've got a pet halibut?"
"Yes. I chose him out of thousands. I didn't like the others, they were all too flat."
Excerpt from Monty Python's "Fish License".

Director's Report

The 2011 halibut year began with controversy over charter halibut fishing regulations and finished with warnings from the staff about the potential effects of continued retrospective issues in the estimation of exploitable halibut biomass. In between, dockside prices for halibut hit record highs, the western Gulf of Alaska saw continued declines in exploitable biomass, while improvements to stock status in Area 2 continued.

At the Commission's Annual Meeting in January, the Commission reacted to a delay in implementation of the Catch Sharing Plan (CSP) for charter and commercial harvesters in Areas 2C and 3A by adopting regulations to restrict charter harvest in Area 2C. The Commission had served notice at its 2010 Annual Meeting that the continued overharvest of the Guideline Harvest Level (GHL) in Area 2C since 2004 was compromising halibut management. The National Marine Fisheries Service was unable to implement the CSP for the 2011 fishing year and the Commission consequently adopted a one-fish, 37-inch maximum size regulation to constrain charter harvest in Area 2C for 2011. The Commission adopted this regulation as the most appropriate regulation that had previously undergone review by the North Pacific Fishery Management Council. After considerable scrutiny and consultation, this regulation was adopted by the U.S. government. The regulation resulted in an estimated 2011 charter catch which was substantially (-51%) below the Area 2C GHL for Area 2C. However, this decline should be viewed against the backdrop of charter overharvests of the GHL of 20-100% over the previous seven years, reductions in the GHL of only 45%, but reductions in the commercial catch limits of over 75% over the same period. The CSP implementation has been again delayed for 2012 and modifications to the charter harvest regulations, to more closely align harvest with the GHL, are under consideration for adoption by the Commission in 2012.

Bruce escaping the office for some quality time on an early season port tour in SE Alaska. Photo by Lara Erikson.

The Commission adopted catch limits in 2011 that were about 19% below the 2010 catch limits, with major reductions happening in Areas 2C, 3A, and 3B and increases in all other areas. With the exception of Area 2C (where the 2011 catch limit was 47% less than 2010), the decreased 2011 catch limits were largely offset by a 39% increase in average dockside prices in the commercial fishery. Dockside prices of over $6/lb (US) were common throughout the year, with prices for large fish in some ports topping $8/lb for large fish.

The Commission staff has been highlighting issues of uncertainty in the stock assessment for a number of years. Indeed, a 2004 paper in the Report of Assessment and Research Activities outlined a number of specific sources of uncertainty in the assessment. However, the uncertainty in the assessment had not been expressed explicitly in the staff's catch limit recommendations. For the 2011 stock assessment, the Commission asked the staff to undertake such an explicit presentation of uncertainty. We did this more comprehensive presentation within the assessment and harvest policy – as well as a discussion of the problems associated with progressive re-estimation of historical biomass as more information on recruitment strengths of year classes is acquired. This re-estimation, called a retrospective bias, results in progressively lower estimation of previous stock biomass over time, as more information on the strength of incoming recruitment is obtained and, in the case of the halibut stock, continuing decreases in size at age. The opposite was true during the 1980s as biomass in the stock was on the upward swing and the assessments produced successively higher biomass estimates. This problem is not uncommon to such stock assessments around the world and we are working hard to solve this issue. However, the ultimate effect is that historical exploitation rates are higher, and catch limits were set higher, than they would have been if subsequent estimates of exploitable biomass are correct and had been available at the time. Our assessment presentation included one approach to treating this symptom which could result in lower harvests but we did not recommend those lower harvests. We need to solve the underlying problem and we need to determine how much of the effects of the problem are already accommodated in our harvest policy before formulating harvest policy to address the issue. This will be a major focus for our assessment staff in 2012.

Bruce M. Leaman
Executive Director

Activities of the Commission

The International Pacific Halibut Commission meets at least twice a year: once in the late fall to hear season wrap-up reports and to start making plans for the following year, and once in January to discuss issues and vote on recommendations to the governments for regulatory and policy changes. Additonal work meetings are scheduled throughout the year as needed.

The 2011 Annual Meeting

The treaty between Canada and the United States for the preservation of the halibut fishery of the northern Pacific Ocean, including the Bering Sea, was completed in 1923 and ratified by both countries on October 21, 1924.

The 87th Annual Meeting of the International Pacific Halibut Commission took place in Victoria, BC from January 25 to January 28, 2011. Dr. Laura Richards was Chair and Dr. Jim Balsiger was Vice-chair. The commissioners heard reports from IPHC staff about the condition of the Pacific halibut population, considered the suggestions of expert advisory groups, and asked for public comments before making final decisions on catch limits and regulations for the 2011 season.

Catch limits for 2011

The Commission recommended to the governments of Canada and the United States that the total catch limit for 2011 should be 41,070,000 pounds, an 18.9% decrease from the 2010 catch limit of 50,670,000 pounds. The IPHC adopted biologically-based catch limits for all individual regulatory areas and for Area 4CDE combined. In addition, the Pacific Fishery Management Council (PFMC) and North Pacific Fishery Management Council (NPFMC) in the U.S., and the Department of Fisheries and Oceans (DFO) in Canada, allocated the halibut limits using Catch Sharing Plans (CSP) among commercial, sport, and tribal fisheries in Area 2A, into three separate areas for Area 4CDE, and to sport and commercial users in Area 2B, respectively. The CSPs were recommended by

The six IPHC commissioners deliberate at the Annual Meeting in Victoria, B.C. Photo by Lara Erikson.

the domestic parties and adopted by IPHC. Catch limits and other information for each area can be found in Appendix I.

The 2011 commercial season was designated to open coastwide at 12 noon local time on Saturday, March 12, 2011 and to close at 12 noon local time on Friday, November 18, 2011. The Alaska Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) for Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E; the Canadian Individual Vessel Quota (IVQ) for Area 2B; and the Area 2A commercial fisheries seasons all fall within these season dates. Within Area 2A, it was recommended that seven 10-hour fishing periods for the non-treaty directed commercial fishery be allowed. The supplementary dates were: June 29, July 13, July 27, August 10, August 24, September 7, and September 21, 2011. All 2A directed commercial fishing was to begin at 8:00 a.m. and end at 6:00 p.m. local time, with fishing period vessel limits.

2011 regulatory issues

The Commission approved the IPHC staff recommendation to eliminate the use of LORAN-C coordinates as a position option in fishing logbooks, since the LORAN system has been decommissioned.

At its Annual Meeting, the Commission tackles issues needing immediate attention, and also prepares for the future.

Quantitative scientist, Steven Hare, delivers the halibut stock assessment. Photo by Lara Erikson.

After noting that the Catch Sharing Plan for Area 2C fisheries was not yet approved, the Commission recommended regulatory actions to restrict the charter harvest of halibut in Area 2C to the Guideline Harvest Level approved by the NPFMC. The Commission's regulatory recommendation was the continuation of a one-fish daily bag limit and that the retained fish be no larger than 37 inches (total length). It also recommended that for halibut legally filleted at sea, the whole frame of the fish (head, spine and tail) be retained until landing.

The Commission directed IPHC staff to review the potential use of tags as an accounting tool, by area and fishery, for all non-commercial removals of halibut. If considered feasible, staff would develop a regulatory proposal for consideration at the 2012 Annual Meeting in Anchorage.

The Commission directed IPHC staff to analyze the biological impacts of incrementally reducing or eliminating the current minimum commercial size limit of 32 inches, and provide analysis for the 2012 Annual Meeting.

Other issues and actions

The Commission heard a report from the Halibut Bycatch Work Group that was reconvened in 2010. The HBWG II (as it is now called), led by a Commissioner from each country, worked to gain better understanding of the amounts and potential impacts of halibut bycatch mortality in other fisheries.

The IPHC Merit Scholarship was first awarded in 2002.

After a fair amount of discussion, the Commission agreed to undertake a performance review to examine the IPHC administrative and governance processes and make recommendations as to whether modifications might be needed to the Convention, or elsewhere, to modernize practices and keep the IPHC efficient and relevant. Government representatives spearheaded the effort and hired a team of external experts in fisheries science and international governance to conduct the assessment. The review team will attend the 2012 Annual Meeting and produce its report by the spring of 2012. The IPHC website will host the final report.

The IPHC honored Ms. Candace Schaack of Cold Bay, Alaska as this year's recipient of the IPHC Merit Scholarship. The $2000 award is renewable for up to four years of study.

The next Annual Meeting for the IPHC is scheduled for Anchorage, Alaska, from January 24 to January 27, 2012. Dr. James Balsiger was elected Chair for the coming year, and Dr. Laura Richards was elected Vice-Chair.

COMMERCIAL FISHERY 2011

As to be expected, commercial fishing vessels dominated the Pacific halibut catch for 2011, pulling in 38.8 million pounds of fish (2% below the catch limit). In addition, 664,000 pounds were landed by IPHC stock assessment surveys. Unlike fisheries that drop nets or pots to catch pollock and crab, halibut fishing is done by baiting individual hooks on a longline and setting it off the stern of the vessel, allowing it to sink to the bottom where the halibut are caught. This section gives an overview of the 2011 commercial catch, with more detail provided in the tables of Appendix I at the back of this report.

"[The Pacific halibut's] scientific name [Hippoglossus stenolepis] was first proposed in 1904 by P.J. Schmidt, a Russian scientist who noted anatomical differences such as scale shape, pectoral fin length, and body shape which Schmidt thought distinguished it from the Atlantic halibut (Hippoglossus hippoglossus)."

—IPHC website

IPHC Regulatory Areas for 2011

The IPHC has established ten regulatory areas, from California northward through the Bering Sea. They were first put into place with the formation of the IPHC in 1923 and initially included only four regulatory areas (numbered one through four). They have changed in their numbering and their geographic boundaries over the years, but the current boundary lines have remained the same since 1990. The numbered areas begin in California and work their way northward. Here is how the regulatory areas are divided in more detail. If what you need is a quick overview, a map can be found on the inside front cover of this report.

Side bar:

Area 2A—all waters off the coasts of California, Oregon, and Washington.

Area 2B—all waters off the coast of British Columbia.

Area 2C—waters off southeast Alaska, south and east of Cape Spencer.

Area 3A—waters off southcentral Alaska, between Cape Spencer and the southernmost tip of Kodiak Island (Cape Trinity).

Area 3B—waters off the Alaskan Peninsula, west of Cape Trinity (Kodiak Island).

Seward port sampler, Theresa Vavrina, getting ready to sample a large halibut. Photo by Lara Erikson.

IVQ (Canadian Individual Vessel Quota) *is where DFO allocates fishing shares to each qualified vessel, not individuals.*

IFQ (U.S. Individual Fishing Quota) *is where NMFS allocates fishing shares to individuals, not vessels.*

CDQ (U.S. Community Development Quota) *is a program in western Alaska that allocates a percentage of all Bering Sea and Aleutian Islands quotas for groundfish, prohibited species, halibut, and crab to eligible communities for economic development and poverty alleviation.*

Area 4A—Eastern Aleutian Islands. The actual 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—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 small square of water surrounding the Pribilof Islands in the Bering Sea. It is measured as "all waters in the Bering Sea north of Area 4A and north of the closed area defined in section 10 which are east of 171°00'00" W. longitude, south of 58°00'00" N. latitude, and west of 168°00'00" W. longitude."

Area 4D—Western 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—Eastern Bering Sea, including "all waters in the Bering Sea north and east of the closed area, east of 168°00'00" W. longitude, and south of 65°34'00" N. latitude."

Closed Area—This trapezoid-shaped body of water in Bristol Bay is closed to commercial halibut fishing. It's a relatively shallow body of water that serves as a nursery for juvenile Pacific halibut. Specific boundaries for this and other areas can be found in the IPHC regulations available on the agency website.

Season dates

The 2011 commercial fishing season opened at 12 noon local time on March 12, 2011 (a Saturday, to facilitate better marketing), and closed at 12 noon local time on November 18, 2011 (a Friday) for the Canadian IVQ fishery in Area 2B, the U.S. IFQ and CDQ fisheries in Areas 2C, 3AB, and 4ABCDE. The Area 2A treaty and non-treaty commercial fisheries season dates differed from the overall commercial season dates, however they were all within that time period.

Commercial landings

When a Pacific halibut is hauled aboard a fishing vessel, it has not yet been "landed" until it has been delivered to a port for processing. As the majority of halibut are caught in Alaskan waters, they are typically landed in Alaskan ports. The data that form these landing patterns come from the IPHC, National Fisheries Service (NMFS), DFO, Washington treaty tribes (including the Northwest Indian Fisheries Commission, and the Makah, Lummi, Jamestown, Swinomish, Quileute, and Quinault tribes) and state agencies including Washington Department of Fish and Wildlife (WDFW), and Oregon Department of Fish and Wildlife (ODFW).

Area 2A (California, Oregon and Washington)

The licensing regulations remained the same in 2011 as in 2010, where all harvesters had to choose between a sport charter vessel license or a commercial one. In 2011 the IPHC issued 604 vessel licenses for Area 2A: 316 for incidental halibut catch in the salmon troll fishery, 147 for the directed commercial fishery, and 141 for the sport charter fishery. The licenses for the incidental halibut catch in the salmon troll fishery increased (from 2010) by 83 because of the PFMC's

Port sampler, Levy Boitor, records fishing log information in Petersburg, AK. Photo by Lara Erikson.

decision to allow commercial chinook salmon fishing in all waters of California and Oregon, for the first time in three years. The incidental catch ratio was one halibut per three chinook, plus one extra halibut per landing, though the total number of incidental halibut couldn't exceed 35 per vessel. This fishery opened on May 1 and closed on May 28 and landed 22,800 pounds of halibut. As this was below the catch limit of 28,126 pounds, the season was reopened on July 29. By the time the fishery was closed for good on October 31, a total of 23,400 pounds were taken, still 17% under the limit.

The 147 vessels in the directed fishery caught 171,700 pounds of halibut—12,300 pounds over the limit—during the two 10-hour fishing periods (June 29 and July 13).

In 2011, the B.C. commercial fishery landed a little over 6.6 million pounds of halibut.

In Area 2A-1, the treaty Indian tribes managed the commercial catch by allocating 75% of the catch limit to an open access (unrestricted) fishery and the remaining 25% to a restricted fishery with daily and vessel limits. Both the unrestricted and restricted fisheries consisted of two fishing periods each. The total treaty Indian commercial catch was 328,700 pounds, 12% over the 293,200 pound limit.

Area 2B (British Columbia)

The DFO allocated a total catch limit of 7,898,000 pounds of halibut to commercial and sport user groups in Area 2B. For the commercial fishery, the catch limit was 6.702 million pounds, which was the initial allocation (88%) adjusted by commercial wastage, underage/overage, and relinquishment programs.

Each vessel was given an "Individual Vessel Quota" (IVQ), which allowed a fixed poundage of halibut to be caught during the season. This year, 6,612,000 pounds of Pacific halibut were landed (1% under the catch limit) by 228 active licensees, of which 154 were halibut licenses and 74 were from licenses for other groundfish species. This catch was subject to the Groundfish Integrated Fisheries Management Plan (IFMP), which has sought to improve catch sustainability since 2006.

Alaska—Quota share fisheries

The halibut and sablefish fisheries in Alaska have operated under a quota share system since 1995. The NMFS Restricted Access Management (RAM)

Juneau port sampler, Michele Drummond, samples a table full of halibut from a commercial fishing delivery. Photo by Lara Erikson.

Kodiak and Homer tied as the top landing ports in Alaska, each receiving 18% of the total catch.

division managed the quota shares to 2,740 recipients in 2011 (down from 4,831 at the program's inception). The total 2011 catch from the IFQ/CDQ halibut fishery for Alaskan waters was 31,711,000 pounds (2% under the catch limit).

The commercial quota share halibut catch for each Alaskan regulatory area was close to the catch limit for each respective area. In the case of Area 2C, it was over by 1%. Areas 3A and 3B were over by less than 1% and under by 4%, respectively. Areas 4A and 4B were under by 4% and 7%, respectively. Individually, Areas 4D and 4E exceeded and 4C was under the limits, since the NPFMC allowed 4D fish to be harvested in 4E, and 4C fish to be harvested in either 4C or 4D. Taken collectively, Area 4CDE's commercial catch of 3,413,000 pounds was under the limit of 3,720,000 pounds by 8%.

Alaska—Area 2C Metlakatla fishery

The Annette Islands Reserve (just south of Ketchikan) is part of Area 2C. The Metlakatla Indian Community, which makes its home there, has been authorized by the U.S. government to conduct a commercial halibut fishery within the Reserve. The community ran 13 two-day openings between April 15 and October 2 for a total catch of 61,900 pounds (which was included in the Area 2C commercial catch).

Landing patterns

Area 3A landed more halibut in 2011 than any other regulatory area, with three of its ports accounting for nearly half of the Alaskan commercial catch. Homer and Kodiak received the most halibut of any of the Alaskan ports, at 18% each, and Seward came next, at 11%. In southeast Alaska, Sitka landed the most fish (4%), followed by Juneau and Petersburg (each at 3%). Area 2B divided its catch among ten different ports, with Port Hardy landing 3,129,000 pounds (47% of the Canadian commercial catch). Prince Rupert/Port Edward followed with 37% of the catch, and Vancouver was third with 6%.

For Alaska, May was the most productive month of the over eight month season, featuring 18% of the year's landings. For British Columbia, March was the busiest at 16% with August and October tied in close second with 15% each. Live halibut landings in Area 2B, allowed by the DFO since 1999, weighed in at a mere 3,500 pounds. This was the lowest poundage taken since a high of 103,800 pounds in 1999.

Commercial catch sampling

Besides its own survey vessels, there are a handful of ways the IPHC collects data on Pacific halibut. One of these is the sampling of the commercial catch. IPHC samplers staffed ports coastwide during the season and sampled specified percentages of the catch as it came in. In Area 2A, this occurred in Newport, Oregon, and Bellingham, Washington. Also in Washington, the Makah, Quinault, Lummi, Swinomish, and Jamestown Klallam tribes contributed to the sampling. For British Columbia, samplers worked out of Prince Rupert, Port Hardy, and Vancouver. In Alaska, the ports of Dutch Harbor, Sand Point, Kodiak, Homer, Seward, Juneau, Sitka, Petersburg, and St. Paul were staffed.

IPHC port samplers do a variety of jobs including interviewing skippers about their catch and collecting samples from the landed halibut.

The IPHC samplers collected logbooks (which provided information on weight per unit effort, fishing location, and data for research projects), measured halibut lengths, collected otoliths (earbones, used for determining the age of the fish), and checked for tags (which provide information on migration and exploitation rates).

For commercial sampling, the goal is to remove 1,000 otoliths from fish in Area 2A, and 1,500 otoliths (plus or minus 500) from each of the other regulatory areas (excluding 4E), with Areas 4C/4D combined. Collection goals were met in every area except for Area 4B (858 collected).

The sampling protocols—percentages sampled, what boats were sampled, hours worked—all differed slightly from port to port in order to obtain statistically valid data. Samplers used their own judgment to resolve sampling conflicts among plants and vessels, along with the prescribed and approved guidelines, in order to obtain useful information and usable otoliths. More details on the sampling process can be found in the *2011 Report of Assessment and Research Activities* available on the IPHC website.

Age distribution of halibut in the commercial fishery

The IPHC samplers stationed in ports measured fork lengths (from which mean weight was calculated), and removed otoliths for age determination. In 2011, a total of 11,391 otoliths was collected and aged. The 10-13 year olds made up 56% of the sampled catch (6,358 fish), with the most abundant group hailing from the 1999 year class at 12 years of age (1,974 fish at 17% of the total).

The youngest and oldest halibut in the market samples were five and 51 years, respectively. The two five-year-old fish came from Area 2B (91cm in length) and Area 2C (86 cm), while the 51-year-old was caught in Area 4A (167 cm). The largest halibut sampled was a 204 cm fish from Area 4A, which was later determined to be 25 years old. The smallest halibut was a 68 cm fish from Area 2A that was 10 years old.

Chad Aldridge of Soldotna, Alaska won the 2011 Homer Halibut Derby with a female Pacific halibut weighing 350.8 pounds. Chad and his father, Ron, were fishing in their boat "The Seabee" on Father's Day (June 19th) when they pulled in the 244 cm fish. For his efforts, Chad brought home not merely hundreds of pounds of fish for his freezer, but also the $28,260 First Prize.

Sport Fishery 2011

The sport fishery for Pacific halibut harvested an estimated 7,503,000 pounds in 2011, a 4.1% decrease from 2010. The IPHC assembles its estimate from estimates reported by state and federal agencies, and data collection methods vary widely by area. For the sport fishery in Area 2A, dockside sampling is conducted by state agencies. For Area 2B, harvest estimates are assembled from a combination of overflights by DFO aircraft, logbooks, a DFO creel monitoring program and self-reporting by some fishing lodges. For Alaska, harvest estimates are divided into unguided (private) and guided (charter) fisheries—the latter which are required to keep a daily logbook— along with a post-season mail survey administered by the Alaska Department of Fish and Game (ADF&G). Supplementing this is an ADF&G dockside creel sampling program in major ports, though many fishing lodges are excluded due to their remoteness. Appendix II includes catch information for the recreational fishery.

Area 2A (California, Oregon, and Washington)

The sport allocation for Area 2A was 403,995 pounds of halibut, though only an estimated 385,580 pounds (95.4%) were actually caught. The allocation was divided into six subareas (Washington Inside Waters, Washington North Coast, Washington South Coast, Columbia River, Oregon Central Coast and Southern Oregon/ California). According to the PFMC Catch Sharing Plan formula, Washington was granted the larger share (at 216,489 pounds), while Oregon and California split 187,506 pounds. The Oregon Central Coast was the subarea with both the highest allocation (172,505 pounds) and the highest estimated catch (169,956 pounds). Southern Oregon and California had the smallest allocation (5,625 pounds) and the lowest estimated catch (9,648 pounds), though very productive fishing from just north of Brookings and into California waters pushed the catch over the limit by 4,023 pounds (72%).

Recreational fishers posing with their catch after a day on the water with J. Dock Fish Company in Seward, AK. Photo by Lara Erikson.

Area 2B (British Columbia)

The sport allocation for British Columbia in 2011 was 948,000 pounds, which was 12% of the total catch limit for Area 2B. The actual catch estimate came to 1,220,000 pounds (28.7% over the allocation). To slow the rate of catch and extend the season during 2011, DFO continued with restrictions initially implemented in 2010. These included a daily bag limit of one fish and a possession limit of two fish for the entire season, as well as a prohibition on retaining halibut seaward of 12 nautical miles in the DFO Pacific Fishery Management Area 121 (waters off Vancouver Island near Juan de Fuca Provincial Park). One further restriction was delaying the opening of the season to March 1. The B.C. season closed on September 5, when the sport quota was estimated to have been reached.

Areas 2C, 3, and 4 (Alaska)

The sport fishery in Areas 2C and 3A is divided into the guided and unguided categories. With a Catch Sharing Plan for Areas 2C and 3A delayed, management of the guided fishery for 2011 continued under the Guideline Harvest Level (GHL) program developed by the North Pacific Fishery Management Council (NPFMC). The ADF&G provided preliminary harvest estimates for the 2011 guided sport fishery from logbook returns through July 31 and mathematical projections for the remainder of the season.

The NPFMC has been working on a catch sharing plan for the Alaskan fishery for some time. Until that is finalized, bag limits and other regulations are employed to keep the sport harvest within the GHL.

The 2011 Area 2C sport harvest was estimated to be 1,313,000 pounds (a 33% drop from the previous year), of which the unguided harvest was 925,000 pounds and the guided harvest was 388,000 pounds (far below the 788,000 pounds allowed by the GHL). And though the number of fish caught in the guided fishery remained nearly unchanged from 2010, the mean weight declined from 26.4 pounds to 9.4 pounds due to a 37-inch maximum size restriction that was implemented by IPHC in 2011. In contrast, the unguided fishery mean weight remained nearly the same, while the number of fish caught increased by 6.5%, resulting in a higher harvest.

In Area 3A, the sport harvest was estimated to be 4,541,000 pounds, a 6% increase over 2010, of which the private harvest accounted for 1,704,000 pounds and the guided harvest was 2,837,000 pounds (about 22% below the GHL of 3,650,000 pounds). For both guided and unguided fisheries, the daily bag limit remained at two halibut of any size.

Areas 3B and 4 pulled in an estimated 25,000 pounds and 18,000 pounds, respectively. These estimates relied upon the ADF&G's Statewide Harvest Survey, which counts number of fish, not weight. The weight was estimated by IPHC by applying the average weight of halibut caught in Kodiak.

Finally, several new regulations from 2010 remained in place for 2011: 1) a charter vessel angler may use only one fishing line, and no more than six lines are allowed on a charter vessel fishing for halibut; 2) charter operators, guides, and crew may not catch and retain halibut during a charter fishing trip; 3) the names and fishing license numbers of anglers are to be recorded in the trip logbook; and 4) anglers retaining halibut must sign the log at the end of the charter vessel fishing trip.

"The Salish people traditionally cooked whole halibut fish in underground ovens (similar to the Hawaiian "imu"). After preparing a pit with hot rocks and coals, they would clean the fish, wrap it in leaves (usually maple, ironwood, or fern leaves) and place it on the coals, with green, sand-free seaweed beneath and above the fish. They would cover it up and let it bake until done. A five-pound halibut would take about an hour to finish."

- Batdorf, Carol - "The Feast is Rich: A Guide to Traditional Salish Indian Food Gathering and Preparation" Bellingham, Washington: Whatcom Museum of History and Art, 1980. p. 42-43.

INCIDENTAL MORTALITY FROM THE COMMERCIAL HALIBUT FISHERY (WASTAGE)

During the commercial halibut fishery there is mortality of halibut that is not accounted for in the commercial fishery catch estimates, including the mortality of legal-sized (32 inches and over, or "O32") halibut from lost or abandoned longline fishing gear as well as a proportion of the sublegal (or "U32") halibut that must be released by regulation but subsequently die. This estimated incidental mortality of halibut in the commercial halibut fishery is termed "wastage" in IPHC reports. It's worth noting that similar mortality in non-halibut commercial fisheries is called "bycatch", a concept that is presented in the Incidental Catch chapter later in this report.

Incidental mortality (wastage) from lost or abandoned gear

The IPHC estimates that approximately 104,000 pounds of O32 Pacific halibut were killed by lost or abandoned longline gear in 2011, similar to last year (105,000 pounds), and the lowest level of wastage since 3,200,000 pounds were estimated in 1986.

O32 wastage was calculated by multiplying the total catch by the ratio of effective skates lost to effective skates hauled aboard. Effective skates are defined as standardized skates where no data (such as skate length, hook spacing, and number of hooks per skate) are missing. For 2011, the ratios of effective skates were: 0.007 (Area 2A), 0.004 (Area 2B), 0.002 (Area 2C), 0.002 (Area 3A), 0.001 (Area 3B), and a range between 0.002 and 0.006 for Area 4.

A predator had this halibut for lunch. Photo by David Bryan.

Incidental mortality (wastage) from discarded U32 halibut

Another type of mortality —U32 halibut caught by the commercial halibut fleet that legally could not be kept—amounted to 2,213,000 pounds in 2011. Although this amount was down from the 3,038,000 pounds in 2010 (an all-time high), it was still higher than the average for each of the past four decades. Area 3A logged the highest levels, at 881,000 pounds, while Area 2A had the lowest, at 6,000 pounds. The large number of small fish in the halibut population at this time is largely responsible for the higher level of U32 wastage in recent years.

U32 wastage is calculated by first determining the area-specific ratio of U32 fish to 032 fish (derived from the top one-third IPHC surveys stations by weight). The top one-third stations are used as a proxy for the commercial fishery. The U32:O32 ratio of the average of the last three year's survey is multiplied by the estimated commercial catch in that area. The three-year average is used as it is less variable than a ratio based one year's data. The final number is obtained by multiplying this number by the discard mortality rate (DMR). The DMR is the percentage of fish discarded after capture that do not survive. A mortality rate of 16% has been applied to all longline discards since the beginning of individual quota fishing (1991 in Canada and 1995 in Alaska). For the earlier years of derby fishing and for all years in Area 2A, a mortality rate of 25% was used.

The IPHC determined that halibut between 26 and 32 inches in length (U32/O26) needed to be accounted for separately in the determination of catch limits, in order to standardize their treatment with the sport and personal use fisheries. The wastage mortality for U32/O26 halibut in 2011 was 2,052,000 pounds, down from the historical high of 2,869,000 pounds wasted in 2010.

Mary O'Neill wrote ***Hailstones and Halibut Bones****, a highly regarded and entertaining book of children's poetry about colors. In the poem "What is White?" she answers, "...a ship's sail, a kite's tail, a wedding veil, hailstones and halibut bones, and some people's telephones...." Published by Doubleday in 1961, it is still in print and available.*

PERSONAL USE (SUBSISTENCE) HARVEST 2011

The personal use—or subsistence—harvest doesn't capture as much attention as the sport or commercial fisheries but it remains an important source of halibut for many people. It's all about folks in small boats—mostly their own—trying to fill first a cooler, and eventually their freezer back home. Despite the humble nature of this fishery, the fish caught are an important food source for those involved.

Personal use is defined as halibut caught neither for sport nor commercial use (since resale is forbidden), but to allow those who have traditionally depended on it as a critical food source to continue to harvest it. The IPHC defines it 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 California, Oregon, and Washington; and 4) U32 halibut retained by commercial fishers in Areas 4DE under IPHC regulations.

"One common ceremonial use was in meetings to commemorate the recent dead (cremation potlatch), to remember more distant dead (anniversary memorial potlatch), a means to enhance the political and social status of the host (prestige potlatch), and for peace ceremonies. At all these occasions, the host would provide days of food and entertainment."

- Mary Giraudo Beck "Potlatch: Native Ceremony and Myth on the Northwest Coast" Anchorage, Alaska: Northwest Books, 1993.

Estimated harvests by area

The estimates for the subsistence harvest typically lag by a year, with the most recent figures being for 2010. Coastwide, subsistence fishers harvested 1,242,600 pounds of halibut in 2010, down from the 1,305,600 pounds caught in 2009. The majority of personal use halibut was taken from waters off Alaska. Area 2C had the highest harvest level, at 424,800 pounds, closely followed by Area 2B, at 405,000 pounds. Area 4B had the lowest catch, at 500 pounds.

Halibut under 32 inches in length cannot be retained in the commercial fishery, but are fair game for the personal use harvest. Photo by Danielle Courcelles.

Area 2A (California, Oregon, and Washington)

The PFMC allocates the catch limit to directed and incidental commercial fisheries, sport fisheries, and Treaty Indian fisheries operating off northwest Washington. The Treaty tribes further subdivide part of their allocation to their own Ceremonial and Subsistence (C&S) fishery. The 2011 C&S catch was 24,500 pounds, down from the 30,400 pounds caught in 2010.

Area 2B (British Columbia)

The personal use harvest in British Columbia served primarily the First Nations FSC fishery, which pulled in 405,000 pounds of halibut in 2011 (and was also the figure used from 2007 through 2010). This is a rough estimate supplied by the DFO, since the IPHC doesn't have independent data to make its own estimate.

First Nations FSC fishery refers to the "food, social, and ceremonial purposes" catch. It is part of the Canadian First Nations fishery program. A Canadian Supreme Court ruling determined that FSC fisheries have priority over all other fisheries in Canada.

Areas 2C, 3, and 4 (Alaska)

The IPHC began estimating the personal use catch in Alaska in 1991. Although figures for 2011 were not available at time of writing, 807,200 pounds were harvested in 2010, down slightly from 871,600 pounds in 2009. The ADF&G's annual voluntary survey of fishers for 2010 showed that the highest catch, at 424,800 pounds (53%), came from Area 2C (southeast Alaska). Area 3A (central Alaska) was next with 312,700 pounds (39%). Area 3B (Alaskan Peninsula) accounted for 23,000 pounds (3%), while the combined Area 4 (Bering Sea/Aleutian Islands) pulled in 37,200 pounds (5%).

Supplementing the Alaskan personal use catch listed above was the Area 4DE CDQ harvest of U32 halibut. This harvest is reported directly to IPHC, and came to 9,500 pounds in 2010 and 16,900 pounds in 2011. The CDQ fishery in the Bering Sea is allowed to retain U32 halibut—an exemption that occurs nowhere else and which was approved by the IPHC in 1998 for Area 4E and was expanded in 2002 to include Area 4D.

The rationale for these exemptions was to balance the good of the halibut population with the good of the communities in this part of the Bering Sea. The southeast Bering Sea holds a larger percentage of juvenile halibut than any other regulatory area—a valuable commodity to the Pacific halibut population. On the other hand, local communities have a traditional reliance on natural resources such as halibut and have shown their cultural responsibility for the fishery. Furthermore, as opportunities for work and obtaining food are limited here, the NPFMC (which is responsible for groundfish management in the Bering Sea, Aleutian Islands, and Gulf of Alaska), petitioned the IPHC to allow the exemptions, to which the IPHC agreed, as long as reporting requirements were met.

Who retains U32 halibut in the CDQ fishery?

Coastal Villages Regional Fund (CVRF)

The twenty communities that comprise the CVRF—Chefornak, Chevak, Eek, Goodnews Bay, Hooper Bay, Kipnuk, Kongiganak, Kwigillingok, Mekoryuk, Napakiak, Napaskiak, Newtok, Nightmute, Oscarville, Platinum, Quinhagak, Scammon Bay, Toksook Bay, Tuntutuliak, and Tununak—are remote coastal villages bounded by Norton Sound to the north and Bristol Bay to the

south. The CVRF's motto is "WORK FISH HOPE." Focusing on the middle word of that motto, the CVRF processed 9,909 pounds of U32 Pacific halibut in 2011, a catch that was 153% greater than the 3,924 pounds caught in 2010. The number of halibut caught totaled 1,100, for an average weight of 9.0 pounds.

Norton Sound Economic Development Corporation (NSEDC)

The NSEDC is an organization that provides fishing opportunities for its fifteen member communities, located primarily on the coast of the Seward Peninsula, bounded by Kotzebue Sound on the north and Norton Sound on the south. From approximately south to north, they are: 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. The NSEDC processed 4,206 pounds of U32 halibut in its Nome plant in 2011, a 22% increase over the 3,438 caught in 2010. The number of halibut caught was 447, for an average weight of 9.4 pounds.

Bristol Bay Economic Development Corporation (BBEDC)

The southernmost of the three CDQ organizations, The BBEDC is an organization whose goal is "building sustainable communities from sustainable harvests." To paraphrase its mission statement, its programs provide jobs, training, and educational opportunities to its residents, and economic development tools and resources for its member communities. It is made up of seventeen member villages on the shores of Bristol Bay: Aleknagik, Clark's Point, Dillingham, Egegik, Levelock, Ekuk, King Salmon/ Savonoski, Manokotak, Naknek, Pilot Point, Port Heiden, South Naknek, Togiak, Twin Hills, Ugashik, Ekwok, and Portage Creek. The halibut it caught were landed primarily at Togiak, with some delivered to Dillingham. In 2011, the BBEDC processed 2,732 pounds of U32 halibut, a 28% increase over the 2,155 pounds caught in 2010. The number of halibut caught was 336, for an average size of 7.7 pounds, and 73% of them were 29 inches or more in length.

"You always carried a spear. Ordinarily, halibut are hard to kill and may become dangerous, so when the spear is used it takes away a lot of worry—so they carry the spear with them on their canoe at all times, even for halibut fishing."

Tlingit member John Jackson in Our Food Is Our Way of Life: Excerpts From Oral Interviews. Richard G. Newton and Madonna L. Moss. *Washington, DC: US. Department of Agriculture, 2005. p.13.*

INCIDENTAL CATCH 2011

Incidental catch, or bycatch, has been and continues to be a serious and challenging problem for the Pacific halibut resource and managers. It is defined as the unintentional or incidental catching of Pacific halibut by other fisheries. Regulations require those halibut to be returned to the sea with no additional injury. However, serious injury and death commonly occur if halibut languish on board for long periods of time before being sorted out and tossed back overboard.

Incidental catch can happen with any gear. Shown here are the results of a research trawl tow. Photo by Paul Logan.

The rate of mortality assigned to halibut that are discarded varies by fishery and gear.

The amount of bycatch in 2011

The IPHC estimates that 9,995,000 pounds of Pacific halibut were killed due to bycatch in 2011, a significant improvement over the 10,631,000 pounds caught in 2010, and the lowest amount since 1986. In fact, only four years have had lower bycatch levels in the past 50 years.

An estimated 140,000 pounds was taken in Area 2A. Area 2B accounted for 297,000 pounds. Area 2C caught 341,000 pounds. Area 3A and 3B caught 2,898,000 and 1,185,000 pounds, respectively, while Area 4 pulled in 5,134,000 pounds of bycatch.

Observer programs provide information about the amount of halibut caught and their condition.

Sources of bycatch information

The IPHC hasn't the capabilities to monitor the incidental catch of Pacific halibut, but must instead rely on state and federal agencies for information. In the United States, the NMFS operates observer programs that monitor groundfish fisheries off Alaska, and for British Columbia, the DFO provides comprehensive bycatch estimates. Where such observer programs are not available, the IPHC uses research survey information to project bycatch estimates. New in 2011, an individual quota program was implemented for the domestic groundfish trawl fisheries operating in Area 2A. Similar to the trawl program in Area 2B, it contains an individual bycatch quota component for managing and reducing halibut bycatch mortality. The Appendix I tables at the end of this report provide more detail on bycatch mortality.

Discard mortality rates (DMRs)

DMRs are used to determine the fraction of the estimated bycatch that dies, and this varies by fishery and area. Where observers are used, DMRs are calculated from data collected on the release viability (or the injury) of caught halibut. NMFS manages the groundfish fisheries off Alaska according to DMR schedules recommended by the IPHC. In both Areas 2A and 2B, observers on the bottom trawl vessels examine each halibut to determine release viability. Where there are no observers, DMRs are assumed from similar fisheries where data are available. For instance, the sablefish hook-and-line fishery in Area 2A uses a DMR of 16% (based on the sablefish fishery off Alaska), and the whiting fishery uses a DMR of 75%.

Bycatch mortality by regulatory area

Area 2A (California, Oregon, and Washington)

Area 2A had 140,000 pounds of bycatch mortality in 2011, far less than the 346,000 pounds reported in 2010. This dramatic reduction was due entirely to the implementation of an individual quota program for the bottom trawl fishery. For the fixed gear sablefish fishery, there was no halibut retention allowance as there was in previous years, and a total of 50,000 pounds was killed. Another development in 2011 was the incorporation of information that fish excluders had been required on shrimp trawls since 2003. This reduced the assumed loss in that fishery from 25,000 pounds per year to zero.

Area 2B (British Columbia)

Bycatch mortality in the British Columbia trawl fishery came to 297,000 pounds in 2011, an increase from the 181,000 pounds killed in 2010. Most of it occurred in the summer months. Unfortunately, this was the highest amount since 2007.

Area 2C (Southeast Alaska)

Area 2C had a bycatch mortality of 341,000 pounds, a level that has been fairly static for the past ten years. It comes mostly from pot fishing for brown

crab and beam trawling for shrimp and flounder. Admittedly, the above estimate is not perfect, because observer coverage is poor in this area due to 1) vessels operating in state waters with no observer requirement, or 2) vessels that fall below the 60-foot length, triggering observer coverage in federal waters.

Area 3 (Gulf of Alaska)

Combined Area 3 had a bycatch mortality of 4,083,000 pounds, up from the 3,679,000 pounds caught in 2010. Of all the regulatory areas, Area 3 has the poorest estimates of bycatch mortality, due to low observer coverage for many fisheries. Area 3A accounted for 2,898,000 pounds of the total, while 3B accounted for 1,185,000 pounds. Groundfish trawl fisheries (targeting arrowtooth flounder, rock sole, and yellowfin sole) pulled in 75% of the bycatch in this area (3.2 million pounds).

The Rockfish Pilot Program has been operating in the Gulf of Alaska since 2007. It permits harvesters to form voluntary cooperatives and thus gain exclusive harvest privileges for certain rockfish species, with pooled halibut bycatch mortality allowances. For 2011, only 119,000 pounds (35% of the 344,000 pound limit) of halibut had been taken, while 88% of the cooperative's groundfish allocation had been harvested.

Area 4 (Bering Sea/Aleutian Islands)

Bycatch mortality for Area 4 was estimated to be 5,134,000 pounds, a reduction from the 6,082,000 pounds caught in 2010 and the lowest amount since 1985. The majority of it (77%) came from the groundfish trawl fisheries. The hook-and-line fishery, mostly catching Pacific cod, accounted for the next 21% of the bycatch.

Bycatch from the Prohibited Species Donation program

The Alaska groundfish fishery participates in a Prohibited Species Donation (PSD) program that enables Pacific halibut caught by trawl vessels in the Bering Sea/Aleutian Islands and (new in 2011) the Gulf of Alaska to be processed and donated to food banks throughout the United States by special permit. SeaShare, an organization in Bainbridge Island, Washington, acquires the bycaught halibut, processes it into steaks and sends it out to hunger relief programs. The PSD program was adopted by the NMFS and the NPFMC in 1998, and has contributed over 300,000 pounds of processed halibut ever since.

In 2011, 18,429 pounds of halibut was landed for the PSD program, with 11,191 (61%) from the Bering Sea/Aleutian Islands, and 7,328 pounds (39%) from the Gulf of Alaska.

In 2011, more than 18 thousand pounds of halibut was donated to food banks as part of a special program. Processing and delivery are donated by local companies.

STOCK ASSESSMENT

Winston Churchill, in an October 1939 radio address, described the Soviet Union as "a riddle, wrapped in a mystery, inside an enigma...." Assessing the abundance of the Pacific halibut stock could be described similarly. The IPHC invests considerable time trying to understand the riddle of where they go, the mystery of what they do, and the enigma of why they do it. Most of all, the IPHC tries to determine how many halibut are out there. Only when that is determined can it decide how many halibut it is prudent to catch in a given year. For 2011, IPHC staff recommended a total commercial catch limit of 39,693,000 pounds (net weight).

The 2011 catch limits for Pacific halibut were based on the coastwide exploitable biomass at end of 2010, which was 317 million pounds.

Stock assessment at the end of 2010/beginning of 2011

At the beginning of 2011, coastwide exploitable biomass (E_{bio}) was estimated to be 317 million pounds, a revision downward from the beginning of 2010. Female spawning biomass (S_{bio}) was estimated to be 350 million pounds, an increase of 6% over the 331 million pounds estimated at the beginning of 2010. The fact that there are revisions downward of E_{bio} with each new year of data, and that the downward revisions do not appear to be a factor in the S_{bio}, supports the possibility that the ongoing decline in observed size at age is at least one of the contributing causes of model "retrospective behavior" (explained later in this chapter). Both exploitable and spawning biomasses are expected to increase over the next several years, tempered by decreasing fish size. Although the halibut fishery is projected to see more halibut, more of them will be small.

A plant worker at Alaska Pacific Seafoods in Kodiak, AK, processes a commercial halibut trip. Photo by Lara Erikson.

Coastwide biomass apportionment

The stock assessment from the end of the previous year is used to formulate the recommended catch limits for the coming year. In this case, the coastwide assessment at the end of the 2010 fishing season was used to make recommendations for the 2011 season.

The coastwide exploitable biomass (E_{Bio}) estimate was apportioned among the regulatory areas in a consistent and objective manner, using the survey weight per unit effort (WPUE) and the amount of bottom area per regulatory area. This provided the best way to distribute the catch proportionally among all the regulatory areas.

Taken from the 2010 Stock Assessment, Area 2A had the lowest E_{Bio} level, at 2,997,000 pounds (2.1% of the total). Area 2B had 38,250,000 pounds (12.9%). Area 2C had 23,874,000 pounds (7.9%). Area 3A had the highest E_{Bio}, with 109,841,000 pounds (34.5%). Area 3B had 48,066,000 pounds (18.1%). Area 4A had 23,583,000 pounds (6.7%). Area 4B had 26,992,000 pounds (5.1%), and the combined Areas 4CDE had 43,397,000 (12.7%). These totaled 317 million pounds coastwide (net weight).

Stock assessment scientists go through a multi-step process to produce stock size estimates.

How stock assessment works

Once the assessement was finished and the catch limits were set in January, work began on the new stock assessment. In 2011, it took 23 consecutive steps, performed over the course of the year, for the assessment and allocation process to come together. Although each step contains numerical results, for the sake of brevity they aren't listed in this report.

1. Assemble estimates of halibut density from NMFS and ADF&G trawl surveys (for Area 4CDE)
2. Determine WPUE from IPHC setline survey (all IPHC areas except 4CDE)
3. Assemble sex, age, and weight data for survey-caught halibut
4. Determine WPUE for commercial catch (from logbooks collected in ports)
5. Assemble sex, age, and weight data for commercial catch
6. Assemble "other removals" data (bycatch, sport, subsistence, wastage)
7. Put values into the Standardized Stock Assessment model
8. Fit the Assessment Model to survey and commercial catch rates
9. Evaluate the Stock Assessment
10. Determine Exploitable Biomass
11. Determine the Estimate of Uncertainty
12. Determine Retrospective Performance
13. Adjust survey WPUE for hook competition & timing of setline survey
14. Average the survey WPUE using Kalman filtering
15. Apportion Biomass among Regulatory Areas
16. Compute Constant Exploitation Yield (CEY)
17. Compute Fishery Exploitation Yield
18. Input Slow Up Fast Down (SUFD) or SUFullD adjustment
19. IPHC staff develops Catch Limit Recommendations (CLR)
20. Staff recommendations posted on IPHC website for public comment

21. Commission Advisory Bodies (PAG, Conference Board) provide evaluation of staff recommendations and their own recommendations.
22. IPHC Commissioners announce catch limits at the Annual Meeting in January
23. U.S & Canadian governments implement catch limits

Area 4CDE: large size + low density = special treatment (Step 1)

The combined areas of 4C, 4D, and 4E (Area 4CDE) are notable for their comparatively low density of halibut. Coupled with a large geographic size (over 55% of total halibut habitat), this part of the Bering Sea is not quantifiable with the normal stock assessment survey. So instead of an area-wide grid of setline survey stations, a statistical dataset was constructed that projected a comprehensive and representative count.

To construct the dataset, five subareas were identified and analyzed. The first three—Area 4D Edge (the northwest-to-southeast drop-off to the Aleutian Basin), the Pribilof Islands (known operationally as Area 4IC), St. Matthew Island (known operationally as Area 4ID)—received their density estimates from the IPHC setline survey. The latter two—the northern Bering Sea Flats and southern Bering Sea Flats (known operationally as Area 4N and 4S, respectively)—got theirs from NMFS trawl surveys.

Surveys (Steps 2 & 3)

Coastwide setline surveys

The IPHC setline survey is a major dataset that is independent of the commercial fishery. The annual setline survey, also called the Standardized Stock Assessment (SSA) survey, was conducted during the summer of 2011 from southern Oregon (Area 2A) through Attu Island in the Aleutian Islands (Area 4B). The survey dropped longline sets every ten nautical miles at depths that ranged from 20 fathoms (120 feet or approximately 36 meters) to 275 fathoms (2,400 feet or approximately 732 meters). Each set formed a station, for a total of 1,315 stations.

An important result from the survey was the weight of O32 Pacific halibut caught per standardized skate, which was defined as the "survey WPUE" and was an indicator of halibut density and stock status. The SSA survey showed there has been a coastwide 50% decline in survey WPUE over the last ten years, which indicates a consistent coastwide decline in exploitable biomass (E_{Bio}).

An important byproduct of the NMFS Eastern Bering Sea survey is that, for stock assessment purposes, the expansive Bering Sea "flats" area is surveyed in its entirety up to 65.5° N latitude.

The survey also collected age and sex distributions for all regulatory areas. The average age for both sexes was 12.4 years (females–11.5 years, males–13.6 years). As in recent years, in 2011 there was a tendency for the western areas to have an older population compared to the eastern areas.

Alaskan trawl surveys

NMFS conducts Alaskan groundfish trawl surveys in the Bering Sea (every year), and Gulf of Alaska (biennial). These are also a valuable independent indicator of long-term trends in Pacific halibut biomass.

Each year the IPHC places one of its biologists aboard the NMFS survey ship as it conducts a groundfish and crab trawl survey in the Eastern Bering Sea (EBS). The trawl survey is used to count halibut because the standard IPHC setline survey (used in the other regulatory areas) would be too expensive and

The *F/V Pender Isle* has helped the IPHC conduct the stock assessment survey for many years. Photo credit: IPHC archive.

would catch too few fish to be statistically useful. The trawl survey produces swept-area estimates of abundance at length. By applying an estimated survey-selectivity-at-length schedule to the survey results, the IPHC obtains a highly reliable index of halibut abundance for the EBS flats.

The trawl survey indicated that the index of total halibut biomass (T_{Bio}) in the EBS increased steadily since 2002 and peaked in 2010 (322 million pounds) before declining 4% in 2011 (308 million pounds).

The triennial Aleutian Islands trawl survey was not conducted in 2011, but NMFS did conduct its biennial Gulf of Alaska (GOA) survey this year. The GOA estimates are not used directly in the halibut stock assessment, but provide a comparison dataset. Swept-area estimates of total biomass and total numbers of halibut declined since the last GOA survey in 2009.

Catch Per Unit Effort (CPUE) *is a term that has largely been replaced by Weight Per Unit Effort (WPUE) and Number Per Unit Effort (NPUE). It measures the efficiency of a fishery, the density of halibut in an area. These are a standardized measure of either halibut weight or number that is caught on the gear.*

Commercial fishery (Steps 4 & 5)

A second primary method of annual data collection for the IPHC is the sampling of the commercial landings for age and length data and interviewing fishers for logbook information. Like the survey WPUE, the coastwide commercial WPUE also declined over the last ten years, though not as dramatically, mostly because while survey vessels fish pre-determined locations whether or not the fishing is good, commercial fishers tend to move to find better fishing conditions.

Approximately 1,500 otoliths were collected from each regulatory area (except for Areas 2A and 4B). Through November 15, 2011, a total of 11,622 otoliths were obtained from commercial catch sampling. Of these, 11,391 were aged, with the remainder crystallized and not readable.

Lost yield from U32 bycatch (Step 6)

Bycatch from non-directed fisheries is not sexed since that determination requires the fish be sacrificed, which is at odds with the mandate that bycaught halibut must be returned to the sea as soon as possible after capture to minimize mortality. However, length is known. A method of estimating how much halibut was lost due to bycatch was developed in 2009, using length as one of the factors. In 2011, the yield loss ratio on a coastwide basis was 1.23, i.e., for every pound of halibut taken as juvenile bycatch, an estimated 1.23 pounds was lost to the directed commercial halibut fishery, had that halibut matured and spawned.

The assessment model (Step 7)

The coastwide average of the estimated amount of yield lost for every pound of juvenile halibut caught as bycatch was 1.23 pounds in 2011.

The 2011 coastwide assessment model was identical to that which was peer-reviewed and accepted by the Commission several years ago. Because of that acceptance, most of the focus of the IPHC staff and the halibut industry has been on how the coastwide estimate of E_{Bio} is apportioned among the regulatory areas.

The assessment model was structured by both age and sex, and was fitted to the actual commercial and survey catch for age, sex, and catch per unit effort (CPUE). Before 2006, each regulatory area was evaluated as a closed area. As a result of a large-scale tagging project which showed that migratory behavior in adult fish was larger than previously thought, the model was changed to a coastwide analysis (from California northward through the Bering Sea).

Alternative model fits (Step 8)

No statistical model is perfect, though some models come closer to perfection than others. A critical part of the stock assessment is fitting the chosen model to actual data, to better fine-tune the accuracy of the model. As in the past several years, the IPHC looked at several different model variations, to determine which one was most accurate.

For 2011, the model variant chosen by the IPHC (to assess the stock for the 2012 season), and the one with the best fit to the data was the "WobbleSQ Survey q drift model." This was a departure from the "Trendless model" that had been used from 2007 through 2010. Also identified as Alternative 2, it was different because the survey catchability was allowed to drift freely.

Effect of the 2011 data on abundance estimates

The 2011 data had a two-stage effect on the abundance estimates. To begin with, survey WPUE declined by 5% and commercial WPUE increased by 1% between 2010 and 2011 coastwide. However, there was more to the story. Late arriving data lowered the initial commercial WPUE value of 232 pounds/skate to 210 pounds/skate, which caused the E_{Bio} estimate to drop from an initial 317,000,000 pounds to a revised value of 292,000,000 pounds. After further adjustments (for the WobbleSQ model variant and the 2011 assessment), the E_{Bio} estimate at the end of 2011 (and beginning of 2012) was 260,000,000 pounds.

Quality of fits (Step 9)

Four steps encompass the evaluation of the assessment: quality of the fits (step 9); coastwide estimates of recruitment, exploitable biomass and spawning biomass (step 10); estimates of uncertainty (step 11); and retrospective performance (step 12).

Beginning with the quality of fits, the WobbleSQ variant fit the actual data very well in three areas: survey number per unit effort (NPUE) at sex/age, commercial NPUE at sex/age and commercial catch at age. It also fit the increasing numbers of fish aged 25 years and older, especially males, which were appearing in both the survey and commercial catches. The very slow growth rate for males meant that many were not "recruiting" into the commercial halibut fishery until they were older than 25 years, despite recruitment of males historically occurring at about age eight. This group is destined to increase even more through 2013 as the remains of the very large year classes of 1987 and 1988 reach 25 years of age.

Coastwide estimates of recruitment, exploitable biomass and spawning biomass (Step 10)

The annual stock assessment produces an estimate of the total mass of male and female halibut, ages six and older, in the ocean. At the end of 2011, the S_{Bio} for Pacific halibut was estimated to be 319,000,000 pounds (a decline of about 9% from end of 2010). The E_{Bio} reflected a decline of about 18%. Only half that decline could be attributed to changing from the Trendless to the WobbleSQ model. Both S_{Bio} and E_{Bio} declined continuously between 1998 and 2007, with S_{Bio} bottoming out in 2007 and E_{Bio} hitting bottom in 2009. Both are now estimated to be on the rise again but this expectation needs to be tempered by continuing declines in size at age and the retrospective behaviour of the model.

There are currently three year classes making up the majority of fish recruiting into the commercial fishery: those born in 1998-2000.

There are presently three large year classes (from 1998, 1999, and 2000) that have recruited and should be the largest contributors to the E_{Bio} (and the halibut catch) for several more years. All three are estimated to be numerically greater than the famous classes of 1987 and 1988. However, their strength has not yet been well determined. Furthermore, observed size at age is much smaller now than it was twenty years ago, which means that their collective biomass is expected to be much smaller than the 1987 and 1988 classes. It also means that they have just begun to reach the commercially exploitable size range and their true numbers remain uncertain.

Estimates of uncertainty and retrospective performance (Steps 11 & 12)

All models contain uncertainty. The degree of uncertainty is a measure of how correctly that model portrays the real world. One standard way to illustrate uncertainty is by using the "likelihood profile." The 95% confidence interval (C.I.) for E_{Bio} at the end of 2011 was 187 to 342 million pounds. In other words, one can be 95% certain that the E_{Bio} was between those two numbers. Similarly, the C.I. for spawning biomass (S_{Bio}) was 228 to 423 million pounds.

For several years, the halibut assessment model has exhibited a retrospective downward correction, i.e., as new data is added each year, the estimates for previous years adjusts downward. "Retrospective behavior" in a model is not uncommon, but it's a good idea to try and find its cause especially when the biomass estimates are correcting downward. To that end, besides the standard variants used every year to determine uncertainty, an additional sixteen variants were used in 2011 in an attempt to diagnose the cause. Unfortunately, this analysis did not produce any new insights

The cause of the halibut model's retrospective behavior may have to do with one or more of several possibilities: inaccuracies within the model, incorrectly assuming that incoming year classes really have low selectivity and that these year classes are stronger than they actually are, incorrect estimation of the sex composition of the commercial catch (which is gutted at sea), or declining size at age rates. A full analysis will continue into 2012 and beyond to identify the source of the problem.

Slow Up Fast Down (SUFD) and Slow Up Full Down (SUFullD) *are management policies designed to ensure the stock is protected from overharvest as it naturally fluctuates.*

Harvest policy and status relative to reference points

IPHC staff catch limit recommendations are based on a "Slow Up Full Down" (SUFullD) adjustment. The SUFullD is a variation of SUFD that started in 2010, and a more drastic adjustment that increases harvest carefully and

A view from the *F/V Proud Venture* during the stock assessment survey near Port Hardy, B. C. Photo by Sam Parker.

slowly (usually by one-third) when EBio is going up, and reduces it by 100% immediately when EBio is going down, in order to protect the halibut stock. This meant that only one-third of potential increases were taken and 100% of decreases were taken.

Since the 1980s the IPHC has developed, refined, and used a constant-rate harvest policy, which was to harvest 20% of the coastwide E_{Bio} when S_{Bio} (the combined mass of adult females able to spawn) was estimated to be greater than 30% of the unfished level biomass (what the biomass would be if all halibut fishing ceased). The purpose of this policy was to maximize the available yield for fishers while minimizing the risk to the S_{Bio} (and therefore to the future of the species).

The S_{Bio} at the end of 2011 of 319 million pounds was a healthy 42% of the unfished biomass level of 768 million pounds. The target harvest rates for 2012, were set at 21.5% (Areas 2 and 3A) and 16.1% (Areas 3B and 4). In contrast, the realized harvest rates in 2011 coastwide hovered around 25%, resulting from the retrospective downward revision of E_{Bio} combined with unchanged estimates of total removals. A method to revise applied harvest rates was developed: if the contemporary biomass estimates were eventually revised downwards, the applied

harvest rates would be revised downward by the same magnitude. An analysis of this adjustment will be undertaken in 2012.

Comparing assessment and trawl survey EBio

An important step in the coastwide stock assessment is its validation against other independent measurement methods. The Gulf of Alaska and Bering Sea NMFS trawl surveys provide swept-area estimates of abundance at length for Areas 2C westward through Area 4CDE. By first applying a commercial selectivity curve and then the IPHC length-weight relationship, an independent E_{Bio} estimate was derived for comparison to the assessment results.

The trawl survey data confirmed once again the large numbers of smaller halibut. Since the total biomass hasn't changed dramatically, it follows that the total number of halibut has increased. As they grow up, they should contribute to a steady increase in E_{Bio}, as predicted in the coastwide assessment.

Step 13 involves a number of adjustment factors that account for timing of the data collection, competition for food, and bottom area.

Adjustment factors (Step 13)

There are two factors used to adjust the coastwide E_{Bio} estimate before apportioning among the regulatory areas: hook competition and timing of the setline survey. For the purposes of weighting individual regulatory areas and apportioning E_{Bio}, the adjustments and weights described below were applied to the raw survey WPUE.

Hook competition

The catchability of halibut is affected by the presence of other bait takers vying for baited hooks, a struggle known as "hook competition." The average number of baits available to halibut differs significantly among the regulatory areas (depending on the manner and number of competitors in each area), and so the survey data (such as the WPUE) needed to be adjusted to account for that.

Timing of setline survey

The setline survey always occurs at mid-year, yet halibut removals occur all through the season. The setline survey results in an area would be very different if it had already been fished heavily, versus not fished at all. The timing adjustment identifies the midpoint of the survey and estimates the removals that occurred before that.

Bottom-area weighting factor

The setline surveys were conducted between 20 and 275 fathoms. However, halibut habitat is defined as bottom area between zero and 400 fathoms. Recognizing that inequity existed in either definition, the IPHC also recognizes that fishing does occur at all depths in most areas, and therefore recommends that the latter (broader) definition be used coastwide for apportionment.

Time-averaging methods of adjusting survey WPUE (Step 14)

In past years, the IPHC used the adjusted WPUE which was equally averaged over the most recent three years so that no single year would have a disproportionate influence on the results. A study conducted in 2010 determined that equal weighting was inferior to a method called reverse Kalman weighting, and the latter was adopted for 2011. Reverse Kalman weighting gives the most recent year's WPUE a "weight" of 75%, the one before it 20% and the one before that 5%.

The Constant Exploitation Yield (CEY) *is the biologically determined level for total removals of halibut from each regulatory area. It's calculated annually by applying a fixed harvest rate to the estimate of exploitable biomass (E_{Bio}) in that area. The corresponding level for catches in directed fisheries subject to allocation is called the Fishery CEY. It is the sum of the commercial setline catch in all areas plus the sport catch in Area 2B, plus the sport, ceremonial, and subsistence catches in Area 2A.*

Methods of apportioning biomass and computing fishery CEY (Steps 15 & 16)

There were four possible options for apportioning E_{Bio} among the regulatory areas (Step 15). In 2011, the IPHC chose the same option that it had for the past three years—zero to 400 fathoms bottom area weighting, with survey WPUE adjustments for hook competition and survey timing.

Computing the constant exploitation yield (CEY) was accomplished by multiplying the E_{Bio} of each regulatory area by the harvest rate for that area.

Area-apportioned biomass, total CEY and fishery CEY (Steps 17 & 18)

After the total CEY is computed, the next step is to find the fishery CEY by deducting "Other Removals." Other removals is defined as O32 and U32/O26 wastage, O32 and U32/O26 bycatch, personal use, and sport catch (except for Areas 2A and 2B, where it is included in fishery CEY instead of in other removals). The amount leftover is the fishery CEY.

Port sampler, Darlene Haugan, collects fishing log information for the halibut stock assessment from Josh Young of the *F/V Sharon Diane* in Prince Rupert, B.C. Photo by Kirsten MacTavish.

This concludes the description of the current stock assessment process. The five remaining steps occur as policy decisions and are not included in this section. Up to this point, the stock assessment has largely looked at the halibut population as a whole. What follows is a summary of the regulatory areas, to show in more detail what is happening on a local basis.

Area summaries

The coastwide stock assessment indicates that the E_{Bio} of Pacific halibut has declined by about 60% over the past ten years. The reasons for (and the amount of) the decline vary by regulatory area, and are explained in the following summaries.

Area 2A, 2B, and 2C (coasts of California, Oregon, Washington, British Columbia, and the Alaska Panhandle)

Removals were generally larger than surplus production for the past decade—from the mid-1990s through 2007—which led to a steadily declining E_{Bio}. Realized harvest rates were regularly higher than the 20% target rate, even

up to 50% of the E_{Bio} for a few years. These higher rates largely resulted from not completely understanding movement of adult halibut. The results of our PIT tagging program showed that harvest rates on the eastern side of the stock needed to be reduced. Adding to the decline in E_{Bio} was the effect of the two very large classes of 1987 and 1988 moving through the population and being followed by much smaller classes.

A reduction in allowed removals in the last few years seems to have arrested the decline. Although realized harvest rates remain slightly above target, they are closer to target than at any time in the past decade. It appears that a rebuilding of stocks has begun across Area 2, which could be sustained with the expected entrance of two or three large year classes into the E_{Bio}.

Detailed information on the assessment model can be found on the IPHC website in the Library section. Look for Scientific Report No. 83, "Assessment and management of Pacific halibut: data, methods, and policy", written in 2006 by William G. Clark and Steven R. Hare.

Area 3A and 3B (central and western Gulf of Alaska)

Areas 3A and 3B, which occupy most of the southern coast of Alaska, are geographically central to the distribution of halibut stock, and immigration and emigration are roughly equal. The two areas differed substantially in biomass levels and exploitation rates from 1990 to the present.

In Area 3A, the highest level of total removals occurred in 1990 (38.124 million pounds). The levels fluctuated only slightly through 2007, averaging 33.129 million pounds per year. Beginning in 2008, the levels began to decline each year, culminating in the lowest removals level in decades in 2011 (23.195 million pounds). The commercial catch mirrored this, with the highest catch occurring in 1990 (28.847 million pounds) and the lowest in 2011 (14.533 million pounds).

Area 3A contained the largest E_{Bio} of halibut of any regulatory area. Despite the sharp declines in biomass in recent years , the IPHC is not yet labeling Area 3A as an "area of particular concern." This might change if the biomass decline does not reverse itself soon.

Area 3B has experienced more fluctuation in removals from year to year, with a corresponding mirroring of the commercial catch levels. The low occurred in 1995, when only 4.987 million pounds of halibut were removed. The year 1996 saw the beginning of a spike in removals that peaked in 2002 (19.832 million pounds), with a gradual decline that culminated in a relatively low 9.343 million pounds removed in 2011. The IPHC estimates that removals greatly exceeded surplus production between the years of 1998 and 2007.

The ongoing decline of halibut stock in Area 3B is a problem of paramount importance. It has concerned the IPHC for several years, and must be turned around before Area 3B's true level of continuing productivity can be estimated. The area was lightly fished until the mid-1990s. A regular survey was then implemented, and quotas increased incrementally from 4 million to 17 million pounds, with a corresponding decline in catch rates. The exploitable biomass that had accumulated as a surplus was harvested at a higher rate, but despite lowering that rate as the surplus was removed, WPUE has continued to decline sharply.

Area 4A, 4B and 4CDE (western Gulf of Alaska and Bering Sea)

Area 4 provided the IPHC with both concern and hope in 2011. For most of the 2000s, removals exceeded surplus production in all three areas, leading to a decline in E_{Bio}. It has now been an area of particular concern for several years, with a resultant target harvest rate of 15%. Area 4B was the first to be reduced from 20% to 15% in 2004, followed by Area 4CDE in 2006 and Area 4A in 2008.

As a result, there has been a recent leveling of the WPUE, which indicates a leveling off of the E_{Bio}.

Bycatch mortality continues to be a concern for Area 4. For the past decade, both O32 and U32 bycatch have averaged 3 to 4 million pounds per year. The latter amount represents an even greater loss, due to the smaller size and greater numbers of killed halibut.

On a hopeful note, all three areas increased their survey WPUE in recent years, with the turnaround occurring immediately after the cut in the harvest rate in each area. Also encouraging are the age distributions, which are the broadest of any regulatory area. This indicates that Area 4 not only contributes to the spawning biomass in a ratio exceeding its removals, it is also a reservoir of older females—a valuable commodity for a population.

Evolution of halibut management strategy

Simulation models are used in fishery management to look at how a stock will respond to different conditions, and to examine different harvest policies.

Looking at the 2011 stock assessment process, it's easy to focus on the current process and accept it for what it is. What's easy to forget is that the stock assessment is a work in progress that is continually developing. For nearly 90 years, the IPHC has looked for better ways to quantify and evaluate the Pacific halibut stock. Over time, the process has become both more complex and hopefully more accurate. For one example, prior to 2006 the stock assessment plan used a closed-area assessment (where each area was considered separately), resulting in realized harvest rates that were triple the target rates in Areas 2B and 2C, while half the target rate in Area 4. After changing over to a coastwide assessment, migration has been taken into account and accuracy has improved.

Another management approach—that dovetails into the annual stock assessment process—is called Management Strategy Evaluation (MSE). MSE is a framework that is used to evaluate management procedures (sets of pre-agreed decision rules that specify what data are to be collected and how they are to be used to set total allowable catch). Putting it into a halibut context, it is a formal way to evaluate the performance of the current harvest strategy. It can also be used to evaluate different management elements as alternatives to the current strategy. MSE works by applying four steps to analyze a harvest strategy: 1) operating models, 2) a conditioning module, 3) a projection module and 4) an evaluation module.

Operating models are simulation models that describe potential past and future scenarios. Their goal is to describe halibut population and fishery dynamics under other conditions in order to capture statistical and structural uncertainty. For the halibut fishery, they are currently being conditioned to different time spans of available data, one from 1996 to the present, and another from 1888 to the present.

The conditioning module's goal is to condition (or adjust) the operating models using historical data so that they are consistent with the historic dynamics of the halibut stock. Its focus is not on finding the best stock assessment; rather, it focuses on ensuring that the operating models are consistent with historical data. For example, MSE conditioning modules being used in the fisheries community include: recent stock assessments, available data, and expert opinion. For the halibut fishery, conditioning means using a modern framework for modeling fish stocks called Stock Synthesis Version 3 (SS3). SS3 is a flexible and powerful tool

Dutch Harbor port sampler, Melanie Pilon, on the dock at Westward Seafoods. Photo by Lara Erikson.

that has been widely reviewed and used in the fisheries industry worldwide. It uses all halibut removals from 1888 to the present in four fisheries (commercial, sport and subsistence, bycatch, and wastage), along with the IPHC survey. It has produced good fits both to historical data and recently available data.

The goal of the projection module is to recreate all the steps involved in the annual halibut management process. This includes how catches are taken, what data to collect, how to use those data to determine stock status, how to determine next year's catches, and any other relevant management practices. An example of its use was the recent analysis of different stock assessment models to estimate natural mortality.

The evaluation module summarizes the results of the simulations based on performance indicators of alternative management strategies. These performance indicators—typically measures of yield, conservation risk and stability, among others—reflect management goals and are instrumental in the evaluation, comparison and eventual selection of alternative halibut management strategies.

MSE and the IPHC

The development of an MSE is a time-consuming process that requires involvement, consultation, and agreement among all interested parties (including scientists, resource managers, and industry), that follows a sequence of six steps:

- Define objectives and performance metrics
- Develop possible harvest strategies and control rules
- Develop operating models and condition them to historic data
- Simulation testing of possible harvest strategies
- Selection of harvest strategy
- Implementation of harvest strategy

The IPHC will be pursuing the development of a halibut MSE during 2012 and subsequent years.

The Management Strategy Evaluation is a process that can span several years.

SURVEYS

The IPHC carries out surveys to collect catch information and biological data on Pacific halibut and other species which is used as a "fishery independent" look at the stock. For example, halibut fishers tend to go where the halibut are, whereas survey vessels fish in a consistent geographic pattern. Despite the value of independent surveys, they are only a small fraction of the commercial effort, and only occur for a short time in the summer. The data collected are used to monitor changes in biomass, growth, and mortality in adult and older juvenile halibut. 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 IPHC also participates in the NMFS trawl surveys which cover the Bering Sea and Gulf of Alaska. Data from these surveys provide some overlap with commercial-sized halibut as well as a glimpse at the upcoming year classes.

"The total biomass of the lightly exploited arrowtooth flounder in the Gulf of Alaska increased over five-fold between 1970 and 2006, and they now consume at least four times the weight of pollock that humans do."
Gunderson, Donald. The Rockfish's Warning. Seattle, WA: University Bookstore Press, 2011. p. 138.

Setline survey

Design and procedures

The 2011 Standardized Stock Assessment (SSA) Survey design encompassed both nearshore and offshore waters coastwide from Oregon to the Bering Sea. The area was divided into 28 regions, each requiring between 15 and 38 charter days to complete. Commercial vessels and crews were hired to conduct the fishing and on-board IPHC biologists carried out the scientific sampling. The eleven vessels (seven Canadian and four from the United States) completed a combined 73 trips and 694 charter days to fish 1,314 stations (out of 1,315 possible stations). Stations (the location at which the survey longlines were dropped) were located at the intersections of a 10x10 nautical mile grid within the depth range occupied by Pacific halibut during summer months (20 to 275 fathoms in most areas). Also included in southeast Alaska for the past several years were extra survey stations that did not follow the standard grid pattern, due to the intricate inlet and island structure of the area. As in years past, the data from these stations were not used for stock assessment.

The survey gear and sampling procedures were standardized for all 1,315 stations coastwide, and haven't changed since 1998. Gear 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. All hooks were baited with 0.25 to 0.33 pound pieces of Alaska Seafood Marketing Institute grade (ASMI) No. 2 semi-bright A-to-E chum salmon. Each vessel set one to four stations daily beginning at 5:00 a.m. local time, and soaked the gear at least five hours before hauling it in. Vessels avoided soaking the gear at night when possible. Data from gear soaked longer than 24 hours were not used for assessment purposes. Sets were considered not usable for stock assessment if the predetermined limits for lost gear, snarls, predation, or displacement from predetermined station coordinates were exceeded.

The fork lengths of all halibut captured were recorded to the nearest centimeter, and were converted to an estimated weight using a standard formula (the formula can be found in the 1992 IPHC Scientific Report No. 75), which was then used to generate the WPUE data. Average 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.

Area 2A survey expansion

In an experiment for 2011, the IPHC setline survey was expanded by 52 stations in Area 2A both in geographic range and in depth (now from 10 to 400 fathoms), going from 84 stations in 2010 to 136 total stations. WPUE has become increasingly important as an index of biomass distribution when the

The survey area off of Oregon and Washington was expanded in 2011 to include a greater depth range and areas previously not surveyed.

Sea sampler, Greg Riepma, along with *F/V Predator* crew members, Patrick Lane and Greg Bottjen, during the 2011 setline survey. Photo by Cal Blood.

coastwide exploitable biomass of halibut is apportioned among the regulatory areas, and inaccurate WPUEs can lead to inaccurate catch limits. The expansion was done because Area 2A historically had the least precise WPUE estimates of all the regulatory areas, and more stations would lead to more accurate WPUE estimates.

The expansion of survey area meant not only more stations off the coasts of Oregon and Washington, but also placement of stations in the Salish Sea (including the Strait of Juan de Fuca and Puget Sound). Special care was taken to limit impacts on endangered and threatened species in the Salish Sea, such as orca whales, Steller sea lions, yelloweye rockfish, and canary rockfish. Although accuracy was improved, it is important to note that there was no intention of using the new deep and shallow stations for stock assessment and apportionment in 2011, because no other regulatory area had a similar expansion and because they did not considerably change the outcome.

The IPHC surveyed the Salish Sea for the first time in 2011 on a trial basis, taking special care to minimize impacts.

Almost no halibut were caught at the stations between 275 and 400 fathoms. The overall WPUE for the 84 existing stations was 26.6 pounds/skate. Counting all effective stations (134 area wide), the WPUE decreased to 22.4 pounds/skate. Considering the expanded number of stations (106) within the 20 to 275 fathom zone, the WPUE increased to 27.0 pounds/skate. The expansion was considered a success, as variance in Area 2A now more closely resembles Areas 4A and 4B. There is no longer a need to make the previous survey grid any denser, as was being considered prior to the expansion that was implemented.

Sampling protocols

IPHC sea samplers collected data according to the protocols established in both the survey manual and the bycatch sampling manual. As gear was set to soak, they evaluated the performance of the bird avoidance devices and recorded the exact number of hook sets and baits lost per skate. As gear was retrieved, they recorded the hook status (empty, returned bait, species captured) generally of only the first 20 consecutive hooks of each skate (with occasional exceptions to record all hooks), along with length and skate number. The survey vessel crew then dressed each O32 halibut and passed it along to the IPHC sampler, who collected various data from it, including sex, maturity, prior-hooking injury assessment, and evidence of depredation, finishing with removal of otoliths for further study.

Samplers assessed whether male halibut were mature or immature, and whether females were immature, mature, spawning, or spent/resting. The sex and maturity level of U32 halibut was recorded only if that fish was randomly selected for otolith removal. Those not selected were measured and released alive. Prior-hooking injuries were recorded for all measured halibut. At the end of each haul, samplers recorded the presence and abundance of seabirds within a 50-meter radius of the vessel's stern.

Sampling protocols also included special projects, bait purchases, fish sales and field personnel, which are covered in the following pages.

Special projects

Along with catching and counting Pacific halibut at survey grid stations, the IPHC was tasked with special projects that looked at a variety of things. The projects included data collection on rockfish, spiny dogfish, Pacific cod, environmental contamination, marine mammal depredation, seabird occurrence,

oceanography, *Ichthyophonus* infection, and halibut tagging. The last three projects on the list are discussed in the Research chapter of this report. The others are described below.

Rockfish sampling Regulatory Area 2A

IPHC samplers retained all rockfish caught in Area 2A, marked them with a tag and recorded the station and skate of capture. After the fish were offloaded, state biologists from WDFW and ODFW collected additional data (such as sex, weight, length, and maturity) and biological material such as otoliths from each fish.

Rockfish sampling in Regulatory Area 2B

IPHC samplers, in cooperation with DFO, worked aboard two boats to record round weight, round length, sex, and maturity, and to take otoliths from all rockfish species taken as bycatch during the survey in waters off British Columbia. In this continuing project, they sampled 2,541 rockfish in 2011 (representing 16 different species), and took otoliths from 2,304 of them. The data and otoliths were shared with DFO.

IPHC often works with other agencies to provide data on subjects of interest.

Yelloweye rockfish enumeration in Alaska

IPHC samplers worked aboard six boats in 2011 to record the capture of all yelloweye rockfish encountered by survey vessels in Area 2C and in the Fairweather charter region of Area 3A. A total of 1,250 yelloweye rockfish were recorded, with all associated data sent to ADF&G for analysis.

Spiny dogfish sampling

As the first part of a two-year project requested by NMFS, IPHC samplers recorded the length and sex of 2,841 spiny dogfish captured in 2011 (specifically the first three from each set in Area 2B, and the first five from each set in all other regulatory areas). Data from the project will be compared with that collected on NMFS longline surveys from 2011, both to examine species distribution and to test a theory that there are two stocks of dogfish in Alaskan waters—an inside population in Southeast Alaska and those that live in coastal waters elsewhere. This data will be used to develop a length-based population dynamics model for the annual dogfish stock assessment.

Pacific cod length frequencies and photos of Pacific lamprey wounds

The Alaska Fisheries Science Center (a research branch of NMFS) requested data from the IPHC regarding Pacific cod captured on IPHC surveys. The data, when combined with current NMFS data, were used in a continuing study to assess the stock of Bering Sea and Aleutian Islands Pacific cod. In 2011, samplers aboard the *F/V Kema Sue* collected 4,102 Pacific cod lengths for this study.

Along with length measurements, 217 digital photographs of lamprey wounds on Pacific cod were taken. A student at the University of Alaska Fairbanks is conducting a study of Pacific lamprey and fishery interaction.

Environmental contaminant sampling

IPHC samplers collected flesh samples from halibut caught on survey as an ongoing project with the Alaska Department of Environmental Conservation

(ADEC) to study environmental contaminants in Alaskan fish. The samples were part of a larger study involving thirteen fish species and numerous environmental contaminants. The goal was to collect samples from four size categories. There were 139 samples collected in all—74 from the Yakutat/Fairweather region, 49 from the Portlock region and 16 from the St. Matthew region.

Marine mammal depredation tracking

Marine mammals such as orca whales, sperm whales, seals, and sea lions target Pacific halibut. Halibut caught by the commercial fishery are especially vulnerable to predation, since they are unable to escape once hooked on the gear. In 2011, IPHC samplers were tasked with recording all damaged and missing hooks during gear retrieval, to establish a baseline rate of gear damage against which stations with suspected depredation problems could be compared. Damaged gear and partial halibut carcasses are thought to be due to orcas, while the much larger sperm whales are thought to be responsible for missing gear predominantly, as they take the fish (and gear) whole. In the study, if samplers observed toothed whales, seals, or sea lions within 100 meters of a survey vessel, they identified the species of predator, how many there were, their position relative to the boat, the hook number at the first and last sighting, and how long the encounter lasted.

In 2011, marine mammals approached charter vessels during gear retrieval on 65 stations. Twenty-two of these encounters (34%) involved either sperm whales or orca whales.

Washington Sea Grant-sponsored research identifies and addresses important marine issues, provides better tools for management of the marine environment and use of its resources, and initiates and supports strategic partnerships within the marine community.

Seabird occurrence

The IPHC (in collaboration with Washington Sea Grant) began collecting seabird occurrence data along with the 2002 NMFS sablefish survey. The purpose of the project was to assemble a seabird database that could be analyzed for

Orca whales, sperm whales, and other marine mammals will sometimes eat fish directly from the longline. Here an Orca is spotted off the bow of a survey vessel. Photo credit: IPHC archive.

population purposes, and to take part in the process regulating seabird avoidance requirements for commercial fishing vessels. 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.

This juvenile short-tailed albatross was seen in British Columbian waters in 2011. Photo by Levy Boitor.

In 2011, a total of 57,448 seabirds were observed in 1,284 separate counts during survey fishing operations. There were 21 unique species observed, though the most commonly observed bird was the northern fulmar, counted 41,784 times (73%). After the fulmar, the glaucous-winged gull was next most common (12%), followed by the black-footed albatross (8%). The endangered short-tailed albatross—which is more commonly a Western Pacific bird—was counted 204 times in 2011. And unusually, two of these rare birds were seen in Washington waters and one was seen off of British Columbia.

Twenty-one different species of sea-birds were observed during the survey.

Fish sales

O32 Pacific halibut caught by survey vessels—and sacrificed for their otoliths and other biological information—were retained and sold in 24 different ports in 2011 to offset costs of the survey program. Ten percent of the halibut proceeds were shared with the charter vessels, to supplement the lump sum charter fees. Survey vessels also kept rockfish and Pacific cod that were caught as bycatch, because their swim bladders were typically irreversibly damaged as they were pulled to the surface. The IPHC did not keep any of the proceeds from selling the latter two species. Instead, proceeds are split between the survey vessel and requisite agency.

Survey results

The IPHC targeted the months of June through August for survey fishing. Only 61 stations (amounting to less than 5% of the total) were fished outside this window. The greatest number of stations was fished in June (with the week of June 5 to 11 being the busiest). Coastwide, survey activity tapered off by the end of August.

The SSA survey covered both commercial and non-commercial fishing grounds, so the average WPUE for all regulatory areas was below that of the

commercial fleet. Coastwide, the average WPUE was 59.8 pounds per skate. The average WPUE figures for the regulatory areas were: Area 2A (27 pounds/skate), Area 2B (80 pounds/skate), Area 2C (132 pounds/skate), Area 3A (121 pounds/skate), Area 3B (80 pounds/skate), Area 4A (58 pounds/skate), Area 4B (68 pounds/skate), Area 4C (51 pounds/skate) and Area 4D (31 pounds/skate).

Although weight is the governing unit of measure when studying population and removals, the number of halibut is also a useful measure. The NPUE for O32 halibut has trended slightly downward in the past decade (at just over four halibut/skate), while the NPUE for U32 halibut has gone up slightly (to just under six halibut/skate) during the same period. This indicates that the numbers of large fish are declining, while the numbers of small fish are increasing.

Nearly 55% of the halibut caught were shorter than 32 inches, with a median length of 80 cm (31.5 inches) coastwide. Area 3B had the greatest proportion of these. The largest median lengths occurred in Areas 4B (90 cm) and 2A (89 cm). In 2011, the median lengths increased in Areas 2A, 2B, and 2C, and decreased in Areas 4C and 4D. There was no change in Areas 3A, 3B, 4A, and 4B.

An otolith *is a flattened oval-shaped bone found in the head of a Pacific halibut. The concentric rings in the otolith are examined to determine the age of the fish.*

The sex composition of the 2011 survey catch varied noticeably by regulatory area. Coastwide, females were caught 63% of the time. In fact, more females than males were caught in every regulatory area except 4B, where females made up only 40% of the catch. Females made up 71% of the catch in Area 2A, 73% in Area 2B, 74% in Area 2C, 65% in Area 3A, 60% in Area 3B, 56% in Area 4A, 73% in Area 4C and 56% in Area 4D. Most females caught in the summer survey months were ripening, and expected to spawn in the upcoming season.

A key part of the survey operations was the removal and analysis of halibut otoliths. A total of 14,780 otoliths were obtained for age determination for stock assessment. Of these, 14,451 were aged, with the remainder crystallized or otherwise not readable. The otoliths collected and used for age determination were stored in a glycerin/thymol solution to better reveal the readability of the concentric rings. Additional otoliths were collected on surveys for a "clean otolith archive", in which they were merely cleaned, dried and stored in climate-controlled conditions for future analysis. The latter will be discussed in more detail in the Research chapter of this report.

Bycatch

Approximately 111 species of fish and invertebrates were caught as bycatch during the survey. Special precautions were taken to prevent the capture of birds or marine mammals, with the result that no birds were taken and only one harbor seal was caught (in Area 2A). Coastwide, the most frequently caught bycatch species was the Pacific cod, followed by the spiny dogfish. Dogfish were the most commonly caught shark species in Areas 2A (97%), 2B (99.9%), 2C (96%), and 3A (97%). Sleeper sharks were the most common in Areas 3B (53%), 4A (69%), and 4D (80%). Sixgill sharks were a common bycatch in southern Puget Sound.

Age distribution

In 2011, the most commonly occurring year class was 1999, with 2,134 (14.7%) twelve-year-olds caught. Next most common were the years 2000 and 1999, with 2,026 (14.0%) and 1,847 (12.8%) fish caught, respectively. The oldest halibut caught in the survey was a 51-year-old female from Area 4B that had a fork length of 159 cm. The youngest halibut, at four years of age, were a

female from Area 3B with a fork length of 51 cm, and a male from Area 4C with a fork length of 68 cm. The largest halibut was a 39-year-old female caught in Area 4B with a fork length of 200 cm. The smallest was a six-year-old female from Area 4C measuring 42 cm in length.

Bait comparison study

The IPHC uses standardized bait in all of its survey operations to remove bait as a variable. The problem is that the chosen bait—#2 semi-bright, ASMI grade chum salmon—is getting both more expensive and less available. So a pilot study was conducted in August 2011 that compared the standard survey bait of chum salmon with three alternative baits. One goal of this study was to determine the variability of catch rates among the four baits used. Another was to select one of two competing study designs. The results were to be used to design a more comprehensive bait study for 2012.

Everything is standardized on the survey down to the type and grade of bait. Unfortunately, that bait is becoming increasingly expensive, leading the IPHC to look at alternatives.

Besides chum salmon, the other three baits chosen were pink salmon, pollock, and herring. Two regions in Area 3A—the Fairweather region and the Albatross region—were chosen, and two study designs were tested. Design 1 used a randomized block design where all four baits were placed in a random order on a single set. Design 2 used only one type of bait on each set, with sets placed far enough apart that there would be little interaction between them.

In the Albatross region, the gear was fished in depths between 35 and 92 fathoms, and caught 1,309 O32 halibut (with an estimated weight of 22,237 pounds) and 1,517 U32 halibut. The Fairweather region was fished in depths between 52 and 125 fathoms. Survey vessels caught 1,191 O32 halibut (with an estimated weight of 24,967 pounds) and 876 U32 halibut.

Chopping bait on the setline survey. Photo by Colleen Duifhuis.

Design 1 was far more cost effective, using only one-fourth of the sets required by Design 2, and likely to be the method used in the 2012 study. Pollock performed the best in Design 1, with a WPUE significantly greater than that of the chum salmon. Chum salmon performed better in Design 2. For both designs, pollock caught the greatest amount of both O32 and U32 halibut. Herring performed the worst among the baits, both for being less effective for catching fish and for being most likely to fall off the gear. All three of the alternative baits were better than chum salmon at avoiding common bycatch such as spiny dogfish and Pacific cod.

Trawl surveys

Two NMFS cruises took place this year in which IPHC participated: the Bering Sea shelf bottom trawl survey, and the Gulf of Alaska bottom trawl survey. While the setline survey targets adult and older juvenile halibut, the trawl survey tends to catch halibut as young as two years old, but also misses the older fish that are larger in size (>100 cm fork length). Both surveys seem to do an adequate job of catching halibut that are about 60-90 cm in length.

NMFS Bering Sea trawl survey

The IPHC participated in the NMFS annual Bering Sea trawl survey for the 14th straight year (since 1998). The survey was a continuation of a time series started in 1982. Two chartered fishing vessels (the *F/V Alaska Knight* and the *F/V Aldebaran*) were each staffed with six scientific crewmembers. An IPHC biologist was aboard the *F/V Alaska Knight* for the entire survey.

The NMFS Bering Sea shelf survey includes the "flats", an area not surveyed by IPHC due to the high cost of doing so.

The IPHC objective was to sample 100% of the halibut caught on the IPHC-staffed vessel for length, gender, maturity, and prior hooking injuries, along with the collection of otoliths. Supplementing this was the collection of a small sample of “clean otoliths” for the clean otolith archive collection (described in further detail in the Research chapter of this report). The NMFS objectives were to survey crab and groundfish.

The standard survey consisted of 376 stations north and west of the Alaska Peninsula and Bristol Bay, encompassing both the Pribilof Islands and St. Matthews Island. It used a 20x20 nautical mile grid, in depths ranging from 30 to 200 meters (5 to 40 fathoms). Halibut were sampled for length on all standard tows on both vessels. The halibut on the *F/V Alaska Knight* were also sampled for gender, maturity, prior hooking injuries and otoliths. For the latter, 196 tows were conducted (183 standard tows, six crab tows, six exploratory near-shore tows and one gear test tow), In total, 1,664 halibut (805 female and 859 male) were captured and sampled. In addition, 97 otolith pairs were collected for the clean otolith collective.

Abundance estimates and age

In most years, the NMFS trawl survey is the only measure of abundance for much of the Bering Sea, as the IPHC doesn’t have the financial resources to sample the area in its entirety. Estimates of relative abundance are derived by expanding the survey catches from the area swept by the trawl to the total survey area. It’s important to note the distinction between estimates of abundance which are numbers of animals and biomass which is pounds. Total halibut abundance

Biologists sort through the catch aboard the NMFS trawl survey. Photo credit: Paul Logan.

for the area was estimated to be 96 million fish in 2011, which continued a downward trend from a high of 134 million fish in 2006.

Back in 2006, two-year-olds (from the year class of 2004) were the most abundant year class. This continued to hold true in 2010, with just over 30% (484 fish) of the total catch (1,706 fish) from that year class. The 2005 year class, although smaller than the 2004, has also been a strong contributor to the juvenile halibut catch. Although the large numbers are reminiscent of the large year classes of 1987 and 1988, the size at age today is much smaller than 20 years ago, which could lower the contributions these fish make to the commercial fishery.

The trawl surveys tend to catch smaller and younger fish than the setline survey, providing a glimpse of what's to come in the commercial halibut fishery.

NMFS Gulf of Alaska trawl survey

The IPHC has taken part in the NMFS Gulf of Alaska bottom trawl surveys since 1996, but the series began in 1984. The survey focused on groundfish and invertebrates, gathering data on their distribution, abundance, and biological condition. Two fishing vessels—the *F/V Ocean Explorer* and the *F/V Sea Storm*—each carried a scientific crew of six as well as a professional fishing crew and captain. The two vessels conducted four survey trips between May 22 and August 14 at depths between 15 and 700 meters (approximately 2.5 to 116 fathoms). The survey area ranged from the Islands of Four Mountains (in the Aleutians just southwest of the Alaskan Peninsula) eastward along the continental shelf to Dixon Entrance (just west of Prince Rupert, BC). This area was divided into 59 strata (based on depth, major geographic features, and statistical areas), and overlaid with a 5x5 square kilometer grid. At least two samples were required from each stratum.

The IPHC sampler stationed aboard the *F/V Ocean Explorer* was tasked with collecting Pacific halibut data and assisting the scientific crew in attaining

their survey goals. All halibut caught by the *F/V Ocean Explorer* were eligible to be sampled for length, gender, maturity and prior hooking injuries, with a goal of 100% sampling. Otoliths were also collected for the clean otolith archive. On the other vessel, all halibut caught were measured and released alive, if possible.

The *F/V Ocean Explorer* conducted 355 tows over the course of the survey, with 334 of them considered suitable for abundance estimation. The stations ranged in depth from 28 to 668 meters (approximately 5 to 111 fathoms). A total of 3,545 halibut were caught and measured for fork length, of which 3,076 were sampled for sex and otoliths. Females numbered 1,290 (42%) and males numbered 1,786 (58%). The most abundant length category (15% of the halibut) were 45 to 49 cm. Of the caught females, 10.2% were coded as mature. For the males, 99.2% were coded as mature. Average size at age for both males and females has steadily dropped in recent years.

Abundance and age

Along with more general survey data discussed in the previous section, abundance and age composition data (from collected otoliths) were also gathered. Relative abundance estimates were then calculated. This was accomplished by calculating a mean density of halibut for each survey stratum, multiplying that mean density by the stratum area, and summing the values across all the strata. This process is described more fully in IPHC Technical Report 37, published in 1997.

The NMFS abundance estimate of 136 million fish in 2011, was substantially lower than the 2009 estimate of 243 million fish.

The abundance estimate for the Gulf of Alaska in 2011 was 136 million halibut, considerably less than the 243 million estimated in 2009. It is not yet clear how much of the decline in halibut numbers may be real and how much is survey variability. Of the 3,277 halibut sampled in the 2009 survey, a large proportion of them—633 (18.9%) and 532 (16.0%)—were from the 2005 and 2004 year classes, respectively.

This halibut has a healed injury that removed part of its jaw. Photo by Levy Boitor.

Prior hook injuries

Prior hook injuries (PHIs) are defined as injuries that appear to have occurred when fish were released during a previous capture by hook-and-line gear. The IPHC is concerned with PHIs because they are evidence carried by survivors of rough handling, and past studies have shown that moderate to severe injuries often kill fish. That raises the unanswerable question: "How many halibut did not survive past encounters with fishers, of which there is no evidence?"

All halibut captured during 2011 survey operations—approximately

76,950 fish caught on 7,631 survey skates—were examined for evidence of prior hook injuries. Additionally, IPHC samplers aboard NMFS trawl survey vessels in the Bering Sea also examined halibut for PHIs. In total, 6,270 (8.3%) coastwide were found to have PHIs. This was a slight reduction from the 8.7% rate in 2010 and the 9.0% rate in 2009. In 2011, PHIs increased in Areas 2A, 3A, 3B, 4A (Bering Sea) and 4C. They decreased in Areas 2B, 2C, 4A (Aleutians), 4B, and 4D. Area 4D was most problematic, with an overall PHI rate of 25.8%, and a U32 PHI rate of 18.8% (compared to the coastwide rate of 5.9%). The IPHC can't say for certain why Area 4D has such high rates of prior hook injuries, but it is most likely due to the groundfish fisheries for Pacific cod. In the NMFS trawl surveys, 1,664 Bering Sea halibut were examined and 3,076 Gulf of Alaska halibut were examined. Both regions showed a PHI rate of 3.3%.

The area with the highest rate of previous hooking injuries in halibut was Area 4D in the Bering Sea.

There are no simple fixes for the problem of prior hook injuries. Fisher education programs in the past decade may have stabilized or slightly reduced the size of the problem.

SCIENTIFIC RESEARCH

If the heart and soul of the IPHC's operations is quantifying the biomass of Pacific halibut, biological research would have to be at least a strong leg to stand upon. Research subjects change from year to year but add to the general knowledge needed to fully understand the fish and the fishery. In 2011, this research included oceanographic monitoring, tagging studies, the prevalence of the marine parasite *Ichthyophonus*, a re-evaluation of the length-weight relationship in halibut, and the new clean otolith archive collection.

Oceanographic monitoring

The profiler data provide both a snapshot of summer environmental conditions on the north Pacific continental shelf as well as a look at the conditions experienced directly by the fishes on the survey gear.

The IPHC continued its annual oceanographic profiler project in 2011 from southern Oregon northward into the Bering Sea. Conducted in concert with the stock assessment survey since 2009, each profile is essentially a snapshot of a column of seawater at a specific place and time, measuring depth, temperature, salinity, dissolved oxygen, pH, and chlorophyll *a* concentrations. Measurements are taken at each survey station just prior to hauling so the environmental data collected is directly applicable to the animals on the gear. A total of eleven fishing vessels were chartered to complete the survey and each was supplied with a profiling unit, a laptop computer and accessory gear. Out of a possible 1,315 stations coastwide, 91% provided useable data. New in 2011, fifteen stations in the Salish Sea (Puget Sound and the Strait of Juan de Fuca) were surveyed.

Crystal Peterson prepares the seacat for another launch on the *F/V Star Wars II* during the IPHC survey. Photo by Levy Boitor.

Two problems arose with this year's deployment of profilers. First, one unit was lost off of the south side of

Adak Island due to strong currents parting its connector line to the survey vessel. A $1,500 reward was announced for the successful return of the profiler to the IPHC as well as for the one lost off Kodiak Island in 2009 (more information on page 82 of this report). The second problem was depth related. Profiler sensors are rated to function as deep as 1000 meters (approximately 547 fathoms), which includes all defined halibut habitat. Unfortunately, the floats currently used to keep the instrument from impacting the bottom have a shallower maximum depth. This limited some deep-water readings off the coast of Washington and Oregon to 500 meters.

A primary goal of the oceanographic monitoring project is to make the data gathered available worldwide. With that in mind, the IPHC is working with the University of Washington's Joint Institute for the Study of the Atmosphere and Ocean (JISAO), and NOAA's Pacific Marine Environmental Laboratory to process and post the oceanographic data. Both the 2009 and 2010 data have been posted for public use and the 2011 data is scheduled to become available in summer 2012 at:

http://www.ecofoci.noaa.gov/projects/IPHC/efoci_IPHCData.shtml

Tagging studies

The IPHC has been tagging Pacific halibut since 1925. The types of tags used and the experiments they are connected to vary widely, so every year there are a hodgepodge of recoveries from previous releases. In 2011, 28 tags were recaptured from IPHC tagging experiments, along with 20 tags from non IPHC sport tagging programs.

Tags are recovered each year from a variety of projects. If you come across a tag, see the reward information in this report.

Recoveries

Wire tags

In 2010 the IPHC tagged 773 halibut with plastic-coated wire tags around their dark-side preopercular bone (behind the mouth and above the gills) and released them in the Aleutian Islands as part of a study to define active spawning periods and to examine their migration. In 2011, ten of these tags (13 total to date) were recovered. Separately, one wire tag from a 1995 trawl mortality study was also recovered, which makes 178 recovered out of the 4,852 released.

Passive integrated transponder (PIT) tags

In 2003 and 2004 the IPHC conducted a large scale experiment in which PIT tags were implanted into halibut. In the 2003 group, 43,999 fish were tagged and released coastwide, and in the 2004 group, 23,437 fish were tagged and released in Areas 2B and 3A. PIT tags were implanted near the corner of the jaw on the white side of the halibut's head and because they were implanted internally, they are not visible. The scanning project ended in 2009, but one PIT tag from the 2004 release was found in 2011 in a processing plant where halibut were being cheeked.

In 2003 the IPHC launched an experiment where 2,661 halibut were double-tagged, with both an external wire tag (on the dark-side operculum) and an internal PIT tag (over the white-side interopercular bone), and released in Hecate Strait, BC. Three of these double tags were recovered in 2011, bringing the total

recovered to 726. Since 2003, fifteen PIT tags have been shed and two were broken (for a shedding/breakage rate of 2.4%), and 40 wire tags were shed (for a shedding rate of 6%).

Pop-up satellite transmitting archival (PAT) tags

In 2009 the IPHC conducted an experiment studying the dispersal of halibut from the Bering Sea. Seventeen fish were implanted with PAT tags. In 2010 the first of these tags became damaged and failed to pop up after it released from the fish.

Two other PAT tag leaders were recovered in 2011. The first was from the 2008 Bering Sea dispersal experiment (similar to the 2009 experiment, but with 115 releases), bringing that total recovery number to four. The second PAT tag leader was unidentifiable. Finally, one satellite body that had previously detached and popped up washed ashore in the Aleutian Islands.

Archival & dummy archival tags

In 2009 the IPHC conducted an experiment where 200 halibut were double tagged—with a wire tag and a dummy archival tag—and released in Area 3A. In 2011, nine of these fish were recovered, five with external dummy tags and four with internal dummy tags, which brings the total to 36 recovered.

Sport tags

The IPHC regularly supplies tags for the Homer Jackpot Halibut Derby that takes place between May and September of every year. In 2011 it supplied 101 tags, of which nine were recovered in the Derby. Additionally, eleven older derby tags were recovered: 2003 (1), 2005 (1), 2008 (1), 2009 (2) and 2010 (6).

Rogue tags

Over the past decade there has been occasional unauthorized tagging of live Pacific halibut in waters off Washington and Alaska by various individuals or groups. The IPHC, ADF&G, and NOAA have contacted them to request that they desist, and most have complied. However, one rogue tag was recovered in 2011 from a commercial delivery to southeast Alaska, and a second was recovered on an IPHC survey trip in Area 3A.

Tag releases

The IPHC tagged 30 halibut in 2011 with geomagnetic-sensing archival tags, and released them into Areas 2C and 3A. Two tag models were used: one that attached externally to the dorsal musculature, and another that was implanted internally into the coelomic cavity. Twenty-six fish were tagged with both types; four were tagged only with the external tag.

Thirty tags were released in 2011 as part of the geomagnetic archival tag project.

External archival tagging project

In the ten years that the IPHC has been implanting electronic archival tags on halibut, large and cumbersome tags with limited battery life have given way to smaller tags that can operate for more than five years on a single charge. Although this sounds like great news, it has raised a new, more complicated

challenge: how to keep a tag on a fish for a period of years without it falling off or being absorbed into the halibut's body.

Since the IPHC began implanting archival tags it has tried to find an optimum method that not only meets its scientific information needs, but also doesn't impact the health, mobility, and behavior of the tagged fish. For instance, PAT tags are not useful for more than one year at a time, as batteries wear out, and their size prevents deployment on any but relatively large halibut. In order to fully understand halibut movement, behavior and population structure, the IPHC is attempting to expand its electronic archival tagging program to include smaller fish, and longer periods of observation for individual fish. The program's goals include quantifying how far halibut migrate between summer and winter, identifying spawning grounds in poorly studied areas such as the Bering Sea, examining the loyalty of halibut to various basins from year to year, defining when halibut migrate and at what depths they live in different seasons, and identifying when halibut spawn in different regions by studying how they move vertically in the water column.

Proper placement of the tags is crucial to realizing the ultimate goals of the project.

A laboratory holding study that began in 2009 and continued in 2011 analyzed ten tagging methods that might meet the IPHC's need for information and the halibuts' need for health and mobility. In November 2009, five tagging methods were employed, including intracoelomic implantation, external attachment to the dorsal musculature with three different tags, and perpendicular attachment to the operculum. In 2011, another five tagging methods were added. These included parallel attachment to the operculum, external attachment to the dorsal musculature with two different tags, and two different tags embedded in the dorsal musculature. All fish were studied in captivity at the Oregon Coast Aquarium in Newport, Oregon.

IPHC scientist, Tim Loher, uses an ultrasound to detect the sex of the fish about to be tagged and released. Photo by Andy Vatter.

Results to date

All the tagged halibut were examined and observed at regular intervals after tagging. These occurred at weeks 0 (initial tagging in November 2009), 2, 5, 13, 22, 32, 44, 54, 69, 77 and 89. Observations are expected to continue at 12-to-16 week intervals throughout 2012. The initial five treatments were started in November 2009. The "parallel attachment to the operculum" treatment began in week 69 (February 2011), and the other four treatments began in week 77 (April 2011).

Since the program began, two fish have died—one from the 2009 intracoelomic implantation group died in week 6 from suture failure, and one control (untagged) fish died from unknown causes in week 48. Persistent sores and irritation have been observed in four treatments: intracoelomic implantation, external attachment to the dorsal musculature, and the two opercular attachment configurations. Tag shedding has been observed in three methods (two through-body dorsal attachments and one perpendicular opercular attachment). One method has already been abandoned: the 2009 external attachment to the dorsal musculature using a through-body cradle. Up to now, no behavioral differences have been noted between the various tagging groups. Behavioral data will be statistically analyzed at the end of the experiment. No single method has yet been identified as the best future option.

Geomagnetic-sensing electronic archival tagging project

Although not part of the original plan when the archival tag study began, geomagnetic tags show great promise in recording a fish's daily activity.

Recent developments in tagging technology have enabled the development of tags that can record the Earth's magnetic field strength on three axes, along with pitch and roll motion sensors. Theoretically, this means tags that can identify—along with the usual temperature, depth, and light levels—a fish's location in latitude and longitude on a daily basis.

With this potential in mind, and in order to evaluate current tag performance and to facilitate future improvements, the IPHC tagged 30 halibut in August 2011 with tags from two different companies. The two tags were the Desert Star LLC SeaTag GEO (the "SeaTag"), and the Lotek Wireless LAT2310M (the "LAT2310M"). Fifteen fish were tagged in Area 2C, off southern Prince of Wales Island, and fifteen were tagged in Area 3A, off Kodiak Island. These areas were chosen both for the orientation of the coastline and for proximity to the IPHC summer setline survey. In Area 2C, eleven fish were tagged with both the SeaTag and the LAT2310M; four were tagged only with the SeaTag. In Area 3A, all fifteen fish carried both tags.

All tags carried both an identification number and return address information (including a $500 reward for the return of each tag). As this project has just begun, no results have yet been recorded.

Ichthyophonus prevalence in Pacific halibut

Ichthyophonus is a marine parasite that has been identified in over 80 species of fish worldwide. In some species, such as the Atlantic herring, it is believed to be responsible for six massive die-offs over the last 100 years. In other species, the effects may include mortality, reduced swimming performance, and energy consumption and growth. It is not yet known if or how it affects

humans. However, it does cause visible tainting of the flesh, which may become a problem for commercial fisheries.

Ichthyophonus was first identified in the northeast Pacific in 1986, and since then its reported host range has expanded dramatically. It is ubiquitous in Pacific herring stocks south of the Bering Sea and is believed to have affected populations in Prince William Sound and Puget Sound. Significant numbers of Yukon River Chinook salmon have recently died from *Ichthyophonus* infections prior to spawning.

Where does that leave Pacific halibut? The IPHC set out to answer that question in 2011 with a pilot study to determine its prevalence in Pacific halibut from three geographically distinct areas: the northern Bering Sea, Prince William Sound (Alaska), and the Oregon coast. These areas were chosen both for their distance from each other, as well as for being known Pacific herring habitat.

The prevalence of the marine parasite Ichthyophonus in Prince William Sound Pacific halibut is high enough for it to be considered "epizootic." This means that new cases of it appear in the halibut population at a rate that is substantially greater relative to the background levels elsewhere.

Ichthyophonus prevalence results

A total of 190 halibut samples were collected in the three areas, of which 85 (44.7%) were infected. The highest infection rate came from Prince William Sound, where 46 out of 60 fish were infected, a 76.7% infection rate. The Oregon Coast was next in prevalence. Of the 65 fish sampled there, 22 were infected (33.8%). As expected, the Bering Sea had the lowest infection rate. Of the 65 samples tested, 17 came back positive for *Ichthyophonus* (26.2%). Although there was a tendency for more females to be infected, this may be due to the fishing gear being more selective for larger females. Age or size didn't appear to matter in the pilot study. It is important to note that there is no historical data on *Ichthyophonus* infection in Pacific halibut—whether it is a new phenomenon or a long-standing one. The IPHC also doesn't yet know its health effects on individual halibut, or its effects on the population as a whole. What is known is that *Ichthyophonus* in halibut will be investigated further in the coming years.

Length-weight relationship in Pacific halibut

When halibut are caught by commercial or survey fishing vessels, they are not weighed. Instead, they are measured for length, and their weight is obtained later from a formula that was derived in 1926, based on fish caught in Masset, Canada (a city on the north coast of Gwai Hanas (Graham Island), just west of Prince Rupert). This length-weight ratio is a critical part of the IPHC's operations, including the stock assessment process, the setting of harvest policies, and the eventual allocation of catch to the regulatory areas. But it never hurts to check back once in a while.

A revisit of the subject in 1989 ended up revalidating the 1926 length-weight formula. Despite that revalidation, IPHC staff noticed discrepancies in length and weight from the 1926 formula, especially in Alaskan ports. Revisiting that question was at the heart of this 2011 trial, which re-evaluated the length-weight relationship of halibut and compared it to the length-weight relationship from the 1989 study.

In the trial, an IPHC-chartered commercial fishing vessel caught 193 Pacific halibut from 32 survey stations just south of Seward (Alaska) in June 2011. The captured halibut were dressed (gills and all internal organs removed), measured for fork length and tagged for later identification. They were separated into three

classes: under 80 cm, between 80 and 110 cm, and over 110 cm. The halibut were then laid in ice and brought into port (Seward in early June and Kodiak in mid-June) for further measurement. Once in port, the fish were weighed (head-on, dressed, including ice and slime).

In order to compare the 2011 halibut raw weight to the 1989 net weight, net weight was first determined. The raw weight of each fish was multiplied by 0.88 (to account for the weight of the head, and ice and slime) to get net weight. Then both the samples were plugged into a dataset to generate a 2011 length-weight equation. The 2011 equation was: $W_N = (9.321x10^{-6}) L^{3.16}$. Superficially, this differed from the 1989 equation of $W_N = (1.290x10^{-5}) L^{3.11}$, and the 1926 equation of $W_N = (6.921x10^{-6}) L^{3.24}$. More importantly, the 2011 length-weight equation differed substantially from both the 1989 and 1926 equations. For example, plugging an 82-centimeter fish into each formula, it should weigh 10.99 pounds (1926 formula), 11.55 pounds (1989 formula) or 10.40 pounds (2011 formula). Smaller fish produced a greater difference between 2011 and 1989, while larger fish produced a greater difference between 2011 and 1926.

The length weight relationship in halibut is revisited periodically to ensure accuracy in the assumptions made for the stock assessment.

What does this mean? First of all, it means that the length-weight relationship of halibut caught in the Gulf of Alaska does not identically match the length-weight relationship assumed for the coastwide stock assessment. More importantly, it also means that the standard method used to assess halibut length and weight coastwide (the 1926 equation) may need to be revisited. Finally, it may mean that if there are regional differences in the length-weight relationship (a possibility not studied in this trial), regions may have to develop unique length-weight equations to more accurately assess their halibut stock. What effect this will have on the overall stock assessment and quota allocation has not yet been determined.

Clean otolith archive collection

As was mentioned in the Survey chapter of this report, the IPHC began collecting “clean” otoliths in 2010. Otoliths measure not only time (age), but also the elemental environment in which the fish lived. Recent otolith research has begun to analyze the trace elements within the otolith—such as magnesium, calcium, strontium, barium and manganese—to better understand the life of the halibut. When “standard” otoliths are stored, a glycerin/thymol solution is used to increase readability. Unfortunately, it also contaminates them, preventing an effective trace analysis.

The clean otolith archive collection (COAC) takes otoliths from all IPHC otolith collections, in pairs. This includes those from the SSA survey, the commercial port collection (CPC), the NMFS trawl surveys and any special charter that sacrifices halibut for research. These otoliths will not be used for current age determination, but will be stored carefully in climate-controlled conditions for future analysis. The goal is to collect 100 otolith pairs from each regulatory area each year, ideally capturing sex and exact capture location. In cases where otolith sampling is already at 100% (and more are not available for the COAC), clean otoliths may be collected from commercial deliveries.

COAC results

The total number of clean otoliths collected from the SSA was 479 in 2011 and 623 in 2010. The Commercial Port Collection program added 197 otoliths. These came from commercial deliveries that originated in regulatory areas that were not sampled in the SSA. The regulatory areas were 2A (Newport, Oregon, specifically), and 4C and 4D (St. Paul, Alaska).

The NMFS surveys contributed 219 otoliths (from the Gulf of Alaska and the Bering Sea). Most of these halibut were small in size and not represented in the SSA and CPC collections. Although samplers on board the survey vessels collected most otoliths, some whole halibut were frozen and shipped back to the IPHC offices for otolith removal in a clean lab environment.

Finally, in 2011, samplers were deployed on several commercial halibut vessels during commercial trips in Areas 2B, 3B, 4A, and 4D to collect otoliths and tissue samples for genetic analysis. Paired otoliths from 1,370 fish were collected dry and shipped back to the IPHC office. Once there, the left otoliths were placed in glycerin/thymol for aging, and the right ones were added to the COAC.

The clean otolith archive is an effort to supply future scientists with the means to look back at the generations we're working with today.

Photo by Paul Logan.

APPENDICES

The tables in Appendix I provide catch information for the 2011 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 2011 total removals (thousands of pounds, net weight), 2011 catch limits and catch of Pacific halibut by IPHC regulatory area, and 2011 sport guideline harvest level and sport guided harvest for Areas 2C and 3A.

Table 2. The 2011 Area 2B catch limits as allocated by the Canadian Department of Fisheries and Oceans and estimated catches (thousands of pounds, net weight).

Table 3. The Area 2A 2011 catch limits allocated by the Pacific Fishery Management Council Catch Sharing Plan and catch estimates (pounds, net weight).

Table 4. The total catch (thousands of pounds, net weight) of Pacific halibut from the 2011 commercial fishery, including IPHC research catch, by regulatory area and month.

Table 5. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2011 commercial fishery for Area 2B, Alaska, and the Alaskan regulatory areas.

Table 6. Commercial fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by IPHC regulatory area for the 2011 Pacific halibut commercial fishery.

Table 7. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality; and IPHC research catch for 2011.

Table 8. Commercial halibut catch (thousands of pounds, net weight) in 2011 by statistical area[1] and regulatory area.

Table 9. The fishing period limit (pounds, net weight) by vessel class used in the 2011 directed commercial fishery in Area 2A.

Table 10. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2011.

Appendix II.

Appendix I.

Table 1. The 2011 total removals (thousands of pounds, net weight), 2011 catch limits and catch of Pacific halibut by IPHC regulatory area, and 2011 sport guideline harvest level and sport guided harvest for Areas 2C and 3A.

Area	2A	2B	2C	3A	3B	4	Total
Commercial	524	6,612	2,363	14,379	7,218	7,751	38,847
Sport	386	1,220	1,313	4,541	25	18	7,503
Bycatch Mortality:							
O32 fish	106	152	214	1,035	430	2,107	4,044
U32 fish	34	145	127	1,863	755	3,028	5,952
Breakdown of U32							
U32/O26	31	122	88	846	402	1,037	2,526
U26 fish	3	23	39	1,017	353	1,991	3,426
Personal Use[1]	25[2]	405	425	313	23	54[3]	1,245
Wastage Mortality:							
O32 fish	4	27	5	29	7	32	104
U32 fish	6	177	65	881	752	332	2,213
Breakdown of U32							
U32/O26	6	173	61	840	678	293	2,051
U26 fish	0	4	4	41	74	39	162
IPHC Research	17	80	91	290	103	83	664
Total Removals	1,102	8,818	4,603	23,331	9,313	13,405	60,572
2011 Catch Limits[4]	910[5]	7,650[6]	2,330	14,360	7,510	8,310	41,070
2011 Catch	935[5]	7,832[6]	2,363	14,379	7,218	7,751	40,478
2011 Sport GHL			788	3,650			NA
2011 guided harvest			388	2,837			NA

[1] Includes 2010 Alaskan subsistence harvest estimates.
[2] Treaty Indian ceremonial and subsistence catch.
[3] Includes 17,000 pounds of sublegal halibut retained in the 2011 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.
[6] Includes commercial and sport catch.

Appendix I.

Table 2. The 2011 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	6,702.2[1]	6,612.0
Sport fishery[2]	947.8	1,220.0
Total allocation/catch	7,650.0	7,832.0
IPHC research catch		80.0
Total	7,650.0	7,912.0

[1] Adjustments totaling -32,000 pounds were made to the commercial fishery catch limit which included carryover from the previous year's underage/overage plan and quota held by DFO for First Nations through relinquishment processes.

[2] An experimental permit program was implemented in 2011 which allowed sport operators to lease quota from commercial operators. Details on the amount leased were not available at time of writing.

Table 3. The Area 2A 2011 catch limits allocated by the Pacific Fishery Management Council Catch Sharing Plan and catch estimates (pounds, net weight).

Area	Catch Limit	Catch
Non-treaty directed commercial	159,380	171,665
Non-treaty incidental commercial during salmon troll fishery	28,126	23,351
Treaty Indian commercial	293,200	328,711
Treaty Indian ceremonial and subsistence	25,300	24,500
Sport – Washington	216,489	202,354
Sport – Oregon/California	187,506	183,226
Total allocation	910,000	933,807
IPHC research catch		17,546
Total	910,000	951,353

Appendix I.

Table 4. The total catch (thousands of pounds, net weight) of Pacific halibut from the 2011 commercial fishery, including IPHC research catch, by regulatory area and month.

	March	April	May	June	July	August	September	October	November	GrandTotal
2A[1]	212		140	75	105	8	1	-	-	541
2B	1,046	772	622	499	731	1,020	453	993	556	6,692
2C	328	349	476	357	180	309	241	159	55	2,454
3A	1,653	2,011	2,971	2,238	1,477	1,601	1,523	1,004	191	14,669
3B	138	379	1,320	1,379	974	1,541	867	575	148	7,321
4A[2]		58	415	263	332	748	268	243	24	2,351
4B[3]		74	348	348	426	325	324	162	47	2,054
4C[4]	-	-	-	157	378	174	39	42		790
4D	-	-	290	453	235	382	324	405	93	2,182
4E	-	-	8	147	219	30	43	10	-	457
AlaskaTotal	2,119	2,871	5,828	5,342	4,221	5,110	3,629	2,600	558	32,278
GrandTotal	3,377	3,643	6,590	5,916	5,057	6,138	4,083	3,593	1,114	39,511

For confidentiality:

[1]Area 2A catch in April was combined with May

[2]Area 4A catch in March was combined with April

[3]Area 4B catch in March was combined with April

[4]Area 4C catch in November was combined with October

Appendix I.

Table 5. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2011 commercial fishery for Area 2B, Alaska, and the Alaskan regulatory areas.

Overall Vessel Length	Area 2B No. of Vessels	Area 2B Catch (000's lbs.)	Alaska No. of Vessels	Alaska Catch (000's lbs.)
Unk. Length	13	467	66	471
0 to 25 ft.[1]			234	329
26 to 30 ft.[1]			116	623
31 to 35 ft.[1]	12	214	195	3,158
36 to 40 ft.	25	689	128	1,137
41 to 45 ft.	34	838	140	2,509
46 to 50 ft.	28	1,228	133	2,974
51 to 55 ft.	23	1,337	60	1,775
56 + ft.	34	1,919	252	19,302
Total	169	6,692	1,324	32,278

Overall Vessel Length	Area 2C No. of Vessels	Area 2C Catch (000's lbs.)	Area 3A No. of Vessels	Area 3A Catch (000's lbs.)
Unk. Length	52	78	8	139
0 to 25 ft.	49	53	24	43
26 to 30 ft.	37	101	25	76
31 to 35 ft.	88	316	83	1,560
36 to 40 ft.	71	239	58	682
41 to 45 ft.	74	283	69	1,480
46 to 50 ft.	78	424	70	1,259
51 to 55 ft.	37	280	35	934
56 + ft.	100	680	189	8,496
Total	586	2,454	561	14,669

Overall Vessel Length	Area 3B No. of Vessels	Area 3B Catch (000's lbs.)	Area4 No. of Vessels	Area4 Catch (000's lbs.)
Unk. Length	3	54	5	200
0 to 25 ft.[2]			161	233
26 to 30 ft.	0	0	56	446
31 to 35 ft.[2]	34	530	32	752
36 to 40 ft.	18	147	4	69
41 to 45 ft.	32	524	5	222
46 to 50 ft.	34	730	10	561
51 to 55 ft.	13	330	6	231
56 + ft.	136	5,006	66	5,120
Total	270	7,321	345	7,834

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 31 to 35 ft. vessels

Table 5. continued

Overall Vessel Length	Area 2A Directed Commercial		Area 2A Incidental Commercial (Salmon)	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	0	0.0	0	0.0
0 to 25 ft.[1,2]				
26 to 30 ft.[1,2]	5	0.5	8	0.8
31 to 35 ft.	6	5.8	9	0.7
36 to 40 ft.	12	24.3	12	0.7
41 to 45 ft.	12	28.6	28	9.9
46 to 50 ft.	22	41.7	22	9.6
51 to 55 ft.	8	9.9	5	1.7
56 + ft.	11	60.9	0	0.0
Total	76	171.7	84	23.4

[1] Vessels 0 to 25 ft. in the Area 2A Directed Commercial fishery were combined with 26 to 30 ft. vessels.
[2] Vessels 0 to 25 ft. in the Area 2A Incidental (Salmon) fishery were combined with 26 to 30 ft. vessels.

Appendix I.

Table 6. Commercial fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by IPHC regulatory area for the 2011 Pacific halibut commercial fishery.

Area 2A	Fishing Period	Catch Limit	No. of Days	Commercial Catch	Research Catch	Total Catch
Treaty Indian	Unrestricted:					
	3/20 –22		48-hours	148.7		
	5/1 – 2		19-hours	117.0		265.7
	Restricted:					
	3/12-19, 3/24-28		13 days	63.0		63.0
Total		293.2		328.7		328.7
Commercial						
Incidental in	5/1 – 5/28	28.1	28 days	22.8		
Salmon Fishery	7/29 – 10/31		95 days	0.6		
Total				23.4		23.4
Directed[1]	6/29		10-hours	92.4		
	7/13		10-hours	79.3		
Directed Total		159.4		171.7		171.7
2A Total		480.7		524	17	541

Area	Fishing Period	Catch Limit	Adjusted Catch Limit[2]	Commercial Catch	Research Catch	Total Catch
2B	3/12 – 11/18	6,702.2	6,670	6,612[3]	80	6,692
2C	3/12 – 11/18	2,330.0	2,407	2,363[4]	91	2,454
3A	3/12 – 11/18	14,360.0	14,505	14,379	290	14,669
3B	3/12 – 11/18	7,510.0	7,615	7,218	103	7,321
4A	3/12 – 11/18	2,410.0	2,450	2,316	35	2,351
4B	3/12 – 11/18	2,180.0	2,268	2,022	32	2,054
4C	3/12 – 11/18	1,690.0	1,723	784[5]	6	790
4D	3/12 – 11/18	1,690.0	1,715	2,172[5, 6]	10	2,182
4E	3/12 – 11/18	340.0	340	457[6]	0	457
Alaska Total		32,510.0	33,023	31,711	567	32,278
Grand Total		**39,692.9**	**40,173.7[7]**	**38,847**	**664**	**39,511**

[1] Fishing period limits by vessel class.

[2] Includes adjustments from the underage/overage programs. Additionally, in 2B, quota held by DFO for First Nations through relinquishment processes are included.

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

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

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

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

[7] Includes Area 2A catch limit.

Appendix I.

Table 7. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality; and IPHC research catch for 2011.

IPHC Group	Canada	United States	IPHC Research	Grand Total
CA & OR	-	155	11	166
Bellingham/Seattle	-	732	6	738
WA	-	256	1	257
Vancouver	400	-	-	400
Port Hardy	3,129	-	28	3,157
Southern BC	373	-	8	381
Prince Rupert & Port Ed.	2,468	-	117	2,585
Northern BC	242	-	-	242
Ketchikan, Craig, Metlakatla	-	292	15	307
Petersburg, Kake	-	926	8	934
Juneau	-	1,070	11	1,081
Sitka	-	1,302	25	1,327
Southeast AK	-	613	-	613
Cordova	-	879	-	879
Seward	-	3,503	78	3,581
Homer	-	5,641	45	5,686
Kenai	-	56	-	56
Kodiak	-	5,556	84	5,640
Central AK	-	3,867	138	4,005
Akutan & Dutch Harbor	-	4,195	78	4,273
Bering Sea	-	3,192	11	3,203
Grand Total	6,612	32,235	664	39,511

Appendix I.

Table 8. Commercial halibut catch (thousands of pounds, net weight) in 2011 by statistical area[1] and regulatory area.

Stat Area	Catch			Regulatory Area	Catch for Reg Area
	Commercial	Research	Total		
08-09	13	1	14	2A	541
10	48	3	51		
20	82	4	86		
30	12	1	13		
40	47	2	49		
50	322	6	328		
60	133	3	136	2B	6,692
61	28	0	28		
70	139	5	144		
80	154	2	156		
81	15	0	15		
90	183	3	186		
91	389	8	397		
92	118	0	118		
100	580	1	581		
102	1,285	22	1,307		
103	19	0	19		
110	29	1	30		
112	970	15	985		
114	52	0	52		
120	134	0	134		
121	260	4	264		
122	40	0	40		
130	443	6	449		
131	776	2	778		
132	279	4	283		
133	175	2	177		
134	45	1	46		
135	366	1	367		
140	21	13	34	2C	2,454
141	14	7	21		
142	65	9	74		
143	110	3	113		
144	14	0	14		
150	148	13	161		
151	106	8	114		
152	180	3	183		
153	36	2	38		
160	329	9	338		
161	132	3	135		
162	316	4	320		
163	62	3	65		
170	142	3	145		
171	112	2	114		
173	56	2	58		
174	33	0	33		
181	212	4	216		
182	145	1	146		
183	54	2	56		
184	76	0	76		

Appendix I.

Table 8. continued.

185	846	32	878		
190	703	20	723		
200	767	12	779		
210	741	6	747		
220	876	10	886		
230	368	11	379		
232	59	1	60		
240	2,017	18	2,035	3A	14,669
242	143	4	147		
250	2,578	36	2,614		
260	1,921	41	1,962		
261	590	12	602		
270	1,300	42	1,342		
271	250	11	261		
280	1,069	27	1,096		
281	151	7	158		
290	2,658	21	2,679		
300	1,229	23	1,252		
310	624	18	642	3B	7,321
320	1,509	14	1,523		
330	812	19	831		
340	386	8	394		
350	209	6	215		
360	259	1	260		
370	92	3	95		
380	116	5	121		
390/395	40	1	41		
400	199	1	200	4	7,834
410	36	2	38		
420	29	1	30		
430	58	2	60		
440	168	2	170		
450	205	10	215		
BeringSea	6,340	49	6,389		
GrandTotal	38,847	664	39,511		39,511

[1] Statistical areas as defined in IPHC Technical Report No. 49

Appendix I.

Table 9. The fishing period limit (pounds, net weight) by vessel class used in the 2011 directed commercial fishery in Area 2A.

Vessel Class		Fishing Period & Limits	
Letter	**Feet**	**June 29**	**July 13**
A	0-25	840	420
B	26-30	1,050	525
C	31-35	1,680	840
D	36-40	4,630	2,315
E	41-45	4,980	2,490
F	46-50	5,960	2,980
G	51-55	6,650	3,325
H	56+	10,000	5,000

Table 10. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2011.

Fishing Period Dates	Number of Vessels	Catch (Pounds)
April 15 – 17	8	4,259
April 29 – May 1	9	3,881
May 13 – 15	12	5,181
May 27 – 29	16	10,643
June 10 – 12	14	5,157
June 24 – 26	11	5,225
July 8 – 10	8	3,828
July 22 – 24	7	2,039
August 5 – 7	9	4,205
August 19 – 21	6	2,633
September 2 – 4	9	5,578
September 16 – 18	11	5,443
September 30 – October 2	7	3,875
13 Fishing Periods		61,947

Appendix II.

Table 1. Harvest of Pacific halibut by sport fishers (millions of pounds, net weight) by IPHC regulatory area, 1977-2011. Estimates for 2011 are preliminary.

Year	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	Total
1977	0.013	0.008	0.072	0.196	-	-	0.289
1978	0.010	0.004	0.082	0.282	-	-	0.378
1979	0.015	0.009	0.174	0.365	-	-	0.563
1980	0.019	0.006	0.332	0.488	-	-	0.845
1981	0.019	0.012	0.318	0.751	-	0.012	1.112
1982	0.050	0.033	0.489	0.716	-	0.011	1.299
1983	0.063	0.052	0.553	0.945	-	0.003	1.616
1984	0.118	0.062	0.621	1.026	-	0.013	1.840
1985	0.193	0.262	0.682	1.210	-	0.008	2.355
1986	0.333	0.186	0.730	1.908	-	0.020	3.177
1987	0.446	0.264	0.780	1.989	-	0.030	3.509
1988	0.249	0.252	1.076	3.264	-	0.036	4.877
1989	0.327	0.318	1.559	3.005	-	0.024	5.233
1990	0.197	0.381	1.330	3.638	-	0.040	5.586
1991	0.158	0.292	1.654	4.264	0.014	0.127	6.509
1992	0.250	0.290	1.668	3.899	0.029	0.043	6.179
1993	0.246	0.328	1.811	5.265	0.018	0.057	7.725
1994	0.186	0.328	2.001	4.487	0.021	0.042	7.065
1995	0.236	0.887	1.751	4.511	0.022	0.055	7.462
1996	0.229	0.887	2.129	4.740	0.021	0.077	8.083
1997	0.355	0.887	2.172	5.514	0.028	0.069	9.025
1998	0.383	0.887	2.501	4.702	0.017	0.096	8.586
1999	0.338	0.859	1.843	4.228	0.017	0.094	7.379
2000	0.344	1.021	2.251	5.305	0.015	0.073	9.009
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	0.481	1.536	3.264	5.320	0.026	0.040	10.667
2009	0.458	1.098	2.383	4.758	0.030	0.024	8.751
2010	0.373	1.133	1.971	4.285	0.024	0.016	7.802
2011	0.386	1.220	1.313	4.541	0.025	0.018	7.503

Appendix II.

Table 2. Summary of the 2011 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 5 – 21	3 (Thurs – Sat)	9	1
	May 26 – 29	4 (Thurs – Sun)	4	1
Low Point to Sekiu River	May 26 – 29	4 (Thurs – Sun)	4	1
	Jun 2 – 18	3 (Thurs – Sat)	9	1
WA North Coast (Sekiu Rvr to Queets Rvr)	May 12 – 21	2 (Thurs, Sat)	4	1
	Jun 2, 4, 16, 30	2 (Thurs, Sat)	4	1
WA South Coast (Queets Rvr to Leadbetter Pt.)				
All depths	May 1 – 22	2 (Sun, Tues)	7	1
Northern nearshore	May 2 – May 21	5 (Mn, Wd – Sa)	15	1
	May 23 – Jul 24	7 (Mon – Sun)	33	1
Columbia River (Leadbetter Pt. to Cape Falcon)	May 5 – Jun 4	3 (Thurs – Sat)	15	1
	Aug 5 – Sep 30	3 (Fri – Sun)	57	1
OR Central Coast (Cape Falcon - Humbug Mtn.)				
All Depths	May 13 – Jun 25	3 (Thurs - Sat)[a]	14	1
	Aug 5 – 6	2 (Fri – Sat)	2	1
Less than 40 fathoms	May 1 – Jul 6	7 (Sun – Sat)	37	1
	Aug 13 – Oct 31	7 (Sun – Sat)	80	1
OR/CA (South of Humbug Mtn.)	May 1 – Oct 31	7 (Sun – Sat)	184	1
Area 2B - British Columbia	Mar 1 – Sep 5	7 (Sun – Sat)	188	1
Area 2C - Alaska				
Guided anglers	Feb 1 – Dec 31	7 (Sun – Sat)	334	1[b]
Unguided anglers	Feb 1 – Dec 31	7 (Sun – Sat)	334	2
Areas 3 and 4 - Alaska	Feb 1 – Dec 31	7 (Sun – Sat)	334	2

[a]Fishing was prohibited during May 19 – 21.

[b]A maximum size limit of 37 inches (fork length) was in effect in 2011.

Appendix II.

Table 3. 2011 IPHC Area 2A sport harvest allocations and preliminary catch estimates (pounds, net weight) by Catch Sharing Plan subarea.

Subarea	Allocation	Estimate	Pounds Over/(Under)	Percent Taken
WA Inside Waters	58,155	45,856	(12,299)	78.9
WA North Coast	108,792	103,741	(5,051)	95.4
WA South Coast	43,500	45,100	1,600	103.7
Columbia River	15,418	11,279	(4,139)	73.2
OR Central Coast	172,505	169,956	(2,549)	98.5
South OR/California	5,625	9,648	4,023	171.5
Total	403,995	385,580	(18,415)	95.4

Table 4. Estimated harvest by the private (unguided) and charter (guided) sport halibut fisheries (millions of pounds, net weight) in IPHC Areas 2C and 3A, 2000–2011. Also shown are the Guideline Harvest Level (GHL) applicable to the guided fishery. Harvest estimates for 2011 are preliminary.

	Area 2C				Area 3A			
Year	Private	Charter	Total	GHL	Private	Charter	Total	GHL
2000	1.126	1.132	2.258	-	2.165	3.14	5.305	-
2001	0.723	1.202	1.925	-	1.543	3.133	4.676	-
2002	0.814	1.275	2.089	-	1.478	2.733	4.211	-
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	1.123	1.245	2.368	0.788	2.023	2.734	4.758	3.650
2010	0.885	1.086	1.971	0.788	1.587	2.698	4.285	3.650
2011	0.925	0.388	1.313	0.788	1.704	2.837	4.541	3.650

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 2010 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.

2011 Research publications

Erikson, L. M. and Kong, T. M. 2011. Changes in commercial catch sampling for Pacific halibut 1994 to 2009. Int. Pac. Halibut Comm. Tech. Rep. 54. 35 p.

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Gilroy, H. L., Kong, T. M., and MacTavish, K. A. 2011. Regulations and management decisions of the Pacific halibut fisheries, 1993-2009. Int. Pac. Halibut Comm. Tech. Rep. 55. 112 p.

Kaimmer, S. M. 2011. Special setline experiments 1985-1994 objectives, data formats, and collections. Int. Pac. Halibut Comm. Tech. Rep. 53. 33 p.

Loher, T. 2011. Analysis of match–mismatch between commercial fishing periods and spawning ecology of Pacific halibut (Hippoglossus stenolepis), based on winter surveys and behavioural data from electronic archival tags. ICES J. Mar. Sci. 68(10):2240-2251.

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Seitz, A. C., Loher, T., Norcross, B. L., Nielsen, J. L. 2011. Dispersal and behavior of Pacific halibut Hippoglossus stenolepis in the Bering Sea and Aleutian Islands region. Aquat. Biol. 12: 225–239. doi: 10.3354/ab00333

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1. Report of the International Fisheries Commission appointed under the Northern Pacific Halibut Treaty. John Pease Babcock, William A. Found, Miller Freeman, and Henry O' Malley. 31 p. (1931).[Out of print]
2. Life history of the Pacific halibut. Marking experiments. William F. Thompson and William C. Herrington. 137 p. (1930).
3. Determination of the chlorinity of ocean waters. Thomas G. Thompson and Richard Van Cleve. 14 p. (1930).
4. Hydrographic sections and calculated currents in the Gulf of Alaska, 1927 and 1928. George F. McEwen, Thomas G. Thompson, and Richard Van Cleve. 36 p. (1930).
5. History of the Pacific halibut fishery. William F. Thompson and Norman L. Freeman. 61 p. (1930).
6. Biological statistics of the Pacific halibut fishery. Changes in the yield of a standardized unit of gear. William F. Thompson, Harry A. Dunlop, and F. Heward Bell. 108 p. (1930). [Out of print]
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8. Biological statistics of the Pacific halibut fishery, Effects of changes in intensity upon total yield and yield per unit of gear. William F. Thompson and F. Heward Bell. 49 p. (1934). [Out of print]
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10. Hydrographic sections and calculated currents in the Gulf of Alaska. 1929. Thomas G. Thompson, George F. McEwen, and Richard Van Cleve. 32 p. (1936).
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14. Regulation and investigation of the Pacific halibut fishery in 1948 (Annual Report). IFC. 30 p. (1949).
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24. Regulation and investigation of the Pacific halibut fishery in 1955 (Annual Report). IPHC 15 p. (1956).

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42. Mortality estimates from tagging experiments on Pacific halibut. Richard J. Myhre. 43 p. (1967).
43. Growth of Pacific halibut. G. Morris Southward. 40 p. (1967).
44. Regulation and investigation of the Pacific halibut fishery in 1966 (Annual Report). IPHC 24 p. (1967).
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54. A reassessment of effort in the halibut fishery. Bernard E. Skud. 11 p. (1972).
55. Minimum size and optimum age of entry for Pacific halibut. Richard J. Myhre. 15 p. (1974).
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60. The incidental catch of halibut by foreign trawlers. Stephen H. Hoag and Robert R. French. 24 p. (1976).
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62. Distribution and abundance of juvenile halibut in the southeastern Bering Sea. E.A. Best. 23 p. (1977).
63. Drift, migration, and intermingling of Pacific halibut stocks. Bernard Einar Skud. 42 p. (1977).
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65. Abundance and fishing mortality of Pacific halibut, cohort analysis, 1935-1976. Stephen H. Hoag and Ronald J. McNaughton, 45 p. (1978).
66. Relation of fecundity to long-term changes in growth, abundance and recruitment. Cyreis C. Schmitt and Bernard E. Skud. 31 p. (1978).
67. The Pacific halibut resource and fishery in regulatory Area 2; I. Management and biology. Stephen H. Hoag, Richard J. Myhre, Gilbert St-Pierre, and Donald A. McCaughran. II. Estimates of biomass, surplus production, and reproductive value. Richard B. Deriso and Terrance J. Quinn, II. 89 p. (1983).
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81. Microsatellite screening in Pacific halibut (Hippoglossus stenolepis) and a preliminary examination of population structure based on observed DNA variation. Lorenz Hauser, Ingrid Spies, and Timothy Loher. 28 p. (2006).
82. Seasonal migration and environmental conditions experienced by Pacific halibut in the Gulf of Alaska, elucidated from Pop-up Archival Transmitting (PAT) tags [Appendices included in attached compact disk]. Timothy Loher and Andrew Seitz. 40 p. (2006).
83. Assessment and management of Pacific halibut: data, methods, and policy. William G. Clark and Steven R. Hare. 104 p. (2006).
84. Seasonal movements and environmental conditions experienced by Pacific halibut in the Bering Sea, examined by pop-up satellite tags. Andrew C. Seitz, Timothy Loher, Jennifer L. Nielsen. (2007).
85. Seasonal movements and environmental conditions experienced by Pacific halibut along the Aleutian Islands, examined by pop-up satellite tags. Andrew C. Seitz, Timothy Loher, and Jennifer L. Nielsen. 24 p. (2008).

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4. Relationship of halibut stocks in Bering Sea as indicated by age and size composition. William H. Hardman. 11 p. (1969).
5. Recruitment investigations: Trawl catch records Gulf of Alaska, 1968 and 1969. Edward A. Best. 48 p. (1969).
6. The Pacific halibut. F. Heward Bell and Gilbert St-Pierre. 24 p. (1970). [Out of print]
7. Recruitment investigations: Trawl catch records Eastern Bering Sea, 1963, 1965,and 1966. Edward A. Best. 52 p. (1970).
8. The size, age and sex composition of North American setline catches of halibut (*Hippoglossus stenolepis*) in Bering Sea, 1964-1970. William H. Hardman. 31 p. (1970).
9. Laboratory observations on early development of the Pacific halibut. C.R. Forrester and D.G. Alderdice. 13 p. (1973).
10. Otolith length and fish length of Pacific halibut. G. Morris Southward and William H. Hardman. 10 p. (1973).
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13. The sport fishery for halibut: Development, recognition and regulation. Bernard Einar Skud. 19 p. (1975).
14. The Pacific halibut fishery: Catch, effort, and CPUE, 1929-1975. Richard J. Myhre, Gordon J. Peltonen, Gilbert St-Pierre, Bernard E. Skud, and Raymond E. Walden, 94 p. (1977).
15. Regulations of the Pacific halibut fishery, 1924-1976. Bernard E. Skud. 47 p. (1977).
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18. Halibut assessment data: Setline surveys in the north Pacific Ocean, 1963-1966 and 1976-1979. Stephen H. Hoag, Gregg H. Williams, Richard J. Myhre, and Ian R. McGregor. 42 p. (1980).
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35. Evaluation of two methods to determine maturity of Pacific halibut. Cyreis C. Schmitt and Gilbert St-Pierre. 24 p. (1997).
36. Bottom area estimates of habitat for Pacific halibut. Stephen H. Hoag, Gilbert St-Pierre, and Joan E. Forsberg. 28 p. (1997).
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38. Age dependent tag recovery analyses of Pacific halibut data. Kenneth H. Pollock, Heidi Chen, Cavell Brownie, and William L. Kendall. 32 p. (1998).
39. Specific dynamics of Pacific halibut: A key to reduce bycatch in the groundfish fisheries. Sara A. Adlerstein and Robert J. Trumble. 94 p. (1998).
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42. A review of IPHC catch sampling for age and size composition from 1935 through 1999, including estimates for the years 1963-1990. William G. Clark, Bernard A. Vienneau, Calvin L. Blood, and Joan E. Forsberg. 40 p. (2000).
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44. Chalky halibut investigations, 1997 to 1999. Stephen M. Kaimmer. 24 p. (2000).
45. A study of the dynamics of a small fishing ground in British Columbia. Tracee Geernaert and Robert J. Trumble. 20 p. (2000).
46. Aging manual for Pacific Halibut: procedures and methods used at the International Pacific Halibut Commission (IPHC). Joan E. Forsberg. 56 p. (2001).
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51. A pilot study to evaluate the use of electronic monitoring on a Bering Sea groundfish factory trawler. Howard I. McElderry, Rhonda D. Reidy, and Dale F. Pahti. 29 p. (2008).
52. Diet of Pacific halibut (Hippoglossus stenolepis) in the northwestern Pacific Ocean. I. N. Moukhametov, A. M. Orlov, and B. M. Leaman. 24 p. (2008).
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Other Publications

Miscellaneous

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 it is also 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

Bulletins and news releases are periodically issued to disseminate important information in a timely manner. They can be accessed on the IPHC website.

You caught a tagged halibut
Now what?

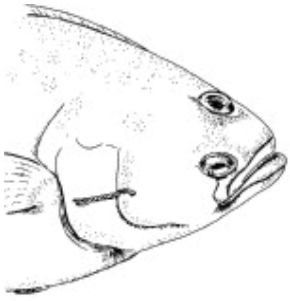
Fishers should retain all tagged halibut regardless of gear type used, time of year caught, size of halibut, or type of tag!

Instructions

1. Leave the tag on the fish until landed.
2. Notify the IPHC office or local port sampler for further instructions.

Traditional wire tags

- Threaded through the operculum (cheek area) on the dark side of the body.
- The usual reward is $5 cash or an IPHC tag hat for each tag returned.
- Some wire tags are worth $100 or $200 and these have the reward printed on the tag.



Spaghetti tags

- Plastic spaghetti tags were used in the voluntary sport charter-boat tagging program from the 1990s. Tags were attached to either a plastic or stainless steel dart and inserted either in the back of the fish (plastic darts) or the cheek on the dark side (stainless steel dart). Recoveries of this tag type are not very common since releases occurred quite some time ago.

Pop-up archival transmitting tags

- Attached near the dorsal by a metal dart and leader.
- Rewards: $500 for tag body*, $50 for the leader and metal dart tag only, $5 or tag hat for leader only.

*Note that these tags may be found attached to a halibut, free floating, or washed ashore.

Electronic archival tags

- Attached near the dorsal via a plastic "cradle" and wires.
- $500 reward for the return of the tag body.

"Dummy" archival tags

- Fish has both a pink wire tag in the cheek and either an internal or external dummy archival tag.
- Internal "gut" tags have the tag body inside the abdominal cavity with the stalk protruding outside the fish. (below, top)
- Externally mounted tags are attached near the dorsal. (below, bottom)
- $100 reward for the return of the archival tag body.
- $100 reward for the return of the pink wire tag (reward printed on tag).

$500 REWARD for tags from double-tagged halibut

- **External (backpack) tag**
- **Stalk from gut tag**

The IPHC has double-tagged 30 halibut in Regulatory Areas 3A and 2C with a combination of external electronic “backpack tags” and electronic internal “gut tags”. The IPHC is asking harvesters to look for tagged halibut, bearing in mind that each fish should carry two tags.

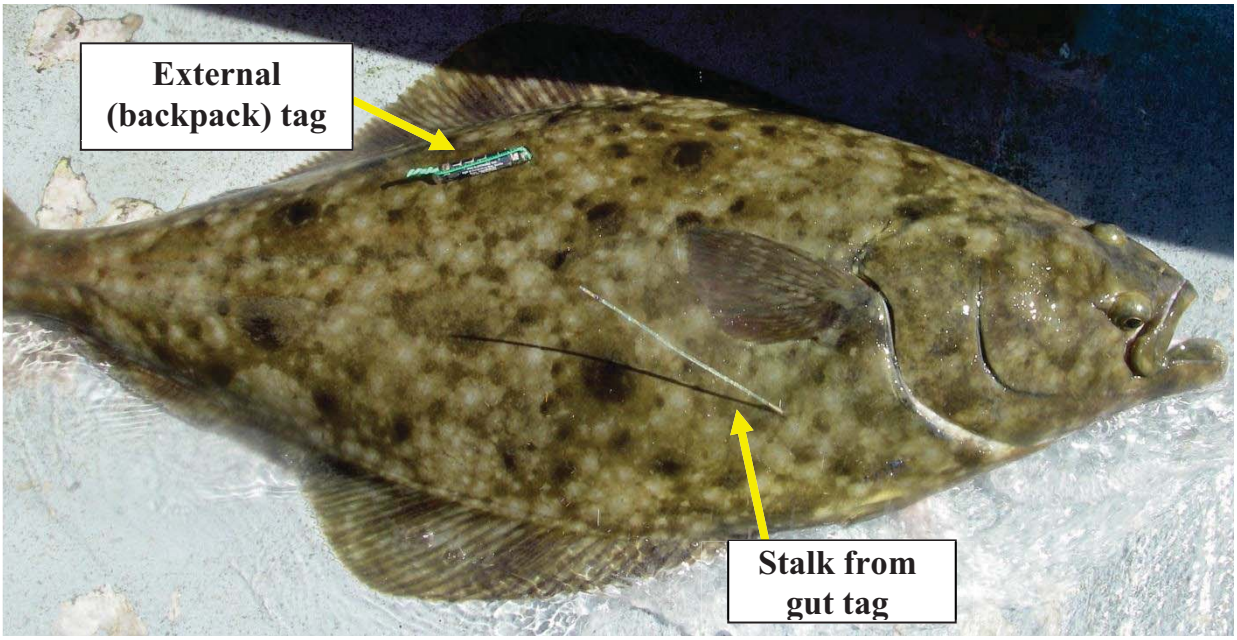
What’s this study about?

The study looks at whether geomagnetism can be used as a means of tracking halibut migrations. The tags are capable of recording the local magnetic field in ways that can be converted into location estimates.

Tag descriptions:

1) The backpack is a black plastic cylinder that measures ~3” (7.6 cm) long by ½” (1.2 cm) in diameter, and is attached to the dark side of the fish, below the dorsal fin, using a green-coated tagging wire, with a white backing plate that rests on the underside of the fish.
2) Gut tags are surgically implanted in the gut cavity, but have a translucent green stalk that protrudes from the belly on the fish’s dark side (see picture below). The stalk contains sensors that record ambient light levels. Note that, over time, gut tags can become “encapsulated” by the intestines, making them difficult to find without the stalk.

- Two different tags that are each worth $500 so keep and return both tags.
- One tag is a black plastic cylinder with tagging wire and backing plate.
- One tag is internal but has a translucent green stalk protruding from the belly.
- Tags are on the dark side of the halibut.
- Tagged halibut can be retained regardless of the fishery (see the poster on the previous page for more instructions).
- Contact the IPHC if you find any tagged halibut.

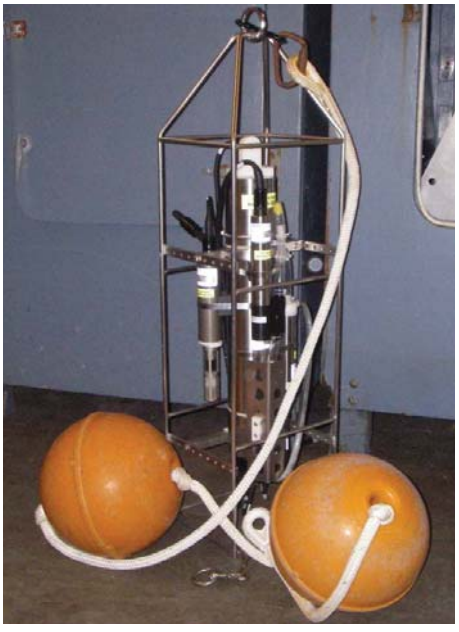


$1500 Reward

For the Recovery and Return of Oceanographic Research Equipment

In 2009, the International Pacific Halibut Commission (IPHC) launched a program to collect oceanographic data alongside survey fishing data to better understand halibut distributions and abundance in relation to climate. Since then, oceanographic profilers have been routinely launched from the decks of the survey boats and safely retrieved. However, in two cases, the profilers were not retrieved safely and remain on the fishing grounds. The instruments, or profilers, weigh about 60 pounds each and are housed inside a steel cage that measures approximately 11" width x 9" depth x 42" height (see figure below). **The IPHC is offering a $1500 reward each for the retrieval and return of the missing instruments.**

Missing Profiler One. A profiler was lost on July 30, 2009 off the east side of Kodiak Island at 56°49.95N latitude and 153°09.12W longitude in about 45 fathoms of water. When lost, the profiling instrument had a 40 pound anchor attached to the bottom and no floats attached on top. The profiler is thought to be sitting hard on bottom and may be snagged by fishing or other gear.



Sea-bird profiling instrument and floats used for IPHC research.

Missing Profiler Two. The second profiler was lost June 11, 2011 on the south side of Adak Island at coordinates 51°29.785N latitude and 176°53.543W longitude in about 247 fathoms of water and moderate currents. When lost, the instrument had a 60 pound weight attached to the bottom via 15 m of buoy line, and orange hardball floats attached to the top. If the anchor/float assembly is intact, the floats will have suspended the profiler approximately 15 m off bottom. The instrument is attached to the anchor line via a weak link that is designed to pull loose if forced, sending the instrument and float configuration to the surface. It may be possible to snag the assembly with fishing or other gear.

A reward of $1500 is offered for each of these instruments if recovered either alone, or with supplemental gear (anchor and/or floats) attached. No reward is offered for floats and anchor only.

If found, please contact Lauri Sadorus (x7677) or Michael Larsen (x7671) at the IPHC (206-634-1838).

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