ISSN: 0074-7238

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report
2009

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

This report produced by IPHC staff
and Hal Geiger
2010

International Pacific Halibut Commission
P.O. Box 95009
Seattle, Washington 98145-2009, U.S.A.
(206) 634-1838
www.iphc.washington.edu

PREFACE

Hal Geiger, co-writer of this report, is a writer and biologist living in Juneau, Alaska. Dr. Geiger studied Pacific salmon with the Alaska Department of Fish and Game for 25 years and he currently works for the St. Hubert Research Group.

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 on the campus of the University of Washington in Seattle, Washington.

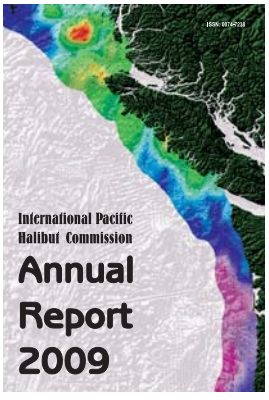
The Commission meets annually to review all regulatory proposals, including those made by the scientific staff and industry; specifically the Conference Board and the Processor's Advisory Group. The measures recommended by the Commission are submitted to the two governments for approval. Upon approval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

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

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

On the cover

Pictured on the cover is a representation of dissolved oxygen concentration on the halibut grounds off the U.S. and B.C. west coast in 2009. This year, the IPHC launched its coastwide oceanographic monitoring program made possible by a grant from NOAA. The data will be useful to IPHC, but also to scientists globally. This plot uses pinks, blues, and greens to indicate very low, slightly higher, and somewhat higher oxygen levels at depth, respectively.



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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 of Alaska NMFS/RACE division in Seattle for saving us a spot on their surveys.
• Dr. Robert Gerlach of ADEC.
• Carol Henry of WDFW and Steve Kupillas of ODFW for rockfish sampling.
• Makah, Quinault, and Lummi samplers for port sampling Area 2A tribal commercial fisheries.
• Makah, Lummi, and Quinault samplers for scan sampling in Area 2A tribal commercial fisheries.
• ODFW and WDFW for scan sampling sport catch in Area 2A.
• Toshihide "Hamachan" Hamazaki, PhD (ADF&G) for providing Norton Sound trawl data which enabled IPHC staff to develop a halibut density measurement for the northern Bering Sea shelf.
• The many plants who store and stage IPHC survey gear, equipment, and bait.

Activities of the Commission

Following a period of Pacific halibut depletion in the early 20th century, the International Pacific Halibut Commission (IPHC or Commission) was born out of an effort to study, understand, and manage the west-coast halibut fishery. The Commission's style of research-based management has led to a sustained fishery for a period approaching 100 years—a period when many other fisheries and renewable natural resources around the world have been exhausted. The early documents of the International Fisheries Commission—as the Commission was known then—shows that from the beginning its scientists were drawing on biology, economics, history, oceanography, and other fields of science, to maintain the benefits of the halibut resource for the people alive today and on into the future. In other words, the Commission has built a sustainable fishery based on informed management actions—and specifically informed by practical and applied research.

As the Commission's understanding of halibut has grown, the research questions have naturally evolved. Recently, the Commission's research has led to a new understanding about the movement of catchable halibut from the east to the west, and that understanding has changed the way the fishery has been managed. Many of the scientific problems the Commission is currently working on involve questions about the movement of halibut. Similarly, many of the management problems involve refining management and assessment tools to take this movement into account. A great deal of the Commission's work has always been taken up with statistical models and data collection that are used to estimate the biomass, or size of the halibut stock. As the Commission has moved to a stock assessment approach that estimates coastwide halibut biomass as a

How far halibut go and when they move among areas is a current topic of investigation at the IPHC.

The *F/V Bold Pursuit* offloads the halibut catch. Photo by Levy Boitor.

single entity, the question of apportionment—that is the methods to estimate the amount of the coastwide total available for harvest in local areas—has taken up more time and effort. For example, the Commission's staff worked to finish a PIT tagging study that began in 2003, worked on pop-up archival transmitting tags (or PAT tagging) studies to track movement, and began studying the feasibility of using acoustic tags to study movement in Pacific halibut. Also, the Commission is continuing its use of modern genetic tools, which may give additional insights into Pacific halibut movement and reproduction.

The stock assessment is a process that includes data gathering from many different sources.

Some of the most important research the Commission carries out is the routine data gathering and processing to support ongoing stock assessment and management. The management of Pacific halibut rests largely on the products that come from the annual Standardized Stock Assessment Survey, a setline survey designed to directly check on the state of the halibut stock, as well as from data shared by harvesters when they land their catches. The estimates of halibut abundance, which form the basis of the catch limits and allocations, are the direct result of these activities. This survey produces many other benefits, such as oceanographic observations, biological observations of ecologically related species, and detailed biological information on halibut. The Commission's scientists participated in routine research cruises with other agencies, cooperatively monitored and reported on bycatch, and routinely updated and maintained management databases and statistical models. The Commission's staff also put on public workshops on the topics of biomass apportionment and bycatch mortality of halibut in other fisheries.

The Annual Meeting

The 85th meeting of the Commission took place from January 13 to 19, 2009, in Vancouver, British Columbia with Dr. Laura Richards as Chairperson. The Commission heard reports and discussed the state of the halibut stock, as well as set catch limits and opening and closing dates. The Commission also reviewed research and management activities, and heard from its Staff, advisory boards, and the public prior to rendering decisions.

One hot topic was how to account for and manage removals from the fast-growing sport charter fishery in Alaska. Following substantial discussion, there was broad support for harvest tags or tickets to improve data collection. Although the Commission does not implement such programs directly, it agreed to send a letter to the North Pacific Fishery Management Council (NPFMC) and Alaska Department of Fish and Game (ADF&G) in support of the idea.

The Commission asked the Staff to hold workshops on the subjects of bycatch and apportionment.

In stock assessment, there was general acceptance of the coastwide assessment model, but many concerns remained on how best to apportion the catch among IPHC regulatory areas. Likewise, many attending the meeting expressed concern over the high bycatch rate in the Bering Sea and how that catch of smaller fish may be affecting the exploitable stock in areas to the east over time. In response to these concerns, the Commission agreed that the Staff would hold both apportionment and bycatch workshops to better understand the problems, and hear new ideas.

Fishing: How much and when?

For 2009, the Commission set an overall catch limit of 54.08 million pounds, a 10.6% decrease from the 2008 catch limit of 60.40 million pounds, and the sixth year in a row that the Commission has deemed it necessary to lower the catch limit to ensure the long-term welfare of the halibut stocks. Although the Commission staff recommended a lower overall catch compared to previous years, the staff recommended similar *harvest rates* for most areas. Specifically, a 20% harvest rate for use in Areas 2A through 3B, and a 15% harvest rate in Area 4A due to stock decline and an analysis suggesting lower productivity in the area.

The 2009 coastwide catch limit represented a 10.6% decrease from 2008.

The Commission approved a commercial season opening date of March 21 and closing date of November 15 for the U.S. and Canadian Individual Quota fisheries (IFQ, CDQ, IVQ fisheries) and Treaty tribal fisheries in Area 2A. Area 2A commercial fishing, including the treaty Indian commercial fishery, will fall within the March 21 to November 15 period. All other fishing dates including Area 2A incidental commercial halibut during the salmon troll fishery, incidental commercial halibut during the sablefish (*Anoplopoma fimbria*) fishery, and recreational fisheries are determined domestically.

Stock apportionment and bycatch workshops

In 2009 the Commission's scientific staff offered two workshops on topics of interest to the fishing industry and to observers of the Pacific halibut fishery. On April 29 and 30, 2009, the biomass apportionment workshop took place. The workshop dealt with a wide variety of subjects, including harvest policy, the use of simulation to study the effects of harvest policy, and a review of the stock assessment approach that the Commission uses.

On September 29, 2009, the staff held a one-day workshop in Seattle on the topic of determining and incorporating the impacts of halibut bycatch mortality. During this second workshop the staff also covered topics such as the effects of mortality of sublegal fish in halibut fisheries and incorporating bycatch mortality into the assessment and management of halibut stocks.

The staff-held workshops provided a forum for scientists, industry, and others to examine topics of interest to the halibut resource.

All workshop presentations and a summary of the workshops are available on the Commission's website: http://www.iphc.washington.edu . In addition, the workshops resulted in a number of comments and questions, for which the Commission staff has compiled detailed responses, which are also available on the website.

DIRECTOR'S REPORT

In my report for the 2008 Annual Report, I noted the predominance of issues surrounding methods to apportion the estimate of coastwide halibut biomass into estimates for each regulatory area. The 2009 IPHC annual meeting resulted in a Commission directive to the staff that it continue to investigate alternative approaches to biomass apportionment. Accordingly, the staff held a second Biomass Apportionment Workshop (BAW II) during the year and it is reviewed elsewhere in this report. In conjunction with this workshop, we also hosted an online Discussion Forum both before and after the workshop. This Forum proved to be a valuable tool for continued dialogue on issues, allowing both industry and staff to explore issues in more detail and with (at times!) considerable iteration on central points of discussion. We plan to continue the Forum since it provides the opportunity for all to either review what participants have discussed or to engage in discussion themselves. We endeavour to respond to all queries posted on the Forum website as quickly as we can, although these often come during periods of intense assessment activity by staff, so we ask for your patience.

While on board the *F/V Exception,* Bruce Leaman works on a vessel logbook with IPHC port sampler, Jessica Marx. Photo by Kirsten MacTavish.

Staff preparation for BAW II, and the discussions at the meeting, resulted in a number of potential adjustments to the survey-based apportionment – invoking hook competition, depth adjustments, survey timing, various forms of averaging, a fixed method based on historical catch shares, and then combinations of these adjustments. This led to a dizzying array of 33 potential choices for determining apportionments for each area in the 2009 stock assessment. Placing

this many choices in front of everyone has the predictable effect that folks tend to choose those favourable to their particular area, without considering that an apportionment framework must apply to all areas. While the staff believes that dialogue on alternatives is always healthy, if the result of that dialogue is confusion in the management goals for the stock, then we need to identify more meaningful endpoints for that dialogue. To that end, staff is working with the Commission on procedures to develop a more restricted but realistic suite of alternatives for future consideration.

The other major public event in 2009 was the Bycatch Workshop in September and a summary is presented elsewhere in this report. The workshop updated participants on our current understanding of bycatch impacts, which has changed in conjunction with our understanding of fish movements. It also highlighted the shortcomings of estimating bycatch mortality in some areas, particularly the Gulf of Alaska, and our ability to estimate area specific impacts with precision. On the latter, even the large PIT tagging program conducted by IPHC did not provide data of resolution sufficient to estimate the precise movement and residency rates of halibut, which vary by size, sex, and year. The staff is continuing its research into alternative ways to estimate bycatch mortality impacts on an area-specific basis.

The ongoing decline in growth rate of halibut continues to frustrate our efforts to reduce the realized exploitation rates in some regulatory areas. This decline in growth means that our projections fall short of reality and catch limits do not achieve the anticipated management goals. Evaluation of our harvest policy, while contemplating continued low growth rates, did not factor in a continued decline in growth rates. This situation may require more aggressive management actions to reduce exploitation rates and improve the levels of biomass in some areas. We believe the low growth rates result primarily from competition with arrowtooth flounder, which is extremely abundant in the central Gulf of Alaska. Unfortunately, we do not see the situation reversing in the near future due to the likely continued high abundance of this flounder. The positive news in the midst of this biological cauldron is that halibut abundance is high but the low growth rates mean biomass is not as high as it has been in the past, when abundance of halibut was at similar levels.

Bruce M. Leaman
Executive Director

2009 Commercial fishery

The 2009 commercial catch was just over 51.181 million pounds.

The modern commercial fishery for Pacific halibut started when sailing ships from New England began fishing off the coast of the state of Washington in the late 1880s. However, by 1910 there was already worry about depletion in the commercial fishery—at least locally on the fishing grounds around Puget Sound. Before the end of World War I, the biologist W. F. Thompson coauthored several reports, arguing that the halibut stocks were showing signs of overfishing, and he called upon industry to create a body to manage and preserve the commercial halibut fishery. To understand what was really happening with the resource, one had to look beyond the overall catch statistics available at the time. In the Commission's sixth report, the authors reported the following: "Until 1911 the total of over 50 millions of pounds was taken within 500 or 600 miles north of Seattle, whereas in 1930 approximately the same catch came from over 2100 miles of coast." Because some fishing skippers had maintained careful catch records, the early halibut biologists could see that in 1915, the catch weight per unit of fishing effort in the Pacific Northwest and along Vancouver Island averaged 183 pounds per skate, but by 1928 this statistic had dropped to 62 pounds per skate for these same areas. Even so, these early biologists found the lack of information about the fishery was the first challenge they had to confront. One of the Commission's most important accomplishments has been to build on the foundation laid by those early halibut skippers, and create an extensive and accurate history of catch records and other statistics for the commercial fishery.

The size of the total commercial catch declined somewhat in 2009, and that decline continues a downward trend that started in 2002. The estimated

IPHC employee, Huyen Tran, collects logbook information in Petersburg, AK. Photo by Bruce Leaman.

commercial catch in all regulatory areas was slightly over 51.181 million pounds, approximately 540 thousand pounds below the commercial catch limit for the year. In contrast, the comparable catch was 57.834 million pounds in 2008 and 74.660 million pounds at the most recent peak, in 2002. In 2009, the majority of the catch came from Alaska, with 86% of the reported commercial catch. Alaskan Regulatory Areas 3A and 3B accounted for 63% of the total commercial harvest. Catch statistics for the 2009 fishery can be found in Appendix I.

Regulatory Areas for 2009

Boundary lines for the IPHC regulatory areas have remained the same since 1990. The southeastern flats in the Bering Sea, excluding Bristol Bay, remained closed in 2009 to all halibut fishing. A brief description of the regulatory areas for the 2009 halibut fishery follows:

Boundaries for the IPHC regulatory areas have not changed in 20 years.

Area 2A - all waters off the coast of California, Oregon, and Washington.
Area 2B - all waters off the coast of British Columbia.
Area 2C - all waters off the coast of Alaska, south and east of Cape Spencer.
Area 3A - all waters between Cape Spencer and Cape Trinity, Kodiak Island.
Area 3B - all waters between Cape Trinity and a line extending southeast from Cape Lutke, Unimak Island.
Area 4A - all waters west of Area 3B and the Bering Sea closed area that are south of 56°20' N and east of 172°00' W.
Area 4B - all waters in the Gulf of Alaska and the Bering Sea west of Area 4A and south of 56°20' N.
Area 4C - all waters in the Bering Sea north of Area 4A and the closed area that are east of longitude 171°00' W, south of 58°00' N, and west of 168°00' W.
Area 4D - all waters in the Bering Sea north of Areas 4A and 4B, north and west of Area 4C, and west of 168°00' W.
Area 4E - all waters in the Bering Sea north and east of the closed area, east of Areas 4C and 4D, and south of 65°34' N.

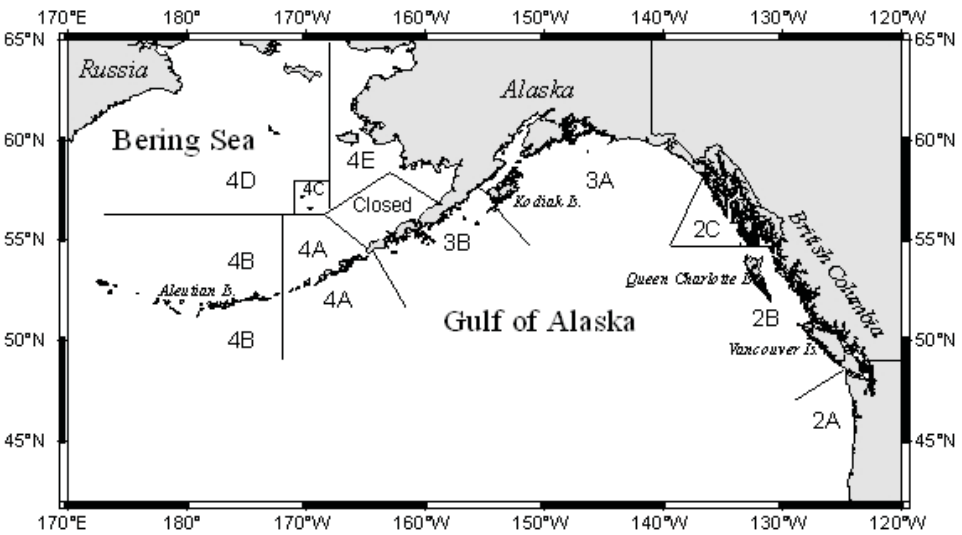

Figure 1. IPHC regulatory areas for 2009.

Changes to the regulations for 2009

The regulations for the 2009 fishery were adopted at the IPHC 2009 Annual Meeting in Vancouver, B.C. They were later approved by the Canadian and United States governments, with one exception. Since 1999, the Canadian government has allowed the landing of live halibut caught in British Columbia waters by choosing not to approve the regulation that required commercially caught halibut to have their gills and entrails removed before being offloaded from a vessel.

For Alaska, the Commission revised the sport regulation that had stated no person shall possess on board a *fishing vessel*, including charter vessels and pleasure craft, halibut that has been filleted, mutilated, or otherwise disfigured in any manner except that each halibut may be cut into no more than two ventral and two dorsal pieces and two cheeks, all with skin on. The revision changed the reference from *fishing vessel* to *vessel*, and added an exemption so that halibut in excess of the possession limit may be on the vessel for transportation when the vessel is not carrying fishing gear.

Port sampler, Amy Schmitt, has no trouble getting her data. Photo by Lara Erikson.

A regulation in 2009 included allowing Area 4 fishers to fish in multiple areas provided certain requirements were met.

The Commission approved a regulation that allowed fishing in multiple regulatory areas (4A, 4B, 4C, or 4D). This regulation affected boats in one of two cases: (1) provided a certified observer was on board, or (2) provided a vessel monitoring system was on board and at no time was more halibut on board than the individual fishing quotas (usually called IFQ) allowed in the area currently being fished. In both cases, the halibut needed to be identifiable by regulatory area. This regulation had been adopted in 2008, but was not recorded correctly as part of the IPHC regulations in the U.S. Federal Register.

The Commission approved a change to the 72-hour restriction prior to the Area 2A directed commercial fishery. This change was to restrict all vessels, not just setline vessels, and required vessels and skippers fishing before the 72

hours immediately prior to the opening to offload their catch or submit to a hold inspection. Without this change, enforcement officers could not tell if fish was caught before or within the 72-hour period.

Season dates

In 2008, there was a proposal from a Washington processor for a late May start date for the Area 2A directed commercial fishery. The Commission adopted a mid-June starting date in 2008, as not all affected industry interests had a chance to comment. Prior to the 2009 Annual Meeting of the Commission, the staff sent a survey to all directed commercial and incidental sablefish license holders asking about their preferred opening day and week. The results for the opening date were as follows: 29% preferred May 13; 12% preferred May 27; 16% preferred June 10; 39% preferred June 24: and 4% left the preference blank.

This year's non-treaty directed catch was taken in two, 10-hour fishing periods.

The 2009 non-treaty directed commercial fishery was allowed 10-hour fishing periods, beginning at 8:00 a.m. and closing at 6:00 p.m. local time, on June 24, July 8, July 22, August 5, August 19, September 2, September 16, and September 30, 2009. Catches were monitored after each fishing period and the fishery was closed when the catch limit was taken.

The Canadian Individual Vessel Quota (IVQ) fishery in Area 2B and the United States Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) fisheries in Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E commenced at 12 noon local time on March 21 and closed at 12 noon local time on November 15. The treaty Indian commercial fishery in Area 2A was required to occur during the same calendar period (March 21 to November 15). The 2009 opening date of March 21 was the latest opening date since the implementation of the quota-share programs.

Catch limits

The Commission adopts biologically based catch limits for all individual regulatory areas and for Areas 4C, 4D, and 4E combined. As in other years, the Pacific Fishery Management Council (PFMC) allocated halibut catch limits among user groups in Area 2A through a Catch Sharing Plan (CSP). Since 2008, no adjustment has been made to the allocation of 35% to tribal and 65% to non-tribal fisheries, an allocation that had been in place since 2000. Individual catch limits for Areas 4C, 4D, and 4E were determined by the CSP under the control of the NPMFC and approved by the Commission at the Annual Meeting.

Area 2A fishers have several choices on how to harvest halibut, but the decision must be made pre-season.

The Area 2A licensing regulations have remained unchanged since 2000. All fishers have had to choose between a commercial or sport charter vessel license, with the commercial license applications having deadline dates. Further, commercial fishers have had to choose between a license for (1) retaining halibut caught incidentally during the salmon troll fishery, or (2) fishing in the directed commercial Pacific halibut fishery (south of Point Chehalis, Washington) and/or retaining halibut caught incidentally in the primary sablefish fishery (north of Point Chehalis).

Since 2004, the Commission has adopted a combined sport and commercial catch limit for Area 2B that has been allocated by the Canadian Department of Fisheries and Oceans (DFO) between commercial and sport fishers by an 88:12

ratio. This year, 208.4 thousand pounds of commercial quota were leased to the recreational sector in Canada; 179.4 thousand pounds were used and the remaining 29 thousand pounds were carried over to the 2010 season.

Fishing season by area

The port of Newport, OR is a hub of activity in the summer months. Photo by Sarah Stephens.

Area 2A

The number of licenses issued in Area 2A decreased, perhaps influenced by the decreased catch limit.

In 2009, the Commission issued 510 Area 2A vessel licenses: 132 licenses for the incidental commercial catch of halibut during the salmon troll fishery, 238 for the directed commercial fishery and the incidental catch of halibut during the sablefish fishery, and 140 for the sport charter fishery. The number of licenses issued for the sport charter and incidental halibut during the salmon troll fisheries were similar to the previous year. However, the number of licenses issued in 2008 and 2009 for incidental catch during the salmon troll fishery, were much lower than the average number (315) issued annually for the 2003 to 2007 period. This is because for the second year in a row, the salmon troll fishery south of Cape Falcon, Oregon was closed. The number of licenses issued for the directed commercial fishery and the incidental fishery during the sablefish fishery decreased by 58 from 2008 to 2009. The decrease is likely due to the 28% decrease in the halibut catch limit from 2008 to 2009.

Area 2A was managed to provide a total allowable catch of 950 thousand pounds for all user groups. The sport fishery was allocated 409,858 pounds; the treaty Indian fishery was allocated 332,500 pounds (29 thousand pounds for ceremonial and subsistence use); and 195,747 pounds were allocated to the non-treaty commercial fishery and 11,900 pounds of that were allocated to the incidental halibut fishery during sablefish fishing. Because the Area 2A catch limit exceeded a threshold of 900,000 pounds, under the CSP, the longline sablefish fishery north of Point Chehalis, Washington (46°53’18”N)

was allocated part of the Washington sport allocation poundage. The directed commercial fishery was restricted to waters south of Point Chehalis, Washington, and the incidental halibut fishery during the sablefish season was restricted to waters north of Point Chehalis, under regulations promulgated by NMFS.

The incidental commercial halibut fishery conducted during the salmon troll season in Area 2A allowed for an incidental catch ratio of one halibut per two Chinook salmon (*Oncorhynchus tshawytscha*), plus an "extra" halibut per landing. However, the total number of incidental halibut per vessel per landing could not exceed 35. The 1:2 ratio of halibut to Chinook salmon was new in 2008 and had been 1:3 from 2000 to 2007. These ratios have increased over the years, from the 1:20 ratio seen in the first year of the program (1995). The incidental commercial halibut fishery during the salmon troll season opened on May 1 and closed on November 15 when the commercial halibut fishery closed for the year. The halibut catch (11,600 pounds) was 60% under the catch limit.

In 2009, the directed commercial fishery in Area 2A consisted of two 10-hour fishing periods with fishing period limits. The fishing period limits were assigned by vessel class; the H-class vessels received 9,000 pounds for the June 24 opening and 7,000 pounds for the July 8 opening and limits decreased with the size of the vessel (Appendix I Table 10). The total directed commercial catch in this area (165,200 pounds) was less than 1% under the catch limit.

The incidental halibut fishery during the limited-entry sablefish season opened May 1 and closed on October 31 with the closure of the sablefish season. The 2009 catch limit (11,895 pounds) for the incidental halibut catch during the sablefish fishery was substantially lower than the 2008 catch limit. With the lower catch limit, the incidental landings of halibut were restricted to 100 pounds (dressed weight) of halibut per landing, a decrease from last year's landing restriction of 100 pounds of halibut per 1,000 pounds of sablefish landed, with up to two "extra" halibut in excess of the 100:1,000 pound ratio.

The treaty Indian tribes receive a percentage of the Area 2A catch limit through the catch sharing plan and then further allocate between open access and restricted fisheries.

The treaty Indian tribes manage the commercial catch by allocating 75% to an open access fishery and the remaining 25% to a restricted fishery with daily limits of 500 pounds per vessel. A CSP among treaty Indian tribes was in place in the early 2000s, but was not in place in 2009. The commercial fishery occurred between March 21 and July 15. The total tribal commercial catch (303,300 pounds) was less than 1% under the catch limit.

Area 2C Metlakatla fishery

The Metlakatla Indian Community was authorized by the United States government to conduct a commercial halibut fishery within the Annette Islands Reserve. Ten 48-hour fishing periods were allowed between May 8 and September 20, producing a total catch of 29 thousand pounds, which was included in the Area 2C commercial catch. The catch was almost 12 thousand pounds less than last year's catch of 41 thousand pounds. The total catch has varied over time from a high of 126 thousand pounds in 1996 to a low of 12 thousand pounds in 1998.

The quota-share fisheries

The quota-share fisheries of British Columbia (Area 2B) and Alaska (Areas 2C, 3, and 4) were open from March 21 to November 15.

Area 2B

The Commission adopted a combined sport and commercial catch limit of 7.63 million pounds for Area 2B, which was to be allocated to the user groups by DFO. An additional 23 thousand pounds was added to include the projected commercial wastage from the commercial halibut fishery for halibut over 32 inches (halibut termed O32 are *legal-sized halibut* in the commercial fishery), resulting in a total catch limit of 7.653 million pounds. The commercial fleet allocation of 88% of the total catch limit (6,734,600 pounds) was reduced by 23,000 pounds to account for wastage, resulting in an allocation of 6,711,600 pounds. In 2008, the underage/overage program resulted in a 339,000-pound surplus roll-over to the 2009 catch limit and an adjusted catch limit of 7.051 million pounds. Each vessel was allocated a fixed poundage of halibut, or IVQ as calculated by DFO. The Area 2B commercial catch of 6.538 million pounds was within 3% of the catch limit. The sport fishery was allocated 12% of the total catch limit, resulting in a 918.4 thousand-pound allocation.

In 1991, when the halibut IVQ program was implemented, 435 vessels received quota. Each initial IVQ was split into two shares called blocks. Many changes have been made since then, including first allowing temporary block transfers (1993) and then permanent block and IVQ transfers (1999). Since 1999, the number of active vessels with L licenses, including Native communal commercial licenses (FL licenses), has steadily decreased from a high of 269 in 2000, to 154 in 2009. However, halibut was landed from a total of 186 active vessels in 2009, 32 of which were from other licensed fisheries. Many small sub-areas in Area 2B, such as a group of 164 *rockfish conservation areas*, were closed to halibut fishing in 2009 to protect localized stocks of non-halibut species.

The Area 2B IVQ halibut fishery has been managed under a 100% catch monitoring plan since 2006.

In 2006, DFO implemented the Integrated Fisheries Management Plan (IFMP) for groundfish to address conservation needs and to improve catch monitoring. This plan was developed with the consultation of the groundfish industry and other stakeholders. Under this plan, a pilot fishery was launched with quota shares for all hook-and-line groundfish fisheries, transferability with limits among license holders, 100% at-sea and dockside monitoring, and vessel accountability for all catch (both landed and discarded). There was 100% monitoring through logbook recordings, video camera coverage, and dockside coverage. The newly designed logbook required the recording of all retained and discarded species, and allowed comparison to the video recordings.

The management plan was extended into 2009, with DFO's intent to have a complete review finished by the end of the year. The Commission reviewed how the IFMP affected halibut fishing patterns, and there did not appear to be any significant changes to fishing patterns since its implementation.

Alaska

The IFQ Pacific halibut fishery has been in effect in Alaska since 1995. Quota-share transfers were permitted with restrictions on the amount of quota shares a person could hold and the amount that could be fished from an individual vessel. At the end of the 2009 fishery, NOAA Fisheries reported that 2,855 persons held quota shares, down from the initial 4,830 persons at the start of the program. The 2006 Magnuson-Stevens Fisheries Act established the CDQ fisheries for some Western Alaskan communities.

The total 2009 catch from the IFQ/CDQ Pacific halibut fishery for the waters off Alaska was just over 44 million pounds, 3% under the catch limit. For Areas 3A, 3B, and 2C the commercial quota-share catches were within 1%, 3%,

and 3%, respectively, of the catch limits. Areas 4A and 4CDE's catches were 3 and 5%, respectively, and Area 4B's catch was 18% of the catch limit. The NPFMC CSP allowed Area 4D CDQ to be harvested in Areas 4D and 4E and Area 4C IFQ and CDQ to be fished in Areas 4C or 4D. These two regulations were the reason the catch in Area 4D exceeded the catch limit. The total commercial catch of 3.279 million pounds was under the combined Areas 4CDE catch limit (3.460 million pounds).

Landing patterns and highlights

Homer was at the top of the list for most pounds landed followed by Kodiak and Seward.

Homer received over 12.024 million pounds of halibut, or 27% of the commercial Alaskan catch (44.158 million pounds). Kodiak and Seward received the second and third largest landing volumes, each moving between 10% and 16% of the Alaskan commercial catch. In southeast Alaska, Sitka received

Plant workers process the catch from the *F/V Bold Pursuit.* Photo by Levy Boitor.

2.184 million pounds, Juneau 2.174 million pounds, and Petersburg/Kake 1.564 million pounds. Only 2.3% of the Alaskan quota-share catch was landed outside of Alaska. The biggest change from 2008 was that Homer received almost three million more pounds. That is, Homer received an additional 9% of the total commercial Alaskan catch, up from the 18% it received in 2008. Some of this increase may be attributed to decreased poundage landed in Sand Point and King Cove. There are likely other ports with decreased poundage as well.

The catches for commercial trips from Area 2B were delivered into 10 different ports in 2009. The ports of Prince Rupert/Port Edward, Port Hardy, and Vancouver were the major landing locations, receiving about 91% of the Area 2B commercial catch. Port Hardy and Prince Rupert/Port Edward received about 41% and 44% of the B.C. commercial landings, respectively.

The 2009 quota-share fishery landings were spread over nine months of the year. August was again the busiest month for Alaska landings, as it was in 2008. This was a change, as May had been the busiest for the previous seven years. August landings represented 17% of the total catch for Alaska. For the second year in a row, April was the busiest month for poundage delivered in British Columbia. In 2009, 17% of the Area 2B catch was landed in April compared to 14% during the busiest month (April) last year.

The landing of live halibut from Area 2B was legally allowed by DFO and resulted in a total landing weight of 18,849 pounds. Live fish landings have ranged from a low of 7,900 pounds in 1998 to a high of 103,000 pounds in 1999.

Electronic reporting project for Alaska

The IPHC, the ADF&G, and NMFS continued to refine the web-based Interagency Electronic Reporting System (IERS), a computer system for electronic reporting and catch accounting. For Pacific halibut, the system reduced duplicate reporting resulting from the requirements of completing ADF&G's fish tickets and NMFS's quota-share reports. This system has been operational since May 2006. The application (eLandings) recorded data elements required by regulations, printed fish tickets, and connected with the NMFS quota-share database. The appropriate information was then sent to the agencies for their internal databases. In 2008, 97.5% of the halibut tickets were entered by processors into the IER system, and in 2009, 99% were entered into the IERS.

Age and size distribution of the commercial halibut catch for 2009

The average fork length of commercially caught fish decreased by 0.6 cm compared to a year earlier.

Size and age trends in commercially caught halibut are monitored through a system of catch sampling. The catch was sampled within each regulatory area over the entire landing period, or season, using prescribed sampling rates that varied among areas and ports. On the dock, the samplers collected halibut length measurements and otoliths (bony structures used to age the fish). Samplers also collected information from fishing logs and other fishery records throughout the entire season, and collected tags from recovered tagged fish. The sampling effort was dependent on the Commission's ability to position field sampling staff in ports where there was an opportunity to sample a majority of the catch for each regulatory area. For 2009, the commercial otolith collection target was 1,500 (±500) per regulatory area for Areas 2, 3, 4A, 4B, and 1,500 (±500) for Areas 4C and 4D combined. Otolith targets were met or exceeded in all areas in 2009. Sampling targets were exceeded in Areas 3A and 3B.

The average fork length of Pacific halibut increased in Areas 2, 3B, and 4D, in 2009, but decreased in all other areas. The average fork length for all areas combined decreased by 0.6 cm in 2009.

The age of a particular fish was determined by the fish's otolith, a bone-like structure found in the halibut's head. Calcium carbonate is deposited on the otolith as the fish grows and forms an annual pattern which can be used to determine the fish's age, much like rings on a tree trunk. In the 2009 commercial harvest, the average age for all areas combined was slightly lower than in 2008. The youngest halibut in the 2009 sample was determined to be five years old,

IPHC port sampler, Danielle Kane, samples halibut at Westward Seafoods in Dutch Harbor, AK. Photo by Joan Forsberg.

and this fish was captured in Area 2B and measured 107 cm. The oldest fish in the sample was 54 years old, and this fish was captured in Area 4B and had a fork length of 129 cm. The largest halibut in the 2009 commercial sample was a 221 cm fish from Area 3A, which was determined to be 22 years old. The 1999 year class (10-year-olds) accounted for the largest number of fish in the catch sample (15%), for all areas combined. The next most abundant year classes, for all areas combined, were 1998 and 2000, accounting for 13% and 10% of the catch sample, respectively. Ten-year-old fish were the most abundant age class in Regulatory Areas 2A, 2B, and 3B, and the second most abundant in Areas 2C, 3A, 4A, and 4C. In Areas 4A and 4C, 11-year-old fish (1998 year class) were the most abundant age class. Fourteen-year-old fish (1995 year class) were the most abundant age class in Regulatory Areas 2C, 3A and 4D, while 13-year-old fish (1996 year class) made up the most abundant age class in Area 4B. The average age of fish sampled from Areas 4B and 4C increased in 2009 relative to 2008, while average ages from all other areas decreased. The average age from all areas combined in 2009 was 0.6 years lower than in 2008.

Average age decreased in all areas except 4B and 4C.

THE RECREATIONAL FISHERY

What we now think of as *sport fishing* has largely evolved from the European tradition of fishing in streams or rivers with poles and hooks as a form of recreation. The terms *recreational fishery* and *sport fishery* are used here synonymously to refer to fisheries that individuals participate in for pleasure. These two terms serve in contrast to the *commercial fisheries* and *personal use fisheries*, discussed in other sections.

The term "sport fishing" may refer to the weekend fisher casting a line from shore or the sport charter lodge treating paying clients to an at-sea fishing experience.

To some extent, this pastime of sport fishing has always been thought of as a kind of noble endeavor, not exclusively aimed at yield. Since the invention of the printing press there has been a tradition of writing about the contemplative aspects of sport fishing. In the 17th century, Izaak Walton wrote "...the fruits of that pleasant labour which you enjoy, when you purpose to give rest to your mind, and divest yourself of your more serious business,..." Today that tradition of writing about the fishing experience continues with such publications as *Grey's Sporting Journal* and many other magazines and books on the subject.

Although sport fishing for halibut may have some of its origins with the contemplative, solitary European with a hook and pole, obviously fishing in marine waters for a potentially very large fish is in many ways different. Sport fishing for halibut usually involves fishing from some kind of a vessel. For that reason, sport fishing for halibut involves some commercial aspects. For example, many small businesses offer charters for individuals that would otherwise not have the means to reach the halibut fishing grounds. Similarly, many businesses

The day's catch is displayed for all to see in Ninilchik, AK. Photo by Lara Erikson.

now depend to some extent on selling gear and equipment, clothing, and other services. The American Sportfishing Association estimates that recreational fishing for all species in the U.S. results in $45 billion dollars in sales to industries supporting sport fishing.

Today many individuals, with many different interests, benefit from the sport fishery for halibut. Some may live near coastal areas, have access to boats, and may be motivated largely by an interest in halibut as a food resource. These individuals are classed as sport fishers really as just a matter of administrative convenience. Others may view a marine fishing trip, out on a boat away from shore, as the chance of a lifetime, to experience some connection with the sea. These individuals may represent the extreme end of the recreational spectrum. Still others might be involved in a small family run business, providing services to halibut sport fishers.

The sport harvest of halibut was estimated to be 8.7 million pounds in 2009, a 19% drop from 2008 and the lowest harvest since 2003. The sport harvest declined in all areas, with the largest decreases observed in Areas 2B, 2C, and 3A. However, only Areas 2B and 2C had any change in regulations from 2008, primarily reduced bag limits. The current economic downturn was frequently cited as the main contributing factor in reduced angler trips and lower harvests.

The Commission depends on state and provincial agencies for sport fishing estimates.

The Commission depends on state and federal management agencies to estimate the sport fishery harvest. The catch-sharing plan developed for Area 2A necessitates in-season management of the sport fishery, so the estimate of harvest for that area is based on dockside sampling by state agencies in the current year. Harvest estimates for the Canadian sport fishery are based on a combination of self-reporting by remote lodges, overflights, logbooks, and a creel monitoring program. Sport catch statistics for waters off British Columbia were provided by DFO. For the Alaska sport fishery, ADF&G uses a post-season mail survey of license holders and requires logbooks for charter (guided) operators. For their preliminary 2009 estimates, ADF&G used different approaches to projecting the catch in the guided and unguided sectors. Changes in bag limit regulations for the guided fishery in the past two years led ADF&G to project the 2009 harvest from the 2008 and 2009 charter logbook data, whereas the projections for the unguided fishery continue to be made from Alaska's Statewide Harvest Survey—a probability-based mail-in survey which is considered very reliable. For the most current sport fishing statistics, see Appendix II.

Area 2A—US West Coast

The 2009 sport harvest in Area 2A was estimated to be 460,000 pounds. The allocation to the sport fishery, as provided by the CSP, was 409,858 pounds. This allocation was further subdivided to six sport fish subareas, resulting in 214,110 pounds to Washington areas and 195,748 pounds to the combined Oregon-California areas. The overall harvest was roughly 65,000 pounds (or 12%) over the total sport allocation due to an overage by the fishery in Puget Sound waters. As in past years, effort in the sport halibut fishery was heavily dependent upon other sport fishing opportunities, especially opportunities to fish for salmon and albacore.

The catch in three of six regulatory sub-areas in 2A was below the allocation and the harvest in one sub-area exceeded the allocation. Specifically, in both the North Coast and South Coast areas of Washington, catches were below their

Late in the summer, the combination of good weather and large numbers of anglers resulted in high catches in Area 2A.

allocations. The season for the Columbia River area, straddling Oregon and Washington, was split into spring and fall periods, as in past years. The spring fishery lasted just 13 days during the May 1 to 29 period, when it was closed because the spring allocation was reached. It reopened on August 7 for three days a week and continued into late September. Little to no effort was reported after the third week of August, and the area quota was not caught. The Central Oregon area opened on May 14 for three days per week for its traditional spring fishery, and the catch averaged about 20,000 pounds per week. After four weeks of fishing, the harvest was approaching the seasonal quota, and the fishery changed to being open for three days every other week. This change allowed for two additional fishing weeks (i.e., six days), following which the spring season was closed. No fishing was scheduled for July in order to avoid conflict with the commercial fishery openings. The Central Oregon area reopened on August 7 for three days with the expectation of lasting into late September, as in past years. However, a catch of 52,000 pounds exceeded the quota and the area was closed for the remainder of the year. A "perfect storm" of nice weather and ocean conditions and the presence of a large angler population in the area fishing for salmon and albacore resulted in very high effort and high halibut catch rates.

Area 2B—British Columbia

The preliminary 2009 sport harvest estimate for Area 2B is 1.095 million pounds. The initial allocation of 12% of the Area 2B combined catch limit was 0.914 million pounds, and there were additional commercial individual quotas leased to the sport fishery to address the overage. DFO adopted several changes to the sport fishery regulations at the beginning of the season to constrain the harvest. These changes included delaying the season opening until March 1, reducing the daily bag limit from two to one fish from March 1 through August 21, a reduction in the possession limit from three to two fish from March 1 through December 31, and the prohibition on halibut retention in Area 121 seaward from 12 nautical miles.

Areas 2C, 3A, and 4—Alaska

For Area 2C, the sport harvest dropped from 3.26 million pounds in 2008 to 2.55 million pounds in 2009. This drop was largely due to the decline in the charter harvest and driven by the reduction in the bag limit to one fish. ADF&G projects that the number of fish caught by the charter sector dropped almost in half (from 103,000 to 52,000 fish), but that drop in catch numbers was offset by a substantial increase in the size of the one fish retained by charter fishers (from 19.4 pounds in 2008 to 25.0 pounds in 2009). In contrast, the bag limit for the unguided sector remained at two fish per day, and the catch by this sector was relatively unchanged. Without additional restrictions to the charter fishery there is no reason to believe that sector's harvest will drop much further in 2010.

In addition to the one-fish bag limit for the guided fishery in Area 2C (see below), NMFS adopted other regulations for the guided fishery, which were in addition to regulations developed by the Commission. These regulations were as follows:

- A charter vessel angler may use only one fishing line. No more than six lines are allowed on a charter vessel fishing for halibut.
- Charter operators, guides, and crew may not catch and retain halibut during a charter fishing trip.
- Anglers' names and fishing license numbers are recorded in the trip log book.
- Anglers retaining halibut must sign the log at the end of the charter vessel fishing trip.

The sport fishery harvest in Area 3A also declined in 2009, driven solely by a decrease in the charter fishery harvest. The charter fishery in Area 3A is also heavily dependent on tourism but less than the 2C fishery. In any case, the bag limit remained unchanged at two fish per day, so the decline is quite likely due to a depressed economy and the resulting loss of the angler's ability to pay to go out on charter vessels. The average size of fish landed was relatively unchanged from 2008 for both the charter and private sectors.

A peaceful day in Kodiak, AK. Photo by Lara Erikson.

Harvest estimates for Areas 3B and 4 are based exclusively on information provided by the mail-based Statewide Harvest Survey in Alaska. ADF&G has no creel sampling in those areas, so the Commission has traditionally estimated the weight of the catch by applying the average weight of halibut caught in Kodiak. The estimated 2009 harvests for these areas were virtually unchanged from 2008: 25,000 pounds in Area 3B and 39,000 pounds in Area 4. Halibut sport fishing is much less common in the western Gulf of Alaska and Bering Sea due to the relative remoteness of the ports. Since 2005, annual harvest estimates have ranged from 14,000 to 26,000 pounds in Area 3B, and 39,000 to 50,000 pounds in Area 4.

Sport fishing is less common further west because the ports are more remote and more difficult for clients to reach.

A one fish bag limit was implemented then challenged in court, but was not overturned.

Bag limit reduction for the 2009 Area 2C guided fishery

For the 2009 guided (charter) halibut fishery in Area 2C, the National Marine Fisheries Service proposed reducing the daily bag limit from the "one fish of any size + one under 32 inches" (the regulation in place for 2008) to one fish of any size. The one-fish bag limit went into effect on June 5, but was quickly followed by litigation from a group of charter operators. A request for a preliminary injunction seeking to overturn the reduced bag limit was denied by the U.S. District Court (District of Columbia) in a decision on June 25, and the season was conducted with the one-fish bag limit in place.

The charter operators and United States Secretary of Commerce later sought a summary judgment on the reduced bag limit regulation. On November 23, the court rendered its decision. The ruling came down in favor of the U.S. Secretary of Commerce (and the National Marine Fisheries Service) supporting the one-fish bag limit. Specifically, the court ruled that, "Because the record as a whole reflects that the Secretary adequately considered the equities of the allocation of the halibut harvest, the Secretary's decision was not arbitrary, capricious, or contrary to law" (Van Valin et al. v. Locke, Civil Action No. 09-961-RMC).

Halibut sport fishery length distributions

State agencies routinely measure sport caught halibut as part of their annual monitoring and catch estimation programs. The Commission last reviewed the size composition of the sport catch in 2003. Because of changes to the halibut stock assessment and size restrictions to charter caught fish in Area 2C, the Commission decided it was time to take another look at the size of halibut caught in the sport fishery. To that end, in 2009 the Commission requested length statistics from the Alaska Department of Fish and Game, Washington Department of Fish and Wildlife (WDFW), and Oregon Department of Fish and Wildlife (ODFW).

Length measurement and statistics from sport caught halibut that were obtained from state agencies were only available for Regulatory Areas 2A, 2C and 3A. In Area 2A, 19% of the harvest was smaller than 80 cm (which approximately corresponds to the size of halibut that can be legally taken in the commercial fishery and also corresponds to a size at which there are biological changes in the fish) in 2009. In Area 2C, the percentage smaller than 80 cm ranged from 44% to 51% over the period 2005 to 2008, and dropped to 39% for 2009, likely due to highgrading caused by the one-fish bag limit for charter anglers. In Area 3A, the percentage of fish below 80 cm ranged from 33% to 35% from 2005 to 2007, but this percentage jumped up to 39% for the 2008 to 2009 period.

WASTAGE IN THE COMMERCIAL FISHERY

Wastage in the commercial halibut fishery includes halibut 32 inches and over (which are legal-sized halibut in the commercial fishery and known as O32) that are killed or lost by abandoned longline gear and a proportion of the halibut that are under 32 inches (U32 or previously called *sublegal-sized*) that are discarded and die. Information on lost gear is collected through logbook interviews and fishing logs received by mail.

The IPHC also accounts for halibut lost during the halibut fishery.

Prior to 1997, estimates of wastage from the mortality of O32 and U32 halibut were deducted prior to calculating the fishery constant exploitation yield. Since 1997, only the commercial fishery wastage of O32 halibut was deducted. The estimated mortality of U32 halibut is accounted for when setting exploitation rates and is not treated as a direct removal.

Wastage can also occur if more gear is set than is needed to obtain fishing-period limits in Area 2A, IVQ in Area 2B, and IFQ/CDQ in the Alaskan regulatory areas. Wastage occurs when the halibut above these limits are discarded and die. In addition, halibut may occasionally be discarded at sea due to poor fish quality, which can result from sand flea, shark, or other predation.

This fish has been chewed on, most likely by dogfish, and cannot be commercially harvested. Photo by Lauri Sadorus.

The amount of O32 halibut caught in excess of quota or catch limits, and discarded at sea, is recorded during logbook interviews. However this mortality is not currently included in the estimates of wastage removal.

Wastage from lost or abandoned gear

Information on the amount of gear lost or abandoned in the halibut longline fishery was collected through logbook interviews or from fishing logs received via mail. Fishery-wide estimates of wastage were then extrapolated using qualified logbook catch and effort statistics. Throughout the fishery, the length of skates, hook size, and hook spacing have varied, and only those that can be standardized are used. With the directed halibut IFQ fishery in Alaska and with the incidental halibut catch during

the sablefish longline fishery in Area 2A, there were mixed halibut and sablefish trips as well as trips that targeted sablefish and landed incidentally caught halibut. Sablefish gear is considered a non-standard halibut gear that fishes differently. Therefore fishing effort that was directed at sablefish was not used or included in the calculation of wastage.

Wastage was calculated from the ratio of effective skates lost to effective skates hauled, multiplied by the size of the total catch. The calculation was performed using both fixed-hook and snap gear in all areas. Prior to 1998 the gear-standardization process described above was not conducted. Rather, the gear type used for the wastage calculation was the gear type used to calculate catch per unit effort (fixed hook gear was used in Alaska and a combination of fixed-hook and snap gear was used in B.C. and Area 2A). The Area 2A catch has always included the non-treaty directed commercial catch, treaty commercial catch, and incidental catch during the longline sablefish fishery. Wastage from lost or abandoned gear was first estimated in 1985.

The 2009 ratios of effective skates lost to effective skates hauled, by regulatory area, were as follows: 0.002 for Areas 2A, 2C, 3A, 3B, 4D; 0.003 for Area 2B; and Area 4A, 0.013 for Area 4B; and .001 for Area 4C. Since the implementation of the quota-share fisheries in 1995, the ratios have fluctuated slightly between years, but have remained lower than they were during the derby fisheries.

Discard mortality of U32 halibut

The IQ fisheries are assessed a 16% mortality rate on discarded halibut and the remaining derby fisheries a 25% rate.

In 2007, U32 halibut mortality was re-estimated for all years back to 1974 using data from the Commission's Standard Stock Assessment Survey (SSA) stations from catch per skate in the top third in each area. Presumably stations with higher catch rates would better represent the commercial fleet catches. Using these stations with high catch rates, staff computed the ratio of U32 to O32, and then used this estimate to estimate the U32 halibut caught by commercial fleet. For 2009, the average of the survey ratios from the last three years was used. This is less variable than a ratio based on only the current year's data.

A mortality rate of 16% was applied to all discards in the years since the beginning of individual quota fisheries (1991 in Canada, 1995 in Alaska). For the earlier years of derby fishing, and for all years in Area 2A, a 25% discard mortality rate was applied. The Area 2A commercial catch numbers include the catch from the directed commercial fishery and the incidental halibut fishery during the sablefish season, but these numbers do not include catch from either the tribal fishery (as U32halibut are accounted for as part of the ceremonial and subsistence fishery), or from the incidental halibut caught during the salmon season (as it is an incidental troll fishery).

To estimate the pounds of U32 halibut captured in the commercial halibut fishery, the area-specific ratio of U32 to O32 was multiplied by the estimated commercial catch in each regulatory area, for each year. The resulting poundage was then multiplied by the discard mortality rate to estimated poundage of U32 halibut killed by the commercial fishery.

Personal use harvest of Pacific halibut

The first halibut fishery was conducted by aboriginal people for the purpose of survival. When European Americans industrialized the halibut fishery in the late 1800s, very little in the way of knowledge of the original fisheries was preserved. There was no history of catch statistics nor history of regulatory actions that transferred into the new management system. Although the aboriginal fisheries had been governed by customs and traditions, these were generally not understood by the new managers. However, elaborate and

The *F/V Tolstoi* tied to the dock in St. Paul, AK. Photo by Tom Kong.

highly crafted fishing artifacts, such as lures and hooks, survived as testimony to the value that aboriginal fishers placed on halibut fishing. Early Europeans recognized the importance native peoples placed on halibut, and there is a note about halibut capture by natives in Captain Cook's 1778 records. It remained the task for anthropologists to try and recover some of the knowledge, wisdom, and history of the earlier halibut fisheries. Even so, fishing for halibut to subsist remains important to this day, and these aboriginal fisheries have evolved into what we now call the personal use fisheries. The category includes harvests taken in (1) the federal subsistence fishery in Alaska; (2) the sanctioned First Nations Food, Social and Ceremonial (FSC) fishery conducted in British Columbia; (3) the ceremonial and subsistence removals in the Area 2A treaty Indian fishery; and (4) the halibut under 32 inches (which are undersized in the commercial fishery) retained by commercial fishers in Areas 4D and 4E under the Commission's regulations. Although these estimates were in some cases based on sparse information, statistics on personal use removals are provided for 2008, the most

The personal use fishery encompasses several different categories of removals.

recent year for which full information is available. In addition, you will find incomplete statistics for 2009.

Estimated harvests by area

The coastwide personal use harvest was estimated by the Commission at more than two million pounds in 1991. This catch series declined rapidly through 1995, and became relatively stable over the following two years. However, the Commission revised the harvest estimation methods in 1998. The resulting revised catch series was somewhat higher and remained fairly stable through 2002. Harvests took another jump in 2003 following the implementation of new subsistence fishery regulations in Alaska and a more comprehensive harvest estimation survey. It is important to note that many of the changes seen in the harvest estimates prior to 2003 were due primarily to changes in estimation methods and may not necessarily have reflected actual changes in harvest levels. The majority of the personal use harvest continues to be taken from waters off Alaska.

Alaska

The Commission began estimating the personal use harvest in Alaska in 1991. Documentation of estimation methods cannot be located, but the available estimates indicated that personal use in Alaska totaled 1.95 million pounds that year. The estimate for 1992 dropped by half, to one million pounds. Estimates were subsequently made for each of the Commission's areas independently, but not necessarily annually for all areas.

In 1998, a new method was developed to estimate personal use based on information gathered by household interviews and postal surveys conducted by ADF&G. The surveys did not distinguish between sport and personal use harvests, so the estimates of personal use were ultimately based on assumptions about the amount of sport and personal use in Alaska Native and non-Native households. The resulting estimates were used for Alaska for 1998 through 2002, with the only annual changes being the pounds of sublegal-sized halibut retained by the Area 4E, and later 4D CDQ fishers.

For 2008, the most recent data available, a little over half of the Alaska subsistence catch came from Area 2C.

In 2003, the subsistence fishery for halibut off Alaska was recognized by the NPFMC, and a separate set of fishery regulations was created, which vary according to IPHC's regulatory area. One provision of the subsistence fishery management program was the establishment of an annual survey of fishers to determine the annual harvest. The voluntary survey of the 2008 fishery participants, the sixth since the surveys began in 2003, was conducted by the Subsistence Division of ADF&G under contract to the NMFS. For 2008, the resulting estimates totaled 887,000 pounds (net weight) in Areas 2C through 4E. This represents a 14.1% decrease from 2007.

The 2008 ADF&G survey indicated that 52% of the total subsistence harvest in Alaska was taken in Area 2C, with 38% harvested in Area 3A. The five subareas of Area 4 totaled 49,000 pounds, or 5.5% of the Alaskan subsistence harvest. The communities within Area 4E accounted for 32% of the subsistence harvest within Area 4, which was substantially lower than in previous years.

The Commission also adds the amount of U32 halibut retained by the Area 4D/4E CDQ fishery. The CDQ organizations are required to report to the

Commission the amounts retained. Estimates of personal use harvest based on the ADF&G subsistence survey included all registered fishers and households in all Areas, but Area 4D and 4E fishers were instructed to exclude any retained sub-legal sized halibut caught during commercial fishing. Also, fishers who retained sublegal-sized fish as part of their Area 4D/4E commercial harvest were not required to register for the subsistence fishery and therefore should not have participated in the survey. Therefore, estimates of the sub-legal harvests were added to ADF&G's estimates of the subsistence harvest to fully account for the total 2008 personal use harvest.

British Columbia

The primary source of personal use harvest in British Columbia was the First Nations Food, Social, and Ceremonial fishery (often abbreviated FSC). In past years, the IPHC has received some logbook and landing data for this harvest from DFO, but those data have not been adequate for the Commission to make an independent estimate of the fishery harvest. Thus, the IPHC relies on the DFO for these estimates. Through 2006, the Canadian estimate of this harvest was 300,000 pounds annually. Since 2007, this harvest has been estimated at 405,000 pounds. In the commercial fishery, the fish not sold and take-home fish were considered personal use harvest prior to the implementation of the IVQ program. Currently, in the IVQ program all halibut landed by a vessel are weighed by the port monitors at the time of the offload, and any take-home fish are taken from this quantity. Thus, personal use harvest associated with the commercial harvest is accounted for as part of the vessel's catch.

In British Colunbia, take home fish from the commercial fishery is taken off the vessel's quota.

A juvenile halibut like this one cannot be taken as commercial catch, but can be caught in the subsistence fishery. IPHC photo archive.

Washington, Oregon, and California

In Area 2A (Washington, Oregon, and California), 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 a portion of their allocation to their own ceremonial and subsistence fishery. For 2008 and 2009, the treaty tribes allocated 30,000 and 29,000 pounds, respectively, to their ceremonial and subsistence fishery.

State regulations require that personal use fish from the commercial hook-and-line halibut fisheries be recorded on the fish tickets. This reporting requirement causes the personal use catch to be included in the commercial catch.

Retention of halibut under 32 Inches in the Area 4D/4E CDQ fishery

Of the three organizations reporting, all showed decreases from 2008.

In 1998, the IPHC approved a two-year exemption to the regulation preventing retention of U32 halibut in Area 4E. A reporting requirement was added for the 1999 fishery. The IPHC approved another two-year exemption covering the 2000 and 2001 fishing seasons. At the 2002 Annual Meeting, the Commission agreed to extend the allowance to CDQ operations in Area 4D and to amend the regulation to apply only to vessels that land all of their catch in Areas 4D or 4E. The harvests reported herein are reported separately from the household survey conducted by ADF&G for the subsistence harvest. As stated previously, survey participants were instructed to exclude any sublegal halibut retained during commercial fishing.

Reports for 2009 were received from three organizations: Coastal Villages Regional Fund (CVRF), Norton Sound Economic Development Corp. (NSEDC), and Bristol Bay Economic Development Corp. (BBEDC). Overall the 2009 landings of U32 halibut totaled 11,259 pounds, down 48% from 2008. All three organizations reported lower amounts retained in 2009, with CVRF and BBEDC down substantially. Generally, these changes are a reflection of the amount of effort by the local small boat fleets and the availability of fish in their nearshore fisheries.

Incidental catch and mortality

Sometimes fisheries that target a particular fish or shellfish inadvertently catch a non-targeted species. This incidental catch—often called *bycatch*—is substantial in some fisheries. Reducing or even eliminating bycatch has been a major objective of many organizations interested in the health of the world's fisheries. The Food and Agriculture Organization of the United Nations (FAO), NMFS, DFO, and many other organizations have issued policy statements, conducted research, and otherwise tried to deal with bycatch as a problem. In the 1980s, concerns about the bycatch of Pacific salmon and other species in the high seas driftnet fisheries resulted in action by the United Nations calling for "moratoria on all large-scale pelagic driftnet fishing on the high seas by 30 June 1992," except for special cases that can be shown to be well regulated.

Bycatch of unwanted species has inspired ogoing controversy, and halibut caught incidentally is no different.

Birds, marine mammals, fishes, or shellfishes have all been the subject of concern at one time or another. In a 1997 report, FAO identified shrimp fisheries as those having the highest bycatch rates, worldwide. The issue of bycatch has been a major source of conflict between some conservation groups and various fishing interests. In general, regulations require that halibut caught as bycatch be returned to the sea quickly and with no additional injury. However, some fish die from being caught and handled. The preliminary estimate of bycatch mortality for halibut in 2009 is 11.6 million pounds. This is a 2.2% decrease from 2008 and the lowest level seen since 1986.

Bycatch is taken by all gear types including trawl, longline, and pot. Photo by Paul Logan.

Sources of bycatch information and estimates

The IPHC relies upon information supplied by observer programs to provide estimates of bycatch in most fisheries. Research surveys provide information used to generate estimates of bycatch in the few cases where fishery observations are unavailable. NMFS operates observer programs covering the groundfish fisheries off Alaska and the U.S. west coast, and this is one of the key sources of information. Estimates of bycatch off Alaska for 2009 were based on bycatch reported from fishing conducted through mid-November and projections for the remainder of the year. The observer coverage leading to these bycatch mortality estimates varies by fishery. Coverage is based on vessel length and can range from 100% coverage of fishing days in many Bering Sea fisheries to values as low as 30% coverage of fishing days for most Gulf of Alaska fisheries. Because of questions about the coverage, the bycatch estimates presented here might understate the extent of halibut bycatch mortality.

In the absence of direct fishery observations, the Commission's staff has developed estimates of bycatch mortality in crab pot and shrimp trawl fisheries off Alaska from bycatch rates observed on research surveys and previous studies of these fisheries.

Estimating bycatch and resulting mortality is no easy task and varies depending on area and fishery.

The amount of information varies for fisheries conducted off British Columbia. For the trawl fishery, bycatch is managed with an individual bycatch quota program instituted in 1996 by DFO. Fishery observers sample the catch on each bottom trawler, collecting data to estimate bycatch and discard mortality. Until recently, the bycatch levels in other fisheries, such as the shrimp trawl, sablefish pot, and rockfish hook-and-line fisheries, have been largely unknown. This situation changed with the inception of the Integrated Groundfish Management Program in 2006. The program has provisions for full accounting and accountability of all bycatch, and includes 100% at-sea monitoring, either by human observers or electronic monitoring.

Halibut bycatch in the domestic groundfish trawl fishery operating in Area 2A is estimated from information collected by at-sea observers. Bycatch rates (number per hour) are derived from the observer data, and applied to commercial fishery effort from logbooks. Shrimp trawl fishery bycatch estimates are provided by Oregon Department of Fish and Wildlife staff from examinations of halibut bycatch during gear experiments. The estimates are considered rough approximations given the limited amount of data available. Even so, these estimates appear reasonable and are updated every few years.

Discard mortality rates and assumptions

Discard mortality rates (DMRs) are used to determine the fraction of the estimated bycatch that dies from the trauma of capture, and these rates vary by fishery and area. These discard mortality rates are calculated from observers' assessments of the viability or extent of injury of halibut.

Observer data are used to directly calculate DMRs in fisheries in three major areas. NMFS manages the groundfish fisheries off Alaska using a schedule of discard mortality rates provided by the Commission. In Area 2A, NMFS observers have been collecting release condition data on bottom trawlers for several years. In Area 2B, observers monitoring the Canadian trawl fishery

examine each halibut to determine release viability. The bycatch mortality reported to the Commission is based on those release mortality observations.

Data to determine these mortality rates for other fisheries are not available. Therefore, the IPHC matches fisheries without estimates with similar fisheries were the estimates are available. Estimates for areas without direct observations are then based on observations from the matched, similar fisheries. For Area 2A, the unobserved hook-and-line fishery for sablefish is assigned an assumed DMR of 16%, based on an analysis of the observer data from the sablefish fishery off Alaska prior to the implementation of individual fishing quotas in 1995. The midwater fishery for whiting is assumed to have a 75% DMR, based on the large catches of whiting typical of this kind of fishery.

Bycatch mortality by regulatory area

Halibut bycatch mortality was relatively small until the 1960s, when it increased rapidly due to the sudden development of the foreign trawl fisheries off the North American coast. The total bycatch mortality (excluding the Japanese directed fishery in the eastern and western Bering Sea) peaked in 1965 at about 21 million pounds. Bycatch mortality declined during the late 1960s, but increased to about 20 million pounds in the early 1970s. During the late 1970s and early 1980s, it dropped to roughly 13 million pounds, as foreign fishing off Alaska came under increasing control. By 1985, bycatch mortality had declined to 7.2 million pounds, the lowest level since the Commission began its monitoring nearly 25 years earlier. Bycatch mortality increased in the late 1980s, due to the unregulated growth of the U.S. groundfish fishery off Alaska, and peaked at 20.3 million pounds in 1992. Bycatch mortality has since declined. Preliminary estimates for 2009 total 11.6 million pounds, representing a 2.2% decrease from 2008 and a 44% decrease from the peak in 1992 of 20.3 million pounds. Bycatch mortality ranged between 12 and 14 million pounds since the late 1990s, and has been below 12 million pounds in 2008 and 2009.

Halibut mortality has decreased by 44% since its last peak in 1992.

Area 2

In 2009, the bycatch mortality in Area 2 was estimated at 0.94 million pounds, up 8% from 2008 but below the 10-year average of 1.1 million pounds. The primary bycatch fisheries in Area 2 are the groundfish trawl fisheries operating off Washington, Oregon, and British Columbia; the crab pot and shrimp trawl fisheries in southeast Alaska; and fixed-gear fisheries in Area 2A.

NMFS estimated halibut bycatch mortality for the 2008 west coast trawl fishery at 0.281 million pounds, a 9% increase from 2007. The amount of bottom trawl effort increased 23% from 2007 and effort continued to shift into deeper waters, outside of areas closed to protect rockfish. The total amount of bycatch increased 35% from 2007, although estimated mortality increased only 9%. Even though the amount of mortality was lower than 2005 and 2006, the amount of bycatch from fish over 32 inches in total length was the highest since 2004, reflecting the shift to fishing deeper water. This 2008 estimate has been used for 2009, but the 2008 statistic will be replaced when an actual estimate for 2009 is obtained, probably in late 2010. Finally, no new estimate of halibut bycatch mortality is available for the shrimp trawl fishery, so the estimate from 2008 has been rolled forward to 2009.

A fishing effort shift to deeper waters has contributed to an increased bycatch of O32 halibut in Area 2A.

An estimate of bycatch in the west coast fixed gear fishery was estimated by NMFS for the first time in 2009.

The bycatch level in the U.S. west coast fixed-gear fisheries was estimated by NMFS for the first time in 2009. These fisheries target sablefish, rockfish, and lingcod. The bycatch level was estimated from observed bycatch rates applied to fish ticket landings data. Mortality was estimated by using an assumed discard mortality rate of 16%. The Commission's analysts noted that the west coast fixed-gear groundfish fishery does not have regulations specifying the use of certain release methods (i.e., careful release), as is the case for the groundfish fishery off Alaska. The analysts also had concerns about potential bias and nonrandom collection of observations. The 16% discard mortality rate that the Commission's scientists assumed for the discard mortality of halibut under 32 inches in length is based on observed discarding of halibut in Alaska. Therefore, this assumption is a reasonable proxy value for the west coast fixed-gear fishery. The resulting annual estimates for the 2002–2008 period ranged from 38,000 pounds to 77,000 pounds, with an estimate for 2008 of 77,000 pounds. However, the 2006 estimate was 177,000 pounds — an exception that could not be explained. Excluding the 2006 value, the estimates are about double what the Commission had been previously assuming.

The stern of a trawl fishing vessel. Photo by Paul Logan.

Trawl mortality in Area 2B increased by 50% this year, but is still below the 10-year average.

For Area 2B, trawl fishery bycatch mortality was estimated at 220,000 pounds, an increase of 50% from 2008 but still below the average of 250,000 pounds for the 2000–2009 period. This past year saw a return to more summer fishing than in 2008. Fishing in the summer had been avoided in recent years due to high fuel prices.

In Area 2C, crab pot fishing and shrimp trawling occur in various locations throughout the region. Pot fishing for brown king crab (*Lithodes aequispina*) occurs in the deep waters of Chatham Strait during the winter months, and beam trawling occurs for shrimp and flounders in the inside waters of southeast Alaska. These fisheries have not been reviewed since the early 1990s, but they are small scale in nature, with low bycatch. Commission scientists assumed that mortality has been relatively stable in this area since it was first examined.

Area 3

Estimates of bycatch mortality in Area 3 were relatively unchanged from 2008. The bycatch mortality in this area was estimated at 4.3 million pounds in 2009, a 2% decrease from the 2008 level. Trawl fishery bycatch mortality was estimated at 3.3 million pounds, which was about the same as in 2008. The amount taken in Area 3A and 3B was also very similar to 2008. At 0.48 million pounds, the hook-and-line fishery bycatch mortality was also about the same as in 2008, but a greater proportion was caught in Area 3B in 2009. Hook-and-line fishing primarily targets Pacific cod (*Gadus macrocephalus*). In 2009, hook-and-line vessels increased their share of the cod catch in the western Gulf of Alaska by over 50% and by roughly 20% in the central Gulf. The proportion caught by the trawl fishery subsequently declined. The total 2009 Area 3 bycatch mortality is slightly below the 10-year average of 4.45 million pounds.

A bycatch cooperative program is showing promise in Area 3A.

The Rockfish Pilot Program, a program operating from 2007 to 2011 in the central Gulf of Alaska (Area 3A), permits harvesters to form voluntary cooperatives and receive exclusive harvest privileges for certain rockfish species. These cooperatives are usually referred to as co-ops. Co-op participants are assigned rockfish quota shares based on their catch histories and are required to have 100% observer coverage. The quota share is then fished collectively by co-op members. Two cooperatives have been formed, one composed of catcher/processors and one of catcher vessels. The cooperatives operate within the limits of their halibut bycatch mortality constraints. The limits are a portion of the overall trawl bycatch mortality limits for the Gulf of Alaska and were set at 0.28 million pounds for all cooperative fishing in 2009. Preliminary estimates indicate that only 16% of the limit, or 0.045 million pounds, was caught in 2009.

Area 4

Bycatch mortality in Area 4 was estimated at 6.3 million pounds for 2009, a drop of 4% from 2008. Since 2000, bycatch mortality in this area has ranged from 6.6 million pounds to 7.7 million pounds annually, averaging 7.1 million pounds. The 2009 estimate is well below the long-term average. This drop is attributed to the fishery cooperatives allowed by Amendment 80, a program recently approved by the NPFMC. As with the Rockfish Pilot Program, the Amendment 80 cooperative program structure allowed for a slower pace and greater flexibility in the progress of the bottom trawl fishery for flatfish. This was the second year of operation for the Amendment 80 cooperative. The cooperative was assigned a portion of the Bering Sea trawl bycatch mortality limit of 6.1 million pounds. The initial limit is being reduced by 0.33 million pounds between 2008 and 2012.

Bycatch co-ops in Area 4 have resulted in greater flexibility for fishers and allowed for a slower paced fishery.

In 2009, a 5% decrease in trawl fishery bycatch was offset by a 14% increase in bycatch by the hook-and-line fisheries. Driven by cod fishing, bycatch by hook-and-line gear increased markedly, even with lower cod quotas, although total hook-and-line fishery bycatch was well below the bycatch limit for the sector.

Analyses of halibut discard mortality rates in the Alaskan groundfish fisheries

As previously mentioned, Pacific halibut DMRs in the Alaskan groundfish fisheries are estimated from viability (injury and condition) observations

collected by NMFS observers. These data are analyzed each year by the IPHC staff, which recently completed an analysis of viability data collected during the 2008 CDQ and non-CDQ groundfish fisheries off Alaska. The analytical results also form the basis for recommended DMRs for in-season management of halibut bycatch in the 2010–2012 CDQ and non-CDQ groundfish fisheries.

The hook-and-line fishery for cod was the only Bering Sea/ Aleutian hook-and-line fishery to receive significant sampling in 2008.

Non-CDQ Fisheries

Observer coverage and sampling in the major fisheries produced a large number of sampled hauls, and a substantial number of halibut sampled. For example, observers sampled over 9,000 hauls and 8,500 halibut in the Bering Sea/Aleutian midwater pollock fishery. Specific vessel trips can target different species; these fishing trips are categorized by referring to the intended target species as *targets*. Two flatfish targets, yellowfin and rock sole, had more halibut examined than any other target. Sample sizes were also very high (more than 1,000 hauls and more than 1,000 halibut measured) in most Bering Sea/ Aleutian trawl fisheries. The hook-and-line fishery for cod was the only Bering Sea/Aleutian hook-and-line fishery to receive significant sampling in 2008. In past years, sampling has also occurred on rockfish and turbot vessels but only minimally, and 2008 was no exception, as only turbot fishing had any sampling. Pot fishing was focused on cod, as in past years.

Most of the sampling in Gulf of Alaska trawl fisheries occurred in the cod, rockfish, and flatfish targets, which continued patterns seen in past years. The rockfish fishery tallied the largest number of observed tows, but it's not clear how the Rockfish Pilot Program might have factored into this result, as hauls were not coded with any project designation. (The Rockfish Pilot Program is a fishery cooperative operating in the Gulf of Alaska, targeting pelagic rockfish species. It has its own halibut bycatch allocation and attendant groundfish allocation to support the rockfish catches. It also has a 100% observer coverage requirement.) Sampling of the cod and the two pollock fisheries occurred at similar levels (29–38 vessels or about 160–400 hauls). Sampling of flatfish fishing operations was highest in the shallow-water flatfish, arrowtooth, and rex sole targets. For the third year in a row, no vessel effort was noted in the deepwater flatfish target, which in past years was primarily directed at Dover sole. In 2005 high catches of Dover sole were most frequently associated with even greater catches of arrowtooth flounder or rex sole, and to a lesser extent flathead sole. More directed fishing at arrowtooth and rex sole has likely made Dover sole a secondary target. Thus, vessel effort was assigned to those targets and not to deepwater flatfish. The number of sampled hook-and-line and pot vessels targeting cod was similar to past years.

CDQ Fisheries

In 2008, CDQ fishing was conducted using pots, trawls, and hook-and-lines. The primary species targeted by trawl operations included pollock, rock sole, and yellowfin sole. Pacific cod were targeted by hook-and-line, and sablefish by pots.

Almost all halibut caught in the trawl operations were dead when examined. However, in most cases, the mean tow duration was about the same or slightly shorter in CDQ fishing than in non-CDQ fishing for the same target. Haul size was also not consistently greater nor smaller between the two sectors, though in several targets (e.g., Atka mackerel, cod, rockfish, and midwater pollock) the differences were large. Discard mortality rates for the CDQ trawl targets ranged

from 86% to 90%, which are generally higher than what is seen in non-CDQ fishing for the same species. This difference suggests there are other factors at work that affect the condition of the released halibut, such as different catch processing or handling methods for CDQ hauls.

Hook-and-line CDQ fishing consisted of 17 vessels targeting cod. Distribution of release injuries to halibut in the CDQ hook-and-line cod fishery was similar to that observed in the non-CDQ cod fishery, which is reflected by very similar discard mortality rates (about 8.4% in both).

The pot fishery targeted sablefish, with three vessels observed (compared to five in 2007). Very few halibut were examined by observers. Conversely, only 15 halibut were caught, so the infrequent capture probably contributed to the low number of sampled fish. The fishery discard mortality rate of about 22% was almost identical to the 2007 value, and more in line with the long term mean. Pot soak time is positively correlated with halibut mortality. The long soaks increase the potential for amphipod predation and injury from hard-shell crab in the pot.

Recommendations for 2010–2012

The NPFMC is using a plan, recommended by IPHC analysts, in which the discard mortality rates (used to monitor halibut bycatch) will be computed as an average from the most recent, moveable 10-year period. This approach will be used for three years. For example, from 2010 to 2012 the Council will use a 10-year moving average based on 1999 to 2008. The intent is to provide stability for industry participants and to allow them to better plan operations.

To provide stability for participants DMRs will be computed using a moveable 10-year average.

For CDQ targets with no past observations or data, such as hook-and-line turbot, and pot cod, discard mortality rates derived from non-CDQ fisheries data have been recommended. The current non-CDQ fisheries are probably more like the current CDQ fisheries, at least when compared to fishing conducted five years ago or more. For any other target not explicitly noted here in the non-CDQ fisheries, the discard mortality rates for the cod fishery in that region or gear stratum has been recommended.

Regarding interannual variability, discard mortality rates generally do not change greatly from one year to the next, absent regulations that directly affect halibut discard and handling practices. The recent introduction of fishery cooperatives and attendant allocation of bycatch to the cooperatives potentially provides opportunity to improve handling, and therefore survival, of discarded halibut. Discard mortality rates are an expression of fishing practices and crew handling, so the potential for tracking discard mortality rates by cooperative should be explored.

The 2009 Bering Sea trawl fishery Prohibited Species Donation Program

Since 1998, SeaShare of Bainbridge Island, Washington has operated a program that acquires unintentionally landed halibut bycatch in Alaska for donation to hunger relief programs. After several years of development and approval by the Commission, the program was adopted by the NMFS and NPFMC. Although limited to shore-based trawl catcher vessels that land in Dutch Harbor, there is neither a limitation on the amount of halibut that can be donated nor a requirement that the halibut bycatch originates from specific fisheries. In

Vessels tied to the dock in Dutch Harbor, AK. Photo by Paul Logan.

Alyeska, Unisea, SeaFreeze, Coastal Transportation, Food Lifeline, and Seashare all worked together to provide 16,000 pounds of halibut to food banks in 2009.

2009, halibut collected for this program totaled almost 16,000 pounds and were landed by shore-based catcher vessel trawlers at two participating processors in Dutch Harbor. The 2009 total represents a 63% decrease from 2008. Handling of fish in 2009 was similar to past years. The fish were delivered to SeaFreeze in Seattle through donated shipping by Coastal Transportation. The fish were processed in Seattle into steaks, then sleeved, and repackaged for delivery. Halibut steaks were distributed by Food Lifeline to food banks in Colorado, Pennsylvania, New York, and Washington.

Donations to the program have totaled almost 290,000 pounds (net weight) since program inception. NOAA Office of Law Enforcement has monitored the halibut donated to this program and has reported no incidents.

The 2009 Bycatch Workshop

On September 29, 2009, the Commission's staff held its second workshop on halibut bycatch in Seattle, Washington. The intent of the workshop was to explain the effects of both local and non-local bycatch, and to explain how the Commission takes bycatch into account in the halibut management framework. The workshop began with a welcoming message from the Commission's director, Bruce Leaman. IPHC staff members followed with reports on several topics.

The first presentation was given by Gregg Williams, who gave a historical perspective, describing bycatch in halibut management from the late 1950s to the present. He described observer coverage and observer requirements in Alaska, and the bycatch reductions in recent years. This presentation included a number of questions arising from the public, which led to an extended discussion.

Steven Hare provided a detailed history of the methods of accounting of the effects of bycatch. This presentation included a discussion of the loss in eventual yield when a halibut under 32 inches is taken in bycatch, as these small fish have a high probability of being caught later in the halibut fishery after growing

and gaining in size. Additionally, a fish taken in bycatch would have had some probability of migrating to another area, which also needs to be considered when estimating the effects of bycatch on halibut yield.

Next, Juan Valero gave a presentation that got into further detail on how migration will affect the final yield when a U32 halibut is taken as bycatch. Following this presentation there was some discussion of how the Commission's work with PIT tags has helped the Commission's scientists to better understand how bycatch affects yield in other areas.

Much of the workshop was directed by questions and comments from the audience. Similarly, the Commission's staff heard many suggestions that led to further discussion. Near the end of the workshop, questions from the audience led to a discussion of the topic of the Commission's PIT tagging study. This gave the Commission's staff an opportunity to discuss newer tagging approaches and future research.

The Staff-led Bycatch Workshop provided a chance for industry and the public to fully understand the role of bycatch in the halibut stock assessment.

Assessment of the Pacific halibut stock at the end of 2009

Today's stock assessment reflects almost a hundred years of modeling starting with the earliest catch equations.

One of the definitions of the word *assessment* is to set a value. Each year the Commission's staff assesses the abundance and potential yield of Pacific halibut using all available data from the fisheries and scientific surveys. The modern stock assessment includes setting a biologically determined level for total removals from each regulatory area by applying a fixed harvest rate to the estimate of exploitable biomass in that area. A lot has changed in less than 100 years.

In a 1931 Commission report, the authors stated, "the actual numbers on the banks cannot be counted directly, and even were it possible, there would be little utility in so doing, as there are as yet no means of knowing what the maximum population should be." As most people are not really interested in all of the mathematical details, it is hard to explain how much progress has been made in our ability to use statistical models to understand what is happening with the halibut stocks. The very early foundations of the modern science of fishery stock assessment, Prof. Baranov's Catch Equation (which crudely predicts the number of fish that will be left in a population after fishing and natural mortality), was not available until 1918. However, since the development of these early equations in the first few decades of the 1900s, the Commission has developed an extensive

Stock assessment scientist, Steven Hare, takes a break from the office to go port sampling. Photo by Bruce Leaman.

theory of halibut dynamics, which now allows us to estimate the number of fish on the banks with a degree of accuracy that would have been impossible to imagine in the 1930s. The Commission has developed an extensive set of mathematical tools—tools that allows us to predict the effects of harvest and harvest policy. Even with all of the advances in theory and all of the advances in computing, the Commission is still annually making improvements in its ability to understand halibut production and the effects of fishing.

In order to obtain an unbiased estimate of the total exploitable biomass, beginning with the 2006 assessment, the Commission's staff built a coastwide data set and fitted a statistical model that estimates biomass as a function of the survey data derived from the Standard Stock Assessment (setline) Survey catch rates. Then the biologically determined level of total removals is called the *constant exploitation yield* (sometimes denoted CEY) for each area for the coming year. The corresponding level for catches in directed fisheries, subject to allocation, is called the *fishery* constant exploitation yield.

It comprises the commercial setline catch in all areas plus the sport catch in Area 2B, and the sport plus ceremonial and subsistence catches in Area 2A. It is calculated by subtracting from the total constant exploitation yield an estimate of all unallocated removals—bycatch of halibut over 32 inches in length (sometimes denoted O32 in other documents), wastage of halibut over 32 inches in the halibut fishery, fish taken for personal use, and sport catch except in Areas 2A and 2B. Staff recommendations for catch limits in each area are based on the estimates of fishery constant exploitation yield but may be higher or lower depending on a number of statistical, biological, and policy considerations. Similarly, the Commission's final quota decisions form the management targets for the coming year. The final catch limits are based on the staff's recommendations, but the Commission may choose to set these levels higher or lower.

A growing body of evidence points to a continuing and predominantly eastward migration of catchable fish from the western areas (Areas 3 and 4) to the eastern side (Area 2).

As mentioned previously, for many years the staff assessed the stock in each regulatory area by fitting a statistical model to the data from that area. This procedure relied on the assumption that the stock of fish of catchable size in each area was closed, meaning that the overall number of fish moving in or out of each area was negligible. A growing body of evidence from both the assessments and the ongoing mark-recapture experiment showed that there is a continuing and predominantly eastward migration of catchable fish from the western area (Areas 3 and 4) to the eastern side (Area 2). The effect of this unaccounted for migration on the closed-area stock assessments was to produce underestimates of abundance in the western areas and overestimates in the eastern areas. To some extent this process has almost certainly gone on for some time, meaning that exploitation rates were well above the target level in Area 2 and a disproportionate share of the catches have been taken from there. Now that the total exploitable biomass is based on a coastwide analysis, the exploitable biomass in each regulatory area is estimated by partitioning, or *apportioning*, the total in proportion to an estimate of stock distribution derived from the Standard Stock Assessment (setline) Survey catch rates.

Harvest policy

The term *harvest policy* refers to a management strategy for fishing. For example, a management agency might try to maintain a consistent size of the

breeding stock, termed *a fixed escapement* policy. In this case, all of the natural variation in the stock would be transferred to the harvest. Alternatively, the policy might be to harvest a fixed amount each year, irrespective of the size of the stock. Not surprisingly this policy is called *a fixed yield* or *quota policy*. With this fixed yield policy, all of the natural variation in the stock size is transferred to the breeding stock. The Commission has developed, refined, and used a policy that allows a fixed percentage of this stock to be harvested, as long as the stock is above a statistically determined level. This kind of policy is called a *constant harvest rate policy*, and the Commission has used a policy like this since the 1980s.

Stated succinctly, the Commission's policy is to harvest 20% of the coastwide exploitable biomass when the spawning biomass is estimated to be above 30% of a level defined as *the unfished level*. The harvest rate is linearly decreased towards a rate of zero as the spawning biomass approaches 20% of this estimated *unfished* level. That is, no fishing is allowed if the stock is below 20% of the unfished biomass. This combination of harvest rate and precautionary levels of biomass protection have, in simulation studies, provided a large fraction of maximum available yield while minimizing risk to the spawning biomass. Since the early 2000s, the harvest policy has additionally incorporated a measure designed to avoid rapid increases or decreases in catch limits. Without this feature, the harvest rate could quickly change because of either actual changes in stock level or because of changes in the assessment model due to other factors. The protection from rapid changes is similar to what many fisheries management agencies have done. The dampening adjustment is termed *slow up fast down* (and sometimes denoted SUFD). This *slow up fast down* approach is somewhat different from similar phased-change policies of other agencies. The Commission's policy allows the catch limit to respond more strongly to estimated decreases in biomass than to estimated increases. This occurs for two reasons.

The harvest rate and precautionary biomass levels used together provide for maximum available yield while minimizing risk to the stock.

A small halibut is pulled aboard the *F/V Bold Pursuit* during the stock assessment survey. Photo by Levy Boitor.

First, the assessment generally has a better information base for estimating decreasing biomass compared to when biomass is increasing. Second, such an asymmetric policy follows the Precautionary Principle.

Changes to the assessment and apportionment in 2009

The following list is a summary of changes, additions, and updates to the 2009 assessment and apportionment procedures compared to the previous halibut assessment:

- The 2009 survey and commercial data were added to the database.
- Regulatory area and bottom area definitions were expanded and revised.
- The setline survey stations around the Pribilof Islands and St. Matthew Island were used to measure density for those regions.
- The Norton Sound trawl survey data were assembled and density measurements were computed for Areas 4C, 4D, and 4E northern shelf.
- *Swept area* estimates of *Exploitable Biomass* (often denoted EBio) from independent trawl surveys were assembled for all regulatory areas except 2B and 2A.
- Three adjustment factors were considered for the survey measurements (hook competition, bottom depth distribution, and timing of setline survey), and the adjustments can be combined resulting in eight possible adjustment factors.
- The (possibly adjusted) survey measurements were averaged over the past three years using both an equal weighted (1:1:1) and a reverse weighted (2:1:1) scheme to apportion 2010 estimated beginning-of-year biomass.
- The (possibly adjusted) and 3-year averaged survey measurements were optionally weighted by a fixed 15-year (1993–2007) historical removals share.
- The three factors (adjustment, time averaging, historical shares weighting) resulted in 32 possible apportionment schemes, which were compared and evaluated.
- The terms WPUE and NPUE replace the more generic CPUE to refer to *Weight Per Unit Effort* and *Numbers Per Unit Effort*, respectively.
- The terms *over 32 inches* (sometimes denoted O32) and *under 32 inches* (sometimes denoted U32) replace the terms *legal-sized* and *sublegal-sized* when referring to halibut size in Commission documents.

Apportioning the coastwide biomass among regulatory areas

Given that the Commission now develops a coastwide estimate of biomass, and then estimates biomass in the individual areas through a process of apportionment, the method of this statistical apportionment can have a large effect on local catch levels. The Commission's staff believes that the survey-based apportionment (using the catch in units of *weight per unit of effort*, or WPUE, as the key statistic) is the most objective and consistent method of estimating the biomass distribution among areas. Therefore, the staff believes that

Catchability is the assumption that halibut density in relation to catch is the same in all areas. IPHC staff are looking at ways to test this theory.

this apportionment approach produces the best distribution of fishing effort in order to achieve the Commission's goal of proportional harvest among areas.

In order for the survey-based apportionment, described above, to be valid, the survey catchability—the relationship between density and catch (in weight) per unit of effort—must be roughly equal among areas. Over the past few years, several checks for area differences in catchability were made but results were inconclusive in determining differences. This year three factors were considered for adjusting survey WPUE statistics.

Adjustment factors

To help even the field, the Staff developed a set of possible adjustment factors.

The survey stations in the Standard Stock Assessment Survey are set on a fixed 10-nautical mile grid between the depths of 20 and 275 fathoms. Ideally, such an arrangement should lead to stations having the same physical and oceanic characteristics as the entire bottom area within each regulatory area. However, this might not always be so Additionally. the catchability of halibut could be affected by the presence of other bait takers, a process known as hook competition, and the composition and density of other bait takers varies by area. Necessarily, the timing of the survey varies from station to station and from year to year due to survey logistics. The timing of removals (commercial, sport and subsistence fishing, bycatch, wastage) also varies, even more substantially, among areas. For these and other reasons, the Commission's scientific staff has developed a series of potential *adjustment factors*, which are used to make the WPUE statistics more closely comparable among areas. Additionally, the previous year's survey statistics can be averaged together with recent data to make the measurements more statistically stable.

In 2008, the staff presented 10 methods of apportioning biomass and recommended the method that involved hook competition adjustment of bottom weighted survey WPUE, equally weighted over the prior three years. In 2009, the combination of adjustments and weighting described above results in 32 possible combinations. For 2009, the staff recommends the following adjustments: survey timing + hook adjustment, equal-weighting for time averaging, and no inclusion of historical shares.

The biomass apportionment workshop

The Commission's staff held a two-day workshop on the apportionment issue in the stock assessment on April 29–30, 2009 in Seattle, Washington. Following introductions, Mr. Juan Valero gave the first presentation on a historical perspective on changes to the exploitation rates over time. He explained that the current condition is that the center of halibut distribution is now in central Alaska, and very few older halibut now reside in Areas 2A and 2B. He also explained that the relative contribution of the different areas to the total catch has changed dramatically. Mr. Valero's talk led into a long discussion of the "downstream effects" of bycatch.

Following an extended discussion and a break, Dr. Steven Hare made several presentations, starting with a presentation on the Commission's harvest policy (the basic rules that the Commission uses to control the harvest to ensure sustainability). He specifically talked about how the policy is based on the size of the female spawning biomass. He also described the limit and threshold reference

points and described how the policy is based on keeping a constant harvest rate as long as the biomass is above certain reference points. The presentation continued, covering many other topics related to halibut biology, gear selectivity, and halibut demographics. Later Dr. Hare made a presentation on the Commission's survey-based apportionment methods. Much of the rest of the first day was taken up with discussions of gear selectivity and adjustment factors. The first day ended after an extended discussion of the difference between stock assessment model results using the "closed areas assumption" (treating individual areas as if they contained independent sub-populations with little or no migration among them) and using the single coastwide approach (treating the whole population as a single migratory entity).

The second day of the meeting began with Mr. Valero using the *Widget* computer simulation tool and showing how it worked. The tool generates 120 years of simulated halibut data after the user chooses a harvest policy and a number of other management options and assumptions. The staff used the *Widget* to demonstrate a number of points.

Eventually, the workshop turned to the topic of 12 specific apportionment methods and to the feasibility of using the *Widget* to look at the consequence of using each of these. The workshop ended after an extensive discussion of a number of important points, including the specific apportionment methods, the effect of the timing of the Standard Stock Assessment Survey, and performance metrics.

During the workshop, the Widget simulation was used to look at different apportionment methods and the consequence of each over time.

SURVEYING THE WATERS

Surveys continue to be an integral part of assessing the halibut stock.

In the early years of the Commission, the only reliable catch statistics were the catch records that skippers had made for their own personal use. Unfortunately, these early catch records mostly told a story of stock decline, localized depletion, and the need to sail farther in order to maintain yield. In the Commission's sixth report, issued in 1931, there is extensive discussion of how to use these skipper reports. The authors wrote, "...several measures of depletion, such as catch per fishing hour, have been tried and could be resorted to in necessity, but none proved as useful and adaptable as the yield per set of a unit of gear."

In the 1960s the Commission started surveying the waters independently of the commercial fishery in order to develop a more focused base of information about the halibut population in the ocean. The Commission has changed the design of the survey several times over the years, but the basic structure has remained the same. Operationally, the survey vessels fish 3 or 4 predetermined locations each day. The captured halibut are measured, classified by sex and gonad maturity, and otolith samples are collected and used to estimate the age distribution of the population. This survey collects many kinds of important information, but one of the most important products of the survey is a measure of the catch per unit of effort, as recommended by the Commission's first biologists in the 1930s. By combining information from shoreside commercial catch sampling with the information from the Commission's survey, managers have the information they need to develop a clear picture of the status of the stock, the trends in abundance, and the effects of fishing.

IPHC sea sampler, Richard Bruce, waits for the next set while a crewman baits gear aboard the *F/V Blackhawk* during the IPHC stock assessment survey. Photo by Serge Aucoin.

The Standardized Stock Assessment Survey

The Commission's Standardized Stock Assessment Survey (SSA or setline survey) using standardized methods, bait, and gear during the summer of each year, provide an important comparison with data collected from the commercial fishery. The survey fishing effort, however, is a small fraction of the commercial effort and takes place only during the summer. The commercial fishery is more variable in its gear composition and distribution of fishing effort over time but presents a broad spatial and temporal sampling of the stock. Biological data collected on the surveys (e.g., the size, age, and sex composition of halibut) are used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the population. In addition, records of non-target species caught during survey operations provide insight into bait competition, 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 setline survey collects information not only on halibut, but on non-target species as well.

Survey vessels

The Commission chartered twelve commercial longline vessels, six Canadian and six U.S., for the standard stock assessment grid survey operations in 2009. Eleven of the vessels had previously been chartered for the Commission's research work. The *F/V Masonic* had not conducted stock assessment survey work for the Commission since 1983.

Vessel	Regions fished	Effective stations
Blackhawk	Oregon, Washington	101
Bold Pursuit	Sitka, Prince William Sound,Yakutat	137
Clyde	Chignik, Semidi	92
Free to Wander	Sanak, Shumagin, Unalaska	157
Kema Sue	4A Edge, 4D Edge	121
Masonic	Albatross	45
Pacific Sun	Adak, Attu	88
Pender Isle	Ketchikan, Ommaney	81
Predator	Portlock, Shelikof	90
Proud Venture	Goose Is., St. James, Vancouver	126
Van Isle	Charlotte, Fairweather	93
Waterfall	Gore Pt., Seward, Trinity	139
12 vessels	**27 regions**	**1,270**

Results

Because the SSA covers commercial as well as non-commercial fishing grounds, the average catch expressed in *weight per unit of effort* (or WPUE) for all regulatory areas surveyed was below that of the commercial fleet, as it has typically been in the past. Not all of the survey data are used in the analytical stock assessment. Three survey stations fall outside of the analytical boundaries for Area 4A (stations 7041, 7047, and 7048), and some of the inside stations in Southeast Alaska occur at a different density than the acceptable level for the

A downward trend in WPUE ended in Area 2C this year but continued in Area 3A.

analytical model. In addition, four stations (2169-2172) in the Charlotte charter region (in Area 2B) fall under Area 2C for the analytical assessment.

Compared to the 2008 results, the WPUE decreased in Regulatory Areas 2A (-47%), 2B (-4%), 3A (-21%), 3B (-10%), 4C (-21%), remained unchanged in Regulatory Area 4A, and increased in Regulatory Areas 2C (8%), 4B (3%), and 4D (1%). Area 3A has shown a downward trend for the last five years, while Area 2C ended a five-year downward trend this year.

Relative to 2008, Area 2C showed the greatest increase in overall WPUE. However, increases occurred only in the Ommaney charter region, with the WPUE in the Ketchikan and Sitka charter regions remaining steady. In Area 2B, WPUE decreased in Charlotte and St. James, but continued to increase in Goose Island and Vancouver.

In Area 3A, WPUE declined in all charter regions. In Area 3B, the WPUE rebounded slightly in Chignik, Sanak, and Semidi regions, but was offset by declines in Trinity and Shumagin. The WPUE appears to have leveled on the southeastern Bering Sea shelf edge (4D Edge, 4A Edge) and along the Aleutian Island chain (Unalaska, Adak, Attu). Stations that were clustered around the Pribilof Islands and St. Matthew Island were part of the eastern Bering Sea survey in 2006, and have been incorporated into the standard grid survey. Of these clusters of stations, the St. George Island cluster had the highest average WPUE as well as the highest value for a single station in these clusters.The distribution of halibut, both U32 and O32, by depth was consistent with previous years' surveys. The highest abundance of U32 halibut occurred in shallow waters, and O32 halibut were found in a wide range of depths.

IPHC biologist, Cal Blood, enjoys some sunshine from the deck of a research vessel on the way into port during the stock assessment survey. Cal retired in 2009 after more than 27 years with the Commission. Photo by Tucker Soltau.

Bycatch

More than 100 species of fish and invertebrates were caught as bycatch during the survey. Hook occupancy of the major species-groups varied by regulatory area. Despite vigilant deployment of bird avoidance devices, one black-footed albatross (*Phoebastria nigripes*) and three Laysan albatross (*Phoebastria immutabilis*) were caught in 2009. Detailed encounter reports were filed with the US Fish and Wildlife Service in Anchorage, Alaska.

Cod, dogfish, and other sharks were among the most often caught bycatch.

The species that was most frequently incidentally-captured on the 2009 surveys was Pacific cod, followed by spiny dogfish (*Squalus acanthias*). Most common bycatch in Areas 2A, 2B, 2C, and 3A was sharks, primarily spiny dogfish. The most frequent bycatch in Areas 3B, 4A, 4B, 4C, and 4D was Pacific cod. Although the most frequently encountered bycatch species in Areas 4A, 4B, 4C, and 4D was Pacific cod, the "other species" group, composed primarily of white-blotched skates (*Bathyraja maculata*), Alaska skates (*Bathyraja parmifera*), and yellow Irish lord sculpins (*Hemilepidotus jordani*), was also abundant in these areas.

Dogfish was the largest component of the shark species category in Areas 2A (92%), 2B (99.8%), and 2C (99%). Sleeper sharks (*Somniosus pacificus*) made up the largest component of the shark species category in Areas 3A (89%), 3B (99%), 4A (97%), 4C, (100%), and 4D (100%). In 2009, the Commission's survey vessels encountered blue sharks (*Prionace glauca*), sixgill sharks (*Hexanchus griseus*), and soupfin sharks (*Galeorhinus galeus*) in Areas 2A and 2B. Salmon sharks (*Lamna ditropis*) were encountered in Area 2B and Area 2C.

Otolith collection

The otolith collection goal for the 2009 survey was 2,000 otoliths per IPHC regulatory area, with a minimum target of 1,500 per area. In Areas 2A, 4C, and 4D we did not attain the minimum target. Because of lower catch rates and fewer stations than other areas, it is common to collect fewer than 1,500 otoliths in Areas 2A, 4C, and 4D, despite sampling every fish caught. In Area 2C, where higher than anticipated catch rates were encountered, otolith collection exceeded the target number by nearly 25%.

The 1999 year class accounted for the largest proportion of sampled halibut.

Length distribution

The median length of halibut caught on survey stations in 2009 dropped to 80 cm, which is below the legal size limit for the commercial fishery (82cm or 32 inches) and represents a 1 cm decrease from 2008. Areas 2A, 2C, 3B, 4A, and 4C all had average lengths below the commercial legal size limit. The largest median lengths were found in Areas 4B (93 cm) and 4D (89 cm). In comparison to median lengths for each regulatory area in 2008, the median lengths from 2009 decreased in Area 2A, 2C, 3A, and 4D and increased in Areas 2B, 3B, and 4D.

Age distribution of Pacific halibut in the SSA

The 1999 year class (10-year-olds) accounted for the largest proportion (in numbers) of sampled halibut for all areas and sexes combined. The next most abundant year classes were 2000 and 1998 (nine- and 11-year-olds), respectively. Ten-year-olds were the most abundant age class for female halibut sampled in Areas 2B, 2C, 3A, 3B, 4B, and 4D as well as for females from all areas combined. The second and third most abundant age classes for sampled females

Deckhands chop bait aboard the *F/V Waterfall* during the stock assessment survey. Photo by Amy West.

Generally speaking, in recent years average age of males has been higher and average length smaller than for females.

were nine- and 11-year-olds, respectively. The 1999 year class (10-year-olds) was the largest for male halibut from Areas 2B, 2C, 3A, 4A, 4B, and 4D as well as from all areas combined. The second and third most abundant age classes for sampled males were 11- and nine-year-olds, respectively.

Average fork length was calculated from halibut that had an age determination based on an examination of the fish's otolith. Average age was higher and average fork length was lower for males than females in all areas for all years with the exception of Area 4C in 2008. In this case, the average age was slightly lower for males than females. The youngest and oldest halibut in the 2009 setline survey were determined to be 4 and 47 years old. There were 4, four-year-olds: three females measuring between 49 and 86 cm fork length, and one male measuring 76 cm fork length. There was one 47-year-old male from Area 4B, with a fork length of 109 cm. The maximum fork length recorded for halibut caught in the Standard Stock Assessment Survey in 2009 was 213 cm. There were two 213 cm halibut. Both were females from Area 4B; one was determined to be 29 years old and the other to be 30 years old. The smallest halibut sampled in 2009 measured 44 cm in fork length. There was a single 44 cm fish captured in 2009. This fish was of undetermined sex from Area 4A and was six years old.

Trends in seabird occurrence on stock assessment surveys (2002–2009)

Annually, the number of stations in the survey where bird counts have been performed, ranged from a low of 1,218 to a high of 1,260. More than 460,000 birds were recorded since 2002. Start dates for each year's survey ranged from May 25 to June 5 and the end dates from August 27 to September 14, but the bulk of the surveys took place from June through August.

The most common species for all years were northern fulmars (*Fulmarus glacialis*), making up 73% of the sightings. Various gull species made up

14% of the overall sightings; the albatrosses (*Phoebastria* spp.) and petrels (Procellariiformes) represented 8% and 3% of the sightings, respectively. Black-footed albatross were more commonly observed in Washington and Oregon and northward into the Gulf of Alaska, whereas Laysan albatross were seen in greatest numbers in the central and western Aleutian Islands and rarely east of Kodiak Island. A total of 153 of the endangered short-tailed albatross (*Phoebastria albatrus*) were also sighted in Area 3A and regions westward, more often in July and August than in June. Over time, the number of unidentified gulls has decreased, correlated with an increased number of glaucous-winged gulls (*Larus glaucescens*) identifications, the most common of all the gull species on the eastern Pacific coast. This is likely because of increased focus on gull identification during sea sampler training. Overall, the number of unidentified birds has decreased since the start of the program, indicating that the Commission's sea samplers have improved their identification skills.

Bird watching has become a standard part of the survey.

The survey is not conducted at the same time in each area, which may affect the time series of bird sightings. The IPHC would like to further analyze the influence of charter timing on bird observation trends. Because of the large geographic scope and consistent spatial pattern of the surveys, the Commission's observations on bird abundance are helpful to scientists studying populations of threatened and endangered birds seen during the counts.

Prior hook injuries: Results from the 2009 IPHC setline survey and NMFS trawl surveys

In the mid-1990s halibut fishers began to notice increasing rates of hook injuries from previous captures. Although groundfish and halibut longline harvesters in Alaska are required to practice careful release techniques for all halibut intended for return to the sea, either the regulations were not being observed by all fishers or the careful release procedures were inflicting worse damage than expected. In 1997, the Commission started to collect information on prior hook injuries (PHI) during the coastwide setline survey. The Commission continued the research of PHI incidence in 1998 and subsequent years. In 1998, the PHI categories were expanded to provide more detail about the severity of each injury.

Documenting prior hooking wounds on halibut can provide some insight into the effect of catch and release fishing on the population.

Data collection procedures

All halibut captured during the Commission's 2009 SSA were examined for the presence of prior hook injuries, defined to be injuries that occurred when the fish was being released during a previous capture by hook-and-line gear. If the fish had been captured recently, then the injury might be easily noticed. Alternatively, an older injury may appear as scar tissue. Some injuries may be difficult to categorize, if for example the injury was recent and confused with injuries sustained in the current capture. PHIs occur primarily in the jaw, but can also occur around the eye and eye socket, either alone or in conjunction with a jaw injury.

In 1997, each surveyed fish was coded as having an injury (Y), not having an injury (N), or that the sampler was unsure as to whether an injury was present (U). In 1998, the observation codes were revised to capture more specific details of each injury. The new condition codes were either "1" for no injury, "2" for

a minor injury, “3” for a moderate injury, “4” for a severe injury, or “9” for unknown. These categories have been continued through 2009.

For the analysis that follows, Area 4A was divided into two sub-areas: 4A-Bering Sea and 4A-Aleutians. All stations in Area 4A west of 165º 00’ W longitude and north of 54º 20’ N latitude were designated as 4A-Bering Sea, and the remainder 4A-Aleutian.

Results

Approximately 98,000 halibut were examined during the 2009 survey, on a total of 8,739 standard survey skates. The percentage of halibut with a PHI ranged from a low of 1.9% (Area 2A) to a high of 20.4% (Area 4A-Aleutians). The incidence averaged 9.0% coastwide. The 2009 coastwide PHI rate was higher than that of either 2008 (7.1%) or 2007 (6.6%). The incidence of PHIs on the 2009 surveys decreased in Areas 2A, 2B, 3A, 4C and 4D. The decrease was particularly marked in Area 2A (1.9% from 12.0%). Previous hook injury rates increased in Areas 2C, 3B, 4A-Aleutians, 4A-Bering Sea and 4B. The increase was particularly dramatic in Area 4A-Aleutians (20.4%, up from 4.5% the previous year).

For halibut under 32 inches (U32 in the commercial fishery) that were examined in the 2009 survey, the overall incidence of PHI increased from 4.1% in 2007 to 6.4%. By area, PHI in U32 halibut increased in Areas 2A, 2B, 3A, 4A-Aleutians, 4A-Bering Sea, and 4C, and decreased in Areas 2C, 3B, and 4B. The highest occurrence of PHI in U32 halibut (17.8%) was observed in Area 4A-Aleutians, representing a dramatic rise from the 2.9% seen in 2008. Prior-hook-injury rates in all areas have fluctuated over time. Along with the marked one-year increase in Area 4A-Aleutians, notable increases were also seen in Areas 3B and 4B. Rates have fallen markedly in Area 2A and 4D in recent years.

The incidence of prior hooking injuries varies along the coast depending on the fisheries operating there and the size of the halibut.

The Commission’s samplers on board NMFS trawl surveys in the Bering Sea (annual survey) and Gulf of Alaska (biennial survey) regions also gathered PHI data. In the 2009 Bering Sea trawl survey, 1,844 halibut were inspected, and the prior-hook-injury rates were determined to be 3.5%—about half again the rate of 2.3% seen in 2008. Rates also rose in the Gulf of Alaska, with 5.6% of the 5,228 observed halibut exhibiting PHI, up from the 4.8% observed in 2007.

In 2009, the proportion of moderate injuries in Areas 2A, 2B, and 2C decreased relative to the minor injuries. The relative proportion of moderate injuries increased in Area 4A-Aleutians. The frequency in other areas remained relatively unchanged. As has been our usual observation, the proportion of more severe injuries relative to lesser injuries remains highest in Areas 4B, 4C, and 4D, which are areas that also have high rates of overall injury.

The incidence of PHI in the Gulf of Alaska areas has ranged from 4 to 8% overall, and not exceeded 10% since we started collecting observations. Even so, high PHI rates are common, with localized rates of 25% or more from some individual stations, including stations off the Washington and British Columbia coasts, off southeastern Alaska, and below Kodiak Island. The mean values in the Bering Sea regions have recently been 8% or more, and in Area 4D the value has exceeded 20% for three of the past six years. In general, a PHI rate of 5% to 15% is very common at individual locations, and often the rate is even higher.

Cruise report for the 2009 NMFS Bering Sea trawl survey

In 2009 the Commission participated in the NMFS annual Bering Sea shelf trawl survey for the 12th straight year. The primary NMFS goal was to continue the annual series of crab and groundfish assessment surveys for the eastern Bering Sea that was started in the 1970s. Two chartered fishing vessels, *F/V Aldebaran and F/V Arcturus,* were each staffed by six scientific crew members. The IPHC biologist was aboard the *F/V Arcturus* for the duration.

Aside from helping the NMFS scientists, the Commission biologist's main objective was to sample 100% of the halibut caught on the vessel for length, gender, maturity, PHI, and otoliths for age determination. In addition, all halibut over 55 cm fork length were scanned for PIT tags.

The NMFS trawl surveys are a way for IPHC scientists to get a glimpse of the younger and smaller cohorts of halibut before they've reached commercial size.

Survey area and design

The survey spanned the eastern Bering Sea continental shelf from inner Bristol Bay to the shelf break, as well as Unimak Pass to north of St. Matthew Island. The scientific crew boarded the *Arcturus* in Dutch Harbor, AK on May 28 and the charter concluded on July 31.

The survey consisted of 376 stations positioned on a 20 x 20 nautical-mile grid on the continental shelf in the eastern Bering Sea, in depths ranging from 30–200 meters. In areas surrounding St. Matthew and the Pribilof Islands, grid block corners were also sampled to better assess blue king crab (*Paralithodes platypus*) concentrations. Survey sampling began in Bristol Bay and progressed westward toward the Eastern Bering Sea outer shelf along alternate grid columns. A NMFS 83-112 Eastern trawl, which has a 25.3 meters (83 ft) headrope and 34.1 meters (112 ft) footrope, was used. Net-mensuration equipment recorded net height and width while fishing; a Sea-Bird™ data logger recorded temperature and depth; and a tilt sensor was used to detect when the footrope was in contact with the bottom.

The trawl survey begins in Dutch Harbor, AK, shown here from Mt. Ballyhoo. Photo by Paul Logan.

Results

The *F/V Arcturus* performed 214 standard tows. On average, four to six tows were conducted daily. In total, 1,844 halibut were captured and sampled: and of those, 1,013 were female and 831 were male. In all, 510 halibut were scanned for PIT tags, and no tags were detected.

Of the halibut caught on the Bering Sea survey, 55% were female and 45% were male.

All halibut caught during the survey on both vessels were measured for length. Estimates of relative abundance are derived by expanding the survey catches from the area swept by the trawl to the total survey area. Estimates are not adjusted for size-specific selectivity, so the reader should exercise caution when drawing conclusions regarding halibut that are underrepresented in the trawl survey (i.e., halibut greater than about 100 cm in length). Total abundance in the Bering Sea survey area using the area swept method, was estimated to be just over 102 million halibut in 2009. Abundance has been decreasing since achieving a record high of 134 million fish in 2006, but is still well above the values seen in the past 20 years. From 2006 to 2007, the halibut under 40 cm dominated the overall catch, but in 2008 the 40–79 cm size class regained that position. A similar pattern was seen in the early 1990s, when the exceptionally large 1987 and 1988 year classes were moving through the juvenile population. The overall patterns are similar, but the current number of juvenile halibut is estimated to be higher, which could translate into a very large year class entering the commercial fishery in a few years. However, the halibut growth rates are substantially lower now than they were in the early 1990s, which could delay and dampen the contribution these fish will make to the fishery.

Cruise report for the 2009 NMFS Gulf of Alaska trawl survey

The Gulf of Alaska NMFS trawl survey is conducted every two years and spans the entire U.S. Gulf shelf from Islands of Four Mountains to Dixon Entrance.

In 2009 the Commission also participated in the NMFS Gulf of Alaska bottom trawl survey that was originally started in 1984. Three vessels were chartered to carry out the survey – *F/V Vesteraalen, F/V Sea Storm,* and *F/V Pacific Explorer* – and the Commission biologist was aboard the *F/V Pacific Explorer* for the duration. Each vessel was staffed with a fishing crew and six scientific crew members. The main goal was to gather data to extend this time series for monitoring trends in distribution, abundance, and biological condition of various groundfish stocks in the northeast Pacific Ocean.

As with the Bering Sea survey, the Commission's main objective for this survey was to collect growth and age structures from halibut along the Gulf of Alaska continental shelf to aid in stock assessment and year-class forecasting as well as perform as a productive member of the scientific crew.

Survey area and design

The survey area stretched from the Islands of Four Mountains (170^{o} W longitude x 53^{o} 30' N latitude) to Dixon Entrance (132^{o} W longitude x 54^{o} N latitude) between the depths of approximately 15 and 1,000 meters. The scientific crew boarded the *F/V Pacific Explorer* in Dutch Harbor, AK on May 18th and concluded in Ketchikan, AK on July 28th .

The survey area was divided into 59 strata based on depth, major geographic features, and the International North Pacific Fisheries Commission statistical areas. The number of samples to be taken within each stratum was based

***F/V Pacific Explorer*. Photo by Paul Logan.**

primarily on distribution and abundance estimates from prior surveys and the relative commercial value of the major groundfish species. All three vessels started sampling at the western end of the survey area and proceeded eastward.

The bottom trawl used for all survey sampling was a NMFS standard Poly Nor'Eastern trawl equipped with rubber bobbin roller gear. This trawl has a 27.2 meters headrope and a 36.7 meters footrope consisting of a 24.9 meters center section with adjacent 5.9 meters "flying wing" extensions. Electronic equipment was attached to the trawl net to record data about each tow: Scanmar (432 South 1st Street, Richmond, CA) acoustic sensors recorded net height and width while fishing; a bathythermograph recorded temperature and depth; and a tilt sensor detected when the footrope was in contact with the bottom.

Results

The *F/V Pacific Explorer* conducted 295 tows over the course of the survey. The stations ranged in depth from 26 to 43 meters. One to eight tows were attempted daily. A total of 5,139 halibut were captured and 3,442 were retained for otolith and gender sampling. Of those, 1,422 were female and 2,020 were male. Of the females sampled, 94.0% were coded immature, and 10.7% of the males were coded immature. The percentage of mature females has remained relatively constant over time while the percentage of mature males has increased dramatically in recent years.

The sex composition in the Gulf survey catch showed the opposite pattern of the Bering Sea survey with 41% females and 59% males.

Estimates of relative abundance are derived by expanding the survey catches from the area swept by the trawl to the total survey area. Estimates are not adjusted for size-specific selectivity, so the reader should exercise caution when drawing conclusions regarding halibut that are underrepresented in the trawl survey (i.e., halibut greater than about 100 cm in length). The Gulf of Alaska swept area estimate of abundance for 2009 is the highest seen in more than 20 years, coming in at 243 million halibut. Due to varying growth rates and dispersion over time, high abundance observed at smaller size-classes in the trawl survey does not always translate into similar strength in the halibut commercial fishery (which harvests O32 halibut).

IPHC Research

Many important questions fall outside of the formal stock assessment process and are answered by independent, but related, research.

The Commission was started with a mandate to use research to conserve the benefits from the halibut resource. At the very beginning, the Commission employed the respected scientist W. F. Thompson as its Director of Investigations, and he was given an energetic and competent staff. Also, at the very beginning the Commission assembled a prestigious board of scientific advisors. In the first of the Commission's reports, released in 1931, the authors speak about the scientific framework the Commission was trying to build. Specifically, they state, "the commission determined at the outset that [its research] would be carried out along practical lines, with close adherence to facts and avoidance of unsupported theory." In other words, the Commission was launched with a mandate to first assemble the necessary facts, and then rationally analyze the facts before acting to manage the fishery. The SSA survey and the catch sampling now serve as a very formal process to assemble many of the facts that the IPHC needs. And the stock assessment process now serves as a formal means to analyze some of those facts. However, many important questions fall outside of what can be answered by the stock assessment process. At the beginning, the Commission was perplexed by the question of how to restrict the fishery so as to maintain yield and questions about what sort of management targets the Commission should even be looking for. We know a lot more about halibut today than in the 1930s, but new questions loom having to do with a changing climate and movements of adult halibut.

Sea sampler, Tucker Soltau, pulls the water column profiler back aboard the *F/V Proud Venture* during the stock assessment survey. Photo by Beth Dubofsky.

Oceanographic monitoring

Since the expansion of its survey operations in 1997, the IPHC has annually conducted fishing operations at more than 1,000 stations ranging from Oregon to the Bering Sea. These stations are located on the continental shelf in depths between 35 and 500 meters, on an equidistant 10 nautical mile grid. As such, the Commission operates the largest consistent sampling program of any research agency in the north Pacific. In the late 1990s, the Commission sought proposals on how this sampling platform could be used for other scientific investigations without affecting the core survey activities. One obvious project was the collection of oceanographic data.

In 2009, the IPHC launched its coastwide oceanographic monitoring program made possible by a grant from NOAA.

To better understand the factors driving fluctuations in growth and recruitment of fish populations, researchers are paying increasing attention to climatic and oceanic conditions. Primary and secondary productivity are directly driven by variations in water temperature, salinity, dissolved oxygen, and other factors. Acidification of the oceans and upwelling-induced hypoxia are just two of the phenomena linked to global climate change in recent years. How these fundamental changes in the physical and chemical makeup of the ocean waters affect organisms living there is not well understood. Coupling oceanographic observations with estimates of production from the Commission's setline survey is an obvious next step to increasing the understanding of what drives the abundance and distribution of our natural resources.

In 2000, a Seabird™ Seacat SBE-19 water column profiler was purchased by the IPHC and deployed aboard a commercial halibut longliner chartered for the SSA Survey. In 2007, the Commission received a grant from the Oregon Department of Fish and Wildlife Restoration and Enhancement Program to purchase a second Seabird™ Seacat SBE-19plus (an updated version of the SBE-19) dedicated to the Commission's survey stations off the Oregon coast. This new profiler was equipped with sensors to measure depth, temperature, salinity, dissolved oxygen (SBE-43), pH (SBE-18), and chlorophyll *a* concentration (WebLabs ECO-FLRTD).

Pairing environmental data with biological data may lead to further insights on halibut distribution patterns among other things.

The successful deployment of these two profilers aboard multiple vessels over multiple years provided proof of concept that these oceanographic data could be collected with minimal disruption to the survey operations. To that end, the Commission received a grant from NOAA in late 2008 to purchase 14 new Seabird™ Seacat19plus V2 water column profilers to be deployed on all survey vessels. The first year of coastwide deployment was 2009 and a total of 1,245 successful casts were made out of a possible 1,280.

Deployment method

The most recently purchased Seacat profilers are equipped with a titanium housing that is rated for depths to 7,000 meters. The sensors have depth ratings ranging from 1,000 meters to 7,000 meters, which is sufficient for all of the Commission's survey stations. The units weigh approximately 25 kg in air and 14 kg in water. The profiler is protected by a stainless steel cage, 96 cm tall and specifically designed for this profiler. Software for downloading and displaying the data is provided by the manufacturer. Communication between the profiler and a laptop computer is accomplished via a serial port.

To adapt the profiler for deployment from a halibut fishing vessel, a float/anchor system was designed to permit the profiler to descend as vertically as

possible, rapidly enough through the water column to collect valid data, while also ensuring that the unit does not crash into or become permanently attached to the ocean bottom. A sustained descent rate of 1–2 meters/sec is ideal and is the target for this study. The weight of the assembly in the water is sufficient that, if the unit is allowed to freefall, the target descent rate is achieved.

The profilers are launched from the deck of the survey vessel and allowed to freefall to the bottom, taking 4 measurements per second.

The profiler is deployed over the side of the vessel and allowed to descend to the bottom, taking measurements several times a second as it drops. Photo by Tom Wilson.

A 15-meter anchor line is attached to the bottom of the CTD cage using a section of gangion line as a weak link (in case the anchor cannot be freed from the bottom). A 40-pound longline anchor is attached to the end of the 15-meter line. Two floats are attached to the top of the cage, which effectively offsets the weight of the anchor in water. The floats are attached to standard halibut buoy line which is almost neutrally buoyant.

The unit is deployed at each station just prior to hauling the fishing gear at that station. To deploy the unit, the anchor is lowered into the water followed by the profiler and cage and then the buoys. After a minimum 90-second acclimation period at the surface, the line is released and the full set allowed to free fall. The profiler takes measurements from surface to depth at a rate of four per second and falls at an average rate of about 1.5 m/s. Once the anchor hits the bottom, the remainder of the unit is made positively buoyant with the floats and pulled away from the bottom. During trials with this unit, recorded bottom depths were compared with profiler measured depth, and it appeared that the unit descended approximately five meters after the anchor hit bottom and therefore was never in danger of impacting the bottom. On board the vessel, it is immediately obvious when the anchor hits bottom and the profiler unit stops descending because of a noticeable slackening of the line, at which time the vessel's gurdy is engaged and the profiler is immediately hauled back aboard.

The profilers are equipped with dedicated laptop computers that accompany them into the field. Approximately once a day, the profilers are connected to the

computers, data are uploaded, and the profiler units are then reset for the next day's casts. The data are sent back to the Commission's Seattle office after each trip.

Cast results and plans for the future

In 2009, a total of 12 fishing vessels were chartered to complete the survey and each vessel was outfitted with a Seacat19plus V2 profiling unit, a laptop computer, and accessory gear. Out of a possible 1,280 stations coastwide, 1,245 of those were successfully profiled. Poor weather, heavy tides, profiler deployed without proper preparation, and loss of a profiler were the reasons given for unsuccessful profiles or those stations not attempted.

Environmental data was collected at over 97% of the survey stations.

On July 30, aboard the *F/V Masonic* surveying the Albatross region, one profiler was lost at sea when a communication error resulted in it being deployed before it was properly attached to the vessel. The remainder of the stations for that trip (12) were not profiled, and a replacement profiler was placed aboard at the next port call.

Other problems experienced by the samplers included a failing pH sensor, tangling of profiler buoy line in stabilizer gear, anchors becoming attached to the bottom, and various issues with the laptop computers. However, these problems were successfully dealt with in the field and in most cases resulted in little or no loss of data.

A major goal of the project is to make the survey profiler data available to scientists worldwide. The Commission is working with NOAA's Pacific Marine Environmental Laboratory to process the oceanographic data and post it on either the laboratory's website or the National Ocean Data Center website within the following year. An announcement will be posted on the Commission's website each year as the data become available. Overall, the first year of coastwide data collection went relatively smoothly. The Commission plans to continue the Standard Stock Assessment Survey and thus the coastwide deployment of profilers into the foreseeable future. The longer-term goal is to build a time series of annual snapshots of oceanographic conditions along the continental shelf and to examine fish distribution in relation to environmental factors.

Portside and survey vessel sampling for recovered PIT tags in Pacific halibut

In 2003, the Commission undertook a large-scale mark-recapture experiment using passive integrated transponder (PIT) tags. A PIT tag is about the size of a grain of rice and is composed of an integrated circuit chip and antenna coil encapsulated in glass. Each tag has a unique alphanumeric code that can be transmitted and read *in situ* when the tag is energized by an electronic reader. The main objective of the experiment was to provide the Commission with unbiased estimates of exploitation rates independent from the assessment model. A secondary objective of the program was to provide information on migration.

2009 marked the final year of scanning for PIT tags - concluding the field portion of a large-scale experiment started in 2003.

IPHC staff PIT-tagged and released 43,999 halibut coastwide on longline surveys between late May and early September 2003 in what is referred to in this text as the primary experiment. An additional 23,437 PIT tags were released in 2004 in Areas 2B and 3A. Several pilot studies for evaluating tag insertion sites were also conducted by the Commission in 2001 and 2002. Prior to large-scale

deployment, two demonstration charters using the primary experiment protocol were conducted. To evaluate PIT tag shedding rate *in situ*, a double-tagging study (using both external wire and PIT tags) took place in 2003. Except for a few of the early pilot study releases, halibut were PIT tagged in the head on the opercular plate, just below the preopercular groove on the white side. Scanning equipment was selected and port-side scanning protocols were developed during field tests in 2002.

Port staffing

In Alaska and British Columbia, scan samplers were deployed in the same ports staffed by Commission port samplers, with the addition of Ucluelet and Tofino in British Columbia. Sampled ports received a major portion of the commercial catch.

Petersburg port sampler, Levy Boitor, scans halibut heads for PIT tags. Photo by Joan Forsberg.

Scan samplers lived in the ports throughout the season.

As in previous years, the Commission hired seasonal employees for Alaska, while British Columbia ports were sampled under a contract with Archipelago Marine Research (AMR). The start of portside commercial scan sampling was concurrent with the start of the fishing season, with sampling beginning March 21 in the Alaskan ports of Petersburg, Sitka, Juneau, Seward, Homer, Kodiak, and Dutch Harbor, and in the British Columbia ports of Port Hardy, Vancouver, Prince Rupert, Ucluelet, and Tofino. Sampling in these ports was continuous through November 15. Scan sampling was conducted in St. Paul, Alaska between July 1 and August 30 in 2009. An additional port (Sand Point) was staffed in Alaska in 2009 for the months of June through August in order to increase sampling representation from western Area 3B statistical areas.

In 2009, scan sampling in Area 2A began in March. The Washington tribal commercial fishery was sampled from March through May in the ports of Neah Bay, Bellingham, and Westport by Makah, Lummi, and Quinault fisheries staff, respectively. Non-tribal commercial scan sampling in Area 2A took place in Newport, Oregon for the two fishing periods that occurred between late June and mid-July. Halibut that were landed as incidental catch in the Washington sablefish fishery were sampled in Bellingham from June through October.

Area 2A is the only regulatory area where scanning is done on sport catch, because a relatively large portion (38%) of the Area 2A quota is allocated to the sport fishery. As in 2008, scanning of Area 2A sport-caught halibut was conducted in the Oregon ports of Newport, Depoe Bay, Garibaldi, and Charleston by ODFW staff between May and October. Scanning of the Washington sport fishery was conducted by WDFW staff in the ports of Ilwaco, Westport, La Push, and Neah Bay between May and August.

Scanning on survey vessels

In 2009, sea samplers scanned all halibut brought aboard Commission Standard Stock Assessment Survey (setline survey) vessels. Halibut over 55 cm were also scanned on National Marine Fisheries Service trawl survey vessels staffed by a Commission sampler.

Scanning results

Portside

Over a million halibut were scanned for PIT tags during the 2009 season.

The seventh year and sixth full season of the PIT scan sampling program went smoothly with continued good cooperation from processors. Port-side scanning was conducted from March 21 through November 15 in 2009 and over a million halibut were scanned during that time. Scanning rates were calculated by dividing the estimated pounds scanned by landed weight for each regulatory area. The overall coastwide scanning rate was 46% and scanning rates were greater than 25% in all areas. Estimated pounds scanned were calculated for each area by multiplying the pieces scanned for that area by the average weight of halibut in the 2009 commercial catch for that area. Average weights by regulatory area for the 2009 commercial catch were estimated from commercial catch samples. Estimated poundage scanned for the Area 2A sport fishery was calculated by multiplying the number of fish scanned by the average weight of halibut in the 2009 Washington and Oregon sport fisheries.

Port-side scan samplers detected 330 PIT tags over the season: 188 were releases from the primary experiment conducted on the 2003 setline survey, 135 were recoveries of tags released in 2004, five were recoveries of tags from demonstration charters conducted in 2002 and 2003, and two additional recoveries were releases from the 2003 double-tag experiment.

Survey vessels

On the 2009 summer Standard Stock Assessment Survey, 90,012 halibut were scanned and 36 PIT tags were recovered. Of the 36 tagged fish recovered, only 31 had associated recovery latitude and longitude (five tags were not detected at time of capture due to equipment malfunctions but were detected while scanning the fish during the offload). Twenty of the 31 recovered tagged fish with detailed recovery location were captured on the station of release and

Scan sampler, Kelli Burkinshaw, looks for PIT tags at Glacier Seafoods in Juneau, AK. Photo by Joan Forsberg.

26 were recovered within the statistical area of release. Two of the 36 recovered tagged fish were caught in a different regulatory area than the one they were released in.

Halibut are scanned on the surveys as well as in the ports. Many tags have been detected on the setline survey, and no PIT tags have ever been detected in the halibut caught during the NMFS trawl survey.

Sea samplers were instructed to scan all halibut caught on setline surveys; however, some halibut were not scanned for various reasons (fish lost at roller, tag site damaged, equipment problems, sampler forgot to scan, etc.). In 2009, a lower proportion of measured fish were scanned than in the previous two years: only 92% of measured halibut were scanned in 2009, while 99% were scanned in 2007 and 2008. The increase in the number of fish not scanned in 2009 was due to a dramatic increase in tag-reading equipment failure.

Samplers onboard NMFS trawl surveys were instructed to scan all halibut over 55 cm. A total of 510 halibut was scanned in 2009 on the Eastern Bering Sea survey. An additional 1,714 halibut were scanned on the 2009 Gulf of Alaska survey. No PIT tags were detected on the trawl surveys.

Future scanning

The design of the PIT tagging experiments included portside scanning for five full seasons after 2004, which was the second year of tag deployment. Therefore, 2009 was the last season of the portside PIT tag recovery program. The Commission considered continuing survey vessel scanning for several more years. However, due to the high number of stick reader malfunctions encountered on vessels in 2009, as well as the decreasing recovery rate of PIT tags on surveys, vessel scanning will not be extended past 2009.

The Commission will maintain a number of Boulders in working order over the next few years to read any PIT tags that are returned from the double tag experiments.

Analysis of PIT tag recoveries through 2009

The overall conclusion from the PIT tag analysis is that migration is a ongoing process that can occur for all sizes (and ages) of halibut. While our estimates show particularly high probabilities of migration of smaller fish from Areas 4A and 3B, emigration from these areas continues for fish of larger sizes. The estimated movement trend for eastern areas is in the opposite direction, with larger fish more likely to move. However, with little data for larger fish, these movement-rate estimates are imprecise. The results for Area 3A, in particular, appear to show very large migration rates for larger fish. Although the relationship is not precisely estimated due to sparse data, it is no doubt influenced by the unique pattern of movement out of Area 3A: most Area 3A tags recovered elsewhere are recovered just over the boundary in Area 3B. This result may be due to large fish moving quite short distances back and forth across the boundary rather than a true migration process. However, it is unclear why these shorter movements would be more common with larger fish. Estimates of net migration, in terms of biomass, confirm that Area 2B is a net recipient and Area 4A a net exporter of exploitable biomass.

The PIT tag program has yielded some interesting results. Among them, the conclusion that migration is a ongoing process that can occur for all sizes and ages of halibut.

Deployment, recovery, and reporting of PAT tags to study interannual dispersal and seasonal migration timing in IPHC Regulatory Area 4

Research using Pop-up Archival Transmitting (PAT) tags in the Bering Sea was motivated by earlier results from PIT tags. During the summer of 2008, the Commission initiated a PAT-tagging project to investigate why so few PIT tags were recovered from tagging in the Bering Sea-Aleutian Islands region. Were fewer PIT tags recovered because tagged fish moved into areas where they were less likely to be caught, such as the eastern Bering Sea shelf or the Bristol Bay closed area? PAT tags are the ideal tool to answer this question because they do not need to be physically recaptured in order to generate accurate endpoint locations. On a pre-determined date, the tags are designed to be released from the host fish, float to the surface, and emit signals that will be detected by satellites. The broadcast signals from the tags are used to determine their locations to within as little as 50 meters, no matter where the fish were located at the time of tag release. The satellites also receive accumulated depth and temperature measurements stored on the tags.

Finding halibut that had been PIT tagged in the Bering Sea was more of a challenge than in other areas. This gave rise to the use of pop-up archival transmitting tags to see where the fish were going.

The PAT tag study is also linked with genetic work, and to summer-to-winter PAT deployments that suggested that deep Aleutian passes serve to reduce east-west dispersal rates. According to this hypothesis, the Near and Rat Island groups are the most isolated and most likely to support an independently-operating subpopulation, with intermediate isolation in the Andreanof Island group relative to the remainder of the eastern Bering Sea shelf. Archived depth summaries broadcast by the tags can be used to assess when individual fish are resident on shallow summer feeding grounds, when they are on deepwater winter spawning grounds, and when the fish begin and end migration between shallow and deepwater habitats. Detailed depth observations on the halibut can be used to define periods of putative active spawning. Tag recovery and reporting

During the 2008 summer Standard Stock Assessment Survey, 105 halibut were tagged with PAT tags throughout the Bering Sea and Aleutian Islands.

Some of the tags prematurely release from the halibut, but still provide valuable information.

Another 17 tags were deployed during the summer of 2009. One of the tags deployed at the Pribilof Islands in 2009 prematurely released from its host fish after 45 days at liberty; the remaining 2009 tags are currently at liberty. The total time at liberty for all 105 tags deployed in 2008, for which information was obtained, ranged from a low of 11 days (fish recaptured by the commercial fleet) to a high of 380 days (tag produced weak signal with no associated location). Sixteen tags prematurely released from their host fish during 2008 and reported locations prior to the close of the commercial fishing season (November 15). These releases occurred between June 14 and November 12 after periods at liberty ranging from 14 to 129 days. Eleven tags prematurely released from their hosts during the typical winter closed season (November 15 through March 15) on dates ranging from December 5, 2008 to March 14, 2009. The fish carrying these tags were at liberty for periods ranging from 164 to 255 days. Premature release was observed across nearly the full range of tagged lengths with no obvious relationship between length at tagging and duration of tag retention.

This halibut has been tagged with a PAT tag and is ready for release. IPHC photo archive.

A total of 80 tags were either recaptured (one fish) or reported after March 15, 2009 (79 fish). Examination of depth data associated with prematurely recovered tags (i.e., reporting before 365 days) indicated that the endpoint locations of two of the fish may not reflect a full seasonal movement cycle. The tags from these fish prematurely reported on May 19 and June 1, 2009, after 261 and 323 days at liberty, respectively, and these two fish were not used to estimate interannual dispersal. The first of these fish had not yet fully returned to shallow water following a late winter emigration (initiated on February 25) to water depths in excess of 500 meters.

The second of these fish displayed an abnormal depth trajectory. This fish spent summer and fall at depths of approximately 100 meters and then moved to a depth of 176 meters on December 22. For the next 156 days, represented by 276 eight-hour reporting periods, absolutely no change in depth was observed. The tag then floated to the surface and its location was received on June 1. Given the very long period without vertical activity followed by premature tag release, it seems plausible that the fish had died long before detachment and reporting.

Thus, seventy-eight tags generated environmental data and location fixes after March 15, 2009 that were likely to have represented a full year's migratory circuit. Depth records indicate that these fish had either returned to shallow water following a deep-water winter phase or had remained at their approximate tagging depth throughout their time at liberty.

Tag dispersal

Greatest mean interannual dispersal was observed in Area 4A, south of the Aleutian Ridge (421 ± 97.8 km).. The lowest mean dispersal distance was in the Aleutians west of Amukta Pass (Area 4B; 61 ± 61.4 km), Dispersal distances in the Bering Sea half of Area 4A (north to the Aleutian Ridge) and along the eastern Bering Sea shelf edge (4D) were intermediate and similar to one another (161 ± 97.8 km and 143 ± 88.2 km, respectively).

Individual displacement ranged from a low of 0 km (two observations, both Aleutian) to a high of 2,951 km. The latter fish was tagged in Area 4A south of Unimak Pass and reported one full year later off Grays Harbor, Washington. The true distance travelled by this fish was presumably well in excess of 3,000 km, as it almost certainly did not swim in a straight line directly across the central Gulf of Alaska.

Of the 78 fish generating interannual displacement data, 13 (i.e., 17%) displayed endpoint locations outside of the regulatory area in which they had been tagged. The most commonly-observed out-of-area displacement involved emigration into the Bristol Bay Closed Area. No fish tagged in Area 4B was observed to depart Area 4B, nor the island group (Andreanof, Near, and Rat) where it was tagged. Emigration from southern Area 4A into both Areas 3B and 2A was observed, but overall, cross-basin movement was limited.

Results of the study showed that some halibut stayed put over the course of the year while others traveled long distances.

The only fish to display movement across ocean basins were tagged in the Gulf of Alaska, in southern 4A; these fish moved northward into the Bering Sea. No fish tagged in the Bering Sea—regardless of whether they produced reliable interannual endpoints (64 fish) or had reported earlier (23 fish)—moved in the opposite direction, into the Gulf of Alaska. Of the fish tagged in the Bering Sea, emigrations included movement into the Bristol Bay Closed Area (four fish interannually and seven fish seasonally) and into Russian waters (three fish, all interannually).

Environmental data

The environmental data have not yet been fully decoded and processed. Processing will occur during the winter of 2009–2010, and the analysis will be reviewed in future publications. However, a modest amount of light data has been decoded and warrants brief discussion.

For the 19 premature releases whose light data have been analyzed, a total of 1,138 reliable daily longitude estimates have been generated representing a total of 4,646 days at liberty. In contrast, 56 tags deployed in Areas 2A and 2B in 2006 generated a total of 752 light-based longitude estimates over 13,072 total days at liberty. That is to say that one longitude estimate has been generated for roughly every four days of data recording in the most recent study, as opposed to approximately one longitude estimate per 17 recording days in the previous studies. We do not know why tags from the present study are producing so much more data than in the past; the light sensor on the present tags is the same as that used in the manufacture of the tags deployed in 2006.

Archival tagging to study halibut migration and behavior: Captive holding to develop external tagging protocols, and deployment of internal and external dummy tags off Kodiak Island

Pacific halibut can be highly mobile and do not remain on the same grounds year-round. Spawning occurs during winter in relatively deep water along the shelf break, from the Queen Charlotte Islands to the Pribilof Canyon and probably also along the Aleutian Island chain and northward to Middle Canyon. The result is a biomass distribution that differs between winter and summer, and complex population structure on a variety of spatial and temporal scales. In particular, the population can be viewed as existing in at least three different spatial states each year: a summer state associated with feeding distributions, a winter state associated with spawning structure, and autumn-spring migratory states in which distribution is continually changing. We do not understand the structure of the seasonal redistribution nor do we know much about winter habitat use and the environmental conditions to which halibut are subjected during spawning. Halibut have been reported from as deep as 1,100 meters and the Commission has traditionally used a depth of 550 meters to define the lower limit of significant summertime habitat. However, detailed reports of depth-specific distribution during the spawning season would help us better understand halibut behavior.

Archival tags may be useful when dealing with smaller fish and when multi-year data are needed.

As explained above, the Commission began an electronic archival tagging program to better understand the seasonal movements of halibut. While PAT tags have proven valuable for studying a variety of processes, deployments of tags that spend more than a year attached to fish develop problems due to tag loss and battery-life limitations. Also, the relatively large size of PAT tags has prevented us from extrapolating their results to fish too small to carry the tags.

Accordingly, the Commission has been trying to obtain data on seasonal depth distribution, vertical migration, putative spawning behavior, and light-based longitudinal estimates for halibut that are either too small for PAT tags or in situations where multi-year data are important. Archival tags are an effective tool for studying behavior and environmental conditions experienced by a variety of marine fish species, including plaice (*Pleuronectes platessa*), bluefin tuna (*Thunnus thynnus*), bigeye tuna (*Thunnus obesus*) and school sharks (*Galeorhinus galeus*).

Holding experiment

A total of 24 halibut ranging from 66 to 89 cm fork length (26–35 in) were collected aboard the *F/V Heidi Sue* (homeport in Newport, Oregon) on June 10, 2009. Retained halibut were landed at the port of Newport and trucked to the Oregon Coast Aquarium in insulated fish totes. These fish were added to a pool that already contained eleven halibut of approximately 55 cm fork length that had been in captivity for approximately five years, and that had been transferred from the nearby Alaska Fisheries Science Center laboratory. These latter halibut had been collected as age-0 individuals at Kodiak, Alaska, and were approximately five years of age in 2009. Two of the recently captured fish died shortly after transfer to the holding facility, apparently from capture and transport stress. The fish were treated for *Entobdella*, a parasitic worm, which was successfully eliminated.

Live halibut are carefully offloaded on their way to a research tank in Newport, OR. Photo by Sarah Stephens.

Before tagging fish in the wild, it's important to know whether the tag will affect a halibut's health or behavior.

The experimental design called for six experimental treatment groups plus a control group. On November 4 and 5, fish used in these treatments were either surgically implanted with tags or had tags affixed to them externally. The design left two individuals untagged. Two fish from the smallest size category were omitted.

Behavioral observations were conducted on November 6. Each fish was individually observed for a period of eight minutes and its activity characterized as either swimming, resting, or surfacing. Throughout this observation period, the general activity patterns of all fish were noted. None of the fish in any of the treatment groups appeared to display an excess of any single behavior. One control fish spent a notably large proportion of its time at rest, but it displayed no obvious signs of trauma or injury. Silversides were presented to the fish at the end of the observation period and all fish, including the apparently lethargic control specimen, were observed actively feeding. Recovery, behavior, and physiological tag impacts will be monitored regularly over the next year.

Field deployments

Two types of dummy archival tag were employed in the field (externally mounted tags and internally implanted tags) for the field release. Halibut were collected aboard the *F/V Kema Sue* (homeport in Kodiak, Alaska) between August 20 and September 11, 2009. All fish were subjected to veterinary ultrasound in order to assess gender prior to tagging. Our goal was to tag 100 fish over 82 cm in fork length with externally-affixed tags and an additional 100 fish with surgically-implanted tags. In addition to the dummy tags, all fish were also tagged with a traditional opercular wire tag. Both dummy and wire tags were printed with a tag number and return information, and a notice that each returned tag will yield a $100 reward. We sought an equal size distribution between

externally- and internally-tagged fish by establishing tagging goals for each tag treatment within the four length-classes. No specific sex ratio was required in order to fulfill the tagging requirements, but we aimed to attain a roughly equal sex ratio between fish tagged internally and those tagged externally. In total, 200 fish were captured south of Kodiak Island during September 2009.

A substantially larger number of females were tagged than males, resulting in an approximately 4:1 overall sex ratio. Seventeen males were externally-tagged and 21 males were internally-tagged. The size of male fish ranged from 75 to 133 cm in fork length. The size of females ranged from 82 to 142 cm in fork length.

Consistent with previous at-sea archival tagging, the fish exhibited little physical response to either external tagging or the surgical process despite the absence of anesthesia. Fish tagged in captivity under anesthesia consistently reacted much more forcefully to tagging than fish tagged in the field, especially during application of opercular tags. Fish tagged in the field with both tag-types were observed swimming strongly upon release.

Fishery recoveries will provide a long-term comparison of relative recovery probabilities associated with internal versus external tagging, integrating differences in fish mortality, tag shedding, and differential detection rates between tag treatments. At the time of this writing, four tagged fish had been recovered. All bore internally-implanted tags, and all were recovered with the associated the opercular wire tags. The recovered fish ranged from 86 to 140 cm in fork length, and were recaptured at between 6 and 30 km from their release locations.

Examination of genetic population structure in spawning adults of Pacific halibut: Laboratory work conducted in 2009

IPHC is using genetic studies to help determine how well-mixed the halibut population really is.

Is the eastern north Pacific halibut resource a single fully-mixed population that exists from California through the eastern Bering Sea? Because some studies have shown that there is northwest larval drift balanced by migration of juveniles and adults to the southeast, over broad geographic expanses, one might guess that there is just one large, well-mixed population of halibut. Alternatively, important population structure could exist even within such a population, due to isolation generated by barriers such as the deep passes that divide the Aleutian Islands. In 2002, a project was initiated to investigate genetic population structure in the northeast Pacific, and in 2004 the study was expanded to include spawning groups from British Columbia, the central Gulf of Alaska, and southeastern Bering Sea.

In 2007, historical samples from 1998 were added to the analysis, and winter charters provided a sample from the eastern Aleutian Islands. A population analysis based on 9,702 genotypes, derived from analysis of 16 microsatellite loci, from six collections, showed little genetic differentiation among populations. In 2008, 95 Atlantic halibut (*Hippoglossus hippoglossus*) were genotyped at these same 16 microsatellite loci. Detailed analyses were carried out on three of these loci that were found to be sufficiently correlated to sex in Pacific halibut females. Interestingly, these same loci are not correlated to sex in Atlantic

Live halibut. Photo by Roberta Brooks.

halibut which suggests different mechanisms for sex determination in the two species. Additional comparisons between Atlantic and Pacific halibut based on mitochondrial DNA sequence generally show higher gene diversity in Pacific halibut, indicating a signature of differing demographic histories. Finally, 36 EST-based microsatellites have been optimized for Pacific halibut and an analysis using 18 of these loci in two populations is ongoing.

Range test for a deepwater acoustic tag listening array

Deepwater acoustics are being used to study the activity of migratory species like halibut.

The Pacific Ocean Shelf Tracking (POST) project is a telemetry network designed to monitor the migration of fish and other marine species via acoustic tags. The basic idea is that signals from the acoustic tags in or on the fish will be received and processed by a series of listening posts located along several lines positioned roughly perpendicular to shore at important biological boundary zones along Pacific coast. The project was initiated in 2001 as a component of the Census of Marine Life and was designed to monitor the migration of coho salmon (*Oncorhynchus tschawytscha*) smolts. By 2006 POST had grown to include eight receiver lines spanning from Graves Harbor in southeast Alaska, to Cascade Head, Oregon. The near-term plan is to expand the system into a continental-scale network operated by a consortium of researchers studying a variety of migratory species. The POST project's arrays have added to the scientific literature for a number of salmon species and have also proven effective for species such as sturgeon and squid.

Listening arrays, such as those maintained by POST, could be used to address a number of questions relevant to management of the eastern Pacific halibut stock. For example, listening arrays placed at the northern and southern boundaries of Area 2B could be used to determine timing and magnitude of cross-boundary seasonal migrations in relation to season opening and closing dates. Arrays placed in the far western Gulf of Alaska might be used to examine ontogenetic migration of pre-recruits from the southeast Bering Sea into the Gulf of Alaska. Similarly, the National Marine Fisheries Service and the Alaska Department of Fish and Game are confronted with general questions regarding latitudinal movements of groundfish, and specific issues regarding rates of exchange of sablefish between inside and outside waters of southeast Alaska. However, the POST system has not been tested with reference to deepwater (up to 1,000 meters) species such as halibut and sablefish.

Since halibut occupy a wide depth range depending on time of year, it's unclear whether an array is practical from a cost standpoint.

At this point it is not clear that receiver arrays can be put in place, at a reasonable cost, so as to consistently detect acoustic tags on fish, such as halibut, that move to depths in excess of 800 meters during winter offshore migration. Listening arrays would need to extend offshore to depths of at least 900 meters to confidently capture all possible alongshore migration throughout the year. The present maximum detection distances for 51–78 kHz acoustic tags broadcasting at about 160 dB are estimated to be just over 1 km under ideal conditions. Moreover, the acoustic signal is expected to attenuate in the presence of background noise, such as that produced by waves and vessel traffic. Therefore, the first step in designing an array for deepwater species is to conduct a test of maximum and minimum detection distance for tags and receivers placed at depth.

During the spring of 2009, the IPHC collaborated with researchers from ADF&G (D. Carlile, C. Brylinsky) and the NMFS (C. Lunsford) to conduct an acoustic range test employing Vemco (211 Horseshoe Lake Dr., Halifax, Nova Scotia) V16-5H coded transmitters and Vemco VR2W acoustic receivers in target water depths ranging from 170–560 meters depth. At each target depth, a receiver node was positioned, consisting of one or two moored acoustic receivers, and five acoustic transmitter (tag) nodes placed at distances of 400, 600, 800, 1,000, and 1,200 meters from the base of the receiver mooring. Each receiver and transmitter was moored to a 300 kg railroad wheel. Transmitters were tethered approximately five meters above bottom in order to mimic the position of a benthic or epibenthic fish. Receivers were moored in midwater at target depths of 150, 300, and 400 meters, depending on bottom depth. The receiver node at 170 meters target bottom depth consisted of a single receiver suspended in the water column at 150 meters depth; nodes at 350 meters and 370 meters bottom depth consisted of a single receiver suspended at 300 meters; nodes at 500 and 560 meters bottom depth consisted of two receivers, each suspended at 150 meters and 400 meters. Receivers were buoyed above in order to provide lift and allow for their retrieval at the end of deployment. A pair of Teledyne-Benthos (49 Edgerton Drive, North Falmouth, Massachusetts) 875-TD acoustic releases that will be used to detach the units at the end of their deployment period were attached below each receiver.

Receiver and transmitter nodes were deployed in August 2009 aboard the *R/V Medea*. Three of the nodes were set at their intended locations and depths: south of Lemesurier Island at 150 meters, and at 500 meters and 560 meters in the mouth of Chatham Strait. Weather prevented deployment of offshore nodes (350 meters, 370 meters) but an alternate location of similar depth was substituted within the more protected setting of Frederick Sound. Receiver nodes were deployed in depths of approximately 160, 350, 500, and 560 meters. The receivers will be retrieved after approximately one year and the stored data will be analyzed at that time.

APPENDICES

The tables in Appendix I provide catch information for the 2009 fisheries. The areas specified are the IPHC Regulatory Areas, depicted in Figure 1 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.

Appendix II.

Appendix I.

Table 1. The 2009 removals, catch limits, and catch of Pacific halibut by IPHC regulatory area.

Area	2A	2B	2C	3A	3B	4	Total
Commercial	485	6,538	4,866	21,399	10,616	7,277	51,181
Sport	458	1,098	2,546	4,531	25	39	8,697
Bycatch Mortality:							
O32 fish	250	110	220	1,070	490	2,460	4,600
U32 fish	140	110	130	1,920	860	3,620	6,780
Personal Use[1]	30	405	458	337	42	71	1,343
Wastage:							
O32 fish	1	20	10	44	22	34	131
U32 fish	15	231	262	1,118	773	225	2,624
IPHC Research	5	99	89	356	165	154	868
Total Removals	1,384	8,611	8,581	30,775	12,993	13,880	76,224
2009 Catch Limit	**950[2]**	**7,630[3]**	**5,020**	**21,700**	**10,900**	**7,880**	**54,080**
2009 Catch	**973[2]**	**7,636[3]**	**4,866**	**21,399**	**10,616**	**7,277**	**52,767**

[1]Includes the 2008 Alaskan subsistence harvest estimates and the Area 4 value includes 22,000 pounds of sublegal halibut retained in the 2008 Area 4DE Community Development Quota fishery.

[2] Includes commercial, sport, and treaty ceremonial and subsistence catch.

[3] Includes commercial and sport catch.

Appendix I.

Table 2. The 2009 Area 2B Pacific halibut catch limits as allocated by the Canadian Department of Fisheries and Oceans and estimated catches (thousands of pounds, net weight).

Fishery	2009 Allocation	2009 Catch
Commercial fishery	6,712	6,538
Sport fishery	918[1]	1,098
Total allocation/ catch	**7,630**	**7,636**
IPHC research catch		99
Previous year carryover[2]	339	
Total	**7,969**	**7,735**

[1] In 2009, 208,400 pounds of quota share leased from the commercial to the sport fishery.
[2] Adjustment from the commercial fishery underage/overage plan.

Table 3. The Area 2C and 3A sport charter halibut harvest and the Guideline Harvest Level (GHL) set by the National Marine Fisheries Service (millions of pounds, net weight), 2003-2009.

	Area 2C		Area 3A	
Year	Catch	GHL	Catch	GHL
2003	1.412	1.432	3.382	3.650
2004	1.750	1.432	3.668	3.650
2005	1.952	1.432	3.689	3.650
2006	1.804	1.432	3.664	3.650
2007	1.918	1.432	4.002	3.650
2008	1.999	0.931	3.378	3.650
2009[1]	1.302	0.788	2.564	3.650

[1] Preliminary

Table 4. Summary of the Area 2A 2009 Pacific halibut catch limits allocated by the Pacific Fishery Management Council's Catch Sharing Plan and catch estimates (pounds, net weight).

Area	Catch Limit	Catch
Non-treaty directed commercial	166,385	165,200
Non-treaty incidental commercial with salmon troll fishery	29,362	11,600
Non-treaty incidental commercial with sablefish fishery	11,895	5,100
Treaty Indian commercial	303,500	303,300
Treaty Indian ceremonial and subsistence	29,000	30,400
Sport - North of Columbia River	214,110	266,000
Sport - South of Columbia River	195,748	192,000
Total allocation	**950,000**	**973,600**
IPHC research catch		5,000
Total	**950,000**	**978,600**

Appendix I.

Table 5. The total catch (thousands of pounds, net weight) of Pacific halibut from the 2009 commercial fishery, including IPHC research catch, by regulatory area and month.

Area	March	April	May	June	July	August	September	October	November	Total
2A	47	127	123	97	91	3	1	1	-	490
2B	501	1,124	779	456	865	826	715	1,033	338	6,637
2C	300	992	951	782	312	575	558	393	92	4,955
3A	368	3,423	4,695	2,682	2,082	3,200	2,326	2,403	576	21,755
3B	29	311	1,675	2,206	1,929	1,870	1,186	1,149	426	10,781
4A	-	19	122	308	379	907	481	274	38	2,528
4B	-	108	42	197	270	495	285	138	58	1,593
4C	-	-	-	49	257	220	77	42	-	645
4D	-	-	-	307	630	388	615	152	118	2,210
4E	-	-	1	136	161	67	66	24	-	455
Alaska Total	697	4,853	7,486	6,667	6,020	7,722	5,594	4,575	1,308	44,922
Grand Total	**1,245**	**6,104**	**8,388**	**7,220**	**6,976**	**8,551**	**6,310**	**5,609**	**1,646**	**52,049**

Appendix I.

Table 6a. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2009 commercial fishery for Area 2B, Alaska, and the Alaskan regulatory areas.

Overall Vessel Length	Area 2B		Alaska	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	29	638	34	155
0 to 25 ft.	0	0	233	363
26 to 30 ft.[1]	-	-	107	690
31 to 35 ft.[1]	7	150	208	4,132
36 to 40 ft.	29	629	139	1,624
41 to 45 ft.	45	994	145	3,678
46 to 50 ft.	21	1,099	141	3,982
51 to 55 ft.	25	1,249	63	2,940
56 + ft.	34	1,878	261	27,358
Total	**190**	**6,637**	**1,331**	**44,922**

Overall Vessel Length	Area 2C		Area 3A	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	27	58	5	62
0 to 25 ft.	49	74	30	90
26 to 30 ft.	34	162	26	106
31 to 35 ft.	93	711	92	2,142
36 to 40 ft.	82	550	56	882
41 to 45 ft.	77	549	72	2,195
46 to 50 ft.	82	866	70	1,933
51 to 55 ft.	38	601	36	1,537
56 + ft.	105	1,483	198	12,808
Total	**587**	**4,955**	**585**	**21,755**

Overall Vessel Length	Area 3B		Area 4	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length[2]	3	35	-	-
0 to 25 ft.[2,3]	-	-	153	199
26 to 30 ft.	0	0	49	422
31 to 35 ft.[3]	32	664	34	615
36 to 40 ft.	17	195	7	97
41 to 45 ft.	30	759	5	174
46 to 50 ft.	33	905	9	278
51 to 55 ft.	15	529	5	273
56 + ft.	141	7,694	70	5,373
Total	**271**	**10,781**	**332**	**7,431**

For confidentiality reasons:

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

[2] Unknown length vessels in Areas 4 were combined with 0 to 25 ft. vessels

[3] Vessels 0 to 25 ft. in the Area 3B fishery were combined with 31 to 35 ft. vessels

Appendix I.

Table 6b. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2009 commercial fishery for Area 2A commercial fisheries, not including the treaty Indian commercial fishery.

Overall Vessel Length	Area 2A Directed Commercial	
	No. of Vessels	Catch (000's lbs.)
Unk. Length	0	0.0
0 to 25 ft.	0	0.0
26 to 30 ft.	5	0.7
31 to 35 ft.	8	2.7
36 to 40 ft.	18	21.3
41 to 45 ft.	17	26.7
46 to 50 ft.	20	38.0
51 to 55 ft.	8	20.6
56 + ft.	13	55.2
Total	**89**	**165.2**

Overall Vessel Length	Area 2A Incidental Commercial (Salmon)		Area 2A Incidental Commercial (Sablefish)	
	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.	4	0.3	0	0.0
26 to 30 ft.[1]	-	-	0	0.0
31 to 35 ft.[1]	6	0.4	0	0.0
36 to 40 ft.[2]	7	1.4	-	-
41 to 45 ft.[2]	15	6.7	-	-
46 to 50 ft.[2]	6	2.2	9	4.0
51 to 55 ft.[3]	3	0.6	0	0.0
56 + ft.[3]	-	-	5	1.1
Total	**41**	**11.6**	**14**	**5.1**

For confidentiality reasons:

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

[2] Vessels 36 to 45 ft. in the Area 2A Incidental Commercial (Sablefish) fishery were combined with 46 to 50 ft. vessels.

[3] Vessels 56+ ft. in the Area 2A Incidental Commercial (Salmon) fishery were combined with 51 to 55 ft. vessels.

Appendix I.

Table 7. Commercial fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by regulatory area for the 2009 Pacific halibut commercial fishery.

Area	Fishing Period	Catch Limit	No. of Days	Commercial Catch	Research Catch	Total Catch
2A treaty Indian	Separately managed:					
	3/21 – 7/15		117	224.4		224.4
total	Restricted:					
	3/ 21 – 5/9		50	78.9		78.9
		303.5		303.3		303.3
Commercial Incidental in Salmon fishery	5/1 – 11/15	29.4	199	11.6		11.6
Incidental in Sablefish fishery	5/1- 10/31	11.9	184	5.1		5.1
Directed	6/24[1]		10-hours	82.7		
	7/8[1]		10-hours	82.5		
Directed total		166.4		165.2	5	170.2
2A Total		511.2		485.2	5	490.2
Area	**Fishing Period**	**Catch Limit**	**Adjusted Catch Limit[2]**	**Commercial Catch**	**Research Catch**	**Total Catch**
2B	3/21 – 11/15	6,711.6	7,051.0	6,538.0[3]	99	6,637
2C	3/21 – 11/15	5,020.0	5,253.0	4,866.0[4]	89	4,955
3A	3/21 – 11/15	21,700.0	21,903.0	21,399.0	356	21,755
3B	3/21 – 11/15	10,900.0	10,995.0	10,616.0	165	10,781
4A	3/21 – 11/15	2,550.0	2,620.0	2,464.0	64	2,528
4B	3/21 – 11/15	1,870.0	1,896.0	1,534.0	59	1,593
4C	3/21 – 11/15	1,569.0	1,625.0	638.0[5]	7	645
4D	3/21 – 11/15	1,569.0	1,609.0	2,186.0[5, 6]	24	2,210
4E	3/21 – 11/15	322.0	322.0	455.0[6]	0	455
Alaska Total		45,500.0	46,223.0	44,158.0	764	44,922
Grand Total		**52,722.8**	**53,785.2**	**51,181.2**	**868**	**52,049.2**

[1] Fishing period limits by vessel class.
[2] Includes adjustments from the underage and overage programs.
[3] Includes the pounds that were landed by Native communal commercial licenses (FL licenses).
[4] Includes pounds taken by Metlakatla Indians during additional fishing within reservation waters.
[5] Area 4C IFQ and CDQ can be fished in Area 4D by NMFS and IPHC regulations.
[6] Area 4D CDQ can be fished in Area 4E by NMFS and IPHC regulations.

Appendix I.

Table 8. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality; and IPHC research catch for 2009.

IPHC Port Group	Canada	United States	IPHC Research	Grand Total
CA & OR	-	176	2	178
Seattle	-	1	-	1
Bellingham	-	1,031	3	1,034
WA	-	305	-	305
Vancouver	406	-	-	406
Port Hardy	2,666	-	43	2,709
Southern BC	337	-	9	346
Prince Rupert & Port Ed.	2,876	-	82	2,958
Northern BC	253	-	-	253
Ketchikan, Craig, Metlakatla	-	445	9	454
Petersburg, Kake	-	1,564	23	1,587
Juneau	-	2,174	12	2,186
Sitka	-	2,184	24	2,208
Hoonah, Excursion, Pelican	-	437	-	437
Southeast AK	-	688	-	688
Cordova	-	1,055	-	1,055
Seward	-	4,491	102	4,593
Homer	-	12,024	103	12,127
Kenai	-	39	-	39
Kodiak	-	7,273	113	7,386
Central AK	-	4,688	187	4,875
Akutan & Dutch Harbor	-	4,406	133	4,539
Bering Sea	-	1,662	23	1,685
Grand Total	**6,538**	**44,643**	**868**	**52,049**

Appendix I.

Table 9. Commercial halibut catch (thousands of pounds, net weight) in 2009 by statistical area and regulatory area.

Stat Area Group	Catch			Regulatory Area	Catch for-Reg. Area
	Commercial	Research	Total		
00-03	145	2	147		
04	67	-	67	2A	490
05	273	3	276		
06	251	6	257		
07	38	5	43		
08	207	3	210		
09-I	365	9	374		
09-O	252	4	256		
10-I	965	28	993		
10-O	658	-	658	2B	6,637
11-I	1,016	18	1,034		
11-O	45	1	46		
12-I	376	5	381		
12-O	98	-	98		
13-I	1,800	12	1,812		
13-O	467	8	475		
14-I	232	17	249		
14-O	118	11	129		
15-I	714	12	726		
15-O	352	17	369		
16-I	1,022	10	1,032	2C	4,955
16-O	794	9	803		
17-I	416	4	420		
17-O	228	3	231		
18S-I	506	2	508		
18S-O	484	4	488		
18W	1,094	8	1,102		
19	997	17	1,014		
20	1,194	22	1,216		
21	977	13	990		
22	1,412	12	1,424		
23	654	20	674	3A	21,755
24	2,899	28	2,927		
25	3,903	38	3,941		
26	3,414	85	3,499		
27	2,600	57	2,657		
28	2,255	56	2,311		

Appendix I.

Table 9. continued.

29	4,451	34	4,485	3B	10,781
30	2,390	47	2,437		
31	1,120	34	1,154		
32	1,604	21	1,625		
33	762	19	781		
34	289	10	299		
35	195	6	201	4	7,431
36	232	3	235		
37	53	3	56		
38	120	7	127		
39	56	2	58		
40	185	2	187		
41	27	3	30		
42+	423	29	452		
BeringSea	5,986	99	6,085		
GrandTotal	**51,181**	**868**	**52,049**		**52,049**

Appendix I.

Table 10. The fishing period limits (net weight) by vessel class used in the 2009 directed commercial halibut fishery in Area 2A.

Vessel Class		Fishing Periods (Pounds)	
Letter	**Feet**	**June 24**	**July 8**
A	0-25	755	590
B	26-30	945	735
C	31-35	1,510	1,175
D	36-40	4,165	3,340
E	42-45	4,480	3,485
F	46-50	5,365	4,170
G	51-55	5,985	4,655
H	56+	9,000	7,000

Table 11. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2009.

Fishing Period Dates	Number of Vessels	Catch (Pounds)
May 8 - 10	4	2,996
May 29 – 31	5	4,436
June 12 – 14	8	4,719
June 26 – 28	3	446
July 10 – 12	5	3,240
July 24 – 26	8	4,202
August 7 – 9	1	-
August 21 – 23	8	5,771[1]
Sept. 4 – 6	7	3,567 [2]
Sept. 18 –20	2	-
10 Fishing Periods		**29,377**

[1] Includes landed weight from August 7-9 opening due to confidentiality rules.
[2] Includes landed weight from September 18-20 opening due to confidentiality rules.

Appendix II.

Table 1. Summary of the 2009 Pacific halibut sport fishery season. 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	Apr 23 - Jun 5	5 (Thurs-Mon)	32	1
Low Point to Sekiu River	May 21 - Jul 3	5 (Thurs-Mon)	32	1
WA North Coast (Sekiu River to Queets River)				
	May 14 - 23	2 (Thurs, Sat)	4	1
	Jun 4, 6	2 (Thurs, Sat)	2	1
WA South Coast (Queets River to Leadbetter Pt.)				
All Depths	May 3 - 12	2 (Sun, Tues)	4	1
	May 17 - Jun 28	1 (Sun)	7	1
Northern nearshore	May 7 - Jun 27	3 (Thurs - Sat)	24	1
	Jul 2 - Sep 27	4 (Thurs - Sun)	52	1
Columbia River (Leadbetter Pt. to Cape Falcon)				
	May 1 - 29	3 (Thurs - Sat)	13	1
	Aug 7 - Sep 27	3 (Fri - Sun)	24	1
OR Central Coast (Cape Falcon - Humbug Mtn.)				
All Depths	May 14 - Jul 4	3 (Thurs - Sat)[a]	18	1
	Aug 7 - 9	3 (Fri - Sun)	3	1
Less than 40 fathoms	May 1 - Aug 9	7 (Sun - Sat)	101	1
OR/CA (South of Humbug Mtn.)				
	May 1 - Oct 31	7 (Sun - Sat)	184	1
Area 2B - British Columbia	Mar 1 - Aug 21	7 (Sun - Sat)	174	1
	Aug 22 - Dec 31	7 (Sun - Sat)	132	2
Area 2C - Alaska				
Guided anglers	Feb 1 – Jun 4	7 (Sun - Sat)	334	2[b]
Guided anglers	Jun 5 - Dec 31	7 (Sun - Sat)	334	1
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 season occurred every other week during June.
[b]Two fish daily bag limit, with one fish no greater than 32 inches in total length.

Appendix II.

Table 2. 2009 Area 2A sport harvest allocations and catches (pounds, net weight) by subarea.

Subarea	Allocation	Catch Estimate	Over/(Under) Pounds	Over/(Under) Percent
WA Inside Waters	57,393	114,050	56,657	98.7%
WA North Coast	108,030	102,782	(5,248)	(4.9%)
WA South Coast	42,739	39,595	(3,144)	(7.4%)
Columbia River	15,735	12,738	(2,997)	(19.0%)
OR Central Coast	180,088	182,960	2,872	1.6%
South OR/California	5,872	5,872	0	0.0%
Total	409,858	457,997	65,174	11.7%

Table 3. Harvest of halibut by sport fishers (millions of pounds, net weight) by IPHC regulatory area, 1977-2009.

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	1.759	4.511	0.022	0.055	7.470
1996	0.229	0.887	2.129	4.740	0.021	0.077	8.084
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	8.585
1999	0.338	0.859	1.843	4.228	0.017	0.094	7.379
2000	0.344	1.021	2.258	5.305	0.015	0.073	9.017
2001	0.446	1.015	1.925	4.675	0.016	0.029	8.106
2002	0.399	1.260	2.090	4.202	0.013	0.048	8.011
2003	0.404	1.218	2.258	5.427	0.009	0.031	9.348
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	10.860
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	2.546	4.531	0.025	0.039	8.697

PUBLICATIONS

The IPHC publishes three serial publications - Annual reports, Scientific reports, and Technical Reports - and also prepares and distributes regulation pamphlets and information bulletins. Items produced during 2009 by the Commission and staff are shown below and a list of all Commission publications is shown on the following pages. In addition, a listing of articles published by the Commission staff in outside journals is available on our website at www.iphc.washington.edu.

2009 Research publications

International Pacific Halibut Commission. 2009. IPHC Annual Report 2008.

Loher, T., and Blood, C. L. 2009. Dispersion of Pacific halibut (Hippoglossus stenolepis) summering off British Columbia and the US Pacific Northwest, evaluated via satellite archival tagging. Can. J. Fish. Aquat. Sci. 66(9): 1409-1422.

Yoshizaki, J., Pollock, K. H., Brownie, C., and Webster, R. A. 2009. Modeling misidentification errors in capture-recapture studies using photographic tags of evolving marks. Ecology. 90: 3-9.

IPHC Publications 1930-2009

Reports

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]
7. Investigations of the International Fisheries Commission to December 1930, and their bearing on the regulation of the Pacific halibut fishery. John Pease Babcock, William A. Found, Miller Freeman, and Henry O'Malley. 29 p. (1930). [Out of print]
8. Biological statistics of the Pacific halibut fishery, Effects of changes in intensity upon total yield and yield per unit of gear. William F. Thompson and F. Heward Bell. 49 p. (1934). [Out of print]
9. Life history of the Pacific halibut - Distribution and early life history. William F. Thompson and Richard Van Cleve. 184 p. (1936). [Out of print]
10. Hydrographic sections and calculated currents in the Gulf of Alaska. 1929. Thomas G. Thompson, George F. McEwen, and Richard Van Cleve. 32 p. (1936).
11. Variations in the meristic characters of flounder from the northeastern Pacific. Lawrence D. Townsend. 24 p. (1936).
12. Theory of the effect of fishing on the stock of halibut. William F. Thompson. 22 p. (1937).
13. Regulation and investigation of the Pacific halibut fishery in 1947 (Annual Report). IFC. 30 p. (1948).
14. Regulation and investigation of the Pacific halibut fishery in 1948 (Annual Report). IFC. 30 p. (1949).
15. Regulation and investigation of the Pacific halibut fishery in 1949 (Annual Report). IFC. 24 p. (1951).
16. Regulation and investigation of the Pacific halibut fishery in 1950 (Annual Report). IFC. 16 p. (1951).
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