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INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report

2000

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

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PREFACE

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

Three IPHC Commissioners are appointed by the Governor General of Canada and three by the President of the United States. Each country pays one-half of the Commission's annual expenses, as required by the Halibut Convention. 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 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:
"Hippoglossus ultramaximus" by Ray Troll (1984)

Alaskan artist Ray Troll blends the latest scientific work in ichthyology and paleontology with his sense of humor in his offbeat paintings of fish.

Troll's work has been featured in museum displays at the Smithsonian and he has had solo exhibitions at Seattle's Burke Museum, the Denver Museum of Nature and Science, the Alaska State Museum in Juneau, and the Anchorage Museum of History and Art, among others. He currently has another traveling museum show touring the United States based on his latest book "Sharkabet, A Sea of Sharks from A to Z". He is also a regular contributor to Natural History magazine.

Ray Troll owns and operates the Soho Coho Contemporary Art and Craft Gallery with his wife Michelle in Ketchikan, Alaska. In addition to his gallery and his artwork, Ray enjoys fishing whenever his schedule allows.

For more information on the art of Ray Troll visit http://www.trollart.com/ on the World Wide Web.

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Dancing on the Edge: Activities of the Commission in 2000

The International Pacific Halibut Commission practices the art of sorting out the physical system of the north Pacific while that system, and our ability to quantify it, changes almost daily. Within the widening gyre of issues, some problems seem perpetually to present themselves to the Commission: stock fluctuations, financial uncertainties, and the eternal conundrum of how to make regulations fair, consistent, and reasonable.

The January, 2000 Annual Meeting of the Commission, held in Lynnwood, Washington, focused on the following concerns:

- Most Pacific halibut stocks are easing toward long-term average levels, after several years of high yields. Scientists believe that stocks are decreasing, but are not yet certain about how great the decline may be.
- Chalky halibut investigations have identified the cause of the condition as a combination of exercise-related lactic acid buildup in the flesh and water temperature. IPHC scientists have found a fairly reliable detection method although it appears that because the condition develops in the water, before the fish is landed on the boat, harvesters can do nothing to prevent the condition.
- Stock assessment data can be altered by any changes in the type and size of bait used in survey fishing. With the commercial fleet's help, our scientists are testing ways to assess the relative effectiveness of different baits. How the hook is threaded also may affect catch levels.

Looking ahead, the Commission considered several proposals and ideas from around the region.

Coordinated research. The Commission signed a Memorandum of Understanding with the North Pacific Marine Sciences Organization (PICES), a scientific research association created by convention among six Pacific Rim countries: China, Korea, Russia, Canada, U.S., and Japan. PICES conducts environmental research in the Pacific. This agreement formalizes the cooperative relationship between the two agencies, providing for continuity in research and the possibility for pooling some of the IPHC's scientific efforts with other, larger organizations.

2000 Annual Meeting. Photo taken by Stephen Kaimmer.

The Groundfish Forum showed that a factory trawler might cut its halibut mortality by about 50 percent by towing with halibut excluder gear, and by bringing the cod end aboard far forward of the hatch and running water through it while the catch is sorted.

Cod-end halibut sorting for factory trawlers. The industry group Groundfish Forum has had a proposal before the North Pacific Fishery Management Council (NPFMC) since 1997 to require factory trawlers to sort halibut on-deck rather than in the factory, where the catch is currently sorted. At-sea experiments conducted by the Groundfish Forum showed that a factory trawler could cut its halibut mortality by about 50 percent by towing with halibut excluder gear, and by bringing the cod end aboard far forward of the hatch and running water through it while the catch is sorted. The Groundfish Forum issued a plea for support for this measure, which has lost momentum in the Council process due to higher priorities.

Additional bycatch monitoring and reduction efforts coastwide were slow-moving and under-funded. In Area 2A, trawl effort decreased 12 percent between 1995 and 1998, and resulting halibut bycatch by 40 percent. However, bycatch mortality in Alaska remained at levels similar to recent years.

The Commission voted to continue to support halibut bycatch reduction measures in general, and to take a closer look at the Groundfish Forum's research before endorsing it specifically.

Keeping undersized halibut in Area 4E. The Commission agreed to allow CDQ fishers in Area 4E to keep undersized halibut for personal use regardless of size, with the understanding that the communities would provide accurate statistics of catch to the staff by year's end.

Fish habitat protection. The NPFMC asked the Commission for data to support an effort to protect 14 areas in the Gulf of Alaska and along the Aleutian Chain that feature large congregations of Gorgonian coral. The Commissioners agreed to contribute data about halibut fishing effort activity for those areas.

Fish hook injuries. Serious and minor injuries to halibut from prior hooking incidents have decreased overall since 1988. The staff reported to the commissioners that, though there is no way to identify particular groups who are not releasing halibut as they should, the overall trend is toward more careful release practices. Because injuries affect mortality rates, the IPHC has spent extra effort to monitor prior hook injuries in halibut. Later in this report are the results so far.

How bait affects catch rates. Could our survey data be altered, in one direction or another, by the kind of bait we use? This topic is discussed at length in this Annual Report.

Extending halibut season. Should the commercial fishery open earlier in the year, to blunt developing market sales of farmed halibut and to allow U.S. producers to compete against Canadian operators who sell penned, live halibut? The question garnered much discussion, and the Commission assigned the staff to study the question over the next two years.

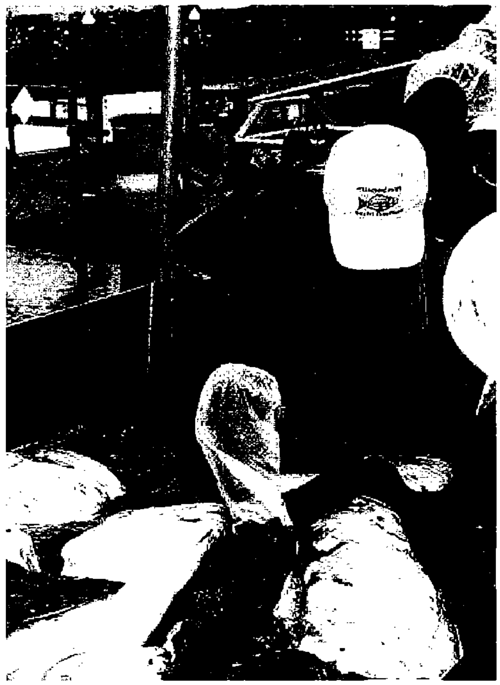
Bycatch. The Commissioners discussed the possibility that, as halibut stocks decline, the number of fish caught as bycatch will exceed the numbers caught in the commercial fishery. Both Canada and the U.S. are aggressively studying ways to reduce halibut bycatch in other fisheries (Alaska's bycatch, for example, remains much higher than levels targeted in the Commission's 1991 agreement), and this topic remained a concern in 2000.

Shifts extreme and subtle

Some issues are of constant concern to the Commissioners. For example biomass estimates, the difficulty of accurately estimating sport catches, halibut bycatch in other fisheries, and finding funding for special research projects. And there are unique quandaries to be addressed: chalky condition in halibut, how a change in bait can affect a population survey, and assessing the impact of a climatic regime shift on the future of halibut yields.

There are the perennial administrative concerns – salaries, travel costs, insurance and other benefits – that try the souls of financial officers.

Late in the year, the Commissioners discussed the idea of setting up a scholarship fund that would help promising students to study specific fisheries problems. The group liked the idea, and put it on the agenda for next year.



Port sampler, Rebecca Hall, sampling the catch. Photo taken by Heather Gilroy.

The two IPHC countries trade chairmanship of the Commission, every year handing off the baton to the other country. Dr. Richard Beamish of Canada's Department of Fisheries and Oceans was named Chair for 2000-2001, and Mr. Steven Pennoyer was named Vice-chair.

Regime shift will bring changes

Harvesters can expect a decreasing halibut resource over the next several years, and one reason is the regime shift in the Pacific Ocean in the late 1990s. Pacific Decadal Oscillation – identified and named by our own Dr. Stephen Hare – creates a twenty to thirty-year mood swing along the North American coast of the Pacific, affecting air and water temperatures, currents and weather patterns. In the past century, this part of the world saw a cool regime from 1890 to 1924, and again from 1947 – 1976. Warm regimes ruled between 1925 and 1946 and again from 1977 to at least the mid 1990s. We predict that halibut declines will continue for a few years, but that stronger year-classes of halibut should begin appearing soon after. It is not known exactly what combination of phenomena cause a regime shift, but we and other scientists are working on methods of predicting them.

IPHC receives prestigious award

The IPHC received the Year 2000 Group Award of Merit from the American Institute of Fishery Research Biologists. This award has been bestowed only ten times in the 44-year history of the Institute. The Institute president made the presentation to the Commission during a ceremony held at the University of Washington School of Fisheries on March 30th. The Commission was praised for its sustained record of scientific excellence and its commitment to sound resource management.

Goals for the future

At the last meeting of the year, the commissioners and IPHC staff set a list of goals as they looked forward to 2001:

1. To compile data on catches of Area 2B halibut landed at Neah Bay, by week, in time for the 2001 Annual Meeting.
2. A new budget, with provisional appropriation funds of $1.881 million identified in the U.S. State Department budget, and a potential catch-based, proportional matching amount from Canada, also to be presented at the 2001 Annual Meeting.
3. To implement corrections and additions to the budgets as noted this year.
4. To review the benefits of five-years worth of comprehensive surveys.
5. To develop a proposal to have a physiologist examine the possibility of reversing chalkiness in landed fish, through chemical or other means.
6. To compare the two different sport catch estimates for Area 2B (the sample-survey estimate, and the DFO Pacific Region composite estimate) and produce an assessment based on each one for the commissioners to review.
7. To include start dates in all research project proposals and reports in the future.
8. To review the staff appraisal format at the 2001 annual meeting.
9. To draft a framework for an IPHC Scholarship Fund in time for the 2001 Annual Meeting.

DIRECTOR'S REPORT

The language of fisheries management has seen the introduction of a new suite of terms over the past decade. Terms such as "Precautionary approach", "Sustainability", and "Risk aversion" are all used commonly to support managers' decisions about harvest levels. These terms may be new but the actions that they represent are not new to the IPHC process. The Commission has been acting according to the precautionary principle ever since the industry demanded that the governments enact harvest controls and the Commission was created in 1923. Simply put, this principle states that when we are uncertain about the status of the resource or its dynamics, we act cautiously.

Bruce Leaman conversing with Jim Gordon, Skipper of *F/V Janatlee* in Port Hardy. Photo by Heather Gilroy.

While the precautionary principle is often spoken of in abstract terms, the halibut industry saw an example of its translation into the real world during 2000. Experiments we conducted in 1999 looked at the effect of alternate baits on survey catch rates, for the purpose of determining which baits might be substituted on our surveys if the standard chum salmon bait could not be obtained. The results showed a striking difference (50-150%) of catching power of salmon over herring, when fished as full skates of each bait. Our pre-1993 surveys had used salmon and herring on alternate hooks and we were very concerned that the change to straight salmon bait after 1993 had artificially increased our survey catch rates, causing us to overestimate halibut abundance from the survey data. This uncertainty caused us to do two things. First, we undertook a new experiment in 2000 that would specifically test the two baits in the configurations that they were actually fished on the surveys, alternate hooks of salmon/herring vs. all salmon. This experiment was done as comparisons on normal grid survey stations. Second, we applied a precautionary downward adjustment to our survey catch rates after 1993. This downward adjustment resulted in lower estimates of abundance. We recommended, and the Commission accepted, only a 50% reduction toward the catch limits suggested by these lower estimates, both because the complete experiment would be conducted in 2000 and there was uncertainty about the applicability of the 1999 experiments to the present surveys.

The results of the 2000 experiment are detailed later in this report but the essential result is that the precautionary adjustment to survey catch rates and consequent reduction in catch limits was not required. The reduction in catch limits for 2000 did cause economic hardship for the industry, although increased ex-vessel price per pound made up much of the difference in economic impact for most areas. Clearly, we would prefer that such shifts in catch limits did not have to happen but we must take a conservative and precautionary approach under such conditions of uncertainty. While the staff endeavours to minimize the occurrence of such events, it is always possible that some yield may be lost in the short term in order to ensure that we are making the correct decisions about harvest over the long term.

The other major area of harvest management that commands our attention is the development of an improved procedure for catch limit estimation in Areas 3B and 4. The lack of historical surveys in these areas and the relatively lower historical exploitation rates means that we have little information upon which to base an analytic assessment. We use the relationship of survey catch rates in these areas to the survey and model estimates in Area 3A, as the basis for harvest management. However, we continue to pursue research that may lead to alternate and independent methods of calculating yield for these areas. Exploitation rates derived from tagging programs may offer the best alternative, although such programs typically take several years to produce meaningful results.

Overall, the halibut biomass is showing indications of reduction from the historic levels of recent years. However, biomass is still considerably above the long-term average for the stock. Recruitment has declined from the high levels of the 1980s and 1990s, due primarily to changes in ocean conditions. Recruitment of year classes from spawnings in the 1990s appear generally below average, although we are only beginning to see these fish in the surveys and the fishery.

The staff continues to assist industry in research directed at the problem of chalky fish. Our approach has been a threefold one of avoidance, detection, and utilization. In 2000, we evaluated and distributed information on a rapid pH meter to assist processors in the detection of potential chalkiness conditions of fish at the plants. Detection at the plant level would provide the opportunity for processors to direct such fish into appropriate markets and minimize the lost value arising from chalky claims by end users. While there does not appear to be a means to reverse chalkiness in dead fish, staff will continue its research on the timing and progress of chalkiness in fish, after they are caught.

Bruce

Bruce M. Leaman
Director

THE ATOMIC CONGRESS OF EVERYDAY LIFE: THE 2000 COMMERCIAL FISHERY

Music critic Stuart Broomer once attributed a piece of improvisational music with "a sense of the teeming life of the micro-organism, of molecules and cells, of flux and change and breathing, and the elaboration of complex organisms, the atomic congress of everyday life in which even remembering is taking place as forgetting." This teeming life of the micro-organism, multiplied billions of times, comprises our own Pacific Ocean, our most intimate and foreign neighbor.

Perhaps we would not know half of what we know about the Pacific and its resources if not for the commercial fisheries. Of the money fisheries along the Continental shelf, the halibut fishery is one of the oldest. It has been more than a hundred years since the *F/V Oscar and Hattie* left Seattle for the continent's edge off the northern coast and brought home the first commercial load of *H. stenolepis.*

A commercial catch of 68.3 million pounds of Pacific halibut was landed during the 2000 season in the waters from Monterey Bay to north of Point Wales.

Crew hauling in a halibut on the *F/V Trident*. Photo by Matt LaCroix.

A commercial catch of 68.3 million pounds of Pacific halibut was landed during the 2000 season in waters from Monterey Bay, California to north of Point Wales, Alaska. These amazingly productive seas along the Pacific continental shelf are fed by the forces of shelf upwelling. Mineral-rich nutrients from the sea bottom are pulled upward to the pelagic layers, where they are circulated by the north Pacific gyre, and help create a cozy, nutritious home for Pacific halibut and their benthic neighbors. More detailed catch information can be found in Appendix I.

The IPHC divides the North American halibut habitat into ten regulatory areas for fishery management purposes. In most cases, each area has its own catch limits, commercial fishing regulations, and even fishery management regimes. The southeastern flats in the Bering Sea, excluding Bristol Bay, remained closed in 2000 to all halibut fishing.

Boundary lines for the regulatory areas, which have remained the same since 1990, are shown in Figure 1.

Area 2A - all waters off the coast of the states 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 latitude 58°00' N., and west of longitude 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 longitude 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.

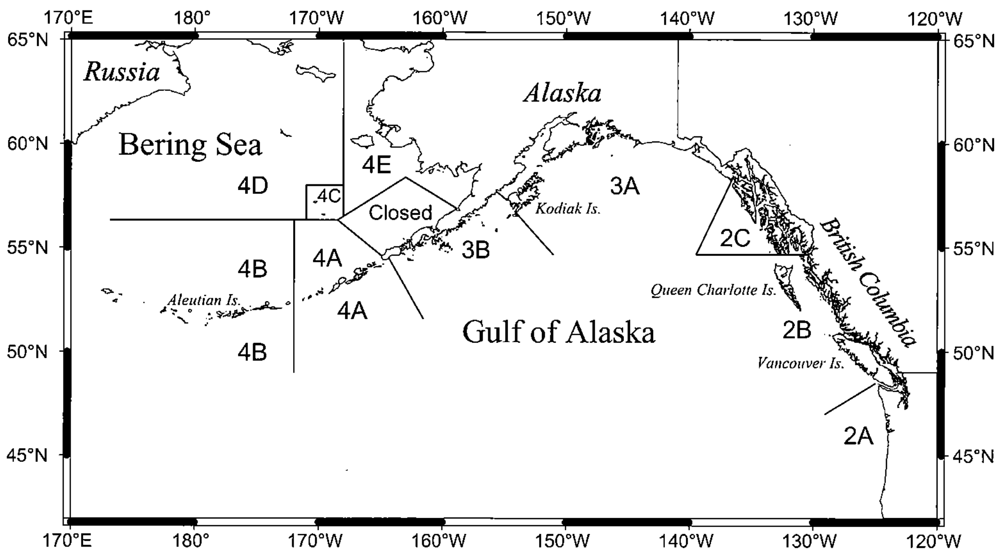


Figure 1. IPHC regulatory areas in 2000.

Key change: Commercial regulations for 2000

The Commission adopted commercial regulations for the 2000 fishery at its Annual Meeting in January. Later, the Canadian and United States governments approved all but one regulation: Canada specifically chose not to approve a regulation requiring commercially caught halibut to be landed with the gills and entrails removed. Some British Columbia operators prefer to land their halibut live, so they can be penned and delivered fresh to the market after the season closes. When the Commission adopted the regulation requiring landing of eviscerated fish, in 1995, its intent was to improve fish quality and to address sampling concerns, not to prohibit live landings by commercial producers.

The live-landing issue has fomented much discussion at the past two Annual Meetings of the Commission. The IPHC scientists are concerned primarily with conservation issues and biological samples for the live fish deliveries. With a proper regulatory and monitoring framework, live penning does not present a conservation issue. Some U.S. halibut producers worry about competition in the marketplace from live landings. However, the IPHC can only address biological and conservation concerns – not marketing issues. After much discussion, the commissioners decided to keep the current regulation in place until a less problematic regulation can be devised.

Some British Columbia operators prefer to land their halibut live, so they can deliver fresh fish to the market after the season closes. This worries producers in the U.S., where vessels must land fish eviscerated and head-off.

The Commission did change one regulation governing off-loading of a vessel landing U.S.-caught halibut. Previously, the processor or buyer was responsible for ensuring that, once off-loading has begun, all the fish are landed, reported and properly documented. In 2000, that responsibility shifted to the vessel operator or owner.

The Commission re-authorized a regulation allowing Community Development Quota (CDQ) commercial fishers in Area 4E to land undersized halibut for subsistence purposes. All CDQ organizations are required to report the total number and weight of undersized halibut, and methodology of data collection to the Commission by December 1 of each year.

The Pacific Fishery Management Council (PFMC) allocates the halibut catch limit between a variety of user groups in Area 2A, including commercial, sport and tribal fisheries. In 2000, the courts ordered an adjustment in the halibut allocations for the years 2000 through 2007, granting an additional 25,000 pounds of catch (above the percentage already allocated) to tribal fisheries.

In 2000, the courts ordered an increase in the halibut allocations to tribal fisheries off the coasts of Washington, giving them an additional 25,000 pounds of catch.

Catches rise in Area 2A

Harvesters of all halibut user groups in Washington, Oregon, and California were allowed to catch up to 830,000 pounds of halibut in 2000, 109% of the 1999 limit. The IPHC then approved an allocation plan put forth by the PFMC.

The sport fishery was allocated 351,404 pounds. The treaty Indian fishery was allocated a total of 315,500 pounds – 10,500 pounds for subsistence and ceremonial use, and 305,000 pounds for the tribal commercial fishery. The non-treaty commercial catch limit was 163,096 pounds, with 138,632 of those pounds allocated to the directed commercial fishery and 24,464 pounds for incidental catch in the salmon troll fishery. The directed commercial fishery was restricted to waters south of Point Chehalis, WA (46°53'18"N. latitude) under regulations promulgated by the NMFS.

Area 2A halibut licenses went to 633 vessels: 235 licenses for salmon trollers to hold incidentally caught halibut, 268 for the directed commercial fishery, and 130 for the sport charter fishery.

In 2000, the IPHC issued 633 vessel licenses for Area 2A: 235 licenses for the incidental commercial catch of halibut during the salmon troll fishery, 268 for the directed commercial fishery, and 130 for the sport charter fishery. This is about the same number as licenses issued in 1999.

Since 1995, chinook salmon trollers in Area 2A have been given a separate allocation for the halibut they catch as bycatch. The ratio of halibut to chinooks landed has increased in the five years of the program, from one halibut per twenty salmon to one per five salmon in 1999 and one per three salmon in 2000 plus one 'extra' halibut regardless of ratio – but the total number of halibut that any troller landed could not exceed 35.

In May and June 2000, salmon trollers caught more than 20,000 pounds of halibut as incidental catch, double the 1999 landing, yet about 3,000 pounds short of their allocation. The remainder was rolled into the directed commercial catch at the end of the June troll fishery. Then, since the total commercial catch limit was not taken during the directed July fisheries, the IPHC allowed two incidental halibut fisheries in August for a total catch of 1,300 pounds.

The directed commercial fishery consisted of three 10-hour fishing periods with fishing period limits (Appendix II, Table 1). The first opening, July 5th, had slightly higher fishing period limits than the previous year's first fishery, resulting in a slightly higher catch – 129,300 pounds. In-season catch estimates were lower than actual catches. The result was the total commercial catch of 171,000 pounds for Area 2A exceeded the catch limit by five percent.

The treaty Indian catch of 312,000 pounds exceeded the catch limit by 7,000 pounds, a mere two percent. The treaty fishery consisted of two unrestricted openings, March 15 and March 30 and a restricted fishery with had fishing period limits of 500 pounds.The ceremonial and subsistence fishery remained open until December 31, 2000.

A good year for the Metlakatla fishery

The Metlakatla Indian Community of Southeast Alaska each year conducts its own government-authorized commercial halibut fishery within the Annette Island Reserve, an area including the waters within 3000 feet of the island. This year, the Metlakatla fishery harvested 54,026 pounds of halibut (Appendix II, Table 2), higher than last year's catch of 35,000 pounds. The Metlakatla catch has varied, since it began in 1991, between a high of 126,000 pounds in 1996 and a low of 12,000 pounds in 1998. This catch is included in the Area 2C commercial catch.

Quota fisheries up north

Quota programs can enhance the possibilities for stewardship of the halibut stocks. The two quota share programs – Individual Vessel Quotas (IVQs) for Canadian operators and Individual Fishing Quotas (IFQs) for operators off Alaska – differ slightly in structure and variation, but each quota program allows individual vessels or operators a predetermined poundage of halibut based on the overall catch limit approved by the IPHC. The Quota Share fisheries of Area 2B and Alaska opened on March 15 and closed November 15. Quota share holders can harvest their quota at any time during the season, catching the best weather and market opportunities. They can also sell, lease, or buy quota shares.

Area 2B: Canada's quota fishery matures

This was the ninth year for the IVQ fishery in waters off British Columbia. Harvesters in the quota fishery landed the total catch limit of 10.6 million pounds. An additional 145,820 pounds that was available as carryover from the underage/overage program from the 1999 fishery was not harvested.

When the initial IVQ program began in 1991, 435 vessels received individual vessel quotas. Each initial IVQ was split into two shares, called blocks. Starting in 1993, the blocks could be transferred between vessels, but a single vessel could only fish a maximum of four blocks. This transfer program stimulated a decrease in fleet size, but the fleet remained steady at around 280 vessels from 1995 to 1998. In 1999, vessel owners were permitted to make unlimited temporary or permanent reallocations of halibut IVQ, subject to minimum and maximum holdings. As a result, the number of active vessels increased in 2000 to 269, from 257 in 1999. In 2000, 6.9 million pounds, comprising 65 percent of the catch limit, was transferred between vessels, 11,137 pounds of that in permanent transfers.

Participants in the Native Communal Commercial Fishing Program (F licenses) landed an estimated 238,948 pounds of halibut from 8 vessels making 39 trips. The 2000 catch was lower than the 1999 catch of 260,911 pounds, and involved one more boat. The Native Communal Commercial Fishing Program was initiated in 1996 as part of the commercial IVQ program to allow First Nation communities of British Columbia to participate in the quota fisheries.

Hauling aboard a big halibut on the *F/V Star Wars II*. Photo taken by Tracee Geernaert.

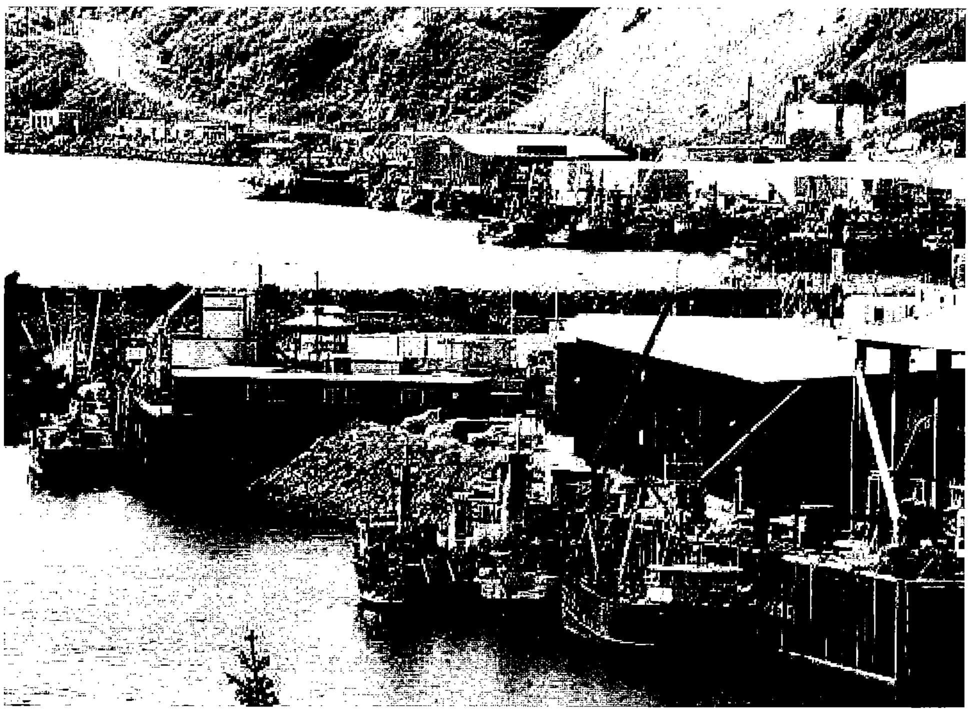
Several small sub-areas in Area 2B were closed to halibut fishing to protect localized stocks of a variety of species, mainly rockfishes, and to provide improved access to food fish for the Native community.

Alaska fleet compresses

This was the sixth year for the IFQ halibut and sablefish fisheries off Alaska. Under the IFQ program, the NMFS each year allocates halibut quota share to recipients in each regulatory area. Quota share transfers are permitted, with restrictions on the amount of quota share a person can hold and the amount that can be fished per vessel. In early December 2000, NMFS reported that 3,542 individuals held quota shares, down from the 4,830 people who received shares initially.

Altogether, quota share harvesters landed 54.8 million pounds of halibut in waters off Alaska in 2000, two percent under the catch limit and approximately four million pounds less than was harvested last year. For Areas 2C, 3A, 3B, and 4A actual landings missed the catch limits by only two percent. The catches in the remaining Area 4 regulatory areas came within 7 to 14 percent of the catch limits.

By the end of the year, 3,542 individuals held quota shares in the Alaska quota fishery, down from 4,830 people who received shares initially in 1995.



Port of Kodiak, Alaska. Photo by Ayala Knott.

Patterns in the nebula

The 2000 ex-vessel price, averaging coastwide approximately $2.50 per pound (U.S. dollars), increased slightly over last year's price, though in some cases the ex-vessel price was deflated because of chalky halibut. Chalky fish, a seemingly un-preventable condition that changes the appearance of the final product, continues to concern processors and harvesters (see "Spotting chalky halibut").

In the Gulf of Alaska, Kodiak and Homer were the leading halibut ports receiving over 9 and 10 million pounds of the total Alaska landings, respectively. Each had about 17 percent of the 57 million pounds of commerical Alaska catch. In southeast Alaska, Sitka and Juneau both received over 2 million pounds, each port handling approximately five percent of the total Alaskan halibut catch.

In British Columbia, 1,272 commercial trips brought halibut into 35 different ports this year. However, once again the three landing ports of Prince Rupert/Port Edward, Port Hardy and Vancouver together received close to 90 percent of the Area 2B catch.

Kodiak and Homer were the top two leading ports, each handling 16 to 17 percent of the commercial Alaska catch.

In Alaska and British Columbia, landings are spread over nine months of the year, from March to November. March landings in Alaska decreased in 2000. The first two weeks of fishing brought in 11 percent of the Area 2C and nine percent of the Area 3A total catch, compared to 18 percent (2C) and 13 percent (3A) in 1999. May was the busiest month for Alaska landings, (10.513 million pounds), while April was busiest for British Columbia (1.926 million pounds).

This year, 74,000 pounds of halibut, harvested on 17 commercial trips, were landed live in Area 2B, as legally allowed by Canada's DFO. This is slightly lower than the previous year, when 103,000 pounds were landed live.

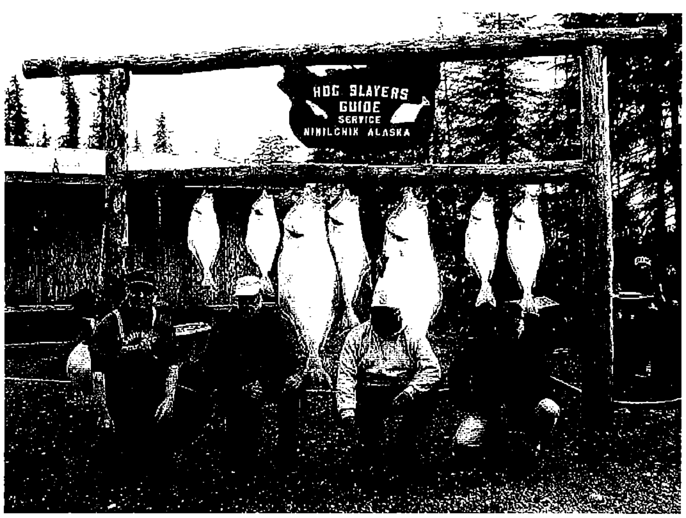
BAITING THE WONDROUS DEEP: THE 2000 SPORT FISHERY

"...You will not find one who, if God baits, does not bite."
– Anne Carson, *Men in the Off Hours*

There are many kinds of bait, but few more enticing than a charter boat pushing off from shore on a windswept day that promises sun and sea and quiet. Anglers' delight is so strong, we can only estimate how many people set to sea for sport each year, and exactly how many halibut they catch.

We puzzle over how to improve the timeliness and accuracy of sport catch estimates, which we collect from a variety of sources, and which are nearly impossible to verify.

Sport catch estimates throughout halibut territory are gleaned from a variety of sources: The Oregon Department of Fish and Wildlife (ODF&W) and Washington Department of Fish and Wildlife (WDF&W) provide in-season creel census estimates for Area 2A. British Columbia's sport catch estimates are under review by the IPHC and the DFO, as we continue to seek the best scientifically-based estimation procedure. Meanwhile, the IPHC assessment used both a revised estimate of the Area 2B catch, based on results from the 1995 DFO National Survey, as well as an alternate DFO estimate synthesized from a variety of sources in the Pacific region. A detailed account of sport catch can be found in Appendix III.



Sport fish catch in Ninilchik, Alaska. Photo by Stephen Kaimmer.

The Alaska Department of Fish and Game (ADF&G) provides sport harvest estimates for Alaska's waters, Areas 2C, 3 and 4. The Alaska estimates are derived from a Statewide Harvest Survey, conducted by mail, in conjunction with creel sampling in Areas 2C and 3A, and always lag behind by one year. Revisions made to the 1996-1998 Statewide Harvest Survey estimates are reflected in the data presented this year.

For Area 3A, the Gulf of Alaska, the sport harvest estimate is based on a projection of the numbers of halibut harvested during 1995-1999 by each user group. The resultant numbers are expanded to pounds net weight after applying the respective average weight for the area.

For Area 2C in Southeast Alaska, estimated catch is projected a little differently. Biologists combine figures from both the Statewide Harvest Survey and in-season creel census for Ketchikan, Juneau, and Sitka to arrive at harvest numbers for the area.

Estimating Areas 3B and 4 is simpler. Biologists use a projection of the 1995-1999 harvest estimated from the Statewide Harvest Survey, applying the average halibut weight landed by sport fishers at Kodiak, the nearest sampled port, to determine the estimated sport harvest for those two areas.

Catch limits in Washington, Oregon, and California

In Area 2A, the sport fishery was divided into several sub-areas where seasons are managed by fishing dates, fishing days, and catch limits. Charter vessels were required to obtain a license from the IPHC to possess halibut during open seasons.

All vessel operators were also required to declare whether they intended to work as a charter or a commercial vessel – they cannot do both. This year saw some minor modifications to the catch sharing plan, which outlined allocative regulations for the sport, commercial and treaty Indian fisheries in Area 2A. The changes were simply to help facilitate management strategies.

Sport fishers landed 344,424 pounds of halibut off the coasts of Washington and Oregon, about two percent below the catch limit of 351,404 pounds.

Sport fishers landed 344,424 pounds of halibut in Area 2A, off the coasts of Washington and Oregon, about two percent below the catch limit of 351,404 pounds. The harvest estimate for Washington Inside Waters of 53,817 pounds came in slightly less than 10 percent over the 49,137-pound quota. Average weight of halibut leapt even higher than last year from 30.9 pounds to 35.6 pounds.

Along Washington's north coast, the halibut weighed in 12 percent heavier this year than in 1999, at 20.8 pounds average, as opposed to the average 18.5 pounds landed in 1999. The Washington North Coast fishery closed at 1,340 pounds above the 99,774-pound quota. The Washington South Coast fishery, centered principally out of Westport, also closed about 1,300 pounds above quota. The average weight of south coast halibut at 18.1 pounds was nearly identical to the 1999 average weight.

The Columbia River sport fishery was closed when landings crept within five percent of its catch limit. This was the second year the area was closed before September 30. Most of this catch was attributed to the Washington fleet, primarily from Ilwaco, but Oregon vessels also participated. Pacific halibut caught in this area averaged 20.1 pounds, down a half-pound from the 20.6-pound average in 1999. Between 55 to 84 percent of the harvest was measured for length data in Washington ports, excluding Washington Inside Waters.

Along the Oregon Central Coast, the early season opening harvest has fluctuated like a wave for the past five years. Since 1996, the harvest has been 22 percent under the quota, 27 percent over quota, 19 percent under quota, 14 percent over quota and, in 2000, 16 percent over quota. With so few days allotted to the early season, fine or foul weather can decide the difference between high and low harvests.

The Oregon South Coast early season fishery landed nearly 75 percent more than its quota of 9,094 pounds. This early season overage caused the cancellation of the August all-depth fishery, which was then rescheduled for September 22. Quota was re-allocated, as allowed under the Catch Sharing Plan, from the restricted 30-fathom fishery to allow the September all-depth fishery to occur. Wind and tide prevented effective halibut fishing on the 22nd, so the harvest of 7,203 pounds fell well short of the 19,044 pounds available. The average weight of halibut landed in Oregon ranged from 20.5 pounds in the Columbia River area to 27.2 pounds along the central coast, in the inside 30-fathom restricted fishery. Statewide, the average weight of sport-caught halibut was 22.7 pounds in 2000. Samplers measured and weighed more than 50 percent of the available harvest this year.

Tough to count in Area 2B

Sport harvests along the British Columbia coast of Area 2B are estimated by a variety of means, none of which is completely satisfactory. As interest in halibut sport fishing increases in B.C. waters, the importance of a scientifically-based catch estimate intensifies. Right now, one of the estimates used by the IPHC is the 1.5 million-pound catch figure, which is based on DFO's National Postal Survey of sport harvests for 1995.

The Pacific Region of Canada's DFO, seeking a more accurate estimate, combined results of several creel survey and logbook programs and derived a different estimate – this one far lower – of 44,400 halibut, or 959,000 *round* pounds (719,000 pounds net). It is very possible that the mail surveys, on which the National DFO survey bases its estimates, are too high, since the more avid and successful anglers tend to return more questionnaires than less avid and successful folks. It is also possible that the alternate Pacific Region estimate is too low, because it is based on a number of partial estimates rather than on a comprehensive reporting or sampling program. Clearly each may be biased in different directions, and for assessment purposes we seek the most accurate figure.

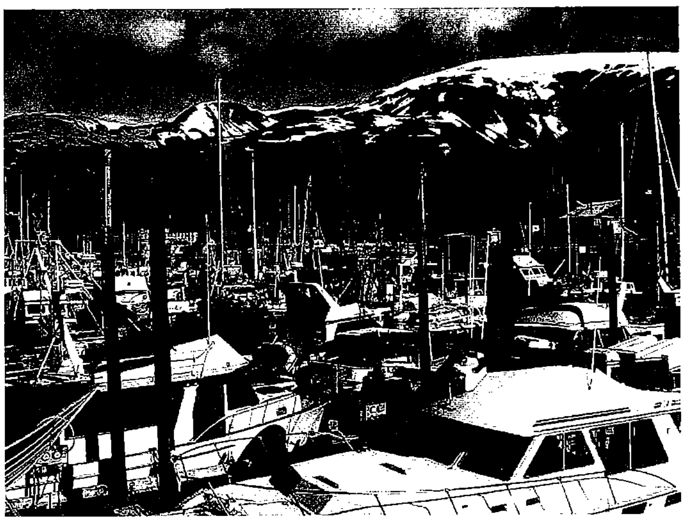
Sport catch figures for Area 2B must also take into account the halibut caught by U.S. fishers seeking recreation in Canadian waters. Washington anglers caught 10,091 individual halibut off Swiftsure Bank in Canadian waters and landed them in Neah Bay in 2000, 257 fewer halibut than in 1999. At an average weight of 20.8 pounds (gleaned from sampling halibut landings at Neah Bay in U.S. waters), this totals 209,893 pounds. Though fewer fish were caught in 2000, the overall poundage is higher because the average weight increased 12 percent over the previous year.

Sharing the waters in Southeast Alaska

All sport catches in Alaska waters since 1996 are considered preliminary, and are still being revised and updated. Meanwhile, ADF&G

biologists estimate projected figures for the sport catches of the current year. As ADF&G biologists updated the 1999 sport catch estimates for Southeast Alaska, their figures came to 1.843 million pounds, only 0.7 percent higher than what they had projected earlier. Private anglers and charter boats share the harvest nearly equally, with charters taking 939,000 pounds, or about 51 percent. The projected 2000 sport catch for Southeast is slightly higher, at 1.978 million pounds.

The IPHC keeps track of numbers of halibut harvested by each subarea, as tallied in the Statewide Harvest Survey. Numbers of fish are multiplied by the average weight of fish caught by each user group. Biologists collect length data in Ketchikan, Craig, Petersburg/Wrangell, Sitka and Juneau. Glacier Bay and Haines/Skagway are not sampled for length information, so Juneau average weights have been used historically as a surrogate to project sport harvests. Halibut in Area 2C averaged 19 pounds net weight in 1999, and preliminary indications show that average might increase to 20 pounds for 2000.



Sport fish vessels in Whittier, Alaska. Photo by Stephen Kaimmer.

Sport catches down in Gulf of Alaska

Estimates now indicate the 1999 sport harvests of halibut from the Gulf of Alaska region at 4.228 million pounds, 19 percent fewer pounds and 21 percent fewer fish than last year's preliminary estimate. Revisions to the Statewide Harvest Survey estimates account for only about half the difference between the projected harvest for 1999 and this year's updated estimate and the rest come from sleuthing errors from the raw data. Charter vessels take a higher proportion (60 percent) of the recreational harvest in Area 3A than in Area 2C. Three primary user groups, private, charter and military recreation camps, share the Gulf of Alaska sport catch. Each user group's share of the take is gauged from the Statewide Harvest Survey. Then we figure average weight, generated from length data collected from the primary ports of sport landings: Kodiak, Yakutat, Whittier, Valdez, Cordova, Seward, Homer, Deep Creek and Anchor Point. In 1999, the average weight throughout 3A was 18.3 pounds. Preliminary indications suggest the average net weight in 2000 at 18.7 pounds.

Fewer fishers, bigger fish in Areas 3B and 4

Not as much sport fishing activity goes on out in these remote waters, where people fish for a living more than for sport. As expected, the recreational halibut catch here is quite small – about 17,000 pounds for 1999 – concentrated at Chignik Bay, Cold Bay, and Sand Point. These estimates, too, are revised from 1996-1998.

Area 4 harvests, along the Aleutian Islands and the Bering Sea, dropped slightly from 96,000 pounds in 1998 to 94,000 pounds in 1999. The Area 4 harvest happens primarily in Dutch Harbor, where it is not uncommon to haul in a halibut weighing 300 pounds or more. No dockside sampling takes place in Dutch Harbor or Sand Point, though one charter operator told us that larger fish were less abundant in 2000 than he had seen previously.

Most of the Area 4 sport catch happens right out of Dutch Harbor, where it is not uncommon to haul in a halibut weighing 300 pounds or more.

The 2000 harvest in Area 4A is expected to hold steady with 1999 catches. Catch figures fluctuated over time due to the small sample size, and estimates may be biased toward the low side because remote fishers do not always retain licenses and sometimes confuse subsistence with sport use.

Currently, we use the average weight obtained from ADF&G sport fish sampling on Kodiak Island to extrapolate poundage for the Area 3B and 4 harvests. However, anecdotal information from sport fish publications and conversations with local charter operators reminds us that the average weight may be quite high in Dutch Harbor and Unalaska. Therefore, the harvest in Areas 3B and 4 may be higher than our estimates show.

THE SHADOW FISHERY: WASTE ON THE HALIBUT GROUNDS

There are five different kinds of removals of Pacific halibut – commercial, sport, personal use, bycatch and waste – and the IPHC estimates each kind when calculating how much halibut has been removed from the total biomass each year. Perhaps the most invisible of these kinds of harvests is the waste – halibut killed by lost and abandoned gear, or tossed back at sea because they are smaller than the legal size limit. The mortality of legal-sized fish from the commercial fishery is wastage and is deducted in setting the setline CEY. Sometimes a certain fishing spot is more abundant than expected, and the gear hauls up more than the fishing period limit allows, in Area 2A, or more quota than an operator has left, in British Columbia or Alaska. Legal-sized halibut discarded at sea for this reason are recorded during logbook interviews.

Not all sublegal-sized halibut returned to the sea survive, though most fishers try to use proper discard methods and return the fish to the water quickly and in good shape. So each year, the IPHC estimates the discard mortality rate for these fish, and their removal from the biomass is accounted for when setting the exploitation rate.

Fish that feed the darkness

Lost and abandoned gear practically operated a major fishery of its own, back in the heyday of the halibut derby fisheries. Fierce competition and openings of only a few hours, sometimes pummeled by ferocious weather, could turn a commercial halibut trip into a nightmare of lost, cut or abandoned gear. Area 3A of the Gulf of Alaska saw the worst gear losses. In some years, in the late 1980s and early 1990s, there were enough skates left on the grounds to hook more than two million pounds of halibut, 75 percent of them in the Gulf. In 1986, halibut mortalities attributed to lost gear topped out at 3.2 million pounds.

The quota fisheries have converted the all-out derby competition into a more sedate, market-driven fishery in which harvesters can take the time to set and pull gear, and to estimate more closely how much gear to set to achieve their catch limit. As a result, the amount of halibut hooked by lost or abandoned gear has shrunk to its lowest levels since we started counting them.

How much halibut does lost gear catch? We calculate wastage as a ratio of effective skates lost to effective skates hauled, multiplied by total catch. Logbook interviews, or fishing logs received in the mail, give us information on the amount of gear lost or abandoned. We extrapolate fishery-wide estimates from qualified logbook catch and effort statistics to estimate total catch values. Gear types vary considerably as to the length of skates, hook size, and hook spacing, but we standardize gear and only standardized gear is used in calculations. If data taken from a particular log are incomplete, or if the gear fishes differently – as in the IFQ fishery in Alaska, where halibut is often harvested on a mixed sablefish/halibut trip, or as bycatch on a sablefish trip, using sablefish gear – those data are not included in the calculation.

The Area 3A ratio is very low, but we can't be sure if this is an anomaly or if in fact very few skates were lost in 2000. Since the quota share fisheries began and overall wastage decreased considerably, the ratios of lost skates to hauled skates have fluctuated slightly between years, but this year's figures are still far lower than they ever have been.

Gear losses decreased in 2000 in all areas except Area 2A, where it was unchanged and the derby-style fisheries still prevail.

Snarl of the gear. Photo by Tracee Geerneart.

Coastwide, 221,000 pounds of legal-sized halibut were taken by lost or abandoned gear in 2000, most of this by far out in Area 4 where weather and rough seas probably account for a lot of those losses.

Discard mortality of sublegal halibut

Commercial fishers are required to throw back any halibut smaller than 32 inches (81.3 cm) long. We know, from years of investigation and observation, that about 84 percent of these hardy, undersized halibut will survive to reproduce. Each year we calculate the mortality of undersized halibut that are returned to the sea.

In 2000, we started estimating the ratio of undersized to legal-sized halibut caught in the commercial fisheries in a different way. Previously, we applied the ratios seen in the grid surveys for each area, but concerns grew that the grid surveys did not target legal-sized fish, as a commercial operation would do. To adjust our ratios to better reflect the commercial fisheries, this year we began calculating the ratio only from those survey stations where the highest number of legal-sized halibut were harvested.

The 1999 ratio will be used for Area 2A as no survey was conducted off of Washington or Oregon in 2000. These adjusted ratios increased for Areas 3A and 3B over the 1999 ratio, and decreased in Area 2B. The ratios in Areas 2C and 4 stayed about the same.

Next, we figured in the mortality rate. Based on bycatch discard mortalities observed in the slow-paced 1992 and 1993 Bering Sea/Aleutian sablefish hook-and-line fishery, and on sablefish IFQ fisheries in 1996 and 1997, we estimated that about 16 percent of sublegals discarded at sea will not survive. So we multiplied the ratio of sublegal halibut from the surveys by the estimated commercial catch in each regulatory area; then multiplied that figure by the mortality rate (16 percent) to calculate the estimated poundage of sublegal-sized halibut killed in the commercial fishery. It was estimated that 1.18 million pounds of sublegal-sized halibut were killed in the 2000 halibut fishery but remember this is accounted for when setting the exploitation.

TAKING HOME THE WILD: PERSONAL-USE HALIBUT HARVESTS

"All the world is one word," writes Robert Penn Warren, "and that single word means joy." Of all the simple joys of living, there probably is none so fine as bringing home a gleaming fish, your hands full of wonder for the thoughtful, and meat for all.

Several communities throughout the Pacific coast take halibut for personal, ceremonial and subsistence uses throughout the year, and this time-honored practice is counted separately from the commercial or sport harvest. Personal-use harvests increased slightly this year, primarily because of increases in Area 4E Community Development Quota retention of sublegal-sized halibut.

This year the personal-use take totaled 739,000 pounds: 439,000 pounds in all areas of Alaska, and 300,000 pounds in British Columbia. Personal-use fish includes only the non-commercial and non-sport halibut. In both countries' individual quota programs for the commercial fisheries, take-home fish are monitored and weighed at the time of offload, and are included in the person's or vessel's quota harvest.

The Indian food fishery in British Columbia is challenging to monitor. We estimate that 300,000 pounds of halibut went to First Nations communities in 2000 under this category.

Personal-use harvests are not always documented, so they are somewhat challenging to count. Personal-use halibut are divided into three categories that are included in our estimates:

1) the sanctioned First Nations food fish fishery in Canada,
2) sublegal halibut retained in Area 4E under IPHC regulations,
3) rod and reel catch not documented in the sport catch (including subsistence fisheries in Alaska);

and three categories that are not included in this estimate:

4) illegally-set commercial gear,
5) illegally-retained bycatch in other fisheries,

Carved native halibut hook. IPHC photo archive.

6) ceremonial and subsistence harvests in the Area 2A treaty Indian fishery, which is counted under the catch sharing plan and therefore is recorded on fish tickets.

The First Nations food fish fishery in British Columbia is challenging to monitor because of remote locations, but Canada's DFO estimates this catch at 300,000 pounds. Some portion of this is documented in logbook and landing data, but not all.

In Alaska, residents are allowed subsistence harvests for personal use, separate from the sport fishery, but these are also challenging to document accurately. Each year ADF&G conducts household interviews and postal surveys to collect subsistence catch data, and then the IPHC adjusts these data for some overlap in the reporting of sport catches, and for areas where no data were collected. Personal-use harvests have been estimated only intermittently since 1991.

In Washington, Oregon and California, state regulations require that halibut taken for personal use be recorded on fish tickets, and therefore these catches are included in the commercial catch.

Special take-home exemption in Area 4E

A special exemption allowing CDQ harvesters to take home sublegal halibut for personal use has attracted much discussion. In 2000, fishers from two CDQ groups retained 13,390 pounds of undersized halibut.

The IPHC has granted a special exemption allowing retention of sublegal halibut in Area 4E. Under a temporary exemption that began in 1998, harvesters participating in the Community Development Quota (CDQ) fishery may retain fish smaller than the legal limit for personal use. That first year, the two CDQ organizations operating in Area 4E voluntarily reported landing 3,590 pounds of sublegal halibut. In 1999 reporting was required, and the two CDQ groups together reported 7,901 pounds of sublegal fish retained. In 2000, retention almost doubled, to 13,390 pounds.

Two organizations conducted the Area 4E CDQ activities, the Coastal Villages Region Fund (CVRF) and Bristol Bay Economic Development Corporation (BBEDC). CVRF works with four fish plants, in Mekoryuk, Quinhagak, Toksook Bay, and Tununak. They operated primarily during June-July, although Toksook Bay recorded sublegal halibut on three days in August. CVRF reported 9,618 pounds in 2000, a 29 percent increase over 1999. A total of 1,198 halibut were counted, at an average weight of eight pounds.

BBEDC harvesters deliver to Dillingham, Togiak, Naknek, Egegik and Ugashik. BBEDC licenses each fisherman involved in the CDQ fishery and requires each operator to fill out a reporting log, which includes the length of each retained sublegal halibut. The lengths are tabulated by BBEDC at the end of the season and then aggregated, converted into weights from the IPHC length/weight table, and totaled.

In 2000, 41 of 105 licensed fishermen participated BBEDC's Community Development Quota fishery, and 34 of those returned reports about retained sublegals. The 34 fishermen retained 461 undersized halibut, weighing 3,435 pounds. Extrapolating for the reports not submitted, they estimated that 3,772 pounds, or 506 fish, were retained in 2000, a six-fold increase from 1999.

The increase reflects a larger fleet of participants (16 in 1999; 41 in 2000) and increased effort from Dillingham and from Togiak, where a new buying station opened this year. There was also more sublegal halibut retained in Naknek and Egegik than in previous years. In 2000, the catch of sublegal halibut represented six percent of the total commercial CDQ harvest for BBEDC.

At its 2000 Annual Meeting, the IPHC renewed the two-year exemption allowing retention of sublegals by CDQ operators in Area 4E. It will expire at the end of 2001.

THE INDIVISIBLE SEA: BYCATCH AND MORTALITY RATES

"Nature," wrote Emerson, "cannot be divided or doubled. Any invasion of her unity would be chaos." And so, whether we fish for pollock or plant pomegranate seeds, it is the whole mesh of life we take up, and sort through it as best we can. Some bycatch of non-target fish is a fact of life for all fisheries; yet the incidental catch of Pacific halibut in other fisheries has been one of the most controversial topics to perturb the North Pacific seafood industry.

Millions of dollars and years of effort have gone into learning more about bycatch, how to prevent it, how big a problem it really is, and to whom. In the interdependent web of life, is one species extricable from another? Is one fishery separable from all the others? And the ultimate question of fishery management: What are the consequences of humans' behavior in relation to this web of life?

The bycatch problem has taught fishermen, biologists and gear designers a lot about fish behavior, gear design, and fishing habits in recent years. As a result of much effort, incidental mortality of halibut in 2000 hit its lowest level since 1987. The coastwide total of halibut bycatch mortality (fish that do not survive after return to the sea) was 13.3 million pounds, reflecting a slight increase in Area 2, a 12 percent drop in Area 3 and a two percent decline in Area 4, primarily attributable to the closure of some Alaskan fishing grounds to protect sea lions. Area 2A saw some advances in estimating bycatch in the groundfish trawl fishery, resulting in a new estimate of bycatch mortality at slightly more than one million pounds.

Halibut bycatch mortalities hit 13.3 million pounds in 2000, their lowest levels since 1987, and a dramatic slash from peak levels of the 1980s.

How we count bycatch

The IPHC relies on observers aboard commercial fishing vessels to provide halibut bycatch estimates in most fisheries. In the few cases where observations are unavailable, we use research survey information to estimate bycatches. For example, bycatch estimates in the crab pot and shrimp trawl fisheries off Alaska are based on bycatch rates observed on research surveys.

The amount of information also varies for fisheries conducted off British Columbia. Canada's DFO instituted an individual bycatch quota program in 1996. Here, fishery observers sample the catch on each trawler, collecting data to estimate bycatch. In other fisheries, such as the shrimp trawl, sablefish pot, and rockfish longline fisheries, bycatch is largely unknown but is believed to be relatively low.

Halibut bycatch in the Area 2A groundfish trawl fishery is estimated using data collected during a voluntary observer program aboard trawl vessels between 1995 and 1998. The National Marine Fisheries Service trawl

Codend on deck. Photo by Hilary Emberton.

shelf survey, and bycatches experienced during gear experiments by the Oregon Department of Fish & Wildlife, provide further data to help us estimate the bycatch in Area 2A.

From total bycatch we must estimate bycatch mortality rates – the percentage of halibut that will not survive after being returned to the sea. Our mortality estimates come from years of research in a variety of fisheries.

A brief history

Halibut bycatch mortality was relatively small until the 1960s, when it leaped upward with 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 an estimated 21 million pounds (Figure 2). Bycatch mortality declined during the 1960s but increased again, to about 20 million pounds, in the early 1970s. During the late 1970s and early 1980s, it dropped to roughly 13 million pounds. By 1985, bycatch mortality had declined to 7.2 million pounds, the lowest level since the IPHC began its monitoring nearly 25 years earlier.

In the late 1980s the U.S. groundfish fishery off Alaska took hold, and bycatch mortalities inflated again, peaking at 20.3 million pounds in 1992. Bycatch mortality has since declined; preliminary estimates for 2000 total 13.2 million pounds, representing a very slight decrease from 1999 and a 35 percent decrease from 1992. Most of the decrease is attributed to the introduction of IFQs in the Alaskan sablefish fishery, the Careful Release program for the Alaskan longline fishery, and Individual Vessel Bycatch Quotas in the Canadian trawl fishery.

In its complete research report for 2000, the IPHC published detailed data on bycatch mortality by fishery, by area, and by area groupings. Following is a brief overview of halibut bycatch mortalities for 2000 by regulatory area.

Area 2

Bycatch mortalities for Area 2 were estimated at 1.64 million pounds in 2000, slightly higher than the 1.6 million pounds estimated in 1999. This year we also revised our Area 2A estimates for 1998 and 1999, based on new information gathered by the Oregon Enhanced Data Collection Program. We now assess the groundfish trawl fishery's bycatch mortality at 1.0 million pounds for 1998 and 1999, almost double the previous estimate, despite a substantially lower amount of trawl effort.

Halibut bycatch mortalities increased this year in Area 2. At the same time, our estimates of previous years' mortalities almost doubled.

In the shrimp trawl fishery, where many harvesters are using finfish excluders, more recent bycatch data prompted us to revise our previous halibut mortality estimates to 26,000 pounds, about half the level we had assumed previously.

Throughout Area 2A, the domestic groundfish and shrimp trawl fisheries are given a 50 percent discard mortality rate. In other words, about half the halibut caught as bycatch will die. The unobserved hook-and-line fishery is given a discard mortality rate of 25 percent. The midwater fishery, which involves huge catches of the target species, is more deadly for halibut caught as bycatch, and this fishery is given a 75 percent mortality rate although the incidence of halibut in this fishery is very low.

In Area 2B, off British Columbia, bycatch mortality in the trawl fishery was projected to be 242,000 pounds, slightly higher than the 1999 level of 193,000 pounds. Here, observers examine each halibut to determine its likelihood for survival.

The Area 2C estimate of halibut bycatch mortality for all gear types is a rollover from 1999 of 0.35 million pounds. Observers of the state-managed scallop fisheries estimated a 50 percent mortality rate for halibut.

Area 3

Bycatch mortality in Area 3 was estimated at 4.08 million pounds in 2000, a 12 percent decrease since 1999. Bycatch declined in Area 3A and even more-so in 3B. In Area 3A, groundfish fishery bycatch in trawl, longline and pot fisheries decreased in minor amounts, resulting in an overall reduction of 5.6 percent for Area 3A. This year, trawlers were prohibited from operating inside critical sea lion habitat that forced vessels into less productive areas and effectively reduced both catch and bycatch. The longline and pot fisheries were given lower Pacific cod quotas this year, also effectively reducing halibut bycatch.

Area 4

Bycatch mortality in Area 4 was estimated at 7.55 million pounds in 2000, a reduction of roughly two percent from 1999, continuing the decline from a peak of 10.7 million pounds in 1992. Here, too, halibut mortality was lower for trawl fisheries, due in part to lower quotas for Pacific cod and some species of flatfish, and due also to closures of prime grounds for some species to protect sea lions.

Bycatch from longline fishing for cod and rockfish was higher in 2000 – 1.38 million pounds versus 0.98 million in 1999. Pot fishing for cod remained at 1998 catch and bycatch levels. The 1999 multispecies Community Development Quota (MSCDQ) fishery targeted mainly on pollock and resulted in 269,000 pounds of halibut bycatch mortality, more than in 1998 when the fishery focused more on cod.

Halibut for the hungry: Donating bycatch to food banks

Northwest Food Strategies has collected nearly 40,000 pounds of bycatch halibut and distributed them to Washington food banks, under a special provision made permanent in June of 2000.

For the last few years, fishery managers have allowed shore-based groundfish trawlers, who cannot sort their catch at sea, to donate their incidental catches of halibut to hunger relief programs. This provision was made permanent in June 2000, and results from years of preparatory work by Northwest Food Strategies (NFS) of Bainbridge Island, Washington, working with National Marine Fisheries Service and the North Pacific Fishery Management Council, under approval by the IPHC. Since 1998, NFS has collected and distributed nearly 40,000 pounds of halibut to a Washington food bank, 14,000 pounds of that in 2000.

This year UniSea, Alyeska Seafoods and Westward Seafoods in Dutch Harbor, all shore-based processors, shipped headed and gutted halibut to Seafreeze in Seattle, with shipping donated by Western Pioneer. Seafreeze then processed the halibut into steaks, sleeved, and repackaged them for delivery. J. McGraw, Quality Assurance Manager at Seafreeze, evaluated the product quality, sorted out any under-par product, and approved the remainder for shipping to Food Lifeline, a food bank in the Seattle area.

All shore-based trawlers delivering to Dutch Harbor are allowed to participate in the donation program; most of them are targeting pollock. There is neither a limitation on the amount of halibut that can be donated nor a requirement that the halibut bycatch come only from specific fisheries. The North Pacific Fishery Management Council will review the halibut donation program every three years.

TALLYING THE WIDE WATERS: PACIFIC HALIBUT STOCK ASSESSMENTS

The Pacific Ocean is 64 million square miles, an average of 14,000 feet deep (36,000 feet deep at the bottom of the Marianas Trench off Guam), covers more than a third of the earth's surface, and holds more than half of its free water, most of it in motion. Scientists say there are probably more than 20,000 separate species of fishes in all the world's seas, all of them living their private yet interrelated lives in the great bouillabaisse of the ocean.

How many *Hippoglossus stenolepis* live between the Monterey Trench off California and Cape Prince of Wales, Alaska? How old are they? Are they decreasing, or increasing in abundance? To answer these questions, IPHC scientists devote years of their lives to rubber boots, computer screens, endless tables of data, and the discipline of statistical analysis.

This year, we estimated halibut abundance – the size of the exploitable biomass of Pacific halibut off the Pacific North American coast – at approximately 549 million pounds. At a 20 percent exploitation yield – the amount is safe to remove from the biomass without affecting its reproductive capacity – the IPHC has set a total harvest level of 109.8 million pounds. This figure is a return to approximately the same level set in 1998.

We estimate the total exploitable biomass of Pacific halibut off the North American coast at about 549 million pounds, yielding a coastwide harvest level of 109.8 million pounds.

Emptying the hold. Photo by Ayala Knott.

Each year we not only estimate the population of halibut off our shores, we also must assess the accuracy of our methods of achieving those estimates.

Last year, abundance was estimated to be substantially lower, to adjust for a change in the bait we used in research surveys after 1993 (see "Bait and switch," on page 36). But further research this year confirmed that the precautionary adjustment was not necessary, and that our earlier estimates had been closer to correct. This year we also returned to a somewhat simpler, more flexible computer model to estimate halibut abundance.

The many steps of assessment

We assess abundance and potential yield of Pacific halibut by compiling all available data from the commercial fisheries and scientific surveys – ours, and surveys conducted by National Marine Fisheries Service – and apply data from each regulatory area to a detailed population model that helps us statistically calculate the overall halibut biomass for that area. For Areas 3B and 4, exploitation rates were low until very recently, and no surveys were done before 1996. Here, analytical assessment is not feasible, so we apply an appropriate percentage, based on the relation of survey results from the areas, and the estimate of abundance in nearby Area 3A, and apply that to Areas 3B and 4.

For each area, we set an annual harvest level, called the "Constant exploitation yield," or CEY. From that we subtract sport catches, bycatch of legal-sized fish, wastage of legal-sized fish in the halibut fishery, and halibut taken for personal use.The remainder of the allowable catch, give or take some poundage for statistical, biological or policy considerations, is the IPHC staff's recommended directed commercial halibut catch. The Commission at its Annual Meeting usually bases its final quota decisions on the staff's recommendations, sometimes raising or lowering levels according to special considerations and recommendations from user groups.

How do you assess the abundance of fish when growth rates change, gear selectivity varies, and everything in the sea is in constant flux? Our scientists have looked at several ways to use size, age and catch rate data.

From 1982 through 1994, the halibut stock assessment relied on a computer model called CAGEAN, which analyzed age data of the fish caught in the commercial fishery (collected at major ports by IPHC port samplers) and catch-per-effort data from the commercial fleet and from research surveys. It was a simple model that relied on the halibut's tendency to be a consistent size at a certain age.

Beginning in the late 1980s, halibut growth rates in Alaska skidded into dramatic decline. Halibut at a certain age just were not as big any more. Our simple, elegant CAGEAN model began to seriously underestimate the strength of incoming year-classes, because it interpreted lower catches of young fish as an indication of lower abundance, whereas the real cause was lower selectivity.

To remedy that problem, we developed a new model that allowed us to account not only for the age structure of the population, but also for the size distribution of each age group and the variations in growth rates that halibut had begun to exhibit. With the new model, we could calculate the age-specific selectivity of an entire age group by integrating length-specific selectivity over the estimated length distribution of the age group. This new model was fitted to both commercial catch data and survey data.

But as we applied this model to data from Oregon north to the Gulf of Alaska, we learned some very interesting things. We learned that fishery selectivity (which fish, among the population, are caught) is not wholly determined by the properties of the gear used and the size of the fish, but selectivity also changes with fish behavior – i.e., migration, which is more a factor of age than of size. We learned that the age of sexual maturity of halibut, for example, remained virtually the same despite the tremendous decrease in growth, so the size of halibut at maturity is now much smaller than it was a decade ago.

Why are all these assessment models so critical? Because the models are our primary tool for assessing historical and current abundance. The more accurate the models, the less chance of overfishing.

We created what we call the "1999 model," for brevity. This model tracks length-based selectivity through all years, and also age-specific selectivity, allowing other parameters to drift over time. This model differs from the CAGEAN in that, rather than using age-specific selectivities themselves, it is based on two parameters of a length-based function from which the age-specific selectivities are calculated. This means that the result, the "fit," is not the same as one would get if directly estimating age-specific selectivities. This 1999 model was the basis for our catch limit recommendations in 1997, 1998 and 1999.

Our assessment models continue to evolve as our knowledge grows. In 2000, we reverted to a simpler model, which we call the "2000 model," which is quite similar to CAGEAN. This model provides for changes in some of the selectivities, and even provides for breaks in the survey parameters – as when our surveys converted from J-hooks to C-hooks, which affected catch figures. When the staff set about recommending catch limits, we based our recommendations on the most parsimonious form of the model.

In principle, the two models should produce almost the same estimates of historical abundance, because they use the same natural mortality rate and the same series of catch at age estimates. But they do not – in fact, they differ substantially, and that difference drove us back to analysis of the two models. The 1999 model tends to overestimate the catch-at-age of the youngest and oldest fish, and to slightly underestimate those in between. The 1999 model is most reliably accurate in the middle of the age range, where the bulk of the catch is. In contrast, the 2000 model stays relatively accurate across the age range and shows no deviating pattern. The 2000 model is completely flexible and can accommodate any pattern of age-specific selectivities, so it can predict the catch at age with no systematic error over the whole age range. We believe the difference between the two fits in this regard results from the rigid constraints imposed on the 1999 model. It now appears that these features caused some problems: the catch at age was incorrectly predicted, the estimated length-specific survey selectivity in recent years in Area 3A was not very credible, and in some cases the size at age was poorly fitted.

The 2000 model is more flexible and simpler. Its estimates of historical abundance agree with our catch-at-age data, and its estimates of present abundance, while they may or may not be correct, are at least not affected by the simultaneous fitting of growth parameters.

As a result, the 1999 model had produced lower estimates of historical abundance. Then, when we adjusted those figures again to compensate for the 1993 change in survey bait, our view of historical abundance showed far lower numbers, though our estimates of present abundance remained pretty similar.

In 2000, we also removed the precautionary bait adjustment, bringing abundance estimates back up to approximately the levels reported in the 1998 assessment.

Bait and switch

Skates baited entirely with salmon caught about twice as many halibut as skates baited entirely with herring. These results suggested that, if half of survey hooks had been baited with herring in the 1990s surveys, catch rates would have been 25 percent lower. So we went to sea to double-check these results.

Why the adjustment of population based on a change of bait - Systematic surveys resumed in 1993, after a six-year hiatus. Researchers adopted chum salmon as standard bait, whereas salmon and herring on alternate hooks had been used as bait in the 1980s.

Loading bait on the *F/V Star Wars II*. Photo by Tracee Geernaert.

At-sea experiments done in 1999 showed that skates baited entirely with salmon caught about twice as many halibut as skates baited entirely with herring. The experiments were not directed at examining the catch rates of bait, but the results suggested that if half of survey hooks had been baited with herring in the 1990s, catch rates would have been 25 percent lower. The results were not absolutely certain – there was also a difference in baiting pattern (full skates vs. alternate hooks) – but as a precaution the staff applied a 25 percent downward adjustment to recent survey catch rates for the 1999 assessment, and that lowered biomass estimates by 20-30 percent.

In the summer 2000 at-sea survey, the staff conducted a direct comparison of survey catch rates using the two bait configurations (all salmon and alternating salmon/herring) and found no practical difference between them. All-salmon skates caught about 10 percent more halibut (in number) than salmon/herring skates in Alaska and about 10 percent fewer in Canada, but the difference was not statistically significant except among legal-sized fish in Alaska. Even there it was small (20 percent in both numbers and weight) relative to the year-to-year variability of the survey and the size of the long-term changes in abundance that survey is designed to track. We therefore chose not to implement an adjustment in any area.

Removing the bait adjustment from our biomass assessment increased the estimate by 30 to 40 percent. Changing the assessment models themselves had little effect on the overall biomass estimates. The only other important change was a large (25 percent) increase in Area 3A estimates after adding 2000 data, as discussed on the next page.

Areas 2A and B: Catch rates increasing, recruitment poor

Since 1985 commercial catch rates have increased by about 50 percent in Areas 2A and 2B. We know the 1985 stock size (exploitable biomass was 53 million pounds) from our catch-at-age data, because by now all the year classes that were present in the fishery have passed through it. In the mid-1990s survey catch rates were about triple the level of survey catch rates in the mid-1980s, but the last three years have indicated a relative change of about 100 percent, much closer to what the commercial data indicate. A commonsense estimate of present abundance would therefore be a variable biomass estimate of 50-100 percent above the 1985 level. The fitted estimate is 73 million pounds, or about 40 percent above 1985, which essentially follows the commercial trend but allows for an estimated 10 percent increase in the fleet's fishing power in the last 15 years. We estimate the fixed exploitable biomass at 68 million pounds, of which 11 percent is assigned to Area 2A and 89 percent to 2B.

We estimate Area 2A/B abundance at 68 million pounds, 11 percent of that in Area 2A and 89 percent in 2B.

Although the yougest age groups are not well estimated due to limited observations of them, this year's model suggests declining recruitment, but in this respect it argues with the Area 2C assessment. We believe the two will agree more closely when the estimates firm up, because relative year-class strengths have always been similar in Areas 2B and 2C.

Area 2C: Better recruitment, but a fuzzy picture

As in Areas 2A and 2B, survey catch rates have been low for the past three years after two high values in the mid-1990s. Our early survey data from Area 2C are highly variable. Overall the survey results show little or no difference in abundance between 1985 and now, but the data scatter makes any conclusions on trends questionable. Meanwhile, both commercial catch rates and our assessment model consistently showed a decline of about one-third since 1985. We estimated an exploitable biomass between 48 million pounds and 56 million pounds (depending on the structure of the computer model) for 2001.

Recruitment looks far more positive in Area 2C than it does in 2A and 2B, but this difference will diminish in the future if year-class strengths turn out to be similar across those areas, as they have in the past.

Area 3A: Halibut declining, but not collapsing

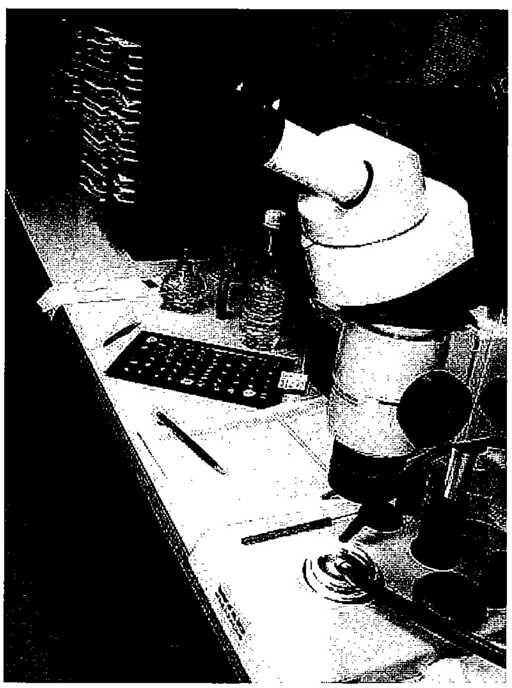
Halibut biomass in 3A was 144 million pounds at the start of 2000, with a healthy generation of younger fish up to 13 years old.

Survey and commercial catch rates agree that halibut are declining in abundance in Area 3A, but perhaps not as drastically as we thought last year. Survey data show the biomass decline at 20 to 25 percent from its 1985 level of 150 million pounds; commercial harvest data show a 10 to 15 percent decline. Adjusting for data anomalies, our model estimates the exploitable biomass at 139 million pounds for 2001. Where last year's estimated abundance was quite low, adding data from 2000 increased our estimate in hindsight. We now believe the biomass at the beginning of 2000 was 144 million pounds (as opposed to the 116 million pounds we estimated last year), most of this reflected in a general increase in abundance of younger fish, up to about age 13.

Estimated recruitment in 3A is low, but not as poor as in last year's assessment.

Areas 3B and 4: A survey-based estimate

In Areas 3B and 4, exploitation rates were very low until recently and there are no survey data before 1996. To estimate exploitable biomass in Areas 3B and 4, we extrapolated the estimated abundance of Area 3A to each area on the basis of total bottom area (0-500 fathoms) and survey catch rates. In 2000, 3B abundance was assumed to be 94 percent of 3A; each of the Area 4 subareas was 35 to 40 percent of 3A. This year the biomass estimates are all substantially higher because the 3A estimate is substantially higher.



IPHC age room. IPHC photo archive.

We take a census of the sea: Age composition

Like the human population of the North American continent, the Pacific halibut population is getting older. Instead of census takers, the IPHC has port samplers, biologists who measure fish length and take otoliths (ear bones) from a portion of the commercial halibut catch. This year, they sampled 13,743 otoliths from all areas, labeled and packed them up for analysis at the IPHC lab, and measured the halibut they came from. Back in the lab, rings on the otoliths are counted, just like rings on a tree, to assess the age of the fish.

The 1987 year-class of 13-year-olds was the largest group, comprising 25 percent of the overall commercial catch and also coming in as the most abundant year-class in each regulatory area. The 12-year-olds accounted for 15 percent of the overall population, and also took second place in each individual area. The 11-year-olds made up 10 percent of the overall catch, and were the third most abundant year class in Areas 2, 4A, 4C, and 4D. The 14-year-olds, from the 1986 year-class, were the third most abundant in Areas 3 and 4B. The average age, in all areas, was 13.7 years.

The oldest halibut caught in the commercial fishery this year was a senior citizen of 45 years, caught in Area 4B, with a fork length of 180 centimeters. The youngest were three 4-year-olds, all caught in Area 2B and measuring between 80 and 93 centimeters. The largest halibut, also caught in 4B, measured 213 centimeters and was 23 years old.

The following table shows the age summaries for each component studied (Note: age is in years and length is in centimeters).

	Minimum		Maximum		Average	Largest
	age	length	age	length	age	age-group
Commercial	4	80	45	213	13.7	13
Setline survey	3	44	55	215	13.2	12
Bering Sea trawl survey	1	13	22	123	5.4	2
Aleutian Is. trawl survey	2	19	30	198	8.7	5

For the setline survey samples, which include sublegal fish (<82 cm in length), 12 year-olds were the most abundant age group in Area 2B, while 13-year-olds were the most abundant age group in all other areas (Areas 2C, 3, 4A, 4B and 4D). Areas 2A and 4C were not surveyed in 2000. Twelve-year-olds made up the second most abundant age group in all areas surveyed except Area 2B. The average age and length by sex for the survey was 12.8 years and 103.9 cm for females, 13.7 years and 86.8 cm for males. The 55 year-old female captured broke the previous age record of 46 for a female halibut. A total of 15,762 otoliths were collected on setline surveys in 2000, around 14,000 of which were aged. Setline survey females outnumbered males in Areas 2, 3A and 4D.

A total of 1,207 otoliths from National Marine Fisheries Service (NMFS) trawl surveys were collected and aged in 2000. IPHC samplers were aboard two NMFS vessels: one in the Bering Sea and the other off the Aleutian Islands. Average age and length for halibut from the Bering Sea trawl survey were 5.4 years and 46.9 cm. The most abundant age group was 2-year-olds, followed by 5- and 6-year-olds. For halibut caught on the Aleutian Islands trawl survey, average age was 8.7 years and average length was 67.3 cm. The most abundant age group for Aleutian Island trawl halibut was 5-year-olds, followed by 4- and 7-year-olds. Males outnumbered females in both regions.

Should we change the exploitation rate?

We have learned from experience the wisdom of keeping harvest rates steady. For that reason we opted to stay with a 0.20 harvest rate, pending further research.

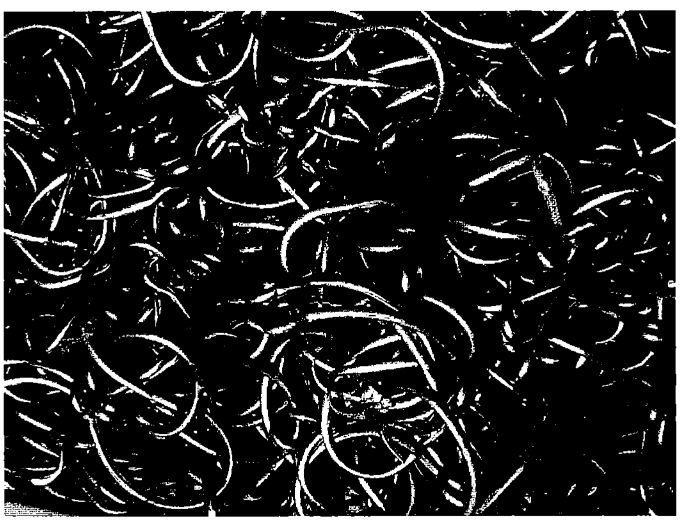
We set annual harvest rates at a level that we believe gives harvesters the optimum yield. For the past few years, the optimum harvest rate has been 0.20, or 20 percent of the overall estimated exploitable biomass. Should this harvest rate change?

We approached this question in two ways. The "per-recruit" approach looks at the effect of different harvest rates on the life history of an average fish—things like average size, average yield, and reproductive output.

The second approach is a simulation study, in which we apply a variety of assumptions about the biological changes in the halibut population and the environment producing them to try to project growth and changes into the future. The goal is to consider the uncertainties of the biology of the stock – and of our ability to assess the stock – balancing yield to the fisheries and conservation of the resource, and come up with the most robust harvest rate possible.

The "per-recruit" approach led us to 0.20 as the most appropriate harvest rate given the biological conditions of the stocks in 1996, and a bit low given conditions observed in 1999. The long-term simulations, run with four different recruitment scenarios, suggest that a somewhat higher harvest rate would increase yield to the fisheries without endangering the spawning biomass. We opted to stay with the 0.20 harvest rate for now, while we refine our research.

We have learned from experience the wisdom of keeping harvest rates steady. In the mid-1970s, a period of very low halibut biomass levels, we adopted a very conservative harvest strategy to help rebuild the halibut stocks. In those years, we determined harvest levels on the basis of estimated annual surplus production, or the amount of catch that could be taken while maintaining constant biomass levels. In 1985, as stocks rebounded, we shifted to an MSY (maximum sustainable yield) policy, under which the catch levels would rise and fall smoothly with abundance, and the exploitation rate would be the same for all areas. For the present, we choose to stick with the 0.20 exploitation rate as both productive and prudent.



Circle Hooks. Photo by Tracee Geernaert.

Who is answering the phone? A look at gear selectivity

Ever since the 1970s, our scientific setline surveys, conducted with longline gear, have caught fewer and fewer small halibut (<80 cm). However, NMFS trawl surveys do not show this decrease. Which is changing, the abundance of small halibut or the gear's selectivity of small fish?

In 2000 we set out to compare the data from the two kinds of survey. We ran comparisons in Areas 3A and 2B, the areas for which we have the most data. We discovered that, for some reason, the setline survey is not as likely to catch the smaller fish as it once was, and that this lack of selectivity may have resulted in an underestimate of recent year-class strength. In 3A, for example, the 1990 setline surveys .3 showed little change in the abundance of fish in the 60-80 centimeter length range from the previous few years, while trawl surveys indicated a large increase.

Why the difference between setline selectivity and trawl selectivity of smaller fish? We ruled out the change to C-hooks in the 1984 setline survey – that change was accounted for in the data, and would have had minimal overall effect in setline trends. We looked at how trawl gear may have increased in selectivity of small fish over the years, but the rigidly consistent fishing parameters of trawl surveys minimizes any meaningful difference there. The most plausible explanation for the increase in halibut trawl catch rates is that halibut were in fact more abundant in 1993 than in 1990. Among the small fish, this jump would have coincided with the arrival of the strong 1987 and 1988 year-classes.

Has longline gear decreased in selectivity of small fish? This seems to be the answer left after the others are ruled out. A decrease in small fish selectivity could result from some shift in the competition for baited hooks among halibut and other takers. It could reflect a change in the ocean bottom after the climactic regime shift of 1976/77, when larger-sized halibut and other flatfish increased in abundance. Whatever the reason, we have no strong reason to doubt the overall trends shown by the trawl surveys, which reveal a bump in abundance of smaller-sized halibut. However, it is interesting to note that in Area 2B, off British Columbia, there is no statistical difference between trawl survey results and setline survey results. Area 2B has historically shown similar patterns of recruitment to the Gulf of Alaska.

SPYING ON THE MYSTERY: AT-SEA SURVEYS

The world is too remote from ordinary experience to be imagined.
– Edward O. Wilson, *Concilience*

Fortunately, we do not have to imagine the world; we just have to go outside and look. Nearly every summer since 1963, the IPHC has conducted surveys of the sea, to look the halibut population in the eye. Aboard chartered vessels, we fish door-to-door along a regular grid pattern, using standardized methods and gear, to gain a regularized view of the size, age and sex composition of the halibut stocks. We also participate routinely in the trawl surveys conducted by the National Marine Fisheries Service.

Surveys provide information about the halibut population independent of the constraints or demands of the commercial fishery. Later, we compare survey data with the information from the commercial fishery, which of course covers a much greater area over a far longer period of the year, but which is not scientifically standardized. These two sources of information together give us a glimpse of what is happening with the halibut biomass, its growth and aging process, and the other species that co-habit with it.

Hauling in the bag and flag on the chartered *F/V Star Wars II*. Photo by Tracee Geerneart.

Drawing the Setline

This year we chartered 15 commercial longline vessels – eight Canadian and seven U.S. vessels – to conduct 84 trips totaling 712 days across 24 separate regions, covering halibut habitat from British Columbia to the island of Attu in the Aleutian

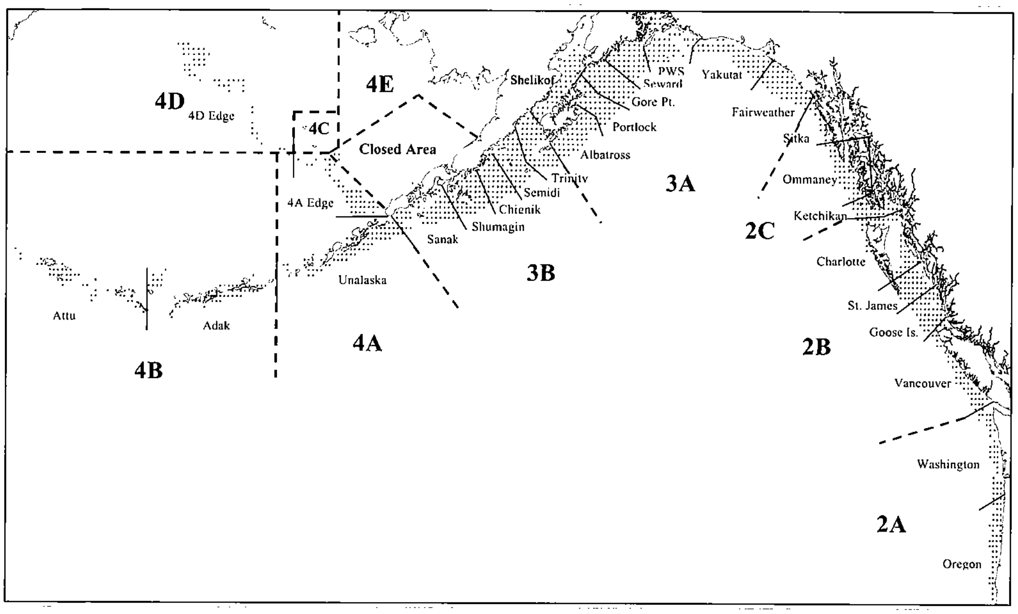


Figure 2. Setline survey areas and stations.

Islands, Alaska. This year's surveys included areas in the 4A Edge and 4D Edge charter regions in the Bering Sea that had not been surveyed for several years. We did not survey the halibut grounds south of Vancouver Island and along the Washington-Oregon coast.

We fished a total of 1,105 planned grid stations, 1,071 of them producing scientifically useful data. We harvested 1,817,365 pounds of halibut, 2,575 pounds of Pacific cod and 98,086 pounds of rockfish.

Currently, the entire halibut range, from Oregon to the northwest Bering Sea, is divided into 27 separate regions, each surveyed in 20 to 40 charter

Vessel	Home Port	Stations completed
Angela Lynn	Vancouver, B.C.	126
Bold Pursuit	Comox, B.C.	142
Free to Wander	Vancouver, B.C.	93
Heritage	Kodiak, AK	97
Kristiana	Seattle, WA	45
Lualda	Seattle, WA	17
Oc. Marauder	W. Vancouver, B.C.	45
Pacific Sun	Newport, OR	73
Pender Isle	Vancouver, B.C.	85
Star Wars II	Vancouver, B.C.	44
Taasinge	Kodiak, AK	11
Trident	Adak, AK	90
Tyanaa	Campbell River, B.C.	81
Vansee	Seattle, WA	17
Viking Spirit	Vancouver, B.C.	139

Catch per unit of effort increased in Areas 2B, 2C and 3A, and decreased in Areas 3B and 4.

days of fishing. Stations were placed at the corners of a square grid measuring 10 nmi by 10 nmi. Stations that fell in unfishable areas, or at depths less than 20 fathoms or deeper than 275 fathoms at the center of the set, were eliminated.

Our survey stations were fished with standard fixed-hook gear consisting of 1800-foot skates with 16/0 circle hooks spaced 18 feet apart and gangions 24 to 48 inches long. All hooks were baited with approximately one-third pound pieces of No. 2 Semi-bright chum salmon. Each vessel set one to four stations daily, beginning around 5:00 a.m., and allowed the gear to soak at least five hours before hauling. We avoided soaking the gear at night whenever possible, and did not use data from soaks longer than 24 hours. Sets were deemed ineffective if they exceeded pre-determined limits for lost gear, snarls, predation, or displacement of the sets.

Along with the halibut survey vessels caught, we also hauled aboard 85 separate species of fish and invertebrates. Shark was the most common bycatch.

First, we measured the fork length of each halibut caught, converted the length to estimated poundage, and dressed all legal-sized fish. An IPHC sampler recorded the sex and maturity of the fish. Males were coded as either mature or immature, and females were assessed as either immature, mature, spawning, or resting. The majority of males large enough to be caught on survey gear were mature.

We also collected otoliths from a sample of the halibut caught, to add age data to the mix. The sex and maturity of halibut less than 82 cm was recorded only if the fish was randomly selected for otolith collection.

Census report

Halibut catch per unit of effort (CPUE, amount of fish per skate of gear) increased in Areas 2B, 2C and 3A, and decreased in Areas 3B and 4, in comparison with recent years. Average CPUE, expressed as pounds per skate, is calculated by dividing the catch, in pounds, of legal-sized halibut by the number of standardized skates hauled for each station, and averaging these values across an area.

	Survey CPUE (lbs/skate)		
Area	**1998**	**1999**	**2000**
2A	-	37	-
2B	92	95	104
2C	232	204	232
3A	281	241	273
3B	436	441	378
4A	304	367	286
4B	216	204	216
4C	-	-	-
4D	-	-	213

Along with the 1.8 million pounds of halibut the survey vessels caught, we also hauled aboard 85 separate species of fish and invertebrates and three species of seabirds. The most common bycatch in Areas 2B, 2C and 3A was shark, 90 percent of which were dogfish (*Squalus acanthias*). Sablefish (*Anoplopoma fimbria*) and rockfishes (*Sebastes* spp.) also appeared fairly often in 2B and 2C. West of Kodiak Island, the most common bycatch was Pacific cod (*Gadus macrocephalus*).

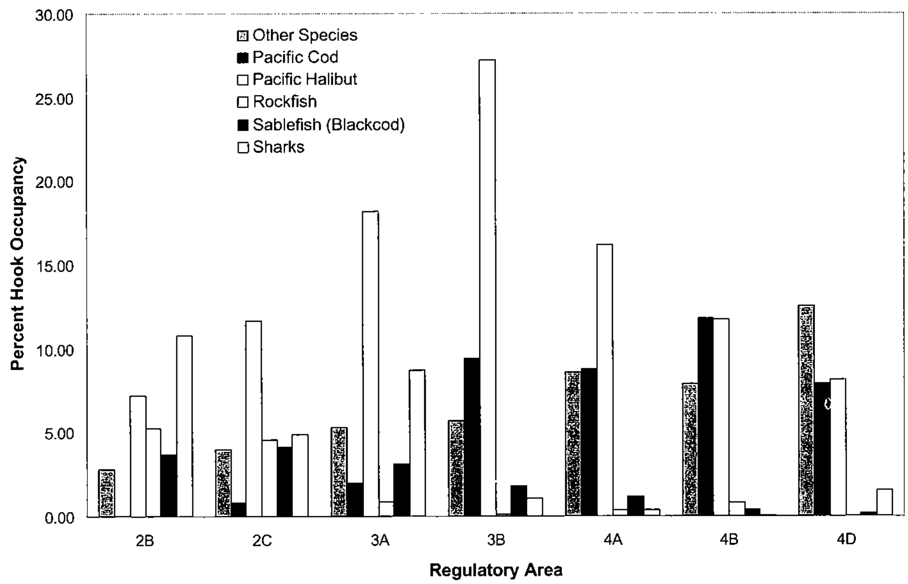


Figure 3. 2000 setline survey species composition.

We aimed to harvest 2,000 halibut otoliths from each regulatory area, hoped for a minimum of 1500 per area, and overall collected 99 percent of our goal. Our lab analysis of the otoliths throughout the year will give us information on the age structure of the halibut population.

The median length of all the halibut caught in the survey in 2000 was 88.5 cm. Median lengths are greatest in the extreme northern and western ends of the halibut range, in Areas 4B and 4D – 95.5 cm and 101.5 cm, respectively – but were consistent throughout the other areas, flexing between 87.5 and 90.5 cm.

Females abound in the halibut community – comprising 54.6 percent to 70.7 percent of the population – throughout all areas but 4B, where the catch was composed of only 38.9 percent females. This percentage is even lower than the proportion we saw in 1999 surveys. In general, the regions west of the Gulf of Alaska tend to have lower percentages of females; coincidentally, these areas have the lowest exploitation rates.

Sometimes the opportunity arises to collect other kinds of information, too, relating to other IPHC experiments not directly associated with stock assessment. In 2000, we completed several other special projects while we were at sea:

1) We compared the effects of fishing with mixed salmon-herring bait (which was our survey practice from 1976 to 1986) with standard salmon bait (which we have used since 1993).

2) We collected halibut flesh samples for stable isotope analysis of the trophic status of halibut.

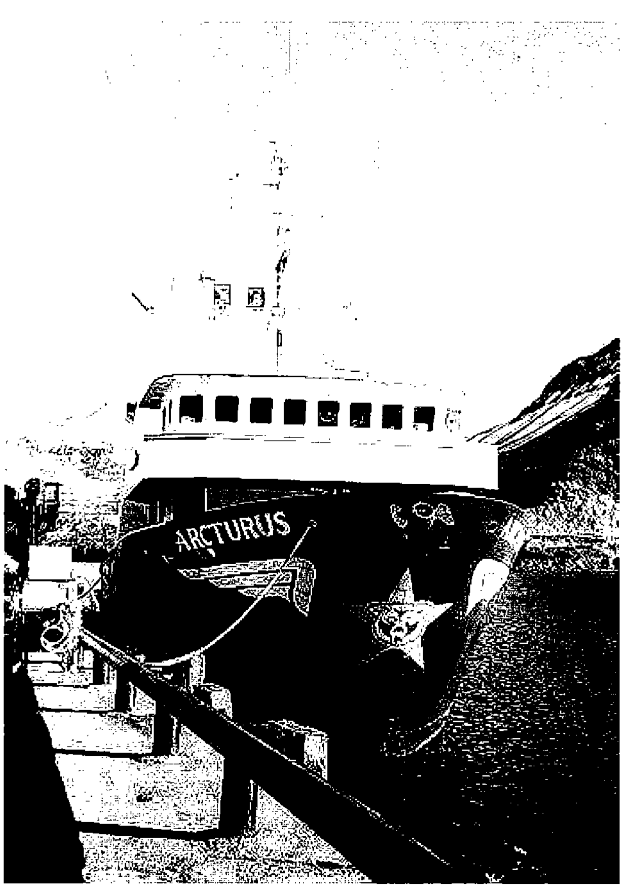
3) We recorded the number of prior hook injuries we found in the halibut we caught.

4) We deployed a water column profiler.

5) We collected paired otoliths for a crystallized otolith study.

Flatfish on the flats: Bering Sea trawl surveys

Since 1998, IPHC biologists have jumped aboard one of two vessels conducting the National Marine Fisheries Service (NMFS) annual trawl surveys of the Bering Sea to gather data about halibut stocks and record the condition of the halibut they find. Our objective - sample 100% of the halibut caught by collecting otoliths and recording length, sex, maturity, as well as flesh samples for isotope studies and prior hook injury assessments (read more about prior hooking injuries in this report). This age composition information helps us identify trends in size at age, and to spot particularly large or small year-classes approaching the commercial fishery.



***F/V Arcturus*. Photo by Joan Forsberg.**

Trawl data used together with that from our setline survey can provide a fairly accurate view of relative abundance throughout the size range of the fish. Trawl gear tends to catch fish primarily from about 20-100 cm in length while the setline survey catches fish from about 60 cm and up. Until recently, trawl survey data were used only as a forecasting tool, but we are currently trying to incorporate them into the stock assessment.

The 2000 Bering Sea trawl survey covered the usual grounds from the continental shelf off inner Bristol Bay to the shelf break, and between Unimak Pass to north of St. Matthew Island. The two vessels chartered were *F/V Arcturus* and *F/V Aldebaran*. Both trawlers left Dutch Harbor on May 21. They fished about 380 stations positioned on a 20 x 20 nautical-mile grid along the shelf, in depths ranging from 0-200 fathoms.

Fecundity and other delicacies

In 178 tows, the *Arcturus* caught 661 halibut – 318 females and 343 males. Fifteen of those tows were new stations added to include depths less than 30 fathoms. A total of 547 halibut were caught at the standard stations compared to 831 in 1999, and 114 halibut were caught at the new, shallow stations.

As expected because the fish are generally small, most were immature. Of the females, 95 percent were immature, two percent were ripening, and three percent were spent/resting; there were no females actively spawning. Males are given only two maturity stages: immature and mature. Of the males sampled, 69 percent were immature, and 31 percent were mature enough to participate in the upcoming spawning season.

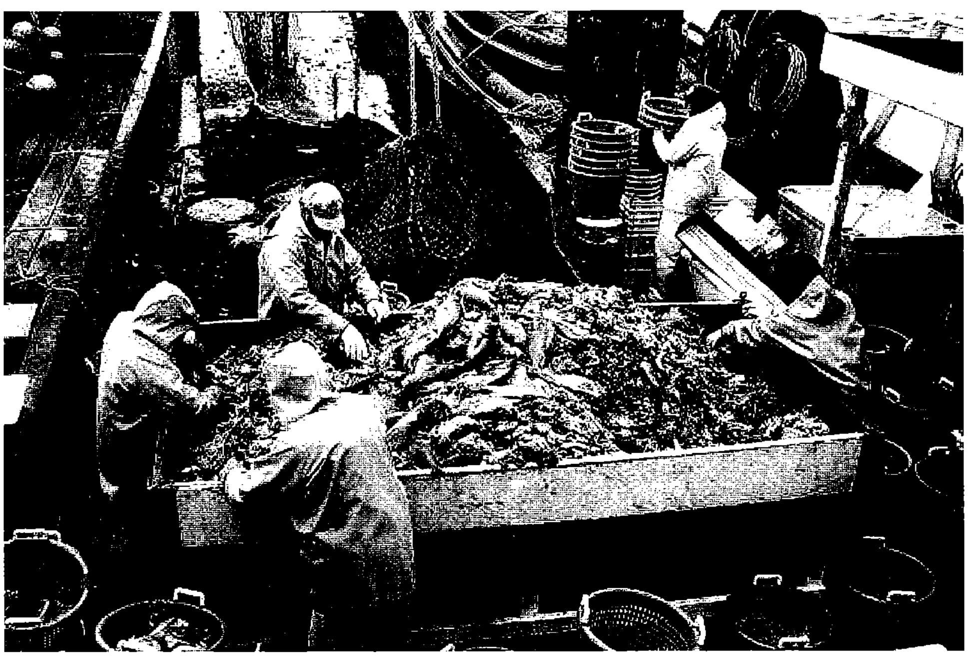
We found prior hook injuries on only five percent of the halibut. Of those 31 individuals, seven showed moderate damage and 24 showed minor damage.

The Arcturus caught 547 halibut on standard stations compared to 831 last year.

Babies boom and blossom

Because the Bering Sea shelf survey is conducted annually, it is possible to watch particular size and age classes travelling through the population. For example, the 1987/88 year class was a huge baby-boom group much larger than the age groups on either side of it. This year we saw a group of very small fish, 10 to 19 cm, beginning to burgeon in both the standard and shallow stations. Fish smaller than 20 cm do not ordinarily show strongly in the surveys, because they are just beginning to become vulnerable to the gear. It will be interesting to see, in the next few years, whether this is the first sign of a strong year-class, or simply annual variability.

A group of very small fish, 10 to 19 centimeters, began to burgeon this year. It will be interesting to see whether this is the first sign of a strong year-class or simply annual variability.



Sorting the trawl survey catch aboard the *F/V Vesteraalen*. Photo by Hilary Emberton.

Overall abundance in the past decade as estimated by this survey swelled to a peak of 67 million fish in 1991 and hit a low of 33 million halibut in 1996. The 2000 estimate was 37 million.

Linking the chain: Aleutian Islands trawl survey

This year marked the second deployment of an IPHC biologist aboard the NMFS Aleutian Islands trawl survey. Previous to 2000, the survey was conducted every three years as in the Gulf and U.S. West Coast, but from now on will be conducted every two years. The area fished spans a geographical region from the Fox Islands adjacent to Akutan Island to Stalemate Bank west of Attu in depths from 30-500 meters. Two vessels were chartered; *F/V Vesteraalen* and *F/V Dominator*, and our sampler rode along on the *Vesteraalen*.

The survey included 450 fishing stations and halibut were subject to sampling in 230 of those. A total of 624 halibut were sampled; 220 females and 404 males (This compares to 863 fish caught in 1997). Of those, 10% of the females were mature while 62% of the males were mature. We expect a higher rate of mature fish on this survey compared to the Bering Sea because the size composition tends to show a larger percentage of bigger fish in this area.

We are giants of the senses: Biological Research

Scientific investigation, writes Katya Walter, gives us enormous eyes, ears and sensory capabilities to see the infinitesimal and the infinite of our world. In the course of our daily business at the IPHC, we investigate many mysteries of the benthic universe, from the minute messages of the otolith to the syncopated patterns of climatic and oceanic regime shifts. We collect a trove of data each year that, while focused on halibut, may also be useful to other scientists.

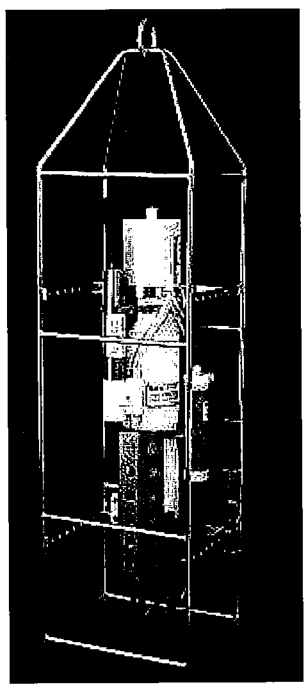
The IPHC conducts the largest consistent marine sampling program of any research agency in the north Pacific. Since 1996, we have surveyed more than 1000 stations on an equidistant 10 nautical mile grid, from Oregon to the Bering Sea, between 35 and 500 meters deep. Recently, we started looking around to see what other scientific investigations could be conducted during our marine surveys without detracting from IPHC priorities.

Most of the forces that drive productivity of the oceans occur between 20 and 100 meters deep, in spring and summer, precisely coinciding with IPHC survey activities.

Profiling the water column

The first and obvious answer was collecting oceanographic data for other agencies. We already record bottom temperatures at 25 to 30 percent of the survey stations; why not begin sampling the entire water column? Climatic and oceanic conditions drive fluctuations in growth and recruitment of fish populations, as well as other global changes. Satellites sample the ocean surface and free drifting arrays of mid-ocean profilers provide data on mid-latitude ocean conditions. However, there is a great lack of observational data for most of the nearshore northeast Pacific. These waters over the continental shelf are, naturally, most important to the groundfish species that comprise most of the fish production of the northeast Pacific.

The IPHC survey is ideally situated to capture a snapshot of upper ocean conditions during the most productive time of the year. Primary and secondary productivity of the oceans are directly driven by variations in water temperature, salinity, mixing, and light penetration, among other factors. Most of this production takes place in the mixed layer, between 20 and 100 meters deep, in spring and early summer.

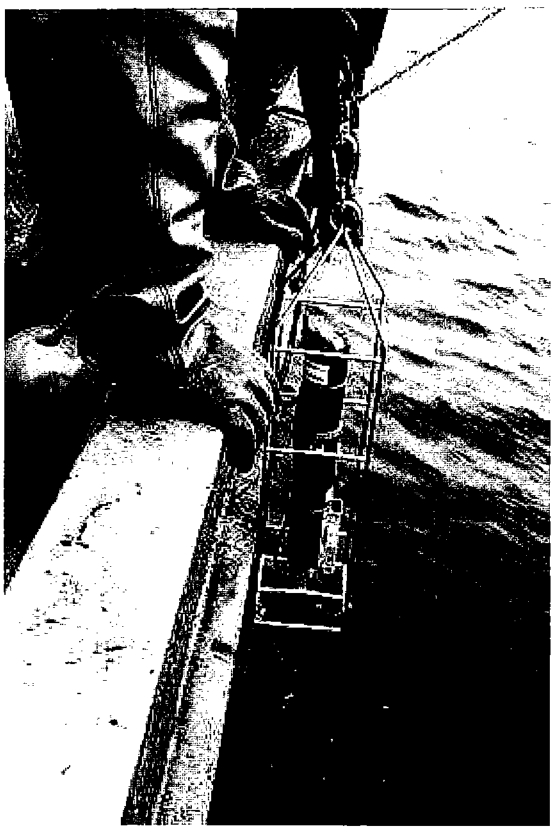


Bottom profiler. IPHC photo archive.

To collect more than bottom temperatures, we needed a water column profiler of some sort. Though profiler technology has greatly improved, even the most basic profilers are still big, expensive, delicate, and somewhat temperamental instruments. There are several challenges to deploying a profiler from the type of longliner that generally fishes for the IPHC assessment surveys. We had to figure out how to deploy the profiler without using a crane or winch, how to keep it from crashing to the ocean floor, and whether or not there would be time to deploy and retrieve the profiler without detracting from normal survey operations.

To adapt the water column profiler for deployment from a working halibut longliner, we had to design a way to let it drop through the water column rapidly enough to collect valid data, but also prevent it from crashing into the bottom.

We purchased a SeaBird SBE 19 "Personal CTD". This profiler can sample at a programmable rate up to two scans per second, allowing it (in the words of its operations manual) to "characterize the water column with high accuracy and half-second resolution." The unit came in an aluminum housing rated for depths up to 3,400 meters, and weighed 9.2 kg in air and 5.2 kg in water. We also purchased a stainless steel cage specially designed to protect the profiler from bumps and scrapes.



Launching the profiler from the *F/V Bold Pursuit*. Photo by Reisa Latorra.

The unit comes with enough computer memory for about 100 casts. The information is then downloaded to the laptop on board the vessel. Power for the unit is supplied by nine D-size alkaline cells, which provide about 40 hours of operation of the basic CTD sensors.

We took the profiler out on the *F/V Bold Pursuit*, a 65-ft vessel that had been chartered to survey the Sitka, Fairweather and Yakutat stations for the 2000 Standardized Stock Assessment survey, and conducted operations between June 1 and July 23, 2000.

To adapt the profiler for deployment from a working halibut longliner, we designed a system using weights and floats that permitted the profiler to drop through the water column rapidly enough to collect valid data, but also ensured that the unit would not crash into the bottom, or get permanently stuck on the sea floor. A sustained descent rate of 1-2 meters per second is generally ideal for CTD sensors. Most scientific researchers deploy the

CTD from winches and let it descend slowly, which is why they need a pump to ensure good water flow through the sensors. We initially preferred to avoid using a pump if possible, because of its cost and the added complexity, and to allow the unit to freefall to gain the target descent rate.

We attached a 15-meter anchor rope to the bottom of the CTD cage using a section of gangion line as a weak link (in case the anchor became attached to the bottom), and tied it to a 40-pound halibut anchor. To the top of the cage we attached two floats that effectively offset the weight of the anchor in water. The floats were attached to standard halibut buoy line, which is almost neutrally buoyant. First we lowered the anchor into the water, followed by the profiler and cage, and then the buoys. After a few minutes of acclimation in the water, the rope was released and the full set allowed to freefall.

When the anchor hit the bottom, the positive buoyancy of the floats slowed the CTD unit and kept it from hitting bottom. Later, when we compared recorded bottom depths with profiler measured depth, it appeared that the unit descended only about five meters after the anchor hit bottom and therefore was never in danger of crashing. On board the vessel, it was immediately obvious when the anchor hit bottom by a noticeable slackening of the rope. At this time, the rope was coiled around the gurney and the profiler immediately hauled back up. The conductivity cell was quickly rinsed with distilled water, anchor and buoy ropes removed from the attaching carabiners and the unit secured to the side of the vessel with bungee cords. Once the crew got the hang of it, they were able to deploy and retrieve the profiler in ten minutes.

Once the crew got the hang of it, they were able to deploy and retrieve the profiler in ten minutes.

By the end of the survey, the profiler had sampled 120 of the 130 stations fished by the *F/V Bold Pursuit,* a 92 percent success rate. The region surveyed by the *F/V Bold Pursuit* included stations from inside waters to 70 nautical miles offshore, covering quite a diversity of grounds, from near-shore stations with high fresh water runoff to an offshore station with a higher salinity and considerably deeper mixed layer. Data from all the casts have been handed over to Pacific Marine Environmental Laboratory (PMEL) for further processing.

We consider this a very successful project, considering its novelty and its goals. Our purpose was to demonstrate that a water profiler could be successfully deployed from a fishing vessel without detracting from normal survey operations. In a subsequent meeting with PMEL oceanographers, we discussed further collaborations and decided:

➩ although the water column was characterized successfully, we agreed to to add a pump to the profiler, to ensure a known constant water flow;

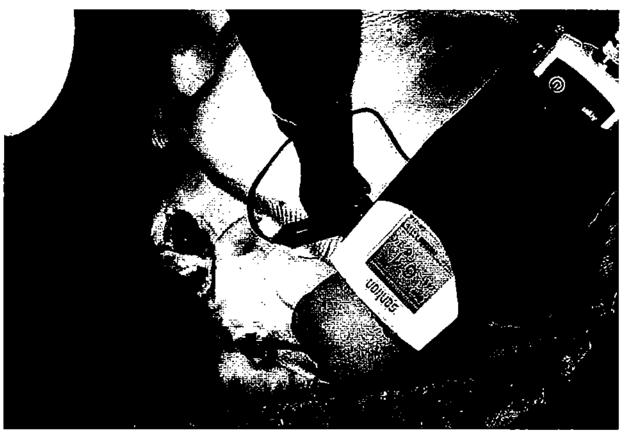
➩ to add a chlorophyll fluorometer to measure chlorophyll *a*, which is the generally utilized measurement of primary productivity;

➩ to loan the profiler to NOAA so it can be deployed side-by-side with a more robust and technologically advanced profiler. This comparison will allow reliable calibration of our data; and

➩ to seek external funding to expand the program. The IPHC's annual survey presents the scientific community with a unique opportunity to measure water column dynamics over virtually the entire Alaska continental shelf for the next several years. The two agencies agreed to cooperatively seek grants to place profilers on as many as a dozen fishing vessels in the next few years, and to publish results on the NOAA web site.

Spotting chalky halibut

Chalky halibut is fish whose flesh looks like it has already been cooked– is a problem for consumers, processors and harvesters alike. Although the chalky halibut is nutritionally as good as non-chalky fish, its appearance is different. We know that it is associated with a low pH level (higher acid level) of the flesh at time of capture. We do not know for sure why some fish are chalky but exercise by the fish, such as fighting on the hook or active feeding, can lead to lactic acid production in the muscles and perhaps in combination with warmer water temperatures, is the likely cause. We also know that excessive lactic acid levels are returned to normal after a live fish has rested without stress. In other words, it is only a temporary condition for a fish in the wild. This year, we found that pH meters could be very useful for quickly screening halibut for acidic pH levels, which indicate a fish is likely to develop the chalky condition.



Using a pH meter to detect chalky condition. Photo by Linda Gibbs.

Normally, the pH of halibut flesh is above 6.2. In fish where the chalky condition develops, the flesh pH is slightly more acidic, lower than 6.2. Fish with pH between 6.0 and 6.2 are sometimes chalky. Fish with pH below 6.0 are always chalky. The change in flesh pH appears to develop within the first one or two days after death, as the result of lactic acid stored in the muscle tissue prior to death. While nothing can prevent halibut flesh from going chalky, halibut producers have asked us to investigate how to identify the condition at the dock, so prices can be adjusted accordingly. We visited New West Fisheries in Bellingham, Washington to field-test pH meters for use in scanning for halibut chalkiness. The plant had already started processing a load of fish from Alaska that were at least four days old when tested.

We tested 33 fish with an Argus pH meter/probe, supplied by Sentron, Inc.of Gig Harbor, Washington. All the fish already had been visually screened for chalkiness by plant personnel, using a small cut on the dark side of the fish just below the dorsal fin. The pH probe was inserted into this same cut, to avoid further marking of the fish. We found a direct relationship between pH range and chalkiness of the fish flesh.

It is interesting to note that the pH meter was in complete agreement with the visual checker on all fish with pH either less than or equal to 6.0, or greater than pH 6.2. Had these fish been screened when they were initially offloaded from the boat, the pH level could have been detected even before the visual cues of chalkiness had developed. With pH levels available right away, it may be easier to tell which fish that are graded Not Chalky might develop chalkiness before they hit the supermarket, and those fish can be directed to specialized markets.

Tags are like post cards from the fish; they tell us about migration, utilization, age, growth and mortalities of halibut, and their return is critical to our research.

Halibut write home

The IPHC has been tagging halibut since 1925, and has released more than 380,000 tagged fish and recovered over 46,000 tags from fishermen. Tags are like post cards from the fish themselves; they tell us about migration, utilization, age, growth and mortality of halibut, and their return is critical to our research.

Tagged fish. IPHC photo archive.

The last major tagging project took place in 1995 as part of a study on halibut mortality in the trawl fishery. The only tags released since that time have been by sport interests in the Ninilchik and Homer halibut derbies.

We recovered 92 tags this year, most of them from Area 3A, where the most recent tagging experiments have taken place. The longest distance traveled was by two tagged fish who moved from Newport, Oregon to the southern Queen Charlotte Islands.

Recovery rates from the most recent experiments vary from three to 47 percent. It makes sense that the oldest tagging experiments see the highest rates of return, because those fish have been available for capture far longer. Nearly half of the tagged fish released in the 1988 Sitka Spot experiment have now been recovered. The 1989 central Oregon study, with 626 recoveries, has a recovery rate of 30%. The most recent project was the 1995 trawl mortality experiment aboard the *F/V Forum Star*. To date, the recovery rate for this experiment is far below average at only three percent.

Oh my aching head: Prior hook injuries

This year we checked 115,000 halibut coastwide, and saw a general decrease in prior hook injuries. The proportion of previously injured halibut ranged from a low of 3.7 percent in Area 2B, to a high of 9.6 percent in 4D.

In the course of a young halibut's life, it is not uncommon to be caught on a longline or a sport fisherman's line. Halibut are also caught as bycatch and discarded at sea. Careful release techniques have been developed to make sure that the halibut that are caught and thrown back are not seriously injured. Do careful release techniques work? Are halibut being injured more often or more seriously than we are aware?

Fishing on the *F/V Angela Lynn*. Photo by Dan Rafla.

Since 1997 we have examined halibut caught during our stock assessment surveys to see if they have prior hooking injuries. This year we checked roughly 115,000 halibut coastwide, and saw a general decrease in prior hook injuries, from 5.4 percent in 1999 to 5.0 percent in 2000. The percentage of previously injured halibut ranged from a low of 3.7 percent (Area 2B) to a high of 9.6 percent (Area 4D). In general, the proportion of halibut with minor injuries decreases from east to west. Also, the proportion of fish with severe injuries is higher in the western areas.

Looking just at sublegal (<32 inches or 82 cm) halibut, hooking scars were least frequent in Area 3B (1.5 percent) and most frequent in the Bering Sea portion of Area 4A and Area 4D, where it exceeded seven percent. Coastwide, an average of 2.2 percent of undersized halibut showed scars, a slight drop from the 1999 average of 2.4 percent. Prior injury rates in the Bering Sea and Aleutians were generally much higher, reflecting the likely interception of sublegals by the groundfish fisheries in those areas, which run into significant bycatches of smaller halibut.

Querying the Quantum: Special experiments in 2000

Every time we drop a line into the ocean, we ask the sea a question. Every time we haul the line back up, we find some kind of answer. How we interpret that answer is affected by a number of factors: the gear we used, the depth we fished, the season of the year, some integer multiplied by our curiosity and the delicacy with which we asked the question.

Aboard three chartered fishing vessels in the summer of 2000, we conducted a series of experiments to find out how varying gear affects catch rates of legal and sublegal halibut. One experiment tested two gangion lengths and the orientation of the hook on the gangion, a second experiment tested two hook sizes and three bait sizes, and a third experiment tested the effect of using different batches of chum salmon bait.

Here is what we found: Just threading the hook differently affects catch rates of all sizes of halibut. Generally, threading the gangion through the front of the hook eye yielded higher catches of both legal-sized and sublegal halibut. In 26 sets in both productive and lean waters, the F/V *Free to Wander* caught 30 to 40 percent larger catches (in pounds, not numbers of fish) on front-threaded gear than on back-threaded gear. Catch rates were slightly affected by gangion length – longer gangions caught a bit more than shorter ones did – but to no statistical effect.

Just threading the hook differently affects catch rates of all sizes of halibut. Threading the gangion through the front hook eye yielded higher catches of both legal-sized and sublegal fish.

Hook and bait size did not affect catches to any marked degree. We expected larger bait on larger hooks to catch larger fish, and it did, to some degree. In general, the highest catch of small halibut was on small hooks with small baits.

On the *F/V Ocean Bay*, we tested chum salmon bait from three different runs. In two cases, we tested bait that had been frozen for more than a year against bait frozen from the current year from the same run. There was no statistical difference – the results were quite variable throughout all the sets – though overall the year-old bait caught more pounds of legal and sublegal halibut than the fresher bait did.

Across the North Pacific, longliners are increasingly using different gear setups. Experiments like these help us better understand whether and how we can incorporate data from non-standard gears into our yearly analysis of commercial fishing activities. This kind of information not only helps us in our scientific assessments, it also provides some interesting information the fleet might want to use.

Food for thought: How bait affects catch rates

Preparing to chop bait on the *F/V Star Wars II*. Photo by Tracee Geernaert.

During the winter and spring of 1999-2000, we tested herring and squid as bait substitutes for the chum salmon usually used in our annual IPHC grid surveys. Because catch per unit of effort (CPUE) strongly influences our stock assessments, and because the commercial fleet doesn't always use the same kind of bait we do on our surveys, we thought it was a good idea to see how bait affects CPUE. Also, because we began using a different bait mix in our surveys a few years ago, we thought a good comparison could help us keep our analysis consistent across those years.

So, we took several trips throughout winter and spring aboard the *F/V Angela Lynn* and the *F/V Heritage* in Area 3A (later adding a few trips aboard the *F/V Masonic*), and aboard the *F/V Bold Pursuit* and *F/V Royal Pursuit* in Area 2B, to test our menu of baits. The variety we offered included semi-brite chum salmon, large herring, small herring, large squid and small squid. All vessels fished with standard 18-foot halibut gear with 16/0 circle hooks, with either 83 or 100 hooks per skate.

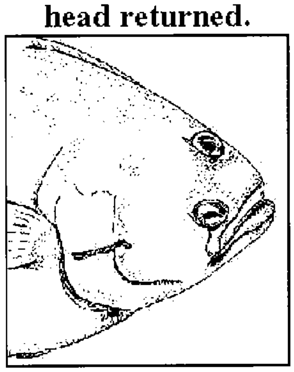
Across all areas and seasons, salmon caught the most halibut and small herring the least.

Across all areas and seasons, salmon caught the most fish and small herring the least. Squid and large herring produced a variety of results, depending on area and season. Generally, the large squid and large herring did better than the small squid and small herring. Since the IPHC usually conducts its surveys in summertime, we looked most closely at the springtime results, and there we found that large squid bait performed best as a chum salmon substitute. It caught 25 percent more sublegals, and 15 to 25 percent fewer legal-sized fish, but this could be adjusted for in the data analysis. The size composition between the two baits was pretty similar.

NEW IPHC TAGGING PROJECT

The INTERNATIONAL PACIFIC HALIBUT COMMISSION conducted a double tagging project in Prince William Sound and Resurrection Bay in 2001. We released about 300 tagged halibut with neon GREEN plastic coated wire tags. Each tag is attached to the dark side cheek, as in the diagram below. These green tagged fish will also have been tagged behind the eye with a 1 cm PIT tag not visible from the outside. The PIT tag consists of a small glass electromagnetic coil and microchip that when activated by a scanner will emit a unique tag number. The PIT tags are being considered for a coast wide halibut tagging project to be conducted in 2002.

REWARD $100 for each GREEN tagged head returned.



When you catch a tagged halibut:

1. Record tag numbers, date location and depth
2. **Retain the head** of these GREEN tagged halibut and contact the IPHC office at **(206) 634-1838**.

The IPHC also rewards $5 or a baseball cap for return of other types of wire tags and the sport dart tags.

APPENDICES

The tables in Appendix I provide catch information for the 2000 commercial and tribal fisheries. The areas specified are the IPHC regulatory areas, depicted in Figure 1 of this report. Appendix II shows the fishing period limits used during the 2000 seasons, and Appendix III shows the most current sport fishing statistics.

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

Appendix I.

Table 1. Commercial catch and catch limits of Pacific halibut by IPHC regulatory area (in thousands of pounds, net weight), 1993 - 2000.

Table 2. The total catch (thousands of pounds, net weight) from the 2000 commercial fishery, including IPHC research, of Pacific halibut by regulatory area and month.

Table 3. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2000 commercial fishery a) for Area 2B, Alaska, and the Alaskan regulatory areas, and b) Area 2A commercial fisheries not including the treaty Indian commercial fishery.

Table 4. Fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by regulatory area for the 2000 Pacific halibut commercial fishery.

Table 5. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port, country of origin and IPHC research catch for 2000.

Table 6. Commercial halibut fishery catch (thousands of pounds) in 2000 by country, statistical area, and regulatory area.

Appendix II.

Table 1. The fishing period limits (net weight) by vessel class used in the 2000 directed commercial fishery in Area 2A.

Table 2. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2000.

Appendix III.

Table 1. Fishing dates, opportunity, size limits, and bag limits for the 2000 Pacific halibut sport fishery.

Table 2. 2000 harvest allocations and estimates (in pounds, net weight) by subarea within Regulatory Area 2A.

Table 3. Harvest by sport fishers (millions of pounds, net weight) by regulatory area, 1977-2000.

Appendix I.

Table 1. Commercial catch and catch limits of Pacific halibut by IPHC regulatory area (in thousands of pounds, net weight), 1993 - 2000.

	Commercial Catch[1]							
Regulatory Area	1993	1994	1995	1996	1997	1998	1999	2000
2A[2]	504	370	297	295	413	460	450	483
2B	10,628	9,911	9,625	9,557	12,420	13,150	12,704	10,811
2C	11,290	10,379	7,761	8,860	9,920	10,192	10,168	8,445
3A	22,738	24,844	18,342	19,696	24,628	25,703	25,292	19,288
3B	7,855	3,860	3,122	3,662	9,072	11,160	13,835	15,413
4A	2,561	1,803	1,617	1,694	2,907	3,418	4,369	5,155
4B	1,962	2,017	1,680	2,075	3,318	2,901	3,571	4,692
4C	831	715	668	680	1,117	1,256	1,762	1,736
4D	836[3]	711[3]	643	703	1,152	1,308	1,891	1,930
4E	64[4]	120[4]	127	120	251	188	264	351
Total	59,269	54,730	43,882	47,342	65,198	69,736	74,306	68,304
	Commercial Catch Limits							
Regulatory Area	1993	1994	1995	1996	1997	1998	1999	2000
2A[2]	361	355.3	278	275	374.2	440.9	412.5	468.1
2B	10,500	10,000	9,520	9,520	12,500	13,000	12,100	10,600
2C	10,000	11,000	9,000	9,000	10,000	10,500	10,490	8,400
3A	20,700	26,000	20,000	20,000	25,000	26,000	24,670	18,310
3B	6,500	4,000	3,700	3,700	9,000	11,000	13,370	15,030
4A	2,020	1,800	1,950	1,950	2,940	3,500	4,240	4,970
4B	2,300	2,100	2,310	2,310	3,480	3,500	3,980	4,910
4C	800	700	770	770	1,160	1,590	2,030	2,030
4D	800[3]	700[3]	770	770	1,160	1,590	2,030	2,030
4E	120[4]	100[4]	120	120	260	320	390	390
Total	54,101	56,755.3	48,418	48,415	65,874.2	71,440.9	73,712.6	67,138.1

[1] Commercial catch includes IPHC research catch and in Area 2C the Metlakatla fishery catch.
[2] Does not include treaty Indian ceremonial and subsistence fish.
[3] Includes Subarea 4D-N : 1993 = < 1,000 pounds; 1994 = 18,000.
[4] Area 4E includes Area 4E-SE (Bristol Bay fishery) and Area 4E-NW (Nelson Island fishery).

Table 2. The total catch (thousands of pounds, net weight) from the 2000 commercial fishery, including IPHC research, of Pacific halibut by regulatory area and month.

RegArea	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
2A	134	163	28	7	146	5	-	-	-	483
2B	1,101	1,926	1,179	1,090	1,205	1,255	1,459	1,064	532	10,811
2C	927	1,496	1,616	1,177	655	877	942	524	231	8,445
3A	1,703	2,674	4,300	2,269	1,596	2,011	2,097	2,044	594	19,288
3B	360	938	3,522	2,717	1,680	2,114	2,364	1,132	586	15,413
4A	-	151	578	1,120	897	1,471	493	306	138	5,154
4B	-	36	317	860	1,299	1,034	763	299	84	4,692
4C	-	-	7	333	1,017	286	62	31	-	1,736
4D	-	-	169	263	489	722	213	75	-	1,931
4E	-	-	4	119	144	70	5	9	-	351
Alaska Total	2,990	5,295	10,513	8,858	7,777	8,585	6,939	4,420	1,633	57,010
Monthly Total	4,225	7,384	11,720	9,955	9,128	9,845	8,398	5,484	2,165	68,304

Appendix I.

Table 3a. Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2000 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	9	252	54	106
0 to 25 ft.	0	0	300	684
26 to 30 ft.	1	15	169	1,144
31 to 35 ft.	8	188	270	5,315
36 to 40 ft.	75	2,042	276	3,124
41 to 45 ft.	62	2,121	223	4,458
46 to 50 ft.	28	1,802	181	5,878
51 to 55 ft.	28	1,951	82	3,121
56 + ft.	33	2,440	299	33,179
Total	244	10,811	1,854	57,009

Overall Vessel Length	Area 2C		Area 3A	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	37	81	8	11
0 to 25 ft.	93	155	45	91
26 to 30 ft.	63	260	46	150
31 to 35 ft.	115	873	117	1,485
36 to 40 ft.	160	1,228	121	1,289
41 to 45 ft.	115	1,170	132	1,854
46 to 50 ft.	106	1,746	106	2,199
51 to 55 ft.	45	969	49	1,183
56 + ft.	114	1,963	234	11,027
Total	848	8,445	858	19,289

Overall Vessel Length	Area 3B		Area 4	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	0	0	9	14
0 to 25 ft.	3	6	160	433
26 to 30 ft.	1	5	61	730
31 to 35 ft.	30	1,006	63	1,952
36 to 40 ft.	33	534	4	72
41 to 45 ft.	47	964	6	471
46 to 50 ft.	42	1,346	9	587
51 to 55 ft.	19	524	5	445
56 + ft.	167	11,029	83	9,160
Total	342	15,414	400	13,864

Appendix I.

Table 3b.Number of vessels and catch (thousands of pounds, net weight) of Pacific halibut by vessel length class in the 2000 commercial fishery for Area 2A commercial fisheries not including the treaty Indian commercial fishery.

Overall Vessel Length	Area 2A Directed Commercial		Area 2A Incidental Commercial	
	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	3	287	3	108
0 to 25 ft.	5	1,181	3	432
26 to 30 ft.	1	n/a	6	405
31 to 35 ft.	2	n/a	11	2,807
36 to 40 ft.	24	25,488	31	6,691
41 to 45 ft.	31	48,244	21	5,081
46 to 50 ft.	19	24,960	16	5,843
51 to 55 ft.	13	18,651	3	n/a
56 + ft.	12	29,595	1	n/a
Total	110	148,406	95	21,367

Appendix I.

Table 4. Fishing periods, number of fishing days, catch limit, commercial, research and total catch (thousands of pounds, net weight) by regulatory area for the 2000 Pacific halibut commercial fishery.

Regulatory Area	Fishing Period	No. of Days	Catch Limit	Commercial Catch	Research Catch	Total Catch
2A Treaty Indian	3/15-4/27	44	305	312.0		312.0
2A Commercial						
Incidental	May-June	61		20.7		
	Aug 1-4	4		0.8		
	Aug 11 - 21	15		0.5		
			24.5[1]			22.0
Directed	July 5[2]	10-hrs		129.3		
	July 19[2]	10-hrs		16.3		
	Aug 2[2]	10-hrs		3.4		
			138.6[1]			149.0
Total Commercial			163.1	171.0		171.0
2A Total			468	483		483
2B	3/15 – 11/15	245	10,600[3]	10,630[4]	181	10,811
2C[5]	3/15 – 11/15	245	8,400[6]	8,266	179	8,445
3A	3/15 – 11/15	245	18,310[6]	18,166	1,122	19,288
3B	3/15 – 11/15	245	15,030[6]	14,888	525	15,413
4A	3/15 – 11/15	245	4,970[6]	4,960	195	5,155
4B	3/15 – 11/15	245	4,910[6]	4,560	132	4,692
4C	3/15 – 11/15	245	2,030[6]	1,736		1,736
4D	3/15 – 11/15	245	2,030[6]	1,864	66	1,930
4E	3/15 – 11/15	245	390[6]	351		351
Alaska Total			56,070	54,790	2,219	57,009
Total			67,138	65,904	2,400	68,304

[1] Pounds were carried over from the incidental to directed commercial catch limit.
[2] Fishing period limits by vessel class.
[3] An additional 145,820 pounds available as carryover from 1999.
[4] Includes the pounds that were landed by Native communal commercial licenses (F licenses).
[5] Includes 54,000 pounds taken by Metlakatla Indians during additional fishing within reservation waters.
[6] Additional net carryover pounds (thousands) from the underage/overage program were: 2C = 376; 3A = 408; 3B = 196; 4A = 39; 4B = 127; 4C = 46; 4D = 34.

Appendix I.

Table 5. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port, country of origin and IPHC research catch for 2000.

Port Region	Canada	United States	IPHC Research	Total
California & Oregon		249		249
Seattle		228		228
Bellingham		1,774		1,774
Misc. Washington		370		370
Vancouver	1,820			1,820
Port Hardy	2,681		101	2,782
Misc. Southern B.C.	1,036			1,036
Prince Rupert	4,827	74	256	5,157
Misc. Northern B.C.	266			266
Ketchikan, Craig, Metlakatla		951		951
Petersburg, Kake		1,718		1,718
Juneau		2,676	104	2,780
Sitka		2,336		2,336
Hoonah, Excursion, Pelican		1,160		1,160
Misc. Southeast Alaska		1,654		1,654
Cordova		1,059	10	1,069
Seward		5,504	715	6,219
Homer		9,605	469	10,074
Kenai		143		143
Kodiak		8,893	293	9,186
Misc. Central Alaska		4,431	35	4,466
Akutan & Dutch Harbor		8,529	279	8,808
Bering Sea		3,920	138	4,058
Grand Total	10,630	55,274	2,400	68,304

Appendix I.

Table 6. Commercial halibut fishery catch (thousands of pounds) in 2000 by country, statistical area, and regulatory area.

Stat. Area Group	Catch: Commercial	Catch: Research	Catch: Total	Regulatory Area	Catch for Reg. Area
00-03	149	-	149		
04	94	-	94	2A	483
05	240	-	240		
06	353	-	353		
07	160	-	160		
08	698	-	698		
10 - I	1,353	65	1,418		
10 - O	1,137	1	1,138		
11 - I	1,205	45	1,250		
11 - O	49	-	49	2B	10,811
12 - I	269	6	275		
12 - O	204	2	206		
13 - I	3,998	20	4,018		
13 - O	702	16	718		
09 - I	296	20	316		
09 - O	206	6	212		
14 - I	529	28	557		
14 - O	208	24	232		
15 - I	1,295	22	1,317		
15 - O	407	39	446		
16 - I	1,658	13	1,671	2C	8,445
16 - O	1,294	26	1,320		
17 - I	554	5	559		
17 - O	757	13	770		
18S - I	941	4	945		
18S - O	623	5	628		
18W	1,138	15	1,153		
19	823	35	858		
20	910	38	948		
21	465	13	478		
22	847	18	865		
23	676	24	700	3A	19,288
24	2,865	80	2,945		
25	2,656	227	2,883		
26	2,631	267	2,898		
27	2,664	251	2,915		
28	2,491	154	2,645		
29	6,837	115	6,952		
30	1,749	122	1,871		
31	1,352	100	1,452	3B	15,413
32	2,557	92	2,649		
33	1,419	70	1,489		
34	974	26	1,000		
35	578	42	620		
36	1,515	17	1,532		
37	121	13	134		
38	254	37	291		
39	-	4	4	4	13,864
40	291	4	295		
41	626	10	636		
42+	1,400	65	1,465		
Bering Sea	8,686	201	8,887		
Total	**65,904**	**2,400**	**68,304**		**68,304**

Appendix II.

Table 1. The fishing period limits (net weight) by vessel class used in the 2000 directed commercial fishery in Area 2A.

Vessel Class		Fishing Periods (Pounds)		
Letter	Feet	July 5	July 19	August 2
A	0-25	310	200	200
B	26-30	390	200	200
C	31-35	620	200	200
D	36-40	1,715	325	230
E	42-45	1,845	350	250
F	46-50	2,205	415	300
G	51-55	2,460	465	335
H	56+	3,700	700	500

Table 2. Metlakatla community fishing periods, number of vessels, and halibut catch (net weight), 2000.

Fishing Period Dates	Number Of Vessels	Catch (Pounds)
April 29 – May 1	0	0
May 13 – 15	3	1,407
May 27 – 29	6	1,216
June 9 –12	7	3,523
June 23 – 25	15	8,474
July 7 – 9	7	5,205
July 21 – 23	5	2,592
August 4 – 6	10	5,057
August 18 – 20	9	6,603
August 25 – 27	13	7,915
September 1 – 3	16	6,850
September 15 –17	5	557
September 22 – 24	5	2,983
September 29 – October 1	3	1,458
October 11 – 13	0	0
15 Fishing Periods		**53,840**

Appendix III.

Table 1. Fishing dates, opportunity, size limits, and bag limits for the 2000 Pacific halibut sport fishery.

Area	Fishing Dates	Fishing Days	Days Open	Size Limit	Bag Limit
2A					
WA Inside Waters (east of Sekiu River)	5/27-7/27	46	5 (Thur-Mon)	No	1
WA North Coast (Sekiu River to Queets River)	5/2-6/16	36	5 (Tues-Sat)	No	1
	7/1 & 7/4				
WA South Coast (all depths) (Queets River to Ledbetter Point)	5/2-5/29	20	5 (Sun-Thur)	No	1
WA South Coast (near shore)	5/2-6/2	32	7	No	1
Columbia River (Ledbetter Point to Cape Falcon)	5/1-7/29	90	7	First @ 32”.	1
OR Central Coast (all depths) (Cape Falcon to Siuslaw River)	5/11-5/13	5	3 (Thur-Sat)	First @ 32”	1
	5/18-19		2(Thur-Fri)		
OR South Coast (all depths) (Siuslaw River to Humbug Mt.)	5/11-5/13	5	3 (Thur-Sat)	First @ 32”	1
	5/18-19		2(Thur-Fri)		
OR Coast (<30 fathoms)(Cape Falcon to Humbug Mountain)	5/1-9/30	153	7	First @ 32”	1
OR Coast (all depths) (Cape Falcon to Humbug Mountain)	9/22	1	1 (Friday)	First @ 32”	1
OR/CA (south of Humbug Mt.)	5/1-9/30	153	7	First @ 32”	1
2B, 2C, 3 and 4	2/1-12/31	334	7	No	2

Appendix III.

Table 2. 2000 harvest allocations and estimates (in pounds, net weight) by subarea within Regulatory Area 2A.

Sub Area	Allocation	Catch Estimate	Over/Under
WA Inside Waters[1]	49,137	49,137	0
WA North Coast	99,774	101,114	+1,340
WA South Coast (all depths)[2]	33,482	35,734	+1,252
WA South Coast (near shore)	1,000	0	0
Columbia River	8,177	7,728	-449
OR Central Coast (all depths)	97,630	112,953	+15,323
OR South Coast (all depths)	9,094	15,620	+6,526
OR Coast (<30 fathoms)	12,324	5,362	-6,962
OR Coast[3]	35,893	7,203	-28,690
OR/CA (south of Humbug Mt.)	4,893	4,893	0
Total	351,404	339,744	+11,660

[1]Season estimate is not yet available, the quota is assumed to be taken.
[2]The Washington South Coast all depth fishery was restricted to fishing in near shore waters when the harvest was projected to be within 1,000 pounds of the overall quota.
[3]After accounting for underages and overages in previous openings from Cape Falcon to Humbug Mountain, about 14,044 pounds remained to be harvested. Therefore, 5,000 pounds were re-allocated from the <30-fathom fishery to allow the September all-depth fishery to occur.

Table 3. Harvest by sport fishers (millions of pounds, net weight) by regulatory area, 1977-2000.

Year	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	Total
1977	0.013	0.017	0.072	0.196			0.298
1978	0.010	0.009	0.082	0.282			0.383
1979	0.015	0.018	0.174	0.365			0.572
1980	0.019	0.011	0.332	0.488			0.850
1981	0.019	0.023	0.318	0.751		0.012	1.123
1982	0.050	0.066	0.489	0.716		0.011	1.332
1983	0.063	0.103	0.553	0.945		0.003	1.667
1984	0.118	0.124	0.621	1.026		0.013	1.902
1985	0.193	0.525	0.682	1.210		0.008	2.618
1986	0.333	0.372	0.730	1.908		0.020	3.363
1987	0.446	0.527	0.780	1.989		0.030	3.772
1988	0.249	0.504	1.076	3.264		0.036	5.129
1989	0.327	0.635	1.559	3.005		0.024	5.550
1990	0.197	0.762	1.330	3.638		0.040	5.967
1991	0.158	0.584	1.654	4.264	0.014	0.127	6.801
1992	0.250	0.580	1.668	3.899	0.029	0.043	6.469
1993	0.246	0.657	1.811	5.265	0.018	0.057	8.054
1994	0.186	0.657	2.001	4.487	0.021	0.042	7.394
1995	0.236	1.582	1.759	4.511	0.022	0.055	8.165
1996	0.229	1.582	2.129	4.740	0.021	0.077	8.779
1997	0.355	1.582	2.172	5.514	0.028	0.069	9.720
1998	0.383	1.582	2.501	4.702	0.017	0.096	9.280
1999	0.338	1.582	1.843	4.228	0.017	0.094	8.102
2000[1]	0.340	1.582	1.978	4.596	0.016	0.103	8.615

[1]Only Area 2A harvest is current data; all other areas are projected harvests. These projections will be updated when data becomes available. Alaska (Areas 2C, 3A, 3B and 4) harvests for 1996-2000 are still considered preliminary.

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 2000 by the Commission and staff are shown below and a list of all Commission publications is shown on the following pages. In addition, a comprehensive listing of articles published by the Commission staff in outside journals is available on our website.

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