INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report
1990

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

Commissioners

Linda J. Alexander	Richard J. Beamish
Richard Eliason	Steven Pennoyer
George A. Wade	Gary T. Williamson

Director

Donald A. McCaughran

Seattle, Washington
1991

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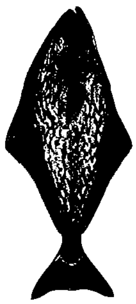
Krys Holmes, Winterholm Press

PREFACE



Cover:
Drawing
by Charles R. Hitz

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 the Conference Board, which represents vessel owners and fishermen. 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 International Pacific Halibut Commission 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 numbering of that series has 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 multiplying the dressed weight by a factor of 1.33.

INTERNATIONAL PACIFIC HALIBUT COMMISSION
P.O. BOX 95009
SEATTLE, WASHINGTON 98145-2009 U.S.A.

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Our feet on the shore, our hearts in the deep blue sea

ACTIVITIES OF THE COMMISSION - 1990

In the 102 years since the first 79-foot sailing schooner pressed through the mists off Cape Flattery and hauled aboard 50,000 pounds of Pacific halibut, fishermen of the North Pacific have pursued *Hippoglossus stenolepis* for meat, money, and other motivations. Naturalist G. Brown Goode, in 1884 pronounced the meat of halibut to be "the highest state of perfection," and in the years since, thousands of North Pacific longliners have agreed with him.

That first commercial catch of Pacific halibut, aboard the *Oscar and Hattie* in 1888, proved that halibut could be caught, iced, and shipped by rail to the East Coast and also turn a pretty profit. And that was just the start. By 1962 longliners and recreational fishermen were hauling in 75 million pounds of Pacific halibut. In the mid 1980s, harvests peaked at nearly 80 million pounds, the highest in history. In 1990, nearly 4,000 commercial boats and 600 recreational charters hit the Pacific in search of the mighty *H. stenolepis.*

In 1990, the deepwater ledges of the continental shelf were less of a mystery but just as much a draw to mariners and fishery managers. The opportunities ahead lie not in fishing harder, but in thinking harder about how we fish. Pacific halibut stocks are declining in the 1990s, much as they did in the early years of our century. Bycatches of juveniles hold the commercial fisheries in a stranglehold. And new commercial management regimes (vessel quotas in British Columbia; rumors of quotas off Alaska) have presented a variety of questions before halibut fishermen, biologists, managers, and consumers from Cape Newenham to California.

The International Pacific Halibut Commission turned 66 years old in 1990, and in that year the Commission launched several research projects, including a cooperative video study, and a series of research survey trips. With the help of fishermen and their logbooks, the IPHC continued to investigate physical and behavioral clues that Pacific halibut suggest of the mysteries of the sea; and how technology and the forces of nature can work together to develop and preserve a healthy Pacific halibut fishery.

ANNUAL MEETING WAS NOT DULL

The Chairman, Mr. Steve Pennoyer of the U.S., opened the 66th Annual Meeting of the Commission on January 29, 1990, in Seattle, Washington, with Mr. Dennis Brock of Canada as vice-chairman. The agenda before them included:

- Review of the 1989 Pacific halibut fishery;
- Summary of results from the 1989 scientific investigations; and
- Presentation of regulatory proposals for the 1990 fishery.

In addition, the Conference Board, an advisory group representing the fishing industry, presented its own regulatory proposals. The Commission also heard from the U.S. Pacific and North Pacific Fishery Management Councils, each of which were considering new fishery management regimes that affect Pacific halibut fisheries.

During the meeting, the Commission also addressed finances, adopted a 1992-93 fiscal year budget, and approved research programs for 1990. At the end of the meeting, Commission members elected Dr. Richard Beamish of Nanaimo, British Columbia, chairman for 1990; Mr. Pennoyer was elected vice chairman.

The 1990 annual meeting was not an easy one. The Canadian Commissioners objected to the high bycatch of juvenile Pacific halibut by the U.S. fisheries off Alaska. They refused to approve any of the proposed catch limit or fishing period regulations, until the U.S. came up with a feasible bycatch reduction plan. The U.S. Commissioners explained what steps they were taking toward addressing the bycatch problem. They also mentioned the significant bycatch of juvenile Pacific halibut by commercial fisheries in Canadian waters.

The Pacific halibut bycatch issue cannot be resolved by the Commission, but must be addressed by each government's fisheries managers. Yet it challenged each Commissioner during the 1990 meeting. The Canadian Commissioners said they could not conscientiously vote on regulations for U.S. waters until the bycatch problem was addressed. In light of their position, the U.S. Commissioners said they would not approve any regulatory proposals for Canadian waters.

Regulatory Proposals for 1990

Normally, fishermen, vessel owners, processors, government agencies, and the Commission's scientific staff may present regulatory proposals to the Commission. A summary of all proposals and their sources is distributed to all interested groups prior to the annual meeting.

Though not officially adopted by the Commission for the reasons stated above, here are the regulations that were presented at the 1990 IPHC meeting:

Total 1990 catch limit:	**59 million pounds (including Area 2A recreational)**
Compare to 1989 limit:	**65 million pounds (including Area 2A recreational)**

The IPHC staff also proposed a series of fishing periods for each regulatory area. The staff did not consider the dates of the openings to be of significant biological concern. They chose those periods (outlined in Appendix Table 2) to enable longliners to stretch their landings over as long a period as possible while avoiding fishing on large tides, landings on weekends and holidays, and conflicts with other fisheries.

The Conference Board met during the first three days of the annual meeting. The Board is made up of individuals representing fishermen's and vessel owners' associations. They proposed catch limits for 1990 that exceeded the Commission proposed range.

Total proposed by commission: 59.1 - 59.3 million pounds
Total proposed by conference board: 60.55 million pounds

The Conference Board recommended establishing a new area in Bristol Bay, Area 4G, for a one-year test fishery with a catch limit of 50,000 pounds. This fishery would have given Bristol Bay area residents a chance to join in the Pacific halibut fishery using their small boats.

In addition, the Board proposed a series of short fishing periods for each area, and commented on the following industry and agency proposals:

(1) The Board opposed a proposal by the U.S. National Marine Fisheries Service (NMFS) requiring fishermen to report lost fishing gear;
(2) opposed emergency changes in fishing dates due to bad weather conditions;
(3) opposed further subdivisions of Areas 2A and 4B;
(4) supported funding of a data collection program for the Washington sport fishery by the Commission;
(5) recommended a log book program for sport charter vessels; and
(6) asked the Commission to stop allowing private presentations to the Commission.

Regulatory Decisions Made by the Commission

The following regulatory decisions were considered by the Commission at its 1990 Annual Meeting:

(1) Recommending the expansion of Area 4E;
(2) Setting catch limits for the 1990 fishery totaling 58.62 million pounds;
(3) Establishing fishing periods for the commercial fishery;
(4) Dividing the allocation for Area 2A among the commercial, treaty Indian, and recreational fisheries. These regulations were developed and recommended by the Pacific Fishery Management Council (PFMC);
(5) Setting fishing periods and trip limits for Areas 4C and 4E. These regulations were developed and recommended by the North Pacific Fishery Management Council (NPFMC); and
(6) Approving regulations for the recreational fishery.

For the remainder of the regulatory proposals, the Commission moved and seconded adoption, but because the conflicts over bycatch management caused a U.S-Canadian split, each commissioner only voted to approve proposals involving his country of origin. After the meeting, however, Canada and the U.S. unilaterally adopted all but one of the proposals listed above that pertained to their own waters. They did not approve the creation of Area 4G.

INTERIM MEETING

The two hottest issues — the decline in the Pacific halibut resource and the problem of increasing Pacific halibut bycatch — took the spotlight at the

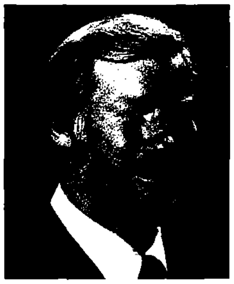
IPHC Interim Meeting. The meeting was held on November 20, 1990, in Seattle, Washington with Chairman Richard Beamish at the helm. The staff outlined activities to date in the 1990 fishery, and reviewed management actions taken during 1990.

The Commission also reviewed research programs for 1991, including development of an observer program on Canadian trawlers, and a variety of projects designed to improve stock assessment and management.

MONEY MATTERS

During the 1989-1990 fiscal year (April, 1989 through March, 1990 the Commission spent a total of US$1,600,000. The Commission expenses were shared equally by Canada and the United States, as stipulated by the Pacific halibut Convention.

DIRECTOR'S REPORT



Donald A. McCaughran,
Director

In like manner to the waxing and waning of halibut stocks, the bycatch problem seems to come and go. Just when we thought we had bycatch under control by controlling the foreign fleet, the new U.S. operated trawl fleet comes along and up goes the bycatch.

We learned much from the process of controlling Pacific halibut bycatch in the foreign groundfish fisheries; the prime lesson was that large Pacific halibut bycatch is not necessary for the prosecution of the groundfish fishery. Given the proper incentives whether positive or negative, trawlers will reduce their bycatch rates to the minimum level necessary to conduct their target fishery. Amendment #3 to the U.S. Bering Sea Groundfish Management Plan instructed the foreign fleets to reduce their bycatch rates by 50% within five years, they accomplished that task within three years. The reduction was accomplished by an individual vessel bycatch quota system instituted by the foreign governments. The total coastwide bycatch under this scheme was reduced to approximately seven million pounds of Pacific halibut annually, and the groundfish catch was approximately two million metric tons. The present U.S. domestic bycatch is roughly 17 million pounds for the same size groundfish catch.

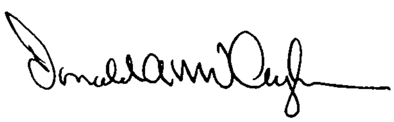
The size composition of the bycatch shows that younger migrating juvenile Pacific halibut are mainly affected. Therefore, the bycatch off Alaska has a potential detrimental effect on the Pacific halibut stocks off British Columbia, Washington, and Oregon. The Canadian Government has strongly objected to this unnecessarily large bycatch and, as protest, refused to vote on the regulatory recommendations of the Commission at the 1990 Annual Meeting. The U.S. Government recognizes the problem and has begun to address it. However, the U.S. council management system is cumbersome in dealing with problems in a timely manner, and therefore, the U.S. Government was not able to give a timetable for bycatch reduction which would satisfy the Canadian delegation.

In response to the bycatch issue the Commission set up a bycatch working group and has scheduled a meeting of the Commission in July 1991 to make recommendations to the governments on bycatch control.

The U.S. has initiated an observer program on all domestic groundfish vessels over 125 feet in length and 30% coverage on all vessels 65-125 feet. This data will be invaluable in terms of designing bycatch control measures. In addition, there are caps for both the Bering Sea and Gulf of Alaska to insure bycatch does not get completely out of control. The bycatch in Canada is not insignificant and largely unmonitored. Canada has plans for a similar observer program to that in the U.S. The Commission staff is looking forward to the resulting data.

The Commission staff has developed a method of compensating the stock for lost juveniles. The commercial Pacific halibut catch is reduced by the amount necessary to equal the reproductive loss to the stocks of those juveniles that never get to spawn. We do not know if this fully compensates the stock because of a number of factors. Unequal egg survival from year to year caused by environmental differences and the lag time between replacing eggs now for eggs lost in the future, complicate the evaluation. Basically, Pacific halibut fishermen pay for the large bycatch by having their quotas reduced.

We are optimistic, however, that bycatch will be reduced, since the U.S. Government managers appear to be committed to reducing bycatch and have begun to develop methods to do so. Since the majority of bycatch is taken by a minority of the trawl fleet, a sound incentive program should produce the desired reductions with minimum expenses. Individual bycatch quotas assigned to the trawlers would provide the necessary reductions and allow "clean" vessels to fish unimpeded by bycatch limits. Once this is accomplished and the fleet is able to take the groundfish TAC, bycatch caps should be reduced to the magnitude of the foreign fleet bycatch. To a few vessels, bycatch reductions may initially mean added expenses to their fishing operation. This, however, is a necessary cost of maintaining international relationships and should not be a consideration in developing a rational bycatch management plan.



Donald A. McCaughran
Director

THE DWINDLING PURSUIT

F/V Sunrunner in Kodiak, Alaska

Pacific halibut spawn in the winter, between November and March, in the depths of 150 to 225 fathoms. Females mature sexually between the ages of 8 and 16 years (males earlier, between ages 6 and 12) and once mature, produce 2-3 million eggs per year, each 3 to 3.5 mm in diameter. These fertilized eggs float to shallow water where they absorb their yolk sac and become larvae, then grow to 18 mm long, and begin to flatten. At 4-5 months, they begin to prepare for their long life on the sea bottom; you can just see the top of the left eye pushing itself over the right side of the head. (Only about one in 5,000 Pacific halibut is left-eyed.)

Larval Pacific halibut rise to about 55 fathoms, move shoreward, and establish themselves on the bottom of the coastal shelf at about the age of 6-7 months. As the juveniles age they move out deeper, settling to the bottom on the edges of shoals, where they camouflage themselves against the mottled bottom of the ocean and catch their prey as it swims over. The large-mouthed, sharp-toothed Pacific halibut eat small fishes, crabs, clams, squids, and invertebrates.

Some say halibut, the largest of the flounders, took their name from the Old English combination of "holy" and "butte," which means flounder or flatfish — holy flounder summarizing how early fishermen may have felt about the tasty white meat of the Pacific halibut's Atlantic cousin. New Englanders in the 1800s say the word came from "Haul-a-boat," which large specimens would have no trouble doing. Language experts, however, assert that "hali" refers simply to holes or the deep sea regions where halibut reside, and that the word "halibut" simply means a deep-water flatfish.

A Pacific halibut by any other name would be pursued as eagerly. They are landed by commercial and recreational fishermen, are pursued in tribal fisheries allocated to Native Americans by treaty, and are also taken incidentally by fishermen targeting on other species. During 1990, commercial catches decreased from previous years, sport landings increased, and the indigenous fisheries remained about the same.

THE COMMERCIAL FISHERY: DRAWING THE LINES

Pacific Halibut Fishing Areas for 1990

F/V Cape Flattery hauling gear

The IPHC has divided the Pacific Coast into regulatory areas (Figure 1), which are the same as in 1989, with the exception of Area 4E, which was enlarged in 1990 to include Bristol Bay. The remainder of the Southeastern Flats of the Bering Sea stayed closed in 1990 to all Pacific halibut fishing.

- 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 — includes all waters in the Bering Sea north and east of the closed area, east of longitude 168°00'00"W, and south of latitude 65°34'00".

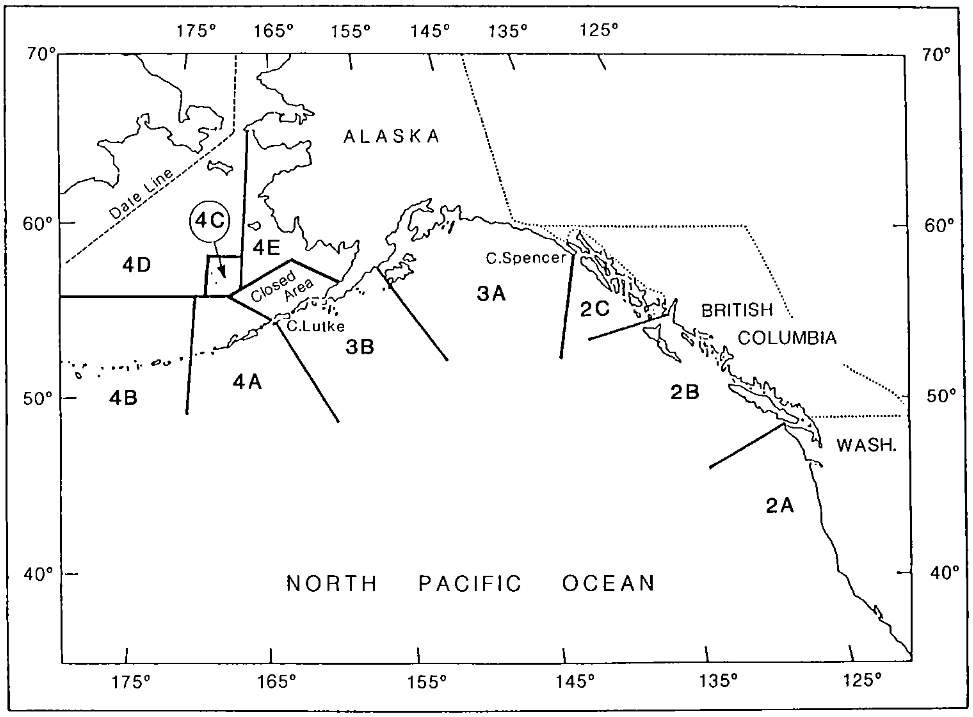


Figure 1. Regulatory areas for the 1990 commercial fishery.

The Rules We Play by: Regulations and Catch Limits

The Pacific halibut bycatch issue stymied attempts to establish regulations and catch limits for the commercial fishery at the 1990 IPHC Annual Meeting. Regulations were proposed, but not officially adopted. As a result the Canadian and U.S. governments separately adopted regulations pertaining only to their own waters and fishermen.

Throughout its history, and certainly during this contentious year, the Commission has promoted flexibility in its fishery management programs, and has advocated setting and changing regulations during the season when needed. A few years ago, for example, the IPHC imposed fishing period limits in some areas to avoid overfishing the last opening, when the limit was almost reached. Boats were divided into size classes, and allocated a catch limit (according to the size of the vessel) for a certain fishing period. All fishing period limits applied to net weight of the fish (dressed, head off) and to the vessel, not the individual fisherman. A boat could make multiple deliveries as long as the cumulative poundage delivered was within the fishing period limit. Any landings over the vessel limit were subject to forfeiture and possible fines.

During 1990, fishing trip limits applied only to some areas. Other commercial regulations, such as size limit, gear restrictions, and clearances remained the same as in 1989.

Fishing seasons in all regulatory areas consisted of one or more fishing periods of a specific length. Fishing periods began and ended at 12:00 noon in all areas except for Area 2A and the July 7 and July 14 fishing periods in Area 4B, where 12-hour fishing periods began at 8 a.m. and ended at 8 p.m.

1989 Commercial catch: 66,946,000 pounds

1990 Commercial catch: 61,607,000 pounds

How the Fishery Fared: A Glimpse at Each Area

Appendix Tables 1 and 2 summarize the 1989 and 1990 (respectively) commercial fishery by regulatory area, quota, dates, and catch.

Area 2A. The Pacific halibut off California, Oregon, and Washington are shared by many different people, for different purposes. Working within the PFMC guidelines, the IPHC adopted a catch-sharing plan for these west coast waters that divided allocations among commercial, sport, and treaty users.

To make catch sharing decisions, the PFMC created several ad hoc groups including a managers' group, a technical group, and advisory groups, each of which every year identify potential problems, analyze proposals, and negotiate a catch sharing plan that is then approved by the PFMC and by the IPHC.

Treaty users, members of 12 tribes from western Washington, are allocated Pacific halibut each year for subsistence, ceremonial, and commercial use. They are allowed to fish in Area 2A-1, which is a portion of Area 2A that has been established as usual and accustomed tribal fishing grounds.

The total allowable catch for Area 2A, for all users, was set at 520,000 pounds. The treaty fishery was allocated 130,000 pounds. Of that 130,000 pounds, only 120,000 pounds could be sold commercially; the remaining 10,000 pounds was restricted to ceremonial and subsistence use only. After the commercial season was closed, ceremonial and subsistence fishing was limited to two halibut per day per person. The non-treaty portion of the catch, totalling 390,000 pounds, was subject to an agreed allocation of 50% sport and 50% commercial harvest, or 195,000 pounds each.

The tribes caught 122,000 pounds commercially during a 26-day season in 1990. The treaty portion of the commercial fishery was 200 days shorter than the 1989 season and 219 days less than the 1988 season. The fishery opened March 1 and was closed to commercial fishing on March 27, with an additional 10,000 pounds taken during ceremonial and subsistence fishing.

The actual total commercial catch for Area 2A was 325,000 pounds — 10,000 pounds over the limit. The non-Indian commercial catch was 203,000 pounds taken in four 12-hour fishing periods. During the first fishing period, 174,000 pounds of the catch limit was taken. The remaining catch was taken during the three remaining 12-hour fishing periods, during which fishermen could only deliver 250 pounds of dressed Pacific halibut per vessel, regardless of vessel size.

The treaty tribes caught 122,000 pounds during a 26-day commercial opening. This was 200 days shorter than the 1989 season, 219 days shorter than 1988. Five tribes participated in the 1990 fishery, three fewer than in 1989.

Area 2B. In British Columbia waters, a fishing vessel could either fish in the April or June fishing period, but not in both. The April and June openings produced 2.6 and 3.0 million pounds, respectively. Most of the smaller vessels, favoring good weather, fished the June opening. In September, an additional 3.0 million pounds was taken by the combined fleet, bringing the area-wide catch to 8.6 million pounds, 0.8 million pounds more than the catch limit.

Area 2C. The catch here was 9.7 million pounds. There were two 1-day fishing periods, one in May and one in June, producing 4.0 and 5.7 million pounds, respectively. The catch limit was exceeded by 1.7 million pounds.

Included in the Area 2C catch was a Metlakatla Indian catch of 33,104 pounds. This was taken in four, 2-day openings within a 3,000-foot Annette Islands Reserve boundary during a test fishery authorized by the United States Secretary of the Interior.

Areas 3A and 3B. Catch limits in Areas 3A and 3B were set at 31 million pounds and 7.2 million pounds, respectively, with the stipulation that both areas would close if the combined catches reached a total of 38.2 million pounds. Fishermen took more than the entire Area 3B catch limit in two 24-hour fishing periods — the first May 1-2 (3.1 million pounds), and the second June 5-6 (5.6 million pounds). After a total catch of 8.7 million pounds, Area 3B was closed for the rest of the year.

Area 3A opened at the same time as 3B, and yielded 10.4 million pounds in May and 14.1 million pounds in June. This left 5.0 million pounds in the combined Area 3A/3B catch limit. Since the Area 3B catch limit was exceeded, only Area 3A was opened August 30, and fishing period limits were imposed, restricting the amount of fish each vessel could deliver.

Fishing period limits are set according to vessel size. The limits imposed in Area 3A during the final opening were set by estimating the average catches landed during the May and June 1990 openings in Area 3A. Averages were adjusted by the number and sizes of boats anticipated in the August opening, and the limits were set to help the fleet get as close as possible to the 5.0 million pounds remaining in the combined catch limit during the 24-hour opening. In the end, the August opening yielded 4.3 million pounds and the area was closed to commercial Pacific halibut fishing for the rest of the year.

Area 4A and 4B. The waters off the Aleutian Chain west of Cape Lutke were also managed with a combined catch limit, although catch limits were set for each of the two separate areas. The catch limit in Area 4A, the eastern Aleutian region, was 1.5 million pounds. A few fishermen participated in the May 1 and June 5 openings but most of the boats chose to stay closer to home in the Gulf. However, the Gulf was closed in August and an expected invasion of boats into Area 4A led the IPHC to cut the August 14-16 opening back to one day.

In Area 4B, resident fishermen received an extra opportunity to participate in the commercial fishery, thanks to some additional openings requested by the NPFMC. They took 10,000 pounds — about 1% of the area's total catch. Area 4B had a series of two-day, one-day, and half-day openings starting May 19. On July 14, after nine fishing periods, Area 4B closed with a total catch of 1.33 million pounds, 167,000 pounds short of the 1.50 million pound catch limit.

As it turned out, however, more than 2 million pounds of Pacific halibut were caught during the August opening in Area 4A, and the total combined catch limit for areas 4A and 4B was exceeded by 836,000 pounds.

Area 4C. As recommended by the NPFMC, vessels fishing in this small area in the Bering Sea were limited to a maximum catch of 10,000 pounds of Pacific halibut per fishing period throughout the season. In Area 4C, the total catch of 530,000 pounds stretched the limit by 30,000 pounds. This catch was taken in five 1-day fishing periods, compared to thirteen 1-day fishing periods in 1989. Resident fishermen caught 188,000 pounds or 35% of the catch, compared to 286,000 or 50% in 1989. Twenty, non-resident vessels caught the remaining 341,000 pounds in 38 trips.

Area 4D. Because a large fleet was expected to descend on this high -seas area for late summer fishing, the August opening in area 4D was shortened from five to three days. Twenty-five vessels caught one million pounds in those three days — double the 500,000 pound catch limit — a vessel average of 13,333 pounds/day. In contrast, ten vessels caught a total of 650,000 pounds during a six-day fishery in August 1989, with a vessel average of 10,833 pounds/day.

Area 4E. A 100,000 pound catch limit proposed for Area 4E at the IPHC annual meeting was later split by the U.S. government between two sub-areas, each with its own catch limit. Boats could only deliver up to 6,000 pounds of Pacific halibut per fishing period throughout the season in all of Area 4E — a restriction set at the request of the NPFMC.

The northwestern portion of Area 4E (Nelson Island) was given a catch limit of 70,000 pounds. The actual catch was 35,000 pounds, of which 11,000 pounds were taken by 28 local vessels and 24,000 pounds were taken by 4 outside vessels making seven trips.

The catch limit in the southeastern portion of Area 4E (Bristol Bay) was 30,000 pounds. During the first 2-day fishing period, 93 vessels delivered 20,000 pounds. On the second 1-day period, 22 vessels delivered 5,000 pounds. Fishermen chose not to participate in the last four 1-day periods.

Number of Vessels Licensed in 1990

In 1990, 435 Canadian vessels qualified to fish for Pacific halibut under the Canadian limited entry system. The U.S. does not restrict the number of vessels that may enter the Pacific halibut fishery; in 1990 6,534 people received commercial licenses. This represented a 3% increase over 1989 in the number of IPHC commercial licenses issued. The number of license applications decreased in all states except in Alaska, where the number increased by more than 450 from 1989.

In 1989 in the U.S., 3,647 non-treaty vessels reported Pacific halibut landings. In 1990, 4,222 non-treaty vessels reported landings. Appendix Table 3 shows the number of vessels in each size class and the total poundage landed in 1990.

Landings by Port

Pacific halibut fishermen delivered just more than 61.6 million pounds of halibut in 1990 to ports in Alaska, British Columbia, Washington, Oregon, and California. Appendix Table 4 lists catches for each area from 1986 to 1990. Deliveries by region were distributed as follows:

Alaska -	**47.8 million pounds**
British Columbia -	**8.8 million pounds**
Wash., Ore., California -	**5.0 million pounds**

It sometimes benefits fishermen to deliver to southern ports, which are closer to markets and usually offer a better price. In 1990, some Seattle processors offered 30 cents per pound more for Pacific halibut than Alaska plants did.

In 1990, 9% of the Canadian halibut catch (789,000 pounds) was delivered to U.S. ports. This was far less than in 1989, when 19% of Canada's catch was delivered to U.S. ports. Also in 1990, 2% of the U.S. catch (1,061,000 pounds) was landed in British Columbia, most of which were delivered by packers from Southeast Alaska. This was a big increase over the .1% of the U.S. catch landed in British Columbia in 1989.

Canadian Fish Company, Vancouver, B.C.

Vancouver, British Columbia was Canada's leading Pacific halibut port, receiving 39% of the Canadian catch (3.4 million pounds), followed by Prince Rupert with 27% (2.3 million pounds), and Port Hardy with 10% (828,000 pounds). Prince Rupert plants unloaded a combined total of 3.4 million pounds of U.S. and Canadian halibut, approximately equal to Vancouver's all-Canadian production.

The leading U.S. halibut port was Kodiak, Alaska (11.6 million pounds), followed by Homer (5.9 million pounds), Seward (5.2 million pounds), and Sitka (3.6 million pounds). Landings in the same ports in 1989 were 16.5 million pounds, 8.0 million pounds, 4.5 million pounds, and 3.9 million pounds, respectively. Appendix Table 5 lists the landings at Canadian and U.S. ports in 1990.

The coast-wide ex-vessel price (U.S.$) in 1990 averaged approximately $1.88 per pound, bringing in a total catch value of $115.7 million, the highest value recorded in the history of the fishery.

Value of the Commercial Catch

It was a good year for Pacific halibut fishermen. The coast-wide ex-vessel price (U.S. $) in 1990 averaged $1.88 per pound, bringing in a total catch value of $115.7 million, the highest value recorded in the history of the fishery. Figure 2 shows the average price per pound and the total value of the fishery since 1930 (Please note that no adjustments have been made for inflation.) In comparison, the coast-wide ex-vessel price in 1989 averaged $1.53 per pound for a total catch value of $102 million for that year. The 1990 U.S. Pacific halibut catch of 53.0 million pounds had a landed value of $96.5 million, and the Canadian halibut catch of 8.57 million pounds was valued at $19.2 million (U.S.) to fishermen. U.S. fishermen received a season average price of $1.82 per pound compared to $2.24 (U.S.) for Canadian fishermen.

WASTE IN THE PACIFIC HALIBUT FISHERY

The short, intense fishing periods common in today's commercial Pacific halibut fishery create big problems for fishermen and managers. Sometimes fishermen feel pressed to set more gear than they can possibly retrieve before the period closes, especially in the 12 and 24-hour openings. Fishermen say it is not uncommon to cut and abandon the excess gear, thus discarding and killing the fish they have already hooked. In a frenzied opening, it is easy to get longline gear tangled up with someone else's gear, or lose it to chafing or snagging on the bottom. Lost gear catches unretrievable fish, thus causing waste.

The first 24-hour Pacific halibut openings were in 1984. Waste was first estimated in 1986, at 3.2 million pounds. IPHC biologists figure that about 2 million pounds of adult Pacific halibut as well as 1.3 million pounds of sublegals were wasted in 1990. That is about the same total figure as in 1989. Roughly half of the Pacific halibut waste occured in Area 3A. Waste in each of the other areas was estimated at 0.3 million pounds or less.

Throw Them Back

Juvenile halibut

Legal size for commercial Pacific halibut is 32 inches. Juveniles are supposed to be gently removed from the hooks and returned, in as good shape as possible, to the sea. We estimate that 75% of the juveniles caught in the commercial Pacific halibut fishery live to tell about it. On the average, 8-11.7% of the commercial halibut catch was sub-legal, depending on the area. Using a 25% discard mortality rate, we estimated the total mortality of sublegal Pacific halibut at 1.27 million pounds in 1990, 6% less than in 1989.

Since 1987, sublegal mortality has averaged 1.4 million pounds in the commercial fishery. The highest was 1.54 million pounds, in 1988.

THE RECREATIONAL FISHERY

On the Books: 1990 Sport Fishing Regulations

Poached, fried, or broiled, nothing beats the taste of a Pacific halibut, especially one you have wrestled up from 20 fathoms on a bite of herring and 80-pound test. Sport fishing regulations are designed to give as many people as possible a chance to land this edible treasure without taking too many fish.

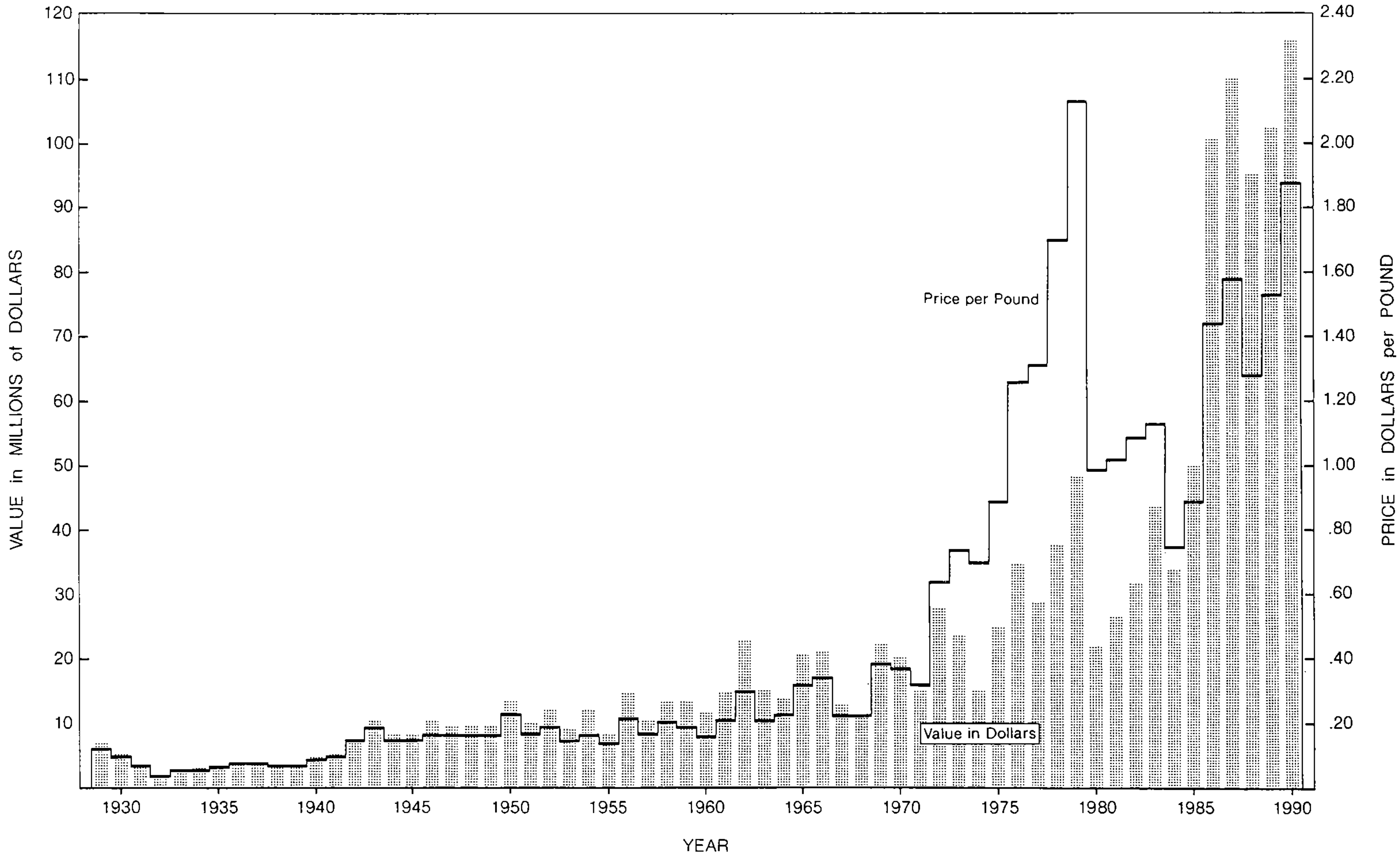


Figure 2. The average price per pound and value of the Pacific halibut fishery (in U.S. dollars) from 1930 through 1990

Most of the regulations for halibut sport fishing stayed the same in Alaska and British Columbia in 1990, but the rules changed quite a bit on the U.S. west coast.

Off the coasts of California, Oregon, and Washington, split-seasons, reduced bag limits, size limits, and some newly created sub-areas, all helped to control recreational fishing, and to spread landings evenly among sportfishing communities. The PFMC was responsible for allocation issues and the IPHC was responsible for the overall quota. East of the Bonilla-Tatoosh line in the Strait of Juan de Fuca and Puget Sound waters, fishermen could bag two fish per day. Only one Pacific halibut per day was permitted for the Washington and northern Oregon coast (the Queets River to Cape Falcon), and in California coastal waters.

South of Cape Falcon, the minimum size was 32 inches; all smaller fish had to be returned to the sea. Fishermen could keep a second halibut if it was longer than 50 inches. Sport fishermen faced quotas for the north Washington coast, and in Oregon south of Cape Falcon. A complex season of openings was scheduled to give the fishing public ample opportunity to chase their favorite fish without endangering the resource.

Nearly 60% of the entire Pacific halibut sport catch came from the Kenai Penninsula area of Alaska. Average weight of halibut that were sport caught in this area increased from 19.6 pounds in 1988 to 21.2 pounds in 1989.

Sportfishing Catch Estimates

Sport fishing information is available from state and federal fishery agencies, but it takes some time to compile. We are usually a year behind with sport fishing data. So preliminary 1990 catch estimates are available only for Area 2A.

The Gulf of Alaska, Area 3A, is Pacific halibut heaven for sport fishermen. The Kenai Peninsula — Homer, in particular — is considered the capital of Pacific halibut sport fishing. Nearly 60% of the entire sport catch comes from this region. Sport catches decreased slightly from 1988 catches in this area, possibly as a result of the 1989 Exxon oil spill in the Sound. Many charter operators hired out their boats for oil spill cleanup work that summer, and cut a chunk out of the recreational fishing activity in Kachemak Bay.

Catches were up significantly in Southeastern Alaska (Area 2C) during 1989, possibly capturing some of the business lost in central Alaska due to the oil spill. Average weight of Pacific halibut that were sport-caught in this area increased from 19.6 pounds in 1988 to 21.2 pounds in 1989.

In British Columbia (Area 2B) catches hit a five-year peak in 1989. Canada's Department of Fisheries and Oceans (DFO) reviewed the sport fishing activity for the 1980s and found that the estimates provided to us were too high for 1986-88. Using more accurate methods for catch estimates, those numbers have been revised.

Recreational fisherman in Homer, Alaska

Sport catches on the U.S. west coast (Area 2A), once again topped the allocations despite aggressive management in 1990. State fishery managers kept the catch off the Oregon coast south of Cape Falcon nearly 3,000 pounds under the quota. A lot of fishermen gave up trying to fish the north Washington coast, north of the Queets River to the Bonilla-Tatoosh Line, where conservative bag limits and partial weekly closures cramped their fishing style; many of them moved north to try the Canadian waters of the

Swiftsure Bank. As a result, the north Washington coast stayed 1,000 pounds within its sport quota but Canada's sport catches swelled. The catch in Canadian waters by Washington recreational fishermen totaled roughly 123,000 pounds, or about 20% of the Canadian recreational halibut fishery.

In the Strait of Juan de Fuca and Puget Sound, fishermen brought in nearly 57,698 pounds in 1990 — 18,000 pounds more than their quota. Preliminary estimates of catch per unit effort (CPUE) indicated that sport fishermen's CPUE increased significantly from 0.04 fish per trip in 1989 to a record 0.18 fish per trip in 1990.

BYCATCH IN 1990

The ocean is a bountiful web of life, as all fishermen discover when they drop a longline baited for Pacific halibut and pull up yelloweye rockfish, Pacific cod, and sablefish along with their catch. These unintended species are called bycatch. Pacific halibut are bycatch, too — often dragged up on longlines or in pots or trawl nets aimed at other fish and shellfish. No fishery is without bycatch, and the bycatch issue is probably the most complex puzzle to grab hold of the Pacific commercial fishing business in a long time. Pacific halibut fishermen are especially concerned because bycatch is shaved directly off the top of the available catch along with sport harvest and waste, thus reducing the commercial quota (Figure 3). Until we learn how to avoid species we are not targeting, we will have to live with fishery closures, observers, regulations, and penalties — and with the risk of depleting one fisherman's pocket for the benefit of another.

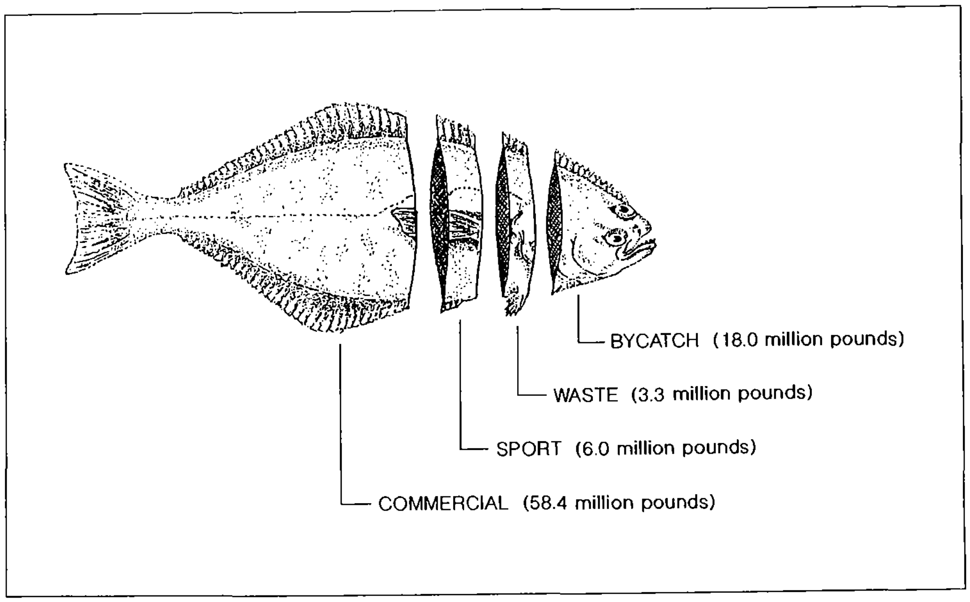


Figure 3. An illustration of how the Pacific halibut allowable catch is divided according to usage, in millions of pounds. (Drawing by Joan Forsberg)

These days, our best way of collecting bycatch data at sea is from observers, who stay aboard fishing vessels and count catches and incidental catches. From observer data collected in the trawl, longline, and pot fisheries, managers can keep tabs on bycatch rates during the season, and estimate total removals from the resource at the end of the year.

Codend coming aboard a trawler

The IPHC does not have the resources to fund an observer program, so we rely upon information supplied by federal observer programs in the U.S. and Canada for our bycatch estimates. We did contribute $50,000 in 1989 to ADF&G to help foot the bill for bycatch data collected.

In previous years, foreign and joint venture boats off Alaska were required by law to carry government observers. These fleets were replaced by U.S. domestic vessels during the 1980s, but observers were not required on domestic vessels, and so this valuable source of first-hand information slowed to a trickle. However, because of the increasing conflicts among different domestic fleets over declining resources in the North Pacific, the NPFMC in 1989 set up a more comprehensive mandatory observer program for the U.S. fleet. Under the new program, observers stepped aboard the trawl, pot, and longline fleets for the first time in 1990.

Most of the Pacific halibut bycatch problems occur in the groundfish fishery off Alaska, and it is there, in the North Pacific, that observer data are so crucial for providing accurate mortality estimates. NMFS oversees the observer program, and provides IPHC with bycatch estimates.

DFO provides bycatch estimates for the groundfish trawl fishery off Canada. DFO plans to initiate an observer program in the future, with start-up help from the IPHC. Observer data collected during the 1970s indicate that Canada's bycatch rate is comparable to that off Alaska, but the total pounds of bycatch in Canada are less because of a smaller fishery.

There were no on-board observers in the crab pot and shrimp trawl fisheries, so the IPHC staff estimates Pacific halibut mortality in those fisheries using bycatch rates observed during research surveys. Crab and shrimp fisheries have declined in recent years — some even have been closed in many areas — and Pacific halibut bycatch has declined accordingly.

NMFS trawl survey

Pacific Halibut Bycatch Mortality by Area

H. stenolepis is a hardy creature, and can withstand stresses that would kill most fish. Therefore, discard mortality — the percentage of Pacific halibut that do not survive capture and release — is lower than for more delicate fish. Biologists estimate the discard mortality differently for each fishery and gear. For 1990, the following rates were used to determine bycatch mortality:

Gear	Area 2A/2B	Area 2C/3	Area 4
Trawl	**100%**	**50%**	**100%**
Longline	**—**	**13%**	**13%**
Groundfish pot	**—**	**12%**	**12%**
Crab Pot/Shrimp trawl	**100%**	**100%**	**100%**

Understanding Bycatch: A Brief History

Pacific halibut bycatch was not a problem until the 1960s, when foreign trawl fleets moved into the waters off the North American coast. Without tight controls, their halibut bycatch bounded up to about 21 million pounds in 1965. Bycatch mortality declined again later in the 1960s, but increased to about 20 million pounds in the early 1970s. During the late 1970s and early 1980s, it dropped to roughly 13 million pounds. By 1985, bycatch mortality had declined to 7.2 million pounds, the lowest level since the IPHC began its monitoring nearly 25 years earlier. But in the late 1980s, the domestic groundfish fleet ballooned, and competition for fish intensified. As a result, bycatch mortality increased again; in 1990, total Pacific halibut bycatch mortality reached 18.0 million pounds.

We are not just concerned with bycatch, but also with mortality from bycatch, since many halibut do survive the ordeal of catch and release. During limited NMFS observer coverage in 1989 and complete coverage in 1990, the program focused on assessing the condition of incidentally-caught halibut in the Gulf, and classifying their condition as Excellent, Poor, or Dead. By evaluating what percentage of the bycatch halibut fell into each category, we got a more accurate picture of bycatch mortality. Currently, we assume that 50% of the halibut caught in trawls in the Gulf will die, compared to 100% in the Bering Sea. We hope that the data collected this year and in years to come will give us a more accurate mortality rate for trawls and other gear types.

Area 2.	**Historic range**	**1.2 - 2.8 million pounds**
	1990 bycatch mortality	**1.94 million pounds**

Bycatch mortality in all of Area 2 was only slightly higher in 1990 than 1989. Most of the bycatch mortality occured in the trawl fishery off Canada; the remainder was caught by crab pots in Area 2C. Canada refined its methods for estimating bycatch among its trawlers in 1990, but the resulting figures changed very little. Since 1986, bycatch mortality in this fishery has ranged from 1.2 to 1.6 million pounds annually.

It is difficult to estimate Pacific halibut mortality among U.S. trawlers in Area 2A, but bycatch probably does occur, because tagged halibut are recovered by trawlers and the trawl fishery is spread throughout the area. In 1991, the IPHC staff will develop bycatch estimates for this area using research survey data or similar sources.

Area 3.	**Historic range**	**1.24 - 16.54 million pounds**
	1990 bycatch mortality	**5.56 million pounds**

In the Gulf of Alaska, Pacific halibut are incidentally killed in the trawl, longline, and pot fisheries. In 1990, trawlers caught and killed about 3.5 million pounds of halibut as bycatch; longliners 1.7 million pounds, and pot fisheries 60,000 pounds. These mortalities were far higher than in previous years, as nearly every Gulf fisherman knows. Our current bycatch figures are more accurate than estimates made before the domestic observer program. Nevertheless, our best information indicated that bycatch mortality in Area 3 has increased more than four-fold since 1986. Groundfish harvests have increased only 50% during the same period.

In 1990, the NPFMC set a Pacific halibut bycatch limit of 2,750 metric tons round weight, which is 4.6 million pounds net weight, for the Gulf of Alaska. When that limit was reached, the bottom trawl and longline fisheries were to be closed to further harvests. The bycatch cap was cut into quarters to help spread fishing throughout the year. Indeed, the longline fisheries exceeded their bycatch cap and fishing was closed in the second quarter. Trawlers were erroneously shut down in the second quarter also, but fishing was reopened when the error was found. Bottom trawling in the Gulf closed for the year after September.

In 1990, the NPFMC set a Pacific halibut bycatch limit of 4.6 million pounds (net weight) for the Gulf of Alaska.

Though it is a huge problem for the pollock, flatfish, and cod fisheries, halibut bycatch mortality in the winter Tanner crab fishery around Kodiak Island is relatively small. Halibut caught incidentally in that fishery is roughly 0.3 million pounds annually.

Area 4.	**Historic range**	**2.04 - 13.10 million pounds**
	1990 halibut mortality	**10.52 million pounds**

Pacific halibut bycatch in 1990 was its highest since 1971 in the Bering Sea. The NPFMC installed bycatch caps which closed trawl fisheries and kept the levels lower than what they might have otherwise been. More than half of the total coast-wide bycatch mortality occurred in the Bering Sea in the bottom trawl fisheries for Pacific cod, turbot, and to a lesser degree, flatfish. A good portion of the pollock, the most abundant species in the Bering Sea, is caught with pelagic (midwater) trawls, which do not catch much halibut. But trawlers were responsible for 8.4 million pounds of bycatch mortality, and joint venture vessels targeting yellowfin sole took 1.3 million pounds. Longliners fishing for Pacific cod, sablefish, and turbot took 450,000 pounds, with most of that hauled up by cod boats. Crab fisheries for king and Tanner crab in the southeast Bering Sea and king crab fisheries in the Aleutian Islands were responsible for roughly 300,000 pounds of bycatch mortality in 1990.

Yield Loss: What Does Bycatch Cost the Fishery?

Bycatch kills primarily the young Pacific halibut that are smaller than the legal size limit for the commercial fishery. These deaths affect the halibut fishery in two ways: First, the young halibut are prevented from recruiting into the fishery; the exploitable biomass is therefore reduced; and fishermen do not have access to as many fish. Second, the fish that are killed as bycatch will not be able to reproduce. We compensate for the lost reproduction by cutting one pound from the commercial halibut catch limit for every pound of bycatch mortality, so that the reproductive contribution of the stock will be approximately the same as if bycatch had not occurred.

In analyzing total yield loss to the fishery, we calculate both the loss to the biomass caused by reduced recruitment, and the loss to the fishery due to catch limit reductions. The combination of those two losses adds up to a total of 1.6 pounds of lost harvest to the fishery for every one pound of bycatch mortality. Thus the total loss in yield to the longline halibut fishery is 1.6 times the actual bycatch mortality, or 28.8 million pounds in 1990.

Yield losses are figured for each Pacific halibut management area. Young halibut migrate southeastward, so the yield losses are lower than bycatch mortality in the Bering Sea, and higher in the Gulf of Alaska (Figure 4). We know that the young halibut would have left the Bering Sea areas anyway; thus yield losses are not as great from bycatch removals. But in the Gulf, where migrating halibut would have gathered and grown to maturity, yield loss is estimated considerably higher.

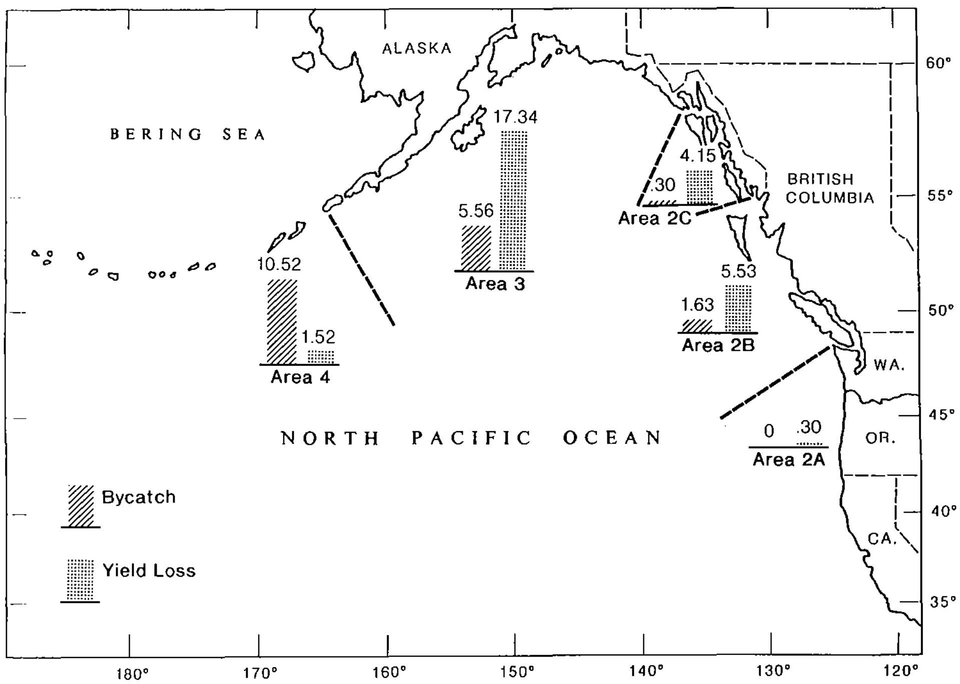


Figure 4. The bycatch and corresponding yield loss for each major IPHC regulatory area, in millions of pounds.

Improvements in Bycatch Management: Tugging at the Sleeve of the Problem

The domestic observer program, for the U.S. groundfish fleet off Alaska, was by far the most important improvement in bycatch management in 1990. Under the program, nearly 90% of the Bering Sea groundfish harvests and 40% of the Gulf of Alaska groundfish harvests were logged in observers' notebooks. Analysis of the observer data will give fishery managers, biologists, and fishermen a far better understanding of bycatch — how it happens, where, and if we are lucky, how to reduce it.

Both longline and trawl fisheries in the Gulf and the Bering Sea were closed down in 1990 after exceeding Pacific halibut and crab bycatch limits. Those limits remain in effect in 1991-92, so bycatch in those areas is not likely to increase. Because of the pressure of fishery closures and some newly designed penalty programs for excessive bycatch, the race is on to develop new gear modifications, fishing behaviors, and other tricks and techniques to decrease halibut bycatch in the groundfish fisheries.

However, bycatch caps affect the fleet as a whole without motivating individual fishermen to fish responsibly. Fishery managers and industry groups have tried to design incentive programs, based on observer data, to identify and penalize individual fishermen whose bycatch rates are high, or to reward those who fish cleanly. The IPHC staff has pushed hard in favor of this incentive concept.

The fishing industry in 1990 drafted an in-season "penalty box" program that would ban fishermen for a period of time if their bycatch rates exceeded a threshold value. The NPFMC adopted the penalty box, but for technical and legal reasons, NMFS could not implement it. Instead, NMFS proposed an after-the-fact penalty system to sanction fishermen with the highest bycatch rates. NMFS, NPFMC, IPHC, and the industry continue to work toward designing an effective bycatch reduction program. But without personal incentives, it is unlikely the groundfish fleets will change their fishing methods to appreciably reduce halibut bycatch.

In the absence of a formal in-season incentive program, the groundfish industry is organizing a voluntary program for fishermen to form "bycatch pools" for specific fisheries. The pools work to keep bycatch rates low by excluding members who fish at unacceptable bycatch rates. The American Factory Trawlers Association (AFTA) is spearheading this effort.

During 1990, the NPFMC adopted a series of management actions to help the groundfish fishery stay below the bycatch cap for 1991. For example, the Council has:

- delayed some fisheries with high bycatch rates in order to avoid Pacific halibut stocks;
- assigned bycatch limits to specific fisheries;
- apportioned bycatch limits by season;
- promised to close areas in-season if bycatch rates become "excessively high;" and
- may require some portion of the pollock to be caught with pelagic trawls.

If these measures work in 1991-92, and if the incentive program proves successful, the NPFMC may be able to reduce Pacific halibut bycatch caps in 1993.

Studying Bycatch Day and Night

We continue our search for ways to decrease Pacific halibut bycatch in the North Pacific groundfish fisheries by questioning whether bycatch levels are higher at night or in the daytime. Processing of the observer data was not finished in 1990, so our analyses here are based only on joint venture operations. However, they are set up to be applicable to the domestic fishery as well.

Some fishermen have reported getting higher bycatches at night; in fact, some have even recommended that the NPFMC ban night fishing. Our results of day/night fishing studies showed bycatch levels were affected more by changes in groundfish species composition than by time of day. Pacific cod and rock sole had higher bycatch rates, day or night, and yellowfin sole and pollock had lower bycatch rates, anytime.

However, after adjusting for changes in the species composition, Pacific cod fishermen's bycatch rates were significantly higher at night. The abundance of Pacific cod, relative to halibut, dropped at night; the amount of cod caught per hour during night hours was in some cases less than half of the daytime cod catch per hour. These results suggest that restricting Pacific cod fishing to daytime could increase the total cod catch for the same amount of halibut bycatch.

Stock assessments tell us the health of the resource

LISTENING TO THE FISH

Port sampling in Excursion Inlet, Alaska

Figuring the size of fish stocks is something like fishing itself. We look at what is caught, where it is caught, and what gear is used. We compare this to what occurred in the past and then try to predict what will happen in the future. There are no perfect predictions, but watching what happens in the fishery each year adds to experience. And experience makes for sound assessments, and hopefully better fishing.

We measure Pacific halibut biomass by compiling information from catch, catch per unit of effort (CPUE), age composition, and average fish weight data. From processing information we determine exploitable biomass: the amount of halibut available for harvest. This tells us what percentage can be harvested regularly without harming the resource, and we call that percentage the constant exploitation yield — CEY. Pacific halibut has an optimal exploitation rate of 0.35, which means that about 35% of the available halibut can be taken each year without damaging the resource.

From the total yield, we subtract the amount of fish taken as sport catch, bycatch, and lost as waste each year, and the remaining figure is the recommended allowable catch for the commercial halibut fisheries. The whole procedure is outlined in Figure 5.

1990 ESTIMATES: STOCKS KEEP DROPPING

Pacific halibut biomass has been shrinking since 1987. The total exploitable biomass of Pacific halibut in 1990 was estimated to be 234.7 million pounds. This was about 8% less than in 1989, a decline that concerns IPHC biologists because it may be part of a long term decline in biomass that may continue for several years. Figure 6 shows coastwide trends in exploitable biomass, recruitment, and CPUE.

Stocks declined most dramatically, 11-12%, in areas 2B, 2C, and 4, and more moderately, at about 6-7%, in areas 3A and 3B. Area 2A showed a slight stock increase. Still, recruitment declined radically in that area, as it did throughout the Pacific halibut region.

WANTED: A FEW GOOD RECRUITS

IPHC biologists expect low recruitment to continue, and the overall size of the stocks to decrease 5-10% per year for the next several years.

Stocks are dropping in part because recruitment is dropping. Since the mid 1980s, recruitment has dropped dramatically up and down the Pacific coast. This decline is part of a 20-year cycle that halibut seem to go through, but recruitment failure is also more complicated than that. Recruitment dropped below average in the past two years, continuing on a downward slope since 1985.

Since year classes fluctuate in size, we might assume that a small spawning stock will produce a small year-class of new recruits — but that is not necessarily so. If we examine how recruitment and spawning stock sizes have fluctuated since 1935, we see that the size of the spawning stock does

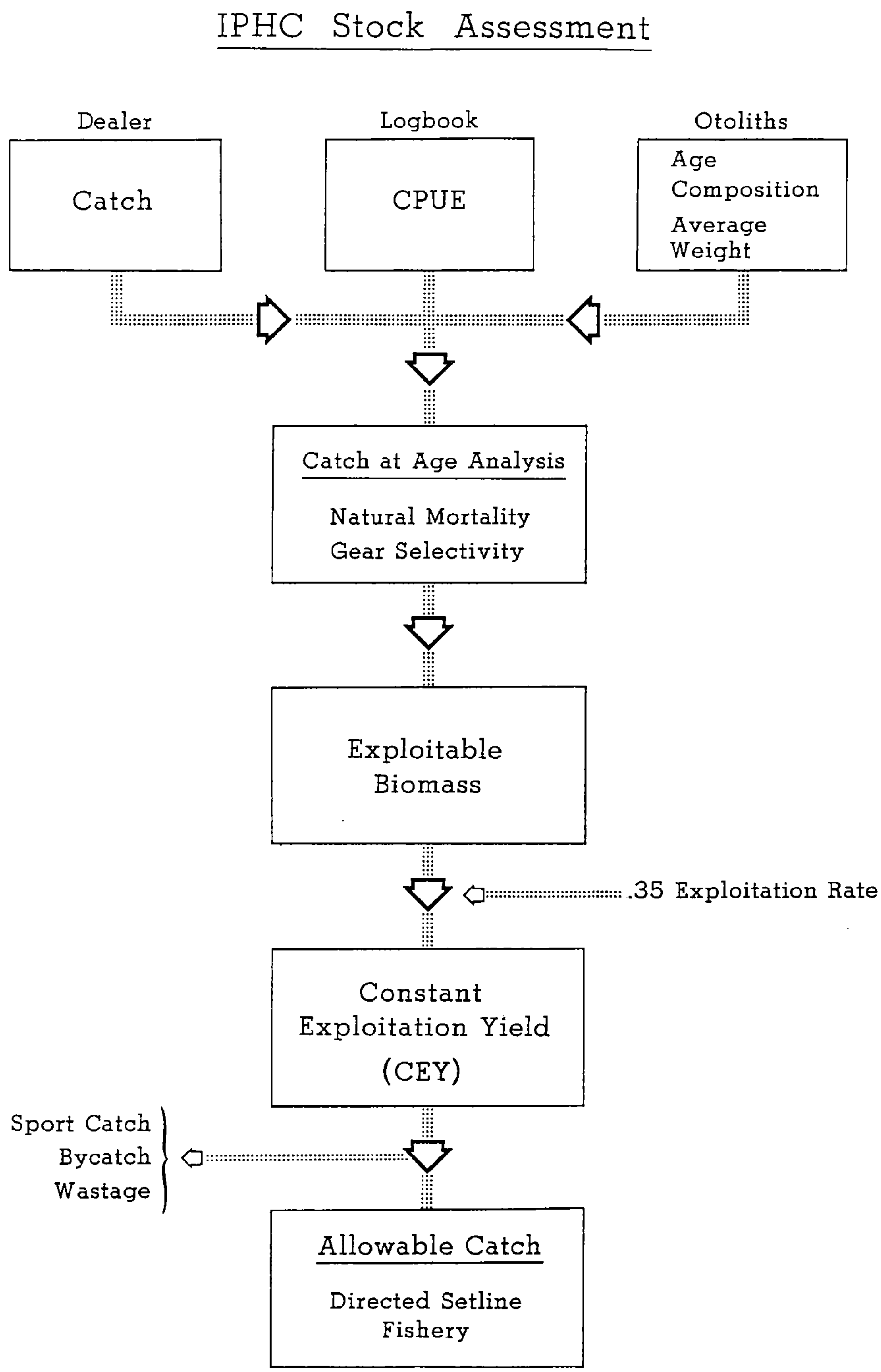


Figure 5. IPHC stock assessment flow chart.

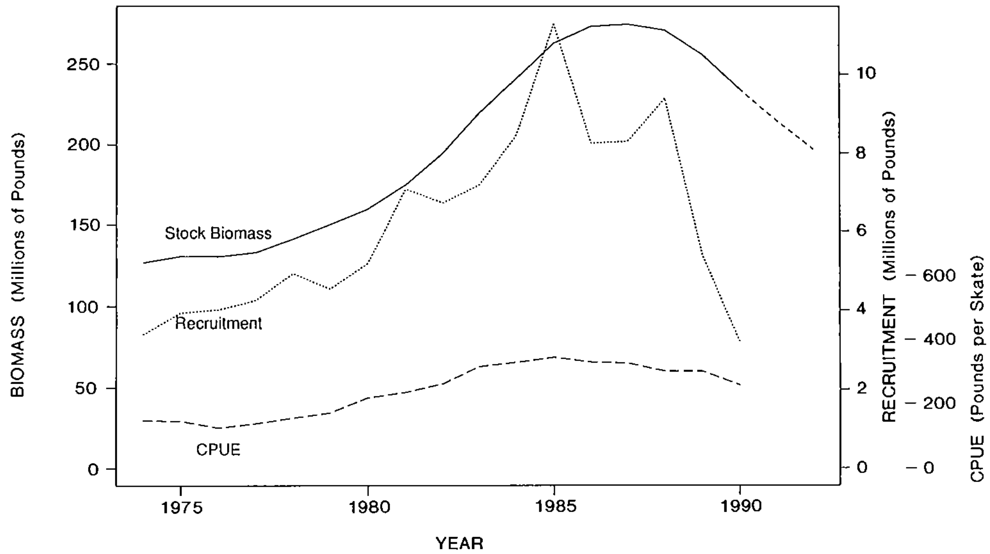


Figure 6. Estimates of biomass, recruitment, and CPUE for the Pacific halibut resource from 1974 through 1990, with a biomass projection to 1993.

not always determine the number of recruits produced. It is possible for runs of strong or weak year-classes to appear out of any population of spawning adults. When there are fewer fish to spawn, or when fewer young survive their first crucial five or six years, then the number of fish that recruit into the fishery declines.

So, we began to look at recruitment trends. Our scientists created a computer model that describes the average relationship between spawning stock size and subsequent recruitment. The model also mimics the way recruitment trends persist for several years at levels better or worse than predicted by the simple spawning stock-recruitment level relationship. We learned that high or low recruitment trends tend to last for several years, and that understanding these trends is crucial to analyzing or predicting halibut recruitment.

Unloading a halibut schooner in Seward, Alaska

In other words, if we had looked only at the relationship between spawning stocks and subsequent recruitment in our analyses, we would have expected that the high spawning stocks in the early 1980s would have yielded high recruitment levels in 1990. However, considering the recruitment trends over the past few years, we could expect this year's recruitment levels to be low — perhaps not as low as they are, but low.

The IPHC staff expects low recruitment to continue for the next few years, and the overall size of the stocks to decrease 5-10% per year. Meanwhile, this year's 13-year-old year class, which recruited strongly as eight-year olds in 1985, is contributing less and less yield to the fishery. These declines are not disastrous; they are the downward slope of a peak that started in the early 1980s with a run of good year-classes. The high stocks of the early 1980s could not have been sustained, even if recruitment levels remained above average. What we are seeing now is an expected decline — caused by the lower-than-normal recruitments and possibly by high bycatch.

We do not expect halibut stocks to drop to dangerous levels, and have set harvest limits to make sure they do not. Yet the staff continues to watch the decline with care.

DOES TRAWL BYCATCH AFFECT RECRUITMENT?

Most Pacific halibut caught as bycatch by trawlers are two to six years old, and therefore bycatch reduces the recruitment of eight-year-olds to the fishery. Since bycatch has been increasing in the last few years and recruitment has fallen, it would be logical to suspect bycatch as contributing to the decline.

The Commission's conclusion: High bycatch is not causing the Pacific halibut recruitment problem, but it does make the problem worse. Because the bycatch consists mostly of two- to six-year-olds, this year's recruitment shows the effect of bycatch about four years ago. For example, the eight-year-old halibut recruited in 1990 were subject to bycatch in about 1986. When 1990 recruitment is compared with bycatch levels in the mid 1980s (Figure 7), it is clear that the recent decline in recruitment coincides with a period of generally decreasing bycatch levels.

The recent decline in recruitment of eight-year-olds is not, therefore, the result of the recent increase in bycatch. Not that bycatch has no effect — if there had been no bycatch in the early 1980s, recruitment would be higher now, but it would still be declining.

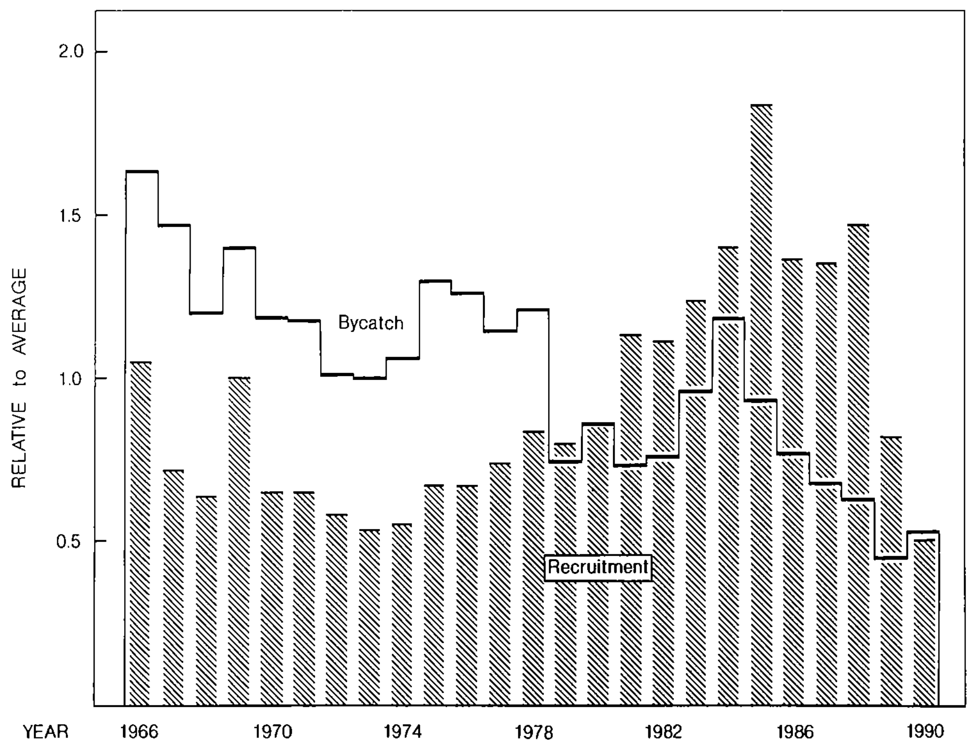


Figure 7. Recruitment plotted along with bycatch four years earlier.

SETTING THE ALLOWABLE CATCH

Not only are the stocks dynamic, our information about them is dynamic, too. This year we re-figured stock levels estimated in previous years, using updated information. Every year we get new, more reliable information about past levels of bycatch, waste, and sport catches, and we get better at charting the inherent variability of the stocks themselves. For example, our information about recruitment in the past year is not as accurate as information we have about previous years, primarily because the older year classes have been around longer to study. As we learn, we go back and adjust previous abundance estimates. This is why catch limits sometimes may go up in an area where stocks are declining. This year, such an increase happened in Areas 3B and 4.

The fishing community sometimes feels that harvest rates should be decreased when recruitment declines, or increased when recruitment is strong, to avoid pressuring stocks already at low levels. This view is reinforced when runs of low productivity last a few years, such as the one we are in now. However, our studies confirm that the exploitation rate that maximizes yield is just above 40%. But fishing at 35% provides virtually the same yield and at the same time lowers the risk of reducing the spawning stock; the staff therefore continues to recommend fishing at a steady 35%. The recommended allowable catch is always based on the most recent information available, and is high enough to sustain a healthy commercial fishery yet conservative enough to maintain a viable halibut stock.

Catch at age: Biologists all over the world use a catch-at-age analysis procedure, nicknamed CAGEAN, which was developed and is still used by the Commission staff. Using CAGEAN analyses, we are asking questions about stock variability, and how the natural dynamics in halibut population affect our ability to measure the stocks. Research indicates that while our CAGEAN estimates are good, they could be better if we could include the stocks' natural variation into the formula. In future years, we will be studying this variability in halibut stocks, and how to use this information to improve stock assessments.

PROSPECTS FOR THE NEXT FEW YEARS

The IPHC staff has projected the decline of the Pacific halibut biomass over the next few years, taking into account previous cycles and the current downward trends in recruitment. Total catches — commercial, sport, and bycatch — are projected to bottom out at roughly 45 million pounds in the middle or late 1990s, and then increase again. Catches probably will rarely again be as high as 80 million pounds, as they were in the 1980s. This was an extraordinarily high level, resulting from the large recruitments of the mid-1980s, which came at a time when IPHC was deliberately limiting removals to rebuild the stock. The long-term average production is still estimated to be about 60 million pounds, with annual removals in the range of 45-75 million pounds.

Remember, though, that this forecast is speculative. We can only guess the future by the past behavior of the stock. The range of catches we can expect over the long term is realistic, but the timing of upturns and downturns is very uncertain. Also, the harvest forecast refers to total removals, including estimated waste, sport catch, and bycatch. If these other removals continue at recent levels of about 20 million pounds per year, the coastwide commercial longline quota could bottom out at around 25 million pounds, and in the long term will range between 25 and 55 million pounds.

Delving the deep for clues

SCIENTIFIC INVESTIGATIONS

IPHC collecting halibut data on NMFS trawl survey

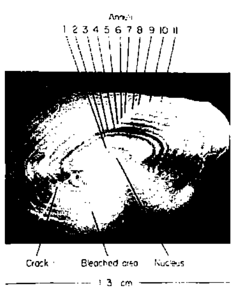
Since its first year, the IPHC staff has led research into Pacific halibut biology, behavior, habitat, and harvest methods to see what we could learn about these creatures of the deep. Here is a summary of the scientific studies the IPHC staff conducted in 1990, and how those studies will help increase our understanding of *Hippoglossus stenolepis*.

GROWTH AND AGING OF THE STOCKS

We Listen by Looking in Their Ears

The otolith (earbone) helps a fish maintain its equilibrium in the water; it gives it a sense of direction and balance. Otoliths give us a clue to what is happening with the fish stocks, too — and reveal some knowledge of the direction and balance of the Pacific halibut resource we would not have otherwise.

An early fish biologist named Rebisch first looked at a flatfish otolith under a microscope in 1899, and when he did he revealed to us a whole new world of fisheries data. Rebisch discovered that he could count the annuli, or rings, on an otolith just like you can count the rings of a felled tree, or the rings on the shell of a mollusc. Now, we collect otoliths every year from a portion of the halibut landed at most commercial ports, and from those otoliths we learn the ages of the halibut. We are also developing the ability to tell the sex of the halibut from this small ear bone.



Halibut otolith

In 1990, we collected about 2,000 otoliths from each regulatory area. To get them all, we had to figure how many fish were likely to be harvested at each port within the area, and what percentage of port landings had to be sampled to come up with the 2,000 otoliths.

The otoliths themselves are clues; we augment them with catch per unit of effort data (CPUE) by interviewing the fishermen who delivered the original owners of the otoliths. We also collect vessel logbook data in all ports where otoliths were collected. We tried to collect 100% of the logs in each port, or as close to it as possible. In 1990, we collected 2,490 U.S. and 426 Canadian fishing logs.

Age Composition of the Pacific Halibut Stocks

First, ages are compiled by regulatory area to estimate the age composition of the catch — that is, how many of the harvested fish fall in each age group. The age composition is an essential consideration in our halibut stock assessments. Increases or decreases in the mean age of the stocks tell us something about the future of the fishery.

The mean age of Pacific halibut from 1986 through 1990 showed a slightly aging resource (Figure 8). The strong year-classes are getting older, and recruitment of young fish has been quite low. The 1980, 1979, 1978, and 1977 year classes, which are now 10-, 11-, 12-, and 13-year-olds, respectively, dominated halibut landings in 1990. Mean age also differs with area, from extremes of Area 2A being dominated by 9-, 10-, and 11- year olds, and Area 4 made up predominantly of 11-, 12-, and 13- year olds.

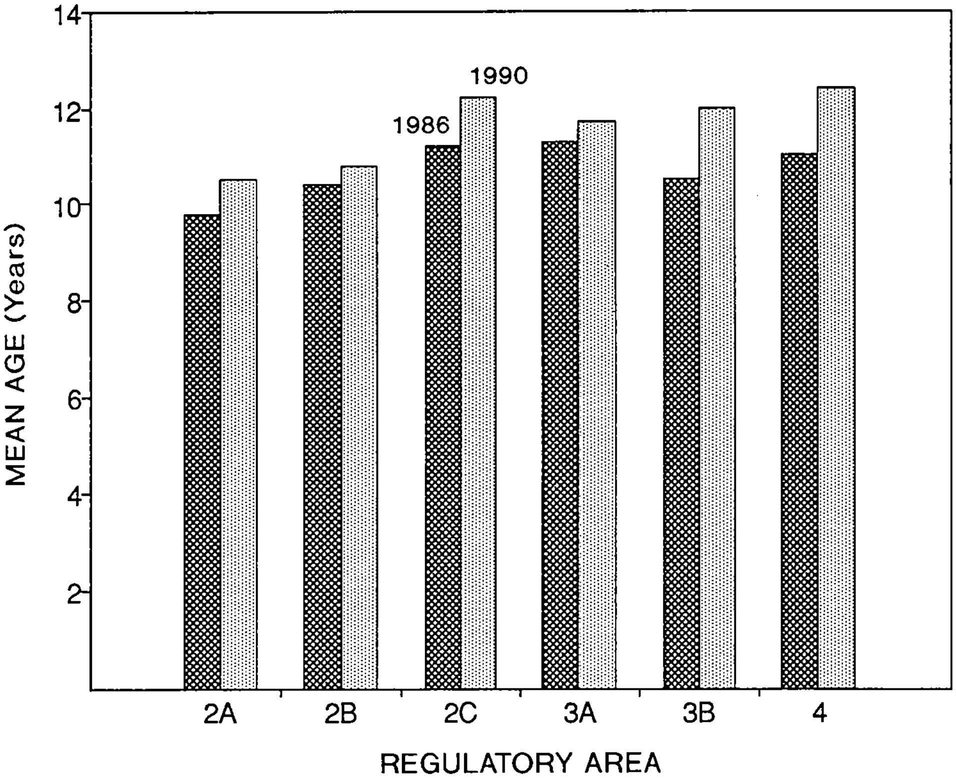
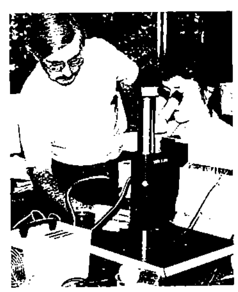


Figure 8. The mean age of Pacific halibut for the years 1986 and 1990.

Evaluating the Age Samples

For the last few years the Commission staff has collected 3,000-4,000 otoliths per year from each regulatory area, and has read each otolith two or three times to arrive at an agreed or "resolved" age. We learned in 1990 that we do not need to take more than 2,000 otoliths from each area, and that single readings produce estimates almost as precise as multiple readings. We have reduced our sample sizes accordingly, and stopped double-reading the samples to make better use of staff time.



Resolving otolith ages

Age validation is as important to fishery biology as standardizing solutions or calibrating instruments are to other fields. To age-validate Pacific halibut, the IPHC staff initiated a mark-recapture study in 1982, using the antibiotic oxytetracycline (OTC) as a marking agent. In 1982 and 1983, 1,791 halibut were injected with OTC during routine IPHC tagging operations off the coasts of British Columbia and Alaska. A control group of 1,455 halibut was also tagged and released. Halibut were tagged through the inner operculum bone with a plastic coated wire tag on the dark or right side. Through 1989, 256 tags had been recovered from the injected and control groups.

Seventy-five otoliths from the injected group were used for validation analysis. Each otolith was read and double-checked by a team of three readers. We compared their age estimates to the length of time the fish actually were at liberty after tagging. This way, we could check our ability to accurately age halibut using otoliths. We discovered that when we read otolith rings, we were seldom more than one year off in estimating the halibut's age.

Can Otoliths Tell us Gender of the Fish?

It is easy to collect otoliths from commercially caught Pacific halibut but because the fish are landed with guts out, it is impossible to collect data on the sex of the fish. However, it is important to know how many males and females are out there, and are being harvested. IPHC biologists now are trying to develop a way to sex halibut by looking at the differences in their otoliths, which do exhibit sexual dimorphism to some degree.

Many otoliths from females have broad bases and narrower tips. Otoliths of male halibut tend to be smaller than those of females at a given age. Otoliths from male fish also tend to be more elongated, and thicker in relation to overall size and length than otoliths of females. This is more pronounced from the otoliths in older fish, but can also be seen in otoliths from younger fish, particularly in the posterior half, between the nucleus and the base. Associated with this thickness in male otoliths is a steep slope or drop to the edge, as opposed to the more flattened edge of female otoliths. Also, the rings tend to be more closely spaced in male otoliths, especially after the first 5 or 6 years.

In our first five experiments, using four different readers, we were successful at accurately judging the sex of a halibut 69% to 77% of the time. These results were encouraging, but it is clear we need to perfect this method of halibut sexing before applying it on a wider scale.

The Microstructure of Otoliths

Photomicrograph (1000x) of a juvenile otolith

We believe the otoliths of Pacific halibut contain untold amounts of information, if we can only develop the ability to understand it. In 1990, the scientific staff studied the structural and chemical composition of otoliths, searching for structural patterns that might help us predict halibut year class strength and stock composition. We focused on juvenile growth by analyzing the annual increment patterns seen in adult otoliths.

We have now analyzed 26 years of annual growth, and we have learned a few things. For example, environmental factors affect halibut most extremely at ages 0 through 4. For fish ages 0 to 2, growth is directly related to sea surface temperatures. Over 50% of the variation in halibut size among fish this age could be related to sea surface temperatures.

For older juvenile halibut, ages 3 and 4, the growth patterns are less clear, and though some environmental effects are indicated, the relationships of growth with sea temperatures are slight. We have not completed analyses of the older year classes. Those clues we have found are just a beginning, but they hint of a wealth of information to come.

Cruising for Otoliths

In 1990, we participated in the NMFS Gulf of Alaska trawl survey of the continental shelf and continental slope from the Islands of Four Mountains eastward to Dixon Entrance. We collected otoliths, length, and sex information from 2,297 of the 6,551 Pacific halibut captured for the study. We also collected an additional 121 halibut ranging in size from 30 to 53 cm for parasite studies, and took blood samples from 40 more for DNA mapping.

NMFS trawl survey

From this survey cruise, we gathered information about young recruitable-age halibut that we can use in assessing the effects of bycatch, in evaluating the 32 inch minimum size limit, and to better understand historical changes in growth.

Two chartered trawl vessels, the *Pat San Marie* and the *Green Hope*, sampled 631 stations in the western and central Gulf of Alaska between the Islands of Four Mountains and Cape St. Elias between June 1 and September 11. In addition, the *Pat San Marie* fished for four days in northern British Columbia. Each cruise was divided into four legs averaging 25 days. A third vessel, the National Oceanic and Atmospheric Administration (NOAA) research vessel *Miller Freeman* sampled 205 stations in the eastern Gulf of Alaska between Dixon Entrance and Cape St. Elias. The *Miller Freeman* cruise was divided into three 15-day legs between July 14 and September 4. One IPHC staff member accompanied the *Pat San Marie* and the *Miller Freeman* during each leg, but the staff did not go along on board the *Green Hope.*

The survey activities for the *Miller Freeman* included the Two Peaks and Masset grounds, located east and west of Rose Spit, respectively, because both are known locations of halibut high abundance in northern British Columbia. Aboard the *Green Hope*, 279 stations were sampled for a total catch of 1,831 halibut, and 86 of them were otolithed.

For the parasite study, 121 Pacific halibut were caught and frozen in the round for shipment to the Pacific Biological Station in Nanaimo, B.C. Researchers there will study internal and external parasites, and the relation of parasites to halibut age, sex, geographical location, and season of capture.

TAGGING STUDIES: CAN'T FOLLOW THEM, BETTER TAG THEM

The IPHC has tagged thousands of Pacific halibut over the years. The information we have gained from the recovered tags gives us more understanding of biomass, mortality, and migration, which is useful for stock management and assessment. Though we do not presently use tagging study data to set annual catch limits, the information is still crucial to our overall understanding of the resource. And we have seen how it is helpful in assessing the effects of bycatch on the halibut population.

Yellow wire tagged halibut

Only 953 tags were redeemed in 1990, compared to 1,492 in 1989. Of the 1990 recoveries, the five recovery locations furthest away from the respective release locations, are shown in Figure 9. As in 1989 the majority of the recoveries were associated with two major experiments; one at the Sitka Spot grounds off northern British Columbia in 1988, and the other off Newport, Oregon in 1989.

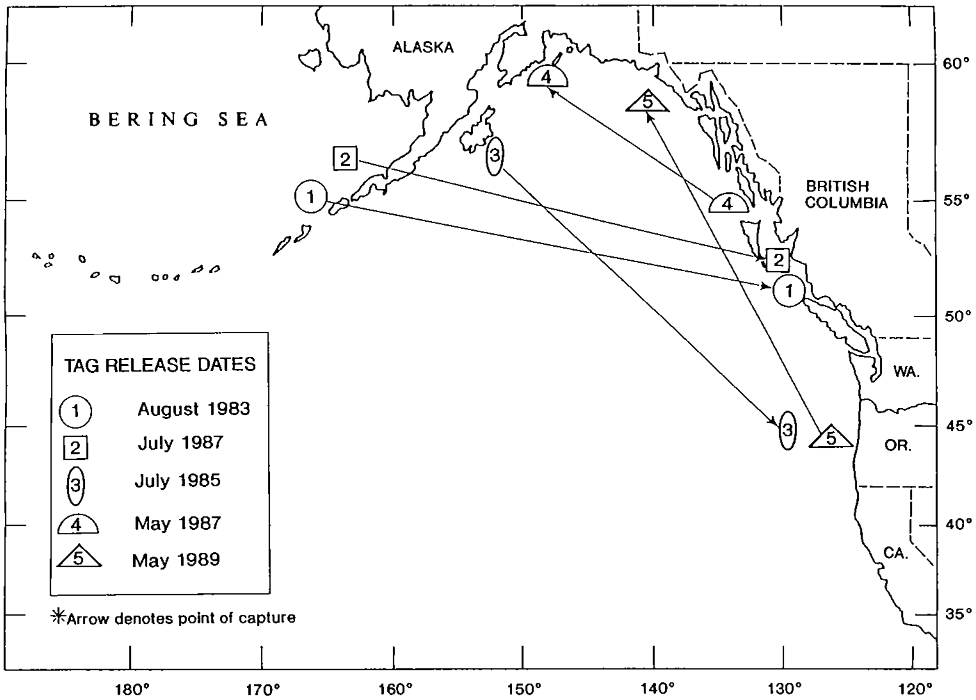


Figure 9. Release and recovery locations for the five fish that migrated the furthest, for 1990 tag recoveries.

Those Fish Can Move

A total of 953 tags were redeemed in 1990 compared to 1,492 in 1989.

The Sitka Spot tag experiment now has a recovery rate of 35% (937 recoveries for 2,652 releases). Most of these fish were recovered in their area of release, but in 1990 two of these fish were recovered in Area 3A off Kodiak.

Tagged fish released in 1980 and 1981, and recovered in 1990, tell us much about halibut movement. Each year a portion of the juveniles migrate southward out of one area into another. In 1990, they moved at a rate of 19-20% per year from Area 3B, 7-10% per year from Area 3A, 16-23% per year from Area 2C, and 3-4% per year from Area 2B. Remember that the halibut caught as bycatch are primarily juveniles. Using information from these tagging studies, we can compare the juveniles' migration patterns with the movement and survival rates of adults, and so we can tell how bycatch in one area might affect the stocks in another.

In 1986 2,099 fish were caught and removed from the hooks either manually or by a hookstripper. They were then tagged and released. Through 1990, 133 tags had been recovered from this experiment. Of the sublegal halibut tagged, which we are especially interested in, we see an 8.2% recovery rate for those removed manually and a 2.4% recovery rate for those removed by the hookstripper. The difference in the handling methods is clearly three-fold in favor of manual release.

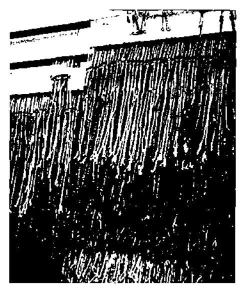
Generally, halibut move southward although older halibut may move back north to spawn. Fish tagged in Newport, Oregon, one of the southernmost grounds for Pacific halibut, generally have stayed in the area with a few exceptions of movement north. So far, we have recovered 295 tags from 2,118 releases, a recovery rate of 13%. Several of these fish were recovered in the Queen Charlotte Islands this year and one in Southeast Alaska near Petersburg.

The special 1989 Newport tagging experiment helped us test the reliability of mark-and-recapture data as a method of stock assessment. We learned that as a simple, reliable, alternative stock assessment procedure, the tagging approach fails. There are just too many variables to make the necessary assumptions which are required to obtain reliable estimates.

By monitoring, through tagging studies, the halibut that migrate south, we can better understand how changes in the environment and changes in the fisheries affect the halibut stocks. This way, we can at least get a glimpse of their activities, and from this we hope to learn more about halibut biology and how our fishing activities affect them.

TESTING THE GEAR

Fishermen and scientists look at fishing gear in slightly different ways. Fishermen want to know what gear is most efficient, and will bring the most dollars to the surface in the quickest amount of time. Fish biologists, though, need to know how efficient a particular piece of gear is, and how its relative efficiency can be mathematically formulated to provide accurate information about the fish resource. In other words, biologists need to know as much about the fish they did not catch as they do about the fish they did. This takes some investigation of the gear itself.



Snap gear

Snap Gear: Less Efficient but Just as Useful?

Many longline boats, especially those in area 2B, use snap gear, which is easier to use but less efficient than traditional fixed gear. Catch records show that the use of snap gear is increasing in area 2B, and that we should include CPUE data from snap gear in that area's stock assessments. But each kind of gear has its own relative efficiencies, and CPUE data taken from the two different kinds of gear can not simply be pooled together. In 1990, the staff began implementing a method to relate CPUE data from snap gear to the data collected from traditional gear throughout the halibut grounds. With that method, we will be able to incorporate CPUE data from snap gear into our overall analyses.

Hook Timers: What Time is Lunch?

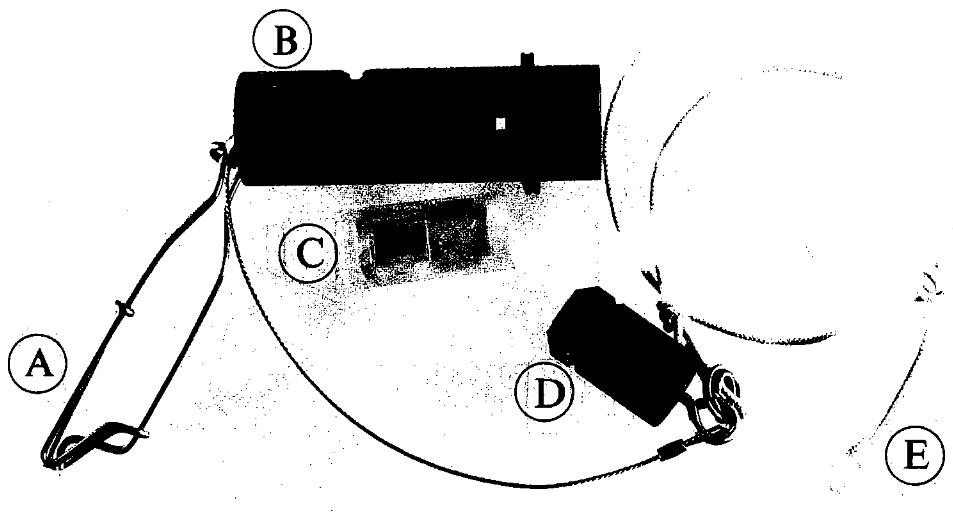
Compiling catch per unit of effort data is an important part of the IPHC annual stock assessment process. Using hook timers, a small electro mechanical device, on research gear, helps us better understand the longline process — in particular the relationships between CPUE and halibut density, and the effects of other species on halibut CPUE.

A strong tug on the hook, such as happens when the bait is taken, starts the clock. The reading on the clock at retrieval can be used to calculate the amount of time the bait soaked before it was attacked. The timer concept was developed by NMFS in Hawaii, and the new O-ring release mechanism was developed for IPHC by the Applied Physics Lab at the University of Washington, Seattle.

Data gathering on the F/V Ocean Viking

In 1990, hook timers were fished in the Carpenter Bay area of the Queen Charlotte Islands in British Columbia and off Cape Ommaney in Southeast Alaska aboard the chartered Canadian vessel *Ocean Viking.* For each timed hook we charted the time of setting, timer status (tripped, not tripped, or apparently malfunctioning), clock reading, bait status, catch species and size, and time of retrieval. The O-ring release mechanism generally worked well. However, some of the timer assemblies were too tight and did not release as easily as others. These problems will be resolved by more stringent machining specifications for next year.

We discovered that there are a lot of scavengers down there who can take the bait without tripping the timers — some of the worst among them: small arrowtooth flounder, rockfish, ratfish, and starfish. Some hooks were retrieved with the timer untripped, but the bait missing. We hope to add the underwater video camera to this experiment and see just what is going on down there.



a) snap; b) release mechanism; c) timer module; d) plunger with magnet; e) eye for the hook

After the research cruise, we designed a couple of refinements to the hook timer, and applied the computer model of the fishing process to the timer results. The model, greatly simplified, describes the catch of different species as a product of numbers of fish, numbers of available baits, attack rates for a species, and the hooking success for individual attacks. When a dogfish comes along, for example, its effect would be to remove available bait from the model, but to not trip the timer. Although the model is still in development, comparing its predictions with the data collected suggests it is relatively successful at describing halibut catches.

BEHAVIOR AND LIFE HISTORY

We can come to all kinds of conclusions about Pacific halibut just by looking at what we bring up from the deep. But we will never really know anything about their behavior unless we can watch them in their own world. In 1990, the Halibut Commission bought an underwater video camera capable of operating in very low light, along with a pan tilt unit and an underwater light. The camera and light were mounted on the pan tilt within an aluminum cage about 3 feet in diameter and 2 feet in height. We used the camera for two investigations, to observe halibut response to bottom trawls, and to watch their behavior in response to longline hooks.

Watching the Trawl Net

Using an underwater video camera, we hope to gain insight into halibut behavior in and around bottom trawls.

In mid-August, we attached the camera to the trawl gear of the *Pacific Star*, a Kodiak-based trawler, to watch how Pacific halibut and other groundfish reacted to a trawl net. The cage containing the camera was secured to the trawl headrope, and was oriented to view halibut behavior in the mouth of the trawl below. We worked on this project for six trawling days, targeting on shallow-water flounders.

The first tow, in 37 fathoms for one hour, provided a clear view of fish and invertebrate bottom life from a distance of 15 to 20 feet. Small flounders and cod were seen swimming in the mouth of the net. Halibut caught in the trawl were similar in size to the other flounders and few in number, making it difficult to identify halibut from other flounders on the T.V. monitor.

Equipment problems prevented us from collecting further footage, but the limited success of the video observation was encouraging; we hope to continue making underwater videos. With improvements, this system should provide useful data to help identify net modifications and other steps fishermen can take to reduce halibut bycatch.

This project benefited from the cooperation of AFTA, NMFS, and Kodiak Westward Trawlers. In addition, ten days aboard the *Pacific Star* were donated for this project.

Underwater video camera

The View from the Groundline

In the second underwater video test, we wanted to observe halibut and dogfish behavior to baited circle hooks. The camera, in its cage, was attached to a 9-foot square steel frame by four 10-foot aluminum legs. When it was set up, the camera pointed down about eight feet to the sea bottom. The viewing angle allowed the entire square frame to be kept in view at all times. The camera/frame assembly was deployed on the sea floor while the vessel maintained station above.

A square of groundline was held approximately 12 inches inside the steel frame and from four to six hooks were snapped to the groundline. All hooks were rigged with hook timers, so we could visually test these devices. Initially, the gear was deployed six times over two days in Puget Sound, Washington, from the U.S. vessel *Golden Dolphin*. Here, we tested the equipment and became familiar with its operation. These sets were very encouraging; natural light was sufficient for a 30-foot visibility at over 45 fathoms depth. Then, between August 30 and September 13, we chartered the Canadian longliner *Clipper II* to deploy the video equipment in southern Hecate Strait in British Columbia.

Aboard the *Clipper II*, the gear was then set four times in 30 to 45 fathoms just south of Ramsey Island. These sets were very successful, the gear worked well, and visibility was in the 20 to 30-foot range. We observed lingcod, dogfish, ratfish, and some unidentified small fish. We watched a sunstar take one bait and two dogfish get hooked during these sets. On the days following, we made sets on the Carpenter Bay grounds at 47-65 fathoms. The artificial light was used for the deeper sets.

On many of the sets, small fish or invertebrates attacked most of the baits 10 to 20 minutes after the gear settled. Small 8- to 10-inch fish vigorously attacked the 1/4 pound baits without tripping the hook timers, but they did not get much; upon retrieval, the bait was not diminished significantly. In another set, a 20-inch sunstar approached and covered a bait, and tried to carry it away but was stopped by the gangion. When the gear was hauled up, the sunstar let go, and never did trip the timer.

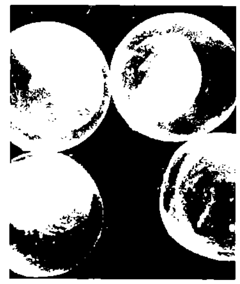
Using video equipment to observe fish behavior toward baited hooks, looks very promising, and we will continue in 1991. Most of the problems encountered during this year's trials were associated with the umbilical cable used, and we are investigating better equipment.

Rearing Live Pacific Halibut: Another Way to Watch Their Habits

Rearing live Pacific halibut is not easy, as they are discovering at the University of Washington in Seattle and DFO in Nanaimo, British Columbia. In 1989, these research stations successfully raised halibut larvae through the yolk sac absorption and jaw formation stages, but those efforts in 1990 brought only disappointment. Though the broodstock appeared swollen from maturing eggs during the winter months, very few viable eggs were produced at either facility. Consequently, neither lab produced larvae in 1990. Because live rearing projects failed at both sites — and because Nanaimo's generally successful program rearing sablefish also failed in 1990 — we believe there may be some environmental problem involved.

The University of Washington program, with the help of the IPHC, has conducted captive halibut rearing experiments at the U.S. Fish and Wildlife's facility at Marrowstone Island. Since 1986, University researchers focused on trying to spawn the captive halibut. In 1989, some Saltonstall-Kennedy funds became available to shift the brood stock into sunken net pens installed in the Port Angeles area of Washington. Startup problems with the pens caused excessive mortality in fish caught for stocking these pens during 1990.

Further north, the DFO program is in its second year with a brood stock consisting of 10 halibut at the field station at Nanaimo on Vancouver Island. This project will coordinate with the University of Washington effort. The University team helped determine hormone profiles for fish at both facilities to determine which animals were most likely to be spawning during the winter of 1990/1991. Also at Nanaimo, researchers are studying the nutritional value of various copepod and rotifer cultures as feed for halibut larvae. To enhance the project, additional brood stock was delivered to both sites during 1990 by the IPHC chartered vessel *Golden Dolphin*. Researchers hope for a better year in 1991.



Halibut eggs

OUR STUDIES CONTINUE

In 1991 and beyond, the IPHC scientific staff will continue to investigate the forces, factors, and influences that affect Pacific halibut, their habitat and the lives of the fishermen who depend on them. If you are interested in more details about these studies, please give us a call.

Our studies in the next few years will include:

- Pacific halibut bycatch reduction
- CPUE-hooktimer experiments
- behavior of Pacific halibut near trawl nets using underwater video
- DNA analysis of Pacific halibut
- sex determination from otoliths
- improved methods of stock assessment

APPENDIX

Table 1. Summary of the 1989 commercial Pacific halibut fishery by regulatory area and fishing period.

Area	Catch Limit (000's lbs)	Opening Date	Closing Date	Fishing Days	Catch (000's lbs)
2A	274	Jun 27	Jun 29	2	330
	142[1]	Mar 1	Oct 13	226	142
					472
2B	10,000	Apr 25	May 3	8	7,187
		Sep 9	Sep 12	3	3,244
				11	10,431
2C	9,500	May 15	May 16	1	3,457
		Jun 12	Jun 13	1	4,570
		Sep 7	Sep 8	1	1,505
				3	9,532
3A	31,000	May 15	May 16	1	6,491
		Jun 12	Jun 13	1	4,570
		Sep 7	Sep 8	1	9,392
		Oct 10	Oct 11	1	7,724
				4	33,734
3B	8,500	May 15	May 16	1	1,009
		Jun 12	Jun 13	1	2,749
		Sep 7	Sep 8	1	2,387
		Oct 10	Oct 11	1.25	1,698
				4.25	7,843
4A	1,800	May 15	May 16	1	13
		Jun 12	Jun 13	1	83
		Aug 11	Aug 12	1	852
		Sep 7	Sep 8	1	77
				4	1,025
4B	1,900	May 15	May 17	2	1
		May 27	May 28	1	2
		Jun 3	Jun 4	1	5
		Jun 12	Jun 14	2	8
		Jun 17	Jun 18	1	2
		Jun 24	Jun 25	1	4
		Jul 22	Jul 23	1	313
		Jul 29	Jul 30	1	369
		Aug 9	Aug 13	4	1,947
				14	2,651
4C	600	Jun 12	Jul 7	13[2]	571
4D	600	Aug 8	Aug 14	6	674
4E	100	May 26	Aug 11	52[3]	5
		Aug 12	Oct 31	80	8
				132	13
Total	**64,426**				**66,946**

[1]Treaty Indian fishery. Catch limit of 152,000 pounds includes 10,000 pounds reserved for ceremonial and subsistence use which is not sold, nor reported as commercial catch in this table.
[2]13 1-day fishing periods.
[3]26 2-day fishing periods.

Table 2. Summary of the 1990 commercial Pacific halibut fishery by regulatory area and fishing period.

Area	Catch Limit (000's lbs)	Opening Date	Closing Date	Fishing Days	Catch (000's lbs)
2A	195	Jul 10	Jul 10	.5	174
		Jul 30	Jul 30	.5	7
		Aug 27	Aug 27	.5	14
		Sep 11	Sep 11	.5	8
	120[1]	Mar 1	Mar 27	26	122
					325
2B	7,800	Apr 16	Apr 20	4	2,552
		Jun 14	Jun 18	4	3,049
		Sep 13	Sep 15	2	2,973
				10	8,574
2C	8,000	May 1	May 2	1	4,026
		Jun 5	Jun 6	1	5,675
		May 20	Jun 3	8[2]	33
					9,734
3A	31,000	May 1	May 2	1	10,421
		Jun 5	Jun 6	1	14,129
		Aug 30	Aug 31	1	4,298
				3	28,848
3B	7,200	May 1	May 2	1	3,050
		Jun 5	Jun 6	1	5,644
				2	8,694
4A	1,500	May 1	May 2	1	50
		Jun 5	Jun 6	1	384
		Aug 14	Aug 15	1	2,069
				3	2,503
4B	1,500	May 19	May 21	2	518
		May 26	May 28	2	363
		Jun 5	Jun 7	2	0
		Jun 11	Jun 12	1	92
		Jun 16	Jun 17	1	129
		Jun 23	Jun 24	1	12
		Jun 30	Jul 1	1	62
		Jul 7	Jul 7	.5	59
		Jul 14	Jul 14	.5	98
				11	1,333
4C	500	Jun 25	Jul 4	5[3]	530
4D	500	Aug 13	Aug 16	3	1,005
4E(NW)	70	Jun 1	Jun 3	2	tr
		Jun 7	Aug 11	44[4]	19
		Aug 12	Oct 31	80	16
				126	35
4E(SE)	30	Jun 1	Jun 3	2	20
		Jun 7	Jun 8	1	5
		Jul 31	Aug 1	1	0
		Aug 7	Aug 8	1	0
		Aug 21	Aug 22	1	0
		Aug 28	Aug 29	1	0
				7	25
Total	**58,415**				**61,606**

[1]Treaty Indian fishery.
[2]Metlakatla Indian Fishery. 4 2-day fishing periods.
[3]5 1-day fishing periods.
[4]22 2-day fishing periods.

Table 3. Number of vessels and catch of Pacific halibut by vessel length class in the 1990 commercial fishery. Information shown for Area 2A does not include the treaty Indian commercial fishery.

	Area 2A		Area 2B	
Overall Vessel Length	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	5	3	62	801
< 26 ft.	47	18	5	59
26 to 30 ft.	13	4	5	30
31 to 35 ft.	19	10	47	480
36 to 40 ft.	27	20	118	1,706
41 to 45 ft.	19	39	78	1,575
46 to 50 ft.	15	19	47	1,374
51 to 55 ft.	8	19	25	1,008
56 + ft.	15	71	46	1,541
Total	168	203	433	8,574

	Area 2C		Area 3A	
Overall Vessel Length	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	26	87	48	238
< 26 ft.	308	367	327	276
26 to 30 ft.	132	286	177	253
31 to 35 ft.	222	851	372	1,669
36 to 40 ft.	367	2,343	431	3,082
41 to 45 ft.	181	1,949	269	2,988
46 to 50 ft.	124	1,647	208	3,308
51 to 55 ft.	47	623	98	2,162
56 + ft.	81	1,581	427	14,872
Total	1,492	9,734	2,357	28,848

	Area 3B		Area 4	
Overall Vessel Length	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	4	51	11	29
< 26 ft.	5	6	66	113
26 to 30 ft.	3	2	37	82
31 to 35 ft.	46	424	117	361
36 to 40 ft.	72	528	6	70
41 to 45 ft.	41	522	8	193
46 to 50 ft.	57	905	11	216
51 to 55 ft.	25	651	8	401
56 + ft.	130	5,605	90	3,966
Total	383	8,694	354	5,431

Table 4. Commercial catch of Pacific halibut by regulatory area for 1986-1990, in thousands of pounds.

Regulatory Area	1986	1987	1988	1989	1990
2A	581	592	486	472	325
2B	11,225	12,246	12,858	10,431	8,574
2C	10,611	10,685	11,369	9,532	9,734
3A	32,790	31,316	37,862	33,734	28,848
3B	8,831	7,758	7,082	7,843	8,694
4A	3,381	3,713	1,930	1,025	2,503
4B	261	1,501	1,593	2,651	1,333
4C	686	878	707	571	530
4D	1,223	703	453	674	1,005
4E	43	90	9	13	60
Total	**69,632**	**69,482**	**74,349**	**66,946**	**61,606**

Table 5. Commercial landings in 1990 of Pacific halibut by port and country, in thousands of pounds.

Ports	Canada	United States	Total
California & Oregon		464	464
Seattle	32	1,914	1,946
Bellingham	399	948	1,347
Misc. Washington	346	873	1,219
Vancouver	3,363		3,363
Port Hardy	828		828
Misc. Southern B.C.	935		935
Prince Rupert	2,308	1,061	3,369
Misc. Northern B.C.	351		351
Ketchikan & Craig	12	1,714	1,726
Wrangell		557	557
Petersburg		2,284	2,284
Juneau		408	408
Sitka		3,638	3,638
Hoonah, Excursion Inlet & Pelican		2,896	2,896
Misc. Southeast Alaska		322	322
Cordova		1,817	1,817
Seward		5,183	5,183
Homer		5,936	5,936
Kenai		1,224	1,224
Kodiak		11,573	11,573
Chignik, King Cove & Sand Point		3,575	3,575
Misc. Central Alaska		3,891	3,891
Akutan & Dutch Harbor		2,514	2,514
Misc. Bering Sea		240	240
Total	**8,574**	**53,032**	**61,606**

PUBLICATIONS

The Commission publishes three serial publications - Annual Reports, Scientific Reports, and Technical Reports - and also prepares and distributes regulation pamphlets and information bulletins. Items produced during 1990 by the Commission and staff are shown below. A list of all Commission publications is shown on the following pages. Commission materials are available upon request free of charge.

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