INTERNATIONAL PACIFIC HALIBUT COMMISSION

Annual Report 1991

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

Commissioners

Linda J. Alexander
Richard J. Beamish
Richard Eliason
Steven Pennoyer
Allan T. Sheppard
George A. Wade

Director

Donald A. McCaughran

Seattle, Washington
1992

Produced jointly by the IPHC staff and
Krys Holmes, Winterholm Press

PREFACE

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

Cover: IPHC staff member Gilbert St. Pierre aboard a tagging charter.

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.

TABLE OF CONTENTS

ACTIVITIES OF THE COMMISSION - 1991

The International Pacific Halibut Commission has stood for 67 years as an institution of hope and husbandry toward the Pacific halibut populations of the North Pacific. The Commission is a testament to the cooperation that is possible between two neighboring countries who share a deep connection to the Pacific Ocean, and to the men and women who gather on the halibut grounds like a family around a feast.

In 1991, the Commission stands on the delta grounds between tradition and the future. The issues before the Commission in this decade are as challenging as the big water those longliners faced a century ago as they dropped lines off their schooners in search of the mighty *Hippoglossus stenolepis*. User conflicts, bycatch, waste of the resource, uncertainties about the factors that affect stock growth - we face some tough questions these days. The IPHC traditionally has sought its answers through information, by gathering otoliths, by tagging fish, by studying genetic signals in the halibut themselves, by surveying the grounds, and by working in partnership with fishermen and biologists up and down the Pacific coast.

"The IPHC is part of the fabric of Canada-U.S. relations"

"The IPHC is part of the fabric of Canada-U.S. relations," Canada's Deputy Minister of Fisheries and Oceans told the audience at the 1991 IPHC Annual Meeting. Forged in 1923, the Convention for the preservation of the halibut fishery of the North Pacific was the first treaty Canada signed as a sovereign nation, and was also the first time any two countries had joined together to manage a single fishery. A bold step it was for Canada and the U.S., and just as much an adventure as the first fishing voyage out on uncharted waters that we now recognize as halibut fishing grounds. And bold steps are taken still, though for our compass and sextant we use the full body of data gained from Commission studies over the last 67 years.

The challenges before the halibut industry are equal in scope to the indefatigable curiosity of its participants. These are no small questions before them: How shall this precious resource be put to the best use? How can regulations or gear or fishing habits be changed to enhance the health of the stocks, or the value of the fishery? How can we use what we learn to improve our stewardship toward this finite resource on behalf of the fishermen who live on their bounty and the fishermen yet to come?

Halibut are deepwater dwellers and are harvested down to 400 fathoms, where no light penetrates. Yet it is light that we seek. Back on shore, from Norton Sound to Newport, a colorful community of longliners, trawlers, buyers, brokers, biologists, and bureaucrats gather around the conference table in search of understanding.

ANNUAL MEETING FOCUSES ON TOUGH ISSUES

The 1991 IPHC Annual Meeting convened in Vancouver, British Columbia on January 28, 1991. For four days, the meetings took commissioners and industry participants on an odyssey through international sport fishing protocol, debates about how gear modifications affect overall harvests, and the ongoing struggle over the incidental catch of halibut by groundfish fishermen. It was not an easy meeting. New and proposed limited entry schemes, bycatch problems throughout the halibut grounds, the declining halibut stocks, and our growing understanding of the natural swings of stock abundance together created a pretty spicy agenda for the Annual Meeting.

The Commission received public testimony on these and other issues. They also received recommendations from the Commission staff, the halibut Conference Board (a group of industry representatives), and other agencies before approving the following measures.

Measures approved in 1991

Under the guidance of Chairman Richard Beamish (Canada) and Vice Chairman Steven Pennoyer (U.S.), the Commission approved budgets for the next three fiscal years, wrapped up some other fiduciary business, and approved regulations for the 1991 fishery. A summary of important decisions include:

- The Commission set catch limits and fishing period dates for all areas. Boundaries for regulatory areas remained the same as in previous years;
- A requested catch-sharing plan was approved for Area 2A, as was a set of allocation regulations for the Bering Sea;
- The Commission established a new rule requiring all halibut caught in Area 2A to be landed head on;
- The Commission approved a 1991 budget of $1,721,000 and spent a total of $1,700,000 during the fiscal year; and
- The Commission approved a research budget of $235,000 for 1991, including $50,000 to help fund an observer program for the Canadian trawl fleet.

In addition, the Commission unanimously approved a resolution reaffirming the Commission's commitment to address the bycatch problem. The resolution created a working group to study the measures taken in both Canada and the U.S. to reduce halibut bycatch, and called for a special meeting in mid-year to assess what the working group had learned.

The Bycatch Work Group was created to study measures taken in both Canada and the U.S. to reduce halibut bycatch

Bycatch problems may have overshadowed, but did not overwhelm, a small chorus of other concerns that were brought to the table at the 1991 Annual Meeting. Sport fishermen in British Columbia aired concern that Washington-based charter boats out of Neah Bay, Port Angeles, and nearby ports, cross into Canadian waters with their paying customers to fish. The propriety of this practice was questioned, and the Conference Board requested that the Commission set up a working group to suggest solutions at the 1992 Annual Meeting.

The Commission also recommended a regulation prohibiting crew members on sport charter fishing vessels from retaining any sport-caught halibut. This proposed regulation later was rejected by the U.S. government, however, and was deleted from the IPHC regulations.

SPECIAL BYCATCH MEETING

Perhaps no conflict challenges the North Pacific seafood industry in this decade as much as the bycatch of halibut in other fisheries. Bycatch removes great numbers of fish from the available biomass on which halibut longliners depend. Most of the halibut caught as bycatch in the North Pacific are juveniles intercepted before sexual maturity. Therefore the halibut population is not just losing members, but future fecundity as well. Halibut fishermen are

not the only ones affected; since the North Pacific Fishery Management Council (NPFMC) sets limits on allowable halibut bycatch in the Gulf of Alaska and the Bering Sea, excessive halibut bycatch has previously closed some of the groundfish fisheries before the total allowable catch is obtained. Fortunately, only a small fraction of the $1 billion per year fishery was affected. In the last two years, pot fishermen, longliners, and trawlers, together with the Halibut Commission and federal fishery managers, have grappled with the entangled issue of halibut bycatch.

At this special meeting, held July 22-23 in Seattle, Washington, the Bycatch Work Group reported the various steps each country had taken to reduce halibut bycatch, and also recommended a proposed bycatch level for each country, and ways to reduce overall bycatch. The Commission also heard public testimony on the bycatch issue. By the end of the meeting, the Commission had adopted the following set of recommendations to both the U.S. and Canadian governments concerning bycatch.

Recommendations for U.S. fisheries

(1) The existing package of bycatch regulations, including bycatch caps, should be continued for 1991;

(2) All groundfish fisheries off Alaska should be brought under existing bycatch limits for 1992;

(3) A program to reduce bycatch limits by 10 percent per year should be implemented by 1993; and

(4) The U.S. should develop measures to estimate and control bycatch off the Washington-Oregon coast.

Recommendations for Canadian fisheries

(1) The observer program should be expanded to cover all bottom trawl fisheries;

(2) Research on the viability of trawl-caught halibut in Canadian waters

should be conducted; and

(3) Further bycatch reduction proposals should be developed and presented to the Commission at the 1992 Annual Meeting.

The Commission's accomplishments

- Anticipated reduction in bycatch mortality in U.S. waters by 25 percent by the end of 1993.
- The stage was set for future reductions in Canadian waters;
- Reductions in bycatch mortality will help compensate for recent declines in abundance and allow for a larger halibut harvest by Canadian and U.S. fishermen; and
- The Bycatch Work Group will continue to monitor bycatch and look for ways of reducing bycatch levels to those of the mid 1980s.

In addition to the bycatch recommendations, the Commission also discussed the new Individual Vessel Quota system now in effect in Canadian waters, and the Bering Sea fishing season.

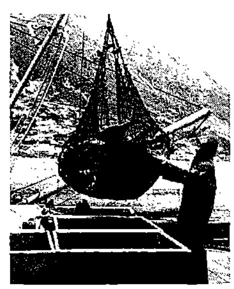
THE INTERIM MEETING

An interim meeting of the IPHC was held November 26, and its agenda focused on a variety of current issues in the fishery. First, the IPHC staff reviewed current stock assessment data, and a discussion followed about including subsistence fishing activities in our storehouse of stock information. Next, the Commission reviewed several issues relating to the 1992 fishery: fishing seasons and period limits, a proposed closure of the Canadian halibut fishery between November 1 and March 31, and the rationale for scheduling a halibut opening prior to the sablefish season off Alaska.

The Commission heard a report from the Halibut Association of North America on a U.S./Russian joint venture halibut fishery operating off the Russian coast. Not much data is available about halibut catches in that area, or about the intermingling of halibut stocks between the eastern and western Bering Sea. The commissioners were concerned not only with the effects of harvests on halibut stocks, but on the increased competition in the marketplace. The IPHC staff was charged to present more information about the effects of this Russian fishery on the U.S. and Canadian industry at the 1992 Annual Meeting.

The Commission heard a report from HANA on a U.S./Russian joint venture halibut fishery operating off the Russian coast

Another topic of considerable concern before the halibut industry is the NPFMC's proposed Individual Fishing Quota (IFQ) system for the waters off Alaska. Though the IPHC has no jurisdiction over NPFMC decisions, the industry looks to the IPHC staff for support data, insight, and information about the potential impact of an IFQ system on the fishery. The Commission's primary concern with an IFQ system is the need for increased enforcement and monitoring, and it was on this topic that commissioners focused when they talked about IFQs. The potential quota system off Alaska is a contentious issue, and it generated long and heated discussions.



Bycatch also gained the floor of the Interim Meeting. The newly formed

Halibut Bycatch Work Group reported again to the Commission. Participants reviewed measures laid out by NMFS for bycatch reduction for 1991 and 1992, and expressed their commitment to helping figure out a way to reduce the incidental catch of halibut in the years to come.

Bycatch and quota systems were not the only meat on the plate for the Halibut Commission. A smorgasbord of other issues kept telephone lines vibrating throughout the year, including season openings and closings, tribal harvests of halibut for ceremonial and subsistence purposes, and the management of the Canadian IVQ fishery.

RETIRED COMMISSIONERS

Gary T. Williamson
Canadian Commissioner
1987 - 1991

Gary Williamson was appointed by the Canadian government to represent Canadian fishermen. Mr. Williamson lives in Surrey, B.C. and operates the fishing vessel *Hanna Lio.*

Dennis N. Brock
Canadian Commissioner
1988 - 1989

Dennis Brock represented the Canadian government and served as chairman and vice-chairman on the Commission. Mr. Brock is an employee of the Canadian Department of Fisheries and Oceans. He was transferred from Vancouver, B.C. to Ottawa, Ontario in 1989.

Director's Report

It is generally acknowledged worldwide that open access to fishery resources is the single leading cause of a fishery's death. By that I mean that the history of fisheries under open access follows a similar pattern: increased competition for fish stimulates an increase in individual fishing power, resulting in overcapitalization, pressure on management agencies to allow more harvest than the stocks will support, major reduction of the stock, and finally the economic collapse of the fishery.

It appears that we may be able to avert this scenario in the Pacific halibut fishery. In 1991, Canada initiated an Individual Vessel Quota (IVQ) system with their already limited fleet. Fishermen are charged approximately 8 cents per pound to cover the administrative and increased enforcement costs. In the first two years this program is experimental and no transferring of quotas is allowed. The system worked extremely well in its first year and experienced a minimum of enforcement problems, probably fewer than with the open access system, although the comparison is not easy since there was much less enforcement effort prior the IVQ system. Canadian fishermen are supplying the market with high quality fresh product and earn $.50 to $1.00 per pound more for their fish. This year a transfer system is under review by the Halibut Advisory Board. Depending on the final design of the system, a further consolidation of the fleet will probably take place.

The open access fishery in the U.S. is also likely to change as the North Pacific and the Pacific Fishery Management Councils move to recommend an individual transferable quota system to the Department of Commerce for approval.

Within five years, it's a good bet that the total halibut fishery will be under individual quotas. The fishery will, for the first time, operate under the free enterprise system similar to how both countries manage their other renewable resources. Since the nation's resources are considered common property, the public has the right to charge rent for their use. The stumpage charged for the right to cut trees on public land, and grazing fees for grazing cattle on public land are examples of rent charged for such resources. Fishing should be no exception. It is not reasonable, in my opinion, to have the general public pay the total cost of management, particularly when they often do not have the opportunity to obtain the product of some fisheries because it is largely exported. If all fishermen were charged $.10 per pound, the 6 million dollars raised would cover the cost of management and enforcement. This also has the added benefit of creating a sense of joint stewardship between fishermen, managers, and scientists.

The competition will still be there, however, not in the search for fish, but in the market place where it belongs. The onus will be on the fishermen to be as efficient as possible and produce the best possible product if they are to be assured a good profit. Since the time constraints will be removed, that should present little problem for innovative fishermen.

The main opposition, over the years, to controlled access systems has been a desire on the part of many fishermen to preserve the particular "lifestyle" they had come to enjoy. In Alaska the maintenance of the "last frontier" lifestyle was intensely protected. However, all things change and Alaska is no exception. All fish species of commercial importance off Alaska are essentially fully exploited (several overexploited). Hopefully fishing will shift its focus from lifestyle to the business of efficiently harvesting the nation's fishery resources.

The limited experience we have from the B.C. halibut fishery is that once the system is changed, fishermen adapt and learn to enjoy the benefits of the new system. I predict that as time goes by and fishermen adapt to the new system it will be impossible to ever go back to open access because of fishermen opposition.

Donald A. McCaughran
Director

A LOOK AT THE COMMERCIAL FISHERY

When the French explorer Count Jean Francois de la Perouse visited the bays and estuaries rimming Alaska in the 1780s, he remarked in his journal on the skill and verve with which native Alaskans went after this fine food fish, the halibut. Two hundred years later this is still true of halibut fishermen. The gear has changed, the fleet has metamorphosed, but skill and verve still rule on deck.

You need to draw the line somewhere

Fishery management is partly about managing fish – and partly about managing fishermen. The first step in fishery management is to draw boundary lines around regulatory areas; the second is to determine how the fisheries will be conducted within those areas.

Ten regulatory areas define the perimeters, and sometimes the personality, of halibut fishing in the North Pacific. Boundary lines, shown in Figure 1, were the same in 1991 as in 1990. The Southeast Flats region of the Bering Sea, south of Area 4E (excluding Bristol Bay) remained closed in 1991 to all halibut fishing.

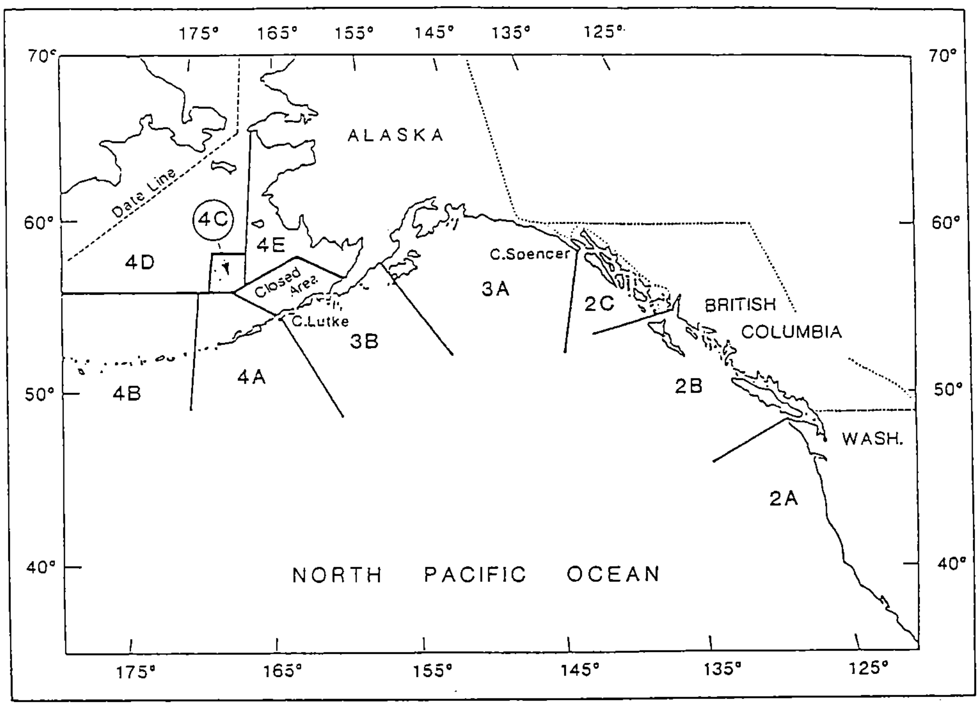


Figure 1. Regulatory areas for the 1991 commercial halibut fishery.

The regulatory areas are:

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 ofAreas 4A and 4B, north and west of Area 4C, and west of longitude 168°00′W.
Area 4E - all waters in the Bering Sea north and east of the closed area, east of Areas 4C and 4D, and south of 65°34′ N.

Rules of the game: 1991 regulations

The harsh realities of declining stocks and increasing bycatch rose up like a returning tide before fishermen in 1991. Catch limits were reduced, as they have been in previous years, and in light of increasing pressure on the fishermen, the IPHC was asked to investigate the effectiveness of enforcement, and to stiffen some regulations that would make it harder for a fisherman to falsify his log book.

Freedom, Robert Frost said, is riding easy in the harness, and so the Commission reaffirmed its policy of remaining flexible wherever possible in establishing and modifying regulations in mid-season. Fishing period limits were imposed when necessary to avoid exceeding the catch limit. Fishing period limits restrict the total poundage of halibut (dressed, head off) that a vessel can deliver during an opening; limits apply to the vessel, not the individual fisherman. Landings can be made in one or several deliveries, as long as the total does not exceed the period limit. Landings over the limit are forfeited, and fishermen could be fined, depending on the extent of the violation. When it appeared that further fishing would shove the catch up over the limit established for that area, the fishery was closed.

Fishing period limits were imposed when necessary to avoid exceeding the catch limit

Appendix I Table 1 summarizes the seasons, catches, and catch limits for 1991. Other regulations – size limits, clearances, etc. – remained the same in 1991 as in previous years.

Catch limits: What we ask of the deep blue sea

Managing a fishery requires equal parts of verve and vision, and so we set limits to prevent overfishing and to ensure the future of the fishery. The total catch limit for all waters of the North Pacific in 1991 was set at 55.2 million pounds, but when all deliveries were accounted for, fishermen actually caught 1.9 million pounds more than that. Still, the 1991 catch was smaller than the 1990 catch by 4.5 million pounds.

Area 2A
Total allowable catch: 450,000 pounds
Actual catch: 495,000 pounds

Pacific halibut are important to the fishermen of Washington, Oregon, and California for many reasons. What is commerce to one fisherman is comestibles to another, and to a third group the halibut represents an important stitch in the spiritual and social fabric of living. Along the Pacific coast, the halibut catch is divided up between commercial, sport, and Washington state treaty Indian fisheries. Each year, groups of managers, technical advisors, and industry participants meet to discuss problems, analyze proposals, and negotiate the catch sharing plan that allocates these important fish among the users.

The total allowable catch of 450,000 pounds for Area 2A was divided into a treaty Indian allocation of 112,500 pounds and a non-treaty allocation of 337,500 pounds. The treaty Indian commercial catch limit was 102,500 pounds, and the remaining 10,000 pounds were used for ceremonial and subsistence fishing; Figure 2 illustrates the breakdown. During periods when the treaty Indian commercial season was closed, the ceremonial and subsistence fisheries were limited to two halibut per day per person.

The non-treaty catch was split fifty-fifty between commercial and sport

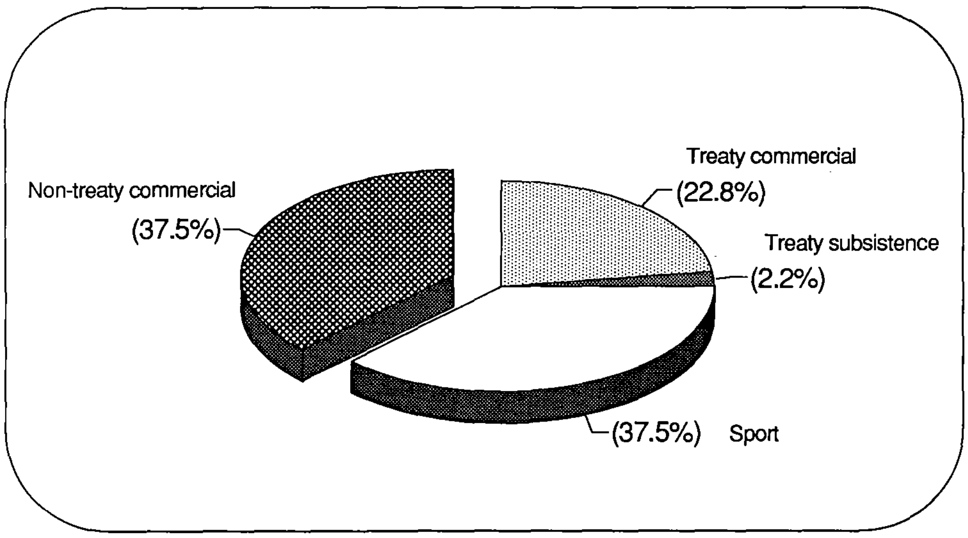


Figure 2. The allocation of Pacific halibut for 1991 in Regulatory Area 2A.

harvesters. Each was given an allocation of 168,750 pounds. The actual commercial catch, including treaty and non-treaty commercial catches, was 355,000 pounds – 84,000 pounds over the catch limit. The non-treaty commercial catch of 233,000 pounds was taken in one 10-hour fishing period. Fishing period limits (ranging from 600 pounds for class A vessels to 12,000 pounds for class H) were implemented but were not strict enough.

The twelve treaty tribes of Washington had two fishing periods. The first was 11 days long and produced 79,000 pounds; the second was three days and produced 43,000 pounds. The treaty Indian ceremonial and subsistence fisheries closed April 14, because the tribal commercial catch of 122,000 pounds exceeded the total treaty Indian allocation. On September 20, the Commission re-opened the ceremonial and subsistence fishery, and through the remainder of 1991 treaty Indian harvesters were allowed to take no more than two halibut per person per day.

Area 2B
Total allowable catch: 7.4 million pounds
Actual catch: 7.2 million pounds

This was the inaugural year for Individual Vessel Quotas (IVQs) in British Columbia's halibut fishing areas. Fishing opened on May 1 in Area 2B and ended November 30. Under the IVQ system each vessel was allowed to catch a predetermined poundage of halibut as calculated by the Canadian Department of Fisheries and Oceans (DFO), based on the 7.4 million pound total catch limit approved by IPHC.

In the first four months of the fishery, vessels harvested about 4% more than they were expected to. The IPHC met by conference call in September to approve a recommendation to both governments that fishermen be allowed to continue fishing until November 30 or until all individual quotas were taken, whichever occurred first. This decision left open the possibility of slightly exceeding the catch limit because of individuals exceeding their IVQ. Though the prospect of overfishing goes against the intentions of the IPHC, commissioners felt that any overage would be minor and that it was important to allow fishermen the opportunity on the grounds until November 30 this first year.

The IPHC met by conference call to approve a recommendation that Canadian fishermen be allowed to continue fishing until November 30 or until all IVQs were taken.

Mother Nature set her own catch limits, however; bad weather and the emigration of halibut to deeper waters diminished fishermen's catches in November, and the total harvest came in 200,000 pounds below the limit.

Area 2C
Total allowable catch: 7.4 million pounds
Actual catch: 8.7 million pounds

The longliners of Southeast Alaska, their legions increased by beleaguered trollers in 1991, caught 8.7 million pounds of halibut in two 1-day fishing periods. A May opening produced 4.8 million pounds, and a September opening 3.9 million. As in Area 2A, fishing period limits (ranging from 1,100 pounds for class A vessels to 15,100 pounds for class H) were not strict enough; the allowable catch was exceeded by 1.3 million pounds.

A portion of the Area 2C catch is taken by the Metlakatla Indians, who fish within the 3,000-foot Annette Islands Reserve boundaries under a treaty with the United States. They caught 61,080 pounds of halibut in 20 fishing days in 1991, and their landings were counted against the total Area 2C catch limit.

Area 3A and 3B
Total allowable catch: 35.4 million pounds
Actual catch: 34.8 million pounds

The Gulf of Alaska is home to so many halibut and so many fishermen that managing everyone requires a loose sense of perfection. Catch limits are set separately for Area 3A and Area 3B, but are managed in such a way that both areas are closed when the combined catch limit of 35.4 million pounds is reached. If one area is overfished, the other goes wanting, and in this way some balance is achieved.

The catch limit was 26.6 million pounds for Area 3A and 8.8 million pounds for 3B in 1991. The Area 3B catch limit was exceeded by 3.1 million pounds in two 1-day fishing periods, one in May producing 4.0 million pounds, and the other in September producing 7.9 million pounds. After those 11.9 million pounds were landed, Area 3B was closed for the rest of the year.

The May and September openings in Area 3A produced 10.8 and 12.1 million pounds, respectively. The Area 3A catch was 3.7 million pounds under the catch limit, but because Area 3B saw a lot of halibut action, the combined Area 3A/3B catch was within 0.6 million pounds of the total catch limit. Such a small amount of fish is too small for another opening even if severe fishing period limits are imposed, so Area 3A was closed for the remainder of 1991.

Area 4A and 4B
Total allowable catch: 3.4 million pounds
Actual catch: 3.8 million pounds

Areas 4A and 4B were also managed under a combined catch limit, with limits set for each area. The catch limit in Area 4A was 1.7 million pounds, but during the 1-day opening in May, fishermen landed only 96,000 pounds (most vessels fished in open areas to the east). However, many boats were expected for the August opening, so the season was shortened from one day to 12 hours. More than 2 million pounds of halibut were landed that half day, and the area was closed for the year.

In Area 4B, a series of 12-hour openings were scheduled in June and July at the request of the NPFMC to encourage participation from local western

Alaska fishermen. On July 13, after six openings, half of the area limit - 900,000 pounds - had been landed, mostly by large non-local vessels. The remaining catch was reserved for the August 19 fishing period, according to an agreement reached at the annual meeting. A large fleet was expected for this opening, too, so the fishing period was shortened from three days to one. Harvests that day brought the total catch up to 1.5 million pounds. This was still 0.2 million pounds below the catch limit, but the total catches of Area 4A and Area 4B exceeded the combined limit by 0.4 million pounds.

Area 4C
Total allowable catch: 600,000 pounds
Actual catch: 680,000 pounds

To encourage halibut fishing among Pribilof Island longliners, the NPFMC required that the IPHC set fishing period limits of 10,000 pounds for Area 4C. The total catch exceeded the limit by 80,000 pounds, and was taken in eight 1-day fishing periods. The area was first closed after the seventh period, but was reopened for a one-day fishery after the initial landings were lower than expected.

Sixteen St. Paul vessels caught only 188,000 pounds, or 28% of the total catch, compared to 35% in 1990. St. George residents did not participate in the 1991 fishery. The remaining 490,000 pounds was caught by 35 non-resident vessels in 68 trips.

Area 4D
Total allowable catch: 600,000 pounds
Actual catch: 1.4 million pounds

We knew the August halibut opening in the Bering Sea would attract a huge fleet of boats, and that pressure would be higher than ever - and indeed it was. The fishing period was shortened from three to two days, but still the fleet of 48 vessels harvested more than double the 0.6 million pound catch limit. This is a difficult area to manage, because if periods are too short, no vessels will participate.

The fishing period was shortened from three to two days, but still the fleet of 48 vessels harvested more than double the 0.6 million pound catch limit.

Area 4E
Total allowable catch: 100,000 pounds
Actual catch: 104,000 pounds

Managing halibut openings is an inexact science, but at least in Area 4E it worked quite well this year. Vessels were limited to a maximum catch of 6,000 pounds of halibut per fishing period throughout the season for all of Area 4E by NPFMC regulations. The catch limit was divided so that 30,000 pounds were to be taken southeast of Cape Newenham in Bristol Bay (4E-SE) and 70,000 pounds were to be taken northwest of Cape Newenham (4E-NW). After August 1, 50 percent of any remaining poundage in 4E-NW would be made available to the Bristol Bay portion.

In the twenty 2-day fishing periods prior to August 1, the catch in 4E-NW was 10,000 pounds, and 60,000 pounds remained. Half of that, or 30,000 pounds, was transferred to 4E-SE. In 4E-SE, a total catch of 25,000 pounds had been landed in three 2-day openings before August 1. Both areas then were opened for 2-day fishing periods from August 1 to August 15. Although

30,000 pounds had been transferred to Area 4E-SE, catch in this area was only 1,000 pounds. August landings from 4E-NW were 68,000 pounds. Thus the combined 100,000 pound limit was taken.

Catches were higher, but fewer played the game

In 1991, 435 Canadian vessels received individual vessel quota shares under Canada's IVQ system. The United States, though, does not restrict the number of vessels that can fish for halibut. This year, 6,072 commercial license applications were processed in the U.S., a 7 percent decrease from 1990. In Alaska, 5,436 people applied for halibut licenses; 231 in Washington; 351 in Oregon and 54 in California. The decrease came from Alaska, where 1990 applications totalled 5,735, and from Washington (317); applications from Oregon and California remained the same both years. Data on actual participation for 1991 are summarized in Appendix I, Table 2.

Hands across the water: The U.S./Russia Joint Venture Fishery

The Iron Curtain may have come down in 1991, but the Ice Curtain between the U.S. and the U.S.S.R. was cracked several years before by the increase in commerce between the two countries. This year, a new U.S./Russia joint venture fishery began operating in the western Bering Sea, within Russian waters. Russian authorities did not limit the harvest, and the operation took between 3 million and 6 million pounds. Because no size restrictions were imposed upon the trawlers and longliners targeting the halibut, many of them were smaller than the legal size limit in Convention waters. Their product was harvested by U.S. vessels and landed at U.S. ports.

The new U.S./Russian joint venture fishery took between 3 and 6 million pounds in 1991

The IPHC and many of its constituents are concerned about the effect this fishery might have on the North Pacific halibut stocks, and on the already challenging job of enforcement. The Commission staff has started to investigate the effects this fishery might have on Pacific Coast halibut management. Our studies continue into 1992.

WASTE WATCHING ON DECK

Coming to terms with waste in the halibut fishery

Left alone, Pacific halibut can live to about the age of forty. Between the hatching and nature's final harvest, though, there are plenty of ways a halibut can meet its end. One of the more interesting was the 74-pounder caught on a home-made Irish Lord fly and an 8-lb. test line at Port Armstrong by Dick deMars in 1990. There are less glamorous endings: halibut are harvested *en masse* commercially and by sport anglers, as bycatch in other fisheries, or perhaps most ignobly, for no use at all.

Waste is what happens when commercial longline gear is lost and its harvest is left to die in the sea, or when sublegal halibut are returned to the water in such bad shape they cannot survive (Figure 3).

The Commission staff learns how much commercial gear is lost or

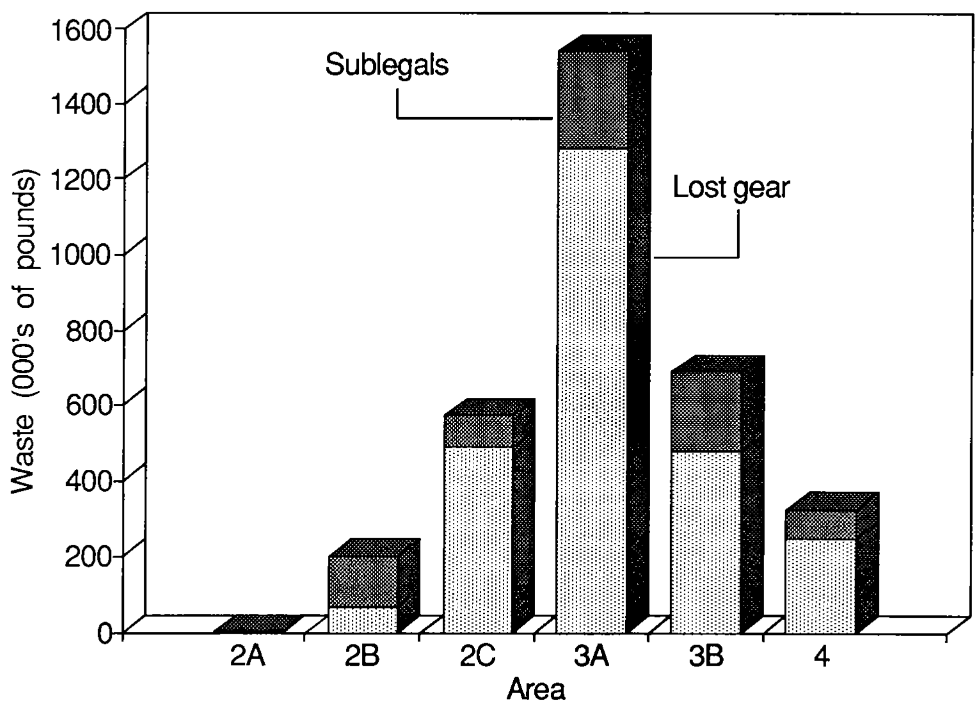


Figure 3. Waste in the 1991 commercial halibut fishery due to sublegal catch and lost gear.

abandoned during the halibut season by logbook data and by interviewing fishermen. The amount of halibut killed by abandoned longlines decreased some in 1990, but increased 26.9 percent in 1991.

One reason 1991 wastes are so much higher may be that waste calculations were done slightly differently than in previous years. Previously, separate haul/loss ratios were used for fixed hook and for snap gear. But after CPUE studies conducted in 1990, it became clear that using the same ratio for fixed hook or snap gear would be preferable.

Let the little guys go

Small halibut, under 32 inches, must be returned safely to the sea. In previous years, we had estimated that 25% of the undersized halibut die as a result of the trauma of untimely harvesting. This mortality rate was based on unobserved longline fisheries for groundfish, gleaned from bycatch studies. In 1991, however, we gained direct information from observers aboard longline vessels in the Gulf of Alaska and the Bering Sea, and re-estimated a mortality rate closer to 16%. In 1991, an estimated 775,000 pounds of undersized halibut were killed in the line of the directed fishery.

In 1991, an estimated 775,000 pounds of undersized halibut were killed in the line of the directed fishery

JIGGING FOR GOLD: THE 1991 PACIFIC HALIBUT SPORT FISHERY

The Pacific halibut was once described by a writer as "weight times energy times wonder of unlimited proportions." Even a well-seasoned angler will stop a moment after catching a halibut and just look at it in amazement - its size, its translucent underbelly that holds such tender meat, at the thin line of nylon that links a deckside human to this mysterious creature from another world. But halibut must be tasted to be believed, and it's a fervor for the flavor, even more than the sport of angling, that drags fishermen offshore every year in pursuit of the king of flounders. As long as there are halibut in the sea, men and women will drop jigs and baited hooks in hopes of introducing one of their kind to the family dinner plate.

". . .I caught this fish while on an experimental fishing permit for Sablefish on Bowie Seamount in April '91. . .One day while my crew was working with the observer doing the sampling and we were drifting around, I decided to throw a Norwegian cod jig over the side and

maybe catch something to eat other than Black Cod. We were in about 30 fathoms and I caught a couple of Yellow Eye Rockfish and on my third try the jig was grabbed by something that felt like a Bull Moose. I had 100 lb test perlon and had to use all the strength I had to fight this fish. I took turns with my engineer and we fought him up to the boat three times before we could get a couple of gaffs into her. That really made her mad and she took off across the surface with the gaffs and the jig hook almost straightened right out, so we knew we only had one more chance. With only one more gaff, one black cod trap hook and some rope all 7 crew were standing by. Fortunately, she was pretty played out when she came in this last time. A gaff and trap hook held the fish while Rob thrust the rope down her gaping mouth and out a gill plate. The boom lifted her aboard. The battle had taken about 2 hours. She was just under 8 feet long and estimated by a couple of halibut length/weight charts at over 400 pounds.. . ."

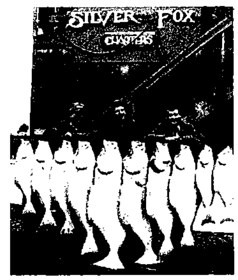
Yours with thanks,
Bob Fraumeni - F/V NOPSA

By the books: 1991 sport fishing regulations

Few changes occurred in sport fishing regulations in 1991. One change, however, stipulated for the first time that any halibut brought aboard a U.S. vessel and not immediately returned to the sea with minimal injuries now must be included in the angler's daily bag limit. Also, charter vessel operators now are liable for any violations of IPHC regulations committed by a passenger aboard their vessel.

In another new regulation, a sub-area of IPHC Area 2A was created between Cape Falcon and the Nestucca River in Oregon. Throughout Area 2A, fishing seasons were adjusted to give fishermen plenty of angling opportunities while staying within the decreased total allowable catch. The season schedule was complex, with several openings and closures, but harvests stayed pretty close to the allocations throughout Area 2A. In all areas, an IPHC license was required for sport charter boats that intended to pursue halibut.

The fish that did not get away: Sport catch estimates



Preliminary 1991 catch estimates are available only for Area 2A. Here, catch allocations are set by an agreement forged by the Pacific Fishery Management Council between commercial and sport fishermen. Recreational catches here were below the amount allowed, except in the Strait of Juan de Fuca and Puget Sound, where catches of 33,789 pounds slightly topped the catch allocation. Catches in the north Washington coast stayed slightly below the allocation of 64,590 pounds. These fishermen did not get skunked, they preferred to motor north into Canadian waters where bag limits and seasons are more liberal.

The newly created sub-area between Cape Falcon and the Nestucca River (Nestucca area) exceeded its small quota, but did offer local anglers plenty of opportunity to fish. The catch off the Oregon coast south of the Nestucca River to the California border (Newport area) was nearly 10,000 pounds under its quota. Inclement weather in late August kept most fishermen off the water, and after Labor Day in September they seemed to lose interest entirely.

In the Gulf of Alaska and Prince William Sound, catches rebounded from 1989 levels, increasing more than 20 percent. This region, Area 3, is by far the halibut fishing center of the Pacific Coast, and was home to more than 60 percent of 1990's sport landings. The Kenai Peninsula - Homer, in particular - draws thousands of anglers each year with nothing but halibut on their minds.

Catches were down about 15 percent in Southeast Alaska (Area 2C) in 1990. The average weight of sport-caught halibut dropped slightly from 21.2 pounds in 1989 to 20.5 in 1990. Area 4 (Bering Sea-Aleutian Islands) catch estimates have been revised to include landings back through 1981. Catches in British Columbia (Area 2B) increased in 1990. Historical landings were also revised in Area 2A with updated catch information provided by the Washington Department of Fisheries.

HOW THE WORLD SUSTAINS US: SUBSISTENCE FISHING IN THE NORTH PACIFIC

Alaska

Halibut are not just commerce and casual sport to the people of the North

Pacific. In some coastal communities, halibut provide the flavor of life itself, tying people to their land and their region. For those who live from the bounty of the land, halibut play an important role as a subsistence fishery.

In a 1990 survey of some Alaska communities, the documented subsistence halibut catch topped 1.2 million pounds. However, not all villages were surveyed, and we estimate the actual subsistence catch of halibut to be higher - possibly closer to 3 million pounds per year. This amounts to 125,000 people in Alaska each consuming 25 pounds of halibut per year. It can be difficult to separate subsistence catch from sport catch in some communities. Therefore, we have estimated the total combined sport and subsistence catch at between 6 and 7 million pounds. These estimates are preliminary and further review is scheduled for 1992.

British Columbia

Subsistence amounts to about 125,000 people in Alaska each consuming 25 pounds of halibut per year.

Subsistence fishing for halibut in British Columbia occurs on a much smaller scale, and here our documentation of the catch is even more sparse. Records show that the native food fishery for halibut between 1985 and 1989 harvested between 135 and 717 fish per year. If these fish weighed an average of 25 pounds, the annual catch would range from 3,375 pounds to 17,925 pounds. Our catch records are incomplete, and some permits that were issued were not included in the documentation. No firm estimates can be made at this time, but we suspect that the native food fishery is about 50,000 pounds per year.

THE TOUGHEST CUT OF ALL: MANAGING HALIBUT BYCATCH MORTALITY

It is an interwoven world we live in: Tug on one string of Nature's garment, and another unravels. In the North Pacific, fishermen, managers and environmentalists are all coming to terms with the passionately interconnected nature of our environment. Fish, marine mammals, sea birds, and humans are all tied together by instinct and intention. In the halibut fishery, the tangled web leads us right to bycatch.

Pacific halibut are inadvertently caught by trawlers, longliners, and pot fishermen intent on other species, and this is called bycatch. Halibut harvested under these circumstances are required to be returned to the sea in good condition, but their survival rate varies widely - depending on the way they were caught and handled - from zero to over 90 percent.

How many die? Changes in discard mortality rates

The best way to calculate bycatch is to look the fish in the eye, and so we rely on observers aboard fishing vessels to count halibut and assess their condition. This year, information from the mandatory NMFS Observer Program off Alaska allowed us to recalculate the mortality of bycatch-caught halibut that are returned to the sea.

Observers assign a condition factor (excellent, fair, and poor, based on pre-established criteria) to each halibut that indicates the probability that it will survive. In 1990, observers examined more than 231,000 halibut in the trawl fisheries, 114,400 halibut in the longline fisheries, and 3,000 halibut in the pot fisheries. Our analysis treated shore-based vessels separately from at-sea processing vessels, though it later became clear that mortality rates were the same for both kinds of vessels.

In 1990, observers examined more than 231,000 halibut in the trawl fisheries, 114,400 halibut in the longline fisheries, and 3,000 halibut in the pot fisheries.

From the observers' data, we were able to revise our estimates of bycatch mortality and better assess how many of the halibut caught as bycatch die, and how many survive. Discard mortality rates in 1990 and 1991 are broken out in Figure 4.

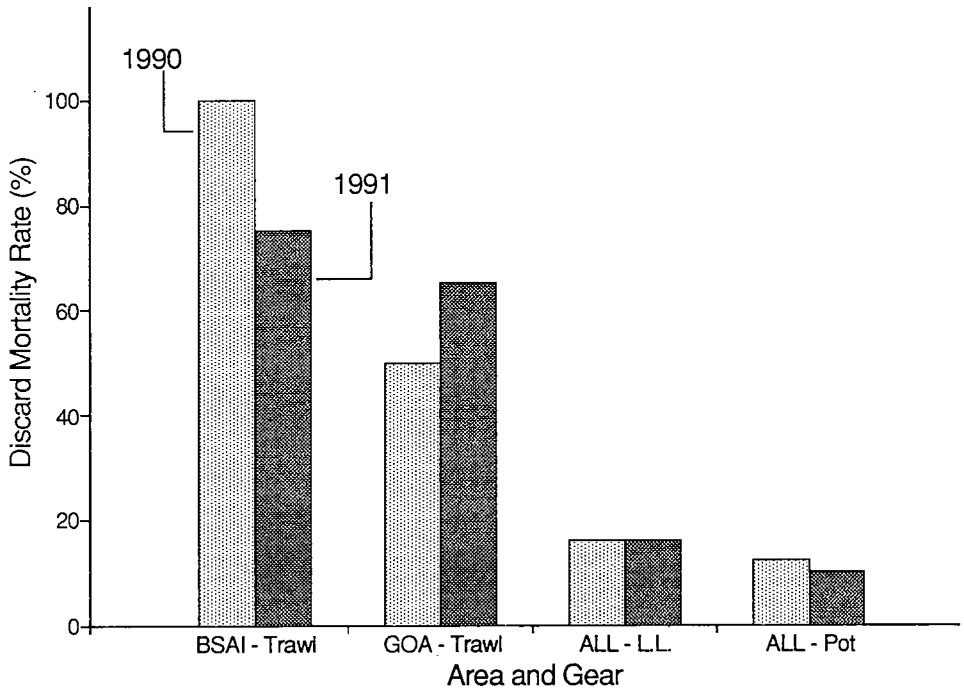


Figure 4. Pacific halibut discard mortality rates for 1990 and 1991, used in Alaskan groundfish fisheries.

In the Bering Sea, bycatch mortality by trawlers was changed from 100 percent, as we had previously assumed, to 75 percent. But trawl mortality was higher than expected in the Gulf of Alaska – 65 percent, as opposed to the previous estimate of 50 percent. And discard mortality for pot vessels decreased from 12 to 10 percent. No changes were made in discard mortality rates for Canadian or Washington-Oregon-California waters.

How can observers tell? The following is a page from the NMFS Observer Manual, which describes the criteria by which an observer judges the condition of a bycatch-caught halibut, and its chances of survival.

NMFS Halibut Viability Criteria

Trawls and Pots

Excellent: No sign of stress.
Injuries, if any, are minor.
Muscle tone or physical activity is strong.
Gills are red (not pink) and fish is capable of closing gill cover (operculum) tightly.

Poor: Alive, but showing signs of stress.
Moderate injuries may be present.
Muscle tone or physical activity is weak.
Gills are red (not pink) and fish is capable of closing gill cover (operculum).

Dead: No sign of life or, if alive, likely to die from severe injuries or suffocation.
Vital organs may be damaged.
No sign of muscle tone or physical activity.
Severe bleeding may occur.
Gills may be pink and fish is not able to close gill cover (operculum).

Longlines

Excellent: No sign of stress.
Hook injuries are minor and located in the jaw or cheek.
No sign of severe bleeding; gills are red (not pink).
No sign of sand fleas.

Poor: Alive, but showing signs of stress.
Hook injuries may be severe, but vital organs are not injured.
Moderate bleeding may be observed, but gills are still red (not pink).
No sign of sand fleas.

Dead: No sign of life or, if alive, likely to die from severe injuries.
Vital organs may be damaged.
Sand fleas may be present (they usually first attack the eyes).
Severe bleeding may occur, gills may be pink.
No sign of muscle tone.

Thanks to the observer program, we will be able to gather much more complete bycatch data every year, to refine the discard mortality rate estimates, and to calculate mortality rates separately for specific fisheries. For example, the mortality rate may be different in the longline sablefish fishery than it is in for the longline Pacific cod fishery. The longer observers are out on the water, the more data they bring home for us to use.

Counting the bycatch

We estimate total halibut bycatch mortality by multiplying actual bycatch by the discard mortality rate calculated from the 1990 data. The estimated 1991 coast-wide bycatch loss of 16.9 million pounds is slightly lower than the 1990 estimated total of 17.5 million pounds. The old discard mortality rates would have figured these estimated losses at 18.5 million pounds in 1991 and 18.0 million pounds in 1990. Thanks to the revised numbers, these 1.6 million pounds can be added to the coast-wide catch limit in 1992.

As in earlier years, the highest bycatch mortality occurred in Area 4, the Bering Sea and Aleutian Islands. Here, halibut bycatch mortality reached 8.7 million pounds in 1991, down from 10.5 million pounds in 1990. In the Gulf (Area 3), mortalities increased from 5.5 million pounds in 1990 to 5.8 million pounds this year. And in Area 2 - primarily British Columbia - mortalities increased from 1.9 million pounds in 1990 to 2.4 million pounds in 1991.

Reductions in recruitment and reproductive losses further down the line are calculated at 1.6 times the actual poundage lost to bycatch

Catch limits are reduced one pound for each pound of bycatch mortality to compensate for reproductive losses. But that is not all the fishery loses. Reductions in recruitment and reproductive losses further down the line are calculated at 1.6 times the actual poundage lost to bycatch. By this method, we figure that the total loss in yield to the longline halibut fishery is 1.6 times the 16.9 million pound bycatch mortality, or 27.0 million pounds in 1991.

Scratching our heads over bycatch

The bycatch problem generated more trauma among longliners, trawlers, and fishery managers in 1991. Groundfish harvesters saw their fisheries shut down when bycatch caps were reached in the Gulf of Alaska and the Bering Sea. Halibut fishermen saw half as much yield loss to the fishery from bycatch mortality as occurs from a whole year of harvesting in the directed fishery. And fishery managers cogitated over incentive programs, time/area closures and other management tools that, in the end, were found to be too small to immediately fix the problem of bycatch in the North Pacific.

The Bycatch Work Group established at the 1991 IPHC Annual Meeting pointed out that bycatch rates are higher now than in the mid-1980s, and are far higher than bycatch rates seen when foreign fishing dominated the U.S. waters of the North Pacific. The Commission and the special working group will continue to monitor halibut bycatch and look for ways of reducing bycatch to the levels achieved in the mid-1980s and shown in Figure 5.

Bycatch started its latest climb in the waters off Alaska in 1986, when overcapitalization of the U.S. groundfish fisheries intensified competition on the grounds. In the past couple of years, management actions taken by the U.S. government have halted the pattern of increasing bycatch in Alaskan waters. Bycatch limits helped. In both 1990 and 1991, bycatch caps were reached and the responsible fisheries were closed down. A mandatory observer program gave us first-hand information about in-season bycatches, and contributed to our overall understanding of the factors that affect bycatch. An individual incentive program for certain groundfish trawl fisheries laid responsibility for high bycatch rates at the feet of the fishermen, who are liable to large fines ($100,000 or more) for exceeding acceptable bycatch rates. In spite of these restrictions, Alaskan groundfish fishermen still were able to harvest nearly 4.4 billion pounds of their target species each year.

Pot and longline fisheries in the Bering Sea, which were not even under bycatch limits before, will be in 1992

Further steps taken in 1991 should reduce bycatch mortality even more next year. Some groundfish trawl fisheries that were not closed when bycatch caps were reached in 1991 will find themselves affected next year. Pot and longline fisheries in the Bering Sea, which were not even under bycatch limits before, will be in 1992. In fact, all groundfish fisheries except for bottom trawling for Atka mackerel and midwater trawl for pollock - both of which have very low bycatch rates - will be included in the bycatch cap program and subject to in-season closure.

NPFMC action in 1991 expanded the incentive program for 1992 to include all trawl fisheries. Though nearly everyone understands the bycatch problem, not everyone is fishing responsibly. It has become clear that most of the bycatch is taken by a few fishermen, and if those individual vessels fished as cleanly as the rest of the fleet, bycatch rates would decrease significantly. If these actions work as planned, bycatch rates should diminish in 1992 and groundfish harvests increase.

Perhaps the most effective bycatch management tool is the incentive program. Using observer data to identify and punish individual fishermen who cause high bycatch rates, or reward those with low bycatch rates, seems to work effectively. The IPHC staff has pushed hard for the incentive concept; without it the groundfish fisheries are reduced to a competition for bycatch. As rates are lowered, more groundfish may be harvested for a fixed bycatch limit, and eventually the NPFMC may be able to reduce bycatch limits.

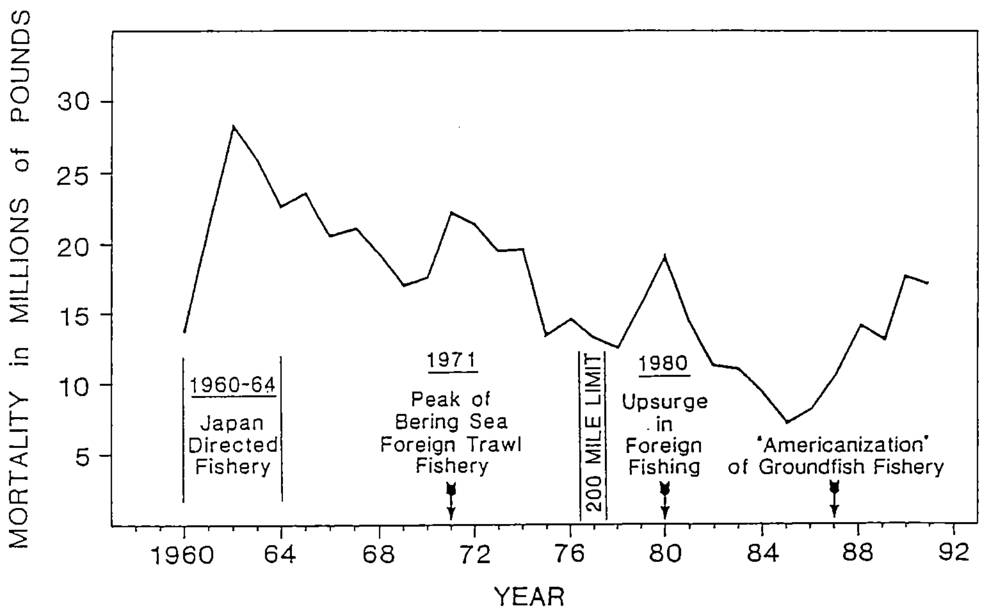


Figure 5. Pacific halibut bycatch mortality from 1960 through 1991.

The Halibut Commission is assisting the NPFMC and NMFS in preparation of a long-term plan for bycatch management that gives on-the-grounds incentives to individual vessels. One concept we have begun discussing is an Individual Bycatch Quota (IBQ), under which each groundfish vessel would receive an allotment of bycatch to be used at the vessel's discretion. Bycatch halibut still would have to be discarded, as they are now. But each vessel would be inspired to decrease bycatch as much as possible in order to keep fishing that year. This approach is a bit of a departure for the North Pacific fisheries; if it is approved for analysis by the NPFMC, its pros and cons will be scrutinized and, no doubt, debated loudly.

Coaction in Canada: We also struggle with bycatch

Department of Fisheries and Oceans (DFO) is researching bycatch rates in Canadian waters, and how best to work with the Canadian groundfish fleet to reduce unnecessary losses of halibut. In the meantime, a voluntary pilot observer program is in place in the British Columbia trawl fleet, funded jointly by DFO and the IPHC at a cost of $120,000. Also in this program, observers estimate halibut bycatch by numbers, determine halibut condition on the trawl deck (dead or alive), and document catch composition.

Unfortunately, there were not enough funds to cover the entire British Columbia fleet. Second best was to concentrate on two areas of the coast - Hecate Strait and the lower west coast of Vancouver Island. Our previous studies showed that the fisheries in these two areas have the highest incidence of halibut bycatch of any trawl area in British Columbia.

The 1991 observer program was limited for a number of reasons, primarily inadequate funding and the voluntary nature of the observer program (vessels were not required to carry observers on board, and paid some of the expenses). So some sampling opportunities may have been lost, some of the data skewed, and a full perspective on the bycatch picture in British Columbia is yet to be painted. However, cooperation between the trawl fleet, the observers, and fishery managers allowed everyone to do the best they could.

POPULATION ASSESSMENT

THE PRIVATE LIVES OF PACIFIC HALIBUT

Pacific halibut stock assessment is truly a survey on the run. Halibut conduct their private lives in the dark folds of the North Pacific ocean floor, and we can never know enough about what fantastic forces determine their health and behavior. Yet, over the past 67 years, we have accumulated an intimate knowledge of halibut stocks off our shores, and have learned enough about these populations and their environment to paint a careful picture of their future.

Fish stocks are estimated by analyzing catch-at-age data from each area and figuring in catch per unit of effort (CPUE), and average weight of the fish. From this we can learn something about the size of the stocks out there, what proportion of each community is made up of different year classes, and the general upward or downward trend in the population. From this data we estimate the exploitable biomass – in other words, the amount of fish available for harvest.

Conservative management dictates that we harvest only about one-third of the exploitable biomass. So the constant exploitation yield (CEY) is determined as a fraction of the exploitable biomass, or 0.35. From that figure we subtract fish taken by sport catch, as bycatch, by subsistence users and also the fish lost as waste. The remaining figure gives us a recommended allowable commercial catch of Pacific halibut.

STOCK ASSESSMENT 1991: COUNTING THE VOTES

From our stock assessments, we believe the total exploitable biomass of Pacific halibut in 1991 to be 262.6 million pounds. This level is higher than previously estimated, but our methods of assessing the stocks have refined in recent years, and we now believe halibut populations to be a little higher than we thought. This 262.6 million pounds represents an overall decline in biomass this year of 10 percent, a rate similar to the 5-10 percent declines we have experienced in previous years. We believe that the stock is well above its sustainable level, given its past abilities to reproduce and sustain itself. Therefore, it is not surprising for us to expect a continued decline over the next several years.

Figure 6 shows the trends in exploitable biomass for the coast-wide halibut stock. There was no change in the estimated exploitable biomass in Area 2A, it declined 6-7 percent in Areas 2B, 2C and 4, dipped 11 percent in Area 3A, and dropped 21 percent in Area 3B.

Recruitment of 8-year-old halibut appears to have remained steady or increased this year in all areas.

When a young halibut grows large enough to exceed the harvest limit of 32 inches, usually around the age of eight years, it is said to be recruited into the fishery. Recruitment of 8-year-old halibut appears to have remained steady or increased this year in all areas. This year's 14-year-old year class, which recruited strongly as 8-year-olds in 1985, every year makes a smaller appearance in the fishery. The lower recruitment of recent years indicates that the stock will continue its decline at a rate of about 5-10 percent per year for the next several years. However, if recruitment continues to improve, as it did this year, then the halibut population should begin to stabilize.

Areas 2A and 2B show a downturn in CPUE over last year's slightly higher values, while Area 4 shows an increase. All other areas show little change.

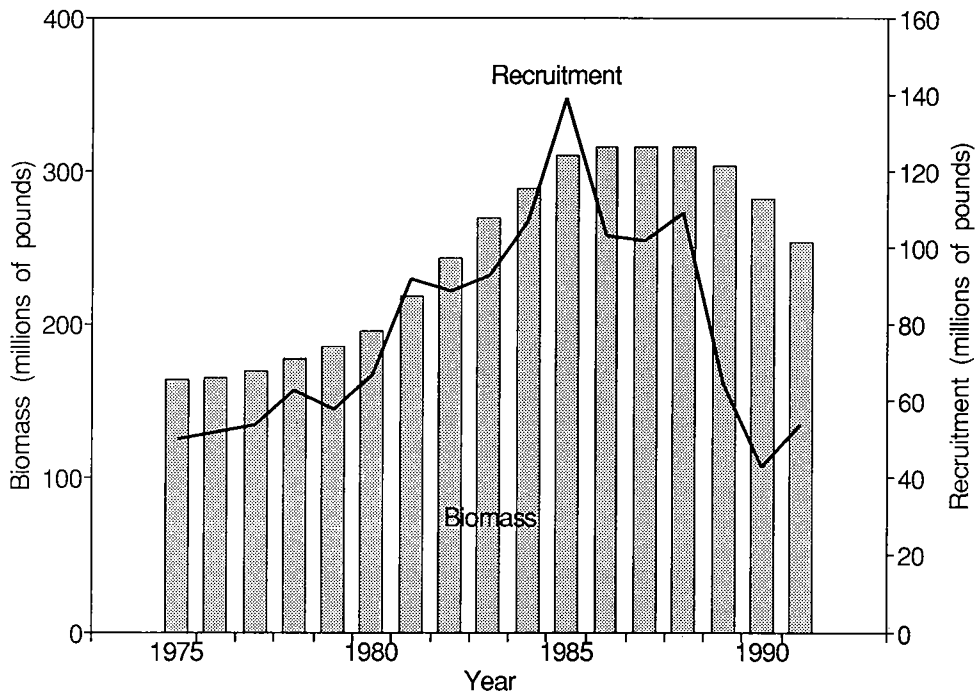


Figure 6. Stock biomass and corresponding recruitment of Pacific halibut for the years 1975 through 1991.

Good news: Our vision improves every year

Each year, in addition to estimating the current year's stock levels, we also adjust our estimates for previous years using the information we have learned since they were made. As our studies continue and we collect more accurate data about activities of previous years, we can refine our picture of historic bycatch, waste, and sport catches. These numbers are overlaid upon our increasing understanding of the natural variability of the stocks, and bit by bit our vision of the dynamic Pacific halibut stocks becomes clearer. This is why, if you compare our stock numbers from previous years to those we publish this year, they might be different. It would also explain why, in some areas where stock abundance may be declining, the allowable catch is increasing. We keep learning about the past, and use that knowledge as a stepping-stone to the future.

THE RISE AND FALL OF HALIBUT AVERAGE WEIGHTS

The average halibut caught in the commercial fishery is between 8 and 14 years old. So the size of the exploitable biomass depends on how many 8-year-old recruits have entered the fishery in recent years, and on the average weight of fish in the exploited age groups.

The average weight of halibut in the different age groups has gone through at least two major changes in this century. There was a dramatic average weight gain in the 1950s and 1960s, amounting to as much as 50%. Average size appears to have peaked in the 1970s and then decreased steadily during the 1980s. Both the increase and the recent decrease were much larger in Alaska than in British Columbia.

Average size appears to have peaked in the 1970s and then decreased steadily during the 1980s

These days, halibut off Alaska are about 10 cm smaller at each age than halibut of the same ages in the late 1970s. This is about a 10 percent drop in size, and a 35 percent drop in average weight. In other words, halibut now weigh about the same as they did before the upsurge in average size at age in the 1950s. The decrease in the average size of recruits may be due to a change in early growth, or in migratory behavior, or in gear selection.

OTOLITH SIZE AND BODY SIZE

Since 1933, the IPHC staff has collected otoliths from the commercial landings to determine the age composition of the catch. Otoliths are the unauthorized biography of a fish - tiny earbones that reveal the age, life history, and other personal information about the fish, the way a ringed cross-section of a tree tells stories about its past. Until 1962, fish were measured when the otolith was taken.

We soon realized that we could predict the size of a fish by measuring the size of its otolith. However, from time to time thereafter, the staff noticed occasional discrepancies between the sizes of fish measured in research projects and the sizes predicted from the otoliths. In 1989, we gathered a large research collection to investigate the otolith size-body size relationship, and we found that the relationship had changed considerably during the 1980s. Specifically, while average body weight (estimated from body length) at each age had decreased during the 1980s, the average otolith weight at each age had hardly changed at all.

In 1991 we resumed routinely measuring halibut at the time the otolith was collected. Now port sampling is a little slower and more tedious, but it provides better information from which to estimate the size of the exploitable biomass. This information has also allowed us to correct previous biomass estimates from the 1970s and 1980s. These corrections in past average weights, and the use of average weights determined for 1991, are among the improvements made to the stock assessment this year.

SHOULD THE SIZE LIMIT BE CHANGED?

In 1973, the IPHC set a commercial size limit of 32 inches (81.3 cm) on the basis of a growth schedule estimated by staff biologist R. J. Myhre. His growth schedule showed the actual size-at-age reflected in setline catches at that time, when size-at-age was larger than it is now. Females and males were not distinguished in his estimate, so the schedule in effect represented an average of female and male growth.

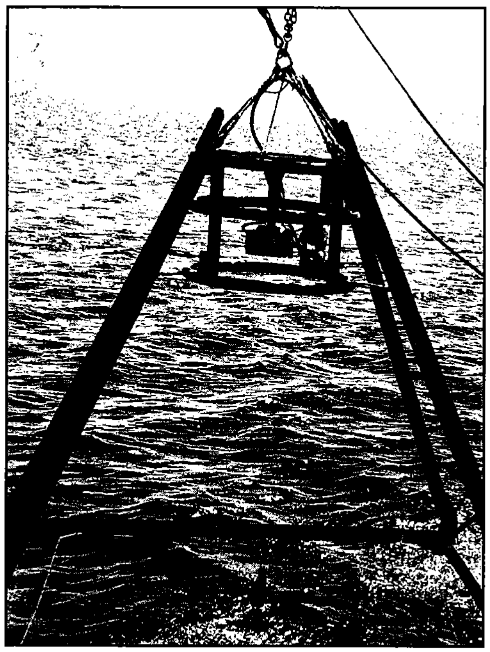
Mean size-at-age is similar for all areas in Alaska, but in Canada and the U.S. West Coast (Areas 2A and 2B), older fish are considerably smaller than in Alaska.

Average halibut weights have declined since then, and we now wonder if the size limit is too high. Recent data indicate that Myhre's growth schedule overstates average size in all areas. Mean size-at-age is similar for all areas in Alaska, but in Canada and the U.S. West Coast (Areas 2A and 2B), older fish are considerably smaller than in Alaska. In view of the different growth schedules of females and males, and the large variation in length at all ages, it is possible that in the southern areas a sizable proportion of males and some females are effectively excluded from the fishery by the 32-inch size limit. If so, the exclusion of these fish may partly account for the failure of Area 2B to recover to the levels of productivity (15-20 million pounds per year) that it maintained for decades during the middle of this century.

In 1992, the IPHC staff will conduct a detailed re-evaluation of the size limit in all areas. The recommendations for a size limit change will be presented at the 1993 Annual Meeting.

EAVESDROPPING ON THE UNDERWORLD: UNDERWATER VIDEO TELLS US HOW HALIBUT LIKE LONGLINE GEAR

Some of the most revealing studies of halibut behavior have come out of underwater video projects that allow biologists to watch these kings of flatfish in their own habitat. First, we wanted to study how the fish respond to baited circle hooks. In these tests, we watch for two things: the frequency with which hook attacks result in fish capture (the "hooking success"), and the probability that a fish will steal the bait from the hook without being caught. The IPHC chartered the Canadian vessel *Clipper II* for two weeks in mid-June to deploy the camera equipment in southern Hecate Strait in British Columbia.



We mounted the camera onto a pan/tilt unit within a cylindrical aluminum cage about 3 feet in diameter. This cage was attached to a 9-foot square steel frame by four 10-foot aluminum legs. With the whole setup resting on the sea floor, this resulted in the camera looking down at 6 baited hooks attached to a groundline suspended within the square frame. The gear was dropped 60 times during the charter at depths ranging from 9 to 96 fathoms. Of these deployments 54 were successful, the remaining six experiments were foiled by problems with visibility, gear stability, or operation of the camera system.

Thirty halibut volunteered for the video experiment, and six of them actually took the salmon-baited hooks (one went after it twice). The halibut generally would swim around the bait, or would lie beside it a while, though there were cases when a halibut just inhaled the bait as it swam past, and was hooked suddenly. Halibut tore into the salmon fairly quickly without stopping to chew or taste the bait; those that were caught were hooked right away.

Halibut tore into the salmon fairly quickly without stopping to chew or taste the bait; those that were caught were hooked right away

Though many of the fish ignored the setup altogether, approximately 85 percent of the fish that went for it were successfully hooked. Though well hooked, one of the halibut did escape when it pulled the snap loose from the groundline. When last seen, that halibut was swimming out of the camera view with the gangion, timer, and snap trailing behind it.

Other species take the bait

One of the objectives of the 1991 experiments was to determine how often dogfish steal bait off the hook. By observing the stomach contents of dogfish in earlier studies, we know that they are adept at stealing bait without getting hooked; we saw one dogfish that had three baits in its stomach. Our best estimate of bait stealing frequency would be 4/80, or 0.05.

We filmed more than two hundred dogfish during the camera trials, most of them during the last few days of the charter. The *Clipper II* had moved to a shallow bay where dogfish were abundant and made repetitive sets on the same 9-fathom location while tied to pilings. A dogfish typically would approach the bait and, still moving, swim with the bait in its mouth, biting or chewing the bait. When the hooked dogfish was restricted by the length of the gangion, it would make rapid darting movements for one to six minutes. This activity apparently created a feeding frenzy response in other dogfish in the area, and they would gather around for a few minutes before disseminating again. After a few minutes of inactivity, the pattern would repeat.

Salmon chunks on a circle hook are attractive to other species as well – the quillback rockfish and the sunstar, for example. Quillbacks, though captured only four times, were frequently seen nibbling at the baited hooks. Although some baits would be constantly under attack by these rockfish, they were seldom captured and the baits on retrieval showed little or no marks from their nibbles. Large circle hooks do not seem to capture many quillback rockfish.

Sunstars presented a more disturbing problem. These ten-armed yellow creatures were common at the shallow site chosen for the dogfish observations. During 31 sets of the camera, fishing 186 hooks, 28 hooks were covered by sunstars when the gear was pulled. What we could not see from the surface, but could see with the camera, was that a total of 62 hooks – one out of every three fished – was covered by a sunstar while lying on the bottom. The gear at this site was only retrieved through nine fathoms of water, and yet half of the sunstars either remained on the bottom or fell off during retrieval.

LEARNING UNDERWATER: HOW DO HALIBUT RESPOND TO TRAWL NETS?

While IPHC staff looked closely at how halibut behave in the presence of a trawl net, an industry flummoxed by bycatch problems watched this project just as carefully. Biologists, fishery managers, longliners, and trawlers alike hope these underwater observations will provide some clues about how to reduce bycatch of halibut in the trawl fisheries. One possible way is to modify the net to catch fewer halibut, or to allow those that are caught to escape.

Little is known about how halibut behave as a trawl net combs through its habitat. In1990 the IPHC purchased a third-wire underwater camera system to film halibut in bottom trawls, and from September 9 to 30, 1991, we conducted the third research cruise with the underwater gear.

For this cooperative project, NMFS chartered the Kodiak-based trawler, *Royal Baron*. As is expected in Alaska, poor weather, gear changes, and equipment breakdowns reduced the number of days available for fishing to 10, resulting in 35 viable tows. Fishing was generally conducted in depths of 35 fathoms or less, although on one occasion the net and camera reached 50 fathoms.

We aimed for grounds frequented by halibut and Pacific cod, because a major portion of the halibut bycatch in Bering Sea and Gulf of Alaska trawls is caught in fisheries targeting on cod. We wanted to observe the differences between halibut and cod behavior during the trawl fishery. We also wanted to watch several specific locations in the net. Nor'eastern Trawl Systems (NETS), of Bainbridge Island, Washington supplied an experimental net in which the codend was fitted with an escape panel.

We wanted to observe the differences between halibut and cod behavior during the trawl fishery.

Researchers, managers, fishermen – there are few in the halibut or groundfish fisheries who are not interested in results from this project. Generally, the 1991 cruise was moderately successful even with its problems. Underwater visibility was excellent, and the camera provided clear pictures as deep as 45-50 fathoms without artificial light.

The camera system worked reasonably well, though it challenged our patience at times. We learned the value of the protective cage; it paid for itself when it was struck by the propeller and still protected the camera unit. Picture clarity was quite good, providing good views of the fish and gear. Halibut were easily spotted by the darkened appearance of their tail, in contrast to other flatfish.

Several problems hampered the cruise somewhat. Concentrated schools of cod were hard to find,and we were forced to fish on flatfish more than we desired. Weather was worse than expected and allowed fishing on only about half the available days. It was harder than we had expected to measure distances between fish and the net, and the gear itself became a frustration at times. Perhaps the most critical problem occurred when the cable was cut by the propeller, and had to be field-spliced. The integrity of the cable never seemed to recover, as we were plagued by electrical shorts for the remainder of the cruise. Additional hardware problems occurred in the pan/tilt unit, monitor, and connectors.

The learning curve may be high on a project of this kind, but the information generated from each cruise is invaluable to the industry. Copies of the videotape of these underwater observations were distributed to gear designers, trawlers, and others interested in applying its results toward a technical solution to the bycatch problem.

Setting the underwater agenda

In addition to NETS, the staffs of IPHC and NMFS proposed several projects for the cruise. Following is the final agenda for the study, in order of priority:

(1) Observe the escape of halibut and other groundfish when the footrope is positioned above and/or behind roller gear;

(2) Examine the ability of halibut and groundfish to pass through a section of long lines running lengthwise and located in the trawl belly, i.e., between riblines immediately behind footrope. This project is an attempt to

simulate the catching characteristics of pelagic trawls as currently defined by NMFS;

(3) Observe the potential of a codend bottom chute to sort halibut out of the net;

(4) Use a grid in the intermediate to determine the reaction of halibut to a sorting mechanism as they pass through the intermediate;

(5) Compare day and night behavior of halibut;

(6) Examine the herding characteristics of the sweeplines;

Early results: Some modifications do help

While NMFS is still compiling its final analysis of results from this project, we can provide a general discussion of the information we gained. Results from projects 1 through 4 are below; we were not able to conduct projects 5 and 6 because of equipment failure or lack of time.

Project 1: Moving the footrope - This proved the easiest to conduct, although it was harder than expected to determine the height of passage over the footrope. We strung a line across the net mouth roughly three feet above, and in front of, the footrope. Unfortunately, the line often became entangled with the footrope, which probably lowered its height. Nonetheless, most halibut generally passed below the line, whereas cod and other roundfish passed above. Larger halibut passed above the line more frequently than small halibut. The final analysis from NMFS should tell us the proportion of halibut that passed above and below the line.

Project 2: Imitating a pelagic trawl - We strung lines the length of the trawl belly in an attempt to determine differences in fish behavior in the net belly. As in project 1, the lines frequently became entangled, even to the extent of constricting the throat of the net. The lines were adjusted several times, but we were unable to get them aligned to our satisfaction. Mud clouds passing through the net confounded our ability to view fish behavior on camera. In general, our approach may not have provided the necessary observations to answer the questions raised about the pelagic trawl definition. As in project 1, the NMFS analysis should provide more useful conclusions.

Project 3: A halibut excluder chute - NETS provided an experimental net for this project. With the help of the NETS Kodiak manager, we fished the net for two days and scored good catches of cod and halibut. This project probably was the most successful application of the underwater video.

The camera was positioned to monitor the location of fish passage through the grid

Project 4: Underwater sorting - We created a grid consisting of a square frame of aluminum tubing with rope strung from one side to the other. The grid was placed at an angle, slanting either up or down, in the intermediate. The camera was positioned to monitor the location of fish passage through the grid. However, the mud cloud kicked up by the footrope made it difficult to observe anything but the largest fish.

Most fish were hesitant to pass through the grid, preferring to swim in front of it. Some flatfish would lie on the grid itself and not even pass through. Skates would partially block the grid; large skates would block the grid completely. In addition to the mud cloud, continuous problems with the cable or pan/tilt unit of the camera also hampered this project. It is doubtful that the observations collected will be useful in determining whether a sorting device causes changes in behavior.

EATING ON THE RUN: HOOK TIMER TESTS CONTINUE

Hook timers are little clocks that are tripped when a fish gets hooked, to indicate the amount of time that has elapsed between hooking and gear retrieval. The devices were designed by David Somerton of NMFS and produced at the Applied Physics Laboratory of the University of Washington. The IPHC has conducted research with hook timers for the past three years. The results from timer trials are input into a model of the relationship between fish density and CPUE.

Our experience in 1990 taught us that, though the basic design of the hook timers was satisfactory, many of them did not perform well due to quality control problems in their construction. All timers were tested in the office and construction defects were fixed prior to the cruises.

We conducted two hook timer research cruises, one in Area 2B aboard the Canadian vessel *Ocean Viking* between May 29 and June 21, and the other in Area 3A aboard the Kodiak-based *Big Valley* in early August. We hoped to learn about the pattern of bait removal through time, and the species composition in the longline catch.

Parallel to the hook timer trials, an underwater video camera, capable of operating in very low light conditions, was used to make direct observations of fish behavior to baited circle hooks. The Canadian vessel *Clipper II* was chartered for two weeks in mid-June to deploy the camera equipment in southern Hecate Strait in British Columbia. All hooks fished were rigged with hook timers in order to give a visual verification of their operation. Observations made with the camera are used to estimate the frequency with which fish attacks result in fish capture, the "hooking success", and the probability of bait stealing for major species observed during hook timer trials.

Although the total number of halibut observed interacting with the baits was small, results indicate that hooking success is very high, and that all halibut trip the timer when they are hooked. Dogfish, instead, have a much lower hooking success. Eighty dogfish were observed interacting with the bait, half of which were caught. Only in a few cases, dogfish that escaped took the bait with them. Most of the dogfish that were caught tripped the timer.

IDENTITY RUNS DEEP: CAN WE IDENTIFY SEPARATE STOCKS BY THEIR DNA?

In 1990 we began to study the DNA of halibut to see if we could identify separate stocks from the genetic name tags nature provides. This year, the IPHC staff sent several samples of refrigerated halibut blood to Therion, Inc. for processing. Unfortunately, these samples had degraded due to the antibodies present in halibut blood. As a result, other types of samples were considered. During the summer, frozen blood samples as well as fin and tissue samples were evaluated for viability. Samples were taken on board both the *Ocean Viking* and *Big Valley*. The tests showed a variety of results, which we are still analyzing. Frozen blood and fresh fin samples provided the most informative data.

To make usable collections, samples must be taken during winter months when halibut gather back at their spawning grounds. (Otherwise, if samples are taken in the summer, both the fish and the larvae will have dispersed, creating a homogeneous population in which group distinctions would be hard to measure.) Because halibut cover such a large geographic region, samples will be taken from the extreme ends of the region first - that is, from the Russian and American Bering Sea areas, and from lower British Columbia and Washington. If the results from these samples prove informative, we will begin a more intensive sampling scheme in the winter of 1992.

WE ALL FEED ON EACH OTHER: A STUDY OF PARASITES AND PACIFIC HALIBUT

As we gain understanding of the delicate plexus of life around us, one thread of research leads to another. In late 1990 the IPHC began a study of the significance of the parasites found in Pacific halibut. By exploring these parasites and their effects on halibut - potentially on humans as well - we hope to learn more about the complexity of factors that affect halibut flesh quality, the health of the fish themselves, and the myriad of other clues parasites can tell us about the hosts in which they make their homes.

The study, a cooperative project involving the IPHC, DFO, and the Department of Zoology at the University of Alberta, focused on five objectives:

- to survey the Pacific halibut for all kinds of parasites;
- to clarify the taxonomy of those parasites;
- to identify possible halibut or human pathogens;
- to identify parasites that have an impact on flesh quality and marketability of halibut; and
- to assess the value of parasites as indicators of halibut stocks or migratory pathways.

By October 1, 1991, approximately 100 fish had been examined. Samples of immature (4-7 year old) fish from three localities in the Gulf now have been completed and a fourth from off Washington is being processed. Data from other samples taken from localities, ranging from Oregon to the Bering Sea, are being analyzed.

So far, we have identified 29 parasite species, each of them found in low intensities

So far, we have identified 29 parasite species, each of them found in low intensities. Of these different species, 14 are found in the digestive tract, five occur in various organs, four occur as ectoparasites, five live in the body cavity or in mesenteries (the membranes surrounding internal organs), and one lives solely in muscle tissue. Of the body cavity parasites, two species may migrate into the flesh, especially upon the death of the host. Three species are nearly ubiquitous. Identification of the parasites is still underway.

The majority of digestive tract parasites are trematodes (small 5-10 mm oblong worms that attach to the inside of the intestine using suckers) that are commonly found in a variety of marine fish. There is little evidence that these or the other digestive tract parasites cause significant harm to the fish (with the possible exception of massive infections). The same may be said for most of the other species. Relatives of *Aporocotyle* sp., a relatively uncommon blood fluke inhabiting the blood vessels in the gills of halibut, have been shown to harm other species of fish. *Anisakis simplex,* the most common of the body cavity parasites, may cause damage during the post-mortem migration into the flesh.

A. simplex, along with *Pseudoterranova decipiens,* encapsulates in muscle tissue around the body cavity. These parasites cause concern because they are capable of infecting humans who undercook or improperly freeze parasitized halibut. *Kudoa thrysites,* a muscle-dwelling protozoan, is of interest because it changes the quality of the flesh, producing a milky texture, if the fish are not frozen soon after landing.

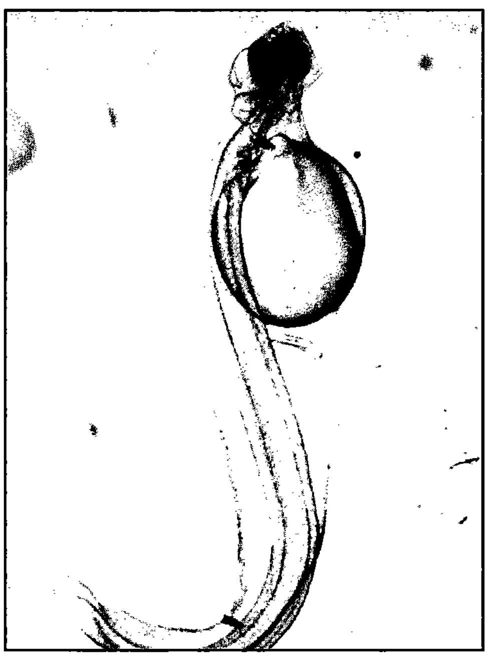
From comparisons of the samples processed so far, we have learned that the species of parasites that inhabit halibut may depend largely on the local conditions in the fish's habitat. Halibut in neighboring regions seem to have similar parasite problems, even similar percentages of the different species. A brief comparison between samples of adults and immatures from a locality off Washington shows that parasites seem to afflict all ages and sizes of both 4-7 year old and adult fish similarly, but may differ among areas.

A brief comparison between incomplete samples of adult and immatures from a locality off Vancouver Island show the parasite communities seem to afflict all ages and sizes of fish similarly, but change with area.

One of our primary objectives was to determine if parasite information could tell us anything about stock differentiation among the halibut. Not enough samples have been analyzed to produce any definitive data, but we are hopeful that we can discover some parasite tags that will help us identify separate stocks, or match fish with their geographic origins, in the future.

BABYING THE BROODSTOCK: IMPROVEMENTS IN PACIFIC HALIBUT CULTURE

One way to gain respect for the petulance and puissance of nature is to try to replicate conditions close enough to nature's own to grow a healthy halibut from scratch. The IPHC and DFO have struggled for three years to culture Pacific halibut at the Pacific Biological Station at Nanaimo, British Columbia. The primary objective is to figure out what conditions are required to spawn high-quality eggs from captive broodstock and to incubate and rear those eggs beyond the metamorphosis stage into viable halibut.



At the beginning of the year, nine male and two female halibut were on hand, having been captured in 1987, 1988, and 1989. Researchers tried to induce spawning by injecting the hormone LHRH, beginning in late January. However, water temperatures at this time were approximately 9°C, warm enough to prevent ovulation. By mid-March, water temperatures dropped below 8°C and ovulation began spontaneously and continued until early April.

This was the first time there was multiple spawning of captive halibut at the Pacific Biological Station – a breakthrough for the project. (In 1989, a single batch of just over 5,000 eggs had been obtained by means of hormonal induction.) In cooperation with Drs. W. Dickhoff and R. Stickney of the University of Washington, blood samples were collected periodically from the brood fish and frozen for later analysis of sex steroid levels to help clarify the reproductive cycle.

Researchers at the Station collected eight batches totalling 78,000 eggs from the first female, and eleven batches totalling 248,000 eggs from the second female. The fertilization rate for the various batches ranged up to 88 percent, but many showed signs of abnormal development at epiboly (an early stage of larval development) and mortality increased sharply one week after fertilization.

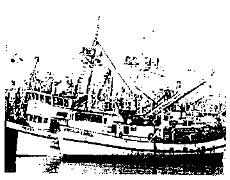
In July, a new insulated 12-foot tank was installed and supplied with refrigerated seawater. In mid September, additional broodstock were collected, and eleven newly captured halibut were placed in the new broodstock tank in waters of about 9°C. Fifteen fish were placed in a separate tank filled with 12°C seawater, and nine died within ten days.

Life grabs the larvae

Just what conditions are optimum for halibut larvae growth? And what is the normal larvae growth rate? Information from the experiments outlined above, and research conducted at the University of Washington, revealed that the best temperature range for hatching is between 6°C and 8°C. Temperatures higher than 9°C were lethal. Salinity did not affect hatching as much as temperature, as long as eggs were floating during the incubation period.

Light intensity is also important. The larvae seemed to do well in moderate light intensity, but high intensity light and red and blue light produced frequent abnormalities in the larvae. Other experiments with moving unfertilized eggs demonstrated that the eggs can be safely transported during the first 12 hours after collection with low mortality (8.3%) and high subsequent fertility (92.3%).

Samples of halibut eggs collected in the wild have led some biologists to theorize that development occurs near the seabed and others, alternatively, to speculate that they develop well up in the water column. The University's study should help resolve these conflicting theories and should help culturists provide the best environmental conditions for egg development and hatching.



GETTING PERSONAL IN 2A: DO HALIBUT SPAWN OFF THE OREGON COAST?

One question that has posed a mystery to managers and biologists for years is whether or not halibut spawn off the northern Oregon coast. Early reports from fishermen suggest that halibut may spawn seaward of Destruction Island, along the edge of the continental shelf off the northern Washington coast. And, of course, we know that halibut spawn north of there, off British Columbia and Southeast Alaska. However, no spawning activity has up to now been documented off the Oregon coast. Still, some preliminary results from our 1989 tagging experiment off central Oregon suggest that some halibut may be migrating to deep waters (200-250 fathoms) to spawn along the edge of the continental shelf west of the Oregon coast during the November-April spawning period.

Preliminary results indicate that some halibut migrate to deep water to spawn along the edge of the continental shelf west of the Oregon coast.

Many of the tagged halibut caught during the 1989-90 and 1990-91 spawning periods off the Oregon and Washington coasts were large enough to be sexually mature. This data brought the spawning question to the forefront. In early 1991, IPHC began studying the developmental stages of halibut gonads that were taken from larger individuals captured off Oregon. By classifying the ovaries according to their developmental stage biologists could conclude if any halibut spawning occurs in this area. Since the tagged halibut in question had been incidentally caught primarily by trawl gear, it was judged appropriate and economically preferable to trawl for the needed specimens.

A Newport-based trawler was granted a halibut possession permit for January, February, and March, 1991, to land incidentally caught halibut larger than 45 inches (114 cm) in length. This length threshold was chosen to ensure that a majority of the fish collected would be mature females, assuming that a number of them would have remained in the area for spawning. Male halibut, which mature at a smaller size than females, were not needed in this collection because it was presumed that if females stay in the area for spawning, the males will also.

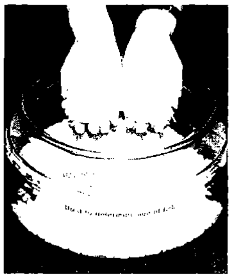
The collection was limited to no more than 10 halibut per trip, with a cumulative total not to exceed 21 fish per month. All halibut collected were dressed and iced head-on, with the gonads left intact inside the body cavity. Upon landing, port samplers from the Oregon Department of Fish and Wildlife (ODFW) collected the pertinent biological data and the halibut gonads were stored frozen and shipped to Seattle for examination and classification at the end of the collection period. The trawler delivered ten females of the targeted size. Of those ten, one was classified as immature, two were maturing (prior to first spawn), and seven had already spawned.

Though the results indicate that seven of these halibut had recently spawned, we still cannot conclude whether they spawned near their capture locations or further north along the continental shelf. The developmental stages of these ovaries suggest that spawning had not been recent, but rather had taken place at least one or two months earlier. It was possible that the halibut could have had time to migrate back south from spawning off the coast of Washington. Even so, these results are encouraging and a new collection of ovaries taken during the winter of 1991-92 could help draw a clearer picture of the seasonal maturation and distribution of Pacific halibut in the southern reaches of their habitat.

This study was enhanced greatly by cooperation from the ODFW's Newport Laboratory, particularly Jerry Butler, and by Bill Dixon and Leroy Evans, the owner and captain, respectively, of the *Corsair,* who brought the specimens to port.

LISTENING TO NATURE: WHAT CAN OTOLITHS TELL US?

How can we tell the gender of the fish?



Last year, we began developing a method of determining the sex of halibut from their otoliths. We first explored what morphological features of the otoliths – their size, inter-annular spacing, thickness, and shape – could be associated with each sex, and then tried to judge the sex of a sampling of halibut just by looking at their otoliths. The experiment yielded poor results, however; only 69 percent to 77 percent of the samples were correctly sexed. More mistakes were made with younger fish. Our researchers are still confident that these morphological differences exist, particularly in younger otoliths, but that they are probably too subtle to see with the naked eye.

The shape of the otolith appears to be sex-specific to some degree.

The shape of the otolith appears to be sex-specific to some degree. Male otoliths tend to be more elongated, while female otoliths tend to have broad bases and narrower tips. Shape can also be quantified relatively easily, and it was felt that subtle sex-related differences in shape could be detected mathematically. To quantify the shapes of otoliths, we applied Fourier shape analysis. Fourier shape analysis can be used to classify images of objects, or to distinguish between different shape types. We used linear discriminant function analysis to classify otolith shape and information by sex.

In fisheries applications, Fourier shape analysis has been used to measure differences in scale and otolith shape for stock separation and identification. Success rates of classification by this method vary widely with the species used. But these methods have not before been used for the sole purpose of distinguishing sex.

Otolith detectives at work

First, we investigated the structural composition of halibut otoliths by examining the trace elements incorporated into otolith microstructures. We suspected that the mix of elements could indicate the fish's location during the time that portion of the otolith was laid down. This might serve as a type of natural tag by which the nursery area of the adult halibut could be determined. To test out this suspicion, we looked at the trace elements present in otoliths taken from halibut one-year-old and younger collected in Bristol Bay, Prince William Sound, and in Shelikof Bay in Southeast Alaska. The Shelikof Bay samples consisted of two collections taken more than 20 years apart, one in 1957 and the other in 1989. In addition, an adult otolith was examined to look for seasonal correspondence with annuli marks, or rings.

An exploratory search told us that elements Strontium (Sr), Sodium (Na), Potassium (K), Sulphur (S), and Calcium (Ca) were present within the detection level of the equipment. Distribution maps of Sr were of particular interest; changes in Sr/Ca ratios seemed to correspond to the annuli in adult otoliths as well as regions in juvenile otoliths that correspond to life history changes. The results of these scans suggested significant variations between areas and between individuals, though no significant variation was detected within the individual or within the otolith. Halibut from one area collected 20 years apart appeared to have significant differences in elemental concentrations.

The possibility of stock separation of halibut by otolith characteristics might be restricted by the limited detection level of the equipment. In addition, we detected some interannual variation in the presence of elements observed, and there may not be an accurate way to account for these variations within the methods used.

LOG FROM THE SEA OF HIPPOGLOSSUS: CRUISING FOR OTOLITHS - 1991

Some of our best information comes right from the grounds, and so the IPHC staff joined three NMFS western Alaska surveys in 1991, sampling the grounds of the eastern Bering Sea continental shelf, the Bering Sea continental slope, and the Aleutian Islands. Our primary objective was to collect halibut age and length data to fill the gap between our juvenile surveys and adult setline surveys. Each survey documented length composition and otolith samples by sex. In all, 555 stations were occupied by four research vessels and 2,578 halibut were captured, of which 1,432 were otolithed and sexed. From those fish not otolithed, 96 halibut were collected for our parasite study.

Our intent was to catalogue the length distribution of partially recruited halibut age groups (8-12) by sex and regulatory area. We also hoped to expand our halibut age-length data base, which gives us basic information about the growth patterns of the stocks, by gleaning new data from the halibut's western range. From this information, we will be better able to approximate the rate of reproduction required to compensate for bycatch harvests, and to evaluate the present 32-inch size limit.

We were aboard the *Alaska* and the *Ocean Hope 3* to sample the eastern Bering Sea continental shelf grounds in June, July, and August. During July, August, and September, the chartered vessels *Ocean Hope 1* and *Green Hope* sampled the continental shelf and slope grounds adjacent to the Aleutian Islands. A fifth vessel, the *Miller Freeman,* sampled the eastern Bering Sea slope during September. Each cruise lasted between 23 and 26 days.

We surveyed the continental shelf in the eastern Bering Sea between the 20 m and 200 m isobaths. The survey area extended from deep in eastern Bristol Bay to Norton Sound waters. (We did not accompany the vessel in Norton Sound because so few halibut live in that northern section of the continental shelf.)

HELLO, MY NAME IS ... TAGGING HALIBUT FOR FUTURE IDENTIFICATION

Over the years, we have tagged thousands of halibut in the North Pacific, and each time we receive a tag from a fisherman, processor, or researcher, it's like looking up a lost schoolmate in the yearbook. In 1991 we received 622 tags from commercial and sports fishermen, fish processors and government agencies. We catalogue these tags according to where they were released and where they were recovered. This year, we received nine tags from unknown recovery areas. These tags are mostly from plant workers and fish tenders who recover tags secondarily and do not have access to fishing locations.

Figure 7 gives some amazing evidence of long-distance travel by a few halibut. Look at tagged halibut #3, which ventured more than 1,500 nautical miles in four years, and grew 15 centimeters while on the road. Tagged halibut #4 went the opposite direction. Released during the 1989 Newport experiment, old #4 was recovered near Portlock Bank in Southcentral Alaska only 2 years later. Only 38 fish were tagged and released in 1991, all of them in conjunction with the Homer Halibut Derby. Because of this decrease in releases this year and last, we recovered far fewer tags than in previous years. Newport, Oregon and B.C. fishermen recovered many of the tags as they fish in areas where the most recent experiments took place. The 1989 Newport tagging study is yielding a recovery rate of 19 percent, so far.

The 1988 Sitka Spot experiment has a recovery rate over 40 percent, and this rate is not decreasing as fast as we had expected. We believe the strong tag recoveries from this area are related to the new Canadian IVQ system, which helped spread the fishing effort out over most of the year. Therefore, there is more opportunity for a wider variety of boats to target this popular halibut area.

Look at those kids move

In 1980 and 1981, we tagged more than 68,000 juvenile Pacific halibut in the Gulf of Alaska and Southeast Alaska, hoping to trace their travels through the murky waters of their habitat. Now, nearly a dozen years later, we are able to analyze their movements through these areas, and learn something about the trials and tribulations they encounter along the way. Specifically, we looked at size-specific natural mortality, tagging mortality, and size selectivity for commercial gear in Areas 3A and 3B. We found that all of these influences on halibut livelihood could be estimated with little confounding, and we also discovered that tag recoveries came in about as we had predicted – which was some reassurance for those who set up the experiment.

We estimate that 16% of the fish tagged in Area 3B will recruit as adults in 2B, and that 30% of fish tagged in Area 3A will recruit as adults to 2B.

Halibut inhabit the same biological gyre that sweeps northward and west along the margin of the continent. Halibut larvae drift northwest to Alaska, where they grow and develop in the nursery areas of the Bering Sea and the Gulf of Alaska. Juvenile halibut generally move southward through the central region of their habitat. But there is some contrary motion, too; we estimate that 16% of the fish tagged in Area 3B would recruit as adults in 2B, and that 30% of fish tagged in Area 3A would recruit as adults to 2B. Tagging studies of adult halibut (9 years and older; 80 cm and longer), indicate that they move very little.

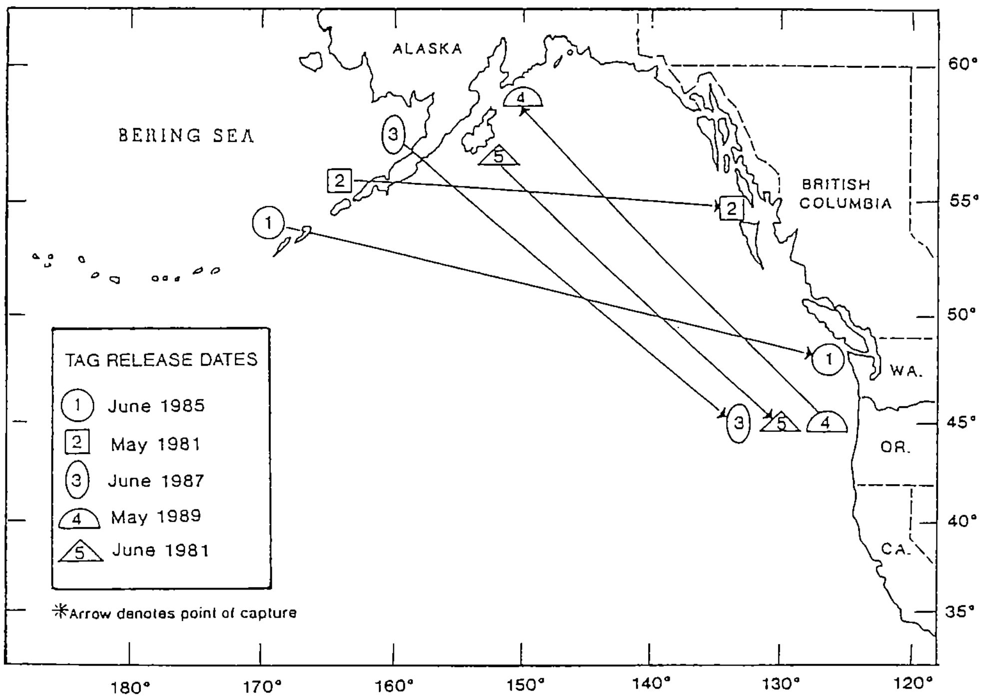


Figure 7. 1991 top five movers - tagged halibut that moved farthest from their release point.

Biologists view the southerly juvenile migration as a kind of balance against the passive drift of eggs and larvae north. Adult halibut are caught predominantly by longline gear, but juveniles rarely are. Juveniles can be caught, however, in trawl gear, so their movements through heavily trawled areas is of keen interest.

Drawing a map of the life of the Pacific halibut is intriguing research indeed, and its resulting information is useful in expanding our understanding of these amazing fish. As we continue to study halibut movement, we hope to understand how halibut move within each region, and to compare our tagging information with catch-at-age data. This knowledge, balanced with results from our ongoing research, provides an increasingly clear picture of the Pacific halibut that live off our coasts.

APPENDICES

The tables in Appendix I provide season and catch information for the 1991 fishery. The areas used are the IPHC regulatory areas, depicted in Figure 1 of this report. All of the weights used are dressed, head off. Round weight can be calculated by multiplying dressed weight by a factor of 1.33.

Appendix II provides catch information for the years 1987 through 1991, and Appendix III includes corrections to the 1990 Annual Report.

APPENDIX I.
Catch statistics for 1991.

APPENDIX II.

APPENDIX III.

APPENDIX I.

TABLE 1. Summary of the 1991 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	168.5	Jul 22	Jul 22	10 hrs	233
	102.5[1]	Mar 1	Mar 12	11	79
		Apr 11	Apr 14	3	43
				14	122
					Total: 355
2B	7,400	May 1	Nov 30	213	7,191
2C	7,400	May 7	May 8	1[2]	4,806
		Sep 3	Sep 4	1	3,881
				2	8,687
3A	26,600	May 7	May 8	1	10,793
		Sep 3	Sep 4	1	12,133
				2	22,926
3B	8,800	May 7	May 8	1	3,992
		Sep 3	Sep 4	1	7,942
				2	11,934
4A	1,700	May 7	May 8	1	96
		Aug 20	Aug 20	0.5	2,159
				1.5	2,255
4B	1,700	Jun 8	Jun 8	0.5	120
		Jun 17	Jun 17	0.5	76
		Jun 22	Jun 22	0.5	34
		Jun 29	Jun 29	0.5	140
		Jul 6	Jul 6	0.5	259
		Jul 13	Jul 13	0.5	260
		Aug 19	Aug 20	1	624
				4	1,513
4C	600	Jun 17	Jun 30	7[3]	515
		Jul 13	Jul 14	1	163
				8	678
4D	600	Aug 19	Aug 21	2	1,437
4E(NW)	70	Jun 1	Aug 15	50[4]	78
4E(SE)	30	Jun 1	Jun 9	6[5]	25
		Aug 1	Aug 15	10[6]	1
				16	26
Total	**55,171**				**57,080**

[1]Treaty Indian fishery: 102,500 pounds commercial, 10,000 pounds subsistence.
[2]Metlakatla Indian fishery included
[3]7 1-day fishing periods
[4]25 2-day fishing periods
[5]3 2-day fishing periods
[6]5 2-day fishing periods

APPENDIX I.

TABLE 2. Number of vessels and catch of Pacific halibut by vessel length class in the 1991 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	1	1	67	776
< 26 ft.	48	15	4	45
26 to 30 ft	11	4	8	49
31 to 35 ft.	15	6	41	407
36 to 40 ft.	39	32	114	1,385
41 to 45 ft.	24	47	82	1,318
46 to 50 ft.	18	32	43	1,009
51 to 55 ft.	10	22	30	830
56+ ft.	15	74	46	1,372
Total	181	233	435	7,191

	Area 2C		Area 3A	
Overall Vessel Length	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	29	68	28	172
< 26 ft.	374	338	262	205
26 to 30 ft.	161	266	188	229
31 to 35 ft.	252	735	327	1,096
36 to 40 ft.	423	1,968	401	2,054
41 to 45 ft.	220	1,699	287	2,322
46 to 50 ft.	168	1,544	210	2,314
51 to 55 ft.	63	607	119	2,095
56+ ft.	113	1,462	409	12,439
Total	1,803	8,687	2,231	22,926

	Area 3B		Area 4	
Overall Vessel Length	No. of Vessels	Catch (000's lbs.)	No. of Vessels	Catch (000's lbs.)
Unk. Length	4	27	9	28
< 26 ft.	1	5	47	117
26 to 30 ft.	6	19	18	92
31 to 35 ft.	74	724	93	481
36 to 40 ft.	107	777	27	157
41 to 45 ft.	90	1,056	22	224
46 to 50 ft.	78	1,086	32	461
51 to 55 ft.	38	765	19	394
56+ ft.	194	7,475	130	4,033
Total	602	11,934	397	5,987

APPENDIX I.
TABLE 3. Commercial landings in 1991 of Pacific halibut by port and country, in thousands of pounds.

Ports	Canada	United States	Total
California & Oregon		411	411
Seattle	20	1,260	1,280
Bellingham	165	712	877
Misc. Washington	32	725	757
Vancouver	2,664	126	2,790
Port Hardy	1,161		1,161
Misc. Southern B.C.	972		972
Prince Rupert	1,952	1,285	3,237
Misc. Northern B.C.	196		196
Ketchikan, Craig, & Metlakatla	29	1,912	1,941
Wrangell		553	553
Petersburg & Kake		2,467	2,467
Juneau		535	535
Sitka		2,956	2,956
Hoonah, Excursion, & Pelican		2,758	2,758
Misc. Southeast Alaska		104	104
Cordova		1,385	1,385
Seward		3,283	3,283
Homer		5,465	5,465
Kenai		871	871
Kodiak		11,285	11,285
Chignik, King Cove, & Sand Point		4,352	4,352
Misc. Central Alaska		3,488	3,488
Akutan & Dutch Harbor		3,520	3,520
Misc. Bering Sea		436	436
Total	7,191	49,889	57,080

APPENDIX II.

TABLE 1. Commercial catch of Pacific halibut by regulatory area[1] (in thousands of pounds), 1987-1991.

Regulatory Area	1987	1988	1989	1990	1991
2A	592	486	472	325	355
2B	12,246	12,858	10,431	8,574	7,191
2C	10,685	11,369	9,532	9,734	8,687
3A	31,316	37,862	33,734	28,848	22,926
3B	7,758	7,082	7,843	8,694	11,934
4A	3,713	1,930	1,025	2,503	2,255
4B	1,501	1,593	2,651	1,333	1,513
4C	878	707	571	530	678
4D	703	453	674	1,005	1,437
4E	90	9	13	60[2]	104[3]
Total	69,482	74,349	66,946	61,606	57,080

[1]Regulatory areas as defined in the 1991 Pacific Halibut Fishery Regulations (except from 1987 to 1989 Bristol Bay was not included in Area 4E).

[2]1990 Area 4E catch: Northwestern portion (Nelson Island) - 35,000 pounds
Southeastern portion (Bristol Bay) - 25,000 pounds

[3]1991 Area 4E catch: Northwestern portion (Nelson Island) - 78,000 pounds
Southeastern portion (Bristol Bay) - 26,000 pounds

APPENDIX III

Errata

International Pacific Halibut Commission Annual Report 1990

Page 43	Table 1. Column for Catch in Area 3A should read: 6,491 ; 10,127 ; 9,392 ; 7,724 ; 33,734 (total)
Page 45	Table 3. Total for No. of Vessels in Area 2C should read: 1,488
Page 45	Table 3. Column for No. of Vessels in Area 3A should read: 48 ; 327 ; 177 ; 372 ; 431 ; 269 ; 208 ; 98 ; 424 ; 2,354 (total)

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.

CALENDAR YEAR 1991

Clark, W. G. 1991. Evaluation of Pacific halibut management for Regulatory Area 2A: II. Critique of the Area 2A stock assessment. International Pacific Halibut Commission, Scientific Report 74, p. 39-44.

Clark, W. G. 1991. Groundfish exploitation rates based on life history parameters. Can. J. Fish. Aquat. Sci. 48: 734-750.

Hagen, P. T. and T. J. Quinn II. 1991. Long-term growth dynamics of young Pacific halibut: evidence of temperature-induced variation. Fish. Res. 11: 283-306.

International Pacific Halibut Commission. 1991. Pacific halibut fishery regulations 1990, 13 p.

_______. 1991. Annual Report, 1990, 52 p.

_______. 1991. Information Bulletin No. 39, 6 p.

_______. 1991. Information Bulletin No. 40, 1 p.

McFarlane, G. A., J. O. T. Jensen, W. T. Andrews, and E. P. Groot. 1991. Egg and yolk sac larval development of Pacific halibut (*Hippoglossus stenolepis*). International Pacific Halibut Commission, Technical Report No. 24, 22 p.

Sullivan, P. J. 1991. Stock abundance estimation using depth-dependent trends and spatially correlated variation. Can. J. Fish. Aquat. Sci. 48: 1691-1703.

Sullivan, P. J. 1991. Pacific halibut, pgs. 49-50. (IN) Status of living marine resources off Alaska as assessed in 1991 (Loh-Lee Low, editor). U.S. Dept. of Commerce NOAA Technical Memorandum NMFS-F/NWC-211.

Trumble, R. J., G. St-Pierre and I. R. McGregor. 1991. Evaluation of Pacific halibut management for Regulatory Area 2A: I. Review of the Pacific halibut fishery in Area 2A. International Pacific Halibut Commission, Scientific Report 74, p. 7-38.

Zhang, C. I., D. R. Gunderson, and P. J. Sullivan. 1991. Using data on biomass and fishing mortality in stock production modelling of flatfish. Netherlands Journal of Sea Research 27: 459-467.

Commission Publications 1930-1991

REPORTS

1. Report of the International Fisheries Commission appointed under the Northern Pacific Halibut Treaty. John Pease Babcock, William A. Found, Miller Freeman, and Henry O'Malley. 31 p. (1931). [Out of print]
2. Life history of the Pacific halibut (1) Marking experiments. William F. Thompson and William C. Herrington. 137 p. (1930).
3. Determination of the chlorinity of ocean waters. Thomas G. Thompson and Richard Van Cleve. 14 p. (1930).
4. Hydrographic sections and calculated currents in the Gulf of Alaska, 1927 and 1928. George F. McEwen, Thomas G. Thompson, and Richard Van Cleve. 36 p. (1930).
5. History of the Pacific halibut fishery. William F. Thompson and Norman L. Freeman. 61 p. (1930). [Out of print]
6. Biological statistics of the Pacific halibut fishery (1) Changes in the yield of a standardized unit of gear. William F. Thompson, Harry A. Dunlop, and F. Heward Bell. 108 p. (1931). [Out of print]
7. Investigations of the International Fisheries Commission to December 1930, and their bearing on the regulation of the Pacific halibut fishery. John Pease Babcock, William A. Found, Miller Freeman, and Henry O'Malley. 29 p. (1930). [Out of print]
8. Biological statistics of the Pacific halibut fishery (2) Effects of changes in intensity upon total yield and yield per unit of gear. William F. Thompson and F. Heward Bell. 49 p. (1934). [Out of print]
9. Life history of the Pacific halibut (2) Distribution and early life history. William F. Thompson and Richard Van Cleve. 184 p. (1936). [Out of print]
10. Hydrographic sections and calculated currents in the Gulf of Alaska. 1929. Thomas G. Thompson, George F. McEwen, and Richard Van Cleve. 32 p. (1936).
11. Variations in the meristic characters of flounders from the northeastern Pacific. Lawrence D. Townsend. 24 p. (1936).
12. Theory of the effect of fishing on the stock of halibut. William F. Thompson. 22 p. (1937).
13. Regulation and investigation of the Pacific halibut fishery in 1947 (Annual Report). IFC. 35 p. (1948).
14. Regulation and investigation of the Pacific halibut fishery in 1948 (Annual Report). IFC. 30 p. (1949).
15. Regulation and investigation of the Pacific halibut fishery in 1949 (Annual Report). IFC. 24 p. (1951).
16. Regulation and investigation of the Pacific halibut fishery in 1950 (Annual Report). IFC. 16 p. (1951).
17. Pacific Coast halibut landings 1888 to 1950 and catch according to area of origin. F. Heward Bell, Henry A. Dunlop, and Norman L. Freeman. 47 p. (1952).
18. Regulation and investigation of the Pacific halibut fishery in 1951 (Annual Report). Edward W. Allen, George R. Clark, Milton C. James, and George W. Nickerson. 29 p. (1952).
19. The production of halibut eggs on the Cape St. James spawning bank off the coast of British Columbia 1935-1946. Richard Van Cleve and Allyn H. Seymour. 44 p. (1953).
20. Regulation and investigation of the Pacific halibut fishery in 1952 (Annual Report). Edward W. Allen, George R. Clark, Milton C. James, and George W. Nickerson and Seton H. Thompson. 29 p. (1953).
21. Regulation and investigation of the Pacific halibut fishery in 1953 (Annual Report). IPHC. 22 p. (1954).
22. Regulation and investigation of the Pacific halibut fishery in 1954 (Annual Report). IPHC. 32 p. (1955).
23. The incidental capture of halibut by various types of fishing gear. F. Heward Bell. 48 p. (1956).
24. Regulation and investigation of the Pacific halibut fishery in 1955 (Annual Report). IPHC. 15 p. (1956).
25. Regulation and investigation of the Pacific halibut fishery in 1956 (Annual Report). IPHC. 27 p. (1957).
26. Regulation and investigation of the Pacific halibut fishery in 1957 (Annual Report). IPHC. 16 p. (1958).

REPORTS

27. Regulation and investigation of the Pacific halibut fishery in 1958 (Annual Report). IPHC. 21 p. (1959).
28. Utilization of Pacific halibut stocks: Yield per recruitment. Staff. IPHC. 52 p. (1960).
29. Regulation and investigation of the Pacific halibut fishery in 1959 (Annual Report). IPHC. 17 p. (1960)
30. Regulation and investigation of the Pacific halibut fishery in 1960 (Annual Report). IPHC. 24 p. (1961).
31. Utilization of Pacific halibut stocks: Estimation of maximum sustainable yield, 1960. Douglas G. Chapman, Richard J. Myhre, and G. Morris Southward, 35 p. (1962).
32. Regulation and investigation of the Pacific halibut fishery in 1961 (Annual Report). IPHC. 23 p. (1962).
33. Regulation and investigation of the Pacific halibut fishery in 1962 (Annual Report). IPHC. 27 p. (1963).
34. Regulation and investigation of the Pacific halibut fishery in 1963 (Annual Report). IPHC. 24 p. (1964).
35. Investigation, utilization and regulation of the halibut in southeastern Bering Sea. Henry A. Dunlop, F. Heward Bell, Richard J. Myhre, William H. Hardman, and G. Morris Southward. 72 p. (1964).
36. Catch records of a trawl survey conducted by the International Pacific Halibut Commission between Unimak Pass and Cape Spencer, Alaska from May 1961 to April 1963. IPHC. 524 p. (1964).
37. Sampling the commercial catch and use of calculated lengths in stock composition studies of Pacific halibut. William H. Hardman and G. Morris Southward. 32 p. (1965).
38. Regulation and investigation of the Pacific halibut fishery in 1964 (Annual Report). IPHC. 18 p. (1965).
39. Utilization of Pacific halibut stocks: Study of Bertalanffy's growth equation. G. Morris Southward and Douglas G. Chapman. 33 p. (1965).
40. Regulation and investigation of the Pacific halibut fishery in 1965 (Annual Report). IPHC. 23 p. (1966).
41. Loss of tags from Pacific halibut as determined by double-tag experiments. Richard J. Myhre. 31 p. (1966).
42. Mortality estimates from tagging experiments on Pacific halibut. Richard J. Myhre. 43 p. (1967).
43. Growth of Pacific halibut. G. Morris Southward. 40 p. (1967).
44. Regulation and investigation of the Pacific halibut fishery in 1966 (Annual Report). IPHC. 24 p. (1967).
45. The halibut fishery, Shumagin Islands westward not including Bering Sea. F. Heward Bell. 34 p. (1967).
46. Regulation and investigation of the Pacific halibut fishery in 1967 (Annual Report). IPHC. 23 p. (1968).
47. A simulation of management strategies in the Pacific halibut fishery. G. Morris Southward. 70 p. (1968).
48. The halibut fishery south of Willapa Bay, Washington. F. Heward Bell and E. A. Best. 36 p. (1968).
49. Regulation and investigation of the Pacific halibut fishery in 1968 (Annual Report). IPHC. 19 p. (1969).
50. Agreements, conventions and treaties between Canada and the United States of America with respect to the Pacific halibut fishery. F. Heward Bell. 102 p. (1969). [Out of print]
51. Gear selection and Pacific halibut. Richard J. Myhre. 35 p. (1969).
52. Viability of tagged Pacific halibut. Gordon J. Peltonen. 25 p. (1969).

SCIENTIFIC REPORTS

53. Effects of domestic trawling on the halibut stocks of British Columbia. Stephen H. Hoag. 18 p. (1971).
54. A reassessment of effort in the halibut fishery. Bernard E. Skud. 11 p. (1972).
55. Minimum size and optimum age of entry for Pacific halibut. Richard J. Myhre. 15 p. (1974).
56. Revised estimates of halibut abundance and the Thompson-Burkenroad debate. Bernard Einar Skud. 36 p. (1975).
57. Survival of halibut released after capture by trawls. Stephen H. Hoag. 18 p. (1975).
58. Sampling of landings of halibut for age composition. G. Morris Southward. 31 p. (1976).
59. Jurisdictional and administrative limitations affecting management of the halibut fishery. Bernard Einar Skud. 24 p. (1976).
60. The incidental catch of halibut by foreign trawlers. Stephen H. Hoag and Robert R. French. 24 p. (1976).
61. The effect of trawling on the setline fishery for halibut. Stephen H. Hoag. 20 p. (1976).
62. Distribution and abundance of juvenile halibut in the southeastern Bering Sea. E. A. Best. 23 p. (1977).
63. Drift, migration, and intermingling of Pacific halibut stocks. Bernard Einar Skud. 42 p. (1977).
64. Factors affecting longline catch and effort: I. General review. Bernard E. Skud; II. Hookspacing. John M. Hamley and Bernard E. Skud; III. Bait loss and competition. Bernard E. Skud. 66 p. (1978). [Out of print]
65. Abundance and fishing mortality of Pacific halibut, cohort analysis, 1935-1976. Stephen H. Hoag and Ronald J. McNaughton, 45 p. (1978).
66. Relation of fecundity to long-term changes in growth, abundance and recruitment. Cyreis C. Schmitt and Bernard E. Skud. 31 p. (1978).
67. The Pacific halibut resource and fishery in Regulatory Area 2: I. Management and Biology. Stephen H. Hoag, Richard J. Myhre, Gilbert St-Pierre, and Donald A. McCaughran. II. Estimates of biomass, surplus production, and reproductive value. Richard B. Deriso and Terrance J. Quinn, II. 89 p. (1983).
68. Sampling Pacific halibut (*Hippoglossus stenolepis*) landings for age composition: History, evaluation, and estimation. Terrance J. Quinn II, E. A. Best, Lia Bijsterveld, and Ian R. McGregor. 56 p. (1983).
69. Comparison of efficiency of snap gear to fixed-hook setline gear for catching Pacific halibut. Richard J. Myhre and Terrance J. Quinn, II. 37 p. (1984).
70. Spawning locations and season for Pacific halibut. Gilbert St-Pierre. 46 p. (1984).
71. Recent changes in halibut CPUE: Studies on area differences in setline catchability. Stephen H. Hoag, Richard B. Deriso, and Gilbert St-Pierre. 44 p. (1984).
72. Methods of population assessment of Pacific halibut. Terrance J. Quinn, II, Richard B. Deriso, and Stephen H. Hoag. 52 p. (1985).
73. Recent studies of Pacific halibut postlarvae in the Gulf of Alaska and eastern Bering Sea. Gilbert St-Pierre. 31 p. (1989).
74. Evaluation of Pacific Halibut Management for Regulatory Area 2A, I. Review of the Pacific Halibut Fishery in Area 2A, II. Critique of the Area 2A Stock Assessment. Robert J. Trumble, Gilbert St-Pierre, Ian R. McGregor and William G. Clark. 44 p. (1991).

TECHNICAL REPORTS

1. Recruitment investigations: Trawl catch records Bering Sea, 1967. E. A. Best. 23 p. (1969).
2. Recruitment investigations: Trawl catch records Gulf of Alaska, 1967. E. A. Best. 32 p. (1969).
3. Recruitment investigations: Trawl catch records Eastern Bering Sea, 1968 and 1969. E. A. Best. 24 p. (1969).
4. Relationship of halibut stocks in Bering Sea as indicated by age and size composition. William H. Hardman. 11 p. (1969).
5. Recruitment investigations: Trawl catch records Gulf of Alaska, 1968 and 1969. E. A. Best. 48 p. (1969).
6. The Pacific halibut. F. Heward Bell and Gilbert St-Pierre. 24 p. (1970). [Out of print]
7. Recruitment investigations: Trawl catch records Eastern Bering Sea, 1963, 1965 and 1966. E. A. Best. 52 p. (1970).
8. The size, age and sex composition of North American setline catches of halibut (*Hippoglossus hippoglossus stenolepis*) in Bering Sea, 1964-1970. William H. Hardman. 31 p. (1970).
9. Laboratory observations on early development of the Pacific halibut. C. R. Forrester and D. F. Alderdice. 13 p. (1973).
10. Otolith length and fish length of Pacific halibut. G. Morris Southward and William H. Hardman. 10 p. (1973).
11. Juvenile halibut in the eastern Bering Sea: Trawl surveys, 1970-1972. E. A. Best. 32 p. (1974).
12. Juvenile halibut in the Gulf of Alaska: Trawl surveys, 1970-1972. E. A. Best. 63 p. (1974).
13. The sport fishery for halibut: Development, recognition and regulation. Bernard Einar Skud. 19 p. (1975).
14. The Pacific halibut fishery: Catch, effort, and CPUE, 1929-1975. Richard J. Myhre, Gordon J. Peltonen, Gilbert St-Pierre, Bernard E. Skud, and Raymond E. Walden. 94 p. (1977).
15. Regulations of the Pacific halibut fishery, 1924-1976. Bernard E. Skud. 47 p. (1977).
16. The Pacific halibut: Biology, fishery, and management. International Pacific Halibut Commission. 56 p. (1978). [Out of print]
17. Size, age, and frequency of male and female halibut: Setline research catches, 1925-1977. Stephen H. Hoag, Cyreis C. Schmitt, and William H. Hardman. 112 p. (1979).
18. Halibut assessment data: Setline surveys in the north Pacific Ocean, 1963-1966 and 1976-1979. Stephen H. Hoag, Gregg H. Williams, Richard J. Myhre, and Ian R. McGregor. 42 p. (1980).
19. I. Reducing the incidental catch of prohibited species in the Bering Sea groundfish fishery through gear restrictions. Vidar G. Wespestad, Stephen H. Hoag, and Renold Narita. II. A comparison of Pacific halibut and Tanner crab catches (1) side-entry and top-entry crab pots and (2) side-entry crab pots with and without Tanner boards. Gregg H. Williams, Donald A. McCaughran, Stephen H. Hoag, and Timothy M. Koeneman. 35 p. (1982).
20. Juvenile halibut surveys, 1973-1980. E. A. Best and William H. Hardman. 38 p. (1982).
21. Pacific halibut as predator and prey. E. A. Best and Gilbert St-Pierre. 27 p. (1986).
22. The Pacific halibut: Biology, fishery, and management. International Pacific Halibut Commission. 59 p. (1987).
23. Incidental catch and mortality of Pacific halibut, 1962-1986. Gregg H. Williams, Cyreis C. Schmitt, Stephen H. Hoag, and Jerald D. Berger, 94 p. (1989).
24. Egg and yolk sac larval development of Pacific halibut (*Hippoglossus stenolepis*). G. A. McFarlane, J.O.T. Jensen, W.T. Andrews and E.P. Groot. 22 p. (1991).

INFORMATION BULLETINS

1. Bait experiments. 2 p. (1972).
2. Hook-spacing. 2 p. (1972).
3. Length-weight relationship. 1 p. (1972).
4. Minimum commercial size for halibut. 1 p. (1973).
5. Information on Japanese hooks. 1 p. (1974).
6. 1974 halibut regulations. 1 p. (1974)
7. Halibut catch in 1974. 1 p. (1974).
8. $300 halibut landed in Seattle. 1 p. (1974).
9. Fisherman needed for tagging study with U.S.S.R. 1 p. (1975).
10. Soak-time and depth of fishing. 1 p. (1975).
11. Japanese hooks in halibut. 1 p. (1975).
12. Notice on 1975 halibut regulations. 1 p. (1975).
13. Cooperative halibut research with U.S.S.R. 1 p. (1975).
14. Halibut catch improves in 1975. 1 p. (1975).
15. Japanese hooks and IPHC premium tags. 1 p. (1976).
16. 1976 halibut catch. 1 p. (1976).
17. Questionnaire on 1977 regulations. 1 p. (1977).
18. Why split the halibut season? 2 p. (1977).
19. Environmental conditions-1977. 1 p. (1977).
20. Possession of halibut during closed periods. 1 p. (1977).
21. Halibut migrates from Soviet Union to Alaska. 1 p. (1977).
22. 1978 halibut regulations. 1 p. (1978).
23. Halibut tags-May 1979. 1 p. (1979).
24. Progress report on the 1979 halibut fishery. 2 p. (1979).
25. Stock assessment research program-detailed catch information. 1 p. (1979).
26. Commercial halibut regulations for 1980. 1 p. (1980).
27. Commercial halibut regulations for 1983. 2 p. (1983).
28. Circle hooks outfish traditional halibut hooks. 1 p. (1983).
29. Commercial halibut regulations for 1984. 2 p. (1984).
30. New halibut license system. 1 p. (1984).
31. Commercial halibut regulations for 1985. 2 p. (1985).
32. Research fishing off the coast of Oregon. 1 p. (1985).
33. Commercial halibut regulations for 1986. 4 p. (1986).
34. Commercial halibut regulations for 1987. 4 p. (1987).
35. Commercial halibut regulations for 1988. 5 p. (1988).
36. Fishing period limits. 2 p. (1988).
37. New British Columbia tag releases. 1 p. (1988).
38. Halibut regulations for 1989. 5 p. (1989).
39. Halibut Regulations for 1991. 6 p. (1991).
40. Halibut length/weight table 1 p. (1991)

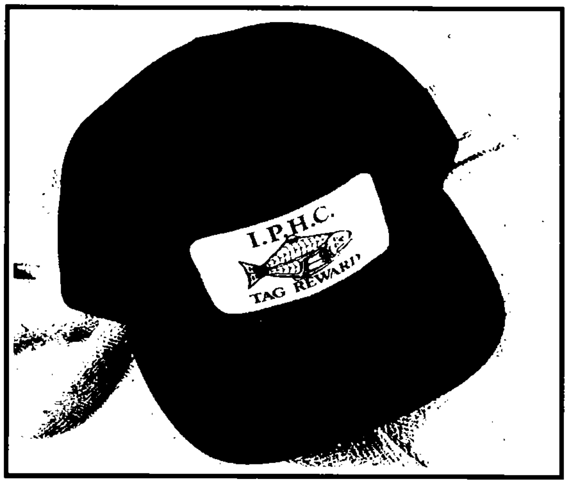
ANNUAL REPORTS

Annual Report 1969. 24 p. (1970).
Annual Report 1970. 20 p. (1971).
Annual Report 1971. 36 p. (1972).
Annual Report 1972. 36 p. (1973).
Annual Report 1973. 52 p. (1974).
Annual Report 1974. 32 p. (1975).
Annual Report 1975. 36 p. (1976).
Annual Report 1976. 40 p. (1977).
Annual Report 1977. 39 p. (1978).*
Annual Report 1978. 40 p. (1979).*
Annual Report 1979. 43 p. (1980).
Annual Report 1980. 49 p. (1981).
Annual Report 1981. 48 p. (1982).
Annual Report 1982. 56 p. (1983).
Annual Report 1983. 59 p. (1984).
Annual Report 1984. 63 p. (1985).
Annual Report 1985. 59 p. (1986).
Annual Report 1986. 73 p. (1987).
Annual Report 1987. 51 p. (1988).
Annual Report 1988. 62 p. (1989).
Annual Report 1989. 39 p. (1990).
Annual Report 1990. 52 p. (1991).

*out of print

TAGGED HALIBUT

The INTERNATIONAL PACIFIC HALIBUT COMMISSION attaches plastic tags to the cheek on the dark side of the halibut. Fishermen should return all tags, even those from halibut below legal size or those caught in trawls.



REWARD

$5.00 will be paid for the return of each tag.

OR

A "Hat" will be paid for the return of each tag.

WHEN YOU CATCH A TAGGED HALIBUT:

1. Record tag numbers, date, location and depth in your log book.
2. Leave the tag on the fish.
3. Mark the fish with a gangion around tail.

WHEN YOU LAND A TAGGED HALIBUT:

1. Report fish to a Commission Representative or Government officer

   or

2. Forward tags to address below and enclose recovery information (see above), your name, address, boat name, gear, length of fish, and, if possible, earstones.

FINDER WILL BE ADVISED OF MIGRATION AND GROWTH OF THE FISH.

International Pacific Halibut Commission
P.O. Box 95009
Seattle, Washington 98145-2009