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The Pacific Halibut: Biology, Fishery, and Management

by

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Introduction

The International Pacific Halibut Commission (IPHC or Commission) has a long and storied tradition of successful fishery management. Since 1924, the IPHC has conducted research, assessed the Pacific halibut stock biomass of the northern Pacific Ocean and Bering Sea, and regulated the commercial and sport fisheries. This report is a general review of the biology and management of Pacific halibut, and updates IPHC Technical Reports 6, 16, 22, and 40.

Pacific halibut (*Hippoglossus stenolepis*) is a flatfish which inhabits the continental shelf of the United States and Canada, ranging from California to the Bering Sea, and extending into Russia and Japan. Because a halibut can grow to be as much as 500 pounds, is firm textured, and has relatively few bones compared to other fishes, it is a popular food fish. In addition, halibut is a sought-after target for sport fishing enthusiasts because of its strength and large size.

Fishery data presented in this report are current through the 2012 fishing season. All weights from here forward are in units of pounds, net weight (eviscerated, head off), followed by the metric round weight equivalent in parentheses. Pacific halibut harvests have been reported in net weight since the beginning of the commercial fishery and those involved with the industry are accustomed to halibut weights reported in this format. However, it is recognized that the standard in many other fisheries is to report weights in "round" (whole-fish) units. The round weight can be estimated by dividing the net weight by 0.75. Similarly, other units of measurement (length, distance, etc.) that are typically expressed in imperial units in the halibut industry are presented as such in this report, followed by the metric equivalent in parentheses.

Pulling a halibut aboard the *F/V Waterfall* during the IPHC summer survey. Photo by David Bryan.

History of the IPHC and Pacific halibut management

Pacific halibut has been fished for hundreds of years by members of Indian tribes and First Nations groups who inhabited what is now known as Alaska, British Columbia, and the U.S. west coast (Washington, Oregon, and California). The North American commercial fishery officially started in 1888 when halibut were landed in Tacoma, Washington by the sailing vessel *Oscar and Hattie* and were subsequently shipped to Boston. Two other commercial vessels fished halibut that year, and halibut's popularity soon grew because the fish, if well-iced, could be kept for an extended time without spoiling.

In the 1890s, an extensive fleet of sailing vessels fished with 2-man dories. Large, company-owned U.S. and Canadian steam-powered vessels soon dominated the fishery, carrying 10 to 12 dories and as many as 35 crew, compared to two or three dories and fewer than six crew on a smaller vessel. However, by the 1910s catch rates had declined and members of the halibut fishing industry asked the governments of both the U.S. and Canada for international management of the resource. The fleet itself was integrated since there were no international boundaries pertaining to fishing at the time.

The *F/V Seymour*, built in 1913 and shown here in the early 1900s, is still active in the halibut fishery today. IPHC photo archive.

An attempt at an international agreement failed in 1919. However, after further negotiations, the U.S. and Canada signed a Convention in 1923, which was ratified in 1924, making it the first international treaty of any kind entered into by Canada independent of Great Britain. From that convention, the International Fisheries Commission (later to become the International Pacific Halibut Commission) was formed. The Convention was modified a number of times in subsequent years. The Convention and its amendments are discussed at greater length later in this report.

The Commission began its management of the halibut resource in 1924 with a three-month winter closure to fishing. By 1932, it was evident that further action was needed and the first catch limit was set. Over the next two decades, the fleet grew and the fishers became more skilled, resulting in progressively shorter seasons to avoid exceeding the catch limit. As

Halibut fishing boats tied up to the dock. Photo by Levy Boitor.

a result, fish quality suffered and fishing effort was often concentrated in one area and light in another. It became clear that further regulatory measures were needed. This occurred despite an industry attempt at self-regulation, which included a 10-day lay-up between trips and individual vessel allocations based on crew size. The lay-up program was discontinued during World War II. By 1953, season length was less than two months, so the Convention was modified to allow the setting of seasons by area. Industry again established a voluntary program in 1956 which included eight-day lay-ups, and these management tools together were sufficient through the early 1970s. An increasing number of vessels entered into the halibut fishery in the 1970s, leading to a breakdown in the lay-up program, and in 1977 it was discontinued. Because seasons were so short, the Commission began setting multiple seasons for each area that year in an effort to spread the catch over a longer period of time.

The U.S. Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and the Canadian Coastal Fisheries Protection Act extended each country's fishery jurisdiction to 200 nautical miles (370 km) from shore beginning in 1977. In 1979, the Protocol to the Convention of 1953 signed by the two countries brought an end to U.S. fishing in Canadian waters in 1979 and Canadian fishing in U.S. waters in 1981. The Protocol also enabled the individual governments to make regulations pertaining to their own fleets as long as they were not in conflict with Commission regulations.

The two countries started down decidedly different paths. Canada limited entry into its halibut fishery in 1979, which enabled longer seasons and eased the transition to an individual quota system in 1991. The U.S. fishery remained open access; the fleet expanded and the seasons grew shorter, intensifying the "derby" or race for the fish. As the need for new management measures became clear for the fishery off Alaska, the U.S. government began considering options for limiting access. The U.S. regional councils (the North Pacific Fishery Management Council (NPFMC) in Alaska and the Pacific Fishery Management Council (PFMC) on the west coast) were given the authority in 1982 to establish limited access regulations, and authority to allocate catches among user groups was given to the Councils in 1987. However, because of the controversy surrounding limited access, it would take several more years to establish a limited access fishery in Alaska.

In 1987 the Commission used fishing period limits for the first time, which restricted the maximum pounds landed per vessel during a fishing period. The fishing period limits were evaluated by industry and, starting in 1988, were imposed by vessel length class during "clean-up" fisheries, which refer to openings where the remaining catch limit is small, and likely to be exceeded in another unrestricted opening.

By 1994, season length was as short as 24 hours in the Gulf of Alaska, 12 hours in some parts of the Bering Sea, and 10 hours on the U.S. west coast. Fishing period limits were widely used in clean-up fisheries and in some cases were needed during the first fishing period as well. In contrast, the British Columbian individual vessel quota system established in 1991 allowed for seasons upwards of 213 days in length. An individual quota system was implemented for Alaska by the U.S. government in 1995, putting an end to the derby-style fishery in Alaskan waters.

Derby fishing continues off the U.S. west coast, with 10-hour openings and fishing period limits. The area's catch limit, applicable to all users, is set by the Commission, but the PFMC allocates the catch limit among the numerous user groups: commercial non-treaty (incidental to salmon troll, incidental to sablefish, and directed), sport, and treaty tribes.

Historically, active management of the sport fishery was left to the Commission. However, steady increases in sport removals off the U.S. west coast, British Columbia, southeast Alaska, and central Gulf of Alaska during the 1980s led to the development of allocation plans by domestic agencies. The first was implemented in 1988 for the U.S. west coast, followed by the other areas in 2003 and subsequent years. These allocation plans are discussed later in this report.

Regulatory area descriptions

Research shows that halibut form a single genetic stock across their entire range, and abundance estimates are therefore derived for the coastwide population (this concept is discussed in the next section). However, management of the resource is conducted on a regulatory area basis. Regulatory areas were first defined in 1932 and were frequently redefined and reshaped. The present arrangement was established in 1990 (Fig. 1). There are currently three major regulatory

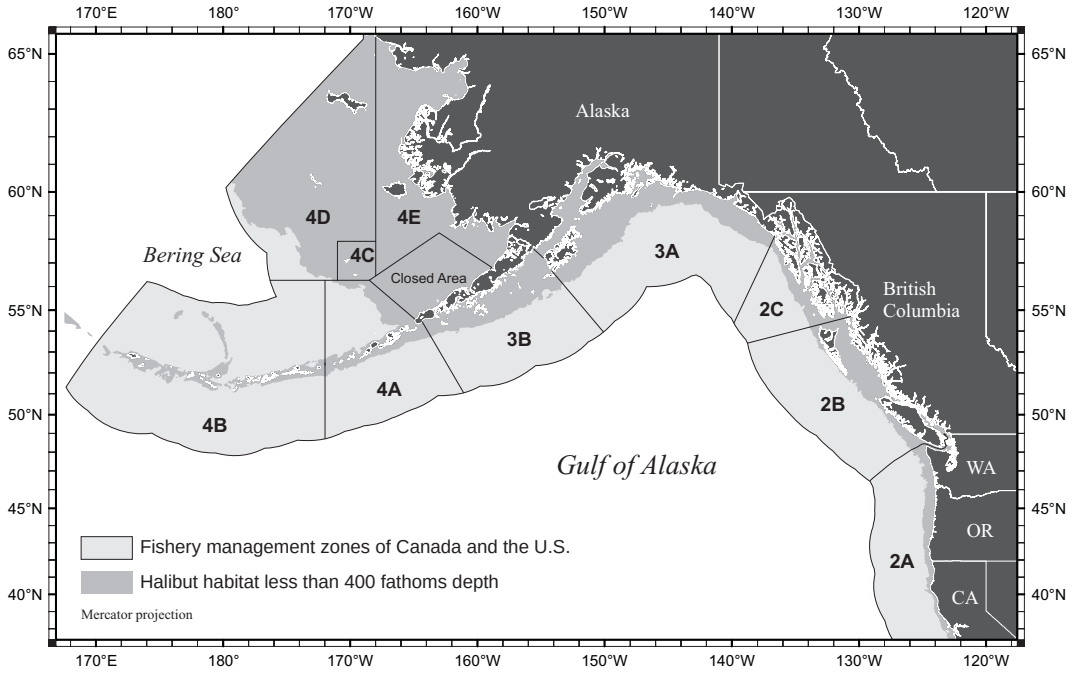


Figure 1. IPHC Regulatory Areas from 1990 - present.

areas - Areas 2, 3, and 4, and each is further divided into subareas. Area 2 is comprised of 2A (California, Oregon, and Washington), 2B (British Columbia), and 2C (southeast Alaska). Area 3 is comprised of 3A (central Gulf of Alaska) and 3B (western Gulf of Alaska). The largest regulatory area is Area 4 and is comprised of five subareas - 4A (eastern Aleutian Islands and southeast Bering Sea shelf edge), 4B (western Aleutian Islands), 4C (Pribilof Islands), 4D (western Bering Sea) and 4E (eastern Bering Sea). These areas will be referenced frequently in this report.

Fluctuations in abundance and the fishery

The Commission staff has monitored changes in the Pacific halibut stock and fishery since the 1930s. Its historical archive of research data and commercial fishery logbooks and catches is one of the most extensive in the world. Removals from the Pacific halibut stock have been closely documented since the late 1800s (Fig. 2). The commercial fishery for Pacific halibut generally proceeded from southerly waters off the coasts of the United States and British Columbia, to the Gulf of Alaska, and then finally to include the waters of the Aleutian Islands and the Bering Sea. The majority of the stock biomass, and therefore the commercial fishery, has been located in the Gulf of Alaska in recent years.

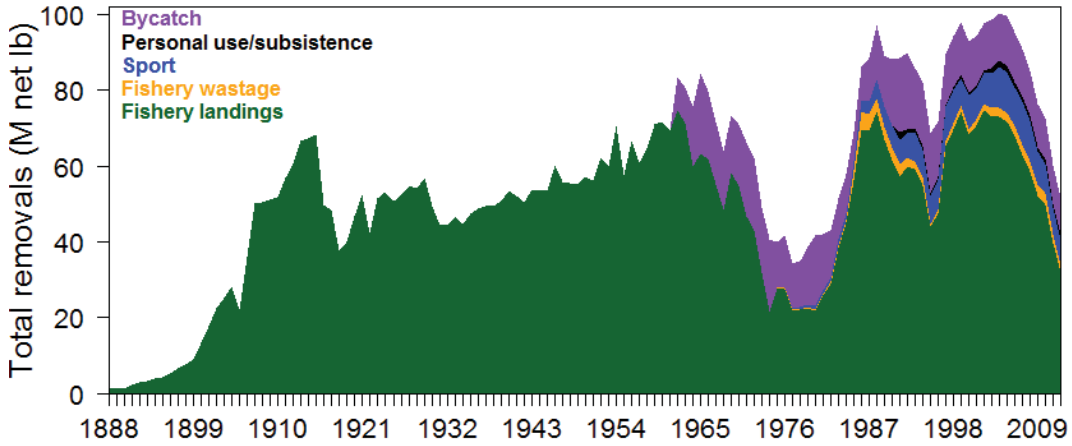


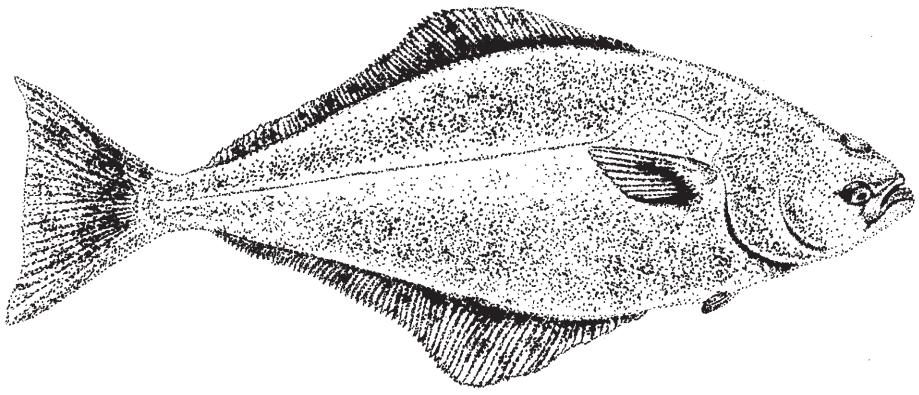
Figure 2. Total removals from the Pacific halibut resource since the commercial fishery began in 1888 through 2012.

The halibut stock has undergone many fluctuations in abundance with consequent effects on the commercial fishery removals. These fluctuations are understood to be linked to changes in recruitment (the number of young halibut entering the population each year), which appears to be linked to the productivity of the northeastern Pacific Ocean, specifically, the Pacific Decadal Oscillation. Population fluctuations are also linked to the size-at-age of Pacific halibut, which has gone through marked changes over the last 100 years, from fish that were quite small for their age in the 1920s and 1930s, to much larger fish in the 1960s through 1980s, and back to relatively small fish in the current stock. The mechanisms creating these changes are poorly understood, but may represent a combination of density-dependent competition for food, ocean productivity, fishing effects, and other natural and anthropogenic factors. Such changes in size-at-age can result in fluctuations in the catch, even when similar numbers of fish are being removed from the stock. These changes in stock abundance have not been identical among all regulatory areas, with some showing much more pronounced trends and others more stability.

Biology

Introduction

Pacific halibut are among the largest teleost fishes in the world, with reported lengths up to 8 feet (2.4 m). They can be found along the continental shelf in the northern Pacific Ocean and Bering Sea. They have flat, diamond-shaped bodies and are able to migrate long distances. It was long believed that most adult fish tend to remain on the same grounds year after year, making only a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in winter, sometimes covering large distances. Recent research, however, has demonstrated that a measurable proportion of the adult population continues to migrate, generally, though not entirely, eastward, even at large sizes and older ages.



Adult Pacific halibut, *Hippoglossus stenolepis*. Drawing by Joan Forsberg.

Halibut spawn in deep water, where the eggs are fertilized. As the eggs develop into larvae and grow, they become positively buoyant and drift slowly upward in the water column. During development, the larvae are carried great distances with the ocean currents in a counter-clockwise direction around the northeast Pacific Ocean. After five or six months, the young fish settle to the bottom. For those that settle in shallow nursery areas, a significant journey awaits. Following two to three years in these shallow waters, many of the young halibut counter-migrate and move into more southerly and easterly waters, journeys which can take years and cover many hundreds of miles.

The weight of a halibut differs by sex and age, and has varied substantially over the past 85+ years. The recent trend has been one of decline, and fish today are much smaller than fish of the same age in the 1990s, but similar to those of the 1920s. Trends such as this are tracked each year as biologists collect age and length data from the commercial fishery and the IPHC's setline survey.

Description and scientific name

Halibut belong to a family of flounders called Pleuronectidae. The scientific name for Pacific halibut is *Hippoglossus stenolepis*, a name derived from the Greek *hippos* (horse), *glossa* (tongue), *steno* (narrow), and *lepis* (scale). The name was first proposed in 1904 by Russian scientist P. J. Schmidt, who distinguished Pacific halibut from its Atlantic counterpart (*Hippoglossus hippoglossus*) by anatomical differences such as the shape of the scales, length of the pectoral fin, and the shape of the body. Since the identification was made, it has been debated as to whether the two are indeed separate species, although recent genetic work has confirmed the validity of the two different species.

Most fishes are torpedo-shaped and symmetrical, often with heavily pigmented backs and light, white bellies. Flounders are compressed laterally and, except in the larval stages, have both eyes on one side of the head; halibut usually are dextral, that is, both eyes are on the right side. On the eyed side, pigmentation varies from olive to dark brown or black with lighter, irregular blotches that are similar to the color pattern of the ocean floor. This protective coloration makes the fish less conspicuous to predators and prey. The left or blind side is white with occasional blotching and faces the ocean bottom.

Halibut are more elongate than most other flatfishes. The average width of the body is about one-third its length. The mouth is relatively large, extending to below the lower eye, and nearly symmetrical. The small, smooth scales are well buried in the skin and the lateral line has a pronounced arch above the pectoral fin. The tail or caudal fin is crescent-shaped or lunate.

Reproduction and development

Reproductive output varies with sex, age, and size of the fish. Females grow faster, but mature slower than males. Most males are mature by the time they are eight years old, whereas the average age of maturity for females is about 12 years; these average ages have remained invariant despite the large size-at-age decrease over the past 20 years. From November to March, mature halibut concentrate annually on spawning grounds along the edge of the continental shelf at depths from 600 to over 1,600 feet (183 to 500+ m). The major spawning sites include Cape St. James, Langara Island (Whaleback), and Frederick Island in British Columbia; Yakutat, Cape Suckling - Yakataga ("W" grounds), Portlock Bank, and Chirikof Island in Alaska. Other reported spawning locations include Goose Islands, Hecate Strait, and Rose Spit in British Columbia and Cape Ommaney, Cape Spencer, and Cape St. Elias in Alaska. Spawning concentrations also occur in the Bering Sea and Aleutian Islands. In addition to these major grounds, there is evidence that spawning is widespread and occurs in many areas, although not in as dense concentrations as those mentioned above (Fig. 3). Evidence to support this conclusion is based on the widespread distribution of sexually mature halibut during the winter months as indicated by research and commercial fishing.

The number of eggs produced by a female is related to its size. A 50-pound (30 kg round weight) female will produce about 500,000 eggs, whereas a female over 250 pounds (151 kg

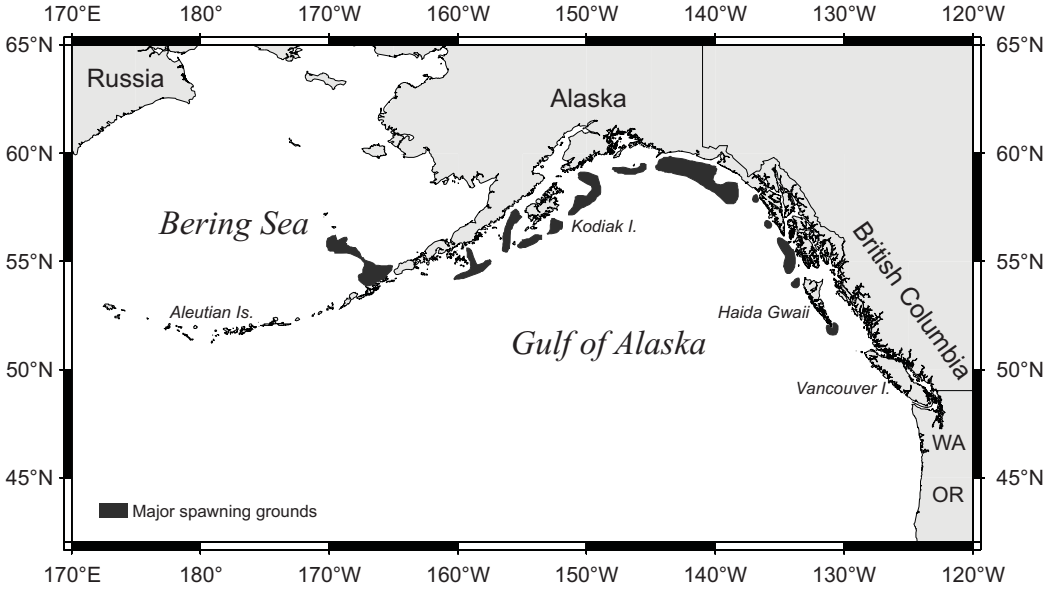


Figure 3. Major spawning grounds for Pacific halibut.

round weight) may produce four million eggs. Halibut are believed to be “batch spawners”, meaning that only a portion of a female’s eggs are hydrated at a time and released, and this process is repeated several times over the spawning season until all the eggs have been expelled. The free-floating eggs are about 0.12 inches (3 mm) in diameter when released and fertilization takes place externally. Developing ova generally are found at depths of 300 to 600 feet (91 to 183 m), but occur as deep as 1,500 feet (457 m). The eggs hatch after 15 to 20 days at 5-6°C, and more quickly in warmer water (12 to 14 days at 7-8°C). The eggs and larvae are heavier than the surface seawater and drift passively in deep ocean currents. As the larvae grow, their specific gravity decreases and they gradually move towards the surface and drift to shallower waters on the continental shelf. Postlarvae may be transported many hundreds, even thousands of miles by the Alaskan Stream and Alaska Coastal Current, which flow counter-clockwise in the Gulf of Alaska and westward along the Alaska Peninsula and Aleutian Islands. Some of the larvae are carried into the Bering Sea. The velocity of the currents varies depending on geographic location but typical speeds range from around 0.5 knots to over 2.5 knots (0.3-1.3 m/s).

Larvae begin life in an upright position with an eye on each side of the head. Nutrition is derived from a prominent yolk sac until it is absorbed during the early postlarval stage; then the young fish must begin feeding on small planktonic organisms. When the larvae are about an inch long (2.5 cm), an extraordinary transformation or metamorphosis occurs: the left eye moves over the snout to the right side of the head and pigmentation on the left side fades (Fig. 4). When the young fish are about six months old, they have the characteristic adult form and settle to the bottom in shallow inshore areas (Fig. 5). The survival of young halibut, and the varying strength of each year class, may be driven by food availability, proximity to predators, temperature or other environmental factors, or a combination of these. Recruitment of juvenile halibut to the stock has been highly variable over the historical record, with apparently strong links to the productivity cycles of the north Pacific (i.e., the Pacific Decadal Oscillation).

Distribution and migration

Pacific halibut are found on the continental shelf of the northern Pacific Ocean and the Bering Sea. They have been recorded on the North American coast from Santa Barbara, California to Nome, Alaska and also occur along the Asiatic coast from the Gulf of Anadyr, Russia to Hokkaido, Japan. Halibut are demersal (living on or near the bottom), and are routinely found in water temperatures ranging from 3°C to 8°C. Although halibut have been caught as deep as 4,000 feet (1,219 m), they are most often caught between 90 and 900 feet (27 and 274 m).

To counter the egg drift that occurs with counter-clockwise ocean currents, the young halibut migrate long distances in a clockwise direction. One- and two-year-old Pacific halibut are commonly found in inshore areas of central and western Alaska, but are virtually missing from southeast Alaska and British Columbia. Juvenile halibut tend to move further offshore at age two or three and can be found off southeast Alaska and British Columbia by age four and older.

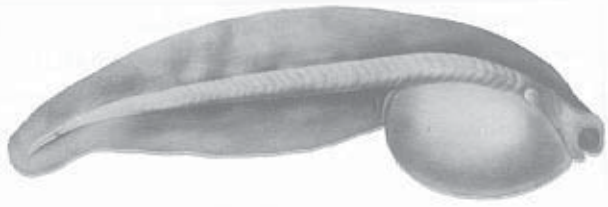
By the time Pacific halibut become large enough to be caught by the commercial fishery, much of the extensive counter-migration to balance egg and larval drift has apparently taken place. However, many adult halibut continue to migrate along the continental shelf and also migrate across the shelf annually, moving to deeper depths on the slope during the winter for spawning, and returning to shallow coastal waters in the summer months for feeding.

Tagging studies

The IPHC has tagged almost 450,000 halibut since 1925 and over 50,000 tagged fish have been recovered. Traditionally, the tags are attached on the outside of the fish, where they will be seen by fishers and processors. A reward is paid for their return, and in 1986 the IPHC began using a baseball cap as a tag reward, increasing returns. Most of the tagging experiments have been conducted in the summer and many of the recoveries occur during the summer, when the

Newly-hatched larva (Stage 1)

Showing prominent yolk sac.



Postlarva (Stage 3)

Yolk sac has been absorbed.

Postlarva (Stage 7)

Postlarva (Stage 9)

Showing the beginning of eye migration.

Young halibut

Adapted to bottom life.

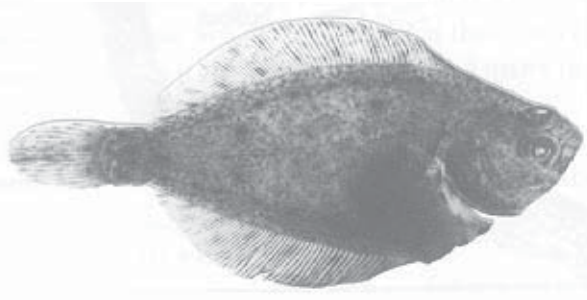


Figure 4. Growth and early development of halibut.

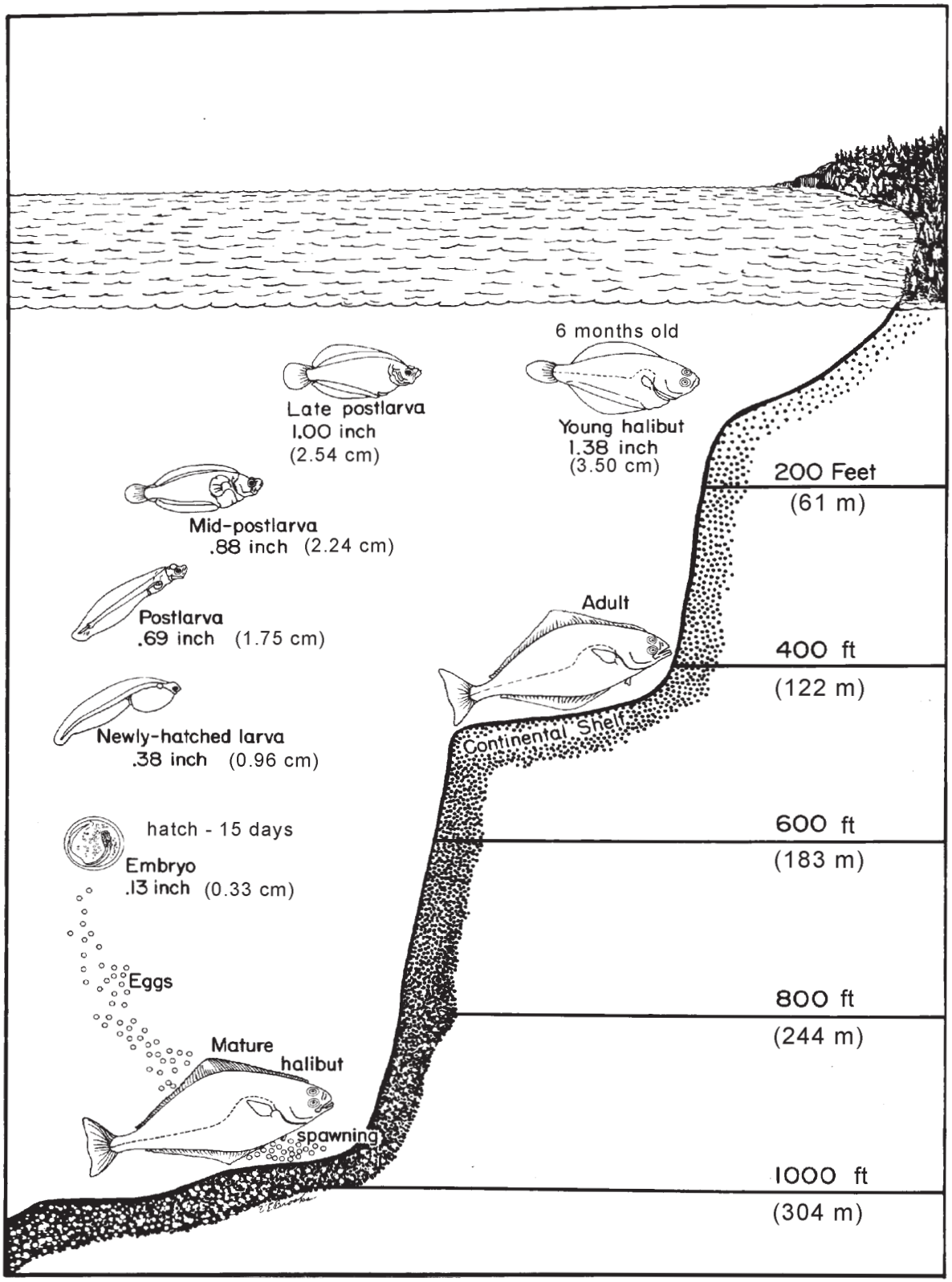


Figure 5. Life cycle of Pacific halibut.

weather is better and halibut fishing occurs more often. In the 2000s, the IPHC tagged 71,780 halibut with Passive Integrated Transponder (PIT) tags, primarily to estimate exploitation rates but also to look at migration and other factors (Fig. 6). These tags were embedded in the flesh of the fish and were detectable only by specialized equipment used in the ports; therefore, their detection/return was not dependent on recovery and reporting by harvesters. Another tag used in recent years is the archival tag. These come in various forms, some of which pop off the halibut at a pre-set time, then transmit data to satellites; and others that must be recovered from the fish, but store extensive information on location and depth. Archival tags are expensive and therefore are not released in large numbers, but the data provide a valuable glimpse at the finer details of a halibut's migration and movements.

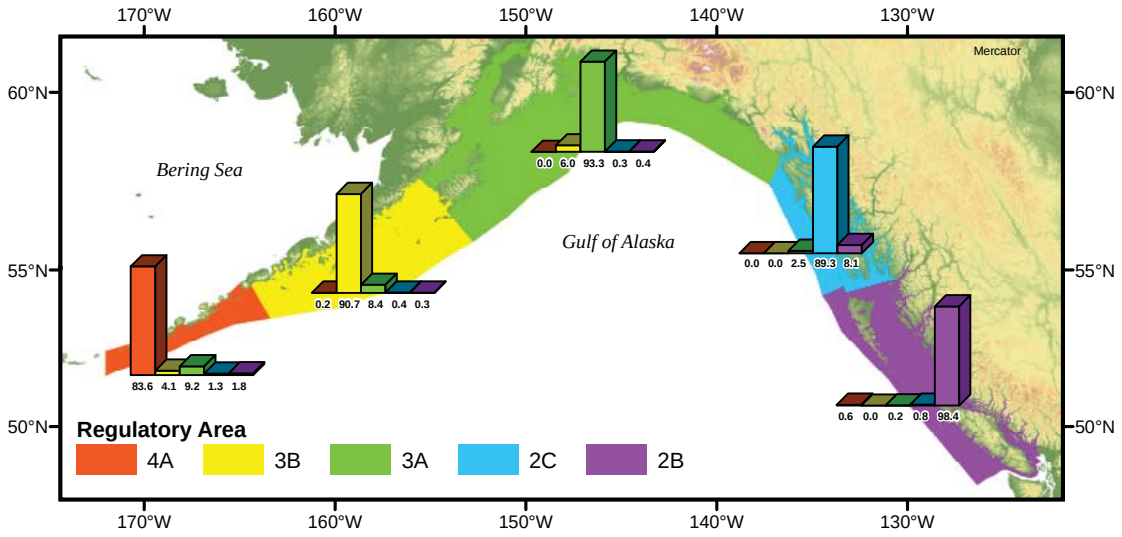


Figure 6. Distribution of tag recoveries from a comprehensive PIT tag project implemented in the 2000s. Each bar graph is placed in the area where the tags were released and the bars indicate the estimated movement rates of tags to each other area.

Although extensive summer-to-summer movements have been recorded, most tag recoveries take place within 60 miles (97 kilometers) of the release area. Data from tagging experiments in which halibut were tagged or recovered in the winter are limited, but the results show that summer-winter movements are more extensive than those between summers and the predominant direction of movement may differ substantially between the two seasons.

The distance and direction of the migrations also may differ with the size and age of the fish. Emigration has been observed from all regions, but few recoveries of adult halibut released in the Gulf of Alaska have been made in the Bering Sea. The longest recorded migration from any tagging experiment was for a fish released near Atka Island in 1967 and recovered 2,500 miles (4,023 km) south near Coos Bay, Oregon in 1972. Another halibut tagged off Newport, Oregon in 1989 was recovered just five months later near Cape Spencer in southeast Alaska. This fish traveled over five nautical miles a day to make the journey. Although tagging studies have shown that coastal migrations of hundreds of miles do occur, most adult halibut tend to return to the same feeding grounds each year.

Food and feeding

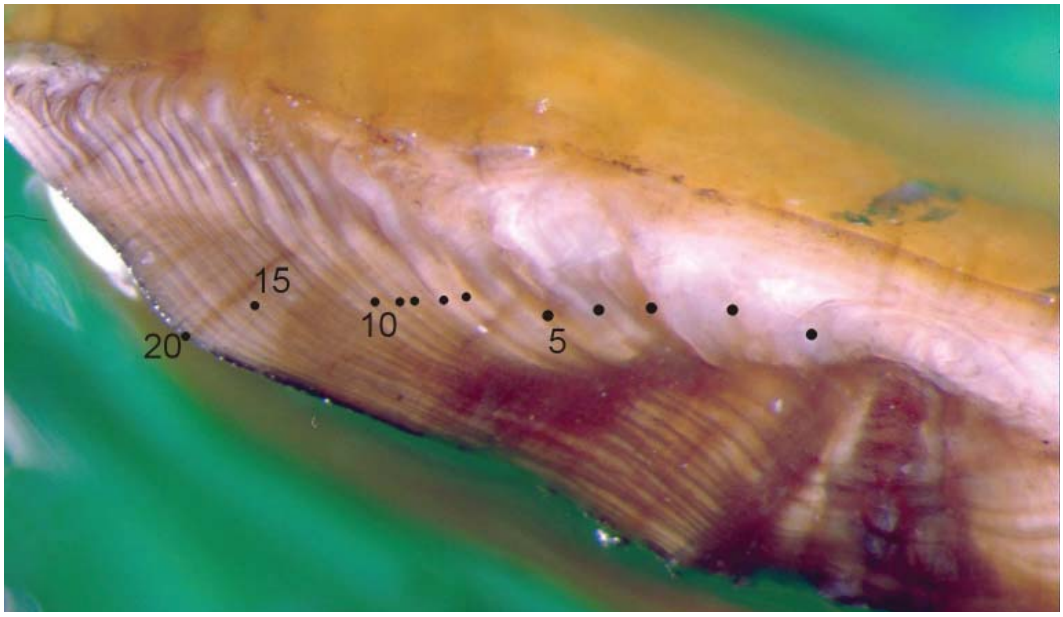
The feeding habits of halibut change throughout its lifetime. Larval halibut feed on zooplankton. Halibut which are 1-3 years of age are usually less than 12 inches (30 cm) in length and feed on small, shrimp-like organisms, crabs, and small fish. As halibut increase in size and become stronger swimmers, fish become a more important part of their diet. The species of fish frequently observed in stomachs of large halibut include cod, sablefish, pollock, rockfish, sculpins, turbot, and other flatfish. Halibut often leave the bottom to feed on pelagic fish such as sand lance and herring. Octopus, crabs, clams, and an occasional smaller halibut also contribute to their diet. Crabs with a carapace width of up to seven inches have been found in the stomachs of halibut, although adult halibut do not appear to be a primary predator of crab.

Larval and juvenile halibut are small and highly vulnerable to predation by other fishes. However, the size, active nature, and bottom dwelling habits make larger halibut less vulnerable to predation than other species. Adult halibut are occasionally eaten by marine mammals and sharks, but are rarely prey for other fish.

Age, size, and growth

Halibut are the largest of all flatfish and are among the larger species of fish in the sea. The largest specimens in the Atlantic are over nine feet long (2.7 m) and have been reported to weigh 700 pounds (423 kg), although these weights have not been thoroughly documented. Several Pacific halibut weighing 500 pounds or 227 kg live weight (375 pounds or 170 kg, net weight) have been landed and documented in Alaska and Russia over the years. These fish are about eight feet long (2.4 m) and generally aged in their 30s. In the 2012 North American market, the fish would be worth about $1,571 (USD).

The age of halibut is determined from the otolith, a calcareous or stone-like body in each internal ear that serves as a hydrostatic or balancing organ. Each year, alternating opaque (summer) and translucent (winter) rings are deposited on the otolith. The annual growth rings, called annuli, are counted to determine the age of the fish. IPHC collects otoliths and growth information from a number of different sources, including the commercial catch and the setline survey (See



The halibut that this otolith came from is estimated to be 20 years old. Photo by Joan Forsberg.

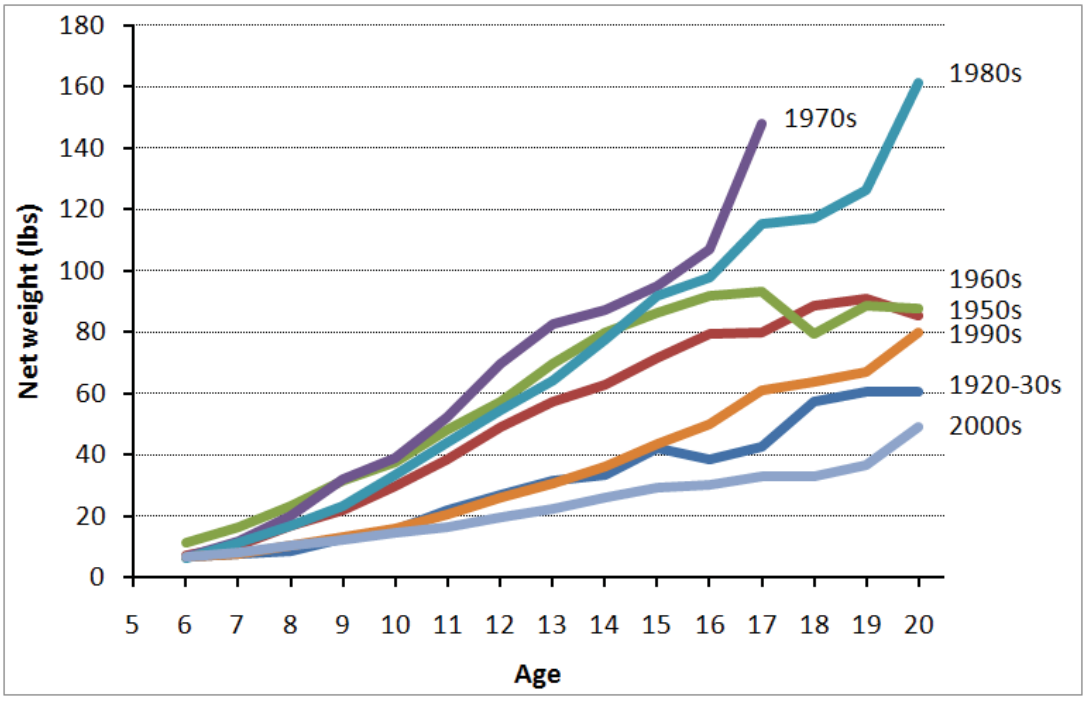


Figure 7. Changes in weight at age of Pacific halibut from the 1920s - 2000s.

port sampling and scientific monitoring sections below). The oldest male and female halibut on record were both aged at 55 years. The average age of halibut in the commercial fishery was 13.6 years in 2012. At one time, the IPHC staff considered the otolith weight to be proportional to the body weight of the fish and that this relationship was constant over time. However, more recent investigation has shown that the relationship between the two measurements changes over time, making otolith weight an unreliable indicator of body weight.

IPHC studies show that female halibut typically grow faster and attain much larger sizes than males. For this reason the commercial catch, which has a minimum size limit, is predominantly female. The North American catch of Pacific halibut, mostly by longline gear, consists of individuals chiefly from 10 to 200 pounds (6 to 121 kg). Few males reach 80 pounds (48 kg), and nearly all halibut over 100 pounds (60 kg) are females. The average size in the commercial catch in 2012 was 22.1 pounds (13 kg). This is a large decrease from 20 to 30 years before when the average weights were 30 to 40 pounds (18 to 24 kg). For the past 25 years, weight at a given age has been decreasing. Similarly low weight-at-age was seen in the 1920s, but subsequently increased to a maximum in the 1980s (Fig. 7). Years of scientific studies have proven inconclusive in explaining these variations in annual growth. Research in the 1990s showed that variation occurred most strongly in juvenile fish. However, more recent research demonstrated that the decrease in size-at-age is most strongly present in older halibut. Anthropogenic, environmental ("density-independent"), and population ("density-dependent") factors all likely contribute to the observed changes in size-at-age. To better understand the role of environment on the halibut stock, the IPHC began an environmental monitoring program aboard its setline survey in 2009, which provides an annual summer snapshot of conditions along the continental shelf of the eastern north Pacific and Bering Sea.

The Directed Fisheries

Pacific halibut are captured from the depths of the north Pacific Ocean and Bering Sea in a number of ways. The fish is primarily targeted by the commercial longline fishery and by sport fishers, as well as taken for personal use (subsistence). The catch also includes fish killed by lost fishing gear, and fish too small to legally retain (which are therefore discarded, and some of which subsequently die); these discards are termed "wastage" by IPHC. Additional mortality occurs in the form of bycatch in commercial fisheries targeting other species which are not allowed to retain halibut. In 2012, an estimated 51.5 million pounds (31.1 thousand metric tons) of directed and non-directed catch were removed from the population.

Today's commercial fishing fleet is diverse, using various strategies to harvest the resource. Both the U.S. and Canadian federal fisheries agencies have implemented individual quota (IQ) systems in Alaska and British Columbia, which enables a vessel to fish anytime during an extended season, and thus use the market to their advantage. In addition, the IQ fisheries have had ramifications for the fishers themselves, the fishing grounds, and the types of gear. A complete description of the IQ fisheries can be found later in this report. In addition to its commercial appeal, halibut continues to be one of the most popular sport fish targets, which has fueled growth in sport harvests, the charter industry, and remote fishing lodges.

The crew aboard the commercial *F/V Clyde*, prepare the gear for setting. Photo by Russell Black.

The commercial fishery

A typical halibut fishing trip in today's fishery begins with the vessel taking on several tons of crushed ice so that the catch can be chilled near, but usually not below, the freezing point. Once the vessel reaches the fishing grounds, the gear is set, left to soak for several hours, then hauled back aboard. As the halibut are brought aboard, they are often clubbed or 'stunned' and

then cut in the gill area to induce bleeding and create a better product. Halibut are dressed soon after capture by removing the viscera and gills. The body cavity or "poke" is scraped, washed, and filled with ice. The head is not removed until the catch is delivered at dockside. The fish are stored in the hold in layers separated with crushed ice. Many vessels now have refrigeration that reduces the amount of ice needed and maintains a lower and more uniform temperature in the hold. Some vessels have refrigerated sea water or an ice/seawater mixture in which to store the fish. The fish are then delivered to a dockside plant where they are headed, cleaned, and either frozen or shipped fresh to buyers who then sell them to consumers.

The mechanics of capturing, cleaning, and storing halibut at sea in the commercial fishery have changed little over time. However, technological advances, steel-hulled vessels, modern electronics, and improved gear (particularly circle hooks and stronger fishing lines), have made fishing more efficient and has allowed the fishing fleet to capture Pacific halibut throughout the entire extent of their geographic and depth distribution.

The fleet

The initial impetus for expansion of the commercial fishery for halibut occurred in 1888 when three sailing vessels from New England began fishing off Cape Flattery, Washington. The catch was shipped from Tacoma to Boston on the newly completed trans-continental railroad. By 1892, following completion of the trans-Canada railroad, Vancouver, British Columbia became the major center for the fishery. At the outset, fishing was conducted from two-man dories that were carried to the fishing grounds by relatively small sailing vessels. The dories were launched from the sailing vessel in the morning and retrieved at the end of the fishing day. This method was dangerous not only because the small dories were vulnerable to sea conditions, but because hauling halibut into small boats created a hazard if the fish were active. Larger sailing schooners and sloops joined the fishery during the next decade; however, by the late 1890s, the fishery was dominated by large, company-owned, steam-powered vessels that carried 10 to 12 dories. Over the years, these steamers declined in number because of their high operating costs, labor problems, and a reduction

Early in the halibut fishery, two-man dories were launched from sailing vessels to conduct the actual setting and retrieving of gear. IPHC photo archive.

Seine-type vessel, *F/V Proud Venture*. Note pilothouse forward compared with a schooner type vessel where pilothouse is aft. Photo by Levy Boitor.

in the stocks of halibut. At the same time, smaller, independently-owned vessels powered by gasoline engines began entering the fishery. Several of these were two-masted schooners carrying from five to seven dories.

During the 1920s, the rising economy, the development of diesel engines, and the expansion of the fishery across the Gulf of Alaska as far west as Unimak Pass led to a sharp increase in the number of owner-operated schooners. These diesel-powered schooners were designed to mechanically haul longline gear directly from the deck. This innovation quickly phased out the hand operations from dories. Most of the halibut schooners were built prior to 1930 and few have been built since that time. They ranged in size from 50 to 80 feet (15 to 24 m) and were between 25-60 net tons. Most schooners still operating in the halibut fishery have been completely renovated. New propulsion systems, advanced navigation devices, communication equipment, hydraulic power and deck controls, cargo-hold modifications, refrigeration, new types of gear and bait, and other technological advances reduced the necessary manpower per vessel by 30%.

After 1930, most of the additions to the fleet were more versatile; the vessels could be used for trawling and purse seining in other fisheries as well as for longlining halibut. Small vessels, particularly salmon trollers and gillnetters, gradually entered the fishery during the 1930s and 1940s.

The composition of the fleet was relatively stable from 1950 through the 1960s. During the 1970s, there was a further influx of smaller vessels fishing relatively close to port and making short trips. In part, this influx was caused by a marked increase in the price of halibut, but also many fishers entered the halibut fishery because they were no longer eligible to fish salmon under several limited entry programs. Most of these small vessels were between 40 and 50 feet (12 to 15 m) in length. Many were designed originally for the salmon gillnet fishery and were

This boat crew takes a break to pose for the camera in the early days of the halibut fishery. IPHC photo archive.

equipped with a power-driven wheel for the storage of the gillnet. The gillnet and drum could be replaced with halibut gear.

Canada limited the number of vessels in its British Columbia halibut fleet in 1979, but the number of vessels increased sharply in the early 1980s in the open-access Alaskan fishery. Many of these vessels were being used in other fisheries and entered the halibut fishery in response to decreases in stocks of other species, the increasing halibut stocks, and the relatively inexpensive gear needed to begin fishing halibut. Many of these vessels were over 70 feet (21 m) in length and proved very efficient at catching halibut. By the late 1980s, the NPFMC and industry were discussing limited entry options for Alaska, which, along with high ex-vessel prices, seemed to inspire a further influx of vessels. The number of commercial licenses issued in the U.S. peaked in 1991 at 6,711.

Fishers

The commercial halibut fishery was pioneered by fishers of Norwegian ancestry. Many of the original immigrants had fished halibut in Norway and came to North America intent on earning their living in the Pacific halibut fishery. Once established in the fishery, relatives followed and now there are many third- and fourth-generation Norwegians in the Canadian and U.S. fisheries. Many Nova Scotians and Newfoundlanders also have participated in the west coast fishery.

Crew size on today's halibut vessels generally ranges from one to six people, depending on the size of the vessel and type of gear used. Before IQ management systems, compensation was always on a share basis. Since IQ systems began, compensation has varied greatly among vessels. For example, on a larger vessel in the Seattle-based fleet, about 40% of the gross proceeds from the sale of the catch is known as the "boat share," which goes to the owner of the vessel. In Alaska, this percentage is known to be as high as 45% in some cases. Lost gear, insurance, and other items are also deducted from the gross. From the remainder, the trip expenses (such as food, bait, fuel, and worn gear) are deducted. The net balance or "crew share" is divided equally among all members, including the captain. If the captain is not the vessel owner, he usually receives an additional portion of the boat share. Apprentice fishers, or "in-breakers," are paid a partial share until they can demonstrate sufficient ability to justify a full share. On larger vessels, the cook often works on deck but to a lesser degree than other crew, as cooking duties require time in the galley. In Alaska, crew may also own catch quota of their own, which alters the traditional crew-share framework for revenue sharing on a trip.

As seasons became shorter and shorter in the 1980s and early 1990s (down to one or two days), fishers often worked the entire opening without sleep. This, along with pressure to fish in

even the worst weather or risk losing a large percentage of the year's income, was the cause of several mishaps at sea. With the advent of the IQ systems, fishers generally work shorter hours and do not fish in strongly inclement weather. Trip length can be as long as 15 days in some Bering Sea areas where the commute from the fishing grounds to port is significant. However, most fishing trips range from one to six days depending on refrigeration facilities.

Regulatory structure

Individual Quota (IQ) Fisheries

In 1991, Canada implemented an individual vessel quota system (IVQ) where each vessel was given a percentage of the area catch limit to harvest at any time over an extended fishing season. The Commission approved a seven-month season for the area that year. Because of the limited entry system already in place, consolidation of the fleet was not an issue and the fleet remained at 435 vessels. In 2006, the Canadian Department of Fisheries and Oceans (DFO) implemented a Groundfish Integrated Fisheries Management Plan (IFMP), where all vessels were accountable for all of their catch, both retained and discarded. All hook-and-line vessels, even those not officially licensed as halibut vessels, could retain and sell halibut as long as they had, or purchased, halibut quota shares to cover their catch. The IFMP was to be a three-year pilot project and was extended through 2009. In 2010, the IFMP was officially approved and instated by DFO in Canada. Despite the addition of vessels from other fishing fleets, the number of active Canadian vessels catching halibut in 2012 was 176, largely due to leasing of halibut quota among license holders.

Access into the U.S. fishery remained unrestricted through the 1980s and early 1990s. Safety issues, fish quality issues, and unacceptably short seasons prompted the NPFMC to pass regulations for an individual fishing quota (IFQ) system for Alaska, which was implemented by the National Marine Fisheries Service (NMFS) in 1995. Individual fishers were given a percentage of an area catch limit based on historical fishing records. A total of 4,831 fishers received quota shares initially. Because the shares were issued to fishers and not vessels, as was the case in Canada, the fleet initially remained diverse; however, the number of vessels participating declined slowly as quota shares were combined.

The result of the IQ systems in both countries has been highly favorable from a consumer standpoint and for most fishers. Fishers with quota shares are generally receiving more money per pound for their halibut, and catches are spread over a seven- to eight-month season so that there is fresh fish available to the market most of the year. Quality has also improved because the race for fish no longer exists and crews have more time to ensure proper icing and storage procedures at sea.

The safety record has improved as well. It was not uncommon in the past to have multiple vessel losses and injuries on deck during the derby. Previously, with only a few short seasons a year, fishers felt intense pressure to fish even when common sense told them to stay in port or to get some sleep. For many, their yearly income was dependent on their halibut catch. Under the IQ systems, injuries have decreased because fishing in adverse conditions is no longer necessary.

With the implementation of the IFQ program in Alaska came an allocation to certain communities bordering the Bering Sea through a Community Development Quota (CDQ) program. The program provides for the specific allocation of a percentage of the halibut catch limit for each IPHC regulatory area within Area 4 to the CDQ entities; the percentage varies by area.

The Commission believes that the IQ programs have been successful in accomplishing the goal of having a safer, more spread-out fishery, which allows more accurate control of the harvest and adherence to management targets. There have been proposals from industry in recent years for longer seasons into the winter months, but the IPHC has not adopted these primarily out of concern for intercepting migrating fish.

Derby fishing

Management on the U.S. west coast is unique in several ways, and not only because it remains the last non-tribal derby fishery for halibut. Aside from directed fishing, there is a series of tightly managed sport, treaty Indian, and incidental allocations, all defined in a PFMC Catch Sharing Plan, which was implemented in 1988. The non-treaty, directed commercial fishery remains unrestricted in terms of entry, resulting in a season comprised of 10-hour openings with catch restrictions based on vessel size. Starting in 1995, a non-treaty fisher had to choose to either participate in the sport charter fishery or the commercial fishery. If the commercial fishery was chosen, only one type of fishery could be selected; either target halibut during the directed fishery or catch halibut incidentally in the salmon troll fishery. In 2001, a third commercial fishery option was available: the retention of incidentally-caught halibut during the longline sablefish fishery north of Point Chehalis, Washington.

Fishing grounds

Historically, most fishing occurred in specific areas or grounds where halibut tended to concentrate because of favorable conditions such as abundant food supply or preferred bottom type. These fishing grounds are located throughout the entire range of the species from northern California to the central Bering Sea. In the open access or derby-style fisheries, the major grounds were often heavily targeted during the short openings. However, in the limited entry fisheries, fishers tend to stay closer to port if they are fishing strictly for halibut, or take halibut at the same time that they are harvesting other species, thus spreading effort over a greater area.

Successful halibut fishing depends on an intimate knowledge of the distribution of the species and the technique of setting gear with bait that will attract the fish. Experienced fishers often prefer to set their gear on hard bottom (rock or gravel) or areas of vertical relief. Electronic depth sounders and navigation devices (Global Positioning System, plotters) assist the captain in locating the fishing grounds. Some grounds cannot be fished when tidal currents are strong; others are difficult to fish because rock outcrops tend to snag the gear and chafe the groundline.

A crewman sets tubs of baited halibut gear from the stern of the vessel. Photo by Serge Aucoin.

Fishing gear

The type of gear used to fish for halibut has changed little over the years (Figs. 8 and 9). However, in the 1950s, with the influx of salmon seine and troll boats into the fishery, snap gear was introduced. This gear is still used on many vessels which require multi-species layouts. Another change occurred in the 1990s when the individual quota systems were implemented.

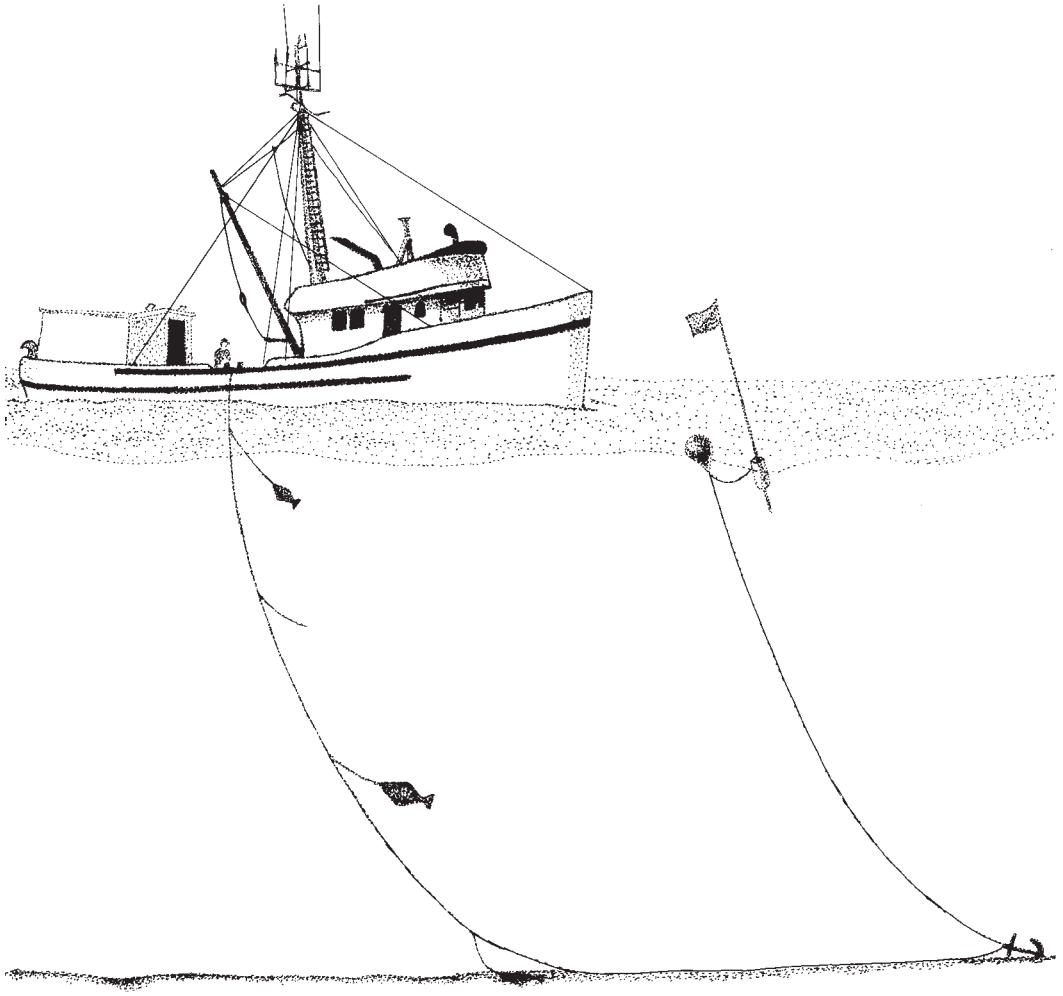


Figure 8. Halibut fishing gear.

Halibut are oftentimes fished in tandem with sablefish, and many fishers are choosing to use sablefish or combination gear, which utilize smaller hooks at a closer spacing, for both tasks.

In the early years of the fishery, the groundline was formed by splicing together a number of lines, each 300 feet (91 m) in length. The number of lines varied considerably, but the six-line skate (1,800 feet or 549 m) eventually was adopted by most. Groundline is now sold in 1,800-foot (549 m) coils.

The interval between hooks or "rig" of the gear varies from 3 feet (0.9 m) to as much as 42 feet (13 m) depending on gear and fishing target. Most halibut gear today is rigged 12 to 18 feet (3.7 to 5.5 m) and about 70% of the catch comes from spacing at 9 feet (2.7 m) or greater.

The lines of conventional setline gear were originally made of natural fibers such as hemp, cotton, manila, or sisal, depending on their availability, quality, and cost. These natural fibers now have largely been replaced with man-made materials, mainly nylon. In 1982 and 1983 fishers converted to circle-shaped hooks from the traditional J-shaped hooks. IPHC studies indicate that circle hooks are two to three times more efficient at catching halibut than J-hooks, depending on fish size. The reason for this is better hooking qualities, as well as lower escape rates once the fish are on the hooks. Large hooks are most commonly used when targeting halibut exclusively and smaller hooks are more common when targeting other species simultaneously, such as sablefish.

The skates are tied together and set in strings of 4 to 12 skates each. The number of skates per string depends on factors such as the size of the fishing grounds and the likelihood of snagging on the bottom. Each end of the string is attached to an anchor and buoy line and marked at the

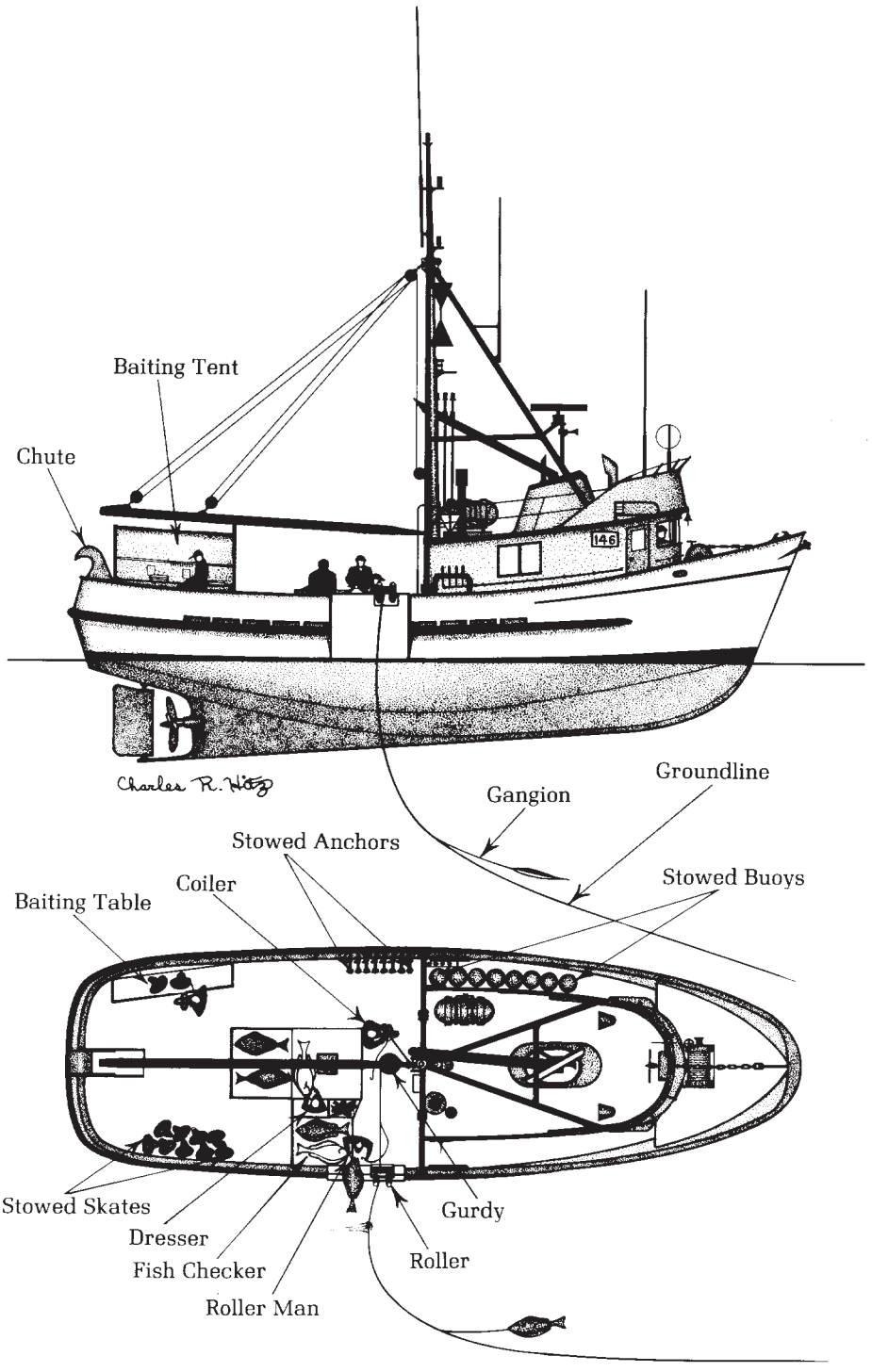


Figure 9. Deck layout of a vessel fishing with conventional gear.

surface with a buoy, flagpole, and flag. When fishing at night or in heavy fog, lights or radar reflectors are used on each flagpole to aid in locating the gear. Depending upon the grounds, time of year, and bait used, most of the gear is left in the water, or "soaked," for 4 to 24 hours, but the average soak for each skate is about 12 hours. Extensive soak times have been directly related to sand flea (a small amphipod) predation, which will kill the fish and make it unmarketable. Sand fleas are usually more active at night, prompting many fishers to try to retrieve their gear before the dark hours. Most fishing is conducted in depths ranging from 15 to 150 fathoms (27 to 274 m); up to 700 fathoms (1,280 m) if also fishing for sablefish.

Baits used in the halibut fishery are either fresh or frozen and include herring, octopus, salmon, squid, shad, and "shack" or "gurdy" bait which consists of species caught incidentally on the halibut gear. Much of the frozen herring, squid, and shad comes from the eastern U.S. or fisheries outside the U.S.

Conventional gear

Traditionally, a unit (skate) of conventional setline gear or fixed gear consists of groundline, gangions, and hooks. Loops of light twine (beckets) are attached at regular intervals to the groundline. Short branch lines (gangions) three to four feet (0.9 to 1.2 m) long are attached to the beckets and a hook is attached to the end of each gangion. The most common rigs are 3, 3.5, 9, 12, and 18 feet, (0.9, 1.1, 2.7, 3.7, and 5.5 m) as those intervals facilitate baiting the hooks and coiling the lines. The skates with the baited hooks are set over a chute at the stern of the vessel. A variant of conventional gear, called tub gear, involves the harvesters coiling the groundline in plastic tubs (either half-skate or full-skate tubs) and notching the hook end of the gangions in slots which have been cut around the edge of the tub. This gear requires less expertise to coil and results in fewer snarls during setting.

The gear is retrieved on a power-driven wheel (gurdy). One person stands at the roller, tending the gear and fish as they come aboard, and one person coils the line after it passes the gurdy. The gear is then inspected for necessary repairs, baited, and recoiled in preparation for the next set.

Snap gear

Snap gear differs from traditional setline gear in that the branch lines (gangions) are attached to the groundline with removable metal snaps rather than being tied to the groundline with twine. Further, the groundline used for snap gear is one continuous line that is simply stored on a drum after the gangions are removed, instead of being separately coiled. The method of attaching the hooks to the gangions is the same for snap gear and traditional gear. In recent years, some fishers have incorporated swivels, which act as rotating joints between the snap and gangion, the gangion and hook, or occasionally at both joints. When rockfish or dogfish are hooked, they tend to spin. It is thought that swivels extend the life of the gear and decrease the likelihood a fish will "spin off" the gear. The IPHC is developing analyses to account for swivel usage and any differential impacts on halibut catch rates.

Gangions with snaps and baited hooks are stored on racks, and a fisher snaps the gangions to the groundline as it unwinds from the drum during setting. Hook intervals can be changed with each set or within a set. When the gear is retrieved, the gangions are unsnapped as the groundline is rewound on the drum.

For small boats with only two or three fishers, snap gear has several advantages over traditional gear. First, storing the groundline on a drum eliminates the need for a person to coil gear and reduces the amount of storage space required. Although catch rates tend to be higher with traditional gear on a larger boat, more snap gear can usually be set by a small crew than it would be able to handle in the traditional manner. Another advantage is that the hooks can be widely spaced when prospecting for fish and more closely spaced when a concentration of fish

is located. These advantages coupled with the relatively low capital investment for a small boat were some of the reasons for hundreds of new fishers entering the fishery in the 1970s.

Autoline gear

Autoline gear is a third type of gear used in the longline fishery. Although not ordinarily found on a halibut-only vessel, this type of gear is used frequently to fish for Pacific cod and sometimes sablefish. If a vessel is fishing for multiple species at one time, this gear may be used for halibut as well. As with conventional gear, the gangions are tied to the groundline at fixed intervals, but the autoline gear is unique because the hooks are stored on a magazine and then automatically baited as the gear is set. Upon hauling, the hooks are automatically cleared and replaced on the magazine for the next set. The gangions are generally shorter and closer together than on conventional gear, and there is no need for crew members to coil during hauling or to bait the individual hooks. Bent and broken hooks and gangions can be replaced when the gear is in the storage magazine. The disadvantage is that the system is costly to purchase and maintain, and outgoing hooks sometimes go unbaited.

Statistics of the fishery

The commercial landings of Pacific halibut first peaked in 1915 with 68 million pounds (41.1 thousand metric tons) caught by both Canadian and U.S. fishers. For several years following that peak, landings decreased (Fig. 10). Landings peaked again in the early 1960s, the late 1980s, and, most recently, the early 2000s, as the fishery responded to fluctuations in the stock abundance. Since 2002, the fishery landings have declined steadily due to management measures tracking declining size-at-age and recruitment. Landings in 2012 totaled 31.9 million pounds (19.3 thousand metric tons) across all regulatory areas.

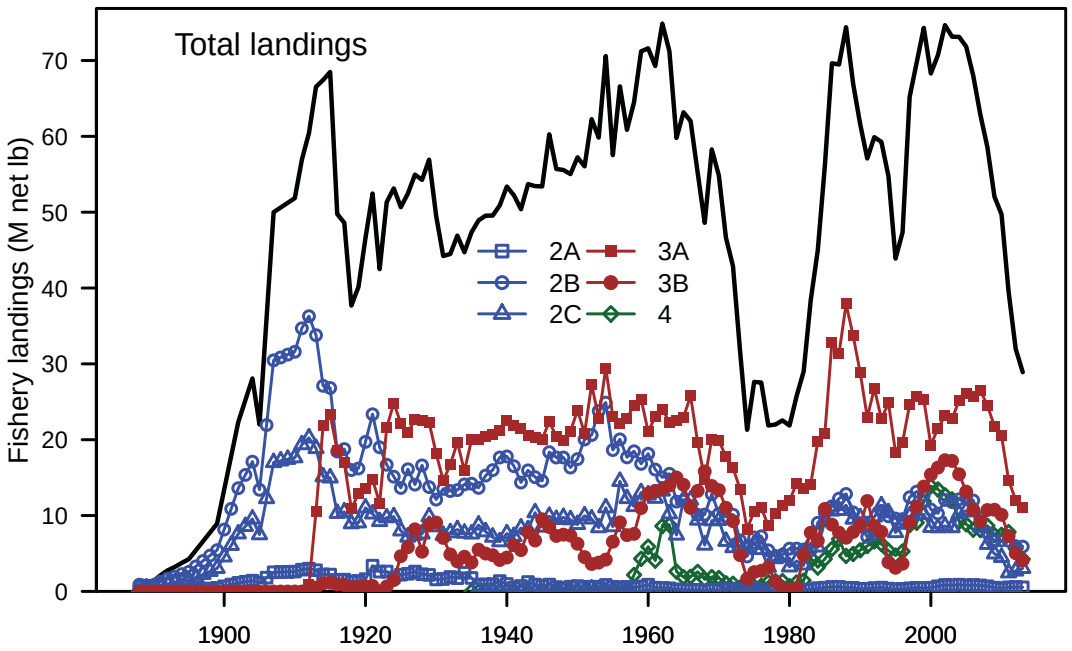


Figure 10. Total commercial landings by regulatory area, 1888-2012.

Landing ports

In the early years of the fishery, most landings were made on the west coast of North America, either in Puget Sound or Vancouver, B.C., because the fish were then shipped by railroad to other parts of North America. As transportation improved, landings spread to Alaska

and other parts of British Columbia. Prince Rupert, B.C. was termed "The Halibut Capital of the World" for sixty years, although in some of the years, Seattle, Washington had higher landings. In the late 1970s, Kodiak and Seward in Alaska became important landing ports, and in 1981, surpassed Prince Rupert.

In 2012, the top ports in the U.S. were Kodiak with 19% of the U.S. landings, followed by Homer with 17%, and Seward with 10%. Sitka, Petersburg, and Juneau received the top landings in southeast Alaska. The top ports in Canada were Port Hardy with 49% of the landings, followed by Prince Rupert/Port Edward with 39%, and Vancouver with 5% (Table 1).

Table 1. Commercial landings (thousands of pounds, net weight) of Pacific halibut by port and vessel nationality for 2012.

IPHC Group	Canada	United States
CA & OR	-	140
Bellingham/Seattle	-	659
WA	-	316
Vancouver	298	-
Port Hardy	2,898	-
Southern BC	279	-
Prince Rupert & Port Ed.	2,309	-
Northern BC	90	-
Ketchikan, Craig, Metlakatla	-	233
Petersburg, Kake	-	1,013
Juneau	-	939
Sitka	-	1,209
Hoonah, Excursion, Pelican[1]	-	
Southeast AK	-	763
Cordova	-	543
Seward	-	2,595
Homer	-	4,419
Kenai	-	54
Kodiak	-	4,866
Central AK	-	2,403
Akutan & Dutch Harbor	-	2,755
Bering Sea	-	2,477
Total	5,874	25,384
Grand Total	31,258	

[1]Included in Southeast AK

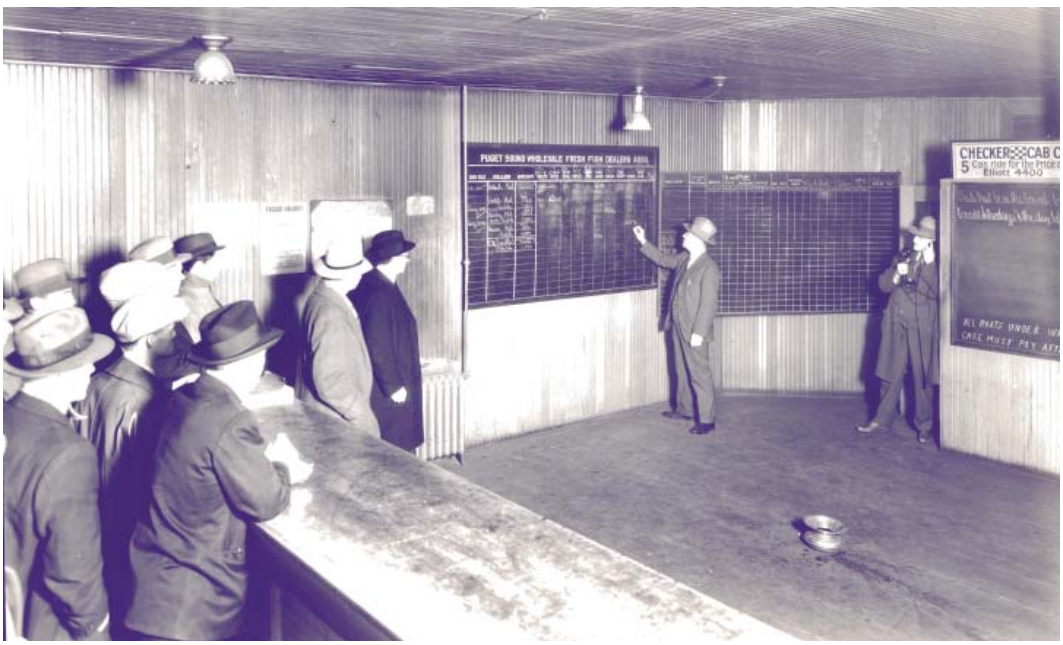
Value and marketing

Pacific halibut is one of the most valuable fish species in the north Pacific and the value has increased since the 1930s. Before 1940, the average annual price per pound was usually less than $0.10 (all values are U.S. dollars). Adjusting for inflation, $0.10 in 1935 translates to

approximately $1.68 in the 2012 market. During the 1940s through the 1960s, the price varied from $0.10 to $0.38 per pound. The price steadily increased through the 1970s, with a high of $2.13 per pound in 1979, when the catch limit was fairly low. As abundance of halibut began to again increase in the early 1980s, price dropped back down to between $0.89 and $1.13 per pound. During the late 1980s and early 1990s, fishing seasons were short and few, resulting in the majority of fish entering the frozen market. The average price during this period ranged from $1.28 to $2.12 per pound.

In 1991, when Canada implemented the IQ system, most of the Canadian-caught fish went to the fresh market instead of frozen, and the price that Canadian fishers received jumped to as much as $2.70 per pound. A similar increase occurred when the U.S. implemented its IQ system in 1995. The average price per pound in 1996 was $2.27 in the U.S. (including Alaska, Washington, Oregon, and California) and $2.67 in Canada. In 2012, the average ex-vessel price was $4.19 in Alaska and $5.40 (CAD) in Canada (Fig. 11).

In the early years of the fishery, public auctions were a common way for fishers to sell their catch to processing plants. As seasons grew shorter and the number of deliveries that a plant had to accommodate grew, auctions became less frequent and fishers would sell directly to the processors. Oftentimes processors would accommodate a vessel with ice and bait in return for their business, or the best price was negotiated from the fishing grounds prior to delivery. In the



In the early years of the fishery, public auctions were commonly used to sell a load of halibut. IPHC photo archive.

past few years, auctions have been used periodically, and fishers can even sell their catch online, although direct negotiations with the processors remain the most common.

After the sale, the halibut are unloaded from the vessel and graded into trade categories according to weight. In the earlier years of the fishery, the standard weight categories were “chickens” or “chix” (5-10 pounds; 3 to 6 kg), small (10-20 pounds; 6-12 kg), medium (20-60 pounds; 12-36 kg), and large (60+ pounds; 36+ kg), but by the late 1980s, the weight categories varied greatly among the plants. In 1973 the legal size limit was increased from 26 to 32 inches (66 to 81.3 cm) and few fish under 10 pounds (6 kg) are now landed.

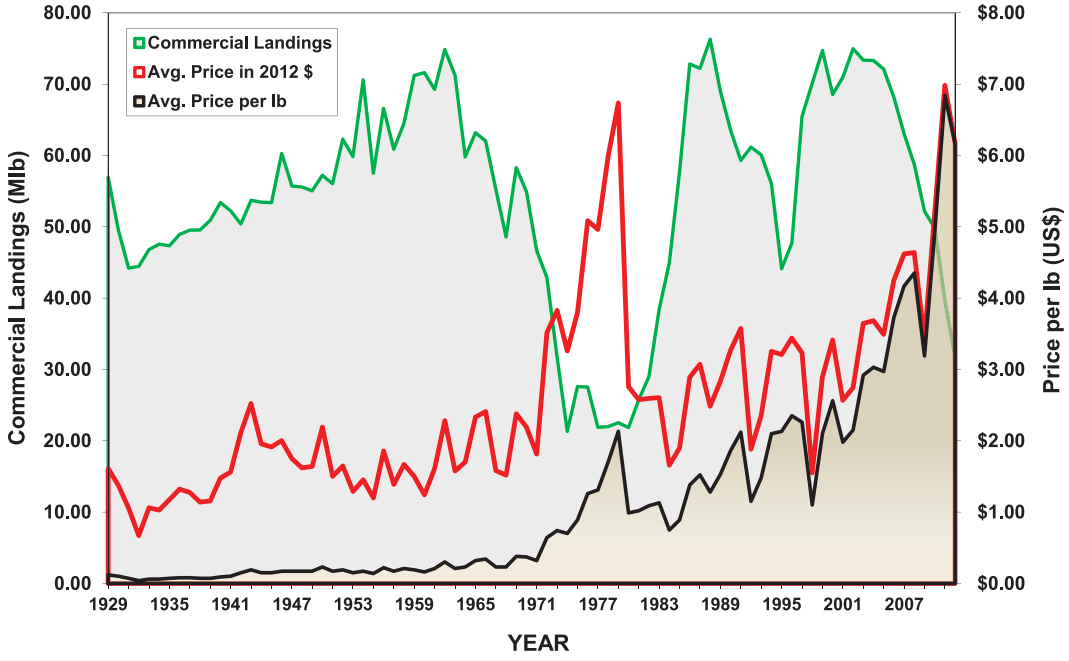


Figure 11. Commercial halibut landings and average price per pound 1929-2012.

Processing the fish once it reaches the plant varies depending on the market. The fish is delivered to the plant with entrails removed (dressed). The plant then often beheads the fish and completes the cleaning process. If prepared for the fresh market, the fish is packed in ice and shipped. If the fish is frozen, the process consists of freezing initially, then dipping several times in water to "glaze" or coat the body with ice to prevent dehydration in storage.

IPHC port sampler, Levy Boitor, and biologist, Lara Erikson, sample a large halibut in Petersburg, AK. Photo by Joan Forsberg.

Following processing by the plant, the fish are shipped to retail markets, often as whole, fresh fish to then be further portioned into roasts, fillets, or steaks by the retail fish market. The "cheeks" of the halibut, a tender piece of meat found on the outside of the gill covers or opercula, have been a delicacy enjoyed by fishers for many years, but have only recently been marketed commercially. Preparation for the table varies and includes poaching, frying, baking, steaming, and barbecuing.

IPHC port sampling

The IPHC has collected biological data and logbook information from the commercial fishery since the 1930s. The port sampling program obtains biological data from commercial deliveries, by collecting random samples of halibut otoliths and corresponding fork length measurements, and collects detailed fishing

records from commercial fishers. Otoliths sampled from the commercial catch provide age composition information, while fork lengths provide weight estimates, important components to the annual stock assessment. During 2010-2012, the program collected fishing logs representing approximately 85% of the commercial catch, by weight.

During the pre-IQ fishery openings in Alaska and British Columbia, key landing ports were staffed, short-term, by Seattle office staff and locally-hired personnel. Post-IQ, full-time seasonal port samplers have been stationed in the major ports of delivery, including: Bellingham, Dutch Harbor/Unalaska, Homer, Juneau, Kodiak, Petersburg, Seward, Sitka, and St. Paul Island in the U.S.; and Port Hardy, Prince Rupert, and Vancouver in Canada. Sampled ports have changed in response to shifts in commercial landing patterns. In recent years, the ports of Adak and Sand Point, Alaska have also been staffed. In Area 2A, IPHC works cooperatively with Washington State tribal biologists to collect data from the tribal commercial fisheries, while Seattle staff and locally-hired personnel continue to sample the derby-style, directed commercial fishery landings in Newport, Oregon.

Wastage

Wastage refers to three categories of removals that are not landed: 1) halibut that are caught during the commercial halibut fishery and are left to perish on lost or abandoned gear; 2) the fraction of "sub-legal" (i.e. under 32 inches in length or U32) halibut that are caught and must be released during a commercial halibut fishing trip which subsequently die from the capture process; and 3) fish that are discarded for regulatory reasons. The IPHC staff estimates the O32 (i.e. 32 inches and greater in length) waste through commercial logbook information, and the U32 catch rates from the setline survey and from logbooks in Area 2B.

Wastage was very high in the late 1980s during the peak of the 'derby' fishery in Alaska (Fig. 12). Wastage declined as the IQ programs went into effect when the survival of discarded halibut was assumed to increase with more careful handling and there was much less lost fishing gear. The result was that O32 waste decreased 69% from 1994 to 1996, and U32 waste decreased 33% in the same time period. The decrease occurred because the fleet size was smaller, and also that fishers started setting only as much gear as they could haul in a trip, more often fished

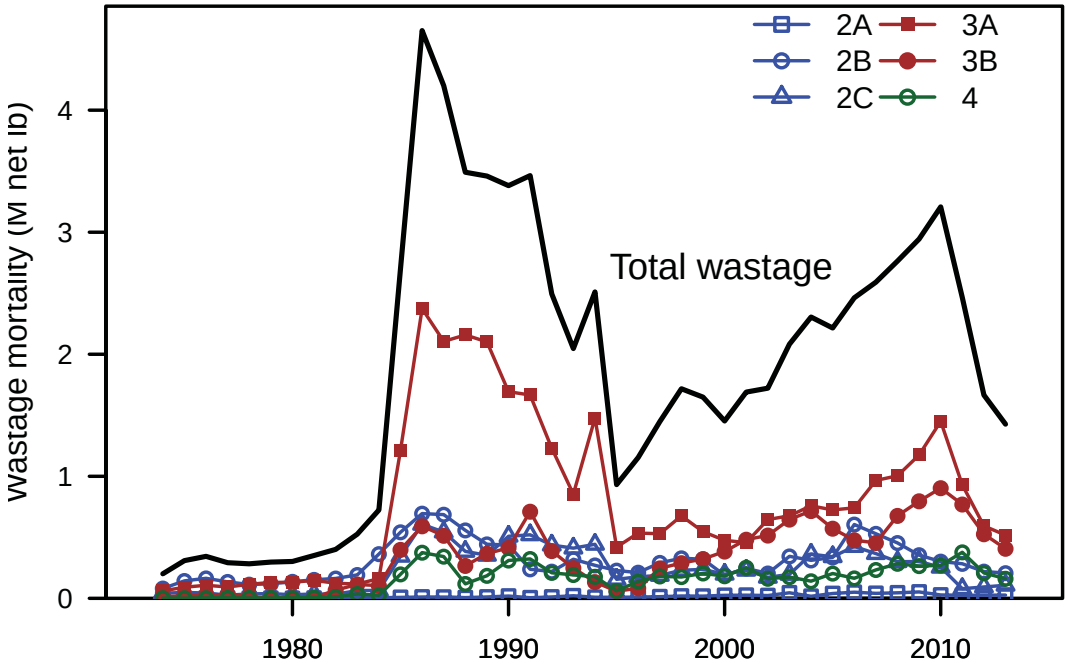


Figure 12. Wastage removals (millions of pounds, net weight), 1974-2012.

during better weather, and were more careful when hauling the gear. Wastage of U32 halibut subsequently increased, peaking near 3 million pounds in 2010 and has since decreased once again to about 1.6 million pounds in 2012. The decrease in halibut size-at-age likely contributed to increased catch rates of halibut below the 32-inch limit, which are discarded, many of them ultimately suffering mortality as a result of their capture.

The sport fishery

The sport fishery for halibut had a slow beginning. Prior to 1973, all fishing for halibut was governed by the commercial fishing regulations; thus it was illegal for anyone to catch halibut when the commercial season was closed. Sport-caught halibut, though, were frequently taken during these closed periods. Because the sport catch, including sport-caught fish taken out of season, was relatively small compared with the commercial catch, IPHC concluded that the problem was not a serious concern in the management of the fishery.

Sport fishers in Ninilchik, AK pose with their catch. Photo by Lara Erikson.

As the sport catch increased, federal and state agencies urged the IPHC to officially recognize the sport fishery. Legal interpretations by the two federal governments indicated that the Halibut Convention provided the authority to regulate the sport fishery. After consultation with the DFO in Canada, the NMFS in the U.S., and the appropriate state agencies in Alaska, California, Oregon, and Washington, the Commission adopted sport regulations in 1973.

Prior to about 1975, taking of halibut by sport fishers was usually incidental to saltwater fishing for salmon. Since that time, however, the popularity of bottomfish with sport fishers has surged. Estimates of halibut catch are compiled by domestic agencies and obtained through creel census and postal surveys in Alaska, and creel census and telephone interviews on the U.S. west coast. Catch estimates for British Columbia are generated from a combination of voluntary reporting and limited creel census sampling. DFO is currently working on developing a more accurate accounting system.

In Alaska, the harvest by the sport fishery steadily increased, but has declined in the past few years. In 1977, the Alaskan sport harvest was 268,000 pounds (162 metric tons), growing to a peak of 9.4 million pounds (5,671 metric tons) in 2009. Increased fishery restrictions coupled with declines in abundance have resulted in the harvest in 2012 of 6.87 million pounds (4,144 metric tons). Virtually all of the Alaskan sport harvest comes from southeast Alaska and the central Gulf of Alaska.

The fishery off British Columbia has also grown in popularity in recent years. Marketed as part of a "destination experience", halibut fishing is a significant activity of many remote lodges which are only reached by float plane. Anglers usually go out in small boats with a guide, but can also be furnished with a boat which they operate independently. The remoteness of the locations and joint monitoring of sport salmon, bottomfish, and halibut fisheries led to poor and infrequent estimates of the halibut sport harvest during the 1970s and 1980s. DFO has sought improvements to its monitoring, and is continuing to expand its efforts. Nonetheless, harvests by the Canadian sport fishery are estimated to have grown from less than 100,000 pounds (60 metric tons) in the mid-1980s, to an all-time high of 1.8 million pounds (1,085 metric tons) in 2005. Bag limit restrictions in recent years lowered the annual harvest to the 1.1-1.2 million-pound (664-724 metric tons) range by 2012.

Sport halibut fisheries off the coasts of Washington, Oregon, and California are much more tightly regulated to fulfill domestic agency management goals. Sport fishery catch limits have been set as a percentage of a combined fishery catch limit which has been applicable to all sectors, including the sport fishery, since 1988. Because of that limitation, the sport harvest off the U.S. west coast has not increased as markedly as it has in Alaska and British Columbia. In recent years, sport harvests have ranged from 0.23 million pounds (139 metric tons) in 1996 to as high as 0.52 million pounds (314 metric tons) in 2006.

As in many areas, sport fishers have individual preferences for their halibut gear. Lines usually test from 40 to 80 pounds (18 to 36 kg) and circle or treble hooks, either 6/0 or 8/0 are used. Light or poorly-made hooks can be straightened out or bent by large halibut. A 10- to 32-ounce (0.3 to 0.9 kg) sinker is used with baited hooks and spreader bars when fishing with bait, whereas jigs weigh from 17 to 28 ounces (0.5 to 0.8 kg). Rods generally are heavy and stiff to handle the heavy sinkers and the potentially large halibut. Reels with a high gear ratio are desirable to reduce the effort in retrieving the gear from depths as great as 600 feet (183 m). Jigging gear is used extensively off British Columbia and Alaska.

Because of their size, halibut are considered a trophy fish. A 459-pound (208 kg) round-weight (head-on, not eviscerated) halibut caught on a rod and reel in 1996 holds the Alaska state record. The record in British Columbia is 482 pounds (219 kg) round weight. The record in the state of Washington is 288 pounds (131 kg) round weight. All sport fishers should be aware of the dangers in handling a large fish in a small boat. Halibut are powerful and have been known to smash objects with their tails.

Numerous activities involve sport halibut fishing around the northern Pacific. Started in 1986, the Homer Halibut Derby is the longest running halibut derby in Alaska. Prior to the start of each year's derby, numerous halibut are caught, tagged, and released. Sport fishers then try and recover these tagged fish, which are randomly valued between $250 and $50,000 USD.

The coastwide sport harvest of halibut has grown considerably since IPHC began keeping sport catch statistics in the late 1970s (Fig. 13). The sport harvest first reached one million pounds (605 metric tons) in 1981 and continued to grow, surpassing five million pounds (3,024 metric tons) in 1989 and 10 million pounds (6,048 metric tons) in 2004. Sport harvest peaked at 11.5 million pounds (6,955 metric tons) in 2007 and has since declined somewhat to 7.5 million pounds (4,525 metric tons) in 2011.

The sport catch in Alaska is sampled for length and otoliths by the Alaska Department of Fish and Game (ADF&G) and the samples are forwarded to IPHC for aging. Local agencies in other areas conduct similar length sampling as part of their harvest estimation programs.

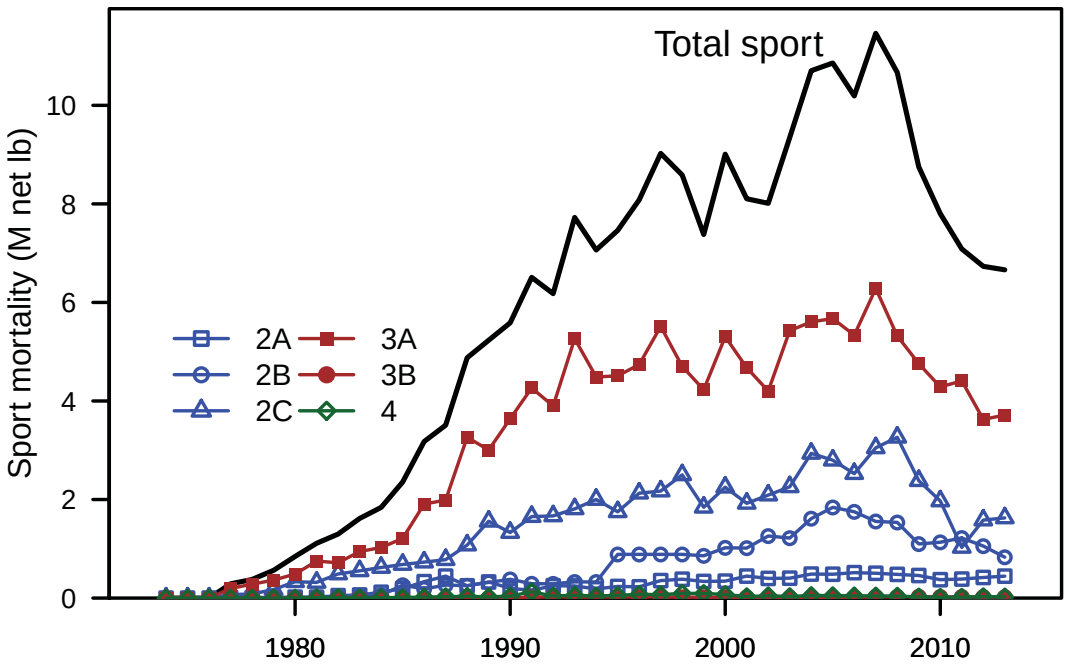


Figure 13. Sport catch removals (millions of pounds, net weight) since accounting began, 1977-2012.

Regulatory structure

Sport fisheries are managed jointly by the IPHC, the U.S. fishery management councils, and the individual states in the U.S., and cooperatively by IPHC and DFO in Canada.

Methods for managing and limiting the sport harvest vary by jurisdiction. Prior to 2014, there was no overall sport halibut catch limit in Alaska, just daily bag and possession limits for the individual angler. In 2003 the NPFMC implemented a Guideline Harvest Level (GHL) program for the guided sport charter fishery in Areas 2C and 3A. The GHL program specified predetermined harvest targets which changed in relation to changes in halibut abundance. Management restrictions were to be imposed by NMFS when the harvest exceeded the GHL in order to reduce the harvest in the subsequent year. However, the GHL for the Area 2C sport charter fishery was exceeded every year until 2011, when fishery restrictions were finally imposed and the harvest was reduced below the GHL. In Area 3A, its GHL was exceeded only once, in 2007. In general, the program had limited success in Area 2C in achieving the goals of effectively managing the charter fishery to the specific GHLs.

In 2011, NMFS implemented a limited entry program for the sport charter fishery, which requires that the vessel operator possess a special permit to participate in the fishery. Beginning in 2014, a catch sharing plan governs harvest allocations for the Areas 2C and 3A commercial and sport charter fisheries. In this plan, the IPHC sets a combined catch limit (CCL) for the commercial and sport charter fisheries; subsequent allocation percentages then split the CCL into catch limits for each fishery.

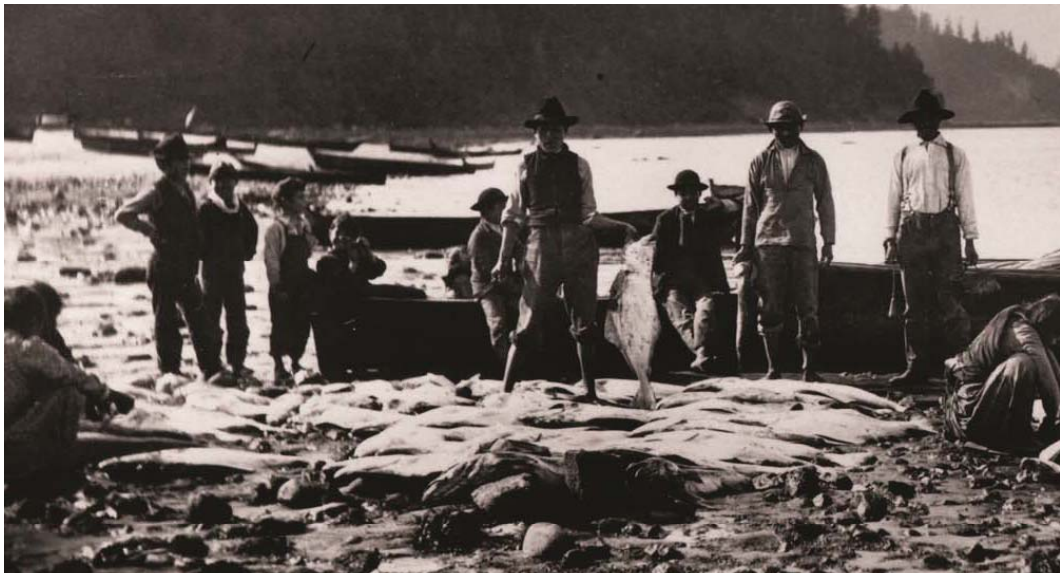
Through 2003, the Canadian sport fishery was managed without any fishery limits, but anglers were restricted by bag and possession limits. However, in 2004 DFO enacted a catch sharing plan which works from a combined commercial-sport fishery catch limit set by IPHC. Under the plan, DFO allocated 12% of the combined limit to the sport fishery and 88% to the commercial fishery. DFO uses management tools such as adjusting season lengths, reduced bag and possession limits, and area closures to maintain the sport catch within its allocation. In years when the sport fishery has exceeded its allocation, the sector has purchased unharvested

commercial quota to cover the sport harvest overage. Catch statistics are compiled by DFO and provided annually to IPHC. In 2008 and 2010, the sport fishery reached its allocation and was closed in October. DFO and the commercial and sport fishing sectors are currently exploring methods of more efficiently using the combined catch limit. Beginning with the 2013 fishing season, DFO changed the allocation between sectors to 85% for the commercial fishery and 15% for the sport fishery.

The U.S. west coast sport fishery is also managed by bag and possession limits, and receives an allocation through the PFMC's Catch Sharing Plan. Close monitoring by NMFS, Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and IPHC, along with in-season adjustments to opening dates, has kept the west coast sport fishery at or near its overall catch limit. In recent years, halibut sport harvests off northern California have grown and been the focus of discussion about increased monitoring and management of the area. This has brought California Department of Fish and Wildlife into halibut sport fishery management discussions. Sport fishing is very popular off the U.S. west coast, in part due to the proximity to major population centers. Anglers view halibut as an alternative to salmon, other bottomfish, and albacore tuna. Because of this popularity, the area is divided into seven subareas, each with its own allocation and season structure. Season dates are set to not conflict with other fisheries, and may be open for only one to three days per week in some subareas.

Artisanal and subsistence fisheries

Pacific halibut were fished historically by the indigenous peoples inhabiting the lands bordering the north Pacific, and was included in the diet of many groups who conducted their fishery by hook and line from large canoes, which could venture as far as 20 miles from shore (32 km). The hooks were elaborately carved and were selective for large fish suitable for drying and



Catch of halibut by Makah members at Neah Bay, Washington (circa 1910). Photographed by A. H. Barnes. Hillary Irving of the Makah Tribe identified the location.

smoking. The technique of these fishers was well developed and very efficient as the following excerpt by F. Boas[1] explains:

> *Halibut are caught with hooks made of crooked branches of red or yellow cedar, attached to fishing-lines made of red cedar bark sixty fathoms long. The halibut hook is tied to the fishing line with split spruceroots. Devilfish (octopus) is used as bait. The fishing lines are taken out by the fishermen in their canoes and thrown overboard. After a while they are pulled up again. After the halibut hooks have been taken up, the fish are killed by clubbing. Then hooks are thrown back into the water. At this place it is said that there were two fishermen in the canoe, who distinguished the halibut they had caught by placing them with the head toward the owner. The fishermen had his knees covered with a mat.*

Today, in addition to providing active commercial and sport fisheries, halibut continues to be an important subsistence and ceremonial fish. Subsistence halibut is a traditional food that has always been relied on to feed the communities. Ceremonially, halibut is used to feed people at culturally important events like weddings, funerals, and naming ceremonies. Several tribes in the U.S. have specific allocations or boundaries for their usage only.

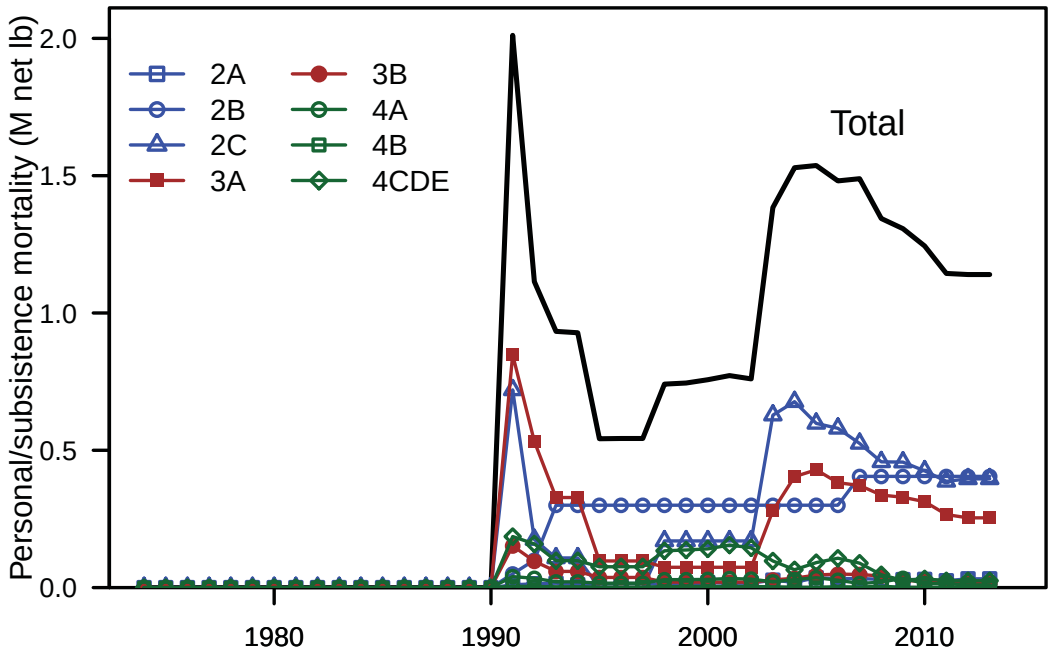


Figure 14. Historical accounting of personal use/subsistence halibut catch (millions of pounds, net weight) from 1990-2012.

Around Annette Island in southeast Alaska, an exclusive fishing reserve extending 3,000 feet (914 m) out from the shoreline was created for the Metlakatla tribal fishery. The Bureau of Indian Affairs approved the fishery in 1990, initially on a test basis. Each season length is restricted to 48 hours. No total catch limit exists, but catch totals are included in the Area 2C total. Only tribal fishers may commercially fish within the boundary, and specific regulations

[1]Boas, F. 1910. Tsimshian Mythology. Bureau of American Ethnology, Annual Report 1909-1910, U.S. Government Printing Office, Washington, D.C., pp. 27-1037.

beyond those established by the Commission, have been enacted by the tribal Council. The Commission does not exercise jurisdiction over the seasons and total catch because the fishery is executed internally, but the vessels do submit catch and log information to the Commission for stock assessment purposes. If the Area 2C fishery closes for any reason, the Metlakatla fishery closes as well. In 1996, the Metlakatla Indian fishery catch peaked at over 126,000 pounds (57 metric tons), though in recent years, catches have been on the order of 50,000 pounds (30 metric tons) a year.

In Washington State, 13 tribes exercise treaty rights to obtain an allocation of the total halibut catch limit in Area 2A. In 1995, the U.S. government prohibited non-treaty commercial halibut fishing north of Pt. Chehalis off the coast of Washington to achieve court-ordered allocation to the tribes. Local management of the fisheries is overseen by the tribal groups and the Northwest Indian Fisheries Commission.

Native groups in both Alaska and Washington also have subsistence fisheries. The Alaskan fishery falls under the general subsistence framework managed by the NMFS, while the Area 2A tribal ceremonial and subsistence fishery is part of the PFMC's Catch Sharing Plan.

Like their U.S. counterparts, First Nations members in British Columbia have access to the commercial fishery and a separate halibut fishery for food, social, and ceremonial purposes. The First Nations Food, Social and Ceremonial fishery allows tribal subsistence use and is estimated to land about 405,000 pounds (183 metric tons) per year. In 1996, DFO issued "FL" licenses instead of the "L" licenses to some of the Aboriginal groups. The "FL" license is fished as part of a First Nations communal commercial fishing program.

In aggregate, subsistence and personal use fisheries for Pacific halibut represent less than 2 million pounds of removals annually, with most of those removals coming from British Columbia and the Eastern Gulf of Alaska (Fig. 14).

Removals by non-target fisheries (bycatch)

Pacific halibut are captured in large numbers by vessels fishing for other species, primarily with pot, trawl, and longline gear targeting groundfish. Not all halibut caught will die from the injuries if the fish are discarded in a careful and timely manner. In many areas, observers work onboard groundfish vessels and gather information regarding the amount of halibut incidentally

Halibut can be caught inadvertently with many different types of gear. Shown here are the results of a trawl tow aboard a NMFS survey. Photo by Paul Logan.

caught and the condition of those halibut at release. From these data, the IPHC is able to estimate both the total amount of halibut caught and discarded in each fishery, and the discard mortality rate, or percentage that subsequently die. Many halibut captured as bycatch are below the commercial minimum size limit of 32 inches (81.3 cm) fork length, especially in the Bering Sea. Because halibut are migratory, incidental catches of juveniles in one area will have a potential effect on the future abundance in other areas.

The Commission regulates which gear types can legally retain Pacific halibut, but it does not have authority over incidental halibut catch in fisheries whose management is controlled by the domestic agencies. However, the Commission regularly makes policy recommendations to its member governments and assists in designing and analyzing bycatch reduction measures. In the United States, the regional fishery management councils are assigned the task of setting policy and management programs concerning bycatch, and NMFS implements the policies and enforces the regulations. In Canada, the DFO makes and enforces policy.

Halibut bycatch is not a new problem. Prior to the 1960s, bycatch was relatively minor due to the minimal amount of fishing for those species with overlapping distribution with halibut. However, in the early 1960s, Japanese vessels began fishing for groundfish in the Bering Sea and bycatch increased dramatically, peaking in 1965 at approximately 21 million pounds (12,701 metric tons) from all areas of the north Pacific (Fig. 15). Bycatch levels have risen and fallen several times since then in response to fishery development, the introduction of bycatch management measures, and the level of halibut abundance. Since the early 1990s, total bycatch mortality has decreased steadily to just under 10 million pounds (6,049 metric tons) in 2012. The history of halibut bycatch off the United States versus Canada is quite different, as the following sections describe.

United States

Fishing by foreign fleets continued throughout the 1960s and 1970s, harvesting groundfish and catching substantial amounts of halibut in the process, particularly off Alaska. With the implementation of extended fisheries jurisdiction in 1977, the catch of groundfish by foreign

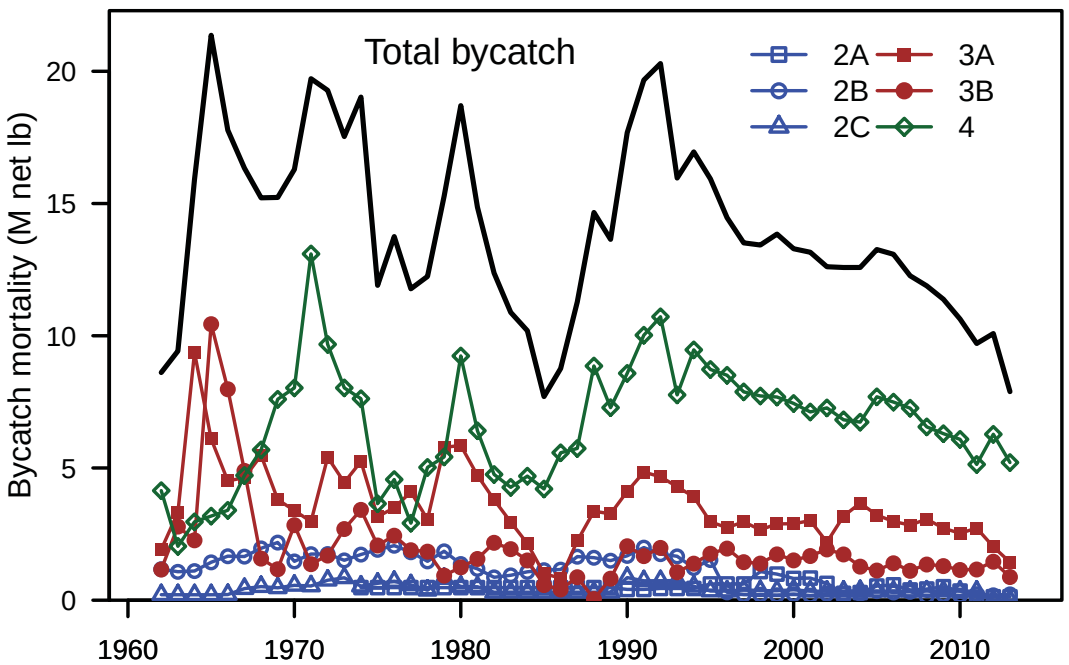


Figure 15. Total bycatch removals (millions of pounds, net weight) from 1962 - 2012.

fleets was slowly curtailed while U.S. fishers began developing their ability to harvest groundfish. In response, the NPFMC began increasing the allocations to the domestic fishery and further reducing allocations to the foreign fishery. As this transition occurred, halibut bycatch reached a record low of 6.1 million pounds (3,689 metric tons) in 1985, although the domestic fishery was not well monitored and bycatch not well estimated. By 1989, the foreign fleet was almost completely phased out of U.S. waters, replaced by a fully domestic fishery in 1990. With a rapidly growing domestic groundfish fleet off Alaska and little bycatch management, incidental catch again rose quickly. Many of the bycatch restrictions that had been placed upon the foreign fleets were not implemented for the domestic groundfish fleet, as they were perceived to be overly restrictive on the developing domestic fishery.

Since 1990, halibut bycatch management of U.S. domestic groundfish fisheries in Alaska has principally been conducted through the use of limits to the annual amount of halibut bycatch mortality. The limits are specific to specified target fisheries or fishery groups. The limits are divided among seasons and subareas within the Bering Sea and the Gulf of Alaska. Once a limit is reached, all groundfish fishing by that fishery ceases for the remainder of the year. Most fisheries have limits which are split among seasons to better spread the catch over the year. Gear restrictions are another tool used to help make sure that bycatch does not become excessive. For example, one restriction ensures that pelagic trawls are not fishing on-bottom where halibut bycatch occurs. The limits for the Bering Sea groundfish trawl fisheries have declined slightly since 1993, and totaled 5.8 million pounds (3,525 metric tons) in 2012. Limits were unchanged for the Gulf of Alaska groundfish trawl fisheries since initially introduced in 1985 through 2013. Halibut bycatch in these trawl fisheries was 8.0 million pounds (4,837 metric tons) in 2012. Recent action by the NPFMC reduced the limit in this area by 15 percent beginning in 2014.

Groundfish fisheries conducted off Washington, Oregon, and California are managed by the PFMC. Historically, halibut bycatch was believed to be quite low until an analysis by the Commission in 1998 suggested otherwise. The increased focus on halibut bycatch and the weakened status of certain groundfish species led to the creation of an observer program in 2001. While better estimates of bycatch were available as a result, the economic health of the groundfish fishery was declining, and little was done to manage halibut bycatch. In 2011 an Individual Transferable Quota (ITQ) program was implemented for the trawl fishery. Importantly, the program contained requirements for 100% observer coverage and a program for managing halibut bycatch. Similar to the Canadian system (see next section), an Individual Bycatch Quota (IBQ) program was established in which each trawl vessel was provided a share of a total amount of allowable bycatch. As a consequence, halibut bycatch dropped substantially, from a peak of 475,000 pounds (287 metric tons) in 2005 to less than 60,000 pounds (36 metric tons) in 2012.

Canada

Incidental catch in groundfish trawl fisheries off Canada's western province of British Columbia, although lower than in Alaska, was still a problem historically. Canada allowed fishing by foreign vessels until 1979. From then to the present, only Canadian domestic vessels have prosecuted the fishery, with the exception of a joint venture operation using midwater trawls for Pacific whiting. Halibut bycatch mortality in the trawl fishery had been relatively stable, averaging 1.6 million pounds (968 metric tons) annually during 1990 to 1995.

Until 1995, virtually no regulations were in place to control bycatch. A small voluntary observer program had operated for several years providing information to estimate halibut bycatch in the trawl fishery. Then, in 1995, the DFO initiated a staged reduction of trawl bycatch mortality by first implementing a halibut mortality limit for the trawl fishery, with a goal of reducing bycatch mortality to 1 million pounds (605 metric tons) by 1997.

In 2010, Canada implemented a program whereby all catch is retained and accounted for. Photo by Tracee Geernaert.

To provide further incentive to reach the bycatch goal, in 1996 DFO implemented a groundbreaking system of individual vessel bycatch quotas (IVBQ), along with a 100% mandatory observer program, for bottom trawl vessels in all major groundfish fishing areas. The IVBQ system made individual fishers responsible for their own bycatch, thus providing incentive to minimize their bycatch. Fishers made dramatic changes to fishing operations, primarily through reduced towing time, improved handling of discarded fish, and increased area/time/depth selectivity in their operations. Other measures not directly targeted to halibut also had an effect, such as increased trawl mesh size, delayed openings, time/area closures originally directed at reducing rockfish bycatch, and a season-long closure of Pacific cod due to conservation concerns. In the end, the trawl fishery reduced its halibut bycatch mortality from 1.5 million pounds (907 metric tons) in 1995 to approximately 299,000 pounds (181 metric tons) in 1996, well below the 1997 goal. Since that time, bycatch has remained low, ranging from 150,000 to 350,000 pounds (91 to 212 metric tons) annually.

Previously noted in the *Directed Fishery* section, in 2006 DFO implemented the Commercial Groundfish Integrated Pilot Program, which covered all groundfish fisheries, including halibut. The program sought to address concerns about adequate monitoring, catch reporting, and full accountability of catches. The program was comprised of ITQs for all species, the ability to retain species which had previously been discarded, a requirement that harvesters acquire quota to cover the mortality of all catch, including discards, and quota transfers between fisheries. The program was refined in the initial years of the pilot period, and became permanent in 2010. Within the Commercial Groundfish Integration Program, halibut can now be retained in some fisheries where it had been historically discarded, but only if quota was obtained from halibut IVQ holders. This allows for a fuller and more accurate accounting of halibut mortality occurring in all fisheries.

Management of the Resource

The Commission is responsible for the health of the Pacific halibut resource and engages in basic scientific research, fishery-dependent and fishery-independent sampling, as well as quantitative analyses to support management decisions. These scientific results are provided annually to the Commissioners and stakeholders for decision-making during the Annual Meeting process. The process relies on several key steps: 1) the annual stock assessment integrates available data into a statistical framework which produces coastwide stock estimates and a decision table-based risk assessment; 2) coastwide stock estimates are apportioned by regulatory area; 3) the current harvest policy is applied to these area-specific estimates to produce yield estimates; and 4) these estimates, along with the coastwide risk assessment and input from stakeholder groups are used by the Commissioners to set annual catch levels for the upcoming year (Fig. 16). All allocative responsibility, including implementation of the individual quota systems and construction of the catch sharing plan formulas, falls under the jurisdiction of the individual national governments.

The crew of the *F/V Proud Venture* pull in a large halibut during the IPHC setline survey. Photo by Levy Boitor.

Scientific monitoring: the IPHC setline survey

The primary data upon which stock abundance and trend are estimated are collected during the annual setline survey conducted by the IPHC. The current design, used since 1998, covers a broad spatial extent, spanning the continental shelf area from northern California to the Bering Sea and Aleutian Islands (Fig. 17).

Since 1925, the IPHC has relied on three primary setline survey designs: spot surveys, random stratified surveys, and grid surveys. Spot survey design was used for all surveys prior to 1961 and occasionally through 2003. Specifically, a spot survey is when fishing locations are intentionally chosen by the vessel captain within larger designated regions. These surveys were well suited to mark and recapture experiments that required a high rate of recapture, and which were the primary purpose of this field work.

The random stratified design was used only for setline surveys off the coast of Oregon, Washington, and Vancouver Island from 1995-1997. This design consisted of predetermined survey station locations stratified on commercial and non-commercial fishing grounds. Because

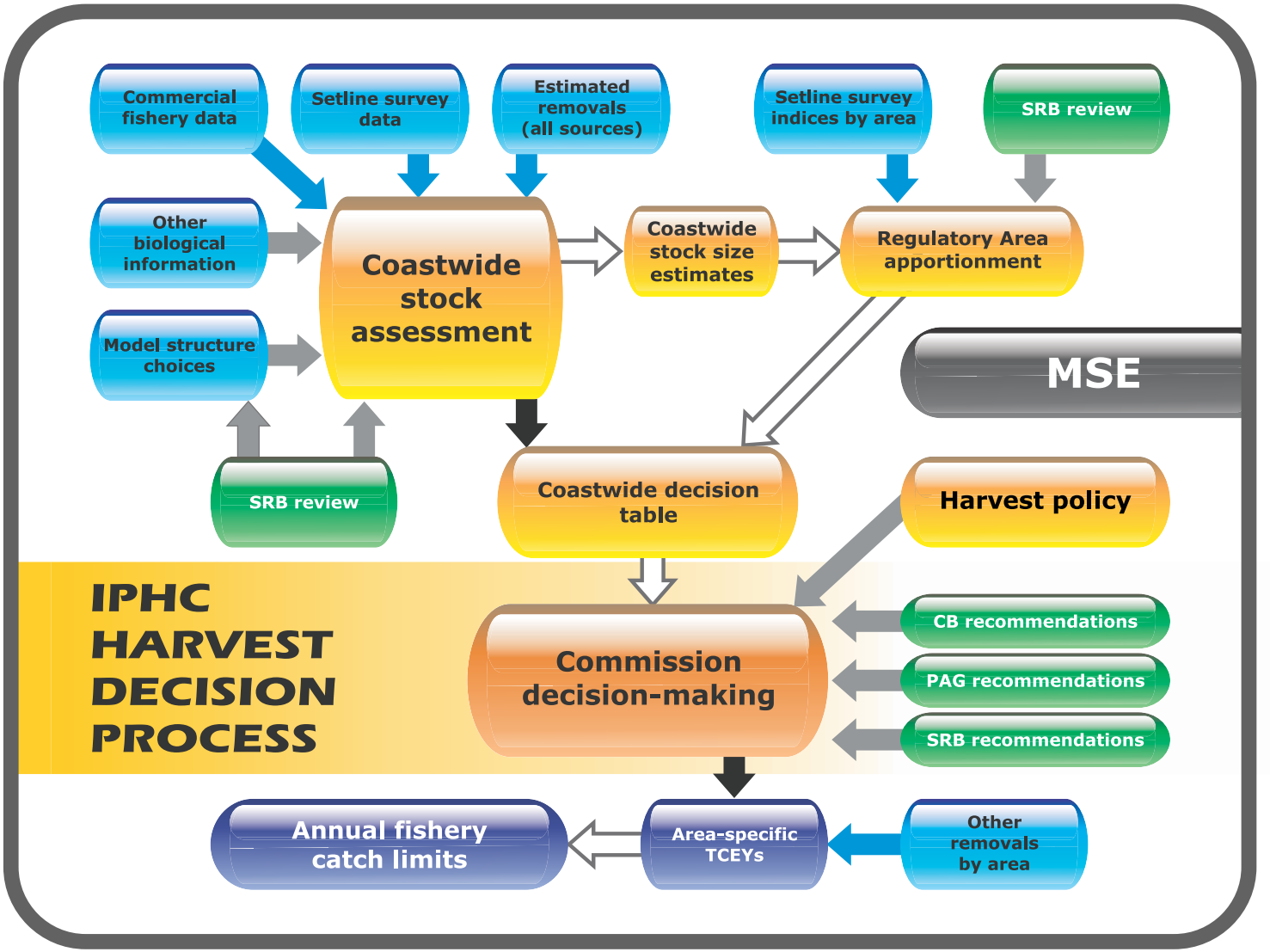


Figure 16. IPHC harvest decision process.

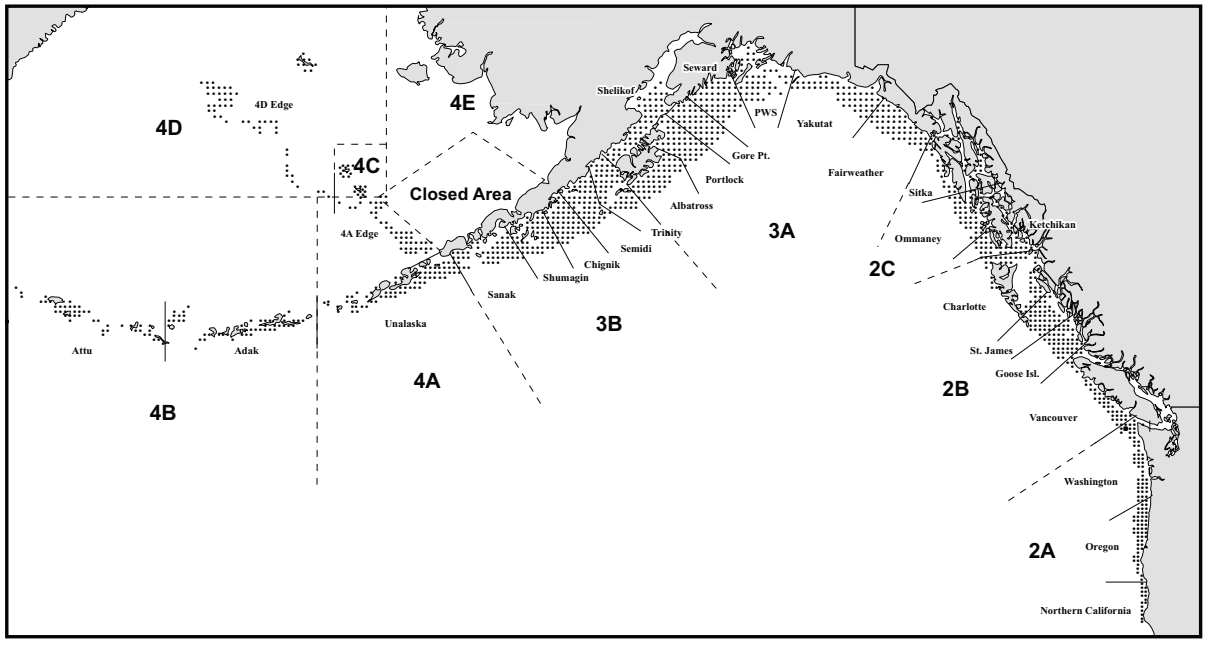


Figure 17. IPHC setline survey stations fished each summer. Note that each dot represents one station.

halibut tend to concentrate in small irregular groups that are often transient, meaningful stratification of the sampling area was often not practical.

Grid surveys were first used by the IPHC in 1961 and are the primary survey design used today. The IPHC grid design consists of survey stations placed at the intersection of a network of longitudinal and latitudinal transects. Over the years the grid has evolved to meet different goals, but has remained largely unchanged since it was last modified in 1998 (with occasional expansion or contraction of the number of stations and area covered). The pattern consists of stations located at the intersections of a 10 x 10 nautical mile square grid in depths of 20-275 fathoms in most areas. In 2012 there were 1,274 stations included in the design. More information of the grid survey designs over time can be found in IPHC Technical Reports 18 and 58. The setline survey is conducted annually, using standardized methods, bait, and gear during the summer months.

The biological data collected on the annual setline surveys includes the size, age, and sex composition of halibut which is used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the halibut population. In addition, records of non-target species caught during survey operations provide insight into bait competition, rate of bait attacks, and serve as an index of abundance over time, making them valuable to the assessment, management, and avoidance of non-target species. The survey also includes a number of supplemental projects including environmental monitoring, tagging experiments, and special tissue collections.

Additionally, the IPHC relies on halibut catch rates, and length and age data collected during the NMFS trawl surveys in Alaska. The trawl surveys mainly catch halibut that are smaller than seen in the setline survey. These surveys encompass a large area of the Bering Sea that the IPHC cannot survey annually. Results from that area are used to calibrate the setline survey index for the halibut stock assessment.

Stock assessment

The annual stock assessment integrates observed data from the commercial fishery and the setline survey, along with the current understanding of biological processes such as maturity, natural mortality, and growth, in order to estimate the relative trend and abundance level of

A water column profiler is deployed at each setline survey station to collect environmental data on the halibut grounds. Photo by Beth Dubofsky.

the resource. The halibut stock assessment has the important benefits of an extensive historical record of removals, a comprehensive fishery-independent survey, and a rigorous port-sampling program enhanced by a high level of cooperation by fishers in filling out and reporting of fishery logbooks. Primary information comes from the absolute amount of removals from each source, including the directed commercial fishery, sport, and personal use/subsistence harvests, as well as mortality from bycatch. Given removals from the stock, the assessment incorporates trend information from the fishery-independent setline survey as well as the catch rates reported in commercial fishery logbooks. Detailed information on the size and age of the survey and fishery catches provides an ability to estimate the demographics of the stock and how these relate to the observed trends. A statistical computer model is used to make predictions, which are compared to the observed data. There is a considerable amount of uncertainty inherent in many of the data sources, and in the many complex biological processes operating within and on the halibut stock, such as migration and ecosystem interactions. There are therefore many alternative stock assessment models which can explain the observed data, and each may result in a different perspective on the stock trend and abundance. In 2012, in acknowledgement of the uncertainty associated with the stock assessment, the Commission provided the results of the assessment in a probabilistic decision-making table, in which the relative risks to the stock and fishery could be weighed against the benefits of alternative levels of harvest, taking into explicit consideration the uncertainty in the assessment estimates.

History of assessment methods

The Pacific halibut stock assessment has served as a testing ground for many of the quantitative fisheries methods that have been developed in recent decades, with many highly

respected analysts contributing their expertise. Despite this history, Pacific halibut population dynamics are complex, and many alternative approaches have been explored, used for management, and ultimately discarded for more robust methods.

An annual stock assessment has been performed since the late 1970s. Prior to that time, analyses focused on keeping steady catch rates and yields. These models primarily utilized data from the center of the stock distribution (Areas 2B, 2C, and 3A); more northern and western areas (3B, 4A-4E) were much less heavily exploited and their dynamics largely unknown.

Age-structured assessment models can capture more realistic demographic detail and provide for annual estimates of trend and abundance. By estimating the fluctuations in the numbers of fish at each age, annual estimates of trend and abundance can be made. These are particularly useful for the setting of annual catch levels. Early age-structured models also covered only the central portion of the stock distribution, and relied primarily on the catch rates from the fishery for trend information. The next period of development included an expanded geographic scope, including the Aleutian Islands and Bering Sea. Both coastwide models and models with explicit geographic areas were built, based on analyses of IPHC tagging data.

From the late 1980s through 2005, separate assessments were conducted for each IPHC regulatory area, which provided detailed information for the setting of catch levels, but neglected the migration of juveniles and adults among areas. In other words, each regulatory area was treated as if it were closed to outside influence. These models also had trouble capturing the effects of rapidly changing size-at-age, which influenced which ages were above the legal size limit and therefore available for harvest by the directed fisheries. An extensive tagging program was introduced during 2003 and 2004, which led to a major revision to the previous hypothesis that migration of Pacific halibut occurred largely during the juvenile phase. Analyses of the tagging results indicated significant adult movement among regulatory areas, which resulted in the shift to a coastwide stock assessment for 2006. The change to a coastwide model required aggregation and weighting of the data sources (i.e. survey and commercial catch rates, biological data) to account for differing trends among regulatory areas. Even though the assessment was coastwide, the fishery continued to be managed by IPHC regulatory area. Therefore coastwide stock estimates required the additional step of apportioning the biomass in order to provide information for area-specific catch levels.

Subsequent to the 2006 assessment, a strong negative retrospective bias emerged, which resulted in each subsequent stock assessment indicating that the previous analysis had overestimated both the stock size and positive trend at the end of the time-series. Although somewhat variable in magnitude over time, the pattern compounded and was identified in both the assessment and supporting analyses as a major concern to management. Despite this pattern, annual assessment results (but not the forecasts) did indicate a declining stock, which corresponded to both the fishery catch rates and the setline survey index of abundance.

In 2012, this pattern was explored and a solution was found. It appeared to be a combination of an assumption in the assessment model that could be easily adjusted, and the fact that halibut distribution had changed so that availability of halibut to fishing and survey gear was different than expected. Allowing for this pattern in the assessment model resulted in a much more pronounced decline in the estimated stock trend in recent years, which was consistent with the fisheries-independent trend data from the setline survey. This corresponded to a large reduction in the scale of current population estimates, and also a decrease in the estimated level of average productivity.

Trends in the population

The Pacific halibut stock has been through several cycles of increasing and decreasing abundance in response to changes in recruitment, size-at-age, and fishing intensity. In the 1970s the stock, and therefore the removals, declined to very low levels after nearly three decades

of poor recruitment. Following this period, halibut achieved some of the largest sizes at age observed in the historical record and, in combination with above-long-term-average recruitment levels, rebounded to high levels of abundance and catch through the late 1990s and early 2000s. Subsequently, the stock has been estimated to be in decline due to poor recruitment and declining size-at-age. Historical analyses are underway and may eventually yield answers, but it is currently difficult to estimate the absolute magnitude of the stock in relation to previous levels. Catches have been reduced in response to the available scientific information documenting this decline, and there are some signs in the 2012 data from the fishery and the setline survey that the rate of decline in the stock has slowed or even stabilized. There is a large research project currently underway to investigate historical changes in size-at-age, however there is currently no reliable way to precisely forecast future changes in recruitment or size-at-age. Unless these factors improve, the halibut stock is likely to remain near the current level of abundance in the near future.

Apportionment among regulatory areas

The stock assessment produces estimates of coastwide trend and abundance. Because catch levels are set by regulatory area, an apportionment analysis is used to estimate the distribution of biomass across these areas. This approach differs from historical processes which directly estimated biomass levels in each area, but could not adequately account for migration among areas. If the stock assessment determines the size of the "pie" (the halibut stock), then apportionment provides a method for determining the size of each area's "slice."

Larger halibut are often offloaded using slings. Photo by Lara Erikson.

Apportionment is based on the assumption that the standardized setline survey catch rates provide an accurate estimate of the relative density of halibut in each area. These density estimates, combined with the extent of available habitat (currently defined by the bathymetric extent of the 0-400 fathom depths in all areas) provide a relative distribution of biomass. Specifically, each area's "share" of the exploitable biomass is then the product of its fish density as determined by the setline survey multiplied by the area's bottom area, divided by the sum of all bottom areas.

Several requirements are inherent in this survey-based approach, which is commonly applied to groundfish species in the north Pacific and elsewhere in the world. The most important

assumption of the method is that halibut are equally catchable by the survey in all areas. The survey covers all depths from 20-275 fathoms (37 to 503 m), however halibut are found in waters from 0 to 400 fathoms (732 m). Catch rates in unsurveyed depths are assumed to represent an equal proportion of those that are surveyed across all regulatory areas. The Commission staff has investigated a number of factors that might potentially cause differences in catchability among areas, including station distribution, competition for baits by non-target species, and the timing of the survey relative to the removals in each area. Both competition and survey timing are currently accounted for in the apportionment estimates.

Regulatory measures

The 1923 Convention which established the Commission also launched the process of halibut stock management. The Commission holds its Annual Meeting each January to set catch limits, fishing seasons, and to adopt other regulatory recommendations. During that meeting, the staff reports on the previous year's commercial fishery and research survey. Results from the stock assessment and apportionment analyses, as well as any updated information on harvest policy and other ongoing research, are also presented. The industry advisory boards, the Conference Board and the Processor Advisory Group (described later in this report), meet concurrently with the Commission and present their recommendations for catch limits, seasons, and other regulatory issues.

Although the Commission has the authority to establish policy on conservation matters, it has no direct enforcement authority and cannot allocate fish among users. Instead, the individual governments enforce the regulations and set allocative policy. The regulations are enforced by the NMFS, the Coast Guard, and the state police in the U.S., and by DFO in Canada.

Commission Organization

Commissioners

The Privy Council of Canada and the President of the United States each appoint three commissioners who serve without remuneration. The commissioners appoint the Executive Director who supervises the scientific staff, which collects and analyzes statistical and biological data needed to manage the halibut fishery. The commissioners annually review the regulatory proposals made by the scientific staff and consider proposals from the industry, the Conference Board, and the Processor Advisory Group (PAG). The regulatory measures adopted by the Commission are submitted to the two governments for approval and fishers of both nations are required to observe the approved regulations.

During the Annual Meetings, Commissioners hear staff reports and consider comments from stakeholders before setting regulations for the coming year.

The average tenure of the commissioners since 1924 has been eight years, and the longest serving member thus far served for 24 years. The length of service and the overlapping terms of the members have had a stabilizing influence on the Commission and the management of the resource.

Traditionally, one commissioner from each country has been an employee of the federal fisheries agency, one a fisher, and one either a buyer or processor, though this composition has changed in recent years. The chairmanship of the Commission alternates annually between countries. Initially, most of the Commission meetings were held in Seattle. Later a system was devised to hold every third meeting in either Canada or Alaska. In 1972, a policy was adopted to alternate the Annual Meetings between Canada and the U.S.

Scientific Advisors

Each country appoints one scientific advisor to its commissioners, who becomes involved in the more technical aspects of Commission research. This advisor has a scientific background and offers advice to the staff and guidance to the commissioners. These appointees generally

work for their country's governmental fishery science and management agency, and are involved with Commission issues on a part-time basis. They receive no monetary compensation from the Commission for their services.

Staff

The Commission staff of Canadian and U.S. employees consisted of four biologists and four supporting personnel in 1925. In 2013, the permanent staff consisted of the Executive Director, the Assistant Director, three Program Managers, two project managers, 12 biologists, three quantitative scientists, one senior research scientist, four computer support staff, and five administrative and support personnel. Staff member citizenship included U.S., Canada, and New Zealand. The staff is supervised by the Executive Director, who is responsible to the Commission for its research, regulatory, and administrative functions.

The new IPHC headquarters resides on the top floor of this office building located near Fishermen's Terminal in Seattle, WA. Photo by Tracee Geernaert.

Commission headquarters houses the IPHC permanent staff and was located at the University of Washington in Seattle, Washington from 1925-2010, except for five years (1931-1936) when the staff was housed in a laboratory of the U.S. Bureau of Fisheries. In 2010, through an agreement with the University of Washington, the office was moved to Salmon Bay, a location near Fishermen's Terminal in Seattle.

Seasonal temporary employees are engaged each year to collect data on the landings and the fishery, and to participate in vessel research. The ports of Bellingham/Vancouver, Port Hardy, Prince Rupert, Petersburg, Sitka, Juneau, Seward, Homer, Kodiak, and Dutch Harbor are staffed approximately eight months out of the year to sample the commercial catch as it is landed. In addition, St. Paul and Sand Point have recently been staffed for shorter periods during the summer months. From June through August each year, 20 to 25 IPHC sea samplers work on chartered fishing vessels conducting the Commission's standardized setline stock assessment survey.

Administration

The Commission, as an intergovernmental organization established by treaty, has a separate international legal personality from its member countries. The Commission was afforded the rights and privileges of a public international organization in the United States under the International Organizations Immunities Act (22 U.S. Code Section 288) in 1962 (Executive Order 11059). In 1987, the Commission was also granted 501(c)(3) (non-profit) status by the U.S. Internal Revenue Service. Such privileges have not been extended to the Commission by the Government of Canada.

The Commission has adopted formal Rules of Procedure and Financial Rules, which are amended by the Commission as required. These rules govern operating procedures related to authorities, roles, and responsibilities of officers, voting procedures, reporting and communication to governments, scheduling of meetings, financial authorities, and maintenance of financial records and audits. The Rules of Procedure authorize the appointment of an Executive Director and Assistant Director for the Commission staff. Appointment and management of the rest of the Commission staff is delegated to the Executive Director.

Financing of the Commission is authorized through the Convention and specifies that expenses of the Commission are to be shared equally by the two governments. The first budget of the Commission in 1924/1925 was $20,000 (USD). The Convention also specifies that the two governments could vary the proportion of joint expenses after March 31, 1981. Unequal funding of the Commission first occurred in 2001 when the U.S. government funding increased to $1,881,500 from $800,000. The funding levels in FY2013 (October 2012 to September 2013) from the United States and Canada were $4,500,000 and $947,120, respectively.

Until the 1970s, all billings and salaries for the Commission were paid by the Canadian government, and the United States government reimbursed Canada for one-half these payments. In 1971, the IPHC petitioned the two governments for its own financial regulations. This request was approved and the Commission adopted its own fiscal policies and financial rules. Since then, appropriated funds from both governments have been deposited into a Commission account and expenses are paid directly by the IPHC.

The Executive Director submits a detailed budget and research plan for approval to the Commissioners, reports on expenses, and provides an audit report to the governments annually. Funding from the U.S. is through the International Fisheries Commissions line item in the Department of State appropriations. Funding from Canada occurs through the DFO. Historically, the majority of appropriated funds have been used to cover staff salaries, commercial fisheries data collection, and research. Funding for annual stock assessment surveys is provided through a cost recovery program of selling fish which are caught and sampled, to the level necessary to make the program cost-neutral over the long term.

The Commission staff administrative policies and salaries are modeled after U.S. Civil Service programs, with some modifications to accommodate the unique character of the Commission. The Commission has a defined benefit pension plan under the auspices of the International Fisheries Commissions Pension Society, and an employee-owned defined contribution pension plan through an independent administrator.

Governance

Conventions and treaties pertaining to Pacific halibut

The International Pacific Halibut Commission, originally called the International Fisheries Commission, was established in 1923 by a Convention between Canada and the United States. Halibut abundance had been declining and industry representatives requested international control. The Convention was the first international agreement for joint management of a marine fishery and has been revised several times to extend the Commission's authority and to meet new conditions in the fishery. This section presents a brief review of the several revisions of the Halibut Convention and other treaties relating to halibut.

The Halibut Convention of 1923

Initial efforts to consummate a treaty in 1919 were unsuccessful, but the halibut industry persisted in advocating international control. In 1922, another convention was drafted that excluded sensitive provisions of port use and tariffs, and Canada and the United States signed the Convention for the Preservation of the Halibut Fishery of the northern Pacific Ocean on March 2, 1923. In the past, Canada and Great Britain both signed treaties that involved Canada, but Canada contended that it alone should sign the Halibut Convention because it dealt with domestic matters. Great Britain preferred to retain this right but finally agreed that the Government of Canada could sign on behalf of the Crown. This symbolic act of national sovereignty was a first for Canada and the other member nations of the British Commonwealth.

The Convention went into effect on exchange of ratifications on October 23, 1924. It provided for a 3-month closed season during the winter and for regulations concerning halibut

An official copy of the Convention and the 1979 Protocol was presented to IPHC Director Bruce Leaman (left) by Ambassador David Balton (right), Deputy Assistant Secretary for Oceans and Fisheries, U.S. Department of State, on March 7, 2011.

caught incidentally during the closed season. The Convention also created an International Fisheries Commission of four members. Each country was to pay the expenses of its two Commissioners, but expenses of the Commission and its staff were to be shared equally by the contracting parties. The Commission was charged with studying the life history of halibut and with recommending regulations for the preservation and development of the fishery.

The Halibut Convention of 1930

In 1928, the Commission reported that the closed season alone could not protect the resource and requested authority to institute other conservation measures. A new Convention was signed in 1930 and ratified on May 9, 1931. The 1930 Convention empowered the Commission to establish regulatory areas, to limit the halibut catch from each area, to regulate the licensing and departure of vessels for halibut fishing, to collect statistics, to regulate the type of gear, and to prohibit fishing on nursery grounds where young fish are concentrated. Annual regulations were subject to the approval of the Governor General of Canada and the President of the United States. Enforcement of regulations was the responsibility of the individual governments. To provide an industry forum for the discussion of regulatory proposals, the Commission established a Conference Board of fishers and vessel owners on May 27, 1931.

The Halibut Convention of 1937

As the catch increased, more vessels entered the fishery and the catch limits were taken more rapidly. The 1937 Convention permitted more effective control of vessels catching halibut incidentally while fishing for other species during the closed season.

The Halibut Convention of 1953

The trend toward shorter fishing seasons continued and concentrated on certain fishing grounds. Treaty changes were recommended by the IPHC in 1946 to permit multiple seasons within a fishing area, but the new Convention was not signed until March 2, 1953, on the 30th anniversary of the signing of the first Halibut Convention. On exchange of ratifications, the new convention became effective on October 28, 1953.

The 1953 Convention contained several important changes. Multiple seasons were permitted to distribute fishing effort in accordance with seasonal availability of different stocks, the number of Commissioners was increased from four to six, three from each country, and the International Fisheries Commission was renamed the International Pacific Halibut Commission. In addition, the Commission was charged with developing and maintaining halibut stocks at a level which would permit the maximum sustainable yield. This directive was implied in earlier conventions but had not been explicitly stated.

In 1969, to expedite the approval of regulations in the United States, the presidential authority was delegated to the Secretary of State, who was to consult with the Secretary of the Interior (now the Secretary of Commerce).

Convention for the Extension of Port Privileges

In 1897, Canada granted special port privileges to a United States firm, the New England Fish Company, which had established an office in Vancouver, British Columbia. Vessels owned by the company were permitted to land halibut and take on supplies in Vancouver. These privileges were renewed in subsequent years and in 1915 were extended to all United States flag vessels and included the port of Prince Rupert. This unilateral action was renewed each year by an Order-in-Council in Canada. In 1918, the United States reciprocated and permitted Canadian vessels to land and outfit in the United States.

In 1950, Canada and the United States signed a *Convention for the Extension of Port Privileges to Halibut Fishing Vessels on the Pacific Coasts of the United States of America and*

Canada. The express purpose of this Convention was "to further the well-being" of halibut fishers and to permit landings without payment of duty other than that required by the customs agency. Fishers could trans-ship or sell their catch in bond for export and could obtain supplies, repairs, and equipment. The convention specified that vessels of one country landing in a port of the other country shall comply "with applicable customs, navigation, and fisheries laws" of the host country. The agreement included sablefish as well as halibut.

The 1979 Protocol to the Halibut Convention of 1953

The *U.S. Magnuson Fisheries Conservation and Management Act of 1976* required renegotiation of all international fisheries treaties. As a result, Canada and the United States negotiated an amendment to the 1953 Halibut Convention during 1978 and early 1979. The amendment, termed a "Protocol," was signed by both countries on March 29, 1979. In addition, the Commission's mandate was altered somewhat from managing on the basis of maximum sustainable yield to that of optimum yield.

The Protocol called for a two-year phase-out of reciprocal fishing privileges between the two countries and also required that 60% of the catch in Area 2 be taken in Canadian waters (Area 2B) and 40% in U.S. waters until 1981 (paragraph 3 of the Annex to the Protocol).The required 60/40 division of the Area 2 catch had as its basis the average long-term productivity of the stock in the two areas, the distribution of habitat, and the historical catches. However, a fixed harvest ratio between areas presented management problems. After the signing of the amendment in 1979, the distribution of the stock in Area 2 departed from the long-term average. Southeast Alaska stocks became more abundant than those in British Columbia. In 1985, the Commission recommended to the governments of both countries a departure from the 60/40 requirement and adopted a harvest strategy which takes a constant proportion of the exploitable biomass in each region. The resolution further stipulated that the catch will be optimized until such time that the stock returns to its long term average condition of a 60/40 proportion.

Northern Pacific Halibut Act of 1982

No further action was needed in Canada to enact the provisions of the Convention amended by the 1979 Protocol. Enabling legislation was needed in the U.S., however, and so in the spring of 1982, the United States passed the Northern Pacific Halibut Act of 1982, giving effect to the 1979 Protocol and repealing the previous enabling legislation; the amended *Northern Pacific Halibut Act of 1937*. The Act provided for representation on the Commission, for funding and enforcement, and discussed the role of the regional fishery management councils as allocative bodies, among other things. The councils were granted the authority to develop limited access regulations as long as they were not in conflict with Commission regulations.

The NPFMC passed regulations for a commercial fishery individual fishing quota system in 1990, which was implemented in 1995. Entry into the U.S. west coast directed commercial fishery remains unrestricted.

International North Pacific Fisheries Commission

A convention was signed in 1952 and entered into force on June 12, 1953, which established the International North Pacific Fisheries Commission (INPFC). Canada, Japan, and the United States were members. This convention, like that for the preservation of halibut, was to "ensure the maximum sustained productivity of the fishery resources of the North Pacific."

Included in the Annex of the Convention is an abstention provision under which member countries agreed to abstain from fishing specific stocks of fully utilized fish in waters of another

country. Japan agreed to abstain from fishing halibut along the coast of North America, and the fishery east of 175 degrees W longitude remained under the jurisdiction of the IPHC. In 1962, the INPFC decided that the halibut in the Bering Sea east of 175 degrees W longitude no longer qualified for abstention, thereby allowing Japan to begin a directed fishery for halibut in 1963. This change was unpopular among North American halibut fishers and was labeled "the Bering Sea halibut giveaway" by critics. After this decision, the condition of the halibut stock in the eastern Bering Sea was reviewed and conservation measures were recommended annually by both the IPHC and the INPFC for adoption by the respective governments. Although Japan discontinued fishing after 1967, this procedure was followed until 1977 when Canada and the United States extended their fisheries jurisdiction out to 200 nautical miles from shore, obviating the authority of the INPFC relative to halibut.

Advisory and Industry Organizations

A number of organizations have been formed by people in the halibut industry to promote their respective interests. Some of these organizations have been in existence for decades and represent hundreds of members. These organizations not only provide many services to their members, but also have contributed substantially to the management of the halibut fishery.

Conference Board

The Conference Board (CB) is an IPHC advisory panel representing Canadian and United States halibut fishers. The CB was created in 1931 to obtain advice and recommendations from halibut harvesters on conservation measures and halibut management. The CB also reviews staff reports and recommendations and provides its advice concerning these items to the Commission at its Annual Meeting, or on other occasions as requested. It is self-regulating in terms of membership. Its members are designated by union and vessel owner organizations throughout the halibut range and include commercial, sport, and tribal interests.

Following staff presentations and proposals at the IPHC Annual Meeting, the CB meets separately to discuss the proposals and its advice. Its recommendations are then presented to the Commission for consideration at a later session of the Annual Meeting, before the Commission sets regulations for the coming year.

Fishing unions and associations

Many halibut fishers are active union and/or association members. Different groups represent commercial halibut fishers, fishers from several fisheries, aboriginal fishing groups, and occasionally even shore workers at fish processing plants. The traditional unions often function as wage/price negotiators, offer accounting assistance, and encourage safety improvements on the job, among other things. Union and association representation on advisory panels such as the Conference Board is common, as are testimonial appearances at workshops and regulatory meetings.

The CB and PAG meet concurrent to the IPHC during the Annual Meetings. Shown here is a CB session in 2008. IPHC photo archive.

Fishing vessel owners associations

Many owners of commercial halibut vessels belong to associations which provide a number of useful functions for their members such as accounting assistance, insurance pools, and price negotiations for their fish. Association spokespersons frequently provide information to executive and legislative branches of their governments and participate in national and international meetings, often as members of advisory panels such as the IPHC Conference Board.

Sport fishing associations

Sport fishing associations have existed for some time, primarily as marketing entities for charter businesses and support services. These associations often work with federal and state/provincial biologists to facilitate biological sampling of the catch and communication with boat operators. In more recent years, in response to more restrictive regulatory measures being proposed for the halibut sport charter sector, new associations have been born and established associations have expanded their mandates. Most of these organizations represent the commercial guided halibut sport fishing industry. In order to better participate in the regulatory process, these groups often hire independent consultants, retain legal counsel, and send representatives to attend regulatory meetings and workshops. As the sport fishing regulatory framework was put into law and implemented in the late 2000s, many of the organizations that had formed in response to the regulatory process became less active, but many remained.

Processor Advisory Group

The Processor Advisory Group (PAG) was formed in 1995 and is composed exclusively of processors from the United States and Canada. The PAG advises the Commission on issues related to the management of halibut resources and on various potential conflicts between participants within a given fishery resource or area. Membership has varied over the years and included 21 processors at the 2013 Annual Meeting.

The PAG reviews staff recommendations and supporting information at the Annual Meeting and then meets separately to consider its advice. The Commission hears the PAG recommendations along with the CB recommendations at a later session of the Annual Meeting, before setting regulations for the coming year.

U.S. Tribes and Canadian First Nations

The U.S. tribes and Canadian First Nations have relationships with the federal governments, in some cases as part of treaty rights, or by federal regulations outside of the IPHC process. Within the IPHC process, participation can take place at many levels including: as stakeholders (IPHC Conference Board), members of an IPHC advisory board (MSAB), through management of catch limits within their communities, and as representatives that hold Commission seats.

Research Advisory Board

The Research Advisory Board (RAB) was formed by the IPHC Executive Director in 1999 to gain insight on issues of concern to the halibut industry when considering future research projects. Board members bring forth their own ideas for consideration as well as consider staff research already in progress or proposed. The Board meets annually with the Executive Director and IPHC staff and is composed of active members of the fishing community who are interested in contributing to the direction of IPHC research. A report of the RAB's proceedings and recommendations is presented to Commissioners and becomes part of the research discussion at the Interim and Annual Meetings.

Management Strategy Advisory Board

At the 2013 Annual Meeting, the Commission advanced the development of a Management Strategy Evaluation (MSE) program for the halibut resource. MSE is a formal process for evaluating alternative stock management procedures and their outcomes through model simulation exercises. The results give decision-makers a better idea of how to successfully manage the real fishery as stock dynamics and conditions change over time.

The Commission approved the formation of a Management Strategy Advisory Board (MSAB) to oversee the MSE process and advise the Commission on the development and evaluation of candidate objectives and strategies for managing the fishery. The MSAB is comprised of harvesters, fisheries managers, processors, IPHC staff, commissioners, and academics. The MSAB consists of approximately 15 to 20 members approved by the Commission, broadly based both geographically and by harvesting sector. Members are nominated from existing Commission advisory bodies, from partner agencies, and by direct application from the public. The MSAB began its work during 2013.

Scientific Review Board

The Commission also approved the formation of a Scientific Review Board (SRB) at the 2013 Annual Meeting. The SRB provides an independent scientific review of Commission science products and programs, and the stock assessment process. In the near term, this standing peer review process is expected to focus on a review of the annual stock assessment model and harvest policy prepared by the IPHC staff. Over time, this emphasis will shift to a broader review of scientific programs, including outputs from the RAB and MSAB, in addition to the annual stock assessment results and advice. The SRB will also conduct other key reviews, as directed by the Commission, on topics such as research plans, updates and changes to survey methodology, and white papers on selected critical issues.

The SRB consists of three independent fisheries science experts approved by the Commission, with terms staggered in order to facilitate continuity while regularly bringing in fresh scientific viewpoints. Future expansion will bring the membership to five. The SRB began its work in 2013.

Marketing organizations

Halibut Association of North America

Many of the fish processing companies that buy and sell halibut in Canada and the United States belong to this organization. Membership in 2013 included 14 companies. The Association maintains a fund for promoting sales of halibut and works to maintain standards that provide a high quality product for the consumer. The Association frequently consults with the IPHC staff and commissioners on matters concerning the management of the fishery by retaining membership in and facilitating the work of the Commission's PAG.

Fishery certification

In the late 1990s, with many of the world's fisheries in an overfished or depleted state, fishery certification was developed. Fishery certification is a process initiated by industry to certify its fishery as sustainable and environmentally sound. Specifically, the certification process entails a third-party examination of the sustainability of the fish stock, the environmental impact of the fishery, and the effectiveness of management to respond to changing conditions of the resource. In return, a certified product is labeled and marketed as such in restaurants and through grocery vendors, with the intended result of enhancing its value.

In Canada, as part of the quality control process, halibut are verified and tagged as they are offloaded. Photo by Tracee Geernaert.

At the request of industry, the IPHC staff provided information to the Marine Stewardship Council (MSC) in the 2000s. The Alaska halibut fishery was MSC-certified first in April 2006, and the Canadian halibut fishery in September 2009. Certification is reevaluated every five years. In 2010, the Alaska Seafood Marketing Institute also initiated a certification process with Global Trust, an Iceland-based organization, based on standards developed by the Food and Agriculture Organization of the United Nations. The certification was granted in 2011.

Publications

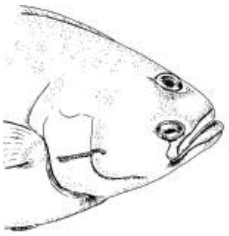
The IPHC produces three publication series: Technical Reports, Scientific Reports, and Annual Reports. In addition, the IPHC produces various annual updates in the form of the Report of Assessment and Research Activities, the Annual Meeting Bluebook, and the halibut fishing regulations as well as periodic publications such as news releases, information bulletins, and a non-fiction, full-color children's book produced in 2005. All publications and materials can be accessed via the IPHC webpage at www.iphc.int/library. Some reports may be available in hard copy and are free of charge upon request. The IPHC website also provides links to current events and information via social media outlets.

You caught a tagged halibut
Now what?

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

Instructions

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



Traditional wire tags

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

Spaghetti tags

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

Pop-up archival transmitting tags

- Attached near the dorsal by a metal dart and leader.
- Rewards: $500 for tag body*, $50 for the leader and metal dart tag only, $5 or tag hat for leader only.
  *Note that these tags may be found attached to a halibut, free floating, or washed ashore

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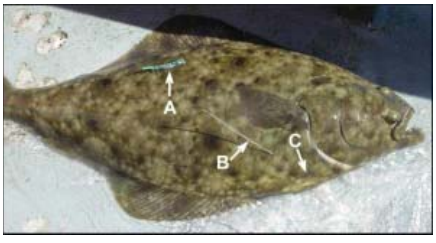
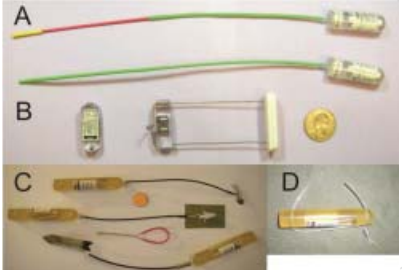
Electronic archival tags

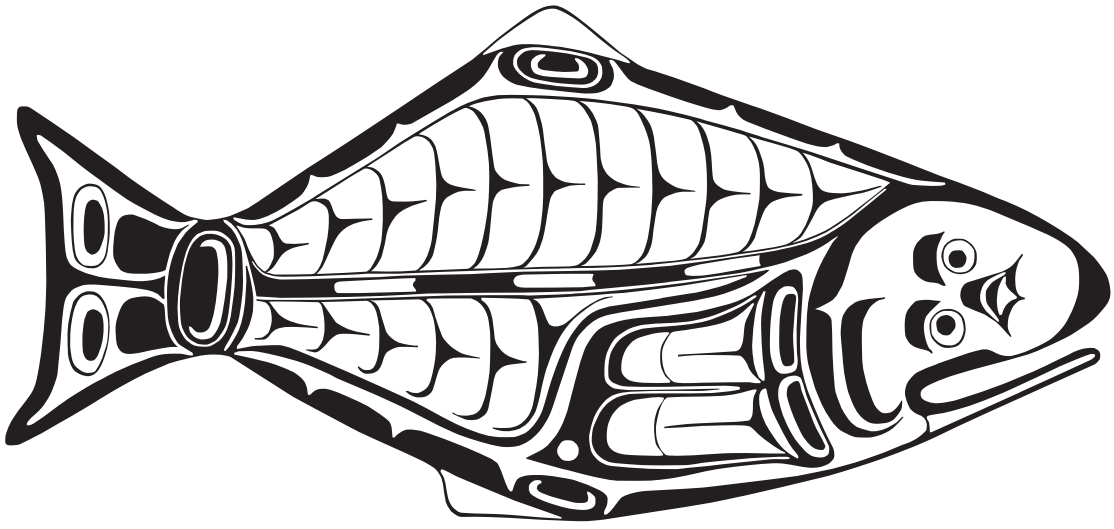


- May be either an external electronic “backpack tag” or an internal “gut tag”
- Externally mounted tag is a black plastic cylinder with tagging wire and backing plate, attached on the dark side below the dorsal fin (A in photo).
- Internal tag has the tag body inside the abdominal cavity with the translucent green stalk protruding outside the fish from the belly (B in photo).
- Some fish have both internal and external tag. $500 reward for the return of each tag type so keep and return both tags.

"Dummy" archival tags



- Fish with internal dummy archival tag or external dummy tag attached near the dorsal also has pink wire tag in the cheek.
- Internal "gut" tag has the tag body inside the abdominal cavity with the stalk protruding outside the fish (A).
- There are two general types of externally mounted tags that are attached near the dorsal fin, either with wires (B) or using one of three different dart-and-leader configurations (C)
- Third type of external dummy tag is attached to the operculum with monofilament (D). Fish tagged with opercular dummy tag does not have a pink wire tag.
- $100 reward for the return of each tag type (dummy archival and wire).



HALIBUT CREST - adapted from designs used by Tlingit, Tsimshian, and Haida peoples.