

INTERNATIONAL PACIFIC HALIBUT COMMISSION

**ESTABLISHED BY A CONVENTION BETWEEN
CANADA AND THE UNITED STATES OF AMERICA**

Technical Report No. 54

**Changes in commercial catch
sampling for Pacific halibut
1994 to 2009**

by

Lara M. Erikson and Thomas M. Kong

**SEATTLE, WASHINGTON
2011**

The International Pacific Halibut Commission has three publications: Annual Reports (U.S. 0074-7238), Scientific Reports, and Technical Reports (U.S. ISSN 0579-3920). Until 1969, only one series was published (U.S. ISSN 0074-7426). The numbering of the original series has been continued with the Scientific Reports.

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INTERNATIONAL PACIFIC HALIBUT COMMISSION
2320 WEST COMMODORE WAY, SUITE 300
SEATTLE, WASHINGTON 98199-1287, U.S.A.
www.iphc.int

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Abstract

The International Pacific Halibut Commission has sampled the commercial catch since the 1930s. Documentation of port coverage, logbook data collected, sampling methods, and otolith collection for the years 1994 to 2009 are presented in this report.

Key ports were staffed by Seattle permanent and locally-hired personnel during the derby fisheries and by full-time seasonal port samplers that are residents in the ports for the Individual Fishing Quota fishery in Alaska and for the Individual Vessel Quota fishery in British Columbia. The location of sampling ports was adjusted as the pattern of landings shifted. Logbook data forms were modified to reflect changes in gear type per vessel, with increased use of non-halibut gear. The frequency of combined-target trips increased with the change to the quota share fisheries. An increased usage of swivels on snap gear was documented. The collection of information on lost or abandoned gear was continued and the change in lost and abandoned gear during the short derby openings versus during the quota share fisheries is reviewed. Biological sampling, i.e., fish length and otolith sampling, within a port, follows similar methods established in 1994, with the necessary sampling rate for a given regulatory area and a given port being calculated each year, based on the current otolith target number, the average fish weight, the current catch limit and the proportion of catch estimated to be available for sampling. The sampling rate is applied to the vessel's hailed weight. This results in unbiased random sampling of the commercial halibut catch.

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Introduction

The International Pacific Halibut Commission (IPHC or Commission) manages the Pacific halibut (*Hippoglossus stenolepis*) fishery for Canada and the United States. Otoliths collected from the commercial catch provide age composition information; a key component to the annual stock assessment. Port data collection also provides average fish lengths, which are converted to weights, by regulatory area (Fig. 1). The IPHC has sampled the commercial halibut catch since the 1930s and details of the methods employed prior to 1994 are found in Hardman and Southward (1965), Southward (1976), Quinn et al. (1983), and Gilroy et al. (1995).

Another essential component of the annual stock assessment is commercial catch per unit effort (CPUE) data. These data have been collected through the IPHC logbook collection program since 1932. It is a legal requirement for most halibut skippers to maintain an IPHC approved logbook and make it accessible to IPHC staff. In the U.S. it is required for any vessel over 26 feet. British Columbian captains are required to maintain a log and mail their log sheets to the IPHC within seven days of their final landing of the season, if they are not collected by an IPHC sampler. Along with CPUE data, catch and location information from the logs is used to assign areas to the otolith samples and to the landing records.

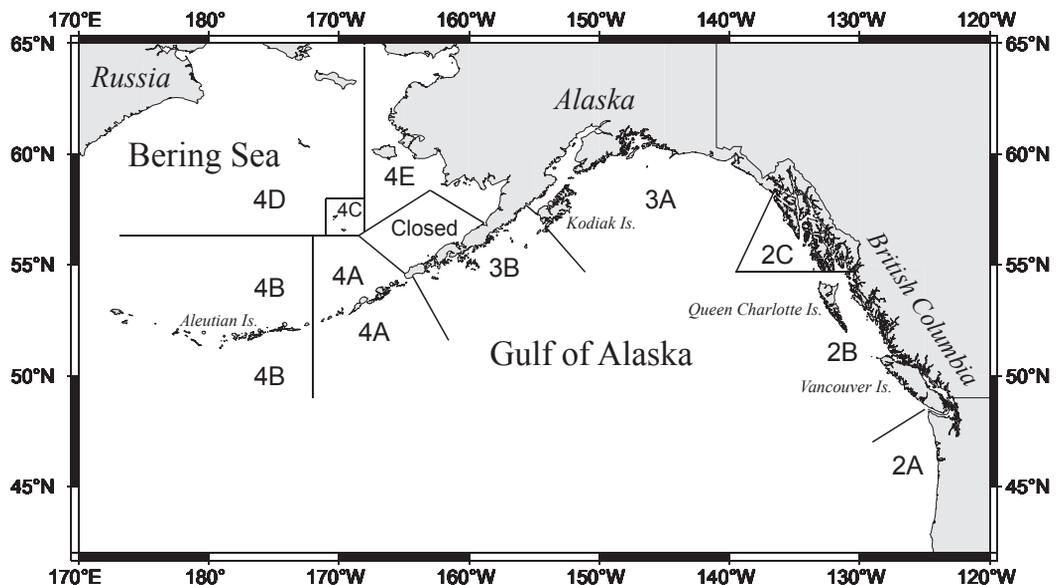


Figure 1. IPHC Regulatory Areas for 1994 to 2009.

The logbook information collected during a skipper interview has evolved over time. The standard data that have been collected since 1932 are the vessel name, fishing dates, location, type and amount of gear deployed and retrieved, and estimated weight of halibut taken at each location. Additional and more specific information has been collected at different times throughout the sampling program's history in response to current practices, issues, or concerns. As an example, since 2003, information on the use of swivels on snap gear, and in one year, fixed gear, has been collected. Collection of these data began as the use of swivels by the fleet was observed by a port sampler. The initial goal was to determine how prevalent this use was and then study its possible effect on the catch per unit effort. The collection of logbook information continues to be reviewed and modified to ensure the accuracy and efficacy of the data.

Port sampling activities along with modifications to the procedures employed since 1994 are discussed in this report. Port coverage, logbook data collection, sampling methods, otolith sampling sizes, the processing of these otoliths, and special research projects are among the items reviewed. Halibut tag data are also obtained while collecting commercial catch data, however, this detailed information is presented in Forsberg (2010b).

Modifications are made to catch sampling procedures in response to changes in the commercial halibut fishery. The adoption of new management measures such as individual quota programs and incidental fisheries are the most significant changes since 1994. In 1991, the Canadian Department of Fisheries and Oceans (DFO) had implemented an Individual Vessel Quota (IVQ) fishery in British Columbia, and in 1995, the National Marine Fisheries Service (NMFS) implemented an Individual Fishing Quota (IFQ) fishery in Alaska. The fishing season lengths for all commercial fisheries, including the quota share fisheries (Table 1) are adopted by IPHC annually. These changes greatly altered the amount of time samplers spent in ports and impacted sampling efficiency and sampling procedures for these areas. Additional changes to the IFQ fisheries, and implementation of a Groundfish Integrated Fisheries Management Plan (Plan) in British Columbia in 2006, have also led to changes in sampling procedures. IVQ and IFQ fisheries are not utilized in Washington, Oregon, and California (Area 2A) where a directed commercial fishery with 10-hour fishing periods, tribal fisheries, and incidental fisheries are defined under the Catch Sharing Plan (CSP) that is implemented by the NMFS. The IPHC sampling plans are modified to reflect the development of the different fisheries.

Sampling in the ports

Sampling the commercial halibut fishery includes collecting the left (blind side) sagittal otolith and fork length from randomly selected fish, collecting logbook information through skipper interviews, and recovering tagged halibut. The fork length measurements of the sampled fish are used to estimate the fish weight. The relationship of halibut length to halibut weight was established in 1926 and was most recently reviewed in Clark (1992).

The collection of logbook information during in-season skipper interviews allows the IPHC staff to observe changes in the commercial halibut fishery including variations in hook spacing, hook sizes, the use of swivels, and the target species for a given set. Management decisions and regulatory revisions have been made following analysis of logbook data. Snap gear CPUE data were included in the stock assessment for Area 2B based on the prevalence of this gear type and its efficiency. However, the data for snap gear is not included in the assessment for other areas as logbook data continue to indicate that the prevalence of this gear type in other areas does not warrant its inclusion. Fixed gear continues to be the most prevalent gear type in all other areas.

Since the implementation of the IVQ system in B.C., key ports are staffed by local biologists for the length of the season. Under the IVQ system, the skipper is required to notify DFO of the landing time, port, and estimated pounds, 24 hours prior to offloading. This allows observers to validate the landing weight as the halibut are offloaded. This also provides notification to the IPHC port samplers, allowing them to collect samples and logbook information.

Table 1. Season or period dates (number of days), 1994-2009.

	2A Treaty Indian	2A Commercial Incidental	2A Commercial Directed	2B	2C	3A	3B	4A	4B	4C	4D	4E
1994	3/05-3/26 (8.75)	n/a	7/06 (10 hrs), 7/19 (10 hrs), 8/03 (10 hrs)	3/01-11/15 (2.59)	6/06-6/07 (1), 9/12-9/14 (2)	6/06- 6/07(1), 9/12-9/14 (2)	6/06-6/07 (1), 9/12-9/14 (2)	6/06-6/07 (1), 8/15 (0.5), 9/12-9/14 (2)	6/06-6/07 (1), 6/15-7/09 (6.5) ¹ , 8/15-8/19 (4), 9/12-9/14 (2)	6/03-6/30 (14) ² , 8/02-8/03 (1)	8/15-8/16 (1.25) 7/01-8/13 (22) ² (4D-N)	5/02-7/24 (56) ³ (4E-NW) 5/02-6/15 (30) ³ (4E-SE)
1995	3/05-6/12	5/01-7/2 (63)	7/05 (10 hrs), 7/18 (10 hrs), 8/01 (10 hrs), 8/15 (10 hrs), 8/29 (10 hrs), 9/12(10 hrs), 9/26 (10 hrs)	3/15 -11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15 -11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15 -11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
1996	3/15-4/07	5/01-6/30 (61)	7/10 (10 hrs), 7/24 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
1997	3/15-3/27	5/01-6/30 (61)	7/08 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
1998	3/15-3/20 (6)	May-June (61), Aug- Oct. (92)	7/22 (10 hrs), 8/12 (10 hrs), 8/26 (10 hrs), 9/23 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
1999	3/15-4/21 (38)	May-June (61)	7/7 (10 hrs), 7/21 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
2000	3/15-4/27 (44)	May-June (61), 8/1-4 (4), 8/11-21 (15)	7/5 (10 hrs), 7/19 (10 hrs), 8/2 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)
2001	3/21-3/23 (2.5), 4/19-4/20 (1), Restricted 3/15-4/15 (32), 4/25-5/11 (17)	Salmon Troll 5/1-7/11(72) Sablefish 8/15-10/31 (78)	6/27 (10 hrs), 7/11 (10 hrs), 7/25 (10 hrs), 8/8 (10 hrs), 8/22 (10 hrs), 9/5 (10 hrs)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)	3/15-11/15 (245)

Table 1. continued

2008	3/8-6/3; Restricted 3/17-4/15	Salmon Troll 5/1-11/15 (198) Sablefish 5/1-10/31 (183)	6/11 (10 hrs), 6/25 (10 hrs), 7/9 (10 hrs), 7/23 (10 hrs)	3/8-11/15 (252)								
2009	3/21-7/15; Restricted 3/21-5/9	Salmon Troll 5/1-11/15 (198) Sablefish 5/1-10/31 (183)	6/24 (10 hrs), 7/8 (10 hrs)	3/8-11/15 (252)								

¹ 12-hour opening every second day

² Alternating one day open and one day closed

³ Alternating two days open and one day closed

In 1994, the IPHC set opening periods in Alaska and sent samplers, often Seattle office staff, to key ports to collect otoliths and logbook data from the catch as it was landed over the course of a week. Since the implementation of the IFQ program, the IPHC sets the season dates and key ports are staffed for the season length, similar to the IVQ system. From 1995 to 2002, vessel skippers were required to notify NMFS six hours prior to unloading. Since 2002, this has been reduced to three hours. This prior notification requirement was initiated along with the IFQ program in order to enable National Oceanic and Atmospheric Administration Office of Law Enforcement (NOAA OLE) to monitor halibut IFQ offloads. This notification also enables the IPHC port samplers to meet each landing and collect samples and logbook information. Under the IFQ program, vessels are only allowed to begin landing their catch between 6:00 AM and 6:00 PM, local time.

In Alaska and B.C., to meet the objective of sampling as many vessels as possible, port samplers are on call six days a week between 6:00 AM and 6:00 PM, with Sunday as their day off. Sampling occurred from two days to five days a week, depending on the regulatory area from which the catch originated. The days that were covered, with respect to sampling, were determined by the port sampler and their supervisor, prior to the start of the season, from 1994 to 2008, and in 2009 by a random sampling schedule determined prior to the season. Protocols are designed to ensure that as many landings as possible have a probability of being sampled so that the sampled halibut are a representative sample from the population of landed halibut. To this end, in 2009, the weekly sampling schedule (Monday through Saturday) for each port was randomized so that catch landed on each day had an equal chance of being selected for sampling. With the exception of Sundays, when landings were relatively few (and in order to give samplers one fixed day off per week) all days were available for sampling, with the additional restriction that one day per week be set aside for logbooks. For ports with different numbers of sampling days for different regulatory areas, the sampling days for the areas which required fewer days are a subset of the area that required the most days. As an example, a single week's sampling in a given port may be considered. For most areas, five days of sampling is required, while for Area 3A, only two days per week may be needed. First, at random, a logbook day from Monday to Saturday was selected. If Thursday was picked for logbooks, then the remaining five days (Sunday excluded) would be sampling days for all areas except Area 3A. For Area 3A, two of the five sampling days would be randomly selected, Monday and Friday say (not Thursday). This random selection was repeated each week of the sampling season.

In Area 2A, the ports were staffed for the directed fishery when the offloads occurred. The tribal fisheries were staffed by tribal biologists. Bellingham was staffed for the entire Alaskan and British Columbian Pacific halibut commercial season to cover the incidental catch during the primary sablefish fisheries in 2A, landings of Alaskan catch as well as Area 2B landings.

Special projects have periodically been undertaken, with assistance from port samplers, in order to answer specific questions. Some of these projects include the deployment of Water Data Recorders (WADARs, temperature and depth recorders) on sets in Regulatory Area 4C (Loher 2006) as well as collection of genetic information from halibut landings in Adak, St. Paul, Sitka, Petersburg, and Newport (Hauser et al. 2006). Tag recovery information is routinely collected by port samplers. Tagging projects have included the passive integrated transponder (PIT) tag project, the Area 2B double-tagging project (Kaimmer and Geernaert 2006) and various (PAT) projects (Loher and Clark 2010) to name a few. Beginning in 2005, port samplers assisted the scan samplers with PIT tag seeding tests to establish tag detection rates (Forsberg 2010a).

Port coverage and selection

All sampling of the commercial halibut catch is done dockside and field samplers are placed in strategic ports to sample the halibut catch being landed. The sampling effort allocated

to the various ports is based on the total percentage of the catch that is processed in a given port, the management area from which the fish are caught, the target number of otoliths required from each management area, and the ability to obtain unbiased samples. Landing patterns are reviewed annually to evaluate which ports need to be staffed in the subsequent season and for what duration. Once the ports are selected, deciding how to spread the sampling effort among the ports is accomplished by predicting, at the beginning of the year, the proportion of the catch by weight that would be landed into each selected port from each regulatory area. Sampling methods are reviewed annually to ensure unbiased samples are obtained in each of the ports. Changes in port coverage during the review period are listed in Table 2. In 1994, the 19 sampled ports received 77% of the total catch. In 2009, even though there were fewer sampled ports (16), a higher percentage (83%) of the total catch was received into those ports.

Many factors have contributed to changes in the landing patterns of the commercial halibut catch. Some of these factors include improvements in transportation by road, sea, and air and the addition of cold storage plants and offloading sites. A combination of management decisions and economic forces resulted in an increase in the distance between unloading sites and the market. The leading port of landing prior to the IFQ fishery and from 1994 to 1997 was Kodiak, receiving between 18-28% of the yearly commercial halibut catch. Moving to an IFQ fishery in Alaska in 1995 was a major management decision that impacted the processing of the halibut catch and became another contributing factor to changes in the ports receiving halibut. Homer has been the leading port of landing for the commercial halibut catch since 1998, receiving between 17 and 27%. In B.C. two ports receive the majority of the landings (Prince Rupert and Port Hardy). In Area 2A, Newport continues to receive the bulk of the directed commercial landings and as a result is the main port staffed during the directed catch openings.

Landing patterns are reviewed every season. New sampling ports are staffed when a particular management or statistical area is in danger of being under-sampled. The following section reviews the changes by area.

Area 2A

Since 1994, otoliths and logbook data have been collected from the Washington (Area 2A) commercial tribal halibut fisheries at Neah Bay; in Taholah or Westport in 1996 and from 1998 to 2005; and in La Push from 1994 to 2002. The Area 2A tribal communities set unrestricted openings as well as a restricted fishery when halibut landings must be 500 pounds or less. Tribal biologists, working with IPHC staff, collect the necessary samples.

The bulk of the directed commercial catch, which is south of Point Chehalis, is landed in Newport, OR. The directed commercial fishery periods are every two weeks until the limit is reached. Therefore, locally-hired personnel and IPHC staff are able to satisfy the sampling requirements for this fishery. Additional Area 2A sampling is performed in Bellingham, WA by the local IPHC port sampler, primarily from incidental halibut taken during the Washington sablefish fishery north of Point Chehalis.

Sampling the Area 2A catch is challenging. Difficulties arise in that the catches are small and spread among several key ports. Therefore, a large proportion of each individual landing needs to be sampled in order to collect the targeted number of otoliths required for stock assessment. From 1995 to 1999, an average of six ports were staffed, with a maximum of eight ports in 1995, to ensure that enough sampling was performed for the stock assessment. Since 2000, under the CSP, commercial harvesters have had to choose among a license for retaining halibut caught incidentally during the salmon troll fishery, fishing in the directed commercial halibut fishery south of Point Chehalis, WA, and/or retaining halibut caught incidentally in the sablefish fishery north of Point Chehalis. Otoliths have been collected at an average of five ports and the licensing change led to a more consistent landing pattern, making it easier to maintain appropriate staff coverage in the key ports.

Table 2. Data collection ports by year.

State	Location	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
OR	Newport	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Bellingham		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
WA	La Push	X	X	X	X	X	X	X	X	X								
	LaConner		X															
	Neah Bay	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Seattle	X	X	X	X	X	X			X								
	Taholah			X		X	X	X				X		X				
	Washington (General)		X															
	Westport/Grayland		X					X	X	X	X	X	X	X	X	X	X	
	Port Hardy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Prince Rupert	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Vancouver, B.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AK	Adak									X	X							
	Cordova		X	X														
	Craig	X	X															
	Dutch / Unalaska	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Excursion Inlet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Homer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Hoonah		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Juneau			X														
	Ketchikan	X	X															
	King Cove	X																
	Kodiak	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Metlakatla		X	X	X													
	Pelican		X															
	Petersburg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Sand Point																	
	Savoonga	X																
	Seward	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Sitka	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	St Paul			X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Wrangell			X														
Yakutat		X	X	X	X													

Alaska and British Columbia

The final year for the derby style or short period openings in Alaska was 1994 and was the last season when samplers were in port for the short duration of the unloading period only. In terms of staffing, there were drawbacks to the short fishing periods in 1994. It was difficult to predict the last day a vessel might arrive into a given port. In general, vessels landed halibut in a nearby port, in the same management area they were fishing, to be among the first to get their fish to market. Transit times from the fishing grounds were relatively short. Occasionally, vessels delivered fish from a different, more distant, management area. Because of the long transit times, in these cases the samplers left prior to the arrival of all of these vessels. The inability to predict how many or if any vessels would deliver catch from distant grounds made it challenging to ensure that certain management areas were not being under-sampled or certain landings underrepresented. The move to the IVQ and IFQ fisheries helped to alleviate many of these concerns.

Since 1991 in Canada and 1995 in Alaska, the majority of the key ports have been staffed for the length of the commercial fishing season. The objective of sampling the maximum number of landings into a given port regardless of the area of catch remains the same. For the first couple of years of the IFQ program in Alaska, it was difficult to predict landing patterns so a higher number of ports were staffed for these years to ensure that sampling requirements were met. With subsequent seasons, clearer patterns emerged making it easier to identify the ports that should be staffed each season. In 1995, a maximum of 16 ports were staffed, while in 2009, the fifteenth season of the IFQ program, 12 ports were staffed. Coverage of Seattle landings were discontinued in 2000 as these landings became infrequent and sampling needs were satisfied by staff in other ports. Hoonah was staffed part time for the length of the season from 1995 to 2001, when it was decided that sampling requirements could be satisfied by staff in other ports, particularly with the addition of Juneau in 2000.

Adak was staffed for two months in 2002 in response to the increased number of landings to this port from Area 4B. This landing pattern continued, so Adak was staffed again in 2003. However, in 2004, following review of the previous season's landing patterns, it was determined that landings to Adak had decreased significantly and shifted back to Dutch Harbor. Therefore, Adak has not been staffed since.

St. Paul has been staffed since 1996, as the fisheries in Areas 4C and 4D became more localized with the bulk of the catch being landed in St. Paul. This Bering Sea location is a key port because Area 4C samples are not recovered in any other sampled port. Area 4C fish are caught by local harvesters who typically begin fishing mid- to late June each season as weather and ocean conditions are more favourable. From 1996 to 2000, St. Paul was staffed for roughly one month per season, usually beginning mid-June. Since 2001, this port has been staffed for a longer duration as the fishery has evolved. In August of 2004, the CSP for Areas 4CDE implemented by the North Pacific Fishery Management Council was modified to allow Area 4C quota to be fished in either Area 4C or 4D. This management decision affected the landing pattern in this port and in 2009 St. Paul was staffed for three months to meet sampling needs.

Upon review of landing patterns, it was determined that some key statistical areas in Area 3B were underrepresented in the commercial catch samples. As a result, Sand Point was staffed for three months of the IFQ season in 2009 to rectify this.

Otoliths were collected from 1995 to 1997 and logbook data since 1994 by the Metlakatla Indian community during set fishing seasons within the Annette Islands Reserve waters, in Regulatory Area 2C.

Logbook data collection

Logbook data collected from 1994 to 2009 accounted for 74% to 86% of the total coast wide catch in pounds (Table 3) and has increased since the implementation of the Individual Quota (IQ) programs.

The halibut fishery regulations in 1994 required the operator of any vessel that was five net tons or greater to keep a fishing log. This regulation was modified in 1995 to specify that the operator of any vessel with an overall length of 26 feet or greater was legally required to keep a fishing log. This regulation was further modified in 1998 to state that any U.S. vessel with an overall length of 26 feet or greater and all Canadian vessels, regardless of length, are legally required to keep a fishing log. However, the IPHC typically obtains logbook information on a voluntary basis, assuming that compulsory disclosure of logbook data could result in false records. Log information has also been collected from vessels less than five net tons and less than 26 feet in length, even though it is not a requirement in the U.S.

Fishing logs contain information on date, locality, amount of gear used, and the total weight of halibut taken daily in each locality. The majority of the log data (80%) is collected by the samplers interviewing the skippers with a lesser percentage of the log data coming from logs submitted by the skippers themselves. While the port samplers interview the skippers, the accuracy of the data is verified with the skippers and adjustments are made when necessary to the IPHC copy of the log. There is no selection or targeting of specific vessels for log data. Conflicting sampling schedules are the main factor determining whether a log is collected from a specific vessel. However, particular emphasis is placed on collecting log data on trips that are sampled for otoliths for stock assessment.

Letters and log forms are sent to skippers requesting that log information be provided when this information has not been obtained in-season. Letters are not sent for all landings. There is a threshold of landed poundage for each area. In 2009, the thresholds were lowered to 250 pounds

Table 3. The percentage of total landed weight represented by logs.

Year	Log wt (net lbs)	Ticket wt (net lbs)	% by wt
1994	40,068,153	54,295,358	73.8
1995	32,718,654	43,545,847	75.1
1996	35,875,784	46,438,043	77.3
1997	51,721,002	63,898,751	80.9
1998	54,490,807	66,783,876	81.6
1999	59,835,336	71,605,799	83.6
2000	55,270,041	65,889,123	83.9
2001	57,536,771	69,467,013	82.8
2002	62,874,864	73,387,730	85.7
2003	61,302,036	72,083,862	85.0
2004	61,167,610	72,015,525	84.9
2005	60,296,011	70,337,204	85.7
2006	55,782,961	66,989,553	83.3
2007	52,528,389	61,978,727	84.8
2008	49,828,684	57,834,047	86.2
2009	44,949,364	51,181,338	87.8

(formerly 500 pounds) for Area 2A and to 2500 pounds (formerly 5000 pounds) for Areas 2C and 4C in Alaska. All other Alaskan areas maintained the 5000 pound threshold. This means that at least one landing, during the season, must meet the area-specific threshold for a letter and log form to be sent to the skippers. In Area 2B, all captains are sent log forms to complete, as submission of logs is required for all vessels in this regulatory area under the IPHC regulations. Whenever possible, skipper submitted logs are compared to logs collected and edited by IPHC staff from the same vessel to ensure accuracy.

IPHC-issued hardcover logbooks have been used by the halibut fleet since the 1930s. The logbooks are given to the skippers at no charge and become their personal property. Booklets known as trip pads, which contain log forms, or “trip sheets”, are designed and printed for port samplers to collect log information from skippers. Log data are transcribed or recorded on these sheets and whether the information was collected verbally, read by the skipper, or written is indicated. Transcription is time-consuming and a possible source of error. Additionally, the printing of the hardcover logbooks is quite costly. In 1998, new logbooks, so-called Captain’s “tear-out” logs, were designed to help resolve these issues. These logs have carbonless copies that allow the skipper to record fishing information, keep the original on board the vessel, and return a copy of the log to the IPHC via either submission to the port sampler or directly to the Seattle office. The IPHC began distributing these logs to the U.S. fleet in 1998. Once the hardcover logbooks were gone, only the tear-out logs were available. The tear-out logs are not always well-received. Many skippers prefer the hardcover logbooks, particularly skippers with smaller vessels or skiffs, where clean or dry space is limited. Since 2001, hardcover logbooks were reprinted and both logbook types are furnished by the IPHC.

Logbook data requirements were the same in Canada and the U.S. from 1994 to 1997. However, in 1996, the NMFS passed regulations requiring vessels, with a length greater than 60 feet, that were fishing groundfish (including halibut) to maintain a groundfish daily fishing logbook provided by the NMFS. IPHC staff worked with NMFS staff to ensure the logbook format covered all of the data elements required by IPHC regulations. Therefore, in 1997, IPHC regulations were modified to allow log data to be recorded in this logbook to avoid duplication of effort. In 1998, IPHC regulations were further modified to specify that U.S. catch data must be recorded in either the groundfish daily fishing logbook provided by the NMFS, the Alaska hook-and-line logbook provided by the Petersburg Vessel Owners Association or the Alaska Longline Fisherman’s Association, or the logbook provided by the IPHC. In 2001, the Alaska Department of Fish and Game (ADF&G) longline-pot logbook was added to the list for Alaska. IPHC regulations have required that a logbook be completed by the Canadian fleet since the advent of the IVQ program. In 1998, the regulations were modified to indicate that logbook information must be recorded in the British Columbia Halibut Fishery logbook provided by DFO. This was updated further in 2006, stating that accurate log information must be recorded in the British Columbia Integrated Groundfish Fishing logbook.

For all areas of the coast, the general information collected from the logbooks is the same and includes: vessel name, vessel number, captain’s name, crew size, fishing date, location fished, depth, type of gear fished, number of skates hauled, number of skates lost, pounds (or number) of halibut caught, date of landing, buyer, and port of landing. Latitudinal and longitudinal coordinates are preferred for the location fished. However, LORAN coordinates were acceptable through 2009. When presented with a location given as a direction and distance from a point of land, the sampler uses a chart partitioning fishing areas into 10-minute by 10-minute squares to pinpoint fishing locations. Appendix Tables 1-3 provide a complete list of information collected in the logbooks.

With the implementation of the IFQ fishery in Alaska, the IPHC logbook underwent many modifications in order to accommodate the changes in required data. Since 1995, captains’ IFQ numbers are recorded as well as the names and IFQ numbers for any other permit holders on

the vessel landing halibut. In 1994, prior to IQs, harvesters deployed a large number of skates to ensure they would reach their vessel's halibut limit within the time allowed and in many cases, set more gear than they could haul. If harvesters reached their vessel limit and still had skates in the water, the crew discarded all halibut off the remaining skates. The number of skates from which halibut were discarded was recorded on the log in 1994. With longer seasons under the IQ fisheries, harvesters generally made multiple trips, only discarding legal-sized halibut when they estimated they had reached their IFQ, which may not have been until the final set of the last trip. Beginning in 1995, the number of skates from which halibut were discarded was no longer recorded and only the estimated pounds of legal-sized halibut discarded in excess of IFQ are recorded.

Over the years, as fisheries have developed, fishing targets have changed. To account for mixed fishing trips, reason codes have been used to define targets for each set. The reason codes include sets targeting halibut, sablefish only, mixed halibut and sablefish, and the target of other species (i.e., rockfish or Pacific cod). In 2000, a new reason code was added to account for sets with a mixed target of halibut and other species (i.e., rockfish). In 2005, the reason code for sets targeting sablefish and other species was added. The different reason codes allow tracking of the different types of targets and they also allow non-halibut sets to be removed from CPUE calculations for stock assessment purposes.

Along with the increase in mixed-target trips, a greater variety of gear types are deployed on a given trip than was noted pre-IFQ. Specific gear type for each set (skate length, hook spacing, and hook count) is recorded on the log form and a gear standardization calculation compensates for the change in gear type. Typically, gear that is deployed when targeting halibut has a wider hook spacing than gear deployed when targeting sablefish. The hook spacing on 'sablefish' gear tends to be three to three and a half feet. Sets with gear that have hook spacing less than four feet are not included in the CPUE calculations for stock assessment. However, the data are available for future studies. Data on hook size are also collected and entered into the database and are available for future studies.

Canadian logbooks look quite different from those used by the U.S. fleet. Canadian logbooks collect all of the information listed previously. Additionally, the trip number, captain's address, and legal discards are recorded. The block (blocks were used to restrict/cap halibut quota accumulation) number and soak time were no longer recorded after 1994. Collection of the "L" tab (halibut licence) number was added in 1995. From 1994 to 1999, information on other species sold and bait type were collected. A field for the hail number was added in 2000.

Gear type is collected in all areas. However, data on sets using snap gear are only included in the CPUE calculations for stock assessment purposes in Areas 2B and 2A. In Areas 2A and 2B, snap gear accounted for around 90% of the effort while the gear is more evenly split between fixed and snap gear in the other regulatory areas. The CPUE for snap gear in Area 2A and 2B was weighted to the CPUE for fixed gear in these areas. In all other regulatory areas, only data on sets with fixed gear are included. This is done to avoid variations in commercial CPUE from changing proportions of fixed and snap effort and because sufficient observations of fixed gear are available for stock assessment.

During logbook interviews, particular attention is paid to the relationship between skate length, hook spacing, and hook count. The skate length is defined as the length of groundline that is actually fishing (has hooks attached), spacing is the distance between each hook, and hook count is the number of hooks on each skate. The length of a given skate can be arrived at by multiplying the hook spacing by the hook count. However, what was sometimes recorded by the skipper was not an exact calculation. From 1994 to 2001, the hook count was allowed to deviate up to 10% from the calculated value (skate length/hook spacing) after which point the gear was not included in the database or the CPUE calculations for stock assessment purposes. In 2002,

this allowed-deviation was reduced to less than 5%. When the calculated hook count deviates by 5% or more, the data are verified with the skipper. If the difference cannot be resolved, the data are excluded from the database and the CPUE calculations.

Data on abandoned or lost gear are collected during logbook interviews and from logs that were submitted directly to the IPHC. The percentage of lost gear has declined since 1994 with a marked drop from 1994 to 1995 (Table 4). This decrease presumably reflects improved fishing practices during the IFQ fishery. Lost gear has represented a steady percentage of 0.3 or 0.4 since 2005.

Table 4. Amount of fishing gear lost by year.

Year	Skates hauled	Skates lost	Skates set	% Gear lost
1994	137,832	2,568	140,400	1.8
1995	111,861	846	112,707	0.8
1996	117,236	854	118,090	0.7
1997	154,913	919	155,832	0.6
1998	161,993	955	162,948	0.6
1999	187,357	1,212	188,569	0.6
2000	169,250	967	170,217	0.6
2001	177,515	815	178,330	0.5
2002	198,623	958	199,581	0.5
2003	202,239	850	203,089	0.4
2004	205,978	830	206,808	0.4
2005	219,590	854	220,444	0.4
2006	212,226	661	212,887	0.3
2007	199,056	722	199,778	0.4
2008	195,889	607	196,496	0.3
2009	171,125	636	171,761	0.4

Presence of swivels on snap gear

Initially, in an attempt to reduce hooked rockfish loss and gear damage, swivels were added to the snap gear. It is thought that the swivel reduces the coiling and snarls created when a fish spins on the hook, preventing the gangion from parting and the subsequent loss of the fish. In the late 1990s, IPHC port samplers in Canadian ports began noticing the presence of swivels on snap gear used by the harvesters they were interviewing. In 2001, port sampling interviews in Area 2B were expanded to capture more specific gear information, and harvesters who indicated they used snap gear were queried further as to whether their gear incorporated the use of swivels. During the 2002 halibut season, an Alaskan port was covered for a brief period by a Canadian port sampler, who continued to verify whether swivels were used on the snap gear. It was noted that this gear modification was also being employed in Alaska. In 2003, the collection of these data was extended to encompass all regulatory areas. Since 2003, snap gear without swivels accounted for about 50% of the snap gear used in all areas combined (Table 5). The use of snap gear with swivels varied among areas. Considering only areas where the use of swivels on snap gear was known, swivel use was most prevalent in Area 2B and least prevalent in Area 2C and Areas 4C and 4D. Monitoring the use of this gear is important as further studies will investigate whether there is an effect on CPUE.

Table 5. Percentage of trips using snap gear, with and without swivels, by regulatory area, 2003-2009.

Reg Area	2003			2004			2005			2006		
	Regular snap	Swivel-snap	Snap un-known									
2A	22.2	15.9	61.9	17.2	60.2	22.6	6.1	11.6	82.3	14.5	19.9	65.7
2B	28.3	46.3	25.4	31.1	45.1	23.7	28.4	49.8	21.8	37.0	53.2	9.8
2C	77.3	4.1	18.6	73.6	10.7	15.7	81.5	4.2	14.3	71.8	5.9	22.3
3A	50.3	35.0	14.7	45.4	39.3	15.3	43.4	33.6	23.0	38.4	37.9	23.7
3B	48.8	30.7	20.5	42.3	31.3	26.3	41.0	29.7	29.3	38.9	36.8	24.3
4A	60.0	30.0	10.0	41.2	40.2	18.6	46.5	34.6	18.9	13.3	61.0	25.7
4B	2.9	30.9	66.2		36.6	63.4	4.0	4.0	92.0		100.0	
4C	86.0		14.0	64.1	0.4	35.4	91.6	2.1	6.3	75.8	1.0	23.2
4D	50.0		50.0			100.0	62.5	37.5		26.7	66.7	6.7
4E											2.0	98.0
Total	50.4	28.1	21.5	47.5	31.4	21.0	49.8	26.8	23.4	46.0	30.5	23.5

Reg Area	2007			2008			2009			
	Regular snap	Swivel-snap	Snap un-known	Regular snap	Swivel-snap	Snap un-known	Regular snap	Swivel-snap	Snap un-known	
2A	12.4	83.1	4.5	5.5	85.0	9.4	1.8	90.2	7.1	0.9
2B	24.3	65.3	10.4	22.7	68.0	9.1	20.8	38.0	7.3	33.9
2C	74.8	8.9	16.3	71.4	7.7	20.9	69.7	10.1	20.2	
3A	39.3	42.1	18.7	39.8	42.4	17.9	37.6	47.6	14.7	0.1
3B	40.9	36.5	22.6	43.4	34.0	22.6	41.9	49.2	8.9	
4A	40.4	51.0	8.7	28.8	44.1	27.0	5.6	75.6	18.9	
4B	77.8	22.2		9.5	66.7	23.8		89.5	10.5	
4C	83.7	0.3	16.0	66.8	8.6	24.6	55.5	30.8	13.7	
4D	33.3	61.1	5.6	21.4	78.6			50.0	50.0	
4E	24.2	1.6	74.2			100.0		100.0		
Total	46.6	37.1	16.3	43.9	38.3	17.8	38.0	41.1	13.2	7.8

Automated GIS statistical area conversions

Since the 1920s, the IPHC has classified the coast wide Pacific halibut catch information into geographical regions referred to as statistical areas (Kong et al. 2004). Catch information from logbook records are included in IPHC reports and provided to other agencies and to the public by these statistical areas as it ensures the preservation of specific logbook confidentiality. To assign catch data to the appropriate statistical area, location information was plotted by hand for each set until 2004, first by Seattle staff and then by port samplers, and was a very time-consuming task. In 2004, a program was designed, using Geographic Information Systems (GIS) technology, to convert latitudinal and longitudinal coordinates for a given set to the corresponding statistical area. This program was tested in early 2004 while hand plots continued to be performed. The new program was subsequently implemented mid-year, negating the need for hand plotting of location information. However, hand plotting does allow in-the-field verification of location information, enabling the sampler to check with harvesters when given abnormal coordinates (i.e., on land or too far apart). As a result, it became even more important for port samplers to be vigilant about checking the coordinates on every set during the initial skipper interview. Additionally, the logbook entry program was modified in 2004 and no longer allows sets spanning a distance greater than 60 thousand feet (more than 33 standard skates), to be entered into the database. Any logs with sets that could not be entered into the database are returned to the port sampler for verification with the skipper during their next interview. LORAN coordinates and location data given by a ten-minute by ten-minute chart square number were plotted by hand.

Bycatch on Canadian logbooks

Special projects were undertaken to collect data to answer specific questions posed by the IPHC and other fishery agencies (Table 6). Some of these data were entered into the IPHC computer database or summarized and forwarded to other agencies. The collection of incidental catch (bycatch) information on Canadian logbooks was one such project. For the 2002 season, the log pages were stamped with a bycatch form and any bycatch species and their weights were recorded. Another stamp was used allowing the skipper to acknowledge that these data would be sent to the DFO stock assessment scientists. These data were then entered into the IPHC database, sorted by DFO groundfish area, summarized, and sent to DFO. Vessels were assigned a unique identifier (number) to mask their identity for confidentiality purposes. The British Columbia Halibut Fishery logbook provided by DFO was modified in 2003, such that the stamps were no longer required. Fields were added to the log to collect the rockfish information and the skipper's signature. In 2004, a Memorandum of Understanding (MOU) was established between the IPHC and DFO, outlining the conditions of the data collection and transfer. Under the MOU, the signature release was no longer required and was removed from the logbook. On July 15, 2005 this MOU was terminated and the data collected up to that point was sent. The project ended as DFO decided to obtain the data through other methods.

Sablefish logbook data collection

IPHC works on several data collection projects with other agencies. One such project is the agreement between the IPHC and the NMFS Auke Bay Laboratory (ABL). Prior to IPHC involvement, there was a voluntary program funded by the sablefish fleet to provide CPUE data to the ABL sablefish scientists. The joint project was initiated at the request of sablefish skippers, who worked with both agencies on implementation. In 1999, the initial agreement had IPHC samplers collecting the IFQ distribution log sheets from the *NMFS Catcher Vessel and Catch Processor DFL Groundfish/IFQ Longline and Pot Gear Logbooks* for sablefish landings, in addition to collecting the halibut information also recorded on these logbooks. In 2002, the project was expanded to include the collection of sablefish information from vessels under 60 feet using the *IPHC Logbooks*, the *Alaska Hook-and-Line Logbooks* provided by the Petersburg

Table 6. Special data collection projects undertaken for IPHC and other agencies.

Data Collected	Years	Description & location of question(s)	In IPHC database	Conclusion	Documentation
Rockfish Bycatch	1992- 1997	Amount of rockfish caught on sets in SE Alaska	No	Summarized data given to ADF&G	
Short-tailed albatross sightings	1998- 2001	Recorded short-tailed albatross sightings	No	Information provided to USFWS and RARA	Geernaert et al. 2001
Bycatch	2002- 2005	All bycatch species retained and discarded on sets in B.C.	Yes	Electronic, summarized data given to DFO Project terminated mid-year in 2005	From 2003, program was through a Memorandum of Understanding with DFO
Shark & Whale Interactions	2003	Recorded interactions on a trip basis	Yes	Reviewed by RAB and found to be too subjective	Hutton and Geernaert, 2004b
Observer data	1998-2004	Presence of observer & cruise number	No	NMFS observer database updated to record this	
Swivels on fixed gear	2005	Prevalence of swivels on fixed gear	No	Minimal to no use in all areas	
Whale sightings	2007-2008	Recorded sightings on a set basis in Alaska	Yes	Reviewed by Program Head and found to be too subjective Survey expanded to collect	Hutton 2009
Sablefish catch and effort data	1999- 2009	Alaska sablefish logbook data	Yes, 2004 -2009	1999-2003: Signed paper copies mailed to ABL 2004-2009: Signed log data, summarized and electronically sent to ABL	Program is through Statement of Work between IPHC and ABL
Swivels on snap gear	2001- 2009	Prevalence of swivels on snap gear	Yes	Began in 2001 in B.C. and in 2003 extended to all Areas	Hutton and Geernaert, 2004a

Vessel Owner’s Association and the Alaska Longline Fishermen’s Association, and skipper’s logbooks. The fleet voluntarily gives sablefish catch information to IPHC staff to be forwarded to the NMFS ABL. Any logbook information provided to the NMFS ABL has a skipper’s signature acknowledging and agreeing to the transfer. From 1999 to 2003, signed copies of the sablefish catch information were provided to the NMFS ABL. In 2004, the NMFS ABL scientists requested that the IPHC, in addition to collecting and editing sablefish log information, also enter these data. The IPHC and the NMFS ABL scientists established a Statement of Work to facilitate capture of sablefish information for stock assessment purposes, while maintaining the IPHC confidentiality policy. To meet the confidentiality requirements, specific set and landing locations are provided, but each vessel is assigned a unique number code, thereby preventing identification of the vessel.

Otolith collection

Sampling the commercial catch and collecting otoliths are essential to obtaining commercial catch age composition. To ensure a representative sample of total commercial halibut removals, the sampling objectives for age composition are to sample an equal and acceptable proportion of the total catch from each regulatory area, to sample throughout the unloading period, and to sample as many vessels as possible.

Number of otoliths collected and aged

Target numbers for otolith collection are set by regulatory area. Until 1996, Area 4 was considered a single area, with respect to otolith targets (Table 7a). Beginning in 1997, Areas 4C and 4D were considered a single area for otolith targets (Table 7b). However, Areas 4A and 4B were considered unique areas and assigned the same targets as Areas 2B, 2C, 3A, and 3B. Until 2003, these areas were assigned a target of 2000 otoliths and Area 2A, a target of 1000 otoliths. Gilroy et al. (1995) documented the analysis that was performed to arrive at these targets. Areas are prioritized and otoliths from these areas must be read first to be available for use in the current year’s stock assessment. In 2003, the number of priority areas was increased (Forsberg 2005). To

Table 7. Area 4 otolith collection target and actual numbers collected by regulatory area and year.

Year	a) Otolith target				b) Otoliths collected				
	4A	4B	4C & 4D	Total	4A	4B	4C	4D	Total
1994				2,000	919	1,399	287	341	2,946
1995				2,000	710	768	115	191	1,784
1996				2,000	888	903	94	404	2,289
1997	2,000	2,000	2,000	6,000	1,935	1,773	663	987	5,358
1998	2,000	2,000	2,000	6,000	1,819	1,684	783	1,124	5,410
1999	2,000	2,000	2,000	6,000	1,468	1,056	752	1,053	4,329
2000	2,000	2,000	2,000	6,000	1,581	1,402	681	858	4,522
2001	2,000	2,000	2,000	6,000	1,961	1,279	679	480	4,399
2002	2,000	2,000	2,000	6,000	2,785	2,802	886	720	7,193
2003	2,000	2,000	2,000	6,000	1,910	2,497	431	685	5,523
2004	1,500	1,500	1,500	4,500	1,207	364	721	708	3,000
2005	1,500	1,500	1,500	4,500	2,088	1,161	890	1,464	5,603
2006	1,500	1,500	1,500	4,500	1,424	1,412	443	835	4,114
2007	1,500	1,500	1,500	4,500	1,957	1,504	549	1,846	5,856
2008	1,500	1,500	1,500	4,500	1,959	1,431	463	1,174	5,027
2009	1,500	1,500	1,500	4,500	1,207	1,279	497	867	3,850
Total	23,000	23,000	23,000	75,000	25,818	22,714	8,934	13,737	71,203

meet this goal, the commercial otolith aging targets for each regulatory or sample area (except Area 2A) were reduced, in 2004, to 1500 with a range of plus or minus 500 otoliths.

For Area 2A, otoliths are collected by tribal biologists during the tribes' restricted and unrestricted fisheries; by Commission staff from the directed commercial fishery landings in Newport, OR; and by the port sampler in Bellingham, WA from the incidental halibut catch during the sablefish fishery.

Sampling methods

Random sampling techniques are applied and sampling rates are calculated for each regulatory area and each port. This calculation is made by considering such factors as the otolith target, the average halibut weight, the weight of halibut into sampled ports, and the weight of halibut available to sample. For example, if the Area 3A target is 1500 otoliths, 37,500 pounds of halibut would need to be sampled given the halibut caught in this area have an average weight of 25 pounds (1500 x mean weight of 25 pounds). With a catch limit of 25 million pounds, the resultant overall sampling rate of the total catch would be 0.15%, (37,500/25 million). Sampling rates are calculated for sampled ports only, as not all the halibut is landed in the sampled ports. With 85% of the catch landing in sampled ports, the sampling rates for those ports would be 0.2% (0.0015/0.85). It isn't possible to sample every landing in the sampled ports. Several vessels may deliver at once and at different plants or they may deliver on the sampler's day off. With only 25% of the catch available to sample, the sampling rate would be 1% (0.2/0.25 rounded to the nearest 0.5% and never less than 1). In this example port, if a vessel landed 25,000 pounds, 250 pounds of halibut would be sampled. For every otolith collected, the fork length of the halibut is measured and recorded. The lengths of the sampled halibut are used to estimate the weight of those specific fish. A running total of these weights indicates when the target sample weight has been reached. In 1994, the lead sampler in the Alaskan ports was responsible for the otoliths' collection either by direct collection or through supervision. Since 1995, key Alaskan and Canadian ports are staffed for the duration of the halibut fishery season and the port samplers follow the prescribed sampling protocols to collect the necessary otoliths.

To achieve the target sample weight, the sampler applies the sampling rate for the regulatory area of the catch to the skipper's hail as provided by the skipper, contracted port validator in Canada, or NMFS Restricted Access Management (RAM) in Alaska. The sampling design must allow every fish an equal chance of being sampled.

One of three different sampling procedures is utilized. The preferred method, which entails a mechanical way to ensure randomness, is to sample off the line ("line sampling") (Fig. 2). It is best to sample at a point on the line where all the fish pass by single file and can be treated as part of a sequence, for example the conveyor belt on the way to the header. With the fish passing in sequence, a sampling frequency (every n^{th} fish) is chosen to ensure the sample is spread throughout the offload. Smaller landings necessitate a smaller frequency or chosen number while larger landings require a larger frequency. Fish are counted as they pass the determined point until the chosen number is reached and this fish is sampled. Fish continue to pass while the otolith is collected and once the sampled fish is returned to the line, counting begins again at one and so on until the offload ends or the target sample weight has been obtained. The initial halibut that is sampled must be randomly selected. Once the sampling frequency is set, a random number is chosen within the frequency range (e.g., from 1 to 9) using a dice, a watch or a random number table.

Another method is sampling off the unloading or sorting table ("table sampling"). This method is used when the fish cannot be sequenced. Several fish are taken from the table immediately after each unloading sling or tote is dumped (Fig 3). The number of fish taken each time is determined prior to beginning the sample by considering the average weight of the fish, the weight that each sling holds, and the hail weight for the sample. This is done to ensure the

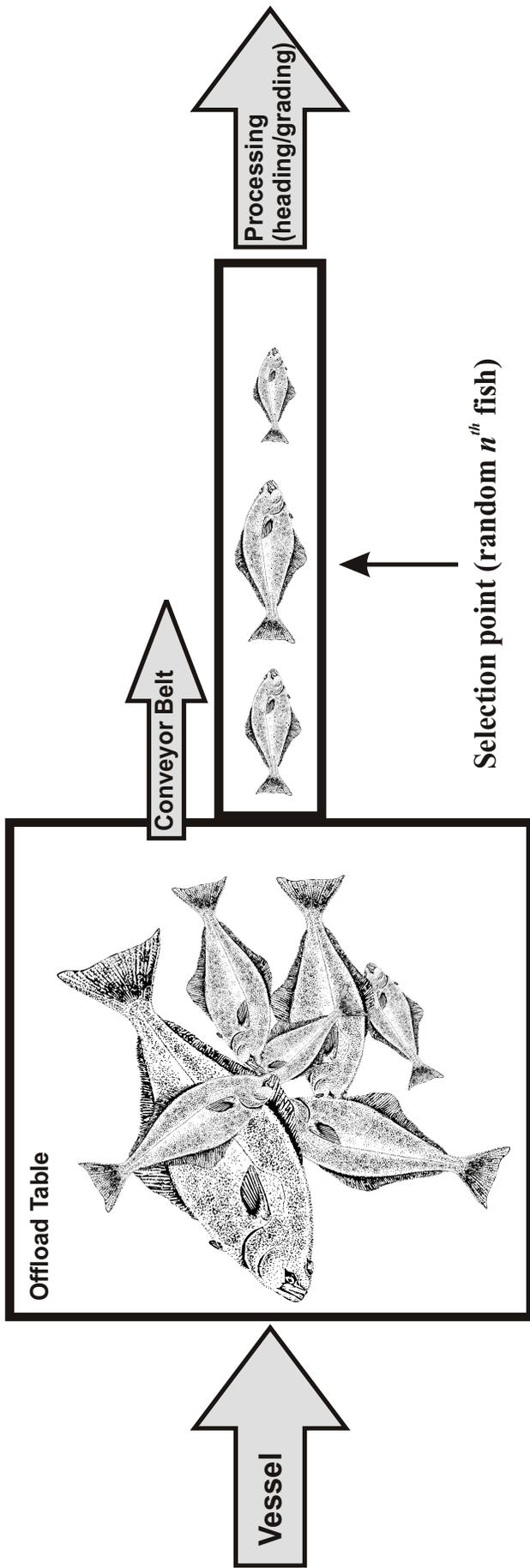


Figure 2. Depiction of line sampling procedures.

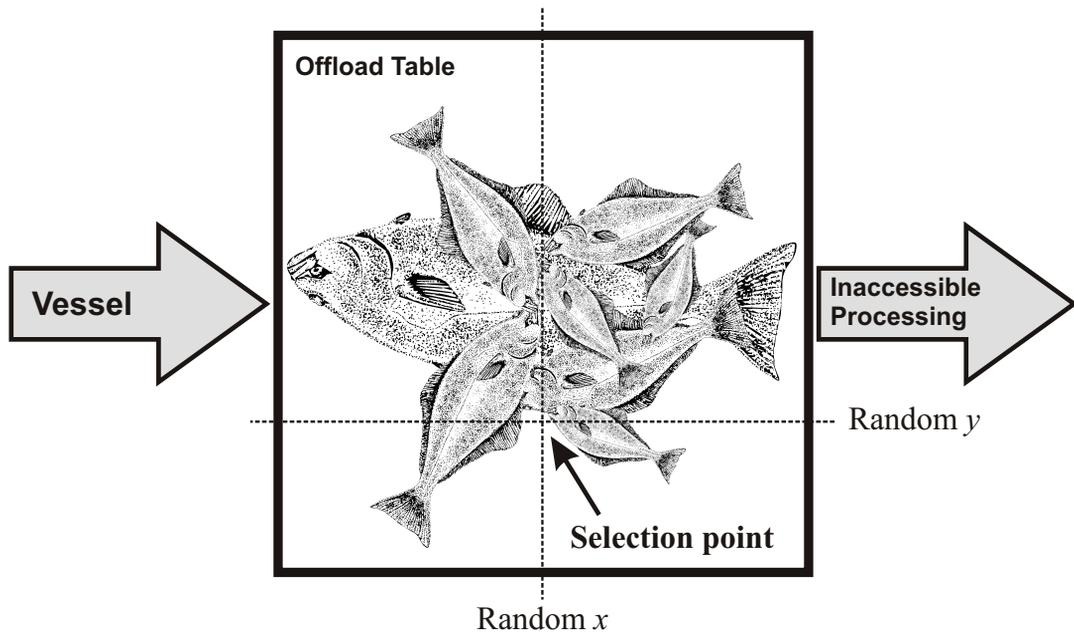


Figure 3. Depiction of table sampling procedures.

target sample weight is reached and that the sample is spread throughout the offload. Prior to the fish being dumped, a spot on the table is chosen and the predetermined number of fish, whose noses are closest to this spot, is removed to be sampled. The spot is not near the edge of the table as the large fish tend to spread or extend out to this area of the table more frequently than smaller ones as can be seen in Figure 3. Fish are removed from the table each time a sling or tote is dumped until the target sample weight is reached or the offload completed. One challenge to this method is the occurrence of strapped fish. Strapped fish are typically halibut that are too large to fit in the sling or tote and therefore must be offloaded by wrapping a strap around the tail and hoisting them off the boat with the crane (Fig. 4). Strapped fish are offloaded at any point during the offload and it is important to sample these halibut at the same rate as the rest of the landing/catch. Therefore, an estimated numerical sampling frequency (n value) is calculated for these fish. For example, if a sling holds 1000 pounds, and two fish, averaging 25 pounds each, had been calculated to be removed from each sling, the numerical sampling frequency of sling fish is two fish out of every 40 (1000/25) or about one in 20. Sampling strap fish at the same rate, a running tally of strap fish is maintained with every 20th fish being sampled. The sampler continues to sample both sling and strap fish in this manner until the target sample weight has been reached or the offload completed. The running tally of strapped fish is carried over throughout the season for a given port to every sampled offload.

The third method of sampling is from totes or slings (“tote sampling”). Most landings are unloaded sling by sling, allowing the offload to be regarded as a sequence of slings from which one or more could be randomly selected, giving every sling an equal chance of being chosen. The probability that a particular fish is chosen is then the probability of its sling being chosen and therefore equal for all fish. At plants where slings and totes are used for offloading, slings are emptied into a single tote or an array of totes such that either the slings themselves or the totes serve as the sampling unit. Care is taken to ensure the selected sampling unit is obtained. Often the entire tote of fish is not needed to reach the target sample weight; sometimes only half, a third, or a quarter of the tote is needed. In these instances, methods are employed to randomly



Figure 4. Depiction of strapped fish.

select a fraction of the fish throughout the tote. For example, if a tote holds 1000 pounds of halibut and only 300 pounds of halibut are required to arrive at the target sample weight, a third of the fish in the tote are sampled. Three fish in the tote are assigned number one, two, and three with one of these three numbers being chosen randomly. The corresponding fish is then sampled and the other two fish are removed from the tote. Another three fish are assigned these numbers and again a random number is chosen and that fish is sampled with the other two fish being removed from the tote. This procedure is continued until all the fish in the tote are either selected for sampling or removal (Fig 5). This method provides each fish an equal chance of being included in the sample.

All landings are sampled at the same rate for a given regulatory area and a given port. Sampling of small landings is challenging particularly with low sampling rates (1%) as the resultant target sample weight will be less than the weight of an average fish. High sampling rates also present a challenge as small offloads are processed quickly and limit the time or opportunity to obtain enough fish (weight) for the sample. To address this, the requirement of sampling as many landings as possible remains, however, small offloads are “pooled” for sampling purposes. Landings for a specific port and regulatory area are pooled to a set weight with only one vessel from the pool having its catch sampled. For example, if the set pool weight is 10,000 pounds and the sample rate for that port and regulatory area is 2%, a 200 pound sample is collected from one

of the pooled vessels' catch. To identify pools and the vessel's catch to sample, a running weight tally of all of the landings less than 10,000 pounds is maintained by regulatory area for any vessel's landing that is available for sampling. Vessels' catch that is not available for sampling, as they may be delivering at the same time as another vessel or delivering on a day the sampler does not work or sample, are not included in pools. The vessel that is sampled is the first one that brings the total to or over the set pool weight, in this example, 10,000 pounds. This ensures the choice of the vessel is objective. Larger pool weights are used in ports where fish are unloaded into totes. Pooling to a large enough poundage allows the sampler to sample a quarter, a third, a half, or whole tote. The port, the trip size, the sampling rate, and the prevalence of tote sampling are all considered when setting a pool size for a particular port and regulatory area.

Regardless of the method used, the sample is drawn from only a fraction of the offload. For smaller deliveries, it is easier to ensure the sample is spread throughout the offload. However, with larger deliveries and in particular, tote sampling, this is a challenge or impossible. There is a tendency to select a tote or all the fish from the first sling or first few slings of every landing. With fewer delivery conflicts (vessels delivering at the same time) as landings are spread throughout the season under the IQ fisheries, there is concern that this may compromise the objective of the sample being representative of the catch. Since 1999, the offload is divided into thirds when it is not possible to spread the sample throughout the offload. Once it is determined that a particular landing must be sampled, the offload is split into thirds by weight, sling count, or tote count and the sample is taken from a random third, e.g., if a landing of 30,000 pounds is being delivered and the second third is randomly chosen, the sample is taken after 10,000 pounds have been offloaded, yet prior to 20,000 pounds being offloaded. If upon arrival, that portion of the catch has already been unloaded, that vessel's catch is not sampled. This helps ensure that all portions of the different catches are represented more or less equally in the combined samples.

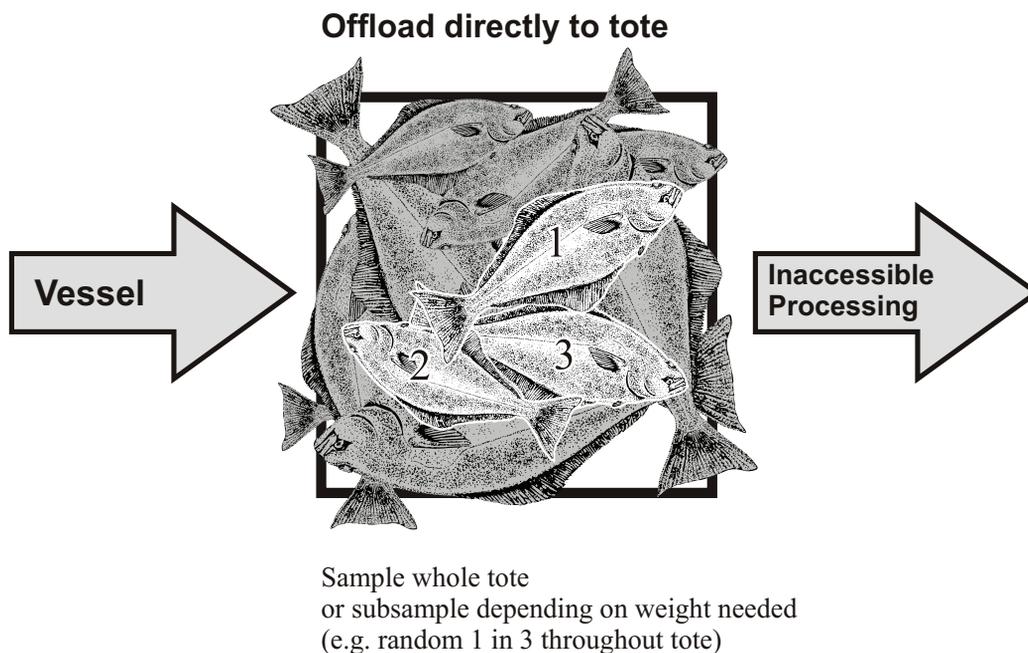


Figure 5. Depiction of tote sampling procedures.

While sampling, otoliths are occasionally 'lost'. Fish selected for sampling that had a crystallized otolith that could not be aged (Forsberg 2001), an external tag, an otolith that was shattered, or an otolith that could not be found in the head cavity are removed from the sample and the corresponding weight is not included in the sample weight. When line or table sampling, once the fish is removed, sampling continues until the target sample weight is reached within the average weight of a fish from that particular offload. When tote sampling, the tote is the sample unit such that the removed fish is not replaced by a fish outside the tote. If an unusually large number of fish have lost otoliths, all otoliths that are collected from that tote of fish are discarded and the sample is restarted with a new randomly selected tote. High rates of otolith loss often occur when fish are subjected to heavy amphipod (sandflea) predation. As the membrane and fluids around the otoliths are consumed by the fleas, the otoliths drop back inside the head and become impossible to find. Otolith loss also occurs when the fluid around the otolith becomes frozen and they cannot be extracted, or they shatter when removed.

Information that is collected along with the otolith, and entered into the market sample database, includes: fork length, port, nation, dealer, number of otoliths, landing date, vessel name, vessel number, hail weight, and regulatory area. The sample number is generated by the computer during data entry. From 1994 to 2002, the gear code was recorded, as well as the hook spacing for the gear used on the trip that was sampled. Since 2002, the tribe number, sampler identification number, and a unique port sample number, selected by the port sampler, have been recorded and entered into the database. This port sample number is also recorded on the log for the trip that was sampled. Entering this value into the market sample and log databases allows the data to be linked and matched such that all otolith data for a particular sample can easily be viewed along with all catch information for the landing from which the sample was taken. Linking these two databases allowed the entry of gear and spacing information into the market sample database to be discontinued as this can be retrieved directly from the log. The statistical area for the majority of the catch for a given sample was recorded on the market sample form until 2004. This was discontinued as this information can be retrieved from the log. Since 2003, whether the sample is from a 'pool' or not is recorded and entered into the database. The regulatory area for the catch has been entered into the database since 2005.

Tagging programs

Recovery of tagged halibut provides information on seasonal migration, utilization, age, rates of growth, and estimates of fishing and natural mortality rates (Forsberg 2010b). IPHC regulations allow any vessel at any time to retain externally tagged halibut. Tagged halibut may be recovered by any fishery and by any gear. External halibut tags are collected by the port samplers and hats, mugs, or monetary rewards are distributed to the finders.

In 2003, the IPHC released 43,999 halibut coast wide and in 2004, an additional 23,437 halibut, in Areas 2B and 3A, that had been internally tagged with a passive integrated transponder (PIT) tag (Forsberg 2010a). Since the release of the PIT tags in 2003, key ports were staffed with scan samplers. These samplers, working alongside the port samplers, scanned offloads to detect and recover PIT tags. Since 2005, port samplers aided the scan sampling program by seeding a portion of select halibut landings with PIT tags. The scan samplers then attempted to recover these seeded tags through normal sampling procedures. The results provided important information on PIT tag detection rates. The final year for the PIT scanning program was 2009.

Port evaluation

A yearly review of sampling activities was recommended by Quinn et al. (1983). In Alaska, in 1994, reports on the sampling activities were completed by the port leads after each opening. The data provided in these reports were used to evaluate the sampling program throughout the season.

The reports assisted in determining additional ports in which to sample for upcoming openings, available pounds to be sampled in each port, and the number of staff necessary to adequately cover the sampling needs for a given port. Additionally, the port leads completed reports on the methods used to sample and collect the otoliths during each opening. This information allowed the stock assessors to ensure that unbiased, random samples were continually taken.

Since 1994 in Canada, and commencing in 1995 in Alaska, port samplers have submitted weekly reports to the head office in Seattle. These reports detail the port activities for the week, including the number of landings, number of vessels sampled, number of otoliths and logs collected, as well as the number of tags collected. The reports provide weekly feedback, including recommendations on improvements. In addition to these reports, the port samplers submit plant sampling reports at the beginning of the season for each plant within their ports. The reports identify the plant, key personnel, contact information, and also lay out the sampling rates and priorities for the different regulatory areas. The reports also detail the sampling procedures established and followed at each plant, are specific in describing the sampling unit that is used (fish, sling, or tote), and how the sampling unit is selected from within a landing. The reports are reviewed by the stock assessment scientist (biometrician) to ensure random and representative samples are being taken at each plant, and any necessary modifications and clarifications are made. At the end of each sampling season, the port sampler submits a port sampling report summarizing the activities and personnel within the port. The intent of this report is to enable any new sampler arriving in the port to quickly and easily find their way around the port and begin sampling. The reports include maps, describe the port in detail, list important contacts (including plant personnel, ADF&G, DFO, NMFS, or NOAA OLE staff), outline the sampling procedures including rates and priorities, and include any interesting or pertinent information or photographs that may help a new sampler arriving in the port for the first time. Additionally, an inventory of the gear within the port is provided along with a list of any gear that is needed for the start of the subsequent season.

With the quota share fisheries, in order to maintain consistency among the ports and make sure proper sampling procedures are being followed, each staffed port is visited by a supervisor at least once during the course of the halibut season, with major ports having random follow-up visits. The initial visit takes place at the beginning of the season. This is important when new samplers are hired, when samplers return after a three and a half to four month closed period, and when most changes are first being implemented. Furthermore, the beginning of the season maintains some of the derby fishery characteristics in that the fleet tends to immediately pursue the fish after the closed period, hoping for a high price. Follow-up tours are done in major staffed ports to ensure consistent sampling procedures are followed and objectives are being met. After each visit, a report is completed by the visiting supervisor to provide feedback to the port sampling program with direct guidance being provided to the sampler while in their port. Joint evaluations of supervisor and sampler are conducted annually.

Summary and future research

In the 1990s, the halibut fishery underwent considerable changes. The number of vessels landing halibut decreased after the change from derby style fishing to the IQ programs, and the number of fishing days increased from a few to as many as 261 days in 2005. The initial change in Canada helped prepare for the changes in otolith and logbook data collection methods that were subsequently necessary in Alaska. Otoliths are collected in proportion to the weight of the offload with 7-78% of each regulatory area's catch being sampled (Table 8). As the fleet adapted to the changes in the fishery and modified their activities, log collection procedures as well as sampling protocols were adjusted.

Table 8. The percent of the total catch (pounds) sampled for age composition by regulatory area.

Year	2A	2B	2C	3A	3B	4A	4B	4C	4D
1994	66	61	21	25	33	33	58	31	46
1995	74	58	28	43	26	42	43	14	24
1996	59	73	28	38	34	40	27	7	32
1997	43	53	29	27	40	51	59	38	44
1998	62	33	30	19	23	42	60	31	49
1999	42	27	26	20	19	35	25	49	51
2000	31	46	31	30	32	33	24	57	52
2001	36	41	32	23	19	37	16	68	30
2002	27	44	29	23	19	44	35	69	41
2003	35	41	27	26	19	44	33	39	44
2004	24	36	26	20	12	27	8	35	36
2005	35	30	28	15	24	35	16	78	30
2006	57	32	29	23	23	28	32	49	21
2007	31	38	30	21	25	35	25	46	31
2008	44	41	27	20	21	37	19	30	24
2009	34	57	36	18	36	25	21	40	28

Through 2009, snap gear continues to be used in the stock assessment only in Areas 2A and 2B. The use of this gear modification has been recorded coast wide since 2003 and because of its high prevalence in some areas future research will be done to assess its effect on the CPUE.

When the IFQ program in Alaska and the integrated fishery program in British Columbia were implemented, sampling methods changed dramatically. Samplers are now stationed in the ports throughout the season, and the sampling methods are reviewed continually as the fishing patterns of vessels change. Fishing behaviour, in turn, continues to change as the industry adjusts to the new programs. It is important that the samplers recommend improvements to the port sampling program as they deal directly with industry and notice any changes early on. This input, in addition to having the samplers summarize their sampling methods regularly and having the supervisors visit the ports several times during the season, helps ensure the sampling methods do not become biased or outdated over time.

Changes in technology have been considerable and the IPHC actively works at keeping up with these changes by automating different tasks. The generation of IPHC statistical areas for given sets is a prime example. Automating this task improved both the efficiency and accuracy of these assignments. Continuing along these lines, a secure SharePoint site was implemented in 2006 for use in the field and Seattle office to allow for timely feedback and communication. IPHC is continually updating, improving and extending the application of this important site as well as working on developing an electronic logbook option for the fleet. Each advance makes it easier for the captains to maintain accurate and timely records and facilitates the submission of these records. Additionally, research on methods of electronic capture of sampling data will be reviewed in the future.

The Pacific halibut fishery in both the U.S. and Canada is constantly changing. It is important for the IPHC port sampling program to adapt and meet these challenges and to be proactive at working out solutions or better options with industry, other IPHC programs, and other agency staff.

Acknowledgements

We thank the IPHC staff, past and present, for their contributions to this report. We also acknowledge and appreciate the continued cooperation and support we have received from Industry (both the fleet and processors) and other agencies with whom we have a long history of working collaboratively.

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Appendix tables

Appendix Table 1.

Vessel, landing, and general information collected as part of the logbook data collection, 1932-2009.

Data collected	Years
Vessel name	1932-2009
Vessel number (state number)	1975-2009
Captain's name	1932-2009
Captain's address	1958-2009
Trip number for the year	1932-2009
Number of crew including skipper	1932-2009
Bait: type, in comments	1958-1960
Bait: used, fresh or frozen herring, salmon, octopus, frozen cod, gurdy	1961-1981
Sighting of foreign vessels: date, nationality, number, and type	1967-1973
Sighting of foreign vessels: interference (if any), lost gear due to it	1967-1979
Date copied	1943-2009
Copied by (sampler's initials)	1975-2009
Log source (written, verbal, other)	1975-2009
Plant, port, and date of sale	1975-2009
Comment code with comments	2009

Appendix Table 2.

Catch and location information collected by fishing day as part of the logbook data collection, 1932-2009.

Data collected	Years
Fishing dates	1932-2009
Number of days (e.g. 1, 2, 3, 4)	1961-1974
Fishing location from captain (place name, latitude/longitude, LORAN)	1932-2009
Depth (individual column in 1980-1981, and since 1994)	1975-2009
Compass: NW, SE...	1932-1957
Statistical Area (District): assigned by IPHC staff and automated in 2004	1932-2009
Skates hauled (gear run)	1932-2009
Skates hauled: actual and effective	1958-1959
Time set and hauled (little information)	1975-1980
Average soak time	1978-1981
Hail: total weight (pounds)	1932-2009
Hail: number of fish (found occasionally)	1940
Hail: catch by medium, large, chix (pounds)	1943-1944
Hail of other species: sablefish, rockfish, ling cod	1934, 1940, 1944, 1999-2009
Reason code to designate target and usability: assigned by IPHC staff	1961-2009

Appendix Table 3.**Gear information collected during logbook data collection, 1932-2005.**

Data collected	Years
Groundline	1932-1942
Groundline: weight and kind (m)	1943-1979
Gangion	1932-1942
Gangion: weight and kind (hemp, cotton)	1943-1979
Hooks (large, medium)	1932-1942
Size of hooks	1943-2009
Rig (spacing of hooks)	1932-2009
Number of lines in a skate	1932-1979
Length of skate (feet)	1980-2009
Number of skates on vessel	1935-1979
Type of gear (conventional, snap)	1973-1974
Type of gear (conventional, snap, troll, other)	1975-1979
Type of gear (conventional, snap, troll, tub, other)	1980-2009
Presence of swivels on snap gear	2003-2009

Appendix Table 4a.
Commercial catch (including IPHC research catch) and catch limits of Pacific halibut by IPHC regulatory area (in thousands of pounds, net weight), 1994 - 2001.

Regulatory Area	Commercial Catch ¹									
	1994	1995	1996	1997	1998	1999	2000	2001		
2A²	370	297	296	413	460	450	482	680		
2B	9,911	9,623	9,554	12,420	13,172	12,705	10,811	10,288		
2C	10,379	7,766	8,872	9,920	10,196	10,143	8,445	8,403		
3A	24,844	18,336	19,693	24,628	25,698	25,316	19,288	21,541		
3B	3,860	3,125	3,662	9,072	11,161	13,835	15,413	16,336		
4A	1,803	1,617	1,699	2,907	3,418	4,369	5,155	5,015		
4B	2,017	1,680	2,069	3,318	2,901	3,571	4,692	4,466		
4C	715	668	680	1,117	1,256	1,762	1,737	1,647		
4D	711 ³	643	706	1,152	1,308	1,891	1,931	1,844 ³		
4E	120 ⁴	127	120	251	188	264	351	479 ³		
Total	54,730	43,882	47,342	65,198	69,758	74,306	68,305	70,699		
Regulatory Area	Commercial Catch Limits ⁵									
	1994	1995	1996	1997	1998	1999	2000	2001		
2A²	355.3	278	275	374.2	440.9	412.5	468.1	681.4		
2B	10,000	9,520	9,520	12,500	13,000	12,100	10,600	10,510		
2C	11,000	9,000	9,000	10,000	10,500	10,490	8,400	8,780		
3A	26,000	20,000	20,000	25,000	26,000	24,670	18,310	21,890		
3B	4,000	3,700	3,700	9,000	11,000	13,370	15,030	16,530		
4A	1,800	1,950	1,950	2,940	3,500	4,240	4,970	4,970		
4B	2,100	2,310	2,310	3,480	3,500	3,980	4,910	4,910		
4C	700	770	770	1,160	1,590	2,030	2,030	2,030		
4D	700 ³	770	770	1,160	1,590	2,030	2,030	2,030		
4E	100 ⁴	120	120	260	320	390	390	390		
Total	76,755.3	48,418	48,415	65,874.2	71,440.9	73,712.6	67,138.1	72,721.4		

¹ Commercial catch includes IPHC research catch and in Area 2C, the Metlakatla fishery catch.

² Does not include treaty Indian ceremonial and subsistence fish.

³ Includes Subarea 4D-N: 1994 = 18,000 pounds.

⁴ Area 4E includes 4E-SE (Bristol Bay fishery) and Area 4E-NW (Nelson Island fishery).

⁵ Additional carryover from the underage/overage plan for the QS programs not included.

Appendix Table 4b.
Commercial catch (including IPHC research catch) and catch limits of Pacific halibut by IPHC regulatory area (in thousands of pounds, net weight), 2002 - 2009.

Regulatory Area	Commercial Catch ¹								
	2002	2003	2004	2005	2006	2007	2008	2009 ²	
2A³	851	819	884	803	829	789	682.2	502.9	
2B	12,074	11,789	12,162	12,331	12,005 ⁴	9,772 ⁴	7,756 ⁴	6,666 ⁴	
2C	8,602	8,410	10,233	10,625	10,492	8,473	6,206	4,949	
3A	23,131	22,748	25,168	26,033	25,714	26,493	24,521	21,708	
3B	17,313	17,231	15,460	13,171	10,792	9,249	10,748	10,785	
4A	5,091	5,024	3,562	3,404	3,332	2,828	3,015	2,511	
4B	4,080	3,863	2,719	1,975	1,590	1,416	1,763	1,584	
4C	1,210	886	954	534 ⁴	493 ⁵	551 ⁵	724 ⁵	631 ⁵	
4D	1,753 ⁶	1,965 ⁶	1,655 ⁶	2,578 ^{5,6}	2,368 ^{5,6}	2,720 ^{5,6}	2,552 ^{5,6}	2,250 ^{5,6}	
4E	555 ⁶	415 ⁶	314 ⁶	369 ⁶	366 ⁶	579 ⁶	600 ⁶	441 ⁶	
Total	74,660	73,141	73,111	71,823	67,981	62,870	58,567.2	52,027.9	
Regulatory Area	Commercial Catch Limits ⁷								
	2002	2003	2004	2005	2006	2007	2008	2009	
2A³	817.9	817.9	890.4	788.6	818.5	799.2	718.4	511.2	
2B	11,750	11,750	12,550	11,658	11,631	10,089.4	7,918	6,711.6	
2C	8,500	8,500	10,500	10,930	10,630	8,510	6,210	5,020	
3A	22,630	22,630	25,060	25,470	25,200	26,200	24,220	21,700	
3B	17,130	17,130	15,600	13,150	10,860	9,220	10,900	10,900	
4A	4,970	4,970	3,470	3,440	3,350	2,890	3,100	2,550	
4B	4,180	4,180	2,810	2,260	1,670	1,440	1,860	1,870	
4C	2,030	2,030	1,720	1,815	1,610	1,866.5	1,769	1,569	
4D	2,030	2,030	1,720	1,815	1,610	1,866.5	1,739	1,569	
4E	390	390	345	359	330	367	352	322	
Total	74,427.9	74,427.9	74,665.4	71,567.6	67,629.5	63,248.6	58,816.4	52,722.8	

¹ Commercial catch includes IPHC research catch and in Area 2C, the Metlakatla fishery catch.

² Preliminary.

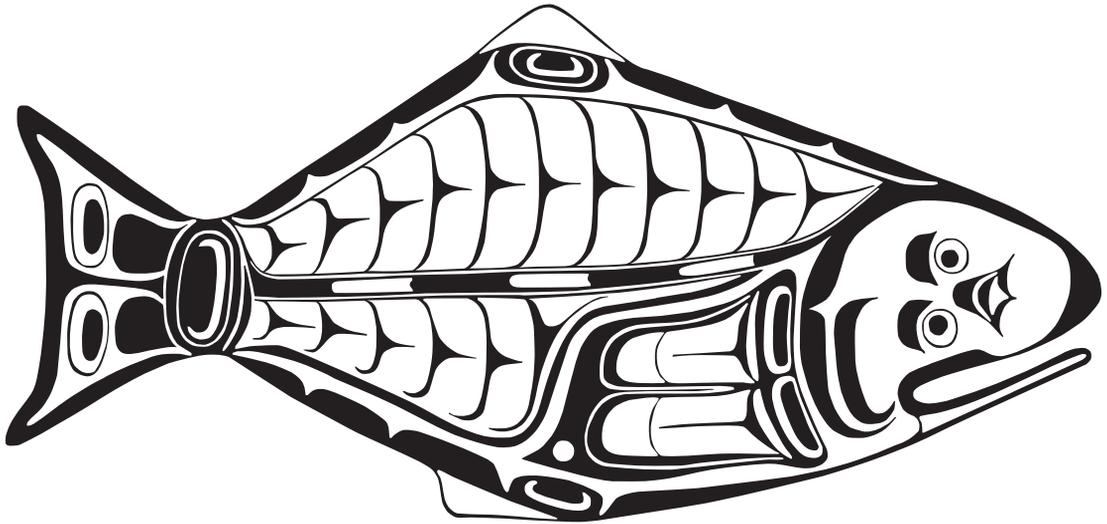
³ Does not include treaty Indian ceremonial and subsistence fish.

⁴ Includes the pounds that were landed by Native communal commercial licenses (F licences).

⁵ Area 4C CDQ and IFQ could be fished in Area 4D as of July 22, 2005.

⁶ Area 4D CDQ could be fished in Area 4E by NMFS enforcement waiver (2001) and IFQ regulation (since 2002).

⁷ Additional carryover from the underage/overage plan for the QS programs not included.



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

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