A Feasibility Study that Investigates Options for Monitoring Bycatch of the Short-tailed Albatross in the Pacific Halibut Fishery off Alaska

PRINCIPAL CONTRIBUTORS

Tracee O. Geernaert

Heather L. Gilroy

Stephen M. Kaimmer

Gregg H. Williams

International Pacific Halibut Commission Seattle, Washington

AND

Robert J. Trumble

Trumble Research and Consulting St. Petersburg, Florida

Prepared for the National Marine Fisheries Service by the Staff of the International Pacific Halibut Commission

February 1, 2001
Revised

This report was prepared in completion of Contract Reference Order Number 40HANF000046 dated March 2, 2000 between the National Marine Fisheries Service, Juneau, AK and the International Pacific Halibut Commission, Seattle, WA

Cover photo: H. Hasegawa

A Feasibility Study that Investigates Options for Monitoring Bycatch of the Short-tailed Albatross in the Pacific Halibut Fishery off Alaska

Prepared for the National Marine Fisheries Service by the staff of the International Pacific Halibut Commission

Principal Contributors

Tracee O. Geernaert, Heather L. Gilroy,
Stephen M. Kaimmer, and Gregg H. Williams
International Pacific Halibut Commission,
Seattle, Washington

and

Robert J. Trumble
Trumble Research and Consulting,
St. Petersburg, Florida

February 1, 2001
(revised)

A Feasibility Study That Investigates Options For Monitoring Bycatch of the Short-tailed Albatross in the Pacific Halibut Fishery off Alaska

Contents | Page

EXECUTIVE SUMMARY

The listing of the short-tailed albatross (*Phoebastria albatrus*) as endangered by the U.S. Fish and Wildlife Service (FWS) prompted regulatory action by the National Marine Fisheries Service (NMFS) to monitor takes and develop a plan to minimize bycatch in the hook-&-line fisheries off Alaska, including the commercial fishery for Pacific halibut. NMFS contracted with the International Pacific Halibut Commission (IPHC) to study the monitoring options for the Alaskan halibut fishery. The study includes background information on the halibut fishery, information known about the distribution of short-tailed albatross as observed by the halibut fleet, bycatch of seabirds by the halibut fleet, and an evaluation of potential monitoring options.

The monitoring programs examined were: (1) self-monitoring by the fleet; (2) monitoring by IPHC port samplers; (3) on-board monitoring, either by existing groundfish observers or separate and stand-alone observers for the halibut fishery; and (4) technological monitoring, possibly with video systems.

None of the systems evaluated completely fits the diverse, wide-ranging halibut fleet fishing off Alaska. A combination of monitoring systems may prove more efficient and cost effective than a single system. A requirement for self-monitoring, the least expensive and least complicated system, would require statutory obligations for reporting bycatch of short-tailed albatross. At present, there is no requirement to report encounters and regulations are recommended to require self-monitoring for this feature alone. However, self-monitoring alone will not adequately summarize all short-tailed albatross bycatch because of the incentive for fishers to misreport any bycatch. A requirement for monitoring short-tailed albatross with IPHC port samplers offers no advantage over self-monitoring, because the same incentive exists to misreport. In addition, the IPHC port sampling program interviews only a subsample of the fishery, although the program could be expanded if it was determined to be the best monitoring method.

An observer program represents the traditional method for obtaining bycatch information for fishing vessels in Alaska. Complete coverage of the fleet is impractical due to the high number of vessels in the fishery. Critical issues for this option include observer cost, coverage levels, and cost recovery. If an observer program is determined as the best option, it is recommended that program developers look at a minimum vessel size between 40-60 feet, and evaluate times and areas for elimination or reduction of coverage. Observer programs involving partial coverage have often been promoted under the rationale that observations expanded from the observed to the unobserved fleet will be “statistically sound”, insofar as fleet differences and potential bias is recognized and addressed in the sampling design. The validity of such extrapolations rests on the assumption that the fishing processes on observed and unobserved vessels will be identical. This assumption may be questionable in situations where the sampled fleet represents a small component of the total and the impacts of observed encounters (violations) are large. Therefore, reliance on estimates derived using low levels of coverage should be done with caution.

A video and GPS-based system has high potential for nearly complete monitoring of the short-tailed albatross mortality in the Pacific halibut fishery. Such systems are being used successfully in other fisheries for monitoring. A video system has clear advantages in cost and ease of logistics over other methods, if developers can assure adequate accuracy and preclude fishers from affecting the image captured by the camera. Developers may improve video monitoring to a satisfactory level with advance notice and support from NMFS or FWS, over the time necessary for the NMFS and FWS to evaluate and recommend a monitoring system for short-tailed albatross. We strongly recommend the development of the video monitoring option.

Finally, whatever final design is adopted to monitor short-tailed albatross, that design should also incorporate data gathering on other Alaskan seabirds.

A Feasibility Study That Investigates Options For Monitoring Bycatch of the Short-tailed Albatross in the Pacific Halibut Fishery off Alaska

INTRODUCTION


Photo courtesy H. Hasegawa

The purpose of this contract is to provide the National Marine Fisheries Service (NMFS) with the information required to identify the best and most practical option for monitoring the potential mortality of the short-tailed albatross in the Pacific halibut fishery in waters off Alaska (Fig. 1).

NMFS contracted with the International Pacific Halibut Commission (IPHC) to conduct a study of the monitoring options for the Alaskan fishery for Pacific halibut. The study includes background information on the halibut fishery, information known about the distribution of short-tailed albatross as observed by the halibut fleet, bycatch of seabirds by the halibut fleet, and an evaluation of potential monitoring options.

The endangered short-tailed albatross (*Phoebastria albatrus*) co-occurs with commercial fisheries off Alaska, and NMFS engages with the Fish and Wildlife Service (FWS) in consultations required by Section 7 of the Endangered Species Act (ESA). Short-tailed albatrosses have been observed from commercial fishing vessels off Alaska, and groundfish (i.e. non-halibut) longline operations have taken several birds. A single short-tailed albatross mortality was recorded in the Alaskan halibut fishery in 1987.

The presence of “free food” in the form of offal and bait attracts many seabirds to fishing operations. In the process of feeding, the birds sometimes come into contact with fishing gear and are accidentally killed. For example, most seabirds taken during hook-and-line operations are attracted to the baited hooks during setting of the gear. The birds become hooked at the surface and are then dragged underwater, where they drown.

NMFS is required to prepare and implement a plan to investigate all options for monitoring the incidental take of the endangered short-tailed albatross in the commercial fisheries including that for Pacific halibut (*Hippoglossus stenolepis*) in waters off Alaska. NMFS would then institute appropriate changes to the fishery as a result of its investigation. These measures are consistent with the Food and Agricultural Organization International Plan of Action for Seabirds, that calls for assessments of longline fisheries for seabird bycatch, monitoring of seabird bycatch, and assessments of the effectiveness of mitigation measures.

NMFS and the North Pacific Fishery Management Council (NPFMC) have the responsibility to develop alternative management measures and to provide environmental and regulatory assessments that lead to a decision on monitoring for the Pacific halibut fishery. The IPHC has not recommended specific regulatory actions in this report, pending the environmental and regulatory assessments. Additional components of these assessments, such as evaluating the efficacy of seabird avoidance measures, are beyond the scope of the IPHC contract with NMFS.

SUMMARY OF OPTIONS

The IPHC and NMFS staffs have identified the following potential monitoring programs for short-tailed albatross bycatch in the Pacific halibut fishery:

1. Self-monitoring by the fleet;
2. Monitoring by IPHC port samplers;
3. On-board monitoring, either by existing groundfish observers, or separate and stand-alone observers for the halibut fishery; and
4. Technological monitoring, possibly with video systems.

Self-monitoring by the Northeast Pacific groundfish fishing fleet currently occurs for some types of fishery data. For example, logbook data required by NMFS include reports of halibut bycatch and discard. However, the halibut bycatch data are neither analyzed nor used, because many scientists and managers have little faith in the accuracy of the reported bycatch data. In addition to self-reporting via logbooks, fishers could also report via phone, fax, e-mail or in person when they catch short-tailed albatross.

IPHC port samplers currently monitor halibut landings in major ports throughout Alaska, as described later in this report. Port samplers collected reports of seabird bycatch and short-tailed albatross sightings for 1998 and 1999. Seabird data collection did not continue because the IPHC was not confident that fishers accurately reported the seabird bycatch. Data from a fishing season became available later in that year, and analysis occurred the year following. However, an IPHC port sampler could pass on any reported short-tailed albatross bycatch information to NMFS or FWS.

An observer program for the Pacific halibut fishery has several major options that would greatly affect the program. Options include:

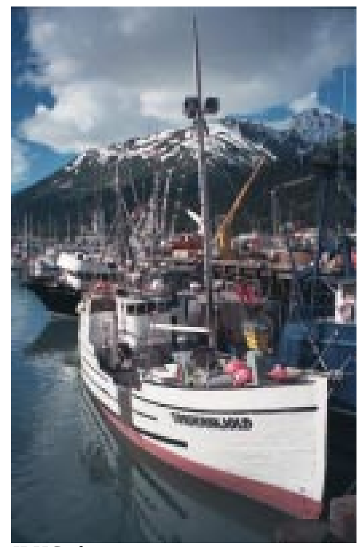
- Integrate with the groundfish (i.e., non-halibut) fishery observer program, or stand alone;
- Observers monitor only short-tailed albatross bycatch, or have other duties; and
- 100% coverage, or coverage restricted to particular areas, times, or classes of vessels.

Rapidly developing technological monitoring has added and will continue to add capabilities for assessing short-tailed albatross bycatch. At this time, the IPHC staff is aware only of video-monitoring systems that are currently capable, or nearly so, of fulfilling the short-tailed albatross needs. Two video-monitoring systems are currently in use in the North Pacific, with a third under development. Canadian fisheries for sablefish (longline) and crab (pot) are utilizing systems designed to monitor the activity of the vessel and crew. A system being developed in Alaska is projected to enable enumeration of the catch through image recognition software; however, the technology and software are still under development and are not expected to be in use for several years, if at all.

HALIBUT FLEET PROFILE

The Pacific Halibut Fishery and Gear

Today's commercial halibut fishing fleet is diverse, using various types of longline gear and strategies to obtain its quarry. Both Alaska and British Columbia have implemented an individual quota (IQ) system that enables a vessel to fish anytime during an eight-month season, and thus play the market to their advantage. In addition, the IQ fisheries have had ramifications for the fishers themselves, the fishing grounds, and the gear used. In addition to its commercial appeal, halibut is also one of the most popular sport fish targets, as seen by the still increasing charter boat industry.


IPHC photo

The type of gear used to commercially fish for halibut has changed little over the years. In the early years, a number of lines, each 300 feet in length, were spliced end to end to form the groundline. The number of lines varied considerably, but most fishers eventually adopted the 6-line (1,800 feet) skate. Groundline is now sold in 1,800-foot lengths. The interval between hooks, or "rig" of the gear, varies from three feet if the gear is used to also fish sablefish (*Anoplopoma fimbria*), to as much as 42 feet depending on gear and fishing target. Most fishers targeting halibut use gear rigged 12 to 18 feet. Fishers set multiple skates tied together to form a string of gear. Halibut fishers use three types of longline gear: conventional gear, snap gear, and autoline gear. Conventional gear consists of gangions (branch lines with hooks) tied to the groundline. Traditionally, fishers coiled each skate to form a bundle, held together with lanyards from canvas squares underneath the bundle that tied together on top (skate bottom gear). Recently, tub gear was developed when some fishers cut the groundline into smaller sections, and coiled them into tubs. Snap gear consists of groundline wrapped onto a drum. Gangions snap onto and off the groundline. Autoline gear consists of groundline and gangions retrieved and set from a machine that stores the gear.

In 1982 and 1983 halibut 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 its J-hook counterpart, 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 simultaneously targeting other species such as sablefish.

Fishers typically set gear in the morning, and retrieve gear through the day into the evening. Soak time ranges from a few hours to 24 hours, but averages around 12 hours. Setting gear occurs in approximately the same way for the three types of longline gear (Fig. 2). Fishers throw over a buoy and flag attached with running line to an anchor. The groundline is attached to the anchor with a short running line. Resistance of gear in the water pulls the groundline with baited hooks over the stern of the moving vessel for conventional and autoline gear. The rotating drum pays out line for snap gear. For most vessels, the groundline falls quickly to the water behind the vessel and gradually sinks below the surface. Baits sink below the diving depth of seabirds within several hundred feet behind the vessel. An anchor and pole and flag on the other end of the groundline complete the set.

Hauling occurs amidships, usually on the starboard side (Fig. 2). The vessel operator keeps the groundline nearly vertical below the side of the vessel as the line comes in, although large angles can occur with strong winds or currents. Because the rail of the vessel at the hauling point is usually six to eight feet off the water, any baited hooks come out of the water close to the side of the vessel. A fisher removes the halibut from the hooks while another coils conventional gear. Other fishers clean fish, bait gear, or perform other duties.

Seabirds experience highest vulnerability to hooking during setting, as the baited hooks are near the surface and at some distance from the vessel. During retrieval, few of the hooks still have bait remaining but these hooks spend only several seconds in the depth zone of feeding birds, and proximity to the vessel deters seabirds.

The 1998 Alaskan Halibut Fishery And IPHC Data Coverage

The 1998 data year

The most recent year for which IPHC log and ticket data are complete and available is 1998 and will be used to characterize the fishery for Pacific halibut in Alaska. The 1998 season opened at noon on March 15 and closed at noon on November 15. Some deliveries were made every day from March 16 through November 19. The 1998 commercial catch (excluding IPHC research catch) of Pacific halibut from Alaskan waters was 53.4 million pounds. All weights discussed in this report are dressed, head-off, unless otherwise stated. Although the industry standard for other fisheries is to report weights in “round, head-on” units, the IPHC receives weights from the fish buyers after the fish have been headed and gutted. Thus, a net weight reporting is more accurate than an extrapolation back to round weight. Approximate round weight units can be figured by dividing the net weight by a factor of 0.75.

The sale of halibut during 1998 averaged about $1.40 per pound in Alaska. A series of events caused the 1998 price to drop far below the average prices in the two years before and after. The IPHC estimated average prices per pound for 1996, 1997, 1999, and through August 2000 at $2.21, 2.21, 2.05, and 2.25, respectively. For calculating purposes in this report, we used $2.20 as the ex-vessel value of Pacific halibut.

An Individual Fishing Quota (IFQ) fishery has been in place for Pacific halibut and sablefish since 1995. Restrictions on transfers of IFQ between vessel classes (35 feet and under, between 35 and 60 feet, and over 60 feet) help stabilize the relative annual landing distribution pattern among vessel classes.

Ticket and log data

The IPHC data series includes both fish ticket (landing reports required by the states) and log data (effort and location data required by the IPHC). The ticket data are complete, representing all commercial landings of Pacific halibut from 1,802 vessels in 1998. The log data are less complete, their collection designed to represent a majority of the larger landings and a majority of the major ports. The log data for 1998 represent 78% of the total catch, 41.5 million pounds from 1,107 vessels and 4,086 commercial landings (Table 1). Any 1999 IPHC data in this report are preliminary. The ticket data are the best source for simple landing information by port. For any discussion of landings by vessel size, catch area, or time, it is necessary to use the log data. This report will use data from both sources. IPHC port samplers interview vessel operators who catch Pacific halibut in Alaskan waters to obtain information required in logbooks. IPHC confidentiality policy requires combining data for fewer than three processors or fishers in any category to prevent potential identification of individuals and landings amounts.

Much of the discussion that follows is from the landings with completed logbook data. The log files have line entries for every string of fishing effort that resulted in a catch of halibut. The retrieval was formatted so that IPHC research fishing and landings were not included. We are also not including legal tag recoveries (which may be legally retained by vessels using any gear), illegal fishing trips, or vessels that sunk with fish on board. For discussions of fishing gear, fishing effort, or trip duration and average landing size, we are further including only those trips or sets that were identified by the vessel master as targeting Pacific halibut. Many landings of halibut are small and incidental to the fishing for sablefish, Pacific cod, or other species. While IPHC records the line information for the mixed targeted fishing effort, it is not typical of the majority of the effort that is directed towards catching Pacific halibut. Most of the 1998 tables in this report will identify the data as from vessels and sets targeting Pacific halibut. The effect on the data set is to greatly reduce the number of hooks represented, while having only a small effect on total pounds of halibut landed. It will also make the data more representative of the directed halibut fleet. However, we cannot distinguish trips that are targeting only halibut from trips that have sets targeting both halibut and other target species. Putting these restrictions on the log data, we have 3,558 landings from trips that targeted Pacific halibut for one or more sets. These landings were made by 971 individual vessels and totaled 39.2 million pounds (Table 1).

Landing patterns in 1998 year were similar to those of 1997 and 1999 (Table 2). Landings increased in each of these years by two to five million pounds, with the relative magnitude of monthly landings following similar patterns. Generally, landings are between 4 and 9 million pounds per month. During 1998, a lower ex-vessel price slowed early landings. In 1998, 13% of the total catch was landed in the first 1.5 months where in 1997 and 1999 the landing during the same period represented 16% and 19% of the annual totals, respectively.

Landings by port. Landings by port during 1998 were reasonably typical of the 1997-1999 period (Table 3), with two port groups, Homer and Kodiak, receiving the largest overall amounts, followed by Seward and Akutan-Dutch Harbor. Homer increased in importance from 1997 to 1999, by doubling the pounds landed and becoming the leading port in terms of total pounds landed. Kodiak, the leading port in recent years, declined in weight landed and especially in proportion of the total landed. In 1999, Juneau nearly doubled its landings from 1997 and became the leading port in SE Alaska.

Comparing logbook data to total landing data by port group for those ports where IPHC has port samplers (Bellingham, Prince Rupert, Petersburg, Sitka, Hoonah, Seward, Homer, Kodiak, Dutch Harbor, and St. Paul), logbook data represent over 70% of the pounds landed during 1998 (Table 4). In many cases, the logbook data represent closer to 90% of the pounds within the port or port group. In 2000, IPHC added Juneau as a port with an IPHC sampler.

Monthly landings show fairly consistent weights for May through September at about 5.6 to 6.0 million pounds per month (Table 5), or about 15% of the landings during each of these months (Table 6). However, the ports in southeast Alaska and the eastern-most of the 3A ports (Cordova and Seward) had most landings earlier in the year than in other areas. In most of these ports, 50% or more of the total weight was landed by the end of May, and Cordova tallied 74%. In all cases, the month with the highest landings month was April or May. In contrast, the Bering Sea and Aleutian Islands areas had little or no landings until June, with July the modal month.

Kodiak and Homer had landings spread out through the season, and did not reach 50% of total weight until the modal months of July or August.

Targeted halibut catch and effort. IPHC log information describes over 41 million pounds caught by over 28 million hooks (Table 7). However, 95% of the catch – about 39 million pounds – was the result of about 70% of the hooks – 20 million – directed at Pacific halibut. Also, while log data represent effort from fishing that targeted sablefish or other species, only those sets of fishing gear that caught halibut are recorded. The Bering Sea had the highest proportion of directed halibut effort – 84% of the hooks, and Areas 2C and 3A had the lowest – 65%. However, these data would not be a good representation of either directed sablefish effort or mixed fishing effort.

Seasonal halibut effort by number of hooks. Effort during 1998 by IPHC regulatory area and month for vessels and sets targeting Pacific halibut (Table 8) showed a similar pattern to the monthly catch by area and port (Tables 5 and 6). Fluctuations in monthly effort were somewhat greater than those in the monthly catch by port. Total peak effort occurred during June and September, and generally ranged from 2.3 to 3.0 million hooks per month from May through September. Most of the Area 2C effort occurred early in the season, and effort in Areas 4 occurred mostly during June and July.

Gear and hook type and hook size. Virtually 100% of the hooks fished during 1998 were circle hooks, with only a few J-type hooks documented. Over 75% of these hooks were fished with fixed gear, which includes both skate-bottom and tub gear (Table 9). A further 16% were fished with snap gear, and 8% were fished with autoline gear. Troll, commercial handline, mixed fixed and snap gear, and unknown gear types combined accounted for less than one percent of the fishing documented in the logs. There is a wide variation of gear fished by vessels catching Pacific halibut. For vessels and sets directly targeting Pacific halibut, there are about equal amounts of short spacing and long spacing, short gear using more of the smaller 14/0 hooks, while the longer-spaced gear uses almost all the larger 16/0 hook. The small hooks/short spacing gear that was used during sets targeting halibut could be from sablefish trips where a few directed halibut sets were fished. The smaller hooks and shorter spacing are most common in the efforts targeting sablefish, or both halibut and sablefish.

Log data by vessel size. Comparing the logbook data to total commercial landing data by vessel length (Table 10), the logbook data represent over 75% of the weight of halibut landed by vessels over 40 feet in length. The vessels over 40 feet in length landed 82% of the total catch in 1998, and landed about 87% of the weight accounted for by logbook data. The logbook data represent 58% to 67% of the weight landed by vessels between 31 and 40 feet. For vessels under 30 feet in length the logbook data represent 24% of the catch. However, vessels under 30 feet account for only 3% of the total landings.

Daily landing patterns. From one to 90 landings were made each day during the 1998 landing period, with an average of 16 landings per day (± 9.5 S.D.). Daily landing sums from Alaskan fishing ranged from a low of just over 11,000 to a high of over 783,000 pounds. The average aggregate landings per day was 167,000 pounds (± 97,800 pounds S.D.). By day of the week, Sunday saw the fewest landings overall, with 397. Monday through Saturdays ranged from

525 to 710 landings for the total landing period. The average sizes of landings did not differ much by day of the week, ranging from 9,073 to 11,396 pounds.

Landings per vessel. Individual vessels made from 1 to 29 landings during 1998 (Table 11), and the number of landings per vessel decreased rapidly at three or greater landings. Over half the vessels made 3 or fewer landings, over 75% made 5 or fewer, and 90% made 7 or fewer landings.

Pounds per vessel. Annual cumulative landing totals for individual vessels ranged from 17 pounds to just over 442,000 pounds, with a vessel average just under 41,000 pounds. Most landings were relatively small, and the number of vessels dropped rapidly for landings above 50,000 pounds per year (Table 12). Twenty-one percent landed less than 5,000 pounds, 61% less than 25,000 pounds, and almost 90% less than 100,000 pounds per year.

Size of vessel landings. There is a strong trend towards larger landings by larger vessels (Table 13). The largest vessels, 60 feet and up, averaged over 28,000 pounds, while the vessels under 26 feet averaged less than 600 pounds. Smaller vessels had a proportion of total landed weight much smaller than their proportion of landings. Vessels under 46 feet made 53% of the landings, but only 8.9% of the landed weight. Vessels greater than 56 feet made 28% of the landings, but accounted for 62% of the landed weight. Landings by individual vessels averaged 11,024 pounds (± 13,436 S.D.) The magnitude of the standard deviation is a clear indication of the level of variation in vessel landings. In addition, it indicates a highly skewed distribution of these data, which is also typical of vessel landings. If the variance results were to be used in a quantitative manner, transformation with a negative binomial, lognormal or other skewed distribution would be required to provide an accurate basis for subsequent estimation or testing.

Trip duration. Trip duration was calculated as days from first fishing through the landing date. A vessel fishing and selling on the same day would have a trip duration of one day. Trip duration ranged from one to 25 days (Table 14); the average trip duration was 3.1 days (± 2.5 S.D.). Most trips ranged from 2 to 5 days. Trip duration was one day for less than 8% of the landings, two days or less for 25% of the landings, and three days or less for almost half the landings. Over 90% of trips were 7 days or less. There is a clear trend for larger vessels to make longer trips (Table 15). The smallest vessels averaged 1.5 days per trip, while the largest averaged 5.9 days.

Bait Usage

No current data exist to characterize the bait usage of the Pacific halibut fishing fleet. The most comprehensive record of halibut fishers' activities, the IPHC logbook interview program, does not inquire about bait use. As a proxy, we interviewed halibut buyers along the Alaska coast from southeast Alaska to the Aleutian Islands and Bering Sea. We asked the proportion by species of bait sold to fishers targeting halibut, whether fishers caught other fish species to use as bait, and whether species used as bait differed by classes of vessels. We selected buyers that regularly sell bait. Because bait sales are a proprietary business activity, we will not present information from individual bait sellers. The list of buyers interviewed is presented in Appendix I. Fish buyers reported little consistency in bait use. Processors in adjacent towns often reported bait sales with different proportions by species. However, some regional differences occurred. Reports of bait sales in a port or region may not represent bait use in that region, as fishers on large boats often take bait in an area, but run to distant areas for fishing. Most halibut fishers bait hooks by hand, but some use autoline gear that baits automatically by pulling empty hooks through a hopper of cut bait.

Southeast Alaska

Salmon, squid, and herring accounted for virtually all of the bait sales in southeast Alaska. Three of the five halibut buyers interviewed reported that chum salmon accounted for about 50% of the bait sales, one reported pink salmon made up more than 50%, and the fifth reported a strong predominance of squid. For the two buyers where chum salmon did not dominate, chum sales were nearly non-existent. Pink salmon made up 10-20% of bait sales for three buyers but one buyer did not sell pink salmon as bait. All buyers sold squid, generally in the 10-25% range of total bait sales. Though herring did not dominate at any southeast Alaska buyer interviewed, it represented the second most popular bait from two buyers at 25-35%. The other buyers reported herring sales ranging from nearly absent to 10%.

According to reports from buyers, fishers typically take sufficient bait for the amount of halibut fishing anticipated during a trip. While fishers will occasionally supplement the purchased bait with bycatch, especially Pacific cod, one of the five buyers indicated that up to 30% of fishers take bait specifically to fish for Pacific cod to use as the primary bait for halibut. Some buyers suggested that most squid and chum salmon go to larger boats, often with large individual quotas, while pink salmon typically go to smaller boats.

Gulf of Alaska

Squid and herring dominate bait sales in the central Gulf of Alaska. For six of the seven buyers interviewed, squid was either number one or tied for number one, and number two in sales for the seventh buyer. The proportion of squid varied with the diversity of bait sold ranging from 60-75% for three buyers that sold primarily squid and herring, to 30-40% for two buyers with a large variety of bait sales. Only one buyer reported a low proportion of squid, about 15%, where herring made up about 80% of sales. Herring tied for top sales, at 30-40%, at two buyers with diverse sales, and made up 20-30% for buyers with sales dominated by squid. Two plants reported substantial sales of Alaska pollock and Pacific cod. No buyers reported sales of pink salmon as bait, and most reported that chum salmon made up less than 10% of bait sales. Several buyers suggested that fishers would use more chum salmon, but that chums are difficult to obtain for much of the halibut season.

Two of the five buyers indicated that as much as 30% of fishers use herring or squid to fish specifically for Pacific cod to use as halibut bait. The other buyers believe that fishers take all bait necessary for the anticipated amount of fishing, and supplement with bycatch of Pacific cod if necessary. Some of the buyers reported different bait use by size classes of boats. Four reported squid used mostly by larger boats and herring by smaller boats, and another reported larger boats using Pacific cod, Alaska pollock, and chum salmon while smaller boats used squid and herring.

We did not inquire about size of baits used for halibut fishing. Based on experience of IPHC staff, we estimate that fishers averaged at least 0.25 pounds per bait. For the estimated 30 million hooks used annually by halibut fishers, we estimate that fishers use about 8 million pounds of bait per year.

Bering Sea-Aleutian Islands

Squid and herring dominate the bait sales in the Bering Sea-Aleutian Islands. Along the Aleutian Islands, squid account for around 60% of the bait sales and herring around 40%. Fishers using autoline systems generally use squid, which works best for auto-baiting. Fishers who hand-bait more often use herring than squid. The Community Development Quota fisheries of the Bering Sea use mostly herring for halibut fishing.

Ability to Carry Observers

Vessel characteristics

We cannot make a blanket statement about the ability of halibut vessels to carry observers. We received no criteria from NMFS with which to evaluate suitability of various vessels. Individual vessels within any size range of vessels vary considerably for number of crew carried, number of bunks, living space, and workspace. Cost of observers will be a variable proportion of gross and net revenues. In some cases, adding an observer will require additional safety equipment, such as a larger raft, at further additional cost. The duties of the observer will also affect the ability of a vessel to carry an observer, especially for smaller vessels. An observer who only watches deck activities and counts short-tailed albatross could deploy on a smaller vessel more easily than an observer who needs deck space to collect and process samples.

Little information is available for assessing the ability of the halibut fleet to carry observers. Vessels over 60 feet in length must carry observers for 30% of fishing days when fishing for groundfish. We assume that halibut vessels greater than 60 feet that do not fish groundfish will have characteristics similar to the groundfish vessels greater than 60 feet, and have the same suitability to carry observers. Therefore, we will focus on smaller vessels. We did not conduct a random survey of individual vessels. Rather, we contacted leaders of fishing associations (Appendix 2) that represent smaller vessels, and used the experience of IPHC staff members who have interviewed many small and medium sized vessels in the course of collecting logbook data.

Wynn and Merklein (1996) canvassed vessels in eight salmon fisheries in Alaska to help assess suitability of the vessels for carrying marine mammal observers during the salmon fisheries. While marine mammals and short-tailed albatross can be distributed in widely different areas and salmon and halibut fisheries operate quite differently, many salmon vessels participate in the halibut fishery. The conclusions of Wynn and Merklein offer a reference point for comparing the comments of association leaders. Of the eight fisheries they assessed, four represent potential halibut vessels – southeast Alaska drift gillnet, southeast Alaska purse seine, Cook Inlet drift gillnet, and Bristol Bay drift gillnet. According to Wynn and Merklein, most vessels in these four fisheries could accommodate an observer at some time during the fishing period, although the living and storage space is limited. Not all vessels will have an extra bunk. The southeast Alaska drift gillnet fishery has fishing periods in the two to seven day range. Vessels range from 25 to 35 feet, have two to four bunks, a head, a small galley, and a crew (including captain) of one to two fishers. Southeast Alaska purse seine openings last from a day or two up to a week. These purse seine vessels usually carry a crew of four to six. Vessels range in size from 30 to 50 feet, with four to eight bunks, a head, and small galley. The Cook Inlet drift gill net fishery is typically limited to two 12-hr fishing periods per week. Vessels range in size from 25 to 50 feet, with a crew of one or two fishers. Vessels have two to four bunks, a head, and a small galley. Vessels in the Bristol Bay drift gill net fishery are limited to a maximum length of 32 feet, and have crews of three to five. These vessels generally have no extra bunks.

Interviews with leaders of halibut fishers' associations and IPHC staff observations generally confirm the information from Wynn and Merklein, and supplement with additional information. The range of effective size and capabilities of vessels within a given size range varies enormously. Many new vessels have been built for maximum fishing ability, holding capacity, and living space, and have more room than older boats 10-20 feet longer. Old, narrow purse seiners at the 58-foot Alaska limit may have living space comparable to wide, new gillnetters in the 40-50 foot range. Thus, no single length limit will adequately describe an ability to carry observers. Association leaders suggested minimum sizes for a vessel to have physical capacity to carry an observer ranging from 32 to 50 feet. However, the leaders indicated that the cost of observers, if paid for by the fishers, would seriously affect the fishers on small and medium vessels. Many of these fishers find the halibut fishery profitable at low catches because they have low costs. Some vessel owners, unable to afford the added costs for observers, would sell IFQ shares or consolidate quota on fewer vessels.

Single-day trips for halibut are generally uncommon in most areas, so observers must have a bunk and storage space for two or more days. Most vessels, with tight storage space for personal gear, reserve an empty bunk for storage. Eliminating this storage for an observer causes some hardship on the crew. The IPHC has successfully chartered many vessels for longline surveys in which all bunks were used, often for periods of a month or more – multiple times longer than the typical duration of a halibut trip with an observer. However, the IPHC generally charters vessels larger than 60 feet, and always greater than 50 feet. Single-day fishing does occur in some areas, for example around the Pribilof Islands, in which case bunk space would not be an issue. However, the small size of the vessels and limited deck space would restrict the activities of an observer. A marine mammal observer program for the drift gillnet salmon fishery occurred along the Alaska Peninsula about 10 years ago. Observers, who had no sampling duties, stayed on tenders at night, and spent days on the gillnet vessels.

Many small to medium vessels fish primarily for salmon, and fish for halibut to fill in gaps between salmon seasons. Many of these vessels can take halibut crews that are smaller than the crews used for salmon, especially for purse seine vessels. However, the full salmon crew may go on halibut trips if the crewmembers have IFQ, or if the vessel owner wants to assure keeping the crew together. Taking observers in these cases, if the salmon crew fills all the bunks, would cause some IFQ to be taken on a follow-up trip and risk losing regular crew who might be bumped for an observer.

Port logistics

Wynn and Merklein (1996) provide an overview of port logistics for southeast Alaska, Cook Inlet, Bristol Bay, and Kodiak. Airlines and ferries serve most of the Alaska communities, but high volume travel often results in little or no space available. Living space in hotels, bed and breakfast units, or rental units is also limited in Alaskan ports, especially in the summer months. Restaurants and grocery stores are available. Observer companies that provide observers for the Alaskan groundfish fisheries must arrange for moving personnel through many ports to meet vessels. These companies must keep up to date on facilities, and are the best source of port logistic information. The companies will provide information to NMFS if needed.

Observer Program in the Canadian Halibut Fishery

The following was provided by Ms. Diana Trager, DFO (personal communication).

In 1999, DFO introduced an observer program to the Canadian fishery in Area 2B in response to concerns over undocumented catch and discards of rockfish. The program that year was voluntary, operating during September and October following several months of program development. Archipelago Marine Research Ltd. (AMR) provided observers, who attempted to secure trips by contacting vessel operators during vessel offloads and arranging to observe the following trip. A total of 20 trips were observed in 1999.

In 2000 the program became mandatory, with an observer requirement in the regulations and as a condition of license. Every halibut vessel was eligible to take an observer if requested. DFO set a goal of observing ten percent of all vessel days, which amounted to about 280-300 days, or 80 trips. As in 1999, observers contacted vessel operators during an offload to arrange for observing the following trip. The vessel operator was then responsible for notifying the observer 48 hours prior to departure. The program was funded out of the 6.5¢ (CDN) per pound license fee charged to each IQ holder. DFO set aside $200,000 (CDN) from this collection for overall observer program costs. Total cost of an observer was estimated at $420 (CDN) per day, with the federal government paying one third, bringing the cost to the industry to $280 (CDN) per day. The only extra costs borne by observed vessels were for the additional food required.

The actual experiences of 2000 fell far short of expectations, as just 22 trips were observed. In general, opposition to the program was widespread within the fleet, regardless of vessel size, IQ holdings, or area of operation. Major problems included:

(1) a large portion of the halibut fleet does to have enough room to accommodate an observer;
(2) disregard for the 48-hour prior notice requirement;
(3) a lack of observers when needed; and
(4) a lack of involvement of Enforcement staff in program development and daily operation.

Perhaps the primary problem faced by DFO is the difficulty with placement of observers on small vessels. The lack of bunk space is serious, as in many cases the observer may displace a member of the crew, creating a workload problem for the operator. Vessel operators also state that the additional food costs make it uneconomical in some cases for the vessel to go fishing. Some small vessels do not have a head on board and AMR will not permit observers to go on trips longer than 2 d on these vessels. Additionally, many small vessels do not carry the necessary safety equipment or have passed a recent safety exam. AMR will not permit observers to go on vessels in this condition. For 2001, DFO is considering conducting vessel inspections of those vessels that claim to be too small to carry an observer. However, DFO and the halibut industry are still attempting to determine how they will work with the vessels that cannot accommodate an observer.

The 48-hour prior notice was a problem when vessels would leave port without the observer, explaining later that they forgot to phone prior to departure or some other reason. For 2001, DFO is looking at requiring all vessels to phone in 48 hours prior to departure (a hail-out notice), at which time they will be notified whether they will be carrying an observer on the next trip. While DFO has an existing hail-out requirement, it is only “prior to leaving port”. AMR believes they could have 3-4 observers working full time to accommodate the halibut fishery under this system.

The lack of observer availability in 2000 further eroded acceptance. Several halibut vessels were ready to depart with an observer, but a need for observers by the trawl fishery that was higher than expected created a shortage. Currently, observers come from a single at-sea observer company, which also covers the trawl fishery. It may be necessary to assign specific observers to the halibut fishery, or to keep a fixed number of observers on standby specifically for the halibut fishery.

The relatively short program development time in 1999 resulted in less than the desired input from Enforcement staff. The lack of involvement created compliance problems and a lack of coordination of monitoring by DFO and AMR staffs. For example, Fishery Officers would be needed to check out the vessels that claim they don't have room for observers, but this has yet to occur.

CURRENT STATUS OF SEABIRD BYCATCH AND MONITORING IN THE PACIFIC HALIBUT FISHERY

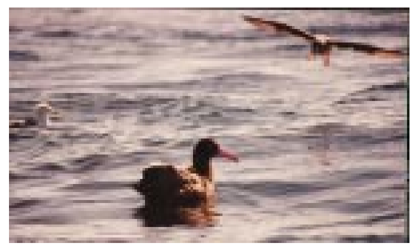


Photo courtesy R. LaTorra.

At present, the requirement to carry an observer in the North Pacific only applies to vessels fishing groundfish. However, with the advent of the IFQ management program in 1995, longline vessels are able to concurrently fish halibut and groundfish. These mixed trips may be one of two forms: (1) targeting groundfish, with the halibut as a small retainable bycatch, or (2) targeting halibut with small amounts of retained groundfish. In the case of the former, an observer may be present depending on the coverage requirements for specific vessel and the groundfish fishery involved. In the second instance, the vessel is not required to carry an observer as long as the amount of groundfish retained is less than ten percent of the total catch on board. Any retained amounts of groundfish greater than ten percent will require that an observer be present. For this reason, most vessels targeting halibut retain little, if any, amounts of groundfish.

Without a requirement for observers, no comprehensive data set exists for estimating the amount of seabird bycatch in the halibut fisheries. Limited information on seabird bycatch in the Pacific halibut fishery comes from three sources: interviews of halibut fishers by IPHC port samplers (1998 and 1999 only); reports of observers on halibut vessels that also fished for groundfish; and data from IPHC longline stock assessment surveys conducted since 1998.

Port Sampler Interviews

Data collection and coverage. The IPHC regulations require captains of Pacific halibut vessels 26 ft and greater to complete logbooks detailing aspects of each fishing trip. IPHC port samplers interviewed captains of vessels landing halibut in 1998 and 1999, including vessels that fished primarily for sablefish, and asked for the following information specific to seabirds: sightings of short-tailed albatross, including date and location; catch and date of short-tailed albatross by IPHC area; and number, dates, and location of other bird bycatch by major groups (albatrosses, fulmars, shearwaters, and others as a group) caught in the IPHC areas.

While the primary focus was on Alaskan waters, port samplers in Canadian ports also inquired about short-tailed albatross and other seabirds. To increase awareness of the project, the IPHC staff sent out a news release and talked to various members of the media. All fishers licensed for longline fishing in Alaska and British Columbia received a placard with identification characteristics for short-tailed, Laysan (*P. immutabilis*), and black-footed (*P. nigripes*) albatrosses.

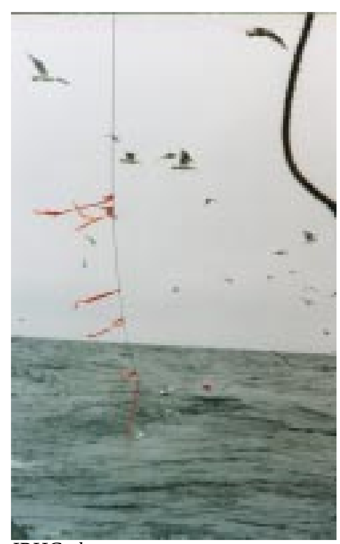
The total weight of halibut represented in the seabird data queries was obtained by adding up documented landing weights. The seabird data from the interviewed vessels were matched to the IPHC log database. The seabird data and the logbook data are in different files, and any corrections (such as for dealer codes or landing dates) to the log file did not occur in the seabird file. Therefore, useable seabird data were reduced by mismatches in the data. The total number of hooks hauled was calculated for each landing interview that matched a fishing log, by dividing groundline length of a skate by hook spacing and multiplying it by skates hauled. All seabird bycatch rates are reported per million hooks interviewed.

Of the nearly 67 million pounds of Pacific halibut caught off of British Columbia and Alaska in 1998, IPHC port samplers interviewed captains of vessels that represent about 69% of the landings (Table 16), and matched interviews to logs for about 52% of the total pounds landed. For the 71 million pounds landed in 1999, interviews represented about 65% of the landings and matched interviews to log books for about 51% of the landings. In general, proportions of pounds landed and interviews matched to logbooks were higher in British Columbia than in Alaska. IPHC port samplers conducted 4,000 to 5,000 vessel interviews per year for 1998 and 1999, and matched 70-90% of the interviews with logbooks (Table 16).

<u>Short-tailed Albatross sightings.</u> Reported numbers of short-tailed albatross depends in part on the number of birds and in part on the number of fishers over time to observe them. Ability to identify the birds and the level of honesty in reporting them could greatly influence the reported distribution of short-tailed albatross. The total number of hooks represented by the interviews during 1998 and 1999 were similar, around 20 million hooks, but the number of short-tailed albatross sightings dropped from 138 to 110.

For both 1998 and 1999, the halibut fishing effort (as represented by the number of hooks hauled for the interviews) followed a similar pattern (Fig. 3). Number of hooks hauled increased rapidly from March to April to May and June, fell back slightly in July, August, and September, and then dropped rapidly in October. In both years, the greatest number of reported sightings occurred in June. In 1998, the number of reported sightings remained at relatively high levels for May through August, while June dominated the sightings in 1999.

The greatest number of reported sightings both years occurred in Area 3A (Fig. 4.) However, the number of hooks hauled dropped nearly 50% from 1998 to 1999 even as the reported sightings remained at similar levels. The number of short-tailed albatross reported in Area 2B tripled from 1998 to 1999, while the number of hooks hauled increased about 50%. Sightings in Area 3B for 1999 dropped to one-third of the 1998 level even though the number of hooks hauled dropped only about 25%.


IPHC photo

<u>Seabird avoidance devices.</u> NMFS regulations for Alaskan waters allow a number of seabird avoidance measures. The devices typically used in Alaska and British Columbia include the following type categories:

- "Buoy" refers to a buoy towed from a line behind the vessel. Fishers usually call this device a bird bag. The erratic motion of the buoy in the wake disturbs the seabirds attempting to feed on the surface.

- “Tori” refers to a Tori line, which consists of a towed line with streamers, suspended above the water over the longline gear. The streamers scare birds attempting to land in the vicinity of the longline gear.
- “Weight” refers to weighted longlines. Weights snapped onto the longline during setting or fixed to the longline cause the gear to sink more quickly then unweighted gear.
- “Dark” refers to setting during hours of darkness, during which seabirds cannot see the gear and bait as well as during daylight.
- “Noise” refers to various noise-making activities designed to scare the birds from the vicinity of the gear. “Offal” refers to throwing offal from the vessel in a location to distract the birds from the baited gear.
- “OtherDD” refers to any other deterrent device used by fishers.

Alaskan fishers from the Pacific halibut fishery reported using towed buoys far more often than any other device (Fig. 5). The use of towed buoys increased from 1998 to 1999 by about 30%, from about 41% of devices used to about 54%. All other devices declined in usage from 1998 to 1999. Tori lines, which accounted for 10% of the devices in 1998, declined to 8% in 1999 and the use of weights dropped over 50%. In general, the proportions of device type used during the May-September period of peak fishing for halibut remained fairly constant (Table 17). The early and late fishing months showed higher fluctuations in proportions of device types used.

<u>Seabird bycatch rates.</u> In 1998, fishers reported catching seabirds on many different devices (Fig. 5). Fishing in the dark and use of multiple devices had the highest reported seabird bycatch, about 10-15 birds per million hooks. Towed buoys, noise, no device, other devices, and Tori lines had reported bycatch in the 1-4 birds per million hooks. Yet in 1999, only three devices – multiple devices, Tori lines, and towed buoys – had reports of seabird bycatch.

Average reported bycatch ranged from about one to two birds per million hooks with the rate declining for all seabird groups from 1998 to 1999 (Table 18). Overall, the total bycatch rate dropped from just over four birds per million hooks to just under two per million hooks. In nearly all cases, the rates dropped for each of the seabird groups and for each of the regulatory areas. Area 2B remained the area with the predominant reported bycatch of albatross, especially the black-footed albatross. Fulmars experienced highest reported bycatch rates in Areas 3A and 3B. Fishers reported no seabird bycatch in Area 2C either year, and only one bird in Area 4 in 1999 (Figure 5).

IPHC stock assessment surveys

The IPHC stock assessment surveys provide catch information and biological data for Pacific halibut independent of the commercial fisheries. Data include catch per effort (standard skate), size, age, sex, and bycatch at specified locations (stations). All data are recorded on forms for subsequent entry into the IPHC database. Prior to 1997, the IPHC surveys emphasized Areas 2B and 3A, as indicators of the status of the halibut population. In response to industry requests for more survey data, the IPHC committed to a 5-year program of stock assessment in all regulatory areas, starting in 1997. In 1998, in response to concerns about the mortality of seabirds in longline fisheries, the IPHC began species-specific seabird data collection during the surveys. Most IPHC survey vessels in Alaska used a seabird deterrent device in 1998, and the IPHC requested that all survey vessels use a device in 1999.

The IPHC re-designed the station layout in 1998 using a 10-nmi by 10-nmi grid. Stations were selected in a depth range of 20-275 fathoms at the center of the station. Vessels generally completed three stations per day. Previously, the stations were laid out in triangles with a station in the middle, which required four stations per day. The new design allowed more flexibility for charter vessels to select stations. The new design also increased the number of skates from six per station to seven per station, which increased catch and helped offset the increased cost of surveying additional areas with lower catch rates.

The IPHC surveys documented seabird bycatch rates about 4.5 to 9 times greater than reported by fishers during the IPHC interviews (Table 19). All but one bird caught during the 1998 surveys occurred onboard a single vessel on the first day of operations in the western Aleutian Islands. The crew inadvertently forgot to deploy the bird avoidance device when the Laysan albatross density was high and the birds were very aggressive towards the bait. Two buoy bags were used for the remainder of the 2-month charter and no further seabird bycatch occurred. The other 1998 bird was caught in Area 2B. The 1999 surveys caught no birds in either Area 2B or 4, but caught at least one in each of the other areas. The seabird bycatch rate on IPHC surveys dropped by a factor of five from 1998 to 1999. Because the number of hooks hauled during the surveys in each regulatory areas are so low relative to the number of hooks hauled by interviewed fishers, the catch of one bird can make a substantial difference in the reported rates for the surveys.

Observer Data

Vessels that fish for halibut only or that also catch groundfish in quantities less than bycatch levels do not need to carry groundfish observers. The IPHC has no requirement for observers aboard halibut vessels. Only a small proportion of vessels that target halibut catch sufficient quantities of groundfish to require observers. The identification of a vessel trip targeting halibut which also had an observer was determined by comparing observer data records against halibut fish tickets. At present there is no direct link between the two databases. Consequently, observer haul data was aggregated into trips and associated with a halibut landing by comparing fishing dates with the landing date. Landing dates were found to be either closely following the latest trip fishing date or were very distant from the observed fishing. In the latter case, the landing was assumed to have come from unobserved fishing.

An observer will be on an IFQ trip which is either (1) targeting sablefish with no halibut retention (halibut is PSC bycatch), (2) a mixed sablefish/halibut strategy with halibut catch and retention (either minimal, as sablefish is the principle target, or a preponderance if vessel is attempting to maximize catch or both species), or (3) a groundfish target (e.g., Pacific cod or rockfish) with retention of whatever halibut is caught as bycatch.

Unfortunately, the small amount of observer coverage on halibut vessels (Table 20) prevents meaningful conclusions from the data. The NMFS North Pacific Groundfish Observer Program concurs that the observer coverage on halibut vessels is not representative of the fleet as a whole (Martin Loefflad, NMFS, NPGOP, Seattle, WA, personal communication). In 1996, 1997, and 1998, observers monitored halibut vessels that landed about 200,000, 300,000, and 1,000,000 pounds, respectively. Rather than risk application of poor data, we chose not to include them.

DESCRIPTIONS AND EVALUATIONS OF SEABIRD MONITORING

The IPHC and NMFS staffs have identified the following potential monitoring programs for short-tailed albatross bycatch in the Pacific halibut fishery:

- Self-monitoring by the fleet;
- Monitoring by IPHC port samplers;
- On-board monitoring, either by existing groundfish observers, or separate and stand-alone observers for the halibut fishery; and
- Technological monitoring, possibly with video systems.

All of the potential programs have funding issues in common. At the present time, no mechanism exists to provide funding for any of the programs. Funding could come from the federal budget, either as an appropriation or from agency budgets, from the fishers, or from a combination of federal/fishing industry funds.

Most of the options for monitoring short-tailed albatross bycatch have been discussed earlier in this report (monitoring by IPHC port samplers), are well known by NMFS personnel (observer programs), or are self-evident (self reporting). The video monitoring option, however, has no precedent in the Alaskan fisheries, so we have provided details about current status and developments underway. We provide information as necessary for the other options.

Self-monitoring by the fleet

Self-monitoring by the Northeast Pacific groundfish fishing fleet currently occurs for some types of fishery data. For example, logbook data required by NMFS include reports of halibut bycatch and discard. However, the halibut bycatch data are neither analyzed nor used, because many scientists and managers have little faith in the accuracy of the reported bycatch data. In addition to self reporting via logbooks, fishers could also report via phone, fax, e-mail or in person when they catch short-tailed albatross.

Pro. Self-monitoring would be inexpensive, with no new administration required. The logbook entry package would require minimal modification, and information on the bycatch of other seabirds could also be collected.

Con. There could be an incentive to misreport. Current logbook collection programs would not obtain logbooks from 100% of fishers. Logbooks alone would not allow in-season management. In early 1998, as part of its Biological Opinion on the Short-tailed Albatross for the Pacific halibut fishery, the U.S. Fish and Wildlife Service (FWS) recommended conservation measures including a provision as follows: "....The USFWS strongly discourages the use of self-reporting as a sole method for monitoring this fishery, and strongly encourages the use of observers on Pacific halibut vessels over 60 ft in length.".

Cost. If regulations require only that fishers report mortalities of short-tailed albatross, then the program cost would be limited to that necessary to modify existing logbooks. Printing new logbooks with space for reporting seabird bycatch mortality would cost approximately $10,000. If the intent is to create a separate seabird logbook the IPHC could enter the data in an existing seabird database. A new logbook program might require some reformatting of the database depending on the design of the logbook but it should be minimal expense. Printing new logbooks with tear-out sheets would cost approximately $10,000. IPHC could provide data entry and processing for less than $20,000.

Monitoring by IPHC port samplers

IPHC port samplers currently monitor halibut landings in major ports throughout Alaska, as previously described in this report. Port samplers collected reports of seabird bycatch and short-tailed albatross sightings for 1998 and 1999. Seabird data collection did not continue because the IPHC was not confident that fishers accurately reported the seabird bycatch. Data from a fishing season became available later in that year, and analysis occurred the year following. However, an IPHC port sampler could pass on any reported short-tailed albatross bycatch information to NMFS or FWS.

Pro. This program would be inexpensive, as the logistic framework already exists. Halibut fishers have given confidential and sensitive information to the IPHC for many years. This program could also get information on bycatch of other seabirds.

Con. There is an incentive to misreport, and there is no validation procedure for the results. Using the IPHC infrastructure, there would be only partial coverage of fleet by port samplers, especially ≤ 40’ vessels.

Cost. Because the port sampling program already exists, no additional cost would occur for monitoring. The IPHC would accrue a small cost of data entry and processing. Data from approximately 4,700 vessel interviews would need to be entered with the logbook information each year. It would take an additional 5 minutes to enter the seabird data for each of these logbook records. The IPHC could accomplish data entry and processing for less than $10,000 per year.

Monitoring by onboard observers

An observer program for the Pacific halibut fishery has several major options that will greatly affect the practicality of the program. Options include:

- Integrated with groundfish observers, or stand alone;
- Observers monitor only short-tailed albatross bycatch, or have other duties;
- 100% coverage, or coverage restricted to particular areas, times, or classes of vessels.

Pro. Reporting would be objective. The infrastructure exists for data reporting and analysis if integrated with groundfish observer program. There could be 100% coverage by requiring that all sets have an observer. An integrated program could use observers cross-trained for groundfish; Observers with limited duties (only responsible for short-tailed albatross observations) could have lower qualifications at lower cost.

Con. The program could be very expensive (expense decreases with reduced coverage, but results in incomplete data). Covering every set increases cost and decreases efficiency. A user-pay funding could drive out of the fishery many owners of small vessels and fishers currently in debt as the result of buying quota shares. If the program allows incomplete coverage, then it must rely on self-reporting or subsampling for the portion of the fleet or sets that do not get observed. A stand-alone program would require a new administrative infrastructure. Many small boats have little halibut catch – vessels ≤ 40’ make about 13.5% of catch but make 39% of trips. The ability of vessels to carry observers decreases as vessel size decreases, especially if observers have deck-duties.

Cost and options. The cost of any observer program will be directly related to the degree of coverage needed to meet seabird data and monitoring objectives. Using the fishery profile for 1998, there were an estimated 4,578 vessel trips assumed to target halibut on at least one set in

Alaskan waters (extrapolated from Table 1). During 1998, these targeted trips caught almost 95% of the total halibut catch and fished 25.7 million hooks. With an average trip duration of four days, plus three transit days per trip, total observer coverage of all Alaskan halibut trips could require as many as 32,100 observer days at sea. At an estimated $300 per observer day, this would cost approximately $9.6 million. (This does not include training or deployment costs or days.) The direct cost for observers would probably be similar whether the observer program was integrated in the current groundfish observer program, or was a stand-alone program for the halibut fishery only. Using an average 1999 ex-vessel price of $2.20 per pound (the price in 1998, about $1.10/pound, was far below the range of prices for 1997 and 1999-2000), the total value of the fishery was approximately $130 million. A full observer program on all targeted halibut trips would cost about eight percent of the value of the fish landed, or about 17 cents per pound. This would not observe all sets of gear, but would have a single observer viewing a subsample of each vessel's fishing effort.

Substantial reduction in cost could be achieved by focusing the program on those areas, vessel sizes, and seasons where short-tailed albatross are most likely to be encountered (Table 21). In estimating the effect of reducing overall observer coverage to some component less than the entire fleet, we have assumed a linear relationship in coverage and cost reductions. In reality this will likely lead to an underestimate of the true costs because of areal and spatial differences in trip durations and fleet characteristics. For example, vessels greater than 40 feet tend to have longer trips than smaller vessels (Table 15), so the average trip duration would increase when the smaller vessels are excluded. The following discussion is intended to provide an indication of the effect that applying various criteria would have on overall observer cost.

Area. Hasegawa and DeGange (1982) report that short-tailed albatross occur along the west coast of North America, the Bering Sea, and offshore from the Aleutian Islands, coincident with areas of high biological productivity. Observations from the last 10-15 years of fishery observer data (65 CFR 46647; July 31, 2000) show concentration of bird sightings on Alaska's shelf breaks. USFWS records contain many sightings of birds within 10 km (6 mi) of shore and several within 5 km (3 mi) of shore (65 CFR 46647; July 31, 2000). During 1998 and 1999 IPHC surveys, most short-tailed albatross were observed in the Aleutians Islands region and in offshore pelagic waters of the Gulf of Alaska (36 and 30 birds, respectively). Sightings of two juvenile short-tailed albatross in the Forrester Island region of Area 2C and two birds in Area 2B during the same survey years were also documented. Short-tailed albatross have not been documented by IPHC in the inside waters of Area 2C in five years of summer surveys of the area. The sightings in the Forrester Island region suggest that short-tailed albatross are found in the outside waters of Area 2C and that vessels fishing in that area should not be excluded from observer coverage requirements. Removing the inside waters of Area 2C from an observer requirement would result in an approximate 16 percent reduction in the amount of sampled vessel effort. Representatives of several fishermen's organizations in Southeast Alaska have suggested special observer requirements for Area 2C in order to provide information that short-tailed albatross rarely occur in the area.

Vessel size. NMFS could require that only halibut vessels of a certain size be required to carry observers. For example, vessels under 40 feet could be excluded from the program, as they generally fish closer to the shore where albatross are less prevalent. These vessels would also have more difficulty carrying observers. Requiring only vessels over 40 feet to carry an observer would reduce the estimated number of observer at-sea days by an additional ten percent. This assumes observers on all vessels over 40 feet. Extending to the halibut fishery the existing groundfish coverage requirement for observers on vessels greater than 60 feet would capture only 30 percent of the halibut fishing days.

Time. Observer coverage could be further restricted to certain months or seasons determined to have a greater potential for seabird interactions. For example, May through July in Areas 3A and 3B, and April through July in Area 4, are times of major seabird occurrence in the Alaskan area, according to the IPHC fleet interviews. This could result in a further reduction in sampling effort of about 41 percent.

From a cumulative standpoint, by sampling only those vessels over 40 feet, sampling only in Areas 3 and 4, and sampling area 3 in May through July and Area 4 in April through July, the amount of coverage would be reduced to approximately 1/3 that of a full coverage program, and would probably be adequate to describe and monitor short-tailed albatross interactions. The cost of this program would be around $4.8 million, or about eight cents per pound of halibut landed.

Duties. No observer coverage occurs for vessels fishing for Pacific halibut that do not catch more than bycatch amounts of groundfish. Putting observers on the halibut vessels would offer an opportunity to collect biological and fishery data for the halibut fishery. These data would come at the cost of higher qualifications for observers than if they only monitored short-tailed albatross. Observers with multiple duties would require larger vessels with adequate deck space for deck sampling.

Technological monitoring, possibly with video systems

Rapidly developing technological monitoring has added and will continue to add capabilities for assessing short-tailed albatross bycatch. At this time, the IPHC staff is aware only of video monitoring systems currently capable, or nearly so, of fulfilling the short-tailed albatross needs. Two video-monitoring systems are currently in use in the North Pacific, with a third under development. Canadian fisheries for sablefish (longline) and crab (pot) are utilizing systems designed to monitor the activity of the vessel and crew (McElderry et al 1999). A system being developed in Alaska is projected to enable enumeration of the catch through image recognition software; however, the technology and software are still under development and is not expected to be in use for several years, if at all.

<u>B.C. sablefish seamount fishery.</u> The British Columbia Blackcod Fishermen’s Association, in cooperation with Archipelago Marine Research Ltd. (AMR), has developed a video surveillance system designed to effectively replace human at-sea observers in the experimental Blackcod Seamount fishery. The system is comprised of three components: (1) a battery/back-up power source, which ensures that the system will continue working if the vessel’s power source is cut, (2) a combination GPS/VCR, which constantly indicates the vessel’s position in latitude and longitude on the video screen, and (3) the camera itself, which is secured in a location providing the best view of the fishing deck. The Seamount fishery licenses no more than three vessels at a time. Each vessel is able to rent one of the systems from the Association. AMR delivers and sets up the system on the vessel, ensures that it is working and locks the GPS/VCR box. The camera then takes a picture of the deck every 10 seconds for the duration of the trip. AMR is responsible for retrieving the equipment and tape when the vessel lands. When the video is played back at the AMR offices, it is monitored to ensure that the vessel is fishing where it should be and is not loading or off-loading product at sea. The video does not currently have adequate resolution for identifying species. This technology is also not suitable for catch enumeration applications.

The temptation for crew sabotage of the system has been effectively circumvented. The GPS/VCR component has a small screen on its exterior, which shows exactly what the camera is picking up at any given time. The crew is responsible for ensuring that the camera is working properly. If it is not, the trip is effectively over and the vessel is required to proceed immediately to port. Any gaps in the film would be reported by AMR to the Department of Fisheries and Oceans (DFO) and appropriate action would be taken (e.g., relinquishment of the catch, a fine, etc.).

The cost to produce each unit was approximately $10,000 (CDN) with a total of 4 units being produced. The Association rents the units to the vessel for approximately $1,500 for the 30-day permit period. This presents about a 500% cost savings to the vessel over onboard observer coverage (~$8,000).

System failures have been very infrequent. During the initial phase of the program, a problem with the power source was common, as was damage to wiring between components. Power supply problems required vessels to return to port, thereby incurring financial loss. However, if the equipment is well cared for and maintained, the system has been shown to be trouble free.

<u>B.C. Dungeness crab fishery.</u> AMR was approached by the Area 'A' Crab Fishermen's Association to develop a comprehensive monitoring program for their fishery using state-of-the-art digital video imagery (H. McElderry, Archipelago Marine Research Ltd., Canada, personal communication). The Area 'A' crab fishery is the largest and most valuable of British Columbia's Dungeness crab (*Cancer magister*) fisheries. The fishery primarily takes place in the shallow marine waters of Hecate Strait and Dixon Entrance adjacent the Queen Charlotte Islands. Since 1990, the fishery has intensified markedly in terms of catch, vessels involved and amount of trap gear. Catches of crab peaked at about 4,800 t in 1993 and recent levels are around 1,100 t, valued at about $10 million. Currently, the fishery involves a fleet of about 50 vessels, ranging in size from 24 to 67 feet in length, collectively deploying about 50,000 traps. Fishery managers are very concerned about the large quantity of gear in use and will be implementing vessel size-based trap restrictions to reduce the fleet inventory to about 35,000 traps for the 2000 fishery. Intense fishing effort has also sparked conflict among fishery participants. There are widespread concerns about the high incidence of traps being pirated for catch, stolen and re-marked, or vandalized by cutting buoy lines.

The monitoring program came about as a result of the mutual requirements of fishery authorities and industry in controlling vessel trap limits, and industry's desire to control catch and gear theft. AMR began working with the Area 'A' Crab Association to develop a monitoring program that was both affordable and effective. While the monitoring requirements could be achieved with a comprehensive at-sea observer program, the cost of such a program would be prohibitive. Other lower cost options involving random inspections by patrol boats were also considered but rejected because they would not effectively control fleet activities when no patrol boats were present. Instead, the fishery adopted a custom-designed automated Vessel Monitoring System (VMS). The VMS integrates an assortment of off-the-shelf components in a unique manner to create a powerful monitoring system. All vessels in the fishery are equipped with a VMS unit that automatically logs various data during all fishing trips. After completion of about 15 days of fishing activity, the VMS is serviced and data retrieved for analysis by AMR project staff. Compliance issues are easily spotted and, as a result, the system has proven to be very effective at controlling fleet activity.

The VMS unit consists of an on-board computing system, housed in a locked, tamper-proof container, and an assortment of sensors on the fishing deck and other parts of the vessel. One of the main features of the VMS is a digital time-lapse video system that provides a continuous record of fishing deck activities. The mast-mounted video camera provides imagery of the fishing deck every second, providing a visual record of fishing operations including hauling operations, catch disposition, and gear identity, as revealed by vessel specific buoy colors. A 40 GB hard disk is expected to hold about 15 days of continuous video at this frame rate. Digital video technology far surpasses its tape-based predecessor, allowing rapid search and viewing of specific imagery. Technology advancements that enable computerized capture of video imagery include: higher capacity hard drives; more efficient image compression formats; faster processors for writing large amounts of image data to hard disk; and software developments to enable efficient searching and retrieval of video imagery.

A second feature of the VMS is an independent GPS receiver, taking satellite readings to log date, time, vessel position (latitude and longitude), speed and heading. Recent improvements in GPS signal accuracy were an unexpected bonus to this system, providing pinpoint accuracy in a fishery where distances of a few meters may be critical. GPS information is superimposed on the video image and recorded as a separate data file.

While the video imagery and GPS information are a powerful tool for *documenting* compliance to fishery regulations, *detecting* compliance events from these data would be difficult and labor intensive because of the time required to visually examine the imagery. The inclusion of additional sensor information made detection of compliance issues easier. One of the main issues was finding a way to reliably keep track of the 36,000 traps, according to their respective owners. RFID (Radio Frequency Identification Device) technology proved to be a reliable way of uniquely identifying each of the crab traps in the fishery. After initial frustrations with bar-code tags and readers, RFID technology proved the only way to accomplish trap identification given the large number of traps, the fast pace of trap hauling and setting operations, and the wet, dirty conditions of the fishing deck. Each vessel marked their crab traps by inserting pre-assigned RFID read-only tags into the core of the hard-foam trap buoys. Embedding the RFID tags within the buoy core results in firm attachment, quick application, and good protection. The buoy is passed over a scanner while the trap is being hauled, providing a quick, reliable and easy means of identifying the fishing gear.

Another important sensor in the VMS was a hydraulic pressure transducer, mounted on the supply side of the vessel's hydraulic system. The transducer monitors pressure and therefore work conducted by the vessel's winches. Oscillations in hydraulic pressure correspond to hauling of traps and are easily detected in the data record.

The analysis that follows the fishing trip is focused on making an objective assessment of whether the vessel complied with the fishing rules. Vessel data are loaded into a central computer system for analysis. The data set provides a very powerful analytical tool because of the large volume and the interrelated information. Information from the GPS, RFID tags and hydraulic sensor are examined using MS Access and ESRI Arcview to spot anomalous events. Each vessel's trap inventory is maintained in a database and all trap scans are compared against the allotted inventory. Cases where a scanned trap serial number does not match the inventory are easily spotted. Similarly, events where hydraulic pressure oscillations suggest trap hauling but no RFID tag scan is evident are also easily spotted. Vessel speed, heading and cruise track may also reveal curious vessel behavior. In such cases, the video imagery associated with the event is observed. If a violation is observed, the video clip and associated data are archived and reported. Reports from the data analysis alert fisheries authorities and the Area ‘A’ Crab Association to compliance issues in their fishery. As well, routine reports to fishers following analysis of sampled data outline any issues identified and provide positive feedback for good compliance.

Of equal importance to the design and operation of the VMS are the rules that govern its use. The monitoring service is provided through the Area ‘A’ Crab Association and there are strict requirements to ensure fishers comply with the rules. During a fishing trip, fishers must keep the VMS unit continuously powered, not interfere with any of the sensors, and scan all traps when hauled. Failure to meet these requirements could result in fines being levied by fisheries authorities, or other penalties levied by the Association. Repeated violations could result in suspension of monitoring services, effectively causing fishing operations to cease until other monitoring arrangements could be made. Undoubtedly, monitoring costs for these displaced fishers would be very high.

With the Area ‘A’ Crab fishery monitoring system just completing its first year of operation, support for the program has been very positive. Depending on trap allocation, fishers paid between $13,000 (CDN) to $20,000 (CDN) for the VMS, RFID tags, a share of the shore-based analysis equipment, and program operating costs. The cost for future years is expected to decline to less than a third of year one costs. The program is entirely funded by the fishing industry and, despite the initial up-front fees, there is widespread feeling that the system provided a significant deterrent, creating an unprecedented degree of order and co-operation among fishery participants. Some fishermen feel that the equipment paid for itself in the first season through more catch and less gear loss. The fishery also changed because for the first time there was a sense of fairness, that all fishery participants were respecting the rules and being treated the same.

The crab monitoring system is designed to record fishing effort and information about catch is not recorded in the electronic record, although catch information can be obtained through visual examination of the video record. The equipment would be applicable in any other serial fishery where gear is pulled one pot or one hook at a time. Recently, AMR has started research to incorporate catch information directly into the electronic record, hopefully to address monitoring needs in the halibut and groundfish longline fisheries.

<u>Digital observer project for Alaskan longliners.</u> A group in Kodiak started work in 1999 to assemble this system, which is expected to take 3.5 years to bring to fruition. Project developers are attempting to bring together monitoring systems such as those used in the B.C. sablefish seamount fishery and image recognition software already in use in other parts of the world for fish identification. In this system, a digital camera would be mounted on a davit outboard of the gear hauling area, focusing on the fish, not the fisher. Shortly after each hook emerges from the water, a light signal is tripped which causes the camera to take a picture. The image will then go to a computer loaded with species recognition software. Using telemetry and length-weight data, the computer will estimate each fish’s length, area, and weight. A concurrent program will note location, date, and time and enter all the information in an electronic logbook. On a periodic basis the computer will use the vessel’s communication system to transmit its data to shore. When the vessel returns to port, observer company representatives will retrieve videotapes and digital data for analysis.

Commercial costs of this system have yet to be established. Development is budgeted at $0.8 million in cash and $1.0 million in in-kind support for the 3.5-year period.

Evaluation of video monitoring.

Pro. Technology exists for a deck system. A 10-sec frame rate (6 frames per minute) has high chance of detection if all birds are held up towards camera for identification, but a faster frame rate would likely be necessary to identify birds without crew cooperation; potentially a lower cost than an observer program; could be set up to monitor all seabird bycatch.

Con. Development needed to enable specific species identification; 10-sec frame rate allows risk of seabird discard although fishers will not know whether frame being taken; a fisher could possibly cut gangion out of camera view; need reliable staff to download data; image recognition software not proven for this type of application.

Cost. The cost of a video monitoring system is dependent upon the configuration of the system. The Canadian examples presented in this report illustrate two very different types of systems, and a discussion of each will serve to identify the wide range of costs associated with this type of technology. For either of these systems, a vessel could purchase a system, pool with others to purchase several systems to share, or associations (or towns or processors) could purchase systems and rent them to members (or residents or customers). In the following discussion, we estimate startup and annual costs for each system to provide a measure of the costs associated with these types of systems. This example is intended to illustrate the general nature of the costs associated with these systems, and not a precise accounting of VMS systems.

The sablefish seamount VMS is a video (VHS) analog-based system. The objectives identified by the Blackcod Fishermen's Association were to monitor the activity of the vessel and its compliance with regulations. With those objectives, a slow frame rate was determined to be sufficient to monitor the vessel and the crew's activities, with a strong degree of certainty regarding compliance. The slow frame rate also permits a larger amount of data to be stored on a single 6-hr videocassette. Each deck unit cost the B.C. fishermen about $6,500 (US) in initial costs. Using this figure, 500 units for the U.S. halibut fleet fishing off Alaska would be $3.25 million. Some savings may be achieved with such a large acquisition through economies of scale.

Annual costs primarily consist of expenses associated with (1) personnel to monitor and review the tapes, (2) maintenance and repair of equipment, and (3) program administration. We estimated the monitoring costs (per trip and annual) using the 10-sec frame rate (6 frames per minute) configuration of the B.C. sablefish seamount fishery as follows. We assumed an average of 4 days per halibut trip (Table 15), a total of 6,700 trips being monitored (an extrapolation from the number of landings per vessel shown in Table 1), and personnel costs of $15 per hour for examining the video for birds and/or violations. Additionally, we believe it would probably take 6 hours to review 5 hours of video, due to the expected starting and stopping to examine the picture. The calculations resulted in a total of $90 per average 4-day trip and $0.6 million per year in monitoring costs associated with this configuration for coverage of all halibut

Summary of Analog VMS System

Estimated Initial Acquisition Costs –

- $6,500 per unit based on Cdn system
- $3.25 million for 500 units

Estimated Annual Monitoring Costs –

- $0.6 million, calculated as follows:
  1) 6 frames/min x 1,440 min/day x 4 days/trip = 34,600 frames/trip
  2) @ 0.5 sec/frame = 17,300 sec/trip = 5 hr/trip
  3) 6 hr/trip x $15/hr = $90 trip
  4) 6,700 trips x $90/trip = $603,000

trips. Even at double or triple these estimated costs, a video system using this frame rate would cost of fraction of complete, or of even restricted, observer coverage.

A higher standard was demanded in the B.C. Dungeness crab fishery. Although regulatory compliance is one objective, catch monitoring was an important need identified by the fishermen. Consequently, a higher frame rate (1 per second, or 60/minute) is used in the crab fishery VMS and the entire fishing trip is recorded. The system is digital, so data are written to a computer disk drive rather than a video tape. The extremely large drives (e.g., 40GB) available today provide for ample storage of such data. Additional sensors monitoring other deck equipment, such as hydraulics and gurdy rotation, can enable tracking of vessel activity and events. By examining the computer-generated logs of such activity, shoreside video review can skip to the points when gear is being retrieved, greatly reducing the amount of time required to look for seabird bycatch. Also, camera positioning and lens specifications can enhance the ability to provide species identification. Several cameras can be placed on one system, providing several different views of the deck and gear retrieval area. AMR's experience shows that such a system can be installed on a vessel in about a 4-5 hours. The inevitable attempts at tampering by vessel crew would require sufficient deterrents or penalties, e.g., fines, loss of catch, etc.

Initial acquisition costs of this system ranged from $8,500 (US) to $13,000 (US) per vessel for the 48 vessels in the crab fishery. This figure included the first year program operating costs, shoreside monitoring equipment, and RFID tags. The actual per-vessel cost varied according to the number of RFID tags needed for the trap floats in use on each vessel. A system used for monitoring seabird bycatch in the halibut fishery would not need the RFID component, so costs for a similar system for the halibut fishery would be lower than the crab fishery. We assumed at the RFID component added approximately $2,000 to the unit cost on average and thus arrived an average per-unit cost of $8,000. Using this average, 500 units could be purchased, operated for the first year, maintained, and provide for the data review for $4.0 million. Costs in the second and third years of the Canadian system and totaled approximately $120,000 (US) annually, or $2,500 (US) per vessel. Revenues generated through license fees were used primarily for data review and maintenance of the 48 systems, included replacement computer components as well as RFID tags.

Summary of Digital VMS System

Estimated Initial Acquisition Costs –

- $8,000 per unit based on Cdn system
- $4.0 million for 500 units

Estimated Annual Monitoring Costs –

- $0.7 million, calculated as follows:
  1) 1.5 hrs setting + 10 hrs haulback = 11.5 hrs of video
  2) Review at 2x speed plus extra stop/start time = 7 hrs
  3) 7 hrs/trip x $15/hr = $105 per trip
  4) 6,700 trips x $105/trip = $703,500

We estimated the annual monitoring costs for the halibut fishery off Alaska in the same manner as with the analog system. Although the digital system is on continuously, only the setting and hauling need to be reviewed. Sensors employed in the system can pinpoint when a vessel's hydraulics are on, enabling a reviewer to quickly move to that point in the video. We didn't have any information on setting or hauling durations, so we assumed a daily average of 1.5 hrs for setting and 10 hrs for hauling on a 4-day halibut trip as an example. From this starting point of 11.5 hrs of digital video, a reviewer would be able to go through the video at twice the normal playback speed while looking for seabird occurrences. We added some additional time for the usual setup and start/stop time that would be expected during such a review, bringing the total review time to 7 hours. We also used the same $15 per hour personnel costs. The total estimated cost for monitoring came to roughly $0.7 million, just slightly more than the analog video model.

System costs would increase if more cameras are employed or better camera lenses are used. Cost reductions are also possible. One technique suggested for the B.C. crab fishery VMS was to distribute dummy systems in place of fully operational systems without the vessel's knowledge. Virtually indistinguishable from a regular system, the dummy systems would lack many of the expensive internal components. The presence of a system would be enough of a factor to reduce the occurrence of trap piracy. Other decisions about areas covered and/or vessel size categories monitored would also affect costs.

The latter system probably more closely resembles the type of system needed for the halibut fishery. The catch of seabirds is not necessarily predictable nor common, but is more likely a random event. As such, a continuous monitoring of gear setting and retrieval would be necessary, which is what the digital VMS system is capable of doing. Camera set-up would be unique to each vessel in order to satisfactorily monitor the gear. Also, other monitoring sensors would need to be employed to facilitate the video review. A more critical factor in determining costs, however, is the area and fleet coverage.

CONCLUSIONS

The Pacific halibut fleet in Alaskan waters consists of a wide diversity of vessels, ranging from small skiffs that fish exclusively in nearshore waters, to large vessels that fish throughout Alaska. None of the systems we evaluated to monitor mortality of short-tailed albatrosses completely fits the fleet. A combination of monitoring systems may prove more efficient and cost effective than a single system.

A requirement for self-monitoring, the least expensive and least complicated system, would establish statutory obligations for reporting bycatch of short-tailed albatross. At present, there is no requirement by NMFS to report encounters and we recommend regulations to require self-monitoring for this feature alone. However, self-monitoring alone will not adequately capture all short-tailed albatross bycatch because of the incentive for fishers to misreport any bycatch. On the other hand, crewmembers may have personal or professional reasons for reporting bycatch even if the captain refuses.

A requirement for monitoring short-tailed albatross with IPHC port samplers offers no advantage over self-monitoring, because the same incentive exists to misreport. Additionally, IPHC port samplers can interview only a subsample of the fleet. However, if information on bycatch of other seabirds became a priority, IPHC port sampler interviews could add considerable data. Such data probably represent minimal estimates, as the IPHC staff does not believe that fishers reported all seabird bycatch.

An observer program represents the traditional method in Alaska for obtaining bycatch information for fishing vessels. However, observers cannot completely monitor the halibut fishery if the program has similarities to the observer program for groundfish. Almost no vessels longer that 125 feet (100% coverage) fish for halibut, and vessels from 60-125 feet (30% coverage) account for less than half the catch. Complete coverage of the fleet is impractical. Vessels smaller than 40 feet make a large number of landings but make small aggregate landings, so the cost for observing these vessels is high. Short-tailed albatross abundance is low in some areas and times, and the probability of an already rare event decreases in these areas. A decision on who would pay for an observer program for the halibut fleet is critical in determining the future composition of the fleet. Many small vessels have small revenues relative to observer costs. Many fishers have taken on large debt to purchase individual quota shares. A fisher-pay system might force a large number of these fishers out of the fishery, either through bankruptcy, sale of quota shares, or consolidation on fewer vessels. Observed vessels pay for the current groundfish observer program ("pay as you go"), but this may change pending upcoming decisions by the NPFMC following a program review. Developing a program with on-deck duties for observers will eliminate smaller vessels and will require higher standards for observers, compared to observers who only monitor for short-tailed albatross bycatch. If an observer program is chosen for monitoring the short-tailed albatross, program developers should look at a minimum vessel size between 40-60 feet, and further evaluate times and areas for elimination or reduction of coverage. Decisions on observer duties and the distribution of observers can occur only after consideration and assessment by the NPFMC and NMFS. Observer programs involving partial coverage have often been promoted under the rationale that observations expanded from the observed to the unobserved fleet will be "statistically sound", insofar as fleet differences and potential bias is recognized and addressed in the sampling design. The validity of conclusions reached from such extrapolations rests on the assumption that the fishing processes on observed and unobserved vessels will be identical. This assumption may be questionable, particularly in situations where the sampled fleet represents a small component of the total and the impacts of observed encounters (violations) are large. Therefore, reliance on estimates derived using low levels of coverage should be done with caution.

A video and GPS-based system has high potential for nearly complete monitoring of the short-tailed albatross mortality in the Pacific halibut fishery. Existing systems currently monitor fisheries for compliance with regulations. Determining if existing systems have the sufficient accuracy to monitor short-tailed albatross bycatch will require working closely with developers of the video systems. Adult short-tailed albatross and Laysan albatross have similarities in appearance, and juvenile short-tailed albatross and black-footed albatross have similarities in appearance, that may be hard to distinguish for birds brought up on hooks after hours on the ocean bottom. Some technical problems also need addressing. The system must assure that fishers cannot cut gangions or otherwise release a seabird out of view of the camera. A cut gangion could occur in the time of a one-frame blackout of the video system. Can a video system detect such a short-term obscuring of the camera? A video system has clear advantages in cost and ease of logistics over other methods, if developers can assure adequate accuracy and preclude fishers from preventing the camera from seeing the catch. We believe that developers may improve video monitoring to a satisfactory level with advance notice and support from NMFS or FWS, over the time necessary for the NMFS and FWS to evaluate and recommend a monitoring system for short-tailed albatross, and proceed through the NPFMC process. We strongly recommend that NMFS, FWS, and the NPFMC actively pursue development of video monitoring.

Whatever final design is adopted to monitor short-tailed albatross, that design should also incorporate data gathering on other Alaskan seabirds. In late September of 2000, the World Conservation Union released its new "red list" of globally endangered plants and animals. Thirteen more species of albatross have been placed on the list.

ACKNOWLEDGEMENTS

We would like to thank the following individuals who contributed comments on an earlier draft of this report: Mr. E. Gilman of the National Audubon Society; Mr. G. Winegrad of the American Bird Conservancy; Mr. M. Lundsten, a Seattle halibut fisherman; and Mr. G. Merrigan, of the Petersburg Vessel Owner's Association. We would also like to thank Mr. Howard McElderry of Archipelago Marine Research Ltd. for his timely contribution detailing the VMS system being used in Canada.

REFERENCES

Hasegawa, H. and A. R. DeGange. 1982. The Short-tailed Albatross, *Diomedea albatrus*, its status, distribution and natural history. Am. Birds. 36: 805-814.

McElderry, H., W. A. Karp, J. Twomey, M. Merklein, V. Cornish, and M. Saunders. 1999. Proceedings of the First Biennial Canada/U.S. Observer Program Workshop. U.S. Department of Commer., NOAA Technical Memorandum NMFS-AFSC-101. 113p.

McElderry, H. 2000. Automated Fishery Monitoring Systems. Archipelago Marine Research Ltd, Victoria, B.C., January newsletter.

Wynn, K. M. and M. M. Merklein. 1996. Marine mammal observer program design considerations: a survey of eight Alaskan small-boat fisheries. Sections I, II, and III. Marine Advisory Program, Alaska Sea Grant.

List of Figures

List of Tables

Table 15. Trip duration by length class for vessels targeting Pacific halibut in Alaskan waters during 1998. IPHC log data only.

Table 16. Summary information regarding IFQ trips monitored by observers, broken down by whether halibut was released or landed. Halibut catch figures obtained from observer catch estimates and not from fish tickets.

Table 17. 1998 and 1999 landings characteristics for port sampler interviews for seabird bycatch.

Table 18. Monthly percent use of bird avoidance devices in Alaska, 1998 and 1999.

Table 19. Bycatch rates (number of birds per million hooks) of seabirds reported in IPHC interviews, 1998 and 1999.

Table 20. Comparison of seabird bycatch rates (birds/million hooks) for IPHC surveys and IPHC port interviews, 1998 and 1999.

Table 21. Effect on percent of fishery coverage by progressively focusing effort by area, boat length, and season (from IPHC log and landing data, extrapolated to total catch).

List of Appendices

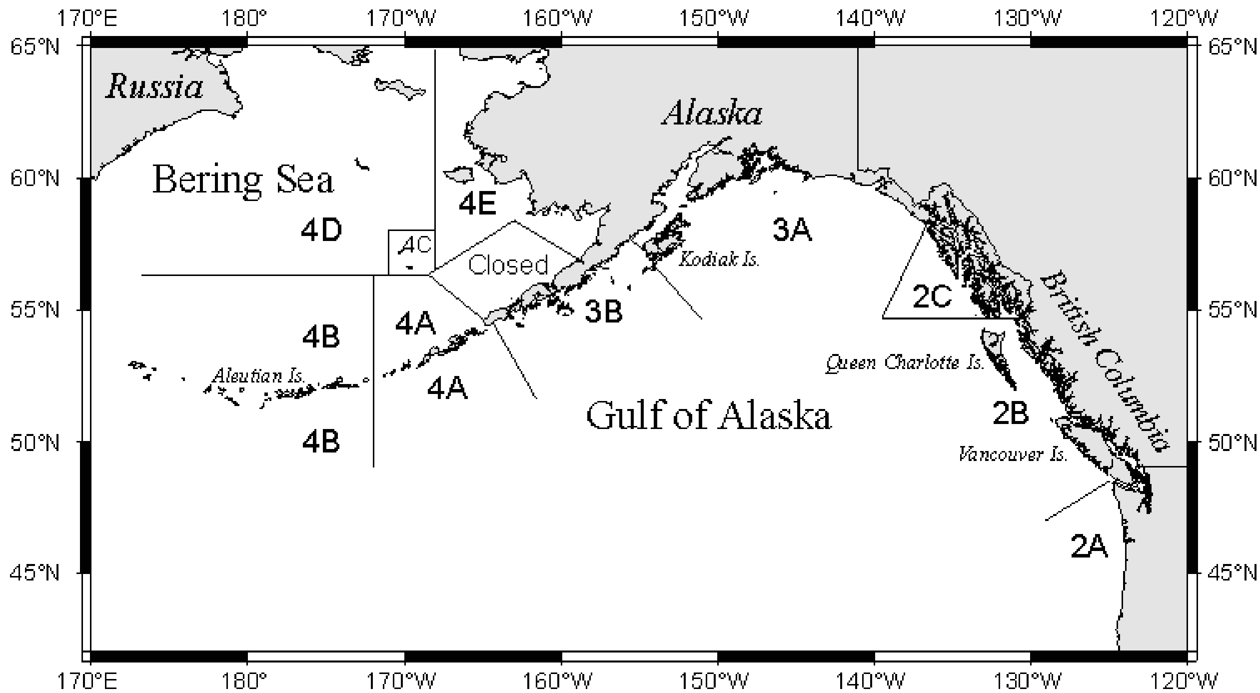


Figure 1. International Pacific Halibut Commission regulatory areas.

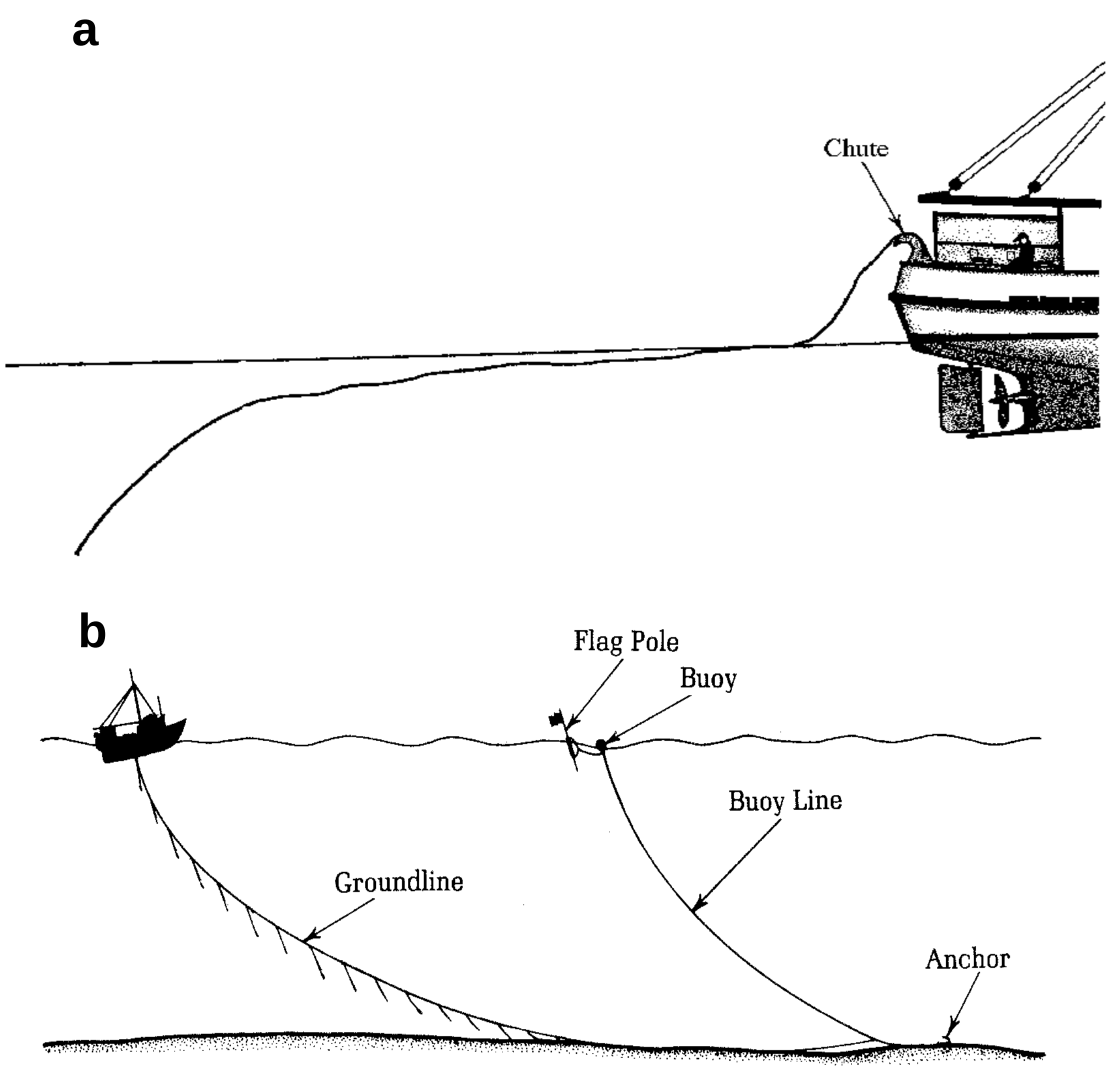


Figure 2. Schematic description of Pacific halibut fishing gear: (a) Setting, (b) Hauling.

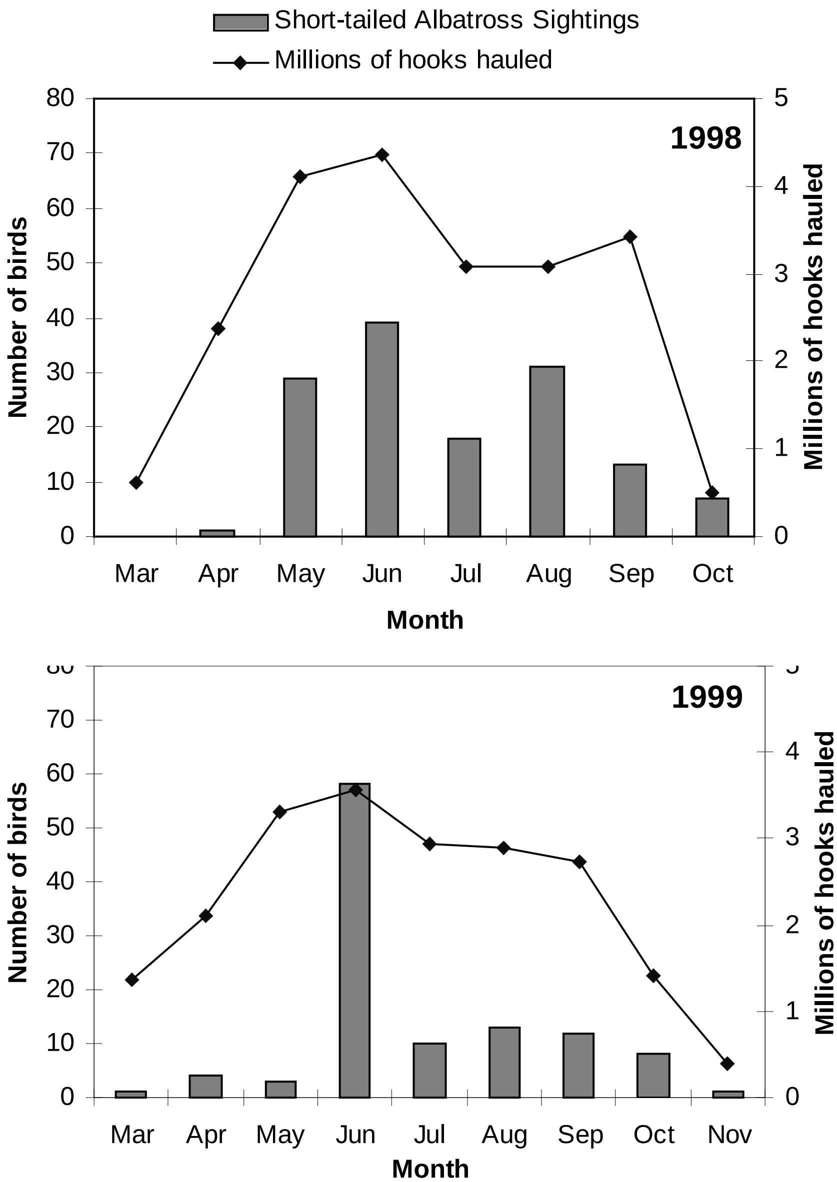


Figure 3. Short-tailed albatross sightings and number of hooks hauled by month for all areas, 1998 and 1999.

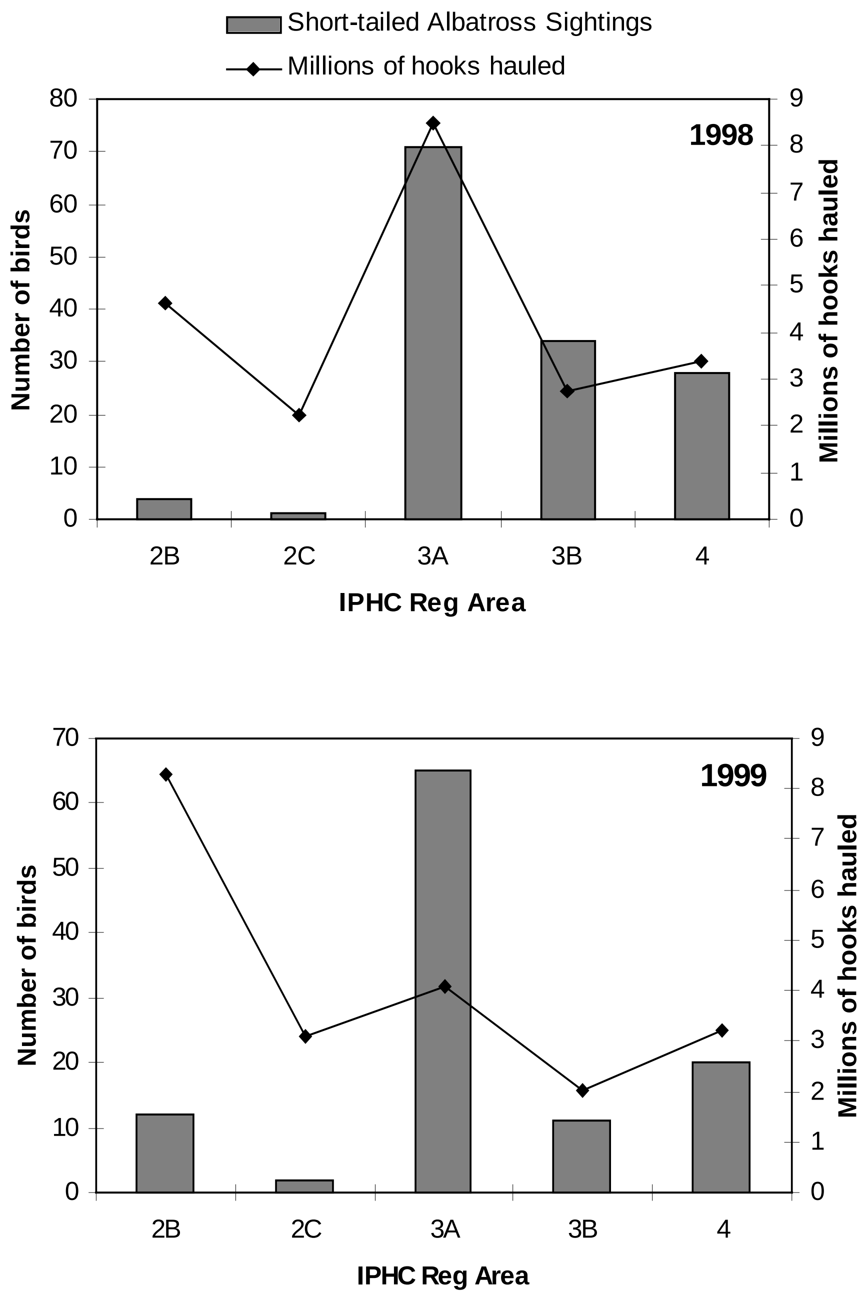


Figure 4. Short-tailed albatross sightings and number of hooks hauled by IPHC Regulatory Area, 1998 and 1999.

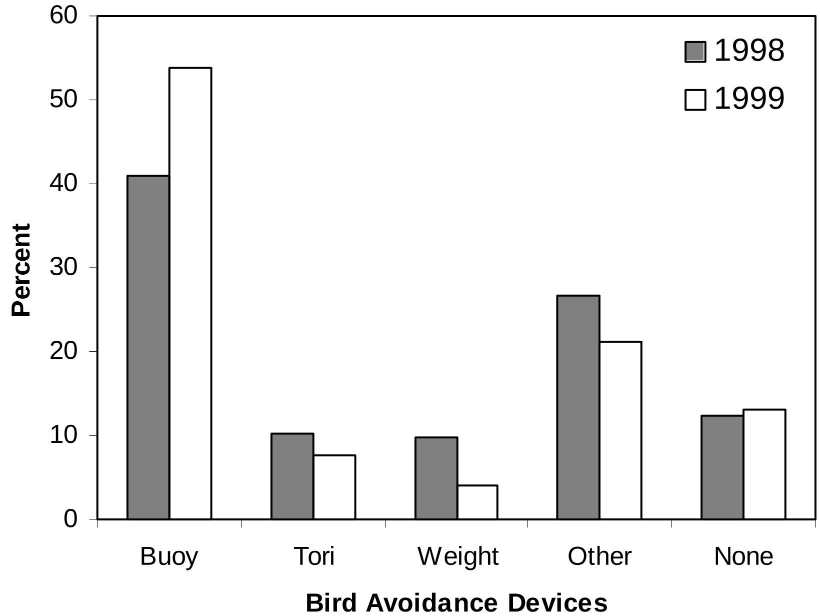


Figure 5. Reported bird avoidance device usage in Alaska, 1998 and 1999.

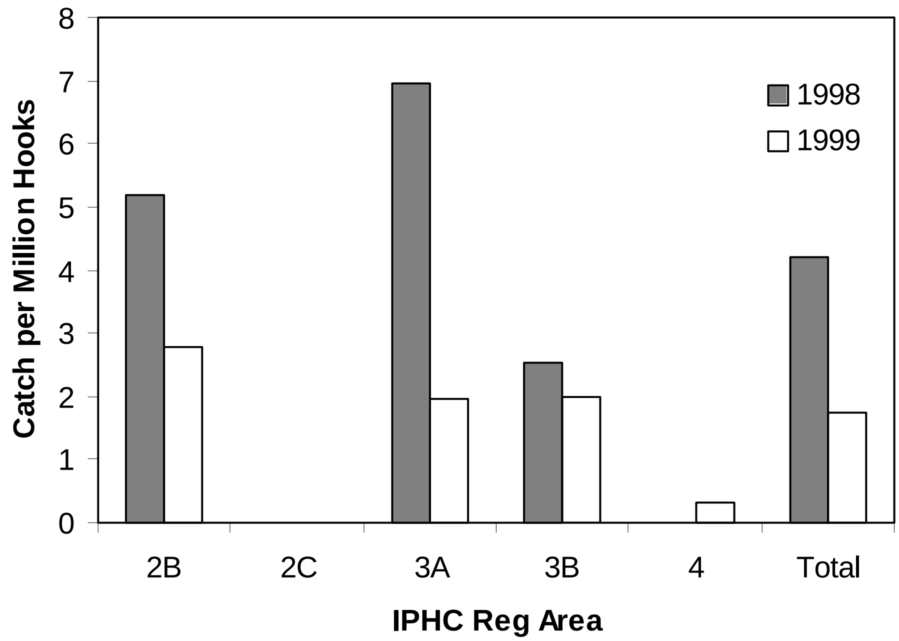


Figure 6. Bycatch rates by area of seabirds (all species combined) reported in IPHC interviews, 1998 and 1999.

Table 1. Numbers of landings, vessels, and pounds of 1998 Pacific halibut caught in Alaskan waters in total and represented by IPHC logs and in retrievals for fishing trips that targeted Pacific halibut on at least one set.

1998 landings of Pacific halibut caught in Alaskan waters	**Total pounds (millions)**	**Total hooks (thousands)**	**Number of deliveries**	**Number of vessels**
Total of all deliveries, incl. research	56.4	-	-	1,819
Total without research, etc.	53.4	-	-	1,802
Landings covered in logs	41.5	28,447	4,086	1,107
Logs for targeted halibut trips/sets	39.2	19,994	3,558	971

Table 2. Landings (thousands of pounds and percent) by year and month of Pacific halibut from IPHC ticket data for commercial vessels fishing in Alaskan waters 1997 to 1999.

	Thousands of pounds and percent by month						**Average % 1997-1999**
	1997		**1998**		**1999**		
Mar	2,857	(6%)	2,438	(5%)	4,852	(8%)	(6%)
Apr	5,025	(10%)	4,482	(8%)	6,376	(11%)	(10%)
May	9,030	(18%)	7,700	(14%)	9,725	(17%)	(16%)
Jun	8,433	(16%)	7,832	(15%)	9,286	(16%)	(16%)
Jul	5,640	(11%)	8,061	(15%)	6,713	(11%)	(13%)
Aug	7,288	(14%)	8,116	(15%)	8,1548	(14%)	(14%)
Sep	5,928	(12%)	7,401	(14%)	7,226	(12%)	(13%)
Oct	5,401	(11%)	4,571	(9%)	4,102	(7%)	(9%)
Nov	1,576	(3%)	2,815	(5%)	2,491	(4%)	(4%)
Total	**51,179**		**53,416**		**58,919**		

Table 3. Total commercial landings of Pacific halibut caught in Alaska waters for years 1997, 1998, and 1999.

Port Region	**1997**	**1998**	**1999**
Misc. CA, OR, WA	194	107	128
Seattle	1,209	581	276
Bellingham	2,463	3,463	2,488
Prince Rupert	226	598	200
Ketchikan, Craig, Metlakatla	1,277	1,087	1,026
Petersburg, Kake	3,036	2,828	2,306
Juneau	1,560	1,816	2,968
Sitka	3,512	3,501	2,789
Hoonah, Excursion	1,864	1,458	1,334
Misc. SE Alaska	3,045	2,948	3,388
Cordova	1,217	1,173	1,437
Seward	4,745	5,436	6,853
Homer, Iliamna	5,258	10,450	11,514
Kenai	192	256	184
Kodiak	10,389	8,523	9,237
Misc. Central Alaska	3,143	2,820	3,638
Akutan, Dutch Harbor	5,977	4,612	5,873
Misc. Bering Sea	1,873	1,761	3,279
Grand Total	**51,179**	**53,416**	**58,919**

Table 4. 1998 commercial landings of Pacific halibut (thousands of pounds) of Alaskan origin by port or port group. Ports are grouped when necessary to protect data confidentiality.

Port Region	Log data	Total landings	% in logs
Misc. CA, OR, WA	32	107	29.9
Seattle	303	581	52.2
Bellingham[1]	2,898	3,463	83.7
Prince Rupert[1]	427	598	71.4
Ketchikan, Craig, Metlakatla	410	1,087	37.7
Petersburg[1], Kake	2,279	2,828	80.6
Juneau	612	1,816	33.7
Sitka[1]	2,663	3,501	76.1
Hoonah[1], Excursion	1,233	1,458	84.6
Misc. SE Alaska	1,744	2,948	59.2
Cordova	639	1,173	54.5
Seward[1]	5,255	5,436	96.7
Homer[1], Iliamna	9,761	10,450	93.4
Kenai	106	256	41.4
Kodiak[1]	7,107	8,523	83.4
Misc. Central Alaska	1,329	2,820	47.1
Akutan & Dutch Harbor[1]	4,372	4,612	94.8
Misc. Bering Sea (St. Paul[1])	341	1,761	19.4
Grand Total	**41,510**	**53,416**	**77.7**

[1]Port with IPHC port sampler

Table 5. 1998 Commercial landings of Pacific halibut (thousands of pounds) for vessels and sets targeting Pacific halibut in Alaskan waters, by port or port group from IPHC logs. Ports are grouped when necessary to protect data confidentiality.

	Landing month									
Port or port group	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Total**
Misc. CA, OR, WA	-	-	-	15	-	-	17	-	-	32
Seattle	28	-	49	129	22	-	70	-	-	297
Bellingham	2	123	404	614	502	354	525	246	36	2,807
Prince Rupert	29	151	141	71	-	-	-	27	-	418
Ketchikan, Craig, Metlakatla	5	49	149	50	69	42	12	4	12	391
Petersburg, Kake	490	396	319	194	110	94	283	120	100	2,105
Juneau	78	133	72	54	21	119	48	21	15	559
Sitka	202	352	655	378	233	198	288	132	90	2,527
Hoonah, Excursion	117	145	315	164	76	158	126	59	-	1,159
Misc. SE Alaska	69	244	344	282	170	237	214	121	8	1,690
Cordova	79	216	115	73	18	-	47	-	-	548
Seward	541	608	922	566	393	686	301	252	172	4,441
Homer (& Iliamna)	97	608	732	1,519	1,154	1,862	1,916	983	535	9,406
Kenai	-	28	3	13	36	20	-	-	-	100
Kodiak	224	406	1,150	798	1,320	822	876	788	498	6,882
Misc. Central Alaska	17	52	388	146	169	290	149	27	-	1,239
Akutan & Dutch Harbor	-	32	123	591	1,391	1,097	673	338	62	4,306
Misc. Bering Sea	-	-	-	158	67	36	74	6	-	341
Total	**1,978**	**3,543**	**5,879**	**5,812**	**5,752**	**6,014**	**5,618**	**3,123**	**1,529**	**39,249**

Table 6. 1998 Commercial landings of Pacific halibut (as proportion of row total) of Alaskan origin by port or port group from IPHC logs. Ports are grouped when necessary to protect data confidentiality.

	Landing month									Thousands
Port or port group	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**of pounds**
Misc. CA, OR, WA	-	-	-	0.45	-	-	0.55	-	-	32
Seattle	0.09	-	0.16	0.43	0.07	-	0.24	-	-	297
Bellingham	0.00	0.04	0.14	0.22	0.18	0.13	0.19	0.09	0.01	2,807
Prince Rupert	0.07	0.36	0.34	0.17	-	-	-	0.07	-	418
Ketchikan, Craig, Metlakatla	0.01	0.12	0.38	0.13	0.18	0.11	0.03	0.01	0.03	391
Petersburg, Kake	0.23	0.19	0.15	0.09	0.05	0.04	0.13	0.06	0.05	2,105
Juneau	0.14	0.24	0.13	0.10	0.04	0.21	0.09	0.04	0.03	559
Sitka	0.08	0.14	0.26	0.15	0.09	0.08	0.11	0.05	0.04	2,527
Hoonah, Excursion	0.10	0.13	0.27	0.14	0.07	0.14	0.11	0.05	-	1,159
Misc. SE Alaska	0.04	0.14	0.20	0.17	0.10	0.14	0.13	0.07	0.01	1,690
Cordova	0.14	0.39	0.21	0.13	0.03	-	0.09	-	-	548
Seward	0.12	0.14	0.21	0.13	0.09	0.15	0.07	0.06	0.04	4,441
Homer (& Iliamna)	0.01	0.06	0.08	0.16	0.12	0.20	0.20	0.10	0.06	9,406
Kenai	-	0.28	0.03	0.13	0.36	0.20	-	-	-	100
Kodiak	0.03	0.06	0.17	0.12	0.19	0.12	0.13	0.11	0.07	6,882
Misc. Central Alaska	0.01	0.04	0.31	0.12	0.14	0.23	0.12	0.02	-	1,239
Akutan & Dutch Harbor	-	0.01	0.03	0.14	0.32	0.25	0.16	0.08	0.01	4,306
Misc. Bering Sea	-	-	-	0.46	0.20	0.10	0.22	0.02	-	341
Total	**0.05**	**0.09**	**0.15**	**0.15**	**0.15**	**0.15**	**0.14**	**0.08**	**0.04**	**39,249**

Table 7. Effort from IPHC log data (in thousands of hooks) by target species and IPHC regulatory area and catch (in thousands of pounds) by target species during 1998.

Regulatory Area	Target Species				Total
	Halibut	Sablefish	Mixed halibut and sablefish	Other Species	
2C	4,203	2,106	124	28	6,461
3A	8,636	3,183	1,401	20	13,241
3B	3,253	662	82	77	4,074
4A-Gulf	550	5	10	-	565
4B-Gulf	806	173	121	-	1,100
4B-BS	1,068	148	123	-	1,339
4A-BS	557	161	30	-	747
4C	376	-	-	-	376
4D	544	-	-	-	544
All area effort	**19,994**	**6,436**	**1,892**	**125**	**28,447**
All area catch	**38,908**	**987**	**1,180**	**21**	**41,096**

Table 8. Pacific halibut effort (in thousands of hooks) by IPHC regulatory area and month for vessels and sets targeting Pacific halibut in Alaskan waters during 1998.

Regulatory	**Month**									
Area	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Total**
2C	728	746	697	487	220	242	671	271	142	4,203
3A	607	1,209	1,448	1,303	884	890	1,256	740	299	8,636
3B	79	206	482	672	492	494	495	265	70	3,253
4A-Gulf	-	-	105	65	120	114	101	24	21	550
4B-Gulf	-	-	77	116	256	192	48	94	23	806
4A-B. Sea	-	-	18	365	348	135	89	107	8	1,068
4B-B. Sea	-	-	82	145	160	89	58	10	12	557
4C	-	-	-	189	68	31	89	-	-	376
4D	-	-	4	22	110	146	247	15	-	544
Total	**1,413**	**2,160**	**2,912**	**3,364**	**2,658**	**2,332**	**3,054**	**1,526**	**574**	**19,994**

Table 9. Effort (in thousands of hooks) by hook size, gear style, target species, and short (< 7 feet) and long (≥ 7 feet) hook spacing during 1998. Mixed fishing indicated targeting on both halibut and sablefish.

Target Species		Halibut			Sablefish			Mixed			All
Hook Spacing		Short	Long	Total	Short	Long	Total	Short	Long	Total	Types
Gear Style	Hook size										
Fixed	10	34	-	34	32	-	32	-	-	-	66
	11	6	-	6	-	-	-	-	-	-	6
	12	136	20	156	57	3	60	32	-	32	248
	13	1,535	104	1,640	1,295	1	1,296	320	-	320	3,255
	14	4,688	300	4,987	3,169	9	3,178	885	11	896	9,061
	15	1,349	650	1,999	615	10	625	227	19	247	2,871
	16	951	4,516	5,467	55	141	196	47	94	142	5,805
	18	4	3	7	-	-	-	-	-	-	7
Fixed Total		**8,702**	**5,593**	**14,296**	**5,224**	**163**	**5,387**	**1,512**	**124**	**1,636**	**21,319**
Snap	10	-	7	7	-	-	-	-	-	-	7
	11	2	-	2	14	-	14	-	-	-	15
	12	2	18	21	-	-	-	-	-	-	21
	13	11	85	96	13	16	29	-	4	4	129
	14	117	500	617	28	65	92	-	15	15	724
	15	3	431	434	11	34	44	-	16	16	495
	16	75	3,067	3,142	-	7	7	-	13	13	3,162
	18	-	5	5	-	-	-	-	-	-	5
Snap Total		**210**	**4,113**	**4,323**	**65**	**121**	**187**	**-**	**48**	**48**	**4,557**
Autoline	12	40	-	40	44	-	44	41	-	41	126
	13	541	94	635	447	24	471	164	-	164	1,270
	14	488	11	498	273	-	273	2	-	2	773
	15	42	5	47	32	5	37	-	-	-	84
	16	2	12	14	5	9	14	-	-	-	28
Autoline Total		**1,113**	**121**	**1,234**	**801**	**38**	**839**	**208**	**-**	**208**	**2,281**
All Gear Styles		**10,026**	**9,827**	**19,853**	**6,090**	**322**	**6,412**	**1,720**	**172**	**1,892**	**28,157**

Table 10. Log coverage (thousands of pounds) during 1998 by vessel length class.

Length Class	Catch from 1998 logs	Total 1998 landings	% log coverage
<26	90.7	613.0	15
26-30	317.2	1,082.3	29
31-35	2,813.0	4,216.8	67
36-40	2,211.7	3,817.6	58
41-45	3,652.9	4,667.5	78
46-50	3,938.9	5,281.1	75
51-55	2,623.0	3,510.1	75
56-59	10,729.0	11,828.1	91
60+	15,036.5	18,283.3	82
Total	**41,438.6**	**53,429.2**	**78**

Table 11. Number of annual landings by individual vessels fishing Pacific halibut in Alaskan waters during 1998. (Includes vessels targeting halibut for a trip and vessels with individual sets targeting halibut).

Number of landings	Number of vessels	Percent	Cumulative Percent
1	237	24.4	24.4
2	210	21.6	46.0
3	139	14.3	60.4
4	117	12.0	72.4
5	80	8.2	80.6
6	63	6.5	87.1
7	37	3.8	90.9
8	24	2.5	93.4
9	21	2.2	95.6
10	11	1.1	96.7
11	8	0.8	97.5
12	6	0.6	98.1
13	3	0.3	98.5
14	3	0.3	98.8
15-29[1]	12	1.2	100.0
Total	**971**	**---**	**---**

[1] Data are combined to protect confidentiality

Table 12. Frequency of total annual catch vessel targeting Pacific halibut in Alaskan waters during 1998.

Annual catch (pounds)	Frequency	%	Cumulative %
1 - 4,999	202	20.8	20.8
5,000 - 9,999	131	13.5	34.3
10,000 - 24,999	254	26.2	60.5
25,000 - 49,999	152	15.7	76.1
50,000 - 74,999	84	8.7	84.8
75,000 - 99,999	38	3.9	88.7
100,000 - 124,999	28	2.9	91.6
125,000 - 149,999	18	1.9	93.4
150,000 - 174,999	19	2.0	95.4
175,000 - 199,999	9	0.9	96.3
200,000 - 224,999	8	0.8	97.1
225,000 - 249,999	6	0.6	97.7
250,000 - 274,999	12	1.2	99.0
275,000 - 299,999	6	0.6	99.6
300,000 +[1]	4	0.4	100.0

[1] Data are combined to protect confidentiality

Table 13. Pacific halibut landings (number and pounds) by vessel length class for vessels targeting Pacific halibut in Alaskan waters during 1998.

Length Class	Count	Max.	Avg.	Std. Dev.	Total	% of Total
<26	152	2,610	597	458	90,713	0.2
26-30	189	8,474	1,656	1,343	313,003	0.8
31-35	601	27,082	4,600	4,168	2,764,502	7.0
36-40	449	22,310	4,785	3,607	2,148,587	5.5
41-45	514	29,474	6,815	4,989	3,503,119	8.9
46-50	434	58,648	8,660	8,433	3,758,460	9.6
51-55	202	44,630	12,003	8,982	2,424,568	6.2
56-59	479	63,419	18,748	13,318	8,980,282	22.9
60+	538	84,287	28,327	19,501	15,239,753	38.9
Total	3,558	84,287	11,024	13,436	39,222,987	--

Table 14. Trip duration for vessels targeting Pacific halibut in Alaskan waters during 1998.

Duration (No. Days)	**Number (Freq.)**	**%**	**Cumulative %**
1	272	7.6	7.6
2	609	17.1	24.8
3	869	24.4	49.2
4	660	18.5	67.7
5	430	12.1	79.8
6	278	7.8	87.6
7	157	4.4	92.0
8	98	2.8	94.8
9	48	1.3	96.1
10	38	1.1	97.2
11	37	1.0	98.3
12	23	0.6	98.9
13	11	0.3	99.2
14	10	0.3	99.5
15	9	0.3	99.7
16	3	0.1	99.8
17-25[1]	6	0.2	100.0

[1] Data are combined to protect confidentiality

Table 15. Trip duration by length class for vessels targeting Pacific halibut in Alaskan waters during 1998. IPHC log data only.

Length Class	**Number of trips**	**Trip Length (days)**		
		Maximum	**Average**	**Std. Dev.**
<26	152	8	1.5	0.90
26-30	189	7	1.8	1.16
31-35	601	25	3.4	1.72
36-40	449	13	3.8	1.65
41-45	514	12	3.9	1.73
46-50	434	18	4.3	2.16
51-55	202	15	4.5	2.47
56-59	479	16	4.7	2.43
60+	538	25	5.9	3.33
Grand Total	**3,558**	**25**	**4.1**	**2.44**

Table 16. 1998 and 1999 landings characteristics for port sampler interviews for seabird bycatch.

	British Columbia		Alaska	
Year	**Pounds/Vessels**	**Percent**	**Pounds/Vessels**	**Percent**
1998				
Pounds landed (000's)	12,875		53,416	
Pounds interviewed (000's)	10,348	80.4	35,559	66.6
Pounds interviewed matching logs (000's)	7,400	57.5	28,032	52.5
Number of vessels interviewed	940		3,427	
Number of log matches	694	73.8	2,493	72.7
1999				
Pounds landed (000's)	12,214		58,919	
Pounds interviewed (000's)	9,495	77.7	36,868	62.6
Pounds interviewed matching logs (000's)	8,942	73.2	27,261	46.3
Number of vessels interviewed	891		3,778	
Number of log matches	827	92.8	2,995	79.3

Table 17. Monthly percent use of bird avoidance devices in Alaska, 1998 and 1999.

	March		April		May		June		July		August		Sept.		Oct.		Nov.		Total	
Device	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**	**98**	**99**
Buoy	22.8	49.7	38.5	56.9	40.1	59.8	45.2	50.8	40.4	46.0	39.2	55.3	42.9	57.1	43.7	54.6	NA	65.0	40.9	53.8
Tori	10.9	8.5	13.0	8.5	11.2	9.1	7.8	6.7	12.8	4.7	9.6	8.6	10.4	9.3	8.5	6.8	NA	8.0	10.3	7.7
Weight	4.3	8.2	9.1	4.1	9.6	4.0	9.8	2.8	7.7	0.7	13.4	5.4	8.9	3.0	11.3	6.8	NA	5.0	9.7	4.1
Other	26.1	24.5	26.9	23.6	31.0	21.7	20.6	18.3	27.1	18.4	23.9	25.7	32.7	20.5	32.4	22.5	NA	12.0	26.7	21.2
None	35.9	9.2	12.5	6.9	8.1	5.3	16.7	21.4	12.0	30.2	13.8	5.1	5.1	10.1	4.2	9.2	NA	10.0	12.4	13.2

Table 18. Bycatch rates (number of birds per million hooks) of seabirds reported in IPHC interviews, 1998 and 1999.

	Catch rate per million hooks							
	Albatross		N. Fulmar		Other		Total	
Area/Year	98	99	98	99	98	99	98	99
2B	3.46	1.93	0.43	0.12	0.43	0.72	5.19	2.77
2C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3A	1.18	0.00	5.55	1.47	0.12	0.49	6.96	1.96
3B	0.36	0.50	2.17	0.99	0.00	0.50	2.54	1.98
4	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.31
Total	**1.26**	**0.82**	**2.56**	**0.43**	**0.14**	**0.48**	**4.19**	**1.74**

Table 19. Comparison of seabird bycatch rates (birds/million hooks) for IPHC surveys and IPHC port interviews, 1998 and 1999.

	1998			1999		
Area	No. Birds	Million Hks	Catch Rate	No. Birds	Million Hks	Catch Rate
			Surveys			
2B	1	0.08	11.9	0	0.1	0.0
2C	0	0.07	0.0	1	0.1	13.0
3A	0	0.25	0.0	1	0.3	3.9
3B	0	0.16	0.0	4	0.2	25.0
4	26	0.12	214.5	0	0.1	0.0
Total	**27**	**0.69**	**38.9**	**6**	**0.8**	**7.9**
			Port Interviews			
2B	24	4.63	5.2	23	8.3	2.8
2C	0	2.24	0.0	0	3.1	0.0
3A	59	8.48	7.0	8	4.1	2.0
3B	7	2.76	2.6	4	2.0	2.0
4	0	3.37	0.0	1	3.2	0.3
Total	**90**	**21.47**	**4.2**	**36**	**20.7**	**1.7**

Table 20. Summary information regarding IFQ trips monitored by observers, broken down by whether halibut was released or landed. Halibut catch figures obtained from observer catch estimates and not from fish tickets.

Region of fishing	1996 No Halibut Landed	1996 Halibut Landed	1997 No Halibut Landed	1997 Halibut Landed	1998 No Halibut Landed	1998 Halibut Landed
Bering Sea/Aleu.						
No. vessels	10	5	11	2	15	12
No. vessel trips	14	5	15	2	26	12
No. days of fishing	81	23	67	5	376	75
No. of sets	59	16	57	13	707	122
Lbs. halibut caught	77,504	47,502	53,109	24,041	261,972	277,836
Gulf of Alaska						
No. vessels	7	18	11	17	22	49
No. vessel trips	10	18	15	19	26	63
No. days of fishing	40	52	100	53	200	324
No. of sets	48	46	98	51	499	703
Lbs. halibut caught	112,621	163,976	142,904	273,716	243,997	877,638
All Areas Combined						
No. vessels	1	0	0	1	2	2
No. vessel trips	1	0	0	1	3	2
No. days of fishing	39	0	0	7	20	32
No. of sets	32	0	0	9	31	74
Lbs. halibut caught	45,413	0	0	26,193	2,188	80,548

Table 21. Effect on percent of fishery coverage by progressively focusing effort by area, boat length, and season (from IPHC log and landing data, extrapolated to total catch).

Data collection focus (progressive)	**Millions of hooks observed**	**Millions of pounds observed**	**Est. Cost (millions)**
All targeted halibut effort	27.2 (100%)	53.3 (100%)	$9.6
Excluding the inside waters of Area 2C	23.3 (86%)	47.7 (89%)	$8.6
Limiting to vessels 40 foot and greater	20.8 (76%)	42.1 (79%)	$7.6
May through July 3A/3B, April through July in Area 4	10.0 (37%)	20.2 (38%)	$3.6

Appendix 1. Bait Usage Interview Information

List of processors interviewed for bait usage:

Norquest Seafoods, Ketchikan AK

Icicle Seafoods, Petersburg AK

Sea Level Seafoods, Wrangell AK

Seafood Producers Co-op, Sitka AK

Taku Smokeries, Juneau AK

Sitka Sound Seafoods, Yakutat AK

Norquest Seafoods, Cordova AK

Icicle Seafoods, Seward AK

Alaska Fresh Seafoods, Kodiak AK

Alaska Pacific Seafoods, Kodiak AK

Great Alaska Fish, Homer AK

Unisea, Seattle WA

Questions Asked of Bait Sellers

- ❑ What proportion of bait by species do you typically sell to halibut fishers?
- ❑ Do fisheries typically use bycatch of other species, or target other species, to use as bait for halibut?
- ❑ Do different categories of vessels have different bait usage?

Appendix 2. Observer Program Interview Information

List of fishermen associations interviewed for effects of observers on small boats

Southeast Seiners Association, Juneau AK

Petersburg Vessel Owners Association, Petersburg AK

United Fishermen of Alaska, Juneau AK

APICDA, Juneau AK

Native Corporation, St. Paul AK

United Fishermen's Marketing Association, Kodiak AK

Aleutian East Borough, Juneau AK

Joe Macinko, Kodiak AK

Alaska Longline Fisheries Association, Sitka AK

Questions Asked of Association Leaders

- ❑ How big are the vessels you represent?
- ❑ How many bunks and crew on the vessels?
- ❑ What trip length (days) do your members make?
- ❑ What do you consider the minimum size of vessel to carry an observer?
- ❑ What effect will an observer program have on your members?