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IPHC Setline Charters 1963 through 2003

by

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IPHC Setline Charters 1963 through 2003

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Survey background

Introduction

The International Pacific Halibut Commission (IPHC or Commission) is the oldest fisheries management body in North America. For more than 80 years, the IPHC has successfully managed a sustainable Pacific halibut fishery by applying knowledge obtained through the IPHC's extensive and ongoing research at sea. Since 1925, when the IPHC chartered the F/V *Seamaid* to conduct its first halibut research, the IPHC has continued to build a rich history of field research providing a better understanding of the life history, migration, behavior, effects of fishing methods, and stock dynamics of the Pacific halibut, *Hippoglossus stenolepis*.

The Commission has completed more than 340 distinct research charters since it began conducting at-sea research in 1925. The majority of research cruises have collected halibut using setline (longline) or trawl gear. Some research trips, however, have collected data using traps, plankton nets, and underwater cameras. Research charters have ranged in length from only a few days to upwards of four months. Most charters have occurred during the summer when weather is favorable and halibut are present over the continental shelf at depths of less than 275 fathoms. The primary purpose of most charters has been to collect information pertaining to stock assessment and Pacific halibut migration patterns. In addition, the research platform provided by the chartered vessels has enabled researchers to complete projects outside this realm, to collaborate with outside agencies, and to investigate a range of issues such as oceanic conditions, fish flesh quality, seabird populations, and the effects of oil spills.

Setline stock assessment surveys

The IPHC samples the halibut population using standardized setline surveys and, since 1925, has relied on three primary setline survey designs: spot surveys, random stratified surveys, and grid surveys.

Spot survey design was used for all surveys prior to 1961 and occasionally through 2003. On a spot survey, the captain of a research vessel selects a specific fishing *spot* within a larger area designated by the IPHC. Spot surveys are ideal for mark and recapture experiments that require a high rate of recapture. Random stratified survey design was used by the IPHC only for setline surveys off the coast of Oregon, Washington, and Vancouver Island from 1995 to 1997.

A random stratified survey design consists of predetermined, random survey station locations stratified on commercial and non-commercial fishing grounds. Because halibut tend to concentrate in small, irregular groups that are often transient, meaningful stratification of the sampling area was not often practical. Therefore, to ensure full coverage of an area and to allow for standardized setting and hauling times during the survey operation, IPHC researchers prefer systematic sampling over random sampling. For a thorough description of the grid survey design refer to Technical Report No. 18 as well as Report of Assessment and Research Activities (RARA) documents from 1996 and 1998.

Grid surveys were first used by the IPHC in 1961. A grid survey consists of survey stations placed at the intersection of a network of longitudinal and latitudinal transects. Logistical considerations and fish distribution favor a grid design if the objective is to sample areas. Over

the years the grid has evolved to meet different goals. The current grid pattern used for setline stock assessment surveys has remained unchanged since it was last modified in 1998 (however in 1998 and 2000 regulatory area 2A was not surveyed).

Standardized setline survey gear

The IPHC employs industry-standard gear and fishing practices on surveys, and the design of setline gear used on surveys has evolved with the fishery over the years. Figure 1 displays standard components of typical setline halibut gear. On most surveys described in this document, a skate consisted of about 1,500 to 1,800 feet of 28- to 32-pound nylon groundline with braided nylon gangions, varying in length from about 12 to 72 inches and attached to the groundline at intervals of 12 to 24 feet. J-hooks, typically Mustad No. 6283, were the industry-standard hook prior to 1984. In 1984, the IPHC conducted an experiment to compare fishing power of j-hooks and circle hooks. Since 1985, only circle hooks have been used on the surveys. The amount of gear set at each station has varied from two to twelve skates dependent upon survey design, fishing location, and bottom type. Herring, Pacific cod, walleye pollock, sablefish, sculpins, squid, octopus, and salmon have been used for bait on surveys, since 1963. Incidentally captured animals used as bait are referred to as shack bait, which was primarily Pacific cod, sablefish, sculpin, and octopus. Records also refer to *frozen* shack bait, which has several possible meanings: the same species commonly caught on halibut gear but purchased frozen in port, incidentally captured fish that were frozen in port and reloaded on the vessel, or fish captured at sea and frozen in the boat's bait hold. Piece weights of cut baits typically varied between 0.2 and 0.5 lbs depending upon bait type, baiting methods, and experimental requirements. Since 1997, gear and bait type and weight has been standardized. One skate of standardized survey gear comprises 1800 feet of groundline, with 100 number 3 (16/0) circle hooks, tied through the front, spaced 18 feet apart and attached to the groundline with gangions between 24 and 48 inches in length. Bait has been standardized as #2 semi-bright or better, individually quick frozen, headed and gutted, chum salmon (*Oncorhynchus keta*), cut to pieces weighing 0.25 lbs to 0.33 lbs.

Mark and recapture studies

Tagging experiments provide information regarding the relationships between stocks and the extent of utilization of these stocks by the fishery. In addition, both fishing and natural mortality rates can be ascertained from tagging studies. Halibut tagging was the emphasis of most charters prior to 1990. Between 1963 and 1990 25% to 50% of halibut caught on setline charters were tagged and released. Although all halibut were measured on IPHC charters, typically only fish that were unsuitable for tagging because of injuries sustained during capture were retained for age and sex determination. Occasionally, uninjured fish were sacrificed to obtain sufficient age and sex samples. Landing fish destined for tagging requires additional care at the roller because the rollerman must lift the fish on board without using a gaff hook and without injuring the fish. If a gaff hook is needed to land the large fish, an attempt was made to gaff the fish through the lower jaw or in the fleshy part of the cheek. All fish caught were examined individually for the hooking wound location and the extent of the wound. Because sex and maturity determination generally require the specimen be sacrificed (sex can be determined by external characteristics, but not maturity), these data are absent for tagged fish, except for fish that were tagged during winter spawning and were actively displaying their gender and maturity by expelling eggs or milt.

Length measurement

The IPHC has consistently used the straight-line distance between the tip of the lower jaw with the mouth closed to the end of the middle rays of the caudal fin as the fork length. Most fork length measurements were made using a measuring cradle designed for halibut, with a centimeter rule running from the headboard to the end. An additional measuring strip, aligned with the end of the cradle, accommodated fish longer than the cradle.

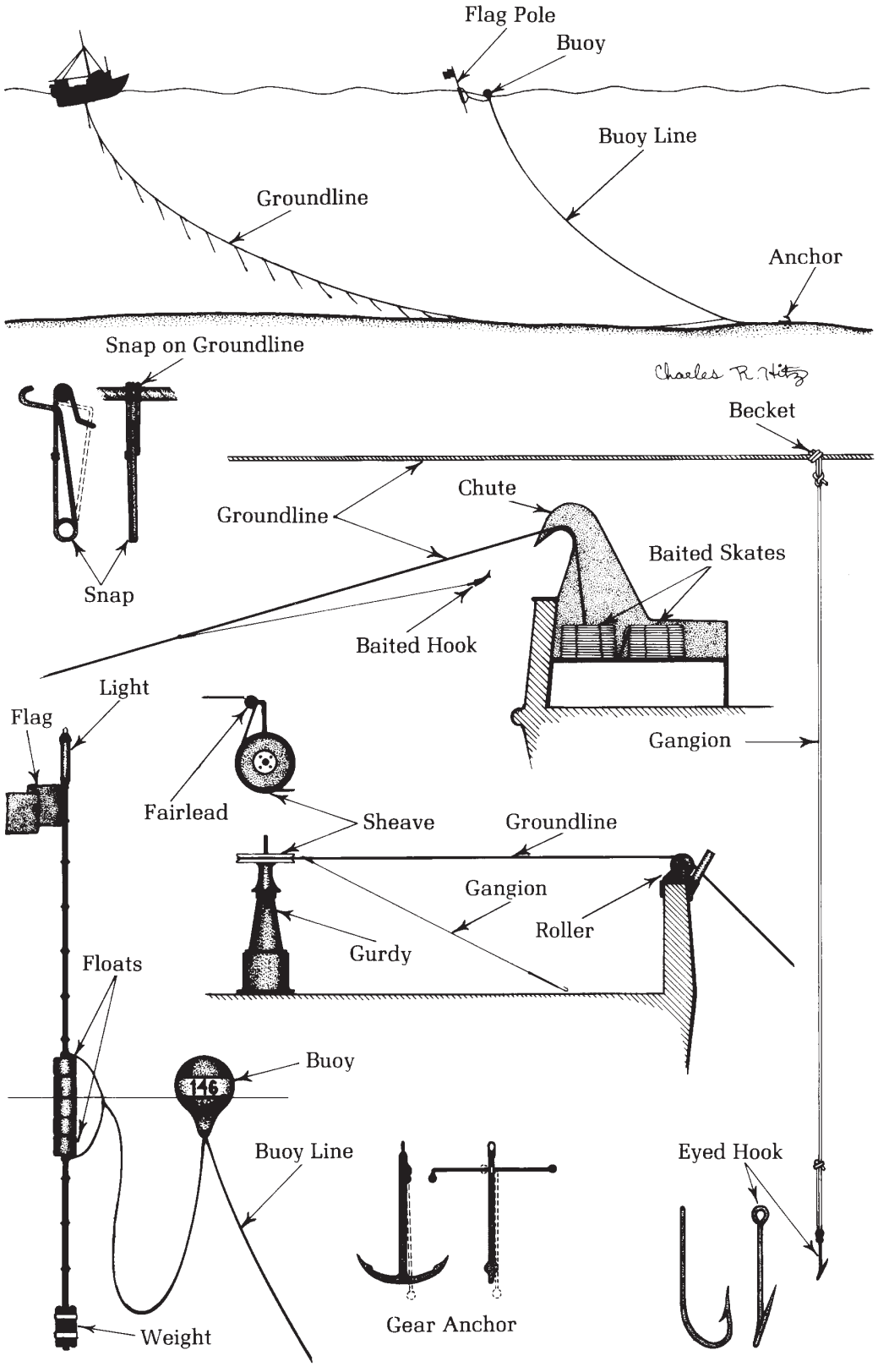


Figure 1. Standard setline halibut gear components.

Initially, IPHC researchers recorded lengths to the nearest millimeter for all sizes of fish, but soon considered it sufficient to record lengths to nearest centimeter for adult fish. Head length correlates to fork length and is used to calculate the fork length if the fork length could not be measured because of damage to the specimen, typically by predators such as sharks and marine mammals. The head length of halibut is measured as the straight-line distance from the tip of the jaw when the mouth is closed to the posterior edge of the opercular bone, excluding the flap of skin that extends posterior to the edge of the opercular bone (Fig. 2).

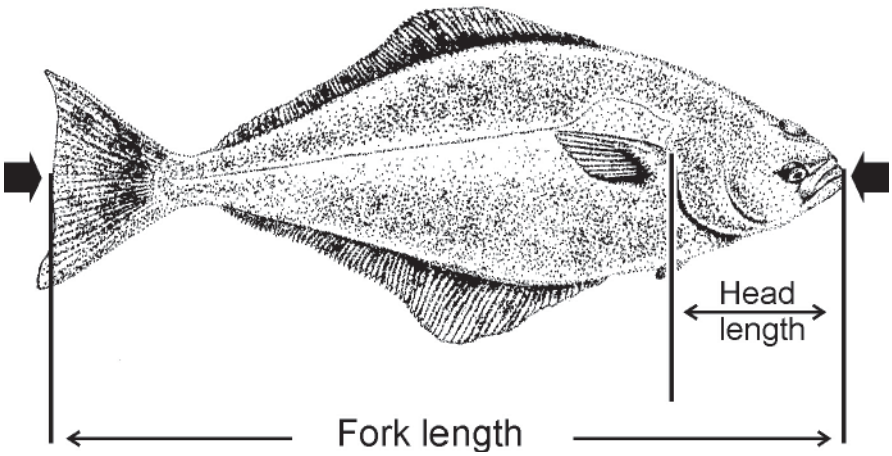


Figure 2. Fork length and head length measurements.

Bycatch and hook occupancy data

In 1971, the IPHC began tracking organisms other than halibut captured on surveys. These data provide insight into bait competition and are also helpful in investigating how halibut fishing interacts with other species. Over the years, the IPHC has collaborated with various outside agencies for fish collection and bycatch monitoring. Initially bycatch species identification and recording was given low priority. However, as bycatch and ecosystem management issues have become more important to managers and fishers, more emphasis has been placed on collecting detailed and accurate bycatch data at the species level.

Oceanographic data

Each year the IPHC's fleet of chartered vessels presents a unique research platform for collecting oceanographic data. The technology used by the IPHC has evolved over time from a simple reversing thermometer in the early days to modern instruments that record temperatures, dissolved oxygen, and conductivity while descending the water column. Bottom and sea surface temperatures were taken at least once per day on most surveys between 1963 and 1995. After 1995, only bottom temperatures were collected because accurate sea surface temperatures became available from other sources.

Seabird avoidance

In 1998, following rising concerns in the commercial fishing and scientific communities involving the incidental catch of seabirds in longline gear, the Commission began requiring that all IPHC survey vessels use an approved seabird avoidance device. A seabird avoidance device consists of a buoy or another object providing drag attached to a streamer line. This setup is

towed behind the boat while the boat is setting gear and is intended to scare and distract the seabirds until the bait has sunk. Figure 3 is an illustration provided by Washington State Sea Grant showing a standardized bird avoidance device (BADs). In 2002, the Commission began working with Alaska Department of Fish and Game (ADF&G), National Marine Fisheries Service (NMFS), and Washington State Sea Grant to record seabirds sighted during the agencies' various research activities.

Halibut predators

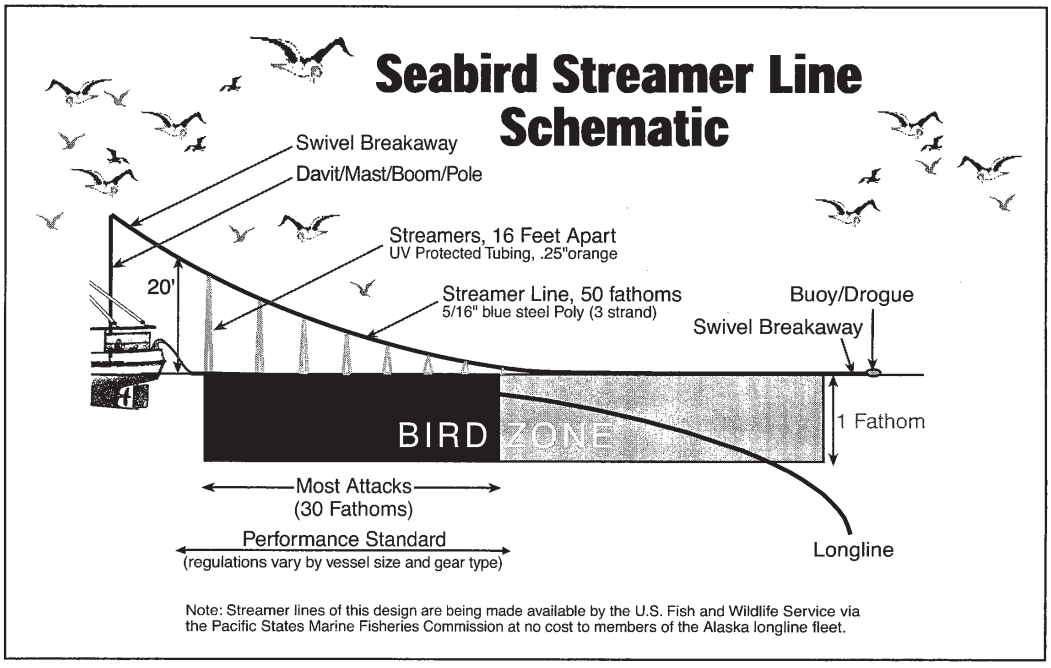


Figure 3. Seabird avoidance device schematic provided by Washington State Sea Grant.

Although halibut is a top-tier predator, while hooked on setline gear they are susceptible to predation from a variety of animals such as whales, pinnipeds, sharks, octopus, and amphipods. These predators either damage fish or remove them entirely from the hook. When there is significant predator interaction on a survey station, data from the station are analyzed to determine whether depredation likely affected the CPUE to the extent that data from that station should not be used for stock assessment.

Logbook entries from early charters indicate 80% and higher losses due to sea lion depredation. Sea lions posed a problem on many of the early setline charters in the northern Gulf of Alaska and Bering Sea. Large herds of 30 to 40 sea lions sometimes shadowed chartered vessels for days. Seal bombs (Department of Transportation Explosive Pest Control Device 1.4E NA-0412) were widely used in the 1960s and early 1970s to deter predators. It is not clear how significant sea lion depredation was accounted for in the data collected at the time. Yet is is safe to assume that since the main objective for most early setline charters was halibut tagging and not CPUE estimates, it is likely that the loss to marine mammal predation was not accounted for or recorded other than brief notations in the lead biologist's logbook.

Over time, pinniped depredation waned and depredation by orca and sperm whales moved to the forefront of concern. Since the 1990s it has not been uncommon for halibut vessels to be shadowed by a pod of orcas for days at a time. The IPHC researchers on setline surveys recorded

incidences of whale depredation in logbooks and indicated on data sheets which individual fish were subjected to whale depredation.

Sleeper sharks (*Somniosus pacificus*) became a significant halibut predator in the mid-1990s. Some fishers have reported 30% fewer halibut in areas where sleeper sharks are prevalent.

Survey locations

The names of IPHC setline charter regions have traditionally derived from nearby place names, geographic landmarks, or well-known fishing grounds. For instance, the Yakutat charter region encompasses fishing grounds located near the town of Yakutat in the central Gulf of Alaska, and the Portlock charter region refers to the Portlock Bank northeast of Kodiak Island. Charters have also been referred to by regulatory area (e.g., 2B charter). Unfortunately, the areas designated by these place names and regulatory areas have changed throughout IPHC survey history. For consistency, this paper will refer to the regulatory area boundaries in place during the year 2003 (Fig. 4).

Document conventions

Each of the projects described in this document is prefaced with a list of areas fished, charter duration, trips, and sets completed when this information was available. Each project's purpose, general description, gear, bait, survey design, and sampling protocols are described. Additional experiments and data coinciding with the main project are also noted. Sampling manuals developed for each of the experiments provide much of the procedural information.

Throughout this document, legal size (i.e., minimum length permissible for commercial harvest) for halibut is reported in metric units; however, the official legal length for halibut is also set in inches. IPHC researchers recorded halibut lengths using metric units in the field.

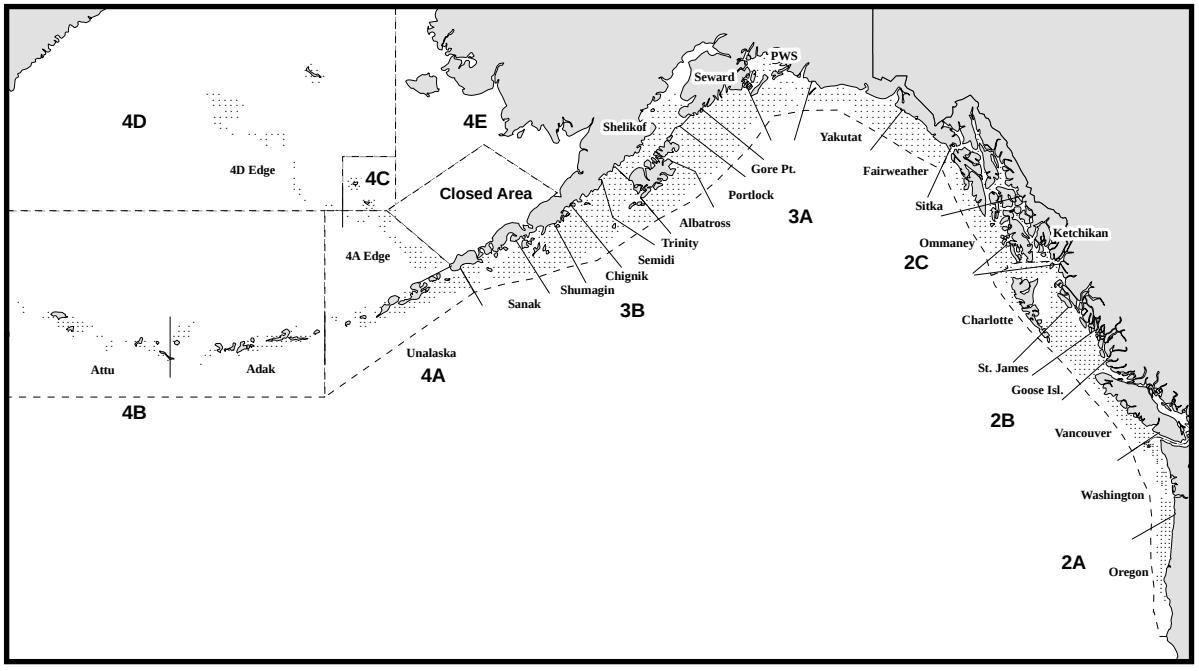


Figure 4. Halibut Commission regulatory areas, charter regions, and setline stock assessment (SSA) survey grid stations 1998 – 2003. (Note: Area 2A was not surveyed in 1998 and 2000)

Survey grid design evolution

1961 through 1963

The first survey grid designed by the IPHC was a trawl survey conducted between 1961 and 1963 to estimate the possible extent of a trawl fishery (foreign and domestic) for demersal fish in the survey region and the effect that such a trawl fishery would have on the population of adult and juvenile halibut.

Although station placement was modified many times, this grid became the basis for all setline grid surveys until the survey was redesigned in 1998. The original design positioned transects at every 15 minutes of longitude and every three minutes of latitude. Stations were selected by choosing points along the longitudinal lines at every other transect junction (six minutes of latitude apart) at depths ranging from approximately 20 to 250 fathoms. Stations along neighboring longitudinal transects were offset by three minutes of latitude providing a more even station distribution (Fig. 5). Additional stations were placed at the deep end of most longitudinal transects at 125 and 250 fathoms deep, regardless of the distance between stations. These deep stations were added to provide a denser survey of depth stratifications along the shelf slope.

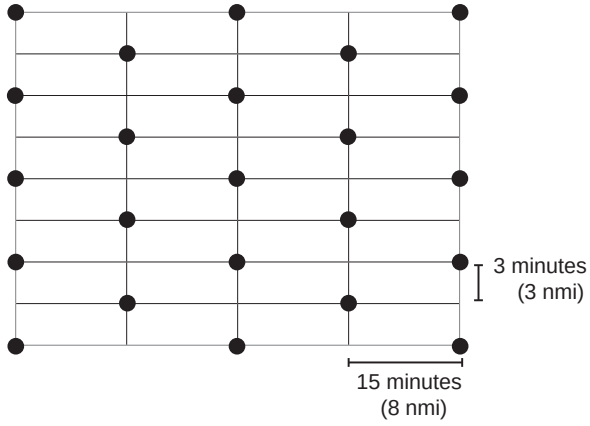


Figure 5. Original grid pattern used for 1961 to 1963 trawl surveys.

1963 through 1966

The IPHC implemented setline surveys in 1963 covering parts of Areas 3A and 3B. Fewer stations could be completed in a timely manner using setline gear than trawl gear, so the design of the new survey grid was modified from the original 1960 to 1963 trawl survey design. The new design increased the distance between the longitudinal transects from 15 to 22.5 minutes apart, which equated a distance of approximately 12 nmi near Kodiak Island. Because lines of longitude converge toward the poles, the transect separation was about 13.5 nmi near Umnak Island and less than 11.5 nmi near Montague Island. The latitudinal transects were drawn every three minutes with stations placed every six minutes along the longitudinal transects beginning from the shore and extending to a depth of about 250 fathoms. Additional stations were placed at the deep end of most longitudinal transects. Instead of placing all stations on transect junctions they were offset along neighboring longitudinal transects by 1.5 minutes of latitude (Fig. 6).

A similar grid design, covering the area from Vancouver Island to Dixon Entrance, was implemented in Area 2B in 1965. This grid differed from the Area 3 design in that the transects were latitudinal rather than longitudinal. Stations were placed every 10 minutes of longitude along the transects at right angles to each other, i.e., not offset as in Areas 3A and 3B. This produced a station separation along transects of about 7 nmi at the south end and 6 nmi in the north end. Additional stations were placed at the deep end of some latitudinal transects as described above (Fig. 6).

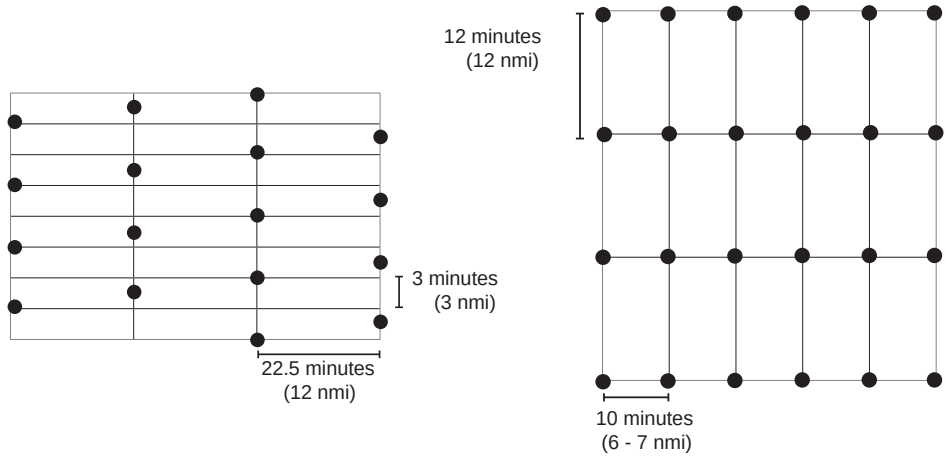


Figure 6. Area 3 (left) and 2B (right) grid patterns modified in 1963 and used until 1966.

1976 through 1986

After a 10-year hiatus, the setline grid survey resumed in 1976. The grid design was modified to maximize available resources and minimize temporal variation by reducing the amount of time needed to complete the survey. The 1963 to 1966 station positions were used, but only the odd numbered longitudinal transects in 3A and 3B and latitudinal transects in 2B were sampled. The added stations at the deep end of the transects from the previous design were dropped and a consistent six minutes of latitudinal separation in 3A and 3B and 10 minutes longitudinal separation in 2B was adopted for all survey positions (Fig. 7).

Since the first the IPHC setline grid survey was performed in 1963, many changes were made to the grid design, necessitated by logistical problems and general expansion of the program. Some stations were added in Area 3 resulting in cumbersome identification designations, while others were eliminated. Transect numbers were sometimes changed from one year to the next, and in some cases numbers were duplicated between regulatory areas. To eliminate confusion, the transect numbers and some station designations were standardized in 1979. These changes were retroactively assigned to grid survey stations going back to 1963 before entry in the IPHC database. The logbooks, raw data sheets, and instruction manuals were not updated to reflect the new station designations. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

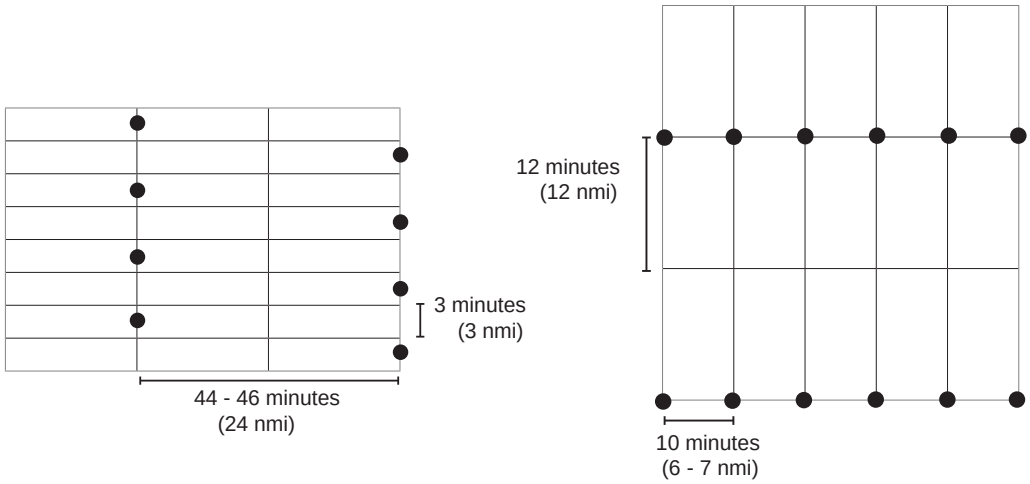


Figure 7. Area 3 (left) and 2B (right) grid patterns modified in 1976 and used until 1986.

1993 through 1995

In 1993, IPHC biologists analyzed the historical grid design and proposed modifications to satisfy new survey demands. The primary goal of the redesign was to create a more even station distribution while maintaining a logistically efficient system, so that large areas could be thoroughly surveyed with a minimum of time and resources. The IPHC adopted a triangular sampling pattern based on and using as many stations as possible from the 1963 though 1986 grid surveys. The same 12 x 3 nmi grid pattern used previously in Area 2B (Fig. 7) formed the base for stations set between 6 nmi and 18 nmi apart on the transects. In order to use as many historical stations as possible, the new stations were placed along the transects either on or directly between transect junctions.

Several qualifying factors determined station placement along a transect. The stations had to be chosen so that they could be formed into a fishable triangle for each survey day, i.e., the corners of the triangles could be no more than 15 nmi apart, obstructions (e.g., islands, reefs, underwater cables, traffic lanes) could not impede transit, and there needed to be at least 1.5 nmi buffer of fishable depth on all sides of a station to allow for the length of gear fished and drift. All historical stations meeting the above criteria were given preference in the new design.

After stations were chosen along the transects and formed into triangular sampling patterns, a new station, not plotted on the grid pattern, was added in the center of each triangle. In 1993 the location of the center station was chosen by the captain of each survey vessel. Thereafter, the center station was fixed before the survey as the centroid of the triangle (Fig. 8).

Stations were designed in 1993 in the Kodiak and Portlock regions of Area 3A and the Charlotte region in Area 2B. In 1994, the survey was expanded into Area 3B as far as 157 degrees 30 minutes West. In 1995, additional stations were added at the deep end of many transects in an attempt to increase the station density along the shelf slope and maximize the depth range of the surveys.

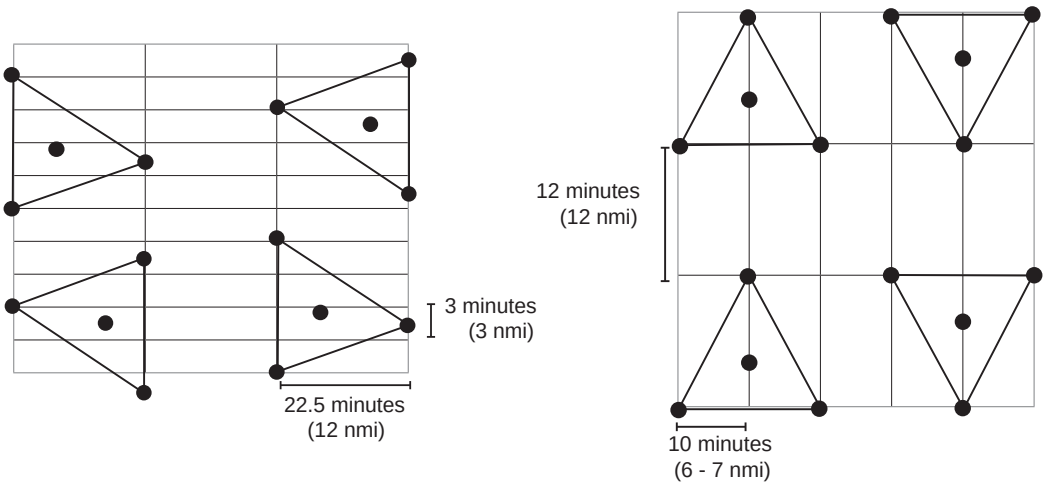


Figure 8. Area 3 (left) and 2B (right) grid patterns modified in 1993 and used until 1995.

1996 and 1997

The setline grid survey was expanded in 1996 to include all halibut grounds from Unimak Pass in Area 3B to Vancouver Island in Area 2B, but excluding Shelikof Strait, Cook Inlet, and the Prince William Sound. In 1997, the survey grid design was again expanded to include the Aleutian Islands in Areas 4A and 4B and the Bering Sea. The Bering Sea grid covered halibut grounds in Areas 4A and 4C as well as the Area 4D continental shelf edge (70 – 275 fathom

range). Because the Commission had not recently surveyed western 3B and had not previously conducted setline grid surveys in eastern 3A, the Bering Sea, Aleutian Islands, or southeast Alaska, new survey stations were designed for these areas.

The base grid used in the newly added survey areas in 1996 was slightly different from that used in the Kodiak, Chirikof, and Charlotte regions. Although the new grid follows the historical pattern developed in 1963, which was intended to be 12 nmi by 3 nmi, the longitudinal transects were adjusted to maintain an approximate 12 nmi separation throughout the survey range. This was accomplished by reducing the standard 22 – 23 minutes of separation to 21 minutes west of 157° 30' W and increasing transect separation to 23 minutes east of 148° 00' W. The latitudinal transects were drawn at every 3 nmi. Stations in the new survey areas were placed on transect junctions according to the same criteria used in the other regions.

The southeast Alaska (Area 2C) survey design was similar to the grid used in the other areas but modified in order to obtain a more random distribution on the inside waters. All of the fishable waters in Area 2C along transects drawn at each minute of longitude were identified. Fishable waters were considered to be between 10 and 275 fathoms deep and had a clear 2 nmi path oriented along the longitudinal transect line. A grid was then drawn with transects at every six minutes of latitude and every 10 minutes of longitude. Points were selected along these transects based on the triangular pattern used in the other areas; however, many of the triangle points lay on land or outside fishable depths and were discarded, leaving several triangle fragments. Additional stations, not part of the grid survey (designated ES for experimental stations), were then added around orphaned stations and in areas where additional data were desired.

During the 1996 survey season, stations were moved closer together within each triangle to reduce distance traveled between stations and to provide a more reasonable work day. The two stations sharing a transect were each moved 1 nmi toward each other and the single station on the neighboring transect was moved 2 nmi toward the first two. The center station was moved 1 nmi toward the first two stations (Fig. 9). Stations that were first surveyed in 1997 were designed using the same protocols as stations in other areas before being adjusted as described above. This compacted triangle design was incorporated into all areas utilizing the standard grid pattern in 1997.

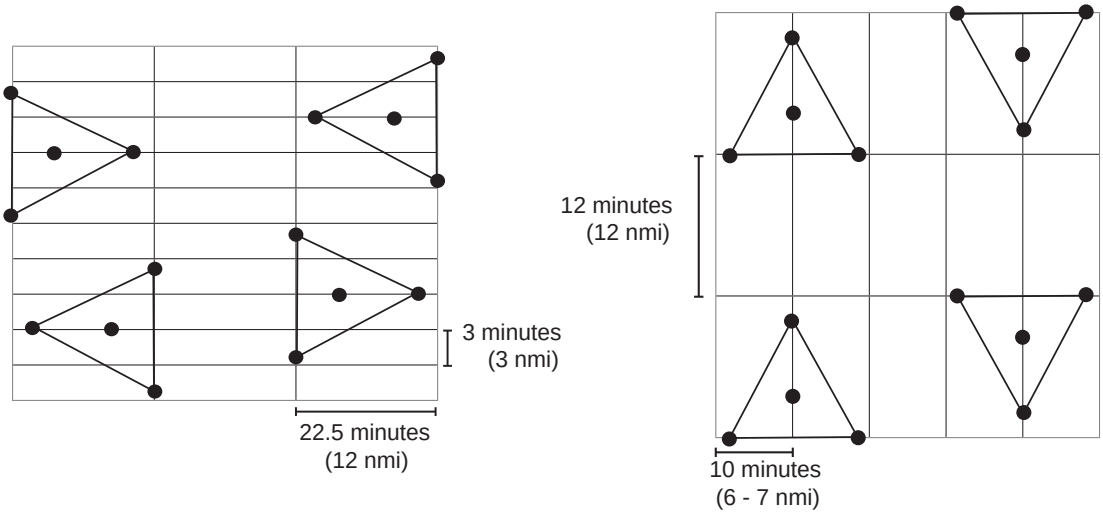


Figure 9. Grid patterns modified during the 1996 survey season and adopted in 1997 for Areas 2C, Area 3, and Area 4 (left) and for 2B (right).

1998 through 2003

Since the majority of survey operating expenses are covered by the sale of fish sacrificed in order to collect age structures, expanding the survey into areas of lower CPUE during the 1997 season reduced the ability of the survey to be cost-neutral. To offset the increased cost, the survey needed to be made more efficient. Staff projections indicated that it would be extremely difficult for survey vessels to set additional gear using the four-station triangular pattern. The staff decided to completely redesign the survey again for 1998. After analyzing several design alternatives with regard to resources, revenue, and area coverage, the IPHC decided to use a simple 10 nmi by 10 nmi distribution of stations (Fig. 10).

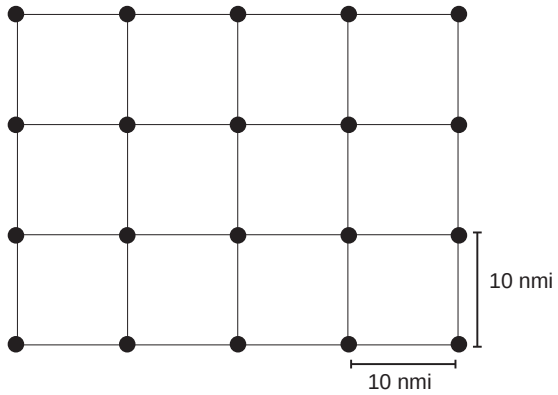


Figure 10. Grid pattern used 1998-2003.

The grid design provides superior scientific results as well as operational flexibility. The 10 nmi by 10 nmi design results in a denser station pattern in most areas and a better station distribution in areas where halibut habitat is widely dispersed, such as the Aleutian Islands. A standardized design throughout the range of Pacific halibut from California to the Bering Sea benefits data analysis. By abandoning the four-station groups, survey vessels can fish one to four stations per day, allowing adjustments for vessel speed, weather, heavy fishing, and other variables. The new design enables vessels to fish more gear in a reasonable workday (0500 to 2200 hours) than previous designs, thereby improving the efficiency of the work.

The first step in designing the new survey was to generate station coordinates at right angles to each other, with 10 nmi north and south separation and 10 nmi east and west separation. Because lines of longitude converge toward the poles and the distribution was based upon a consistent distance between stations, the longitudinal transects are slightly tapered. To maintain consistent spacing, the station coordinates were generated in four separate sections along the continental shelf; however, it was necessary to add and delete some stations at the junction of these sections. Detailed nautical charts were then used to plot each station to ensure that they were fishable and lay within the survey range, which was defined as 42 degrees North to 60 degrees North extending from 20 fathoms to 275 fathoms at the station center. Excluded were the Puget Sound and Strait of Juan De Fuca, the inside waters of Vancouver Island, and Bering Sea waters less than 76 fathoms. Some stations, which fell in major shipping channels or in areas of extreme currents, were later excluded. Additional stations, not part of the grid survey (designated ES for experimental stations), were added in southeast Alaska around orphaned stations to maintain efficiency.

As part of the new design, the survey range was expanded into areas not previously surveyed: Shelikof Strait, Cook Inlet, and Prince William Sound. This survey design pattern has not changed as of the publication of this document.

1963 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Eclipse*	3A	Seward Gully to south of Kodiak Island	May 1 – August 13	1-6	1-259

Fishing effort	2,611 skates
Legal-sized halibut	4,624 fish 205,015 lbs
Sublegal-sized halibut	1,323 fish

The halibut schooner *Eclipse* conducted the first stage of a three-year tagging program from setline vessels on a predetermined grid, or network of stations similar to that used between Cape Cleare and the Trinity Islands during the 1961-1963 trawl survey. The *Eclipse* fished a total of 2,611 skates and caught 205,015 pounds of halibut.

The 1964 Eclipse Grid Operation instruction manual provided much of the information below. The 1963 version is not available (if there was one); however, a comparison of these instructions with the 1963 survey logbook, data forms and other records indicate that the design and operation were very similar.

Survey design

Station pattern

The original grid was designed by drawing transects at every 15 minutes of longitude and every three minutes of latitude. Stations were selected by choosing points along the longitudinal lines at every other transect junction (6 minutes of latitude apart) from approximately 20 to 250 fathoms. Stations along neighboring longitudinal transects were offset by three minutes of latitude providing a more even station distribution. Additional stations were placed at the deep end of most longitudinal transects at 125 and 250 fathoms regardless of the distance between stations. These additional stations were added to provide a denser survey of depth stratification along the shelf slope. Appendix I Figure 1 shows station placement for the 1963 standardized grid survey.

Longitudinal transects were numbered from west to east beginning with number one at the westernmost transect. Stations were assigned alphanumeric identifiers. The first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Before being incorporated into the IPHC database, these station identifiers were changed to correspond to the standardized grid design from 1979. The logbooks, raw data sheets, and instruction manuals were not updated to reflect the new station designations. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

The *Eclipse* set four sets of 10 skates each day. Setting usually began around 0200. Hauling usually began at least five hours after the first station was set. Hauling was usually completed by around 1900 hours.

Gear and bait specifications

Each skate of longline gear was 1,500 feet. There were 80 large J-hooks per skate spaced at 18-foot intervals. The number of hooks on each skate was counted at the time the gear was baited or set. Each skate was marked in some manner so that it was readily identifiable. All broken gangions and missing hooks were replaced at each baiting. If a portion of a skate was lost or condemned, a recount of the number of hooks was made prior to resetting of that skate. There does not appear to have been a specified baiting protocol for the 1963 grid survey. The data indicates that salmon (S), Pacific cod (C), shack bait (K), or a combination of these were used on each set throughout the charter. Convenience and availability probably determined the type of bait chosen. The last 11 sets list the bait code "x" for unknown bait type. Reference was made in the 1964 manual about counting the number of "reusable" baits from each skate, indicating that some bait may have been used on more than one set.

The skate length, number of hooks, and hook spacing were pre-filled on the data form and consistently recorded as exactly five lines (1,500 ft), 80 hooks, and spaced at 18 feet.

Sampling protocol

Halibut sampling

All halibut caught (sublegals, tagging candidates, discards, and retained fish) were measured to the nearest centimeter. Estimated lengths were recorded for halibut lost at the roller and within gaffing distance. Head lengths, measured to the nearest millimeter were recorded on the raw data forms, but are not present in the database. Damaged fish, unsuitable for retention and sale, were recorded as discards. Unless needed to obtain sufficient age and sex data, all viable halibut were tagged and released after being examined for running sex products. Non-viable halibut were sampled for sex and maturity by observing the gonads. Otoliths (white-side only) were collected. Commercial-sized (>64 cm) non-viable fish were dressed and iced for sale.

Data about halibut that were tagged and released were recorded on tagged fish data forms. Length, sex, and maturity information were first recorded on an otolith envelope for fish from which an otolith was collected as well as fish that were only measured, then transferred to data sheets back in the lab. These data are currently available in otolith logs and on handwritten notebook paper stored in measured-only files or with the raw data forms.

Oceanographic data

Ocean bottom temperatures using a bathythermograph and surface temperatures were recorded at each station to the nearest 0.1 degree centigrade.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

1963 Setline and trawl grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Arthur H*	Area 4	Northern 4A, 4E and Closed area in SE Bering Sea	April 30 – August 24	1-6	1-59, (Trawl sets- 1-100)

Fishing effort	389 skates
Legal-sized halibut	8,356 lbs

This tagging experiment was designed to provide information on the possible relationship between young fish in this area and the adult population in the Bering Sea or elsewhere in the eastern Pacific. The fishing vessel *Arthur H* was chartered in 1963 to conduct the first exploratory halibut fishing survey utilizing both commercial setline and otter trawl gear. This operation used both setline and trawl gear on a grid of 82 predetermined stations, located mostly on the flats in the southeastern Bering Sea where large foreign trawl fleets operated at the time.

This survey was continued in 1965 and 1966. The 1965 survey was conducted by the vessel *Tordenskjold*. The *Arthur H* was again chartered to conduct the 1966 survey of the Bering Sea. In 1966 the use of setline gear was omitted, which permitted a reduction of personnel aboard the vessel.

An additional experiment was conducted by the *Arthur H* in the winter prior to this survey between January 21 and March 19, 1963. While completing round three of the 1961-1963 trawl survey, the vessel began fishing a combination of setline and trawl gear in spots between Kodiak and Yakutat, including some plankton tows off Cape Sarichef. Due to very poor weather, few data are available for these early sets and are not addressed here.

Survey design

Station pattern

Station charts indicate that on the Bering Sea flats the grid was designed with a 15 nmi latitudinal separation. Stations were placed every 60 minutes of longitude (approximately 34 nmi) along these transects. Stations were offset 30 minutes of longitude along neighboring transects. A denser station pattern was used along the shelf edge from Unimak pass to the Pribilof Islands. A less dense pattern was used north of 58 degrees and west of 164 degrees. Appendix I Figure 2 shows station placement for the 1963 setline and trawl survey.

Fishing pattern

Typically, longline gear was set on a station early in the morning. The vessel usually set either seven or eight skates of longline gear at each trawling station during the 1963 survey. The station was then fished twice using trawl gear, once with 3 ½-inch mesh, then again with 1 ¼-inch mesh, after which the longline gear was hauled. Most stations were trawled one hour at each mesh size. Sometimes the longline gear was set in the evening and left soaking overnight. Other variations occurred depending upon weather, bottom characteristics, and gear or mechanical problems.

Gear and bait specifications

Setline gear used concurrently with trawl gear on this project in 1963 and 1965 was the type commonly used in the North American Pacific halibut fishery. In both years, a skate consisted of 1,800 feet of nylon groundline with Mustad No. 6283 J-hooks on 58-inch braided nylon gangions spaced at 18-foot intervals.

A specified baiting protocol used for this project is not evident. It appears that the vessel primarily used octopus or herring or a mixture of each. Shack bait, preferably Pacific cod, was used if the vessel ran low on either octopus or herring.

Sampling protocol

Halibut sampling

The fork length of all halibut landed was recorded. The fork length and sex for halibut sampled for otoliths was recorded on the corresponding otolith envelope. Length data were recorded on the back of the haul sheets.

Bycatch and hook occupancy

The total count, minimum and maximum lengths, and the minimum and maximum weight of incidentally caught species were recorded from trawl sets, but not from the longline catch.

Predation

Notes in the haul sheets and the vessel log indicate that halibut loss due to sea lion predation was considerable on several sets.

Oceanographic data

Air, sea surface, and bottom temperatures were recorded at each station.

1963 – 1964 Winter spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Seattle*	3B, 4A	Bering Sea shelf edge and the Trinity Islands to Unimak Pass	November 6 – December 18	1-2	1-77 (1963)
			January 6 – March 3	1-3	1-81 (1964)

Fishing effort (1963)	651 skates
Legal-sized halibut (1963)	96,764 lbs

The *Seattle* was chartered in November 1963 for a three and one-half month period to tag halibut during the winter months in the Bering Sea and south of the Alaska Peninsula. Wintertime tagging had not yet been conducted west of Kodiak Island. This experiment was designed to provide information regarding the relationship between halibut spawning in the eastern Bering Sea and those on grounds in the western Bering Sea and south of the Alaska Peninsula, particularly the Shumagin Gully. The vessel set a total of 651 skates and caught approximately 96,764 pounds

of halibut during the first phase of the operation. Total effort and pounds of halibut landed during the second phase was never calculated.

Survey design

Station pattern

This was a spot survey operation. The captain chose the exact fishing location within an area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The vessel usually set four sets per day consisting of anywhere from four to 14 skates. There was no standard set, haul, or soak time and the gear seems to have been turned over constantly throughout the day. It was not uncommon for gear to soak overnight. Some sets were logged with soak times in excess of 24 hours due to poor weather or gear problems. Sets were either berthed side to side or set end to end. Set and haul times were recorded in the survey logbook

Gear and bait specifications

The *Seattle* used conventional, fixed-hook gear. No references could be located describing a standard gear specification for this survey. At the beginning of the charter, a large supply of bait was purchased in Seattle and kept frozen in a refrigerated bait shed on board. The survey logbook mentions purchasing a small amount of octopus for one trip and another reference describes the purchase of herring, octopus, and salmon on a later trip. Half of the bait was purchased frozen, the other half was shack bait. Baiting protocol was to bait frozen herring, then shack bait, then frozen salmon, then shack bait, then frozen octopus, then shack bait, and so on.

Sampling protocol

Halibut sampling

All halibut were recorded by set number. Overall length to the nearest centimeter was recorded for all landed halibut. Head length to the nearest millimeter was recorded for tagged halibut whenever possible. Injury location and condition of tagged halibut were recorded on the data sheets. Because the survey took place during spawning season and running sex products were present, sex was recorded for most tagged halibut. Halibut not suitable for tagging were sampled for sex, maturity, and otoliths were collected. Data were not recorded for fish lost at roller, or for fish that were too damaged by predation to collect such information.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Predation

Substantial sea lion damage was experienced on many sets during the charter. The lead biologist estimated that up to 50% of the fish landed during latter portions of the survey (in the Bering Sea) were damaged beyond tagging condition. Three sea lions were captured on the gear during the last trip.

Oceanographic data

Bathythermograph casts were made during the survey. It is unknown whether surface and air temperatures were measured.

1964 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Eclipse*	3A, 3B	Shelikof Strait and from Kodiak to the Shumagin Islands	May 1 – August 20	1-6	1-312

Fishing effort	2,600 skates
Legal-sized halibut	7,223 fish
Sublegal-sized halibut	2,421 fish

The vessel *Eclipse* was chartered for 112 days in 1964 to complete the second stage of the stock assessment grid tagging program that the vessel initiated in 1963. The vessel fished a total of 2,600 skates of gear and dressed or tagged 9,275 halibut totaling 281,646 pounds. There were 7,223 legal-sized halibut and 2,421 sublegal-sized halibut caught, 369 of which were too damaged to retain for sale.

For detailed information regarding the design and sampling protocols of this charter, please refer to the 1964 *Eclipse* grid operation instruction manual.

Survey design

Station pattern

The *Eclipse* used the same grid pattern, designed in the same manner as the first stage conducted in 1963 (Fig. 3), but shifted westward. In general, the stations were located on a grid roughly 12 nmi of longitude and 3 nmi latitude. Appendix I Figure 3 shows station placement for the 1964 standardized grid survey. Stations were placed every 6 nmi along the longitudinal transects. The vessel began at the northern end of Shelikof strait and fished alternate transects to the Shumagin Islands. The vessel then picked up the remaining transects starting at the northern end of the Shelikof Strait beginning with trip 4.

Longitudinal transects were numbered from east to west beginning with number one at the easternmost transect. Stations placed every 6 nmi along the transects were assigned a letter beginning with A at the north end and continuing alphabetically southward. Individual stations were therefore referred to by their alphanumeric designation; the first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Before being incorporated into the IPHC database in 1979, these station identifiers were changed to correspond to the identifiers used in the standardized grid design in place at the time. The logbooks, raw data sheets, and instruction manuals were not updated to reflect the new station designations. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

Each day, one set of eight skates was set at each of four stations. Setting usually began between midnight and 0300. Hauling usually began between 0500 and 0900. All gear was generally aboard around 1900.

Some stations were fished multiple times. One passage in the survey logbook stated "stations 6K, 6L were fished again today in order to make a full day of fishing." There are several such repeated stations currently included in the database.

Gear and bait specifications

The database indicates the standard setline skate used during the survey was six lines long, or 1,800 feet, with 18-foot hook spacing and 100 large J-hooks per skate. Gangion length was not specified in the reference material. The number of hooks on each skate was counted at the time the gear was baited or set. This was only done once. Each skate was marked in some manner so that it was readily identifiable. All broken gangions and missing hooks were replaced at each baiting. If a portion of a skate was lost or condemned, a recount of the number of hooks was made prior to setting that skate again. Records do not indicate whether the number of hooks per skate was the number of hooks actually retrieved.

The 1964 survey manual outlines two formulas strictly prescribing how each skate in a set was to be baited. The first formula specified a protocol, which alternated herring, octopus, and shack bait throughout the set. The second formula, to be used if shack bait was lacking, alternated herring and octopus. The reason for confusion in baiting practices is that the directions in the manual do not correspond to the bait codes entered on the data forms and in the database. The survey logbook states that herring was used and that the protocols in the manual were being followed. The database, however, indicates that sets were baited with shack bait, frozen cod, a combination of the two, or unknown.

Reference was made in the 1964 manual as to counting the number of reusable baits from each skate, indicating that some bait (likely octopus) may have been used on more than one set.

Sampling protocol

Halibut sampling

The fork length of all halibut landed was measured to the nearest centimeter on a measuring cradle. Estimated lengths were recorded for halibut lost at the roller (within gaffing distance). Head length was also recorded for all tagged halibut. Damaged fish, unsuitable for retention and sale, were recorded as discards. Unless needed to obtain sufficient age and sex data, all viable halibut were tagged and released after being examined for running sex products. Non-viable halibut were sampled for sex and maturity by observing the gonads. Otoliths (white-side only) were collected. Commercial-sized (>64 cm) non-viable fish were dressed and iced for sale.

In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

Data for tagged fish were recorded on tagged fish data forms. Length, sex, and maturity information was recorded on an otolith envelope for all other halibut, including those that were only measured; length data were transferred to data sheets back in the lab.

Bycatch and hook occupancy

The survey manual instructed the biologists to maintain a stroke tally of all fish, other than halibut, that were retained for shack bait. Records were maintained in the following categories: Pacific cod, sablefish, bullhead, and others. No other observations or data were recorded regarding other species incidentally caught during the survey.

Oceanographic data

Bottom and sea surface temperatures were measured at each set.

1964 Summer spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Pacific*	4A, 4B, 4C, 4D	North Bering Sea, Pribilof Islands and the Aleutian chain	July 7 – November 21	1-4	1-3 15-157
F/V *Eclipse*	3B, 4A, 4B, 4C	Shumagin Islands, Southeast Bering Sea and Pribilof Islands	August 27 – September 21	7	313-369

Fishing effort	718 skates

The halibut vessels *Pacific* and *Eclipse* were chartered for a survey in the Bering Sea during the summer and fall of 1964. The vessels had planned to work together fishing the shelf edge west of the Pribilof Islands; however, the *Pacific* was delayed and did not make visual contact with the *Eclipse* until September 15. The primary focus of this charter was to tag halibut on the shelf edge west of the Pribilof Islands between 175 degrees west and 180 degrees. An additional objective was the tagging of halibut on grounds along the Aleutian Chain and on Bowers Bank. The *Pacific* operated in the Bering Sea for 112 days. The *Eclipse* joined the *Pacific* for 28 days (roughly 15 fishing days) beginning August 27th, after completing the second stage of the 1964 setline grid survey.

For several days during September, the *Pacific* and *Eclipse* fished stations along the Pribilof Islands. The *Pacific* fished the Pribilof portion of the survey in two sections, the first on July 19 and then July 22 through 28, and the second from September 11 to 19. The July survey was conducted at St. George Island off Tolstoi Point and Dalnoi Point in depths ranging between eight and 83 fathoms. September's survey was conducted near St. Paul Island in depths ranging from seven to 39 fathoms. A total of 301 skates were hauled by the *Pacific* in July and 335 skates were hauled in September during the Pribilof portion of the survey. The *Eclipse* spent three days in the Pribilof Islands, September 4, 15, and 16 fishing south of St. Paul Island and north of St. George Island of Dalnoi Point in depths ranging from five to 42 fathoms. A total of 82 skates of gear were hauled by the *Eclipse* during the Pribilof portion of the survey.

Survey design

Station pattern

This was a spot survey operation. The captain chose the exact fishing location within an area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

Each vessel usually set three to four sets per day each consisting of between seven and 12 skates. There was no standard set, haul, or soak time and the gear seems to have been turned over constantly throughout the day. It was not uncommon for gear to soak overnight. Some sets had soak times in excess of 24 hours due to poor weather or gear problems. Sets were either berthed side to side or set end to end. Set and haul times were recorded in the survey logbook.

Gear and bait specifications

The *Pacific* used 1,500-foot skates of gear with large J-hooks spaced every 18 feet and baited primarily with herring and octopus. The *Eclipse* used 1,800-foot skates with large J-hooks spaced every 18 feet baited with herring and Pacific cod. Because this was a tagging operation, bait size or sequence protocols were not established.

Sampling protocol

Halibut sampling

This project was primarily a tagging operation. The majority of healthy fish landed were tagged and released. The fork length to the nearest centimeter and head length to the nearest millimeter were recorded for all halibut caught. Injury and condition codes were recorded for all tagged fish. If a fish was not suitable for tagging, its otolith(s) was removed and sex and maturity were recorded.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

Air, sea surface, or bottom temperatures were not recorded during this survey.

1964 Parallel fishing survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Pacific*	4A	Misty Moon grounds	July 18 – July 20	1	4-14

Fishing effort	24.4 skates
Legal-sized halibut	15 fish; 190 lbs

Early in 1964, arrangements were made between the Fisheries Agency of Japan and the International Pacific Halibut Commission for their respective research vessels, the *Izumo Maru* and the *Pacific* to conduct parallel setline fishing operations in southeastern Bering Sea in July 1964. The dressed weight of the 15 legal-sized halibut caught on the 24.4 standard IPHC skates fished by the *Pacific* during these experiments was calculated to be 190 pounds. Such poor fishing hindered acquisition of adequate information on the relative effectiveness of the hachi (a Japanese unit of gear, which is shorter than a standard setline skate) and the skate; however, the experiments did demonstrate the feasibility of such parallel fishing surveys.

Survey design

Fishing pattern

Parallel fishing was conducted on the Misty Moon grounds in statistical area 560170 on July 18-21. It was planned that 50 hachi and 10 skates would be set *daily* by the respective vessels, the gear being set parallel and about 1.0 nmi apart. Both vessels set and hauled their gear at

approximately the same time to provide equal soak time. However, on July 19, the *Izumo Maru* set about half of its gear before the *Pacific* started its parallel set. On that day only the last five skates of the *Pacific* gear was recorded in the experiment. On the last day the *Pacific* shortened its set to eight skates.

Gear and bait specifications

Fishing gear carried by the *Pacific* included 54 skates each consisting of five 50-fathom lines (1,500 feet) of #28 nylon. Each skate had about 80 large J-hooks (Mustad No. 6283) spaced 18 feet apart and attached to the groundline by nylon gangions and nylon beckets.

Bait used by the *Pacific* during the parallel fishing experiments consisted of frozen octopus, frozen herring and species other than halibut taken during the fishing operation.

Sampling protocol

Halibut sampling

The fork length to the nearest centimeter and head length to the nearest millimeter was recorded for all halibut caught. Injury and condition codes were recorded for all halibut tagged and released. Fish not suitable for tagging were sampled for sex and maturity, and otoliths were collected.

Bycatch and hook occupancy

According to the trip report, records were kept of the species caught and all halibut and Pacific cod were measured for all experimental skates fished by the *Pacific*.

Oceanographic data

Air, sea surface, or bottom temperatures were not recorded during this survey.

1965 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	3B, 4A	Shumagin Islands to Umnak Island	May 26 – August 10	1-4	1-188
F/V *Christian S*	2B	Southern Hecate Strait	May 17 – July 29	1-4	1-142

Fishing effort	330 sets
Legal-sized halibut	3,971 fish
Sublegal-sized halibut	1,072 fish

The *Chelsea* was chartered for 77 days to complete the third phase of the standardized grid, tagging program, which began with the *Eclipse* in 1963. The 1965 Area 3B survey included grounds from the Shumagin Islands and westward to Cape Sagak on Unmak Island. The *Chelsea* completed a total of 185 stations in four trips. There were 2,517 legal-sized halibut and 550 sublegal-sized halibut caught. A second vessel, the *Christian S,* was chartered for 74 days initiating a standardized grid tagging program in Area 2B similar to that carried out west of

Cape Spencer. The original intent was to conduct operations at 152 stations between the northern end of Vancouver Island and the middle of Hecate Strait; however, some of the stations were not fished. This charter was initiated to provide more precise data concerning the distribution, population size, age composition and mortality rates of the halibut in Area 2B, as well as to evaluate possible effects of the United States and Canadian trawl fisheries upon the Canadian halibut population. There were 1,454 legal-sized halibut and 522 sublegal-sized halibut caught.

The 1965 *Chelsea* and *Christian S* operation instruction manuals, available in the IPHC archives, contain detailed descriptions of experiment design and sampling protocols.

Survey design

Station pattern

A total of 233 stations were designated in Area 3 on 27 transects running in a north-south direction. In Area 2B, 141 stations were plotted on 14 transects running in a east-west direction. A distance of about 11 nmi separated the transects and stations were placed 6 nmi apart on the transect lines (Fig. 3). At the outside end of each transect, additional stations were located at depths of 125 fathoms and 250 fathoms regardless of the distance between stations. Alternate transects were designated as red lines and blue lines. Red stations were to be fished first, working from east to west. Then the blue stations were fished in a similar manner. If depth, current, or other conditions precluded fishing a station, it was omitted. Some stations at the ends of transects may have been so close together that up to three stations could be fished with one set; the middle station designation was used for these sets. Appendix I Figure 4 shows station placement for the 1965 standardized grid survey.

Each of the longitudinal transects in Area 3 were numbered from east to west beginning with number 17 at the easternmost transect. This represented an overlap with the *Eclipse* 1964 grid that ended on transect number 19. The latitudinal transects in Area 2B were numbered from south to north beginning with number one at the southernmost transect. Individual stations, placed every 6 nmi along each transect, were assigned a letter beginning with A at the northern end in Area 3 and at the eastern end in Area 2B and continued alphabetically. Individual stations were therefore referred to by their alphanumeric designation; the first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Before being incorporated into the IPHC database, these station identifiers were changed to correspond to the standardized grid design in place at the time. The logbooks, raw data sheets, and instruction manuals were not updated to reflect the new station designations. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

The plan was to fish nine skates on each station allowing the gear to soak for a minimum of six hours. Night sets may have been used to increase the soak time on the first set hauled each day. Data indicates the *Chelsea* normally set nine skates at four stations each day and the *Christian S* normally set eight skates at four stations each day. Many stations set later in the day by the *Chelsea* were not hauled until the following morning. Extra sets may have been set on some stations to make a full day of work.

Gear and bait specifications

The *Chelsea* fished 1,500-foot skates with large J-hooks spaced at 18-foot intervals. The *Christian S* used 1,500-foot skates with large J-hooks spaced at 17-foot intervals. Both vessels averaged around 90 hooks per skate.

It's not clear what the baiting protocol was during *Chelsea*'s survey. The database indicates only cod and herring were used on every set (presumably on alternating hooks). The 1965 instruction manual describes a bait experiment during the *Chelsea* grid tagging survey. This experiment investigated variation in hook spacing from 13 to 18 feet and used both large and extra large hooks. Bait during the experiment included herring, octopus and shack bait. There is no indication that this experiment was ever actually attempted.

Bait used aboard the *Christian S* was well documented in the biologist's log. The majority of bait used on each skate throughout the charter was frozen herring. Reference was made to baiting three herring for each shack bait, or using mostly shack bait with some herring. Shack bait consisted of fresh octopus, sablefish, and turbot.

Sampling protocol

Halibut sampling

The fork length of all halibut caught was recorded. Halibut captured in viable condition were tagged and released after length, injury, and condition codes were recorded. Non-viable, legal-sized halibut were sampled for sex and maturity and otoliths were collected. Non-viable sublegal-sized halibut were sampled for sex and stomach contents.

In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Predation

If predators appeared to have reduced the catch of halibut on the stations by 10% or more, a code was recorded identifying suspected predator. Predators included sand fleas, sharks, sea lions, crabs, and starfish.

Oceanographic data

Bathythermograph casts as well as sea surface and air temperature readings were to be made at each station when possible, even if the station was considered not fishable. The data indicates that temperatures were only taken sporadically.

Supplemental projects

Tumor collection

Biologists aboard the *Chelsea* were instructed to collect samples of any tumors encountered on the gill covers and gill arches of Pacific cod and other species including halibut. This request was made following a large number of observed tumors during a 1959 Bering Sea tagging survey. Reference was made in the *Christian S* logbook of collecting pH samples for analysis back in the lab. The purpose and disposition of these samples is unknown.

1965 Bering Sea spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	4C, 4D, 4E	Nunivak, St. Matthew, and Pribilof Islands	August 11 – September 2	5	189-246

Fishing effort	58 sets

The *Chelsea* abandoned the completion of the standardized grid survey to address an urgent need for information on the interrelationships between the halibut found in the summer on the northeastern Bering Sea "flats" with those concentrated on the shelf edge grounds in the spring. *Chelsea* fished one trip (23 days) on grounds near Nunivak Is., St. Matthew Is., and the Pribilof Islands in the Bering Sea.

Survey design

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The Pribilof portion of the survey was conducted from August 26th to the 29th. The *Chelsea* fished on both the north and south sides of St. Paul Island along the beach in 9 to 14 fathoms, and the north side of St. George Island in depths ranging from 20 to 34 fathoms.

Fishing pattern

The *Chelsea* usually set three to five sets per day of 9 to 12 skates each. The vessel usually set all gear early in the morning and finished hauling the last set before midnight. Gear set later in the day was often not hauled until the following day.

Gear and bait specifications

The *Chelsea* fished conventional fixed-hook setline gear. Each skate consisted of 1,500 feet of groundline with large J-hooks spaced at 18-foot intervals. Each skate averaged around 90 hooks. Bait used during this survey was primarily Pacific cod and herring.

Sampling protocol

Halibut sampling

The fork lengths of all halibut caught were recorded. Halibut captured in viable condition were tagged and released after length, injury, and condition codes were recorded. Biologists collected otoliths from non-viable legal-sized halibut and sampled them for sex and maturity. Non-viable, sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1965 Combined setline trawl grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Tordenskjold*	4E and 4E-Closed area	Southeastern Bering Sea flats	May 28 – September 8	1-5	1-41 Longline sets

Fishing effort	364 skates 102 paired tows
Legal-sized halibut	3,569 lbs

The *Tordenskjold* was chartered to continue the combined setline trawl surveys in the southeastern Bering Sea initiated by the *Arthur H* in 1963. During this survey, both trawl and longline gear were fished on a predetermined grid located on the large expanse of flats on southeastern Bering Sea. The *Tordenskjold* completed five trips from May 28th to September 8th. The primary objective was to ascertain the stock size and age composition of the large population of one- to four-year-old halibut that inhabit this region. All viable halibut were tagged to provide information on the relationship between these young halibut and the adult populations in other areas of the Bering Sea, the Gulf of Alaska, and Area 2. The *Tordenskjold* fished 102 stations with trawl gear and 41 with setline gear. A total of 364 skates of setline gear were fished producing a total catch of 3,569 pounds.

For detailed information regarding the design and sampling protocols of this charter, please refer to the 1965 *Tordenskjold* operation instruction manual, available in the IPHC archives.

Survey design

Station pattern

One-hundred-four stations were laid out on 12 transects running in a NW-SE direction. The transects were placed 29 nmi apart with stations located every 17 nmi along each transect. Stations were offset by 30 minutes of longitude along neighboring transects.

Fishing pattern

Survey operations called for a 1-hour tow with a 3-1/2 inch mesh net and a 15-minute tow with a 1-1/4 inch net at each station. Eight skates of setline gear, averaging 100 hooks per skate, were set at every other trawl station and were allowed to soak for a minimum of six hours. This plan was followed as weather and bottom terrain permitted. Because of looming time constraints, some setline sets were omitted during the latter part of August to allow greater coverage of the area with trawl gear within the charter period and, therefore, more than twice as many trawl stations were fished than setline stations. Some stations could not be occupied because of interference with Japanese king crab harvesters in the region. Setline gear was usually set in the morning and hauled before midnight. Occasionally setline gear was set the night before resulting in soak times approaching 24 hours.

Gear and bait specifications

Setline gear used on this project was the type commonly used in the North American Pacific halibut fishery. A skate consisted of 1800 feet of nylon groundline with Mustad No. 6283 J-hooks on 58-inch braided nylon gangions spaced at 18-foot intervals. In 1965, eight skates were fished at every other trawl station, except toward the end of the trip when several longline sets were omitted due to time constraints.

Sampling protocol

Halibut sampling

The fork length was recorded for all halibut caught. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Biologists samples non-viable legal-sized halibut for sex and maturity and collected otoliths. Non-viable, sublegal-sized halibut were sampled for sex and stomach contents. In the event that an exceptionally high percentage of halibut fit for tagging was encountered, some were sacrificed to obtain an adequate composition sample from the area. In general, an average of at least five otoliths were to have been taken at each station.

Bycatch and hook occupancy

Aside from the supplemental project listed below, there were no observations recorded regarding the catch of species other than halibut.

Oceanographic data

Bathythermograph casts were to be made at each station when possible, even if the station was considered unfishable.

Supplemental projects

Tumor collection

Biologists aboard the *Tordenskjold* were instructed to collect samples of any tumors encountered on the gill covers and gill arches of Pacific cod and other species including halibut. This request was made following a large number of observed tumors during a 1959 Bering Sea tagging survey.

Meristics

Meristic character counts were obtained from approximately 178 Pacific halibut during the survey, which were frozen round and sent to Seattle for examination. In addition to the usual length and sex data, biologists obtained anal and dorsal fin ray counts and vertebral counts. It was perceived during the mid-1960s that halibut migration from one area to another could affect the final meristic results if older aged individuals were predominantly used in the analysis. Therefore, to minimize any such distortion of results, the halibut collections for meristic studies in 1965 were concentrated on the youngest individuals.

Outside agency collaboration

A number of bycatch species were retained in drums in a formalin solution following a request from Dr. N.J. Wilimovsky of the Institute of Fisheries at the University of British Columbia. A list of species requested and retained is available in the 1965 *Tordenskjold* instruction manual.

1966 Setline and trawl comparison survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	Goose Island grounds and Queen Charlotte Sound	June 2 – 20	1	1-62

Fishing effort	62 sets

The *Chelsea* began the 1966 charter on the Goose Island grounds in Queen Charlotte Sound where fishing was conducted in conjunction with the chartered trawler *Don Edwards*. The purpose of the joint operation was to compare the size composition and the relative viability of halibut taken by setline and trawl gear. Sixty-two sets were fished during this charter, which was conducted between June 2 and June 20.

Survey design

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Chelsea* fished with conventional halibut setline gear while the *Don Edwards*, an otter trawler, used a trawl net with a 3.5-inch mesh codend. Comparability was obtained by having the trawler tow its net between and around the sets of longline gear. Longline gear was usually set between 0500 and 0900. The first set was hauled after the last set was in the water resulting in a minimum soak of about four hours. The vessel usually set eight skates per set, but the number often varied between 8 and 11 skates per set. Set length varied in relation to bottom characteristics, which was surveyed for trawl suitability prior to setting the gear.

Gear and bait specifications

The grid survey skates were standardized at 1,500-foot with large J-hooks spaced at 18-foot intervals providing approximately 90 hooks per skate. Hooks may have been baited with frozen salmon tails at the beginning of the charter, but the majority of bait used was fresh shack bait (primarily Pacific cod) obtained from the *Don Edwards* trawl catch.

Sampling protocol

Halibut sampling

The fork lengths of all halibut caught were recorded. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable, legal-sized halibut were sampled for sex, and otoliths were collected. Non-viable sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1966 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	Northern Hecate Strait and Dixon Entrance	June 22 - July 26	2-4	63-159

Fishing effort	75 sets
Legal-sized halibut	490 fish
Sublegal-sized halibut	255 fish
Tagged Halibut	547 fish

The *Chelsea* fished trips two, three, and the first part of trip four as a continuation of the Hecate Strait grid-tagging program initiated in 1965. During this phase, 85 stations were fished in northern Hecate Strait and Dixon Entrance. This charter was conducted because it was believed that grid-based tagging experiments would provide mortality rates more representative of the total population than those obtained with the customary spot tagging surveys. A total of 547 halibut were tagged during this portion of the survey. There were 490 legal-sized halibut and 255 sublegal-sized halibut caught.

For detailed information regarding the design and sampling protocols of this charter, please refer to the 1966 *Chelsea* operation instruction manual.

Survey design

Station pattern

A total of 233 stations were laid out on 27 transects running in a north-south direction. A distance of about 11 miles separated transects. Stations were placed every 6 nmi along each transect (Fig. 3). At the outside end of each transect, additional stations were located at depths of 125 fathoms and 250 fathoms regardless of the distance between stations. Alternate transects were designated as red lines and blue lines. Red stations were fished first, working from east to west. Then the blue stations were fished in a similar manner. Stations determined to be unfishable were omitted. Some stations at the ends of transects were so close together that up to three stations were fished with one set, in which case, the middle station designation was used for the set. Appendix I Figure 5 shows station placement for the 1966 standardized grid survey.

Each latitudinal transect in Area 2B was numbered from south to north beginning with number 12 at the southernmost transect. This represented an overlap with the *Christian S* 1965 grid that ended on transect number 14. Individual stations placed every 6 nmi along each transect were assigned a letter beginning with “A” at the eastern end and continuing alphabetically. Individual stations were therefore referred to by their alphanumeric designation; the first one or

two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Before being incorporated into the IPHC database in 1979, these station identifiers were changed to correspond to the standardized grid design in place at the time. The logbooks, raw data sheets, and instruction manuals were not updated to reflect the new station designations. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

The plan was to fish eight skates on each station allowing the gear to soak for a minimum of six hours. Night sets may have been used to increase the soak time on the first set hauled each day. Extra sets may have been set on some stations to utilize a full day.

Stations on the grid were fished on set numbers 63-95, 100-124, 126, 132, 134-142, and 144-159. The vessel prospected fishing spots (spot survey) on sets 96-99, 125, 128-131, 133, and 143.

Gear and bait specifications

The grid survey skates were standardized at 1,500-foot with large J-hooks spaced at 18-foot intervals providing approximately 90 hooks per skate. The baiting protocol during this survey was unclear. The database indicates only cod and herring used on every set.

Sampling protocol

Halibut sampling

The fork lengths of all halibut caught were recorded. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable legal-sized halibut were sampled for sex, subjected to otolith removal, and iced for sale. Non-viable sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

Bathythermograph casts as well as sea surface and air temperature readings were to be made at each station when possible, even if the station was considered not fishable. The data indicates temperatures were recorded at each station during trip two and sporadically thereafter.

Predation

If predators appeared to have reduced the catch of halibut on the stations by 10% or more, a code identifying the suspected predator was recorded. Predators included sand fleas, sharks, sea lions, crabs, and starfish.

Supplemental projects

Tumor collection

Biologists aboard the *Chelsea* were instructed to collect samples of any tumors encountered on the gill covers and gill arches of Pacific cod and other species including halibut. This request was made following a large number of observed tumors during a 1959 Bering Sea tagging survey.

1966 Spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	Hecate Strait	July 26 to August 7	4	160-221

Fishing effort	62 sets

The *Chelsea* completed 62 sets on trips four and five between July 26 and August 7. This phase of the operation was a spot survey conducted on commercial grounds within the grid-tagging area, rather than on the predetermined stations. The purpose of this experiment was to determine if these two methods of tagging (only spaghetti tags on fish smaller than 64 cm, only Monel® strap tags on fish larger than 80 cm, and both types on fish between 64 cm and 80 cm) would provide information on the relative effectiveness of grid and spot tagging.

Survey design

Fishing pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The vessel set four to six sets per day consisting of five to nine skates per set. There was no specified set or haul times and the gear was turned over constantly day and night.

Gear and bait specifications

No information is available on the specific gear configuration used by the *Chelsea* during this survey, though it is reasonable to assume the vessel may have utilized the same gear later fished during the standardized grid survey. The grid survey skates were standardized at 1,500-foot with large J-hooks spaced at 18-foot intervals providing approximately 90 hooks per skate. Bait was a mix of frozen herring, fresh and frozen octopus, and fresh and frozen shack bait.

Sampling protocol

Halibut sampling

The fork length was recorded for all halibut caught. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Biologists collected otoliths from non-viable legal-sized halibut and sampled them for sex and maturity. Non-viable sublegal-sized halibut were sampled for sex and stomach contents. When high numbers of halibut fit for tagging were captured, some were sacrificed to obtain an adequate composition sample from the area. In general, the goal was to collect at least five otoliths at each station.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1966 Comparison of Japanese and American gear spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	Hecate Strait and Goose Island Grounds	August 14 – 29	5	222-289

Fishing effort	67 sets

Incidental to the Commission's tagging operations on the chartered vessel *Chelsea*, test fishing was conducted to compare the selectivity and effectiveness of Japanese hooks and gangions versus North American hooks and gangions. The experiment was conducted on the eastern side of Moresby and Kunghit Islands in Hecate Strait, as well as one day fishing on the Goose Island grounds.

Survey design

Fishing pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Gear and bait specifications

Four skates of the *Chelsea* gear were modified by replacing every other hook and gangion with their Japanese gear counterparts, which had been removed from Japanese groundline. The Japanese groundline could not be hauled on gurdies used on North American vessels due to differences in the lay of the rope. A minimum of two and a maximum of five skates were fished each day.

The setline gear fished by the *Chelsea* consisted of 275-fathom (1,650-foot) skates each made up of #32 nylon groundline with about 90 hooks (Mustad No. 6283) attached to the groundline by nylon gangions and nylon beckets at intervals of 18 feet. The Japanese gear was from parallel fishing experiments with the *Pacific* and the research vessel *Izumo Maru* in July of 1964 . Japanese gear consisted of flattened hooks, weighing 4.3 grams and overall length and width of 79 mm and 25 mm respectively. The Japanese gangions were about 1.8 mm in diameter and were made of the synthetic fiber Cremona, a polyvinyl alcohol derivative. Records of bait protocols are not available.

Sampling protocol

Halibut sampling

The fork length was recorded for all halibut caught. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable legal-sized halibut were sampled for sex, subjected to otolith removal, and iced for sale. Non-viable, sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

All halibut that were under 80 cm and alive were tagged and released regardless of the extent of the injury. Dead fish were not tagged.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1966 West Coast spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2A	Northern California, Oregon, and Washington	September 3 – 18	6	290-337

Fishing effort	260 skates
Legal-sized halibut	253 fish 7,263 lbs
Tagged halibut	166

The final trip of the *Chelsea* in 1966 was devoted to tagging of setline-caught halibut off northern California, Oregon, and Washington to provide information on the distribution, stock size, age composition, and mortality rates of the halibut in this area. A total of 7,263 pounds of halibut were caught on 260 skates; of the 253 halibut caught, 166 were tagged and 87 were sampled for otoliths.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Chelsea* fished 11 different locations ranging from Willapa Bay, Washington to Cape Mendocino, California. The *Chelsea* fished 22 skates at eight locations and 28 skates at three locations. Setting usually began around 0630, while hauling generally began around 0930 allowing a minimum soak time of three hours.

Gear and bait specifications

No information is available on the specific gear configuration used by the *Chelsea* during this survey, though it is reasonable to assume the vessel utilized the same gear fished during the standardized grid survey. The grid survey skates were standardized at 1,500-foot with large J-hooks spaced at 18-foot intervals providing approximately 90 hooks per skate. The type of bait used during this survey is unknown.

Sampling protocol

Halibut sampling

The fork length was recorded for all halibut caught. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable legal-sized halibut were sampled for sex, subjected to otolith removal, and iced for sale. Non-viable sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

All halibut that were under 80 cm and still alive were tagged and released regardless of the extent of injury. Dead fish were not tagged.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1967 Bering Sea and Aleutian Islands spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	4B, 4C, 4D, 4E	Western Bering Sea, Pribilof Islands, Aleutian Islands, Russian waters off Cape Navarin	June 2 – September 8	1-4	1-214

Fishing effort	1,859 skates
Legal-sized halibut	12,283 fish
Tagged halibut	6,107

The setline vessel *Chelsea* completed four trips between June 2 and September 8. On the first trip, the *Chelsea* fished the shelf-edge grounds in Russian waters of the western Bering Sea off Cape Navarin and to the Pribilof Islands. The second was to Bowers Bank and the Aleutian Chain. The third and fourth trips were to the northeastern Bering Sea offshore flats. All cruises resulted in catches and tag releases greater than expected.

Over the course of the survey, 1,859 standardized skates were fished. A total of 12,283 halibut were captured; 6,107 of these were tagged and 6,176 were sub-sampled for sex and age composition.

Survey design

Station pattern

This survey was a spot fishing operation. Survey operations were divided into 10 experiments on the basis of fishing location and time period. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded for each set along with the average depth.

Fishing pattern

The Pribilof Islands portion of the survey was conducted from June 26 to June 30. The south side of St. George Island was fished near Cascade Point in the nine- to 17-fathom depth range for one day. The remaining four days were spent near Halfway Point at St. Paul Island in depths ranging between seven and 20 fathoms. A total of 241 skates were hauled during the Pribilof portion of the survey.

Gear and bait specifications

The official trip report from the *Chelsea* stated that the gear used throughout the charter consisted of skates of about 1,500 feet of 32-pound nylon groundline with about 90 hooks (Mustad No. 6283) attached to the groundline by nylon gangions and nylon beckets at 18-foot intervals. Herring, octopus, grey cod, and salmon were used as bait.

Technical Report No. 34 states that the *Chelsea* used 1,500-foot gear with 18-foot spacing while fishing the Pribilof portion of the survey, and that the vessel used Pacific herring, salmon tails, and octopus as bait.

Sampling protocol

Halibut sampling

Immediately after being landed on deck, each halibut was examined for hook injuries and, if in viable condition, was measured to the nearest centimeter, tagged, and released. The sex was determined and the left otolith was collected from a sub-sample of fish unsuitable for tagging.

Bycatch and hook occupancy

No observations or data were recorded regarding the status of hooks as they came out of the water or the catch of other species aside from the supplemental project listed below.

Oceanographic data

Thirty-five bathythermograph casts were made, generally on the basis of one on each day of fishing. Sea surface temperatures were taken in conjunction with each bathythermograph cast for reference purposes.

Supplemental projects

Other species

While fishing near Cape Navarin during the first cruise, 60 specimens of incidentally caught Greenland turbot (*Reinhardtius hipposlossoides*) and 67 specimens of arrowtooth flounder (*Atheresthes stomias*) were retained for study of morphometric and meristic characters. In addition, a sodium content analysis was made on flesh samples from six *Reinhardtius* and six *Atheresthes*.

Halibut weights

The report from this charter stated that weights were obtained from a stratified sample of 436 halibut as part of a study investigating age-weight relationships in the Bering Sea that indicates a progressive decrease in the average weight at each age from the southeast to the northwest grounds and suggesting little intermingling along the edge.

1971 Hook-Spacing spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	3A	Portlock Bank and Seward Gully	July 8 to August 18	1-3	1-155

Fishing effort	1560 skates
Legal-sized halibut	~100,000 lbs

The *Chelsea* was chartered in 1971 to conduct an experiment to determine the relative effectiveness of various gear spacings. The vessel carried ten 1500' skates of each of four types of hook spacing: 12, 18, 21, and 24 feet between gangions. Fishing was conducted near Kodiak Island similar to regular commercial operations and all skates were baited similarly with herring and cod. Approximately 100,000 pounds of halibut were caught in 32 days from July 8th to August 18th.

Prior to this charter, a preliminary gear study using observers aboard the *Chelsea* was conducted from April 30th to May 27th, 1971.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The grounds chosen for this survey were in Area 3A on the Portlock banks and the Seward gully.

Fishing pattern

Fishing was conducted as a regular commercial operation (i.e., no tagging). Gear with varying hook spacing was set on a rotating schedule, i.e., 12-, 18-, 21-, and 24-foot spacing on the first day, 18-, 21-, 24-, and 12-foot spacing on the next day and so forth. Five sets were made each day. Skates of each hook spacing were set in separate sets parallel to sets of other hook spacing. A set of mixed gear spacing, mostly half 12-foot and half 24-foot was usually set as the last set. Gear was usually set between about 0330 and 0600 each morning with the number of skates per set varying from 7 to 14. The gear was allowed to soak for a minimum of five hours and was usually hauled in the reverse order of setting. Hauling began around 0830 and the last skate was usually aboard by late in the evening. The time each set was set and hauled was recorded.

Gear and bait specifications

Skates used for the experiment were all 1,500 long with large J-hooks spaced consistently at intervals of 12, 18, 21, or 24 feet intervals. Each set consisted of seven to 14 skates of one type of hook spacing, except for the last set set each day composed of mixed skates with different hook

spacing. The number of hooks was counted on each skate during the first trip, but the distance between hooks was never verified.

All skates were baited uniformly at each location. Bait usually consisted of frozen herring and cod, or herring and shack bait. Due to a shortage of shack bait, gear was often baited two herring to one shack bait. Shack bait was usually fresh Pacific cod.

Sampling protocol

Halibut sampling

This is one of the first setline charters in which no halibut were tagged. The fork length of each halibut caught was measured to the nearest centimeter and recorded along with the corresponding skate number. Most halibut were dressed and iced for sale and an unknown number of otoliths were collected.

Bycatch and hook occupancy

Hook-by-hook observations were made during the first trip. Hooks status was recorded either as empty, baited, halibut on the hook, or other fish on the hook.

Oceanographic data

No oceanographic data were collected on this cruise.

Supplemental projects

Environmental contaminants

Biologists took flesh samples from a stratified subsample of halibut for mercury analysis by NMFS. At the beginning of the charter, biologists cut a ½- to 1-pound wedge of flesh from behind the head of each fish; a liver sample was also collected from these fish. Later in the survey, flesh samples were taken and paired with otoliths instead of liver samples. On trip 3, flesh samples were collected and paired with length and sex information.

1972 Hook-Spacing spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Alaska Queen II*	2A	Oregon and Washington coast	October 2 – 15	1	1-60
F/V *Cape Beale*	2B	Masset and Ramsay Island grounds	August 14 – September 7	1-2	1-83
F/V *Republic*	4A, 3B	Bering Sea and Shumagin Gully	March 9 – May 4	1-3	1-80
F/V *Seapak*	2B	Goose Island and Bonilla Island grounds	June 8 – July 2	1-2	1-105

Fishing effort	328 sets

Four vessels were chartered by the Commission in 1972 as a continuation of the 1971 hook spacing experiment conducted by the *Chelsea*. The primary objective was to study the relationship between catch per unit effort (CPUE) and the spacing of hooks on longline gear. A secondary objective on most vessels was to tag and take data on the halibut catch and survey halibut stocks. Tagging was not well suited to the hook-spacing study and was lower priority.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Alaska Queen II* fished 341 skates of 18-, 36- and 42-foot gear off the Washington and Oregon coasts with the primary objective of completing a hook spacing experiment while tagging halibut. Fishing was conducted similar to a commercial operation (i.e., no tagging). Gear with varying hook spacing was set on a rotating schedule, i.e. 18-, 36- and 42-foot gear on the first day, 36-, 42-, and 18-foot gear on the next day and so forth. Six sets were made each day consisting of two sets of each gear spacing treatment. The plan was to set six skates per set, but occasionally only five were set. Unlike the other vessels, the *Alaska Queen II* did not berth the sets, but instead deployed the gear end to end or spaced to provide a wider survey of the area. The gear was set around 0700 and hauling began after 1000, providing a minimum soak time of three hours.

The *Republic* fished 380 skates of gear with gangions spaced at 12, 21, and 42 feet in the Bering Sea and Shumagin Gully. Three sets, one of each spacing treatment, were set and hauled in rotating order each day. Between one and three additional sets of gear with 21-foot spacing were also made to aid in surveying the grounds. Some of the 21-foot gear was actually spaced at 18 feet with every third or fourth hook removed. In the Bering Sea and the first days of work in the Shumagin Gully, the three comparable sets were not set parallel because the vessel was attempting to achieve the secondary charter objective of surveying the grounds. The standard was nine skates per set but varied occasionally from 8 to 10. Most gear was set between 0500 and 1000 and hauled before midnight, though sets hauled the next day were not uncommon.

The *Seapak* performed the first part of the hook-spacing experiment in northern British Columbia between June 8 and July 2. The *Cape Beale* continued this experiment from August 14 to September 7. Both of these vessels fished gear with gangions spaced at 9, 13, and 18 feet. The stated objective in the survey manual was to conduct hook spacing studies in Area 2. Most fish were measured and released, no representative age data were obtained. Some fish were sacrificed for ovary examination. Both vessels recorded the latitude and longitude at each day's location and the minimum and maximum depths for each set. The vessels usually set six sets per day of five skates each. Sets of alternate hook spacing were set parallel and berthed at approximately 1 nmi. Setting began at around 0500 and all gear was usually aboard before midnight.

Gear and bait specifications

Although information could not be located regarding the specific length of groundline used for any of the charters during this project, it is probable that the length of groundline varied for each different hook spacing because much of the gear was acquired from different sources. Though a variety of bait was utilized on each vessel, all sets were baited similarly each day.

The *Alaska Queen II* used skates with large J-hooks spaced at 18-, 36-, and 42-foot intervals, though the 42-foot gear actually ranged from 42 to 52 feet. Pacific cod and herring were the

primary bait although some incidentally-caught sablefish was also used.

The *Republic* used skates with large J-hooks spaced at 12-, 21-, and 42-foot intervals and used salmon tails, octopus, Pacific cod, and herring as bait throughout the charter. At the beginning of the charter, the *Republic*'s 12-foot gear had smaller hooks than the 21-, and 42-foot gear. This was gradually changed throughout the charter.

The *Seapak* and *Cape Beale,* on their respective charters in Area 2B, used the same gear: skates with large J-hooks spaced at 9-, 13-, and 18-foot intervals. The *Seapak* used fresh and frozen herring, frozen cod, and frozen chum salmon as bait while the *Cape Beale* used only frozen herring and Pacific cod.

Sampling protocol

Halibut sampling

Some halibut brought aboard the *Republic* and *Seapak* were sacrificed for sex determination and otolith collection. All vessels except the *Seapak* also sacrificed a number of halibut for ovary collections.

Bycatch and hook occupancy

Biologists aboard the *Alaska Queen II* and *Republic* monitored each hook as it came out of the water and recorded the status as either empty, baited, halibut, or other fish. It is not known whether this was done on the *Seapak* and *Cape Beale*.

Predation

The *Republic* reported heavy sea lion predation throughout the charter, with the lead biologist reporting herds of 20 or more animals feeding off the gear.

Oceanographic data

No oceanographic data were collected on this cruise.

Supplemental projects

Fecundity study

Ovary samples for fecundity analyses were taken from all vessels except the *Republic*. Samples were to be taken from about five fish in each 10 cm size class. These fish were then marked and weighed during the offload. Otoliths were taken from each fish selected for ovary samples.

Environmental contaminants

Biologists aboard the *Republic* and *Seapak* took a number of flesh samples from halibut over 80 pounds for mercury analysis by NMFS and Canadian authorities.

1973 Hook spacing spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V Republic	2B	Queen Charlotte Sound	March 26 – April 30	1-2	1-72

Fishing effort	72 sets

A hook spacing study was performed aboard the *Republic* in 1973 following similar experiments in 1971 and 1972. This was the last in a series of charter and observer trips intended to compare the CPUE on separate sets using various hook spacing. Secondary purposes of this charter were to tag halibut when possible, survey the halibut grounds, and perform a number of supplemental projects.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Republic* set alternating sets of 12-, 21-, 36-, and 42-foot gear berthed at approximately 1-nmi intervals. Each set consisted of six to 10 skates and was set and hauled in a rotating order each day. The vessel began fishing four sets of 10 skates per day but soon realized this was too much for a day's work and settled for four sets of eight skates per day. On a few occasions, the vessel only set six skates per set. Most gear was set between 0500 and 1000 and hauled before midnight. The gear soaked a minimum of five hours before hauling began.

Gear and bait specifications

The length of groundline skates used by the *Republic* seems to have been a mix of 1,500-foot and 1,800-foot gear. Each skate had large J-hooks spaced at 12-, 21-, 36-, or 42-foot intervals.

The vessel used fresh or frozen sablefish, frozen herring and salmon tails as bait. Each skate was baited with the pattern herring-salmon-herring-sablefish and this pattern was maintained throughout the charter. Fresh sablefish was used if the vessel caught enough of it in the previous day to bait for the whole day's fishing. Otherwise, they used frozen sablefish.

Sampling protocol

Halibut sampling

The fork length of all halibut caught was measured to the nearest centimeter and an estimated length was recorded for halibut lost at the roller. Each halibut length was recorded with its corresponding set number. Most halibut were released immediately after lengths were taken. Some halibut in suitable condition were tagged before release, but this was only done when convenient and when it did not interfere with the other charter objectives. On the second trip, as many halibut as possible in the 5- to 10-pound range were tagged. Otoliths were to be taken from all halibut caught on one day during the first trip. Otherwise, otolith collection was a low priority item and otoliths were collected only when convenient. Sex and maturity was recorded for each fish selected for otolith collection.

Bycatch and hook occupancy

Hook-by-hook observations were made during the first trip. Hook observations were recorded either as empty, baited, halibut, or other fish.

Oceanographic data

No oceanographic data were collected on this cruise.

Supplemental projects

Length-weight study

Due to the increase in the size-limit from 26 inches to 32 inches, paired samples of total length and head-off length were taken from a sample of halibut between 30 and 36 inches long. On each trip about 10 samples were taken from each 2-cm size class within this range.

Environmental contaminants

A 2-pound flesh sample and a second, smaller flesh sample were collected from 30 fish that had been sacrificed for otolith collection. The large sample was sent to Canadian authorities for heavy metal content analysis and the smaller piece was sent to NMFS for a protein study.

Outside agency collaboration

Twelve halibut were collected during the first trip and delivered alive to the West Vancouver Laboratory of Environment Canada. Interestingly, some of those halibut spawned in the holding tank during the following winter.

1973 Spawning stock spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Universe*	2B and 3A	Queen Charlotte Sound and the "W" grounds east of Kayak Is.	November 2 – December 21	1-2	1-57

Fishing effort	57 sets

The *Universe* was chartered to conduct an assessment of halibut spawning stocks in the Queen Charlotte Sound during the first trip and on the "W" grounds west of Yakutat during the second trip. A secondary purpose of this survey was to ascertain the feasibility of weighing halibut at sea and to obtain data relevant to head and body length-weight relationships.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Universe* usually set 4 to 6 sets per day but varied from 3 to 12. Each set consisted of four to six skates. There was no specified setting protocol or soak time. Gear was usually turned over around the clock. Gear was generally allowed to soak for a minimum of five hours.

Gear and bait specifications

The length of groundline used by the *Universe* is unknown, though we do know the vessel used large J-hooks spaced at either 18 or 26-foot intervals. The vessel generally set two or three skates of each spacing on each set.

Bait taken on board for the first trip consisted of frozen Pacific cod and salmon parts. No documentation was located to confirm bait used on the second trip. There were no specified baiting protocols.

Sampling protocol

Halibut sampling

The fork length of all halibut caught was recorded. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable, legal-sized halibut were sampled for sex, and otoliths were collected. Non-viable sublegal-sized halibut were sampled for sex and stomach contents. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives.

A number of halibut were weighed at sea during the survey using butcher scales. Halibut seem to have been weighed when convenient, was permitted by sea state, and when it did not conflict with tagging operations. There were no apparent protocols used to collect the weight samples. The logbook denotes problems due to the tilt of the vessel.

A sample of 105 pairs of ovaries from ripe females was collected on the Cape St. James and Yakutat spawning grounds for fecundity analysis. To determine the number of eggs produced by each female, all left ovaries and 10 right ovaries were prepared for enumeration in the IPHC lab. The results were to be compared with a similar study completed in 1936. See Scientific Report Number 66 for more details.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1975 Soak time and stock assessment spot/grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Seymour*	4, 3A	Bering Sea, Kodiak, and Portlock Bank	May 27 to July 4	1-2	1-104

Fishing effort	831 skates

The *Seymour* was chartered to perform survey operations during the spring and summer of 1975. The primary purpose of the charter was to study the effect of soak-time on CPUE. A secondary purpose was to determine the abundance of halibut on traditional fishing grounds in the

eastern Bering Sea during the summer. The first trip was a spot survey in Area 4 on the Clipper, Polaris, and Misty Moon grounds. The second trip took place in Area 3A around Kodiak and on the Portlock Bank and was classified a spot survey though the vessel set gear on specified grid survey stations. The results of the soak time study were inconclusive due to a low CPUE, which averaged less than 15 pounds per skate. CPUE in the eastern Bering Sea was far below levels encountered during the early 1960s.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. During the first trip, the vessel fished four days on each of the Polaris, Clipper, and Misty Moon grounds in the Bering Sea. During the second trip, it fished in the Shelikof Strait and on the Portlock Bank near Kodiak Island. On the second trip, the *Seymour* requested CPUE graphs from grid survey stations in Area 3A and proceeded to set on and around seven different grid stations throughout the trip.

Fishing pattern

On both trips, the method of fishing was strictly controlled to meet the requirements of the soak-time study. Sixty-four skates were set in eight parallel sets every other day. Half of these were set and hauled on the same day with an average 9.7 hours of soak time. The rest were hauled the next day with an average soak of 33.7 hours, i.e., roughly 24 hours longer than the short soak.

Gear and bait specifications

The *Seymour* used skates with large J-hooks spaced at intervals of 21 feet. The length of groundline used by the vessel is undocumented. Only frozen Pacific cod was used as bait to reduce possible variability in the soak time study due to bait differences.

Sampling protocol

Halibut sampling

The fork length of all halibut caught during the survey was measured to the nearest centimeter. No halibut were tagged during this survey and the majority of fish were sacrificed for otolith collection. All legal-sized halibut were iced and retained for sale.

Bycatch and hook occupancy

No observations were recorded about the status of hooks as they came out of the water or other species incidentally caught during the survey.

Oceanographic data

No air, sea surface, or bottom temperatures were taken during this survey.

1976 Spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Polaris*	4A, Closed area	Southeast Bering Sea, Slime Banks, and Makushin Bay	August 20 – September 10	1	1-58

Fishing effort	490 skates
Legal-sized halibut	1,568 fish
Tagged halibut	700 fish

The *Polaris* was chartered in late August of 1976 with the primary purpose of tagging halibut in the Southeast Bering Sea. The charter began in Kodiak and the vessel fished primarily in the Slime Banks and just north of Akutan and Unalaska Islands. The trip lasted 18 days during which the *Polaris* fished 11 consecutive days before returning to Kodiak. The vessel set 490 skates of gear and caught a total of 1,568 halibut of which 700 were tagged and released, 47 were release without tags, and 821 were sacrificed for age and sex samples.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude of the general fishing area was recorded once for each day along with the minimum and maximum depths from all sets.

Fishing pattern

The *Polaris* set between five and six sets of gear each day consisting of 6 to 10 skates each. The gear was generally set in the morning between 0600 and 1100. Hauling began around 1030 and all gear was usually aboard by 0200 the following morning. Fishing occurred in depths ranging from 6 to 20 fathoms on the Slime Banks and between 20 and 250 fathoms in the area north of the Aleutians Islands.

Gear and bait specifications

The *Polaris* used conventional fixed-hook gear consisting of 1,800-foot skates with large J-hooks spaced at 23-foot intervals providing approximately 81 hooks per skate. The hooks were baited with a mixture of herring, salmon tails, dressed salmon (mostly pink salmon), and dressed Pacific cod. There was no baiting protocol and all bait types may or may not have been used on each set.

Sampling protocol

Halibut Sampling

The fork length length of all halibut caught was recorded. Halibut captured in viable condition were tagged and released after head length, injury, and condition codes were recorded. Non-viable halibut were sampled for sex, subjected to otolith removal, and iced for sale. In the event that large numbers of halibut were caught, a stratified sample of age and sex data may have

been collected for each 5-cm size class. A sample may have been taken from a general fishing area, including several stations. An amply-stratified sample would have been one in which each 5-cm class of halibut would have three or four representatives. On at least one day during the charter, no otoliths were collected for non-viable halibut because the biologists had already collected a surplus of otoliths for the grounds. Sex and length composition samples were still collected on these days.

Bycatch and hook occupancy

There were no observations recorded on the incidence of other species caught during the survey.

Oceanographic data

Bottom and sea surface temperatures were not measured.

1976 Standardized grid pilot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Polaris*	3A	Portlock and Albatross Grounds	September 13 – 24	2	59-82 (1-24 in database)
F/V *Seymour*	2B	South of Cape St. James to Dixon Entrance	August 27 – September 28	1-2	1-82

Fishing effort	108 sets
Legal-sized halibut	520 fish
Sublegal-sized halibut	268 fish
Tagged Halibut	337 fish

This project was a return to the standardized stock assessment grid survey last performed in 1966. For the first time during survey operations, emphasis was placed on gathering data for stock assessment, such as catch per unit effort, age, and sex composition. Halibut tagging was a secondary objective.

The 1976 survey was a pilot test for sampling design modifications. For operational reasons, the survey was confined to Hecate Strait in Area 2B and the Portlock grounds in Area 3A. During this time period, these grounds produced nearly half of the total commercial catch. The survey was designed with 100 stations in each area. Stations were placed on a 6 x 24 nmi grid and all fishing procedures were standardized to minimize variability in sampling. The *Seymour* surveyed 70 stations in Area 2B and caught a total of 535 halibut, of which 337 were tagged and 198 were sampled to determine age and sex composition. There were 380 legal-sized halibut and 146 sublegal-sized halibut caught. Only 24 stations on two separate transects were sampled by the *Polaris* in Area 3A. There were 140 legal-sized halibut and 122 sublegal-sized halibut caught.

An examination of the results from the 1976 operation indicated that the design was satisfactory; a full-scale grid experiment was planned for 1977.

Survey design

Station pattern

The setline grid survey developed in 1963 placed longitudinal transects every 15 to 22.5 minutes apart which was approximately 12 nmi near Kodiak Island. Because lines of longitude converge toward the poles, the transect separation was about 13.5 nmi near Umnak Island and less than 11.5 nmi near Montague Island. Latitudinal transects were drawn every three minutes with stations placed every six minutes along the longitudinal transects beginning from the shore and extending to a depth of about 250 fathoms. Additional stations were placed at the deep end of most longitudinal transects. Instead of placing all stations on transect junctions they were offset along neighboring longitudinal transects by 1.5 minutes of latitude. A similar grid was designed in 1965 in Area 2B except that transects were drawn east to west instead of north to south and stations were not offset along neighboring transects. In order to reduce sampling effort for logistical reasons as well as to minimize temporal variation, the sampling design was modified when the setline grid surveys were reinstated in 1976. The 1963-1966 station positions were used but only every other transect was sampled resulting in approximately a 6 nmi by 24 nmi grid. The additional stations at the end of the transects were dropped and a consistent 6 nmi of latitudinal separation was adopted for all survey positions (Fig. 7). No additional gear outside of the survey design was fished. Appendix I Figure 6 shows station placement for the 1976 standardized grid survey.

The longitudinal transects in Area 3 were numbered from west to east ascending from the westernmost transect. The latitudinal transects in Area 2B were numbered from south to north ascending from the southernmost transect. Though all transects from the original 1963-1966 survey were numbered, only the even numbers in Area 3 and odd numbers in Area 2 were surveyed. Individual stations placed every 6 nmi along each transect were assigned a letter (A-Z) beginning with "A" at the northern end in Area 3A and at the eastern end in Area 2B. Individual stations were therefore referenced by their alphanumeric designation; the first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Some station designations were later altered in 1979 to correspond with the standardized grid design in place at that time. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

Whenever possible, the goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0600 and the first gear was hauled around 1100. Both vessels averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak was 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both vessels fished conventional fixed-hook longline gear. The *Polaris* used 1,800-foot skates with large J-hooks spaced at 22-foot intervals. The *Seymour* fished 1,500-foot skates with large J-hooks spaced at intervals of 21 feet. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The vessels used three types of bait: whole chum salmon, herring, and shack bait (fresh or frozen). The baits were alternated uniformly among hooks on each skate, i.e., each bait was used

on every third hook. Frozen Pacific cod was purchased along with frozen salmon and herring, but fresh shack replaced the frozen when available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Halibut unfit for tagging were sampled for sex and the blind-side otoliths were collected. Fish sampled for sex aboard the *Seymour* were examined for sexual maturity and rated as either mature or immature. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

There were no observations made of the hooks as they were retrieved and no data were taken regarding the catch of other species.

Oceanographic data

Bottom or sea surface temperatures were not recorded.

1977 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	North Hecate Strait inside of the Queen Charlotte Islands	August 11 – 29	1	1-51
F/V *Evening Star*	2B	South Hecate Strait from Vancouver Island to the Queen Charlotte Is.	August 12 – 29	1	1-50
F/V *Polaris*	3A	North Portlock Bank and south of the Kenai Peninsula	August 11 - 28	1	1-52
F/V *Resolute*	3A	North Albatross Bank and south Portlock Bank	August 12 – 27	1	1-52

Fishing effort	204 sets
Captured halibut	~2,300
Tagged halibut	~1,300

After the preliminary test of the standardized stock assessment grid survey in 1976 proved feasible, the first full-scale operation was carried out in 1977. Four vessels were chartered during the same time frame to limit temporal variation. All vessels began on the 11th or 12th of August and finished between the 27th and 29th of August. The *Chelsea* and *Evening Star* surveyed 101 stations in the Hecate Strait region of Area 2B and the *Polaris* and *Resolute* surveyed 103 stations in the Portlock and Albatross grounds of Area 3A. Approximately 2,300 fish were caught during the 1977 surveys, of which nearly 1,300 were tagged and released.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey please refer to the 1977 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey design and station pattern was continued from 1976, i.e., the 1963-1966 station positions were used but only every other transect was sampled. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of approximately 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along each transect. Stations in Area 3A were offset by 3 nmi between neighboring transects. No additional gear outside of the survey design was fished. For comparison, Appendix I Figure 3 shows station placement for the 1964 standardized grid survey and Appendix I Figure 7 shows station placement for the 1977 standardized grid survey.

The longitudinal transects in Area 3 were numbered from west to east ascending from the westernmost transect. The latitudinal transects in Area 2B were numbered from south to north ascending from the southernmost transect. Though all transects from the original 1963-1966 survey were numbered, only the even numbers in Area 3 and odd numbers in Area 2 were surveyed. Individual stations placed every 6 nmi along each transect were assigned a letter (A-Z) beginning with "A" at the northern end in Area 3A and at the eastern end in Area 2B. Individual stations were therefore referenced by their alphanumeric designation; the first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Some station designations were subsequently altered in 1979 to coincide with the standardized grid design in place at that time.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0500 and the first gear was hauled around 1000. All vessels averaged four stations per day fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was five hours and maximum soak was 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch

Gear and bait specifications

The *Polaris* and *Resolute* fished 1,800-foot conventional gear with 21-foot hook spacing. The *Chelsea* fished 1,800-foot gear with 23-foot spacing. The *Evening Star* fished 1,800-foot gear with 25-foot hook spacing. All vessels used large J-hooks. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The vessels used three types of bait: whole chum salmon, herring, and shack bait (fresh or frozen). The baits were alternated uniformly among hooks on each skate, i.e., each bait was used on every third hook. Frozen shack (Pacific cod) was purchased along with frozen salmon and herring but fresh shack replaced the frozen when it was available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Halibut found unfit for tagging were sampled for sex and the left-side otolith was collected. Fish sampled for sex aboard the *Resolute* were also examined for sexual maturity. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were recorded on the back of the data sheets.

Oceanographic data

No bottom or sea surface temperatures were recorded aboard any vessel during this survey.

1978 Bait loss survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2A	Puget Sound	1 or 2 days in March	1	1-4

Fishing effort	4 sets

A special study was conducted in March of 1978 in Puget Sound to determine the loss of baits in sets of less than five hours duration. The fishing technique and method of recording data were similar to those described for the other experiments (1971-1973).

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Chelsea* set four sets of gear of four skates each. On two of the sets, the gear was retrieved immediately after setting. During these sets, the last skate set may not have reached the bottom before hauling began. All skates were retrieved between 10 and 67 minutes. Skates in the other two sets were retrieved after soaking for 100 to 244 minutes.

Gear and bait specifications

The *Chelsea* fished 1,800-foot skates of conventional, fixed-hook setline gear of the type commonly found in the halibut fishery. Each skate had large J-hooks spaced at intervals of 21 feet. All hooks were baited alternately with herring and sablefish.

Sampling protocol

Halibut sampling

No halibut were captured on this charter.

Bycatch and hook occupancy

All hooks were monitored as they were retrieved. Each hook was recorded as either empty, bait still attached, or the species of fish caught.

Oceanographic data

Ocean bottom or sea surface temperatures were not collected during this survey.

1978 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2B	Hecate Strait from Vancouver Island to Dixon Entrance	August 11 - September 13	1-2	1-102
F/V *Vansee*	3A	Portlock and Albatross grounds	August 11 - September 11	1-2	1-104

Fishing effort	206 sets
Legal-sized halibut	~1,700 fish
Tagged halibut	~900

During August and September of 1978, the IPHC conducted its standardized grid survey for the third consecutive year in the core areas of 3A and 2B. The *Vansee* was chartered in Area 3A to survey 103 stations on the Portlock and Albatross grounds and the *Chelsea* was chartered in Area 2B to survey 102 stations in Hecate Strait. Approximately 1,700 halibut were caught during the survey, of which roughly 900 were tagged and released.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey please refer to the 1978 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey design and station pattern was continued from 1977. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with

approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects. No additional gear outside of the survey design was fished. Appendix I Figure 8 shows station placement for the 1978 standardized grid survey.

The longitudinal transects in Area 3A were numbered from west to east ascending from the westernmost transect. The latitudinal transects in Area 2B were numbered from south to north ascending from the southernmost transect. Though all transects from the original 1963-1966 survey were enumerated, only the even numbers in Area 3A and odd numbers in Area 2B were surveyed. Individual stations placed every 6 nmi along each transect were assigned a letter beginning with "A" at the northern end in Area 3A and at the eastern end in Area 2B. Individual stations were therefore referenced by their alphanumeric designation; the first one or two characters were numbers referring to a specific transect, followed by a letter indicating the station placement along the transect. Some station designations were later altered in 1979 to coincide with the standardized grid design in place at that time. Detailed documentation of the station number changes made to earlier grid surveys is available in the 1979 IPHC survey files.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines); that is, north-south in Area 3A and east-west in Area 2B. Setting began around 0500 and hauling began around 1000. All vessels averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was five hours and maximum soak was 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with large J-hooks predominant in the commercial halibut fishery. The *Chelsea* fished 1,800-foot skates with hooks spaced at intervals of 21 feet. The *Vansee* fished 1,800-foot skates with hooks spaced at 25-foot intervals. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The vessels used three types of bait: whole chum salmon, herring, and shack bait (fresh or frozen). The baits were alternated uniformly among hooks on each skate, i.e., each bait was used on every third hook. Frozen shack (Pacific cod) was purchased along with frozen salmon and herring but fresh shack replaced the frozen when available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Halibut found unfit for tagging were sampled for sex and the left-side otolith was collected. Halibut sampled for sex aboard the *Vansee* from trip two forward were examined for sexual maturity and rated as either mature or immature. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were recorded on the back of the data sheets.

Oceanographic data

No bottom or sea surface temperatures were recorded aboard either vessel during this survey.

1979 Winter Spawning grounds spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Seymour*	2C	Southeast Alaska off Cape Bartolome and Cape Addington	January 10 – February 12	1-2	1-54

Fishing effort	54 sets
Tagged halibut	~1,540 fish

The extension of national boundaries and exclusion of Canadians from the Alaska halibut fishery, made it necessary to determine the extent of trans-boundary movements of halibut and the extent that fishing in one national zone affected the maximum sustainable yield in the other national zone. Components of this research included trawl surveys, larval surveys, genetic research, and winter spawning ground surveys by longline.

The object of the longline spawning ground component performed in 1979 by the *Seymour* was to estimate the magnitude of the spawning populations that contribute to the U.S. juvenile stocks off Alaska, to estimate the movement of adults between summer feeding grounds and winter spawning grounds, and to determine if the breeding populations are separate genetic stocks. The *Seymour* tagged approximately 1,540 halibut and retained almost all non-viable fish for age and sex determination.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. This survey focused on potential spawning grounds. The IPHC survey archives provided insight on where spawning grounds were likely to be located.

Fishing pattern

There were no setting or hauling protocols specified for the charter and the time gear was set and hauled was often weather dependent. The *Seymour* generally set 4-6 sets per day of 7-9 skates each. Setting usually began early in the morning and all gear was aboard around 2100 hours. Sometimes gear was set late in the afternoon and not hauled until the following day.

Gear and bait specifications

The *Seymour* fished conventional fixed-hook longline gear with large J-hooks predominant in the halibut fishery at the time. The length of groundline and spacing between hooks used by the *Seymour* are not available. On trip 1, the *Seymour* baited all hooks, alternating among herring, octopus, and salmon tails. On trip 2, only herring and octopus were used. It is possible that some shack bait of unknown type was used on both trips.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Halibut unsuitable for tagging were sampled for sex and the left-side otolith was collected. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

There were no observations made of the hooks as they were retrieved and no data were taken regarding the catch of other species.

Oceanographic data

No bottom or sea surface temperatures were recorded during this survey.

Supplemental projects

Maturity study

Blood samples were collected and the observed state of maturity was recorded for 18 halibut during the winter tagging cruise. The results of the serological tests for maturity agreed with the observed maturity for 15 samples (83%). Approximately 50 additional blood and tissue samples were taken during the 1979 stock assessment cruise to further evaluate the validity of the serological technique.

Stock genetics

Tissue samples were taken from approximately 100 halibut on each spawning ground in an attempt to identify genetic variability within the halibut stock.

1979 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	3A	Seward Gully, Portlock and Albatross grounds	August 17 – September 13	1-2	1-104

Fishing effort	104 sets
Legal-sized halibut	~1,700 fish
Tagged halibut	~800 fish

The standardized stock assessment survey was continued for the fourth consecutive year. The 1979 survey conducted aboard the *Chelsea*, was confined to Area 3. The Hecate Strait to Queen Charlotte Sound survey was postponed until 1980 in order to utilize additional monies for more timely research needs. Approximately 1,700 halibut were caught during the 1979 survey, of which slightly more than 800 were tagged and released.

For detailed information regarding the survey design, sampling protocols, and data recording instructions for this survey please refer to the 1979 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey design and station pattern was continued from 1978, i.e., the 1963-1966 station positions were used but only every other transect was sampled resulting in approximately a 6 nmi by 24 nmi grid (Fig. 4).

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along that transect. Appendix I Figure 9 shows station placement for the 1979 standardized grid survey.

To bring uniformity and consistency to the entire survey, the grid transects were numbered beginning with line one at the most southerly transect (50°36' North latitude) in Area 2B. The remaining transects were assigned consecutively south to north through number 21 in Area 2B and east to west using numbers 40 through 95 in Area 3. Numbers 22 through 39 were reserved to enable transects to be added to the grid in the central Gulf. As in earlier grid surveys, individual stations were located every 6 nmi along each transect and assigned a letter, beginning with "A" at the eastern end of each transect in Area 2B and at the northern end in Area 3.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been parallel to the transect, i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0500 and the first gear was hauled around 1000. The *Chelsea* averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was five hours and maximum soak was 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch

Gear and bait specifications

The *Chelsea* fished 1,800-foot skates of conventional fixed-hook longline gear with large J-hooks spaced at 22-foot intervals. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip and deviations of more than 10% were repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The vessels used three types of bait: whole chum salmon, herring, and Pacific cod (fresh or frozen). The baits were alternated uniformly among hooks on each skate, i.e., each bait was used on every third hook. Frozen Pacific cod was purchased along with frozen salmon and herring. Fresh shack bait replaced frozen when available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and

released. Biologists collected the left-side otolith and sex and maturity data from injured halibut. Sex was recorded as male or female and maturity was rated as mature or immature. One objective of the survey was to collect representative age and sex data from at least 750 fish. If it became apparent later in the charter that insufficient fish were being sampled for age and sex, then the proportion tagged were to have been systematically reduced, e.g., every other fish could have been treated as a tagging candidate. Only fish in the very best condition were tagged so that the remainder could be used for sex and age samples (i.e., fish with only minor injuries (hooked in the jaw or cheek) and with no sign of bleeding or stress were tagged). Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were to have been recorded on the back of the data sheets.

Oceanographic data

No ocean bottom or sea surface temperatures were recorded during this survey.

Supplemental projects

Maturity study

Blood and tissue samples were collected from approximately 50 halibut to test a serological method of maturity analysis. This collection augmented 18 samples taken by the *Seymour* during the 1979 winter spawning ground survey and were used to further evaluate the validity of the serological technique. The first priority for collecting samples was blood from dead fish, followed by tissue samples from dead females. Lowest priority was blood samples from tagged fish. The blood samples were taken using a disposable Vacutainer® tube and frozen within two hours of collection. Tissue samples from dead females included a 1-cm² sample cut from the ovary, kidney, liver, gill, tongue, and eye, each stored in a separate vial. Blood samples from tagged fish were taken from approximately 75 randomly selected fish between 80 and 130 cm. The observed state of maturity during this experiment was recorded for male halibut as immature or mature. Females were recorded as immature, ripening, running ripe, or spent.

1980 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Elling K*	2B	Hecate Strait from Vancouver Island to Dixon Entrance	June 19 - August 22	1-2	1-104
F/V *Seymour*	3A	Seward Gully, Portlock and Albatross grounds	June 18 - August 15	4-5	1-104

Fishing effort	208 sets
Legal-sized halibut	2,978 fish
Tagged halibut	1,316 fish

The IPHC standardized stock assessment survey, which at the time known as the adult halibut survey, was conducted for the fifth consecutive year in 1980. The main objectives of the survey were to collect CPUE, sex, size, and age data independent of the commercial fishery. In addition, all halibut without serious injuries were tagged, resulting in a systematic dispersal of tagged fish in each survey region. The 1980 surveys caught 2,978 halibut, of which 1,316 were tagged and released.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1980 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey design was continued from 1979. The survey grid consisted of longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of approximately 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects.

In previous years, the surveys consisted of approximately 104 stations in each area fished during August and September. However, the 1980 surveys were modified to provide additional information on seasonal movements of halibut over the fishing grounds. Stations were sampled in groups of four, skipping three to five stations between groups. Only half of the stations were fished, about 52 in each area, but each station was fished twice: first in June and then again in August. Appendix I Figure 10 shows station placement for the 1980 standardized grid survey.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the stations location along the transect.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0500 and the first gear was hauled around 1000. Both vessels averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was five hours with maximum soak time of up to 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch

Gear and bait specifications

The *Elling K* fished 1,800-foot skates of conventional setline gear with large J-hooks spaced at 26-foot intervals. The *Seymour* fished 1,500-foot skates of conventional setline gear with large J-hooks spaced at intervals of 21 feet. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The vessels used three types of bait: whole chum salmon, herring, and shack bait (fresh or frozen). The baits were alternated uniformly among hooks on each skate, i.e., each type of bait was used on every third hook. Frozen shack (typically Pacific cod) was purchased along with frozen salmon and herring. Fresh shack bait replaced frozen when it was available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Biologists collected the left-side otolith and sex and maturity data from injured halibut. Sex was recorded as either male or female. The observed state of maturity during this experiment was recorded for male halibut as immature or mature. Females were recorded as immature, ripening, running ripe, or spent.

One objective of the survey was to collect representative age and sex data from at least 125 fish per trip during the 2B survey and 375 fish per trip on the 3A survey. If it became apparent later in the charter that insufficient fish were being sampled for age and sex, then the proportion of tagged were to be systematically reduced (e.g. every other fish would be treated as a tagging candidate). Only fish in the very best condition (i.e., fish with only minor injuries from being hooked in the jaw or cheek, and with no sign of bleeding or stress) were tagged so that the remainder could be used for sex and age samples. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were recorded on the back of the data sheets.

Oceanographic data

No bottom or sea surface temperatures were recorded during this survey.

Supplemental projects

Maturity study

Blood and tissue samples were collected to test a serological method of maturity analysis. Collecting blood from dead fish was first priority, followed by obtaining tissue samples from dead females, and collecting blood samples from tagged fish was third priority. The blood samples were taken using a disposable Vacutainer® tube and frozen within two hours of collection. Tissue samples from dead females included a 1-cm² sample cut from the ovary, kidney, liver, gill, tongue, and eye; each stored in a separate vial. Blood samples from tagged fish were taken from approximately 75 randomly selected fish between 80 and 130 cm.

Length-weight study

A project was carried out aboard the *Seymour* to evaluate the feasibly of weighing halibut during survey operations. Approximately 40 halibut over 125 cm were earmarked at sea and weighed head-on and head-off at the plant when unloading the fish. An attempt was also made to weigh large halibut at sea using a beam scale, but this proved to be unsuccessful due to movement of the vessel.

Outside agency collaboration

One biologist from NMFS was on board the *Seymour* to perform cooperative research by tagging sablefish . The NMFS biologist worked as the third biologist for the IPHC when no sablefish were being caught. Very few sablefish were caught during this charter.

Biologists from the Pacific Biological Station in Nanaimo, BC were aboard the *Elling K* to tag dogfish. The Canadian Department of Fisheries and Oceans retained all data from this experiment; approximately 2,500 dogfish were tagged.

During one trip in June, the *Elling K* delivered nine live halibut to the Pacific Biological Station at Nanaimo, British Columbia for use in growth studies.

1980 Stock assessment spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Evening Star*	3B	South of the Alaskan Peninsula, vicinity of the Chirikof and Shumagin Islands	September 15 - October 22	1-2	1-159
F/V *Republic*	3B	South of the Alaskan Peninsula, vicinity of the Chirikof and Shumagin Islands	August 2 – October 8	1-2	1-109

Fishing effort	268 sets
Legal-sized halibut	~244,000 lbs
Tagged halibut	619 fish

Commercial CPUE and age information from the Chirikof and Shumagin Islands vicinity was lacking because most fishers were drawn to the exceptionally good fishing in the eastern Gulf of Alaska. The Commission chartered two setline vessels, the *Evening Star* and the *Republic*, to conduct test fishing in offshore waters west of Kodiak Island. Each vessel made one trip in the Chirikof region and one trip in the Shumagin region. Their total catch was 244,000 pounds. While the primary objective of the operations was to collect age and sex information, all undersized fish and some legal-sized fish were tagged and released. The *Republic* tagged 253 halibut and the *Evening Star* tagged 366.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude (loran coordinates) were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

Fishing was conducted in a manner similar to a commercial operation. The survey vessels set and hauled gear throughout the day and often left gear soaking overnight. The *Evening Star* usually set six sets per day of nine skates each. The *Republic* usually set five to six sets per day of 10 skates each.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with large J-hooks, gear predominant in the halibut fishery. The *Evening Star* used skates of 1,800-foot groundline with hooks spaced every 25 feet providing approximately 72 hooks per skate. The *Republic* fished 1,800-foot skates of groundline with hooks spaced every 21 feet providing around 86 hooks per skate.

The *Evening Star* used herring, octopus, salmon, and cod for bait. The *Republic* used herring, octopus, and salmon. Each type of bait was usually alternated on every third or fourth hook. Both vessels used fresh shack when available.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged fish included head length, injury code, and condition code. Halibut found unfit for tagging were sampled for sex (male or female) and the left-side otolith was collected. Legal-sized halibut, sacrificed for sex and age structures, were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

There were no observations made of the hooks as they were retrieved and no data were taken regarding the catch of other species. No bottom or sea surface temperatures were recorded during this survey.

Predation

The charter logbook from the *Evening Star* recorded that large numbers of halibut had sand-flea damage on some sets. These fish were not brought aboard nor recorded.

Oceanographic data

No oceanographic data were collected on this cruise.

1980 – 81 Winter spawning ground spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Proud Canadian*	2B	Cape Flattery to Dixon Entrance	October 28 – January 20	1-4	1-67
F/V *Seymour*	2C	Cape Ommaney to Cape Spencer	January 2 – February 22	1-3	1-88

Fishing effort	155 sets
Tagged halibut	1,511

This survey was the continuation of a project, which began with the *Seymour* in 1979. The project was initiated when the U.S. and Canadian national boundaries were extended, thus excluding Canadians from the Alaska halibut fishery. Because these new boundaries changed

fishing effort, it became necessary to investigate the magnitude of trans-boundary movements of halibut and to determine how fishing in one national zone affected the maximum sustainable yield in the other national zone. Components of this research included trawl surveys, larval surveys, genetic research, and winter spawning ground surveys by longline. The *Seymour* and *Proud Canadian* were chartered in 1980 to continue the longline component of the research. The object of the longline spawning ground component was to estimate the magnitude of the spawning biomass, to estimate the movement of adults between summer feeding grounds and winter spawning grounds, and to determine if the breeding populations were separate genetic stocks.

The *Seymour* began this project by surveying the southern portion of southeast Alaska in 1979. The vessel was again chartered during January and February of 1980 to continue the survey in the northern part of southeast Alaska. The *Seymour* tagged and released 1,511 halibut.

The *Proud Canadian* was chartered from October 1980 to January 1981 to conduct the spawning stock survey off the British Columbia coast. Poor weather plagued this vessel throughout the charter. Most of trip three (five days) was spent anchored behind Langara Island and no gear could be fished on that trip.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. This survey focused on potential spawning grounds. The IPHC survey archives provided insight on where spawning grounds were likely to be located. Other locations may have been tried on the advice of the captain. The vessels were instructed to remain in locations where fishing was good, even if it meant omitting other areas designated for the trip.

Fishing pattern

There were no setting or hauling protocols specified for the charter and the time gear was set and hauled was often weather dependent. The *Seymour* generally set four sets of eight skates per day, but the number varied from two to six sets of 4 to 10 skates depending upon weather and location. Setting usually began early in the morning and all gear was aboard around 2100 hours. Sometimes gear was set late in the afternoon and not hauled until the following day.

The *Proud Canadian* began the charter setting seven to nine sets of nine skates per day, but switched to six sets of five skates, and by the last trip, only fished two to three sets of five to six skates per day. Set and haul times were highly variable. To work around bad weather, the *Proud Canadian* often set gear late in the afternoon and hauled late in the evening or the following day.

Gear and bait specifications

Both vessels fished conventional, fixed-hook, longline gear with large J-hooks typically found in the halibut fishery at the time. The *Seymour* used skates of groundline a little over 1,500 feet long, with approximately 75 hooks spaced at intervals of 21 feet. The *Proud Canadian* fished 1,500-foot skates of groundline with about 70 hooks spaced at intervals of 21 feet.

The *Seymour* used a combination of salmon tails, herring, and octopus as bait. *The Proud Canadian* used salmon, Pacific cod, and octopus. Each type of bait may have been used on alternate hooks and all bait types may not have been used on every set. Both vessels may also have used some shack bait.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged fish includes head length, injury code, and condition code. Insofar as possible, the tagged fish were to be representative of the total catch. Every halibut captured, regardless of size, was considered suitable for tagging; however, biologists were cautioned about selecting fish larger than 60 pounds for tagging because of the severity of injuries commonly inflicted while landing these fish.

Halibut found unfit for tagging were sampled for sex and maturity and both otoliths were collected. The observed state of maturity was recorded as immature or mature for males and immature, ripening, ripe, or spent for females. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

There were no observations made of the hooks as they were retrieved and no data were taken regarding the catch of other species.

Oceanographic data

No air, ocean bottom or sea surface water temperatures were recorded aboard the *Seymour*. Biologists aboard the *Proud Canadian* collected temperature readings approximately once per day. Air temperatures were taken using a handheld thermometer. Sea surface temperatures were measured in a bucket of freshly-collected water. Ocean bottom temperatures were to be collected using a new disposable, hand-launched probe called an expendable bathythermograph (XBT). During the first day of fishing, the IPHC biologists found the XBT gave inaccurate readings and switched to using the standard reversible thermometer.

Supplemental projects

Egg size

Ovaries were collected and blood samples taken from a number of halibut caught aboard both the *Seymour* and *Proud Canadian* as part of an egg size study. From one trip aboard each vessel, left ovaries were to be collected from 15 ripe females under 135 cm and 15 ripe females over 160 cm. Five right ovaries in each size group were also collected. The ovaries collected were to contain at least 200 eggs in the large, translucent stage. Some fish that were fit for tagging may have been sacrificed to complete each sample. A blood sample was also taken from each ovary sampled female. Each halibut sampled for this collection was tagged aboard the vessel and weighed at the plant when unloaded.

Stock genetics

As part of a biochemical study to identify genetic variability within the halibut stock, tissue samples were collected from halibut landed aboard the *Proud Canadian* when fishing off Cape Flattery and Cape Knox. Approximately 50-80 halibut were sampled from each location. The samples consisted of one eyeball and one small piece of the heart, liver, and muscle of each fish. This study may have also taken place on the *Seymour* charter, but data could not be located.

Outside agency collaboration

One biologist from NMFS was aboard the *Seymour* throughout the charter to aid the IPHC staff and tag sablefish . A total of 63 sablefish were tagged during the charter. All data recorded by the NMFS biologist relating to species other than halibut were retained by NMFS.

1981 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Evening Star*	3A	Seward Gully, Portlock and Albatross grounds	August 6 – September 25	1-2	1-102
F/V *Proud Canadian*	2B	Hecate Strait from Vancouver Island to Dixon Entrance	August 10 - September 13	1-2	1-102

Fishing effort	204 sets
Legal-sized halibut	3,437 fish
Tagged halibut	1,294 fish

The IPHC standardized stock assessment survey was continued for the 6th consecutive year. The main objectives of the survey were to collect CPUE, sex, size, and age data independent of the commercial fishery. All halibut without serious injuries were tagged, resulting in a systematic dispersal of tagged fish in each survey region. The 1981 surveys caught 3,437 halibut, of which over 85% were caught on the Area 3A survey. A total of 1,294 were tagged and released. The remaining 2,151 were used to estimate the size, sex, and age compositions of the catches in the two areas.

The *Evening Star* took a break during the 3A charter to participate in a short Area 3B halibut opening. Two IPHC biologists stayed aboard the vessel during the opening as observers between the 24th and 29th of August. The biologists collected otolith and sex ratio data to supplement information gathered through port sampling. These data were not included as part of the 1981 setline charter data set.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1981 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design was continued from 1980, except that the only stations skipped along surveyed transects were those deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects. No additional gear outside of the survey design was fished. Appendix I Figure 11 shows station placement for the 1981 standardized grid survey.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter

(A-Z) specifying the stations location along the transect. The 1981 instruction manual states, "Preferably, the latitude and longitude should indicate where the gear was actually set and not the locations provided to the skipper. However, in the absence of the former, the latter may be used."

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0600 and the first gear was hauled around 1100. Both vessels averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak time was 12 hours. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

The *Evening Star* and *Proud Canadian* used conventional fixed-hook setline gear with large J-hooks typical in the commercial halibut fishery at the time. Skates on the *Evening Star* consisted of 1,500 feet of groundline with hooks spaced at intervals of 21 feet providing approximately 72 hooks per skate. Due to lost gear, the *Evening Star* was forced to fish a mixture of 1,500- and 1,800-foot gear on two sets: sets 97 and 100. The 1,800-foot gear consisted of large J-hooks spaced at 18-foot intervals providing approximately 100 hooks per skate. The average hook spacing and number of hooks per skate were recorded for each trip.

The *Proud Canadian* used 1,500-foot skates with hooks spaced at intervals of 21 to 23 feet. The number of hooks per skate aboard the *Proud Canadian* varied from 64 to 71. The hook count and hook spacing were checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

Baiting protocols were continued from 1980, i.e., salmon, herring, and Pacific cod were baited alternately among hooks on each skate. The only change from the 1980 instructions was that fresh shack was only used if the vessel ran out of the frozen cod purchased before the trip.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were tagged and tagging occurred at all stations). This was to be accomplished while tagging only halibut in the very best condition so that the remainder could be used for sex and age samples (i.e., fish with only minor injuries (hooked in the jaw or cheek) with no sign of bleeding or stress were tagged). If it became apparent that insufficient fish were being sampled for age and sex, then the proportion tagged was to have been reduced, e.g. every other fish potential became a tagging candidate.

Biologists collected the left-side otolith and sex and maturity data from injured halibut. Sex was recorded as either male or female. The observed state of maturity was recorded as immature or mature for males and immature, ripening, ripe, or spent for females. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were recorded on the back of the data sheets.

Oceanographic data

No bottom or sea surface temperatures were recorded during this survey.

1981-1982 Winter spawning ground spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Quest*	3A, 3B	Northern Gulf of Alaska and Shumagin and Chirikof Island	October 21 - February 14	1-5	1-220
F/V *Star Wars II*	2B	Northern British Columbia	October 27 – January 28	1-4	1-99

Fishing effort	319 sets
Tagged halibut	5,845 fish

This survey was a continuation of a project, which began with the *Seymour* in 1979 and continued with the *Seymour* and *Proud Canadian* in 1980-81. The project was initiated after the U.S. and Canadian national boundaries were extended, thus excluding Canadians from the Alaska halibut fishery. Because these new boundaries changed fishing effort, it became necessary to investigate the magnitude of trans-boundary movements of halibut and to determine how fishing in one national zone affected the maximum sustainable yield in the other national zone. Components of this research included trawl surveys, larval surveys, genetic research, and winter spawning ground surveys by longline. The *Quest* and *Star Wars II* were chartered in 1981-82 to continue the longline component of the research. The object of the longline spawning ground component was to estimate the magnitude of the spawning biomass, to estimate the movement of adults between summer feeding grounds and winter spawning grounds, and to determine if the breeding populations were separate genetic stocks.

The *Quest* was chartered to survey the northern Gulf of Alaska in 1981 and the Shumagin and Chirikof area in 1982. The vessel encountered heavy fishing and tagged a total of 5,439 halibut. The *Star Wars II* was chartered to survey British Columbia waters in 1981 and 1982 and encountered poor fishing throughout the charter, tagging only 406 halibut.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. This survey

focused on suspected spawning grounds. The IPHC survey archives provided insight on where spawning grounds were likely to be located. Other locations may have been tried on the advice of the captain and not all of the designated areas needed to be fished. The vessels were instructed to remain at locations where fishing was good, even if it meant omitting other areas designated for the trip.

Fishing pattern

There were no setting or hauling protocols specified for the charter and the time gear was set and hauled was often weather dependent. The *Quest* usually set four or five sets of 10 skates per day and the *Star Wars II* usually set four or five sets of four to six skates per day. The number of sets set and skates per set often varied depending upon weather and location. Setting usually began early in the morning and all gear was aboard around 2100 hours. Sometimes gear was set late in the afternoon and hauled the following day.

Gear and bait specifications

Both vessels used conventional fixed-hook longline gear with large J-hooks typical in the commercial halibut fishery at the time. The *Quest* may have switched to a larger hook size at the beginning of trip 3. The length of groundline, hook spacing, and number of hooks per skate used by the *Quest* and *Star Wars II* were not documented.

The *Quest* used salmon, herring, and octopus as bait. The *Star Wars II* used salmon and herring. Both vessels may have also used fresh shack bait when available. Each bait type may have been used on alternate hooks, or only one or a combination of baits may have been used on a particular set.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged fish included head length, injury code, and condition code. Insofar as possible, the tagged fish were to be representative of the total catch. Every halibut captured, regardless of size, was considered suitable for tagging; however, biologists were cautioned about selecting fish larger than 60 pounds for tagging because of the severity of injuries commonly inflicted while landing these fish.

Halibut found unfit for tagging were sampled for sex and maturity and both otoliths may have been collected. The observed state of maturity was recorded as immature or mature for males and immature, ripening, ripe, or spent for females. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded. The disposition of sex and age data collected during this survey is unknown.

Bycatch and hook occupancy

There were no observations made of the hooks as they were retrieved and no data were taken regarding the catch of other species.

Oceanographic data

Air, ocean bottom, and sea surface water temperatures were recorded approximately once per day aboard each vessel. Air temperatures were taken using a handheld thermometer. Sea surface temperatures were measured using a handheld thermometer in a bucket of freshly-collected water. Ocean bottom temperatures were to be collected using a new disposable hand-launched probe called an XBT. At the end of trip 4, biologists aboard the *Quest* noted that the XBT did not seem to be giving accurate readings and cautioned against the use of earlier data.

1982 Catchability spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Proud Canadian* *(Longliner)* F/V *Nore-Dick* *(Trawler)*	2B	North of Rose Spit off Masset and south of Banks Island on the Horseshoe Grounds	July 24 – August 2	1	1-37

Fishing effort	228 skates 37 trawls

Prior to taking part in the 1982 Grid survey, the *Proud Canadian* was chartered to work with the trawler *Nore-Dick* on an experiment examining the validity of CPUE as a measure of fish density in British Columbia. The trawl catch, adjusted for the selective properties of trawl gear, provided an independent measure of the density of halibut that was compared with setline catch. A total of 36 station locations were sampled. This survey was designed specifically to examine the effect of dogfish and trawl disturbance on setline CPUE in British Columbia. A second study, conducted in 1983, was designed to estimate the catchability of halibut using setlines in British Columbia relative to areas where setline CPUE was much higher.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. Latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The stations were located along depth contours from 23 to 71 fathoms. The precise choice of station locations was determined on the grounds, and dictated by the suitability of the grounds for bottom trawling. The trawler acoustically surveyed the area prior to fishing to avoid unsuitable areas. Only areas with a high probability of finding halibut were fished. Each station was approximately 1.6 miles long and could be covered in about 30 minutes of trawling and six skates of setline gear.

Fishing pattern

Four sets of setline gear were made each day. Each set was comprised of six skates. Setting began at around 0600 hours and the gear was allowed to soak a minimum of five hours. All the gear was generally aboard by 1800 hours. To avoid physical interference between the two types of gear and provide an indication of the effect of trawling, each gear type was fished on each station during alternating days (i.e., the stations fished by setline on the first day were fished by trawl on the second day and vice versa). Because the trawl gear could be fished faster than setline gear, each station was usually fished once by the trawler in the morning and again later in the day.

Gear and bait specifications

The *Proud Canadian* used conventional fixed-hook setline gear typical in the commercial halibut fishery at the time. The gear consisted of 1,500-foot skates of groundline with approximately 69 large J-hooks (Mustad No. 6282) spaced at intervals of 21 feet. All skates were baited with herring, salmon, and Pacific cod. Presumably, each bait type was used on alternate hooks on every skate; however, only one or a combination of any of the baits may have been used.

Sampling protocol

Halibut sampling

The halibut were measured and recorded with their corresponding skate number. Halibut in suitable condition were tagged and released. Halibut found unfit for tagging were sampled for sex, maturity, and otoliths were collected. Sex was recorded as male or female and maturity was recorded as mature, immature or unknown. Most halibut sampled for maturity were recorded as unknown. Both tagging and otolith collecting were low priority during this survey. Legal-sized fish that were unsuitable for tagging were iced and retained for sale.

Bycatch and hook occupancy

All fish caught at each station were counted and identified by species or species group. The weight of species other than halibut was estimated by weighing up to 10 individuals in each species group on each station and extrapolating the average weight to the total count.

Oceanographic data

No bottom temperatures were collected during this survey.

1982 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Kristine*	2C	Southeast Alaska inside and outside waters	July 19 – August 22	1-2	1-46 (inside) 47-95 (outside)
F/V *Proud Canadian*	2B	Hecate Strait from Vancouver Island to Dixon Entrance	August 6 – September 6	2-3	38-131 (Grid) 132-143 OTC study
F/V *Thor*	3A, 3B	Portlock, Albatross Grounds in 3A Shumagin Islands to Unimak Pass in 3B	July 1 – October 1	1-3	1-153

Fishing effort	341 Grid sets
Captured halibut	8,484 fish
Tagged halibut	4,016 fish

Three vessels were chartered in 1982 to continue the standardized stock assessment survey, which had been performed every year since 1976. Prior to 1982, the surveys sampled a predetermined grid of stations in the Charlotte region in Area 2B and the Kodiak region in Area 3A. In 1982, the survey expanded to the southeastern Alaska region of Area 2C and the Shumagin Island-Davidson Bank region of Area 3B. The surveys were designed to obtain information on the adult halibut population that was independent of the information obtained

from the commercial fishery. Halibut captured without serious injuries were tagged, resulting in a systematic dispersal of tagged fish in each survey region.

Several supplemental projects were completed during the 1982 grid surveys. These included gear comparison studies, weighing individual fish at sea, and marking otoliths with oxytetracycline hydrochloride (OTC). The 1982 surveys caught 8,484 halibut of which 4,016 were tagged.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1982 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design in Area 2B and 3A was continued from 1981. Some plotted stations were skipped if deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed every 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects. No additional gear outside of the survey design was fished.

In addition to the core areas in 2B and 3A normally fished during the stock assessment survey, vessels were also chartered to survey Area 3B and the inside and outside waters of Area 2C. The 3B survey was designed according the same pattern used in 3A. The offshore stations in southeast Alaska were selected from the 1960s survey grid and were laid out in the same manner as the stations in Area 2B. Because surveying by transect was considered impractical in the inside waters of Area 2C, these stations were grouped by geographic area. The areas chosen were those which received a significant amount of effort by the commercial fleet. Exact station locations were predetermined based upon a method consistently applied for all areas. Appendix I Figure 12 shows station placement for the 1982 standardized grid survey.

Several important areas were surveyed minimally or skipped all together due to a lack of time or competing priorities. In addition, strong tides made surveying Dixon Entrance extremely difficult. The plan was for the *Kristine* to skip transects on the outside waters of southeast Alaska, but adjoining transects were sometimes fished because of limited run time or if it was felt that additional coverage was required.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the stations location along the transect. Stations in the inside waters of southeast Alaska were assigned a simple three-digit designation beginning with 401 in the south and continuing north through number 802. Station numbers were sequential within each geographical area and blocks of numbers were skipped between areas to allow for additional stations in the future.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0600 and the first gear was hauled around 1100. All vessels averaged four stations per day and fished eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak time was 12 hours.

Modified standards applied when fishing the inside waters of southeast Alaska. In this region, vessels completed four to eight stations (depending on geographic area) per day, fishing

six skates at each station. Several days were spent within specific geographic areas. The plan called for setting the Southeast stations beginning at 0500 hours and to haul the first stations at 1000 hours regardless of the number of stations set that day. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All vessels fished conventional fixed-hook setline gear with large J-hooks typical in the commercial halibut fishery at the time. The *Kristine* used 1,800-foot skates of groundline with an average of 85 hooks spaced at 22-foot intervals. The *Proud Canadian* fished 1,500-foot skates of groundline with an average of 69 hooks spaced at intervals of 21 feet. The *Thor* used 1,800-foot skates with an average of 85 hooks spaced at intervals of 21 feet. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

Salmon, herring, and Pacific cod were baited alternately among the hooks on each skate. Fresh shack bait may have been used if the vessel ran out of frozen cod. Because the catch of shack bait was rather spotty, when catches were high the vessel dress and ice some for later use.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were to have been tagged and tagging was to have occurred at all stations). This was accomplished by tagging only halibut in the very best condition (i.e., fish with only minor injuries, those hooked in the jaw or cheek and with no sign of bleeding or stress) so that the remainder could be used for sex and age samples. If it became apparent later in the charter that insufficient fish were being sampled for age and sex, then the proportion tagged was to be reduced (e.g., every other fish could have been treated as a tagging candidate).

Biologists collected the left-side otolith and sex and maturity data from injured halibut. Sex was recorded as either male or female. Biologists aboard the *Kristine* and *Proud Canadian* recorded maturity stage as immature, mature, or unknown for males and immature, ripening, ripe, spent, or unknown for females. Biologists aboard the *Thor* recorded maturity stages as immature, mature, or unknown. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized fish sacrificed for sex and age structures were discarded. If a halibut was lost at the roller, a note was made in the "remarks" section of the haul summary form. Biologists did not estimate lengths of lost fish. Similarly, if only a head was remaining on the hook due to predation, the occurrence was noted but estimated length was not recorded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were to have been recorded on the back of the data sheets.

Oceanographic data

Since depth and bottom type were considered important factors influencing catchability, sounder tapes for each set were to be collected by each vessel and identified by date, depth range, and station. Bottom temperatures using a reversible thermometer were taken at stations where opportunity and time permitted. Few bottom temperatures were taken on the outside waters of southeast Alaska because of equipment problems.

Supplemental projects

Gear comparison

During a portion of the charters, several snap-gear boats fished in parallel with the grid survey vessels to test the relative effectiveness of the different gear types. A description of this project is in the 1982 Snap/Fixed-Hook Gear Comparison Surveys.

Length-weight studies

An expanded effort was made to collect length-weight information from the grid survey operations in the Charlotte, Southeastern, Kodiak, and Shumagin regions to test the IPHC's conversion factors for dressed weight to gross weight and head weight to body weight. In addition, the collection protocols afforded an opportunity to test for shrinkage of the fish while stored in a vessel's hold. Ten fish in each 10 cm size class were to be sampled for weight at sea; a sub-sample was to be weighed at the time of unloading. The instructions during each trip were to measure 10 fish in each length interval to the nearest centimeter, take an otolith, and weigh the fish to the nearest pound. Each fish was numbered in the order of collection and this number was recorded on the otolith envelope. Three of the fish from each 10-cm interval were marked with a numbered jaw tag and a rubber band was placed around the caudal peduncle. The first of the three fish in each 10 cm size class were marked on the first two days of fishing, the second three in the middle of the trip, and the third on the last two days. Biologists measured and weighed these fish before evisceration (dressing) and again after evisceration. The tag number was recorded on the otolith envelope. During unloading, all jaw-tagged fish were measured and weighed prior to heading. After heading, the tagged heads were weighed and tags were removed.

Oxytetracycline hydrochloride otolith marking

Injections of oxytetracycline hydrochloride (OTC) were given to 111 live halibut by the IPHC staff aboard the *Proud Canadian* during the last three days of the charter, 69 of which were tagged and released. The injections were given to create a timestamp in the otolith. Upon examination under ultraviolet light, the time mark can be seen on one annuli, resulting in a more accurate age determination. Only halibut less than 75 cm were chosen to receive injections. This period of the charter was conducted as a spot fishing operation completely within McIntyre Bay in Area 2B and cannot be considered part of the standardized stock assessment charter.

1982 Snap and fixed-hook gear comparison grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Daily*	2C	The outside waters of Southeast Alaska	July 22 to August 6	1	1-41
F/V *Valorous*	3B	Shumagin Islands to Unimak Pass	July 3 - 21	1	1-55

Fishing effort	82 comparable sets

Two commercial snap gear setline vessels, the *Valorous* and *Daily*, were chartered to fish stations in parallel with the conventional setline vessels *Thor* and *Kristine* conducting the 1982 grid survey. The purpose of the survey was to provide information on factors that may reduce the fishing power (effectiveness) of snap gear and to provide information needed for equating snap gear CPUE to conventional CPUE. The *Thor*, using fixed-hook gear, operated with the *Valorous*, using snap gear, in the western Gulf of Alaska. The *Kristine*, using fixed-hook gear, fished alongside the *Daily*, using snap gear, in the outside waters of Southeastern Alaska. Each gear type was not fished at each station due to weather and other considerations. In all, the *Thor* and *Valorous* fished 53 comparable stations, and the *Kristine* and *Daily* fished 29 comparable stations.

During the course of survey operations, the *Valorous* collected 1,397 pounds of halibut, which was donated to the World's Fair.

Survey design

Station pattern

Fishing was done on the standardized stock assessment survey stations. Stations were spaced 6 nmi apart on transects that were approximately 12 nmi apart.

Fishing pattern

The paired vessels were to set and haul eight skates at each of four stations in their representative areas each day, weather and other conditions permitting. The *Kristine Daily* pair fished only six skates per station after the first two days due to problems with maintaining the time schedule.

With some exceptions, gear was set between 0500 and 0800 hours and hauling began between 1000 and 1900 hours. The snap vessel set gear alternately to the port and starboard sides of the fixed-hook vessel by station in the western Gulf of Alaska. Because this alternation created too much extra running time for the snap vessel in southeast Alaska, this alternation was made only once per day. To avoid gear competition and interference, the *Kristine* and *Daily* gear was set an average of 1.6 km apart the *Thor* and *Valorous* gear was set around 1.0 km apart.

Gear and bait specifications

The snap gear vessels were to use the same hook spacing as the fixed-hook gear vessels. During the grid survey, the *Thor* used gear with hooks spaced at 21 feet while the *Kristine* gear

averaged 22 feet. Accordingly, when the *Valorous* set gear, the hooks were snapped on the groundline spaced at intervals of 21 feet and the *Daily* gear was spaced at 22-foot intervals.

Baiting was the same on each pair of vessels, in that herring, salmon, and Pacific cod were used in rotation throughout. The snap-gear boats cut their baits to the same size and placed them on the hooks in the same manner as the fixed-hook vessels.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were to have been tagged and tagging was to have occurred at all stations). The majority of fish caught aboard both the *Daily* and *Valorous* were tagged and released.

Halibut found unfit for tagging were dressed and iced for sale. Sex was recorded aboard the *Valorous*; however, biologists aboard the *Daily* did not record sex. No otoliths were taken aboard these vessels and the observed state of maturity was not recorded.

Bycatch and hook occupancy

No observations were made of the hooks as they were retrieved and no data were recorded regarding the incidental catch of other species.

Oceanographic data

Since depth and bottom type were considered important factors influencing gear effectiveness, sounder tapes for sets made by each vessel were collected and identified by date, depth range, and station. There were no air, sea surface, or bottom temperatures taken during this survey.

Supplemental projects

Oxytetracycline hydrochloride otolith marking

IPHC staff aboard the *Valorous* injected oxytetracycline hydrochloride (OTC) into 459 live halibut and marked with an external tag. As a control, approximately 282 halibut were also tagged without the OTC injection. The injections were given to create a time mark in the otolith. Upon examination under ultraviolet light, the time mark can be seen on one annuli resulting in a more accurate age determination. Only halibut between 45 cm and 200 cm were chosen to receive injections.

1982 Submarine observation survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Tiffy*	3A	Kodiak Island area	July 15 -22	1	Unknown
F/V *Thor*	3A	Off Kodiak Island near Cape Chiniak	July 21	1	1 set only

A study was conducted in conjunction with the NMFS in July of 1982 involving the direct observation of setline gear through the use of the NMFS submersible *Nekton Gamma*. The primary objective of the survey was to observe bait loss through repetitive dives to observe snap gear hooks baited alternately with herring, Pacific cod, salmon, and octopus. A second and equally important objective was a comparison of the fishing characteristics of snap gear and conventional longline gear. Very little information is available regarding this study.

Survey design

Fishing pattern

In the first experiment, the *Tiffy* set snap gear in various depths and bottom types. The *Nekton Gamma* then observed the gear noting relative loss of the various bait types and hooked species. One IPHC biologist worked in the submersible and the other remained aboard the *Tiffy* to record catch and bait data during retrieval. The fishing technique used by the crew of the *Tiffy* did not appear to be as effective as those used on vessels with more experienced halibut fishing crew, which probably reduces the reliability of the data collected.

For the second experiment the *Thor* set fixed-hook gear and the *Tiffy* set snap gear for observation by the *Nekton Gamma.* The observations were used to compare the fishing characteristics of fixed-hook versus snap-hook setline gear. There were three biologists aboard the *Thor* to record data from the fixed-hook set. It was determined before the charter that at least four days of comparative gear work would be needed to enable the vessels to set gear on different bottom types and in different depths in order to provide some idea of the various factors causing differences in CPUE between the two gear types. Since the *Thor* was only able to participate for one day, the data from the survey's secondary objective may not have been analyzed.

Gear and bait specifications

The *Tiffy* used snap gear, the predominant gear in the halibut fishery at the time. The *Thor* used conventional fixed-hook gear with 1,800-foot skates containing approximately 85 large J-hooks spaced at intervals of 21 feet.

Herring, salmon, Pacific cod, and octopus were used as bait aboard the *Tiffy*. The *Thor* may have only used herring, salmon, and Pacific cod. It is not known whether all bait types were used on each set or if the baits were alternated among hooks.

Sampling protocol

The purpose of this survey was to observe the retention and loss of various types of bait on longline gear, and to determine how many hooked halibut are actually brought to the surface. All hooks were monitored at the time the gear was hauled and information on bait presence or loss, and information on fish caught (including length, sex and otoliths for halibut) was recorded. Data such as bait loss, fish caught (and lost), bottom type was gathered by the submersible crew. The disposition of the data obtained during this survey is unknown. No logbooks or data could be located from the *Tiffy* charter. The data from the one set made by the *Thor* was given immediately to the IPHC lead biologist aboard the NMFS vessel and was not included in the grid survey data set.

1983 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Evening Star*	2B	Hecate Strait	May 20 – June 2	1	1-47
F/V *Masonic*	3A	Portlock/ Albatross grounds and Seward Gully	May 2 – June 7	1-2	1-103
F/V *Polaris*	2C	Southeast Alaska inside and outside waters	April 29 – June 9	1-2	1-129
F/V *Windward Isle*	2B	Vancouver Island to Cape St. James	May 21 – June 6	1	1-43

Fishing effort	322 sets
Legal-sized halibut	8,037 fish
Tagged halibut	4,630

The IPHC standardized stock assessment grid survey was continued for the 8th consecutive year. The grid survey entailed fishing a predetermined grid of stations on a 6 nmi x 12 nmi grid. The surveys were designed to obtain information on the adult halibut population independent from information collected from the commercial fishery. Halibut without serious injuries were tagged, resulting in a systematic dispersal of tagged fish in each survey region. The 1983 survey included the core areas of 2B and 3A as well as 2C, which included some stations not fished in the 1982 survey.

Since 1976, an attempt had been made to conduct the grid survey during the same time period each year, generally August and September. The 1980 grid survey was done in June and August to test if a temporal difference affected the catch. Following the results of this experiment and considering the difficulties in scheduling charters around commercial openings, it was decided that the timing of the grid survey in subsequent years may vary within the summer months. The period of May and June was chosen in 1983 to provide more time for analysis prior to the annual meeting.

Several supplemental projects (a continuation of the gear comparison, fish length-weight data collection, and oxytetracycline project) were incorporated into these charters. The 1983 surveys caught 8,037 halibut, of which 3,407 fish were used to estimate the size, sex, and age composition of the catches. The remaining 4,630 halibut were tagged and released.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1983 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design in Areas 2B and 3A was continued from 1982. Some stations may have been skipped if deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects.

In addition to the core areas in 2B and 3A usually fished during the stock assessment survey, an additional vessel was chartered to survey the inside and outside waters of Area 2C. The offshore stations in southeast Alaska were continued from 1982 and laid out in the same manner as the stations in Area 2B. Because surveying by transect was considered impractical in the inside waters of Area 2C, these stations were grouped by geographic area. The areas chosen were those which received a significant amount of effort by the commercial fleet. Exact station locations were predetermined based upon a systematic method consistently applied between areas. Several additional stations were added to the inside waters in 1983 to more adequately cover known commercial grounds. The plan was for the *Polaris* to skip alternate transects on the outside waters of southeast Alaska, but adjoining transects were sometimes fished if there was enough run time or if it was felt that additional coverage was required. Appendix I Figure 13 shows station placement for the 1983 standardized grid survey.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect. Stations in the inside waters of southeast Alaska were assigned a simple 3-digit designation beginning with 401 in the south and continuing north through number 802. Station numbers were sequential within each geographical area and blocks of numbers were skipped between areas in case stations were added in the future.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0600 and the first gear was hauled around 1100. All vessels averaged four stations per day, fishing eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak was 12 hours. Slightly different standards applied when fishing the inside waters of southeast Alaska. In this area, four to eight stations were fished per day depending upon the geographic area. Four to seven skates were fished at each station. The plan was for setting the southeast stations beginning at 0500 hours and to haul the first stations at 1000 hours regardless of the number of stations set that day. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All survey vessels used conventional fixed-hook setline gear with large J-hooks. *The Evening Star* used skates of 1,500-foot groundline with hooks spaced at 18-foot intervals providing approximately 85 hooks per skate. The *Polaris* used 1,800-foot skates with hooks spaced at intervals of 21 feet providing around 83 hooks per skate. The *Masonic* and *Windward Isle* both used 1,800-foot skates with hooks spaced at 26-foot intervals providing around 70 hooks per skate. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or

more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

Salmon, herring, and Pacific cod were baited alternately among hooks on each skate (i.e., each bait was used on every third hook). Fresh shack bait of any type could be used if the vessel ran out of frozen cod that had been purchased before the trip.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were to be tagged and tagging was to have occurred at all stations). This was accomplished by tagging only halibut in the very best condition (i.e., fish with only minor injuries, those hooked in the jaw or cheek and with no sign of bleeding or stress) so that the remainder could be used for sex and age samples. If it became apparent later in the charter that insufficient fish were being sampled for age and sex, then the proportion tagged was reduced (e.g. only every other fish might have been treated as a tagging candidate).

Biologists collected the left-side otolith and sex and maturity data from injured halibut. If the left-side otolith was lost or crystallized, the right-side otolith was collected. Sex was recorded as either male or female. The observed state of maturity was recorded as either immature or mature on the *Windward Isle*. The remaining vessels did not record the stage of maturity. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded. If a halibut was lost at the roller, a note was made on the haul summary form. Estimated lengths of lost fish were not recorded. Similarly, if only a head returned, the occurrence was noted but an estimated length was not recorded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were to have been recorded on the back of the data sheets.

Oceanographic data

Sea surface and bottom temperatures were recorded at stations as opportunity and time permitted. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

Supplemental projects

Oxytetracycline hydrochloride otolith marking

Injections of oxytetracycline hydrochloride (OTC) were given to halibut by IPHC staff on the *Masonic,* while it was being shadowed by the *Valorous* which was conducting a concurrent gear comparison project (see 1983 Snap and Fixed-hook Gear Comparison Grid Survey). The injections were given to create a timestamp in the otolith. Upon examination under ultraviolet light, the time mark can be seen on one annuli resulting in a more accurate age determination. Only halibut less than 75 cm were chosen to receive injections.

Length-weight study

If time permitted, individual fish were weighed at sea during the Area 2C southeast Alaska survey. This was a continuation of the project that began during the 1982 grid surveys. Ten fish in each 10 cm size class were to be sampled for weight at sea; a sub-sample was to be weighed at the time of unloading. The instructions during each trip were to measure 10 fish in each length interval to the nearest centimeter, take an otolith, and weigh the fish to the nearest pound. Each fish was numbered in the order of collection; this number was recorded on the otolith envelope. Three of the fish from each 10-cm interval were marked with a numbered jaw tag and a rubber band was placed around the caudal peduncle. The first of the three fish in each 10 cm size class were marked on the first two days of fishing, the second three in the middle of the trip, and the third on the last two days. Biologists measured and weighed these fish before evisceration (dressing) and again after evisceration. The tag number was recorded on the otolith envelope. During unloading, all jaw-tagged fish were measured and weighed prior to heading. After heading, the tagged heads were weighed and tags were removed.

1983 Catchability spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Lorelei II (Longliner)* F/V *Pacific Harvester (Trawler)*	3A, 2B	Portlock Bank to the Fairweather grounds and Vancouver Island to Dixon Entrance	May 10 – June 9	1-2	1-79

Fishing effort	40 stations 2 sets per station 2 – 4 trawls per station
Legal-sized halibut	754 fish
Sublegal-sized halibut	867 fish

The setline vessel *Lorelei II* and the trawler *Pacific Harvester* were chartered to conduct a comparative trawl-setline study in British Columbia and in the Gulf of Alaska during 1983. This survey was a continuation of the 1982 catchability study conducted by the setline vessel *Proud Canadian* and trawler *Nore-Dick*. The 1983 survey was designed to determine if setlines were less effective at catching halibut in British Columbia than in Alaska, where commercial CPUE is much higher. This survey varied from the 1982 study in that locations were chosen. In both 2B and 3A, the fishing effort was increased at each station, and both gear types were fished during the same day.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The IPHC specified

general areas providing a fairly even dispersion of effort along the B.C. coast in Area 2B and the northern Gulf of Alaska in Area 3A. Area 2C was not included in this survey because the bottom was generally considered too rough for trawling. Exact set locations in Areas 2B and 3A were chosen on grounds where the bottom was smooth enough to avoid damage to the trawl net. The sampling design varied from that used in 1982 in that fishing effort was increased on each station and both gears were fished during the same day. A total of 40 stations were sampled: 18 in Area 2B and 22 in Area 3A.

Fishing pattern

The *Lorelei II* set two sets at each station and fished two stations each day. Each set normally had eight skates, though the number often varied between five and eight. The first two sets were fished at the first station in the morning between 0500 and 1200. The second station was fished in the afternoon, generally between 1300 and 1900. Trawl gear, fished by the *Pacific Harvester*, was set at the same time and fished systematically between and around the longline sets. The number of trawl sets per station ranged from two to four. There were 754 legal-sized halibut and 867 sublegal-sized halibut caught.

Gear and bait specifications

The *Lorelei II* used conventional fixed-hook longline gear typical in the commercial halibut fishery at the time. Each skate was 1,800 feet long with approximately 72 large J-hooks (Mustad No. 6282) spaced along the groundline at 25-foot intervals.

Sixty of the 79 sets made by the *Lorelei II* were baited with salmon and herring on alternate hooks. The remaining 19 were baited with salmon, herring, and Pacific cod. The cod bait was likely fresh fish that had been caught incidental to survey operations.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. All legal-sized halibut (≥82 cm) were sacrificed, the sex was noted as male or female, and otoliths were collected. Sublegal-sized halibut were released immediately after measurements were taken. No fish were tagged during this charter.

Bycatch and hook occupancy

On the setline vessel, all fish caught at each station were counted and identified by species or species group. The weight of other species was estimated by weighing up to 10 individuals in each species group on each station and extrapolating the average weight to the total count. The total weight of the trawl catch was obtained using a Dynameter scale.

Oceanographic data

No air, sea surface, or bottom temperatures were taken during this survey.

1983 Submarine observation and hook type survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *China B*	2C	Southeast Alaska near Sitka	Late July to early August	Unknown	Unknown

A study of setline gear was conducted in late July and early August near Sitka, Alaska when snap gear set by the IPHC-chartered vessel *China B* was observed underwater by the submersible *Mermaid II*, which was under charter to NMFS. In addition to setting gear for the submersible to observe, the *China B* also conducted an experiment comparing circle hooks with conventional halibut J-hooks. This experiment was conducted to test reports by halibut fishermen that the circle hooks were more effective in catching halibut than the conventional halibut hook.

Survey design

Station pattern

This was a spot fishing operation. Methods used to determine setting locations for observation by the submersible were not documented. As well, setting and hauling protocols employed by the *China B* are unknown. Presumably, the underwater observation study was similar in design to that utilized by the IPHC chartered vessels *Tiffy* and *Thor* when setting gear for the NMFS submersible *Nekton Gamma* in 1982.

Gear and bait specifications

Two experimental designs were used in the hook type study. The first involved alternating hook-type within each skate fished (i.e., a circle hook followed by a traditional J-hook). The second design called for alternating hook type on every other skate. It's unknown what role (if any) the NMFS submersible played in the hook-type study.

The *China B* used snap-hook setline gear and a combination of circle and J-hooks. Bait types used for the submarine observation and hook type surveys are unknown.

Sampling protocol

The type and disposition of data obtained during this survey is unknown. Halibut catch records must have been obtained since the 1983 annual report indicated 39% and 61% more fish were caught using circle hooks during the two experimental designs utilized for the hook comparison study.

Color footage of surface and underwater scenes were taken by the *Mermaid II*. A preliminary 25-minute preview film was produced in cooperation with NMFS describing the submersible operation, some fishing scenes, and the action of fish while hooked on the gear.

1983 Circle hook and J-hook gear comparison spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Windward Isle*	3A, 2B	Cape Cleare and Kayak Island and Queen Charlotte	October 25 – November 28	2-3	44-87

Fishing effort	43 sets

The *Windward Isle* was chartered in October and November of 1983 to conduct an experiment comparing the relative effectiveness of J-hooks and circle hooks. The first trip was in the central Gulf of Alaska and the second took place in northern British Columbia. This charter was performed following a similar experiment conducted by the *China B* in early August that was initiated to test reports by halibut fishermen that the circle hooks were more effective in catching halibut than the conventional halibut hook

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Fishing pattern

The *Windward Isle* generally alternated setting two sets on one day followed by four sets the following day. Each set consisted of either four or eight skates of alternating circle and J-hooks. Each skate contained only one hook type. The skates of circle and J-hooks were alternated between sets (i.e., if a skate of circle hooks was set first on the first set, a J-hook skate was set first on the following set).

Setting usually began around 0500 and the first set was hauled at about 1000. All gear was usually aboard before 2200. Soak times varied from five to 18 hours.

Gear and bait specifications

The *Windward Isle* used conventional fixed-hook setline gear typical in the commercial halibut fishery at the time. Each skate was 1,800 feet long and had either circle or J-hooks spaced every 26 feet providing approximately 70 hooks per skate. Each skate had only one hook type.

Most skates were baited with salmon, herring, and Pacific cod on alternating hooks (i.e., each bait type was used on every third hook).

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number.

Halibut found unfit for tagging were sampled for sex, and the left-side otolith was collected. Sex was recorded as either male, female, or unknown. The observed state of maturity was not recorded. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by set. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count.

Oceanographic data

Sea surface and bottom temperatures were recorded approximately once per day as opportunity and time permitted. Sea surface temperatures were measured with a hand-held

thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

Supplemental project

Oxytetracycline hydrochloride otolith marking

Injections of oxytetracycline hydrochloride (OTC) were given to tagged halibut to mark the otolith and permit a more accurate age reading. All halibut in a defined size range suitable for tagging were to be injected with OTC. The injections were given intraperitoneally, i.e., directly into the body cavity. Multiple injections may have been necessary on larger halibut.

1983 Snap and fixed-hook gear comparison grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Valorous*	3A	Portlock Bank and Seward Gully	May 18 – June 3	1	1-48

Fishing effort	48 sets
Legal-sized halibut	1,183 fish
Sublegal-sized halibut	264 fish

This survey was a continuation of the snap versus conventional gear comparison experiment begun in 1982. The main objective of this survey was to estimate the relative efficiency of snap gear to fixed-hook gear as a function of the relative haul speed. The *Valorous* was chartered in 1983 to set snap gear parallel to the *Masonic*, while the *Masonic* fished fixed-hook gear as part of the 1983 standardized grid survey. The two vessels fished 46 comparable stations side-by-side at a distance of about 1.25 km apart. There were 1,183 legal-sized halibut and 264 sublegal-sized halibut caught.

Survey design

Station pattern

The charter was completed on standardized stock assessment survey stations. The stations were spaced 6 nmi apart on transects berthed 12 nmi from each other. Approximately 50 stations were selected in the Portlock Bank and Seward Gully areas of the grid survey. Appendix I Figure 14 displays stations fished on this gear comparison survey.

Fishing pattern

Eight skates were to be fished at four stations each day by both the *Masonic*, using fixed-hook gear, and the *Valorous,* using snap gear. The *Masonic* attempted to set gear so the midpoint of the set was at the center of each station, with the direction of setting the same as the line of stations, i.e., north-south in the Kodiak region. The *Valorous* set snap gear parallel to the gear set by the *Masonic* at a distance of at least 0.5 nmi to avoid gear competition and interference. The depth and bottom type for the two parallel sets was as similar as possible. The *Valorous* fished

on the same side of the *Masonic* for all four stations fished in one day and alternated sides every other day. The fishing plan may have been changed if required by weather or other logistical problems, but under no circumstances was the setting to be altered to intentionally increase or decrease the catch. Soak times were to vary among stations but were relatively constant from day to day. Within a day, soak time ranged from six to 12 hours, though occasional adjustments were necessary due to weather and other problems.

A precise setting and hauling schedule was to be followed by both vessels for each day of fishing. The *Valorous* and *Masonic* were to begin hauling at the same time at each station. The *Valorous* was to haul gear at varying speeds in relation to the *Masonic*. These speeds were designated as slow (30 min. slower than *Masonic*), normal (same as *Masonic*) and fast (30 min. faster than *Masonic*). The *Masonic* was instructed to try to maintain a consistent haul speed throughout the charter. A predetermined schedule specified the haul speed the *Valorous* was to use for every set on each day of the survey. The lead biologist's comments and the poor weather encountered during the charter indicate it is unlikely this experiment could be completed as intended.

Gear and bait specifications

The snap gear used by the *Valorous* was to mimic the grid survey gear set by the *Masonic*. The average hook spacing achieved by the *Valorous* was 25 feet providing about 75 hooks per 1,800-foot skate. The *Masonic* gear was set at 26 feet providing 70 to 72 hooks per 1,800-foot skate. Both vessels used large J-hooks.

Salmon, herring, and Pacific cod were baited alternately among hooks on each skate (i.e., each bait was used on every third hook). Fresh shack bait of any type was used if the vessel ran out of frozen cod that had been purchased before the trip. The salmon bait was primarily chum salmon.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were tagged and tagging occurred at all stations). The majority of fish caught aboard both the *Valorous* were tagged and released. Halibut deemed unsuitable for tagging were dressed and iced for sale. Sex was recorded as either male, female, or unknown when the gonads were unavailable for examination due to predation or mishandling on deck. No otoliths were taken and the observed state of maturity was not recorded.

Bycatch and hook occupancy

No observations were made of the hooks as they were retrieved, and no data were recorded regarding the incidental catch of other species.

Oceanographic data

No oceanographic data were collected on this cruise.

Supplemental project

Oxytetracycline hydrochloride otolith marking

Injections of oxytetracycline hydrochloride were given to tagged halibut to mark the otolith and permit a more accurate age reading. All halibut in the size range suitable for tagging were

to be injected with OTC. The injections were made intraperitoneally. Multiple injections may have been necessary on larger halibut.

1984 Circle and J-hook comparison standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	2C, 3A	Southeast Alaska (inside and outside) and Portlock/ Albatross Banks	May 29 – July 27	1-4	1-197
F/V *Seymour*	3A	Portlock/ Albatross Banks and Seward Gully	June 27 – July 27	1-2	1-104
F/V *Star Wars II*	2B	Cape Scott to Dixon Entrance	June 11 – July 7	1-2	1-74
F/V *Windward Isle*	2B	Cape Scott to Dixon Entrance	June 8 – 25 and August 29 – September 24	1-3	1-94

Fishing effort	469 sets

The IPHC standardized stock assessment grid survey was continued for the 9th consecutive year. The grid survey entailed fishing a predetermined pattern of stations on a 6 nmi x 12 nmi grid. The surveys were designed to obtain information on the adult halibut population independent of the commercial fishery while providing a measure of recruitment of the adult population via sublegal-sized halibut. Halibut without serious injuries were tagged, resulting in a systematic dispersal of tagged fish in each survey region. Prior to the 1984 surveys, the IPHC staff noted that circle hooks were rapidly replacing the traditional J-hooks in the commercial halibut fishery. It was widely believed at the time that fishermen were able to obtain a considerably higher CPUE by using the new hooks. Because all previous surveys used traditional J-hooks, it was clear to the IPHC biologists that a catch rate index for circle hooks was needed for halibut stock assessment. Therefore, the 1984 stock assessment surveys in Areas 2B and 3A were conducted in conjunction with a comparison of circle and J-hooks. Comparative fishing of circle and J-hooks was conducted by the *Windward Isle* and *Star Wars II* in Area 2B during June-September, and by the *Chelsea* and *Seymour* in Area 3A in July.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1984 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design in Areas 2B and 3A was continued from 1983. Some stations were skipped if deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects. Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed every 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects. No additional gear outside of the survey design was fished.

In addition to the core areas in 2B and 3A typically fished during the stock assessment survey, a vessel surveyed the inside and outside waters of Area 2C. The Southeast survey was initiated in 1982 with new areas added for the 1983 survey. During 1984, circle hooks were used exclusively for the first time in southeast Alaska. The offshore stations in southeast Alaska were continued from 1983 and laid out in the same manner as the stations in Area 2B. Because surveying by transect was considered impractical in the inside waters of Area 2C, these stations were grouped by geographic area. Surveys on the inside waters focussed on areas where the commercial fleet concentrated effort. Exact station locations were predetermined based upon a systematic method consistently applied between areas. The plan was for the *Chelsea* to skip alternate transects on the outside waters of southeast Alaska, but adjoining transects were sometimes fished if there was not enough run time or if additional coverage was required. Appendix I Figure 15 shows the stations fished on this survey.

Stations in the inside waters of southeast Alaska were assigned a simple three-digit designation beginning with 401 in the south and continuing north through number 675. Station numbers were sequential within each geographical area and blocks of numbers were reserved for future survey expansion. Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect.

Fishing pattern

Between four and eight stations were set each day in the inside waters of southeast Alaska, fishing between four and seven skates at each station. The plan called for setting the southeast stations beginning at 0500 hours and to haul the first stations at 1000 hours regardless of the number of stations set that day. Under no circumstances was the setting altered so as to increase or decrease the catch.

In Areas 2B and 3A, each boat fished both circle and J-hooks in an alternating pattern by station. Boat "A" fished down the center of each station and boat "B" fished about 0.5 nmi from boat "A". Boat "B" alternated daily, fishing to the starboard and port of boat "A". Four stations were fished each day, alternating hook type by station. Boat "B" would begin with the opposite hook type from boat "A". For simplicity, the *Windward Isle* was designated boat "A" in Area 2B and the *Chelsea* was boat "A" in Area 3A.

Eight skates were set through the center of each station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. An attempt was made to keep the gear, bait, setting, and the hauling similar on both boats. The gear was set from 0500 hours to 0700 hours each morning, without a break except for the runs between stations. The sets were hauled in the same order in which they were made. The first set was always hauled starting at 1000 hours, the second set at 1300 hours, the third at 1600 hours, and the forth at 1900 hours. These times were exceeded on a few occasions when hauling was slow due to large catches or gear problems. Usually the boats arrived at the stations 10-30 minutes early, and drifted or jogged until the starting time.

A typical set took slightly over two hours to haul. A slightly different design was used at over half of the stations in Area 2B because the *Windward Isle* suffered mechanical problems about 15 days into the charter. During this time only one vessel was used, which set the second or "parallel" set after the first, rather than simultaneously. This resulted in two comparative sets each day. On several sets, the wrong hook type was mistakenly used. For these sets, hook type was coded as "M" for mixed.

Gear and bait specifications

All vessels used conventional fixed-hook setline gear of the type normally used in the halibut fishery. The *Star Wars II* and *Windward Isle* fishing in Area 2B both used 1,500-foot skates of groundline with alternating circle and J-hooks spaced at 25-foot intervals providing approximately 60 hooks per skate. The *Chelsea* and *Seymour* fishing in Area 3A both used 1,500-foot skates of groundline with alternating circle and J-hooks spaced at intervals of 21 feet providing around 75 hooks per skate. During the southeast Alaska survey in Area 2C, the *Chelsea* fished with circle hooks. The logbook from the *Seymour* included the original labels taken from the hook boxes. These labels indicate that both the circle and J-hooks were manufactured by O. Mustad and Son Inc. of Albany, New York. The J-hooks were quality no. 9401, size 6282, and the circle hooks were quality no. 39965, size 3. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

The 1984 standardized stock assessment survey differed from previous years by using only frozen salmon and herring as bait. The two bait types were varied uniformly among hooks on each skate (i.e., each bait was used on every second hook). The salmon bait consisted of whole frozen salmon, salmon tails, or heads.

Sampling protocol

Halibut sampling

Samplers recorded the fork length to the nearest centimeter of every halibut landed or estimated a length for halibut lost at the roller (within gaffing distance). Fork lengths were recorded along with the corresponding skate number. For all fish, the location and severity of the hooking injury and hook type was recorded.

Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were tagged and tagging occurred at all stations). Biologists only tagged halibut in the very best condition, those with minor hooking injuries and exhibiting no sign of bleeding or stress, so that the remainder could be used for sex and age samples.

Biologists collected the left-side otolith and sex and maturity data from injured halibut. If the left-side otolith was lost or was crystallized, the right-side otolith was collected. To ensure that the age and sex sample was representative of the halibut catch, otoliths were collected and sex was recorded for every third halibut caught smaller than 175 cm and all halibut >175 cm. Sex was recorded as either male or female. The state of sexual maturity was not recorded on any of the vessels.

Bycatch and hook occupancy

For other species of fish and for sea stars, the numbers and estimated aggregate weights caught per set were recorded. If time permitted, individual weights and lengths were recorded on the back of the data sheets. On the *Seymour* only, all hooks of the first two skates of each set were

tallied as to whether they came in empty, with bait remaining, or with a catch of fish or starfish.

Bait loss at the chute was recorded on the *Chelsea* on three mornings of trip one, and on the *Seymour* on three mornings of trip one and two mornings of trip two.

Oceanographic data

Sea surface and bottom temperatures were recorded at stations as opportunity and time permitted on the "A" vessels only (*Windward Isle* and *Chelsea*). Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

Supplemental projects

Outside agency collaboration

Forty-two halibut between 96 cm and 140 cm were iced round aboard the *Seymour*. These fish, weighing approximately 1,200 pounds net, were saved for the University of Alaska to create a film on how to properly dress a halibut.

1984 Pribilof Island stratified survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Valorous*	4C	Pribilof Islands, St. George Island, and St. Paul Island	June 26 – July 17	1	1-37

Fishing effort	248 skates
Legal-sized halibut	2,372 fish 52,459 lbs
Sublegal-sized halibut	264 fish
Tagged halibut	1497 fish

The *Valorous* was chartered in 1984 after Pribilof Island residents petitioned the IPHC to create a regulatory area with a separate quota around the islands. The primary goals of this survey were to establish CPUE by depth strata on fishing grounds around the Pribilof Islands and to develop a separate quota for the area.

The *Valorous* set 248 standard skates at 37 stations using snap gear with circle hooks. A total of 2,372 halibut were caught weighing 52,459 pounds. Of these, 1,497 halibut were tagged and released, 611 were sampled for age, length, and sex information, and 264 fish under 82 cm were measured and returned to the sea.

Survey design

Station pattern

The survey was designed by drawing transects beginning near shore from both St. George and St. Paul Islands and extending outward to a depth of at least 50 fathoms. Four transects were

created around St. George Island and six transects were drawn around St. Paul Island. Survey stations were placed along these transects on the 10, 20, 30, 40, and 50 fathom contour lines. Appendix I Figure 16 shows the stations fished during this survey.

Fishing pattern

The *Valorous* fished the first four days off of St. George Island in the 15 to 50 fathom depth range, and the remaining six days off St. Paul Island in the 6 to 40 fathom range. Three or four stations were set each day fishing eight skates at each station. Setting generally began around 0530 and the first set was hauled at around 1030. All gear was usually aboard by 2200, though sometimes the last set was not aboard until early the next morning due to unusually heavy fishing in some areas.

Gear and bait specifications

The *Valorous* used snap gear with large circle hooks space along the line at an average of 25 feet. Skates of groundline were 1,800 feet long, each containing approximately 75 hooks. All hooks were baited with salmon, herring, and Pacific cod. Each type of bait was alternated among hooks (i.e., each bait was used on every third hook).

Sampling protocol

Halibut sampling

The fork length of all halibut landed aboard the *Valorous* was measured to the nearest centimeter and recorded with its corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number.

Halibut found unfit for tagging were sampled for sex, and the left-side otolith was collected. If the left-side otolith was lost or was crystallized, the right-side otolith was collected. Sex was recorded as either male or female or unknown. The observed state of maturity was recorded as either immature or mature. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded. An unusually high number of halibut were "measured-only" because the vessel had an insufficient supply of tags and otolith envelopes. The scientific crew selected legal-sized fish for tagging rather than sublegal-sized fish.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by set. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count.

Oceanographic data

Sea surface and bottom temperatures were recorded approximately once per day when opportunity and time permitted. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

1984 Hook-size setline and trawl comparison spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Pacific Harvester*	2B	Masset and Carpenter Bay	July 18 – August 3	3	1-12

Fishing effort	12 sets
Legal-sized halibut	205
Sublegal-sized halibut	1,068
Tagged halibut	~1,100

The *Pacific Harvester* was chartered in 1984 to perform a gear study in Area 2B. Two general areas were chosen for the survey with 10 stations being fished off of Masset, north of Rose Spit, and two stations fished outside of Carpenter Bay in Hecate Strait. The objective of this survey was to provide information on the relative efficiency and size composition of halibut caught using large and small circle hooks on setline gear compared with halibut captured by trawling. There were 205 legal-sized halibut and 1,068 sublegal-sized halibut caught. The *Pacific Harvester* tagged and released 1,100 halibut over the course of the charter.

Survey design

Station pattern

This was a spot fishing operation. The captain chose the exact fishing location for each set within an area specified by Commission biologists. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Fishing off Carpenter Bay was limited because the topography of the ocean bottom was not considered suitable for the trawl portion of the project.

Fishing pattern

The *Pacific Harvester* completed two stations each day. Each station was set with one set of setline gear consisting of five skates with alternating large and small circle hooks (i.e., each every other hook in each skate was a small hook). The vessel maintained a consistent setting and hauling schedule. The first setline set was set at around 0630 each morning and the second set was set at around 0700. Hauling began at the first set at around 1030 and was generally completed by 1300. The second set was generally hauled between 1530 and 1800. The vessel also completed either two or three trawl tows *daily* of approximately 25 minutes each. The tows were between and around the setline station locations. The first tow was made in the morning after the gear was set, the second tow was completed after the first setline set was hauled, and the third tow (if done) was completed after the last setline set was hauled.

Gear and bait specifications

The *Pacific Harvester* used conventional fixed-hook longline gear, the predominant gear in the commercial fishery. The skates were 1,800 feet long with large and small circle hooks space alternately at 12-foot intervals. Each skate contained approximately 120 hooks (60 large and 60 small).

The vessel used a combination of herring and salmon on some sets and herring and cod on other sets. It is not known whether a combination of baits was used on each skate.

Sampling protocol

Halibut sampling

The fork length of all halibut landed aboard the *Pacific Harvester* was measured to the nearest centimeter and recorded with its corresponding skate number. Records were also kept for every halibut noting whether it was caught on a large or small hook and whether the hook was baited with salmon, herring, or cod. Sublegal-sized halibut (<82 cm) with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number.

Legal-sized halibut were either measured, tagged, and released, or were sampled for sex and subjected to otoliths removal and iced for sale. Sex was recorded as either male or female or unknown. The state of maturity was not recorded. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught by either the trawl or setline gear during the survey was recorded by set. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count.

Oceanographic data

Sea surface and bottom temperatures were recorded at every station. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

1985 Oregon coast grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Blue Harvest*	2A	Oregon Coast from Heceta Bank to Stonewall Bank	August 6 - 17	1	1-23

Fishing effort	40 skates
Legal-sized halibut	237 fish 3,459 lbs

During August of 1985, the setline vessel *Blue Harvest* fished 23 sets (40 skates) off the central Oregon coast. The primary purpose of this charter was primarily stock assessment—to determine the distribution of halibut over the central Oregon grounds, to estimate relative abundance of fish in the study area, and to gather information on the size and age structure of the population with particular emphasis on sublegal-sized fish. The secondary purpose of this charter was to assess the feasibility of conducting a grid survey in Area 2A. The *Blue Harvest* caught a total of 237 halibut weighing 3,459 pounds.

Survey design

Station pattern

A survey grid was designed to include waters both inside and outside known fishing grounds from Heceta Bank to Stonewall Bank. Transects were drawn using plots of commercial halibut grounds and six stations were placed along each transect at regular intervals of about 8 nmi to cover a total coastal area of about 454 nmi. Transects were chosen to coincide with Loran W lines from 13180 to 12880 at intervals of 60 microseconds. The extent of the fishing area and number of stations were subject to budget limitations.

Four stations occupied each transect. Two stations in each transect were pre-selected based upon historical stock information. Additional stations were pre-selected but were only fished at the discretion of the lead biologist and captain. Alternate stations within 2-3 nmi of the transect line were fished to increase understanding of stock distribution and abundance. In choosing these alternate stations, consideration was given to proximity to other stations along the transect and the bottom depth. Plots made of the recorded station locations reveal many sets may not have been placed in the intended locations. Survey instructions gave the captain an allowance of 2-3 nmi from the transect line, but it is likely greater discrepancies happened due to problems setting the gear or difficulty in using the vessel's Loran unit. The survey covered a depth range of 28 to 108 fathoms. Appendix I Figure 17 shows stations fished during the 1985 Oregon coast grid survey.

Fishing pattern

The *Blue Harvest* generally set four stations per day fishing between two and three skates per station. The gear was set between 0630 and 1000 each morning and hauled after a minimum soak of three and one-half hours. All gear was usually aboard before 1800.

Gear and bait specifications

The *Blue Harvest* used snap gear during the survey. Each skate of snap gear was approximately 1,800 feet long with about 45 circle hooks spaced at 40-foot intervals along the groundline.

Records indicate that pink salmon was the primary bait purchased and used for the charter. The vessel began using a combination of pink salmon and shack bait on sets 18 and 19 as salmon supplies dwindled. Sets 20 through 23 were baited entirely with shack bait, consisting primarily of octopus and sablefish.

Sampling protocol

Halibut sampling

The fork length of every halibut landed aboard the *Blue Harvest* was measured to the nearest centimeter and recorded with its corresponding set number. All halibut caught during the survey were sacrificed for sex determination and otolith collection. No fish were tagged during the charter. Sex was recorded as either male, female, or unknown. The state of maturity was not recorded. Legal-sized halibut were retained aboard the vessel along with blue sharks, soupfin sharks and assorted other bycatch species and iced for sale at the end of the trip. Sublegal-sized halibut were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by set. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count.

Oceanographic data

No oceanographic data were collected on this cruise.

1985 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	2B, 2C	East of Cape St. James and Southeast Alaska	May 7 – June 10 August 18 - 28	1-3	1-107
F/V *Chelsea*	3A	Portlock/ Albatross grounds and Seward Gully	May 6 – June 17 September 1 – 3	1-3	1-97; 152-158
F/V *Star Wars II*	2B	Cape Scott to Dixon Entrance	May 7 – June 2	1-2	1-80

Fishing effort	290 sets
Legal-sized halibut	13,465 fish
Tagged halibut	8,046 fish

The IPHC standardized stock assessment grid survey was continued for the 10th consecutive year. The grid survey entailed fishing a predetermined grid of stations on a 6 nmi by 12 nmi grid. The surveys were designed to obtain information on the adult halibut population that is independent of the commercial fishery data. Halibut without serious injuries were tagged, establishing a systematic dispersal of tagged fish in each survey region. The 1985 survey included the core areas of 2B and 3A as well as 2C. A total of 13,465 halibut were caught, of which 6,130 were sampled to estimate the sex and age composition of the catches, 140 were measured and released, while the remaining 8,046 halibut were measured, tagged and released

Several additional projects were performed in 1985 as a supplement to the grid survey. These included dead halibut collections for NMFS, live halibut collections for the Marrowstone Marine Field Station in Marrowstone, Washington, and cooperative research in southeast Alaska with ADF&G.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1985 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design in Areas 2B and 3A was continued from 1984. Some stations may have been skipped if deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of around 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects.

In addition to the core areas in 2B and 3A usually fished during the stock assessment survey, a vessel was chartered to survey the inside and outside waters of Area 2C. The offshore stations in Southeast Alaska were continued from 1984 and laid out in the same manner as the stations in Area 2B. Surveying by transect was impractical in the inside waters of Area 2C, so these stations were instead grouped by geographic area. The chosen sampling areas coincided with those that received a significant amount of effort by the commercial fleet. Exact station locations were predetermined based upon a systematic method consistently applied between areas. The survey manual allowed for changes in the design to be made by the biologist in charge during the course of the operation. Appendix I Figure 18 shows stations fished on the 1985 standardized grid survey.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect.

Stations in the inside waters of southeast Alaska were assigned a simple three-digit designation beginning with 403 in the south and continuing north through number 824. Station numbers were sequential within each geographical area and blocks of numbers were skipped between areas in case stations were added in the future.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. When feasible, the direction of setting was to have been the same as the line of stations (along transect lines), i.e., north-south in Area 3 and east-west in Area 2B. Setting began around 0500 and the first gear was hauled around 1000. Vessels surveying Areas 2B and 3A averaged four stations per day. The *Chelsea* in Area 3A set six skates at each station while the *Star Wars II* in Area 2B set eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak was 12 hours.

Slightly different standards applied for the Area 2C survey. When fishing the inside waters of southeast Alaska the vessel set six skates per station, completing between four and eight stations per day depending on the limits of the geography. The plan was to begin setting the southeast Alaskan stations at 0500 hours and to haul the first stations at 1000 hours regardless of the number of stations set that day. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All survey vessels used conventional fixed-hook setline gear, the predominant gear in the halibut fishery. Circle hooks were first used in 1984. Both circle hooks and J-hooks were fished in Areas 2B and 3A in a hook comparison study of 1984. Ratio estimators were determined for comparison of effort between the two gear types. During 1985, only circle hooks were used on survey. The *Cape Flattery* fished skates with 1,800-foot groundline and hooks spaced at 24-foot intervals providing approximately 75 hooks per skate. The *Chelsea* used 1,500-foot skates with hooks spaced at intervals of 21 feet providing around 75 hooks per skate. The *Star Wars II* fished 1,500-foot skates with hooks spaced at 26-foot intervals providing around 75 hooks per skate. The hook count and hook spacing was checked on the first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

Only frozen salmon and herring were used as bait. The two baits were varied uniformly among hooks on each skate (i.e., each bait was to be used on every second hook). The type of salmon bait used was not specified and consisted of any species of whole frozen salmon, salmon tails, or only salmon heads.

Sampling protocol

Halibut sampling

The fork length of every halibut caught was measured to the nearest centimeter and recorded with the corresponding skate number. If a halibut was lost at the roller (or within gaffing distance), a note was made in the remarks section of the haul summary form. Biologists did not estimate lengths of lost fish. Similarly, if only a head returned, the occurrence was noted but an estimated length was not recorded. A hooking injury code (1-9 indicating level of severity) was also recorded for every halibut landed.

Halibut with only minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were tagged and tagging occurred at all stations). This was accomplished by tagging only halibut in the very best condition (i.e., fish with only minor hooking injuries and with no sign of bleeding or stress were tagged) so that the remainder could be used for sex and age samples.

Biologists collected the left-side otolith and sex and maturity data from injured halibut. If the left-side otolith was lost or was crystallized, the right-side otolith was collected. To ensure that the age and sex sample was representative of the halibut catch, otoliths were collected and sex was recorded for every other halibut smaller than 175 cm and from all halibut 175 cm or larger from Area 2B and 2C surveys. Otolith and sex samples during the Area 3A survey were taken from every third halibut smaller than 175 cm and from all halibut 175 cm or larger. Sex was recorded as either male or female. The state of sexual maturity was not recorded on any of the vessels. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Occasionally, heavy fishing or other conditions on board the vessel may have made it difficult to keep up with the sampling schedule. Under these conditions, some halibut may have been measured and released without having been tagged or sampled for age and sex.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were recorded on the back of the data sheets.

Oceanographic data

Sea surface and bottom temperatures were recorded at stations as opportunity and time permitted. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

Supplemental projects

Other species

One biologist from the Alaska Department of Fish and Game (ADF&G) participated in the *Cape Flattery* charter. This person took a variety of data on bycatch species as well as length frequencies from sablefish . A number of sablefish were tagged and released. ADF&G retained all raw data collected by this biologist.

If time permitted, the IPHC staff were instructed to measure Pacific cod at stations near Cook Inlet, Outer Kenai Peninsula, and outer Prince William Sound. The target sample size for each general area was 200 lengths. The disposition of these data are unknown.

Outside agency collaboration

The *Chelsea* collected 20 halibut for a study on the effect of handling on halibut quality. The study was conducted by NMFS and the Fisheries Industrial Technology Center, Fisheries Utilization Research Lab, Kodiak, Alaska. The IPHC collected 20 halibut just east of Marmot Island that were less than 16 hours old when delivered in Kodiak. The intention was to evaluate the effect of holding dressed halibut on ice, refrigerated sea water (RSW), and slush-ice on the quality of the fish.

The *Cape Flattery* fished the inside and outside waters of southeast Alaska on the first two trips. On the third trip, between August 12 and August 15, the vessel fished about 20 skates on the Swiftsure bank to collect live halibut for the Marrowstone Marine Field Station on Marrowstone Island, Washington. These halibut were to be used for early life history studies in association with the IPHC.

1985 Hook-spacing and depletion spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	3A	East of Kodiak Island between Albatross and Portlock Banks	August 23 – 31	3	98-151
F/V *Star Wars II*	2B	Carpenter Bay and north of Cape Scott	June 26 – July 4	3	81-134

Fishing effort	108 sets
Legal-sized halibut	4,620 fish
Sublegal-sized halibut	2,611 fish

After completing the 1985 Standardized Grid Survey the *Star Wars II* and *Chelsea* extended their charters into a third trip to conduct specialized survey operations in areas 2B and 3A. The purpose of this survey was to obtain data to compare the CPUE of standard halibut gear using circle hooks spaced at three different intervals. The secondary goal of the survey was to study the local depletion of halibut by repeatedly fishing the same location.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Three locations were selected in both the Charlotte and Kodiak regions that were broad enough to allow six

sets of gear to be berthed (set side by side) approximately 0.5 nmi apart. These locations were chosen with the expectation that halibut would be abundant.

Stations were designated by a five-character alphanumeric code. The first three characters were numeric; the first was always "9" identifying the experiment as hook spacing, the second was 1 - 3, indicating the repetition, and the third was 1 – 6, indicating berth position. The fourth and fifth characters were alphabetic: the fourth was A-E indicating berthing set within the major area, and the last digit was either H (Hecate) for 2B or K (Kodiak) for 3A. For example: 925BK meant hook spacing experiment, second repetition of the 5th berth position in sample set B in the Kodiak area.

Fishing pattern

The *Chelsea* fished between four and six skates per set while the *Star Wars II* fished strictly six skates per set. Each day, two sets of each hook spacing treatment were fished for a total of six sets per day. The sequence for fishing sets of each hook spacing was predetermined. On the first day, the six sets were set in a specific sequence. On each of two following days the same locations were fished but in a different sequence of hook spacing. This experimental design was meant to minimize the effects of a local hot spot and of soak time, to facilitate factoring out in the analysis effects other than hook spacing.

After three days at the first location the operation moved to the second site and the procedure was repeated. The experimental design also allowed estimation of day to day depletion effects on catch rate in the different locations. There were 4,620 legal-sized halibut and 2,611 sublegal-sized halibut caught.

The *Chelsea* fished depths ranging from 30 to 100 fathoms. The *Star Wars II* fished depths ranging from 30 to 85 fathoms.

Gear and bait specifications

Both the *Chelsea* and *Star Wars II* fished skates of 1,500-foot groundline. Each set of gear was comprised of one of three hook spacings. Skates had 16/0 circle hooks spaced at either 13-, 21-, or 26-foot intervals. Gear spacing and number of hooks per skate was verified once at the beginning of the charter and periodically through the trip.

Only frozen salmon and herring were used as bait. The two baits were varied uniformly among hooks on each skate (i.e., each bait type was to be used on every second hook). The type of salmon used for bait was not specified and consisted of any species of whole, frozen salmon, salmon tails, or salmon heads.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. All halibut over 83 cm landed aboard the *Star Wars II* or those of any length landed on the *Chelsea* and found unsuitable for tagging were sacrificed for otolith collection and sex determination. Sex was recorded as either male or female. Sexual maturity was not observed.

Aboard the *Star Wars II,* only halibut under 84 cm were tagged. Halibut of any size landed aboard the *Chelsea* in suitable condition were tagged. The head length in millimeters along with injury and condition codes were recorded for tagged fish.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count.

Oceanographic data

Sea surface and bottom temperatures were recorded approximately once per day when opportunity and time permitted. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

1986 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	2C, 3A	Southeast Alaska (inside and outside) and Portlock/ Albatross grounds	May 12 – August 21	1-6	1-192
F/V *Snowfall*	2B	Cape Scott to north of Cape St. James	July 24 – August 22	1	1-59
F/V *Windward Isle*	2B	Hecate Strait	May 20 – June 25	1	1-35

Fishing effort	1,543 skates
Legal-sized halibut	10,789 fish
Tagged halibut	5,712 fish

The IPHC standardized stock assessment grid survey was continued for the 11th consecutive year. The grid survey entailed fishing a predetermined grid of stations on a 6 nmi by 12 nmi grid. The surveys were designed to obtain information on the adult halibut population that is independent of the commercial fishery data. Halibut without serious injuries were tagged, establishing a systematic dispersal of tagged fish in each survey region. Three vessels were chartered for the 1986 survey. The *Cape Flattery* fished 90 stations in Area 2C and 98 stations in Area 3A. The *Windward Isle* completed 35 stations in Area 2B before their charter was terminated due to problems with the vessel and crew. The *Snowfall* was chartered in July and August to complete the remaining 59 stations left by the *Windward Isle* in Area 2B. These surveys caught a total of 10,785 halibut. Sex and age composition of the catches was estimated using data from 5,051 fish, 22 were measured and released, and the remaining 5,712 halibut without serious injuries were tagged and released. Out of 293 stations located in the three survey regions, 277 were successfully fished, requiring 1,543 standard skates of gear. Non-halibut species accounted for 88 percent of the total catch by number, which was similar to the 1985 results.

For detailed information regarding the survey design, sampling protocols, and data recording instructions for this survey, please refer to the 1986 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The survey grid design in Area 2B and 3A was continued from 1985. Some stations may have been skipped if deemed unfishable due to logistical or operational problems. The survey grid was created by drawing longitudinal transects in Area 3A and latitudinal transects in Area 2B with approximately a 24 nmi separation between transects (Fig. 4). Each transect began near shore and extended to a depth of about 250 fathoms. Survey stations were placed at a consistent separation of 6 nmi along the transects. Stations in Area 3A were offset by 3 nmi between neighboring transects.

In addition to the core areas in 2B and 3A usually fished during the stock assessment survey, a vessel was chartered to survey the inside and outside waters of Area 2C. The offshore stations in southeast Alaska were continued from 1985 and laid out in the same manner as the stations in Area 2B. Surveying by transect was considered impractical in the inside waters of Area 2C, so these stations were instead grouped by geographic area. The areas chosen were those which received a significant amount of effort by the commercial fleet. Exact station locations were predetermined based upon a systematic method consistently applied between areas. Appendix I Figure 19 shows the stations fished on this survey. The survey manual allowed for changes in the design to be made by the biologist in charge during the course of the operation.

Individual stations were identified by a two- or three-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect. Stations in the inside waters of southeast Alaska were assigned a simple three-digit designation beginning with 403 in the south and continuing north through number 824. Station numbers were sequential within each geographical area and blocks of numbers were reserved between areas so stations could be added in the future.

Fishing pattern

The goal was to set the gear so that the midpoint of the set was at the center of the station. The direction of setting was along transect lines (i.e., north-south in Area 3 and east-west in Area 2B). Setting began around 0500 and the first gear was hauled around 1000. Vessels surveying Areas 2B and 3A averaged four stations per day. The *Cape Flattery* in Area 3A set six skates at each station while the *Snowfall* and *Windward Isle* in Area 2B set eight skates at each station. All gear was usually aboard by 2200. Minimum soak time was six hours and maximum soak time was 12 hours. Slightly different standards applied for the Area 2C survey. When fishing the inside waters of southeast Alaska the vessel set six skates per station completing between four and eight stations per day depending upon the geographic area. The plan was to begin setting the Southeast stations at 0500 hours and to haul the first stations at 1000 hours regardless of the number of stations set that day. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear left soaking overnight because of mechanical breakdown or weather was considered unsuccessful in terms of stock assessment studies. The fish from these unsuccessful stations were processed as usual. These stations may have been set again at a later date if time permitted.

Gear and bait specifications

All survey vessels used conventional fixed-hook setline gear with large circle hooks, the predominant gear in the halibut fishery. The *Cape Flattery* fished skates with 1,800-foot groundline and hooks spaced at 24-foot intervals providing approximately 75 hooks per skate. The *Windward Isle* used 1,500-foot skates with hooks spaced at 25-foot intervals providing around 60 hooks per skate. The *Snowfall* fished 1,800-foot skates with hooks spaced at 22-foot intervals providing around 81 hooks per skate. The hook count and hook spacing was checked on the

first fishing day and periodically throughout the trip. If the number of hooks or spacing deviated from the standard by 10% or more, the gear was repaired. Lost or damaged hooks were replaced daily. The average hook spacing and number of hooks per skate were recorded for each trip.

Only frozen salmon and herring were used as bait. The two baits were varied uniformly among hooks on each skate (i.e., each bait was to be used on alternating hooks). The type of salmon bait was most likely dressed chum salmon due to price and availability, but this was not a charter requirement and salmon used for bait was any species of whole or dressed frozen salmon, salmon tails, or salmon heads.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. If a halibut was lost at the roller, a note was made in the "remarks" section of the haul summary form. Biologists did not estimate lengths of lost fish. Similarly, if only a head returned, the occurrence was noted but an estimated length was not recorded. A hooking injury code (1-9 indicating level of severity) was also recorded for every halibut landed.

Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, head length, injury code, condition code, and tag number. Attempts were made to keep the tagged fish as representative of the total catch as possible (i.e., fish of all sizes were tagged and tagging occurred at all stations). This was accomplished by tagging only halibut in the very best condition (i.e., fish with only minor injuries and with no sign of bleeding or stress) so that the remainder could be used for sex and age samples.

Biologists collected the left-side otolith and sex and maturity data from injured halibut. If the left-side otolith was lost or was crystallized, the right-side otolith was collected. To ensure that the age and sex sample was representative of the halibut catch, otoliths were collected and sex was recorded for every other halibut smaller than 175 cm and all halibut 175 cm or larger caught on the Area 2B and 2C surveys. Otolith and sex samples during the Area 3A survey were taken from every third halibut smaller than 175 cm and all halibut 175 cm or larger. Sex was recorded as either male or female. The state of sexual maturity was not recorded. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Occasionally, heavy fishing or other conditions on board the vessel may have made it difficult to keep up with the sampling schedule. Under these conditions, some halibut may have been measured and released without having been tagged or sampled for age and sex.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station. The weight of other species was estimated by weighing a random sample of approximately 10 fish and applying the average weight to the total count. If time permitted, individual weights and lengths were to have been recorded on the back of the data sheets.

Oceanographic data

Sea surface and bottom temperatures were recorded at stations when opportunity and time permitted. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

Supplemental projects

Other species

Following data requests from other agencies, the IPHC biologists were asked to collect information on the size and distribution of Pacific cod, sablefish, and rockfish. If time permitted, length frequencies of these species may have been tallied. Pacific cod may have been measured at stations near Cook Inlet, outer Kenai Peninsula, and outer Prince William Sound. The target sample size for each general area was 200 lengths. Sablefish may have been measured in all survey regions. Rockfish, identified to species, may have been measured in southeast Alaska.

1986 Hook stripper mortality spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Moriah*	3A	Off the northeast end of Kodiak Island	September 1 – 3	1	1-9

Fishing effort	9 sets
Legal-sized halibut	2,366 fish
Sublegal-sized halibut	1,240 fish

During the summer of 1986, the IPHC became aware that an increasing number of halibut vessels were modifying their hauling apparatus to incorporate a hook stripper, also known as a crucifier, to remove both target and non-target species from the hooks. This raised some concern that the practice may increase the injury and mortality of sublegal-sized halibut. After observing the technique during a brief ride-along, the IPHC staff chartered the setline vessel *Moriah* for a three-day investigation of hook stripper efficiency and hook removal injury. During the three-day operation 2,366 halibut were handled including 1,240 sublegal-sized fish.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. A site, north of the Chiniak Gully and east of Kodiak Island, was selected for exhibited high catches of small fish in the standardized grid survey. It was also anticipated that this area would be fished heavily by the commercial fleet in the following season, thus facilitating recovery of a high proportion of tagged fish. All gear was set at depths of 27 to 50 fathoms.

Fishing pattern

The *Moriah* set three sets of seven skates each day. Setting usually began at 0630 in the morning and the gear was allowed to soak a minimum of four hours. Each set took about three hours to haul and All gear was usually aboard by 1930. Due to survey design requirements, hauling speed was substantially slower than that usually seen during a commercial halibut opening.

The *Moriah* was equipped with a hook stripper, a wide roller in a partially cutout rail with an aluminum chute leading to a set of closely spaced rollers. All halibut intended for eventual tagging were landed without the aid of gaffs; gaff hooks were used only as an aid in shaking halibut from hooks. At gear retrieval, halibut were separated into two treatment groups using alternate skates for each group. All halibut on one skate would be carefully shaken from the hook; halibut on the following skate would be removed by hook stripper, and so on. On skates when fish were shaken from the hooks, the gurdy was stopped when necessary to minimize time between fish capture and release. When using the hook stripper, small halibut and other fish were landed without assistance from the rollerman, while intermediate-sized fish (up to 80 pounds) were gaffed to prevent fish from falling off the hook while being hauled aboard. Fish stripped from the hooks fed into a flat tray and into the checker. Large fish were brought aboard in a conventional manner: gaffed and hauled over the rail.

Gear and bait specifications

The *Moriah* used conventional fixed-hook setline gear consisting of 1,800-foot skates of 3/8" groundline stored in tubs. Each skate had 15/0 circle hooks (Mustad No., 39965D) tied at 12-foot intervals using approximately 2-foot nylon gangions. Each hook was baited with a roughly one-quarter pound piece of salmon.

Sampling protocol

Halibut sampling

Immediately following capture and hook removal, all halibut under about 120 cm were examined for hook location and hook removal injury and this information was recorded with the length of the fish and the corresponding skate number. Uniquely numbered spaghetti tags were inserted between the opercular bones of the eyed side of the fish before release. For any halibut smaller than 120 cm, the total time on board never exceeded two minutes. Halibut over 120 cm were sacrificed for sex determination and retained for sale. Sex was recorded as male, female, or unknown. No otoliths were collected during this survey

Bycatch and hook occupancy

No data were recorded regarding the catch of other species.

Oceanographic data

No oceanographic data were collected on this cruise.

1987 Depletion spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	2B, 3A	Hecate Strait and N. end of Kodiak Island	July 15 – August 15	1-2	Prospecting: 1-5, 38-40, 53-58, 71-75 Survey: 6-37, 41-52, 59-70

Fishing effort (Charlotte region)	70 sets
Legal-sized halibut (Charlotte region)	1,576 fish

The commercial setline vessel *Cape Flattery* was chartered in 1987 to complete two separate projects. The first was a depletion comparison study between British Columbia grounds in Area 2B and Kodiak grounds in Area 3A, and the second was a hook spacing experiment on the Kodiak grounds described in the following section. The first two trips involved depletion fishing. This experiment examined the decline in catch rate as fish are removed from an area. During a preliminary investigation of this methodology, fishing was conducted on several consecutive days in the Charlotte and Kodiak regions. The data collected provided information on changes in catch rate, stock composition, and movement of fish into and out of the surveyed area over the fishing period. The Kodiak portion of the survey was plagued by bad weather so results from this area were deemed not usable for depletion analysis. Data was usable from eight days of fishing conducted in the Charlotte region off Carpenter Bay (just inside and north of Cape St. James in Hecate Strait). Twenty-eight skates of gear were fished each day in about 65 fathoms in the Charlotte region and 1,576 halibut were caught.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. In each area, grounds were prospected to locate areas of uniform depth and bottom topography where relatively high concentrations of halibut were located. Prospecting sets consisted of 3-skate sets set at the captain's discretion according to two guidelines. First, the site was to be representative of grounds fished by the commercial fleet; the grounds in Hecate Strait were expected to be off Carpenter Bay at the southern end of Graham Island in about 80-90 fathoms. Second, the initial catch rate was to be such that with the expected decrease in catch rate, the total catch would not exceed the capacity of the vessel's holds. The Kodiak grounds were to be chosen to yield an initial catch rate of around 500 pounds per skate. Suitable grounds were expected to be found on the shelf edge outside of Chignik or in the Marmot flats area.

Stations were designated by a six-character alphanumeric code following the system developed during the 1985 hook spacing survey. The first three digits were numeric: the first was always "9" identifying the experiment, the second was 1-3 indicating the repetition (in this case 0), and the third was 1-4 indicating berth position. The fourth character was alphabetic: either H for the Hecate region, or K for the Kodiak region. Null station positions indicate a prospecting set.

Fishing pattern

After locating a suitable spot, a fishing pattern was established using 28 skates of gear as four sets of seven skates each and set parallel, berthed about 0.7 nmi between each set. Each skate was considered a sample, so the design provided 28 samples for each fishing day. All gear was set in the morning between 0500 and 0600 hours. The first set was hauled at 1000 hours and the remaining sets were hauled at 150 minute intervals thereafter. Setting order was held constant from day to day while the survey manual specified that the hauling sequence was to be rotated each day to distribute soak times among the various berth positions. For example on day one, the easternmost set was hauled first working westward, counting one, two, three, and four. On the second day, the hauling order was two, three, four, and one. On the third day, the order was set number three, four, one, and two, and so forth on following sets.

Gear and bait specifications

During the depletion survey phase of the *Cape Flattery's* charter (trips one and two), the vessel used conventional fixed-hook halibut longline gear consisting of 1,500-foot skates with

large circle hooks spaced at intervals of 21 feet providing an average of 71 hooks per skate. Bait was previously frozen chum salmon.

Sampling protocol

Halibut sampling

The manual specified that all halibut caught were to be sacrificed. The rationale was that if returned to the grounds, the fish might interfere with the next day's fishing, even if they themselves did not take the bait. This applied to all sizes of halibut and any other species encountered. The database confirms that in fact all halibut caught during this survey were sacrificed and sex was recorded for each fish. Survey reports written after the charter stated during the prospecting phase of the charter in each area all live halibut were tagged and released. Legal-sized halibut killed during the survey were iced and sold to offset charter costs.

No fish were tagged during this survey and no otoliths were collected. The overall length and sex of all halibut caught was recorded with its corresponding skate number.

Bycatch and hook occupancy

Species other than halibut were counted and catch weights were estimated from representative weights throughout the experiment.

Oceanographic data

Sea surface temperatures were taken at almost every set using a handheld thermometer in a bucket of freshly-collected sea water. Ocean bottom temperatures were recorded approximately once per day using a reversible thermometer attached to a hydraulic winch.

1987 Hook spacing spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	3A	Kodiak Island	August 15 – 26	3	Prospecting: 76-81 Survey: 82-117

C*ape Flattery* went on to conduct a hook spacing survey on its third and final trip for the IPHC of 1987. The goal of this phase of the charter was to reproduce the hook spacing survey conducted by the *Chelsea* and *Star Wars II* in 1985. Unfortunately, due to poor weather, the data from this experiment was considered unusable for analysis.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Set positions were designated by a four-digit alphanumeric code. The first three digits were numeric; the first was always "9" identifying the experiment as hook spacing, the second was 1-3 indicating the repetition, and the third was 1-6 indicating berth position. The fourth

digit was alphabetic and designated as K for the Kodiak region of Area 3A. For example: 925K meant hook spacing experiment, second repetition of the 5th berth position in the Kodiak area.

Fishing pattern

After prospecting for a location providing suitable catch rates, the vessel began setting a pattern of six sets of four skates each and berthed at approximately 0.7 nmi. Three hook-spacing arrangements were used with intervals between hooks of 13, 18, and 24 feet. Two 4-skate sets of each hook spacing were used and the order of the hook spacing within the pattern were rotated each day so that all hook spacings would be used at each berthing location on every third day. Gear was set beginning around 0630 each morning. The first set was hauled around 1130 and the remaining sets were hauled as soon as practical thereafter. All gear was usually aboard before 2100 hours.

Gear and bait specifications

The *Cape Flattery* used a mixture of 1,500 and 1,800-foot skates during the hook spacing survey. Skates of groundline with large circle hooks spaced at 13- and 18-foot intervals were 1,500 feet. Skates with hooks spaced at 25-foot intervals were 1,800 feet. Each skate averaged 115 hooks on the 13-foot gear, 82 hooks on the 18-foot gear, and 72 hooks on the 25-foot gear.

All skates were baited with salmon and herring on alternating hooks.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. All halibut landed on sets 76 through 111 were sacrificed and the sex recorded. Beginning with set 112, all sublegal-sized (<82 cm) halibut were tagged and released. The tag type, condition code, and tag number were recorded. Most legal-sized fish after set 111 were sacrificed for sex determination and retained for sale. Others were measured and released alive. No otoliths were collected during this survey.

Bycatch and hook occupancy

Species other than halibut incidentally caught during the survey were totaled by set and recorded as the estimated total weight of each species.

Oceanographic data

Sea surface temperatures were taken at almost every set while bottom temperatures were recorded approximately once per day.

1987 Catchability spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Snowfall*	3A, 2B	Cape Scott to Dixon Entrance and Northeast end of Kodiak Island	May 21 – June 19	1-2	1-54

Fishing effort	54 sets
Legal-sized halibut	1,819 fish
Sublegal-sized halibut	1,464 fish

During 1987, the Commission conducted experiments in Areas 2B and 3A to investigate perceived differences in the effectiveness of setline gear in catching halibut between those areas. During May-July, the trawler *Ocean Star* and setline vessel *Snowfall* were chartered to determine paired estimates of relative abundance and stock composition in each area. Twenty-five locations were fished in the Charlotte region of Area 2B and 27 locations were fished in the Kodiak region of Area 3A. There were 1,819 legal-sized halibut and 1,464 sublegal-sized halibut caught.

The 1987 experiment was a modification of an experiment conducted in 1983. While the overall design and execution of the 1983 and 1987 experiments are generally the same, the 1987 experiment used the knowledge gained in 1983 when establishing the survey design, fishing grounds, gear, and analysis for the 1987 effort. Most of the modifications for the 1987 survey were directed towards increasing the sample size at each fishing location and maximizing the number of locations that could be sampled during the survey period. These modifications included a larger trawl net and the use of circle hooks on the longliner.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Stations were located at good fishing grounds in as many different sites and habitat types as possible within each major area to ensure that the catch ratio between the trawl and setline gear would be representative of any differences existing between Areas 2B and 3A. As in 1983, the fishing locations were selected for bottom conditions that allowed for trawling. Fifty-two locations were fished successfully in 1987 (25 in Area 2B and 27 in Area 3A). In Area 2B, fishing depth ranged from 18 to 104 fathoms with an average of 49 fathoms. In Area 3A, depths ranged from 34 to 98 fathoms with an average of 61 fathoms.

Survey stations were designated as alphanumerics. The first one or two characters were the same as the set number followed by either “H” for Hecate Strait in Area 2B or “K” for the Kodiak region in Area 3A.

Fishing pattern

The *Snowfall* began setting gear early in the morning with the *Ocean Star* leading or following alongside to mark loran settings for the setline location. The *Ocean Star* then began the first of two trawl sets, one on each side of the longline gear, berthed about 0.3 to 0.5 nmi to either side. A full fishing day resulted in two or three stations being sampled, each station consisting of one set of setline gear and two trawls. At each location, eight skates of longline gear were set, allowed to soak for 85 to 105 minutes, and retrieved in an average of one hour and fifty minutes.

Gear and bait specifications

The *Snowfall* used conventional fixed-hook longline gear commonly found in the commercial halibut fishery. Each skate consisted of 1,500 feet of groundline with approximately 78 large (16/0) circle hooks spaced along the line at 20-foot intervals.

Bait used during the survey consisted of either pink or pale chum salmon weighing between six and nine pounds. The average bait size was 0.25 pounds.

The *Ocean Star* used a two-seam 80’/111’ (headrope/footrope) Eastern style bottom trawl with 5-1/2” polyethylene netting throughout, forty-one 8-inch aluminum floats on the headrope, and was modelled after an 83’/112’ net used in NMFS baseline studies of demersal fish.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, condition code, and tag number. The majority of halibut caught by the *Snowfall* were tagged and released. All halibut caught on the *Ocean Star* were measured, and then released well away from the next comparative tow, so the released fish were unavailable for immediate recapture by the trawl gear.

Halibut unfit for tagging aboard the *Snowfall* were sampled for sex identification. The sexual maturity was not recorded. Legal-sized halibut sacrificed for sex identification were retained and iced for sale. Sublegal-sized halibut sacrificed for sex identification were discarded. No otoliths were collected during this survey.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station.

Oceanographic data

Sea surface and bottom temperatures were recorded at almost every set. Sea surface temperatures were measured with a hand-held thermometer in a bucket of freshly-collected sea water. Bottom temperatures were obtained using a reversible thermometer attached to a hydraulic winch.

1987 Near-shore Bristol Bay spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Coral*	4E	Near shore waters in Bristol Bay	July 27 – August 11	1	1-10
F/V *Erika C*	4E	Near shore waters in Bristol Bay	July 27 – August 11	1	1-17
F/V *Valorous*	4E and 4E-Closed Area	Cape Newenham to Cape Seniavin	July 23 – August 2	1	1-44

Fishing effort	71 sets
Legal-sized halibut	210 fish
Tagged halibut	166 fish

A proposal to open Bristol Bay to commercial halibut fishing was presented to the IPHC by local Bristol Bay industry groups. This area had been closed to commercial fishing since 1967 because it was a known nursery ground and Commission biologists feared an unacceptable rate

of sublegal-sized halibut bycatch if the area was opened. In 1987 the IPHC agreed to conduct an exploratory survey of the area to assess the commercial size halibut stock and incidence of sublegal-sized halibut. The objectives of the survey were to systematically sample the coastal area from Cape Newenham to Cape Seniavin and to fish areas where the local community reported catches of legal-sized halibut. There were 210 halibut caught during the survey of which 166 were tagged and 44 were sacrificed to provide age and sex data. All 44 fish sacrificed were caught aboard the *Erica C* and *Coral* and were sold in Dillingham, AK. The *Valorous* fished for 11 days, the *Erica C* for eight days, and the *Coral* six days.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The survey encompassed an area along the coast from Cape Newenham to Cape Seniavin to 20 nmi offshore. Two 32-foot local vessels, the *Coral* and *Erica C*, were chartered to target on coastal areas where the local community thought legal size halibut were concentrated.

Fishing pattern

The *Coral* and *Erica C* fished for eight and six days respectively, up to a maximum of 10 nmi offshore in depths ranging from 2 to 21 fathoms. Data from one day (two sets) were not used due to rotten bait and excessive soak time. The *Valorous*, a larger commercial vessel, was chartered to fish the complete coastal area of Bristol Bay by moving an average of 19 miles each day. The *Valorous* fished for 11 days in waters up to 20 nmi offshore in depths ranging from 4 to 32 fathoms.

The *Coral* and *Erica C* set one to four sets per day; each set had between two and 10 skates. The *Valorous* set four sets per day, setting eight skates at each set. Set and haul times were highly variable. Soak times ranged from 5 hours to 21 hours on the *Coral* and *Erica C* and from 4 to 10 hours on the *Valorous*.

Gear and bait specifications

All vessels fished with snap gear, the predominant gear in the small boat commercial halibut fleet. The *Coral* and *Erica C* used 1,800-foot skates with No. 3 and No. 5 circle hooks spaced at intervals of 24 to 36 feet providing between 50 and 75 hooks per skate. The *Valorous* used 1,800-foot skates of gear with No. 3 circle hooks spaced at intervals of 21 feet providing approximately 86 hooks per skate.

There was no specified baiting protocol for the survey. The *Coral* and *Erica C* baited most sets with salmon but many sets were baited with a combination of salmon and herring or sometimes salmon, herring, and octopus. The *Valorous* baited all sets alternating herring and Pacific cod among the hooks on all skates.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, injury code, condition code, and tag number. All halibut landed aboard the *Valorous* were tagged.

Halibut found unfit for tagging aboard the *Coral* and *Erica C* were sampled for sex and the left-side otolith was collected. Sex was recorded as either male or female. The state of sexual

maturity was not recorded on any of the vessels. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station.

Oceanographic data

No air, ocean bottom, or sea surface temperatures were taken during this survey.

1987 Halibut bycatch observer trip (not a charter)

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Polaris*	3A	Shelikof Strait and Southeast of Kodiak Island	July 22 – August 4	1	1-27

The IPHC was contacted by the captain of the commercial halibut schooner *Polaris* who offered to take a Commission observer on a Pacific cod fishing trip in late July-early August in the Kodiak area. The offer was accepted because it was believed the data would provide the IPHC with firsthand knowledge of the incidence of halibut bycatch in the growing Pacific cod fishery. Data collected during the trip was to be shared with the state of Alaska and added to the growing ADF&G observer database.

Survey design

This observer trip was run as a regular commercial fishing operation targeting Pacific cod. The captain chose fishing locations based upon the abundance of the target species. The IPHC had no input as to the fishing locations or any other aspect of the operation. One temporary IPHC employee worked aboard the vessel strictly as an observer to document fishing activities, enumerate the catch, and observe procedures used by the crew in handling the halibut bycatch.

The *Polaris* set between one and three sets each day in depths ranging from 35 to 128 fathoms. Each set generally included 19 skates of gear, but varied on occasion from 10 to 20 skates. The middle position of each set was recorded along with the minimum and maximum depths in fathoms.

Gear and bait specifications

The *Polaris* used conventional fixed-hook longline gear. Skates used aboard the vessel consisted of 720 feet of groundline with #6 (13/0) circle hooks spaced at intervals of 42 inches on 8-inch gangions. There were approximately 200 hooks per skate. The vessel used a hook stripper to remove cod from the gear. All gear was baited with herring.

Sampling protocol

Halibut sampling

The observer initially tried to measure the halibut caught, but quickly found that the light-weight cod gear made it next to impossible to get halibut, especially the big ones, on board. He next attempted to estimate the length, but found that too difficult. Starting with the second set,

the observer estimated the weight of each halibut, conferring with the skipper and rollerman as the fish was landed. There were no otoliths collected, no halibut were tagged, and no data (length, sex, condition) was taken on individual halibut other than estimated weights.

Bycatch and hook occupancy

In effect, the only data collected during this operation includes a full enumeration of all species caught by set and documentation of fishing locations, depths, and skates.

Oceanographic data

No oceanographic data were collected on this cruise.

1988 Sitka Spot depletion and tagging surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Snowfall*	2B	Dixon Entrance	May 27 – June 24	1	1-66
F/V *Cape Flattery*	2B	Dixon Entrance	June 14 – August 1	1	Survey: 1-42 Live fish collection: 43-45

Fishing effort	111 sets
Tagged halibut	2,652 fish

A research operation was conducted in northern Area 2B to investigate the effects of concentrated fishing on a small fishing ground and to systematically release tagged halibut at this location. The location was a small ground inside Dixon Entrance called the "Sitka Spot" normally fished by only two or three vessels during commercial fishing periods due to the small size of the productive fishing area. Two research trips were made to survey the area. The first trip used the chartered vessel *Snowfall* and was conducted from May 27 to June 24. The second trip, July 14 to August 1, was carried out with the *Cape Flattery.* The two specified goals for this survey were to conduct an extensive tagging operation to track movement of halibut off the chosen fishing ground, and to examine the effect of continuous fishing on the abundance of halibut within a small area to test the hypothesis that if the area were isolated from other grounds, depletion of halibut would occur.

Sets 43 through 45, set by the *Cape Flattery,* were for a supplementary live fish collection project and were not part of the primary experiment.

Survey design

Station pattern

Though the pattern of station placement was clearly defined by the IPHC prior to the charter, this survey was still considered a spot fishing operation. The captain of the vessel chose the exact fishing location and the positions were recorded at each set along with the minimum and maximum depths. The location chosen for the study was a small but productive fishing ground

locally known as the "Sitka Spot" in the inside area of Dixon Entrance. The Sitka Spot had an area of about 1.0 by 2.5 nmi with a depth range of 87 to 105 fathoms.

Fishing pattern

The station layout prescribed six sets per day, fishing four skates per set. The sets were laid out in a north-south orientation with about 0.5 nmi between sets. The fishing pattern was repeated each day on the same grounds, although the setting and retrieval order was alternated to distribute soak times among the sets from day to day. Soak times varied from two to five hours. Gear was set between 0500 and 0600 each morning and between 1300 and 1400 hours each afternoon. Hauling commenced each day at 0700 and continued until all gear was retrieved.

Weather and logistical problems hampered both charters and reduced the number of fishing days. Since this experiment was conducted before the individual vessel quota (IVQ) system was in place, the trips were timed to fall between the two commercial fishing periods. Fishing on trip one began 17 days after the end of the first commercial fishing period in Area 2B. The second commercial fishing period in Area 2B started on August 19, 23 days after the end of the second research trip. This timing allowed a rest period so that fish tagged from either trip would no longer be hook-shy and might be recaptured by the commercial fleet during the second fishing period.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear typical in the commercial halibut fishery at the time. Skates set by the vessels were 1,500 feet long with 16/0 circle hooks spaced at intervals of approximately 18 feet. The *Snowfall* averaged around 85 hooks per skate and the *Cape Flattery* averaged between 80 and 83 hooks per skate. The number of hooks per skate and hook spacing was checked at the beginning of the charter and periodically throughout the survey. If any of the skates deviated by more than 10% from the uniform standard, the gear was repaired or set aside and not used.

All skates were baited with salmon and herring on alternate hooks.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut with minor hook and capture injuries were tagged and released. Information recorded for tagged halibut included fork length, condition code, and tag number. In addition, a sample of tagged fish was sexed before being released using a method of external sex identification. Sex was recorded as either male or female. There were 2,652 fish tagged and released during the charter, of these 1,328 were sexed. A number of halibut judged as male were sacrificed during the first trip to confirm the external sexing methodology. Only running males from the first trip and all tagged fish on the second trip were included in the data set.

Halibut deemed unfit for tagging were sampled for sex, and the left-side otolith was collected. The state of sexual maturity was not recorded on either vessel. Legal-sized halibut that were sacrificed to determine sex and collect age structures were retained and iced for sale. Sublegal-sized halibut that were sacrificed to determine sex and collect age structures were discarded.

Bycatch and hook occupancy

The number and estimated weight of species other than halibut incidentally caught during the survey was recorded by station.

Oceanographic data

Sea surface and bottom temperatures were recorded aboard both vessels approximately once per day. Bottom temperatures were collected using a J-90 thermometer preferably attached

to the buoy line about 10 feet above the anchor. Sea surface temperatures were collected using a hand-held thermometer in a bucket of freshly-collected sea water.

Supplemental projects

Outside agency collaboration

On the last fishing day of its charter, the *Cape Flattery* set 12 skates of gear in three sets (43-45) off Cape Calvert in Area 2B. The purpose of these sets was to obtain live halibut for the Nanaimo facility (Pacific Biological Station) of the Department of Fisheries and Oceans Canada. Instructions were to collect seven mature females and five mature males.

1988 Halibut and sablefish gear comparison spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	3A	Yakutat and the south end of Kodiak Island	August 15 – September 3	2	Prospecting: 46-49, 62-65 Survey: 50-61, 66-77

Fishing effort	32 sets
Legal-sized halibut	1,077 fish
Sublegal-sized halibut	847 fish

In 1988, many boats were using sablefish gear or a mixture of sablefish and halibut gear during commercial halibut openings. Because a conversion factor from mixed gear to standardized halibut gear had not yet been developed, it created a problem for the IPHC staff trying to use catch and effort statistics from the commercial fleet. During the late summer of 1988, the IPHC chartered the commercial setline vessel *Cape Flattery* to complete a survey using both halibut and sablefish gear. The Commission intended to use data from this survey in an attempt to determine a conversion factor between these two types of gear. Unfortunately, the survey was not entirely successful due to poor weather.

The *Cape Flattery* made 32 sets and caught a total of 1,077 legal-sized halibut (≥ 82 cm) and 847 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed and iced aboard the survey vessel and sold at the end of the trip to offset the cost of the survey.

Survey design

Station pattern

Though the pattern of station placement was clearly defined by the IPHC prior to the charter, this survey was still considered a spot fishing operation. The captain of the vessel chose the exact fishing location and the positions were recorded at each set along with the minimum and maximum depths. Two locations were tested, the first off Yakutat Bay and the second off the southern end of Kodiak Island.

Fishing pattern

Each day the *Cape Flattery* set two groups of three unique gear configurations, so that each of the three gear types was fished twice each day. Sets of halibut gear were 2-skate sets (3,000 feet) while sets of sablefish gear were 4-skate sets (2,800) feet. If the three gear types were identified as A, B, and C, then the first days fishing would entail setting out gear in the order ABCCBA. At the end of the third day, each gear would have been fished at each location once. All gear was set beginning at 0700. Hauling commenced at 1000 and continued until all gear had been retrieved. Gear was deployed at the set locations in the same order on each day of the experiment. Hauling order was rotated from day to day to distribute soak times among the various set locations.

The original field plan was to complete 3-day experiments at three sites. Poor weather severely hampered efforts and only two experiments were initiated. Neither experiment was carried through all three days of fishing. The first effort was terminated due to severe weather after the second day's fishing. The operation was moved to the Kodiak Island area, where fishing was discontinued after the second day due to poor weather and time constraints.

Gear and bait specifications

Three different configurations of conventional fixed-hook setline gear were used. The first was halibut gear consisting of 1,500-foot skates of groundline with 16/0 circle hooks spaced at 18-foot intervals providing approximately 83 hooks per skate. The second was sablefish gear consisting of 700-foot skates of groundline with 14/0 circle hooks spaced at 3.5-foot intervals providing approximately 210 hooks per skate. The third configuration was intended as an intermediate between the first two and consisted of 700-foot skates of groundline with 14/0 hooks spaced at 18-foot intervals providing approximately 38 hooks per skate. During experimental fishing, two skates of sablefish gear (1,400 feet) were fished against one skate of halibut gear (1,500 feet) in order to make the ground covered comparable between the different gear types.

All skates were baited with salmon and herring on alternate hooks.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. On set numbers 50 through 60, many sublegal-sized halibut with minor hook and capture injuries were tagged and released. Sublegal-sized halibut on all other sets were released immediately after they were measured. The majority of legal-sized halibut were sampled for sex identification. Sex was recorded as male, female, or unknown. Other legal-sized halibut were only measured. All halibut in marketable condition were dressed, iced, and retained for sale. Additionally, some select bycatch species captured at the end of the charter were dressed and iced for sale.

Bycatch and hook occupancy

The catch of commercially valuable species other than halibut was recorded with an estimated total weight of each species by station.

Oceanographic data

Only a few sea surface and bottom temperatures were recorded sporadically through the charter. Bottom temperatures were collected using a J-90 thermometer attached to the buoy line about 10 feet above the anchor. Sea surface temperatures were collected using a hand-held thermometer in a bucket of freshly-collected sea water.

1988 Otolith collection spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Polaris*	3A, 3B	Albatross Grounds, Marmoth Island and south of Trinity Island	July 17 – 26	1	Survey: 1-9 Extra sets: 10-13 Film sets: 14-16

Fishing effort	16 sets
Legal-sized halibut	1,812 fish
Sublegal-sized halibut	728 fish

One of the most important data sets used by the Commission in 1988 was catch and age information from landings sampled from the commercial setline catch. These samples consisted of structured collections of otoliths from landed commercial catches. Fish age was determined by visual examination of annuli on the otolith surface. Fish length and weight were predicted from measurements of otolith length and weight. The methods used to convert otolith measurements to fish length and weight were based on numerous measurements pooled over many years and regions. The *Polaris* was chartered in July of 1988 to add newer observations to this data set. Analysis of the sex, fish length, otolith length and weight, and dressed fish weight were used to verify the 1988 system of extrapolating fish length and weight from otolith measurements.

The *Polaris* encountered exceptionally good fishing and completed the otolith collection after the first nine sets. Sets 10 through 13 were done essentially to fill the vessel with legal-sized halibut and tag and release the sublegal-sized fish. Set 14 through 16 were fished on the last two days of the charter to demonstrate fishing and tagging procedures for a film crew invited aboard the vessel. In all, the *Polaris* made 16 sets and caught 1,812 legal-sized halibut (≥82 cm) and 728 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold to fund the survey.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The captain chose locations where he expected to encounter heavy fishing. The first nine sets were made in Area 3A on the shelf edge of the Albatross Bank. The next four sets were made in Area 3B on the shelf edge just north and east of the Trinity Islands. The last three sets performed for the filming crew were set just south of Marmot Island in Area 3A.

Fishing pattern

The *Polaris* generally made three sets per day during survey operations. Each set consisted of nine skates and were usually set beginning around 0600 each morning and allowed to soak three to six hours before hauling began. The final four sets consisted of two to five skates each and were allowed to soak for four to five hours.

Gear and bait specifications

The *Polaris* used conventional fixed-hook setline gear throughout the charter. Each skate was uniformly rigged with 1,800 feet of groundline and 16/0 circle hooks spaced at 18-foot intervals providing approximately 100 hooks per skate.

There was no specified baiting protocol for this charter. The vessel was instructed to use whatever bait they thought would result in the highest catch rates. The *Polaris* purchased herring, octopus, Pacific cod, and bright chum salmon at the beginning of the charter. It is not known whether only one or a combination of these baits was used on each skate or set.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. On the first nine sets, otoliths were collected from all legal-sized halibut only. All sublegal-sized halibut were released immediately after the fork length was recorded. Each legal-sized halibut was marked with a numbered plastic disc attached to the tail by a nylon electrical tie. The tag number, fish length, and sex were recorded for each fish. The stage of sexual maturity was not observed. These fish were then dressed and iced in the hold. During the sale of the fish, after heading and washing, the fish were individually weighed and these weights were recorded along with the tail tag numbers. Total weight of the heads from the tagged fish was also recorded.

On sets 10-12, all sublegal-sized halibut with minor hook and capture injuries were tagged and released after the fork length, condition code, and tag number was recorded. Sublegal-sized halibut not suitable for tagging were measured and discarded. All of this set's legal-sized halibut were measured before being dressed and iced for sale; however, sex and maturity were not recorded nor were otoliths collected from these fish. On set 13, all halibut caught were measured and discarded; these fish were not tagged and otoliths were not collected. All 10 halibut caught on sets 14-16 were legal-size fish, of which, seven were tagged and released, two were sampled for sex and age structures, and one was only measured.

Bycatch and hook occupancy

The catch of species other than halibut was not observed or recorded during the survey.

Oceanographic data

The ocean bottom temperature was taken only once (set 14) during the survey using a J-90 thermometer attached to the buoy line about 10 feet above the anchor.

Supplemental projects

Film footage

A film crew boarded the *Polaris* on July 24th and stayed through the unloading process completed on July 26th. Three sets were competed for the film crew (14-16), during which the IPHC staff tagged and released seven legal-sized halibut and took otoliths from two others. No sublegal-sized halibut were caught. The crew filmed fishing and tagging operations including some underwater footage. The unloading process was also filmed when the vessel sold the catch in Kodiak at the end of the charter.

1989 Otolith collection spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Chelsea*	3A, 3B	Seward Gully to Albatross Grounds, Trinity Island to Shumagin Islands	June 1- 9 August 16 – September 2	1-3	1-38
F/V *Ocean Viking*	2B, 2C	Cape Scott to Dixon Entrance and South of Cape Muzon	May 31 – June 25	1-2	1-57

Fishing effort	95 sets
Legal-sized halibut	4,687 fish
Sublegal-sized halibut	1,561 fish

In 1988 some basic questions arose about the Commission's established procedure for estimating the weight of fish from the size of the otolith. In particular, it appeared that the average weight at age was declining as a result of a change in the sex ratio of the catch, and that the estimates of body weight from otolith weight had developed a bias owing to a difference between males and females in the otolith weight to body weight relationship. The *Chelsea* and *Ocean Viking* were chartered in the summer of 1988 to collect a large number of otoliths from fish of known sex and weight in order to investigate differences between regions and sexes and ultimately to update the standard method of weight estimation.

The *Chelsea* and *Ocean Viking* made 95 sets during this survey and caught 4,687 legal-sized (≥82 cm) halibut and 1,561 sublegal-sized (<82 cm) halibut. Due to problems with data collection, only about 5,100 of the 6,248 halibut caught were utilized for the analysis.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The *Ocean Viking* was assigned Areas 2B and 2C, and the *Chelsea* surveyed part of western Area 3A in June and eastern 3B in August before returning to 3A. Within each regulatory area, catch was distributed among statistical areas in approximately the same proportions as the commercial catch. Within each statistical area the skippers chose fishing locations as though they were fishing commercially (i.e., so as to maximize the catch).

Fishing pattern

The number of skates fished and the soak times at each fishing location were to provide approximately the number of fish desired from each location. The *Ocean Viking* generally set four to five sets per day of between three and five skates each. The *Chelsea* usually set two to four sets per day with the number of skates per set varying from three to 10. The soak time was usually three to five hours.

Gear and bait specifications

The *Chelsea* used conventional fixed-hook gear and the *Ocean Viking* fished with snap gear. Skates fished by the *Chelsea* were 1,500 feet long and had 16/0 circle hooks spaced at 13-foot intervals providing approximately 115 hooks per skate. The snap gear used by the *Ocean Viking* also consisted of 1,500-foot skates with 16/0 circle hooks snapped to the groundline at approximately 18-foot intervals for between 87 and 100 hooks per skate.

There was no specified baiting protocol for this survey. The vessel was free to select bait type and size. The *Chelsea* used chum salmon, herring, squid, sablefish, and possibly some shack bait during the charter. The *Ocean Viking* used salmon, herring, Pacific cod, and octopus. Each set may have consisted of only one or a combination of all bait types.

Sampling protocol

Halibut sampling

No fish were tagged and released or discarded during this survey. All fish caught were used for the experiment, including all sublegal-sized halibut. Sublegal-sized halibut were sacrificed so that the sample as a whole would provide data on the total catch taken by longline gear, rather than just the retained catch. Sublegals also provided data on the otolith weight-body weight relationship in fish below the legal size limit.

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. After measurements were taken, the sex was recorded and the white-side otolith was collected. A numbered plastic disk was then attached to the tail with a nylon electrical tie. When the fish were sold, each was weighed individually after heading and washing. (Fish landed by the *Chelsea* in August were not washed.)

A few problems were encountered on both vessels in data collection during the survey. The nylon ties often broke in the hold or during unloading and weighing, thereby resulting in the loss of about three percent of the data. Mistakes in recording data reduced the amount of usable data by another sixteen percent. Movement of a tare weight during unloading in Kodiak cost another two percent of the data. In total, usable data were obtained on about 5,100 of the 6,429 fish caught. After weighing fish in port, sublegal-sized halibut were retained and donated to food banks.

Bycatch and hook occupancy

The catch of species other than halibut was not observed or recorded during the survey.

Oceanographic data

No oceanographic data were collected on this cruise.

1989 Hook timer pilot spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Ocean Viking*	2B	Cape Scott to Nigei Island	October 2 – 11	3	58-64

Fishing effort	7 sets
Legal-sized halibut	44 fish
Sublegal-sized halibut	41 fish

Since 1987, the IPHC staff had planned to conduct an experiment using hook timers to investigate the degree to which dogfish reduce the effectiveness of longline fishing off the British Columbia coast. The first trials were completed in the fall of 1989 using the chartered commercial longline vessel *Ocean Viking*. The pilot survey aimed to assess the suitability of a particular type of hook timer for an investigation of the dynamics of halibut CPUE and the interactions of other species with the halibut gear. The pilot survey was completed in waters north of Vancouver Island. It provided some promising results as well as revealing several flaws in the hook timer design and methodology.

The *Ocean Viking* fished for four consecutive days and made only seven sets. The total halibut catch consisted of 44 legal-sized (≥82 cm) halibut and 41 sublegal-sized (<82 cm) halibut.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The surveyed area was just north of Vancouver Island between Cape Scott and Nigei Island in a depth range of 7 to 150 fathoms.

Fishing pattern

The *Ocean Viking* deployed the hook timers on four consecutive fishing days during the charter. The vessel set either one or two sets per day of three skates each. The middle skate was rigged with the hook timers attached between the snap and gangion. Release tensions ranged from about 1 kg to 4.5 kg. At the lowest settings, there were numerous false releases as the gear was being set. At the highest release setting, the release mechanism was unreliable when fish were hooked.

Gear and bait specifications

Hook timers are small devices about the size of a C-cell battery. Each device contains a clock mechanism, a battery, and a reed switch, all encased in hard plastic. A magnet plug located in one end of the timer provides a variable release mechanism. Release of the plug started the clock, thus giving a relative time of a hooking event. One hundred of these timers were borrowed from NMFS in Honolulu where the timers were developed for longline studies of atoll fishes. One of the primary tasks of the *Ocean Viking* charter was to determine the proper release tension at which the magnet-plug should be set. Although the timers had a number of faults, particularly in the design of the release mechanism, the appropriate release range was determined during these studies to be 2-4 kg.

The *Ocean Viking* fished snap gear consisting of 1,800-foot skates with 16/0 circle hooks spaced at approximately 18-foot intervals. The second of three skates set in each set had a hook timer attached to the gangion between the groundline and hook.

The vessel used pink salmon, Pacific cod, squid, and octopus for bait during the charter. Only salmon was used on three sets, one set used only Pacific cod, and one set contained only octopus or squid. The last two sets used a combination of either salmon or cod with octopus or squid.

Sampling protocol

Halibut sampling

The fork length of every halibut caught was measured to the nearest centimeter and recorded along with its corresponding skate number. The fish were then immediately released, except during the last set (set number 64) when several halibut were sacrificed and the sex was recorded.

Hook timer

All hooks were carefully monitored as they were retrieved. The hook status and catch of all species was recorded by skate, along with an estimated weight of each bycatch species by set. A biologist recorded the following for every hook timer: release setting, set time, haul time, timer status (tripped, not tripped, malfunctioned), bait status (missing, present, partially eaten), species captured, and estimated weight.

Oceanographic data

A bathythermal timing device was set on the anchors or the hook timer skate to determine sinking rate for the experimental gear.

1989 Coded wire tagging pilot spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Donna*	2A	West of Newport, Oregon between Heceta Head and Cascade Head	May 8 – June 8	1-6	1-78

Fishing effort	423 skates
Legal-sized halibut	1,586 fish
Sublegal-sized halibut	675 fish
Tagged halibut	1,541 fish

The IPHC chartered the commercial snap-gear vessel, *Donna*, in the summer of 1989 to conduct a pilot tagging survey in Area 2A off of Newport, Oregon. This survey had two objectives: to determine the feasibility of using mark-recapture techniques for assessing halibut population size, and to examine the dynamics of the fishery and the behavior of the halibut population to gain insight on how these factors influence interpretations of stock dynamics. In addition to the standard external tag, each fish was injected with a coded wire microtag. The IPHC staff scanned for the microtags during subsequent halibut openings in 1989 and 1990.

The *Donna* set 423 skates of gear in 78 sets and tagged a total of 1,586 legal-sized (≥82 cm) and 675 sublegal-sized (<82 cm) halibut.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The area chosen for this survey was the commercial grounds outside of Newport, Oregon between Heceta Head and Cascade Head. Each day, the *Donna* set between three and four sets of between four and six skates. The gear was usually set between 0700 and 1100 each morning and allowed to soak for around four hours before hauling began. Often, the gear was not set until later in the morning, but all gear was always aboard before midnight.

Gear and bait specifications

The *Donna* used snap gear of the type commonly found on smaller longliners in the area. The skates consisted of 1,800 feet of groundline with approximately 50 hooks spaced at 36-foot intervals.

There was no baiting protocol specified for this survey. The vessel used salmon, sablefish, octopus, and American shad as bait throughout the charter. It is not know if this bait was mixed or alternated among the hooks.

Sampling protocol

Halibut sampling

Legal-sized halibut caught during the charter were tagged on their dark side with both a wire spaghetti tag through the opercular bone and an internal coded wire tag that was injected into the cheek. Sublegal-sized halibut were tagged only with external tags. Coded wire tags were injected into 1,541 of the 1,556 legal-sized fish. Later, tag collection teams from the IPHC scanned totes of fish heads for internal tags in Newport during openings in 1989 and 1990.

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. The majority of halibut caught during the survey, regardless of size, were tagged and released. Information recorded for tagged fish included fork length, tag type, condition code, and sex. Sublegal-sized halibut, not suitable for tagging, were measured and discarded. Legal-sized fish that were unsuitable for tagging, were dressed, iced, and, along with a variety of bycatch species, sold at the end of the trip to help fund the charter.

Sex was recorded either as male, female, or unknown. A fish could be of unknown sex if its gonads were unavailable for examination and determination based on external characteristics was not possible. The sex of tagged fish was determined using a non-lethal method of external identification. No otoliths were collected from halibut sacrificed during this survey.

Bycatch and hook occupancy

The catch of bycatch species was not recorded other than an accounting of retained species in the survey logbook.

Oceanographic data

Starting at set number 30, ocean bottom temperatures were taken approximately once per day.

1989 Oil spill grid and spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Royal Quarry*	3A	Prince William Sound, Cape Cleare to the Barren Islands and lower Cook Inlet	April 24 – May 7	1	Grid: 1-31, 36-39, 61-65 Spot: 32-35, 40-60

Fishing effort	65 sets
Legal-sized halibut	731 fish
Sublegal-sized halibut	423 fish
Tagged halibut	218 fish

Following the *Exxon Valdez* oil spill on March 24, 1989, there was concern that the halibut resource in Prince William Sound and surrounding waters may have been negatively impacted. At the request of NMFS and the US Government, the IPHC conducted a joint survey with NMFS of portions of Price William Sound, lower Cook Inlet and the eastern Gulf of Alaska to see if Pacific halibut had been affected by the oil spill. The IPHC chartered the commercial halibut vessel *Royal Quarry*. One Commission staff member and two NMFS technicians were assigned to the vessel during the survey to sample the halibut catch and record other pertinent observations. One of the objectives of the survey was to determine if there was any need to delay the May 15 - 16 halibut opening in the Gulf of Alaska or provide for spot closures in areas of heavy oil contamination such as occurred in Prince William Sound.

The *Royal Quarry* made 65 sets and caught 731 legal-sized (≥82 cm) halibut and 423 sublegal-sized (<82 cm) halibut. Of these, IPHC biologist and NMFS technicians sampled around 400 halibut, tagged and released about 218, and measured and released another 199.

Survey design

Station pattern

Predetermined station locations from the IPHC Standardized Grid Survey made up the basic sampling design in the central Gulf of Alaska. The captain of the vessel and Commission staff selected several additional spot survey stations to assess heavily oiled areas in Blying Sound, Prince William Sound, and lower Cook Inlet. These additional stations maintained the same approximate station separation as the grid survey, i.e., around 6 nmi. Standardized Grid Survey stations 47 M through T were fished during this survey as a control to represent an area unaffected by the spill. The majority of fishing was done in depths ranging from 20 to 140 fathoms. Appendix I Figure 20 shows the station locations fished this survey.

Fishing pattern

The *Royal Quarry* generally fished six to eight stations each day setting two skates at each station. This sampling schedule was selected so the vessel could survey the largest area possible prior to the upcoming halibut opening. Setting began at around 0500 in the morning. The gear was usually hauled in the reverse order it was set allowing for as little as one hour of soak time before hauling began. Maximum soak time ranged up to 18 hours.

Gear and bait specifications

The *Royal Quarry* used conventional fixed-hook setline gear coiled in tubs. Each skate consisted of 900 feet of groundline with 16/0 circle hooks spaced at 9-foot intervals. The vessel was asked to provide uniformly rigged gear. The hooks spacing and hook count were verified at the beginning of the charter and periodically throughout.

There was no specified baiting protocol for the charter. Bait type and size was left to the discretion of the vessels. The vessel primarily used squid as bait but may have used some octopus on later sets.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. When available, 10 halibut (five from each skate) were selected from each station for sampling. The IPHC and *Royal Quarry* personnel dressed sampled halibut in the traditional manner. Gall bladder, liver, tissue, and stomach-content samples from each sampled halibut were sent to a lab and subjected to chemical analysis of petroleum hydrocarbons

and their derivatives. Sex was recorded as male or female and otoliths were removed for age determination from all sampled halibut. The stage of sexual maturity was not recorded.

All sampled and non-sampled halibut underwent a thorough visual examination of the mouth, gills, and white and dark sides of the fish for presence of oil. Suspicious areas of pigmentation were scraped and examined under ultraviolet light. Some tissue samples were sealed and cooked in a microwave boil bag and smelled for presence of hydrocarbons. Halibut not used for samples were either tagged, measured and released unharmed, or iced for sale to help offset charter expenses.

Bycatch and hook occupancy

The catch of bycatch species was observed and recorded by set with an estimated total weight of each species. Other fish species were examined visually for signs of oil contamination when time was available.

Oceanographic data

The ocean bottom temperature was recorded using the J-90 thermometer on a few stations between sets one and 30, and on most stations beginning with set 31.

1990 Underwater video pilot spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Clipper II*	2B	Near Ramsey Island and on the Carpenter Bay Grounds	August 31 – September 13	1	1-9
F/V *Golden Dolphin*	2A	Puget Sound near Seattle	2 days in Spring or Summer	1	1-6

Fishing effort	15 sets

Two vessels were chartered in 1990 to deploy underwater video equipment to observe halibut and dogfish interactions with baited circle hooks. The primary objectives of these charters were to determine the feasibility of deploying this type of equipment for underwater observations and to determine the ratios between observed number of fish, number of hook attacks, and number of fish caught. The *Golden Dolphin* deployed the camera six times during two days in the Puget Sound and the *Clipper II* deployed the camera gear nine times during 13 days while operating in southern Hecate Strait.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of each vessel chose the exact deployment locations within a broader area specified by the IPHC. The camera apparatus was initially deployed over a 2-day period from the *Golden Dolphin* operating in the Puget Sound near Seattle. The purpose of these sets was to test the equipment and to become familiar with

its operation. The *Golden Dolphin* also spent some time collecting live halibut as brood stock for the University of Washington and Canadian Department of Fisheries and Oceans. Following the successful deployments completed by the *Golden Dolphin*, the *Clipper II* was chartered to deploy the camera in southern Area 2B. Two initial deployments were made in about 20 fathoms of water near Queen Charlotte City to test the gear and familiarize the crew with the deployment and operation of the camera. The camera was then deployed four times in 30 to 45 fathoms just south of Ramsey Island. The remaining sets were made in 50 to 65 fathoms near the Carpenter Bay grounds.

Gear and bait specifications

The camera in its cage was attached to a 9-foot square steel frame by four 10-foot aluminum legs. The camera aimed down from about eight feet above the sea bottom. The viewing angle of the camera allowed the entire square frame to be in view at all times. The camera/frame assembly was deployed on the seafloor with the vessel maintaining station above. Two cables were used to deploy the equipment; one cable was used to set and retrieve the frame while a second cable connected the camera to the shipboard control console. The two cables were tied together at 10-fathom intervals with floats and a large buoy was used to float the lines at the surface.

A square loop of groundline was held approximately 12 inches inside the steel frame formed by the camera legs with a bungee cord at each corner. Between four and six hooks were snapped to the groundline. All hooks were rigged with hook timers as a visual test of these devices. Unfortunately, the construction of the camera/frame assembly and the close attachment of the hooks to the frame resulted in many of the hooks becoming fouled during the setting process. Gangions were frequently wrapped under the frame itself. Although these hooks still fished adequately for the camera experiment, the trapped gangion did not allow the timer to trip on fish attacks. The project was terminated early due to problems with the camera's cable.

The type of bait used during this survey was not recorded.

Sampling protocol

Halibut sampling

The behavior of fish and invertebrates in and around the gear was recorded on video along with hand written observations maintained by IPHC biologists. The disposition of any halibut or other species caught on the hooks during camera deployment is unknown.

Oceanographic data

No oceanographic data were collected on this cruise.

Supplemental projects

Outside agency collaboration

The *Golden Dolphin* delivered live halibut brood stock to both the University of Washington's facility at Marrowstone Island in (Marrowstone Marine Field Station) and the Canadian Department of Fisheries and Oceans facility in Nanaimo, British Columbia.

1990 Hook timer spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Ocean Viking*	2B, 2C	Carpenter Bay and Cape Ommaney and Coronation Island	May 29 – June 21	1-2	1-43

Fishing effort	183 skates
Legal-sized halibut	~37,000 lbs

Following the hook timer pilot study in 1989, the IPHC chartered the commercial setline vessel *Ocean Viking* to continue investigations into the feasibility of using hook timers in evaluating bait competition in the halibut longline fishery. The goals of the 1990 survey were to investigate the effectiveness of a new hook timer design and to collect a large amount of hook timer data that would allow the IPHC to investigate the performance of the new model.

The *Ocean Viking* conducted survey operations in both Area 2B around Carpenter Bay and in Area 2C near Cape Ommaney. Hook by hook information was collected from 6,175 hooks in Area 2B and 7,367 hooks in Area 2C. Close to 40% off all fish caught in both areas were halibut. The total catch of halibut off Carpenter Bay was over 12,000 pounds on 93 skates of gear, and a total of 90 skates fished off Cape Ommaney yielded 25,000 pounds of halibut.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The first area chosen for this survey was a 60 to 80 fathom slope about 30 nmi east of Carpenter Bay in Area 2B. The second area surveyed was on known commercial halibut grounds near Coronation Island and Cape Ommaney in Area 2C. The *Ocean Viking* returned to the Carpenter Bay area for a short time near the end of the charter.

Fishing pattern

A standard fishing day was comprised of setting two sets of gear in the morning and two in the afternoon. Each set was made up of five skates of snap gear, with only the middle skate rigged with the hook timers. About 90 timers were deployed in each set of gear. Two sets were laid out and then retrieved after a one to two hour soak time. One of the two sets carried a device that recorded the depth at one-minute intervals while the companion set carried a dummy device, which approximated the size and weight of the time/depth device. A total of 21 sets were fished in Area 2B at the beginning of the charter. The first two sets were made using empty (un-baited) hooks and two different types of timer o-rings in order to assess the incidence of timer firings not associated with fish attacks. The next four sets were used to determine which of the two o-ring types was the most appropriate for the experiment. Hooks were baited and timers with the two o-ring types were placed on alternate hooks in the skates. All subsequent sets were made with one o-ring type and baited hooks. A total of 18 sets were completed in Area 2C. The final three sets were fished back at the Carpenter Bay grounds at the end of the charter

Gear and bait specifications

The pilot survey in 1989 used hook timers borrowed from NMFS that had originally been designed for the Hawaiian longline fishery. Though the timers generally worked well, the release mechanism was found to be inappropriate for use on halibut longline sets. The Applied Physics Laboratory of the University of Washington was contracted to design a more appropriate release mechanism for the timer module for use during the 1990 survey. The new hook timer design consisted of essentially the same clock assembly as that of the timer design used in 1989, but with a different release mechanism. The electrical clock circuit, encased in hard plastic, was inserted into a tube of PVC. The clock was actuated by the removal of a plunger/magnet from the end of the PVC tube. The plunger was held in the tube by the action of an o-ring that lay across a slot in the tube matching a groove in the head of the plunger. Differential release tensions were obtained by altering the size, material, and hardness of the o-ring.

The *Ocean Viking* used snap gear of the type commonly found on smaller commercial halibut fishing vessels. Each skate of snap gear was approximately 1,500 feet long. The hook spacing and number of hooks per skate was not recorded prior to set number 22. Records for the remaining sets indicate a highly variable hook spacing ranging from 14 to 26 feet providing anywhere from 64 to 113 hooks per skate.

All hooks set during this survey were baited with semi-bright chum salmon. The crew was instructed to cut the bait into pieces weighing approximately 0.25 pounds each.

Sampling protocol

Halibut sampling

The fork length of every halibut caught was measured to the nearest centimeter and recorded along with its corresponding skate number. Sublegal-sized halibut were then released alive. Legal-sized halibut were dressed and iced for sale and the sex was recorded as male, female, or unknown.

Bycatch and hook occupancy

All hooks were carefully monitored as they were retrieved. Hook status and species catch information was recorded by skate along with an estimated bycatch weight by set. Data recorded for each hook timer included time of setting, timer status (tripped, not tripped, or apparently malfunctioning), clock reading, bait status (present, nibbled, only skin remaining, bait missing), and time of retrieval.

Oceanographic data

A bathythermal timing device was set on the anchors or the hook timer skate to determine sinking rate for the experimental gear.

1991 Underwater video spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Clipper II*	2B	Ikeda Bay, Juan Perez Sound, Rankine Island, and Carpenter Bay	June 7 – June 23	1	1-59

Fishing effort	60 deployments

A survey testing the feasibility of using an underwater camera to observe the behavior of fish around setline hooks proved successful during a pilot study in 1990. Following the success of this operation, the commercial fishing vessel *Clipper II* was again chartered for two weeks during the summer of 1991 to deploy a slightly modified camera apparatus. The primary objectives of this survey was to determine the rate of hooking success, i.e., the frequency that hook attacks result in fish capture, and the probability that a fish removes the bait from the hook without being caught. The *Clipper II* completed 60 successful camera deployments in several locations around the southern end of Hecate Strait in Area 2B.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact deployment locations within a broader area specified by the IPHC. The camera was deployed 60 times in southern Hecate Strait at depths ranging from nine to 96 fathoms. Fifty-four of these deployments resulted in usable hook observations; the remaining six were unusable due to problems with visibility, gear stability, or operation of the camera system.

Gear and bait specifications

All hooks were rigged with hook timers in order to give a visual verification of the operation of the new hook timer design. In several instances where fish interacted with baited hooks, the gangion or timer became fouled under or around the camera frame.

An underwater video camera capable of operating in very low light conditions was mounted on a pan and tilt unit, within a cylindrical (3 feet diameter) aluminum cage. This cage was then attached to a 9-foot square steel frame by four 10-foot aluminum legs. With the whole setup resting on the seafloor, this resulted in the camera looking down at six baited hooks attached to a groundline suspended within the square frame. New for 1991 was a combination cable, which served as both a tether and electrical conductor. This combination electrical-mechanical cable greatly simplified the setting and retrieving of the camera gear. The cable was set and retrieved using a hydraulic winch specially developed for this task. A square of groundline was held approximately 12 inches inside the steel frame formed by the camera legs with a bungee cord at each corner. Between four and six hooks were snapped to the groundline. All hooks were rigged with hook timers as a visual test of these devices.

The *Clipper II* used 0.25 pound pieces of salmon as bait, except that one of the six hooks of each set during two days of the experiment was baited with octopus.

Sampling protocol

Halibut sampling

The behavior of fish and invertebrates in and around the gear was recorded on video along with hand written observations maintained by the IPHC biologists. The disposition of any halibut or other species caught during camera deployment is unknown.

Oceanographic data

No oceanographic data were collected on this cruise.

1991 Hook timer spot surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Big Valley*	3A	Albatross Grounds on the shelf edge south of Kodiak	August 2 - 12	1	1-14
F/V *Ocean Viking*	2B	East of Carpenter Bay	May 30 – June 19	1	1-45
F/V *Trekkor II*	2A	Near Bellingham, WA	May 3 - 4	1	1-4

Fishing effort	295 skates
Legal-sized halibut	~35,000 lbs

Studies using hook timers on halibut fishing gear began in 1989 and were continued in 1990 and 1991. Hook timers are essentially small clocks, attached between the groundline and the hook and are tripped when a fish is hooked, that indicate the amount of time that has elapsed between hooking and gear retrieval. The first surveys in 1989 and 1990 revealed several problems with the design of the hook timers. These flaws led to changes in the design of the apparatus. Early in 1991, the *Trekkor II* was chartered out of Bellingham, WA for a one-day pilot test of these modifications. The first full survey using the new hook timers began with the *Ocean Viking* during a 20-day charter in May of 1991. This was followed by a short charter aboard the *Big Valley* in early August, which was terminated after one trip due to problems with the vessel and crew. The primary goal of the hook timer studies was to learn as much as possible about the pattern of bait removal through time, and the species composition in the longline catch. In addition, frozen blood samples as well as fin and tissue samples were taken as part of an ongoing genetic study.

The *Ocean Viking* set a total of 225 skates of gear in 45 sets and caught over 21,000 pounds of halibut. The *Big Valley* set 70 skates of gear in 14 sets and caught around 14,000 pounds of halibut. The *Trekkor II* completed only four sets and the amount of halibut and other species caught was not recorded.

Survey design

Station pattern

This survey was a spot fishing operation. The captain of each vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The *Ocean Viking* fished grounds in Area 2B near the same area occupied during the 1990 survey. The *Big Valley* fished several locations on the shelf edge of the Albatross grounds south of Kodiak Island. The *Trekkor II* set gear during one day near Bellingham, Washington.

Fishing pattern

The *Ocean Viking* fished snap gear in Area 2B near Carpenter Bay. A standard fishing day was comprised of setting two sets of gear in the morning and two in the afternoon. Each set was made up of five skates of snap gear with only the middle (third) skate rigged with the hook

timers. Between 75 and 90 timers were deployed in each set of gear. Two sets were set and then retrieved after a two to three hour soak time. Timers were rinsed after each set to minimize the surface effects of slime on o-rings and release tension. One of the two sets carried a device that recorded the depth at one minute intervals while the companion set carried a dummy device, which approximated the size and weight of the time/depth device. Baits that fell off the hooks during the setting process or were stolen by birds were identified by hook number and discarded from the analysis.

The *Big Valley* completed one trip south of Kodiak Island in depths ranging from 14 to 49 fathoms. Only 14 sets were completed in the first five days of the charter. The charter was terminated early because of an injury to a crewman and the general inability of the vessel to complete the tasks. Data from the *Big Valley* was not used in the analysis because of problems encountered on the vessel and because observations indicated the grounds were not suitable for the experiment due to significant competition by Pacific cod and starfish.

Gear and bait specifications

Many problems were identified during a previous hook timer survey in 1990 with the design and quality of the hook timer cases. These problems were addressed prior to the 1991 charters by testing a variety of o-rings to arrive at a repeatable release tension of four to six pounds. An appropriate o-ring was selected during a one-day charter aboard the *Trekkor II,* out of Bellingham, Washington. On this short charter, *Trekkor II* set over 600 timers. An additional test of 160 timers was conducted during the *Ocean Viking* charter in British Columbia. This test showed that the tension needed to trip the timer ranged from 1.25 to 10.25 pounds with a mean of 4.39 pounds.

The *Ocean Viking* used snap gear of the type commonly found on smaller commercial halibut fishing vessels. Each skate of snap gear was approximately 1,800 feet long. The hook spacing and number of hooks per skate was not recorded, but hook-by-hook observations indicate there may have been anywhere from 75 to 100 hooks per skate. The *Big Valley* also used snap gear. Records indicate the skates used by the *Big Valley* were 1,800 feet long with an average of 90 hooks spaced at 20-foot intervals. The type of gear used by the *Trekkor II* was not recorded.

All hooks set by the *Ocean Viking* were baited with semi-bright chum salmon while the *Big Valley* used dark chum salmon. The *Trekkor II* used number one semi-bright salmon of unknown species. The vessel crews were instructed to cut the bait into pieces weighing approximately 0.25 pounds each.

Sampling protocol

Halibut sampling

The fork length of every halibut caught was measured to the nearest centimeter and recorded along with its corresponding skate number. Sublegal-sized halibut were then released alive. Legal-sized halibut were dressed and iced for sale and the sex was recorded as male, female, or unknown.

Bycatch and hook occupancy

All hooks were carefully monitored as they were retrieved. Hook status and catch of other species was recorded by skate along with estimated weights of each bycatch species by set. Data recorded for each hook timer included time of setting, timer status (tripped, not tripped, or apparently malfunctioning), clock reading, bait status (present, nibbled, only skin remaining, bait missing), and time of retrieval. In addition, counts were made of the number of fresh baits found in the stomachs of captured dogfish.

Oceanographic data

A bathythermal timing device was set on the anchors or the hook timer skate to determine sinking rate for the experimental gear.

Supplemental projects

Stock genetics

IPHC biologists collected blood samples for DNA analysis during the hook timer charter in 1990. The samples were refrigerated and sent to Therion Inc. for processing. Unfortunately, the samples had degraded due to antibodies present in halibut blood. Therefore, other types of samples were considered during the *Ocean Viking* and *Big Valley* charters in 1991. During these surveys, the IPHC staff collected and froze blood samples and collected fin and tissue samples.

1991 Live halibut collection spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Ocean Viking*	2A	Near Cape Flattery	September 12 - 15	1	46

Fishing effort	1 set
Live halibut	26 fish

The commercial setline vessel *Ocean Viking* was chartered for a single 4-day trip to collect live halibut. These halibut were to be used as part of an ongoing halibut culture project conducted by the Pacific Biological Station (PBS) in Nanaimo, British Columbia. The vessel set only one set of setline gear during the charter and the IPHC staff tried their luck fishing with sport halibut gear. At the end of the charter, 26 live halibut were delivered to the Marrowstone Marine Field Station at Marrowstone Island for PBS biologists.

Survey design

Station pattern

This was a spot fishing operation. The captain of the vessel chose the exact fishing location within a broader area specified by the Commission. The area chosen for the live fish collection was a known commercial halibut ground west of Cape Flattery in approximately 25 fathoms of water. The fishing location was recorded as a single coordinate noted in the survey logbook. Personnel aboard the vessel included the captain and one deck hand, and four IPHC staff members; one representative from the Pacific Biological Station met with the team before the vessel left port.

Fishing pattern

The *Ocean Viking* set one set of five skates at 0715 in the morning. The gear was allowed to soak for approximately eight hours. All gear was aboard by 1700. While the gear was soaking, the IPHC staff spent some time fishing with sport halibut gear. It is not know how many of the 26 live fish delivered to Nanaimo were caught using the sport gear.

Gear and bait specifications

The *Ocean Viking* used snap gear, the predominant gear on smaller halibut fishing vessels. The length of groundline making up a skate of gear and the average hook spacing and number of hooks per skate used by the vessel are unknown.

The type of bait used during this charter was not recorded, but was likely salmon.

Sampling protocol

Halibut sampling

No data regarding the halibut catch or the incidental catch of other species was recorded during this survey. Live halibut were brought aboard and those in excellent condition were retained in seawater for later delivery to the facility at Marrowstone Marine Field Station.

Bycatch and hook occupancy

The catch of bycatch species was not recorded

Oceanographic data

No oceanographic data were collected on this cruise.

1992 Otolith collection spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Kaare*	3A, 3B, 4A, 4B, 4C, 4D	Portlock and Albatross Grounds, Trinity Is. to Shumagin Is., Unalaska Is. to Seguam Is., Atka Is. to Attu Is., Pribilof Is. and edge of 4D to 58.30N	June 17 – September 18	1-7	1-135

Fishing effort	135 sets
Legal-sized halibut	6,018 fish
Sublegal-sized halibut	1,958 fish

Only one setline survey was conducted in 1992. The *Kaare* was chartered from June to September to continue the otolith collection survey last conducted in 1989. Five trips were completed in the Bering Sea and along the Aleutian Islands in Area 4. Two trips were completed in the western and central Gulf of Alaska. The goal of this charter was fivefold: to validate the length-weight relationship in Area 4A, 4B, 4C, and 4D; to collect biomass information and CPUE in area 4B; to obtain length at age and maturity data; to estimate the proportion of sub-legal fish in catches; and to compare results of otolith weight-body weight relationships in Areas 3A/3B in 1992 with those collected in 1989.

The *Kaare* made 135 sets and caught 6,018 legal sized (≥82 cm) halibut and 1,958 sublegal-sized (<82 cm) halibut. Of these, a combined total of some 7,000 fish were collected for otolith weight-body weight comparisons of known sex, age, and individual weight from Areas 3 and

four. In addition, length at age and maturity data were also recorded by sex for the other halibut not included in the otolith weight-body weight collection.

In depth information regarding the survey design, sampling protocols and data recording instructions for this survey is available in the 1992 Area 4 instruction manual.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC and based on information collected from the commercial fishery. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Sampling operations were to simulate commercial fishing operations. Accordingly, sampling magnitude was spread over four or five major commercial grounds and different depth strata within each area so that the biological data would adequately represent the fish that appear in the commercial landings. A similar approach was used in sampling the eastern and western portions of Area 4B for the biological data collection. In addition, enough grounds throughout the western area were sampled to ensure that good estimates of catch rates would be obtained.

Fishing pattern

The gear was set in accordance to usual commercial practice, with special care taken at locations where strong currents and tides were present. Generally, soak time for the first set was kept relatively constant from day to day at four hours. Although soak times varied if two or more sets were set, long soaks were avoided by intermingling the setting and hauling of additional sets to ensure the shortest soak possible and highest fish quality. Consequently, setting did not adhere to a strict schedule and instead facilitated movements between grounds and maximize sampling operations in a particular area. Weather conditions and other logistical problems necessitated frequent schedule adjustments. The number of skates set at each location varied according to the number of fish needed and the number of locations to be sampled. An average of 200 to 250 fish of all sizes was required at each location fished. Therefore, under expected catch rates, an average of 20 to 24 skates of gear were set in as many different depth strata as possible at each location sampled.

Gear and bait specifications

The *Kaare* used conventional fixed-hook setline gear consisting of 1,500-foot skates with 16/0 circle hooks spaced at approximately 13-foot intervals. The number of hooks per skate averaged 113. The gear was checked at the beginning of the charter and periodically throughout

There were no specified baiting protocols for the survey. The vessel was allowed to use whatever bait was convenient and cut the pieces to the size desired by the crew. The *Kaare* purchased frozen herring as the primary bait used throughout the charter. In addition, some salmon bait was loaded later in the charter and a variety of shack bait was used throughout.

Sampling protocol

Halibut sampling

Data collection procedures were essentially unchanged from those implemented during the 1989 otolith collection survey. The main differences included sub-sampling of sublegal-sized halibut for otolith collection and the documentation of maturity stages for all sampled halibut.

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. After length measurements were recorded, all legal-sized halibut,

as well as at least three sublegal-sized halibut, from each 1-cm size interval were sampled for sex and maturity and were subjected to white-side otolith removal.

The gonads of all halibut sampled were examined by IPHC biologists for maturity determination. This maturity data were needed as a supplement to data previously collected by the IPHC and as a basis for comparison with the previous collection. The maturity stage was recorded using a newly developed eight-stage system for females and a two-stage system for males. Female stages one and two were considered immature and stages three through eight was mature. Male stage one was immature and stage two were considered mature. This survey was the first time the eight-stage system was used by IPHC. The stage of sexual maturity was not recorded during the trip seven. After data were recorded for each fish and otoliths had been collected, a numbered plastic disk was attached to the tail of the halibut with braided nylon twine. The otolith was stored in an envelope with the corresponding number of the plastic disk recorded on the outside. During the unloading procedure each fish's individual weight and tag number were recorded after the fish was headed.

Bycatch and hook occupancy

The estimated total weight of each bycatch species was recorded by set.

Oceanographic data

No ocean bottom or sea surface temperatures were collected during this survey. The observation of major bycatch species was recorded either by skate or totaled by set.

1993 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Flattery*	3A	Portlock and Albatross Banks	July 1 – 31	1-3	1-91
F/V *Kristiana*	2B	Cape Scott to Dixon Entrance	July 24 – September 1	1-4	1-101

Fishing effort	1146 skates
Legal-sized halibut	8,000 fish
Sublegal-sized halibut	4,149 fish

The IPHC standardized stock assessment grid survey, last conducted in 1986, was revived in 1993. The grid survey was not conducted between 1988 and 1992 due to the expense of conducting the survey and the amount of commercial data collected by the Commission during those years. The decision was made to continue the standardized survey in 1993 following a desire to augment the commercial data and concerns over the accuracy of commercial data in reflecting halibut abundance. Goals were to obtain information on CPUE, size, age, sex, maturity, species composition, growth and distribution of halibut, relative abundance of other species, and rate of bait attacks on the gear.

The *Kristiana* was chartered for a 40-day period in Area 2B and harvested 69,295 pounds of halibut on 606 skates fished at 101 grid survey stations. The *Cape Flattery* was chartered

for 31 days in Area 3A and harvested 127,144 pounds of halibut on 540 skates fished at 90 grid survey stations. All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs. There were 8,000 legal-sized halibut and 4,149 sublegal-sized halibut caught.

For detailed information regarding the survey design, sampling protocol and data recording instructions for this survey, please refer to the 1993 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

IPHC biologists reviewed the historical survey design when the standardized grid survey was revived in 1993. After careful analysis (see 1993 RARA document for more information), it was decided that a further modification of the old (1986) design was necessary in order to survey large areas using the limited resources available at the time. The major concerns addressed in the reorganization were to create a more even station distribution while maintaining a logistically efficient system that would allow large areas to be thoroughly surveyed with a minimum of time and resources.

After comparing several possibilities, planners selected a triangular sampling pattern based upon and using as many stations as possible from the 1963-86 grid surveys. The same 12 x 3 nmi grid pattern used in previous years provided the basis for the new design. The major difference was that stations located along longitudinal transects in Area 3A and latitudinal transects in Area 2B were between 6 and 18 nmi apart. In order to use as many historical stations as possible, new stations were placed along transects either on or directly between transect junctions. Station locations along transects in the new survey design were determined by several qualifying factors. The stations were positioned so that they could be formed into a triangle fishable in a survey day. This meant that the vertices of the triangles (the stations) could be no more than 15 nmi apart and that care had to be given to avoid obstructions such as islands, reefs, underwater cables, traffic lanes etc. A desire to sample all depth ranges along each transect influenced station locations. An attempt was made to place stations along transects with the deepest end at approximately 275 fathoms and as shallow as 20 fathoms on the end closest to shore. To allow for the length of the gear and drift while setting and hauling, stations had a buffer of safe and fishable depths of 1.5 nmi on all sides of each survey point. All historical stations meeting the above criteria were given preference in the new design. No new stations were added in Area 2B (i.e., all stations fished in 2B in 1993 were in the same location as the last grid survey in 1986). A number of new stations were added in Area 3A to provide optimal coverage and logistical efficiency. Appendix I Figure 21 displays stations fished during the 1993 SSA survey.

After stations were chosen along the longitudinal transects and formed into triangular sampling patterns and a new station, not part of the grid pattern, was added in the center of each triangle.

The location of the center station was chosen by the captain of each survey vessel in 1993 and was intended to represent a location preferable to commercial fishermen, i.e., the position within the triangle that the captain felt would provide the highest CPUE.

Individual stations were identified by a two- to four-character alphanumeric designation following the system used for the last grid survey in 1996. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect. The captain's station was identified by combining the nearest alphanumeric station designation with the letter "C".

Fishing pattern

The survey was designed so a vessel could fish one triangle of four stations each day. The vessels were instructed to set all three grid-stations before the captain's station. If weather or other problems arose, the captain's station may not have been set. A single coordinate for the grid stations at the vertices of the triangle was provided. Instructions called for the vessels to begin setting the first skate of each set on the station coordinate.

Both vessels set six skates at each station. If weather and tide conditions permitted, the vessel was instructed to set the gear in the direction of the next station to reduce run time between stations. The first station was set at 0500 each morning. Hauling began after the first station had soaked for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any gear left soaking overnight, or more than 14 hours was considered ineffective for stock assessment purposes. Aside from the captain's selection of the location for the so-called captain's station within each triangle, under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with 16/0 circle hooks spaced at 18-foot intervals. Skates fished by the *Kristiana* were 1,800 feet long, while the *Cape Flattery* fished 1,500-foot skates. The number of hooks on each skate were counted at the beginning of the survey and marked to indicate whether it fell within the standard. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey (prior to this, 10% deviation was the trigger to repair the gear.

The only bait used during the standardized survey was previously frozen chum salmon. The crew was instructed to cut the bait to approximately 0.25-pound pieces, which was described as about the size of a cigarette pack. Bait, however, was not weighed to confirm weight.

Sampling protocol

Halibut sampling

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. An estimated length was recorded for halibut lost at the roller. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

Every halibut landed, regardless of length, was sacrificed in order to visually examine the gonads. Sex was recorded as male, female, or unknown. In addition, the stage of sexual maturity of all halibut caught was recorded for all stations except the ones selected by captain. Maturity was determined through visual examination and recorded as either immature, mature, or unknown. Female halibut may have been assigned a more detailed stage of maturity based on a scale of one to eight developed during a survey in 1992. Stages one and two were considered immature and three through eight were considered mature. The eight-stage system was only used during trips two and three on the *Cape Flattery* and trip four on the *Kristiana*.

The white-side otolith was collected from all halibut landed from the grid stations but not from the captain's stations. Due to the large number of otoliths collected during the survey, only a sub-sample of the total number were analyzed when returned to the IPHC age room.

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute and recorded the incidence of lost bait. Bait lost during each set, was recorded by skate.

Bycatch and hook occupancy

One of the three IPHC biologists aboard each vessel was assigned to exclusively monitor the hooks as they were retrieved from each set and to record the hook status (e.g., empty, baited, or the species caught on the hook). At the end of each set, the average weight of each species

caught was estimated. This hook-by-hook information was recorded with the corresponding skate number.

Oceanographic data

Ocean Bottom and sea surface temperatures were taken on one grid station each day. Bottom temperatures were collected using a J-90 thermometer preferably attached to the buoy line about 10 feet above the anchor. Sea surface temperatures were collected using a hand-held thermometer in a bucket of freshly collected water.

1993 Setline mortality spot tagging pilot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Rebecca B*	3A, 3B	East of Kodiak Island and SW of Kodiak Island	April 25 – May 8	1	Autoline gear: 1-10, 12-14, 16-19, 23 Conventional gear: 11, 15, 19-22 Special: 24

Fishing effort	23 sets
Legal-sized halibut	3,549 fish
Sublegal-sized halibut	2,642 fish
Tagged halibut	3,800 fish

The commercial setline vessel *Rebecca B* was chartered to take part in a pilot study to investigate the handling mortality associated with different methods of releasing halibut from longline gear commonly found in the Pacific cod and sablefish fisheries. The objective of this study was fourfold: to determine mortality coefficients for different handling methods using cod-style gear; to evaluate the criteria used by NMFS observers relating to halibut viability and, if possible, to develop criteria which could relate handling moralities to some combination of condition, release method, or hook removal injury; to determine the feasibility of holding halibut on-board for time periods of three days or longer in order to determine short-term mortality rates associated with different handling methods and injury types; and to produce a video document summarizing early observations and highlighting handling methods and damage done by poor handling (e.g., crucifying at the roller). The study area extended from the shelf edge outside of Ugak Island (east of Kodiak Island) to the region around Chirikof Island (southwest of Kodiak Island).

The *Rebecca B* made 23 sets and caught a total of 3,549 legal-sized halibut (≥82 cm) and 2,642 sublegal-sized halibut (<82 cm). Of these, a total of 3,800 halibut were tagged and released. All legal-sized halibut not suitable for tagging and some bycatch were dressed, iced, and sold at the end of each trip help fund the survey.

Set number 24 in the database represents the release of eight sublegal-sized halibut in Kodiak harbor that had been held during a live fish experiment described below. This was not a gear set made by the vessel.

Survey design

Station parameter

This survey was a spot fishing operation. The captain chose the exact fishing location within a larger area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The vessel was originally asked to fish in and around the Chiniak Gully offshore from the town of Kodiak, but bad weather forced the vessel south to the Trinity Islands after the first day, then further south to the Chirikof Island area after the fourth day.

The *Rebecca B* set between one and four sets of gear each day. Gear was generally set as early as practical each day and retrieval began after a five to seven hour soak time. If time allowed, additional gear was set during the early afternoon. All gear was usually retrieved before midnight of the day of setting, although on three instances hauling continued two or more hours after midnight.

Fish intended for tagging were removed from the hook by one of four methods: careful shaking, mechanical stripping by the crucifier, cutting the gangion, or straightening the hook. All fish fell to the deck area inside of the vessel's rail. Fish were quickly measured, observed for hooking location, hook removal injury, assigned a NMFS condition code, then tagged and released. With the exception of eight fish held for three days in seawater tanks, no fish were held for longer than four minutes between capture and release, and in most cases this time was less than 40 seconds.

Gear and bait specifications

This study employed two types of fishing gear: a Mustad autoline system using fixed-hook gear, and conventional skate-bottom type fixed-hook gear. Although both gears used similar sized hooks (#13/0), the conventional gear used a full circle style hook (Mustad 39975, 13/0) while the autoline gear used a Mustad "easy-baiter" design required for the racking and auto-baiting system. In both cases hooks were attached to a 5/16 inch groundline by 15 inch gangions at 42 inch intervals. Gangion weight varied between 54 and 60 thread, intermixed among the two gear types.

The *Rebecca B* baited hooks with whole, previously frozen squid (*Loligo spp*.), packaged in Maine. It was reported that a large number of hooks that were set using the autoline gear were not baited by the easy-baiter system and were consequently set without bait. And, hence, was one of reasons the vessel switched from autoline to conventional longline gear for this survey.

Sampling protocol

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter. Because of the light gear employed by the autoline equipment on the *Rebecca B*, many of the larger fish were lost at the roller. After the fish were measured, the hook removal method, hooking location, hook removal injury, and condition codes were recorded. The condition codes employed during the charter were consistent with those used by NMFS observers. The sex of several fish caught during the survey was recorded as male or female. The stage of sexual maturity was not observed.

All fish under 100 cm were tagged and released. Initially, the plan was to tag only sublegal-sized halibut (<82 cm), but not enough were caught so the size for tagging was increased to 100 cm. All legal-sized halibut unsuitable for tagging (approximately 50%, most over 100 cm) were dressed and retained for sale. Since several halibut were being lost at the roller, the vessel crew began harpooning many of the fish before they were able to swim away. In addition, approximately 1,000 pounds of halibut were caught by jig.

Bycatch and hook occupancy

The catch of other fish species was recorded sporadically. For sets with bycatch records, each species was totaled by set and a rough estimate of average weight was applied.

Oceanographic data

No air, sea surface, or bottom temperatures were recorded during this survey.

Supplemental project

Short-term mortality study

During the last three days of the trip, eight halibut, all less than 80 cm, were held in a seawater tank on deck. The fish were held for three days in an aluminum tank approximately three feet by three feet by five feet. The tank was supplied with a constant stream of seawater and the fish were checked daily. The purpose of this experiment was to give an indication of short term hooking mortality. After examining each halibut at the end of the treatment, it was released into Kodiak Harbor.

1994 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Kristiana*	3A, 3B	West Albatross Banks & Kodiak Island to Chignik	June 24 – August 6	1-4	1-91
F/V *Thor*	3A	Albatross Bank to Cape Cleare	June 18 – July 28	1-4	1-119

Fishing effort	210 sets
Legal-sized halibut	12,272 fish
Sublegal-sized halibut	6,537 fish

In 1994, the IPHC standardized stock assessment grid survey was continued for the second consecutive year. The standardized survey entailed fishing a predetermined grid of stations designed to cover the range of halibut habitat within a desired area. These surveys provided information, independent of the commercial fishery, for stock assessment and a variety of data pertaining to the biology and distribution of the halibut resource. Traditionally, the standardized survey included the core areas of the U.S. (Area 3A) and Canadian (Area 2B) waters containing the majority of the halibut resource and commercial effort. The Area 2B survey was postponed until 1995 so that the 1994 survey could be expanded into a larger portion of Area 3A and parts of Area 3B. Two vessels were chartered in 1994 to complete the expanded survey in U.S. waters. The *Kristiana* and *Thor* completed 210 stations and caught a total of 12,272 legal-size and 6,537 sublegal-sized halibut. All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1994 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized triangular pattern for the grid survey initiated in 1993 was continued in 1994 with some minor changes. This design placed stations along longitudinal transects. In order to use as many historical stations as possible, new stations were placed along transects either on or directly between transect junctions. The choice of where to place the stations along transects was based upon several qualifying factors. The stations were positioned so that they could be formed into a triangle fishable in a survey day, i.e., the vertices of the triangles (the stations) could be no more than 15 nmi apart and that care had to be given to avoid obstructions such as islands, reefs, underwater cables, traffic lanes etc. The desire to cover all depth ranges along each transect meant stations were placed along the transects with the deepest end at approximately 275 fathoms and as shallow as 20 fathoms on the near-shore end. To allow for the length of the gear and drift while setting and hauling, stations had a buffer of safe and fishable depths of 1.5 nmi on all sides of each survey point. All historical stations meeting the above criteria were given preference in the new design.

After stations were chosen along the longitudinal transects and formed into triangular sampling patterns, a new station, not part of the grid pattern, was added in the center of each triangle (Fig. 8). The location of the center station was chosen by the captain of each survey vessel during operations in 1993. Thereafter the center station was fixed before the survey as the centroid of the triangle, i.e., the point of intersection formed by lines drawn from the midpoint of each side to the opposing vertex. Appendix I Figure 22 displays stations fished during the 1994 SSA survey.

Individual stations were identified by a two- to four-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect. The center station was identified by combining the nearest alphanumeric station designation with the letter "C".

Fishing pattern

The survey was designed so a vessel could fish one triangle of four stations each day. If weather or other problems arose, the center station may not have been set. A single coordinate representing the center of each grid station was provided. Instructions called for the vessels to set the gear in a north-south orientation with the set centered on the given station coordinate. When weather or tide conditions did not allow this, it was permissible to set in any directions necessary as long as the gear was centered on the station.

Both vessels began setting six skates at each station. However, after the second day fishing the *Kristiana* concluded that they could not finish the prescribed four stations of six skates in a reasonable fishing day because they were using longer skates than the *Thor*; the *Kristiana* reverted to setting five skates at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or more than 14 hours was considered ineffective. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with 16/0 circle hooks spaced at 18-foot intervals. Skates fished by the *Kristiana* were 1,800 feet long, while the *Thor* fished 1,500-foot skates. The number of hooks on each skate were counted on the first day and checked periodically throughout the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only type of bait used during the standardized survey was previously frozen chum salmon. The crew was instructed to cut the bait to approximately 0.25-pound pieces, which was described as about the size of a cigarette pack. Bait, however, was not weighed to confirm weight.

Sampling protocol

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with the corresponding skate number. An estimated length was recorded for halibut lost at the roller. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The sex of every halibut captured was determined by killing the fish and visually examining the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a more detailed stage of maturity on a scale of one through eight. Stages one and two were considered immature and three though eight were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The white-side otolith was collected from approximately one-third of all halibut caught. Random sampling sheets dictated which halibut were chosen for otolith collection. Due to the large number of otoliths collected during the survey, only a sub-sample of the total number were analyzed.

While setting the gear, one or more of the IPHC staff recorded the incidence of lost bait during setting. Bait lost while setting was recorded by skate.

Bycatch and hook occupancy

One of the three IPHC staff aboard each vessel was assigned to monitor the hooks as they were retrieved and to record the hook status and corresponding skate number. Hook status was recorded as empty, baited, broken, or whether it captured a halibut or other organism. Invertebrates that were merely snagged by the gear were not recorded. At the end of each set, a rough estimation of the average weight of each species caught was recorded.

Oceanographic data

Ocean bottom and sea surface temperatures were taken on one of the grid stations each day. Bottom temperatures were collected using a J-90 thermometer attached to the buoy line about 10 feet above the anchor. Surface temperatures were collected using a hand-held thermometer in a buoyant perforated PVC casing trailed alongside the vessel.

1994 West coast pilot grid and spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Coolidge*	2A	Grays Harbor to Cape Flattery	June 21 - 30	1	Grid stations: 1-3, 5-12, 14-17, 19-21 Spot stations: 4, 13, 18, 22-24

Fishing effort	24 sets
Legal-sized halibut	361 fish
Sublegal-sized halibut	449 fish

Due to a renewed interest in the use of standardized grid surveys in 1994, the IPHC chartered the commercial longline vessel *Coolidge* to perform a pilot survey in the northern part of Area 2A between Grays Harbor and Cape Flattery. The purpose of this survey was to explore the possibility of using a grid pattern in Area 2A similar to that used in Alaska and Canada. In seven fishing days, the *Coolidge* made 24 sets and caught a total of 361 legal-sized halibut (≥82 cm) and 449 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset survey costs. Most of the halibut landed were caught on stations selected by the skipper.

Survey design

Station pattern

A grid was laid out by drawing east-west transects every 10.4 nmi along the coast and placing stations every 12 nmi along each transect. Each transect's starting station position was offset 6 nmi from neighboring transects so that stations on neighboring transects were staggered. The starting point of the grid was far outside the area to be surveyed, so the entire grid covered a large geographic area. The stations to be fished were simply the ones that fell within Area 2A-1 seaward of a baseline 2 nmi offshore and in depths of 100 fathoms or less.

Fishing pattern

The plan was to fish three grid stations a day, plus one station chosen by the skipper as likely to yield good catches. The skipper stations (labeled SS in the database) were fished because the captain wanted to prove there were halibut in the area. These stations were on the captain's own commercial halibut grounds and were mostly placed on or near the shelf edge where grounds are deeper.

A total of 18 grid stations and six skipper stations were fished. One planned grid station and one skipper station could not be fished because shrimp trawlers working near the shelf edge occupied the stations; another grid station was fished instead. Six skates were set at each station, except the last two skipper stations, where only four were set. Setting commenced at about 0600 hours and hauling began around noon. If the day's three grid stations lay in a triangle and the skipper station also fell within the triangle, the day's work could be finished by 2200 or 2300 hours. More often, though, the stations were more scattered, and running time added two or three hours to the workday.

Gear and bait specifications

The *Coolidge* used conventional fixed-hook longline gear that had been borrowed from the halibut schooner *Vansee*. The lead biologist aboard the *Coolidge* reported a considerable variation in the number of hooks per skate, but the hook spacing and hook type was fairly consistent. In general, each skate averaged 1,500 feet of groundline with 16/0 circle hooks spaced at 18-foot intervals.

The *Coolidge* used only previously frozen chum salmon as bait. The crew was instructed to cut the bait to approximately 0.25-pound pieces, which was described as about the size of a cigarette pack. Bait, however, was not weighed to confirm weight.

Sampling protocol

Halibut sampling

Due to the small size of the *Coolidge*, the recording shack normally mounted on the deck of IPHC chartered vessels was not used. Instead, the Commission crew used a small portable desk with a built-in storage space when recording data and packaging otoliths on deck.

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute and recorded the incidence of lost bait.

The fork length of every halibut was measured to the nearest centimeter and recorded with the corresponding skate number. Halibut lost at the roller were not recorded. Every halibut landed, regardless of length, was sacrificed in order to visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity was recorded as either immature, mature, or unknown. The unknown rating was used for either sex or maturity if the biologists on board could not make a diagnosis or the gonad was lost before examination. After recording the sex and maturity, the white-side otolith was collected from all halibut regardless of size.

Bycatch and hook occupancy

As the gear was retrieved, one of the IPHC biologists monitored the hooks as they were retrieved from each set to record the hook status and corresponding skate number. Hooks were recorded as either empty, baited, broken, or named the species caught. Invertebrates that werwe merely snagged by the gear were not recorded.

Oceanographic data

No sea surface or ocean bottom temperatures were collected during this survey.

1994 Setline mortality spot tagging survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Rebecca B*	3A	Albatross Bank	July 3 – July 29	1-3	1-60

Fishing effort	744 skates
Captured halibut	14,452 fish
Tagged halibut	9,296 fish

The commercial setline vessel *Rebecca B* was chartered for the second consecutive year to continue a setline mortality study, which began in 1993. The purpose of this survey was to investigate the handling mortality associated with different methods of releasing halibut from gear targeting cod and sablefish. The objective of this study was manifold: to determine mortality coefficients for different handling methods using cod-style gear; to evaluate the criteria used by NMFS observers relating to halibut viability and, if possible, to develop criteria which could relate handling moralities to some combination of condition, release method, or hook removal injury; and to evaluate the feasibility of holding halibut on board for three days or longer in order to determine short-term mortality rates associated with different handling methods and injury types; and to produce a video document summarizing early observations and highlighting handling methods and damage done by poor handling. The main difference between the 1993 and 1994 surveys was a change in the longline gear used by the vessel.

The *Rebecca B* made 60 sets, fishing a total 744 skates of 150 hooks each. This included 313 skates (24 sets) with autoline-style hooks, 409 skates (33 sets) with small circle hooks and 33 skates (3 sets) with large (#3) circle hooks. Of the 14,452 halibut landed, 2,870 legal-sized

halibut and 6,426 sublegal-sized halibut were tagged and released. All legal-sized halibut that were not tagged and some bycatch were dressed, iced, and sold at the end of each trip to offset survey costs.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing location within a larger area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The study area chosen for this survey was in the Albatross Bank area east of Kodiak Island.

Fishing pattern

The *Rebecca B* usually set between three and four sets of gear each day, but the number occasionally varied from two to five. Gear was generally set as early as practical each fishing day and retrieval began after a five to seven hour soak time. If time allowed, additional gear was set during the early afternoon. All gear was usually retrieved before midnight of the day it was set.

Fish intended for tagging were brought aboard by the groundline/gangion/hook and the fish were removed from the hook by one of four methods: careful shaking, mechanical stripping by the crucifier, cutting the gangion, or straightening the hook. All fish fell to the deck area inside of the vessel's rail after being unhooked. Biologists quickly measured the fish once on board, inspected for hooking location, assessed a hook removal injury, rated the fish according to NMFS condition code, and then tagged and released the specimen. Most halibut were tagged and released within four minutes of arrival on deck; in most cases holding time was less than 40 seconds.

Gear and bait specifications

The only change in fishing gear between the pilot study in 1993 and the survey in 1994 was in the method used to fish the autoline gear. The *Rebecca B* removed its autoline system between 1993 and 1994 and subsequently hand baited the autoline hooks fished in 1994. During 1993, the autoline hook was a Mustad "easy-baiter" design (Mustad 39975 13/0) required by the racking and baiting system. This hook had a straight bend. During 1994, about 20 percent of the autoline hooks used were another brand (Milward 13/0). These hooks were mixed throughout the Mustad hooks and no attempt was made to note when or where they were used. There was little functional difference between these two autoline-style hooks. Overall, the autoline hooks are substantially lighter than the circle hooks used with the conventional gear and had a smaller wire size and therefore were easier to bend or straighten.

As in the pilot study, all hooks fished by the *Rebecca B* were baited with whole, previously frozen squid (*Loligo* spp.) packaged in Maine.

Sampling protocol

Halibut sampling

The fork length of all halibut under about 100 cm was measured to the nearest centimeter. Larger halibut and those unsuitable for tagging were dressed, iced, and retained for sale. No data from larger fish was recorded and only data from tagged fish is available in the database. Since many were being lost at the roller, the vessel crew began harpooning many of the fish before they were able to swim away. In addition, a number of halibut were caught by jig.

After the small fish were measured, the hook removal method, hooking location, hook removal injury, and condition codes were recorded. The condition codes employed during the charter in the 1993 pilot survey were consistent with those used by NMFS observers. The

condition codes used in 1994 were adjusted from 1993 so they were more descriptive and less susceptible to subjective interpretation.

Bycatch and hook occupancy

The catch of other fish species was recorded sporadically and only during the first trip. For sets when bycatch was recorded, each species was totaled by set and a rough estimate of average weight was applied.

The hook status and catch of species other than halibut was not recorded as the gear was retrieved because were fully occupied with halibut work.

Oceanographic data

The vessel did not record air, sea surface, or bottom temperatures during this survey.

Supplemental project

Holding tank test

Halibut were held in four aluminum tanks approximately 4 ft x 4 ft (one tank) and 3 ft x 5 ft (three tanks) and 30 inches deep. The tanks were fitted with plywood covers and received a constant supply of fresh seawater throughout the holding time. Eight to 10 fish (36 fish total) were put into each tank on July 6, with the attempt being made to mix severely damaged fish with less damaged fish in each tank. Fish length ranged from 56 cm to 90 cm. The experiment was terminated on July 16 due to heavy weather that created problems keeping the fish in the tanks.

1994 Underwater video and hook timer spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Clipper II*	2B	Queen Charlotte Is.	June 6 - 21	1	1-45
F/V *Ocean Viking*	2B	Queen Charlotte Is.	June 9 - 21	1	1-32

Fishing effort: Clipper II Fishing effort: Ocean Viking	40 hours video 32 sets
Legal-sized halibut: Ocean Viking	~14,000 lbs
Sublegal-sized halibut	27 fish

The chartered vessel *Clipper II* worked in concert with the commercial setline vessel *Ocean Viking* in conducting a research survey involving the use of hook timers and an underwater video camera in Area 2B, around the Queen Charlotte Islands. This survey was part of an ongoing project aimed at analyzing and modeling the longline fishing process with the purpose of evaluating the effect of bait competitors on the catch rate of halibut. The primary goal of the survey was to explore a few fishing grounds, and collect information on the pattern of bait removals through time, the species composition of the catch, and the hooking success of the most common species

competing for bait on those grounds. While the *Ocean Viking* fished longline gear with hook timers, the *Clipper II* deployed an underwater camera in the vicinity to observe the behavior different species exhibited toward a few baited hooks placed in the field of view of the camera.

Specific objectives for the *Clipper II* were to record the behavior of halibut and other competing species towards baited hooks on a few fishing grounds using an underwater video camera, as well as to observe the general conditions on the fishing ground, for example, species consuming baits and presence of scavengers. A total of 45 camera deployments were completed and over 40 hours of video was collected from these sets.

The specific objective for the *Ocean Viking* was to fish with longline gear rigged with hook timers on one or two grounds in order to collect hook-by-hook information on the time elapsed before baits are attacked, and the outcome of the attacks (species caught or bait status). A total of 32 longline sets (142 skates) were made over nine days of fishing which resulted in a catch of legal-sized halibut close to 14,000 pounds. There were 27 sublegal-sized halibut caught.

More detailed information about the survey design, sampling protocols and data recording instructions for this survey can be found is the 1994 Camera / Timer Instruction Manual, available in IPHC's archives. See also Kaimmer 1999.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing location within a larger area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Because spiny dogfish are among the primary bait competitors in Canadian waters, one of the goals of the project was to evaluate their effect on halibut CPUE. This experiment, therefore, was conducted on grounds that were expected to produce an average halibut CPUE with variable dogfish abundance. Conditions required by the video camera also influenced selection of the grounds. To operate effectively, the camera required good visibility in depths providing adequate ambient light (approximately 40 fathoms) and protection from tides and weather.

The plan was to start fishing in the Hecate Strait grounds west of Porcher Island. If problems arose (e.g., bad weather conditions, poor water visibility, insufficient catch rates) researchers were to consider moving west to other predetermined locations.

Fishing pattern

Each day the *Ocean Viking* usually set four sets of approximately five skates each. Shorter sets of three skates were used on some fishing grounds that were too small for a regular 5-skate set. Between 95 and 102 hook timers were mounted on the middle skate. (The leading part of the next skate was used when the 100 hook timers did not fit on the middle skate.) The middle skate was marked to help maintain regular hook spacing. A device that records time and depth was deployed at the beginning of the hook-timer skate. Two sets were laid out and then retrieved after a two to three hour soak time. An attempt was made to follow a predetermined setting and hauling schedule, which allowed a minimum soak time of three hours.

The *Clipper II* was always in the proximity of the longline vessel *Ocean Viking*. Radio contact was maintained to coordinate the operations. Underwater observations were made continuously throughout the day, always in proximity to the fishing gear. Several locations along the longline were usually explored.

Gear and bait specifications

The *Clipper II* used a video camera setup that was generally unchanged from that used for the 1991 survey. The only significant change was that the pan and tilt unit for the camera was

changed to one developed by NMFS in Seattle. Essentially, a camera capable of operating in very low light conditions was mounted on a pan and tilt unit at the apex of a steel and aluminum frame. The camera was held about eight feet above a 9-foot square base by aluminum legs. Baited hooks were attached to a groundline suspended within the square frame. The whole arrangement was deployed from an anchored vessel by a combination electrical-mechanical cable, allowing the baits to be observed throughout the deployment.

The *Ocean Viking* fished regular snap gear of the type commonly found in the commercial halibut fishery. Skates were about 1,800 feet long with approximately 70 to 100 circle hooks (16/0) spaced at intervals of about 18 feet. The hook timers initially used in 1990 were again used for this survey. (See the section 1990 Hook Timer Spot Survey in this report for details.) The tension needed to pull off the plunger and activate the timer was periodically checked with a spring scale. The goal was to maintain it in the range of three to eight pounds so that timers were sensitive to weak attacks, yet would not be tripped during setting of the gear. Timers were rinsed after each set to reduce the interference of slime on the o-rings release tension.

All hooks were baited with previously frozen chum salmon. Special care was taken to cut bait pieces as homogeneous as possible (tails and heads were discarded).

Sampling protocol

Setting

When setting the setline snap gear, the *Ocean Viking* recorded the usual header information including the position and depth of each set, orientation of the set with respect to current direction, weather conditions. Echo sounder paper tracks were retained for most sets. Observations of the gear included time at set for each skate and time at set (minute by minute) for hooks on the hook-timer skate. Timers that tripped while setting and baits that fell off were identified by hook number.

Video monitoring

A Camera Observation form was completed aboard the *Clipper II* while observations were being recorded. The header information for the set and a summary of hook status at retrieval were recorded on Set Form A-Camera Special.

Halibut sampling

The fork length of every halibut caught was recorded to the nearest centimeter. Halibut and bycatch data were not entered in the database.

Bycatch and hook occupancy

While hauling the setline gear, biologists aboard the *Ocean Viking* monitored each hook from all skates as they were retrieved. Records taken during the hook-by-hook observations included the time of retrieval, bait status, and any bycatch species or halibut caught. Estimated weights were recorded individually for each bycatch species.

In addition to the usual observations, the middle (hook timer) skate was monitored for timer status and the reading on the clock was recorded. Biologists also examined the stomach contents of as many halibut and dogfish as possible and recorded the number of fresh baits found.

Oceanographic data

The vessel did not record air, sea surface, or bottom temperatures during this survey.

1995 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Kilkenny*	3A	Trinity Islands to Cape Cleare	June 19 – August 17	1-7	1-128
F/V *Kristiana*	2B	Cape Scott to Dixon	July 1 - 26 August 28 – September 21	1-5	1-120

Fishing effort	248 sets
Legal-sized halibut	13,273 fish
Sublegal-sized halibut	6,814 fish

The IPHC standardized stock assessment grid survey was continued for the third consecutive year. The standardized survey entailed fishing a predetermined grid of stations designed to cover the range of halibut habitat within a designated area. These surveys provided information, independent of the commercial fishery, used for stock assessment purposes. The surveys also collected data pertaining to the biology and distribution of the halibut resource. The Area 2B survey, which had been postponed in 1994, was completed in 1995 by the *Kristiana*. The *Kristiana* took a 1-month break between trips three and four to participate in a commercial fishery. The *Kilkenny* was chartered to complete the Area 3A survey. The 1995 survey vessels made 248 sets and caught a total of 13,273 legal-sized halibut (≥82 cm) and 6,814 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1995 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized triangular pattern for the grid survey initiated in 1993 was continued in 1995 with some minor changes. This design placed stations along longitudinal transects in Area 3A and latitudinal transects in Area 2B. In order to use as many historical stations as possible, new stations were placed along transects either on or directly between transects. The choice of where to place the stations along transects was based upon several qualifying factors. The stations were positioned so that they could be formed into a triangle fishable in a survey day, i.e., the vertices of the triangles (the stations) could be no more than 15 nmi apart and transit was not precluded by obstructions such as islands, reefs, underwater cables, and traffic lanes. In order to cover all depth ranges along each transect, stations were placed along the transects with the deepest end at approximately 275 fathoms and as shallow as 20 fathoms on the near-shore end. To allow for the length of the gear and drift while setting and hauling, stations had a buffer of 1.5 nmi on all sides of each survey point of safe and fishable depths. All historical stations meeting the above criteria were given preference in the new design. An additional 12 stations were added to the Area 2B survey in 1995 along with several small position changes to

facilitate fishing around or near dangerous obstructions. Several stations were also added at the southern end of many longitudinal transects in Area 3A to increase the station density along the shelf slope and maximize the depth range of the surveys.

After stations were placed along the longitudinal transects and formed into triangular sampling patterns, a new station, not part of the grid pattern, was added in the center of each triangle. The center station was placed at the triangle's centroid. Figure 23 in Appendix I displays stations fished during the 1995 SSA survey.

Individual stations were identified by a two- to four-character alphanumeric designation. The first one or two characters identified the transect number and the last character was a letter (A-Z) specifying the station's location along the transect. The center station was identified by combining the nearest alphanumeric station designation with the letter "C".

Fishing pattern

The survey was designed so a vessel could fish one triangle cluster of four stations each day. A single coordinate for the center of each grid station was provided to the vessels. Instructions called for the vessels to set the gear centered on the given coordinate and oriented along the transect lines, i.e., north-south in Area 3A and east-west in Area 2B. When weather or tide conditions did not allow these instructions, it was permissible to set in any direction necessary as long as the gear was centered on the station.

Five 1,800-foot skates were set at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or more than 14 hours was considered ineffective. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both the *Kristiana* and *Kilkenny* used conventional fixed-hook setline gear with skates consisting of 1,800 feet of groundline and approximately one hundred No. 3 (16/0) circle hooks spaced at 18-foot intervals. The number of hooks on each skate were counted on the first day and checked periodically throughout the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pounds each. The bait was not weighed to confirm size.

Sampling protocol

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length was recorded for halibut lost at the roller. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

Every halibut landed, regardless of length, was sacrificed in order to visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a more detailed stage of maturity based on a scale of one of eight. Stages one and two were considered immature and three through eight were considered mature. A "U", for unknown, may have been recorded for either sex or maturity if the biologist could not make a determination.

The left-side otolith was collected from approximately 2/3 of all halibut caught in Area 2B and 1/5 of the halibut from Area 3A regardless of size. Random sampling sheets dictated which

halibut were chosen for otolith collection.

While setting the gear, one or more of the IPHC staff recorded the incidence of bait lost during setting. The number of baits lost during each set was recorded by skate.

Bycatch and hook occupancy

One of the three IPHC staff aboard each vessel was assigned to exclusively monitor the hooks as they were retrieved from each set to record the hook status and corresponding skate number. Hooks were recorded as either empty, baited, broken, or species caught. Invertebrates snagged by the gear were not recorded.

Oceanographic data

Ocean Bottom and sea surface temperatures were taken on one of the grid stations each day. Bottom temperatures were collected using a J-90 thermometer, preferably attached to the buoy line about 10 feet above the anchor. Sea surface temperatures were collected using a hand-held thermometer trailed over the side inside a buoyant PVC casing.

Supplemental projects

Bottom type

IPHC biologists aboard the *Kristiana* attempted to ascertain the general composition of the ocean bottom by attaching a coffee can to the end of one set each day and examining the contents upon retrieval.

Invertebrate competition

Aboard the *Kristiana*, a crab pot was attached to the end of several sets throughout the charter in an attempt to better understand bait competition by crabs and other invertebrate species.

1995 Random stratified survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Risky Business*	2A, 2B	Brookings to Cape Flattery & West coast of Vancouver Island	July 10 – September 22	1-7	1-117

Fishing effort	117 sets
Legal-sized halibut	1,348 fish
Sublegal-sized halibut	817 fish

The Commission performed a pilot grid survey off the coast of Washington State in 1994 to assess the feasibility of using a standardized grid pattern on the traditionally low CPUE grounds of Area 2A. Conclusions were that a standard grid survey probably would not give the information needed, but that a random stratified survey with sampling stations more concentrated in the areas known to be rich halibut habitat was more appropriate. Following this conclusion, a random stratified survey was designed for Areas 2A and southern 2B. The *Risky Business* was

chartered in the summer of 1995 to perform the survey and succeeded in completing 117 of the planned 120 stations. The *Risky Business* caught a total of 1,348 legal-sized halibut (≥82 cm) and 817 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed and iced aboard the survey vessel and sold at the end of each trip to offset program costs.

Survey design

Station pattern

This was a random stratified survey consisting of 90 stations placed on known halibut grounds and 30 placed off halibut grounds. The design of this survey began with the IPHC staff plotting all of the productive halibut grounds reported in commercial logbooks during the years 1930 to 1994, plus some sport charter locations from recent years. Nearly all of the grounds were in depths between 30 and 200 fathoms. Transects were then drawn from 30 to 200 fathoms at each minute of latitude from the Oregon-California border in Area 2A to Cape Scott in Area 2B. Each transect segment was limited to commercial halibut grounds.

A predetermined number of stations were positioned on and off fishing grounds via a stratified random procedure modified to avoid stations in close proximity to each other. All of the qualifying transect segments were ordered from south to north and east to west, and the cumulative mileage along the segments was divided into a number of intervals equal to the allocated number of stations. A point within each interval was chosen by drawing a random number from a uniform (0,1) distribution. That point on the interval was mapped to the point on the sequence of the segments that was the same distance from the starting point. If the station location was within 5 nmi of a station previously placed, it was discarded and another random number was drawn. This modification produced a noticeably more uniform distribution of stations on irregularly shaped grounds. Some transect segments were excluded from the selection procedure because they were either too short to accommodate a standard set, or because they lay within designated shipping lanes at the mouth of the Strait of Juan de Fuca. Figure 24 in Appendix I displays all stations fished during the 1995 random stratified survey.

Stations were numbered sequentially beginning with one near Brookings, Oregon, and ending with 120 near Cape Scott on Vancouver Island. Each station was assigned a two-letter purpose code to indicate whether the station fell on commercial (RC) or non-commercial (RN) grounds.

Fishing pattern

Five skates were set at each station and three stations were usually set each day. Setting began between 0600 and 0700 and hauling began after the first set was allowed to soak for a minimum of five hours. Typically, the last station was aboard before 1900. The random nature of the station pattern prevented maximizing the number of stations fished in a day and sometimes resulted in long runs between sets.

Gear and bait specifications

The *Risky Business* used conventional fixed-hook setline gear with 1,800-foot skates with approximately one hundred No. 3 (16/0) circle hooks spaced at 18-foot intervals. The number of hooks on each skate were counted on the first day and checked periodically throughout the charter. Lost or damaged hooks were replaced daily. If the hook count varied by more than 5%, the skate was repaired or set aside and not used.

The only bait used during the random stratified survey was previously frozen chum salmon. The crew was instructed to cut the bait so that the average size ranged from 0.25 to 0.33 pound each. The bait was not weighed to confirm size.

Sampling protocol

Setting

While setting the gear, one or more of the IPHC staff recorded the incidence of bait lost during setting.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length may have been recorded for halibut lost at the roller; however, when the IPHC biologist on deck was not able to make an accurate estimate a "0" was entered for length. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

Every halibut landed, regardless of length, was sacrificed in order to visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male and female halibut was recorded as immature, mature, or unknown. Beginning with trip 4, female halibut were assigned a more detailed stage of maturity based on a scale of one to eight. Stages one and two were considered immature and three through eight were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, it was recorded as unknown. After sex and maturity were recorded, the left-side otolith was collected from approximately one-third of all halibut. Random sampling sheets dictated which halibut were chosen for otolith collection.

Bycatch and hook occupancy

As the gear was hauled, one of the three IPHC staff on board was assigned to exclusively monitor the hooks as they were retrieved to record the hook status and corresponding skate number. Hook status was recorded as empty, baited, broken, or whether it captured a halibut or other organism. Invertebrates snagged by the gear were not recorded. Biologists also recorded an estimated weight for each bycatch species at the end of each set.

Oceanographic data

Ocean Bottom and sea surface temperatures were taken sporadically throughout the survey. Bottom temperatures were collected using a J-90 thermometer, typically attached to the buoy line about 10 feet above the anchor. Sea surface temperatures were collected using a hand-held thermometer trailed over the side inside a buoyant PVC casing. No temperatures were collected during trips three, four, and seven.

1996 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Cape Ball*	2B	Cape Scott to Dixon Entrance	July 3 – September 6	1-5	1-121
F/V *Cape Devon*	3A	Portlock Banks to Middleton Island	May 29 – July 11	1-4	1-103
F/V *Kilkenny*	3A, 3B	Middleton Island & Trinity Island	August 2 – September 17	1-2	1-35
F/V *Kristiana*	3B	Chirikof Island to Unimak Pass	July 3 – August 17	1-4	1-100
F/V *Kristina*	3A	Cape Spencer to Yakutat	July 13 – August 20	1-5	1-68
F/V *Lualda*	3A, 3B	Albatross Bank & Chirikof	July 1 – August 18	1-5	1-116
F/V *Norska*	3A	Yakutat to Hinchinbrook Island	August 20 – September 16	1-3	1-43 (69-111 in database)
F/V *Ocean Viking*	2C	Southeast Alaska	June 5 – 20 August 19 – September 19	1-5	1-97

Fishing effort	683 sets
Legal-sized halibut	35,192 fish
Sublegal-sized halibut	16,759 fish

The IPHC standardized stock assessment grid survey was continued for the fourth consecutive year, yet with a much more ambitious plan than any previous year. The 1996 survey was expanded to include most halibut habitat in Areas 2B, 2C, 3A, and 3B. The standardized survey entailed fishing a predetermined grid of stations designed to cover the range of halibut habitat within a designated area. These surveys provided information, independent of the commercial fishery, used for stock assessment purposes. The surveys also collect data pertaining to the biology and distribution of the halibut resource. The 1996 survey vessels made 683 sets and caught a total of 35,192 legal-sized halibut (≥82 cm) and 16,759 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocol, and data recording instructions for this survey, please refer to the 1996 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized triangular pattern for the grid survey initiated in 1993 was continued in 1996 and expanded into several new areas. For the 1996 season, the IPHC made plans to survey virtually all halibut grounds along the continental shelf from Unimak Pass in Area 3B to Vancouver Island in Area 2B, excluding Shelikof Strait, Cook Inlet, and the Prince William Sound. Since the IPHC had not recently surveyed western 3B, eastern 3A, and southeast Alaska (2C), it was necessary to design new survey stations for these areas. The base grid used for the new survey regions was slightly different from those used in the core areas of 3A and 2B. The new grid followed the historical pattern developed in 1963, which was intended to be approximately 12 nmi x 3 nmi; however, the longitudinal transects had to be adjusted to maintain an approximate 12 nmi separation throughout the survey range. This was accomplished by adjusting the standard 22-23 minutes of longitudinal separation to 21 minutes west of 157° 30' W and 23 minutes east of 148° 00' W. Following the design of previous surveys, the latitudinal transects were drawn at every 3 nmi. Stations in the new survey regions were all placed on transects following the same selective factors used in the other regions.

The southeast Alaska (Area 2C) survey design was similar to the grid used in the other areas but modified in order to obtain a more random distribution on the inside wasters of southeast Alaska. This design was created by first defining all of the fishable waters in Area 2C along transects drawn at each minute of longitude. Fishable waters were defined as between 10 and 275 fathoms deep and allowing a clear path at least 2 nmi in length along the north-south transect line. A grid was then drawn with transects at every six minutes of latitude and every 10 minutes of longitude. Random points were chosen along each transect using the logistically efficient triangular pattern similar to that used in other areas. Triangle points that lay on land or outside fishable depths were discarded leaving several triangle fragments. Additional stations, not part of the grid survey (designated ES for experimental stations), supplemented these orphaned stations or were positioned in areas where additional data may have been useful in determining halibut distribution or local depletion.

After stations were chosen along the longitudinal transects and logically formed into triangular sampling patterns, a new station, which was not part of the grid pattern, was added in the centroid of each triangle. Figure 25 in Appendix I displays stations fished during the 1996 SSA survey.

Individual stations were identified by a four- or five-digit numeric designation. The first two or three numbers identified the statistical area in which the station was placed and the last one or two numbers specified individual stations within the statistical area. For example, station number 22017 was the 17th station in statistical area 220 and station 23017 was the 17th station in statistical area 230.

Fishing pattern

The survey was designed so a vessel could fish one triangle (4 stations) each day. A single coordinate representing the center of each grid station was provided. Instructions called for the vessels to set the gear centered on the given coordinate and, when not precluded by bad weather or strong tides, to orient the set along the transect lines, i.e., north-south in Areas 3A, 3B, and 2C and east-west in Area 2B. Midway through the 1996 survey season, it was decided to move the stations closer together within each triangle to limit the amount of running required and provide a more reasonable work day. The two stations sharing a transect were each moved 1 nmi toward each other and the single station on the neighboring transect was moved 2 nmi toward the first two. The center station was moved 1 nmi toward the first two stations. Station in Areas 2B, western 3B, and part of western 3A were fished using the original (12 nmi x 12 nmi) triangular

pattern. The remaining stations in eastern 3B, eastern 3A, and part of western 3A were fished using the compressed (10 nmi by 10 nmi) triangles.

Approximately 500 hooks on 9,000 feet of gear were set at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or more than 14 hours was considered ineffective. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All vessels were asked to provide uniformly rigged, conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The vessels were allowed to use either 1,500-foot skates with approximately 83 hooks per skate or 1,800-foot skates with approximately 100 hooks per skate. Vessels using 1,500-foot skates set six per station, and vessels using 1,800-foot skates set five per station. The *Cape Ball, Cape Devon*, and *Lualda* fished 1,500-foot skates, while the *Kilkenny, Kristiana, Kristina, Norska*, and *Ocean Viking* used 1,800-foot skates. The number of hooks on each skate was counted on the first day and checked periodically throughout the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily. The *Ocean Viking* accidentally began the survey (sets 1-6) with 2,100-foot skates and hooks spaced at intervals of 21 feet. The gear was changed to survey standards as soon as the IPHC staff realized the mistake.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. The bait was not weighed to confirm size.

Sampling protocol

Setting

While setting the gear, one or more of the IPHC staff recorded the incidence of bait lost during setting. The number of baits lost during each set was recorded by skate.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length was recorded for halibut lost at the roller. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. The eight-stage scale for female maturity used since 1993 was simplified to a four-stage system in 1996. Stage one (formerly one and two) was considered immature and stages two through four (formerly three through eight) were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The left-side otolith was collected from a randomly selected sample of all halibut landed regardless of size. The proportion of otoliths sampled was about 40% in Area 2B, 50% in Area 2C, 11% in Area 3A and 14% in Area 3B. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection

were measured and released alive.

Beginning in 1996, the grid survey vessels were asked to begin collecting information on the occurrence of injuries to halibut from being previously captured and released by hook-and-line gear. The observation of prior hook injuries (PHI) was recorded as either present, absent, or unknown or unsure.

Bycatch and hook occupancy

One of the three IPHC staff members aboard each vessel exclusively monitored hooks during retrieval and recorded each hook's status and corresponding skate number. Hook status was recorded as empty, baited, broken, or by the species caught. Invertebrates snagged by the gear were not recorded. On the *Cape Ball, Kristina, Lualda, Norska, Ocean Viking* there was not enough space to carry a third biologist, so the IPHC staff aboard these vessels attempted to use a variety of methods to obtain the same hook by hook data. Some methods were more successful than others, therefore, hook status data from these vessels is unreliable.

Oceanographic data

Ocean bottom temperatures were taken once each day, preferably on the center station of each triangle. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the Seattle office to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

The IPHC discontinued the collection of surface water temperatures in 1996 because it was found these data were available from other sources.

1997 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Aleutian*	3A	Resurrection Bay to Kayak Island	July 6 – August 1	1-3	1-56
F/V *Bold Pursuit*	2B	Cape St. Hames to Dixon Entrance	June 1 - 25	1-3	1-60
F/V *Cape Ball*	2B	Cape Scott to Cape St. James	June 28 – July 23	1-3	1-60
F/V *Cape Cross*	3B	Shumagin Island to Unimak Pass	May 28 – June 8; July 9 – 18; August 14 - 24	1-4	1-62
F/V *Dorthy Jean*	2C	Northern Southeast Alaska	May 30 – June 18	1-2	1-45
F/V *Elizabeth F*	3B	Chirikof Island to Shumagin Island	July 13 – August 27	1-5	1-116
F/V *Heritage*	4D	Pribilof Island to Russian Border	June 12 – July 29	1-4	1-90
F/V *Judi B*	3A, 4B	Albatross Bank & West Aleutians	May 30 – September 5	1-4	1-108
F/V *Kristiana*	3A	Cape Spencer to Kayak Island	July 5 – August 15	1-4	1-84
F/V *Lualda*	3A	Portlock Banks	June 24 – July 15	1-2	1-56
F/V *Northern Prince*	4A	Unalaska to Pribilof Island	May 30 – June 24	1-3	1-60
F/V *Norska*	4A, 4C	East Aleutians and Pribilof Island	May 31 – September 14	1-9	1-169
F/V *Ocean Viking*	2C	Southern Southeast Alaska	June 2 – 30	1-3	1-52

Fishing effort	1,018 sets
Legal-sized halibut	52,981 fish
Sublegal-sized halibut	26,476 fish

The IPHC standardized stock assessment grid survey was continued for the fifth consecutive year and expanded to include all areas surveyed in 1996, plus Areas 2A, southern 2B, 4A, 4B,

4C, and 4D. The Area 2A and southern 2B surveys utilized a different survey design, which is discussed in the following section. The expansion of survey range resulted from a request by IPHC commissioners and the halibut industry to acquire additional data in all areas within the Commission's jurisdiction. The IPHC committed to surveying all areas to the extent possible given the necessary resources for a period of five years (1997 through 2001).

The standardized survey entailed fishing a predetermined grid of stations designed to cover the range of halibut habitat within a designated area. These surveys collected information used for stock assessment purposes that is independent of the commercial fishery data. The surveys also collected data pertaining to the biology and distribution of the halibut resource. The 1997 survey vessels made 1,018 sets and caught a total of 52,981 legal-sized halibut (≥82 cm) and 26,476 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1997 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized triangular pattern for the grid survey, initiated in 1993 and expanded in 1996, was expanded again in 1997. For the 1997 season, the IPHC made plans to survey virtually all halibut grounds along the continental shelf from Vancouver Island to the Bering Sea and Aleutian Islands, excluding Shelikof Strait, Cook Inlet, Prince William Sound, and the Bering Sea flats. Since the IPHC had not recently surveyed the Bering Sea and Aleutian Islands, it was necessary to design new survey stations for these areas.

The base grid used for the new survey regions differed slightly from those used in the core areas of 3A and 2B. The design for the new grid followed the historical pattern developed in 1963, which was intended to be approximately 12 nmi x 3 nmi; however, the longitudinal transects had to be adjusted to maintain an approximate 12 nmi separation throughout the survey range. This was accomplished by adjusting the standard 22-23 minutes of longitudinal separation to 21 minutes west of 157° 30' W and 23 minutes east of 148° 00' W. The latitudinal transects were drawn at every 3 nmi as in previous years. Stations in the new survey regions were all placed on transect junctions following the same selective factors used in the other regions. The Area 4D survey was restricted to the edge of the continental shelf in depths between 70 and 275 fathoms. After stations were chosen along each transect and logically formed into triangular sampling patterns, a new station not part of the grid pattern, was added on the centroid of each triangle. Figure 26 in Appendix I displays stations fished during the 1997 SSA survey.

Due to difficulty experienced by some survey vessels during the 1996 season, it was decided to move the stations closer together within each triangle to limit the amount of running required and provide a more reasonable working day. The two stations sharing a transect were each moved 1 nmi toward each other and the single station on the neighboring transect was moved 2 nmi toward the first two. The center station was moved 1 nmi toward the first two stations. All previous survey stations from 1996, as well as the new ones designed in 1997, were modified according to this new compressed triangle pattern.

The southeast Alaska (Area 2C) survey design was similar to the grid used in the other areas but modified in order to obtain a more even distribution on the inside waters of southeast Alaska. This design was created by first defining all of the fishable waters in Area 2C along transects drawn at each minute of longitude. Fishable waters were defined as between 10 and 275 fathoms deep and allowing a clear path at least 2 nmi in length along the north-south transect line. A grid was then drawn with transects at every six minutes of latitude and every 10 minutes

of longitude. Random points were chosen along these transects using the logistically efficient triangular pattern similar to that used in other areas. Triangle points on land or outside fishable depths were discarded, orphaning several triangle points. Additional stations, which were not part of the grid survey (designated ES for experimental stations), were then added around orphaned stations or in areas where additional data would provide better insight into halibut distribution or local depletion.

Individual stations were identified by a four- to eight-digit numeric designation. The first two to six numbers identified the statistical area in which the station was placed and the last two numbers specified individual stations within the statistical area. For example, station number 22017 was the 17th station in statistical area 220 and station 57317317 was the 17th station in statistical area 573173.

Fishing pattern

The survey was designed so a vessel could fish one triangle (four stations) each day. A single coordinate representing the center of each grid station was provided. Instructions called for the vessels to set the gear centered on the given coordinate and oriented along the transect lines; i.e., north-south in Areas 2C, 3A, 3B, 4A, 4B, 4C, and 4D and east-west in Area 2B. When weather or tide conditions did not allow this, it was permissible to set in any directions necessary as long as the gear was centered on the station.

Approximately 500 hooks on 9,000 feet of gear were set at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were deemed ineffective. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All vessels were asked to provide uniformly rigged, conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The vessels used either 1,500-foot skates with approximately 83 hooks per skate or 1,800-foot skates with approximately 100 hooks per skate. Vessels using 1,500-foot skates set six skates per station; vessels using 1,800-foot skates set five skates per station. The *Aleutian, Bold Pursuit, Cape Ball, Judy B, Lualda, Northern Prince*, and *Ocean Viking* fished 1,500-foot skates. The *Cape Cross, Dorothy Jean, Elizabeth F, Heritage, Kristiana*, and *Norska* used 1,800-foot skates. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. The bait was not weighed to confirm size.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length may have been recorded for halibut lost at the roller; however, when the IPHC biologist on deck was not able to make an accurate estimate, a "0" was entered for length. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The left-side otolith was collected from a randomly selected sample of all halibut landed. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was about 33% in Areas 2B and 4A, 40% in Area 2C, 8% in Area 3A, 13% in Area 3B, 50% in Areas 4B and 4D, and 67% in area 4C. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured and released alive.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The observation of prior hook injuries (PHI) were recorded as either "Y" for the presence of a PHI, "N" for no PHI, or "U" if unknown or unsure.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, or the organism captured. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges were not recorded. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day, preferably on the center station of each triangle. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the Seattle office to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

1997 Random stratified surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Anita M*	2A	Brookings to Cape Flattery	May 27 – June 30	1-4	1-79
F/V *Risky Business*	2B	West Coast of Vancouver Island	July 14 - 29	1-2	1-39

Fishing effort	118 sets
Legal-sized halibut	1,688 fish
Sublegal-sized halibut	635 fish

This survey was a continuation of the southern Area 2 random stratified survey first performed by the *Risky Business* in 1995. This survey was not performed in 1996 because resources were channeled to the expanded Alaskan survey. The purpose of the random stratified survey was identical to the standardized grid survey described previously—to collect data independent of the commercial fishery for stock management purposes. A random stratified design was chosen over the grid design because it was felt at the time that it would yield better results due to the low CPUE usually encountered in this area. In completing the survey, the *Risky Business* and *Anita M* made 118 sets and caught 1,688 legal-sized halibut (≥82 cm) and 635 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

Survey design

Station pattern

This was a random stratified survey consisting of 90 stations placed on known halibut grounds and 30 placed off halibut grounds. The design of this survey began with the IPHC staff plotting all of the productive halibut grounds reported in commercial logbooks from 1930 to 1994, plus some sport charter locations from recent years. Nearly all of the grounds were in depths between 30 and 200 fathoms. Transects were then drawn from 30 to 200 fathoms at each minute of latitude from the Oregon-California border in Area 2A to Cape Scott in Area 2B. Each transect segment was limited to commercial halibut grounds.

A predetermined number of stations were located on and off grounds using a stratified random procedure modified to avoid stations in close proximity to each other. To accomplish that, all of the qualifying transect segments were numbered from south to north and east to west, and the cumulative mileage along the segments was divided in to a number of intervals equal to the allocated number of stations. A point within each interval was chosen by drawing a random number from a uniform (0,1) distribution; that point on the interval was mapped to the point on the sequence of the segments that was the same distance from the starting point. If the selected station position was within 5 nmi of a station already present, the selected station was discarded and another random number was drawn. This modification produced a noticeably more uniform distribution of stations on irregularly shaped grounds. Some transect segments were excluded from the selection procedure because they were either too short to accommodate a standard set,

or because they lay within designated shipping lanes at the mouth of the Strait of Juan de Fuca. Figure 27 in Appendix I displays stations fished during the 1997 random stratified survey.

Stations were numbered sequentially beginning with one near Brookings, Oregon and ending with 120 near Cape Scott on Vancouver Island. Each station was assigned a two-letter purpose code to indicate whether the station fell on commercial (RC) or non-commercial (RN) grounds.

Two to four stations, consisting of approximately 9,000 feet of groundline each, were fished each day. This effort may have consisted of either five skates of 1,800-foot gear or six skates of 1,500-foot gear. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. The random nature of the station pattern prevented maximizing the number of stations fished in a day and sometimes resulted in long runs between sets. Any set that soaked overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were deemed ineffective. Under no circumstances was setting altered so as to increase or decrease the catch.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with No. 3 (16/0) circle hooks spaced at 18-foot intervals. The *Anita M* fished 1,500-foot skates and the *Risky Business* used 1,800-foot skates. The number of hooks on each skate were counted on the first day and checked periodically throughout the charter. Lost or damaged hooks were replaced daily. If the hook count varied by more than 5%, the skate was repaired or set aside and not used.

The only bait used during the random stratified survey was previously frozen chum salmon. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. The bait was not weighed to confirm size.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. The number of baits lost during each set was recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length may have been recorded for halibut lost at the roller; however, when the IPHC biologist on deck was not able to make an accurate estimate, a "0" was entered for length. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All halibut landed aboard the survey vessels were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown. After sex and maturity were recorded, the left-side otolith was collected.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The observation of prior hook injuries (PHI) was recorded as either present, absent, or unknown or unsure.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

On the *Anita M*, ocean bottom temperatures were taken approximately once each day using a device called a Water Data Recorder or WaDaR. This device was programmed at the Seattle office to take a temperature reading once each hour for the duration of the charter. The electronic components of the WaDaR were sealed in a titanium housing, which was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle. No temperatures were recorded aboard the *Risky Business*.

1998 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	4A, 3A	North of Pribilof Island & Portlock Banks	May 27 – June 30 August 13 – September 11	1-3 8-12	1-46 157-201
F/V *Bold Pursuit*	2C, 3A	Sitka to Kayak Islands	May 30 – August 4	1-8	1-143
F/V *Defiant*	3B, 3A	Trinity Island & Portlock Bank	June 22 – August 14	1-6	1-97
F/V *Elizabeth F*	3B	Chignik	July 18 – August 13	1-4	1-45
F/V *Kristina*	3B	Kupreanof Point to Unimak Pass	May 28 – July 27	1-7	1-94
F/V *Lualda*	3A	Nuka Bay to Cape Cleare	July 1 – 27	1-3	1-48
F/V *Ocean Viking*	2C	Sitka to Ketchikan	June 1 – July 9	1-4	1-7, 9-12, 17, 30-45, 81-92
F/V *Pacific Sun*	4A	Unimak Pass to Seguam Island	July 27 - September 1	1-4	1-66

F/V *Sand Island*	4B	Amchitka Island to Stalemate Bank	May 31 – July 11	1-2	1-31
F/V *Taasinge*	3B	Chignik to Semidi Islands	June 22 - 27 August 4 – 24	1-4	1-45
F/V *Tradition*	3A	Albatross Bank and Shelikof	June 28 – September 4	1-10	1-90
F/V *Tyanaa*	2C	Dixon Entrance to Petersburg	June 16 – July 18	1-4	1-42
F/V *Venturous*	2B	Goose Island to Dixon Entrance	May 29 – July 30	1-6	1-44 53-90
F/V *Western Sunrise*	2B	Cape Scott to Goose Island	July 9 – August 5	4-6	161-206
F/V *Zenith*	4B, 3A	Seguam to Amchitka & PWS	May 30 – June 29 July 17 – August 13	1-2 4-6	1-42 55-9

Fishing effort	1,047 sets
Legal-sized halibut	76,716 fish
Sublegal-sized halibut	35,376 fish

The IPHC standardized stock assessment grid survey was continued for the sixth consecutive year and initiated a 10 nmi by 10 nmi station grid. The purpose of the standardized surveys was to provide halibut catch information and biological data independent of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Conducting surveys over large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. Biological data were collected from captured halibut. Records from incidentally captured species were collected to investigate bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

The 1998 survey was the second of a five-year commitment to survey virtually all halibut habitat in Oregon, Washington, British Columbia, and Alaska. Though the first year of survey was a great success, certain aspects needed improvement before the 1998 survey. Prior to 1997, the standardized surveys were concentrated on areas of high halibut CPUE. In 1997, in response to a request from industry and IPHC commissioners, the surveys were expanded to cover virtually all halibut habitat in the U.S. and Canada. The expansion of the survey into areas of lower CPUE endangered the ability of the project to be financially self-sustaining were halibut prices or CPUE to fall. Because the IPHC received no government or industry funding for these surveys, it became necessary to change the survey design and some procedures for financial reasons. After a thorough analysis of the available options, it was decided to discontinue the triangular survey design used since 1993 and replace it with a regular distribution of stations on a 10 nmi by 10 nmi square grid.

Stations planned off Oregon, Washington, Vancouver Island, and the northern Bering Sea were not surveyed in 1998 due to financial limitations caused by unexpectedly low halibut prices. Several vessels scheduled to survey these areas were diverted to conduct specialized experiments. The 15 vessels chartered to fish the standardized survey made 1,047 sets and caught a total of 76,716 legal-sized halibut (≥82 cm) and 35,376 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1998 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The first step in redesigning the survey for 1998 was to generate station coordinates at right angles to each other 10 nmi apart north and south and 10 nmi apart east and west, i.e., a square grid (Fig. 10). Because lines of longitude converge toward the poles and the distribution was based upon a consistent distance between stations, the station coordinates were generated in four separate sections along the continental shelf. Some stations had to be added or deleted at section junctions. Detailed nautical charts were then used to plot each station to ensure they were fishable and within the survey range, defined as the area between 42° N to 60° N, extending from 20 fathoms to 275 fathoms at the center of each station. Areas in Shelikof Strait, Cook Inlet, and Prince William Sound were added to the survey. The Puget Sound, the Strait of Juan de Fuca, and the inside waters of Vancouver Island were excluded. A minimum depth of 75 fathoms was chosen for the Bering Sea regions because adequate data for shallower waters were available through the annual trawl surveys conducted by NMFS. This resulted in the exclusion of Area 4C, where waters are shallower than 75 fathoms. Stations which fell in major shipping channels or in areas of extreme currents were also excluded. Additional stations, not part of the grid survey (designated ES for experimental stations), were added in southeast Alaska around orphaned stations to maintain design efficiency. Figure 28 in Appendix I displays stations fished during the 1998 SSA survey (but includes stations fished during following years (2A) as well).

After all station placements were finalized, the survey was divided into 27 separate survey regions for operational and administrative reasons. Survey stations were numbered from east to west and from south to north within each charter region. A different number series was used for each regulatory area: Area 2A (1001 to 1999), Area 2B (2001 to 2999), Area 2C (3001 to 3999), Area 3A (4001 to 4999), Area 3B (5001 to 5999), Aleutian Islands (6001 to 6999), and the Bering Sea (7001 to 7999).

Fishing pattern

The survey was designed so that typical vessels could fish three stations per day. Under ideal conditions, vessels with faster running and hauling speeds may have been able to fish four stations per day. Instructions called for the vessels to set gear centered on a station's given coordinates and to attempt to keep the orientation of the sets consistent throughout each charter region. If weather or strong tides affected setting direction, it was, however, permissible to set in any direction as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

Either seven skates of 1,800-foot gear or eight skates of 1,500-foot gear were set at each station. The first station was set at 0500 each morning. Gear was hauled after it had soaked a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the

vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Any sets left soaking longer than 24 hours was deemed ineffective and the vessel was required to reset that station. Under no circumstances was the setting altered so as to increase or decrease the catch.

Gear and bait specifications

All vessels were asked to provide uniformly rigged, conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The vessels were allowed to use either 1,500-foot skates with approximately 83 hooks per skate or 1,800-foot skates with approximately 100 hooks per skate. Vessels using 1,500-foot skates set eight per station and vessels using 1,800-foot skates set seven per station. The *Angela Lynn, Bold Pursuit, Lualda, Ocean Viking*, *Sand Island, Venturous,* and *Western Sunrise* fished 1,500-foot skates. The *Defiant, Elizabeth F, Kristiana, Pacific Sun, Taasinge, Tradition, Tyanaa, and Zenith* used 1,800-foot skates. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The crew was instructed to cut bait so that the average weight ranged from approximately 0.25 to 0.33 pounds per piece. On most vessels, the IPHC staff weighed samples of the cut bait at the beginning of the charter and periodically thereafter to check that the average weight fell within this range.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged during hauling and repaired.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. An estimated length was recorded for halibut that were lost at the roller or fell off the hook within gaffing distance aboard the *Western Sunrise*. On all other vessels no length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four indicated the level of severity if a PHI was observed. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the

specimen.

The left-side otolith was collected from a randomly selected sample of all halibut captured. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was about 20% in Areas 2B and 4A, 14% in Area 2C, 5% in Areas 3A and 3B, 25% in Area 4B, and 100% in Area 4D. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI's, and released alive.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

1998 Miscellaneous bait and gear surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3B, 3A	Shumagin & Kodiak to Seward	July 1 – August 12 September 12 - 22	4-8 13	47-156 202-239
F/V *Bold Pursuit*	2C	Cape Ommaney	August 5 - 28	9-10	144-231
F/V *Lulalda*	3A	Yakutat to Cape Cleare	July 28 – August 27	4-7	49-106
F/V *Ocean Viking*	2C	Craig to Cape Ommaney	June 9, 21 – 23 July 1 – 7 August 6 – September 25	1, 3-8	13-16, 18-29, 46-80, 93-246 Test: 8
F/V *Sand Island*	4B, 3A	Agattu & Kodiak to PWS	July 3 – 4 July 12 – August 6	2-5	32-96
F/V *Tradition*	3A	Albatross to Gore Pt.	September 5 - 16	11-12	91-124
F/V *Tyanaa*	2B	Rennell Sound to Cape Knox	July 14 – 28	4-5	43-96

F/V *Venturous*	2B	Dixon Entrance	June 28 – 29	4	45-52
F/V *Western Sunrise*	2B	South Hecate Strait	May 31 – July 3 August 19 – October 1	1-3 7-8	1-160 207-323
F/V *Zenith*	3B	Shumagin Island area	June 30 – July 8	3	43-54

Fishing effort	950 sets
Legal-sized halibut	36,766 fish
Sublegal-sized halibut	12,500 fish

Standardized stock assessment grid stations planned off the Oregon and Washington coasts, Vancouver Island, and the northern Bering Sea were not surveyed in 1998 due to financial constraints resulting from unexpectedly low halibut prices. Several vessels scheduled to survey these areas, as well as vessels surveying other areas, were either diverted or given the opportunity to participate in a variety of special pilot experiments.

The 10 chartered vessels taking part in the bait and gear experiments made 950 sets and caught a total of 36,766 legal-sized halibut (≥82 cm) and 12,500 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The captain chose fishing locations that were likely to yield a fairly high CPUE, while avoiding sets on slopes or across varying bottom types.

Vessels participated in the specialized experiments under one of three scenarios: opportunity fishing, in which extra sets of gear were fished during the standardized grid survey; extended charters, in which specific experiments were conducted during extensions of the grid survey charters; or diverted charters, in which vessels were diverted from their contracted grid survey operations into specific experiments. Opportunity fishing ranged from 3 to 15 sets. The extended and diverted experiments involved between 15 and 30 sets of gear, and from 5 to 15 fishing days.

All experiments used the same basic survey design. Each experiment was intended to compare two gear treatments, A and B. Each set of gear alternated the type of gear by skate. The total number of skates set determined the number of pairs in each set. An 8-skate set, made up of four pairs, would be set either ABABABAB or BABABABA. The order of appearance of the treatments A and B in each set usually alternated from day to day. The alternation of treatment types throughout the set was intended to help minimize treatment variation within sets which might be due to changes in habitat or fish abundance over the ground covered by the set.

There were five different treatment groups tested during the experiments. These experiments compared bait size, hook size, bait quality, bait type, and gear type.

Bait size experiments were conducted by the *Ocean Viking* (trips one, three, five, and six), *Western Sunrise* (trips one and two), and *Tradition* (trips 11 and 12). The purpose of this project was to compare two, three, six, seven, and eight ounce pieces of chum salmon bait to the survey standard four ounce bait.

Hook size experiments were conducted by the *Bold Pursuit* (trips nine and ten), the *Tyanaa* (trip five), and the *Western Sunrise* (trip three). The purpose of this project was to compare 13/0 circle hooks against the survey standard 16/0 circle hook.

Bait quality experiments were conducted by the *Angela Lynn* (trips seven, eight, and 13), the *Ocean Viking* (trips three though eight), and the *Sand Island* (trips four and five). This project involved comparing either dark chum salmon to semi-bright chum, two different batches of semi-bright chum salmon, or two different batches of silver-bright chum salmon.

Bait type experiments were conducted by the *Angela Lynn* (trips four through six), *Sand Island* (trip three), and *Venturous* (trip four). This project involved comparing either Pacific cod or octopus to semi-bright chum salmon, or pollock to squid.

Gear type experiments were conducted by the *Lualda* (trips four through seven). The purpose of this experiment was to compare sablefish gear commonly found in the commercial fishery to the survey standard halibut gear. These sets were made with the same or differently sized chum baits, or with chum salmon on halibut gear and herring on the sablefish gear.

In addition to these experiments, the *Venturous* set three sets on trip four intended to compare day versus night sets.

Gear and bait specifications

All vessels were asked to provide uniformly rigged, conventional fixed-hook setline gear following the specific requirements of each operation. All vessels using halibut gear provided 16/0 circle hooks spaced at 18-foot intervals unless comparing large and small hooks. In this case the large hooks were 16/0 and the small hooks were either or 13/0 or 14/0. Vessels using cod-style gear as part of the experiment provided skates with 14/0 hooks spaced at 3.5-foot (42 inch) intervals. The length of groundline comprising a skate varied between vessels. In general, the *Angela Lynn, Bold Pursuit, Lualda, Ocean Viking*, *Sand Island, Venturous,* and *Western Sunrise* fished 1,500-foot skates. The *Tradition, Tyanaa, and Zenith* used 1,800-foot skates. If the hook count varied by more than 5%, the skate was repaired or set aside and not used. Lost or damaged hooks were replaced daily.

The bait size and hook size experiments utilized the standard grid survey bait, i.e., previously frozen #2 semi-bright chum salmon. A few of the hook size sets used herring on the cod-style gear. The bait quality experiments compared the standard semi-bright chum salmon to a dark chum salmon or the semi-bright chums to a silver-bright chum. The bait type experiments compared either Pacific cod or octopus to semi-bright chum salmon, or pollock to squid. In all cases, bait size was carefully controlled. Baits were cut to uniform average size and regularly weighed in batches of 30 to 40 pieces using a spring scale to ensure consistent weights.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. The number of baits lost during each set was recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

On most vessels, the gonads of all legal-sized (≥82 cm) halibut were visually examined and the sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. A "U" (indicating unknown) may have been recorded for either sex or maturity if the biologist could not make a diagnosis or the gonad was lost before examination.

On some vessels, all halibut landed were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four indicated the level of severity if a PHI was observed. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded during the 20-hook sample. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

1998 – 1999 Bait Size and Type Surveys

Vessel	Reg. Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	2B	Dixon Entrance	May 1 – 20	1-3	1-35
F/V *Bold Pursuit*	2C, 2B	Cape Ommaney Dixon Entrance	December 1 – 14 January 5 – February 10	*1998:*11-12 *1999:* Prospecting: 1 Survey: 2-4	*1998:* 232-251 *1999*: Prospecting: 1-23, 46, 49, 51 Survey: 24-45, 47, 48, 50, 52-97
F/V *Heritage*	3A	Albatross Bank, Seward Gully, Middleton Is. "W" Gully	December 1 - 15 January 5 – February 19	*1998:* 1-2 *1999:* 1-6	*1998:* 1-25 *1999*: 1-110
F/V *Masonic*	3A	Yakutat area, "W" Grounds	January 17 - February 23	*1998:* 1-2 *1999:* 1-6	*1998:* 1-25 *1999:* 1-110
F/V *Royal Pursuit*	2B	Dixon Entrance	December 1 – 15 January 5 – February 7 April 30 – May 31	*1998:* 1-2 *1999:* Prospecting: 1 Survey: 2-7	*1998:* 1-22 *1999:* Prospecting: 1-30, 32, 34, 36-37, 40, 45, 48-49, 53 Survey: 31, 33, 35, 38-39, 41-44, 46-47, 50-52, 54-201

Fishing effort	581 sets
Legal-sized halibut	820,000 lbs sold

The IPHC conducted a series of surveys during the winter and spring of 1998 and 1999. The purpose of these surveys was to determine the relative effectiveness of herring and squid as possible bait substitutes for the chum salmon normally used during the annual the IPHC standardized grid surveys. This included determining what differences in catch or size composition might be associated with different baits, and whether there was a bait which could be directly substituted with no associated corrections. Winter fishing was conducted during December of 1998 as a trial period to test the feasibility of the survey design. The majority of fishing was completed during January-February and May of 1999.

This survey was designed to operate in both Areas 2B and 3A, and in both the winter and summer seasons. The chartered vessels were expected to catch around 350,000 pounds of halibut in each of the two areas with the area totals split between the two seasons. In both winter and summer fishing, the survey vessels made approximately 581 sets and caught and sold over 820,000 pounds of legal-sized halibut. Approximately 25,000 pounds of halibut was lost when

the *Royal Pursuit* went aground on Rose Spit, resulting in a total loss of the vessel and cargo. Thankfully, all vessel crew and IPHC staff were safely evacuated from the vessel.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1998 - 1999 Winter Assessment Survey and 1999 Summer Experimental Fishing instruction manuals available in the IPHC archives.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. Areas chosen for this survey extended from northern Area 2B to Cape Ommaney in Area 2C and in Area 3A from Yakutat to the Albatross Banks.

Gear and bait specifications

All vessels were asked to provide uniformly rigged, conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The vessels were allowed to use either 1,500-foot skates with approximately 83 hooks per skate or 1,800-foot skates with approximately 100 hooks per skate. The *Bold Pursuit, Masonic, and Royal Pursuit* fished 1,500-foot skates. The *Angela Lynn* and *Heritage* used 1,800-foot skates. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The five bait types being compared in this survey were: "SA" four ounce pieces of semi-bright chum salmon, "LH" large herring, "SH" small herring, "LS" large squid, and "SQ" small squid. Hanging scales and buckets were used to batch weigh all baits while the crew was cutting bait. A bait weight form was used to document all bait weights. The large and small squid and herring baits averaged around 0.25 and 0.13 pound respectively. The survey was designed using a randomized complete block design. Each set was considered a block, and each of the five bait descriptions were included once, in random order, within each block. A random setting table was provided to determine the order of baits within each set deployed during the experiment.

Following the survey design, three different types of bait were used in five configurations: standard-sized #2 semi-bright chum salmon (*Oncorhynchus keta*), large and small sizes of squid (*Illix* sp.), and large and small sizes of herring (*Clupea harengus*). The salmon baits were cut to between 0.25 and 0.35 pound. The large squid baits consisted of whole squid weighing an average of 0.22 pound. Small squid bait was created by cutting the whole squid in half across the mantle for an average weight of 0.11 pound. The herring bait was not consistently sized, ranging anywhere from 0.23 to 0.31 pound. To arrive at a standardize size, the herring baits were divided into batches of large and small fish. Either a whole small herring or 2/3 of a large herring was used for the large herring bait. The remaining third of the large herring, or half a small herring, was used for the small herring bait. All herring was salted for a minimum of 12 hours after being cut.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. The number of baits lost during each set was recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected

before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The gonads of all legal-sized (≥82 cm) halibut were visually examined and the sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

Most vessels were required to collect otoliths for a marginal increment study being conducted by the IPHC staff. The project required collecting 100 otoliths from halibut regardless of size for each area and month. There was no fixed protocol regarding size distribution of the sample, but biologists were asked to try and be representative of the halibut catch. Both the right and left side otoliths were collected.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded during the 20-hook sample. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

Supplemental projects

Stock genetics

During the winter portion of the survey, flesh samples were collected from spawning halibut for a DNA stock discrimination study. The DNA collection required 100 samples from spawning halibut in each region. The sex ratio of the DNA collection was balanced between male and female fish. The DNA samples were paired with the otoliths collected following the procedure described above. One sample was taken from each fish consisting of a small piece of flesh (approximately 1 cm by 1 cm) cut from the caudal fin.

1999 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3B	Chignik to Unimak Pass	May 28 – September 2	4-11	36-172
F/V *Blackhawk*	2A	Oregon/ California border to Cape Flattery	June 10 – July 25	1-6	1-84
F/V *Bold Pursuit*	3A	Cape Spencer to Kayak Island	June 24 – August 15	8-13	163-180 185-266
F/V *Cape Ball*	2B	Banks Island to Dixon Entrance	June 25 – July 24	1-3	1-44
F/V *Defiant*	3A	Kodiak Island to Barren Islands	August 5 – 24	1-3	1-47
F/V *Kristiana*	3B	Trinity Islands to Chignik	July 2 – September 7	1-6	1-95
F/V *Lulada*	3A	Nuka Bay to Cape Cleare	June 23 – July 19	1-3	1-48
F/V *Ocean Viking*	3A	PWS, Kayak Island to Cape Cleare	July 26 – August 2	5-9	71-130
F/V *Pacific Sun*	4A	Unimak Pass to Seguam Island	August 8 – September 7	1-4	1-66
F/V *Pender Isle*	2B	Cape Flattery to Banks Island	August 8 – 12	1-7	1-126
F/V *Taasinge*	3A	Barren Island to Gore Point	July 21 – August 11	1-3	1-45
F/V *Tradition*	3A	Albatross Banks and Stalemate Bank	June 7 – August 14	1-8	1-76
F/V *Trident*	4B	Seguam Island to Stalemate Bank	May 30 – September 1	1-6	1-88

Fishing effort	1,140 sets
Legal-sized halibut	73,034 fish
Sublegal-sized halibut	32,278 fish

The IPHC standardized stock assessment grid survey was continued for the seventh consecutive year. The survey entailed fishing a number of predetermined stations evenly

distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The purpose of the standardized survey was to collect halibut catch information and biological data independent of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Conducting surveys over large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. In addition to biological data collected from the halibut catch, other species caught were recorded to provide insight into bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

The 1999 survey represented the third year of a five year minimum commitment to survey virtually all halibut habitat in Oregon, Washington, British Columbia, and Alaska. The northern Bering Sea shelf edge in Area 4D was the only part of the survey not completed in 1999. Vessels assigned the survey regions in southeast Alaska completed a design experiment in conjunction with the standardized grid stations. This experiment is described in the following section. Including the experimental 1999 grid stations in southeast Alaska, the 13 survey vessels made 1,140 sets and caught a total of 73,034 legal-sized halibut (≥82 cm) and 32,278 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1999 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized 10 nmi survey grid, first implemented in the 1998 survey, was continued in 1999. See the 1998 Standardized Grid Survey section for specific details. The survey was divided into 27 separate survey regions for operational and administrative reasons. Figure 28 in Appendix I displays planned stations for the 1999 SSA survey.

Survey stations were numbered from south to north and from east to west within each charter region. A different number series was used for each regulatory area: Area 2A-1001 to 1999, Area 2B-2001 to 2999, Area 2C-3001 to 3999, Area 3A-4001 to 4999, Area 3B-5001 to 5999, Aleutian Islands-6001 to 6999, and the Bering Sea-7001 to 7999. The northern Bering Sea Edge (4D Edge) was not fished in 1999.

Fishing pattern

The survey was designed so the average vessel could fish three stations per day. Under ideal conditions, vessels with faster running and hauling speeds may have been able to fish four stations per day. Instructions called for the vessels to set the gear centered on the given coordinate. Attempts were made to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any directions necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

Either seven skates of 1,800-foot gear or eight skates of 1,500-foot gear were set at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

All vessels provided uniformly rigged conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The vessels used either 1,500-foot skates with approximately 83 hooks per skate or 1,800-foot skates with approximately 100 hooks per skate. Vessels using 1,500-foot skates set eight per station, and vessels using 1,800-foot skates set seven per station. The *Bold Pursuit, Cape Ball, Lualda*, and *Pender Isle* fished 1,500-foot skates. The *Angela Lynn, Blackhawk, Defiant, Kristiana, Ocean Viking, Pacific Sun, Taasinge, Tradition, Trident,* and *Tyanaa* used 1,800-foot skates. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used on the standardized grid survey since 1993 was almost always headed and gutted. The tails were sometimes used and the backbones may or may not have been removed at the discretion of the vessel crew. In 1999, the IPHC staff decided to experiment with using previously frozen whole chum salmon and using the heads and tails as bait in addition to the rest of the body meat. The entrails were not used. This experiment proved to be a failure as many of the survey vessels had trouble baiting the heads and some stopped using them altogether. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. On most vessels, the IPHC staff weighed samples of the cut bait at the beginning of the charter and periodically thereafter to confirm the average weight.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. Baits lost during each set were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The left-side otolith was collected from a randomly selected sample of all halibut landed regardless of size. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was about 100% in Area 2A, 33% in Areas 2B and 4B, 25% in Area 2C, 5% in Areas 3A and 3B, and 20% in Area 4A. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI and released live.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of a prior hook injury (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicate the level of severity if a PHI was observed. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded during the 20-hook sample. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

Supplemental projects

Seabirds

Following growing concern over the incidence of seabird bycatch in the halibut fishery, biologists aboard the standardized survey vessels were asked to collect additional data on seabird interaction with the gear. At the end of each setting event, after completing the hook count, a rough estimate of the number of albatross, fulmars, and various gulls present around the gear was recorded. Bird counts were made up to 20 meters on either side of the gear as far back as the birds showed interest in the bait.

Outside agency collaboration

Halibut flesh samples were collected for scientists at the Prince William Sound Science Center in Cordova, Alaska. This project required the removal of a small (approximately 2” x 2” x 1”) piece of flesh from a random sample of all halibut caught during the survey. Samples were packaged, frozen, and mailed to Cordova as the vessels returned to port between trips. Using these samples, scientists planned to perform a stable isotope analysis in an attempt to determine whether spatial or temporal differences were present in the trophic level of halibut.

1999 Standardized grid southeast Alaska design survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Bold Pursuit*	2C	Sitka to Cape Spencer	May 29 – June 23 July 6	5-7, 9	98-162 181-184
F/V *Ocean Viking*	2C	Ketchikan to Sitka	May 10 – July 25	1-4	1-70
F/V *Tyanaa*	2C	Dixon Entrance to Petersburg	June 15 – July 28	1-5	1-70

Fishing effort	209 sets
Legal-sized halibut	8,518 fish
Sublegal-sized halibut	3,523 fish

The annual IPHC standardized grid survey was completely redesigned prior to the 1998 survey season. Results from the 1998 survey indicated a notable drop in catch per unit effort (CPUE) in Areas 2B, 2C, and 3A from the previous year. An experiment was completed by survey vessels in Area 2C during the 1999 grid survey to ensure that this CPUE shift was not a result of the design change. The experiment entailed fishing stations from the old survey design, alongside the new survey stations. Results indicated the old survey stations had a higher catch rate but that the difference was within the expected range of sampling variation. Counting both the old and new survey stations, vessels chartered to survey Area 2C made 209 sets and caught 8,518 legal-sized halibut (≥82 cm) and 3,523 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 1999 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

This project called for stations from surveys prior to 1998 to be fished together with the survey stations added in 1998. The design and station layout of both the old and new surveys can be found in corresponding sections of this document. The captain of each survey vessel was free to set the stations in whatever order was most operationally efficient. If there was danger of the gear becoming entangled between the old and new stations, the old station was berthed away from the new station by approximately 0.5 nmi. If this was necessary, the captain was instructed to keep the old station within the same depth stratum and substrate type as the original position. Under no circumstances were stations relocated to purposefully increase or decrease the catch.

The old grid stations were set according to the protocol listed in the 1997 survey manual. The new grid stations were set according to the protocol listed in the 1999 survey manual. These manuals are available in the IPHC archives and brief descriptions are provided elsewhere in this document. Differences between the setting protocols include the standard depth range and

the number of skates fished per station. The center of the new stations fell between 20 and 275 fathoms, though the remaining gear may have extended deeper or shallower. The old stations fell entirely within the 20 to 275 fathom depth range. The new stations were fished with either seven 1,800-foot skates or eight 1,500-foot skates per station. The old stations were fished with either five 1,800-foot skates or six 1,500-foot skates. All other setting and hauling instructions from the 1997 and 1999 manuals were the same and remained in effect. Figure 28 in Appendix I displays planned stations for the 1999 SSA survey.

Fishing pattern

The first station was set at around 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective.

Gear and bait specifications

All vessels provided uniformly rigged, conventional fixed-hook setline gear for the charter with 16/0 circle hooks spaced at 18-foot intervals. The *Bold Pursuit* used 1,500-foot skates with approximately 83 hooks per skate. The *Ocean Viking* and *Tyanaa* used 1,800-foot skates with approximately 100 hooks per skate. Lost or damaged hooks were replaced daily. If the hook count varied by more than 5%, the skate was repaired or set aside and not used.

The only bait used during this project was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used on the standardized grid survey since 1993 was almost always headed and gutted. The tails were sometimes used and the backbones may or may not have been removed at the discretion of the vessel crew. In 1999, the IPHC staff decided to experiment with using previously frozen whole, rather than headed and gutted, chum salmon and using the heads and tails as bait in addition to the rest of the body meat. The entrails were not used. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. On most vessels, the IPHC staff weighed samples of the cut bait at the beginning of the charter and periodically thereafter to check the average weight.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. Baits lost during each set were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut

was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was recorded if no injury was present. Codes two through four were used to indicate the level of severity if a PHI was observed. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

On the new grid stations only, the left-side otolith was collected from a randomly selected sample of the halibut captured. The goal was to collect 2000 otoliths in Area 2C. Based upon expected catch rates, the proportion of otoliths sampled was about 25%. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

Bycatch and hook occupancy

Twenty hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. All fish species, starfish, birds, and marine mammals were recorded. Species not actively competing for the bait, such as anemones and sponges, were not recorded during the 20-hook sample. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

Supplemental projects

Seabirds

Following growing concern over the incidence of seabird bycatch in the halibut fishery, biologists aboard the standardized survey vessels were asked to collect additional data on seabird interaction with the gear. At the end of each setting event, after completing the hook count, a rough estimate of the number of albatross, fulmar, and miscellaneous gulls present around the gear was recorded. Bird counts were made up to 20 meters on either side of the gear as far back as the birds showed interest in the bait.

Chalky halibut

A pilot study was performed to determine a tag type and develop the methodology for tag attachment and body temperature measurement for a chalky halibut survey later in the summer. Approximately 100 halibut were tagged with both t-bar and metal strap tags, then marked with a length of surveyor's tape tied through the mouth. Once sold, the marked fish were tallied as to whether either of the tags had been lost. Digital thermometers were used to determine core body temperatures of live fish immediately after capture and of dressed fish prior to being put in the hold. After sale, the fish were checked for chalkiness.

Outside agency collaboration

Halibut flesh samples were collected for scientists at the Prince William Sound Science Center in Cordova, Alaska. This project required the removal of a small (approximately 2" x 2" x 1") piece of flesh from a random sample of all halibut caught during the survey. Samples were packaged, frozen, and mailed to Cordova when the vessels returned to port between trips. Using these samples, scientists planned to perform a stable isotope analysis in an attempt to determine whether spatial or temporal differences were present in the trophic level of halibut.

1999 Chalky halibut survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3A, 3B	Cook Inlet & Semidi Islands	September 6 – 13	12	173-194
F/V *Start Wars II*	2B	Hecate Strait	August 21 – September 23	1-2	1-46

Fishing effort	68 sets
Legal-sized halibut	2,741 fish

During the late summer of 1999, the IPHC conducted a survey at the request of the halibut industry to study the effects of stunning and bleeding on the development of the chalky condition. Several representatives of the halibut industry gave input into the project design and helped track evidence of chalky halibut during the 1999 commercial fishing season. Chalky halibut were expected to be most evident in the late summer or early fall, and the survey was scheduled for that period. The two vessels taking part in this study made 68 sets and caught 2,741 legal-sized halibut.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The project was intended to mimic the conditions experienced by halibut caught during the commercial fishery. The type of bait used during the survey, gear specifications, and soak times were left to the discretion of the chartered vessels.

Fishing pattern

The *Angela Lynn* generally set four to five sets per day of three or four skates each. The *Star Wars II* usually set five or six sets per day of two to five skates each. The set and haul times employed by both vessels was highly variable.

Each experiment was conducted as a randomized block design. Halibut were tagged with a metal strap tag upon capture. This allowed individual fish to be tracked through shipboard handling and shore processing. After capture and tagging, fish were randomly assigned one of four treatments: stunning, bleeding, stunning and bleeding, and no treatment. Twelve fish were

sampled for core body temperatures when caught to determine a typical capture temperature for all fish in a set. Time of capture was recorded for all fish tagged.

After sale, the halibut were held on ice for up to three days to allow chalkiness to fully develop. This was facilitated by the transit time necessary to transport fish from the point of sale to processing locations. As many fish as practical were checked for chalkiness at the processing location. This was accomplished either by visually inspecting a cut made about mid-body and just below the dorsal fin, or by inspecting fillets or steaks cut from tagged fish. Records were kept on all fish with the tag number and comments including time and day of processing, location, and degree of chalkiness.

Gear and bait specifications

Both vessels used conventional fixed-hook setline gear with 16/0 circle hooks. The *Angela Lynn* used 1,800-foot skates with 16/0 circle hooks spaced at 18-foot intervals. The *Star Wars II* used 1,800-foot skates with 16/0 circle hooks spaced at approximately 13-foot intervals.

The *Angela Lynn* used standard chum salmon bait of the type, and cut to the same size, as used on the standardized grid surveys. The *Star Wars II* used an unspecified mixture of bait.

Sampling protocol

Halibut sampling

Only commercial sized halibut in marketable condition were recorded during this survey. All sublegal-sized halibut and legal-sized halibut in poor condition were released at the roller.

The fork length of all legal-sized (≥82 cm) halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. After each fish was measured, the sex and maturity of each fish was determined by visually examining the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

After landing, the core body temperatures were taken from the halibut using digital stem thermometers (Hanna HI9063, Hanna Instruments, Italy). After making a small cut through the skin, thermometer probe was inserted about 0.5 to 1.0 inch into the flesh. Temperatures were read and recorded to the nearest 0.1 degree C.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

2000 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3B	Kupreanof Point to Unimak Pass	May 28 – October 1	1-6	1-92
F/V *Bold Pursuit*	2C, 3A	Sitka to Kayak Islands	May 30 – July 24	1-7	1-142
F/V *Free To Wander*	3A	PWS, Kayak Islands to Cape Cleare	August 11 – September 5	7-10	126-170
F/V *Heritage*	4A, 4D	Unalaska to 60° N.	May 30 – July 30	1-6	1-97
F/V *Ocean Marauder*	3B	Chignik to Kupreanof Point	May 30 – June 19	1-2	1-45
F/V *Pacific Sun*	4A	Unimak Pass to Seguam Island	July 23 – August 20	1-3	1-66
F/V *Trident*	4B	Seguam Island to Stalemate Bank	June 16 – August 16	1-6	1-90
F/V *Tyanna*	2C	Dixon Entrance to Sitka	June 1 – June 26	1-6	1-81
F/V *Viking Spirit*	3B, 3A	Trinity to Chignik & Shelikof	May 31 to August 23	1-9	1-139

Fishing effort	797 sets
Legal-sized halibut	57,068 fish
Sublegal-sized halibut	25,050 fish

The IPHC standardized stock assessment grid survey was continued for the eighth consecutive year. The survey entailed fishing a number of predetermined stations evenly distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The purpose of the standardized survey was to collect halibut catch information and biological data independent of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Conducting surveys over large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. In addition to biological data collected from the halibut catch, other species encountered were recorded to provide insight into bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

The 2000 survey represented the fourth year of a five-year commitment to survey virtually all halibut habitat of the coasts of Oregon, Washington, British Columbia, and Alaska. The Oregon and Washington coasts (Area 2A) and Vancouver Island (southern Area 2B) were the only areas not completed in 2000. Vessels assigned the survey regions from Kodiak to Cape Cleare in Area

3A and from Cape Scott to Dixon Entrance in Area 2B completed a bait comparison survey in conjunction with the standardized grid stations. This experiment is described in the following section. Not including the areas fished during the bait comparison experiment, the nine vessels listed above made 797 sets and caught a total of 57,068 legal-sized halibut (≥82 cm) and 25,050 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2000 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized 10 nmi survey grid first implemented in the 1998 survey grid was continued in 2000. The survey was divided into 27 distinct survey regions for operational and administrative reasons. Figure 28 in Appendix I displays planned stations for the 2000 SSA survey, although it also shows stations off Oregon, Washington, and southern Area 2B, which were not surveyed in 2000.

Survey stations were numbered from south to north and from east to west within each charter region. A different number series was used for each regulatory area: Area 2A-1001 to 1999, Area 2B-2001 to 2999, Area 2C-3001 to 3999, Area 3A-4001 to 4999, Area 3B-5001 to 5999, Aleutian Islands-6001 to 6999, and the Bering Sea-7001 to 7999. The Oregon and Washington regions in Area 2A and the Vancouver Island region in Area 2B were not fished in 2000.

Fishing pattern

The survey was designed so the average vessel could fish three stations per day. Under ideal conditions, vessels with faster running and hauling speeds may have been able to fish four stations per day. Instructions called for the vessels to set the gear centered on the given coordinate. Attempts were made to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any direction necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

All vessels set seven skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. The practice of attaching weights to the groundline had become increasingly popular among survey vessels over previous several years. This practice was standardized among all vessels in 2000 by requiring the use of A 5- to 10-pound weight at each skate junction. All skates had 100 hooks each. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The majority of salmon bait used in 2000 was headed and gutted, but a small percentage was purchased round. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each. During the first trip on each vessel, the IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size. After the first trip, bait size was monitored for consistency and weighed at least once per trip.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged when the set was hauled and then corrected prior to the next setting event.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The left-side otolith was collected from a randomly selected sample of all halibut landed regardless of size. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was about 38% in Area 2B, 27% in Area 2C, 6% in Area 3A, 5% in Area 3B, 18% in Area 4A, 36% in Area 4B, and 100% in Area 4D. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicate the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in the twenty-hook subsample, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

A water column profiler was purchased by the IPHC and deployed aboard the *Bold Pursuit* as a pilot program to assess the feasibility of using such a device during the standardized grid survey. The profiler purchased for this survey was a SeaBird SBE 19 CTD, which measured conductivity, temperature, and depth through the water column. The profiler was successfully deployed on 120 of the 130 stations surveyed by the *Bold Pursuit*.

Supplemental projects

Bait study

A bait comparison experiment was conducted in Area 2B and parts of Area 3A. This experiment entailed fishing sets baited with a mixture of salmon and herring alongside the standardized grid stations using only salmon bait.

Crystallized otoliths

Paired otoliths were collected from four stations in the Adak region of Area 4B for a study of left and right side otolith crystallization rates and to compare ages between right and left side otoliths. Station numbers 6095, 6096, 6097, and 6105 were chosen because they had historically yielded a relatively high rate of crystallized otoliths.

Outside agency collaboration

Halibut flesh samples were collected for scientists at the Prince William Sound Science Center in Cordova, Alaska. This project required the removal of a small (approximately 2” x 2” x 1”) piece of flesh from a random sample of all halibut caught during the survey. Samples were packaged, frozen, and mailed to Cordova as the vessels returned to port between trips. Using these samples, scientists planned to perform a stable isotope analysis in an attempt to determine whether spatial or temporal differences were present in the trophic level of halibut.

2000 Standardized grid and bait comparison survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3A	Albatross Bank	August 3 – September 5	7-10	93-160
F/V *Free To Wander*	3A	Nuka Bay to Cape Cleare	June 20 – August 1	3-7	30-125
F/V *Kristiana*	3A	Barren Island to Nuka Bay	July 11 – September 16	1-6	1-90
F/V *Lualda*	3A	Kodiak to Barren Island	June 29 – July 13	1-2	1-34
F/V *Pacific Sun*	3A	Kodiak to Barren Island	August 28 – September 4	4	67-90
F/V *Pender Isle*	2B	Cape Scott to Bank Island	May 30 – August 29	1-10	1-170
F/V *Star Wars II*	2B	Banks Island to Dixon Entrance	June 6 – August 8	1-4	1-88
F/V *Taasinge*	3A	Albatross Bank	June 6 – 20	1	1-22
F/V *Vansee*	3A	Kodiak to Barren Island	August 20 – September 3	1-2	1-34

Fishing effort	626 sets
Legal-sized halibut	40,520 fish
Sublegal-sized halibut	20,738 fish

Survey vessels working on grid survey charter regions within Area 2B, and the border between 3A and 3B, and in the Cape Cleare region in Area 3A participated in a bait comparison experiment along with the standardized grid survey. The purpose of this experiment was to compare the relative effectiveness of using only salmon bait, which had been the standard on the annual surveys since 1993, with mixed salmon and herring which was the standard used between 1976 and 1986. The standardized grid survey entailed fishing a number of predetermined stations evenly distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The bait comparison experiment required vessels to set a second set of gear berthed approximately 1 nmi away and parallel to the grid survey station.

For details of the standardized grid survey also conducted by the vessels listed above, please refer to the previous section. Survey vessels fishing both the standardized grid survey stations and bait comparison sets made 626 sets and caught a total of 40,520 legal-sized halibut (≥82 cm) and 20,738 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2000 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

Vessels fishing in Area 2B and western 3A completed a bait comparison experiment in conjunction with the standardized grid survey. These vessels set a second set of gear at each station parallel to the grid survey set and berthed between 0.75 nmi and 3.00 nmi away. An attempt was made to distribute the experimental sets in a similar fashion as the stock assessment survey stations. The experimental stations were set parallel to the survey stations with the center of each set aligned. To avoid setting experimental sets adjacent to each other, vessels were required to set the experimental gear either to the north or east parallel to the survey station set. If obstructions or depths outside the survey range (20 to 275 fathoms at the center) were encountered to the north or east, the vessel was allowed to set the gear to the south or west of the grid survey station. Vessels were instructed to try to keep the experimental set in the same depth stratum and bottom type as the stock assessment set.

Fishing pattern

Most vessels were able to set two grid survey stations and two experimental sets each day. The survey station did not have to be set and hauled on the same day as the corresponding experimental station. If weather was poor, or the running and hauling speed was slow, the vessel may have fished fewer sets each day. For example, the vessel may have only fished one survey station and one experimental set, two survey stations and one experimental set, or one survey station and two experimental sets on any given day.

Each vessel fished seven skates of standardized gear at each survey and experimental station. Setting generally began around 0500 each morning. When all stations were set, the vessel returned to the first station and began hauling after the set was allowed to soak for a minimum of five hours. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective. The choice of where to begin and the number of stations to fish on a particular day was left to the discretion of the captain and lead biologist in consideration of the logistical situation, weather and tide conditions, and distance between sets. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels in 2000 was standardized and consisted of 1,800-foot skates of groundline with 16/0 circle hooks attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. The hooks were oriented on the gangions by inserting the gangion through the front of the hook eye. All skates contained 100 hooks each at the beginning of the charter. Lost or damaged hooks were replaced daily. The practice of attaching weights to the groundline had become increasingly popular among survey vessels over the previous several years; therefore, this practice was standardized among all vessels in 2000 by requiring a 5- to 10-pound weight at each skate junction. This practice proved difficult for several vessels.

The grid survey sets were baited with pieces of previously frozen headed and gutted chum salmon on every hook. The experimental sets were baited with previously frozen chum salmon and Pacific herring on alternate hooks, i.e., each bait type occurred on every second hook. The salmon bait was cut to pieces between 0.25 and 0.33 pound each. The salmon tails were used, but not the heads or entrails. The backbones may have been removed when cutting the bait at the discretion of the crew. Most of the herring provided for the experimental sets was relatively small in size, averaging approximately 0.11 to 0.20 each. These were baited whole, and the occasional larger herring was cut to the approximate size of the small herring. During the first

trip on each vessel, the IPHC staff weighed at least three samples of 20 - 50 baits per day to ensure proper size. After the first trip, bait size was monitored for consistency and weighed at least once per trip.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. A fork length of "0" was recorded for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in the twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

2000 Hook orientation and gangion length survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Free To Wander*	3A	South of Cape Cleare	June 7 - 18	1-2	1-29

Fishing effort	29 sets
Legal-sized halibut	1,739 fish
Sublegal-sized halibut	390 fish

A discussion began during the IPHC annual meeting in January of 2000 about whether the way a circle hook is threaded on a longline gangion has an effect on catch rates. This was potentially important to the IPHC because the Commission's standardized grid survey allowed

the chartered vessels to thread the gangion onto the hook either from the front or the back side of the eye. Although no records were kept detailing which orientation was used, it was felt most fishers threaded gangions through the front of the eye. This orientation was also specified as a standard during NMFS sablefish longline surveys. Another part of this debate centered around standard gangion lengths. Though the IPHC's standardized grid surveys specified gangion lengths between 24 and 36 inches, many vessel were given some leeway to use different lengths, largely because there was no data indicating this might be a factor affecting catch rate. Because these unknown factors could potentially have an effect on survey catch rates, it was decided to perform a special survey in 2000 to collect data on both hook orientation and gangion length.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2000 experimental fishing instruction manual.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The survey was limited to 40,000 pounds of legal-sized halibut. Since a minimum of 20 sets were necessary for analysis, the vessel chose an area where the captain expected to catch an average of less than 2,000 pounds per set. To reduce variability within a set, the captain was asked to set the gear on relatively flat ground with a consistent substrate. There were 1,739 legal-sized halibut and 390 sublegal-sized halibut caught.

Gear and bait specifications

The *Free to Wander* used conventional fixed-hook setline gear. Each skate consisted of 1,800-foot groundline with approximately 100 No. 3 (16/0) circle hooks spaced at 18-foot intervals. Lost or damaged hooks were replaced daily. The *Free to Wander* fished four 1,800-foot skates per set. The sets consisted of four alternating skate configurations: a 12" gangion through the front of the hook eye, a 12" gangion through the back of the eye, a 36" gangion through the front of the eye, and a 36" gangion through the back of the eye. The experiment was conducted as a randomized block design with each skate representing a treatment. A random table dictated the order in which the different treatments of gear were set. The setting and hauling schedule conformed to the IPHC's standardized grid survey protocols, i.e., the gear was set beginning at around 0500 and the first set was hauled after a minimum soak of five hours. Standards for the effectiveness of each set were also the same as grid survey standards.

The only bait used during this survey was previously frozen headed and gutted chum salmon (#2 semi-bright or better). The vessel was instructed to use the body meat as well as the tails; the backbones may or may not have been removed at the discretion of the vessel crew. The crew was instructed to cut the bait so that the average size ranged from approximately 0.25 to 0.33 pound each.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. A fork length of "0" was recorded for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. Sublegal-sized halibut (<82 cm) were only sampled for sex and maturity if chosen for otolith collection for the marginal increment experiment. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

One hundred halibut were chosen for otolith collection. These otoliths were later used for a marginal increment analysis conducted by IPHC staff. The otoliths were not collected randomly and included all halibut regardless of size. Sublegal-sized halibut, not selected for otolith collection, were measured and released alive.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored for hook status as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in these twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

2000 Bait-size and hook-size survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Ocean Bay*	3A	Albatross Bank and Marmot Bay	July 16 – 26	1-2	1-22

Fishing effort	22 sets
Legal-sized halibut	3,386 fish
Sublegal-sized halibut	1,463 fish

Over the years, the IPHC has performed a number of gear and bait experiments to better understand the variables surrounding the commercial harvesting of halibut and the factors affecting the catch on the Commission's own surveys. Following the bait size and hook size experiments conducted in 1998 and 1999, the *Ocean Bay* was chartered to conduct two separate bait and gear surveys in the year 2000. This survey was performed to compare two sizes of salmon bait with two sizes of hooks. The *Ocean Bay* made 22 sets and caught 3,386 legal-sized halibut (≥82 cm) and 1,463 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2000 experimental fishing instruction manual.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The survey was limited to 40,000 pounds of legal-sized halibut. Since a minimum of 18 to 20 sets was necessary for analysis, the vessel was asked to choose an area where the captain expected to catch an average of less than 2,000 pounds per set. Unfortunately, almost half of the catch limit was caught on the first day and effort had to be shifted to areas of much lower CPUE. This made the resulting data difficult to analyze and perhaps affected the validity of the experiment. To reduce variability within each set, the captain was asked to set the gear on relatively flat ground with a consistent substrate.

Fishing pattern

The *Ocean Bay* set four or five sets each day consisting of five skates each. The experiment was conducted as a random block design with five treatment groups. Each skate represented a treatment and was configured with one of the following: large hook-small bait, large hook-medium bait, large hook-large bait, small hook-small bait, and small hook-medium bait. The small hook-large bait treatment was not used because it seemed impractical to use such a large bait on a small hook. The hooks sizes used were 14/0 (small) and 16/0 (large), both were Mustad type (or equivalent) circle hooks.

A random treatment table dictated the order in which the different treatments of gear were set. The setting and hauling schedule conformed to the IPHC's standardized grid survey protocols, i.e., the gear was set beginning at around 0500 and the first set was hauled after a minimum soak of five hours. Standards for the effectiveness of each set were also the same as grid survey standards.

Gear and bait specifications

The *Ocean Bay* used conventional fixed-hook setline gear with 1,800-foot skates. Each skate had either 14/0 or 16/0 circle hooks spaced at 18-foot intervals on 24" to 48" gangions (after tying). The hooks were oriented on the gangions by inserting the gangion through the front of the hook eye. At the start of the charter, every skate of gear had 100 hooks. Lost or damaged hooks were replaced daily.

The only bait used during this survey was previously frozen headed and gutted chum salmon (#2 semi-bright or better). The vessel was instructed to use the body meat as well as the tails, while the backbones may or may not have been removed at the discretion of the vessel crew. The crew was instructed to cut the bait into 2 oz, 4 oz, and 6 oz sizes following the survey design outlined above.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. A fork length of "0" was recorded for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

After measurements were taken all sublegal-sized halibut (<82 cm) were released alive. All legal-sized (≥82 cm) halibut were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in the twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

2000 Bait quality survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Ocean Bay*	3A	Marmot Bay	July 26 – July 31	2	23-42

Fishing effort	22 sets
Legal-sized halibut	1,611 fish
Sublegal-sized halibut	493 fish

After completing the 2000 bait size and hook size survey, the *Ocean Bay* went on to perform a study investigating the effect of using salmon bait from a variety of sources. This was of particular interest to the IPHC because the annual standardized grid surveys conducted by the Commission was using up to 400,000 pounds of chum salmon bait each year. The bait was usually of similar size and quality, but was purchased from a variety of runs throughout Washington State, Canada, and Alaska and may have included chum from the current year or frozen the previous year. If differences in catch occurred using these different batches of bait, the IPHC would be forced to consider this in planning future research activities. The *Ocean Bay* made 22 sets and caught 1,611 legal-sized halibut (≥82 cm) and 493 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2000 experimental fishing instruction manual.

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths. The survey was limited to 40,000 pounds of legal-sized halibut. Since a minimum of 18 to 20 sets was necessary for analysis, the vessel was asked to choose an area where the captain expected to catch an average of less than 2,000 pounds per set. Also, to reduce variability within each set, the captain was asked to set the gear on relatively flat ground with a consistent substrate.

For this survey, batches of bait were acquired from runs in Area 2B, 2C, and 3A. The batches from 2C and 3A were obtained both as salmon frozen in 1999 and as salmon caught during the 2000 run. One of these batches was baited on each of five skates set in each set. The experiment was conducted as a random block design with each skate representing a treatment. A random treatment table dictated the order in which the different treatments of gear were set.

Fishing pattern

The *Ocean Bay* set four sets of gear per day consisting of each of the five treatment groups (skates). The setting and hauling schedule conformed to the IPHC's standardized grid survey protocols, i.e., the gear was set beginning at around 0500 and the first set was hauled after a minimum soak of five hours. Standards for the effectiveness of each set were also the same as used during the grid surveys.

Gear and bait specifications

The *Ocean Bay* used conventional fixed-hook setline gear with 1,800-foot skates. Each skate had approximately 100 Mustad (or equivalent) 16/0 circle hooks spaced at 18-foot intervals on 24" to 48" gangions (after tying). The hooks were oriented on the gangions by inserting the gangion through the front of the hook eye. At the start of the charter, every skate of gear had 100 hooks. Lost or damaged hooks were replaced daily. Bait for this survey included five different batches of semi-bright chum salmon. The bait was acquired from runs in Areas 2B, 2C, and 3A. As well, the batches from 2C and 3A were obtained both as salmon frozen in 1999 and as salmon caught during the 2000 run. The salmon were headed and gutted prior to freezing and the vessel was instructed to use the body meat as well as the tails. The backbones may or may not have been removed at the discretion of the vessel crew. The crew was instructed to cut the bait into pieces weighing between four and five ounces each.

Sampling protocol

Samples were collected from each of the five bait batches used for the survey. These samples were packaged and shipped to a lab for an analysis of amino acid content.

Setting

While the gear was being set, members of the IPHC staff monitored the hooks as they exited the chute, counted the number of hooks on each skate, and recorded the incidence of lost bait. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. A fork length of 0 was recorded for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

After measurements were taken, all sublegal-sized halibut (<82 cm) were released live. All legal-sized (≥82 cm) halibut were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in the twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

2001 Standardized grid surveys

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3B	Shumagin, Sanak	May 30 – July 17	1-5	1-92
F/V *Blackhawk*	2A	Oregon, Washington	June 30 – August 3	1-5	1-84
F/V *Bold Pursuit*	2C, 3A	Sitka, Fairweather	May 30 – July 3	1-5	1-91
F/V *Free To Wander*	2C, 3A	Ommaney, Prince William Sound, Gore Point	May 31 – August 27	1-6 8-10	1-91 99-137
F/V *Heritage*	4A, 4D	4A Edge, 4D Edge	May 31 – July 20	1-5	1-97
F/V *Kristiana*	3A	Portlock, Albatross	July 1 – August 25	1-7	1-91
F/V *Norska*	3B	Chignik	June 1 – July 12	1-4	1-45
F/V *Pacific Sun*	4A	Unalaska	May 29 – June 19	1-3	1-66
F/V *Pender Isle*	2B	Goose Island, St. James	May 30 – July 4	1-4	1-85
F/V *Star Wars II*	2B	Vancouver, Charlotte	July 8 – August 13	1-4	1-85
F/V *Trident*	4B	Adak, Attu	June 9 – August 31	1-6	1-92
F/V *Viking Joy*	3B, 3A	Shelikof, Semidi, Trinity	May 30 – June 26	1-3	1-69
F/V *Viking Spirit*	3B, 3A	Shelikof, Semidi, Trinity	May 30 – June 27	1-4	1-70
F/V *Waterfall*	2C, 3A	Ketchikan, Yakutat, Seward	June 1 – August 10	1-9	1-140

Fishing effort	1,235 sets
Legal-sized halibut	55,961 fish
Sublegal-sized halibut	25,549 fish

The IPHC standardized stock assessment grid survey was continued for the ninth consecutive year. The survey entailed fishing a number of predetermined stations evenly distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The purpose of the standardized survey was to collect halibut catch information and biological data independent of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Surveying large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. In addition to biological data collected from halibut, biologists kept track of other captured species to provide insight into bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

The 2001 survey was the fifth year of a five-year commitment to survey virtually all halibut habitat off of Oregon, Washington, British Columbia, and Alaska. The 14 vessels listed above made 1,235 sets and caught a total of 55,961 legal-sized halibut (≥82 cm) and 25,549 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2001 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized 10 nmi by 10 nmi survey grid, first implemented in the 1998 SSA survey, was continued in 2001. The survey was divided into 27 separate survey regions for operational and administrative reasons. Figure 28 in Appendix I displays planned stations for the 2001 SSA survey.

Survey stations were numbered from south to north and from east to west within each charter region. A different number series was used for each regulatory area: Area 2A-1001 to 1999, Area 2B-2001 to 2999, Area 2C-3001 to 3999, Area 3A-4001 to 4999, Area 3B-5001 to 5999, Aleutian Islands-6001 to 6999, and the Bering Sea-7001 to 7999.

Fishing pattern

The survey was designed so the average vessel could fish four stations per day. Instructions called for the vessels to set the gear centered on the given coordinate. Skippers attempted to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any direction necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

All vessels set five skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks threaded through the front and attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. A 5- to 10-pound

weight was attached to the groundline at each skate junction. At the start of the charter, every skate of gear had 100 hooks. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used in 2001 was headed and gutted. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. Vessel crew cut the bait at approximately 0.25 to 0.33 pound each. During the first trip on each vessel, the IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size. After the first trip, bait size was monitored for consistency and weighed at least once per trip.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff counted the number of hooks on each skate and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The left-side otolith was collected from a randomly selected sample of all halibut landed, With the goal of collecting 2000 otoliths per regulatory area, sampling rates were developed for each Regulatory area based on anticipated catch. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, examined for PHI, and released alive.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicate the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in these twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

A water column profiler was successfully deployed on 100 stations surveyed by the *Kristiana* and *Viking Spirit* in Portlock, Albatross, Trinity, Semidi, and Shelikof. The profiler used on this survey was a SeaBird SBE 19 CTD, which measured conductivity, temperature, and depth throughout the water column.

Supplemental projects

Crystallized otoliths

Paired otoliths were collected when the left-side otolith was crystallized for a study of left and right side otolith crystallization rates and to compare ages between right and left side otoliths.

Shoreside PIT tag detection

Biologists on the *Star Wars II* inserted PIT tags into some of the dressed halibut on board the vessel as part of an experiment to test the feasibility of detecting PIT tags as fish are being offloaded. Roughly one-third of the fish marked with PIT tags were also marked externally. Tag recoveries from the externally marked halibut examined tag durability and function, while recoveries from solely PIT tagged fish shed light on scanning rates.

Outside agency collaboration

Halibut flesh samples were collected for scientists at the Prince William Sound Science Center in Cordova, Alaska. This project required the removal of a small (approximately 2" x 2" x 1") piece of flesh from a random sample of all halibut caught during the survey. Samples were packaged, frozen, and mailed to Cordova when survey vessels returned to port between trips. Using these samples, scientists planned to perform a stable isotope analysis in an attempt to determine whether spatial or temporal differences were present in the trophic level of halibut.

2001 Pilot studies on the use of PIT tags in halibut

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Hot Spur*	3A	Near Seward	May 22 - 24	1-2	1-8
F/V *Free To Wander*	2B	Cape St. James	July 31 – August 5 August 29 – 30	1	N/A
F/V *Resurrection*	3A	Near Seward	October 11 – 13	1	1-5

Fishing effort	13 sets
Tagged halibut	733 fish

During 2001 several pilot studies investigated the use of passively integrated transponder (PIT) tags in halibut in anticipation of a coastwide mark and recapture experiment that was conducted in 2003 and in areas 2B and 3A in 2004. The goal of the setline components of these pilot studies was to capture halibut for studies to determine the optimal tagging location. An optimal tagging location would exhibit low tag-shedding rates and allow for easy detection during offload. Captured halibut were PIT tagged in various locations and held in a tank with circulating seawater for a period ranging from 12 hours to several months. While being held in tanks, the halibut were periodically captured and scanned with a PIT tag reader to confirm tag operation.

Long-term tagging study

The *Hotspur* was chartered to collect live halibut in May 2001. The goal was to deliver approximately 70 halibut weighing between eight and 15 pounds and 70 halibut weighing between 25 and 35 pounds. On two trips, a total of 151 live halibut were captured. The IPHC biologists inserted PIT tags slightly forward of the anterior end of the dorsal fin of each fish. These fish were delivered to Seward Marine Center in May 2001, where the halibut were kept in live tanks to examine the rate at which PIT tags were shed from fish. The experiment design called for holding the fish for six to eight months and checking for PIT tag shedding biweekly.

Short-term shedding and tag durability

The *Free To Wander* was chartered from July 31 to August 5 to conduct a study to determine a PIT tag insertion point that results in lower tag shedding rates. Each day 70 to 100 fish were captured, PIT tagged above the dorsal eye, and held for 12 hours or more in a flooded fish hold aboard the vessel. On the morning following capture, fish were removed individually and scanned to determine whether the PIT tag was still present and functional. If a PIT tag was present, the fish was marked externally with a neon green spaghetti tag and released. A $100 reward was offered to fishers who captured these fish and returned them with the tags still attached to the heads so that the PIT could be scanned again to verify long-term operation.

An additional component to this experiment examined how the durability and detection of PIT tags inserted near the eye are affected by stunning and heading halibut. It was discovered that the heading process damaged PIT tags and sometimes separated them from the head, an undesirable outcome and impetus to select another tagging location. The *F/V Free To Wander* was chartered again at the end of August to conduct another similar tagging and short-term holding experiment. Two-hundred-four fish were PIT tagged in a new location, the opercular flap, and held overnight in a flooded fish hold to evaluate short-term shedding rate. Minimal shedding was observed.

The *Resurrection* was chartered from October 11-13 to collect 80 halibut and deliver them live to the Seward Marine Science Center to examine the long-term shedding rate of tags inserted into the opercular groove. When captured halibut were brought aboard, the IPHC biologists immediately inserted PIT tags in the opercular groove and kept the fish alive in a flooded fish hold until delivery at the Seward Marine Science Center, where these fish were kept alive for several months and periodically scanned for PIT tag presence. This opercular flap tagging location proved to be the optimal PIT tag insertion point for the coastwide PIT tag mark and recapture experiment of 2003 and 2004.

Survey design

Station pattern

These charters were spot fishing operations. The captain of the vessel chose the exact fishing locations within a broader area specified by the IPHC. The latitude and longitude were recorded at the beginning and end of each set along with minimum and maximum depths.

Gear and bait specifications

Because the objective of the setline component was merely to capture halibut to be held in tanks, no gear or bait parameters were specified for these charters. The *Free To Wander* completed its charters in the middle of its 2001 setline stock assessment (SSA) survey charter work, so it is safe to assume the *Free To Wander* fished with standardized IPHC survey gear; however, it may not have been maintained in accordance with SSA standards during these charters.

Sampling protocol

Halibut sampling

After being landed aboard the vessel, all halibut were measured and a PIT tag was inserted. The insertion site differed depending on the experiment. After the tag was inserted the fish were immediately put in to a flooded fish hold, where they remained until released, sacrificed, or delivered to a long–term holding facility.

Bycatch and hook occupancy

Bycatch and hook occupancy were not recorded.

Oceanographic data

No oceanographic data were collected on this cruise.

2002 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Angela Lynn*	3A	Portlock, Albatross	June 4 – July 7	1-4	1-92
F/V *Barren Islands*	3A	Shelikof	August 1 - 12	1-2	1-15
F/V *Blackhawk*	2A	Oregon, Washington	June 30 – August 6	1-5	1-84
F/V *Bold Pursuit*	2C, 3A	Ommaney, Sitka, Fairweather	June 2 – July 14	1-6	1-131
F/V *Clyde*	4A	Unalaska	July 31 – August 27	1-3	1-66
F/V *Free To Wander*	3A, 3B	Gore Point, Shelikof, Semidi, Chignik	June 14 – July 16 August 5 – August 29	1-7	1-157
F/V *Heritage*	4A, 4B, 4D	4A Edge, Attu, 4D edge	June 6 – August 24	1-7	1-144
F/V *Kristiana*	3A, 3B	Shelikof, Trinity	July 6 – August 3 August 27 - September 2	1-4	1-63
F/V *Norska*	3B	Shumagin, Sanak	June 11 – July 31	1-6	1-92
F/V *Pacific Sun*	4B	Adak	June 25 – July 9	1-2	1-45
F/V *Pender Isle*	2B	Goose Island, St. James	June 4 – July 5	1-4	1-85
F/V *Star Wars II*	2B, 2C	Vancouver, Charlotte, Ketchikan	July 4 - August 18	1-6	1-126
F/V *Waterfall*	3A	Yakutat, Prince William Sound, Seward	June 5 – August 2	1-8	1-144

Fishing effort	1,241 sets
Legal-sized halibut	56,407 fish
Sublegal-sized halibut	29,391 fish

The IPHC standardized stock assessment grid survey was continued for the tenth consecutive year. The survey entailed fishing a number of predetermined stations evenly distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The purpose of the standardized survey was to collect halibut catch information and biological data independent of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Surveying large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. In addition to biological data collected from halibut, biologists kept track of other captured species to provide insight into bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

Thirteen vessels made 1,241 sets and caught a total of 56,407 legal-sized halibut (≥82 cm) and 29,391 sublegal-sized halibut (<82 cm). All legal-sized halibut and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2002 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized 10 nmi survey grid, first implemented in the 1998 survey grid, was continued in 2002. The survey was divided into 27 separate survey regions for operational and administrative reasons. Figure 28 in Appendix I displays planned stations for the 2002 SSA survey.

Survey stations were numbered from south to north and from east to west within each charter region. A different number series was used for each regulatory area: Area 2A-1001 to 1999, Area 2B-2001 to 2999, Area 2C-3001 to 3999, Area 3A-4001 to 4999, Area 3B-5001 to 5999, Aleutian Islands-6001 to 6999, and the Bering Sea-7001 to 7999.

Fishing pattern

The survey was designed so the average vessel could fish four stations per day. Instructions called for the vessels to set the gear centered on the given coordinate. Skippers attempted to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any direction necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

All vessels set five skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks threaded through the front attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. A 5- to 10-pound weight was attached to the groundline at each skate junction. At the start of the charter, every skate of gear had 100 hooks. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used in 2002 was headed and gutted. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. Vessel crew cut the bait at approximately 0.25 to 0.33 pound each. During the first trip on each vessel, the IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size. After the first trip, bait size was monitored for consistency and weighed at least once per trip.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff counted the number of hooks on each skate and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The left-side otolith was collected from a randomly selected sample of all halibut landed. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was about 100% in 2A, 40% in Area 2B, 29% in Area 2C, 8% in Area 3A, 8% in Area 3B, 30% in Area 4A, 57% in Area 4B, and 100% in Area 4D. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

All legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed aboard the survey vessels were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut landed aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicate the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in the twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

On the *Heritage* and *Pacific Sun* in charter regions Unalaska, Adak, Attu, 4A Edge and 4D Edge, hook occupancy data for all hooks retrieved were recorded as part of an experiment

investigating the feasibility of collecting catch data using video cameras rather than human observers stationed aboard commercial vessel. For more information on this project, see the IPHC Scientific Report No. 80.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

The profiler was successfully deployed in the Portlock, Albatross, and Trinity charter regions by the *Kristiana* and *Angela Lynn*. The profiler used on this survey was a SeaBird SBE 19 CTD, which measured conductivity, temperature, and depth throughout the water column.

Seabird occurrence

At the end of each haul just prior to or immediately after the last hook was aboard, samplers recorded a 'snapshot' of seabird presence around the vessel. The sample area was a 50-meter semi-circle from the stern of the vessel. All birds within this sample area were identified and counted. Birds outside this area were also noted. These data were collected on the Seabird Occurrence Form.

Supplemental projects

Crystallized otoliths

Paired otoliths were collected when the left-side otolith was crystallized for a study of left and right side otolith crystallization rates and to compare ages between right and left side otoliths.

Seabird avoidance device monitoring

Under a contract with NMFS, video camera units were placed aboard two survey vessels, *Heritage* and *Pacific Sun*, operating in Area 4. Along with the camera units, an additional staff member was aboard to test and evaluate equipment performance. The purpose of this project was twofold: to assess the equipment's ability to detect bird avoidance device performance, and to assess the equipment's ability to conduct hook by hook monitoring during gear retrieval. For more information on this project, see the IPHC Scientific Report No. 80.

Environmental contaminants

In conjunction with the Alaska Department of Environmental Conservation, the IPHC collected halibut flesh and liver samples for a large-scale study of environmental contaminants in Alaskan fish. Seven vessels were involved in the collection of two size-classes of halibut from eight different areas where commercial catch is high. These samples were analyzed for a suite of environmental contaminants including organochlorine pesticides, dioxins, furans, polybrominated diphenyl ethers, PCB congeners, methyl mercury and heavy metals. The data are stored in a searchable database maintained by the Seafood and Safety Lab in Palmer, Alaska. The collection and analysis of the samples was continuing at the time this report was published.

Shoreside PIT tag detection

Biologists on the *Star Wars II* and the *Pacific Sun* inserted PIT tags into some of the dressed halibut on board the vessel as part of an experiment to test method of detecting PIT tags as fish are being offloaded as well as to test equipment used to detect the tags. Some of the fish marked with PIT tags were also marked externally. Tag recoveries from the externally marked halibut examined tag durability and function, while recoveries from fish tagged with PIT tags only shed light on scanning rates.

Pop-up archival transmitter (PAT) tag

PAT tags collect temperature, depth, and light level data while attached to a fish. Twelve of these tags were attached to 12 fish over 110 cm in length. The tags were programmed to release from the fish on a specific date during the spawning season in January and then transmit these data to a satellite. These data will shed light on halibut migration and behavior between summer and winter. For more information see the report by Loher, *Assessing seasonal migration of adult halibut in the Gulf of Alaska using pop-up satellite-transmitting archival tags*, in Report of Assessment and Research Activities 2003 (2004).

Outside agency collaboration

A halibut flesh sample collection project was continued for the fourth year at the request of scientists at the Prince William Sound Science Center in Cordova, Alaska. This project required the removal of a small (approximately 2" x 2" x 1") piece of flesh from a random sample of all halibut caught during the survey in Areas 2A, 2B, 3A, 4A, and 4D. Samples were packaged, frozen, and mailed to Cordova when survey vessels returned to port between trips. Using these samples, scientists planned to perform a stable isotope analysis in an attempt to determine whether spatial or temporal differences were present in the trophic level of halibut.

During one trip on the *Waterfall*, a University of Washington graduate school student performed research on spiny dogfish (*Squalus acanthias*) and sleeper sharks (*Somniosus pacificus*) in Prince William Sound.

2002 PIT tag demonstration charter

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Pender Isle*	2B	Queen Charlotte Sound	October 10 – 15	5	86-100

Fishing effort	15 sets
Legal-sized halibut	18,740 lbs
Tagged halibut	349 fish

In preparation for the coastwide release of passively integrated transponder (PIT) tags in 2003, this demonstration charter was conducted to field test the PIT tagging procedures, workload, electronic equipment, deck setup, and workflow. The *Pender Isle*, a vessel that had worked on the IPHC charters for several years, was chartered for this experiment. The intent of this charter was to mimic typical IPHC setline stock assessment survey fishing so that problems and process bottlenecks could be tested and problems resolved prior to main PIT tagging experiment in 2003. A description of the coastwide PIT tagging project is incorporated in the 2003 Standardized Grid Survey section. Additional PIT tag project info can be found in the 2003 PIT Tagging Project Manual (internal publication).

Survey design

Station position

Stations fished on this demonstration charter were both skipper selected locations and actual SSA survey stations in the Goose Island charter region.

Fishing pattern

The *Pender Isle* mimicked the fishing pattern that was to be used on the 2003 Standardized Grid Survey. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

The *Pender Isle* set eight skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks threaded through the front and attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. A 5- to 10-pound weight was attached at each skate junction. All skates contained 100 hooks each at the beginning of the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait was headed and gutted. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. Vessel crew cut the bait at approximately 0.25 to 0.33 pound each. The IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff counted the number of hooks on each skate and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The first three skates hauled at each station were dedicated to the PIT tag mark and recapture experiment; these three skates were referred to as *PIT skates* and the remaining five skates were referred to as *survey skates*. All halibut captured on the first three skates hauled were tagged with PIT tags and released. Biologists did not collect sex and maturity data for these fish.

On the last five skates hauled at each station, all legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sublegal-sized

halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The left-side otolith was collected from a randomly selected sample of all halibut landed on the survey skates, i.e., the last five skates hauled at each station. The goal was to mimic the sampling rate on the summer survey. On this demonstration charter otoliths were collected using random sampling rates that were the same or higher than what was predicted for the upcoming summer's survey work. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

All halibut captured on survey skates (i.e., skates not dedicated to PIT tagging) aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicate the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each survey skate (i.e., not on PIT tagging skates) were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in these twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

No oceanographic data were recorded on this charter.

2003 Standardized grid survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Blackhawk*	2A	Oregon, Washington	July 16 – August 24	1-5	1-84
F/V *Bold Pursuit*	2C, 3A	Ommaney, Sitka, Fairweather	May 26 – August 2	1-7	1-131
F/V *Free To Wander*	3A, 3B	Portlock, Albatross, Chignik, Shumagin, Sanak	June 3 – August 26	1-8	1-154
F/V *Heritage*	4A, 4B, 4D	4A Edge, Attu, 4D Edge	June 3 – August 24	2-7	14-153
F/V *Kristiana*	3B	Trinity, Semidi	July 5 – September 6	1-5	1-94
F/V *Norska*	3B	Shumagin, Sanak	June 5 – June 28	1-3	1-35
F/V *Pacific Sun*	4A, 4B	Unalaska, Adak	June 10 – August 7	1-5	1-111
F/V *Predator*	3A	Shelikof	May 27 – June 19	1-3	1-45
F/V *Star Wars II*	2B	St. James, Charlotte	July 5 – August 11	1-5	1-86
F/V *Viking Joy*	2B	Vancouver, Goose Island	May 27 – July 11	1-6	1-84
F/V *Viking Spirit*	3A	Yakutat, Prince William Sound	May 26 – July 9	1-5	1-96
F/V *Waterfall*	2C, 3A, 3B	Ketchikan, Seward, Gore Point, Sanak	May 28 – August 27	1-10	1-173

Fishing effort	1,233 sets
Legal-sized halibut	75,663 fish
Sublegal-sized halibut	47,074 fish
Tagged halibut	43,999 fish

The IPHC standardized stock assessment grid survey was continued for the eleventh consecutive year. The survey entailed fishing a number of predetermined stations evenly distributed on a 10 nmi by 10 nmi grid and using standardized gear and techniques. The purpose of the standardized survey was to collect halibut catch information and biological data independent

of commercial sources. Catch data were primarily used for halibut stock assessment purposes. Surveying large areas also provided data useful in determining halibut distribution and local depletion, as well as the effects of fleet distribution on the halibut population. In addition to biological data collected from halibut, biologists kept track of other captured species to provide insight into bait competition, rate of bait attacks, and bycatch on commercial halibut gear.

Twelve vessels made 1,233 sets and caught a total of 75,663 legal-sized halibut (≥82 cm) and 47,074 sublegal-sized halibut (<82 cm). All legal-sized halibut caught on the last five skates and some bycatch were dressed, iced, and sold at the end of each trip to offset program costs.

In 2003, the IPHC initiated a massive, coastwide mark and recapture study to provide insight on halibut migration as well as to serve as a standalone population estimate. Biologists used a modified hypodermic needle and syringe to tag fish a with passively integrated transponder (PIT) tags. PIT tags were injected into fish just below the skin near the opercular groove on the blind side. A total of 43,999 PIT tags were released in all regulatory areas on the stock assessment survey in 2003.

For detailed information regarding the survey design, sampling protocols and data recording instructions for this survey, please refer to the 2003 Standardized Stock Assessment instruction manual.

Survey design

Station pattern

The standardized 10 nmi survey grid, first implemented in the 1998 survey grid, was continued in 2003. The survey was divided into 27 separate survey regions for operational and administrative reasons. Figure 28 in Appendix I displays planned stations for the 2003 SSA survey.

Survey stations were numbered from south to north and from east to west within each charter region. A different number series was used for each regulatory area: Area 2A-1001 to 1999, Area 2B-2001 to 2999, Area 2C-3001 to 3999, Area 3A-4001 to 4999, Area 3B-5001 to 5999, Aleutian Islands-6001 to 6999, and the Bering Sea-7001 to 7999.

Fishing pattern

The survey was designed so the average vessel could fish three stations per day. Instructions called for the vessels to set the gear centered on the given coordinate. Skippers attempted to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any direction necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

All vessels set eight skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks threaded through the front and attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. A 5- to 10-pound weight was attached at each skate junction. All skates contained 100 hooks each at

the beginning of the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used in 2003 was headed and gutted. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. Vessel crew cut the bait at approximately 0.25 to 0.33 pound each. During the first trip on each vessel, the IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size. After the first trip, bait size was monitored for consistency and weighed at least once per trip.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff counted the number of hooks on each skate and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The first three skates hauled at each station were dedicated to the PIT tag mark and recapture experiment; these three skates were referred to as *PIT skates* and the remaining five skates were referred to as *survey skates*. All halibut captured on the first three skates hauled were tagged with PIT tags and released. Biologists did not collect sex and maturity data for these fish; however, they did collect information on the severity and location of the current hooking injury. For more information on this project refer to the IPHC's 2003 Report of Assessment and Research Activities and the 2003 PIT Tag Project Manual, both available in the IPHC archives.

The left-side otolith was collected from a randomly selected sample of all halibut landed on the survey skates, i.e., the last five skates hauled at each station. The goal was to collect 2000 otoliths per regulatory area. Based upon expected catch rates, the proportion of otoliths sampled was 100% in Area 2A, 44% in Area 2B, 27% in Area 2C, 6% in Area 3A, 8% in Area 3B, 31% in Area 4A, 100% in Area 4B, and 80% in Area 4D. Random sampling sheets dictated which halibut were chosen for otolith collection. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

On the last five skates hauled at each station, all legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

All halibut captured on survey skates (i.e., skates not dedicated to PIT tagging) aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four

were used to indicated the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each survey skate were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Except for the PIT skates, biologists recorded every animal caught in the twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

In Canada, in partnership with the Pacific Halibut Management Association and the Canadian Sablefish Association, all chartered IPHC research vessels carried a third scientific staff member under contract with Fisheries and Oceans Canada to collect bycatch data. This researcher collected hook occupancy data for all hooks retrieved. Additionally, he or she examined a subsample of rockfish and sablefish for sex and maturity and collected otoliths from these fish.

Oceanographic data

Ocean bottom temperatures were taken once each day. Bottom temperatures were collected using a device called a Water Data Recorder or WaDaR. This device was programmed at the IPHC office in Seattle to take a temperature reading once each hour for the duration of the charter. The WaDaR was typically attached to one of the longline gear anchors. WaDaR data were not downloaded until the unit returned to Seattle.

A water column profiler was successfully deployed from the *Heritage* 128 times: 96 times on the Bering Sea Shelf edge and 44 times along the Aleutian island chain. The profiler was a SeaBird SBE 19 CTD, which took conductivity, temperature, and depth measurements of the water column.

Seabird occurrence

At the end of each haul just prior to or immediately after the last hook was aboard, samplers recorded a 'snapshot' of seabird presence around the vessel. The sample area was a 50-meter semi-circle from the stern of the vessel. All birds within this sample area were identified and counted. Birds outside this area were also noted. These data were collected on the Seabird Occurrence Form.

Supplemental projects

Crystallized otoliths

Paired otoliths were collected when the left-side otolith was crystallized for a study of left and right side otolith crystallization rates and to compare ages between right and left side otoliths.

Environmental contaminants

In conjunction with the Alaska Department of Environmental Conservation, the IPHC collected halibut flesh samples for a large-scale study of environmental contaminants in several species of Alaskan fish. Seven vessels were involved in the collection of two size-classes of halibut from eight different areas where commercial catch is high. These samples were analyzed for a suite of environmental contaminants including organochlorine pesticides, dioxins, furans, polybrominated diphenyl ethers, PCB congeners, methyl mercury and heavy metals. The data are stored in a searchable database maintained by the Seafood and Safety Lab in Palmer, Alaska.

Stock genetics

Fin clips from halibut were collected from a number of stations ranging from Cape Fairweather to Attu Island. The goal of this experiment was to compare genetic diversity on

summer feeding grounds with spawning areas located between Cape St. James (British Columbia) and the southeast Bering Sea shelf-break. Spawning areas were sampled on winter charters in early 2004.

Maturity study

The IPHC intern was aboard the *Pacific Sun* to conduct an analysis of gonad staging methods.

Outside agency collaboration

IPHC collaborated with Fisheries and Oceans Canada to collect additional bycatch data in Area 2B. See *Bycatch and hook occupancy* above.

2003 PIT tagging demonstration charter

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Heritage*	3A	Albatross	April 19 – April 23	1	1-13

Fishing effort	13 sets
Legal-sized halibut	24,000 lbs
Tagged halibut	981 fish

As a component to the coastwide release of passively integrated transponder (PIT) tags in 2003, a demonstration charter was conducted to field test the PIT tagging procedures, workload, electronic equipment, and workflow. The *Heritage*, a vessel that had worked on the IPHC charters for several years, was chartered for this experiment. The intent of this charter was to mimic typical IPHC setline stock assessment survey fishing so that workflow bottlenecks or other shortcomings in the proposed experimental design could be identified before the experiment began in full force later that summer. A description of the PIT tagging project is incorporated in the 2003 Standardized Grid Survey section. Additional PIT tag project info can be found in the 2003 PIT Tagging Project Manual (internal publication).

Survey design

Station position

Stations fished on this demonstration charter were actual SSA survey stations in the Albatross charter region. This operation was fished at actual survey station so that a typical survey day, including runtime between stations, would be recreated.

Fishing pattern

The *Heritage* mimicked the fishing pattern that was used later in the year on the 2003 Standardized Grid Survey. The skipper attempted to keep the orientation of the sets consistent throughout each charter region. When weather or tide conditions did not allow consistent orientation, it was permissible to set in any direction necessary as long as the gear was centered on the station. The center of each station was within the survey depth range of 20 to 275 fathoms. The ends of some sets may have extended deeper or shallower than the standard range.

All vessels set eight skates of 1,800-foot gear at each station. The first station was set at 0500 each morning. Hauling began after the station was allowed to soak for a minimum of five hours. Occasional adjustments in the schedule may have been necessary if the vessel was delayed due to weather or other problems. Any set left soaking overnight or between 14 to 24 hours may have been considered ineffective at the discretion of the lead biologist. Sets left soaking more than 24 hours were always considered ineffective and were to be reset. Under no circumstances was the setting of the gear altered so as to increase or decrease the catch.

Gear and bait specifications

The conventional fixed-hook setline gear used by survey vessels was standardized in 2000 and consisted of 1,800-foot skates of groundline with 16/0 circle hooks threaded through the front and attached to the groundline by 24 to 48 inch gangions spaced 18 feet apart. A 5- to 10-pound weight was attached at each skate junction. All skates contained 100 hooks each at the beginning of the charter. If the hook count varied by more than 5%, the skate was repaired or set aside and not used during the survey. Lost or damaged hooks were replaced daily.

The only bait used during the standardized survey was previously frozen chum salmon (#2 semi-bright or better). The salmon bait used in 2003 was headed and gutted. The crew was instructed to use the tails as bait if possible and the backbones may or may not have been removed at the discretion of the vessel crew. Vessel crew cut the bait at approximately 0.25 to 0.33 pound each. During the first trip, the IPHC staff weighed at least three samples of 20 to 50 baits per day to ensure proper size.

Sampling protocol

Setting

While the gear was being set, members of the IPHC staff counted the number of hooks on each skate and recorded the incidence of lost bait. Baits lost during setting were recorded by skate. If the number of hooks on any skate varied by more than 5% from the survey standard, the skate was flagged and corrected before it was set again.

Halibut sampling

The fork length of every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number. No length estimate was made for halibut that were lost at the roller or fell off the hook within gaffing distance. The length of halibut damaged by predation was calculated by dividing the head length by 0.22.

The first three skates hauled at each station were dedicated to the PIT tag mark and recapture experiment; these three skates were referred to as *PIT skates* and the remaining five skates were referred to as *survey skates*. All halibut captured on the first three skates hauled were tagged with PIT tags and released. Biologists did not collect sex and maturity data for these fish. For more information on this project refer to the IPHC's 2003 Report of Assessment and Research Activities.

On the last five skates hauled at each station, all legal-sized (≥82 cm) halibut and some sublegal-sized halibut landed were sampled for sex and maturity identification. To determine sex and maturity, it was necessary to kill the fish and visually examine the gonads. Sublegal-sized halibut (<82 cm) were sacrificed for sex and maturity samples only if they were randomly chosen for otolith collection. Sex was recorded as male, female, or unknown. The stage of sexual maturity for male halibut was recorded as either immature or mature. Female halibut were assigned a stage of maturity on a scale of one to four. Stage one was considered immature and stages two through four were considered mature. If the biologist was unable to rate the maturity stage with certainty or if the gonad was lost prior to examination, the maturity was recorded as unknown.

The left-side otolith was collected from a randomly selected sample of all halibut landed on the survey skates, i.e., the last five skates hauled at each station. The goal was to collect 2000 otoliths per regulatory area. On this demonstration charter otoliths were collected using random sampling rates that were the same or higher than what was predicted for the upcoming summer's survey work. Sublegal-sized halibut that were not selected for otolith collection were measured, checked for PHI, and released alive.

All halibut captured on survey skates aboard the survey vessels were inspected for evidence of injuries incurred from being previously captured and released by hook-and-line gear. The severity of prior hook injuries (PHI) was recorded on a scale of one to four. A code one was entered if no injury was present. Codes two through four were used to indicated the level of PHI severity. Code nine was recorded if the biologist was unsure if an injury was present or failed to examine the specimen.

Bycatch and hook occupancy

Twenty consecutive hooks at or near the beginning of each survey skate (i.e., not on PIT tagging skates) were monitored as they were retrieved from the water. The hook status was recorded as empty, baited, broken, capturing a halibut, or capturing a different species. Biologists recorded every animal caught in these twenty-hook subsamples, including fish, corals, sponges and other invertebrates. The entire set was monitored for the incidental catch of birds and marine mammals.

Oceanographic data

No oceanographic data were recorded on this charter.

2003 Double-tagging spot survey

Vessel	Regulatory Area	Survey Area	Charter Dates	Trip No.	Set No.
F/V *Pender Isle*	2B	Hecate Strait area: Carpenter Bay, the Hospital, and Goose Island grounds	September 5 – 15	1-2	1-39

Fishing effort	39 sets
Tagged halibut	2,661 fish

As a component to the coastwide release of passively integrated transponder (PIT) tags in 2003, a mark and recapture experiment was designed to determine an estimated rate at which halibut *in situ* shed PIT tags. The IPHC staff conducted a double-tagging experiment on popular fishing grounds in northern British Columbia. The spot nature of the release effort resulted in a first-year recovery rate of nearly ten percent.

Three IPHC biologists, on the *Pender Isle*, released a total of 2,661 halibut, which they tagged internally with PIT tags and externally with spaghetti tags. The goal of this mark and recapture experiment was to determine the rate at which halibut shed PIT tags. Of the 243 double-tagged fish recovered, seven had either shed the internal PIT tag or the PIT tag was non-functional. To encourage harvesters to keep tags attached to fish, the IPHC offered to double the reward for those who delivered external tags still attached to halibut heads.

For more information on this and the coastwide PIT tag mark and recapture experiment, refer to Report of Assessment and Research Activities 2004 (2005).

Survey design

Station pattern

This survey was a spot fishing operation. The captain chose the exact fishing locations within a broader area specified by the IPHC. Because the goal was to tag 2,500 halibut as quickly as possible, gear was set in areas where high CPUE was expected. The latitude and longitude were recorded at the beginning and end of each set along with depths at each skate junction. The vessel made several shorter prospecting sets, trying to locate heavy fishing areas on which to concentrate effort.

Fishing pattern

The *Pender Isle* set and hauled as much gear as possible, all the while dodging poor weather and its potential impact on soak time. Long soaks were avoided to minimize sand flea damage, which would render captured fish unfit for tagging. Additionally, because the goal was to tag and release as many healthy, uninjured halibut as possible, fish were not allowed to remain on deck for more than two minutes. If fishing was so heavy that capture halibut could not be tagged and released quickly, hauling was slowed or paused.

Gear and bait specifications

The *Pender Isle* used conventional fixed-hook setline gear with 1,800-foot skates. Each skate had approximately 100 Mustad (or equivalent) 16/0 circle hooks threaded through the front and spaced at 18-foot intervals on 24" to 48" gangions (after tying). The hooks were oriented on the gangions by inserting the gangion through the front of the hook eye. The vessel was free to use whatever bait desired; chum salmon and octopus were the primary baits used on this charter.

Sampling procedure

Halibut sampling

All fish were brought aboard with extreme care. Small fish were lifted over the roller by the gangion. Large fish, which had to be gaffed to be landed, were carefully gaffed through the lower jaw. Fish that were bleeding heavily or were severely injured in this process were not tagged; however, because this was not a proportional release study, the criteria used to determine whether a fish was fit for tagging was not as strict as for the coastwide tagging experiment conducted on grid surveys in 2003.

A team of three biologists worked aboard the vessel to collect data; two samplers worked on deck while one sampler was in the shack preparing tags and recording data. The two researchers on deck had distinct duties: one tagged the fish externally with a coded wire tag and then passed it to the other researcher, who inserted and scanned a PIT tag and supplied the researcher in the shack with a rating of the hooking injury, a length measurement, and a confirmation of the number on the coded wire tag. Every halibut landed was measured to the nearest centimeter and recorded with its corresponding skate number.

Immediately after a fish had been marked with a coded wire tag and a PIT tag, it was returned to the sea.

Bycatch and hook occupancy

Bycatch and hook occupancy were not recorded on this charter because the purpose of this charter was to tag and release as many halibut as quickly as possible.

Oceanographic data

No oceanographic data were recorded on this charter

Acknowledgements

We would like to thank the IPHC staff members involved in these survey operations for help in completing this project. Their ability to cheerfully revisit the past through formal interviews as well as numerous casual conversations ensured accuracy and detail in recounting the extraordinary history of the IPHC setline surveys.

We would also like to acknowledge the work of the IPHC data entry staff, especially Linda Shen in hopes that this simple compilation of project descriptions will aid scientists in utilizing the wealth of data that she and others had worked so diligently to transcribe and digitize in her over 25 years of service to the IPHC.

Annotated bibliography

Barto, T. J., and Williams, G. H. 1999. Prior hook injuries found on halibut in the 1998 surveys. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1998: 311-318.
Description of PHI codes, collection procedures, and analysis of data acquired through the IPHC survey operations.

Bell, H. F., and Best, E.A. 1966. Preliminary observations on the distribution, magnitude and age composition of young halibut on the flats in southeastern Bering Sea. Int. Pac. Halibut Comm. Annual Meeting Documents, 1965: 16 p.
Brief description and results following the setline/trawl grid survey conducted by the F/V *Tordenskjold* in 1965.

Bell, H. F., and Myhre, R. J. 1967. The halibut fishery south of Willapa Bay, Washington. Int. Pac. Halibut Comm. Annual Meeting Documents, 1966: 8 p.
References to the west coast spot survey conducted by the F/V *Chelsea* in 1966.

Blood, C. L. 1983. The use of oxytetracyclene as a marking agent for age validation. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Activities 1982: 42-43.
Background and summary of OTC injections during the catchability spot survey and standardized grid survey in 1982.

Blood, C. L. 1990. Preliminary results of Pacific halibut survey in waters affected by the Exxon Valdez oil spill. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1989: 16-26.
Full report of the oil spill grid/spot survey conducted by the F/V *Royal Quarry* in 1989.

Blood, C. L. 1996. 1995 setline survey in southern Area 2. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1995: 255-262.
Report of the first Area 2 random stratified survey conducted by the F/V *Risky Business* in 1995.

Best, E. A. 1970. Recruitment investigations: Trawl catch records eastern Bering Sea, 1963, 1963 and 1966. Int. Pac. Halibut Comm. Tech. Report No. 7: 52 p.
Good source relating to the early trawl survey grid design, especially the 1963 and 1965 setline/trawl grid surveys conducted by the F/V *Arthur H* and F/V *Tordenskjold*.

Chen, D. G. and Clark, W. G. 2000. Survey bait comparison. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2000: 183-202.
Description and analysis of the standardized grid/bait comparison survey conducted in 2000.

Clark, W. G., Larsen M. J., and Henchman, T. 1989. Otolith Collection cruises. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1989: 29-41.
Description and preliminary results of the otolith collection spot survey conducted by the F/V *Ocean Viking* and *F/V Chelsea* in 1989.

Clark, W. G. 1995. Results of a pilot grid survey in Area 2A-1. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 241-248.
Report of the west coast pilot grid/spot survey conducted by the F/V *Coolidge* in 1994.

Clark, W. G. 1996. Design of the 1995 setline survey in southern Area 2. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1995: 263-270.

Clark, W. G. 2000. Catalog of the IPHC setline survey data, 1963-1999. Report of Assessment and Research Activities 1999: 345-354.
Lists standardized grid survey vessels ’63 to ’99 and describes proper query parameters

Deriso, R. B. 1987. A multi-species stochastic model for long-line depletion experiments: Application to Pacific halibut. J. Cons. Int. Explor. Mer, 00: 000-000.
References to the depletion spot survey conducted by the F/V *Cape Flattery* in 1987.

Deriso, R. B. and Kaimmer, S. M. 1987. Unpublished. Continuous fishing studies in Area 2B and 3A. Int. Pac. Halibut Comm.
References to the depletion spot survey conducted by the F/V *Cape Flattery* in 1987.

Dunlop, H. A., Bell, F. H., Myhre, R. J., Harman, W. H., and Southward, G. M. 1964. Investigation, utilization and regulation of the halibut in southeastern Bering Sea. Int. Pac. Halibut Comm. Report No. 35: 72 p.
Information and background regarding the 1963 setline/trawl grid survey conducted by the *Arthur H*.

Forsberg, J. E. and Larsen, M. J. 1996. 1995 Area 2B setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1995: 225-236.

Geernaert, T., Parma, A. M., St-Pierre, G., and Kaimmer, S. M. 1993. A depletion and tagging study in British Columbia. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 269-284.
Report of the 1988 Sitka Spot depletion/tagging surveys conducted by the F/V *Snowfall* and F/V *Cape Flattery*.

Geernaert, T., Trumble, R. J. 2000. A study of the dynamics of a small fishing ground in British Columbia. Int. Pac. Halibut Comm. Tech Report No. 45: 20 p.
A complete description of the 1988 Sitka Spot depletion/tagging surveys conducted by the F/V *Snowfall* and F/V *Cape Flattery*.

Gilroy, H. L. and Hoag, S. H. 1988. Results of the 1987 Bristol Bay survey of halibut. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1987: 61-71.

Gilroy, H. L. and Hoag, S. H. 1993. The 1987 Bristol Bay survey and the Bristol Bay halibut fishery, 1990-1992. Int. Pac. Halibut Comm. Tech. Report No. 28: 55-72.

Hamley, J. M. 1973. Unpublished. Report: Setline charter, March 26 – April 28, 1973. Int. Pac. Halibut Comm.
A full report of the Hook Spacing spot survey conducted by the F/V *Republic* in 1973.

Hamley, J. M. 1973. Unpublished. Experiments to study the effect of hook spacing on catches of halibut, 1971-73. Int. Pac. Halibut Comm.
A draft report of all hook spacing surveys conducted between 1971 and 1973.

Hamley, J. M. and Skud, B. E. 1978. Factors affecting longline catch and effort: Part II. hook spacing. Int. Pac. Halibut Comm. Sci. Report No. 64: 15-24.
A review of all hook spacing surveys conducted between 1971 and 1973.

Hamley, J. M. 1984. Unpublished. Circle-hooks in the Pacific halibut fishery: Preliminary results of the *Chelsea* and the *Seymour* cruises near Kodiak in 1984. Int. Pac. Halibut Comm.

Hare, S. R. 2000. Deployment of a water column profiler from a halibut longliner during the IPHC survey operations. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2000: 257-264.
Report of profiler deployment success on F/V *Bold Pursuit* during grid survey operations in 2000.

Hoag, S. H., Schmitt, C. C., and Hardman, W. H. 1979. Size, age, and frequency of male and female halibut: Setline research catches, 1925-1977. Int. Pac. Halibut Comm. Tech. Report No. 17: 112 p.
Provides a fairly complete list of both charter and observer setline research conducted by the IPHC prior to 1978. Also includes general comments on survey design and sampling protocols.

Hoag, S. H., Williams, G. H., Myhre, R. J., and McGregor, I. R. 1980. Halibut assessment data: Setline surveys in the north Pacific Ocean, 1963-1966 and 1976-1979. Int. Pac. Halibut Comm. Tech. Report No. 18: 44 p.
General information regarding the standardized grid survey design and operations during the specified period.

Hoag, S. H. 1983. Synopsis. Int. Pac. Halibut Comm. Stock Assessment Doc. II: Research Activities, 1982: 4-7.
Overview of all setline projects completed in 1982.

Hoag, S. H., Deriso, R. B., and St-Pierre, G. 1983. Trawl-setline catch comparison. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Activities 1982: 39-41.

Hoag, S.H., Deriso, R.B., and St-Pierre, G. 1984. Recent changes in halibut CPUE: Studies on area differences in setline catchability. Int. Pac. Halibut Comm. Sci. Report No. 71: 44 p.
Design, description, and analysis of the 1982 and 1983 catchability spot surveys.

IPHC Staff. 1963 Unpublished. Summary report upon a trawl survey of the demersal fish stocks conducted by the International Pacific Halibut Commission between the eastern end of Kodiak Island and Cape Spencer, Alaska from May 1962 to April 1963. Int. Pac. Halibut Comm.
Design of the Bering Sea grid survey and description of the setline/trawl grid survey performed by the F/V *Arthur H* in 1963.

IPHC Staff. 1984. Setline catchability in Area 3A relative to Area 2B. Int. Pac. Halibut Comm. Stock Assessment Document II, 1983: 8-19.
Full report of the catchability spot survey conducted by the F/V Lorelei II in 1993 with references to the same study conducted in 1992 by the F/V *Proud Canadian*.

IPHC Staff. 1997. 1996 Setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1996: 263-294.

IPHC Staff. 1998. Setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1997: 341-368.

Kaimmer, S. M. 1987. Automated hook strippers in the Pacific halibut fishery. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1988: 35-40.
Background, survey design, and summary discussion following the hook stripper mortality spot survey conducted by the F/V *Moriah* in 1986.

Kaimmer, S. M. 1987. 1986 adult halibut surveys. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1986: 24-32.
Report of the last of the 1980's series of standardized grid surveys.

Kaimmer, S. M. 1988. Field research, 1987. Int. Pac. Halibut Comm. Annual Meeting Documents, 1988. 12-18.
Includes an overview of all setline projects completed in 1987.

Kaimmer, S. M., and Deriso, R.B. 1988. Continuous fishing studies in Area 2B and 3A. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1987: 82-97.
Report and data summary of the depletion spot survey conducted by the F/V *Cape Flattery* in 1987.

Kaimmer, S. M., St-Pierre, G., and Smith, P. J. 1988. Annual halibut surveys. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1987: 46-60.
Includes the 1987 depletion, hook spacing, and catchability surveys

Kaimmer, S. M. 1989. Comparison of the catching efficiency of sablefish gear with conventionally rigged halibut gear. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1988: 3-9.
Report of the halibut/sablefish gear comparison spot survey conducted by the F/V *Cape Flattery* in 1988.

Kaimmer, S. M. 1989. A depletion fishing and tagging study in British Columbia. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1988: 10-15.
Report of the Sitka Spot depletion/tagging surveys conducted by the F/V *Cape Flattery* and F/V *Snowfall* in 1988.

Kaimmer, S. M. 1989. Preliminary analysis of tag returns from crucifier study. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1988: 16-18.
Report of the hook stripper mortality spot survey conducted by the F/V *Moriah* in 1986.

Kaimmer, S. M. 1989. Live halibut project. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1988: 19-20.
References the delivery of live halibut from the survey vessels *Cape Flattery* and *Satin Doll* in 1988.

Kaimmer, S. M. 1989. Otolith weight-fish length experiment. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1988: 56.

Kaimmer, S. M. 1990. A progress report on the use of hook timers to investigate the setline CPUE function. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1989: 12-13.
A brief report of the hook timer pilot spot survey conducted by the F/V *Ocean Viking* in 1989.

Kaimmer, S. M, Parma, A. M., and Sullivan, P. J. 1991. A progress report on the use of hook timers to investigate the relationship between CPUE and fish density. Int. Pac. Halibut Comm. Report of Commission Activities 1990: 159-168.
Complete report of the hook timer spot survey conducted by the *Ocean Viking* in 1990.

Kaimmer, S. M. 1991. Mortalities associated with hook strippers. Int. Pac. Halibut Comm. Report of Commission Activities 1990: 115.
Provides some details of the hook stripper mortality spot survey conducted by the F/V *Moriah* in 1986.

Kaimmer, S. M. 1991. Live halibut rearing projects. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1990: 103-104.
References delivery of live halibut from the charter vessel F/V *Golden Dolphin* in 1990.

Kaimmer, S. M., and Williams, G. H. 1991. Underwater video observation of groundfish trawls and baited circle hooks. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1990: 99-101.
A brief report of the underwater video pilot sot surveys conducted by the F/V *Clipper II* and F/V *Golden Dolphin* in 1990.

Kaimmer, S. M. 1992. Underwater video observations of fish behavior to baited circle hooks. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1991: 233-236.
Description and discussion of the underwater video spot survey conducted by the F/V *Clipper II* in 1991.

Kaimmer, S. M., Trumble, R. J., and Geernaert, T.O. 1994. Longline tagging for discard mortality rates. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1993: 263-276.
Report of the 1993 setline mortality spot tagging survey conducted by the F/V *Rebecca B*.

Kaimmer, S. M., and St-Pierre, G. 1993. Further studies of Area differences in setline catchability of Pacific halibut. Int. Pac. Halibut Comm. Sci. Report No. 77: 41-100.
Descriptions of the 1983 and 1984 setline/trawl comparison surveys.

Kaimmer, S.M., and Trumble, R. J. 1995. Longline tagging for discard mortality rates. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 167-180.
Complete report of the 1994 setline mortality spot tagging survey conducted by the F/V *Rebecca B*.

Kaimmer, S. M. 1994. Halibut injury and mortality associated with manual and automated removal from setline hooks. Fisheries Research 20: 165-179.
Description of the hook stripper mortality study conducted aboard the F/V *Moriah* in 1987.

Kaimmer, S. M, and Larsen, M. J. 1996. 1995. Area 3A setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1995: 237-248.

Kaimmer, S. M. In review. 1998 gear and bait experiments. Int. Pac. Halibut Comm. Tech. Report.
A complete description and analysis of the miscellaneous bait and surveys conducted during the summer of 1998.

Kaimmer, S. M. 1999. 1998 Experimental fishing. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1998: 331-338.
An overview of the Miscellaneous bait and gear surveys performed in 1998.

Kaimmer, S .M. 1999. Direct observations on the hooking behavior of Pacific halibut, *Hippoglossus stenolepis*. Fish. Bull. 97: 320-331.
Information relating to underwater camera studies.

Kaimmer, S. M. 2000. 1998-99 experimental fishing – a winter/spring comparison of bait size and type. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1999: 365-366.
A brief report of the 1998-1999 bait size and type surveys.

Kaimmer, S. M. 2000. 1999 chalky halibut study. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1999: 263-266.

Kaimmer, S. M. 2000. Pacific halibut tag release programs and tag release and recovery data, 1925 through 1998. Int. Pac. Halibut Comm. Tech. Report No. 41: 32 p.
General information relating to the tag database. Also used to confirm projects within the time frame of this paper in which tagging took place.

Kaimmer, S. M. 2000. Chalky halibut investigations, 1997-1999. Int. Pac. Halibut Comm. Tech Report No. 44: 24 p.
Background and description of the 1999 chalky halibut survey.

Kaimmer, S. M., and D.G. Chen. 2001. 2000 special setline experiments. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2000: 395-410.
A brief report and analysis of the 2000 hook orientation/gangion length survey, 2000 Bait size/hook size survey, and 2000 bait quality survey.

Kaimmer, S. M., and Chen, D. G. 2001. Relative fishing effectiveness of salmon, squid, and herring for Pacific halibut setlines. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2000: 411-424.
Description and analysis of the 1998-1999 bait size and type surveys.

Kaimmer, S. M. and Geernaert, T. O. 2005. Recoveries of double-tagged fish and PIT tag loss rate. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2004: 357-362.
A brief description of the double-tagged fish and PIT tag shedding experiment.

Larsen, M. J. 1992. Stock identification using DNA analysis. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1990: 241.
References samples taken during the 1991 hook timer spot surveys.

Larsen, M. J., and St-Pierre, G. 1994. 1993 setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1993: 325-340.

Larsen, M.J., and L.L. Sadorus. 1995. 1994 setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 227-240.

Leaman, B. M., Van Wormer, K. L., and Ranta, A. M. 2001. 2000 standardized stock assessment survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2000: 295-312.

McGregor, I. R. 1967. Summary of field activities conducted during 1966. Int. Pac. Halibut Comm. Annual Meeting Documents, 1966: 7 p.

Myhre, R. J. 1966. Preliminary results of tagging conducted in Bering Sea and between Shumagin Islands and Unimak Pass in the Winter of 1963-64. Int. Pac. Halibut Comm. Annual Meeting Documents, 1965: 4 p.
Report of the spot tagging survey conducted by the F/V *Seattle* in the winter of 1963-1964.

Myhre, R. J. 1969. Gear selection and Pacific halibut. Int. Pac. Halibut Comm. Report No. 51: 35 p.
Includes references to several 1963-1966 setline surveys and descriptions of early setline gear and bait of the type used on pre-1970's setline surveys.

Myhre, R. J., Pentonen, G. J., St-Pierre, G., Skud, B. E., and Walden, R. E. 1977. The Pacific halibut fishery: Catch, effort and CPUE, 1929-1975. Int. Pac. Halibut Comm. Tech. Report No. 14: 96 p.
Addresses changes in bait, hook spacing and growing popularity of snap gear.

Myhre, R. J., and Quinn, T. J. 1983. Comparison of fishing efficiency for Pacific halibut of snap gear to conventional setline gear. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Activities 1982: 37-38.

Myhre, R. J. 1985. Pribilof island halibut survey, 1984. Int. Pac. Halibut Comm. Stock Assessment Document II, 1984: 68-72.
Report, summary data, and diagrams of the Pribilof island stratified survey conducted by the *F/V Valorous* in 1984.

Myhre, R. J. and Quinn II, T. J. 1984. Comparison of efficiency of snap gear to fixed-hook setline gear for catching Pacific halibut. Int. Pac. Halibut Comm. Sci. Report No. 69: 37 p.
Description and analysis of the 1983 snap/fixed-hook gear comparison grid survey conducted by the *F/V Valorous*.

Myhre, R. J. 1987 Unpublished. Some useful length and weight relationships for Pacific halibut. Int. Pac. Halibut Comm.
Good background into the standards historically used by the IPHC for taking head and fork length measurements.

Parma, A. M., Larsen, M. J., Kaimmer, S. M. 1992. A progress report on the use of hook timers on longline gear. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1991: 101-106.
Report on the hook timer spot surveys conducted in 1991.

Parma, A. M., Sullivan, P. J., and Pelletier, D. 1994. Alternative sampling grids for the setline surveys. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1993: 145-154.
Reasoning and analysis of the change from the transect surveys used since 1963 to the triangular design used in 1993.

Parma, A. M., Kaimmer, S. M., and Sullivan P. J. 1995. A progress report on the use of hook timers and underwater observations to assess the effect of bait competition on CPUE. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 211-221.
Project description and preliminary results of the 1994 underwater video/hook timer spot survey.

Pelletier, D. and Parma, A. M. 1994. Spatial distribution of Pacific halibut (*Hippoglossus stenolepis*): An application of geostatistics to longline survey data. Can. J. Fish. Aquat. Sci., Vol. 51: 1506-1518.
Description and analysis of the old and new standardized grid survey designs when changing from transects to triangles in 1993.

Peltonen, G. J. 1967. Comparison of selectivity and effectiveness of Japanese and north American longline fishing gear. Int. Pac. Halibut Comm. Annual Meeting Documents, 1966: 3 p.

Peltonen, G. J. 1983. Submarine observations. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Activities 1982: 44-45.

Pollock, K. H., Chen, H., Brownie, C., and Kendall, W. L. 1998. Age Dependent Tag Recovery Analyses of Pacific halibut data. Int. Pac. Halibut Comm. Tech. Report No. 38: 32 p.
References the IPHC setline tagging studies.

Randolph, D. L., and Larsen, M. J. 1996. Evolution of the Area 3 survey grid design. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1995: 249-254.
Documentation of historical grid survey designs and methodology used to expand the current survey design throughout Area 3.

Randolph, D. L., and Larsen, M. J. 1999. 1998 setline grid survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1998: 251-292.

Randolph, D. L. 1999. The IPHC setline survey grid design changes 1960-1998. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1998: 293-300.

Randolph, D. L., and Clark, W. G. 2000. Grid survey design experiment. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1999: 367-374.
Description and analysis of the standardized grid/S.E. Alaska design survey conducted during the summer of 1999.

Randolph, D. L. 2000. 1999 standardized stock assessment survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1999: 299-336.

Sadorus, L. L., and St-Pierre, G. 1995. The IPHC Research and management of Pacific halibut in the Pribilof Islands through 1994. Int. Pac. Halibut Comm. Tech. Report No. 34: 35 p.
Interesting history behind the early Pribilof surveys and brief descriptions of the charters in that area during 1964, 1965, 1967, and 1984.

Schmitt, C., and Williams, G. H. 1984. 1983 adult halibut surveys. Int. Pac. Halibut Comm. Stock Assessment Document II, 1983: 30-39.

Schmitt, C. 1985. Halibut catches by large and small circle hooks. Int. Pac. Halibut Comm. Stock Assessment Document II, 1984: 54.
Very brief description of the hook size trawl/setline comparison spot survey conducted by the F/V *Pacific Harvester* in 1984.

Schmitt, C. 1985 Unpublished. Evaluation of two methods to determine maturity of female Pacific halibut *Hippoglossus stenolepis*. Int. Pac. Halibut Comm.
Refers to sample collection during the 1979 and 1980 winter spawning ground survey charters.

Skud, B. E. 1972. A reassessment of effort in the halibut fishery. Int. Pac. Halibut Comm. Sci. Report No. 54: 11 p.
Addresses the new "standard skate" and provides a good overview of the 1971 hook spacing survey conducted by the F/V *Chelsea*.

Skud, B. E. 1978. Factors affecting longline catch and effort: Part III. Bait loss and competition. Int. Pac. Halibut Comm. Sci. Report No. 64: 26-43.
Primarily analyzes the 1978 bait loss survey conducted by the *F/V Chelsea* with several references to many earlier surveys.

Skud, B. E. 1972. Effect of hook-spacing on halibut catches. Western fisheries, Vol. 83, No. 5: 12-13.
A brief description of the hook spacing spot survey conducted by the *F/V Chelsea* in 1971.

St-Pierre, G., and Larsen, M. J. 1993. 1992 Bering Sea and Gulf of Alaska longline survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1994: 241-250.

St-Pierre, G., and Larsen, M. J. Unpublished. Setline halibut surveys: 1989 and 1992 otolith collections. Int. Pac. Halibut Comm.
Otolith collections surveys completed by the *Chelsea* and *Ocean Viking* in 1989 and the Kaare in 1992.

Sullivan, P.J., Kaimmer, S. M., St-Pierre, G., and Geernaert, T. O. 1990. Newport tagging feasibility study. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results in 1989: 67-72.
Sampling design and methods used during the coded wire tagging pilot spot survey conducted by the F/V *Donna* in 1989.

Sullivan, P.J., Geernaert, T. O., St-Pierre, G., and Kaimmer, S. M. 1992. Mark recapture methods for Pacific halibut assessment: A feasibility study conducted off Newport, Oregon. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1991: 163-166.
Primarily concerns the justification and design of the coded wire tagging pilot spot survey conducted by the F/V *Donna* in 1989.

Sullivan, P. J., Geernaert, T. O., St-Pierre, and Kaimmer, S. M. 1993. Mark-recapture methods for pacific halibut assessment: A feasibility study conducted off the central coast of Oregon. Int. Pac. Halibut Comm. Sci. Report No. 76: 1-40.
Background and description of the coded wire tagging pilot survey conducted by the F/V *Donna* in 1989.

Trumble, R. J. and St-Pierre, G. Unpublished. Results of studies on the meristic characters of Pacific halibut. Int. Pac. Halibut Comm.
References meristic character counts made during several the IPHC setline surveys.

Trumble, R.J., McGregor, I. R., St-Pierre, G., McCaughran, D. A., and Hoag, S. H. 1990. Sixty years of tagging Pacific halibut: A case study. American fisheries Society Symposium, 7: 831-840.
An excellent overview of the IPHC tagging procedures and platforms through about 1990. Also describes several of the specialized tagging experiments included in this paper.

Trumble, R. J. 1999. Experiments with a bird avoidance device during International Pacific Halibut Commission longline surveys. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1998: 321-330.

Williams, G. H. 1981. Adult halibut survey. Int. Pac. Halibut Comm. Stock Assessment Document No. 5, 1980: 104-116.

Williams, G. H. 1983. Adult halibut survey. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Activities, 1982: 19-22.

Williams, G. H., and McCaughran, D. A. 1985. Results of Comparative fishing of J-hooks and circle hooks. Int. Pac. Halibut Comm. Stock Assessment Document II, 1985: 34-40.
Brief description and analysis of the circle hook/J-hook comparison standardized grid survey conducted in 1984.

Williams, G. H. 1986. Field research, 1985. Int. Pac. Halibut Comm. Annual Meeting Documents, 1986: 13-21.
Includes an overview of all setline surveys completed in 1985.

Williams, G. H. 1987. Field research, 1986. Int. Pac. Halibut Comm. Annual Meeting Documents, 1987: 11-21.
Includes an overview of all setline surveys completed in 1986.

Williams, G. H. 1988. Results of 1987 the IPHC observer trips. Int. Pac. Halibut Comm. Stock Assessment Document II: Research Results, 1987: 32-37.
Report and summary data of the halibut bycatch observer trip aboard the F/V *Polaris* in 1987

Williams, G. H., and Larsen, M. J. 1998. Observations of prior hook injuries on the 1997 stock assessment surveys. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1997: 379-388.
Description of PHI codes, collection procedures, and analysis of data acquired through the IPHC survey operations.

Williams, G. H. and Carpenter, K. D. 1987 Unpublished. 1987 longline observer trip summary report. Int. Pac. Halibut Comm.
Report written by the IPHC biologist aboard the F/V *Polaris* during the 1987 halibut bycatch observer trip. Also includes background, instructions, and a summary of the trip.

Williams, G. H., Geernaert, T. O., and Chen, D. 2005. PIT tagging in 2004. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2004: 345-350. Report and summary of PIT tag operations on SSA in summer of 2004.

Other sources of information

International Pacific Halibut Commission Annual Reports

By the IPHC staff

All the IPHC annual reports from 1963 to 2003 were reviewed in the preparation of this paper. Typically the annual reports only provide information on survey operations in a broad context. These reports were primarily used in determining which projects were completed within each calendar year, and (when provided) an explanation of the purpose or background behind each survey.

Survey logbooks

By the IPHC biologists aboard survey vessels

It has been standard procedure during virtually every the IPHC survey operation since 1925 for the lead biologist aboard each vessel to maintain a daily log documenting survey operations. All available survey logbooks relevant to this project were thoroughly reviewed and used in the preparation of this paper. The amount of information available in the logbooks is highly variable. There was usually no guide as to the information to include in the log and the entries were often dependent upon the judgment of the recorder.

Administrative archive

By the IPHC administrative officer and other staff

A wealth of information on past survey operations is available in files maintained by the IPHC administrative office. These files typically contain charter proposals, notices, specifications, and contracts as well as financial receipts and other information relevant to the administrative aspects of the setline surveys. These files usually contain very little information on the scientific aspects and final results of each charter.

Annual meeting documents, briefing books, and "Blue Books".

By the IPHC Staff

The Commission staff has traditionally assembled a variety of summary reports and analysis for the IPHC annual meeting. These documents served to outline the financial, stock assessment, and research activities the Commission has performed over the year. Prior to 1982, the documents were provided as a compilation of numbered reports. Between 1982 and 1989, the reports were divided into two main sections: Stock Assessment Document I; trends in the fishery, and Stock Assessment Document II; Research Results. Beginning in 1990, the Commission integrated the reports into a single document entitled "Report of Assessment and Research Activities" (RARA).

A summary of this compilation called the "Blue Book" has also been provided since about 1989. In addition, the IPHC commissioners have been provided a briefing book, which included more proprietary information in addition to report summaries.

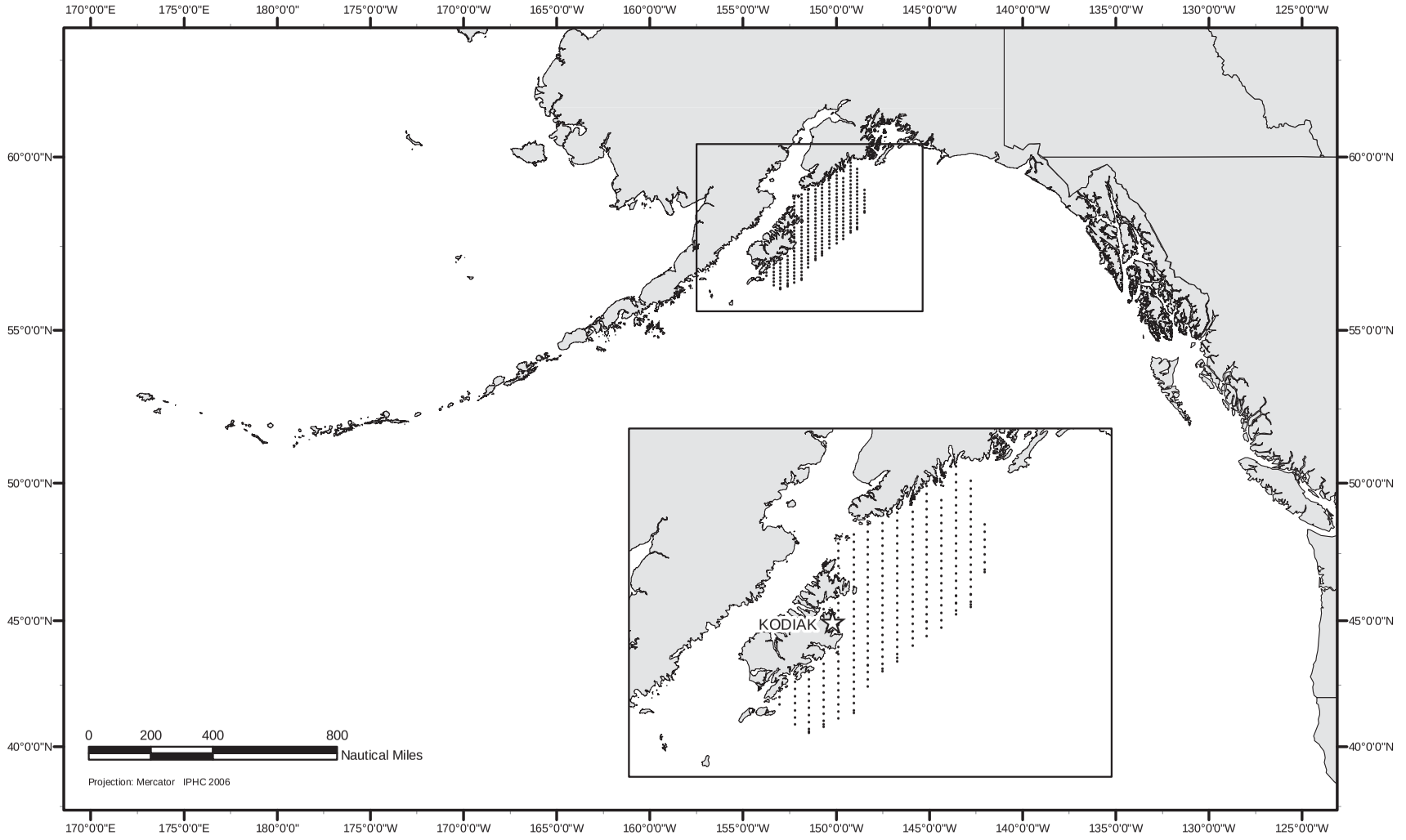
Standardized grid survey manuals

1964 – Instruction manual; Eclipse grid operation
1965 – Copies of instructions for Christian S, Tordenskjold, Chelsea, Don Edwards
1965 – Instruction manual; *Chelsea* operation
1965 – Instruction manual; *Tordenskjold* operation
1966 – Instruction manual; *Chelsea* operation
1976 – Instructions for standardized stock assessment; August-September
1977 – Instructions for standardized stock assessment
1979 – Instruction manual; standardized stock assessment
1980 – Adult halibut survey manual
1981 – Instruction manual; adult halibut survey
1982 – Instruction manuals; Areas 2B, 2C, 3A, 3B - SSA, Snap
1983 – Adult halibut survey instruction manual
1984 – Adult survey manual
1985 – Adult halibut survey manual
1986 – Adult halibut survey instruction manual
1993 – Setline survey handbook, standardized setline grid survey
1994 – Setline survey handbook, standardized setline grid survey
1995 – Setline survey handbook, standardized setline grid survey
1996 – Setline survey manual, standardized setline grid survey
1997 – Survey manual, standardized stock assessment survey
1998 – Survey manual, standardized stock assessment survey
1999 – Survey manual, standardized stock assessment survey
2000 – Survey manual, standardized stock assessment survey
2001 – Survey manual, standardized stock assessment survey
2002 – Survey manual, standardized stock assessment survey
2003 – Survey manual, standardized stock assessment survey

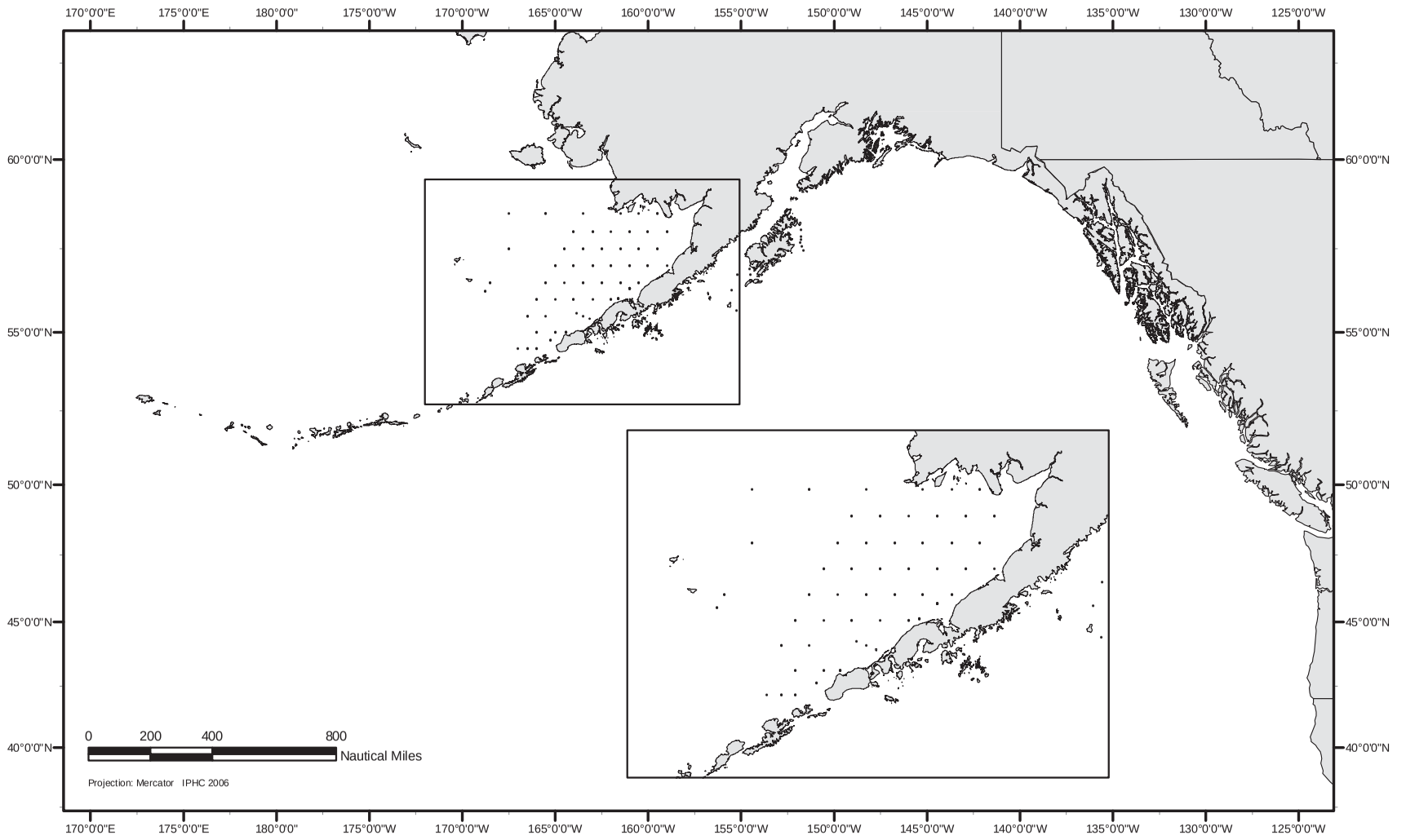
Other survey manuals

1961 – Trawl survey program
1966 – Copies of instructions for M/V *Don Edwards*, M/V *Arthur H*, M/V *Chelsea*
1980/81 – Instruction manual, winter charter
1981 – Ageing room procedures
1983 – Longline gear comparison instruction manual
1983 – trawl-setline comparison field manual, trawl vessel
1986 – Adult halibut survey instruction manual, Cape Flattery depletion/hook spacing
1988 – Adult halibut survey, BC 3-trip experiment and Kodiak depletion experiment
1991 – Setline survey handbook
1989 – Instruction manual, otolith/dressed weight collection
1992 – Setline survey handbook, Bering Sea survey
1994 – Setline survey handbook, hook-camera cruise
1998/99 – Winter survey manual, winter assessment survey
1999 – Summer charter manual, summer experimental fishing, bait type experiment
1999 – Chalky study manual, fall chalky halibut survey
2000 – Manual for 2000 experimental fishing (supplement to grid survey manual)
2003 – PIT Tag Project Manual

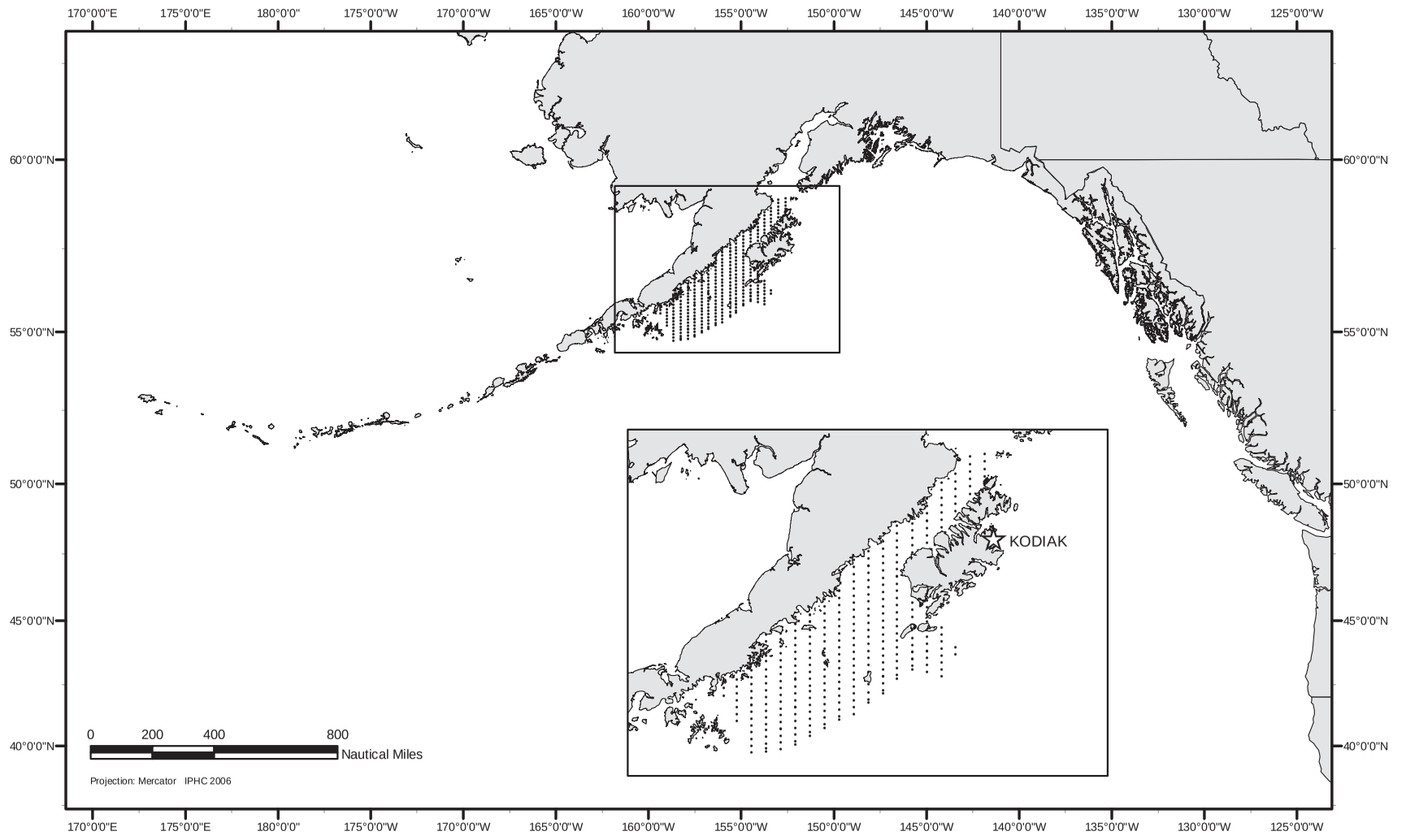
Appendix I. Survey maps



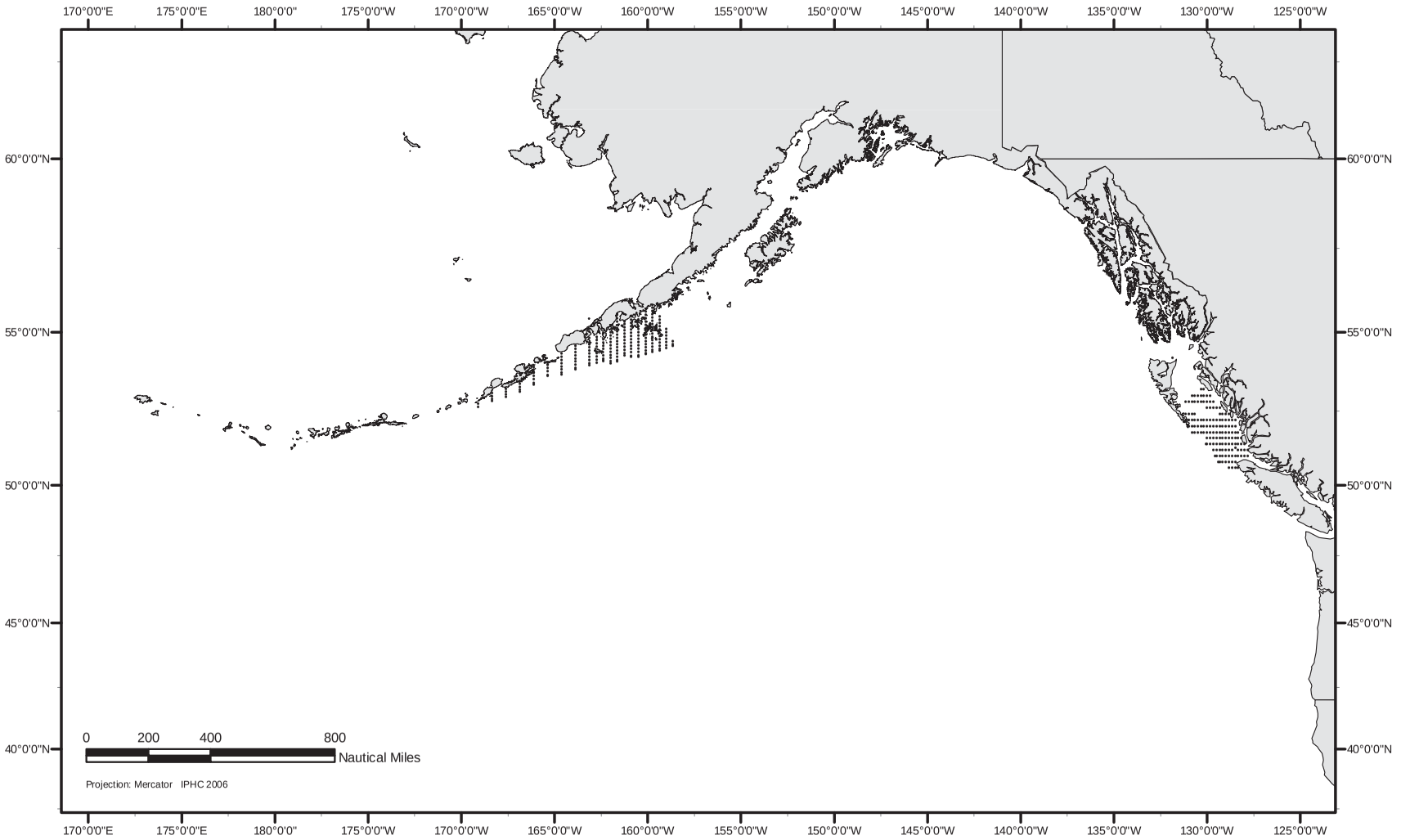
Appendix Figure 1. 1963 Standardized Grid Survey.



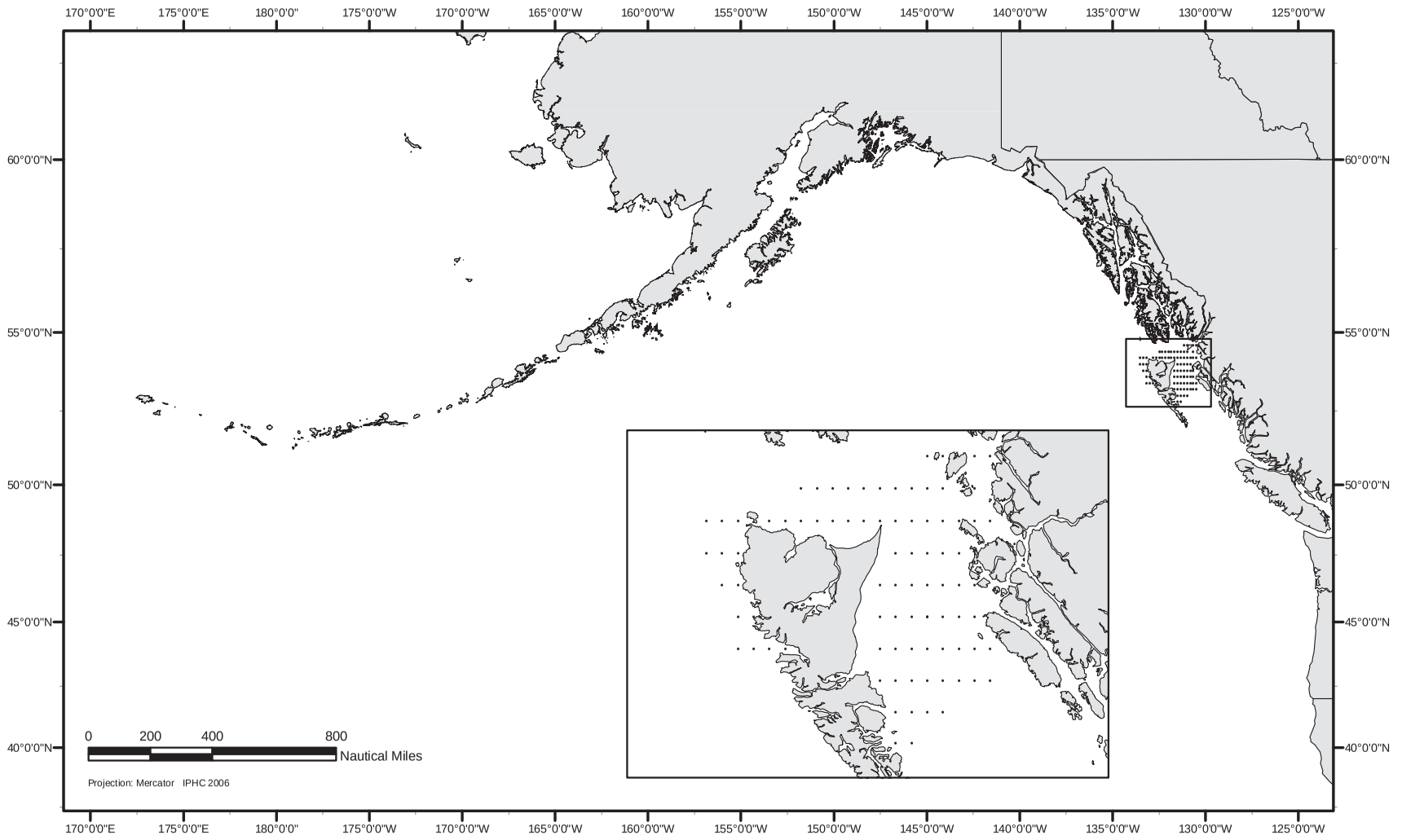
Appendix Figure 2. 1963 Setline Trawl survey.



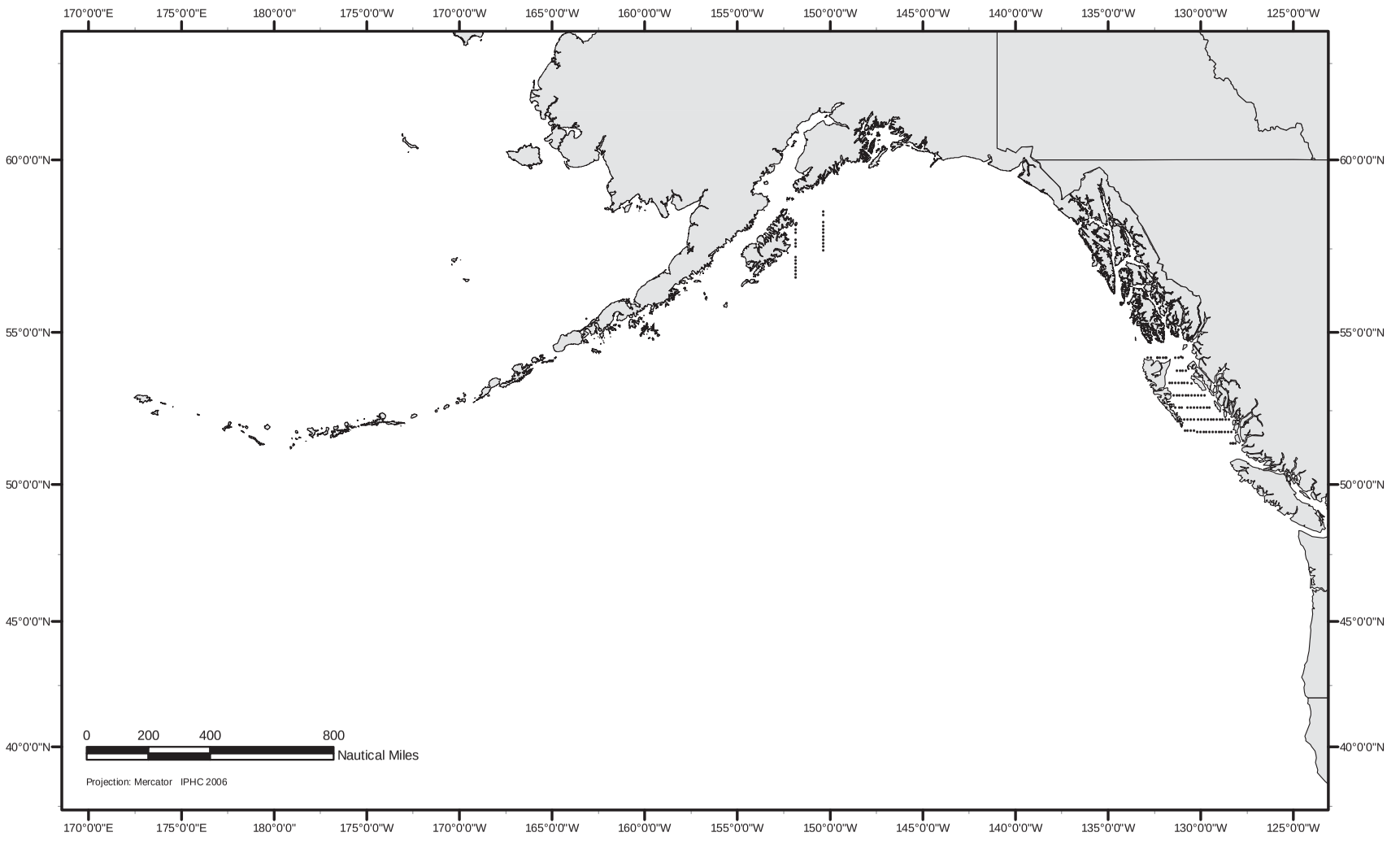
Appendix Figure 3. 1964 Standardized Grid Survey.



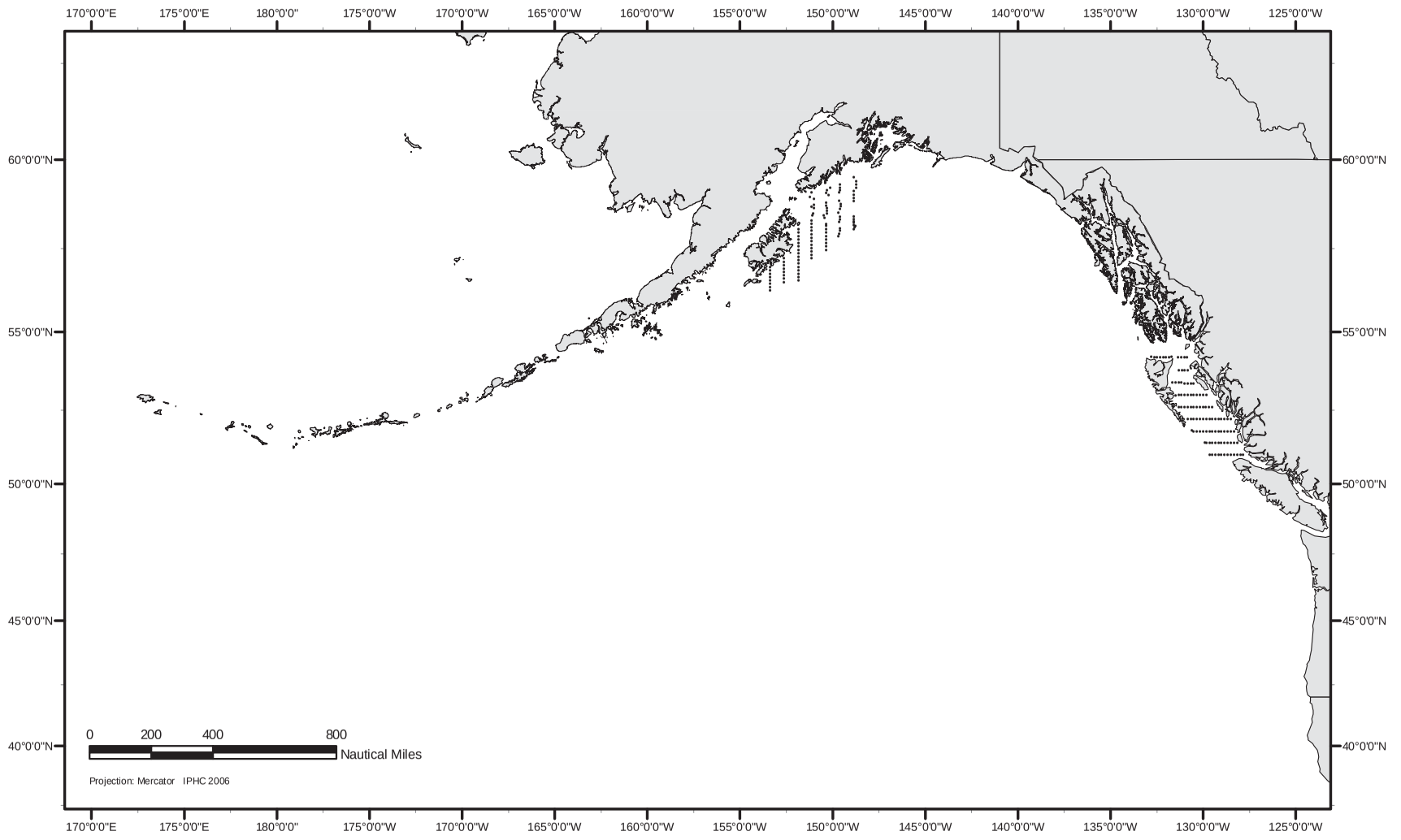
Appendix Figure 4. 1965 Standardized Grid Survey.



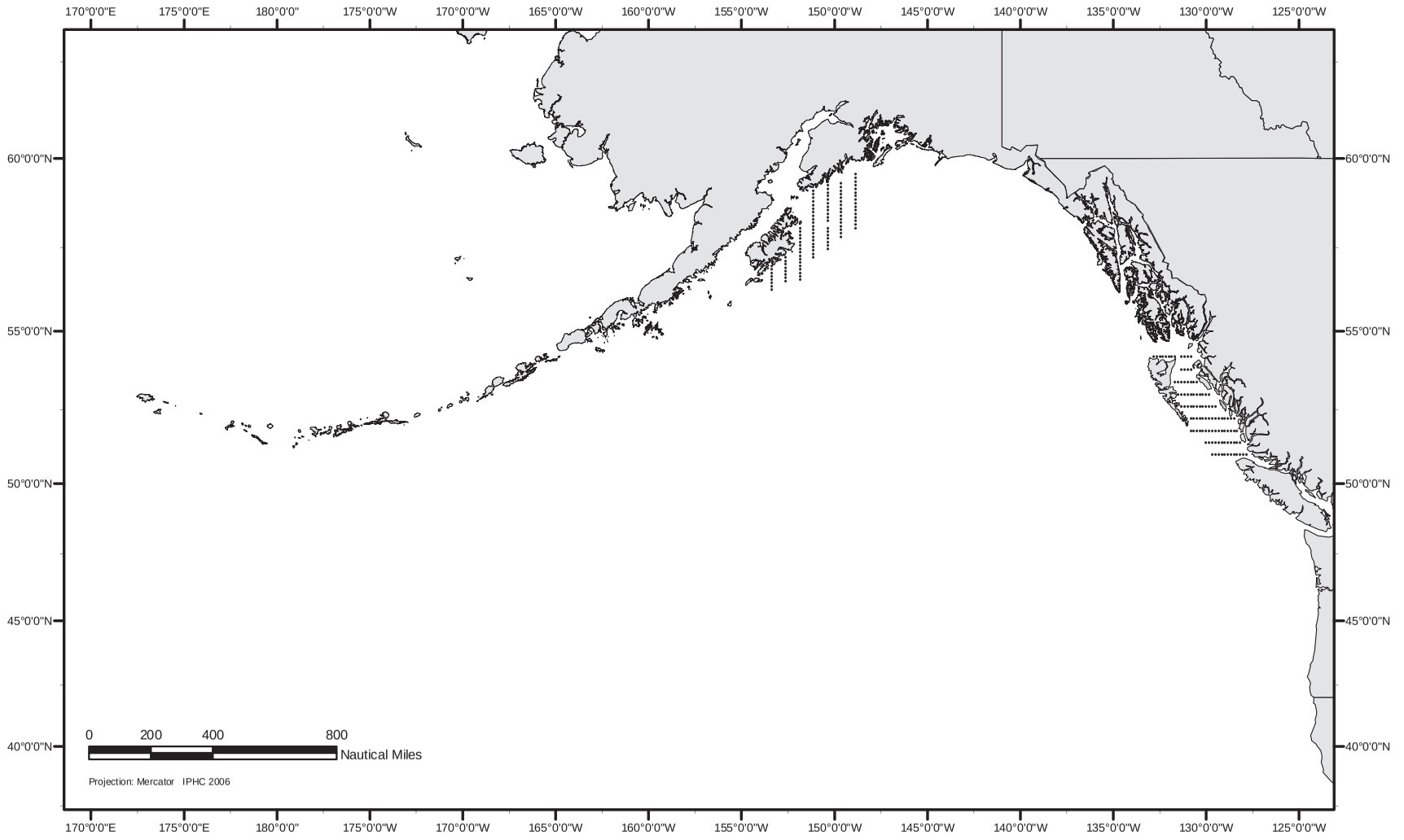
Appendix Figure 5. 1966 Standardized Grid Survey.



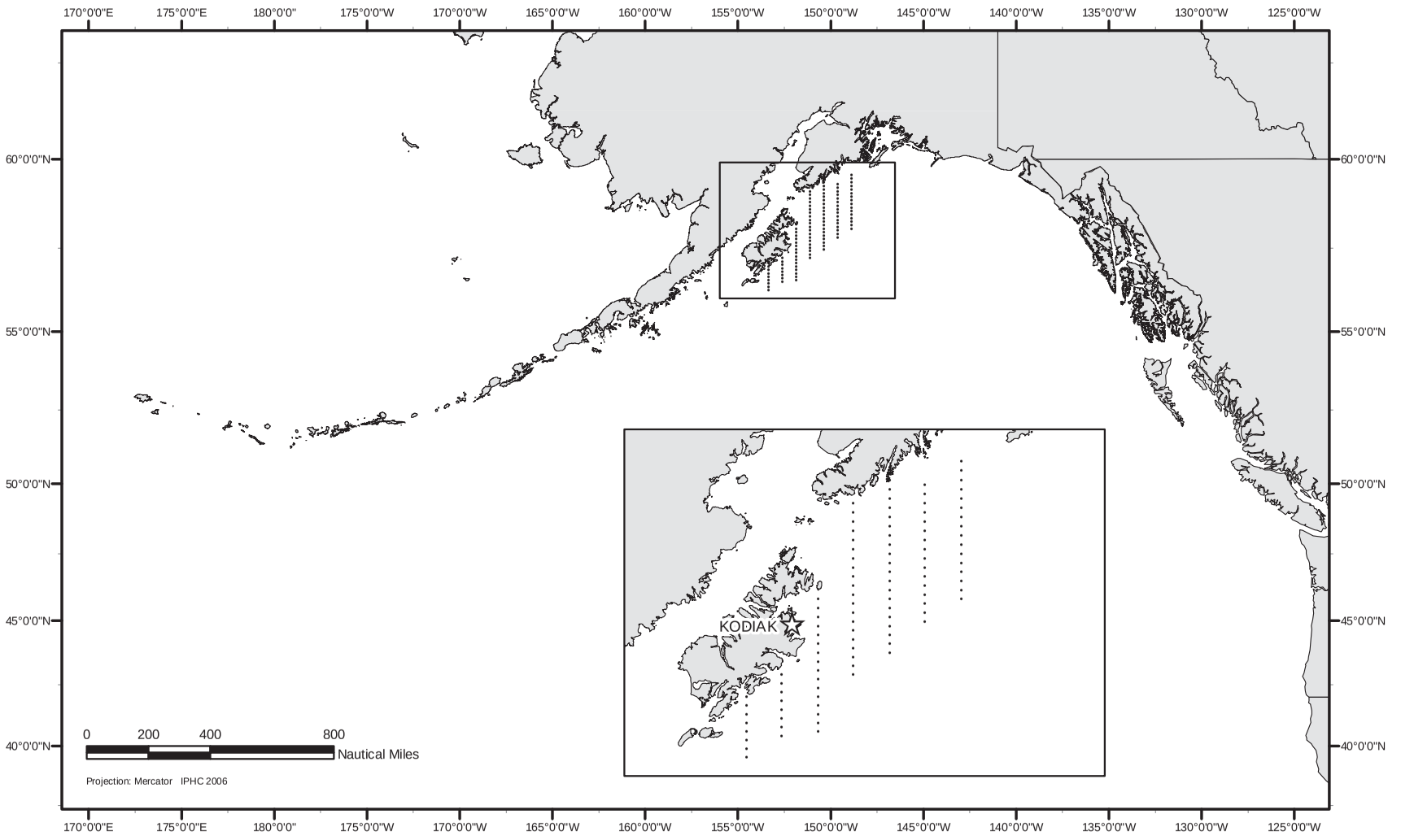
Appendix Figure 6. 1976 Standardized Grid Survey.



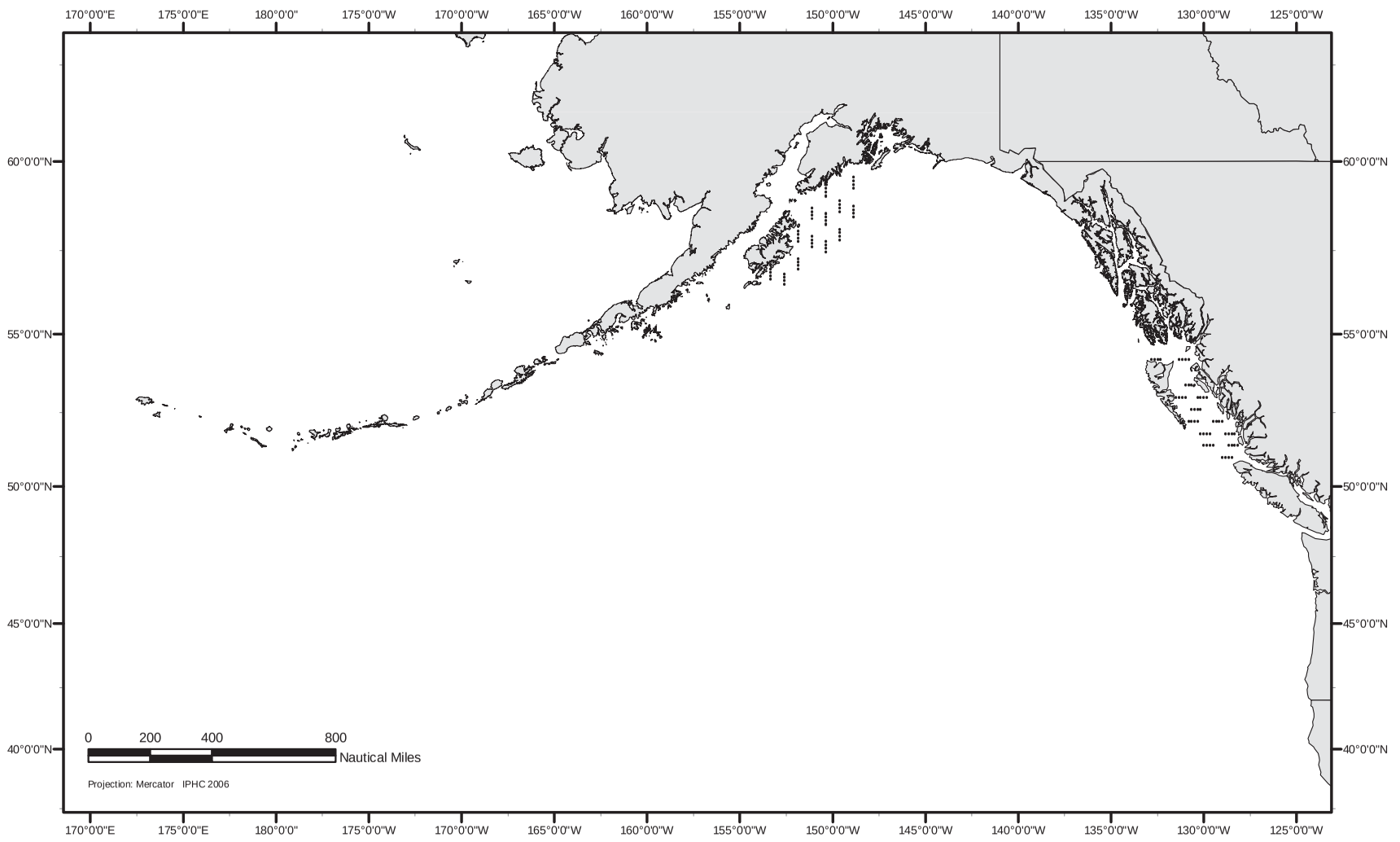
Appendix Figure 7. 1977 Standardized Grid Survey.



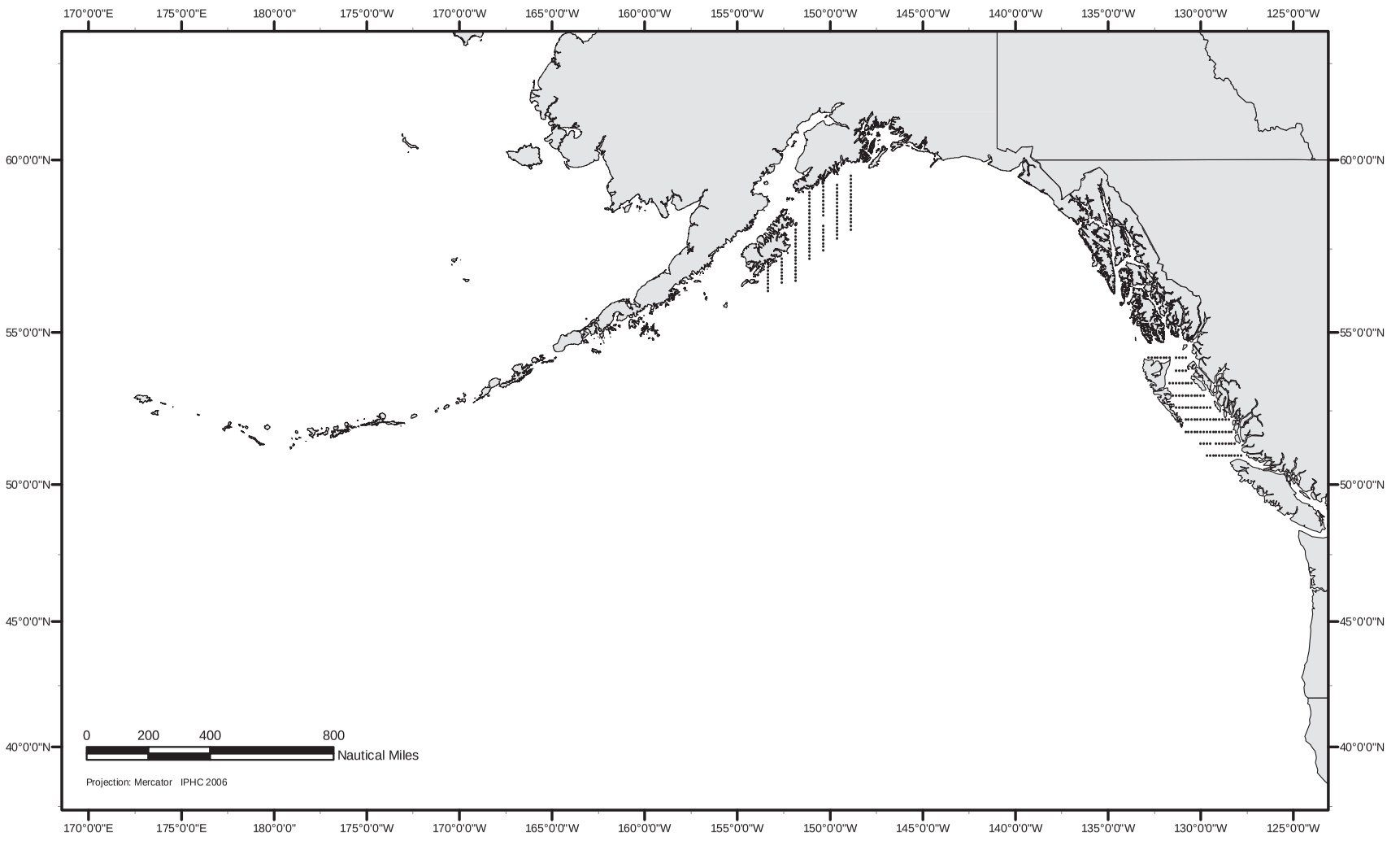
Appendix Figure 8. 1978 Standardized Grid Survey.



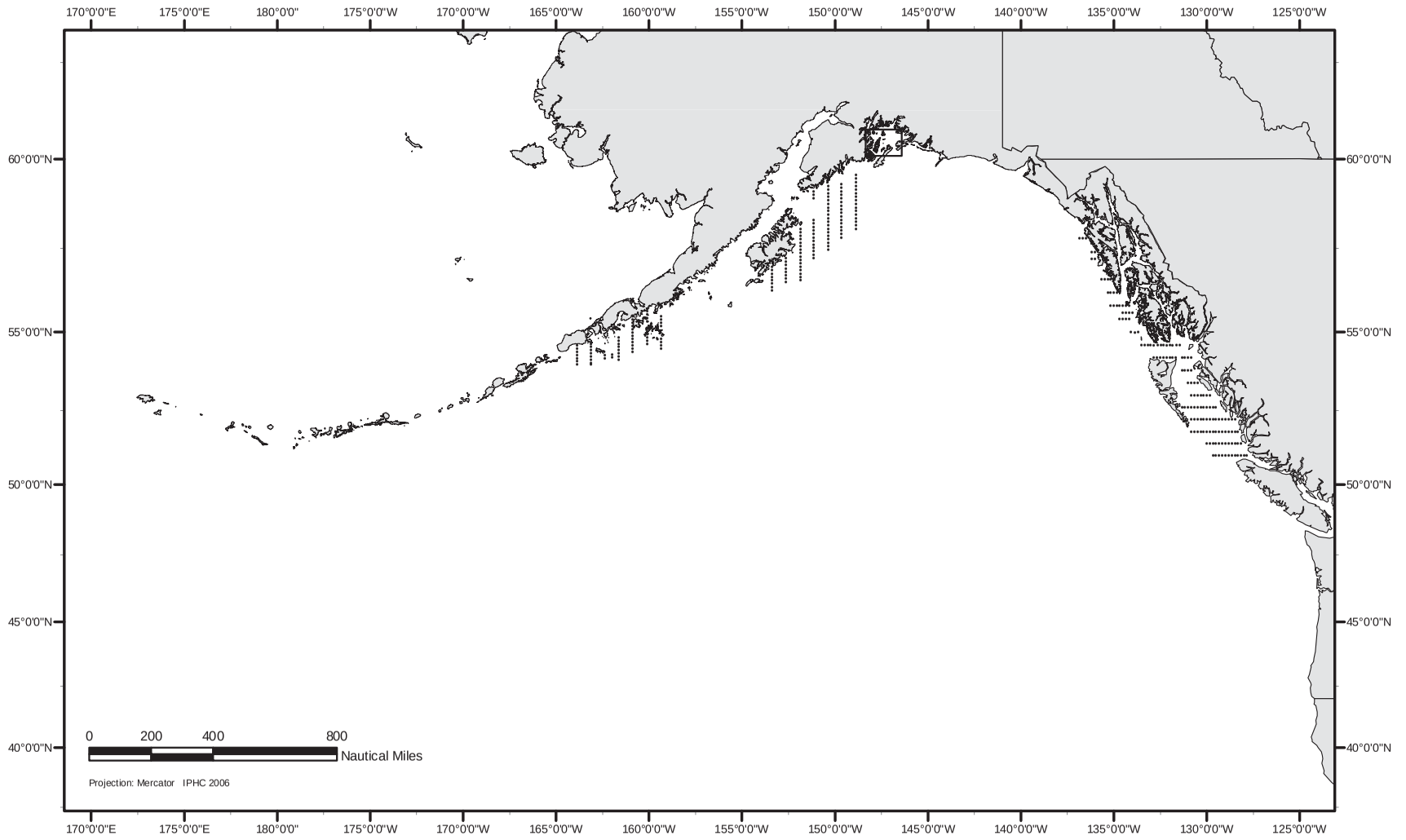
Appendix Figure 9. 1979 Standardized Grid Survey.



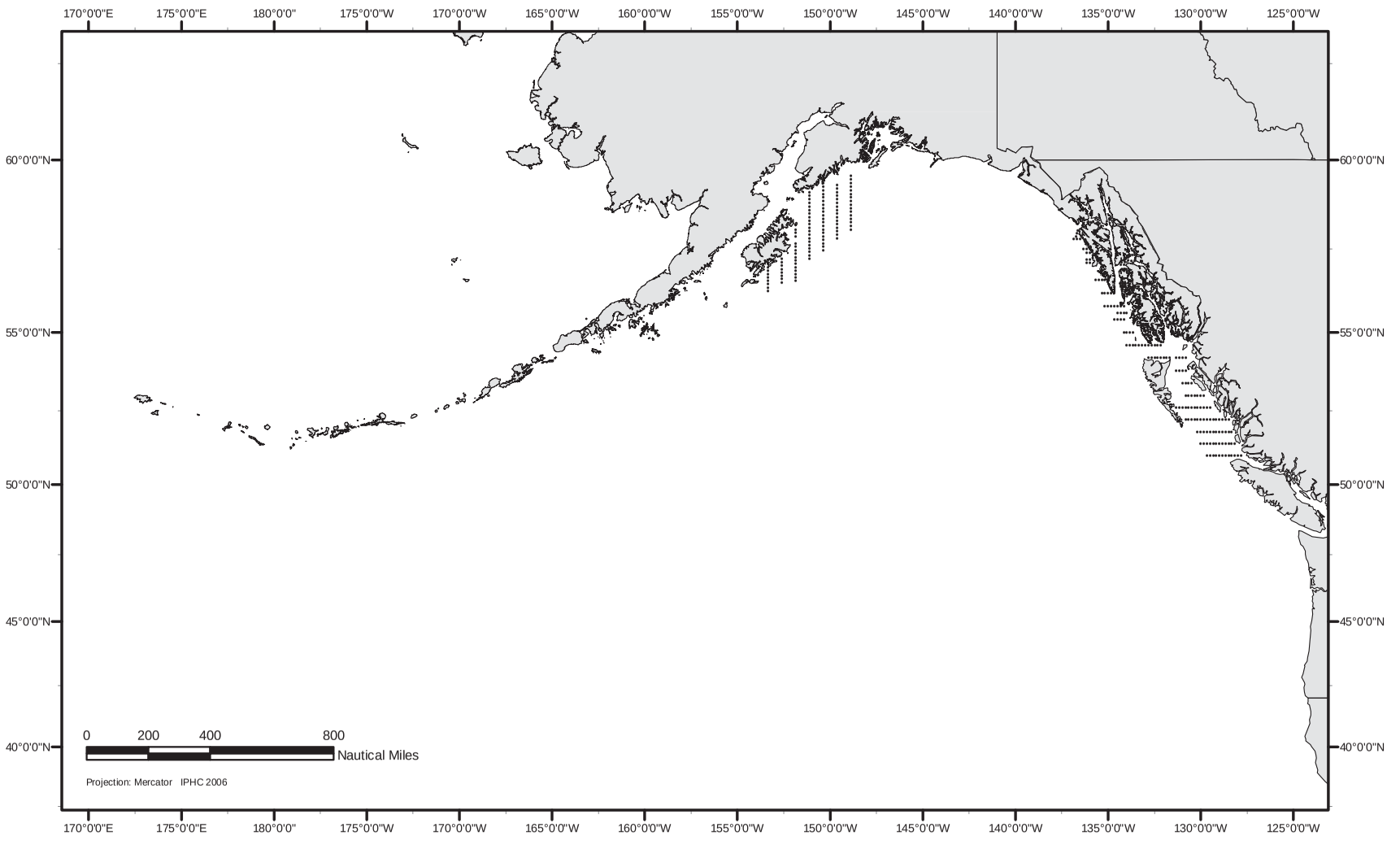
Appendix Figure 10. 1980 Standardized Grid Survey.



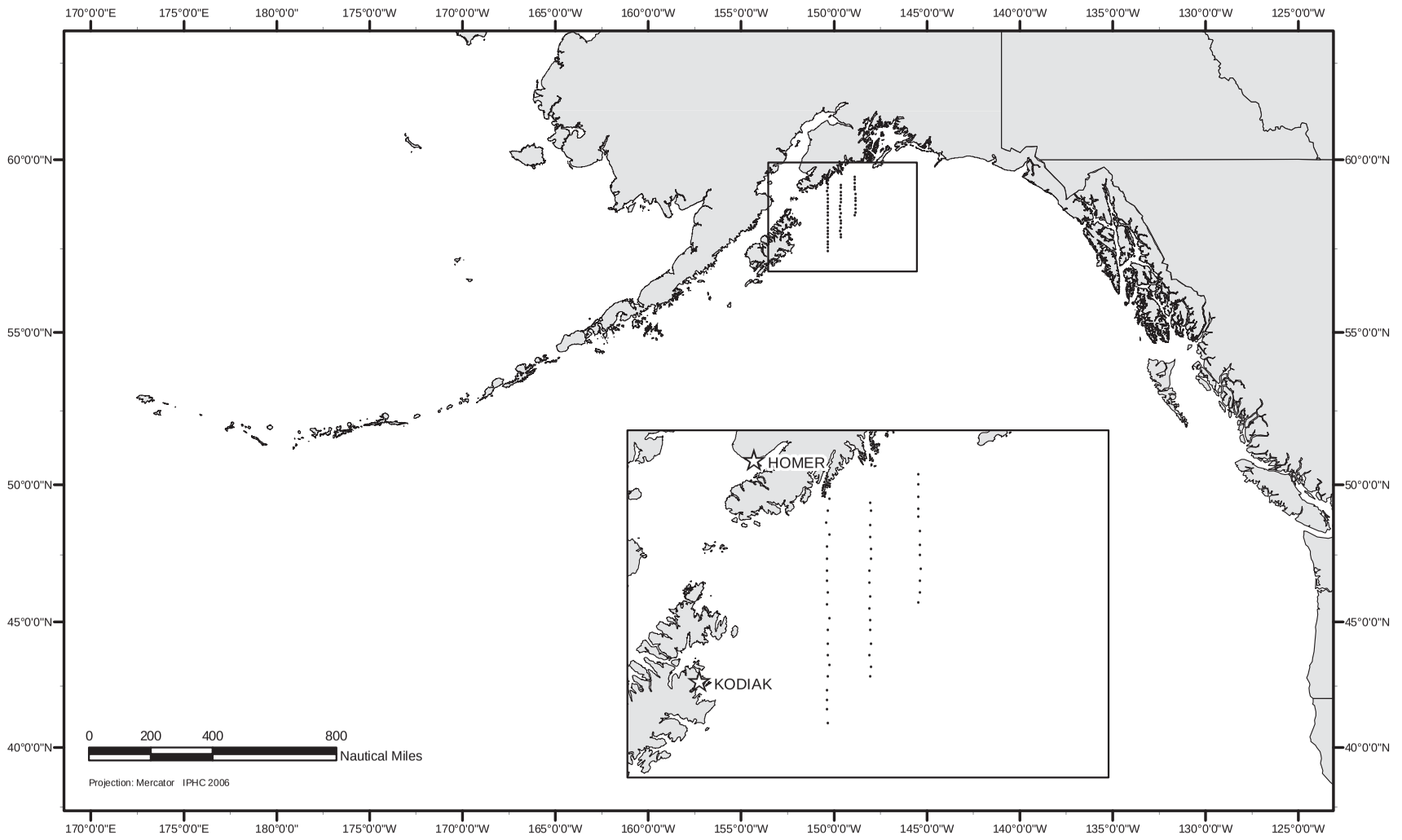
Appendix Figure 11. 1981 Standardized Grid Survey.



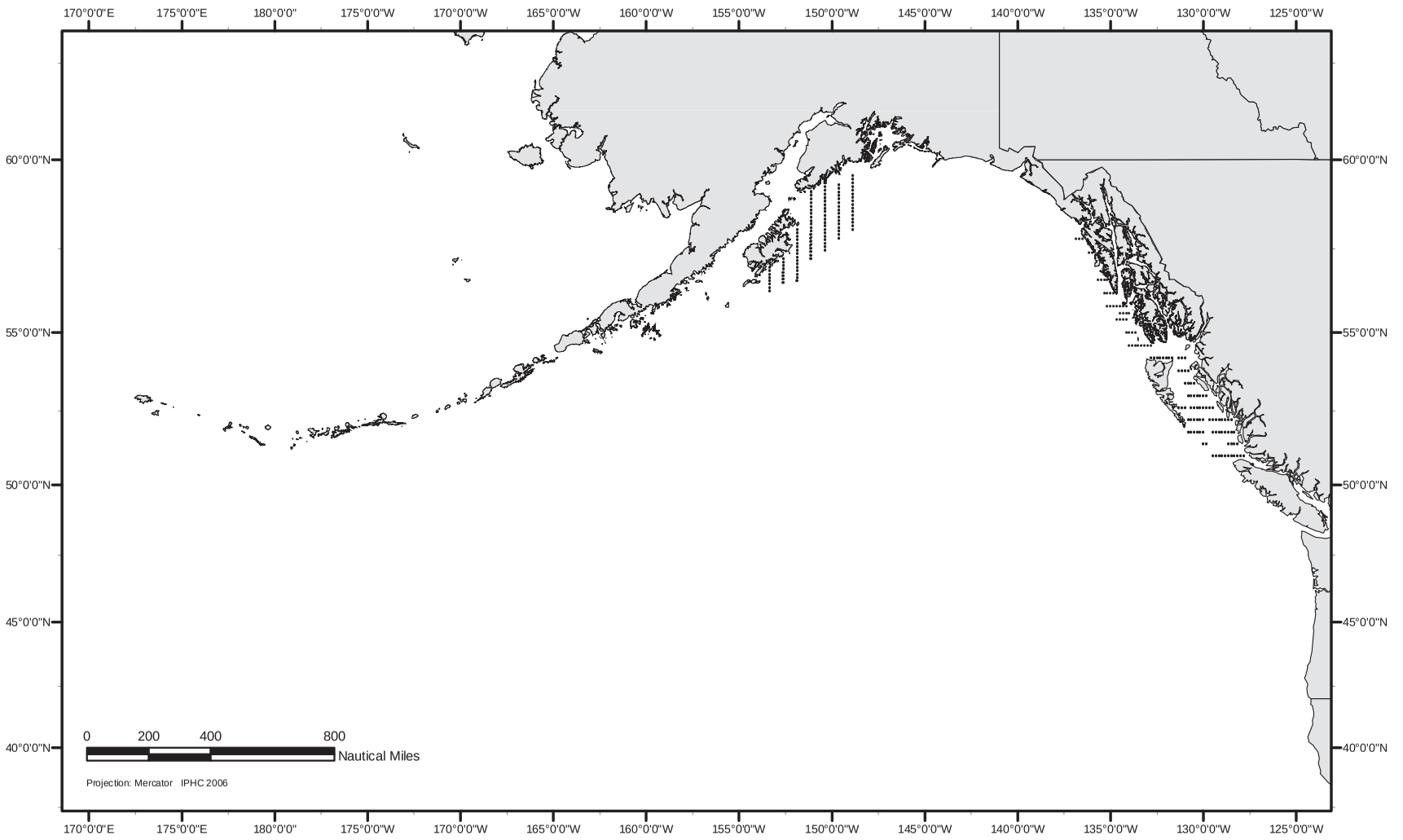
Appendix Figure 12. 1982 Standardized Grid Survey.



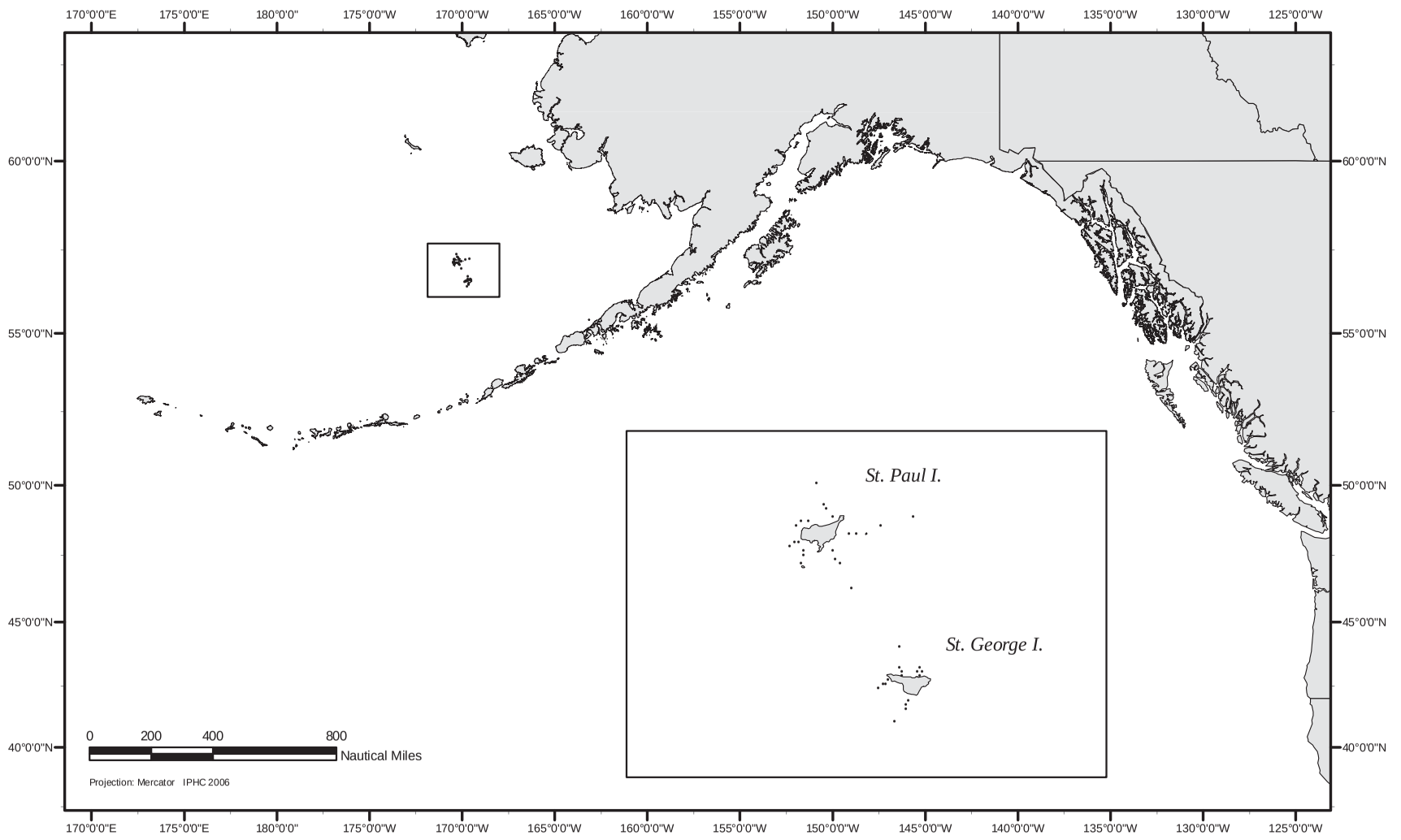
Appendix Figure 13. 1983 Standardized Grid Survey.



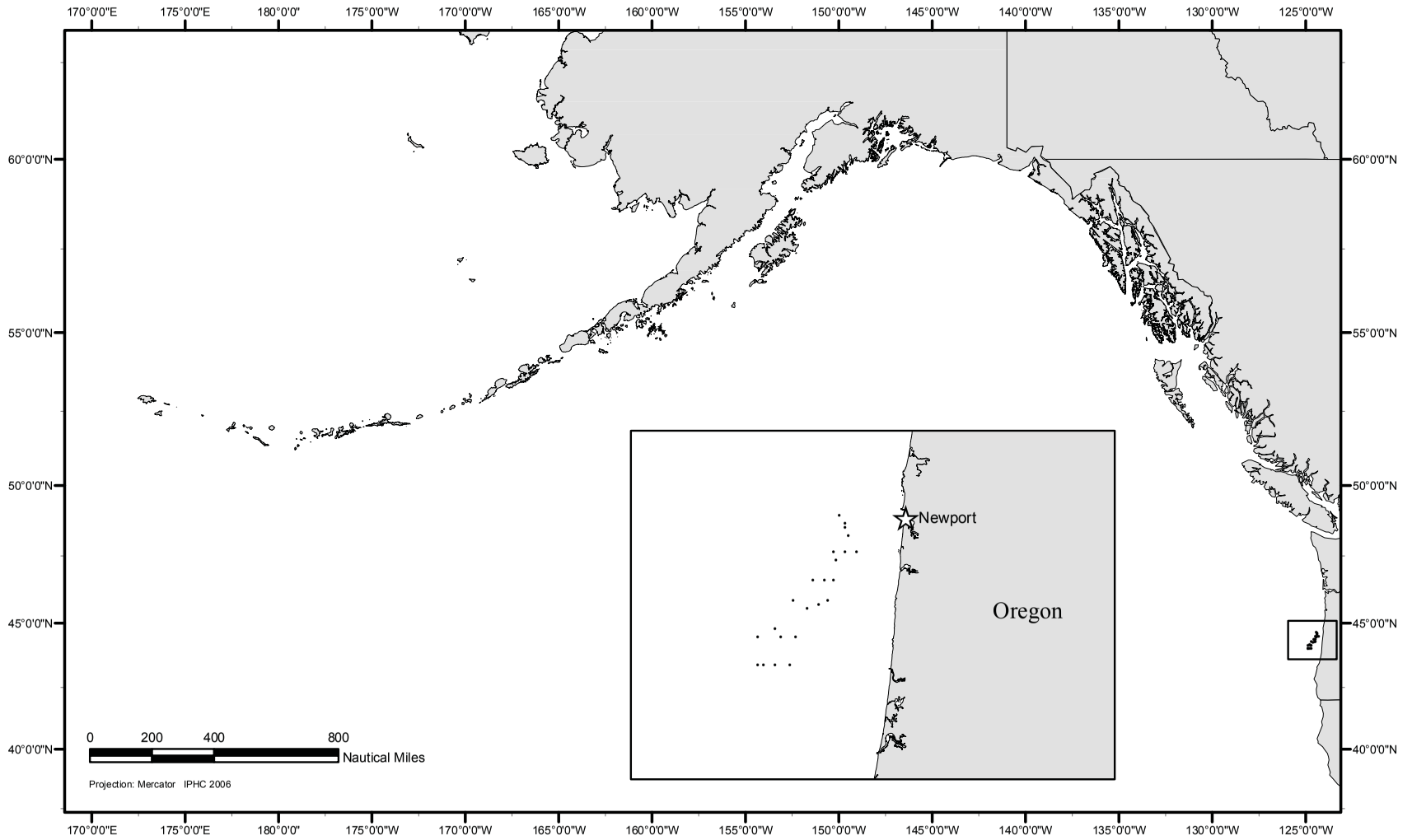
Appendix Figure 14. 1983 Snap-gear fixed-gear comparison spot survey.



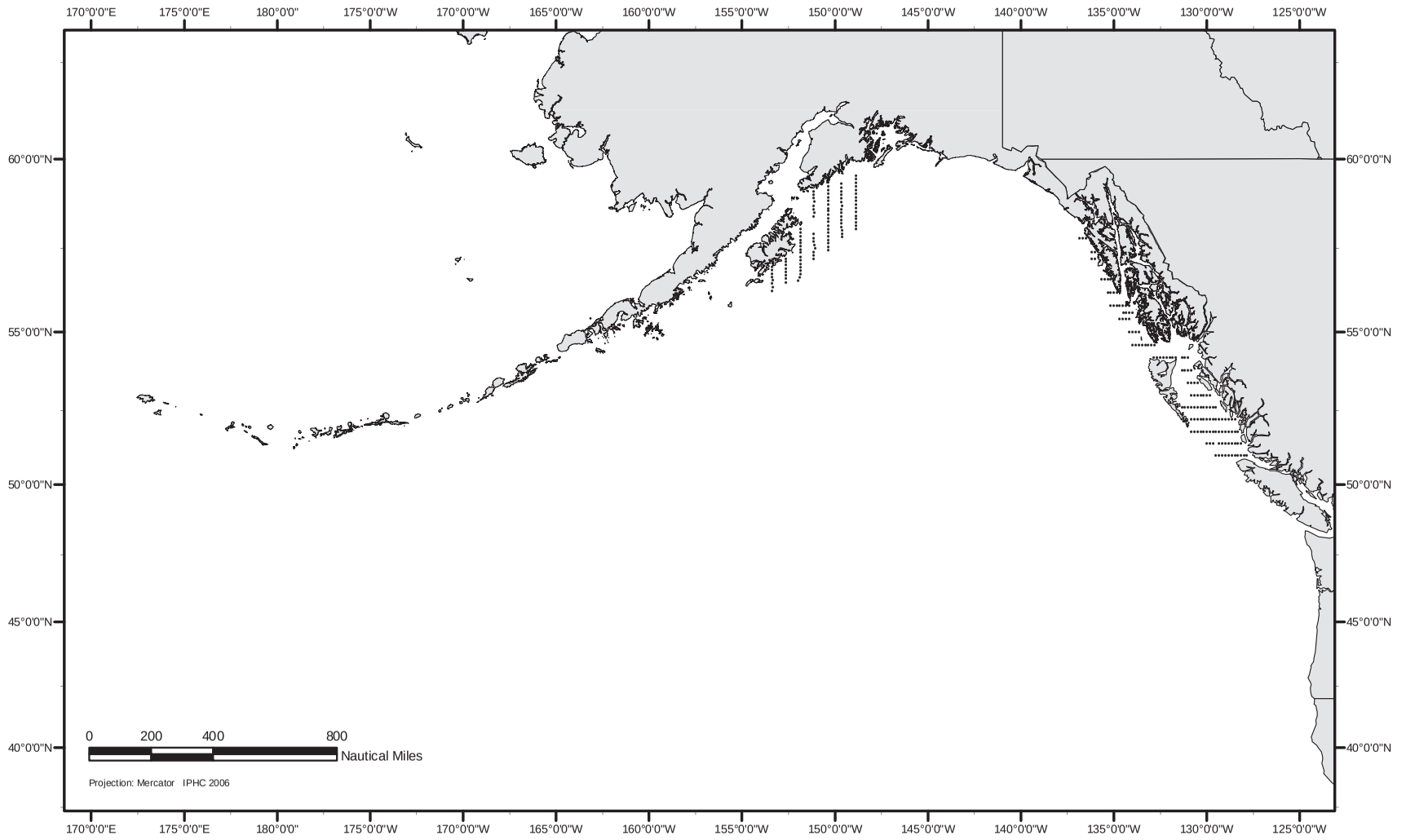
Appendix Figure 15. 1984 Circle-hook J-hook comparison Standardized Grid Survey.



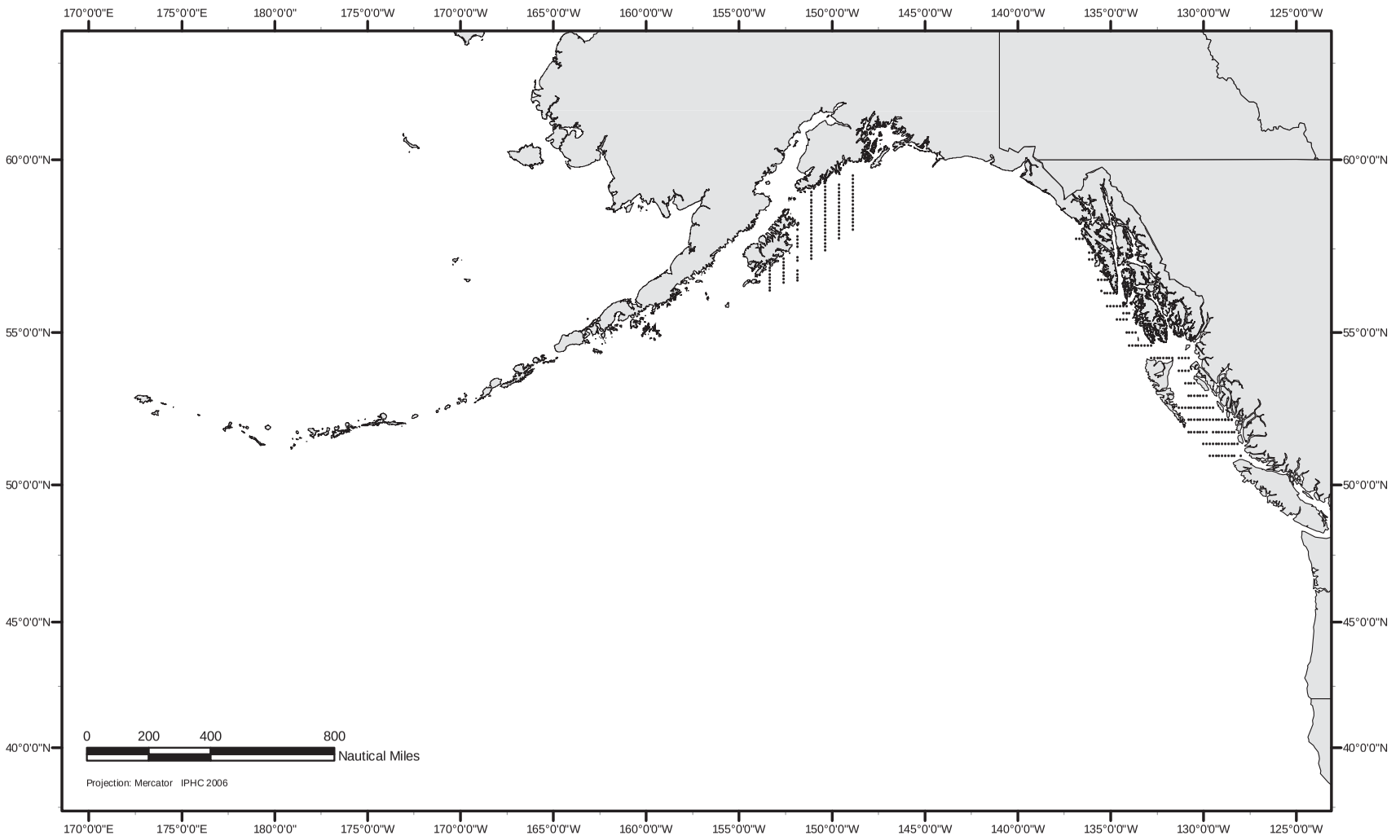
Appendix Figure 16. 1984 Pribilof Island Stratified Survey.



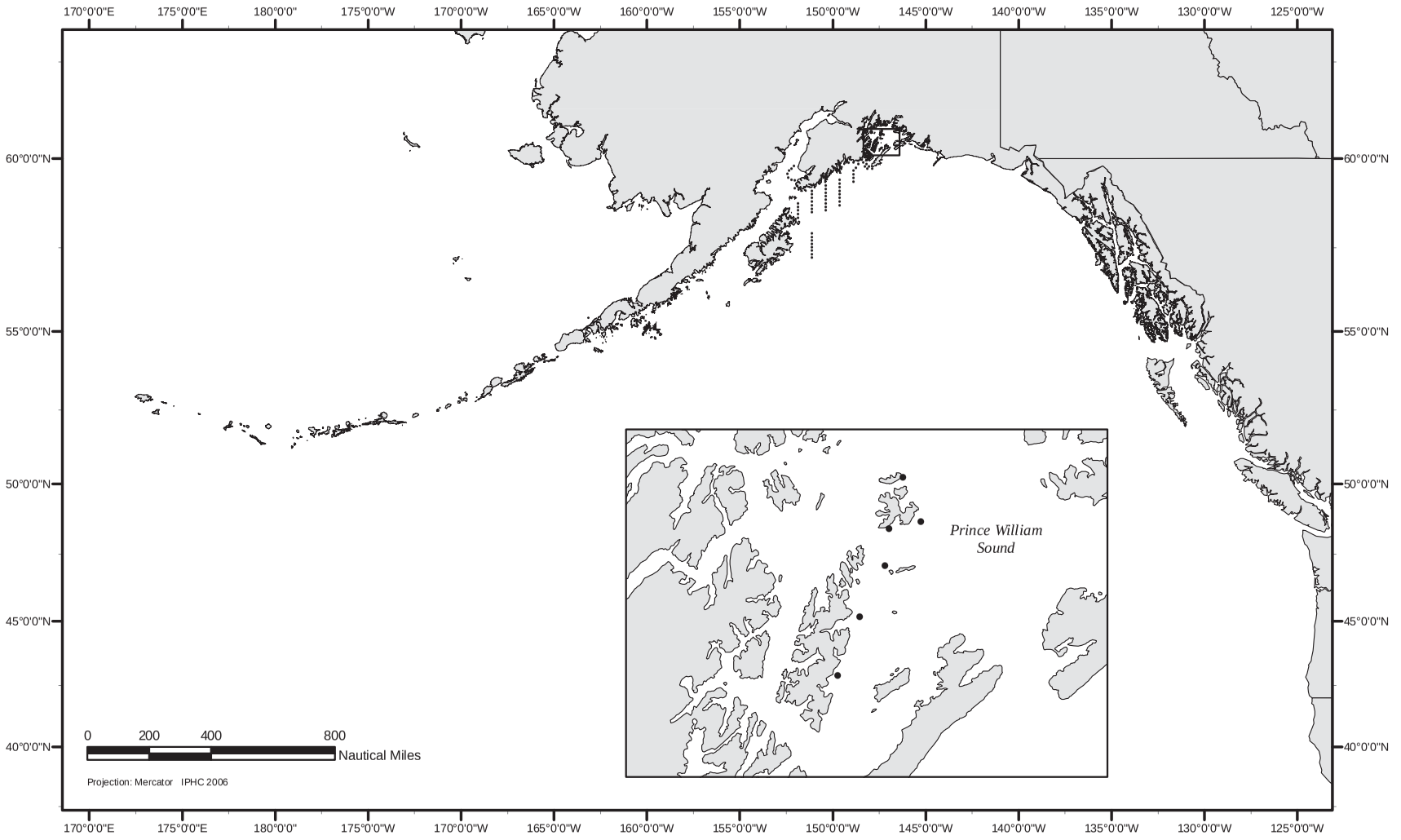
Appendix Figure 17. 1985 Oregon Coast Grid Survey.



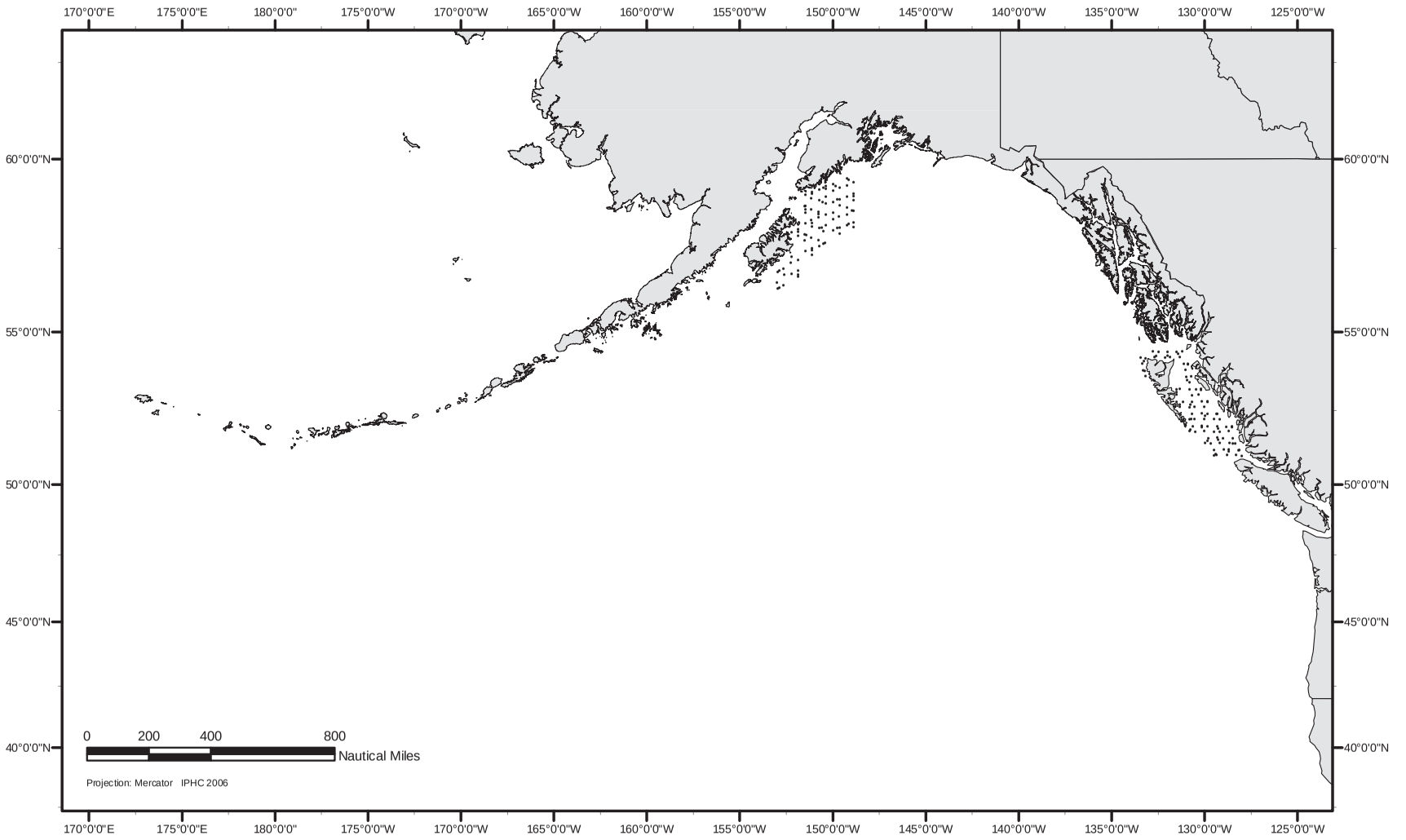
Appendix Figure 18. 1985 Standardized Grid Survey.



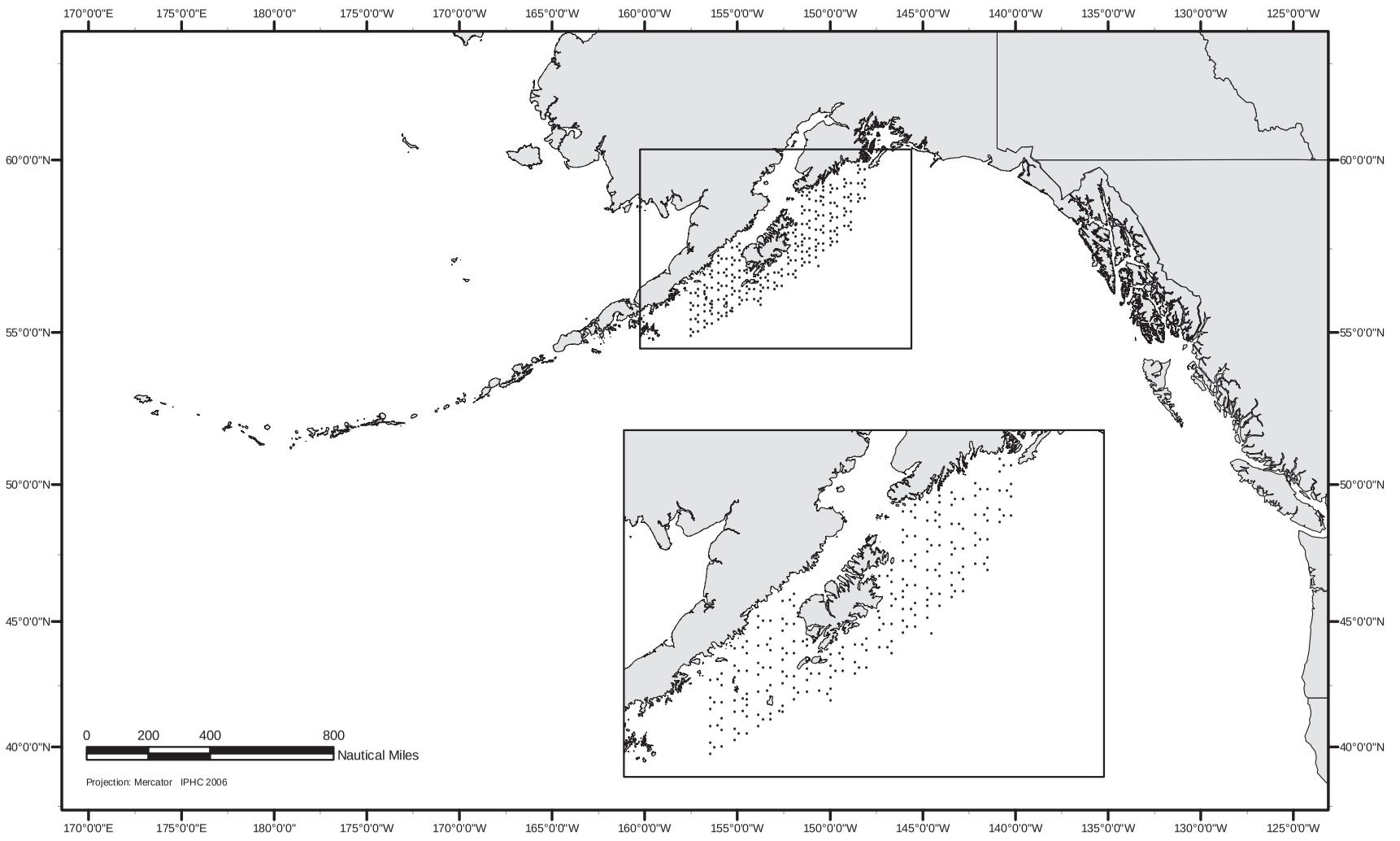
Appendix Figure 19. 1986 Standardized Grid Survey.



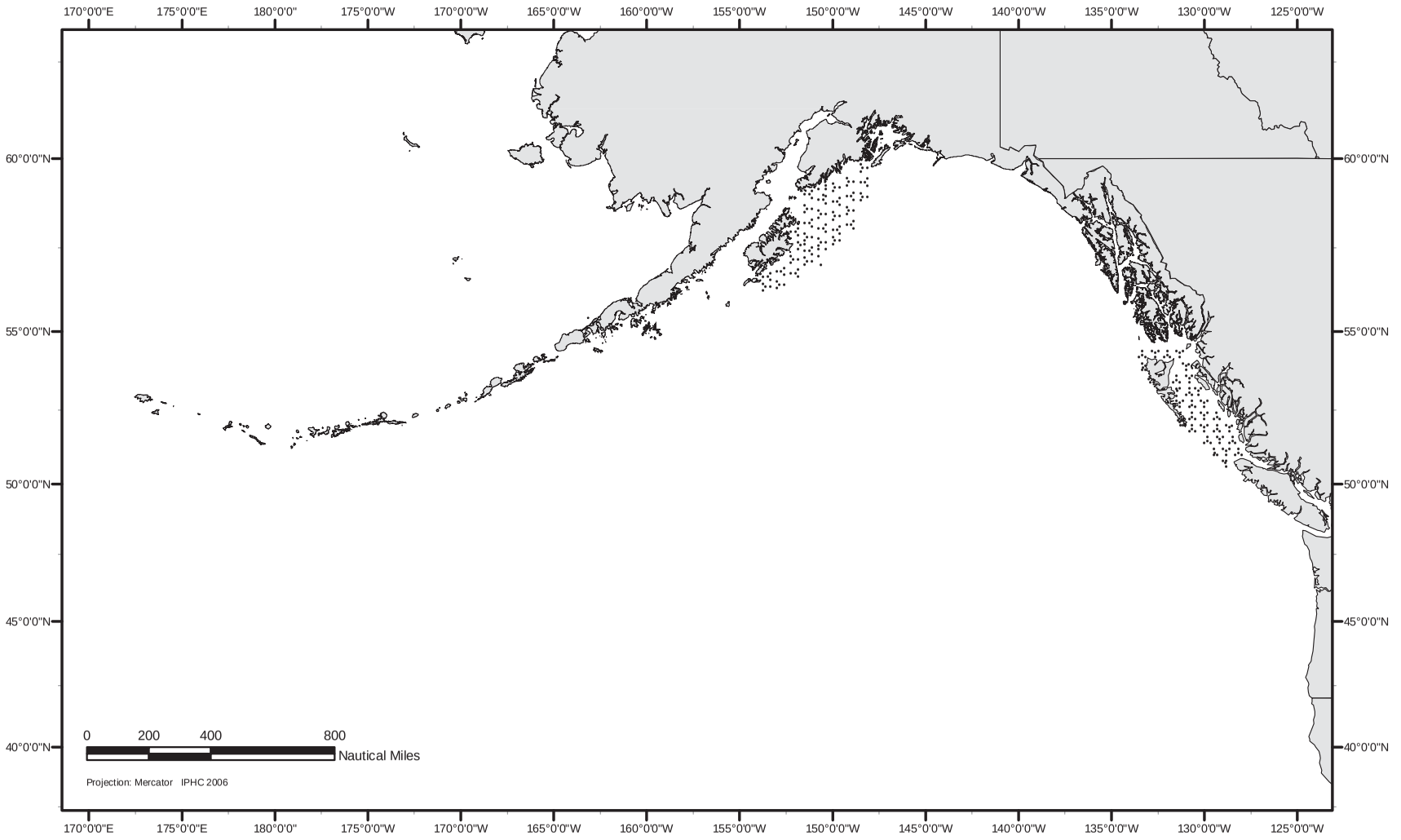
Appendix Figure 20. 1989 Exxon Valdez Oil Spill Study.



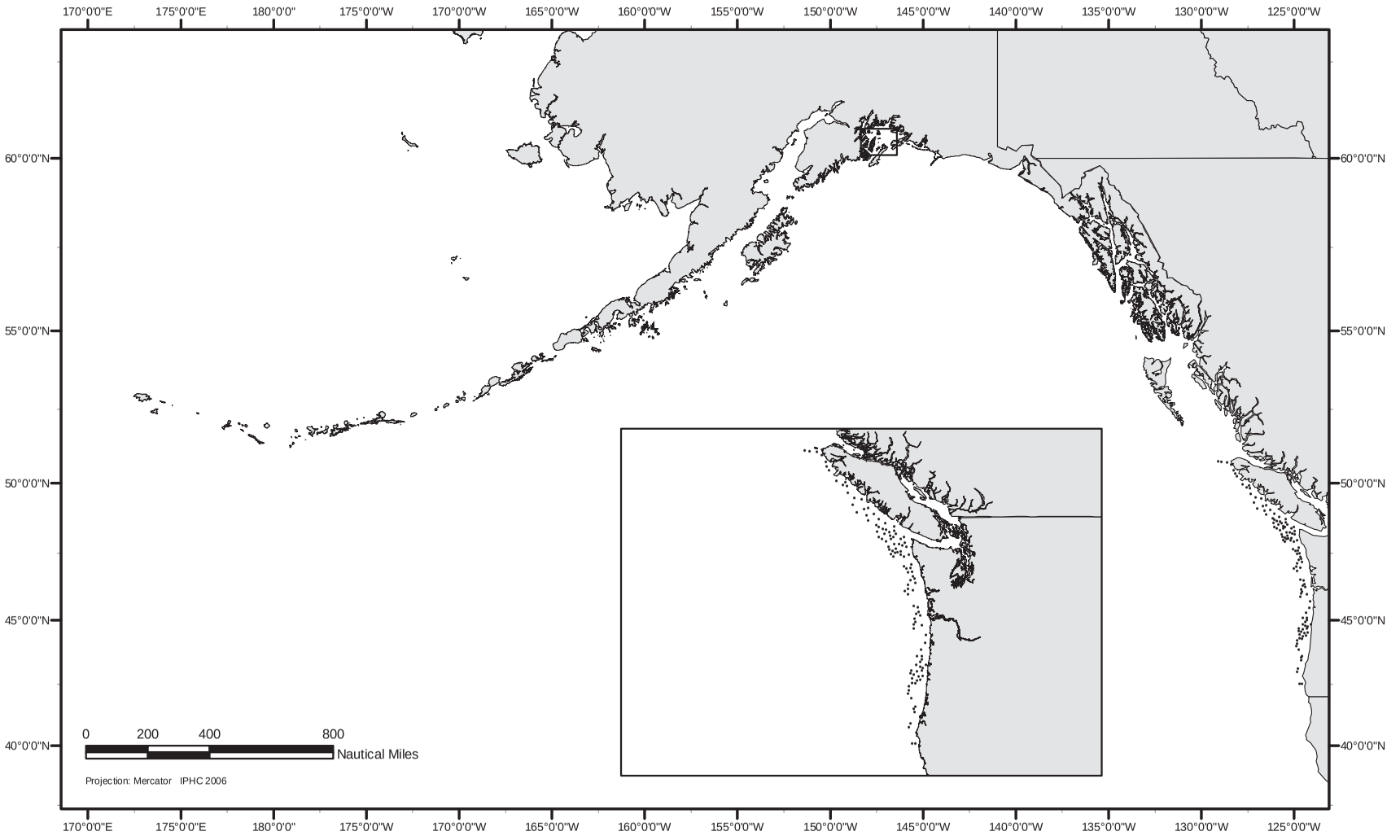
Appendix Figure 21. 1993 Standardized Grid Survey.



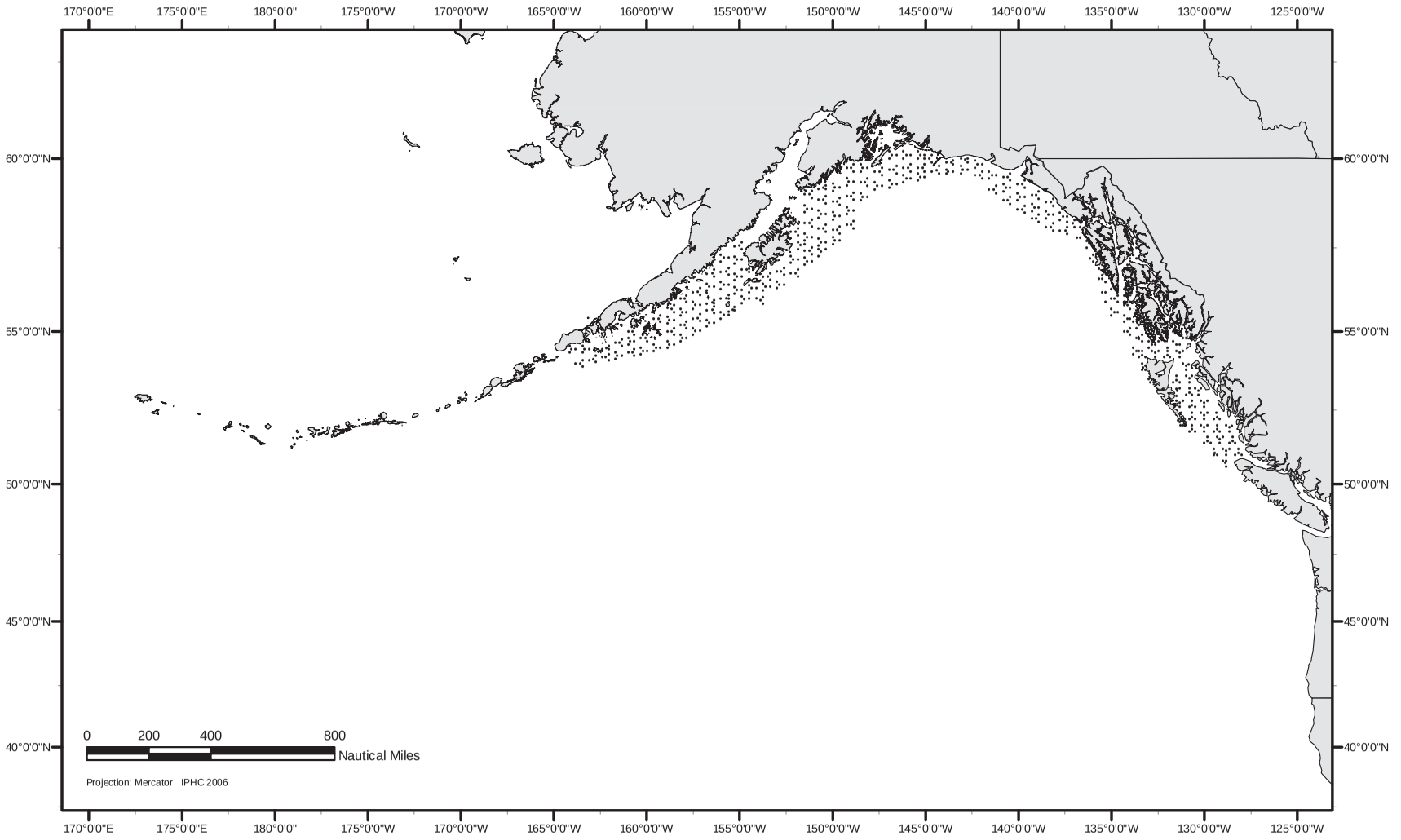
Appendix Figure 22. 1994 Standardized Grid Survey.



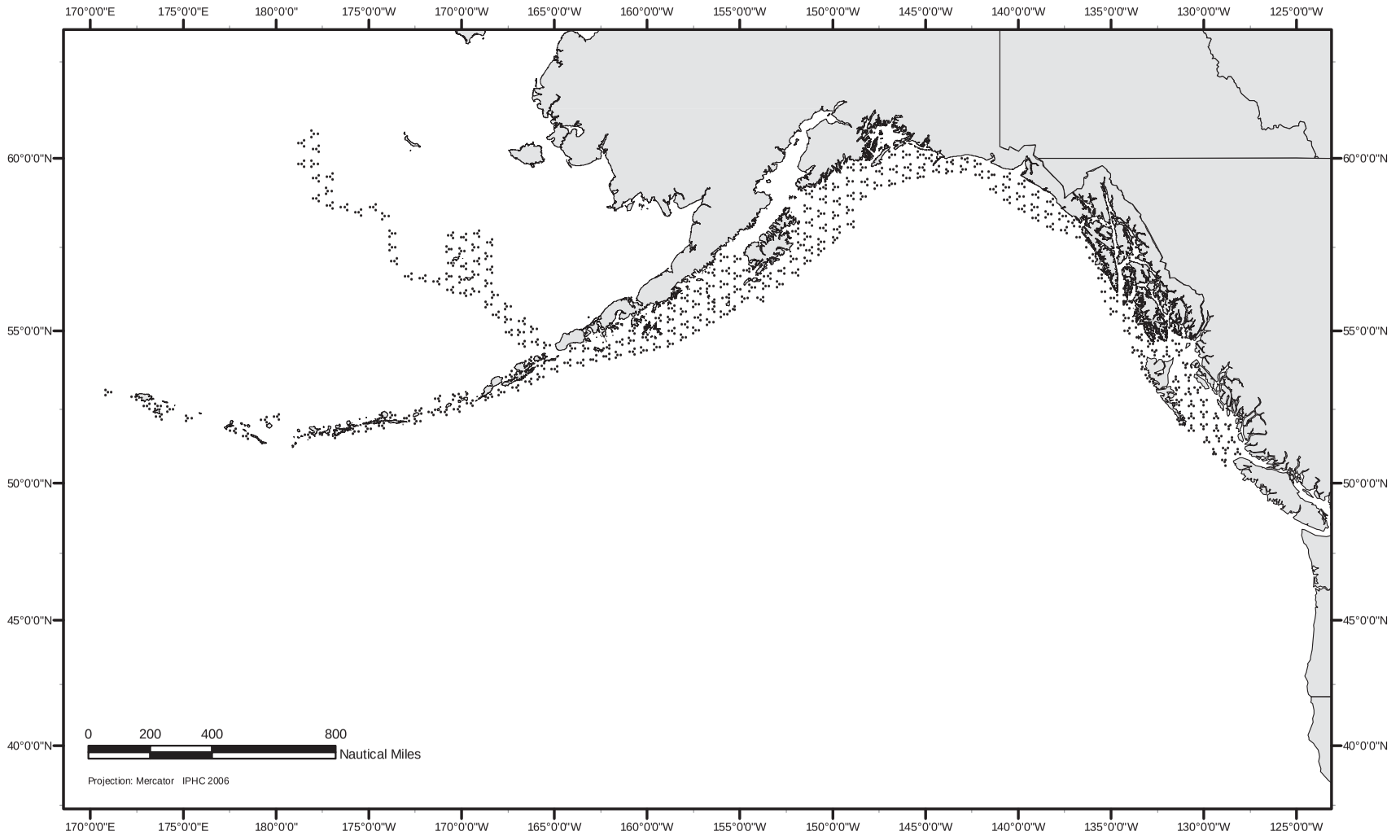
Appendix Figure 23. 1995 Standardized Grid Survey.



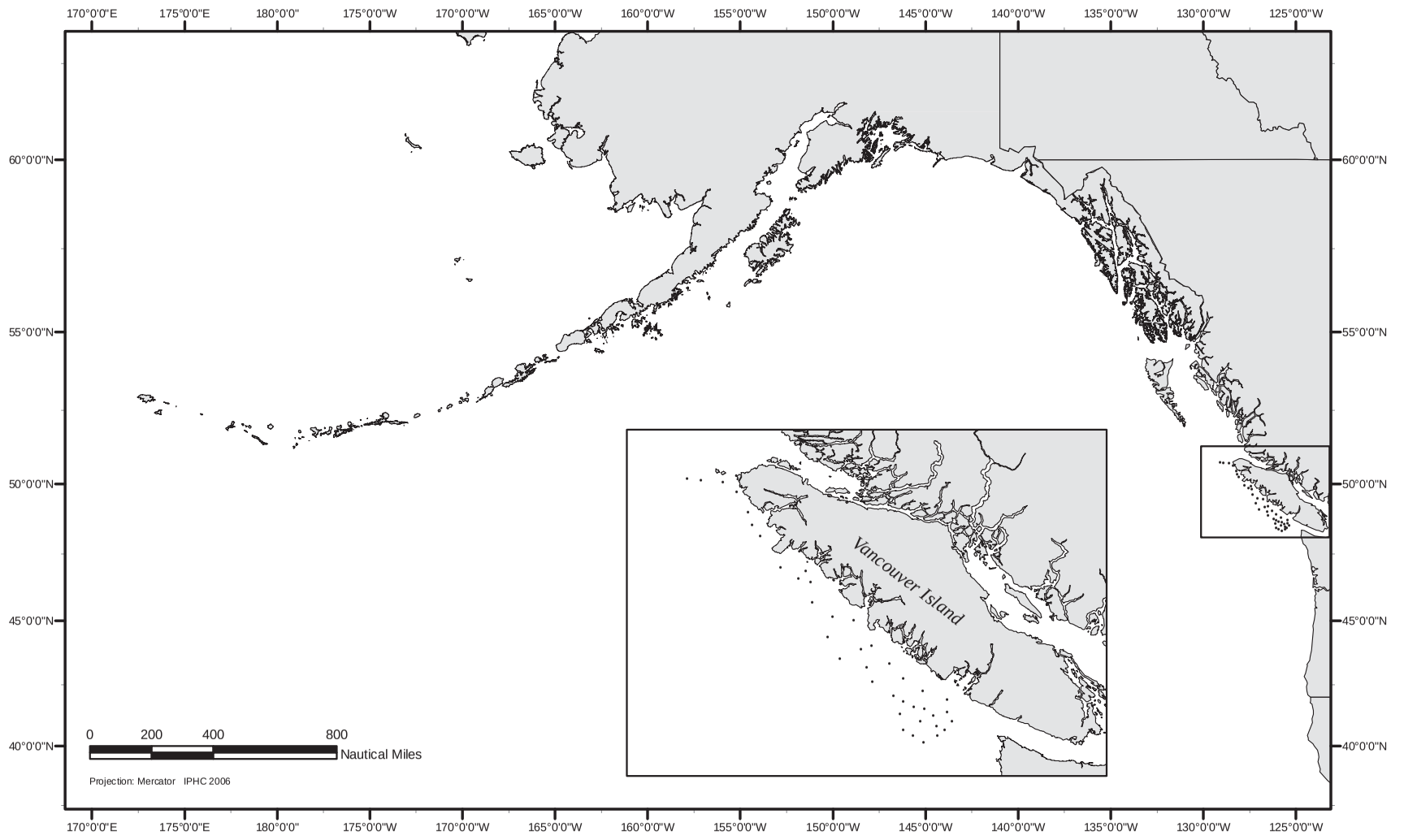
Appendix Figure 24. 1995 Random Stratified Survey.



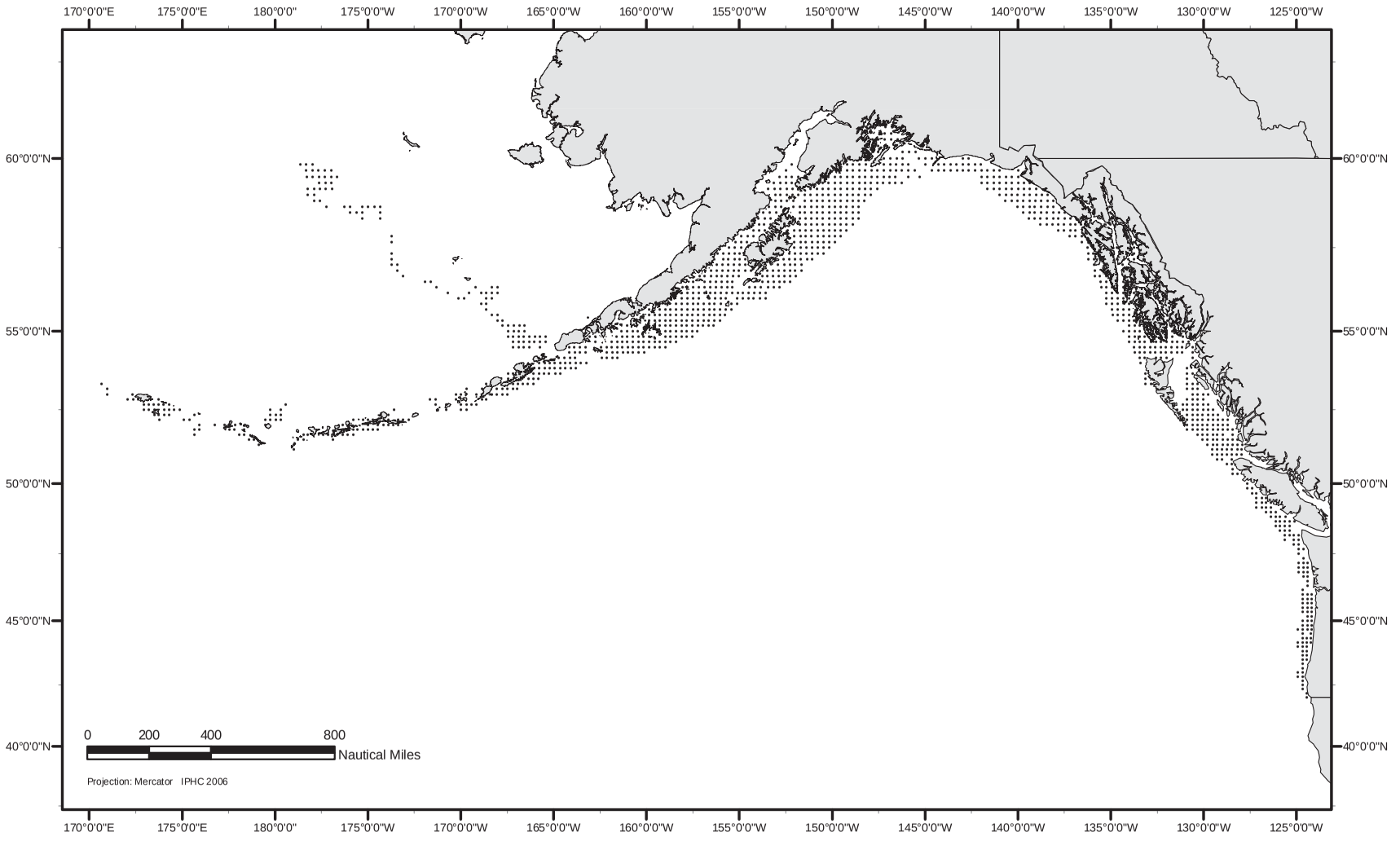
Appendix Figure 25. 1996 Standardized Grid Survey.



Appendix Figure 26. 1997 Standardized Grid Survey.



Appendix Figure 27. 1997 Random Stratified Survey.



Appendix Figure 28. 1998 – 2003 Standardized Grid Survey.

Appendix II. Summary of set numbers by year, project, and vessels

Year	Vessel	Project	Set Numbers
1963	*Eclipse*	3A Standardized Grid Survey	1-259
1963	*Arthur H*	Area 4 Setline/Trawl Grid Survey	1-59
1963-64	*Seattle*	3B, 4A Winter Spot Survey	1-77 (1963), 1-81 (1964)
1964	*Eclipse*	3A, 3B Standardized Grid Survey	1-312
1964	*Pacific*	Area 4 Spot Survey	1-3 and 15-157
1964	*Eclipse*	3B, Area 4 Spot Survey	313-369
1964	*Pacific*	4A Parallel Fishing Survey	4-14
1965	*Chelsea*	3B, 4A Standardized Grid Survey	1-188
1965	*Christian S*	2B Standardized Grid Survey	1-142
1965	*Chelsea*	Area 4 Spot Survey	189-246
1965	*Tordenskjold*	Area 4 Setline/Trawl Grid Survey	1-41
1966	*Chelsea*	2B Setline/Trawl Comp. Spot Survey	1-62
1966	*Chelsea*	2B Standardized Grid Survey	63-95, 100-124, 126, 132, 134-142, 144-159
1966	*Chelsea*	2B Grid Survey “free” sets	96-99, 125, 128-131, 133, 143
1966	*Chelsea*	2B Spot Survey	160-221
1966	*Chelsea*	2B Gear Comp. Spot Survey	222-289
1966	*Chelsea*	2A Spot Survey	290-337
1967	*Chelsea*	Area 4 Spot Survey	1-214
1971	*Chelsea*	3A Hook Spacing Spot Survey	1-155
1972	*Alaska Queen II*	2A Hook Spacing Spot Survey	1-60
1972	*Cape Beal*	2B Hook Spacing Spot Survey	1-83
1972	*Republic*	3B, 4A Hook Spacing Spot Survey	1-80
1972	*Seapak*	2B Hook Spacing Spot Survey	1-105
1973	*Republic*	2B Hook Spacing Spot Survey	1-72
1973	*Universe*	2B, 3A Spot Survey	1-57
1975	*Seymour*	3A, 4 Spot/Grid Survey	831 skates, sets undetermined
1976	*Polaris*	4A, Closed Area Spot Survey	1-58
1976	*Polaris*	3A Standardized Grid Survey	59-82 (numbered 1-24 in the database)
1976	*Seymour*	2B Standardized Grid Survey	1-82
1977	*Chelsea*	2B Standardized Grid Survey	1-51
1977	*Evening Star*	2B Standardized Grid Survey	1-50
1977	*Polaris*	3A Standardized Grid Survey	1-52
1977	*Resolute*	3A Standardized Grid Survey	1-52
1978	*Chelsea*	2A Bait Loss Survey	1-4
1978	*Chelsea*	2B Standardized Grid Survey	1-102
1978	*Vansee*	3A Standardized Grid Survey	1-104
1979	*Seymour*	2C Spawning Ground Spot Survey	1-54
1979	*Chelsea*	3A Standardized Grid Survey	1-104
1980	*Elling K*	2B Standardized Grid Survey	1-104
1980	*Seymour*	3A Standardized Grid Survey	1-104
1980	*Evening Star*	3B Stock Assessment Spot Survey	1-159
1980	*Republic*	3B Stock Assessment Spot Survey	1-109
1980-81	*Proud Canadian*	2B Spawning Ground Spot Survey	1-67

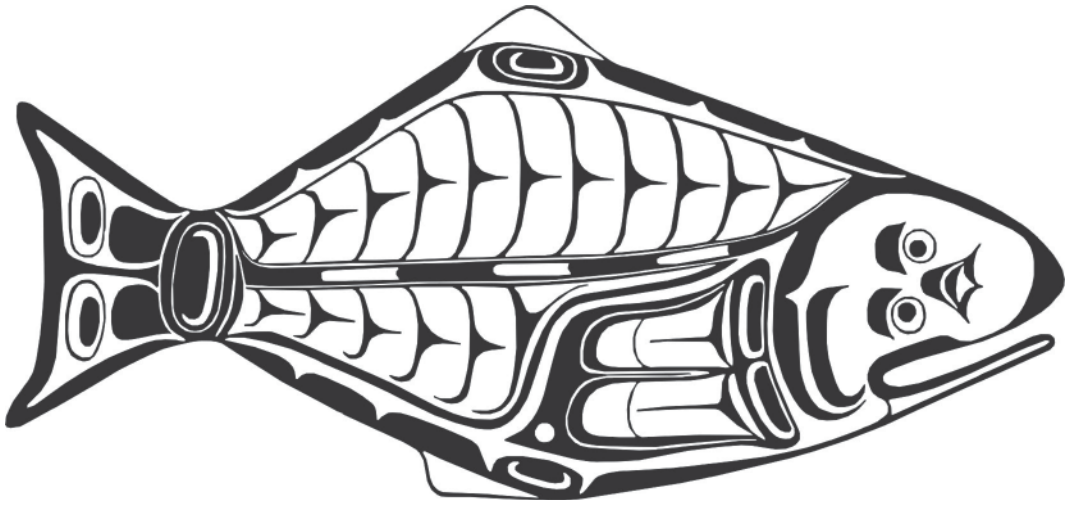
1980-81	*Seymour*	2C Spawning Ground Spot Survey	1-88
1981	*Evening Star*	3A Standardized Grid Survey	1-102
1981	*Proud Canadian*	2B Standardized Grid Survey	1-102
1981-82	*Quest*	3A Spawning Ground Spot Survey	1-220
1981-82	*Star Wars II*	2B Spawning Ground Spot Survey	1-99
1982	*Proud Canadian*	2B Catchability Spot Survey	1-37
1982	*Kristine*	2C Standardized Grid Survey	Outside waters: 1-46, Inside waters: 47-95
1982	*Proud Canadian*	2B Standardized Grid Survey	Grid survey: 38-131, OTC sets: 132-143
1982	*Thor*	3A Standardized Grid Survey	1-153
1982	*Daily*	2C Snap/Fixed Gear Comp. Survey	1-41
1982	*Valorous*	3B Snap/Fixed Gear Comp. Survey	1-55
1982	*Thor*	3A Submarine Observation Survey	1 set between grid sets 55 and 56
1982	*Tiffy*	3A Submarine Observation Survey	Unknown
1983	*Evening Star*	2B Standardized Grid Survey	1-47
1983	*Masonic*	3A Standardized Grid Survey	1-103
1983	*Polaris*	2C Standardized Grid Survey	Inside: 1-76, 130-134, Outside: 77-129
1983	*Windward Isle*	2B Standardized Grid Survey	1-43
1983	*Lorelei II*	3A, 2B Catchability Spot Survey	1-79
1983	*China B*	2C Submarine Obs./Hook Type Survey	Unknown
1983	*Windward Isle*	3A Circle/J-hook Comp. Spot Survey	44-87
1983	*Valorous*	3A Snap/Fixed hook Comp Grid Survey	1-48
1984	*Chelsea*	2C, 3A Circle/J-hook Std. Grid Survey	2C inside: 1-53, Grid: 54-197
1984	*Seymour*	3A Circle/J-hook Std. Grid Survey	1-104
1984	*Star Wars II*	2B Circle/J-hook Std. Grid Survey	1-74
1984	*Windward Isle*	2B Circle/J-hook Std. Grid Survey	Survey: 1-90, Extra sets to clean gear: 91-94
1984	*Valorous*	4C Pribilof Islands Stratified Survey	1-37
1984	*Pac. Harvester*	2B Trawl/Setline Hook Sz Spot Survey	1-12
1985	*Blue Harvest*	2A Oregon Coast Grid Survey	1-23
1985	*Cape Flattery*	2B, 2C Standardized Grid Survey	Grid: 1-7, 38-48, 73-107, 2C inside: 8-37, 49-72
1985	*Chelsea*	3A Standardized Grid Survey	1-93, 152-158
1985	*Star Wars II*	2B Standardized Grid Survey	1-80
1985	*Chelsea*	Hook Spacing/Depletion Spot Survey	98-151
1985	*Star Wars II*	Hook Spacing/Depletion Spot Survey	81-134
1986	*Cape Flattery*	2C, 3A Standardized Grid Survey	Grid: 15-18, 24-53, 87-192, 2C inside: 1-14, 19-23, 54-86, 94-192
1986	*Snowfall*	2B Standardized Grid Survey	1-59
1986	*Windward Isle*	2B Standardized Grid Survey	1-35
1986	*Moriah*	3A Hook Stripper Mortality Spot Survey	1-9
1987	*Cape Flattery*	2B Depletion Spot Survey	Prospecting: 1-5, 38-40, 53-58, 71-75 Survey: 6-37, 41-52, 59-70
1987	*Cape Flattery*	3A Hook Spacing Spot Survey	Prospecting: 76-81, Survey: 82-117
1987	*Snowfall*	2B Catchability Spot Survey	1-54
1987	*Coral*	4E Near Shore Bristol Bay Spot Survey	1-10
1987	*Erika C*	4E Near Shore Bristol Bay Spot Survey	1-17
1987	*Valorous*	4E Near Shore Bristol Bay Spot Survey	1-44

1987	*Polaris*	3A Observer Trip	1-27
1988	*Snowfall*	2B Depletion/Tagging Survey	1-66
1988	*Cape Flattery*	2B Depletion/Tagging Survey	Survey: 1-42, Fish Collection: 43-45
1988	*Cape Flattery*	3A Gear Comparison Spot Survey	Prospecting: 46-49, 62-65 Survey: 50-61, 66-77
1988	*Polaris*	3A, 3B Otolith Collection Spot Survey	Survey: 1-9, Extra: 10-13, Film: 14-16
1989	*Chelsea*	3A, 3B Otolith Collection Spot Survey	1-38
1989	*Ocean Viking*	2B, 2C Otolith Collection Spot Survey	1-57
1989	*Ocean Viking*	2B Hook Timer Pilot Spot Survey	58-64
1989	*Donna*	2A Coded Wire Pilot Spot Survey	1-78
1989	*Royal Quarry*	3A Oil Spill Spot/Grid Survey	Grid: 1-31, 36-39, 61-65, Spot: 32-35, 40-60
1990	*Clipper II*	2B Underwater Video Spot Survey	1-9
1990	*Golden Dolphin*	2A Underwater Video Spot Survey	1-6
1990	*Ocean Viking*	2B, 2C Hook Timer Spot Survey	1-43
1991	*Clipper II*	2B Underwater Video Spot Survey	1-59
1991	*Big Valley*	3A Hook Timer Spot Survey	1-14
1991	*Ocean Viking*	2B Hook Timer Spot Survey	1-45
1991	*Trekkor II*	2A Hook Timer Spot Survey	1-4
1991	*Ocean Viking*	2A Live Halibut Collection Spot Survey	46
1992	*Kaare*	Area 3 and 4 Oto. Collect. Spot Survey	1-135
1993	*Cape Flattery*	3A Standardized Grid Survey	1-91
1993	*Kristiana*	2B Standardized Grid Survey	1-101
1993	*Rebecca B*	3A, 3B Setline Mort. Pilot Spot Survey	Autoline: 1-10, 12-14, 16-19, 23 Conventional: 11, 15, 19-22, Special: 24
1994	*Kristiana*	3A, 3B Standardized Grid Survey	1-91
1994	*Thor*	3A Standardized Grid Survey	1-119
1994	*Coolidge*	2A West Coast Pilot Survey	Grid: 1-3, 5-12, 14-17, 19-21 Spot: 4, 13, 18, 22-24
1994	*Rebecca B*	3A Setline Mortality Tag Spot Survey	1-60
1994	*Clipper II*	2B Video and Hook Timer Spot Survey	1-45
1994	*Ocean Viking*	2B Video and Hook Timer Spot Survey	1-32
1995	*Kilkenny*	3A Standardized Grid Survey	1-128
1995	*Kristiana*	2B Standardized Grid Survey	1-120
1995	*Risky Business*	2A, 2B Random Stratified Survey	1-117
1996	*Cape Ball*	2B Standardized Grid Survey	1-121
1996	*Cape Devon*	3A Standardized Grid Survey	1-103
1996	*Kilkenny*	3A, 3B Standardized Grid Survey	1-35
1996	*Kristiana*	3B Standardized Grid Survey	1-100
1996	*Kristina*	3A Standardized Grid Survey	1-68
1996	*Lualda*	3A, 3B Standardized Grid Survey	1-116
1996	*Norska*	3A Standardized Grid Survey	1-43 (69-111 in database)
1996	*Ocean Viking*	2C Standardized Grid Survey	1-97
1997	*Aleutian*	3A Standardized Grid Survey	1-56
1997	*Bold Pursuit*	2B Standardized Grid Survey	1-60
1997	*Cape Ball*	2B Standardized Grid Survey	1-60
1997	*Cape Cross*	3B Standardized Grid Survey	1-62
1997	*Dorothy Jean*	2C Standardized Grid Survey	1-45

1997	*Elizabeth F*	3B Standardized Grid Survey	1-116
1997	*Heritage*	4D Standardized Grid Survey	1-90
1997	*Judi B*	3A, 4B Standardized Grid Survey	1-108
1997	*Kristiana*	3A Standardized Grid Survey	1-84
1997	*Lualda*	3A Standardized Grid Survey	1-56
1997	*Northern Prince*	4A Standardized Grid Survey	1-60
1997	*Norska*	4A, 4C Standardized Grid Survey	1-169
1997	*Ocean Viking*	2C Standardized Grid Survey	1-52
1997	*Risky Business*	2B Random Stratified Survey	1-39
1997	*Anita M*	2A Random Stratified Survey	1-79
1998	*Angela Lynn*	3A, 4A Standardized Grid Survey	1-46, 1-157
1998	*Bold Pursuit*	2C, 3A Standardized Grid Survey	1-143
1998	*Defiant*	3A, 3B Standardized Grid Survey	1-97
1998	*Elizabeth F*	3B Standardized Grid Survey	1-45
1998	*Kristina*	3B Standardized Grid Survey	1-94
1998	*Lualda*	3A Standardized Grid Survey	1-48
1998	*Ocean Viking*	2C Standardized Grid Survey	1-7, 9-12, 17, 30-45, 81-92
1998	*Pacific Sun*	4A Standardized Grid Survey	1-66
1998	*Sand Island*	4B Standardized Grid Survey	1-31
1998	*Taasinge*	3B Standardized Grid Survey	1-45
1998	*Tradition*	3A Standardized Grid Survey	1-90
1998	*Tyanaa*	2C Standardized Grid Survey	1-42
1998	*Venturous*	2B Standardized Grid Survey	1-44, 53-90
1998	*Western Sunrise*	2B Standardized Grid Survey	161-206
1998	*Zenith*	4B Standardized Grid Survey	1-42, 55-99
1998	*Angela Lynn*	3A, 3B Miscellaneous Bait/Gear Survey	47-156, 202-239
1998	Bold Pursuit	2C Miscellaneous Bait/Gear Survey	144-231
1998	Lualda	3A Miscellaneous Bait/Gear Survey	49-106
1998	Ocean Viking	2C Miscellaneous Bait/Gear Survey	Survey: 13-16, 18-29, 46-80, 93-246 Test Set: 8
1998	*Sand Island*	3A, 4B Miscellaneous Bait/Gear Survey	32-96
1998	Tradition	3A Miscellaneous Bait/Gear Survey	91-124
1998	*Tyanaa*	2B Miscellaneous Bait/Gear Survey	43-96
1998	*Venturous*	2B Miscellaneous Bait/Gear Survey	45-52
1998	Western Sunrise	2B Miscellaneous Bait/Gear Survey	1-160, 207-323
1998	*Zenith*	3B Miscellaneous Bait/Gear Survey	43-54
1998-99	*Angela Lynn*	2B Bait Size/Type Survey	1-35
1998-99	*Bold Pursuit*	2C Bait Size/Type Survey	Prospecting: 232-251, 1-23, 46, 49, 51 Survey: 24-45, 47-48, 50, 52-97, 232-251
1998-99	*Heritage*	3A Bait Size/Type Survey	(1998): 1-25, (1999): 1-110
1998-99	*Masonic*	3A Bait Size/Type Survey	1-47
1998-99	*Royal Pursuit*	2B Bait Size/Type Survey	(1998): 1-22, (1999) Prospecting: 1-30, 32, 34, 36-37, 40, 45, 48-49, 53, (1999) Survey: 31, 33, 38-39, 41-44, 46-47, 50-52, 54-201
1999	*Angela Lynn*	3B Standardized Grid Survey	36-172
1999	*Blackhawk*	2A Standardized Grid Survey	1-84

1999	*Bold Pursuit*	3A Standardized Grid Survey	163-180, 185-266
1999	*Cape Ball*	2B Standardized Grid Survey	1-44
1999	*Defiant*	3A Standardized Grid Survey	1-47
1999	*Kristiana*	3B Standardized Grid Survey	1-95
1999	*Lualda*	3A Standardized Grid Survey	1-48
1999	*Ocean Viking*	3A Standardized Grid Survey	71-130
1999	*Pacific Sun*	4A Standardized Grid Survey	1-66
1999	*Pender Isle*	2B Standardized Grid Survey	1-126
1999	*Taasinge*	3A Standardized Grid Survey	1-45
1999	*Tradition*	3A Standardized Grid Survey	1-76
1999	*Trident*	4B Standardized Grid Survey	1-88
1999	*Bold Pursuit*	2C Grid Design Survey	98-162, 181-184
1999	*Ocean Viking*	2C Grid Design Survey	1-70
1999	*Tyanaa*	2C Grid Design Survey	1-70
1999	*Angela Lynn*	3A, 3B Chalky Halibut Survey	173-194
1999	*Star Wars II*	2B Chalky Halibut Survey	1-46
2000	*Angela Lynn*	3B Standardized Grid Survey	1-92
2000	*Bold Pursuit*	2C, 3A Standardized Grid Survey	1-142
2000	*Free To Wander*	3A Standardized Grid Survey	126-170
2000	*Heritage*	4A, 4D Standardized Grid Survey	1-97
2000	*Ocean Marauder*	3B Standardized Grid Survey	1-45
2000	*Pacific Sun*	4A Standardized Grid Survey	1-66
2000	*Trident*	4B Standardized Grid Survey	1-90
2000	*Tyanaa*	2C Standardized Grid Survey	1-81
2000	*Viking Spirit*	3A, 3B Standardized Grid Survey	1-139
2000	*Angela Lynn*	3A Bait Comparison Survey	93-160
2000	*Free To Wander*	3A Bait Comparison Survey	30-125
2000	*Kristiana*	3A Bait Comparison Survey	1-90
2000	*Lualda*	3A Bait Comparison Survey	1-34
2000	*Pacific Sun*	3A Bait Comparison Survey	67-90
2000	*Pender Isle*	2B Bait Comparison Survey	1-170
2000	*Star Wars II*	2B Bait Comparison Survey	1-88
2000	*Taasinge*	3A Bait Comparison Survey	1-22
2000	*Vansee*	3A Bait Comparison Survey	1-34
2000	*Free To Wander*	3A Hook Orient./Gangion Length Survey	1-29
2000	*Ocean Bay*	3A Bait Size/Hook Size Survey	1-22
2000	*Ocean Bay*	3A Bait Quality Survey	23-42
2001	*Angela Lynn*	3B Standardized Grid Survey	1-92
2001	*Blackhawk*	2A Standardized Grid Survey	1-84
2001	*Bold Pursuit*	2C, 3A Standardized Grid Survey	1-91
2001	*Free To Wander*	2C, 3A Standardized Grid Survey	1-91; 99-137
2001	*Heritage*	4A, 4D Standardized Grid Survey	1-97
2001	*Kristiana*	3A Standardized Grid Survey	1-91
2001	*Norska*	3B Standardized Grid Survey	1-45
2001	*Pacific Sun*	4A Standardized Grid Survey	1-66

2001	*Pender Isle*	2B Standardized Grid Survey	1-85
2001	*Star Wars II*	2B Standardized Grid Survey	1-85
2001	*Trident*	4B Standardized Grid Survey	1-92
2001	*Viking Joy*	3A, 3B Standardized Grid Survey	1-69
2001	*Viking Spirit*	3A, 3B Standardized Grid Survey	1-70
2001	*Waterfall*	2C, 3A Standardized Grid Survey	1-140
2002	*Angela Lynn*	3A Standardized Grid Survey	1-92
2002	*Barren Islands*	3A Standardized Grid Survey	1-15
2002	*Blackhawk*	2A Standardized Grid Survey	1-84
2002	*Bold Pursuit*	2C, 3A Standardized Grid Survey	1-131
2002	*Clyde*	4A Standardized Grid Survey	1-66
2002	*Free To Wander*	3A, 3B Standardized Grid Survey	1-157
2002	*Heritage*	4A, 4B, 4D Standardized Grid Survey	1-144
2002	*Kristiana*	3A, 3B Standardized Grid Survey	1-63
2002	*Norska*	3B Standardized Grid Survey	1-92
2002	*Pacific Sun*	4B Standardized Grid Survey	1-45
2002	*Pender Isle*	2B Standardized Grid Survey	1-85
2002	*Star Wars II*	2B, 2C Standardized Grid Survey	1-126
2002	*Waterfall*	3A Standardized Grid Survey	1-144
2003	*Blackhawk*	2A Standardized Grid Survey	1-84
2003	*Bold Pursuit*	2C, 3A Standardized Grid Survey	1-131
2003	*Free To Wander*	3A, 3B Standardized Grid Survey	1-154
2003	*Heritage*	3A PIT Tag Demonstration Charter	1-13
2003	*Heritage*	4A, 4B, 4D Standardized Grid Survey	14-153
2003	*Kristiana*	3B Standardized Grid Survey	1-94
2003	*Norska*	3B Standardized Grid Survey	1-35
2003	*Pacific Sun*	4A, 4B Standardized Grid Survey	1-111
2003	*Pender Isle*	2B Double Tagging Charter	1-39
2003	*Predator*	3A Standardized Grid Survey	1-45
2003	*Star Wars II*	2B Standardized Grid Survey	1-86
2003	*Viking Joy*	2B Standardized Grid Survey	1-84
2003	*Viking Spirit*	3A Standardized Grid Survey	1-96
2003	*Waterfall*	2C, 3A, 3B Standardized Grid Survey	1-173



Halibut Crest - adapted from designs used by Tlingit, Tsimshian and Haida Indians