

WEATHERVANE SCALLOP FISHERY IN ALASKA WITH A FOCUS ON THE
WESTWARD REGION, 1967-2002

Report to the Alaska Board of Fisheries



By

Jeffrey P. Barnhart

Regional Information Report¹ No. 4K03-5

Alaska Department of Fish & Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615

February 2003

¹ The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

AUTHOR

Jeffrey P. Barnhart is statewide scallop fishery biologist/scallop observer program coordinator for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 211 Mission Road, Kodiak, Alaska 99615.

ACKNOWLEDGMENTS

The author would like to acknowledge vessel operators for volunteering to a conditional release of their confidential fishing information so that it could be included in this and other reports. The data will help the Alaska Board of Fisheries make informed decisions on management issues in areas where few fishermen participated. This spirit of cooperation from industry is commendable and it is important to the successful management of the weathervane scallop resource in the state. Thanks to Heidi Morrison, Alaska Department of Fish and Game, for her assistance with the report preparation.

This report is funded by a grant-cooperative agreement from the Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), and National Marine Fisheries Service (NMFS) for the cooperative management of scallop fisheries in the EEZ off Alaska. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub agencies.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	i
LIST OF FIGURES.....	ii
ABSTRACT.....	1
INTRODUCTION	2
SCALLOP BIOLOGY	2
DESCRIPTION OF THE FISHERY	3
MANAGEMENT HISTORY.....	4
Historic Management Measures.....	4
Weathervane Scallop Season Dates	4
High Impact Emerging Fishery.....	5
Unregulated Scallop Fishing in the EEZ.....	5
Establishment of Guideline Harvest Ranges.....	6
Chronology of State and Federal Management Measures	6
OBSERVER PROGRAM.....	8
CURRENT MANAGEMENT	8
Stock Assessment.....	8
Annual Exploitation Rates	9
Overfishing Definition.....	9
Crab Bycatch Limits.....	10
Industry.....	11
Other Management Measures.....	11
KODIAK REGISTRATION AREA	12
Historic Background	12
2001/02 Fishery.....	12
Northeast District	12
Shelikof District	13
Semidi District.....	13
ALASKA PENINSULA REGISTRATION AREA	13
Historic Background	14
2001/02 Fishery.....	14

TABLE OF CONTENTS (Cont.)

	<u>Page</u>
BERING SEA REGISTRATION AREA	14
Historic Background	14
2001/02 Fishery.....	15
DUTCH HARBOR REGISTRATION AREA	15
Historic Background	15
2001/02 Fishery.....	16
ADAK REGISTRATION AREA	16
Historic Background	16
2001/02 Fishery.....	16
LITERATURE CITED	17
TABLES	20
FIGURES	27

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Historic statewide commercial weathervane scallop catch, number of vessels and number of landings, excluding Cook Inlet, 1967-2001/02.....	20
2. Statewide crab bycatch limits, in percent of the crab abundance estimate or number of crab	21
3. Historic commercial catch, effort and value of weathervane scallops, Kodiak Registration Area, 1967 through 2001/02.....	22
4. Commercial harvest, average shell height from retained catch and catch per unit effort from observer data, Westward Region 1993/94 through 2001/02	23
5. Historic commercial catch, effort and value of weathervane scallops, Alaska Peninsula Registration Area, 1975 through 2001/02.	24
6. Historic commercial catch, effort and value of weathervane scallops, Bering Sea Registration Area, 1987 through 2001/02	25
7. Historic commercial catch, effort and value of weathervane scallops, Dutch Harbor Registration Area, 1982 through 2001/02.....	26

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. State of Alaska weathervane scallop fishing registration areas	27
2. Major weathervane scallop fishing locations in coastal waters of Alaska.....	28
3. Kodiak weathervane scallop fishing registration area and closed waters.....	29
4. Alaska Peninsula weathervane scallop fishing registration area and closed waters	30
5. Bering Sea weathervane scallop fishing registration area and closed waters.....	31
6. Dutch Harbor weathervane scallop fishing registration area and closed waters	32
7. Adak weathervane scallop fishery registration area and closed waters.....	33

ABSTRACT

The Alaska weathervane scallop fishery began in 1967 as an open access, passively managed fishery, that remained relatively unchanged until the early 1990s. From the early 1990s through 2001 the character of the fishery changed dramatically through a series of state and federal measures resulting in a highly regulated, limited access fishery.

This report provides a description of the Alaskan weathervane scallop fishery and management history, scallop biology, and onboard observer program. Detailed information pertaining to scallop fishing in the Westward Region including catch history and value of the fishery, closed waters, and current management measures including crab bycatch limits is presented.

INTRODUCTION

Alaskan weathervane scallop *Patinopecten caurinus* populations were first evaluated for commercial potential in the early 1950s by both government and private sector research (Kaiser 1986). However, it was not until the late 1960s as catches declined in the U.S. and Canadian scallop fisheries on Georges Bank, that interest in a fishery off Alaska began to take shape (Orensanz 1986). Initial commercial fishing effort took place in 1967 when fishermen on two vessels harvested weathervane scallops from fishing grounds off the eastside of Kodiak Island. By the following year, 19 vessels consisting of New England type scallop vessels, converted Alaskan crab boats, salmon seiners, halibut longliners, and shrimp trawlers entered the fishery (Kaiser 1986). The commercial fishery progressed through several developmental phases. From 1967 through 1973 virgin scallop beds throughout the state were identified and exploited. This was followed by a period of declining scallop harvests from 1974 to the end of the decade. A smaller, more stable fishery followed through the 1980s (Shirley and Kruse 1995). By 1993, the fishery again expanded with an influx of scallop boats from the east coast of the United States (Table 1). The fishery changed in the 1990s from one characterized by short trips with numerous deliveries each season to one of long trips with few deliveries as the fleet converted from icing to freezing of the product on board the vessel (Barnhart 2000). The average number of deliveries per year between 1990 and 1994 was 133. By 1996, all the scallop catcher boats participating in the statewide fishery were converted to catcher-processors with on board freezing capability. Freezing product onboard allowed longer trips without the fear of product spoilage. The fleet averaged 20 deliveries per year between 1996 and 2001. There are nine scallop fishing registration areas in Alaska (Figure 1).

SCALLOP BIOLOGY

Variable quantities of weathervane scallops are found in patchy distribution along the continental shelf from Southeast Alaska to the Bering Sea and Aleutian Islands. Scallop “beds” are typically elongated shaped and oriented in a north-south direction consistent with prevailing currents parallel to Alaska’s coastline. Major scallop fishing locations in Alaska coastal waters are shown in Figure 2. Scallops are typically found at depths of 20–125 fathoms (120 feet to 750 feet), with the majority of the fishing effort occurring between 40 and 60 fathoms (240 feet to 360 feet) (Barnhart and Rosenkranz 2000). Statewide, approximately 128 square nautical miles were fished in the 2001/02 season (Barnhart and Rosenkranz 2003). Bottom substrate types inhabited by weathervanes are variable throughout the state and include mud, clay, silt, sand, and pebble.

Weathervane scallops are dioecious, males are distinguished by white colored testes and females by bright red/orange ovaries. Spawning occurs annually between May and early July. Spermatozoa and eggs are released directly into the water where fertilization occurs. Fertilized eggs settle to the bottom where they hatch into larvae within several days. For the next two to three weeks the young scallop larvae gain shell weight as they drift with prevailing currents in the upper water column. The scallops then settle to the bottom and attach to the substrate with byssal threads. While attached, the foot of the scallop develops. Scallops may move about the substrate using their foot or remain attached with the byssal. Within four to eight weeks, the nearly transparent juveniles develop the ability to swim, and after a few months, the shell

becomes pigmented. At this point, young scallops resemble the adult form but are less than one-half inch across the shell. Food is obtained by filtering microscopic plankton from the water. Hennick (1970) suggested that weathervane scallops become sexually mature at age three or older. Studies conducted in Oregon showed that weathervane scallops less than 70 mm in shell height contained gonads without gametes (Starr and McCrae 1983).

Scallops are the only bivalves in Alaska capable of swimming. Propulsion is accomplished by rapid ejection of water from the interior of the shell in a jet-like action. Older, heavier scallops are less adept at swimming than juveniles. The ability of scallops to move may be important to reproductive success. Many mobile invertebrates and fish aggregate or swim during spawning (Levinton 1982; Pennington 1985 cited in Levitan 1991). An individual spawning a large number of gametes in isolation has poor reproductive success. However, a temporary spawning aggregation would increase the likelihood of fertilization at low population density and reduce the nutritional costs of living at high density (Levitan 1991). Up-slope movement observed in the scallop species *Pecten maximus* may be to increase population densities in shallow water and possibly enhance synchronized spawning and thereby increase gamete fusion (Minchin 1989). Stokesbury and Himmelman (1993) suggest that aggregation, on the scale of centimeters, in scallop beds may be an adaptation to increase fertilization success. If this is true, it is likely that disturbing such aggregations, by dredging or other activities, would decrease reproductive success. Scallop dredging may have other negative effects on scallop populations because it increases mortality (directly and indirectly) and stimulates aggregation of predators (Caddy 1970, 1973 cited in Stokesbury and Himmelman 1993).

DESCRIPTION OF THE FISHERY

The weathervane scallop fishery is prosecuted using a standard “New Bedford style” scallop dredge. On average, a 15-foot dredge weighs approximately 2,600 pounds and a 6-foot dredge weighs about 900 pounds. The frame design provides a rigid, fixed dredge opening. Attached to and directly behind the rigid frame, is a steel ring bag consisting of 4-inch (inside diameter) rings connected with steel links. A sweep chain footrope is attached to the bottom of the mesh bag. The top of the bag consists of 6-inch stretched mesh polypropylene netting. The mesh netting helps hold the bag open while it is towed along the ocean floor. A club stick attached at the end of the bag helps maintain the shape of the bag and provides for an attachment point to dump the dredge contents on the deck. Steel dredge “shoes” are welded onto both lower corners of the rigid frame. The dredge shoes bear most of the weight and act as “sled runners” permitting the dredge to move easily along the substrate. Each dredge is attached to the boat by a single steel wire cable operated from a deck winch. Vessels fishing inside the Cook Inlet Registration Area are limited to operating a single dredge not more than 6 feet in width. Vessels fishing in the remainder of the state are limited to operating no more than 2 scallop dredges at one time and each scallop dredge is limited to a maximum width of 15 feet. Vessels used in the weathervane scallop fishery range in size from 58 feet to 124 feet length overall (LOA), with a maximum of 1,200 horsepower.

Scallop fishing operations involve the following steps: (a) dredge deployment, (b) dredge towed for 50 to 60 minutes on the bottom at an average speed of 4.7 knots, (c) dredge retrieved, (d) dredge contents emptied on deck, (e) retained scallops sorted from the catch while discarding

bycatch overboard, (f) baskets of retained scallops moved from the deck to the shucking house, (g) gear prepared for the next set, (h) gear deployed, and (i) shuck, wash, grade, package and freeze scallop meats. The scallop meat is the single adductor muscle that is removed from the scallop by crew members using specialized hand-held scallop knives.

MANAGEMENT HISTORY

Historic Management Measures

From the inception of the fishery in 1967 through mid May 1993, the Westward Region scallop fishery was passively managed employing minimal management measures. Scallop dredges with a minimum ring size of four inches inside diameter were the established gear type. Under a permit issued by the department, 3 inch rings could be fished west of the longitude of the westernmost point on Sanak Island (162° 49' W. long.). Closed waters and seasons were established to protect crabs and crab habitat. Scallop management was not based on scallop stock abundance or biology. As catches declined in one bed vessels moved to better grounds. While this may have been generally acceptable for a sporadic low intensity fishery, increased participation led to boom and bust cycles experienced from 1967-1992.

Weathervane Scallop Season Dates

When the Alaska scallop fishery began in 1967, there were no closed seasons. In 1971, a scallop season was established to protect spawning king crab in the Kodiak Area. Scallops could be taken from June 1 through March 31 in Pacific Ocean waters north of 57° 37' 07" N. lat., and east of 152° 09' 01" W. long (Cape Chiniak Light) and the waters of Shelikof Strait north of 57° 17' 20" N. lat. (the latitude of Cape Ikolik).

In 1973, season dates were established on the east side of Kodiak Island to protect molting and softshell king crabs. The opening date was established as July 15 because king crabs were thought to molt later in this area than in other areas with an opening date of June 1. Scallops could be taken from July 15 through March 31 in Pacific Ocean waters south of the latitude of Cape Chiniak light and north and east of Black Point, excluding those waters northwest of a line from Cape Barnabas to Narrow Cape.

In 1975, scallops could be taken from July 15 through March 31 in the Pacific Ocean waters south of the latitude of Cape Chiniak light and waters east of the longitude of Cape Barnabas to Narrow Cape. However, the scallop season in the remainder of Statistical Area J including the Semidi District of the Kodiak Management Area, Alaska Peninsula, Dutch Harbor, Bering Sea, and Adak Management Areas remained open year around. It was not until the BOF meeting in March 1994 that the weathervane scallop season in the Westward Region (entire Statistical Area J) was changed to July 1 through February 15 to provide additional protection for the crab resource. The regulations became effective July 1, 1994.

High Impact Emerging Fishery

During the early 1990s, an influx of vessels from the East Coast of the U.S. into the weathervane scallop fishery prompted concerns from both the scallop industry and the Alaska Department of Fish and Game (ADF&G) over scallop resource conservation and impacts on depressed stocks of red king crab *Paralithodes camtschaticus* and Tanner crab *Chionoecetes bairdi*. Between 1990 and 1993, statewide scallop harvests were at levels comparable to those between 1968 and 1973, which proved to be unsustainable. Reduced scallop abundance was at least partly responsible for the fishery collapse in the 1970s (Kruse 1994). As a result, the weathervane scallop fishery was designated a high impact emerging fishery on May 21, 1993 and was closed until an interim scallop management plan was completed (Barnhart and Sagalkin 1998). The resulting interim scallop management plan included 100% onboard observer coverage, a ban on automatic shucking machines aboard scallop vessels, maximum crew size of 12, crab bycatch caps, and establishment of scallop guideline harvest ranges (GHRs) (Kruse et al.). In addition, minimum dredge ring size was established at four inch inside diameter, chaffing gear or other devices that decreased the legal inside ring diameter of a scallop dredge were prohibited, no more than two scallop dredges were permitted to be operated at one time from a vessel, and the opening of a scallop dredge was restricted to a maximum width of 15 feet. Four registration areas were established in the Westward Region, including Kodiak (K), Alaska Peninsula (M), Dutch Harbor (O), and Adak-Bristol Bay-Bering Sea (Q). Scallop Area R (Adak), was established at the March 1994 BOF meeting.

Unregulated Scallop Fishing in the EEZ

From inception of the fishery in 1967 until 1995, all vessels participating in the Alaska scallop fishery were registered under the laws of the State of Alaska. Scallop fishing in both state waters (0 to 3 miles) and the federal exclusive economic zone (EEZ) (3 to 200 nautical miles offshore) was managed under state jurisdiction.

In January 1995, the captain of a scallop fishing vessel home-ported in Norfolk, Virginia returned his 1995 scallop interm use permit card to the Commercial Fisheries Entry Commission (CFEC) in Juneau and proceeded to fish scallops in the EEZ with total disregard to harvest limits, observer coverage, and other management measures. In response to this unanticipated, uncontrolled fishing for scallops in the EEZ by this single vessel outside the jurisdiction of the state of Alaska, federal waters in the EEZ were closed to scallop fishing by emergency rule on February 23, 1995. The initial emergency rule was in effect through May 30, 1995, and was extended for an additional 90 days through August 28, 1995. The intent of the emergency rule was to control the unregulated scallop fishery in federal waters until a federal fishery management plan (FMP) could be implemented closing the fishery. Prior to August 28, the North Pacific Fishery Management Council (NPFMC) submitted a proposed FMP which closed scallop fishing in the EEZ for a maximum of one year, with an expiration date of August 28, 1996. The final rule implementing Amendment 1 to the FMP was filed July 18, 1996 and published in the Federal Register on July 23, 1996. It became effective August 1, 1996, allowing the weathervane scallop fishery to open in the EEZ. Scallop fishing in state waters of the Westward Region was delayed until August 1, 1996 to coincide with the opening of the EEZ. The state continued as the active manager of the fishery with inseason actions duplicated by the federal system.

Establishment of Guideline Harvest Ranges

GHRs were established in the state Fishery Management Plan for Commercial Scallop Fisheries in Alaska (Kruse 1994) adopted by the Alaska Board of Fisheries (BOF) in 1994 for registration areas where scallop fishing traditionally occurred. Traditional areas included Yakutat, Prince William Sound, Cook Inlet, Kodiak, and Dutch Harbor. The combined upper limits of the GHRs totaled 890,000 pounds of shucked meats. The GHR for each area was determined by averaging historic catches from 1969 to 1992 excluding years when there was no fishing or “fishing-up effect” occurred. “Fishing-up” is considered to over-estimate production. The changes observed during the first few years of the Alaskan scallop fishery were not unlike the exploitation histories of many other fisheries worldwide (Walters 1986, cited in Kruse 1994). Typically, early catches exceed sustained levels as the fishery crops off large, old individuals from the population including concentrations on marginal beds that rebuild slowly. This widely recognized phenomenon is known as the “fishing-up effect” or “removal of accumulated stock” (Ricker, 1975; Walters 1986 cited in Kruse 1994).

Prior to the August 1, 1996 opening of the weathervane scallop fishery, the department established GHRs for non-traditional areas including the Alaska Peninsula, Bering Sea, and Adak Registrations. The historic high catches for each registration area were established as the upper end of the GHRs. The combination of GHRs from traditional and non-traditional areas totaled 1.8 million pounds of shucked scallop meats, which was defined as maximum sustainable yield (MSY) in Amendment 1 to the federal Fishery Management Plan for the Scallop Fishery off Alaska (FMP).

In 1998, the scallop plan team recommended defining MSY as 1.24 million pounds of shucked adductor muscles based on the average landings from 1990-1997, excluding 1995 when the fishery was closed most of the year. Subsequently, MSY was established in Amendment 6 of the FMP at 1.24 million pounds and optimum yield (OY) as a range from 0 to 1.24 million pounds. To accommodate the lower limits the department reduced the upper end of the GHR in Kodiak from 400,000 to 300,000 pounds, in Dutch Harbor from 170,000 to 110,000 pounds, and in the Bering Sea from 600,000 to 400,000 pounds.

Chronology of State and Federal Management Measures

- 1967 through early 1995. Management of scallops (in both state and EEZ waters) under jurisdiction of the State of Alaska. No federal Fishery Management Plan for Scallops.
- 1992. ADF&G initiated development of a Fishery Management Plan for Scallops (Kruse et al. 1992).
- 1993. ADF&G Commissioner declared the scallop fishery a high impact emerging fishery. State Interim Fishery Management Plan for Scallops including 100% observer coverage, became effective July 1 (Kruse et al. 1992).
- 1994. State of Alaska, Fishery Management Plan for Commercial Scallop Fisheries in Alaska, adopted by the BOF in March. Guideline harvest ranges established for scallops in

Registration Areas D, E, H, K, and O. Scallop season dates set as July 1-February 15 in the Westward Region.

- February 23, 1995. NMFS implemented a 90 day emergency interim rule (effective through May 30 1995) to close federal waters off Alaska to scallop fishing in response to unanticipated, uncontrolled fishing in the EEZ. Subsequent extension closed the fishery for an additional 90 days through August 28, 1995.
- May 10, 1995. To control an anticipated increase in fishing pressure on scallop stocks in state waters as a result of the EEZ closure, ADF&G issued notice that all state waters in the Westward Region except Dutch Harbor and Adak Registration Areas, would not open to scallop fishing.
- July 26, 1995. NMFS approved the FMP prepared by NPFMC. The FMP closed federal waters off Alaska to scallop fishing for up to one year (until August 28, 1996) or until an amendment provided for management in federal water. During the closure, NPFMC developed Amendment 1 (State-Federal Management Regime) to the federal FMP. Federal management measures to parallel most state management measures. Regulations allowing the scallop season to open in EEZ were published in the federal register on July 23, 1996 with effective date August 1, 1996. Scallop fishing in state waters of the Westward Region was delayed until August 1, 1996 to coincide with the opening of the EEZ. MSY for weathervane scallops set at 1.8 million pounds of shucked scallop meats.
- 1997. NMFS approved FMP Amendment 2 (vessel moratorium) on March 5. Eighteen vessels qualified for federal moratorium permits.
- 1997. Alaska legislature approved legislation (AS 16.43.906) establishing a scallop vessel moratorium in state waters. Moratorium to expire June 30, 2001. Ten vessels qualify to fish scallops under the state moratorium.
- 1998. NMFS approved Amendment 3 to the FMP that delegated authority to the state to manage all aspects of the scallop fishery in federal waters except limited access.
- April 1998. Amendment 5 to the FMP defined and described essential fish habitat for scallops.
- April 1998. Draft Amendment 6 to the FMP revised definition of overfishing and OY, described new definitions for MSY and minimum stock size threshold (MSST). MSY set at 1.24 million pounds. Final action on Amendment 6 occurred on February 10, 1999.
- May 1998. Final rule. Magnuson-Stevens Act Provisions; National Standard Guidelines. NMFS revises guidelines addressing ten National Standards for Fisheries Management Plans. The MSFCMA requires the Secretary of Commerce to “establish advisory guidelines, based on the national standards, to assist in the development of fishery management plans.”
- February 1999. NPFMC final action, Amendment 4, license limitation program (LLP). No area endorsements (all boats permitted to fish statewide). Seven boats permitted to fish

statewide (outside Cook Inlet Registration Area) utilizing two 15 foot dredges. Two other vessels permitted to fish outside Cook Inlet with a single 6-foot dredge. All vessels permitted to fish Cook Inlet with a single 6-foot dredge.

- May 2000. House Bill 429, with an effective date of May 12, 2000, extends AS 16.43.906 (scallop vessel moratorium) through June 30, 2004.
- May 2000. Most scallop vessel owners form a fishing cooperative.
- January 2001. Federal scallop LLP became effective January 16, 2001 for the commercial scallop fishery in federal waters off Alaska.

OBSERVER PROGRAM

The 1993 ADF&G interim Alaska Scallop Fishery Management Plan and the final Fishery Management Plan For Commercial Scallop Fisheries in Alaska adopted by the BOF in March 1994, included requirements for onboard observer coverage. The primary purposes of the onboard observer program are to collect biological and fishery-based data, monitor bycatch, and provide for regulatory enforcement. Data collection efforts in the early years of the observer program focused on detailed examination of crab bycatch and collection of baseline data relative to scallop biology. Since that time, data collection has evolved and expanded to help answer specific questions related to resource management. Data are collected on crab and halibut bycatch; discarded scallop catch; retained scallop catch; catch composition; scallop meat weight recovery; location, area, and depth fished; and catch per unit effort (CPUE) (Barnhart 1998; Barnhart 2001). Summary and analysis reports of observer-collected data are produced from these data (Urban et al. 1994; Barnhart et al. 1996; Barnhart and Sagalkin 1998; Barnhart and Rosenkranz 1999; and Barnhart and Rosenkranz 2003). Observers report scallop harvest, number of tows, area fished, and crab bycatch to the department three times each week during the season. Data are used to manage the fishery inseason and to set GHRs for the following season. Data are provided to local advisory committees, BOF, NPFMC, NMFS, and the public. Observer-collected data have been used by the BOF and the NPFMC for making informed decisions regarding the scallop fishery and for preparing documents including Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC).

CURRENT MANAGEMENT

Stock Assessment

ADF&G began working on video techniques for fishery-independent scallop surveys in spring 2000. Earlier attempts to utilize fishery CPUE as an index of abundance in a stock assessment context were not effective, primarily due to non-random spatial distribution of fishing effort and large differences in CPUE from proximate tows. During the initial pilot survey, ADF&G used a video drop camera to film 400 m² of the Shelikof Strait bed near Kodiak Island and counted a

total of 19 scallops. This research indicated that a sampling device that could cover more area would be necessary to obtain meaningful estimates of scallop density. The department constructed and began testing a towable aluminum sled the following spring. During the initial deployment, 40,000 m² of the Shelikof Strait bed were filmed and 1,371 scallops were counted. After additional testing and equipment modifications, the department conducted a full-fledged video scallop survey in the eastern Gulf of Alaska during spring 2002. Over 124,000 m² of the bottom were surveyed and over 12,000 scallops were counted during video review. A paper detailing the survey is currently in progress. A video survey of the Bering Sea scallop bed is scheduled for May 2003. The long-range goal is to conduct video survey assessments of scallop beds in Shelikof Strait, the eastern Gulf of Alaska, and the Bering Sea (the 3 highest-producing areas) on a rotating schedule.

Annual Exploitation Rates

A target exploitation rate for weathervane scallops is not defined in Amendment 6 of the scallop FMP. However, NMFS guidelines for National Standards 1, prevention of overfishing and achieving optimum yield (OY) were revised in 1998 so that the annual harvest level obtained under an OY control rule must always be less than or equal to the harvest level under a maximum sustainable yield (MSY) control rule (NMFS 1998a). The NMFS report providing technical guidance on the use of precautionary approaches to implementing National Standard 1 states “Target reference points, such as OY, should be set safely below limit reference points, such as the catch level associated with the fishing mortality rate or level defined by the status determination criteria” (NMFS 1998b). The precautionary approach implements conservation measures even in the absence of scientific certainty that fish stocks are being overexploited.

Amendment 6 to the scallop FMP established the overfishing control rule as $F=0.13$, where F is an instantaneous rate which corresponds to a 0.12 annual exploitation rate. So, the target annual exploitation rate should be < 0.12 . Harvesting at a 0.10 rate (75% of the annual exploitation rate) would appear to satisfy the precautionary approach and is consistent with the NMFS technical guidance on implementing National Standard 1.

Overfishing Definition

Sustainable fisheries is the objective of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The idea of sustainability is inherent in MSY, a quantity that is central to the MSFCMA’s definition of both overfishing and OY (MSFCMA 1996).

Instantaneous natural mortality (M), growth, and common biological reference points (BRPs) were estimated for weathervane scallops in Alaska (Kruse 1995). BRPs are benchmarks against which the abundance of the stock or the fishing mortality rate can be measured, in order to determine its status. Estimates of M ranged from 0.04 to 0.21 with a median of 0.13

The overfishing definition for scallops was revised in Amendment 6 to the Fishery Management Plan for the Scallop Fishery off Alaska. Overfishing is a level of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis. Overfishing is defined as a fishing rate in excess of the natural mortality rate ($F_{\text{overfishing}}$

$\geq M=0.13$). MSY is defined as the largest long-term average catch that can be taken from a stock under prevailing ecological and environmental conditions. The MSY for weathervane scallops is 1.24 million pounds of shucked scallop meats based on the average catch from 1990-1997 (excluding 1995). The MSY control rule is a harvest strategy expected to result in a long-term average catch approximating MSY. The MSY control rule is based on natural mortality, using the estimate of $M=0.13$ for scallops, the MSY control rule is $F_{msy}=M$. The minimum stock size threshold (MSST) equals one-half MSY stock size or 4.76 million pounds.

Crab Bycatch Limits

Crab bycatch limits (CBLs) were first instituted by the state in July 1993. Methods used to determine CBLs in 1993 and 1994 were approved by the BOF and the NPFMC and, with few exceptions, remain unchanged. Annual CBLs are established pre-season by ADF&G based on the most current crab resource abundance information. However, in some registration areas or districts the CBL is a fixed number of crabs and is not adjusted seasonally.

In the Kodiak, Alaska Peninsula, and Dutch Harbor Registration Areas the CBLs are set at 0.5% or 1.0% of the total crab stock abundance estimate based on the most recent survey data (Table 2). In registration areas or districts where red king crab or Tanner crab abundance is sufficient to support a commercial crab fishery, the cap is set at 1.0% of the most recent red king crab or Tanner crab abundance estimate. In registration areas or districts where the red king crab or Tanner crab abundance is insufficient to support a commercial fishery, the CBL is set at 0.5% of the most recent red king crab or Tanner crab abundance estimate. Bycatch caps are expressed in numbers of crabs and include all sizes of crabs caught in the scallop fishery.

In the Kamishak District of the Cook Inlet Registration Area, the Tanner crab bycatch limit is set at 0.5% of the total crab stock abundance and the red king crab limit is fixed at 60 crabs. In the Prince William Sound Registration Area the CBL for Tanner crab is fixed at 0.5% of the total crab stock abundance, although this is a recent change from a fixed number of crabs.

In 1993, Bering Sea (Registration Area Q) CBLs were set by ADF&G to allow the fleet adequate opportunity to explore and harvest scallop stocks while protecting the crab resource. CBLs were established at 260,000 *Chionoecetes* spp. and 17,000 red king crabs.

In 1995, ADF&G recommended that CBLs be established at 0.003176 percent of the best available estimate of *C. opilio* (snow crab) and 0.13542 percent of the best available estimate of Tanner crab abundance in Registration Area Q. That equated to about 300,000 snow and 260,000 Tanner crabs based on 1994 crab abundance estimates in Registration area Q. In Amendment 1 of the federal scallop FMP, the NPFMC approved the CBLs established by ADF&G. The NPFMC also recommended that king crab bycatch limits be set within a range of 500 to 3,000 annually. Beginning with the 1996/97 fishing season ADF&G took a conservative approach and set the red king crab limit in Registration Area Q at 500 red king crabs annually.

From the 1996/97 through 1998/99 fishing seasons the CBL for *Chionoecetes* sp. in the Bering Sea was established annually by applying the percentages established for snow and Tanner crab limits in Amendment 1 of the FMP. In 1998, consistent with the Tanner crab rebuilding plan in

the Bering Sea, crab bycatch limits were modified. A three tier approach was established utilizing the bycatch limits established in Amendment 1 of the FMP, 300,000 snow crab and 260,000 Tanner crab. The three tiers include (1) Tanner crab spawning biomass above minimum stock size threshold (MSST); bycatch limit is set at 260,000 crabs, (2) Tanner crab spawning biomass below MSST; bycatch limit is set at 130,000 crabs, and (3) Tanner crab spawning biomass is below MSST and the commercial fishing season is closed; Tanner crab limit is set at 65,000 crabs. A similar three tier approach was taken with the snow crab bycatch caps. The three tiers include (1) snow spawning biomass above the MSST; bycatch limit is set at 300,000 crabs, (2) snow crab spawning biomass below MSST; bycatch limit is set at 150,000 crabs, and (3) snow crab spawning biomass below MSST and the commercial fishing season is closed; the snow crab limit is set at 75,000 crabs.

Industry

A majority of the scallop vessel owners formed a fishing cooperative in May 2000. This program is not endorsed or managed by the ADF&G or any federal agency. Within the cooperative, vessel owners allocated shares based on previous fishing history. Some owners opted to remove their boats from the fishery and arranged for their coop shares to be caught by other members of the cooperative. The formation of the cooperative slowed the harvest rate and extended the fishing effort over a longer time period.

Vessel owners within the cooperative have taken an active role in developing measures aimed at reducing crab bycatch. The vessel operators now provide their confidential inseason fishing information to an independent consulting company contracted by the cooperative. The consulting company reviews the crab bycatch data, fishing location information, and scallop harvest. This procedure allows for real time identification of high crab abundance areas. If an area of high crab abundance is identified the fleet is provided with that information and directed to avoid the area.

Vessel operators also volunteered to a conditional release their confidential fishing information to ADF&G so that it can be used in this and other reports to help the BOF make informed decisions on management issues in areas where few fishermen participate.

Other Management Measures

By definition, GHRs are specified as a range from zero to the upper end of the range. The department may decide to close an area at any appropriate level within the range if conditions warrant. A registration area or district may be closed inseason based on resource concerns due to declining CPUE, indications of little or no recruitment of scallops into the fishery, localized depletion, or other factors.

KODIAK REGISTRATION AREA

The Kodiak Registration Area (Area K) includes the waters of the Pacific Ocean south of the latitude of Cape Douglas, east of the longitude of Cape Kumlik, and west of the longitude of Cape Fairfield (Figure 3). The Kodiak Registration Area is comprised of the Northeast, Shelikof, and Semidi Districts. Extensive areas are closed to scallop fishing to protect crab habitat.

Historic Background

When commercial fishing for weathervane scallops began in Alaska, vessel operators targeted fishing grounds along the eastside of Kodiak Island. In 1968, 734,084 pounds of scallop meats were landed from eight vessels (Table 3). The Kodiak scallop fishery peaked in 1970 when 1.4 million pounds of scallop meats were landed from seven vessels. Catches declined by the mid-70s with no participation in 1977 or 1978. Since 1980 landings have fluctuated from 46,971 pounds to 689,497 pounds of scallop meats. There was no harvest in 1995 because the EEZ was closed by federal emergency rule and ADF&G subsequently closed state waters by emergency order.

Concerns about the impact of scallop dredging on crab resources began in 1969 when ADF&G closed the south end of Kodiak Island and Marmot Bay to scallop fishing by emergency order because of red king crab bycatch. Subsequently, the BOF adopted the department's recommendation, closing both areas by regulation. During the early 1970s the regulatory season ending date was changed to March 31 to protect red king crabs. In 1990, to protect depressed red king crab and Tanner crab populations, the BOF closed scallop fishing in Kodiak's westside bays which had been previously closed to non-pelagic trawling. Crab bycatch limits were initiated in the Kodiak Area with the development of the Alaska Scallop Fishery Management Plan in 1993.

2001/02 Fishery

The 2001/02 scallop fishing season was open July 1, 2001 through January 18, 2002. Four catcher-processors fished in the Kodiak Registration Area.

Northeast District

The Northeast District of the Kodiak Registration Area as applied to the scallop fishery includes all waters northeast of a line extending 180° from the easternmost tip of Cape Barnabas, east of a line from the northernmost tip of Inner Point to the southernmost tip of Afognak Point, east of 152° 30' in Shuyak Strait, and east of the longitude of the northernmost tip of Shuyak Island (152° 20' W. long.) (Figure 3).

The GHR for the Northeast District was set at zero to 80,000 pounds of shucked scallop meats. Three catcher-processors participated in the fishery with initial effort in mid-August. Inseason observer reports indicated that approximately 23,000 Tanner crabs and no red king crabs were caught from a bycatch limit of 425,000 Tanner crabs and 15 red king crabs. Observer reports also

indicated that the upper end of the GHR was achieved, prompting an emergency order closing the Northeast District to scallop fishing on January 18, 2002. Final fish tickets summaries totaled 80,470 pounds of shucked meats (Table 4).

Shelikof District

The Shelikof District of the Kodiak Registration Area includes all waters north of a line from the westernmost tip of Cape Ikolik to the southernmost tip of Cape Kilokak, west of a line from the northernmost tip of Inner Point to the southernmost tip of Afognak Point, west of 152° 30' W. long. in Shuyak Strait, and west of the longitude of the northernmost tip of Shuyak Island, 152° 20' W. long.

The GHR for the Shelikof District was set at zero to 180,000 pounds of shucked meats. Four catcher-processors participated in the fishery with initial effort on July 1, when the season opened. Inseason observer reports showed that approximately 29,000 Tanner crabs and no red king crabs were caught from a bycatch limit of 59,000 Tanner crabs and 50 red king crabs. Inseason observer reports also indicated that the upper end of the GHR was achieved prompting an emergency order closing the Shelikof District to scallop fishing on December 8, 2001. Final fish ticket summaries totaled 179,202 pounds of shucked meats.

Semidi District

The Semidi District of the Kodiak Registration Area includes all Pacific Ocean waters west of the longitude of Cape Kilokak and east of the longitude of Cape Kumlik. No guideline harvest range has been developed for this district.

State waters of the Semidi District were closed to scallop dredging by the BOF at the March 2000 meeting, however, federal waters remain open. No fishing activity occurred in the Semidi District during the 2001/02 fishing season, although it was open from July 1, 2001 to February 15, 2002.

ALASKA PENINSULA REGISTRATION AREA

The Alaska Peninsula Registration Area (Area M) includes waters of the Pacific Ocean west of the longitude of Cape Kumlik and east of the longitude of Scotch Cap Light (Figure 4).

Areas closed to fishing include all state waters and offshore waters of Unimak Bight and around Mitrofanina Island. The Unimak closure was adopted in the early 1970s to protect king crab habitat. The Mitrofanina Island closure was adopted in the mid-1980s to protect Tanner crab populations.

Historic Background

Historic fishing effort for scallops in the Alaska Peninsula Registration Area has been sporadic. Most catch and effort information prior to 1993 is confidential because few fishermen participated in any given year. However, the average annual harvest during the nine years of participation prior to 1993 was 41,888 pound of scallop meats. The highest harvest was in 1982 when 205,691 pounds of shucked meats were landed from six vessels. (Table 5).

2001/02 Fishery

The Alaska Peninsula Registration Area did not open to scallop fishing for the 2001/02 season due to low abundance of scallops in areas open to commercial fishing. It remained closed to preserve the remaining scallop resource in areas open to fishing and allow for stock recovery in those areas. The department does not intend to reopen the Alaska Peninsula Registration Area until the 2003/04 season. Large closed water areas of the Alaska Peninsula are known to contain weathervane scallop populations.

BERING SEA REGISTRATION AREA

The Bering Sea Registration Area (Area Q) includes waters of the Bering Sea north of a line extending from the latitude of Cape Sarichef at 54° 36' N lat. to 171 W. long, north to 55° 30' and west to the U.S. - Russia Convention Line of 1867 (Figure 5). Waters closed to scallop fishing have been established to protect king crab stocks and juvenile Pacific halibut nursery areas.

Historic Background

ADF&G records indicate that scallops were first harvested from the Bering Sea in 1987, and then again in 1990 and 1991 (Table 6). During those years few fishermen participated in any given year, so catch and effort information is confidential. However, the average annual catch for the three confidential years was 68,189 pounds of shucked meats. No additional landings were made from this area until 1993 when 613,813 pounds of scallop meats were landed from ten vessels. During the 1994/95 fishery, 505,439 pounds of shucked meats were landed from eight vessels. The 1995/96 fishery was closed by federal emergency rule. Between 1996/97 and 1999/00 scallop catches were restrained by Tanner or snow crab bycatch limits, averaging 127,000 pounds of shucked meats per year. In the 2000/01 season the upper limit of the GHR, 205,520 pounds of shucked meats, was landed from three vessels. This was the first season since 1994 that the scallop harvest reached the upper limit of the GHR without being restrained by crab bycatch limits.

2001/02 Fishery

The GHR for the Bering Sea Registration Area was set at zero to 200,000 pounds of shucked meats. Crab bycatch limits were established at 65,000 Tanner crabs, 300,000 snow and hybrid crabs, and 500 red king crabs. Three catcher-processors participated in the Bering Sea fishery with initial effort on July 1 when the season opened. The 2001/02 fishery closed by emergency order on October 31, 2001 largely due to poor fishery performance, with a harvest of 140,871 pounds of scallop meats. Projections based on inseason observer reports indicated a bycatch of 48,000 Tanner crabs and 67,000 snow and hybrid crabs.

Preliminary carbon isotope analysis conducted on Bering Sea scallop shells show an overall $\delta^{13}\text{C}$ value decrease following the third year of shell growth suggesting that sexual maturation occurs at this time (age four) (Carpenter and Barnhart 2000). Carbon isotope analysis of scallop shells collected from the Gulf of Alaska suggest that sexual maturation occurs following the second year of shell growth (age three). Based on these results, a more conservative management approach may be appropriate for the Bering Sea Registration Area.

DUTCH HARBOR REGISTRATION AREA

The Dutch Harbor Registration Area (Area O) includes Aleutian Island waters west of the longitude of Scotch Cap Light, east of 171°W. long., and south of the latitude of Cape Sarichef (Figure 6).

Historic Background

In the Dutch Harbor Registration Area closed waters were established in 1986 to protect crab nursery areas. Through the 1993 season, the Registration Area was open year-round to scallop dredging. At the BOF meeting in March 1994 the regulatory season dates were established as July 1 through February 15.

The first harvest of weathervane scallops from the Dutch Harbor Registration Area took place in 1982 when 62,105 pounds of scallop meats were landed from five vessels (Table 7). The average annual catch from 1985 through 1992 was 203,695 pounds of scallop meats. In the 1993/94 season, 39,346 pounds of scallop meats were landed from three vessels. During the 1994/95 season, 1,931 pounds of scallop meats were landed from three vessels. Scallop fishing was limited to state waters during the 1995/96 season because federal waters were closed by federal emergency rule. Catch and effort information is confidential because only one vessel participated in the fishery. The scallop catch increased to 5,790 pounds in the 1997/98 season and to 46,432 pounds during the 1998/99 season. The harvest dropped during the 1999/2000 season to 6,465 pounds of shucked meats and was closed by emergency order to prevent localized depletion.

2001/02 Fishery

The Dutch Harbor Registration Area did not open to scallop fishing for the 2001/02 season. It remained closed to preserve the remaining scallop resource in areas open to fishing and allow for stock recovery in those areas. The department does not intend to reopen the Dutch Harbor Registration Area until the 2002/03 season. The waters closed to scallop fishing in 1986 had historically produced the majority of the harvest.

ADAK REGISTRATION AREA

The Adak Registration Area (Area R) includes Aleutian Island and Bering Sea waters west of 171°W. long. and east of the U.S. – Russia Convention Line of 1867 and south of 55° 30' N. lat. (Figure 7).

Historic Background

ADF&G records indicate that scallops were first harvested from the Adak Registration Area in 1979, and then again in 1992, and 1995. During those years few fishermen participated in any given year, so catch and effort information is confidential. Little is known about the scallop population in the area. The continental shelf adjacent to the Aleutian Islands is narrow, providing limited weathervane scallop habitat.

The Petrel Bank, between 51°30' N lat. and 54° 30' N lat., west of 179° W long. and east of 179° E long. was closed by emergency order on March 21, 1991 due to concerns about red king crab bycatch in the *Chlamys* sp. fishery. On November 1, 1991, before the initial emergency order expired, a second emergency order was issued closing this area until June 1, 1994, providing time for the department to bring the conservation concerns to the attention of the BOF. In 1993, the BOF adopted the department's recommendation closing the area by regulation.

2001/02 Fishery

The 2001/02 fishery opened July 1, 2001 and closed by regulation on February 15, 2002. A GHR of zero to 75,000 pounds was announced by news release. No vessels participated in the fishery during 2001/02 season.

LITERATURE CITED

- Barnhart, J. P. 1998. Weathervane scallop observer manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K98-32, Kodiak.
- Barnhart, J. P. 2000. Annual Management Report for the Weathervane Scallop Fisheries of the Westward Region, 1999/00. In Annual Management Report for the Shellfish Fisheries of the Westward Region, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K00-55, Kodiak.
- Barnhart, J. P. 2001. Weathervane scallop observer manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K01-36, Kodiak.
- Barnhart, J. P., I. Vining and L. Byrne 1996. A summary of data collected by scallop observers from the 1994/1995 commercial scallop fishery in Alaska's Westward Region. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4k96-33, Kodiak.
- Barnhart, J. P., and N. Sagalkin. 1998. Summary and analysis of onboard observer collected data from the 1996/1997 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K98-38, Kodiak.
- Barnhart, J. P., and G. Rosenkranz. 1999. Summary and analysis of onboard observer collected data from the 1997/1998 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K99-63, Kodiak.
- Barnhart, J. P., and G. Rosenkranz. 2000. Summary and analysis of onboard observer collected data from the 1998/1999 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K00-8 Kodiak.
- Barnhart, J. P., and G. Rosenkranz. 2003. Summary and analysis of onboard observer collected data from the 1999/00 through 2001/02 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report xxxx-xx Kodiak.
- Carpenter S.J. and J. Barnhart. 2000. Seasonality and physiological changes observed in the carbon and oxygen isotope ratios in modern weathervane scallops (*Patinopecten caurinus*) from the Alaskan Coast. Geological Society of America Annual Meeting Abstracts w. Programs, v. 32, p. 93.

LITERATURE CITED (Cont.)

- Caddy, J. F. 1970. A method of surveying scallop populations from a submersible. J. Fish. Res. Bd Can. 27: 535-594.
- Caddy, J. F. 1973. Underwater observations on tracks of dredges and trawls and some effects of dredging on a scallop ground. J. Fish. Res. Bd Can. 30: 173-180.
- Hennick, D. P. 1970. Reproductive cycle, size at maturity, and sexual composition of commercially harvested weathervane scallops, *Patinopecten caurinus*, in Alaska. J. Fish. Res. Bd. Canada. 28:608-609
- Kaiser, R. J. 1986. Characteristics of the Pacific weathervane scallop (*Pecten* [*Patinopecten*] *caurinus*, Gould 1850) fishery in Alaska, 1967-1981. Alaska Department of Fish and Game. Kodiak.
- Kruse, G.H. 1994. Fishery Management Plan for Commercial Scallop Fisheries in Alaska. Alaska Department of Fish and Game (ADF&G) Draft Special Publications No. 5.
- Kruse, G. 1995. Biological reference points for weathervane scallops in Alaska. Abstract *from* North Pacific Symposium on Invertebrate Stock Assessment and Management. Nanaimo, B.C. Canada.
- Kruse, G.H., P.R. Larson, and M.C. Murphy. 1992. Proposed interim management measures for commercial scallop fisheries in Alaska. ADF&G Regional Information Report No. 5J92-08.
- Levinton, J. S. 1982. Marine Ecology. Prentice-hall, Englewood Cliffs.
- Levitan, D. R. 1991. Influence of body size and population density on fertilization success and reproductive output in free-spawning invertebrate. Biol. Bull. 181: 261-268.
- Minchin, D. 1989. Up-slope movements in the scallop *Pecten maximus*. J. Mollusc. Stud. 55: 423-425.
- MSFCMA. 1996. Magnuson-Stevens Fishery Conservation and Management Act as Amended Through October 11, 1996. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-23. December 1996.
- National Marine Fisheries Service (NMFS). 1998a. Magnuson-Stevens Act Provisions; National Standard Guidelines. Final Rule. May 1998.
- National Marine Fisheries Service (NMFS). 1998b. Technical guidance on the use of precautionary approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Technical Memorandum NMFS-F/SPO-31. August 1998.

LITERATURE CITED (Cont.)

- Orensanz, J. M. 1986. Size, environment, and density: the regulation of a scallop stock and its management implications. Pages 195-227. In G.S. Jamieson and N. Bourne (eds.). North Pacific Workshop on Stock Assessment and Management of Invertebrates. Can. Spec. Publ. Fish. Aquat. Sci. 92.
- Pennington, J. T. 1985. The ecology and fertilization of echinoids eggs: the consequences of sperm dilution, adult aggregation, and synchronous spawning. Biol. Bull. 169: 417-430.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada, Bulletin 191. Ottawa.
- Shirley, S.M. and G.H. Kruse. 1995. Development of the fishery for weathervane scallops, *Patinopecten caurinus* (Gould, 1850), in Alaska. Journal of Shellfish Research, 14 (1): 71-78.
- Starr, R.M. and J.E. McCrae. 1983. Weathervane scallop (*Patinopecten caurinus*) investigations in Oregon, 1981-1983. Oregon Department of Fish and Wildlife Marine Region, Newport, Oregon.
- Stokesbury, K. D., and J. H. Himmelman. 1993. Spatial distribution of the giant scallop, *Placopecten magellanicus* in unharvested beds in Baie des Chaleurs, Ouebec. Mar. Ecol. Prog. Ser. 96:159-168.
- Urban, D., D. Pengilly and I. Vining. 1994. The scallop observer program and statewide data analysis, summary to the Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K94-28, Kodiak.
- Walters, C. 1986. Adaptive management of renewable resources. MacMillan Publishing Company, New York.

Table 1. Historic statewide commercial weathervane scallop catch, number of vessels and number of landings, excluding Cook Inlet, 1967-2001/02.

Year	Number Vessels	Number Landings ^a	Commercial Catch ^b
1967	2	6	778 ^c
1968	19	125	1,677,268
1969	19	157	1,849,947
1970	7	137	1,440,338
1971	5	60	931,151
1972	5	65	1,167,034
1973	5	45	1,109,405
1974	3	29	504,438
1975	4	56	435,672
1976		Confidential	
1977		Confidential	
1978		No Fishery	
1979		Confidential	
1980	8	56	616,717 ^c
1981	18	101	924,441
1982	13	120	913,996
1983	5	30	192,310
1984	6	52	383,512
1985	7	47	615,564
1986	8	74	667,258
1987	4	54	599,947 ^d
1988	4	47	341,070
1989	7	55	534,763
1990	9	144	1,473,535
1991	6	139	1,136,649
1992	7	133	1,741,578
1993	13	144	1,510,563
1994/95	15	104	1,240,775
1995/96	10	29	410,743 ^d
1996/97	4	19	704,196
1997/98	6	24	783,703
1998/99	8	23	818,064
1999/2000	8	18	817,559
2000/01	7	15	730,101
2001/02	4	20	554,831

^aPrior to and including 1995, number of landings is equal to the number of fish tickets.

After 1995, number of landings is equal to number of deliveries. A delivery typically includes multiple tickets.

^bPounds of shucked scallop meats.

^cUnshucked scallop deliveries were converted to shucked meats using a 10% conversion factor.

^dIncludes illegal harvest.

Table 2. Statewide crab bycatch limits, in percent of the crab abundance estimate or number of crab.

Scallop Registration Areas	Red King Crab	C. bairdi	C. opilio
Yakutat (D)			
District 16	NA	NA	NA
Remainder of Area D	NA	NA	NA
Prince William Sound (E)			
Eastern Section of outside District	NA	0.5% ^a	NA
Cook Inlet (H)			
Kamishak District	0.5% ^a	60 crabs ^a	NA
Outer/Easter/Barren Island Districts	NA	NA	NA
Kodiak (K)			
Shelikof District	0.5% or 1.0%	0.5% or 1.0%	NA
Northeast District	0.5% or 1.0%	0.5% or 1.0%	NA
Semidi District	Regulated inseason	Regulated inseason	NA
Alaska Peninsula (M)	0.5% or 1.0%	0.5% or 1.0%	NA
Bering Sea (Q)	500 crabs ^a	Three Tier Approach	Three Tier Approach
Dutch Harbor (O)	0.5% or 1.0%	0.5% or 1.0%	NA
Adak (R)	50 ^b	10,000 ^b	NA

NA= Not applicable

^aFixed CBL

^bBycatch limit set to allow scallop fleet adequate opportunity to explore and harvest scallop stocks while protecting the crab resource.

Table 3. Historic commercial catch, effort and value of weathervane scallops, Kodiak Registration Area, 1967 through 2001/02.

Year	Number Vessels	Number Landings ^a	Commercial Catch (pounds) ^b	Average Landing (pounds) ^b	Average Price/Lb.	Est. Value Exvessel (dollars)	Number Tows
1967 ^c	2	6	778	130	0.70	545	-
1968 ^c	8	89	734,084	8,248	0.85	623,971	-
1969	11	86	1,012,860	11,777	0.85	861,000	-
1970	7	102	1,417,612	13,898	1.00	1,500,000	-
1971	5	48	841,211	17,525	1.05	883,000	-
1972	5	68	1,038,793	15,276	1.15	1,200,000	-
1973	4	42	935,705	22,279	1.20	1,123,000	-
1974	3	14	147,945	10,568	1.30	192,000	-
1975	3	29	294,142	10,143	1.40	412,000	-
1976	1	6	75,245	12,541	1.59	119,000	-
1977	0	0	0	0	0	0	-
1978	0	0	0	0	0	0	-
1979				Confidential			
1980 ^c	7	33	355,200	10,763	3.60	1,278,720	-
1981	15	62	439,804	7,094	4.00	1,759,216	-
1982	8	62	435,645	7,026	3.25	1,416,000	-
1983	4	24	147,747	6,156	5.00	739,000	-
1984	7	37	309,502	8,365	4.00	1,238,000	-
1985	3	10	46,971	4,697	4.00	188,000	-
1986	5	21	180,600	8,600	4.25	767,550	-
1987	3	25	253,451	10,138	3.45	874,406	-
1988	3	21	195,811	9,324	3.68	720,584	-
1989	5	29	242,557	8,364	3.87	938,696	-
1990	7	73	689,497	9,445	3.43	2,364,974	10,950
1991	4	61	514,348	8,432	3.82	1,964,809	12,884
1992	3	44	389,854	8,860	3.96	1,543,822	8,328
1993 ^{d,e}	4	16	88,279	5,517	5.15	454,637	1,708
1993/94	10	48	318,361	6,633	5.15	1,639,559	7,060
1994/95	10	32	355,628	11,113	5.79	2,052,543	6,449
1995/96				Season Closed			
1996/97	4	13	268,545	20,657	6.30	1,691,833	2,760
1997/98	5	14	360,339	25,739	6.50	2,342,203	4,757
1998/99	8	12	301,600	25,133	6.40	1,930,240	3,515
1999/2000	6	9	266,012	29,557	6.25	1,662,575	2,673
2000/01	5	7	260,052	37,150	5.50	1,430,286	1,989
2001/02	4	8	259,672	32,459	5.25	1,363,278	2,439

^a Prior to 1995/96, number of landings is equal to the number of fish tickets. After 1995/96, number of landings is equal to number of deliveries (off-loads containing Kodiak scallops).

^b Pounds of shucked scallop meats.

^c Unshucked scallop deliveries were converted to shucked meats using a 10% conversion factor.

^d January 1 - June 30 time period.

^e Includes harvest from exploratory fishery.

Table 4. Commercial harvest, average shell height from retained catch and catch per unit effort from observer data, Westward Region, 1993/94 through 2001/02.

REGISTRATION AREA/DISTRICT																		
Year	Kodiak Area									Alaska Peninsula			Bering Sea			Dutch Harbor		
	Northeast District			Shelikof District			Semidi District											
	Harvest ^a	SH ^b	CPUE ^c	Harvest ^a	SH ^b	CPUE ^c	Harvest ^a	SH ^b	CPUE ^c	Harvest ^a	SH ^b	CPUE ^c	Harvest ^a	SH ^b	CPUE ^c	Harvest ^a	SH ^b	CPUE ^c
1993/94	155,187	144	319	105,017	128	467	58,157	145	319	112,087	119	575	284,414	146	598	38,731	128	517
1994/95	35,517	151	220	313,741	131	404	^d 153	^d	65,282	127	372	505,439	147	535	1,931	158	291	
1995/96	season closed			^d 134	^d													
1996/97	11,430	144	253	219,305	136	537	37,810	154	283	12,560	126	398	150,295	147	619	no reported effort		
1997/98	95,858	140	439	258,346	139	565	6,315	147	176	51,616	135	374	97,002	151	482	5,790	127	326
1998/99	120,010	127	497	179,870	137	522	15,806	151	149	63,290	128	383	96,795	147	514	46,432	128	417
1999/2000	77,119	131	689	187,963	130	442	930	152	253	75,535	124	386	164,929	145	562	6,465	134	249
2000/01	79,965	135	619	180,087	134	608	no reported effort			7,660	119	299	205,520	142	708	season closed		
2001/02	80,470	140	720	179,202	140	539	no reported effort			season closed			140,871	141	554	season closed		

^a Harvest in pounds of shucked meats.

^a Scallop shell heights (SH) in mm.

^c Catch per unit effort (CPUE) is equal to pounds (round weight) of retained scallops per dredge-hour.

^d Confidential.

Table 5. Historic commercial catch, effort and value of weathervane scallops, Alaska Peninsula Registration Area, 1975 through 2001/02.

Year	Number Vessels	Number Landings ^a	Commercial Catch (pounds) ^b	Average Landing (pounds) ^b	Average Price/Lb	Est. Value Exvessel (dollars)	Number Tows
1975				Confidential			
1976				No Fishing			
1977				No Fishing			
1978				No Fishing			
1979				No Fishing			
1980				No Fishing			
1981				Confidential			
1982	6	20	205,691	10,284	3.35	689,064	-
1983				Confidential			
1984				No Fishing			
1985				Confidential			
1986				No Fishing			
1987				Confidential			
1988				Confidential			
1989				No Fishing			
1990				Confidential			
1991				Confidential			
1992				No Fishing			
1993 ^c				Confidential			
1993/94	6	7	112,087	16,012	5.15	577,248	928
1994/95	7	11	65,282	5,935	5.79	377,983	1,006
1995/96				Closed			
1996/97	2 ^d	2	12,560	6,280	6.30	79,128	185
1997/98	3	6	51,616	8,603	6.50	335,504	1,054
1998/99	4	4	63,290	15,822	6.40	405,056	684
1999/2000	5	5	75,535	15,107	6.25	472,094	1,107
2000/01	3	3	7,660	2,553	5.50	42,130	189
2001/02				Closed			

^a Prior to 1995/96, number of landings is equal to the number of fish tickets. After 1995/96, number of landings is equal to number of deliveries (off-loads) containing Alaska Peninsula scallops.

^b Pounds of shucked scallop meats.

^c January 1-June 30 time period.

^d Vessel operators released confidential data.

Table 6. Historic commercial catch, effort and value of weathervane scallops, Bering Sea Registration Area, 1987 through 2001/02.

Year	Number Vessels	Number Landings ^a	Commercial Catch (pounds) ^b	Average Landing (pounds) ^b	Average Price/Lb	Est. Value Exvessel (dollars)	Number Tows
1987							
				Confidential			
1988				No Reported Catch			
1989				No Reported Catch			
1990				Confidential			
1991				Confidential			
1992				No Reported Catch			
1993 ^c	6	23	329,399	14,322	5.22	1,719,463	3,792
1993/94	9	16	284,414	17,776	5.22	1,484,641	3,578
1994/95	8	29	505,439	17,429	6.00	3,032,634	6,619
1995/96				Season Closed			
1996/97	1 ^d	2	150,295	75,147	NA	NA	952
1997/98	2 ^d	5	97,002	19,400	7.05	683,864	1,276
1998/99	4	4	96,795	24,198	6.30	609,808	1,175
1999/2000	2	4	164,929	41,232	6.25	1,030,806	1,736
2000/01	3	4	205,520	51,380	5.50	1,130,360	1,608
2001/02	3	5	140,871	28,174	5.25	739,572	1,406

^a Prior to 1995/96, number of landings is equal to number of fish tickets. After 1995/96, number of landings is equal to number of deliveries (off-loads) containing Bering Sea scallops.

^b Pounds of shucked scallop meats.

^c January 1- June 30.

^d Vessel operators released confidential data.
NA = Not Applicable

Table 7. Historic commercial catch, effort and value of weathervane scallops, Dutch Harbor Registration Area, 1982 through 2001/02.

Year	Number Vessels	Number Landings ^a	Commercial Catch (pounds) ^b	Average Landings (pounds) ^b	Average Price/Lb.	Est. Value Exvessel (dollars)	Number Tows
1982	5	8	62,105	7,763	3.11	193,147	NA
1983			No Reported Catch				
1984			No Reported Catch				
1985			Confidential				
1986	5	37	406,642	10,990	3.50	1,423,247	8,752
1987			Confidential				
1988			Confidential				
1989			Confidential				
1990			Confidential				
1991			Confidential				
1992			Confidential				
1993/94	3	6	39,346	6,558	NA	NA	572
1994/95	3	3	1,931	644	NA	NA	52
1995/96			Confidential/State Water Only				
1996/97			No Reported Fishing				
1997/98	1 ^c	1	5,790	5,790	7.05	40,819	105
1998/99	4	5	46,432	9,286	6.30	295,522	479
1999/2000	1 ^c	1	6,465	6,465	6.25	40,500	167
2000/01			Season closed				
2001/02			Season closed				

^aPrior to 1995/96, number of landings is equal to number of fish tickets. After 1995/96, number of landings is equal to number of deliveries (off-loads) containing Dutch Harbor scallops.

^b Pounds of shucked scallop meats.

^c Vessel operator released confidential data.

NA = Not Applicable

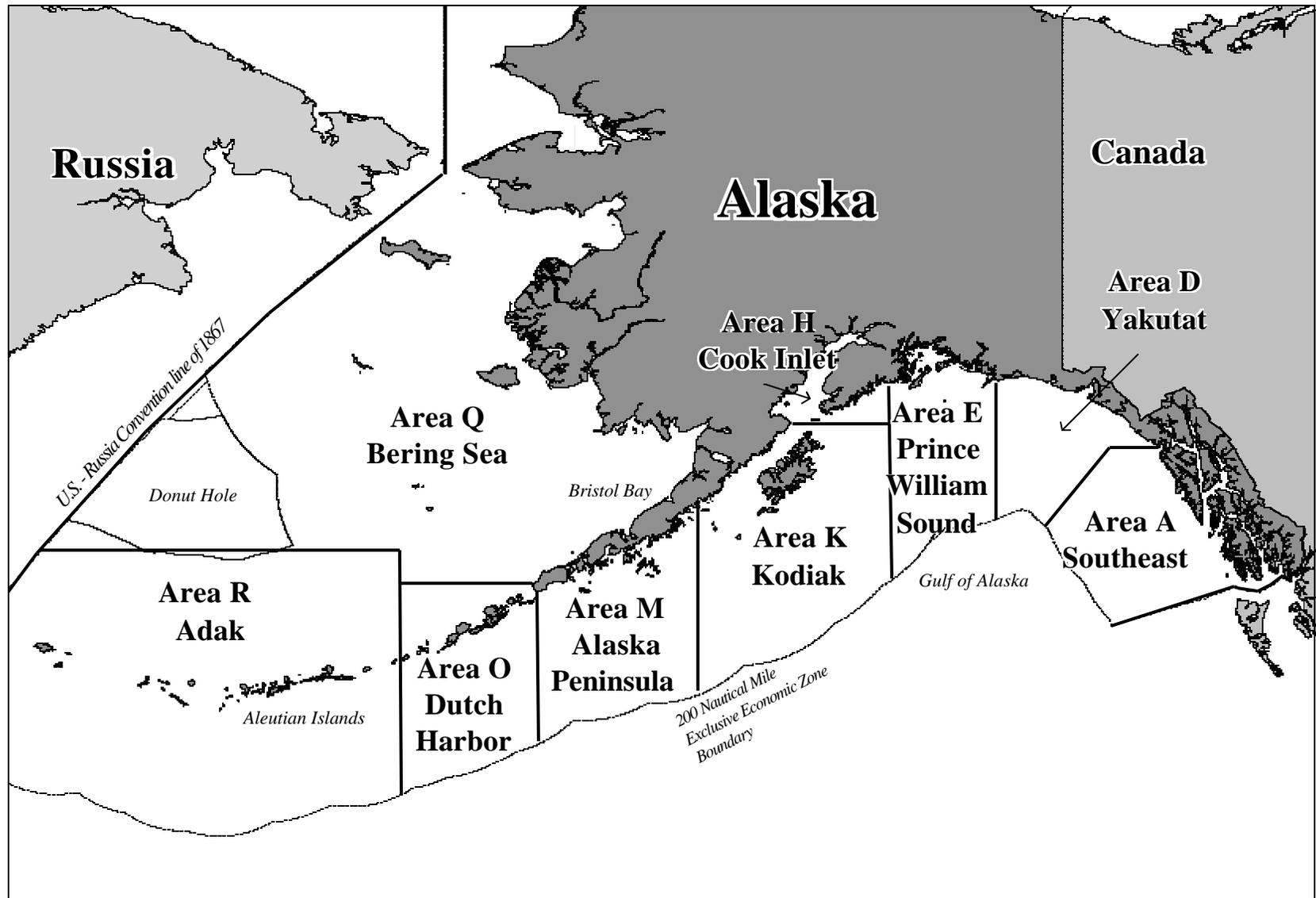


Figure 1. State of Alaska weather vane scallop fishing registration areas.

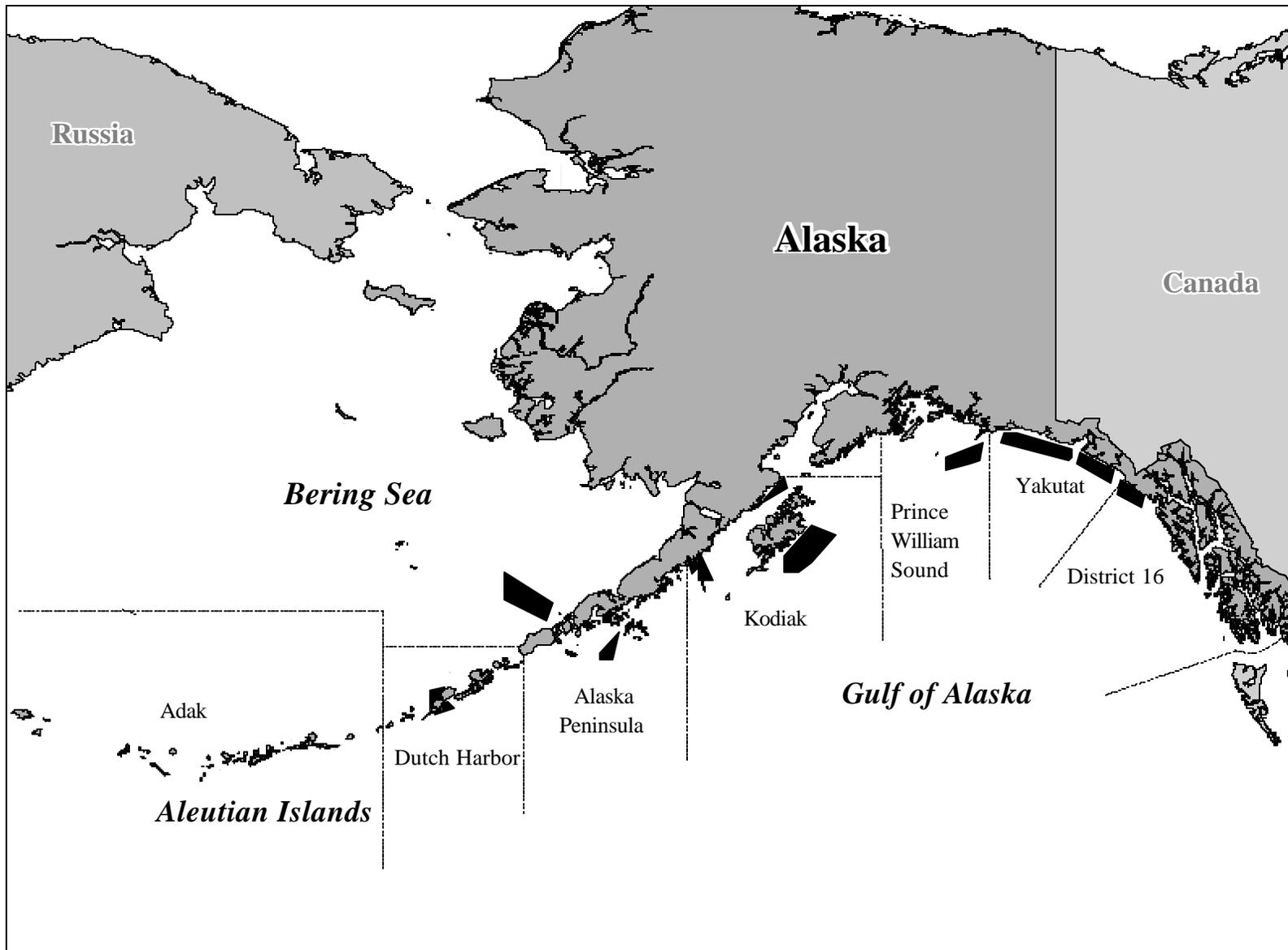


Figure 2. Major weathervane scallop fishing locations in coastal waters of Alaska.

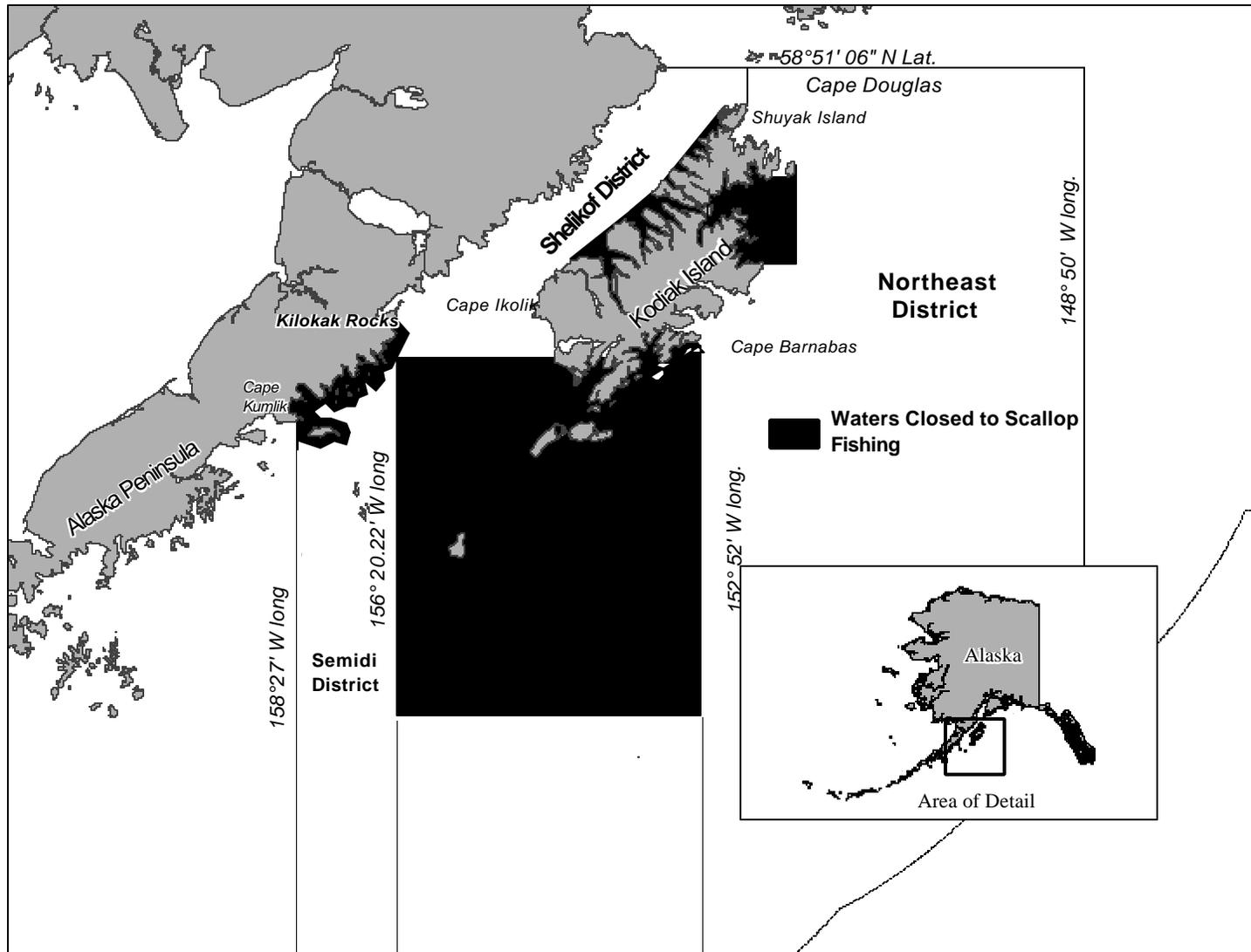


Figure 3. Kodiak weathervane scallop fishing registration area and closed waters.

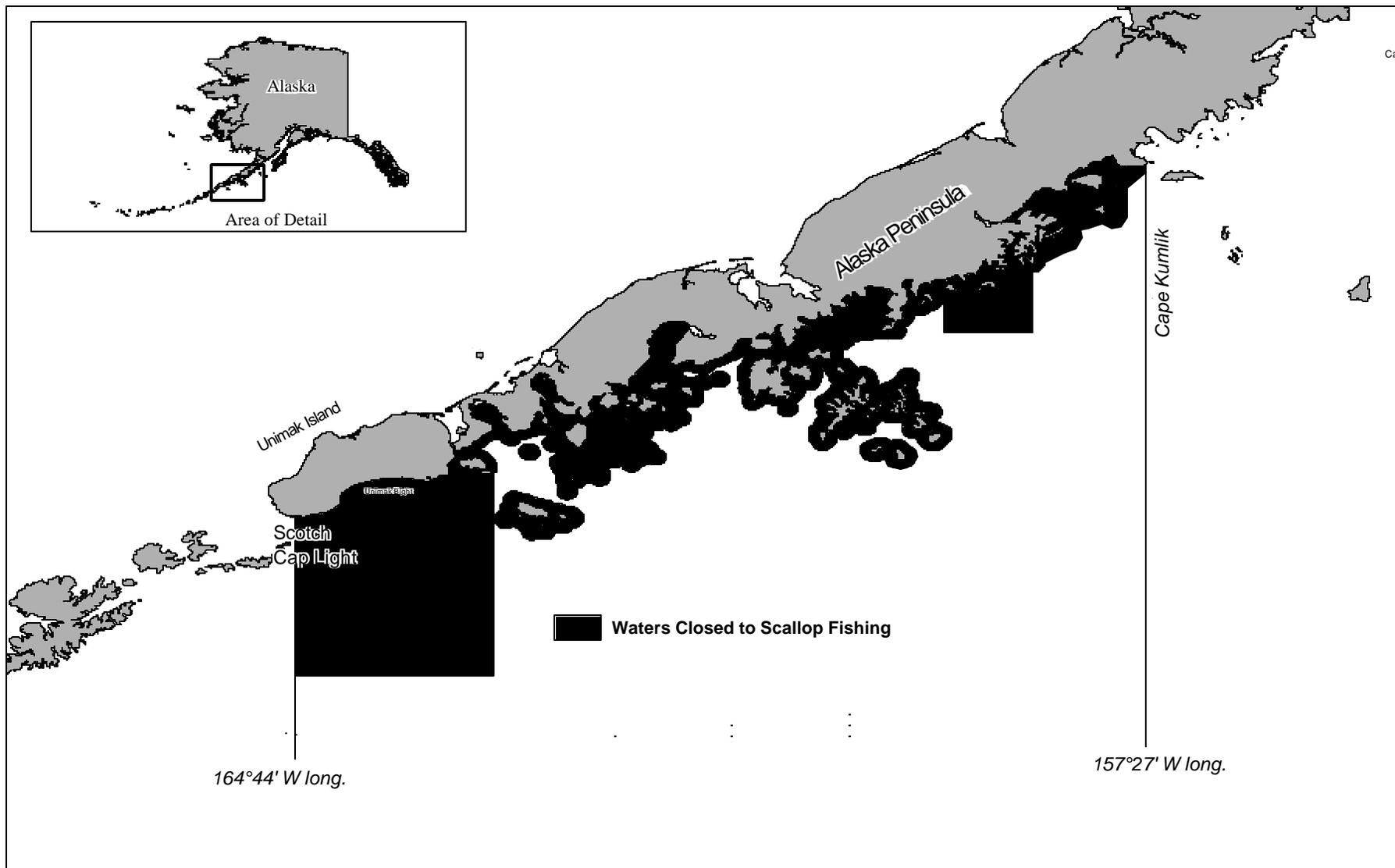


Figure 4. Alaska Peninsula weathervane scallop fishing registration area and closed waters.

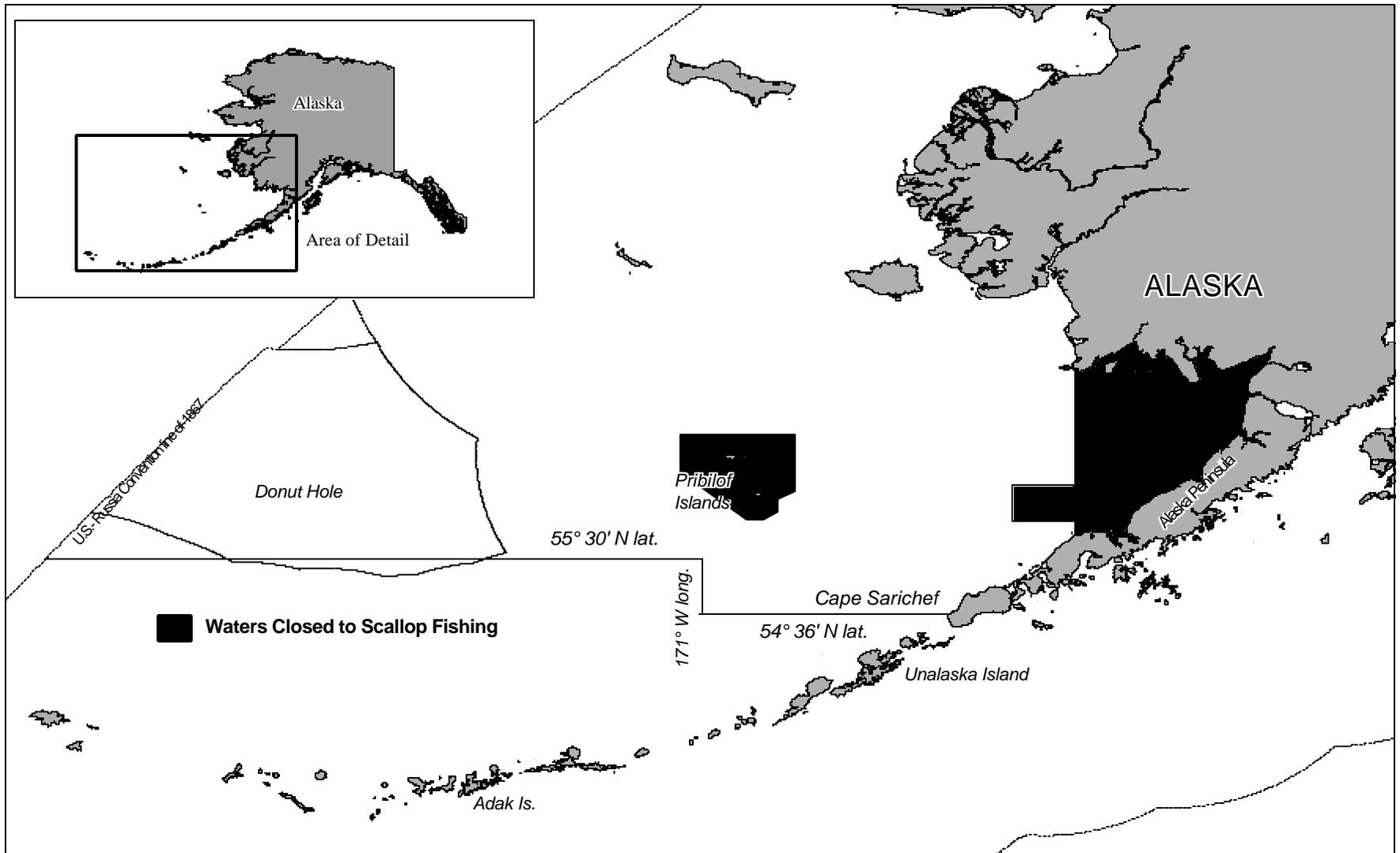


Figure 5. Bering Sea weathervane scallop fishing registration area and closed waters.

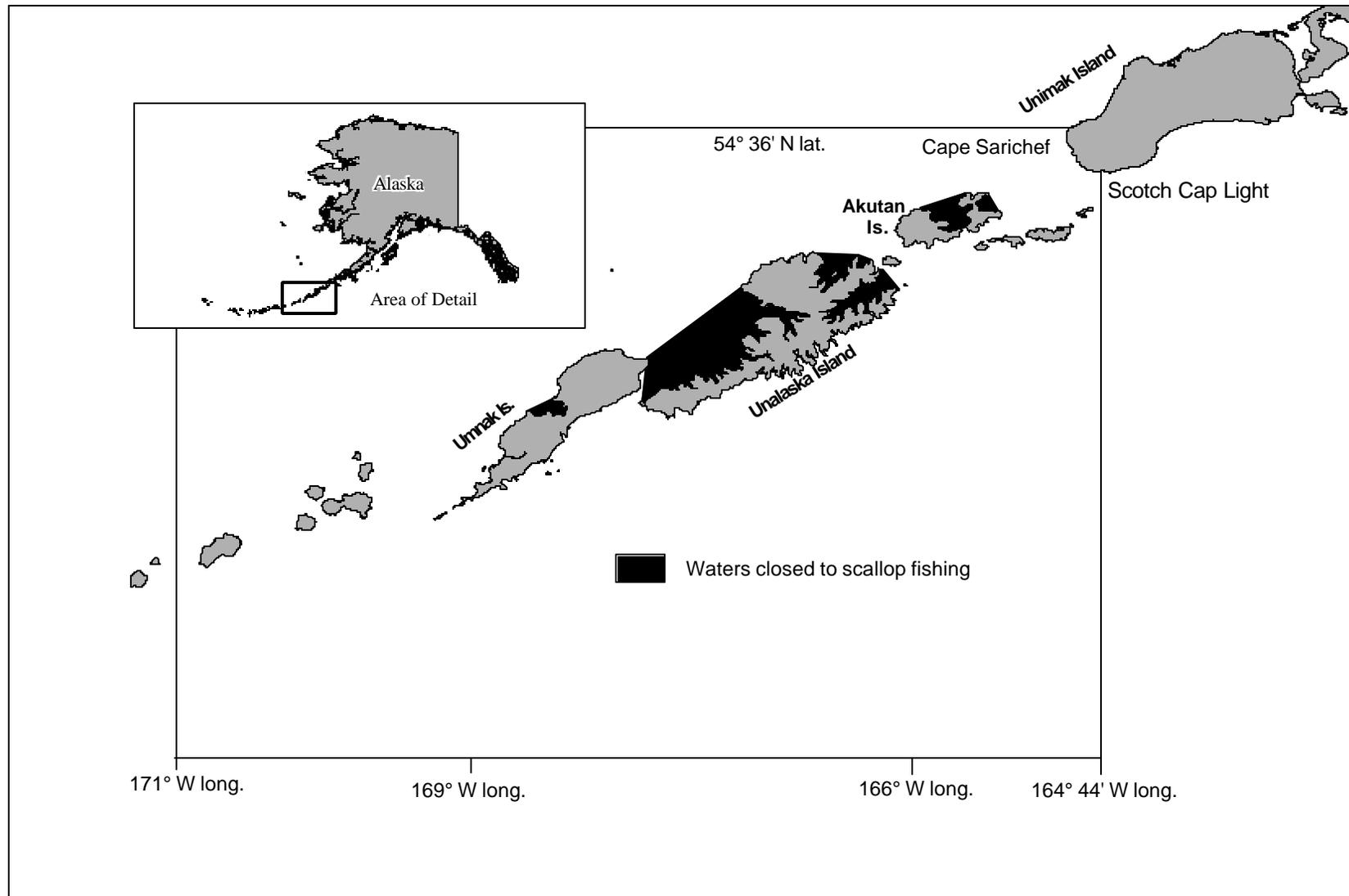


Figure 6. Dutch Harbor weathervane scallop fishing registration area and closed waters.

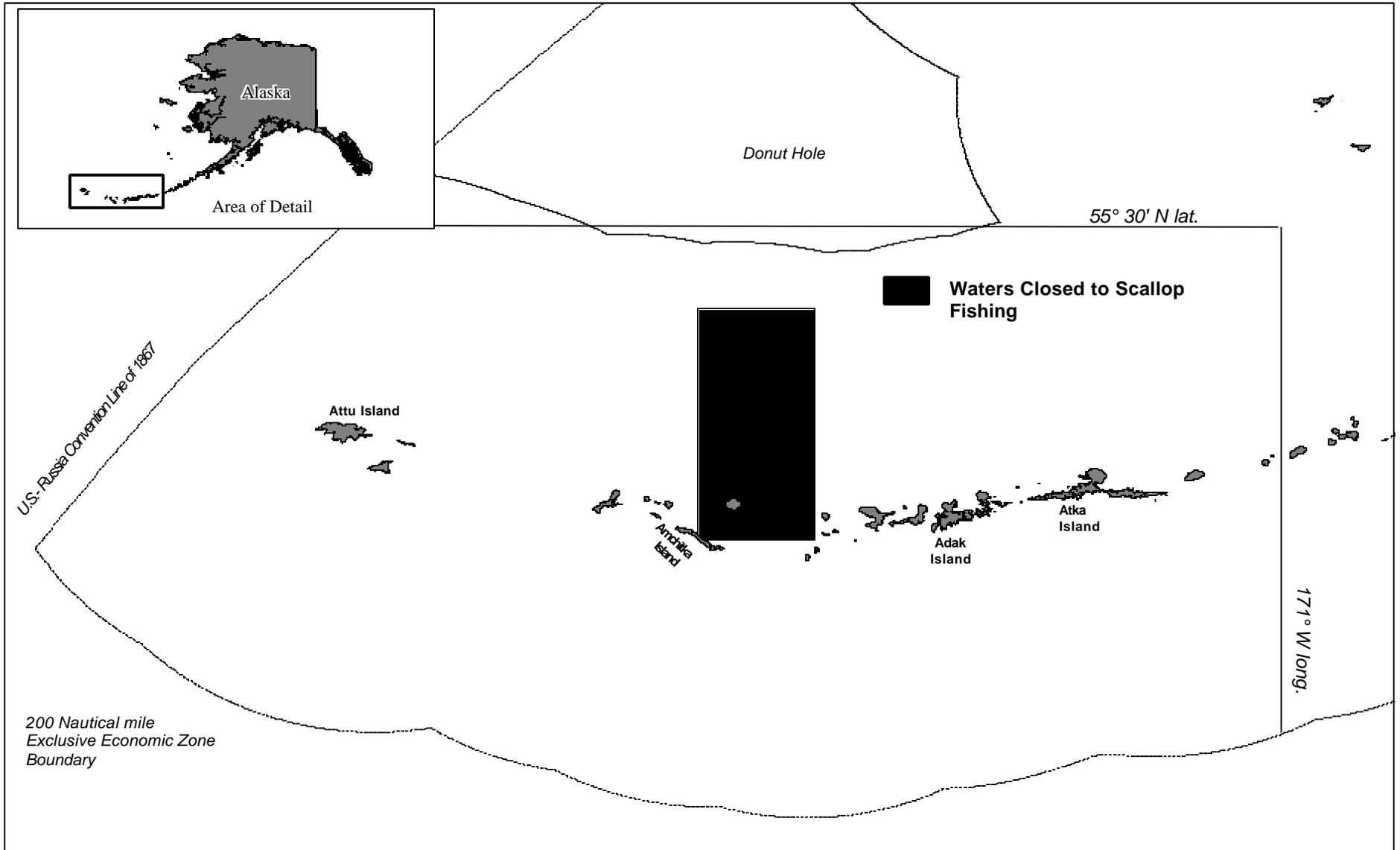


Figure 7. Adak weathervane scallop fishery registration area and closed waters.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.