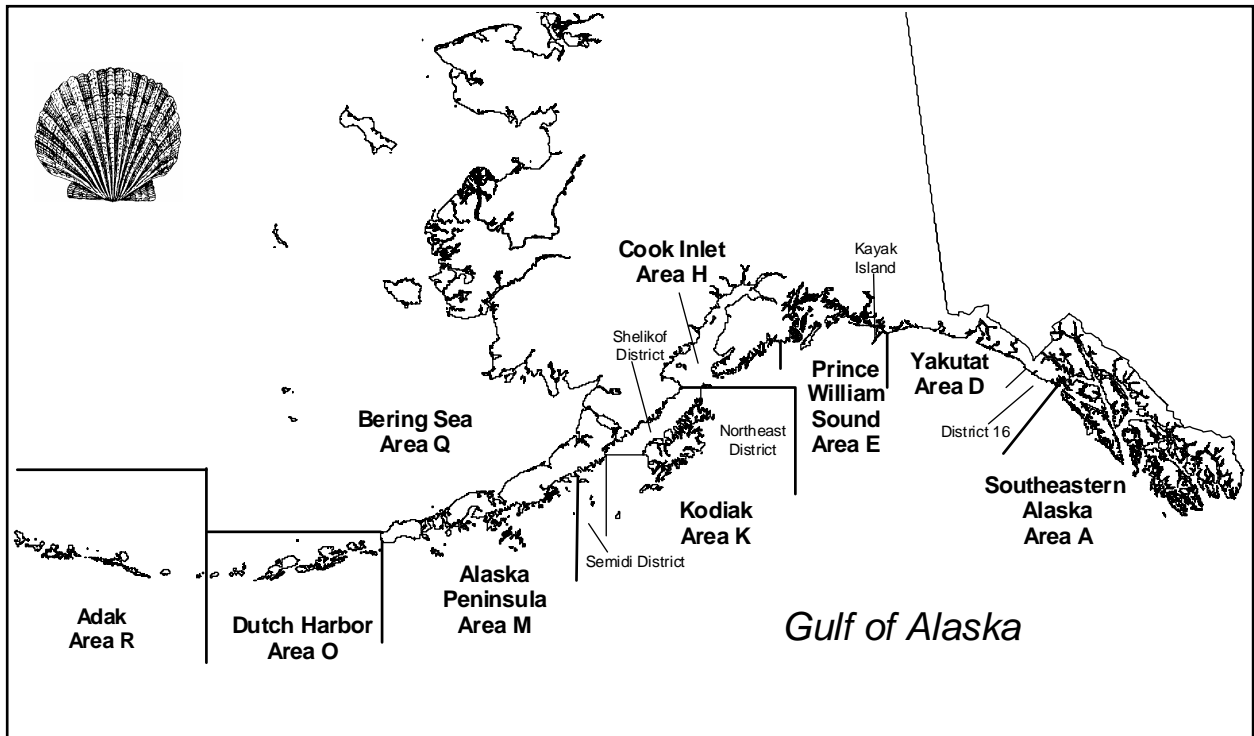


# STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

## FOR THE WEATHERVANE SCALLOP

### FISHERY OFF ALASKA



Compiled by

### The Scallop Plan Team

With contributions by:

F. Bowers, R. Burt, K. J. Goldman, R. L. Gustafson, G. Harrington,  
S. E. Melton, S. Miller, G. Rosenkranz, M. Stichert,  
D. L. Stram, J. Stratman, C. E. Trowbridge, and J. Zheng.

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North Pacific Fishery Management Council  
605 West 4<sup>th</sup> Avenue, Suite 306  
Anchorage, Alaska 99501

# Table of Contents

List of Tables .....	iii
List of Figures .....	iv
1 Introduction .....	1
1.1 Responses to Comments from the SSC .....	1
1.2 Summary of New Information Included in the SAFE Report .....	3
1.3 Historical Overview of the Scallop Fishery .....	3
1.4 Weathervane Scallop Biology .....	4
1.5 Economic Overview of the Scallop Fishery .....	7
2 Overview of Scallop Fishery and Management .....	8
2.1 Management .....	10
2.2 Stock Assessments and GHGs .....	11
2.3 Fishery .....	13
2.4 Observer Program .....	13
2.5 Crab Bycatch Limits .....	14
2.6 Scallop License Limitation Program .....	18
2.7 Voluntary Scallop Cooperative .....	18
2.8 Overfishing Definition .....	19
3 Stock Status .....	22
3.1 Yakutat Registration Areas: Area D and District 16 .....	22
3.2 Prince William Sound Registration Area .....	29
3.3 Cook Inlet Registration Area, Kamishak District .....	33
3.4 Kodiak Registration Area, Northeast District .....	37
3.5 Kodiak Registration Area, Shelikof District .....	41
3.6 Kodiak Registration Area, Southwest District .....	44
3.7 Kodiak Registration Area, Semidi District .....	44
3.8 Alaska Peninsula Registration Area .....	45
3.9 Bering Sea Registration Area .....	48
4 Ecosystem Considerations .....	53
4.1 Ecosystem Effects on the Stock .....	53
4.2 Fishery Effects on Ecosystem .....	53
4.3 Trawl Survey Information on Scallop Stocks .....	55
5 Literature Cited .....	58

## List of Tables

Table 1	Statewide Commercial Weathervane Scallop Real Wholesale Value, 1993/94—2008/09. ....	8
Table 2	Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.....	15
Table 3	Bycatch of crabs (number crabs) by species in the Bering Sea scallop fishery, 1995–2008. ....	16
Table 4	Bycatch of Tanner crabs by Area/District in the Gulf of Alaska scallop fishery, 2008/2009. ....	16
Table 5	Alaska weathervane scallop harvest and Maximum Sustainable Yield from FMP, 1993/94—2008/09 seasons. ....	19
Table 6	Yakutat Area D scallop fishery summary statistics. ....	23
Table 7	Yakutat District 16 scallop fishery summary statistics. ....	26
Table 8	Standardized Kayak Island dredge survey summary—standardized areas are 78.99 nm <sup>2</sup> for the East bed and 48.66 nm <sup>2</sup> for the West bed .....	30
Table 9	Prince William Sound Area E scallop fishery summary statistics .....	31
Table 10	Cook Inlet, Kamishak District scallop fishery summary statistics.....	35
Table 11	Kodiak Northeast District scallop fishery summary statistics. ....	38
Table 12	Kodiak Shelikof District scallop fishery summary statistics. ....	42
Table 13	Kodiak Semidi District scallop fishery summary statistics.....	45
Table 14	Alaska Peninsula Area scallop fishery summary statistics. ....	46
Table 15	Bering Sea Area scallop fishery summary statistics. ....	49
Table 16	Dutch Harbor Area scallop fishery summary statistics. ....	52
Table 17	Most frequently caught species/items in 2008/2009 scallop dredges (% by weight). ....	55

## List of Figures

Figure 1	Alaska Weathervane Scallop Commercial Fishing Registration Area. ....	9
Figure 2	Map showing Alaska scallop fishery registration areas. General areas of effort during the 2008/09 season are overlaid by black polygons .....	9
Figure 3	Statewide scallop harvest (pounds shucked scallop meats) and MSY levels from FMP (note that 2009/10 catch data are preliminary). ....	20
Figure 4	Scallop catch (top), dredge-hrs (center), and CPUE (bottom) during the 2008/09 statewide weathervane scallop fishery .....	21
Figure 5	Yakutat Area D Scallop Harvest and CPUE, 1993/94—2008/09 seasons. ....	24
Figure 6	Estimated scallop shell height distributions from the 2000/01—2008/09 Yakutat Area D fishing seasons. ....	25
Figure 7	Yakutat District 16 Scallop Harvest and CPUE, 1993/94—2008/09 seasons. ....	27
Figure 8	Estimated scallop shell height distributions from the 1999/00—2008/09 Yakutat District 16 fishing seasons. No 2003/04 plot was created due to small samples size. ....	28
Figure 9	Prince William Sound Scallop Harvest and CPUE, 1993/94—2008/09 seasons. ....	31
Figure 10	Estimated scallop shell height distributions from the 2001/02 – 2008/09 Prince William Sound fishing seasons. ....	32
Figure 11	A) Photo of sled-dredge onboard deck of R/V Pandalus, with 8’ dredge bag in foreground; B) ADF&G sled-dredge with bag stretched out on deck after trial tow (8’ dredge can be seen in background). ....	34
Figure 12	Barplots of Area H scallop fishery statistics. ....	36
Figure 13	Kodiak Northeast District Harvest and CPUE, 1993/94—2008/09 seasons. ....	39
Figure 14	Estimated scallop shell height distributions from the 2001/2002—2008/09 Kodiak Northeast District fishing seasons. ....	40
Figure 15	Estimated scallop shell height distributions from the 2001/02—2008/09 Kodiak Shelikof District fishing seasons. ....	43
Figure 16	Kodiak Shelikof District Harvested and CPUE, 1993/94—2008/09 seasons. ....	44
Figure 17	Barplots of Alaska Peninsula scallop fishery statistics. ....	47
Figure 18	Bering Sea Scallop Harvest and CPUE, 1993/94—2008/09 seasons. ....	49
Figure 19	Estimated scallop shell height distributions from the 2001/02—2008/09 Bering Sea fishing seasons. ....	50
Figure 20	Dutch Harbor Area Scallop Harvest and CPUE, 1994/95—2008/09 seasons. ....	52
Figure 21	Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS trawl surveys in the eastern Gulf of Alaska. ....	56
Figure 22	Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS and ADF&G trawl surveys in the Kodiak Area. ....	56
Figure 23	Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS and ADF&G trawl. ....	57

# 1 Introduction

The *National Standard Guidelines for Fishery Management Plans*, published by the National Marine Fisheries Service, require that a stock assessment and fishery evaluation (SAFE) report is prepared and reviewed annually for each fishery management plan (FMP). The SAFE report summarizes the current biological and economic status of the fishery and analytical information used in fishery management such as guideline harvest levels (GHLs) and harvest strategies. The report is assembled by the Scallop Plan Team (SPT, Plan Team) with contributions from the State of Alaska Department of Fish and Game (ADF&G), the National Marine Fisheries Service (NMFS), and the North Pacific Fishery Management Council (NPFMC, Council). The SAFE report is presented to the Council on an annual basis and is also available to the public.

The Scallop Plan Team met in Juneau on March 3-4, 2010 to review the status of the weathervane scallop stocks, to discuss additional issues of importance in scallop management, and to compile the annual SAFE report. The Plan Team review was based on presentations by staff of the NPFMC, NMFS, and ADF&G with opportunity for public comment and input. Members of the Plan Team who compiled the report were Gregg Rosenkranz (co-chair), Diana Stram (co-chair), Gretchen Harrington, Scott Miller, Jie Zheng Richard Gustafson, Ryan Burt, and Joe Stratman.

The scallop fishery in Alaska's Exclusive Economic Zone (EEZ; from 3 to 200 miles offshore) is jointly managed by the state and federal government under the FMP. Most aspects of scallop fishery management are delegated to the State of Alaska (State), while limited access and other federal requirements are under jurisdiction of the federal government. The FMP was developed by the NPFMC under the Magnuson Stevens Act (MSA) and approved by NMFS on July 26, 1995. The NPFMC updated and adopted a revised FMP in 2005.

Although the FMP covers all scallop stocks off the coast of Alaska, including weathervane scallops (*Patinopecten caurinus*), pink or reddish scallops (*Chlamys rubida*), spiny scallops (*Chlamys hastata*), and rock scallops (*Crassadoma gigantea*), the weathervane scallop is the only commercially exploited stock at this time. Commercial fishing for weathervane scallops occurs in the Gulf of Alaska, Bering Sea, and Aleutian Islands. Scallop registration areas used by ADF&G in management of the fishery are shown in Figure 1 and general fishing locations are shown in Figure 2.

In 1996, optimum yield (OY) was established as 0 to 1.8 million pounds of shucked scallop meats. A more conservative approach was taken in 1998, when OY was defined as 0 to 1.24 million pounds of shucked scallop meats. Statewide scallop harvests have not exceeded OY, and scallop stocks are not overfished.

## 1.1 Responses to Comments from the SSC

Comments on the 2009 SAFE provided by the Scientific and Statistical Committee (SSC) in April 2009 and responses from the SPT relative to this 2010 SAFE are below:

**Comment:** The SPT minutes reflect many of the same issues the SSC discussed in previous SAFE reviews. The SSC notes that the Scallop FMP will need to be amended to comply with ACL requirements. Given that the ACLs need to be set by 2011, the SSC recommends that the SPT initiate the process to develop ACLs, providing justification and incorporating uncertainty into the estimates. The SSC recommends the development of an FMP amendment to comply with new ACL rules. SAFE authors should consider developing a set of tier levels that address differing information levels to establish these specifications.

**SPT response:** The SPT reviewed a draft document on the upcoming ACL amendment for the Scallop FMP prepared by Council staff. Consideration of a set of tier levels to address differing levels of information by

region is contained in the suite of alternative management measures in that analysis. Further comments from the SPT on the ACL approach, consideration of uncertainty, and recommendations are contained in the SPT minutes.

**Comment:** The SAFE document, itself, is not well organized and includes a set of documents prepared for other purposes. This was formerly also the case for the Crab SAFE. Separate annual documents should be integrated into one comprehensive document, in which Appendices include only occasional special additions. The report should contain necessary information to evaluate reference points (OFLs, GHLS, etc.). In restructuring the SAFE, the SSC recommends that the authors use the guidelines for the Crab and Groundfish SAFE documents as a template.

**SPT response:** The SAFE has been revised to better address the concept of one, single comprehensive document and contains no appendices of additionally published information. Further reorganization and restructuring of the SAFE will occur next year as progress is made towards reporting necessary information in the SAFE to comply with ACL requirements.

**Comment:** In the March/April 2008 SSC minutes, the SSC recommended that “next year’s SAFE include an explanation in the management chapter describing the process by which changes to GHLS are determined each year,” by registration area. This has not yet been accomplished. This topic is of particular interest with respect to potential biological conservation issues. The SSC further noted that, without prior documentation of the process (and undocumented scallop research conducted on local scales), there is concern of loss of institutional knowledge as managers and biologists retire. The SSC requests that the authors articulate the process by which fishery information (e.g., fishery CPUE, age/size composition, apparent recruitment levels) is used by managers to adjust GHLS.

**SPT response:** This information has been included by region in this year’s SAFE report.

**Comment:** The SSC requests the SPT to work with ADF&G fishery managers to move toward more formalized and consistent control rules that are biologically based, to aid in a transparent process for setting GHLS within registration areas each year.

**SPT response:** The SPT continues to discuss harvest control rules as they relate to ACL implementation. The selection of a preferred alternative for ACLs (and particularly the scale of management for ACLs, i.e., whether specified statewide or by region) will influence the necessity of revising regional management strategies. The establishment of harvest control rules for GHLS-setting is a delegated management responsibility to the State of Alaska.

**Comment:** The SSC makes the following additional requests:

- 1) The SSC encourages the development of a statewide ageing protocol and development of an age-structured model for scallop stocks in the Central Region.
- 2) The SSC would like to see the investigation of scallop movement within beds as a research priority, with the purpose of determining whether scallops can fill areas previously harvested.
- 3) SAFE authors should consider modeling the ecosystem section of the scallop SAFE after the groundfish SAFE and remove the last sentence in section 4.1.
- 4) The SAFE should include a more thorough description of predator-prey relationships, including effects of fishing on scallop predators, as well as considerations of habitat effects and bycatch.
- 5) An implementation plan should be developed for a potential statewide scallop survey, so that its efficacy can be evaluated. This should consider cost and efficiency of video review, transcription and the potential for sub-sampling.
- 6) The SSC encourages an evaluation of differences in dredge selectivity between fishing regions.

**SPT response:** Development continues towards an age-structured model for the Central region. The SPT continues to list scallop movement and larval studies amongst research priorities. The SPT will continue to work towards a more applied ecosystem considerations section understanding that modeling it after the groundfish SAFE report is beyond the scope of this section. The section on predators of scallop has been updated to reflect current information; however there remains limited information on predator-prey relationships for scallop species. Updated tables summarizing crab bycatch in the directed scallop fishery (Section 2.5) and bycatch of other species by weight (Table 17), have been included in this report. Implementing a plan for a statewide scallop survey is beyond the scope of this report. Additional discussion of dredge selectivity between regions in the State of Alaska as well as comparison with other regions for scallop fishing is contained in the draft ACL analysis.

## 1.2 Summary of New Information Included in the SAFE Report

This SAFE Report includes updated information through the 2008/2009 fishing season. New information included in this report since the previous report (NPFMC, 2009) includes the following:

- 1) Updated observer program summary data through 2008/2009 fishing season; including shell height distributions, retained catch, discarded catch, preliminary 2009/10 catch data where available, bycatch information from the directed fishery including Tanner, snow and red king crab bycatch by region;
- 2) Overview sections on regional fishery management added;
- 3) Updated information on Scallop Observer Program;
- 4) New revised section on scallop biology.

## 1.3 Historical Overview of the Scallop Fishery

Alaska weathervane scallop *Patinopecten caurinus* populations were first evaluated for commercial potential in the early 1950s by government and private sector investigators. Interest in the Alaska fishery increased in the late 1960s as catches from U.S. and Canadian sea scallop *Placopecten magellanicus* fisheries on Georges Bank declined. Commercial fishing effort first took place in Alaska during 1967 when two vessels harvested weathervane scallops from fishing grounds east of Kodiak Island. By the following year, 19 vessels including New England scallopers, converted Alaskan crab boats, salmon seiners, halibut longliners, and shrimp trawlers, entered the fishery.

From the inception of the fishery in 1967 through mid-May 1993, the scallop fishery was passively managed with minimal management measures. Closed waters and seasons were established to protect crabs and crab habitat. When catches declined in one bed, vessels moved to new areas. While this management strategy may have been acceptable for a sporadic and low intensity fishery, increased participation inevitably led to boom and bust cycles (Barnhart, 2003).

In the early 1990s, the Alaska weathervane scallop fishery expanded rapidly with an influx of boats from the East Coast of the United States. Concerns about overharvest of scallops and bycatch of other commercially important species such as crabs prompted the ADF&G Commissioner to designate the weathervane scallop fishery a high-impact emerging fishery on May 21, 1993. This action required ADF&G to close the fishery and implement an interim management plan prior to reopening. The interim management plan contained provisions for king and Tanner crab bycatch limits (CBLs) for most areas within the Westward Region. Since then, crab bycatch limits have been established for the Kamishak District of the Cook Inlet Registration Area and for the Prince William Sound Registration Area. The commissioner adopted the regulations and opened

the fishery on June 17, 1993, consistent with the measures identified in the interim management plan. The interim management plan included a provision for 100% onboard observer coverage to monitor crab bycatch and to collect biological and fishery data. In March 1994, the Alaska Board of Fisheries (BOF) adopted the interim regulations identified as the Alaska Scallop Fishery Management Plan, 5 AAC 38.076.

From 1967 until early 1995, all vessels participating in the Alaska scallop fishery were registered under the laws of the State of Alaska. Scallop fishing in both state and federal waters was managed under state jurisdiction. In January 1995, the captain of a scallop fishing vessel returned his 1995 scallop interim use permit card to the State of Alaska Commercial Fisheries Entry Commission in Juneau and proceeded to fish scallops in the EEZ with total disregard to harvest limits, observer coverage, and other management measures and regulations. In response to this unanticipated event, 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 an FMP could be implemented to close the fishery. Prior to August 28, 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 reopen 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 in-season actions duplicated by the federal system (Barnhart, 2003).

In March 1997, NPFMC approved Amendment 2, a vessel moratorium under which 18 vessels qualified for federal moratorium permits to fish weathervane scallops in federal waters off Alaska. By February 1999, the Council recommended replacing the federal moratorium program with a Federal License Limitation Program (LLP), which became Amendment 4 to the FMP. The Council's goal was to reduce capacity to approach a sustainable fishery with maximum net benefits to the Nation, as required by the Magnuson-Stevens Act. NPFMC's preferred alternative created a total of nine licenses with no area endorsements; each vessel is permitted to fish statewide. However, vessels that fished exclusively in the Cook Inlet Registration Area where a single 6-foot dredge was the legal gear type during the qualifying period were also limited to fishing a single 6-foot dredge in federal waters outside Cook Inlet. The NPFMC later modified the gear restriction in Amendment 10 to allow these vessels to fish 2 dredges with a combined maximum width of 20 feet. Amendment 10 was approved on June 22, 2005. NMFS published final regulations on July 11, 2005, which were effective August 10, 2005. NMFS implemented Amendment 10 by reissuing the two LLP licenses with the larger gear restriction.

## 1.4 Weathervane Scallop Biology

There are eight known species of scallops in Alaskan waters (Hennick, 1973), but only the Pacific Weathervane scallop and to a small extent, the pink scallop *Chlamys rubida* are commercially fished. Weathervane scallops are distributed from Point Reyes, California, to the Pribilof Islands, Alaska. The highest known densities in Alaska have been found to occur along the eastern Gulf of Alaska coast from Cape Spencer to Cape St. Elias, off Kodiak Island and in the Bering Sea. Weathervane scallops are found from intertidal waters to depths of 300 m, but abundance tends to be greatest between depths of 40-130 m on beds of mud, clay, sand, and gravel. Beds tend to be elongated along the direction of current flow. A combination of large-scale (overall spawning population size and oceanographic conditions) and small-scale (site suitability for settlement) processes influence recruitment of scallops to these beds.

**External Anatomy.** Scallops are bivalves, referring to the right and left valves of a scallop's shell. The



weathervane scallop is a large scallop with prominent, heavy, widely spaced, smooth ribs. The valves are wider than long and slightly convex. Weathervane scallops naturally lie on their right valve (bottom valve) which is white in color when scallops are small and light brown to golden yellow in mature scallops. The right valve is typically larger than the left valve (top valve), has less discrete color patterns, and flattened ridges.

The left valve is typically brown in color and may have barnacles and other marine flora and fauna attached to it. The left valve is normally always brown in color but, on occasion, an all white scallop may be found in the catch. A ligament along the dorsal margin at the hinge holds the two valves together. This ligament is a dark, elastic pad called the resilium and is located in a pit in the center of the hinge, at a point referred to as the umbo. The resilium will spring the valves open when the adductor muscle relaxes. Two protrusions at the hinge called auricles (sometimes called ears or wings) lengthen the hinge line. The auricles on individual weathervane scallops are nearly the same size. In a scallop, the hinge area of the shell is dorsal and the edge of the shell opposite the hinge is the ventral margin.

***Internal Anatomy.*** A scallop's soft inner parts can be viewed if the left (top) valve is carefully removed by cutting the adductor muscle away from the valve. The mantle is a thin, almost transparent sheet of tissue that envelops the body. It is normally attached to the valves except near the edges. The functions of the mantle are to secrete the shell, assist in respiration, control the inflow and outflow of water, and control movement when the animal swims. A row of tentacles emerge from the mantle and act primarily as feeding organs. A second row of shorter, more proximal tentacles are chemoreceptors. Numerous eyes occur along the margin of the mantle, capable of sensing shadows or movement.

The large, white, circular adductor muscle is centrally located on the valves. The adductor is composed of a large anterior smooth muscle (known as the "quick muscle") which contracts to snap the valves closed when the scallop is disturbed or swimming, and a smaller posterior striated muscle (known as the "catch muscle") which holds the valves in position after they have been closed by the smooth muscle. The adductor is known as the meat of the scallop and is normally the only part retained. Crescent-shaped gills encircle the adductor muscle and are composed of four demibranchs, two on either side of the body. Along with the mantle, they are used for respiration. The gills are also important in feeding.

The urogenital system is conspicuous upon dissection of a scallop, with the gonad lying in a semicircle around the anterior and ventral portions of the adductor. Sex is easily distinguished by the appearance of the gonad, unless it is completely empty of reproductive cells. The female gonad is orange-red to red in color and the male gonad is creamy white. Two kidneys, seen as small, thin, brown sac-like bodies lie flattened against the anterior part of the adductor muscle. The kidneys empty through large slits into the mantle chamber. Eggs or sperm are likewise extruded through ducts into the lumen of the kidney and then flow into the mantle chamber and expelled.

The small, white-colored foot is located anterior and ventral to the gonad. In the larval and juvenile stages, the foot is used for locomotion but in the adult, the foot is rudimentary and has little function. The opening of the byssal gland is halfway along the foot. Weathervane scallops often attach themselves to surfaces with an abbyssal thread until they are about one year old.

The digestive system consists of a mouth (located anteriorly near the hinge), a short esophagus, a stomach, an intestine that loops through the gonad and around the adductor muscle and an anus. Lying partly in the stomach and partly in the section of the intestine that enters the gonad is a structure called the crystalline style. This organ is amber colored, translucent, and rod-shaped. The crystalline style churns food in the stomach and releases an enzyme that assists in digestion. A simple circulatory system carries blood throughout the soft tissues. The heart lies in a transparent sac (the pericardium) dorsal to the adductor muscle.

Blood flows through the anterior and posterior aorta to all parts of the body, and returns via a series of thin walled sinuses which form the venous system.

**Growth.** Embryonic and larval scallop development is highly affected by temperature. The embryo normally develops into a larva within 72 hours. In the early stage, the larva has two valves, a complete digestive system and a velum. The velum is an organ peculiar to molluscan larvae, and is ciliated along its outer margin enabling the larva to swim well enough to maintain itself in the water column though it drifts with tides and currents. The velum also collects unicellular phytoplankton on which the larva feeds.

Adult scallops are filter feeders, feeding on plankton and other organic materials. Growth is very rapid in the first few years and is minimal after age 10. In general, weathervane scallops are long lived and individuals with shell height of 250 mm and 28 years have been reported.

Most scallops have concentric rings (circuli) on the shell and by studying these it is possible to tell their approximate age. Annuli are compressions of circuli that form during periods of very little growth; an annulus begins to develop on the margin of the scallop shell around October or November. These slow growth periods may correspond to gonad development and spawning activity (November to June) and changes in water temperatures in winter. Growth in young scallops, as indicated by the distances between the first three annuli is rapid, but slows down progressively afterward.

Prior to sexual maturity, annuli are not distinct because growth is relatively rapid for immature scallops. However, an annulus can often be found during the first three years by examining a scallop shell under a microscope and looking for a slowdown in growth. By the ten-ring stage and beyond, the gaps between succeeding annuli are often less than one millimeter. Very little growth takes place after the seventeenth annulus. In the Bering Sea, shells with up to twenty-nine annuli have been noted. Accurate shell aging of scallops is most easily accomplished after a biologist has a wide range of experience with scallop shells. Average shell heights of weathervane scallops vary from population to population.

**Reproduction.** Weathervane scallops sexually mature around age 3 or 4. They spawn annually, usually in early summer between May and early June and are generally about 100mm in shell height when they are sexually mature. Scallops are dioecious (the sexes are separate) although one hermaphroditic specimen has been reported (Kaiser, 1986). The sexes can be distinguished by the color of the gonads; female gonads are orange-red to red in color, and male gonads are creamy white. Otherwise, male and female gonads are similar in size and shape.

The mechanisms that initiate production and release of eggs and sperm are poorly understood, but water temperature is likely important. Spawning occurs over a protracted period of time and timing of spawning varies based on geographical location. Scallops discharge million of eggs and sperm, which leave the gonads, pass through the lumen of the kidney, and are expelled from the mantle cavity. Fertilization occurs at random in the water; eggs that are fertilized drift with the tides and currents for several weeks.

Within two to three weeks, metamorphosis takes place and the larva settles to the bottom. Metamorphosis is a time of high mortality, because the animal must rely on food reserves accumulated during the larval period. Over a two-week period, the gills develop into feeding organs. At this stage the larva is mature, with a well-developed foot, a pair of eyespots, rudimentary gills and a transparent shell. The juvenile scallop, or spat, may attach itself to the substrate, use its foot to move around, or swim. Within a few months, the shell becomes pigmented as they become adults.

**Behavior.** Scallops generally lie on the bottom on their right valve with the valves open about 10-15 mm at the ventral margins. The tentacles are extended and the eyes can be seen. If the scallop is disturbed, the

valves are quickly snapped shut. Often, a disturbed scallop will spin in place and end up faced in a different direction. Scallops are the only bivalve mollusks capable of swimming. The scallop uses a water jet action by opening its valves and taking in water, then closing its valves and forcing the water out - propelling the animal forward, ventral margin first. Repetition of this action lifts the scallop off the bottom, allowing it to swim forward. Swimming is most likely used to avoid predators and distances covered are short, no more than about 10 meters.

## 1.5 Economic Overview of the Scallop Fishery

An overview of Alaska weathervane scallop harvest and wholesale revenue is presented in Figure 1. Some of this data is excerpted from Kruse et al. (2005) and updated with information from annual scallop harvest information contained in Chapter 3, Stock Status. Vessel participation in this fishery has declined in recent years due to the Federal LLP and formation of a voluntary marketing cooperative. The Federal LLP limits the participation to 9 permit holders. Since 2000, no more than 8 vessels have participated, and in recent years only 4 vessels have participated.

Table 1 provides the statewide average price per pound of landed scallop meats, as well as an inflation adjusted price and total value. Total real gross first wholesale revenue is calculated by multiplying landed pounds of meats by the adjusted price. Adjusted price converts the landed prices by year to year 2009 values to allow for comparisons in current dollar values, after accounting for inflation.

It is important to note that landed scallop meats have been processed (shucked) and frozen at sea or delivered fresh for dock or roadside sales. Prior to 1996, almost all scallop meats were placed in muslin bags and iced (not frozen) at sea. Thus, although landed price is often referred to as an ex-vessel price, since 1996 it is actually primarily a first wholesale price in that the landed product is a primary processed product. As a result, gross revenue is identified as first wholesale value here, although some fresh product sales may continue to occur at dockside in the Cook Inlet region.

Also important to note is that there can be significant differences in prices for scallops that are frozen at sea compared to those that are sold fresh at the dock or on the roadside. In the past, some Cook Inlet scallops have been sold fresh. The statewide scallop price used here is calculated by the Alaska Department of Revenue (ADOR), Division of Taxation, and is an average of all the reported fish tax revenue collected from the scallop fishery. Thus, the average price is likely less than the prices received for fresh product and more than those received for frozen product. From 1993 through 2004, a spot price was used that was estimated from fish ticket data and informal surveys of the fleet (Barnhart, 2006). That price estimation process, however, has not occurred since the 2004/05 scallop season. Thus, the statewide average price calculated by ADOR (ADOR, 2009) is used in Table 1 for the 2005/06 through 2008/09 seasons. Of note is that the ADOR prices are considerably higher than the survey prices that were previously used, but declined significantly in the 2007/08 season when there was no Cook Inlet harvest.

Adjusted price has fluctuated during the past; trending upwards from a \$6.95 in 1993/94 to \$8.13 in 1997/98, then falling to \$5.88 in 2003/04, rebounding to \$8.10 by 2006/07, and then falling to \$5.94 in 2007/08. The statewide average 2008/09 price reported by ADOR increased to \$6.34. These price fluctuations may be directly related to U.S. East coast scallop stock conditions and related market prices. The dependence of market prices in the Alaska scallop fishery on east coast markets, and imported scallop prices, is a topic for further research.

First wholesale revenue in this fishery has varied considerably over the period as both price and landings have varied. The peak value in the fishery, since 1993, occurred in 1994/95 season when about \$9.6 million was earned. Since that time, real total first wholesale revenue in the fishery has fluctuated with prices. Overall, the total value has trended downward as landings have fallen from more than 1.2 million pounds down to a

low in 2008/09 of 342,434 pounds. The total real first wholesale revenue of a little less than \$2.2 million in the 2008/09 season was the lowest revenue total since 1993.

**Table 1 Statewide Commercial Weathervane Scallop Real Wholesale Value, 1993/94—2008/09.**

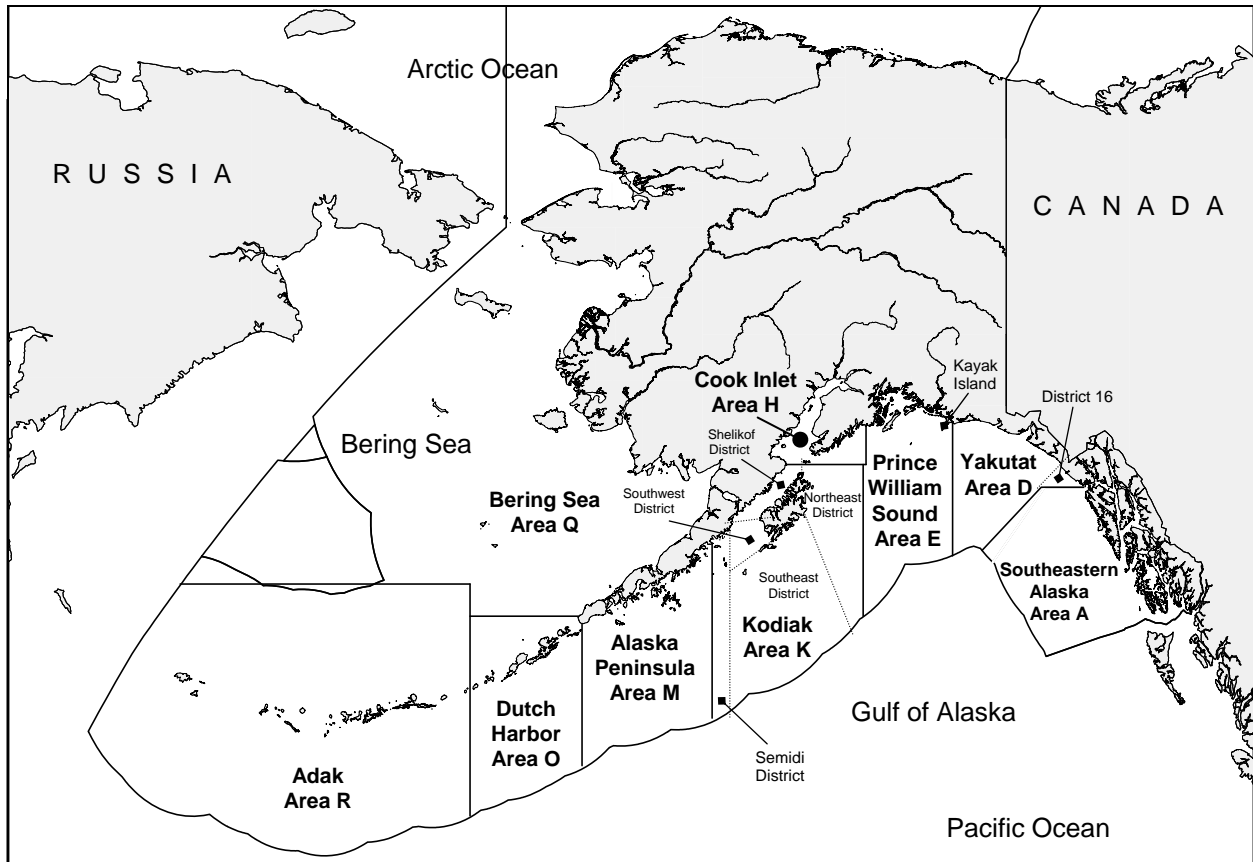
Year	Vessels	Catch (lbs. meats) <sup>a</sup>	Average Price/lb.	Inflation Factor	Adjusted Price	Real Wholesale Value
1993/94	15	984,583	\$5.15	1.35	\$6.95	\$6,845,313
1994/95	15	1,240,775	\$5.79	1.33	\$7.70	\$9,554,836
1995/96	10	410,743 <sup>b</sup>	\$6.05	1.3	\$7.87	\$3,230,494
1996/97	9	732,424	\$6.30	1.28	\$8.06	\$5,906,267
1997/98	9	818,913	\$6.50	1.25	\$8.13	\$6,653,668
1998/99	8	822,096	\$6.40	1.24	\$7.94	\$6,524,154
1999/00	10	837,971	\$6.25	1.22	\$7.63	\$6,389,529
2000/01	8	750,617	\$5.50	1.2	\$6.60	\$4,954,072
2001/02	6	572,838	\$5.25	1.17	\$6.14	\$3,518,657
2002/03	6	509,455	\$5.25	1.15	\$6.04	\$3,075,835
2003/04	4	492,000	\$5.25	1.12	\$5.88	\$2,892,960
2004/05	5	425,477	\$5.50	1.09	\$6.00	\$2,550,735
2005/06	5	525,357	\$7.58	1.06	\$8.03	\$4,221,138
2006/07	4	487,473	\$7.86	1.03	\$8.10	\$3,946,484
2007/08	4	458,313	\$5.94	1.01	\$5.98	\$2,740,619
2008/09	4	342,434	\$6.34	1.00	\$6.34	\$2,171,032

<sup>a</sup> Pounds of shucked scallop meats.

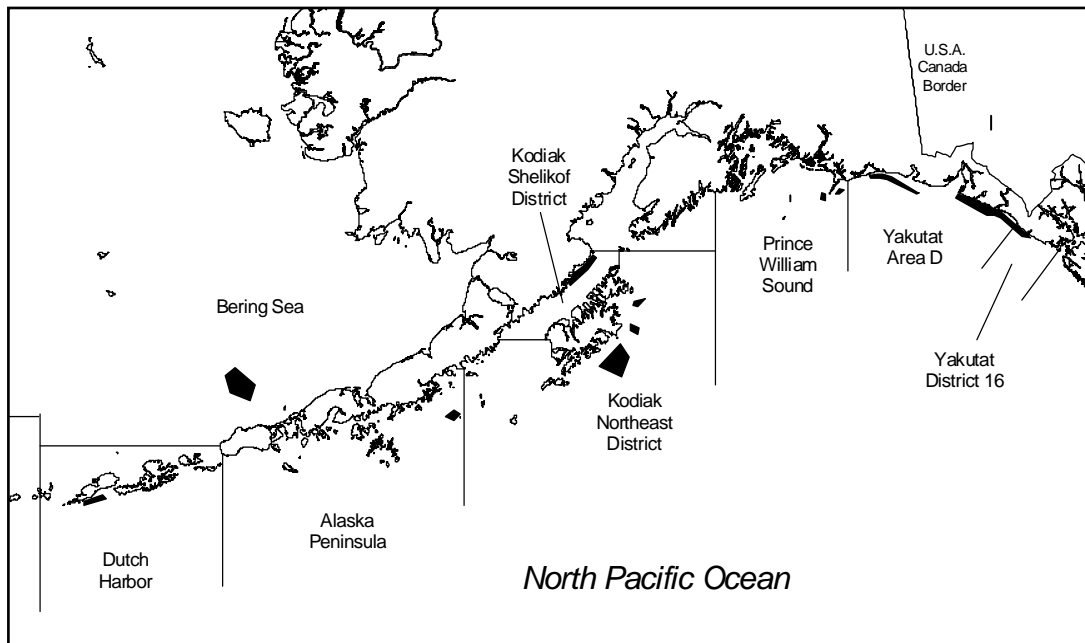
<sup>b</sup> Includes illegal harvest.

## 2 Overview of Scallop Fishery and Management

The scallop fishery is managed jointly by NMFS and ADF&G under the federal FMP for the Scallop Fishery off Alaska. Most management measures under the FMP are delegated to the State for management under Federal oversight. ADF&G management of the weathervane scallop fishery covers both state and federal waters off Alaska. The following sections provide background on the fishery and its management, including registration areas, season, guideline harvest ranges and levels, the onboard observer program, crab bycatch limits, and the Federal License limitation program.



**Figure 1 Alaska Weathervane Scallop Commercial Fishing Registration Area.**



**Figure 2 Map showing Alaska scallop fishery registration areas. General areas of effort during the 2008/09 season are overlaid by black polygons**

## 2.1 Management

**Registration Areas.** The State of Alaska Scallop Fishery Management Plan established 9 scallop registration areas in Alaska for vessels commercially fishing scallops (Figure 1). These include the Southeastern Alaska Registration Area (Area A); Yakutat Registration Area (Area D and District 16); Prince William Sound Registration Area (Area E); Cook Inlet Registration Area (Area H); Kodiak Registration Area (Area K), which is subdivided into the Northeast, Shelikof and Semidi Districts; Alaska Peninsula Registration Area (Area M); Dutch Harbor Registration Area (Area O); Bering Sea Registration Area (Area Q); and Adak Registration Area (Area R). Scallop seasons have never been opened in Area A, and effort occurred in Area R during 1995 only.

**Seasons:** The regulatory fishing season for weathervane scallops in Alaska is July 1 through February 15 except in the Cook Inlet Registration Area. In the Kamishak District of Cook Inlet, the season is August 15 through October 31, and in all other districts of Cook Inlet, the season is from January 1 through December 31 under conditions of an exploratory permit. Scallop fishing in any registration area in the state may be closed by emergency order prior to the end of the regulatory season. Scallop GHLs and CBLs are typically announced by ADF&G approximately one month prior to the season opening date.

**Guideline Harvest Ranges (GHR):** ADF&G manages the fishery by registration areas and districts. Guideline harvest ranges (GHRs) are hard caps established in State of Alaska regulations for each registration area and are not to be exceeded. Guideline harvest limits (GHLs) are pre-season targets set for each fishing area (registration area, district, or statistical area) prior to each season. Total harvest for each fishing area during a given season will typically be near or below the GHL but may exceed it.

Regulatory GHRs for traditional scallop fishing areas were first established by the State of Alaska in 1993 under the Interim Management Plan for Commercial Scallop Fisheries in Alaska. Regulatory GHRs (lbs of shucked scallop meats) were set at 0–250,000 lbs. for Yakutat, 0–50,000 lbs. for Prince William Sound, 0–20,000 lbs for the Kamishak District of Cook Inlet, 0–400,000 lbs for Kodiak, and 0–170,000 lbs for Dutch Harbor. These area GHR ceilings were determined by averaging historic catches from 1969 to 1992 excluding years when there was no fishing or a “fishing-up effect” occurred (Barnhart, 2003).

Prior to the August 1, 1996 re-opening of the weathervane scallop fishery, the State of Alaska established GHRs for non-traditional registration areas, including 0–200,000 lbs for the Alaska Peninsula, 0–600,000 lbs for the Bering Sea, 0–35,000 lbs for District 16, and 0–75,000 lbs for Adak. The combined total of the upper limits from traditional and non-traditional areas was 1.8 million lbs, which was defined as maximum sustainable yield (MSY) in Amendment 1 to the federal FMP.

In 1998, the scallop plan team recommended a more conservative definition of MSY. Based on average landings from 1990–1997 excluding 1995 when the fishery was closed for most of the year, MSY was subsequently established in Amendment 6 of the FMP at 1.24 million lbs, with optimum yield defined as the range 0–1.24 million pounds. To accommodate the new definition, regulatory GHR ceilings were reduced by the State of Alaska from 400,000 to 300,000 lbs for Kodiak, from 170,000 to 110,000 for Dutch Harbor, and from 600,000 to 400,000 lbs for the Bering Sea. Hence, MSY and the regulatory GHR ceiling written into Alaska law are both 1.24 million lbs.

**Inseason data:** Observers that are required on all vessels fishing for scallops in Alaska outside Cook Inlet monitor the fishery during the season and transmit data to ADF&G at least thrice weekly. Fishing may be closed in any area before the GHL is reached due to concerns about localized depletion, trends in CPUE, or bycatch rates. Inseason data are also used by the scallop industry to avoid areas of high bycatch.

## 2.2 Stock Assessments and GHLS

Management of the Alaska scallop fishery is handled by ADF&G biologists from the three regions where scallop fishing occurs. In general, the state's approach to management is conservative, with large areas known to contain scallops closed to fishing (see Section 4.3) and onboard observers required on all vessels operating outside Cook Inlet.

Dredge surveys are conducted only in Central Region and data are used to set GHLS for Kayak Island (Area E) and Cook Inlet. Scallop observer program data are the primary information source for setting GHLS in all other areas. These data consist of time series of scallop harvest and fishing effort, including catch per unit effort (CPUE), fishing locations, size structure of the catch, discard of scallops, and crab bycatch. Spatially explicit catch and effort data that cannot be displayed in the SAFE report due to State of Alaska confidentiality requirements are examined by ADF&G staff each year when GHLS are set.

ADF&G and the SPT recognize inherent weaknesses in using fishery data for management purposes. CPUE may be an unreliable index of scallop abundance due to factors such as market conditions, weather on the grounds, tides, gear efficiency, bycatch avoidance, captain and crew performance, etc. Industry participants have noted that the time of year when fishing occurs can drastically affect CPUE due to differences in weather and sea state between summer and winter. Size composition data from the commercial catch are affected by choice of fishing locations and gear selectivity and hence may not be representative of the true size composition of any scallop population.

ADF&G is developing methodology to survey scallop beds with a towed imaging system, the ADF&G CamSled (Rosenkranz et al, 2008). Currently, efforts are focused on collection of baseline data from primary fishing areas in the Gulf of Alaska (GOA) and training personnel to operate the equipment and to handle and review the large data sets acquired. An additional goal for the 2009 field season is to transect unexploited scallop beds in areas closed to dredging. ADF&G hopes to conduct more CamSled surveys of GOA scallop beds in the future.

***Southeast Alaska Region:*** No regular assessment surveys are conducted in the Southeast Alaska Region. Management of the fishery relies solely on fishery dependent data. Separate GHLS are assigned for Area D and District 16, both of which fall into Scallop Registration Area D (Yakutat). Southeast shellfish management staff meets annually with the scallop biometrician to go over his analysis of the most recent scallop observer data. Data considered when adjusting GHLS include: total harvest and CPUE for the entire registration area; total harvest and CPUE by scallop bed; daily CPUE versus cumulative catch in each bed where effort occurred; shell height histograms for Area D and District 16; and Tanner crab bycatch for the entire registration area. The GHLS are set prior to each fishing season based on these data. There are no crab bycatch limits in Scallop Registration Area D. The fishery is managed by Joe Stratman (Petersburg office) and Adam Messmer (Douglas office).

***Central Region:*** ADF&G conducts biennial dredge surveys in the Kamishak District of the Cook Inlet Registration Area and near Kayak Island in the Prince William Sound Registration Area. Data from these surveys are used to set GHLS. In the Kamishak District fishery, observers are not required, but vessels are limited to a single 6 ft dredge, and the ADF&G staff is regularly deployed as observers when fishing occurs. The Cook Inlet fishery is managed by Charlie Trowbridge from the Homer office and the Kayak Island fishery is managed by Bob Berceci in Cordova.

***Surveys through 2006:*** Central Region conducts fishery-independent, area-swept, dredge surveys with a systematic sampling design. From 1996 through 2006, this systematic survey design was accompanied by an

adaptation for delineating the edge of the scallop beds. Sampling stations were defined by overlaying a checker-board grid of 1,855 m<sup>2</sup> (1.0 nmi<sup>2</sup>) squares over a chart of the study area (see Figure 1 and Figure 2). A systematic design was used in which every other station was designated for sampling after the primary sampling unit (light or dark squares) was randomly selected to give an equal probability of selecting either set of grid cells. The vessel skipper, in cooperation with the project leader, determined the specific tow location within each sample station. The dredge was towed for a distance of approximately 1,855 m (1.0 nmi) within the sample station. To delineate the scallop bed margin, stations (light or dark) were added diagonally when catches along the edge of the initial sampled stations exceeded a threshold level of 9.1kg (20 lb). The edge of a scallop bed was considered delineated when catch in a given station was below the threshold amount.

**Surveys since 2007:** The 2007 Kamishak Bay and 2008 Kayak Island surveys were set to standardized areas, which will continue to be used. The survey designs were done in a manner that enables all previous years of survey data to be standardized and comparable; all historical survey catch data was entered into ARC GIS and a polygon was drawn around all stations where the catch exceeded the threshold of 9.1 kg/nm (20 lbs). Ancillary stations will be conducted outside these standardized areas to look for changes in bed size. Central Region staff also developed an additional aspect to the survey design whereby data from the systematic dredge survey can be compared to the video assessment method that continues to be developed and used by statewide scallop staff in Kodiak. The survey design accomplishes; 1) comparison of a systematic video survey to Central Region's systematic dredge survey; and 2) comparison of both the systematic video and systematic dredge surveys to a full/complete line transect video survey. These comparisons will be critical if Central Region moves to full video assessment of scallops in the future as there is a need to have a statistically valid and efficient survey design for the towed camera system and have future data comparable to current dredge data. If Central Region does move to full video assessment to obtain abundance information, some dredging (from a sub-sample of stations) will still need to be conducted in order to obtain meat weights, and scallop shells for assessing age.

**Guideline Harvest Levels (GHLs) in Central Region:** Regular assessments have been conducted biennially on Central Region scallop beds at Kamishak Bay and at Kayak Island since 1996. Data from the assessments are used to set GHLs which are then in effect for the subsequent two seasons. Following several surveys designed to establish the extent of the beds, the department standardized the survey area for each bed beginning in 2007 for Kamishak and in 2008 for Kayak. The Kayak Island estimate was adjusted using a dredge catchability of 0.83, which is based upon the relative catchability from a small amount of dredge/video comparison work conducted there in 2004. No similar comparison has been conducted at Kamishak. The department has applied a 5% harvest rate to the final survey estimates of abundance and used whole weight to meat weight conversions to assign the GHL for each area. Typically, the fishery remains open until the GHL is achieved. However, through its emergency order authority the department may close a season or area in response to declines in CPUE or even apparent die-offs as occurred at Kamishak in 2002. Additionally, in setting GHLs the department may consider such factors as a narrow size or age distribution or truncation of sizes observed within an area.

**Westward Region:** Regular scallop stock assessment surveys are not conducted in Westward Region. GHLs are set after review of observer data collected during recent seasons. For some areas, GHLs are set by statistical area to spread effort and reduce the likelihood of localized depletion. Management staff also set CPUE benchmarks for some areas prior to the season, and if CPUE falls below the benchmark level during fishing, management staff meets to review inseason observer data and the fishery may be closed or allowed to continue. In all areas, crab bycatch and CPUE are closely monitored during the season, and scallop harvest may be stopped due to high crab bycatch or poor fishery performance.



## 2.3 Fishery

Scallop vessels in the Alaska fishery are 58–124 feet length overall, with maximum 1,200 horsepower. Standard New Bedford style scallop dredges are used in the fishery. On average, a 15-foot dredge weighs a minimum of 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 frame is a steel ring bag consisting of 4-inch (inside diameter) rings connected with steel links; 4 inch or larger rings are required by state law. 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 which helps hold the bag open while the dredge is towed along the ocean floor. A club stick attached to the end of the bag helps maintain the shape of the bag and provides for an attachment point to dump the dredge contents on deck. Steel dredge shoes that are welded onto the lower corners of the frame bear most of the dredge's weight and act as 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.

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 and bycatch discarded overboard; (f) baskets of retained scallops moved from the deck to the shucking area; (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. Scallop meats represent approximately 8-12% of the round weight depending on area and season (Barnhart and Rosenkranz, 2003). Scallop meats are graded by size and sold primarily to domestic seafood markets, with a smaller amount going to foreign markets (Kruse et al, 2005).

## 2.4 Observer Program

The primary purposes of the onboard scallop observer program are to collect biological and fishery data and to monitor bycatch. ADF&G requires observers on all trips of all vessels fishing scallops outside Cook Inlet in both state and federal waters. Observers are briefed and debriefed by ADF&G staff in each management area where fishing occurs prior to and after deployment.

Dredge hauls are sampled to collect data on retained scallop catch, crab and halibut bycatch, scallop discards, and catch composition. Detailed logbooks completed by vessel operators are checked by observers and submitted to ADF&G along with other observer data forms. Observers send summary reports to ADF&G fishery managers thrice weekly or more frequently during the season by radio or email. Data are entered, stored, and maintained by ADF&G staff in Kodiak. Observer data are used for inseason management and in setting seasonal GHLS. Scallop observer data are released to the public in reports prepared by ADF&G (e.g., Rosenkranz and Burt, 2009).

Onboard observer coverage is funded by industry through direct payments to independent contracting agents. Scallop observers are trained at the University of Alaska North Pacific Fisheries Observer Training Center in Anchorage. Observer training and deployment manuals (e.g., ADF&G, 2009) are prepared by ADF&G staff.

Observer cost for vessels limited to a single 6-ft dredge in federal waters was addressed in Amendment 10, section 6.8 of the Scallop FMP. The Council determined that given existing observer requirements and their associated costs, the single 6-ft dredge restriction created a disproportionate economic hardship when fishing in federal waters (NPFMC, 2004). Amendment 10 allows two vessels to fish with two 10-ft dredges to capture a larger share of the total catch, thus allowing them to offset observer costs and perhaps enhance their economic viability.

## 2.5 Crab Bycatch Limits

Bycatch of crabs in the scallop fishery is controlled through the use of Crab Bycatch Limits (CBLs) that are based on condition of individual crab stocks. 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 preseason by ADF&G for areas with current crab resource abundance information (surveys). For areas without crab abundance estimates, CBLs may be set as a fixed number of crabs that 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. Statewide CBLs by region are shown in Table 2. Information specific to individual regions is indicated in the sections below. 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 from the most recent dredge survey and the red king crab limit is fixed at 60 crabs. In 2001, ADF&G set Tanner crab bycatch caps in the Prince William Sound Registration Area at 0.5% of the Tanner crab population estimate from the 2000 scallop survey. This resulted in bycatch limits of 2,700 and 8,700 for the east and west harvest areas. These levels have remained in place for all subsequent years.

CBLs in the Bering Sea (registration Area Q) have evolved from fixed numbers in 1993 to a three tier approach used in the current fishery. In 1993, Bering Sea 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* spp. 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.

The current three tier approach was established utilizing the bycatch limits established in Amendment 1 of the FMP, 300,000 snow crabs and 260,000 Tanner crabs. 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 crab 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.

**Table 2 Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.**

Area/District	Red King Crab	<i>C. bairdi</i>	<i>C. opilio</i>
Yakutat District 16	NE <sup>a</sup>	NE	NA <sup>b</sup>
Yakutat Area D	NE	NE	NA
Prince William Sound	NE	0.5%	NA
Cook Inlet Kamishak District	60 crab	0.5%	NA
Kodiak Northeast District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Shelikof District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Semidi District	NE	NE	NA
Alaska Peninsula	0.5% or 1.0%	0.5% or 1.0%	NA
Bering Sea	500 crab <sup>c</sup>	3 tier approach	3 tier approach
Dutch Harbor	0.5% or 1.0%	0.5% or 1.0%	NA
Adak <sup>d</sup>	50	10,000 crab	NA

<sup>a</sup> Not established.

<sup>b</sup> Not applicable.

<sup>c</sup> Fixed CBL.

<sup>d</sup> Bycatch limit established to provide scallop fleet opportunity for exploratory fishing while protecting crab resources.

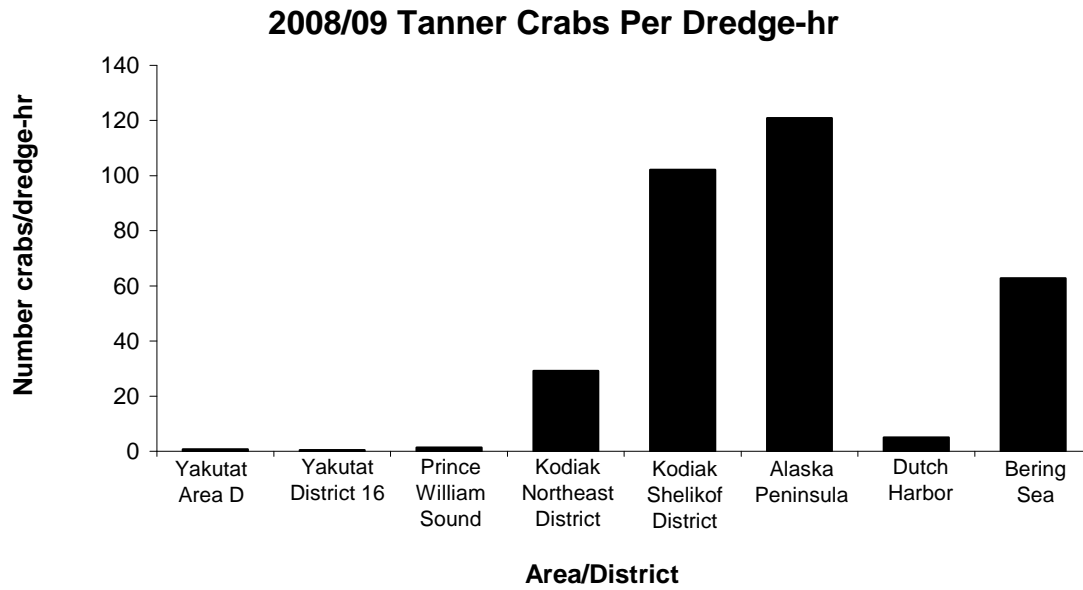
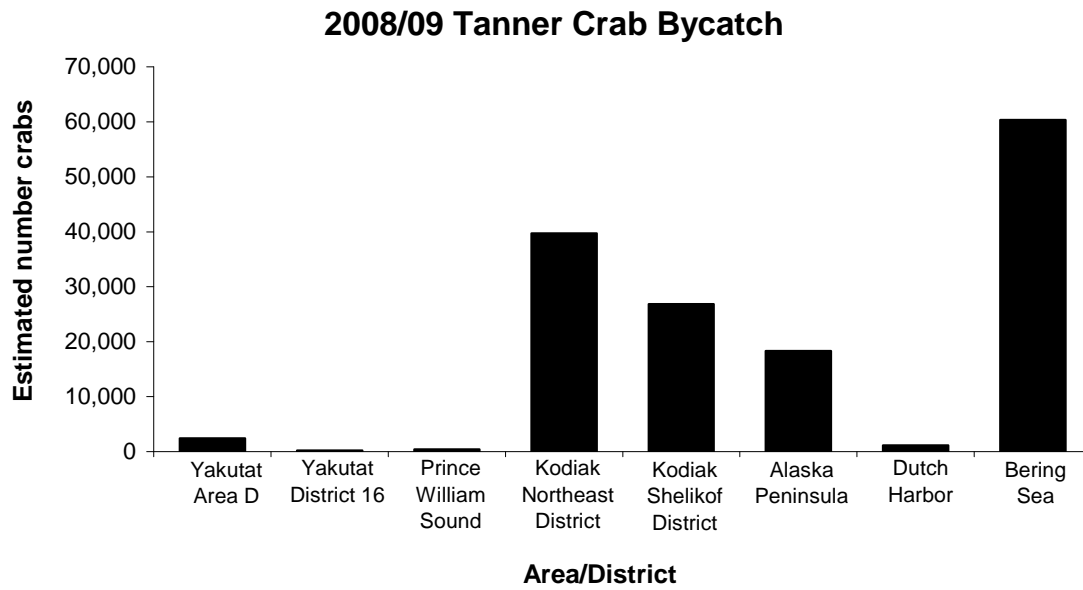
Bycatch of snow crabs, Tanner crabs, and Bristol Bay red king crabs by scallop fisheries are shown in Table 3 and Figure 3. Bycatch of snow, king, and Tanner crabs during the Bering Sea scallop fishery tends to be much lower than for other Bering Sea fisheries. Scallop fishery closures due to attainment of CBLs have decreased over the years, in part due to decreased crab abundance (Barnhart and Rosenkranz, 2003) as well as a voluntary industry cooperative, which provides the fleet additional flexibility to move off of high bycatch areas. ADF&G closely monitors bycatch rates during scallop seasons and has used a rate of one crab per pound of scallop meats as a benchmark since 1993. Bycatch may affect harvest and CPUE in the Bering Sea scallop fishery as vessel operators move or cease fishing when bycatch rates meet or exceed this benchmark.

**Table 3 Bycatch of crabs (number crabs) by species in the Bering Sea scallop fishery, 1995–2008.**

Year	Snow crab	Bristol Bay red king crab	Tanner crab
1995	0	0	0
1996	104,836	0	17,000
1997	195,345	0	28,000
1998	232,911	146	36,000
1999	150,421	1	n/a
2000	105,602	2	53,614
2001	68,458	0	48,718
2002	70,795	2	48,053
2003	16,206	0	31,316
2004	3,843	0	15,303
2005	5,211	2	15,529
2006	8,543	10	45,204
2007	19,367	1	35,288
2008	17,205	1	60,373

**Table 4 Bycatch of Tanner crabs by Area/District in the Gulf of Alaska scallop fishery, 2008/2009.**

Area/District	Number of crabs
Yakutat Area D	2,416
Yakutat District 16	189
Prince William Sound	424
Kodiak Northeast District	39,732
Kodiak Shelikof District	26,845
<b>Other Areas</b>	—
Alaska Peninsula	18,302
Dutch Harbor	1,120



**Figure 3** Estimated Tanner crab bycatch (top) and bycatch rate (bottom) during the 2008/09 scallop fishing season.

## 2.6 Scallop License Limitation Program

Commercial weathervane scallop fishing in federal waters off Alaska is limited by a Federal license limitation program (LLP), while participation in state waters (0-3 nautical miles) is limited by a vessel-based limited entry program. The LLP limits participation in the statewide scallop fishery in Federal waters to nine vessels.

The Federal Scallop License Limitation Program became effective in 2001. The NPFMC created the scallop LLP under Amendment 4 to the FMP to limit the number of participants and reduce fishing capacity. The LLP license is required on board any vessel deployed in the weathervane scallop fishery in federal waters off Alaska. NMFS granted 7 vessel owners licenses to fish statewide outside Cook Inlet. Originally, NMFS granted two vessel owners licenses to fish statewide utilizing a single 6-foot dredge. In August, 2005, NMFS implemented Amendment 10 to the FMP, which modified the gear restriction to allow these two licenses to be used on vessels with up to two 10-foot dredges statewide. All 9 licenses allow vessel owners to fish inside Cook Inlet with a single 6-foot dredge. Vessel length is limited to that of the qualifying period. All vessels fishing inside the Cook Inlet Registration Area are limited by state regulation to a single dredge not more than 6 feet in width. Unless otherwise restricted by the LLP, vessels fishing in the remainder of the state may simultaneously operate a maximum of 2 dredges that are 15 feet or less in width.

In 1997, the Alaska legislature approved legislation (AS 16.43.906) establishing a scallop vessel moratorium in state waters. In 2001, the legislature authorized a 3-year extension of the moratorium set to expire July 1, 2004. During the 2002 legislative session, passage of CSHB206 resulted in significant changes to the state's limited entry statutes. The changes authorized use of a vessel-based limited entry program in the weathervane scallop and hair crab fisheries. However, the program has a sunset provision. Under AS 16.43.450-520, the current vessel permit system was set to expire on December 30, 2008 unless statutory authority was extended. Introduced in the 25th Alaska Legislature in January 2007, House Bill 16 would have extended the existing vessel permit system until December 30, 2013. House Bill 16 became locked in committee. It was offered up under Senate Bill 254, where it passed through the legislative process and was signed into law on June 5, 2008. Therefore, the vessel permit system for scallops and hair crab will sunset on December 30, 2013. Eight vessel owners received permits to fish for weathervane scallops in state waters.

Two vessels with multiple LLP permits as well as state vessel-based limited entry permits have harvested most of the scallop catch outside Cook Inlet over the past several seasons. Three vessels 80 feet or less LOA typically participate in the Cook Inlet Registration Area fishery. Occasionally, one or more of these vessels participate in the scallop fishery outside of Cook Inlet. More information on the scallop LLP can be found on the NMFS Alaska Region web page at: <http://www.fakr.noaa.gov/ram/smp.htm>.

## 2.7 Voluntary Scallop Cooperative

In May 2000, six of the nine LLP owners formed the North Pacific Scallop Cooperative under authority of the Fishermen's Cooperative Marketing Act, 48 Stat. 1213 (1934), 15 U.S.C. Sec. 521. The cooperative is self-regulated and is neither endorsed nor managed by ADF&G or NMFS. The cooperative regulates individual vessel allocations within the GHR and crab bycatch caps under the terms of their cooperative contract. Non-coop vessels are not bound by any contract provisions. The cooperative does not receive an exclusive allocation of the scallop harvest. Some owners opted to remove their boats from the fishery and arranged for their shares to be caught by other members of the cooperative. Since formation of the cooperative, harvest rates have slowed and fishing effort occurs over a longer time period each season.

Vessel owners within the cooperative have taken an active role in reducing crab bycatch. Vessel operators provide confidential in-season fishing information to an independent consulting company contracted by the cooperative. This firm reviews crab bycatch data, fishing locations, and scallop harvest, which allows for real

time identification of high crab bycatch areas. When these areas are identified, the fleet is provided with the information and directed to avoid the area. More information on the voluntary scallop cooperative can be found in the EA/RIR/IRFA for Amendment 10 to the Scallop FMP available on the Council website at: [www.fakr.noaa.gov/npfmc/analyses/analyses.htm](http://www.fakr.noaa.gov/npfmc/analyses/analyses.htm).

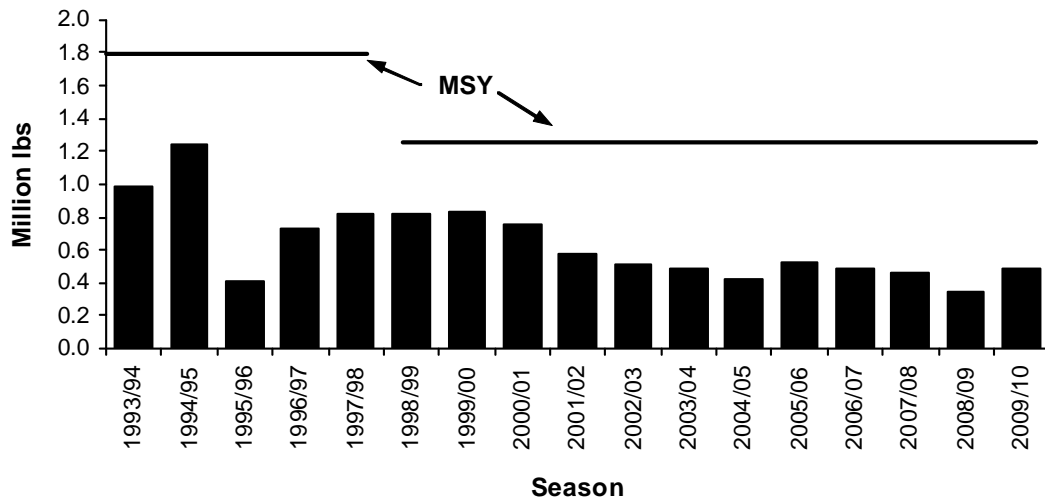
## 2.8 Overfishing Definition

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. MSY is defined as the largest long-term average catch that can be taken from a stock under prevailing ecological and environmental conditions. Amendment 6 to the scallop FMP established MSY for weathervane scallops at 1.24 million lbs of shucked meats based on the average catch from 1990-1997 excluding 1995. Optimum Yield (OY) was defined as 0–1.24 million lbs, and the overfishing control rule was defined as a fishing rate in excess of the natural mortality rate, which has been estimated as  $F_{\text{overfishing}} = M = 0.13$  (12% per year) statewide. At this time, abundance is estimated for only two of the nine registration areas and a determination of MSST cannot be made. The fishery is managed conservatively with harvest levels well below MSY. Figure 3 shows statewide scallop catch and MSY levels both prior to amendment 6 and following inception of the new MSY level in 1996. Since 1996, catches have averaged from 39% to 66% of MSY (Figure 3). Control rules for other Alaskan scallop species have not been developed as no commercial harvests occur. Catch by individual registration area is shown in Figure 4.

**Table 5 Alaska weathervane scallop harvest and Maximum Sustainable Yield from FMP, 1993/94—2008/09 seasons.**

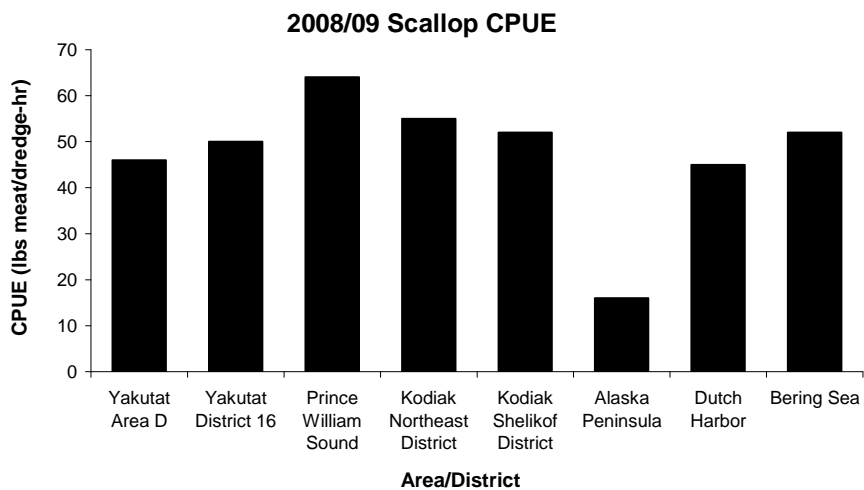
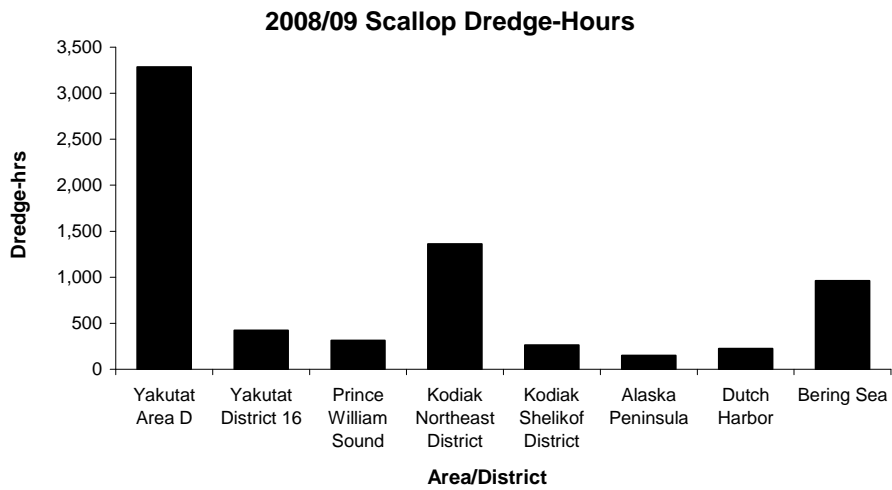
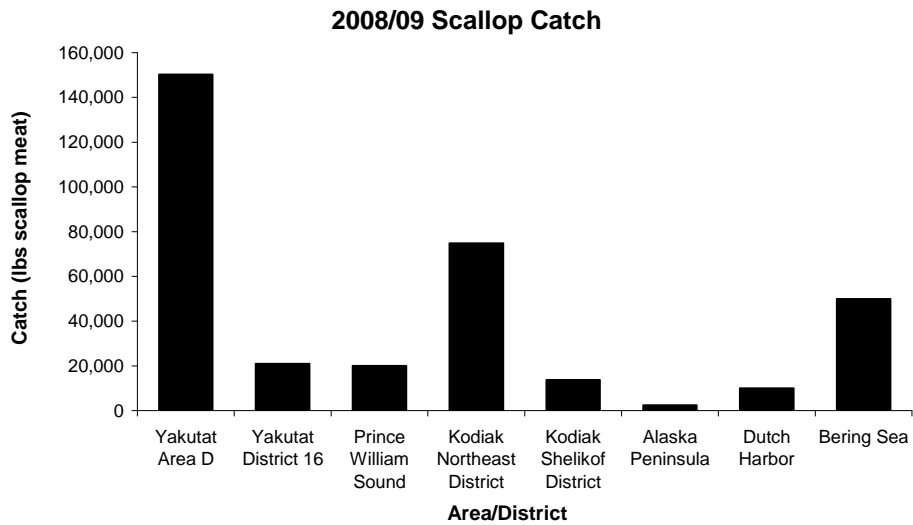
Season	Harvest (lbs meat)	MSY	% MSY
1993/94	984,583	1,800,000	55
1994/95	1,240,775	1,800,000	69
1995/96	410,743	1,800,000	23
1996/97	732,424	1,800,000	41
1997/98	818,913	1,800,000	45
1998/99	822,096	1,240,000	66
1999/2000	837,971	1,240,000	68
2000/01	750,617	1,240,000	61
2001/02	572,838	1,240,000	46
2002/03	509,455	1,240,000	41
2003/04	492,000	1,240,000	40
2004/05	425,477	1,240,000	34
2005/06	525,357	1,240,000	42
2006/07	487,473	1,240,000	39
2007/08	458,313	1,240,000	37
2008/09	342,434	1,240,000	28

### Statewide Scallop Catch and MSY



**Figure 3** Statewide scallop harvest (pounds shucked scallop meats) and MSY levels from FMP (note that 2009/10 catch data are preliminary).





**Figure 4** Scallop catch (top), dredge-hrs (center), and CPUE (bottom) during the 2008/09 statewide weathervane scallop fishery

### 3 Stock Status

The following sections provide summaries of recent scallop fishery performance for each registration area. Dredge survey summary data are provided for Prince William Sound and the Cook Inlet Registration Area. In other areas, dredge surveys are not performed. Fishery CPUE and data from the scallop observer program are the primary information sources. ADF&G camera sled image data have been collected in several management areas, but these data have not yet been used for fishery management purposes.

#### 3.1 Yakutat Registration Areas: Area D and District 16

When considering GHLs for the Yakutat scallop fishery, data included fishery, observer and survey information. The GHRs in regulation for scallop harvest are 0 – 35,000 pounds in District 16 [5 AAC 38.168(1)], and 0 – 250,000 pounds in Area D [5 AAC 38.168(2)]. These GHRs were established with implementation of the scallop management plan in the 1993 season and are based on the average historic catch from 1969 to 1992, minus years when no fishery and ‘fishing up effect’ occurs (NPFMC, 2005) Prior to 1980, the harvest was sporadic, averaging 112,000 pounds in the 1970s, 125,000 in the 1980s, and increasing to 377,000 in the 1990s. The peak harvest of 1.1 million pounds occurred in 1992.

Declining catch rates in Area D during the 2000/01 season led to a reduction of the GHL to 200,000 pounds for the Yakutat area beginning in the 2001/02 season (Table 5, Figure 4). Catch rates (observer data) during the first several days of fishing in individual beds of Area D were compared between years. A decline in initial catch rates was observed for most beds, and this decline was used as a proxy as a decline in scallop abundance. The GHL was reduced from the upper end of the GHR down to 200,000 pounds as a precautionary measure. For 2001/02 – 2004/05 seasons, the harvest ranged from 87,000 – 161,000 averaging 119,000 pounds. Only in the 2005/06 season was the 200,000-lb GHL reached in Area D, necessitating early season closure by emergency order. Data from this 2005/06 season noted a significantly declining commercial catch rate, poor recruitment in recent seasons, and decreases in the proportion of scallops in excess of 132 mm shell height (Figure 5). For these reasons the GHL for Area D was reduced 25% to 150,000 pounds prior to the 2006/07 season. During the 2006/07 season, the GHL in Area D was reached and the area was closed by emergency order.

During this period, the District 16 GHL remained at the upper end of the 0 - 35,000 pound GHR. Harvest in this area ranged from 1,000 – 22,000, averaging 12,000 pounds for the 2001/02 – 2004/05 season period (Table 6). Harvest in the 2005/06 season did not reach the GHL of 35,000 pounds. Data from the 2005/06 season noted a significantly declining commercial catch rate, poor recruitment in recent seasons, and decreases in the proportion of scallops in excess of 132 mm shell height (Figure 6, Figure 7). For these reasons, and since the GHL in the area had not been reached since the late 1990’s, the GHL for District 16 was reduced 40% to 21,000 pounds prior to the 2006/07 season. During the 2006/07 season, the GHL in District 16 was not reached.

No adjustments were made to the Area D and District 16 GHLs prior to the 2007/08 season. The observer data compiled from the 2006/07 season noted the following: a shift in effort to one of the beds in Area D; an overall increase in CPUE; anecdotal evidence from industry that scallop meat quality had improved overall; shell height histograms from Area D showed a more evenly distributed age structure in the harvest; and shell height histograms from District 16 showed a harvest made up of smaller scallops than Area D, and some small signs of recruitment. During the 2007/08 season the GHLs for Area D and District 16 were not reached. Again, prior to the 2008/09 season no adjustments were made to the Area D and District 16 GHLs. The observer data compiled from the 2007/08 season noted the following: a shift in effort to two separate beds in Area D; an overall slight decrease in CPUE; shell height histograms from Area D showed a harvest of slightly smaller scallops than the previous season; and the fourth consecutive year of increasing Tanner crab bycatch.

During the 2008/09 season, GHGs were reached in both Area D and District 16 and both areas were closed by emergency order. Adjustments to the GHGs for both Area D and District 16 were made prior to the 2009/10 season. The observer data compiled from the 2008/09 season noted the following: stable catch rates; no evidence of localized depletion within the beds; in Area D, the mode of the shell height histogram was at its largest size in the last eight seasons; in District 16, the mode of the shell height histogram was at its largest size since the 2002/03 season; possible evidence of a larger than average recruitment event in the District 16 shell height histogram; and a drop in Tanner bycatch. An increase of <10% was proposed for Area D to take advantage of large, high quality scallops harvested in the area, and no evidence of localized depletion or declining catch rates since the last GHG adjustment prior to the 2006/07 season. In District 16, an increase of 20% was proposed to take advantage of large, high quality scallops harvested in the area and also evidence of a larger than average recruitment event, and no evidence of localized depletion or declining catch rates since the last GHG adjustment prior to the 2006/07 season. The GHGs were set at 160,000 pounds for Area D, and 25,000 pounds for District 16. During the 2009/10 season, the GHG was reached in Area D and the area was closed by emergency order, but the GHG in District 16 was not reached.

**Table 6 Yakutat Area D scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs per dredge hr)	Discarded scallops <sup>d</sup>	
						Number	Weight
1993	7 <sup>b</sup>	250,000	1,999	139,057	70		
1994	10 <sup>b</sup>	250,000	4,130	246,862	60		
1995	8 <sup>c</sup>	250,000	4,730	237,417	50		
1996	4	250,000	4,438	238,736	54		
1997	4	250,000	3,956	243,810	62		
1998/99	8	250,000	4,154	242,929	58		
1999/00	3	250,000	3,840	249,681	65		
2000/01	3	250,000	4,241	195,699	46		
2001/02	2	200,000	2,406	103,800	43		
2002/03	2	200,000	2,439	122,718	50		
2003/04	2	200,000	3,360	160,918	48		
2004/05	2	200,000	2,132	86,950	41		
2005/06	2	200,000	5,089	199,351	39		
2006/07	2	150,000	2,817	150,950	53		
2007/08	2	150,000	2,601	125,960	48		
2008/09	3	150,000	3,286	150,289	46	1,383,589	417,545
2009/10 <sup>e</sup>		160,000		158,955			

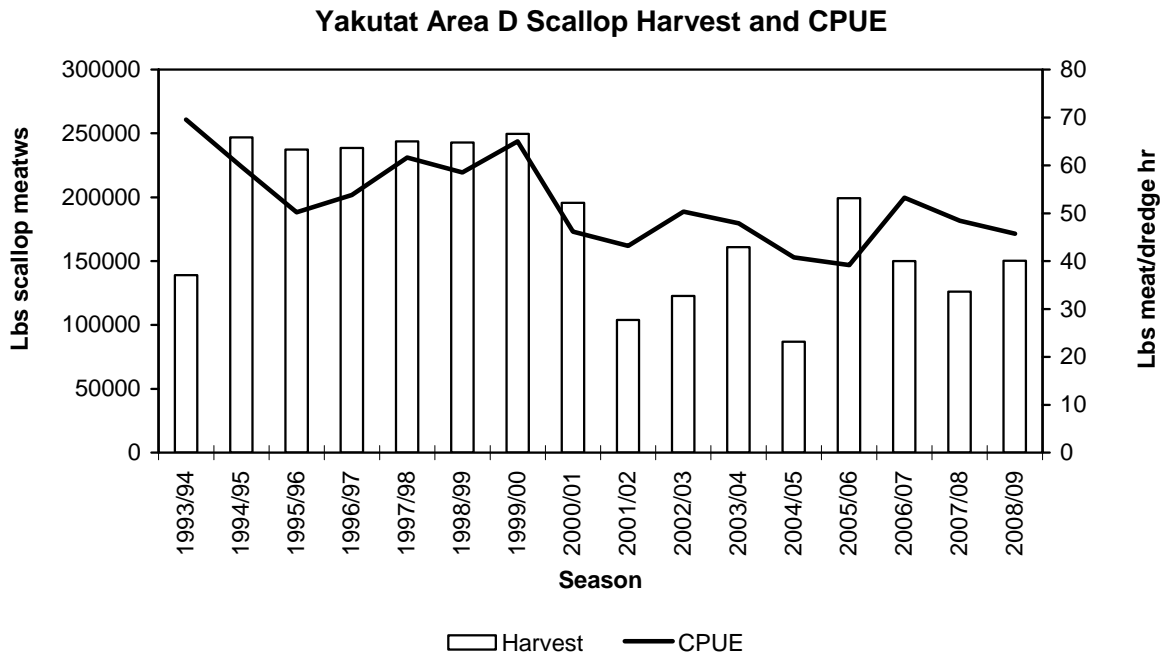
<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> One additional vessel fished by waiver without an observer; data not included.

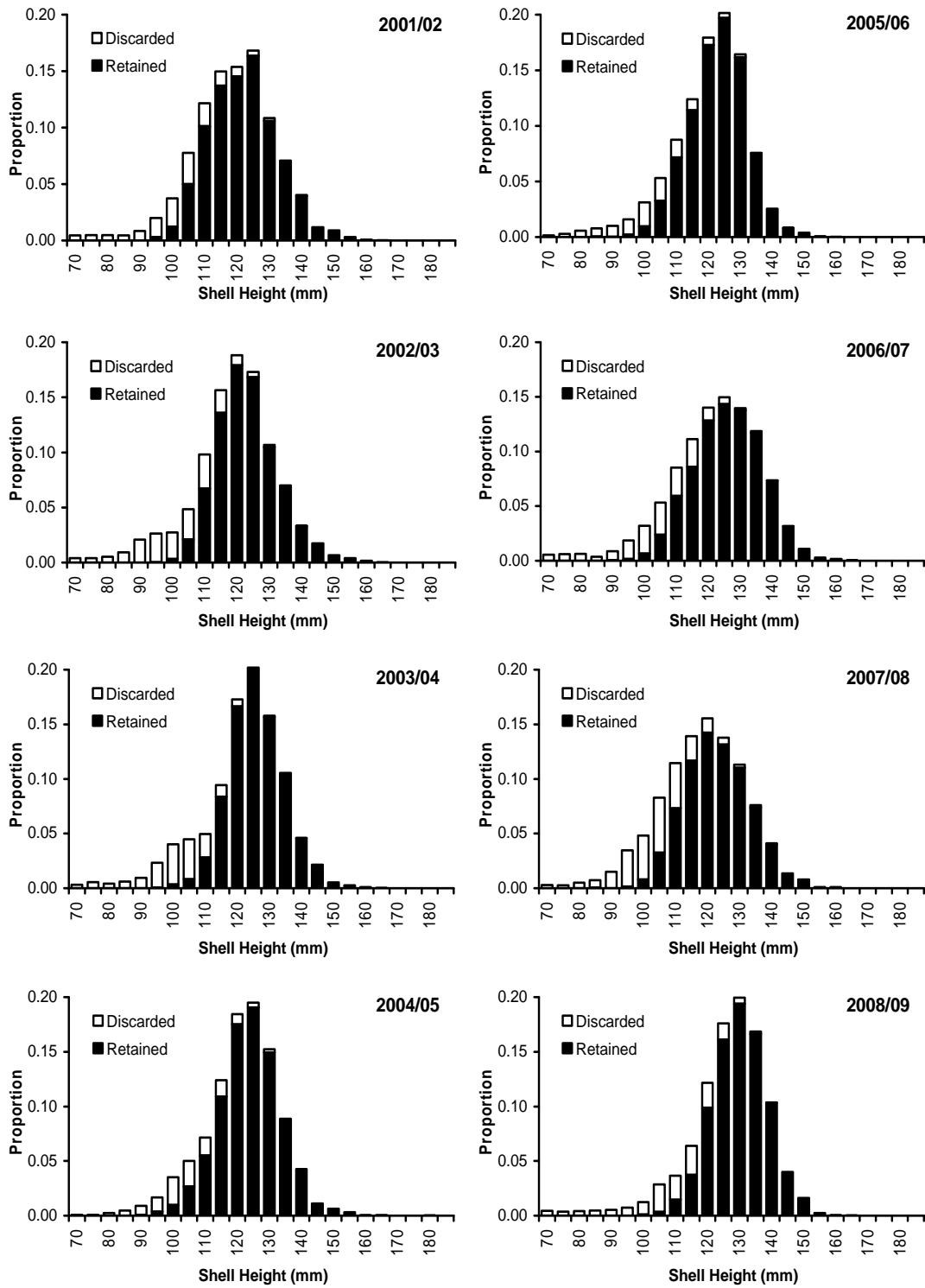
<sup>c</sup> Two additional vessels fished by waiver without observers; data not included.

<sup>d</sup> Estimated from bycatch samples.

<sup>e</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 5** Yakutat Area D Scallop Harvest and CPUE, 1993/94—2008/09 seasons.



**Figure 6** Estimated scallop shell height distributions from the 2000/01—2008/09 Yakutat Area D fishing seasons.

**Table 7 Yakutat District 16 scallop fishery summary statistics.**

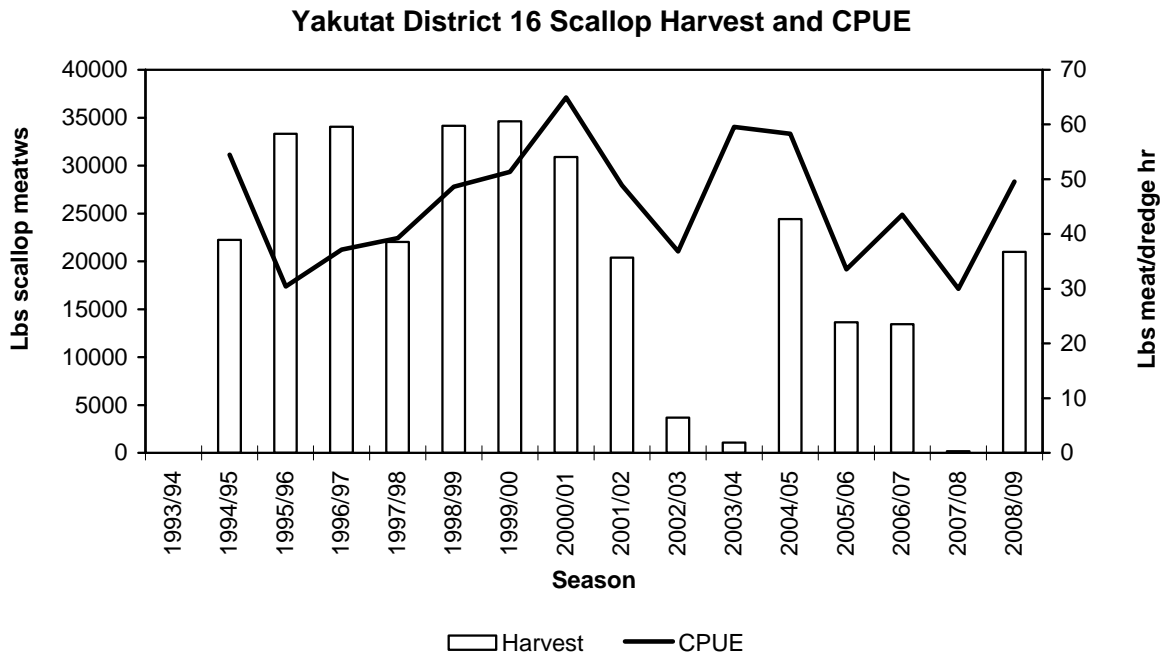
Season	Number vessels	GHL ceiling (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>c</sup>	
						Number	Weight (lbs)
1993	1	35,000		confidential			
1994	7 <sup>b</sup>	35,000	408	22,226	54		
1995	6 <sup>b</sup>	35,000	1,095	33,302	30		
1996	2	35,000	917	34,060	37		
1997	4	35,000	561	22,020	39		
1998/99	2	35,000	702	34,153	49		
1999/00	2	35,000	674	34,624	51		
2000/01	3	35,000	476	30,904	65		
2001/02	2	35,000	417	20,398	49		
2002/03	2	35,000	100	3,685	37		
2003/04	2	35,000	18	1,072	59		
2004/05	2	35,000	419	24,430	58		
2005/06	2	35,000	407	13,650	34		
2006/07	2	21,000	309	13,445	44		
2007/08	1	21,000	6	180	30		
2008/09	2	21,000	423	20,986	50	248,117	68,819
2009/10 <sup>d</sup>		25,000		11,785			

<sup>a</sup> Confidential data released by vessel operators.

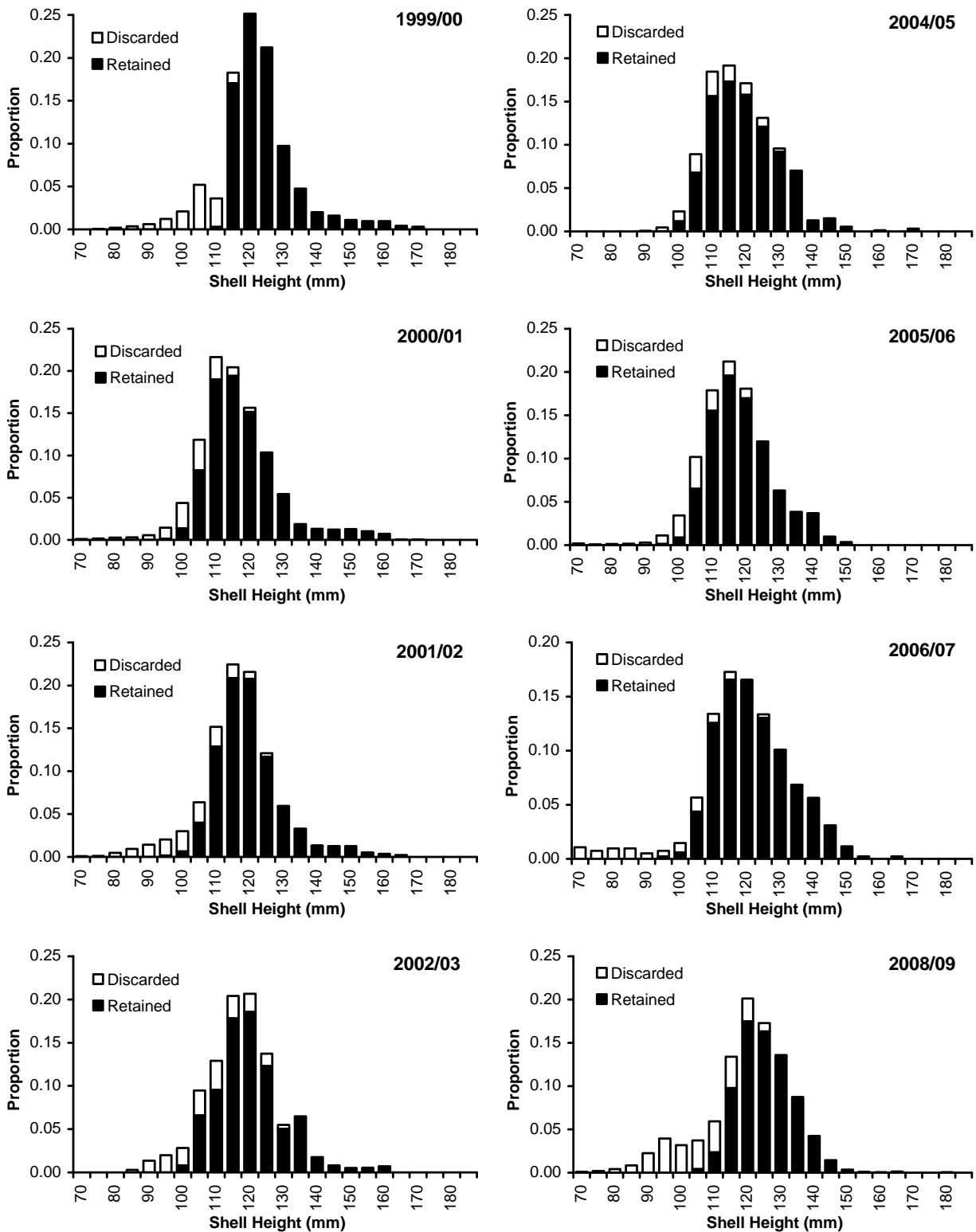
<sup>b</sup> One additional vessel fished by waiver without an observer; data not included.

<sup>c</sup> Estimated from bycatch samples.

<sup>d</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 7** Yakutat District 16 Scallop Harvest and CPUE, 1993/94—2008/09 seasons.



**Figure 8** Estimated scallop shell height distributions from the 1999/00—2008/09 Yakutat District 16 fishing seasons. No 2003/04 plot was created due to small samples size.



### 3.2 Prince William Sound Registration Area

Scallop dredge surveys are conducted biennially in the Prince William Sound Registration Area (Area E) near Kayak Island (Figure 1, Table 7). In 2008, the survey was set to a standardized area. A total of 47 successful 1nm dredge tows were made during the 2008 Kayak Island survey (37 in the East bed and 10 in the West bed). The slightly fewer number of tows in this year was due to inclement weather conditions. Catch in the east bed was 4,356 weathervane scallops weighing 1,340 kg (2,954 lb). Catch abundance ranged from 0 to 654 scallops/nm resulting in a mean among all stations of 117.7 scallops/nm. Standardized catches by weight ranged from 0 to 199.7 kg/nm (440.3 lb/nm) with a mean catch among all stations fished of 36.2 kg/nm (79.8 lb/nm). Catch in the west bed was 1,058 weathervane scallops weighing 196 kg (432 lb). Catch abundance ranged from three to 374 scallops/nm resulting in a mean among all stations of 105.8 scallops/nm. Standardized catches by weight ranged from 0.01kg (0.02 lb/nm) to 71.5 kg/nm (157.6 lb/nm) with a mean catch among all stations fished of 19.6 kg/nm (43.2 lb/nm). Abundance and biomass estimates from all Kayak Island surveys are given in Table 9 Preliminary efforts using underwater video techniques to evaluate survey dredge catchability in 2004 provided a mean catchability coefficient ( $q$ ) of 0.83, which has been applied since 2006 (Table 7). The goal is to further assess dredge catchability and better estimate  $q$ , thereby increasing accuracy of survey estimates and resulting in more appropriate harvest limits by using a  $q$ -value less than one.

Two catcher processors participated in the 2006/07 Area E fishery and harvested approximately 37,000 lbs of scallop meats (Table 8). Fishery data from recent seasons are presented in Table 8, Figure 8 and Figure 9. Two vessels participated in the 2007/08 Area E fishery and harvested approximately 37,000 lbs of scallop meats (Table 8). Area E CPUE was 90 lbs meat dredge hr for the 2007/08 season (Table 8, Figure 8). Plots of Prince William Sound SH distributions from the commercial fishery show that the range of shell heights caught in the fishery has been very consistent over the years (Figure 9).

**Table 8 Standardized Kayak Island dredge survey summary—standardized areas are 78.99 nm<sup>2</sup> for the East bed and 48.66 nm<sup>2</sup> for the West bed. Table provides biomass estimates using catchability coefficients (q) of 1 and 0.83 (which stems from preliminary work on dredge catchability).**

Year	Number stations sampled	Mean catch kg/nm	Estimated abundance	95% CI	CV	Scallop density (scal/m <sup>2</sup> )	Average weight (g/scal)	Estimated biomass q = 1.0 (kg meat)	Estimated biomass q = 0.83 (kg meat)
<b><u>East Bed</u></b>									
1996	38	29.3	7,665,330 ±	5,055,277	0.34	0.028	230	139,401	
1998	28	21.1	5,496,099 ±	1,807,737	0.16	0.020	230	96,411	
2000	33	37.6	9,513,606 ±	2,435,296	0.13	0.035	237	165,743	
2002	20	10.5	2,579,532 ±	1,163,924	0.22	0.010	245	45,304	
2004	31	77.3	17,905,822 ±	11,691,177	0.33	0.066	259	304,720	
2006	32	58.0	9,771,298 ±	5,395,445	0.28	0.036	277	194,880	228,009
2008	37	36.2	7,063,665 ±	2,860,387	0.21	0.026	308	132,311	154,804
<b><u>West Bed</u></b>									
1998	21	34.2	5,156,119 ±	2,309,193	0.21	0.031	245	96,403	
2000	20	94.0	17,777,746 ±	10,269,460	0.28	0.107	196	255,312	
2002	17	39.3	6,027,791 ±	3,104,626	0.24	0.036	241	104,133	
2004	25	84.9	14,278,296 ±	7,276,183	0.25	0.086	220	205,950	
2006	20	61.4	10,106,636 ±	6,068,318	0.29	0.061	225	163,803	191,650
2008	10	19.6	3,910,300 ±	3,129,662	0.35	0.023	185	44,071	51,563

**Table 9 Prince William Sound Area E scallop fishery summary statistics**

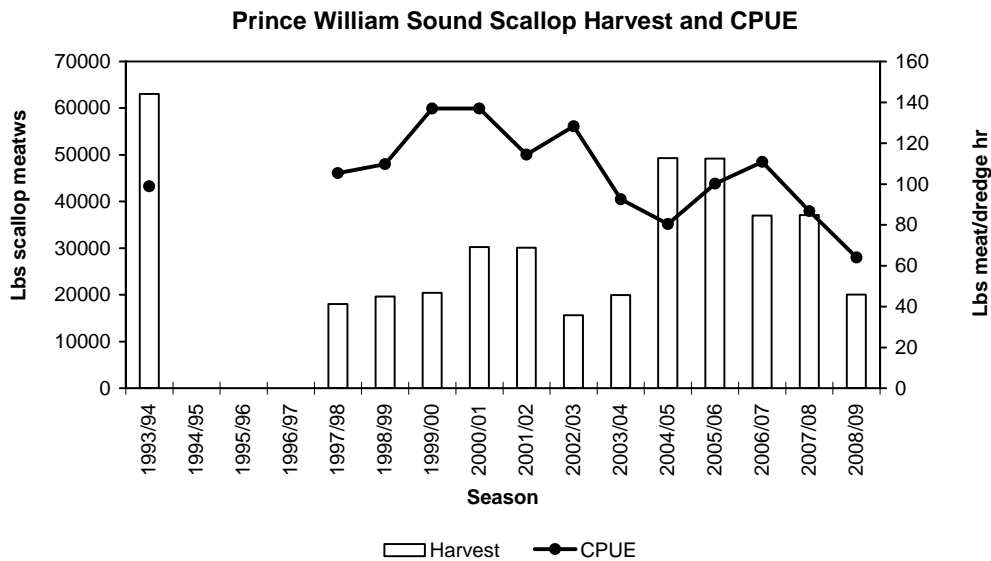
Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>c</sup>	
						Number	Weight (lbs)
1993	7	50,000	638	63,068	99		
1994		Closed					
1995	3	50,000		108,000 <sup>b</sup>			
1996		Closed					
1997	1	17,200	171	18,000	105		
1998/99	2	20,000	179	19,650	110		
1999/00	2	20,000	149	20,410	137		
2000/01	3	30,000	221	30,266	137		
2001/02	1	30,000	263	30,090	114		
2002/03	2	20,000	122	15,641	121		
2003/04	1	20,000	216	19,980	93		
2004/05	2	50,000	614	49,320	80		
2005/06	3	50,000	491	49,205	100		
2006/07	2	37,000	334	36,990	111		
2007/08	2	37,000	428	37,105	87		
2008/09	1	20,000	313	20,040	64	50,577	29,663
2009/10 <sup>d</sup>		20,000		19,985			

<sup>a</sup> Confidential data released by vessel operators.

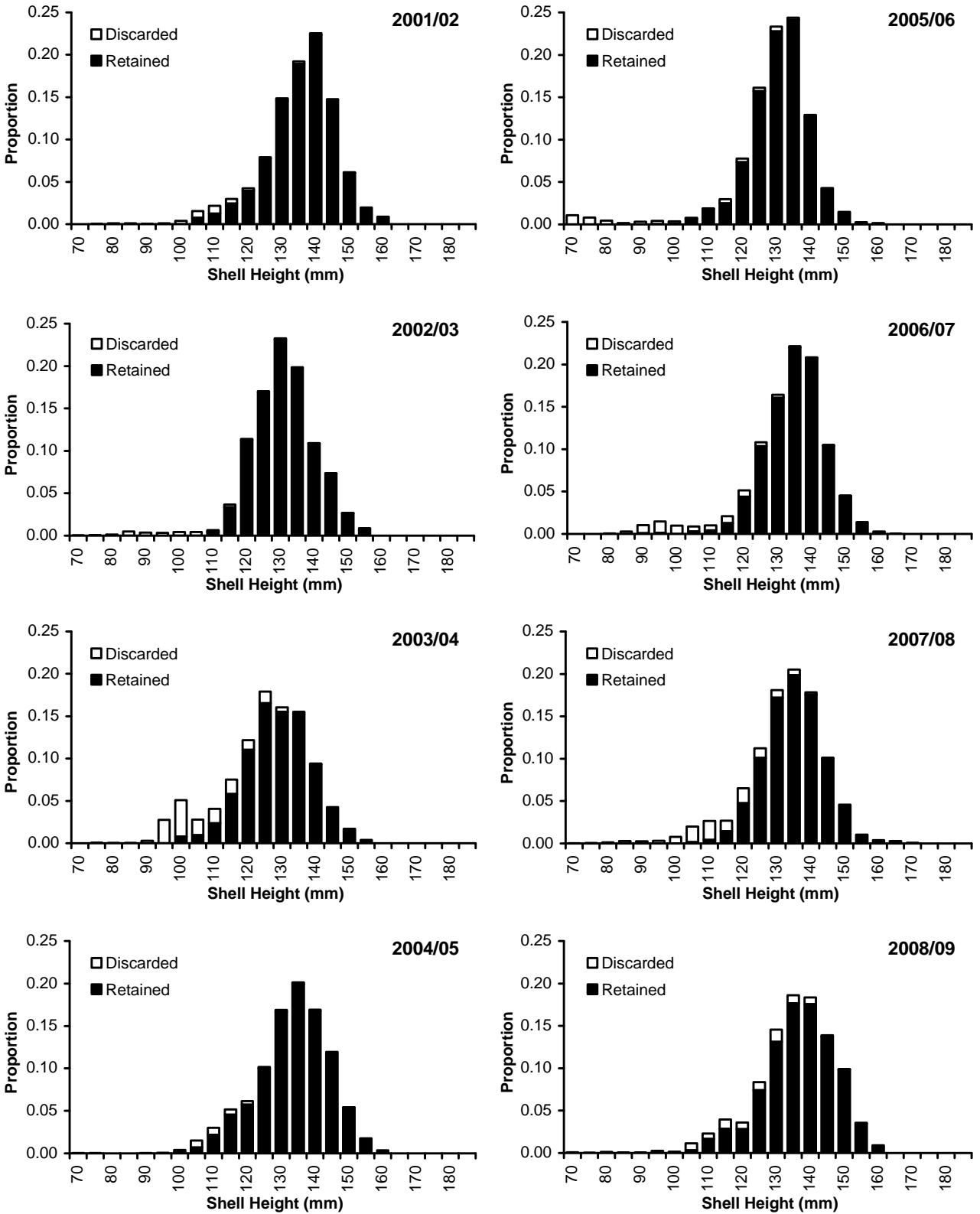
<sup>b</sup> Total includes illegal fishing by one vessel; effort data not available.

<sup>c</sup> Estimated from bycatch samples.

<sup>d</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 9 Prince William Sound Scallop Harvest and CPUE, 1993/94—2008/09 seasons.**



**Figure 10** Estimated scallop shell height distributions from the 2001/02 – 2008/09 Prince William Sound fishing seasons.

### 3.3 Cook Inlet Registration Area, Kamishak District

Scallop dredge surveys are conducted biennially in the Cook Inlet Registration Area (Area H) in Kamishak Bay (Figure 1). The Cook Inlet scallop fishery is prosecuted in the Kamishak District by vessels that are limited to one 6-foot dredge. The third-party contract observer requirement is waived by the ADF&G fishery manager provided that participants accommodate an ADF&G observer when requested. Other areas of Cook Inlet were explored briefly but are not currently fished (Trowbridge and Bechtol, 2003). Much of Cook Inlet is closed to scallop dredging (Figure 2).

A total of 66 successful 1nm dredge tows were conducted during the 2009 Kamishak Bay weathervane scallop survey (43 in the north bed and 23 in the south bed). Catch in the north bed was 2,319 weathervane scallops weighing 879.4 kg (1,938.7 lb). Catch abundance ranged from 0 to 207 scallops/nm resulting in a mean among all stations of 54.0 scallops/nm. Standardized catches by weight ranged from 0 to 69.5 kg/nm (153.2lb/nm) with a mean catch among all stations fished of 20.5 kg/nm (45.1lb/nm). Catch in the south bed was 1,231 weathervane scallops weighing 211.8 kg (466.9 lb). Catch abundance ranged from 0 to 197 scallops/nm resulting in a mean among all stations of 53.4 scallops/nm. Standardized catches by weight ranged from 0 to 27.0 kg/nm (59.5 lb/nm) with a mean catch among all stations fished of 9.2 kg/nm (20.3 lb/nm). Abundance and biomass estimates from all Kamishak Bay surveys are given in Table 11.

**Table 11 Standardized Kamishak Bay dredge survey summary. Standardized area are 90.02nm<sup>2</sup> for the north bed and 68.0 nm<sup>2</sup> for the south bed. The dredge used was a 2.4-meter (8-foot) New Bedford style dredge with 4 inch ring inside diameter and lined with a 24 thread (1 ½ inch) stretch mesh, total dredge weight, 726 kg(1,600 lbs).**

Survey Year	Number stations sampled	Mean catch kg/nm	Estimated abundance	95 % CI	CV	Scallop density (scal/m <sup>2</sup> )	Average weight (g/scal)	Estimated biomass q =1.0 (kg meat)
<b>North Bed</b>								
1996	26	62.9	16,298,521 ±	6,190,250	0.18	0.053	264	367,980
1999	41	68.7	12,382,976 ±	4,200,007	0.17	0.040	380	308,168
2001	37	63.1	9,999,335 ±	3,446,756	0.18	0.032	432	275,120
2003	31	26.2	4,117,007 ±	1,129,507	0.14	0.013	435	121,603
2005	38	22.6	3,555,537 ±	1,029,326	0.15	0.011	439	107,057
2007	43	26.3	5,076,309 +	1,324,241	0.13	0.016	353	139,157
2009	43	20.5	3,698,853 +	1,098,973	0.15	0.012	379	109,108
<b>South Bed</b>								
2003	31	74.4	8,269,024 +	3,078,303	0.18	0.035	335	260,870
2005	29	16.2	3,935,269 +	1,427,531	0.18	0.017	214	57,922
2007	31	23.5	5,997,827 ±	2,420,729	0.19	0.026	202	97,958
2009	23	9.2	2,757,005 ±	1,461,832	0.26	0.012	172	31,346

The guideline harvest regulation specified by state regulation for the Kamishak District is 10,000 to 20,000 pounds of shucked meats. The most recent harvest occurred in the 2004/05 season, 3 vessels participated in the fishery harvesting 6,117 lbs of scallop meats (Table 10). Participation and CPUE in this small fishery vary widely (Table 10, Figure 10) and no vessels have fished these scallop beds in the past four years.

**Sled-dredge:** Preliminary efforts have been made using underwater video techniques to evaluate survey dredge catchability, thereby increasing accuracy of the survey estimates and resulting in more appropriate harvest limits by using a catchability coefficient of less than one. Because the scallop “beds” of significant aggregation appear to occur in a discrete area, project results are further delineating essential fish habitat (EFH) of weathervane scallops, which is required under the Magnuson-Stevens Act. The Central Region staff has also developed a sled-dredge (Figure 11).

The sled is analogous to that used by the statewide scallop program in Kodiak, but instead of only allowing for video and counts to be made, this sled has a pinning system on the back to allow for an ~6’ wide dredge setup to be attached. The sled-dredge setup allows for video cameras to look forward and aft to obtain counts of scallops before the sled reaches them and, looking aft at the foot of the dredge bag, to examine the efficiency of the gear (i.e., how many scallops go in vs. under the dredge). The sled-dredge underwent initial field trials comparing catches to the 8’ dredge during the 2009 Kamishak survey with the goal of eventually replacing the eventually replacing the 8’ dredge with the sled dredge for all scallop surveys in the Central Region. These tests indicated modifications need to be made to the sled and camera system. These modifications will be made and testing will continue in the 2010 field season.



**Figure 11 A) Photo of sled-dredge onboard deck of R/V Pandalus, with 8’ dredge bag in foreground; B) ADF&G sled-dredge with bag stretched out on deck after trial tow (8’ dredge can be seen in background).**

**Weak Meats:** During the 2009 Scallop Plan Team Meeting, “weak meats” were discussed (refer to Scallop Plan Team minutes, March 2010). Weak meats are characterized by the adductor muscle coming off the shell when the viscera are pulled off the shell in the shucking process. These meats are off color, with a stringy consistency that makes them unacceptable for marketing by the industry. Weathervane scallops with “weak meats” were observed while shucking the age and meat weight sample (~20 scallops/tow) from the 2009 Kamishak survey. Of scallops observed for “weak meats,” 10.4% had weak meats in the north bed and 4.9% in the south bed. The sled-dredge had 14.7% weak meat scallops. The sled dredge was only trialed in the north bed.

**Table 10 Cook Inlet, Kamishak District scallop fishery summary statistics**

Season	Number vessels	GHL (lbs meat)	Dredge hours	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>b</sup>	
						Numbers	Weight (lbs)
1993	3		529	20,115	38		
1994	4		454	20,431	45		
1995		closed					
1996	5		534	28,228	53		
1997	3	20,000	394	20,336	52		
1998	1	20,000	390	confidentia			
1999	3	20,000	333	20,315	61		
2000	3	20,000	276	20,516	74		
2001	2	20,000	406	confidentia			
2002	3	20,000	311	8,591	28		
2003	2	20,000	862	confidentia			
2004	3	20,000	364	6,117	17		
2005	2	7,000	199	confidentia			
2006	1	7,000	10	confidentia			
2007	1	12,000		confidentia			
2008							
2009							
2010							

<sup>a</sup> Includes estimated dead loss.

<sup>b</sup> Estimated from bycatch samples.

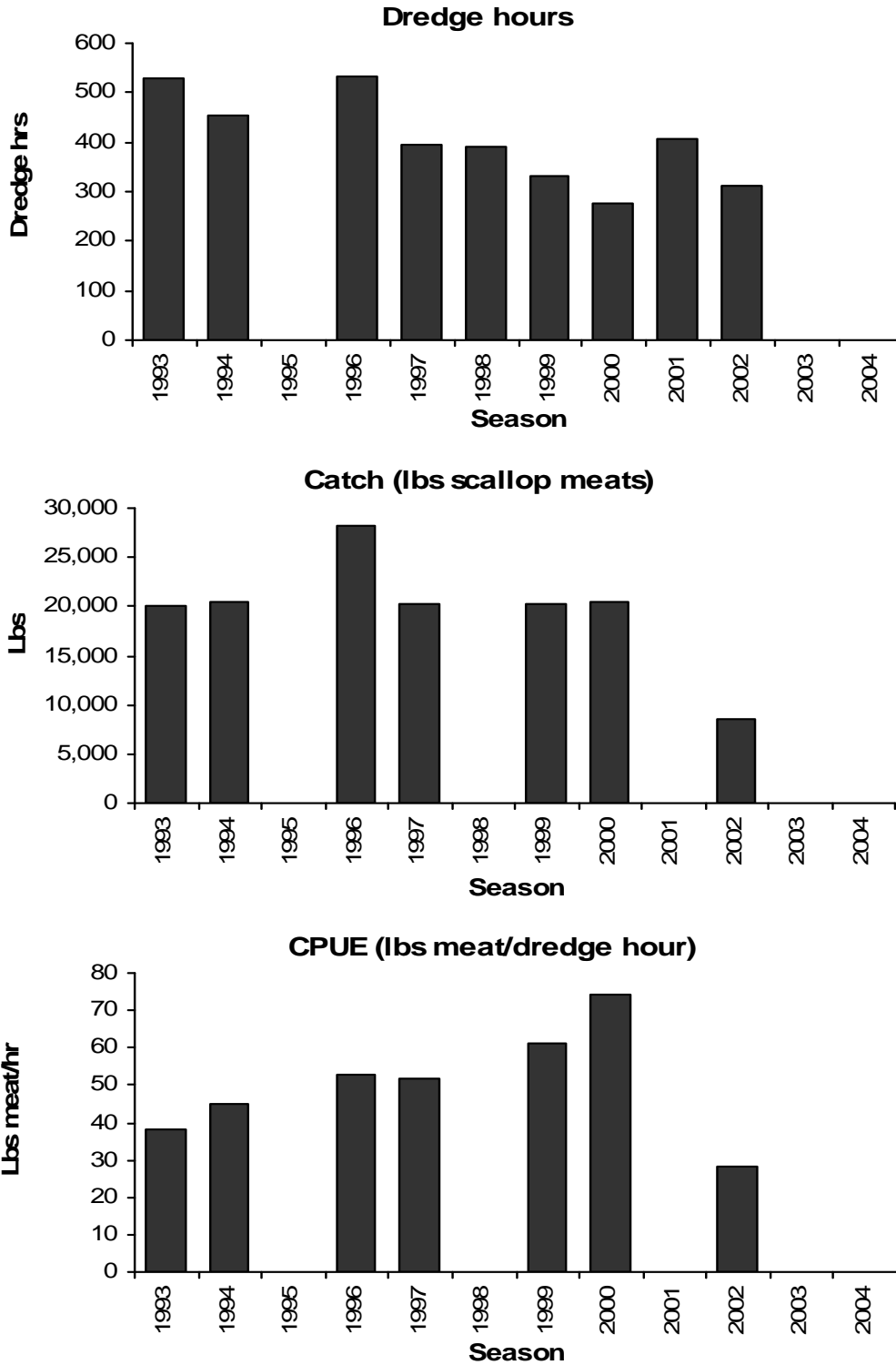


Figure 12 Barplots of Area H scallop fishery statistics.



### 3.4 Kodiak Registration Area, Northeast District

Guideline Harvest Levels (GHL) must be in compliance with harvest ranges established by the Alaska Board of Fisheries, 5 AAC 38.430 Guideline Harvest Range for the Taking of Scallops. Harvest levels for the weathervane scallop fishery in the Northeast District are set by reviewing fishery-dependent data collected from the onboard observer program. Data available consist of effort (dredge hours), size frequency of retained and discarded scallops (discarded scallops are smaller size than retained scallops and indicate recruitment trends), harvest location and depth. ADF&G tracks catch per unit effort (CPUE) by vessel throughout the season.

The management program employs an overall guideline harvest level for the district, with individual scallop bed harvest caps within the district, coupled with inseason tracking of CPUE against predetermined CPUE benchmarks. The management program annually reviews recent fishery performance against historical trends in the fishery. Prior to 1999, weathervane scallop harvests in the Northeast District were not constrained by a GHL (Table 11, Figure 11). The 1999/00 season was the first in which a GHL was established. The 1999/00 season GHL was based on 75% of the average harvest from the 1997/98 and 1998/99 seasons, and further reduced by 5,000 pounds as a precautionary approach; the initial GHL range was 0-75,000 pounds.

Along with implementing a GHL during the 1999/00 season, ADF&G also established individual harvest caps for scallop beds within the district. This management measure was aimed to distribute effort across the three known scallop beds. For the 2000/01 season the GHL was increased to 80,000 lbs based on improving fishery performance during the 1999/00 season. The 80,000 pound GHL remained in effect from the 2000/01 through the 2005/06 seasons. During this time period, CPUE ranged from 46 to 73 pounds meat/dredge hr (Table 11, Figure 11) and observer program shell height data demonstrated catches contained a wide range of scallop sizes (Figure 12) suggesting sustained recruitment through that time period.

Beginning in the 2003/04 season ADF&G tracked inseason fishery performance, by individual scallop bed, against a preseason established benchmark. The benchmark was established as the lowest recent annual cumulative CPUE. The benchmark was used to assess inseason fishery performance after the scallop participants had harvested one-half the GHL. The performance thresholds are used to assess if the upper end of the GHL range should be taken or if harvests should be limited below the upper end of the GHL range.

Prior to the start of the 2006/07 season, the harvest cap for Statistical Area 525630 was reduced by 5,000 pounds due to a decline in CPUE during the previous season. To provide an opportunity for exploratory fishing in the northern portion of the district, the GHL was increased by 15,000 pounds. The GHL for the 2006/07 season was 90,000 pounds, and remained at this level through the 2008/09 season. The exploratory addition of 15,000 pounds could only be harvested north of Cape Izhut (58.1° N latitude). This area lies east of Afognak Island and north of areas fished since inception of the observer program in 1993. Scallops were last harvested in this area during the 1980s. Due to fuel costs and other considerations, the exploratory area saw little effort, with less than 100 pounds of scallop meats harvested from 2006/07 through the 2008/09 season. Prior to the 2009/10 season the exploratory harvest level of 15,000 pounds was removed from the Northeast District GHL reducing the overall GHL to 75,000 pounds.

Two vessels harvested about 75,000 pounds of scallop meats from the Northeast District during the 2008/09 season. Summary statistics from recent fishery data are presented in Table 11, Figure 11, and Figure 12. Northeast District catches and CPUE have remained stable since the 2000/01 fishing season (Table 11, Figure 11). Large portions of the Northeast District that contain scallops are closed to scallop dredging (Figure 2). These closures were recommended by ADF&G and adopted by the Alaska Board of Fisheries over 30 years ago due to concerns about red king crab bycatch and gear conflicts.

**Table 11 Kodiak Northeast District scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>b</sup> Number	Weight (lbs)
1993/94	10	NA	6,940	155,187	22		
1994/95	7	NA	1,773	35,207	20		
1995/96		closed					
1996/97	3	NA	581	11,430	20		
1997/98	3	NA	2,604	95,858	37		
1998/99	4	NA	2,749	120,010	44		
1999/00	3	75,000	1,384	77,119	56		
2000/01	4	80,000	1,101	79,965	73		
2001/02	3	80,000	1,142	80,470	70		
2002/03	2	80,000	1,350	80,000	59		
2003/04	2	80,000	1,248	79,965	64		
2004/05	2	80,000	1,227	80,105	65		
2005/06	3	80,000	1,759	79,990	45		
2006/07	2	90,000	1,168	75,150	64		
2007/08	2	90,000	1,170	75,105	64		
2008/09	3	90,000	1,363	74,863	55	308,758	110,457
2009/10 <sup>c</sup>		75,000		68,940			

<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> Estimated from bycatch samples.

<sup>c</sup> 2009/2010 catch data is preliminary and subject to change.

### Kodiak Northeast District Harvest and CPUE

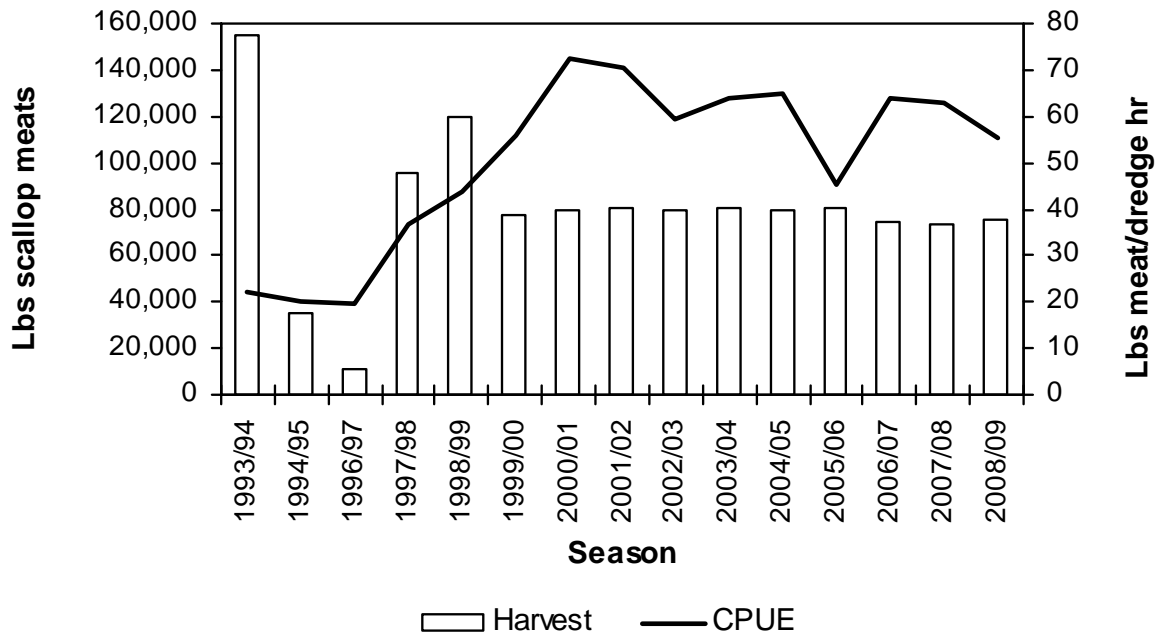
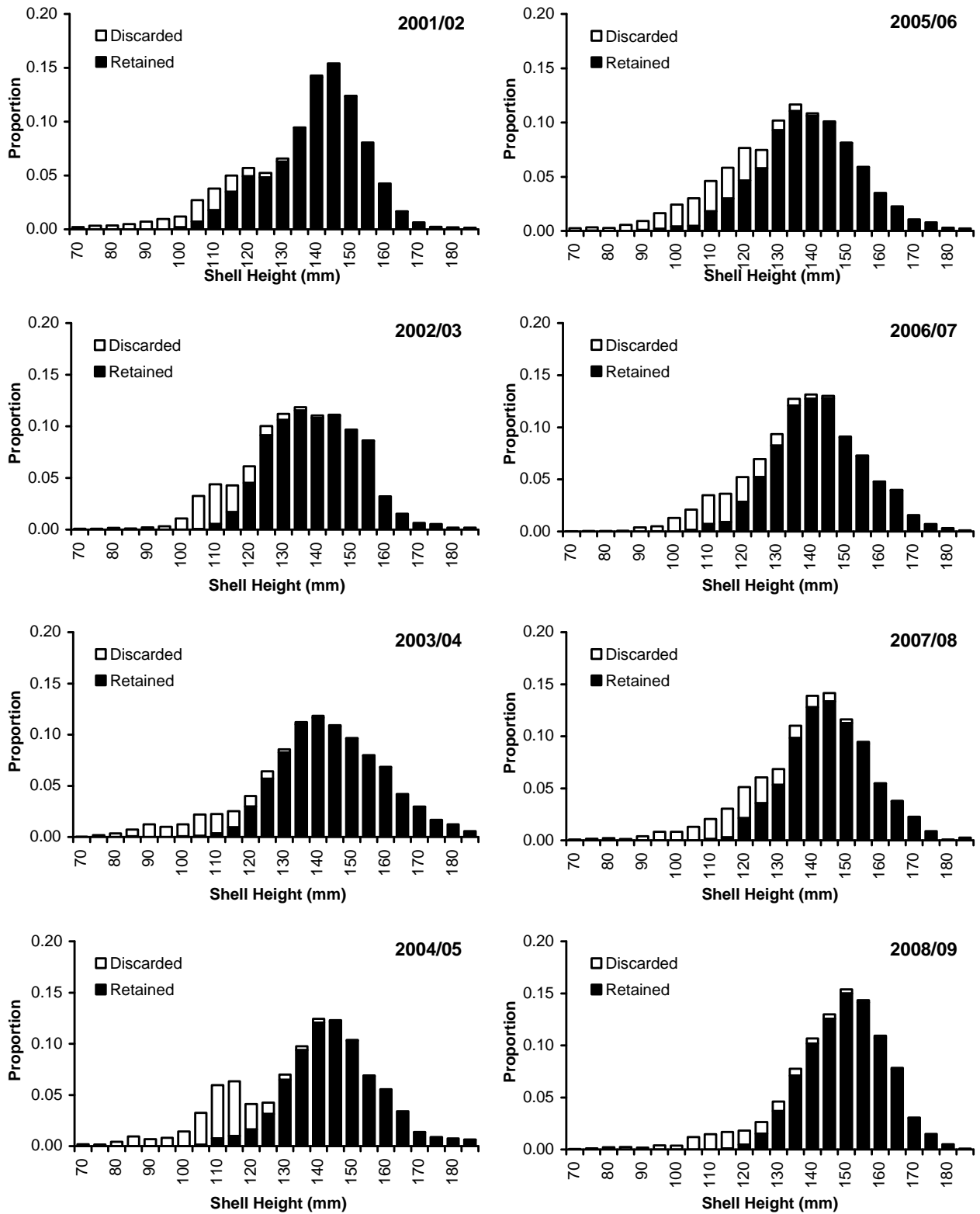


Figure 13 Kodiak Northeast District Harvest and CPUE, 1993/94—2008/09 seasons.



**Figure 14** Estimated scallop shell height distributions from the 2001/2002—2008/09 Kodiak Northeast District fishing seasons.

### 3.5 Kodiak Registration Area, Shelikof District

Similar the Northeast District, managers use fishery dependent data and information obtained through the observer program to establish Shelikof District GHLS and manage harvests inseason.

A GHLS of 180,000 pounds of shucked scallop meat was established in the Shelikof District prior to the 1999/2000 season. The initial GHLS was calculated by applying a tier 6 calculation to the historic (1990-1997) proportion of weathervane scallops harvested in the Shelikof District relative to the total upper limit of the Kodiak Registration Area Guideline Harvest Range (GHR). Between 1990 and 1997 the total Kodiak Area weathervane scallop GHR was 300,000 pounds and 72% of all weathervane scallops in the Kodiak Area were harvested in the Shelikof District resulting in an average Shelikof District harvest of 216,000 pounds. Applying a tier 6 calculation (216,000 lbs x .75) resulted in a precautionary GHLS of 162,000 pounds which was revised up to 180,000 pounds to match the amount of scallops harvested during the 1998/99 season.

The GHLS was reduced to 160,000 pounds for the 2005/06 and 2006/07 seasons due to concerns about the concentration of effort in the northern part of the main Shelikof bed. This action led to a split GHLS with 130,000 pounds allocated to the northern portion (north of 58° 30' N Lat.) of the district and 30,000 pounds allocated to the southern portion. Prior to the 2007/08 season, the GHLS was set at 130,000 pounds for the northern portion of the district and increased to 40,000 pounds for the southern portion based on an increase in CPUE from 38 pounds meat/dredge hr during the 2004/05 season to 66 pounds meat/dredge hr during the 2006/07 season.

Two vessels using 15 foot dredges and a smaller vessel that deployed a single 10 foot dredge participated in the 2007/08 fishery and harvested about 170,000 pounds. Summary statistics from recent fishery data are presented in Table 12, Figure 13, and Figure 14.

Shelikof District CPUE decreased to 58 pounds meat/dredge hr for the 2007/08 season (Table 12, Figure 13) ADF&G attributes this decline in part, to participation of a smaller vessel deploying a smaller dredge. ADF&G does not account for dredge width in CPUE calculations. Overall Shelikof District CPUE has been greater than 50 pounds meat/dredge-hr in each season since 2003/04. Significant numbers of scallops less than 120 mm shell height were discarded during the 2007/08 season (Figure 14).

During the 2008/09 season the Shelikof District was closed prior to the GHLS being achieved when the Tanner crab bycatch cap was exceeded. Tanner crab bycatch limits for the Shelikof District were set preseason at 16,900 crabs. Only 12,700 pounds of scallop meats were harvested district-wide before the fishery was closed in July 2009.

**Table 12 Kodiak Shelikof District scallop fishery summary statistics.**

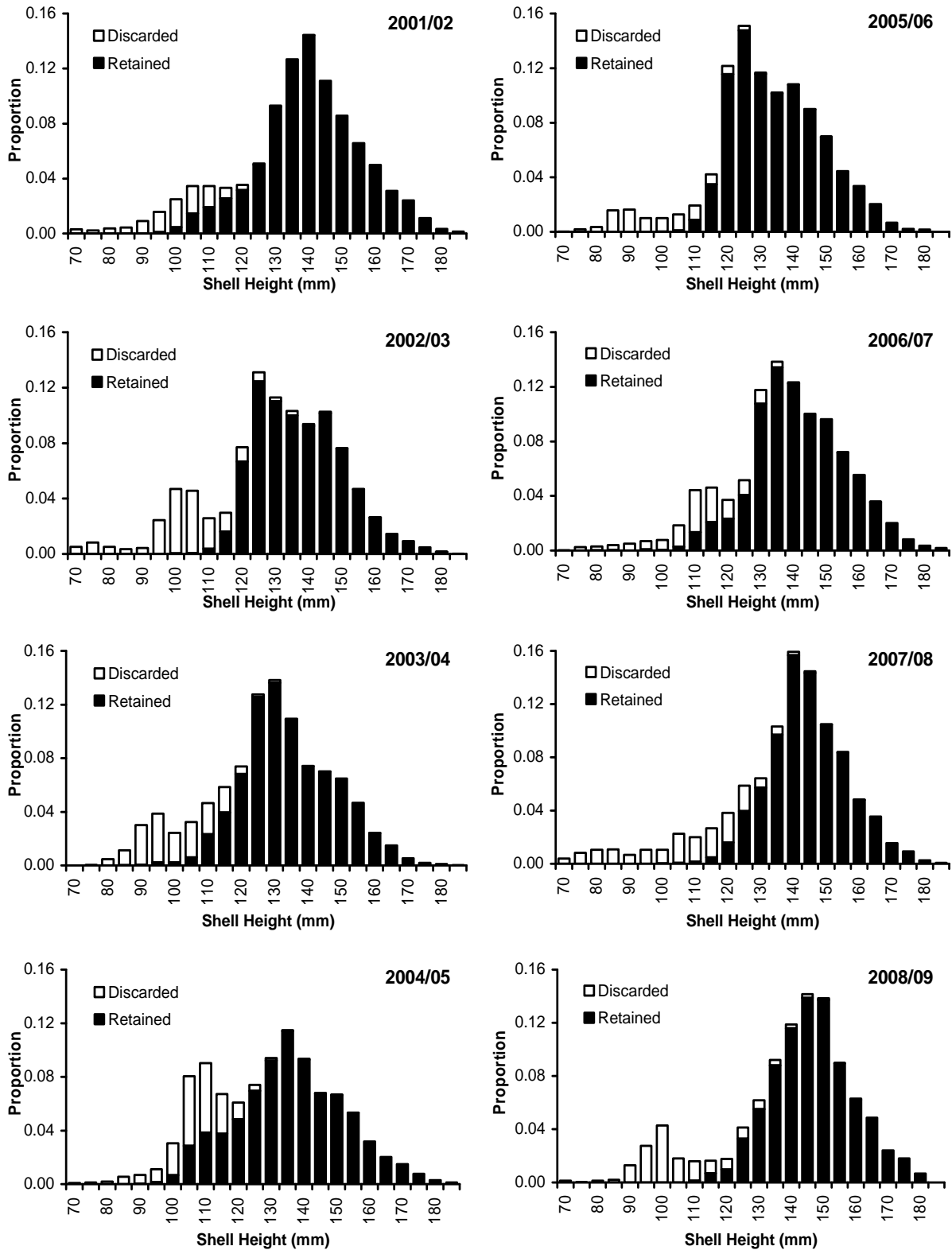
Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>c</sup> Numbers	Weight
1993/94	5	NA	2,491	105,017	42		
1994/95	11	NA	8,662	314,051	36		
1995/96		closed					
1996/97	3 <sup>b</sup>	NA	3,491	219,305	63		
1997/98	4	NA	5,492	258,346	47		
1998/99	8	NA	4,081	179,870	44		
1999/00	6	180,000	4,304	187,963	44		
2000/01	5	180,000	2,907	180,087	62		
2001/02	4	180,000	3,398	177,112	52		
2002/03	3	180,000	3,799	180,580	48		
2003/04	2	180,000	3,258	180,011	55		
2004/05	2	180,000	3,467	174,622	50		
2005/06	2	160,000	2,280	159,941	70		
2006/07	3	160,000	2,183	162,537	74		
2007/08	3	170,000	2,937	169,968	58		
2008/09	2	170,000	263	13,761	52	127,995	33,442
2009/10 <sup>d</sup>		170,000		169,945			

<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> One additional vessel fished but data were not available.

<sup>c</sup> Estimated from bycatch samples.

<sup>d</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 15** Estimated scallop shell height distributions from the 2001/02—2008/09 Kodiak Shelikof District fishing seasons.

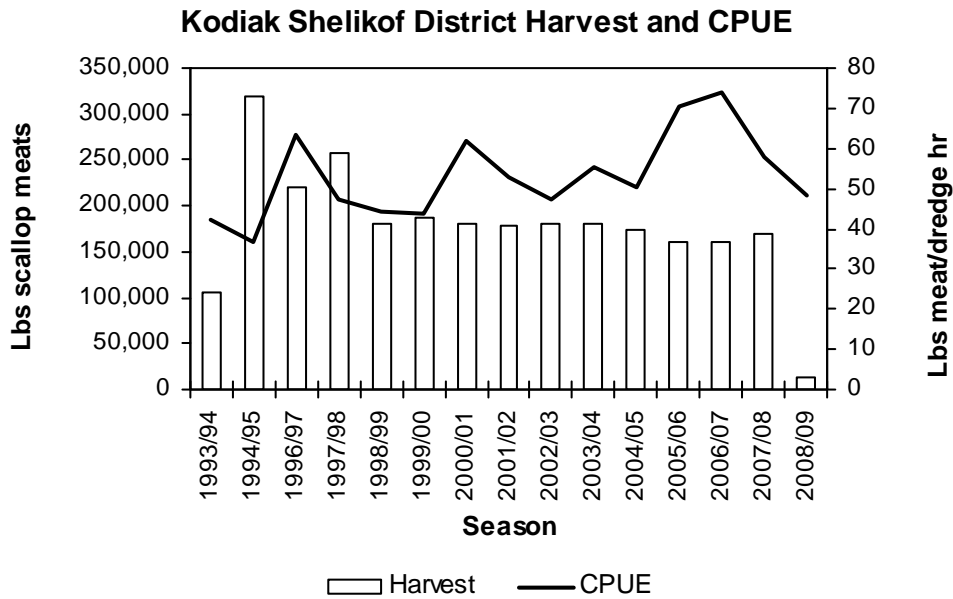


Figure 16 Kodiak Shelikof District Harvested and CPUE, 1993/94—2008/09 seasons.

### 3.6 Kodiak Registration Area, Southwest District

In March 2009, the Alaska Board of Fisheries opened, on an experimental basis, previously closed waters for scallops in the Southwest District south of a line from the westernmost tip of Cape Ikolik to the southernmost tip of Cape Kilokak, and west of 155° W Long., north of 56° 07' N Lat., and east of 156° 20.22' W Long. The Southwest District was closed to scallop fishing in 1969 due to king and Tanner crab bycatch concerns.

Participation in this area is allowed only by ADF&G commissioner’s permit as specified in 5 AAC 38.420 Fishing Seasons for Scallops in Registration Area J. During the board meeting, managers recommended a 25,000 pound GHL for the Southwest District to encourage participants to distribute effort to help delineate scallop beds. ADF&G plans to conduct video surveys in this area to further assess the resource.

### 3.7 Kodiak Registration Area, Semidi District

Traditional scallop fishing areas of the Semidi District are located in state waters that were closed to scallop dredging by the Alaska Board of Fisheries in 2000 (Figure 2). Offshore waters of the district remain open to fishing, but no effort has occurred since the 1999/00 season (Table 13).



**Table 13 Kodiak Semidi District scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>c</sup> Numbers Wright (lbs)
1993/94	6 <sup>b</sup>	NA	1,819	55,487	32	
1994/95	2	NA	272	confidential		
1995/96		closed				
1996/97	3	NA	1,017	37,810	37	
1997/98	1	NA	349	6,315	18	
1998/99	2	NA	106	1,720	16	
1999/00	1	NA	45	930	21	

<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> Two additional vessel fished but data are not available.

<sup>c</sup> Estimated from bycatch samples.

### 3.8 Alaska Peninsula Registration Area

Similar the Northeast District, managers use fishery dependent data and information obtained through the observer program to establish Alaska Peninsula GHLs and manage harvests inseason. Scallop fishing in the Alaska Peninsula Registration Area (Area M) was traditionally concentrated in a small region near the Shumagin Islands between 160° and 161° W longitude. Area M was closed during the 2001/02 and 2002/03 seasons due to localized depletion (Table 14, Figure 15).

For the 2003/04 and 2004/05 seasons, the area between 160° and 161° W longitude remained closed to promote stock rebuilding, while the remainder of the area was opened with a 10,000 pound GHL. For the 2005/06 season, the area between 160° and 161° W. longitude was opened with a 10,000 pound GHL, the remainder of the area was opened with a 10,000 pound GHL, and no effort occurred. Prior to the 2006/07 season, the GHL was increased to 25,000 pounds for the area to increase incentive for participation, and two cooperative vessels fished traditional areas and adjacent waters on an experimental basis. Catches were very poor, indicating 5-yrs of no fishing did not rebuild the scallop stock.

In response, the GHL for the 2007/08 and 2008/09 seasons was lowered to 10,000 pounds and waters between 160°-161° W longitude were closed to scallop fishing. Total harvest from the 2007/08 season was 2,460 pounds, CPUE was low, and crab bycatch was relatively high. No vessels participated in the 2008/09 fishery.

**Table 14 Alaska Peninsula Area scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>b</sup>	
						Numbers	Weight (lbs)
1993/94	8	NA	1,847	112,152	61		
1994/95	7	NA	1,664	65,282	39		
1995/96		closed					
1996/97	2	200,000	327	12,560	38		
1997/98	4	200,000	1,752	51,616	29		
1998/99	4	200,000	1,612	63,290	39		
1999/00	5	200,000	2,025	75,535	37		
2000/01	3	33,000	320	7,660	24		
2001/02		closed					
2002/03		closed					
2003/04		10,000					
2004/05		10,000					
2005/06		20,000					
2006/07	2	25,000	64	155	2		
2007/08		10,000					
2008/09	1	10,000	151	2,460	16	16,801	4,120
2009/10 <sup>c</sup>		10,000		0			

<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> Estimated from bycatch samples.

<sup>c</sup> 2009/2010 catch data is preliminary and subject to change.

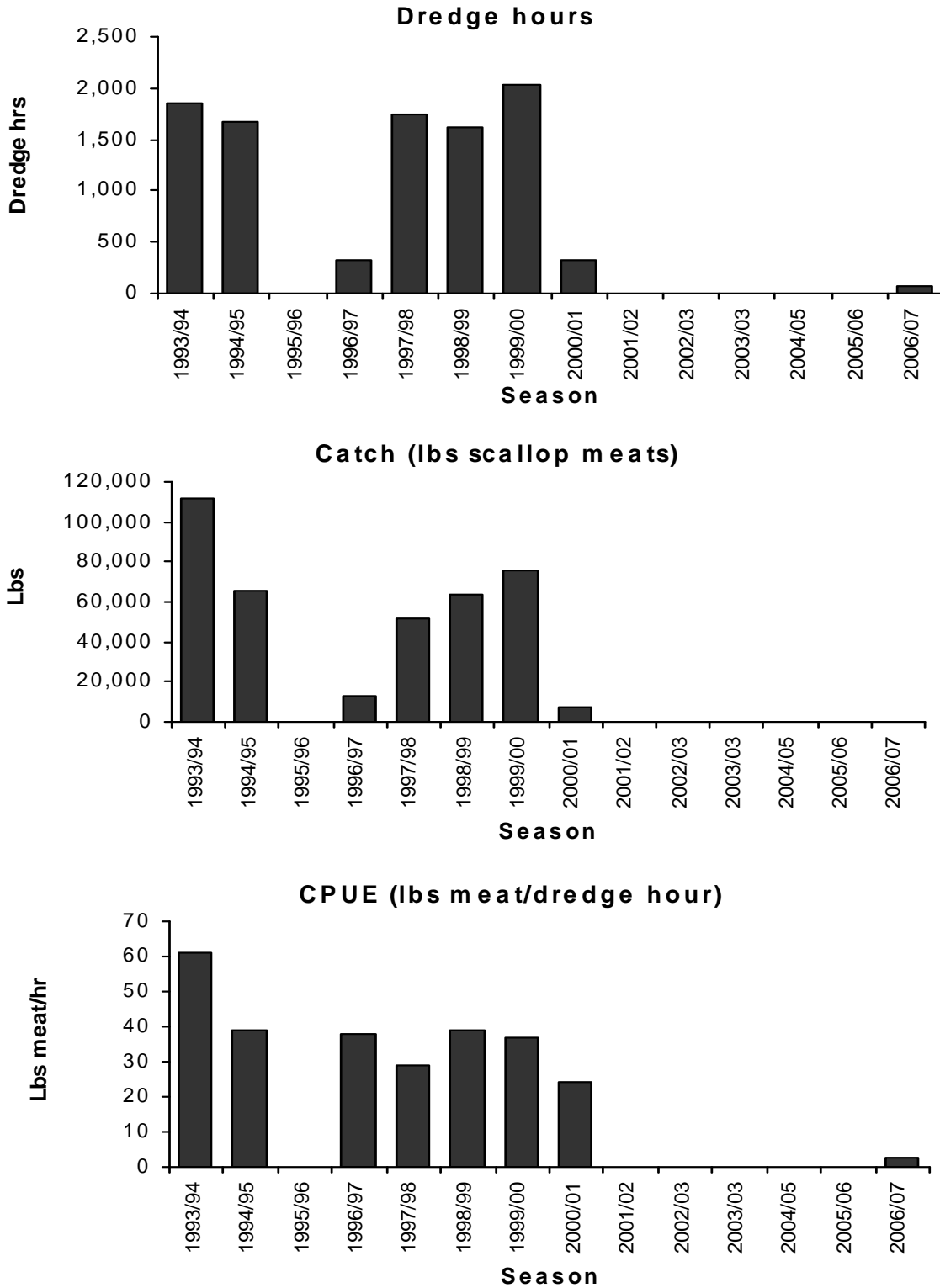


Figure 17 Barplots of Alaska Peninsula scallop fishery statistics.

### 3.9 Bering Sea Registration Area

Weathervane scallop fisheries in the Bering Sea Registration Area (BSRA) were unconstrained by a GHL prior to the 1996/97 season (Table 15, Figure 16). Once established, early GHL ranges were set optimistically, with upper bounds of 400,000 to 600,000 pounds of shucked scallop meats. Catch rates were relatively high during the mid to late-1990s, but annual harvests never exceeded half the upper bound of the GHL range. Scallop catches in the mid to late 1990s were often restricted by Tanner crab bycatch limits.

The upper bound of the BSRA weathervane scallop GHL was adjusted downward to 200,000 pounds beginning with the 2000/01 season and that level was retained for the following season when CPUE dropped by approximately 25% and total harvest was 70% of the upper limit of the GHL range. In response to diminishing fishery performance during the 2000/01 and 2001/02 seasons, managers set a GHL range of zero to 105,000 pounds of shucked scallop meats for the 2002/03 and 2003/04 seasons. The 2002/03 season performed reasonably well, but catch rates and overall catch continued to decrease in 2003/04.

Experimental video survey tows conducted in 2003 showed scallops distributed over a wide, poorly defined area at low densities. BSRA scallop density was low enough to raise concerns for reproductive potential of the stock. The absence of smaller size scallops during the video survey is partially confounded by shell height data from the commercial fishery indicating periodic recruitment events (Figure 17).

In addition to the incorporation of video survey data into the stocks assessment process, the 2003/04 season was the first in which managers established a CPUE hard threshold below which the fishery would be closed.

Inseason fishery performance data was evaluated against the hard threshold mid way to the GHL. The threshold was somewhat arbitrarily set at the CPUE level of the 2002/03 season, or 44 pounds of shucked scallop meats per dredge hour. The CPUE hard threshold was not met during both the 2003/04 and 2004/05 seasons thereby triggering fishery closures before the GHL upper bound was achieved.

Fishery performance has improved since the mid-2000s – Season average CPUE levels are well above the hard threshold, the upper bound of the GHL range is regularly met, and scallop shell-height data shows moderate recruitment (Figure 19). The current 50,000 pound GHL upper bound appears to be sustainable under prevailing conditions.

Given the paucity of stock status data available for weathervane scallop populations, managers place a heavy reliance on the imperfect metric of fishery dependent CPUE data. CPUE data may be skewed by fleet behavior and weather effects, and in the BSRA may be influenced, in part, by crab bycatch rates. Incidental catches of *Chionoecetes* crabs in the Bering Sea scallop fishery have remained below established limits in recent years, but concerns about *Chionoecetes* bycatch rates may alter fleet behavior in the fishery.

Large portions of the eastern Bering Sea shelf and the Pribilof Islands Habitat Conservation Area are closed to scallop fishing to protect red and blue king crab habitat and to provide for habitat conservation (Figure 2).

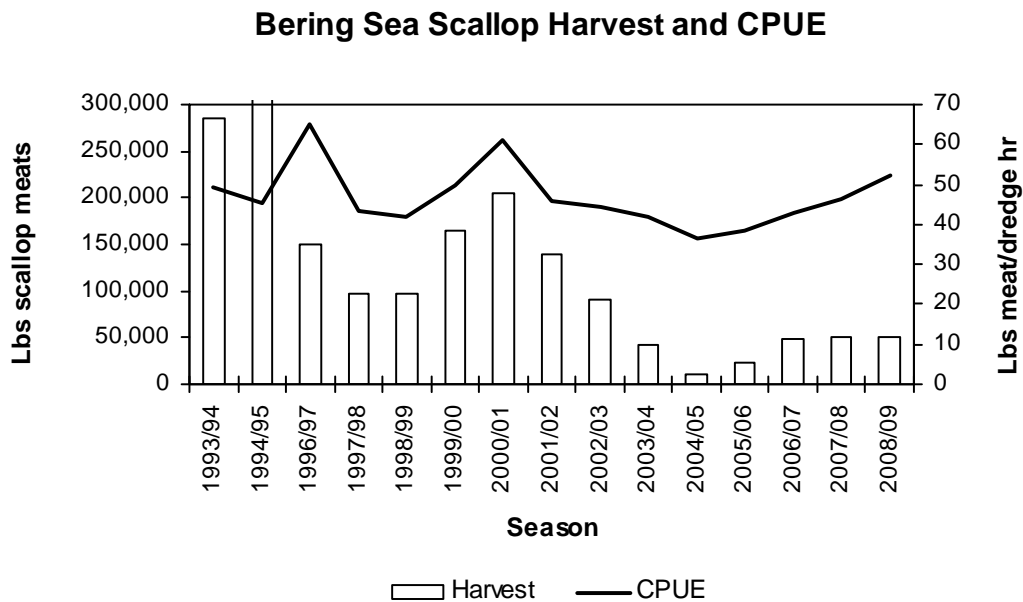
**Table 15 Bering Sea Area scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallops <sup>b</sup> Number	Weight (lbs)
1993/94	9	NA	5,764	284,414	49		
1994/95	8	NA	11,113	505,439	45		
1995/96		closed					
1996/97	1	600,000	2,313	150,295	65		
1997/98	2	600,000	2,246	97,002	43		
1998/99	4	400,000	2,319	96,795	42		
1999/00	2	400,000	3,294	164,929	50		
2000/01	3	200,000	3,355	205,520	61		
2001/02	3	200,000	3,072	140,871	46		
2002/03	2	105,000	2,038	92,240	45		
2003/04	2	105,000	1,020	42,590	42		
2004/05	1	105,000	275	10,050	37		
2005/06	1	50,000	602	23,220	39		
2006/07	1	50,000	1,138	48,246	43		
2007/08	2	50,000	1,084	49,995	46		
2008/09	1	50,000	962	49,995	52	139,564	60,894
2009/10 <sup>c</sup>		50,000		48,889			

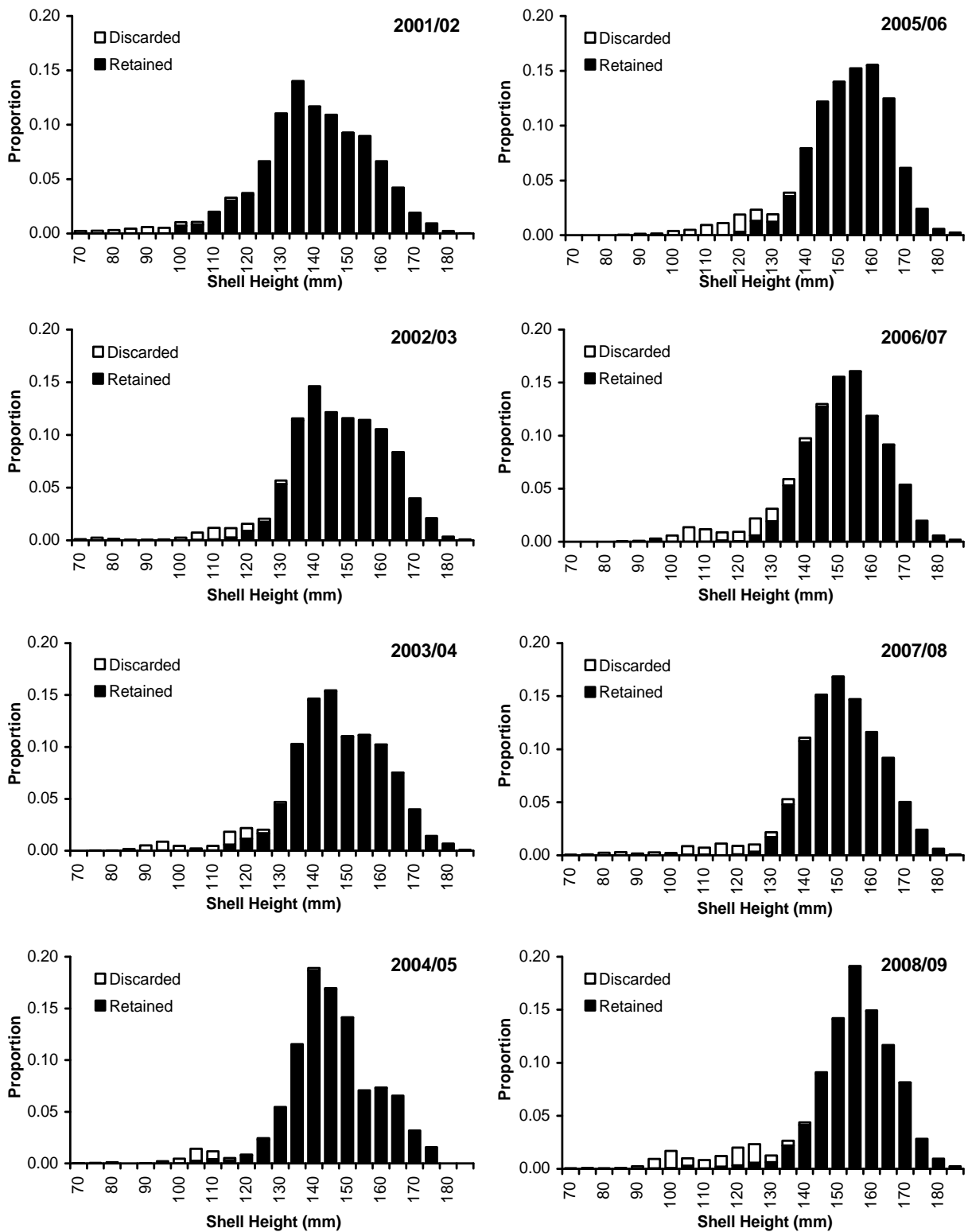
<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> Estimated from bycatch samples.

<sup>c</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 18 Bering Sea Scallop Harvest and CPUE, 1993/94—2008/09 seasons.**



**Figure 19** Estimated scallop shell height distributions from the 2001/02—2008/09 Bering Sea fishing seasons.

### 3.9 Dutch Harbor Registration Area

The first landings of weathervane scallops from the Dutch Harbor Registration Area (DHRA) occurred in 1982, however GHM ranges were not established until 1993. The initial DHRA GHM range was zero to 170,000 pounds of shucked scallop meats and was lowered to a range of zero to 110,000 pounds of shucked scallop meats for the 1998/99 and 1999/00 seasons Table 16. The DHRA scallop fishery failed to meet preseason performance expectations when GHM ranges included levels above 100,000 pounds: under those scenarios catch rates were often less than half that observed on other, more productive scallop beds and annual harvests consistently fell short of even half of the upper bound of the GHM range.

ADF&G closed the DHRA to commercial fishing for weathervane scallops for the 2000/01 and 2001/02 fishing seasons and reopened the area in 2002/03 with a GHM range of zero to 10,000 pounds of shucked meats. In setting this GHM range, managers established that the fishery would be closed inseason if preseason expectations of catch rate, effort distribution, and overall harvest were not met. The 10,000 pound upper bound was crafted to provide sufficient economic incentive for industry to cautiously pursue the fishery and generate information needed to assess stock status. In addition, the 10,000 pound upper bound is indicative of a change in fishery managers' perception of DHRA scallop abundance relative to the previous decade. Fishery performance during the 2002/03 season was not markedly improved from those of the 1990s resulting in closure of the DHRA for the next five fishing seasons to allow for stock rebuilding.

The DHRA was reopened to commercial fishing for weathervane scallops during the 2008/09 season with a GHM range of zero to 10,000 pounds of shucked scallop meats. Justification for the GHM was the same as that applied in setting the 2002/03 GHM. Fishery performance was greatly improved during the 2008/09 season (see Figure 20): the upper limit of the GHM range was met, catch per unit of effort was among the highest on record, catches showed reasonable spatial and temporal distribution, and size-frequency data indicated potential for future scallop recruitment.

Based on positive results of the 2008/09 season ADF&G set a 2009/10 GHM range of zero to 10,000 pounds of shucked scallop meats for the DHRA. Fishery information suggests that scallop beds in the DHRA are small and isolated, so the 2009/10 GHM was set with the limitation that no more than 5,000 pounds of shucked scallop meats could be taken from either waters of the Bering Sea or Pacific Ocean waters. This restriction was intended to spatially distribute fishing effort and reduce the chance of overharvesting a single bed. Fishery performance for the Bering Sea portion of the 2009/10 DHRA fishery was among the best on record; catches were sporadic in Pacific Ocean waters.

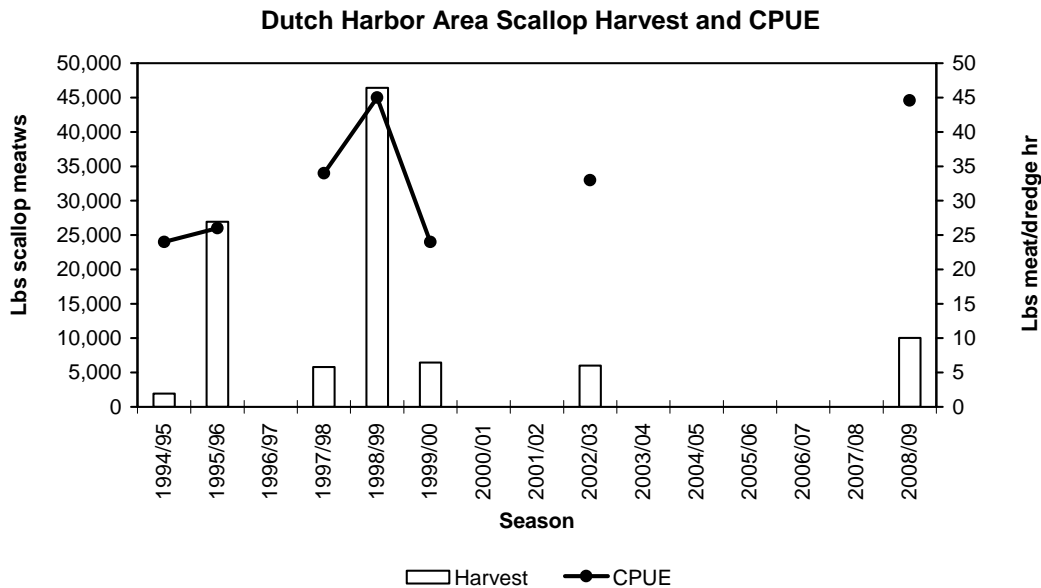
**Table 16 Dutch Harbor Area scallop fishery summary statistics.**

Season	Number vessels	GHL (lbs meat)	Dredge hours <sup>a</sup>	Catch <sup>a</sup> (lbs meat)	CPUE (lbs meat per dredge hr)	Discarded scallop <sup>b</sup> Number	Weight
1993/94	2	170,000	838	confidentialia	46		
1994/95	3	170,000	81	1,931	24		
1995/96	1	170,000	1,047	26,950	26		
1996/97		170,000					
1997/98	1	170,000	171	5,790	34		
1998/99	4	110,000	1,025	46,432	45		
1999/00	1	110,000	273	6,465	24		
2000/01		closed					
2001/02		closed					
2002/03	1	10,000	184	6,000	33		
2003/04		closed					
2004/05		closed					
2005/06		closed					
2006/07		closed					
2007/08		closed					
2008/09	1	10,000	225	10,040	45	82,188	32,209
2009/10		10,000		6,080			

<sup>a</sup> Confidential data released by vessel operators.

<sup>b</sup> Estimated from bycatch samples.

<sup>c</sup> 2009/2010 catch data is preliminary and subject to change.



**Figure 20 Dutch Harbor Area Scallop Harvest and CPUE, 1994/95—2008/09 seasons.**



### 3.10 Adak Registration Area

Scallops were first harvested from the Adak Registration Area (ARA) in 1979 with subsequent fishing periods in 1992 and 1995; all harvest information from the ARA is confidential due to limited participation in the fishery. Bathymetry of the Aleutian Islands, with a narrow continental shelf edge, provides limited scallop habitat; however, a major scallop bed was known to occur on Petrel Bank, an area of important red king crab habitat. To protect red king crab habitat on Petrel Bank, and reduce red king crab bycatch mortality, waters between 51° 30' N. latitude and 54° 30' N. latitude, and between 179° W. longitude and 179° E. longitude were closed to commercial scallop fishing in 1991.

Scant information is available for scallop populations in the ARA; both weathervane and pink scallops are known to occur in the area, but distribution and abundance are unknown. No scallop assessment surveys have been conducted in the ARA and future stock status information will likely be limited. Previous ADF&G management action set a GHL range of zero to 75,000 pounds of shucked scallop meats for the ARA, but that GHL range was poorly justified. Under the current management approach ADF&G does not set a GHL for the ARA scallop fishery and is unlikely to allow future commercial scallop fishing there due to ongoing concerns for red king crab bycatch mortality and limited information on the scallop resource.

## 4 Ecosystem Considerations

The Ecosystem Considerations section was added to the SAFE in 2006, and the SPT hopes to continue improving the section. A wealth of information on climate effects on ecosystems and ecosystem trends contained in the GOA Groundfish Plan Team Ecosystems Considerations document is equally relevant to the scallop fishery and may be accessed at: <http://www.fakr.noaa.gov/npfmc/SAFE/SAFE.htm>.

Commercial concentrations of weathervane scallops occur along the Alaska coast in elongated beds oriented in the same direction as prevailing currents. Image data from ADF&G CamSled tows show that benthic habitats where scallop fishing occurs in the Bering Sea, eastern GOA, and Shelikof Strait, consist predominately of fine sediments (silt, mud, and sand), with heavy sediment clouds regularly suspended by tidal currents. Areas of harder bottom and larger sediments are found inshore from where scallop fishing occurs. ADF&G is beginning to use CamSled data to document and map habitat in the vicinity of scallop fishing areas.

Essential Fish Habitat (EFH) descriptions for scallops may be revised in conjunction with the EFH 5-year review. More information on the current EFH designations may be found at: <http://www.fakr.noaa.gov/habitat/efh.htm>. The Council is scheduled to take action to initiate EFH amendment analyses to the April 2010 meeting.

### 4.1 Ecosystem Effects on the Stock

Little is known about how changes in marine ecosystems affect the Alaska scallop stock. The fishery began in the 1960s, but data from the period before inception of the observer program in 1993 are scarce. Hence, there is no basis for comparison of stock dynamics in response to, for example, the 1977 regime shift. The bivalve mollusk design appears to be extremely robust, as scallops with morphology similar to weathervane scallops have inhabited oceans around the world for millions of years.

### 4.2 Fishery Effects on Ecosystem

The Alaska weathervane scallop fishery occurs in continental shelf waters at depths 40–150 m in three main areas: the eastern Gulf of Alaska between Prince William Sound and Cape Spencer; around Kodiak Island; and in the eastern Bering Sea (Figure 2). Because the fishery footprint is confined to these areas and because

many areas of similar habitat are closed to scallop dredging, we expect the effects of the scallop fishery on the GOA and Bering Sea ecosystems to be minor.

**Predators:** Little is known about scallop predators. Plankton feeders probably eat a large amount of floating larvae. Small weathervane scallops have been found in the stomachs of flounders and crabs may also be scallop predators. Starfish, shell boring worms and sponges may also prey upon scallops. Twentyarm sea stars are a known predator of juvenile weathervane scallops.

**Bycatch:** Scallop fishery bycatch is closely monitored by the onboard observer program (see Section 2.4). Bycatch in the scallop fishery includes prohibited species such as red king crab, Tanner crab, snow crab, and Pacific Halibut, other commercially important species of fish and invertebrates, miscellaneous non-commercial species, and natural and man-made debris. Crab bycatch in the scallop fishery is highest in the Bering Sea, although this accounts for a small proportion of total Bering Sea crab bycatch.

Although a variety of marine vertebrates, invertebrates, and debris are caught incidentally in scallop dredges, weathervane scallops predominate catches. Gorgonian (hard) corals are infrequently encountered by scallop observers; since 1996, corals have been observed in only 11 of the 15,836 tows sampled for catch composition and bycatch. Summaries of haul composition sampling by area are presented in observer reports prepared by ADF&G (e.g., Rosenkranz and Burt, 2009).

For example, during the 2000/01–2007/08 seasons, the most frequently caught species or items in the statewide scallop fishery by weight were weathervane scallops and scallop shells (84%), twentyarm sea stars *Pycnopodia helianthoides* (4%), natural debris (kelp, wood, etc., 3%), and several species of skates (2%). A comparison of the 2000/01–2007/08 statewide incidental catch and the incidental catch for each scallop fishery area/district for the 2008/2009 season are listed in Table 17.

**Table 17 Most frequently caught species/items in 2008/2009 scallop dredges (% by weight).**

Species/ Item	Statewide	Yakutat		Prince	Kodiak		Alaska Peninsula	Dutch Harbor	Bering Sea
	2000/01— 07/08 seasons	Area D	District 16	William Sound	Northeast District <sup>d</sup>	Shelikof District			
Scallops and scallop shells	84	87.5	83.2	87.8	71.1	87.3	40.6	85.6	84.9
<sup>a</sup> Sea Stars	8	1.3	2	3.7	14.1	2.1		2.2	
Natural Debris	3	1.4	2.5	0.7	5.5	2.7	8.7	2	
<sup>b</sup> Skate species	2	1.2				2.1			2.2
<i>Squalus acanthia</i> (spiny dogfish)	1		2						
<i>Solaster stimpsoni</i>				3.9				3.9	
<i>Chionoecetes bairdi</i> (Tanner crab)							6.2		2.8
<i>Microstomus pacificus</i> (Dover sole)							3.3		
<sup>c</sup> Other					1.8				1.1

<sup>a</sup> "Sea Stars" include sea, sunflower sea, brittle, and basket stars: *Pycnopodia helianthoide*, *Pycnopodia helianthoides*, *Ophiura sarsi*, and *Gorgonocephalus caryi*.

<sup>b</sup> "Skates" include Alaska, big, and unspecified skates: *Raja binoculata* and *Pycnopodia helianthoides*.

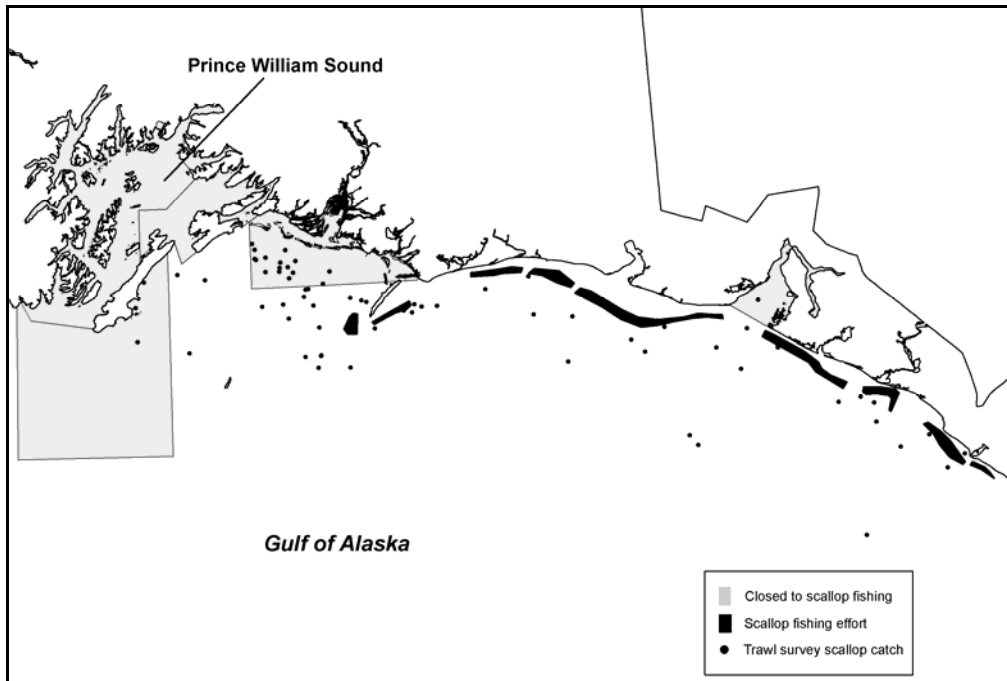
<sup>c</sup> "Other" includes unidentified sponge (Phylum *Porifera*) and sea anemone.

<sup>d</sup> The dredge composition for the Kodiak Northeast District is calculated from the 2007/2008 season.

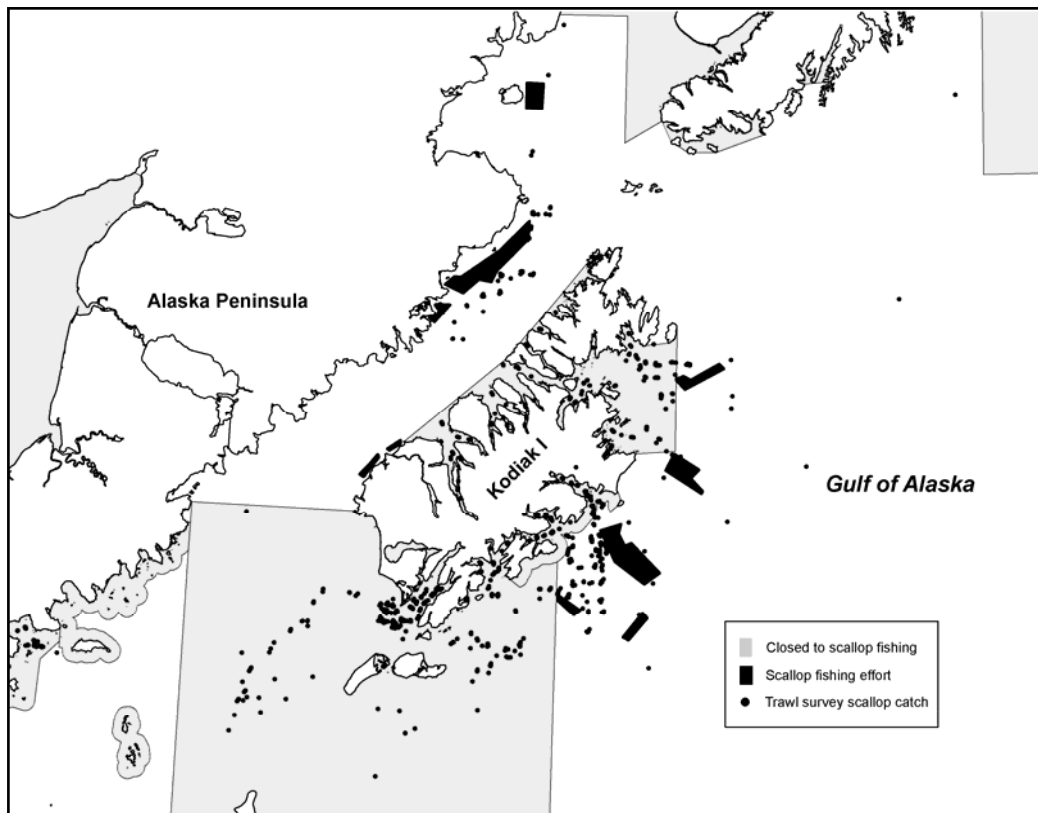
### 4.3 Trawl Survey Information on Scallop Stocks

Trawl surveys for fisheries stock assessment are conducted annually in the Gulf of Alaska and the Bering Sea by NMFS and ADF&G. Although these surveys target crab and groundfish and the gear is not designed to efficiently capture scallops, weathervane scallops are caught in some areas and survey data provide information on the range of the species.

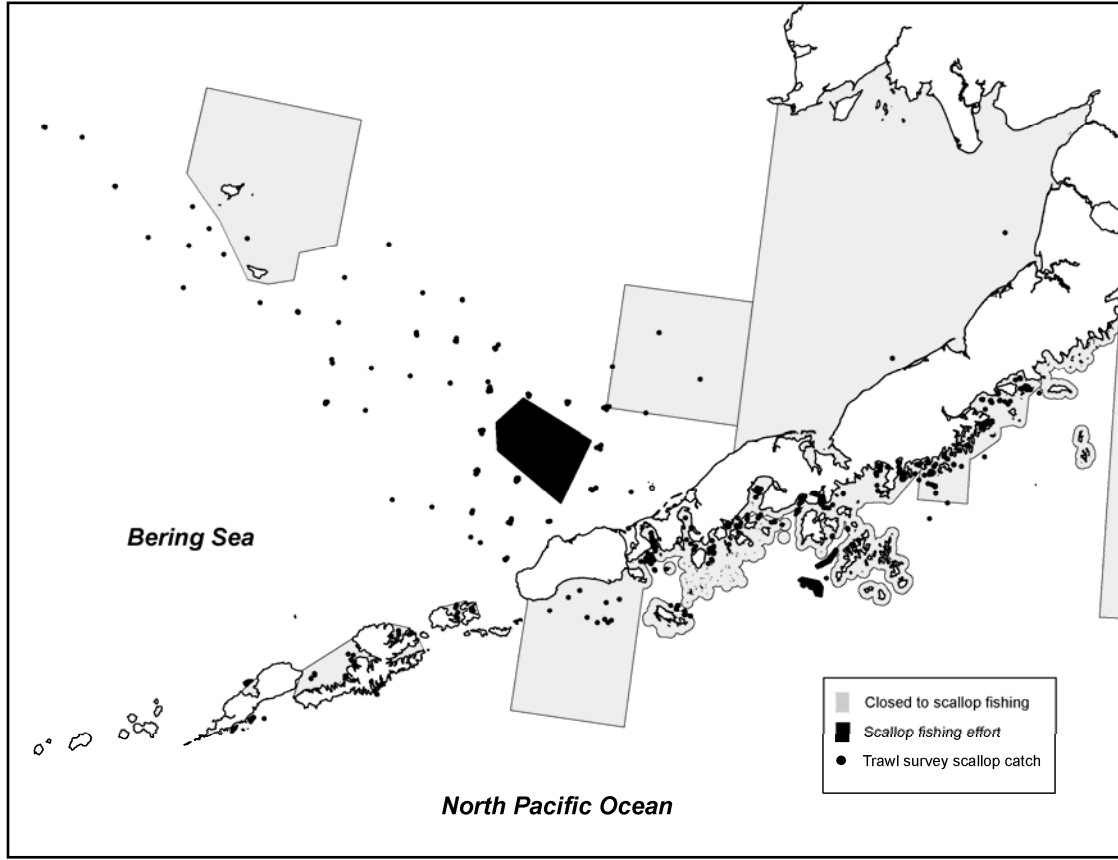
In the eastern GOA (Figure 2), weathervane scallops have been captured during trawl surveys offshore from traditional scallop fishing grounds and in closed waters adjacent to Prince William Sound. Around Kodiak Island (Figure 22), trawl surveys have captured scallops in closed waters south of the island and in many bays and inlets. Along the south side of the Alaska Peninsula, trawl survey data indicate that most scallop habitat lies in coastal waters that are closed to scallop fishing, while scallops have been captured during trawl surveys over a large swath of the eastern Bering Sea shelf Figure 23.



**Figure 21** Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS trawl surveys in the eastern Gulf of Alaska.



**Figure 22** Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS and ADF&G trawl surveys in the Kodiak Area.



**Figure 23** Map showing scallop fishing areas, areas closed to scallop fishing by regulation, and locations where weathervane scallops were captured during NMFS and ADF&G trawl.

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