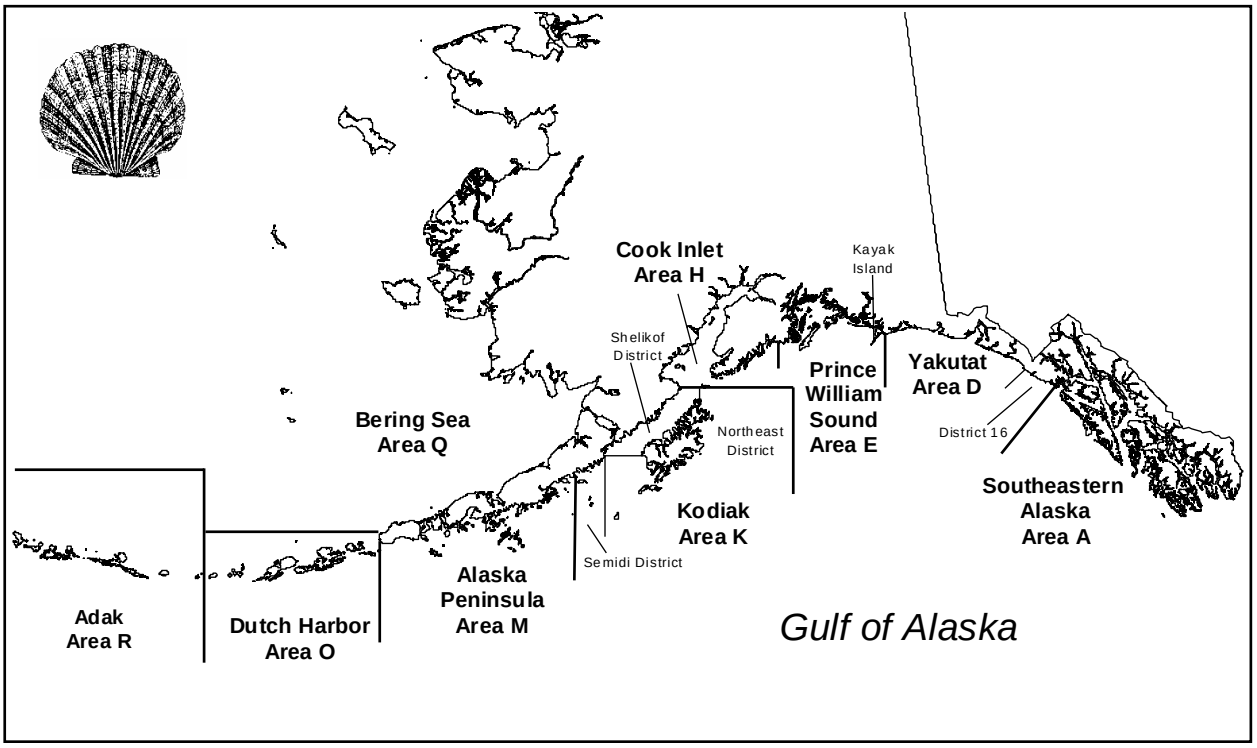
STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

FOR THE WEATHERVANE SCALLOP

FISHERY OFF ALASKA



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1 Introduction

The National Standards Guidelines for Fishery Management Plans, published by the National Marine Fisheries Service, require that a stock assessment and fishery evaluation (SAFE) report be 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 Anchorage on February 23rd, 2015 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 Diana Stram (co-chair), Scott Miller, Ryan Burt, Quinn Smith, Jie Zheng, Peggy Murphy, and Jim Armstrong.

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 scallop (*Patinopecten caurinus*), reddish scallop (*Chlamys rubida*), spiny scallop (*Chlamys hastata*), and rock scallop (*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 waters off the Aleutian Islands. Scallop registration areas used by ADF&G in management of the fishery and general fishing locations are shown in Figure 2-1.

In 1996, optimum yield (OY) was established as 0 to 1.8 million lb of shucked scallop meats. A more conservative approach was taken in 1998, when OY was defined as 0 to 1.24 million lb of shucked scallop meats. OY was just recently redefined again in 2012 to 0 to 1.29 million lb of shucked meats to include known discards over the time frame for which the upper end of the OY range was defined. Statewide scallop harvests have not exceeded OY, and scallop stocks are not overfished.

1.1 Responses to Comments from the SSC

2014 SSC comments:
Comment 1: The SSC appreciates the SPT's continued application of the stock structure template to weathervane scallops. The template provides several lines evidence that suggests that the stock is composed of regional meta-populations including: (a) regional differences in growth rate, age composition (possibly an indicator of regional differences in recruitment), and morphology; and (b) weak evidence of genetic partitioning between the Bering Sea and GOA populations. **This evidence suggests that although current harvest practices are consistent with local area management, further**

refinement of the stock delineations for the purposes of setting the OFL and ABC for this species should be considered during the proposed workshop in 2015.
Response: These issues are anticipated to be addressed as part of the data-limited workshop.

Comment 2: Fishery independent surveys are conducted in only a few scallop beds in the Central Region. Therefore, confirmation of the validity of fishery-dependent CPUE as an index of local abundance is important. The SAFE document contains a comparison of trends in survey biomass estimates and fishery CPUE in Kamishak Bay. The analysis showed a positive correlation between dredge survey biomass and fishery CPUE in North Bed, a negative relationship in the South Bed, but a positive correlation overall. It was also noted that an observed decline in fishery CPUE in the Kodiak Shelikof area was potentially due to Tanner crab avoidance. These observations suggest that time trends in fishery CPUE are uncertain indicators of local abundance trends. **The SSC recommends that during the workshop proposed for 2015, analysts review the processes that may influence fishery CPUE.**
Response: These issues are anticipated to be addressed as part of the data-limited workshop.

Comment 3: Initial runs of an age-structured model for Kamishak Bay were brought forward at the 2014 SPT meeting. **The SSC is very supportive of continued model development for Kamishak Bay, supports plans for the development of a model for the Kayak Island area and requests a full description of the model.** The SSC agrees with the SPT that the authors consider a range of fixed natural mortality estimates and, if possible, annually variable natural mortality. In addition, the SSC recommends that the authors investigate how gear efficiency and uncertainty in survey data impact model results.
Response: ADF&G staffing challenges prevented progress on the age-structured model.

Comment 4: It was confusing to read the document's descriptions that jump back and forth among multiple districts within the areas. For example in Section 3.2 on the Yakutat Registration Areas, the text jumps back and forth between District 16 and the rest of the Yakutat region (referred to as Area D). The SSC recommends that each of the beds or districts within a registration area be discussed completely before moving on to the next district.
Response: These changes were made to the 2014 SAFE report.

Comment 5: The SSC wishes to clarify that last year, when the Depletion Corrected Average Catch (DCAC) model was mentioned, this modeling approach was advanced just as an example. It should be noted that the DCAC modeling approach was developed for west coast groundfish stocks, and caution should be taken when applying this modeling approach to species other than groundfish. **The SSC encourages authors to examine a variety of alternative data-poor management approaches during the workshop to determine which, if any, could be applied to scallop.**
Response: These issues are anticipated to be addressed as part of the data-limited workshop.

1.2 Summary of New Information Included in the SAFE Report

This SAFE Report includes updated information through the 2013/14 fishing season. New information included in this report since the previous report (NPFMC 2014) includes the following:

1) Updated observer program summary data through 2013/14 fishing season; including shell height distributions, retained catch, discarded catch, preliminary 2014/15 catch data, bycatch information from the directed fishery including Tanner, snow and red king crab bycatch by region;
2) Updated information on economic wholesale value of the fishery;
3) Annual catch limits (ACL) recommendation for 2015/16 fishing year and preliminary catch through 2014/15;
4) Updated survey information in Prince William Sound and Cook Inlet;
5) Updated haul composition data indicating bycatch in the directed fishery:
6) Updated scallop discard data with mortality rates applied; and
7) Updated shell height and age histograms are included for the Central Region in both tabular and figure formats (as requested by the SSC). Also included are correlation and regression relationships between Central Region fishery independent surveys and commercial fishery CPUE (as requested by the SSC), and a presentation of survey scallop discard mortality estimates for Kamishak Bay.

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. 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.

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 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. The State's vessel-based limited entry program for weathervane scallops did expire on December 30, 2013.

In January, 2014, the Board of Fisheries implemented a new State-Waters Weathervane Scallop Management Plan (5 AAC 38.078) that delineates additional tools needed to manage open-access weathervane scallop fisheries in waters of Alaska. The management plan applies to the Yakutat, Prince William Sound, Kodiak, and Dutch Harbor scallop registration areas which all have scallop beds that span both state and federal waters. The new management plan is in addition to the existing Alaska Scallop

Fishery Management Plan (5 AAC 38.076) that establishes registration, reporting, gear, and observer coverage requirements.

The state-waters management plan allows the department to manage scallop beds in waters of Alaska separately from beds in adjacent federal waters if effort increases in the open-access state-waters fishery. The plan defines the scallop vessel registration year (April 1 – March 31) and establishes an annual preseason registration deadline of April 1. It also requires a registered scallop vessel to have onboard an activated vessel monitoring system, permits the department to establish trip limits, and allows for separate registrations for state and federal-waters fishing. The additional management measures are necessary to prevent overharvest of the weathervane scallop resource during an open-access fishery.

In 2014, eight vessels acquired state open-access permits. None of these vessels fished for scallops, however. Information provided at the 2015 Scallop Plan Team meeting indicated that these vessels may not have fished due to the cost of carrying observers and/or a lack of needed scallop harvesting gear.

1.4 Weathervane Scallop Biology

There are eight known species of scallops in Alaskan waters (Hennick 1973), but only the Pacific Weathervane scallop is commercially fished. Exploratory fishing for the pink scallop *Chlamys rubida* has not found commercial concentrations and the species is not targeted commercially off Alaska. 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 a byssal 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 ageing 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 (Figure 1-1).

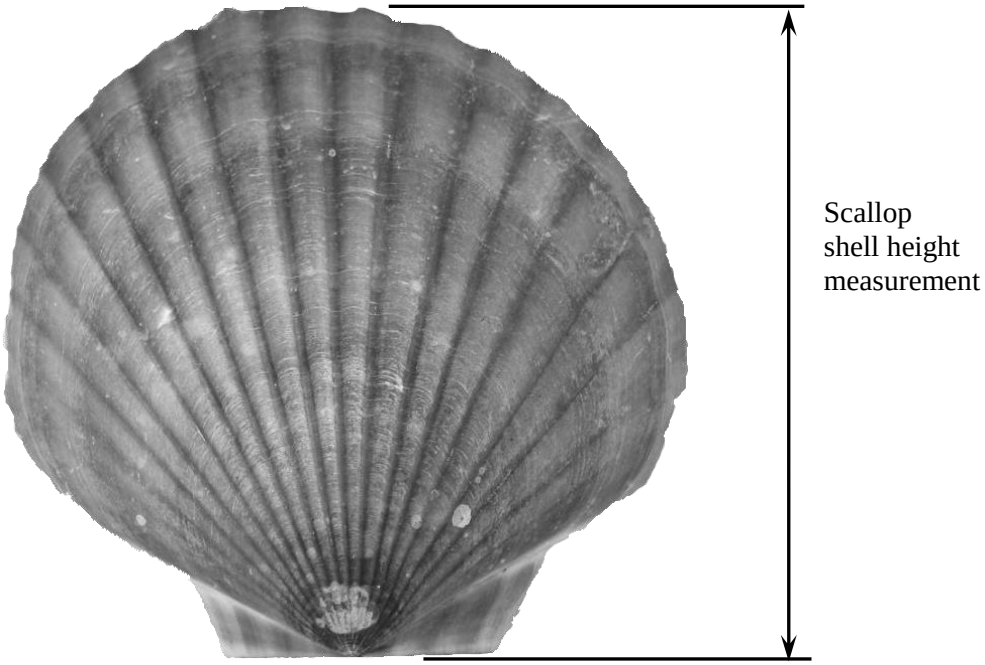

Figure 1-1. Left (upper) valve of weathervane scallop shell showing orientation of shell height measurement.

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 millions 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 Weathervane Scallop stock structure

A summary of the available data on the stock identification for weathervane scallops is shown in Table 1-1. These were taken from Spencer et al (2010) and have been applied here for the weathervane scallop stock to help assimilate information necessary to determine stock structure, stock boundaries, as well as to identify data gaps and research needs for scallops. The Scallop Plan Team intends to update these data as additional information becomes available in the annual SAFE report.

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Table 1-1 Summary of available data on stock identification for Weathervane scallop.

HARVEST AND TRENDS	
Factor and criterion	Available information
Fishing mortality (5-year average percent of F_{max})	Cook Inlet and Kayak bed-specific information available where surveyed, unknown for other areas.
Spatial concentration of fishery relative to abundance (Fishing is focused in areas << management areas)	Fishery concentrated in areas smaller then broad distribution of scallop stocks by management region. See figures in SAFE for overall distribution. Scallops known to occur in closed waters, sometimes in dense aggregations.
Population trends (Different areas show different trend directions)	Survey biomass trends in some regions, CPUE trend data available for other regions, trends differ by area, no clear overall trend statewide, age distributions differ by region and beds, recruitment difficult to detect due to fishery-dependent data (commercial fishery catch does not necessarily indicate recruitment or biomass trends)
Barriers and phenotypic characters	
Generation time (e.g., >10 years)	No, areas tend to be similar, some differences in growth rates by area and maturity
Physical limitations (Clear physical inhibitors to movement)	Consideration of GOA oceanography and the ~30 day larval phase (Bourne, 1991) suggest linkages between different subpopulations of this spatially structured metapopulations but advection and settlement information unknown
Growth differences (Significantly different LAA, WAA, or LW parameters)	Yes, Kodiak scallops grow faster and are larger at given shell height than scallops from the eastern GOA; unknown if genetic or environmental but literature suggests environmental factors such as depth, water temperature, and primary production strongly affect growth. (Ignell and Haynes, 2000; Kruse et al. 2005).
Age/size-structure (Significantly different size/age compositions)	Complicated by comparison of survey data with fishery data; age structure varies regionally and is may be affected by fishery removals in local subpopulations.
Spawning time differences (Significantly different mean time of spawning)	Scallop spawning occurs in early summer and appears to be temperature dependent. Spawning of southern populations (Washington, BC) starts earlier (MacDonald and Bourne 1987)
Maturity-at-age/length differences (Significantly different mean maturity-at-age/ length)	Unknown, histological analyses not completed but visual inspection indicates age 3 in both Kamishak and Kayak but no data available for other regions
Morphometrics (Field identifiable characters)	Yes shell shape, weight, height differences by region
Meristics (Minimally overlapping differences in counts)	Unknown

Table 1-1 (cont'd) Summary of available data on stock identification for Weathervane scallop.

Behavior & movement	
Spawning site fidelity (Spawning individuals occur in same location consistently)	Yes scallops are sessile
Mark-recapture data (Tagging data may show limited movement)	N/A
Natural tags (Acquired tags may show movement smaller than management areas)	Unknown
Genetics	
Isolation by distance (Significant regression)	Unknown
Dispersal distance (<<Management areas)	Unknown
Pairwise genetic differences (Significant differences between geographically distinct collections)	Weak evidence for difference between Bering Sea and GOA, no evidence for differences within GOA (Gaffney et al, 2010). Gaffney et al. (2010) note that "lack of genetic differentiation measured by neutral markers does not preclude the existence of locally adapted, self-sustaining populations". Limited genetic data available may not be relevant to time scales for management.

2 Overview of Scallop Fishery and Management

The Alaska weathervane scallop fishery is managed jointly by NPFMC 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.

2.1 Management

The following sections provide background on the Alaska weathervane scallop fishery and its management including the overfishing definition, ACLs, registrations areas, seasons, Guideline Harvest Ranges (GHRs) and GHLs, and use of in season data collected by the onboard scallop observer program.

2.1.1 Registration Areas

The State of Alaska Scallop Fishery Management Plan established nine scallop registration areas in Alaska for vessels commercially fishing scallops (Figure 2-1). These include the Southeastern Alaska Registration Area (Area A); Yakutat Registration Area (Area D), which is subdivided into the Yakutat District and District 16; Prince William Sound Registration Area (Area E), which is subdivided into the East and West Kayak Island Subsections; Cook Inlet Registration Area (Area H), which is subdivided into the Northern, Central, Southern, Kamishak Bay, Barren Islands, Outer and Eastern Districts (Figure

2-2); Kodiak Registration Area (Area K), which is subdivided into the Northeast, Shelikof, Southeast, Southwest and Semidi Islands Districts; Alaska Peninsula Registration Area (Area M), which is subdivided into the West Chignik, Central and Unimak Bight Districts; 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.

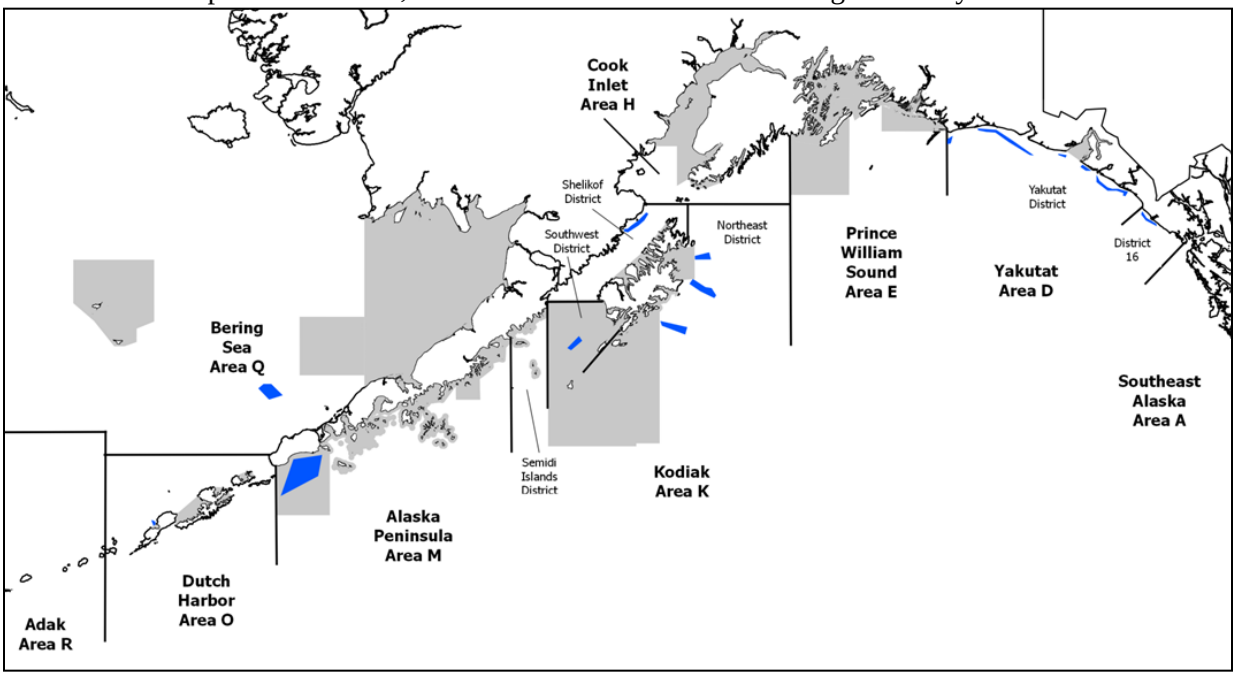

Figure 2-1. Map showing Alaska scallop fishery registration areas. General areas of effort during the 2013/14 season are overlaid by blue polygons. Exploratory fisheries in waters normally closed to scallop fishing (gray shading) were opened by ADF&G Commissioner's Permit in the Kodiak Southwest District and Alaska Peninsula Area during the season.

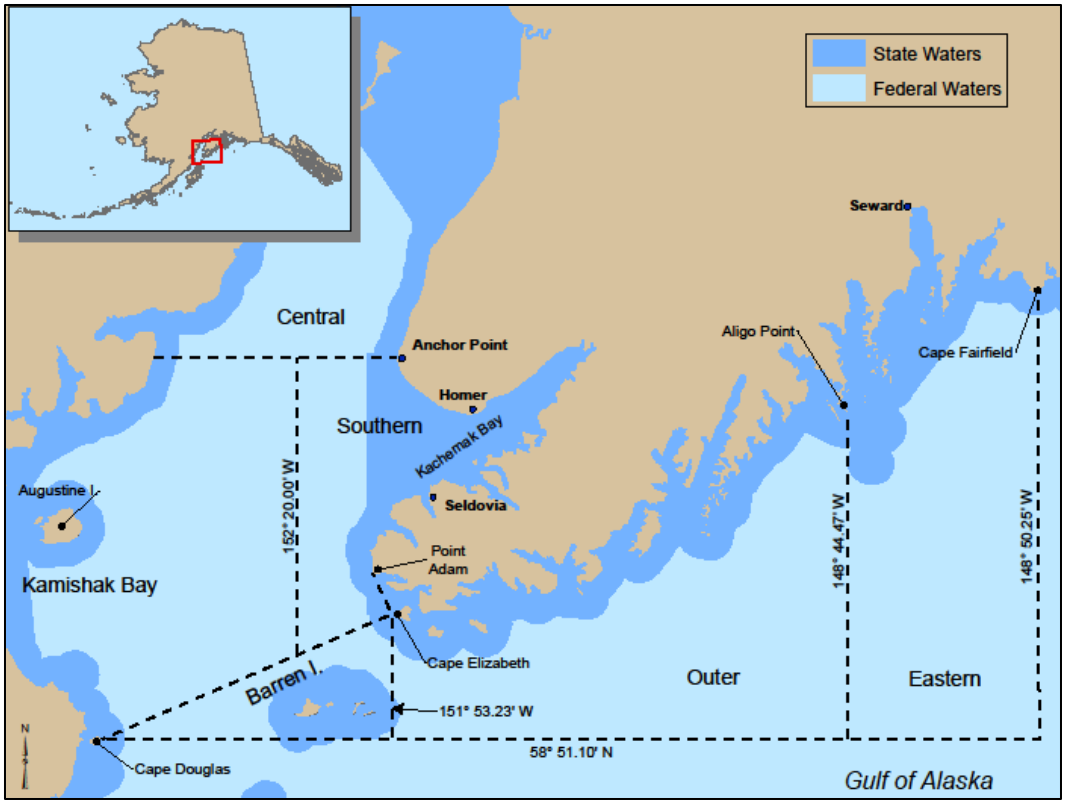

Figure 2-2. Cook Inlet Management Districts.

2.1.2 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. In all other districts of Cook Inlet, the season is from January 1 through December 31 only under terms of a commissioner's 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.

2.1.3 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. GHLs are pre-season targets set for each fishing area (registration area, district, or statistical area) prior to the season by ADF&G regional managers. Total harvest for each fishing area in a given season is typically 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 (pounds of shucked scallop meats) were set at 0–250,000 lb. for Yakutat; 0–50,000 lb for Prince William Sound; 0–20,000 lb for the Kamishak District of Cook Inlet; 0–400,000 lb for Kodiak; and 0–170,000 lb 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 lb for the Alaska Peninsula; 0–600,000 lb for the Bering Sea; 0–35,000 lb for District 16; and 0–75,000 lb for Adak. The combined total of the upper limits from traditional and non-traditional areas was 1.8 million lb, which was defined as 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 lb, with optimum yield defined as the range 0–1.24 million lb. To accommodate the new definition, regulatory GHR ceilings were reduced by the State of Alaska from 400,000 to 300,000 lb in Kodiak; from 170,000 to 110,000 in Dutch Harbor; and from 600,000 to 400,000 lb in the Bering Sea. Hence, the regulatory GHR ceiling written into Alaska regulatory code is also 1.24 million lb.

2.1.4 In-season data

Observers, which 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 three times per week. Fishing may be closed in any area before the GHL is reached if collected data raise concerns about localized depletion, trends in Catch Per Unit Effort (CPUE – lb of meat/dredge hr), or bycatch rates. In-season data are also used by the scallop industry to avoid areas of high crab bycatch.

2.1.5 Overfishing Definition

Overfishing is a level of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce Maximum Sustained Yield (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 lb of shucked meats based on the average catch from 1990 – 1997 excluding 1995. Optimum Yield (OY) was defined as 0 – 1.24 million lb, and the overfishing control rule was defined as a fishing rate in excess of the natural mortality rate, which has been estimated as $F_{overfishing} = M = 0.13$ (12% per year) statewide. OY was just recently redefined again in 2012 to 0 to 1.29 million lb of shucked meats to include known discards over the time frame for which the upper end of the OY range was defined. Catch towards the OFL (and ACL, see Section 2.1.2 below) is a total catch and thus includes discards.

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 2-3 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 (Table 2-1). Control rules for other Alaskan scallop species have not been developed as no commercial harvests occur. Catch by individual registration area is shown in Table 2-2 and Table 2-3.

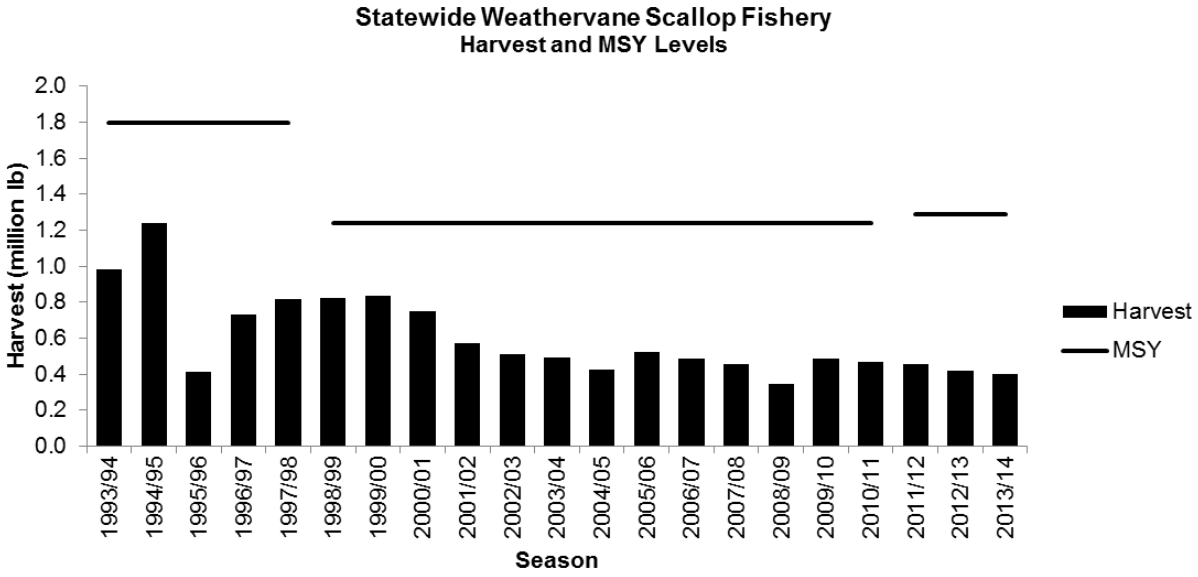

Figure 2-3 Statewide scallop harvest (lb shucked scallop meats) and MSY levels from FMP.

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Table 2-1 Alaska weathervane scallop harvest and MSY from FMP, 1993/94 - 2014/15 seasons.

Season	Harvest (lb 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
1999/00	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
2009/10	488,059	1,240,000	39
2010/11	459,759	1,240,000	37
2011/12	456,058	1,290,000	35
2012/13	417,551	1,290,000	32
2013/14	399,134	1,290,000	31
2014/15[a]	307,472	1,290,000	24

[a] PRELIMINARY data subject to change.

Table 2-2 GHLs and summary statistics from 2013/14 Alaska weathervane scallop fishery.

Area/District	GHL (lb meat)	Retained catch (lb meat)	CPUE (lb meat per dredge hr)	Est scallop discard mortality (lb meat)[a]
Yakutat District	120,000	122,290	51	3,770
Yakutat District 16	25,000	25,110	40	708
Prince William Sound	closed	0		
Cook Inlet	closed	0		
Kodiak Northeast District	55,000	54,926	59	1,457
Kodiak Shelikof District	105,000	106,099	43	1,162
Kodiak Southwest District[b]	25,000	20,340	39	301
Kodiak Semidi Islands District[b]	20,000	0	0	5
Alaska Peninsula Unimak Bight District[b]	15,000	15,155	61	325
Dutch Harbor	5,000	5,225	94	96
Bering Sea	50,000	49,989	46	400
Statewide total	420,000	399,134	48	8,220

[a] Calculated from round weight discard estimates assuming 20% mortality (as previously used in scallop ACL analysis) for discarded scallops and meat recovery percentages from observer experiments.
[b] Exploratory fishery prosecuted under ADF&G Commissioner's Permit.

Table 2-3 GHLs and preliminary catch from the 2014/15 Alaska weathervane scallop fishery.

Area/District	GHL (lb scallop meats)	Retained catch (lb scallop meats)
Yakutat District	120,000	119,893
Yakutat District 16	25,000	9,141
Prince William Sound	closed	0
Cook Inlet	closed	0
Kodiak Northeast District	55,000	55,061
Kodiak Shelikof District	105,000	65,779
Kodiak Southwest District[a]	25,000	24,993
Alaska Peninsula Central District[a]	7,500	0
Alaska Peninsula Unimak Bight District[a]	15,000	15,000
Dutch Harbor	5,000	5,160
Bering Sea	50,000	12,445
Statewide total	407,500	307,472

[a] Exploratory fishery prosecuted under ADF&G Commissioner's Permit.

2.1.6 Annual Catch Limits and Accountability Measures

On January 16, 2009, NMFS issued final guidelines for National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). These guidelines provide guidance on how to comply with new annual catch limit (ACL) and accountability measure (AM) requirements for ending overfishing of fisheries managed by federal fishery management plans. Annual catch limits are amounts of fish allowed to be caught in a year.

The new requirements include provisions intended to prevent overfishing by requiring that: FMPs establish a mechanism for specifying ACLs in the plan (including a multiyear plan); implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery; and including measures to ensure accountability (AMs). The MSRA includes a requirement for the SSC to recommend fishing levels to the Council, and provides that ACLs may not exceed the fishing levels recommended by the SSC. NMFS's National Standard 1 Guidelines state that the ABC is the fishing level recommendation that is most relevant to ACLs.

A maximum ABC control rule is established equal to 90% of the OFL. The OFL was re-estimated to include known discards at the time of the average catch calculation employed in establishing this level which was estimated based upon retained catch only. The OFL is considered to be a conservative estimate due to the fact that there are areas of known scallop beds that are not included in the catch calculation as they are currently closed to fishing although they have supported historic harvests in the past. The OFL is equal to 1.29 million lb.

Accountability measures were established such that the sum of the annual GHLs for each scallop management area be established by the State of Alaska at a level sufficiently below the ACL so that the sum of the estimated discard mortality in directed scallop and groundfish fisheries as well as the directed scallop fishery removals does not exceed the ACL. Anytime an ACL is exceeded the overage will be accounted for through a downward adjustment to the GHL during the fishing season following the overage.

Directed fishing only occurs on weathervane scallops and the FMP only provides an estimate of MSY and OY for weathervane scallops thus it is defined as being 'in the fishery'. The remaining species of scallops under the Alaska Scallop FMP include pink scallops, spiny scallops and rock scallops are contained in an 'Ecosystem component (EC)' of the FMP. ACLs are not required for EC species provided they are not being explicitly targeted. EC species generally are not retained for any purpose, although *de minimis* amounts might occasionally be retained.

Additional information on the non-target scallop stocks is contained in Section 4.1.

2.1.6.1 ACL recommendation for the 2015/16 Scallop fishing season

The SPT recommends that the annual catch limit (ACL) for the 2015/16 weathervane scallop catch specifications be established as the maximum ABC control rule equal to 90% of the statewide OFL, which includes discards. This equates to an ABC equal to 1.161. million pounds of shucked meats understanding that this will include all catch including discards for which a 20 percent discard mortality rate will be applied. The SPT will evaluate total catch (including discards) against this statewide ACL level in the 2016 SAFE report for the 2014/15 fishing year to determine if this ACL has been exceeded.

2.1.6.2 Catch in relation to ACLs

A summary of the 2013/14 season total catch in relation to the area-specific GHLs (retained catch), discards by area, and average CPUE are in Table 2-2. Total catch is compared against the ACL which is applied statewide. Preliminary retained catch from the 2014/15 fishery is provided in Table 2-3 but discard estimates are not yet available for comparison. This information will be provided in the 2016 SAFE report. Final catch in relation to the ACL for 2014/15 will be provided in the 2016 Scallop SAFE report.

2.2 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 lb and a 6-foot dredge weighs at least 1,000 lb. 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).

2.3 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 from the Kodiak office 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 in-season 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 by ADF&G staff in Kodiak. Observer training and deployment manuals (e.g., ADF&G, 2014) 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.

2.4 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 2-4. 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. Crab abundance estimates are not available in the Southwest District of the Kodiak Area or the Unimak Bight area of the Alaska Peninsula Area. In each of these areas, CBLs are fixed at 50 red king crabs and 12,000 Tanner crabs. Bycatch caps are expressed in numbers of crabs and include all sizes of crabs caught in the scallop fishery.

Table 2-4. Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.

Area/District	Red King Crab	*C. bairdi*	*C. opilio*
Yakutat District 16	NE[a]	NE	NA[b]
Yakutat District	NE	NE	NA
Prince William Sound	NE	0.5%	NA
Cook Inlet Kamishak District	30 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 Southwest District	50[c]	12,000[c]	NA
Kodiak Semidi Islands District	NE	NE	NA
Alaska Peninsula	0.5% or 1.0%	0.5% or 1.0%	NA
Alaska Peninsula Unimak Bight District	50[c]	12,000[c]	NA
Bering Sea	500 crab[c]	3 tier approach	3 tier approach
Dutch Harbor	0.5% or 1.0%	0.5% or 1.0%	NA
Adak[d]	50	10,000 crab	NA

[a] Not established.
[b] Not applicable.
[c] Fixed CBL.
[d] Bycatch limit established to provide scallop fleet opportunity for exploratory fishing while protecting crab resources.

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 was fixed at 60 crabs in earlier years and has since been reduced to 30 crabs commensurate with the reduction in red king crab catch in trawl and dredge surveys in recent years. 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. Starting in 2010, the department set crab bycatch limits at 0.5% of the Tanner crab abundance estimated from the scallop survey.

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. Crab bycatch caps for the 2013/14 season are shown in Table 2-5.

Bycatch of snow crabs, Tanner crabs, and red king crabs by scallop fisheries are shown in Table 2-5 and Figure 2-4. Bycatch of snow, king, and Tanner crabs during the Bering Sea scallop fishery tends to be much lower than for other Bering Sea fisheries. Observer data on carapace width for samples crabs by registration area are available in Figure 2-5 and 2-6 for 2013/14 fisheries.

Table 2-5 Crab bycatch caps by Area/District for the 2013/14 Alaska weathervane scallop fishery.

Area/District	**Chionoecetes crabs**	**King crab**
Yakutat District	NE	NE
Yakutat District 16	NE	NE
Prince William Sound	NA (Closed)	NA
Cook Inlet	NA (Closed)	NA
Kodiak Northeast District	49,124	25
Kodiak Shelikof District	27,450	50
Kodiak Southwest District	12,000	50
Kodiak Semidi Islands District	NE	NE
Alaska Peninsula Unimak Bight District	12,000	50
Dutch Harbor	5,000	10
Bering Sea *C. bairdi*	260,000	500
Bering Sea *C. opilio* and hybrids	300,000	NA

NE: not established; NA: not applicable

Table 2-6 Bycatch of *Chionoecetes* crabs by Area/District in the 2013/14 Alaska weathervane scallop fishery.

Area/District	**Est number crab**	**Est weight (lbs)[a]**
Yakutat District	21,784	697
Yakutat District 16	2,165	30
Prince William Sound	0	0
Cook Inlet	0	0
Kodiak Northeast District	25,510	7,123
Kodiak Shelikof District	13,462	1,563
Kodiak Southwest District	8,354	2,402
Kodiak Semidi Islands District	20	NA
Alaska Peninsula Unimak Bight District	3,405	1,094
Dutch Harbor	1,206	189
Bering Sea *C. bairdi*	88,040	46,455
Bering Sea *C. opilio* and hybrids	32,005	25,702
Statewide total	195,951	85,256

[a] Weight estimation for areas outside Cook Inlet uses estimated number crab, carapace width distributions from scallop observer sampling (Figures 2-7–2-12), and statistical CW-weight relationship parameters from NMFS Bering Sea crab research. Cook Inlet estimate is based on sampling weight of crab by ADF&G.

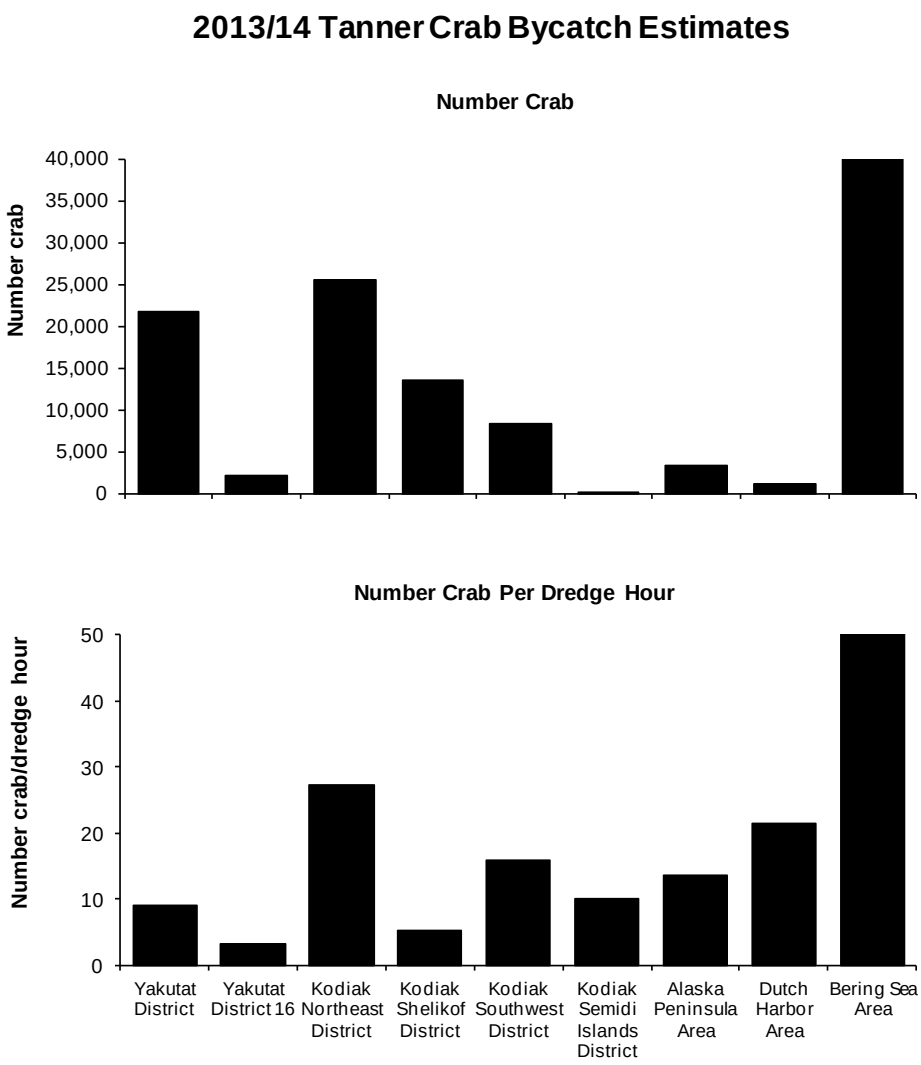


Figure 2-4 Estimated Tanner crab bycatch (top) and bycatch rate (bottom) during the 2013/14 scallop fishing season.

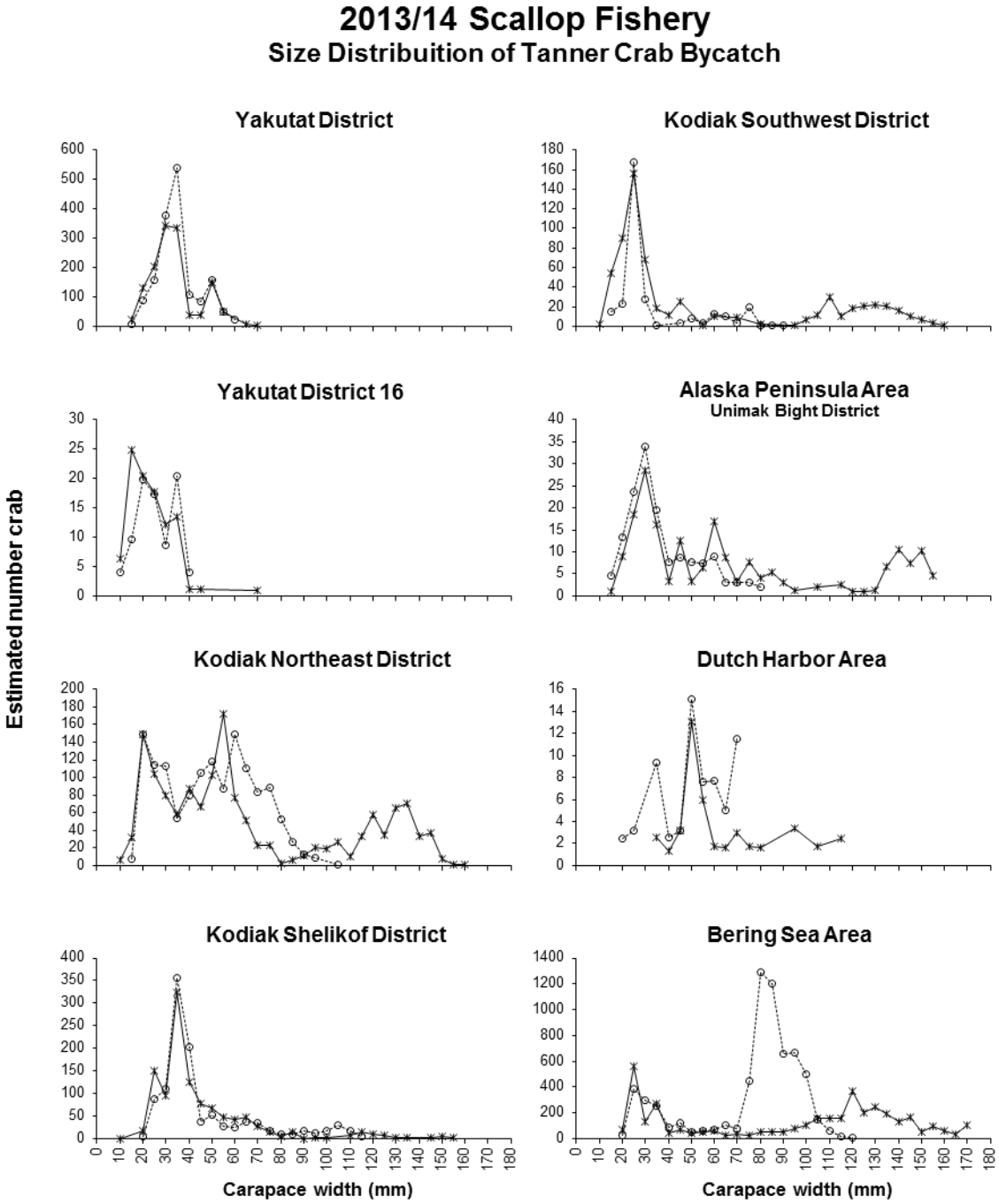
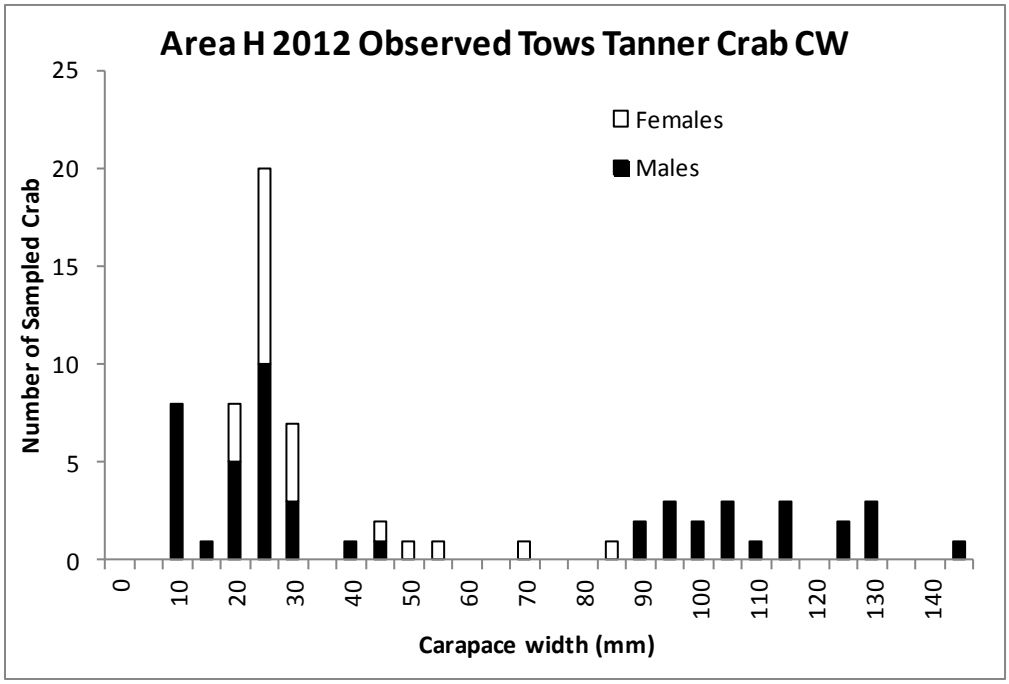


Figure 2-5 Tanner crab carapace width distributions by management unit from catch sampling during the 2013/14 scallop fishery.



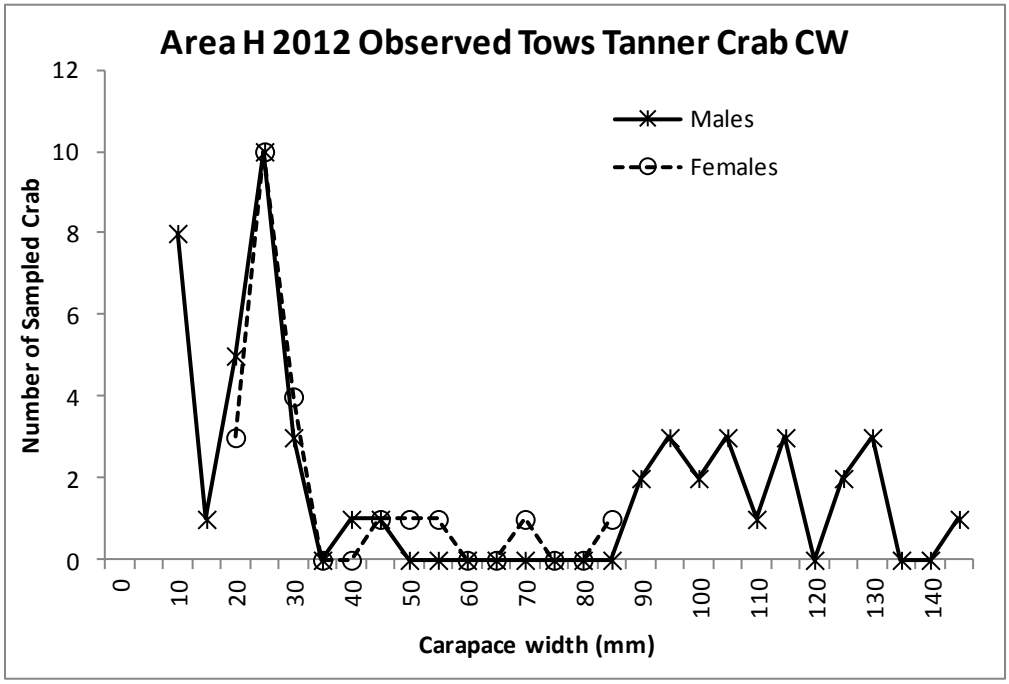


Figure 2-6 Tanner crab bycatch carapace width and frequency in Kamishak District fishery in 2012. The fishery was closed in 2013 and 2014.

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.

2.5 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.

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

2.6 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.

3 Stock Status

The following sections provide summaries of stock assessment information available for management by region and 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. A comparison of information compiled across all registration areas is show in Figure 3-1.

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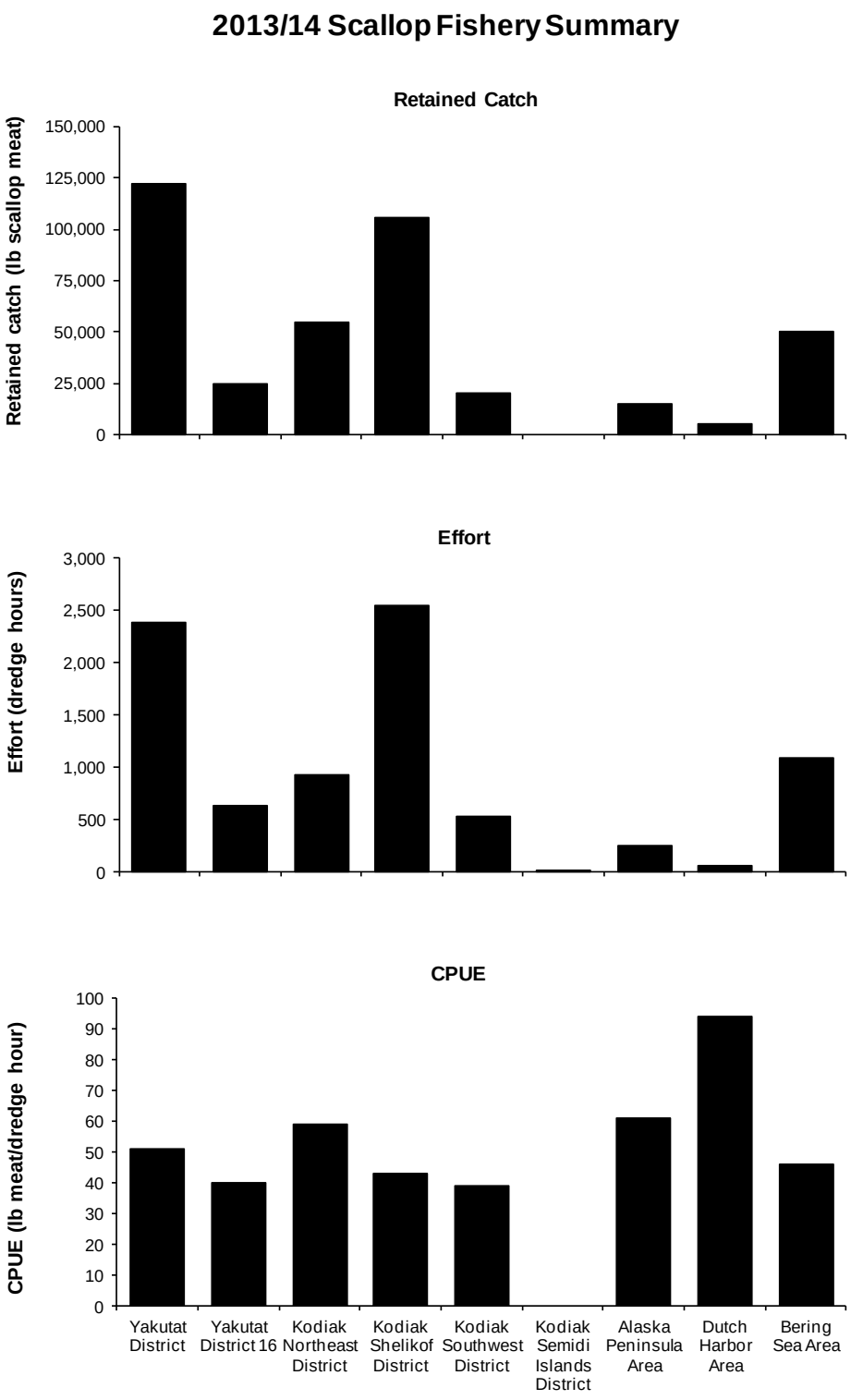


Figure 3-1. Scallop catch (top), dredge-hrs (center), and CPUE (bottom) during the 2013/14 statewide weathervane scallop fishery.

3.1 Stock Assessments and GHLs

Weathervane scallop data are gathered via the scallop observer program and through fishery independent surveys. The surveys are conducted only in Central Region and data are used to set GHLs for Kayak Island (Area E) and Cook Inlet (Area H). The 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 CPUE, fishing locations, size and age composition 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 confidentiality constraints 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.

Experimental scallop surveys using Alaska CamSled, ADF&G's towed underwater imaging system, will continue in 2014 on a chartered scallop vessel working in the Kodiak vicinity. Research over the past several years has focused on CamSled system improvements, image processing (color and lightfield correction), software and database development, statistical aspects of abundance estimation, and collaboration with the HabCam group from Wood's Hole Oceanographic Institution. Scallop abundance estimates from CamSled surveys over the period 2006–2011 have been calculated for some areas, but ADF&G considers these estimates to be preliminary (not for use in management) because image annotation and statistical methods are still under development and have not been reviewed. Recently, a cooperative agreement was established between ADF&G and Dr. Brad Harris's lab at Alaska Pacific University so that CamSled images can be manually annotated by students. Efforts are also underway to process CamSled images with scallop-counting software developed by HabCam and their collaborators.

3.1.1 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 review 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; and shell height histograms for Area D and District 16. 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 Quinn Smith (Douglas office).

3.1.2 Central Region

ADF&G conducts biennial dredge surveys for weathervane scallops in the Kamishak District of the Cook Inlet Management Area and near Kayak Island in the Prince William Sound Management Area (Figure 3- and Figure 3-3). Data from these surveys are used to set GHLs for two scallop beds at each location (see below). In the Kamishak District fishery, observers are not required, but vessels are limited to a single 6 ft dredge, and ADF&G staff is regularly deployed as observers when fishing occurs to track the fishery and provide some in-season management capability. The Cook Inlet fishery is managed by Jan Rumble and Elisa Russ from the Homer office and the Kayak Island fishery is managed by Jan Rumble and Maria Wessel from the Cordova office.

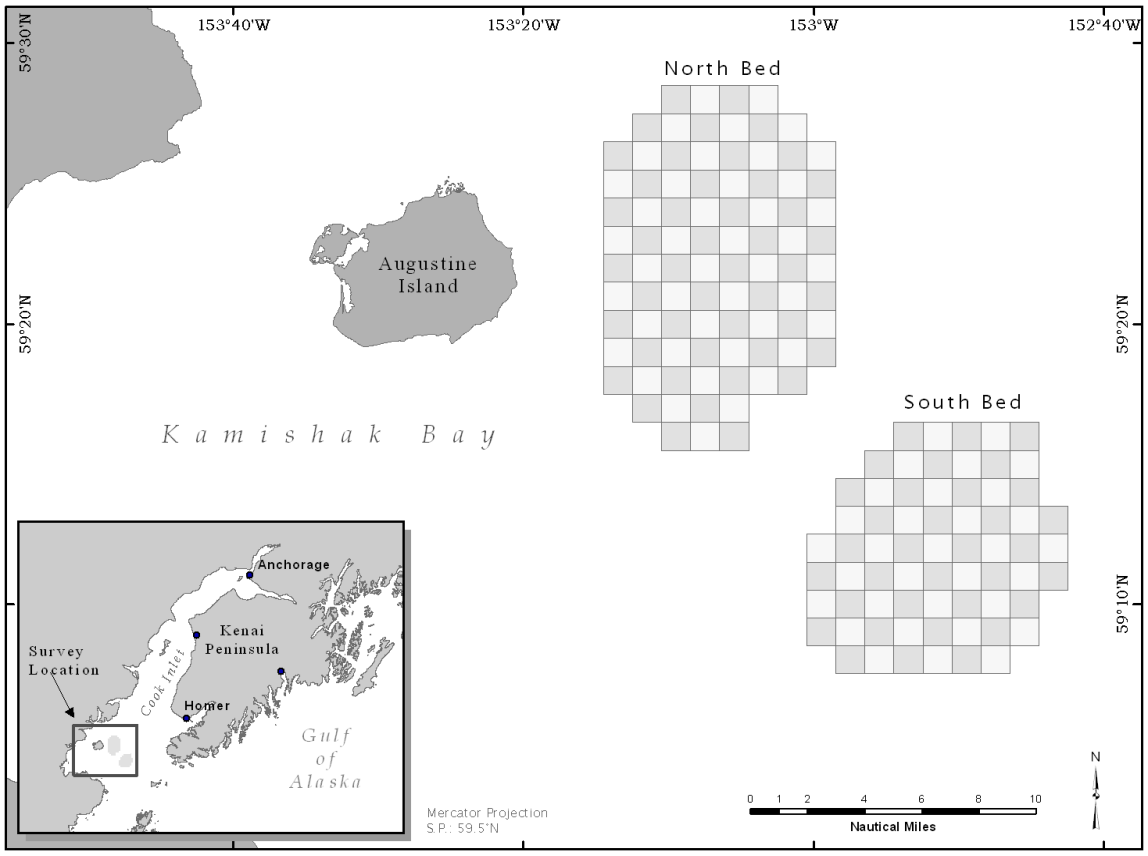


Figure 3-2 Location of main scallop beds in Kamishak Bay with the delineated edge of each scallop bed and black and white checkerboard sampling grid shown.

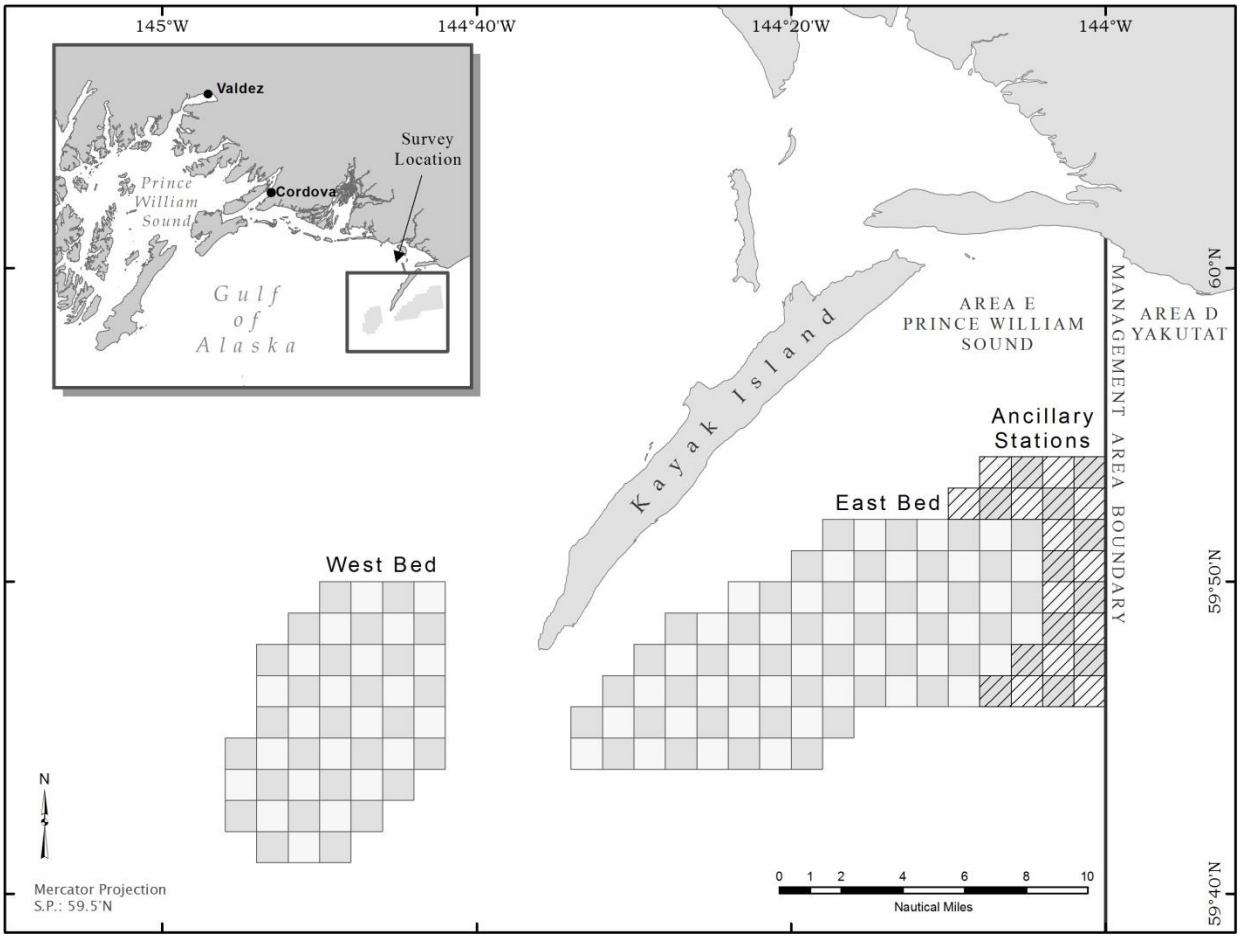


Figure 3-3 Location of main scallop beds at Kayak Island with the delineated edge of each scallop bed and black and white checkerboard sampling grid shown.

3.1.2.1 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^2 (1.0 nmi^2) squares over a chart of the study area (Figure 3- and Figure 3-3). 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 based on weather, wind direction and sea state. The dredge was towed for a distance of approximately 1,855 m (1.0 nmi) within each 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 9.1kb (20 lb). The edge of a scallop bed was considered delineated when catch in a given station was below the threshold amount. If above that threshold amount, the station was added into the survey area, but that did not occur.

3.1.2.2 Surveys since 2007

The 2007 Kamishak Bay and 2008 Kayak Island surveys were set to standardized areas, which continue to be used (Gustafson and Goldman 2012). The surveys were designed to enabl all previous years of survey data to be standardized and comparable; all historical survey catch data (from 1996 through 2006)

were entered into ARC GIS and, for each year, a polygon was drawn around all stations where the catch exceeded the threshold of 9.1 kg/nm (20 lb). Ancillary stations are conducted outside these standardized areas as time and funding permit to look for changes in bed size or shape.

Central Region staff has also developed a sled-dredge, which is analogous to the video sled used by the statewide scallop program in Kodiak; however, 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) and collects scallops for obtaining data on shell height, age and meat weight, which are critical to setting GHL's under the current management scheme and to pursuing an age-structured model and for setting the GHL's at Kayak Island and in Kamishak Bay. The sled-dredge continues to undergo field tests with the goal of comparing catches to the 8' dredge and eventually replacing the 8' dredge with the sled dredge for all scallop surveys in Central Region (Gustafson and Goldman 2012).

Age assessment of Central Region scallops is conducted by visually enumerating the annuli. Weathervane scallop shells are collected for age assessment from research dredge surveys and from the Alaska Scallop Fishery Observer Program. Central Region dredge surveys collect scallop shells from Kamishak Bay and the Kayak Island area; the first age reading occurs on board the research vessel with second age readings in the lab. Discrepancies in ages within and between readers are resolved through re-ageing and agreement by multiple age readers. If agreement cannot be reached, the sample is discarded.

3.1.2.3 Guideline Harvest Levels (GHLs) in Central Region

Data from Central Region's biennial fishery independent scallop surveys are used to set GHLs, which are in effect for the subsequent two seasons. The Kayak Island estimate has been adjusted using a dredge efficiency of 0.83 since 2006, which is based upon the relative efficiency from a small amount of dredge/video comparison work conducted in 2004. Based on that work and continuing efforts by Central Region staff to assess the gear efficiency of the 8' dredge, department staff felt that applying 0.83, instead of a value of 1.0, was a prudent first step to address an identified weakness in the estimate while protecting recovering biomass. Continuing work indicates that the gear efficiency is likely lower than 0.83. Until such time as current efforts to estimate gear efficiency are completed, Central Region staff will continue to apply the 0.83 value to derive GHL's for scallops. However, current and future plans are to continue gear efficiency field tests with both the 8' dredge and the sled dredge. Once enough data are gathered to provide quality statistical analysis, those data will be incorporated into biomass estimates and for setting GHL's. Until that time, Central Region staff is applying the 0.83 gear efficiency estimate from Kayak Island to the Kamishak data for setting GHL's (the Kayak gear efficiency estimate of 0.83 has been applied to Kamishak Bay since 2009). Comparison between the video sled and the dredge was conducted at Kamishak in 2007 but has not been incorporated into management decisions.

Determination of an appropriate harvest rate, and corresponding GHL, should be, and currently are, based on available biological data, tempered by harvest experiences within a particular bed or harvest histories in comparable beds in other areas. The current method of setting harvest limits for the Central Region commercial weathervane scallop fishery adheres to the recommendation that F be less than M, creating conservative and sustainable harvest limits. The Central Region applies a 0.05 harvest rate to the estimate biomass derived from the survey, and used whole weight to meat weight conversions to assign the GHL for each area (Gustafson and Goldman 2012). The justification for the use of 0.05 is: both survey and commercial fishery CPUE has been low in recent years, however, a small surplus of scallops was still available for harvest. The department chose to use an exploitation rate that was either below or at the low end of estimates of natural mortality (Restrepo et al. 1998) to provide for fishing yet allowing for

recruitment to the adult portion of the bed to increase the biomass. Natural mortality estimates for weathervane scallops in Alaska have been reported to range from 0.04 to 0.25 (Kruse 1994, Kruse et al. 2005) with a median of 0.15 (Kruse 1994). Estimates of natural mortality from Kamishak Bay in Central Region were estimated at 0.19 (Bechtol et al. 2009). To accomplish the previously stated goals, the department chose the exploitation rate of 0.05 to apply to biomass data to set the GHL, and to consistently apply this level of exploitation until such time as biomass levels increase and allow for greater harvest.

The fishery typically 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 fishery CPUE or even apparent die-offs as occurred at Kamishak in 2002. Additionally, in setting GHLs the department may consider other aspects of the survey results such as a narrow size or age distribution or truncation of sizes observed within an area to assist in the final management decision.

3.1.3 Westward Region

Regular scallop stock assessment surveys are not conducted in Westward Region. In general, ADF&G manages scallops without biomass estimates. Therefore, in-season management should be precautionary given the lack of biomass information. 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. An area, district, section or portion thereof may close to fishing before or after the GHL has been reached if principles of management and conservation dictate such action. 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 in-season observer data and the fishery may be closed or allowed to continue. In all areas, crab bycatch and scallop CPUE are closely monitored during the season, and scallop harvest may be stopped due to high crab bycatch or poor fishery performance. State regulation 5 AAC 39.975(27) defines GHL as the preseason estimated level of allowable fish harvest which will not jeopardize the sustained yield of the fish stocks.

In the Westward Region, stock information consists of previous seasons' fishery data CPUE, retained shell height, discard quantity and discard shell height) and in-season information on CPUE and crab bycatch. CPUE is assumed to decline as the stock declines.

Beginning in 2010 concern over declining harvest prompted a review of fishery performance. Westward Region implemented a minimum performance standard as part of in season management assessment. All major harvest areas now have standards developed. Area specific minimum performance standards are based on the lowest fishery CPUE within the observer time series (Table 3-1).

Table 3-1 CPUE minimum performance standards and basis years for major harvest areas within the Westward Region.

Area	Minimum Performance Standard (CPUE)	Basis Year
Kodiak Area		
Northeast District		
Statistical Area 525630	45	2005/06
Statistical Area 525702	52	2002/03
Remainder of NE District	43	2005/06
Shelikof Distict		
Combined North/South Bed	47	2003/04
Bristol Bay-Bering Sea	43	2004/05 - 2009/10[a]

[a] Based on average CPUE during the 2004/05 to 2009/10 seasons

CPUE is tracked throughout the season by management area and compared to the minimum performance standard. If the in season cumulative CPUE is less than or equal to the minimum performance standard, when approximately half of the GHL is taken, the fishery may close prior to achieving the upper end of the GHL. If CPUE is higher than the minimum performance standard, the fishery may continue toward the upper end of the GHL with continued monitoring. This approach is applied to management areas, major beds within management areas and statistical reporting areas, depending upon the level of concern. This approach is used to help guard against localized depletion.

3.2 Yakutat Registration Areas: Area D and District 16

3.2.1 Yakutat Area D

The GHL in Area D was reduced three times, and increased once between the 2000/01 and 2013/14 seasons. Declining catch rates, based on observer data in Area D during the 2000/01 season led to a reduction of the GHL from the upper end of the GHR down to 200,000 lb as a precautionary measure beginning in the 2001/02 season (Table 2-1). This GHL was kept in place through the 2005/06 season. Only in the 2005/06 season was the 200,000 lb GHL reached in Area D. The GHL was reduced 25% to 150,000 lb for the 2006/07 season due to a consistent 4 year decline in CPUE from 50 lb/hr in 2002/03 to 39 lb/hr in 2005/06, and an apparent decline in both the number of small scallops entering the fishery, and the proportion of large scallops based on visual analysis of shell height (SH) histograms from the observer program. The Guideline harvest level in Area D was increased prior to the 2009/10 season to 160,000 lb due to larger mean scallop size and increased apparent abundance of small scallops based on observer SH data (Figure 3-4). The GHL was then reduced prior to the 2012/13 season due to decreased CPUE, spatial shifts in effort, and a narrowing of size classes. No GHL adjustments were made for the 2013/14 season in order to examine the effects of the 2012/13 season cuts. Area D CPUE has increased slightly; this should be expected with new GHL cuts.

Table 3-2 Yakutat Area D scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours[a]	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	7	250,000	139,057	1,999	70	
1994/95	10	250,000	246,862	4,130	60	
1995/96	8	250,000	237,417	4,730	50	
1996/97	4	250,000	238,736	4,438	54	5,226
1997/98	4	250,000	243,810	3,956	62	5,295
1998/99	8	250,000	242,929	4,154	58	4,795
1999/00	3	250,000	249,681	3,840	65	9,416
2000/01	3	250,000	195,699	4,241	46	10,401
2001/02	2	200,000	103,800	2,406	43	4,809
2002/03	2	200,000	122,718	2,439	50	6,326
2003/04	2	200,000	160,918	3,360	48	6,940
2004/05	2	200,000	86,950	2,132	41	3,869
2005/06	2	200,000	199,351	5,089	39	6,988
2006/07	2	150,000	150,041	2,817	53	6,715
2007/08	2	150,000	125,960	2,601	48	9,184
2008/09	3	150,000	150,289	3,286	46	7,361
2009/10	2	160,000	158,225	3,946	40	10,985
2010/11	3	160,000	156,575	3,495	45	10,216
2011/12	3	160,000	156,463	4,598	34	10,303
2012/13	3	120,000	118,140	3,354	35	8,706
2013/14	3	120,000	122,290	2,391	51	3,770
2014/15[b]	3	120,000	119,893	2,720	44	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 8.8% from observer experiments.

[b] PRELIMINARY data subject to change.

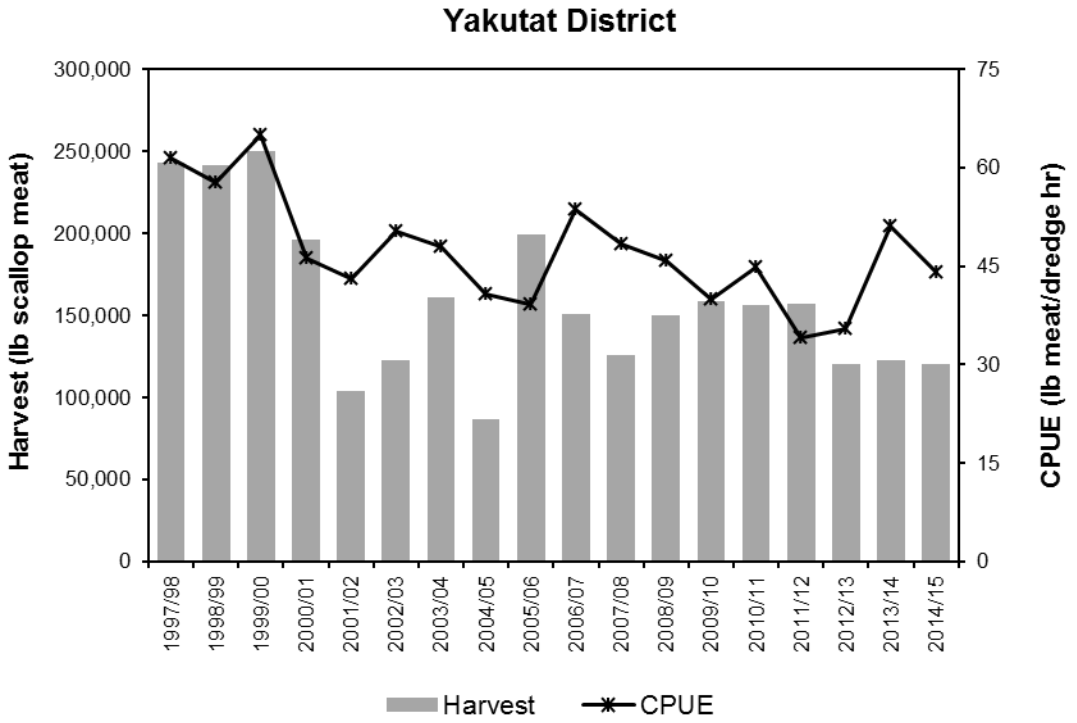


Figure 3-4. Yakutat Area D Scallop Harvest and CPUE, 1997/98 - 2013/14 seasons.

Estimated shell height distributions in Area D show an increased range of scallop sizes in the 2012/13 and 2013/14 seasons, with an apparent increase in <110mm scallops (Figure 3-2**)**. Whether this is due to growth rates, fleet behavior, or an increase in prerecruit populations is not known. The bulk of the retained scallops remain in the 115–145 mm shell height (SH) range.

In the 2013/14 Area D fishery, 122,290 lb of scallop meats were retained and an estimated 18,850 lb were discarded of, for an estimated discard rate of 15.4% of the total meat weight catch. Using a 20% discard mortality estimate 3,770 lb of scallop meat weight was lost to discard mortality in the 2013/14 season (Table 3-1). Average estimated Area D scallop meats discard for the last 10 seasons was 39,049 lb or 27.6% of total catch. Variation in discard proportion during recent seasons is apparent in SH plots from resampling (Figure 3-2).

Crab Bycatch estimates calculated from 2013/14 Area D observer samples were 21,784 Tanner crabs, and 37 Dungeness crabs. Estimated Yakutat Tanner crab bycatch increased 63% from the 2012/13 season. Carapace width (CW) of Tanner crabs sampled by observers ranged from about 10mm to about 70mm, with 90% in the 20-50mm range.

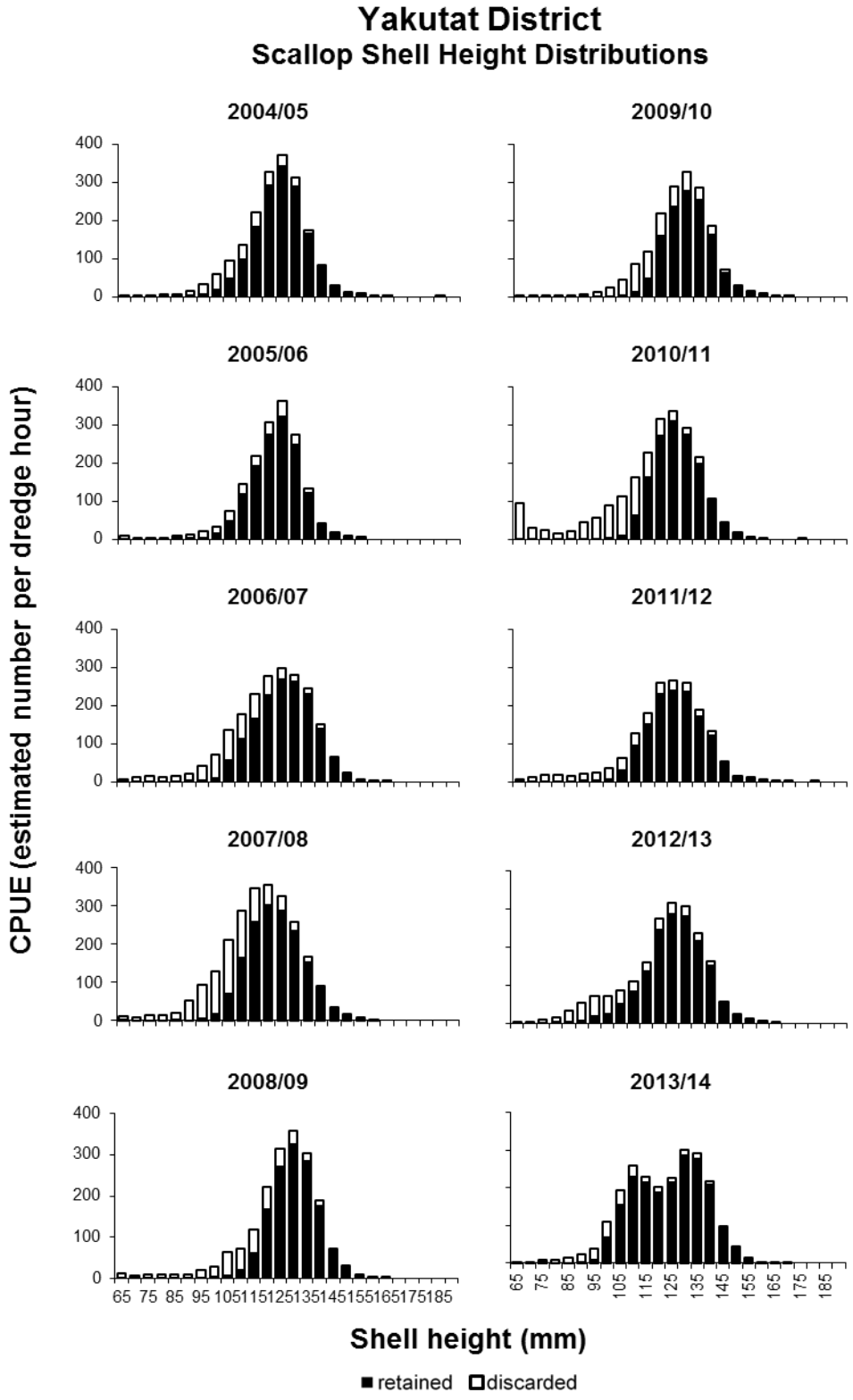


Figure 3-5. Estimated scallop shell height distributions from the 2004/05 - 2013/14 Yakutat Area D fishing seasons.

3.2.2 Yakutat District 16

The Yakutat District 16 GHL remained at the upper end of the 0 - 35,000 pound GHR from the 2000/01 season to the 2005/06 season. The GHL was reduced 40 % to 21,000 lb for the 2006/07 season due to a sharp 3 year decline in CPUE from 60 lb/hr in 2003/04 to 34 lb/hr in 2005/06 (Table 3-3), and an apparent decline in the proportion of large scallops based on visual analysis of SH histograms from the observer program. The GHL was then increased 20% to 25,000 lb prior to the 2009/10 due to larger mean scallop size and increased apparent abundance of small scallops based on observer program SH data (Figure 3-6).

Table 3-3 Yakutat District 16 scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	1	35,000	NA			
1994/95	7	35,000	22,226	408	54	
1995/96	6	35,000	33,302	1,095	30	
1996/97	2	35,000	34,060	917	37	2,667
1997/98	4	35,000	22,890	561	41	547
1998/99	2	35,000	34,153	702	49	422
1999/00	2	35,000	34,624	674	51	963
2000/01	3	35,000	30,904	476	65	854
2001/02	2	35,000	20,398	417	49	815
2002/03	2	35,000	3,685	100	37	211
2003/04	2	35,000	1,072	18	60	18
2004/05	2	35,000	24,430	419	58	332
2005/06	2	35,000	13,650	407	34	597
2006/07	2	21,000	13,445	309	44	415
2007/08	1	21,000	180	6	30	34
2008/09	2	21,000	20,986	423	50	1,259
2009/10	2	25,000	11,791	439	27	1,745
2010/11	1	25,000	2,655	83	32	468
2011/12	1	25,000	1,777	57	31	51
2012/13	1	25,000	25,255	684	37	1,019
2013/14	2	25,000	25,510	634	40	708
2014/15[b]	2	25,000	9,141	439	21	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 8.3% from observer experiments.
[b] PRELIMINARY data subject to change.

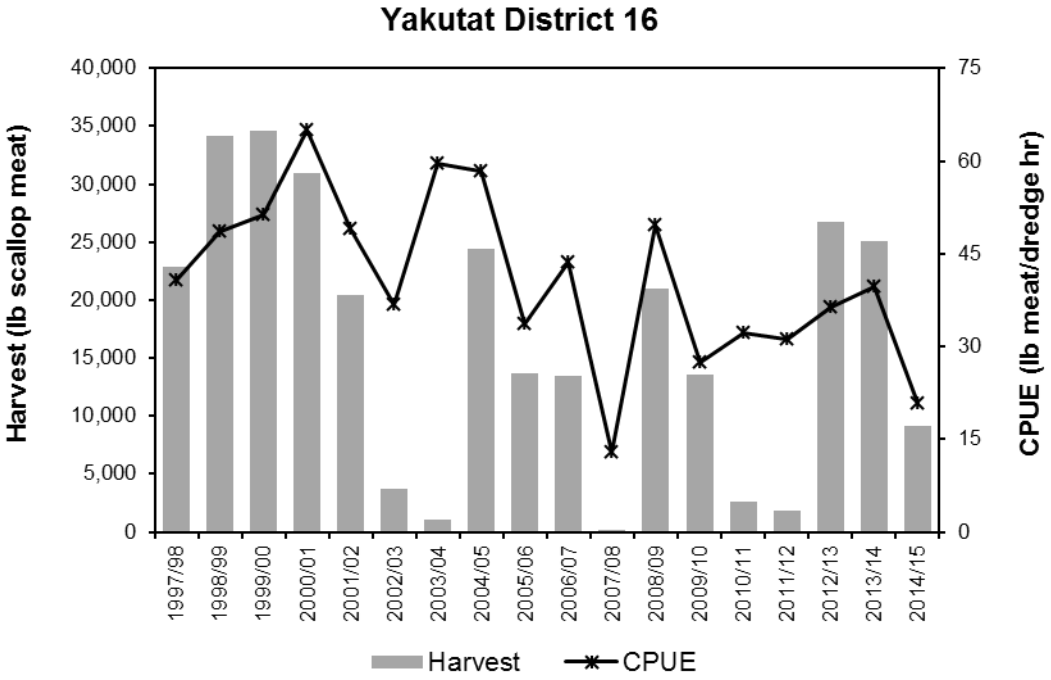


Figure 3-6. Yakutat District 16 Scallop Harvest and CPUE, 1997/98 - 2013/14 seasons.

Although CPUE has been declining since the 2000/01 season, it is difficult to parse out an explanation. Effort is highly variable in the area with years with practically no harvest and relatively low CPUE, immediately followed by a season of high harvest and relatively high CPUE, making inter-annual variation analyses difficult. However when the four most recent seasons with roughly equivalent catch and effort (2004/05, 2008/09, 2012/13, 2013/14) were examined there is a clear decreasing trend in CPUE (Figure 3-6).

Estimated shell height distributions in Yakutat District 16 show an decreased range of scallop sizes in the 2013/14 season compared with the and 2012/13 seasons, with an apparent increase in <110mm scallops (Figure 3-2**)**. Whether this is due to growth rates, fleet behavior, or an increase in prerecruit populations is not known. The bulk of the retained scallops also decreased to the 100-120 mm shell height (SH) range, one of the lowest ranges in the past 10 seasons.

In the 2013/14 Yakutat District 16 fishery, 25,510 lb of scallop meats were retained and an estimated 3,540 lb were discarded of, for an estimated discard rate of 13.9% of the total meat weight catch. Using a 20% discard mortality estimate 708 lb of scallop meat weight was lost to discard mortality in the 2013/14 season (Table 3-3). The highly variable fishing pressure and meat quality in Yakutat District 16 makes year to year examination of discard rates difficult. Variation in discard proportion during recent seasons is apparent in SH plots from resampling (Figure 3-2).

Crab Bycatch estimates calculated from 2013/14 Yakutat District 16 observer samples were 2,165 Tanner crabs, and no Dungeness crabs. Estimated crab bycatch increased 24% from the 2012/13 season. Carapace width (CW) of Tanner crabs sampled by observers ranged from about 10mm to about 70mm, with 90% in the 20-50mm range.

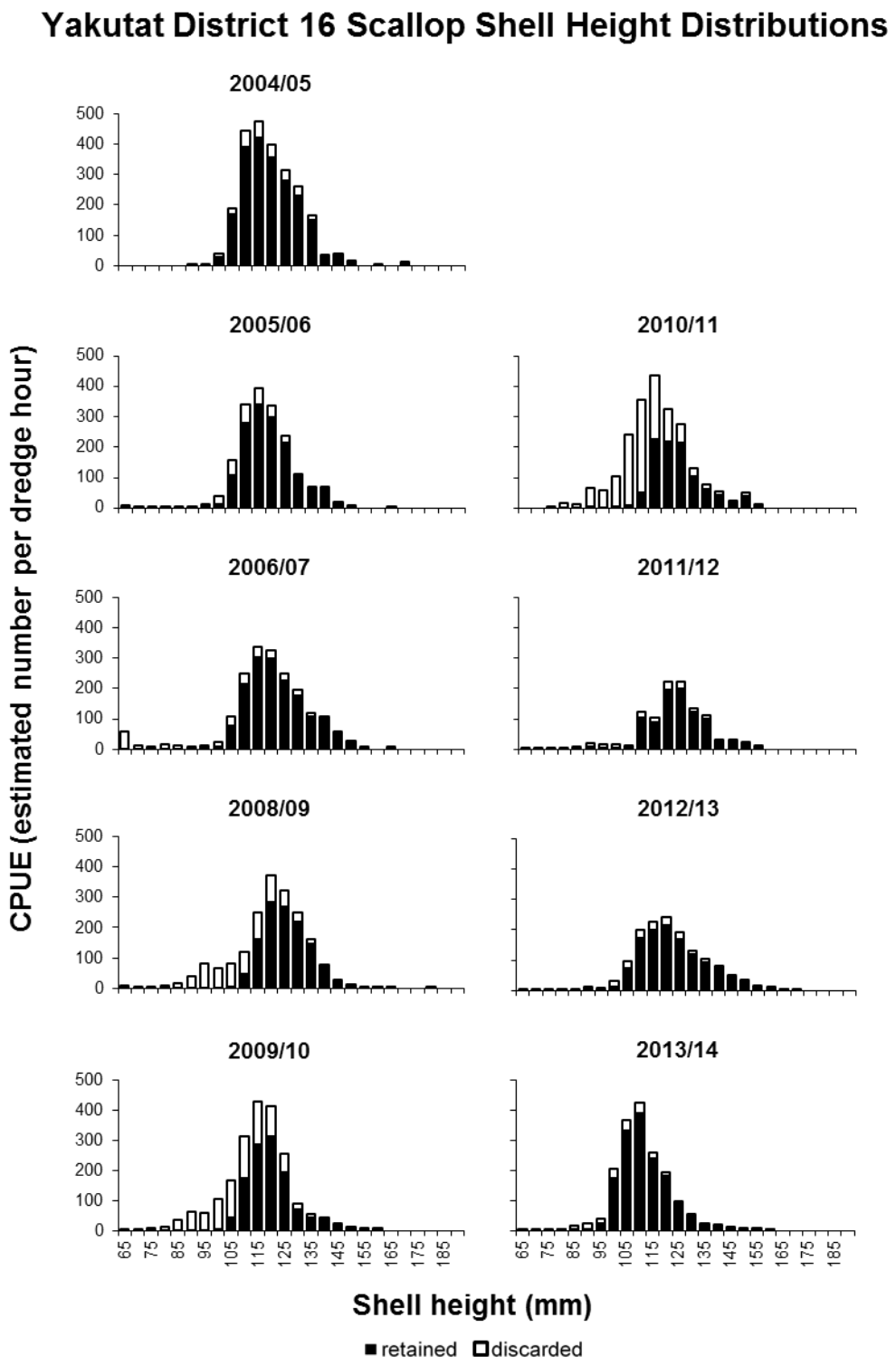


Figure 3-7. Estimated scallop shell height distributions from the 2004/05 - 2013/14 Yakutat District 16 fishing seasons. No 2007/08 plot was constructed due to small samples size.

3.3 Prince William Sound Registration Area

Scallop abundance and biomass near Kayak Island was surveyed from May 4-14, 2014. All stations within the previously delineated east and west beds were sampled (Figure 3-3). An additional 12 stations were surveyed extending from the eastern margin of the east bed to the state's boundary between Central and Southeast Regions, to explore an area where fishing effort has been more heavily directed in recent years. These ancillary stations were not used for estimating abundance in either of the main beds.

In the east bed, both abundance and biomass have decreased every year since record highs in 2004, and the 2014 estimates were the lowest in the history of the survey (Table 3-4, Figure 3-5). In addition, commercial CPUE within the East Section trended downward from 2005 until the fishery was closed in 2012 (Figure 3-6). The age frequency distribution of scallops caught in the east bed in 2014 was bimodal with peaks at 6 and 13 years (Figure 3-7). The progression of these relatively strong cohorts is easily discernible in the time series of the survey.

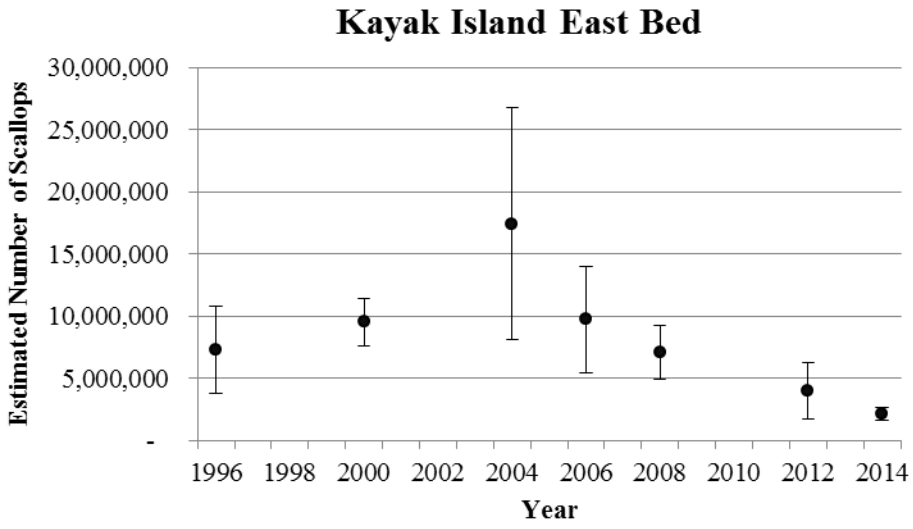
Table 3-4 Summary of systematic estimates for weathervane scallop survey in Kayak Island 1996 - 2014, using a standardized area of 78.9 nm^2 east bed and 48.6 nm^2 west bed. The dredge was 8 feet wide and weighed ~1600 lb, ring size 4 inches inside diameter, and lined with 1.5 inch stretch 24 thread nylon mesh.

Survey year	Number stations sampled	Mean catch kg/nm	Estimated abundance		95% CI	CV	Scallop density (scal/m^2)	Average weight (g/scal)	Estimated biomass q =1.0 (kg meat)	Estimated biomass q =0.83 (kg meat)
					East Bed					
1996	38	27.8	7,302,813	±	3,507,901	0.24	0.027	229	132,501	
1998[a]	28	20.5	5,288,624	±	1,393,135	0.13	0.020	232	89,347	
2000	33	37.6	9,535,026	±	1,900,677	0.10	0.035	237	146,181	
2002[b]	20	10.2	2,294,907	±	910,967	0.19	0.008	266	43,367	
2004	31	77.1	17,441,115	±	9,355,190	0.26	0.064	265	278,594	
2006	32	44.4	9,720,639	±	4,263,246	0.22	0.036	274	190,243	229,208
2008	37	36.5	7,114,451	±	2,180,486	0.15	0.026	308	130,480	157,205
2010	12	34.9	†	-	†		0.032	244	†	†
2012	19	13.4	3,997,740	±	2,265,460	0.27	0.015	201	57,380	69,133
2014	40	8.7	2,141,005	±	510,818	0.12	0.008	245	37,617	45,322
					West Bed					
1998[a]	21	33.9	6,382,639	±	2,851,028	0.21	0.038	196	105,132	
2000	20	94.7	17,900,280	±	7,957,941	0.21	0.107	196	302,316	
2002[b]	17	39.6	5,745,859	±	2,428,439	0.20	0.034	255	105,646	
2004	25	84.8	14,502,511	±	5,102,276	0.17	0.087	216	235,274	
2006	20	61.0	10,113,094	±	4,648,662	0.22	0.061	223	167,262	201,520
2008	10	19.7	3,934,444	±	2,811,818	0.32	0.024	185	34,843	41,980
2010	26	9.1	2,025,382	±	745,216	0.18	0.012	166	23,929	28,830
2012	10	8.3	2,830,766	±	2,069,955	0.32	0.017	108	22,116	26,646
2014	26	16.8	5,063,971	±	2,429,407	0.03	0.030	122	40,446	48,730

[a] A smaller New Bedford dredge was used weighing ~800 lb, 8 feet wide, with 3 inch inside diameter ring and 1.5 inch stretch 24 thread nylon mesh liner.

[b] Incorrect scope and smaller liner may have compromised the survey.

† Survey estimate not done because only perimeter stations were sampled.



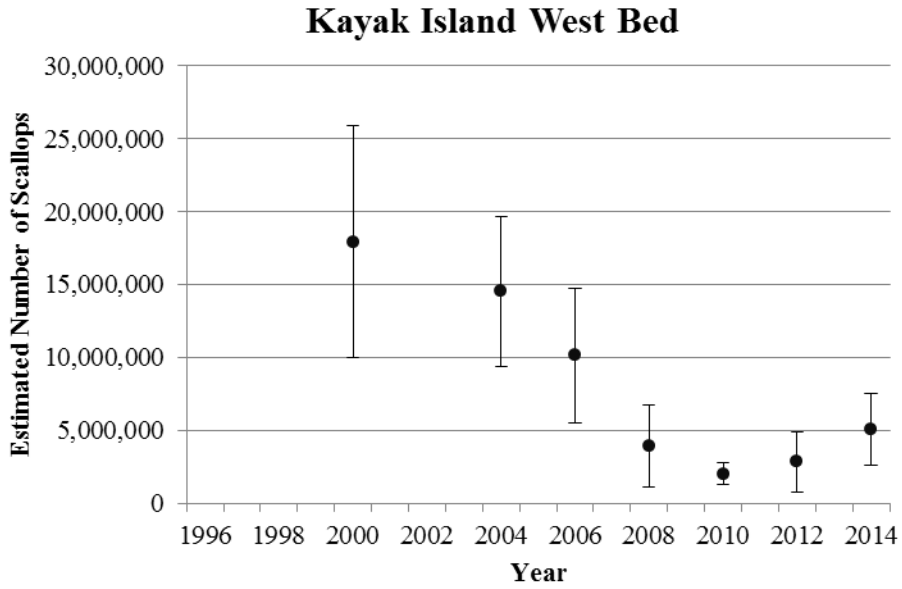


Figure 3-8. Survey estimates of weathervane scallop abundance for the east and west beds at Kayak Island, 1996 - 2014 (note: 1998 and 2002 survey estimates not shown due to compromised surveys – see Table 3.3 above).

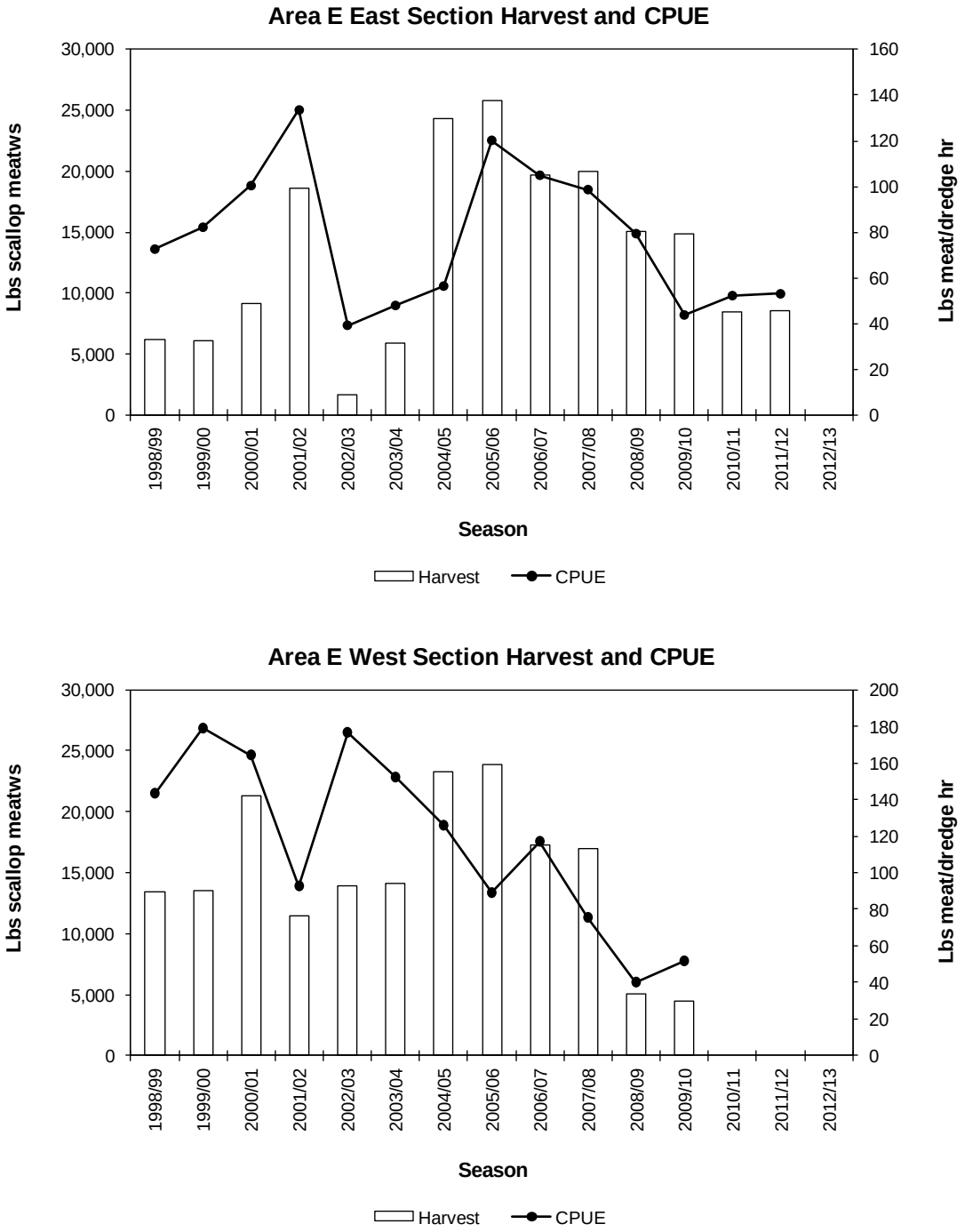


Figure 3-9. Prince William Sound Scallop Harvest and CPUE, 1993/94 - 2012/13 seasons.

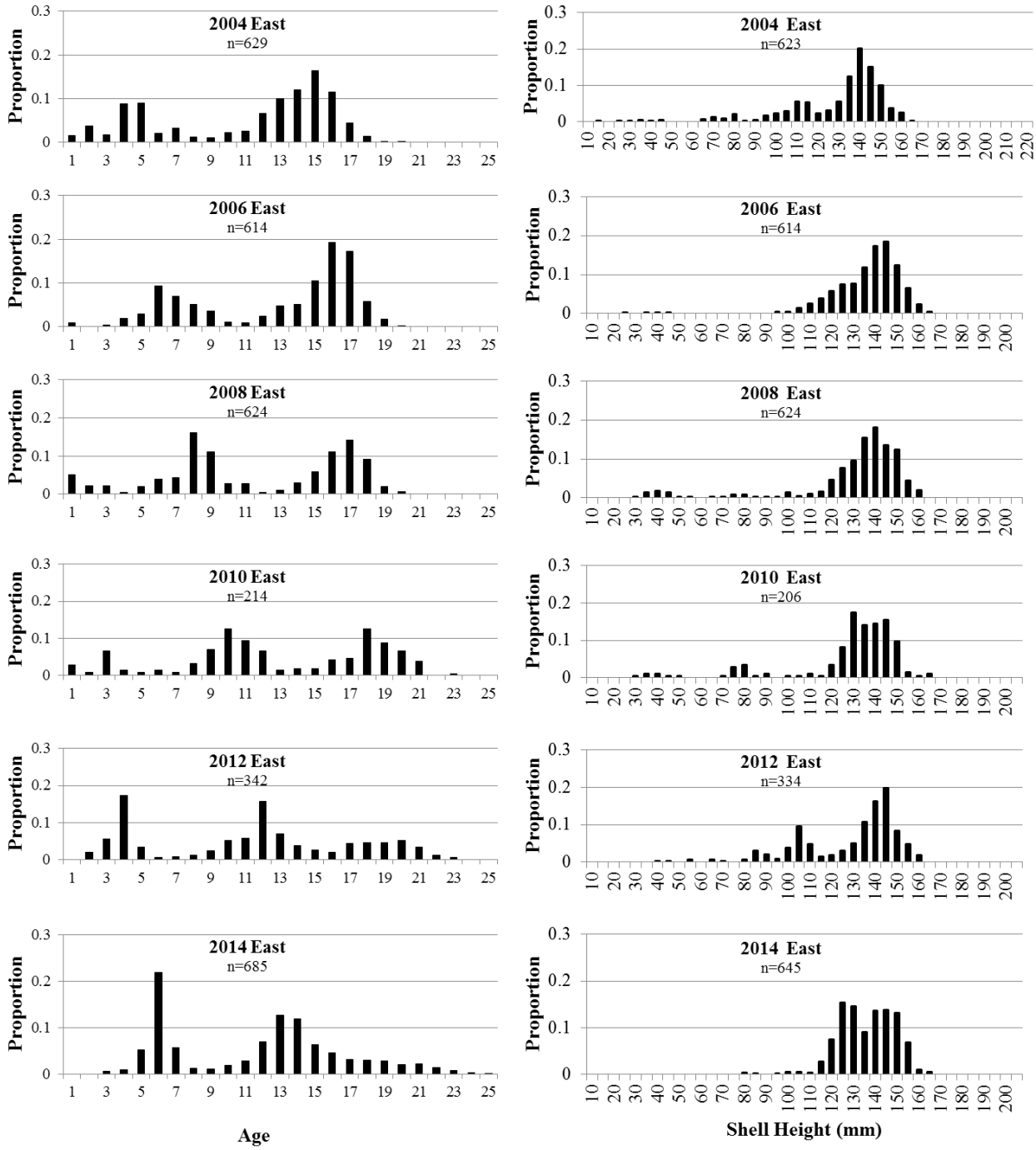


Figure 3-10. Comparison of survey age and shell height distributions, Kayak east bed, 2004 – 2014.

In the west bed, abundance has increased in both 2012 (+40%) and 2014 (+79%) since the record low in 2010. Although the 2014 abundance was the median of the 7 years of uncompromised surveys, it was similar to the relatively low abundances surveyed from 2008 to 2012 as opposed to the relatively high abundances surveyed between 2000 and 2006. Biomass in the west bed increased (+83%) in 2014 from the record low in 2012, however like abundance, it remained well below the levels surveyed prior to 2008. The age distribution of scallops caught in the west bed was unimodal with a peak at 5 years (Figure 3-8).

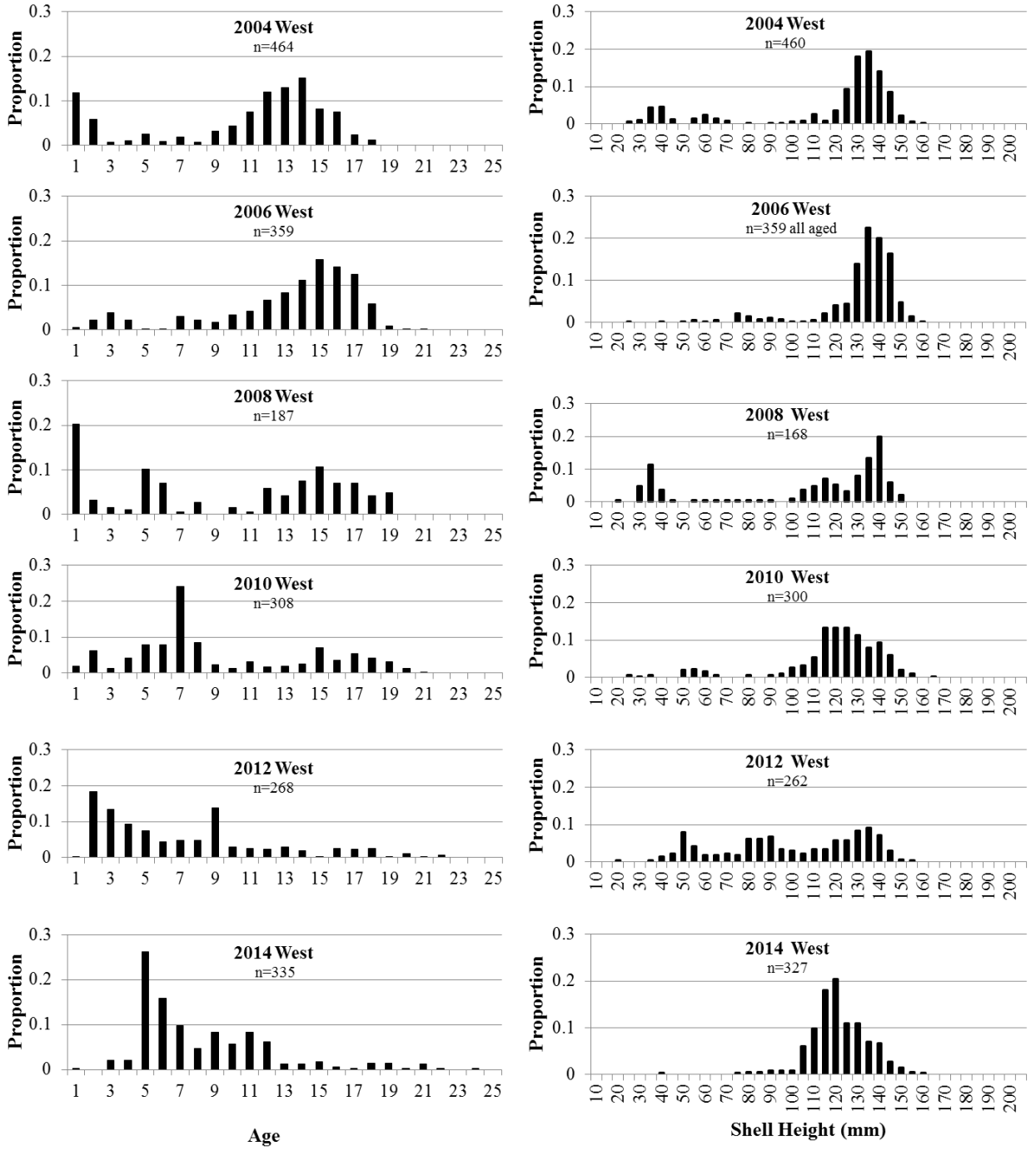


Figure 3-11. Comparison of age and shell height distributions, Kayak west bed, 2004 - 2014.

Scallop catches were low in the east ancillary stations with none of the 12 stations surveyed in 2014 exceeding the 9.1 kg/nm threshold previously used to delineate the main east and west beds. Furthermore, of the three east ancillary stations surveyed in 2012, only one exceeded the threshold, a catch of 10.5 kg/nmi directly adjacent to the main bed. While this exploratory surveying east of the main bed was warranted by the recent commercial effort directed there, the east bed delineation established in 2007 remains valid, and no future surveying effort is planned for the east ancillary stations at this time. The

age distribution of scallops caught in the east ancillary stations was unimodal with a peak at 14 years (Figure 3-9).

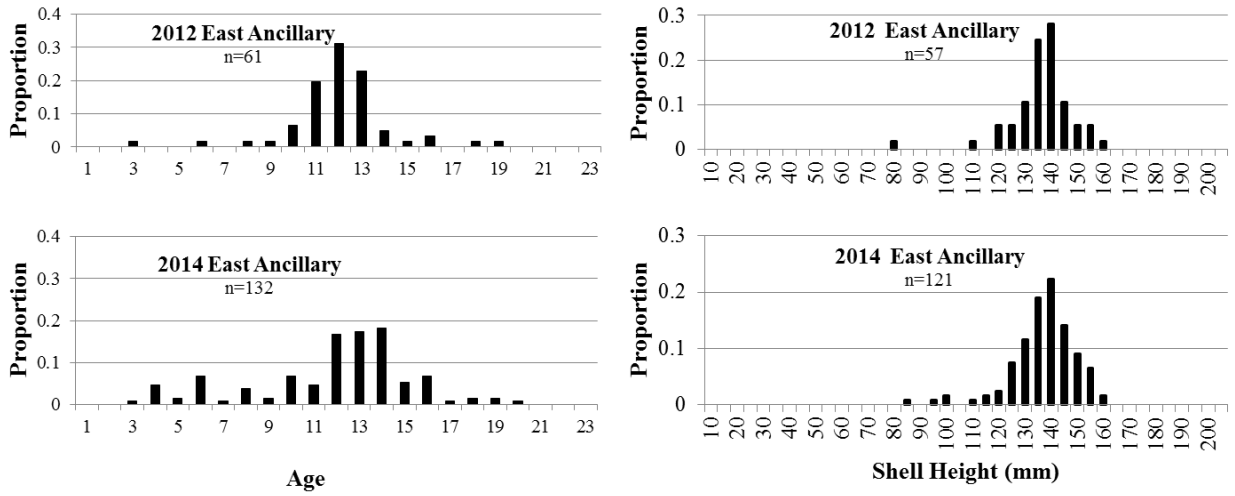


Figure 3-12 Comparison of age and shell height distributions Kayak east ancillary stations, 2012 - 2014.

Weak Meats: During the 2009 Scallop Plan Team Meeting "weak meats" were discussed. 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. In 2010, representatives of the industry mentioned finding scallops with weak meats in Kayak Island fishery. To address this problem, sampling for weak meats was incorporated into our age-height-sexual maturity sampling protocols. The prevalence of weak meats by count amongst all sampled scallops in the main beds was 2.9% (n=1105) in 2014, which was less than both the 3.8% (n= 475) observed in 2010 and the 8.9% (n=524) in 2012.

Fishery overview:

2012/13 and 2013/14 Season summaries

In light of both the decline in survey abundance and biomass, and commercial CPUE, the department closed the East Section fishery in 2012. Because the survey abundance and biomass decreased further in 2014 (-46% and -34% respectively), the East Section will remain closed at least until the area is next surveyed in 2016 (Table 3-5).

Due to the record low abundance surveyed in 2010 and the commensurate declining trend in the west section commercial CPUE, the department closed the west section commercial fishery in 2010. Because the 2014 survey abundance and biomass were still well below the levels surveyed prior to 2008, the West Section will remain closed at least until the area is next surveyed in 2016 (Table 3-5).

Table 3-5. Commercial harvest of weathervane scallops from Prince William Sound, 1992 - 2013/14.

		East Bed				West Bed				Total Both Beds			
Year	Number of vessels	GHL[a] lb meat	Catch (lb) of shucked meats	Dredge hours	CPUE lb/hour	GHL[a] lb meat	Catch (lb) of shucked meats	Dredge hours	CPUE lb/hour	GHL[a] lb meat	Catch (lb) of shucked meats	Dredge hours	CPUE lb/hour
1992	4									64,000	208,836	NA	NA
1993	7									50,000	63,068	638	99
1994 / 95										Closed			
1995 / 96	3									50,000	108,000	NA	NA
1996 / 97		Closed				Closed				Closed			
1997 / 98	1[b]									17,200	18,000	171	105
1998 / 99	2[b]	6,000	6,210	85		14,000	13,440	94		20,000	19,650	179	110
1999 / 00	2[b]	6,000	6,065	74		14,000	13,525	76		20,000	20,410	149	137
2000 / 01	3	9,000	8,998	95		21,000	21,268	129		30,000	30,266	221	137
2001 / 02	1[b]	9,000	9,060	140	65	21,000	21,030	124	170	30,000	30,090	263	114
2002 / 03	2[b]	6,000	1,680	43	39	14,000	13,961	79	177	20,000	15,641	122	128
2003 / 04	1[b]	6,000	5,910	123	48	14,000	14,070	93	151	20,000	19,980	216	93
2004 / 05	2[b]	26,000	25,350	430	59	24,000	23,970	185	130	50,000	49,320	614	80
2005 / 06	3	26,000	24,435	214	114	24,000	24,781	268	92	50,000	49,216	491	100
2006 / 07	2[b]	20,000	20,010	188	106	17,000	17,005	147	116	37,000	37,015	334	111
2007 / 08	2[b]	20,000	20,015	203	99	17,000	17,090	225	76	37,000	37,105	428	87
2008 / 09	1[b]	15,000	15,030	189	80	5,000	5,010	125	40	20,000	20,040	331	61
2009 / 10	2[b]	15,000	15,035	339	44	5,000	4,980	87	57	20,000	20,015	419	48
2010 / 11	1[b]	8,400	8,445	161	52	Closed				8,400	8,445	161	52
2011 / 12	1[b]	8,400	8,460	160	53	Closed				8,400	8,460	160	53
2012 / 13		Closed				Closed				Closed	-		
2013 / 14		Closed				Closed				Closed			

a Separate GHLs were estabolished for beds east and west of Kayak Island beginning in 2008.

b Confidential data voluntary released by vessel operators.

2011/12 Season summary

One vessel fished the open area east of Kayak Island from 31 July through 5 August 2011, making 91 tows to harvest 8,460 lb of scallop meats. CPUE was 53 lb/hr, up from 52 lb/hr in 2010/11. CPUE remained well below the 1999/2000–2010/11 average of 90 lb/hr.

The observer sampled 17 of 91 tows made during the 2011/12 season. Using these data, estimates were 139,345 lb of whole scallops retained and 11,469 lb whole scallops discarded, for a discard rate of 7.6%.

Plots of shell height distributions from resampling observer measurements provided by the statewide observer program (Figure 3-9) show that the 2011/12 harvest was comprised primarily of scallops 125–155 mm SH, with very few small scallops caught and discarded. The range of shell heights caught in the fishery has been very consistent over the years, providing an additional, positive, indication that the age (and therefore shell height) structure of the population is stable.

No Tanner or Dungeness crabs or halibut were encountered in sampled dredges during the season; although this was unusual, the onboard observer was highly experienced and scallop observer program staff has no reason to question these results.

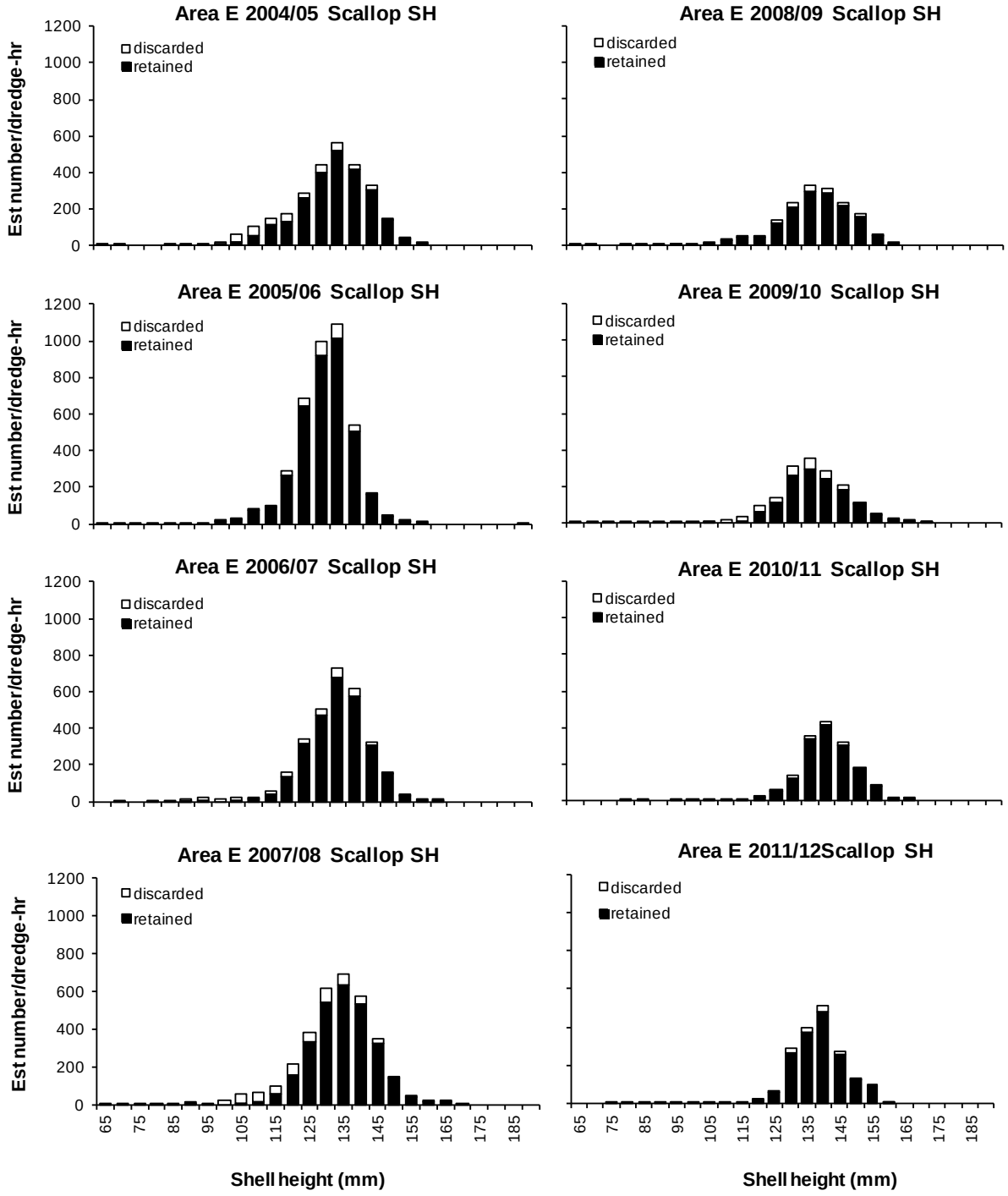


Figure 3-13 Estimated scallop shell height distributions from the 2004/05 - 2011/12 Prince William Sound fishing seasons.

Comparison of Fishery CPUE to Survey Abundance and Biomass Estimates

The SSC requested that the statistical relationship between fishery-independent surveys and commercial fishery CPUE be examined. First we plotted survey abundance and fishery CPUE by year and the initial look show that harvest and survey data appear to track reasonably well. However, since we produce both abundance and biomass estimates and the commercial fishery harvest is based on biomass estimates

(Table 3-4); we compared survey estimated biomass of whole scallops to fishery CPUE. As with survey abundance estimates, biomass estimates of whole scallops appears to track reasonably well with the fishery CPUE (Figure 3-10). Results from the 1998 and 2002 dredge surveys were included in Figure 3-10 for presentation, and even though they also appear to track well with the commercial fishery we chose not to include them in any statistical analysis as data for both years were compromised: In 1998, a lighter dredge was used due to the loss of the original survey dredge in Kamishak Bay, and after completion of the 2002 survey it was discovered that the dredge liner from the lighter dredge was used and warp scope lengths from the lighter dredge were used.

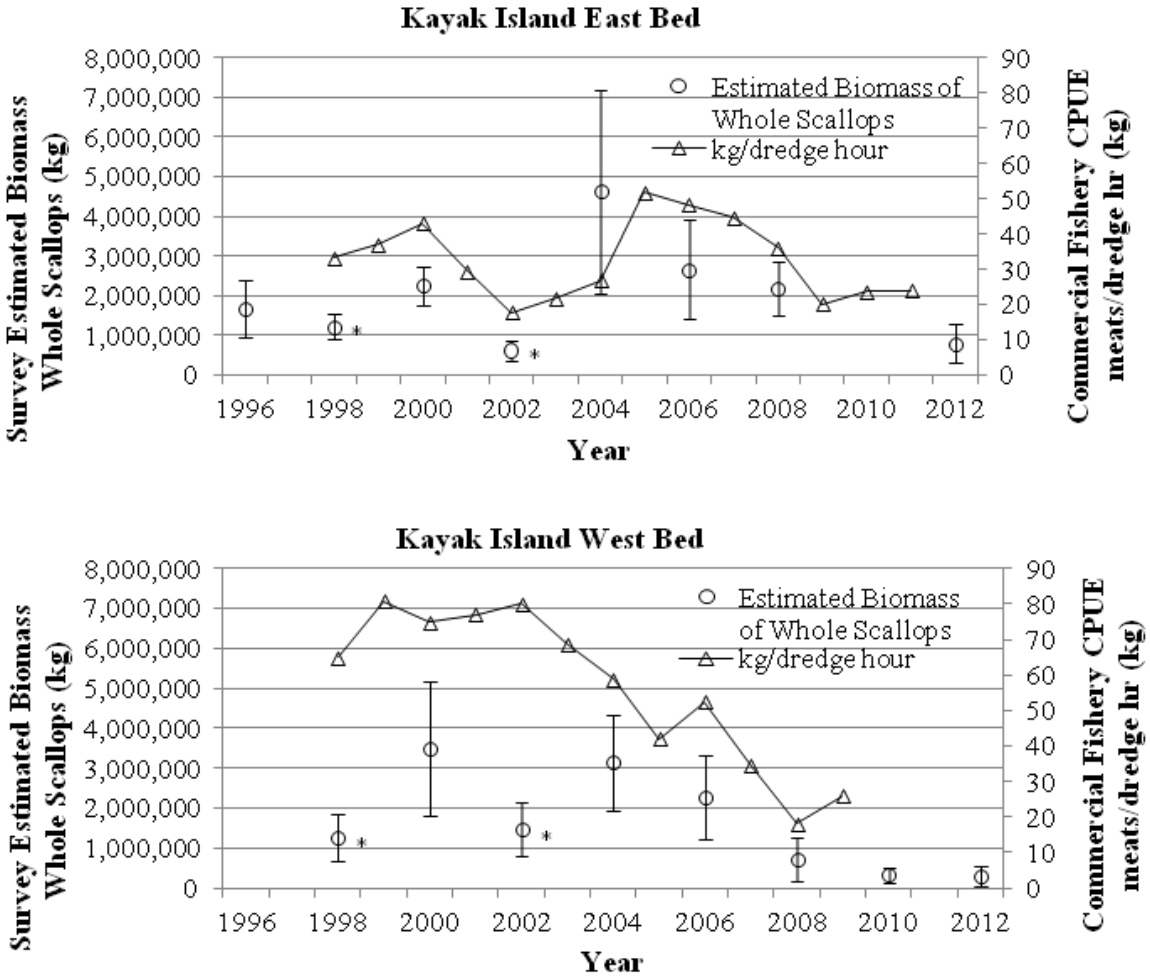


Figure 3-14. Comparison of fishery-independent survey biomass (kg whole scallops) to commercial fishery CPUE, 1996 - 2012. Asterisks indicate compromised survey data that were not used in statistical analysis (see text).

Linear regression of east bed fishery CPUE (kg meats/dredge hour) compared to survey estimated biomass of whole scallops (kg) (Figure 3-11), had a negative correlation with an R^2 of 0.55. This is caused by the 2004 data point, which if removed provides an R^2 of 0.80. While the 2000, 2006 and 2008 data show high correlation to the survey biomass data, one would not know this if attempting to use in a forecasting manner. Linear regression of west bed fishery CPUE compared to survey estimated biomass of whole scallops (kg), shows a positive relationship (Figure 3-12) and a strong correlative relationship to survey data ($R^2 = 0.96$). Thus with the exception of the 2004 east bed data, the estimated survey biomass

appears to correlate well with the fishery CPUE in seven out of eight surveys where data are available to compare.

Central Region staff has taken a first look at comparing survey estimates with commercial fishery performance (CPUE). Homer staff will continue to pursue incorporating additional aspects of the data (such as ways to incorporate variability and uncertainty into the comparisons) and on methods of examining the relationship between fishery CPUE and survey data including examining how well survey data relate not only to that year's fishery data, but to the following year's fishery CPUE data as well since our survey is biennial and, as such, the GHL's are set for a two year period.

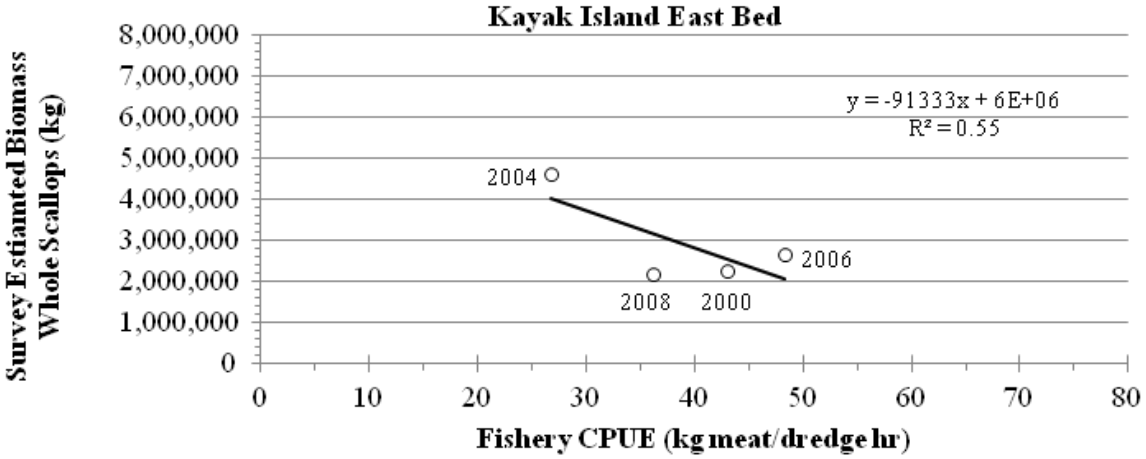


Figure 3-15. Linear regression of Kayak east bed fishery CPUE and survey estimated biomass with survey year shown (n=4; P=0.259; Std. Error=944,049).

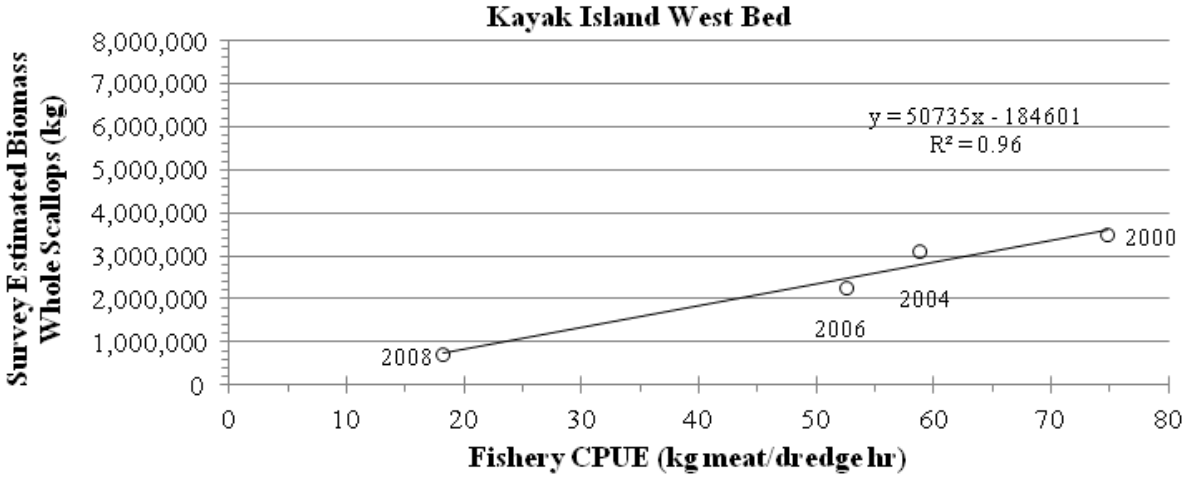


Figure 3-16. Linear regression of Kayak west bed fishery CPUE and survey estimated biomass with survey year shown (n = 4; P=0.019; Std. Error=296,459.4).

3.4 Cook Inlet Registration Area, Kamishak District

Scallop dredge surveys are conducted biennially in the Cook Inlet Registration Area (Area H) in Kamishak Bay. 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). Other districts of Cook Inlet are only open under terms of a commissioner's permit.

2013 Kamishak Survey

The 2013 survey results showed a continuing decline in scallop abundance and biomass. A total of 75 successful 1nm 8' dredge tows were conducted during the survey (43 in the north bed and 32 south bed). Total catch in the north bed was 1,218 weathervane scallops weighing 544 kg (1,200 lb). Mean abundance among all stations was 28.3 scallops/nm (±24.7 scallops/nm SD, n=43). Mean catch by weight among all stations fished was 12.6 kg/nm (27.9 lb/nm) (±11.0 kg/nm SD, n=43). Total catch in the south bed was 1,193 weathervane scallops weighing 270 kg (596 lb). Mean abundance among all stations was 37.0 scallops/nm (±53.6 scallops/nm SD, n=32). Mean catch by weight among all stations fished was 8.4 kg/nm (18.5 lb/nm) (± 10.7 kg/nm SD, n=32). Abundance and biomass estimates from all Kamishak Bay surveys are given in Table 3-6 and Figure 3-13 and show the decline in scallops over recent surveys. Age distributions from 2005-2013 scallops collected during the Kamishak dredge survey are found on Figure 3-14 and Figure 3-15. The department uses this information to see if the full range of ages is present on the beds and is also being incorporated into an age-structured model.

Table 3-6. Summary of systematic estimates for weathervane scallop survey in Kamishak Bay 1996 - 2013, using a standardized area of 90.2 nm2 North Bed and 68.0 nm2 South Bed and Arc GIS distance for estimates. The dredge was 8 feet wide and weighed ~1600 lb, ring size 4 inches inside diameter, and lined with 1.5 inch stretch 24 thread nylon mesh.

Survey Year	Number stations sampled	Mean catch kg/nm	Estimated abundance	95% CI	CV	Scallop density (scal/m^2)	Average weight (g/scal)	Estimated biomass q =1.0 (kg meat)	Estimated biomass q =0.83 (kg meat)
North Bed									
1996	26	60.0	15,674,085	± 4,921,324	0.15	0.05	262	351,141	
1999	41	67.1	12,115,707	± 3,032,424	0.12	0.04	380	300,950	
2001	37	62.9	9,980,638	± 2,708,305	0.13	0.03	431	274,801	
2003	31	26.2	4,120,643	± 948,209	0.11	0.01	435	110,137	
2005	38	22.7	3,535,142	± 795,020	0.11	0.01	439	101,483	
2007	43	26.4	5,094,047	± 978,442	0.10	0.02	354	139,580	
2009	43	20.5	3,701,402	± 808,379	0.11	0.01	379	97,408	117,359
2011	45	17.2	2,885,639	± 540,212	0.09	0.01	409	94,188	113,479
2013	43	12.6	1,937,665	± 371,769	0.10	0.01	447	63,120	76,049
South Bed									
2003	28	59.7	9,434,220	± 2,467,551	0.13	0.04	327	221,258	
2005	29	16.2	3,935,459	± 1,069,549	0.13	0.02	212	60,881	
2007	31	23.5	5,988,540	± 1,648,559	0.13	0.03	202	97,851	
2009	23	9.2	2,757,557	± 1,179,705	0.21	0.01	172	18,146	21,863
2011	16	13.9	2,799,128	± 1,642,687	0.28	0.01	254	62,428	75,214
2013	32	8.4	1,913,247	± 716,715	0.18	0.01	227	26,064	31,402

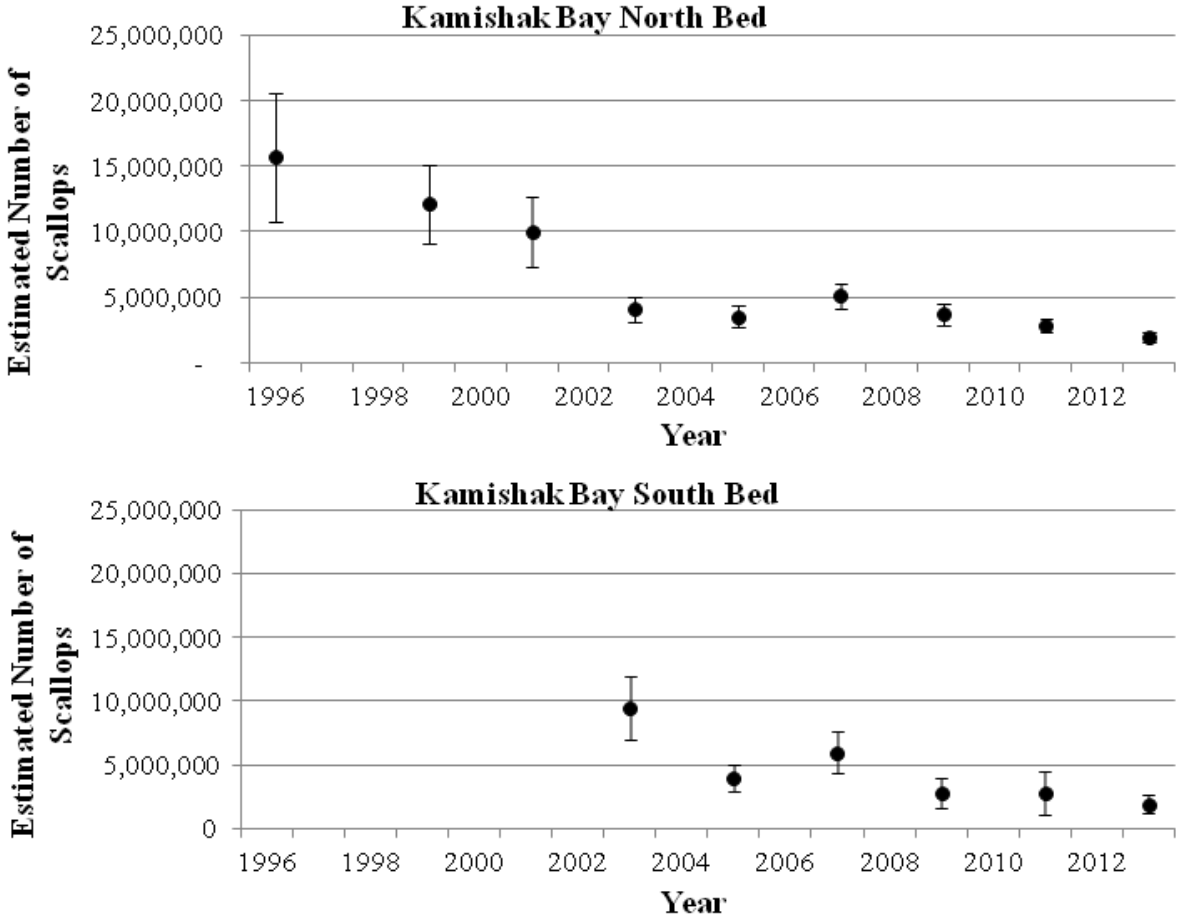


Figure 3-17. Survey estimates of weathervane scallop abundance for the north and south beds in Kamishak Bay, 1996 - 2013 (error bars = 95%CI).

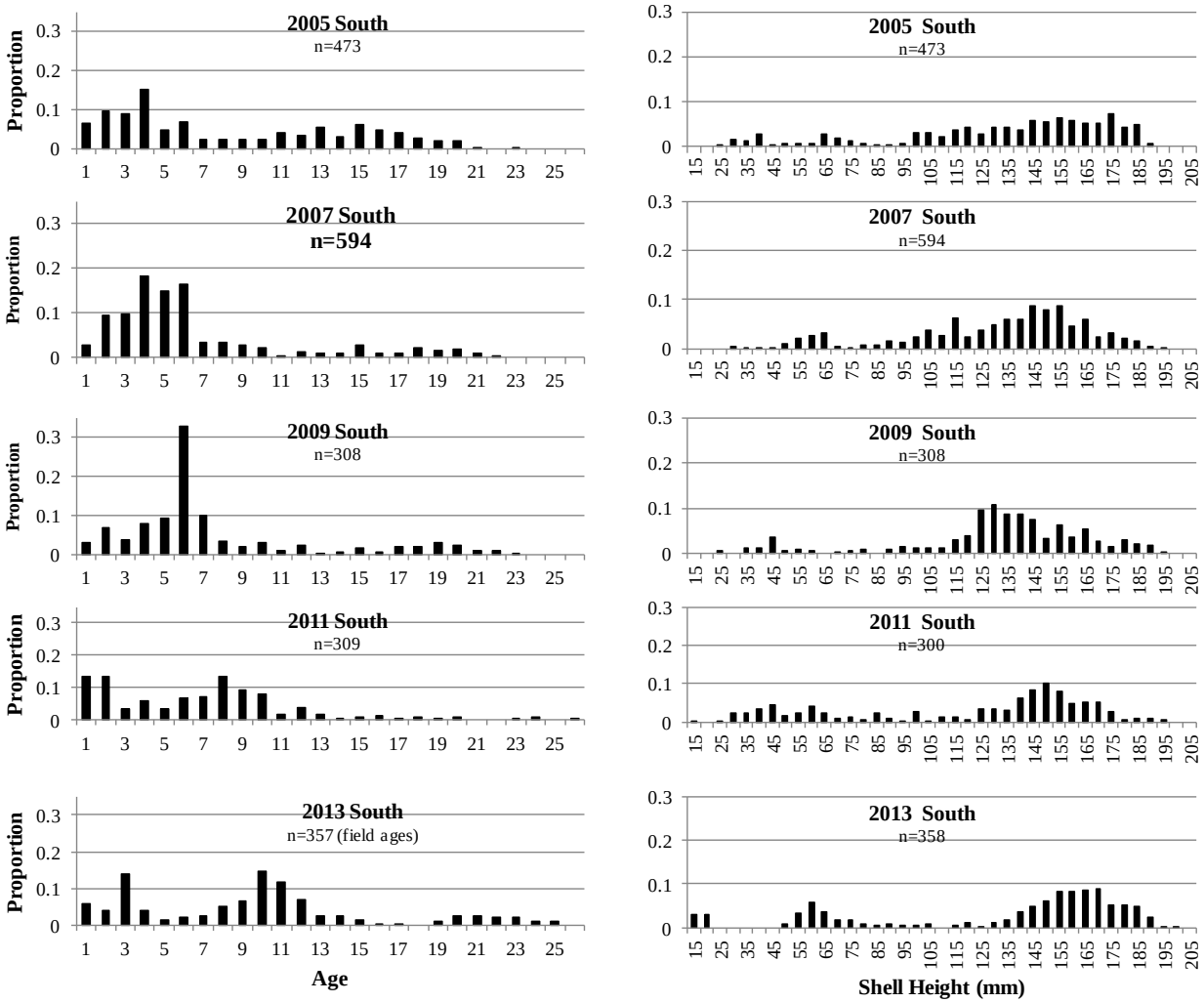


Figure 3-18 Comparison of ages and shell height distribution, Kamishak south bed, 2005 - 2013.

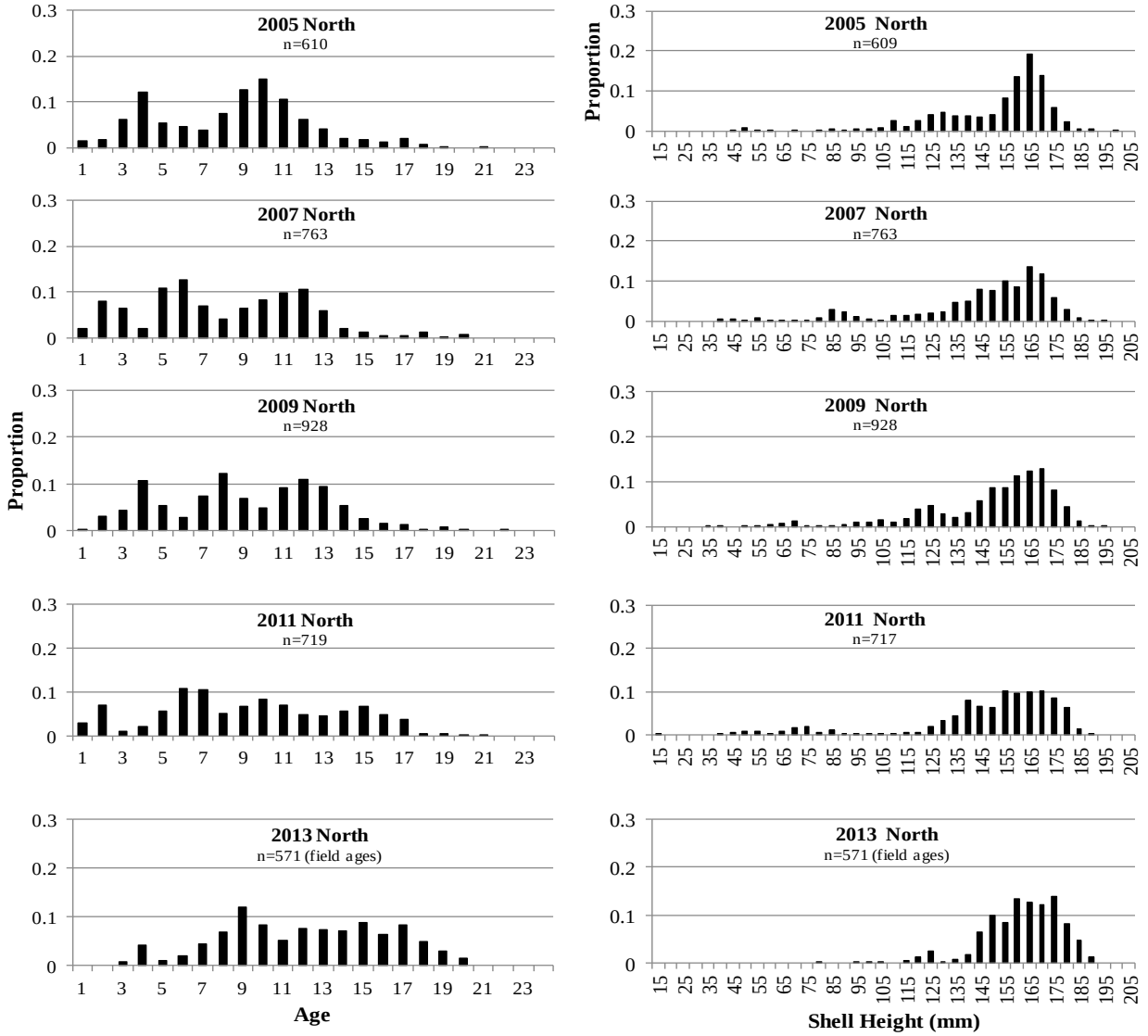


Figure 3-19 Comparison of ages and shell height distributions, Kamishak north bed, 2005 - 2013.

The results of the 2013 survey showed a decline in both abundance and biomass to the lowest level in the history of the survey for both the north and south beds. Accompanying these low levels of abundance and biomass were some of the lowest pound per nautical mile catches witnessed in the survey, and the age structure of the scallops in the south bed is currently supporting a low number of older scallops. Closing both beds to fishing for two seasons will allow the current biomass to reproduce and generate potential future recruitment and enable younger scallops to grow and potentially recruit to the fishery. The next survey in Kamishak Bay will occur in 2015.

Sled-dredge: Efforts continue with using underwater video techniques to evaluate the efficiency of the 8'survey dredge, with the goal of increasing accuracy of survey estimates resulting in more appropriate harvest limits. Central Region staff attempt to conduct as many sled-dredge tows as time allows on each survey to measure gear efficiency with video and compare catch to the standard 8' survey dredge for scallop height and age frequency. Because the scallop beds of significant aggregation appear to occur in

discrete areas, project results are further delineating essential habitat of weathervane scallops, a need specified in the Magnuson-Stevens Act. Central Region staff has also developed a sled-dredge (Figure 3-16). The sled is analogous to that used by the statewide scallop program in Kodiak, however 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). While still in its early stages of testing, the goal is to compare shell heights and age-structure of the sled-dredge catch to that of the 8' dredge to see if a gear-switch can be made from the 8' dredge to the sled-dredge for all future Central Region surveys.

A B

Figure 3-20. 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).

In the 2013 Kamishak survey nine successful sled-dredge tows averaging 1.0nm were conducted, six in the north bed, three in the south bed, and one unsuccessful tow in the south bed. Total catch in the north bed was 138 weathervane scallops weighing 58 kg (128 lb). Standardized catch abundance ranged from three to 50 scallops/nm, resulting in a mean among all stations of 23.1 scallops/nm (± 16.4 scallops/nm SD, n=6). Standardized catches by weight ranged from 2 kg/nm (4 lb/nm) to 21 kg/nm (47 lb/nm) with a mean catch among all stations fished of 9.8 kg/nm (21.5 lb/nm) (± 6.9 kg/nm SD, n=6). Total catch in the south bed was 12 weathervane scallops weighing 2 kg (5 lb). Standardized catch abundance ranged from one to six scallops/nm, resulting in a mean among all stations of 4.0 scallops/nm (±2.6 scallops/nm SD, n=3). Standardized catches by weight ranged from 0.04 kg/nm (0.1 lb/nm) to 2.4 kg/nm (5.2 lb/nm) with a mean catch among all stations fished of 0.8 kg/nm (1.8 lb/nm) (± 1.3 kg/nm_SD, n=3). Four weathervane scallops weighing 0.4 kg (1.0 lb) were caught in the one unsuccessful tow in the south bed and not used for further data analysis.

Video Review

Video was collected on six stations in the north bed and two stations in the south bed during the 2013 Kamishak survey. Results of the review are shown on Table 3-7. One tow was not used for analysis because the camcorder did not complete recording the whole tow, so five tows in the north and two in the south were used to calculate gear efficiency. During the review we classified scallops in to three categories, live weathervane, questionable scallops, cluckers or clackers, and total (sum of live, questionable scallops, and cluckers). Gear efficiency for live scallops (total captured/total viewed) ranged

from 25% to 60% in north bed, with a mean among all tows 45%. South bed gear efficiency ranged from 9% to 20% with a mean among tows of 9%. Both beds had a mean among all stations of 38%. It is noteworthy that more cluckers were captured than viewed. This is likely due to the fact that the resilium degrades faster than the hinge ligament. The sum of live and cluckers resulted in gear efficiency that ranged from 31% to 63% with a mean of 49% in the north bed and 9% to 20% with a mean of 9% in the South. Both beds had a mean among all tows of 41%.

Table 3-7 Video review of the sled-dredge trials during the 2013 Kamishak scallop survey, video count verses catch.

	Live Weathervane Scallops			Cluckers		Total Sum of Live Scallops & Cluckers		
Bed	Viewed	Total captured	Gear efficiency	Cluckers Viewed	Total captured	Viewed	Total captured	Gear efficiency
North	117	50	43%			117	50	43%
North	43	15	35%	1	3	44	18	41%
North	59	31	53%		6	59	37	63%
North	12	3	25%	1	1	13	4	31%
North	40	24	60%		1	40	25	63%
South	5	1	20%			5	1	20%
South	70	6	9%			70	6	9%
	North Bed							
Total	271	123	45%	2	11	273	134	49%
	South Bed							
Total	75	7	9%			75	7	9%
	Both Beds							
Total	346	130	38%			348	141	41%

In 2011, the sled dredge was trialed in a small bed in the Southern District of Cook Inlet, Kachemak Bay. One tow was 1.0 nm, while the other five were reduced to 0.5 nm due to time constraints. Gear efficiency for the 1.0 nm tow was 25% and 0.5 nm tows ranged from 13% to 40% with a mean among all 0.5 nm tows of 19%.

Size and Age distribution comparison between 8' dredge and Sled-dredge

The main question to address prior to shifting from the 8' dredge to the sled-dredge for future surveys is gear selectivity (i.e. does the sled-dredge capture the same size and age distribution as the 8' dredge?). In the 2013 survey we compared stations that had both 8' dredge and sled-dredge tows. In the north bed, the 8' dredge caught 396 scallops weighing 173 kg (380 lb), compared to the sled-dredge catch of 138 scallops weighing 58 kg (128 lb) (n=6 stations). In the south bed the 8' dredge caught 234 scallops weighing 57 kg (125 lb), compared to sled-dredge catch of 12 scallops weighing 2kg (5 lb) (n=3 stations). Initial work shows the size distributions appear similar, however, additional tows are necessary to increase sample size to enable a complete statistical analysis to be conducted (Figure 3-17). Age distribution comparisons to date are found on Figure 3-18.

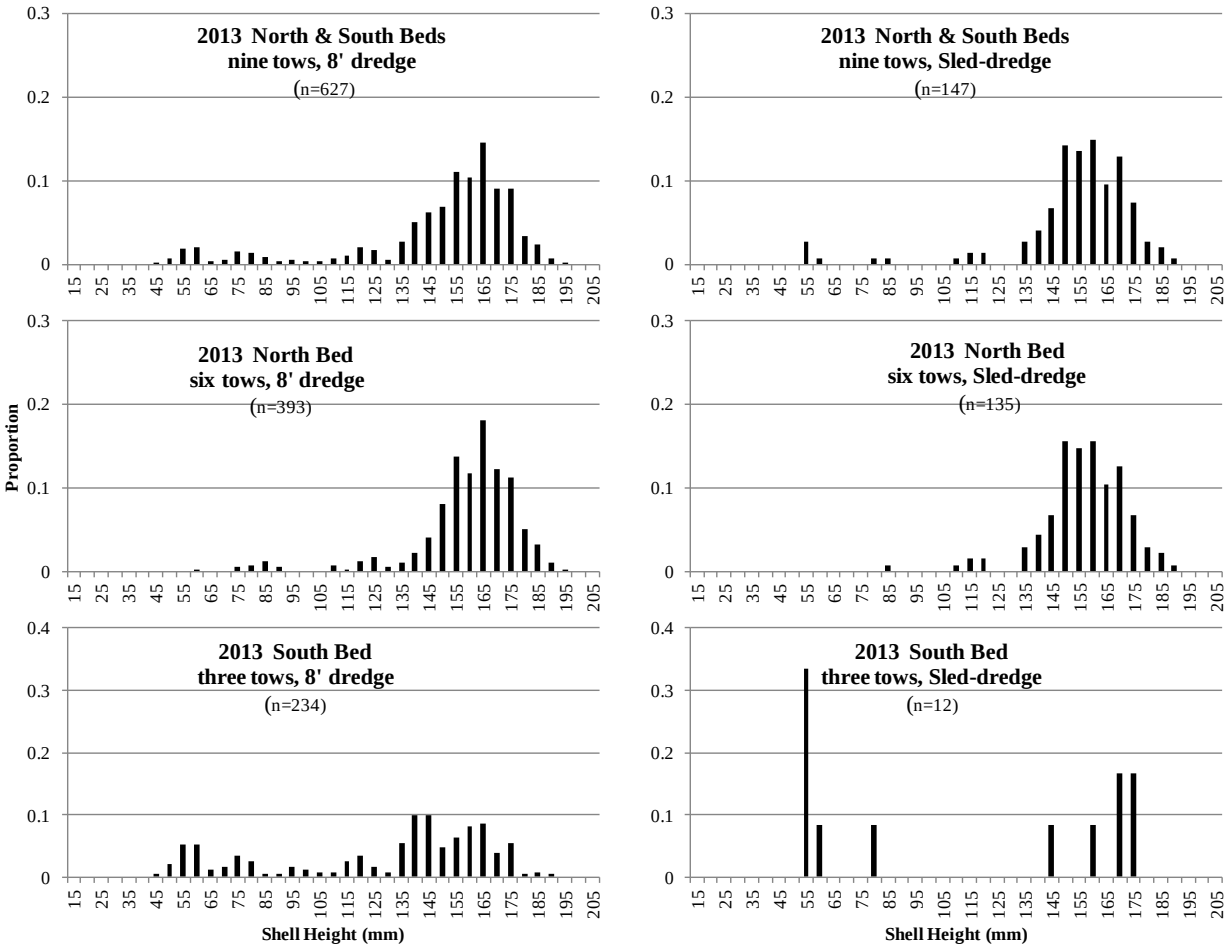


Figure 3-21 Size (shell height) distribution comparison between 8’ survey dredge on left and sled-dredge on right from the 2013 Kamishak weathervane scallop survey.

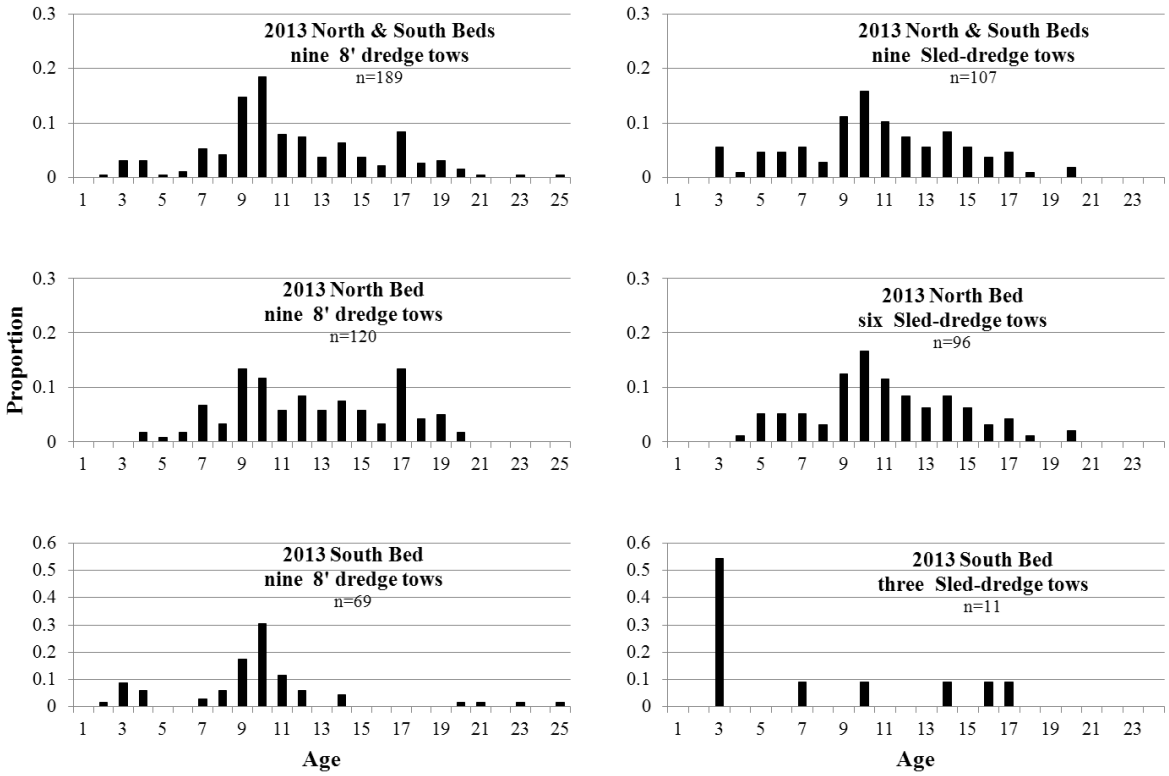


Figure 3-22. Age distribution comparison between the 8' survey dredge (left) and sled-dredge (right) from the 2013 Kamishak weathervane scallop survey.

Weak Meats: During the 2009 Scallop Planning Team Meeting "weak meats" were discussed. Weak meats are characterized by 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 during the 2009 survey. During the 2011 survey only the 8' dredge was used with the north bed having 12.9% weak meats and the south bed having 3.3% weak meats. During the 2013 survey the 8' dredge weak meat catch rate was 10.1 % for the north bed and 4.0% for the south bed. The sled-dredge weak meat catch rate was 9.0% for the north bed and no weak meats for the south bed.

Fishery overview

The GHR specified by state regulations for the Kamishak District is 10,000 to 20,000 lb of shucked meats, with a season dates of August 15–October 31. Harvest peaked in 1996 with five vessels harvesting 28,228 lb of shucked meats with catch rates of 53 lb/hr. Participation and CPUE in this small fishery have varied widely (Table 3-8). The fishery was closed in 1995 due to regulatory issues not biological issues, therefore the manager decided that an additional 8,000 lb harvest was allowable during the 1996 season since the survey that year indicated the Kamishak north bed was healthy. Allowing an additional harvest resulted in only a 3% harvest rate being applied, which is less than the 5% harvest rate typically applied when stocks fall within the GHR. Harvest has typically occurred only in the north bed, with only three years of harvest in the south bed (2002-2004). In response to exploratory commercial fishing effort in the south bed in 2002, ADF&G began surveying the south bed in 2003. The fishery has been closed in

the south bed since 2005 after a poor fishery performance in 2006, except for two years when no effort occurred. Until the closure in 2013, the fishery in the north bed was relatively stable for the prior three years, which followed a three-year period of no effort (2007-2009), however, CPUE was still considerably lower (29 lb/hr average) than peak years of the fishery between 1993 and 2001 when CPUE averaged 54 lb/hr, with the highest CPUE in 2000 at 75 lb/hr.

Table 3-8 Cook Inlet, Kamishak District scallop fishery summary statistics, 1983 - 2013.

		North Bed				South Bed				Total Both Beds			
Year	Number vessels	GHL lb meat	Catch (lb)[a] of shucked meats	Hours[b]	CPUE[c] lb/hour	GHL lb meat	Catch (lb)[a] of shucked meats	Hours[b]	CPUE[c] lb/hour	GHL lb meat	Catch (lb)[a] of shucked meats	Hours[b]	CPUE[c] lb/hour
1983 [d]	1		2,346	109.1	21.5						2,346	21.5	109.1
1984	3		6,305	248.2	25.4						6,305	25.4	248.2
1985 [d]	1	20,000	11,810	299.0	39.5						11,810	39.5	299.0
1986	3	20,000	15,364	424.4	36.2						15,364	36.2	424.4
1987 [d]	2	20,000	1,488	23.8	15.1						1,488	15.1	98.5
1988													
1989													
1990													
1991													
1992													
1993	3	20,000	20,115	528.0	38.1					20,000	20,115	528.0	38.1
1994	4	20,000	20,431	458.1	44.6					20,000	20,431	458.1	44.6
1995			Closed							-			
1996	5	28,000	28,228	534.0	52.9					28,000	28,228	534.0	52.9
1997	3	20,000	20,336	394.0	51.6					20,000	20,336	394.0	51.6
1998 [d]	1	20,000	17,246	390.0	44.2					20,000	17,246	390.0	44.2
1999	3	20,000	20,315	325	62.5					20,000	20,315	325.0	62.5
2000	3	20,000	20,516	275.1	74.6					20,000	20,516	275.1	74.6
2001 [d]	2	20,000	20,097	325.0	61.8					20,000	20,097	325.0	61.8
2002	3	20,000	6,045	235.3	25.7		2,546	76.1	33.5	20,000	8,591	311.4	27.6
2003 [d]	2		Closed			20,000	15,843	896.0	17.7	20,000	15,843	896.0	17.7
2004	3	6,500	4,519	197.7	22.9	13,500	1,598	165.9	9.6	20,000	6,117	363.6	16.8
2005 [d]	2	7,000	7,378	372.0	19.8		Closed			-	7,378	372.0	19.8
2006 [d]	1	7,000	50	10.0	5.0		Closed			-	50	10.0	5.0
2007	0	7,000				5,000				12,000			
2008	0	7,000				5,000				12,000			
2009	0	14,000					Closed			14,000			
2010 [e]	1	14,000	9,460	365.0	25.9		Closed			14,000	9,460	365.0	25.9
2011 [e]	1	12,500	9,975	324.0	30.8		Closed			12,500	9,975	324.0	30.8
2012 [e]	1	12,500	11,739	392.0	29.9		Closed			12,500	11,739	392.0	29.9
2013			Closed				Closed				Closed		
2014			Closed				Closed				Closed		

[a] Catch incluses harvested scallops and estimated deadloss

[b] Dredge-hours equils one dredge fished for 60 minutes.

[c] CPUE(catch per unit effort) equils pounds of scallops caught per dredge-hour.

[d] Confidential data (fewer than 3 vessels fished).

[e] Confidential data released by vessel operators.

The 2012 harvest was 11,407 lb of shucked meats and an estimated 332 lb of deadloss, totaling 11,739 lb, with a fishery CPUE of 30 lb/hr (Table 3-8). Deadloss was calculated using 100% mortality rate on crushed or broken discarded scallops and a 20% mortality rate on discarded live (small) scallops using observed discard rates. The 20% mortality rate on live discarded scallops was implemented in 2011 in response to ACL requirements (refer to the section below on the ongoing discard mortality study to ascertain actual mortality rates to apply to this fishery). The department sent an observer out on two of the four fishery trips. The height distribution of scallops from observed tows had a tri-modal distribution with predominate modes at 65 mm, 115 mm and 155 mm (Figure 3-19). Additionally the department ages an approximately 200 samples from each trip (the vessel operator or onboard observer must collect a minimum of 100 scallop top valves from each trip per regulation 5 AAC 38.327 Kamishak Bay District Scallop Management Plan). The age distribution had a tri-modal distribution with predominate ages at seven, 11, and 15 (Figure 3-19).

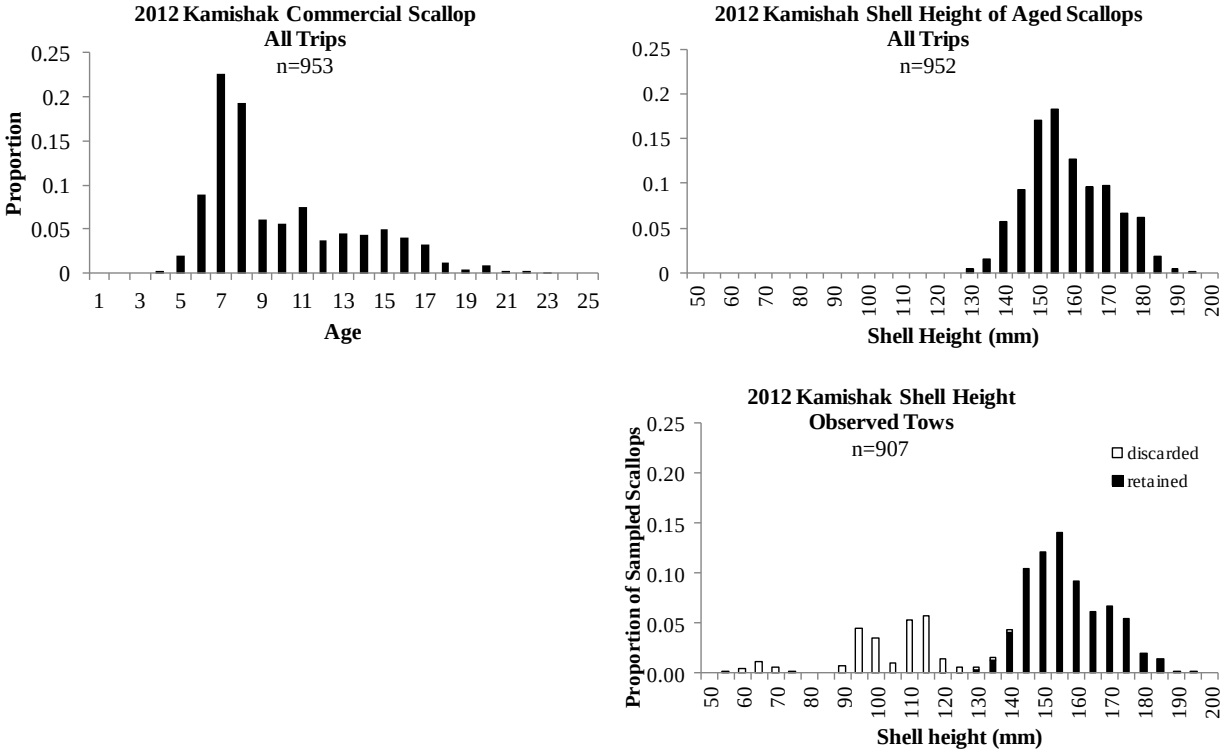


Figure 3-23. Age and height distribution comparing all trips shell height distribution to observed trips, 2012.

Comparison of Fishery CPUE to Survey Abundance and Biomass

As with Kayak Island, Central Region staff also examined the relationship between fishery-independent surveys and commercial fishery CPUE for Kamishak Bay. Comparing the biomass of whole scallops to fishery CPUE was examined because this fishery is a biomass fishery (Figure 3-20). Results indicate that the survey estimated biomass and fishery CPUE in the north and south bed at Kamishak Bay show the same trends.. Linear regression of the north bed fishery CPUE (kg meat/dredge hr) compared to survey estimated biomass of whole scallops (kg) had a strong relationship (Figure 3-21). When the 2005 south bed data are added, the relationship becomes stronger (Figure 3-22). Homer management shellfish biologists will continue to examine the relationship between fishery CPUE and survey information. We support the NPFMC, SSC's goal to see if these relationships can be used to shed light on the validity of CPUE-based indices being used in all other Regions of the state.

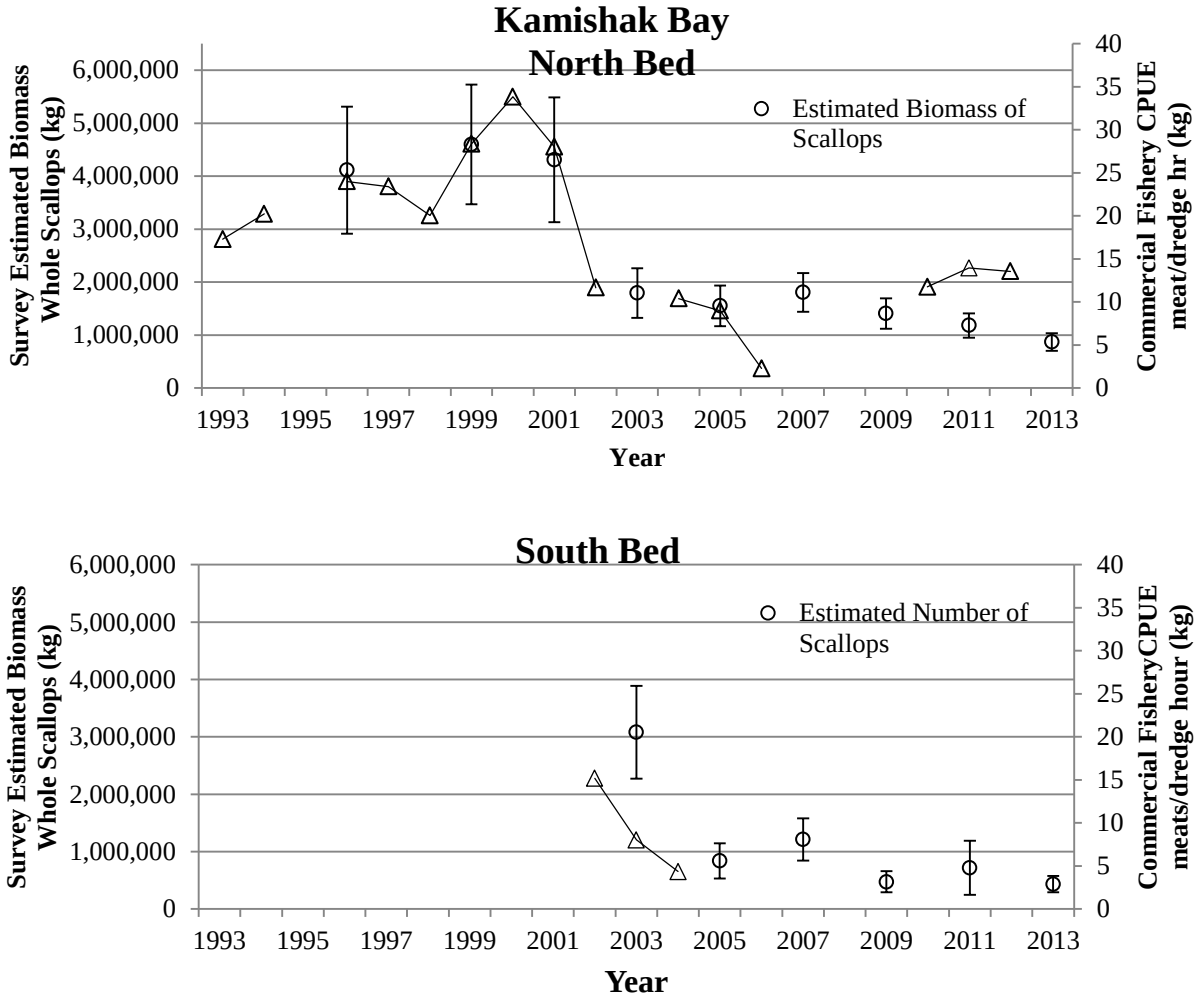


Figure 3-24. Comparison of fishery-independent survey biomass estimates (kg whole scallops) to commercial fishery CPUE, 1993 - 2013.

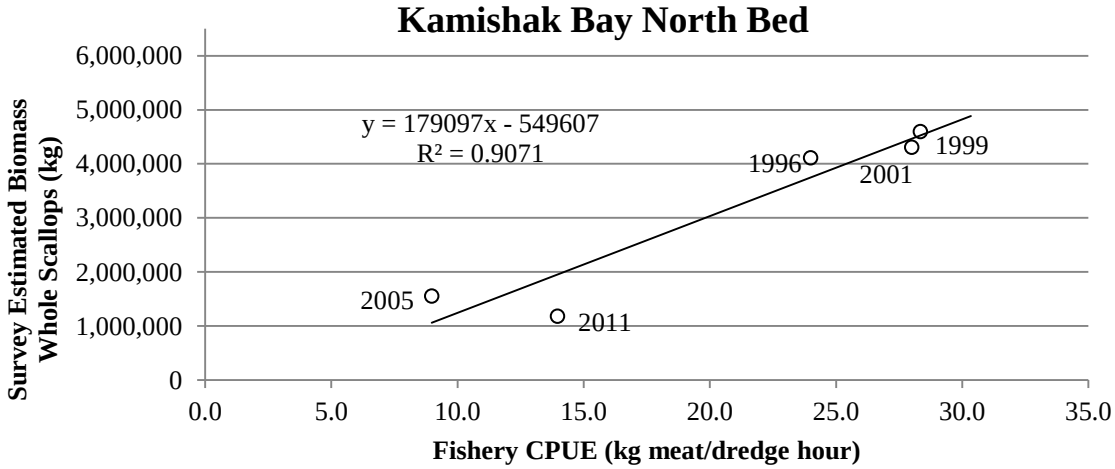


Figure 3-25. Linear regression of Kamishak Bay north bed fishery CPUE and survey estimated biomass with survey year shown (n = 5; P=0.012; Std. Error=578,093.4).

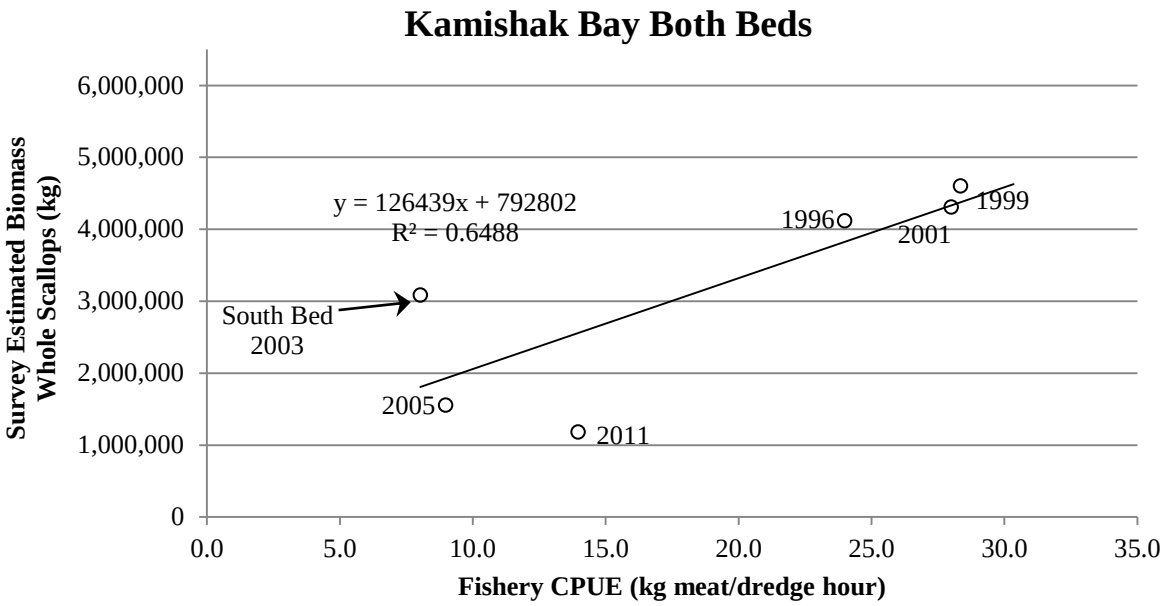


Figure 3-26. Linear regression of Kamishak Bay north bed fishery CPUE and survey estimated biomass with 2005 south bed data included (n = 6; P=0.0016; Std. Error=501,002.7).

Discard Mortality Study

In 2013, Central region staff in collaboration with Dr. Brad Harris (Alaska Pacific University) began a scallop discard mortality study in Kamishak Bay. The research consisted of taking groups of small (<50mm shell height), medium (between 50 and 100mm shell height) and large (>100mm shell height) scallops and placing them in cages that were deployed back to the sea floor for varying periods of time (~ 11-14 days). The cage dimensions were 24"x24"x13" with a few cages being 24"x24"x8". Only small and medium sized scallops went into the 8" high cages – the goal being to ensure that large scallops had enough space to turn over in the cages.

Scallops were selected for the discard mortality study at the measuring station where shell height measurements are taken. Selected scallops were placed in totes under the measuring board table until the dredge tow sample was completely worked up after which they were placed in the respective cages for deployment. Time on deck from landing to in-water and air temperature was recorded. Prior to being placed in their respective totes under the measuring board table, each scallop will have its general condition assessed into one of the following five shell damage categories:

A. Undamaged	B. Broken margin	C. Cracked
D. Punctured	E. Broken Hinge	F. Crushed

Only category A, B and C samples were placed into cages, along with some undamaged scallops, for deployment. We did not place scallops from categories D, E or F in the cages for the discard mortality study as those shell conditions are assumed to have 100% mortality. We tested that hypothesis by placing shells from those three condition categories in totes and holding them on board for ~24 hours to evaluate the level of mortality for each condition.

Twelve individual strings of gear consisting of five cages each were set. Gear strings consisted of an anchor at each end of the string with 10 fathoms between the anchors and the nearest cage. Each cage had 5 fathoms of line between them and a buoy line that extended to a surface float from one of the anchors. Scallops were placed into their cages based on size (small, medium and large). Each cage was

wrapped in a 1¼" stretch mesh bag (size 18 thread) to prevent sea star predation while allowing water flow through the cages so scallops may filter feed while enclosed. Upon retrieval of the cages, each scallop was measured again and its condition assessed as live or dead. Condition was assessed by the animal's response to attempting to open the scallop if the shell is closed or pushing the shell closed if it is agape. Negative (or no) response was deemed a mortality.

Initial examination of the discard mortality data has been conducted. There were 393 scallops used in the study of which 363 were placed in the cages leaving 30 that were placed in totes on deck (from categories D. E and F). Twenty six of the 363 scallops (7.16%) placed in the cages died, while 18 out of the 30 placed in totes on deck (60%) died after 24 hrs, but indications were that all of those scallops would have died after not too much longer (i.e. eventual 100% mortality). The combined mortality from both groups is 11.12%. An initial estimate of overall survey mortality using these results and expanding them to the approximately 3,500 scallops examined for shell damage on the survey provides on overall estimate of survey mortality of 8.16% (with lower and upper 95% CI of 6.03% and 10.28%, respectively). Central Region staff are examining the use of different cages and determining whether or not to conduct another discard mortality study at Kamishak Bay in 2015. The eventual goal is to also examine Tanner crab discard mortality in our scallop survey and to partner with the commercial scallop industry to conduct a scallop discard mortality study aboard a commercial scallop fishing vessel to examine the discard mortality in the fishery relative to our survey estimates.

Age Structured Model
Central region staff biometrician, Dr. Xinxian Zhang, has been working on an age structured model for Kamishak Bay. The model framework is based on Bechtol (2000) and will be presented by Dr. Zhang at the April 2015 NPFMC SSC meeting in Anchorage.

3.5 Kodiak Registration Area, Northeast District

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 hrs), 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.

Large portions of the Kodiak Registration Area that contain scallops are closed to scallop dredging. 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.

The management program employs an overall guideline harvest level for the district, coupled with in-season tracking of CPUE against predetermined CPUE benchmarks in an effort to distribute effort and reduce localized depletion. 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 3-9; Figure 3-23). 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 lb as a precautionary approach; the initial GHR range was 0-75,000 lb.

The 2013/14 Northeast District GHL was 55,000 pounds. Scallop harvest totaled 54,926 pounds from four vessels (Table 3-9). Since the 1999/00 season, the Northeast District fishery CPUE has remained relatively stable, generally ranging between 55 and 65 lbs meat/dredge hour (Figure 3-23). Tanner crab bycatch (25,510 crab,) was below the 2013/14 bycatch cap of 98,248 Tanner crab.

Table 3-9 Kodiak Northeast District scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	10	NA	155,187	6,940	22	
1994/95	7	NA	35,207	1,773	20	
1995/96		closed				
1996/97	3	NA	11,430	581	20	175
1997/98	3	NA	95,858	2,604	37	874
1998/99	4	NA	120,010	2,749	44	4,000
1999/00	3	75,000	77,119	1,384	56	2,380
2000/01	4	80,000	79,965	1,101	73	2,382
2001/02	3	80,000	80,470	1,142	70	2,286
2002/03	2	80,000	80,000	1,350	59	3,497
2003/04	2	80,000	79,965	1,248	64	2,384
2004/05	2	80,000	80,105	1,227	65	5,522
2005/06	3	80,000	79,990	1,759	45	4,408
2006/07	2	90,000	75,150	1,168	64	2,842
2007/08	2	90,000	75,105	1,170	64	4,264
2008/09	3	90,000	74,863	1,363	55	2,328
2009/10	1	75,000	69,360	1,222	57	2,541
2010/11	3	65,000	64,475	1,015	64	1,804
2011/12	4	70,000	61,209	986	62	2,014
2012/13	4	60,000	62,496	1,322	47	2,086
2013/14	4	55,000	54,926	935	59	1,457
2014/15[b]	3	55,000	55,061	748	74	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.5% from observer experiments.

[b] PRELIMINARY data subject to change.

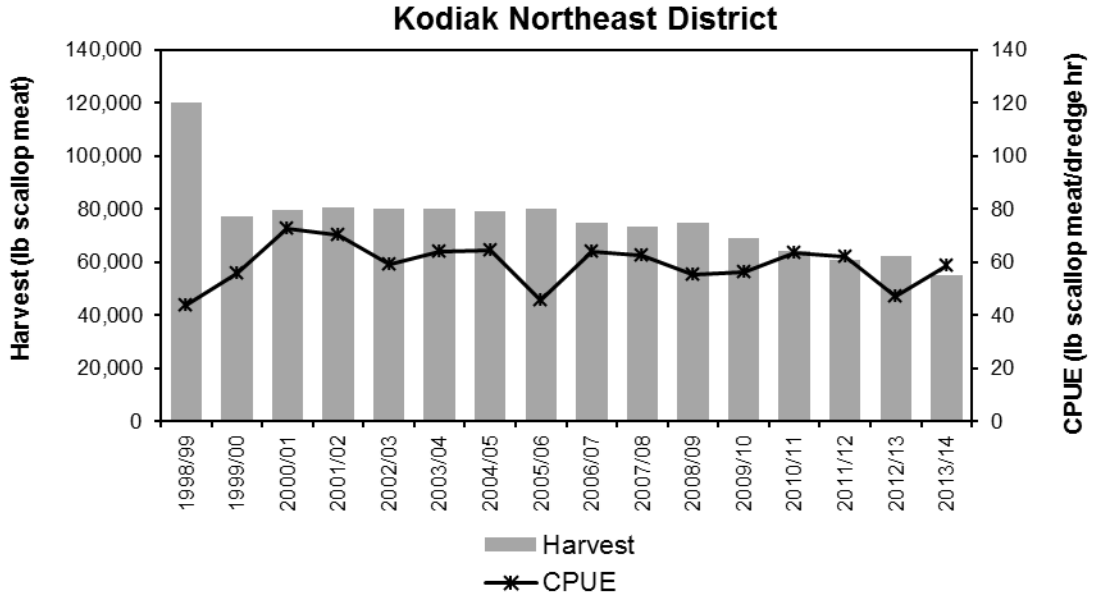


Figure 3-27. Kodiak Northeast District Harvest and CPUE, 1998/99 - 2013/14 seasons.

Scallop shell height (SH) histograms from the Northeast District observer data (Figure 3-24) show the shell height of retained scallop catch has remained relatively stable since 2010/11 although there has been little sign of recruitment. Age composition data shows age-11 and age-12 scallops were the most represented age classes in the 2013/14 catch sample which represent the oldest scallops to dominate a season's catch since 2003/0 suggesting an aging population.

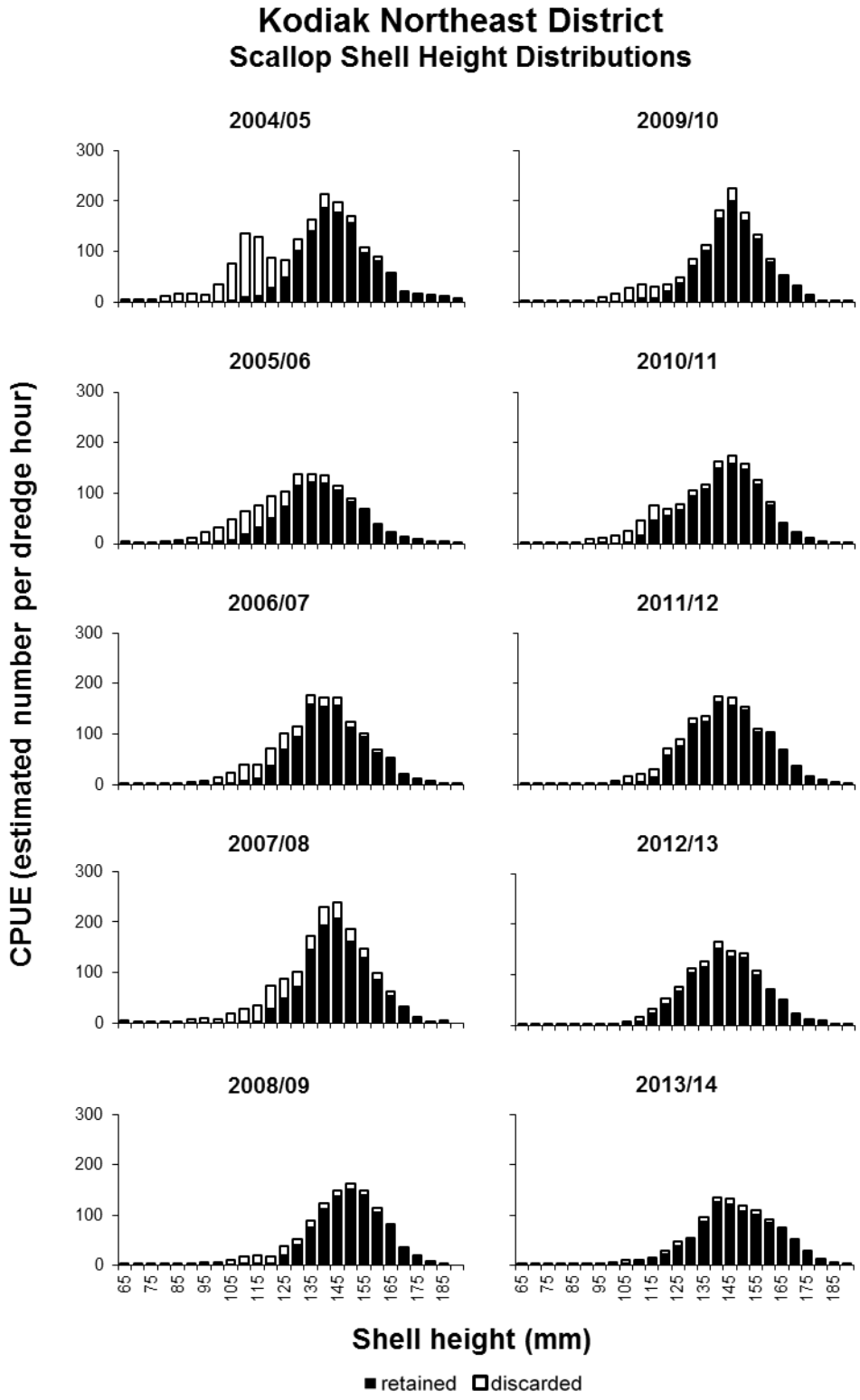


Figure 3-28. Estimated scallop shell height distributions from the 2004/2005 - 2013/14 Kodiak Northeast District fishing seasons.

Beginning with the 2010/2011 season, staff recognized abundance in some Northeast District scallop beds may be declining. In response, staff established a MPS for statistical area 525630 (45 lb/hr) based upon the lowest CPUE observed in this statistical area (2005/06 season). At that time, a MPS was also established for scallop bed 2 (43 lb/hr), also based upon the lowest CPUE observed in that area (2005/06 season). The MPS for statistical area 525702 is 52 lb/hr and has been in place since 2003/04 which is the lowest CPUE observed in this statistical area (2002/03 season).

Fine scale management at the individual bed or statistical area level has evolved as a method to better distribute fishing effort and monitor health of individual scallop beds. While this management approach has been effective at distributing effort, it limits the fleet's ability to move in response to low CPUE or high crab bycatch because, for example, areas with the highest GHLs may coincide with areas of high crab abundance. Additionally, observer data suggest the fleet may be discarding less undersized or less marketable scallops in an effort to maintain higher CPUEs and avoid in-season closures.

Bed level management additionally confounds establishing GHLs. During periods of declining CPUE staff are often unable to determine if poor fishery performance is a predictor of a declining stock or a function of fleet behavior. In response to fluctuating bed or stat area CPUEs ADF&G has adopted a pattern of adjusting annual bed level harvest caps up or down in increments of 5,000 or 10,000 pounds. However, it is unknown if these adjustments promote conservation during periods of declining scallop abundance or further modify behavior of the fleet. Based on these factors, ADF&G established a district wide GHL for the 2013/14 Northeast District scallop season and discontinued use of bed or statistical area level GHLs for controlling harvest within the district. Despite transitioning to a district wide GHL, ADF&G will continue to monitor the fishery in-season and use previously established MPSs close individual areas within the district before the total GHL is harvested should in-season observer data suggest poor fishery performance or localized depletion.

3.6 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 in-season.

The 2013/14 Shelikof District GHL totaled 105,000 pounds and was apportioned 100,000 pounds east of 154° W. long. and 5,000 pounds west of 154° W. long. Harvest totaled 108,128 pounds with a cumulative CPUE of 43 (Table 3-10, Figure 3-25). Despite lowering the GHL twice since the 2010/11 season, the 2013/14 cumulative CPUE is the second lowest since 1993/94. The low Tanner crab bycatch limit may have constrained traditional fishing practices and influenced fishing behavior, resulting in a conservative and less efficient fishing approach by vessel operators. Despite low CPUE, the distribution shell heights from the Shelikof District scallop harvest continues to show contributions from a wide range of cohorts (65-185 mm), with scallops ranging from 145-155 mm (ages 6-8) providing the largest contribution (Figure 3-26). Age classes that first appeared in the 2010/11 fishery have continued to progress through the population and dominate the age classes harvested in the fishery. Preliminary estimated ages from the 2013/14 catch indicate a possible sign of recruitment in age-4 scallops however staff are concerned about the lack of recruitment observed over the past several seasons. Estimated Tanner crab bycatch during the 2013/14 season was 19,342 crabs from a cap of 27,450.

Table 3-10 Kodiak Shelikof District scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	5	NA	105,017	2,491	42	
1994/95	11	NA	314,051	8,662	36	
1995/96		closed				
1996/97	3	NA	219,305	3,491	63	4,018
1997/98	4	NA	258,346	5,492	47	1,900
1998/99	8	NA	179,870	4,081	44	4,409
1999/00	6	180,000	187,963	4,304	44	5,907
2000/01	5	180,000	180,087	2,907	62	2,621
2001/02	4	180,000	177,112	3,398	52	4,880
2002/03	3	180,000	180,580	3,799	48	10,120
2003/04	2	180,000	180,011	3,258	55	8,209
2004/05	2	180,000	174,622	3,467	50	8,883
2005/06	2	160,000	159,941	2,280	70	4,767
2006/07	3	160,000	162,537	2,183	74	4,789
2007/08	3	170,000	169,968	2,937	58	7,685
2008/09	2	170,000	13,761	263	52	658
2009/10	3	170,000	169,877	3,496	49	7,132
2010/11	4	170,000	171,076	3,508	49	8,623
2011/12	4	135,000	136,491	2,437	56	2,618
2012/13	4	105,000	106,051	2,001	53	2,575
2013/14	4	105,000	106,099	2,469	43	1,162
2014/15[b]	3	105,000	65,779	1,629	40	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.

[b] PRELIMINARY data subject to change.

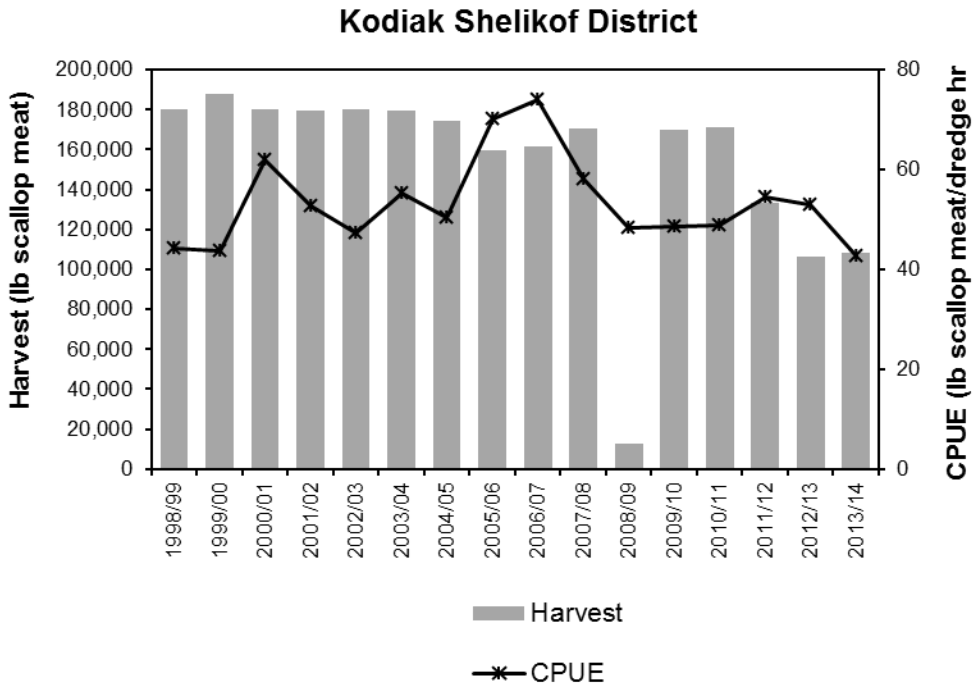


Figure 3-29. Kodiak Shelikof District Harvest and CPUE, 1998/99 - 2013/14 seasons.

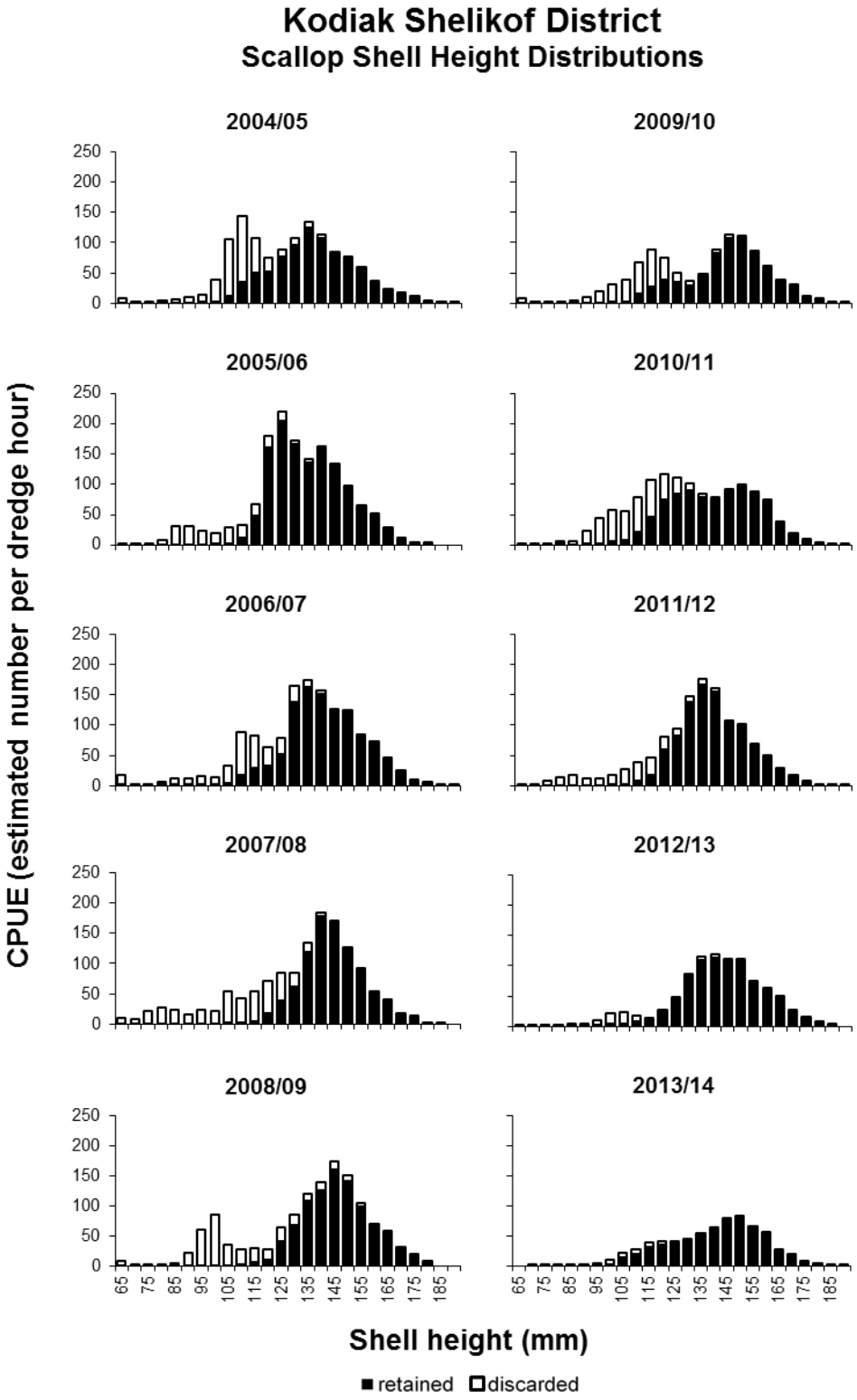


Figure 3-30. Estimated scallop shell height distributions from the 2004/2005 - 2013/14 Kodiak Shelikof District fishing seasons.

3.7 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 an initial 25,000 pound GHL for the Southwest District and encouraged participants to distribute effort to help delineate scallop beds. As funding allows, ADF&G plans to conduct video surveys in this area to further assess the resource.

The 2013/14 season was the fifth season since the BOF opened this area for exploratory fishing and the fourth season that vessels participated. Two vessels harvested 20,340 pounds of shucked scallop meat with a cumulative CPUE of 39 lb/hr (Table 3-11 and Figure 3-27). Measured shell height from retained and discarded scallops shows that large scallops with SH >140 mm comprised the bulk of the harvest, with few small scallops encountered (Figure 3-28). The 2013/14 Tanner crab bycatch totaled 8,354 crab from a cap of 12,000 Tanner crab.

Table 3-11 Kodiak Southwest District scallop fishery summary statistics, 2009/10 - 2013/14.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
2009/10	1	25,000	3,480	159	22	76
2010/11	0	25,000	0			
2011/12	1	25,000	25,110	455	55	364
2012/13	2	25,000	25,014	670	37	312
2013/14	2	25,000	20,340	526	39	301
2014/15[b]	2	25,000	24,993	559	45	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.
[b] PRELIMINARY data subject to change.

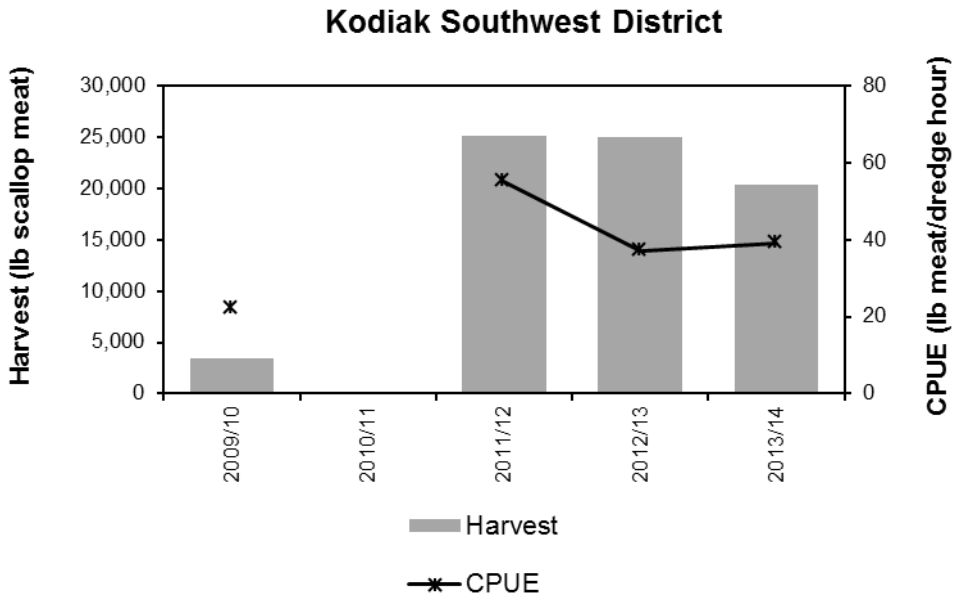


Figure 3-31 Kodiak Southwest District Harvest and CPUE, 2009/10 and 2011/12 - 2013/14 seasons.

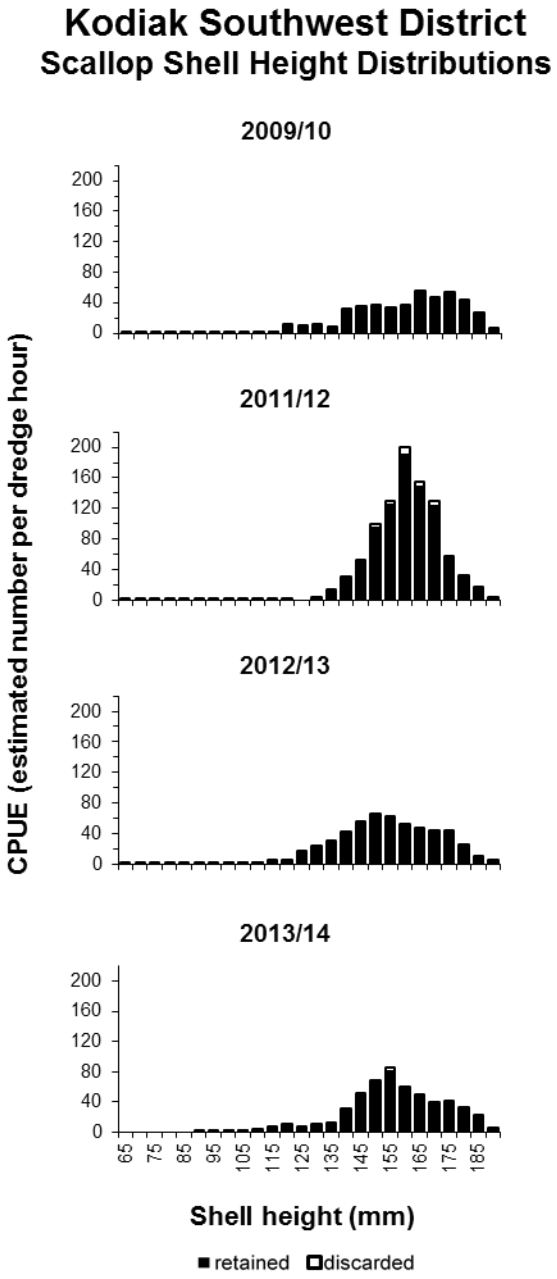


Figure 3-32. Estimated shell height distributions from the exploratory 2009/10 and 2011/12 - 2013/14 Kodiak Southwest District scallop fisheries.

3.8 Kodiak Registration Area, Semidi Islands District

Traditional scallop fishing areas of the Semidi Islands District are located in state waters that were closed to scallop dredging by the Alaska Board of Fisheries in 2000 (Figure 2-1). Offshore waters of the district remain open to fishing; marginal exploratory effort occurred during the 2013/14 season but no scallops were retained (Table 3-12).

Table 3-12 Kodiak Semidi Islands District scallop fishery summary statistics, 1993/94 - 1999/00 and 2013/14.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	6	NA	55,487	1,819	31	NA
1994/95	2	NA	NA	272	NA	NA
1995/96		closed				
1996/97	3	NA	37,810	1,017	37	122
1997/98	1	NA	6,315	349	18	55
1998/99	2	NA	1,720	106	16	10
1999/00	1	NA	930	45	21	8
2013/14	1	NA	0	2	0	0

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.

3.9 Alaska Peninsula Registration Area

Fishery dependent data and information obtained through the observer program are used to establish Alaska Peninsula GHLs and manage harvests in-season. Scallop fishing in the Alaska Peninsula Registration Area (Area M) was traditionally concentrated in a small core region near the Shumagin Islands between 160° and 161° W longitude.

Beginning in 2009/10, the Alaska Peninsula Area east of Unimak Bight was closed for a period of five years to allow stocks to recover (Table 3-13). Preceding the closure was a period of low effort (2003/04 to 2008/09) and another 2-year (2001/02-2002/03) closure period.Only 155 pounds of scallops have been harvested in the core Alaska Peninsula scallop beds since the 2001/02 season. The Alaska Peninsula Area between 160° W long. and 161° W long. will reopen in 2014/15 with a conservative GHL to assess if recruitment of younger scallops has occurred in this area. Following the 2014/15 season, future harvest opportunity in the Alaska Peninsula Area east of Unimak Bight will be based on review of age composition and fishery performance data from the 2014/15 harvest.

Table 3-13 Alaska Peninsula scallop fishery summary statistics, 1993/94 – 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	8	NA	112,152	1,847	61	
1994/95	7	NA	65,282	1,664	39	
1995/96		closed				
1996/97	2	200,000	12,560	327	38	136
1997/98	4	200,000	51,616	1,752	29	703
1998/99	4	200,000	63,290	1,612	39	794
1999/00	5	200,000	75,535	2,025	37	1,087
2000/01	3	33,000	7,660	320	24	83
2001/02		closed				
2002/03		closed				
2003/04		closed				
2004/05		closed				
2005/06	0	20,000	0			
2006/07	2	25,000	155	64	2	15
2007/08	0	10,000	0			
2008/09		10,000	2,460	151	16	75
2009/10		closed				
2010/11		closed				
2011/12		closed				
2012/13[b]	1	15,000	15,040	255	59	541
2013/14[b]	1	15,000	15,155	247	61	325
2014/15[b,c]	2	15,000	15,000	291	52	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 9.2% from observer experiments.

[b] Exploratory fishery in Unimak Bight District prosecuted under ADF&G Commissioner's Permit.

[c] PRELIMINARY data subject to change.

In March 2012, the Alaska Board of Fisheries modified closed waters for scallops (5 AAC 38.425) by opening an area south of Unimak Bight in the Alaska Peninsula Area to directed scallop fishing under the authority of a commissioner's permit. This area was closed to scallop fishing in 1975 due to declining red king crab stocks. Scallop fishing historically occurred in this area prior to the 1975 closure, however, catch records are unreliable.

An exploratory GHL of 15,000 lb was established for the 2012/13 season in Unimak Bight. The remainder of the Alaska Peninsula Area remained closed to scallop fishing. One vessel harvested 15,040

lb of scallop meats with a CPUE of 59 lb/hr (Table 3-13, Figure 3-29). The vessel fished continuously except when modifying or repairing gear, in cases of severe weather, or when running to a different fishing area. Dredge tow paths consisting of horseshoe, J shaped, and half circles were generally made on known beds, while straight line tows were used to explore. Exploratory tows were made along the 50 fathom depth contours, as well as into adjacent shallower and deeper depths to roughly define bed boundaries. In total, 248 hauls, using 255 dredge hours, were made and the total harvest was 15,040 lbs. of shucked scallop meats from 357,009 retained scallops.

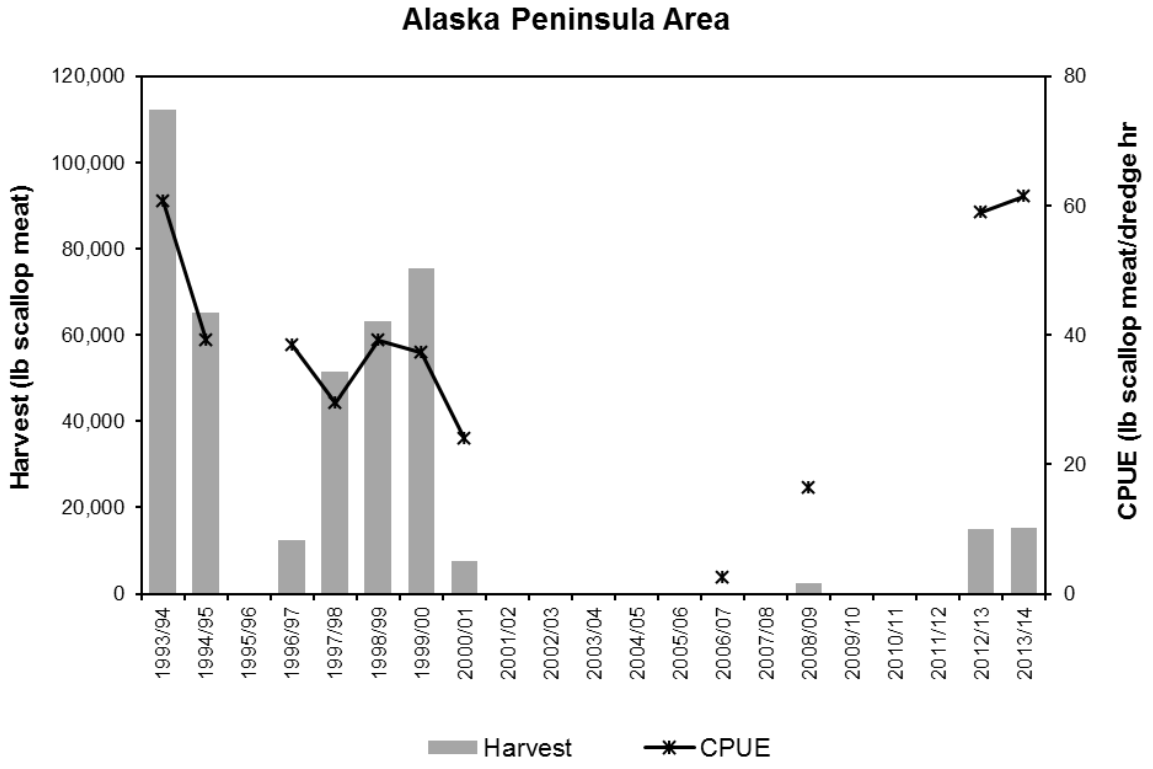


Figure 3-33 Alaska Peninsula harvest and CPUE, 1993/94 - 2013/2014 seasons.

With two observers aboard the vessel, each working a 12 hour shift, 77 hauls (31%) were sampled for scallop catch and crab bycatch. A subset of 39 of the 77 sampled hauls, or 51%, were additionally sampled for haul composition. The results of the sampling effort provided an estimated total retained scallop round weight of 205,950 lbs., with 29,382 round pounds estimated to have been discarded. Discards accounted for about 12.5% of the catch, with 3.4% intact at discard, and 9.1% having broken shells at discard. Shell height measurements of 1,342 retained scallops ranged from 125mm to 170mm, while shell heights of 887 discarded scallops ranged from 65mm to 130mm (Figure 3-30). Visual shell aging indicates that there may be three fairly distinct age groups in the Unimak Bight area: one group that is 3 to 5 years old, a group that is 6 to 9 years old, and a third group that is 12 to 17 years old.

During the 2013/14 season one vessel harvested 15,155 pounds of scallops for a CPUE of 61 lb/hr (Table 3-13, Figure 3-29). Given the limited history of scallop fishing in this area, meaningful comparisons of fishery performance or stock status over time are unavailable. However, preliminary shell height and age data (Figure 3-30), indicate the stock has a broad range of age classes with ages 7-10 most represented in the sampled catch.

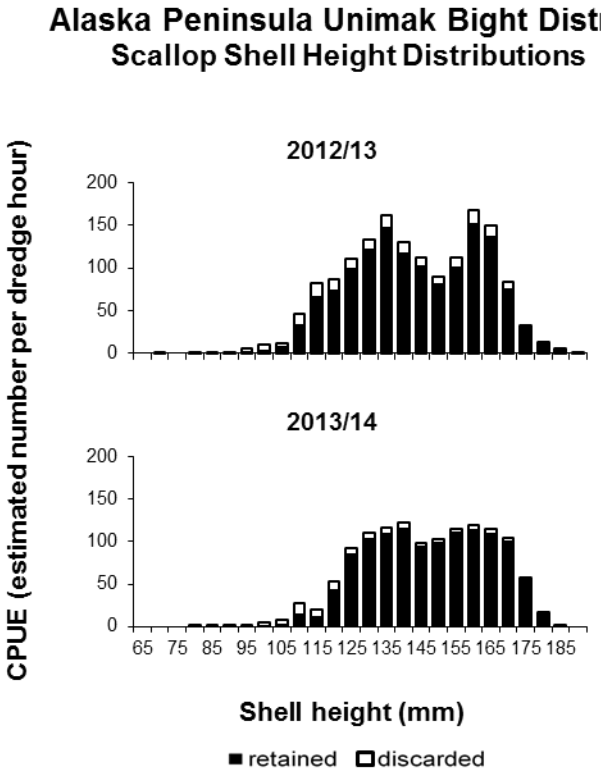


Figure 3-34 Estimated shell height distributions from the exploratory 2012/13 - 2013/14 Alaska Peninsula Unimak Bight District scallop fisheries.

3.10 Bering Sea Registration Area

Prior to the 1996/97 season, weathervane scallop fisheries in the Bering Sea Registration Area (BSRA) were unconstrained by a GHL (Table 3-14). Once established, early GHL ranges were set with upper bounds of 400,000 to 600,000 lb of shucked scallop meat. Annual harvests never exceeded half the upper bound of the GHL range. Through the 1990s, the BSRA was often closed in-season due to reaching Tanner crab bycatch limits.

Table 3-14 Bering Sea Area scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	9	NA	284,414	5,764	49	
1994/95	8	NA	505,439	11,113	45	
1995/96		closed				
1996/97	1	600,000	150,295	2,313	65	296
1997/98	2	600,000	97,002	2,246	43	699
1998/99	4	400,000	96,795	2,319	42	2,330
1999/00	2	400,000	164,929	3,294	50	1,249
2000/01	3	200,000	205,520	3,355	61	1,789
2001/02	3	200,000	140,871	3,072	46	1,393
2002/03	2	105,000	92,240	2,038	44	1,008
2003/04	2	105,000	42,590	1,020	42	627
2004/05	1	105,000	10,050	275	37	103
2005/06	1	50,000	23,220	602	39	318
2006/07	1	50,000	48,246	1,138	42	995
2007/08	2	50,000	49,995	1,084	46	901
2008/09	1	50,000	49,995	962	52	1,067
2009/10	1	50,000	48,855	1,275	38	1,059
2010/11	2	50,000	50,100	971	52	1,336
2011/12	2	50,000	50,275	984	51	563
2012/13	1	50,000	50,045	943	53	716
2013/14	2	50,000	49,989	1,086	46	400
2014/15[b]	2	50,000	12,445	526	24	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 9.1% from observer experiments.

[b] *PRELIMINARY data subject to change.*

The upper bound of the BSRA weathervane scallop GHL was adjusted downward to 200,000 lb beginning with the 2000/01 season (Figure 3-31). 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 lb of shucked scallop meat 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.

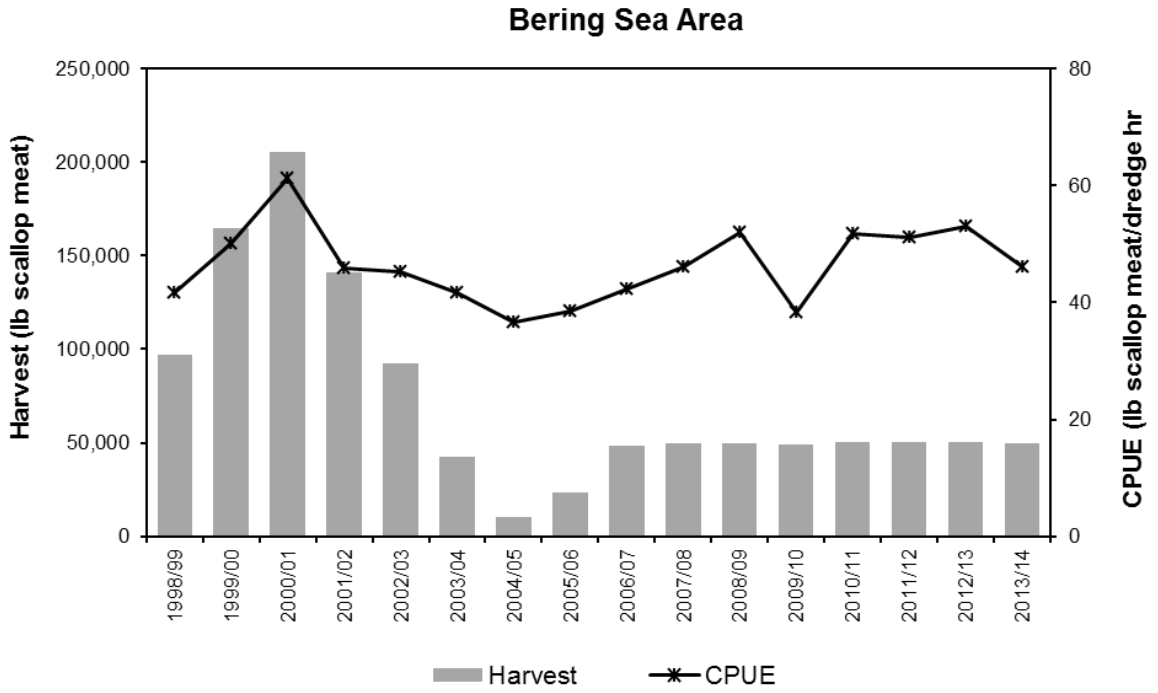


Figure 3-35. Bering Sea Scallop Harvest and CPUE, 1998/99 - 2013/14 seasons.

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 3-32).

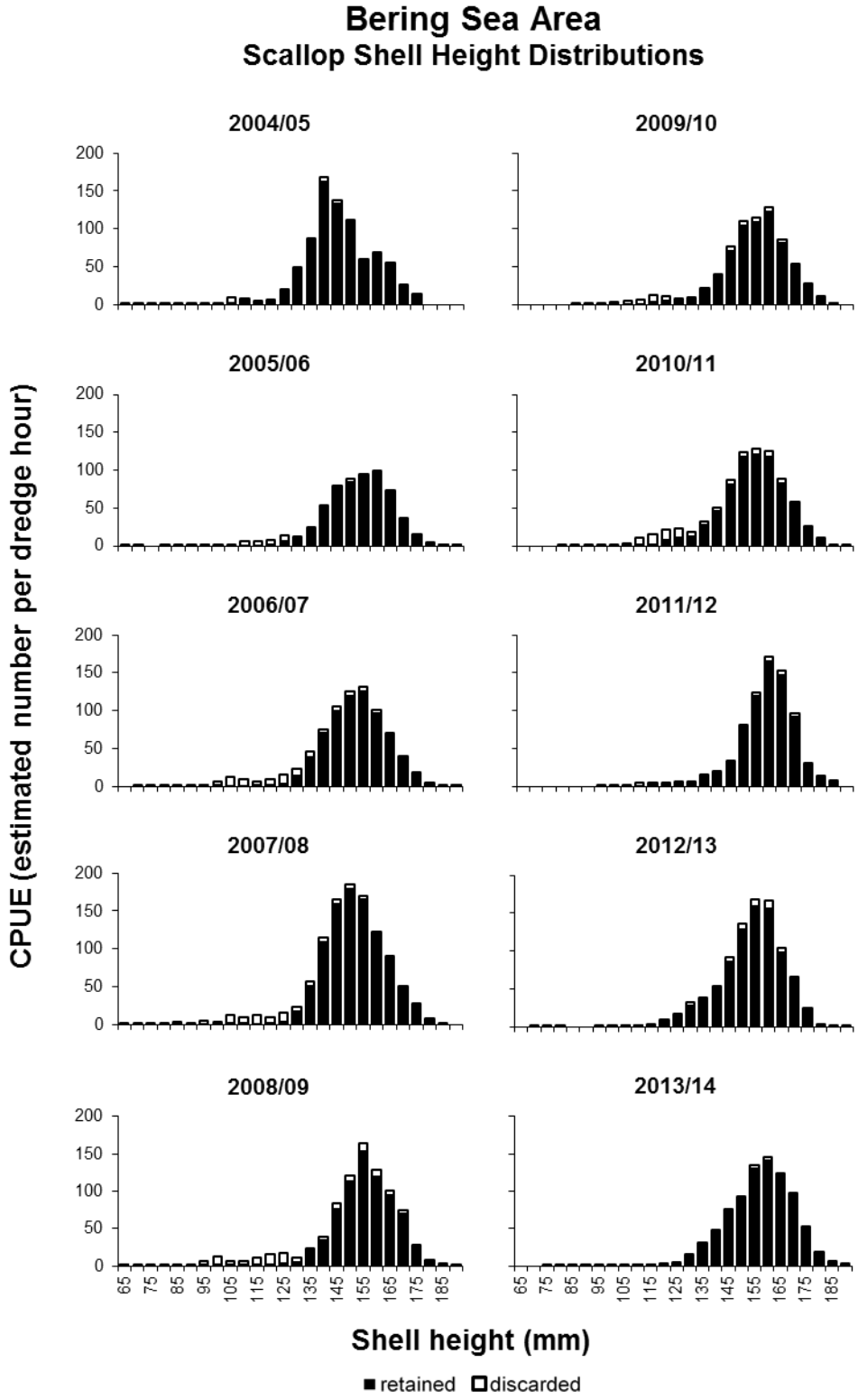


Figure 3-36. Estimated scallop shell height distributions from the 2004/05 - 2013/14 Bering Sea fishing seasons.

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 threshold below which the fishery would be closed. The threshold was set at the CPUE level of the 2002/03 season, or 44 lb/hr. The CPUE threshold was not met during both the 2003/04 and 2004/05 seasons thereby triggering fishery closures before the GHL was achieved.

Prior to the 2005/06 season, the upper bound of the GHL range was further reduced to 50,000 lb. Overall, since the mid-2000s, fishery performance has improved. Season average CPUE levels are above the threshold, the upper bound of the GHL range, which has been 50,000 lb since the 2004/05 season, is regularly met, and scallop shell-height data shows moderate recruitment (Figure 3-32). The current 50,000 pound GHL upper bound appears to be sustainable under prevailing conditions.

CPUE data may be skewed by fleet behavior and weather effects, and, in the BSRA, may be influenced by crab bycatch rates. Incidental catches of *Chionoecetes* crabs in the BSRA have remained below established limits in recent years, but concerns about both *Chionoecetes* and red king crab bycatch rates occasionally alters fleet behavior. In a measure to protect red and blue king crab in the Bering Sea, large portions of the eastern Bering Sea shelf and the Pribilof Islands Habitat Conservation Area are closed to scallop fishing to provide for habitat conservation.

For the 2013/14 season, a GHL of 50,000 lb shucked scallop meat was established for the BSRA. Two vessels completed a total of 719 tows, harvesting 49,989 lb scallop meat with a CPUE of 46 lb/hr (Table 3-14).

Observers measured shell height of 3,875 retained and discarded scallops during the 2013/14 season. Retained scallops were between 110 mm and 198 mm shell height (Figure 3-32).

Observers sampled 161 (22%) of the tows. From these data, an estimated 400 lb meat weight of scallops was discarded; discards accounted for about 0.8% of the total catch. Estimated bycatch during the season was 30,204 Tanner crabs from a cap of 65,000 crabs and 11,546 snow crabs from a cap of 300,000 (Table 2-5). Additionally, 19 red king crabs from a cap of 500 crabs were incidentally caught during the season.

3.11 Dutch Harbor Registration Area

The first landings of weathervane scallops from the Dutch Harbor Registration Area (DHRA) occurred in 1982; however, GHL ranges were not established until 1993. The initial DHRA GHL range was zero to 170,000 lb of shucked scallop meat and was lowered to a range of zero to 110,000 lb of shucked scallop meat for the 1998/99 and 1999/00 seasons (Table 3-15; however, the DHRA scallop fishery failed to meet preseason performance expectations, 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 GHL range.

Table 3-15 Dutch Harbor Area scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours[a]	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	2	170,000	38,731	838	46	
1994/95	3	170,000	1,931	81	24	
1995/96	1	170,000	26,950	1,047	26	
1996/97		170,000				
1997/98	1	170,000	5,790	171	34	402
1998/99	4	110,000	46,432	1,025	45	636
1999/00	1	110,000	6,465	273	24	93
2000/01		closed				
2001/02		closed				
2002/03	1	10,000	6,000	184	33	94
2003/04		closed				
2004/05		closed				
2005/06		closed				
2006/07		closed				
2007/08		closed				
2008/09	1	10,000	10,040	225	45	706
2009/10	1	10,000	6,080	104	59	45
2010/11	1	10,000	5,640	83	68	70
2011/12	1	10,000	5,570	77	73	56
2012/13	1	5,000	5,100	64	79	59
2013/14	1	5,000	5,225	56	94	96
2014/15[b]	1	5,000	5,160	74	70	NA

[a] Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.8% from observer experiments.
[b] *PRELIMINARY data subject to change.*

ADF&G closed the DHRA to commercial fishing for weathervane scallops for the 2000/01 and 2001/02 fishing seasons. The DHRA was reopened in 2002/03 with a GHL range of zero to 10,000 lb of shucked meat. Managers established that the fishery would be closed in season if preseason expectations of catch rate, effort distribution, and overall harvest were not met. The 10,000 pound upper bound was created to provide sufficient economic incentive for industry to 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 seasons to allow for stock rebuilding.

The DHRA was reopened to commercial fishing for weathervane scallops during the 2008/09 season with a GHL range of zero to 10,000 lb of shucked scallop meat, the same as that applied in setting the 2002/03 GHL. Fishery performance improved during the 2008/09 season (Figure 3-33): the upper limit of the GHL 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.

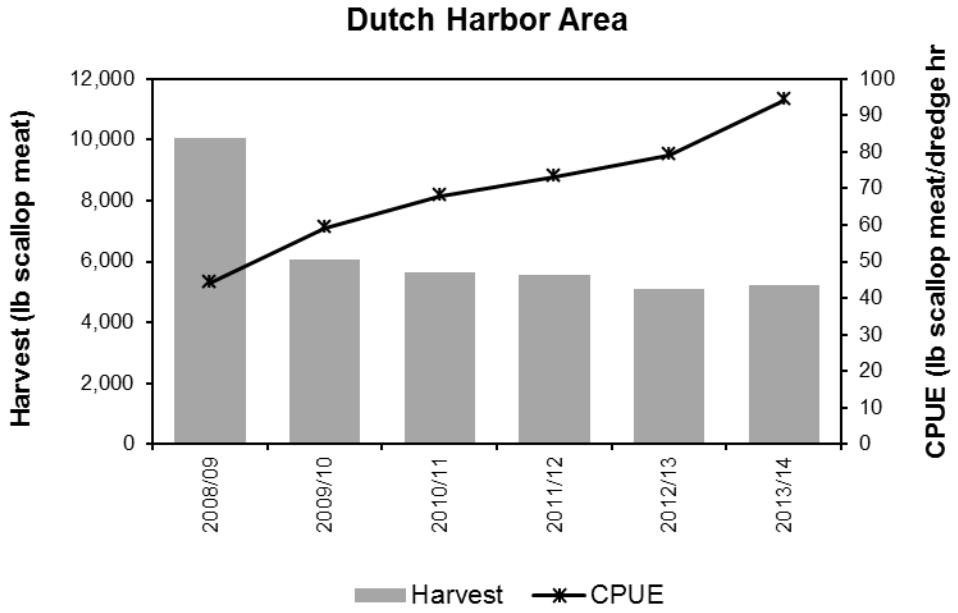


Figure 3-37. Dutch Harbor Area Scallop Harvest and CPUE, 2008/09 - 2013/14 seasons.

Based on positive results of the 2008/09 season, ADF&G set a 2009/10 GHL range of zero to 10,000 lb of shucked scallop meats for the DHRA. Fishery information suggests that scallop beds in the DHRA are small and isolated, so the 2009/10 GHL was set with the limitation that no more than 5,000 lb of shucked scallop meat could be taken from either waters of the Bering Sea or Pacific Ocean. 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 season was among the best on record; however, catches were sporadic in Pacific Ocean waters. The 2010/11 and 2011/12 seasons GHLs was again 10,000 pounds split evenly between the Bering Sea and Pacific Ocean. One vessel participated in each season on both sides. Approximately 5,600 lb were harvested each season with 90% of the harvest coming from the bed outside of Inanudak Bay on the Bering Sea side. Additionally, CPUE ranged from 73 to 95 lb/hr in the Bering Sea but peaked at 34 lb/hr in the Pacific Ocean.

Due to the poor fishery performance in the Pacific Ocean, ADF&G implemented a 3-yr closure on the Pacific Ocean side. For the 2012/13 to 2014/15 seasons, the DHRA GHL for the Bering Sea side was 5,000 lb of shucked scallop meats. One vessel participated each season. The 2013/14 harvest was 5,225 pounds with a CPUE of 94 lb/hr, the highest CPUE for the DHRA. All harvest from 2012/13 to 2014/15 came from the same bed outside Inanudak Bay. (Table 3-15, Figure 3-33).

The onboard observer sampled 6 (21%) tows during the 2013/14 season. Estimates from observer data show 96 lb of scallop meats discarded (1.8% discard rate). Estimated bycatch during the season was 189 Tanner crab from a cap of 10,000 crab.

Bering Sea – Inanudak Bay
The onboard observer measured 120 retained and 108 discarded scallop shells from the 2013/14 season. Retained scallops were 135 to 184 mm shell height. Average shell height of retained and discarded scallops was 161 mm and 127 mm, respectively (Figure 3-34).

Pacific Ocean
Closed for the 2013/14 season.

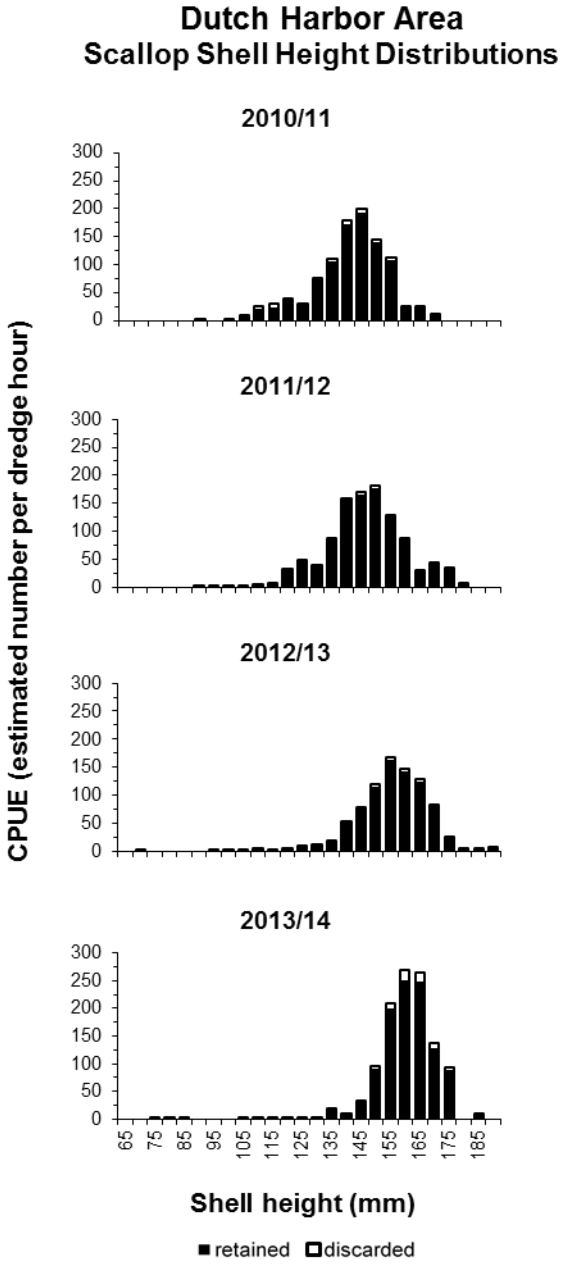


Figure 3-38 Estimated scallop shell height distributions from the 2010/11 - 2013/14 Dutch Harbor Area, Bering Sea side, fishing seasons

3.12 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, along 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 51º 30' N latitude and 54º 30' N latitude, and between 179º W longitude and 179º E longitude were closed to commercial scallop fishing in 1991.

Limited 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 lb 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 Component

In conjunction with the proposed amendment to the Scallop FMP to comply with ACL requirements, a new category is to be created within the FMP for the 'Ecosystem Component"(EC). The non-target scallop stocks (pink, rock and spiny scallops) are to be moved into this EC under the FMP. Stocks contained under this category of the FMP are intended to be stocks which are not the subject of a directed fishery. For these stocks ACLs are not required to be annually specified.

While these stocks are currently not targeted commercially, moving them to the ecosystem component would be intended to discourage uncontrolled fishing on these species without applicable management measures in place should they become economically viable in the future. There is currently is a low-level personal use/subsistence fisheries for some of these species.

The EC species may be identified at the species or stock level, and may be grouped into complexes. Determination of conformity to the above criteria may require more in-depth analysis, with contributions by ADF&G and NMFS, than is provided in this document. In addition, a periodic assessment of these non-target stocks would be beneficial. The EC species may be included in an FMP or FMP amendment for any of the following reasons:

> "…for data collection purposes; for ecosystem considerations related to specification of OY for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem

> issues. While EC species are not considered to be "in the fishery," a Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored on a regular basis, to the extent practicable, to determine changes in their status or their vulnerability to the fishery. If necessary, they should be reclassified as in the fishery."

Limited data exists currently to assess the spatial extent or biomass of these non-target scallop stocks. No commercial harvests have been documented for scallop species other than weathervane scallops in waters off Alaska since at least 1992 (C. Russ, ADF&G, Homer, pers. Comm.). Major fishery development is not anticipated for non-weathervane scallops but market potential does exist for both "pink and rock" scallops. The spatial distribution of non-weathervane scallop species is not well defined, although these species currently compose a relatively minor component of catches in both NMFS and ADF&G surveys. In conjunction with the EA for amendment 12, data on capture of non-target scallop species was derived from ADF&G and NMFS trawl surveys for the years 1998–2008 (M. Stichert, ADF&G, Kodiak; M. Spahn, ADF&G, Homer; and R. Foy, NMFS, Kodiak, all pers. comm.). Trawl surveys are conducted in Region 1 only by NMFS and in Regions 2 and 4 by both ADF&G and NMFS. Among all ADF&G surveys, all non-target scallops were recorded as *Chlamys* sp. Although data extrapolated to area-swept estimates were not available for the ADF&G surveys, and these trawl surveys are not designed to assess non-target scallop species, surveys catches of non-target scallops were relatively minor (Table 4-1). Data on non-target species was summarized according to whole weight (lb). In Region 1, catches of non-target scallops by the NMFS survey in odd-numbered years from 1999 to 2007 averaged 1 lb annually. For Region 2, ADF&G catches among either annual trawl surveys averaged 22 lb (whole weight; CV = 84%) annually, ranging from <1 to 53 lb, whereas NMFS surveys caught an average of 4 lb annually. For Region 4, annual catch of *Chlamys* among ADF&G trawl surveys ranged from 3 to 109 lb, averaging 35 lb (CV = 97%), whereas NMFS survey catches averaged 70 lb (CV = 50%) annually.

Table 4-1 Annual biomass (whole pounds) of non-target scallops captured in ADF&G and NMFS surveys within ADF&G management region during 1998-2008.

	Region 1		Region 2				Region 4		
Year	NMFS Trawl	Region Total	ADF&G Dredge	ADF&G Trawl	NMFS Trawl	Region Total	ADF&G Trawl	NMFS Trawl	Region Total
Non-target scallop species									
	Survey Catch (whole pounds)								
1998			NA	46		46	75		75
1999	1	1		6	10	15	68	36	105
2000				33		33	109		109
2001	0	0		53	2	55	23	32	55
2002				15		15	19		19
2003	2	2		12	2	13	33	96	129
2004				38		38	11		11
2005	3	3		10	3	14	3	111	114
2006				18		18	20		20
2007	0	0		7	2	9	15	77	92
2008				<1		<1	8		8
Total	5	5		238	18	257	384	352	736
Mean	1.0	1.0		21.7	3.7	23.3	34.9	70.3	66.9
CV (%)	55.1	55.1		24.9	43.0	22.2	29.3	22.4	20.8

[a] Meat weight based on a median meat recovery of 10% statewide.
[b] Discard mortality assumes a 20% mortality on scallops that were captured, but nor retained.

Additional information will be included in the SAFE report on these non-target stocks as it becomes available. Any recorded catch of these species will be recorded in order to best evaluate retention of these species in conjunction with their vulnerability and potential for directed targeting. Should a target fishery becomes desirable for any of these species, either as a whole complex or by individual stock grouping, an FMP amendment would need to be initiated by the Council to move the stock 'into the fishery' under the FMP and ACLs annually specified.

4.2 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.

4.3 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 2-1). 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, starfish, shell boring worms and sponges may also be scallop predators. Twenty-arm sea stars and giant octopus are known predators of weathervane scallops.

Bycatch: Scallop fishery bycatch is closely monitored by the onboard observer program (see Section 2.3). 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 *Pycnopidia helianthoides* (4%), natural debris (kelp, wood, etc., 3%), and several species of skates (2%). A summary of results of select species encountered during scallop observer haul composition sampling (% by weight) during the 2013/14 season is shown in Table 4-2.

Table 4-2 Summary of results from scallop observer haul composition sampling (% by weight) during the 2013/14 season.

Area/District	weathervane scallops	shells/ debris	sea stars	skates [b]	flatfish	basket/ brittle stars	*Chionoecetes* crabs [c]
Yakutat District	80.7	7.2	4.3	2.1	2.1	1.4	0.1
Yakutat District 16	77.6	11.1	3	2	2.2	0.3	0.1
Kodiak Northeast District	69.7	5.1	11.9	2.6	6.2	0.4	0.3
Kodiak Semidi Islands District [a]	0	26.6	7.5	11.7	45.9	2.1	4.3
Kodiak Shelikof District	67.6	14	4.6	7.1	3.2	0.1	0.3
Kodiak Southwest District [a]	69.6	3.9	0.1	9.2	6.9	5.8	1.1
Alaska Peninsula Unimak Bight District [a]	90.1	2.9	0.3	0.4	2.4	1.2	0.5
Dutch Harbor Area	80.3	7.3	2.8	0	1.5	4.9	0.1
Bering Sea Area	80.7	1.4	0.1	3.6	2.5	0.5	5.9
Statewide Total	75.8	7.6	4.7	3.7	3.2	0.9	1.1

[a] Exploratory fishery prosecuted under ADF&G Commissioner's Permit.
[b] Includes all species skates plus all skate egg cases.
[c] Includes snow crab, Tanner crab, and snow crab × Tanner crab hybrids.

4.4 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 4-1), 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 4-2), 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 4-3.

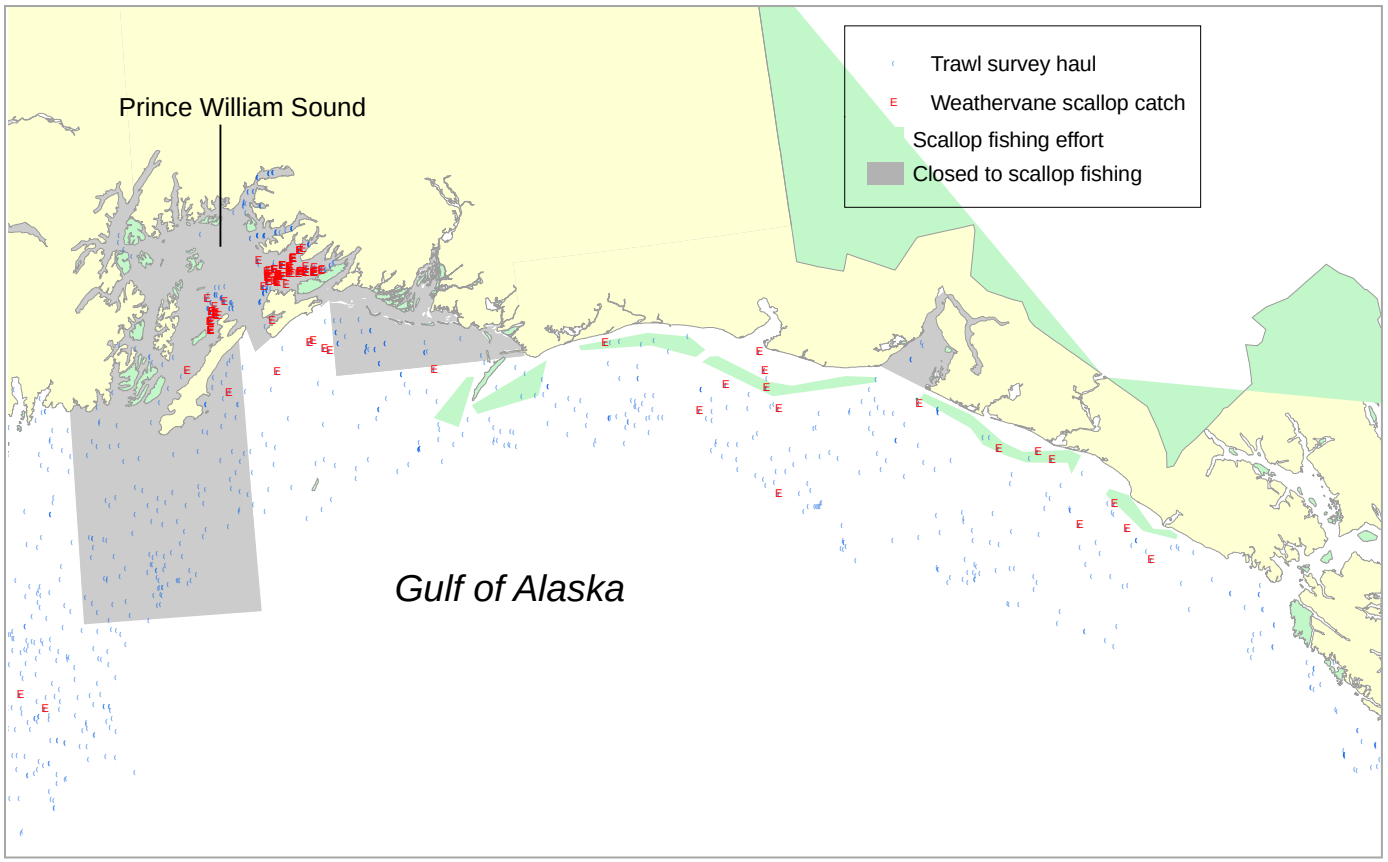


Figure 4-1 Map showing trawl survey haul locations (blue circles), survey locations with weathervane scallop catch (red crosses) in the eastern Gulf of Alaska, 2001-2010.

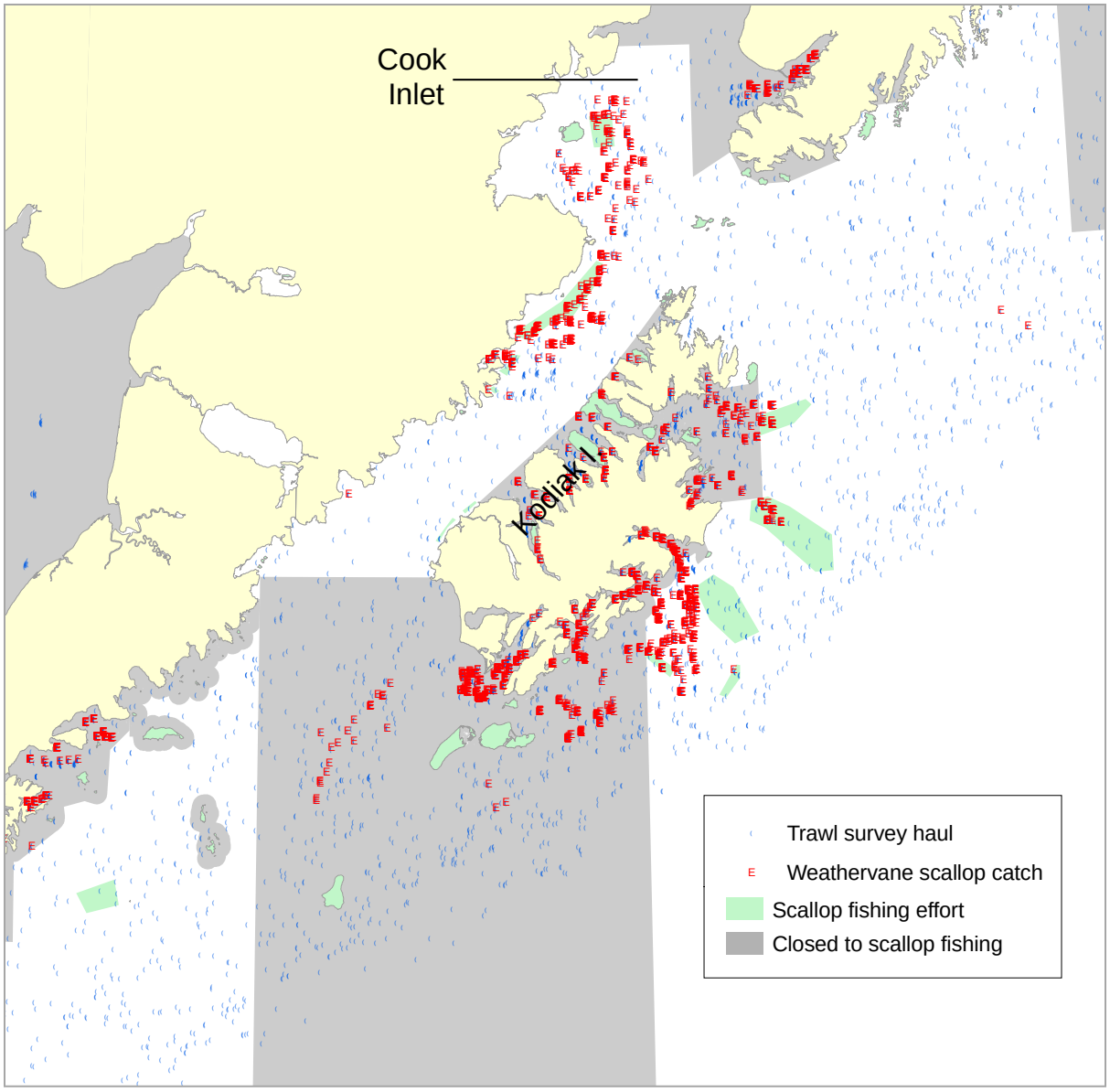


Figure 4-2 Map showing trawl survey haul locations (blue circles) and locations with weathervane scallop catch (red crosses) in the Lower Cook Inlet and Kodiak Island vicinity, 2001-2010.

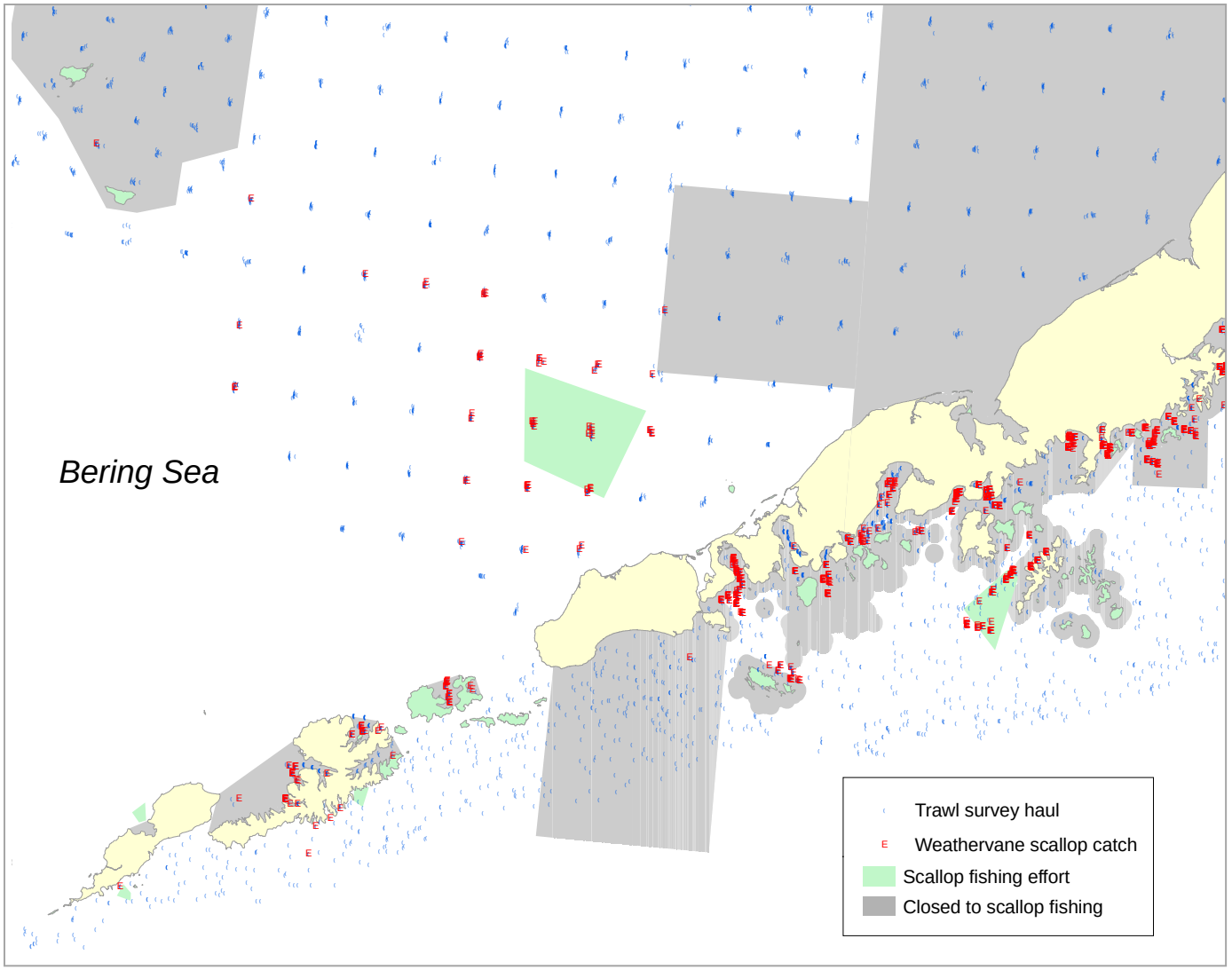


Figure 4-3 Map showing trawl survey haul locations (blue circles) and locations with weathervane scallop catch (red crosses) in western Alaska, 2001-2010.

5 Economic Overview of the Scallop Fishery

An overview of Alaska weathervane scallop harvest and wholesale revenue is presented in Table 5-1. The underlying data used to calculate fishery economic value is 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 association. The Federal LLP limits the participation to 9 permit holders. Since 2000, no more than 8 vessels have participated, and in recent years no more than 4 vessels have participated.

Table 5-1 provides the statewide average price per pound of landed scallop meats, as well as an inflation adjusted price and total value. Inflation adjustment is made to 2013 values using the Producer Price Index for Intermediate Commodities tabulated by the U.S. Bureau of Labor Statistics[1]. 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 2013 values to allow for comparisons in current dollar values, after accounting for inflation.

The majority of the scallop meats that are landed have been processed (shucked) and frozen at sea and their value represents gross revenue at the first wholesale level. However, some shucked meats are delivered fresh to dockside processors who then freeze and market the scallops at the first wholesale level (pers. comm, Bill Harrington, February 2013). Thus, although landed price is often referred to as an ex-vessel price, 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 gross revenue here. 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 State fish tax revenue collected from all participants in the scallop fishery through 2012.

Nominal Alaska scallop prices have shown considerable variability over time and have increased dramatically in recent years. After trending downward to $5.25 per pound in the early to mid-2000s, nominal scallop prices increased to $7.86 by the 2006/07 season. However, in the 2007/08 season the nominal scallop price declined significantly to $5.94 per pound of shucked meats. Since the 2007/08 season, nominal scallop price has increased in each year and reached $10.63 per pound of shucked meats in 2013. The historical variability in Alaska scallop prices are likely due to market factors that are driven by the much larger U.S. east coast sea scallop fishery, as well as by import markets. However, in recent years, the Alaska Scallop Association has made considerable progress in its marketing efforts and has been able to maintain an upward trend in the prices it receives for the scallops landed by the three vessels that are associated with the cooperative. The present strength in Alaska scallop prices is expected to continue, and may be enhanced by market forces as landings of east coast scallops are expected to decline in the coming years (pers. comm, Jim Stone, February 2013). Operators of the fourth vessel presently fishing Alaska scallops report receiving a price similar to the statewide average price for 2012 (pers. comm, Bill Harrington, February 2013).

Adjusted price has fluctuated considerably during the past. After trending upwards from $8.86 in 1993/94 to $10.62 in 1998/99, adjusted price then fell to $7.43 in 2004/05, rebounded to $9.59 by 2006/07, and then fell to $6.65 in 2007/08. Since 2007/08, adjusted price has trended upwards along with nominal price.

1 SOURCE: http://data.bls.gov/pdq/SurveyOutputServlet

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 inflation adjusted $11.7 million was earned. Since that time, real total first wholesale revenue in the fishery has fluctuated with prices, and the reduction in landed pounds. Overall, the total value has trended downward as landings have fallen from more than 1.2 million lb down to a low in 2008/09 of 342,434 lb. The total real first wholesale revenue of a little more than $2.5 million in the 2008/09 season was the lowest revenue total since 1993; however, with increased prices in recent years the total revenue increased to $4.7 million in 2011/12, and $4.4 million in 2012/13.

Table 5-1 Statewide Commercial Weathervane Scallop Real Wholesale Value, 1993/94—2012/13.

Year	Vessels	Catch (lb. shucked meats)[a]	Nominal Average Price/lb.	Inflation Factor[b]	Real Average Price/lb	Real Wholesale Value
1993/94	15	984,583	$5.15	1.72	$8.86	$8,721,436
1994/95	15	1,240,775	$5.79	1.63	$9.44	$11,710,062
1995/96	10	410,743	$6.05	1.6	$9.68	$3,975,992
1996/97	9	732,424	$6.30	1.58	$9.95	$7,290,548
1997/98	9	818,913	$6.50	1.61	$10.47	$8,569,925
1998/99	8	822,096	$6.40	1.66	$10.62	$8,733,948
1999/00	10	837,971	$6.25	1.59	$9.94	$8,327,337
2000/01	8	750,617	$5.50	1.52	$8.36	$6,275,158
2001/02	6	572,838	$5.25	1.6	$8.40	$4,811,839
2002/03	6	509,455	$5.25	1.53	$8.03	$4,092,197
2003/04	4	492,000	$5.25	1.47	$7.72	$3,797,010
2004/05	5	425,477	$5.50	1.35	$7.43	$3,159,167
2005/06	5	525,357	$7.58	1.24	$9.40	$4,937,936
2006/07	4	487,473	$7.86	1.22	$9.59	$4,674,476
2007/08	4	458,313	$5.94	1.12	$6.65	$3,049,065
2008/09	4	342,434	$6.34	1.16	$7.35	$2,518,397
2009/10	3	488,059	$6.48	1.11	$7.19	$3,510,511
2010/11	3	459,759	$8.35	1.05	$8.77	$4,030,937
2011/12	4	451,183	$10.39	1	$10.39	$4,687,791
2012/13	4	417,551	$10.63	1	$10.63	$4,438,567

[a] Lb of shucked scallop meats are reported by the State Observer Program.

[b] inflation adjustment uses the Bureau of Labor Statistics, Intermediate Commodities Producer Price Index through 2013. Note that there was an imperceptible, at two decimal places, change in the PPI between 2012 and 2013.

Crew Usage and Wages

Scallop vessels in the Alaska Weathervane Scallop fishery are allowed, by State of Alaska regulation, to carry 12 crew including the skipper. In the past, prior to formation of the scallop cooperative and when many more vessels participated, it was commonplace for vessels to carry the maximum allowed crew. This was largely due to the fact that, even under the license limitation program, there was still a "race for

fish" approach of attempting to capture as much of the unallocated GHL as possible in the shortest time possible. To do this, a vessel would use the full complement of crew allowed by regulation in order to speed up the processing time (shucking, freezing, and packaging) and allow continued deployment of the gear, especially in instances of high CPUE. (Pers. Comm. Jim Stone and Brendan Harrington, March 2012)

The formation of the scallop cooperative, along with declining CPUE in several areas has had some impacts on crew positions. The scallop cooperative reports that they will vary the number of crew they carry depending on their expectations of fishing conditions. Essentially, if they feel that the pace of fishing will slow, on any given trip, they may carry anywhere between 8 and 12 crew. The one non-cooperative vessel in the fleet, the Kilkenny, is presently fishing the Kamishak Bay beds, when open, and areas near Kodiak Island. They are delivering fresh shucked meats to buyers in Homer and Kodiak and indicate that, since they are not freezing their product at sea, they can fish with as few as 3 crew but usually take 4 or more (pers. comm, Bill Harrington, February 2013). Thus, the current Alaska scallop fishery is likely using fewer crew due to the efficiency gains they have created through the cooperative and through the ability of the Kilkenny to sell fresh product.

Crew wages in the present fishery are undoubtedly less, in the aggregate, than they would have been as a share of total revenue in the past. What is not clear; however, is whether individual crew shares have increased for those who continue to work in the scallop fishery. Improved efficiency and reduced numbers of crew on a vessel create the opportunity to have increased crew shares; however, there is no economic data collection program in the scallop fishery that could be used to confirm this possibility.

Participants were asked to voluntarily submit information on the percent of total revenue paid to crew during the 2012/13 season. However, three quarters of the present participants declined to provide crew payment data due to the information being highly proprietary to each fishing business. One operator did provide an estimate of crew wages paid; however, this information is somewhat unique to that fishing operation and not necessarily indicative of crew wage percentage for the entire fishery. Further, were that information divulged here, it would allow a straightforward back calculation of total revenue earned by that operation, which could then be used to calculate landed pounds. Since that operation delivers product to two processors in two ports, divulging information that could then be used to calculate landed pounds delivered to fewer than three processors would violate confidentiality restrictions. Thus, it is not possible to address current crew compensation, or changes in crew compensation, with existing sources of data.

Port of Landing and Impacts on Communities

At the present time all Alaska scallop harvests are landed in ports within Alaska. The vessels that fish within the Alaska Scallop Association make landings of frozen product in several ports including, but not limited to, Dutch Harbor, Kodiak, Yakutat, Juneau, and Sitka (pers. comm, Jim Stone, February 2013). Given that these landings are often made by a single vessel in a port, these landings are confidential. In addition to the cooperative vessels, one vessel makes landings of fresh product in Homer and Kodiak. However, these landings are made to too few processors for the data to be released due to confidentiality restrictions. Thus, it is not possible to release landings by port. Furthermore, there is no economic data collection program in place to collect vessel expenditure data while vessels, and crew, are in port. Unfortunately, the limits of confidentiality and limited expenditure data make it difficult to establish the potential importance of this fishery to dependent communities.

There have been several developments in this fishery with regard to the permanent location of vessels and with maintenance and repair of these vessels. All three cooperative associated vessels, that are presently

fishing, are now permanently home ported in Kodiak. In addition, the one non-cooperative vessel presently fishing is also permanently home ported in Kodiak.

With the installation of a new 600 ton Marine Travelift, virtually all maintenance and repair work is now done in Kodiak (pers. comm, Bill Harrington and Jim Stone, Tom Minio, February 2013). Thus, at present, all landings of Alaska scallops are made in Alaska ports, all vessels presently operating in the fishery are home ported in Kodiak, Alaska, and the Port of Kodiak is able to provide the necessary facilities for haul out, repair, and annual maintenance that these vessels require.

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