Fishery Data Series No. 12-62

Assessment of Weathervane Scallops in Kamishak Bay and at Kayak Island, 2004 through 2010

by

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and

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October 2012

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 12-62

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ABSTRACT

Between 2004 and 2010, the Alaska Department of Fish and Game (ADF&G) conducted biennial area-swept surveys on weathervane scallops, *Patinopecten caurinus*, in Kamishak Bay in lower Cook Inlet, and at Kayak Island in the Gulf of Alaska (GOA). Survey objectives were to assess the abundance and biomass as well as the age and shell height composition of scallops on the north and south scallop beds in Kamishak Bay and on the east and west scallop beds at Kayak Island. Scallop abundance and biomass estimates for Kamishak Bay are lower from when the survey began in the mid-1990s; abundance and biomass on the Kamishak north scallop bed has been relatively stable since 2005 while the south bed has shown more variability over the same time period. While the south bed contains a greater number of young scallops, both beds are supported by a robust range of age classes ranging from 1 to 23 years of age. Scallop abundance and biomass estimates for the Kayak Island west bed is down relative to when it was first surveyed in the mid-1990s, while it has increased overall during that same time period in the east bed. Since 2004, scallop abundance and biomass at Kayak Island has decreased in both beds, more sharply in the west bed; however, both beds are supported by a robust range of age classes ranging from 1 to 23 years of age.

Key words: Weathervane scallop, *Patinopecten caurinus*, abundance, biomass, age, shell height

INTRODUCTION

Weathervane scallops, *Patinopecten caurinus*, are distributed in the northeast Pacific Ocean from Pt. Reyes, California north to the Pribilof Islands in the Bering Sea, and west to the Aleutian Islands, and occur from intertidal depths to roughly 300 m (Foster 1991). They are a long-lived species, attaining ages between 20 and 28 years in Alaska waters (Hennick 1973; Bechtol et al. 2009). Densities that support commercial harvest typically occur between 45 and 130 m on discrete aggregations (or beds) (Kruse et al. 2005), and in a wide variety of habitats ranging from rock and gravel to silt and mud (Hennick 1973). Scallop beds are typically elongated or elliptical in shape with an orientation in the direction of mean current flow (Kruse et al. 2000).

The weathervane scallop is a large scallop with prominent, heavy, widely spaced, smooth ribs, and valves that are wider than long and slightly convex. They 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. A ligament along the dorsal margin at the hinge holds the 2 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.

Scallops are dioecious, with males distinguished by white testes and females by red-orange ovaries (Hennick 1970). Gonads reach full maturity in mid-December to late January, and remain “ripe” until spawning. Broadcast spawning of spermatozoa and eggs occurs once each year, typically over a period of 3–4 days from May to July. Fertilized eggs settle to the substrate and hatch into larvae after several days. The larvae assume a pelagic existence, known as a veliger that uses velium, or cilia, to swim and feed (Mottett 1979). After approximately 3 weeks, veligers settle to the substrate where they move across it or attach with byssal threads. After 4–8 weeks, the nearly transparent juveniles develop an ability to swim, and after a few months shell pigmentation develops at a shell height of approximately 10–15 mm (0.5 inch). These juveniles feed on microscopic plankton. While it appears that growth rates and shell height at maturity

varies across the state, weathervane scallops in Alaska become sexually mature at around 3 or 4 years of age, equivalent to a shell height of approximately 76 mm (3 inch) (Hennick 1973; Kaiser 1986; Ignell and Haynes 2000). Recruitment to the commercial fishery typically occurs at around 100 mm shell height, although this may depend on the sorting of participating crew for their markets and/or size distribution of the scallops in a given bed. Regulation dictates that scallop dredges have 102 mm (4 inch) inside diameter escapement rings, allowing small scallops to escape. However, as the dredge bag fills, smaller scallops are usually retained. Typically, scallops less than 100 mm shell height are discarded while larger scallops are retained.

The stock structure of weathervane scallops in Alaska waters is not well understood, although some work has been done to elucidate polymorphic loci using microsatellite and nucleotide techniques (Elfstrom et al. 2005a, b). Because larvae are pelagic for a period of time, the genetic relationship between scallop beds across Alaska is not known. As such, it is unknown if scallops across the Gulf of Alaska consist of a single stock, and if so, what the dynamics are. A recent study attempting to assess genetic differentiation among scallop beds ranging 2,500 miles across the Gulf of Alaska and southeast Bering Sea using allozyme, microsatellite, and single nucleotide polymorphism sequencing methods found no isolation by distance. However, their study also concluded that the lack of genetic differentiation measured by neutral markers does not preclude the existence of locally adapted, self-sustaining populations that are important in their harvest management (Gaffney et al. 2010).

Statewide, exploratory fishing for weathervane scallops dates back to 1956; occurring around Yakutat and Kodiak Island (Hennick 1973; Hammarstrom and Merritt 1985). In 1967 and 1968, these commercial fisheries developed further and explorations for scallops began in Lower Cook Inlet (LCI; Hennick 1973; Hammarstrom and Merritt 1985). The Kamishak Bay scallop fishery began slowly until 1983 when commercial catch rates increased. Commercial catches increased throughout the 1980s and into the 1990s, peaking in 1993 and 1994. The fishery closed in Federal waters (open in State waters only) the following year, and based on previous fishery performance, it was determined that a fishery independent survey was necessary to estimate abundance and biomass – the initial survey occurred in 1996 when the fishery reopened (Bechtol et al. 2009). The Kayak Island scallop fishery did not develop until 1992. In 1995, the fishery harvested 50,000 pounds, its maximum allowable guideline harvest limit (GHL) under the scallop management plan. Following the fishery closure, a vessel neither licensed by the state of Alaska nor registered with the Alaska Department of Fish and Game (ADF&G) harvested 60,000 lb of weathervane scallop meat from federal waters off Kayak Island (Berceli and Brannian 2000). This fishing activity identified a previously undetected regulatory issue and NMFS subsequently closed all federal waters off Alaska to scallop fishing. Due to this unprecedented harvest, the Kayak Island scallop fishery remained closed in 1996 until federal regulations were amended. This also brought about the necessity for fishery independent surveys to be initiated in the area beginning in 1996. The survey area at Kayak Island expanded in 1998 to include a western bed. Both the east and west beds have been surveyed on a biennial basis since then.

Currently, commercial fisheries for weathervane scallops in southcentral Alaska occurs in the Kamishak Bay area of LCI and adjacent to Kayak Island near Prince William Sound (PWS; Berceli et al. 2003, Trowbridge and Bechtol 2003). These fisheries, beginning in 1983 at Kamishak Bay and 1992 at Kayak Island, occur mainly in federal waters but are managed by ADF&G, Division of Commercial Fisheries, Central Region, under oversight of a federal fishery

management plan (FMP; NPFMC 1995; NPFMC 2006). Management of these fisheries was historically based on inseason fishery performance (catch per unit effort; CPUE). In contrast to relying on fishery performance indicators as the primary management tool, Central Region's adoption of fishery independent dredge surveys for weathervane scallop assessments has substantially improved the ability to manage for sustained yield based on the underlying abundance and biomass of these resources (Bechtol and Bue 1998; Bechtol and Gustafson 2002; Bechtol 2003a,b; Bechtol et al. 2003; Gustafson and Goldman 2008; Bechtol et al. 2009).

Fishery-independent, area-swept, dredge surveys were initially conducted by ADF&G in Kamishak Bay and Kayak Island in 1984 and 1996, respectively (Hammarstrom and Merritt 1985, Bechtol 2003b), and have been conducted on a biennial schedule since 1996. These surveys enable ADF&G to (1) delineate the primary scallop beds in the 2 management areas; (2) better estimate scallop abundance and biomass within these beds; (3) define bed composition through age and shell height-at-age data; and (4) estimate bycatch rates of non-target species, particularly Tanner crab (Bechtol and Bue 1998; Bechtol 2000; Bechtol and Gustafson 2002; Bechtol 2003a,b; Bechtol et al. 2003). This report contains survey results on weathervane scallop abundance and biomass and information on the age and shell height composition of Kamishak Bay and Kayak Island scallop beds from 2004 through 2010. Results from 2005 to 2008 presented herein also appear in a NOAA research report by Gustafson and Goldman (2008).

The Cook Inlet and PWS registration areas (which contain the Kamishak Bay and Kayak Island scallop beds, respectively) are currently the only 2 management areas in Alaska where scallop abundance and biomass is assessed by fishery independent research surveys, and where the commercial scallop fishery is managed based on survey results. Survey results were used to set annual commercial fishery GHLs for Central Region scallop beds (see *Data Analysis* section below). Specific criteria used for setting GHLs included scallop biomass, abundance, age composition, and changes in these measures since the previous survey. Following discussions of recommendations between ADF&G research and management staff, GHLs (and Tanner crab bycatch limits) are finalized and announced through ADF&G news releases issued prior to the season opening for each respective harvest area.

OBJECTIVES

The goal of this project was to assess scallop abundance and biomass in Kamishak Bay and at Kayak Island in southcentral Alaska. Specific objectives were:

1) Determine weathervane scallop abundance, biomass, and age and shell height composition from fishery independent surveys.

2) Present findings and harvest recommendations to the Alaska Board of Fisheries and the North Pacific Fisheries Management Council as necessary.

STUDY AREAS

Weathervane scallops are found throughout Kamishak Bay District; however, the fished component of the population is aggregated in 2 limited areas, or scallop beds, located east and southeast of Augustine Island (Figure 1). The scallop bed occurs on relatively flat or gradually sloping bottom ranging from 30 to 90 m (16.5 to 50 fathoms) in depth with mud, sand, and pumice substrate interspersed with shale outcroppings. This area can experience severe weather conditions and fishing vessels are afforded little protection in the vicinity of the scallop beds.

Currents primarily run southerly as part of a counter-clockwise gyre running out of Cook Inlet, and maximum tidal exchanges can exceed 7 m (23 ft). Mud and glacial flour are common in the nearshore marine waters as outfall from glacial rivers located in Kamishak Bay and farther north in Cook Inlet.

The Kayak Island study area is located near Cape St. Elias on the southern end of Kayak Island in the Gulf of Alaska (Figure 2). This area is subject to severe weather conditions and large ocean swells. Coastal currents primarily run westerly as part of a counter-clockwise gyre in the northern Gulf of Alaska, and maximum tidal exchanges are typically less than 5 m (16.5 ft). Bottom substrate in the study area is primarily sand and pebbles with some rock and mud; rocky reefs are present near Cape St. Elias. Mud and glacial flour are common in the nearshore marine waters as outfall from glacial rivers located east of Kayak Island. Depth contours run from southwest to northeast, approximately parallel to the Kayak Island shoreline. Bottom depths in the scallop beds gradually slope from approximately 55 m (30 fathoms) in the northwest to over 110 m (60 fathoms) in the southeast.

METHODS

VESSELS AND GEAR

The state research vessel *Pandalus* conducted the weathervane scallop survey from 2004 through 2009. The *Pandalus* has an overall length of 20.2 m (66.0 ft), a displacement of 175.8 mt (173.0 long tons), and a 365 hp diesel main engine. The state research vessel *Solstice* conducted the 2010 Kayak Island survey. The *Solstice* has an overall length of 17.4 m (57 ft), a displacement of 127 mt (125 long tons) and a 550 hp main diesel engine. Survey staff typically included 4 biologists and 2 or 3 vessel crew members. Vessel tow speeds were approximately 7,420 m/h (4.0 nautical miles per hour; nmi/h), with a tow duration of approximately 15 min, and an average cable scope (ratio of tow cable to bottom depth) of 3:1 + 10 fathoms (= + 60 ft); the additional 10 fathoms was the recommended scope from Alaska commercial scallop fishermen as it provided them the best dredge performance (i.e., provided the best scope for keeping the dredge on the bottom. Dredge setting, tow, and retrieval occurred from about 0800 hours to 1700 hours each survey day.

All surveys were conducted with a 2.4 m (8 ft) dredge having a ring bag consisting of 10.2 cm (4.0 in) inside diameter rings. To facilitate retention of small scallops, the ring bag was fitted with a 3.8 cm (1.5 in) mesh liner. Dredge weight was approximately 816 kg (1,800 lb).

SURVEY DESIGN

Central Region conducts fishery-independent, area-swept, dredge surveys with a systematic sampling design using a random starting point. Sampling stations were defined by overlaying a checker-board grid of 1,855 m (1.0 nmi) squares over a chart of the study area (see Figures 1 and 2). Prior to 2010, a systematic design used every other station for sampling with the primary sampling unit (light or dark squares) randomly selected to give an equal probability of selecting either set of grid cells. Starting in 2010, we decided to alternately sample the black and white squares in each successive survey (i.e., one year white grid squares would be sampled and the next would be black). The vessel skipper, in cooperation with the project leader, determined the specific tow location within each sample station. The dredge was towed for a distance of approximately 1,855 m (1.0 nmi) within the sample station. To delineate the scallop bed margin, stations (light or dark) were added diagonally when catches along the edge of the initial sampled

stations catch exceeded a threshold level of 9.1kg (20 lb). The edge of a scallop bed delineated when catch in a given station was below the threshold amount. For animal populations with individuals that are randomly distributed, a single systematic sample provides good variance estimates. Because weathervane scallops have a patchy distribution and are not uniformly clustered within beds, a systematic sample tends to overestimate the population variance (Thompson 1992). However, similar to previous surveys (Bechtol and Bue 1998; Bechtol 2003a,b), equally distributing sampling effort across the survey area and achieving a delineation of weathervane scallop bed boundaries took precedence over variance precision.

The 2007 Kamishak Bay and 2008 Kayak Island surveys were set to standardized areas for the first time (see Figures 1 and 2). The survey designs enabled all previous survey data to be standardized to the new delineated area and therefore be comparable across all years. Each year of historical survey catch data was entered into ArcGIS with a polygon drawn around all stations where catch exceeded the threshold of 9.1 kg/nm (20 lbs). The standardized areas for all beds were based on all years of polygons overlaid in GIS, using the outside edges of all polygons to delineate the bed using only stations which met the 9.1 kg criterion. Very little change in polygon shape occurred over the years, making the area delineation relatively easy for each bed. Aware that scallop bed shape and size changes over time, we frequently conduct dredge tows in ancillary stations immediately adjacent to the delineated beds.

DATA COLLECTION

The vessel captain recorded the following information for each tow:

1. sequential tow number;
2. alphanumeric station code;
3. date;
4. start and stop locations (lat and long);
5. tow compass heading;
6. average vessel speed;
7. tow start and stop times;
8. distance towed;
9. maximum and minimum depths;
10. sea conditions;
11. scope;
12. gear performance.

Upon completion of each tow, catches were washed and separated into weathervane scallops, weathervane scallop shells, fish, Tanner crab, and other bycatch, including debris. Tanner crab were weighed in aggregate sampled for carapace width, shell condition, and sex. Fish were weighed in aggregate and enumerated by major species group. Debris, assorted invertebrates, and any remaining bycatch were weighed and their relative contribution visually estimated (e.g., 60% sea stars and 40% rocks). However, beginning in 2009 fish were separated by species, enumerated and weighed. In 2010 the remaining catch aggregate was weighed and an approximate 4 kg subsample was taken, separated by species or taxon, weighed and enumerated.

Weathervane Scallop Sampling

Total live weight and abundance of weathervane scallops, including broken shells with attached viscera, were recorded. Weathervane scallop shells and shell fragments without attached viscera were weighed and discarded. Empty weathervane scallop shells with both valves connected by an intact hinge ligament (referred to as “cluckers” or “clappers”), were retained, cleaned, measured for shell height, aged, labeled, and bagged for archival purposes.

Twenty weathervane scallops were randomly selected from each tow, weighed, and shucked aboard the vessel. Their meats (i.e., the large adductor muscle, referred to as the "quick" by the fishing industry) were placed into a container, and their dorsal shells were cleaned, labeled, measured, aged, and placed in storage for a second age determination in the lab. Several samples of immature weathervane scallops from each tow were also selected, shucked, cleaned, measured, aged, and stored to ensure representative shell height-at-age data from each survey bed. Shell heights of all weathervane scallops remaining from a tow were measured with an electronic board for constructing shell height frequency distributions. For some tows, a large scallop catch necessitated that only a subsample of the scallops be measured for shell height with the remaining scallops discarded after collecting weight and abundance.

In order to estimate meat weight yield per bed to set harvest limits from, fresh weathervane scallop meat recovery was estimated each day from whole weight of the twenty scallops sampled from each tow and the weight of their shucked meats. Mean fresh meat recovery was estimated as the sampled pooled meat weight divided by the sampled pooled whole scallop weight. Meat weight recovery was then multiplied by the population estimate providing a population meat value to which a harvest rate was applied for setting the commercial fishery harvest limits.

Age of Central Region scallops is determined by visually observing 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 were resolved through re-aging and agreement by multiple age readers. If agreement cannot be reached, the sample is discarded.

The Alaska Scallop Fishery Observer Program collects scallop shells from all commercially fished areas of the state, except Kamishak Bay–Central Region often provides their own observer to collect data and/or shells from the Kamishak Bay commercial scallop fishery. Central Region staff, along with ADF&G staff in Kodiak, is currently developing a scallop ageing protocol to standardize the ageing of scallops statewide. This will allow ADF&G staff to pursue estimating vital rates (e.g., population growth and natural mortality rates) and move towards developing age-structured population models. Additionally, we hope to validate the temporal deposition of annuli on scallop shells (i.e., age classes) via isotope and/or laser ablation techniques, or verify deposition timing via indirect techniques such as marginal increment analyses.

DATA ANALYSIS

The weathervane scallop abundance and biomass estimates derived from surveys are based on area-swept calculations (Sokal and Rohlf 1969; Gunderson 1993), the same approach taken for previous weathervane scallop surveys in southcentral Alaska (Hammarstrom and Merritt 1985; Bechtol and Bue 1998; Bechtol and Gustafson 2002). Mean catch per nautical mile ($\bar{c}$), variance (s^2), and 95% confidence interval (c.i.) within a bed were calculated by

$$\bar{c} = \frac{\sum_{i=1}^{n} \frac{c_i}{l_i}}{n}, \qquad (1)$$

and

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(\frac{c_i}{l_i} - \bar{c}\right)^2, \quad (2)$$

$$Var(\bar{c}) = \left(\frac{N-n}{N}\right)\frac{s^2}{n}$$

$$c.i. = \pm t_{n-1}\sqrt{Var(\bar{c})}, \quad (3)$$

where:

c_i = the catch of a species, either as abundance or weight, in sample tow *i*;
l_i = the distance towed in nautical miles for sample tow *I*,
n = the number of stations sampled, and
N = the number of stations total in the survey area.

An estimate of the surveyed population ($\hat{P}$) was calculated by expanding $\bar{c}$ over the surveyed area as

$$\hat{P} = \left(\frac{6{,}076}{8}\right)A\bar{c}, \quad (4)$$

where:

6,076 = the length, in feet, of a nautical mile,
8 = the width of the dredge in feet, and
A = standardized survey area (nm^2).

Variance of the surveyed population was estimated by

$$Var(\hat{P}) = \left(\frac{6{,}076}{8}A\right)^2 Var(\bar{c}). \quad (5)$$

Coefficients of variation (CV) were calculated by dividing the standard error by the abundance estimate.

GHLs were calculated independently from shucked scallop meats for each individual scallop bed. This calculation relies on scallop biomass and meat recovery while also considering biology, such as age composition, and the target guideline harvest range (GHR) in each management area. An exploitation (harvest) rate of 5% is typically applied to the survey data to generate a GHL for each bed (C. E. Trowbridge, Division of Commercial Fisheries, ADF&G, Homer, personal communication). ADF&G may lower that rate based on whether the GHL calculation using 5% exceeds the GHR in regulation or if biomass estimates are low, but a harvestable surplus still exists. Alternatively, the department could apply a higher rate if the biomass significantly increased on a given bed or, for example, if a high proportion of scallops on a given bed were at or near maximum age.

Homer and Kodiak ADF&G staff collaborated on research about gear efficiency of Central Region's scallop dredge in 2004 at Kayak Island. Calculations from a series of tows at 5 stations provided a gear efficiency estimate of 0.83 for the dredge, which was adopted and applied to the

survey data for setting the GHL for both beds at Kayak Island in 2006. This value has been applied to all GHLs for Kayak Island since then. Starting in 2009, the 0.83 gear efficiency value has also been used to set GHLs for Kamishak Bay scallop beds. While gear efficiency is likely less than 0.83 (based on preliminary results from continuing gear efficiency field tests), it provides a reasonable application to our survey data for more accurate biomass estimates used to set GHLs. Additionally, this value (0.83 instead of 1.0) still provides for a conservative approach to setting harvest limits for this fishery.

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. Traditional fisheries approaches suggest that fishing mortality, *F*, should be set at something less than natural mortality, *M* (Restrepo et al. 1998). Kruse (1994) examined several methods for calculating instantaneous natural mortality in weathervane scallops; *M* ranged from 0.04 to 0.25 with a median of 0.15. An initial attempt at an age-structured model for scallops in Kamishak Bay provided a mortality estimate of 14% (Bechtol 2000). Mortality at Kayak Island scallops is likely similar. 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* (based on estimates of *M* listed above), creating conservative and sustainable harvest limits.

The Tanner crab bycatch limit for the Kamishak Bay commercial scallop fishery is 0.5% of the total crab stock abundance from the most recent dredge survey, while the red king crab limit is fixed at 60 crabs. In 2001, ADF&G set Tanner crab bycatch limits in the PWS registration area at 0.5% of the Tanner crab population estimate from the 2000 scallop survey. This resulted in bycatch limits of 2,700 and 8,700 for the east and west harvest areas. These levels have remained in place for all subsequent years.

RESULTS

As previously stated, the Kamishak Bay and Kayak Island surveys are set to standardized sampling areas. All data for each of the scallop beds from all survey years have been standardized to those areas (Figures 1 and 2). The standardized areas for Kamishak Bay are 90.2 nm^2 for the north bed and 68.0 nm^2 for the south bed. The standardized areas for Kayak Island are 78.9 nm^2 for the east bed and 48.6 nm^2 for the west bed. Although additional stations were sampled, only catches from the standardized area stations are presented herein (see Appendix A1).

KAMISHAK BAY SCALLOP SURVEY

2005

A total of 67 successful 1 nm dredge tows were conducted during the 2005 Kamishak Bay weathervane scallop survey (38 in the north bed and 29 in the south bed; Table 1). Catch in the north bed was 1,972 weighing 867 kg (1,910 lb). Catch abundance ranged from 0 to 183 scallops/nm with a mean of 52 scallops/nm. Standardized catches by weight ranged from 0 to 75.2 kg/nm (165.9 lb/nm) with a mean of 22.7 kg/nm (50.0 lb/nm). Catch in the south bed was 2,237 weighing 473 kg (1,044 lb). Catch abundance ranged from 0 to 293 scallops/nm with a mean of 76 scallops/nm. Standardized catches by weight ranged from 0 to 72.0 kg/nm (158.7 lb/nm) with a mean of 16.2 kg/nm (35.8 lb/nm).

2007

A total of 74 successful 1 nm dredge tows were conducted during the 2007 Kamishak Bay weathervane scallop survey (43 in the north bed and 31 in the south bed; Table 1). Catch in the north bed was 3,202 weighing 1,134 kg (2,501 lb). Catch abundance ranged from 0 to 305 scallops/nm with a mean of 74 scallops/nm. Standardized catches by weight ranged from 0 to 84.0 kg/nm (185.1 lb/nm) with a mean of 26.4 kg/nm (58.1 lb/nm). Catch in the south bed was 3,598 weighing 728 kg (1,605 lb). Catch abundance ranged from 0 to 453 scallops/nm with a mean of 116 scallops/nm. Standardized catches by weight ranged from 0 to 108.0 kg/nm (238.1 1lb/nm) with a mean of 23.5 kg/nm (51.7 lb/nm).

2009

A total of 66 successful 1 nm tows were conducted during the 2009 Kamishak weathervane scallop survey (43 in the north bed and 23 in the south bed; Table 1). Catch in the north bed was 2,319 weighing 880 kg (1,939 lb). Catch abundance ranged from 0 to 207 scallops/nm with a mean of 54 scallops/nm. Standardized catches by weight ranged from 0 to 68.8kg/nm with a mean of 20.5kg/nm (45.2 lb/nm). Catch in the south bed was 1,231 weighing 212 kg (467 lb). Catch abundance ranged from 0 to 197 scallops/nm with a mean of 53 scallops/nm. Standardized catches by weight ranged from 0 to 27.3 kg/nm (60.1 lb/nm) with a mean of 9.2 kg/nm (20.3 lb/nm).

Survey Age Composition

The current focus on scallops in Central Region is to pursue development of an age-structured model for weathervane scallops. Prior to the development of that model, a statewide scallop ageing protocol is being developed by Central Region staff with assistance from ADF&G staff in Kodiak. Upon completion of the ageing protocol, age and growth models will be developed from scallop ages from Central Region beds to build an age-structured model. Ageing of scallops is also being done for all scallop beds across the state; however, shells in all beds outside Central Region are only obtained from the fishery so a fishery independent sample will likely be required to obtain age and height from smaller scallops not retained in commercial fishing gear.

Survey age composition in Kamishak Bay ranged from age 1 to 23, with a maximum of 22 in the north bed and 23 in the south bed (Figures 3 and 4), with height of aged shells ranging from 32 mm to 196 mm in the north bed and 22 mm to 192 mm in the south bed. The progression of strong cohorts can be seen across calendar years in both beds. Young age classes tend to be the most abundant age classes. From 2005 to 2009, the percentage of individuals that were 10 years of age or less decreased from 70% to 58% in the north bed, but increased from 62% to 82% in the south bed.

Survey Shell Height Frequency

Between 2005 and 2009, 13,887 (7,391 in the north bed and 6,496 in the south bed) scallops were measured on Kamishak Bay surveys (Figures 5 and 6). The shell height frequency of scallops less than 100 mm in shell height increased from 4.7% in 2005, to 21.4% in 2007, then decreased to 5.1% in 2009 in the north bed. In the south bed, it decreased from 45.4 in 2005 to 19.3% in 2007 and then increased to 29.8% in 2009. Scallop shell height ranged from 20 mm to 199 mm and was consistent over all surveys (Figures 5 and 6). Upon completion of the scallop ageing protocol and age assessments, all shell heights will be related to ages (or small groups of age classes) to examine the statistical relationship between shell height and age and see if that

relationship is static or may have changed over time. However, the focus of our program is pursuing the development of age-structured population models, not size-structured (or shell height) models.

KAYAK ISLAND SCALLOP SURVEY

2004

A total of 56 successful 1 nm dredge tows were conducted during the 2004 Kayak Island weathervane scallop survey (31 in the east bed and 25 in the west bed; Table 2). Catch in the east bed was 8,679 weighing 2,293 kg (5,056 lb). Catch abundance ranged from 20 to 2,913 scallops/nm with a mean of 291 scallops/nm. Standardized catches by weight ranged from 0.9 kg/nm (2.0 lb/nm) to 801.0 kg/nm (1,766.0 lb/nm) with a mean of 77.1 kg/nm (170.0 lb/nm). Catch in the west bed was 9,840 weighing 2,129 kg (4695 lb). Catch abundance ranged from 0 to 1,530 scallops/nm with a mean of 392 scallops/nm. Standardized catches by weight ranged from 0 kg/nm (0.5 lb/nm) to 381.7 kg/nm (841.6 lb/nm) with a mean of 84.8 kg/nm (186.9 lb/nm).

2006

A total of 52 successful 1 nm dredge tows were conducted during the 2006 Kayak Island weathervane scallop survey (32 in the east bed and 20 in the west bed; Table 2). Catch in the east bed was 5,254 weighing 1,441 kg (3,177 lb). Catch abundance ranged from 5 to 1,319 scallops/nm with a mean of 162 scallops/nm. Standardized catches by weight ranged from 0.7 kg/nm (1.5 lb/nm) to 393.8 kg/nm (868.1 lb/nm) with a mean of 44.4 kg/nm (98.0 lb/nm). Catch in the west bed was 5,510 weighing 1,229 kg (2,710 lb). Catch abundance ranged from 1 to 1,332 scallops/nm with a mean of 273 scallops/nm. Standardized catches by weight ranged from 0.2 kg/nm (0.5 lb/nm) to 287.9 kg/nm (635 lb/nm) with a mean of 61.0 kg/nm (134.4 lb/nm).

2008

A total of 47 successful 1 nm dredge tows were made during the 2008 Kayak Island survey (37 in the east bed and 10 in the west bed; Table 2). Inclement weather conditions caused a fewer number of tows in 2008. Catch in the east bed was 4,332 weighing 1,332 kg (2,936 lb). Catch abundance ranged from 0 to 674 scallops/nm with a mean of 119 scallops/nm. Standardized catches by weight ranged from 0 to 205.9 kg/nm (453.9 lb/nm) with a mean of 36.5 kg/nm (80.4 lb/nm). Catch in the west bed was 1,058 weighing 196 kg (432 lb). Catch abundance ranged from 3 to 378 scallops/nm with a mean of 106 scallops/nm. Standardized catches by weight ranged from 0.01 kg (0.02 lb/nm) to 72.2 kg/nm (159.2 lb/nm) with a mean catch among all stations fished of 19.7 kg/nm (43.5 lb/nm).

2010

A total of 38 successful 1 nm dredge tows were made during the 2010 Kayak Island survey (12 in the east bed and 26 in the west bed; Table 2). Inclement weather conditions forced fewer number of tows and the postponement of the May east bed survey to July. A combination of additional inclement weather and a mechanical problem with the trawl winch resulted in only surveying the perimeter of the bed. Catch in the east bed was 1,733 weighing 425 kg (936 lb). Catch abundance ranged from 6 to 647 scallops/nm with a mean of 143 scallops/nm. Standardized catches by weight ranged from 0.01 kg/nm (0.03 lb/nm) to 192.3 kg/nm (424.0 lb/nm) with a mean catch of 34.9 kg/nm (76.9 lb/nm). Catch in the west bed was 1,445 weighing 240 kg (528 lb). Catch abundance ranged from 0 to 266 scallops/nm resulting in a mean among all stations of 55 scallops/nm. Standardized catches by weight ranged from 0 to 93.0 kg/nm (205.1 lb/nm) with a mean of 9.1 kg/nm (20.0 lb/nm). Due to the small number of stations

sampled in the east bed, abundance and biomass estimates were only done for the west bed (Table 2).

Survey Age Composition

Survey age composition ranged from age 1 to 23, with a maximum of 23 in the east bed and 21 in the west bed (Figures 7 and 8), with the height of aged shell ranging from 13 mm to165 mm in the east bed and 18 mm to 163 mm in the west bed. The progression of strong cohorts can be seen across calendar years, but is easier to see in the east bed than in the west bed; neither shows more clearly than Kamishak Bay. The east bed age composition is bimodal with strong age classes between 7 and 11 years of age and between 13 and 20 years of age over the past 3 surveys (Figure 7). Over the same time period, the west bed shows a strong series of age classes between 10 and 19 years of age, however, the 2010 survey also shows a strong group of 4 to 8 year old scallops on that bed as well (Figure 8).

While there are dominant age classes on each bed, the full range of age classes are observed in the survey data. From 2004 through 2010, the percentage of individuals that were 10 years of age or less reached a high of 50% in 2008 then decreased to 32% in 2010 on the east bed, and increased from 33% in 2005 to 65% in 2010 on the west bed. An age-structured model will be developed for this area over the next several years for presentation to the Alaska Board of Fisheries and the North Pacific Fisheries Management Council.

Survey Shell Height Frequency

Between 2004 and 2010, 17,264 (10,246 in the east bed; 7,018 in the west bed) scallops were measured on the Kayak Island survey (Figures 9 and 10). Scallop shell heights at Kayak Island range from 13 mm to 193 mm, with the majority of shell heights falling between 70 and 160 mm (Figures 9 and 10). Shell height frequency less than 100 mm ranged between 0.6 % in 2006 and 10.5 % in 2010 for the east bed and 12.7% in 2006 to 41.6% in 2010 for the west bed. Upon completion of the scallop ageing protocol and age assessments, all shell heights will be related to ages (or small groups of age classes); however, the focus of our program is pursuing the development of age structured population models.

FISHERY AGE AND SHELL HEIGHT COMPOSITION

Kamishak Bay

Harvest data collected from the Kamishak Bay District weathervane scallop fishery, in addition to the weight of harvested meats, included shell height. Shell samples from shucked scallops have been collected annually by both department observers and commercial fishing crews. Fishermen were instructed to randomly select 100 shells over the duration of a trip or for each 5 day period within a trip. For the north bed, early 1980's samples showed a fishery supported by a relatively broad range of shell heights from approximately 110 mm to 190 mm. Following the 1987 closure due to low abundance caused by suspected illegal harvest, the fishery was supported by a narrow shell height range of scallops through 1995. Over subsequent years, larger recruitment events occurred and the fishery was again supported by a broader shell height and age range of scallops. A large die-off observed in the 2002 fishery was accompanied by a decline in the range of shell heights supporting the fishery. The range was narrower and appeared truncated at the upper end. A decrease in allowable harvest and fishing effort ensued from 2003 to 2005 and fishing effort decreased to a single vessel in 2006 with only 50 whole lb of scallops

harvested (Table 3). No commercial fishing occurred in Kamishak Bay from 2007 through 2009. Fishing effort began again on Kamishak scallop beds in 2010 with 9,460 pounds of shucked meats harvested.

Kayak Island

Harvest data collected from the Kayak Island weathervane scallop fishery (Table 4), in addition to the weight of harvested meats, included shell height composition. Shell samples from shucked scallops have been collected annually by both department observers and commercial fishing crews. Data indicate a fairly narrow range of scallop shell heights supported the fishery with scallop shell heights between 125 and 140 mm, which comprised approximately 77% of the catch sample. Overall shell heights of scallops commercially fished at Kayak Island range from approximately 105 mm to 187 mm. Scallop age classes from the fishery will be examined upon completion of the statewide ageing protocol.

DISCUSSION

The Cook Inlet and PWS registration areas (which contain the Kamishak Bay and Kayak Island scallop beds, respectively) are currently the only 2 management areas in Alaska where scallop abundance and biomass are assessed by fishery independent research surveys, and where the commercial scallop fishery is managed based on survey results. Survey results were used to set annual commercial fishery GHLs for Central Region scallop beds. As previously mentioned, GHLs are developed from scallop biomass, abundance, and age composition. GHLs (and Tanner crab bycatch limits) were finalized and announced through ADF&G news releases prior to the season opening for each respective harvest area.

Scallop abundance and biomass estimates for Kamishak Bay are down relative to estimates from when the survey began in the mid-1990s (Table 1), which is in part due to a large die-off of scallops that occurred in Kamishak Bay in 2002 (noticed by the fishery that year and in our 2003 survey). However, between 2005 and 2009, abundance and biomass on the north bed has been relatively stable (Table 1). Over the same time period, the south bed numbers have been more variable with the 2009 survey showing the lowest abundance and biomass since we began surveying it. The low biomass level in the south bed in 2009 may appear alarming; however, it has so many more smaller scallops than the north bed (see Figures 3, 4, 5, and 6) that a lower biomass is expected. A commensurate decrease in allowable harvest and fishing effort ensued from 2003 to 2005 and fishing effort virtually came to a standstill in 2006 (Table 3). No commercial fishing occurred in Kamishak Bay from 2007 through 2009. Fishing effort began again on Kamishak scallop beds in 2010.

Scallop abundance and biomass estimates for the Kayak Island west bed is down relative to when it was first surveyed in the mid-1990s, while in east bed abundance is similar, but biomass has increased during that same time period (Table 2). The sharp decrease in abundance and biomass estimates at both beds in 2002 occurred because survey estimates were compromised from incorrect scope on the dredge and a liner that was too small for the dredge bag. These issues were corrected for the 2004 survey, which indicated that abundance and biomass were only slightly decreased in the west bed since the 2000 survey and that abundance and biomass had increased in the east bed (Table 2). Between 2004 and 2010, scallop abundance and biomass decreased on both beds with the west bed showing all time low estimates in 2010 (Table 2). While the sample size for the east bed in the 2010 survey at Kayak Island was too small (due to

inclement weather) to use for estimating abundance and biomass (Table 2), ages were assessed and shell height measurements were still obtained (Figures 7 and 9).

There are inherent difficulties associated with assessing weathervane scallop abundance; mainly their patchy distribution and the efficiency of the gear used to survey them (i.e., dredge). Hence, the variance associated with survey abundance estimates (i.e., confidence intervals and CVs) stems from a synergistic combination of these two factors. Weathervane scallops are patchily distributed on both large and small geospatial scales (Adams et al. 2010); for example, the Gulf of Alaska and the north bed at Kamishak Bay, respectively. Research has also shown that dredge efficiency is typically very low and may be influenced by scallops swimming out of the dredge path (i.e., avoidance behavior) (Caddy 1968). When taking the above factors into account, the CVs for our abundance estimates (Tables 1 and 2) are quite low and very comparable to CVs from other research estimating scallop abundance (Serchuk and Wigley 1986). Central Region currently applies a dredge efficiency or 0.83 and continues to examine the efficiency of our 8 ft dredge as well as that of the sled-dredge in order to improve on that preliminary estimate.

Survey age composition in Kamishak Bay ranged from age 1 to 23, with a maximum age of 22 in the north bed and 23 in the south bed. The progression of 2 to 3 strong cohorts is shown across calendar years in the north bed (Figure 3), while one strong set of young cohorts is shown across years in the south bed (Figure 4). Both beds show a robust range of age classes (and shell heights) with the north bed dominated by ages 2 to 13 and the south bed dominated by younger age classes ranging from 1 to 7 years old. High diversity in age composition of the survey catch and the fishery suggests a healthy scallop bed with strong resilience to population level disturbances.

Survey age composition at Kayak Island ranged from age 1 to age 23, with a maximum age of 23 in the east bed and 21 in the west bed. The progression of strong cohorts is visible across calendar years. The east bed is bimodal with strong age groups between 7 and 11 years of age and between 13 and 20 years of age over the past 3 surveys (Figure 7). Over the same time period, the west bed shows a strong series of age classes between 10 and 19 years of age; however, the 2010 survey also shows a strong group of 4 to 8 year old scallops (Figure 8). While there are dominant age classes on each bed, the full range of age classes are observed in the survey data. From 2004 through 2010, the percentage of individuals 10 years of age or less decreased from 50% in 2008 to 38% in 2010 on the east bed, and increased from 20% in 2006 to 65% in 2010 on the west bed. This sharp increase in the percentage of scallops under 100 mm shell height hopefully bodes well for future recruitment to the west bed and ultimately the fishery, but warranted closure in 2010 to avoid killing high numbers of small scallops for a small GHL (the east bed was open to harvest in 2010). Overall, the diversity in the age composition of the survey catch as well as in the fishery suggests a healthy scallop bed with strong resilience to population level disturbances.

Survey data suggests that mortality increases rapidly around age 13 and 7 in the Kamishak Bay north and south beds, respectively, as evidenced by the reduction in proportions of age classes beyond those ages. The commercial harvest data show similar ages as surveys for ages greater than 2 or 3, which is reasonable since the commercial gear does not retain smaller scallops like the survey gear. Survey data from Kayak Island is different with younger age classes having low numbers in the east bed, but yet 2 separate cohort groups appear to track well over time (Figure 7), and with older age classes dominating the west bed until the recent 2 surveys that show

younger age classes coming into reasonable numbers (Figure 8). Even with the differences at Kayak Island, older age classes are still present in good numbers (Figures 7 and 8).

The process affecting weathervane scallop recruitment and natural mortality at Kamishak Bay and Kayak Island are poorly understood. For long-lived species, a broad age distribution is important for providing resilience at the population level (Leaman and Beamish 1984; Berkeley et al. 2004). Weathervane scallop beds at both survey locations are supported by a wide range of age classes and shell heights (Figures 3 through 10), which indicates continued and relatively consistent recruitment is occurring at both locations over time. It also provides an indication that the reduction in abundance and biomass in Kamishak Bay is more related to the die-off that occurred in 2003 than to fishing mortality. While recruitment is occurring at both survey locations and young cohorts can be reasonably tracked across years, it appears to be stronger or more consistent (i.e., represented by larger proportions of younger age classes) in Kamishak Bay (Figures 3 and 4) and a bit more sporadic at Kayak Island (Figures 7 and 8). Relative abundance and biomass at the Kayak Island west bed is at its lowest point in the history of the survey, yet the east bed is at similar levels to 2000 (Table 1). Even though recruitment at both beds appears to be reasonably good across years (Figures 7 and 8), factors affecting the west bed versus the east bed may relate to currents and associated variability in post-settling survivorship associated with an open ocean environment such as Kayak Island. Additionally, a combination of patchy distribution of scallops within the beds, where the dredge tow path occurs within a grid square and whether the black or white grid squares are being sampled in a given year all factor into the variability of survey estimates at both locations. As biotic and abiotic factors likely play a large role in determining the overall size of scallops beds and changes in beds over time, we continue to conduct dredge tows at ancillary stations to monitor and track any changes in scallop distribution and scallop bed size at Kamishak Bay and Kayak Island.

Cluckers (empty scallop shells with both valves connected by an intact hinge ligament) are counted and weighed on all surveys as the relative percentage of cluckers is another gauge on the overall health of a given scallop bed (i.e., less cluckers indicates a healthier bed). Over the years from 2005 through 2009 at Kamishak, percentages of cluckers have been very low ranging between 0.5% and 2.8%, with the 2009 survey producing the lowest percentage of cluckers for the period of years covered by this report (0.9% in the north bed and 0.5% in the south bed). Between 2004 and 2010 at Kayak Island, percentages of cluckers varied between 0.1% and 10.2%. The percentage of cluckers on the east bed has steadily increased since 2004 going from 0.5% to 5.9% in 2010, while the number of cluckers on the west bed increased between 2004 and 2008 (from 0.6% to 10.2%), but then decreased to 1.5% in 2010. Overall, the relative percentage of cluckers to live scallops caught in the survey is very low, providing another indication of reasonable overall health of the scallop beds at Kamishak Bay and Kayak Island.

In the 2009–2010 Kayak Island commercial scallop fishery, a significant portion of fishing effort occurred outside of the standardized assessed survey area (Figure 11). This fishing effort not only occurred outside the eastern boundary of the Kayak Island dredge survey grid, but crossed the Central Region-Southeast Region boundary at Cape Suckling (144.0° W longitude, Area D/Area E boundary; Figure 11). The area directly east of 144.0° W longitude in Area D has not seen any effort since inception of the scallop observer program in July 1993. Fishing across the boundary of our survey grid and even across the 144.0° W longitude, Area D boundary line is not novel to the 2009–2010 commercial fishery. It also occurred in the mid-1990s; however, the occurrence may becoming more frequent in recent years. Central Region staff will survey the

Kayak Island area again in May 2012 and investigate the abundance and biomass of scallops between our survey grid's eastern boundary and the 144.0° W longitude, Area D boundary. While our delineation of the eastern boundary of the Kayak Island east bed was clearly evident upon application of our 9.1 kg criterion, the scallop bed appears to have an area of low abundance at our delineation line and then increases again to, and across, the 144.0° W longitude boundary between Central Region and Southeast Region. Ultimately, we plan to adjust our grid size and boundaries to reflect the additional abundance and biomass, which has yet to be surveyed.

CONTINUING AND FUTURE RESEARCH

Preliminary efforts have used underwater video techniques to evaluate survey dredge gear efficiency. If successful, the eventual incorporation of these data will increase accuracy of the survey estimates and give more appropriate harvest limits by using a gear efficiency value less than the current 0.83. Central Region staff has also developed a sled-dredge, analogous to that used by the statewide scallop program in Kodiak; however, instead of only capturing video and counts, this sled has a pinning system on the back that allows an ~6 ft wide dredge setup to be attached. The sled-dredge setup allows for video cameras to look forward to obtain counts of scallops before the sled reaches them and to look aft at the foot of the dredge bag to examine gear efficiency (i.e., how many scallops go in versus under the dredge). The sled-dredge recently began field testing with the goal of comparing catches to the 8 ft dredge, and eventually replacing the 8 ft dredge with the sled dredge for all scallop surveys in Central Region.

Recent discussions amongst scallop researchers in Alaska and with the North Pacific Fishery Management Council's scallop plan team have focused on weak meats and the relative percentages found throughout the state. 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. Weathervane scallops with weak meats were observed while shucking the age and meat weight sample (~20 scallops/tow with the standard 8 ft dredge) in the 2009 Kamishak Bay survey. Of scallops observed, 10.4% had weak meats in the north bed and 4.9% in the south bed. Initial testing of the sled-dredge on the north bed in Kamishak Bay resulted in 14.7% weak meat scallops. Central Region weathervane scallop surveys will continue to document weak meats, as well as mud blisters and other scallop parasites in future surveys as these can provide important information on the general health of weathervane scallop beds.

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TABLES AND FIGURES

Table 1.–Data summary and estimates for weathervane scallops in Kamishak Bay, 1996–2009.

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 w/dredge efficiency =1.0 (kg meat)	Estimated biomass w/dredge efficiency =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
				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

Table 2.–Data summary and estimates for weathervane scallops at Kayak Island, 1996–2010.

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 w/dredge efficiency =1.0 (kg meat)	Estimated Biomass w/dredge Efficiency =0.83 (kg meat)
					East Bed					
1996	38	27.9	7,302,813	±	3,507,901	0.24	0.028	228	132,501	
1998[a]	28	20.5	5,288,624	±	1,393,135	0.13	0.020	231	89,347	
2000	33	37.6	9,535,026	±	1,900,677	0.10	0.036	237	146,181	
2002[b]	20	10.2	2,294,907	±	910,967	0.19	0.009	266	43,367	
2004	31	77.1	17,441,115	±	9,355,190	0.26	0.062	264	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	307	130,480	157,204
2010	12	34.9	[a]		[a]		0.032	245	[a]	[a]
					West Bed					
1998[b]	21	33.9	6,382,639	±	2,851,028	0.21	0.04	196	105,132	
2000	20	94.7	17,900,280	±	7,957,941	0.21	0.11	195	302,316	
2002[c]	17	39.6	5,745,859	±	2,428,439	0.20	0.03	254	105,646	
2004	25	84.8	14,502,511	±	5,102,276	0.17	0.09	216	235,274	
2006	20	61.0	10,113,094	±	4,648,662	0.22	0.06	223	167,262	201,520
2008	10	19.7	3,934,444	±	2,811,818	0.32	0.02	185	34,843	41,979
2010	26	9.1	2,025,382	±	745,216	0.18	0.01	166	23,929	28,475

Note: Using a standardized area of 79.0 nm^2 East Bed and 48.7 nm^2 West Bed and ArcGIS distance for estimates. The dredge was 8 feet wide and weighed ~1,600 pounds, ring size 4 inches inside diameter, and lined with 1.5 inch stretch 24 thread nylon mesh.

[a] Sample size insufficient for parameter estimation (survey shortened due to weather and mechanical problems)

[b] The 1998 survey used a lighter New Bedford style dredge weighing ~800 lbs with 3 inch i.d. rings with 1.5 inch nylon liner. Due to lighter weight, efficiency of this dredge was less than standard survey dredge used in all other years.

[c] The 2002 survey was compromised by using a longer scope ~4:1 to 5:1 and liner that was too small for the dredge bag.

Table 3.–Commercial harvest of weathervane scallops in Kamishak Bay, 1993–2010.

Year	Number vessels	GHL (lb meat)	Catch (lb)[a] shucked meats	Dredge[b] Hours	CPUE[c] lb/hour
1993	3		20,115	528	38
1994	4		20,431	458	45
1995				Closed	
1996	5	28,000	28,228	534	53
1997	3	20,000	20,336	394	52
1998[d]	1	20,000	17,246	390	44
1999	3	20,000	20,315	325	63
2000	3	20,000	20,516	275	75
2001[d]	2	20,000	20,097	325	62
2002[e]	3	20,000	8,591	311	28
2003[d, f]	2	20,000	15,843	896	18
2004[d]	3	20,000	6,117	364	17
2005[d]	2	7,000	7,378	372	20
2006[d]	1	7,000	50	10	5
2007		12,000		No Effort	
2008		12,000		No Effort	
2009		14,000		No Effort	
2010[g]	1	14,000	9,460	365	26
2011[g]	1	10,000	9,975	324	31

Note: If not specified, harvest was from North bed, north of 59° 16.00'N. lat.

[a] Catch includes harvested scallops and estimated deadloss.

[b] Dredge-hour equals one dredge fished for 60 minutes.

[c] CPUE (catch per unit effort) equals pounds of scallop meats caught per dredge-hour.

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

[e] Harvest in 2002 and 2004 from both North and South beds.

[f] Harvest in 2003 from South bed only.

[g] Confidential data released by vessel operators.

Table 4.–Commercial harvest of weathervane scallops from Prince William Sound, 1992–2011.

Year	Fishery Area	GHL[a] (lb meat)	Number of Vessels	Harvest (lb meat)	Dredge Hours	CPUE
1992		64,000	4	208,836	NA	NA
1993		50,000	7	63,068	638	99
1994/95		Closed				
1995/96		50,000	3	108,000	NA	NA
1996/97		Closed				
1997/98		17,200	1[b]	18,000	171	105
	East	6,000				
1998/99	West	14,000	2[b]	19,650	179	110
	East	6,000				
1999/00	West	14,000	2[b]	20,410	149	137
	East	9,000		8,998		
2000/01	West	21,000	3	21,268	221	137
	East	9,000		9,060		
2001/02	West	21,000	1[b]	21,030	263	114
	East	6,000		1,680		
2002/03	West	14,000	2[b]	13,961	122	128
	East	6,000		5,910		
2003/04	West	14,000	1[b]	14,070	216	93
	East	26,000		25,350		
2004/05	West	24,000	2[b]	23,970	614	80
	East	26,000		24,435		
2005/06	West	24,000	3	24,781	491	100
	East	20,000		20,010		
2006/07	West	17,000	2[b]	17,005	334	111
	East	20,000		20,015		
2007/08	West	17,000	2[b]	17,090	428	87
	East	15,000		15,030		
2008/09	West	5,000	1[b]	5,010	331	64
	East	15,000		15,035		
2009/10	West	5,000	2[b]	4,980	419	46
	East	8,400		8,445		
2010/11	West	Closed	1[b]	Closed	161	52
	East	8,400		8,460		
2011/12	West	Closed	1[b]	Closed	160	53

[a] Separate GHLs were established for areas east and west of Kayak Island beginning in 1998.

[b] Confidential data voluntarily released by vessel operators.

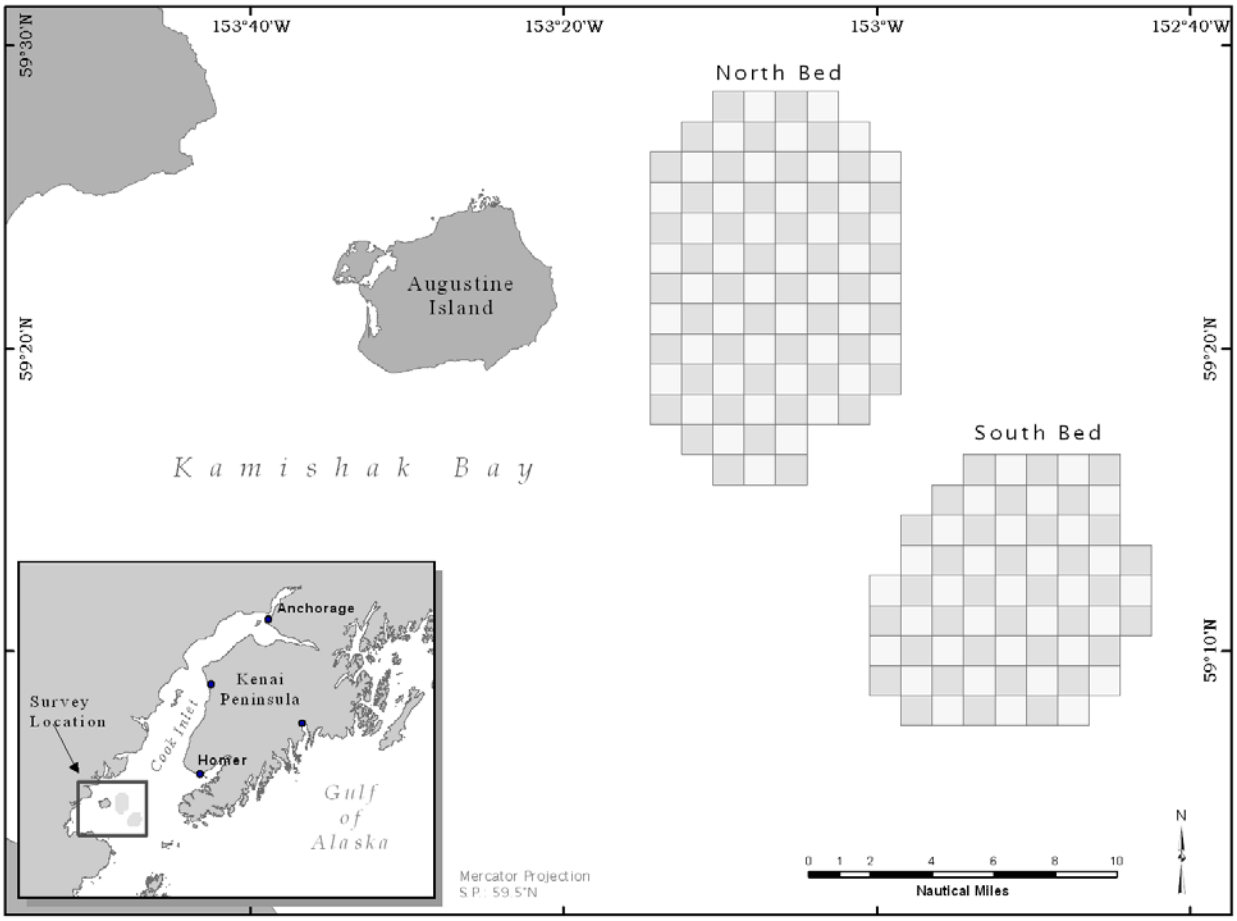

Figure 1.–Location of main scallop beds in Kamishak Bay with the delineated edge of each scallop bed and black and white checkerboard sampling grid shown.

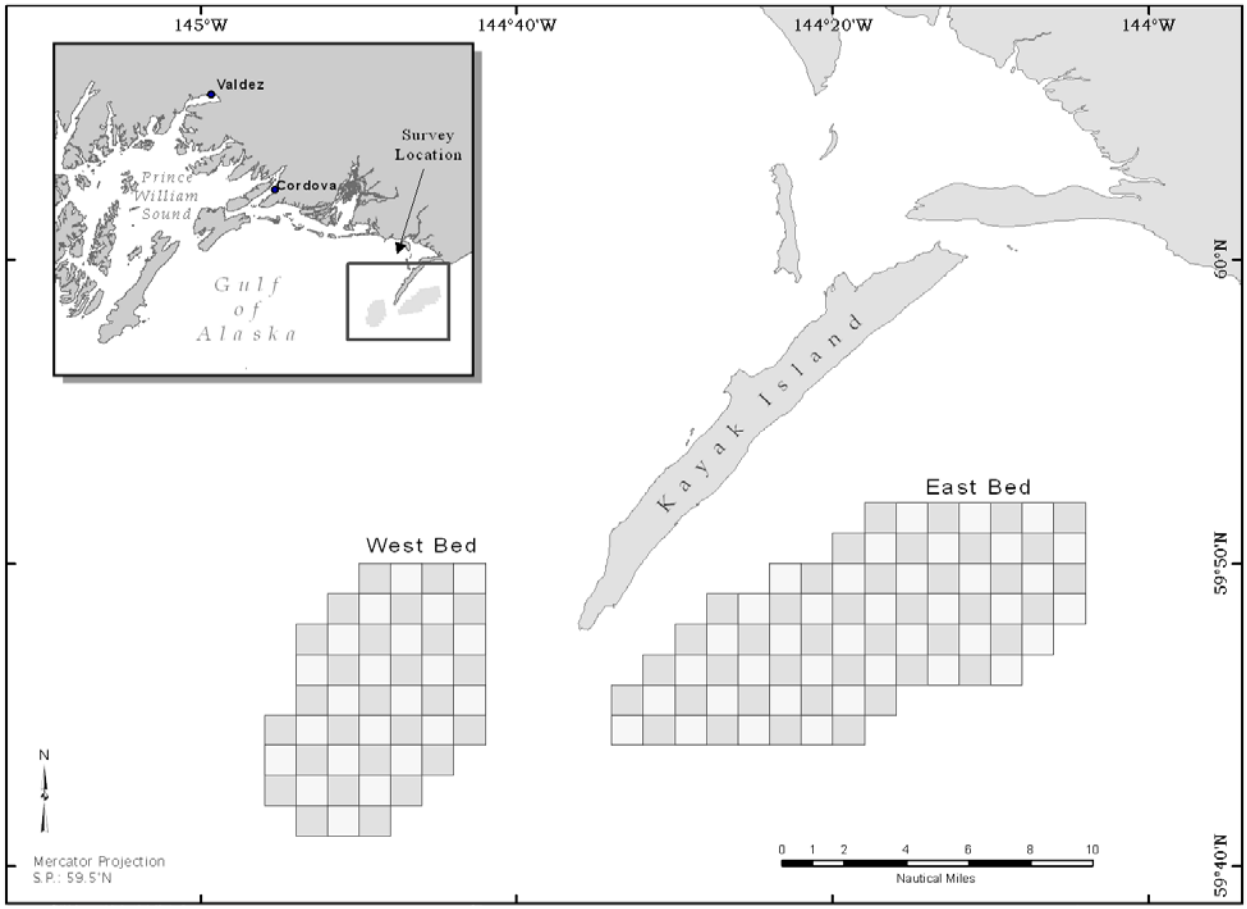

Figure 2.–Location of main scallop beds at Kayak Island with the delineated edge of each scallop bed and black and white checkerboard sampling grid shown.

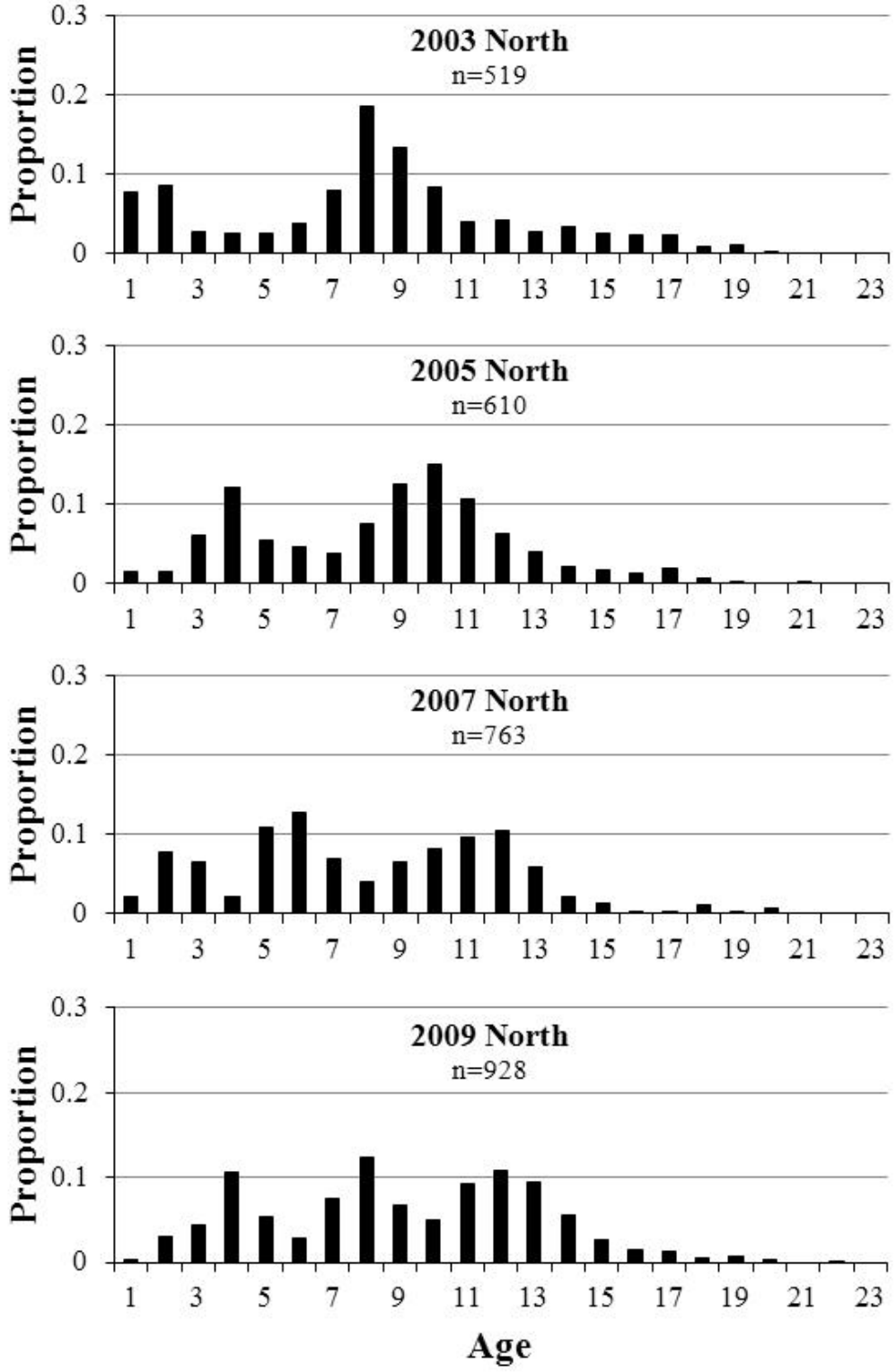

Figure 3.–Age composition of weathervane scallops from the Kamishak Bay north bed for 2003, 2005, 2007, and 2009 (2003 is included to assist in tracking cohorts).

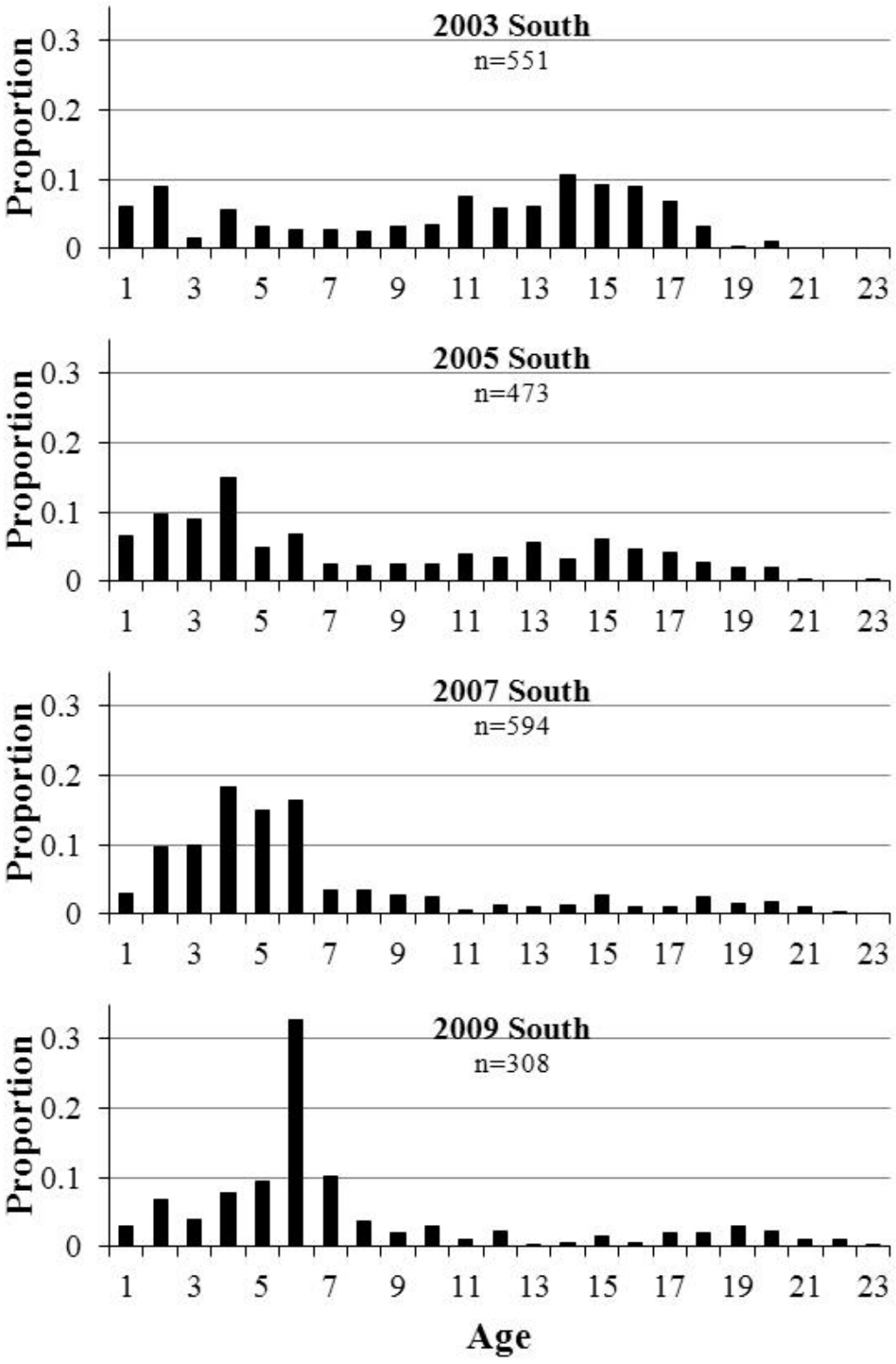

Figure 4.–Age composition of weathervane scallops from the Kamishak Bay south bed for 2003, 2005, 2007, and 2009 (2003 is included to assist in tracking cohorts).

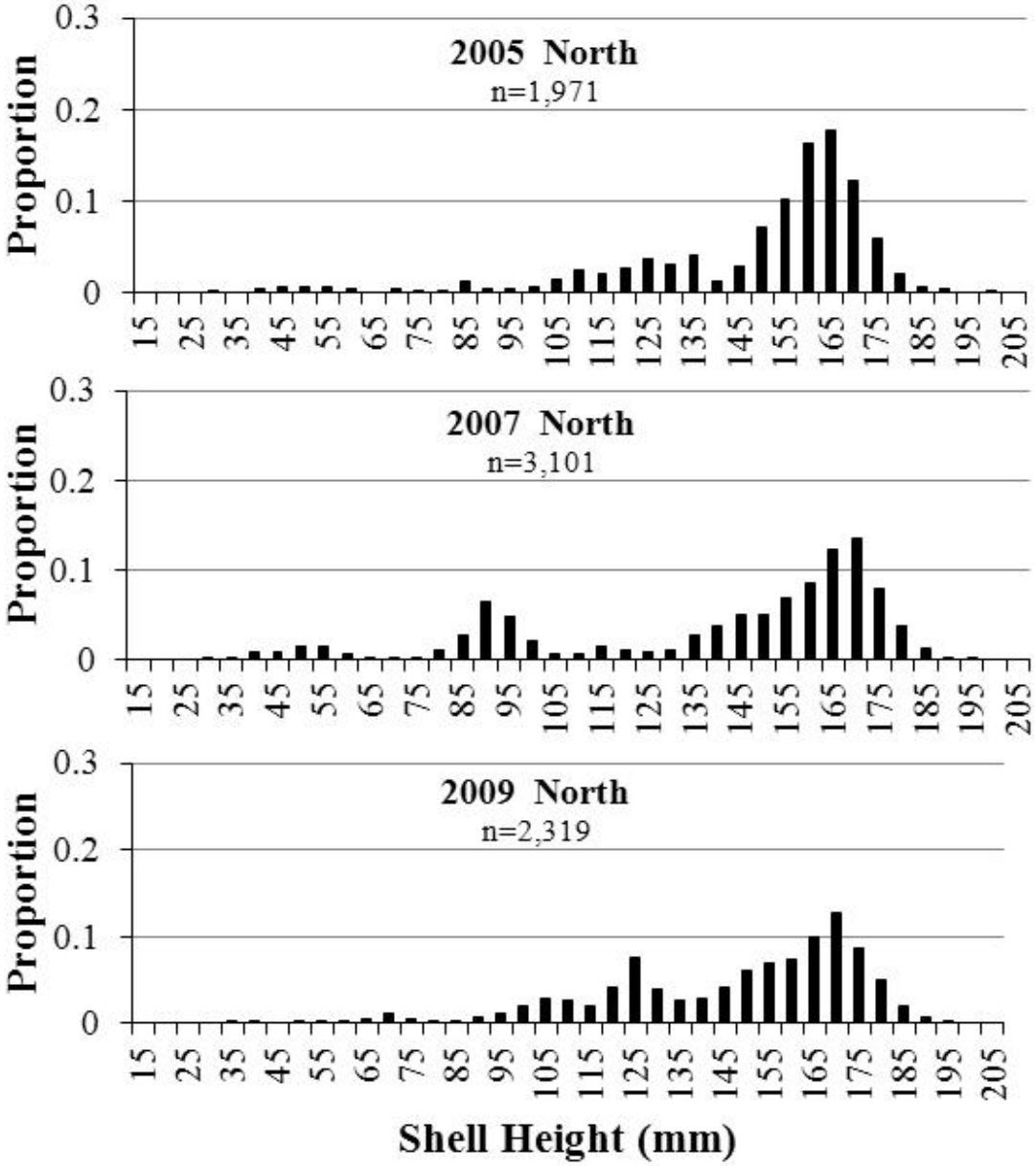

Figure 5.–Shell height composition of weathervane scallops from the Kamishak Bay north bed for 2005, 2007, and 2009.

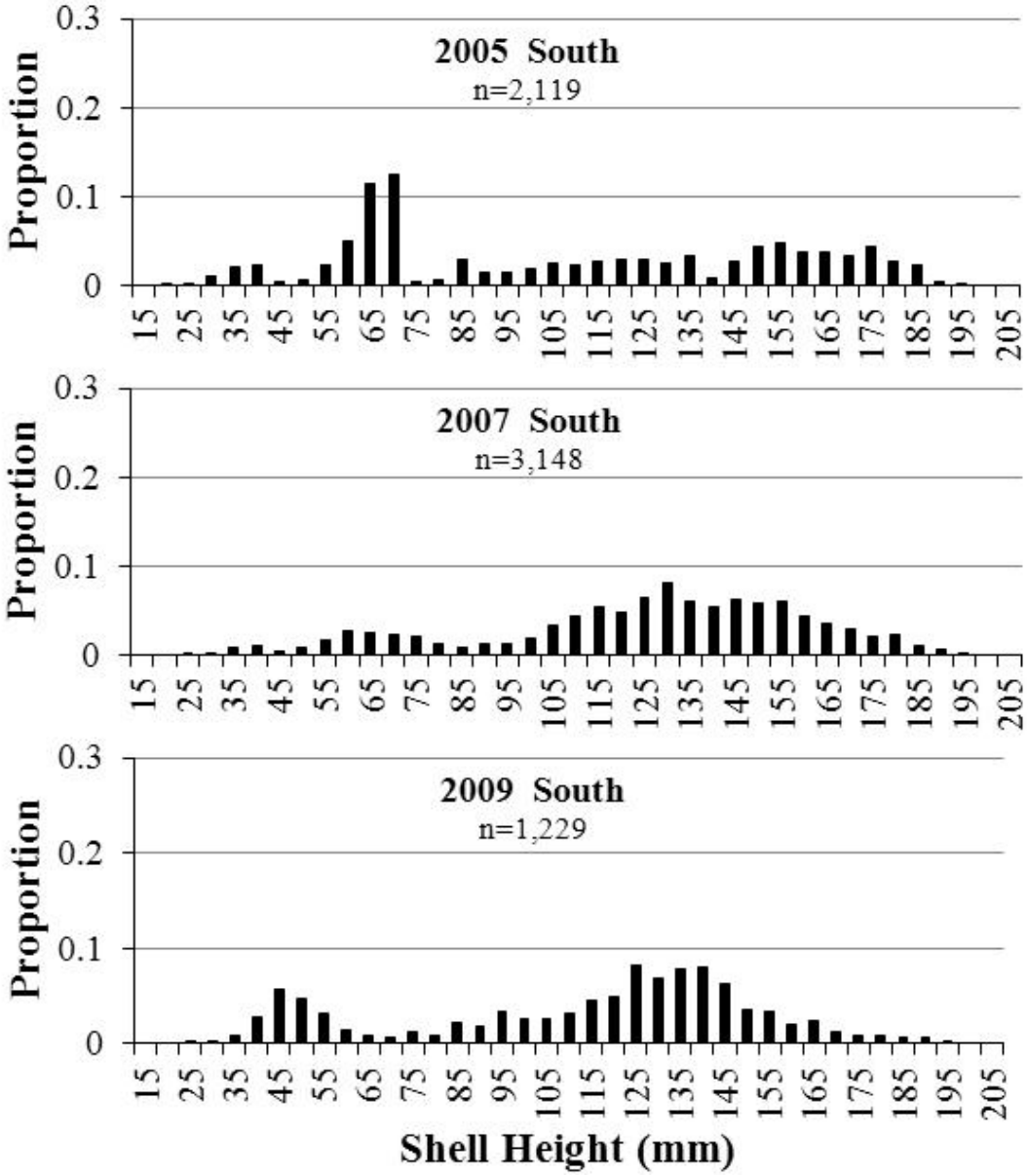

Figure 6.–Shell height composition of weathervane scallops from the Kamishak Bay south bed for 2005, 2007, and 2009.

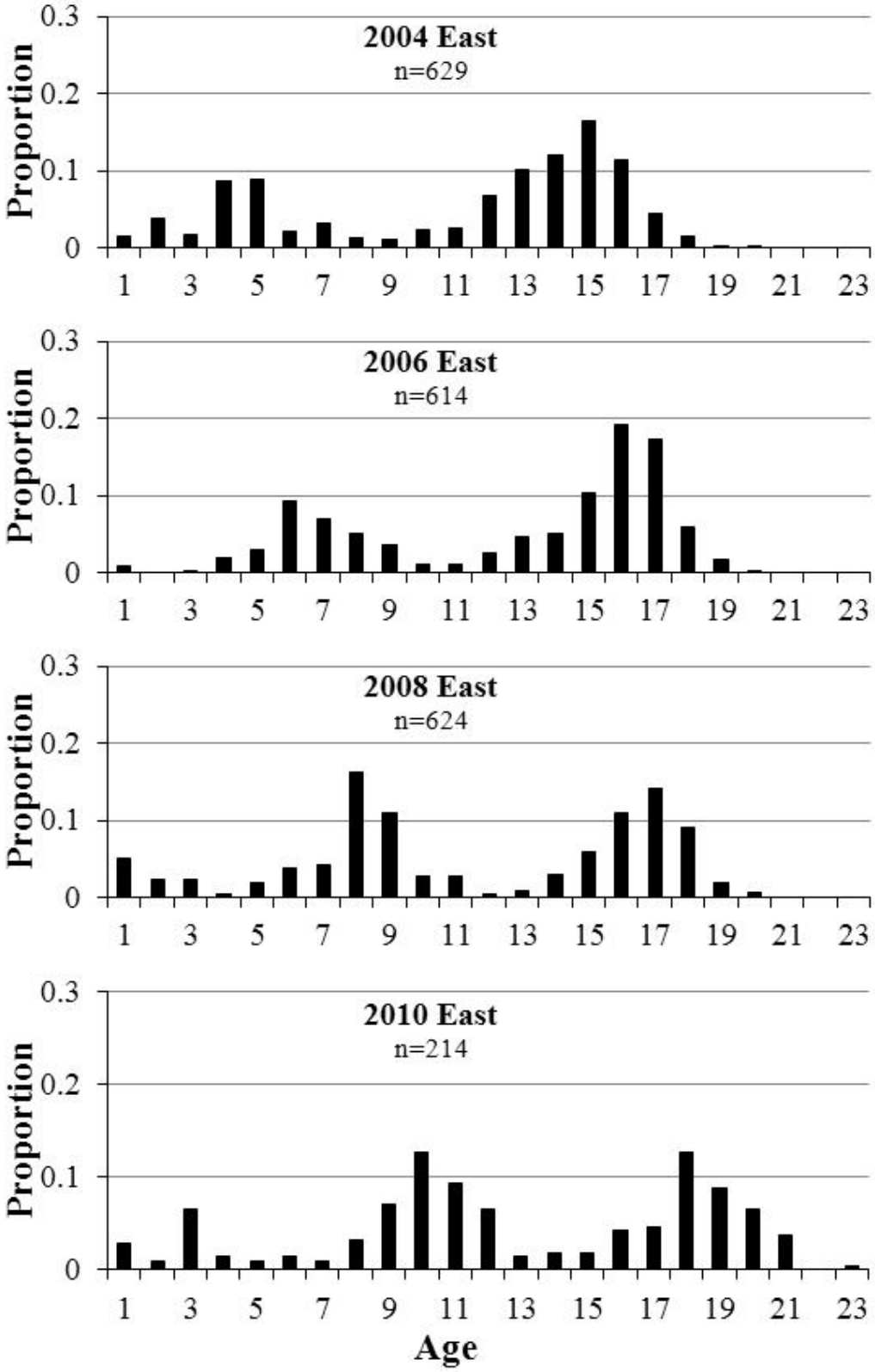

Figure 7.–Age composition of weathervane scallops from the Kayak Island east bed in 2004, 2006, 2008, and 2010.

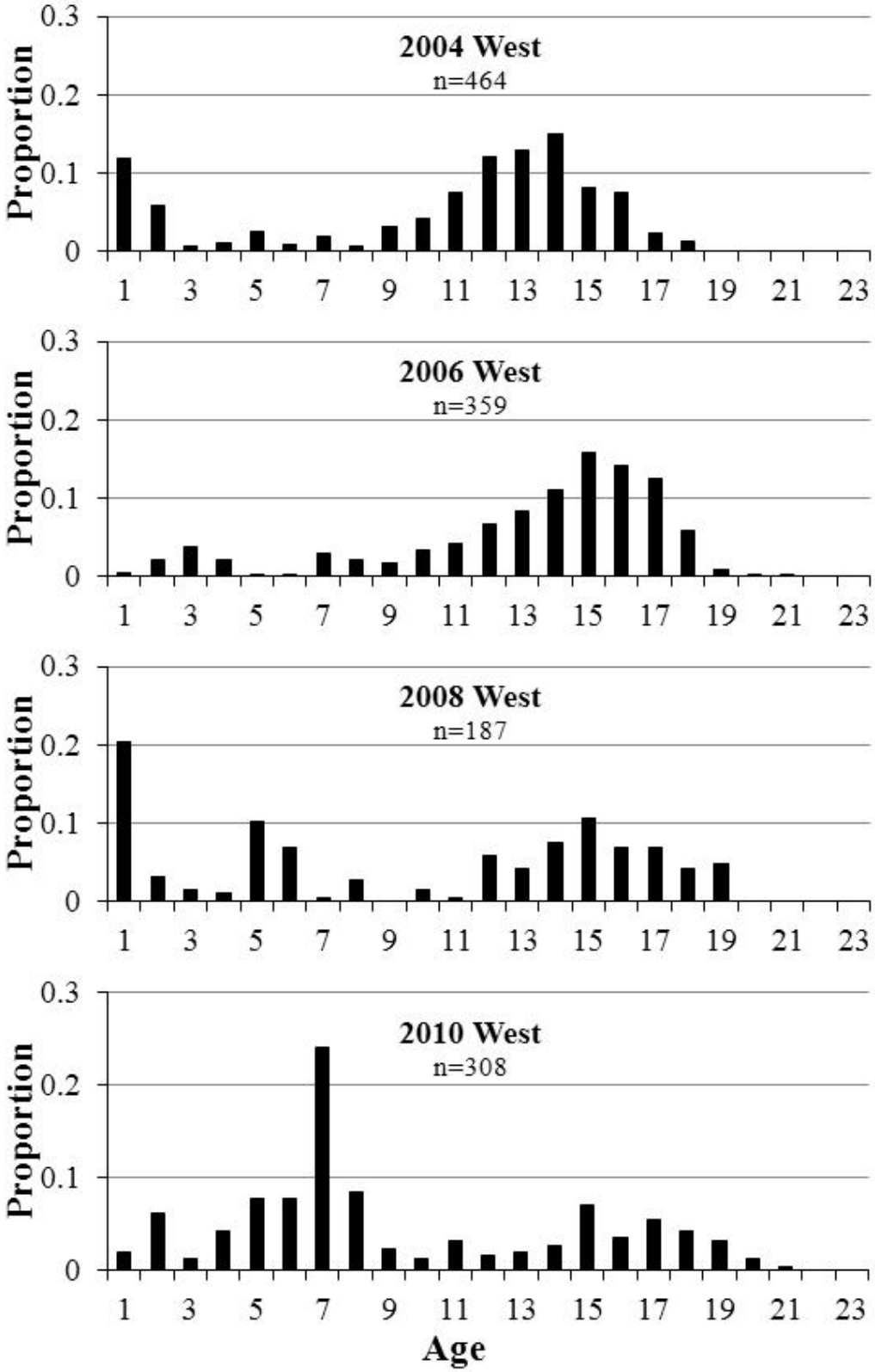

Figure 8.–Age composition of weathervane scallops from the Kayak Island west bed in 2004, 2006, 2008, and 2010.

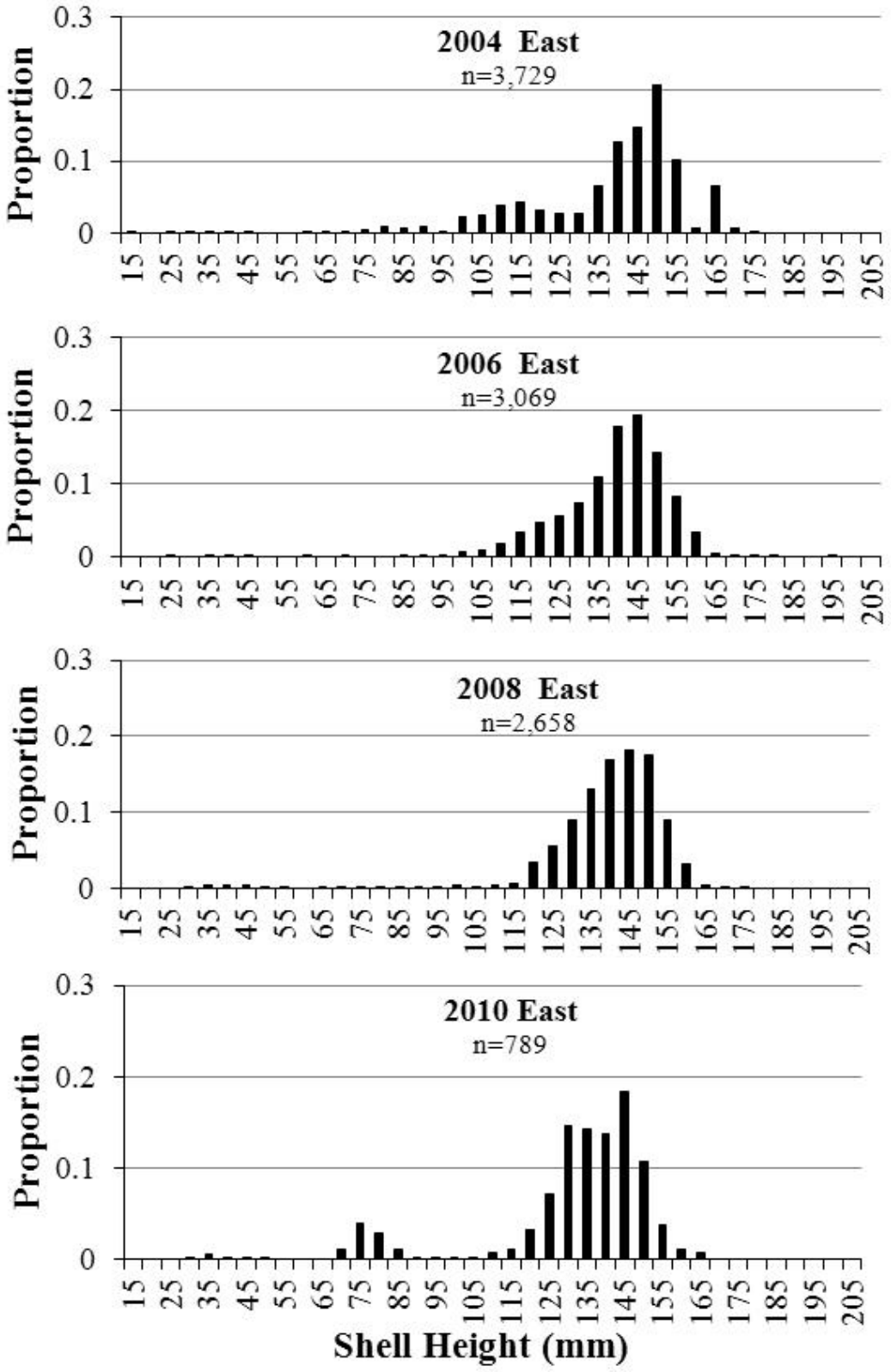

Figure 9.–Shell height composition of weathervane scallops from the Kayak Island east bed for 2004, 2006, 2008, and 2010.

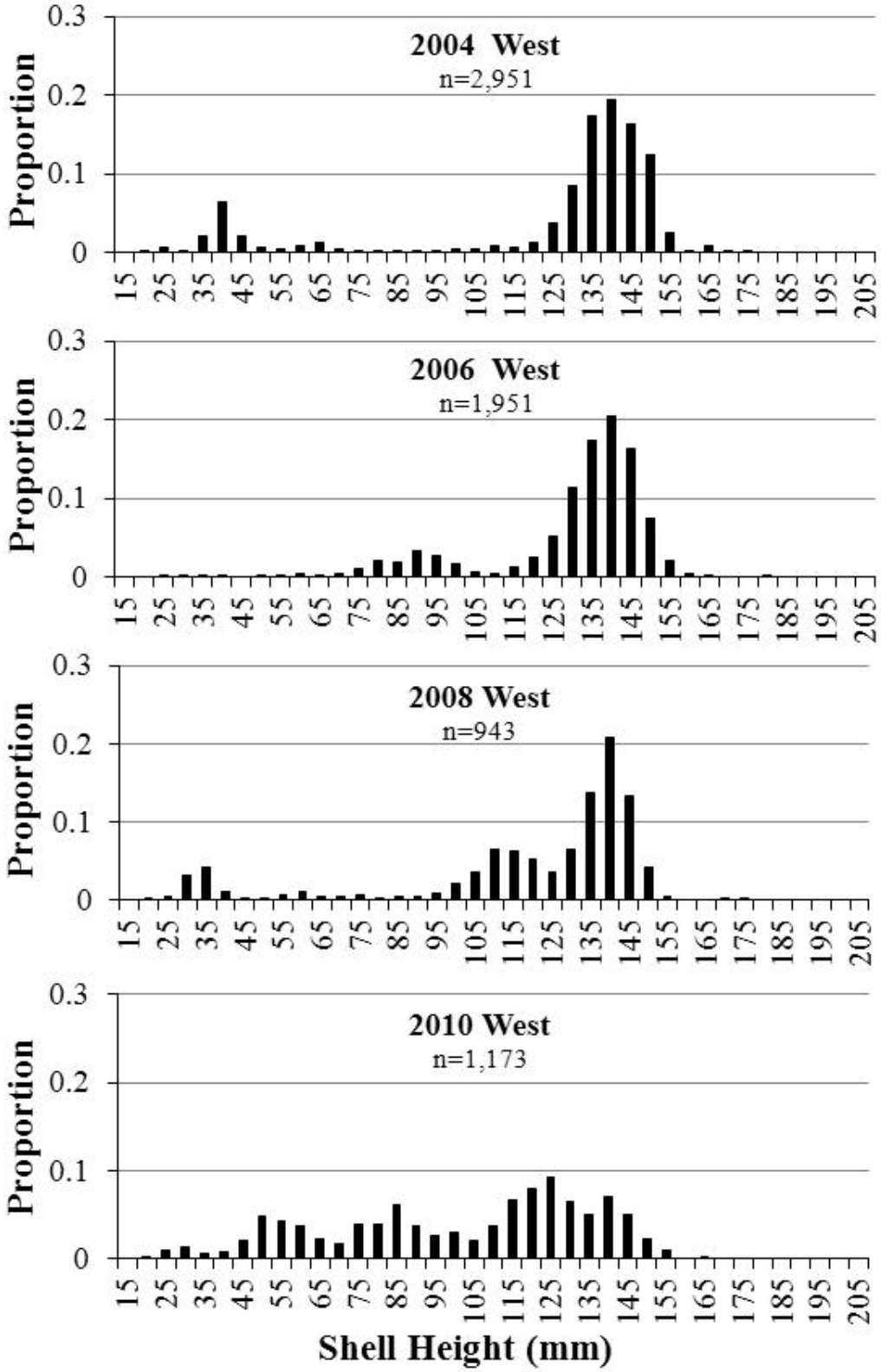

Figure 10.–Shell height composition of weathervane scallops from the Kayak Island west bed for 2004, 2006, 2008, and 2010.

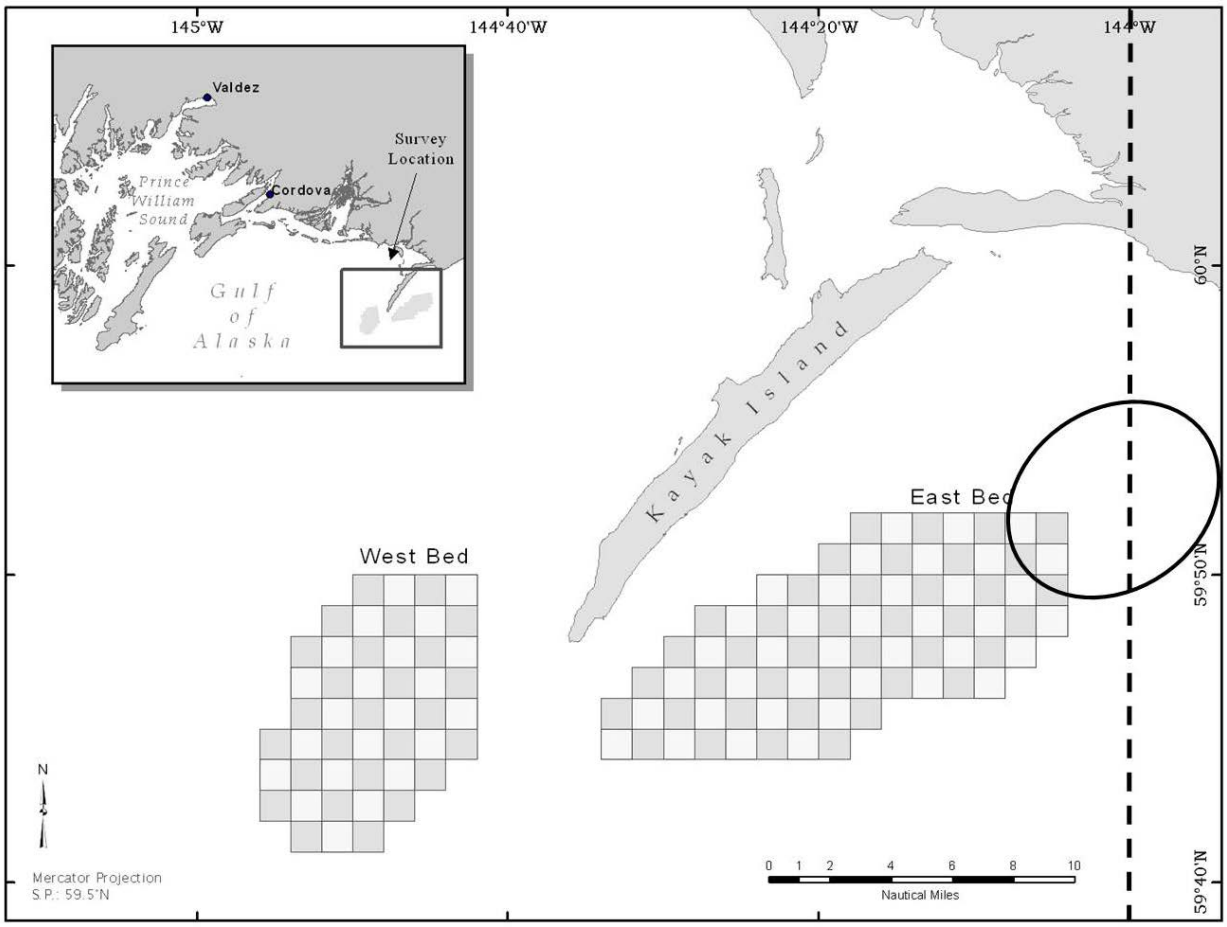

Figure 11.–Map of the Kayak Island, Cape Suckling vicinity, showing general area outside standardized east bed boundary and across the 144.0° W longitude; Area D–Area E boundary (area denoted by the circle and Area D–Area E boundary denoted by dashed line) where commercial scallop fishing effort has occurred in recent years.

APPENDIX A: WEATHERVANE SCALLOP SURVEY NON-TARGET CATCH FROM 2004 THROUGH 2010

Appendix A1.–Total target (standard plus ancillary stations) and non-target catch in the Kamishak Bay and Kayak Island weathervane scallop surveys from 2004 through 2010. Numbers with an asterisk (*) next to them are total counts and weights; all other numbers are estimates based on subsamples expanded to total catch. A double asterisk (**) indicates where the Tanner crab numbers are a combination of all large crab measured and weighed with small crab where numbers were expanded from a subsample. For surveys that had multiple fish species listed with a single weight, only abundance is provided.

KAMISHAK BAY			
2005 Kamishak Bay North Bed Numbers and Weights			
Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	2,265*	1,002.55
scallop, weathervane - cluckers	*Patinopecten caurinus*	63*	-
scallop, weathervane - shells	*Patinopecten caurinus*	-	28.11
empty bivalve shells	-	-	656.86
parma sand dollar	*Echinarachnius parma*	-	625.22
Oregon triton	*Fusitriton oregonensis*	-	266.52
hermit crab unidentified	*Paguridae*	-	226.14
crab, Tanner, bairdi	*Chionoecetes bairdi*	3,722**	222.82
scallop, pink (or calico)	*Genus Chlamys*	-	158.41
sea star unidentified	*Asteroidea unidentified*	-	154.46
snails	*genus Neptunea*	-	136.95
notched brittlestar	*Ophiura sarsi*	-	94.80
green sea urchin	*Strongylocentrotus droebachiensis*	-	72.38
orange sea pen	*Ptilosarcus gurneyi*	-	58.93
snail unidentified	*Gastropod unidentified*	-	43.67
Pacific lyre crab	*Hyas lyratus*	-	31.95
sponge unidentified	*Porifera*	-	31.68
groundfish, general	*Multiple families*	14	30.50
sole, butter	*Isopsetta isolepis*	182	24.63
bryozoan unidentified	*Bryozoa unidentified*	-	22.23
graceful decorator crab	*Oregonia gracilis*	-	19.95
flounder, arrowtooth	*Reinhardtius stomias*	16	16.32

-continued-

2005 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
basketstar	*Gorgonocephalus eucnemis*	-	14.22
lampshell unidentified	*brachiopod unidentified*	-	14.22
skate, *Bathyraja* sp.	*Bathyraja* sp.	7	12.10
northern horsemussel	*Modiolus modiolus*	-	8.01
crab, red king	*Paralithodes camtschaticus*	1	6.00
Greenland cockle	*Serripes groenlandicus*	-	3.33
sole, flathead	*Hippoglossoides elassodon*	6	3.32
nudibranch unidentified	*Nudibranchia unidentified*	-	2.80
sandpaper skate	*Bathyraja interrupta*	1	2.60
invertebrate unidentified	-	-	2.24
clam, Arctic surf	*Mactromeris polynyma*	-	1.96
sole, rex	*Glyptocephalus zachirus*	19	1.37
crab, Dungeness	*Cancer magister*	2*	1.35
northern ronquil	*Ronquilus jordani*	12	1.27
sea anemone unidentified	*Actiniaria*		1.05
crab unidentified	-	-	1.00
sole, rock	*Paraplagusia bilineata*	6	0.71
sculpin, general	*family Cottidae*	4	0.61
sturgeon poacher	*Podothecus accipenserinus*	7	0.58
bivalve unidentified	*Bivalvia unidentified*	-	0.55
sole, sand	*Psettichthys melanostictus*	1	0.50
poacher, general	*family agonidae*	6	0.48
pollock, walleye	*Theragra chalcogramma*	8	0.48
Oregon rock crab	*Cancer oregonensis*	-	0.45
unsorted catch and debris	-	-	0.40
prickleback, warbonnet, ellblenny, cockscome	*family Stichaeidae*	5	0.30
skate egg case unidentified	-	-	0.30

-continued-

2005 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
skate, big	*Raja binoculata*	1	0.20
halibut, Pacific	*Hippoglossus stenolepis*	1	0.10
starsnout poacher unidentified	*Bathyagonus* sp.	2	0.03
sole, dover	*Microstomus pacificus*	1	0.02
sole, butter	*Isopsetta isolepis*	43	-
flounder, arrowtooth	*Reinhardtius stomias*	6	-
sculpin, general	*family Cottidae*	3	-
skate, *Bathyraja* sp.	*Bathyraja* sp.	3	-
sole, flathead	*Hippoglossoides elassodon*	3	-
flounder, starry	*Platichthys stellatus*	2	-
skate unid	*Rajidae unidentified*	2	-
sole, rex	*Glyptocephalus zachirus*	2	-
crab, red king	*Paralithodes camtschaticus*	1[†]	-
halibut, Pacific	*Hippoglossus stenolepis*	1	-
poacher, general	*family agonidae*	1	-
searcher	*Bathymaster signatus*	1	-
debris_natural	-	-	896.56
debris_general	-	-	274.00
Grand Total		6,420	5,178.18

[†]Red king crab thrown over before weight taken

2005 Kamishak Bay South Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	2,380[*]	518.25
scallop, weathervane -cluckers	*Patinopecten caurinus*	31[*]	-
scallop, weathervane	*Patinopecten caurinus*	-	8.08
parma sand dollar	*Echinarachnius parma*	-	2,833.26

-continued-

2005 Kamishak Bay South Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
crab, Tanner, bairdi	*Chionoecetes bairdi*	1,319**	204.97
notched brittlestar	*Ophiura sarsi*	-	187.18
green sea urchin	*Strongylocentrotus droebachiensis*	-	100.63
Oregon triton	*Fusitriton oregonensis*	-	87.26
hermit crab unidentified	*Paguridae*	-	76.12
snails	*genus Neptunea*	-	73.70
tube worm unidentified	-	-	58.60
flounder, arrowtooth	*Reinhardtius stomias*	34	31.95
snail unidentified	Gastropod unidentified	-	26.85
halibut, Pacific	*Hippoglossus stenolepis*	6	25.06
scallop, pink (or calico)	*Genus Chlamys*	-	21.72
skate, *Bathyraja* sp.	*Bathyraja* sp.	17	17.85
left-hand whelk	*Pyrulofusus harpa*	-	8.30
empty bivalve shells	-	-	8.06
sole, butter	*Isopsetta isolepis*	36	7.99
skate, longnose	*Raja rhina*	2	7.40
sea star unidentified	*Asteroidea unident*	-	7.04
sole, flathead	*Hippoglossoides elassodon*	13	5.50
basketstar	*Gorgonocephalus eucnemis*	-	3.26
sole, dover	*Microstomus pacificus*	7	3.25
sole, rex	*Glyptocephalus zachirus*	6	1.48
sole, English	*Paraphrys vetulus*	1	0.75
sculpin, general	*family Cottidae*	10	0.42
Irish lord	*Hemilepidotus* sp.	1	0.30
starsnout poacher unidentified	*Bathyagonus* sp.	5	0.17
rockfish, other	*Sebastes* unspecified	1	0.12
skate unidentified	*Rajidae unidentified*	1	0.10

-continued-

2005 Kamishak Bay South Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
crab, Tanner, bairdi	*Chionoecetes bairdi*	1,319**	204.97
notched brittlestar	*Ophiura sarsi*	-	187.18
green sea urchin	*Strongylocentrotus droebachiensis*	-	100.63
Oregon triton	*Fusitriton oregonensis*	-	87.26
hermit crab unidentified	*Paguridae*	-	76.12
snails	*genus Neptunea*	-	73.70
tube worm unidentified	-	-	58.60
flounder, arrowtooth	*Reinhardtius stomias*	34	31.95
snail unidentified	*Gastropod unidentified*	-	26.85
halibut, Pacific	*Hippoglossus stenolepis*	6	25.06
scallop, pink (or calico)	*Genus Chlamys*	-	21.72
skate, *Bathyraja sp.*	*Bathyraja* sp.	17	17.85
left-hand whelk	*Pyrulofusus harpa*	-	8.30
empty bivalve shells	-	-	8.06
sole, butter	*Isopsetta isolepis*	36	7.99
skate, longnose	*Raja rhina*	2	7.40
sea star unidentified	*Asteroidea unidentified*	-	7.04
sole, flathead	*Hippoglossoides elassodon*	13	5.50
basketstar	*Gorgonocephalus eucnemis*	-	3.26
sole, dover	*Microstomus pacificus*	7	3.25
sole, rex	*Glyptocephalus zachirus*	6	1.48
sole, English	*Paraphrys vetulus*	1	0.75
sculpin, general	*family Cottidae*	10	0.42
Irish lord	*Hemilepidotus* sp.	1	0.30
starsnout poacher unidentified	*Bathyagonus* sp.	5	0.17
rockfish, other	*Sebastes* unspecified	1	0.12
skate unidentified	*Rajidae unidentified*	1	0.10

-continued-

2005 Kamishak Bay South Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
sturgeon poacher	*Podothecus accipenserinus*	-	0.05
eelpout unidentified	*Zoarcidae*	1	0.02
poacher, general	*family agonidae*	2	0.02
flatworm unidentified	*Platyhelminthes*	1	0.01
ronquil unidentified	*Bathymasteridae*	1	0.01
snailfish	*Liparidae unid*	1	0.01
pollock, walleye	*Theragra chalcogramma*	1	0.01
debris_general	-	-	292.00
Grand Total		3,877	4,617.76

2007 Kamishak Bay North Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
parma sand dollar	*Echinarachnius parma*	-	1,300.42
scallop, weathervane -live	*Patinopecten caurinus*	3,202**	1,134.32
scallop, weathervane - cluckers	*Patinopecten caurinus*	56*	-
scallop, weathervane - shells	*Patinopecten caurinus*	-	15.80
scallop, pink (or calico)	*Genus Chlamys*	-	228.07
crab, Tanner, bairdi	*Chionoecetes bairdi*	5,865**	184.77
green sea urchin	*Strongylocentrotus droebachiensis*	-	130.96
sea star unidentified	*Asteroidea unidentified*	510	123.40
Oregon triton	*Fusitriton oregonensis*	-	119.17
empty bivalve shells	-	-	108.64
orange sea pen	*Ptilosarcus gurneyi*	-	88.53
hermit crab unidentified	*Paguridae*	-	76.50
Pacific lyre crab	*Hyas lyratus*	-	68.06
graceful decorator crab	*Oregonia gracilis*	-	66.98
groundfish, general	Multiple families	-	35.29

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2007 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
snail unidentified	*Gastropod unidentified*	-	34.13
basketstar	*Gorgonocephalus eucnemis*	-	30.40
northern horsemussel	*Modiolus modiolus*	-	29.65
sandpaper skate	*Bathyraja interrupta*	9	19.40
bryozoan unidentified	*Bryozoa* unidentified	-	19.15
Oregon rock crab	*Cancer oregonensis*	-	17.68
sea cucumber, *Cucumaria* sp.	*Cucumaria* sp.	-	15.20
snails	genus Neptunea	-	13.35
halibut, Pacific	*Hippoglossus stenolepis*	1	12.00
sole, butter	*Isopsetta isolepis*	91	10.22
crab unidentified	-	-	9.00
skate egg case unidentified	-	5	3.10
big skate egg case	*Raja binoculata* egg case	7	2.40
cockle unidentified	-	-	1.12
crab, red king	*Paralithodes camtschaticus*	1*	1.00
cushion sea star	*Pteraster temnochiton*	1	0.40
sole, flathead	*Hippoglossoides elassodon*	1	0.35
snail eggs	*gastropod eggs*	1	0.30
scaled crab	*Placetron wosnessenskii*	2*	0.20
sturgeon poacher	*Podothecus accipenserinus*	1	0.20
sole, rex	*Glyptocephalus zachirus*	2	0.15
Alaska Skate	*Bathyraja parmifera*	1	0.10
skate, Bathyraja sp.	*Bathyraja* sp.	1	0.10
sole, English	*Paraphrys vetulus*	1	0.01
sole, butter	*Isopsetta isolepis*	162	-
sturgeon poacher	*Podothecus accipenserinus*	25	-
flounder, arrowtooth	*Reinhardtius stomias*	17	-

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2007 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
searcher	*Bathymaster signatus*	16	-
sole, rex	*Glyptocephalus zachirus*	15	-
sculpin, general	family *Cottidae*	14	-
sole, dover	*Microstomus pacificus*	12	-
sole, flathead	*Hippoglossoides elassodon*	10	-
pollock, walleye	*Theragra chalcogramma*	4	-
sole, yellowfin	*Limanda aspera*	4	-
sole, rock	*Paraplagusia bilineata*	3	-
prickleback, warbonnet, ellblenny, cockscome, shan	family Stichaeidae	2	-
spinyhead sculpin	*Dasycottus setiger*	2	-
poacher, general	family *agonidae*	1	-
skate egg case unidentified	-	1	-
smelt, eulachon	*Thaleichthys pacificus*	1	-
snailfish	*Liparidae unid*	1	-
sole, English	*Paraphrys vetulus*	1	-
yellow Irish lord	*Hemilepidotus jordani*	1	-
debris_general	-	-	1,728.00
debris_natural	-	-	586.98
Grand Total		10,050	6,215.51

2007 Kamishak Bay South Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
parma sand dollar	*Echinarachnius parma*	-	1,479.31
scallop, weathervane - live	*Patinopecten caurinus*	3,598*	728.11
scallop, weathervane - cluckers	*Patinopecten caurinus*	22*	-
scallop, weathervane	*Patinopecten caurinus*	-	9.45

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2007 Kamishak Bay South Bed Numbers and Weights (cont.)			
Common Name	Scientific Name	Number	Weight (kg)
skate egg case unidentified	-	1	0.10
yellow Irish lord	*Hemilepidotus jordani*	1	0.10
sandpaper skate	*Bathyraja interrupta*	19	-
flounder, arrowtooth	*Reinhardtius stomias*	16	-
sole, dover	*Microstomus pacificus*	15	-
sole, butter	*Isopsetta isolepis*	11	-
sole, flathead	*Hippoglossoides elassodon*	7	-
sole, rex	*Glyptocephalus zachirus*	3	-
debris_general	-	-	28.00
debris_natural	-	-	2.70
Grand Total		4,252	2,762.68

2009 Kamishak Bay North Bed Numbers and Weights			
Common Name	Scientific Name	Number	Weight (kg)
parma sand dollar	*Echinarachnius parma*	-	1,061.96
scallop, weathervane - live	*Patinopecten caurinus*	2,655*	1,026.81
scallop, weathervane - cluckers	*Patinopecten caurinus*	24*	5.24
scallop, weathervane - shells	*Patinopecten caurinus*	-	30.59
sole, butter	*Isopsetta isolepis*	2,096	265.01
crab, Tanner, bairdi	*Chionoecetes bairdi*	6,946**	253.33
knobby six-rayed seastar	*Leptasterias polaris*	539	212.16
sandpaper skate	*Bathyraja interrupta*	16	38.20
empty bivalve shells	-	-	30.93
snails	genus *Neptunea*	7	30.34
flounder, starry	*Platichthys stellatus*	14	27.50
scallop, pink (or calico)	Genus *Chlamys*	3	25.87
hermit crab unidentified	*Paguridae*	36	23.03

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2009 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
flounder, arrowtooth	*Reinhardtius stomias*	33	20.35
graceful decorator crab	*Oregonia gracilis*	8	16.40
Pacific lyre crab	*Hyas lyratus*	6	16.34
shrimp, humpy	*Pandalus goniurus*	-	16.29
cod, Pacific (gray)	*Gadus macrocephalus*	5	14.10
crab, red king	*Paralithodes camtschaticus*	4*	12.20
skate, big	*Raja binoculata*	3	9.80
bryozoan unidentified	*Bryozoa unidentified*	-	9.55
green sea urchin	*Strongylocentrotus droebachiensis*	-	9.55
shrimp, northern (pink)	*Pandalus borealis*	9	9.43
sea star unidentified	*Asteroidea unidentified*	11	8.51
Oregon triton	*Fusitriton oregonensis*	45	8.02
plain sculpin	*Myoxocephalus jaok*	3	6.30
halibut, Pacific	*Hippoglossus stenolepis*	12	5.10
pollock, walleye	*Theragra chalcogramma*	73	4.38
sole, flathead	*Hippoglossoides elassodon*	34	4.12
sturgeon poacher	*Podothecus accipenserinus*	67	4.03
purple-orange sea star	*Asterias amurensis*	1	3.50
orange sea pen	*Ptilosarcus gurneyi*	29	3.20
sole, rock	*Paraplagusia bilineata*	26	2.28
crab, Dungeness	*Cancer magister*	3	2.20
yellow Irish lord	*Hemilepidotus jordani*	13	2.10
wattled eelpout	*Lycodes palearis*	14	1.82
ribbed sculpin	*Triglops pingeli*	52	1.80
sea cucumber	class *Holothuroidea*	1	1.80
searcher	*Bathymaster signatus*	43	1.51
sole, yellowfin	*Limanda aspera*	5	1.30

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2009 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
spinyhead sculpin	*Dasycottus setiger*	22	1.21
sand dollar unidentified	-	59	1.00
snailfish	*Liparidae* unidentified	41	0.89
starsnout poacher unidentified	*Bathyagonus* sp.	51	0.81
tomcod, Pacific	*Microgadus proximus*	16	0.71
poacher, general	family *agonidae*	8	0.64
sole, rex	*Glyptocephalus zachirus*	18	0.55
sole, sand	*Psettichthys melanostictus*	1	0.45
shrimp unidentified	-	-	0.44
skate egg case unidentified	-	1	0.40
prickleback, warbonnet, ellblenny, cockscome	family *Stichaeidae*	18	0.38
shrimp, *Argis* sp.	*Argis* sp.	23	0.23
smelt, eulachon	*Thaleichthys pacificus*	2	0.23
Pacific sand lance	family *Ammodytidae*	8	0.17
sole, dover	*Microstomus pacificus*	10	0.17
Pacific staghorn sculpin	*Leptocottus armatus*	1	0.15
snail eggs	*gastropod eggs*	1	0.10
octopus, North Pacific	*Enteroctopus dofleini*	1	0.05
rockfish, black	*Sebastes melanops*	1	0.05
rockfish, other	*Sebastes unspecified*	1	0.05
rose sea star	*Crossaster papposus*	1	0.04
snail, Beringius kennicottii	*Beringius kennicottii*	1	0.04
snail unidentified	*Gastropod unidentified*	3	0.04
shrimp, *Eualus* sp.	*Eualus* sp.	5	0.03
slim sculpin	Radulinus asprellus	3	0.03
bivalve, *Astarte* sp.	*Astarte* sp.	1	0.02
shrimp, *Crangon* sp.	*Crangon* sp.	6	0.01

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2009 Kamishak Bay North Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
shrimp, Spirontocaris	*Spirontocaris* sp.	5	0.01
spiny lebbeid	*Lebbeus groenlandicus*	1	0.01
brittlestar unidentified	*Ophiuroid unidentified*	7	0.01
Greenland cockle	*Serripes groenlandicus*	1	0.00
debris_general	-	-	3,612.89
debris_natural	-	-	1,158.47
unsorted catch and debris	-	-	786.00
unsorted catch and debris	-	-	0.92
Grand Total		13,153	3,235.86

2009 Kamishak Bay North Bed Numbers and Weights from Unsorted and Debris Catch

Common Name	Scientific Name	Number	Weight (kg)
bivalve, Astarte sp.	*Astarte* sp.	14.68	0.25
blood sea star	*Henricia leviuscula*	10.75	0.21
brittlestar unidentified	*Ophiuroid unidentified*	183.11	0.61
bryozoan unidentified	*Bryozoa unidentified*	-	19.74
chiton unidentified	*Polyplacophora unidentified*	185.84	0.19
cockle unidentified	*Clinocardium sp.*	64.60	1.89
graceful decorator crab	*Oregonia gracilis*	14.21	0.20
hermit crab unidentified	*Paguridae*	1696.12	50.12
left-hand whelk	*Pyrulofusus harpa*	196.59	7.19
orange sea pen	*Ptilosarcus gurneyi*	832.53	22.75
Oregon rock crab	*Cancer oregonensis*	38.56	0.19
Oregon triton	*Fusitriton oregonensis*	1565.97	31.31
Pacific lyre crab	*Hyas lyratus*	243.89	9.80
sand dollar unidentified	-	5662.87	96.24
scallop, pink (or calico)	Genus *Chlamys*	2463.17	52.02

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2009 Kamishak Bay North Bed Numbers and Weights from Unsorted and Debris Catch (cont.)

Common Name	Scientific Name	Number	Weight (kg)
shrimp, *Argis* sp.	*Argis* sp.	133.47	5.27
shrimp, *Crangon* sp.	*Crangon* sp.	940.39	10.56
shrimp, *Eualus* sp.	*Eualus* sp.	17.82	0.10
shrimp, humpy	*Pandalus goniurus*	20173.32	95.39
shrimp, northern (pink)	*Pandalus borealis*	204.45	3.40
snail unidentified	Gastropod unidentified	62.21	1.14
snail, *Beringius kennicottii*	*Beringius kennicottii*	17.66	1.77
snails	*genus Neptunea*	149.06	3.95
sole, butter	*Isopsetta isolepis*	5.07	1.52
spiny lebbeid	*Lebbeus groenlandicus*	49.31	0.30
sponge hermit	*Pagurus brandti*	185.84	5.58
whelk, *Buccinum* sp.	*Buccinum* sp.	86.53	2.09
debris_natural	-	-	362.21
Grand Total		35,198	786.00

2009 Kamishak Bay South Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
parma sand dollar	*Echinarachnius parma*	-	1,874.13
scallop, weathervane - live	*Patinopecten caurinus*	1,231*	211.87
scallop, weathervane - cluckers	*Patinopecten caurinus*	6*	0.60
scallop, weathervane - shells	*Patinopecten caurinus*	-	2.43
notched brittlestar	*Ophiura sarsi*	-	150.56
green sea urchin	*Strongylocentrotus droebachiensis*	-	71.74
snails	genus *Neptunea*	-	47.37
Oregon triton	*Fusitriton oregonensis*	-	46.37
flounder, arrowtooth	*Reinhardtius stomias*	22	37.80
sandpaper skate	*Bathyraja interrupta*	21	27.50

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2009 Kamishak Bay South Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
hermit crab unidentified	*Paguridae*	-	25.12
skate, big	*Raja binoculata*	2	14.50
sand dollar unidentified	-	-	12.50
crab, Tanner, bairdi	*Chionoecetes bairdi*	6,227**	10.08
empty bivalve shells	-	-	10.03
scallop, pink (or calico)	Genus *Chlamys*		10.03
skate, longnose	*Raja rhina*	1	10.00
tube worm unidentified	-	-	8.00
sole, butter	*Isopsetta isolepis*	20	7.55
basketstar	*Gorgonocephalus eucnemis*	-	5.82
halibut, Pacific	*Hippoglossus stenolepis*	1	5.50
sea whip	*Halipteris* sp.	-	5.15
snail unidentified	*Gastropod* unidentified	-	4.82
sole, dover	*Microstomus pacificus*	5	4.00
sole, flathead	*Hippoglossoides elassodon*	3	4.00
knobby six-rayed seastar	*Leptasterias polaris*	3	3.00
sea anemone unidentified	*Actiniaria*	-	2.71
blackspined sea star	*Lethasterias nanimensis*	3	2.60
left-hand whelk	*Pyrulofusus harpa*	-	1.66
sole, English	*Paraphrys vetulus*	2	0.90
morning sun sea star	*Solaster dawsoni*	-	0.80
sea star unidentified	*Asteroidea unidentified*	2	0.60
long-rayed star	*Stylasterias forreri*	1	0.60
snailfish	*Liparidae* unid	2	0.40
striped sun sea star	*Solaster stimpsoni*	2	0.35
rose sea star	*Crossaster papposus*	7	0.35
lumpsucker or snailfish unidentified	*Cyclopteridae*	1	0.30

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2009 Kamishak Bay South Bed Numbers and Weights (cont.)			
Common Name	Scientific Name	Number	Weight (kg)
northern sea star	*Dipsacaster borealis*	8	0.28
blood sea star	*Henricia leviuscula*	2	0.24
pollock, walleye	*Theragra chalcogramma*	1	0.20
tadpole sculpin	*Psychrolutes paradoxus*	5	0.10
starsnout poacher unidentified	*Bathyagonus* sp.	1	0.04
debris_general	-	-	435.20
unsorted catch and debris	-	-	-
Grand Total		7,579	3,060.79

KAYAK ISLAND

2004 Kayak Island East Bed Numbers and Weights			
Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	8,679*	2,293.36
scallop, weathervane - cluckers	*Patinopecten caurinus*	40*	-
scallop, weathervane - shells	*Patinopecten caurinus*	-	15.69
notched brittlestar	*Ophiura sarsi*	-	1,181.76
sea star unidentified	*Asteroidea unidentified*	-	37.78
skate, Bathyraja sp.	*Bathyraja* sp.	4	19.05
bristleworm, sea mouse	*Aphrodita negligens*	-	14.12
sunflower sea star	*Pycnopodia helianthoides*	8	11.79
groundfish, general	Multiple families	14	10.28
snail unidentified	*Gastropod* unidentified	-	3.74
empty bivalve shells	-	-	2.96
hermit crab unidentified	Paguridae	-	2.43
shrimp unidentified	-	-	2.18
crab, Tanner, bairdi	*Chionoecetes bairdi*	139**	1.11
Oregon rock crab	*Cancer oregonensis*	-	0.82

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2009 Kayak Island South Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
northern sea star	*Dipsacaster borealis*	8	0.28
blood sea star	*Henricia leviuscula*	2	0.24
pollock, walleye	*Theragra chalcogramma*	1	0.20
tadpole sculpin	*Psychrolutes paradoxus*	5	0.10
starsnout poacher unidentified	*Bathyagonus* sp.	1	0.04
debris_general	-	-	435.20
unsorted catch and debris	-	-	-
Grand Total		7,579	3,060.79

Kayak Island

2004 Kayak Island East Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	8,679*	2,293.36
scallop, weathervane - cluckers	*Patinopecten caurinus*	40*	-
scallop, weathervane - shells	*Patinopecten caurinus*	-	15.69
notched brittlestar	*Ophiura sarsi*	-	1,181.76
sea star unidentified	Asteroidea unidentified	-	37.78
skate, Bathyraja sp.	*Bathyraja* sp.	4	19.05
bristleworm, sea mouse	*Aphrodita negligens*	-	14.12
sunflower sea star	*Pycnopodia helianthoides*	8	11.79
groundfish, general	Multiple families	14	10.28
snail unidentified	*Gastropod* unidentified	-	3.74
empty bivalve shells	-	-	2.96
hermit crab unidentified	*Paguridae*	-	2.43
shrimp unidentified	-	-	2.18
crab, Tanner, bairdi	*Chionoecetes bairdi*	139**	1.11
Oregon rock crab	*Cancer oregonensis*	-	0.82

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2004 Kayak Island East Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
basketstar	*Gorgonocephalus eucnemis*	-	0.37
crescent sea cucumber	*Pentamera lissoplaca*	-	0.32
sole, rex	*Glyptocephalus zachirus*	2	0.20
eelpout unidentified	*Zoarcidae*	1	0.07
prickleback, warbonnet, ellblenny, cockscome, shan	*family Stichaeidae*	2	0.05
flounder, arrowtooth	*Reinhardtius stomias*	1	0.02
eelpout unidentified	*Zoarcidae*	85	-
sole, dover	*Microstomus pacificus*	77	-
flounder, arrowtooth	*Reinhardtius stomias*	30	-
smelt, eulachon	*Thaleichthys pacificus*	7	-
shortfin eelpout	*Lycodes brevipes*	5	-
sole, rex	*Glyptocephalus zachirus*	5	-
starsnout poacher unidentified	*Bathyagonus* sp.	5	-
dwarf wrymouth	*Lyconectes aleutensis*	4	-
octopus, North Pacific	*Enteroctopus dofleini*	3	-
pollock, walleye	*Theragra chalcogramma*	3	-
sole, flathead	*Hippoglossoides elassodon*	3	-
prickleback, warbonnet, ellblenny, cockscome, shan	family *Stichaeidae*	2	-
searcher	*Bathymaster signatus*	2	-
skate, Bathyraja sp.	*Bathyraja* sp.	2	-
skate, big	*Raja binoculata*	1	-
snailfish	*Liparidae unid*	1	-
wattled eelpout	*Lycodes palearis*	1	-
debris_natural	-	-	131.55
Grand Total		9,126	3,729.64

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2004 Kayak Island West Bed Number and Weights			
Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	9,840*	2,129.48
scallop, weathervane - cluckers	*Patinopecten caurinus*	57*	-
scallop, weathervane - shells	*Patinopecten caurinus*	-	25.04
notched brittlestar	*Ophiura sarsi*	-	349.80
common mud star	*Ctenodiscus crispatus*	-	318.20
sunflower sea star	*Pycnopodia helianthoides*	25	110.44
groundfish, general	Multiple families	-	49.93
sea star unidentified	*Asteroidea* unidentified	-	26.01
bristleworm, sea mouse	*Aphrodita negligens*	-	12.80
empty bivalve shells	-	-	9.73
wolf-eel	*Anarrhichthys ocellatus*	1	5.44
shrimp unidentified	-	-	2.61
crab, Tanner, bairdi	*Chionoecetes bairdi*	161**	1.29
hermit crab unidentified	*Paguridae*	-	1.00
skate egg case unidentified	-	6	0.91
snail unidentified	*Gastropod* unidentified	-	0.64
sweet sea potato	*Molpadia intermedia*	-	0.41
sole, dover	*Microstomus pacificus*	3	0.06
sole, rex	*Glyptocephalus zachirus*	1	0.02
sole, dover	*Microstomus pacificus*	111	-
sole, rex	*Glyptocephalus zachirus*	60	-
eelpout unidentified	*Zoarcidae*	42	-
sole, flathead	*Hippoglossoides elassodon*	9	-
sole, English	*Paraphrys vetulus*	8	-
flounder, arrowtooth	*Reinhardtius stomias*	6	-
skate, Bathyraja sp.	*Bathyraja* sp.	5	-
searcher	*Bathymaster signatus*	3	-

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2004 Kayak Island West Bed Number and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
pollock, walleye	*Theragra chalcogramma*	2	-
dwarf wrymouth	*Lyconectes aleutensis*	1	-
prickleback, warbonnet, ellblenny, cockscome, shan	family *Stichaeidae*	1	-
sculpin, general	family *Cottidae*	1	-
skate, longnose	*Raja rhina*	1	-
smelt, eulachon	*Thaleichthys pacificus*	1	-
snailfish	*Liparidae unid*	1	-
sole, butter	*Isopsetta isolepis*	1	-
starsnout poacher unidentified	*Bathyagonus* sp.	1	-
debris_natural	-	-	186.03
debris_general	-	-	60.78
unsorted catch and debris	-	-	0.20
Grand Total		10,348	3,290.62

2006 Kayak Island East Bed Number and Weights

Common Name	Scientific Name	Number	Weight (kg)
notched brittlestar	*Ophiura sarsi*	-	1,836.82
scallop, weathervane - live	*Patinopecten caurinus*	5,280*	1,445.73
scallop, weathervane - cluckers	*Patinopecten caurinus*	66*	4.76
scallop, weathervane -shells	*Patinopecten caurinus*	-	33.45
basketstar	*Gorgonocephalus eucnemis*	-	71.00
sea star unidentified	*Asteroidea unidentified*	-	70.21
bristleworm, sea mouse	*Aphrodita negligens*	-	20.83
sole, dover	*Microstomus pacificus*	62	15.53
empty bivalve shells	-	-	5.20
sunflower sea star	*Pycnopodia helianthoides*	-	5.16
sole, flathead	*Hippoglossoides elassodon*	6	3.35

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2006 Kayak Island East Bed Number and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
sea whip	*Halipteris* sp.	-	3.20
sole, rex	*Glyptocephalus zachirus*	19	2.80
flounder, arrowtooth	*Reinhardtius stomias*	4	2.52
tunicate unidentified	*Ascidian unidentified*	-	1.98
sandpaper skate	*Bathyraja interrupta*	4	1.75
eelpout unidentified	*Zoarcidae*	30	1.73
hermit crab unidentified	*Paguridae*	-	1.63
sole, English	*Paraphrys vetulus*	2	0.70
crab, Tanner, bairdi	*Chionoecetes bairdi*	70**	0.59
invertebrate unidentified	-	-	0.34
dwarf wrymouth	*Lyconectes aleutensis*	9	0.29
prickleback, warbonnet, ellblenny, cockscome, shan	family *Stichaeidae*	6	0.19
pollock, walleye	*Theragra chalcogramma*	2	0.13
octopus, North Pacific	*Enteroctopus dofleini*	1	0.12
searcher	*Bathymaster signatus*	5	0.10
sculpin, general	family *Cottidae*	2	0.04
poacher, general	family *agonidae*	1	0.02
starsnout poacher unidentified	*Bathyagonus* sp.	1	0.01
brittlestar unidentified	Ophiuroid unidentified	-	1.70
sea mouse unidentified	*Aphroditidae*	-	0.05
sea star unidentified	*Asteroidea unidentified*	-	0.15
welk	*Neptunea* sp.	-	0.05
debris_natural	-	-	738.39
debris_general	-	-	414.00
unsorted catch and debris	-	-	13.30
Grand Total		5,570	4,697.81

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2006 Kayak Island West Bed Numbers and Weights			
Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	5,523*	1,232.44
scallop, weathervane - cluckers	*Patinopecten caurinus*	114*	8.65
scallop, weathervane - shells	*Patinopecten caurinus*	-	24.92
notched brittlestar	*Ophiura sarsi*	-	309.72
sunflower sea star	*Pycnopodia helianthoides*	83	157.76
common mud star	*Ctenodiscus crispatus*	4	145.70
sole, dover	*Microstomus pacificus*	153	56.58
empty bivalve shells	-	-	51.08
sea star unidentified	*Asteroidea unidentified*	-	33.18
bristleworm, sea mouse	*Aphrodita negligens*	-	14.02
skate egg case unidentified	-	51	9.50
sole, rex	*Glyptocephalus zachirus*	106	8.75
bivalve unidentified	*Bivalvia unidentified*	-	8.30
sole, flathead	*Hippoglossoides elassodon*	18	4.12
sole, English	*Paraphrys vetulus*	7	3.02
eelpout unidentified	*Zoarcidae*	34	1.95
flounder, arrowtooth	*Reinhardtius stomias*	10	1.03
crescent sea cucumber	*Pentamera lissoplaca*	-	0.84
big skate egg case	*Raja binoculata egg case*	3	0.75
crab, Tanner, bairdi	*Chionoecetes bairdi*	76**	0.64
sole, butter	*Isopsetta isolepis*	2	0.60
pollock, walleye	*Theragra chalcogramma*	2	0.35
skate, big	*Raja binoculata*	4	0.33
coral	genus *Corallium*	-	0.25
sandpaper skate	*Bathyraja interrupta*	1	0.25
searcher	*Bathymaster signatus*	3	0.25
sponge unidentified	*Porifera*	-	0.25

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2006 Kayak Island West Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
dwarf wrymouth	*Lyconectes aleutensis*	2	0.08
debris_natural	-	-	155.14
debris_general	-	-	114.00
unsorted catch and debris	-	-	0.40
Grand Total		6,196	2,344.85

2008 Kayak Island East Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
notched brittlestar	*Ophiura sarsi*	-	2,364.25
scallop, weathervane -live	*Patinopecten caurinus*	4,332*	1,331.68
scallop, weathervane -cluckers	*Patinopecten caurinus*	98*	10.06
scallop, weathervane - shells	*Patinopecten caurinus*	-	56.00
sunflower sea star	*Pycnopodia helianthoides*	36	98.30
groundfish, general	Multiple families	-	30.60
basketstar	*Gorgonocephalus eucnemis*	39	21.35
sea star unidentified	*Asteroidea* unidentified	31	19.47
invertebrate unidentified	-	-	13.93
empty bivalve shells	-	-	12.25
bristleworm, sea mouse	*Aphrodita negligens*	-	12.08
snail unidentified	Gastropod unidentified	-	9.86
sandpaper skate	*Bathyraja interrupta*	8	7.00
sole, dover	*Microstomus pacificus*	10	4.60
hermit crab unidentified	Paguridae	-	3.04
sea whip	*Halipteris* sp.	-	2.13
bivalve unidentified	Bivalvia unidentified	-	1.62
lingcod	*Ophiodon elongatus*	1	1.30
sole, English	*Paraphrys vetulus*	2	1.00

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2008 Kayak Island East Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
skate egg case unidentified		7	0.96
orange sea pen	*Ptilosarcus gurneyi*	-	0.74
sea whip unidentified	*Virgularidae*	1	0.68
wattled eelpout	*Lycodes palearis*	4	0.60
eelpout unidentified	Zoarcidae	8	0.53
crab, Tanner, bairdi	*Chionoecetes bairdi*	94**	0.40
rockfish, rougheye	*Sebastes aleutianus*	3	0.22
big skate egg case	Raja binoculata egg case	1	0.20
searcher	*Bathymaster signatus*	1	0.15
whitebarred prickleback	*Poroclinus rothrocki*	5	0.10
starsnout poacher unidentified	*Bathyagonus sp.*	1	0.03
sole, dover	*Microstomus pacificus*	48	-
sole, rex	*Glyptocephalus zachirus*	23	-
eelpout unidentified	*Zoarcidae*	20	-
shortfin eelpout	*Lycodes brevipes*	20	-
wattled eelpout	*Lycodes palearis*	6	-
sole, English	*Paraphrys vetulus*	4	-
prickleback, warbonnet, ellblenny, cockscome, shan	family Stichaeidae	3	-
sablefish (blackcod)	*Anoplopoma fimbria*	3	-
dwarf wrymouth	*Lyconectes aleutensis*	2	-
flounder, arrowtooth	*Reinhardtius stomias*	2	-
pollock, walleye	*Theragra chalcogramma*	2	-
sandpaper skate	*Bathyraja interrupta*	2	-
smelt, eulachon	*Thaleichthys pacificus*	2	-
debris_natural	-	-	727.64
debris_general	-	-	253.98
Grand Total		4,819	4,986.72

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2008 Kayak Island East Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
skate egg case unidentified		7	0.96
orange sea pen	*Ptilosarcus gurneyi*	-	0.74
sea whip unidentified	*Virgularidae*	1	0.68
wattled eelpout	*Lycodes palearis*	4	0.60
eelpout unidentified	Zoarcidae	8	0.53
crab, Tanner, bairdi	*Chionoecetes bairdi*	94**	0.40
rockfish, rougheye	*Sebastes aleutianus*	3	0.22
big skate egg case	*Raja binoculata* egg case	1	0.20
searcher	*Bathymaster signatus*	1	0.15
whitebarred prickleback	*Poroclinus rothrocki*	5	0.10
starsnout poacher unidentified	*Bathyagonus* sp.	1	0.03
sole, dover	*Microstomus pacificus*	48	-
sole, rex	*Glyptocephalus zachirus*	23	-
eelpout unidentified	*Zoarcidae*	20	-
shortfin eelpout	*Lycodes brevipes*	20	-
wattled eelpout	*Lycodes palearis*	6	-
sole, English	*Paraphrys vetulus*	4	-
prickleback, warbonnet, ellblenny, cockscome, shan	family *Stichaeidae*	3	-
sablefish (blackcod)	*Anoplopoma fimbria*	3	-
dwarf wrymouth	*Lyconectes aleutensis*	2	-
flounder, arrowtooth	*Reinhardtius stomias*	2	-
pollock, walleye	*Theragra chalcogramma*	2	-
sandpaper skate	*Bathyraja interrupta*	2	-
smelt, eulachon	*Thaleichthys pacificus*	2	-
debris_natural	-	-	727.64
debris_general	-	-	253.98
Grand Total		4,819	4,986.72

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2008 Kayak Island West Bed Numbers and Weights			
Common Name	Scientific Name	Number	Weight (kg)
notched brittlestar	*Ophiura sarsi*		248.32
scallop, weathervane - live	*Patinopecten caurinus*	1,058*	195.81
scallop, weathervane - cluckers	*Patinopecten caurinus*	108*	11.16
scallop, weathervane	*Patinopecten caurinus*	-	13.70
sunflower sea star	*Pycnopodia helianthoides*	52	107.10
common mud star	*Ctenodiscus crispatus*	-	91.80
groundfish, general	Multiple families	-	13.20
sea star unidentified	*Asteroidea* unidentified	10	6.87
wolf-eel	*Anarrhichthys ocellatus*	1	5.00
scallop, pink (or calico)	Genus *Chlamys*	-	3.51
big skate egg case	*Raja binoculata egg case*	13	3.40
empty bivalve shells	-	-	3.38
skate egg case unidentified	-	15	3.10
sole, dover	*Microstomus pacificus*	4	2.40
shrimp unidentified	-	-	2.34
bristleworm, sea mouse	*Aphrodita negligens*		0.92
crab, Tanner, bairdi	*Chionoecetes bairdi*	122**	0.58
sole, flathead	*Hippoglossoides elassodon*	1	0.30
wattled eelpout	*Lycodes palearis*	2	0.30
shortfin eelpout	*Lycodes brevipes*	1	0.10
poacher, general	family *agonidae*	1	0.01
sole, dover	*Microstomus pacificus*	16	-
sole, rex	*Glyptocephalus zachirus*	12	-
shortfin eelpout	*Lycodes brevipes*	8	-
sole, butter	*Isopsetta isolepis*	3	-
sole, English	*Paraphrys vetulus*	3	-

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2008 Kayak Island West Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
pollock, walleye	*Theragra chalcogramma*	2	-
Snailfish	*Liparidae* unid	2	-
wattled eelpout	*Lycodes palearis*	2	-
dwarf wrymouth	*Lyconectes aleutensis*	1	-
eelpout unidentified	*Zoarcidae*	1	-
flounder, arrowtooth	*Reinhardtius stomias*	1	-
octopus, North Pacific	*Enteroctopus dofleini*	1	-
poacher, general	family agonidae	1	-
skate, big	*Raja binoculata*	1	-
sole, yellowfin	*Limanda aspera*	1	-
spinyhead sculpin	*Dasycottus setiger*	1	-
debris_general	-	-	40.50
debris_natural	-	-	3.94
unsorted catch and debris	-	-	2.80
Grand Total		1,444	760.53

2010 Kayak Island East Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane -live	*Patinopecten caurinus*	1,733*	424.76
scallop, weathervane - cluckers	*Patinopecten caurinus*	103*	12.62
scallop, weathervane - shells	*Patinopecten caurinus*	*	34.65
sunflower sea star	*Pycnopodia helianthoides*	15*	26.00
sand sea star	*Luidia foliolata*	14*	10.18
sole, dover	*Microstomus pacificus*	24*	9.90
basketstar	*Gorgonocephalus eucnemis*	16*	6.90
skate, Bathyraja sp.	*Bathyraja* sp.	4*	2.60
sandpaper skate	*Bathyraja interrupta*	1*	1.90

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2010 Kayak Island East Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
skate egg case unidentified	-	19*	1.10
sole, flathead	*Hippoglossoides elassodon*	2*	0.90
shortfin eelpout	*Lycodes brevipes*	7*	0.65
eelpout unidentified	*Zoarcidae*	2*	0.52
sole, English	*Paraphrys vetulus*	2*	0.35
sponge unidentified	*Porifera*	1*	0.25
wattled eelpout	*Lycodes palearis*	1*	0.20
welk	*Neptunea* sp.	1*	0.10
flounder, arrowtooth	*Reinhardtius stomias*	3*	0.08
sole, rex	*Glyptocephalus zachirus*	4*	0.06
rockfish, rougheye	*Sebastes aleutianus*	1*	0.03
sculpin, general	family *Cottidae*	1*	0.03
dwarf wrymouth	*Lyconectes aleutensis*	1*	0.01
prickelback unidentified	*Stichaeidae*	1*	0.01
vermilion sea star	*Mediaster aequalis*	1*	0.01
searcher	*Bathymaster signatus*	1*	0.01
debris_natural	-	*	0.75
unsorted catch and debris	-	*	581.80
Grand Total		1,958	1,116.35

2010 Kayak Island East Bed Numbers and Weights from Unsorted and Debris Catch

Common Name	Scientific Name	Number	Weight (kg)
notched brittlestar	*Ophiura sarsi*	75,097	519.35
common mud star	*Ctenodiscus crispatus*	1,048	17.98
sea mouse unidentified	*Aphroditidae*	247	6.75
sea urchin	class *Echinoidea*	59	5.90
bivalve unidentified	*Bivalvia* unidentified	362	3.79

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2010 Kayak Island East Bed Numbers and Weights from Unsorted and Debris Catch (cont.)

Common Name	Scientific Name	Number	Weight (kg)
skate egg case unidentified	-	88	3.64
cockle unidentified	*Clinocardium* sp.	181	3.02
hermit crab unidentified	Paguridae	64	1.77
moonsnail, Natica sp.	*Natica* sp.	40	1.53
shrimp unidentified	-	81	1.48
box crab	*Lopholithodes mandtii*	30	1.48
yellowleg pandalid	*Pandalus tridens*	30	1.48
Neptune snail	*Neptunea* sp.	30	1.48
crab, Tanner, bairdi	*Chionoecetes bairdi*	66	0.76
graceful kelp crab	*Pugettia gracilis*	19	0.75
black mussel	*Musculus niger*	58	0.58
razor clam	*Siliqua* sp.	58	0.58
shrimp, Crangon sp.	*Crangon* sp.	58	0.58
crab unidentified	-	14	0.35
sand sea star	*Luidia foliolata*	-	0.33
scallop, weathervane -shells	*Patinopecten caurinus*	-	0.30
bristleworm, sea mouse	*Aphrodita negligens*	5	0.05
sea cucumber	class *Holothuroidea*	5	0.05
debris_natural	-	130	7.85
Grand Total		77,767	581.80

2010 Kayak Island West Bed Numbers and Weights

Common Name	Scientific Name	Number	Weight (kg)
scallop, weathervane - live	*Patinopecten caurinus*	1,520*	259.49
scallop, weathervane - clucker	*Patinopecten caurinus*	22*	0.85
scallop, weathervane - shells	*Patinopecten caurinus*	*	8.94
sunflower sea star	*Pycnopodia helianthoides*	112*	121.14

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2010 Kayak Island West Bed Numbers and Weights (cont.)

Common Name	Scientific Name	Number	Weight (kg)
Raja sp. egg case	*Raja* sp. egg case	98*	31.05
sand sea star	*Luidia foliolata*	64*	27.40
sole, dover	*Microstomus pacificus*	60*	25.65
wolf-eel	*Anarrhichthys ocellatus*	3*	16.90
skate egg case unidentified	-	47*	4.44
flounder, arrowtooth	*Reinhardtius stomias*	9*	4.35
shark, spiny dogfish	*Squalus acanthias*	2*	4.20
notched brittlestar	*Ophiura sarsi*	*	2.13
Aleutian skate	*Bathyraja aleutica*	1*	1.30
wattled eelpout	*Lycodes palearis*	2*	1.30
sole, flathead	*Hippoglossoides elassodon*	5*	0.59
sole, rex	*Glyptocephalus zachirus*	15*	0.42
sea whip unidentified	*Virgularidae*	1*	0.40
sole, English	*Paraphrys vetulus*	3*	0.40
sea anemone unidentified	*Actiniaria*	1*	0.28
sea star unidentified	*Asteroidea unidentified*	2*	0.25
hermit crab unidentified	*Paguridae*	16*	0.07
shortfin eelpout	*Lycodes brevipes*	1*	0.03
dwarf wrymouth	*Lyconectes aleutensis*	1*	0.02
nudibranch unidentified	*Nudibranchia unidentified*	1*	0.02
graceful decorator crab	*Oregonia gracilis*	1*	0.01
poacher, general	family *agonidae*	1*	0.01
bivalve unidentified	*Bivalvia* unidentified	2*	0.00
bristleworm, sea mouse	*Aphrodita negligens*	1*	0.00
debris_general	-	*	0.18
unsorted catch and debris	-	*	1,372.50
Grand Total		1,969	1,884.32

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2010 Kayak Island West Bed Numbers and Weights from Unsorted and Debris Catch			
Common Name	Scientific Name	Number	Weight (kg)
common mud star	*Ctenodiscus crispatus*	44,572.0	23.63
notched brittlestar	*Ophiura sarsi*	5,117.6	23.34
sand sea star	*Luidia foliolata*	0.0	2.20
sweet sea potato	*Molpadia intermedia*	129.0	1.75
sea star unidentified	*Asteroidea unidentified*	65.1	1.27
bristleworm, sea mouse	*Aphrodita negligens*	1,367.9	1.16
coral	genus Corallium	0.0	0.40
bryozoan unidentified	Bryozoa unidentified	0.0	0.34
hermit crab unidentified	Paguridae	1,259.0	0.26
skate egg case unidentified	-	117.9	0.25
bivalve unidentified	Bivalvia unidentified	1,700.1	0.15
moonsnail, Natica sp.	*Natica* sp.	956.6	0.08
Pacific lyre crab	*Hyas lyratus*	104.5	0.04
shrimp, northern (pink)	*Pandalus borealis*	528.4	0.03
northern horsemussel	*Modiolus modiolus*	212.0	0.02
shortfin eelpout	*Lycodes brevipes*	46.6	0.02
spinyhead sculpin	*Dasycottus setiger*	13.7	0.02
moonsnail eggs unid.	*Naticidae eggs*	0.0	0.02
orange sea pen	*Ptilosarcus gurneyi*	25.6	0.02
sea anemone unidentified	*Actiniaria*	18.9	0.02
crab, Tanner, bairdi	*Chionoecetes bairdi*	113.0	0.01
sponge unidentified	*Porifera*	11.0	0.01
snail unidentified	*Gastropod unidentified*	15.9	0.01
smelt, eulachon	*Thaleichthys pacificus*	10.1	0.01
Hind's scallop/ reddish scallop	*Chlamys rubida*	2.6	0.01
tadpole sculpin	*Psychrolutes paradoxus*	62.7	0.01

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2010 Kayak Island West Bed Numbers and Weights from Unsorted and Debris Catch (cont.)			
Common Name	Scientific Name	Number	Weight (kg)
nudibranch unidentified	*Nudibranchia unidentified*	19.9	0.00
sole, dover	*Microstomus pacificus*	16.7	0.00
cockle unidentified	*Clinocardium* sp	5.2	0.00
Oregon triton	*Fusitriton oregonensis*	19.8	0.00
sole, rex	*Glyptocephalus zachirus*	16.7	0.00
lampshell unidentified	*brachiopod unidentified*	14.1	0.00
dwarf wrymouth	*Lyconectes aleutensis*	12.3	0.00
shrimp, sidestriped	*Pandalopsis dispar*	10.0	0.00
poacher, general	*family agonidae*	7.0	0.00
sole, flathead	*Hippoglossoides elassodon*	3.8	0.00
debris_general	-	0.0	-
unsorted catch and debris-not subsampled from 3 tows	-	-	13.13
Grand Total		56,576.1	1,372.50