STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

for the

SCALLOP FISHERY off ALASKA

Prepared by

The Scallop Plan Team

With contributions by:
J. Armstrong, R. Burt, N. Richardson, J. Rumble, Q. Smith, B. Williams, XXX, XXX

March 8, 2019

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

Table of Contents

List of Tables

List of Figures

Executive Summary

The Scallop Plan Team met in Kodiak, AK from 9 am to 5 pm on February 20th, 2019 to review the status of the weathervane scallop stocks, to discuss additional issues of importance to scallop management, and to compile the 2019 SAFE report. Plan Team review was based on presentations by staff from the Council, NMFS, and ADF&G and included opportunities for public comment and input. Members of the Plan Team who compiled the report are Quinn Smith (Chair), Jim Armstrong (Vice-Chair), Ben Williams, and Ryan Burt.

New Information in the 2019 SAFE:

- *Updates to stock assessment*

Scallop Harvest:

Total scallop harvest off Alaska in the 2017/18 season was 238,740 lb (108 t) of shucked meats, which is 20.6% of specified ABC (1.161 million lb; 527 t). Area-specific harvest limits (areas depicted in Figure 1-1, area-specific harvest in Table 4-1) were met in a approximately two thirds of the fishing areas, specifically the Yakutat, District 16, Prince William Sound, Kodiak Shelikof, Kodiak Southwest, Unimak Bight, and Bering Sea Districts. Areas that were abandoned by the fleet before the GHL was harvested included Kodiak Northeast and Dutch Harbor.

The preliminary total catch estimate for the 2018/19 season is 238,088 lb (108 t) of shucked meats. This is 20.5% of the ABC specified for 2018/19 (1.161 million lb; 527 t).

Scallop Plan Team Harvest Recommendations:

The Scallop Plan Team recommends that OFL in the 2019/20 season be set equal to maximum OY (1.29 million lb; 585 t) as defined in the Scallop FMP, and which includes discards for which a 20% discard mortality rate is applied. The Team also recommends that ABC for scallops in 2019/20 be set consistent with the maximum ABC control rule (90% of OFL) and which is equal to 1.161 million lb (527 t).

The Scallop Plan Team will evaluate total catch in the 2020 SAFE report for the 2018/19 fishing year to determine if ABC has been exceeded. Overfishing of scallop stocks in Alaska waters is not occurring by the definition of the OFL.

Definitions

The FMP (incorporating all changes made following adoption of Amendment 24) contains the following stock status definitions:

Acceptable Biological Catch (ABC) is a level of annual catch that accounts for the scientific uncertainty in the estimate of OFL as well as any other specified scientific uncertainty and is set to prevent OFL from being exceeded. Since there is uncertainty in the OFL estimate, ABC is set below OFL.

ABC Control Rule is a specified approach in the Council's five-tier system for shellfish stock assessments and sets the maximum permissible ABC for weathervane scallops. The control rule sets the maximum statewide ABC at 90 percent of the OFL, providing a 10 percent buffer to account for scientific uncertainty in OFL.

Annual Catch Limit (ACL) is the level of annual catch that, if exceeded, invokes reactive accountability measures. For weathervane scallops, the ACL is set equal to ABC.

B_{MSY} is the total weight of the stock, i.e., biomass (B) that results from fishing at F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Catch per unit Effort (CPUE) is related to abundance through catchability and for scallops is expressed as lb of meats per dredge hour. CPUE for fishing vessels is monitored through onboard observers.

F_{MSY} Control Rule is a harvest strategy based on fishing mortality (F) which would be expected to result in a long-term average catch approximating MSY.

Guideline Harvest Level (GHL) is specified by the State and represents the pre-season estimated level of harvest that will not jeopardize the sustained yield of a stock. GHL may be expressed as a range of allowable harvests for each State registration area, district, sub-district, or section.

Maximum Sustainable Yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Minimum Stock Size Threshold (MSST) is the biomass below which the stock is considered to be overfished and is usually equal to one half of B_{MSY}.

Optimum yield (OY) is defined in 50 CFR 600.310(e)(3)(i)(A) "the amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; that is prescribed on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, that provides for rebuilding to a level consistent with producing the MSY in such fishery.

Overfishing Limit (OFL) is the catch above which overfishing is occurring and is equivalent to MSY.

Overfishing Control Rule (F_{OFL}) is defined as the level of fishing mortality above which OFL will be exceeded, meaning that it will jeopardize the capacity of the fishery to produce MSY on a continuing basis.

1. Introduction

National Standard 2 guidelines (50 CFR 600.315) require regular preparation and review of a Stock Assessment and Fishery Evaluation (SAFE) report, or similar document, for each federal fishery management plan (FMP). The SAFE report summarizes the current biological and economic status of the fishery as well as analytical information used in fishery management such as survey and fishery catches and OFL/ABC. This report was prepared by the Scallop Plan Team (SPT), members of which include biologists and researchers from the Alaska Department of Fish and Game (ADF&G), the National Marine Fisheries Service (NMFS), and the North Pacific Fishery Management Council (Council). The SAFE report is presented to the Council on an annual basis and is also available to the public.

The scallop fishery in Alaska's Exclusive Economic Zone (EEZ; from 3 to 200 miles offshore) is jointly managed under Federal and State of Alaska authority under the FMP. Most aspects of scallop fishery management are delegated to the State, while Federal requirements are maintained within the FMP. The initial FMP was developed by the Council under the Magnuson Stevens Act (MSA) and approved by NMFS in 1995. The Council has adopted several amendments to the FMP with the latest (Amendment 15) being approved in 2012.

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

The Alaska Department of Fish and Game has obtained release forms signed by vessel operators in order to display confidential catch information. Whenever possible, unless otherwise indicated as "confidential", catch records have been made available for publication by the State.

Basis for Optimum Yield

In the original FMP, optimum yield (OY) was established as a range from 0 to 1.1 million lb (~500 t) of shucked scallop adductor muscles (meats) with the upper end being based on the historic high in landings since 1993. Under Amendment 1, in 1996, the upper end for OY was increased to 1.8 million lb (816 t) to account for historic State water landings. A more conservative approach was taken in 1999, when OY was re-defined as 0 to 1.24 million lb (562 t) with the upper end reflecting *average* rather than *maximum* catch. The reference period for defining the upper range for OY is 1990-1997 excluding 1995 (Table 1-1). Most recently, in 2012, under Amendment 13, OY was re-defined as 0 to 1.29 million lb (585 t) of shucked meats to include estimated discards over the reference time frame. Alaska scallop harvests have not exceeded OY in any year since it was first established.

In the absence of a stock assessment for scallops off Alaska, OFL and ABC have been set historically and recently based on the above definition of OY such that max OFL = OY. The maximum ABC control rule is defined as max ABC = 90% of OFL.

Table 1- 1 Weathervane scallop harvest 1990-1997 including state and federal waters

Year	Unique Vessels	Total Pounds	Total Est. Earnings	Unique IUPs	Average Price / lb
1990	9	1,488,737	$5,073,572	15	$3.41
1991	6	1,136,649	$4,279,200	7	$3.76
1992	8	1,753,873	$6,796,699	12	$3.88
1993	15	1,511,539	$6,981,415	22	$4.62
1994	17	1,256,736	$7,039,262	22	$5.60
1995*	10	351,023	$1,847,666	10	$5.36
1996	9	728,424	$4,670,515	10	$6.41
1997	9	802,383	$4,329,752	11	$5.40
Mean all years	10.4	1,128,671	$5,127,260	13.6	$4.81
Mean excluding 1995	10.4	1,239,763	$5,595,774	14.1	$4.73

Adapted from Free-Sloan 2007. Catch differs from catch numbers in Figure 2-1 due to the lack of discard mortality accounting.
* From February 23, 1995, until August, 1996, the EEZ was closed to fishing. 1995 federal waters harvest and earnings occurred in January and February prior to closure.

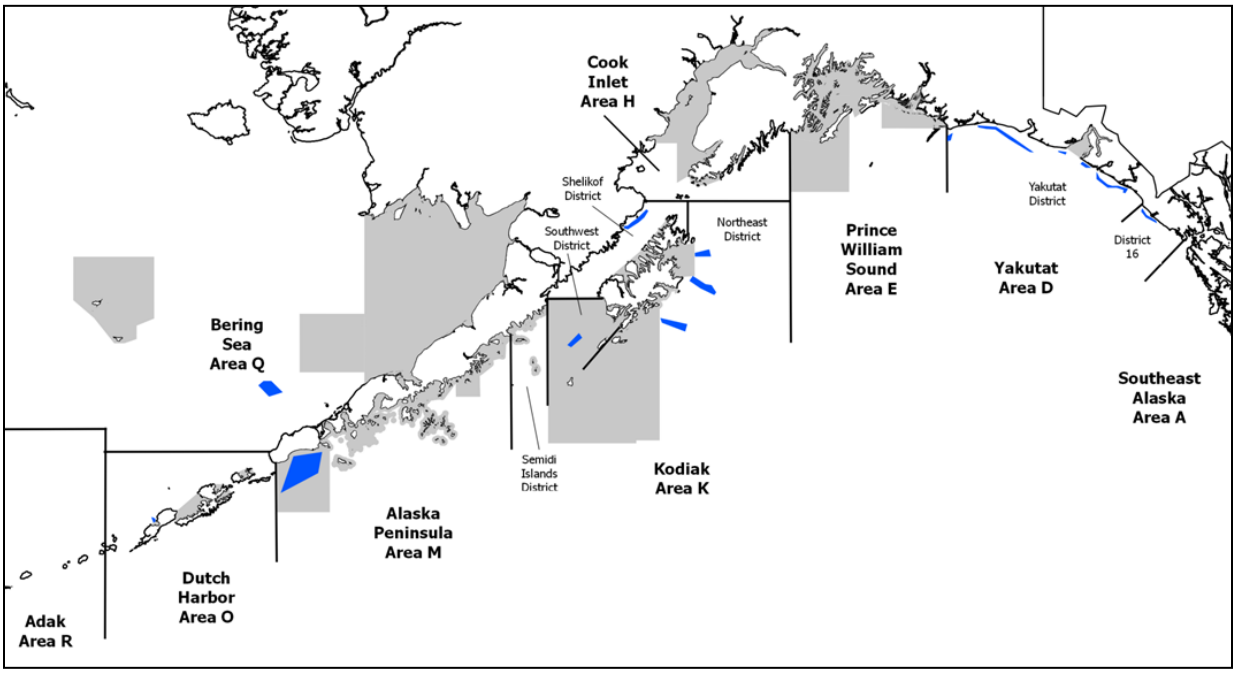

Figure 1-1 Map showing Alaska scallop fishery registration areas. General areas of effort are overlaid by blue polygons. Exploratory fisheries in waters normally closed to scallop fishing (gray shading) have been opened by ADF&G Commissioner's Permit in the Kodiak Southwest District and Alaska Peninsula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

2. Weathervane Scallop Stock Assessment

A functional stock assessment model for weathervane scallops in Alaska does not exist, although efforts to develop an age-based assessment are ongoing. In the absence of a formal stock assessment, State harvest limits (i.e., GHLs) are established using data gathered through the scallop fishery observer program as well as a number of ADF&G-operated scallop dredge surveys.

Fishery Observer Program

The data gathered through the observer program comprise the primary information source for the State in setting harvest limits. These data include time series of scallop harvest and fishery CPUE, fishing location, size and age composition of the catch, scallop discards, and crab bycatch. ADF&G and the SPT recognize inherent weaknesses in using fishery-dependent data for management purposes. Industry CPUE may be an unreliable index of scallop abundance due to factors such as the general incentive to seek out areas with the highest CPUE, but also market conditions, weather, tides, gear efficiency, bycatch avoidance, captain and crew performance, etc. Industry participants have noted that the time of year when fishing occurs can affect CPUE considerably due to summer and winter differences in weather and sea state. Additionally, fishery-dependent size composition data may not be representative of the true size composition of a given scallop bed, since fishing location within the bed is non-random and gear does not select all shell sizes.

Fishery Independent Survey

The Alaska Department of Fish and Game (ADF&G) initiated a statewide weathervane scallop (Patinopecten caurinus) dredge survey in 2016 to collect fishery-independent data for use in managing weathervane scallops in Alaska. Prior to 2016, fishery-independent weathervane scallop (hereafter scallop) dredge surveys had been restricted to the Cook Inlet and Prince William Sound registration areas (Figure 1). Initial surveys were conducted for Kamishak Bay and Kayak Island in 1984 and 1996, respectively (Hammarstrom and Merritt 1985, Bechtol et al. 2003), and were conducted biennially since 1996 (Gustafson and Goldman 2012). These surveys enabled ADF&G to (1) delineate the primary scallop beds; (2) estimate scallop abundance and biomass within these beds; (3) define bed composition through age and shell height data; and (4) estimate bycatch rates of non-target species, particularly Tanner crab (Chionoecetes bairdi). All other management areas in the state were reliant on fishery-dependent data gathered from the statewide scallop observer program to inform management decisions (NPFMC 2018). The statewide survey supersedes the previous survey, though follows a similar survey design (Gustafson and Goldman 2012, Smith et al. 2016) in order to provide fishery-independent information for the sustainable management of scallop stocks in Alaska waters.

The spring 2018 survey was scheduled to include the Yakutat, Kodiak, Kamishak and Kayak Island Areas. There is limited fishery-independent data for a number of these areas to assist managers in their GHL determinations. In this report we examine the methods and results of the 2018 scallop dredge survey including (1) changes in methods from Smith et al. (2016), (2) examinations of the coefficient of variation of catch rates and abundance estimates at the bed level and, (3) the survey abundance estimates from survey sites.

Study Areas

Under the current Operational Plan (Smith et al. 2016) the statewide scallop survey targets the main scallop beds from Cape Fairweather south of Yakutat to the Southwest District of the Kodiak Management Area. The areas surveyed in a given year is dependent on a combination of management, research and stock assessment considerations, as well as survey logistics and the availability of financial, personnel and material resources. The 2018 survey included a total of seven scallop beds in the Kodiak Shelikof, Cook Inlet, Prince William Sound, and Yakutat Districts (Figure 2–1).

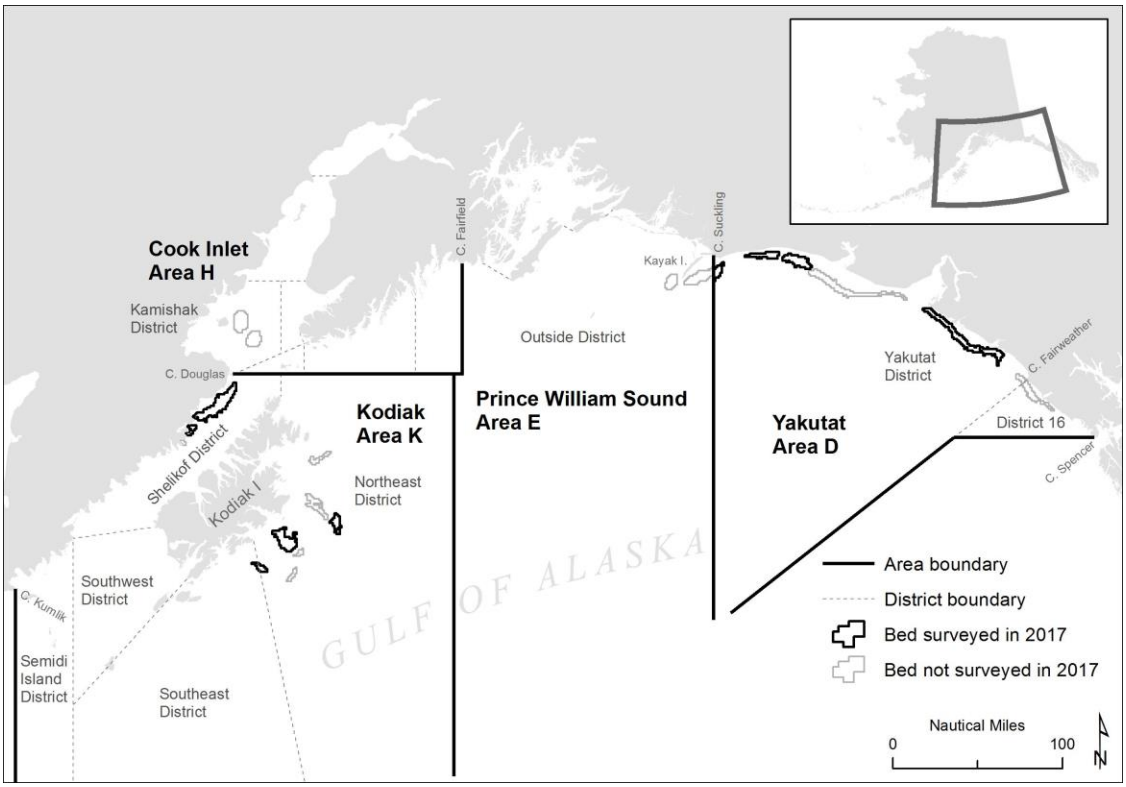

Figure 2-1 Location of scallop beds in ADF&G statewide scallop dredge survey areas. Dark outlines indicate beds surveyed in 2017.

Kodiak Shelikof District

The Kodiak Shelikof District (KSH) survey area is in the northwest portion of Shelikof Strait between Kodiak Island and the Alaska Peninsula (Figure 2-2). Depth contours run from southwest to northeast, approximately parallel to the Alaska Peninsula shoreline. Bottom depths in the scallop beds slope from approximately 30 fathoms (55 m) in the northwest to over 80 fathoms (146 m) in the southeast portions of bed KSH1. Bed KSH1 was sampled in 2018, bed KSH2 will no longer be surveyed due to a consistently high sampling CV and the relatively small size of the bed.

Kamishak District

The Kamishak District (KAM) survey area is located in Cook Inlet near Augustine Island (Figure 2-3). Bottom depths in the scallop beds vary between 20–80 fathoms (36–146 m) throughout the area where commercial fishing occurs. Both beds KAMN and KAMS were surveyed in 2018.

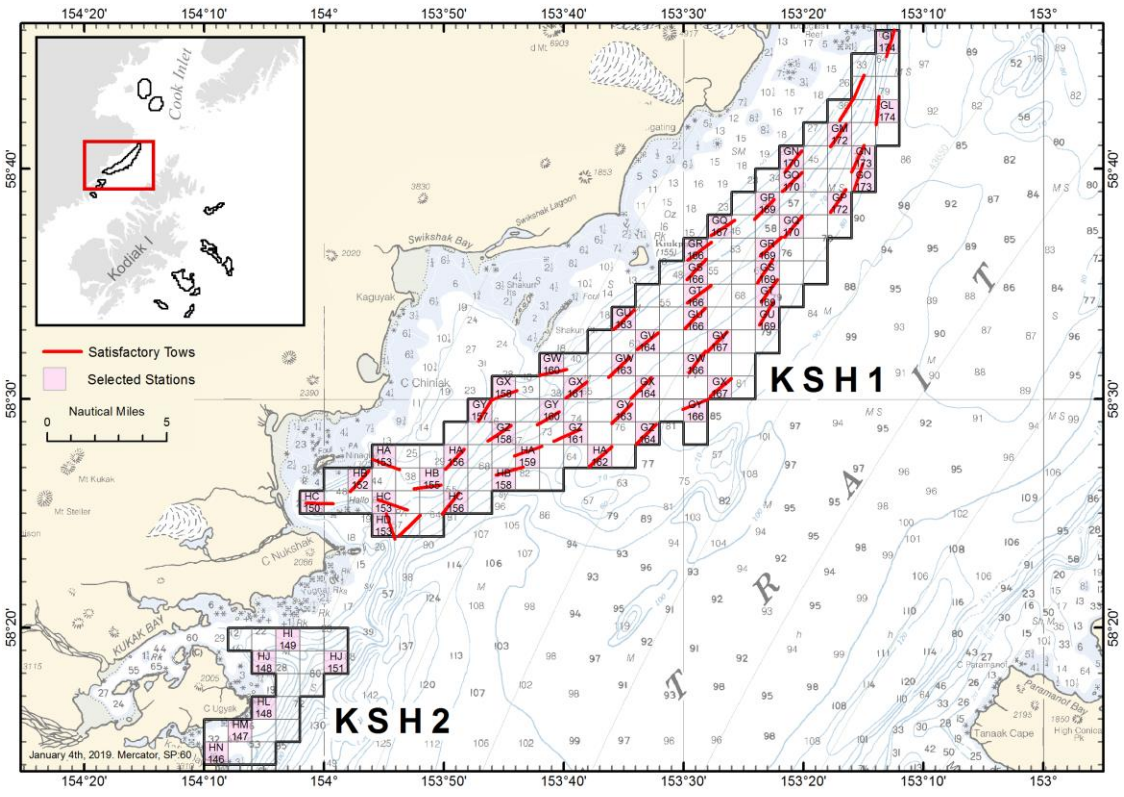

Figure 2-2 Sample locations in Kodiak Shelikof District bed KSH1 during the 2018 weathervane scallop survey. Red lines indicate successful dredge tow tracks in sampled stations. Pink cells were the randomly selected dredge location.

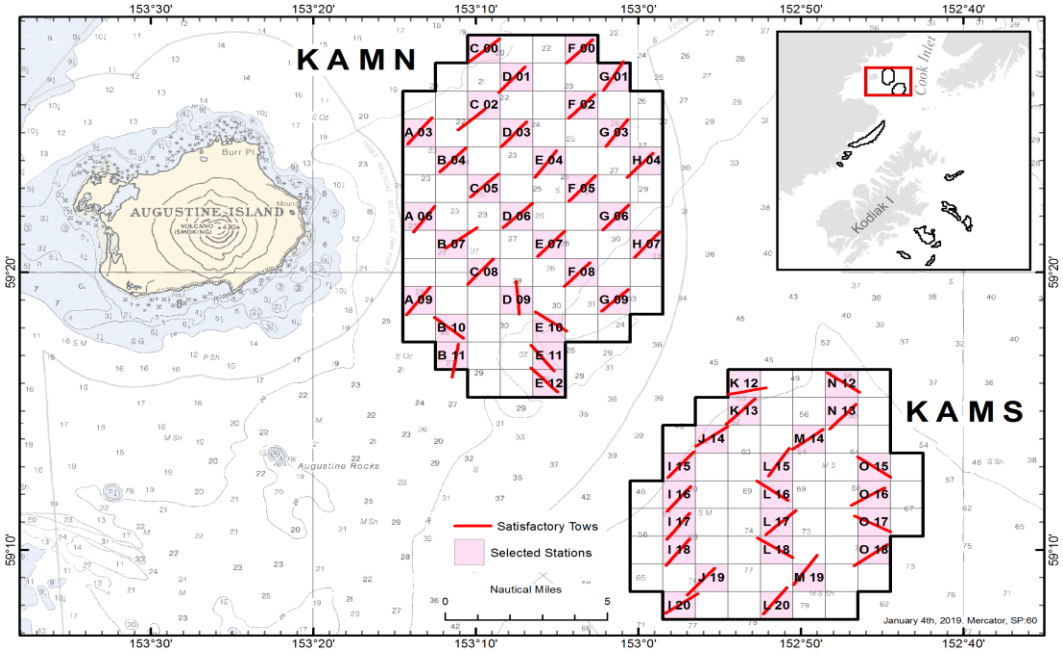

Figure 2-3 Sample locations in the Kamishak District beds KAMN and KAMS during the 2018 weathervane scallop survey. Red lines indicate successful dredge tow tracks in sampled stations. Pink cells were the randomly selected dredge locations.

Prince William Sound District

The eastern Kayak Island bed (EK1) bed was surveyed in 2018 (Figure 4). Bottom depths in this bed vary between 30–65 fathoms (55–120 m) throughout the area where commercial fishing occurs.

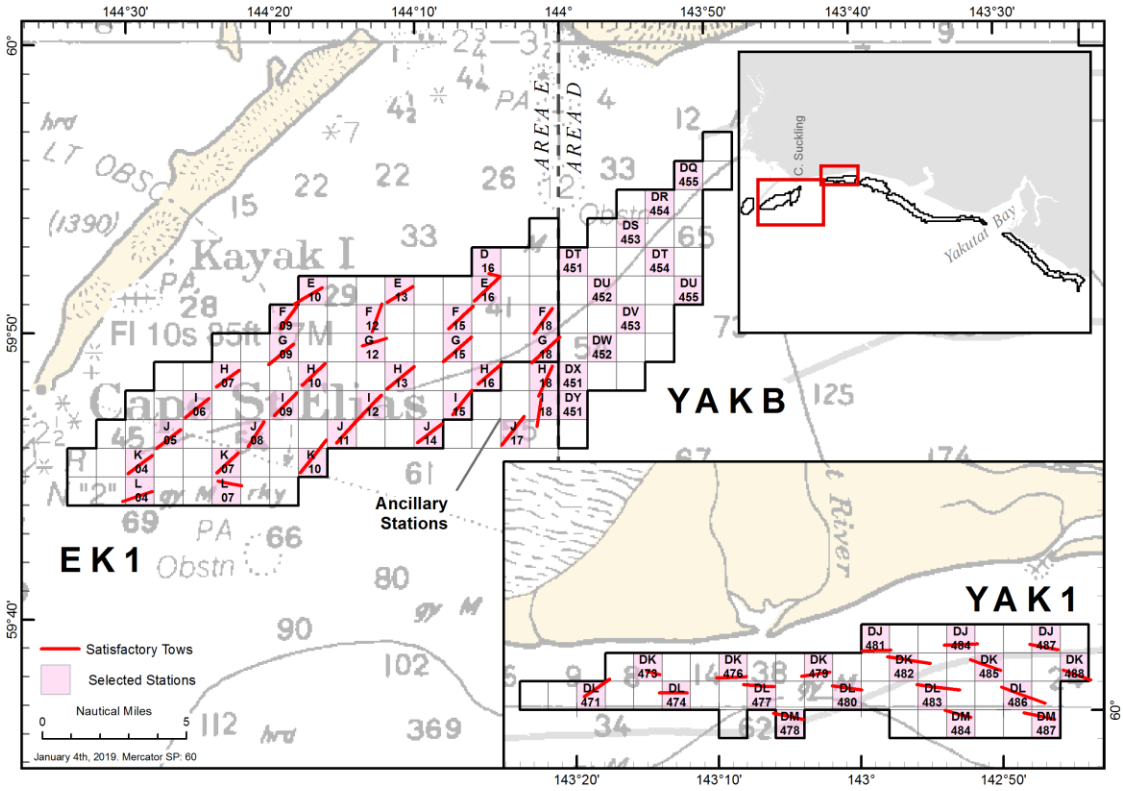

Figure 2-4 Location of Prince William Sound and Yakutat District 2017 weathervane scallop surveyed beds EK1, YAKB, YAK1 and YAK2. Red lines indicate successful survey dredge tow tracks in selected stations. Note that there are two survey dredge tracks outside of selected stations in the northwest portion of bed YAK2.

Yakutat District

The Yakutat District (YAK) survey area is a long narrow swath from the northwest to the southeast along the coast of Alaska on either side of Yakutat Bay (Figures 2-4 and 2-55). The scallop beds depths vary from 10–80 fathoms (18–146 m). Three distinct beds between Kayak Island and Yakutat Bay were surveyed in 2018.

Methods

Survey stations within defined scallop beds (Smith et al. 2016) were fished using a New Bedford style scallop dredge. Scallop beds were delineated into a grid of 1 nmi x 1 nmi survey stations. Survey stations were selected for sampling using systematic random sampling independently for each bed. The target number of survey stations to be sampled in a given bed was chosen with the goal of keeping the coefficient of variation (CV) of catch rates and abundance estimates ≤20% for large-size scallops. The 2.43 m (8 ft) dredge was equipped with a ring bag composed of rings with an inside diameter of 101.6 mm (4.0 in) additionally a 38.1 mm (1.5 in) mesh liner was used to facilitate the retention of smaller scallops. A single 15–min tow approximately 1.0 nmi in length was made in each selected survey grid. Dredge performance

was monitored, and stations were re-towed if performance was judged unsatisfactory. Actual tow lengths, needed for area-swept calculations, were determined by comparing the linear distance between tow start and end points with the distance recorded by the vessel's navigational system, the latter was used if the discrepancy between the two distances exceeded 10%.

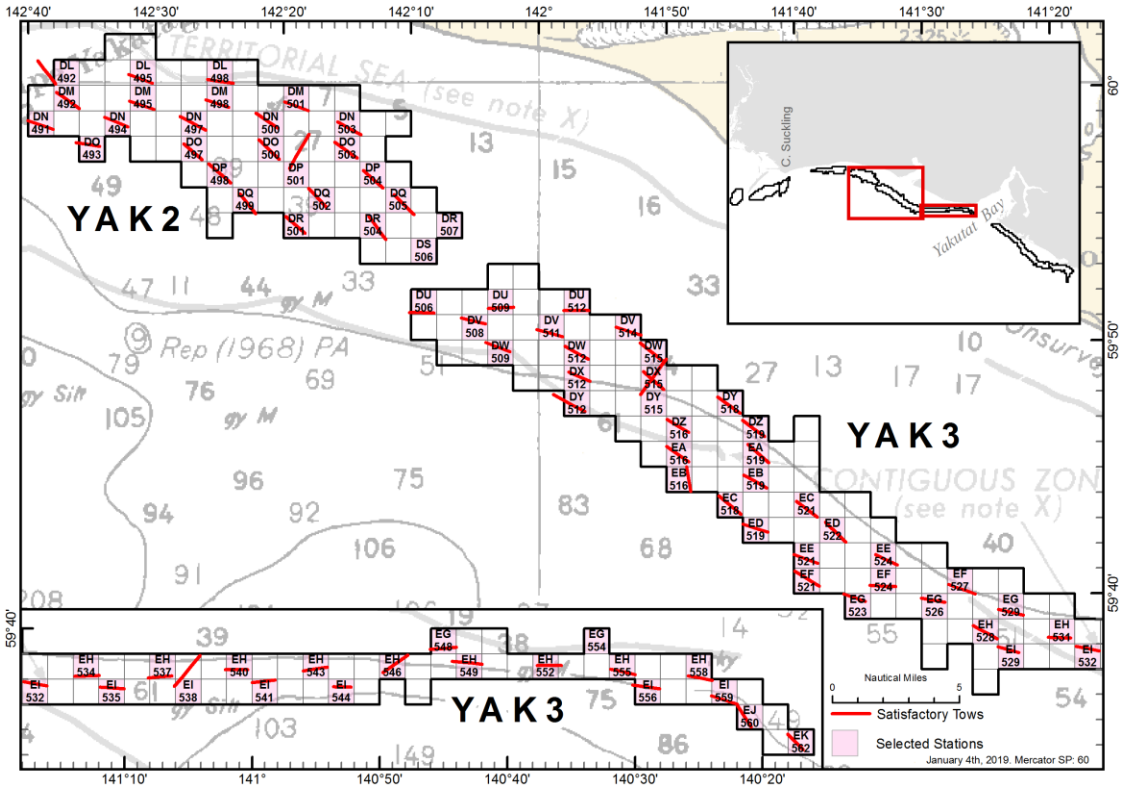

Figure 2-5 Location of the Yakutat District 2018 weathervane scallop surveyed beds YAK4 and YAK5. Red lines indicate successful survey dredge tracks in selected stations.

Dredge haul contents were processed and all data were recorded consistent with the protocols detailed in the statewide scallop survey Operational Plan (Smith et al. 2016). Scallops were sorted by size class (shell height < 100 mm; shell height ≥100 mm, small and large, respectively), counted and collectively weighed. The two size classes were subsampled for collection of individual biological information including shell height and for the larger size class: round weight, meat weight, i.e., weight of the shucked adductor muscle, meat condition, sex, gonad condition and various measures of shell condition. Shells from a secondary subsample of the large scallops were retained for aging (Siddon et al. 2017).

Abundance and Biomass

Area-swept estimates of abundance and round-weight biomass were estimated for both small and large scallops for each bed surveyed. Letting A denote total bed area in nmi^2 and n the number of survey stations with successful tows, the area-swept estimate of scallop abundance by bed is:

$$\hat{N} = A \cdot \frac{1}{n} \sum_{i=1}^{n} \frac{N_i}{Q \cdot a_i}, \qquad (1)$$

where N_i is the number of scallops caught during tow i, a_i is the corresponding area swept, and Q is the efficiency, or catchability, of the dredge. Dredge efficiency Q was assumed equal to 0.83 based on Gustafson and Goldman (2012). The area-swept estimate of scallop round weight biomass $\hat{B}_R$ was estimated by substituting round weight W_i in place of N_i. Confidence intervals for these estimators were calculated using using bootstrapping and the percentile method (Efron and Tibshirani 1993).

Scallop meat-weight biomass was estimated for each bed using the two-stage estimator. Survey protocols entail measuring individual scallop meat weight from a subsample of captured large scallops in each tow (Smith et al. 2016). Accordingly, bed meat weight biomass is estimated using the two-stage estimator

$$\hat{B}_M = A \cdot \frac{1}{n}\sum_{i=1}^{n} \frac{N_i}{n_i} \cdot \frac{\sum_{j=1}^{n_i} w_{i,j}}{Q a_i}, \qquad (2)$$

where n_i is the number of subsampled large scallops associated with tow i, $w_{i,j}$ the meat weight of subsampled scallop j from tow i.

Approximate confidence intervals were estimated through bootstrapping of the two-stage design. Note that this method of estimating meat weight biomass differs from that used in the reported results of the 2016 statewide scallop dredge survey (Williams et al. 2017).

Shell Height Distributions

Measurements of shell height were recorder for up to 30 scallops for both small and large scallops from each tow (Smith et al. 2016). Scallop shell height distributions were weighted by bed, to account for both subsampling of measured scallops within the two size classes and between-tow variation in the area swept by the dredge, measured scallop *j* captured in tow *i* was assigned weight

$$\lambda_{i,j} = \frac{\left(\frac{N_i}{n_i}\right)}{a_i}.$$

Here N_i denotes the number of large or small scallops captured in tow *i*, and n_i the number of those that were measured in subsampling. For display, histograms were constructed so that bar heights reflect the sum of the weights rather than the simple count of scallops within each bin.

Summaries of other biological data collected (e.g., presence of weak meats and clappers) during the survey were used as additional indicators of scallop stock status on surveyed beds.

Results

Survey Performance

A total of 227 successful ~1.0 nm survey tows were completed during the 2018 statewide scallop dredge survey between April 2 and June 15, 2018 (Table 2-1). Three ancillary stations were also examined in the EK1 bed (Figure 4) that were not among the original randomly selected grids. These untowable stations were subsequently removed from selection for future surveys. Survey vessels performed an additional 30 tows that were unsuccessful or of an experimental or exploratory nature. The commercial vessel F/V Provider was the survey platform for all stations. This effort covered all planned survey areas for 2018.

Successful tows were completed at 50 randomly selected stations during the 2018 Kodiak Shelikof District scallop dredge survey (Table 2-1; Figure 2-2). Total scallop catch was 10,323 animals with a combined weight of 1,939 lb. Average small scallop density was 101,497 scallops nm^2 with a standard deviation of 174,731 nm^2. Large scallop densities ranged from 0 to 127,924 scallops nm^2 with an average of 28,715 nm^2 (Figure 2-6). Associated CVs were within the 20% target value for large and small scallops in Bed 1 (Table 2-1).

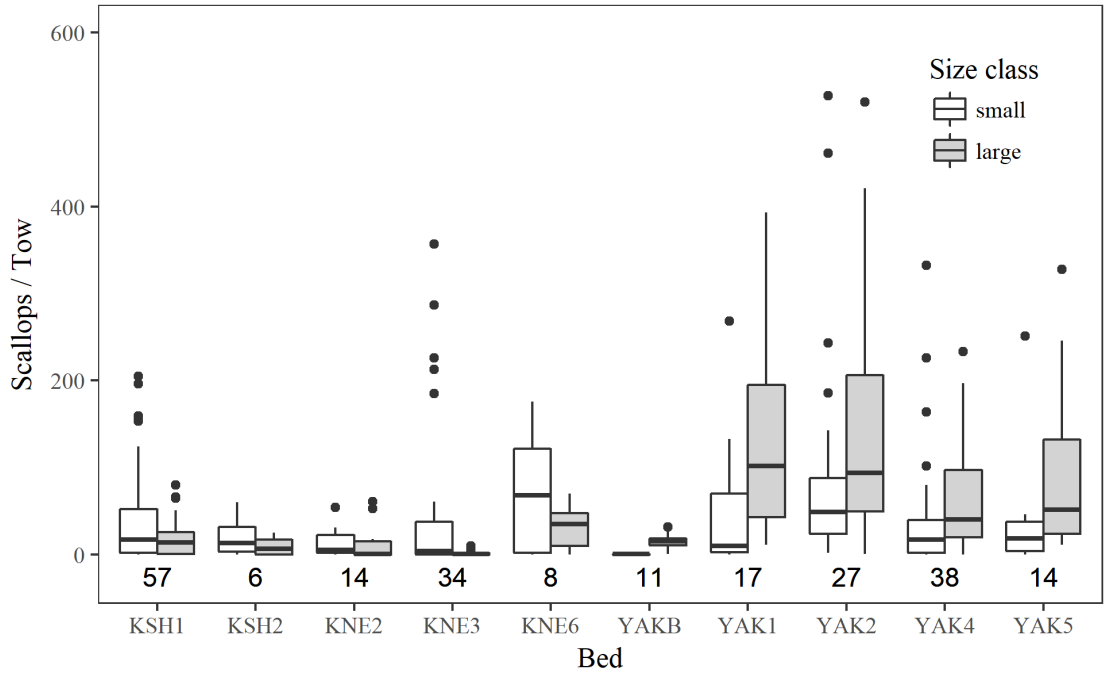

Figure 2- 6 Catch distributions of small and large weathervane scallops by bed from successful tows completed during the 2018 statewide scallop dredge survey. Note: two hauls in bed KNE 3 had > 2,000 small scallops, they were removed from the figure for display purposes. Each bed is labeled with the number of tows.

A total of 29 successful tows were completed in the Eastern Kayak Island bed (Table 2-1). Total catch was 825 scallops with a combined weight of 477 lb. Average density of small and large scallops were, 314 and 19,999 scallops nm^2, respectively. Small scallop densities had a standard deviation of 723 scallops nm^2, whereas large scallops had a standard deviation of 24,809 scallops nm^2 (Figure 2-6). Associated CVs were as high as 43%. However, large scallops had a CV close to the target. Small scallop distributions were patchier, therefore had a higher CV (Table 2-1).

The survey vessel made 52 successful tows in the Kamishak area during the 2018 statewide scallop dredge survey: 30 in KAMN, and 22 in KAMS bed (Figure 2-3; Table 2-1). Total catch was 1,082 scallops with a combined weight of 484 lb. Small scallops had an average density of 7,538 scallops nm^2, with a standard deviation of 15422 scallops nm^2. Large scallops had an average density of 5,274 scallops nm^2 with a standard deviation of 7,359 scallops nm^2. Survey efficiency, as measured by catch rate CVs, was within the CV target for large individuals in the KAMN bed. CVs of small scallops in both beds and large scallops in bed KAMS exceeded the desired 20% target (Table 2-1).

Table 2-1 Number of stations and tows for surveyed beds in the 2017 statewide scallop dredge survey with total scallop catches, average scallop densities and corresponding CVs by scallop size class.

Bed	Area	Sampled Stations	Size Class	Catch Number	Mean Density (nm^2)	CV %
EK1	89.11	29	large	812	19,999	23
			small	13	314	43
KAMN	90.21	30	large	396	8,336	18
			small	100	2,114	36
KAMS	68.03	22	large	40	1,097	45
			small	546	14,935	31
KSH1	145.92	50	large	2,299	28,715	14
			small	8,024	101,497	25
YAK1	52.31	18	large	1,903	76,525	18
			small	1,778	73,062	41
YAK2	78.58	24	large	2,833	87,048	13
			small	2,090	64,008	13
YAK3	167.46	54	large	2,273	31,064	17
			small	1,423	19,400	31

The survey vessel made 52 successful tows in the Kamishak area during the 2018 statewide scallop dredge survey: 30 in KAMN, and 22 in KAMS bed (Figure 2-3; Table 2-1). Total catch was 1,082 scallops with a combined weight of 484 lb. Small scallops had an average density of 7,538 scallops nm^2, with a standard deviation of 15422 scallops nm^2. Large scallops had an average density of 5,274 scallops nm^2 with a standard deviation of 7,359 scallops nm^2. Survey efficiency, as measured by catch rate CVs, was within the CV target for large individuals in the KAMN bed. CVs of small scallops in both beds and large scallops in bed KAMS exceeded the desired 20% target (Table 2-1).

The survey vessel made 96 successful tows in the Yakutat area during the 2018 statewide scallop dredge survey: 18 in YAK 1, 24 in YAK 2, and 54 in YAK 3 (Figures 2-4 and 2-5; Table 2-1). Total catch was 12,300 scallops with a combined weight of 3,235 lb. Small scallops had an average density of 40,613 scallops nm^2, with a standard deviation of 68,358 scallops nm^2. Large scallops had an average density of 53,584 scallops nm^2 with a standard deviation of 52,614 scallops nm^2. Survey efficiency, as measured by catch rate CVs, was somewhat better in this area than in the previous district. CVs of larger scallops were within the desired 20% target, though smaller scallops had higher CVs than desired (Table 2-1).

Abundance and Biomass

Survey estimates of scallop abundance were highest for bed KSH1 at ~5 million large-size scallops (Table 2-2; Figure 2-7). However, almost 18 million small-size scallops are estimated for bed KSH 1. This was in contrast to the Yakutat district where large and small scallop abundance estimates are similar or estimate fewer small scallops than large. The Kamishak and Prince William Sound beds have lower abundance estimates than the Kodiak Shelikof and Yakutat beds, with the EK1 bed showing almost no small scallops and the KAMS bed with few large scallops.

Overall, biomass estimates of large scallops was similar in beds of the Kodiak Shelikof and Yakutat Districts (Table 2-3; Figure 2-8). The highest was 3.2 million pounds in bed YAK2. The Kamishak beds were estimated to have under 1 million pounds of biomass and the EK1 bed was estimated to have 1.2 million pounds of biomass

Bed KSH1, the largest of the surveyed beds at 2.3 times the size of bed YAK2, had the second largest estimated round-weight biomass of about 2.5 million pounds. Beds with the highest round-weight biomass also had the highest estimated meat-weight biomass (Table 2-3, Figure 2-8).

Meat weights were proportional to round weight (Figure 2-9) and to shell height (Figure 2-10).

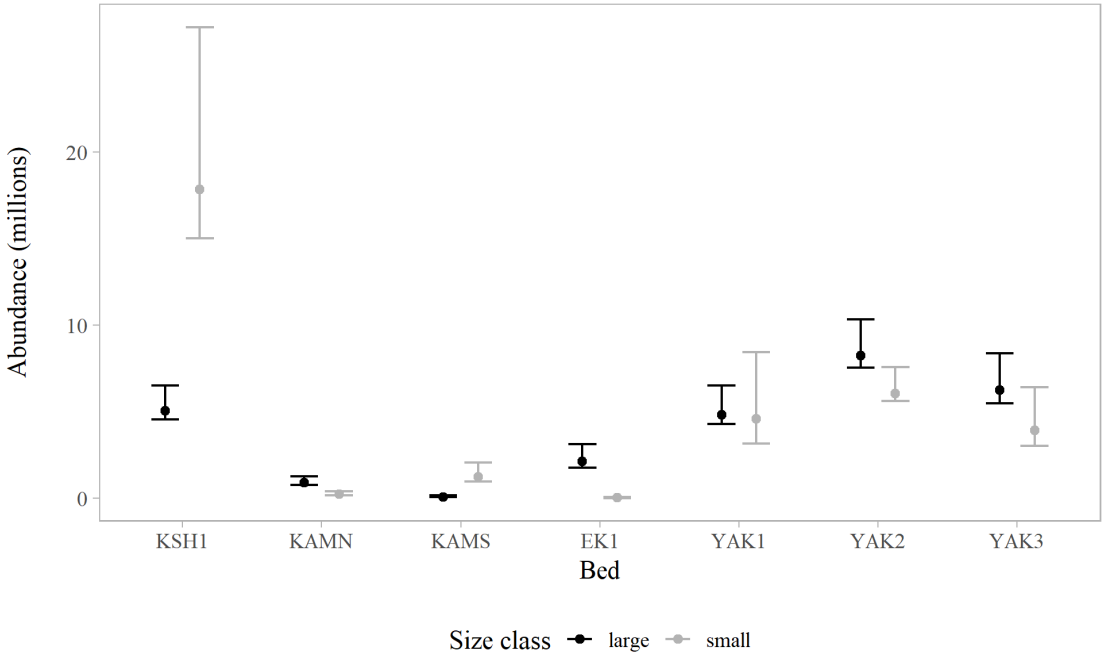

Figure 2-7 Estimates of scallop bed abundance based on 2018 statewide scallop dredge survey data. Error bars represent approximate 95% confidence intervals. Large scallops are those with shell height >= 100 mm.

Intentionally Left Blank

Table 2-2 Bed estimates of scallop abundance with 95 percent confidence intervals based on 2018 statewide scallop dredge survey. Large scallops are those with a shell height ≥100 mm.

Bed	Size-class	Abundance	Lower 95% CI	Upper 95% CI
	large	2,147,116	1,783,447	3,126,157
EK1	small	33,748	23,316	64,532
	large	906,049	781,445	1,252,527
KAMN	small	229,751	175,382	403,672
	large	89,935	59,299	179,711
KAMS	small	1,224,157	958,581	2,050,225
	large	5,048,284	4,565,718	6,512,700
KSH1	small	17,843,824	15,033,088	27,201,999
	large	4,822,905	4,299,583	6,531,378
YAK1	small	4,604,656	3,164,164	8,453,908
	large	8,241,277	7,535,079	10,321,917
YAK2	small	6,059,958	5,612,035	7,578,132
	large	6,267,500	5,493,475	8,375,556
YAK3	small	3,914,035	3,040,811	6,419,879

Table 2-3 Bed estimates of scallop round weight biomass (pounds) with 95 percent confidence intervals based on 2018 statewide scallop dredge survey. Large scallops are those with a shell height ≥100 mm.

Bed	Size-class	Biomass (lb)	Lower 95% CI	Upper 95% CI
	large	1,257,860	1,068,623	1,812,707
EK1	small	2,186	1,377	4,611
	large	995,166	873,942	1,344,158
KAMN	small	11,827	9,222	21,202
	large	21,507	15,383	39,827
KAMS	small	77,464	58,921	131,749
	large	2,688,396	2,495,037	3,287,989
KSH1	small	1,580,788	1,268,584	2,433,243
	large	2,146,914	1,912,356	2,868,591
YAK1	small	240,919	195,523	382,639
	large	3,246,553	2,958,771	4,029,249
YAK2	small	516,360	451,076	691,746
	large	2,549,329	2,268,009	3,412,411
YAK3	small	215,219	189,958	296,675

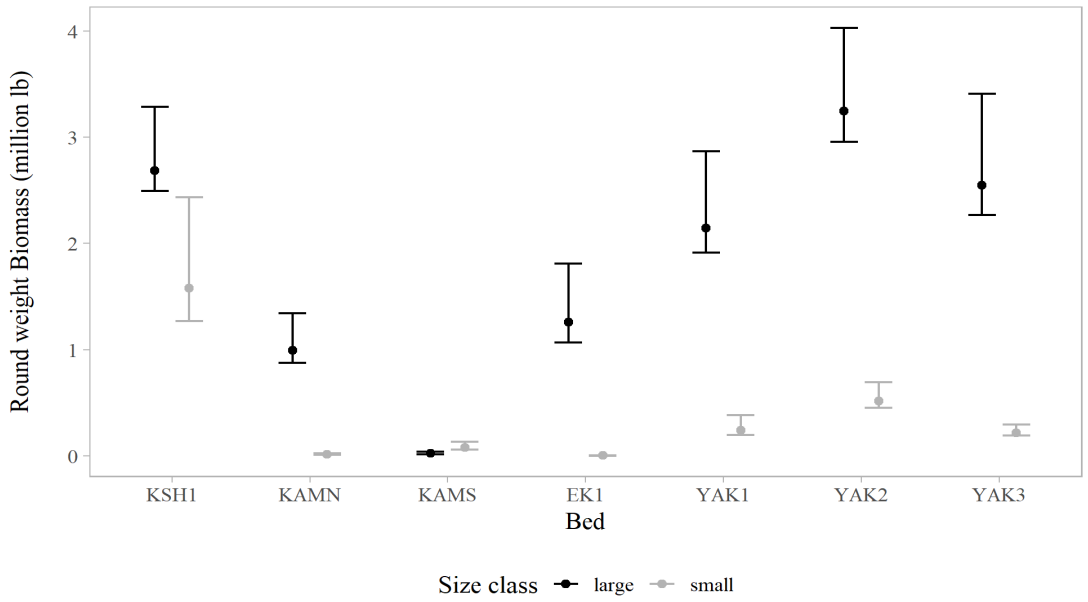

Figure 2-8 Estimates of scallop bed round weight biomass based on 2018 statewide scallop dredge survey data. Error bars represent approximate bootstrap 95% confidence intervals. Large scallops are those with shell height ≥ 100 mm.

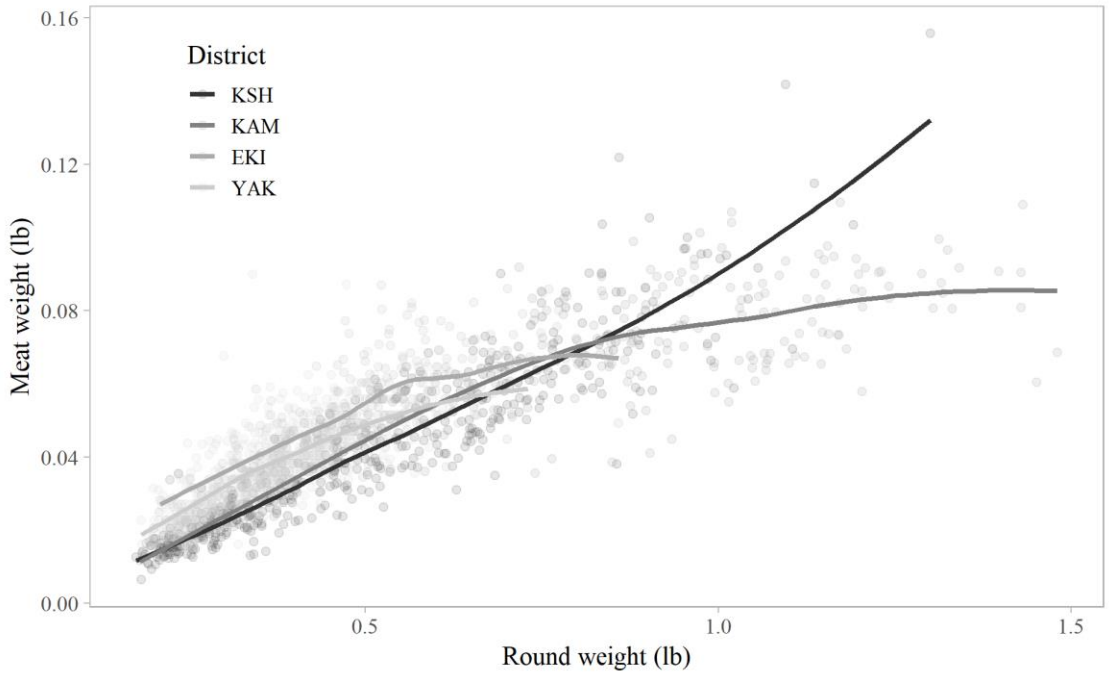

Figure 2-9 Comparisons of meat weight versus round weight by district for subsampled large scallops from the 2018 statewide scallop dredge survey.

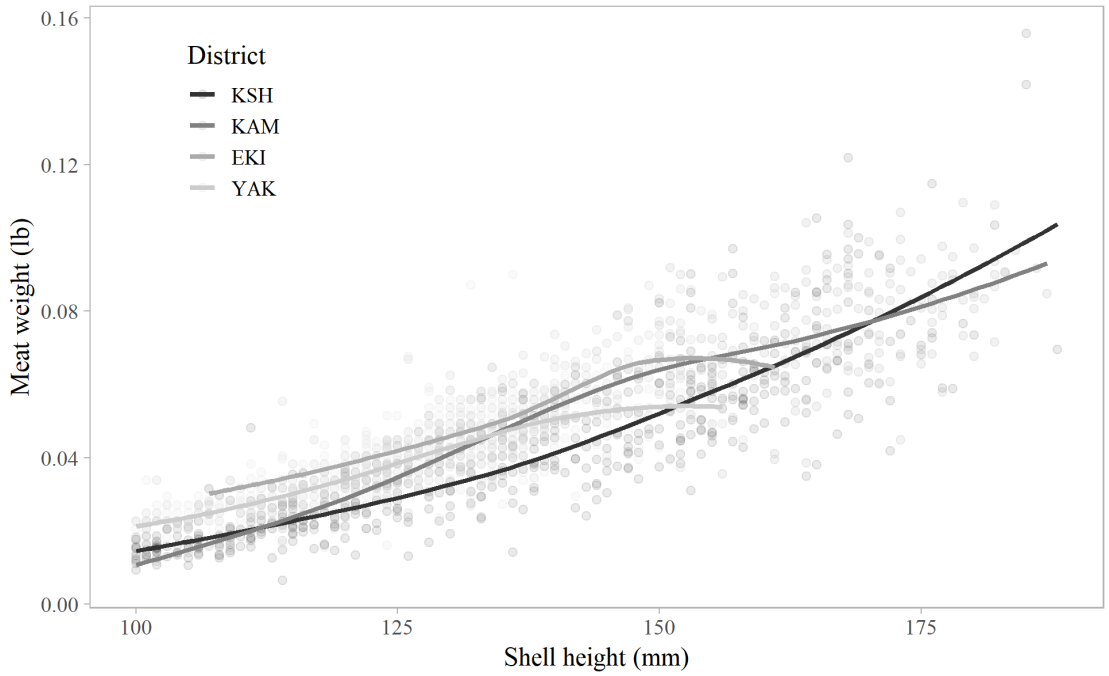

Figure 2- 10 Comparisons of meat weight versus shell height by district for subsampled large scallops from the 2018 statewide scallop dredge survey data.

Shell Height Distributions

Survey biologists measured the shell height of 4,079 small and 5,067 large scallops, ranging from 11-193 mm. Estimated bed shell-height distributions are in line with estimates of small and large scallop abundance and biomass (Table 2-2; Figure 2-7). There is general evidence of a higher proportion of large scallops in the Yakutat beds compared to the other surveyed beds (Figure 2-11), with a similar distributional pattern across beds YAK1, YAK2, and YAK3. Overall, beds EK1 and KAMN stand out in they appear to consist almost entirely of large scallops, whereas bed KAMS is notable in that it appears to be dominated by small scallops. Scallop shell height distribution in the KSH1 bed indicate few large scallops relative to a substantial number of small scallops, this is conducive with observations from the fishery the past few seasons.

Additional Biological Data

Because the percentage of "clappers" (empty, still connected valve pairs) with respect to the number of live scallops may provide a rough index of scallop natural mortality, clappers are included in haul catch sampling. The highest percentage of clappers in survey catches was 2.3% (N = 600) in bed KAMS and the lowest was 0.1 % (N = 3,701) in bed YAK3 (Table 2-4). These values are well below the 13% instantaneous natural mortality rate assumed for Alaska weathervane scallop stocks (NPFMC 2014). Though it is remains unclear exactly how observed clappers relates to instantaneous mortality.

An indicator of scallop stock status of importance with respect to the commercial scallop fishery is the prevalence of weak meats. "Weak meat" is a diseased condition of the adductor muscle characterized by tissue of stringy texture that tears easily during shucking (Brenner et al. 2012). The presence of this

condition was recorded for subsampled large scallops in surveyed beds. The highest prevalence was 15.1% (N = 383) in bed KAMN and the lowest was 0% (N = 619) in bed YAK1 (Table 2-4).

Table 2-4 Bed percentages of clappers and weak meats from 2018 statewide scallop dredge survey data. Meat condition was assessed only for subsampled large scallops. N denotes the sample size.

Bed	Clappers	N	% clappers	N (large)	Weak meats
EK1	14	839	1.7	548	0.4
KAMN	10	506	2	383	15.1
KAMS	14	600	2.3	40	0
KSH1	44	10367	0.4	1398	2.6
YAK1	27	3708	0.7	619	0
YAK2	17	4940	0.3	962	0.8
YAK3	5	3701	0.1	1161	0.5

As indicators of stock reproductive potential, the sex and gonad condition of subsampled large scallops were also recorded (Tables 2-5 and 2-6). Sex was determined based on the color of the gonad after it fills with gametes. Among those scallops for which sex could be determined, males and females were roughly equally represented in most beds. Most beds had scallops recorded as having gonads that were filling, followed by immature gonads, with the exception of bed YAK1 where one third half (34.1%; N = 334) were recorded as having gonads in initial recovery, i.e. having just spawned.

Table 2-5 Observed sex ratios (percent of scallops ≥100 mm). N denotes the sample size.

Bed	Unknown	Male	Female	Hermaphrodite	N
EK1	5.6	46.8	47.6	0	233
KAMN	0	49.5	50.5	0	188
KAMS	0	50	50	0	32
KSH1	0.2	46.1	53.7	0	462
YAK1	0	49.4	50.6	0	180
YAK2	2.1	45.5	52.3	0	235
YAK3	1.2	52.5	46	0.2	413

Table 2-6 Observed gonad status by bed. Values are percent of sampled scallops ≥100 mm. N denotes the sample size.

Bed	N	Immature	Empty	Initial Recovery	Filling	Full
EK1	246	4.9	5.3	17.5	62.2	10.2
KAMN	255	20.0	0	0.4	51.4	28.2
KAMS	156	51.3	0	0	48.1	0.6
KSH1	941	24.5	0.1	2.2	62.4	10.7
YAK1	334	36.5	0	34.1	28.1	1.2
YAK2	469	25.2	1.3	4.3	59.9	9.4
YAK3	721	16.9	0.8	2.6	73.5	6.1

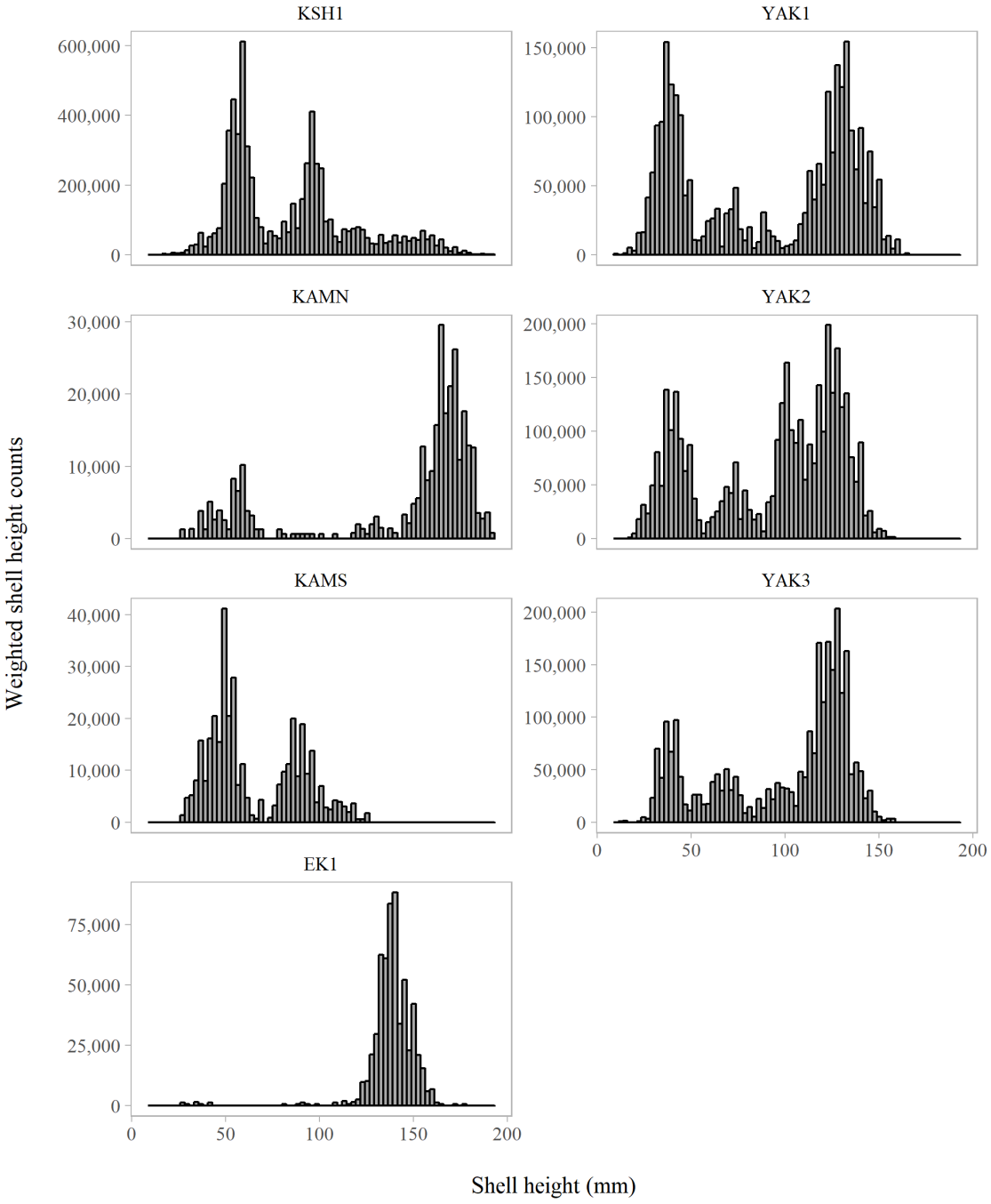

Figure 2-11 Scallop bed shell height distributions for the 2018 statewide scallop dredge survey. Distributions were weighted by sample sizes.

The survey team additionally recorded information describing the extent of shell-worm infestation and mud-blisters on the shells of subsampled large scallops using an ordinal scale based on percent of shell coverage (Tables 2-7 and 2-8). Prevalence of both mud blisters and shell-worm intrusion was greatest for the EK1 and KAMN beds.

Table 2- 7. Area of scallop shells ≥100 mm with evidence of boring worms, by bed. N denotes the sample size.

Bed	N	0%	1-24%	25-49%	50-74%	75-100%
EK1	246	57.7	41.9	0	0.4	0
KAMN	255	43.5	29.8	14.1	7.8	0
KAMS	156	99.4	0.6	0	0	0
KSH1	941	97.6	2	0.4	0	0
YAK1	334	88	12	0	0	0
YAK2	469	69.9	29.6	0.4	0	0
YAK3	721	81	18.6	0.4	0	0

Table 2- 8. Area of scallop shells ≥100 mm with evidence of mud blisters, by bed. N denotes the sample size.

Bed	N	0%	1-24%	25-49%	50-74%	75-100%
EK1	246	65.9	33.7	0.4	0	0
KAMN	255	70.6	21.6	7.1	0.8	0
KAMS	156	100	0	0	0	0
KSH1	941	98.1	1.8	0	0	0
YAK1	334	93.7	6.3	0	0	0
YAK2	468	90.4	8.3	1.3	0	0
YAK3	721	91.5	7.6	0.8	0	0

Age data from secondary subsampling of large scallops were not available for this report.

Discussion

The primary objective of this survey was to estimate scallop abundance by survey area with a CV <20%. From results reported in Table 2-1, only large-size scallop abundance estimates for bed KAMS were well above the target level. The high CVs are due to high levels of spatial patchiness in scallop distributions within this bed, and generally low abundance. Additional sampling would be recommended to achieve a smaller CV in this survey areas for large scallops. The sample size for the other beds sampled during this survey produced acceptable results.

Comparisons of 2016-2018 survey abundance estimates for the Kodiak Shelikof District (Figure 2-12) show a similar abundance of large scallops in bed KSH 1 in 2016 and 2017, with a slight increase in 2018. This increase is likely due to the substantial number of small scallops observed in 2017 recruiting into the fisheries targeted size. The substantial increase in small scallops in KSH1 is likely due, in part, to the

selectivity of the sampling gear catching more individuals as they grow. Similarly, round-weight biomass has increased in KSH1 (Figure 2-13) along with the associated growth and increased abundance estimates.

The abundance estimates for the Yakutat area were similar between years (Figure 2-14) for large scallops. There was an increase in the abundance estimate of small scallops in bed YAK1. There was not a substantial difference in the biomass estimates of YAK1 and YAK2 between 2017 and 2018 (Figure 2-15).

Without a more substantial timeseries it remains difficult to ascertain how the survey relates to catch in the fishery. Future surveys will help address this question. Additionally, it is unknown whether the Q=0.83 used in these abundance estimates is appropriate for the dredge used for this survey. Since this Q is uncertain, the abundance estimates, and associated meat weight estimates are indices rather than absolute population estimates. In the past GHLs in the Prince William Sound and Cook Inlet Areas were set based upon a 5% annual exploitation rate (Gustafson and Goldman 2012), though this rate it is not recommended barring further evaluation of Q for differing vessel/gear/bed combinations.

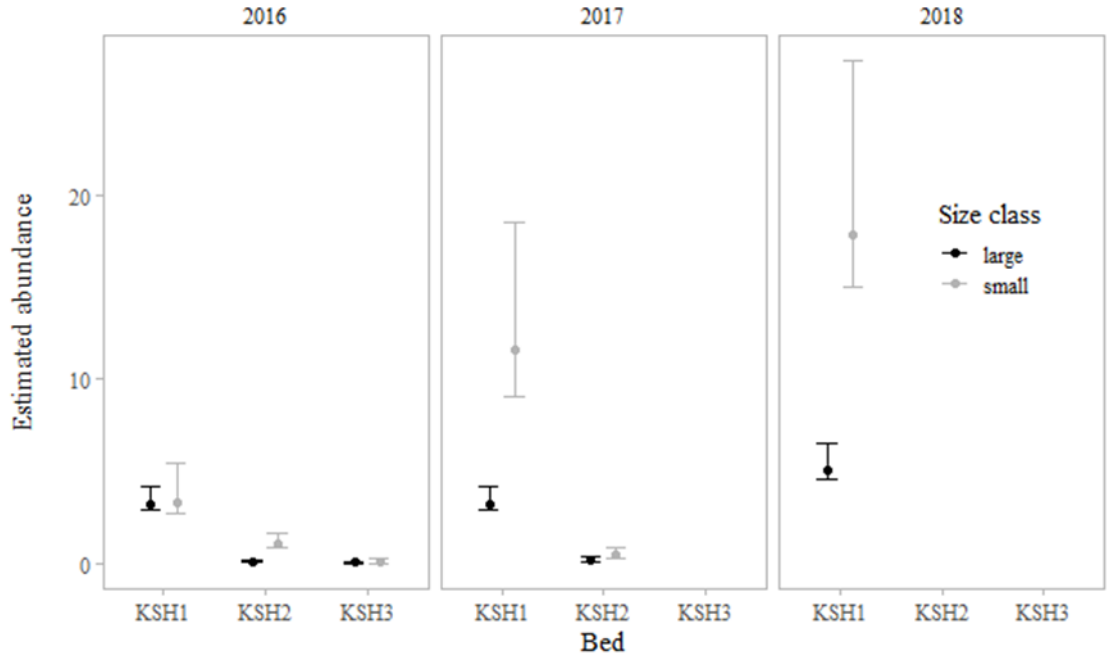

Figure 2-12 Comparisons of 2016 and 2018 survey abundance estimates for the Kodiak Shelikof District.

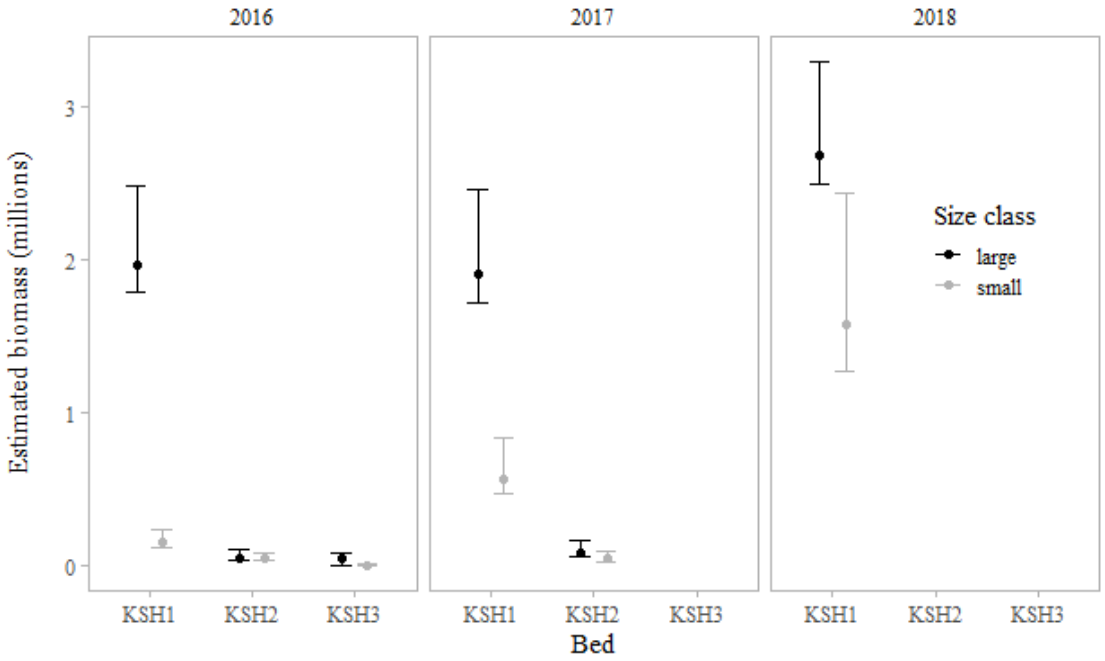

Figure 2- 13 Comparisons of 2016 - 2018 survey biomass estimates for the Kodiak Shelikof District.

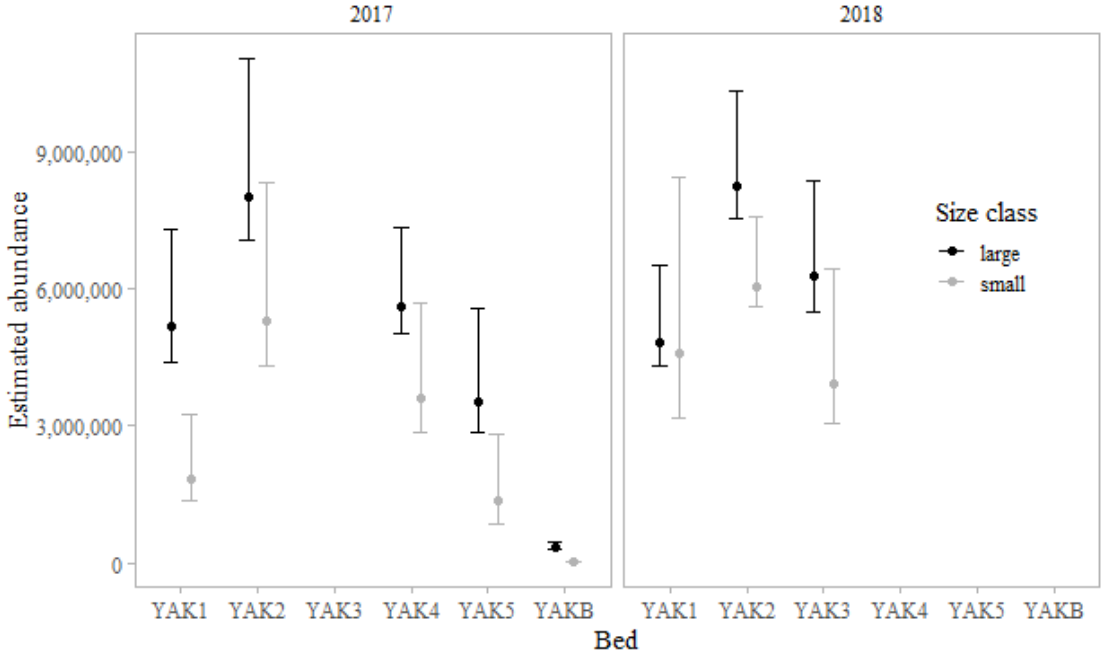

Figure 2- 14 Comparisons of 2016 - 2018 survey abundance estimates for the Yakutat Area.

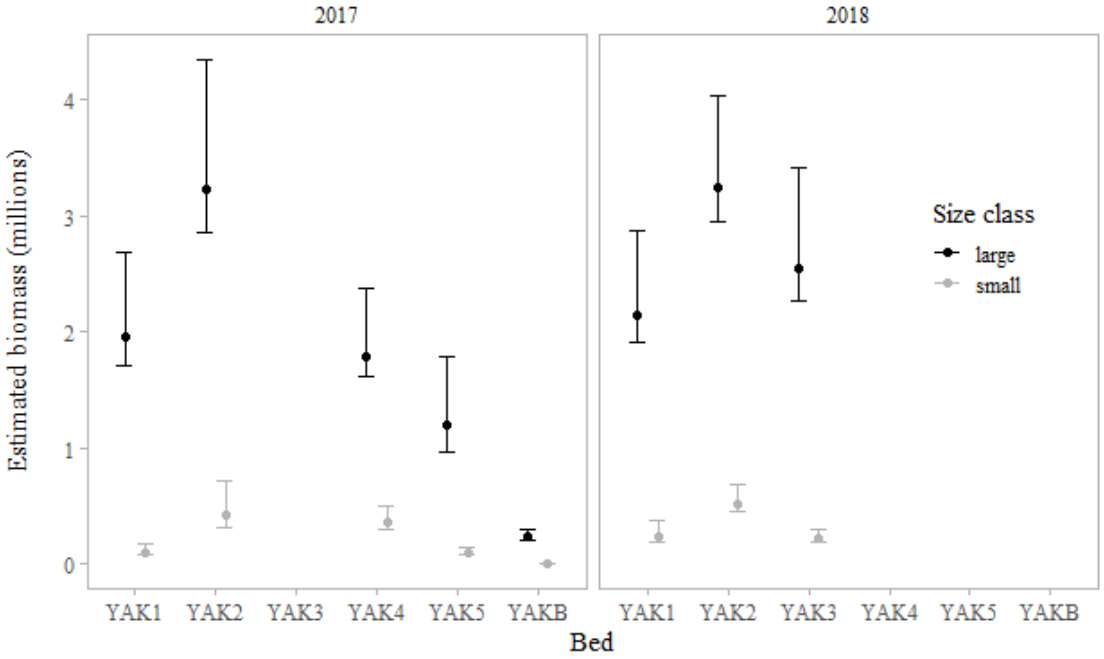

Figure 2- 15 Comparisons of 2016 - 2018 survey biomass estimates for the Yakutat Area.

Acknowledgements

The authors would like to thank Capt. Thomas Minnio and the crew of the F/V Provider. We would also like to thank Jim Stone and the Alaska Scallop Association for their logistical support.

Stock Status Determination

Scallop abundance is estimated for portions of two of the nine registration areas and a determination of MSST cannot be made. As such, **the status of the scallop stocks is "unknown"**; however, this is not considered to be a conservation concern since scallops are distributed in many areas that have been closed to fishing to protect crab populations and in areas not defined as commercial beds.

OFL, for Alaska scallops in 2016/17 was specified as equivalent to maximum OY. Currently, maximum OY is defined as 1.284 M lb of meats, which includes discards. Total scallop removals in 2016/17 was estimated to be 233,009 lb (117 t), therefore, **overfishing is not occurring** for scallop stocks in waters off Alaska.

Figure 2- 16 shows statewide scallop catch in relation to historic OY/OFL levels. Since 1996, catches have averaged from 39% to 66% of OY (Table 2-9). Control rules for other Alaskan scallop species have not been developed as no commercial harvests occur. Catch by individual registration area is shown in Table 4-1 and Table 4-2.

Table 2-9 Alaska weathervane scallop harvest and OY/MSY/OFL, 1993/94 - 2017/18 seasons.

Season	Harvest (lb meat)	OY / MSY / OFL	% OY
1993/94	984,583	1,800,000	55
1994/95	1,240,775	1,800,000	69
1995/96	410,743	1,800,000	23
1996/97	732,424	1,800,000	41
1997/98	818,913	1,800,000	45
1998/99	822,096	1,240,000	66
1999/00	837,971	1,240,000	68
2000/01	750,617	1,240,000	61
2001/02	572,838	1,240,000	46
2002/03	509,455	1,240,000	41
2003/04	492,000	1,240,000	40
2004/05	425,477	1,240,000	34
2005/06	525,357	1,240,000	42
2006/07	487,473	1,240,000	39
2007/08	458,313	1,240,000	37
2008/09	342,434	1,240,000	28
2009/10	487,913	1,240,000	39
2010/11	468,466	1,240,000	37
2011/12	455,331	1,290,000	35
2012/13	418,880	1,290,000	32
2013/14	399,134	1,290,000	31
2014/15	308,868	1,290,000	24
2015/16	264,532	1,290,000	20
2016/17	232,991	1,290,000	18
2017/18	238,740	1,290,000	19
2018/19[a]	237,813	1,290,000	18

[a] PRELIMINARY data subject to change.

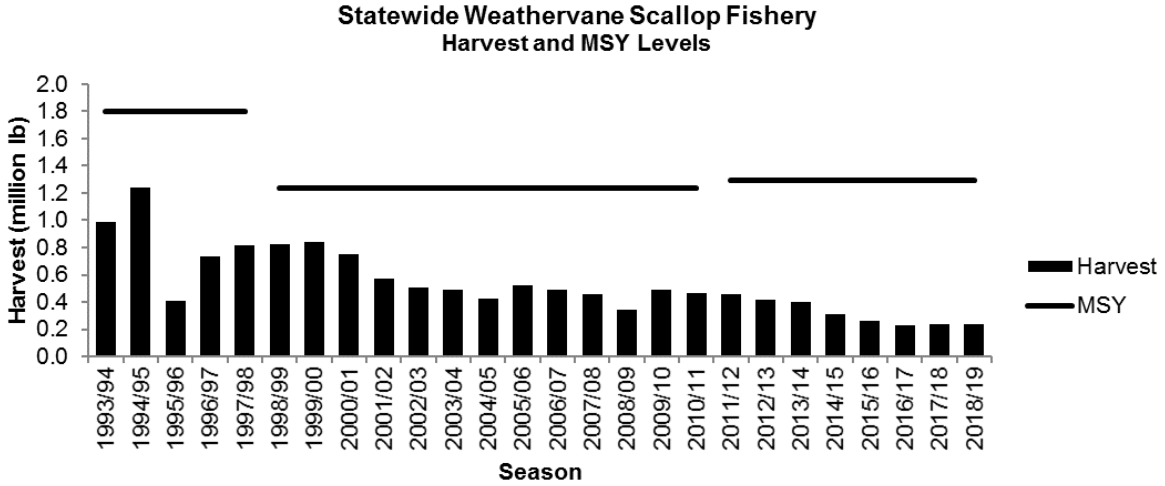

Figure 2-16 Statewide scallop harvest (lb shucked scallop meats) and MSY levels from FMP.

3. Weathervane Scallop Fishery and Management

The Alaska weathervane scallop fishery is managed jointly by NPFMC and ADF&G under the Federal FMP for the Scallop Fishery off Alaska. Measures that are fixed in the FMP, implemented by Federal regulation and require an FMP amendment to change include: license limitation program, OY specification, overfishing specification, and EFH/HAPC designation. All other management measures under the FMP are delegated to the State for management under Federal oversight. ADF&G management of the weathervane scallop fishery covers both State and Federal waters off Alaska.

Vessel Participation in the Scallop Fishery

Commercial weathervane scallop fishing in Federal waters off Alaska is limited by a Federal license limitation program (LLP), while scallop fishing in State waters is open access. The Federal LLP, effective 2001 under Amendment 4, limits participation in the scallop fishery in Federal waters to nine vessels. Seven LLP vessels were permitted to fish statewide outside of Cook Inlet using up to two 10-foot dredges statewide, and two LLP vessels were permitted to fish statewide utilizing single 6-foot dredges. In August, 2005, NMFS implemented Amendment 10 to the FMP, which modified the gear restriction to allow the single 6-foot dredge LLPs to be used with up to two 10-foot dredges outside of Cook Inlet. All 9 licenses allow vessel owners to fish inside Cook Inlet with a single 6-foot dredge. Vessel length for a given LLP is restricted to vessel length during the qualifying period. Unless otherwise restricted by the LLP, vessels fishing in the remainder of the state may simultaneously operate a maximum of 2 dredges that are 15 feet or less in width.

Participating in the Scallop fishery in Alaska state waters (0-3 nautical miles) had been limited by a vessel-based limited entry program until State limited entry expired in 2013 and was not renewed by the Alaska State Legislature. To date, no additional state-only vessels have participated in the open access state water fishery.

Four vessels with Federal LLP permits as well as state vessel-based limited entry permits (when required) have harvested most of the scallop catch outside Cook Inlet over the past several seasons. Only one of these vessels typically participates in the Cook Inlet Registration Area fishery.

Voluntary Scallop Cooperative

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

Vessel owners within the cooperative have taken an active role in reducing crab bycatch. Vessel operators provide confidential in-season fishing information to an independent consulting company contracted by the cooperative. This firm reviews crab bycatch data, fishing locations, and scallop harvest, which allows for real time identification of high crab bycatch areas. When these areas are identified, the fleet is provided with the information and directed to avoid the area.

Alaska State Registration Areas

The State Scallop Fishery Management Plan established nine scallop registration areas in Alaska for vessels commercially fishing scallops (Figure 1-1). These include the Southeastern Alaska Registration Area (Area A); Yakutat Registration Area (Area D), which is subdivided into the Yakutat District and District 16; Prince William Sound Registration Area (Area E), which is subdivided into the East and West Kayak Island Subsections; Cook Inlet Registration Area (Area H), which is subdivided into the Northern, Central, Southern, Kamishak Bay, Barren Islands, Outer and Eastern Districts; Kodiak Registration Area (Area K), which is subdivided into the Northeast, Shelikof, Southeast, Southwest and Semidi Islands Districts; Alaska Peninsula Registration Area (Area M), which is subdivided into the West Chignik, Central and Unimak Bight Districts; Dutch Harbor Registration Area (Area O); Bering Sea Registration Area (Area Q); and Adak Registration Area (Area R). Scallop seasons have never been opened in Area A, and effort occurred in Area R during 1995 only.

Seasons

The regulatory fishing season for weathervane scallops in Alaska is July 1 through February 15 except in the Cook Inlet Registration Area (5 AAC 38.167 & 5 AAC 38.420). In the Kamishak District of Cook Inlet, the season is August 15 through October 31 (5 AAC 38.220 & 5 AAC 38.320). These seasons were developed to limit fishing during scallop spawning periods, to achieve the highest possible product quality, to limit gear conflicts with other fisheries, and to increase vessel safety. Scallop fishing in any registration area in the state may be closed by emergency order prior to the end of the regulatory season. Scallop GHLs are typically announced by ADF&G one month prior to the season opening date.

Annual Catch Limits

Annual catch limits (ACLs) and accountability measures (AMs) are requirements under the MSA for all fisheries managed by federal fishery management plans. The requirements include provisions intended to prevent overfishing by requiring that: FMPs establish a mechanism for specifying ACLs in the plan; implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery; and including measures to ensure accountability (AMs). The MSA includes a requirement for the SSC to recommend fishing levels to the Council and provides that ACLs may not exceed the fishing levels recommended by the SSC. NMFS's National Standard 1 Guidelines state that the ABC is the fishing level recommendation that is most relevant to ACLs. For scallops off Alaska, ACL=ABC.

Accountability measures were established in Amendment 13 such that the sum of the annual GHLs for each scallop management area be established by the State of Alaska at a level sufficiently below the ACL so that the sum of the estimated discard mortality in directed scallop and groundfish fisheries as well as the directed scallop fishery removals does not exceed the ACL. Anytime an ACL is exceeded the overage will be accounted for through a downward adjustment to the GHL during the fishing season following the overage.

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

Catch in relation to ACLs

Total scallop catch is compared against the ACL and is applied statewide. Total catch from 2016/17 is reported in Table 4-1, and preliminary retained catch from the 2017/18 fishery is provided in Table 4-2. Note that discard estimates are not yet available for 2017/18. Final catch in relation to the ACL for 2017/18 will be provided in the 2019 Scallop SAFE report.

Guideline Harvest Ranges

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

Regulatory GHRs for traditional scallop fishing areas were first established by the State of Alaska in 1993 under the Interim Management Plan for Commercial Scallop Fisheries in Alaska. Regulatory GHRs (pounds of shucked scallop meats) were set at 0–250,000 lb for Yakutat; 0–50,000 lb for Prince William Sound; 10,000–20,000 lb for the Kamishak District of Cook Inlet; 0–400,000 lb for Kodiak; and 0–170,000 lb for Dutch Harbor. These area GHR ceilings were determined by averaging historic catches from 1969 to 1992, excluding years when there was no fishing or a "fishing-up effect" occurred (Barnhart, 2003).

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

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

In Season Data Use

Observers, which are required on all vessels fishing for scallops in Alaska outside Cook Inlet, monitor the fishery during the season and transmit data to ADF&G at least three times per week. Fishing may be closed in any area before the GHL is reached if collected data raise concerns about localized depletion, trends in CPUE, or bycatch rates. In-season data are also used by the scallop industry to avoid areas of high crab bycatch.

Beginning in 2010 concern over declining harvest prompted a review of fishery performance. Westward Region implemented a minimum performance standard as part of in season management assessment. All major harvest areas now have standards developed. A minimum performance standard was also implemented in the Yakutat area prior to the 2013/14 season. Area specific minimum performance standards are based on the lowest fishery CPUE within the observer time series (Table 3-1).

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

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

Area	Minimum Performance Standard (CPUE)	Basis Year
Yakutat Area		
Yakutat	34	2011/12
Kodiak Area		
Northeast District		
Statistical Area 525630	45	2005/06
Statistical Area 525702	52	2002/03
Remainder of NE District	43	2005/06
Shelikof District		
Combined North/South Bed	47	2003/04
Bristol Bay-Bering Sea	43	2004/05 - 2009/10[a]

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

Crab Bycatch Limits

Bycatch of crabs in the scallop fishery is controlled through the use of Crab Bycatch Limits (CBLs) that are based on condition of individual crab stocks. CBLs were first instituted by the state in July 1993. Methods used to determine CBLs in 1993 and 1994 were approved by the BOF and the Council and, with few exceptions, remain unchanged. Annual CBLs are established preseason by ADF&G for areas with current crab resource abundance information (surveys). For areas without crab abundance estimates, CBLs may be set as a fixed number of crabs that is not adjusted seasonally.

In the Kodiak, Alaska Peninsula, and Dutch Harbor Registration Areas, the CBLs are set at 0.5% or 1.0% of the total crab stock abundance estimate based on the most recent survey data. Statewide CBLs by region are shown in Table 3-2. Information specific to individual regions is indicated in the sections below. In registration areas or districts where red king crab or Tanner crab abundance is sufficient to support a commercial crab fishery, the cap is set at 1.0% of the most recent red king crab or Tanner crab abundance estimate. In registration areas or districts where the red king crab or Tanner crab abundance is insufficient

to support a commercial fishery, the CBL is set at 0.5% of the most recent red king crab or Tanner crab abundance estimate. Crab abundance estimates are not available in the Southwest District of the Kodiak Area or the Unimak Bight area of the Alaska Peninsula Area. In each of these areas, CBLs are fixed at 50 red king crabs and 12,000 Tanner crabs. Bycatch caps are expressed in numbers of crabs and include all sizes of crabs caught in the scallop fishery.

Table 3-2 Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.

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

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

In the Kamishak District of the Cook Inlet Registration Area, the Tanner crab bycatch limit is set at 0.5% of the total crab stock abundance from the most recent dredge survey and the red king crab limit was fixed at 60 crabs in earlier years and has since been reduced to 30 crabs commensurate with the reduction in red king crab catch in trawl and dredge surveys in recent years. In 2001, ADF&G set Tanner crab bycatch caps in the Prince William Sound Registration Area at 0.5% of the Tanner crab population estimate from the 2000 scallop survey. This resulted in bycatch limits of 2,700 and 8,700 for the east and west harvest areas. Starting in 2010, the department set crab bycatch limits at 0.5% of the Tanner crab abundance estimated from the scallop survey.

CBLs in the Bering Sea (registration Area Q) have evolved from fixed numbers in 1993 to a three tier approach used in the current fishery. In 1993, Bering Sea CBLs were set by ADF&G to allow the fleet adequate opportunity to explore and harvest scallop stocks while protecting the crab resource. CBLs were established at 260,000 *Chionoecetes spp*. and 17,000 red king crabs. In Amendment 1 of the federal scallop FMP, the Council approved the CBLs established by ADF&G. The Council also recommended that king crab bycatch limits be set within a range of 500 to 3,000 annually. From the 1996/97 through 1998/99

fishing seasons the CBL for *Chionoecetes spp*. in the Bering Sea was established annually by applying the percentages established for snow and Tanner crab limits in Amendment 1 of the FMP. Beginning with the 1996/97 fishing season ADF&G took a conservative approach and set the red king crab limit in Registration Area Q at 500 red king crabs annually. In 1998, consistent with the Tanner crab rebuilding plan in the Bering Sea, crab bycatch limits were modified.

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

Bycatch of snow crabs, Tanner crabs, and red king crabs by scallop fisheries are shown in Tables 3-3 and 3-4. Bycatch of snow, king, and Tanner crabs during the Bering Sea scallop fishery tends to be much lower than for other Bering Sea fisheries. Observer data on carapace width for samples crabs by registration area are available in Figure 3-1 for 2015/16 fisheries.

Table 3-3 Bycatch of King crabs by Area/District in the 2017/18 Alaska weathervane scallop fishery.

Area/District	**King crab bycatch cap**	**Est number crab**
Yakutat District	NE	0
Yakutat District 16	NE	0
Prince William Sound	NE	0
Cook Inlet	30	0
Kodiak Northeast District	25	0
Kodiak Shelikof District	50	0
Kodiak Southwest District	50	2
Alaska Peninsula Central District	NE	0
Alaska Peninsula Unimak Bight District	50	0
Dutch Harbor	20	0
Bering Sea	500	0
Statewide total	725	2

NE: not established

Table 3-4 Bycatch of *Chionoecetes* crabs by Area/District in the 2017/18 Alaska weathervane scallop fishery.

Area/District	Chionoecetes bycatch cap	Est number crab	Est weight (lb)[a]
Yakutat District	NE	2,083	164
Yakutat District 16	NE	44	0.2
Prince William Sound	1,600	75	1
Cook Inlet	3,933	0	0
Kodiak Northeast District	19,388	5,593	1,512
Kodiak Shelikof District	63,926	3,639	2,155
Kodiak Southwest District	12,000	6,945	706
Alaska Peninsula Central District	NE	0	0
Alaska Peninsula Unimak Bight District	12,000	5,058	357
Dutch Harbor	10,000	8	1
Bering Sea *C. bairdi*	65,000	6,905	5,590
Bering Sea *C. opilio* and hybrids	300,000	4,199	5,638
Statewide total	487,847	34,549	16,124

NE: not established

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

Scallop fishery closures due to attainment of CBLs have decreased over the years, in part due to decreased crab abundance (Barnhart and Rosenkranz, 2003) as well as a voluntary industry cooperative, which provides the fleet additional flexibility to move off of high bycatch areas. ADF&G closely monitors bycatch rates during scallop seasons and has used a rate of one crab per pound of scallop meats as a benchmark since 1993. Bycatch may affect harvest and CPUE in the Bering Sea scallop fishery as vessel operators move or cease fishing when bycatch rates meet or exceed this benchmark.

Intentionally Left Blank

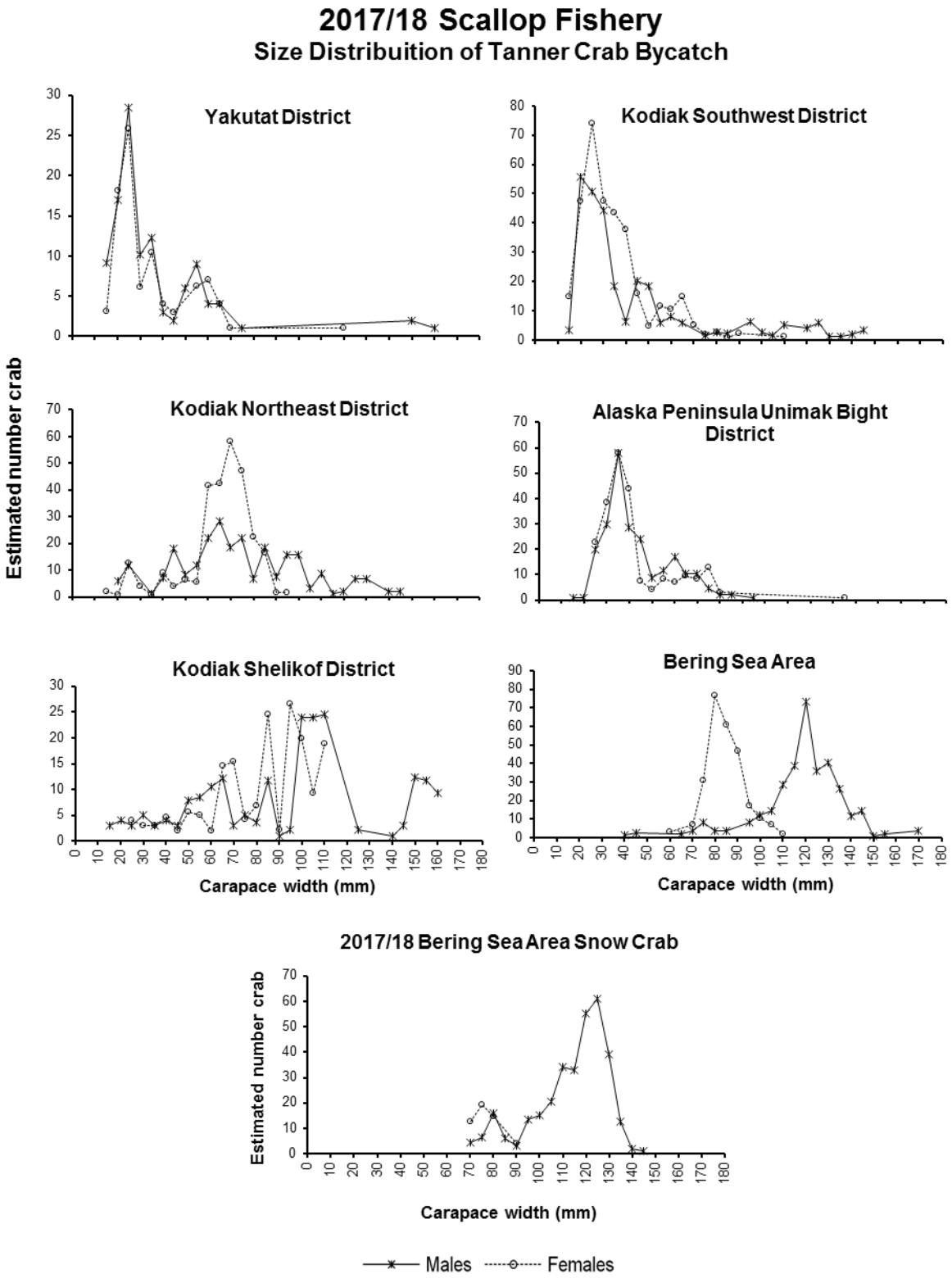

Figure 3-1 Tanner and snow crab carapace width distributions by management unit from catch sampling during the 2017/18 scallop fishery. Yakutat District 16, West Kayak Island Subsection and the Dutch Harbor Area are not shown due to very low sample sizes.

4. Regional Fishery Performance

The 2016/17 season statewide Guideline Harvest Level (GHL) for weathervane scallops was 286,300 lb of shucked meats. Of this GHL 233,003 lb were retained with an additional 7,037 lb of estimated discard mortality for a total take of 240,040 lb of shucked meats (Table 4-1).

Table 4-1 GHLs and summary statistics from 2017/18 Alaska weathervane scallop fishery.

Area/District	GHR (lb meat)	GHL (lb meat)	Retained catch (lb meat)	CPUE (lb meat per dredge hr)	Est scallop discard mortality (lb meat)[a]
Yakutat District	0-250,000	140,000	140,075	51	6,964
Yakutat District 16	0-35,000	5,000	5,005	16	121
Prince William Sound	0-50,000	6,300	6,330	62	220
Cook Inlet	10,000-20,000	10,000	0		0
Kodiak Northeast District	0-300,000 for whole Kodiak Area	55,000	14,190	41	432
Kodiak Shelikof District		25,000	25,050	46	932
Kodiak Southwest District[b]		25,000	25,020	66	1,699
Alaska Peninsula Central District	0-100,000 for whole Alaska Peninsula Area	7,500	0		0
Alaska Peninsula Unimak Bight District[b]		15,000	15,250	47	448
Dutch Harbor	0-110,000	10,000	285	12	1
Bering Sea	0-300,000	7,500	7,535	24	72
Statewide total		306,300	238,740	48	10,889

[a] Calculated from round weight discard estimates assuming 20% mortality (as previously used in scallop ACL analysis) for discarded scallops and meat recovery percentages from observer experiments.

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

Table 4-2 GHLs and preliminary catch from the 2018/19 Alaska weathervane scallop fishery.

Area/District	GHL (lb scallop meats)	Retained catch (lb scallop meats)
Yakutat District	145,000	145,093
Prince William Sound	6,300	6,420
Cook Inlet	Closed	
Kodiak Northeast District	15,000	14,340
Kodiak Shelikof District	25,000	25,010
Kodiak Southwest District	30,000	30,000
Kodiak Southeast District	15,000	455
Alaska Peninsula Central District	7,500	0
Alaska Peninsula Unimak Bight District[a]	15,000	8,905
Dutch Harbor	5,000	325
Bering Sea	7,500	7,540
Statewide total	271,300	238,088

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

Southeast Region

District 16

At their January 2019 meeting in Sitka the State of Alaska Board of Fisheries approved a proposal to combine the District 16 GHR with the remainder of the Yakutat District. That decision was implemented prior to the 2018/19 season. The 2017/18 GHL of 5,000 lb of shucked meats was added to the 140,000 lb Yakutat GHL. To reflect this change future SAFE documents will present District 16 and Yakutat harvest history in combined form.

Due to consistently poor fishery performance, the District 16 GHL was reduced 80% to a monitoring level of 5,000 lb for sucked meats prior to the 2016/17 season. The GHL was fully taken in the 2017/18 season with the highest CPUE in 4 seasons (Table 4-3, Figures 4-1, 4-2). The fleet cited poor densities and product quality as the reasons for the low harvest numbers in previous seasons. This variation in product quality between years seems to be standard in District 16. District 16 is the easternmost scallop bed in the state, and the product quality issues may be due to marginal habitat.

Table 4-3 Yakutat District 16 scallop fishery summary statistics, 2000/01 - 2017/18.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	3	35,000	30,904	310,370	476	65	652	854
2001/02	2	35,000	20,398	245,319	417	49	588	815
2002/03	2	35,000	3,685	60,928	100	37	609	211
2003/04	2	35,000	1,072	16,780	18	60	932	18
2004/05	2	35,000	24,430	326,228	419	58	779	332
2005/06	2	35,000	13,650	209,487	407	34	515	597
2006/07	2	21,000	13,445	184,106	309	44	595	415
2007/08	1	21,000	180	8,888	6	30	635	34
2008/09	2	21,000	20,986	207,251	423	50	490	1,259
2009/10	2	25,000	11,791	210,006	439	27	437	1,745
2010/11	1	25,000	2,655	31,266	83	32	370	468
2011/12	1	25,000	1,777	21,978	57	31	361	51
2012/13	1	25,000	25,255	335,178	684	37	452	1,019
2013/14	2	25,000	25,510	313,000	634	40	494	708
2014/15	2	25,000	9,140	108,803	423	22	257	256
2015/16	1	25,000	870	10,512	41	21	255	34
2016/17	1	5,000	240	2,331	16	15	308	16
2017/18	1	5,000	5,005	59,157	158	32	374	121

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 8.3% from observer experiments.*

Overall CPUE in District 16 has been declining since the 2000/01 season (Figure 4-1); it is difficult to parse out an explanation. Inter-annual variation analysis is difficult because effort is highly variable in the area. There are years with practically no harvest and relatively low CPUE immediately followed by a season of high harvest and relatively high CPUE. However, due to the large and sudden decrease in CPUE and reports of poor fishery performance from the fleet, beginning in the 2014/15 season, a decrease in harvest pressure appeared necessary. Harvest had averaged 11,200 lb of shucked meats over the past 10 seasons prior to 2016/17. In order to produce a substantial and effective reduction in harvest, a 5,000 lb GHL was introduced prior to the 2016/17 season. This amount allows for exploratory effort by the fleet in order to monitor the fishery performance while reducing harvest on a stock of concern.

No crab bycatch was observed in the 2016/17 season (Table 3-4).

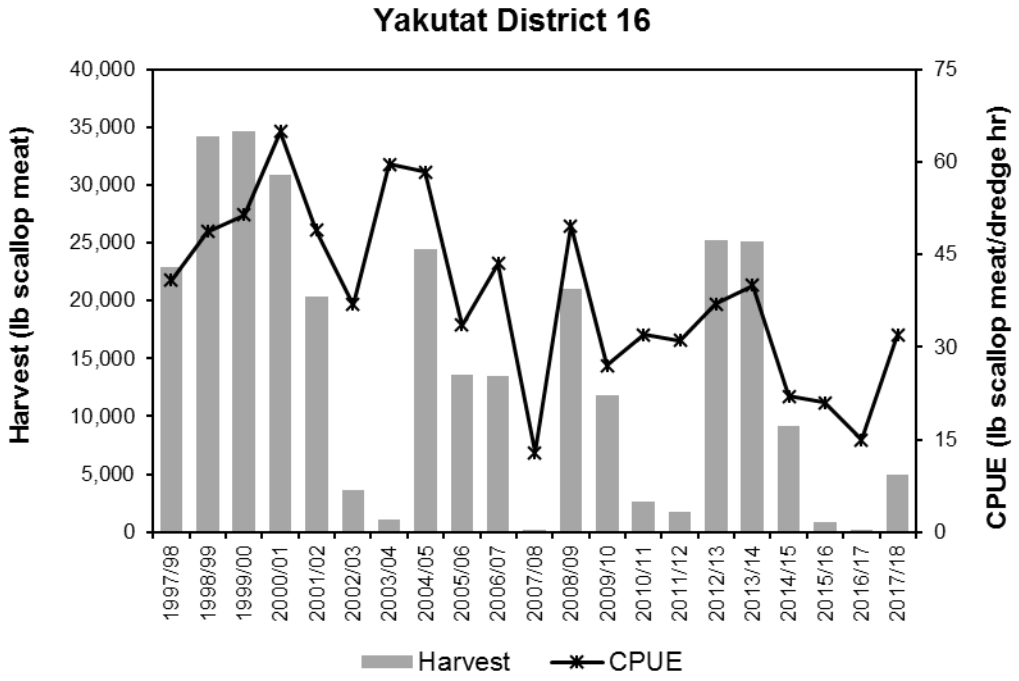

Figure 4-1 Yakutat District 16 scallop harvest and CPUE, 1997/98 - 2017/18 seasons

Table 4-4 District 16 catch summary for the 2009/10-2017/18 seasons for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	414.4	440.7	263.0	359.7
2010/11	352.2	371.2	206.3	319.9
2011/12	312.6	360.1	214.7	327.9
2012/13	426.4	445.5	201.8	387.8
2013/14	527.2	484.5	255.9	365.4
2014/15	254.9	255.0	113.7	249.6
2015/16	241.6	255.2	155.2	195.3
2016/17	50.9	62.5	52.5	80.0
2017/18	370.1	369.1	154.1	405.4

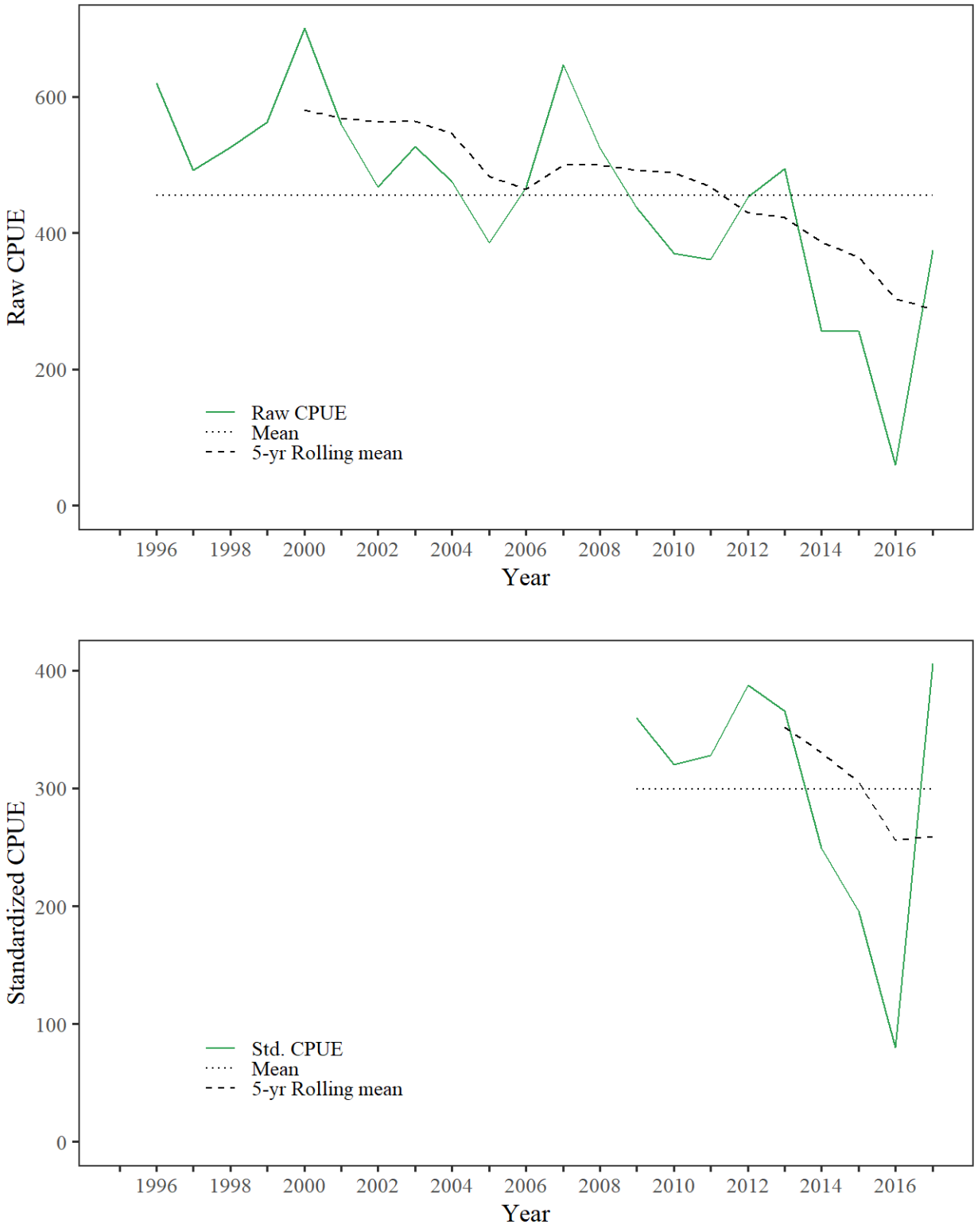

Figure 4-2 Yakutat District 16 scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

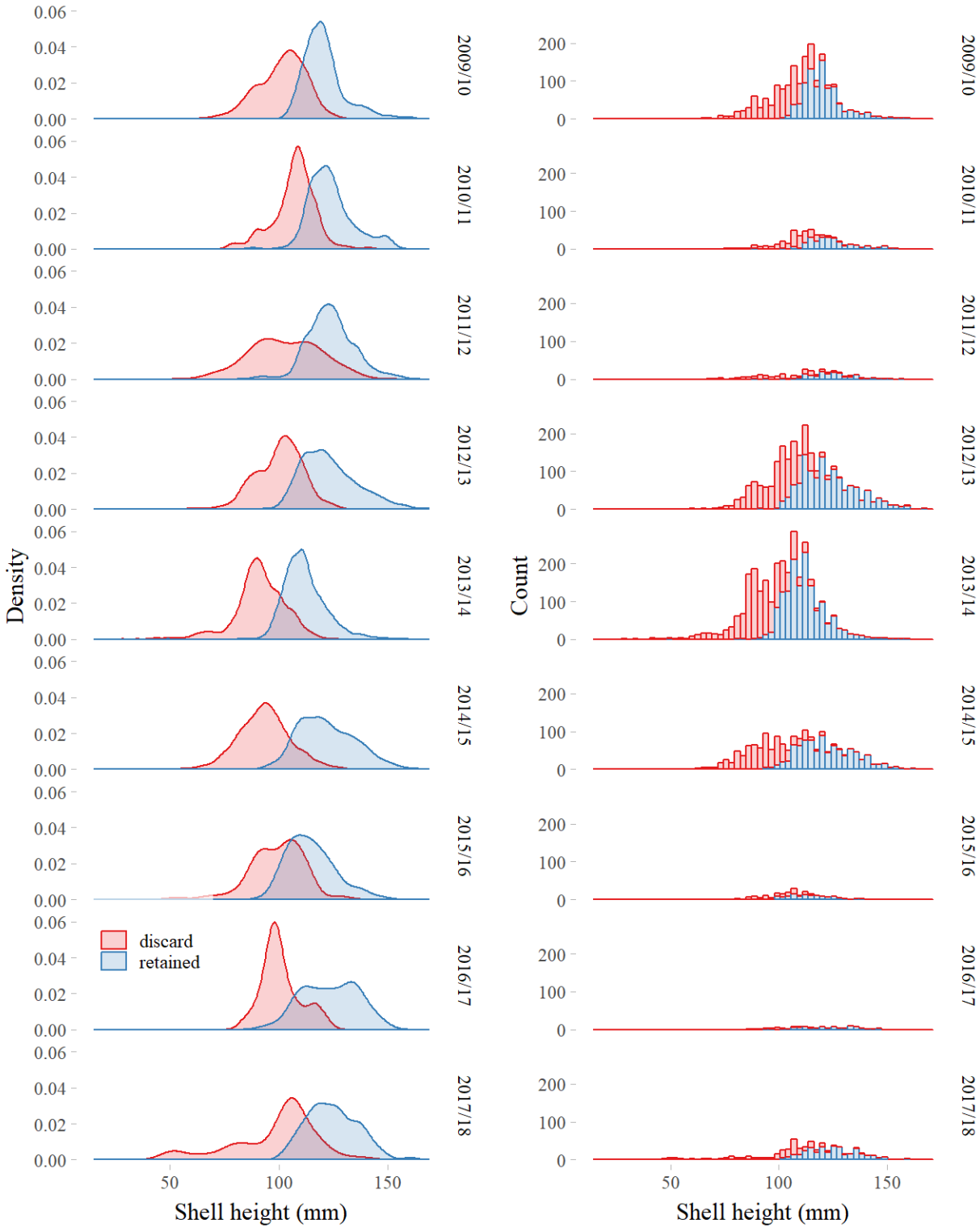

Figure 4-3 Yakutat District 16 retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Yakutat

At their January 2019 meeting in Sitka the State of Alaska Board of Fisheries approved a proposal to combine the District 16 GHR with the remainder of the Yakutat District. That decision was implemented prior to the 2018/19 season. The 2017/18 GHL of 5,000 lb of shucked meats was added to the 140,000 lb Yakutat GHL for a total GHL of 145,000 lb of shucked meats for the 2018/19 season.

The 2018/19 season was the 2nd season at an increased GHL in Yakutat. This GHL increase was possible as the previous 5 years at a reduced GHL appeared to have been effective as CPUE increased from the mid-30s to the high 40s and 50s (Figures 4-4, 4-5). Based on preliminary harvest and effort from the 2018/19 season, CPUE is up 88% from the 2011/12 low to the highest level since the 1999/00 season.

Table 4-5 Yakutat Area D scallop fishery summary statistics, 2000/01 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours[a]	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	3	250,000	195,699	2,734,559	4,241	46	645	10,401
2001/02	2	200,000	103,800	1,521,537	2,406	43	632	4,809
2002/03	2	200,000	122,718	1,541,867	2,439	50	632	6,326
2003/04	2	200,000	160,918	1,939,004	3,360	48	577	6,940
2004/05	2	200,000	86,950	1,262,499	2,132	41	592	3,869
2005/06	2	200,000	199,351	2,662,031	5,089	39	523	6,988
2006/07	2	150,000	150,041	1,771,229	2,817	53	629	6,715
2007/08	2	150,000	125,960	1,593,223	2,601	48	613	9,184
2008/09	3	150,000	150,289	2,053,912	3,286	46	625	7,361
2009/10	2	160,000	158,225	2,317,273	3,946	40	589	10,985
2010/11	3	160,000	156,575	2,087,228	3,495	45	610	10,216
2011/12	3	160,000	156,463	2,386,748	4,598	34	513	10,303
2012/13	3	120,000	118,140	1,708,044	3,354	35	501	8,706
2013/14	3	120,000	122,290	1,540,114	2,391	51	644	3,770
2014/15	3	120,000	120,353	1,446,693	2,736	44	529	2,861
2015/16	2	120,000	119,820	1,684,050	2,530	47	666	3,169
2016/17	2	120,000	120,140	1,633,663	2,083	57	784	4,424
2017/18	2	140,000	140,075	1,782,558	2,728	51	650	6,964
2018/19[d]	2	145,000	145,093	NA	2,269	64	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 8.3% from observer experiments.*
[d] PRELIMINARY data subject to change.

In the 2017/18 Yakutat fishery, 140,075 lb of scallop meats were retained and an estimated 34,820 lb, or approximately 24.8%, were discarded, Discards have been increasing for three years increased, and are now approximately equal to the 10-year mean level of 24.5%. Using a 20% discard mortality, an estimated 6,964 lb of scallop meat weight was lost to discard mortality in the 2017/18 season (Table 4-5).

Estimated shell height distributions in Area D show a slight decrease in the range of scallop sizes in the 2017/18 season, with an apparent prerecruit pulse in the 80mm range no longer discernable. The bulk of the retained scallops remain in the 115–140 mm shell height (SH) range (Figure 4-6).

Beginning in 2013 a minimum performance standard was implemented for Yakutat as part of in season management assessment, as had been developed in the Westward region in 2010. The minimum performance standard is based on the lowest fishery CPUE within the observer time series. In the case of Yakutat this is 34 lb shucked meats / dredge hour based on the 2011/12 season (Table 3-1).

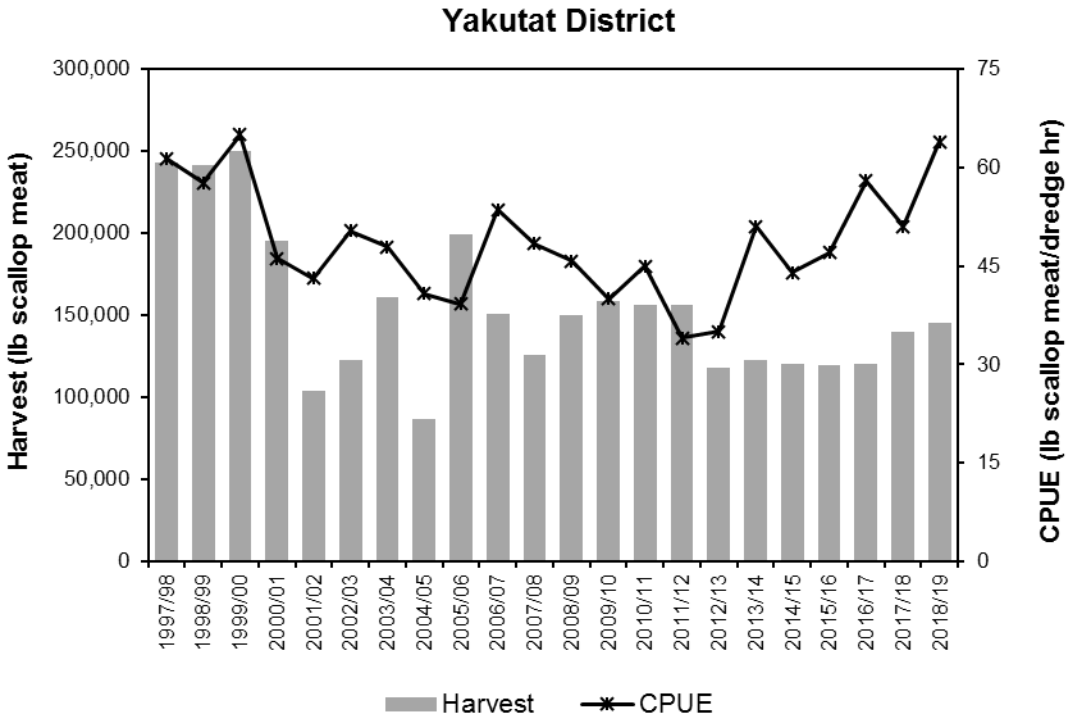

Figure 4-4 Yakutat Area D scallop harvest and CPUE, 1997/98 - 2018/19 seasons.

Crab bycatch estimates calculated from 2017/18 Yakutat observer samples were 2,083 933 Tanner crabs (Table 3-4), and 31 Dungeness crabs. The estimated Yakutat Tanner crab bycatch is 220% of the 2016/17 season but remains quite low compared to historical averages. Carapace width (CW) of Tanner crabs sampled by observers ranged from about 10mm to 60mm, with the vast majority in the 20-30mm range (Figure 3-1).

Table 4-6 Yakutat District catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	584.8	592.8	260.4	239.2
2010/11	572.6	613.7	252.9	223.1
2011/12	508.3	519.8	202.4	192.5
2012/13	466.9	496.8	228.1	180.0
2013/14	645.3	643.6	260.8	241.8
2014/15	508.5	516.4	204.1	217.7
2015/16	638.4	666.1	242.7	250.7
2016/17	661.8	732.2	333.0	313.3
2017/18	602.4	641.6	285.5	248.7

Intentionally Left Blank

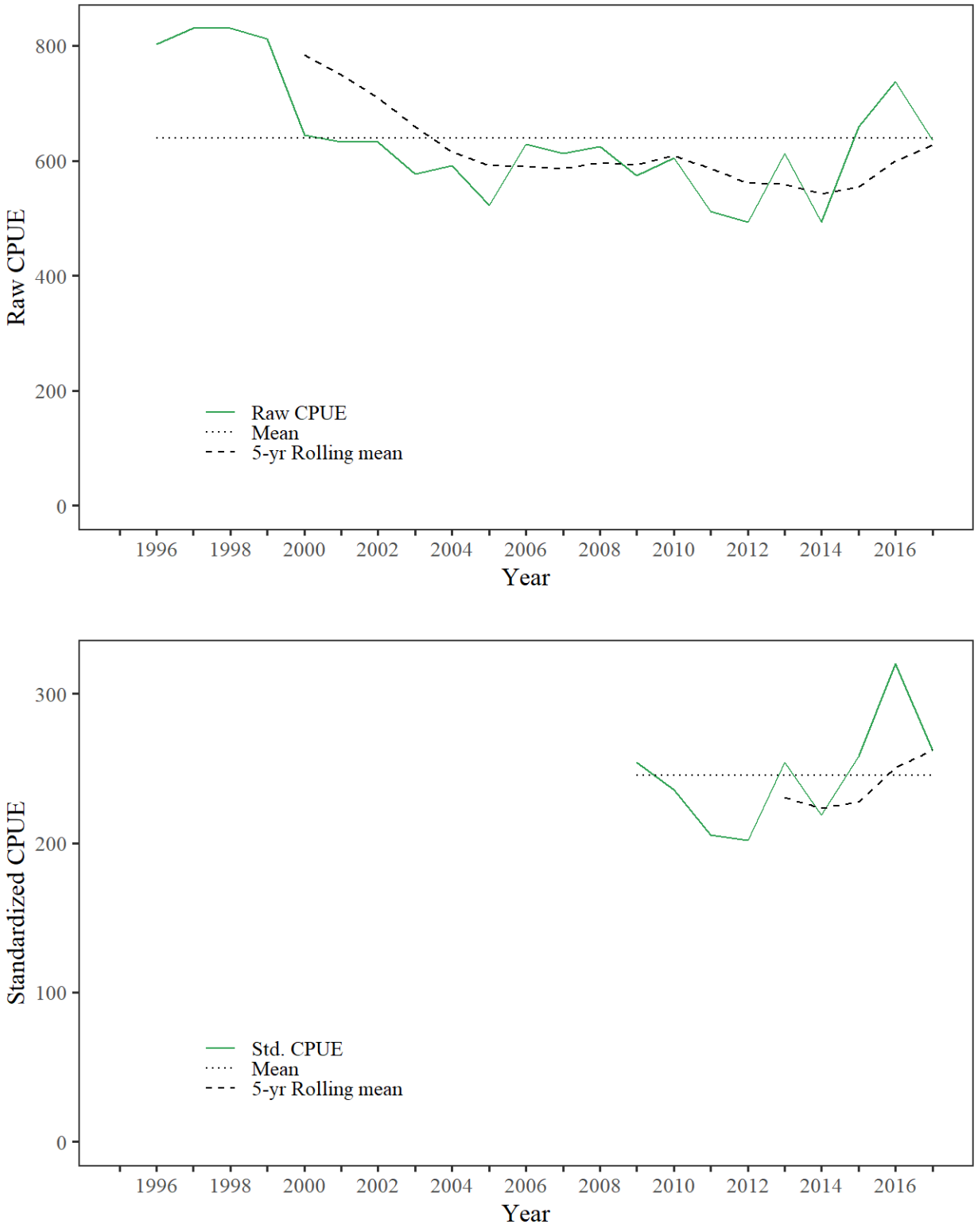

Figure 4-5 Yakutat District scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

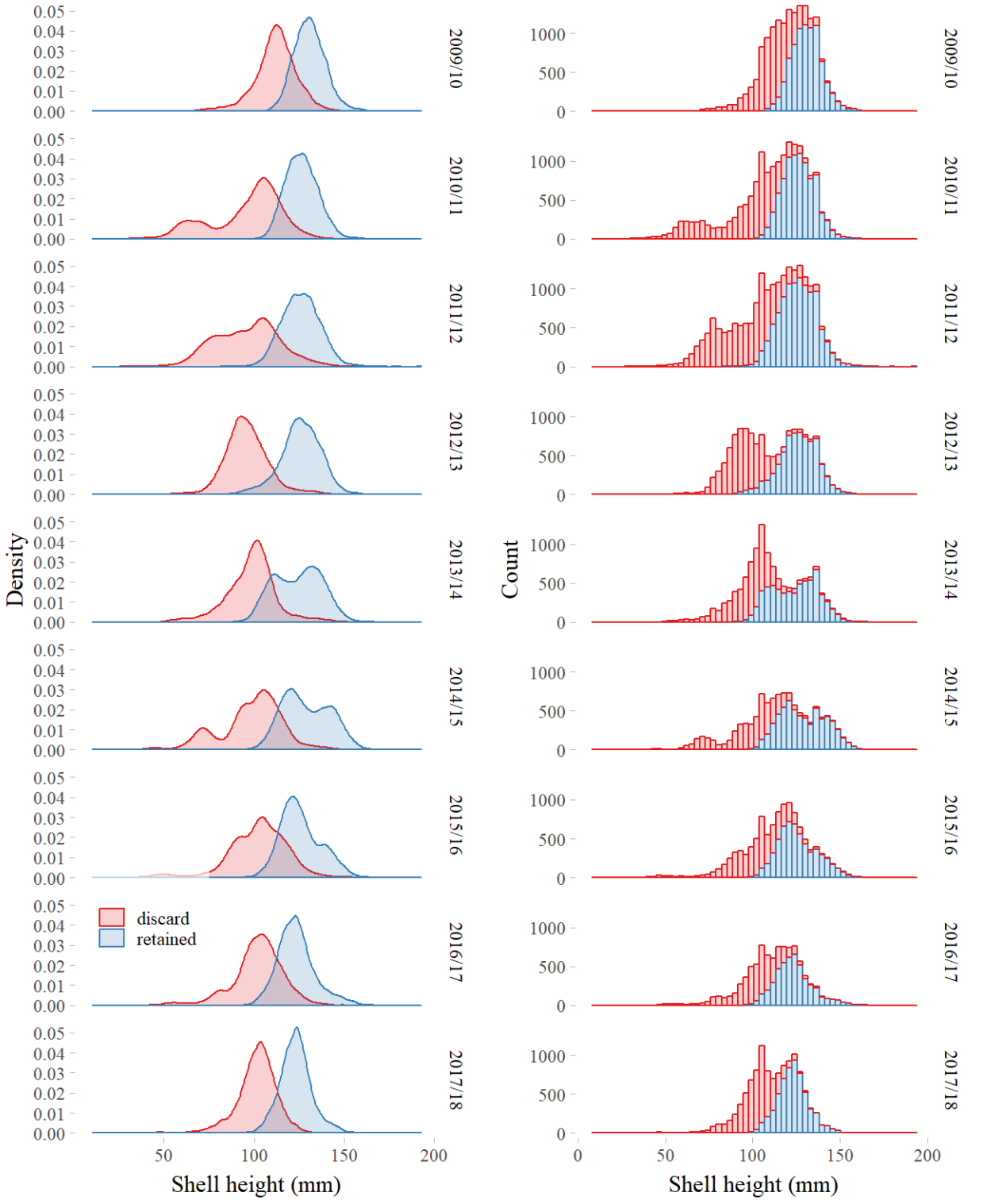

Figure 4-6 Yakutat District retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Central Region

Kayak Island

The 2018/19 Kayak Island weathervane scallop fishery in the Prince William Sound Area (PWS, Area E) opened for the third consecutive season after being closed for four seasons, 2012/13 through 2015/16. The fishery opened in the West Kayak Subsection (WKS) on July 1 with a 6,300 lb guideline harvest level (GHL). The East Kayak Subsection (EKS) remained closed for the 2018/19 season. During the 2018/19 season in the WKS, one vessel participated and harvested 6,420 lb; the season closed at 12:00 noon August 21 when the GHL was projected to be achieved, which represented 5 days of actual fishing time. The 2018/19 CPUE of 48 lb/hr, a decrease of 23% from the 2017/18 season CPUE (Table 4-7).

The Kayak Island scallop fishery has a guideline harvest range (GHR) of zero to 50,000 lb of shucked scallop meats, open July 1 through February 15 in the Eastern Section of the Outside District of PWS. The GHL is set based on the Kayak Island ADF&G dredge survey estimates of abundance and biomass. For the PWS scallop fishery, the Eastern Section is divided into the WKS (West bed) and EKS (East bed) marked by Cape St. Elias.

The 2017/18 season opened July 1 in the WKS with a GHL of 6,300 lb and closed at 6 p.m. August 6 when the GHL was achieved. One vessel participated in the 2017/18 fishery and harvested 6,330 lb of scallop meats in 4 days of actual fishing time with a CPUE of 62 lb/hr; this was above the CPUE of 57 lb/hr for the 2016/17 season when 6,360 lb were harvested in 5 days with the same GHL.

Using observer information for the 2017/18 season in the WKS, scallop catch estimates were 88,328 lb round weight retained and 12,916 lb round weight discarded, a discard rate of 14.6%, nearly double the 2016/17 discard rate of 8.5% in the WKS. This is similar to the 2011/12 season discard rate of 8.3% in the EKS, the last season the EKS was open.

Shell height distributions provided by the statewide observer program indicate that scallops retained during the 2017/18 season in the WKS ranged from 94 to 140 mm with an average shell height of 123 mm, n=220 sampled (Figure 4-8). Although the range of scallops from the 2017/18 season indicated smaller sized scallops than the previous season, the average shell height was higher than the 2016/17 season in the WKS. These shells ranged from 105 to 143 mm with an average shell height of 121 mm, n=240 sampled. Scallops harvested during the 2011/12 season in the EKS were larger and ranged between 118 and 158 mm in shell height, with an average of 139 mm, n=420 sampled. Similarly, discarded scallops averaged 95 mm during the 2017/18 season, compared to 86 mm during the 2016/17 season, and 124 mm during the 2011/12 season.

During the 2017/18 season in the WKS, 75 Tanner crab were caught as bycatch, less than half the 2016/17 season in the WKS, when 180 Tanner crab were caught (Table 3-4); however, catches for both seasons are considered low and Tanner crab size was very small with total crab weight estimated at 1 lb for both years. No King or Dungeness crab have been encountered in sampled dredges during the last three open seasons. Forty-three halibut were caught during the 2017/18 season.

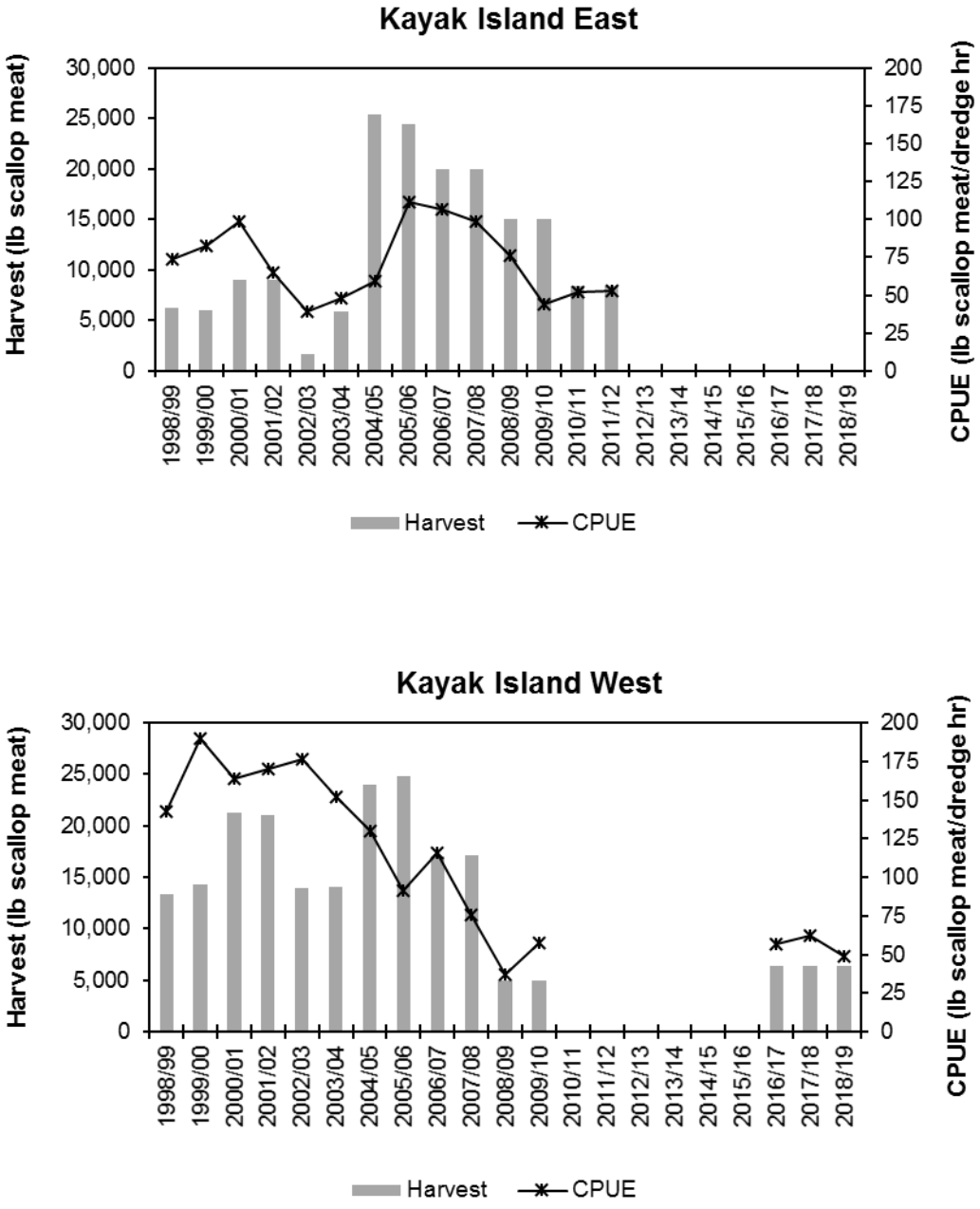

Figure 4-7 Prince William Sound scallop harvest and CPUE, 1996/97 - 2018/19 seasons.

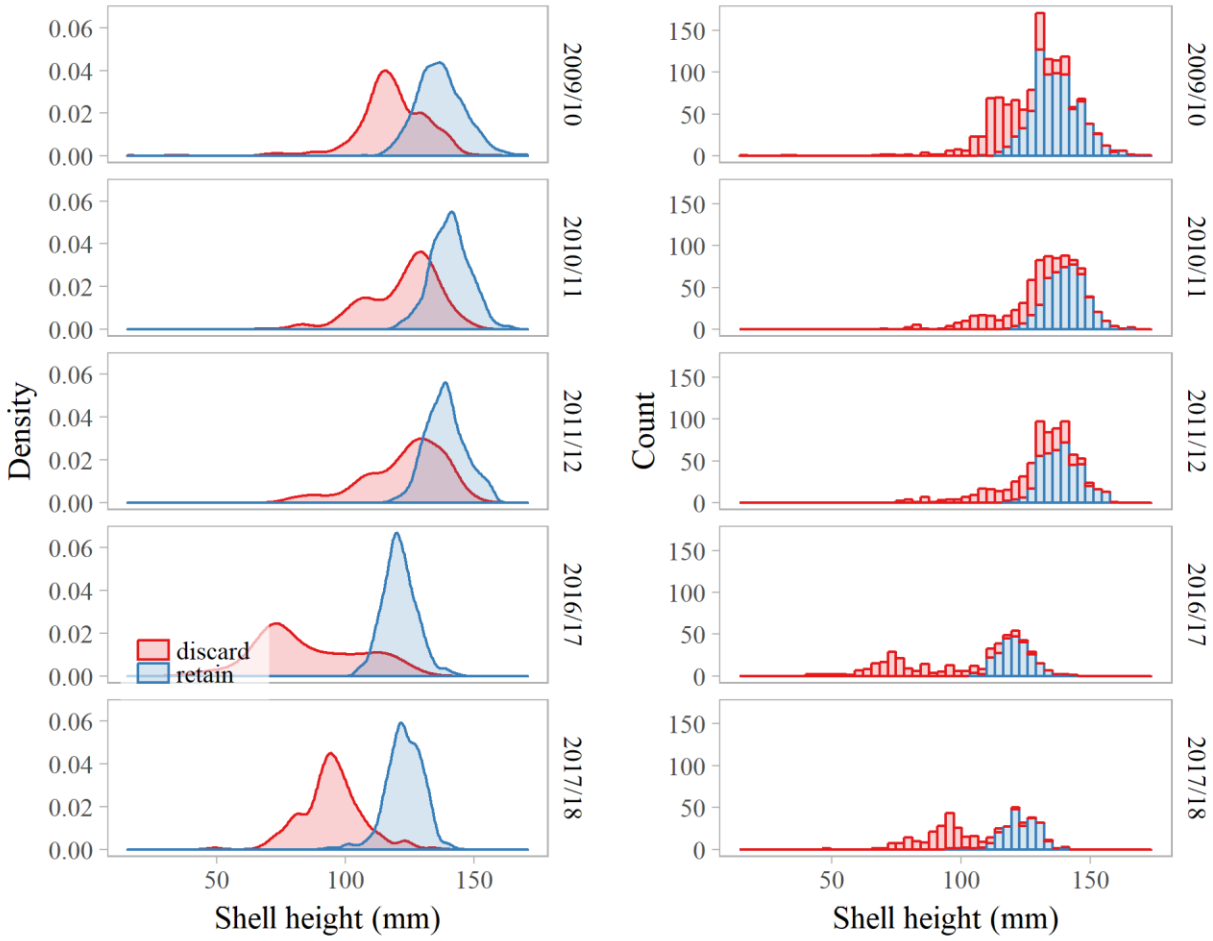

Figure 4-8 Prince William Sound retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Table 4-7 Commercial harvest of weathervane scallops from Kayak Island beds, 1995/96 - 2018/19.

		East Bed				West Bed				Total Both Beds			
Season	Numbe Vessels	GHL[a] (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb per dredge hr)	GHL[a] (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	GHL[a] (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)
1995/96	3									50,000	108,000	NA	NA
1996/97		Closed				Closed				Closed			
1997/98	1									17,200	18,000	171	105
1998/99	2	6,000	6,300	85	74	14,000	13,350	94	142	20,000	19,650	179	110
1999/00	2	6,000	6,065	74	82	14,000	13,345	76	190	20,000	20,410	149	137
2000/01	3	9,000	8,998	92	98	21,000	21,268	129	164	30,000	30.266	221	137
2001/02	1	9,000	9,060	140	65	21,000	21,030	124	170	30,000	30,090	263	114
2002/03	2	6,000	1,680	43	39	14,000	13,961	79	177	20,000	15,641	122	128
2003/04	1	6,000	5,910	123	48	14,000	14,070	93	152	20,000	19,980	216	93
2004/05	2	26,000	25,350	430	59	24,000	23,970	185	130	50,000	49,320	615	80
2005/06	3	26,000	24,435	219	112	24,000	24,781	272	91	50,000	49,216	491	100
2006/07	2	20,000	20,010	188	106	17,000	17,005	147	116	37,000	37,015	335	110
2007/08	2	20,000	20,015	203	99	17,000	17,090	225	76	37,000	37,105	428	87
2008/09	1	15,000	15,030	197	76	5,000	5,010	134	37	20,000	20,040	331	61
2009/10	2	15,000	15,035	335	45	5,000	4,980	84	59	20,000	20,015	419	48
2010/11	1	8,400	8,445	161	52	Closed				8,400	8,445	161	52
2011/12	1	8,400	8,460	160	53	Closed				8,400	8,460	160	53
2012/13		Closed				Closed				Closed			
2013/14		Closed				Closed				Closed			
2014/15		Closed				Closed				Closed			
2015/16		Closed				Closed				Closed			
2016/17	1	Closed				6,300	6,360	112	57	6,300	6,360	112	57
2017/18	1	Closed				6,300	6,330	102	62	6,300	6,330	102	62
2018/19[b]	1	Closed				6,300	6,420	133	48	6,300	6,420	133	48

[a] *Separate GHLs were established for the east and west beds in 1998*

[b] PRELIMINARY data subject to change

Kamishak Bay

In 2018, the Kamishak District weathervane scallop fishery was closed. A department survey was conducted in 2018 in the North bed. Biomass estimates had declined sharply from the last surveys completed for each bed. In the North Bed, the biomass estimate was less than half of the 2015 estimate, and in the South Bed, the biomass estimate decreased 91% from 2013. The guideline harvest range set in regulation is 10,000 to 20,000 lb of shucked scallop meats for the Kamishak District. The 2018 scallop harvestable biomass estimates were far below the 10,000 lb needed to allow for a fishery.

The past two open seasons have been characterized by low effort. In 2016, one vessel participated and harvested 3,982 lb of scallops (Table 4-8), less than half of the 10,000 lb GHL. Effort was 271 dredge hours for a CPUE of 15 lb/hour, the second lowest CPUE in the history of the fishery (Table 4-8, Figure 4-9). The CPUE decreased as the 2016 fishery progressed from 17 lb/hr on the first trip to 13 lb/hr on the third and final trip. In 2017 the Kamishak District was open with a GHL of 10,000 lb. No vessels registered or fished in the 2017 season

In 2016, retained scallops from observed tows ranged from 129 to 190 mm, with an average shell height of 162 mm, an increase from 160 mm in 2015 and 155 mm in 2012. Discarded live (small) scallops in 2016 averaged 107 mm in shell height compared to 119 mm in 2015 and 101 mm in 2012. Age data for 2016 was unavailable for this report. In 2015, harvested scallops' ages ranged from 4 to 20 years with an average age of 11 years; in 2012, ages ranged from 4 to 23 years with an average age of 10 years.

Vessels participating in the Kamishak District scallop fishery are not required to have a statewide observer onboard, although department staff observers must be accommodated upon request. Typically, at least half of trips are observed. The department placed an observer on two of the three fishery trips in 2016 to collect data on scallop catch, discards, crab bycatch, and catch composition; the observer sampled 47 of 237 (20%) tows. This information was used to calculate deadloss, a discard rate (by weight) of 2.1%, and an average meat recovery of 8.8%. The occurrence of weak meats was also observed during the fishery. In 2016, 220 scallops were sampled for meat quality during observed trips and 9 scallops (4.0%) had weak meats, which was less than the 5.1% observed in 2015 and higher than the 2.7% observed in 2012.

Crab bycatch allowable levels in 2017 were set at 3,933 Tanner crab and 30 king crab, however, there was no participation in the fishery and therefore zero crab were caught (Table 3-3 and 3-4). Crab bycatch has remained well below the crab bycatch caps in recent years.

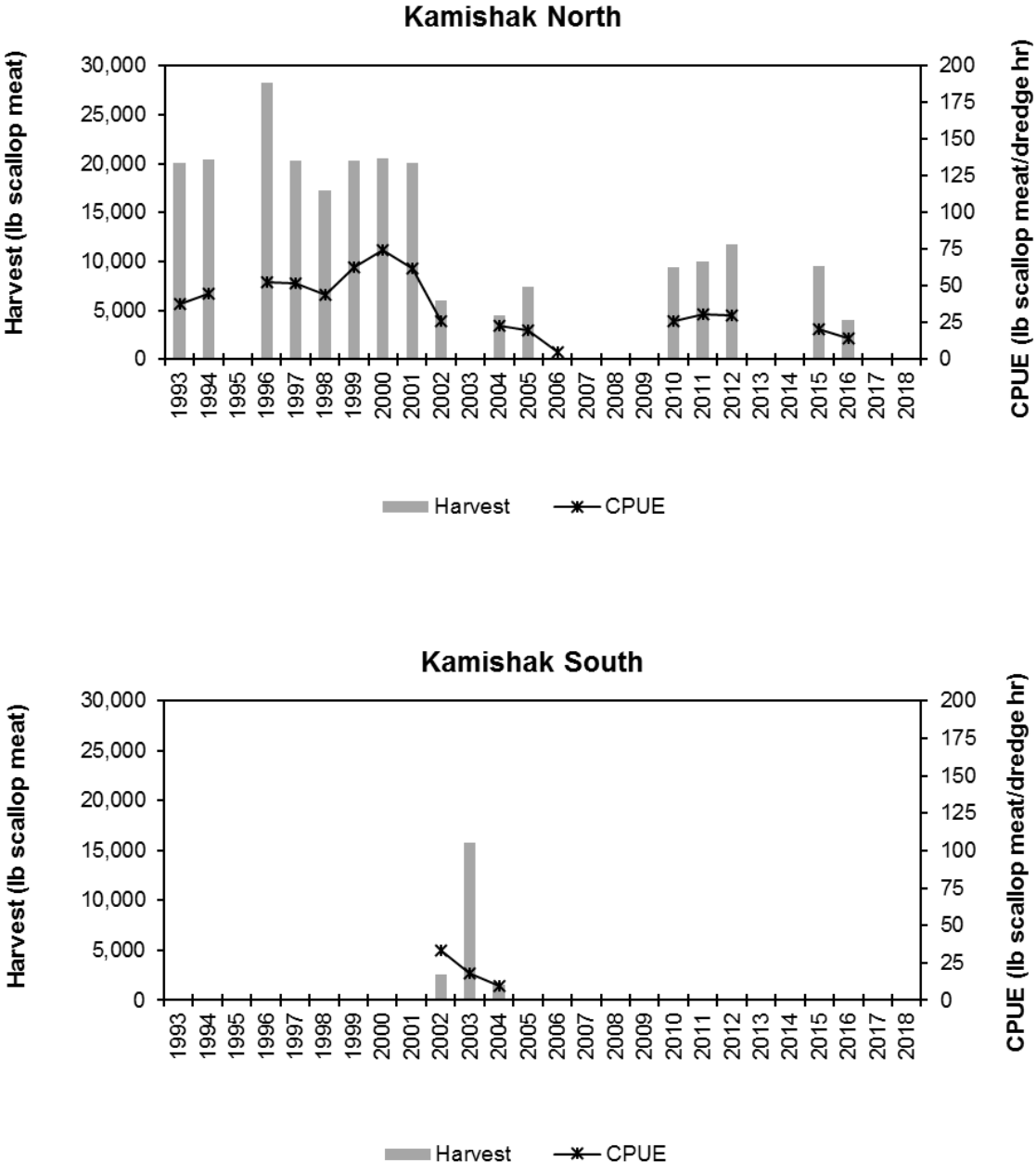

Figure 4- 9 Cook Inlet scallop harvest and CPUE, 1993 - 2018 seasons.

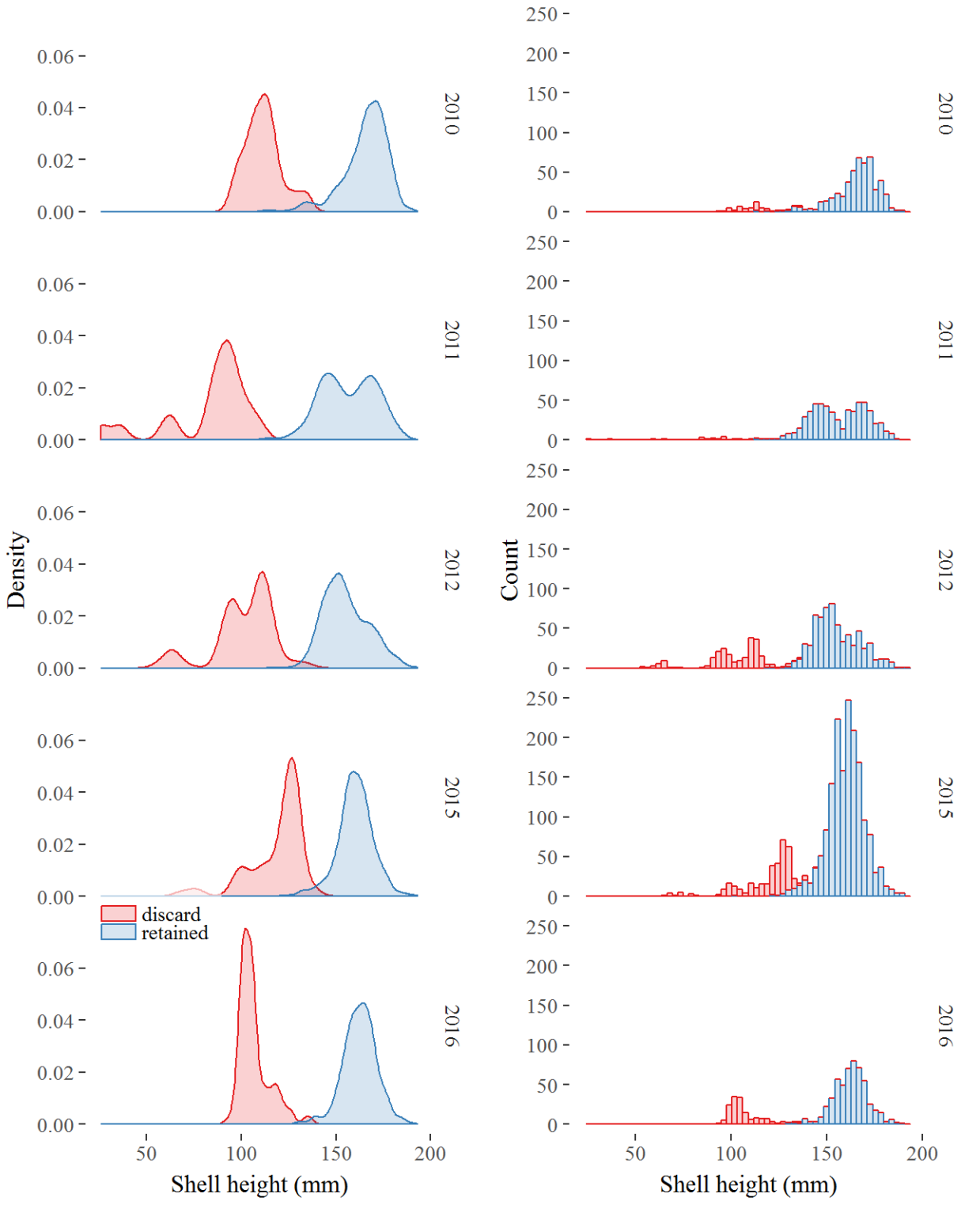

Figure 4-10 Cook Inlet retained and discarded shell heights by density and count for the 2010-2012 and 2015 -2016 seasons. Values are unadjusted to size of catch.

Table 4-8 Cook Inlet, Kamishak District scallop fishery summary statistics, 1994 - 2018.

		North Bed				South Bed				Total Both Beds			
Season	Number Vessels[a]	GHL (lb	Catch (lb meat)	Dredge hours	CPUE (lb per dredge	GHL (lb	Catch (lb meat)	Dredge hours	CPUE (lb per dredge hr)	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb per dredge hr)
1994	4	20,000	20,431	458	45					20,000	20,431	458	45
1995		Closed											
1996	5	28,000	28,228	534	53					28,000	28,228	534	53
1997	3	20,000	20,336	395	52					20,000	20,336	395	52
1998	1	20,000	17,246	390	44					20,000	17,246	390	44
1999	3	20,000	20,315	325	63					20,000	20,315	325	63
2000	3	20,000	20,516	275	75					20,000	20,516	275	75
2001	2	20,000	20,097	325	62					20,000	20,097	325	62
2002	3	20,000	6,045	235	26		2,546	76	34	20,000	8,591	311	28
2003	2	Closed				20,000	15,843	896	18	20,000	15,843	896	18
2004	3	6,500	4,519	198	23	13,500	1,598	166	10	20,000	6,117	364	17
2005	2	7,000	7,378	372	20	Closed				7,000	7,378	372	20
2006	1	7,000	50	10	5	Closed				7,000	50	10	5
2007	0	7,000	0			5,000	0			12,000	0		
2008	0	7,000	0			5,000	0			12,000	0		
2009	0	14,000	0			Closed				14,000	0		
2010	1	14,000	9,460	365	26	Closed				14,000	9,460	365	26
2011	1	12,500	9,975	324	31	Closed				12,500	9,975	324	31
2012	1	12,500	11,739	392	30	Closed				12,500	11,739	392	30
2013		Closed				Closed				Closed			
2014		Closed				Closed				Closed			
2015	1	10,000	9,485	459	21	Closed				10,000	9,485	459	21
2016	1	10,000	3,982	271	15	Closed				10,000	3,982	271	15
2017	0	10,000	0			Closed				10,000	0		
2018		Closed				Closed				Closed			

Confidential data voluntarily released by vessel operators

Westward Region

Kodiak Registration Area

Kodiak Northeast

The Northeast District GHL was reduced from 55,000 to 15,000 lb of scallop meat for the 2018/19 season due to the CPUE remaining below the minimum performance standards (MPS) for three consecutive seasons (2015/16–2017/18) and the GHL not being fully harvested for the past two seasons. Based on preliminary harvest and effort from the 2018/19 season, 15,210 lb of meats were retained from an effort of 262 dredge hours, with a CPUE of 58 lb of meats/dredge hour (Table 4-9; Figure 4-11).

Table 4-9 Kodiak Northeast District scallop fishery summary statistics, 1993/94 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	4	80,000	79,965	681,198	1,101	73	619	2,382
2001/02	3	80,000	80,470	822,110	1,142	70	720	2,286
2002/03	2	80,000	80,000	871,918	1,350	59	646	3,497
2003/04	2	80,000	79,965	747,517	1,248	64	599	2,384
2004/05	2	80,000	80,105	848,527	1,227	65	692	5,522
2005/06	3	80,000	79,990	831,378	1,759	46	473	4,408
2006/07	2	90,000	75,150	703,388	1,168	64	602	2,842
2007/08	2	90,000	75,105	822,697	1,170	63	703	4,264
2008/09	3	90,000	74,863	808,277	1,363	55	596	2,328
2009/10	1	75,000	69,360	831,709	1,222	57	681	2,541
2010/11	3	65,000	64,475	671,928	1,015	64	663	1,804
2011/12	4	70,000	61,209	663,927	986	62	678	2,014
2012/13	4	60,000	62,496	748,055	1,322	47	568	2,086
2013/14	4	55,000	54,926	524,124	935	59	563	1,457
2014/15	3	55,000	55,659	667,123	752	74	888	1,327
2015/16	3	55,000	55,577	568,543	1,228	45	463	1,981
2016/17	2	55,000	24,410	196,939	1,095	22	180	574
2017/18	1	55,000	14,190	136,295	349	41	391	432
2018/19[d]	1	15,000	15,210	NA	262	58	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.5% from observer experiments.*
[d] PRELIMINARY data subject to change.

In the 2017/18 Northeast District fishery, 14,190 lb of scallop meats were retained and 2,160 lb, or approximately 13.2%, were discarded. This discard rate is above the previous year but similar to the 10-year mean of 14.0%. Using a 20% discard mortality estimate, 432 lb of scallop meat weights was lost to discard mortality in the 2017/18 season (Table 4-9).

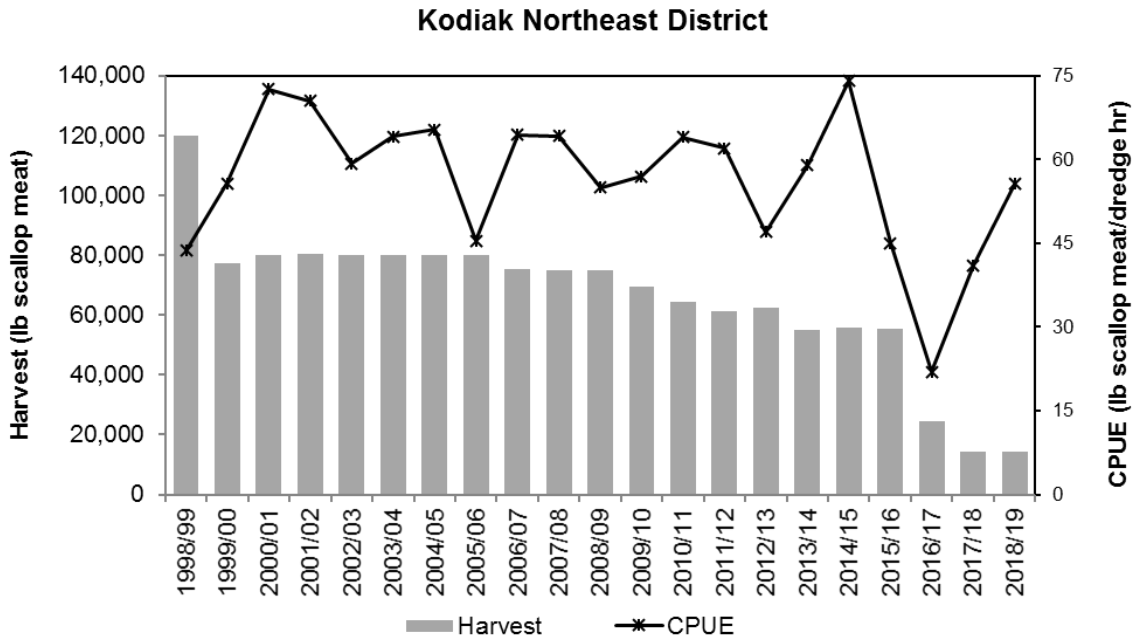

Figure 4-11 Kodiak Northeast District harvest and CPUE, 1998/99 - 2018/19 seasons.

Estimated shell height distributions in Northeast District for 2017/18 showed a broad range of scallop sizes, similar to those observed in the 2016/17 season. The bulk of the retained scallops were in the 100–175 mm shell height (SH) range (Figure 4-13).

Beginning with the 2010/11 season, abundance in some Northeast District scallop beds showed signs of decline and minimum performance standards (MPS) were established for ADF&G statistical areas associated with those beds. In 2013/14, management shifted from bed-level to district-level however, bed level MPSs remained in place. In response to steep declines in CPUE in 2015/16 and 2016/17, a districtwide MPS of 46 was established for the Northeast District for the 2017/18 season based upon the lowest CPUE observed for the district prior to the 2015/16 season. Managers may consider closing the season if the Northeast District CPUE is below the MPS after 25,000 pounds (or half the GHL) have been harvested. In 2017/18, districtwide CPUE was below the MPS but the participating vessel stopped fishing before 25,000 pounds were harvested primarily due to low fishery performance (Table 4-9). In 2018/19, the districtwide CPUE was 58 which is above the MPS and 43% higher than the 2017/18 (Table 4-9; Figure 4-11).

Crab bycatch estimates calculated from 2017/18 Northeast District fishery observer samples were 6,819 Tanner crab (Table 3-4). Estimated Northeast District Tanner crab bycatch decreased by 33% from the 2016/17 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 15mm to 145mm, with the majority in the 40–90mm range (Figure 3-1).

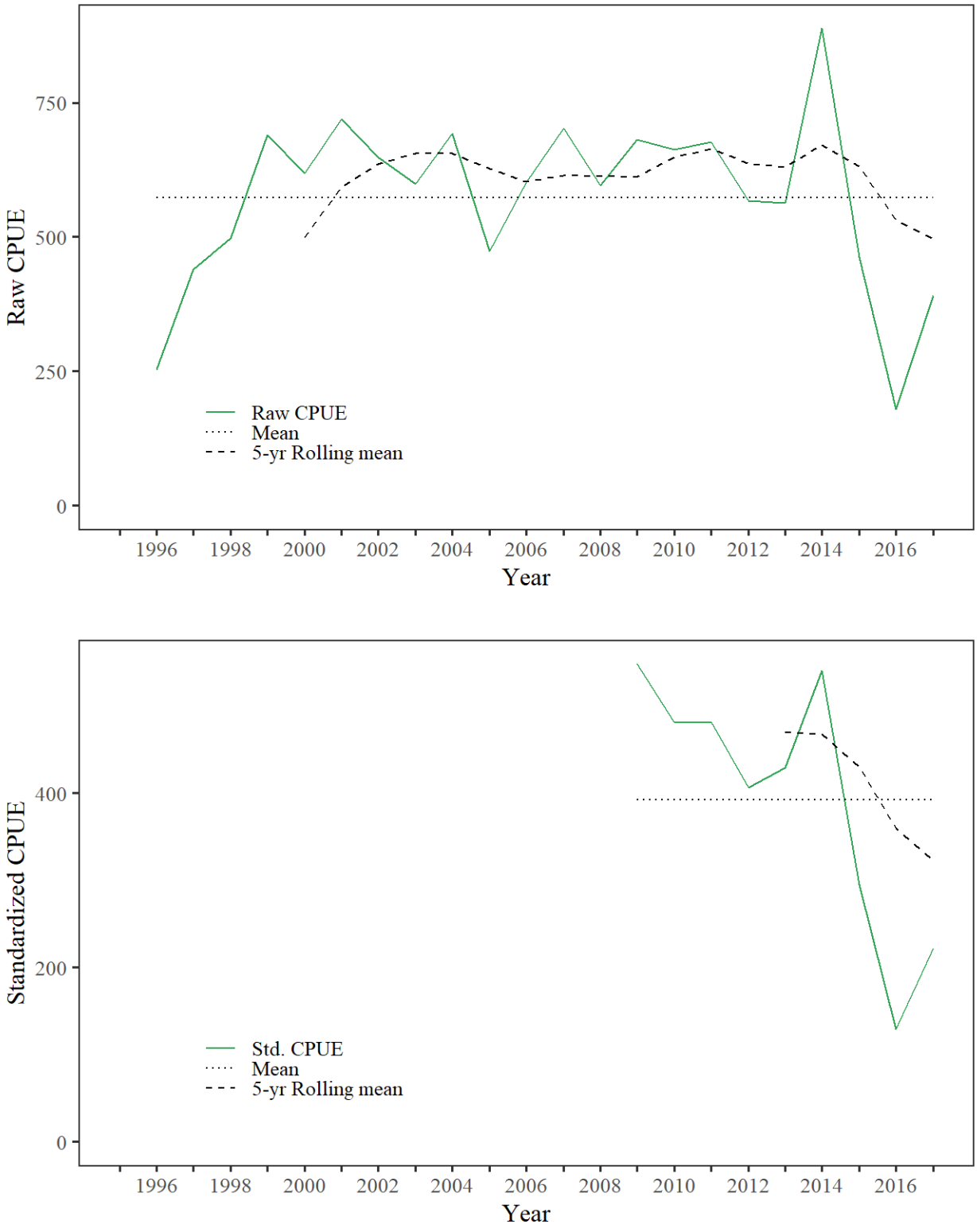

Figure 4-12 Kodiak Northeast District scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

Table 4-10 Kodiak Northeast District catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	597.4	674.0	348.8	547.9
2010/11	594.6	634.1	371.4	481.0
2011/12	547.7	636.7	423.3	481.2
2012/13	529.6	553.3	289.0	405.8
2013/14	440.3	567.5	446.8	428.9
2014/15	885.3	867.5	385.4	539.9
2015/16	436.9	445.6	216.4	295.0
2016/17	162.1	174.0	118.8	129.1
2017/18	407.2	389.4	166.1	221.7

Intentionally Left Blank

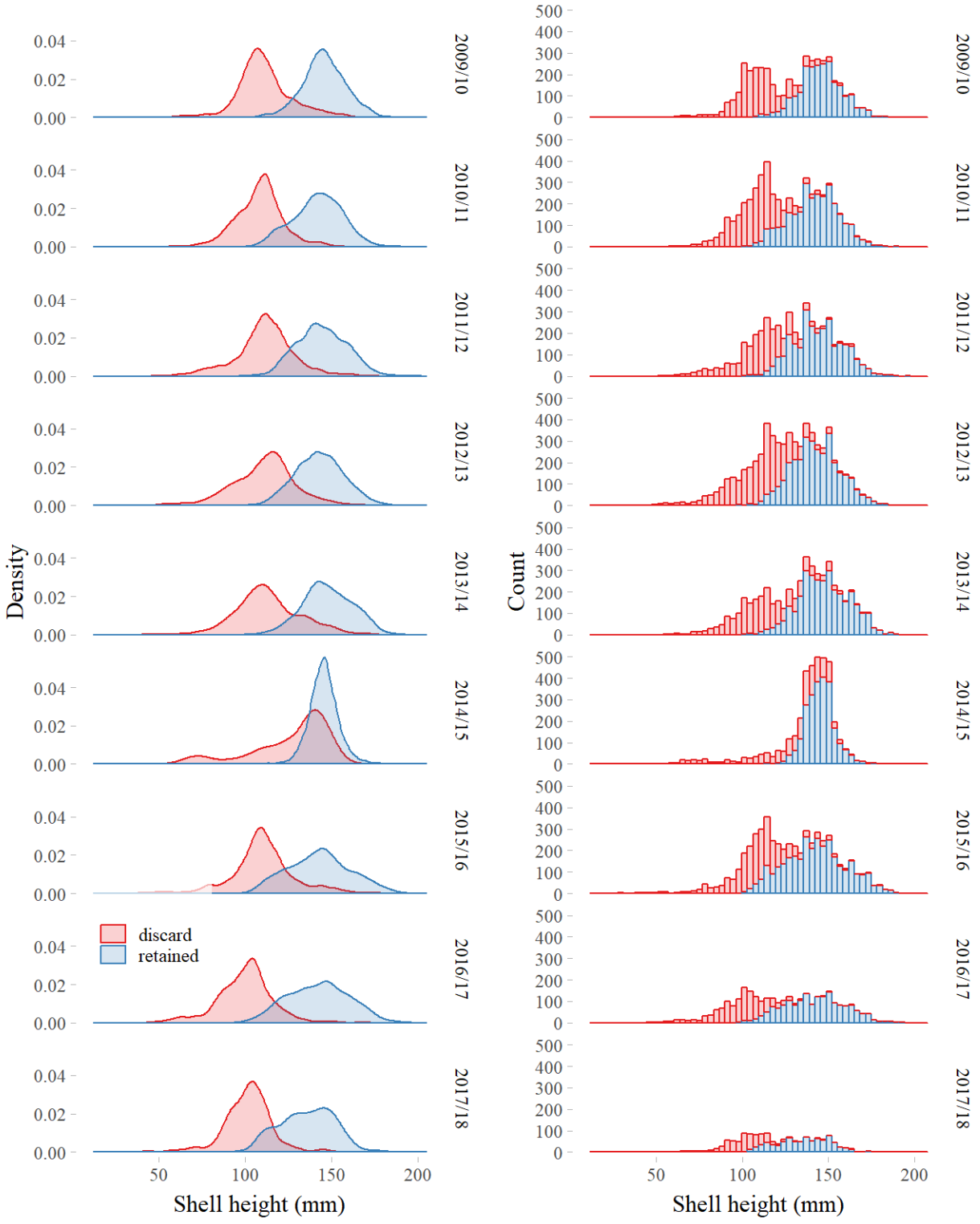

Figure 4-13 Kodiak Northeast District retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Shelikof

The 2018/19 season was the 3rd consecutive season with the reduced GHL of 25,000 pounds for the Shelikof District; the 2016/17 GHL was set at 25,000 pounds, down 66.7% from the 2015/16 GHL (75,000 pounds) and down 76.2% from the 2014/15 season GHL (105,000 pounds). Based on preliminary harvest and effort from the 2018/19 season, 25,010 lb of meats were retained with a CPUE of 54 pounds of meats/dredge hour (Table 4-11; Figure 4-14).

Table 4-11 Kodiak Shelikof District scallop fishery summary statistics, 1993/94 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	5	180,000	180,087	1,768,376	2,907	62	609	2,621
2001/02	4	180,000	177,112	1,830,265	3,398	52	539	4,880
2002/03	3	180,000	180,580	1,857,466	3,799	48	489	10,120
2003/04	2	180,000	180,011	1,724,498	3,258	55	529	8,209
2004/05	2	180,000	174,622	1,641,608	3,467	50	474	8,883
2005/06	2	160,000	159,941	1,453,656	2,280	70	638	4,767
2006/07	3	160,000	162,537	1,404,134	2,183	74	644	4,789
2007/08	3	170,000	169,968	1,695,563	2,937	58	577	7,685
2008/09	2	170,000	13,761	161,065	263	52	615	658
2009/10	3	170,000	170,021	1,667,958	3,496	49	477	7,132
2010/11	4	170,000	171,076	1,888,965	3,507	49	539	8,623
2011/12	4	135,000	136,491	1,437,781	2,437	56	590	2,618
2012/13	4	105,000	106,051	992,769	2,002	53	496	2,575
2013/14	4	105,000	106,099	910,919	2,472	43	369	1,162
2014/15	3	105,000[1]	66,138	650,367	1,629	41	399	962
2015/16	3	75,000[2]	40,290	482,896	1,323	30	365	1,100
2016/17	2	25,000	25,120	326,111	830	30	393	971
2017/18	1	25,000	25,050	261,384	545	46	480	932
2018/19[d]	1	25,000	25,010	NA	465	54	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.*
[d] PRELIMINARY data subject to change.
[1] Inseason Closure at 65,000 lb
[2] Inseason Closure July 30, 2015

In the 2017/18 Shelikof District fishery, 25,050 lb of scallop meats were retained and 4,660 lb, or approximately 15.7%, were discarded. This discard rate is similar to the previous year and slightly above the 10-year mean of 13.2%. Using a 20% discard mortality estimate, 932 lb of scallop meat weights was lost to discard mortality in the 2017/18 season (Table 4-11).

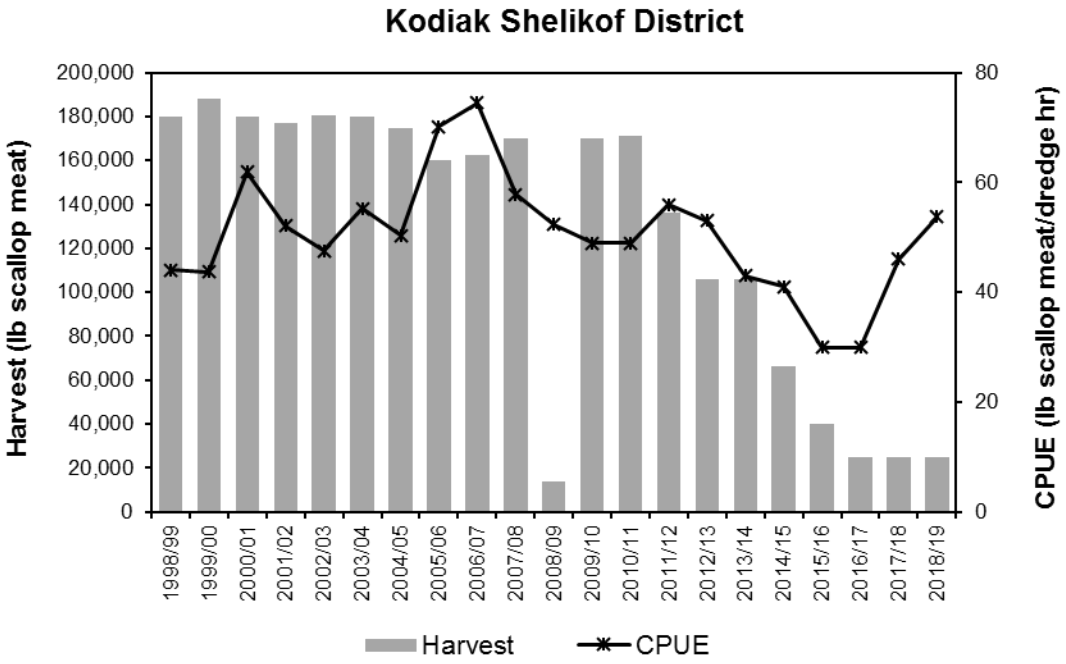

Figure 4-14 Kodiak Shelikof District harvest and CPUE, 1998/99 - 2018/19 seasons.

Estimated shell height distributions in Shelikof District show a similar range of scallop sizes in the 2017/18 season, relative to prior seasons, with signs of recruitment in the smaller size classes (50–75 mm). The bulk of the retained scallops remain in the 100–175 mm shell height (SH) range (Figure 4-16).

Beginning with the 2013/14 season, abundance in some Shelikof District scallop beds showed signs of decline. In response, managers aggressively reduced the GHL and began making inseason closures prior to achieving the GHL when fishery performance failed to maintain CPUEs above the established MPS of 47 pounds of meats/dredge hour (Table 3-1). Since the GHL reduction, CPUE remained stable in 2016/17, increased 52% in 2017/18 to 46, and increased another 17% in 2018/19 to 54 (Table 4-11; Figure 4-14).

Crab bycatch estimates calculated from 2017/18 Shelikof District fishery observer samples were 3,639 Tanner crab (Table 3-4). Estimated Shelikof District Tanner crab bycatch increased 9.5% from the 2016/17 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 20mm to 165mm, with the size frequency of sampled crab being well distributed across the range (Figure 3-1).

Intentionally Left Blank

Table 4-12 Kodiak Shelikof District catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	475.4	472.9	158.1	494.7
2010/11	536.7	540.0	215.0	547.4
2011/12	573.3	590.4	231.9	599.5
2012/13	470.4	493.4	164.8	510.9
2013/14	372.6	372.3	135.5	409.8
2014/15	379.3	402.5	141.7	428.1
2015/16	322.9	332.7	125.7	364.7
2016/17	333.8	349.0	159.3	351.8
2017/18	447.5	485.1	187.1	517.7

Intentionally Left Blank

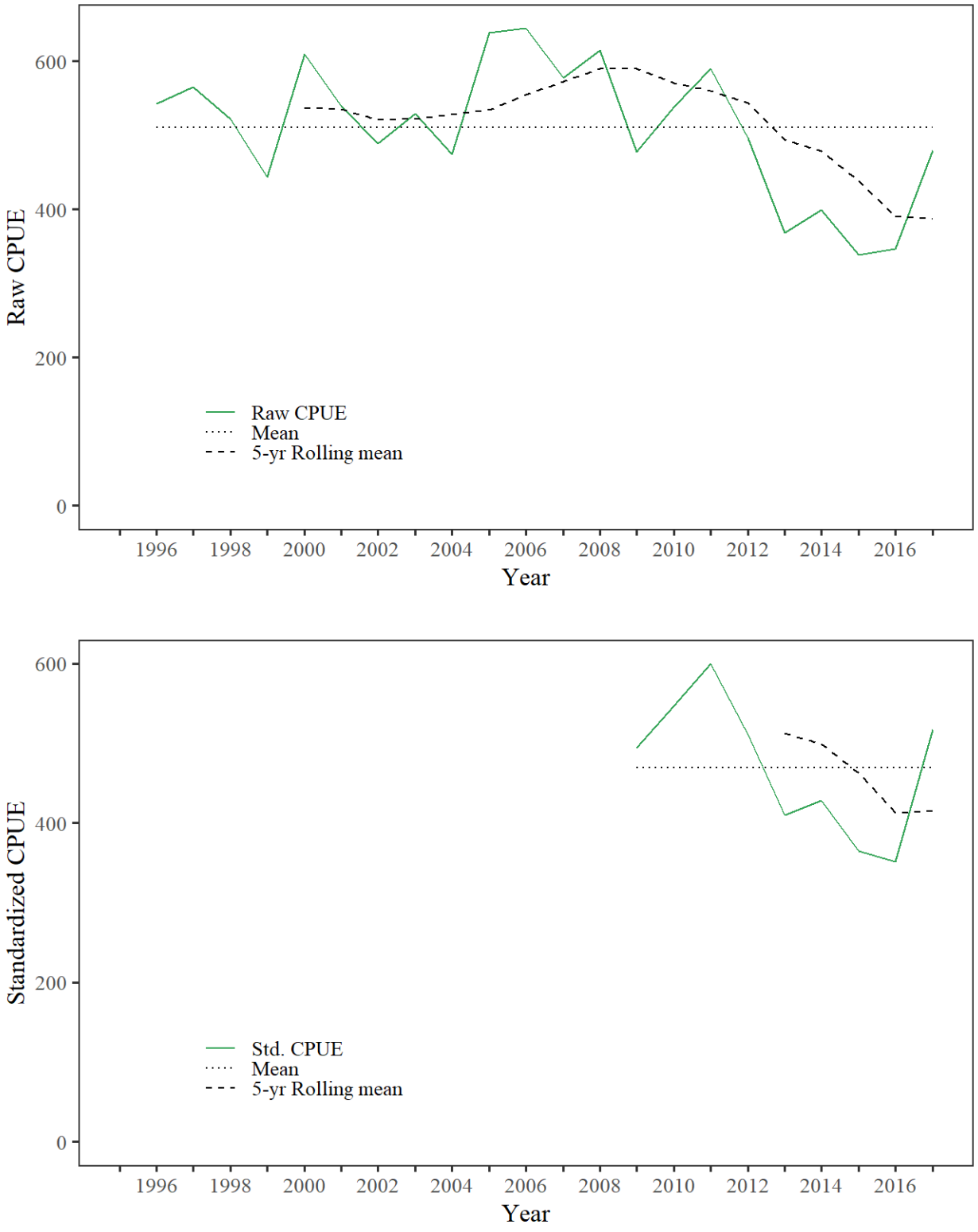

Figure 4-15 Kodiak Shelikof District scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

Figure 4-16 Kodiak Shelikof District retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Kodiak Southwest

The 2018/19 Southwest District GHL was 30,000 pounds, an increase of 5,000 pounds from the previous seasons GHL. Rational for increasing the GHL include stable and improving CPUE, strong signs of recruitment, and increased fishing area. In March of 2018, the Alaska Board of Fisheries expanded the area open to scallop fishing in the Southwest District and removed the requirement for a Commissioner Permit in order to fish in the Southwest District. Based on preliminary harvest and effort data from the 2018/98 season, 30,000 lb of meats were retained with a CPUE of 66 pounds of meats/dredge hour (Table 4-13; Figure4-17).

Table 4-13 Kodiak Southwest District scallop fishery summary statistics, 2009/10 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2009/10	1	25,000	3,480	62,241	159	22	392	76
2010/11	0	25,000	0					
2011/12	1	25,000	25,110	348,142	455	55	766	364
2012/13	2	25,000	25,014	261,318	671	37	389	312
2013/14	2	25,000	20,340	230,034	526	39	437	301
2014/15	2	25,000	24,973	310,921	555	45	561	193
2015/16	1	25,000[1]	10,950	157,087	281	39	558	143
2016/17	1	25,000	25,110	441,088	448	56	984	455
2017/18	1	25,000	25,020	334,784	377	66	887	1,699
2018/19[d]	1	30,000	30,000	NA	425	66	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.*
[d] PRELIMINARY data subject to change.
[1]Inseason closure due to Tanner crab bycatch

The 2018/19 Southwest District CPUE is the highest reported for the District. The Southwest District CPUE has been steadily increasing since the 2012/13 season, with exception to the 2015/16 season when the district closed prior to harvesting the full GHL because the Tanner crab bycatch cap of 12,000 crab was exceeded.

In the 2017/18 Southwest District fishery, 25,020 lb of scallop meats were retained and 8,495 lb, or approximately 25.4%, were discarded. This is the highest discard rate for the Southwest; the average discard rate for the 2011/12 through 2016/17 seasons is 6.3%. Using a 20% discard mortality estimate, 1,699 lb of scallop meat weight was lost to discard mortality in the 2017/18 season (Table 4-13).

Estimated shell height distributions in the Southwest District from the 2016/17 season were similar to previous seasons and a recruitment pulse first detected in 2015/16 continues to track in the population. The bulk of the retained scallops remain in the 125–175 mm shell height (SH) range (Figure 4-19).

Crab bycatch estimates calculated from 2017/18 Southwest District fishery observer samples were 6,945 Tanner crab (Table 3-4). Estimated Southwest District Tanner crab bycatch decreased 12% from the 2016/17 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 10 mm to 145 mm, with the majority in the 15–60 mm range (Figure 3-1).

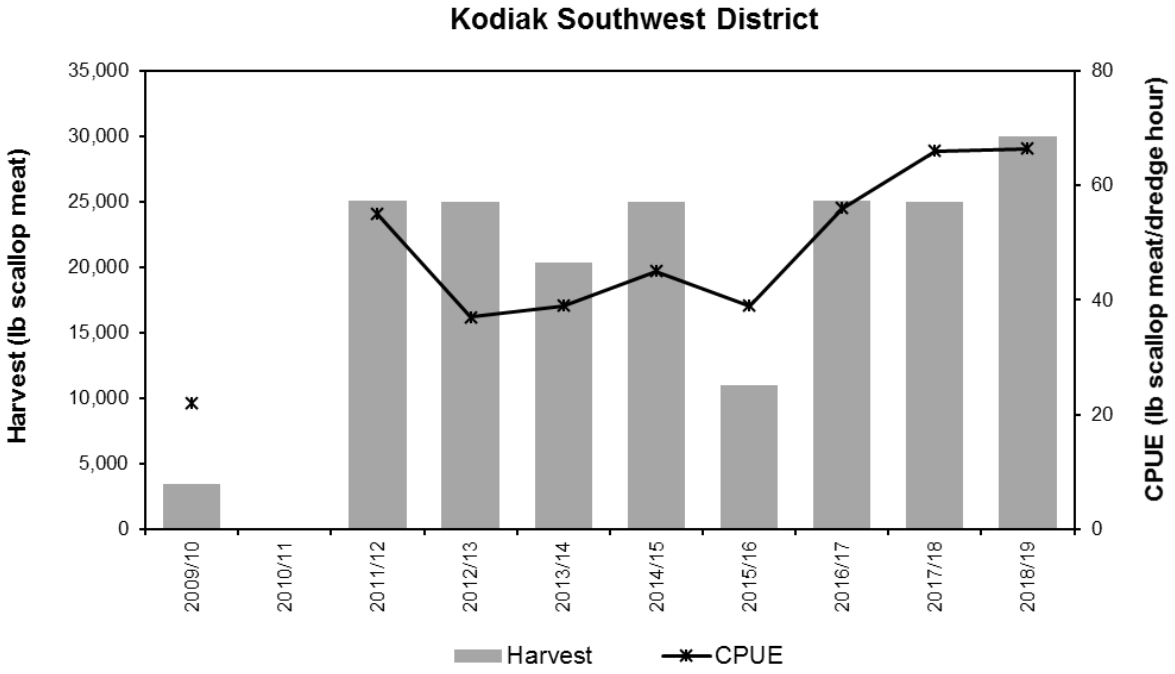

Figure 4-17 Kodiak Southwest District harvest and CPUE, 2009/10 and 2011/12 - 2018/19 seasons.

Table 4-14 Kodiak Southwest District catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	382.9	343.4	220.9	440.1
2010/11	NA	NA	NA	NA
2011/12	785.6	772.4	304.9	689.2
2012/13	360.1	386.5	188.3	384.9
2013/14	348.1	408.7	247.7	519.2
2014/15	553.8	543.6	229.4	467.8
2015/16	513.0	532.6	245.8	451.4
2016/17	711.4	820.7	484.8	548.7
2017/18	851.9	881.1	328.4	545.3

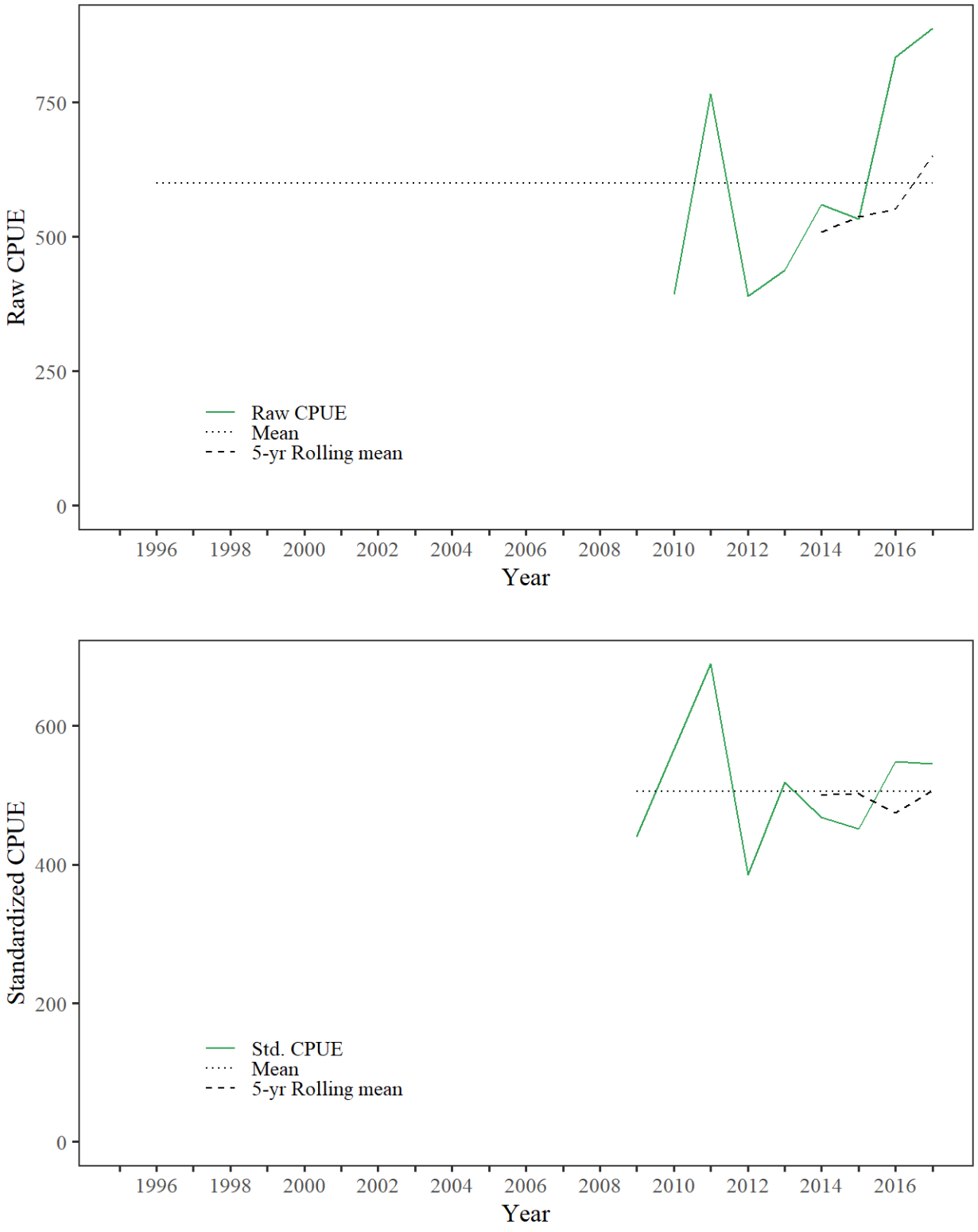

Figure 4-18 Kodiak Southwest District scallop raw and standardized (when available) meat CPUE, 2009/10 - 2017/18 seasons.

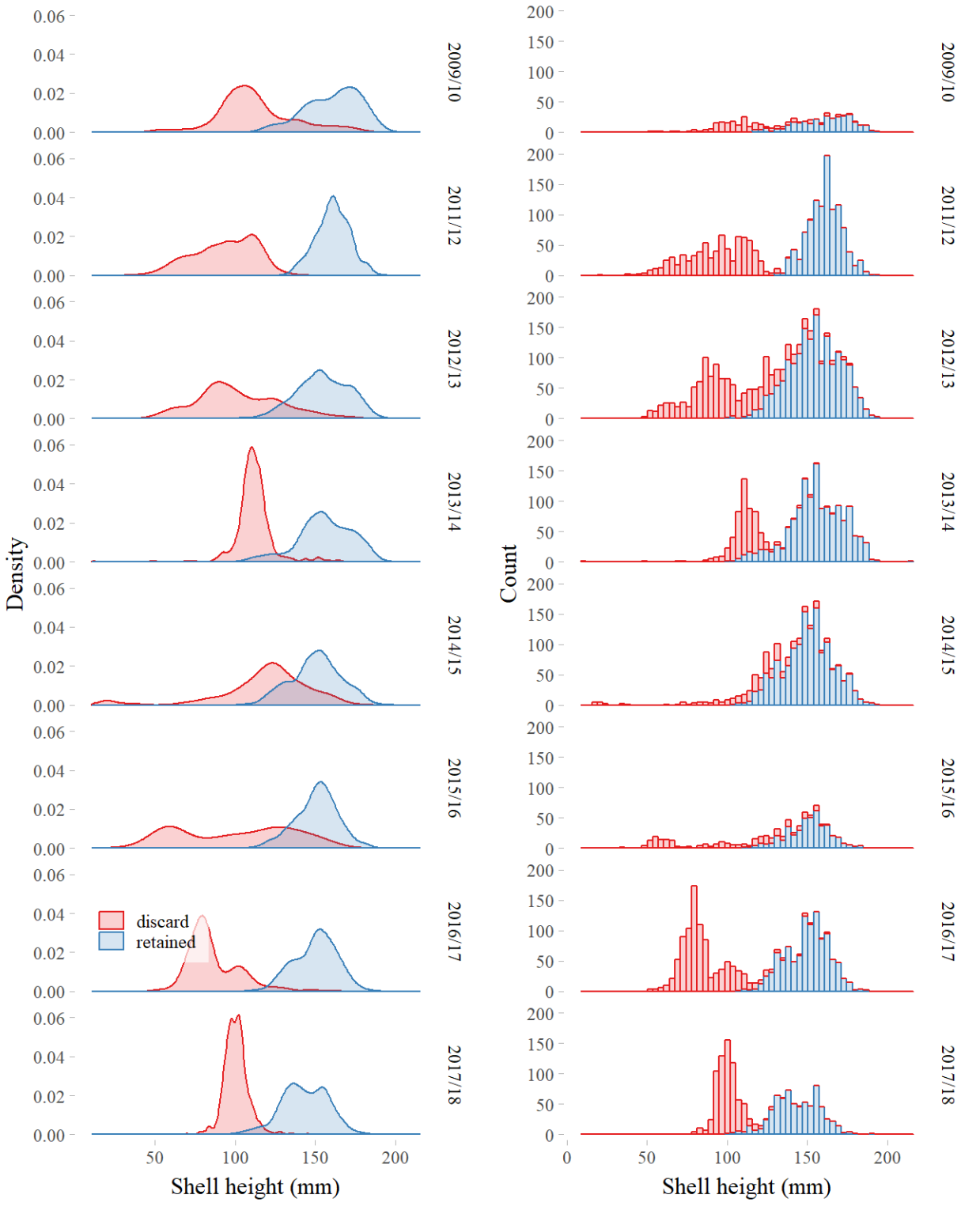

Figure 4-19 Kodiak Southwest District retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Kodiak Southeast

Since 1969, most state and federal waters of the Southeast District have been closed to commercial scallop fishing due to concerns about king and Tanner crab bycatch. In March of 2018, the Alaska Board of Fisheries adopted the federal nonpelagic closure area to protect king and Tanner crab while established a fishing season for scallops in the remaining Southeast District. 2018/19 was the first season of scallop fishing effort in the Southeast District; the GHL was established at 15,000 pounds. Based on preliminary harvest and effort from the 2018/19 season, 455 lb of meats were retained from an effort of 59 dredge hours, with a CPUE of 8 lb of meats/dredge hour (Table 4-15).

Table 4- 15 Kodiak Southeast District scallop fishery summary statistics, 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2018/19[d]	1	15,000	455	NA	59	8	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 10.2% from observer experiments.*
[d] PRELIMINARY data subject to change.

Harvest and CPUE from the Southeast District are low, likely due to exploratory fishing in a newly opened area. Because 2018/19 was the first season of harvest, information on discards and shell high distributions are not yet available.

Intentionally Left Blank

Alaska Peninsula Registration Area

The Unimak Bight District of the Alaska Peninsula Area has been fished annually since 2012/13 under the provisions of a Commissioner Permit issued by ADF&G. The 2017/18 Unimak Bight District GHL was 15,000 pounds. Based on preliminary harvest and effort data from the 2018/19 season, 8,905 lb of meat was retained with a CPUE of 34 pounds of meats/dredge hour. This is the lowest CPUE since 2012/13 (Table 4-16; Figure 4-20).

Table 4-16 Alaska Peninsula Area scallop fishery summary statistics, 1993/94 – 2018/19

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	(lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	3	33,000	7,660		320	24		83
2001/02		closed						
2002/03		closed						
2003/04		closed						
2004/05		closed						
2005/06	0	20,000	0		0			
2006/07	2	25,000	155		64	2		15
2007/08	0	10,000	0		0			
2008/09		10,000	2,460		151	16		75
2009/10		closed						
2010/11		closed						
2011/12		closed						
2012/13	1	15,000[1]	15,040	217,607	255	59	853	541
2013/14	1	15,000[1]	15,155	193,106	247	61	781	325
2014/15	2	15,000[1]	15,000	227,369	288	52	789	325
2015/16	1	15,000[1]	15,000	207,991	302	50	689	172
2016/17	1	15,000[1]	15,013	202,806	340	44	597	200
2017/18	1	15,000[1]	15,250	181,646	328	47	555	448
2018/19[d]	1	15,000[1]	8,905	NA	265	34	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 9.2% from observer experiments.*
[d] PRELIMINARY data subject to change.
[1] Exploratory fishery opened by Commissioner's Permit

In the 2017/18 Unimak Bight District fishery, 15,250 lb of scallop meats were harvested and 2,240 lb, or 12.8%, were discarded. This discard rate is higher than the previous year and 10-year mean of 8.8%. Using a 20% discard mortality estimate, 448 lb of scallop meat weight was lost to discard mortality in the 2017/18 season (Table 4-15).

Estimated shell height distributions in Unimak Bight District show a continued decrease in the range of scallop sizes in the 2016/17 season which is consistent with trends in age structure seen in other beds that have been reopened after prolonged closures. The bulk of the retained scallops remain in the 125–175 mm shell height range (Figure 4-22).

There is no MPS established for Unimak Bight District but there is a bycatch crab cap of 12,000.

Crab bycatch estimates calculated from 2017/18 Unimak Bight District fishery observer samples were 5,058 Tanner crab (Table 3-4). Estimated Unimak Bight District Tanner crab bycatch increased 45.5% from the 2016/17 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 20 mm to 110 mm but the majority of sampled crab were between 20 mm to 60 mm (Figure 3-1).

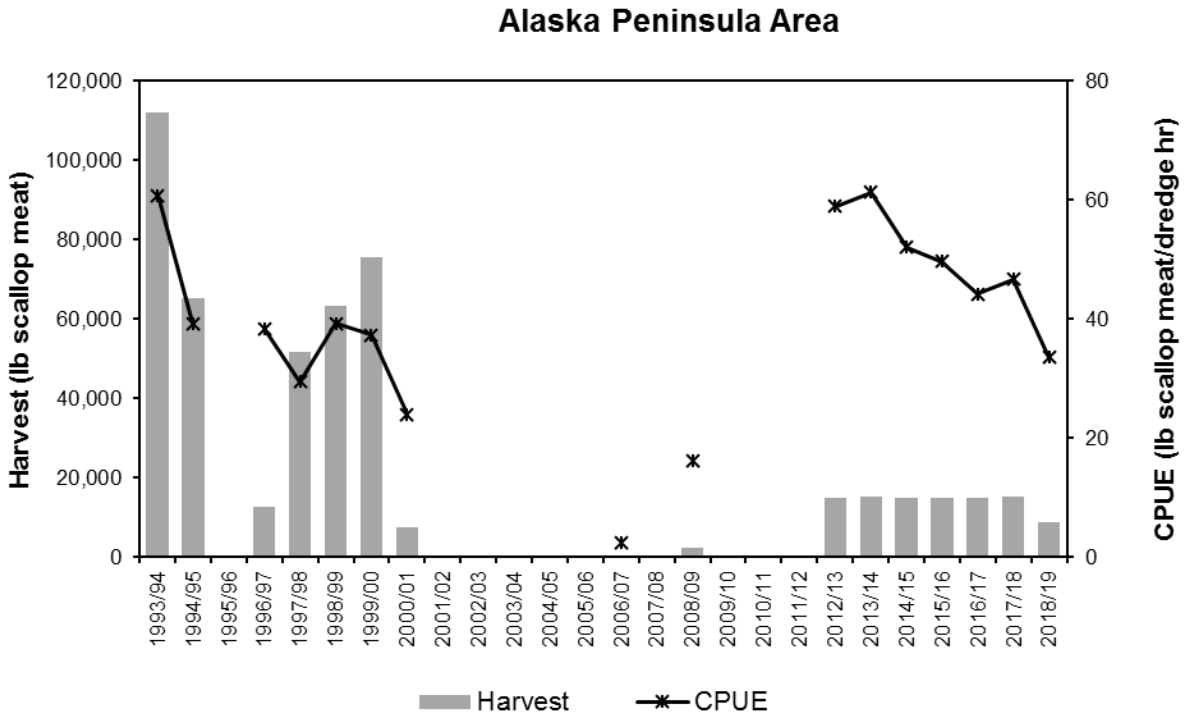

Figure 4-20 Alaska Peninsula Area harvest and CPUE, 1993/94 - 2018/2019 seasons.

Table 4-17 Alaska Peninsula Area catch summary for the 2012/13-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2012/13	686.8	812.7	631.2	1087.7
2013/14	718.6	842.6	525.1	1374.4
2014/15	807.4	824.3	426.5	969.9
2015/16	636.8	618.5	230.1	826.7
2016/17	507.7	507.3	238.1	552.2
2017/18	491.0	551.4	337.0	617.2

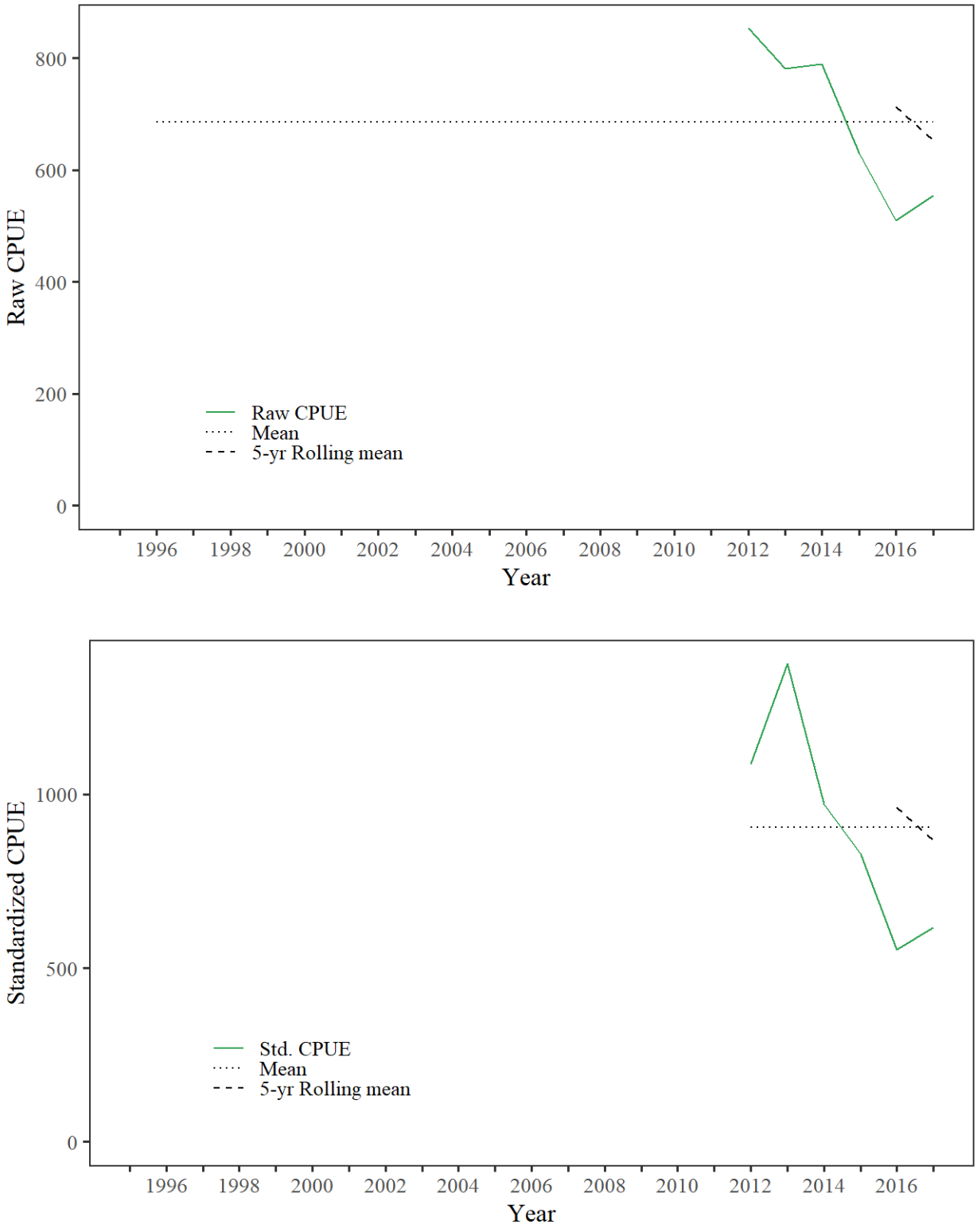

Figure 4-21 Alaska Peninsula Area scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

Figure 4-22 Alaska Peninsula Area retained and discarded shell heights by density and count for the 2012/13-2017/18 seasons.

Bering Sea Registration Area

The 2018/19 season was the fourth season with reduced GHL in the Bering Sea Registration Area (BSRA). Based on preliminary harvest and effort from the 2018/19 season the CPUE of 21 lb of shucked meats per dredge hour is down slightly with respect to 2017/18 and is the lowest seen in the timeseries (Table 4-17).

Table 4-18 Bering Sea Area scallop fishery summary statistics, 2000/01 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01	3	200,000	205,520	2,376,601	3,355	61	710	1,789
2001/02	3	200,000	140,871	1,700,500	3,072	46	559	1,393
2002/03	2	105,000	92,240	951,938	2,038	45	468	1,008
2003/04	2	105,000	42,590	537,552	1,020	42	527	627
2004/05	1	105,000	10,050	128,128	275	37	475	103
2005/06	1	50,000	23,220	231,700	602	39	386	318
2006/07	1	50,000	48,246	529,590	1,138	42	466	995
2007/08	2	50,000	49,995	697,288	1,084	46	647	901
2008/09	1	50,000	49,995	502,450	962	52	525	1,067
2009/10	1	50,000	48,921	595,602	1,275	38	467	1,059
2010/11	2	50,000	50,100	547,302	972	52	563	1,336
2011/12	2	50,000	50,275	529,235	984	51	538	563
2012/13	1	50,000	50,045	564,787	943	53	599	716
2013/14	2	50,000	49,989	561,033	1,086	46	517	400
2014/15	2	50,000	12,445	227,196	525	24	432	144
2015/16	1	7,500	7,500	107,337	307	24	350	85
2016/17	1	7,500	7,575	108,191	275	28	393	123
2017/18	1	7,500	7,535	105,668	316	24	334	72
2018/19[d]	1	7,500	7,540	NA	357	21	NA	NA

[a] *lb scallop meat / dredge hour*
[b] *lb scallop round / dredge hour*
[c] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 9.1% from observer experiments.*
[d] PRELIMINARY data subject to change.

In the 2017/18 BSRA fishery, 7,535 lb of scallop meats were retained with a CPUE of 24 lb of shucked meats per dredge hour. Meat weight CPUE decreased 17% from the 2016/17 season (Figure 4-23) and is 50% of the long-term fishery average (2000/01-2016/17) of 48 lb of shucked meats per dredge hour. In addition to the retained catch an estimated live scallop equivalent of 334 lb of meats were discarded, for an estimated discard rate of 0.9% of the total meat weight caught, a 7.1% decrease from the 2016/17 season. Using a 20% discard mortality estimate, 72 lb of scallop meat weight was lost to discard mortality in the 2017/18 season (Table 4-17). Average estimated BSRA scallop meats discarded for the last 10 seasons was 2,754 lb.

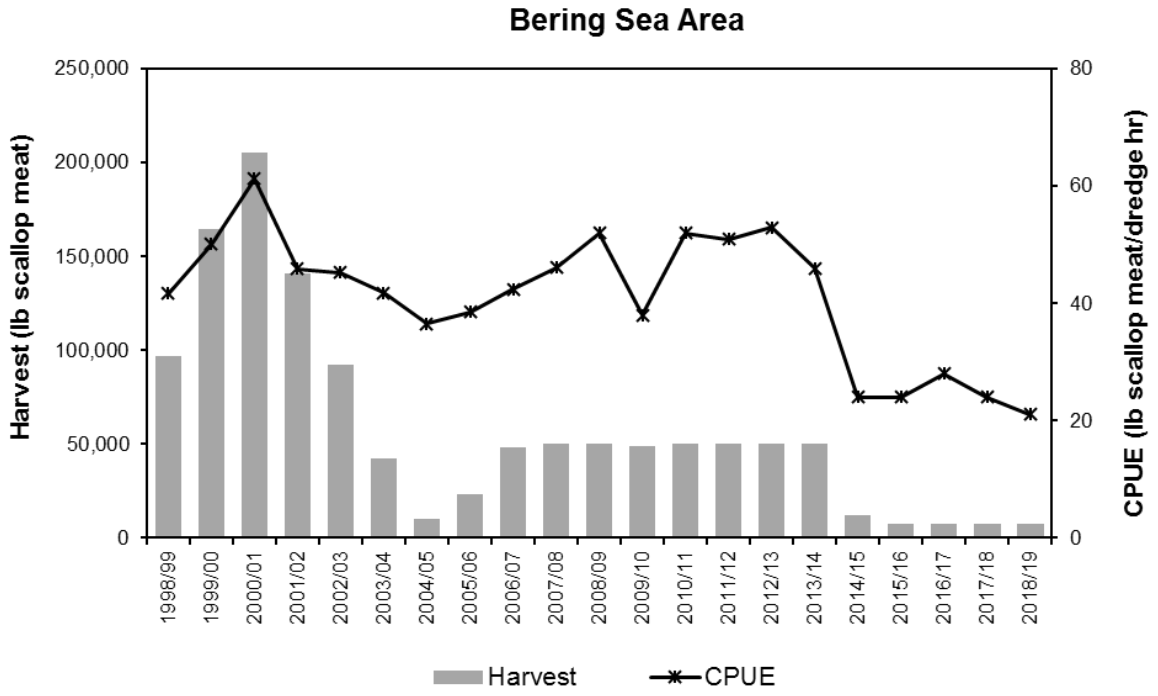

Figure 4-23 Bering Sea Area scallop harvest and CPUE, 1998/99 - 2018/19 seasons.

Estimated shell height distributions in BSRA show a decreased range of scallop sizes from the 2014/15 through 2018/19 seasons. Whether these changes are due to growth rates, disease, fleet behavior, or a decrease in pre-recruit scallops is not known. The bulk of the retained scallops are currently in the 150–180 mm shell height range and seems to be trending toward smaller sized scallops (Figure 4-25).

Since the 2010/11 season the BSRA fishery has been managed using an inseason minimum performance standard of 43 lb of shucked scallop meats per dredge hour. This MPS is based on the average CPUE during the 2004/05 to 2009/10 seasons, a period chosen because the GHL was static at 50,000 pounds and it encapsulated a broad range of fishery CPUE values (37 to 52 lb of shucked scallop meats per dredge hour). The 2017/18 season CPUE was 24 lb of shucked scallop meats per dredge hour, was well below the MPS (Table 3-1). During the 2015/16, 2016/17, 2017/18 and 2018/19 seasons the fishery was allowed to continue despite low CPUEs to gather data following a disease event first observed in 2014/15.

Bycatch cap for Tanner crab was 65,000 crab for the 2017/18 scallop season due to closure of the eastern Bering Sea Tanner crab fishery. Expanded crab bycatch rates are unavailable at this time. Preliminary raw counts form observer sample data indicate that crab bycatch rates were much lower than 2016/17 season.

Table 4-19 Bering Sea Area catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE	Standardized

Season	Median	Mean	SD	CPUE
2009/10	459.9	470.1	153.2	558.8
2010/11	572.4	569.9	196.8	555.6
2011/12	529.1	544.3	135.2	577.1
2012/13	606.3	611.7	158.3	587.7
2013/14	521.2	518.4	127.1	543.1
2014/15	434.1	432.5	94.8	522.7
2015/16	368.7	340.4	79.6	441.3
2016/17	365.3	371.8	112.9	423.8
2017/18	329.2	336.2	114.5	399.8

Intentionally Left Blank

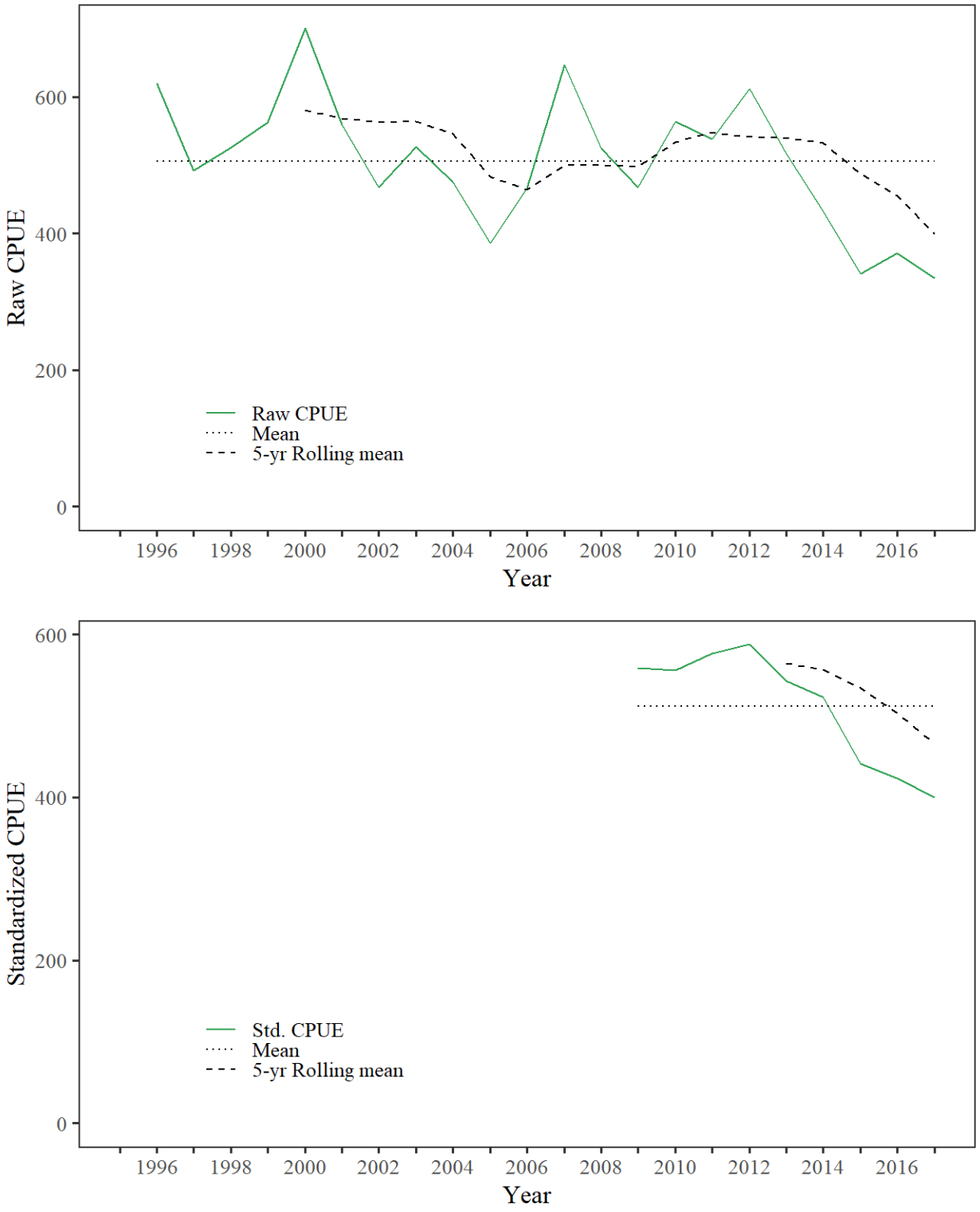

Figure 4-24 Bering Sea Area raw and standardized (when available) meat weight CPUE, 1995/16 - 2017/18 seasons.

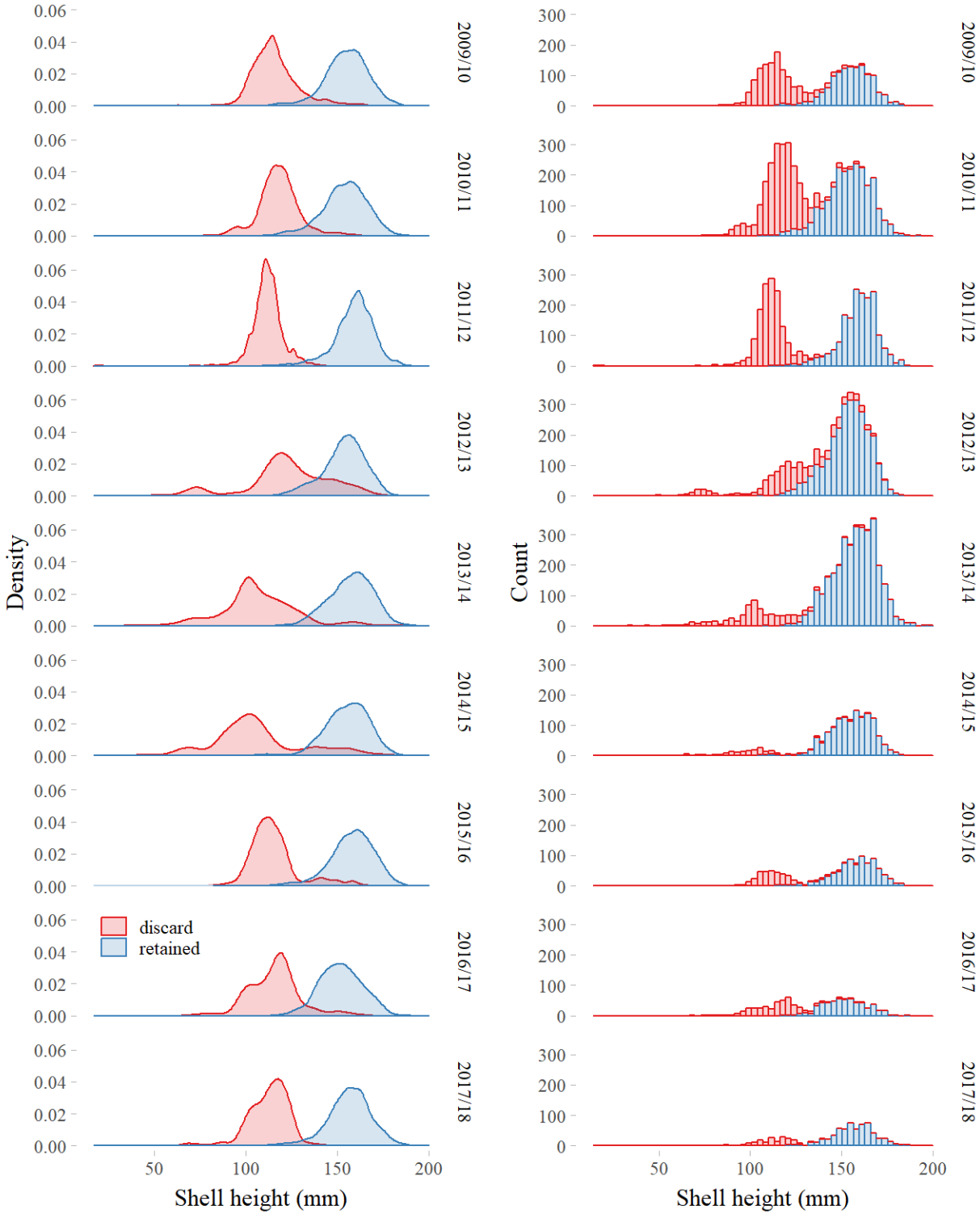

Figure 4-25 Bering Sea Area retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Dutch Harbor Registration Area

The 2018/19 season returned to previous management regime with a lower GHL in the Dutch Harbor Registration Area (DHRA). This decrease reflects the closure of the Pacific Ocean side of the DHRA. Based on harvest and effort from the 2018/19 season CPUE was up slightly from the 2016/17 low (Table 4-19, Figure 4-26) but fishing overall was very poor with very few scallops found. All harvest occurred in the Bering Sea subarea of the DHRA.

Table 4-20 Dutch Harbor Area scallop fishery summary statistics, 1993/94 - 2018/19.

Season	Number vessels	GHL (lb meat)	Retained catch (lb meat)	Retained catch (lb round)	Dredge hours	Meat weight CPUE[a]	Round weight CPUE[b]	Discard mortality (lb meat)[c]
2000/01		closed						
2001/02		closed						
2002/03	1	10,000	6,000	59,066	184	33	333	94
2003/04		closed						
2004/05		closed						
2005/06		closed						
2006/07		closed						
2007/08		closed						
2008/09	1	10,000	10,040	93,077	225	45	488	706
2009/10	1	10,000	6,080	54,882	104	59	528	45
2010/11	1	10,000	5,640	42,177	83	68	506	70
2011/12	1	10,000	5,570	45,513	77	73	593	56
2012/13	1	5,000	5,100	37,730	64	79	588	59
2013/14	1	5,000	5,225	44,572	56	94	798	96
2014/15	1	5,000	5,160	41,323	73	70	563	85
2015/16	1	10,000	5,040	45,215	157	32	288	74
2016/17	1	10,000	5,050	39,181	104	48	376	35
2017/18	1	10,000	285	2,250	24	12	93	1
2018/19[d]	1	5,000	325	NA	24	14	NA	NA

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

In the 2017/18 DHRA fishery, 285 lb of scallop meats were retained with a CPUE of 12 lb of shucked meat per dredge hour. Catch per unit effort decreased 76% from the 2016/17 season and is 79% lower than the long-term (2008/09-2015/16) fishery average CPUE of 57 (Figure 4-26). In addition to the retained catch an estimated whole weight of 5 lb were discarded, for an estimated discard rate of 1.7% of the total meat weight caught, a 97% decrease from the 2016/17 season, although this decrease is due to lack of catch overall and not a change in fishing behavior. Using a 20% discard mortality estimate 1 lb of scallop meat weight was lost to discard mortality in the 2017/18 season (Table 4-19). Average estimated DHRA scallop

meats discard for the last 8 seasons was 325 lb and does not include the high proportion of discards in the 2008/09 season.

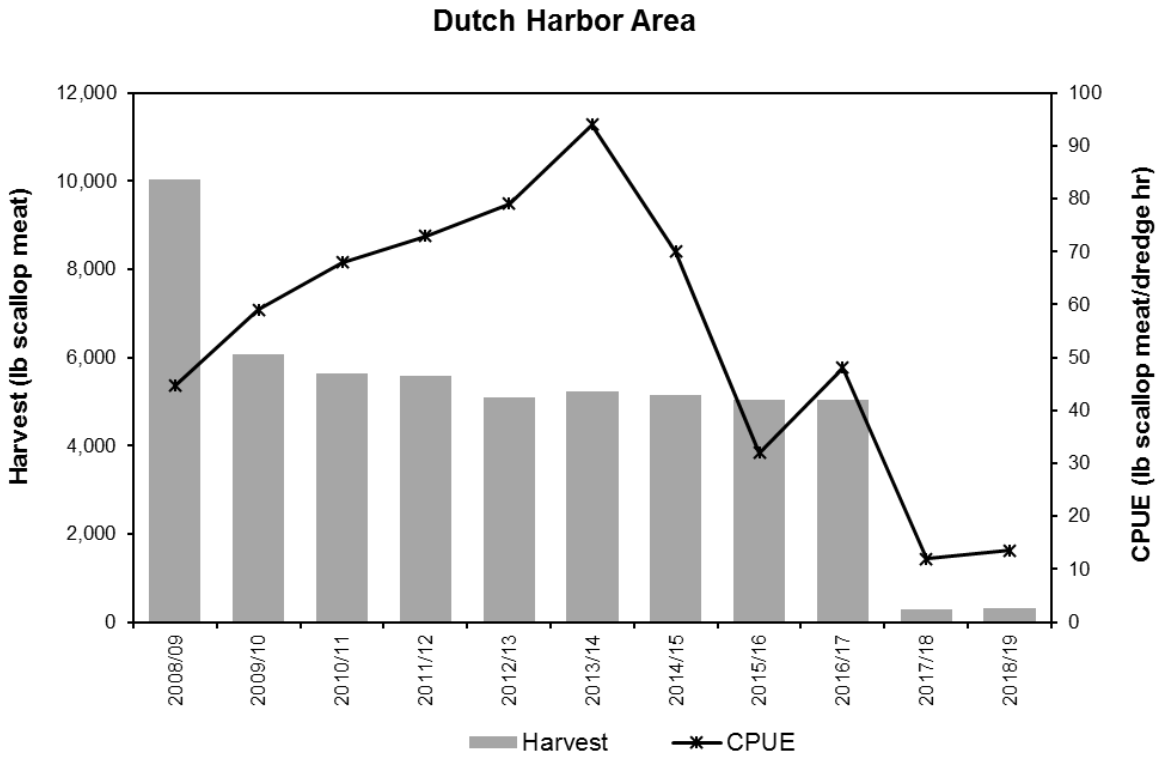

Figure 4-26 Dutch Harbor Area scallop harvest and CPUE, 2008/09 - 2018/19 seasons.

Shell height distributions in the DHRA show a decreased range of scallop sizes with respect to all other seasons. It is not known why these drastic changes have occurred in this population but minimal recruitment was seen in the little fishing effort that occurred. The few retained scallops that were sampled were in the 150–180 mm shell height range (Figure 4-28).

Tanner crab bycatch estimate calculated from 2017/18 DHRA fishery observer sample was 1 crab. With such minimal fishing, it is estimated that there was no impact on crab bycatch from scallop efforts this season.

Intentionally Left Blank

Table 4-21 Dutch Harbor Area catch summary for the 2009/10-2017/18 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized
Season	Median	Mean	SD	CPUE
2009/10	363.3	474.5	362.4	766.7
2010/11	475.3	496.9	345.3	655.9
2011/12	530.3	566.1	344.0	747.9
2012/13	622.2	593.8	367.2	562.7
2013/14	799.0	797.2	183.7	853.3
2014/15	541.6	557.6	164.7	565.7
2015/16	286.4	249.9	126.1	320.8
2016/17	258.9	221.8	145.0	301.2
2017/18	83.3	83.1	64.1	147.3

Intentionally Left Blank

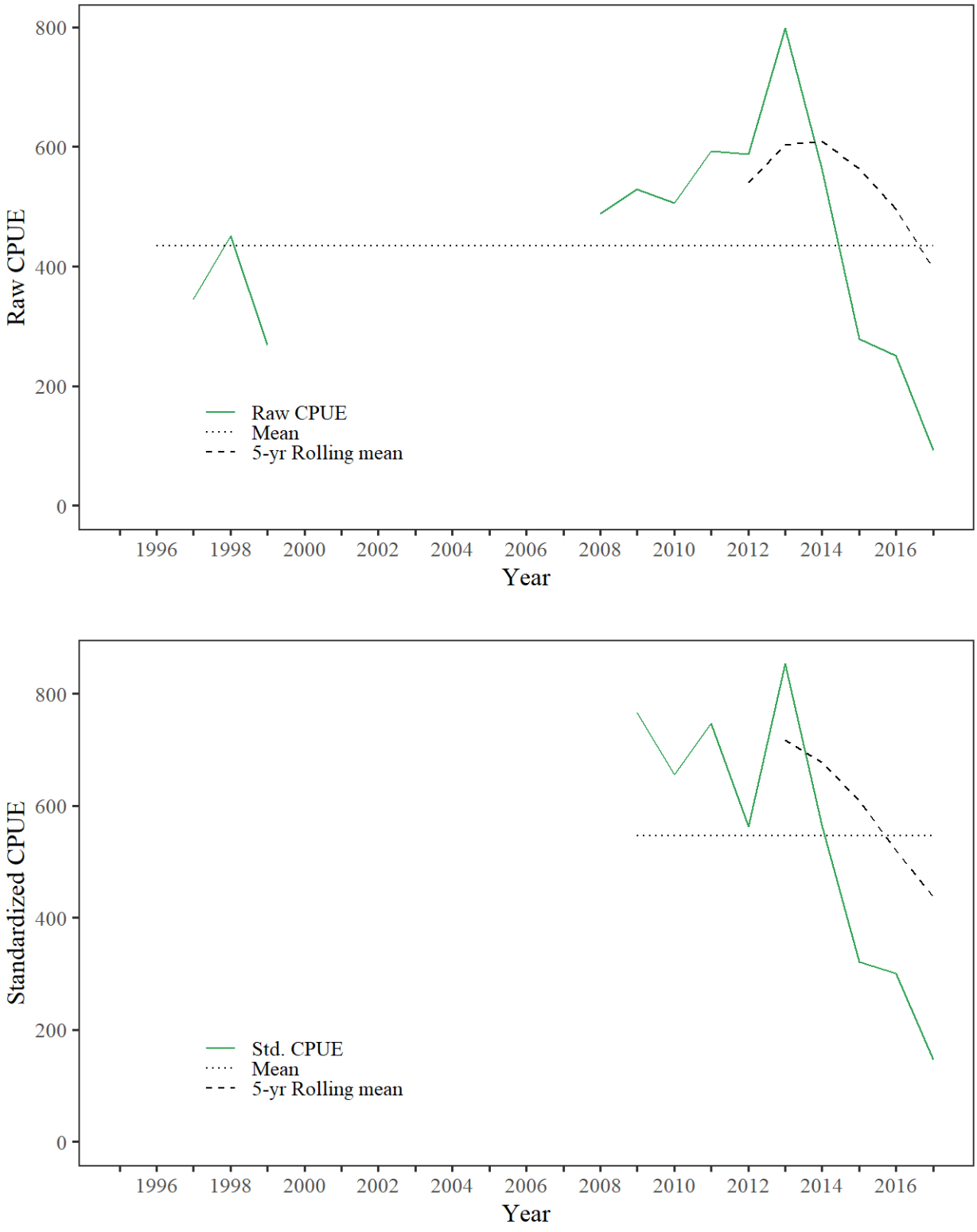

Figure 4-27 Dutch Harbor Area scallop raw and standardized (when available) meat CPUE, 1995/96 - 2017/18 seasons.

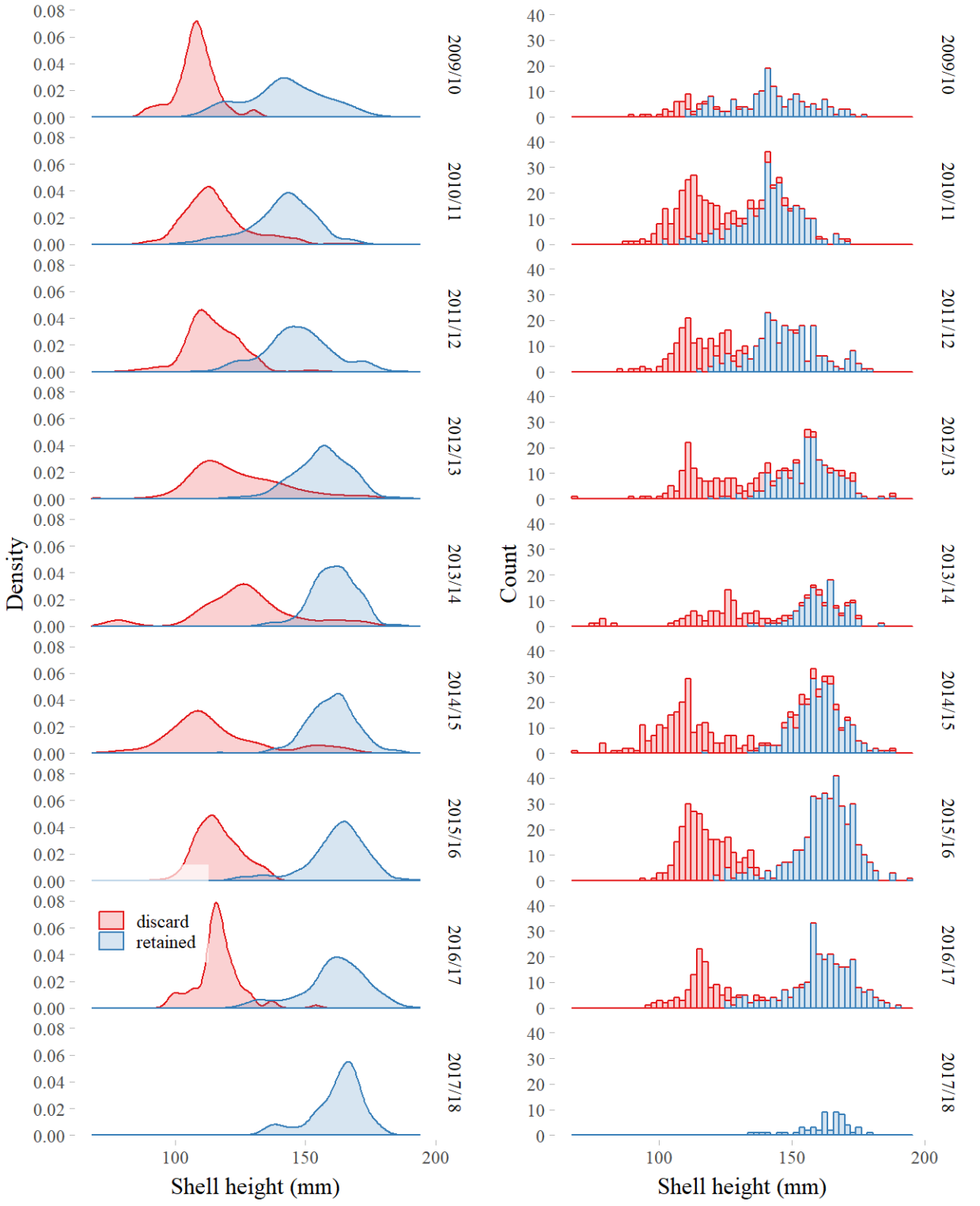

Figure 4-28 Dutch Harbor Area retained and discarded shell heights by density and count for the 2009/10-2017/18 seasons.

Adak Registration Area

Scallops were first harvested from the Adak Registration Area in 1979 with subsequent fishing periods in 1992 and 1995. Bathymetry of the Aleutian Islands, along with a narrow continental shelf edge, provides limited scallop habitat; however, a scallop bed was known to occur on Petrel Bank, an area of important red king crab habitat. To protect red king crab habitat on Petrel Bank, and reduce red king crab bycatch mortality, the waters were closed to commercial scallop fishing in 1991.

Intentionally Left Blank

5. Economics

An overview of Alaska weathervane scallop harvest and wholesale revenue is presented in Table 5-1. The underlying data used to calculate fishery economic value is from annual scallop harvest information contained in Chapter 4. Vessel participation in this fishery has declined since the late 1990s due to the Federal LLP and formation of a voluntary marketing association. The Federal LLP limits the participation to 9 permit holders. In the early 2000s as many as 8 vessels have participated; however, since 2014 no more than 4 vessels have participated. In each of the past three years two vessels have participated, as the harvest levels have fallen to historically low levels. A further discussion of participation, ownership, markets, and economic conditions in this fishery is provided in Appendix 2; however, due to the Federal Government shutdown new data was not available to revise time series analyses so the appendix is largely unchanged from the previous version.

Table 5-1 provides estimated statewide commercial Weathervane scallop landings and value from 1993/94 to present. Total real gross first wholesale revenue is calculated by multiplying landed pounds of meats by the adjusted price. Adjusted price converts the landed prices by year to year 2018 values to allow for comparisons in current dollar values, after accounting for inflation. The statewide scallop price used here is calculated by the Alaska Department of Revenue (ADOR), Division of Taxation, and is an average of all the reported annual State fish tax revenue collected from all participants in the scallop fishery. Note that the statewide price in the past three years is based on the quantity weighted average prices of all Alaska Weathervane scallop landings reported on 2017 Commercial Operators Annual Report submissions provided by the Alaska Scallop Cooperative.

The majority of the scallop meats that are landed have been processed (shucked) and frozen at sea and their value represents gross revenue at the first wholesale level. However, in some past years some shucked meats were delivered fresh to dockside processors (pers. comm, Bill Harrington, February 2013). There have also been some anecdotal reports of scallop meats landed and sold in a roadside stand outside of Homer in the distant past. In 2018, the Alaska Board of Fisheries approved a proposal to allow delivery of live scallops; however, none of the current Scallop LLP holders have delivered live scallops to port to date. Thus, although landed price is often referred to as an ex-vessel price, it is actually primarily a first wholesale price in that the landed product is a primary processed product. As a result, gross revenue is identified as first wholesale gross revenue here.

Nominal Alaska scallop prices have shown considerable variability over time and have increased dramatically since the mid-2000s. After trending downward to $5.25 per pound in the early to mid-2000s, nominal scallop prices increased to $7.86 by the 2006/07 season. However, in the 2007/08 season the nominal scallop price declined significantly to $5.94 per pound of shucked meats. Since the 2007/08 season, nominal Alaska Weathervane scallop price has trended upward and reached $12.53 per pound of shucked meats in 2016/17 but fell to $11.54 in 2017/18 and rose slightly to $11.60 in 2018/19.

The historical variability in Alaska scallop prices are likely due to market factors that are driven by the much larger U.S. east coast sea scallop fishery, as well as by import markets. However, in recent years, the Alaska Scallop Association has made considerable progress in its marketing efforts and has been able to maintain an upward trend in the prices it receives for the scallops landed by the three vessels that are

Table 5- 1 Statewide Commercial Weathervane Scallop Real Wholesale Value, 1993/94—2018/19.

Year	Vessels	Catch (lb. shucked meats)[a]	Nominal Average Price/lb.	Inflation Factor[b]	Real Average Price/lb	Real Wholesale Value
1993/94	15	984,583	$5.15	1.48	$7.61	$7,491,342
1994/95	15	1,240,775	$5.79	1.46	$8.48	$10,520,805
1995/96	10	410,743	$6.05	1.50	$9.10	$3,737,433
1996/97	9	732,424	$6.30	1.39	$8.77	$6,419,856
1997/98	9	818,913	$6.50	1.32	$8.58	$7,028,704
1998/99	8	822,096	$6.40	1.13	$7.23	$5,945,280
1999/00	10	837,971	$6.25	1.01	$6.32	$5,297,194
2000/01	8	750,617	$5.50	1.16	$6.37	$4,779,911
2001/02	6	572,838	$5.25	1.16	$6.10	$3,495,463
2002/03	6	509,455	$5.25	1.14	$6.00	$3,059,055
2003/04	4	492,000	$5.25	1.05	$5.50	$2,707,200
2004/05	5	425,477	$5.50	1.14	$6.29	$2,674,427
2005/06	5	525,357	$7.58	1.39	$10.52	$5,525,127
2006/07	4	487,473	$7.86	1.28	$10.09	$4,916,922
2007/08	4	458,313	$5.94	1.29	$7.64	$3,499,537
2008/09	4	342,434	$6.34	1.39	$8.79	$3,009,430
2009/10	3	487,913	$6.48	1.20	$7.80	$3,807,175
2010/11	3	468,466	$8.35	1.09	$9.11	$4,269,364
2011/12	4	455,331	$10.39	1.20	$12.47	$5,678,577
2012/13	4	418,880	$10.63	1.01	$10.72	$4,488,507
2013/14	4	399,134	$12.25	1.02	$12.50	$4,988,904
2014/15	4	308,868	$12.39	1.06	$13.11	$4,050,401
2015/16	3	264,532	$12.22	0.98	$11.92	$3,152,920
2016/17	2	232,991	$12.53	1.03	$12.95	$3,017,693
2017/18	2	238,740	$11.54	1.00	$11.54	$2,755,060
2018/19[c]	2	238,808	$11.60	1.00	$11.60	$2,770,173
10 year av.	3	351,366	$10.84		$11.37	$3,897,877

[a] lb of shucked scallop meats are reported by the State Observer Program.
[b] uses the Bureau of Labor Statistics, prepared frozen shellfish industry Producer Price Index through 2018.
[c] preliminary

associated with the cooperative. However, the present strength in Alaska scallop prices may face some market pressure in the coming years as indicated by declines in U.S. commercial sea scallop average price per pound from $12.52 per pound in 2014 to $12.00 per pound in 2016. Similarly, the average price per pound of imported scallop products declined from $7.11 to $6.40 between 2015 and 2017. Please see Appendix 2 for further discussion of competing scallop markets.

First wholesale revenue in this fishery has varied considerably over the period as both price and landings have varied. The peak value in the fishery, occurred in 1994/95 season when inflation adjusted $10.5

million was earned. Since that time, real total first wholesale revenue in the fishery has fluctuated with prices, and the reduction in landed pounds. Overall, the total value has trended downward as landings have fallen from more than 1.2 million lb down to a low in 2016/17 of 232,991 lb. The total real first wholesale revenue of approximately $2.8 million in the most recent two seasons are among the lowest revenue total historically. If market forces continue to exert downward pressure on prices with harvest held relatively constant, as has occurred since 2017 the total value of the fishery will continue to decline in the near future.

Intentionally Left Blank

6. Ecosystem Considerations

The Ecosystem Considerations section was added to the SAFE in 2006, and the SPT hopes to continue improving the section. A wealth of information on climate effects on ecosystems and ecosystem trends contained in the GOA Groundfish Plan Team Ecosystems Considerations document is equally relevant to the scallop fishery and may be accessed at:
https://www.afsc.noaa.gov/REFM/Docs/2017/ecosysGOA.pdf.

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

Ecosystem Components

In Amendment 13 to the Scallop FMP, a new category was created within the FMP for the 'Ecosystem Component" (EC). The non-target scallop stocks (pink, rock and spiny scallops) were moved into this EC under the FMP. Stocks contained under this category of the FMP are stocks which are not the subject of a directed fishery. For these stocks ACLs are not required to be annually specified.

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

The following factors were considered, per the National Standard 1 Guidelines, in classifying these non-target species as an EC species:

- These scallop species are not the target of commercial exploitation or retention by commercial fisheries;
- None of the non-target scallop species are generally retained for sale or personal use;
- The best available scientific information indicates that none of the non-target scallop species are overfished or subject to overfishing; and
- The best available scientific information indicates that none of the non-target stocks are likely to become subject to overfishing or overfished in the absence of conservation and management measures.

Limited data exists currently to assess the spatial extent or biomass of these non-weathervane scallop stocks. No commercial harvests have been documented for scallop species other than weathervane scallops in waters off Alaska since at least 1992 (C. Russ, ADF&G, Homer, pers. Comm.). Major fishery development is not anticipated for non-weathervane scallops, but market potential does exist for both "pink and rock" scallops. The spatial distribution of non-weathervane scallop species is not well defined, although these species currently compose a relatively minor component of catches in both NMFS and ADF&G surveys. In conjunction with the EA for amendment 12, data on capture of non-target scallop species was derived from ADF&G and NMFS trawl surveys for the years 1998–2008 (M. Stichert, ADF&G, Kodiak; M. Spahn, ADF&G, Homer; and R. Foy, NMFS, Kodiak, all pers. comm.). Trawl surveys are conducted in Region 1

only by NMFS and in Regions 2 and 4 by both ADF&G and NMFS. Among all ADF&G surveys, all non-target scallops were recorded as *Chlamys* sp. Although data extrapolated to area-swept estimates were not available for the ADF&G surveys, and these trawl surveys are not designed to assess non-target scallop species, surveys catches of non-target scallops were relatively small (Table 6-1). Data on non-target species was summarized according to whole weight (lb). In Region 1, catches of non-target scallops by the NMFS survey in odd-numbered years from 1999 to 2007 averaged 1 lb annually. For Region 2, ADF&G catches among either annual trawl surveys averaged 22 lb (whole weight; CV = 84%) annually, ranging from <1 to 53 lb, whereas NMFS surveys caught an average of 4 lb annually. For Region 4, annual catch of *Chlamys* among ADF&G trawl surveys ranged from 3 to 109 lb, averaging 35 lb (CV = 97%), whereas NMFS survey catches averaged 70 lb (CV = 50%) annually.

Table 6-1 Annual biomass (whole pounds) of non-target scallops captured in ADF&G and NMFS surveys within ADF&G management region during 1998-2008.

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

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

Ecosystem Effects on the Stock

Weathervane scallops are distributed in dynamic relationship to other benthic marine organisms as well as the non-living components of the marine ecosystem off Alaska. Spatiotemporal ecosystem dynamics, therefore, influence the abundance and distribution of scallops and other benthic community organisms. A

recent study by Glass and Kruse (2017) provides analyses of continental shelf benthic communities off Alaska in areas historically and currently targeted by the commercial Weathervane scallop fishery. Based on observer records of bycatch from 1996–2012 the researchers found significant changes in community composition associated with a temperature regime shift in 1998. Differences in community structure in the Kodiak Northeast and Yakutat management districts were correlated with abiotic ecosystem features such as depth and sediment size.

Species distribution models (SDM) were developed for most managed groundfish and crab species in Alaska as part of the Essential Fish Habitat (EFH) 5-year review (Simpson et al 2017). Scallops, however, were not included in this modeling effort due to a lack of data for SDMs. Glass and Kruse (2017) advance potentially useful information to defining EFH for scallops by characterizing the composition of biotic habitat in weathervane scallop EFH areas. According to the authors, further improvements in understanding scallop EFH could be achieved through bed-specific sampling of environmental variables.

Fishery Effects on Ecosystem

The Alaska weathervane scallop fishery occurs in continental shelf waters at depths 40–150 m in three main areas: the eastern Gulf of Alaska between Prince William Sound and Cape Spencer; around Kodiak Island; and in the eastern Bering Sea (Figure 1-1). There is strong evidence that scallop dredging reduces diversity, at least in the near term, however, the level of impact and the recovery rate tend to vary among habitat types (Collie et al. 2000; Kaiser et al. 2006). Past studies on the effects of scallop dredging in the Gulf of Alaska have found differences in community abundance and diversity for areas either open or closed to dredging (Stone et al. 2005). More recently, Glass and Kruse (2017) found evidence of recovery from disturbance by fishing gear in the Bering Sea scallop bed through increases in sessile benthic organisms during a period of decreased fishing activity. Although Glass and Kruse (2017) also found contrasting impacts in the Kodiak Shelikof district, the authors suggest that reductions in bycatch through self-regulatory fishing practices, extensive closure areas, and the small size of the fishery combine to constrain impacts, overall. It is proposed, however, that controlled fishing experiments that apply a before–after, control–impact (BACI) approach could be used to better characterize the effects of scallop dredging on benthic communities off Alaska.

A Fishing Effects (FE) model was developed to assess the effects of fishing on managed species as part of the 2017 EFH 5-year review (Simpson et al 2017). However, catch data for scallops was not available. For the 2022 EFH 5-year review, model authors will seek to include scallop fishery data into the FE model to estimate habitat reduction across modeled scallop habitat.

Effects on Predators: Little is known about scallop predators. Plankton feeders probably eat a large amount of floating larvae. Small weathervane scallops have been found in the stomachs of flounders, crabs, and sea stars. Twenty-arm sea stars and giant pacific octopus are known predators of weathervane scallops.

Bycatch: Scallop fishery bycatch is closely monitored by the onboard observer program. Bycatch in the scallop fishery includes prohibited species such as red king crab, Tanner crab, snow crab, and Pacific halibut, other commercially important species of fish and invertebrates, miscellaneous non-commercial

species, and natural and man-made debris. Crab bycatch in the scallop fishery is highest in the Bering Sea, although this accounts for a small proportion of total Bering Sea crab bycatch.

Although a variety of marine vertebrates, invertebrates, and debris are caught incidentally in scallop dredges, weathervane scallops predominate catches. For example, during the 2000/01–2007/08 seasons, the most frequently caught species or items in the statewide scallop fishery by weight were weathervane scallops and scallop shells (84%), twenty arm sea stars *Pycnopidia helianthoides* (4%), natural debris (kelp, wood, etc., 3%), and several species of skates (2%). A summary of results of select species encountered during scallop observer haul composition sampling (% by weight) during the 2016/17 season is shown in Table 6-2. Gorgonian (hard) corals are infrequently encountered by scallop observers. Since 1996, corals have been observed in only 11 of the 15,836 tows sampled for catch composition and bycatch. Summaries of haul composition sampling by area are presented in observer reports prepared by ADF&G (e.g., Rosenkranz and Burt, 2009).

Table 6-2 Summary of results from scallop observer haul composition sampling (% by weight) during the 2017/18 season.

Area/District	weathervane scallops	shells/ debris	basket/ brittle stars	*Pycnopodia* seastar	All other seastars	Skates [b]	Flatfish	*Chionoecetes* crabs [c]
Yakutat District	85.6	4.2	4.9	0.8	0.1	2	0.9	0
Yakutat District 16	85.5	2.6	0.9	0	4.3	3.3	2.2	0.1
Prince William Sound	86.2	2.3	0.1	0.1	0.2	4.5	5.3	0
Cook Inlet	0	0	0	0	0	0	0	0
Kodiak Northeast	68.2	5	1	13.2	0.4	2.9	6.3	0.9
Kodiak Shelikof	81.7	7.2	0	0.6	0.1	4.7	2	0.1
Kodiak Southwest	76.6	7.2	5.3	0.1	0.1	2	1.3	0.1
Alaska Peninsula	91.3	2.4	0.4	0	0.1	0.7	3.4	0.2
Dutch Harbor Area	0	96.3	0.1	0.5	0.1	0.2	0.5	0.1
Bering Sea Area	82.4	2.4	1.8	0	0	3.4	1.9	6.4

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

[b] Includes all species skates plus all skate egg cases.

[c] Includes snow crab, Tanner crab, and snow crab × Tanner crab hybrids.

7. Literature Cited

Abramoff, M.D., P.J. Magalhaes, and S. J. Ram. 2004. Image Processing with ImageJ. Biophotonics International, volume 11, issue 7, pp. 36-42.

Alaska Department of Fish and Game and University of Alaska Fairbanks. 2000. A workshop examining potential fishing effects on population dynamics and benthic community structure of scallops with emphasis on the weathervane scallop *Patinopecten caurinus* in Alaskan waters. Alaska Department of Fish and Game, Division of Commercial Fisheries. Spec. Pub., 14 (2000) Juneau.

Barnhart, J.P. 2003. Weathervane scallop fishery in Alaska with a focus on the Westward Region, 1967-2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K03-5, Kodiak.

Barnhart, J. P., and G. E. Rosenkranz. 2003. Summary and Analysis of Onboard Observer-Collected Data from the 1999/2000 through 2001/2002 Statewide Commercial Weathervane Scallop Fishery. Alaska Department of Fish and Game, Regional Information Report #4K03-9, 115 pp.

Bechtol, W. R., R. L. Gustafson and T. R. Kerns. 2009. A survey of weathervane scallops in Kamishak Bay, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 09-24, Anchorage.

Bechtol, W.R., Gustafson, R.L., and Cope, J.L. 2003. A survey of weathervane scallops in Kamishak Bay, Alaska, 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A03-31, Anchorage.

Brenner, K., Oliveira, A.C.M., Rozenkranz, G., Burt, R., Spaford, M., Bechtel, P., Crapo, C.A., and Ralonde, R. 2012. Quality of Weathervane scallops (*Patinopecten caurinus*) in Eastern and Western Gulf of Alaska. Journal of Shellfish Research. 31: 1123-1132.

Caddy, J.F. 1968. Underwater observations on scallop (*Placopecten magellanicus*) behaviour and drag efficiency. J. Fish. Res. Bd. Can., 25 (1968), pp. 2123–2141.

Caddy, J.F. 1989. A perspective on the population dynamics and assessment of scallop fisheries, with special reference to the sea scallop, *Placopecten magellanicus* Gmelin. J.F. Caddy (Ed.), Marine Invertebrate Fisheries: Their Assessment and Management, John Wiley and Sons, New York (1989), pp. 559–589.

Collie, J. S., S. J.Hall,M. J. Kaiser, and I. R. Poiner. 2000.Aquantitative analysis of fishing impacts on shelf-sea benthos. Journal of Animal Ecology 69:785–798.

Efron, B., and Tibshirani, R.J. 1993. An introduction to the bootstrap. Chapman and Hall, New York.

Free-Sloan, N. 2007. A brief overview of the Alaska weathervane scallop fishery and the vessel permit limited entry program. Alaska Commercial Fisheries Entry Commission, Report 07-2N.

Glass and Kruse (2017; Spatiotemporal variability of benthic communities on weathervane scallop beds off Alaska. Marine and Coastal Fisheries, 9:1, 521-534, DOI: 10.1080/19425120.2017.1370041).

Gustafson, R. J., and K. J. Goldman. 2012. Assessment of weathervane scallops in Kamishak Bay and at Kayak Island, 2004 through 2010. Alaska Department of Fish and Game, Fishery Data Series No.12-62, Anchorage .

Hammarstrom, L., and Merritt, M. 1985. A survey of Pacific weathervane scallops (*Pecten caurinus*) in Kamishak Bay, Alaska. Alaska Department of Fish and Game, Informational Leaflet No. 252, Juneau.

Howland, J., S. Gallager, H. Singh, A. Girard, L. Abrams, and C. Griner. 2006. Development of a towed survey system for deployment by the fishing industry. IEEE Oceans (2006), p. 06.

Kaiser, M. J., K. R. Clarke, H. Hinz, M. Austen, P. J. Somerfield, and I. Karakassis. 2006. Global analysis of response and recovery of benthic biota to fishing. Marine Ecology Progress Series 311:1–14.

Kruse, G.H. 1994. Draft fishery management plan for commercial scallop fisheries in Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Draft Special Publication 5, Juneau. 56 pp.

Kruse, G. H., Barnhart, J.P., and G.E. Rosenkranz. 2005. Management of the data-limited weathervane scallop fishery in Alaska. Pages 51-68 In G.H. Kruse, V.F. Galucci, D.E. Hay, R.I. Perry, R.M. Peterman, T.C. Shirley, P.D. Spencer, B. Wilson, and D. Woodby (eds.). Fisheries Assessment and Management in Data-limited Situations. Alaska Sea Grant College Program, University of Alaska Fairbanks. 958 pp.

MacDonald, B. A., and N. F. Bourne. 1987. Growth, reproductive output, and energy partitioning in weathervane scallops, *Patinoyecten caurinus*, from British Columbia. Canadian Journal of Fisheries and Aquatic Sciences. 44: 152- 160.

North Pacific Fishery Management Council (NPFMC). 2014. Fishery Management Plan for the Scallop Fishery off Alaska.

Northeast Fisheries Science Center (NEFSC). 2007. 45th Northeast Regional Stock Assessment Workshop (45th SAW): 45th SAW assessment report. NEFSC Ref Doc. 07-16.

Quinn, T.J., and R.B. Deriso. 1999. Quantitative Fish Dynamics. Oxford University Press, New York (1999).

Restrepo, V. R, G. G. Thompson, P. M. Mace, W. L. Gabriel, L. L. Low, A. D. MacCall, R. D. Methot, J. E. Powers, B. L. Taylor, P. R. Wade, and J. F. Witzig. 1998. Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Technical Memorandum NMFS-F/SPO-31. 54 p.

Rosenkranz, G.E., S.M. Gallager, R.W Shepard, and M. Blakeslee 2008. Development of a high-speed, megapixel benthic imaging system for coastal fisheries research in Alaska. Fisheries Research 92:340–344.

Rosenkranz, G., and R. Burt. 2009. Summary of observer data collected during the 2006/07 Alaska weathervane scallop fishery. Alaska Department of Fish and Game, Fishery Data Series No. 09-49, Anchorage.

Siddon, C., Smith, Q., McNeel, K., Oxman, D., and Goldman, K. 2017. Protocol for estimating age of weathervane scallops *Patinopecten caurinus* in Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 17-07, Anchorage.

Simpson, S. C., Eagleton, M. P., Olson, J. V., Harrington, G. A., and Kelly, S.R. 2017. Final Essential Fish Habitat (EFH) 5-year Review, Summary Report: 2010 through 2015. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-15, 115p.

Smith, Q., B. Williams, and R. Burt. 2016. Statewide weathervane scallop survey operational plan, 2016 through 2018. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF.1J.2016.07, Juneau.

Spencer, P., M. Canino, J. DiCosimo, M. Dorn, A.J. Gharrett, D. Hanselman, K. Palof, and M. Sigler. 2010. Guidelines for determination of spatial management units for exploited populations in Alaskan fishery groundfish management plans. Paper prepared for the September 2010 NPFMC Plan Team meeting.

Stone, R. P., M. M. Masuda, and P. W. Malecha. 2005. Effects of bottom trawling on soft-sediment epibenthic communities in the Gulf of Alaska. Pages 439–453 in P. W. Barnes and J. P. Thomas, editors. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

Williams, B., Q. Smith, K. Palof, and J. Mumm. 2017. 2016 Statewide Weathervane Scallop Dredge Survey Report. Alaska Department of Fish and Game, Fishery Data Series No. 17-09 Anchorage

8. Appendices

Appendix 1: Response to Comments from SSC

2018 SSC comments:

Comment 2018-1: The SSC requests a report and presentation on this model for SSC review when it is ready. Further, the SSC encourages attempts to develop age- or size-based models for data-poor areas to determine the general applicability of these methods for scallops throughout Alaska.

Response 2018-1: *This will be completed as staffing and funding allow. Further work on the age-based model is scheduled in 2019.*

Comment 2018-2: The SSC recommends examining catchability for different depths, bottom types, and other factors, which may affect catchability. Size selectivity needs to be considered so that fishery independent survey results can be accurately interpreted.

Response 2018-2: *The SPT agrees with the need for further studies into catchability. Due to weather and equipment breakdown there were very few paired tows completed in the 2018 surveys. Paired tows are on the schedule for the 2019 surveys in Yakutat beds 3-5. Further studies will be designed and implemented as staffing and funding allow.*

Comment 2018-3: The SSC requests the Scallop Plan Team explore the application of OFL calculations analogous to Tier 5 used for groundfish.

Response 2018-3: *Advances on biomass and natural mortality estimates are dependent on model development, and accumulation of survey data. The majority of fished areas have 1-3 years of survey data which is insufficient for estimation for the large majority of the scallop stocks. Once sufficient survey data has been collected calculations will be completed as staffing and time allow.*

Comment 2018-4: The ecosystem section would be enriched by considering the detailed spatio-temporal analysis of observed scallop bycatch reported by Glass and Kruse (2017; Spatiotemporal variability of benthic communities on weathervane scallop beds off Alaska. Marine and Coastal Fisheries, 9:1, 521-534, DOI: 10.1080/19425120.2017.1370041).

Response 2018-4: *This suggestion has been followed and is reflected in the 2019 SAFE.*

Comment 2018-5: The SSC appreciates the additional economic analyses in this year's SAFE and offers the following comments. Since for scallop, there is no stand-alone Economic Considerations chapter like those produced by for groundfish and crab, the Scallop SAFE would benefit from a series of tables tracking a time series of annual quantitative indicators of sustained community participation, per National Standard 8. These could include:

- LLPs by community of ownership address
- Active vessels by community of ownership address
- Active vessels by homeport (both as determined from vessel data and other sources)
- Active vessel diversity (fishing portfolio)
- Number of offloads by port
- Number of unique vessels making offloads by port
- Number of processors receiving deliveries by port

Additionally, brief narrative text qualitatively describing the major patterns of change tracked in these indicators (and, where possible, the drivers of those changes) would inform the nature, direction, and order of magnitude of community engagement in and dependency on the scallop fishery. Further, some of the information provided in the economic analysis in the 2017 SAFE (pgs. 59-60) that was not carried forward would be beneficial to incorporate in future SAFE documents, including:

- Crew size pre-co-op formation.
- Attempted crew wage data collection effort in 2012/2013.
- Vessel maintenance and repair work done in Kodiak.

This is particularly important in the absence of quantitative data on volume and value of landings by port, due to data confidentiality restrictions, or other information on the community context of the fishery. For example, the Scallop FMP (February 2014) provides data on the number of offloads by specific port, but only for the years 1990-2003 (Table 5).

The FMP is supplemented with community profiles (FMP Appendix F) for those communities that had landings of scallops in 1990-2003. However, while they were "intended to give an overview of the community, demographics, and involvement in North Pacific fisheries with particular emphasis placed on harvesting and processing of scallops," data on engagement was limited to the year 2000 alone and 10 of the 13 community profiles contain no mention of scallops (Cordova, Ketchikan, Pelican, Petersburg, Sand Point, Seattle, Seldovia, Seward, Sitka, and Yakutat). Information on the scallop fishery presented for the other three communities was limited to the following: Homer, 1 permit; Kodiak, 1 permit, 2 vessels delivered scallops, and scallop processing occurred; and Unalaska/Dutch Harbor, 1 vessel delivered scallops. This lack of basic information on the human dimensions of the fishery highlights the need to incorporate updated time series for community engagement indicator tracking in annual SAFE documents going forward.

Response 2018-5:

Comment 2018-6: The SSC requests an update on the SSC's seven comments from April 2017 in next year's SAFE.

Response 2018-6: *See below.*

2017 SSC comments

Comment 2017-1: The SSC strongly supports the 2016 survey sampling and continued efforts to implement a statewide scallop survey. This will provide for fishery-independent GHLs that do not rely on standardization of fishery CPUE, and may support a refinement of the OFL/ABC approach based only on

historical landings and discard mortality. This will also require further consideration of dredge efficiency, and aggregate survey catchability.

Response 2017-1: *Addressed in 2018 comments.*

Comment 2017-2: Progress on assessment modelling remains a priority for this species. With fishery-independent survey abundance estimates and associated age information available for some beds, this path appears promising. Efforts should first rely on bed-specific modelling, but could be extended to incorporate meta-population considerations (and possibly genetic information) in the future. The SSC is encouraged that ADF&G is in the process of hiring a Biometrician II to tackle this modelling in the near future.

Response 2017-2: *A biometrician has not yet been hired.*

Comment 2017-3: The SSC reiterates the need to compare and evaluate survey-based scallop abundance estimates and fishery CPUE. This can be approached both through time-series, as well as calibrations for which fishery-independent information is only recently available. Fishery CPUE standardization efforts should be continued, including an effort to provide standardized values on a similar scale as those observed in the raw data (back-transformed).

Response 2017-3: *Standardization of fishery CPUE is ongoing, and as fishery independent data become more available, these examinations can take place.*

Comment 2017-4: The ageing protocol represents an important framework for future aging efforts. The SSC recommends using this protocol, but emphasizes that validation of some sort (perhaps O18-based methods) is still required to determine the relationship between age estimates and true age. Specifically, the methods in the ageing protocol should not be confused with actual bias or precision. There are existing methods (e.g., Punt, A.E.; Smith, D.C.; KrusicGolub, K.; Robertson, S. 2008. Quantifying age-reading error for use in fisheries stock assessments, with application to species in Australia's southern and eastern scalefish and shark fishery. Can. J. Fish. Aquat. Sci. 65:1991-2005) available to deal with precision correctly – naïve estimates of reader agreement disregard the joint probability that matching age estimates are both incorrect, and therefore tend to overstate precision.

Response 2017-4: *See Response 2017-2*

Comment 2017-5: The SSC reiterates its concern that a 'plus group' may be required for older ages at which reader agreement and/or relative bias may be unacceptable. The current protocol recommends that if ages cannot be resolved, the samples should be excluded (p.11, #3). However, this would bias the age distribution; it is preferable to aggregate these ages, rather than exclude them.

Response 2017-5: *Preliminary age validation has been done and there is interest in building on that. There is a formal policy in place for addressing precision and accuracy, i.e., age reader error estimation. Once an age-structured assessment is developed, concerns about treatment of the plus group can be addressed. The use of a plus group adds efficiency to processing shells for age data.*

Comment 2017-6: The SSC recommends continuing to consider collecting data (survey and fishery) and managing in numbers rather than shucked or round weight – both of which appear seasonally variable.

Response 2017-6: *The Plan Team reviews catches expressed in meat weight and round weight, and is developing methods for interpreting data in terms of numbers of scallops*

Comment 2017-7: The SSC continues to look forward to improved estimates of discard mortality rates, based on information provided in previous analyses.

Response 2017-7: *This issue continues to be a high priority for the Plan Team and will be needed for development of an age-structured model.*

Appendix 2: Economic Factors in the Scallop Fishery off Alaska

Economic Factors in the Scallop Fishery off Alaska

Scott A. Miller
Industry Economist
National Marine Fisheries Service
Juneau, Alaska
March 2018

Introduction

This appendix to the 2018 Scallop SAFE document provides an update of available economic information in an attempt to identify factors that have contributed to major changes in the Alaska scallop fishery over time. This discussion was last presented as an appendix to the 2006 Scallop SAFE and is being provided following an expression of interest by the Council. Note that historical information provided in 2006 is largely retained and has been updated as appropriate, as have tables of economic and participation information. While it may appear that much of this data is dated, it is important to recognize that there is no economic data collection mechanism for the Alaska scallop fishery. Thus, the analyst is limited to landings, price, value, ownership, and basic marketing data and does not have access to current vessel operational costs, crew shares, or other economic information. Nonetheless, every effort has been made to utilize data submissions from industry for past analyses to highlight likely current conditions in the fishery.

The following overview of the history of the fishery is largely excerpted from information presented in Appendix A of the current Scallop Fishery Management Plan (NPFMC, 2009) and incorporates that discussion and information sources identified in that discussion here by reference. Additional historical information can also be found in Appendix 4 of this document. Landings data and harvest limits are discussed in Chapter 3 of this document.

The Early Years

The Atlantic sea scallop fishery is the predominant source of U.S. domestic sea scallop supply. A cyclical decrease in stocks, possibly due to overfishing, began to occur on the Atlantic's Georges Bank in the late 1960's. In response to these stock conditions, management measures, focused on protecting stocks, were adopted. The result was a steady decline in sea scallop landings from the Georges Bank area. As a direct result of these changes, interest in developing a weathervane scallop fishery off Alaska materialized in the late 1960's. Weathervane scallop stocks off Alaska had been evaluated for commercial potential in the 1950's but the first effort recorded in the fishery occurred in 1967. In that year, two vessels made six landings of scallops totaling less than 1,000 pounds of shucked meats.

As shown in Table 1, an additional 17 vessels entered the fishery in 1968 and the 19 vessels that participated made 125 landings totaling 1,677,268 pounds of shucked meats. In 1969, 19 vessels continued harvesting scallops and made 157 landings totaling 1,849,947 pounds of shucked meats. The 1969 fishery had the largest number of landings and the largest pound total in the history of the fishery. The inflation adjusted first wholesale value of the 1969 catch was just over $1.5 million (inflation adjusted value would exceed $6.6 million[1]). However, this level of harvest and effort was not to be sustained.

[1] Note that the 2006 version of this document provided inflation adjusted number; however, since that time at the urging of the SSC the inflation adjustment that has been provided in the economic section of the Scallop SAFE utilizes the Frozen and Processed Seafood Producer Price Index and that index is presently re-based to the year 1996, and not available for the historic time series of harvests shown here. The intent here is to show the changing scale of harvest and participation in this fishery and inflation adjusted wholesale value from 1993/94 to present is available in table 5-1 of the main body of the 2018 Scallop SAFE.

Table 1: Historic Statewide Commercial Weathervane Scallop Statistics, 1967-2017/18.

Year	Vessels	Landings[a]	Catch (lb meats)[b]	Average Price/lb	Wholesale Value
1967	2	6	778[c]	$0.70	$545
1968	19	125	1,677,268	$0.85	$1,425,678
1969	19	157	1,849,947	$0.85	$1,572,455
1970	7	137	1,440,338	$1.00	$1,440,338
1971	5	60	931,151	$1.05	$977,709
1972	5	65	1,167,034	$1.15	$1,342,089
1973	5	45	1,109,405	$1.20	$1,331,286
1974	3	29	504,438	$1.30	$655,769
1975	4	56	435,672	$1.40	$609,941
1976	7	21	264,788	$1.59	$421,013
1977-79			No Fishery		
1980	8	56	616,717[c]	$3.60	$2,220,181
1981	18	101	924,441	$4.00	$3,697,764
1982	13	120	913,996	$3.25	$2,970,487
1983	5	30	192,310	$5.00	$961,550
1984	6	52	383,512	$4.00	$1,534,048
1985	7	47	615,564	$4.00	$2,462,256
1986	8	74	667,258	$4.25	$2,835,847
1987	4	54	599,947[d]	$3.45	$2,069,817
1988	4	47	341,070	$3.68	$1,255,138
1989	7	55	534,763	$3.87	$2,069,533
1990	9	144	1,481,136	$3.43	$5,080,296
1991	6	136	1,136,649	$3.82	$4,341,999
1992	8	136	1,785,673	$3.96	$7,071,265
1993[e]	7	51	568,077	$5.15	$2,925,597
1993/94	15	111	984,583	$5.15	$5,070,602
1994/95	15	104	1,240,775	$5.79	$7,184,087
1995/96	10	29	410,743[d]	$6.05	$2,484,995
1996/97	9	30	732,424	$6.30	$4,614,271
1997/98	9	31	818,913	$6.50	$5,322,935
1998/99	8	35	822,096	$6.40	$5,261,414
1999/00	10	22	837,971	$6.25	$5,237,319
2000/01	8	20	750,617	$5.50	$4,128,394
2001/02	6	26	572,838	$5.25	$3,007,400
2002/03	6	28	509,455	$5.25	$2,674,639
2003/04	4	32	500,379	$5.25	$2,626,990
2004/05	5	22	431,594	$5.50	$2,373,767
2005/06	3	35	532,741	$8.02 [g]	$4,272,583
2006/07	3	21	486,564	$7.78 [g]	$3,785,468
2007/08	4	21	458,313	$5.94	$2,722,379

Year	Vessels	Landings[a]	Catch (lb meats)[b]	Average Price/lb	Wholesale Value
2008/09	4	20	342,434	$6.34	$2,171,032
2009/10	3	31	488,059	$6.48	$3,162,622
2010/11	3	37	459,759	$8.35	$3,838,988
2011/12	4	26	456,058	$10.39	$4,738,443
2012/13	4	24	417,551	$10.63	$4,438,567
2013/14	4	20	399,134	$12.25	$4,889,392
2014/15	4	24	308,888	$12.39	$3,827,122
2015/16	3	20	264,316	$12.22	$3,229,942
2016/17	2	17	233,003	$12.53	$2,919,528
2017/18[f]	2	n/a	238,710	$11.54	$2,754,713

Sources: ADF&G fish ticket data, and Alaska Department of Revenue annual fish prices.

[a] Prior to and including 1995, number of landings equals number of fish tickets. After 1995, the number of landings equals number of deliveries (off-loads). A delivery typically includes multiple tickets, normally one per week.
[b] Pounds of shucked scallop meats.
[c] Unshucked scallop deliveries were converted to shucked meats using a 10 percent conversion factor.
[d] Includes illegal harvest.
[e] January 1 through June 30
[f] preliminary
[g] estimated by fresh product ex-vessel price and limited first wholesale product value data.

Data from 1970 suggest that there may have been relatively few vessels landing most of the scallops during 1968 and 1969. This appears so because only 7 vessels remained in the fishery in 1970 despite an 18 percent increase in the average nominal price per pound. These 7 vessels made 137 landings totaling 1,440,338 pounds of shucked meats, which was 78 percent of the harvest taken by 19 vessels the previous year. The first wholesale value of the 1970 catch was about $1.4 million, or an average of more than $205,000 per vessel. While this revenue picture appears rosy, there is no data available on operating costs or effort levels in the early days of this fishery, and the trend during the rest of the 1970's suggests that the fishery was not as lucrative as the 1970 revenue numbers suggest.

In 1971, effort fell to 5 vessels and remained at 5 vessels for several years before falling to 3 vessels in 1974. During those years, landings fell from 137 in 1970 to 29 in 1974. However, shucked meat totals stayed near or above 1 million pounds through 1973 before falling by more than 50 percent to approximately a half million pounds in 1974. Prices continued to rise over this time frame, however, the declining catch forced revenue to decline to just over $421,000 in 1976 when 264,788 pounds, just 14 percent of the 1969 peak harvest, of shucked meats were caught. In 1977 and 1978, no effort was expended in the weathervane scallop fishery off Alaska.

The period of 1967 to 1976 demonstrates what can happen in an emerging fishery with passive management. There were no effort controls, limits, or guideline harvest levels in place. The fishery expanded rapidly as scallop beds were located and exploited, experienced substantial effort consolidation as marginal vessels departed, and eventually overexploited the known beds to the point that the fishery was not economically viable by 1977 and 1978. This could have been the end of the weathervane scallop fishery off Alaska, except for the fact that scallops are somewhat resilient and discoveries of new beds had yet to be made.

In 1979, following two years with no harvest, a single vessel made 4 landings totaling less than 25,000 pounds. of shucked meats. Three years of zero or minimal effort had likely allowed the scallop resource to regenerate somewhat. That likelihood, combined with a price increase to $3.80 per pound contributed to 8 vessels making 56 landings totaling about 617,000 pounds in 1980.

Given fishing success in 1980 and significant price increases to $3.60 per pound, it is not surprising to see that 1981 participation increased to 18 vessels that made 101 landings totaling 924,441 pounds of shucked meats. The 1980 first wholesale value was approximately $2.2 million and rose to nearly $3.7 million in 1981. However, data for the next several years show a similar cycle as occurred between 1969 and 1974. By 1983, five vessels made 30 landings totaling less than 200,000 pounds of shucked meats. However, 1983 was the year of record high nominal prices of $5 per pound so first wholesale value was nearly $1 million.

Over the next several years, participation increased slightly as did landings and catch but repeated the cyclical pattern by trending back downwards before another cyclic increase in landings and catch began in 1989. Beginning in 1990, an influx of East Coast scallop vessels began to occur; once again this was because of unfavorable economic conditions in East Coast scallop fisheries. The upward trend continued into 1992, when the second highest historic catch of 1,785,673 pounds was taken by 8 vessels making 136 landings. The first wholesale value of over $7 million recorded in 1992 is the second highest nominal first wholesale value ever recorded in the fishery and if inflation adjusted is the historic high value in the history of this fishery.

This period of this fishery has been characterized as a “gold rush atmosphere” (Barnhart, 2006). It is also important to note that by this time, scallop beds had been located in several areas around Kodiak Island, in Shelikof Strait, near Yakutat, in the Northern Gulf of Alaska near Kayak Island, in Cook Inlet, as well as in the Aleutians and Bering Sea.

In the early 1990’s, the State of Alaska determined that the fishery was expanding rapidly without active management. Thus the State moved to declare this fishery a high impact emerging fishery in May of 1993. This action required fishery closure and implementation of an interim management plan. Table 1 shows that, prior to closure in May of 1993, the fishery had participation by 7 vessels with 51 landings totaling 568,077 pounds. Following implementation of the interim management plan, the fishery reopened on June 17, 1993. The interim management plan required 100 percent observer coverage and set crab bycatch limits. From this point on, data is presented by season years. Thus, the remained of 1993 catch is listed for the 1993-94 season. The seasons established in the management plan extend into the first three months of the following year.

Catch statistics shown in table 1 for the 1993-94 season indicate participation by 15 vessels making 111 landings of a total of 984,583 pounds of shucked meats. Total first wholesale value was just over $5 million in 1993-94. The 1994-95 season also had participation by 15 vessels making 104 landings totaling 1,240,775 pounds. Total first wholesale value in 1994-95 was nearly $7.2 million, the highest nominal value in history.

In the 1995/96 season the captain of a single vessel turned in his State scallop registration card but proceeded to fish scallops in the Federal waters of the Exclusive Economic Zone (EEZ) without State observer coverage and with total disregard for harvest limits. In response, Federal regulators closed the EEZ to scallop harvest by emergency rule on February 23rd of 1995 and then enacted a Fisheries Management Plan for the scallop fisheries off Alaska (FMP) and an amendment to that plan that closed the fishery in the EEZ until August of 1996, nearly 18 months later. (NPFMC, 2005) The actions of this one individual, and the resulting closures likely had a devastating economic impact on remaining participants.

Nonetheless, the period from 1994/95 to 2000, with the exception of the 1995/96 season, had fairly constant participation and landed pounds trended upwards.

In 1997, the North Pacific Fisheries Management Council (Council) sought to restrict effort in the scallop fishery off Alaska by adopting a vessel moratorium, under which 18 vessels qualified to fish in Federal waters. Following that action, the Council undertook analysis of further capacity reductions and adopted a License Limitation Program, including 9 vessels, which took effect in 2000.(NPFMC, 2005) These changes ushered in a new era in the scallop fishery off Alaska. The successes of the early exploratory years had now necessitated stock and effort management measures and capacity reduction.

Scallop Fishery Transition and Fleet Consolidation

A review of fish ticket data suggest that, in the early days of this fishery, much of the harvest was made by catcher vessels (CVs) making single day trips and delivering to shoreside processors. The shoreside processors then processed the meats (e.g. trim, freezing, and packaging) and moved the product to market, whether in fresh or frozen form. That method appears to have continued into the mid 1990's. At that time, single day trips had begun to be replaced by multiday trips and freezing at sea by catcher processors (CPs). This change was likely the result of some vessels earning marginal returns due to the cost of daily transit to and from port as well as the 10 day maximum that shucked meats can be held on ice by a CV (Kandianis 2006) The further vessels operated from port the more severe this inefficiency became. As new beds were found in distant areas some vessels likely found their participation was not economically sustainable. This fact was likely exacerbated by the fact that harvesters had little or no market power.

Under these conditions, vessel operators are constrained by the inefficiency of the day trip and external market forces dictating the value of their catch. Thus, operators would look to reduce inefficiencies, reduce operating costs, and attempt to capture processing value added that was being captured by the shoreside processing sector. Operators might even attempt to improve value by increasing quality. It can be argued that fresh frozen (at sea) product may be superior to product that is iced for a period of time before being consumed and/or frozen. The result of these forces appears to be the entrance of catcher processors (CPs) into the scallop fishery. That this began to happen should be no surprise. It was around this time that the CP fleet began to expand in several of the Bering Sea fisheries for many of the same reasons.

This practice expanded over the next several seasons. By the time the vessel moratorium was imposed in 1997 there were 18 vessels included under the moratorium. Further consolidation of the fleet was deemed necessary by the North Pacific Fisheries Management Council.

In 1999 the Council adopted Amendment 4 to the Scallop FMP, which established the Federal License Limitation Program (LLP). The LLP recognized 9 participants and granted them statewide access with maximum vessel length overall (MLOA) limits (equal to the length of the vessel they were using during the qualifying period) and with gear restrictions for two vessels that primarily fished inside the Cook Inlet registration area. All of the remaining 7 participants in the statewide fishery outside the Cook Inlet registration area were using vessels categorized as CPs. Thus, at the time of the LLP, virtually all effort in the statewide fishery outside the Cook Inlet registration area was from CPs. Thus, the transition away from the inefficiency of day trips, the capture of shoreside processing value added by offshore processing, and any potential improvement in quality brought about by at-sea freezing appeared to be complete by the time of LLP implementation in 2000. However, further fleet consolidation was predictable, and had already begun.

The Regulatory Impact Review (RIR) analysis supporting the action to create the LLP (NPFMC 1999) develops a breakeven analysis for the scallop fishery in the statewide fishery outside the Cook Inlet

registration area. This analysis estimates the number of vessels that could breakeven in the fishery under a series of price and landings scenarios. The analysis is based on operating cost and revenue data provided voluntarily by fishery participants. Table 2 presents the analysis.

Table 2: Number of Vessels that Could Breakeven Under Various Price and Landings Scenarios (recreated from Regulatory Impact Review for Amendment 4 to the North Pacific Scallop FMP)

Price	Landing (pounds)			
	600,000	800,000	1,000,000	1,200,000
$5.00	3.6	4.9	6.1	7.3
$5.50	4.0	5.3	6.7	8.0
$6.00	4.4	5.8	7.3	8.7
$6.50	4.7	6.3	7.9	9.5
$7.00	5.1	6.8	8.5	10.2
$7.50	5.5	7.3	9.1	10.9
$8.00	5.8	7.8	9.7	11.6

In the 1999/00 season 10 vessels, including two inside the Cook Inlet registration area, landed 837,971 pounds of scallops with an average price of $6.25. The analysis recreated in Table 2 indicates that approximately 6 vessels could breakeven fishing in the statewide fishery outside the Cook Inlet registration area under this price and landings scenario. Thus, participation in the statewide fishery outside the Cook Inlet registration area exceeded the breakeven number of vessel by two.

In 2000/01 8 vessels, including two operating inside the Cook Inlet registration area, landed 750,617 pounds of scallops with an average price of $5.50 per pound. The breakeven analysis suggests that this price and landings combination could probably support 5 vessels in the statewide fishery outside the Cook Inlet registration area; however, 6 were fishing in that season.

In 2001/02 6 vessels, likely four in the statewide fishery outside the Cook Inlet registration area, landed 572,838 pounds of scallops with an average price of $5.25 per pound. The breakeven analysis suggests that this landings and price scenario could support fewer than four vessels at breakeven levels and this appears to be the case in 2002/03 as well.

In 2000 a group of six of the LLP holders, who traditionally have fished in the statewide fishery outside the Cook Inlet registration area, formed a voluntary marketing cooperative (NPFMC 2005). The cooperative members agreed to reduce harvesting capacity and entered into revenue sharing agreements with members who agreed to not use their vessel(s). That the cooperative chose to do this is not surprising given the effect of declining landings and price on breakeven numbers in this fishery between 2000/01 and 2002/03.

In 2001, the cooperative reduced vessel participation by 50 percent, however, one vessel continued to operate independently in the statewide fishery outside the Cook Inlet registration area. Two vessels continued to fish independent of the cooperative inside the Cook Inlet registration area. Thus, capacity reduction efforts made by the cooperative had reduced overall capacity but not to the level suggested by the breakeven analysis presented above.

A point worth considering is that several of the LLP holders who had joined the cooperative had, at one time, been involved in the East Coast Atlantic sea scallop fishery. This was true of the LLP associated with the vessels Carolina Girl and Carolina Boy and the vessel Pursuit. The Pursuit was operating out of Kodiak when the LLP was implemented and the Carolina Boy and Carolina Girl were operating out of Seward (Barnhart, 2006). Each of these operations, however, was East Coast based and likely had to bear costs of travel to and from the east coast, or vessel caretaking costs during the off-season, and idle vessel time.

These factors likely contributed to these three vessels not fishing under the cooperative.

Instead of fishing, the owners of the LLP that originally used these vessels received some form of revenue and/or ownership sharing while the other cooperative members continued to fish. Evidence of this was presented in Appendix A to the Environmental Assessment conducted for Amendment 10 to the FMP (NPFMC 2005). Provider Inc. and Ocean Fisheries LLC provided operating cost data for their scallop fishing enterprise in 2003. This data shows that these two operators paid $244,516 in "scallop leases" in 2003.

The lease fees paid by Ocean Hunter and Provider Inc. could only be afforded if the operations gained considerably more revenue and/or if they are able to decrease operating costs under the cooperative. The revenue earned by these two vessels is confidential.
However, the breakeven analysis presented in the RIR for Amendment 4 (LLP) to the FMP determined that the average fixed and variable non-labor costs of the fleet at the time (pre LLP, pre coop) was approximately 59 percent (NPFMC 2005, Appendix B).

The data provided by Provider Inc. and Ocean Hunter/ Ocean Fisheries LLC in 2003 indicate a non-labor cost ratios of 59 percent and 57 percent for Provider and Ocean Hunter respectively. However, these non-labor cost ratios include lease fees of $157,493 paid by Provider Inc. and $87,097 in lease fees paid by Ocean Hunter. Thus, these two cooperative vessels were able to maintain the same, or slightly lower, cost ratio inclusive of leases paid to other cooperative members totaling $244,516. While revenue cannot be discussed directly, it is likely that overall revenue for these vessels increased with fewer vessels fishing. It is likely that payments to labor, including owner shares, increased with greater overall revenue and similar non-labor cost ratios.

While the cooperative initially limited effort by using revenue sharing to compensate owners of unused vessels, a more permanent effort reduction began to take place in 2002. It is important to understand that Federal Alaska Scallop LLP permits are not directly associated with a specific vessel. The only vessel requirement on the LLP permit is that it cannot be used on any vessel larger than the MLOA assigned to the LLP. Further restrictions are that no more than two LLPs may be held by one "individual" and that LLPs may not be leased.

In contrast, the Alaska Commercial Fisheries Entry Commission (CFEC) Limited Entry Scallop permit, which was allowed to sunset in 2014 and no longer exists, was specifically attached to a vessel. Thus, through 2013, to fish in both Federal and State waters, one had to have a Federal LLP and would need to use the actual vessel assigned the CFEC Limited Entry permit if also fishing in State waters. However, if one wanted to fish only in Federal waters, without harvest restriction, they could use any vessel so long as it was under the MLOA of that LLP and was not an American Fisheries Act (AFA) vessel (sideboarded by State statue). Alternatively, if an individual or entity were to purchase a Federal LLP, they would not be required to actually fish the LLP, nor would they then have need of a CFEC Limited Entry licensed vessel.

Starting in 2002, the members of the cooperative wishing to remain in the fishery formed several Alaska corporations with shared ownership and purchased the interest of those who no longer wished to remain in the fishery and consolidated operations on three vessels. There was one additional original cooperative member; Forum Star Inc. The vessel Forum Star is an AFA eligible vessel and has been permitted as such since 2000. Under Amendment 8 to the FMP authority was delegated to the State of Alaska to set an AFA sideboard in the scallop fishery. The State set a limit of approximately 35,000 pounds (Barnhart, 2006) at present stock levels, on that vessel.

In 2005, Forum Star Inc. and its Scallop LLP were purchased by American Seafoods LLC, also an AFA entity. If the LLP held by American Seafoods LLC remains in the control of an AFA entity, it will continue

to be restricted by the AFA sideboard. It is, however, important to note that the LLP itself is not AFA endorsed. This means that it could presumably be sold to a non-AFA entity. As long as a vessel no longer than 97' (the MLOA allowed under Federal Scallop LLP #002) with no AFA endorsement is used with LLP #002, the AFA sideboard restriction would not apply. Thus, an existing scallop operation could buy this LLP and use it on a 97 foot non-AFA vessel under current federal regulations (50 CFR 679.4, 50 CFR 679.7). Alternatively, an existing entity would not have to use it at all as just holding the second permit means more scallop harvest for the remaining vessels.

Table 3 provides a summary of LLP holdings and changes in those holdings over time separately for independent operators and for cooperative members. The three LLPs not associated with cooperative members have also gone through several permit transfers and organizational changes. LLP #003, and the vessel Kilkenny that has most recently been used to fish that LLP, are now owned by Atlantic Cape Fisheries Inc. of New Jersey. That LLP has not been fished in the past two seasons. LLP #004 is presently registered to its original holder, Max G. Hulse. There are indications that Mr. Hulse may be deceased; however, no application for permit transfer has been received. The vessels historically utilized by Mr. Hulse have been lengthened and re-purposed and would no longer be eligible to fish the LLP. A vessel matching the LOA limit of the LLP could be used to fish LLP #004; however, that has not occurred in many years. Finally, LLP #006 was most recently transferred to EWT LLC, which is an Alaska LLC with ownership by U.S. East coast scallop interests. However, EWT LLC was involuntarily dissolved by the State of Alaska either due to non-filing of renewal and/or nonpayment of fees. The vessel historically used to fish this LLP has been sold by the original LLP holder and is not owned by EWT LLC interests.

Also shown in Table 3 are the present owners of LLPs associated with the Alaska Scallop Cooperative. The information provided includes corporate and individual ownership percentages which will be discussed further below. At present, there are effectively two cooperative associated vessels fishing in the statewide fishery outside the Cook Inlet registration area: Ocean Hunter, and Provider. However, Arctic Hunter LLC recently replaced the Arctic Hunter with the Polar Sea, thus, the cooperative has three vessels prepared to fish scallops. Given that the Killeen could begin to fish under LLP #003 there are effectively four known scallop fishing platforms presently available.

Table 3 provides the ownership percentages of Alaska Weathervane Scallop LLPs, by Alaska Corporation. Alaska corporate records available online include the ownership percentages of each identified owner and they are presented in table 4 as well. Several of the identified owners of LLPs that are associated with the Alaska Scallop Cooperative are Washington based corporate entities. Table 5 provides available information from Washington corporate records online regarding the individuals who own these Washington corporations. Unfortunately, Washington State does not publicly identify ownership percentages. For this analysis, it is assumed that a single identified governor of a Washington corporation holds 100 percent ownership, and when two governors are identified it is assumed they each hold equal 50% shares. Table 4 identifies these individuals and the assumptions regarding their ownership shares.

Utilizing the Alaska corporate LLP ownership percentages and the ownership percentages of individual owners of the Washington corporations identified in Alaska corporate records it is possible to assign ownership shares of each LLP to the individual owners and to tabulate cumulative ownership shares of Alaska Weathervane scallop LLPs attributable to Alaska Scallop Cooperative members. This ownership attribution is provided in table 5 for each cooperative member, individually, and shows that the highest level of cumulative ownership shares is 110%, or the equivalent of 1.1 LLP. LLP ownership limitations enacted when the LLP was established allow up to two LLP to be owned by one person.

Table 3: Federal Scallop LLP Holder History and Current Activity.

LLP	Original Holder	MLOA	Current Holder	Restrictions	Alaska Corporate Ownership	Vessel Historically Used	Fished in 2015-2018
Independent Operators							
003	Hogan, Thomas C.	75	Atlantic Capes Fisheries LLC	2 dredges with 20' max. combined width	Atlantic Capes Fisheries Inc: Daniel Cohen (100%) in good standing	**Kilkenny**: Owned by Atlantic Cape Fisheries Inc, New Jersey	no
004	Hulse, Max G. et al.	79	Hulse, Max G. (Possibly Deceased)	2 dredges with 20' max. combined width	Alaska Dream Ventures LLC: Robert Hulse (100%) in good standing (transfer not yet applied for)	**La Brisa / Wayward Wind**: Vessels rebuilt (lengthened) and re-purposed	no
006	Oceanic Research Services	70	EWT LLC	none	EWT LLC: Eric Orman (66.67%) Warren Alexander (33.33%) Involuntarily Dissolved	**Artic Storm**: sold	no
Alaska Scallop Association Members							
002	Forum Star Inc.	97	American Seafoods Co., LLC	State Imposed AFA Sideboard	American Seafoods Group, LLC (100%), in turn owned by ASG Parent LLC (100%) home state Delaware	Forum Star (owned by Forum Star LLC, which is 100% owned by American Seafoods Company LLC)	no
005	Ocean Fisheries LLC	102	Arctic Hunter LLC	none	Egil Mikkelsen, Glenn Mikkelsen, James Stone, John Lemar, Stein Nyhammer (20% each)	Artic Hunter, Replaced by Polar Sea (owned by Arctic Hunter LLC)	yes
007	Pursuit, Inc.	101	Ocean Fisheries LLC	none	Festus Fisheries Inc (WA). (20%) Mikkelsen Fisheries Inc (WA). (40%) Stein Enterprises Inc. (WA) (20%), Stone Maritime Inc (WA). (20%)	Pursuit (no longer documented)	no
008	Provider, Inc.	124	Provider Fisheries LLC	none	Egil Mikkelsen (20%), Glenn Mikkelsen (20%), James Stone (25%), John Lemar (25%), Tom Minio (10%)	Provider (owned by Provider Fisheries LLC)	yes
009	Carolina Boy, Inc.	95	Ocean Fisheries, LLC	none	Festus Fisheries Inc(WA). (20%) Mikkelsen Fisheries Inc(WA). (40%) Stein Enterprises inc. (WA) (20%), Stone Maritime Inc(WA) (20%)	Ocean Hunter (owned by Ocean Fisheries LLC)	yes
010	Carolina Girl, Inc.	96	Alaska Scallop Fisheries , LLC	none	Egil Mikkelsen (20%), Glenn Mikkelsen (20%), James Stone (25%), John Lemar (25%), Tom Minio (10% each)	Carolina Girl (no longer documented)	no

Source: Public records at https://alaskafisheries.noaa.gov and https://www.commerce.alaska.gov/cbp/main/search/entities

Table 4: Ownership Interest of Washington Corporations

Washington Corporation	Governors	Ownership
Festus Fisheries, Inc.	John Lemar, Curtis Lemar	Assumed equal 50% shares
Mikkelsen Fisheries Inc.	Egil Mikkelsen, Glenn Mikkelsen	Assumed equal 50% shares
Stein Enterprises	Stein Nyhammer	100%
Stone Maritime	James Stone	100%

Source: Washington Corporate Records Search: https://www.sos.wa.gov/corps/

Table 5: Cooperative Member LLP Ownership Attribution

Owner	LLP Number						Cumulative Ownership
	002	005	007	008	009	010	
American Seafoods	100%						100%
John Lemar		20%	10%	25%	10%	25%	90%
Curtis Lemar			10%		10%		20%
Egil Mikkelsen		20%	20%	20%	20%	20%	100%
Glenn Mikkelsen		20%	20%	20%	20%	20%	100%
Tom Minio				10%		10%	20%
Stein Nyhammer		20%	20%		20%		60%
James Stone		20%	20%	25%	20%	25%	110%

Effects of Fleet Consolidation

The story of fleet consolidation in the Alaska Weathervane scallop fishery is not unlike that of any other fishery that has had overexploitation under open access, inefficiency caused by the race for fish, and marginally profitable operations due to overcapacity. Fleet consolidation likely results in access to a greater proportion of available harvest for each remaining participant, and reductions in cost are likely due to reduced crowding on available grounds and elimination of the inefficiencies of the race for fish that occurs in an overcapitalized fishery. However, consolidation has also likely occurred as the harvest levels have trended downwards to historically low levels in the most recent years.

Fleet consolidation undoubtedly has a direct effect on the number of crew and operator positions in the fishery. At the time of the vessel moratorium, 18 vessels qualified and likely employed at least 216 crew members (12, including operator, cooks, mechanics, etc. per vessel). However, crew earnings and data linking crew members to vessels do not exist. It is impossible to say, using presently available data, exactly how many crew were employed or the amount of their crew shares. Similarly, it is impossible to determine how many crew were locally (Alaska Residents) acquired or available. In any event, the Federal LLP effectively reduced the number of crew positions, including operators etc., to 108. The fleet consolidation that has occurred under the cooperative, and due to declining guideline harvest levels, has likely further

reduced crew positions to fewer than 40. It is possible; however, that the crew shares earned by these crew members are higher than what was earned in the past.

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

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

As has been discussed above, the Alaska Scallop Association has entered into a revenue sharing system that resulted in payments to members who agreed to not use their vessels so that the vessels that do fish can remain economically viable. At present, all three active vessels associated with the Alaska Scallop Association members are homeported in Kodiak (personal communication, Jim Stone, February 2018) as is the one identified non-cooperative vessel that has recently fished.

Fleet consolidation has also affected deliveries to several Alaska ports. Information on scallop deliveries to ports from 1990-2017 (ADF&G 2018) show that, since formation of the cooperative and associated fleet consolidation, scallop landing have occurred in several ports and the location of landings has varied over the years. Cordova, Dutch Harbor, Homer, Kodiak, Sitka and Yakutat have all had landings in the past five years, while occasional past landings in Alaska ports of Juneau, Ketchikan, Pelican, Petersburg, Sand Point, Seldovia, Seward and Whittier are not presently occurring. Also of note is that past landings made outside of Alaska to ports in Bellingham, and Seattle have not occurred since 2008 and not by any of the present members of the Alaska Scallop Association. All of the vessels that participate in this fishery, at present, are homeported in Alaska ports and pay both Alaska Business taxes and Resource Landings taxes and any applicable local taxes in landing ports and their home port (e.g. sales tax). While all of the effects mentioned above have negative consequences for some fishery participants and fishing communities, it is likely that the overall effect of fleet reduction is improved profitability for the remaining participants, whether they belong to the cooperative or not.

It is possible to decompose the breakeven analysis from the Amendment 4 Regulatory Impact Review and re-specify those breakeven levels using present harvest and price ranges. Doing so imposes the same fixed cost ratios as were used in the Amendment 4 and data from vessels that, with the exception of the Provider, do not currently participate in the fishery. With that limitation duly noted, application of present price of $11.50 and just over 200,000 pounds of harvest roughly 2.8 vessels would breakeven under present fishery and market conditions assuming cost ratios are similar to the past. However, Appendix B to the analysis of Amendment 10 to the Scallop FMP (NPFMC 2005) contains cost and breakeven data from 2003 for the Provider and Ocean Hunter, both of which are presently active in the fishery. That data, though limited to an average of two vessels shows (Table 6, below) that breakeven levels of income from 2003, inflation adjusted to 2017 values using the U.S. Gross Domestic Product Implicit Price Deflator, suggests that fewer

than two vessels would breakeven under current price and landings values.

Table 6: Number of Vessels that Could Breakeven Under 2017 Price and Landings Scenarios (recreated from Regulatory Impact Review for Amendment 4-10 to the North Pacific Scallop FMP)

Price	Landing (pounds)			
	200,000	400,000	600,000	800,000
$10.00	1.1	2.1	3.2	4.3
$10.50	1.1	2.2	3.4	4.5
$11.00	1.2	2.3	3.5	4.7
$11.50	1.2	2.4	3.7	4.9
$12.00	1.3	2.6	3.8	5.1
$12.50	1.3	2.7	4.0	5.3
$13.00	1.4	2.8	4.2	5.5

Purchase of LLPs from other cooperative members has likely reduced revenue sharing obligations for active participants, albeit with the potential cost of debt finance for these transactions. Overall, it is likely that fleet consolidation has resulted in a more efficient fleet with lower operating costs, potentially greater average crew wages, and improved returns to owned capital. However, the historically low harvest levels in the Alaska Weathervane scallop fishery, even with historically high prices are limiting the economic performance of the fishery and likely also preventing new entrants to the State waters fishery.

Markets

In the domestic U.S. market, Alaska weathervane scallops are similar to Atlantic sea scallops; however they tend to be smaller and sweeter to the palate. Table 7 compares total landings and value of Alaska weathervane scallops with Atlantic sea scallops from 1990 through 2016 and with imports of all scallop products from 1990 through December of 2017. These data show that Atlantic sea scallop harvest is consistently orders of magnitude larger than weathervane scallop harvests off Alaska.

There are some intuitive conclusions that can be made from the data presented in Table 7 and from the price trends displayed in Figure 1. First, domestic markets are dominated by Atlantic sea scallop production and scallop imports. For example, in 2016, 40.5 million pounds of Atlantic Sea Scallops were landed in the United States, and 51 million pounds of scallop products were imported into the United States. This compares to just over 200,000 pounds of Alaska Weathervane scallop landings in 2016. Even in the highest production year of 1994, the 1.2 million pounds of Alaska Weathervane scallop landings made in that year compare to 16.8 million pounds of Atlantic Sea scallop landings and 56.8 million pounds of imported scallop products.

Second, prices of weathervane scallops track closely to those of Atlantic sea scallops. Thus, it is highly likely that domestic market price is dominated by the relationship between quantity supplied in the Atlantic sea scallop fishery and domestic market demand as well as by substitution of imported scallop products. Figure 1 provides a very clear picture of the relationship between Sea scallop prices and Alaska Weathervane scallop prices. These data appear to show that Alaska Weathervane scallop price declines tend to lag U.S. Sea scallop price declines and, at least since formation of the Alaska Scallop Association, have tended to slightly lead market price increase

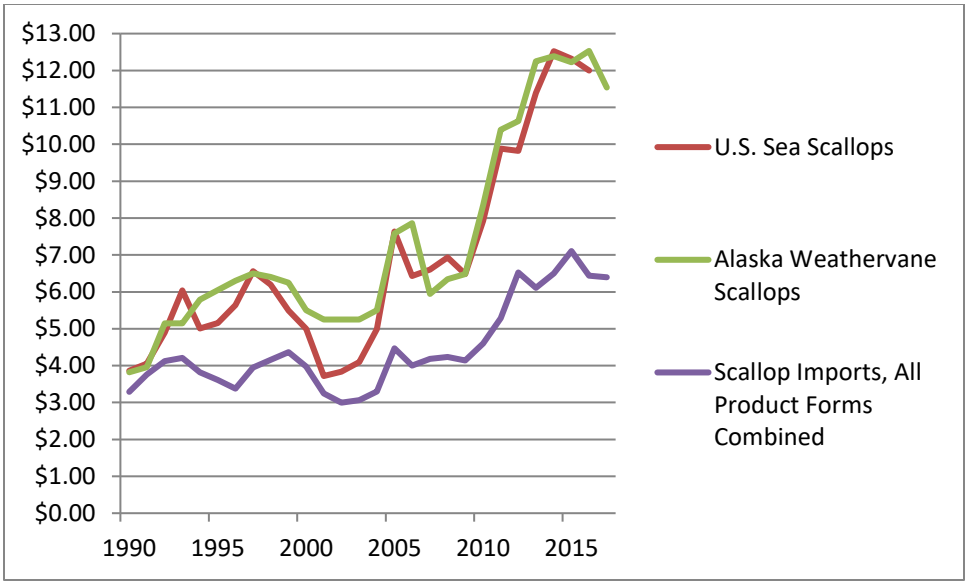

Figure 1: Scallop Price Comparisons, 1990-2017

One might argue that the appearance may be driven by data collection differences. Sea Scallop prices are tabulated somewhat continuously through the season and landings and value are available on a monthly basis. In contrast, Alaska Weathervane scallops are primarily processed at sea and a value is not established at the time of landing but rather via the annual tax filings of harvesting entities with the Alaska Department of Revenue. The Alaska Weathervane scallop price determination for the previous year is usually published May or June of the following year. However, for this analysis, average prices are tabulated for each year and, thus, are from a comparable time frame leading one to wonder as to the price dynamics at work behind the apparent time lag in declines and slight lead in increases that Alaska Weathervane scallops seem to exhibit.

Unfortunately, while Sea Scallop landings and value data are incredibly rich, Alaska Weathervane scallop pricing data is represented by a single data point per year with occasional fish ticket values when fresh product has been landed. These imbalanced data sets largely prevent meaningful econometric analysis of the demand for each product, including the extent to which Alaska Weathervane scallop prices may be driven by the Sea Scallop market.

Another important factor in scallop market is imports of scallop products. Unfortunately, available import data commingles imports of several small scallop species (e.g. pink, calico, bay etc.) with larger scallop varieties such as sea scallops and weathervane scallops. However, as these products are substitutes for one another, although not perfectly, the imports of these other species may have an effect on domestic market prices. In any event, the imported value of scallops has been similar to, or exceeded, total domestic production in recent years. Thus, it is likely that domestic market prices are heavily influenced by imports.

Table 7: US Scallop Landings and Value versus Scallop Imports and Value, 1990-2017

Year	U.S. Sea Scallops			Alaska Weathervane Scallops*			Scallop Imports, All Product Forms Combined		
	Millions of Pounds	Value ($ millions)	Av. $/lb	Millions of Pounds	Value ($ millions)	Av. $/lb	Millions of Pounds	Value ($ millions)	Av. $/lb
1990	38.6	$149.1	$3.87	1.1	$4.3	$3.82	40.0	$131.6	$3.29

1991	37.9	$153.7	$4.05	1.8	$7.1	$3.96	29.7	$111.4	$3.76
1992	31.3	$153.4	$4.90	0.6	$2.9	$5.15	38.8	$160.2	$4.13
1993	16.1	$97.1	$6.04	1.0	$5.1	$5.15	52.1	$219.2	$4.21
1994	16.8	$84.1	$5.01	1.2	$7.2	$5.79	56.8	$216.9	$3.82
1995	17.4	$89.8	$5.16	0.4	$2.5	$6.05	48.4	$174.8	$3.61
1996	17.5	$98.8	$5.64	0.7	$4.6	$6.30	58.8	$198.8	$3.38
1997	13.6	$89.5	$6.56	0.8	$5.3	$6.50	60.3	$238.1	$3.95
1998	12.1	$75.1	$6.19	0.8	$5.3	$6.40	53.2	$221.1	$4.16
1999	22.0	$121.0	$5.49	0.8	$5.2	$6.25	44.6	$194.7	$4.37
2000	32.2	$160.9	$5.00	0.8	$4.1	$5.50	54.1	$214.8	$3.97
2001	46.4	$172.6	$3.72	0.6	$3.0	$5.25	40.0	$130.0	$3.25
2002	52.7	$202.1	$3.84	0.5	$2.7	$5.25	49.0	$146.7	$3.00
2003	56.0	$229.1	$4.09	0.5	$2.6	$5.25	52.9	$161.9	$3.06
2004	64.1	$320.0	$4.99	0.4	$2.3	$5.50	45.3	$149.4	$3.29
2005	56.6	$432.5	$7.64	0.5	$4.0	$7.58	51.4	$229.8	$4.47
2006	60.1	$386.3	$6.43	0.5	$3.8	$7.86	60.8	$243.3	$4.00
2007	58.5	$386.0	$6.60	0.5	$2.7	$5.94	56.6	$236.8	$4.18
2008	53.4	$370.1	$6.93	0.3	$2.2	$6.34	57.8	$244.8	$4.24
2009	57.9	$375.6	$6.48	0.5	$3.2	$6.48	56.3	$233.0	$4.14
2010	57.5	$455.7	$7.92	0.5	$3.8	$8.35	51.9	$238.5	$4.60
2011	59.2	$585.1	$9.89	0.5	$4.7	$10.39	56.8	$300.4	$5.29
2012	56.9	$559.0	$9.82	0.4	$4.4	$10.63	34.5	$224.7	$6.52
2013	41.0	$466.8	$11.39	0.4	$4.9	$12.25	60.9	$371.9	$6.11
2014	33.8	$423.7	$12.52	0.3	$3.8	$12.39	60.7	$394.4	$6.50
2015	35.7	$439.7	$12.32	0.3	$3.2	$12.22	49.3	$350.2	$7.11
2016	40.5	$486.0	$12.00	0.2	$2.9	$12.53	51.0	$328.5	$6.43
2017	n/a	n/a	n/a	0.2	$2.7	$11.54	41.3	$264.5	$6.40

Sources: NMFS Data at https://www.fisheries.noaa.gov and ADF&G Fish Ticket data.

* Seasonal data is displayed as annual data for comparison with annual sea scallop landings

n/a= data for 2017 Atlantic US Sea scallop fishery is not yet available.

The conclusion that can be drawn from the data presented in Table 9 is that the wholesale price of weathervane scallops is likely heavily influenced by other domestic supply and import supply. This suggests that North Pacific harvesters have little, if any, market power to negotiate prices, except perhaps based on quality and taste preferences, and are essentially price takers in the wholesale market.

References

ADF&G (Alaska Department of Fish and Game). 2018. Annual Alaska Scallop Fish Ticket Data. Alaska Department of Fish and Game. Douglas, Alaska.

ADF&G (Alaska Department of Fish and Game). 2018. Annual Alaska Scallop Port Landings. Alaska Department of Fish and Game. Kodiak, Alaska.

ADOC (Alaska Department of Commerce). 2018. Alaska Corporations Business and Professional Licensing Database, available at https://www.commerce.alaska.gov/cbp/main/search/entities

Anchorage Daily News, 2016. Obituary of Max G. Hulse. Published February 16, 2016, Anchorage Alaska.

Barnhart, Jeffrey, 2006. Personal Communication with Jeffrey Barnhart , Alaska Department of Fish and Game, Division of Commercial Fisheries., Kodiak Alaska., January 2006.

Harrington, Bill, 2013. Public testimony at the 2013 Scallop Plan Team meeting, February 24, 2013., Kodiak, Alaska.

Kandianis, Mark, 2006. Public testimony at the 2006 Scallop Plan Team meeting, February 24, 2006., Anchorage Alaska.

NMFS., 2006. National Marine Fisheries Service National Fishery Statistics., available at https://www.fisheries.noaa.gov

NPFMC (North Pacific Fishery Management Council). 1999. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis of Amendment 4 to the Fishery Management Plan for the Scallop Fishery off Alaska. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, Alaska.

NPFMC (North Pacific Fishery Management Council). 2009. Fishery Management Plan for the Scallop Fishery off Alaska. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, Alaska.

NPFMC (North Pacific Fishery Management Council). 2005. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis of Amendment 10 to the Fishery Management Plan for the Scallop Fishery off Alaska. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, Alaska.

State of Washington., 2018 Corporate Records Search available at https://www.sos.wa.gov/corps/

Stone, Jim., 2018 Public testimony at the 2018 Scallop Plan Team meeting, February 21, 2018., Kodiak, Alaska.

Appendix 3: Weathervane Scallop Stock Structure

A summary of the available data (Spencer et al, 2010) on the stock identification for weathervane scallops is shown in Table 6-1. This information is necessary to determine stock structure, stock boundaries, as well as to identify data gaps and research needs for scallops. The Scallop Plan Team intends to update these data as additional information becomes available in the annual SAFE report.

Table 6-1 Summary of available data on stock identification for Weathervane scallop.

HARVEST AND TRENDS	
Factor and criterion	Available information
Fishing mortality (5-year average percent of F_{max})	Cook Inlet and Kayak bed-specific information available where surveyed, unknown for other areas.
Spatial concentration of fishery relative to abundance (Fishing is focused in areas << management areas)	Fishery concentrated in areas smaller then broad distribution of scallop stocks by management region. See figures in SAFE for overall distribution. Scallops known to occur in closed waters, sometimes in dense aggregations.
Population trends (Different areas show different trend directions)	Survey biomass trends in some regions, CPUE trend data available for other regions, trends differ by area, no clear overall trend statewide, age distributions differ by region and beds, recruitment difficult to detect due to fishery-dependent data (commercial fishery catch does not necessarily indicate recruitment or biomass trends)
Barriers and phenotypic characters	
Generation time (e.g., >10 years)	No, areas tend to be similar, some differences in growth rates by area and maturity
Physical limitations (Clear physical inhibitors to movement)	Consideration of GOA oceanography and the ~30 day larval phase (Bourne, 1991) suggest linkages between different subpopulations of this spatially structured metapopulations but advection and settlement information unknown
Growth differences (Significantly different LAA, WAA, or LW parameters)	Yes, Kodiak scallops grow faster and are larger at given shell height than scallops from the eastern GOA; unknown if genetic or environmental but literature suggests environmental factors such as depth, water temperature, and primary production strongly affect growth. (Ignell and Haynes, 2000; Kruse et al. 2005).

Table 6-1 (cont'd) Summary of available data on stock identification for Weathervane scallop.

Age/size-structure (Significantly different size/age compositions)	Complicated by comparison of survey data with fishery data; age structure varies regionally and may be affected by fishery removals in local subpopulations.
Spawning time differences (Significantly different mean time of spawning)	Scallop spawning occurs in early summer and appears to be temperature dependent. Spawning of southern populations (Washington, BC) starts earlier (MacDonald and Bourne 1987)
Maturity-at-age/length differences (Significantly different mean maturity-at-age/ length)	Unknown, histological analyses not completed but visual inspection indicates age 3 in both Kamishak and Kayak but no data available for other regions
Morphometrics (Field identifiable characters)	Yes shell shape, weight, height differences by region
Meristics (Minimally overlapping differences in counts)	Unknown
Behavior & movement	
Spawning site fidelity (Spawning individuals occur in same location consistently)	Weathervane scallops are capable of swimming but it is thought they have spawning site fidelity.
Mark-recapture data (Tagging data may show limited movement)	N/A
Natural tags (Acquired tags may show movement smaller than management areas)	Unknown
Genetics	
Isolation by distance (Significant regression)	Unknown
Dispersal distance (<<Management areas)	Unknown

Table 6-1 (cont'd) Summary of available data on stock identification for Weathervane scallop.

Pairwise genetic differences (Significant differences between geographically distinct collections)	Weak evidence for difference between Bering Sea and GOA, no evidence for differences within GOA (Gaffney et al, 2010). Gaffney et al. (2010) note that "lack of genetic differentiation measured by neutral markers does not preclude the existence of locally adapted, self-sustaining populations". Limited genetic data available may not be relevant to time scales for management.

Appendix 4: Historical Overview of Scallop Fishery

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

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

In the early 1990s, the Alaska weathervane scallop fishery expanded rapidly with an influx of boats from the East Coast of the United States. Concerns about overharvest of scallops and bycatch of other commercially important species such as crabs prompted the ADF&G Commissioner to designate the weathervane scallop fishery a high-impact emerging fishery on May 21, 1993. This action required ADF&G to close the fishery and implement an interim management plan prior to reopening. The interim management plan contained provisions for king and Tanner crab bycatch limits (CBLs) for most areas within the Westward Region. Since then, crab bycatch limits have been established for the Kamishak District of the Cook Inlet Registration Area and for the Prince William Sound Registration Area. The commissioner adopted the regulations and opened the fishery on June 17, 1993, consistent with the measures identified in the interim management plan. The interim management plan included a provision for 100% onboard observer coverage to monitor crab bycatch and to collect biological and fishery data. In March 1994, the Alaska Board of Fisheries (BOF) adopted the interim regulations identified as the Alaska Scallop Fishery Management Plan, 5 AAC 38.076.

From 1967 until early 1995, all vessels participating in the Alaska scallop fishery were registered under the laws of the State of Alaska. Scallop fishing in both state and federal waters was managed under state jurisdiction. In January 1995, the captain of a scallop fishing vessel returned his 1995 scallop interim use permit card to the State of Alaska Commercial Fisheries Entry Commission in Juneau and proceeded to fish scallops in the EEZ with total disregard to harvest limits, observer coverage, and other management measures and regulations. In response to this unanticipated event, federal waters in the EEZ were closed to scallop fishing by emergency rule on February 23, 1995.

The initial emergency rule was in effect through May 30, 1995, and was extended for an additional 90 days through August 28, 1995. The intent of the emergency rule was to control the unregulated scallop fishery in federal waters until an FMP could be implemented to close the fishery. Prior to August 28, NPFMC submitted a proposed FMP which closed scallop fishing in the EEZ for a maximum of one year with an expiration date of August 28, 1996. The final rule implementing Amendment 1 to the FMP was filed July 18, 1996 and published in the Federal Register on July 23, 1996. It became effective August 1, 1996, allowing the weathervane scallop fishery to reopen in the EEZ. Scallop fishing in state waters of the Westward Region was delayed until August 1, 1996 to coincide with the opening of the EEZ. The state

continued as the active manager of the fishery with inseason actions duplicated by the federal system (Barnhart, 2003).

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

Amendment 6 which established over fishing levels for weathervane scallops was approved by the NPFMC in March 1999. This amendment established an overfishing level as a fishing rate ($F_{overfishing}$) in excess of the natural mortality rate M=0.13. It also established an Optimum Yield of 0-1.24 million pounds of shucked meats. The upper bound of which became was designated MSY, and was based on average catch from 1990-1997 (excluding 1995) (Table 2-1).

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

In January, 2014, the Board of Fisheries implemented a new State-Waters Weathervane Scallop Management Plan (5 AAC 38.078) that delineates additional tools needed to manage open-access weathervane scallop fisheries in waters of Alaska. The management plan applies to the Yakutat, Prince William Sound, Kodiak, and Dutch Harbor scallop registration areas which all have scallop beds that span both state and federal waters. The new management plan is in addition to the existing Alaska Scallop Fishery Management Plan (5 AAC 38.076) that establishes registration, reporting, gear, and observer coverage requirements.

The state-waters management plan allows the department to manage scallop beds in waters of Alaska separately from beds in adjacent federal waters if effort increases in the open-access state-waters fishery. The plan defines the scallop vessel registration year (April 1 – March 31) and establishes an annual

preseason registration deadline of April 1. It also requires a registered scallop vessel to have onboard an activated vessel monitoring system, permits the department to establish trip limits, and allows for separate registrations for state and federal-waters fishing. The additional management measures are necessary to prevent overharvest of the weathervane scallop resource during an open-access fishery.

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

Intentionally Left Blank